

SMA SERIES 4 SYNCHRONOUS MULTIPLEXER EQUIPMENT

USER MANUAL

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TABLE OF CONTENTS

TABLE OF CONTENTS	3
LIST OF FIGURES	27
LIST OF TABLES	33
SAFETY INFORMATION	37
IEC (AFTER IEC 60825–1 AMENDMENT 2:2001–01)	38
Optical Safety	38
CDRH/ANSI	39
IEC Conformity	39
IEC (BEFORE IEC 60825–1 AMENDMENT 2:2001–01)	39
SAFETY PRECAUTIONS	41
Safe Working Practices	41
OPTICAL SAFETY PRECAUTIONS	42
HIGH VOLTAGE	43
Protective Earthing	43
TOXIC SUBSTANCES	44
Battery Disposal	44
Toxic Fumes	45
HANDLING PRECAUTIONS	46
Weight	46
High Temperature	46
Sharp Edges	46
ELECTROSTATIC SENSITIVE DEVICES	47
TYPOGRAPHICAL CONVENTIONS	49
USE OF NON–MARCONI EQUIPMENT	51
SERVICING POLICY AND RETURN OF EQUIPMENT	53

COMPATIBILITY WITH EUROPEAN DIRECTIVES	57
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READERS COMMENTS	59
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SECTION 1:	
PRODUCT OUTLINES AND OVERVIEWS	61

CHAPTER 1:	
TERMINOLOGY AND MANUAL STRUCTURE	63

1.1	TERMINOLOGY	63
1.2	MANUAL STRUCTURE	63

CHAPTER 2:	
PRODUCT OUTLINES	67

2.1	SMA–1/4CP	67
2.2	APPLICATIONS	69
2.2.1	POINT TO POINT	70
2.3	SMA–1/4CP PRODUCT OUTLINE	71
2.3.1	GENERAL	71
2.3.2	BASE UNITS	72
2.3.3	EXPANSION MODULES	72
2.3.4	POWER AND BATTERIES	73
2.3.5	NETWORK MANAGEMENT	73
2.4	SMA–1/4C, SMA-1/4UC AND SMA–1/4	73
2.5	APPLICATIONS	75
2.6	SMA–1/4C, SMA-1/4UC AND SMA–1/4 PRODUCT OUTLINE.	78
2.6.1	GENERAL	78
2.6.2	TRAFFIC UNITS	78
2.6.3	NETWORK MANAGEMENT	79
2.7	OPERATION AND CONTROL	79
2.7.2	Back–up and Restore, Software Download	81
2.8	FUNCTIONAL FEATURES	81
2.8.1	Multiplexing Structure	81
2.8.2	Synchronisation	81
2.8.3	Cross–connections	81
2.8.4	Protection	81

2.8.5	Communications	82
2.8.6	Event/Performance Processing And Reporting	82
2.9	NT1 MAINTENANCE FUNCTION	83
2.9.1	Network Applications	83
2.9.2	Loopback From Exchange	84
2.9.3	Loopback Towards Exchange	85
2.10	PORT STATUS	85
CHAPTER 3:		
PRODUCT OVERVIEW		87

3.1	INTRODUCTION	87
3.1.1	SMA–1/4CP	88
3.1.2	SMA–1/4c	88
3.1.3	SMA–1/4(4+4) and SMA–1/4(8)	88
3.2	UNIT AND SHELF LAYOUT	89
3.2.1	SMA–1/4CP	89
3.2.2	Expansion Modules	90
3.2.3	SMA1/4c	91
3.2.4	SMA–1/4(4+4) and SMA–1/4(8)	93
3.2.5	Tributary Units	94
3.2.6	Technical Details	95
3.2.7	Main Hardware Differences between SMA–1/4c and SMA–1/4(4+4),(8)	95
3.3	CORE CARD FEATURES	95
3.4	COMMS/CONTROLLER CARD FEATURES	98
3.4.1	SMA–1/4CP Software Functions	98
3.4.2	SMA–1/4c and SMA–1/4(4+4),(8) Software Functions	98
3.4.3	CONTROLLER FUNCTIONS	98
3.5	PROTECTION	99
3.6	SYNCHRONISATION	100
3.6.1	SMA–1/4CP	100
3.6.2	SMA–1/4c	100
3.6.3	SMA–1/4	101
3.7	POWER DISTRIBUTION	101
3.7.1	SMA–1/4CP	101
3.7.2	SMA–1/4c	101
3.7.3	SMA–1/4	102
3.8	EQUIPMENT CONFIGURATION	103
3.9	EVENT MONITORING	104

3.9.1	SMA–1/4CP	104
3.9.2	SMA–1/4c	104
3.9.3	SMA–1/4	104
3.10	PERFORMANCE MONITORING	104
3.10.1	SMA–1/4CP	104
3.10.2	SMA–1/4c and SMA–1/4	105
3.11	COMMUNICATIONS	105
3.11.1	DCC Communications	105
3.11.2	Transparent Message Routeing	105
3.11.3	Communications Management	106
3.12	INTERFACES	106
3.12.1	External	106
3.12.2	Ancillary Interfaces	106

SECTION 2: PRODUCT FUNCTIONALITY 111

CHAPTER 4: MULTIPLEXING STRUCTURE 113

4.1	INTRODUCTION	113
4.2	STRUCTURE	113
4.3	VIRTUAL CONTAINERS	114
4.4	OVERHEADS	114
4.5	POINTERS	114
4.6	TRIBUTARY UNITS	114
4.7	ADMINISTRATIVE UNITS	115
4.8	STM–N FRAME STRUCTURE	115

CHAPTER 5: SMA–N CROSS–CONNECTIONS 117

5.1	INTRODUCTION	117
5.2	CROSS–CONNECTION OPTIONS	118
5.2.1	SDH STM–N to STM–N Port Cross–connections	118
5.2.2	STM–N Port to 1.5/2Mbit/s Trib Port Cross–connections	119
5.2.3	1.5/2Mbit/s Trib Port to 1.5/2Mbit/s Trib Port Cross–connections	119
5.2.4	STM–N Port to 34/45Mbit/s Trib Port Cross–connections	119

5.2.5	34/45Mbit/s Trib Port to 34/45Mbit/s Trib Port Cross-connections	119
5.2.6	STM-N Port to 140Mbit/s Trib Port Cross-connections	120
5.2.7	140Mbit/s Trib Port to 140Mbit/s Trib Port Cross-connections	120
5.3	SMA-1/4CP	120
5.3.1	Adding Cross Connections	120
5.4	SMA-1/4C, SMA-1/4UC AND SMA-1/4 (4+4)(8)	121
5.4.1	Addition of Higher Order (VC-4) Cross-Connections	121
5.4.2	Addition of Lower Order Cross-Connections	121
CHAPTER 6: SYNCHRONISATION		123

6.1	INTRODUCTION	123
6.2	SYNCHRONISATION MODES	124
6.3	FREE-RUN MODE	124
6.4	SINGLE SETG TIMING SOURCES	125
6.5	SINGLE SETG TIMING MODE CONFIGURATION	126
6.5.1	Line Timing Mode	126
6.5.2	Tributary Timing Mode	127
6.5.3	External Timing Mode	128
6.5.4	SASE Timing Mode	128
6.6	SYNCHRONISATION SOURCE SELECTION	129
6.7	SYNCHRONISATION STATUS MESSAGE BYTE (SSMB)	129
6.7.1	SSMB Mode Enabled	129
6.7.2	SSMB Mode Disabled	130
6.7.3	Holdover Mode	130
6.7.4	Reversion Facility	130
6.8	EXTERNAL SYNC INPUTS AND OUTPUT	131
6.9	PRIMARY RATE RE-TIMING BUFFERS FOR 2MBIT/S TRIBUTARY CARDS 131	
6.9.1	Normal Timing (Re-timing Mode 1)	132
6.9.2	Synchronous Data Channel Timing Buffer (Re-timing Mode 2)	132
6.9.3	Plesiochronous Data Channel Timing Buffer (Re-timing Mode 3)	133
6.9.4	Synchronous Channel Timing Buffer (Re-timing Mode 4)	134
6.9.5	Wander Buffer (Re-timing Mode 5)	134
6.10	LOCAL TERMINAL OPERATION/CONFIGURATION	134
6.11	APPLICATION TO SMA-1/4CP	135
6.11.1	SMA-1/4CP	135

6.11.2	Timing Options	136
6.11.3	Timing Sources	136
6.11.4	Outputs Synchronised to a Timing Source	136
6.11.5	X.21 Timing Modes	137
6.11.6	Internal Oscillator	139
6.11.7	Synchronisation Architecture	139
6.11.8	Synchronisation Configuration on Reset	140
6.11.9	Alarms	140
6.12	APPLICATION TO SMA-1/4C, SMA-1/4UC AND SMA-1/4(4+4)(8)	140
6.12.1	Timing Options	142
6.12.2	Timing Sources	142
6.12.3	Tributary Recovered Clock	143
6.12.4	External Sources	143
6.12.5	Nominated External Source Quality Level	144
6.12.6	Outputs Synchronised to a Timing Source	144
6.12.7	Internal Oscillator	144
6.12.8	Synchronisation Architecture	145
6.12.9	Configuration	148
6.12.10	Synchronisation Configuration on Reset	149
6.12.11	Alarms	149
CHAPTER 7: PROTECTION		151
7.1	INTRODUCTION	151
7.2	1+1 STM-N MULTIPLEX SECTION PROTECTION (MSP)	154
7.2.1	Operation	155
7.2.2	Automatic Protection Switching (APS)	156
7.2.3	Introduction	157
7.2.4	Method	157
7.2.5	Operation	158
7.3	CARD PROTECTION	160
7.4	PSU PROTECTION	160
7.5	SUMMARY OF PROTECTION STATE INITIATION CONDITIONS	160
7.6	1:N TRIBUTARY CARD PROTECTION	161
7.6.1	1.5/2Mbit/s Tributary Cards	161
7.7	34/45/140MBIT/S, 34M TRANSMUX, VC-AM, STM-1 TRIBUTARY CARDS . 162	
7.8	1+1 PDH TRIBUTARY PORT PROTECTION	163
7.8.1	Introduction	163
7.8.2	Modes of Operation	164

7.8.3	Protection Switching Criteria	165
7.8.4	Protection Switching Control	166
7.9	ILLUSTRATION OF SERIES 4 PROTECTION OPTIONS	167
7.9.1	SMA–1/4c /uc 2M Tributary Card Protection	167
7.9.2	SMA–1/4c /uc Higher Order Tributary Card Protection	168
7.9.3	SMA–1/4(4+4)(8) – 1.5/2M Protection	169
7.9.4	SMA–1/4(4+4)(8) – 1+1 Core Tributary Mode Protection	170
7.9.5	SMA–1/4(4+4)(8) – 34/45M, 34M Transmux, 140M, STM–1 and VCam Protection	171
7.9.6	SMA–1/4(4+4)(8) – ATM and ETA Tributary Card Protection	173
CHAPTER 8:	COMMUNICATIONS	175

8.1	INTRODUCTION	175
8.2	PROTOCOL	175
8.3	IMPLEMENTATION	176
8.3.1	Introduction	176
8.3.2	End Systems, Intermediate Systems and Gateways	177
8.3.3	Ethernet Local Area Network	178
8.4	COMMUNICATIONS ROUTEING	178
8.4.1	Introduction	178
8.4.2	Data Communications Channels	179
8.4.3	LAPD Protocol	179
8.4.4	IS–IS Routeing	179
8.4.5	Multiple Areas Working in IS–IS	183
8.4.6	Network Service Access Points (NSAPs)	184
8.4.7	Upgrading	185
8.4.8	Interworking	185
8.4.9	Manual Adjacency (MA) and Reachable Address Prefixes (RAP)	185
8.4.10	CLNS Ping	186
8.5	COMMUNICATIONS APPLICATIONS USING THE AUXILIARY CARD ..	186
8.5.1	Introduction	186
8.5.2	Features	187
8.5.3	Auxiliary LTUs	189
8.5.4	By-pass	189
8.5.5	Clocks	190
8.5.6	A/B Line Security	190
8.5.7	Alarm Indications	190
8.5.8	Auxiliary Card Applications	190
8.6	SETTING UP SUB–NETWORK COMMUNICATIONS	195

8.7	COMMUNICATIONS FUNCTIONS FOR SMA–1/4CP	197
8.8	COMMUNICATIONS FUNCTIONS OF THE COMMS/CONTROLLER CARD .	198
8.8.1	SMA–1/4c /uc and SMA1/4(4+4)(8)	199
CHAPTER 9: EVENTS		201
9.1	INTRODUCTION	201
9.2	PROCESSING	201
9.3	ALARM PARAMETERS	202
9.3.1	Alarm Events	202
9.3.2	Event Recognition And Validation	203
9.3.3	Fault Attributes	203
9.3.4	Persistency and Consequential Suppression	204
9.3.5	Inversion State	204
9.3.6	Alarm Inhibit/Filtering	204
9.4	REPORTING AND DISPLAY FACILITIES	205
9.4.1	Event Reporting	205
9.4.2	Current Event Logs	205
9.4.3	Historical Event Logs	205
9.4.4	Active Source Alarms Display	205
9.4.5	Display and Action all Local Alarms	205
9.5	PROCEDURES	206
9.6	ALARM SCHEMES	206
9.6.1	TEP1E Alarm Scheme	206
9.7	BW7R ALARM SCHEME	206
9.7.2	Subrack Displays	207
9.7.3	Rack Alarm Interfaces	208
9.7.4	SMA–1/4CP	208
9.7.5	Station Alarm Interfaces	209
9.8	FAULT DICTIONARY	210
CHAPTER 10: PERFORMANCE		211
10.1	INTRODUCTION	211
10.1.1	Data Accumulation	211
10.1.2	Performance Threshold Levels	211
10.1.3	2Mbit/s Traffic Monitoring	211
10.1.4	Synchronisation Threshold Levels	212

10.1.5	CSES Performance	212
10.1.6	USE	212
10.1.7	DEG Performance	212
10.1.8	Performance Data Processing	212
10.2	TANDEM CONNECTION MONITORING	213
CHAPTER 11: OPERATOR CONTROL		215
11.1	INTRODUCTION	215
11.2	OPERATOR CONTROL FROM AN ELEMENT MANAGER	215
11.3	OPERATOR CONTROL FROM AN LCT	215
11.4	SECURITY	216
11.4.1	Element Manager Operator Access	216
11.4.2	Element Manager Operator Control of LCT Access	216
11.4.3	LCT Operator Levels	216
CHAPTER 12: SOFTWARE DOWNLOAD		219
12.1	FEATURES	219
12.1.1	Software Download	219
12.1.2	Backing-up the SMA Configuration	219
12.1.3	Restoring the SMA Configuration	219
12.1.4	Software/Memory Management	219
SECTION 3: ADDITIONAL FEATURES		221
CHAPTER 13: APPLICATIONS		223
13.1	INTRODUCTION	223
CHAPTER 14: ADD-DROP MULTIPLEXER		225
14.1	EXAMPLE APPLICATIONS	225
14.1.1	SMA-1(4+4) and SMA-1(8)	225
14.1.2	SMA-4(4+4) and SMA-4(8)	226
14.2	NETWORK APPLICATIONS	226

14.2.1	General	226
14.2.2	Gateway Element	227
14.2.3	Ring Master Multiplexer	227
14.2.4	Fibre Hub	228
14.2.5	Terminal Multiplexer Configuration	228
14.2.6	Broadcast	229
14.2.7	Cross Connect	229
CHAPTER 15:		
VIRTUAL CONTAINER ACCESS MODULE (VC-AM)		231
15.1	INTRODUCTION	231
15.1.1	Configuration(VC-AM)	231
15.1.2	Comms Protection (VC-AM)	232
15.2	I421 FUNCTIONALITY	234
15.2.1	2M NT Mode	234
CHAPTER 16:		
SINGLE FIBRE WORKING		235
16.1	OVERVIEW	235
16.2	OPTIONS	235
16.2.1	Contra-Directional and Co-directional Configurations	236
16.2.2	Contra-Directional Single Fibre Working for 1310/1550nm system ...	236
16.2.3	Co-Directional Single Fibre Working	236
16.2.4	Single Fibre Working for Red/Blue System	237
16.2.5	Contra-Directional Single Fibre Woking	237
16.2.6	Co-Directional Single Fibre Working	238
16.3	SINGLE FIBRE WORKING FILTER/COUPLERS	238
16.3.1	1310/1550 nm Co/ Contra-Directional Filter/ Couplers	239
16.3.2	“Red/Blue” Contra-Directional Filters and Couplers	239
16.3.3	Red/Blue Co-Directional Filters and Couplers	240
16.3.4	Fibre handling for Single Fibre Working	240
16.4	AUTOMATIC LASER SHUTDOWN (ALS)	241
16.4.1	DUAL FIBRE WORKING WITH ALS	242
16.4.2	Single Fibre Working with ALS	242
16.4.3	ALS Using LOS	242
16.4.4	ALS Using Receipt Of Transmitted Section Trace	243
16.4.5	ALS Using J0 Mismatch	243
16.4.6	CONFIGURING ALS FOR SINGLE FIBRE WORKING	244
16.4.7	SETTING THE TRACE SECTION FOR ALS WITH SFW	244
16.4.8	USING THE DUAL STM-1 OPTICAL CARD WITH SFW	244

16.5	LINK SETTINGS	244
CHAPTER 17:		
TANDEM CONNECTION MONITORING		245
17.1	INTRODUCTION	245
17.2	TRUE TCM	246
17.2.1	Pseudo TCM	246
17.2.2	TCM Equipping Rules	247
CHAPTER 18:		
CELLSPAN		249
18.1	GENERAL	249
18.1.1	Common Features	249
18.1.2	ATM Traffic Adapter Card (ATA)	249
18.1.3	ATM Traffic Combiner (ATC)	251
18.1.4	ATM Traffic Extender (ATX)	252
18.2	APPLICATIONS	253
18.2.1	ATM NTE	253
18.2.2	Consolidation of ATM Traffic	254
18.2.3	Point-to-multipoint and Trunk Applications	254
18.2.4	ATM Traffic Adapter (ATA)	255
CHAPTER 19:		
PACKETSPAN		257
19.1	PACKETSPAN LINK PRODUCTS	257
19.2	PACKETSPAN MANAGEMENT	257
19.3	APPLICATION TO SERIES 4	257
CHAPTER 20:		
AUXILIARY		259
20.1	SMA-1/4CP	259
20.1.1	Auxiliary	259
20.1.2	EOW	259
20.2	SMA-1/4C, SMA-1/4UC AND SMA-1/4(4+4)(8)	259
20.2.1	General	259
20.2.2	Management of AUX on SMA1/4c /uc	259
20.2.3	AUX/EOW OH Byte Selection	260
20.2.4	AUX/EOW A/B Selection	260
20.2.5	DCC AUX Selection	261

20.2.6	Management of AUX on SMA–1/4	261
20.2.7	AUX A/B Selection	261

CHAPTER 21: EOW OPERATIONAL INFORMATION FOR SMA–1/4(4+4)(8) 263

21.1	INTRODUCTION	263
21.1.1	Functional Description	263
21.1.2	Card variants	263
21.2	FEATURES	263
21.2.1	Status Indication	263
21.2.2	Push–button Switch States	264
21.2.3	Overhead Buses	264
21.2.4	Ring Master/Slave Control	264
21.2.5	Telephone Number	265
21.2.6	Default Configuration	265
21.2.7	EOW Network Extension	266
21.2.8	64 kbit/s Co–directional Interfaces	266
21.2.9	Handset Loop Disconnect/DTMF Switch	266
21.2.10	Power–up Sequence	266
21.3	2–WIRE EOW OPERATION	267
21.3.1	Using the EOW	267
21.3.2	Audible and Visible Signals	267
21.3.3	Awaiting Answer	268
21.4	4–WIRE FEATURES	271
21.4.1	EOW Network Extension	271
21.4.2	Alternative EOW System	271

SECTION 4: SPECIFIC SHELF CONFIGURATION DETAILS 273

CHAPTER 22: SHELF CONFIGURATION FEATURES SPECIFIC TO SMA–1/4CP, SMA–1/4C, SMA–1/4UC AND SMA–1/4(4+4)(8) 275

22.1	SHELF CONFIGURATION FEATURES SPECIFIC TO SMA–1/4CP	275
22.1.1	PHYSICAL SHELF CONFIGURATION	276
22.1.2	Physical Card and Slot Allocation	276
22.1.3	Minimum Configuration	277
22.1.4	DCC Access	277
22.1.5	PROTECTION	277

22.1.6	ADDRESSING SCHEMES	278
22.2	PHYSICAL SHELF CONFIGURATION FEATURES SPECIFIC TO SMA-1/4C, SMA-1/4UC, SMA-1/4(4+4) AND SMA-1/4(8)	278
22.2.1	PHYSICAL SHELF CONFIGURATION	279
22.2.2	PHYSICAL CARD/SLOT ALLOCATION	281
22.2.3	CARD TYPES	281
22.2.4	MINIMUM SUBRACK CONFIGURATION	282
22.2.5	DCC ACCESS	282
22.2.6	PROTECTION	283
22.2.7	ADDRESSING SCHEMES	283
22.2.8	Backplane slot addressing	283

SECTION 5: INSTALLATION INFORMATION 285

CHAPTER 23: LINE TERMINATION UNITS 287

23.1	POPULATION OPTIONS	287
23.2	POWER LINE TERMINATION UNITS (LTUS)	288
23.2.1	Triple Feed Power LTU – (1HAM60778ABH) SMA-1/4(4+4) and SMA-1/4(8)	288
23.2.2	Dual Feed Power LTU (Italtel) 1HAM60779ABK SMA-1/4(4+4) and SMA-1/4(8)	289
23.3	LOCAL TERMINAL (LCT) LTU (1HAM60783 AAU) SMA-1/4(4+4) AND SMA-1/4(8)	290
23.4	ANCILLARY LTUS	292
23.4.1	Core Ancillary LTU for SMA-1/4C, /UC 1HAM61038ABW.	292
23.4.2	Core Ancillary LTU with Bw7R Alarm Scheme for SMA-1/4C, /UC. ...	293
23.4.3	Enhanced Ancillary LTU for SMA-1/4c, /uc 1HAM61039ABY.	296
23.4.4	Bw7R Alarm LTU – SMA-1/4(4+4) and SMA-1/4(8) 1HAM60780AAN	297
23.4.5	TEP1E Alarm LTU – SMA-1/4(4+4) and SMA-1/4(8) 1HAM60781AAQ ..	299
23.4.6	TEP1E Alarms Connector	300
23.4.7	User Alarms LTU – SMA-1/4(4+4) and SMA-1/4(8) 1HAM60782AAS	301
23.4.8	Q/B3Access Unit Interface (Comms AUI) LTU SMA-1/4(4+4) and SMA-1/4(8) 1HAM60789 AAH	302
23.4.9	Auxiliary LTU (Low Bit Rate) 1HAM60786AAB SMA-1/4(4+4) and SMA-1/4(8)	304
23.4.10	9.6kbit/s Access (V0 and V0.1)	305
23.4.11	64kbit/s Access (V0.1 Only)	306
23.4.12	Aux 1 and Aux 3 connections for EOW Card Application	306

23.4.13	2Mbit/s Test Bus LTU – 1HAM60888AAM SMA–1/4(4+4) and SMA–1/4(8)	307
23.4.14	Types of Cable Used for External Synchronisation Connections	308
23.4.15	Synchronisation LTUs (1HAM60785 AAY/1HAM60784 AAW)	309
23.5	TRAFFIC INTERFACE AREA LTU COMPLEMENT	309
23.5.1	2Mbit/s Traffic Unit LTUs (Core LTU) – SMA–1/4c, /uc	310
23.5.2	1.5/2Mbit/s Tributary LTUs SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8)	316
23.5.3	34Mbit/s Unbalanced LTU – SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60796AAR	319
23.5.4	45Mbit/s Unbalanced LTU – SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60797AAT	321
23.5.5	140/155Mbit/s Unbalanced LTU SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60798ABN	322
23.5.6	Link LTU – SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60839AAN	324
23.5.7	155Mbit/s Electrical LTU – 1HAM60865ACK SMA–1/4c, /uc, SMA–1/4(4+4) and SMA–1/4(8)	324
23.6	VC–AM LTU – SMA–1/4C, SMA-1/4UC, SMA–1/4(4+4) AND SMA–1/4(8)..	324
23.6.1	Optical LTU (1HAM60840AAJ/AAB)	324
23.6.2	Single Fibre Working Optical LTU (1HAM60892AEJ/ABG/ACY)	326
23.6.3	VC–AM LTU Auxiliary Interface	326
23.6.4	Electrical LTU (1HAM60854AAH)	327
23.7	LTU LINK/SWITCH SETTINGS	327
23.7.1	Power LTUs	327
23.7.2	Local Terminal LTU 1HAM60783AAU	328
23.7.3	Alarm LTU	328
23.7.4	User Alarm LTU 1HAM60782AAS	328
23.7.5	AUI LTU 1HAM60789AAH	328
23.7.6	Auxiliary LTU 1HAM60786AAB	328
23.7.7	2Mbit/s Test Bus LTU LTU	328
23.7.8	Sync Balanced LTU (1HAM60784AAW)	328
23.7.9	Sync Unbalanced LTU (1HAM60785AAY)	329
23.7.10	1.5 Mbit/s Balanced LTU (G703) – 1HAM 60623 AAW	329
23.7.11	1.5 Mbit/s Balanced LTU (G703) – 1HAM 60793AAK	329
23.7.12	2Mbit/s Balanced LTU (D Type) – 1HAM 60834AAC	329
23.7.13	2Mbit/s Un–balanced LTU (D Type) – 1HAM 60833AAA	330
23.7.14	34Mbit/s Unbalanced LTU – 1HAM 60796AAR	330
23.7.15	45Mbit/s Unbalanced LTU – 1HAM 60797AAT	330
23.8	POWER CONSUMPTION FIGURES	330
23.9	RECOMMENDED CABLING	331

CHAPTER 24:		
SLIDE-IN CARD UNITS	.....	335

24.1	INTRODUCTION	.....	335
24.1.1	Management Data Communications	.....	335
24.2	CARD COMPATIBILITY	.....	335
24.2.1	Hardware Codes	.....	335
24.2.2	Card Complement	.....	337
24.2.3	Installing the Cards into the Correct Slots	.....	337
24.2.4	Front Panel Connections	.....	337
24.2.5	Power Consumption Figures	.....	338
24.2.6	Typical Power Calculations	.....	339
24.2.7	Unit and Card Weights	.....	339
24.3	CARD LABEL POSITIONS	.....	341
24.4	POWER SUPPLY UNITS	.....	341
24.4.1	PSU Low Voltage Inhibit Circuit	.....	342
24.4.2	Supply Current	.....	343
24.4.3	Protection	.....	343
24.5	SYSTEM POWER-UP	.....	344
24.6	CORE CARD (1HAT60877AAR) AND COMMS/CONTROLLER CARD (1HAT60876AAP)	.....	345
24.7	OPTICAL TRAFFIC CARDS	.....	345
24.7.1	Optical Card Variants	.....	345
24.7.2	Optical Safety	.....	345
24.7.3	External Connections	.....	346
24.7.4	LEDs	.....	346
24.7.5	Push Buttons	.....	346
24.8	AUTOMATIC LASER SHUTDOWN (ALS)	.....	347
24.8.1	Introduction	.....	347
24.8.2	ALS Disabled	.....	347
24.8.3	ALS Enabled	.....	347
24.8.4	ALS Enabled, Auto Laser Restart Disabled	.....	348
24.8.5	STM-1 (TCM)	.....	348
24.8.6	Laser Restart	.....	348
24.8.7	Disabling ALS on Core Card (for SMA1/4(4+4)(8), SMA1/4c and /uc..	.....	348
24.8.8	Disabling ALS on SMA-1/4CP	.....	349
24.9	TRAFFIC CARD INSTALLATION	.....	350
24.9.1	1.5/2Mbit/s Tributary Cards	.....	350
24.9.2	1:N Protection (1.5/2Mbit/s Tributary Cards)	.....	351
24.9.3	34/45/140Mbit/s, Transmux,VC-AM, and STM-1 Tributary Cards	....	351

24.9.4	1:N Tributary Card protection (Not VC–AM)	351
24.9.5	1:1 Tributary Card protection	352
24.9.6	Optical Cards	352
24.9.7	Electrical Cards	355
24.9.8	Quad STM–1 TCM Electrical Card (1HAT60914AAA) – SMA1/4c only	357
24.9.9	140Mbit/s Tributary Card (1HAT60624BFE)	357
24.9.10	45Mbit/s Tributary Card (1HAT60623BAQ)	358
24.9.11	34Mbit/s Tributary Card (1HAT60622BAN)	358
24.9.12	34Mbit/s Transmux Card (1HAT60979AAC)	358
24.9.13	VC–AM Card (1HAT60917AAG)	359
24.10	OVERHEAD BUS ACCESS CARD	361
24.10.1	Auxiliary Card	361
24.10.2	Version ‘0’ (1HAT60004ADD)	362
24.10.3	Version ‘0.1’ (1HAT60647ABA)	362
24.10.4	Engineering Order Wire (EOW) Card	363
24.10.5	EOW Ring Slave	363
24.10.6	EOW Fixed Ringmaster	363
24.10.7	LEDs	363
24.11	TEST BUS/MONITOR POINTS	364
24.11.1	PSU	364
24.11.2	34/45/140MBit/s	364
24.11.3	Conventional STM–1 Optical	364
24.11.4	Dual STM–1 Optical	365
24.11.5	Conventional STM–1 Electrical	365
24.11.6	Dual STM–1 Electrical	365
24.11.7	2MBIT/S Testbus LTU	365
24.12	RECOMMENDED CABLING	366
CHAPTER 25:		
OPTICAL MODULES		369

25.1	HARDWARE CODES	369
25.1.1	SMA1/4CP	369
25.1.2	SMA–1/4CP FITTING PROCEDURE	371
25.1.3	SMA1/4c, /uc, SMA1/4(4+4) and SMA1/4(8)	372
25.1.4	PROCEDURE FOR FITTING OPTICAL MODULES TO CORE CARD AND DUAL STM–1 OPTICAL CARD	374
25.2	GENERAL DESCRIPTION	375
25.3	STM–1 OPTICAL INTERFACE	375
25.4	STM–1 TRANSMIT WAVELENGTH	376
25.5	STM–4 OPTICAL INTERFACE	376

25.6	STM-4 TRANSMIT WAVELENGTH	376
25.7	OPTICAL CONNECTORS	376
25.8	STM-N OPTICAL INPUT	376
25.9	OPTICAL TRANSMIT INTERFACE	377
25.9.1	General Description	377
25.9.2	Laser Alarms	377
25.10	LOOPBACKS	377
25.10.1	Inward Mux Loopback	377
25.10.2	Outward Line Loopback	377
25.11	DATA PATHS	377
25.12	POWER SUPPLIES	378
25.12.1	Input Voltages	378
25.13	RELIABILITY	378
25.13.1	Service Life	378
25.13.2	Mean Time Between Failures (MTBF)	378
25.14	OPTICAL SAFETY	378
25.15	HOT SURFACES	378
25.16	ELECTROSTATIC DAMAGE	378
25.17	EQUIPMENT PRACTICE	379
25.18	MODULE WEIGHT	379

CHAPTER 26: LINK AND SWITCH CONFIGURATION 381

26.1	TRAFFIC CARD LINK/SWITCH SETTINGS	381
26.2	CORE CARD (1HAT60877AAR)	381
26.3	SMA-1/4CP	381
26.4	CONVENTIONAL CARDS	382
26.4.1	1.5/2Mbit/s (16x2) Tributary Card – 1HAT60736 AAW	382
26.4.2	1.5/2Mbit/s (32x2) Tributary Card – 1HAT60707 AAD	382
26.4.3	34Mbit/s Transmux Card – 1HAT60979AAC	383
26.4.4	34/45Mbit/s Tributary Cards – 1HAT60622BAN/ 1HAT60623BAQ	383
26.4.5	140Mbit/s Tributary Cards – (1HAT60624BFE)	383
26.4.6	VC-AM Card – 1HAT60917AAG	384
26.5	POWER SUPPLY UNITS	384
26.5.1	Power Supply 1HAK60550 BAC/BCM	384

26.5.2	Power Supply 1HAK60669 AAW	384
26.5.3	EOW Card DIL Switches and Links	384
26.5.4	Auxiliary Card (V '0') 9.6kbit/s 1HAT60004 AAD	385
26.5.5	Auxiliary Card (V 0.1) 64kbit/s 1HAT60647 ABA	385
26.6	ENGINEERS ORDER WIRE (EOW)	388
26.7	TCM TRAFFIC CARDS	388
26.7.1	STM-1 Optical Mux Card (TCM) – (1HAT60791***)	388
26.7.2	STM-1 Electrical Card (TCM) – (1HAT60803ABT)	388
26.7.3	STM-1 Dual Electrical Card (TCM) – (1HAT60918AAJ)	389
26.7.4	STM-1 Dual Optical Card (TCM) – (1HAT60878***)	389
26.7.5	Optical Module (1HAT60874AAK)	390
26.8	SMA-1/4C AND /UC ENHANCED ANCILLARY LTU (1HAM61039ABY) ...	390
26.9	SFW VARIANT LINK SETTINGS	390
26.9.1	STM-1 Variant Link Settings	390
26.9.2	STM-4 Variant Link Settings	391
26.10	SFW VARIANT LINK SETTINGS	391
26.10.1	STM-1 ALS	391
26.10.2	STM-4 ALS	391
26.10.3	34MBit/s and 45MBit/s Expansion Units	391
CHAPTER 27: POWER SUPPLY OPTIONS		393

27.1	SMA-1/4CP	393
27.1.1	General Information	393
27.1.2	PSU	395
27.1.3	Signal Descriptions	396
27.1.4	Battery	397
27.1.5	Power Module	398
27.1.6	Dual power feeds	399
27.1.7	Installation requirement	399
27.1.8	BATTERY BACK UP TIME	400
27.2	SMA-1/4C AND /UC	401
27.2.1	Station 48V	401
27.2.2	Mains Supply	402
27.2.3	PSU Alarms	403
27.2.4	Battery Backup Solutions	404
27.2.5	Power Module with Battery Backup	404
27.2.6	PSU Alarms	405

27.2.7	Battery Requirement	405
27.2.8	Battery/Mains Monitoring	406
27.2.9	DC Input Fail Alarm	406
27.2.10	Battery Low Alarm	406
27.2.11	Mains Input Fail Alarm	406
27.2.12	Power Connector	406
27.2.13	Shelf Loading	407
27.2.14	Maximum Loading – Full Shelf	407
27.2.15	Maximum Loading – Protected CPE	407
27.2.16	Dual Power Feeds	408
27.3	SMA–1/4	408
27.3.1	Station 48V	408
27.3.2	PSU Alarms	408
27.3.3	Power Connector	409
27.3.4	Shelf Loading	409
 CHAPTER 28:		
INSTALLATION: SMA–1/4CP		411
28.1	SMA–1/4CP BASE UNITS	411
28.2	SMA–1/4CP INSTALLATION KIT	411
28.3	SMA–1/4CP POWER SUPPLY	412
28.4	SMA–1/4CP EXPANSION MODULES	412
28.5	SMA–1/4CP CORE INTERFACE AREA	414
28.6	SMA–1/4CP OPTICAL MODULES	416
28.7	SMA–1/4CP EXPANSION CONSIDERATIONS	417
28.8	BASE UNIT DETAILS	417
28.8.1	Construction	417
28.8.2	Mechanical Details	417
28.9	BASIC INSTALLATION SEQUENCE	417
28.10	FITTING THE BASE UNIT	418
28.10.1	Safety	418
28.10.2	Protective Earthing	418
28.10.3	General Considerations	418
28.10.4	Temperature Control	419
28.10.5	Wall Mounting Installation	419
28.10.6	Direct Wall Mounting	420
28.10.7	Fibre Management Tray Mounting	421
28.10.8	Wall Mounting Plate	422

28.10.9	SMA1/4CP MOUNTING ARRANGEMENTS	423
28.10.10	SMA1/4CP Rack Mounting	424
28.10.11	SMA–1/4CP Fan Module (1HAM61048AAU)	426
28.11	COMMS/CONTROLLER FUNCTIONS	426
28.12	SWITCHING FUNCTIONS	427
28.13	SMA–1/4CP SOFTWARE	427
28.13.1	System Backup Software	427
28.13.2	Local Terminal Software	427
28.14	ETHERNET CONNECTIONS	428
28.14.1	Ethernet Network Specifications	428
28.14.2	‘Thick Ethernet’	429
28.14.3	‘Thin’ Ethernet	430
28.14.4	10BaseT Ethernet	431

CHAPTER 29: INSTALLATION – SMA1/4C AND /UC SUB–RACKS 433

29.1	INTRODUCTION	433
29.1.1	Equipment Complement	433
29.2	EQUIPMENT RACK	433
29.2.1	Multiple Subrack Mounting	433
29.3	SUB–RACK DETAILS	434
29.3.1	Variations	434
29.3.2	Construction	434
29.4	EXTERNAL SUB–RACK CONNECTIONS	434
29.4.1	Slide–In Cards	434
29.4.2	Ancillary LTUs	434
29.4.3	Power LTUs	434
29.5	SUB–RACK BASIC ASSEMBLY	435
29.5.1	Card–Cage Area	435
29.5.2	Fibre Management Area	435
29.6	SYSTEM MEMORY	435
29.6.1	SMA–1/4c and /uc Subrack (1HAG60557AAK)	436
29.7	BASIC INSTALLATION SEQUENCE	436
29.7.1	Fitting the Sub–Rack	436
29.7.2	Ancillary Connections	437
29.7.3	Fuses and Circuit Breakers	437
29.8	CARD CONFIGURATION	438

29.9	PSU, COMMS/CONTROLLER CARD, CORE CARD SWITCHING AND ROUTEING FUNCTIONS	438
29.9.1	Power Supply Units	438
29.9.2	Comms/Controller Card (1HAT60876AAP)	439
29.9.3	Core Card Switching and Routeing Functions	439
29.10	SMA–1/4C SOFTWARE	440
29.10.1	SMA–1/4c Software	440
29.10.2	System Memory KOP	440
29.10.3	System Backup Software	441
29.10.4	Local Terminal Software	441
29.11	EMC COVERS	441
29.12	ETHERNET CONNECTIONS	441
29.12.1	Ethernet Network Specifications	441
29.12.2	‘Thick Ethernet’	442
29.12.3	‘Thin’ Ethernet	443
29.12.4	10BaseT Ethernet	444
CHAPTER 30: INSTALLATION–SMA1/4(4+4) AND SMA1/4(8) SUBRACKS		445

30.1	INTRODUCTION	445
30.1.1	Equipment Complement	445
30.2	EQUIPMENT RACK	445
30.2.1	Multiple Subrack Mounting	445
30.3	SUBRACK DETAILS	446
30.3.1	Variations	446
30.3.2	Construction	446
30.4	EXTERNAL SUB–RACK CONNECTIONS	446
30.4.1	Slide In Cards	446
30.4.2	Ancillary LTUs	446
30.4.3	Power LTUs	447
30.5	SUB–RACK BASIC ASSEMBLY	447
30.5.1	Card–Cage Areas	447
30.5.2	Fibre Management Area	447
30.6	SYSTEM MEMORY	448
30.6.1	SMA–1/4(4+4) Subrack (1HAG60596AAT)	448
30.6.2	SMA–1/4(8) Subrack (1HAG60594AAP)	449
30.7	BASIC INSTALLATION SEQUENCE	449
30.7.1	Fitting the Sub–Rack	450
30.7.2	Ancillary Connections	450

30.7.3	Ancillary and Traffic Blanking LTU Facias	450
30.7.4	Fuses and Circuit Breakers	450
30.8	CARD CONFIGURATION	451
30.9	PSU, COMMS/CONTROLLER CARD, CORE CARD SWITCHING AND ROUTEING FUNCTIONS	452
30.9.1	Power Supply Unit (1HAK60669AAW)	452
30.9.2	Comms/Controller Card (1HAT60876AAP)	452
30.9.3	Core Card Switching and Routeing Functions	454
30.10	SMA–1/4 (4+4) AND SMA–1/4(8) SOFTWARE	455
30.10.1	Software	455
30.10.2	System Memory KOP	455
30.10.3	System Backup Software	456
30.10.4	Local Terminal Software	456
30.11	EMC COVERS	456
30.12	ETHERNET CONNECTIONS	457
30.12.1	Ethernet Network Specifications	457
30.12.2	‘Thick Ethernet’	458
30.12.3	‘Thin’ Ethernet	459
30.12.4	10BaseT Ethernet	460

CHAPTER 31: SMA UPGRADE INFORMATION

461

31.1	STM–1 OPTICAL MULTIPLEXER, STM–4 OPTICAL INTERFACE CARD SAFETY	461
31.2	PROTECTION	461
31.3	SMA–1/4CP STM–N UPGRADE	462
31.4	SMA–1/4C, SMA-1/4UC AND SMA–1/4(4+4)(8) STM–N UPGRADE	463

SECTION 6: COMMISSIONING PROCEDURE

465

CHAPTER 32: COMMISSIONING PROCEDURE

467

32.1	INTRODUCTION AND SCOPE	467
32.2	SAFE WORKING PRACTICES	467
32.3	CLEANING PROCEDURES FOR OPTICAL CONNECTORS	467
32.3.1	Optical Measurements	467

32.3.2	Static Sensitive Warning	467
32.4	TEST EQUIPMENT	467
32.5	PRELIMINARY SMA EQUIPMENT CHECKS	468
32.5.1	Visual Inspection	468
32.5.2	Card/LTU Link and Switch Settings	468
32.6	POWER SUPPLY CHECK	468
32.6.1	Fuse Rating	468
32.6.2	Power Connector Wiring	469
32.7	SHELF CONFIGURATION	469
32.8	SYSTEM POWER-UP	469
32.9	EQUIPMENT CONFIGURATION	471
32.10	FUNCTIONAL CHECKS AT SMA NODES	471
32.11	NETWORK CHECKS	472
32.11.1	Information Required from the Network Operating Authority	472
32.11.2	Element Manager	473

SECTION 7: MAINTENANCE 475

CHAPTER 33: GENERAL MAINTENANCE INFORMATION 477

33.1	INTRODUCTION	477
33.2	CLEANING PROCEDURES FOR OPTICAL CONNECTORS	477
33.2.1	General	477
33.2.2	Materials Required	477
33.2.3	Cleaning Procedures	478
33.2.4	Cleaning of Optical Connector	478
33.2.5	Cleaning of Optical Coupler – Where Practical	478

GLOSSARY OF TERMS 481

LIST OF ABBREVIATIONS 493

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LIST OF FIGURES

Figure 2.1	SMA–1/4CP	67
Figure 2.2	Rear View of 4 x 2 SMA–1/4CP.	68
Figure 2.3	Front View of SMA–1/4CP with Expansion Module	69
Figure 2.4	Example Network Configurations	70
Figure 2.5	Point to Point Operation	71
Figure 2.6	Expansion Solution	72
Figure 2.7	SMA functional element applications	76
Figure 2.8	Example Network Configurations	77
Figure 2.9	Element Manager and Local Terminal (LCT) Connections	80
Figure 2.10	NT1 Function (only) in Transmission Network	83
Figure 2.11	NT1 and LT Functions in Transmission Network	84
Figure 3.1	Rear View of 4 x 2 SMA–1/4CP.	89
Figure 3.2	Core LTU variants for the SMA–1/4CP	90
Figure 3.3	8 x 2M Expansion Module Enclosure	90
Figure 3.4	16 x 2MExpansion Module Enclosure	91
Figure 3.5	Front view of the SMA–1/4CP ADM enclosure with Expansion Module.	91
Figure 3.6	SMA–1/4c	92
Figure 3.7	Core LTUs– 32 x 2M	92
Figure 3.8	Variants of the ancillary panel	93
Figure 3.9	SMA–1/4(8)	93
Figure 3.10	SMA–1/4(4+4) Single Row LTU	94
Figure 3.11	Core Card Features	97
Figure 3.12	SMA–1/4CP Software Functions	98
Figure 3.13	SMA–1/4c and SMA–1/4(4+4),(8) Software Functions	98
Figure 3.14	SMA–1/4CP Power Distribution	102
Figure 3.15	SMA–1/4c Power Distribution	102
Figure 3.16	SMA–1/4 Power Distribution	103
Figure 4.1	SMA Multiplexing Structure For STM–N Signals	113
Figure 4.2	STM–N Frame Structure	115
Figure 5.1	STM–N VC Connectivity	118
Figure 5.2	VC Connectivity STM–N Port <–> 2Mbit/s Port	119
Figure 5.3	VC Connectivity 1.5/2Mbit/s Port <–> 1.5/2Mbit/s Port	119
Figure 5.4	VC Connectivity STM–N Port <–> 34/45Mbit/s Port	119
Figure 5.5	VC Connectivity 34/45Mbit/s Port <–> 34/45Mbit/s Port	120
Figure 5.6	VC Connectivity STM–N Port <–> 140Mbit/s Port	120
Figure 5.7	VC Connectivity 140Mbit/s Port <–> 140Mbit/s Port	120
Figure 6.1	SMA–N synchronisation timing areas and timing signal source options.	123
Figure 6.2	Freerun Mode	125
Figure 6.3	Line Timing Mode	127
Figure 6.4	Tributary Timing Mode	127

Figure 6.5	External Timing Mode	128
Figure 6.6	Stand Alone Synchronisation Equipment Timing	128
Figure 6.7	Synchronous Network	132
Figure 6.8	Plesiochronous Data On Synchronous Network	133
Figure 6.9	Wander Buffers On Synchronous Network	134
Figure 6.10	SMA–1/4CP Synchronisation	135
Figure 6.11	SMA–1/4c Synchronisation	142
Figure 6.12	Core Card and Synchronisation	146
Figure 7.1	SMA–n Protection options	151
Figure 7.2	1+1 STM–1 Line Protection	154
Figure 7.3	SNC Protection	157
Figure 7.4	1.5/2Mbit/s Tributary Card 1:N protection	161
Figure 7.5	High–order Tributary Card 1:N protection	163
Figure 7.6	Tributary Port Protection	164
Figure 7.7	2Mbit/s protected from the Core	168
Figure 7.8	2Mbit/s solution, protected or non–protected	168
Figure 7.9	Non 2M solution (34M/45M, 140M, STM–1, Cellspan, VCAM) protected and non protected	169
Figure 7.10	1.5/2M Protection for SMA–1/4(4+4)	170
Figure 7.11	Fig A: Core Trib Mode Fig B: ‘Normal’ 1:N Protection	171
Figure 7.12	SMA–1/4(8) – 34/45M, 140M, STM–1 and VCAM Protection	172
Figure 7.13	SMA–1/4(4+4)(8) – ATM and ETA Tributary Card Protection	173
Figure 8.1	Communications In SDH Networks	175
Figure 8.2	Network Element Management Data Communications	177
Figure 8.3	IS–IS Routeing	181
Figure 8.4	IS–IS Area Partitioning for Hierarchical Element Rings	183
Figure 8.5	NSAP Address Formats	184
Figure 8.6	Auxiliary Card V0.1 DIL Switch Function	189
Figure 8.7	Auxiliary Card: System Application	191
Figure 8.8	Control and Data Collection	192
Figure 8.9	Network Example	193
Figure 8.10	Example of DIL Switch Settings for the Configuration of Figure 8.9 .	195
Figure 8.11	Setting up Communications for a simple Sub–network	196
Figure 9.1	SMA–N Event Processing Scheme	202
Figure 9.2	Alarm Event Type Configuration Options	203
Figure 11.1	Element Management	218
Figure 14.1	Add-Drop configuration (SMA-1)	225
Figure 14.2	Add-Drop Multiplexer Configuration (SMA-4)	226
Figure 14.3	Examples of Add-Drop Multiplexer applications in STM-N networks .	227
Figure 14.4	Terminal Multiplexer and Fibre Hub applications	228
Figure 14.5	Terminal Multiplexer configuration	228
Figure 14.6	Broadcast	229
Figure 14.7	Cross Connect Cluster	230

Figure 15.1	VC-AMs Installed in an SMA Multiplexer	231
Figure 15.2	Typical VCTS Applications	232
Figure 15.3	VC-TM Protection in IS-IS Areas	233
Figure 16.1	Single Fibre Operation (Contra-Directional)	235
Figure 16.2	1310/1550nm Single Fibre Operation (Contra-Directional)	236
Figure 16.3	1310/1550 Single Fibre Co-directional Operation	237
Figure 16.4	(Red/Blue) Single Fibre Contra-Directional operation	238
Figure 16.5	(Red/Blue) Single Fibre Co-directional Operation	238
Figure 16.6	WD1315U-GPT1 COUPLER	239
Figure 16.7	WD1515RB-GPT1 COUPLER	239
Figure 16.8	WD1515RR-GPT1 COUPLER	240
Figure 16.9	Fibre Tray with 1310/1550nm Working	241
Figure 16.10	ALS Dual Fibre Working	242
Figure 16.11	ALS Single Fibre Working Reflection of Signal	243
Figure 16.12	ALS Single Fibre Working with Section Trace	243
Figure 17.1	Example of Operator Domain Boundaries	245
Figure 17.2	Relationship between Logical and Physical TC Trails	246
Figure 18.1	ATA Location and Mapping Options	250
Figure 18.2	ATA/ATC Differentiation	252
Figure 18.3	Position of the CellSpan Units in an SDH Access Network	253
Figure 18.4	Consolidation ('Hubbing') ATA Application	254
Figure 18.5	CellSpan – Point to Point Application	254
Figure 18.6	ATA Gives Access Efficiency when Carrying ATM in the SDH Network	255
Figure 20.1	AUX Switching on SMA-1/4c Ancillary	260
Figure 20.2	AUX Switching on the SMA-1/4 AUX Card	262
Figure 21.1	Selective and Omnibus Buzzer Cadences	267
Figure 21.2	Supervisory Tone Cadences	268
Figure 22.1	SMA-1/4CP Line Termination representation	276
Figure 23.1	Triple Feed Power LTU Connections	289
Figure 23.2	Dual-feed Power LTU (Italtel)	290
Figure 23.3	Local Terminal LTU	291
Figure 23.4	SMA-1/4c Core Ancillary LTU	292
Figure 23.5	SMA-1/4c Core Ancillary LTU supporting Bw7R alarm scheme	294
Figure 23.6	SMA-1/4c Enhanced Ancillary LTU	296
Figure 23.7	Bw7R Alarm LTU	297
Figure 23.8	TEP1E Alarm LTU	299
Figure 23.9	User Alarm LTU	301
Figure 23.10	User Alarm Examples	302
Figure 23.11	AUI LTU	303
Figure 23.12	Generic Auxiliary LTU	304
Figure 23.13	2Mbit/s Test LTU	307
Figure 23.14	Un-Balanced Sync LTU	309
Figure 23.15	Balanced Sync LTU	309

Figure 23.16	Balanced 2Mbit/s Core LTU (SMA–1/4c)	310
Figure 23.17	Balanced 2Mbit/s Core LTU (SMA–1/4c)	311
Figure 23.18	SMA1/4c – 32 x 2M Unbalanced LTU	314
Figure 23.19	1.5Mbit/s Balanced LTU	316
Figure 23.20	Un–Balanced 2Mbit/s LTU	317
Figure 23.21	2Mbit/s Balanced LTU	319
Figure 23.22	34Mbit/s Tributary Unbalanced LTU	320
Figure 23.23	45Mbit/s Un–Balanced LTU	321
Figure 23.24	140Mbit/s/STM–1 LTU and Link LTU Connections	323
Figure 23.25	34Mbit/s VC–AM LTU Traffic Connections	325
Figure 23.26	VC–AM Electrical LTU	327
Figure 24.1	PSU Front Panel LED Indications and Monitor Point	342
Figure 24.2	Power Supply Unit View Showing Location of Switch SW1	343
Figure 24.3	Power Supply Unit View Showing Location of Switch SW2	343
Figure 24.4	External fibre–optic connectors (FC/PC)	347
Figure 24.5	Procedure for Disabling ALS on Series 4 Core Card	349
Figure 24.6	Procedure for Disabling ALS on SMA–1/4CP and use of other pins .	350
Figure 24.7	Dual STM–1 Optical Card Core Card	353
Figure 24.8	Quad STM–1 Optical Card (SMA–1/4c)	355
Figure 24.9	Electrical STM–1 and 140Mbit/s Tributary Card	356
Figure 24.10	Dual STM–1 Electrical Trib Card	356
Figure 24.11	Quad STM–1 Electrical Card (SMA–1/4c)	357
Figure 24.12	34/45Mbit/s Tributary 34Mbit/s Transmux	359
Figure 24.13	VC–AM Card	360
Figure 24.14	On–card Connectors for 64kbit/s Access	363
Figure 25.1	SMA–1/4CP Optical Module Fitting Procedure	371
Figure 25.2	Procedure for Fitting Optical Modules to Core Card and Dual STM–1 Optical Card	374
Figure 25.3	Optical Module Block Diagram	375
Figure 26.1	EOW Card Switches and Links	385
Figure 26.2	Example of DIL Switch Settings	387
Figure 27.1	SMA–1/4CP Powered from External Mains Brick	393
Figure 27.2	Battery Box Utilised with Mains Brick to Support Battery Back–up ..	394
Figure 27.3	Power Module to Support Battery Back–Up with ATX/16x2M Expansion Module	395
Figure 27.4	SMA–1/4CP Power Interface	396
Figure 27.5	Battery Box Connection to SMA–1/4CP	398
Figure 27.6	Power Module Connection to SMA–1/4CP	399
Figure 27.7	SMA–1/4c with Station Supplying –48V	402
Figure 27.8	SMA–1/4c with Single External Mains PSU	402
Figure 27.9	SMA–1/4c with Dual External Mains PSU	403

Figure 27.10	External PSU for SMA–1/4c	403
Figure 27.11	SMA–1/4c with External Mains PSU and Battery Backup	404
Figure 27.12	Mains Power Module with Battery Backup for SMA–1/4c	405
Figure 27.13	Battery/Mains Monitoring on SMA–1/4c	407
Figure 27.14	SMA–1/4 with Station Supplying –48V	408
Figure 28.1	SMA–1/4CP Expansion	412
Figure 28.2	Front View of SMA–1/4CP with Expansion Module	412
Figure 28.3	8 x 2M Expansion Module	413
Figure 28.4	16 x 2M Expansion Module	414
Figure 28.5	Rear View of 4 x 2 SMA–1/4CP.	415
Figure 28.6	Core LTU variants for the SMA–1/4CP	416
Figure 28.7	16 x 2M Unbalanced Base Unit (1HAN60511AAH)	416
Figure 28.8	Mounting the SMA1/4CP directly to a wall	421
Figure 28.9	Mounting Arrangement on Fibre Management Tray	422
Figure 28.10	SMA1/4CP Wall Mounting Plate	423
Figure 28.11	Mounting Arrangements	424
Figure 28.12	SMA1/4CP Rack Mounting Kit of Parts.	425
Figure 28.13	SMA–1/4CP Fan Module	426
Figure 28.14	‘Thick’ Ethernet Connections	429
Figure 28.15	‘Thin’ Ethernet Connections	430
Figure 28.16	10BaseT Ethernet using UTP cables and a Network Hub	431
Figure 29.1	SMA–1/4c Sub–Rack Layout	436
Figure 29.2	‘Thick’ Ethernet Connections	442
Figure 29.3	‘Thin’ Ethernet Connections	443
Figure 29.4	10BaseT Ethernet using UTP cables and a Network Hub	444
Figure 30.1	SMA–1/4(4+4) Sub–Rack Arrangement	448
Figure 30.2	SMA–1/4(8) Sub–Rack Arrangement	449
Figure 30.3	PSU and Comms/Controller Card Front Layout	454
Figure 30.4	‘Thick’ Ethernet Connections	458
Figure 30.5	‘Thin’ Ethernet Connections	459
Figure 30.6	10BaseT Ethernet using UTP cables and a Network Hub	460
Figure 31.1	Process for Performing Line Module Upgrade	463
Figure 31.2	STM–N Upgrade Procedure	464
Figure 32.1	PSU Front Panel LED Indications and Monitor Point	470

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LIST OF TABLES

Table 1.1: Manual Structure	63
Table 2.1: Expansion Modules	72
Table 3.1: Tributary Units	94
Table 3.2: Main Differences Between SMA–1/4c and SMA–1/4(4+4),(8)	95
Table 3.3: Series 4 Protection	99
Table 3.4: SFW Optical Budget Requirements	108
Table 3.5: Electrical Interfaces	109
Table 5.1: Addition of Higher Order Cross–Connections	121
Table 5.2: Addition of Lower Order Cross–Connections	121
Table 6.1: Default Quality Levels and Codes	129
Table 6.2: On/Off Thresholds for System PLL Out–of–Limits and System Holdover	147
Table 7.1: Series 4 Protection	152
Table 7.2: MSP Protection State Priorities	155
Table 7.3: VC Protection Demand State Priorities	159
Table 7.4: Summary of Protection State Initiation Conditions	160
Table 7.5: SMA Protected PDH Channels	164
Table 7.6: Priority of Failure Conditions	166
Table 8.1: Communications Routeing Requirements	178
Table 8.2: IS–IS Element Routeing Table	181
Table 8.3: Aux Channel Access Routes (V0)	188
Table 8.4: Aux Channel Access Routes V0.1	188
Table 8.5: DCC Accessing Configuration for SMA–1/4CP	197
Table 9.1: LED Location Details	208
Table 9.2: SMA–1/4CP Alarms – Relay 1	209
Table 9.3: SMA–1/4CP Alarms – Relay 2	209
Table 18.1: ATA and ATC Interface Details	251
Table 20.1: SOH Byte Options	260
Table 21.1: EOW Card Variants	263
Table 21.2: EOW Ring Slave/Ring Master	264
Table 22.1: SMA–1/4CP Base Unit Details	275
Table 22.2: SMA–1/4CP Expansion Unit Details	275
Table 22.3: SMA–1/4CP Physical Card and Slot Allocation	277
Table 22.4: SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8)	278
Table 22.5: SMA–1/4(8) Shelf Configuration	279
Table 22.6: SMA–1/4 (4+4) Shelf Configuration	279
Table 22.7: SMA–1/4(8) and SMA–1/4(4+4) Ancillary LTUs	280
Table 22.8: SMA–1/4c Shelf Configuration	280
Table 22.9: SMA–1/4c Ancillary LTUs	281
Table 22.10: Permissible Card/Slot Allocations for SMA–1/4(4+4) and SMA–1/4(8)	281
Table 22.11: Permissible Card/Slot Allocations for SMA–1/4c	281

Table 22.12: SMA–1/4 Tributaries	281
Table 22.13: Backplane Slot Addressing	283
Table 23.1: LTU Options	287
Table 23.2: LCT LTU Connector Pinout	292
Table 23.3: SMA–1/4c Core Ancillary LTU Connector Pinouts (Except PWR)	293
Table 23.4: SMA–1/4c Core Ancillary LTU Connector Pinouts (PWR)	293
Table 23.5: SMA–1/4c Core Ancillary LTU Connector Pinouts (Except PWR)	294
Table 23.6: Bw7R Alarm Connector Pinout	294
Table 23.7: SMA–1/4c Connector Pinouts (PWR)	295
Table 23.8: SMA–1/4c Enhanced Ancillary LTU Connector Pinouts	296
Table 23.9: BW7R Alarm Connector Pinout	298
Table 23.10: TEP1E Alarm Cabling Connector Pin Allocations	300
Table 23.11: User Alarm Connector Pinout	301
Table 23.12: AUI Port Connector Pinout	303
Table 23.13: Aux LTU Connector Pinouts	305
Table 23.14: 9.6 kbit/s LTU Access (V0 Card Fitted)	305
Table 23.15: 9.6 kbit/s LTU Access (V0.1 Card Fitted)	306
Table 23.16: Aux LTU Connector Pinouts For EOW	306
Table 23.17: Test Bus LTU Connector Pinout	307
Table 23.18: External Sync (Balanced) Pinout	309
Table 23.19: Balanced 2Mbit/s Core LTU Pinout	312
Table 23.20: Unbalanced 2Mbit/s Core LTU Pinout	314
Table 23.21: 1.5Mbit/s Balanced Traffic LTU Pinout	316
Table 23.22: 2Mbit/s Balanced Traffic LTU Pinout	319
Table 23.23: SK3 9–Way RJ45 Type Connections	326
Table 23.24: TEP1E & BW7R Alarm LTU Factory Link settings	328
Table 23.25: Termination Impedance	329
Table 23.26: Termination Impedance	329
Table 23.27: LTU Power Consumption	330
Table 24.1: Slide–in Card Units	335
Table 24.2: Typical Power Consumption	338
Table 24.3: Unit and Card Weights	339
Table 24.4: Summary of Switch Operation	343
Table 24.5: Channel / VCTS Line Association	361
Table 24.6: 64kbit/s Access Connectors	362
Table 25.1: STM–1 Dual Fibre Working Optical Modules for SMA–1/4CP	369
Table 25.2: STM–1 Single Fibre Working Non–Integrated Optical Modules for SMA–1/4CP	370
Table 25.3: STM–4 Dual Fibre Working Optical Modules for SMA–1/4CP	370
Table 25.4: STM–4 Single Fibre Working Non–Integrated Optical Modules for SMA–1/4CP	370
Table 25.5: STM–1 Dual Fibre Working Optical Modules for SMA–1/4c and SMA–1/4(4+4)(8)	372

Table 25.6: STM–1 Single Fibre Working Non–Integrated Optical Modules for SMA–1/4c and SMA–1/4(4+4)(8)	372
Table 25.7: STM–4 Dual Fibre Working Optical Modules for SMA–1/4c and SMA–1/4(4+4)(8)	372
Table 25.8: STM–4 Single Fibre Working Non–Integrated Optical Modules for SMA–1/4c and SMA–1/4(4+4)(8)	372
Table 25.9: Operating Wavelengths	376
Table 25.10: Operating Wavelengths	376
Table 26.1: Core Card Link Settings (Jumper Block PL5)	381
Table 26.2: Core Card Link Settings (Jumper Block PL3)	381
Table 26.3: SMA–1/4CP Link Settings	382
Table 26.4: 16 x 1.5/2Mbit/s Tributary Card Link Settings	382
Table 26.5: 32 x 1.5/2Mbit/s Tributary card link settings	382
Table 26.6: 34Mbit/s Transmux card link settings	383
Table 26.7: 34M/45bit/s Tributary card link settings	383
Table 26.8: 140Mbit/s Tributary card link settings	383
Table 26.9: VC–AM Card Link Settings	384
Table 26.10: Power Supply Unit/s Link Settings	384
Table 26.11: Power Supply Unit/s Link Settings	384
Table 26.12: 9.6kbit/s Auxiliary Card (Version 0.0) Link Settings	385
Table 26.13: Auxiliary Card (Version 0.1) Channel Configurations	386
Table 26.14: DIL Switch Functions	386
Table 26.15: STM–1 (TCM) Optical Card Link Settings	388
Table 26.16: STM–1 (TCM) Electrical Card Link Settings	388
Table 26.17: STM–1 (TCM) Dual Electrical Card Link Settings	389
Table 26.18: STM–1 (TCM) Dual Optical Card Link Settings	389
Table 26.19: Optical Module Link Functions	390
Table 26.20: SMA1/4c Enhanced Ancillary LTU Switch Settings	390
Table 26.21: SFW Default Link Settings (STM–1)	390
Table 26.22: SFW Default Link Settings (STM–4)	391
Table 26.23: Link Settings to Enable/Disable ALS for STM–1	391
Table 26.24: Link Settings to Enable/Disable ALS for STM–4	391
Table 27.1: Indicative Battery Back–Up Times for Battery Back–Up Solution + Mains Brick	400
Table 27.2: Indicative Battery Back–up Times for Power Module Solution with Internal Mains PSU (75W)	401
Table 28.1: SMA–1/4CP Base Units	411
Table 28.2: SMA–1/4CP Installation Kit	411
Table 28.3: SMA–1/4CP Expansion Modules	413
Table 28.4: SMA–1/4CP Software	427
Table 28.5: 10Base5, 10Base2 and 10BaseT specifications	428
Table 29.1: SMA–1/4c Subrack Configuration	438
Table 29.2: SMA–1/4c Software	440
Table 29.3: EMC Panels	441
Table 29.4: 10Base5, 10Base2 and 10BaseT specifications	442

Table 30.1: Ancillary and Traffic Blanking LTU Facias	450
Table 30.2: SMA–1/4(4+4) and SMA–1/4(8) Subrack Configuration	451
Table 30.3: SMA–1/4(4+4) and SMA–1/4(8) Software	455
Table 30.4: EMC Panels	456
Table 30.5: 10Base5, 10Base2 and 10BaseT specifications	457
Table 32.1: Voltage Limits	470

SAFETY INFORMATION

This document contains safety notices in accordance with British and European standards. In the interests of conformity with the TCIF standards for North America the equivalent TCIF admonishments are also shown.

Any installation, adjustment, maintenance and repair of the apparatus must only be carried out by trained, authorised personnel. At all times, personnel must comply with associated safety notices and instructions.

Specific hazards are indicated by symbol labels on or near the affected parts of the equipment. The labels conform to BS5378, are triangular in shape, and are coloured black on a yellow background. An informative text label may also accompany the symbol label.

Hazard labelling is supplemented by safety notices in the appropriate handbook. These notices contain additional information on the nature of the hazard and may also specify precautions. The notices are categorised as either Warnings or Cautions/Alerts and are presented in the format shown below.

Note: In order to comply with safety standards EN60950, UL1950 and IEC 950, the equipment shall be professionally installed in a restricted access location.



WARNING

These draw the attention of personnel to hazards which may cause death or injury to the operator or others. Examples of use are cases of high voltage, laser emission, toxic substances, point of high temperature, etc.



ALERT/CAUTION

These draw the attention of personnel to hazards which may cause damage to the equipment. An example of use is the case of static electricity hazard.

Caution notices may also be used in the handbook to draw attention to matters that do not constitute a risk of causing damage to the equipment but where there is a possibility of seriously impairing its performance, e.g. by mishandling or gross maladjustment.

The following pages contain safety notices and illustrations of typical labels pertinent to equipment covered by this handbook. Warnings and Cautions within the main text do not incorporate labels and may be in shortened form.

**WARNING****IEC (AFTER IEC 60825–1 AMENDMENT 2:2001–01)****Optical Safety****Equipment Labels****Hazard Level 1****HAZARD LEVEL 1
LASER PRODUCT****SOLID STATE LASER**
MAX POWER: XX mw cw
WAVELENGTH: XXXX nm
IEC 60825–1 AMENDMENT 2 2001–1**Hazard Level 1M****LASER RADIATION**
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS (MAGNIFIERS)
HAZARD LEVEL 1M LASER PRODUCT**SOLID STATE LASER**
MAX POWER: XXX mw cw
WAVELENGTH: XXXX nm
IEC 60825–1 AMENDMENT 2 2001–1**Optical Safety Hazards**

There are optical source devices used in Marconi equipment which have been classified by their manufacturers under BS EN 60825–1: 1994 as Class 3B laser products, and so can potentially emit invisible optical radiation up to Class 3B.

However, control circuitry is used to limit the power available from the devices such that the radiation actually accessible to the user, meets the Hazard Level 1 or Hazard Level 1M classification as derived from IEC 60825–1 Amendment 2: 2001–01, and IEC 76/224/ISH.

No attempt should be made to adjust or tamper with the laser or its control circuitry as this may result in the Class 1 or Class 1M accessible emission limits being exceeded. High output power latch circuits are provided to ensure that the output power cannot exceed its specified operating limits. In the event of a fault occurring, these circuits remove power from the laser drive circuitry.

External Connection

Connection to other than proprietary Marconi equipment may result in optical output power levels in excess of Class 1 or Class 1M limits thereby exceeding Hazard Level 1 or Hazard Level 1M. For appropriate laser safety information, refer to the associated equipment handbook.

CDRH/ANSI

IEC Conformity

Guidance on Laser Products– Conformance with IEC 60825–1Am. 2 and IEC 60601–2–22 (Laser Notice No. 50) dated May 27 2001, states that CDRH accepts conformance with the comparable sections of IEC 60825–1, as amended by Amendment 2 of January 2001 in lieu of conformance with the following sections of 21 CFR §1040:

- 1040.10(c)(1)
Classification
- 1040.10(d)
Accessible emission limits
- 1040.10(g)
Labelling requirements

IEC (BEFORE IEC 60825–1 AMENDMENT 2:2001–01)

Class 1 Optical Safety Equipment Labels



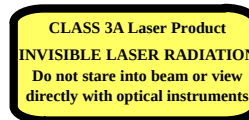
Optical Safety Hazards

Optical Source Devices (Semi-conductor Lasers) are contained within this unit. Laser drive, power monitoring, and control circuitry are used to limit the power available from such devices; and the design and setting-up of the equipment ensures that the product meets Class 1 limits.

No attempt should be made to adjust or tamper with the laser or it's control circuitry as this may result in the class 1 accessible emission limits being exceeded. High output power latch circuits are provided to ensure the that the output power cannot exceed it's specified operating limits. In the event of a fault occurring, these circuits remove power from the laser drive circuitry.

The optical source devices which are used in Marconi SDH equipment have been classified by their manufacturers, under Laser Radiation Safety Standards IEC 60825–1 (Bs En 60825–1: 1994) And IEC 60825–2 (Bs En 60825–2: 1995), as Class 3B laser products, and so potentially can emit invisible optical radiation in excess of the inherently safe Class 1 limits defined by these standards.

Connection to other than proprietary Marconi equipment may result in optical output power levels in excess of Class 1 or Class 3A. For appropriate laser safety information, refer to the associated equipment handbook.

**WARNING****Class 3A Optical Safety Equipment Labels****Optical Safety Hazards**

Optical source devices (semi-conductor lasers) are contained within this unit. Laser drive, power monitoring, and control circuitry are used to limit the power available from the devices; and the design and setting-up of the equipment ensures that the product meets the Class 1 or Class 3A limits.

Note: Class 1 applies provided ALS is active and access to the fibre is not permitted within one second of the fibre break. If the user chooses to disable ALS, the system will meet Class 3A.

No attempt should be made to adjust or tamper with the laser or it's control circuitry as this may result in the Class 1 emission limits being exceeded. The ALS mechanism provided limits the emission duration of the transmitted output power in the event of a fibre breakage to a maximum of 4.6 seconds at Class 1 output power and a maximum of 1.1 seconds at Class 3A output power. High output power latch circuits are provided to ensure the that the output power cannot exceed it's specified operating limits. In the event of a fault occurring, these circuits remove power from the laser drive circuitry.

The optical source devices which are used in Marconi SDH equipment have been classified by their manufacturers, under Laser Radiation Safety Standards IEC 60825-1 (BS EN 60825-1: 1994) and IEC 60825-2 (BS EN 60825-2: 1995), as Class 3B laser products, and so potentially can emit invisible optical radiation in excess of the inherently safe Class 1 limits defined by these standards.

SAFETY PRECAUTIONS

Safe Working Practices

When working on optical equipment, in addition to complying with the provisions of any safety notices displayed on the equipment or highlighted in this manual, the working practices outlined below must be adopted. Personnel must not be allowed to work on the equipment unless they have received adequate instruction in the techniques involved and the relevant safety precautions.

Note: In order to comply with safety requirements EN60950, the equipment must be professionally installed in a restricted access location. A protective earth connection should be made.

- Before making or breaking an optical connection ensure that the power to the optical source is off.
- Always ensure that the optical source is off (confirm by using an optical power meter) before viewing or inspecting any optical port, fibre, or optical connector.
- Handle optical fibre carefully as broken fibre can be very sharp. Keep exposed fibre ends away from the eye.
- Never use a magnifying glass (eg. watch-makers eyeglass) as an aid to viewing any part of an optical system, fibre, or optical connector. If it is required to inspect a terminated fibre end an approved microscope should be used.
- Use only approved methods and materials for cleaning optical connectors.

Measurements

When making optical measurements involving the use of a test lead ensure that:

- The connection to the optical source is the last to be made and the first to be broken.
- The optical measurement path is closed before re-applying power to the optical source.
- Do not apply power to optical source cards when they are not fitted in the sub-rack.
- Do not connect an optical output to line unless the distant end is safely terminated.

House Keeping

Maintain good 'housekeeping' practices. In particular:

- Pieces of glass fibre (e.g. off-cuts, etc.), however small, must be collected and properly disposed of in a suitable container.
- When working above another PMA or SMA sub-rack, care must be taken not to drop small items, particularly metal items such as screws. The mesh of the screen at the top of a sub-rack is large enough to allow very small objects through.

OPTICAL SAFETY PRECAUTIONS

As a minimum, the following precautions should be observed.

- DO NOT POINT AN UNTERMINATED OR BROKEN OPTICAL FIBRE END OR UN-MATED CONNECTOR TOWARDS THE EYE.
- NEVER VIEW AN UN-TERMINATED OR BROKEN OPTICAL FIBRE END OR UN-MATED CONNECTOR, EITHER DIRECTLY OR BY REFLECTION, PARTICULARLY WITH A MICROSCOPE, unless the optical power source HAS BEEN TURNED OFF.
- UNDER CERTAIN FAULT CONDITIONS, WHEN OPERATING UNDER AUTOMATIC LASER SHUT-DOWN (ALS), IT IS POSSIBLE FOR THE LASER TO RESTART AUTOMATICALLY FOR A TEST PERIOD. TESTING FOR OUTPUT POWER IS THEREFORE NOT A GUARANTEE OF LASER SAFETY.
- HANDLE OPTICAL FIBRE CAREFULLY AS BROKEN FIBRE CAN BE VERY SHARP AND CAN CAUSE EYE OR SKIN INJURY.
- The user must never use unfiltered optical aids to inspect optical interfaces of Hazard Level 1M or higher. This includes any cases where local terminal or network management commands such as 'Laser Off' or 'Disable Auto Restart' have been issued. The user must not make the assumption that issuing such a command, or commands, means that the associated interfaces can safely be inspected with unfiltered aids. Failure to follow this advice could result in a serious eye injury.

**WARNING****HIGH VOLTAGE**

Voltages over 42.4v peak AC (60v DC) existing in a circuit which does not meet the requirements for either a **Limited Current Circuit** or a **TNV circuit**, are categorised within safety standards BS EN 60950; 1992, UL1950 and IEC 950 as hazardous and can under certain circumstances, be lethal. Operators and maintenance personnel are warned to take all precautions against electric shock.

The risk of electric shock can be minimised by following the precautions in the local health and safety regulations, as well as those given in British Standards BS415, BS5378 AND BS6204.

This equipment may contain voltages in excess of the levels classified as hazardous in British Standards. The equipment should not be operated with the protective guards on the equipment cards removed. The warning label below identifies the cards carrying such voltages.

Protective Earthing

Before any external cables are connected, the equipment shelf-frame must be connected to protective earth via the shelf support metalwork. The frame must remain connected to protective earth until all external cables are removed.

Note: Units should not be removed/detached until all associated cables are disconnected.



**WARNING****TOXIC SUBSTANCES****Beryllium Copper**

The EMC spring fingers used within the cards and shelf may contain Beryllium Copper. This material can, if not properly handled, constitute a serious hazard to health. Under no circumstances should these items be exposed to fire, broken or abraded.

Scrap items must be placed in a container which is clearly labelled:

'DANGER : BERYLLIUM/BERYLLIUM OXIDE IN THIS CONTAINER'

Subsequent Action Must Be In Accordance With The Appropriate National Regulations For Disposal Of Hazardous Toxic Waste Materials.

Lithium Batteries

Lithium becomes a fire and corrosion hazard if exposed to air and water. The electrolyte in this battery is highly flammable. If Exposed to fire or extreme heat, the battery may give off toxic fumes. In These conditions, safety equipment including breathing apparatus should be used in accordance with the appropriate national safety instructions.

Battery Disposal

The substances contained within the battery are hazardous to health. Precautions taken when disposing of batteries must be in accordance with the appropriate national regulations for disposal of hazardous toxic waste materials. If necessary the item can be returned to Marconi plc for safe disposal.

Toxic Fumes



Certain items within this equipment contain material which, if exposed to fire or extreme heat, may give off toxic fumes. Breathing apparatus should be worn in these conditions.

**WARNING****HANDLING PRECAUTIONS****Weight**

A fully equipped sub-rack may exceed 10kg in weight. It is therefore recommended that shelves are fitted/removed from the equipment rack with the cards removed from the shelf.

High Temperature

Even in normal use, the heat sinks on certain units/components can get extremely hot. Such units should be handled so as to avoid contact with the heat sink.

Sharp Edges

Optical fibre should be handled carefully as broken fibre may be extremely sharp and can cause eye or skin injury.
EMC fingers are constructed from stainless steel and are very thin. They should be handled with care as damaged EMC Fingers may cause cuts or abrasions.

**ALERT/CAUTION****ELECTROSTATIC SENSITIVE DEVICES**

This equipment may contain devices sensitive to electrostatic discharge. Where such is the case the equipment carries a warning label, precautions applicable to the handling of such equipment must be taken. British standard BS5783 Gives guidance in the handling of electrostatic sensitive equipment.

Personnel working on the equipment must wear a static protection wrist strap which is connected to the rack framework Earth Protection Point.

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TYPOGRAPHICAL CONVENTIONS

The following Typographical Conventions are used throughout this document:

- Press <Return>to exit.

Text within chevrons indicates a physical key that must be pressed to perform an associated action.

- **[Network Element Details]**

The full title of a screen (Window or Bulletin Board) is shown within squared brackets. The text is displayed in Italic/Bold font.

- **[Cross-connection Details]**

The full title of a screen drop-down menu option is shown within squared brackets. The text is displayed in Italic font.

- Non Revertive

The full title of a screen field (Window or Bulletin Board) is shown displayed in Italic font.

- **Apply**

Text displayed in Italic/Bold font indicates a screen button (Window or Bulletin Board) that must be clicked to perform an action, or a configuration menu option, or a slider/popup menu/stepper that can be selected to populate a screen field.

- `Are you sure ? Y/N`

Text displayed in standard courier font (above) denotes a screen message, or a system query, that may require a response.

- **123456**

Text displayed in a Bold font indicates a screen field entry that must be input exactly as printed.

- Listed information (having no hierarchical order) is ranged to a bullet.
- Enter **123456**.

Each operator action is presented as a bullet entry (shown above), or when sequential operations are mandatory, the operation actions must be shown as a numbered step (shown below).

1. Select the XYZ field.
2. Enter **123456**.

Note: This does not always apply

Text displayed in *Italic font* preceded by this symbol indicates additional information, or an aid which may apply to some users only.

Note: All data entered may be lost

Text displayed in ***Italic/Bold font*** preceded by this symbol indicates a caution which must be noted and acted upon before proceeding.

USE OF NON-MARCONI EQUIPMENT

Before use, customers must ensure that any non-Marconi equipment is correctly installed and configured as defined in that manufacturer's handbook.

Users must also observe all information provided by the manufacturer relating to the safe operation of the equipment and to any equipment directly or indirectly connected to it.

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SERVICING POLICY AND RETURN OF EQUIPMENT

The repair of individual units and cards of this equipment is not considered practicable without factory facilities. It is, therefore, the policy of Marconi plc. to offer a service whereby faulty units or cards are returned to the company for repair. To enable an efficient, prompt after sales service to be provided for the diagnosis, repair and return of any faulty equipment, please comply with the following requirements.

Items to be sent for repair should be packaged so as to provide both electrostatic and physical protection and a Repair Service Request (as shown on previous pages) completed giving the following information:

- As much detail as possible concerning the nature of the fault and any contributory factors.
- Type of system and equipment in which the item is installed, together with time in service if known.
- If under warranty, the contract number under which supplied.
- The address to which the item should be returned when repaired.

This request must be included with the item for repair.

Subject to operating authority policy (see NOTE below), items for repair should be sent to the following address:

Marconi plc,
Customer Repair Department,
New Horizon Park,
Waterman Road,
Off Red Lane,
COVENTRY,
CV6 5TT
United Kingdom

Note: Some customers have established their own Repair Centres for the receipt of faulty items from a designated area. Under such circumstances, staff should comply with local instructions, but it would be helpful if the information requested above is supplied with the returned item.

SERVICING POLICY AND RETURN OF EQUIPMENT

Section 2. Service Request

a. Fault Description		Modification	
Repair	☒	i. Current Level	
Advance Replacement		ii. Required Level	
Verification			

Address for Repair	Marconi Communications Limited Product Support Centre New Horizon Park Waterman Road COVENTRY CV6 5TT ENGLAND
---------------------------	---

c. Bill To:	Return Address COVENTRY EXCHANGE COVENTRY ROAD COVENTRY Post Code - CV1 2EX
--------------------	---

BELOW FOR Marconi plc USE ONLY

d.

Serial Number	R98765
Contract Number	621232
Customers Purchase Order No.	

e.

Date Received	2 June 1995
Time Received	10:15

TRANSMISSION PRODUCTS REPAIR SERVICE REQUEST

Section 1. Reported Faults

a	Manufacturers Item Code	
	Customers Item Code	
	Item Description	
	Serial Number	Build Level

b. Fault Description

[illegible]

Type
c. Fall

c. Failure Type	Y	N	ELEC *	MECH *
Defective on Receipt (* as appropriate)	✓			✓
Commissioning Failure	✓			
Intermittent		✓		

Time to Fail

IMMEDIATE

d. Site Details

d. Site Details		Customer Fault Reference No.	432/5/084
Site Name			
COVENTRY EXCHANGE			
Site Contact	Joe Smith	Date	
Telephone Number	01203-123455	FAX Number	01203-123456

TRANSMISSION PRODUCTS
REPAIR SERVICE REQUEST
EXPLANATORY NOTES

Section 1. Reported Faults

- a. Manufacturers Item Code.** The code assigned by the manufacturer e.g. 1HAK60558.

Customers Item Code.The code assigned by the customer.

Item Description. The designation of the item, e.g. Subs Card, 10 channel

Serial Number. The unique serial number of the item.

Build Level. The modification level of the unit, usually found near the part number and prefixed with either BSC or ENU.

b. Fault Description.
A summary of the fault symptoms including, where relevant, usage of the card, switch settings, LED indications, etc. at the time of failure.

c. Fault Type

Defective on Receipt:This gives an indication of whether the item was faulty on receipt e.g. would not power up or connection broken. If **YES** , then the appropriate ELEC for electrical type or MECH for mechanical defects should be indicated..

Commissioning Failure:This gives an indication of whether the item failed number and prefixed with either BSC or ENU.during commissioning or whilst in service and carrying traffic

Intermittent Fault. This gives an indication of whether the fault is permanent or periodic.

Time to Fail. This is the time taken for the fault to occur e.g. 10minutes, 1 hour, etc.

d. Site Details

Customer Fault Reference.The unique reference number given to the fault by the customer.

- Site Name.** The site where the fault occurred.

Site Contact. The engineer on site who can be contacted should further fault information be required.

Date. The date of the fault.

Telephone Number and Fax Number (if available). Contact numbers of the engineer on site.

Section 2. Service Request.

- a. Service Required.**

Repair. Standard repair and return of the item.

Advance ReplacementReplacement of the item prior to its repair and return (if contracted).

Verification. To confirm the status of the item if it is not certain the item is faulty.

Modification. Whether the item requires upgrading (e.g. possibly by means of a recall notice). If so, complete the boxes 'Current Level' and 'Required Level' of modification.

Address for Repair.The address to which the faulty item is to be returned.

c.

Bill to: The address to which the bill for repair should be sent, if appropriate.

Return Address:The address to which the repaired item, or advance replacement, is to be sent

Product Support Centre

Reference:PSC/RSR0962 Issue 02 (June 1995)

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COMPATIBILITY WITH EUROPEAN DIRECTIVES

PRODUCT **1ADR60693AAB** SMA Series 4



The equipment meets the following European Directives:
EMC Directive 89/336/EEC (EN55022 class B radiated emission limit)
TTE Directive 91/263/EEC (CTR-12 approved).



A list of the cards making up these products will be found later in this manual.

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READERS COMMENTS

Whilst every endeavour is made to ensure the accuracy of this and all Marconi Communications documents, there is always the possibility that an inaccuracy or omission could occur.

In order that any amendment/remedial action can be carried out promptly, we would appreciate your co-operation in filling out and returning a photocopy of this customer reply sheet as soon as possible.

Customer Information :	
Name: _____	Title: _____
Company: _____	Date: _____
Address: _____ _____ _____	
Town: _____	
County: _____	
Post Code: _____	Telephone number: _____

Customer Comments:	
Handbook Title: _____	
Issue Number: _____	1PHA60071AAY Issue: 05
Page No: _____	Para No: _____ Line No: _____ Fig No: _____
Details of inaccuracies: _____ _____ _____	
Other comments: Level of detail etc. _____ _____	

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SECTION 1: PRODUCT OUTLINES AND OVERVIEWS

CHAPTER 1 TERMINOLOGY PAGE 63

CHAPTER 2 PRODUCT OUTLINES PAGE 67

CHAPTER 3 PRODUCT OVERVIEWS PAGE 87

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CHAPTER 1: TERMINOLOGY AND MANUAL STRUCTURE

1.1 TERMINOLOGY

There are five main products in the SMA Series 4 range. These are referred to in this manual as follows:

- SMA–1/4CP
- SMA–1/4c
- SMA–1/4(4+4)
- SMA–1/4(8)

The SMA–1/4CP is customer premises equipment. Note that the CP suffix is always in capitals.

The SMA–1/4c has a small c suffix. This is a compact version of the larger shelf-based products.

The SMA–1/4(4+4) is a midsize shelf which has a single row of LTUs.

The SMA–1/4(8) is the full size shelf with two rows of LTUs.

Note: Where reference to both SMA–1/4(4+4) and SMA–1/4(8) is required, this is done by reference to either SMA–1/4 or SMA–1/4(4+4)(8).

The SMA Series 4 product range is primarily for use in street cabinets and customer premises applications. The range complements the current STM–1 and STM–4 products in the SMA and MSH families – for example, SMA–1, SMA–4, SMA–4c, MSH11C, MCH11CP and MSH41C.

1.2 MANUAL STRUCTURE

The structure of the manual is as set out in the following table:

Table 1.1: Manual Structure		
Section	Section Purpose	Chapters
Product Outline and Overview	To explain terminology and manual structure, and provide brief product outlines. To give an overview and introduction to all of the Series 4 products.	
		Terminology and Manual Structure
		Product Outline
		Product Overview

Table 1.1:(Cont)Manual Structure		
Section	Section Purpose	Chapters
Product Description	To explain Series 4 generic subjects as per chapter headings. Product differences are indicated in the chapters.	
		Multiplexing Structure
		SMA–N Cross Connections
		Synchronisation
		Protection
		Communications
		Events
		Performance
		Operator Control
		Software Download
Additional Features	This section explains particular additional subjects, usually in generic terms.	
		Applications
		Add–Drop Multiplexer
		VCAM
		Single Fibre Working
		Tandem Connection Monitoring
		Cellspan
		Packetspan
		Auxiliary
		Engineer Order Wire
System Management	This is a separate section covering shelf configuration features specific to different Series 4 products. This section should be read in conjunction with the separate installation chapters (see below).	Specific Shelf Configuration Features
Installation Information	To provide information on installation for all the Series 4 products as per chapter headings. Note that there are three separate installation chapters for SMA–1/4CP, SMA–1/4c, SMA-1/4uc, SMA–1/4(4+4) and SMA–1/4(8).	
		Line Termination Units
		Slide–In Card Units
		Optical Modules
		Link and Switch Configuration
		Power Supply Options
		Installation – SMA1/4CP
		Installation SMA1/4c and /uc
		Installation – SMA1/4(4+4) and SMA1/4(8)
		SMA Upgrade Information

Table 1.1:(Cont)Manual Structure		
Section	Section Purpose	Chapters
Commissioning	To provide basic commissioning information.	Commissioning Procedure
Maintenance	To provide basic maintenance information.	General Maintenance Information

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CHAPTER 2: PRODUCT OUTLINES

2.1 SMA-1/4CP

The Series 4 SMA-1CP and SMA-4CP are full feature ADMS, optimised for both SDH ring and terminal applications. They are primarily solutions for customer premises.

SMA-1CP and SMA-4CP build on the SMA, SDH Extender and MSH products. They complement these products which are already deployed extensively in SDH Access networks – in street cabinets, local exchanges and directly on customer premises. SMA-1CP and SMA-4CP are designed to be deployed in networks with these existing products, in mixed rings and subtended from existing multiplexers.

SMA-1/4CP supports the full range of conventional traffic interfaces, from 2Mbit/s to STM-1 and STM-4, and also IP and ATM interfaces. SMA-1/4CP can be managed centrally by a Marconi network management system or by a local terminal.



Figure 2.1 SMA-1/4CP

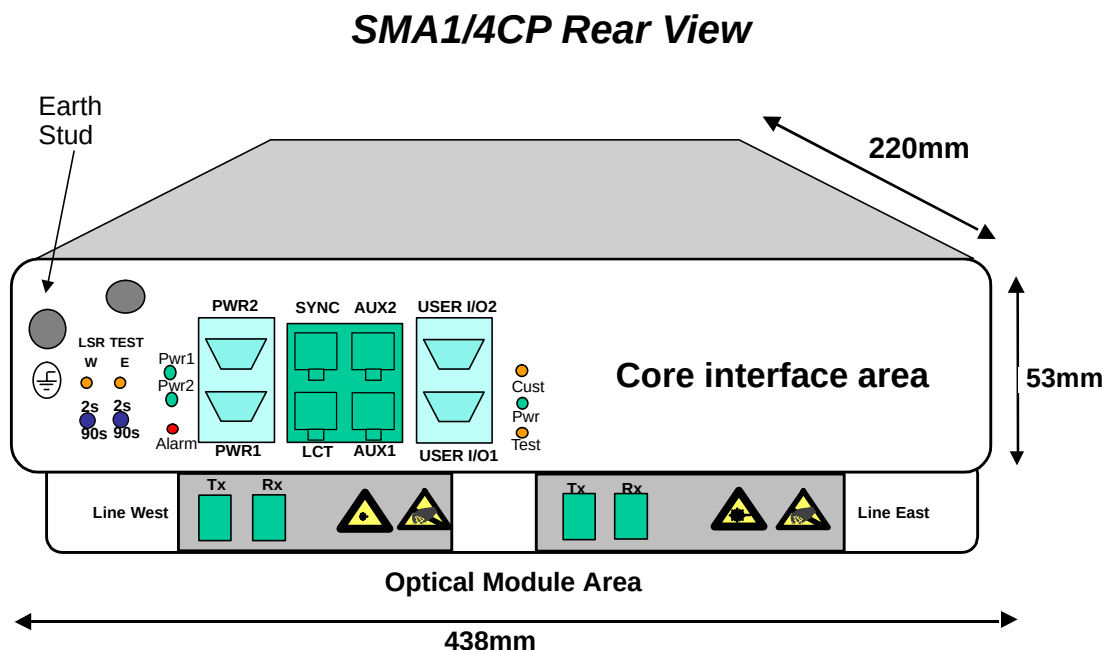


Figure 2.2 Rear View of 4 x 2 SMA-1/4CP.

The compact nature of SMA-1/4CP makes it ideal for applications where space is at a premium. The main features of SMA-1/4CP are as follows:

- SDH add/drop multiplexer with full, non-blocking cross-connection capability.
- Compatible with Marconi range of synchronous multiplexers.
- Two Line interfaces supporting ring and protected terminal applications.
- Supports SNCP and 1+1 MSP traffic protection.
- STM-1 (155Mbit/s) and STM-4 (622Mbit/s) aggregate options.
- Full configuration, fault and performance management features.
- Traffic ports:
 - 2Mbit/s, 34Mbit/s, 45Mbit/s, STM-1
 - Ethernet 10 BASE-T,
 - ATM 34Mbit/s, 45Mbit/s, STM-1
 - Expandable in service
 - X.21 traffic interface option for 2Mbit/s unstructured and N x 64kbit/s leased lines.
 - Support of I.421 for primary rate ISDN
 - TCM for termination of inter-operator paths.

‘Front View’

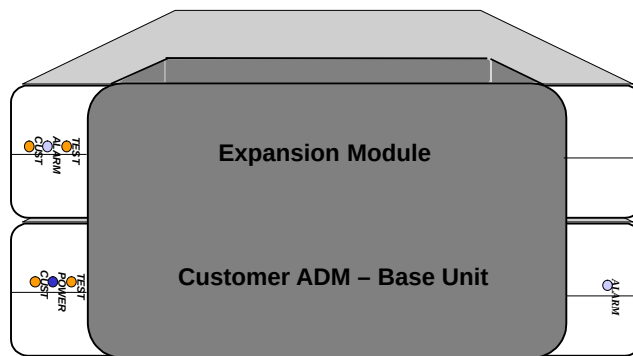


Figure 2.3 Front View of SMA-1/4CP with Expansion Module

2.2 APPLICATIONS

SMA-1/4CP is designed to be deployed extensively, as Network Termination Equipment (NTE), on customer premises. Applications include campus rings and multi-tenanted buildings. It is designed to be deployed either as a terminal, in hubbing architectures, or as a ring-based ADM. Traffic protection may be employed for both these applications, either 1+1 Multiplex Section Protection (MSP) or Sub Network Connection Protection (SNCP).

SMA-1/4CP can also be deployed within the access network, particularly in street side cabinets. Example applications include mass telephony where the product would be deployed alongside primary multiplexers, delivering narrowband services to residential customers. The product can also be deployed in mobile radio networks for the collection of traffic from radio base stations.

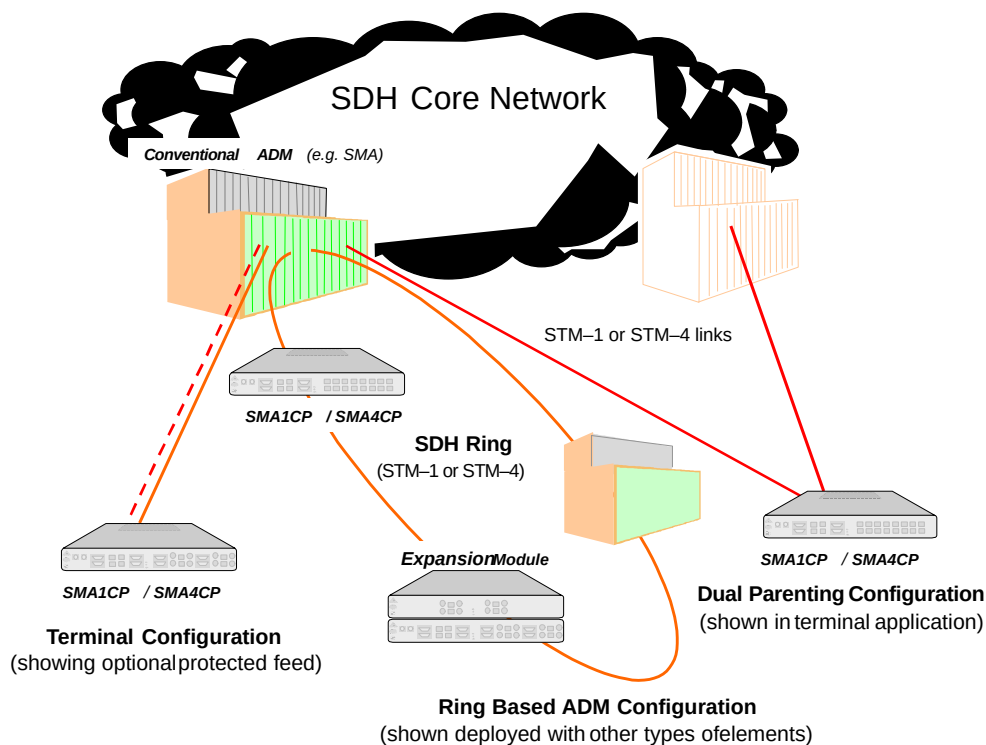


Figure 2.4 Example Network Configurations

2.2.1 POINT TO POINT

Although primarily intended as a solution for integration within an SDH network, SMA-1/4CP can also be used for point to point systems. This configuration, managed via the LCT, can be used to support up to 16 x 2 Mbit/s for services such as 2Mbit/s leased lines and direct connection to PBXs. SMA-1/4CP can also be used in point to point applications for delivering data and higher bandwidth services (when deployed with an expansion module).

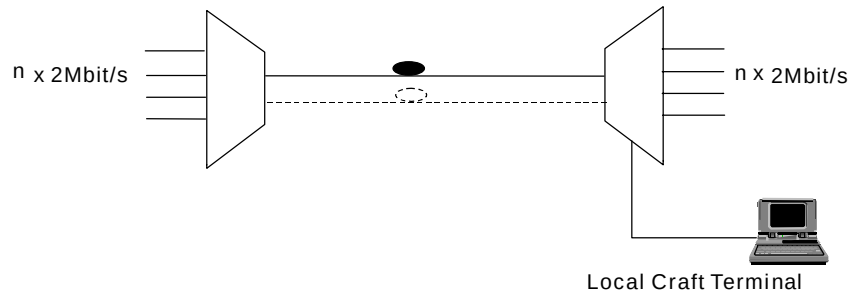


Figure 2.5 Point to Point Operation

2.3 SMA-1/4CP PRODUCT OUTLINE

2.3.1 GENERAL

SMA-1/4CP is designed for use in customer premises and can be wall, desk or rack mounted. It consists of a Base Unit, which supports the multiplexer functionality and delivers a range of traffic interfaces, and an optional Expansion Module, which provides additional traffic interfaces.

Expansion Modules may be equipped during product installation, or as a later upgrade to provide additional services. Upgrade is easily accomplished by simply fitting on the expansion module, and this does not affect traffic.

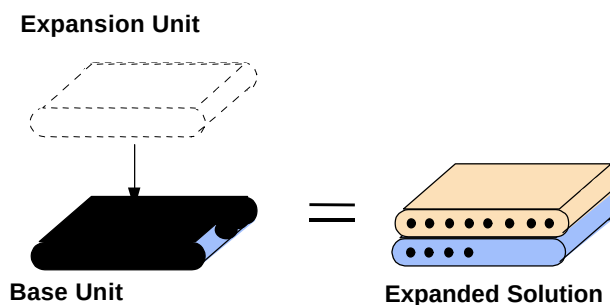


Figure 2.6 Expansion Solution

2.3.2 BASE UNITS

There are a number of variants of base unit as shown below:

4 x 2Mbit/s with X.21
16 x 2Mbit/s balanced
16 x 2Mbit/s unbalanced

Each is provided with one or two SDH aggregate interfaces and may be deployed in both STM–1 and STM–4 ring or terminal applications. As an ADM the base unit provides full VC cross–connect capability. A range of aggregate interface options are supported, for both dual fibre and single fibre working (SFW) operation.

2.3.3 EXPANSION MODULES

Expansion modules are similar in style to the base ADM unit. The two units are simply fitted together to create the new configuration. Power and optical line interface and management functions are supported from the base unit, making the upgrade process straightforward.

A range of expansion modules are supported by SMA–1/4CP including those detailed in the following table:

Table 2.1: Expansion Modules			
	34Mbit/s	45Mbit/s	STM–1 Op- tical
Bit Rate (kbit/s)	34.368	44.763	155.52
Inter- faces	3	3	1
Classi- fication	ITU–T G.703	ITU–T G.703	Intra–office multimode

Interface Type	BNC 75 ohm unbalanced	BNC 75 ohm unbalanced	
Note 1: The 8 x 2Mbit/s module delivers 8 off, 2Mbit/s ports. Each port is presented with a balanced (RJ45), unbalanced (G.703 (BNC) and an X.21 interface (D-type) in accordance with ITU-T G.703, ETS 300-2 ITU-T X.21 for 2Mbit/s unstructured and nx64kbit/s leased lines			

Note: In addition to the TDM modules indicated in the above table, ATM and IP expansion modules will be supported by CellSpan and PacketSpan. These products deliver a range of data interfaces (such as ATM, UNI and Ethernet) and provide solutions for optimised transport of cells (ATM) and packets (IP) across the SDH network.

2.3.4 POWER AND BATTERIES

The base units are equipped with duplicated power connectors for supply from a nominal –48v feed. Battery back up is supported by an external module. Mains working is supported via an in line mains PSU or in conjunction with a battery back up module.

2.3.5 NETWORK MANAGEMENT

Management of SMA–1/4CP is via a Marconi element management system and/or the local craft terminal. Network management information is carried over a DCC channel contained in the SDH Section Overhead. The SOH also provides an auxiliary channel for the transport of network management information for co-located equipment – whether Marconi or other equipment.

The equipment management operations system uses Marconi's standard workstation terminal for providing management and control of the element. Software download can be achieved from the LCT or from the element managers.

2.4 SMA–1/4C, SMA-1/4UC AND SMA–1/4

Note: In the rest of this chapter, the term SMA–1/4 is used to refer to SMA–1/4(4+4) and SMA–1/4(8) in general terms.

The Series 4 SMA range consists of a number of products providing optimum solutions for the complete range of SDH access and outer core applications. The products are identified as follows:

- SMA–1/4c, SMA-1/4uc
- SMA–1/4

These products share common core modules and tributary units but differ with respect to the number of tributary interfaces which may be supported and aggregate interface type. SMA–1/4 may be equipped with up to eight tributary units, whilst SMA–1/4c and /uc may be equipped with up to four tributary positions.

SMA–1/4c, /uc and SMA–1/4 can be configured as a terminal, add/drop, hubbing multiplexer or small cross-connect. They support flexible mapping/multiplexing structures for different VC payloads and unrestricted traffic access at VC–12 granularity.

SMA–1/4c, /uc and SMA–1/4 have compact subracks which provide flexible tributary slots – these accommodate a comprehensive range of interchangeable tributary units which provide PDH and SDH traffic access with both optical and electrical interface options. The tributary slots may also be equipped with a range of ATM and IP units from Marconi CellSpan and PacketSpan products. These deliver data interfaces on customer premises and provide solutions for flexible, efficient and cost effective transport of mixed traffic (TDM, ATM and IP) over an SDH infrastructure. The traffic consolidation functions also minimise the number of expensive traffic ports required on an operator's ATM switches and IP routers.

SMA–1/4c, /uc and SMA–1/4 deliver a higher number of tributary interfaces within a given envelope than Series 3 SMA products. The compact nature of SMA–1/4c, /uc and SMA–1/4 make them ideal for applications where space is limited. They can be managed by a central network management system or by a local terminal.

The main features of SMA–1/4c, /uc and SMA–1/4 are as follows:

- Compatible with Marconi range of synchronous multiplexers.
- Full, non blocking, VC cross-connect capability with unrestricted access and full connectivity at VC–12 granularity.
- STM–1 (155 Mbit/s) and STM–4 (622Mbit/s) aggregate options.
- Can be upgraded in service from STM–1 to STM–4.
- Remote management and control by Network and Element managers.
- Equipment protection including automatic 1:N card protection for tributary units.
- Traffic protection including Sub-Network Connection Protection (SNCP) and Multiplex Section Protection (MSP).
- Wide range of tributary units including SDH, PDH, IP and ATM. Examples are as follows:
 - STM–1 interfaces
 - SDH Extender interfaces
 - 1.5, 2,34,45,140 Mbit/s PDH interfaces
 - CellSpan range of ATM(cell) tributary units
 - PacketSpan range of IP (packet) tributary units
- Tributary units compatible with Series 3 SMA multiplexers.
- High density tributary capability with up to eight dedicated tributary slots and two ADM core slots with further interface capability. Examples of equipping densities are as follows:
 - 252 off 2Mbit/s G.703 interfaces
 - 32 off SubSTM–1 interfaces (SDH Extender), or
 - 20 off full capacity STM–1 interfaces
- Support of I.421 for primary rate ISDN.

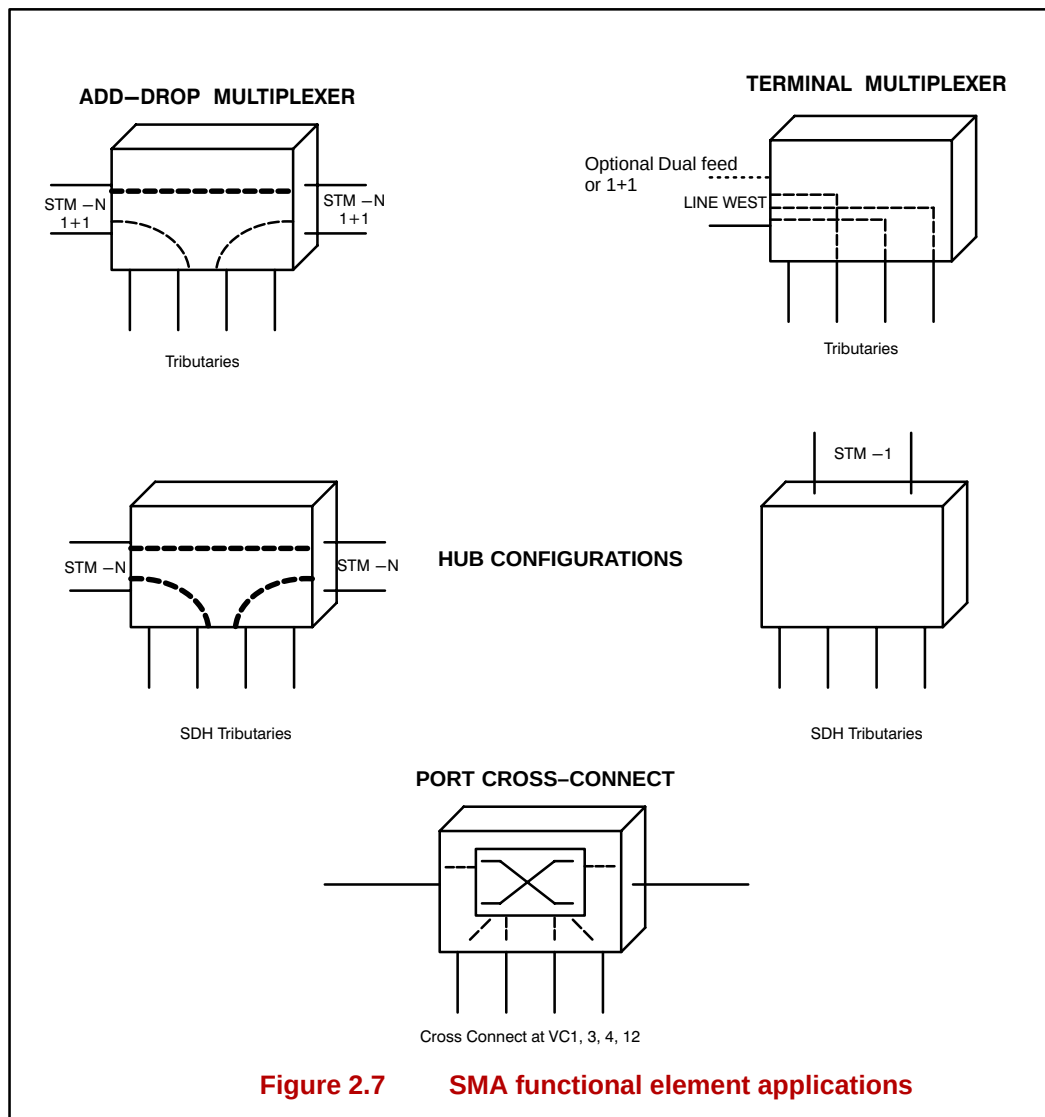
- Tandem Connection Monitoring (TCM) for enhanced fault detection and monitoring of performance across different network operator's boundaries.
- Compact single row subrack design.

2.5 APPLICATIONS

The flexibility of SMA–1/4c, /uc and SMA–1/4 allows them to support the whole range of network applications:

- **Terminal Multiplexer:** SMA–1/4c, /uc and SMA–1/4 provide 1+1 protected optical line systems, for point to point operation or as a spur for remote traffic delivery.
- **Add/Drop Multiplexer:** SMA–1/4c, /uc and SMA–1/4 may be deployed in rings, chains and meshed networks to provide grooming, consolidation and protection of traffic.
- **Hubbing Multiplexer:** SMA–1/4c, /uc and SMA–1/4 (in particular) provides consolidation and grooming of incoming traffic.
- **Cross-Connect:** When fully equipped with STM–1 interfaces SMA–1/4c, /uc and SMA–1/4 form a 4/1 cross-connect.

These network applications are illustrated in Figure 2.7.



SMA-1/4 in particular can be deployed as a hubbing multiplexer (consolidation unit) at operator nodes within the access network. For this application SMA-1/4 terminates transmission links (for example sub STM-1 and STM-1) from Network Termination Equipment. It supports NTEs in both conventional star architecture or as subtended SDH rings. Incoming traffic, consisting of a mix of TDM, cells and packets, is groomed and consolidated prior to connection to:

- collocated service platforms (for example, PSTN switch or Broadband platform), or
- the core transport network, or
- other hubbing multiplexers (either collocated or remote)

SMA1/4c and SMA1/4uc in particular can be deployed on customer premises either as a terminal or as a ring based ADM. It complements SDH Extender and SMA1/4CP as an NTE, principally for applications demanding card protection and/or the delivery of high numbers of interfaces. For these NTE applications, SMA-1/4c and SMA-1/4uc supports therequired physical interfaces to deliver the full range of data services (including ATM, UNI and Ethernet).

SMA-1/4c, /uc and SMA-1/4 can also be used for other applications within the access network, typically within street side cabinets. Example applications include:

- Mass telephony where the product is deployed alongside primary multiplexers to deliver PSTN services to residential customers.
- Access rings for collection and consolidation of mobile traffic from base stations.
- Access rings for the delivery of premium services to business customers.

The high hubbing capability and compact design are attributes which offer significant advantages in conventional core applications, for example outer core segments in rural areas.

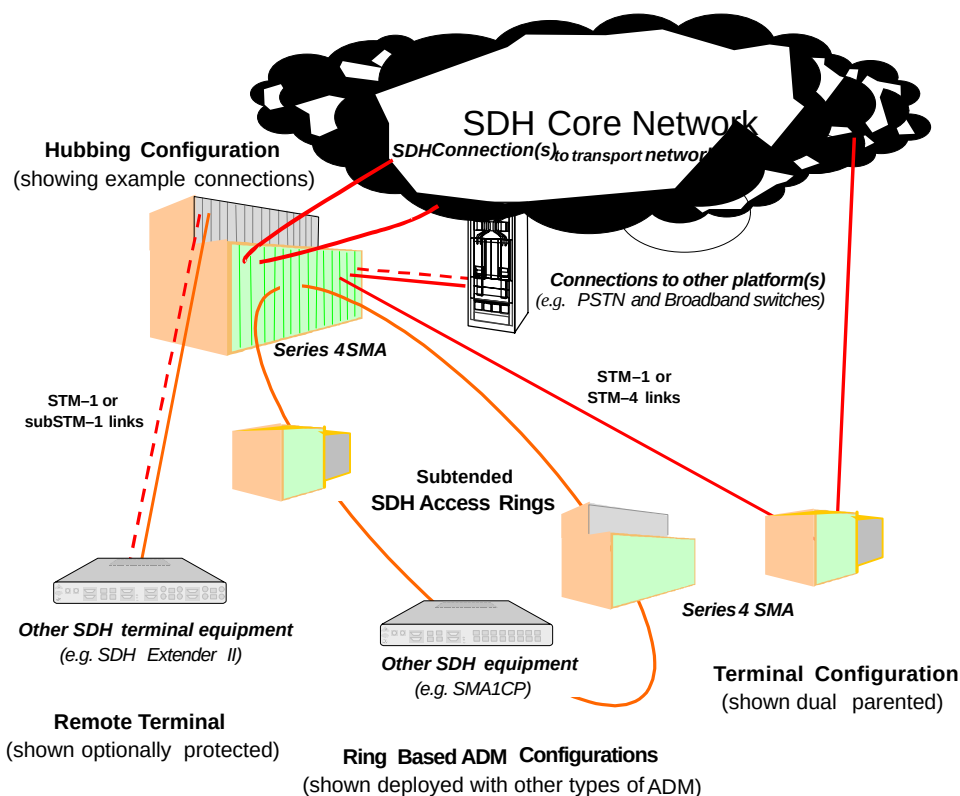


Figure 2.8 Example Network Configurations

2.6 SMA-1/4C, SMA-1/4UC AND SMA-1/4 PRODUCT OUTLINE

2.6.1 GENERAL

SMA-1/4c, /uc and SMA-1/4 are designed for use in operators' telecommunications centres and in customer premises. The key unit within SMA-1/4c, /uc and SMA-1/4 is the ADM unit. This provides a full functionality non blocking switch at VC-12 granularity, two SDH aggregate interfaces, a mapping function supporting thirty-two 2Mbit/s ports, and the Synchronous Equipment Timing Generator (SETG). Each ADM unit can be equipped with two aggregate interfaces at either STM-1 (155Mbit/s) or STM-4 (622Mbit/s). A range of dual fibre options and Single Fibre Working (SFW) options are supported.

Two ADM units can be equipped to provide 1+1 card protection of the core functions. This capability also increases the delivery of SDH interfaces (in hubbing and cross-connect applications) and supports four port operation (for stacked rings and chain applications).

A central unit provides a complete micro based management system. This supports the Synchronous Equipment Management Functions (SEMF), the Management Communications Functions (MCF) and Communications functions. The Communications function provides DCC processing to support remote management of SDH elements and a Q Ethernet interface for local management access in gateway applications. The unit also provides an F interface for local terminal access.

2.6.2 TRAFFIC UNITS

A range of traffic units provide flexible, customised, equipping with access for PDH rates of 1.5, 2, 34, 45 and 140Mbit/s and SDH rates of STM-1 and STM-4.

Special tributary units include:

- SubSTM-1 VC Access Module (SDH Extender).
- Integrated ATM/TDM transmission over SDH (CellSpan).
- Integrated IP/TDM transmission over SDH (PacketSpan).

CellSpan is an integrated solution for the efficient transportation of ATM and TDM traffic over SDH networks. It enables network operators to link end users to ATM switches located at the boundary of the core network in a manner which consolidates traffic. It also has point to point and point to multipoint applications.

Two main elements of CellSpan are supported: ATM Traffic Adapter (ATA) cards and ATM Traffic Combiner (ATC) cards. In the traffic consolidation application, the ATA extends monitoring of ATM service down to the customer premises, providing the 34Mbit/s, 45Mbit/s or 155Mbit/s ATM User Network Interface (UNI). The ATC provides the ATM connection to the public ATM switch, and supports multiple ATAs and the consolidation of ATM traffic. This consolidation function can significantly reduce the required number of interface ports on the ATM switch platform. In the point to point application, pairs of ATAs can be used. ATCs can also provide customer located ATM UNIs when deployed to enable point to multipoint ATM connections over SDH.

PacketSpan provides similar capabilities to CellSpan but is a solution for packet based (IP) service. PacketSpan Link products provide point to point and point to multipoint features based on integrated Ethernet delivery. PacketSpan Ring products offer traffic consolidation and concentration. PacketSpan thus provides a range of units for the efficient transport of packets and the delivery of IP services.

PacketSpan and CellSpan are complementary – both are deployed in networks delivering mixed traffic consisting of TDM, ATM and IP.

2.6.3 NETWORK MANAGEMENT

Management of Series 4 equipment is via a Marconi element management system and/or the local craft terminal. The equipment management operations system uses Marconi's standard workstation terminal for providing management and control of the element. Software download can be achieved from the LCT or from the element managers.

2.7 OPERATION AND CONTROL

2.7.1 Element Manager and Local Terminal (LCT)

Operator monitoring, control, commissioning and fault diagnosis is provided from either a remotely located Element Management Operations System, or at any element of a network by a Local Terminal (LCT) (IBM compatible PC) connected via an RS232 interface (see Figure 2.9). The Element Manager and the Local Terminal (LCT) have some similar and some unique functionalities.

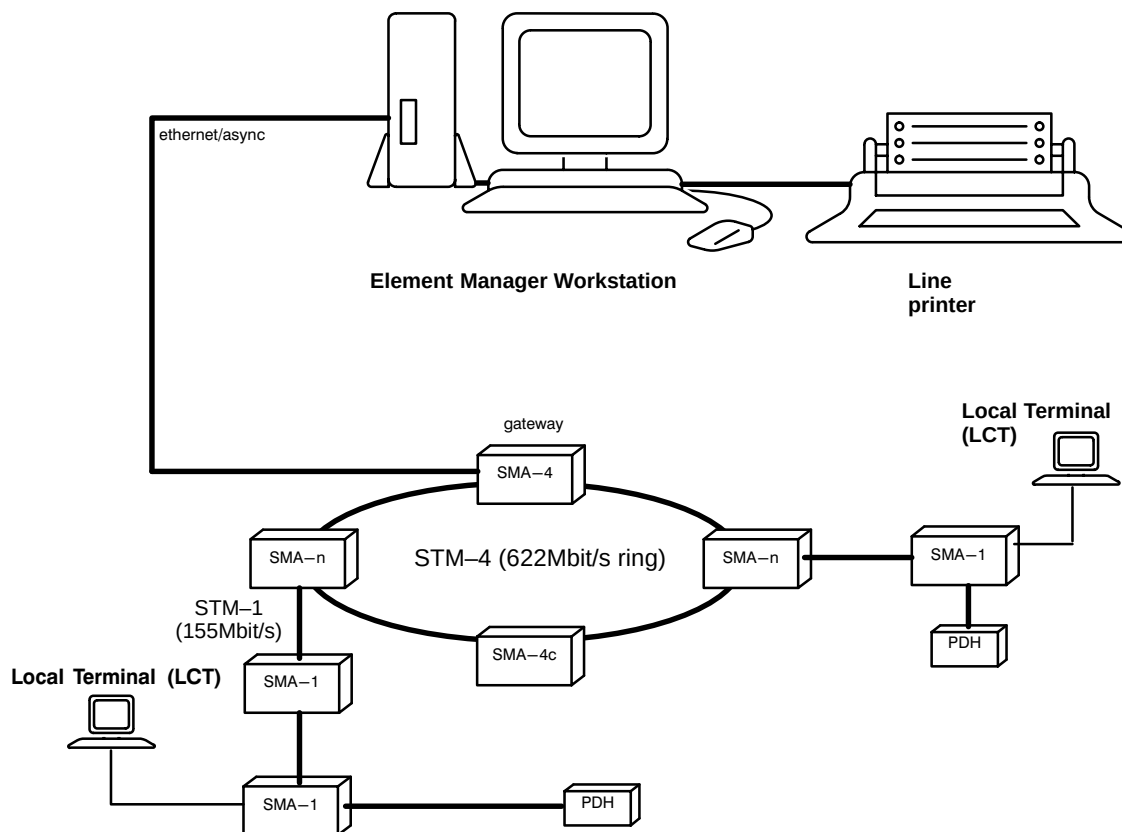


Figure 2.9 Element Manager and Local Terminal (LCT) Connections

The Element Manager can only be connected to a gateway multiplexer configuration. A Local Terminal (LCT) can be connected to any configuration.

The Element Manager is a 'workstation' terminal connected via a CCITT 'Q' interface port, to a network element designated as a 'gateway' element. It interfaces to other elements via the communications channels embedded within the STM connections terminating on the element, and provides network management facilities for the whole network.

The LCT is an IBM compatible PC that is connected, when required, either directly to, or remotely from, the SMA-N network element to be controlled or monitored, i.e. Single Ended Maintenance (SEM).

The PC is loaded with software necessary to perform the complete range of control and monitoring functions. A password protected operator access system ensures that the SMA database is not accessed by unauthorised users. In addition, LCT access is restricted during normal system operation, i.e. when an Element Manager is connected.

LCT software is menu driven. The basic provision is for keyboard operation but an optional 'mouse' can be used for all functions.

2.7.2 Back-up and Restore, Software Download

The Back-up and Restore facility allows the functionality of the SMA to be configured by downloading synchronisation, alarm, and performance parameter default data from a floppy disk. The downloading is performed during commissioning. Any subsequent minor alterations that may be required are made by an operator using the LCT.

Once an SMA has been commissioned and configured, then part or the whole of its firmware can be saved to file (Backed up). The configuration details can then be restored to the network element at a later date (Restore).

Software Download is a facility that allows new versions of the operating software to be downloaded from the LCT or Element Manager. See the chapter on Software Download for further information.

2.8 FUNCTIONAL FEATURES

The functional features of operational significance are outlined under the following sub-headings and described more fully in subsequent chapters.

2.8.1 Multiplexing Structure

The multiplexing structure of the STM signal defines the way the various lower order bit-rate signals are combined, together with supervisory data and pointers, to form the STM frame.

2.8.2 Synchronisation

Timing signals are required to provide synchronisation for internal cross-connection functionality and STM output timing. These signals can be provided from external sources, via a variety of interfaces. The signals are used to phase-lock the SMA's internal generators. The selection of external sources is determined by the operator.

In the event of failure of any external timing signal, the SMA has the ability to 'free run'.

2.8.3 Cross-connections

Cross-connections (traffic paths), routed through the Switch Unit can be created between: Line <--> Line, Line <--> Tributary and Tributary <--> Tributary.

2.8.4 Protection

Traffic can be lost if a card, port or bearer fails, therefore protection measures can be incorporated (typically by duplication of the card, port or bearer) to reduce this risk.

2.8.5 Communications

Communication channels are provided between:–

- The Element Manager (for use by an Operator) and the Gateway Multiplexer, via an Ethernet Local Area Network (LAN).
- The Gateway Multiplexer and the other SMA–N elements of the network, via Data Communication Channel (DCC) bytes in the STM–1 frame.

The communications protocol between SMA–N Network Elements (NE) and between the SMA Gateway Multiplexer and Element Manager is based on the Open Systems Interconnect (OSI) seven–layer model. However, only the first four layers of the OSI model are implemented for the SMA series. Each layer performs a specific function and interfaces only with those layers directly adjacent to it.

Communications routing can either be 'Intermediate System – Intermediate System' (IS–IS) or 'Default/Interim'. Either form of routing gives every element in a network the ability to route to any other element in the network and will automatically provide an alternative route should the preferred route become unavailable.

2.8.6 Event/Performance Processing And Reporting

2.8.6.1 Conventional

Event processing and reporting involves the capture, verification, classification, logging, reporting and indications of change in the status of a Network Element (NE). This involves the detection of changes in state of the configuration of an NE (connectivity, alarm attributes, equipping levels, protection paths etc.) or a new state of the set of fault monitors (changes) within an NE or the performance limits being exceeded.

2.8.6.2 Tandem Connection Non–intrusive Performance Monitoring (Pseudo TCM).

Tandem connection non–intrusive performance monitoring consists of enhanced performance reporting from the existing VC path overhead monitor function. Enhanced VC alarm reporting is also provided.

Tandem connection non–intrusive performance monitoring allows network managers to monitor the quality of the VC through their equipment. Network manager correlation is required to ascertain the change in performance between the monitor points.

2.8.6.3 Tandem Connection Sub–layer Performance Monitoring (Full TCM)

Tandem connection sub–layer performance monitoring allows the operator to create another source of OH information where the VC enters their domain and to terminate it where the trail leaves their domain. This allows network managers to monitor the quality of the VC through their equipment.

2.9 NT1 MAINTENANCE FUNCTION

2.9.1 Network Applications

NT1 functionality is normally offered at the 2Mbit/s VC–TM interface at the customer end of an Access link whereas the LT function would optionally be available at the Exchange end of the link, normally connected via a 2Mbit/s tributary card. However, it is possible to enable either the NT1 function, the LT function, or neither on any 2Mbit/s interface which supports I.421 functionality. When neither function is enabled the corresponding 2Mbit/s signal is transparent in both directions.

Figure 2.10 shows an application with the NT1 function supported by a VC–TM card or 2Mbit/s tributary card at the customer end but without an LT function at the exchange end.

Note: This option would always be used when the 2Mbit/s Tributary Card at the Exchange end does not support I421.

In Figure 2.11 the NT1 function is supported by a VC–TM card or 2Mbit/s tributary card at the customer end, and the LT function supported by a 2Mbit/s tributary card at the exchange (ET) end of the Digital Access Section.

When either of NT1 or LT functions are enabled, support of SSM (synchronisation) detection and insertion is not possible.

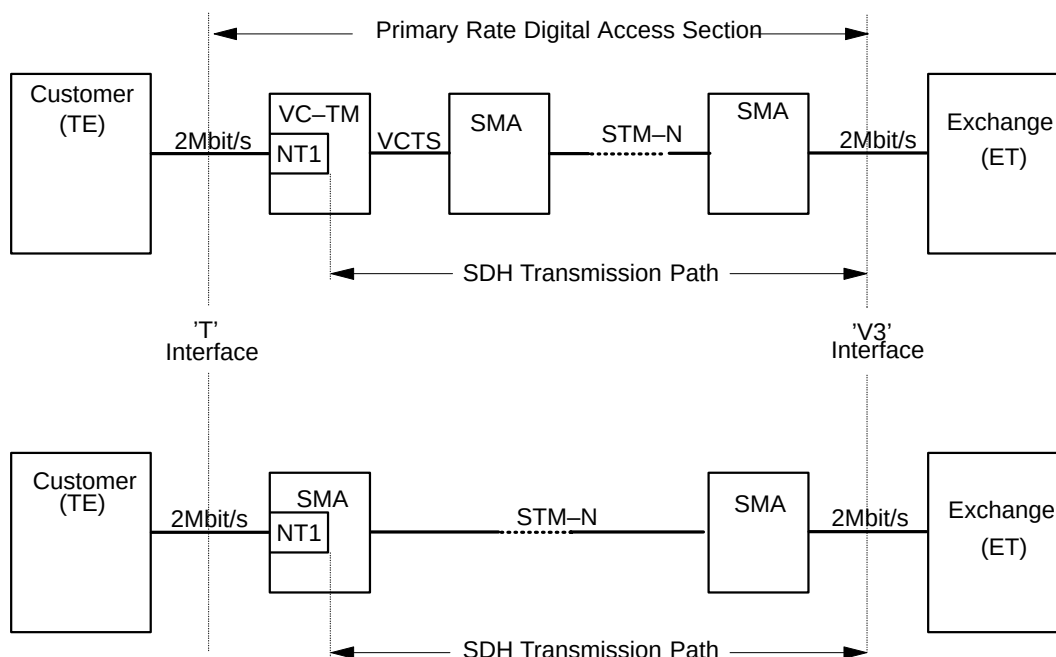


Figure 2.10 NT1 Function (only) in Transmission Network

Figure 2.11 gives a graphical representation of the direction, causes and consequences of NT1 and LT maintenance when both functions are enabled.

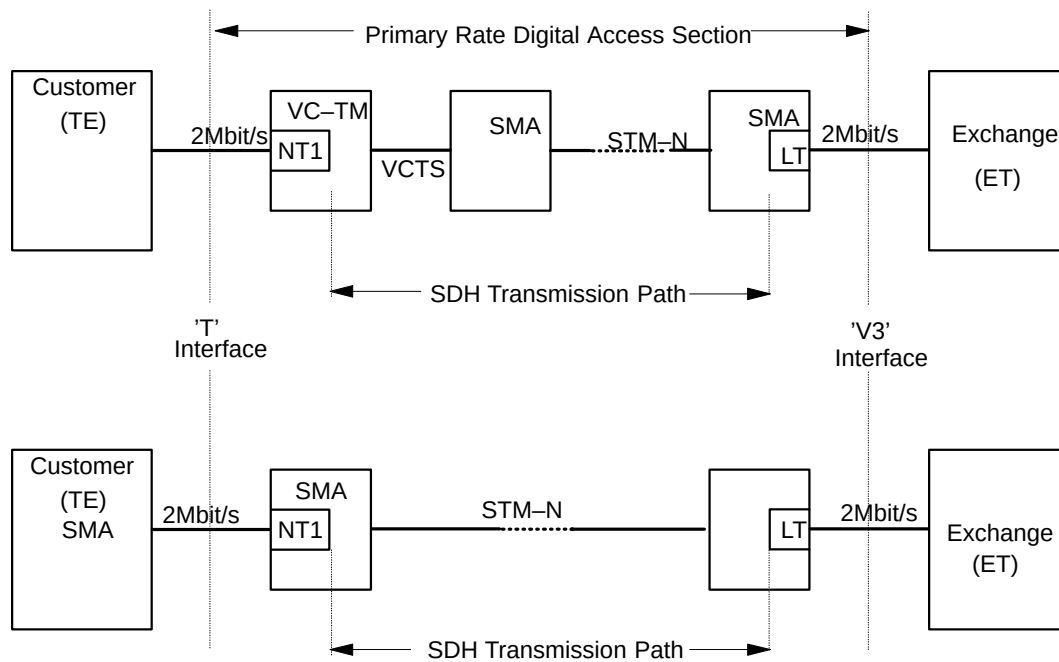


Figure 2.11 NT1 and LT Functions in Transmission Network

2.9.2 Loopback From Exchange

2.9.2.1 Transparent Bypass

The following components of the 2Mbit/s signal are passed through NT1 transparently:

- TS1–TS31 Traffic
- M-channel (Sa4)
- Maintenance Commands (Sa5, Sa6)
- Unused TS0 (Sa7, Sa8)
- RAI ('A' bit in TS0)

An exception to this is when AIS is injected onto the 'T' interface.

2.9.2.2 Loopback Control

A sequence of eight consecutive codewords of loop command are required before applying a loopback. Eight consecutive codewords of loopback release command, or eight codewords which do not contain the loopback command, or detection of LFA will cause the loopback to be removed.

This loopback will not stop the traffic received from the Exchange from being sent to the 'T' interface. The signal sent to the 'T' interface is processed in the same manner as if the loopback was not present, with the exception of the 'E' bits which are fixed to ONE, regardless of the number of CRC errors detected at the 'T' interface.

2.9.3 Loopback Towards Exchange

2.9.3.1 Transparent Bypass

The following components of the 2Mbit/s signal shall be passed through NT1 transparently:

TS1–TS31 Traffic

M–channel (Sa4)

Unused TS0 (Sa7, Sa8)

2.10 PORT STATUS

The status of ports on the SMA equipment is as follows, (refer to European Safety Standard EN 60950 for full definitions of SELV and TNV conditions).

It is a requirement of European Safety Standard EN 60950 (2.10.1) that SELV ports are connected to SELV ports, and TNV ports to TNV ports.

Ports which have been classed as 'TNV–1 (operating within SELV limits)' can be connected to either TNV–1 or SELV ports, but the circuitry supporting the port must meet TNV insulation requirements and operate at SELV voltages (below 60 V DC or 42.4 V peak). It is an accepted designation which allows the interconnection of SELV with TNV ports, and also covers environmental conditions where transient voltages above SELV limits may be imposed on the connecting cable (lightning surges etc).

2.10.1 SELV (Safe Extra–Low Voltage) (< 60 V DC or 42.4 V peak)

- Local Terminal (LCT) Interface port.
- BW7R Alarm input and output ports.
- Alarms/Comms ports.
- External Timing input and output ports (Synch).
- 2 Mbit/s test bus port.
- PSU Monitor points.
- Auxiliary ports.
- SDH and PDH 35/45/140 Mbit/s Tributary Monitoring Ports.

2.10.1.1 TNV–3 (Telecommunications Network Voltage, Class 3)

- DC Power input port (for DC supply voltages up to 75 V).

2.10.1.2 TNV–1 (Operating within SELV limits, but subject to Transient Over Voltages).

- 155 Mbit/s G.703 SDH STM–1 Electrical Mux input and output ports.
- 1.5/2 Mbit/s G.703 PDH Tributary traffic input and output ports.
- 140 Mbit/s G.703 PDH Tributary traffic input and output ports.

- 34 Mbit/s G.703 PDH Tributary traffic input and output ports.
- 45 Mbit/s G.703 PDH Tributary traffic input and output ports.
- Element Manager Interface port.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 3: PRODUCT OVERVIEW

3.1 INTRODUCTION

This chapter provides an overview of the whole product range. The range consists of four products :-

- SMA-1/4CP
- SMA-1/4c
- SMA-1/4(4+4)
- SMA-1/4(8)
- SMA-1/4UC

SMA-1/4CP is a low cost, compact ADM which is primarily intended for use on customer premises as a method of delivering broadband services.

SMA-1/4c and /uc are a small, low cost sub-rack primarily intended for use in one of the following applications :-

- on customer premises as a method of delivering a range of broadband services (for example ATM, highspeed PDH) to larger customers
- in street cabinets as a method of collecting voice and narrowband traffic from a number of co-located access multiplexers.
- in street cabinets as a method collecting broadband traffic from a small number of Extender IIs or customer ADMs

The only difference between SMA-1/4c and /uc is the size of the core subrack.

SMA-1/4(8) is a slightly larger subrack primarily intended for use in one of the following applications :-

- in street cabinets or local exchanges as a method collecting broadband traffic from a large number of Extender IIs, SMA-1/4c ADMs or customer ADMs.
- in exchange buildings as a low cost STM-4 ADM.

SMA-1/4(4+4) has only one row of LTUs and is primarily intended for use in one of the following applications :-

- in street cabinets to replace SMA-1/4c.
- in street cabinets or local exchanges as a method collecting broadband traffic from a large number of Extender IIs, SMA-1/4c ADMs or customer ADMs.
- in exchange buildings as a low cost STM-1 ADM.

All the products are based around a single chip SDH add/drop multiplexer.

3.1.1 SMA–1/4CP

SMA–1/4CP is based on one main core unit (PCB) containing the SCP ASIC. It supports X21 and 2M interfaces as standard. Other interfaces are supported via expansion module options.

Note: The expansion module can be added or replaced with the core unit in service.

Note: The 16x2 CP unit does not support X.21.

3.1.2 SMA–1/4c and SMA-1/4uc

The compact ADM is a smaller version of the SMA–1/4 ADM. The product is packaged in a 7U high (for SMA1/4c) and 6U high (for SMA1/4uc) both 19" wide sub-rack, to allow it to be installed in communications rooms and street cabinets. The product is based on a Core Card containing the SCP ASIC and Optical Modules (STM–1 or STM–4).

Note: See the chapter on Optical Modules for further information on these.

9 slots are supported containing

- 2 x Core Cards (for Card/MSP protection).
- 4 x Trib Card supporting the existing range of tributary card capability.
- 1 x Comms/Controller card
- 2 x PSUs (for SMA1/4c) and 1 x Power LTU two way A and B (for SMA1/4uc).
- LTU access is to 2 of the 4 trib slots.
- 2 x Ancillary LTUs.
- 1 x Core LTU

The system shall be powered by –48V.

3.1.3 SMA–1/4(4+4) and SMA–1/4(8)

The SMA–1/4(8) ADM takes the form of a 15U high 19" wide sub-rack, designed for use in exchanges and street cabinets. The product is based on a Core Card containing the SCP ASIC and Optical Modules (STM–1 or STM–4).

Note: See the chapter on Optical Modules for further information on these.

15 slots are supported containing

- 8 x Trib, supporting the existing range of SMA tributary card capability.
- 2 x Core Cards to allow Line MSP and Core card protection.
- 1 x Comms/Controller
- 1 x AUX (compatible with existing cards)
- 1 x EOW (compatible with existing cards)
- 2 x PSUs

The system is powered by –48V.

The normal range of Protection schemes are supported – 1:n Tributary Card, 1+1 Core card, PSU, SNC/MSP. The tributaries are supported by two rows of Traffic LTUs.

SMA-1/4(4+4) takes the form of a 12U high 19" wide sub-rack but otherwise it provides the same capability as the SMA-1/4(8) ADM with the exception that LTU access is to 4 of the 8 tributaries.

3.2 UNIT AND SHELF LAYOUT

3.2.1 SMA-1/4CP

The SMA-1/4CP ADM is housed in a similar plastic enclosure as that used for the Extender II, with approximate dimensions of 438mm x 220mm x 73mm

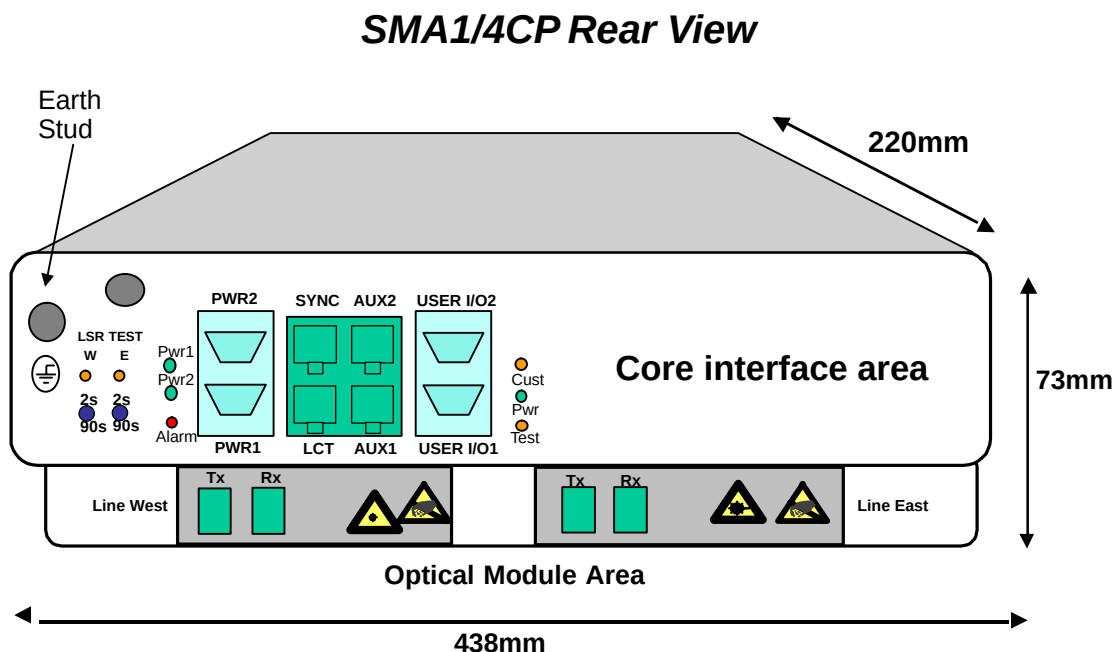


Figure 3.1 Rear View of 4 x 2 SMA-1/4CP.

The Core interface area is capable of supporting different connector variants. Various layout options are detailed below:

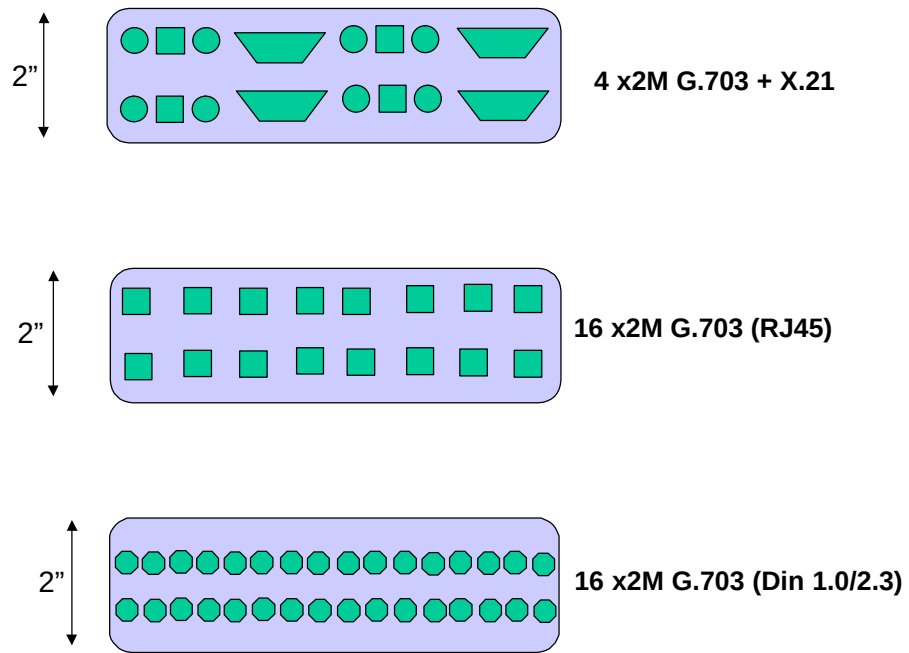


Figure 3.2 Core LTU variants for the SMA-1/4CP

3.2.2 Expansion Modules

A number of expansion modules are supported. Some of these are shown below.

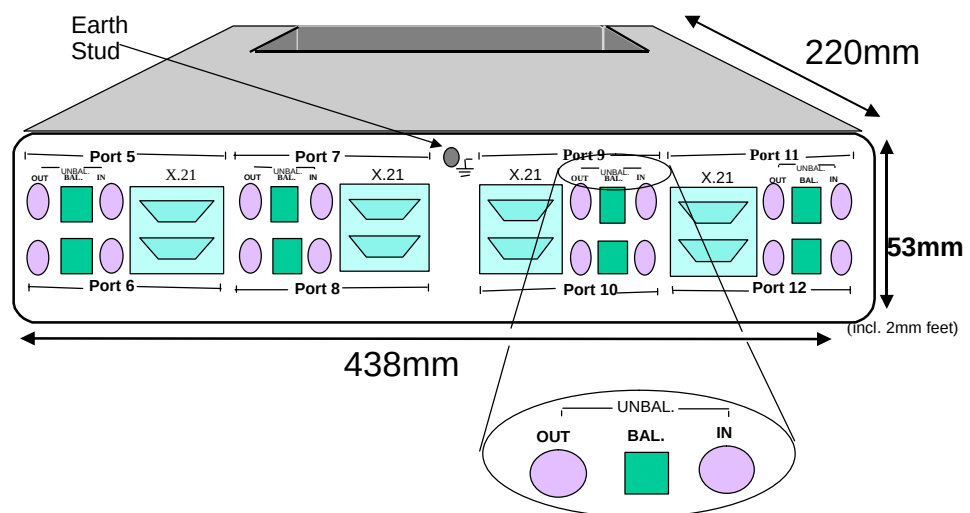


Figure 3.3 8 x 2M Expansion Module Enclosure

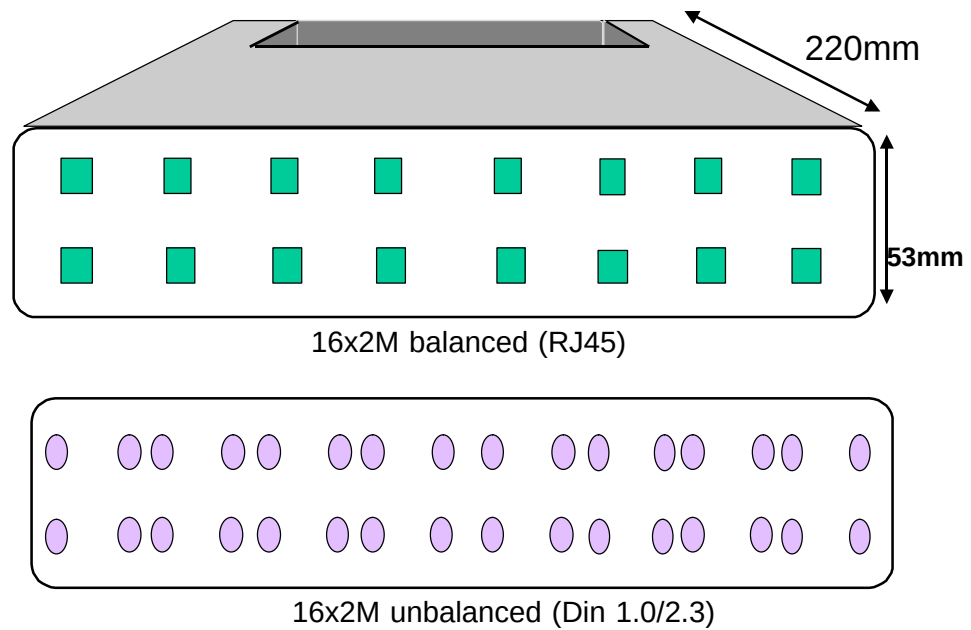


Figure 3.4 16 x 2M Expansion Module Enclosure

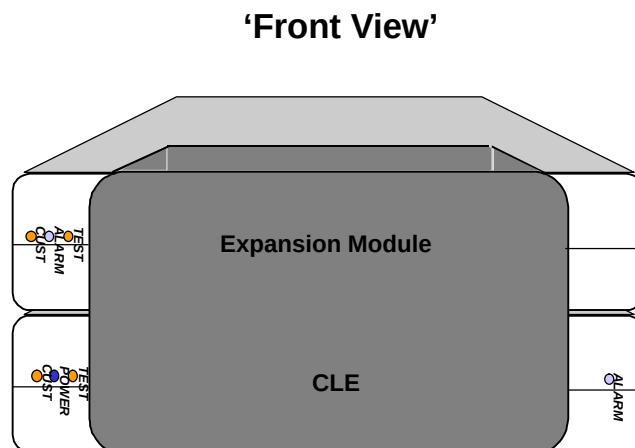


Figure 3.5 Front view of the SMA-1/4CP ADM enclosure with Expansion Module.

3.2.3 SMA1/4c

A diagram of the SMA-1/4c shelf layout is shown below.

CHAPTER 3: PRODUCT OVERVIEW

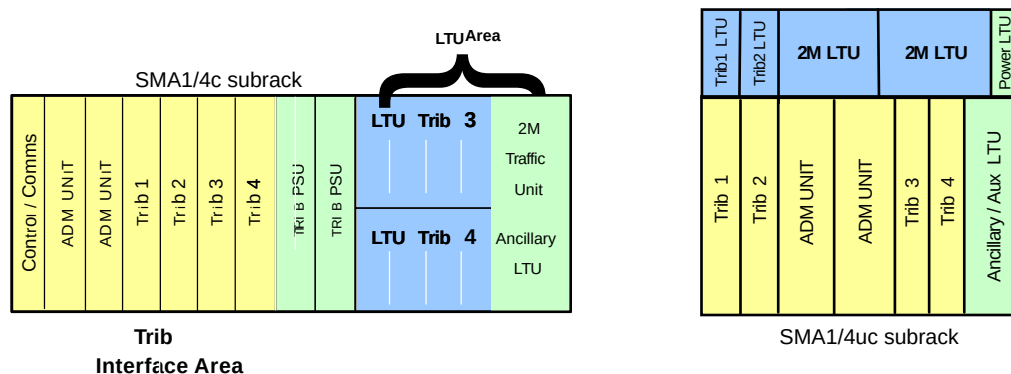


Figure 3.6 SMA-1/4c and SMA-1/4uc

The Components that make up the shelf are:

- 1 x Comms/Controller card
- 2 x Core Cards
- 4 x Series 3 tributary cards
- 8 x Series 3 tributary LTUs (note tributaries 1 and 2 are front plug-up only).
- 2 x PSUs (for SMA1/4c) and 1 x Power LTU two way A and B (for SMA1/4uc).
- 1 x Core LTUs (specific to the SMA-1/4c only), supporting the following variants:
 - 32 x 2M unbalanced, Din 1.0/2.3 (see Figure 3.7)
 - 32 x 2M balanced, 37-way D
- 1 x Ancillary panel.

As shown in the figure, the SMA-1/4c may be equipped with a 2M traffic unit within the Core LTU area. In conjunction with the Core Card, this allows up to 32 x 2Mbit/s to be delivered without the need to equip a conventional 2M tributary card. This function is protected when the Core units are duplicated.

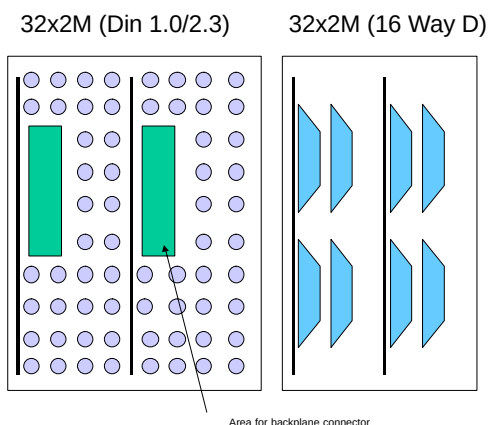


Figure 3.7 Core LTUs- 32 x 2M

Variants of the ancillary panel are shown in Figure 3.8.

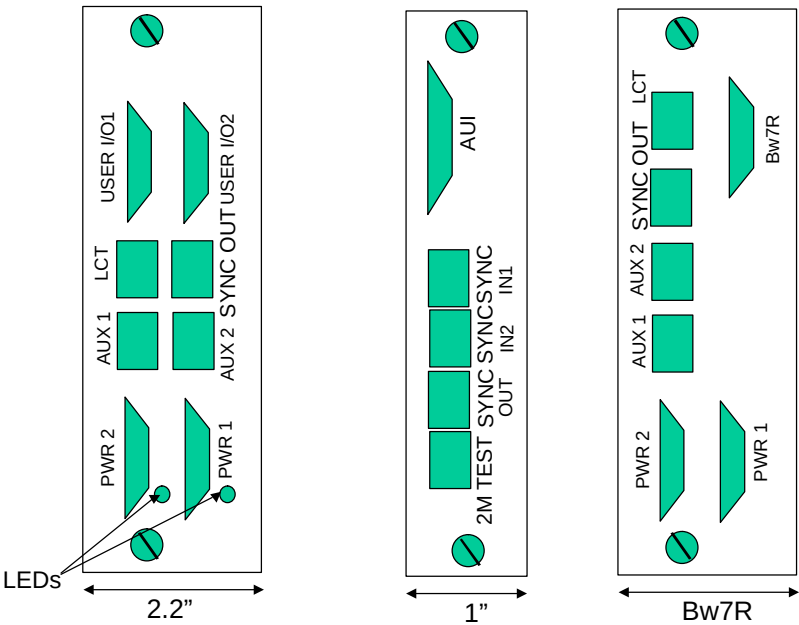


Figure 3.8 Variants of the ancillary panel

3.2.4 SMA–1/4(4+4) and SMA–1/4(8)

A diagram of the SMA–1/4(8) ADM shelf is shown below. It supports a minimum of 8 tributary cards. An ancillary area is supported on top of the tributary cards.

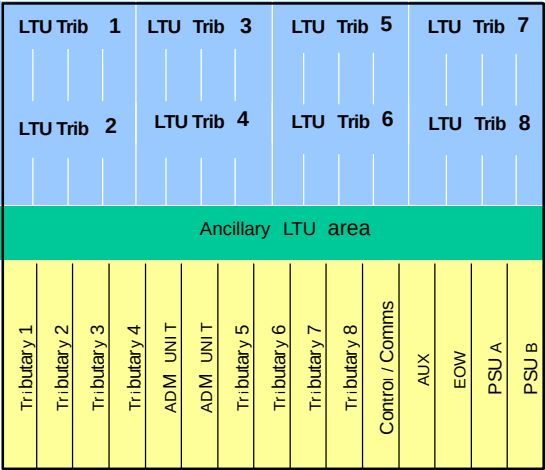


Figure 3.9 SMA–1/4(8)

Note: Dedicated Core LTUs are not supported. One of the tributary LTUs is used to support traffic from either the Core card or the tributary.

For SMA1/4(4+4)(8), the 2M traffic functions provided by the Core units are usually used to provide the equivalent of 1:N card protection of standard 2M tributary cards. However, for those applications requiring low numbers of 2Mbit/s functions, the Core units may be used to provide up to 32 x 2Mbit/s.

A diagram for the minimised SMA–1/4(4+4) shelf, which supports 4 rather than 8 LTU's, is shown below.

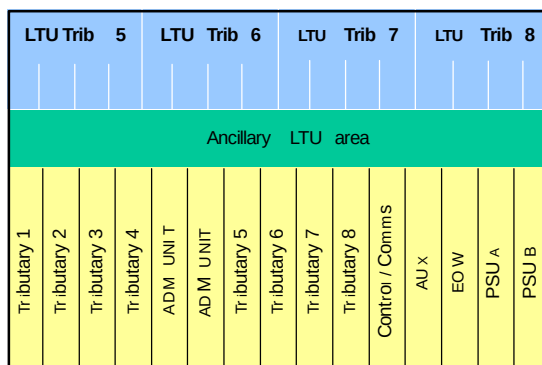


Figure 3.10 SMA–1/4(4+4) Single Row LTU

3.2.5 Tributary Units

Tributary details are shown in the following table:

Table 3.1: Tributary Units		
Tributary Type	Ports per Trib Card	Notes
1.5 Mbit/s	32	
2Mbit/s	32	
34 Mbit/s	3	
45Mbit/s	3	
140Mbit/s	1	
STM–1 Electrical	2	Single port variants available
STM–1 Optical	2	Quad STM–1 cards fit into the SMA1/4c
Cellspan Range (see associated product manual)	Various	Range of solutions for delivering ATM services on customer premises by providing efficient transport of ATM (cells) over SDH networks
Packetspan Range (see associated product manual)	Various	Range of solutions for delivering IP services on customer premises by providing efficient transport of IP (packets) over SDH networks.
VC–AM	4	Sub STM–1 VC–12 access module to SDH Extender I and II (see associated product manual).

3.2.6 Technical Details

- Optical Interfaces: Single Fibre Working (SFW) and Dual Fibre options.

STM-4
STM-1
Sub STM-1/SDH Extender

Connector Type: FC/PC/SC options

- Electrical Interfaces: 1.5,2,34,45,140Mbit/s and STM-1

Connector Type: DIN 1.0/2.3

- LCT Control Interface: IBM compatible PC
- Synchronisation Inputs and Outputs: Configurable for 2Mhz or 1.5/2Mbit/s
- Supply voltage: -48v nominal via duplicated connectors

Note: Triple feed LTU only has one connector.

3.2.7 Main Hardware Differences between SMA-1/4c, SMA-1/4uc and SMA-1/4(4+4),(8)

The basic differences between the SMA-1/4c, SMA-1/4uc and SMA-1/4(4+4),(8) are outlined in the following table.

Table 3.2: Main Differences Between SMA-1/4c, /uc and SMA-1/4(4+4),(8)		
Feature	SMA1/4c and /uc	SMA-1/4(4+4),(8)
Number of Tributary Slots	4	8
Number of Auxiliary Slots	0	2 (Aux 1 and 2)
Ancillary Functionality	Reduced	Full functionality
LTU Access	2 Tributaries	4 Tributaries / 8 Tributaries
Non Standard LTUs	Core LTU/Ancillary 1 and 2	Full Series 3 LTU compatibility
2M Protection Schemes	1:N	Core as 2M Protection tributary
Core Tributary Mode	Isolated	Tied to 1:n Protection

3.3 CORE CARD FEATURES

The Core Card combines the functionality of the Switch, two Lines, and core 2Mbit/s tributary functions. A single processor is used with a single S/W module to control and configure this unit.

The Card provides connection for two STM1/4 optical modules, organised as Line East and Line West. These modules can be plugged on to the card when used with SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4) and SMA-1/4(8).

As far as the Operator is concerned the optical modules and Core Trib function will require configuring separately as if they are separate 'cards'. The modules and Core Trib function configuration will include all aspects normally associated with a Line or Trib card including such things as 'Card out', 'wrong card fitted' and 'card in unconfigured slot' etc.....

The SMA–1/4c and /uc shelf provides full dedicated LTUs for the Core Trib function. When the Core Card is configured in the SMA–1/4c /uc shelf the Core Trib function is available for connections. The Core Trib ports are associated with the Core Trib function. Up to 32 (automatically protected if two Cores are fitted) Core Trib connections can be made – the configuration of the connections to the Core Trib functions is basically the same as connections to a standard Trib position.

In the SMA–1/4c and /uc shelf the Core Trib function is not used for 1:n Trib Card protection. For 1:n (n= 2 maximum) protection, a 2M protection card is fitted in Trib slot 1.

The SMA–1/4 shelf does not provide dedicated LTUs for the Core Trib function and the Operator does not make connections directly to it. The function is used in Core Trib Mode and in 1:n (n= 8 maximum) Trib protection but there is no Operator configuration of connections directly to this function so it does not appear against the Core Card.

See the chapter on Slide–In Card Units and the chapter on Optical Modules for further information regarding optical modules.

The Core Card features are illustrated in Figure 3.11.

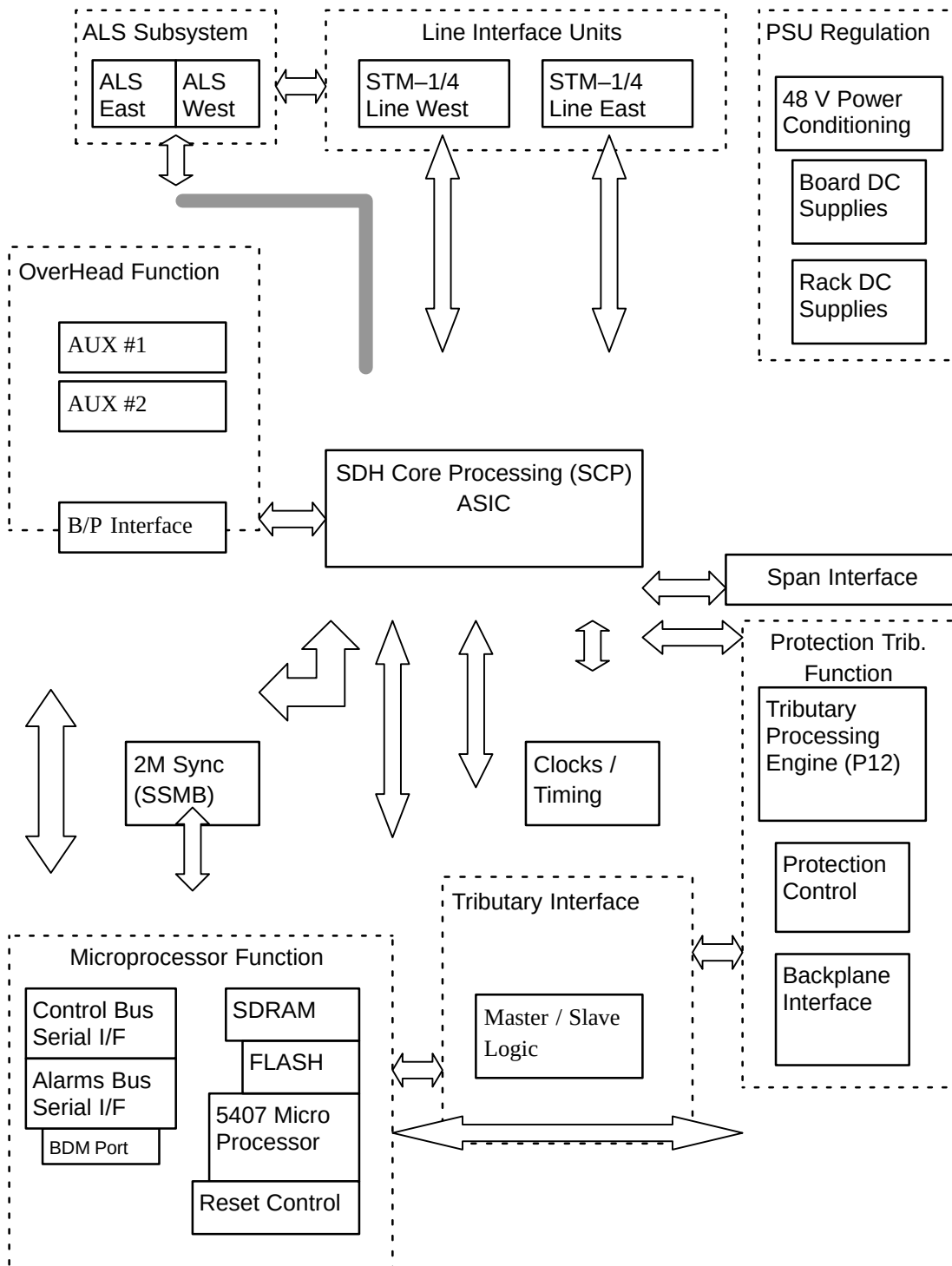


Figure 3.11 Core Card Features

3.4 COMMS/CONTROLLER CARD FEATURES

Series 4 products have a combined Comms/Controller card. The Card combines the Comms and Mux Controller functionalities onto a single card. However there are two processors on this unit so the Controller and Comms functions appear as two separate 'functions'. Once the Comms/Controller card has been configured in the shelf then it is possible to configure the Comms card.

The card also has the SMC as a replaceable module. (this is the equivalent of System Memory Card in Series 3 terms).

It should be noted that the SMA-1/4CP has a single processor to carry out both functions.

3.4.1 SMA-1/4CP Software Functions

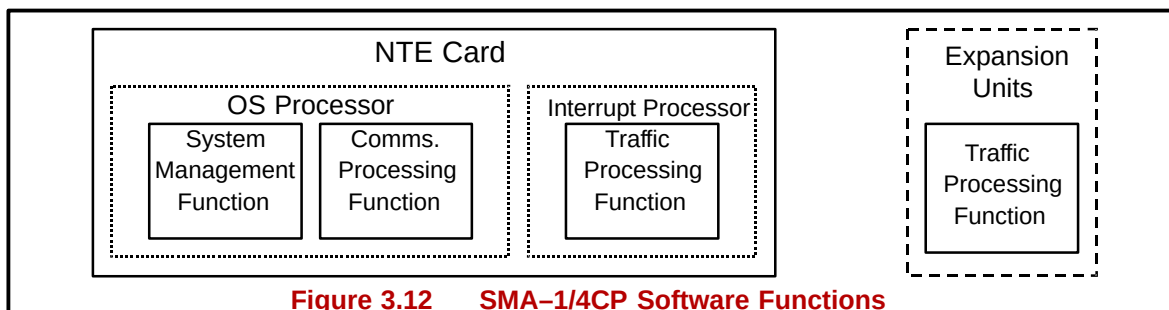


Figure 3.12 SMA-1/4CP Software Functions

The SMA-1/4CP software functions are shown in the above diagram.

3.4.2 SMA-1/4c, /uc and SMA-1/4(4+4),(8) Software Functions

On the SMA1/4c, /uc and SMA1/4(4+4),(8) there is a separate Comms/Controller card to support system management and communications processing software. The Core card only supports traffic processing software. This is illustrated in the following diagram.

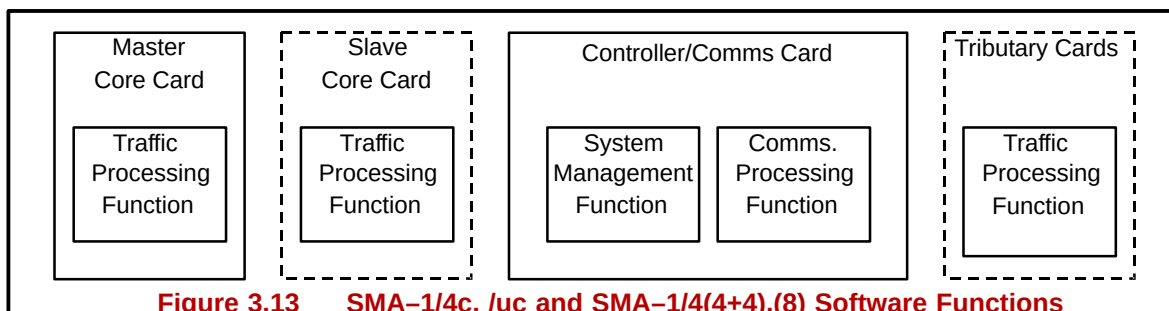


Figure 3.13 SMA-1/4c, /uc and SMA-1/4(4+4),(8) Software Functions

3.4.3 CONTROLLER FUNCTIONS

The Comms/Controller Card performs the system management software functions listed below.

3.4.3.1 Equipment Configuration

On the SMA–1/4c, /uc and SMA–1/4 the shelf and equipment level features are configured by the Comms/Controller Card. This includes: inventory data, slot configuration and end–of–shelf alarms.

On the SMA–1/4CP the equipment level features are configured by the Comms/Controller processor. This includes: inventory data, and card alarms.

3.4.3.2 Traffic Configuration

On the SMA–1/4c, /uc and SMA–1/4(4+4)(8) , in response to commands received from the network management system to set up traffic paths the Comms/Controller Card configures SDH domain traffic processing functions on the Core card and any fitted tributary cards.

On the SMA–1/4CP, the Comms/Controller processor card configures traffic functions on the traffic processor and expansion units in response to commands received from the network management system to set up traffic paths in the SDH domain.

3.4.3.3 SDH Tributary Card Management

On the SMA–1/4c, /uc and SMA–1/4(4+4)(8), the Comms/Controller Card manages the logical addition and card configuration variables for the core cards and all of the tributary cards.

On the SMA–1/4CP, the logical addition and card configuration variables are managed for any expansion units.

3.4.3.4 Secondary Domain Tributary Card Management

On the SMA–1/4CP, SMA–1/4c, /uc and SMA–1/4(4+4)(8), the Comms/Controller Card routes transparent messages for tributary cards or expansion units that have separately managed domains (for example, Cellspan and VCAM). The SDH domain of these cards is managed by the Comms/Controller Card.

3.5 PROTECTION

Traffic and Card protection for the Series 4 products is summarised in the following table:

Table 3.3: Series 4 Protection			
	SMA–1/4CP	SMA–1/4c	SMA–1/4(4+4)(8)

Traffic Protection	MSP STM–1/STM–4 SNC PDH Port	MSP STM–1/STM–4 SNC PDH Port	MSP STM–1/STM–4 SNC PDH Port
Card Protection	Dual Power Supply Feed (battery backup)	Duplicated centralised PSUs provide trib card supplies. Comms/Con- troller and Core Cards have dedicated PSUs. 1+1 Core Card Protec- tion. 1:N Tributary Card Protection Core Trib Protection	Duplicated centralised PSUs provide trib card supplies. Controller/ Comms and Core Cards have dedicated PSUs. 1+1 Core Card Protec- tion. 1:N Tributary Card Protection

3.6 SYNCHRONISATION

3.6.1 SMA–1/4CP

SMA–1/4CP provides a single SETG function but without an external synchronisation input.

Synchronisation sources for the SMA–1/4CP include STM–N line sources and holdover/freerun clock. The following features are supported:

- Single SETG or Freerun modes
- SSMB enable/disable
- Revertive/non–revertive selection
- SSM quality assignment
- SSMB overwrite on STM–N inputs/outputs
- External output squelch on quality threshold
- System Clock and External Output priority tables
- External Output type configuration (2Mbit/s with/without SSM, 2MHz, 1.5MHz)
- STM–N line traffic

3.6.2 SMA–1/4c and /uc

SMA–1/4c/uc provides a single SETG function, and external synchronisation inputs and outputs are supported. The SETG function selects between line sources, tributary card sources, external timing input sources and internal holdover.

The SETG function is protected. The master SETG function drives the external timing output signals.

An ETS tributary timing bus is provided to supply tributary timing to the Core Card for synchronising system timing. SDH tributary cards are also connected to the non–ETS tributary timing bus to provide direct synchronisation of the external timing outputs.

Each line timing source on the Core Cards is passed to the protection Core Card as a 9.72MHz clock signal. This allows the SETG selector to accommodate MSP protected lines as separate synchronisation sources.

Synchronisation sources for SMA–1/4c/uc include STM–N line sources, all tributary synchronisation sources supported on SMA Series 3, External Timing inputs and holdover/freerun clock. The following features are supported:

- Single SETG or Freerun modes
- SSMB enable/disable
- Revertive/non–revertive selection
- SSM quality assignment
- SSMB overwrite on STM–N inputs/outputs
- External output squelch on quality threshold
- Ext/Trib sources, System Clock and External Output priority tables
- External Output type configuration (2Mbit/s with/without SSM, 2MHz, 1.5MHz)
- External Input type configuration (2Mbit/s with/without SSM, 1.5Mbit/s, 2MHz, 1.5MHz)
- Synchronisation function protection (using duplicated core cards)

When using synchronisation protection the master Core always provides the external output synchronisation source.

3.6.3 SMA–1/4

Synchronisation is the same as SMA–1/4c but with an increased number of tributary cards connected to the timing buses.

3.7 POWER DISTRIBUTION

3.7.1 SMA–1/4CP

SMA–1/4CP is powered from nominal –48V input. A DC/DC convertor on the Core shall provide the required voltages (eg. 1.8V, 2.5V, 3.3V, +–5V). Figure 3.14 shows the power arrangement between Core and Expansion boxes.

3.7.2 SMA–1/4c and /uc

The power distribution for SMA–1/4c is shown in Figure 3.15.

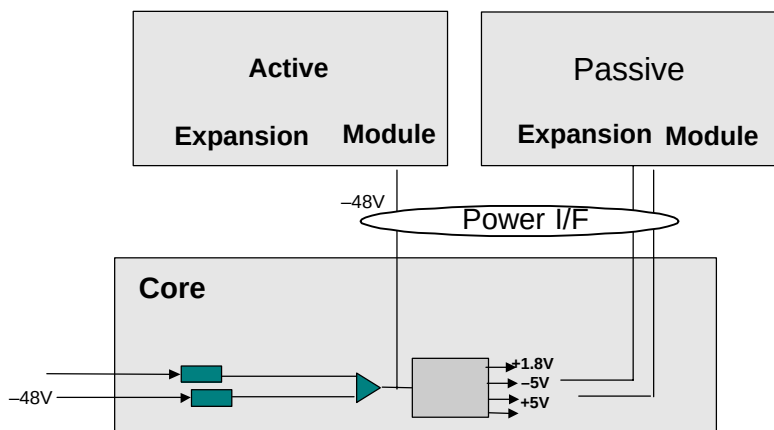


Figure 3.14 SMA-1/4CP Power Distribution

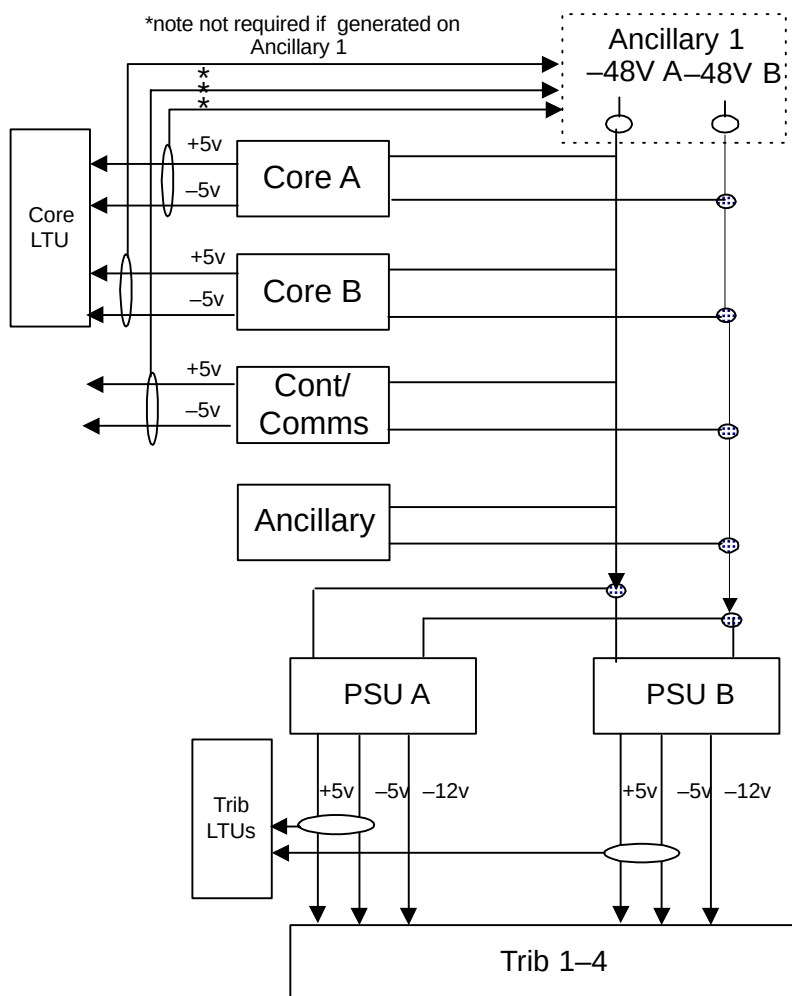


Figure 3.15 SMA-1/4c Power Distribution

3.7.3 SMA-1/4

The power distribution for SMA-1/4 is shown in Figure 3.16. PSUs (optionally protected) are supported to provide the correct voltages to all cards and LTUs via the backplane. Dual power feeds are supported via the Power LTU.

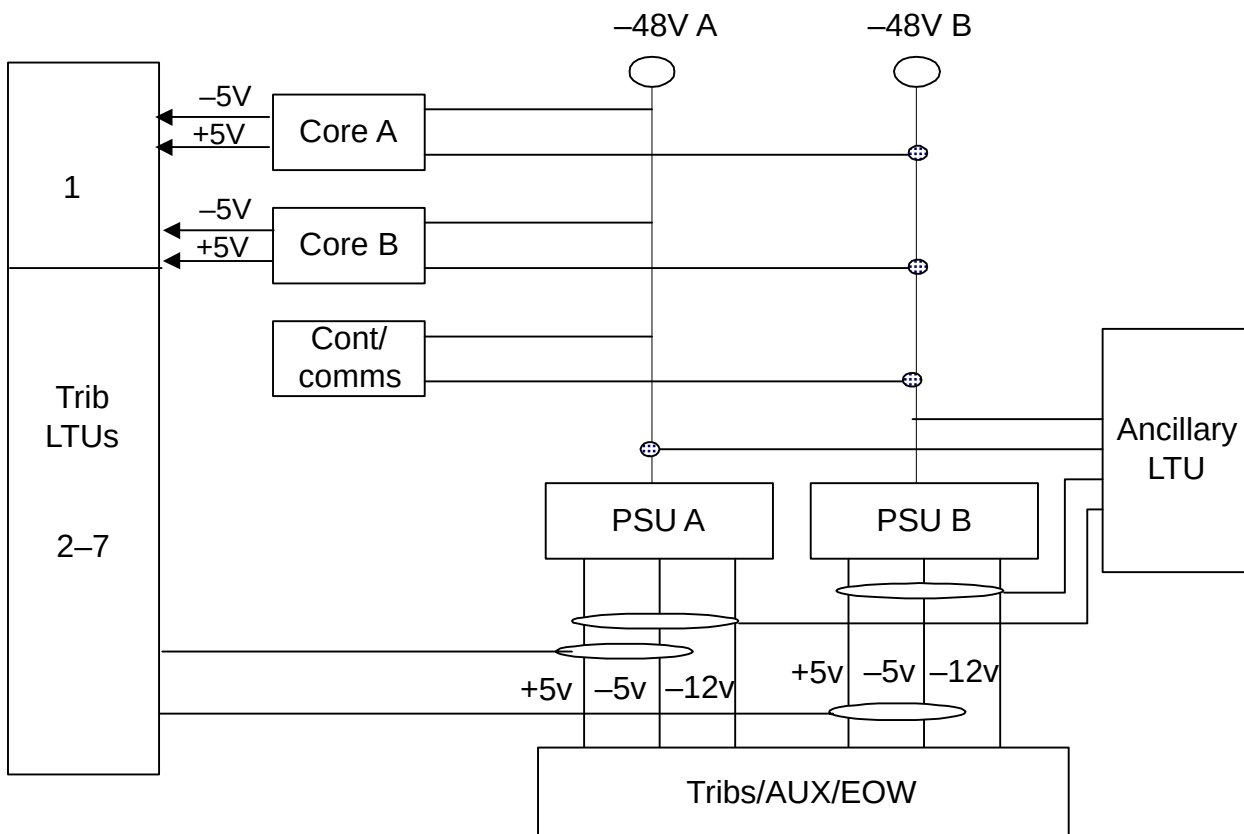


Figure 3.16 SMA-1/4 Power Distribution

3.8 EQUIPMENT CONFIGURATION

The following global configuration options are supported:

- Analogue Monitoring (specific to STM-4 only).
- Laser Bias Current
- Deviation of Tx Power Level
- Rx Power Level
- Consequential Actions for Traffic Defects
- Date and Time (Real-Time Clock)
- Re-Configure Card/Unit
- Reset Card/Unit

3.9 EVENT MONITORING

3.9.1 SMA–1/4CP

Events supported on the SMA–1/4CP are a combination of SMA Line, Switch, STM–1 tributary and 2Mbit/s tributary event types, scaled to the number of ports and VCs. The Controller function events are a combination of SMA Mux Controller and Comms Card event types.

A simple unit alarm LED and 2 x relay (6 input 2 output) contacts (via the USER I/O) are provided to indicate that an equipment fault type exists on the system.

The Controller function on SMA–1/4CP collects alarm events from traffic functions on a 1s polling basis and uses these to maintain historic alarm logs. Performance and Status events are reported to the management system by the Controller function.

3.9.2 SMA–1/4c and /uc

Core Card events are a combination of SMA Line, Switch and 2Mbit/s tributary event types, scaled to the number of ports and VCs.

Bw7R is supported on SMA–1/4c.

Controller events are a combination of SMA Mux Controller and Comms Card event types.

The Controller Card collects alarm events from traffic cards on a 1s polling basis and uses these to maintain historic alarm logs. Performance and Status events are reported to the management system by the Controller Card.

3.9.3 SMA–1/4

Tributary, Core Card and Controller/Comms Card events are as for SMA–1/4c.

TEP1E and Bw7R alarm schemes are supported.

The Controller/Comms Card collects alarm events from traffic cards on a 1s polling basis and uses these to maintain historic alarm logs. Performance and Status events are reported to the management system by the Controller/Comms Card.

3.10 PERFORMANCE MONITORING

3.10.1 SMA–1/4CP

Performance primitives supported on SMA–1/4CP are a combination of SMA Line, Switch, STM–1 tributary and 2Mbit/s tributary performance primitive types, scaled to the number of ports and VCs.

The Controller/Comms function on the SMA–1/4CP collects performance information from traffic functions on a 1s polling basis and uses these to create 15 minute and 24 hour performance reports. Performance information on the Controller/Comms function can be accessed by the management system.

3.10.2 SMA–1/4c, SMA-1/4uc and SMA–1/4

Core Card performance primitives are a combination of SMA Line, Switch and 2Mbit/s tributary performance primitive types, scaled to the number of ports and VCs.

Controller/Comms Card performance primitives are a combination of SMA Mux Controller and Comms Card performance primitive types.

The Controller/Comms Card collects performance information from traffic cards on a 1s polling basis and uses these to create 15 minute and 24 hour performance reports. Performance information on the Controller/Comms Card can be accessed by the management system.

3.11 COMMUNICATIONS

3.11.1 DCC Communications

On the SMA–1/4CP, the Communications function supports 4 DCC channels, giving DCCr and DCCm access on the line ports only.

On the SMA–1/4c, /uc the Communications function supports 24 DCC (4 per Tributary Card, 4 per Core Card) channels, giving both DCCr and DCCm access.

On the SMA–1/4, full support for 40 DCC (4 per Tributary Card, 4 per Core Card) channels is provided.

IS–IS routeing is used to support the following Communications features:

- Level 1 and Level 2 routeing
- Packet throughput of up to 90pkts/s (SMA–1/4CP, SMA–1/4)
- Packet throughput of up to 135pkts/s (SMA–1/4c, SMA–1/4)
- Up to 250 Level–1 nodes supported in routeing tables
- Up to 100 Level–2 nodes supported in routeing tables

3.11.2 Transparent Message Routeing

On the SMA–1/4c, /uc and SMA–1/4, the traffic domains on some tributary cards are managed directly from the network management system. Current tributary card types include:

- ATA/ATC Tributary
- VCAM Tributary
- Ethernet Tributary

- Domain Dependant Expansion modules

Messages between Network Management and these card domains are routed transparently through the Controller/Comms Card without being changed. The Comms/Controller Card only checks the destination address of these messages for routing purposes.

3.11.3 Communications Management

SMA–1/4c/uc and SMA–1/4 are capable of supporting management communications to co-located and subtended products. SMA–1/4CP is not intended to support other products and so will not support communications on any of its tributary ports.

3.12 INTERFACES

3.12.1 External

Customer interface connections are positioned in such a way to enable customer access without the need to access the interior of a unit.

3.12.2 Ancillary Interfaces

3.12.2.1 Local Craft Terminal

The LCT interface is a full duplex asynchronous serial communications link (RS232) between the LCT and the multiplexer unit. The LCT is PC based.

The interface operates up to 19.2kbit/s (with 9600 default).

3.12.2.2 AUI Interface (Q/B3)

This interface is used to connect the unit to a management system such as EMOS.

The Gateway functionality resides on the Comms/Controller Card and interfaces to the AUI LTU.

This interface is not supported on the SMA–1/4CP.

This interface is supported on the SMA–1/4c/uc via the ancillary panel, presented on a 15 way D.

3.12.2.3 Timing Output

A dedicated 2Mbit/s (SSM)/2MHz) connector, supporting balanced and unbalanced options, is supported.

A single interface is supported on the SMA–1/4CP via an RJ45 (balanced and unbalanced supported on one connector)

Two interfaces are supported on the SMA–1/4c/uc on an ancillary panel, presented on RJ45 (balanced and unbalanced supported on the one connector)

Two interfaces are supported on the SMA–1/4 via the LTU. Both balanced and unbalanced options are supported (9 Way D (balanced) and DIN 1.6/5.6 (unbalanced)).

3.12.2.4 Timing Input

This interface is not supported on the SMA–1/4CP.

Two interfaces are supported on the SMA–1/4c/uc on an ancillary panel, presented on RJ45 (balanced and unbalanced supported on the one connector)

Two interfaces are supported on the SMA–1/4 via the LTU. Both balanced (9 Way D) and unbalanced (DIN 1.6/5.6) options are supported.

3.12.2.5 Auxiliary Interface

This is a V.11, 64Kbit/s serial interface providing data and clock, suitable for remote management of subtended equipment (i.e C–MUX 2).

The SMA–1/4CP and SMA–1/4c hardware is capable of supporting 2 AUX ports.

The SMA–1/4 hardware is capable of supporting existing Series 3 SMA AUX ports.

3.12.2.6 User Alarm I/O

The SMA–1/4CP and SMA–1/4c/uc support User Alarm inputs and outputs as provided on the Extender II.

This interface is provided on a double stacked 9 way D type connector.

The SMA–1/4 supports User Alarm inputs and User Outputs. This interface is supported via the LTU, presented on a 15 way D type.

3.12.2.7 Power Interface

For SMA–1/4CP, dual power interfaces are supported via 9 way D type connectors. For SMA–1/4c/uc, dual power interfaces are supported via 15 way D type connectors.

For SMA–1/4, power supplies and the power LTU supporting dual feeds are supported. The DC power (–48V) enters the equipment through the Power LTU.

3.12.2.8 Local Alarm Scheme

This interface is supported on the SMA–1/4 only via the LTU.

Local alarms schemes BW7R and TEP–1E are supported.

Note: Bw7R is supported on SMA–1/4c/uc using a Bw7R basic ancillary LTU.

3.12.2.9 Engineer Order Wire (EOW)

EOW is not supported on the SMA–1/4CP and SMA–1/4c.

For SMA–1/4 and SMA-1/4uc, EOW is supported. This interface is supported via the AUX LTUs.

EOW speech access to the equipment is via an order wire handset connector mounted on the front of the card.

3.12.2.10 PSU Monitor Points

PSU monitor points are not supported on the SMA–1/4CP.

Within the SMA–1/4c, each LTU PSU has monitor points, which are accessible through the front of the PSU cards. A 6-pin block type socket provides voltage monitoring.

For SMA–1/4, the PSU monitor points are supported on the front of the PSUs.

3.12.2.11 2M Tributary Test Access

This allows the operator to be able to select a single port output interface for connection to the output test bus.

This interface is not supported on the SMA–1/4CP.

Both balanced and unbalanced options are supported on the SMA–1/4c/uc via the ancillary panel on an RJ45 connector.

Both balanced and unbalanced options are supported on the SMA–1/4 via the LTU.

3.12.2.12 Line Optical Interfaces

Single Fibre Working Modules:

- STM–1, 1300Tx/Rx
- STM–1, 1300/1500
- STM–4, 1300/1500
- Connector Types: FC/PC, SC, DIN

The optical budget requirements for SFW are:

Table 3.4: SFW Optical Budget Requirements			
TYPE	O/P Power	Rx Sensitivity	S–R Budget
Low Power Laser	–2 dbm Nominal	–20 dbm	15 db minimum

3.12.2.13 Tributary Interfaces

Optical:As per existing SMA G.957 interfaces.

Electrical:As in the table below:

Table 3.5: Electrical Interfaces	
STM–1	G.703 ; CMI
34Mbit/s	G.703 ; HDB3
45Mbit/s	G.703 ; B3ZS
2Mbit/s	G.703 ; HDB3 Balanced and Unbalanced
1.5Mbit/s	G.703 ; B8ZS/AMI Balanced
140Mbit/s	G.703 ; CMI
VCAM (34Mbit/s)	G.703 ; HDB3

3.12.2.14 Expansion Interfaces

Two types of expansion interface are provided on the SMA–1/4CP only. One is passive, providing access to dumb Expansion LTUs.The other is active, providing access to Intelligent expansion modules.The latter is a standard Pseudo STM–1 interface.

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SECTION 2: PRODUCT FUNCTIONALITY

CHAPTER 4 MULTIPLEXING STRUCTURE PAGE 113

CHAPTER 5 CROSS-CONNECTIONS PAGE 117

CHAPTER 6 SYNCHRONISATION PAGE 123

CHAPTER 7 PROTECTION PAGE 151

CHAPTER 8 COMMUNICATIONS PAGE 175

CHAPTER 9 EVENT HANDLING PAGE 201

CHAPTER 10 PERFORMANCE PAGE 211

CHAPTER 11 OPERATOR CONTROL PAGE 215

CHAPTER 12 SOFTWARE DOWNLOAD PAGE 219

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CHAPTER 4: MULTIPLEXING STRUCTURE

4.1 INTRODUCTION

The multiplexing structure of the STM signal defines the way the various lower order bit-rate signals are combined, together with supervisory data and pointers, to form the STM frame. It also defines, therefore, the access path whereby the SMA adds and drops tributaries, the points at which supervisory data can be accessed and the levels at which cross connections can be made.

4.2 STRUCTURE

Figure 4.1 illustrates the STM-N structure (a subset of ITU Recommendation G.709) and also shows the SMA access path.

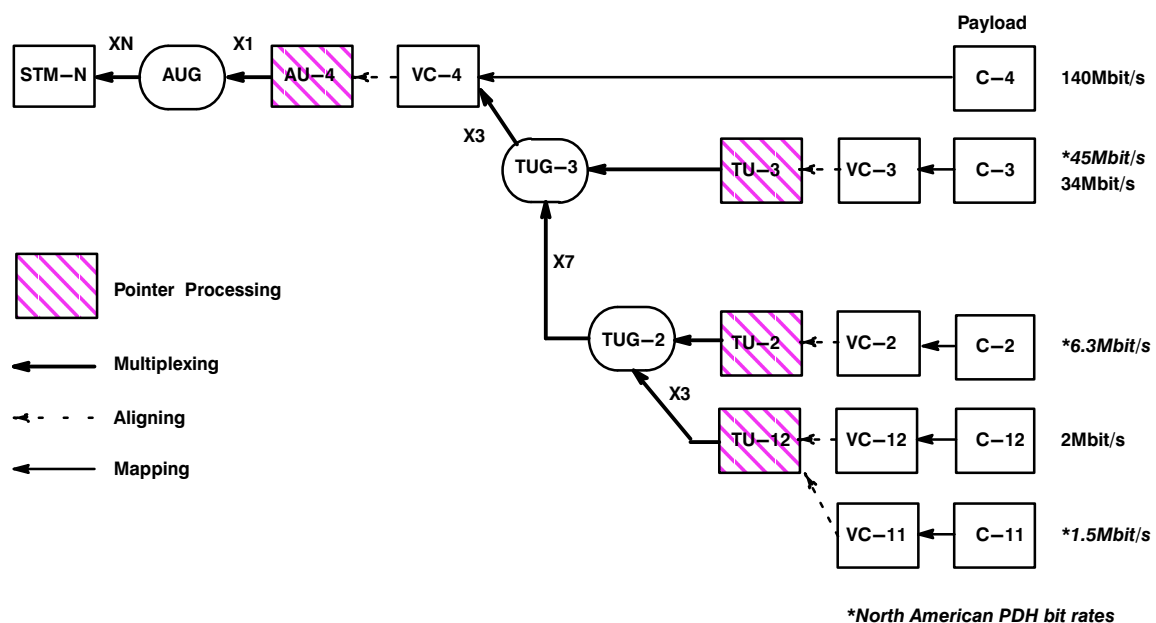


Figure 4.1 SMA Multiplexing Structure For STM-N Signals

The multiplexing structure shown above is a sub-set of G.709 (as determined by ETSI) The structure is a hypothetical representation, showing all the possible signal and traffic levels that may be supported. The 1.5Mbit/s signals are effectively mapped into VC-12 containers using the same Trib Card as is used for 2Mbit/s signals, but with a link position set to ensure 'bit-stuffing' of the excess bytes.

The structure is made up as follows:

- The lowest level is a Container (C), into which the tributary signal is mapped.

- A Virtual Container (VC) is created when a Path OverHead (POH), carrying supervisory information, is added to the container data.
- The VC is re-timed (to SMA Clock) and a pointer added. This combination becomes a Tributary Unit (TU).
- Tributary Units are multiplexed together, via intermediate Tributary Unit Groups (TUG-2 & TUG-3), then to a higher order VC. The High Order VC also contains a POH, i.e. a High Order POH.
- The High Order VC is re-timed (to STM-N Line Clock) and a pointer added. This combination becomes an Administrative Unit (AU).
- A Section OverHead (SOH), carrying more supervisory information, is added to form the STM-N signal frame.

4.3 VIRTUAL CONTAINERS

The SMA handles Virtual Containers for bit rates VC-2, 3, 4, 11 and 12, these are terminated to tributary cards (34/45 140, 1.5 and 2Mbit/s respectively). They may be used when creating traffic paths (cross-connections) between STM-N cards.

4.4 OVERHEADS

The Path and Section overheads incorporate a number of bytes used for in-service monitoring of path and system performance. Path Over Heads provide for monitoring of individual Path (Higher Order and Lower Order) performance, some aspects allowing monitoring of remote elements. Section Over Heads provide for performance monitoring of the repeater and multiplex functions.

4.5 POINTERS

A pointer is added to each virtual container. These pointers are used to adapt signals between different timing clocks used within the network. The pointer indicates the start of the VC within the Higher Order VC frame.

4.6 TRIBUTARY UNITS

The VC and associated pointer combination constitutes a Tributary Unit (TU), thus a VC-12 and its associated pointer is a TU-12.

Multiple Tributary Units are grouped together to form Tributary Unit Groups (TUGs). The method by which a TU-12, 2 and 3 are grouped into TUGs is shown in Figure 4.1. Further details of the Multiplexing Structure can be found in TSS recommendation G.709. TU-12s are initially multiplexed into a TUG-2, seven TUG-2s are then combined to form a TUG-3. The TUG-3 is then multiplexed into a higher order Virtual Container, VC-4.

4.7 ADMINISTRATIVE UNITS

The higher order VC (VC-4) has a pointer added to it to produce an Administrative Unit (AU-4). This is carried in the payload area of the STM-N frame. The Section Overhead (SOH) bytes are added to the STM-N #1 signal.

The bytes of the SOH provide for a variety of ancillary functions associated with the transmission of the STM-N data, e.g. for the SMA-4 these functions include frame alignment bytes, error monitoring data and network communications channels.

An AU pointer is added to the VC-4 forming an AU-4. This AU pointer provides a method of allowing flexible and dynamic alignment of the VC within the AU frame. This pointer indicates the position of the VC-4 in relation to the AU 4 frame. The AU pointer constitutes the first $9 \times N$ bytes of the STM-N frame. With this implementation the resultant frame consists of a complete STM-N signal.

An Administrative Unit Group (AUG) is a group of AUs which are multiplexed together.

4.8 STM-N FRAME STRUCTURE

Figure 4.2 shows the structure of STM-N frames in terms of payload, AU pointer and section overhead areas.

E.g. an STM-4 frame is $(270 \times 4) = 1080$ bytes by 9 bytes, with a frame period of $125 \mu\text{s}$ and constitutes four byte interleaved STM-1 frames.

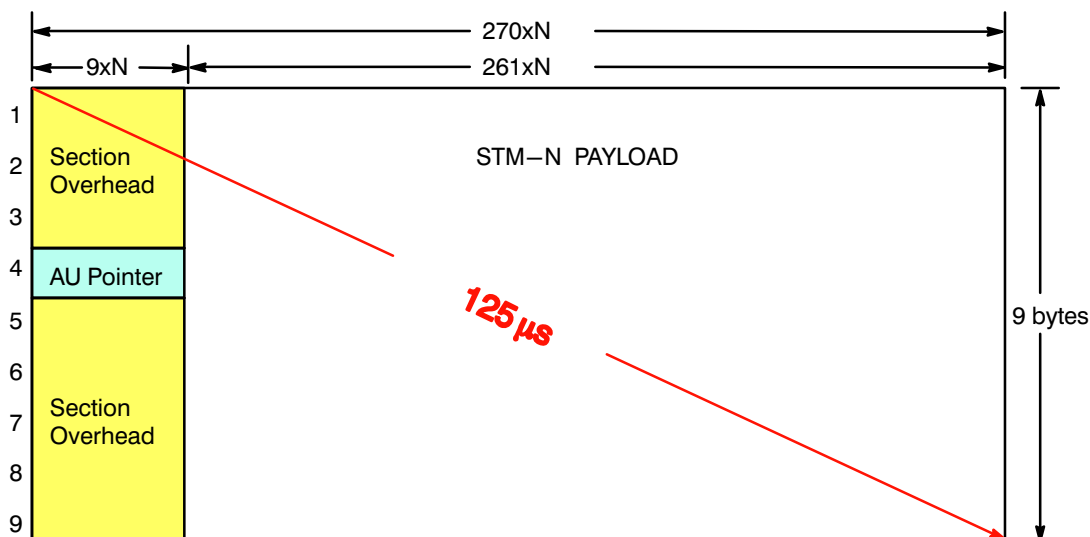


Figure 4.2 STM-N Frame Structure

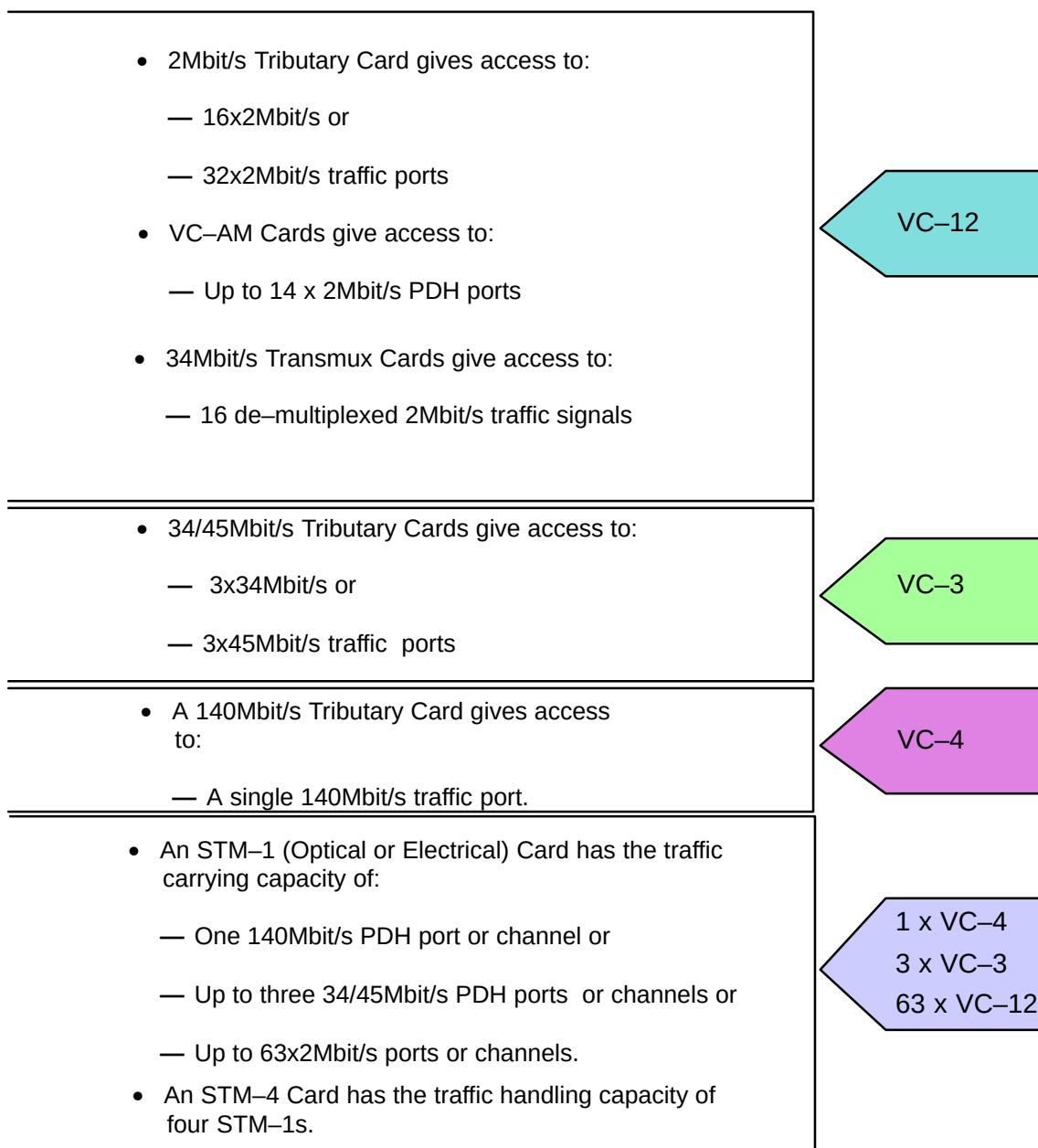
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CHAPTER 5: SMA–N CROSS–CONNECTIONS

5.1 INTRODUCTION

Tributary card port access is as follows:–



Note: Tributary access is available for 100% of Line capacity at TU–12 level for SMA–1 and SMA–4. Access is limited to the application and number of Trib/LTU combinations allocated.

5.2 CROSS-CONNECTION OPTIONS

Cross-connections (traffic paths), routed through the Switch Unit can be created between Line – Line, Line – Tributary and Tributary – Tributary. In this context 'Tributary' means 1.5Mbit/s, 2Mbit/s or 34/40/45/140Mbit/s Tributary Cards, 34Mbit/s VC-AM or STM-N Cards fitted in Tributary slots, or optical or expansion modules as listed below.

Cross-connections between various channels are performed at the VC level. The order of VC Cross-connection is dependent upon the traffic cards between which the cross-connection is to be made:

- 1.5/2Mbit/s Trib Cards connect at the VC-12 level.
- 2Mbit/s Core Trib function on SMA-1/4CP connects at the VC-12 level.
- 2Mbit/s Expansion module connects at the VC-12 level.
- 34Mbit/s VC-AM / 34M Transmux cards connect at the VC-12 level.
- 34/45Mbit/s Trib Cards connect at the VC-3 level.
- 140Mbit/s Trib Cards connect at the VC-4 level.
- STM-N Cards can connect at VC-4, VC-3, VC-2, and/or VC-12 level.
- STM-N Modules can connect at the VC-4, VC-3, VC-2 and/or VC-12 level.

5.2.1 SDH STM-N to STM-N Port Cross-connections

SMA cross-connection capability is illustrated in Figure 5.1.

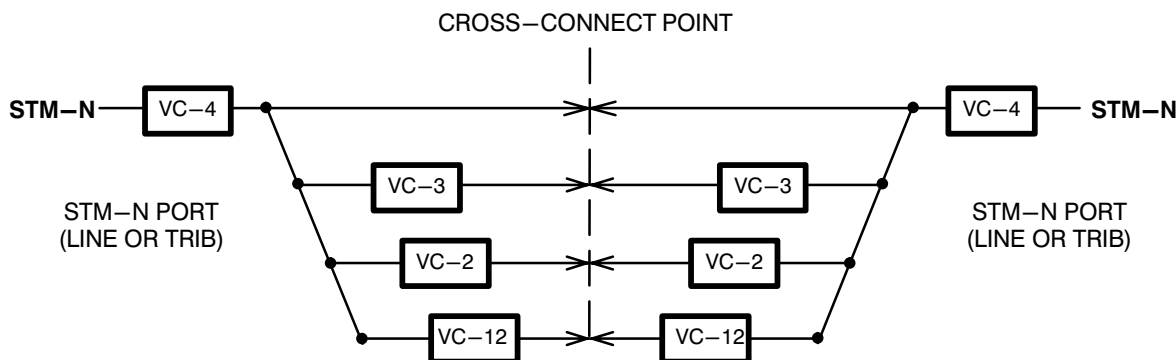


Figure 5.1 STM-N VC Connectivity

Cross-connections can be made for VC-12s, VC-2s, VC-3s and VC-4s. Any allowed mix of VCs can be multiplexed in to the STM-N signal and these VCs can be time switched (Cross-connected) from one timeslot in an incoming STM-N signal to another timeslot in the outgoing STM-N signal (and vice versa for the signal in the opposite direction).

5.2.2 STM-N Port to 1.5/2Mbit/s Trib Port Cross-connections

Figure 5.2 shows the VC connectivity between an STM-N port and a 1.5/2Mbit/s trib port. Only VC-12s can be cross-connected between these two types of cards.

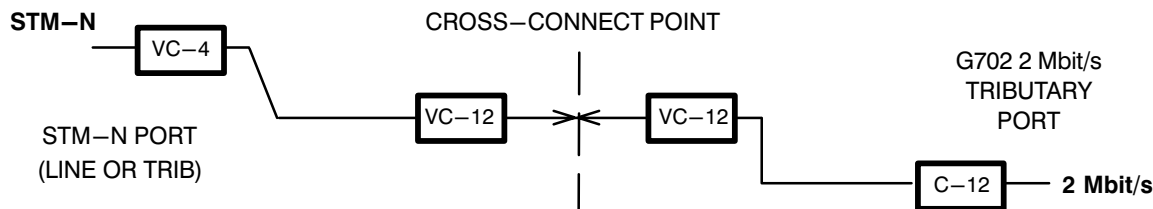


Figure 5.2 VC Connectivity STM-N Port <--> 2Mbit/s Port

5.2.3 1.5/2Mbit/s Trib Port to 1.5/2Mbit/s Trib Port Cross-connections

VC connectivity between 1.5/2Mbit/s plesiochronous ports is shown in Figure 5.3. Only VC-12s can be Cross-connected between these cards.

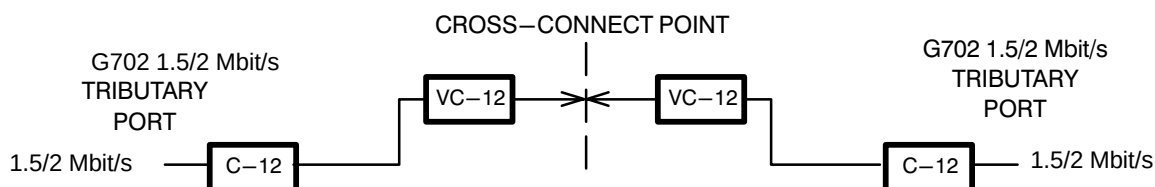


Figure 5.3 VC Connectivity 1.5/2Mbit/s Port <--> 1.5/2Mbit/s Port

5.2.4 STM-N Port to 34/45Mbit/s Trib Port Cross-connections

Figure 5.4 shows the VC connectivity between an STM-N port and a 34/45Mbit/s trib port. Only VC-3s can be Cross-connected between these two types of cards.

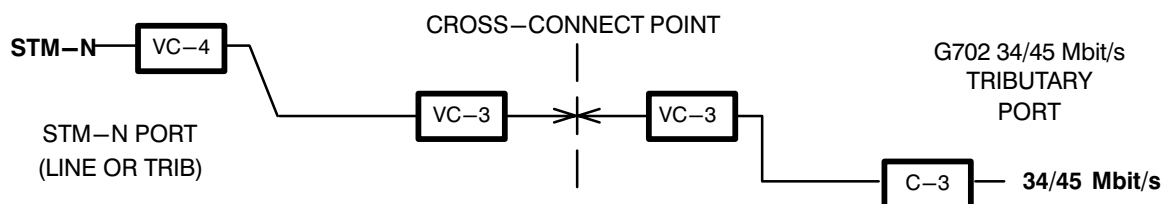


Figure 5.4 VC Connectivity STM-N Port <--> 34/45Mbit/s Port

5.2.5 34/45Mbit/s Trib Port to 34/45Mbit/s Trib Port Cross-connections

VC connectivity between 34/45Mbit/s plesiochronous ports is shown in Figure 5.5. Only VC-3s can be Cross-connected between these cards.

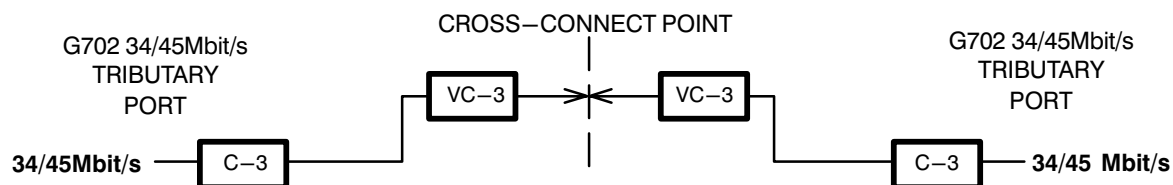


Figure 5.5 VC Connectivity 34/45Mbit/s Port <-> 34/45Mbit/s Port

5.2.6 STM-N Port to 140Mbit/s Trib Port Cross-connections

Figure 5.6 shows the VC connectivity between an STM-N port and a 140Mbit/s trib port. Only VC-4s can be Cross-connected between these two types of cards.

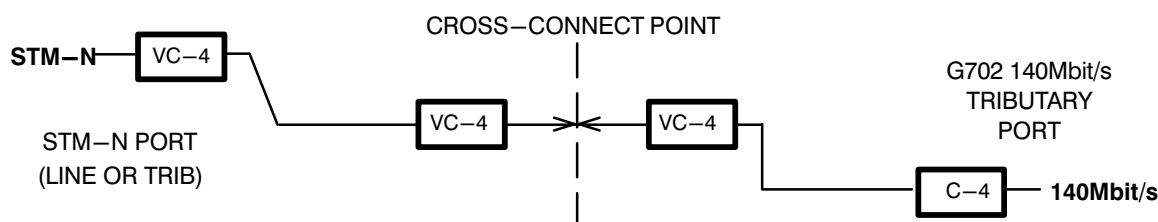


Figure 5.6 VC Connectivity STM-N Port <-> 140Mbit/s Port

5.2.7 140Mbit/s Trib Port to 140Mbit/s Trib Port Cross-connections

VC connectivity between 140Mbit/s plesiochronous ports is shown in Figure 5.7. Only VC-4s can be Cross-connected between these cards.

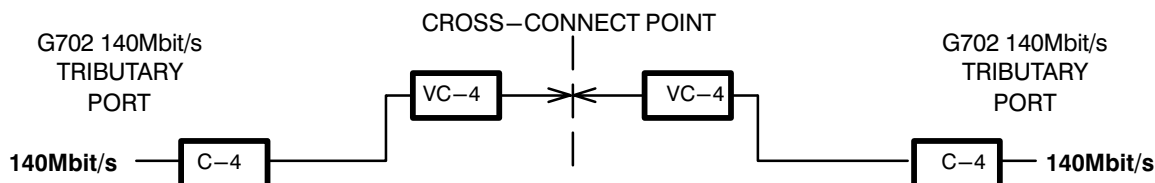


Figure 5.7 VC Connectivity 140Mbit/s Port <-> 140Mbit/s Port

5.3 SMA-1/4CP

5.3.1 Adding Cross Connections

Adding a cross-connection is only allowed between source and destination ports/channels supporting the same traffic type. Part of the validation process ensures that payload capacity exists for a cross-connection to be added.

Note: When used, the ATX card acts as a termination point for the VCs in the SDH domain. However, it does not support any Tributary ports in the SDH domain. This means that tributary input/output port configuration is not configured/supported in the SDH domain.

The ETX card does not terminate the VCs, this is done by the base unit. The ETX card uses the

X.21 traffic signals and as such X.21 port configuration needs to be set up on the base unit when an ETX card is configured.

5.4 SMA-1/4C, SMA-1/4UC AND SMA-1/4 (4+4)(8)

5.4.1 Addition of Higher Order (VC-4) Cross-Connections

VC-4 connections are applicable to the Optical Modules and Switch on the Core card.

Table 5.1: Addition of Higher Order Cross-Connections	
Higher Order Cross-Connection	Processing of VC-4 Signal
STM-N Module <==> STM-N Module	STM-N Module passes all VC-4s through transparently.
STM-N Module <==> 140M or ATA/ATC Trib	Trib card shall terminate / generate the VC-4.
	STM-N Module shall pass the VC-4 through transparently.
STM-N Module <==> STM-N Trib	STM-N Module passes all VC-4s through transparently.

5.4.2 Addition of Lower Order Cross-Connections

Table 5.2: Addition of Lower Order Cross-Connections	
Lower Order Cross-Connections	Processing of Lower Order VC Signal
STM-N Module <==> STM-N Module	STM-N Module passes the LO VC through transparently.
	The LO VC-POH shall not be terminated although it shall be available for protection / performance monitoring.
VC-AM <==> VC-AM/STM-N Module	VC-AM/STM-N Module passes the VC-12 through transparently.
	The VC-12 POH shall not be terminated although it shall be available for protection / performance monitoring.
STM-N Module <==> LOVC Trib	LOVC-trib cards shall terminate / generate the LO VC.
	The STM-N Module shall pass the LO-VC through transparently. The POH shall be available for protection / performance monitoring.

Note: Optical Modules are STM-1 and STM-4 only.

All VC-n are always passed transparently through the Switch function on the Core Card.

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CHAPTER 6: SYNCHRONISATION

6.1 INTRODUCTION

The first part of this chapter describes synchronisation in generic terms. Specific application to SMA–1/4CP and to SMA–1/4c, /uc and SMA–1/4(4+4)(8) are outlined at the end of the chapter.

An SMA has four synchronisation timing areas which are shown in Figure 6.1.

Maintaining accurate synchronisation of the various areas is based on the use of Phase Locked Loop (PLL) oscillators.

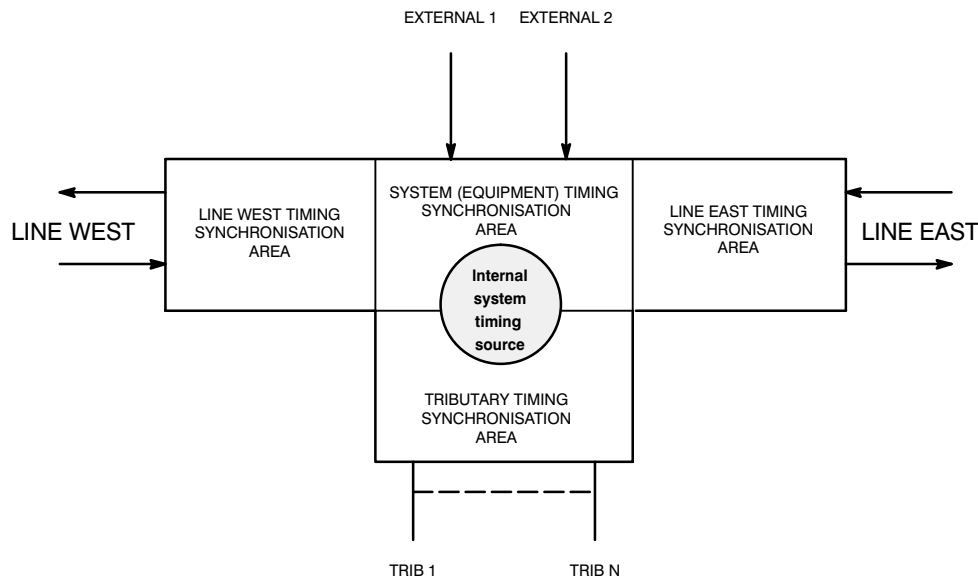


Figure 6.1 SMA–N synchronisation timing areas and timing signal source options.

Timing signals are required for these synchronisation timing areas. The timing signals can be derived from:

- **External sources** – i.e. from a frequency standard via External 1 or 2 inputs or from a Tributary.
- **Line interfaces** – i.e. Line West or Line East.
- **An SMA internal oscillator** (this condition is known as 'freerun' and is also the default condition at commissioning).

Once commissioned, the selection of external or internal source can be altered by the operator. In addition, within certain limits, the various destinations (sinks) of timing signals can be configured independently to accept different externally sourced signals. A detailed description of the setting up procedures is the subject of a dedicated Local Terminal (LCT) operator manual.

6.2 SYNCHRONISATION MODES

An SMA has the following modes of operation:

- **Freerun.** This mode is the default situation supplied by the Mux Controller at the Commissioning stage. When implemented, none of the timing source inputs are used. All PLL's are locked to a highly stable, but free running, synchronisation source (internal oscillator situated on the Link Card section of the Switch Unit).
- **Single Synchronisation Equipment Timing Generation (SETG) mode.** This mode is operator implemented via the Local Terminal (LCT), allowing for the selection of various timing source input(s) for locking the PLL, and is the gateway to further configurations for a number of possible network timing arrangements, together with an overriding quality check. Only one of these arrangements can be used at a given time, but the operator can set up the inoperative feature whilst the multiplexer continues working normally. The new set-up can then be applied (when required) by the operator. This mode of operation is as follows:
 - In the Single SETG mode all the timing sinks are configured together, using the same 38.88MHz equipment clock.
- **Holdover.** This is a standby mode that comes into operation automatically if all timing source inputs fail for a particular PLL it is not operator initiated. In holdover mode a PLL's frequency is held to within close limits of that set by the last used timing source.

6.3 FREE-RUN MODE

In Free-run Mode there are no input or extracted timing signals, synchronisation is derived from a single PLL (on the Switch Unit) configured to run as a stable free-run oscillator. This arrangement is illustrated in Figure 6.2.

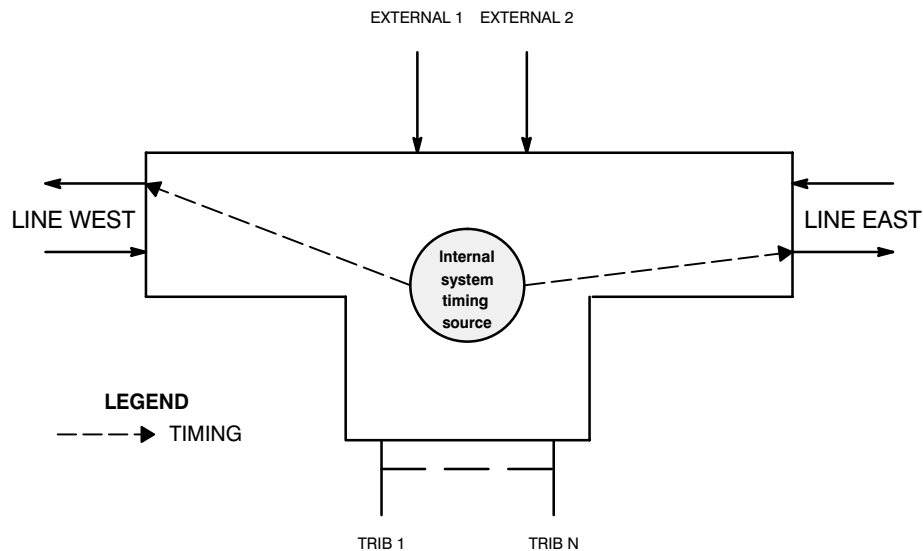


Figure 6.2 Freerun Mode

This mode is applicable when an SMA is used to provide the timing source for a network of SMAs of which it is a part. In this case the slave multiplexers should be set to recovered clock (turnaround mode). This use for network timing is only suitable for SMA networks, for larger applications an external oscillator should be provided and drive the master SMA via an External Sync port. Free-Run is also the default mode, i.e. if an SMA is not configured it will default to Free-Run Mode on power-up. It should also be noted that a programmable Synchronisation Source Marker Byte (SSMB) code is always transmitted in Free-run mode.

6.4 SINGLE SETG TIMING SOURCES

In Single SETG Mode of operation an SMA-N Switch Card can derive timing signals from a choice of seven inputs i.e. different sources as follows:–

- Incoming STM-N Line Port East A & B, STM-N Line Port West A & B.
- A tributary port: either STM-N, 140 Mbit/s, 34/45 Mbit/s or 1.5/2 Mbit/s.
- Two external timing signal ports (1.5/2Mbit/s or 2 MHz).

Selection of timing sources is performed by prioritising the timing sources using the Local Terminal (LCT). The tributary timing source is pre-selected by the LCT operator specifying which tributary card and the port on that card from which tributary timing is to be derived.

One of the two dedicated external timing sources and the tributary source are selected by operator prognostication. The selected External/Tributary timing source is then fed to selectors for the nine timing sinks (Line West A/B, Line East A/B and System Clock), thus reducing the number of simultaneous available sources to five.

In the multiple SETG Mode each timing sink can be configured separately to select one of the five timing sources for synchronisation independently of the other four timing sinks. Configuration is performed by prioritisation of timing sources for each timing sink. This independent configuration of timing sinks allows an SMA–N to be operated using various network timing arrangements. The is for all timing sinks to be configured identically, i.e. from a single source.

In single SETG Mode, all timing sinks are configured together, which means they are configured identically from a single source. This is according to the CCITT/ETSI recommended method.

Prioritisation, i.e. selection, of timing sources is performed at the Local Terminal (LCT). For each timing sink, a priority is allocated to each available source, no two sources being allocated the same priority. The highest priority is allocated to the source that will normally be used. This method of source selection allows for synchronisation continuity in the event of timing source failures.

6.5 SINGLE SETG TIMING MODE CONFIGURATION

When Single SETG mode is set, then the synchronisation architecture can be configured, by prioritisation of timing sources, to support the following timing sync modes:

- Line Timing Mode
- Tributary Timing Mode
- External Timing Mode
- SASE Timing Mode

Note: All the above modes are recommended by CCITT and ETSI.

If Line Timing is used (Figure 6.3), an invalid SSMB code is transmitted on the looped Line output. This is to avoid the creation of further timing loops.

6.5.1 Line Timing Mode

Figure 6.3 illustrates Line Timing. In this mode, timing is recovered from an incoming STM line signal and used to synchronise the corresponding outgoing STM line signal.

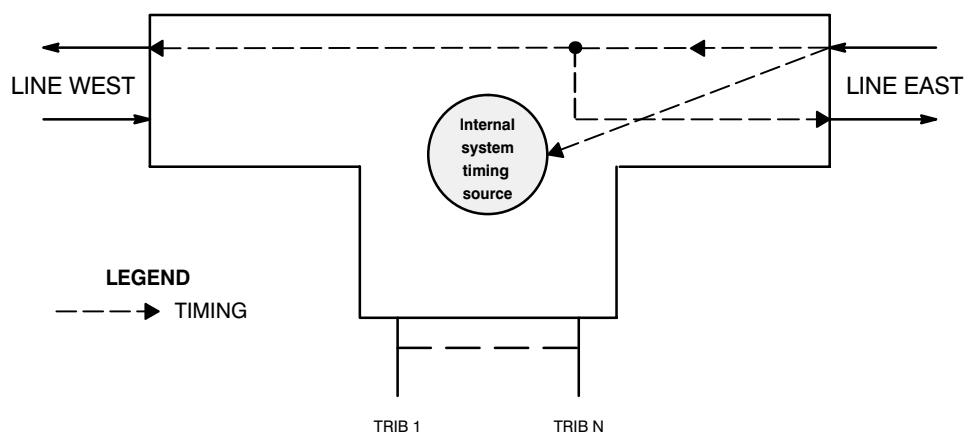


Figure 6.3 Line Timing Mode

6.5.2 Tributary Timing Mode

Figure 6.4 illustrates the Tributary Timing Mode. In this mode, timing is recovered from an incoming tributary channel and used to synchronise the outgoing STM-N line signals.

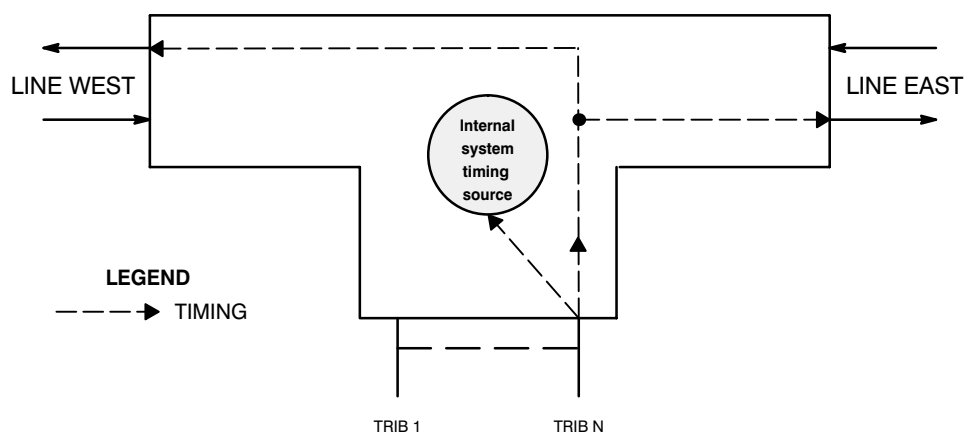


Figure 6.4 Tributary Timing Mode

6.5.3 External Timing Mode

Figure 6.5 illustrates the External Timing Mode. In this mode, timing is derived from any one of two external synchronisation sources (inputs) and used to synchronise the signal transmitted on the STM-N line ports.

Loss of the external signal will cause the SMA to go into Holdover or select another synchronisation source until the preferred external synchronisation source is restore (this is the case for all timing modes with the exception of free-run).

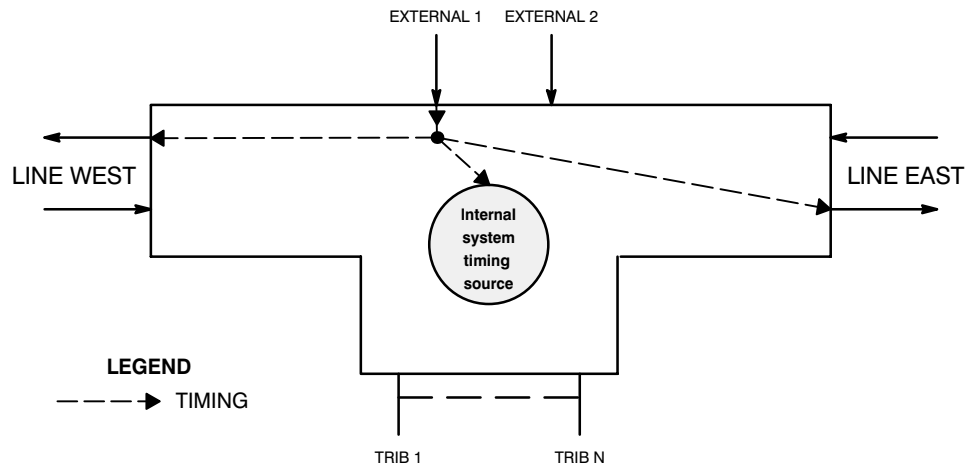


Figure 6.5 External Timing Mode

6.5.4 SASE Timing Mode

Figure 6.6 illustrates SASE Timing (Stand Alone Synchronisation Equipment Timing). This mode is an enhancement of external timing. Timing is recovered from any one of the STM-N line inputs and used to generate an output for external processing. After processing, it is returned as an external timing input that is used to drive all of the traffic timing functions, i.e. STM-N outputs and internal system timing.

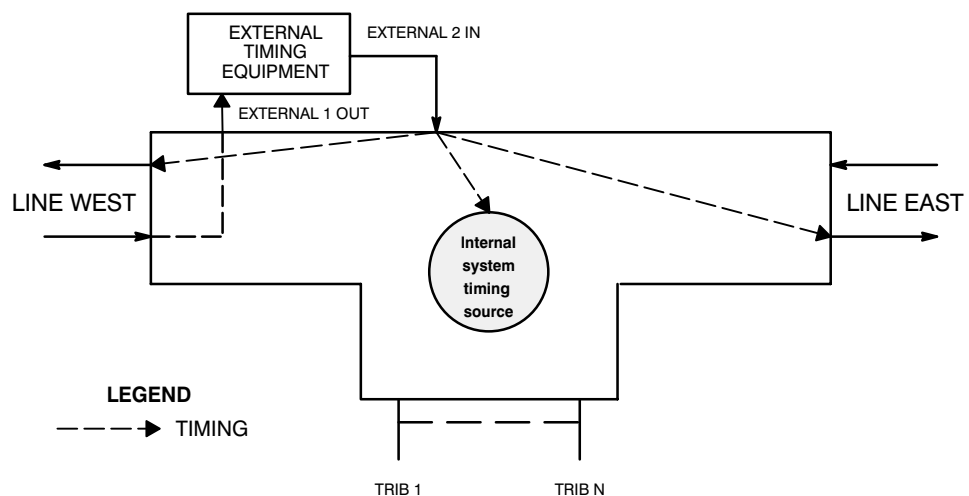


Figure 6.6 Stand Alone Synchronisation Equipment Timing

6.6 SYNCHRONISATION SOURCE SELECTION

The basic continuity assurance scheme is that, if the currently used source fails, another source is automatically selected. If necessary, the process is repeated until all available sources have failed. This basic scheme is refined by incorporation of the following features:

- The sources not currently in use are monitored for failure. If the current source fails, any attempt to change to an already failed alternative is inhibited.
- The Holdover Mode is instituted temporarily on any failure of a currently in use source, or permanently if all available sources fail.
- There is a facility for automatic reversion from a substitute source to a restored, original source. The exact operating rules for this facility are subject to an operator implemented option (paragraph 6.7.4).

6.7 SYNCHRONISATION STATUS MESSAGE BYTE (SSMB)

The Synchronisation Status Message Byte (SSMB) is a byte within the section overhead (SOH) of the STM-N frame. Bits 1–4 of the SSMB are unused, but bits 5–8 carry coded information indicating the quality level of the synchronisation source of the STM-N signal in which the SSMB is carried.

6.7.1 SSMB Mode Enabled

When SSMB operation is enabled the quality level of an STM-N signal source is taken to be as defined by bits 5–8 of that received SSMB.

The SSMB bits 5–8 indicate quality levels between 1 and 16. Default assignment of quality levels and codes are shown in Table 6.1. The code descriptions correspond to G.708 recommendations.

Quality levels and codes can be re-assigned by the operator.

Table 6.1: Default Quality Levels and Codes					
SSMB Code Bits				Quality Level	Description
b5	b6	b7	b8		
0	0	0	0	16	Quality unknown
0	0	0	1	16	Undefined
0	0	1	0	1	Traceable to G811
0	0	1	1	16	Undefined
0	1	0	0	2	Traceable to G812 transit clock
0	1	0	1	16	Undefined
0	1	1	0	16	Undefined

0	1	1	1	16	Undefined
1	0	0	0	3	Traceable to G812 local clock
1	0	0	1	16	Undefined
1	0	1	0	16	Undefined
1	0	1	1	4	Traceable to G813 clock
1	1	0	0	16	Undefined
1	1	0	1	16	Undefined
1	1	1	0	16	Undefined
1	1	1	1	16	Not to be used for synchronisation

The SSMB code bits, extracted from an incoming STM–N signal, after a persistence check, are assigned a quality level by the operator. These quality levels are then utilised to select the source that is to be used. All non STM–N sources are assigned an SSMB quality level by the operator.

When the quality level detected from two separate STM–N signals is the same then the equipment selects the source to be used on the basis of the operator configured priority.

When all sources in the Equipment Destination Priority Table fall below the Minimal Quality Level an alarm is raised (Source Unacceptable).

6.7.2 SSMB Mode Disabled

When SSMB operation is disabled then the equipment will ignore the received SSMB quality level and select the source on the basis of priority. No two sources must be allocated the same priority for the same timing sink.

6.7.3 Holdover Mode

During normal operation, a memory function is continually updated as the PLL tracks its timing source input. If the current timing source fails, the memory locks the PLL to the 'last read' frequency of the failed source. The lock lasts until a new source, or restored original source, is applied.

Depending on the type of signal being generated, in Holdover mode the 2Mbit/s Ext Sync outputs are both disabled (no signal appears on these outputs). On restoration of normal sync operation the outputs are no longer disabled and a signal is re-established.

6.7.4 Reversion Facility

When the SSMB Marker is **enabled**, the basic rules for reversion from an alternative timing source to a restored, previously failed, source is that reversion takes place if any of the available sources quality value changes. If non-revertive mode is configured then reversion only occurs when the quality value of the source currently in use changes.

When the SSMB Marker is **disabled**, the basic rule for reversion from an alternative timing source to a restored, previously failed, source is that reversion takes place if the restored source is of higher priority than the alternative source. If non-revertive mode is configured, then reversion only occurs after the source that is currently in use fails.

In revertive and non-revertive mode, selection of a previously failed source is subject to a delay set by the WTR Period option.

6.8 EXTERNAL SYNC INPUTS AND OUTPUT

Two ports are provided for the input of externally generated timing inputs to an SMA. An SMA can be configured to accept either a 1.5/2Mbit/s HDB3 signal or a 1.5/2MHz signal conforming to G.703 Section 10 at these ports. Bit-rate is configured via the Local Terminal (LCT) as part of the Set Sync Mode operation.

Two ports are provided for the output of a timing signal generated by System Clock from timing sources available to the SMA. The port is configurable to one of a choice of bit-rates via the Local Terminal (LCT) as part of the Set Sync Mode operation.

When all sources in the External Output Priority Table fall below the Minimal Quality Level (SSMB Enabled) set for that particular output, then the external output is disabled and an alarm is raised (Source Unacceptable). The External Output Off State can be configured by the LCT operator, the options are 0V, high impedance and d.c. offset.

When SSMB mode is disabled however, then the External Outputs are disabled when all sources in the External Output priority Table have failed.

6.9 PRIMARY RATE RE-TIMING BUFFERS FOR 2MBIT/S TRIBUTARY CARDS

On specific 2Mbit/s Tributary cards the output ports can support five different options for output synchronisation, i.e.:—

- Normal Timing (Re-timing Mode 1)
- Synchronous Data Channel Timing Buffer (Re-timing Mode 2)
- Plesiochronous Data Channel Timing Buffer (Re-timing Mode 3)
- Synchronous Channel Timing Buffer (Re-timing Mode 4)
- Wander Buffer (Re-timing Mode 5)

After the selection of a specific 2Mbit/s Tributary Card via the Local Terminal (LCT) the re-timing of buffer modes can be effected. These modes permit synchronous and plesiochronous 2Mbit/s transport via the GPT SDH equipment, minimising the usual consequences of pointer adjustments on output wander.

These modes are configurable on a per port basis, although only one mode is possible for any given port at any one time. Operational and network applications for these modes are explained in the following text.

6.9.1 Normal Timing (Re-timing Mode 1)

PDH output timing is derived from the inherent mapping and pointer information to allow the transfer of asynchronous data to pass transparently through the SDH network. It achieves this by way of a 2Mbit/s de-synchroniser which maintains an average fill of an elastic store, the bandwidth of the de-synchroniser is 0.6Hz (normal bandwidth) and 0.15Hz (narrow bandwidth). The response to bit justification is second order and the response to byte justification is third order to further smooth the output response.

Narrow bandwidth mode will change over to normal bandwidth for approximately 10 seconds if an abrupt data rate change threatens to overflow the store.

6.9.2 Synchronous Data Channel Timing Buffer (Re-timing Mode 2)

Under normal working conditions bit/byte justification is unnecessary in a synchronous network. However, under failure conditions some form of justification is required to prevent data slips from occurring, due to an overflow of the elastic store.

A technique exists that utilises re-timing buffers which clock out the primary rate signal using the recovered bearer clock, thus avoiding bit and byte justification.

In the synchronous network depicted in Figure 6.7, Node A maps 2Mbit/s data into an SDH multiplexer synchronised to a locally available network timing reference. Node B de-maps the traffic and feeds it back into the primary rate network. Normally a separate timing 2Mbit/s feed must be supplied to Node B which is free from byte justification. Using re-timing buffers Node B can be synchronised from the 2Mbit/s traffic feeds that carries timing from Node A via the STM-N bearer.

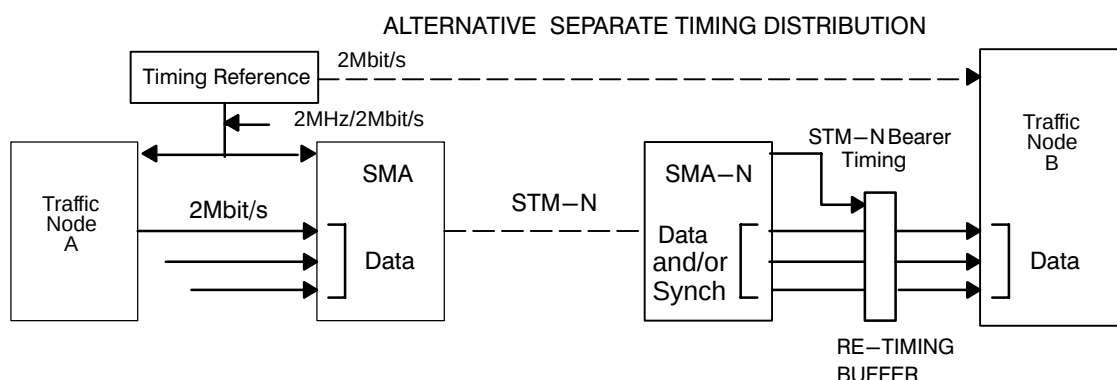


Figure 6.7 Synchronous Network

In Synchronous Data Channel Timing Buffer (Re-timing Mode 2) a 40 micro second buffer is used, whilst re-timing the tributary 2Mbit/s output to the system clock. This option requires that the 2Mbit/s data carried within the network should also be frequency synchronous with the network. If the timing buffer starts to overflow in this mode, due to a synchronisation failure in the SDH path, then a phase leak-out (approx. 5 μ s) will occur. Hysteresis in this leak-out process ensures that as/if the store refills in the opposite direction a minimum of 40 micro seconds must elapse before another leak-out occurs.

6.9.3 Plesiochronous Data Channel Timing Buffer (Re-timing Mode 3)

When a traffic connection across a network is not synchronous with the bearer clock, then the modes mentioned in Paragraphs 6.9.1 and 6.9.2 cannot be used. In this case timing information would normally be carried via a separate timing link on a separate network. Figure 6.8 shows Node Y being synchronised to Node X by this method.

However, the Plesiochronous Data Channel Timing Buffer (Re-timing Mode 3) allows third party timing to be carried in SDH. In this mode the de-synchroniser uses the recovered bearer clock to re-time the 2Mbit/s output. However, the bit de-justification function is activated to correctly de-map a signal which is not synchronous to the SDH network. By using this method a network is capable of carrying independent timing, whilst minimising the effects of byte justifications at the 2Mbit/s output (ie. TU-12 pointer changes are ignored by the de-synchroniser whilst a plesiochronous signal is being transported across the network).

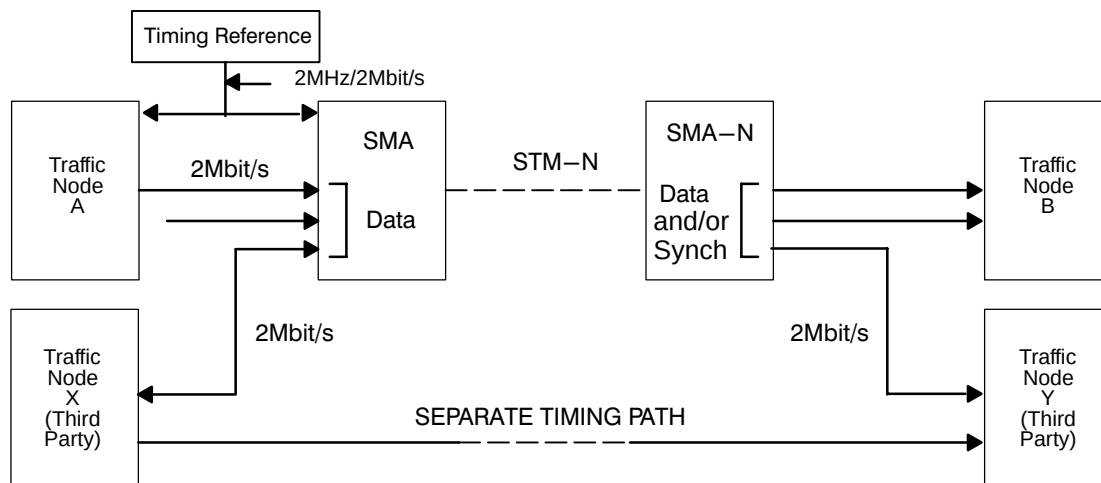


Figure 6.8 Plesiochronous Data On Synchronous Network

When a synchronisation failure occurs in the SDH network the buffer fill will change. If the buffer is ready to overflow, then a phase leak-out of (approx. 5 μ s) would occur. Hysteresis in this leak-out process ensures that as/if the store refills in the opposite direction a minimum of 40 μ s phase slip must occur before another leak-out occurs.

6.9.4 Synchronous Channel Timing Buffer (Re-timing Mode 4)

In Synchronous Channel Timing Buffer (Re-timing Mode 4), operation is almost identical to that explained in Paragraph 6.9.2. The difference is that as the buffer is about to overflow, then rather than a phase leak-out occurring, data is allowed to slip by approximately 5 μ s and a 'Data Slip Event' is reported to the operator. Consequently in this mode, the phase of the 2Mbit/s line output rate would always remain stable, thus permitting its use as a synchronisation link carrying low priority data. This could be considered as a 2Mbit/s version of the 2MHz output timing.

6.9.5 Wander Buffer (Re-timing Mode 5)

When network wander levels exceed the wander tolerances of associated equipments, then an external 40 micro seconds buffer store may be configured in the SMA. (see Figure 6.9).

With Wander Buffer (Re-timing Mode 5) selected operation is similar to that explained previously in paragraph 6.9.4, except that the reference used to clock data out of the SMA is selected from an incoming 2Mbit/s signal.

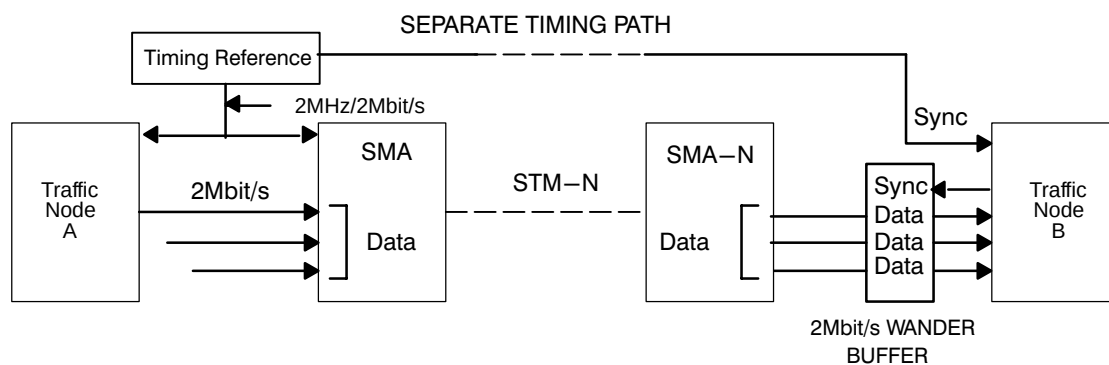


Figure 6.9 Wander Buffers On Synchronous Network

It is assumed that this incoming signal (Node B) is timed from a source that is synchronous to the reference used to time data into the SDH path at Node A. This will usually arrive at Node B over a separate timing path.

6.10 LOCAL TERMINAL OPERATION/CONFIGURATION

Configuration and the setting up of Synchronisation is achieved with the aid of the Local Craft Terminal (LCT) once Commissioning has occurred. A designated operator can:

- Set-up Quality Tables and various Synchronisation modes.
- Configure Priority s for each Synchronisation destination.
- Set-up minimum Quality Thresholds.
- Monitor Alarms for all Synchronisation modes/types of functions.
- Selecting a 2Mbit/s Wander Buffer Timing Source.

- 2Mbit/s Output Buffer Timing Configuration.
- CRC–4 Monitoring.
- 1.5Mbit/s PDH Ports Configuration.

The description of how to set-up synchronisation for this product can be found in a dedicated Local Terminal (LCT) Operator Manual.

6.11 APPLICATION TO SMA–1/4CP

6.11.1 SMA–1/4CP

The timing and synchronisation system for SMA–1/4CP is based on the system as described earlier in this chapter. Differences from this system are as outlined below.

SMA–1/4CP provides a single SETG function but without an external synchronisation input (T3) as illustrated in Figure 6.10.

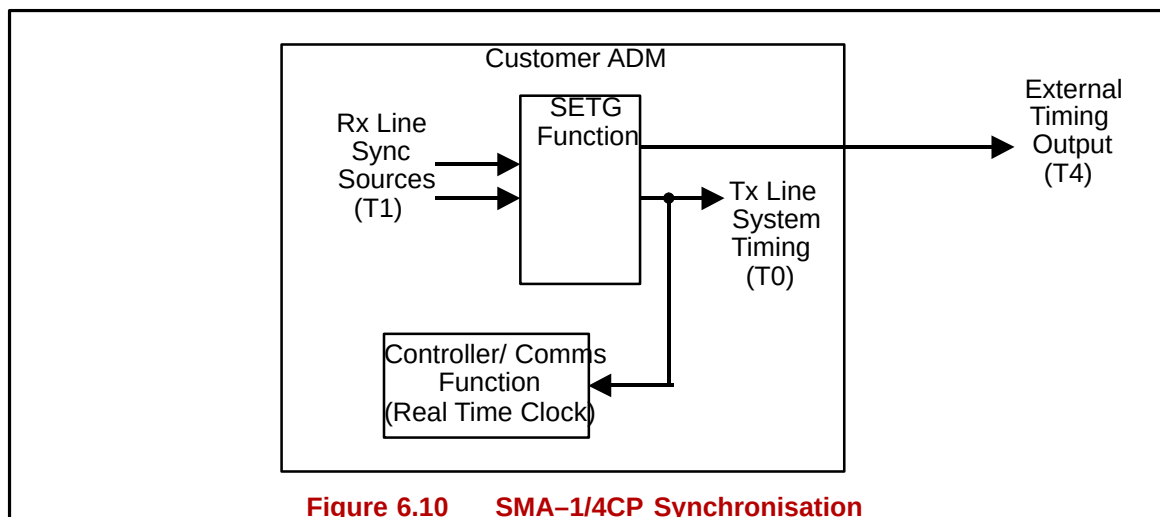


Figure 6.10 SMA–1/4CP Synchronisation

Synchronisation sources for the SMA–1/4CP include STM–N line sources and holdover/freerun clock. The following features are supported:

- Single SETG or Freerun modes
- SSMB enable/disable
- Revertive/non–revertive selection
- SSM quality assignment
- SSMB overwrite on STM–N inputs/outputs
- External output squelch on quality threshold
- System Clock and External Output priority tables
- External Output type configuration (2Mbit/s with/without SSM, 2MHz, 1.5MHz)
- STM–N line traffic

6.11.2 Timing Options

SMA-1/4CP only supports Equipment Freerun and line-timed Single SETG timing options.

6.11.3 Timing Sources

Only line timing sources are supported. With regard to SDH line recovered clock, up to 2 line sources are supported:

- Line East A
- Line West A

6.11.3.1 Nominated Line Source Quality Level

There is a new sync source failure criterion:

- Frequency Error (line/trib)

A Frequency Error condition takes 10 seconds to detect. If any other sync failure criteria occurs the Frequency Error condition clears. At start-up, and when all other failure criteria raised against a sync source clear, the Frequency Error condition remains clear for 10 seconds while the frequency is being measured.

6.11.4 Outputs Synchronised to a Timing Source

SMA-1/4CP supports two synchronisation 'sinks': one sink drives the equipment or system clock (T0) and the other sink drives the external timing output (T4). This is similar to Single SETG mode operation.

6.11.4.1 SDH Line Outputs

All line cards use the system clock and assume the source quality level of the selected system clock source.

6.11.4.2 SDH Line SSMB Timing Marker Generation

"Fast SSMB Transmission" mode is not supported. The only condition where a line function autonomously sets the SSMB value is during card power-up, until the Comms/Controller function has configured the appropriate Tx SSMB.

6.11.4.3 SDH Tributary SSMB Timing Marker Generation

Note that this applies to both the standard STM-1 Expansion unit and the STM-1 ATX Expansion unit.

6.11.4.4 Equipment Clock

On the SMA–1/4CP the equipment clock is used to time all STM–N outputs. The 38.88MHz system traffic clock, distributed to all ‘active’ Expansion units, is used to time standard and ATX STM–1 Expansion unit STM–1 outputs.

6.11.4.5 External Timing Output

There is only one output port supported and only the ‘Equipment output high impedance’ external output off state is used.

6.11.4.6 Timing Buffers for 2Mbit/s Tributary Outputs

The 2Mbit/s timing buffers are also supported on all G.703 outputs.

6.11.5 X.21 Timing Modes

The X.21 traffic ports support the X.21 timing options, on a per port basis. These modes are related to how data is clocked into/out of the network.

6.11.5.1 Master Mode

In this mode, the timing source for the individual X.21 function is the Equipment clock, which can be in Freerun mode, Holdover mode or locked to a line source. Also, the P12 Timing output buffer option should be set to Mode 4 (Synchronisation).

In Master timing source mode, the X.21 function can be configured to any one of the following clock modes:

- S
- Hybrid
- X

6.11.5.2 S Mode (Master)

The “S clock” mode is the default for the SMA–1/4CP as it will be used for most applications. It is supported for applications where the DTE is located close to the DCE.

6.11.5.3 Hybrid Mode (Master)

The Hybrid mode is supported for applications where the DTE is located at a distance from the DCE or if high data rates are used, where clock turn around delays in the DTE may miss clocking the Tx data.

6.11.5.4 X Mode (Master)

The X clock mode is supported for applications where the Extender II is connected to a DCE subtended from another network.

6.11.5.5 Slave

The individual X.21 function is timed from the clock recovered from the incoming 2M signal. The timing of this 2Mbit/s signal is such that it conveys the timing of the far end DCE (whose timing source mode should be set to either “Master” or “Customer X”).

In Slave mode, the X.21 function can be configured to any one of the following clock modes:

- S
- Hybrid
- X

In this mode the P12 timing output buffer option should be set to Mode 3 (Plesiochronous).

6.11.5.6 S Mode (Slave)

The transmit and Receive data paths at the X.21 interface are both timed from the internal S clock which has been sourced from the clock recovered from the network. This clock is also used to clock the transmit and receive data paths at the network interface.

6.11.5.7 Hybrid Mode (Slave)

The S clock used to time the receive data path at the X.21 interface is sourced from the clock recovered from the network, which is also used to clock data at the network interface.

The transmit path at the X.21 interface is clocked in by the X clock, which has been sourced from the DTE turning the S clock round.

6.11.5.8 X Mode (Slave)

The Transmit and Receive data paths at the X.21 interface are both timed from an X clock provided by the Local DTE. It is assumed that the X clock is externally connected to the SDH network clock.

The data paths (Tx and Rx) at the network interface are clocked by the clock recovered from the network. The recovered clock is also used to provide S.

6.11.5.9 Customer X

A third timing mode is available when the X-clock mode is configured. For this timing mode, the individual X.21 function is timed from the incoming clock from the DTE, presented on the X circuit of the X.21. interface. Justification takes place (P12 function) to allow the 2M signal generated by the X.21 function to be mapped into the SDH domain.

Note: In Customer X mode only, in the event of X Clock fail, the X.21 PLL will freerun.

In the Customer X mode, the X.21 function can be configured to any one of the following clock modes:

- Hybrid
- X

In this mode the P12 Timing output buffer should be set to Mode 3 (Plesiochronous).

6.11.5.10 Hybrid Mode (Customer X)

The Local DTE provides the source clock, which is presented onto the X circuit. This clock is used to time the transmit data path at the X.21 interface and the data path into the network.

6.11.5.11 X Mode (Customer X)

The Local DTE provides the source clock, which is presented onto the X circuit. This clock is used to time the transmit and receive data path at the X.21 interface. The X clock is also used to clock the transmit data path at the network interface. As the other end is in Slave mode, the X clock is recovered and turned around and gets presented on the S circuit at the local DCE.

6.11.6 Internal Oscillator

The SMA–1/4CP implements Holdover and Freerun functions.

The holdover function is only supported by the system clock timing sink on the Core card. A mechanism exists to cause the System PLL to enter/exit holdover mode when an out-of-range frequency source is selected.

6.11.7 Synchronisation Architecture

The selection of timing source is performed on the Base unit and passed to all other Expansion units and the external timing output. Recovered Line clocks from the TSHOPP function are fed to the Sync function by internal SCP connections.

6.11.7.1 Base Unit

The Base unit contains the switch, sync and line card functions. Two selectors are available for the equipment clock and external timing output clock sinks and each associated PLL has a holdover function.

6.11.7.2 Timing Inputs

Each Base unit accepts two from the on-card line modules, Line E and Line W.

A "Line Sync Source Fail" alarm is raised when loss of clock is detected by the Sync function from the TSHOPP function in the SCP ASIC. There are 2 alarms in total, one for each line interface.

Frequency monitoring is performed at the inputs to the Core card and used to generate “Frequency Error” alarms.

Whenever a “Sync Source Fail” alarm is raised against a source the “Frequency Error” alarm is cleared. When a “Sync Source Fail” alarm clears consecutive 10 second frequency measurements begin. When a 10 second count matures a Frequency Error alarm is raised or cleared.

6.11.7.3 External Timing Output

A PLL after the external output selector is included to generate a 2048kHz clock and provide an output in the absence of source to this selector. The PLL enters holdover mode if loss of transitions is detected at the card input. If no transitions are detected for greater than 10 seconds the output is inhibited autonomously by the on-card firmware. This autonomous inhibit is removed as soon as transitions are again detected.

6.11.8 Synchronisation Configuration on Reset

The following default configuration occurs for each card on power-up of the SMA-1/4CP Base unit:

- The Comms/Controller function restores the configuration contained in NV memory on the SMC. Until the configuration is restored or before the equipment is declared operative the Comms/Controller function takes no action and individual traffic function power up states will persist.
- During power up of the Base unit traffic function the microcontroller disables all clock sink outputs and the equipment clock will select freerun. The external timing output is disabled in tristate mode. The card then awaits configuration by the Comms/Controller function.
- All SDH Expansion units will power up in on-card freerun mode. The “Do Not Use For Synchronisation” SSMB timing marker code is then transmitted. The unit then awaits configuration by the Comms/Controller function.

6.11.9 Alarms

Note that SMA-1/4CP has Frequency Error alarms.

6.12 APPLICATION TO SMA-1/4C, SMA-1/4UC AND SMA-1/4(4+4)(8)

SMA-1/4c and SMA-1/4(4+4)(8) provide a single SETG function, and external synchronisation inputs (T3) and outputs (T4) are supported. The SETG function selects between line sources, tributary card sources, external timing input sources and internal holdover.

The SETG function is protected. The master SETG function drives the external timing output signals.

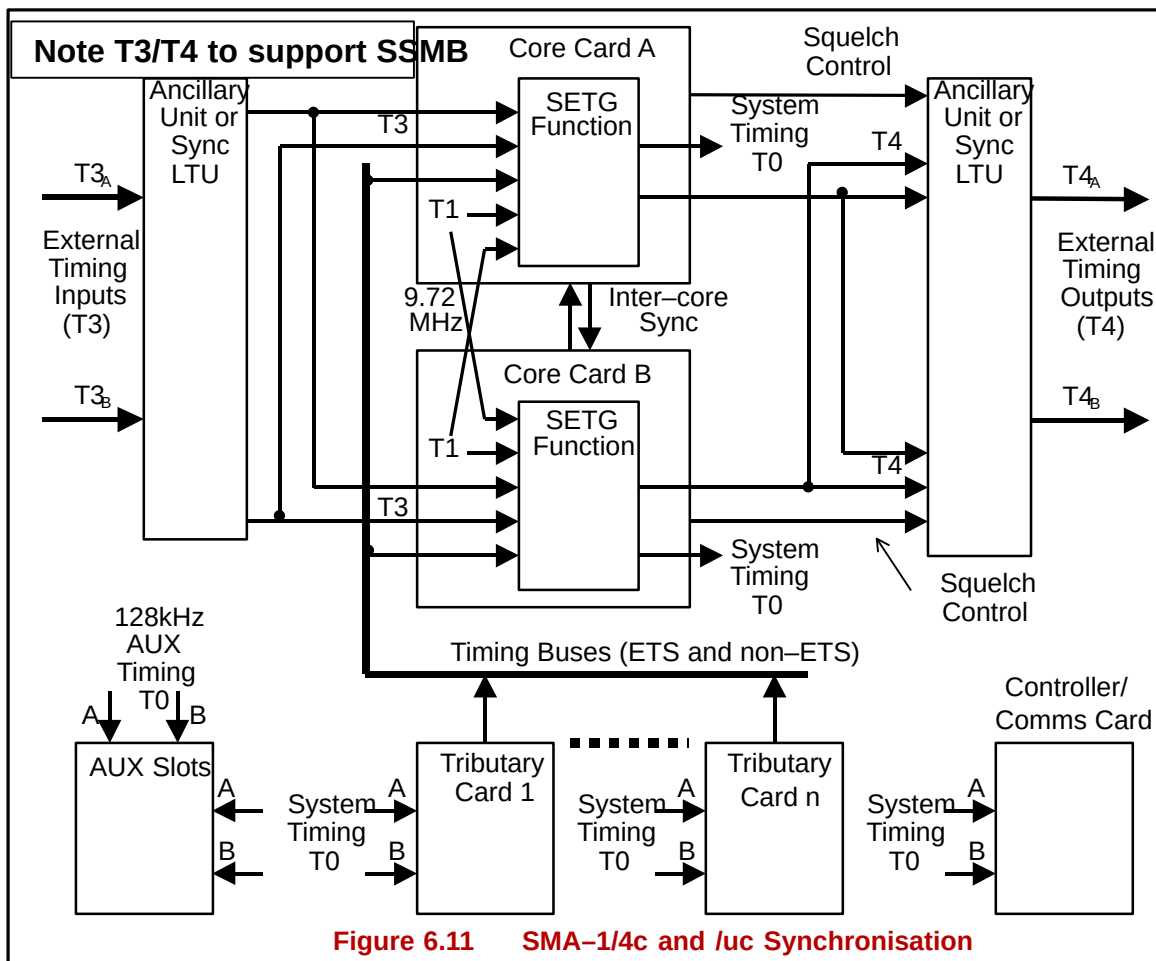
An ETS tributary timing bus is provided to supply tributary timing to the Core card for synchronising system timing (T0). SDH tributary cards are also connected to the non-ETS tributary timing bus to provide direct synchronisation of the external timing outputs.

Each line timing source on the Core cards is passed to the protection Core card as a 9.72MHz clock signal. This allows the SETG selector to accommodate MSP protected lines as separate synchronisation sources.

Synchronisation sources for SMA-1/4c/uc and SMA-1/4(4+4)(8) include STM-N line sources, all tributary synchronisation sources supported on SMA Series 3, External Timing inputs and holdover/freerun clock. The following features are supported:

- Single SETG or Freerun modes.
- SSMB enable/disable.
- Revertive/non-revertive selection.
- SSM quality assignment.
- SSMB overwrite on STM-N inputs/outputs.
- External output squelch on quality threshold.
- Ext/Trib sources, System Clock and External Output priority tables.
- External Output type configuration (2Mbit/s with/without SSM, 2MHz, 1.5MHz).
- External Input type configuration (2Mbit/s with/without SSM, 1.5Mbit/s, 2MHz, 1.5MHz).
- Synchronisation function protection (using duplicated core cards).

When using synchronisation protection the master Core always provides the external output synchronisation source.



Note: The figure shows SMA-1/4c/uc synchronisation. For SMA-1/4(4+4)(8), the figure would be the same, but with an increased number of tributary cards connected to the timing buses.

6.12.1 Timing Options

SMA-1/4c, /uc and SMA-1/4(4+4)(8) support the Equipment Freerun and Single SETG timing options.

6.12.2 Timing Sources

With regard to SDH Line recovered clock, up to 4 line sources are supported:

- Line East A (from Core card A)
- Line West A (from Core card A)
- Line East B (from Core card B, when fitted)
- Line West B (from Core card B, when fitted)

6.12.2.1 Nominated Line Source Quality Level

There is a new sync source failure criterion:

- Frequency Error (line/trib)

A Frequency Error condition takes 10 seconds to detect. If any other sync failure criteria occurs the Frequency Error condition clears. At start-up, and when all other failure criteria raised against a sync source clear, the Frequency Error condition remains clear for 10 seconds while the frequency is being measured.

6.12.3 Tributary Recovered Clock

Any one of the following tributary sources may be used to supply the ETS timing bus (System Timing):

- 1.5/2M G.703 Tributary port
- 2M X.21 Tributary port (future release)
- 34/45M Tributary port
- 140M Tributary port
- STM-1 Tributary port
- Dual-port STM-1 Tributary port
- Quad STM-1 (SMA1/4c and SMA-1/4uc only)
- 34/45M ATA/ATC port
- STM-1 ATA/ATC port

Any one of the following tributary sources may be used to supply the non-ETS timing bus (External Output Timing):

- STM-1 Tributary port
- Dual-port STM-1 Tributary port
- Quad STM-1 (SMA1/4c only)
- 34/45M ATA/ATC port
- STM-1 ATA/ATC port

All the above tributary sources have an additional sync source failure criterion of "Frequency Error" as indicated in the previous section.

6.12.4 External Sources

Up to two external sources may be used to supply the ETS timing bus (System Timing). The format for these inputs is common to both inputs and may be selected from one of the following types:

- 2.048Mbit/s G.703 signal
- 2.048MHz signal conforming to G.703
- 2.048Mbit/s G.703, G.704 framed signal with SSM

- 2.048Mbit/s G.703, G.704 framed signal without SSM
- 1.544Mbit/s signal conforming to G.703
- 1.544MHz signal similar to G.703

6.12.5 Nominated External Source Quality Level

There is a new sync source failure criterion – Frequency Error – as for nominated internal source.

6.12.6 Outputs Synchronised to a Timing Source

SMA–1/4c, /uc and SMA–1/4(4+4)(8) support two synchronisation ‘sinks’: one sink drives the equipment or system clock (T0) and the other sink drives the external timing output (T4). This is similar to Single SETG mode operation.

6.12.6.1 SDH Line Outputs

All line cards use the system clock and assume the source quality level of the selected system clock source.

6.12.6.2 SDH Line SSMB Timing Marker Generation

The only condition where a line function autonomously sets the SSMB value is during card power–up, until the Comms/Controller card has configured the appropriate Tx SSMB.

6.12.6.3 Equipment Clock

The equipment clock is used to time all STM–N outputs. The equipment clock on each Core card is used to time the line outputs on that card. The 38.88MHz system traffic clock, distributed to all tributary cards, is used to time STM–N tributary outputs.

6.12.6.4 External Timing Outputs

The two external timing outputs on the Core card are always configured identically. If a protected Core card is fitted then the external timing outputs are protected with only the master Core card driving the outputs.

6.12.6.5 Timing Buffers for 2Mbit/s Tributary Outputs

The 2Mbit/s timing buffers are also supported by the P12 ASIC on the Core card.

6.12.7 Internal Oscillator

SMA–1/4c, /uc and SMA–1/4(4+4)(8) implement Holdover and Freerun functions.

The holdover function is only supported by the system clock timing sink on the Core card. If protected Core cards are fitted the slave card normally locks to the master Core card when in holdover mode. However, when a Core card protection switch occurs both Core cards temporarily operate in autonomous holdover mode.

A mechanism exists to cause the System PLL to enter/exit holdover mode when an out-of-range frequency source is selected.

6.12.8 Synchronisation Architecture

The selection of timing source is performed on the Core card and passed to all other cards and the external timing outputs. Recovered Line clocks are fed to the Core cards by intra-card and inter-card connections. Up to 3 tributary cards (SMA-1/4c/uc) or 8 tributary cards (SMA-1/4(8)) interface to the Core cards to supply recovered tributary timing via timing busses, TB1 and TB2. TB1 (also called the ETS bus) is used to pass a single selected PDH/SDH tributary source to the Core card for use as an equipment clock source. The P12 ASIC on the Core is able to supply a clock onto TB1. The P12 supplies Core LTU traffic timing sources on the SMA-1/4c and protection traffic timing sources on the SMA-1/4(4+4)(8). TB2 (also called the non-ETS bus) is used to pass a single selected SDH tributary source to the Core card for use as an external output clock source. The selected equipment clock source is fed to all cards via traffic clocks.

The external timing input and output connections exist between the timing interface LTUs and the Core card.

Firmware design incorporates A/B mappings such that when a core card is fitted in both the A and B Core card slots the correct A/B designations will be reported to the Comms/Controller card (i.e. Core card A will report 'A' ASIC ports to the Comms/Controller card as 'A' interfaces; Core card B will report 'A' ASIC ports to the Comms/Controller card as 'B' interfaces; and vice-versa).

6.12.8.1 Core Card

The Core card contains the switch, sync and line card functions as shown in Figure 4.2. Two selectors are available for the equipment clock and external timing output clock sinks and each associated PLL has a holdover function. A 9.72MHz PLL is used to 'pre-select' the Ext/Trib source for the equipment clock and external timing output sinks.

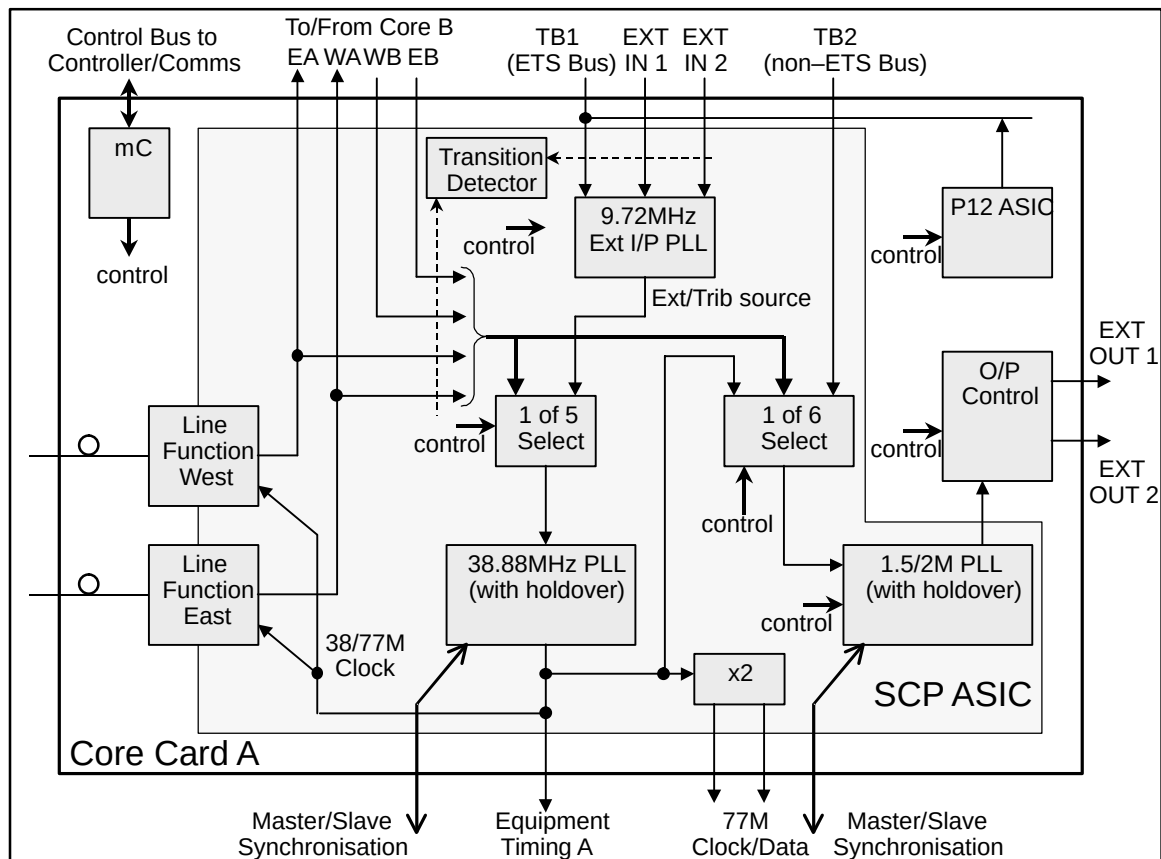


Figure 6.12 Core Card and Synchronisation

6.12.8.2 Timing Inputs

Each Core card accepts four line inputs: two from the on-card line modules (e.g. Line EA and Line WA) and two from the other Core card (e.g. Line EB and Line WB). The on-card recovered line clocks are also passed to the other Core card. Two external inputs (EXT IN 1 and EXT IN 2) and two tributary timing bus inputs (TB1 and TB2) are also supported.

A "Line Sync Source Fail" alarm is raised when loss of clock occurs from either on-card or off-card line modules. There are 4 alarms in total, one for each line interface. A loss of the timing bus clocks raises a "Trib Sync. Source Fail" alarm for TB1 or a "SASE Sync. Source Fail" alarm for TB2 if no transitions at 128kHz are detected. A loss of external timing inputs raises an "External Sync Source Fail" alarm if a loss of signal condition is detected.

Frequency monitoring is performed at the inputs to the Core card and used to generate "Frequency Error" alarms. The SCP ASIC provides counters that the firmware reads to determine the accuracy of the sync sources.

Whenever a "Sync Source Fail" alarm is raised against a source the "Frequency Error" alarm is cleared. When a "Sync Source Fail" alarm clears consecutive 10 second frequency measurements begin. When a 10 second count matures a Frequency Error alarm is raised or cleared.

Frequency calculations occur independent to source selection. This means that re-selection messages from the Comms/Controller card can be acted on immediately as frequency measurement will already have been made in the previous 10 seconds.

6.12.8.3 Equipment (38MHz) Clock Sink

The Core Card generates a 38.88MHz equipment clock (and 77.76MHz clock for dual rate STM-1 tributary interfaces) which is used by the traffic interfaces to the Core Card and by the Tributary Card and Line modules to derive STM-N output timing.

The equipment clock enters holdover mode if loss of clock input is detected on the selected input. The equipment clock also enters holdover mode if a Frequency Error condition is detected on the selected input for a period of greater than 10 seconds. If a tributary or external source is selected via the 9.72MHz PLL then the Core Card ensures that a loss of input causes the equipment clock to enter holdover mode.

The microcontroller is also capable of pre-loading the nominal frequency of the PLL to allow provision of equipment freerun mode.

Two of the unused Line PLLs in the Sync ASIC are used to monitor the System Clock output's frequency. When the system clock frequency exceeds the 'on' threshold (Table 4.3) the "System PLL Out-Of-Limits" alarm shall be raised and the System PLL shall be forced into holdover by the Core Card firmware. When the system clock frequency drops below the 'off' threshold (Table 6.2) for more than 20s, the "System PLL Out-Of-Limits" alarm is cleared and the System PLL exits holdover autonomously by the Core Card firmware. This mechanism is independent to the frequency measurement on sources. The holdover on/off thresholds are given in Table 6.2.

Table 6.2: On/Off Thresholds for System PLL Out-of-Limits and System Holdover		
	'on' threshold (enter holdover)	'off' threshold (exit holdover)
Frequency	±18.6 ppm for >8ms	±18.0 ppm for >20s

Synchronisation connections between core cards support a protection mechanism, which allows one Core Card to fail and be replaced, while the synchronisation function is maintained by the other. The slave Core Card locks its equipment clock to the master such that the difference in output phases between cards is less than 10ns. If the slave card fails to detect a 'companion' equipment clock from the master then the equipment clock enters holdover mode.

The core cards re-clock the data from/to the off-card switch to/from the on-card TSHOPP function respectively.

6.12.8.4 External Timing Output

A PLL after the external output selector is included to generate a 1.544/2048kHz clock and provide an output in the absence of source to this selector. The PLL enters holdover mode if loss of transitions is detected at the card input. If no transitions are detected for greater than 10 seconds the output is inhibited autonomously by the on-card firmware to the off state. This autonomous inhibit is removed as soon as transitions are again detected.

6.12.8.5 STM–N Bearer Timing

The line functions use the 38.88MHz equipment clock (as used by STM–1 tributary cards) to generate STM–N transmit line timing using a rate multiplying PLL with a wide jitter bandwidth.

Because the inter–card line traffic interfaces are re–timed by the on–card system clock, payload errors will be generated when the core cards are un–synchronised, while the outgoing VC–4 and SOH appear fault–free. To compensate for this situation, the protection subsystem inserts MS–AIS (K2) and VC–4 payload AIS for up to 50ms into the line interfaces on the Core Card which is becoming a slave.

6.12.8.6 STM–N Clock Recovery

The recovered STM–N clock is passed to the Sync function in the SCP ASIC at a rate of 9.72MHz. A Core Card crossover connection ensures that both core cards can detect all recovered line clocks. For any of the input signal failure criteria the signal to the Sync function is disabled by the TSHOPP function within 10ms of the causing event. This is the method used to signal clock failure between the TSHOPP function and the Sync function in the SCP ASIC.

6.12.8.7 SDH Tributary Cards

Note that the Fast SSMB Quality Threshold mechanism and Line Sink Holdover flag signalling may still be implemented for compatibility with Series 3 SMAs but are ignored by the Sync function in the Series 4 SCP ASIC.

6.12.9 Configuration

6.12.9.1 Priority Table Options

In "Normal" mode, two priority tables can be configured; one for equipment clock sink and one for external output sink. These tables correspond to the two clock sinks. Assigning a clock source to a priority table defines it as a nominated source. The entries may be chosen from any of the sources listed below:

Equipment Clock sink priority table options:

- SDH line recovered clock – West A
- SDH line recovered clock – West B
- SDH line recovered clock – East A
- SDH line recovered clock – East B
- Ext/Trib clock

External Output sink priority table options:

- SDH line recovered clock – West A
- SDH line recovered clock – West B
- SDH line recovered clock – East A

- SDH line recovered clock – East B
- Timing bus 2 clock
- Equipment clock

Only configured cards may be selected as timing sources in the priority tables

Defaults: External Output Sink Priority Table:

- Equipment Clock = "1"
- All other sources = "none"

Equipment Clock Sink Priority Table:

- All sources = "none"

6.12.10 Synchronisation Configuration on Reset

The following default configuration occurs for each card on power-up of the shelf or on insertion of an equipment card into a powered-up shelf:

- The Comms/Controller Card restores the configuration contained in NV memory on the SMC. Until the configuration is restored or before the equipment is declared operative the Comms/Controller Card takes no action and individual card power up states will persist. During power up of the core card(s) the microcontroller disables all clock sink outputs and the equipment clock will select freerun. The external timing outputs are disabled in tristate mode. The card then awaits configuration by the Comms/Controller Card.
- All SDH tributary cards will power up in on-card freerun mode. Timing bus outputs are also disabled and the "Do Not Use For Synchronisation" SSMB timing marker code is transmitted. The card then awaits configuration by the Comms/Controller Card.
- The PDH line and tributary cards power up with timing bus outputs disabled. The card then awaits configuration by the Comms/Controller Card.

6.12.11 Alarms

Note that SMA-1/4c/uc and SMA-1/4(4+4)(8) have Frequency Error alarms.

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CHAPTER 7: PROTECTION



WARNING

In order to avoid traffic hits during maintenance periods when traffic cards (Core cards, tributary cards) are inserted or removed from the equipment shelf, the operator must first apply a Force Core Protection switch to the current worker card. After maintenance has been carried out, the Core card protection can be returned to the required default state.

7.1 INTRODUCTION

The first part of this chapter describes different forms of protection that can be incorporated in the SMA series covered by this manual. The second part of the chapter illustrates various protection options for SMA-1/4CP, SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4), and SMA-1/4(8).

Protection is applied to overcome traffic vulnerability to equipment failure, e.g. card or path failure. For example, Figure 7.1 shows the various areas where protection may be applied to a SMA-n multiplexer.

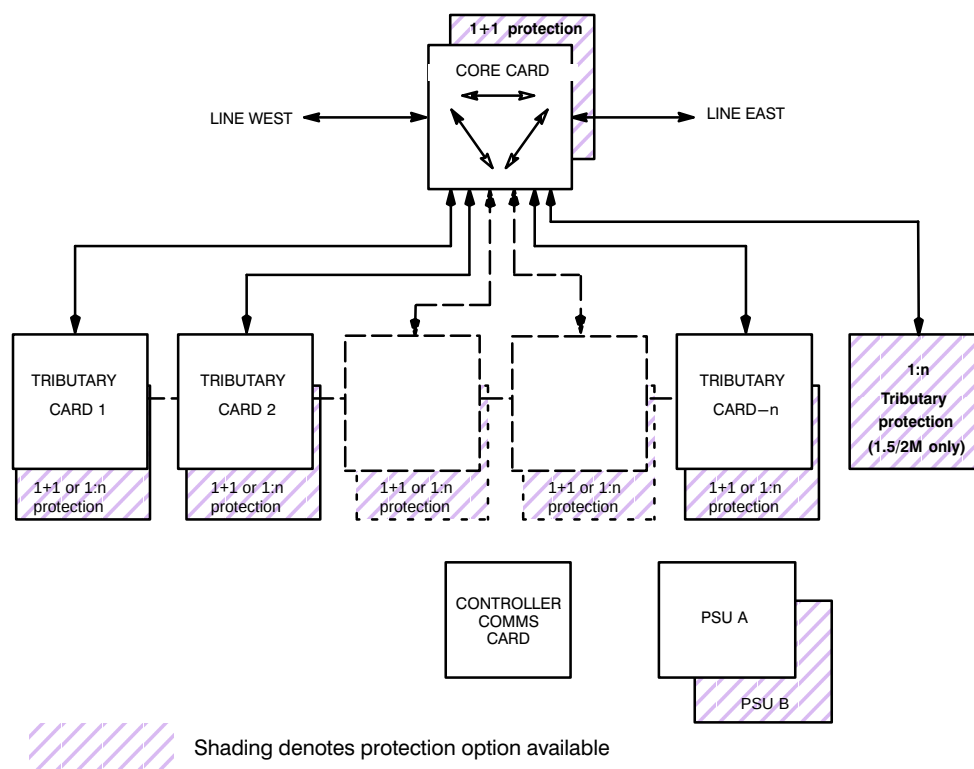


Figure 7.1 SMA-n Protection options

Note: 1. Note that Line and Switch functions are contained within the Core Card.

Note: 2. 1:n Tributary protection (1.5/2M only) is applicable only to SMA–1/4c/uc (core trib protects on SMA–1/4

Some Protection options are designed to protect against failure of equipment external to the multiplexer (eg. TU protection) and hence are intended to provide enhanced availability for complete end-to-end paths in a network. Other options are designed for increasing the availability of signal paths within the SMA equipment itself.

Some protection options are not applicable to all of the SMAs covered in this manual, while other may involve restrictions for differences in operation.

Following is a summary of the types of protection available:–

- a) 1+1 (MSP) STM–n Multiplex Section Protection.
- b) 1+1 (MSP) 34M VCAM Protection.
- c) Intra–card and Inter–card MSP Protection (Dual STM–1 Electrical, only).
- d) Sub–network Connection (SNC) Protection.
- e) Switch Plane Protection.
- f) 1:N 1.5/2Mbit/s Tributary Card Protection.
- g) 1:N 34/45/140Mbit/s Tributary, 34Mbit/s Transmux, 34 Mbit/s VC–AM Card Protection.
- h) 1:1 SDH Extender Card Protection.
- i) 1+1 PDH Tributary Port Protection.
- j) PSU Protection.

In summary, SMA Series 4 protection arrangements are as follows:

- SMA–1/4CP does not support Core Card or Expansion Module protection.
- SMA–1/4CP does support MSP, SNCP and Port Protection.
- SMA–1/4c/uc and SMA–1/4(4+4)(8) support MSP, SNC all VC–n, Port and Card Protection.

Traffic and Card protection for the Series 4 products is summarised in the following table:

Table 7.1: Series 4 Protection			
	SMA–1/4CP	SMA–1/4c and /uc	SMA–1/4(4+4)(8)

Traffic Protection	MSP STM-1/STM-4 SNC PDH Port	MSP STM-1/STM-4 SNC PDH Port	MSP STM-1/STM-4 SNC PDH Port	MSP STM-1/STM-4 SNC 1+1 PDH Port
Card Protection	None	Duplicated centralised PSUs provide trib card supplies. Comms/Controller and Core Cards have dedicated PSUs. 1+1 Core Card Protection. 1:N Tributary Card Protection	Power LTU two way power supplier circuits. 1+1 Core Card Protection. 1:N Tributary Card Protection	Duplicated centralised PSUs provide trib card supplies. Controller/Comms and Core Cards have dedicated PSUs. 1+1 Core Card Protection. 2M:1:N Tributary Card Protection

MULTIPLEX SECTION PROTECTION (MSP)

7.2 1+1 STM-N MULTIPLEX SECTION PROTECTION (MSP)

Multiplexer Section Protection provides a means of protecting against failure of the components of STM-N links including fibres, regenerators and the electrical/optical transducers at the ends of a multiplexer section.

Whilst MSP is principally an 'external' protection mechanism, it also inherently provides a method of protecting against an SMA 'internal' failure of a STM-n unit and its associated backplane interfaces.

The 1+1 (MSP) STM-n Line Protection scheme provides protection for a complete STM-n point to point link between equipments, including the individual STM-n cards. It is also applicable to STM-n cards in Tributary slots in the same pairs as PDH 1+1 protection. Implementation of this scheme for STM-n Line or Trib Cards requires duplication in both East and West directions of transmission.

Note: EOW operation, however, will be lost.

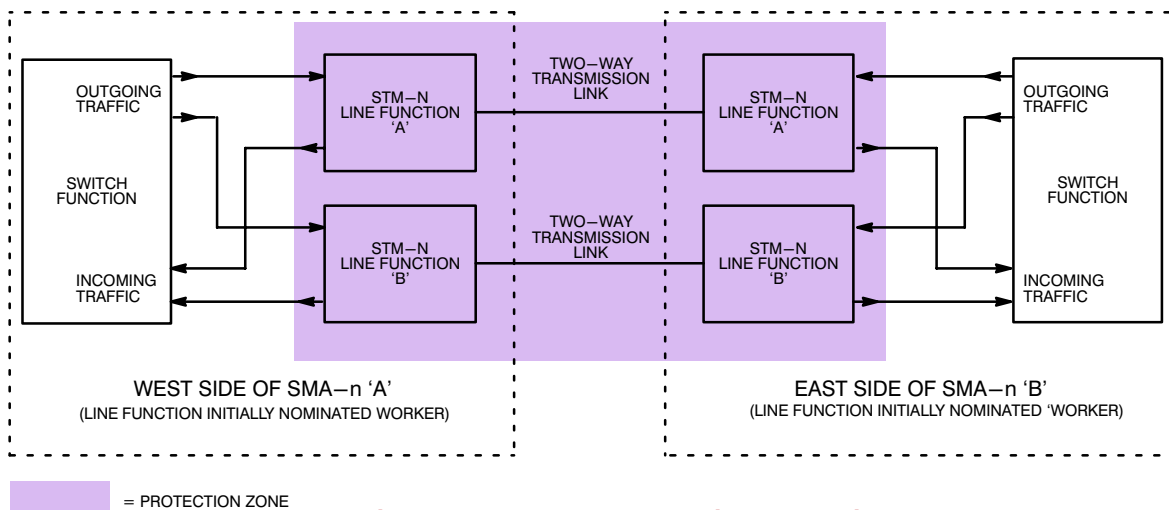


Figure 7.2 1+1 STM-1 Line Protection

Figure 7.2 gives an example of 1+1 STM-n Line protection. At both ends of a point to point section the STM-n Line Cards are duplicated, one of each pair designated as the worker card and the other for protection.

The worker card at the 'near end' is connected by a dedicated line to the worker card at the far end. Correspondingly the protection card is connected by a separate dedicated line to the protection card at the far end. Thus full duplication of Traffic paths is provided.

At each transmitting end, the Switch function routes outgoing traffic to the worker and the protection cards simultaneously.

The receiving worker and protection pair pass the recovered line signals to their associated Switch function, together with supervisory information carried by the Section Overhead. The Switch function assesses, from the supervisory information, which path is providing the best quality service and selects the appropriate STM-n Line Card. Traffic is taken only from the selected card, a mix from both cards is not possible.

7.2.1 Operation

The protection switching is normally automatic when a deterioration in the nominated Worker path is detected, i.e. autonomous mode, however it can be manually controlled or forced, change-over being initiated by operator intervention from the Element Manager or Local Terminal (LCT). The MSP Protection State priorities are shown in Table 7.2.

Table 7.2: MSP Protection State Priorities			
When Traffic On:–	The Indication Received is:–	Priority	Results in Traffic on:–
Protection	Forced Switch from Protection To Worker	1	Worker
Protection	Signal Fail on Protection (Switch from Protection to Worker Channel)	2	Worker
Worker	Forced Switch on Worker To Protection *	3	Protection
Worker	Signal Fail on Worker (Switch from Worker to Protection Channel) *	4	Protection
Protection	Signal Degrade on Protection (Switch from Protection to Worker Channel)	5	Worker
Worker	Signal Degrade on Worker (Switch from Worker to Protection Channel) *	6	Protection
Protection	Manual Switch To Worker (Switch from Protection to Worker Channel)	7	Worker
Worker	Manual Switch To Protection (Switch from Worker to Protection Channel) *	8	Protection
Protection	Wait To Restore (Revertive mode only) *	9	Protection
Protection	Do Not Revert (Non-Revertive mode only) *	10	Protection
Worker	No Request on Protection (Switch from Protection to Worker Channel in Recursive Mode only) or Worker or Protection (in Non-Revertive mode only)	11	Protection

Note: Only local indications apply in uni-directional mode, whilst both local and remote indications apply in bidirectional mode. Remote indications are signalled via the K1 byte. Both the local and remote indications have the same priority. However, should a simultaneous local and remote indication occur of the same/equal priority, then the one that is received first will become active.

Note: Only the Protection Channel may be specified for a No Request indication and only the Worker Channel may be specified for Wait to Restore and Do Not Revert indications.

Note: With priorities marked thus * in Table 7.2, in addition to the the active indication, with bidirectional mode, bits 1–4 of the received K2 byte and bits 5–8 of the transmitted K1 byte must be the same for selection of the Protection Channel.

Note 1: When 1+1 MSP is to be deconfigured, the Worker Section should be checked for normal operation before a 'Forced Switch' is made back to the Worker Section.

7.2.1.1 Revertive/Non-Revertive Modes

The protection scheme can be set for either revertive or non-revertive mode.

In revertive mode, operation will revert automatically to the worker path when normal traffic quality is restored in that path. In non-revertive mode, there is no such automatic reversion. Effectively, the original Worker and protection paths have now swapped over. A reversion will only occur if the new 'Worker' (ex-protection) path deteriorates (refer to the appropriate SMA Operator Manual for more information on modes).

7.2.2 Automatic Protection Switching (APS)

The 1+1 STM-1 Line Protection scheme incorporates provision for a protocol (G.783) which allows communication between the transmitting and receiving ends via bytes, designated K1 and K2, in the Section Overhead. The facility is referred to as Automatic Protection Switching signalling (APS). The 1+1 K1, K2 protocol mechanism being used for this product is compatible with 1:N, as described in G.783.

The K1 and K2 bytes are also used when both ends of a section automatically switch to the protection channel if the Worker channel fails, as in Dual Ended operation (Bi-directional Worker). This signalling protocol (G.783) is contained in the multiplexer section overhead.

SUB-NETWORK CONNECTION (SNC) PROTECTION

7.2.3 Introduction

The Ring Protection scheme protects against path failure between the insertion point and extraction point of a VC- n ($n=12,2,3,4$) signal, i.e. covers cross-connections.

The method uses both available routes around a ring configuration to protect against failure of any one path. Protection is achieved without card duplication but sending one signal by two routes inevitably reduces the traffic handling capacity of the ring. Figure 7.3 illustrates the arrangement.

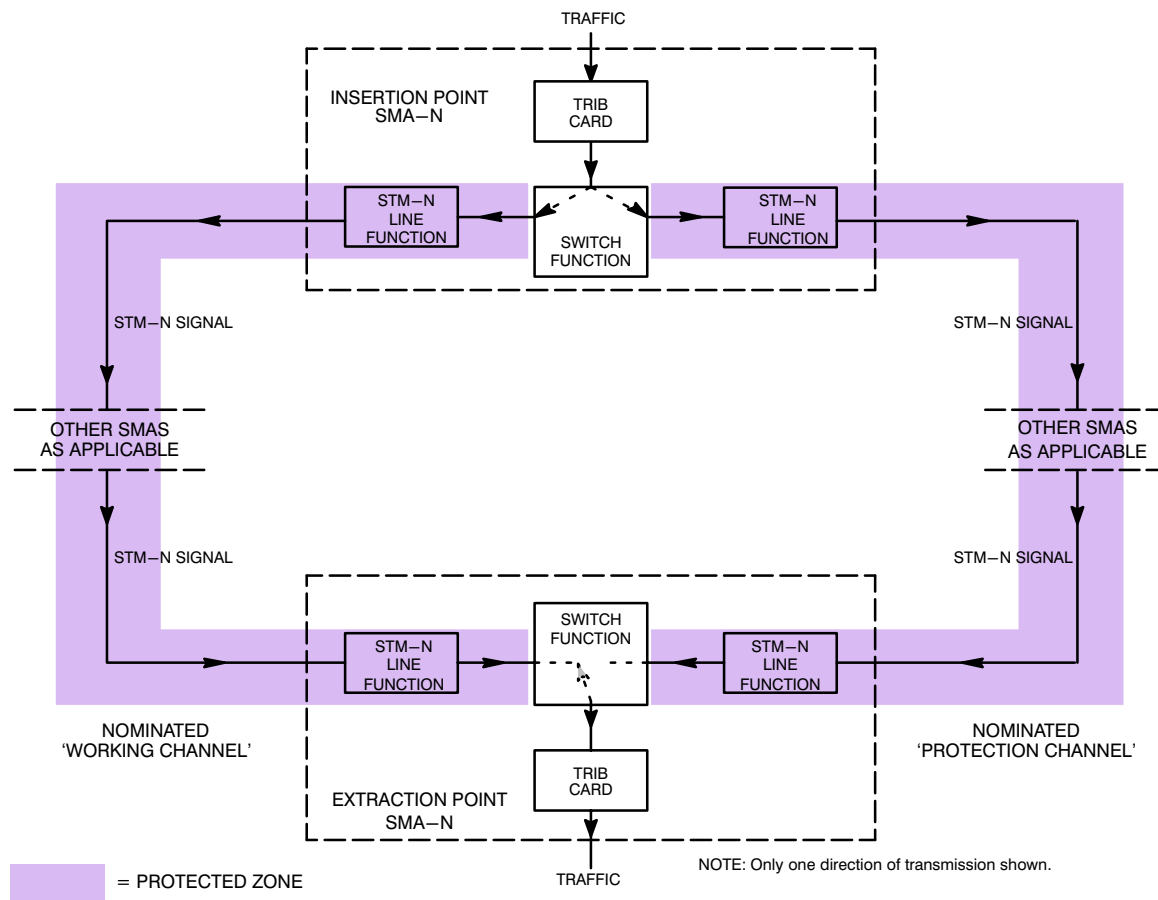


Figure 7.3 SNC Protection

7.2.4 Method

The VC- n signal may originate as a plesiochronous input to a 2,34, 45,140Mbit/s Tributary Card or it may be embedded within an STM- N signal input to an STM- N Tributary Card. In either case, it passes to the Switch function as a VC- n ($n=12,2,3,4$).

At the insertion end, the Switch function applies the VC-n (n=12,2,3,4) to both East and West STM -1 Line Cards for transmission by both routes around the ring. At the point at which the VC channel is dropped, the VCs (n=12,2,3,4) are received simultaneously by the two STM-N Cards (East and West) and passed to the Switch function. The Switch function will extract the VCs (n=12,2,3,4) from the nominated ring direction (worker channel) and route it to the appropriate tributary card.

The Switch function monitors the integrity of the received VC signal (from data in the Path Overhead). If the Switch function detects a degraded signal, a VC selector function will select the equivalent VC received via the opposite ring direction (protection channel).

7.2.5 Operation

The protection switching can either operate autonomously, changing over automatically when a deterioration in the nominated Worker path is detected, it can be manually controlled or forced, change-over being initiated by operator intervention from the Element Manager or Local Terminal (LCT). Operator control can override demands from the autonomous mode.

7.2.5.1 Autonomous Mode

Autonomous mode demands for change-over arise from two conditions which have the following priorities:

- **Signal Fail (SF).** This fault indication is the highest priority and is raised if any of the following conditions are detected:
 - Alarm Indication Signal (AIS) in the VC.
 - Loss Of Pointer (LOP) in the VC.
 - Excessive Bit Error Rate (EBER) of the VC.
 - Signal Label Mismatch (Operator enabled/disabled on a per-path basis: Default is enabled)
 - Signal Label Un-equipped (Operator enabled/disabled on a per-path basis: Default is enabled)
 - Path Trace Error (Operator enabled/disabled on a per-path basis: Default is enabled)
- **Signal Degrade (SD).** This fault indication is raised if an error rate threshold set by the operator is exceeded. (Operator enabled/disabled on a per-path basis: Default is enabled).

Operating autonomously the protection scheme will be set for either revertive or non-revertive mode.

In revertive mode, operation will revert automatically, after a preset delay, to the original path (i.e. the nominated Worker path) when normal traffic quality is restored in that path. The preset delay is termed the Wait To Restore (WTR) period and is operator selectable from 0 – 30 minutes.

In non–revertive mode, there is no automatic reversion. Effectively, the original worker and protection paths have now swapped over. A reversion will only occur if the new worker (ex–protection) path deteriorates.

7.2.5.2 Manual Mode

The VC path can be controlled by commands, entered via the Local Terminal (LCT), that operate on the receive direction only of the protected path. There is priority both in relation to each other and to the autonomous mode demands (see Table 7.3). The operator commands are:

- **Force Switch Traffic To Worker Channel.** Causes traffic to switch to, or be maintained on, the channel nominated as Worker channel. This command has a higher priority than the autonomous mode SF or SD demands, therefore the Worker channel will remain selected regardless of any traffic degradation.
- **Force Switch Traffic To Protection Channel.** Causes traffic to switch to, or be maintained on, the channel nominated as protection channel. This command has a higher priority than the autonomous mode SF or SD demands, therefore the protection channel will remain selected regardless of any traffic degradation.
- **Manual Switch Traffic to Worker Channel.** Causes traffic to switch to, or be maintained on, the channel nominated as Worker channel unless a higher priority demand is in effect (see Table 7.3). Note that autonomous mode SF and SD demands have a higher priority than this operator command. [Note: Locally detected conditions on the Worker channel have a higher priority than the Manual switch command].
- **Manual Switch Traffic To Protection Channel.** Causes traffic to switch to, or be maintained on, the channel nominated as protection channel unless a higher priority demand is in effect (see Table 7.3). Note that autonomous mode SF and SD demands have a higher priority than this operator command. [Note: Locally detected conditions on the Worker channel have a higher priority than the Manual switch command].

Table 7.3: VC Protection Demand State Priorities

Switch State	Priority	Traffic On
Forced Switch To Worker	1	Worker
Forced Switch To Protection	2	Protection
Signal Fail (Switch from Protection to Worker Channel)	3	Worker
Signal Fail (Switch from Worker to Protection Channel)	4	Protection
Signal Degrade (Switch from Protection to Worker Channel)	5	Worker
Signal Degrade (Switch from Worker to Protection Channel)	6	Protection
Manual Switch To Worker	7	Worker
Manual Switch To Protection	8	Protection
Wait To Restore (Revertive mode only)	9	Protection
Do Not Revert (Non–Revertive mode only)	10	Protection
Remote Switch To Worker (Bi–directional mode only)	11	Worker
Remote Switch To Protection (Bi–directional mode only)	12	Protection
No Request on Protection (Switch from Protection to Worker Channel in Revertive Mode only) or Worker or Protection (in Non–Revertive mode only)	13	Protection

7.3 CARD PROTECTION

7.4 PSU PROTECTION

Power Supply Unit Protection is achieved by utilising two PSUs supplying power to the sub-rack simultaneously. The PSUs supply power to the backplane on a power sharing basis.

In the case of the failure of any one PSU, the remaining PSU is capable of supporting the whole sub-rack equipment population.

Note: When using the dual feed PSU variant 1HAK60550AFS, the two incoming feeds are not commonly connected to both supplies, i.e. loss of a feed will cause the operational loss of a PSU, however, one supply feed and PSU can still supply the whole of the rack card population.

7.5 SUMMARY OF PROTECTION STATE INITIATION CONDITIONS

Table 7.4 summarises the conditions, whether manually or automatically initiated, which will cause a change of Protection state.

Table 7.4: Summary of Protection State Initiation Conditions	
Type of Protection	Initiation Condition
MSP, SNC and Port	Signal Fail on Worker Signal Fail on Protection Signal Degrade on Worker Signal Degrade on Protection Forced Switch to Worker Forced Switch to Protection Manual Switch to Worker Manual Switch to Protection Wait to Restore Do Not Revert Remote Request to use Worker *Remote Request to use Protection *No Request – Traffic on Worker No Request – Traffic on Protection NOTE *not applicable to Port Protection
PDH Tributary Card	Lockout of Protection Forced Switch to Protection Restoration Triggered Traffic on Worker Traffic on Protection

Note: SNCP operation at 2M, where traffic is on Worker and there are no fault conditions present, produces an initial protection state of “Remote Request to use Worker – Traffic on Worker”.

7.6 1:N TRIBUTARY CARD PROTECTION

7.6.1 1.5/2Mbit/s Tributary Cards

The 1.5/2 Mbit/s 1:N Tributary Card Protection scheme provides protection in the event of the failure of a 1.5/2 Mbit/s Tributary Card only. It provides for the automatic or manually initiated (via a command from the Element Manager or a Local Terminal (LCT)) functional replacement of a faulty 'Worker' card by a live spare card already in in the sub-rack. Protection can only be extended to one card at any one time.

Note: Only a 32 port 1.5/2Mbit/s card 1HAT60707AAD should only be configured in the Protection slot. The protection slot is not for use with any other rate protection arrangement.

The change-over is effected via a dedicated 2Mbit/s Protection bus on the sub-rack backplane. The advantage of a dedicated 2Mbit/s Protection Bus is that the limitation imposed by a specific physical arrangement of 2Mbit/s Tributary cards, relative to the Protection card, has been removed.

- When required, other (non 2M) trib cards may be fitted in between the protection card and the card(s) to be protected though this is not a recommended practice.

On the failure of the worker card, an alternative route for the signal, to the Protection Tributary card, is provided via the Protection Bus.

- When change-over is initiated, the Multiplex Controller Card then invokes action that ensures traffic is selected from the Protection Tributary Card and the protected card is cleared of traffic.

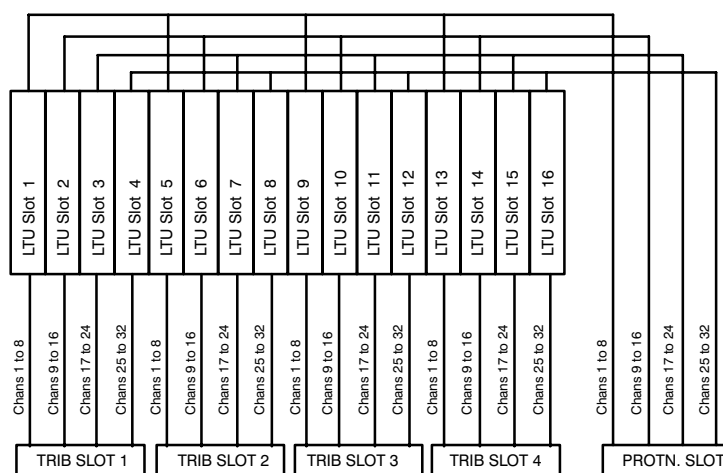


Figure 7.4 1.5/2Mbit/s Tributary Card 1:N protection

Note: The 2Mbit/s Protection buses shown in Figure 7.4 are paralleled along the backplane rather than in series. As a result the Protection bus will not be broken as a consequence of LTU switching. The bus is tracked to the normal traffic ports on the 2Mbit/s Protection card.

Note: Note that the Protection Tributary Card is not required for SMA-1/4(4+4) and SMA-1/4(8). There is a separate slot on the SMA-1/4c/uc for the Protection Tributary Card.

7.7 34/45/140MBIT/S, 34M TRANSMUX, VC-AM, STM-1 TRIBUTARY CARDS

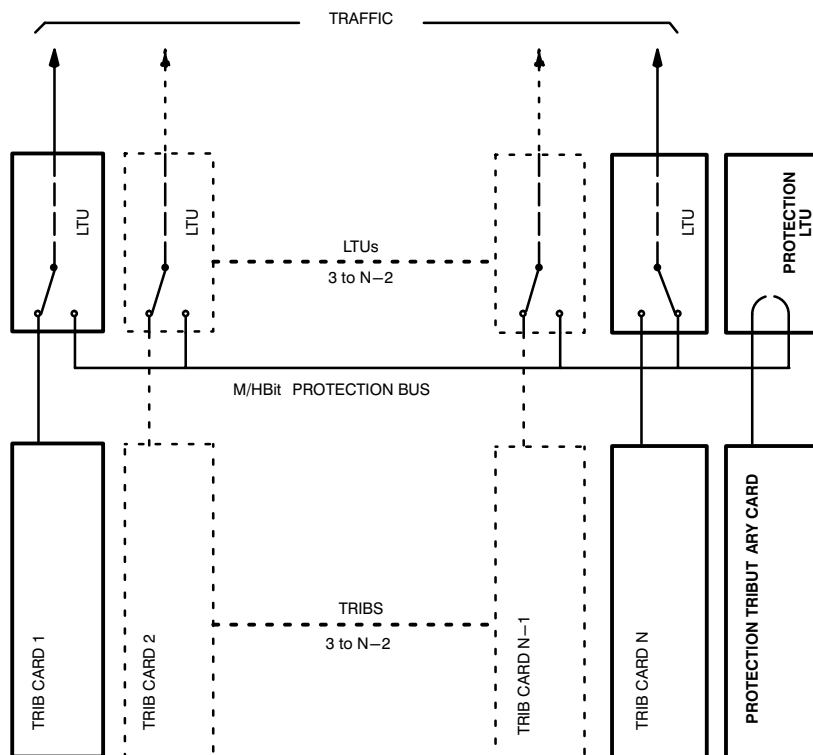
Note: All 140Mbit/s, STM-1 Electrical and Dual Electrical Tributary cards require LTUs for 1:N tributary protection.

Adjacent sets of 34, 45, 140Mbit/s and STM-1 (Electrical) cards may be configured as in a 1:N group where the protection card is the furthest right hand card of the continuous set. Adjacent pairs of cards may be configured as Worker and Protection. Up to four pairs of tributary cards may use 1:1 card protection within the configuration.

The 1:N 34/45/140Mbit/s Tributary, STM-1 Tributary, 34Mbit/s Transmux and VC-AM Card Protection scheme enables the automatic functional replacement of a faulty worker card by a live protection card (see Figure 7.5). The equipping rules are as follows:–

- a) It can only be applied to narrow-bandwidth slots.
- b) It operates on per-card basis only, not per port.
- c) The worker and protection card should be the same type and use the same type of LTU. A Protection LTU must be fitted for 1:N Protection to work.

The LTU transmits the traffic coming from the Worker card and discards traffic from the Protection card. In the receive direction the traffic is broadcast from the LTU to both Worker and Protection tributary cards.



Note: This illustrates the scheme for 1:N protection of 34/45M, 140M and STM-1/4 tributary cards. In this example, the Tributary Card at position N is faulty, therefore the Mux Controller has initiated the switch-over of traffic via the Protection Tributary Card and Protection LUT.

Figure 7.5 High-order Tributary Card 1:N protection

7.8 1+1 PDH TRIBUTARY PORT PROTECTION

7.8.1 Introduction

The Plesiochronous Digital Hierarchy (PDH) Tributary Port Protection scheme provides protection against both in-station interface failure and tributary circuit failure. The scheme requires the use of two ports and duplicated cabling for each protected signal. The arrangement is illustrated in Figure 7.6.

Duplicated signals, each via a dedicated cable, are each terminated at a different tributary port. The terminating ports may be on either the same or different Tributary Cards, but may not be normally routed via the protection tributary card except during tributary card protection.

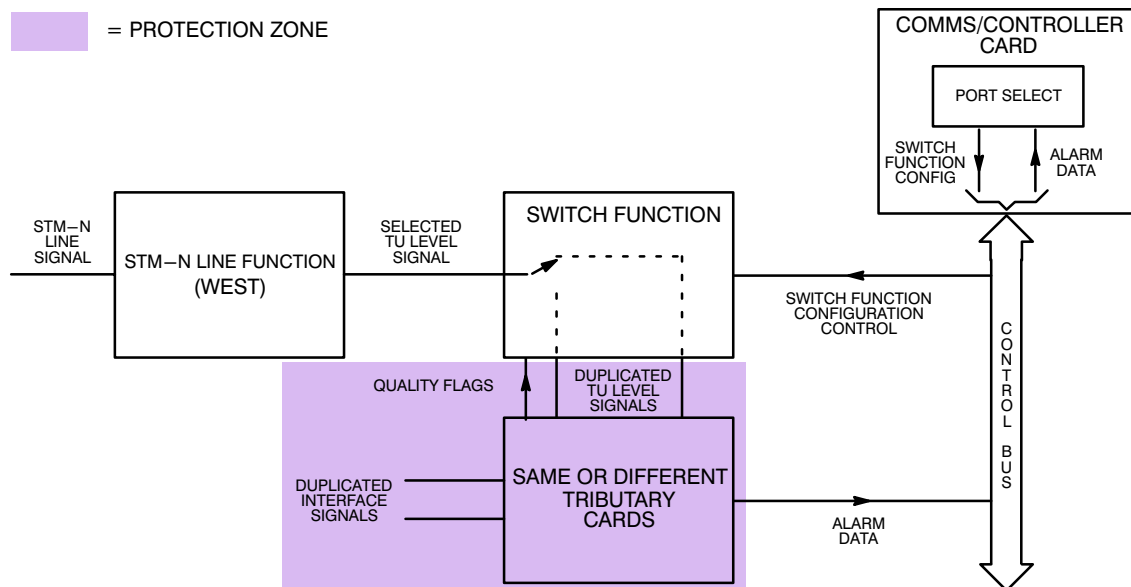


Figure 7.6 Tributary Port Protection

Quality flags go to the switch card which assesses the quality of each input on the basis of received alarm status information and ensures that the card is configured such that the best quality traffic is connected to Line.

7.8.2 Modes of Operation

Table 7.5 gives the number of protected PDH channels a version of SMA can operate.

The protection mechanism operates automatically. The switching criteria are detected by the tributary cards and the relevant SF/SD flags inserted into the internal traffic overhead on the interface cards. The Switch unit provides the switching function. The protection mechanism may also be operated manually via the Local Terminal or the Element Manager. The protection is unidirectional and both revertive and non-revertive.

Should the traffic be currently selected from the 'Protection port' and port protection is removed, the protection mechanism automatically selects traffic from the 'Worker port'.

Table 7.5: SMA Protected PDH Channels		
PDH Channel	SMA-1	SMA-4
1.5/2M	64 ports	128 ports
34/45M	6 ports	12 ports
140M Trib	2 ports	10 ports

Note: The above are maximum figures for single bit rates.

7.8.2.1 Wait To Restore and Do Not Revert

Either a 'Wait To Restore' (WTR) or 'Do Not Revert' state condition applies when a Worker port recovers from a failure, according to how the system has been set up by the Network Management Operator.

In revertive mode of operation, the Wait To Restore state automatically applies when a worker port recovers from a failure. Change to the Wait To Restore state is inhibited if a higher priority condition exists when the Worker port recovers.

When the WTR state occurs, a timer is set. The condition is de-activated upon expiry of the timer period. The condition is de-activated if a higher priority condition is received during the timer period. The timer is an option which can be configured by the operator, selectable from 0 to 30 minutes in one minute steps ($\pm 5s$). The WTR period can be configured both globally and on an individual port basis for protected ports. The default value is 10 minutes.

Note: The operator is only be able to retrieve WTR values from the NE on an individual port basis.

The Do Not Revert state occurs subject to the same conditions as WTR. However, there is no timer associated. The state remains active until a higher level condition is received, at which point it is reset by a re-configuration action into revertive mode.

7.8.3 Protection Switching Criteria

7.8.3.1 Failure Detection

The two criteria are used to indicate the status of the two protected PDH ports are the SF and SD flags. The interface cards generate these flags and the Switch unit receives them and uses them to trigger the next stage of the protection switching sequence.

A failure indication is raised if one or more of the following conditions is detected :–

- a) Loss of Tributary input.
- b) Loss of Frame Alignment.
- c) Receipt of AIS.
- d) Excessive Bit Error Ratio (EBER) – defined as a nominal bit error ratio greater than 10^{-3} . The condition can be Enable or Disable, the default being Enable.
- e) Signal Degrade (SD) – this may be operator configured to the following:–
 - Disabled (SD is never raised).
 - Raised on BER (bit error ratio greater than a single preset threshold in the range of 10^{-9} to 10^{-5}).
 - Raised on unacceptable short term error performance (USE).

Note: The default SD criteria is USE.

Failure conditions cause insertion of a Signal Fail (SF) flag into the internal frame to the Switch unit for the appropriate PDH port.

The Signal Fail and Signal Degrade indications are passed to the Switch unit using the internal traffic interface. The Switch unit monitors the SF and SD flags from the receiving units by polling every 8ms. The states are returned to the protection switching control mechanism.

7.8.3.2 Priority of Failure Conditions

The PDH port selected as the source of selected traffic is shown in Table 7.6.

Table 7.6: Priority of Failure Conditions		
Priority	Switch State	Selected Channel
1	Forced Switch (Protn.)	Worker
2	Forced Switch (Wch)	Protection
3	Signal Fail (Protn)	Worker
4	Signal Fail (Wch)	Protection
5	Signal Degrade (Protn.)	Worker
6	Signal Degrade (Wch)	Protection
7	Manual Switch (Protn.)	Worker
8	Manual Switch (Wch)	Protection
9	'Wait To Restore'	Protection
10	'Do Not Revert'	Protection

7.8.4 Protection Switching Control

7.8.4.1 Protection Switching Operation

The interface cards process the traffic from duplicated ports completely independently and pass the traffic from each input port, with its SD/SF flags to the Switch unit. This unit determines from which port the traffic quality is higher and selects traffic from that channel based on these flags – but taking into account the priority of failure conditions as described in Paragraph 7.8.3.2.

On configuration the identity of duplicate input ports of protected ports is down-loaded from the Mux Controller to the Switch unit, so that on receipt of a SF/SD failure condition or a request to switch to either input of a particular port, traffic may be selected from the appropriately numbered port.

At the outgoing traffic ports, the Switch unit duplicates the output signals to the output ports corresponding to the duplicated protected input ports. Any decision regarding the quality of the traffic at the output ports must be made by equipment external to the SMA.

7.8.4.2 Operator commands for PDH Port Protection

Control of the Protection operation is determined by the configuration of the different related parameters (see the appropriate Operator manual). These are entered either via the Local Terminal or from the Element Manager and are summarised below:–

- a) **'Worker Port'/'Protection Port'** – for each port to be protected, the operator enters the 'Worker Port' and the 'Protection Port' (these could be defined each by a slot number and a port number). Worker and protection port designation cannot be changed thereafter, only removed.
- b) **Operating mode** – i.e. Revertive/Non-revertive mode of operation.
- c) **Wait To Restore' period.**

To control the protection mechanism, the operator can use the following commands:–

- a) **Forced Switch To Worker** – causes traffic to switch to, or be maintained on the designated Worker port. The command has a higher priority than locally detected failures on the Worker port and hence traffic will remain on the Worker port regardless of any failure indications on this port.
- b) **Forced Switch To Protection** – causes traffic to switch to, or be maintained on the designated protection port. The command has a higher priority than locally detected failures on the protection port and hence traffic will remain on the protection port regardless of any failure indications on this port.
- c) **Manual Switch To Worker** – causes traffic to switch to or be maintained on the designated Worker port unless a higher priority switch state is in effect and also has a lower priority than locally detected conditions on the protection port.
- d) **Manual Switch To Protection** – causes traffic to switch to or be maintained on the protection port unless a higher priority switch command is in effect.
- e) **Clear** – clears any of the above commands and also any active WTR states.

7.9 ILLUSTRATION OF SERIES 4 PROTECTION OPTIONS

7.9.1 SMA–1/4c/uc 2M Tributary Card Protection

2Mbit/s traffic is available from the Core Cards and two tributary cards.

Figure 7.7 shows how 2Mbit/s traffic is provided and protected by the Core. Hence, when Core Card protection is invoked, then the 32x2Mbit/s traffic is protected. For SMA1/4c/uc, Core Trib B protects Core Trib A.

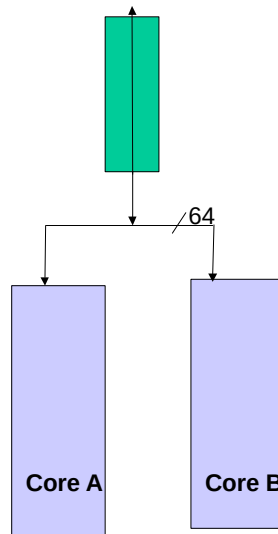


Figure 7.7 2Mbit/s protected from the Core

Figure 7.8 shows a 2Mbit/s solution, whereby 64x2Mbit/s is achieved from two tributaries. Up to 32 of the 64 x 2Mbit/s ports can be protected by fitting the protection 2M trib card.

If 2Mbit/s protection is not required then a front access tributary card can be fitted. Hence tributary 1 is always either a 2M protection tributary or a Front Access tributary. Tributary 2 is always a Front Access tributary card.

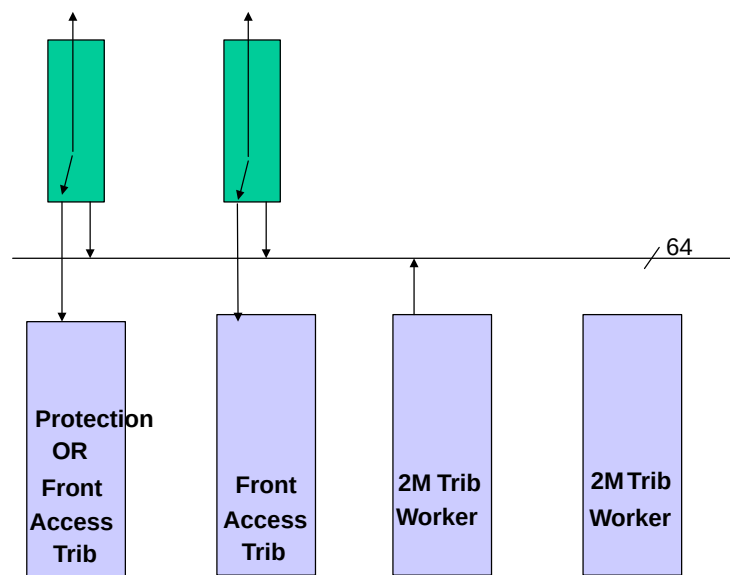


Figure 7.8 2Mbit/s solution, protected or non-protected

7.9.2 SMA–1/4c/uc Higher Order Tributary Card Protection

Figure 7.9 shows a higher order solution, whereby 1:1 card protection is achieved from two higher order tributaries.

Tributaries 3 and 4 are fitted with two higher order tributaries.

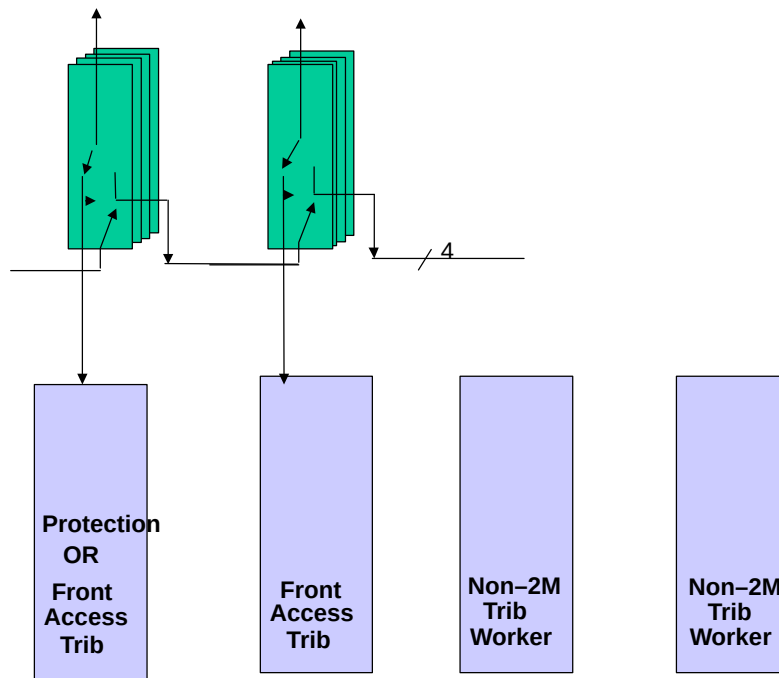
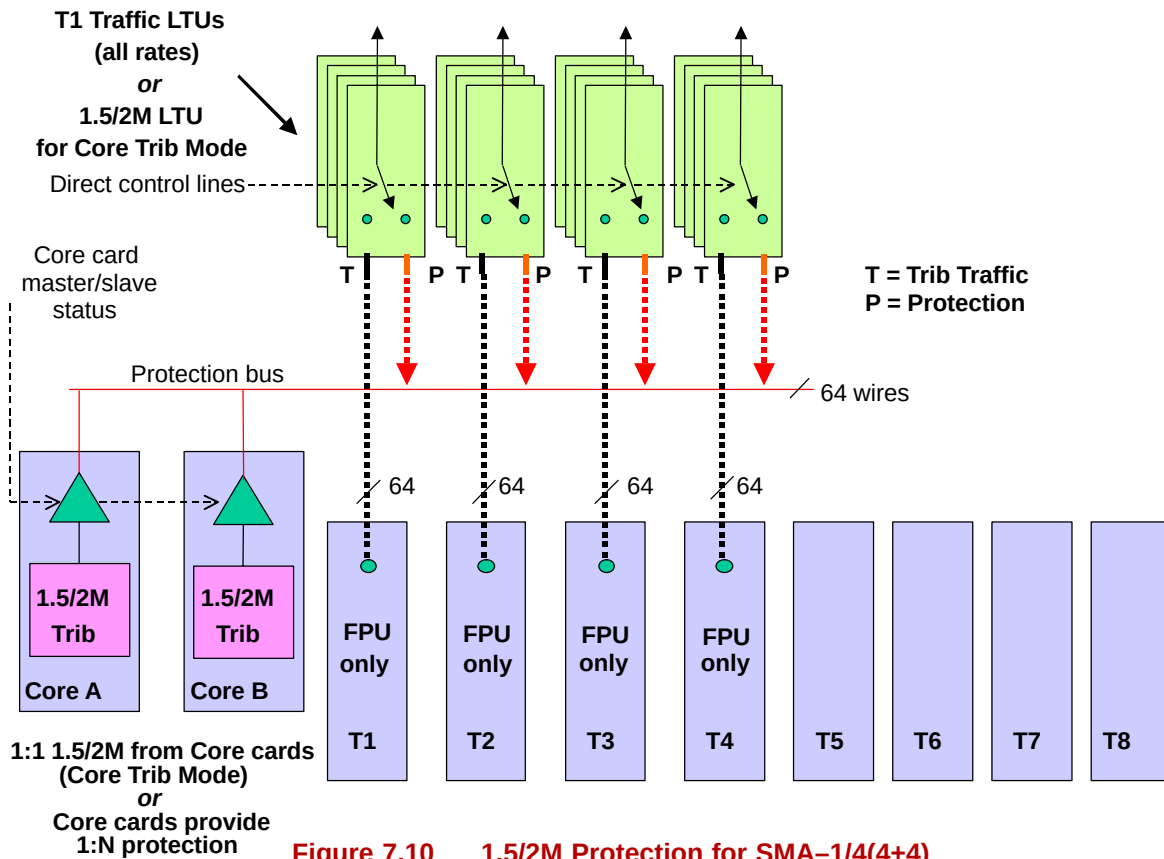


Figure 7.9 Non 2M solution (34M/45M, 140M, STM-1, Cellspan, VCAM) protected and non protected

7.9.3 SMA-1/4(4+4)(8) – 1.5/2M Protection

1.5/2Mbit/s tributary protection for up to 4 tributary cards for SMA-1/4(4+4) is illustrated in Figure 7.10. The protection 'card' for a 1:N scheme is located on the core cards as a 32x1.5/2M tributary module. Protection for up to 8 tributary cards for SMA-1/4(8) is achieved in a similar way.



7.9.4 SMA-1/4(4+4)(8) – 1+1 Core Tributary Mode Protection

SMA-1/4 supports up to 128 (single row LTUs) or 256 (dual row LTUs) channels of 1:N protected 1.5/2M tributary traffic. These channels are provided by up to 4 (single row LTUs) or 8 (dual row LTUs) tributary cards in blocks of 32.

However, it is a feature of Series 4 that the SDH Core Card contains the 1.5/2M protection tributary and so no separate protection card is needed for the 1:N scheme. As a consequence, the first 32 tributary channels (associated with the first tributary slot) can be supported without the need to fit the 1.5/2M tributary card. This is achieved by logically configuring Tributary slot 1 with a 1.5/2M card and then forcing a protection switch. This is called 'Core Trib Mode' – see Figure 7.11 A. The master Core card then drives the traffic LTUs associated with Tributary slot 1 and is protected by the slave Core Card using the Core protection scheme.

When more than 32 ports of protected traffic are required at least 2 tributary cards must be fitted – See Figure 7.11 B.

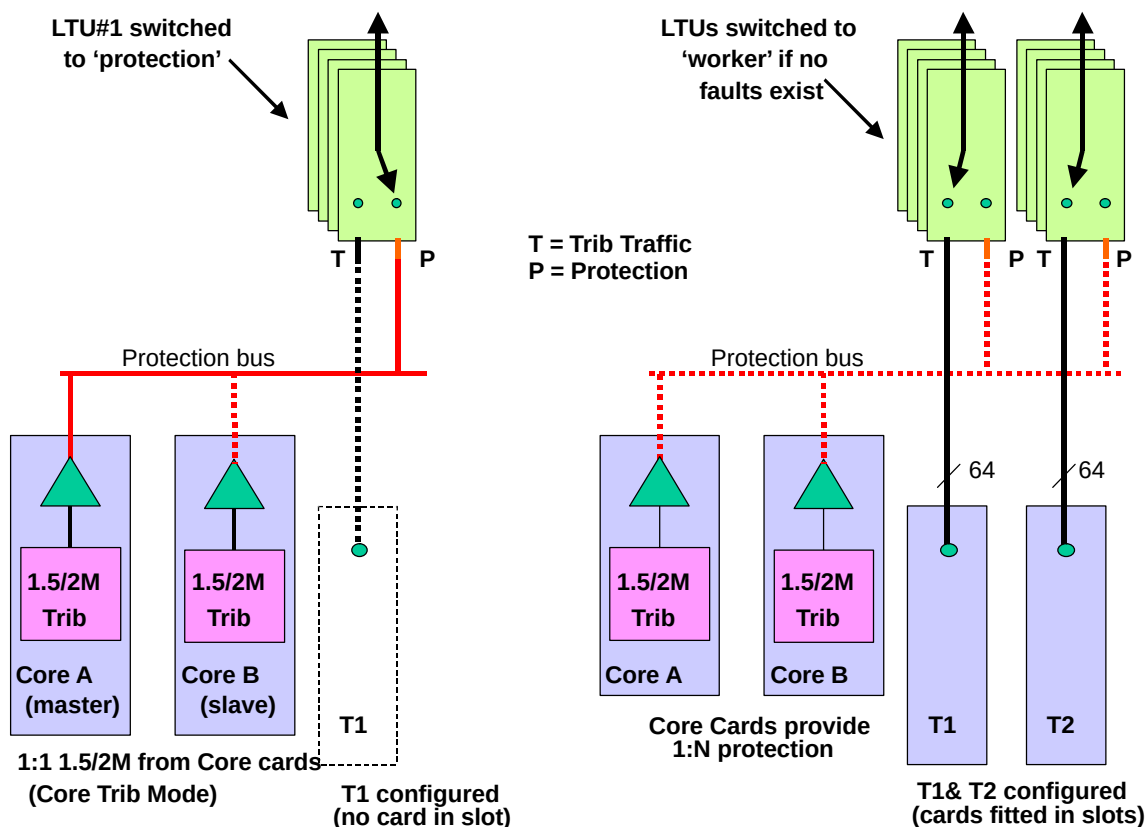


Figure 7.11

Fig A: Core Trib Mode

Fig B: 'Normal' 1:N Protection

7.9.5

SMA-1/4(4+4)(8) – 34/45M, 34M Transmux, 140M, STM-1 and VCAM Protection

For SMA-1/4(8) up to 7 tributary cards can be protected by a single protection card in a 1:N scheme. Multiple protection groups can also be supported. For SMA-1/4(4+4), up to 3 tributary cards can be protected.

7.9.6 SMA-1/4(4+4)(8) – ATM and ETA Tributary Card Protection

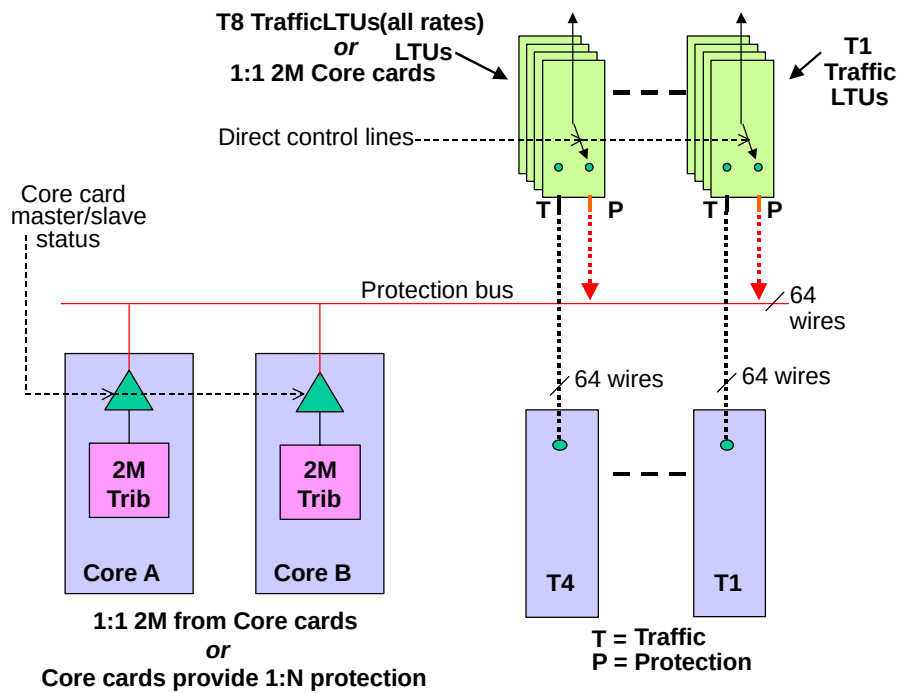


Figure 7.13 SMA-1/4(4+4)(8) – ATM and ETA Tributary Card Protection

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CHAPTER 8: COMMUNICATIONS

8.1 INTRODUCTION

CAUTION Network Data Communications Configuration Parameters must not be altered without the authorisation of the Network Design Authority. To do so can result in loss of Network Data Communications and may only be resolved through recourse to a site visit.

Communication channels are provided between:–

- The Element Manager (for use by an Operator) and the Gateway Multiplexer, via an Ethernet Local Area Network (LAN).
- The Gateway Multiplexer and the other SMA elements of the network, via the Data Communication Channel (DCC) bytes in the STM frame structure.

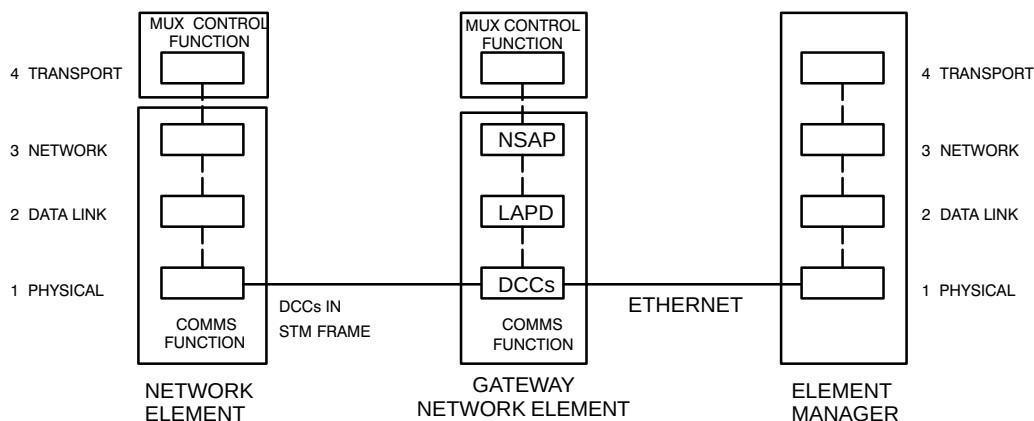


Figure 8.1 Communications In SDH Networks

8.2 PROTOCOL

The communications protocol between Network Elements (NE) and the Element Manager is based on the ISO Open Systems Interconnect (OSI) seven-layer model. However, only the first four layers of the OSI model are implemented for the SMA series (see Figure 8.1). Each layer performs a specific function and interfaces only with those layers directly adjacent to it. The layers implemented are:–

- **Physical Layer** – provides the means to transmit bits of data across a continuous communication path. This layer is concerned with the electrical, optical and mechanical requirements of a communication link. The point to point bearer of the communication link may be copper wire, coaxial cable, optical fibre etc.

- **Data Link Layer** – provides framing for data transfer across a physical connection. The data link layer detects and, where possible, recovers from transmission errors. Where recovery is not possible, the network layer is notified of the error. Various protocols identify the start and end of each frame.
- **Network Layer** – the responsibility of the network layer is to establish a reliable communications stream between a pair of systems. It resolves routing of data between elements and controls congestion avoidance. To facilitate routing, each Network Element (NE) in an OSI network is defined by a unique 'Network Service Access Point' (NSAP) address.
- **Transport Layer** – ensures error free end to end flow of data. It covers flow control, buffering and multiplexing, and also manages call connection and clear-down.

8.3 IMPLEMENTATION

8.3.1 Introduction

Management of the system requires communication between the Element Manager and an SMA Gateway Multiplexer and all other SMA Network Elements in the network. The communication link between the Element Manager and the SMA Gateway Multiplexer is via an Ethernet LAN (IEEE 802.3). Intercommunication between all other SMA elements in the network is via Data Communication Channel (DCC) bytes in the STM frame, or via embedded LANs, using the Ethernet protocol.

The communications network can support the following topological characteristics:–

- Intersecting rings.
- Multiple Element Managers (EM).
- Multiple Gateway Network Elements (GNE) on an Ethernet.
- Multiple GNEs on a ring.
- Interworking between SMAs and SLA line systems.
- 'Mesh' networks.

Physically, the communications function for Network Element applications is processed by the Multiplexer Controller Card and the Communications Card, with the former dealing with Transport Layer (4) level communications to the Element Manager and the latter controlling lower layer functions.

In the Gateway Multiplexer application a full-functionality Communications Card provides 'Q' interface functionality for communications with the Element Manager via an Ethernet LAN (see paragraph 8.3.2).

Communications configuration parameters can be displayed, set or altered via the Local Terminal (LCT) and Element Manager, as given in full in the appropriate Element Manager and LCT Operator Manuals, the following are the principal parameter levels:–

- Transport Layer

- Gateway Interface
- Network Layer
- IS-IS/ES-IS Configuration
- Performance Counts (from the LCT only).
- Routeing Table Display
- CLNS Ping (from the LCT only).
- DCC Configuration
- LAPD Configuration

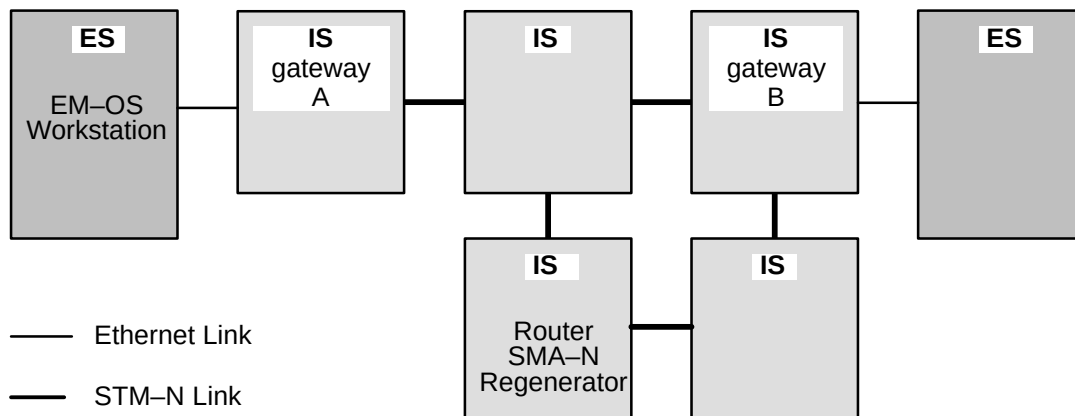
Note: When commissioning a new SMA into a network, the communications parameters must be entered via a LCT at the element itself, subsequent changes can be made remotely via the Element Manager or using LCT Single Ended Maintenance (SEM).

8.3.2 End Systems, Intermediate Systems and Gateways

The purpose of a network is to communicate data from 'End System' (ES) to 'End System'. 'Intermediate Systems (IS)' provide the route (or 'service') for the transfer of that data. In a GPT system an IS element can contain ES functionality and therefore can be the destination or source of information as well as providing a routing function. Key to the communications process is how 'elements' within a network know:

- What their own identity is, i.e. Network Service Access Point (NSAP) address.
- How to connect to other entities ('route').

An Element Manager can be connected to several Gateway Multiplexers simultaneously via the Ethernet. The Gateway Multiplexers and the Element Manager communicate with each other via ES-IS Protocol, with multicast addresses which are recognised by all Gateway Multiplexers.



In the network example above, there are the two types of Network Element which process Network Management data, these are:
End Systems (ES) – these will only process messages intended for themselves.
Intermediate Systems (IS) – these will process messages intended for themselves, but also will pass on messages intended for other elements

Figure 8.2 Network Element Management Data Communications

The All-IS address identifies the target group of entities, (Gateway Multiplexer/Element Manager) to which the multicast relates. Likewise for the All-ES address (refer to paragraph 8.4.6.1 for further details of addressing).

8.3.3 Ethernet Local Area Network

The implementation of management of an SMA network can be achieved physically by an Ethernet cable link to the SMA gateway element.

The Ethernet LAN can support communication with non-GPT equipment. SMAs are equipped with a AUI interface, which when used with an appropriate MAU can connect to the Ethernet link using following types of Ethernet link cabling standards:–

- ‘Thick’ Ethernet – using 10Base5 standard.
- ‘Thin’ Ethernet – using 10Base2 standard.
- Unshielded twisted pair (UTP) – using 10BaseT standard.

Note: Refer to Chapter 28, Chapter 29 or Chapter 30 for further details.

8.4 COMMUNICATIONS ROUTEING

8.4.1 Introduction

Communications routeing between elements in a network can be based on either of the following:–

- The ISO ‘IS-IS’ protocol (ref. ISO 10589) which provides a dynamic solution to routeing CLNP and is a ‘link state protocol’.
- ‘Interim Static Routeing Algorithm’ (ISRA) routeing (prior to R1.21.4), an interim method which involves the generation of static routeing tables.
- Default mechanisms.

The routeing requirements shown in Table 8.1 are supported, where ‘Q’ is the CCITT Interface used with the SMA series for Network Management via the Element Manager and ‘DCC’ are the Data Communications Channels within the STM-N frame.

Table 8.1: Communications Routeing Requirements	
to/from	to/from
Q	DCCr
Q	DCCm
Q	Control Sub-system
DCCr	DCCr
DCCr	DCCm (not default routeing)
DCCr	Control Sub-system
DCCm	DCCm
DCCm	Control Sub-system (not default routeing)

Note: For routing to the PacketSpan expansion module (ETX10), the comms function handles a “tunneling” Data Domain messages (SNMP) procedure through an SDH OSI DCN. The protocol conversion function used for ‘tunnelling’ consists of converting the SNMP transport protocol from its ‘native’ UDP to OSI transport protocol.

8.4.2 Data Communications Channels

Management communication data can be routed from IS to IS via the Data Communication Channel (DCC) bytes in the STM frame structure. ‘DCCr’ apply to the Regenerator Section Overhead frame position and ‘DCCm’ to the Multiplex Section Overhead frame position. When setting up GPT Multiplexer networks, a choice must be made as to which DCC are used for communications within any particular sub-network.

8.4.3 LAPD Protocol

The Link Access Procedure on the ‘D’-channel (LAPD) protocol is used for the data link layer for communications. It requires that each STM port, whether line or tributary, has to be set up as either in User mode or in Network mode.

Setting up during commissioning is via the LCT at the element, but subsequent changes can be made remotely via the LCT using Single Ended Maintenance or via the Element Manager.

Note: As long as both ends of a link are different, i.e. one end has to be allocated ‘User’ and the other ‘Network’, which element is which is arbitrary.

It is assumed that the East STM line position of an equipment is connected to the West STM line position of the adjacent equipment and so on. The default values are:—

- West (all)
Network
- East
User
- Tribs 1–7
User
- HB Tribs
User

Note: On addition of a card, the card adopts the slot specific default DCC and LAPD configuration parameters. Any time one of the card working settings is taken off, the default value for that card position should also be changed.

8.4.4 IS-IS Routing

8.4.4.1 Introduction

Only IS-IS routing is supported by SMA Series 4 products. Both the two sub-domains, Level 1 and Level 2, are managed.

The IS–IS routeing protocol implements routeing, by calculating optimum routes based on dynamically collected information about the topology of the network, at the initiation of the network. It also dynamically adapts to changes within the network topology, recalculating routes when changes occur.

This method has replaced existing default routeing algorithms and Interim Routeing algorithms (ISRA) from R1.21.4 onwards.

The IS–IS Protocol uses two new types of Protocol Data Units (PDU), ‘Hello’ PDUs (or ‘neighbour greeting’) and Link–State Packet (LSP) PDUs. These are the fundamental packets of data all elements in a network make available to each other. The PDUs contain the identity, location, status and condition of the links between them.

When a network is initiated, IS elements begin by learning about elements to which they share direct connectivity, i.e. in the same sub–network, via ‘Hello’s’. IS elements then construct a Link–State Packet, which contains a list of their neighbours and the ‘cost’ to reach each neighbour (based on a system of ‘cost’ metrics), the IS elements then distribute the LSPs to all other IS elements. On completion of the process, each IS will have received a complete map of the network topology in the form of LSPs.

Each IS element uses these LSPs to compute routes to every destination in the network. The route choice is the ‘least cost’ route.

Should the topology change, e.g. a new element is added, the IS–IS protocol initiates a regeneration of the routeing table scheme and the relevant information is made available via the network links to all the elements in the network, i.e. the network is ‘flooded’ with the new information.

8.4.4.2 IS–IS Routeing Protocol Operation

Figure 8.3 shows how IS–IS routeing protocol would operate within a simple network. The numbered elements in the hypothetical network consist of SMA IS and Element Manager elements. The IS elements have multiple ports communicating with other IS or ES.

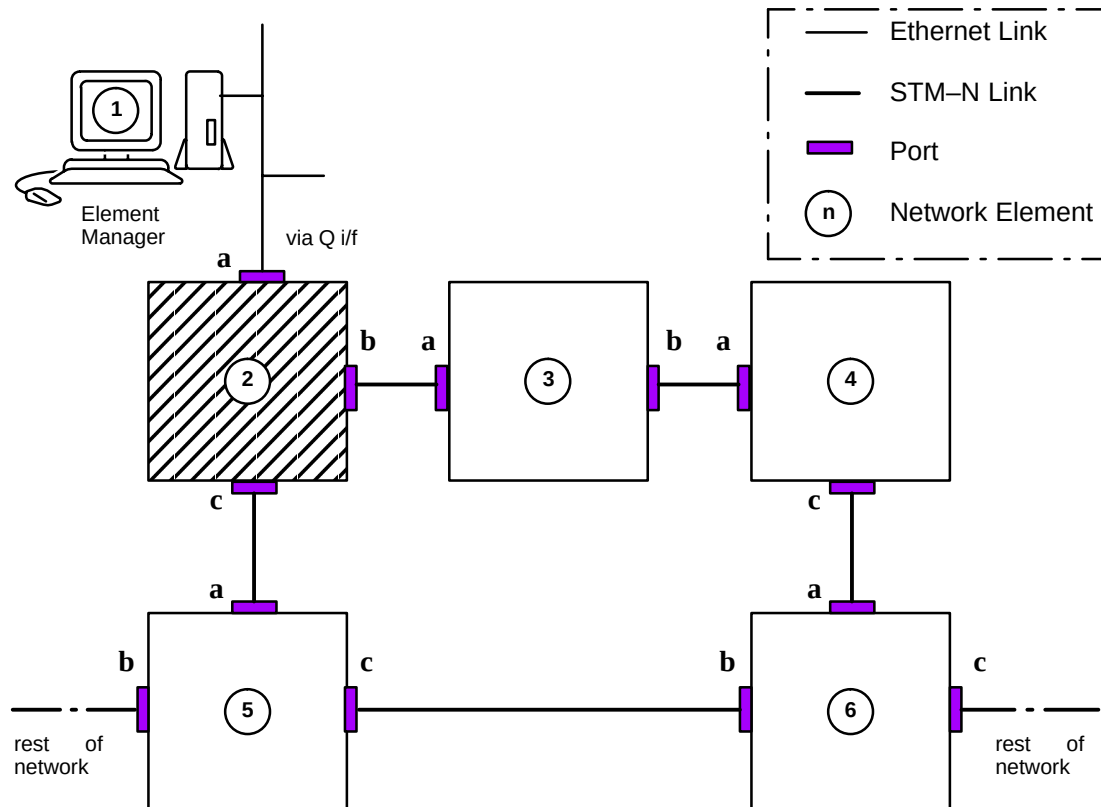


Figure 8.3 IS-IS Routing

Table 8.2: IS-IS Element Routeing Table	
Element to which route is required	Preferred Port by which data must communicate
1	a
3	b
4	b
5	c
6	c

When a network is initiated, the IS-IS Protocol creates routeing tables within each IS element in the network. The tables describe which port of the element data must be directed via, to reach any other element in the network (either IS or ES). The example given in Table 8.2 applies to element 2 (shown shaded) in Figure 8.3.

8.4.4.3 Metrics

Metric values are applicable to Gateway Interfaces, Reachable Address Prefixes (RAP) and DCC interfaces. Each type of interface is assigned a default value for the metric. This may be changed via an LCT or Element Manager.

Default values are as follows:–

- 10 – Ethernet.
- 15 – DCCm bytes.

- 20 – DCCr bytes.

8.4.4.4 Maximum Path Splits

If there are two or more equal cost routes between two elements, the protocol allows for handling the routing in the following ways, either:–

- A Maximum Path Split value of 1 (the default value) is defined during the Network configuration, in which case routing will be across one path only, all other paths of equal cost being discarded, or:–
- A Maximum Path Split value of 2 is defined during the Network configuration, in which case routing will be toggled at ≈ 15 minute intervals across two paths, any further paths of equal cost being discarded.

8.4.4.5 External Domain Flag

The Gateway Interface and DCC interfaces possess a parameter called the External Domain Flag. If set to true, this would have the effect of isolating that element from operating IS–IS protocol, preventing IS–IS protocols being exchanged over the link, whilst still allowing communication to take place between the IS–IS Boundary Nodes, in effect creating a IS–IS block. A possible use for this would be to withhold network information from a competitor.

The block is not essential but sometimes needed to enable IS–IS networks to be constructed. The block circumvents a limitation with IS–IS that only allows two RAPs to a single destination under complex situations. The block is introduced into the IS–IS network by marking the communication interface as 'external'.

8.4.4.6 ES–IS

The IS–IS protocol in itself provides for communications routing between IS elements, but requires complementing with a method of ES to IS communication. The protocol implemented in GPT systems for this purpose is ISO 9542. This uses its own IS and ES 'Hellos' to establish communication which uses ES 'Hellos'. An ES 'Hello' enables an ES to announce itself to IS elements (and other ES elements) on the same sub-network. The two significant factors are 'who is out there?' and 'with whom is it possible to communicate?'

Where the ES is attached to an Ethernet LAN, the ES periodically composes an ES 'Hello', inserting its NSAP address(es), SNPA and a holding time in the ES 'Hello' packet, and sends this packet to the 48 bit multicast Medium Access Control address (MAC) whose value has been set to registered GPT multicast addresses as defined in ISO 10589.

8.4.4.7 Two-Level Hierarchy

In an SDH network in general, SDH Element rings and groups of SDH Element rings will form single IS–IS Areas. The groupings of the rings will depend on the amount of inter-connection of the rings.

Level 2 Routers are Elements that exist at the boundaries of Areas and are the interfaces between the Areas (See Figure 8.4). The non-boundary Elements are generally Level 1 Routers except where to improve resilience, a Level 2 Router may be used between boundary Elements within an Area where greater resilience is needed in the network.

Level 2 Routers know where each of the other L2 IS elements exist in the network (if they all form a contiguous L2 network. Level 2 Routers also have Level 1 Router functionality. Level 2 Routers are only concerned with the Area Address part of the NSAP. Level 1 Routers are only concerned with the System ID (see Figure 8.5).

A Level 1 IS only knows about ES and other Level 1 IS elements in its own area and about the 'nearest' Level 2 IS which it can use to forward traffic out of its own area. A Level 2 IS knows about other Level 2 IS elements in the network (if they all form a contiguous L2 network), the location of Level 1 Areas and the 'best' exit Level 2 IS to use for traffic destined for other routing domains.

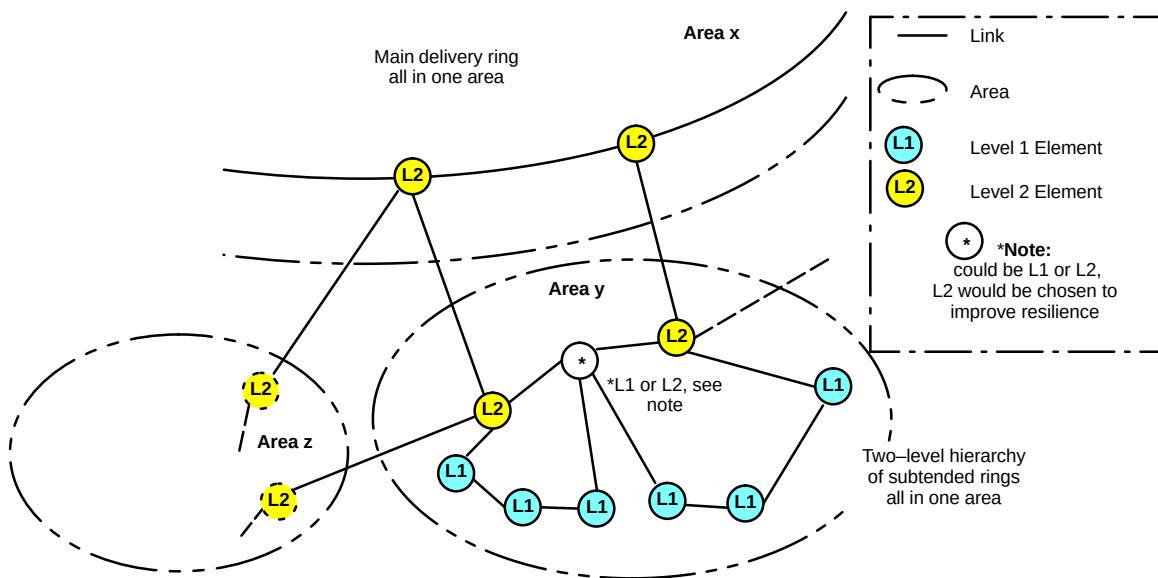


Figure 8.4 IS-IS Area Partitioning for Hierarchical Element Rings

8.4.5 Multiple Areas Working in IS-IS

A Level 1 IS can be configured to route messages to elements in more than one area (ie it recognises Multiple Areas). In the case of the SMA product, up to eight addresses can be held by any one element.

This is achieved, during commissioning, by entering the Manual Area Address for the element, and assigning a Maximum Area Address of the same value (in the range 1 to 8, the default = 3) as all the other elements within the domain, with which that element should associate. These elements then form a unique Level 1 area, ie two IS-IS routers can only become 'neighbours' if they have at least one area address in common.

On initiation of the network, if say, there were ten elements with the Maximum Area Address value of 5, the association process requires that only five discrete Manual Area Addresses are used. These become common to all ten elements, any further discrete Manual Area Addresses will be dropped (with an associated alarm). Only the numerically lowest addresses will be retained.

Introducing Multiple Area capability has the advantage of simplification of network strategies by expanding a Level 1 area to enable a reduction in Level 2 traffic.

8.4.5.1 Partition Repair

Partition repair is a mechanism by which the protocol circumvents a fault which has caused a Level 1 area to be split into parts. The facility uses Level 2 links to act as virtual Level 1 links to repair the split.

8.4.6 Network Service Access Points (NSAPs)

8.4.6.1 NSAP Addresses for IS – IS Routeing

In ISO terminology, the network layer provides a service, and a user or 'client' of the network layer 'attaches' to the network layer with a NSAP (Network Service Access Points). The NSAP is the principle identifier for any Element within a Network. Individual NSAP lengths can be variable, however there is a maximum of 20 octets.

IS–IS Addresses or NSAPs consist of two main parts, the Area Address which is everything up to but not including the System ID (SID) and the System ID itself (plus the NSEL with a value of 01), this is illustrated in the top half of Figure 8.5.

Level 1 Routeing is only concerned with the System ID part of the NSAP. IS–IS Area or Level 2 Routeing takes place on the Area (or 'address prefix') part of the NSAP only, which is treated as a single field.

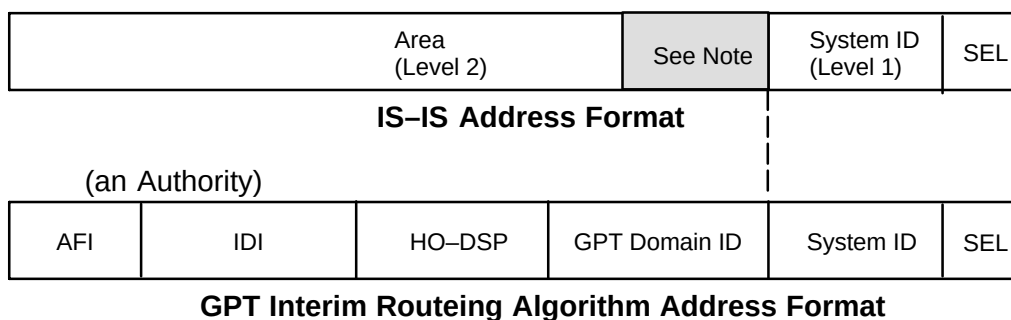


Figure 8.5 NSAP Address Formats

Note: The shaded part of the Area field indicates that it is possible to extend the SID (as defined by the 'System ID Length' parameter), this is useful in certain circumstances to simplify network planning.

The 'SEL' octet is of historical interest and was introduced during the implementation of the ISO specification. It was originally provided to allow identification of the network layer itself. In all GPT implementations, this will have the value of 01.

The SEL is used to distinguish between multiple upper layer entities (layer–4's). The value 00 is used for layer 3 itself.

8.4.6.2 NSAP Addresses – ISRA routeing

ISRA Routeing (Rev 1.21.35 and earlier) uses the X.121, ISO–DCC and ISO–6523 ICD address structures. A simplified version is given in Figure 8.5.

8.4.7 Upgrading

The upgrading of an element from a previous release of software to IS–IS routeing (R1.21.4 onwards) can be achieved locally via an LCT, or remotely via the Element Manager (or remotely, via an LCT operating Single Ended Maintenance, where the equipment configuration allows).

It is possible to configure the NSAP and any static routeing data (refer to 'MA' and 'RAP', Paragraph 8.4.9), prior to the running of the upgrade software. This will minimise the possibility of disturbance to communications within the network.

8.4.8 Interworking

It is possible that the IS–IS Routeing protocol will be operating within groups of, or adjacent to, network elements not operating the same routeing protocol or in the same area. Interworking strategy must be decided during network planning and is beyond the scope of this book.

8.4.8.1 ISRA Routeing (Software Revisions prior to 1.21.4)

Note: This is the routeing method used prior to R1.21.4, the following information is given for situations where interworking of this method and IS–IS areas is envisaged.

The ISRA routeing solution uses a combination of the Default 'Turn Left' algorithm, and static routeing tables which are manually created.

With ISRA Routeing, some or all of the NEs in a network contain static routeing data. In principle this method works in the same way as IS–IS routeing (see Figure 8.3) but without the dynamic functionality of IS–IS routeing.

The routeing data is derived from static routeing tables, which are constructed using the RTC tool for each NE in the network.

8.4.9 Manual Adjacency (MA) and Reachable Address Prefixes (RAP)

Given that other protocol(s), on the initiation of the network, cannot automatically contribute data to the dynamic creation of Routeing tables, data identifying these elements must be entered manually at the boundary elements operating the IS–IS protocol.

The data may be constructed manually, or may have to be constructed using the RTC tool. It may be entered either locally using the LCT or remotely via the Element Manager. The data is then passed automatically around the Domain as if it had been received in an IS-IS update message. Two data types are used according to the level of element being addressed:

- a) **Reachable Address Prefix (RAP)**. provides a method of interworking between an IS-IS domain and an ISRA domain, where the ISRA domain nodes have different area addresses from the IS-IS domain and border node. A Reachable Address Prefix is therefore a Level 2 static route.

Note: Should equal cost paths exist, and provided the maximum path splits value is set to 2, then the protocol will toggle routeing between the paths at 15 minute intervals.

Note: When the RAP is configured onto the Q interface, then the SNPA field should be configured with the host LAN card MAC address.

- b) **Manual Adjacency** entries provide a form of a mapping between system ID and Port (plus the SNPA for an Ethernet (Q) port) in Level 1 areas. A list of system IDs may be associated with that port, e.g. if there is a chain of elements not running IS-IS protocol beyond the particular element assigned a MA.

8.4.10 CLNS Ping

CLNS 'Ping' or Packet Internet Groper, is an echo message and its reply, used to test if a network element can be reached from another element, when operating within a Connectionless Network Protocol.

Using the LCT, a 'Ping' can be chosen to be single or multiple shot and a route trace can be displayed, if required, on receipt of a successful reply.

Note: 'Pings' cannot be applied to, or through non-IS-IS equipment, e.g. VCTM. The elements must also have version 1.21.4 software or later. Given the previous conditions, Pings can work across different IS-IS areas.

Note: Where a Partition Repair has occurred, the path trace will not show the path by which the protocol has implemented the repair.

8.5 COMMUNICATIONS APPLICATIONS USING THE AUXILIARY CARD

8.5.1 Introduction

The auxiliary card passes information around an SDH transmission ring. The card provides access to spare capacity in the STM overhead and can be used for a number of purposes, the most common of which is the management of access multiplexers. The card provides V11 channels at either 9.6kbit/s or 64kbit/s, depending on the card version used. The channels may be used for any purpose which requires a data channel at these speeds. It is also possible to use the 64kbit/s channels at 9.6kbit/s giving more channels of one type.

Two versions of the card are available:

- **Version '0' – 1HAT60004***** provides access to asynchronous V11 data channels up to 9.6kbit/s. These channels are passed transparently and, using suitable external message routing equipments (e.g. RTUs), can be used for management of associated equipments. Two status LEDs indicate a card fault (red) or that the card is in service (amber).
- **Version 0.1 – 1HAT60647***** incorporates all the facilities offered by the earlier version with the addition of a further six ports to provide access to synchronous 64kbit/s data channels. It is possible to use this card as a direct replacement for Version 0 without any change to existing cabling.

Note: The suffix *** represents a three-letter coding which is specific to certain customers. The differences relate to the backplane polarising scheme and the appearance of the fascia and do not affect the working of the equipment in any way.

Note: Both Version '0' and Version '0.1' are compatible with all variants of SMA from release 1,1 upwards.

The card is a 'Double Extended' Eurocard with a width of 20.32mm. It is designed to fit in a modified Type 88 shelf. EMC protection is provided by a shield over the front of the card.

8.5.2 Features

The main features of the cards are:

- Access to Line East and Line West 9.6kbit/s asynchronous channels. Each external port consists of a V11 transmit pair and a V11 receive pair. The receive signal is sampled at 64kbit/s.
- Access to four tributary position 9.6kbit/s asynchronous channels (both versions). It is possible to switch the access capacity from Tributary to Line, thus providing an additional line channel at the expense of two tributary channels (Version 0.1 only).
- Access to Line East and Line West 64kbit/s synchronous channels (Version 0.1 only). Each external port consists of V11 pairs as described in (a)) plus two further pairs carrying transmit and receive 64kbit/s clocks. Both clocks are output from the card.
- Access to four tributary position 64kbit/s synchronous channels. It is possible to switch the access capacity from tributary to line, thus providing an additional line channel at the expense of two tributary channels (Version 0.1 only).
- Inventory storage and retrieval (Version 0.1 only).
- Card Out alarm (both versions) and fault reporting (Version 0.1 only).
- Selectable card configuration data stored in EPROM.

Access to the asynchronous channels is achieved via D-Type connectors on the Auxiliary LTU. Access to the synchronous channels on Version 0.1 is via the front-of-card connectors on the Auxiliary Card itself.

The pin-out details of the Auxiliary LTU and on-card D-Type connectors are given in Chapter 23 and Chapter 24.

Security by means of East A/East B and West A/West B switching is possible via two hardware control signals on the backplane from the Mux Controller.

8.5.2.1 Auxiliary Card Version '0'

Table 8.3 shows the connections of auxiliary channels to line and tributaries for Auxiliary card version '0' via Auxiliary LTUs. Up to two Aux LTUs may be fitted to access the following routes:

Table 8.3: Aux Channel Access Routes (V0)		
9.6kbit/s Access (Via LTU)		
LTU 1 (AUX 1&2) Auxiliary Port		to/from
AUX 1	Upper port 1 (Aux Ch 1)	Trib 1 (If STM-1)
	Upper port 2 (Aux Ch 2)	Trib 2 (If STM-1)
AUX 2	Lower port 1 (Aux Ch 3)	Trib 3 (If STM-1)
	Lower port 2 (Aux Ch 4)	Trib 4 (If STM-1)
LTU 2 (AUX 3&4) Auxiliary Port		to/from
AUX 3	Upper port 1 (Aux Ch 5)	Line East (SOH Ch 1)
	Upper port 2 (Aux Ch 6)	Line West (SOH Ch 1)
AUX 4	Not used in this application	

Note: Whilst both upper and lower connections to LTU 1 (slot AUX 1&2) are used, only the upper connections to LTU 2 (slot AUX 3&4) are used to access Aux Channels 5 and 6.

8.5.2.2 Auxiliary Card Version V0.1

Version 0.1 of the Auxiliary Card supports the connection of additional 64kbit/s auxiliary channels to Line at the expense of channels to Tributaries. For instance, the channels normally connected to Tributaries 3 and 4 can be connected to East A and West A respectively, as shown in Figure 8.6, leaving tributaries 3 and 4 unoccupied. This is achieved by the setting of DIL switches on the card. A different switch setting allows the channels connected to Tributaries 1 and 2 to be connected to West A and East A respectively, as well. Similar switches provide the same function for the asynchronous ports.

Table 8.4 shows the connections of auxiliary channels to line and tributaries for Auxiliary card version 'V0.1' via Auxiliary LTUs or front of card connectors. Up to two Aux LTUs may be fitted to access the following routes:

Table 8.4: Aux Channel Access Routes V0.1	
9.6kbit/s Access (Via LTU)	
LTU 1 Aux Port	To / From
Upper port 1 (Aux Ch 1)	Trib 1 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 3)
Upper port 2 (Aux Ch 2)	Trib 2 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 3)
Lower port 1 (Aux Ch 3)	Trib 3 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 2)
Lower port 2 (Aux Ch 4)	Trib 4 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 2)
LTU 2 Aux Port	To / From
Upper port 1 (Aux Ch 5)	Line East (SOH Ch 1) only
Upper port 2 (Aux Ch 6)	Line West (SOH Ch 1) only
64kbit/s Access (Via Card Front Connectors)	

Table 8.4:(Cont)Aux Channel Access Routes V0.1	
Aux Port Connector	To / From
Connector 1 (Aux Ch 1)	Line West (SOH Ch 1)
Connector 2 (Aux Ch 2)	Trib 1 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 3)
Connector 3 (Aux Ch 3)	Trib 4 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 2)
Connector 4 (Aux Ch 4)	Line East (SOH Ch 1) only
Connector 5 (Aux Ch 5)	Trib 2 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 3)
Connector 6 (Aux Ch 6)	Trib 3 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 2)

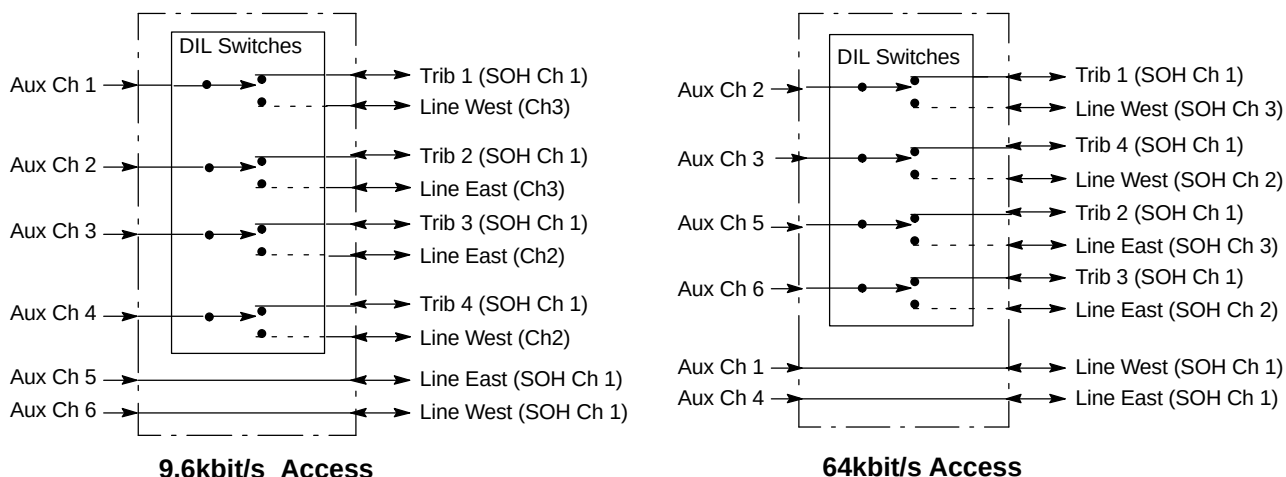


Figure 8.6 Auxiliary Card V0.1 DIL Switch Function

8.5.3 Auxiliary LTUs

One Auxiliary LTU 1HAM60786***, provides 2 off 9 pin 'D type' connectors for two auxiliary channels. One to two LTUs can be fitted to provide connections as follows:

8.5.4 By-pass

Overhead by-pass is provided for sites where the data is not used locally. For the asynchronous channels this is achieved by wiring the ports together on the Ancillary Unit.

On Version 0.1 synchronous ports, this method cannot be used, as the timing requirements may not be met. Instead, six re-timing circuits are provided and these are controlled by DIL switches. This enables each synchronous input to be routed to receive data from its front-of-card connector or from any output including its own. This provides any by-pass that may be required, as well as a 64kbit/s loopback option. The output for any port is inhibited when its input is not routed from its own front connector.

When a synchronous by-pass is invoked the phase of the associated transmit and receive clocks is compared and, if necessary, re-timed.

8.5.5 Clocks

There are two 38.88MHz clock inputs at 5V CMOS levels, one from each Switch Card. One input is designated Clock A and the ASIC is normally configured to use this input. A failure of this clock will be detected within 10 microseconds and the card will be automatically switched to Clock B. In the unlikely event of both clocks failing, the card will shut down.

8.5.6 A/B Line Security

Switching between East A/East B, or West A/West B, is achieved via two control signals on the backplane which select from four configurations stored in EPROM. These allow interworking with East A/West A, East A/West B, East B/ West A or East B/ West B.

8.5.7 Alarm Indications

An alarm condition exists when the card is either reset or is not powered, possibly due to a blown fuse. The reset circuit is invoked when the supply to the card falls below 4.4V or whenever a fault is detected. Following a reset, a fault latch is inhibited for a time sufficient for devices on the card to take up the initial input conditions.

The red LED on the card, when lit by itself, indicates a fault condition. This may be due to loss of switch clocks or that the card has not completed configuration after a reset. Under normal conditions the card provides a 'Card Present' signal to the Mux Controller. On Version 0.1 only, the 'Card Present' signal is removed if a card fault condition is detected.

The amber LED, when lit by itself, indicates that configuration has been successfully completed and the card is in service.

Both LEDs lit simultaneously indicates that an A to B or B to A change-over is in progress on Line East or Line West.

8.5.8 Auxiliary Card Applications

An example of the use of an Auxiliary Card is the omnibus handling of client telemetry, via RTUs, both around a ring and on STM tributaries.

Each external port consists of a V11 transmit pair and a V11 receive pair. The receive signal is sampled at 64kbit/s.

At the head-end, access to the network controller is via an RTU. On a ring, an RTU is provided to control the transmission of data between tributaries and East/West, so switching of data within the Auxiliary Card is not required. Where RTUs are down tributary lines, the Auxiliary Card on the ring provides V11 interfaces connected to the tributary OH-buses.

On the backplane, up to 8 overhead buses (depending on the shelf type) are connected to the Auxiliary Card. For example, on SMA-1 these are East A and B, West A and B, and tributaries 1, 2, 3 and 4. SMA-1c uses a subset of these. Each bus comprises four wires, Rx data, Rx frame sync, Tx data and Tx frame sync.

This typical application is shown in Figure 8.7. Other arrangements of time-slots versus V11 ports are possible within the restrictions shown in the figure.

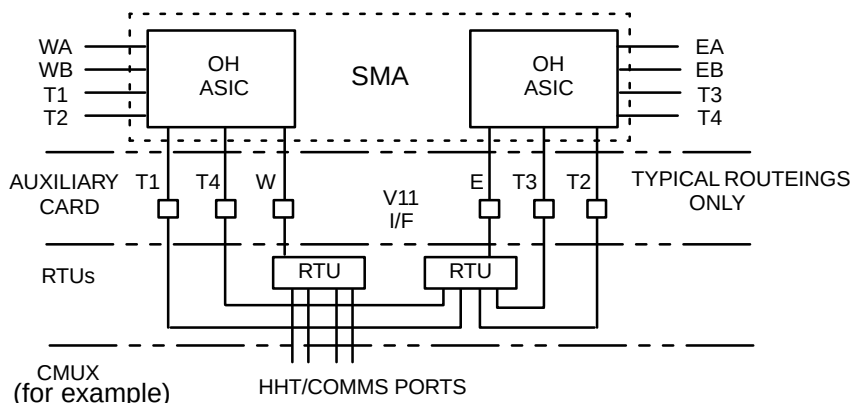


Figure 8.7 Auxiliary Card: System Application

No provision is made for the RTU relay contact alarm. It is assumed that failure of the RTU will be detected by the recognition of communication failure. In ring and star topology this will be handled by other RTUs.

An example of a ring controlling C-Mux products using RTUs and Concentrators is given in Figure 8.8. The Auxiliary Card provides access to the Line East and Line West and to the four tributary positions. All message routing control is performed by the RTUs.

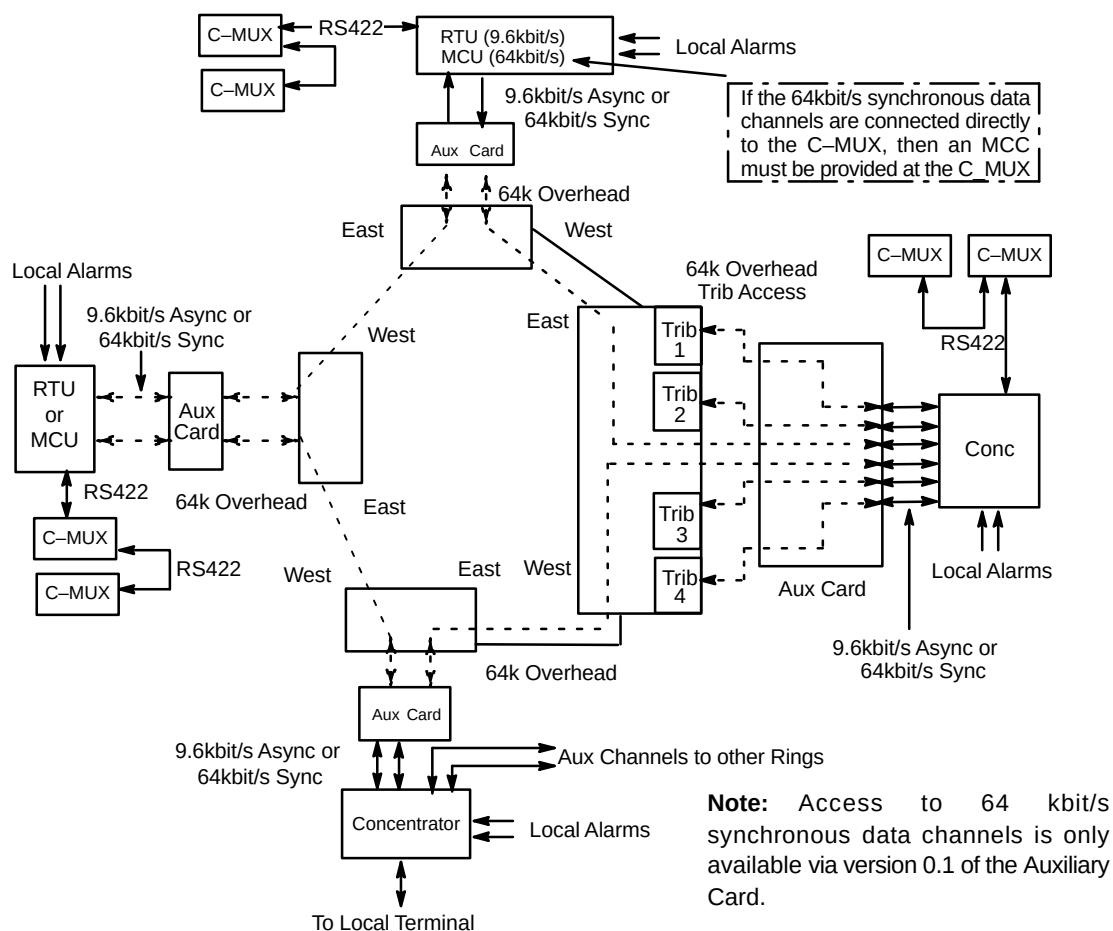


Figure 8.8 Control and Data Collection

If a data channel must be by-passed at a node in the ring, the input channel must be configured to communicate with the output channel and vice versa. For 9.6kbit/s channels normally connected via the Auxiliary LTU, this is achieved by wiring two ports together. For channels normally connected via the front panel of Aux0.1 this is not allowed because of interface timing requirements. Instead, DIL switches on the card must be configured to control the by-pass circuits. Further DIL switches control the allocation of ports to lines.

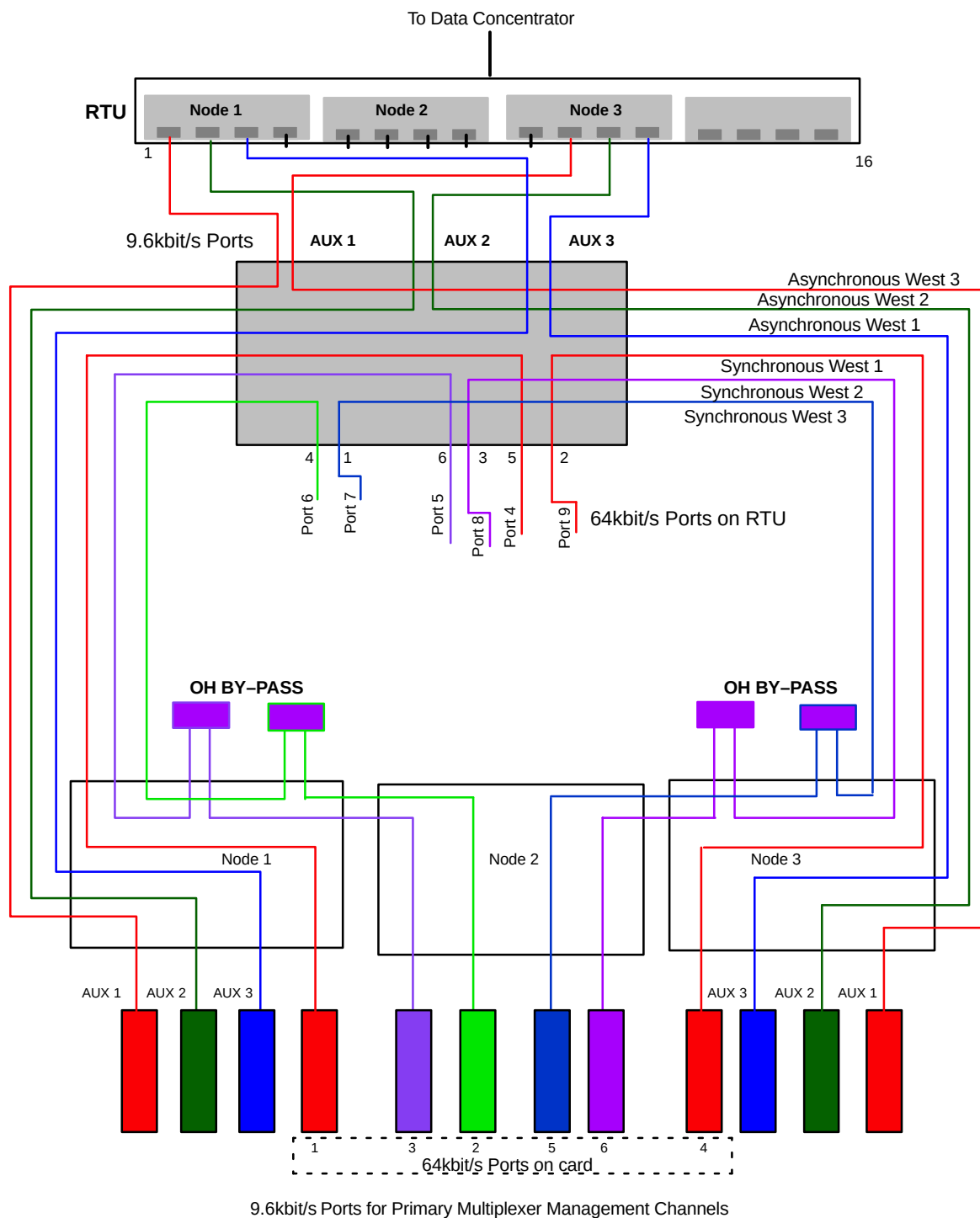


Figure 8.9 Network Example

In the example shown in Figure 8.9, the Synchronous ports are being used as extra 9.6kbit/s Asynchronous ports. (The word Synchronous is still used in this text to separately identify them.) No Tributary lines are used and all Synchronous ports are connected to East or West. All Asynchronous ports are connected to East or West as well, except for node 2 where none are used at all. So for all nodes, SW2-8 and SW3-8 are set to 10. The same setting is needed for SW2-7 and SW3-7, except for node 2 where they are set to 11 (no Asynchronous ports).

The first by-pass block on node one in Figure 8.9 is linking East channel 2 to West channel 2. Switches SW1 to SW3 segments 3 and 4 handle these. Setting segment 3 to 100 causes East channel 2 to listen to West channel 2 and setting segment 4 to 011 causes West channel 2 to listen to East channel 2 thus providing a bidirectional link.

The head-end (shaded) node and node 2 have no OH by-pass requirements so SW1 to SW3 segments 1 to 6 are all off on these nodes.

The configuration of which channels are switched to the East and West are controlled by DIL switches on the card. There are three DIL switches, each divided into 8 segments. Several combinations are available and the settings of the auxiliary card is determined by the EPROM which uses the DIL switches on power-up to set the channels.

An alternative example of the use of Version 0.1 of the card is shown in Figure 8.9. Here an RTU is used at the head-end only. The DIL switch settings for this configuration are shown in the following table.

Head-end (Shaded Node)								
	1	2	3	4	5	6	7	8
SW1	0	0	0	0	0	0	0	0
SW2	0	0	0	0	0	0	1	1
SW3	0	0	0	0	0	0	0	0

Node 1								
	1	2	3	4	5	6	7	8
SW1	0	0	1	0	0	0	0	0
SW2	1	0	0	1	0	0	1	1
SW3	0	1	0	1	0	0	0	0

Note: West and East 64kbit/s channels 2 and 3 are passed straight through. To achieve this, 1 listens to 2, 2 listens to 1, 3 listens to 4 and 4 listens to 3. West and East channel 1 is accessed.

Node 2								
	1	2	3	4	5	6	7	8
SW1	0	0	0	0	0	0	0	0
SW2	0	0	0	0	0	0	1	1
SW3	0	0	0	0	0	0	1	0

Note: The Asynchronous ports are not used.

The connectors used for Figure 8.9 are shown as AUX 1–3 for the Ancillary Card connectors and 1–6 for the card front connectors.

Node 3 will be the same as Node 1.

The DIL switch settings for Figure 8.9 are shown in Figure 8.10.

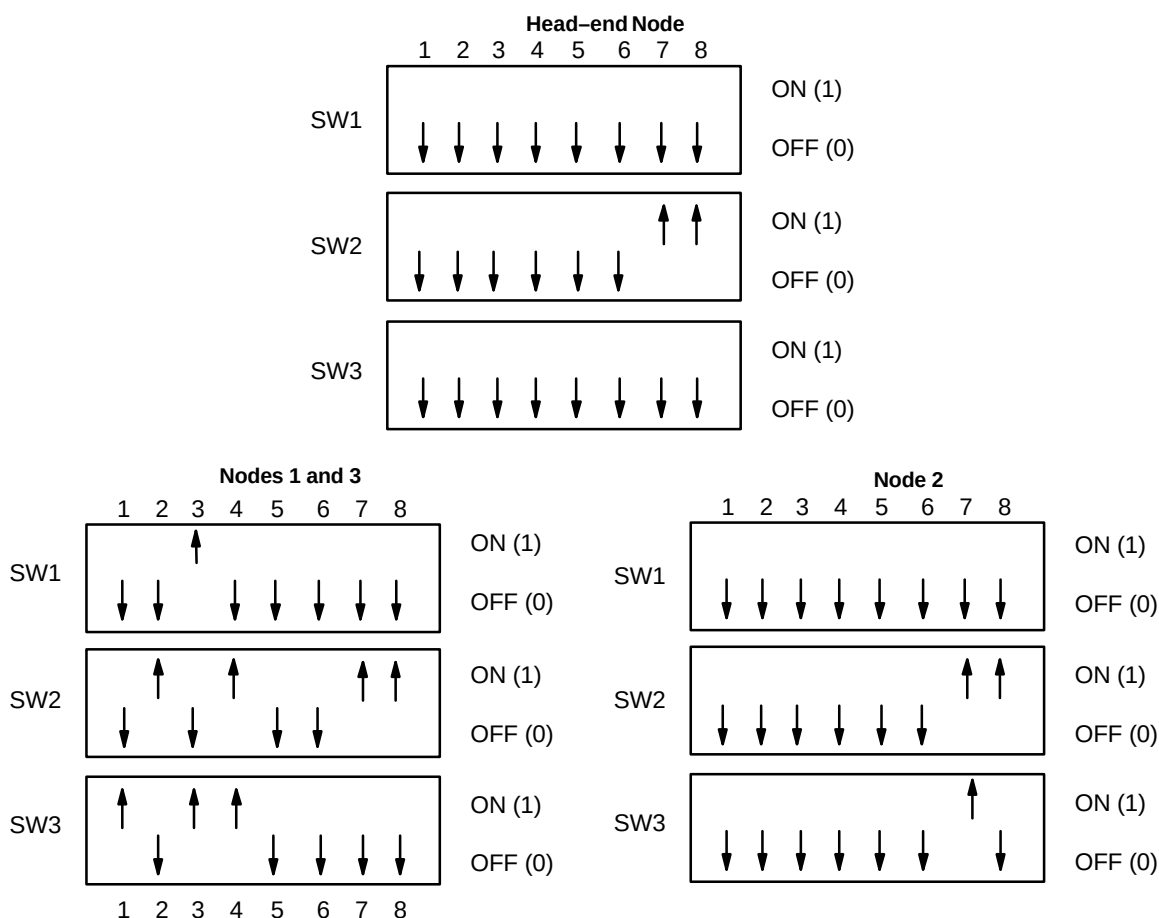


Figure 8.10 Example of DIL Switch Settings for the Configuration of Figure 8.9

8.6 SETTING UP SUB-NETWORK COMMUNICATIONS

At the commissioning stage, the elements in a sub-network must have a minimum of an NSAP address and communications paths established and enabled. These are configured by using a Local Terminal (LCT) at each element.

The sub-network example in Figure 8.11 known as SUB-NET '010RING1', has an NSAP type '37', the Sub-network Domain ID is '0040' and the System IDs for NEs is '0000320004000 to 00003200040004'.

The main steps in SUB-NET '010RING1' comms commissioning via a LCT, are as follows:–

- Set up the physical communications paths with LAPD configuration options, i.e. decide which ports to use and whether the port mode to be used is, i.e. User or Network. A User must connect to a Network or vice-versa. A User cannot communicate with another User, or a Network with a Network.

- b) Decide which DCC bytes must carry the communications data, i.e. DCCm or DCCr.
- c) Enter full NSAP addresses and decide the level of routing, i.e. Level 1 or 2
- d) Revise System diagram with all of the above.

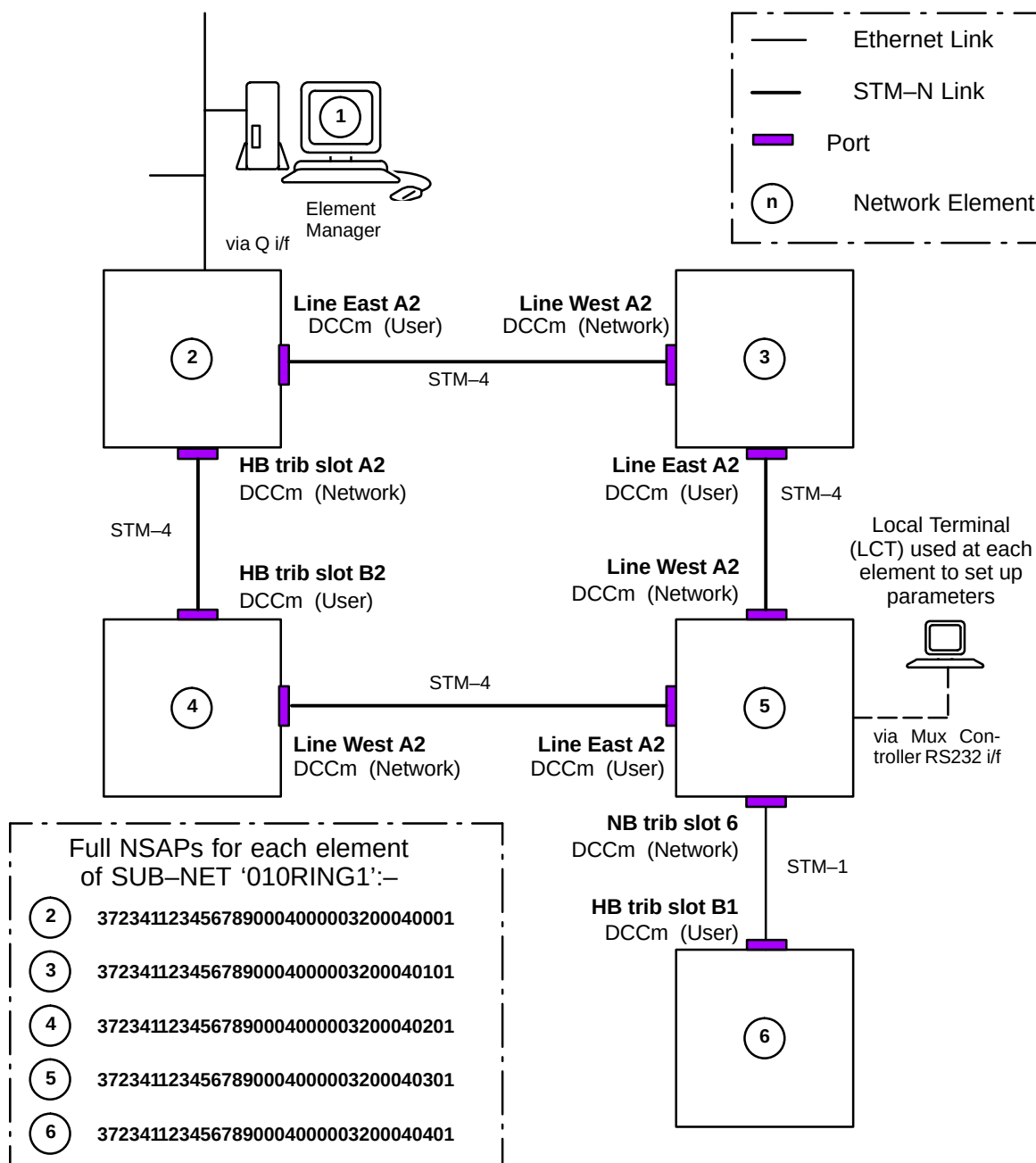


Figure 8.11 Setting up Communications for a simple Sub-network

8.7 COMMUNICATIONS FUNCTIONS FOR SMA–1/4CP

8.7.1 COMMS CONTROLLER

On the SMA–1/4CP, communication functions physically reside on a microprocessor, shared with Controller functions, in the Core unit.

Table 8.5: DCC Accessing Configuration for SMA–1/4CP			
Port Type	CC Slot Ref	Backplane OHB No.	S/W OHB ID
Line West	01H	1	01H
Line East	03H	3	05H
Expansion	n/a	n/a	n/a

8.7.1.1 Comms Controller Generic Features

The following generic features are provided :–

- Simultaneous access to both DCCr and DCCm of all STM–n line ports
- ‘tunnelling’ Data Domain messages (SNMP) through an SDH OSI DCN in order to manage PacketSpan expansion module (ETX10)

The maximum global number of NarrowBand products managed via a single SDH equipment is 24.

8.7.1.2 Comms Controller Generic Interfaces

The Core unit has the following interfaces relevant to Comms functions:

- A bi–directional overhead bus carrying the SOH bytes – in particular the DCCr and DCCm. This extends up to 2 line ports on the SMA–1/4CP.

8.7.1.3 Line Card Functions

The SMA–1/4CP provides two STM–N lines (choosing each between STM–1 electrical, STM–1 optical or STM–4 optical) on each Core card. No VC–AM card is equipped on the SMA–1/4CP.

8.7.1.4 Management of Communications

No physical message passing interface is present on the SMA–1/4CP. Both Communication and Control function reside in the same microprocessor on the Core card.

8.7.1.5 Comms Associations

Communications associations may be opened and closed in the following way:

- The EM is responsible for opening EM–NE communication associations. Once open, an association may be closed by the EM or by the NE. This is applicable also to the communication between MV38B and SMA–1/4CP and between the Ethernet Manager via Front–End Proxy for the SNMP and PacketSpan expansion (ETX) through the SDH ADM.
- An NE is capable of opening and closing associations with other NEs. This is a feature required to support Single–Ended Maintenance. All NEs in a network are reachable.

8.7.1.6 Protection of Communications

A check of “sanity” of each link is performed periodically and a table of active connections is maintained in the Comms subsystem of SDH ADMs and in the Element Manager.

8.7.1.7 Communications Subsystem Performance

The following Comms features are supported:

- Packet throughput of up to 90pkts/s
- Up to 250 Level–1 nodes supported in routeing tables
- Up to 100 Level–2 nodes supported in routeing tables

8.8 COMMUNICATIONS FUNCTIONS OF THE COMMS/CONTROLLER CARD

Communications functions of the Comms/Controller Card (used with SMA–1/4(4+4) and SMA–1/4(8)) deal with network management message handling and message routing to network element Multiplexer Controllers across an SDH network.

Network Management includes remote LCT functionality available from versions 1.21.3 onwards.

The Comms/Controller Card has an AUI interface and when used with the AUI LTU via a 15pin D type, a Q Interface is available. An external attachment unit is required to convert the Q.B3 (AUI) into an Ethernet interface (10base2) for connection to EMOS. Other adaptors may be purchased from suppliers for thick Ethernet cable (10base5) or unshielded twisted pair (10baseT). For example, 1HGB60001AAF–EFA for 10base2 and 1HAQ60764AAC–EFA for 10baseT.

The Card routes messages, for its own Multiplexer Controller, across the internal message passing busses. Messages for other network elements are routed over the overhead access buses and are embedded into the line signal using the STM–1 SOH DCC channels (CCITT G784 Qecc interfaces). Overhead buses interface to the Comms card, each being able to carry a DCC channel (DCCr[192kbit/s] and DCCm[576kbit/s]).

8.8.1 SMA–1/4c, SMA-1/4uc and SMA1/4(4+4)(8)

8.8.1.1 COMMS CONTROLLER

On the SMA–1/4c/uc and SMA–1/4(4+4)(8), communication functions physically reside on a dedicated microprocessor in the Comms/Controller card.

8.8.1.2 Comms Controller Generic Features

The following generic features are provided :–

- Simultaneous access to both DCCr and DCCm of all STM–n ports.
- Gateway functionality to the SDH network, providing a LAN interface (Ethernet).
- Interface with the MC subsystem through a Message Passing Interface.
- Tunnelling Data Domain messages (SNMP) through an SDH OSI DCN in order to manage PacketSpan cards.

The maximum global number of NarrowBand products managed via a single SDH equipment is 24.

8.8.1.3 Comms Controller Generic Interfaces

The Comms/Controller card has the following interfaces relevant to Comms functions:

- A bi–directional overhead bus carrying the SOH bytes. In particular the DCCr and DCCm. This extends up to 20 ports on SMA–1/4(4+4)(8), 10 ports on SMA–1/4c/uc.
- The interfaces to the MC.
- A Q Interface to the EM. This is an Ethernet connection. Both SMA–1/4c/uc and SMA–1/4(4+4)(8) at the gateway may interface to the EM via a Q interface. This is through an AUI.

8.8.1.4 Line Card Functions

SMA–1/4c/uc and SMA–1/4(4+4)(8) provide two STM–N lines (choosing each between STM–1 electrical, STM–1 optical or STM–4 optical) on each core card. The VC–AM card can be equipped.

8.8.1.5 Management of Communications

The message passing interface is used for passing management and supervisory messages as well as relaying layer 3 and layer 4 comms messages between the MC subsystem and CC subsystem. A message set is used for passing these messages.

8.8.1.6 Comms Associations

Communications associations may be opened and closed in the following way:

- The EM is responsible for opening EM–NE communication associations. Once open, an association may be closed by the EM or by the NE. This is applicable also to the communication between MV38B and DCC AUX through the SDH ADM.
- An NE is capable of opening and closing associations with other NEs. This is a feature required to support Single–Ended Maintenance. All NEs in a network are reachable.

8.8.1.7 Protection of Communications

A check of “sanity” of each link is performed periodically and a table of active connections is maintained in the Comms subsystem of Access SDH ADMs and in the Element Manager.

8.8.1.8 Comms Subsystem Performance

The following Comms features are supported:

- Packet throughput of up to 135pkts/s.
- Up to 250 Level–1 nodes supported in routeing tables.
- Up to 100 Level–2 nodes supported in routeing tables.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 9: EVENTS

9.1 INTRODUCTION

Instances of changes are called 'events'. Events fall into the following categories:–

- **Alarm events** – events detected by fault monitoring systems.
- **Status events** – these arise from re–configuration of a NE.
- **Performance events** – these arise when performance thresholds are exceeded.

Event processing (handling) uses parameters that are operator configured via the Local Terminal (LCT). Initially, an element will have default values, these can be changed during commissioning to suit operating authority requirements.

Event handling involves the capture, verification, classification, logging, reporting and indications of changes in the status of a Network Element (NE). This involves the detection of changes in state of the configuration of a NE (connectivity, alarm attributes, equipping levels, protection paths etc.) or a new state of the set of fault monitors (changes) within a NE or the performance limits being exceeded.

The initial default values for events/alarm parameters can be altered via an LCT. Various and a mixture of facilities may also be enabled and disabled via these screens.

9.2 PROCESSING

The event processing scheme is illustrated in Figure 9.1. All events are processed by the Mux Control function.

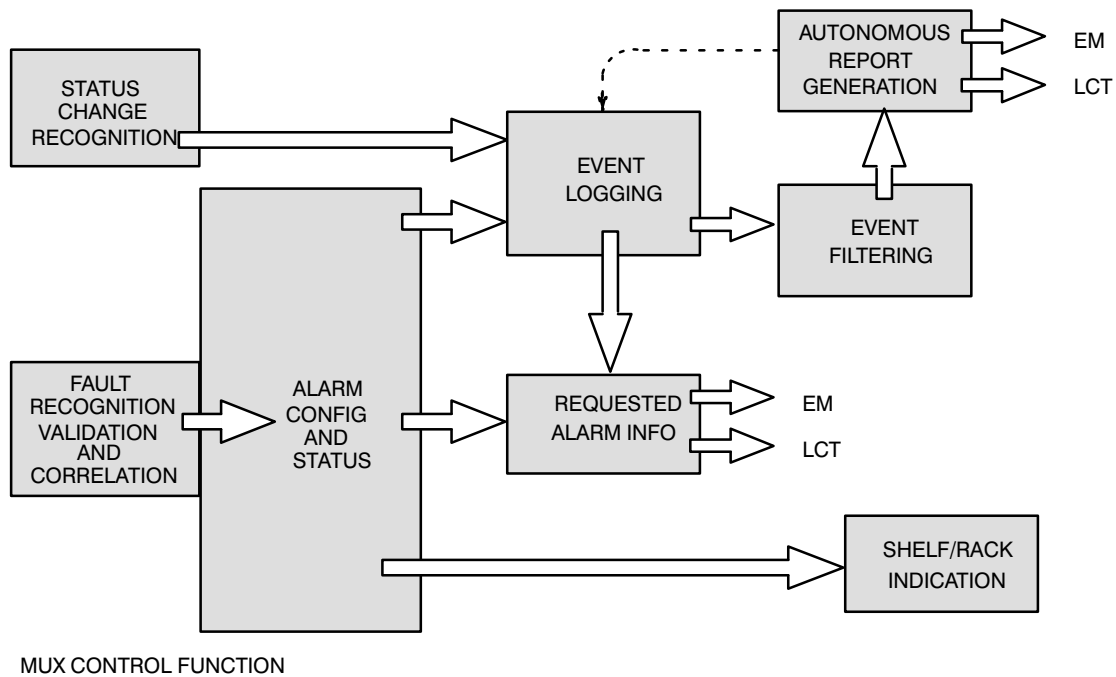


Figure 9.1 SMA-N Event Processing Scheme

Events pass through a two stage logging procedure that:

- Assists in the alignment of a NE and Element Manager (EM) on restoration of a link to an EM.
- Provides a user with an historical event search facility.

Autonomous generation of event reports is supported for alarm, status and performance events, whilst card, shelf indicators and rack extensions are supported for the indication of alarm events in the immediate proximity of the sub-rack installation.

9.3 ALARM PARAMETERS

9.3.1 Alarm Events

Alarm events are derived from fault events that can be defined as the change of state of the output of any individual fault monitor within an NE. Fault monitors recognise and detect conditions that are indicative of a fault within or external to the equipment. These fault events are validated and correlated in order to become alarm events, which can then be filtered for event forwarding purposes.

Alarm events are used to alert an operator to a change occurring in the set of monitor states for a given NE. This may be due to the occurrence or subsidence of a given fault condition. Faults are then categorised into types by the detected condition. Due to the modular construction of a NE a single fault condition can be detected at multiple points within it. Each fault type therefore has a unique identity that indicates its source.

9.3.2 Event Recognition And Validation

Event (fault condition) recognition follows the rules for persistency and hysteresis as defined in ITU Recommendation G.709. All fault conditions that satisfy the persistence criteria are then validated with respect to their inversion state. The validation of fault events fall into four main categories, disable, persistence, consequential suppression and inversion.

9.3.3 Fault Attributes

The previously mentioned events are configurable via the LCT and cover the following (attribute) ranges:

- Event/Alarm Type; Comms, Quality of Service, Processing Error, Equipment and Environmental alarms.
- Perceived Severity; Critical, Major, Minor, Warning, Indeterminate. Detection Thresholds.
- Inhibit; True or False.
- Disable; True or False.
- Persistency; 0 sec off, 100ms, 300ms, 1, 3,10 and 30 seconds.
- Invert; True or False.
- Fault Actions; True or False.
- Local Indications; Customer specific ranges.

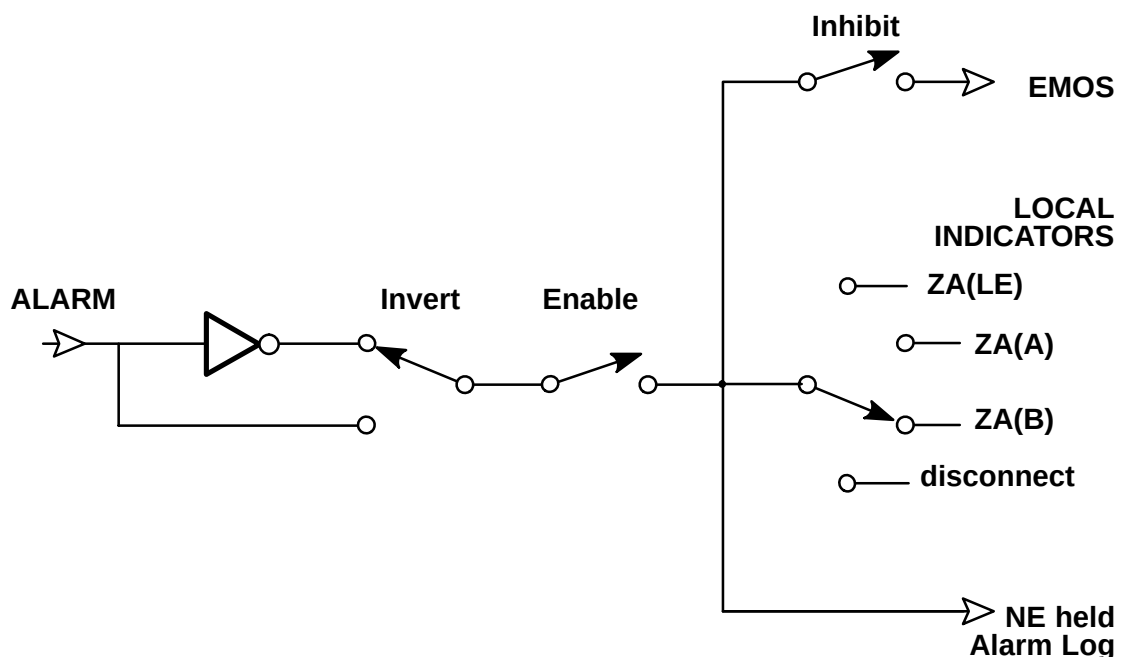


Figure 9.2 Alarm Event Type Configuration Options

Figure 9.2 represents some of the choices that can be made when configuring the Alarm Event Type via the LCT. Note that the Local Indicators would depend on the type of alarm indication scheme used.

9.3.4 Persistence and Consequential Suppression

User configurable persistency is provided on a per monitored entity type basis. The multiplexer is supplied with default values for these entities via the Mux Control function on powering-up. These can then be altered to an individual customer's specific needs after commissioning is completed.

Information gained from the persistency function is used to determine the state of additional fault types. These additional fault types relate to the intermittent state of each monitored entity, being raised if one or more of the fault types associated with that monitored entity is intermittent. When fault types are detected as intermittent, then specific behaviour is required, that is to say:

- Repetitive raised or cleared alarm events are not generated for the intermittent fault type, but are replaced by a steady intermittent fault type for the duration of the intermittent period.
- Consequential suppression uses these steady states, whilst less important fault types are being maintained at their last known state for the duration of the intermittent period.

Consequential suppression thus ensures that when multiple faults arise, that the only alarm which is raised is that which applies directly to the fundamental fault condition. The overall suppression scheme for the NE is defined in ITU Recommendation G.783.

9.3.5 Inversion State

The 'Inversion State' is the nominated state of a fault signal that is interpreted as 'no fault condition'. The nominated state can be either active or inactive, and is operator configurable.

9.3.6 Alarm Inhibit/Filtering

The Alarm Inhibit/Filtering facility can be assigned to each individual alarm that does not require recognition:

- To reduce the number of alarm messages throughout.
- To determine whether or not an alarm condition is reported to the EM and LCT.
- To determine whether or not the alarm condition appears in the alarm log.

9.3.6.1 Category

A 'Category' is a numeric value between 1 and 9 assigned to each alarm and designating its category in terms of type, urgency, and destination (extension and display) within the rack alarm scheme. Dependent upon the alarm scheme being used, categories include 'Disconnected' (i.e. no indication on Shelf Display LEDs and Rack Alarm Unit) and 'Not Monitored' (i.e. totally ignored). Categories are operator configurable via the LCT.

9.4 REPORTING AND DISPLAY FACILITIES

9.4.1 Event Reporting

Event Reporting is the reporting of events to the LCT and EM. An operator at either location can enable or disable the facility.

When the facility is enabled, all autonomous events are reported to the LCT and the EM. At the LCT, an incoming alarm message is announced by a status line at the bottom of the screen, together with an audible warning.

When the facility is disabled, no autonomous alarm events are reported by the SMA–N, and consequently no alerting indication is shown at the LCT. In this case an operator would have to search the Alarm/Event logs for any Alarm conditions/events.

9.4.2 Current Event Logs

Current Event Logs, Alarm Event, Status Event, and Performance Event provide an indication of the current details of event states on a cyclic basis. These logs hold up to 100 events at any given time (apart from the Current Alarm Events Log which holds up to 250 events). The log can be configured so that once the capacity has been exhausted, the log accepts no more changes, or wraps and loses the oldest changes. Alarms/Events are applied to the logs via a priority inhibit/filtering process (para 9.3.6). An operator at either LCT or EM can display and clear these Event logs.

9.4.3 Historical Event Logs

The Historical Event Logs. Alarm Event and Status Event provide an indication of historical changes of event states on a cyclic basis. The logs hold up to 100 events at any given time. The log can be configured so that once the capacity has been exhausted, the log accepts no more changes, or wraps and loses the oldest changes. Events/Alarms are applied to the logs via a priority inhibit/filtering process (para 9.3.6). An operator at either LCT or EM can display and clear these Event logs.

9.4.4 Active Source Alarms Display

An operator at a LCT can display all active alarms recognised by the SMA and received at the LCT. The display is presented on a 'per card' basis.

All active alarms can be displayed, in response to an operator demand, as a list which can be scrolled through to view. Each alarm source, type, state, date and time of any transitions is shown. The operator can sort the alarm list by type or date/time.

9.4.5 Display and Action all Local Alarms

An operator can display and action all Local Alarms recognised by the SMA and received at the LCT. The display is presented on a 'per card' basis.

To action, an operator works down through menus to the specific alarm required, then selects the appropriate action from the option fields.

9.5 PROCEDURES

Operating procedures associated with the display and selection of alarm reporting facility options are covered in the LCT operator manual (supplied under separate cover), together with the fault diagnosis details.

9.6 ALARM SCHEMES

9.6.1 TEP1E Alarm Scheme

The TEP1E alarm scheme recognises various types of alarms. Alarms are also given a perceived severity rating, in the range 1 (highest) to 5 (lowest) which is used to enable an operator to prioritise the fault finding process.

Default values for the Event Types, Perceived Severity and Local Indication (Category) are assigned by software to each alarm at the commissioning or configuration stage.

Subsequent to commissioning, the category and priority of any alarm can be changed, independently, via the Local Terminal. There is also a facility to globally inhibit the drive to the fault LED on all cards except the Comms/Controller Card and PSU.

9.6.1.1 TEP1E Shelf Alarm Display LEDS

The Shelf Alarm Display LEDs are situated at the right-hand side to the middle of the ancillary LTU area of the SMA1/4(4+4) and SMA1/4(8) sub-racks. The area houses two LEDs one RED and the other GREEN, which indicate the overall alarm status of the sub-rack. It also houses a pressbutton switch that provides a receive attention facility. A15-way D-type connector is also fitted to the LTU, and when required to do so, extends the alarm conditions to a Top-of-Rack Display (see LTUs Page 299).

An SMA1/4(4+4) or SMA1/4(8) sub-rack interfaces to the rack alarm schemes via a customer specific LTU. This unit provides an interface for the complete in-station alarm scheme, as well as providing for electrical cross-connectivity between the Mux Controller function of the Comms/Controller Card, Power and Alarm Interface LTUs and the shelf PSUs. It also provides connectivity between the backplane and the LCT LTU, which contains the SMA Backplane Inventory data in EEPROM, together with some configuration data.

9.7 BW7R ALARM SCHEME

The BW7R alarm scheme recognises various types of alarms. Alarms are also given a perceived severity rating, in the range 1 (highest) to 5 (lowest) which is used to enable an operator to prioritise the fault finding process.

Default values for the the Event Types, Perceived Severity and Local Indication (Category) are assigned by software to each alarm at the commissioning or configuration stage. The default inversion state of all alarms is 'Normal'.

The Bw7R alarm scheme recognises two main types of alarms:

- *Fault Alarms.* These indicate a malfunction or failure of one or more cards on the SMA that can be rectified by local action.
- *Disturbance Alarms.* These indicate a degradation or failure of traffic transmission detected by, but not necessarily attributable to this specific SMA.

Fault Alarms are divided into categories of Urgent and Non-Urgent and in each case further categorised into alarms that activate the card LED and those that do not. Disturbance Alarms are categorised as Urgent, Non-Urgent, and a third category specific to an STM-1 or STM-4 Loss Of Signal condition and designated LE.

These basic categories are incorporated into a nine level category scheme that also includes the alarm disconnected state and one which has not been allocated (category 8). For more information refer to the SMA Series 4 Maintenance handbook.

These are default settings only. Subsequent to commissioning, the category and priority of any alarm can be changed, independently, via the Local Terminal. There is also a facility to globally inhibit the drive to the fault LED on all cards except the Comms/Controller Card and PSU.

9.7.1 Bw7R Shelf Alarm Display LEDS

The Shelf Alarm Display LEDs are situated at the right-hand side of the ancillary LCT LTU area of the SMA1/4 and SMA-1/4c/uc sub-racks. The unit houses three LED that together indicate the overall alarm status of the sub-rack, in terms of Bw7R 'Fault Alarms'. It also houses a pushbutton switch that provides a receive attention facility. A15-way D-type connector is also fitted to the LTU, and when required to do so, extends the alarm conditions to a Top-of-Rack Display. The front panel layout is shown on Page 297.

Only Fault alarms are displayed on the Shelf Alarm Display LTU. These alarms may be cancelled by the push-button on the Display LTU. Disturbance alarm extensions, i.e. Za(A), Za(B) and Za(LE) are not visually indicated within the SMA and cannot be cancelled by the Shelf Alarm Display push-button.

9.7.2 Subrack Displays

Eight LED indicators are provided within the SMA-1/4(4+4) and SMA-1/4(8) subracks. These LED indicators are located as shown in Table 9.1. They indicate the existence of alarms with specific local indication categories within the NE. For more information refer to the SMA Series 4 Maintenance handbook.

Table 9.1: LED Location Details			
Location	Indicator Colour	Category	Meaning
Alarms LTU	Red	URG	New faults exist requiring urgent attention
“ “	Red	NURG	New faults exist not requiring urgent attention
“ “	Yellow		Old faults exist (since cancel button last operated)
Alarm Card	Red	INT	Fault is in this equipment
Front Panel	Red	EXT	Fault is in some other equipment
“ “	Yellow	ABN	Abnormal condition exists
“ “	Yellow	IND	Path maintenance signal being received
“ “	Red	POWER	One or more PSUs are faulty

9.7.3 Rack Alarm Interfaces

SMA–1/4(4+4) and SMA–1/4(8) incorporate two separately controllable relay contacts that provide Red and Yellow rack lamp control interfaces. These relay contacts are accessible via the RM interface connector on the Alarms LTU and they switch the positive leg of the service voltage (V Service Pos) which is made available to the SMA on the same connector.

The relay contacts minimum rating are as following :–

- Vmax = 76V (100V pulse)
- Imax = 50mA

Each relay contact is separately protected by a zener diode with the following rating:–

- Voltage = 100V + 15%
- Power = 1W

The Red lamp control extends a summary of alarms to the top of rack display equipment, thus indicating the presence of new alarms within the NE to the operator .

The Yellow lamp control extends a reminder to the top of rack display equipment, thus indicating the presence of cancelled alarms within the NE to the operator.

9.7.4 SMA–1/4CP

As the SMA–1/4CP is not provided with a dedicated rack alarm interface, the option is provided (operator configurable) to allow the user alarm outputs to be assigned to implement a simple Local alarm scheme. When configured to this mode the output states will be set based on the Alarm Extension Category of active alarms.

Two modes of operation are supported:

- User controlled.
The user manages the relay output state (open/closed) from the management system.
- Local alarm scheme.
The relay outputs are activated autonomously by the Base unit based on the local alarm extension category of active alarms.

The mode is configurable from the management system.

The outputs are set as follows:

Table 9.2: SMA-1/4CP Alarms – Relay 1	
Alarm State	Relay 1
No Critical or Major severity alarms active	Open
Critical or Major severity alarm active	Closed

Table 9.3: SMA-1/4CP Alarms – Relay 2	
Alarm State	Relay 2
No Minor or Warning severity alarms active	Open
Minor or Warning severity alarm active	Closed

9.7.5 Station Alarm Interfaces

SMA-1/4(4+4) and SMA-1/4(8) house separately controllable relay contacts, which provide various station alarm control interfaces. These relay contacts are accessible via the B interface connector on the User Alarm LTU (see Page 301), and switch the positive leg of the service voltage (V Service Pos) which is made available to the SMA on the RM connector on the Alarms LTU.

The SMA-1/4(4+4) and SMA-1/4(8) subrack has 32 relay contacts, and these relay contacts have the following minimum rating:–

- $V_{max} = 76V$ (100V pulse)
- $I_{max} = 50mA$

Each relay contact is separately protected by a zener diode with the following rating:–

- Voltage = 100V + 15%
- Power = 1W

Additionally, the SMA-1/4(4+4) and SMA-1/4(8) also support four user alarm inputs via the B interface connector on the User Alarm LTU.

Note: It should be noted that a single fault type such as 'Trib Input Loss of Signal' is required to activate a different B interface connector contact dependent upon the traffic rate assigned to the port.

As the traffic rate can be determined from the type of card sourcing the alarm, the local alarm scheme recognises the presence of an alarm, and dependent upon the source card type, instructs the Italtel alarm card to activate the correct contacts.

9.8 FAULT DICTIONARY

A complete list of all SMA alarms, for the TEP1E and Bw7r alarm schemes, with their corresponding Local Indication, Perceived Severity and Event Type can be found in the appropriate Maintenance manual. Fault Finding procedures included in the Maintenance manual provide instructions on how to rectify all tabulated alarms, as they are reported at the LCT.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 10: PERFORMANCE

10.1 INTRODUCTION

The SDH and PDH multiplexing structures as defined in CCITT recommendations, provide a number of Overhead (OH) bytes which are used for non-intrusive In-service monitoring of the error performance of the network. Within the SDH, bytes are also reserved for the monitoring of Section (Repeater and Multiplex) performance, and individual Path (Higher Order and Lower Order) performances.

10.1.1 Data Accumulation

System performance is continually monitored at each traffic card. The Mux Controller polls each card at 1 second intervals, whilst gathering performance (and alarm) data.

Performance data is processed and reports generated in accordance with CCITT Recommendation G784. The use of this, and other features described in this chapter, will be found in the associated Local Terminal (LCT) Operator Manual.

10.1.2 Performance Threshold Levels

The LCT operator can set configurable parameters (threshold levels) for the various performance related entities. If these operator configured threshold levels are exceeded (as the volume of errors increases over a 1 second period), Block Errors which occur for a second become an 'Errored Second' (ES). Should the ES parameter threshold be set and exceeded, then the Errored Seconds become 'Severely Errored Seconds' (SES). If the SES preset parameter threshold is then exceeded, it will become Unavailable Seconds (UAS). For further details and the meaning of the terminology used in this paragraph, see the Glossary which is included at the front of this manual, together with the associated Local Terminal (LCT) Operator manual.

10.1.3 2Mbit/s Traffic Monitoring

A dedicated 2Mbit/s Test Bus LTU can be fitted to an SMA-1/4c/uc sub-rack in Ancillary slot AUX 5/6. The function of this LTU is to enable the customer/engineer to monitor the performance of 2Mbit/s traffic (ie error free condition) using external monitoring equipment (see Page 307).

Note: For SMA-1/4c/uc, the 2Mbit/s Test Bus is fitted via a connection on the SMA-1/4c/uc enhanced ancillary LTU.

10.1.4 Synchronisation Threshold Levels

Synchronisation Event Report Thresholds are associated with the overall equipments performance. They can either be globally set on a per system basis (default values loaded from the Mux Controller) to specified values, or individually set by an operator as required, via the LCT. A typical example would be a count threshold of 50 set for a 15 minute maximum count of 1×10^6 and a 24hr maximum count of 100×10^6 reporting of TU3 Excessive Pointer Justification Events (EPJE).

10.1.5 CSES Performance

Consecutive Severely Errored Seconds Count (CSES) Performance Thresholds are associated with the monitoring of the overall equipment performance. They can either be globally set on a per system basis (default values loaded from the Mux Controller) to specified values, or individually set by an operator as required. All CSES reports (eg. RS B1 BIP CSES) can have their threshold levels set between 1 and 9, with a default value of 5.

10.1.6 USE

Unacceptable Short-term Errors (USE) is a User configurable condition which may be generated when the number of consecutive Severely Errored Seconds (SES) for a particular Error Performance Monitored Entity exceeds a preset threshold. This condition can be used to instigate protection switching or for example to deem a Sync source unacceptable.

Note: As these Error Performance Primitives do not necessarily lead to data errors, they are not compiled into 15Min and 24Hr reports and used for Long-term Error Monitoring.

10.1.7 DEG Performance

Degrade (DEG) is also a user configurable condition which may be generated when the number of consecutive Severely Errored Seconds (SES) for a particular Error Performance Monitored Entity exceeds a preset threshold. Unlike USE however, the condition parameters are independent of SES.

Note: The DEG threshold range and defaults are based on the SES thresholds. The range for SES is 1 to 50% of max. count; DEG uses 1 to 100% of max. count. The DEG defaults are a half of SES default value used for USE. For more details on threshold values refer to the appropriate Operator Handbook.

10.1.8 Performance Data Processing

The Mux Controller, having processed the counts from the individual traffic cards, maintains aggregated counts for all monitored entities within the SMA over a pre-defined period of time. There are two durations for the performance data report period, 15 minutes and 24 hours. At the end of each subsequent period the SMA is able to generate a performance data report containing all such counts.

The counts generated for the various monitored entities are:–

- Out-of-Frame seconds

- Block errors (configurable thresholds)
- Errored seconds (configurable thresholds)
- Severely Errored seconds (configurable thresholds)
- Unavailable seconds
- Number of unavailable periods during the report period

The SMA is also capable of generating Exception Reports to indicate that the operator configurable performance thresholds have been exceeded and the start and finish of periods of unavailability. Exception reports can be sent at any time and are intended to assist short term maintenance and to give immediate indication of performance degradation.

The SMA maintains a Date and Time clock for the labelling of all of the data and exception reports. The clock can be set via the Network Management Interface.

The operator may enable or disable either or both 15 minute and 24 hour reports.

Note: Enabling/disabling performance reports using the LCT affects reporting at the Element Manager, not the LCT itself.

A limited number of 'old' data reports are stored by the SMA as records. These reports, stored as 'Previous Records', may be requested at any time, via the NMI.

10.2 TANDEM CONNECTION MONITORING

Tandem Connection Monitoring is a form of non-intrusive performance monitoring. For further information see Chapter 17.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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CHAPTER 11: OPERATOR CONTROL

11.1 INTRODUCTION

An element (see Figure 11.1) can be controlled and monitored by an operator either from an Element Manager or a Local Terminal (LCT), but only one of these can have access at any one point in time.

The Element Manager is a 'workstation' terminal, which communicates with all elements in the the network via embedded communication channels. It provides management facilities for the complete network.

The LCT is an IBM compatible PC that is connected locally, when required, to any network element to provide control or monitoring functions.

11.2 OPERATOR CONTROL FROM AN ELEMENT MANAGER

An Element Manager is connected via designated 'Gateway' elements in the network. Connection between an Element Manager and a Gateway element is via an Ethernet Local Area Network A 'full-functionality' Communications Card within the Gateway element provides the Q interface function. Communications between a Gateway element and other network elements is via the Data Communication Channels (DCCs) embedded in the STM frames.

The Element Manager is intended to operate from a network management control centre. As well as the central control functions, it can perform most of the functions applicable to the LCT. It is the subject of a dedicated Element Manager operator manual.

11.3 OPERATOR CONTROL FROM AN LCT

An LCT can be connected, as required, to any element (including the Gateway element). For the SMA-1/4(4+4)(8), the LCT RS232 communications cable is plugged into a 'D-type' connector on the LCT Ancillary LTU. For the SMA-1/4CP and SMA-1/4c/uc, the LCT is an RJ45. Control is exercised via the Mux Controller function.

Note: Both male and female sockets are provided on a single LCT LTU.

Using Single Ended Maintenance (SEM) functionality, the LCT can access other elements in the network from the element it is currently connected to. All necessary application software is contained on the LCT and is mouse/menu driven. LCT operation is the subject of a dedicated LCT operator manual.

11.4 SECURITY

11.4.1 Element Manager Operator Access

There are several levels of permission available to access the Element Manager (Refer to the appropriate Element Manager operator manual).

11.4.2 Element Manager Operator Control of LCT Access

An Element Manager operator can set the LCT access conditions at any of the elements in the network. These conditions are:

- LCT login enabled or disabled.
- LCT login enabled (as above), but read only permission granted.

11.4.3 LCT Operator Levels

LCTs can be used at three levels of operation. The level to which an individual operator can work is determined by password access. The levels are:

- **Administrator** (high level) – all access.
- **System Operator** (intermediate level) – limited read/write access.
- **Casual Operator** (low level) – read only access

Note: Allocation of a level password **must only** be made to suitably qualified personnel for the level concerned. Also, in the presence of Element Manager, the full operation of the LCT is subject to the conditions described in Paragraph 11.4.2.

11.4.3.1 Administrator

An Administrator has full access to all LCT functions, but is the only level of LCT operator who can do the following:

- Add, delete or change lower level LCT user passwords – up to 9 other users can be created and the level of user specified (an LCT Administrator Operator cannot change the Element Manager Operators password, but an Element Manager Operator can change an LCT Administrators password). The passwords are stored in the element memory.
- Request a list of LCT users.
- Decommission the element.

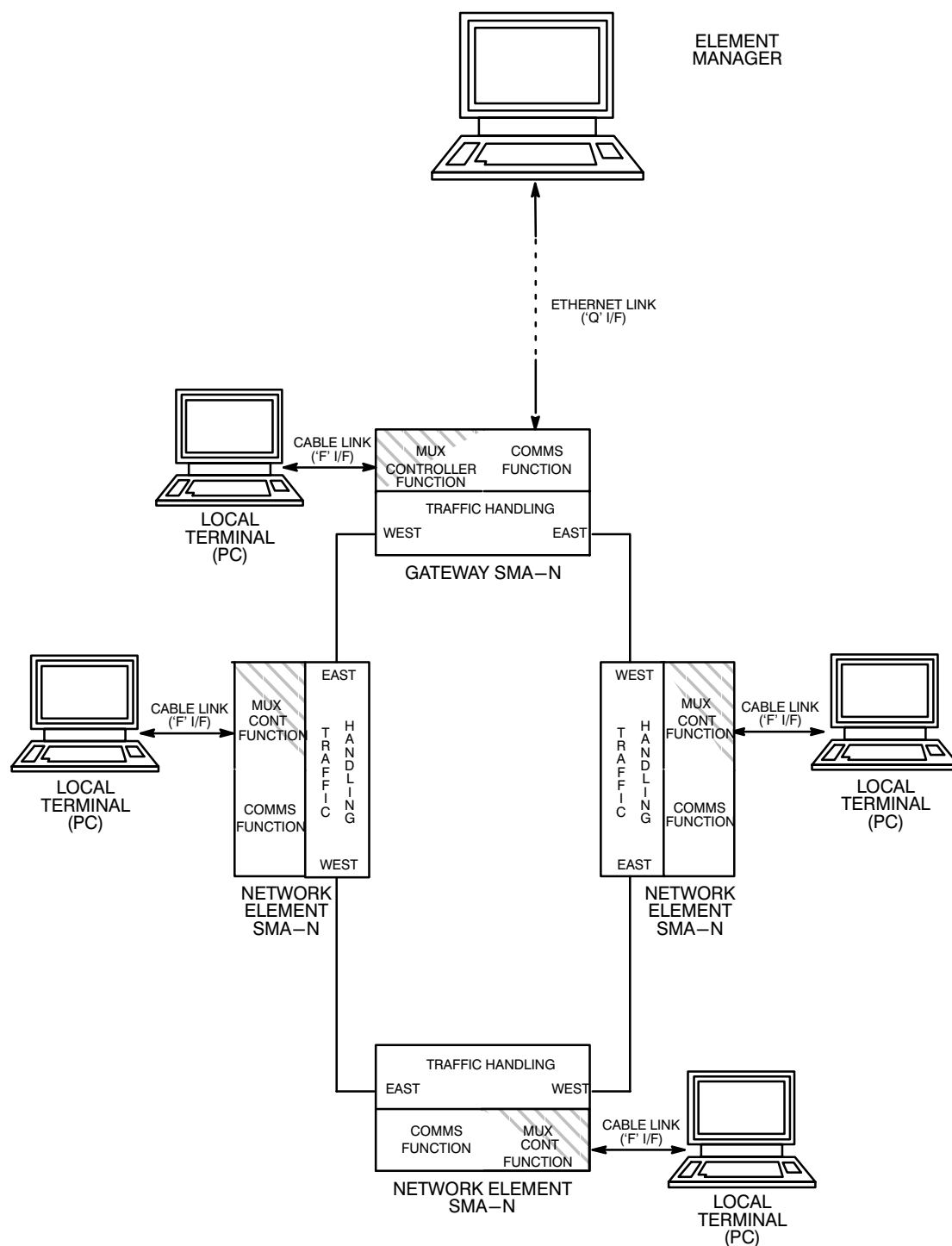
11.4.3.2 System Operator

A System Operator has access to all LCT functions, bar the Administrator specific functions described in Paragraph 11.4.3.1.

11.4.3.3 Casual Operator

The Casual Operator is restricted to read only access, and also cannot perform Software Download.

Note: If communication to the Element Manager fails, any Element Manager operator initiated restrictions to LCT access are automatically lifted and an LCT operator will be able to log in to that element. If an LCT is already logged into an element when the Element Manager attempts to gain access, the Element Manager operator will have to force an LCT logout to gain access.



Note: In this figure, Mux Controller and Comms are illustrated as separate functions of the single Series 4 Comms/Controller Card.

An LCT is not dedicated to a particular SMA. It is connected to an SMA as required for a task (e.g. commissioning, change of configuration, fault finding, etc.) and may be disconnected on completion, without affecting the SMA. An LCT connected to an SMA can access other SMAs remotely, using the Single Ended Maintenance Functionality (SEM)

Figure 11.1 Element Management

◆◆◆◆ END OF CHAPTER ◆◆◆◆

CHAPTER 12: SOFTWARE DOWNLOAD

12.1 FEATURES

12.1.1 Software Download

Software Download is a facility that allows new operating software to be downloaded from a Local Terminal (LCT) or Element Manager to the Controller/Communications Card and all of the equipment cards. The software is downloaded to the SMCs located on the Controller/Communications card and is then selected using the LCT or Element Manager. The software will download without interruption to an already working element.

12.1.2 Backing-up the SMA Configuration

Backing Up the LCT Configuration is a facility that allows the functionality of element configuration Synchronisation, Alarm, and Performance Parameter Default Data, to be copied to a 3.5 inch disc via the LCT.

Once the Multiplexer has been commissioned and configured, then part or the whole of its configuration can be saved to file (Backed up). The configuration details can then be restored to the network element at a later date (Restore). A description of how to use this feature can be found in the LCT Operator Manual.

12.1.3 Restoring the SMA Configuration

Restoring the LCT Configuration is a facility that allows the functionality of SMA to be configured by downloading previously backed-up Synchronisation, Alarm, and Performance Parameter Default Data, from a 3.5 inch disc via the LCT.

Once the element has been decommissioned (Administration Operator), then the previously copied to disk (backed up) configuration can be restored/downloaded at recommissioning. This allows the existing configuration to be restored to the element without the operator having to re-configure it. A description of how to use this feature can be found in the LCT Operator Manual.

12.1.4 Software/Memory Management

Various facilities exist for controlling the operation of software upgrading, downloading, and restoration of configuration data, without adversely affecting traffic:

- Switch Banks.
- Switch MC and Comms Banks.
- Align Banks.
- Set Bank Status.
- Display Software Version.

Full details can be found in the appropriate LCT Operator Manual.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

SECTION 3: ADDITIONAL FEATURES

CHAPTER 13 APPLICATIONS Page 223

CHAPTER 14 ADD/DROP MULTIPLEXER Page 225

CHAPTER 15 VCAM Page 231

CHAPTER 16 SINGLE FIBRE WORKING Page 235

CHAPTER 17 TANDEM CONNECTION MONITORING Page 245

CHAPTER 18 CELLSPAN PAGE 249

CHAPTER 19 PACKETSPAN PAGE 257

CHAPTER 20 AUXILIARY PAGE 259

CHAPTER 21 EOW Page 263

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CHAPTER 13: APPLICATIONS

13.1 INTRODUCTION

As mentioned previously in this manual, the versions of the SMA range are designed to be configured to provide the following Synchronous Digital Hierarchy functional element applications:-

- Add-drop multiplexer.
- Terminal multiplexer.
- Fibre hub.
- Cross-connect.

In any configuration, the core-cards for any particular SMA version remain the same (except when protection is added) but the traffic units and options will vary according to the localised need. Additional Special cards required to access these options are:

- VC-AM
(Virtual Container Access Module). Used in conjunction with a VC-TM, comprises the VC-TS (Virtual Container Transport System) extending VC-12s to Access networks.
- EOW (Engineers Order Wire). Where analogue 4-wire telephony is required.
- Auxiliary Card
Handling of customer telemetry data.

Applications using these additional cards will be described in subsequent chapters. There are also two chapters on Single Fibre Working (SFW) and Tandem Connection Monitoring (TCM).

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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CHAPTER 14: ADD-DROP MULTIPLEXER

14.1 EXAMPLE APPLICATIONS

14.1.1 SMA-1(4+4) AND SMA-1(8)

The SMA-1/4(4+4) and SMA1/4 (8) are part of the Marconi family of synchronous multiplexers using Synchronous Digital Hierarchy (SDH) or Plesiochronous Digital Hierarchy (PDH). The main applications are in adding and dropping a combination of 2Mbit/s, 34Mbit/s, 140Mbit/s or 155Mbit/s (STM-1) tributary signals within an aggregate STM-1 (155Mbit/s) through traffic signal.

Options are available for equipping a variety of optical and electrical cards with various card, port and path protection schemes. Full connectivity is provided, including tributary to tributary switching for VC-4, VC-3, VC-2, and VC-12 granularity with access to 126 x 2Mbit/s.

When deployed in a ring or at the intermediate points in a chain the SMA utilises its switching function to allow traffic to be cross-connected between any tributary and line port and also between tributary to tributary or line to line port. Figure 14.1 illustrates the general internal configuration for SMA-1(4+4) and SMA-1(8) add-drop multiplexers.

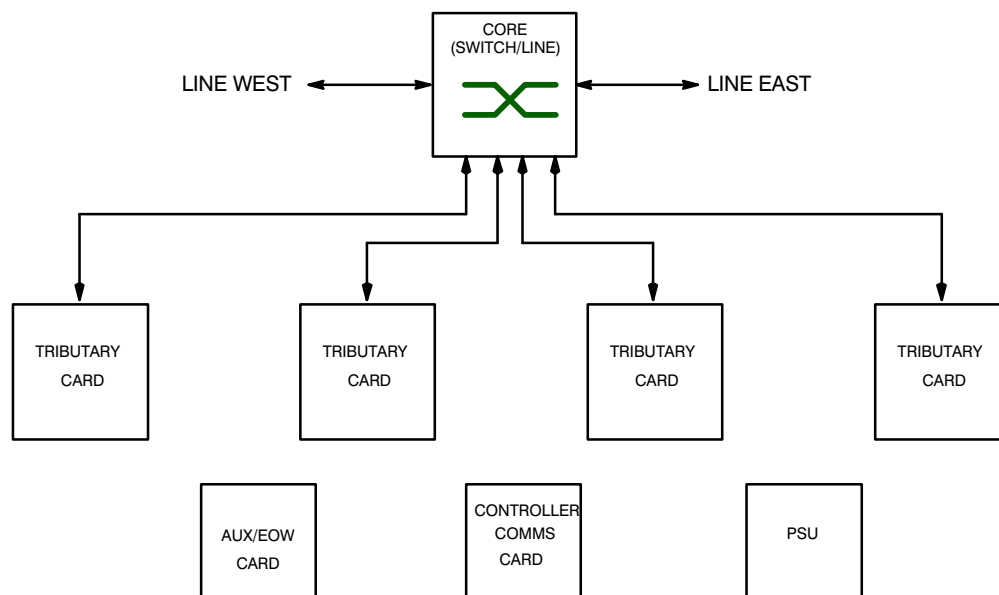


Figure 14.1 Add-Drop configuration (SMA-1)

14.1.2 SMA-4(4+4) and SMA-4(8)

Figure 14.2 is a generic illustration for the SMA-4(4+4) and SMA-4(8) multiplexer configuration.

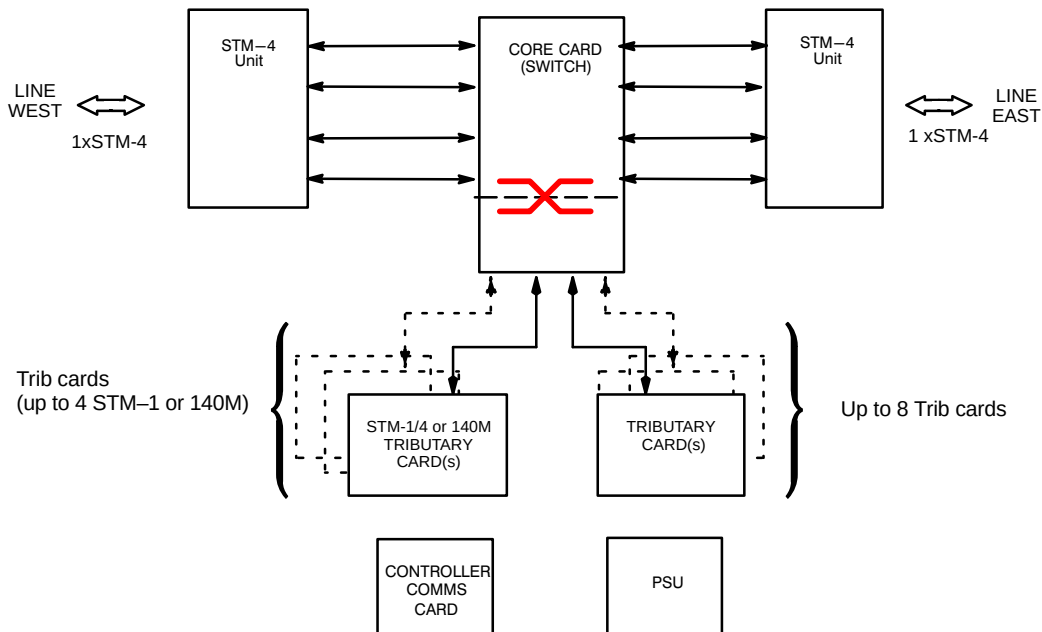


Figure 14.2 Add-Drop Multiplexer Configuration (SMA-4)

14.2 NETWORK APPLICATIONS

14.2.1 General

Add-drop multiplexers can be employed as follows (see Figure 14.3):-

- Form access and multiple ring networks.
- Form chains.

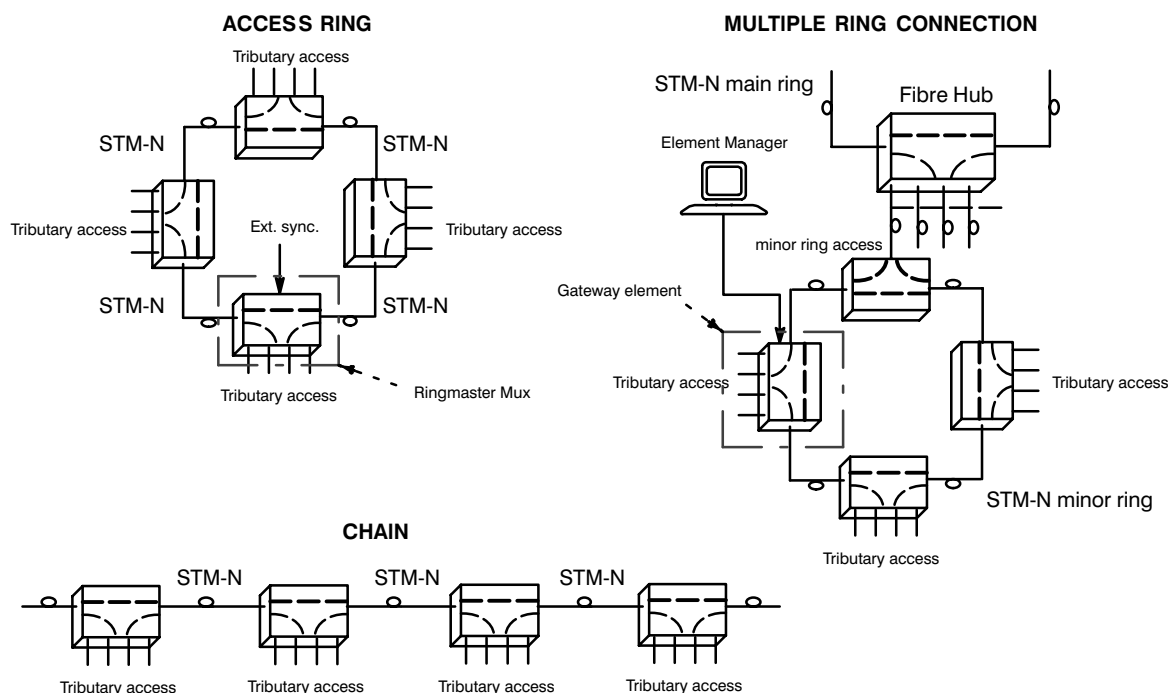


Figure 14.3 Examples of Add-Drop Multiplexer applications in STM-N networks

14.2.2 Gateway Element

Add-drop multiplexers can also function as gateway elements, i.e. provide access to the network for the Element Manager (a gateway element can also be a ring master multiplexer or terminal multiplexer).

14.2.3 Ring Master Multiplexer

If add-drop multiplexers are connected together in a ring network, the Ring Master is the multiplexer that provides access to the ring for synchronisation signals and the majority of the network traffic. Synchronisation is sourced either from an external clock or from a tributary input.

14.2.4 Fibre Hub

The SMA can be configured as a hub node in star type configurations, including points on a ring where traffic is routed to remote terminals directly from the optical tributaries. Figure 14.4 illustrates a fibre hub in a typical network application.

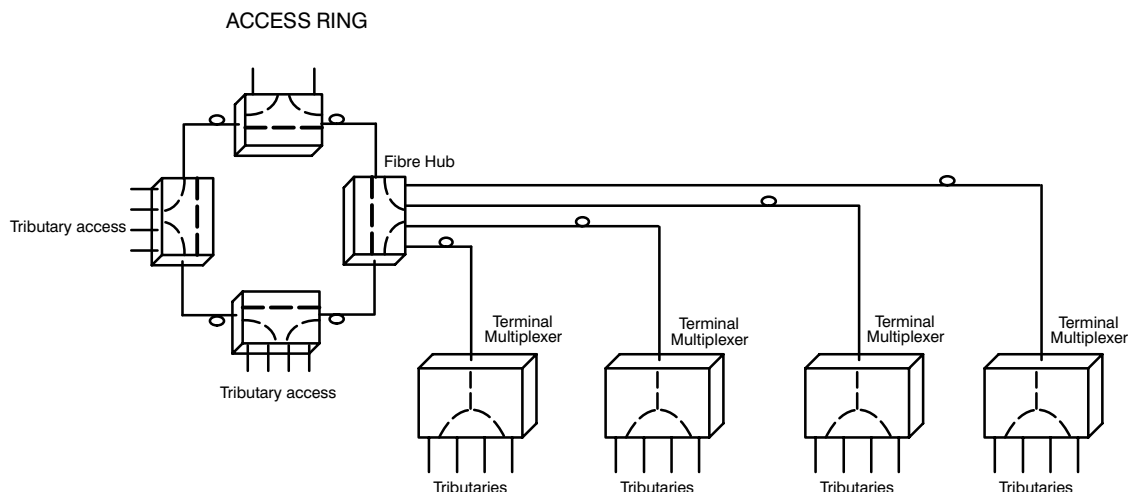


Figure 14.4 Terminal Multiplexer and Fibre Hub applications

14.2.5 Terminal Multiplexer Configuration

The terminal multiplexer configuration is illustrated in Figure 14.4. In this configuration the SMA sub-rack has only one line card fitted, this can be in either the Line East or Line West position. Figure 14.4 illustrates terminal multiplexers in a typical network application.

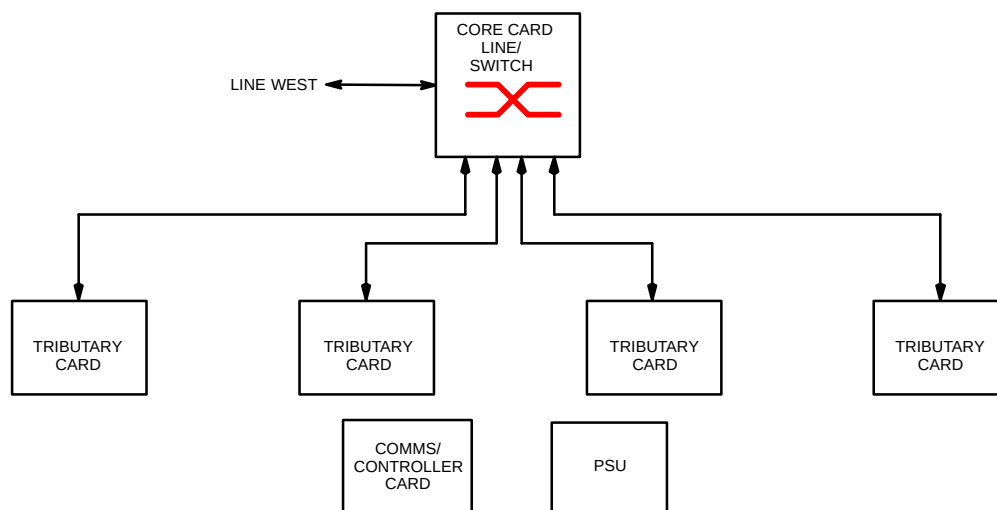


Figure 14.5 Terminal Multiplexer configuration

The Terminal Multiplexer does not have traffic connected through from line port to line port, i.e. in terminal multiplexer mode all incoming line port traffic is dropped off to the tributary positions. A terminal multiplexer can function as a gateway element.

Generally, the purpose of a terminal multiplexer is to multiplex incoming traffic into a single aggregate line rate, however the internal switching capability also allows it to perform timeslot interchange between the lower and higher order virtual containers for grooming and/or consolidation of the incoming tributary traffic. The switch function within the SMA allows a number of fully or partially loaded tributary links to be combined and consolidated into the aggregate line rate.

14.2.6 Broadcast

Broadcasting facilitates point to multi-point transmission of information to a number of destinations simultaneously. The advantage of using broadcast is the reduction of required network bandwidth as given in the example in Figure 14.6. One application of the broadcast feature is the delivery of television and video services.

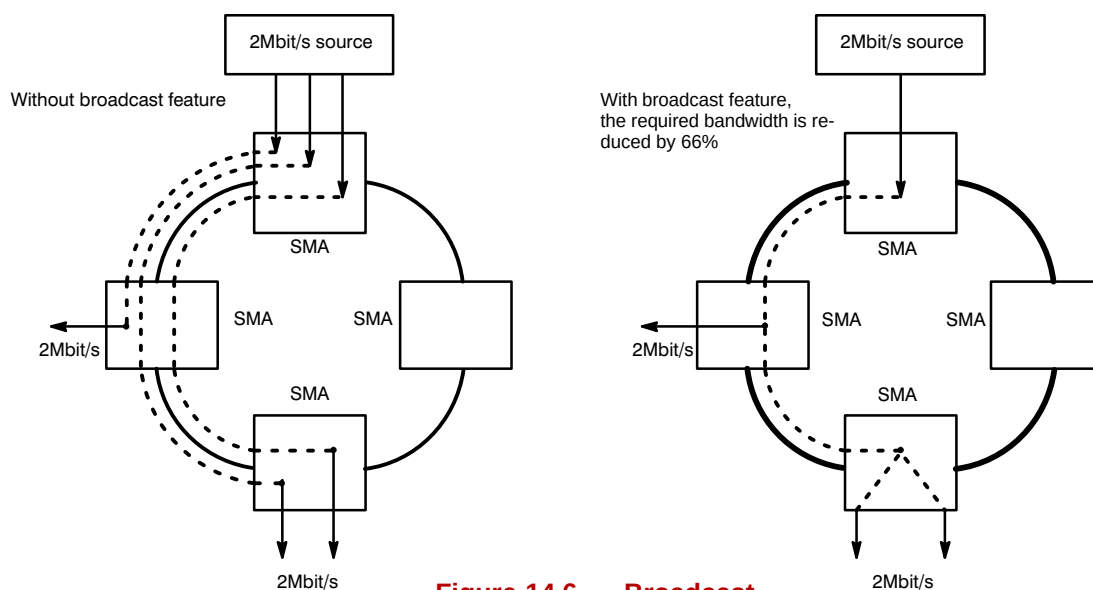


Figure 14.6 Broadcast

14.2.7 Cross Connect

SMAs can be deployed as small cross-connects. A cross connect can be provided by a single SMA or by interconnecting a number of SMAs as a cluster, e.g. four STM-1 rings can be interconnected to provide routing between rings without the need for an external cross-connect (see Figure 14.7).

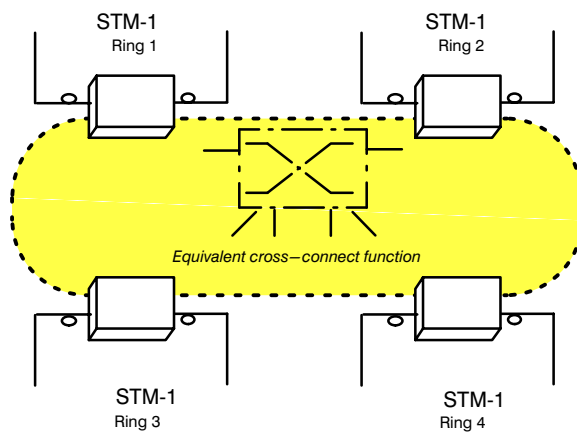


Figure 14.7 Cross Connect Cluster

CHAPTER 15: VIRTUAL CONTAINER ACCESS MODULE (VC-AM)

15.1 INTRODUCTION

The Virtual Container Access Module (VC-AM) is a single slide-in unit which provides access to Virtual Container Transport System (VCTS) networks. The module is a slide in unit which can be fitted into any of the tributary positions (except the Protection slot) and is used in conjunction with a VC-TM card at the Customer premises.

15.1.1 Configuration(VC-AM)

Figure 15.1 shows a basic configuration of VC-AMs installed in an SMA equipment.

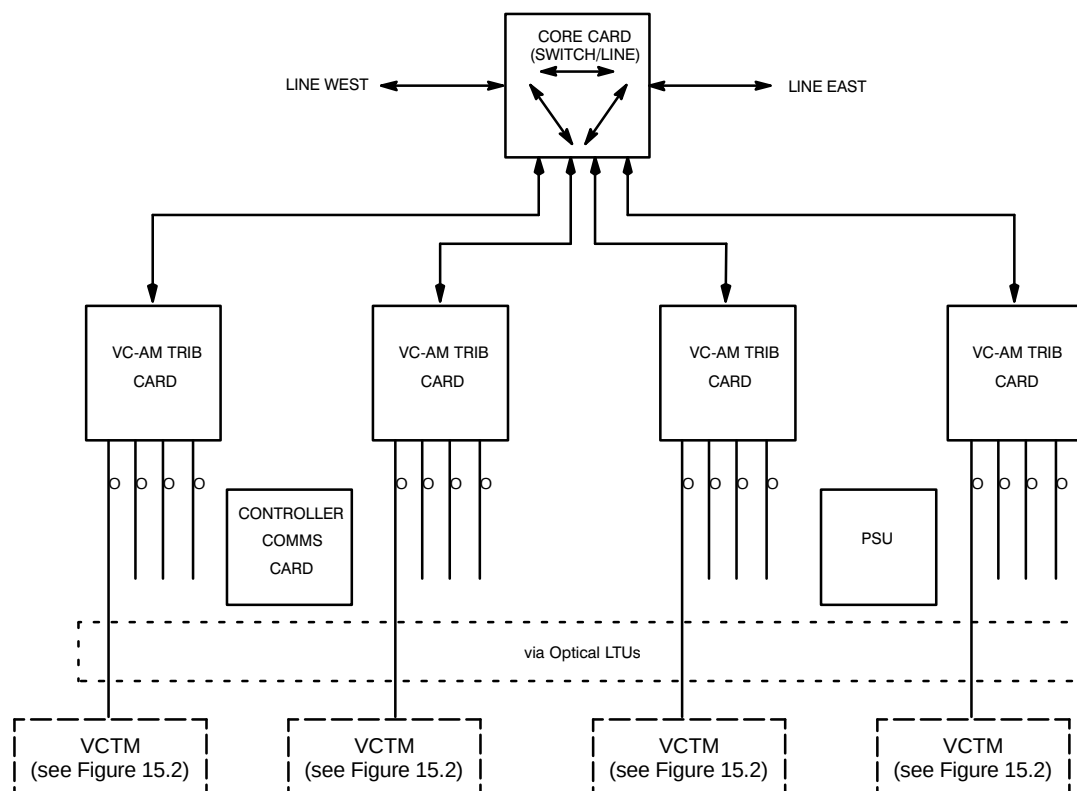


Figure 15.1 VC-AMs Installed in an SMA Multiplexer

VCTS delivers VC-12s or 2Mbit/s streams from the core SDH network into the access network via optical fibre spurs. The VC-TM terminates one 34Mbit/s bearer presenting 14 x 2Mbit/s interfaces.

Figure 15.2 shows typical usages of VC Access Modules (VC-AM) within an STM ring, communicating with the access network via VC Terminating Modules (VC-TM).

Each VC-AM provides up to four bi-directional 34Mbit/s sub STM-1 optical interfaces via four VCTS optical LTUs, each capable of handling up to fourteen VC-12 signals. Each card is therefore capable of delivering fifty six VC-12 signals. Up to 2 VC-AM cards may be fitted (SMA1/4c), or 4 VC-AM cards (SMA1/4(4+4)), or 8 VC-AM cards (SMA1/4(8)). Additionally, adjacent VC-AM cards can provide 1+N card protection.

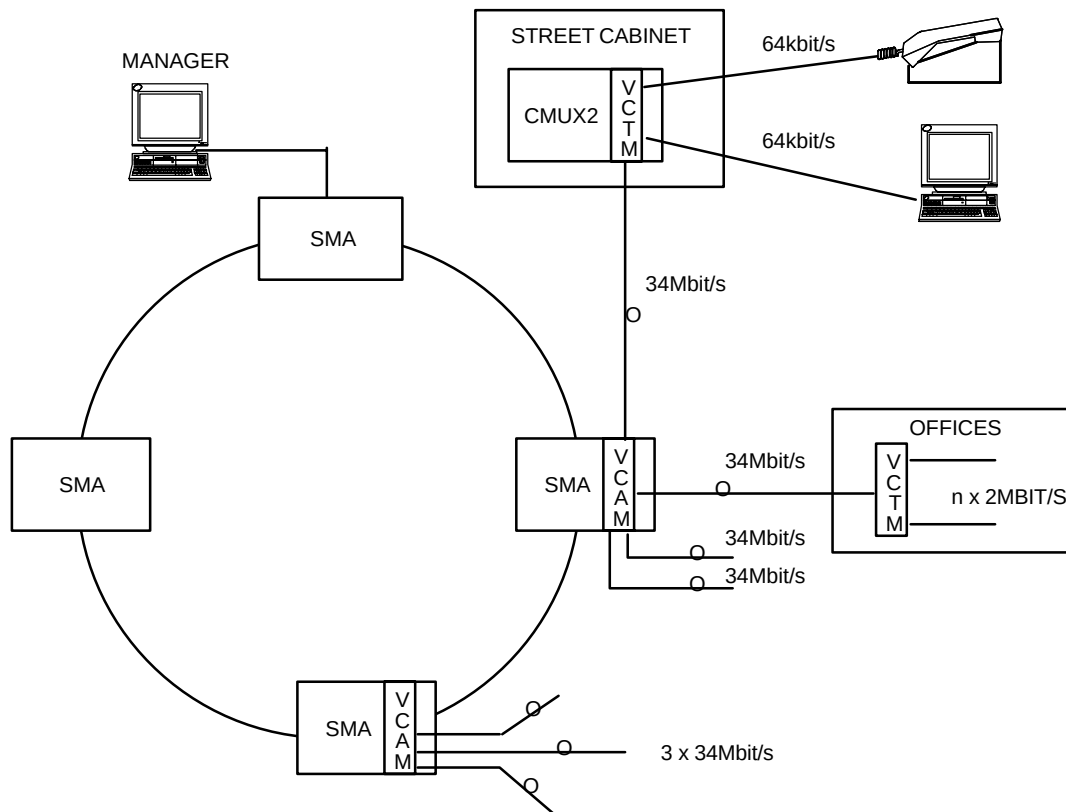


Figure 15.2 Typical VCTS Applications

15.1.2 Comms Protection (VC-AM)

Comms protection, (by connecting a VC-TM to separate SMAs in single fibre mode), is only supported provided both SMAs are in the same IS-IS area.

Note: Multi-homing of SMAs in different IS-IS areas, effectively allowing the SMAs to share a common IS-IS area, is not a recommended practice as it negates the benefits of segregating the network into areas.

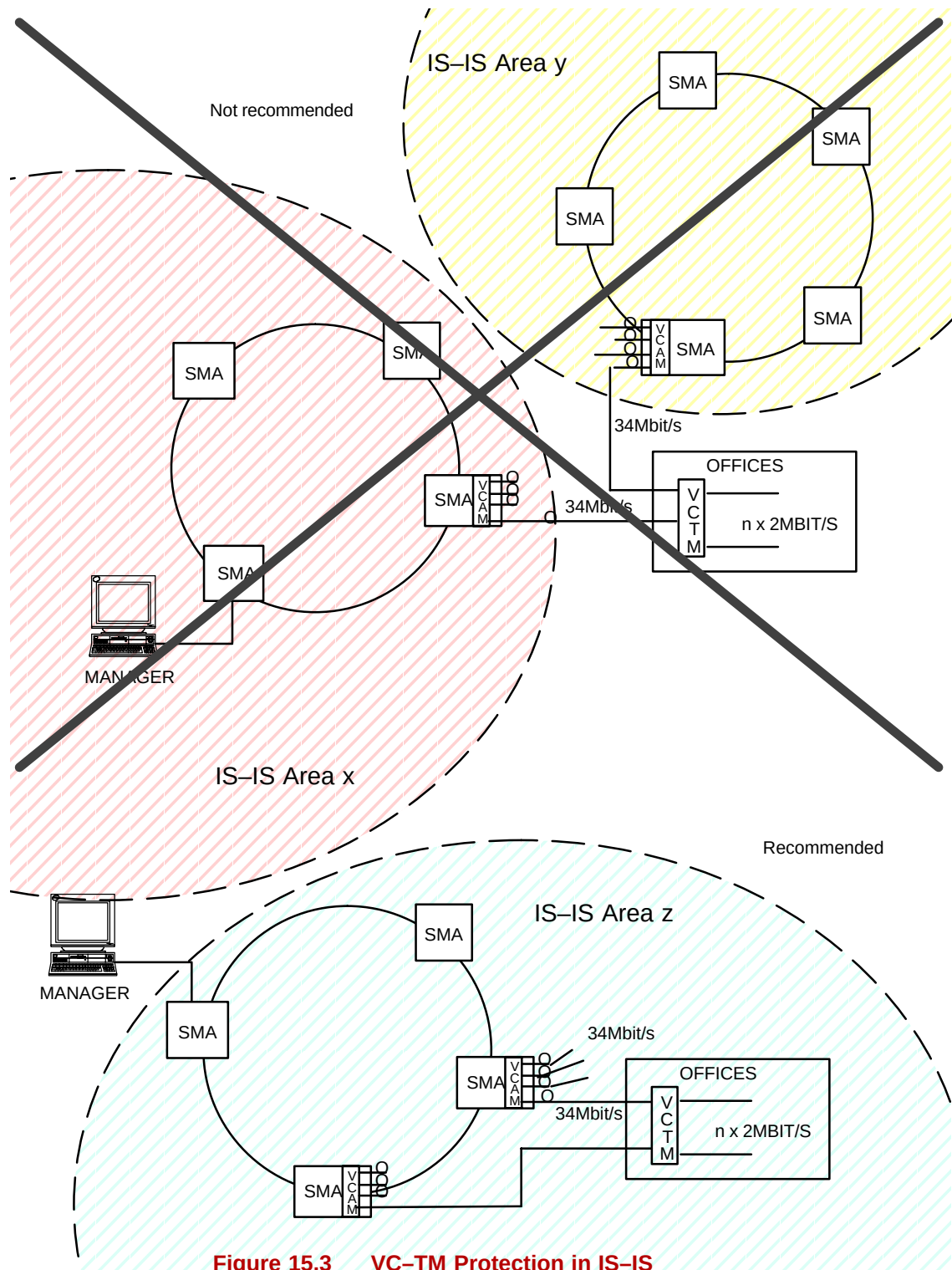


Figure 15.3 VC-TM Protection in IS-IS

15.2 I421 FUNCTIONALITY

VC-TM cards at Release 3, 2Mbit/s tributary cards, and the SMA1/4CP unit all support I.421/2M NT functionality. This provides a method for the exchange provider to remotely test their transmission network. A loopback facility is incorporated together with the facility to report defects to the exchange end, by the insertion of appropriate maintenance codes.

15.2.1 2M NT Mode

A facility is provided for the exchange end (System X), to remotely test their transmission network (e.g. Primary Rate ISDN lines) connected directly to a 2Mbit/s port.

When an exchange initiates an I.421 test, a series of command code-words are sent to the VC-TM causing it to apply or release a 2M NT loopback to the exchange via that port thereby loping back test information to the exchange.

Note: 1. During the application of I.421/2M NT loopbacks any VC-TS configured loopbacks will be removed.

Note: 2. Any attempt to configure VC-TS loopbacks with 2M NT mode enabled, will result in an error message being displayed and the attempt will be rejected.

Note: 3. 2M tributaries also have an LT mode for I.421.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 16: SINGLE FIBRE WORKING

16.1 OVERVIEW

Single fibre operation on STM-N links offers a cost effective mechanism to double the capacity available, without resorting to the installation of full WDM systems. The only additional equipment required over a standard installation are passive bi-directional couplers which act as filters to convert back to unidirectional operation (i.e. from one bi-directional fibre to receive and transmit fibres).

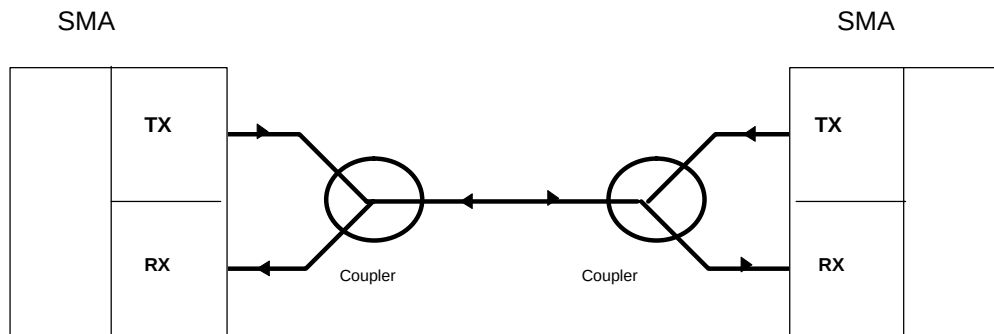


Figure 16.1 Single Fibre Operation (Contra-Directional)

Previously, Single Fibre operation relied on both the Tx and Rx optical interfaces being connected to a coupling device for transmission on a single fibre, both using the same wavelength. This solution had inherent problems with loss associated with the couplers and interference caused when the different wave-lengths cross over. The single fibre working modes recommended here superseded this type of working.

16.2 OPTIONS

There are two basic options offered for single fibre working with: one option is for use on short to medium length optical spans where 1310/1550nm optical units are required; the other option is for longer spans where 1554/1536nm optical units are required. These two options give reliable and repeatable results over optical links.

16.2.1 Contra-Directional and Co-directional Configurations

Within the options available for single fibre multi-wavelength operation there are two possible configurations: “contra-directional single fibre working” and “co-directional single fibre working”. These refer to the direction of transmission over the fibre and the number of systems which can be connected.

16.2.2 Contra-Directional Single Fibre Working for 1310/1550nm system

1310nm optics are usually chosen for short to medium distance links which are typically less than 40km. It is possible at STM-1 to use very simple couplers to allow single fibre working with both transmitters operating at 1310nm. These couplers however introduce a loss, reducing the available optical budget. (The optical link budget being the attenuation in dB/length of section).

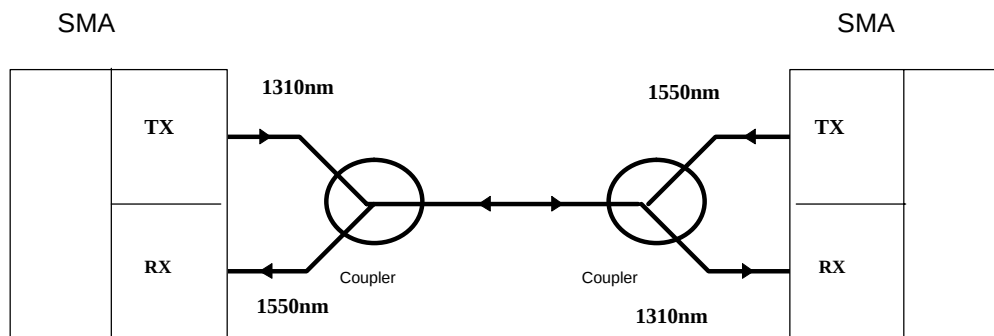


Figure 16.2 1310/1550nm Single Fibre Operation (Contra-Directional)

This option is illustrated in Figure 16.2 above, showing the couplers and the different optical transmit units. It should be noted that the optical link budget is set by the range of the 1310nm units less any additional loss for the couplers and the interference from the other wavelength.

16.2.3 Co-Directional Single Fibre Working

A co-directional system differs from the contra-directional system as the two signals are transmitted down a fibre in the same direction. This is in effect a simple two channel passive WDM system. As with the other single fibre working options this can be extended to provide multiple channels over a single fibre.

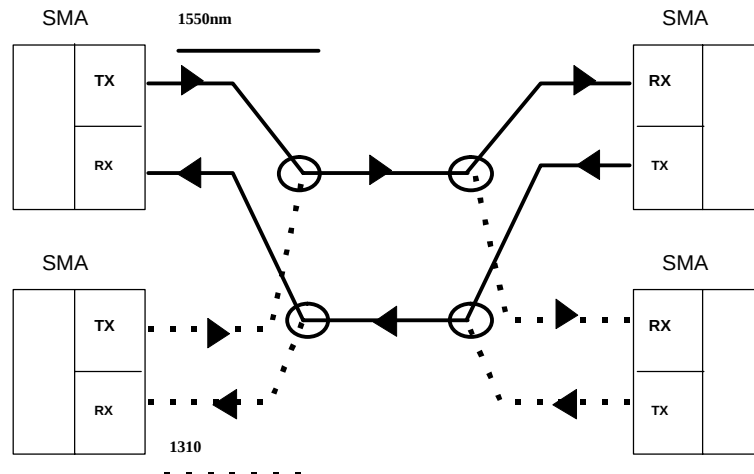


Figure 16.3 1310/1550 Single Fibre Co-directional Operation

The co-directional system available for the SMA products is shown in the above Figure. This feature will double the capacity of the fibre compared with a traditional installation allowing the inter-connection of four SMA systems over two fibres (previously four fibres would be required).

16.2.4 Single Fibre Working for Red/Blue System

At 1550nm the options for single fibre operation are slightly different in that any variations of the transmit wavelengths must be in the “1550nm band” to maintain the optical link budget. This is achieved by using specially selected lasers which have their centre wavelengths in the “1550nm band”. The optical link budget available with this option is similar to that for the standard systems, but with an increased penalty to account for the two couplers and the wavelength interference.

These two channel WDM (Wave Division Multiplexing) systems are often termed “Red/Blue” referring to that fact that the wavelengths are at distinct separable points of the available spectrum.

16.2.5 Contra-Directional Single Fibre Working

Contra-directional operation over a single fibre applies to the situation where two systems are inter-connected by a single fibre which carries both directions of transmission. The couplers installed at each end of the link provide a filtering function allowing the signal from the remote end through and blocking any reflection from the near end transmitter. The application being discussed here is a simple two colour option, but this can be extended to allow multiple channels to be carried bi-directionally over a single fibre link.

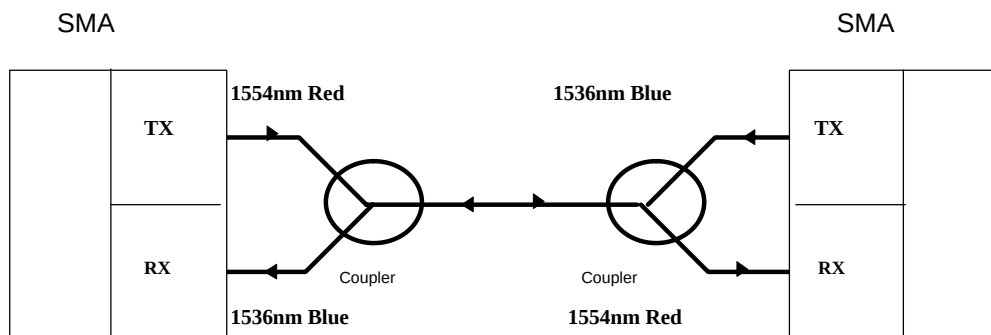


Figure 16.4 (Red/Blue) Single Fibre Contra-Directional operation

16.2.6 Co-Directional Single Fibre Working

A co-directional system differs from the contra-directional system as the two signals are transmitted down a fibre in the same direction. This is in effect a simple two channel passive WDM system. As with the other single fibre working options this can be extended to provide multiple channels over a single fibre.

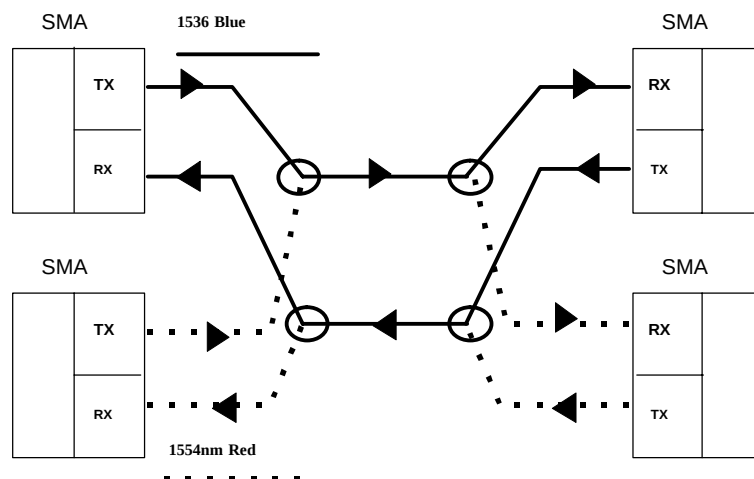


Figure 16.5 (Red/Blue) Single Fibre Co-directional Operation

The co-directional system available for the SMA products is shown in above Figure. This feature will double the capacity of the fibre compared with a traditional installation allowing the inter-connection of four SMA systems over two fibres (previously four fibres would be required).

Note: The Red/Blue co-directional system has the advantage that the span of the network can be increased by using optical amplifiers.

16.3 SINGLE FIBRE WORKING FILTER/COUPLERS

There are a number of options for the couplers used to provide the single fibre working solution. This section gives a brief overview of each type of coupler available and describes some of the options for mounting and installation.

16.3.1 1310/1550 nm Co/ Contra-Directional Filter/ Couplers

The same type of coupler/filter is used to implement 1310/1550nm Co/Contra directional working. These are integrated modules which provide the fibre coupling function for the transmit and receive fibres, and also serve to filter out any reflected signals from the near end transmitter. Hence a different coupler is required at each end of the link. These couplers however are common for all the SDH line rates supported, i.e. STM-1 and STM-4. An example of this type of coupler is given below.



Figure 16.6 WD1315U-GPT1 COUPLER

This device prevents 1310nm light from the 1310 port appearing on the 1550nm port and vice-versa. However it allows light from both 1310/1550 ports to appear on the trunk (TRK) port.

16.3.2 “Red/Blue” Contra-Directional Filters and Couplers

These perform the same function as the 1310/1550nm modules, except that the filtering function is tuned to each end of the 1550nm spectrum. Again a different coupler is required for each end of the link and the couplers are common to the supported line rates of STM-1 and STM-4. An example of this type of coupler is given below.



Figure 16.7 WD1515RB-GPT1 COUPLER

This device prevents 1554nm light from the Red port appearing on the Blue port and 1536nm light from appearing on the Red port. It is designed so that there is a minimal loss on the transmission from the Common (COM) port to the Blue port for signals with a wavelength of 1536nm.

16.3.3 Red/Blue Co-Directional Filters and Couplers

These integrated modules use similar technology to those previously described, but one end of the link (nearest the transmitters) is a simple combiner and the other end (nearest the receivers) splits the signal into the constituent red and blue signals. An example of this type of coupler is given below.



Figure 16.8 WD1515RR-GPT1 COUPLER

This device prevents 1536 light from the Blue port appearing on the Red port and 1554 light from appearing on the Blue port. It is designed so that there is a minimal loss on the transmission from the Common (COM) port to the Red port for signals with a wavelength of 1554nm.

16.3.4 Fibre handling for Single Fibre Working

The couplers and filters are supplied in a pre-terminated format with a choice of connector types. To provide a simple and cost effective mounting for the single fibre working couplers a compact fibre tray can be provided which can be rack mounted in either ETSI of 19" racks. This fibre tray can be fitted with bulkhead mounting units to provide a simple optical distribution facility for small to medium installations. Alternatively the couplers and filters can be installed in the existing optical distribution frames at customer premises.

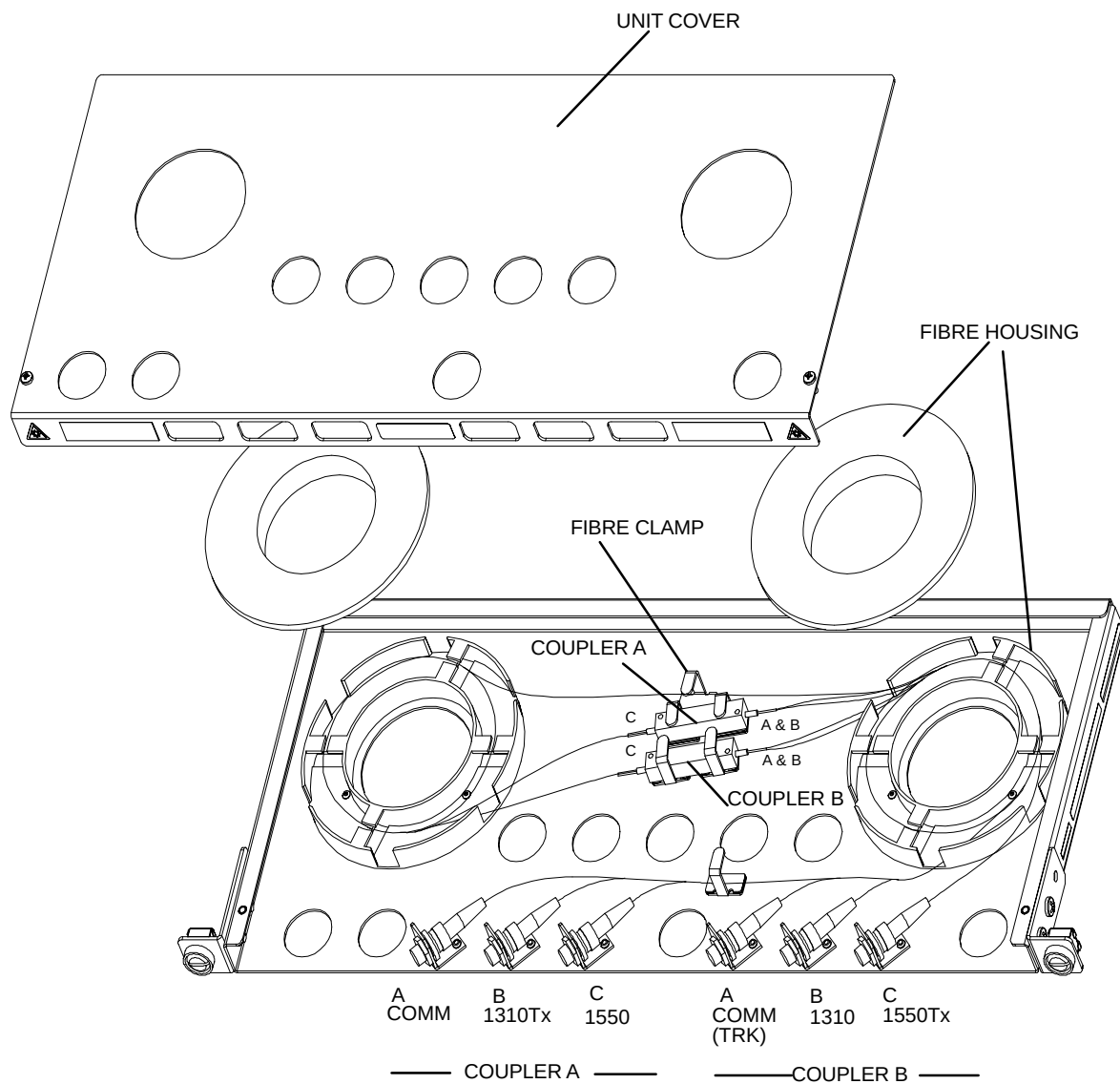


Figure 16.9 Fibre Tray with 1310/1550nm Working

16.4 AUTOMATIC LASER SHUTDOWN (ALS)

The working of ALS is different for single and dual fibre working.

16.4.1 DUAL FIBRE WORKING WITH ALS

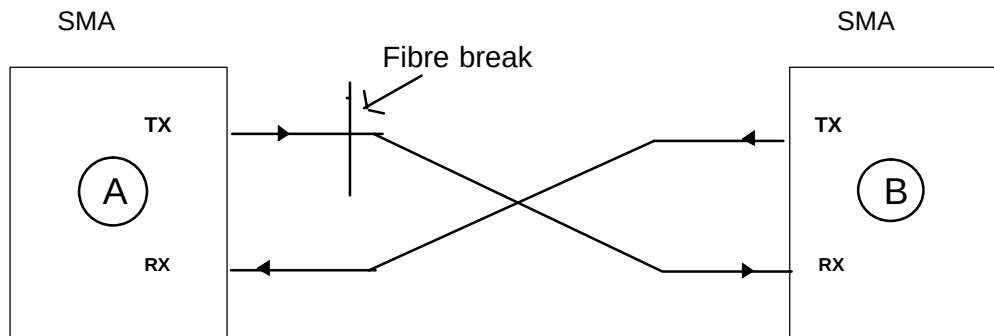


Figure 16.10 ALS Dual Fibre Working

If there is a break in cable from A → B the following sequence of events occurs:

- There is a LOSS OF SIGNAL(LOS) at B
- There is an automatic shutdown of the laser at B
- There is then a LOS at A and an alarm is raised
- There is a shutdown of the laser at A

The system then undertakes a test sequence every 60 seconds by generating a short pulse to check for the re-integration of the cable. Otherwise the lasers remain off.

16.4.2 Single Fibre Working with ALS

The Single Fibre connection can be configured either with or without Automatic Laser Shutdown (ALS).

16.4.3 ALS Using LOS

A number of features are used to enable the management system to detect fibre breaks. In the event of a fibre break a 'STM-n LOS' may be raised, as with dual fibre working, however with single fibre operation it is possible for light to be reflected back from the surface of the break in which case the STM-n card may detect a valid STM-n signal and not operate ALS, and more importantly, not detect the break.

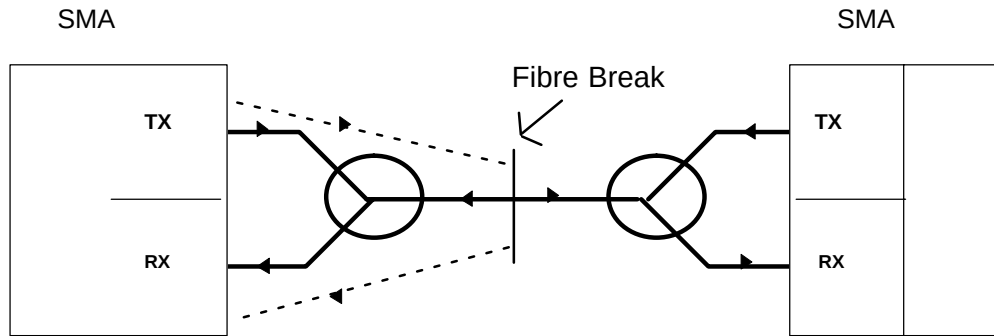


Figure 16.11 ALS Single Fibre Working Reflection of Signal

16.4.4 ALS Using Receipt Of Transmitted Section Trace

To detect fibre breaks under these circumstances Section Trace (JO) and Expected Section Trace strings are set up as in Figure 16.12 so that each direction has a unique Section Trace string. These enable Transmitted Section Trace Detection. All this is found on Section Config screen on the connection screen for the selected interface. The alarm that is raised is an 'Receipt of Transmitted Section Trace'. This alarm indicates when a STM-n card is detecting the same Section Trace as it is transmitting.

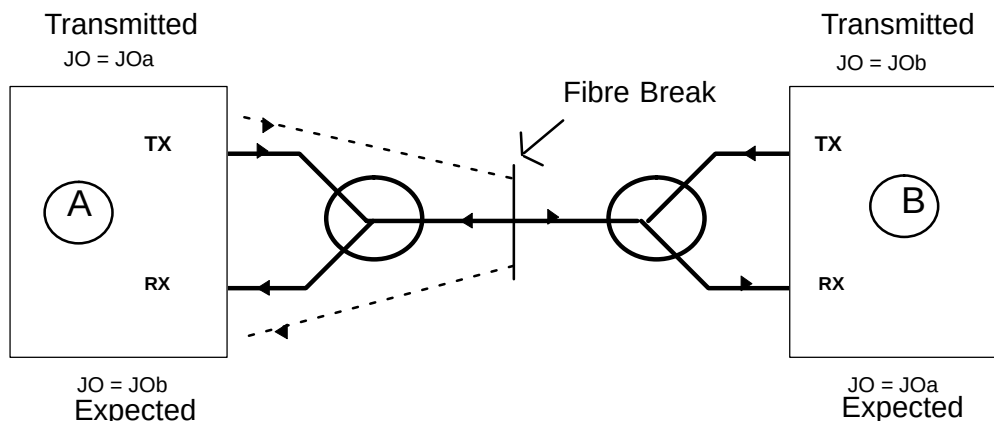


Figure 16.12 ALS Single Fibre Working with Section Trace

16.4.5 ALS Using JO Mismatch

In some circumstances a fibre break may reflect the transmitted light in such a way that it creates errors in the JO such that the reflected JOtx does not equal JOtx, but the signal is not low enough to ensure that there is a LOS. In this case there will be no ALS

To handle this case, an "JO Mismatch" criteria for ALS has been added, which is enabled by the same LCT and card link settings as for "Receipt of Transmitted Section Trace".

16.4.6 CONFIGURING ALS FOR SINGLE FIBRE WORKING

Single Fibre operation with Automatic Laser Shutdown (ALS) is supported by all of the STM–n optical line cards.

Single Fibre ALS operation is supported by dedicated hardware features designed into each type of STM–n optical line card. These are controlled by setting up the Section Trace values and configuring on–card links to enable the ALS hardware circuitry. The next section describes how to set the Trace Section Strings

16.4.7 SETTING THE TRACE SECTION FOR ALS WITH SFW

The procedure for setting the trace section is common to STM–1 and STM–4. Using the LCT (subject to the associated Operator Manual) the Section Trace should be set as follows:

- Connections – Card – Section Config.
- The Transmitted and Expected Section Trace should both be set to Access Point ID and strings entered for the actual Trace values.

Note: 1. The single fibre ALS mechanism relies on each 'direction' having a unique Section Trace string.
2. If the section traces are not configured, the "Unconfigured Section Trace" alarm will be raised.

For further information see the associated Operator Manual.

16.4.8 USING THE DUAL STM–1 OPTICAL CARD WITH SFW

Section traces must be configured if using SFW with the dual STM–1 optical card.

16.5 LINK SETTINGS

Link configuration Information for the following three scenarios can be found in the Link and Switch Configuration chapter.

- Non–ALS Operation (ALS and Bi–directional operation disabled)
- Co–Directional ALS Enabled (ALS and Uni–Directional enabled)
- Contra–Directional ALS Enabled (Bi–Directional Enabled)

These three scenarios are implemented by varying the link settings for:

- ALS operation
- Bi–Directional operation

Note: Removing BIDIR only is not a valid mode of operation.

- Changing the Bi–Directional link setting only, when the ALS disable link is fitted, is not a valid mode of operation.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 17: TANDEM CONNECTION MONITORING

17.1 INTRODUCTION

Within a network, a VC Trail will often pass through a number of different operators' domains, each operator being responsible for the passage of the VC through their equipment.

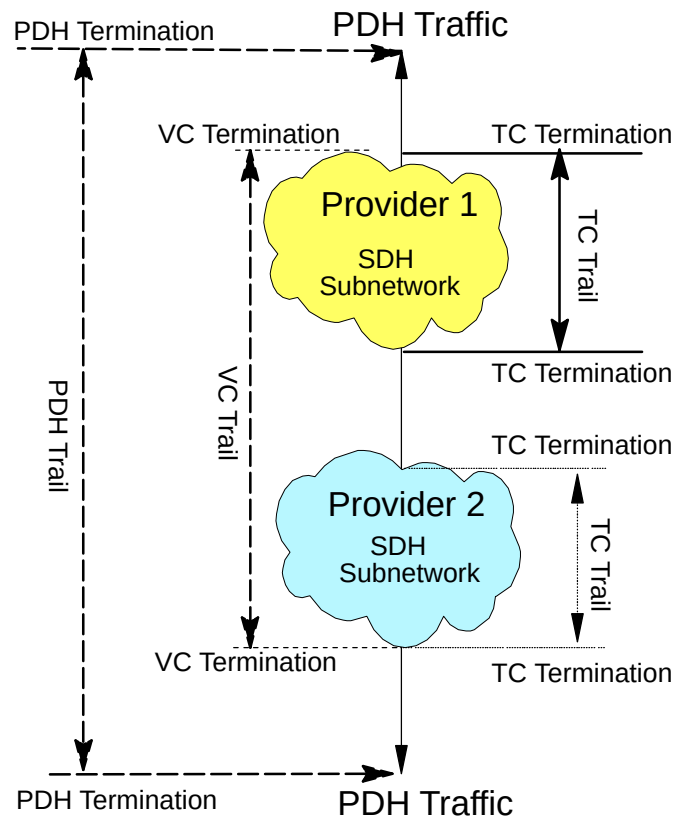


Figure 17.1 Example of Operator Domain Boundaries

Alarms and Performance Information carried in the VC Overhead is an indication of the quality of the trail. As this information is referenced to the source of the TC trail, the operator's domain must include this source in order to obtain quality information specific to that operators equipment.

Tandem Connection Monitoring creates another source of OH information by using data inserted into previously unused bytes (N1/N2 for VC3/4 and VC2/12 respectively). The information is created where the VC enters the domain (the TCM source) and terminated where the trail leaves the domain (the TCM sink). A passive monitor is also available (TCM Monitor) which may be used to monitor the TCM trail between source and sink.

17.2 TRUE TCM

As illustrated in Figure 17.1, the TC trail extends between entry and exit points of an SDH Sub-network. These entry and exit points determine sub-network boundaries, pipeline (passed straight through) to sub-network boundary or VC/TC termination point.

Note: The TC trail is always a sublayer within the associated VC trail which means that at VC termination points, the associated TC is also terminated.

The physical TC termination is always at the STM-N cards however, from the operators perspective, the logical TC trail should be adopted.

Mappings between physical and logical termination points (including any protection switching which may have taken place), are carried out by the Comms/Controller function. Figure 17.2 illustrates the relationship between logical and physical trails and associated mappings.

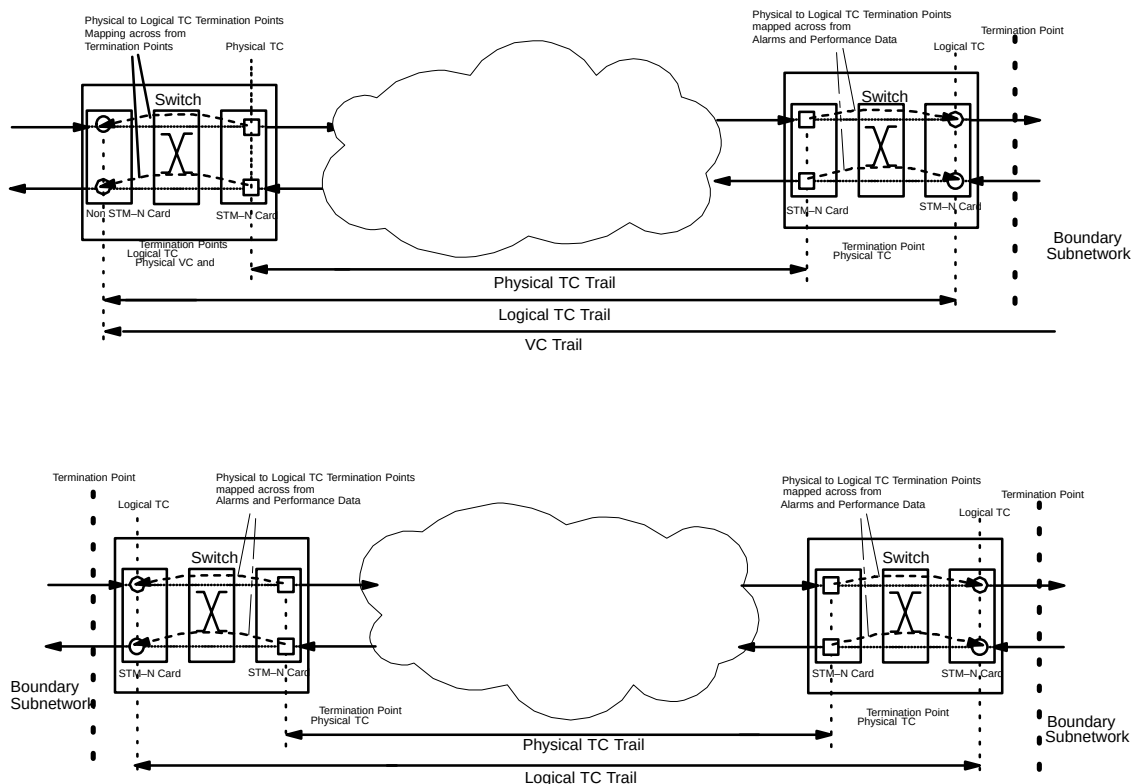


Figure 17.2 Relationship between Logical and Physical TC Trails

17.2.1 Pseudo TCM

Pseudo TCM provides a means of reporting SDH card/path alarms and performance data for faults that exist up to the TCM boundary. This facility may report possible faults that lie outside as well as within the TCM trail. It serves as a guide, allowing further investigation towards the TCM source.

Note: As the network bytes N1 and N2 in the POH cannot be accessed in this mode, Tandem Connection Trail Trace will not be available.

17.2.2 TCM Equipping Rules

Tandem Connection Sub-Layer Performance Monitoring (Full TCM) is only available providing ALL SDH cards installed in the SMA sub-racks are TCM Variants and the correct version of software has been installed

Note: Non-TCM SDH cards are not supported in Series 4, but Tandem Connection Non-Intrusive Performance Monitoring (Pseudo TCM) is available providing the correct version of software has been installed.

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CHAPTER 18: CELLSPAN

18.1 GENERAL

CellSpan is a range of products within the Marconi SDH portfolio which provides a cost-effective means for network operators to extend monitored ATM service down to the customer premises. CellSpan products can be deployed in both retrofit and new build applications and can be managed centrally by the Marconi network management system, Element Manager, or by a local terminal.

Series 4 SMA units support the CellSpan –i SB25 product. The CellSpan–i system comprises three main types of element:

- An ATA (ATM Traffic Adapter)
- An ATC (ATM Traffic Combiner)
- An ATX (ATM Traffic Extender – Extender II and SMA–1/4CP only)

18.1.1 Common Features

Both ATM User Network Interface (UNI) and ATM Network/Network Interface (NNI) formats are supported on the external interfaces of the ATA, ATX and ATC.

The ATA and ATX provide an ATM connection to the end-user. The ATC provides the ATM connection to the public ATM switch.

The ATA, ATX and ATC support connection admission control (CAC).

18.1.2 ATM Traffic Adapter Card (ATA)

The ATM Traffic Adapter card (ATA) is housed in tributary positions of the SMA family of synchronous multiplexers. Up to four ATA cards can be fitted as tributary cards into any host SMA subrack. They are fitted into vacant tributary slots and their associated LTUs are fitted to the trib LTU slots. Each ATA card supports up to three 34 Mbit/s or 45Mbit/s (DS3) electrical bearers or an electrical or optical 155 Mbit/s bearer. These allow ATM cells received to be transported over an appropriate choice of SDH Virtual Container from the following list: VC–12, VC–3, VC–4.

For example, ATM service provided to a customer on an STM–1 interface with sustained cell rates of less than 49 Mbit/s can be carried through the network within a VC–3, rather than the VC–4 required for 'plain' SDH transport.

The ATA in an SMA also offers true dual parenting. Additionally, for maximum flexibility, the ATA can undertake ATM UNI/NNI address conversion thus supporting both UNI and NNI formats but the VPI/VCI value must be unchanged.

The ATA also supports Usage Parameter Control (UPC), the formal name for 'policing' which is used to stop end-users violating the terms of their service contract.

The ATA provides a peak-cell-rate-limited ATM cell flow towards the network, provided on a per-Virtual-Path (VP) basis.

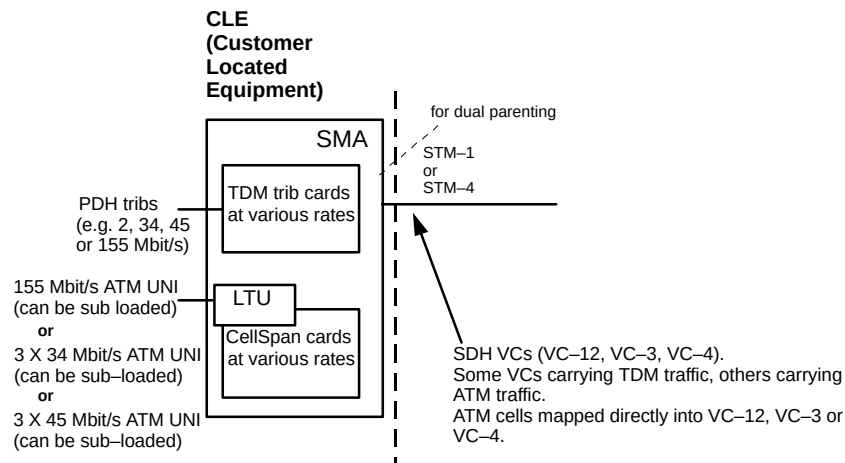


Figure 18.1 ATA Location and Mapping Options

Figure 18.1 shows the SMA on the end-user premises providing both TDM and ATM access from the same SDH platform.

Individual SDH VCs (VC-12, VC-3, VC-4) are assigned to carry ATM cells between the ATA cards and an ATC card – termed 'direct mapping'.

In addition to direct mapping, Cellspan-i products can provide even more bandwidth saving by the use of Inverse Multiplexing (VCIMA) which offers up to 63 VC-12 links per group.

Even though a strict 'ceiling' is imposed on the bandwidth by the VC-n container(s) used, end users are permitted to 'burst' at the 34Mbit/s, 45Mbit/s or 155Mbit/s line rate of their physical connection, i.e. ATM cells containing data can be sent continuously up to a (contractually specified) maximum burst size. Buffers within the ATA are used to store the excess cells for later transfer within the VC-n (or n x VC-n) rate.

The ATA card can be configured to supply Constant Bit Rate (CBR), Variable Bit Rate (VBR), and best effort ATM service categories, with Available Bit Rate (ABR) support envisaged in future CellSpan releases. Multiple ATM streams (identified by their VPI/VCI value) can be provided per physical interface. Each of these can be assigned its own service category, up to 4 different categories per interface. Each traffic category can also be assigned a CAC (Connection Admission Control) and ATM cell policing (UPC – Usage Parameter Control), to stop end-users violating their service contract.

The end-user customer connections are to the appropriate ITU-T PDH, SDH and ATM standards (G.703, G.804, I.432, G.707, G.708 and G.709), and the appropriate ATM Forum specifications (UNI 3.1 and TM 4.0).

Each physical tributary of an ATA card can have multiple VPI/VCI terminations, up to 4000 bidirectional connections per ATA overall. Up to 256 of these terminations per card can be simultaneously monitored (statistics for cell loss, etc.) but there is a limit of 256 per SMA.

The 34 Mbit/s ATA card can support up to 3 x 34M ports. The 45Mbit/s ATA card can support up to 3 x 45M ports.

The cell monitoring features (OAM F4/F5 flows and loopback, and cell performance counts) are as per ITU-T I.610.

Note: The ATA facilities described in paragraphs 7 to 19 above also apply to the ATC card described below (unless otherwise indicated).

18.1.3 ATM Traffic Combiner (ATC)

The ATM Traffic Combiner (ATC) card is housed within the SMA and can be co-located with the ATM switch. The ATC provides the interface from the SDH access network to the ATM switch. In this role it can both:

- Combine ATM traffic from multiple ATAs (or ATXs), presented to it as multiple SDH VCs carrying ATM cells, into a single VC-4 high speed STM-1 interface. In CellSpan Release 2 it can combine ATM cells from any mixture of VC-12, VC-3 (in permutations of SDH VCs allowed by SDH multiplexing), or terminate a VC-4 from an ATA, the so-called 'direct mapping' options. It can terminate traffic from up to 63 ATAs (or ATXs) (the limit is 63 VC-12s).
- Route ATM traffic from the switch to multiple ATA or ATC cards and/or ATX units.

Additionally, for maximum flexibility, the ATC can undertake:

- ATM UNI/NNI address conversion thus supporting both UNI and NNI formats on the interface to the ATM switch
- Virtual Path Identifier/Virtual Channel Identifier (VPI/VCI) address translation to fully support multiple distant ATAs ATCs and ATXs.

18.1.3.1 ATA and ATC Interface Details

Table 18.1: ATA and ATC Interface Details		
Card Name	Interface Rate	Number of Interfaces
ATA/ATC-34	E3/34 Mbit/s	3
ATA/ATC-155	STM-1/155 Mbit/s	1
ATA/ATC - 45	DS3/45-Mbit/s	3

18.1.3.2 ATA/ATC Differences

Compared with the ATA, the ATC can also route ATM cells to multiple destination CellSpan elements, and can combine traffic from multiple physical customer interfaces onto a single SDH VC or group of VCs. The following diagram illustrates these differences:

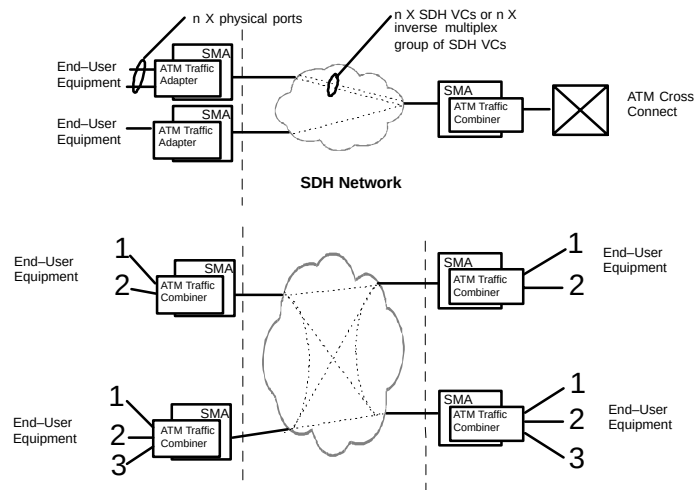


Figure 18.2 ATA/ATC Differentiation

The upper part of Figure 18.2 shows the ATA and ATC in a typical ATM access deployment. This illustrates that the ATA maps one physical interface onto a single SDH VC. If there are multiple interfaces, then they each map onto their own SDH VC (or inverse multiplex group of SDH VCs). All traffic from a single ATA port is routed to the same destination, which can be an ATC as shown, or another ATA for point-to-point links across an SDH network. The ATC combines the ATM traffic arriving from multiple ATAs for presentation as a single stream to the ATM switch.

The lower part of Figure 18.2 shows a point-to-multipoint ATM network built upon SMA and CellSpan components without the use of an ATM switch.

18.1.4 ATM Traffic Extender (ATX)

The ATM Traffic Extender card (ATX) is a unit that can be plugged into the 4x2 Extender II CLE or into the SMA-1/4CP.

The ATX products are Customer Located Equipment which can provide transport towards the network over the Extender II system. In this case, the Ext/ATX units connect into an SMA through a tributary unit (VC-AM) which allows 'hubbing' of up to four ATXs from one VC-AM card. The ATX units can also connect directly into an SMA where they are plugged into the SMA-1/4CP.

SMA-1/4CP equipment supports the four CellSpan-i products:

- 1 x 34M port
- 1 x 45M port
- 1 x 155M port Electrical
- 1 x 155M port Optical

When hosted on SMA-1/4CP units the Extender II VC-TS delivery limitation of 14 x VC12's does not apply. The full ATX unit bandwidth – mapped into the relevant VC12, VC3, VC4 or VC12 VCIMA group of up to 63 VC12 links – is supported.

Note: More detailed information can be found in the appropriate equipment manual.

18.2 APPLICATIONS

Figure 18.3 below shows the ATA, ATX and ATC in a network application. Here a user wishes to connect their site using ATM through the public access network, to another site and also to monitor their traffic. Note that this scenario can be extended to allow many sites to connect to this same remote site through the ATC and the ATM cross-connect (or switch). Thus, users can efficiently inter-connect any equipment (for example, IP routers) with a suitable ATM interface over such a network.

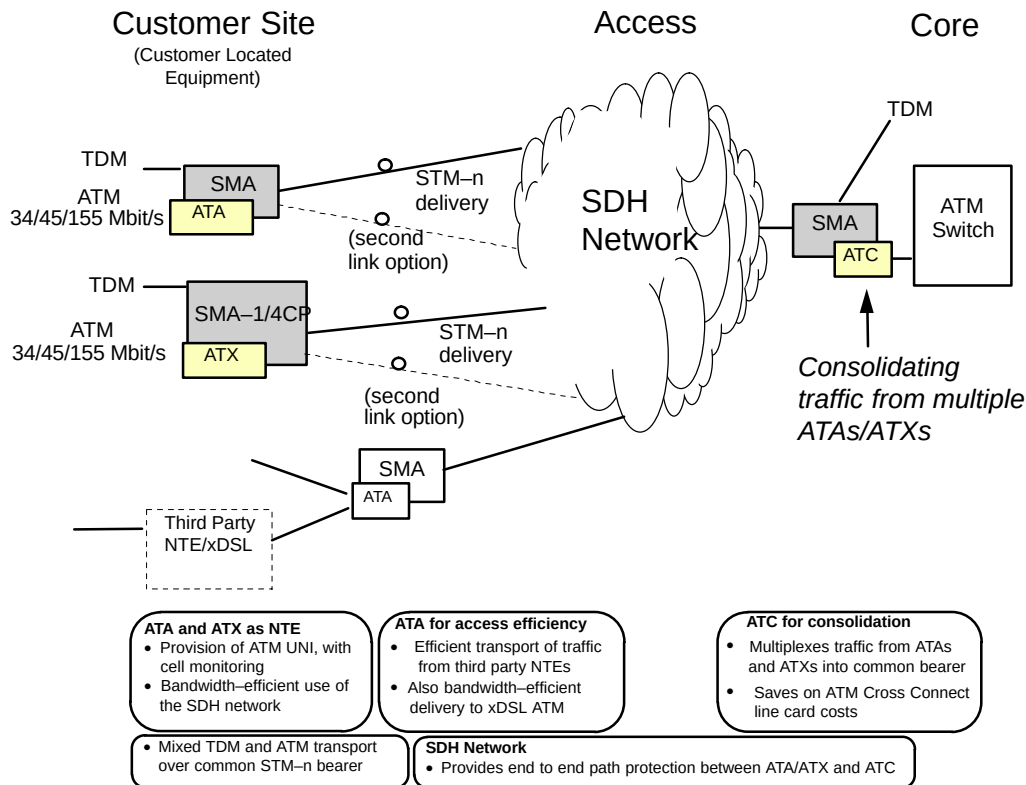


Figure 18.3 Position of the CellSpan Units in an SDH Access Network

Because CellSpan products provide extra features to the SMA (ATA and ATC) or SMA-1/4CP(ATX), the original SDH and PDH features of SMA and SMA-1/4CP are still available. Therefore users can have a combination of ATM, SDH and PDH features from one installation.

18.2.1 ATM NTE

The ATA and ATX also provide ATM Network Termination Equipment (NTE) features. ATM NTE is used by some operators to monitor the quality of ATM delivery on the customer premises, including the collection of ATM statistics relevant to ATM service. Here, the NTE is Customer Located Equipment (CLE) owned by operator, which connects to Customer Premises Equipment (CPE) owned by the customer.

18.2.2 Consolidation of ATM Traffic

The ATA card can be used to 'hub' (or consolidate) ATM traffic from third party NTEs. To achieve this, the ATA card can be located at appropriate nodes in the access network where an SMA is present (See Figure 18.4).

The 155 Mbit/s ATA, with single mode optical interfaces, may be fitted such that it can 'drive' a fibre link to a distant end-user site where the third party NTE is located.

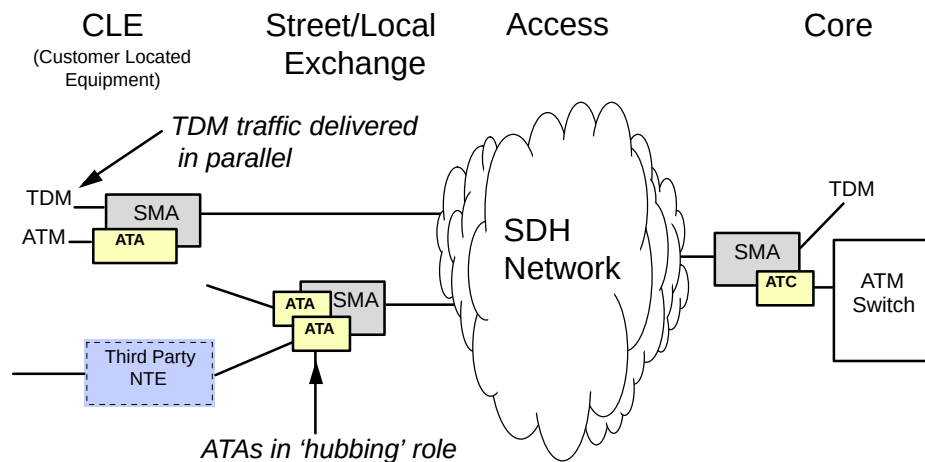


Figure 18.4 Consolidation ('Hubbing') ATA Application

18.2.3 Point-to-multipoint and Trunk Applications

For a limited number of customers served by certain operators, the ATC could be used without connecting to ATM switches as shown in Figure 18.5. This would, for small mesh networks, be cheaper overall than a network using an ATM switch (or switches) in the core.

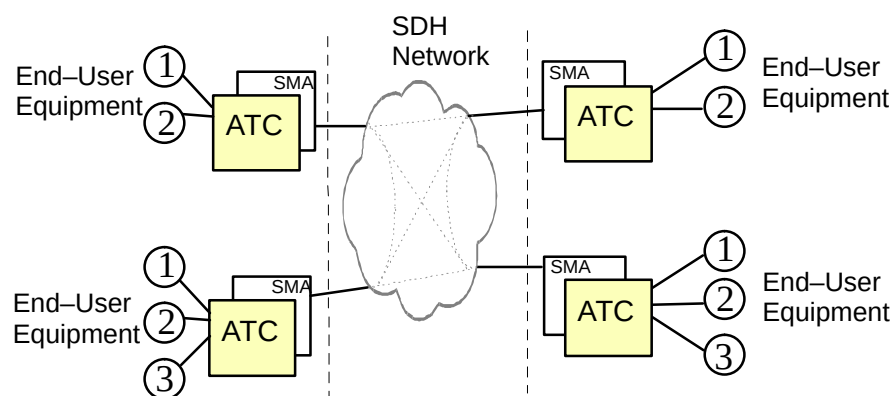


Figure 18.5 CellSpan – Point to Point Application

Figure 18.5 illustrates a point-to-multipoint ATM network built upon SMA and CellSpan components without the use of an ATM switch. The numbers each represent a different piece of equipment or type of service to be connected (for example, the LAN on each site, video conferencing equipment, a specialised finance or CAD network, or even ATM-equipped PBXs on each site).

This application uses the routing features of the ATM Traffic Combiner (ATC) to send ATM traffic to multiple destinations from the same source. It also uses the feature that traffic of multiple service types (indicated by the numbers in circles) can be presented to the ATC on multiple physical connections but transported to a destination ATC on a single SDH VC (or group of SDH VCs).

The multiple service classes are supported on that SDH VC in separate ATM streams. Although not true ATM switching, such a situation provides a valuable managed service for those operators with an SMA infrastructure of managed, customer ATM traffic.

Note: For a limited, point-to-point connection between two sites, an ATA could be deployed at each site with an SDH VC linking the two ATAs across an SDH network. However, as soon as one site requires ATM connection (from the same card) to more than one other site then an ATM Traffic Combiner (ATC) is required – although up to four ATAs can be installed in the same SMA for multiple point-to-point links, if required.

ATC to ATC is also be an option for those wishing to improve use of 'thin' ATM trunk routes (switch to switch connections in the 'backbone' of an ATM network), where they may not wish to allocate entire STM-1 paths through the SDH network to ATM traffic.

18.2.4 ATM Traffic Adapter (ATA)

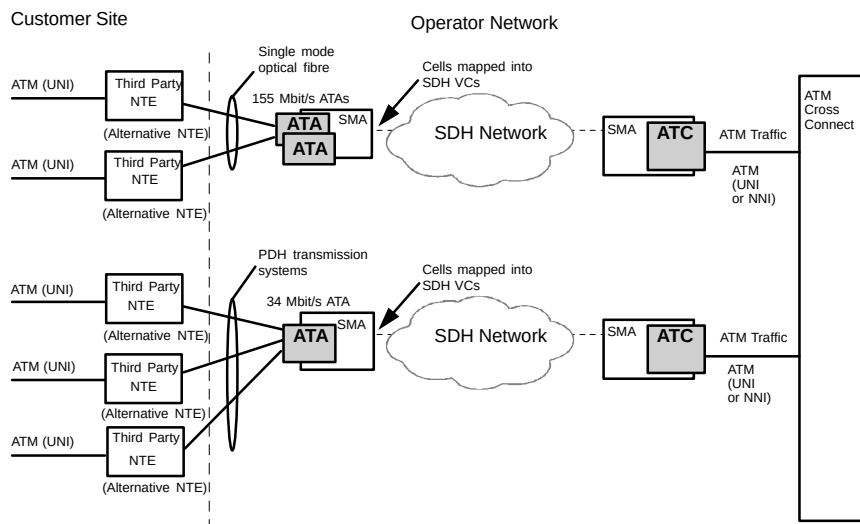


Figure 18.6 ATA Gives Access Efficiency when Carrying ATM in the SDH Network

Unless used as an NTE, the ATM Traffic Adapter (ATA) card need not be located on customer premises.

The ATM-into-SDH mapping features of the CellSpan concept can be used elsewhere in the SDH network to reduce the bandwidth used to carry ATM traffic. To achieve this, the ATM Traffic Adapter (ATA) card can be located at appropriate nodes in the access network where an SMA is present.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 19: PACKETSPAN

19.1 PACKETSPAN LINK PRODUCTS

PacketSpan Link products provide point to point (transparent) transport of packet data across SDH-based networks.

PacketSpan Link products provide mapping of packets into SDH for transmission over a wide area. Packets received over a 10BASE-T interface are mapped into n x 2Mbit/s links, grouped together using Multi Link PPP (Point to Point Protocol) in VC-12 payloads.

19.2 PACKETSPAN MANAGEMENT

The management of the SDH domain and Ethernet (Data) domain is separate. The SDH domain is managed by the Element Manager network management system – while the Ethernet domain on the card is managed from the PacketSpan Data Element Management System.

19.3 APPLICATION TO SERIES 4

With regard to Series 4 SMA products, there are references elsewhere in this manual to PacketSpan and to PacketSpan ETX, ETA and ERA options. Note that PacketSpan ETX options apply to SMA-1/4CP. ETA and ERA options apply to SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8). For further information on PacketSpan see the relevant PacketSpan manual(s).

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CHAPTER 20: AUXILIARY

20.1 SMA–1/4CP

20.1.1 Auxiliary

The SMA–1/4CP is equipped with one 64Kbit/s AUX (V11) interface per optical Line, providing clock and data suitable for remote management of subtended equipment (i.e. CMUX).

Aux port 1 is associated with Line West.

An internal switch is supported for Aux port 2, which selects between either AUX access from Line East or Comms access for DCC AUX. The switch source selection for AUX 2 is user configurable from LT/EMOS.

The switch selection is controlled by the Comms/Controller function.

The AUX byte configuration selection is not carried out via internal switches/links. A user configurable option is provided, whereby the user is allowed to select a single byte from the SOH to be presented onto the AUX port.

20.1.2 EOW

Dedicated EOW interface/access is not supported on SMA–1/4CP and SMA–1/4c. EOW operational information for SMA–1/4 is contained in the following chapter.

20.2 SMA–1/4C, SMA-1/4UC AND SMA–1/4(4+4)(8)

20.2.1 General

SMA–1/4c/uc and SMA–1/4(4+4)(8) are capable of supporting co-located CMUX products. This is achieved by use of the AUX ports:

- On the SMA–1/4c/uc synchronous 64kbts/s recovered from the OH bus is made available at the Ancillary LTUs.
- On the SMA–1/4(4+4)(8) the AUX card must be fitted.

Management of CMUX subtended from Extender products is via the AUX card and VCAM cards in an SMA shelf.

20.2.2 Management of AUX on SMA1/4c/uc

Selection of AUX, EOW and DCC AUX channel routing to the Ancillary connectors is managed by the Comms/Controller card. See Figure 20.1.

20.2.3 AUX/EOW OH Byte Selection

Selection of the appropriate byte for routing to the 64kbit/s Ancillary AUX/EOW port is achieved in the AUX Access Module on the Core Card via a control bus configuration message.

For EOW use, the following bytes can be configured to be sent to the AUX connector on the ancillary: E1,E2,F1 (supported on EOW card).

For AUX use, the following bytes can be configured to be sent to the AUX connector on the ancillary:

Table 20.1: SOH Byte Options	
Row	Column
9	8
9	9
8	8
8	9
7	8
7	9

20.2.4 AUX/EOW A/B Selection

The Ancillary AUX/EOW port can select between the A/B Core Cards either manually or in response to MSP switching events.

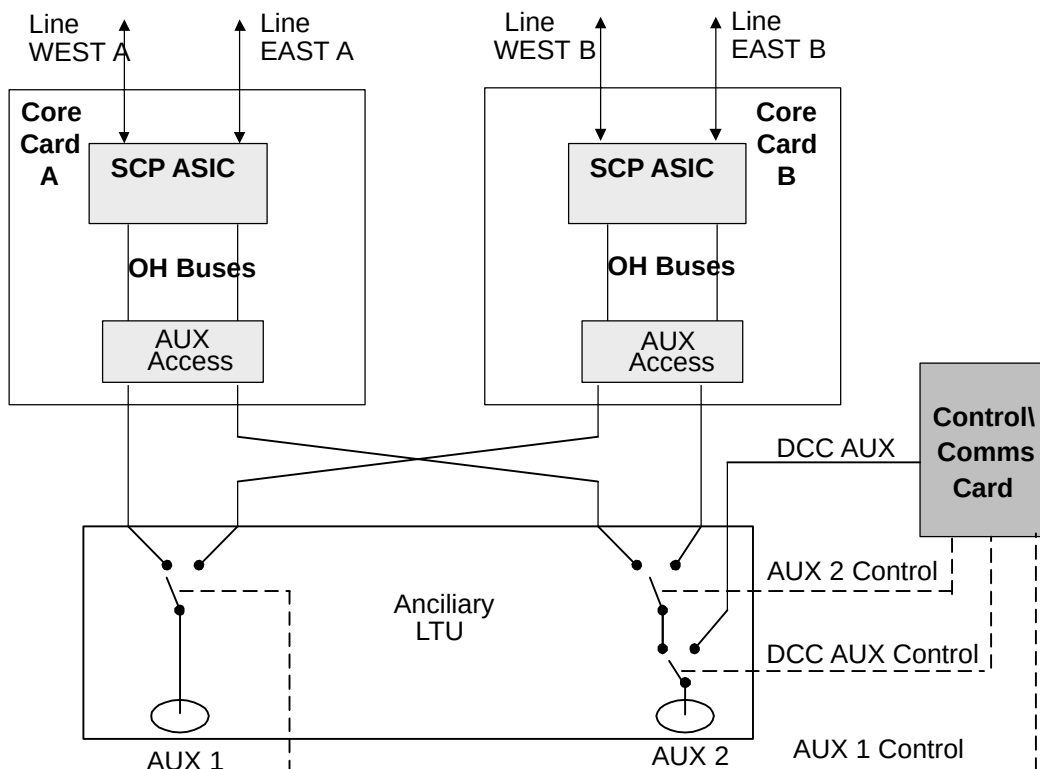


Figure 20.1 AUX Switching on SMA-1/4c/uc Ancillary

20.2.5 DCC AUX Selection

The Ancillary AUX 2 port can further select between the AUX/EOW and DCC AUX support. When DCC AUX support is selected management of Auxiliary Access equipment can be supported via DCC routeing on the Comms/Controller card.

20.2.6 Management of AUX on SMA–1/4

The OH bytes defined above for AUX channels and EOW in relation to SMA–1/4c are accessible via the two AUX slots. Selection of the OH bytes used is not managed by the Comms/Controller Card but is configured via SMA cards.

The following configurations are supported using SMA cards:

- 1 x AUX Card and/or 1x EOW Card providing AUX and/or EOW access for Line East and Line West and AUX Access for tribs 5–8.
- 2 x AUX cards providing AUX Access for Line East and Line West and tribs 1–8.

Note: The AUX Access function that is provided on the Core Cards is disabled when the cards are fitted in the SMA–1/4 ADM.

20.2.7 AUX A/B Selection

The Line AUX ports, available on the AUX LTU, can select between the A/B Core Cards either manually or in response to MSP switching events. See Figure 20.2.

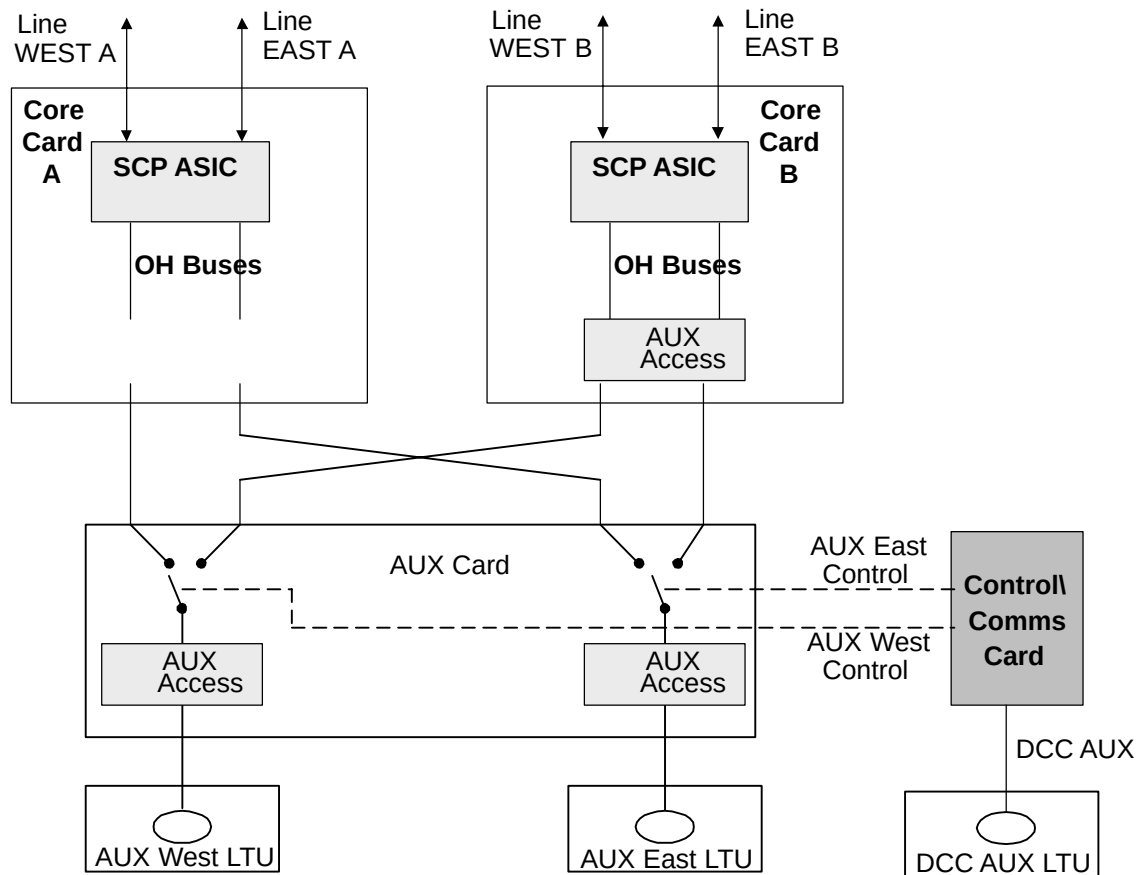


Figure 20.2 AUX Switching on the SMA-1/4 AUX Card

Note: Further information on EOW is provided in the EOW chapter.

CHAPTER 21: EOW OPERATIONAL INFORMATION FOR SMA–1/4(4+4)(8)

21.1 INTRODUCTION

21.1.1 Functional Description

Dedicated EOW interface/access is not supported on SMA–1/4CP and SMA–1/4c. This chapter only applies to SMA1/4(4+4)(8).

Engineers Order Wire facilities are provided by an EOW card which fits in the EOW card position of the sub–rack. The card may be used to provide 2W/4W conversion, hook status detection and DC current feed for use with 2–wire handsets. The handset is connected via a bantam jack on the front of the card. The 4–wire port is connected via an Auxiliary LTU (AUX4). It is transformer coupled with no DC and can be used for EOW network extension, or for an external EOW equipment.

The card performs analogue to digital and digital to analogue conversion, with A–law encoding and decoding. In addition, the card generates supervisory tones, see Figure 21.2. DTMF decoding and a buzzer for incoming calls are provided. The buzzer means the handset itself does not ring. It also allows incoming calls even if the handset is not plugged in or has been left off–hook.

The card is fitted with an Inventory PROM (EEPROM) which carries information about the card.

21.1.2 Card variants

The current card variants are:

Table 21.1: EOW Card Variants		
	Ringmaster	Ring Slave
SMA–1/4	1HAT60576EAG	1HAT60576DAK

21.2 FEATURES

21.2.1 Status Indication

The card has three LEDs on its front edge to provide the following status indications:–

- Red ON indicates an alarm in the unit.

- Green
ON when at least one EOW circuit on the network is in use.
FLASHES when the unit is ringing out.
- Yellow
ON for a user already engaged in a selective call who is making a call to a third user (selective multiple call).
ON for a third user who is intruding in a selective call.
ON for an answering user who is talking in an omnibus call.
FLASHES when an omnibus call is unanswered, or the answering user is only listening.

21.2.2 Push-button Switch States

Two momentary action switches are accessible from the front edge of the card, they provide the following facilities:–

- Access to the upper switch is through a hole in the front panel, so it can only be depressed by a small screwdriver or similar tool. It initialises the EOW to a known state in the case of card failure or after plugging the card in. Note that this will also send a DTMF signal (code 'B') which will reset EOW cards elsewhere on the network.
- The lower switch has a number of functions as follows:
 - It allows any user to include himself in an established selective call by continuously pressing the switch. When this occurs, intrusion tone is heard on the handsets of all the users.
 - It allows a user engaged in a selective conversation to call another user by first momentarily pressing it.
 - If an omnibus call is on-going then any user can be allowed to talk by momentarily pressing the switch. To revert to a listening connection, the switch must be pressed again.

21.2.3 Overhead Buses

The EOW card accesses a selected East and West line overhead bus and the overhead bus of a selected STM–N tributary.

Note: A feature of the design is that the EOW facility is only available as follows:

Table 21.2: EOW Ring Slave/Ring Master	
Ring Slave	Ring Master
1HAT60576DAK	1HAT60576EAG
SMA1/4	SMA1/4
East A, West A, STM–1Trib 1	West A, STM–1Trib 1

21.2.4 Ring Master/Slave Control

The card provides an EOW for an SDH network with or without SLA elements.

To prevent re-generative addition of digitised EOW speech around a ring, the EOW supports master/slave operation. All the EOW units are configured as slaves in a ring, except one which is configured as a master.

When configured as a slave, the EOW card provides a speech bridge between its handset, 4-wire port, STM-N Tributary 1 and both line East/West paths.

When configured as a master, the EOW card provides a speech bridge between its handset, 4-wire port, STM-N Tributary 1 and a selected East or West path.

In addition, the EOW provides ring protection in case of fibre breakage. To provide this feature, the master card periodically transmits particular codes on both East and West transmit paths. The codes are passed on, unmodified, from East to West and from West to East by the slaves. The master detects the codes on its incoming East or West paths so it can determine ring integrity. If the codes are not present on either East or West receive paths, then the master starts to operate like a slave. This means that the EOW will function correctly with a fibre break. When the fibre is repaired the master returns to its original mode.

The selection of ring master/slave operation is via a link on the card. The link is directly below the buzzer and behind the red LED. Link the two pins nearest the LED for Slave operation. Link the two pins furthest from the LED for Master operation.

21.2.4.1 Networks without SLAs

Use card 1HAT60576DAK. Always fit the slave link, **except for one element per ring** which is set to master.

21.2.4.2 Networks with SLAs

If there is an SLA in the ring always fit the slave link. For **one element in the ring** card 1HAT60576EAG should be used instead of 1HAT60576DAK.

21.2.5 Telephone Number

The card telephone number is set by 8 DIP-switches to generate a two digit BCD number between 10 and 99. ("ON" is zero, "OFF" is one, switch 8 is the Most Significant Bit of the More Significant Digit). An invalid BCD code results in a default number 10. [00 is reserved for omnibus calls. 01 is reserved. 02 to 09 are unused.]

21.2.6 Default Configuration

The card powers up in the following state:–

- Switch Clock A/B Selection
Default B
- Optimux A/B setting
A
- G.703 #1
O/H byte F1 (West A)

- G.703 #2
O/H byte F1 (East A)
- EOW O/H byte
E1 (East A, West A and Trib 1)
- EOW Ring Master
Set by link
- EOW Telephone Number
Set by DIP–switches
- EOW Trib Selection
Tributary 1

The EOW card is ready to receive calls from power–on reset. To originate calls after such a reset, either a DTMF code B must have been received from elsewhere on the ring or the upper switch on the card must have been momentarily pressed.

21.2.7 EOW Network Extension

The EOW is designed to include ring security when it resides on a ring. Multiple rings can be linked to form a larger EOW network. The rings can be linked digitally, via the overhead on an STM–N Tributary in position T1. T1 can also be used to include EOW on a spur.

An analogue link can be provided by joining two 4–wire interfaces. This can form an integrated EOW with an existing PDH or analogue network, see also paragraph 21.4.1.

It is possible to use the card for EOW without using the on–board features described. See paragraph 21.4.1 for details.

21.2.8 64 kbit/s Co–directional Interfaces

The card provides two 64 kbit/s interfaces to G.703 which are transformer coupled and meet the jitter requirements of G.823.

The selection of the SOH byte and the overhead bus on which to transmit/receive is independent for each channel. Note that a feature of the design is that port 1 is connected to West A and port 2 is connected to East A.

The access to each channel is via the Auxiliary LTU (Aux 5).

21.2.9 Handset Loop Disconnect/DTMF Switch

The Loop Disconnect/DTMF switch on the handset, marked FV/DC must be set to FV for operation with the EOW card. The switch is located below the handset earpiece.

21.2.10 Power–up Sequence

On Power–up the EOW Card checks to see which Switch Card Clocks are present. In preference it chooses the Switch Card 'B' Clock.

This choice is only made at Power-up. Hence if the Switch Card, whose Clock has been chosen by the EOW card, subsequently fails, the EOW card does not 'change-over' to use the Clock of the other Switch Card.

If on EOW card Power-up Switch Card 'B' is chosen and this Switch Card subsequently fails the EOW card is unable to switch to Switch Card 'A'. To overcome this problem, re-seat the EOW card. Switch 'A' will be selected as Switch 'B' is not available.

21.3 2-WIRE EOW OPERATION

21.3.1 Using the EOW

Plug the telephone into the bantam jack plug on the front of the EOW card. The recommended telephone is 1HFA20002AAJ.

The card uses DTMF codes A, B, C and D (generated by the card itself) to control the call.

21.3.2 Audible and Visible Signals

The card incorporates a buzzer, which indicates incoming calls. The use of a buzzer has the advantage that the handset need be neither on-hook nor plugged in when a call arrives. There are two cadences as shown in Figure 21.1. (The logic signal BUZZER occurs during the time the buzzer sounds, but it is not cadenced.)

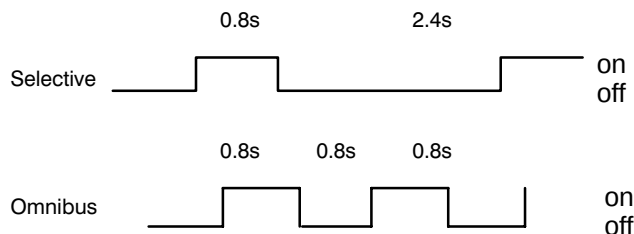


Figure 21.1 Selective and Omnibus Buzzer Cadences

Supervisory tones generated by the card are:—
 'Proceed to dial', 'Awaiting answer', 'EOW busy' and 'Intrusion'.
 Call progress is shown by flashing green and yellow LEDs. The cadences of these tones and LED flashing are shown in Figure 21.2.

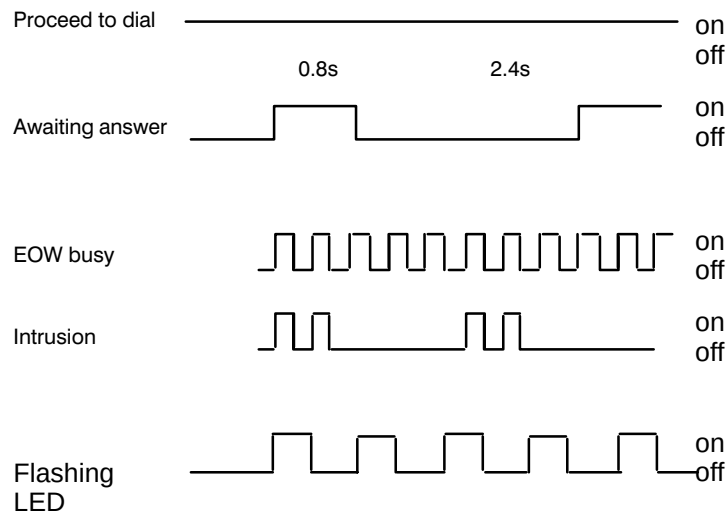


Figure 21.2 Supervisory Tone Cadences

Procedure 1: Originating a Call

1. Replace the handset on-hook.
2. If the green LED is off, pick up the handset.
3. If the green LED comes on and you can hear proceed to dial tone, dial the number of the required user. For an omnibus call, dial 00.
4. If the green LED remains off and intrusion tone is heard, this is the first call following power up of the card. Press the upper button on the card (through the hole in the front panel) and start again. Note that this will reset all the EOW cards in the network.
5. If the green LED is on, the EOW is already in use. Pick up the handset. The EOW busy tone will be heard.
6. To join in with this call, press and hold the lower button on the card. You will be permitted to join the conversation and all users will also hear intrusion tone. (If the lower button has no effect, the EOW is either in the originating or awaiting answer phase of a call. In this case clear down and try again later.)
7. If the green and yellow LEDs are both flashing, see 4.

21.3.3 Awaiting Answer

1. You have originated a call and you can hear awaiting answer tone.
2. THEN, if the call is answered, the awaiting answer tone stops. You can now speak. (If an omnibus call is made, other users will not be heard unless they wish you to. See 5 to 7 and the subsequent note.)
3. ELSE, if the call is not answered within 60 seconds, the call will be aborted and the EOW busy tone will be heard. Clear down and try again later.

Procedure 2: Receiving a Selective Call

1. The buzzer on the EOW card sounds for a selective call.
2. The green LED flashes and the yellow LED is off.
3. You have 60 seconds to answer the call.
4. Lift the handset. The buzzer will stop sounding and the green LED will be permanently lit. The call path is now established.
5. If the handset is already off-hook it should be replaced. The call may then be answered as before.

Procedure 3: Receiving an Omnibus Call

21.3.3.1 Within 60 seconds of the call arriving

1. The buzzer on the EOW card sounds for an omnibus call and the green and yellow LEDs both flash.
2. Lift the handset. The buzzer stops sounding and the green LED comes on continuously. The yellow LED continues to flash. You can listen to the caller and any other users who have established a speaking connection.
3. If the handset was off-hook already, then replace it on-hook. You can then answer the call as above.

21.3.3.2 More than 60 seconds after the call arrived

4. The green and yellow LED's are both flashing, but the buzzer on the EOW card is silent. This means that an omnibus call was not answered at this multiplexer within 60 seconds of it arriving, but it is still in progress. You can still join the call as in 2.

21.3.3.3 How to speak

5. Answering an omnibus call as just described only allows you to listen to the call. If you wish to speak, then momentarily press the lower button on the card. The yellow LED comes on continuously. You may now speak as well as listen.
6. When you no longer wish to speak, THEN, if you wish to continue listening, momentarily press the lower button on the card. The yellow LED starts flashing. You can no longer speak. You can toggle between this state and the previous one by repeatedly pressing the lower button.
7. ELSE, to leave the call, clear down. The yellow LED starts flashing. (If you change your mind, you can re-answer.)

Note: An omnibus call does not end until the originator clears down or the EOW network is reset.

Procedure 4: Additional Calls

1. IF you have reached the conversation phase of a selective call, and you wish to include a third user.
2. THEN momentarily press the lower button on the card. The yellow LED will light, the speech connection is suspended and you will hear proceed to dial tone. The number of the third user may now be dialled.
3. Speech connection is restored. Both users hear awaiting answer tone. When the call is answered, awaiting answer tone stops and the yellow LED goes off.
4. NOTE if after 60s the call is unanswered, it is aborted and the yellow LED goes off.
5. IF you change your mind at any time while the yellow LED is on, you can back out by momentarily pressing the lower button on the card again.
6. NOTE that additional users may only be called by either of the first two parties in the call. If an additional user presses his button there is no effect.

Procedure 5: Finishing a Call

1. To clear down, replace the handset on-hook.
2. IF you originated the call or you answered a selective call, clearing down will clear the EOW network and the green LED will be extinguished.
3. IF you answered omnibus call, or you were an additional user in a selective call, clearing down will not clear the EOW network and the green LED will remain lit.
4. NOTE if another user is holding the network unintentionally, pressing the upper button on any card will clear the network. (This could happen if a user making an omnibus call fails to clear at the end of the call, or both users in a selective call fail to clear.)

Procedure 6: Unused Codes

1. IF you dial your own number or a spare number, the awaiting answer tone will not be heard. The 60 second 'no answer' timeout will run.
2. IF you dial * or # instead of 0–9, an originating call will be aborted and you will receive EOW busy tone. A call to an additional user will be aborted and you will be returned to the original connection.

21.4 4-WIRE FEATURES

21.4.1 EOW Network Extension

The 4-wire circuits can be used to connect a compatible EOW system. This provides a means of linking different SDH rings, for example (though this can also be achieved digitally via an STM-N link in Tributary 1 position). It can also provide a link to a PDH or an analogue EOW network.

Connection is achieved via the Auxiliary LTU (AUX 4), refer to the appropriate installation chapter for connector information.

Unless the same DTMF protocol is used, interworking between the systems is impracticable; e.g. the built-in call control on the card uses DTMF digits A to D to control set-ups.

21.4.2 Alternative EOW System

Provided that DTMF digits A to D are not used, an alternative analogue external system can be connected to the 4-wire port. In this case, most of the EOW features described in this chapter (for example 2-wire port, supervisory tones, LEDs and telephone number control) will be unused.

Some features are still used, however. The upper push-button switch on the card initialises the cards in the network and enables the 4-wire connections to the speech bridge. The master/slave link must still be used to control performance on an SDH ring. The card still provides conversion between analogue and E1 SOH signals.

In some applications it is intended to use the Siemens Selective Call Inset, S42023-A83-A1. This provides similar (but incompatible) features to the built-in system. See its own operating manual for details. This external system ensures compatibility and integration with an established Siemens EOW network.

A brief electrical specification for the 4-wire interface (inputs and outputs) is:–

- Impedance
600 ohm AC balanced
- Reference level
–4dBr $\pm$ 0.5dB @ 1024Hz

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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SECTION 4: SPECIFIC SHELF CONFIGURATION DETAILS

CHAPTER 22 SHELF CONFIGURATION FEATURES SPECIFIC TO
SMA-1/4CP, SMA-1/4c/uc AND SMA-1/4 Page 275

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CHAPTER 22: SHELF CONFIGURATION FEATURES SPECIFIC TO SMA–1/4CP, SMA–1/4C AND SMA–1/4(4+4)(8)

22.1 SHELF CONFIGURATION FEATURES SPECIFIC TO SMA–1/4CP

This section describes the product specific management functions for SMA–1/4CP.

Note: SMA–1/4CP is capable of being upgraded to STM–4 (622mbit/s).

SMA–1/4CP forms a platform for the delivery of traditional PDH/SDH (e.g. 2Mbit/s, 34/45Mbit/s & STM–1 electrical and optical), and Broadband data interfaces (i.e. ATM, Ethernet).

SMA–1/4CP supports three types of expansion modules, referred to as “Passive 2M expansion module”, “PDH/SDH expansion module” and “Broadband expansion module”.

Passive 2M Expansion Modules are considered as ‘Dumb’ modules, which means that these modules are controlled by the SMA–1/4CP Core (e.g. 8x2M expansion module only).

PDH/SDH and Broadband Expansion Modules are considered as ‘intelligent’ modules, which means that these modules support their own microprocessor and are managed as a separate entity (e.g. 16x2M, 34M/45M, STM–1, ATX etc).

The following versions of the SMA–1/4CP Core are supported:

Table 22.1: SMA–1/4CP Base Unit Details		
Capacity	Specification	Connector
4 x 2M (E2)	G.703 & X21	BNC unbalanced/RJ45 balanced/15 way D (X.21)
16 x 2M (E2)	G.703	RJ45, balanced
16 x 2M (E2)	G.703	1.0/2.3 unbalanced

Note: All the above base units are capable of supporting an expansion module.

STM–1 and STM–4 versions of the above SMA–1/4CP base units are supported.

The following Expansion Modules are supported:

Table 22.2: SMA–1/4CP Expansion Unit Details				
TYPE	Capacity	Spec	Connector	Note
ATX– Note 1	1 x E3/DS3	IM	BNC	
ATX –Note 1	1 x STM–1	IM	Optical(multimode) / Electrical (BNC)	
*Passive 2M/X21	8 x 2M/X21	G.703&X.21	G.703, Balanced: RJ45 G.703, Unbalanced: BNC X21, 15W D type	Passive Module
34/45M– Note 2	3 x 34/45		BNC unbalanced	Active card

*ETX	2x10M	10baseT Ethernet	2xRJ45	Active
	STM-1	11.1	Multimode	
	16x2M			

Note: * not supported by the 16 x 2M Base unit.

Note 1: The PDH/SDH expansion Modules shall utilise the 38MHz interface into the SCP ASIC.

Note 2: The ETX expansion module uses the eight X.21 interface for traffic transfer, instead of the P-STM-1. The ETX card comprises of the Ethernet Domain only.

22.1.1 PHYSICAL SHELF CONFIGURATION

The shelf type associated with the SMA-1/4CP is:

- SMA-1/4CP with Expansion

Figure 22.1 illustrates the SMA-1/4CP.

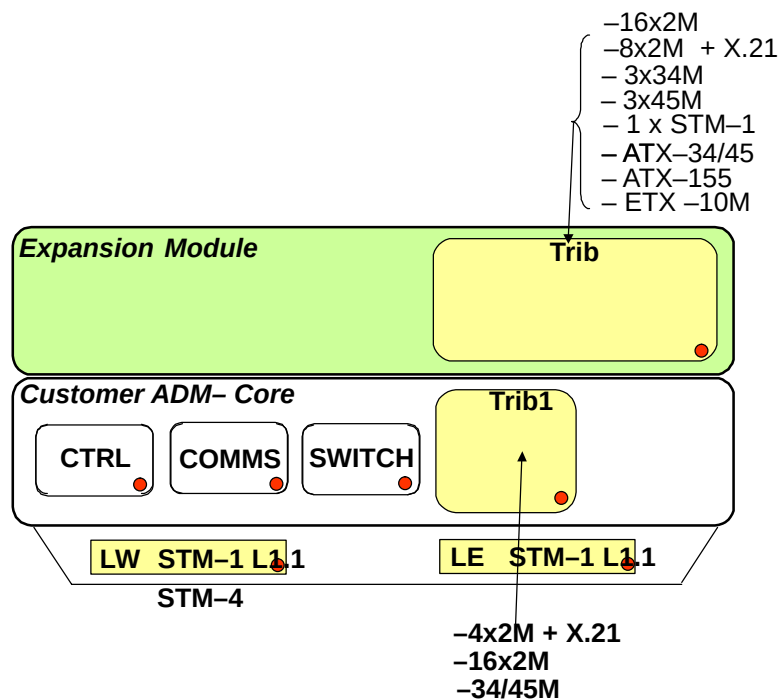


Figure 22.1 SMA-1/4CP Line Termination representation

22.1.2 Physical Card and Slot Allocation

The user can configure, unconfigure, and adopt the Core unit (tributary) and the line modules. The CCF can auto-configure the Controller/Comms and Switch cards.

Note: The Core Unit consists of the Line modules, Controller, Comms, Switch and 2M tributary functions.

In addition, a Global Adopt function is supported. This option applies to the base unit and the expansion module.

The SMA–1/4CP has the ability to support an Expansion Module, which the user can configure, unconfigure or adopt. The modify option is only applicable to specific Expansion Modules (eg STM–1), identified by M in the table below. The SMA–1/4CP ADM consists of two slots as indicated in the table:

Table 22.3: SMA–1/4CP Physical Card and Slot Allocation		
Slots	Description	Allowable Card Types
1	Base unit	4x2M + X.21 16x2M
2	Expansion Module	Passive 8x2M + X.21 (see Note) 16x2M 1x34M/45M ATX 1xSTM–1 electrical ATX 1xSTM–1 optical ATX 1xSTM–1 electrical (M) (see Note) 1xSTM–1 optical (M) 3x34M/45M 2x10M ETX (M) (see Note)

Note: Not supported on the 16x2M SMA–1/4CP base

22.1.3 Minimum Configuration

The SMA–1/4CP base unit is a single Core card which has a minimum configuration of:

- Controller
- Comms
- Switch
- (i.e. no line module, tributary or expansion module).

These functions are always reported as configured by the Controller – the user does not have to configure these functions from LT/EMOS.

22.1.4 DCC Access

The communications support is 4 DCC (2xDCCr and 2xDCCm) from Line East and Line West only.

22.1.5 PROTECTION

The SMA–1/4CP does not support Core Card or Expansion Module protection.

SMA–1/4CP does support the following Traffic protection schemes:

- MSP
- SNCP
- Port

22.1.6 ADDRESSING SCHEMES

The controller function performs the following tasks:

- Identifies the system identity.
- Addresses the Core functions and Expansion Module on the control and inventory buses.
- Determines expansion module and line module insertion and extraction

22.2 PHYSICAL SHELF CONFIGURATION FEATURES SPECIFIC TO SMA–1/4C/UC, SMA–1/4(4+4) AND SMA–1/4(8)

This section describes the product specific management functions for SMA–1/4c and SMA–1/4. The three products are:–

Table 22.4: SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8)	
Product Description	Product code
Fullsize ADM Dual LTU ROW	SMA–1/4 (8)
Midsize ADM Single LTU ROW	SMA–1/4 (4+4)
Compact ADM (4 Tributaries)	SMA–1/4c

These products are based on SMA Series 3. The main new features are:

- the Core Card which comprises of the Switch, two Line interfaces and core 2Mbit/s functionality (32 Channel) Tribs onto a single PCB.
- A combined Comms/Controller card physically combining the Controller and Comms functions.
- A Dual STM–1 Trib using a 78M interface and Optical Modules.

There is software for the Core Card combining the functions of the Switch, Trib and Lines. For the Controller/Comms there will be two processors so separate software for the two functions is retained.

22.2.1 PHYSICAL SHELF CONFIGURATION

There are two versions of SMA–1/4, the SMA–1/4(8) which has two rows of LTUs and the SMA–1/4(4+4) which has a single row of LTUs. The SMA–1/4(4+4) is the same as the SMA–1/4(8) except that the top row of LTUs does not exist. This means in the single row shelf Tributary positions 1 to 4 can only have Front Plug–Up (FPU) Tributaries fitted.

Table 22.5: SMA–1/4(8) Shelf Configuration

Table 22.5: SMA–1/4(8) Shelf Configuration																	
LTU SLOT	LTU 101	LTU 102	LTU 103	LTU 104	LTU 105	LTU 106	LTU 107	LTU 108	LTU 109	LTU 110	LTU 111	LTU 112	LTU 113	LTU 114	LTU 115	LTU 116	
LTU SLOT	LTU 201	LTU 202	LTU 203	LTU 204	LTU 205	LTU 206	LTU 207	LTU 208	LTU 209	LTU 210	LTU 211	LTU 212	LTU 213	LTU 214	LTU 215	LTU 216	PWR 217
ANCILLARY SLOT	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317
	T R I B 1	T R I B 2	T R I B 3	T R I B 4	C O R E A	C O R E B	T R I B 5	T R I B 6	T R I B 7	T R I B 8	C O M M S / C O N T	A U X 1	E O W A U X 2	P S U A	P S U B		
TRIB SLOT	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415		

Table 22.6: SMA–1/4 (4+4) Shelf Configuration

Table 22.6: SMA–1/4 (4+4) Shelf Configuration																	
LTU SLOTS	LTU 201	LTU 202	LTU 203	LTU 204	LTU 205	LTU 206	LTU 207	LTU 208	LTU 209	LTU 210	LTU 211	LTU 212	LTU 213	LTU 214	LTU 215	LTU 216	PWR 217
ANCILLARY SLOTS	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317
	T R I B 1 FPU	T R I B 2 FPU	T R I B 3 FPU	T R I B 4 FPU	C O R E A	C O R E B	T R I B 5	T R I B 6	T R I B 7	T R I B 8	C O M M S / C O N T	A U X 1	E O W A U X 2	P S U A	P S U B		
TRIB SLOTS	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415		

CHAPTER 22: SHELF CONFIGURATION FEATURES SPECIFIC TO SMA1/4CP

Trib positions Trib 1 to Trib 4 do not have LTU access so are limited to Front plug-up (FPU) cards.

For the SMA-1/4(8) and SMA-1/4(4+4) shelves the ancillary LTUs are:–

Table 22.7: SMA-1/4(8) and SMA-1/4(4+4) Ancillary LTUs	
Ancillary LTU Slot	Use
217	Power
301	Sync
302	Not used
303	Not used
304	Not used
305	Not used
306	Not used
307	Not used
308	2M Test
309	LCT
310	AUI
311	MAT AUX
312	AUX
313	AUX
314	AUX
315	User I/O
316/317	Local Alarm

22.2.1.1 SMA-1/4uc

L T U 101	L T U 102	LTU 2M 103		LTU 2M 104		P L W C R T LTU 105
T R I B 1 FPU	T R I B 2 FPU	C O R E A	C O R E B	T R I B 3	T R I B 4	C O M M S / A U X / A N C I L
201	202	203	204	205	206	207

SMA-1/4c

Table 22.8: SMA–1/4c Shelf Configuration															
FIBRE MANAGEMENT AREA															
C O M M S / C O N T	C O R E A	C O R E B	T R I B 1	T R I B 2	T R I B 3	T R I B 4	P S U A	P S U B	L T U 110a	L T U 111a	L T U 112a	L T U 113a	CORE LTU 32 Channels 114a/115a		
			FPU	FPU										A N C	CORE ANCILLARY
101	102	103	104	105	106	107	108	109	110b	111b	112b	113b	114b	115b	

Trib positions 'Trib 1' and 'Trib 2' do not have LTU access so are limited to Front plug-up (FPU) cards.

The SMA-1/4c ancillary LTUs are:–

Table 22.9: SMA-1/4c Ancillary LTUs	
Ancillary LTU	Use
114b	Ancillary (additional functions)
115b	Ancillary (Core functions)

22.2.2 PHYSICAL CARD/SLOT ALLOCATION

There is a hardware card keying mechanism to prevent insertion of cards in invalid slots. For the SMA-1/4(4+4) and SMA-1/4(8) the permitted card equipping is shown in Table 22.10. Permitted card equipping for SMA-1/4c/uc is shown in Table 22.11.

Table 22.10: Permissible Card/Slot Allocations for SMA-1/4(4+4) and SMA-1/4(8)		
Slots	Description	Allowable Card Types
401 to 404	Trib Slots (1 – 4)	Any SMA Trib permitted for the Dual LTU shelf. SMA Tribs not requiring LTUs (Front Plug Up) for the single row LTU shelf.
405 and 406	Core Cards	CORE (Any variant)
407 to 410	Trib Slots (5–8)	Any SMA Trib
411	Comms/Controller Slot	Comms/Controller only
412	Auxiliary Card 1 Slot	AUX 0/0.1
413	Auxiliary EOW Card 2 Slot	AUX 0/0.1, EOW
414 and 415	PSU A and PSU B Slots	SMA-16 PSU only

Table 22.11: Permissible Card/Slot Allocations for SMA-1/4c/uc				
Slots (c)	Slots (uc)	Description	Allowable Card Types	
			(SMA1/4c)	(SMA1/4uc)
101	207	Comms/Controller Slot	Comms/Controller only	Comms/Controller only
102 and 103	203 and 204	Core	CORE (Any variant)	CORE (Any variant)
104	201	Trib 1	SMA Trib not requiring LTUs (Front Plug Up) or a 2M Protection card	SMA Trib LTUs/Front
105	202	Trib 2	SMA Trib not requiring LTUs (Front Plug Up)	SMA Trib LTUs/Front
106 and 107	205 and 206	Trib 3 and Trib 4	Any SMA Trib	2Mbit/s only
108 and 109	-	PSU A and PSU B Slots	SMA1/4c PSU only (1.0")	-

22.2.3 CARD TYPES

SMA-1/4(4+4)(8) and SMA-1/4c Tributaries are defined as:–

Table 22.12: SMA-1/4 Tributaries
Dual STM-1 Electrical Card with LTU access
Dual STM-1 Electrical Card with front access
Dual STM-1 Optical Card
Quad STM-1 Electrical Card
Quad STM-1 Optical Card

VCAM Card
SMA– VCTS SFW Optical LTU
SMA– VCTS Optical LTU
SMA– VCTS Electrical LTU (1.0/2.3)
Ruggedised FC/PC to ASC SFW Coupler
2Mbit/s Trib Balanced 32 Port with LTU access
1.5Mbit/s (G.703) Trib Balanced 32 Port with LTU access
2Mbit/s Trib Unbalanced 16 Port with LTU access
2Mbit/s Trib Balanced 16 Port with LTU access
1.5Mbit/s Trib Balanced 16 Port with LTU access
2Mbit/s Trib Unbalanced 32 Port with LTU access
140Mbit/s Trib 1 Port with LTU access
140Mbit/s Tributary Card (1.0/2.3) with front access
34Mbit/s Trib 3 Port with LTU access
45Mbit/s Trib 3 Port with LTU access
34M Transmux
CellSpan
PacketSpan

22.2.4 MINIMUM SUBRACK CONFIGURATION

The SMA–1/4(4+4)(8) and SMA–1/4c ADM's have been designed to allow various sub-equipping options. The minimum permitted logical card configuration is an unduplicated system consisting of:

- Mux Comms/Controller
- Core Card with 'A' switch module

22.2.5 DCC ACCESS

22.2.5.1 SMA–1/4 ADM

This supports a total of 40 DCC, 4 to each Core Card, providing DCCR and DCCM to each LINE, and four DCC to each Tributary.

- LINE EAST A
- LINE WEST A
- LINE EAST B
- LINE WEST B
- 8xTRIBs

22.2.5.2 SMA–1/4c and SMA-1/4uc Compact ADM

This supports a total of 24 DCC, 4 to each Core Card, providing DCCR and DCCM to each LINE, and four DCC channels to each Tributary.

- LINE EAST A
- LINE WEST A
- LINE EAST B
- LINE WEST B
- 4xTRIBs

22.2.6 PROTECTION

SMA–1/4(4+4)(8) and SMA–1/4c/uc support the following protection features:

- MSP
- SNC all VC–n
- Port
- Card, including Core card
- 1:N

22.2.7 ADDRESSING SCHEMES

The Mux Controller function performs the following tasks:

- Identifies the system identity.
- Addresses a specific card / slot on the control and inventory buses.
- Determines card/optics module insertion/extraction from the shelf.

22.2.8 Backplane slot addressing

For the SMA–1/4(4+4)(8) and SMA–1/4c/uc products the LOGICAL slot addressing as used by the Controller function for the system cards and Modules on the Core Card is as shown in the table below:

Table 22.13: Backplane Slot Addressing					
Card/Module	Card Slot ID	Card Types	Slot Address	Card Out	Compact Use
	00				
Core A Line West	01	STM–1/4	01h	01h	*
	02				
Core A Line East	03	STM–1/4	03h	03h	*
	04				
Core B Line West	05	STM–1/4	11h	05h	*
	06				
Core B Line East	07	STM–1/4	13h	07h	*
	08				
	09				
Core A Trib	10	2M Trib	02h	0Ah	*
Core B Trib	11	2M Trib	12h	0Bh	*
LB Trib 1	12	Tribs	08h	0Ch	*
LB Trib 2	13	Tribs	09h	0Dh	*
LB Trib 3	14	Tribs	0Ah	0Eh	*
LB Trib 4	15	Tribs	0Bh	0Fh	*
LB Trib 5	16	Tribs	0Ch	10h	
LB Trib 6	17	Tribs	0Dh	11h	
LB Trib 7	18	Tribs	0Eh	12h	

CHAPTER 22: SHELF CONFIGURATION FEATURES SPECIFIC TO SMA1/4CP

LB Trib 8	19	Tribs	0Fh	13h	
	20				
Core Switch A	21	Core	04h	15h	*
Core Switch B	22	Core	14h	16h	*
Aux 1	23	Aux	1Ch	17h	
Comms	24	Comms	19h	18h	*
Aux 2	25	Alarm	1Ah	19h	
	26				
	27				
PSU A	28	PSU	1Dh	1Ch	*
PSU B	29	PSU	1Eh	1Dh	*
	31				
Controller/ Comms	32	Controller/ Comms	1Bh	20h	*
	33				
SMC 1	34	Memory		22h	*
SMC 2	35	Memory		23h	*

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

SECTION 5: INSTALLATION INFORMATION

CHAPTER 23 LINE TERMINATION UNITS PAGE 287

CHAPTER 24 SLIDE-IN CARD UNITS PAGE 335

CHAPTER 25 OPTICAL MODULES PAGE 369

CHAPTER 26 LINK AND SWITCH SETTINGS PAGE 381

CHAPTER 27 POWER SUPPLY UNITS PAGE 257

CHAPTER 28 SMA-1/4CP SUB-RACKS PAGE 411

CHAPTER 29 SMA-1/4C SUB-RACKS PAGE 433

CHAPTER 30 SMA-1/4(4+4)(8) SUB-RACKS

CHAPTER 31 SMA UPGRADE INFORMATION PAGE 461

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CHAPTER 23: LINE TERMINATION UNITS

23.1 POPULATION OPTIONS

Table 23.1 lists the available LTU assemblies which may be fitted in SMA–1/4c, SMA–1/4 (4+4) and SMA–1/4(8) sub–racks, dependent on configuration requirements. Details of the complementary 'slide-in' card units can be found in the chapter on Slide-In Card Units.

Note: Some SMA–1/4c LTUs in Table 23.1 are listed more than once for the sake of clarity as to function.

Table 23.1: LTU Options		
Identity/Variants	Description	
POWER LTUs:–		
1HAM60778ABH	Triple Feed Power LTU	SMA–1/4 (4+4) and SMA–1/4(8)
1HAM60779ABK	Dual Feed Power LTU (Italtel)	SMA–1/4 (4+4) and SMA–1/4(8)
1HAM61038ABW	Core Ancillary LTU (Power LTU)	SMA–1/4c and /uc
CORE LTU:–		
1HAM61080AAN	Core LTU (Balanced 2Mbit/s Traffic Unit LTU)	SMA–1/4c and /uc
1HAM61040AAC	Core LTU (Unbalanced 2Mbit/s Traffic Unit LTU)	SMA–1/4c and /uc
1HAM60783AAU	LCT LTU	SMA–1/4(4+4) and SMA–1/4(8)
ANCILLARY LTUs:–		
1HAM61038ABW	Core Ancillary LTU	SMA–1/4c and /uc
1HAM61039ABY	Enhanced Ancillary LTU	SMA–1/4c and /uc
1HAM60780AAN	Rack Alarm LTU Int (BW7R)	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60781AAQ	Rack Alarm LTU UK (TEP–1E)	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60782AAS	User Alarm LTU	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60789AAH	COMMS AUI LTU	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60786AAB	Auxiliary LTU	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60888AAM	2Mbit/s Test Bus LTU	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60784AAW	Balanced External Sync LTU	SMA–1/4(4+4) and SMA–1/4(8)
1HAM60785AAY	Unbalanced External Sync LTU (1.0/2.3 connectors)	SMA–1/4(4+4) and SMA–1/4(8)
TRAFFIC LTUs:–		
1HAM61080AAN	Balanced 2Mbit/s Traffic Unit LTU (Core LTU)	SMA–1/4c and /uc
1HAM61040AAC	Unbalanced 2Mbit/s Traffic Unit LTU (Core LTU)	SMA–1/4c and /uc
1HAM60792AAH	Balanced 1.5Mbit/s LTU (G703) (16 or 32 ports)	SMA–1/4c, SMA–1/4(4+4) and SMA–1/4(8)
1HAM60833AAA	Unbalanced 2Mbit/s LTU(1.0/2.3 connectors)(16 or 32 ports)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60833ABS	Unbalanced 2Mbit/s LTU (1.0/2.3 connectors) with non–isolated earth (16 or 32 ports)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60834AAC	Balanced 2Mbit/s LTU (16 or 32 ports)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60796AAR	Unbalanced 34Mbit/s LTU (1.0/2.3 connectors)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60797AAT	Unbalanced 45Mbit/s LTU (1.0/2.3 connectors)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60798ABN	Unbalanced 140/155 Mbit/s LTU (1.0/2.3 connectors)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc Superseded by 1HAM60661BCK

Table 23.1:(Cont)LTU Options		
Identity/Variants	Description	
1HAM60839AAN	140/155Mbit/s Link LTU	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60865ACK	155Mbit/s Electrical LTU	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60840AAJ	VC–AM Optical LTU (FC/PC)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60840ABB	VC–AM Optical LTU (DIN)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1HAM60892AEJ	VC–AM/Extender II SFW Optical LTU (FC/PC)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc Use with 1HAT60917AAG
1HAM60892ACY	VC–AM/Extender II SFW Optical LTU (Angled SC)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc Use with 1HAT60917AAG
1HAM60892ABG	VC–AM/Extender II SFW Optical LTU (DIN)	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc Use with 1HAT60917AAG
1HAM60854AAH	VC–AM Electrical LTU	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc Use with 1HAT60917AAG
DUST CAPS		
1CXB20133ABC	LCT LTU 9–Way Socket D–type Dust Cap	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1CXB20133AFW	LCT LTU 15–Way Plug D–type Dust Cap	SMA–1/4c and /uc
1CXB20133AAK	LCT LTU 15–Way Plug D–type Dust Cap	SMA–1/4(4+4) and SMA–1/4(8)
EMC COVER LTU's		
1MBA61366***	EMC Cover (1.0" ancillary/traffic dummy) LTU	SMA–1/4c, SMA–1/4(4+4), SMA–1/4(8) and SMA-1/4uc
1MBA61381***	EMC Cover (2.2" ancillary dummy) LTU	SMA–1/4(4+4) and SMA–1/4(8)
1MBA61724***	EMC Cover (3.2" traffic dummy) LTU	SMA–1/4c and /uc
1MBA61395***	EMC Cover (use with 1.5/2Mbit/s trib 1HAT60736AAW and 140Mbit/s trib 1HAT60624BFE with LTU access)	SMA–1/4(4+4) and SMA–1/4(8)
1MBA61396***	EMC Cover (use with 140Mbit/s trib card with front access 1HAT60624BFE)	SMA–1/4(4+4) and SMA–1/4(8)
1MBA61366***	EMC Cover (34/45Mbits) LTU	SMA–1/4(4+4) and SMA–1/4(8)

23.2 POWER LINE TERMINATION UNITS (LTUS)

CAUTION

The power LTU must be fitted before connecting primary (battery) supplies to the equipment; these supplies must be disconnected before removal of power LTUs.

Primary dc power input is connected via a power Line Termination Unit (LTU) which is located to the right hand side of the sub–rack and above the card cage. Refer to the chapter on Power Supply Units for further power supply related topics.

23.2.1 Triple Feed Power LTU – (1HAM60778ABH) SMA–1/4(4+4) and SMA–1/4(8)

The standard Triple–feed Power LTU is illustrated in Figure 23.1. Green LEDs indicate the presence of the Primary (or Battery) d.c. supply.

Note: Series 4 sub-racks only require two power supplies. The third input on the triple feed power LTU is therefore not required and should not be connected.

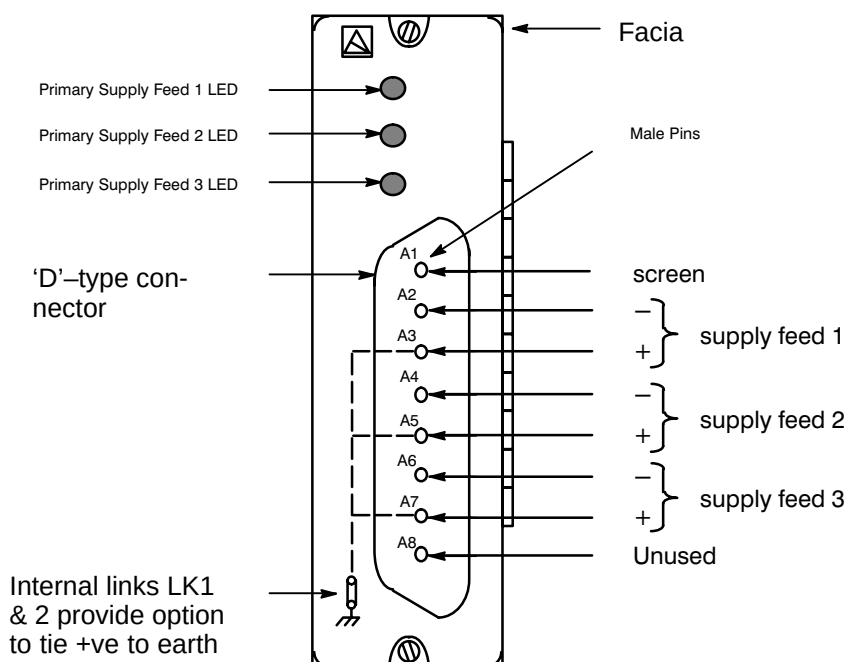


Figure 23.1 Triple Feed Power LTU Connections

23.2.1.1 Interface

- Connector:
1 x 8-way (plug) filtered (1nF) Power "D" type 8W8 (25-way shell)
- Indicators:
3 x Green LEDs, one for each input
- Location:
Front mounted on Power LTU
- Use:
Rack DC supply inputs
- Electrical spec:
prETS 300 132 and BTR 2511

23.2.2 Dual Feed Power LTU (Italtel) 1HAM60779ABK SMA-1/4(4+4) and SMA-1/4(8)

The Dual-feed Power LTU for SMA-1/4(4+4) and SMA-1/4(8) is illustrated in Figure 23.2. Green LEDs indicate the presence of the Primary (or Battery) dc supply.

Note: This LTU will protect against loss of one of the supply feeds when only one PSU is fitted; however, when two PSUs are fitted, if either PSU input goes short circuit, both supply feed fuses will blow (or circuit breakers open).

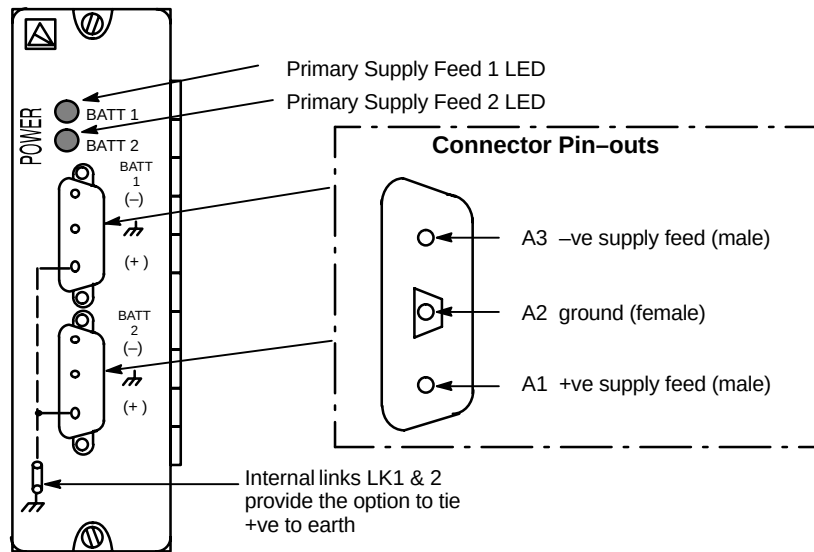


Figure 23.2 Dual-feed Power LTU (Italtel)

23.2.2.1 Interface

- Connector:
2 x 3-way (2 x plug 1x socket) filtered (1nF) Power "D" type 3W3A (15-way shell with Polarised centre pin)
- Indicators:
2 x Green LEDs, one for each input
- Location:
Front mounted on Power LTU
- Use:
Rack DC supply inputs
- Electrical spec:
prETS 300 132 and BTR 2511

23.3 LOCAL TERMINAL (LCT) LTU (1HAM60783 AAU) SMA-1/4(4+4) AND SMA-1/4(8)

Two, 9-way D Type connectors, provide the RS232, full duplex, asynchronous, serial interface between the Local Terminal (LCT) PC and the Mux Control function (also referred to as the 'F' Interface). Figure 23.3 lists connector pin allocations (male and female).

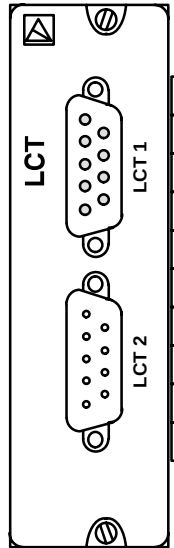


Figure 23.3 Local Terminal LTU

23.3.1 Interface

- Connector:
2 x 9-way 'D' type with a male connector M3 screwlocks and a female connector 4–40 UNC screwlocks.
- Location:
Front mounted on LOCAL TERMINAL LTU
- Use:
Local Operator PC management interface
- Electrical spec:
EIA RS 232
- Protocol:
Full-Duplex Asynchronous serial comms.

The default parameters for the PC port are as follows:–

- 9600 Baud
- 8 Data Bits
- No Parity
- 1 Stop Bit
- Xon/Xoff

Table 23.2: LCT LTU Connector Pinout			
Local Terminal (LTC) Connector 1 (Female)		Local Terminal (LTC) Connector 2 (Male)	
No.	Designation	No.	Designation
1	Not Used	1	CD (Carrier Detect) *1
2	RX DATA (Receive Data)	2	RX DATA (Receive Data)
3	TX DATA (Transmit Data)	3	TX DATA (Transmit Data)
4	Not Used	4	DTR (Data Terminal Ready) *1
5	SIGNAL GROUND (Ground)	5	SIGNAL GROUND (Ground)
6	Not Used	6	DSR (Data Set Ready) *1
7	RTS (Request To Send)	7	RTS (Request To Send) *2
8	CTS (Clear To Send)	8	CTS (Clear To Send) *2
9	Not Used	9	Not Used
Note *1 CD, DTR and DSR are connected on board			
Note *2 CTS and RTS are connected on board			

23.4 ANCILLARY LTUS

Ancillary LTUs provide ports for external interfaces such as external synchronisation, alarms, and LCT.

23.4.1 Core Ancillary LTU for SMA–1/4C/UC 1HAM61038ABW

The SMA–1/4c Ancillary LTU area is located in the bottom right of the SMA–1/4c LTU area. The Core Ancillary LTU provides access to User I/O, external sync, local terminal (LCT) power input, auxiliary and EOW. A diagram of the Core Ancillary LTU is shown below with pinout information in the two tables below.

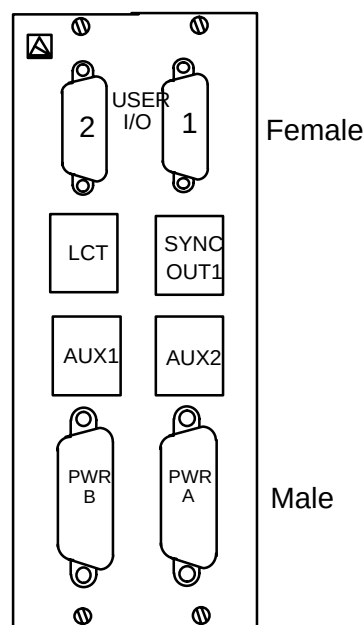


Figure 23.4 SMA–1/4c Core Ancillary LTU

Table 23.3: SMA–1/4c Core Ancillary LTU Connector Pinouts (Except PWR)

No	User I/O1	User I/O2	Sync Out1	LCT	AUX 2	AUX 1
1	Not Used	Not Used	Not Used	Not Used	AUXTXCLKA2	AUXTXCLKA1
2	User I/P 1	User I/P 5	Not Used	LB1 (DSR)	AUXTXCLKB2	AUXTXCLKB1
3	User I/P 2	User I/P 6	Not Used	GND	AUXRXCLKA2	AUXRXCLKA1
4	User I/P 3	User OP 1A	Not Used	LCT Output D	AUXRXCLKB2	AUXRXCLKB1
5	User I/P 4	User OP 2A	SYNCOUTPUT 75	LB1 (DTR)	AUXTXDATB2	AUXTXDATB1
6	GND	GND	SCREEN	LCT Input D	AUXTXDATA2	AUXTXDATA1
7	GND	GND	SYNC OUTPUT 120+	RTS (LB2)	AUXRXDATB2	AUXRXDATB1
8	GND	User OP 1B	SYNC OUTPUT 120–	CTS (LB2)	AUXRXDATA2	AUXRXDATA1
9	GND	User OP 2B				

Table 23.4: SMA–1/4c Core Ancillary LTU Connector Pinouts (PWR)

No	PWR A	PWR B	No	PWR A	PWR B
1	0V	0V	9	0V	0V
2	PosPW	PosPW	10	PosPW	PosPW
3	PosPW	PosPW	11	PosPW	PosPW
4	NegPW	NegPW	12	NegPW	NegPW
5	NegPW	NegPW	13	NegPW	NegPW
6	Not Used	Not Used	14	Not Used	Not Used
7	BLO	BLO	15	MIF	MIF
8	DDF	ADF			

23.4.1.1 Interface

- Connectors:
2 x 9–way ‘D’ type (User I/O), 4 x 8An RJ45, 2 x 15–way D type (Pwr).
- Location:
Front mounted on Ancillary LTU area.
- Use:
Core Ancillary LTU interface (with simple alarm scheme only)

23.4.2 Core Ancillary LTU with Bw7R Alarm Scheme for SMA–1/4C/UC

A variant of the core ancillary LTU for SMA–1/4c is available which supports the Bw7R alarm scheme. A diagram of this variant is shown in Figure 23.5.

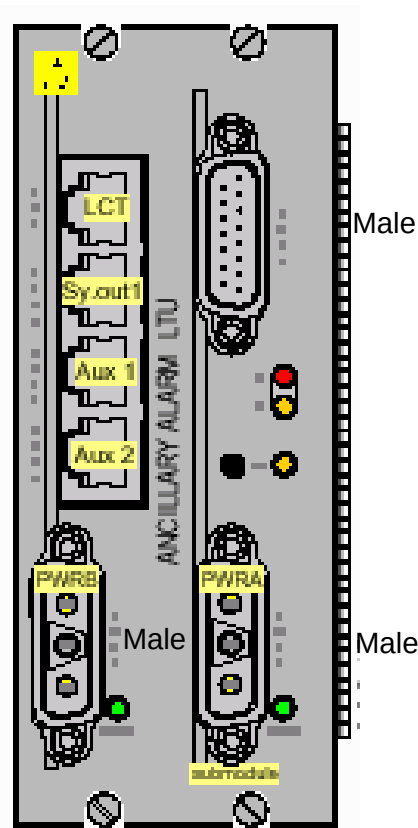


Figure 23.5 SMA-1/4c/uc Core Ancillary LTU supporting Bw7R alarm scheme

Table 23.5: SMA-1/4c/uc Core Ancillary LTU Connector Pinouts (Except PWR)				
No	Sync Out1	LCT	AUX 2	AUX 1
1	Not Used	Not Used	AUXTXCLKA2	AUXTXCLKA1
2	Not Used	LB1 (DSR)	AUXTXCLKB2	AUXTXCLKB1
3	Not Used	GND	AUXRXCLKA2	AUXRXCLKA1
4	Not Used	LCT Output D	AUXRXCLKB2	AUXRXCLKB1
5	SYNCOUPTUT 75	LB1 (DTR)	AUXTXDATB2	AUXTXDATB1
6	SCREEN	LCT Input D	AUXTXDATA2	AUXTXDATA1
7	SYNC OUTPUT 120+	RTS (LB2)	AUXRXDATB2	AUXRXDATB1
8	SYNC OUTPUT 120-	CTS (LB2)	AUXRXDATA2	AUXRXDATA1
9				

Table 23.6: Bw7R Alarm Connector Pinout			
No	Designation	Pin No	Designation
1	+S	9	-S
2	+S	10	-S
3	+S	11	-S
4	a OUT	12	b OUT
5	eI OUT	13	Not Used
6	Not Used	14	Zb OUT
7	Za OUT	15	Zle OUT

Table 23.6:(Cont)Bw7R Alarm Connector Pinout			
No	Designation	Pin No	Designation
8	GND		
FE1	GND	FE2	GND

Note: Bw7R external Alarm supply + & -S, min applied d.c. voltage =10.5V, max =57V. Max d.c. current =21mA.

Table 23.7: SMA-1/4c/uc Connector Pinouts (PWR)		
No	PWR A	PWR B
1 (A1)	+ve	+ve
2 (A2)	GND	GND
3 (A3)	-ve	-ve

23.4.2.1 Interface

- Connectors:
2 x 3-way D-type power connectors must be used in order to support the Bw7R alarm scheme.
1 x 15-way filtered (INF) D-type, 4 x 8Pin RJ45.
- Location:
Front mounted on Ancillary LTU area (same position as ordinary core ancillary LTU).
- Use:
Core Ancillary LTU interface (supporting Bw7R alarm scheme)

23.4.2.2 Front Panel LEDs

- Red LED (a)**
Lit when a_IN Alarm is present or Mux Controller Card has failed.

Inhibited by Mux Card removal.

Lit whenever two PSUs fail when operating in an SMA-4 system.
- Amber LED (b)**
Lit whenever b_IN is present.

Inhibited whenever two PSUs fail when operating in an SMA-4 system.
- Amber LED (e)**
Lit when e_IN Alarm is present or for Mux Controller Card removal.

Inhibited whenever two PSUs fail when operating in an SMA-4 system.

23.4.2.3 Alarm Cancel Button (RA)

- SMA-4 Subrack
Disabled if two or more PSUs are in an inoperative state.
- SMA-1 Subrack
Disabled if PSU1 and PSU2 are in an inoperative state.

23.4.3 Enhanced Ancillary LTU for SMA–1/4c/uc 1HAM61039ABY

The enhanced Ancillary LTU provides access to Sync In, Sync Out, 2M Test and AUI functions. A diagram of the enhanced ancillary LTU is below with the pinout details in the table underneath.

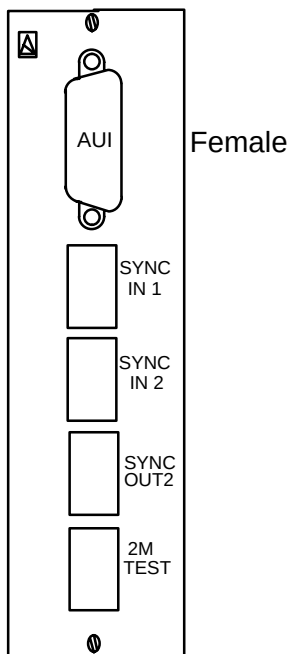


Figure 23.6 SMA–1/4c Enhanced Ancillary LTU

Table 23.8: SMA–1/4c/uc Enhanced Ancillary LTU Connector Pinouts					
No	AUI	Sync In 1	Sync In 2	Sync Out 2	2M Test Out
1	0V	Not Used	Not Used	Not Used	Not Used
2	CP+	Not Used	Not Used	Not Used	Not Used
3	TX+	Not Used	Not Used	Not Used	Not Used
4	0V	Not Used	Not Used	Not Used	Not Used
5	RX+	SYNC INPUT 75	SYNC INPUT 75	SYNC OUTPUT 75	TX Test (Output)
6	0V	SCREEN	SCREEN	SCREEN	SCREEN
7	Not Used	SYNC INPUT 120+	SYNC INPUT 120+	SYNC OUTPUT 120+	TX Test b (Output)
8	0V	SYNC INPUT 120–	SYNC INPUT 120–	SYNC OUTPUT 120–	TX Test a (Output)
9	CP–				
10	TX–				
11	0V				
12	RX–				
13	P12V AUI				
14	0V				
15	Not Used				

23.4.3.1 Interface

- Connector:
15–way 'D' type (AUI), 4 x 8Pin RJ45.

- Location:
Front mounted on Ancillary LTU area.
- Use:
Enhanced Ancillary LTU interface.
- Electrical spec:
- Protocol:

23.4.4 Bw7R Alarm LTU – SMA–1/4(4+4) and SMA–1/4(8) 1HAM60780AAN

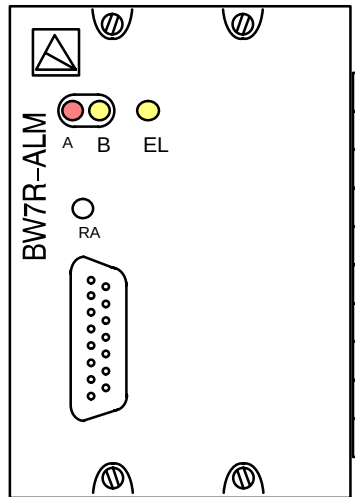


Figure 23.7 Bw7R Alarm LTU

23.4.4.1 Interface

- Connector:
1x5–way filtered (1nF) "D" type Plug M3 screwlocks
- Location:
Front mounted on ALARM LTU
- Use:
Rack interface to Light Signalling Equipment (LZE) and remote Supervision Console
- Electrical spec:
As Marconi System Spec 1ADA 60847AAS–BTA
- Protocol:
As Marconi System Interface Spec 1ADA 60847ACC–BSA

23.4.4.2 Front Panel LEDs

- **Red LED (a)**
Lit when a_IN Alarm is present or Mux Controller card has failed.

Inhibited by by Mux Card removal.

Lit whenever PSU fails when operating in an SMA1/4c or SMA1/4 system.

- **Amber LED (b)**
Lit whenever b_IN is present.
- **Amber LED (el)**
Lit when el_IN Alarm is present or for Mux Controller Card removal.

23.4.4.3 Alarm Cancel Button (RA)

- SMA-4 Subrack
Disabled if two or more PSUs are in an inoperative state.
- SMA-1 Sub-rack
Disabled if PSU1 and PSU2 are in an inoperative state.

Table 23.9: BW7R Alarm Connector Pinout

Pin No.	Designation	Pin No.	Designation
1	+S	9	–S
2	+S	10	–S
3	+S	11	–S
4	a OUT	12	b OUT
5	el OUT	13	Not Used
6	Not Used	14	Zb OUT
7	Za OUT	15	Zle OUT
8	GND		
FE1	GND	FE2	GND

Note: Bw7R external Alarm supply + & –S, min applied d.c. voltage =10.5V, max =57V.
Max d.c. current =21mA.

Note: The cabling from this LTU to the BW7R rack alarm is not normally the responsibility of Marconi and no cable assemblies are specified, however some SMA– subracks with BW7R alarm schemes have been used with BT type 55 rack alarm, in this case, cable assembly 1HAU60858AAA with modification 1QDE60617AAJ–EUA may be ordered (connection to rack alarm bus ribbon is via 1CXB20685AAX).

23.4.5 TEP1E Alarm LTU – SMA–1/4(4+4) and SMA–1/4(8) 1HAM60781AAQ

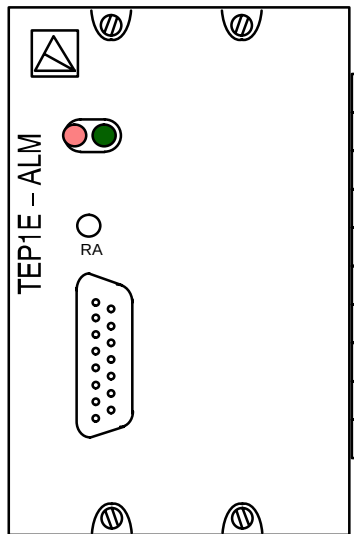


Figure 23.8 TEP1E Alarm LTU

23.4.5.1 Interface

- Connector:
1 x 15–way filtered (1nF) "D" type Plug 4–40 UNC screwlocks
- Location:
Front mounted on ALARM LTU
- Use:
Access to TEP1E local rack alarm scheme
- Electrical spec:
As GPT System Spec 1ADA 60847AAS–BTA
- Protocol:
As GPT System Interface Spec 1ADA 60847ACC–BSA

23.4.5.2 Front Panel LEDs

- **Red LED**
Lit when an alarm indication is sent to the Alarm LTU from the Mux Controller or a Present Alarm is raised by the Alarm LTU.
- **Green LED**
Lit when Receive Attention is received from the Mux Controller, also lit under certain alarm conditions, e.g. Mux Card removal, two PSUs removed.

When the Receive Attention button is depressed a 0V signal is sent to the Mux Controller Card. This signal is also sent to front panel connector CONN1 if links LK1 or LK2 are in their default positions.

23.4.6 TEP1E Alarms Connector

The LTU extends alarm conditions to a Top of Rack Alarm Indicator, interfacing with a standard BT type, female, 10 way header via short length of ribbon cable with a male, 10 way header connector on one end and a 15 way D Type connector on the other.

Table 23.10: TEP1E Alarm Cabling Connector Pin Allocations		
Pin Number at Ancillary Unit	Function	Pin Number for 10-way Header
CONN1 1	–12V	1
CONN1 2	Prompt	3
CONN1 3	Deferred	5
CONN1 4	In–Station	7
CONN1 5	Receiving Attention +ve	9
CONN1 9	Unused	2
CONN1 10	Rx Att. Ind.	4
CONN1 11	Lamp Test	6
CONN1 12	Fault Clear	8
CONN1 13	Receiving Attention –ve	10
CONN1 14 and 15	Unused	
FE1	GROUND	
FE2	GROUND	

Note: TEP1E external alarm supply = –12V $\pm$ 0.2V. Maximum d.c. current = 60mA.

Note: The cabling from this LTU to a TEP1E rack alarm can be achieved by ordering cable assembly 1HAU61136AAQ (connection to rack alarm bus ribbon is via 1CXB20685AAX), however where Network Elements are managed using EMOS rack alarms may not be required.

23.4.7 User Alarms LTU – SMA–1/4(4+4) and SMA–1/4(8) 1HAM60782AAS

Provides access to the Mux Control function for up to six differential external alarm inputs. These User Alarm Extension inputs may be utilised for various user defined purposes. The interfaces are classed as 'SELV' circuits. A nominal 12 volt isolated d.c. output is provided as an optional means of activating the alarms.

Note: The User Alarms LTU should be inserted into a shelf **before** powering up.(If it is inserted into a live shelf it will cause the Comms/Controller Card to reset.)

Table 23.11: User Alarm Connector Pinout

Pin	Designation	Pin	Designation
1	Alarm 1+	9	Alarm 1–
2	Alarm 2+	10	Alarm 2–
3	Alarm 3+	11	Alarm 3–
4	Alarm 4+	12	Alarm 4–
5	Alarm 5+	13	Alarm 5–
6	Alarm 6+	14	Alarm 6–
7	Not Used	15	12V DC Negative Node
8	12V DC Positive Node		Alarm
FE1	GROUND	FE2	GROUND

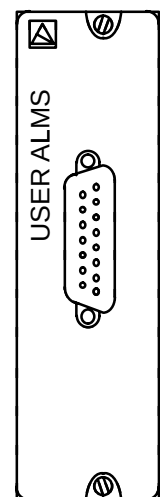


Figure 23.9 User Alarm LTU

23.4.7.1 User Alarm Interface

- Connector:
1x 15–way "D" type Plug M3 screwlocks
- Location:
Front mounted on USER ALARM LTU 1HAM60782AAS
- Use:
Expansion port for external alarm inputs, providing application specific equipment interfaces
- Electrical spec:
As Marconi System Spec 1ADA 60847AAS–BTA
- Protocol:
As Marconi System Interface Spec 1ADA 60847ACC–BSA (Dry or powered loop)

Note: An example of the use of this connector is given in Figure 23.10.

Note: These alarms may be inverted using the Local Terminal (LCT).

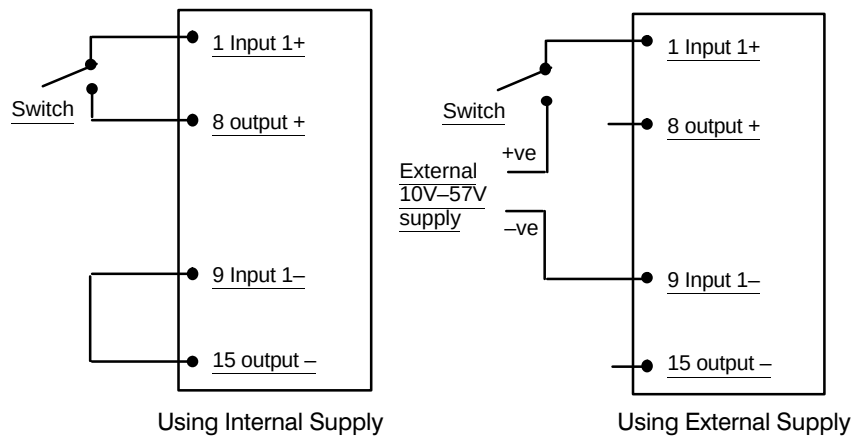


Figure 23.10 User Alarm Examples

Note: The Alarm inputs are designed to meet ETS 300 386–1 and are applicable to an outdoor signal where primary protection is already provided for by the user. Should any other type of cable (ie. not recommended) be used, then they must conform to the following electrical specification:

- Maximum On resistance (to ground) = 20 Ω
- Minimum Off resistance (to ground) = 10 K Ω
- Maximum output current = 45mA
- Output voltage = 10V to 40V over complete range of output currents.

23.4.8 Q/B3Access Unit Interface (Comms AUI) LTU SMA–1/4(4+4) and SMA–1/4(8) 1HAM60789 AAH

Provides the interface for cable extension to an external LAN Medium Adaptation Unit (MAU), e.g. a micro-transceiver unit (typically 1HGB60001AAF–EFA, which fits directly on the D-type connector). This is required to convert the Q.B3 port (AUI) into an Ethernet interface for connection to the Element Manager. Table 23.12 lists connector pin allocations.

With the Comms card fitted, a switch-over will occur automatically under fault conditions to provide protection for the AUI port, under control of the controller card.

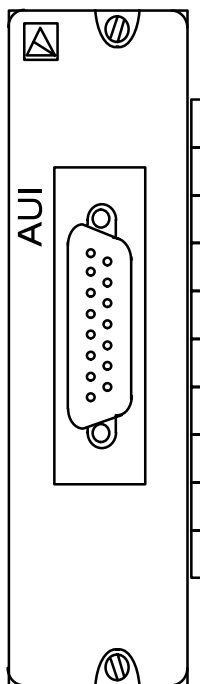


Figure 23.11 AUI LTU

23.4.8.1 Interface

- Connector: 1 x 15-way "D" type Socket with slide lock
- Location:
Front mounted on AUI LTU
- Use:
Adaption Unit Interface (AUI) to Ethernet LAN EMOS adaptor
- Electrical spec:
AUI to IEEE 802.3 standard
- Protocol:
OSI 7-layers conforming to ITU-TSS G773 (Q.811 /Q.812)'B3' stack
- EMOS Adaptor:
Adaption Unit (MAU) into Ethernet LAN (10base2,10base5,10baseT)
1HGB6001AAF.
- Ext connection:
Via MAU where required (15way "D" type to BNC co-axial).

Table 23.12: AUI Port Connector Pinout

Pin No.	Designation	Pin No.	Designation
1	Optional Ground (SW1)	9	Collision Presence –ve
2	Collision Presence +ve	10	Transmit Data –ve
3	Transmit Data +ve	11	Ground

Table 23.12:(Cont)AUI Port Connector Pinout			
4	Ground	12	Receive Data –ve
5	Receive Data +ve	13	+12V DC Output
6	Ground	14	Ground
7	No Connection	15	No Connection
8	Ground		

Note: Ground Coupling Internal switch SW1 selects optional coupling to ground for Pin1. Default setting is pin 1 connected to ground.

23.4.9 Auxiliary LTU (Low Bit Rate) 1HAM60786AAB SMA–1/4(4+4) and SMA–1/4(8)

One Auxiliary LTU provides 2 off 9 pin D Type connectors for two auxiliary channels, one to three LTUs can be fitted.

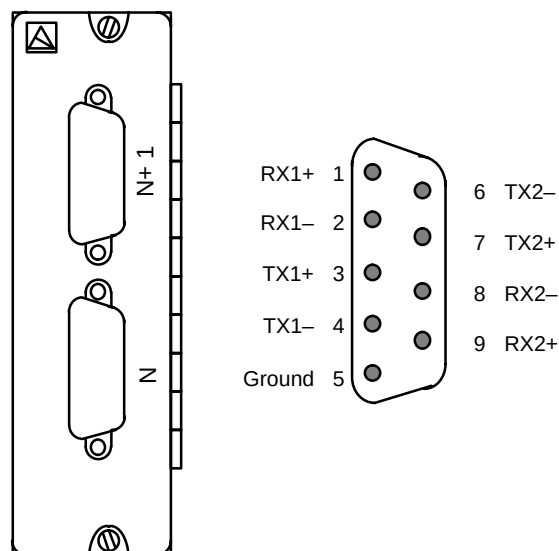


Figure 23.12 Generic Auxiliary LTU

23.4.9.1 Interface

- Connector:
2 x 9–way 'D' type filtered with male connector M3 screwlocks
- Ext Connection:
KOP (1MBB60711AAR)
- Location:
Front mounted on AUXILIARY LTU.
- Use:
External Interface to the Auxiliary/EOW Card, 2off Auxiliary channels per LTU, (use with 1HAT60004ADD or 1HAT60647ABA)
- Electrical spec:
5V CMOS V11 at 9.9Kbit/s.

Table 23.13: Aux LTU Connector Pinouts				
Aux Interface 1 (N)		Aux Interface 2 (N+1)		Designation
Pin Number	Connects to	Pin Number	Connects to	
Conn1 1	Aux1_1	Conn2 1	Aux2 1	RX1+
Conn1 2	Aux1_2	Conn2 2	Aux2 2	RX1–
Conn1 3	Aux1_3	Conn2 3	Aux2 3	TX1+
Conn1 4	Aux1_4	Conn2 4	Aux2 4	TX1–
Conn1 5	Aux1_5	Conn2 5	Aux2 5	GROUND
Conn1 6	Aux1_6	Conn2 6	Aux2 6	TX2–
Conn1 7	Aux1_7	Conn2 7	Aux2 7	TX2+
Conn1 8	Aux1_8	Conn2 8	Aux2 8	RX2–
Conn1 9	Aux1_9	Conn2 9	Aux2 9	RX2+
Conn1 FE1	Ground	Conn2 FE1	Ground	GROUND
Conn1 FE2	Ground	Conn2 FE2	Ground	GROUND

23.4.10 9.6kbit/s Access (V0 and V0.1)

9.6kbit/s access to the following routes are available via the AUX LTU connector: Figure 23.12 and the following tables show the ports available per 'D'-type and the active pin connections. The tables also show how Channels 1 to 3 of the spare bytes in the STM–1 stream, used for can be allocated.

Note: If the Aux data is not to be used locally, the bypass is performed by externally wiring the appropriate ports together via the connectors.

23.4.10.1 Auxiliary Card '0'

Table 23.14: 9.6 kbit/s LTU Access (V0 Card Fitted)			
Connector	OH–BUS	Port Number	Pin Designation
LTU 1 (AUX 1)	Connects data to/from Trib 1 (if STM–1)	1	Aux 1 Pins 1–4
	Connects data to/from Trib 2 (if STM–1)	2	Aux 1 Pins 6–9
LTU 1 (AUX 2)	Connects data to/from Trib 3 (if STM–1)	1	Aux 2 Pins 1–4
	Connects data to/from Trib 4 (if STM–1)	2	Aux 2 Pins 6–9
LTU 2 (AUX 3)	Connects data to/from Line East (Ch 1)	1	Aux 3 Pins 1–4
	Connects data to/from Line West (Ch 1)	2	Aux 3 Pins 6–9
LTU 2 (AUX 4)	Not used in this application		

23.4.10.2 Auxiliary Card V0.1

Table 23.15: 9.6 kbit/s LTU Access (V0.1 Card Fitted)			
Connector	OH-Bus	Port Number	Pin Designation
LTU 1(AUX 1)	Trib 1 or switchable to Line West (Ch 3)	1	Aux 1 Pins 1–4
	Trib 2 or switchable to Line East (Ch 3)	2	Aux 1 Pins 6–9
LTU 1 (AUX 2)	Trib 3 or switchable to Line East (Ch1 2)	1	Aux 2 Pins 1–4
	Trib 4 or switchable to Line West (Ch 2)	2	Aux 2 Pins 6–9
LTU 2 (AUX 3)	East Channel (Ch1) only	1	Aux 3 Pins 1–4
	West Channel (Ch1) only	2	Aux 3 Pins 6–9
LTU 2 (AUX 4)	Not used in this application		

Note: For Version 0 cards, AUX 1 and AUX 2 always provide the tributary option.

Note: A screened cable must be used for connection to the unfiltered port of Aux 3.

23.4.11 64kbit/s Access (V0.1 Only)

64kbit/s access is available at the Auxiliary Card connectors front connectors. For details refer to the chapter on Slide-In Card Units.

23.4.12 Aux 1 and Aux 3 connections for EOW Card Application

When an EOW Card is fitted 9-way D type connectors provide the requisite interfaces. The active pins of these connectors are shown in the following tables:

Table 23.16: Aux LTU Connector Pinouts For EOW					
Pin No.	Port Designation AUX 1	Port Designation AUX 3	Pin No.	Port Designation AUX 1	Port Designation AUX 3
Pin 1	YEXTRA	DTXA1	Pin 7	Reserved	DTXB2
Pin 2	YEXTTA	DRXA1	Pin 8	Reserved	DRXB2
Pin 3	YEXTRB	DTXB1	Pin 9	Reserved	Reserved
Pin 4	YEXTTB	DRXB1	FE 1	Ground	Ground
Pin 5	Reserved	DTXA2	FE 2	Ground	Ground
Pin 6	Reserved	DRXA2			

Note: A screened cable must be used for connection to the unfiltered port of Aux 3.

Note: Aux 4–7 connectors are not used with this product release.

23.4.13 2Mbit/s Test Bus LTU – 1HAM60888AAM SMA–1/4(4+4) and SMA–1/4(8)

The Test Bus LTU is fitted in AUX slot 5&6 and provides a balanced or unbalanced HDB3 test bus output to allow for monitoring of any receiver traffic output.

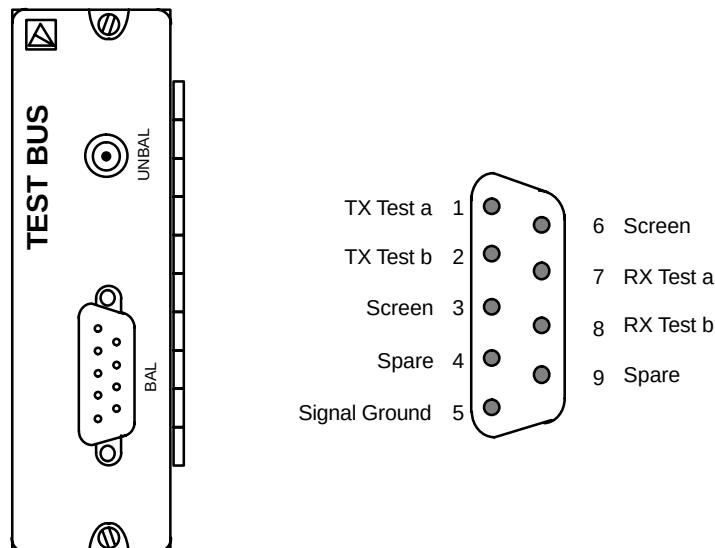


Figure 23.13 2Mbit/s Test LTU

23.4.13.1 Interface

- Connector:
1 off 9–way 'D' type filtered with male connector M3 screwlocks and
1 off x Siemens 1.0/2.3 co–axial.
- Location:
Front mounted on 2 Mbit/s Test Bus LTU.
- Use:
In–station traffic monitoring.
- Electrical spec:
75ohms Un–Balanced to ITU–TSS G703,
120ohms Balanced to ITU–TSS G703.
- Protocol:
HDB3.

Table 23.17: Test Bus LTU Connector Pinout		
Pin No.	Designation	Description
1	TX Test a	Not Used
2	TX Test b	Not Used
3	Screen	Anc. LTU Ground
4	Spare	
5	Signal Ground	Anc. LTU Ground
6	Screen	Anc. LTU Ground
7	RX Test a	Trib Card Output I/F
8	RX Test b	Test Bus
9	Spare	

EXTERNAL SYNCHRONISATION CONNECTIONS

SMA–1/4(4+4) AND SMA–1/4(8)

Synchronisation connections are made via the Sync LTUs (see Figure 23.14 and Figure 23.15).

External Sync Inputs: These enable an external synchronisation source to be fed to the Link/Switch cards to be used for line or equipment timing selection. The input will accept a Signal with one of the following formats:

- 2.048 Mbit/s HDB3 Signal to G.703 (unbalanced). The Signal must be carrying an all–ones Signal.
- 2.048MHz Signal conforming to G.703 section 10.

Sync Outputs: The Switch cards or Auxiliary card 1 select a clock source to supply the Ancillary interface and synchronise external equipment to the SMA–1 System clock. The two outputs are driven from the same clock source. The Mux Controller will inform the cards whether the bus is driven from the Switch cards or Auxiliary card 1, so that only one output will be enabled at any one time. Enabling of the Switch card outputs will correspond to which switch–plane is in use at any time.

- Maximum On resistance (to ground) = 20 Ω
- Minimum Off resistance (to ground) = 10 K Ω

23.4.14 Types of Cable Used for External Synchronisation Connections

Cable Coaxial 3002 miniature flexible 75 Ω (Double Screened) for use with 2Mbit/s unbalanced connections and 2MHz Synchronisation Interfaces. GPT code 1WAE2002 AAE.

23.4.15 Synchronisation LTUs (1HAM60785 AAY/1HAM60784 AAW)

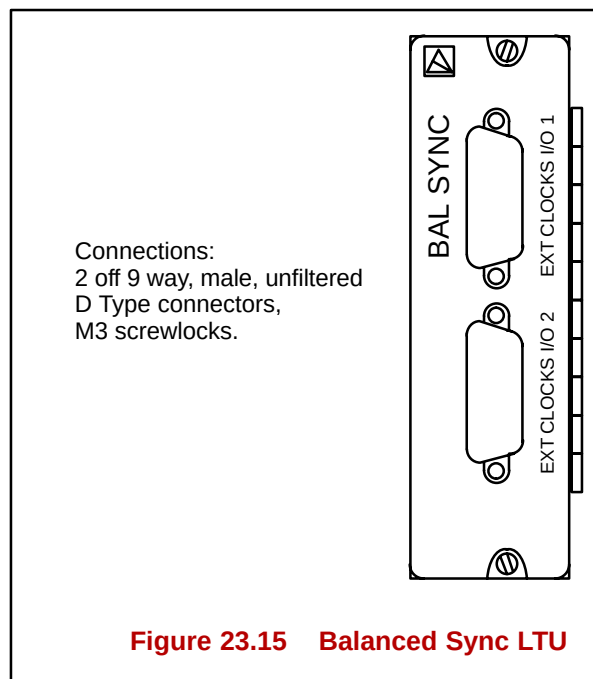
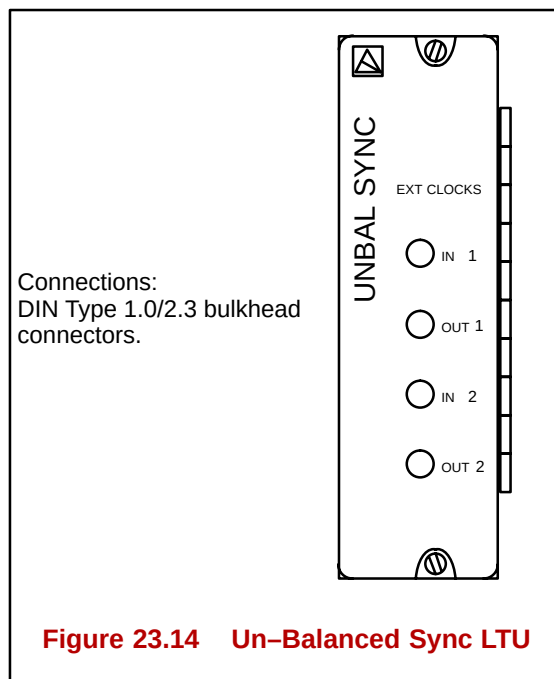


Table 23.18: External Sync (Balanced) Pinout

External Timing 1		External Timing 2	
Conn 1	Function	Conn 2	Function
1	Ground	1	Ground
2	Out 1+ve	2	Out 2+ve
3	Ground	3	Ground
4	In 1+ve	4	In 2+ve
5	Not Used	5	Not Used
6	Out 1 –ve	6	Out 2–ve
7	Ground	7	Ground
8	In 1–ve	8	In 2–ve
9	Not Used	9	Not Used
FE 1	Ground	FE 1	Ground
FE 2	Ground	FE 2	Ground

23.5 TRAFFIC INTERFACE AREA LTU COMPLEMENT

The LTU complement will depend on the tributary card complement of card–cage slots which in turn is dependent on the configuration of the particular SMA.

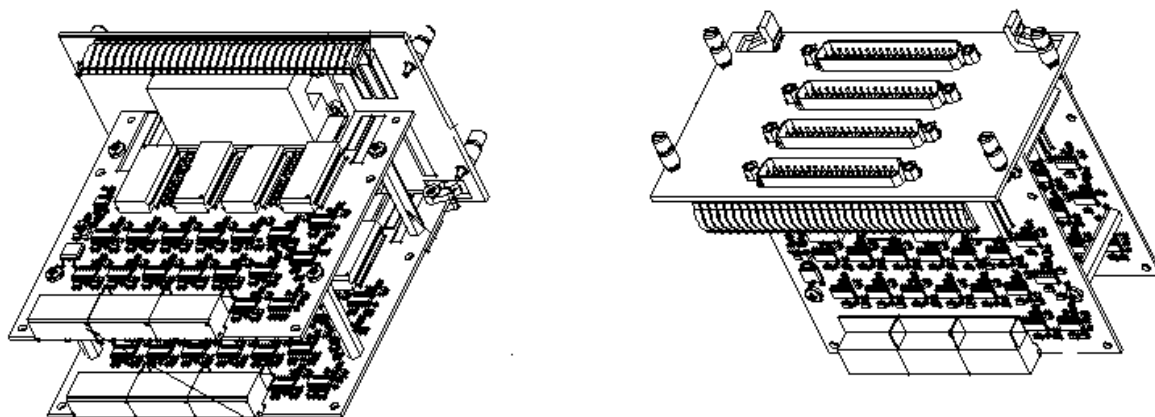
23.5.1 2Mbit/s Traffic Unit LTUs (Core LTU) – SMA–1/4c

- The SMA–1/4c Core LTU area is located in the top right of the LTU Area of the SMA–1/4c shelf. A dedicated Core LTU is required to access the 32x2M traffic capability supported by the core configuration. Note that there are 2 variants of the Core LTU, an unbalanced 2M traffic unit and a balanced 2M traffic unit.

23.5.1.1 Balanced 2Mbit/s Core LTU (1HAM61080AAN)

Each Balanced 2Mbit/s LTU provides thirty-two 120Ω balanced input port connections and thirty-two 120Ω balanced output port connections. Two diagrams are shown below with the pinout details underneath.

Figure 23.16 Balanced 2Mbit/s Core LTU (SMA–1/4c)



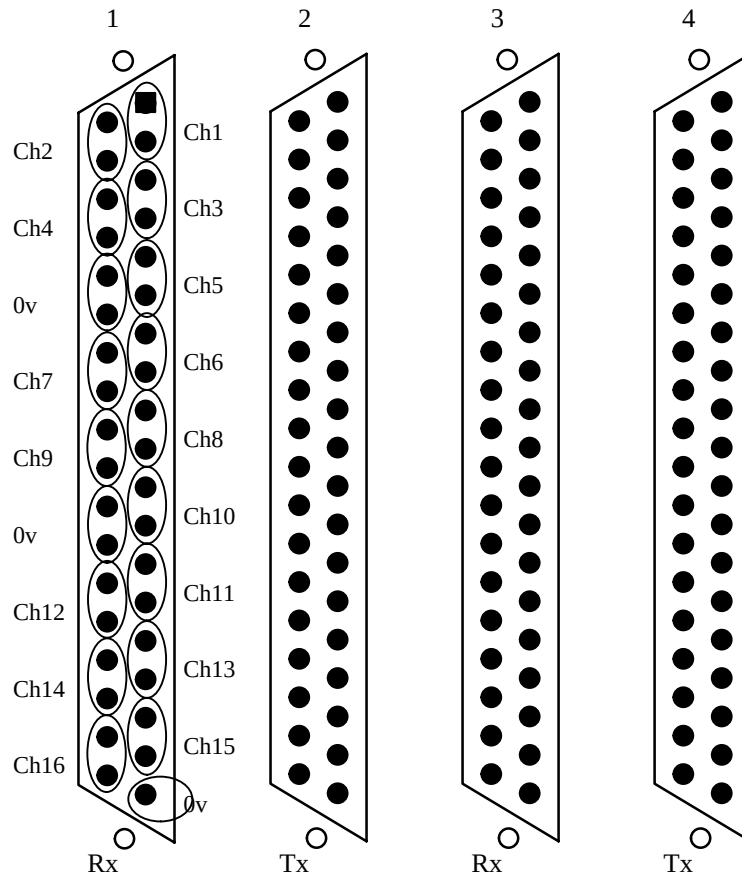


Figure 23.17 Balanced 2Mbit/s Core LTU
(SMA-1/4c)

Table 23.19: Balanced 2Mbit/s Core LTU Pinout				
Channel	Rx		Tx	
	Connector	Pins	Connector	Pins
1	1	1,2	2	1,2
2	1	20,21	2	20,21
3	1	3,4	2	3,4
4	1	22,23	2	22,23
5	1	5,6	2	5,6
6	1	7,8	2	7,8
7	1	26,27	2	26,27
8	1	9,10	2	9,10
9	1	28,29	2	28,29
10	1	11,12	2	11,12
11	1	13,14	2	13,14
12	1	32,33	2	32,33
13	1	16,15	2	16,15
14	1	34,35	2	34,35
15	1	17,18	2	17,18
16	1	35,37	2	35,37
17	3	1,2	4	1,2
18	3	20,21	4	20,21
19	3	3,4	4	3,4
20	3	22,23	4	22,23
21	3	5,6	4	5,6
22	3	7,8	4	7,8
23	3	26,27	4	26,27
24	3	9,10	4	9,10
25	3	28,29	4	28,29
26	3	11,12	4	11,12
27	3	13,14	4	13,14
28	3	32,33	4	32,33
29	3	16,15	4	16,15
30	3	34,35	4	34,35
31	3	17,18	4	17,18
32	3	35,37	4	35,37

The following pins on all four connectors are connected to 0v

19
24
25
30
31

23.5.1.2 Interface

- Connector:
4 x 37–way connectors.
- Location:
Front mounted in Core LTU area.
- Use:
Interface with Core Card.

- Electrical spec:
120ohms balanced to ITU–TSS G703.
- Protocol:
HDB3.

23.5.1.3 Unbalanced 2Mbit/s Core LTU (1HAM61040AAC)

Each Unbalanced 2Mbit/s LTU provides thirty–two 75Ω unbalanced input port connections and thirty–two 75Ω unbalanced output port connections. A diagram is shown below with the pinout details underneath.

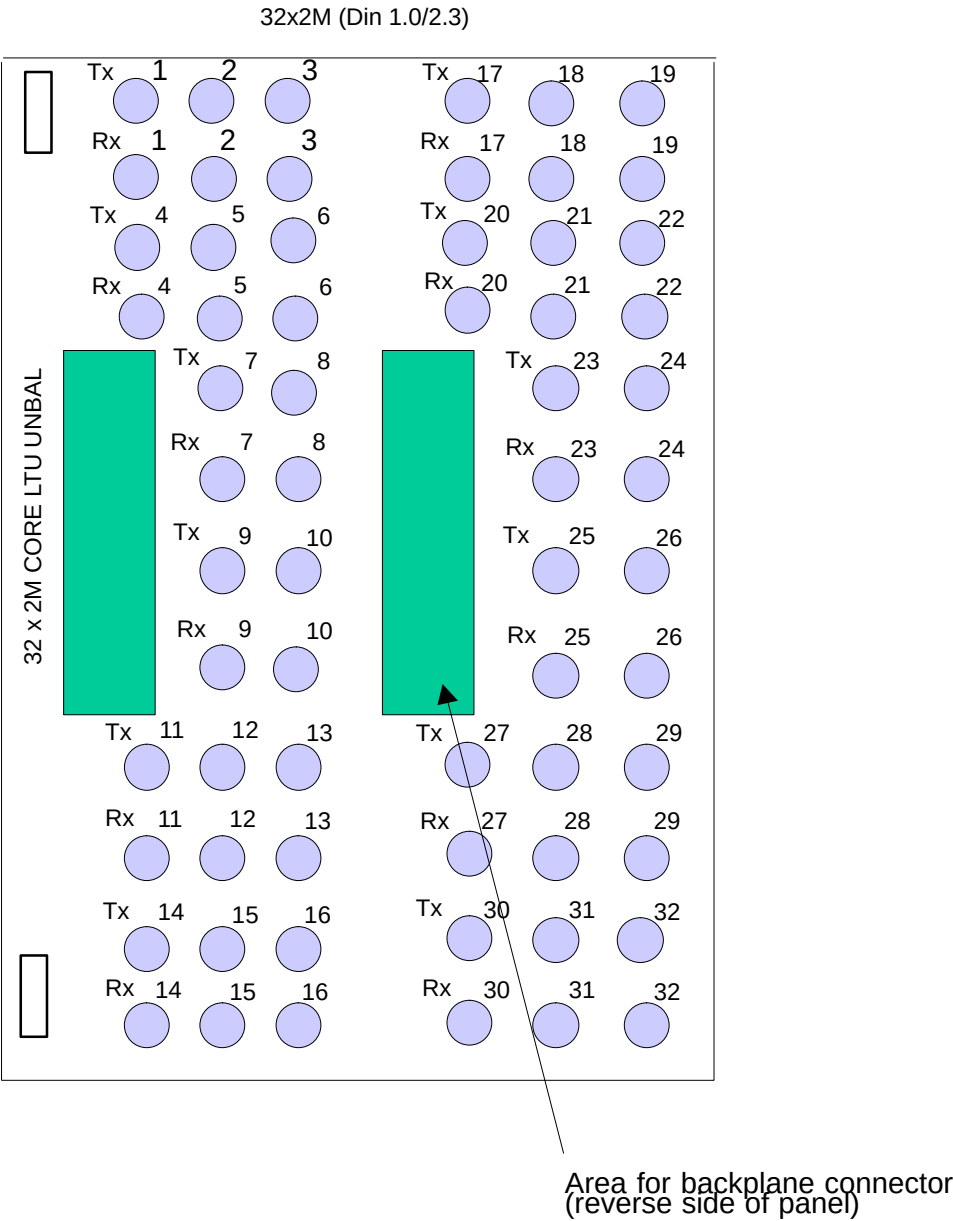


Figure 23.18 SMA1/4c – 32 x 2M Unbalanced LTU

Table 23.20: Unbalanced 2Mbit/s Core LTU Pinout				
Channel	Rx		Tx	
	Connector	Pin	Connector	Pin
1	1	33	1	1
2	2	34	2	2

Channel	Table 23.20:(Cont)Unbalanced 2Mbit/s Core LTU Pinout			
	Connector	Pin	Connector	Pin
3	3	35	3	3
4	4	36	4	4
5	5	37	5	5
6	6	38	6	6
7	7	39	7	7
8	8	40	8	8
9	9	41	9	9
10	10	42	10	10
11	11	43	11	11
12	12	44	12	12
13	13	45	13	13
14	14	46	14	14
15	15	47	15	15
16	16	48	16	16
17	17	49	17	17
18	18	50	18	18
19	19	51	19	19
20	20	52	20	20
21	21	53	21	21
22	22	54	22	22
23	23	55	23	23
24	24	56	24	24
25	25	57	25	25
26	26	58	26	26
27	27	59	27	27
28	28	60	28	28
29	29	61	29	29
30	30	62	30	30
31	31	63	31	31
32	32	64	32	32

23.5.1.4 Interface

- Connector:
1.0/2.3 DIN connectors.
- Location:
Front mounted in Core LTU area.
- Use:
Interface with Core Card.
- Electrical spec:
75ohms unbalanced to ITU–TSS G703.
- Protocol:
HDB3.

Note: The backplane connections are the same for both the balanced and unbalanced units.

23.5.2 1.5/2Mbit/s Tributary LTUs SMA–1/4c, SMA–1/4(4+4) and SMA–1/4(8)

Note that, as well as the 1.5/2 Mbit/s Tributary Card with thirty two input/output ports, there is also a reduced capacity 1.5/2 Mbit/s Tributary Card which can handle up to sixteen 1.544Mbit/s or 2.048Mbit/s traffic signals. The associated LTU complement provides an external connection for each port, the number of LTUs required depends on whether balanced or unbalanced connections are required.

Note: When inserting or removing 2Mbit/s LTUs from the SMA shelf, traffic errors may be generated. To avoid this, the state of any 1:n 2Mbit/s Tributary Card protection should first be set to '**Lockout of Protection**'.

23.5.2.1 Balanced 1.5M LTU (1HAM60792AAH)

(Used with 1HAT60707AAD or 1HAT60736AAW)

Each Balanced 1.5Mbit/s LTU provides eight 120Ω balanced input port connections and eight 120Ω balanced output port connections. The connections are provided by two, sixteen–way D Type connectors, one for inputs and one for outputs.

Note: Two LTUs are required for a sixteen port 1.5/2Mbit/s Tributary card and four for the thirty two port card.

Table 23.21: 1.5Mbit/s Balanced Traffic LTU Pinout			
PL1 (Output)		PL2 (Input)	
Channel	Pins	Channel	Pins
CH 1	1–2	CH 1	1–2
CH 2	9–10	CH 2	9–10
CH 3	3–4	CH 3	3–4
CH 4	11–12	CH 4	11–12
CH 5	5–6	CH 5	5–6
CH 6	13–14	CH 6	13–14
CH 7	7–8	CH 7	7–8
CH 8	15–16	CH 8	15–16

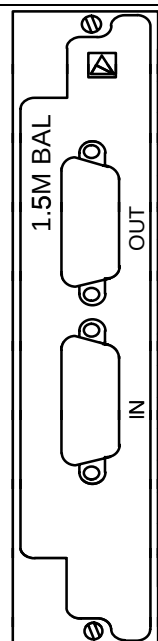


Figure 23.19 1.5Mbit/s Balanced LTU

23.5.2.2 Interface

- Connector:
2 x 16-way Un-Filtered "D" type plug.
- Location:
Front mounted on 1.5 Mbit/s Balanced LTU.
- Use:
In-station electrical tributary interfaces.
- Electrical spec:
120ohms balanced to ITU-TSS G703.
- Protocol:
AMI or B8ZS.

23.5.2.3 Unbalanced 2Mbit/s LTU (1HAM60833AAA)

(Used with 1HAT60707AAD or 1HAT60736AAW)

Each Unbalanced 2Mbit/s LTUs provides eight unbalanced 75Ω input ports and eight unbalanced 75Ω output ports. Two LTUs are required for a sixteen port 1.5/2Mbit/s Tributary card and four for the thirty two port card.

Note: LTU ports, on a multiple configuration, are sequential by card from left to right (see Figure 23.20).

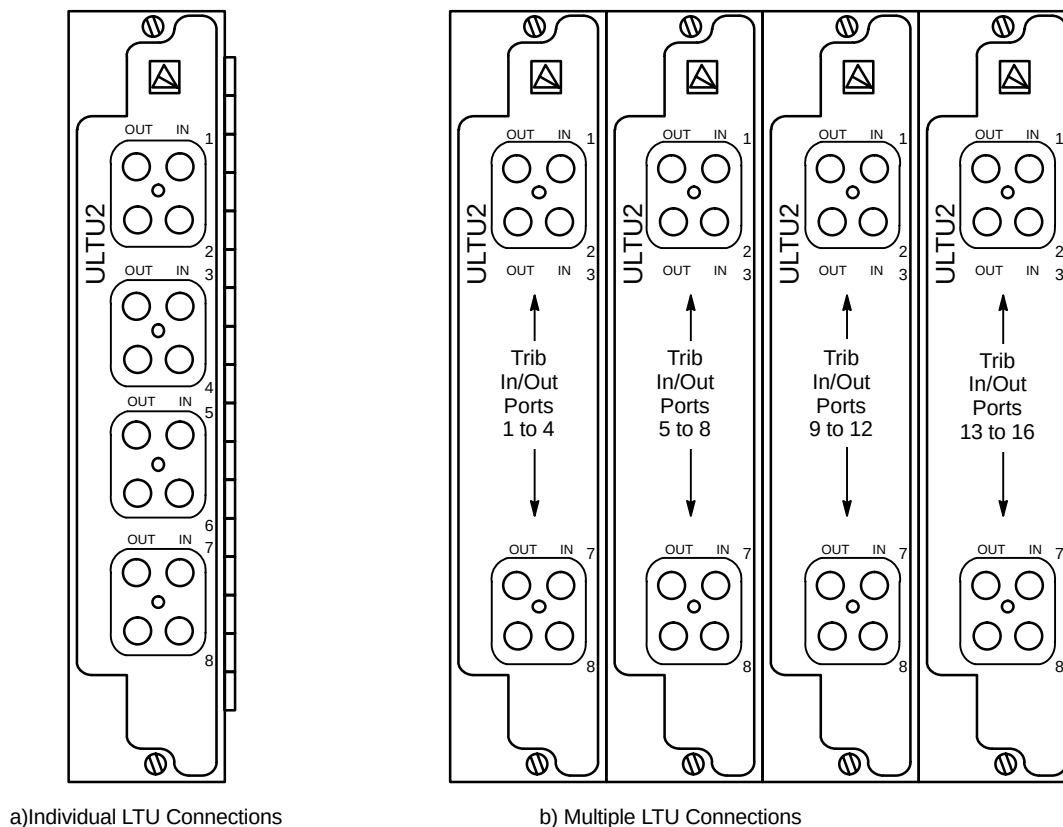


Figure 23.20 Un-Balanced 2Mbit/s LTU

23.5.2.4 Interface

- Connector:
16 x Siemens 1.0/2.3 co-axial.
- Location:
Front mounted on 2 Mbit/s Un-Balanced LTU.
- Use:
In-station electrical tributary interfaces.
- Electrical spec:
75ohms Un-Balanced to ITU-TSS G703
- Protocol:
HDB3.

23.5.2.4.1 Unbalanced 2Mbit/s LTU with non-isolated earth 1HAM60833ABS

Note that there is also a version of the unbalanced 2Mbit/s LTU with a non-isolated earth.

23.5.2.5 Balanced 2M LTU (1HAM60834AAC)

(Used with 1HAT60707AAD or 1HAT60736AAW)

Each Balanced 2Mbit/s LTU provides eight 120Ω balanced input port connections and eight 120Ω balanced output port connections. The connections are provided by two, sixteen-way D Type connectors, one for inputs and one for outputs.

Note: Two LTUs are required for a sixteen port 1.5/2Mbit/s Tributary card and four for the thirty two port card.

Table 23.22: 2Mbit/s Balanced Traffic LTU Pinout

PL1 (Output)		PL2 (Input)	
Channel	Pins	Channel	Pins
CH 1	1–2	CH 1	1–2
CH 2	9–10	CH 2	9–10
CH 3	3–4	CH 3	3–4
CH 4	11–12	CH 4	11–12
CH 5	5–6	CH 5	5–6
CH 6	13–14	CH 6	13–14
CH 7	7–8	CH 7	7–8
CH 8	15–16	CH 8	15–16

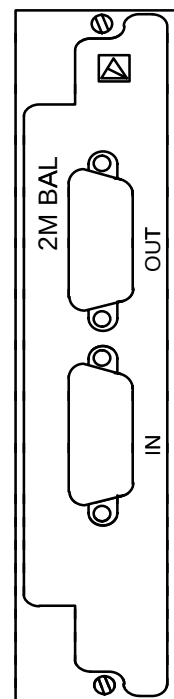


Figure 23.21 2Mbit/s Balanced LTU

23.5.2.6 Interface

- Connector:
2 x 16–way Un–Filtered "D" type plug.
- Location:
Front mounted on 2 Mbit/s Balanced LTU.
- Use:
In–station electrical tributary interfaces.
- Electrical spec:
120ohms balanced to ITU–TSS G703, prETS 300 166.
- Protocol:
HDB3.

23.5.3 34Mbit/s Unbalanced LTU – SMA–1/4c, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60796AAR

(Used with 34Mbit/s Trib 1HAT60622BAN)

Each associated LTU provides one 75–ohm unbalanced input port connector, one 75–ohm unbalanced output port connector and an output monitor point. Three units are required for a fully functional 34Mbit/s Tributary Card. The fourth LTU position must be fitted with an EMC cover.

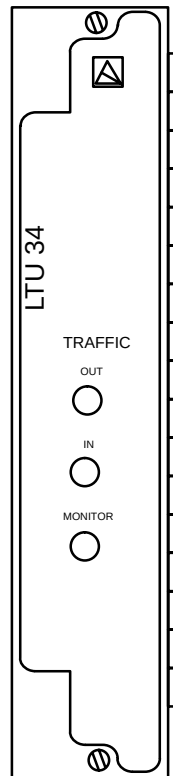


Figure 23.22 34Mbit/s Tributary Unbalanced LTU

23.5.3.1 Interface

- Connector:
3 off Siemens 1.0/2.3 co-axial bulkhead connectors.
- Location:
Front mounted on 34 Mbit/s Un-Balanced LTU.
- Use: (Traffic)
In-station electrical tributary interfaces and output signal monitoring.
- Electrical spec:
75ohms Un-Balanced to ITU-TSS G703.
- Protocol:
HDB3

23.5.4 45Mbit/s Unbalanced LTU – SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8) 1HAM60797AAT

(Used with 1HAT60623BAQ)

Each associated LTU provides one 75-ohm unbalanced input port connector, one 75-ohm unbalanced output port connector and an output monitor point. Three units are required for a fully functional 45Mbit/s Tributary Card. The fourth LTU position must be fitted with an EMC cover

Line Build-out

This LTU incorporates a line build out. If the cable on the output port is less than 225ft (WE728), 163ft (2003) or 91ft (3002), the link should be fitted between PL1/1 and PL1/3 (default setting, see Figure 23.23). If the cable is more than 225ft (WE728) 163ft (2003) or 91ft (3002), the link should be between PL1/2 and PL1/4 (parked).

Note: Note the minimum and maximum cable lengths to be used for the output port, 32ft and 328ft (2003) and 39ft and 377ft (ST214).

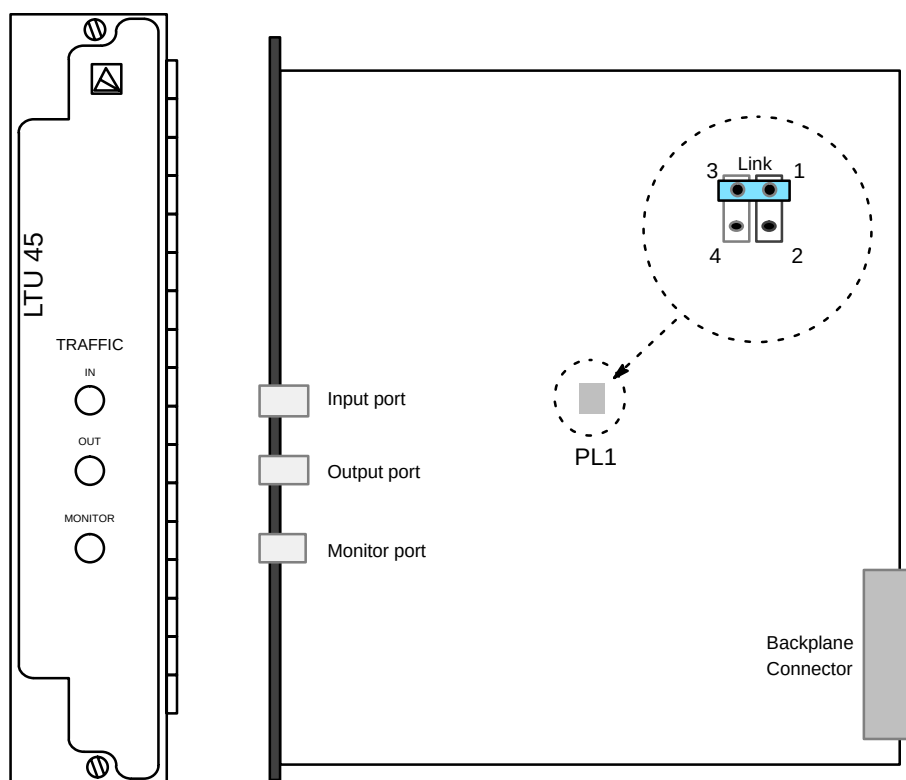


Figure 23.23 45Mbit/s Un-Balanced LTU

23.5.4.1 Interface

- Connector:
3 off Siemens 1.0/2.3 co-axial bulkhead connectors.
- Location:
Front mounted on 45 Mbit/s Un-Balanced LTU.

- Use:
In–station electrical tributary interfaces and output signal monitoring.
- Electrical spec:
75ohms Un–Balanced to ITU–TSS G.703.
- Protocol:
B3ZS.

23.5.5 140/155Mbit/s Unbalanced LTU SMA–1/4c/uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60798ABN

**(Used with 1HAT60624BFE, 1HAT60803ABT or Dual STM–1
Electrical Cards)**

Each LTU provides one 75Ω unbalanced input port connector, one 75–ohm unbalanced output port connector and an output monitor socket. One LTU, fitted in the fourth LTU position, is required for each fully functional 140/155Mbit/s Tributary Card.

Note: A Link LTU fitted in position (slot 1 for Channel 1 or slot 3 for Channel 2) must be used in conjunction with each 140/155Mbit/s LTU (see Figure 23.24).

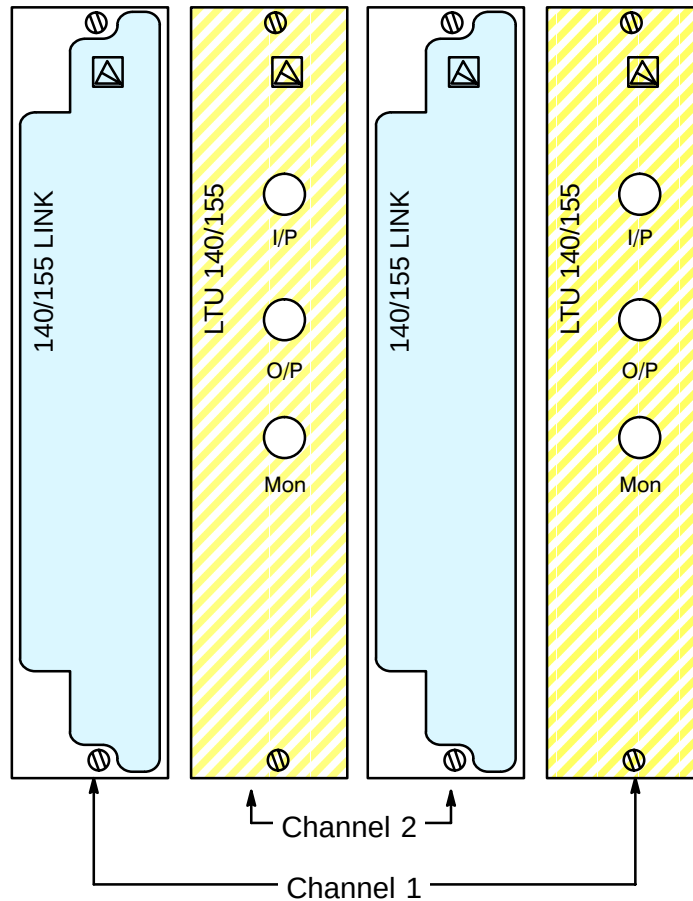


Figure 23.24 140Mbit/s/STM-1 LTU and Link LTU Connections

23.5.5.1 Interface

- Connector:
3 off Siemens 1.0/2.3 co-axial bulkhead connectors.
- Location:
Front mounted on 140/155Mbit/s un-balanced LTU.
- Use:
In-station electrical tributary interfaces and output signal monitoring.
- Electrical spec:
75ohms Un-Balanced to ITU-TSS G.703.
- Protocol:
CMI

23.5.6 Link LTU – SMA–1/4c/uc, SMA–1/4(4+4) and SMA–1/4(8) 1HAM60839AAN

A Link LTU (1HAM60839AAN) must be used in conjunction with the 140/155Mbit/s Trib LTU and is fitted in the first position. The other two LTU positions must be fitted with EMC covers.

Note: A LINK LTU must also be used if STM–1 Electrical Mux access is required.

23.5.7 155Mbit/s Electrical LTU – 1HAM60865ACK SMA–1/4c/uc, SMA–1/4(4+4) and SMA–1/4(8)

Info required as per previous section.

23.6 VC–AM LTU – SMA–1/4C/UC, SMA–1/4(4+4) AND SMA–1/4(8)

Each VC–AM occupies a standard Tributary Card slot in an SMA– sub–rack. A maximum of four VC–AM LTUs (Optical, Electrical or a mixture of both) can be fitted for each fully functional VC–AM Card. These must be fitted in the section of the sub–rack interface area allocated to the tributary slot occupied by the specific VC–AM Card.

An Auxiliary/CMUX2 Management interface provides synchronous 64Kbit/s data and Tx/Rx clocks. These interfaces are supported by a single V11, X24 interface using an RJ45 socket connector.

Note that there are also Single Fibre Working variants of the VC–AM optical LTU's. These are included later in this chapter.

23.6.1 Optical LTU (1HAM60840AAJ/AAB)

(Used with VC–AM 1HAT60917AAG)

There are two versions of the Optical LTU, one with FC/PC connectors (1HAM60840AAJ) and the other with DIN connectors (1HAM60840AAB) for the 34.368Mbit/s optical interfaces. The optical interface characteristics are:–

- Wavelength = 1310nm
- Min. Output Power = –8dB
- Min. Receive Power = –33dB
- Max. Optical Loss = 25dB

Otherwise the units are identical and are secured to the frame by captive screws at the top and bottom.

CAUTION

The VC–AM LTUs **must not** be removed from the sub–rack or disconnected without firstly taking into consideration the Optical Safety rules and Safe Working

Practices outlined in the Safety Notices in the preliminary pages of this manual, and relevant Replacement details in the associated Local Terminal (LCT) Operator Manual.

Connections

- SK1 & SK2 either FC/PC or DIN Optical Sockets (see Figure 23.25).
SK 3 is an RJ45 9-way (female) socket (see Table 23.23).

23.6.1.1 MSP

When MSP is required using a VC-AM Card, the second LTU slot will provide protection for the first slot and the fourth slot provides protection for the third.

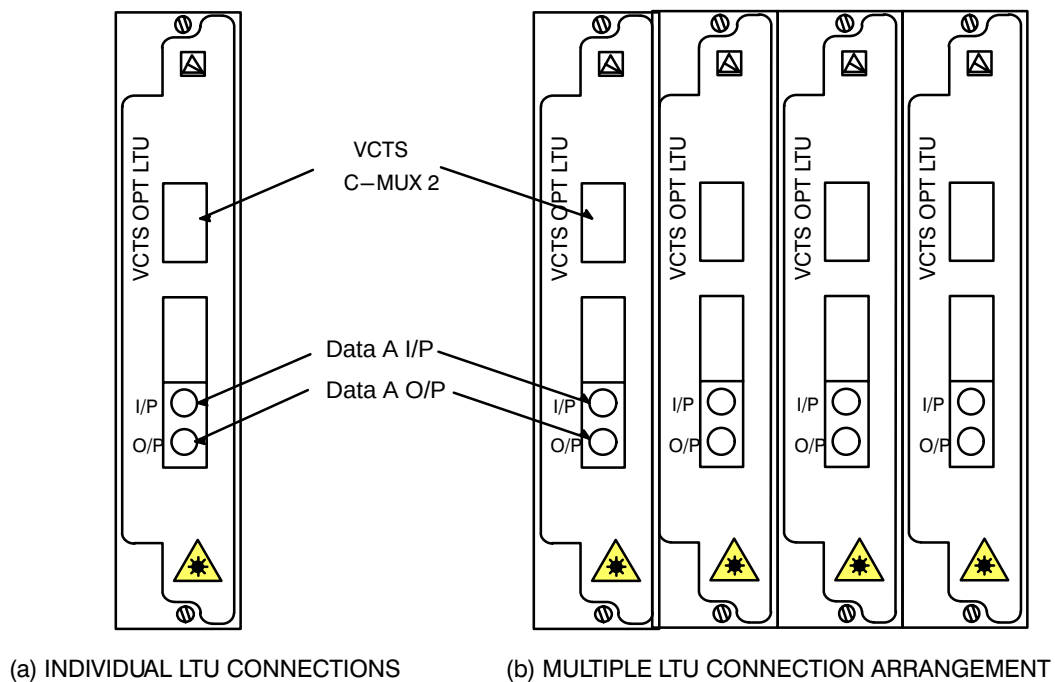


Figure 23.25 34Mbit/s VC-AM LTU Traffic Connections

23.6.1.2 Optical LTU Interface

23.6.1.2.1 Auxiliary Alarm

- Connector:
1 x 7 Pin RJ45 Connector.
- Location:
Front mounted on LTU.
- Use:
To extend Aux Alarm data to an R.T.U.
- Protocol:
V11 X24 Interface.

23.6.1.2.2 Traffic

- Connector:
2 x FC/PC or 2 x DIN.

- Location:
Front mounted on LTU.
- Use:
34.368Mbit/s Sub STM–1 optical access.
- Protocol:
ITU–TSS G832.

23.6.2 Single Fibre Working Optical LTU (1HAM60892AEJ/ABG/ACY)

There are three versions of the VC–AM SFW Optical LTU, one with FC/PC connectors (1HAM60892AEJ), one with DIN connectors (1HAM60892ABG), and one with SC connectors (1HAM60892ACY).

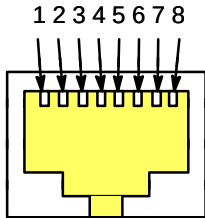
CAUTION

The VC–AM LTUs **must not** be removed from the sub–rack or disconnected without firstly taking into consideration the Optical Safety rules and Safe Working Practices outlined in the Safety Notices in the preliminary pages of this manual, and relevant Replacement details in the associated Local Terminal (LCT) Operator Manual.

23.6.3 VC–AM LTU Auxiliary Interface

An Auxiliary/ CMUX2 Management interface provides synchronous 64Kbit/s data and Tx/Rx clocks. These interfaces are supported by a single V11, X24 interface using an RJ45 socket connector. These connections are designated as following :

Table 23.23: SK3 9–Way RJ45 Type Connections

Number	Signal Designation	 RJ45 Connector (As viewed from front)
SK3–1	AUXRXCLKA	
SK3–2	AUXRXCLKB	
SK3–3	AUXTXCLKA	
SK3–4	AUXTXCLKB	
SK3–5	AUXRXDATB	
SK3–6	AUXRXDATA	
SK3–7	AUXTXDATB	
SK3–8	AUXTXDATA	
SK3–SCREEN	GROUND	

NOTE The RJ45 connector pinout is as per ONP standard with mechanical specification BS EN 28877.

Note: The naming convention on the V11/X24 interface is such that "RX" is an output from the RJ45 and "TX" is an input.

23.6.4 Electrical LTU (1HAM60854AAH)

(Used with VC-AM 1HAT60917AAG)

23.6.4.1 Electrical LTU Interface

Traffic

- Connector: 3 x 1.0/2.3
- Location: Front mounted on LTU
- Use: 34.368Mbit/s Sub STM-1 access.
- Protocol: HDB3

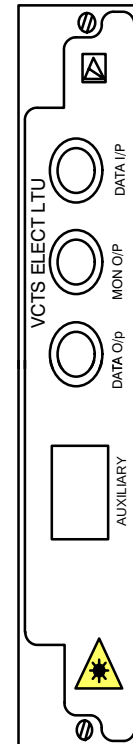


Figure 23.26 VC-AM Electrical LTU

23.7 LTU LINK/SWITCH SETTINGS

23.7.1 Power LTUs

*Triple Feed LTU
1HAM60778ABH*

*Dual Feed LTU
1HAM60779ABK*

The following link settings are common to both Power LTUs listed above:

Link	Default position	Use
LK1	Isolated (open)	Positive supplies Isolated/Grounded
LK2	Isolated (open)	Positive supplies Isolated/Grounded
NOTE User links – Both links used together if selected		

23.7.2 Local Terminal LTU 1HAM60783AAU

- There are no user links or switches on the above LTU.

23.7.3 Alarm LTU

23.7.3.1 (BW7R) 1HAM60780AAN and TEP1E Alarm LTU (1HAM60781AAQ)

- There are no user links on the above LTUs.

Table 23.24: TEP1E & BW7R Alarm LTU Factory Link settings		
Switch	Default position	Use
SW1	Released	Alarm/Cancel Push Button switch
Disabled if PSU1 and PSU2 inoperative (SMA1/4 Subrack)		
Link	Default	Function in Default Position
LK1 (1–2)	1–2	Factory test use (1HAM60781AAQ) only
LK3 (1–2)	1–2	Factory test use (1HAM60781AAQ) only
LK4 (1–2)	1–2	Factory test use (1HAM60781AAQ) only

23.7.4 User Alarm LTU 1HAM60782AAS

- There are no user links or switches on the above LTU.

23.7.5 AUI LTU 1HAM60789AAH

- There are no user links on the above LTU.

Switch	Default position	Use
SW1a	DOWN = Open circuit	Option to ground pin 1 (UP = GND)

23.7.6 Auxiliary LTU 1HAM60786AAB

- There are no user links or switches on the above LTU.

23.7.7 2Mbit/s Test Bus LTU LTU

- There are no user links or switches on the above LTU.

23.7.8 Sync Balanced LTU (1HAM60784AAW)

- There are no user links on the above LTU.

Table 23.25: Termination Impedance		
Switch	Default position	Use
SW1–a	UP	Option to provide 75 Ohm Input Impedance for EXT1 (DOWN = High Impedance)
SW1–b	UP	Option to provide 75 Ohm Input Impedance for EXT2 (DOWN = High Impedance)
NOTE SW1 and SW2 are mounted on the LTU circuit board and are set during commissioning		

23.7.9 Sync Unbalanced LTU (1HAM60785AAY)

- There are no user links on the above LTU.

Table 23.26: Termination Impedance		
Switch	Default position	Use
SW1–a	UP	Option to provide High Impedance for EXT1 (DOWN = 75 Ohm Input Impedance)
SW1–b	UP	Option to provide High Impedance for EXT2 (DOWN = 75 Ohm Input Impedance)
SW2–a	UP = GND	Option to ground EXT1 Input cable screen (DOWN = AC coupling)
SW2–b	UP = GND	Option to ground EXT2 Input cable screen (DOWN = AC coupling)
SW3–a	UP = DC coupling	Option to provide AC/DC Output coupling for EXT1 (DOWN = AC coupling)
SW3–b	UP = DC coupling	Option to provide AC/DC Output coupling for EXT2 (DOWN = AC coupling)
NOTE SW1, SW2 and SW3 are mounted on the LTU circuit board and are set during commissioning		

23.7.10 1.5 Mbit/s Balanced LTU (G703) – 1HAM 60623 AAW

The above 1.5M balanced G.703 LTU has one switch (**SW1**) and no links.

- Default position of **SW1** is **UP** to give a **LOW** Tx output. For up to 3dB of cable loss, SW1 should be in the UP position.

Note: In the non default positions there will be a high Tx output and the Rx cable screen will be short circuited to earth.

23.7.11 1.5 Mbit/s Balanced LTU (G703) – 1HAM 60793AAK

- There are no user links on the above LTU.

The above 1.5M balanced G703 LTU has two switches (**SW1** and **SW2**) and no links.

Switch	Default position	Use
SW1	UP (Tx output earthed)	Tx cable screen will be short circuited to earth or isolated
SW2	DOWN (Isolated Rx input)	Rx cable screen will be isolated from earth or isolated

23.7.12 2Mbit/s Balanced LTU (D Type) – 1HAM 60834AAC

- There are no user links or switches on the above LTU.

23.7.13 2Mbit/s Un-balanced LTU (D Type) – 1HAM 60833AAA

- There are no user links on the above LTU.
- The following switches are set during commissioning:

Switch	Default position	Use (default or DOWN = ON for DC coupling)
SW1–a	UP = AC coupling	Option for AC/DC coupling of input 1 cable screen
SW1–b	UP = AC coupling	Option for AC/DC coupling of input 2 cable screen
SW2–a	UP = AC coupling	Option for AC/DC coupling of input 3 cable screen
SW2–b	UP = AC coupling	Option for AC/DC coupling of input 4 cable screen
SW3–a	UP = AC coupling	Option for AC/DC coupling of input 5 cable screen
SW3–b	UP = AC coupling	Option for AC/DC coupling of input 6 cable screen
SW4–a	UP = AC coupling	Option for AC/DC coupling of input 7 cable screen
SW4–b	UP = AC coupling	Option for AC/DC coupling of input 8 cable screen

23.7.14 34Mbit/s Unbalanced LTU – 1HAM 60796AAR

- There are no user links or switches on the above LTU.

23.7.15 45Mbit/s Unbalanced LTU – 1HAM 60797AAT

- There are no user links or switches on the above LTU.
- Line Build Out
LBO effective = Upper

LBO inactive = Lower

23.7.15.1 1HAM 60798AAV and 1HAM 60839AAN

- There are no user links or switches on the above LTUs.

23.8 POWER CONSUMPTION FIGURES

Table 23.27: LTU Power Consumption		
Ancillary LTUs		
1HAM60783AAU	LCT LTU	0.25W
	PWR/LCT LTU (SMA–1/4c)	
	Enhanced Ancillary Interface Unit (SMA–1/4c)	
	Bw7R LTU (SMA–1/4c)	
1HAM60780AAN	Rack Alarm LTU (BW7R)	2.6W
1HAM60781AAQ	Rack Alarm LTU (TEP–1E)	2.6W
1HAM60782AAS	User Alarm LTU	0.9W
1HAM60789AAH	COMMS AUI LTU	1.5W
1HAM60786AAB	Auxiliary LTU (Low rate 9.6kbit/s)	0.9W
1HAM60883AAM	2Mbit/s Test Bus LTU (1.0/2.03 connectors)	0.6W
1HAM60784AAW	External Sync LTU – Balanced	0.4W
1HAM60784AAY	External Sync LTU – Un-Balanced	0.9W

23.9 RECOMMENDED CABLING

Note: See also cabling information at the end of the chapter on Slide-In Card Units.

Cable (A)

- Copper Braid Screened cable. 3way CY Type (1.5mm²)–2 off per LTU 16A, Raydex/CDT & Farnell Components stock No. .235–210.

Use

- Power Wiring to Subrack for all Dual Feed Power LTUs.

Cable (B)

- Copper Braid Screened cable. 7way CY Type (1.5mm²)–1 off per LTU 16A, Raydex/CDT & Farnell Components stock No. .235–258

Cable (C) Power – SMA–1/4c

- Copper Braid Screened Cable, 4 core.
Leoni V45482–D87–G6 (1300999–0014/AN0001)

Use

- Power Wiring to Subrack for Dual Feed Power LTUs (SMA–1/4c)

Cable (D) Power – SMA–1/4CP

Use

- Power Wiring for SMA–1/4CP

Cable (E)

- 75 Ohm Double Screened coax
GPT Code: 1WAE20028AAX
EBICC BRAND–REX cable ref. HFE 2290 Cable1 or Siemens Cable
V45466–D13–C15

Use

- Int. – Unbalanced connections to all Tributary and Sync signals, however the attenuation characteristics must be checked before use.
(Max distance: 2M=33m, 34M=170m, 45M=150m, 140M=85m, STM–1=80m)

Note: Typical cable may support 5–10% extra length but is not guaranteed.

Cable (F)

- 75 Ohm Double Screened coax to CW1383A
GPT Code: 1WAE20002AAE
BT 3002 Cable

Use

- BT – Unbalanced connections to Tributary and Sync signals up to 2Mbit/s
(Short lengths may be acceptable above 2Mbit/s however the attenuation characteristics must be checked before use and no EMC compliance above 2Mbit/s is offered by GPT).

Cable (G)

- 75 Ohm Double Screened coax (low loss 7/0.2)GPT Code: 1WAE00005AAW
BT 2003 Cable.

Use

- BT – Unbalanced connections to Tributary/Line signals above 2Mbit/s.

Cable (H)

- 75 Ohm Double Screened coax (low loss 7/0.2)
ST212 Cable.

Use

- Italtel – Unbalanced connections to Tributary and Sync signals up to 2Mbit/s.

Cable (I)

- 75 Ohm Double Screened coax (low loss)
ST214 Cable.

Use

- Italtel – Unbalanced connections to Tributary and Sync signals above 2Mbit/s.

Cable (J)

- Screened Pair Cable (8 pair)
GPT Code 1WAD20116AAX

Use

- 120 Ohm balanced connections to Tributary signals.

Cable (K)

- Screened Pair Cable (4 pair)
GPT Code 1WAD20062AAJ
Beldon 9806 cable. 28AWG Beldfoil and Braid
(7/0.127mm diameter tinned Cu).

Use

- 100 – 120 Ohm balanced connections for Tributary, Sync, Auxiliary and
Network Management signals.

Cable (L)

- Screened Multicore Cable.
DEF.Stan.61–12 Parts 4 & 5–10 conductors.
(7/0.2mm Black PVC insulated, 6.3 to 6.9 overall diameter.

Use

- Auxiliary, short length balanced signals.

Cable (M)

- Ribbon Cable (10 way)
GPT Code 1WAC20002ADH
28AWG (7/0.127) Strand Conductors 0.05 Centres.

Use

- Connection to Rack Alarm.

Cable (N)

- LCT Cable Assembly
Belden 9502 or equivalent, 8 way

Use

- Local Terminal Interface for SMA–1/4CP and SMA–1/4c

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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CHAPTER 24: SLIDE-IN CARD UNITS

24.1 INTRODUCTION

SMA–1/4c/uc, SMA–1/4(4+4) and SMA–1/4(8) subracks are populated with slide-in cards. This chapter provides equipping rules and information relevant to individual card installation.

24.1.1 Management Data Communications

Optional cards able to access the overhead data buses, Engineering Order Wire (EOW) and Auxiliary cards, can be used to provide engineering equipment management data communications.

24.2 CARD COMPATIBILITY

Some Series 4 cards are interchangeable with existing cards. Table 24.1 and the following paragraphs detail the card types and give general points to be aware of when replacing existing cards with Series 4 cards.

Note: Refer to the appropriate LCT Operators Manual when replacing a card, upgrading or changing the existing firmware may also be required.

24.2.1 Hardware Codes

Table 24.1 lists Series 4 product core units and associated cards and their variants. The table also includes core units for SMA–1/4CP.

In Series 4, STM–1 and STM–4 optical interface can be achieved using optical modules. For information on these see the chapter on Optical Modules. See also the chapter on Single Fibre Working.

Note: Optical Modules can be used with all Series 4 products including SMA–1/4CP.

Table 24.1: Slide-in Card Units		
CODE	TITLE	COMMENTS
CORE UNITS:–		
1HAN60510AAF	Base Unit (Balanced 16x2)	SMA–1/4CP
1HAN60511AAH	Base Unit (Unbalanced 16x2)	SMA–1/4CP
1HAN60509AAK	Base Unit (X.21 4x2)	SMA–1/4CP
1HAN60514AAP	34M Expansion Module	SMA–1/4CP
1HAN60515AAR	45M Expansion Module	SMA–1/4CP
1HAN60517AAV	STM–1 Optical Expansion Module	SMA–1/4CP
1HAN50512ABC	16x2 Expansion Module (Bal)	SMA–1/4CP
1HAN60513ABE	16x2 Expansion Module (Unbal)	SMA–1/4CP
1HAN60512AAK	32x2 Expansion Module (Bal)	SMA–1/4CP

Table 24.1:(Cont)Slide-in Card Units		
CODE	TITLE	COMMENTS
1HAN60513AAM	32x2 Expansion Module (Unbal)	SMA-1/4CP
1HAG60566AAX	Extender II Expansion Module (X.21 8x2)	SMA-1/4CP (Use with 4x2 base unit only)
1HAG60595AAR	Subrack Core	SMA-1/4c
1HAK60729AAS	Tributary Power Unit	SMA-1/4c
1HAG60596AAT	Subrack Core	SMA-1/4(4+4)
1HAG60594AAP	Subrack Core	SMA-1/4(8)
1HAT60877AAR	Core ADM Card (STM1/4)	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60876AAP	Comms/Controller Card	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAK60669AAW	PSU (Note: 32x2M ports are provided by core configuration. PSU required when trib card fitted)	SMA-1/4(4+4) and SMA-1/4(8)
TRIB CARDS:-		
1HAT60707AAD	2MBIT/S Trib (32 port)	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60736AAW	2MBIT/S Trib (16 port)	SMA-1/4c, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60622BAN	34MBIT/S Trib	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60979AAC	34MBIT/S Transmux	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60623BAQ	45MBIT/S Trib	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
1HAT60624BFE	140MBIT/S Trib	SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8)
TRIB/LINE CARDS:-		
1HAT60803ABT	STM-1 Electrical TCM	LTU/Front Access
1HAT60918AAJ	Dual STM-1 Electrical	SMA-1/4(4+4) and SMA-1/4(8)
1HAT60878AAT	Dual STM-1 Optical TCM	Flexible unit to which optical modules are applied.
1HAT60914AAA	Quad STM-1 Electrical TCM	SMA-1/4c and SMA-1/4uc
1HAT60913AAX	Quad STM-1 Optical TCM	SMA-1/4c/uc (1310NM I1.1/S1.1-FC/PC/SC)
1HAT60922AAL	Quad STM-1 Optical TCM	SMA-1/4c/uc (1310NM L1.1-FC/PC/SC)
1HAT60923AAN	Quad STM-1 Optical TCM	SMA-1/4c/uc (1550NM L1.2-FC/PC/SC)
1HAT60917AAG	VCAM Card	SMA-1/4(4+4) and SMA-1/4(8)
1HAT60791ABU/AFP/ADE	STM-1 Optical TCM	TCM 1310NM L1.1 FC/PC/SC/DIN
1HAT60791ACM/AGG/AEW	STM-1 Optical TCM	TCM 1310NM L1.2 FC/PC/SC/DIN
AUX & EOW CARDS:-		
1HAT60004ADD	Auxiliary Card "0"	SMA-1/4(4+4) and SMA-1/4(8)
1HAT60647ABA	Auxiliary Card "0.1"	SMA-1/4(4+4) and SMA-1/4(8)
1HAT60576DAK	EOW Card	SMA-1/4(4+4) and SMA-1/4(8)
1HAT60576EAG	EOW Fixed Ring Master	SMA-1/4(4+4) and SMA-1/4(8)
1HFA20002AAJ	EOW Handset	
Accessories		
1HAW20014AET	Rug. Universal Coupler	FC/PC to ASC SFW
1HAW20044ABM/ADW/AFG	Tx Rug. Contra-dir Coupler	FC/PC/SC/DIN for SFW 1536nm (1554nm Rx)
1HAW20044AAU/ACE/AEP	Tx Rug. Contra-dir Coupler	FC/PC/SC/DIN for SFW 1554nm (1536nm Rx)
1HAW20048AAD/ACN/AEX	Tx Rug. Co-dir Coupler	FC/PC/SC/DIN for SFW 1536/1554nm
1HAW20048ABV/ADF/AFQ	Rx Rug. Co-dir Coupler	FC/PC/SC/DIN for SFW 1536/1554nm
1HAM60938AAS	Universal Couplers in Fibre Tray	FC/PC for SFW 1310/1550nm

GENERAL FEATURES OF CARD INSTALLATION

CAUTION The Optical Safety rules and Safe Working Practices outlined in the Safety Notices in the preliminary pages of this manual, and relevant card replacement details in the LCT Operator Manual must be read and understood before Optical Multiplexer or Optical Interface Cards are removed from the sub-rack or disconnected.

24.2.2 Card Complement

The card complement of a sub-rack will depend on the application of the particular SMA– in the network. Certain types of card protection schemes may involve duplication of cards (refer to the chapter on Protection and Link and Switch Configuration for details).

In all Card configuration tables, slots for duplicated cards are designated 'A' and 'B', where slot 'A' normally houses the 'worker' card and slot 'B' the 'protection' card.

If the equipment configuration results in any card slot being unoccupied, a suitably sized blank plate must be fitted to that slot in order for complete EMC screening to exist.

24.2.3 Installing the Cards into the Correct Slots

The sequence in which cards are installed is not important. It should be noted however, that some cards have fibre and coaxial connections made at their front panels, therefore it may be more convenient to install these cards last.

Card slots are identified by the numbering scheme 1–N (counting from left to right), when viewing the shelf from the front. Subsequent expansion is possible, e.g. a Terminal Multiplexer can be expanded to provide the Add–Drop function. Which card types can populate what slots are illustrated in the Card configuration tables at the beginning of each Installation chapter.

Note: A mechanical card keying mechanism prevents cards from being fitted in the wrong slots, which could otherwise result in damage to the cards.

Note: To maintain EMC integrity, all un–populated card (and LTU) slot positions should be fitted with dummy blanking plates. A range of plates are available to suit the different slot widths, these are detailed in the previous chapters of this section.

Note: All cards go through an automatic self test routine after they are powered–up. Also note that the power supply unit has a safety feature, whereby it cannot be inserted into the slot or taken out again, without the input switch on the front being set to OFF.

24.2.4 Front Panel Connections

The following cards have active front panel connectors carrying traffic:–

- All fibre–optic Line and Tributary cards (fibre–optic terminations).
- 140Mbit/s and STM–1 Electrical cards (co–axial terminations).

24.2.5 Power Consumption Figures

Cards that interface with LTUs, are given power consumption figures which include a full complement of their associated LTUs. Power values given represent extra power drawn from input supplies and not card dissipation.

Table 24.2: Typical Power Consumption	
Card Type	Power Consumption
SMA–1/4CP 4x2 without optics	20 W
SMA–1/4CP 16x2 Balanced without optics	19 W
SMA–1/4CP 16x2 Unbalanced without optics	19 W
SMA–1/4CP Expansion 3x34Mbit/s	11 W
SMA–1/4CP Expansion 3x45Mbit/s	11 W
SMA–1/4CP Expansion STM1 Optical MM	7 W
ATX 34M Expansion Unit	21 W
ATX 45M Expansion Unit	21 W
ATX 155M Electrical Expansion Unit	21 W
ATX 155M Optical Expansion Unit	21 W
ETX–10 Expansion Unit	8 W
SDH Extender II Expansion Unit 8x2M X.21	8 W
1.5Mbit/s Tributary Card with G703 LTUs (32 port)	11.33 W
1.5Mbit/s Tributary Card with G703 LTUs (16 port)	9.67 W
2Mbit/s Tributary Card with Bal. or Unbal. LTUs (32 port)	15.7 W
2Mbit/s Tributary Card with Bal. or Unbal. LTUs (16 port)	12 W
1.5/2Mbit/s Tributary Card for Protection (32 port)	10 W
34Mbit/s Tributary Card with LTUs	12 W
34Mbit/s Transmux with LTU	11 W
45Mbit/s Tributary Card with LTUs	12 W
140Mbit/s Tributary Card with LTUs	15.5 W
140Mbit/s Tributary Card no LTUs (ie: front access)	13.3 W
VCTS VCAM no LTUs, include LTU power as below for EXTENDER I&II	12.8 W
VC–AM Optical LTU (2off normal[2.5W] & 2off in protection[4.9W]) for EXTENDER I	14.9 W
VCTS VC–AM Electrical LTU (2off normal[2.5W] & 2off in protection[2.25W]) for EXTENDER 1	10.5 W
VCTS VC–AM SFW Optical LTU (each) for EXTENDER I&II	1.9 W
STM–1 Optical Card TCM	7.7 W
Dual STM–1 Optical Card TCM	12.22W
STM–1 Electrical Card with LTU	11 W
STM–1 Electrical Card no LTU (ie: front access)	8.8 W
Dual STM–1 Electrical Card with LTUs	15.9 W
Dual STM–1 Electrical Card no LTUs (ie: front access)	11.5 W
CellSpan–i ATA & ATC 34 ATM Traffic Cards with LTUs	25 W
CellSpan–i ATA & ATC 34 ATM Traffic Cards – protection trib	22 W
CellSpan–i ATA & ATC 45 ATM Traffic Cards with LTUs	25 W
CellSpan–i ATA & ATC 45 ATM Traffic Cards – protection trib	22 W
PacketSpan ETA–10 Card	15 W
PacketSpan ERA Unit	22 W
PacketSpan ERC 34/45 Trib Card with LTU	23 W
PacketSpan ERC 155 Unit	22 W
Comms/Controller Card (including SMC)	10 W
Core Card without optics	20 W

Table 24.2:(Cont)Typical Power Consumption	
Card Type	Power Consumption
STM 1 Dual Fibre Working optical module for SMA–1/4CP, SMA–1/4c, SMA-1/4uc, SMA–1/4(4+4)(8)	5 W
STM 4 Dual Fibre Working optical module for SMA–1/4CP, SMA–1/4c, SMA-1/4uc, SMA–1/4(4+4)(8)	5 W
Auxiliary Card	1.5 W
Auxiliary V0.1 Card	4.0 W
EOW Card & Fixed Ringmaster EOW Card	5.0 W
PSU (each)	10 W
AUI LTU	1.5 W
LCT LTU fitted standard in Core	0.25 W
Sync Balanced LTU	0.4 W
Sync Unbalanced LTU	0.9 W
User Alarms LTU	0.9 W
Rack Alarms LTU (BW7R/TEP–1E)	2.6 W
2M Testbus LTU	0.7 W
SMA–1/4c Basic Ancillary LTU	1.35 W
SMA–1/4c Enhanced LTU	0.75 W
NOTE: Inclusion of the AUI Adaptor Unit (MAU) will typically increase dissipation by 6 W the actual value will depend on the type of MAU fitted.	

24.2.6 Typical Power Calculations

Individual rack power consumption figures will vary considerably for different rack populations. To obtain an approximate power consumption figure for a rack, add up the individual card consumptions and add 8W for the rack itself.

24.2.7 Unit and Card Weights

Table 24.3: Unit and Card Weights	
Card Type	Weight (kg)
SMA–1/4CP 4x2 without optics	2.0
SMA–1/4CP 16x2 Balanced without optics	1.9
SMA–1/4CP 16x2 Unbalanced without optics	1.9
SMA–1/4CP Expansion 3x34Mbit/s	1.5
SMA–1/4CP Expansion 3x45Mbit/s	1.5
SMA–1/4CP Expansion STM1 Optical MM	1.22
ATX 34M Expansion Unit	1.75
ATX 45M Expansion Unit	1.75
ATX 155M Electrical Expansion Unit	1.75
ATX 155M Optical Expansion Unit	1.75
ETX–10 Expansion Unit	1.5
SDH Extender II Expansion Unit 8x2M X.21	1.89
Expansion Interconnect Unit	0.35
1.5/2Mbit/s Tributary Card (32 port)	0.4
34Mbit/s Tributary Card	0.4
34Mbit/s Transmux	0.42
45Mbit/s Tributary Card	0.4
140Mbit/s Tributary Card	0.4
VCTS VCAM Card (EXTENDER I&II)	0.44
STM–1 Optical Card TCM	0.46

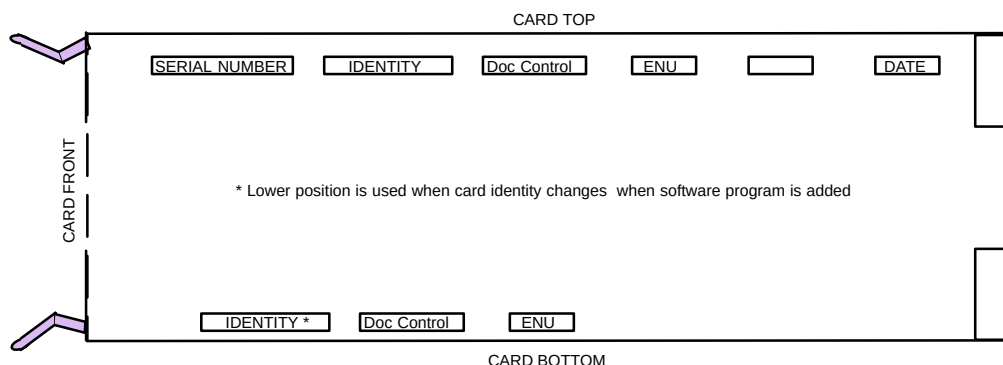
Table 24.3:(Cont)Unit and Card Weights	
Card Type	Weight (kg)
Dual STM-1 Optical Card (without optics fitted)	0.38
Quad STM-1 Optical Card	0.52
STM-1 Electrical Card	0.4
Dual STM-1 Electrical Card	0.38
Quad STM-1 Electrical Card	0.37
CellSpan i ATA and ATC 155 ATM Traffic Cards	0.52
CellSpan i ATC 34 ATM Traffic Cards	0.52
CellSpan i ATC 45 ATM Traffic Cards	0.52
PacketSpan ETA-10 Card	0.43
PacketSpan ERA Unit	0.94
PacketSpan ERC 34/45 Trib Card with LTU	1.0
PacketSpan ERC 155 Unit	0.96
Comms/Controller Card	0.46
System Memory Card	0.04
Core Card without optics	0.63
STM 1 Dual Fibre Working optical module for SMA-1/4CP, SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4)(8)	0.12
STM 4 Dual Fibre Working optical module for SMA-1/4CP, SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4)(8)	0.12
STM 1 Single Fibre Working optical module for SMA-1/4CP, SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4)(8)	0.12
STM 4 Single Fibre Working optical module for SMA-1/4CP, SMA-1/4c, SMA-1/4uc, SMA-1/4(4+4)(8)	0.12
Auxiliary Card	0.3
Auxiliary V0.1 Card	0.4
EOW Card & Fixed Ringmaster EOW Card	0.5
SMA-1/4 PSU	2.1
SMA-1/4c Tributary Power Unit	1.62
Power LTU (1HAM60778ABH)	0.2
Power LTU (1HAM60779ABK)	0.25
1.5Mbit/s Balanced LTU	0.17
2Mbit/s Balanced LTU	0.16
2Mbit/s Unbalanced LTU	0.19
34M/45M/Transmux LTU	0.12
VCTS VCAM Optical LTU for Extender I	0.2
VCTS VCAM Electrical LTU for Extender I	0.15
VCTS VCAM SFW Optical LTU for Extender I and II	0.2
140/155Mbit/s LTU	0.14
140/155Mbit/s Link LTU	0.1
CellSpan Optical and Electrical LTUs	0.15
CellSpan Protection LTU	0.13
Sync Balanced LTU	0.1
Sync Unbalanced LTU	0.09
LCT LTU	0.1
User Alarms LTU	0.09
Rack Alarms LTU (BW7R/TEP-1E)	0.03
AUI LTU	0.1
AUX LTU	0.08
2M Testbus LTU	0.1
SMA-1/4c 2M Unbalanced	0.46
SMA-1/4c 2M Balanced	0.46
SMA-1/4c Basic Ancillary	0.2
SMA-1/4c Enhanced LTU	0.19

Table 24.3:(Cont)Unit and Card Weights

Card Type	Weight (kg)
Mains and Battery Box without batteries	5.4
Mains and Battery Box with batteries	16.0

24.3 CARD LABEL POSITIONS

The card labelling scheme is illustrated below.



Note: The Top Identity refers to the MIC part of the unit and the Bottom Identity to the Top Level Code for the unit.

24.4 POWER SUPPLY UNITS

The power arrangements are different for the SMA–1/4CP, the SMA–1/4c/uc, and the SMA–1/4(4+4) and SMA–1/4(8) products. Full information on PSU's is contained in the chapter on Power Supply Units.

With regard to SMA–1/4(4+4) and SMA–1/4(8), 32 x 2Mbit/s ports are provided by the core configuration – a PSU is required when tributary cards are fitted. This PSU variant is **1HAK60669AAW**. The following PSU variants may also be used:

- **SMA–1 (4+4)/SMA–1(8)** 1HAK60550AEA (Single Input unit)

1HAK60550AFS (Dual input unit) or

1HAK60550 AGK (Italtel option).

Note: The Italtel unit does not alarm if its second supply source is removed.

- **SMA–4(4+4)/SMA–4(8)**
1HAK60550BAC (Dual input) or

1HAK60550BCM (Italtel option).

Note: This unit does not alarm if its second supply input is removed.

With regard to SMA-1/4c/uc, 32 x 2Mbit/s ports are provided by the core configuration – a PSU is required when tributary cards are fitted. This PSU variant is **1HAK60729AAS**.

CAUTION

A Power Supply Unit (PSU) can only be inserted (or withdrawn) when its On/Off switch is in the Off position.

The primary dc source can be batteries or an external PSU. Commissioning the PSU cards is achieved via the Local Terminal (refer to the appropriate Local Terminal (LCT) User manual).

A PSU has two front-panel LEDs to indicate the operational condition of the unit, and dc output test points (see Figure 24.1). There is an on/off switch located at the bottom of the front panel.

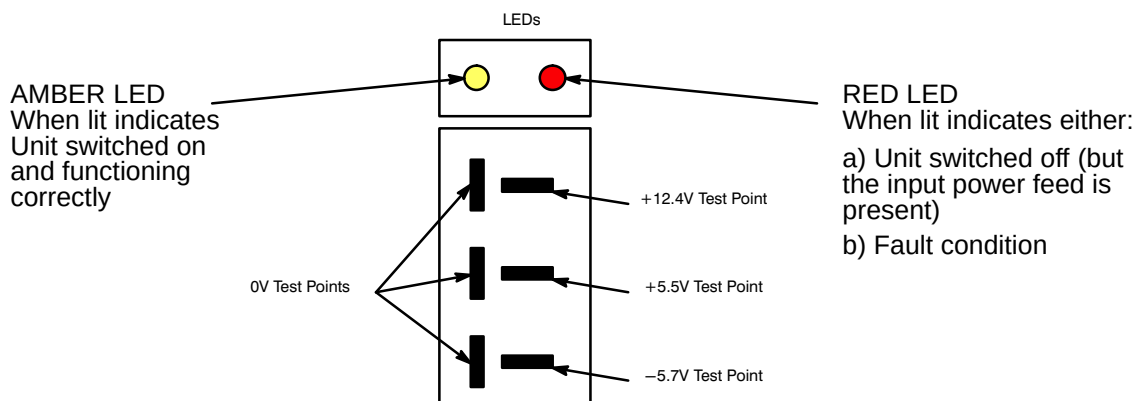


Figure 24.1 PSU Front Panel LED Indications and Monitor Point

24.4.1 PSU Low Voltage Inhibit Circuit

The PSU includes a Low Voltage Inhibit circuit which, when enabled, switches off the outputs if the input feed falls below a predetermined threshold voltage. If, subsequently, the input voltage rises above the threshold, the outputs will be switched on again, but after a one second delay (after which the alarm LED will also extinguish). The purpose of the delay is to allow time for the sub-rack card watch-dog circuits to reset correctly.

The Low Input Voltage Inhibit function is enabled or disabled by means of a slide switch. The switch is identified as SW1 or SW2 and its location on the PCB is determined by the variant and/or ENU level.

- Switch SW2 (which appears on current PSU variants) is readily accessible at the bottom edge of the PCB (see Figure 24.3).

Note: The inhibit is enabled when the switch slider is moved towards the front of the unit.

- Switch SW1 (which appears on some previous PSU variants) is accessible through a cut-out in the side panel (see Figure 24.2) and may be operated by using a small screwdriver blade.

Note: The inhibit is enabled when the switch slider is moved towards the back of the unit.

Note: The default condition for all variants is for the inhibit to be enabled.

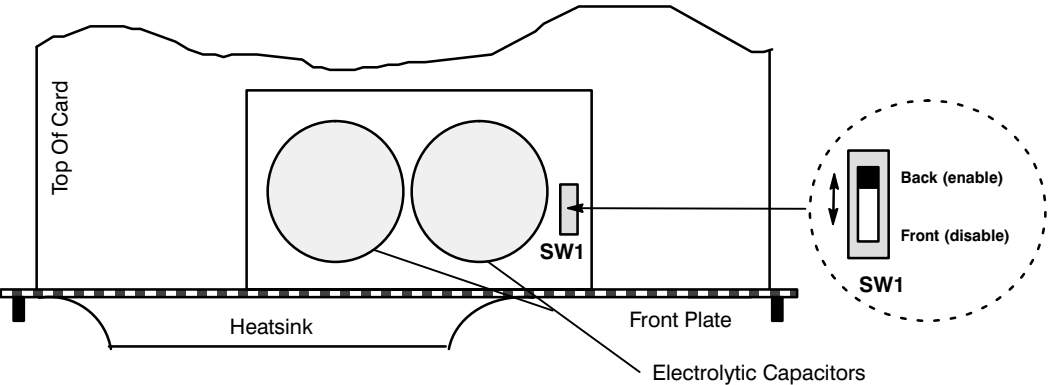


Figure 24.2 Power Supply Unit View Showing Location of Switch SW1

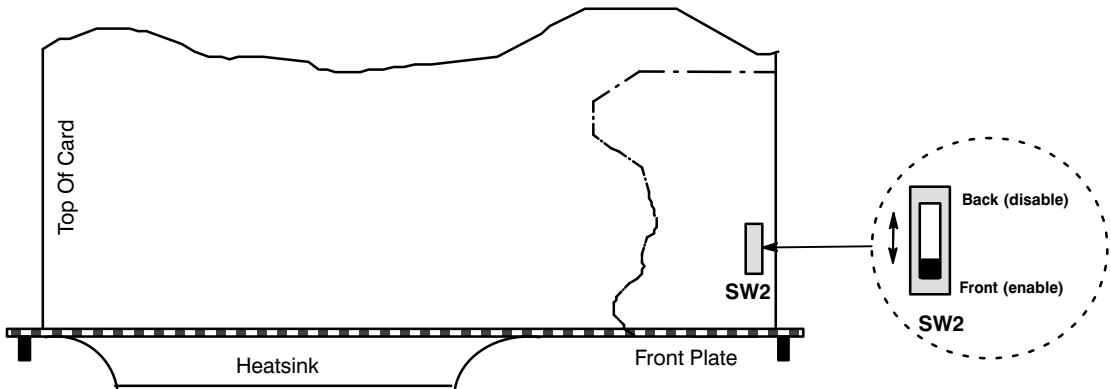


Figure 24.3 Power Supply Unit View Showing Location of Switch SW2

Table 24.4: Summary of Switch Operation			
Switch	Switch Position	Inhibit Switch Status	Operation
SW1	Front	disabled	Initiates a delay to allow time for the sub-rack card watch-dog circuits to reset correctly.
	Back	enabled	

24.4.2 Supply Current

Given the wide tolerance of the possible primary supply voltage which can be chosen (36V dc min, 75V dc max), the total supply current for any rack will depend on the input voltage; e.g. a rack with 370W total consumption, supplied with 60V requires 6.17A (approx), but supplied with 48V requires 7.18A.

24.4.3 Protection

Refer to the chapter on Protection for details of supply protection.

24.5 SYSTEM POWER-UP

CAUTION

The following restrictions, regarding switching the Power Supply Units on or off, should be observed during system power-up:

- A PSU must not be switched off (whether or not one of a group) when the Comms/Controller Card amber LED is still flashing (i.e. during the period it is performing a write sequence). Such an action is likely to result in corruption of the Controller EEPROM data.
- When more than one Power Supply Unit is fitted, they should not be switched between the On/Off states in rapid succession as such action can cause a 'Laser Trip' condition on the Optical Cards.
- **The power-up sequence MUST be followed.** Failure to use the correct sequence may result in the Local Terminal (LCT) failing to communicate with the Comms/Controller card. Should this occur, a re-commissioning sequence, as detailed in the LCT Operators manual should be undertaken. This will cause all previous connections to be lost.

Powering up an SMA

To power-up the SMA correctly, take the following steps:

1. Check that the primary supplies are present, this is indicated by the Green LEDs on the Power LTU.

Note: With the exception of the single feed LTU (now obsolescent), in this case an indication of the presence of primary supplies is the Red LED being lit on the PSU(s).

2. Switch PSU A on.
3. Check that the Amber power LED is lit and the Red LED extinguishes. If not, switch the unit off immediately and remove it from the shelf.
Do not leave a Power Supply Unit in the shelf if the Red LED remains lit after switching on.
4. If the LED indications for PSU A are good, switch PSU B on (if fitted) and repeat the LED checking procedure for PSU B as in 3.

Note: Where there is more than one PSU specified in the rack configuration, ensure that all the PSUs are powered-up within ten minutes of each other; i.e., whenever possible, do not leave a single PSU powering the whole rack for any longer than is required to correctly follow this powering-up procedure.

Note: Immediately after power-up the sub-rack cards will undergo an initialisation period controlled by the Comms/Controller card. During this period, it is normal for a number of the card LEDs to flash on and off. This process stops when the Comms/ Controller card has completed its initialisation cycle.

24.6 CORE CARD (1HAT60877AAR) AND COMMS/CONTROLLER CARD (1HAT60876AAP)

For information on the Core Card and Comms/Controller Cards for the shelf-based products, see the following chapters and sections: 3.3, NO TAG, 24.9.6, 29.9, and 30.9.

The Core Card, which is illustrated in Figure 24.7, has a similar frontal appearance to the Dual STM-1 Optical Card. For information concerning how to fit optical modules to the Core Card and Dual STM-1 Card, see the chapter on Optical Modules in conjunction with Chapter 29 (SMA-1/4c) and Chapter 30 (SMA-1/4(4+4)(8)).

24.7 OPTICAL TRAFFIC CARDS

24.7.1 Optical Card Variants

The launch powers for all Marconi Communications optical card ports satisfy ITU G.957. Variants to cards can be identified as follows:

- I = Intra Office
- L = Long haul
- S = Short haul
- V = Very long haul (primarily for use with an external Optical Amplifier)
- +/JE = Increased optical budget.

Following the prefix letter are digits which identify the STM level

- 1 = STM1
- 4 = STM-4

Following the prefix letter/numbers is a second number which determines the wavelength

- .1 = 1310nm
- .2/3 = 1550nm

The designation $\frac{1}{2}$ + $\frac{1}{2}$ or JE as the suffix denotes a variant with better than G957 optical budget.

Note: Cards shown with the same reference number, are switchable between variants by means of an on-board links.

24.7.2 Optical Safety

CAUTION

The Optical Safety rules and Safe Working Practices outlined in the Safety Notices in the preliminary pages of this manual, and relevant card replacement details in

the LCT Operator Manual **must** be read and understood before Optical Multiplexer or Optical Interface Cards are removed from the sub-rack or disconnected.

A test override switch on the front of the units enables optical measurements to be taken when ALS is operative. This switch has a 12 seconds persistency check built in as a safeguard, and must be enabled (held on) continuously for 12 seconds to activate the laser. At the end of this time limit the laser will be enabled for approximately 90 seconds. A shorter 2 second test can also be performed.

24.7.3 External Connections

Fibre-optic cable connections to Optical Cards are via connectors bracket mounted on the front of the card (Figure 24.4). On-card fibres, running from the connectors into the card, are protected by a guard. or cable guides

CAUTION

Optical power levels when using an Optical Amplifier are such that dirt on the end of a connector can be permanently burnt onto the end face.

24.7.4 LEDs

- **RED**
(Card Fault) Illuminated when card fault is detected or on failure of +5V or –5V card power feeds.
- **AMBER**
(Resource Available) Indicates that the unit is an available resource that has been logically added to the system.
This LED flashes when a software download is in progress.
- **AMBER**
(Laser Test) Illuminated when the laser is in it's test mode.

24.7.5 Push Buttons

There is one push button accessible through the unit front plate assembly used to force the laser on after an Automatic Laser Shutdown has occurred.

- **Press and Hold for 12 seconds** Initiates a 90 second laser test.
- **Press and Release** Initiates a 2 second laser test.

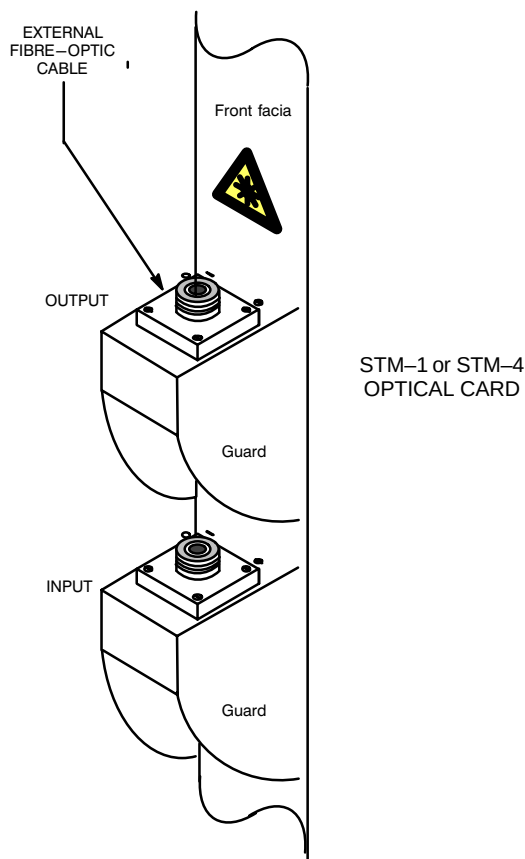


Figure 24.4 External fibre-optic connectors (FC/PC)

Note: See Figure 24.7 for details of optical connector layout on the Core Card and Dual STM-1 Card.

24.8 AUTOMATIC LASER SHUTDOWN (ALS)

24.8.1 Introduction

An Automatic Laser Shutdown (ALS) system is a safety feature designed to prevent exposure to optical radiation in the event of a fibre break or disconnection.

24.8.2 ALS Disabled

With this option enabled, the laser is permanently on and is only disabled when an inward loopback is applied.

Note: TCM variants are permanently disabled regardless of loopback application.

24.8.3 ALS Enabled

In this configuration the laser is disabled in the event of a failure of the received input signal (this is detected by a loss of receive frame alignment). Following a receiver input failure, the laser restart procedure is carried out (see para 24.8.6).

24.8.4 ALS Enabled, Auto Laser Restart Disabled

This is an additional safety feature included for the operation of Transmit optical cards, when used in conjunction with Optical Booster Amplifiers. In this instance, the laser restart signal is suppressed, ensuring that the laser can only be turned on manually by using one of the front panel switches.

In this state, the laser is activated for 0.5s after the card is fitted into the shelf. If no signal is received the laser will shut down and any restart signals will be suppressed.

24.8.5 STM-1 (TCM)

- **ALS Disable** (LK15) 3–4 fitted, (LK19) 1–2 not fitted
When this link is fitted the laser is permanently 'ON' under microprocessor control.
- The ALS override will only function provided (LK19) 1–2 is not fitted.
- **Three Second AIS Extention** (LK15) 3–4 not fitted:
A three second extension of the receive AIS following a potential recovery prevents excess AIS alarms being generated during restart. If this link is fitted the three second AIS extention is disabled.
- **Bi-Directional ALS Enable** (LK14) No links fitted:
The laser is disabled in the event of a 'Section Trace Mismatch' alarm. Fitting LK14 disables the bi-directional shutdown facility.
- **Disabled Automatic Laser Restart** (LK18) 3–4 fitted:
In this configuration the the auto laser restart signal is suppressed. If no signal is received the laser will shut down and can only be restarted manually using one of the front panel switches.

24.8.6 Laser Restart

If the shutdown system has operated, then the laser is automatically enabled for $2.5 \pm 0.2s$ every 1 to 5 minutes (programmable) to test for optical loop continuity.

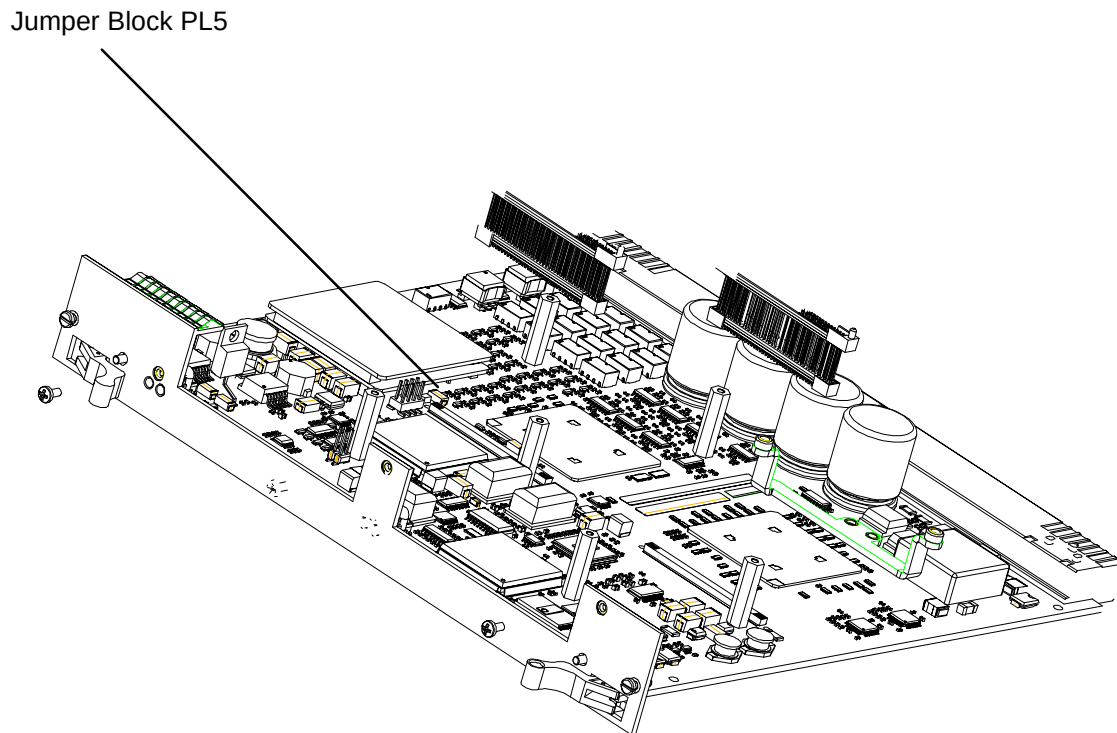
The 1 to 5 minute delay may be overridden by operating the switch SW4 on the card front panel to manually test for loop continuity. If continuity has been established then the then the alarm is cleared and normal operation resumed.

If continuity has not been re-established, the alarm remains active and the laser is again disabled for 1 to 5 minutes or until (SW4) is operated).

24.8.7 Disabling ALS on Core Card (for SMA1/4(4+4)(8), SMA1/4c and SMA1/4uc)

ALS is enabled as standard on all Series 4 equipment. However, in some circumstances there may be a requirement to disable ALS. Figure 24.5 shows how to disable ALS on the Core Card.

Figure 24.5 Procedure for Disabling ALS on Series 4 Core Card

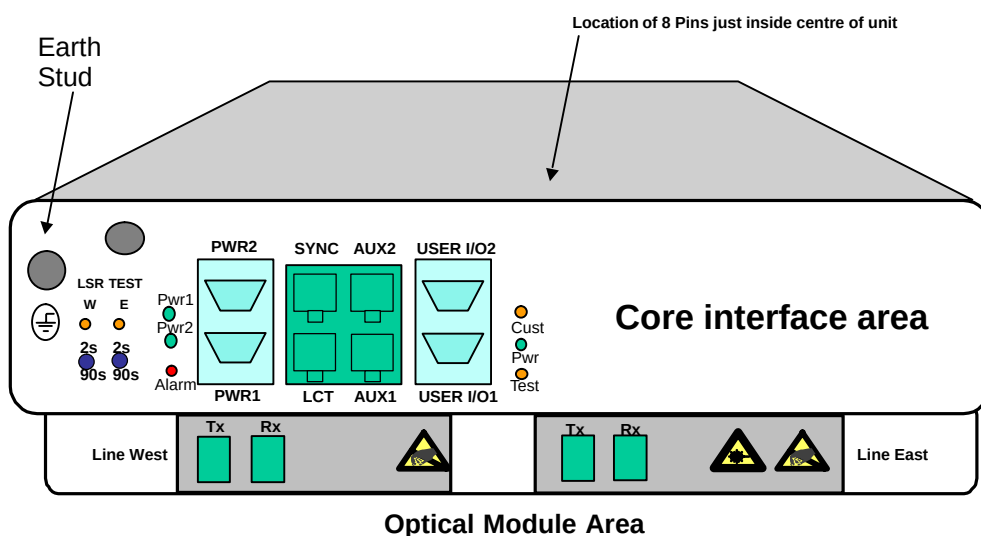
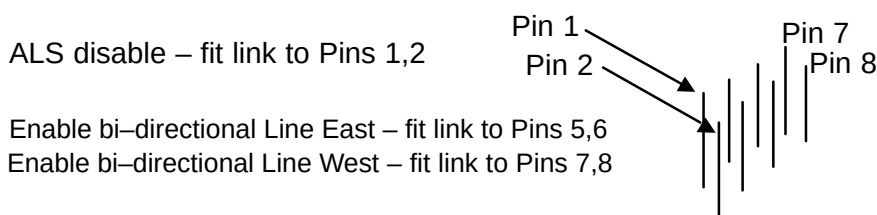


1. Locate jumper block PL5.
2. Locate 2 pins on right hand side labelled 1.
3. Fit jumper over 2 pins labelled 1.

24.8.8 Disabling ALS on SMA-1/4CP

ALS is enabled as standard on the SMA-1/4CP. However, in some circumstances there may be a requirement to disable ALS. Figure 24.5 shows how to disable ALS on the SMA-1/4CP.

Figure 24.6 Procedure for Disabling ALS on SMA-1/4CP and use of other pins



24.9 TRAFFIC CARD INSTALLATION

The following paragraphs give supporting installation details for traffic cards. Use the information given here in conjunction with Table 24.1.

If protection is not being used, a card complement consisting of a mixture of 1.5/2/34/45/140Mbit/s Tributary Cards and STM-1 Tributary Cards is permissible in all Tributary card slots.

24.9.1 1.5/2Mbit/s Tributary Cards

To simplify equipping should a future protection scheme be envisaged, equipping should preferably be in a sequence starting from the lowest slot number working up, i.e. slot 106, then 107 and so on (SMA1/4c), or slot 401, then 402 and so on (SMA1/4(4+4)(8)).

The 1.5/2Mbit/s Tributary Cards will now support thirty two, bi-directional traffic ports. In addition, a reduced capacity card is supported capable of handling up to sixteen bi-directional traffic ports.

24.9.2 1:N Protection (1.5/2Mbit/s Tributary Cards)

For 1:N protection the Protection Tributary Card should be fitted (if appropriate) according to the product variant (in fact this will only be required for SMA1/4c/uc, fitted in slot 104. Traffic card protection is not relevant to SMA1/4CP. On SMA1/4(4+4)(8) 32x2M protection is provided by the Core Card – see the chapter on Protection for further information).

Note: 1:N protection can be utilised for either 1.5 or 2Mbit/s tributaries. Mixed protection is not allowed. Check to ensure that cards being protected are of the same type, otherwise an error message will be generated.

24.9.3 34/45/140Mbit/s, Transmux, VC-AM, and STM-1 Tributary Cards

To simplify equipping should a future protection scheme be envisaged, equipping should preferably be in a sequence starting from the highest slot number working down.

- SMA-1/4c:
four Tributary Cards can be fitted in slots
104 to 107 (104 and 105 are front plug up only).
- SMA-1/4(4+4):
eight Tributary Cards of any type can be fitted in slots 401 to 404 and 407 to 410 (401 to 404 are front plug up only).
- SMA-1/4(8):
eight Tributary Cards of any type can be fitted in slots 401 to 404 and 407 to 410.

STM-1 Cards may be either Optical or Electrical. Functionality of the cards is identical, except for the external interfacing (see Figure 24.4, Figure 24.9 and Figure 24.10), and may be mixed in the same sub-rack, according to network requirements.

24.9.4 1:N Tributary Card protection (Not VC-AM)

The Tributary Protection Card does not have a designated slot (as with the 1.5/2M protection scheme), but has to be in the slot immediately adjacent to, and to the right of the tributary card group. Where space allows, it is possible to protect more than one tributary group where each group may be of different configuration provided the cards within the group are of the same type.

24.9.5 1:1 Tributary Card protection

1:1 protection is a particular form of 1:N protection where N=1. Any two adjacent cards can provide 1:1 card protection with the card on the left configured as Worker and the card on the right as Protection. Traffic LTUs must also be fitted for each Trib card position including LTUs for each protection card.

24.9.6 Optical Cards

24.9.6.1 STM-1 Optical 1HAT60692***

The STM-1 Optical card consists of a single unit providing Interleaving, Disinterleaving and Frame alignment of the STM-1 data stream. Two options are available 1310nm and 1550nm, both Long Haul with a choice of Seiko FC/PC, SC or DIN connectors. For details of the STM-1 Optical Card external connections, refer to paragraph 24.7.3 and paragraph 24.7.4.

STM-1 Optical cards are fitted in the Tributary slots. 1+1 MSP protection is supported across adjacent cards.

24.9.6.2 Dual STM-1 Optical Cards (TCM)

Series 4 Dual STM-1 Optical cards are for use with SMA-1/4c, SMA-1/4(4+4) and SMA-1/4(8).

The cards require the use of optical modules (a maximum of two) to form all front end Rx Tx optical interfaces. These optical modules are field replaceable but not in-service. Note that Series 4 Dual STM-1 Optical Cards support both Dual and Single Fibre Working depending on which optical modules are fitted. See section 24.9.6.2.1 and the chapter on Optical Modules for further information.

There are two backplane traffic interfaces on the Dual STM-1 Optical cards – 38Mbit/s and 78Mbit/s. When used with SMA-1/4c/uc, SMA-1/4(4+4) and SMA-1/4(8), only the 78Mbit/s interface is used, and is automatically configured by the hardware by means of a dedicated backplane pin.

Note: The Series 4 Dual STM-1 Optical cards can be used with Series 3 equipment but at 38Mbit/s interface only.

The Dual STM-1 Optical Interface card variants may be used as tributary interfaces. The cards support two optical interfaces and are only available with TCM.

1+1 MSP (Intra-card) protection is supported across adjacent streams within the same card. 1+1 MSP (Inter-card) is supported across adjacent cards. 1:N protection requires LTUs to be fitted.

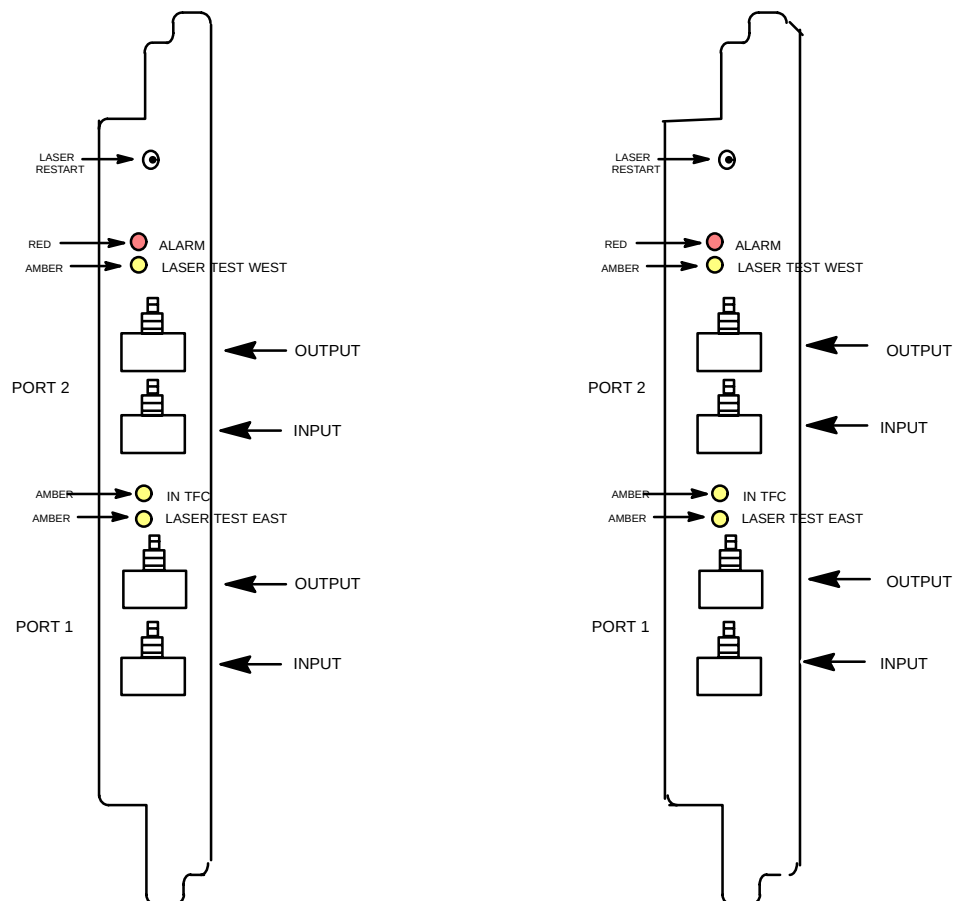


Figure 24.7 Dual STM-1 Optical Card

Core Card

Figure 24.7 shows a Dual STM-1 Optical Card with two optical modules fitted. Figure 24.7 also shows the Core Card with two optical modules fitted. Note that the frontal appearance of the two cards is similar except that the Core Card is slightly wider (1.4" compared to 1").

One or two optical modules can be fitted to each of these cards. If only one optical module is to be fitted, **it must be fitted in the lower port position**. If two modules are to be fitted, one should be fitted in the lower port position first. See the chapter on optical modules for further information.

24.9.6.2.1 Dual STM-1 Optical Modules

The Dual STM-1 optical modules provide the following functionality:

- Transmit source and receive optical termination for a single 155Mbit/s (STM-1) traffic stream.
- Provide ability for automatic laser shutdown and laser parameter monitoring.
- Ability to implement diagnostic loopback functions.

- Provide alarm and performance processing functions.

See the chapter on Optical Modules for further information.

Note: The optical modules can also provide the functionality to transmit source and receive optical termination for a single 622Mbit/s (STM-4) SDH traffic stream.

24.9.6.3 Quad STM-1 Optical Cards – SMA-1/4c and SMA-1/4uc only 1HAT60913AAX/1HAT60922AAL/1HAT60923AAN

Quad STM-1 optical interface card variants may be used as tributary interfaces in conjunction with SMA-1/4c. Quad cards support four optical interfaces and are only available as TCM options. Quad cards do not support single fibre working.

The Quad STM-1 card consists of a single card providing frame alignment and interleaving/disinterleaving of STM-1 data streams. When fitted, the card supports 1+1 MSP (Intra and Inter-card). For each MSP protection type (Intra and Inter), protection is fully flexible (ie any stream can be protected to any other stream).

Eight mating connector tails are required per unit – four for transmit and four for receive. Four optical options are available – 1310nm Intra Office I-1, Short Haul S-1.1, Long Haul L-1.1, and 1550nm Long Haul L-1.2. Monitor ports are not available on Quad cards.

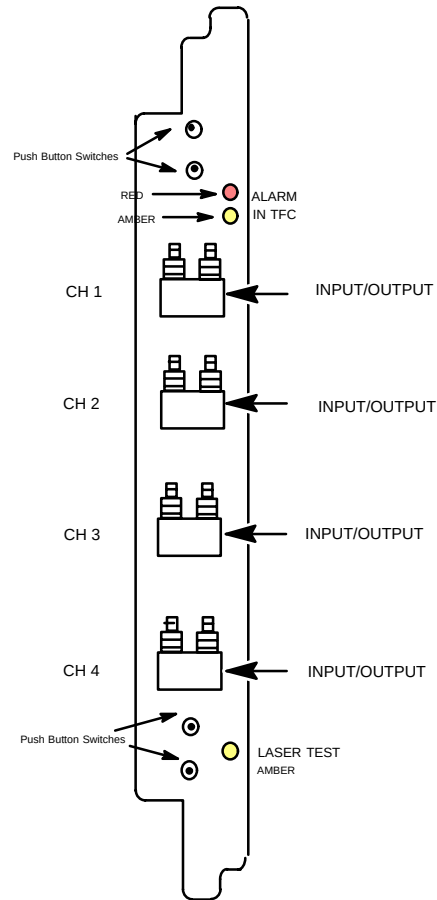


Figure 24.8 Quad STM-1 Optical Card (SMA-1/4c)

24.9.7 Electrical Cards

24.9.7.1 STM-1 Electrical Card

The STM-1 Electrical card performs the same functions as the Optical card except that the optical line functions have been replaced ITU-TSS G703, 155Mbit/s electrical line interface.

Connections to the STM-1 Electrical Card are direct to co-axial connectors on the front of the card. The card (see Figure 24.9) also has a coaxial monitor point socket.

24.9.7.2 Dual STM-1 Electrical Card (1HAT60918AAJ)

Unlike the Dual Optical cards, the electrical interfaces are not supported on modules but are built directly into the main card. Note that the backplane traffic interfaces of the dual card can run at 78Mbit/s or 38Mbit/s.

- If a dual STM–1 electrical card is fitted into an SMA–1/4c/uc, SMA–1/4(4+4) or SMA–1/4(8) shelf, the hardware reads the 78Mbit/s backplane pin and configures the interface to run at 78Mbit/s.
- If a dual STM–1 electrical card is fitted into a Series 3 SMA, the hardware will not be able to read the 78Mbit/s pin and will configure the interface to run at 38Mbit/s
- If a Series 3 electrical card is fitted into an SMA–1/4c/uc, SMA–1/4(4+4) or SMA–1/4(8) shelf, an invalid interface alarm will be generated.

The Dual STM–1 Electrical card provides the same functions as the single STM–1 Electrical card but supports two interfaces via four type 1.0/2.3 coaxial connectors. Monitor points are also provided (see Figure 24.10).

1+1 MSP (Intra–card) protection is supported across adjacent streams within the same card. 1+1 MSP (Inter–card) is supported across adjacent cards. 1:N protection requires LTUs to be fitted.

The Dual STM–1 ports, Port 1 and Port 2, are labelled CH1 and CH2 on the card.

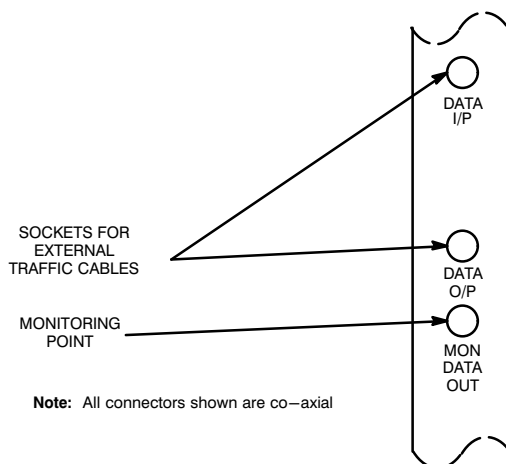


Figure 24.9 Electrical STM–1 and 140Mbit/s Tributary Card

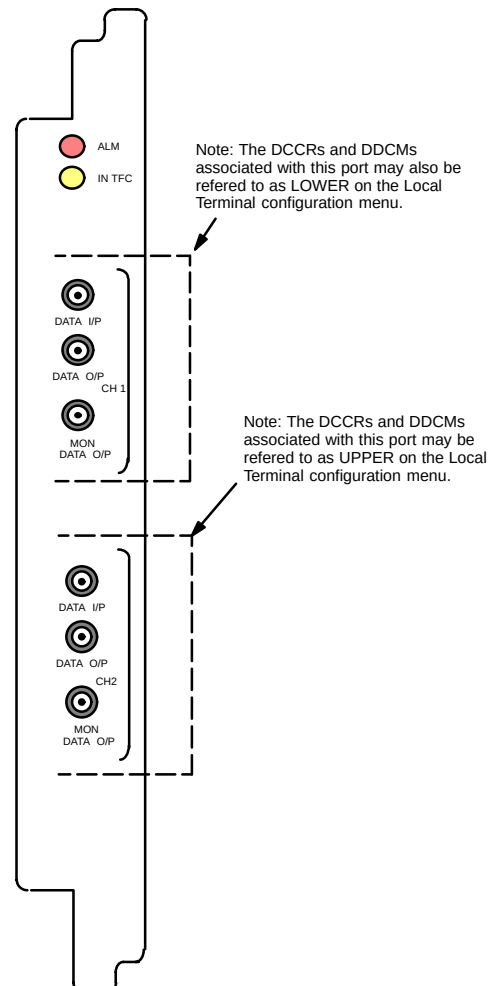


Figure 24.10 Dual STM–1 Electrical Trib Card

24.9.8 Quad STM-1 TCM Electrical Card (1HAT60914AAA) – SMA1/4c and SMA1/4uc only

The Quad STM-1 TCM electrical interface card provides the same basic functionality, protection and equipping rules as the conventional STM-1 electrical interface card, but supports four interfaces in addition to physically supporting Tandem Connection Sub-Layer Performance Monitoring (full TCM). Eight mating 1.0/2.3 coaxial connectors are required per unit (four transmit and four receive).

The Quad STM-1 card consists of a single card providing frame alignment and interleaving/disinterleaving of STM-1 data streams. When fitted, the card supports 1+1 MSP (Intra and Inter-card). For each MSP protection type (Intra and Inter), protection is fully flexible (ie any stream can be protected to any other stream).

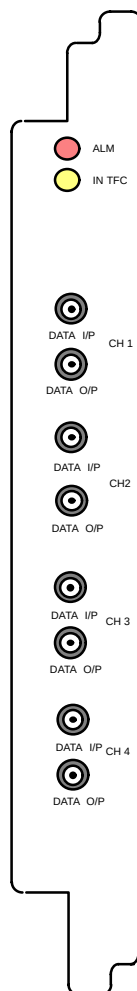


Figure 24.11 Quad STM-1 Electrical Card (SMA-1/4c/uc)

24.9.9 140Mbit/s Tributary Card (1HAT60624BFE)

140Mbit/s Interface cards may be used in Tributary slots.

This card will handle one 139.264Mbit/s traffic signal via two type 1.0/2.3 coaxial connectors or via a 140Mbit/s LTU. Two monitor points are also available on the front of the unit (see Figure 24.9).

24.9.10 45Mbit/s Tributary Card (1HAT60623BAQ)

The 45Mbit/s Tributary Card provides the processing circuitry to map and multiplex primary rate traffic signals into the synchronous STM–1 frame structure. One Tributary Card can handle up to three 44.736 Mbit/s traffic signals.

- Note that the Series 4 card can be used with Series 3 equipment but not vice versa.

24.9.11 34Mbit/s Tributary Card (1HAT60622BAN)

The 34Mbit/s Tributary Card provides the processing circuitry to map and multiplex primary rate traffic signals into the synchronous STM–1 frame structure. In this case one Tributary Card handles up to three 34.368 Mbit/s traffic signals.

- Note that the Series 4 card can be used with Series 3 equipment but not vice versa.

24.9.12 34Mbit/s Transmux Card (1HAT60979AAC)

The 34Mbit/s Transmux Card provides termination of a single structured 34Mbit/s PDH line signal. At the PDH side the card will perform a 2Mbit/s to 34Mbit/s PDH multiplex/demultiplex function. At the SDH side the card will take the 16 demultiplexed 2Mbit/s traffic signals and perform the same SDH mapping and multiplexing function as the 2Mbit/s card.

The Transmux Card provides a single 34M signal interface in conjunction with a single port LTU. The 34M, G.751 framed signal is de–multiplexed into its constituent 16 x 2M PDH payloads. These are then processed as 16 separate 2M channels with equivalent functionality to that of the 2M Tributary Card.

- Note that the Series 4 card can be used with Series 3 equipment but not vice versa.

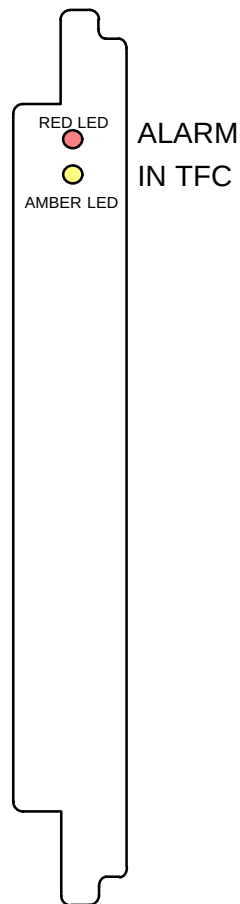


Figure 24.12 34/45Mbit/s Tributary
34Mbit/s Transmux

24.9.13 VC-AM Card (1HAT60917AAG)

The VC-AM card is managed by the Comms/Controller function and is used in conjunction with a V-TERM card located at a customer premises. Up to eight VC-AM cards may be fitted in the tributary slots.

Each VC-AM provides up to four bi-directional 34Mbit/s sub STM-1 optical interfaces via up to four optical LTUs. Both eight and fourteen channel cards are available thus delivering a maximum of fifty six VC-12 signals (ie: $4 \times 14 = 56$ VC-12s).

- Note that the Series 4 card can be used with Series 3 equipment but not vice versa.

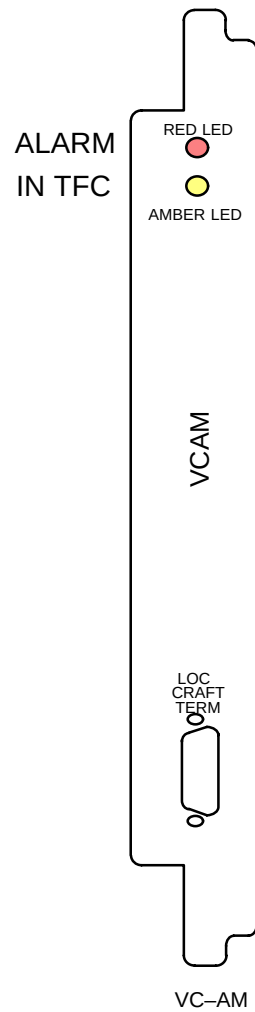


Figure 24.13 VC-AM Card

Cross-connections are made by the SMA Core Card, which treats the VC-AM as an STM-N card providing 32 channels for VC-12 connectivity only. The channels associated with the STM-1 from the SMA Core Card to VCTS lines are mapped as shown in Table 24.5.

Table 24.5: Channel / VCTS Line Association		
Channel No.	TUG3/TUG2/TUG12 Nos	VC-AM Line
1 to 8	1/1/1 to 1/3/2	34M VCTS Line 1 (Channels 1–8)
9 to 14	1/3/3 to 1/5/2	34M VCTS Line 1 (Channels 9–14)
15	1/5/3	Not Available for Cross-connection
16 to 23	1/6/1 to 2/1/2	34M VCTS Line 2 (Channels 1–8)
24 to 29	2/1/3 to 2/3/2	34M VCTS Line 2 (Channels 9–14)
30	2/3/3	Not Available for Cross-connection
31 to 38	2/4/1 to 2/6/2	34M VCTS Line 3 (Channels 1–8)
39 to 44	2/6/3 to 3/1/2	34M VCTS Line 3 (Channels 9–14)
45	3/1/3	Not Available for Cross-connection
46 to 53	3/2/1 to 3/4/2	34M VCTS Line 4 (Channels 1–8)
54 to 59	3/4/3 to 3/6/2	34M VCTS Line 4 (Channels 9–14)
60 to 63	3/6/3 to 3/7/3	Not Available for Cross-connection
NOTE Shaded areas above are applicable only to 14 Channel VC-TS cards.		

24.9.13.1 VC-AM Protection

1:N VC-AM card protection is available on all Series 4 SMAs (with the exception of the Protection slot)

24.9.13.2 VC-AM Firmware

The VC-AM Firmware is held on the VC-AM card and not on the SMC. Should a VC-AM card require configuring into a working subrack, the relevant software has to be downloaded into the VC-AM card using the local terminal or EMOS before traffic can be connected. A description of how to use this feature can be found in the LCT Operator Manual.

24.10 OVERHEAD BUS ACCESS CARD

24.10.1 Auxiliary Card

The Auxiliary Cards allow omnibus handling of client telemetry, via RTUs (Remote Terminal Units used for controlling equipment such as C-MUX primary multiplexers) or MCUs (Management Communications Units), both around a ring and on STM-n tributaries. This is achieved by providing conversion between discrete V11 I/O ports (from the client's equipment) and Section Overhead bytes.

One card can be fitted per Subrack in either auxiliary slot together with the Auxiliary LTU/s. LTU slots are provided for AUX1 to AUX7, however only **AUX1 to AUX 3** are used.

24.10.2 Version '0' (1HAT60004ADD)

24.10.2.1 9.6kbit/s Access

Using Auxiliary LTUs, 9.6kbit/s access is provided via six V11 ports (see Page 305 for pinout details). Each port consists of an input balanced pair and an output balanced pair. No control signals or clocks are provided. Two ports and a ground go to each Auxiliary LTU connector.

Note: If local access to the asynchronous ports is not required at a particular SMA on a ring, the ports can be hard-wired together on the AUX LTU, to pass the data on to the next SMA.

24.10.3 Version '0.1' (1HAT60647ABA)

24.10.3.1 9.6kbit/s Access

Using Auxiliary LTUs, 9.6kbit/s access is provided via six V11 ports, as described for Version '0'.

24.10.3.2 64kbit/s Access

Synchronous 64kbit/s access is also provided via six micro D-type connectors (KOP 1MBB60769AAK), on the front of the card (see Figure 24.14). These ports have balanced pairs for the transmit and receive clocks as well as for the input and output signals. There is only one port available on each connector to carry synchronous data. Variations are controlled by DIL switches on the card.

Note: If local access to the asynchronous ports is not required at a particular SMA on a ring, the ports can be hard-wired together on the AUX LTU, to pass the data on to the next SMA. For the synchronous ports, DIL switches have to be set according to the by-passes required. These can be set separately for each port.

Table 24.6: 64kbit/s Access Connectors

Aux Port Connector	To / From
Connector 1 (Aux Ch 1)	Line West (SOH Ch 1)
Connector 2 (Aux Ch 2)	Trib 1 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 3)
Connector 3 (Aux Ch 3)	Trib 4 (SOH Ch 1) If STM-1, switchable to Line West (SOH Ch 2)
Connector 4 (Aux Ch 4)	Line East (SOH Ch 1) only
Connector 5 (Aux Ch 5)	Trib 2 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 3)
Connector 6 (Aux Ch 6)	Trib 3 (SOH Ch 1) If STM-1, switchable to Line East (SOH Ch 2)

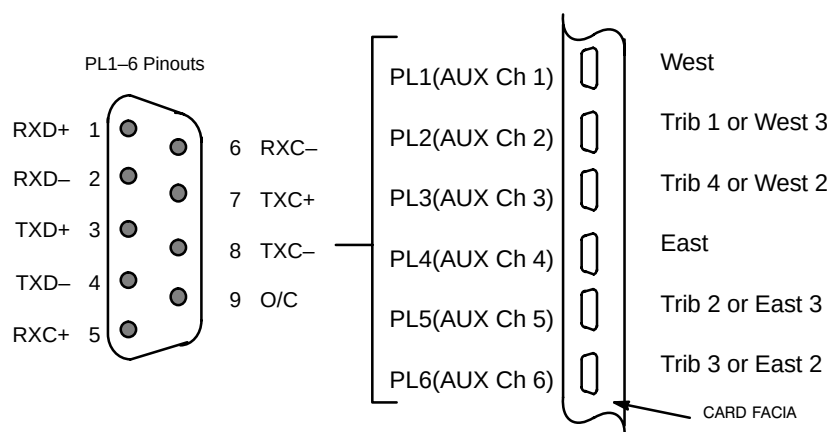


Figure 24.14 On-card Connectors for 64kbit/s Access

24.10.4 Engineering Order Wire (EOW) Card

The Engineers Order Wire Cards can be fitted in the Auxiliary slots Aux1 or Aux2 to provides access to the E1 byte within the section overhead bytes.

24.10.5 EOW Ring Slave

- **1HAT60576DAK**
This card provides EOW on Line East A, West A and STM-1 Trib 1 only. (SMA-1/4(4+4), SMA-1/4(8)).

It is possible to use access to the E1 byte without using the on board EOW features. This is done via an analogue 4-wire port (**AUX 1** on Aux LTU). In this case external EOW equipment is used. This must not use DTMF signals A, B, C or D. The card also provides two 64kbit/s V11 interfaces for customer use (**AUX 3** on Aux LTU), these provide access to the SOH F1 byte on Line East A and West A.

Note: This card can be configured by an on board link, for use as a RING MASTER in a Ring that does **not contain** an SLA (Siemens Line Equipment).

24.10.6 EOW Fixed Ringmaster

- **1HAT60576EAG**
SMA-1/4(4+4), SMA-1/4(8).

Whilst similar to the EOW Ring Slave, Analogue Transmission is to the Line West only. Where a ring **includes** SLAs, one of these cards is instead of the previous card set to MASTER (using a link), ring security will be lost.

24.10.7 LEDs

- Internal (INT) LED:
Indicates the presence of a faulty slide-in unit within the SMA.
- External (EXT) LED:
Indicates that external defects are being detected on customer or comms traffic.

- **Abnormal (ABN) LED:**
Indicates that an off-normal condition exists within the SMA.
- **Indicative (IND) LED:**
When lit this LED indicates the receipt of a path maintenance signal such as AIS or RDI.

24.11 TEST BUS/MONITOR POINTS

24.11.1 PSU

- **Connector:**
ITT–Cannon (block type) 6–pin
- **Location:**
Mounted through the front plate of the PSU's
- **Use:**
Monitor points for the PSU derived supplies
- **Electrical spec:**
Short circuit limit protected to 5mA max.
- **Protocol:**
0v/+5v, 0v/–5v, 0v/+12v DC

24.11.2 34/45/140MBit/s

- **Connector:**
1 x Siemens 1.0/2.3 co–axial.
- **Location:**
Front mounted on appropriate 34/45/140Mbit/s/STM–1 Un–Balanced LTUs.
Also mounted on front of 140Mbit/s/STM–1 Tributary cards.
- **Use:**
Output signal monitor point.
- **Electrical spec:**
Attenuated representation of the signal at the Tributary traffic port
- **Protocol:**
HDB3 – 34Mbit/s
B3ZS – 45Mbit/s
CMI – 140Mbit/s

24.11.3 Conventional STM–1 Optical

- **Connector:**
2 x Siemens 1.0/2.3 co–axial.
- **Location:**
Front mounted on the STM–1 Optical card
- **Use:**
Output signal and clock monitor points.
- **Electrical spec:**
Electrical representation of the signal at the traffic port

- **Protocol:**
ECL Logic Levels, ITU-T G707, G957-8 .

24.11.4 Dual STM-1 Optical

- No monitor point are available on the front plate of this card

24.11.5 Conventional STM-1 Electrical

- **Connector:**
1 x Siemens 1.0/2.3 co-axial.
- **Location:**
Front mounted on the STM-1 Electrical card
Also mounted on associated 140/155Mbit/s unbalanced LTU module.
- **Use:**
Output signal monitor point.
- **Electrical spec:**
Attenuated representation of the signal at the traffic port
- **Protocol:**
CMI, ITU-T G707

24.11.6 Dual STM-1 Electrical

- **Connector:**
2 x Siemens 1.0/2.3 co-axial.
- **Location:**
Front mounted on the Dual STM-1 Electrical card.
Also mounted on associated 140Mbit/s unbalanced LTU module
- **Use:**
Output signal monitor points.
- **Electrical spec:**
Attenuated representation of the signal at the traffic port
- **Protocol:**
CMI, ITU-T G707

24.11.7 2MBIT/S Testbus LTU

- **Connector:**
1 x Siemens 1.0/2.3 co-axial and
1 x 9way D Type plug.
- **Location:**
Front mounted on 2Mbit/s Testbus LTU
- **Use:**
To monitor 2Mbit/s traffic between the Tributary card and traffic LTU
- **Electrical spec:**
75 ohms un-balanced to ITU-T G703 and 120 ohms
balanced to ITU-T G703, ETS300 166.
- **Protocol:**
HDB3

24.12 RECOMMENDED CABLING

CABLE: POWER-1

CODE: 1WAD 20122 AAE

TYPE: Copper Braid Screened Cable, 3way CY Type (1.5mm²),
2off per PLTU

USE: Power Wiring to Subrack for all Dual Feed PLTUs

Note: A minimum length of 2 metres should be used with an earth connection, via the green/yellow wire, at both ends of the cable. Cable screen tails have cream sleeving to distinguish them from equipment earthing.

KOP: 1MBB60853AAN

CABLE: POWER-2

CODE: 1WAD 20122 ABW

TYPE: Copper Braid Screened Cable, 7way CY Type (1.5mm²)
1off per PLTU

USE: Power Wiring to Subrack for Triple Feed PLTUs

Note: A minimum length of 2 metres should be used with an earth connection, via the green/yellow wire, at both ends of the cable. Cable screen tails have cream sleeving to distinguish them from equipment earthing.

KOP: 1MBB60832AAF

CABLE: Power – SMA-1/4c

CODE: **Leoni V45482-D87-G6 (1300999-0014/AN00013171)**

TYPE: Copper Braid Screened Cable, 4 core

USE: Power Wiring to Subrack for Dual Feed PLTUs (SMA-1/4c)

KOP: 1MBB61247AAN

CABLE: Power – SMA-1/4CP

USE: Power Wiring for SMA-1/4CP

KOP: 1MBB61111AAX

CABLE: HFE 2290 Cable 1 or Siemens Cable V45466-D13-C15 or V23614-A102-A76

CODE: 1WAE 20028 AAX

TYPE: 75 Ohm Double Screened co-ax

USE :Unbalanced connections to all Tributary and Sync ports, however the attenuation characteristics must be checked before use.

Note: Max dist. 2M – 330m, 34M – 170m, 45M – 150m, 140M – 85m, STM-1 – 80m (Typical cable may support 5–10% extra length but is not guaranteed)

KOP: 1MBB60891AAU/ABM/ACE, 1MBB61107AAV, 1MBB60892AAW

CABLE:
BT 3002 Cable

CODE: 1WAE 20002 AAE

TYPE: 75 Ohm Double Screened co-ax to CW1383A

USE :Unbalanced connections to Tributary and Sync ports

Note: Signals up to 2Mbit/s, short lengths may be acceptable above 2Mbit/s however the attenuation characteristics must be checked before use and no EMC compliance above 2Mbits is offered by Marconi Communications (for BT)

KOP: 1MBB60913AAJ/BAF/ABB/BBX, 1MBB61107ABN/BBK, 1MBB61120AAL

CABLE:
BT 2003 Cable

CODE: 1WAE 00005 AAW

TYPE: 75 Ohm Double Screened co-ax (low loss)

USE :Unbalanced connections to Line and Tributary ports

Note: Signals above 2Mbit/s (for BT)

KOP: 1MBB60912AAG/BAD

CABLE:
ST212 Cable

CODE: 1WAE 20031 AAX

TYPE: 75 Ohm Double Screened co-ax

USE :Unbalanced connections to Tributary and Sync ports

Note: Signals up to 2Mbit/s (for Italtel)

KOP: 1MBB60861AAY, 1MBB60850AAG, 1MBB60982AAN

CABLE:
ST214 Cable

CODE: 1WAE 20030 AAV

TYPE: 75 Ohm Double Screened co-ax (low loss)

USE :Unbalanced connections to Tributary/Line ports

Note: Signals above 2Mbit/s (for Italtel)

KOP: 1MBB6060851AAJ, 1MBB60852AAL

CABLE:
HFE 2292 Cable

CODE: 1WAD 20116 AAX

TYPE: Screened Pair Cable (8 pair)

USE: Connections to balanced Tributary ports

Note: 120 Ohm balanced signals up to 2Mbit/s

KOP: 1MBB60895AAD, 1MBB60894AAB

CABLE:
Belden 9806 cable

CODE: 1WAD 20062 AAJ

TYPE: Screened Pair Cable (4 pair)

USE :Connections to balanced Tributary, Sync, Auxiliary, Alarm and
Network Management ports

Note: 100–120 Ohm balanced signals up to 2Mbit/s

KOP: 1MBB60769AAK, 1MBB60982AAN, 1MBB60893AAY/ABR,
1MBB61082AAA

CABLE:
Ribbon (10 way)

CODE: 1WAC 20002 ADH

TYPE: Ribbon Cable 28 AWG

USE: Connection to Rack Alarm

KOP: 1MBB60894AAB/ABT

CABLE:
LCT Cable Assembly

CODE: 1HAU61913AAF

TYPE: Belden 9502 or equivalent, 8 way

USE: Local Terminal Interface for SMA–1/4CP and SMA–1/4c

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 25: OPTICAL MODULES

25.1 HARDWARE CODES

CAUTION

The Optical Safety rules and Safe Working Practices outlined in the Safety Notices in the preliminary pages of this manual, and relevant card replacement details in the LCT Operator Manual **must** be read and understood before Optical Modules are removed from equipment or disconnected.

The complete range of variants of the optical modules is given in the tables below. The optical modules in section 25.1.3 are for use with the Core card or Dual STM-1 Card (by plugging on to them) in association with SMA1/4c and SMA1/4.

The optical modules in section 25.1.1 are for use with SMA1/4CP by fitting on to the 4x2 or 16x2 versions of SMA1/4CP.

The optical module provides one optical interface for the SMA1/4c/uc and SMA1/4 Core ADM cards. Up to two cards can be plugged on to each Core ADM card. The optical interface operates at 155Mb/s (STM-1) or 622Mb/s (STM-4).

The optical module provides one optical interface for SMA1/4CP. Up to two cards can be fitted on to each SMA1/4CP. The optical interface operates at 155Mb/s (STM-1) or 622Mb/s (STM-4).

25.1.1 SMA1/4CP

The following optical module mounting kit of parts applies to the SMA1/4CP tables below: **1MBB61185AAN**

Table 25.1: STM-1 Dual Fibre Working Optical Modules for SMA-1/4CP			
SE Code	Rev	Description	Hardware Code
SA66AA	01	FC/PC STM-1 1300NM S1.1	1HAT60874BBY
SA66AA	01	SC STM-1 1300NM S1.1	1HAT60874BCR
SA66AB	01	DIN STM-1 1300NM S1.1	1HAT60874BDJ
SA66AC	01	FC/PC STM-1 1300NM L1.1	1HAT60874BBY
SA66AC	01	SC STM-1 1300NM L1.1	1HAT60874BCR
SA66AD	01	DIN STM-1 1300NM L1.1	1HAT60874BDJ
SA66AE	01	FC/PC STM-1 1550NM L1.2	1HAT60874BBY
SA66AE	01	SC STM-1 1550NM L1.2	1HAT60874BCR
SA66AF	01	DIN STM-1 1550NM L1.2	1HAT60874BDJ

**Table 25.2: STM-1 Single Fibre Working
Non-Integrated Optical Modules for SMA-1/4CP**

SE Code	Rev	Description	Hardware Code
SA66AG	01	FC/PC STM-1 1536NM L1.2	1HAT60874BBY
SA66AG	01	SC STM-1 1536NM L1.2	1HAT60874BCR
SA66AG	01	DIN STM-1 1536NM L1.2	1HAT60874BDJ
SA66AJ	01	FC/PC STM-1 1554NM L1.2	1HAT60874BBY
SA66AJ	01	SC STM-1 1554NM L1.2	1HAT60874BCR
SA66AJ	01	DIN STM-1 1554NM L1.2	1HAT60874BDJ

**Table 25.3: STM-4 Dual Fibre Working Optical
Modules for SMA-1/4CP**

SE Code	Rev	Description	Hardware Code
SA67AA	01	FC/PC STM-4 1300NM S4.1	1HAT60908BBH
SA67AA	01	SC STM-4 1300NM S4.1	1HAT60908BCA
SA67AB	01	DIN STM-4 1300NM S4.1	1HAT60908BDS
SA67AC	01	FC/PC STM-4 1300NM L4.1	1HAT60908BBH
SA67AC	01	SC STM-4 1300NM L4.1	1HAT60908BCA
SA67AD	01	DIN STM-4 1300NM L4.1	1HAT60908BDS
SA67AG	01	FC/PC STM-4 1550NM L4.2	1HAT60908BBH
SA67AG	01	SC STM-4 1550NM L4.2	1HAT60908BCA
SA67AH	01	DIN STM-4 1550NM L4.2	1HAT60908BDS

**Table 25.4: STM-4 Single Fibre Working
Non-Integrated Optical Modules for SMA-1/4CP**

SE Code	Rev	Description	Hardware Code
SA67AL	01	FC/PC STM-4 1536NM L4.2	1HAT60908BBH
SA67AL	01	SC STM-4 1536NM L4.2	1HAT60908BCA
SA67AL	01	DIN STM-4 1536NM L4.2	1HAT60908BDS
SA67AN	01	FC/PC STM-4 1554NM L4.2	1HAT60908BBH
SA67AN	01	SC STM-4 1554NM L4.2	1HAT60908BCA
SA67AN	01	DIN STM-4 1554NM L4.2	1HAT60908BDS

The following points should be noted with regard to SMA1/4CP:

- One or two modules can be fitted to each 4x2 or 16x2 base unit – using the optical module mounting kit of parts, **1MBB61185AAN**.
- If only one module is fitted, then the blank optical module kit of parts needs to be used. The hardware code for this is **1MBB61186AAQ**.
- If only one module is fitted, the optical module can be fitted in either the Line West (left hand side) position, or the Line East (right hand side) position.
- The non-integrated SFW modules in Table 25.2 and Table 25.4 offer the same basic functionality as the conventional DFW modules in addition to supporting co-directional and contra-directional single fibre working(SFW). When co-directional or contra-directional SFW (1310nm/1550nm) is required then the appropriate conventional DFW and/or SFW variant should be selected and **should be fitted with the appropriate ruggedised coupler** (see list of couplers contained in Table 1 in the chapter on Slide-In Card Units).

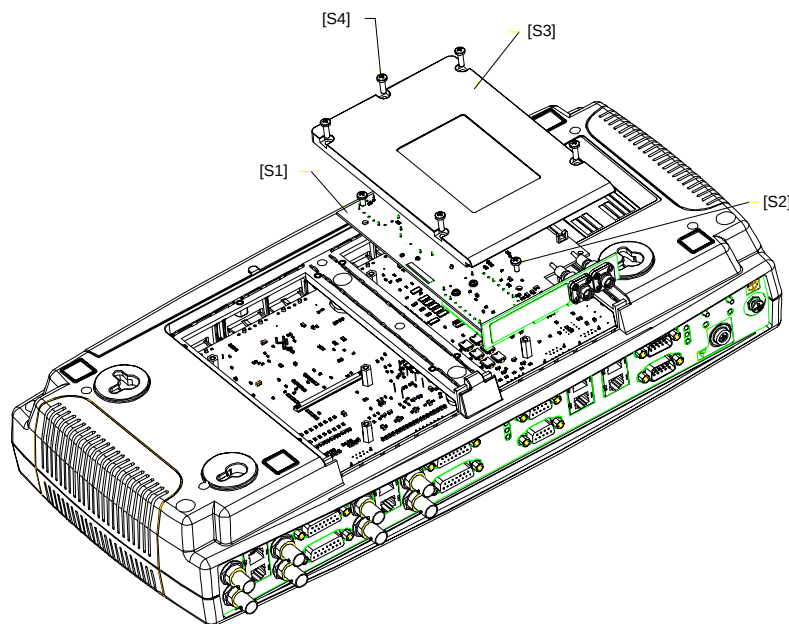
25.1.2 SMA-1/4CP FITTING PROCEDURE



WARNING

The operator should be aware that when optical module units are fitted and installed an optical signal may be generated despite the modules being in an unconfigured state.

The procedure for fitting optical modules on to the SMA-1/4CP is illustrated in Figure 25.1.



- S1. FIT MODULE BY FIRMLY PRESSING METAL FRONT PANEL INTO GROOVE IN ENCLOSURE. ENSURE MULTI-PIN CONNECTOR CORRECTLY ENGAGED.
- S2. FIT AND TIGHTEN 3 SCREWS.
- S3. FIT COVER AND FIRMLY PRESS FRONT EDGE GROOVE TO ENGAGE ONTO METAL FRONT PANEL OF MODULE.
- S4. FIT AND TIGHTEN 5 SCREWS.

Figure 25.1 SMA-1/4CP Optical Module Fitting Procedure

25.1.3 SMA1/4c, SMA1/4uc, SMA1/4(4+4) and SMA1/4(8)

Table 25.5: STM-1 Dual Fibre Working Optical Modules for SMA-1/4c, /uc and SMA-1/4(4+4)(8)

SE Code	Rev	Description	Hardware Code
SP66AA	01	FC/PC STM-1 1300NM S1.1	1HAT60874ABC
SP66AA	01	SC STM-1 1300NM S1.1	1HAT60874ACU
SP66AB	01	DIN STM-1 1300NM S1.1	1HAT60874ADM
SP66AC	01	FC/PC STM-1 1300NM L1.1	1HAT60874ABC
SP66AC	01	SC STM-1 1300NM L1.1	1HAT60874ACU
SP66AD	01	DIN STM-1 1300NM L1.1	1HAT60874ADM
SP66AE	01	FC/PC STM-1 1550NM L1.2	1HAT60874ABC
SP66AE	01	SC STM-1 1550NM L1.2	1HAT60874ACU
SP66AF	01	DIN STM-1 1550NM L1.2	1HAT60874ADM

Table 25.6: STM-1 Single Fibre Working Non-Integrated Optical Modules for SMA-1/4c, /uc and SMA-1/4(4+4)(8)

SE Code	Rev	Description	Hardware Code
SP66AG	01	FC/PC STM-1 1536NM L1.2	1HAT60874ABC
SP66AG	01	SC STM-1 1536NM L1.2	1HAT60874ACU
SP66AG	01	DIN STM-1 1536NM L1.2	1HAT60874ADM
SP66AJ	01	FC/PC STM-1 1554NM L1.2	1HAT60874ABC
SP66AJ	01	SC STM-1 1554NM L1.2	1HAT60874ACU
SP66AJ	01	DIN STM-1 1554NM L1.2	1HAT60874ADM

Table 25.7: STM-4 Dual Fibre Working Optical Modules for SMA-1/4c, /uc and SMA-1/4(4+4)(8)

SE Code	Rev	Description	Hardware Code
SP67AA	01	FC/PC STM-4 1300NM S4.1	1HAT60908ABL
SP67AA	01	SC STM-4 1300NM S4.1	1HAT60908ACD
SP67AB	01	DIN STM-4 1300NM S4.1	1HAT60908ADV
SP67AC	01	FC/PC STM-4 1300NM L4.1	1HAT60908ABL
SP67AC	01	SC STM-4 1300NM L4.1	1HAT60908ACD
SP67AD	01	DIN STM-4 1300NM L4.1	1HAT60908ADV
SP67AG	01	FC/PC STM-4 1550NM L4.2	1HAT60908ABL
SP67AG	01	SC STM-4 1550NM L4.2	1HAT60908ACD
SP67AH	01	DIN STM-4 1550NM L4.2	1HAT60908ADV

Table 25.8: STM-4 Single Fibre Working Non-Integrated Optical Modules for SMA-1/4c, /uc and SMA-1/4(4+4)(8)

SE Code	Rev	Description	Hardware Code
SP67AL	01	FC/PC STM-4 1536NM L4.2	1HAT60908ABL
SP67AL	01	SC STM-4 1536NML4.2	1HAT60908ACD
SP67AL	01	DIN STM-4 1536NM L4.2	1HAT60874ADV
SP67AN	01	FC/PC STM-4 1554NM L4.2	1HAT60908ABL
SP67AN	01	SC STM-4 1554NM L4.2	1HAT60908ACD
SP67AN	01	DIN STM-4 1554NM L4.2	1HAT60908ADV

The following points should be noted with regard to SMA1/4c/uc, SMA1/4(4+4) and SMA1/4(8):

- One or two modules can be fitted to each ADM Core Card unit or Dual STM–1 Card – using the appropriate interconnector from the mounting kit of parts, **1MBB61222AAW**.
- If only one module is fitted, then the blank optical module kit of parts needs to be used. The hardware code for this is **1MBB61222ABP**.
- If only one optical module is to be used on a unit, it must be fitted in the Line East (lower) position. If two modules are to be used on a unit, then one must be fitted in the Line East (lower) position first.
- The non–integrated SFW modules in Table 25.6 and Table 25.8 offer the same basic functionality as the conventional DFW modules in addition to supporting co–directional and contra–directional single fibre working(SFW). When co–directional or contra–directional SFW (1310nm/1550nm) is required then the appropriate conventional DFW and/or SFW variant should be selected and **should be fitted with the appropriate ruggedised coupler** (see list of couplers contained in Table 1 in the chapter on Slide–In Card Units).

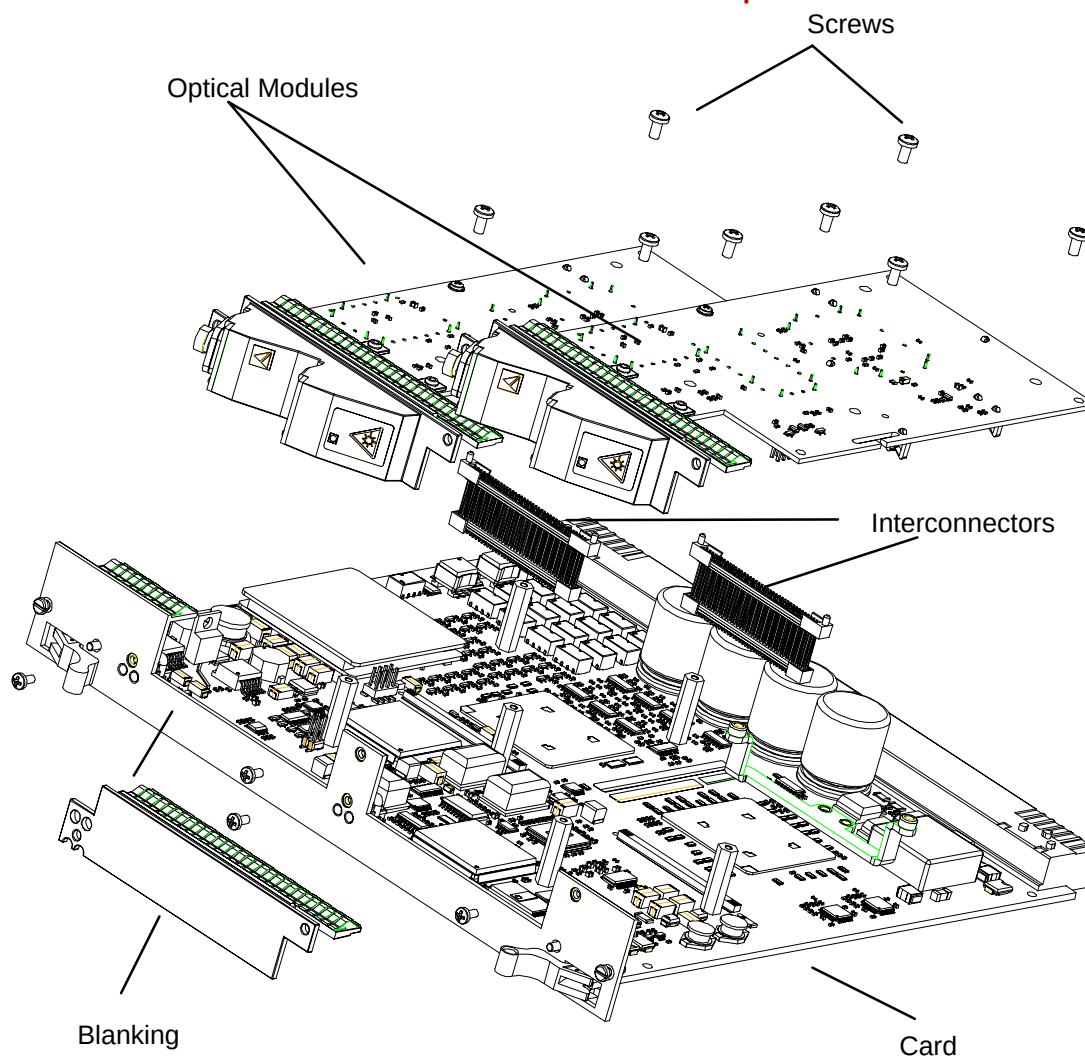
25.1.4 PROCEDURE FOR FITTING OPTICAL MODULES TO CORE CARD AND DUAL STM-1 OPTICAL CARD



WARNING

The operator should be aware that when optical module units are fitted and installed an optical signal may be generated despite the modules being in an unconfigured state.

Figure 25.2 Procedure for Fitting Optical Modules to Core Card and Dual STM-1 Optical Card



1. Fit interconnector(s) to motherboard.
2. Offer up optical module(s) ensuring interconnector pegs are aligned with fixing holes in module.
3. Secure firmly into place
4. Fix with screws supplied.
5. If only one module is fitted, it must be fitted in the Line East (lower) position.
6. If only one module is fitted, fit blanking plate in Line West (upper) position.

Note: The interconnector for fitting modules to the Core Card is 22mm.
The interconnector for fitting modules to the Dual STM-1 Card is 12mm. Both interconnectors are included in KOP **1MBB61222AAW**.

25.2 GENERAL DESCRIPTION

A general block diagram for the optical module is given in the diagram below.

The optical module provides the following functionality based on ITU and ETSI generic functional requirements:

- Transmit source and receive optical termination for a single 155Mb/s (STM-1) SDH traffic stream.
- Transmit source and receive optical termination for a single 622Mb/s (STM-4) SDH traffic stream.
- Provide ability for Automatic laser shutdown and laser parameter monitoring.
- Ability to implement Diagnostic Loopback functions.
- Provide Alarm and performance processing functions.

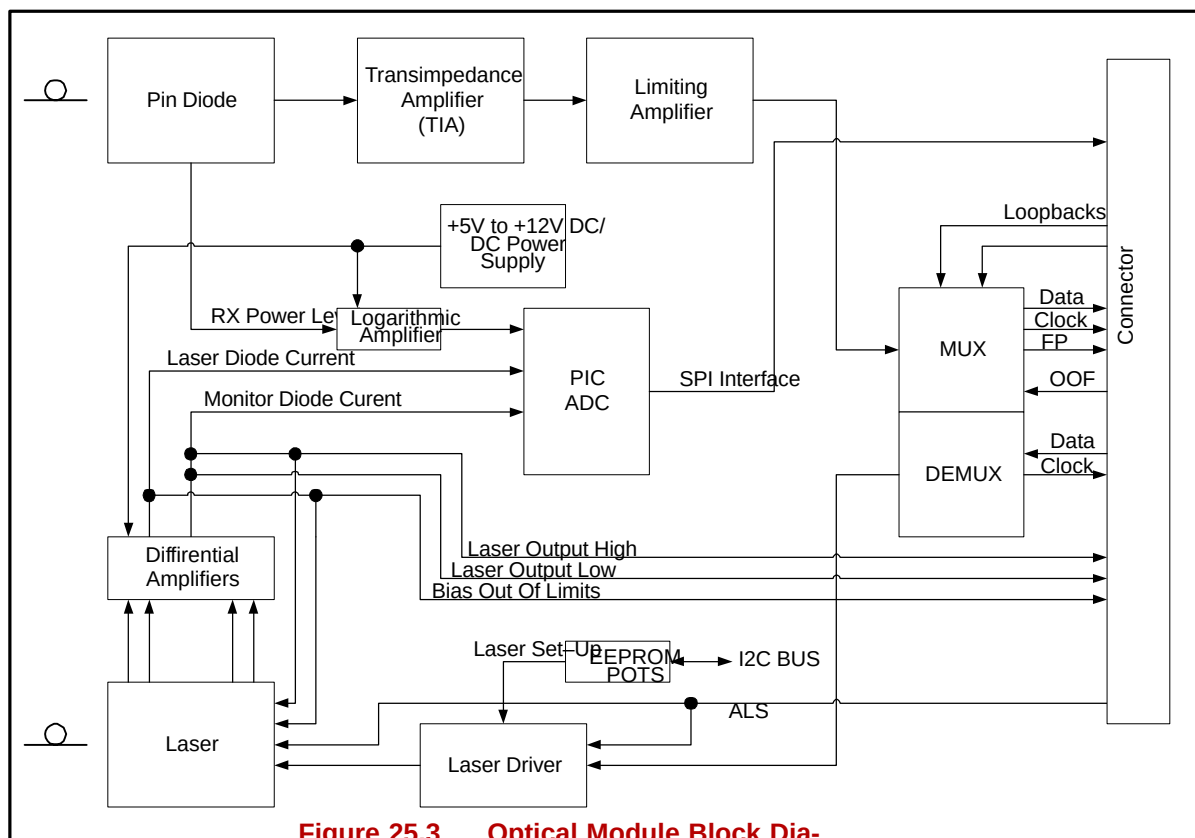


Figure 25.3 Optical Module Block Diagram

25.3 STM-1 OPTICAL INTERFACE

The optical Transmit and Receive interfaces conform with or exceed the ITU requirements for STM-1 SDH interfaces. The interfaces are accessed via bulkhead optical connectors mounted on the front panel of the module.

The variant of the Optical Module determines the specification of the optical interface. Refer to Table 1 for variant codes.

25.4 STM-1 TRANSMIT WAVELENGTH

Three types of lasers will be used on the variants of the optical modules. The operating wavelengths of these is given in the table below:

Table 25.9: Operating Wavelengths	
Variant Type	Operating Wavelength (nm)
S1.1	1293–1334/1274–1356 MLM
L1.1	1300–1325/1296–1330 MLM, 1280–1335 SLM
L1.2	1480–1580 SLM

25.5 STM-4 OPTICAL INTERFACE

The Optical Transmit and Receive Interfaces conform with or exceed the ITU requirements for STM-4 SDH interfaces. The interfaces are accessed via bulkhead optical connectors mounted on the front panel of the unit.

The particular variant of the optical daughter card determines the specification of the optical interface. Refer to Table 1 above for variant codes.

25.6 STM-4 TRANSMIT WAVELENGTH

Three types of lasers are used on the variants of the optical modules. The operating wavelength of these is given in the table below:

Table 25.10: Operating Wavelengths	
Variant Type	Operating Wavelength (nm)
S4.1	1293–1334/1274–1356 MLM
L4.1	1300–1325/1296–1330 MLM, 1280–1335 SLM
L4.2	1480–1580 SLM

25.7 OPTICAL CONNECTORS

The optical connectors are situated on the front of the module. A number of different types are supported. See Table 1 for details.

The transmit and receive optical interfaces correspond to reference points "S" and "R" as defined in ITU-T G.957. The optical receiver has a multimode fibre "pigtail" to minimise connector loss.

25.8 STM-N OPTICAL INPUT

The optical module's STM-n optical input is via a connector mounted on the front of the card. The connector types are defined by the variant codes in Table 1.

25.9 OPTICAL TRANSMIT INTERFACE

This function performs electrical to optical conversion. The optical control circuitry also monitors for laser failure conditions. The Automatic Laser Shutdown (ALS) signal is used to enable the laser restart mechanism.

25.9.1 General Description

The transmit interface generates optical data from electrical data. The interface can operate over either a dual fibre line or a bi-directional single fibre line.

The transmitter generates "Optical Output Low" ("Laser Degrade"), "Optical Output High/Shutdown" and "Bias Out of Limits" alarms to indicate the condition of the Laser output.

25.9.2 Laser Alarms

A number of alarm outputs report the current state of the optical transmitter. The power alarms are triggered when the current through the rear facet and therefore the laser output exceeds certain limits.

25.10 LOOPBACKS

25.10.1 Inward Mux Loopback

It is possible to loop back the transmitted STM-n signal, before electrical to optical conversion, into the STM-n receive circuitry. During this loop back the laser will be turned off because detection of unsafe operation is not possible.

25.10.2 Outward Line Loopback

It is possible to loop back the received STM-4 signal, after optical to electrical conversion, to the outgoing STM-n signal (to the line). The received data will still be passed to the downstream circuitry for processing.

25.11 DATA PATHS

On the receive side the STM-n optical signal is converted to an electrical form by a PIN diode. This is then amplified via an amplifier and passed to an S3037 ASIC. This chip demultiplexes down the serial data to an 8-bit data stream at 77.76Mbit/s for STM-4 or 19.44Mbit/s for STM-1. This is then passed on to the SCP ASIC that performs the majority of the traffic processing before broadcasting the data.

In the transmit direction the SCP ASIC passes 8-bit data, after processing, to the S3037. The 8-bit data is multiplexed up to the line rate. This then passes to a laser driver that performs laser bias and modulation control.

25.12 POWER SUPPLIES

25.12.1 Input Voltages

The main power will originate from the SMA1/4CP, SMA1/4c/uc or SMA1/4 ADM main card power supplies shown below:

- 5.1 volts
- 3.3 volts

25.13 RELIABILITY

25.13.1 Service Life

The service life of the equipment is greater than 15 years.

25.13.2 Mean Time Between Failures (MTBF)

Experience of the actual real life failure rate, as opposed to the theoretical calculated figure, for past designs has led to an MTBF figure of 51 years.

25.14 OPTICAL SAFETY

The optical modules meet class 1 requirements. Refer to the Safety Notices section in the preliminary pages of this manual.

A laser warning label is mounted on the front fascia of the unit.

In addition to the Automatic Laser Shutdown system, a Marconi proprietary control method is employed to ensure that the laser shuts down when fibre breaks occur in a single fibre bi-directional data system.

25.15 HOT SURFACES

Under normal operating conditions the surfaces of the board can become hot. Therefore, care must be exercised when handling the board.

25.16 ELECTROSTATIC DAMAGE

Care must be exercised and correct anti-static handling procedures observed when the module is removed from a card to avoid damage to sensitive devices on the module.

A static damage warning label is mounted on the front fascia of the module.

25.17 EQUIPMENT PRACTICE

The components are mounted on both sides of 220mm deep x 233mm high PCB.

The module is designed to fit on to an SMA1/4CP, SMA1/4c/uc and SMA1/4 ADM card. The maximum height of components is less than 15mm. The module is fitted with 1.27mm pitch type connectors to interface to the main ADM cards.

The module is fitted with a front panel, which in conjunction with the equipment shelf and adjacent cards provides an electromagnetic screen. On this front-panel is a label that identifies the unit variant and front panel features.

The optical Interface is accessed via front panel connectors, mounted vertically. A removable cover allows access to the rear of the optical connectors to allow cleaning access for the optical interfaces.

25.18 MODULE WEIGHT

The approximate weight of a fully assembled optical module is 500g.

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CHAPTER 26: LINK AND SWITCH CONFIGURATION

26.1 TRAFFIC CARD LINK/SWITCH SETTINGS

The following paragraphs give the link settings options for line and trib traffic cards for Conventional, TCM and Single Fibre Working variants.

Note: Owing to the high concentration of components on circuit boards, the printing of component identity on the boards may be omitted.

In all cases however, pin 1 should be identified by an adjacent white spot.

26.2 CORE CARD (1HAT60877AAR)

ALS is enabled as standard on the Core Card. If there is a requirement to disable ALS, the procedure for configuring links (on jumper block PL5) to achieve this is laid out and illustrated in section 24.8.7. Core Card link settings (for jumper block PL5) are summarised in Table 26.1.

Table 26.1: Core Card Link Settings (Jumper Block PL5)		
Link	Setting	Function
Pins 1,2	Not Fitted	ALS enabled
Pins 1,2	Fitted	ALS disabled
Pins 5,6	Not Fitted	Bi-directional Line East disabled
Pins 5,6	Fitted	Bi-directional Line East enabled
Pins 7,8	Not Fitted	Bi-directional Line West disabled
Pins 7,8	Fitted	Bi-directional Line West enabled

The only other links which may need to be configured on the Core Card are on Jumper Block PL3 (NB Not Jumper Block PL5). These link settings are shown in Table 26.2.

Table 26.2: Core Card Link Settings (Jumper Block PL3)		
Link	Setting	Function
Pins 1,2	Not Fitted	2Mbit/s Card
Pins 1,2	Fitted	1.5Mbit/s Card

26.3 SMA-1/4CP

The location and purpose of link settings for the SMA-1/4CP are laid out and illustrated in section 24.8.8. These link settings are summarised in Table 26.3.

Table 26.3: SMA–1/4CP Link Settings		
Link	Setting	Function
Pins 1,2	Not Fitted	ALS enabled
Pins 1,2	Fitted	ALS disabled
Pins 5,6	Not Fitted	Bi-directional Line East disabled
Pins 5,6	Fitted	Bi-directional Line East enabled
Pins 7,8	Not Fitted	Bi-directional Line West disabled
Pins 7,8	Fitted	Bi-directional Line West enabled

26.4 CONVENTIONAL CARDS

26.4.1 1.5/2Mbit/s (16x2) Tributary Card – 1HAT60736 AAW

Table 26.4: 16 x 1.5/2Mbit/s Tributary Card Link Settings		
User Links		
Link	Default Setting	Function
LK3 (1–4)	Not fitted	2Mbit/s card working
LK4 (1–4)	1–2 and 3–4 (using LK6 and LK7 (see note))	
or		
LK3 (1–4)	1–2 and 3–4 (using LK6 and LK7(see note))	1.5Mbit/s card working
LK4 (1–4)	Not fitted	
Factory Link/Pins		
Link	Default Setting	Function
LK1 (1–2)	Not fitted	Watchdog (1–2 disabled)
LK2 (1–2)	Not fitted	Test Prog. (1–2 enabled)
LK5 (1–2)	Not fitted	Debug link
NOTE: Links 6 and 7 are used for “parking”		

26.4.2 1.5/2Mbit/s (32x2) Tributary Card – 1HAT60707 AAD

Table 26.5: 32 x 1.5/2Mbit/s Tributary card link settings		
User Links		
Link	Default Setting	Function
LK3 (1–4)	Not fitted	2Mbit/s card working
LK4 (1–4)	1–2 and 3–4 (using LK6 and LK7(see note))	
or		
LK3 (1–4)	1–2 and 3–4 (using LK6 and LK7(see note))	1.5Mbit/s card working
LK4 (1–4)	Not fitted	
Factory Link/Pins		
Link	Default Setting	Function
LK1 (1–2)	Not fitted	Watchdog (1–2 disabled)
LK2 (1–2)	Not fitted	Test Prog. (1–2 enabled)
LK5 (1–2)	Not fitted	Debug link
NOTE Links 6 and 7 are used for “parking”		

26.4.3 34Mbit/s Transmux Card – 1HAT60979AAC

- There are no user link settings on the above card.

Table 26.6: 34Mbit/s Transmux card link settings		
Link/Pins	Position	Use of Factory Test Links
LK1 (1–2)	Not fitted (enabled)	Disable Watchdog
LK2 (1–3)	Not fitted (disabled)	Enable test monitor program (1–2), 2–3 (park)
LK3 (1–2)	Not fitted (enabled)	Inventory write protection enable
PL1 and PL2	Not fitted	Factory test access only

26.4.4 34/45Mbit/s Tributary Cards – 1HAT60622BAN/ 1HAT60623BAQ

- There are no user link settings on the above card.

Table 26.7: 34M/45bit/s Tributary card link settings		
Link/Pins	Default Position	Use of Factory Test Links
FTP (A1–A2)	Not fitted	Flash (First time program)
TEST A3–A4	Not fitted	Production test link
B1–B2 (If fitted)	Not fitted	µC Watchdog disable
Tags 1 to 7	Not fitted	Single pin tags for factory use only

26.4.5 140Mbit/s Tributary Cards – (1HAT60624BFE)

Table 26.8: 140Mbit/s Tributary card link settings		
User Links		
Link between:	Default Setting	Function
LK2 (A1–A2)	Fitted	Front Plate/LTU controlled automatically
LK2 (A2–A3)	Not fitted	CMI interface = Front Plate (forced)
LK2 (A2–A4)	Not fitted	CMI interface = LTU (forced)
Loopback (A5–A6)	Not fitted	Local Loopback
FERF Enable (A11–A12)	Not fitted	FERF enabled for o/p fail
Factory Test Links		
Link between:	Default Setting	Function
LK1 (A13–A14)	Fitted (enabled)	Watchdog
FTP (A15–A16)	Not fitted	Flash (First Time Program)
TEST (A16–A17)	Not fitted	Factory test access only

Note: Maximum cable span is 120m (2003) or 75m (3002) for a 140Mbit/s Tributary card.

26.4.6 VC-AM Card – 1HAT60917AAG

Note: The above Link card has no User Links and all Factory Links are left open circuit.

Table 26.9: VC-AM Card Link Settings		
Link/Pins	Default Settings	Use of factory test links
LK1	Not fitted	Boot source select
H1(1–2)	Not fitted	Factory test only
H1(3–4)	Not fitted	Factory test only
H1(5–6)	Not fitted	Factory test only
H1(7–8)	Not fitted	Factory test only
H1(9–10)	Not fitted	Factory test only
H2(1–2)	Not fitted	Factory test only
H2(3–4)	Not fitted	Factory test only
H2(5–6)	Not fitted	Factory test only
H2(7–8)	Not fitted	Factory test only
H2(9–10)	Not fitted	Factory test only – Flash download
H2(11–12)	Not fitted	Factory test only – Watchdog disable
DB1	Not fitted	Factory test only
DB2	Not fitted	Factory test only
TAG43,44	Not fitted	Factory test only – 43(0V), 44(+5V)
Other Tps	Not fitted	Factory test only

26.5 POWER SUPPLY UNITS

26.5.1 Power Supply 1HAK60550 BAC/BCM

Table 26.10: Power Supply Unit/s Link Settings		
Switch	Default Position	Use
SW1A	Switch to back of unit	Low input voltage inhibit enabled (factory set) or Switch to front of unit (low input voltage inhibit disabled)

26.5.2 Power Supply 1HAK60669 AAW

Table 26.11: Power Supply Unit/s Link Settings		
Switch	Default Position	Use
SW2	Switch to back of unit	Low input voltage inhibit enabled (factory set) or Switch to front of unit (low input voltage inhibit disabled)

26.5.3 EOW Card DIL Switches and Links

Switch settings are determined by the individual card telephone number (see Figure 26.1, also Section 2: Chapter 4 for a description of EOW configuration and operation).

The link pins associated with setting up master or slave operation, are a set of three pins located above the DIP switch, ignore any other links, as these are factory set.

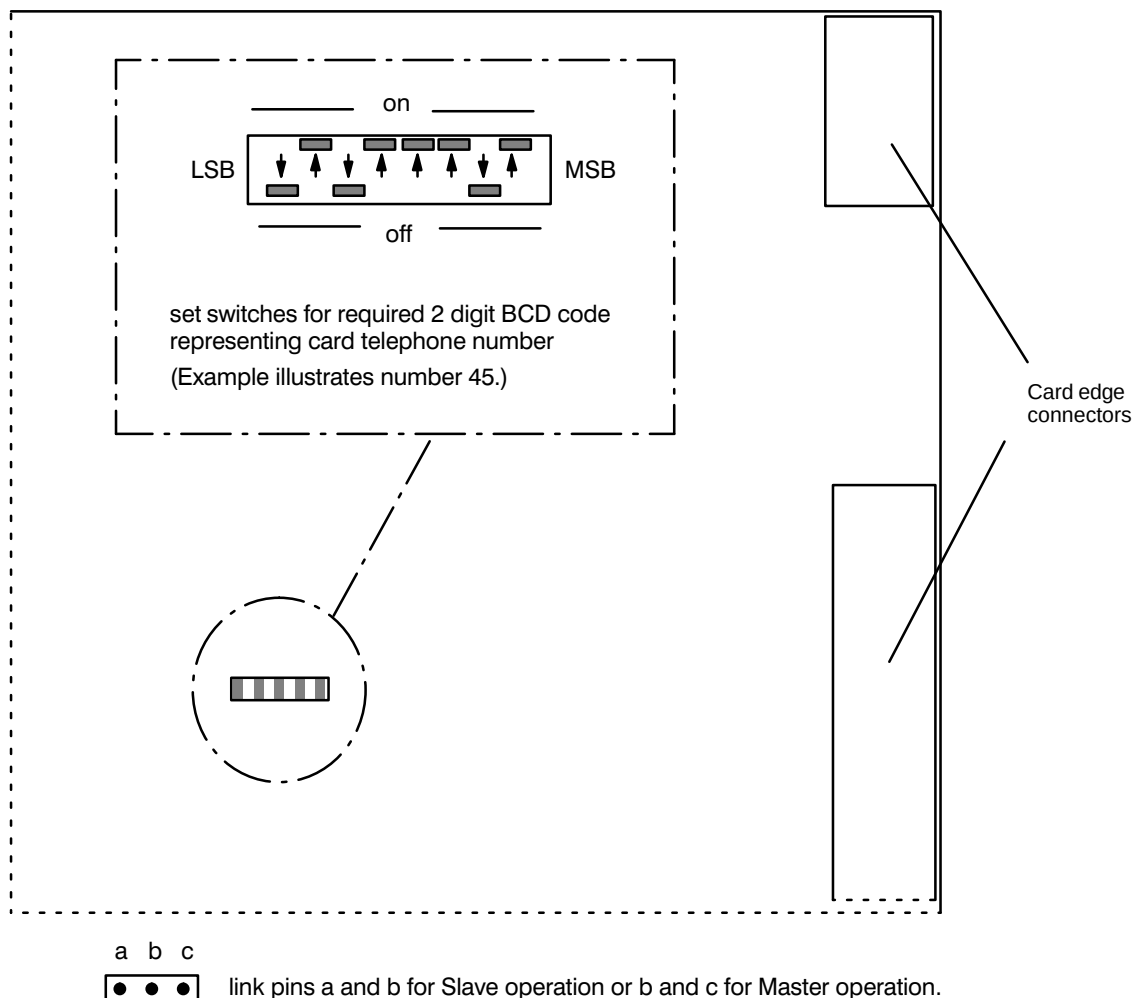


Figure 26.1 EOW Card Switches and Links

26.5.4 Auxiliary Card (V '0') 9.6kbit/s 1HAT60004 AAD

26.5.4.1 Link Settings

Table 26.12: 9.6kbit/s Auxiliary Card (Version 0.0) Link Settings		
Link	Default Setting	FunctionPosition
LK1 (1–3)	2–3	Loopback (1–2 enabled)
LK2 (1–3)	2–3	Clock status data (1–2 DTMX)
LK3 (1–3)	2–3	Clock changeover (1–2 DTMX)
LK4 (1–3)	2–3	Factory use (1–2 DTMX)
LK5 (1–3)	2–3	Factory use (1–2 unused)

26.5.5 Auxiliary Card (V 0.1) 64kbit/s 1HAT60647 ABA

26.5.5.1 DIL Switch Settings

Async and sync channels are configured separately. It is possible to have any combination of configurations. Default configurations will be loaded if DIL switches SW2–7, SW3–7, SW2–8 and SW3–8 are off. The following table shows the three configurations.

Table 26.13: Auxiliary Card (Version 0.1) Channel Configurations

	Config 1 (Default)	Config 2	Config 3
Line East	1	1 and 2	1, 2 and 3
Line West	1	1 and 2	1, 2 and 3
Tributary 1	1	1	–
Tributary 2	1	1	–
Tributary 3	1	–	–
Tributary 4	1	–	–

At power up the card is configured by loading data from the on-card EPROM. This configuration is selected by setting three DIL switches on the card according to the following table. For each switch, segments 1 to 6 are concerned with routing the OH-ASIC inputs, while segments 7 and 8 configure the unit for sync/async operation and loopback.

Note: Similarly numbered segments (from segment 1 to segment 6) of each switch combine to give octal values of 0 to 7.

26.5.5.2 DIL Switch Functions

Table 26.14 lists all the available switch options for SW1, SW2 and SW3. Figure 26.2 shows one particular example of the switch settings.

Table 26.14: DIL Switch Functions

Switch – Segment	Bit	Function
SW1–1 SW2–1 SW3–1	MSB LSB	All Off – 64kbit/s to connector 2. All On – Invalid. Octal value 1 to 6 – Inhibits connector 2 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
SW1–2 SW2–2 SW3–2	MSB LSB	All Off – 64kbit/s to connector 5. All On – Invalid. Octal value 1 to 6 – Inhibits connector 5 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
SW1–3 SW2–3 SW3–3	MSB LSB	All Off – 64kbit/s to connector 6. All On – Invalid. Octal value 1 to 6 – Inhibits connector 6 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
SW1–4 SW2–4 SW3–4	MSB LSB	All Off – 64kbit/s to connector 3. All On – Invalid. Octal value 1 to 6 – Inhibits connector 3 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
SW1–5 SW2–5 SW3–5	MSB LSB	All Off – 64kbit/s to connector 4. All On – Invalid. Octal value 1 to 6 – Inhibits connector 4 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
SW1–6 SW2–6 SW3–6	MSB LSB	All Off – 64kbit/s to connector 1. All On – Invalid. Octal value 1 to 6 – Inhibits connector 1 and re-connects the input internally to provide a one-way 64kbit/s OH by-pass connection.
The invalid code simulates a valid code and must not be used.		
SW1–7		Off – Normal.

Table 26.14:(Cont)DIL Switch Functions		
Switch – Segment	Bit	Function
SW1–8		Off – Normal. On – OH bus loopback. NOTE: Loopback is for out-of-service testing only. It MUST NOT BE USED on a live system.
SW2–7 SW3–7	MSB LSB	Both On (Binary 11) – No asynchronous configuration. 00 – Asynchronous channel configuration 1. 01 – Asynchronous channel configuration 2. 10 – Asynchronous channel configuration 3. See NO TAG for details.
SW2–8 SW3–8	MSB LSB	Both On (Binary 11) – No synchronous configuration. 00 – Synchronous channel configuration 1. 01 – Synchronous channel configuration 2. 10 – Synchronous channel configuration 3. See NO TAG for details.
The default setting for all the switches is Off.		

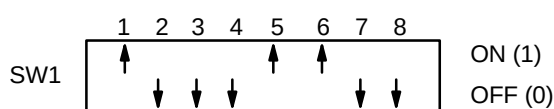


Figure 26.2 Example of DIL Switch Settings

In Figure 26.2 the switches are set to give the following configuration:

- In column 7 all switches are Off, which is the normal asynchronous channel configuration 1 (one OH byte per OH bus).
- In column 8 switch SW3 is On, giving the second synchronous channel configuration (two OH bytes each for Line East and Line West and one each for tribs 1 and 2).
- Columns 5 and 6 are set to 110 and 101 respectively to pass the first Line OH byte directly between East and West.
- Columns 1 and 4 are set to 100 and 001 respectively to pass the second Line OH byte directly to trib 1 and vice versa.
- Only the trib 2 and second Line East OH bytes, set to 000 in columns 2 and 3 respectively, appear on the front panel connectors.

Note: Since SW1–7 and SW1–8 are both Off, the loopback is not selected.

An OH by-pass should normally be bidirectional. This is provided by a pair of by-pass settings, see following table.

Value	By-pass Source
1	West channel 3 or Trib 1
2	East channel 3 or Trib 2
3	East channel 2 or Trib 3
4	West channel 2 or Trib 4
5	East channel 1
6	West channel 1

26.6 ENGINEERS ORDER WIRE (EOW)

Further details of EOW card link settings can be found in paragraph 26.5.3 and in the chapter on EOW.

26.7 TCM TRAFFIC CARDS

26.7.1 STM-1 Optical Mux Card (TCM) – (1HAT60791***)

Table 26.15: STM-1 (TCM) Optical Card Link Settings		
Link	Default Setting	Function
LK11	1–2	Clock: data phase at front panel monitor points. 1–2: clock falling edge in middle of data. 3–4: clock rising edge in middle of data.
LK14 (1–2)		Disable single fibre bi-directional operation when ASL enabled and link fitted.
LK14 (3–4)		Enable LOF term in dLOS equation if fitted.
LK15 (3–4)	3–4	Disable ALS if fitted.
LK18 (1–2)		Force ALS state machine into ALS if fitted.
LK18 (3–4)		Disable automatic restart attempts, if fitted.
LK19 (1–2)		Prevent the micro from disabling ALS, if fitted.
LK19 (3–4)		Disable micro controller restarts, if fitted.
LK20 (1–2)	As fitted	Tie down EPLD's CVAR2 input, if fitted.
LK20 (3–4)	As fitted	Tie down EPLD's CVAR1 input, if fitted.
LK1, 2, 6, 7, 10, 15 (1–2), 23	Not Fitted	These links are for factory test only.

26.7.2 STM-1 Electrical Card (TCM) – (1HAT60803ABT)

Table 26.16: STM-1 (TCM) Electrical Card Link Settings		
Link	Default Setting	Function
LK2 (1–2)	Not fitted (disabled)	EPLD tri-state
LK2(3–4)	Not fitted (enabled)	Watchdog timer
LK4 (1–2)	Not fitted (disabled)	Channel 1 line loopback
LK4 (3–4)	Not fitted	None
LK5 (1–2)	Fitted (3–4 not fitted)	Data select (front panel access)

Table 26.16:(Cont)STM–1 (TCM) Electrical Card Link Settings

Link	Default Setting	Function
LK5 (3–4)	Fitted (1–2 not fitted)	Data select (LTU access)
LK15(1–2)	Not fitted (disabled)	First time programming
LK15 (3–4)	Not fitted	None

26.7.3 STM–1 Dual Electrical Card (TCM) – (1HAT60918AAJ)

Table 26.17: STM–1 (TCM) Dual Electrical Card Link Settings

Link	Default Setting	Function
LK2 (1–2)	Not fitted (disabled)	EPLD tri-state
LK2(3–4)	Not fitted (enabled)	Watchdog timer
LK4 (1–2)	Not fitted (disabled)	Channel 1 line loopback
LK4 (3–4)	Not fitted (disabled)	Channel 2 line loopback
LK5 (1–2)	Fitted (3–4 not fitted)	Data select channel 1 (front panel access)
LK5 (3–4)	Fitted (1–2 not fitted)	Data select channel 1 (LTU access)
LK6 (1–2)	Fitted (3–4 not fitted)	Data select channel 2 (front panel access)
LK6 (3–4)	Fitted (1–2 not fitted)	Data select channel 2 (LTU access)
LK15 (1–2)	Not fitted (disabled)	First time programming
LK15 (3–4)	Not fitted	None

26.7.4 STM–1 Dual Optical Card (TCM) – (1HAT60878***)

Table 26.18: STM–1 (TCM) Dual Optical Card Link Settings

Link	Default Setting	Function
LK1 (1–2)	Not fitted (disabled)	First time programming
LK3 (1–2)	Fitted (disabled)	Bi-directional operation (channel 2)
LK3 (3–4)	Not fitted (disabled)	Enable LOF term in LOS (channel 2)
LK4 (1–2)	Not fitted (disabled)	Laser disable (channel 2)
LK4 (3–4)	Fitted (enabled)	Automatic laser restart (channel 2)
LK5 (1–2)	Fitted (enabled)	Disable micro ALS control (channel 2)
LK5 (3–4)	Fitted (disabled)	Micro controlled restart disable (channel 2)
LK11 (1–2)	Fitted	Card variant (L1.2 (1550nm) AEM,AFE,AGN)
LK11 (1–2)	Not fitted	Card variant (L1.1 (1300nm) ABK, ACC, ADU)
LK14 (1–2)	Fitted (disabled)	Bi-directional operation (channel 1)
LK14 (3–4)	Not fitted (disabled)	Enable LOF term in LOS (channel 1)
LK15 (1–2)	Fitted (disabled) and LK19(1–2) fitted	ALS override (channel 2)
LK15 (3–4)	Fitted (disabled) and LK5 (1–2) fitted	ALS override (channel 1)
LK18 (1–2)	Not fitted (disabled)	Laser disable (channel 1)
LK18 (3–4)	Fitted (enabled)	Automatic laser restart (channel 1)
LK19 (1–2)	Fitted (enabled)	Disable micro ALS control (channel 1)
LK19 (3–4)	Fitted (disabled)	Micro controlled restart disable (channel 1)

26.7.5 Optical Module (1HAT60874AAK)

Table 26.19: Optical Module Link Functions

Link	Function
LK1 (1,3)	Laser power monitor (PWR_MON) set-up point
LK1 (2,4)	Laser power monitor (PWR_MON) monitor point
LK1 (5,4)	Laser driver average optical power monitor point
LK1 (6,4)	Laser driver modulation current monitor point
LK1 (5,4)	Laser driver bias current monitor point
LK1 (8...10)	E ² POTI ² C Bus

26.8 SMA–1/4C ENHANCED ANCILLARY LTU (1HAM61039ABY)

Table 26.20: SMA1/4c Enhanced Ancillary LTU Switch Settings

Switch	Default Position		Use
	1–4	2–3	
S100	Closed		2M TEST Output Unbalanced to Ground
S200 and S400	Open		Input not grounded (CLOSED=Input to Ground)
		Closed	Input resistance 75ohm (OPEN=Input High Impedance)
S201 and S401	Open		75ohm signal not connected to output (CLOSED=75ohm signal connected to output)
		Closed	120ohm signal connected to output (OPEN=120ohm signal not connected to output)
S202 and S402	–		Not connected
		Closed	Input resistance 120ohm (OPEN=Input High Impedance)
S500	Open		SYNC out 75ohm with potential (~1.5V)
		Closed	SYNC out unbalanced to Ground
S600	–		X11/1 not connected
		Closed	X11/1 at 0V

26.9 SFW VARIANT LINK SETTINGS

Note: These link settings concern the card variants for SFW and have nothing to do with ALS.

26.9.1 STM–1 Variant Link Settings

Table 26.21: SFW Default Link Settings (STM–1)

Link	L1.1 (SFW)	L1.2 (RED)	L1.2 (BLUE)
------	------------	------------	-------------

	Variant	Connector	Variant	Connector	Variant	Connector
	APY ARJ AQR	FC/PC DIN SC	AHU AJM AKE	FC/PC DIN SC	ALW AMP ANG	FC/PC DIN SC
LK2 (1–2)	1–2		No Fit		No Fit	
LK3 (1–2)	No Fit		1–2		1–2	

26.9.2 STM–4 Variant Link Settings

Table 26.22: SFW Default Link Settings (STM–4)										
Link	L4.2 (RED)		L4.2(BLUE)		L4.2 (SFW)		L4.2+(RED)		L4.2+(BLUE)	
	ASK AUU ATC	FC/PC DIN SC	AVM AXW AWE	FC/PC DIN SC	BEX BFQ BGH	FC/PC DIN SC	AYP BAD AZQ	FC/PC DIN SC	BBV BDF BCN	FC/PC DIN SC
LK 3 (3–4)	3–4		3–4		3–4		No Fit		No Fit	
LK3 (5–6)	5–6		5–6		5–6		5–6		5–6	
LK 3(7–8)	No Fit		No Fit		7–8		No Fit		No Fit	

26.10 SFW VARIANT LINK SETTINGS

26.10.1 STM–1 ALS

Table 26.23: Link Settings to Enable/Disable ALS for STM–1			
	ALS Disabled	Uni–Direct ALS Enabled	Bi–Direct ALS Enabled
ALS Link	Link 13 Fitted(1–2)	Link 13 Not Fitted	Link 13 Not Fitted
BIDIR Link	Link 14 Fitted(1–2)	Link 14 Fitted(1–2)	Link 14 Not Fitted

26.10.2 STM–4 ALS

Table 26.24: Link Settings to Enable/Disable ALS for STM–4			
	ALS Disabled	Uni–Direct ALS Enabled	Bi–Direct ALS Enabled
ALS Link	Link 6 Fitted(2–4)	Link 6 Not Fitted	Link 6 Not Fitted
BIDIR Link	Link 6 Fitted(1–3)	Link 6 Fitted(1–3)	Link 6 Not Fitted

26.10.3 34MBit/s and 45MBit/s Expansion Units

There are two links on each of these units, both associated with the microcontroller.

Link FLASH_FTP is normally open but when closed enables the FLASH monitor program within the boot PROM. This allows the FLASH memory device to be programmed via control bus 'B' at 19.2Kbaud/s.

Link TEST is included so that any test routines contained within the unit firmware (not the boot Prom) may be initiated at power-up. The “TEST” link is normally open.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 27: POWER SUPPLY OPTIONS

27.1 SMA–1/4CP

27.1.1 General Information

The SDH SMA–1/4CP product variants are powered from –48V Nominal.

For applications where battery back-up is not required, an external mains 45W PSU is supported, capable of powering any of the base unit variants with or without an Expansion unit. See Figure 27.1.

Note: This is based on a maximum base unit power consumption of 21W and a maximum expansion module power consumption of 21W (leaving 3W margin).

Battery Back-Up Not Supported

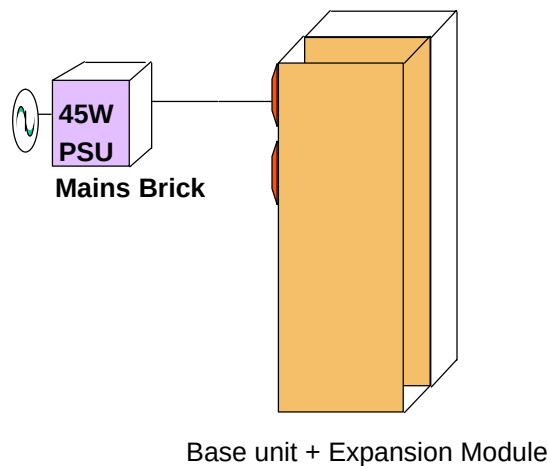


Figure 27.1 SMA–1/4CP Powered from External Mains Brick

For applications where battery back-up is required, two options are required depending on the unit configuration:

- A low cost battery back-up solution for 4x2M SMA–1/4CP with or without the 8x2M expansion module is required. This is achieved by providing an external 'Battery box' to support the batteries and their monitoring circuitry.
- The battery box is used in conjunction with the mains external brick, whereby both power feeds are utilised on the SMA–1/4CP. See Figure 27.2.

Note: The battery box solution may also be used for the 16x2M base unit with/without Passive 2M expansion module or the 8x2M + 34M base unit only and shall support a standby time similar to the 4x2M with the Passive2M expansion module (approximately 3hrs minimum).

The mains brick and the battery box are upgraded by a 'Power Module' for applications where battery back-up is required when higher power expansion modules (i.e. ATX, 16x2M) are supported or when a minimum standby time of 5hrs is required for all configurations. The Power Module incorporates the PSU, the batteries and the battery monitoring circuitry. See Figure 27.3.

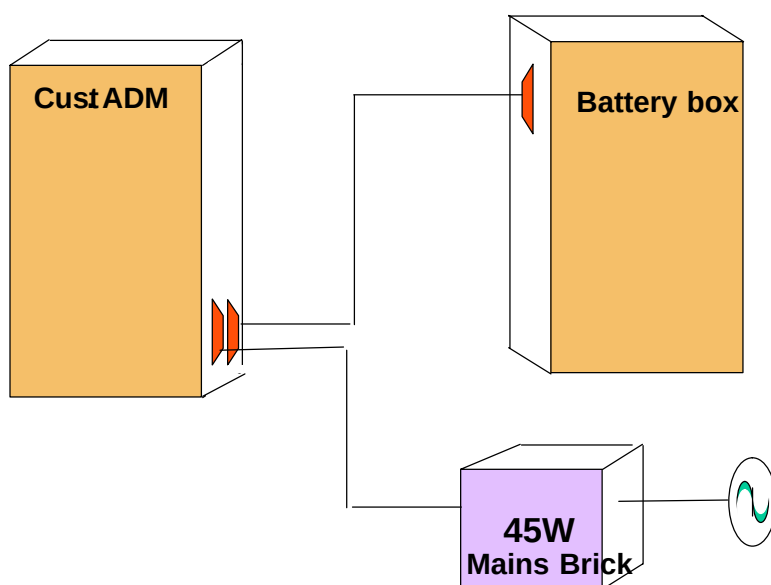


Figure 27.2 Battery Box Utilised with Mains Brick to Support Battery Back-up

Battery Back-Up Supported Via a Power Module for SMA-1/4CP + Expansion Module

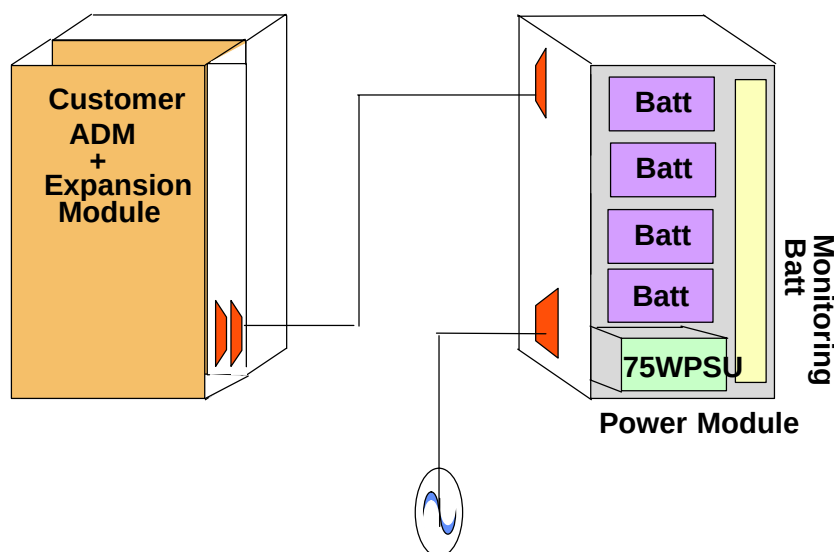


Figure 27.3 Power Module to Support Battery Back-Up with ATX/16x2M Expansion Module

27.1.2 PSU

As seen in Figure 27.1 and Figure 27.2, two types of mains PSU are required depending on the unit configuration:

1. An External in-line '45'W mains power brick is used to power the SMA-1/4CP in the following configurations:

- 4x2M base with/without Passive 2M/ETX/34M (with battery back-up)
- 4x2M base with/without ATX/16x2M/STM-1 (no battery back-up)
- 16x2M base with/without Passive 2M/34M (with battery back-up)
- 16x2M base with/without ATX/16x2M/STM-1 (no battery back-up)
- 8x2M + 1x34M base only (with battery back-up)
- 8x2M + 1x34M base with/without Passive 2M/ETX/ATX/16x2M/STM-1 (no battery back-up)

Note: As long as the total consumption (base + expansion module) is less than 29W, then they can be battery backed with the 45W mains brick.

Where applicable, this PSU is also capable of recharging the batteries (within the battery box) to 80% full charge within 12hrs.

2. The PSU utilised within the Power Module is an open frame 75W PSU capable of powering both the SMA-1/4CP and any of the expansion modules, and able to recharge the batteries to 80% full charge level within 12 hours.

A Mains input fail detection is provided on the PSU. On detection of a mains fail, a 'Mains input fail' alarm is reported to the SMA-1/4CP microprocessor via a dedicated pin on the power connector. See Figure 27.4.

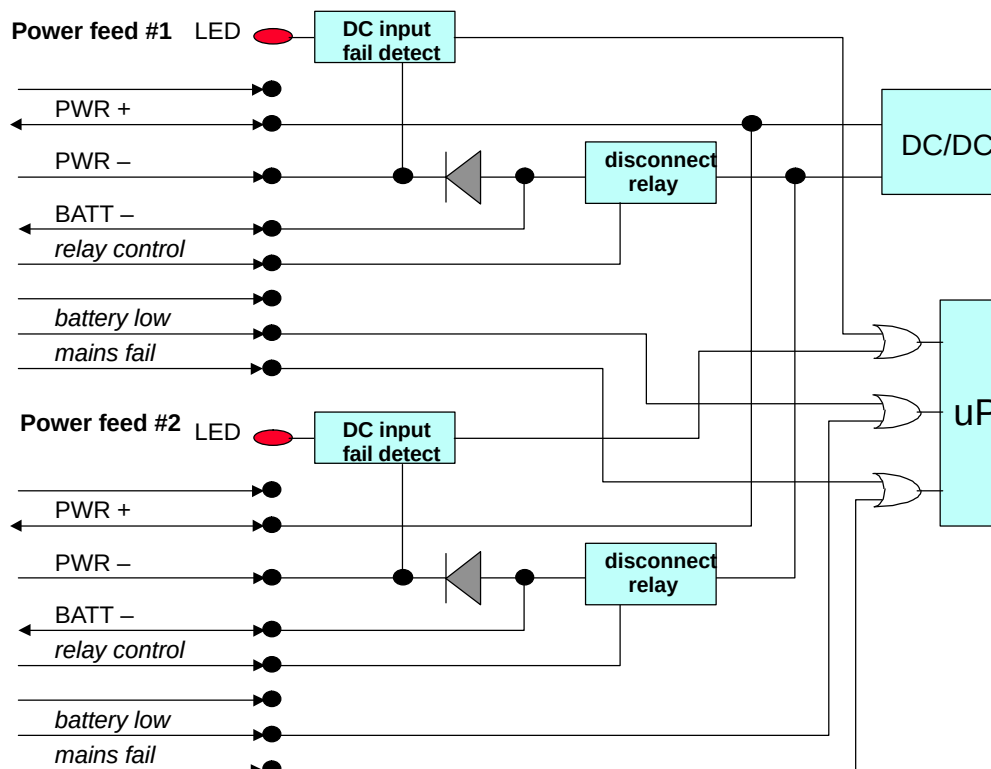


Figure 27.4 SMA-1/4CP Power Interface

27.1.3 Signal Descriptions

PWR+ (Input/Output): Positive side of DC supply, normally connected to 0V. Also used as positive connection to battery backup. N.B. This signal is common to both power connectors.

PWR- (Input): Negative side of DC supply, normally connected to -48V. A DC input fail alarm will be raised and the LED next to the relevant power connector will be turned off if a DC supply falls below 40V. In the event of either of the DC inputs failing, a single 'DC input fail' alarm will be reported to the microprocessor.

BATT- (Input/Output): Negative connection to the battery backup.

Relay Control (Input): In order to avoid energy hazards the negative power pins (PWR- and BATT-) will be disconnected when not in use (i.e. no power connected). The "Relay control" pin is used to signal that a power connector is in use and that the relevant disconnect relay can be closed. To close the disconnect relay, "PWR+" must be connected to "Relay control" and a DC supply connected to the power pins (PWR+ and PWR-). Hence a connection between "PWR+" and "Relay control" should be provided in the power connector so that the relay closes when the power is connected.

Mains fail (Input): This alarm signals that the mains input to the external PSU has failed. An active "Mains Fail" alarm on power feed#1 'OR' on power feed#2 will cause the alarm to be reported.

Battery Low (Input): This alarm signals that the battery voltage is low and warns the user, approximately 30min (minimum) prior to the battery disconnect relay disconnecting the supply. An active 'battery low' alarm on power feed#1 'OR' on power feed#2 will cause the battery low alarm to be reported.

Note: The 'Mains Fail' and 'Battery low' signal active state shall be connected to 'PWR+'. The idle state of the inputs is disconnected.

27.1.4 Battery

Optional battery back-up is provided to allow the equipment to function in the event of a mains failure. The batteries provide enough energy to power the fully equipped unit for a minimum of 5hours. This is achieved when operating under nominal operating temperature (25°C).

Following a mains failure and discharge of batteries, the batteries are recharged to 80% full charge level within 12 hours and fully charged within 15hours.

27.1.4.1 Battery Box

Four 2.3Ah batteries are supported within the battery box. There are no LEDs on this box. The SMA-1/4CP is connected to the battery box via a D type on the battery box front panel.

The batteries are charged from the external mains brick via the power connector supported on the SMA-1/4CP.

The batteries are field replaceable, however, there is no side access into the box. The batteries will be replaced by removing the top cover.

Note: When the battery box is wall mounted, the unit will have to be dismounted from the wall before the batteries can be replaced. This is because the screws for the enclosure are at the rear of the unit.

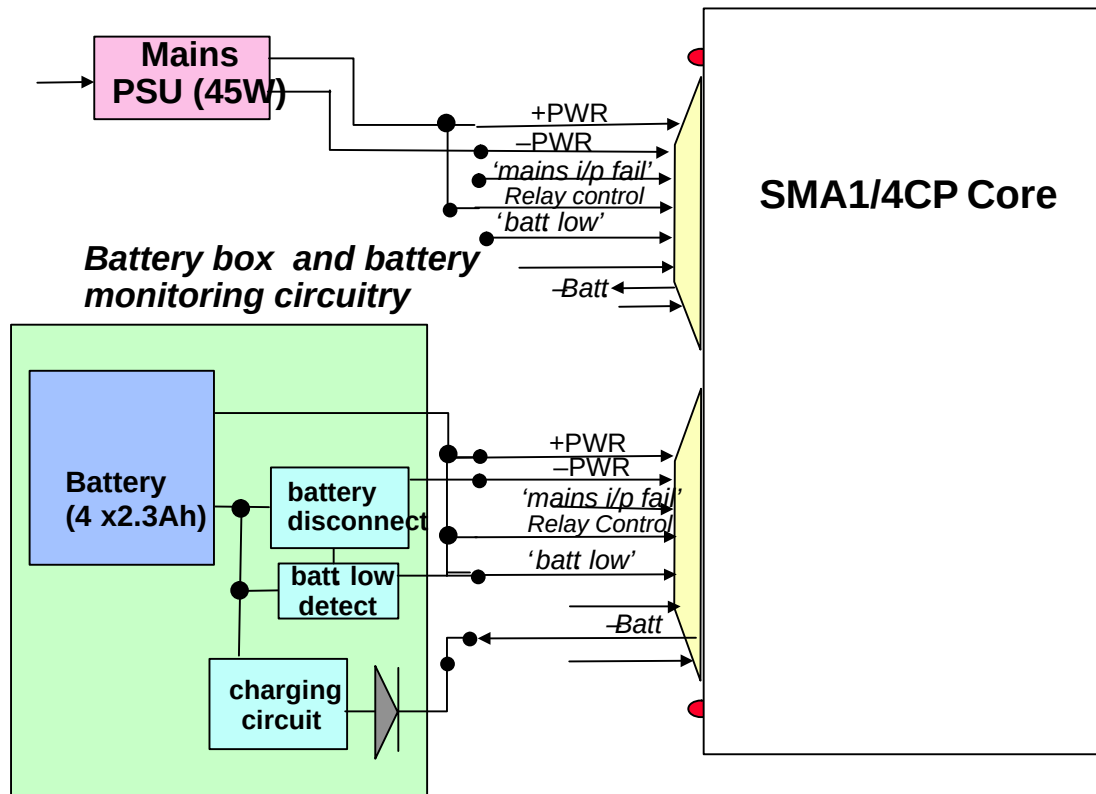


Figure 27.5 Battery Box Connection to SMA-1/4CP

27.1.5 Power Module

Four 7Ah batteries are supported within the Power Module. They are capable of providing a minimum of 5hrs standby time for all unit configurations.

The open frame mains PSU is supported within the box and hence the batteries are charged internally from the PSU. The dedicated 'battery charging' pins used by the battery box to charge the batteries are not utilised when the Power Module is connected up.

The batteries are in-service field replaceable, hence it should be possible to remove the batteries in all mounting orientations.

In order to allow the upgrade process to be achieved rapidly, a battery test facility is included within the Power Module. This consists of a push button/switch and a green LED. When the button is pushed, the Green LED illuminates only if the batteries are fully charged.

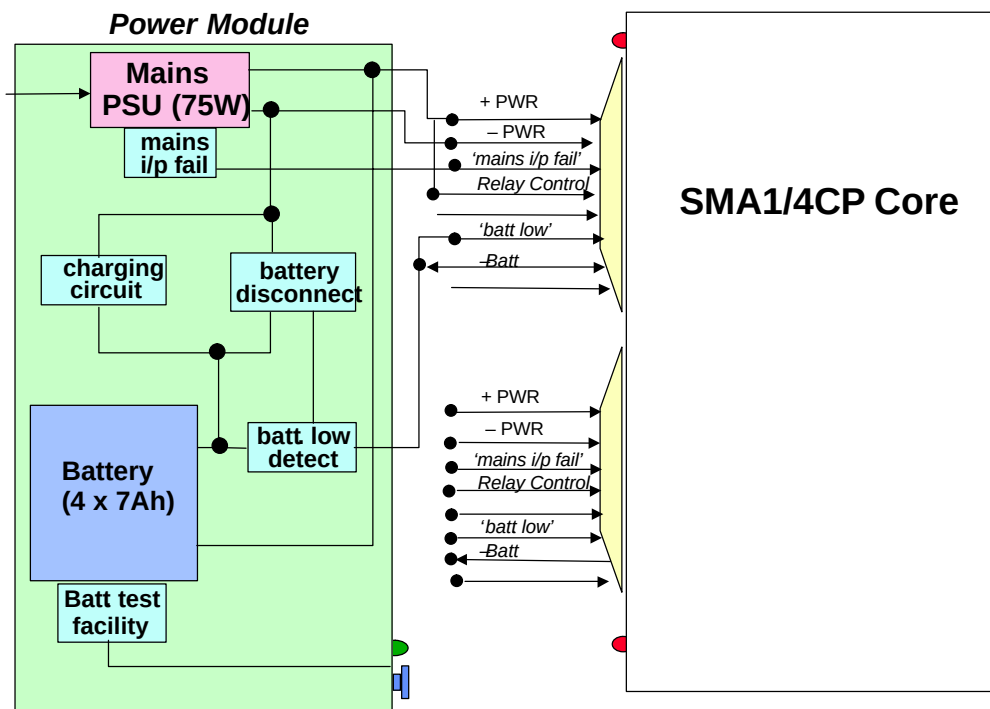


Figure 27.6 Power Module Connection to SMA-1/4CP

27.1.6 Dual power feeds

Dual Power feeds are supported on all SMA-1/4CP base units via two distinct connectors.

An advantage of supporting dual feeds is that it not only provides the option to ensure in-service upgrade of the mains brick to the Power Module without affecting traffic, but it also provides the option for supporting protected supplies, increasing the mains brick capacity by load sharing and in the case of battery back-up for SMA-1/4CP only applications, in-service upgrade to the Battery Box.

27.1.7 Installation requirement

In the event of a suitable second power source not being available, then before the upgrade from battery box to power module is carried out, the installers must ensure that the batteries within the Power Module are fully charged. This can be achieved rapidly with minimum effort by utilising the battery test button provided on the Power Module which shall cause the green LED to illuminate if the batteries are fully charged.

During the upgrade from battery box to power module, the battery box must first be replaced with the Power Module which should be running off its batteries. The mains brick must then be removed and the Power Module mains connection must be connected up. This causes the output from the Power Module to revert back to the PSU.

The Power feed connector is a 9 way D type FEMALE, which supports 'mains input fail' and 'battery low' alarms reporting to the SMA-1/4CP.

Note: A 'Power Shutdown' facility is not supported.

27.1.8 BATTERY BACK UP TIME

Power consumption:

1. Base unit

- 4x2M
=21W
- 16x2M
=20W
- 8x2M + 1x34M
=27.6W

2. Expansion Module

- 34M ATX
=TBD
- STM-1 ATX
=TBD
- 34M
=7W
- 8x2M passive
=8W
- 10M ETX
=9W
- STM-1
=10W
- 16x2M
=12W

3. Mains Brick = 45W (capable of 51W)

- => Requires 15.4W to charge batteries, thus leaving 29.6W total power for the base unit and the Expansion Module (leaving 35.6W if run at 51W).

Table 27.1: Indicative Battery Back-Up Times for Battery Back-Up Solution + Mains Brick

Configuration	Power Consumption	Back-up time (45W)	Back-up time (51W)
4x2M base unit only	20.7W	4hrs	4hrs
4x2M base + Passive 2M	28.7W	3hrs	3hrs
4x2M base + 34M exp.mod	27.7W	3hrs	3hrs
4x2M base + ETX	29.7	2.8hrs	2.8hrs

4x2M base + STM–1 exp.mod	30.7	2.5hrs–	2.7hrs
4x2M base + 16x2M exp. Mod	32.7	2hrs–	2.5hrs
16x2M base only*	20W	4hrs	4hrs

Note: * the 16x2M base unit configurations that shall be battery backed–up shall be similar to the 4x2M base unit configurations.

Power Module PSU=75W

- => Requires 43.5W to charge batteries, thus allowing a total power of 31.5W for the base unit and the Expansion Module.

Table 27.2: Indicative Battery Back–up Times for Power Module Solution with Internal Mains PSU (75W)

Configuration	Back–up Time
4x2M base unit only	14hrs
4x2M base + Passive 2M/ ETX	10.3hrs
4x2M base + 34M exp. mod	10.7hrs
4x2M base + 16x2M exp. mod	–
16x2M base only*	14hrs

Note: * the 16x2M base unit configurations that shall be battery backed–up shall be similar to the 4x2M base unit configurations.

27.2 SMA–1/4C and /UC

The SMA–1/4c/uc is powered from –48V Nominal. When used in a customer's premises a battery backup solution may be required and this is provided by an external unit.

27.2.1 Station 48V

Within a station environment the SMA–1/4c/uc will normally be connected to the protected station supplies.

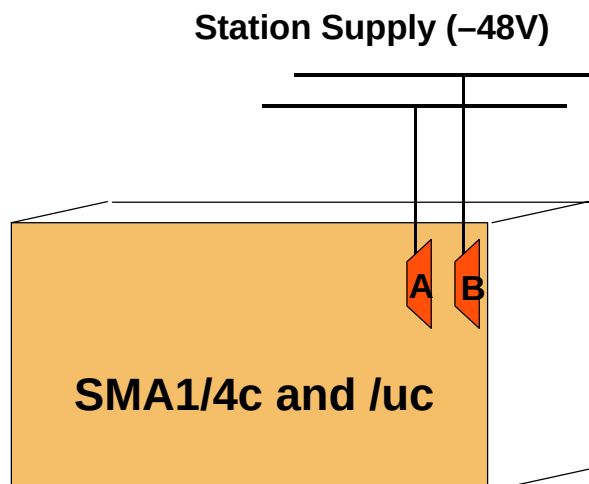


Figure 27.7 SMA-1/4c/uc with Station Supplying -48V

27.2.2 Mains Supply

In customer premises the SMA-1/4c/uc may be powered from an external mains supply which provides a regulated output at -48V nominal. Both single and duplicated mains PSUs can be supported. See Figure 27.8 and Figure 27.9.

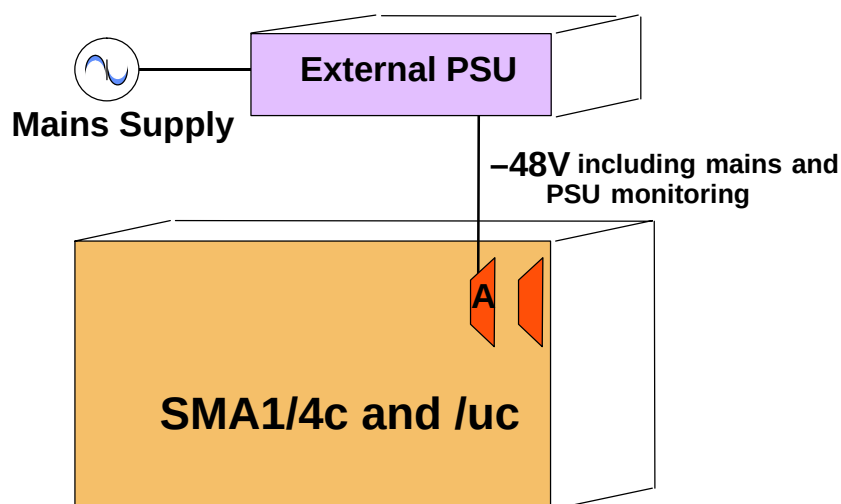


Figure 27.8 SMA-1/4c/uc with Single External Mains PSU

When dual supplies are used there are two sets of mains and PSU monitoring alarms from the A and B power interfaces on the SMA-1/4c/uc.

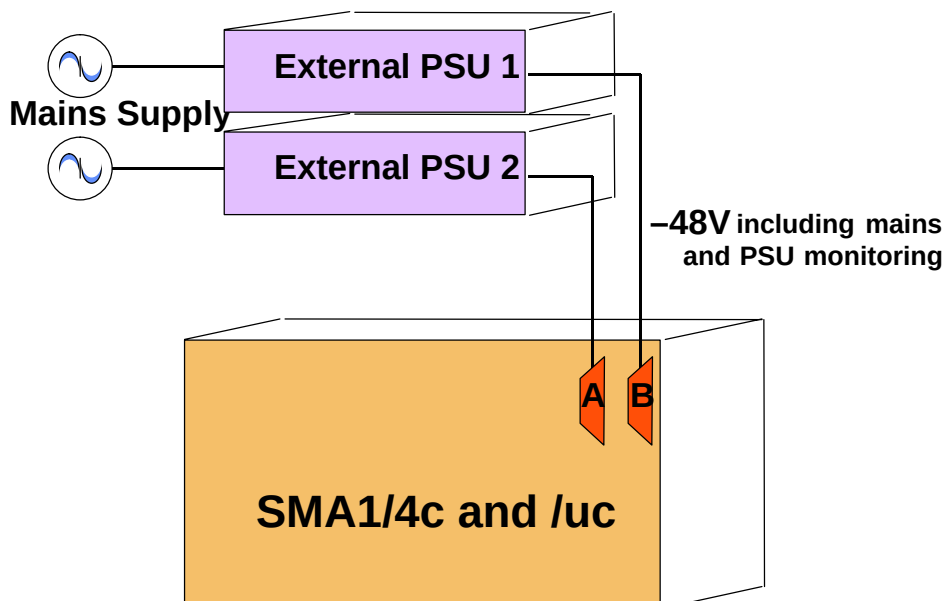


Figure 27.9 SMA-1/4c/uc with Dual External Mains PSU

27.2.3 PSU Alarms

A Mains input fail detection is provided on the PSU. On detection of a mains fail, a 'Mains input fail' alarm is reported to the SMA-1/4c via a dedicated pin on the power connector.

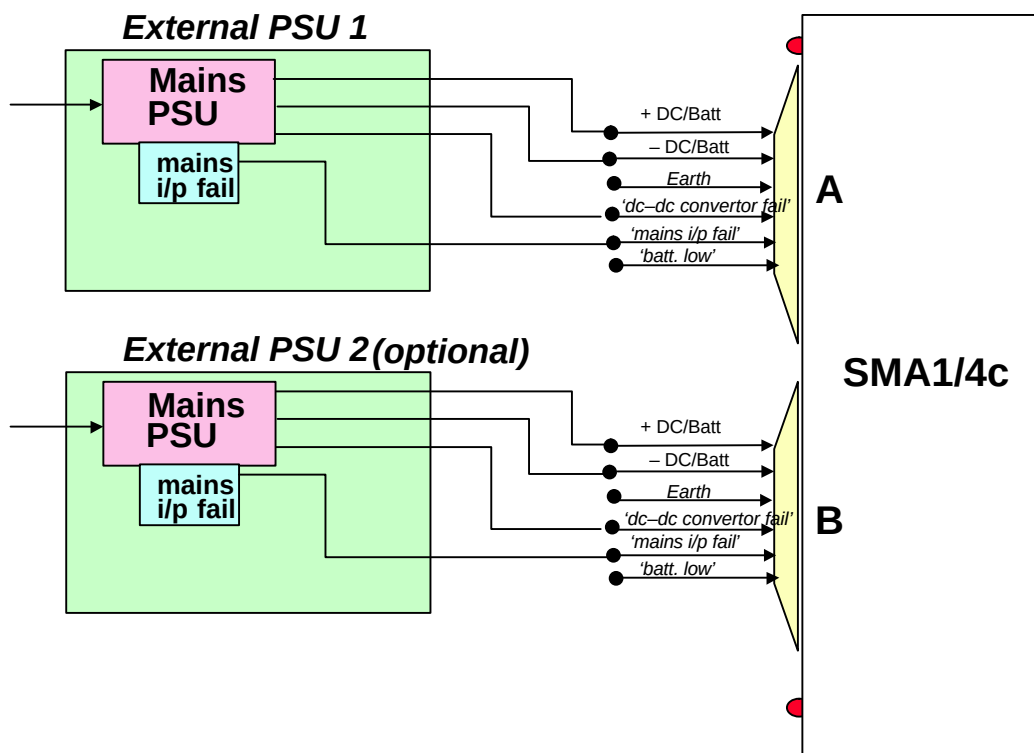


Figure 27.10 External PSU for SMA-1/4c

27.2.4 Battery Backup Solutions

The mains PSUs can be upgraded by a 'Power Module' for applications where battery back-up is required. The Power Module incorporates the PSU, the batteries and the battery monitoring circuitry. SMA-1/4c supports two sets of mains, battery and PSU monitoring alarms from the A and B power interfaces, but in this configuration only one is used.

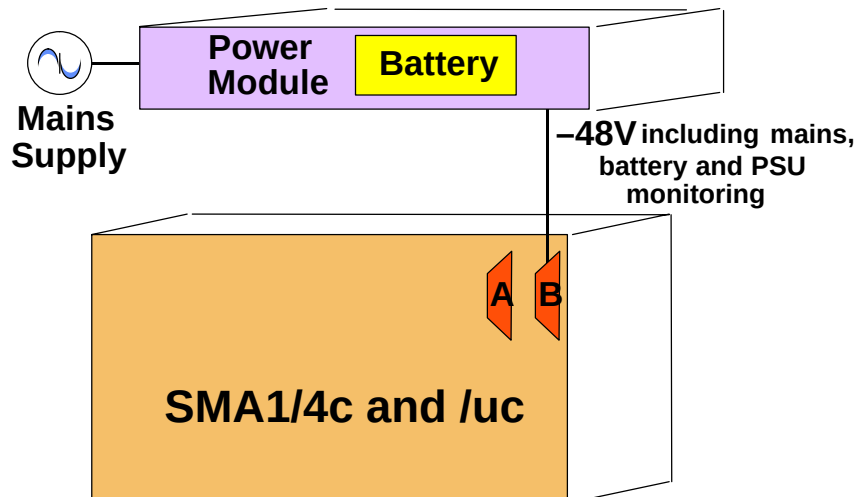


Figure 27.11 SMA-1/4c/uc with External Mains PSU and Battery Backup

27.2.5 Power Module with Battery Backup

A rack mounting Power Module is used to provide a mains/battery power solution for customer premises. The PSU is capable of powering a fully loaded shelf and is able to recharge the batteries to 80% full charge level within 12 hours.

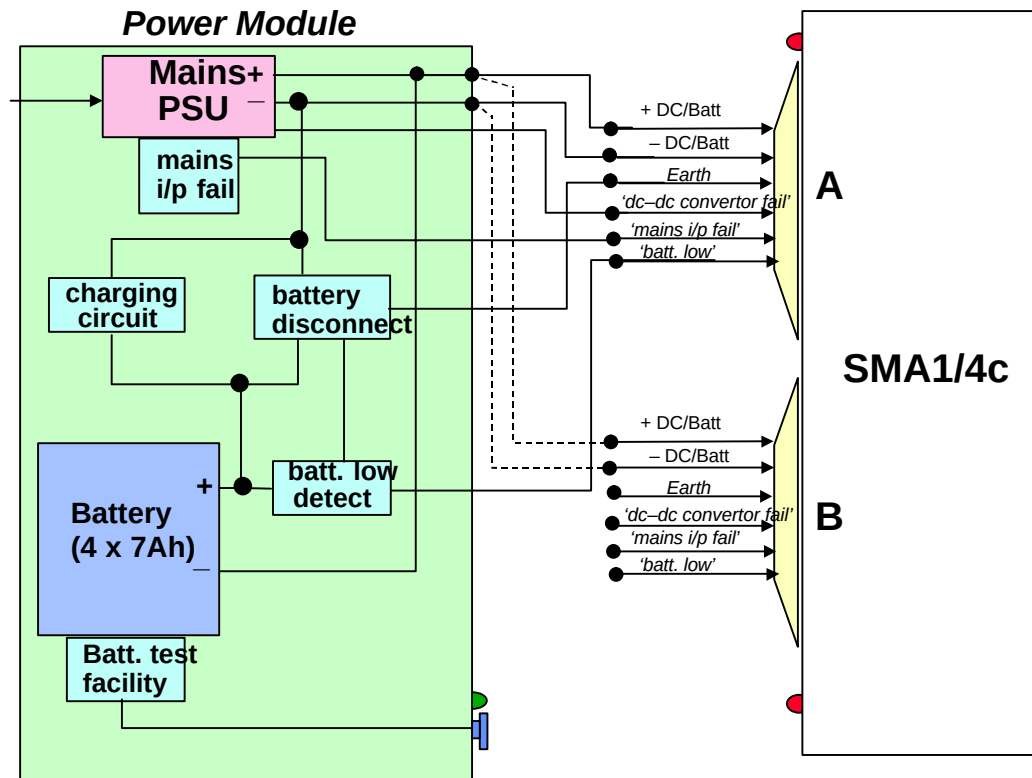


Figure 27.12 Mains Power Module with Battery Backup for SMA-1/4c

27.2.6 PSU Alarms

A Mains input fail detection is provided on the PSU. On detection of a mains fail, a 'Mains input fail' alarm is reported to the SMA-1/4c/uc via a dedicated pin on the power connector.

An AC-DC Convertor Failure is detected on the PSU and signalled to the SMA-1/4c/uc via the power interface. This allows the operator to distinguish between a mains failure and PSU failure.

Battery low – The Battery low detection is supported to provide adequate warning (approximately 30 minutes) before the battery disconnect circuitry kicks in. A 'Battery Low' alarm is reported to the SMA via dedicated pins on the Power connector.

27.2.7 Battery Requirement

Optional battery back-up is provided to allow the SMA-1/4c/uc to function in the event of a mains failure. The batteries provide enough energy to power the shelf for a minimum of 5 hours. This is achieved when operating under nominal operating temperatures (25°C).

Following a mains failure and discharge of batteries, the batteries are recharged to 80% full charge level within 12 hours and are fully charged within 15 hours.

The battery design allows for the batteries to be easily replaced via an in-service upgrade that can be carried out without disruption to traffic. It also allows the upgrade to be achieved rapidly by personnel with minimal training and ensures it does not introduce any safety hazards, or risk of damage to the equipment.

Battery Disconnect – When the battery voltage drops to a level such that further discharge would damage the batteries, the battery disconnect circuitry disconnects the battery output to the SMA.

27.2.8 Battery/Mains Monitoring

The SMA–1/4c/uc can have 4 fault conditions associated with each power interface.

27.2.9 DC Input Fail Alarm

This alarm determines if a –48V DC supply has failed. Seperate 'DC Input Fail' alarms are reported for power feed A and power feed B. A green LED on the Ancillary LTU that contains the power connectors is lit when no alarm condition is present.

Note: This alarm is not supported by SMA–1/4c and SMA-1/4uc.

27.2.10 Battery Low Alarm

This alarm signals that the battery voltage is low and warns the user, approximately 30 minutes prior to the battery disconnect relay disconnecting the supply. Seperate 'Battery Low' alarms are reported for power feed A and power feed B.

Note: This alarm is not supported by SMA–1/4c and SMA-1/4uc.

27.2.11 Mains Input Fail Alarm

This alarm signals that the PSU input has failed. Seperate 'Mains Input Fail' alarms are reported for power feed A and power feed B.

Note: This alarm is not supported by SMA–1/4c and SMA-1/4uc.

27.2.12 Power Connector

There are two power connectors supported by the Ancillary LTU. Each connector supports: +Pwr, –Pwr, Earth and 3 alarm input signals. The alarm signal active state exists when the inputs are connected to +Pwr. The alarm in-active (off) state is when the inputs are disconnected.

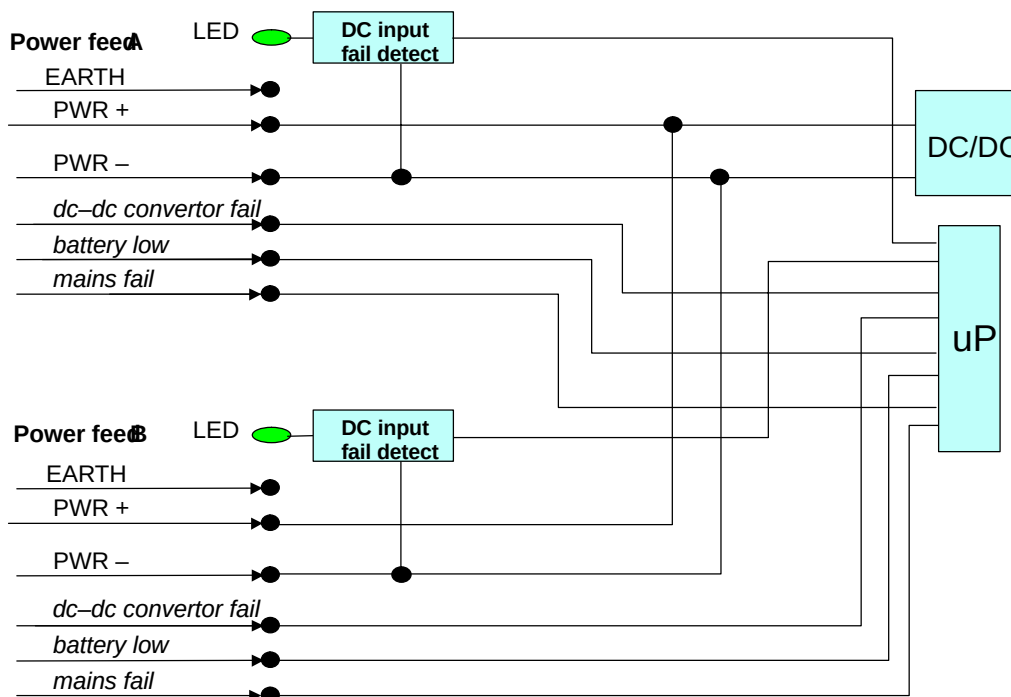


Figure 27.13 Battery/Mains Monitoring on SMA-1/4c

27.2.13 Shelf Loading

There are two standard configurations for the SMA-1/4c and the mains PSU and Battery solutions are designed accordingly. The Full Shelf configuration provides up to 4 tributary slots, duplicated Core cards and shelf DC/DC units. The Protected CPE configuration provides a Customer's Premises Equipment (CPE) solution with protected Core traffic.

27.2.14 Maximum Loading – Full Shelf

Maximum configuration is:

- 2x Core cards
- 4x Tributary card
- 2x Ancillary LTUs
- 8x Tributary Traffic LTUs
- 1x Core Traffic LTU
- 1x Comms/Controller card

The maximum loading of the shelf in this configuration is 150W.

27.2.15 Maximum Loading – Protected CPE

Maximum configuration is:

- 2x Core cards

- 1x Ancillary LTUs (PSU, LCT, Sync Out, AUX, User I/O)
- 1x Core Traffic LTU
- 1x Comms/Controller card

The maximum loading of the shelf in this configuration is 50W.

27.2.16 Dual Power Feeds

Dual Power feeds are supported on the SMA–1/4c. Alarm inputs are reported via the power connector.

The SMA–1/4CP PSU solutions are not be used to power the SMA–1/4c.

27.3 SMA–1/4

The SMA–1/4 is powered from –48V Nominal.

27.3.1 Station 48V

Within a station environment the SMA–1/4 will normally be connected to the protected station supplies.

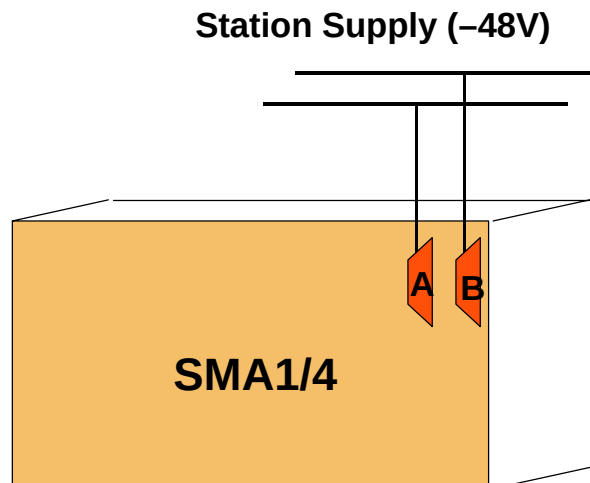


Figure 27.14 SMA–1/4 with Station Supplying –48V

27.3.2 PSU Alarms

Monitoring of the –48V DC supply is performed by the Comms/Controller card. A green LED on the Power LTUs is lit when no alarm condition is present.

27.3.3 Power Connector

There are two power connectors supported by the Power LTU. Each connector supports: +Pwr, –Pwr and Earth input signals.

27.3.4 Shelf Loading

The maximum load of the SMA–1/4(4+4) shelf is 300W.

The maximum load of the SMA–1/4(8) shelf is 300W.

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CHAPTER 28: INSTALLATION: SMA–1/4CP

28.1 SMA–1/4CP BASE UNITS

SMA–1/4CP is designed for use in customer premises and can be wall, desk or rack mounted. It consists of a Base Unit, which supports the multiplexer functionality and delivers a range of traffic interfaces, and an optional Expansion Module, which provides additional traffic interfaces. X21 and 2Mbit/s interfaces are supported as standard, with other interfaces supported via the Expansion Module options.

The range of SMA–1/4 base units is contained in Table 28.1.

Table 28.1: SMA–1/4CP Base Units		
Hardware Code	Name	Comments
1HAN60509AAK	4 x 2 (X.21) Base Unit	
1HAN60510AAF	Balanced 16x2 Base Unit	
1HAN60511AAH	Unbalanced 16x2 Base Unit	
1MBB61176AAA	Mounting Kit	For use with all base unit variants

28.2 SMA–1/4CP INSTALLATION KIT

There are various items of kit required to install an SMA–1/4CP unit. These items are contained in Table 28.2. Note that there are separate items of kit depending on whether the SMA–1/4CP is to be wall or rack mounted.

Table 28.2: SMA–1/4CP Installation Kit		
Hardware Code	Name	Comments
1MBB61297AAP	Fibre Management Tray Kit of Parts	Includes cover
1MBB61105ABJ	Wall Mounting Kit	
1MBB61101AAH	Mains In–Line Unit Mounting KOP	
1HAM60957AAV	Mains In–Line Unit	
1HAU61926AAC/ABU/ACM/ADE	Mains In–Line Unit Mains Leads	UK/Europe/Australia/US options
1HAG60601AAC	Mains and Battery Unit	
1HAU61927ABW	Mains/Battery Unit Power Connector	
1MBB61048AAC	Mains/Battery Unit Mounting KOP	
1HAU61844AAW/ABP/ACG/ADY	Mains/Battery Unit Mains Leads	UK/Europe/Australia/US options
1MBB61085AAG	Battery Pack	
1MBB61088ABF	Rack Mounting Kit	
1HAM61048AAU	Fan Module	See Section 28.10.11

28.3 SMA-1/4CP POWER SUPPLY

Details of the SMA-1/4CP power supply arrangements and installation requirements are contained in the chapter on Power Supply Units. The installation requirements should be studied carefully before setting up the power supply.

28.4 SMA-1/4CP EXPANSION MODULES

Expansion Modules may be equipped during product installation, or as a later upgrade to provide additional services. Upgrade is easily accomplished by simply clipping on the Expansion Module, as illustrated in Figure 28.1 and Figure 28.2, and this does not affect traffic.

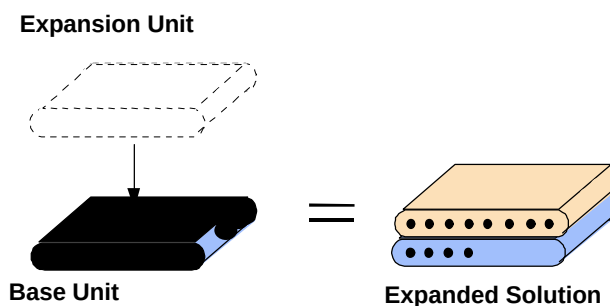


Figure 28.1 SMA-1/4CP Expansion

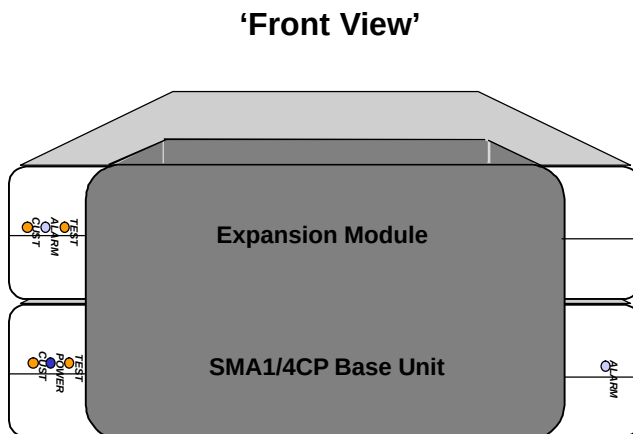


Figure 28.2 Front View of SMA-1/4CP with Expansion Module

Expansion modules are similar in style to the base ADM unit. The two units are slotted together to create the new configuration. Power and optical line interface and management functions are supported from the base unit, making the upgrade process straightforward.

A range of expansion modules are supported by SMA-1/4CP including those detailed in the following table:

Note: The expansion module can be added or replaced with the core unit in service.

Table 28.3: SMA-1/4CP Expansion Modules		
Hardware Code	Name	Comments
1HAN60514AAP	34Mbit/s Expansion Module	
1HAN60515AAR	45Mbit/s Expansion Module	
1HAN60516AAT	STM-1 Electrical Expansion Module	
1HAN60517AAV	STM-1 Optical Expansion Module	
1HAG60566AAX	Extender II 8x2 x.21 Expansion Module	For use with 4x2 Base Unit only
1HAM60943AAW	Expansion Interconnect Unit	
1HAU61934ACX	Cable Assembly (Earth)	
1MBB61041AAM	Expansion KOP	Note that the Expansion KOP contains two plastic covers – the larger cover is used with SMA1/4CP and expansion module (the smaller cover is used where the base unit is smaller eg Extender II).
	Cellspan	Three variants available
	Packetspan	

Some of the SMA-1/4CP Expansion Modules listed in Table 28.3 are illustrated below.

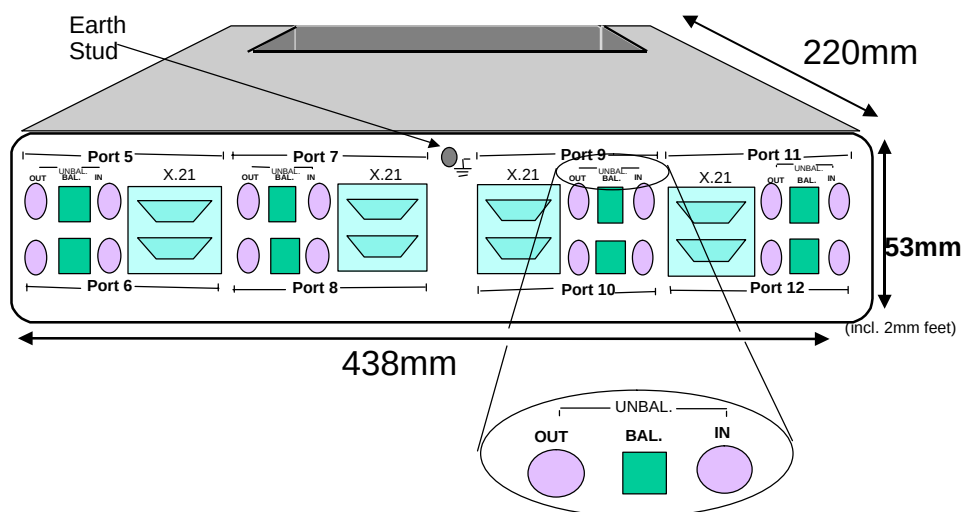


Figure 28.3 8 x 2M Expansion Module

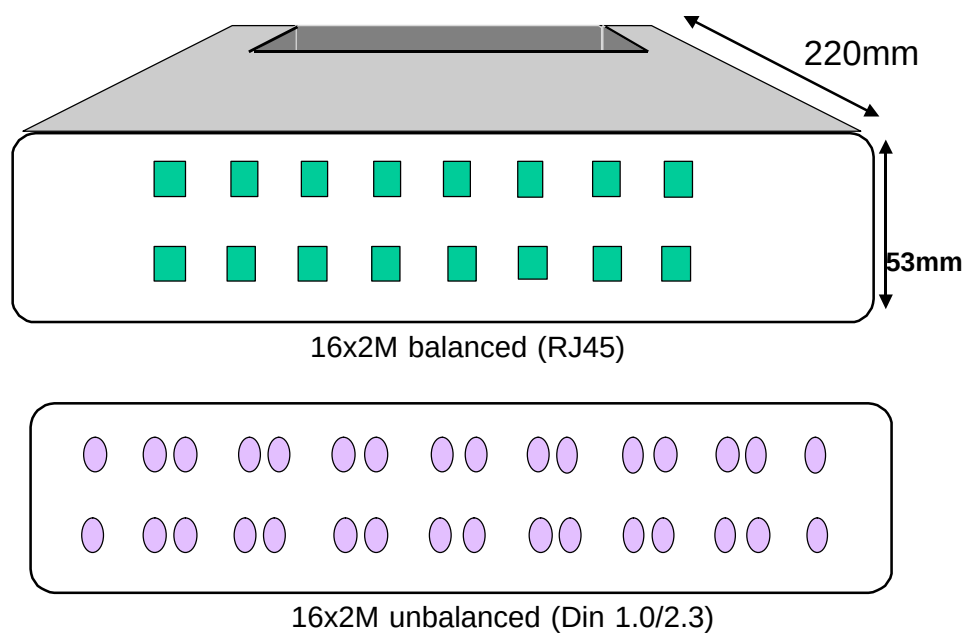


Figure 28.4 16 x 2M Expansion Module

28.5 SMA-1/4CP CORE INTERFACE AREA

The SMA-1/4CP core interface area is shown in Figure 28.5. Note that there are LTU interfaces for Pwr1, Pwr2, User I/O1, User I/O2, Aux1 and Aux2, LCT and Sync. Connector variants illustrated in Figure 28.6.

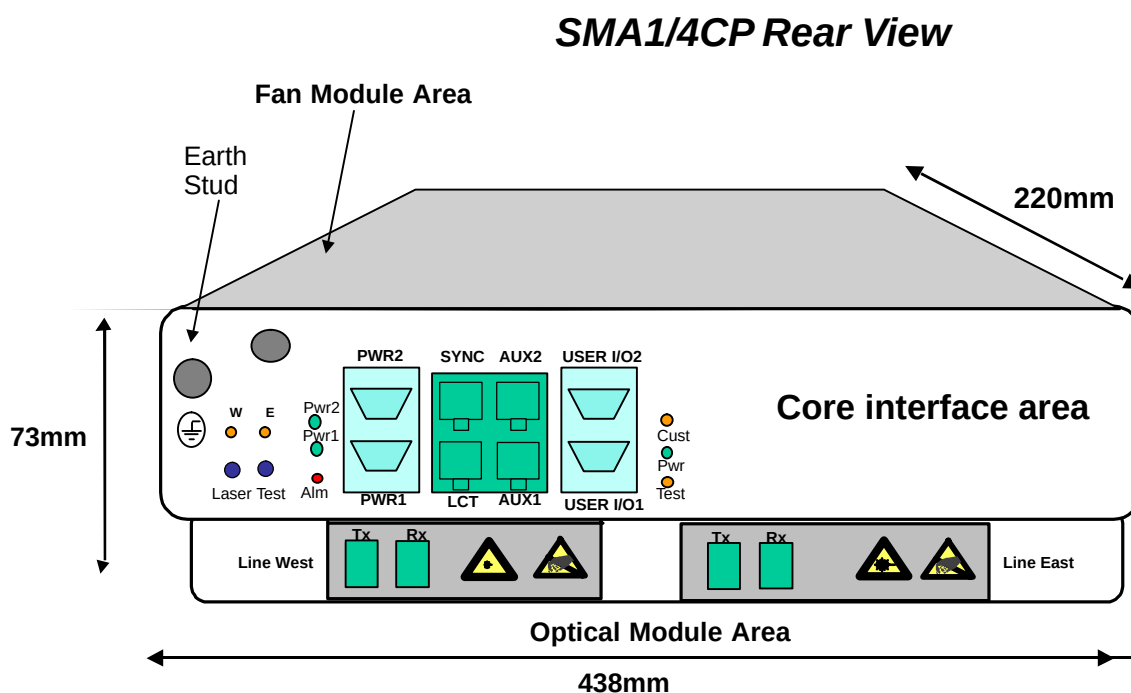


Figure 28.5 Rear View of 4 x 2 SMA-1/4CP.

The Core interface area is capable of supporting different connector variants. Various layout options are detailed below:

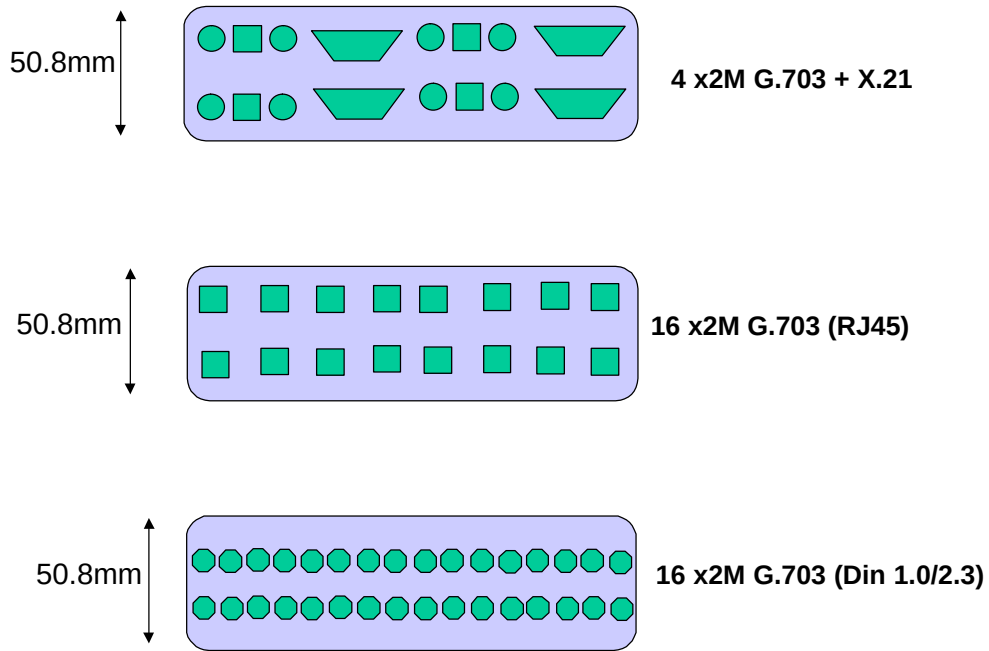


Figure 28.6 Core LTU variants for the SMA-1/4CP

A diagram of the 16 x 2M unbalanced base unit is shown below. Note that the balanced base unit is identical in operation except for the 2M ports (on the right) – on the balanced unit the connector type is 120 ohm twisted pair, whilst on the unbalanced unit the connector type is 75 ohm 1.0/2.3 DIN.

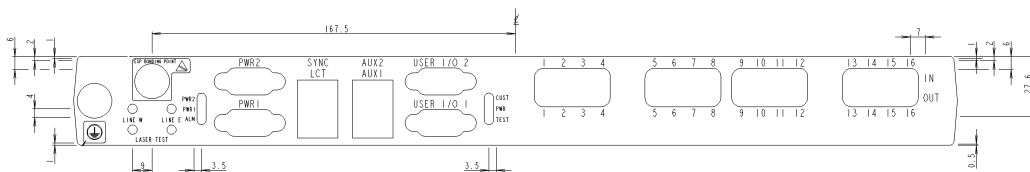


Figure 28.7 16 x 2M Unbalanced Base Unit (1HAN60511AAH)

28.6 SMA-1/4CP OPTICAL MODULES



WARNING

For safety reasons, the power supply for the SMA-1/4CP must be switched off before optical module(s) are installed or changed.

Optical modules are installed by sliding on to the bottom of the SMA–1/4CP base unit. The area for installation is indicated in the “Optical Module Area” in Figure Figure 28.5. An optical module mounting kit of parts, **1MBB61185AAN**, is required.

Note that for Single Fibre Working (SFW), the optical module should be fitted in the Line West (left hand side) position. Note also that, if only one optical module is to be fitted, then a blank optical module kit of parts, **1MBB61186AAQ**, is required.

Full details on optical modules are contained in the chapter on Optical Modules.

28.7 SMA–1/4CP EXPANSION CONSIDERATIONS

When mounting an expansion module on an SMA–1/4CP unit, consideration must be given to the following

- a) The maximum permissible power dissipation in the equipment rack.
- b) The maximum rise in temperature under which the upper SMA will operate.
- c) The ETS Climatic limits. (This equipment has been tested as compliant with ETS 300 019–2 Class 3.1)

Note: The combined power dissipation of all equipment in a rack should be checked against Marconi and customer installation rules.

28.8 BASE UNIT DETAILS

28.8.1 Construction

The SMA–1/4CP is housed in a similar plastic enclosure as that used for the Extender II equipment, with approximate dimensions of 438mm x 220mm x 73mm

Note: The 73mm height measurement includes 2mm feet on the bottom of the base unit.

28.8.2 Mechanical Details

Dimensions	Height: 73mm
	Width: 438mm
	Depth: 220mm

28.9 BASIC INSTALLATION SEQUENCE



WARNING

For safety reasons, the power supply for the SMA–1/4CP must be switched off before optical module(s) are installed or changed.

For reasons associated with safety and access it is recommended that the following restrictions on the sequence of installation operations are observed:

- Fit optical module(s) (if not already fitted).
- Locate the SMA-1/4CP in its desired position ie wall, rack or desk mounted.
- Complete power supply arrangements as appropriate.
- Make the Power and other Core Interface connections.

28.10 FITTING THE BASE UNIT

To install the base unit in a rack, use the mounting kit, **1MBB61176AAA** in conjunction with the rack mounting kit, **1MBB61088ABF**. The base unit should be positioned and aligned with the rack locating pegs.

To install the base unit by wall mounting it, use the mounting kit, **1MBB61176AAA** in conjunction with the wall mounting kit, **1MBB61105ABJ**. The base unit should be positioned and aligned correctly.

28.10.1 Safety

Additional Safety notices published in this chapter are specific to SMA1/4CP. All other Warnings and Cautions laid out in the Preface to this section, Safe Working Practices, must be read and adhered to before and during any maintenance task. In addition, any local, legal requirements must be complied with.

28.10.2 Protective Earthing

WARNING

If this equipment is bolted to an earthed rack assembly, Protective Earthing is provided via the rack metalwork to which it is bolted. The performance of this Earth must be tested to ensure a continuity of not greater than 0.1 Ohm at 20 Amps once installed.

WARNING

Where this equipment is powered up when not bolted to a rack assembly, a separate Protective Earth **MUST** be connected between the SMA1/4CP chassis and a suitable Earth bonding point. The performance of this Earth must be tested to ensure a continuity of not greater than 0.1 Ohm at 20 Amps once installed.

28.10.3 General Considerations

The SMA1/4CP is housed in a plastic enclosure, with dimensions suitable for deployment in a 19" ETSI rack:

- **Width** – 438mm
- **Depth** – 220mm
- **Height** – 73mm (allow 124mm for base unit plus expansion module)

The internal surfaces of the SMA1/4CP enclosure are coated with a metallic spray to meet EMC requirements.

An Electrostatic Protection (ESP) Bonding point is provided on the front plate of the base units only. An earth stud is provided on all SMA1/4CP Core and Expansion modules.

The product is primarily designed to be used in either horizontal or vertical orientations, as a standalone unit or wall mounted. There is also the option for mounting horizontally within an equipment cabinet. The unit is aesthetically styled so as to make it possible for the unit to be installed in an office environment.

28.10.4 Temperature Control

When the SMA1/4CP is mounted with other equipment, e.g. in a rack, sufficient space should be provided between the equipment to ensure that the ambient temperature experienced by the SMA1/4CP does not exceed the limits in ETS 300 019-2-3 Class 3.1E i.e. 45 degrees C. When mounting the SMA1/4CP horizontally in a rack, it is recommended that a minimum vertical spacing of 66.7mm (1.5U) is provided between the SMA1/4CP and other high powered equipment, and that it is mounted **BELOW** this equipment.

Note: It should be noted that improved environmental performance can be achieved by mounting the SMA1/4CP vertically with the ventilation holes uppermost.

WARNING

If the unit is installed in an office environment, steps must be taken to avoid accidental spillage of any form of liquid onto the SMA1/4CP, as slots present on the unit for air ventilation will allow liquid to enter.

WARNING

The SMA1/4CP and any expansion modules must NOT be mounted on top or beneath any battery backup box.

28.10.5 Wall Mounting Installation

CAUTION

It is recommended that precautions are taken to ensure that the wall on which it is to be mounted is sufficiently robust to bear the weight of the unit.

WARNING

The Battery Backup box (see chapter on PSUs) must not be moved with batteries fitted.

WARNING

All Battery Backup boxes must be wall mounted separately to the SMA1/4CP.

Two wall mounting options are available for the SMA1/4CP and/or Battery Backup Boxes in the customer premises.

- The first option consists of a simple plain installation direct to the wall where a paper template is used to locate screw positions. The SMA1/4CP is hooked directly onto these screws.

- The second option is for the fitting of a fibre management tray to the wall, the SMA1/4CP can then be hooked directly onto this tray.

In addition to the two options listed above, an SMA1/4CP wall mounting plate is supplied which can be screwed to weaker walls. This will help to distribute the weight of the SMA1/4CP and further expansion units more evenly. The fibre management tray can also be fitted to the wall mounting plate.

The final procedure in this section describes the installation of a typical Expansion Module onto the SMA1/4CP.

28.10.6 Direct Wall Mounting

The lower sides of the SMA1/4CP or battery backup boxes contain key holes enabling the units to be wall mounted. A paper template is provided and this is to be used to mark off the hole positions for drilling into a suitable wall. (See Figure 28.8)

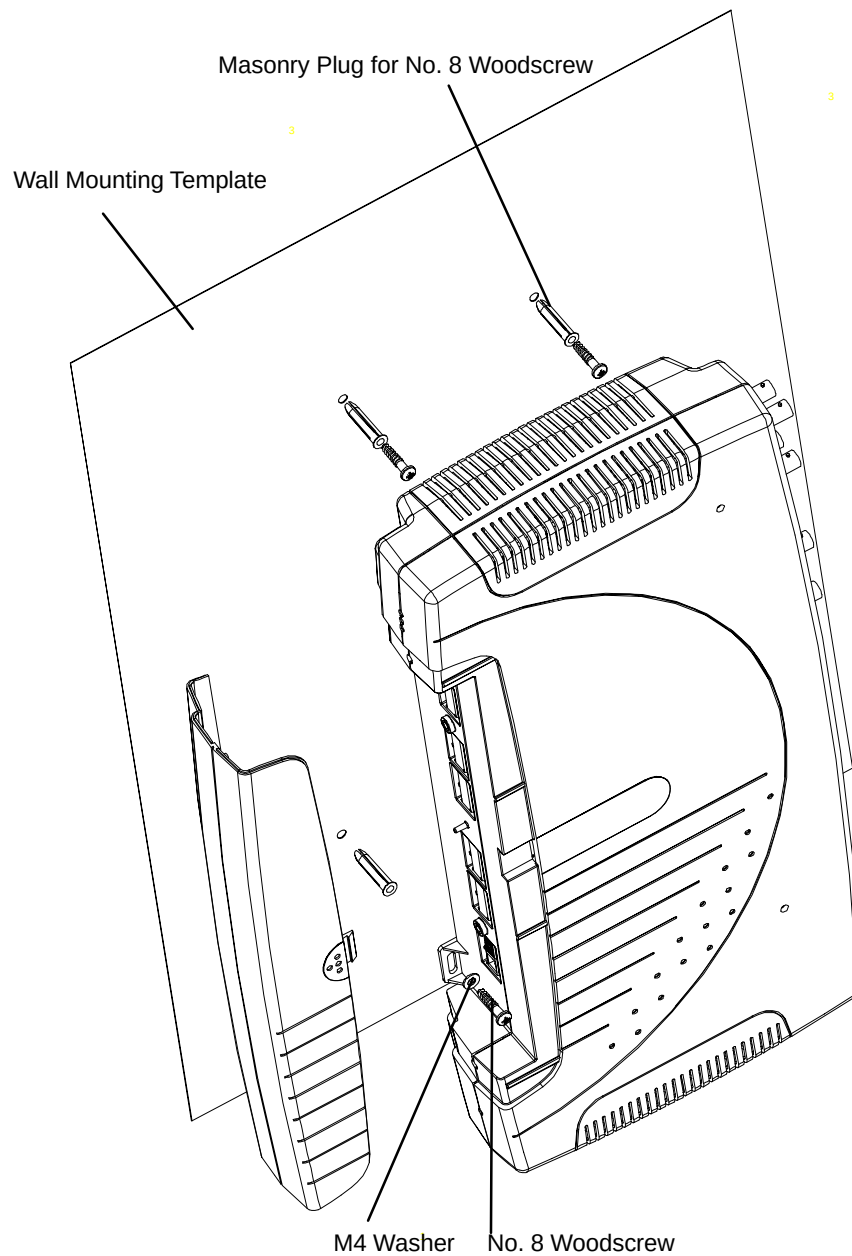


Figure 28.8 Mounting the SMA1/4CP directly to a wall

28.10.7 Fibre Management Tray Mounting

The fibre management tray can be fixed to the wall directly. The SMA1/4CP is then mounted on interface screws which have been fitted to the fibre management tray. (See Figure 28.9 and Procedure 7)

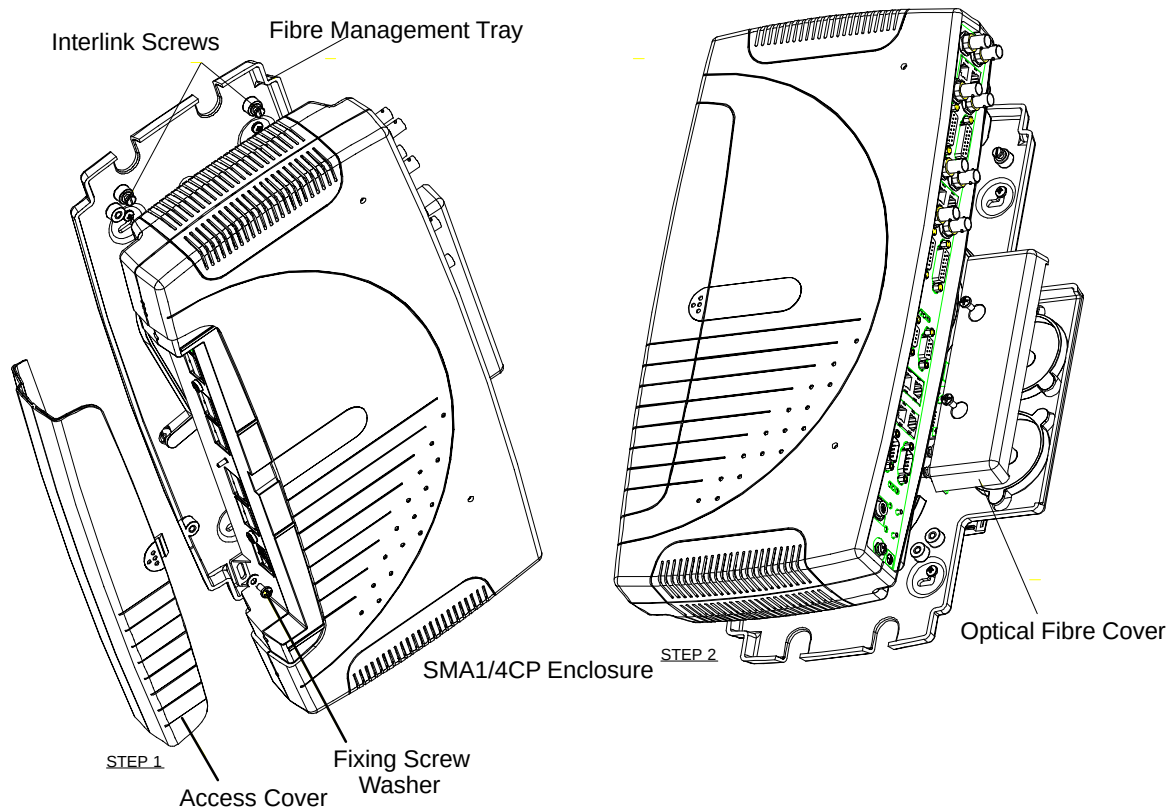


Figure 28.9 Mounting Arrangement on Fibre Management Tray

Procedure 7: Fibre Management Tray Mounting Sequence

5. Locate SMA1/4CP enclosure onto interface screws and slide to lock
6. Fit washer and fixing screw then tighten fixing screw.
7. Clip access cover onto enclosure.
8. Connect Optical Fibre (s)
9. Fit optical Fibre cover and tighten screw.

◆◆◆◆ END OF PROCEDURE ◆◆◆◆

28.10.8 Wall Mounting Plate

For the mounting of the SMA1/4CP or Battery Backup Boxes onto weaker walls, a wall mounting plate is provided. This is designed to help spread the applied load of the SMA1/4CP and additional equipment. The SMA1/4CP will hang on interface screws fitted in the the plate. The fibre management tray can also be hung on interface screws in the plate and therefore the SMA1/4CP will hang on interface screws fitted in the fibre management tray. (See Figure 28.10)

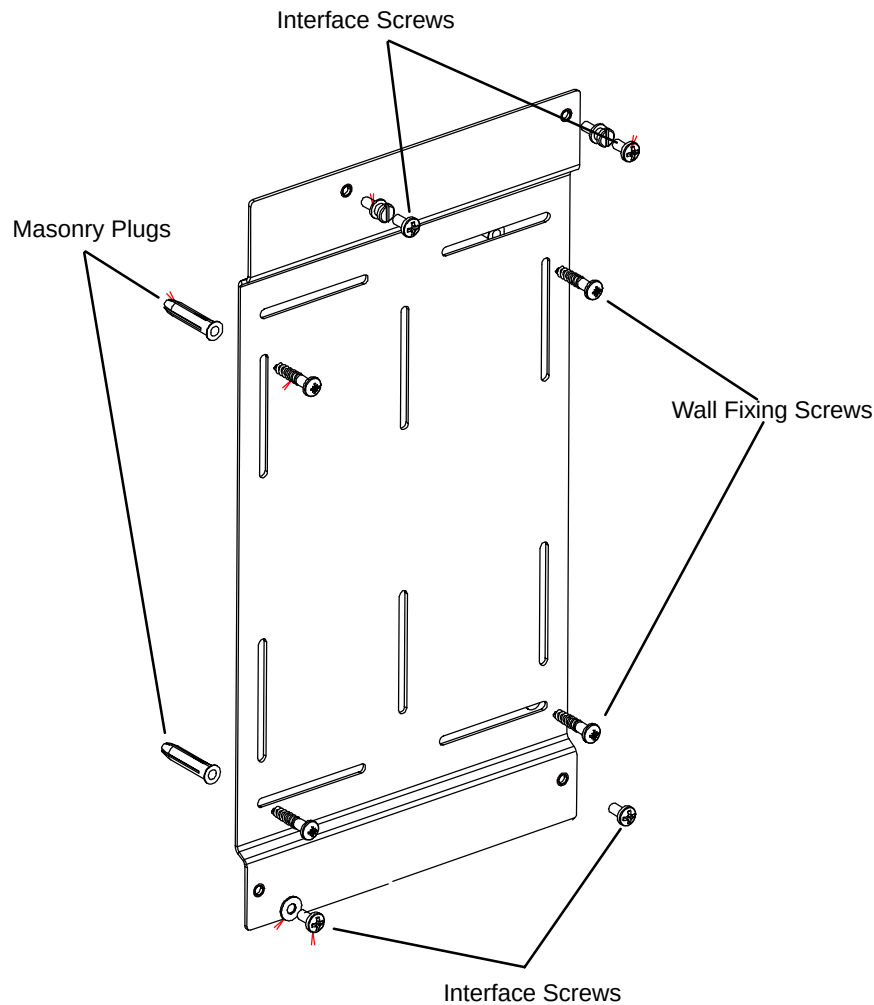


Figure 28.10 SMA1/4CP Wall Mounting Plate

28.10.9 SMA1/4CP MOUNTING ARRANGEMENTS

Figure 28.11 shows the mounting arrangements for the SMA1/4CP Core Card with any Expansion Module. It also shows the fitting of one of two suitable backplane (expansion assembly) connectors for either combination of Core Card and Expansion Module.

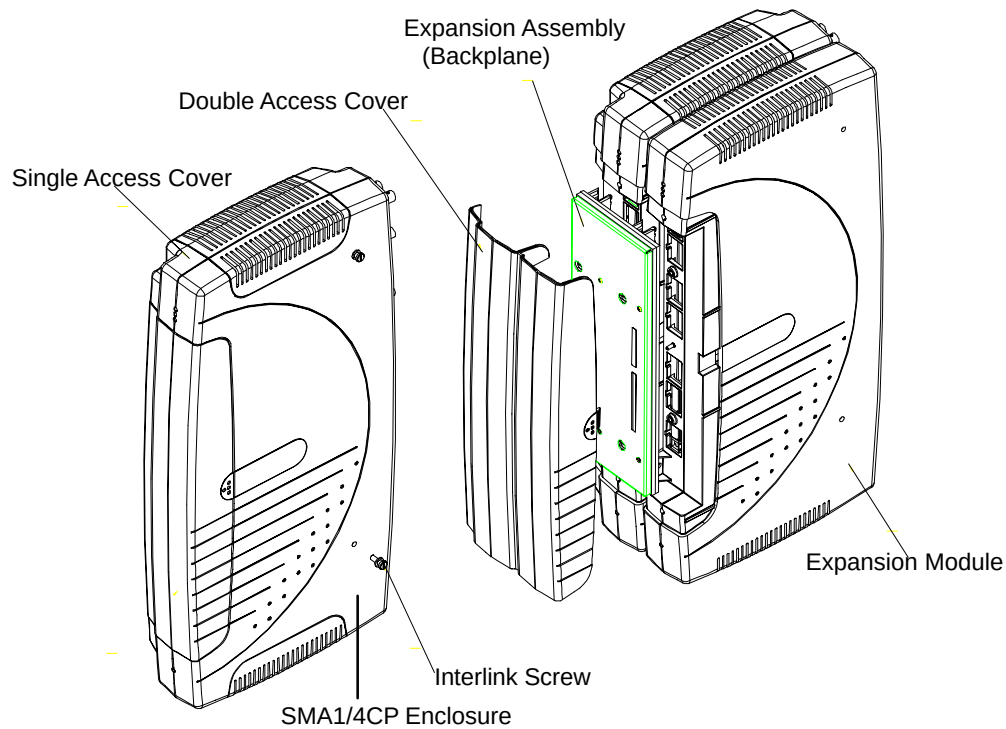


Figure 28.11 Mounting Arrangements

Procedure 8: Expansion Module Fitting Sequence

1. Fit interface screws to Core SMA1/4CP enclosure and tighten.
2. Locate upgrade expansion module enclosure onto interface screws and slide to lock.
3. Fit interface screws to Core SMA1/4CP enclosure and tighten.
4. Remove single cover.
5. Fit expansion assembly (backplane) and tighten screws.
6. Clip double access cover onto enclosures.

◆◆◆◆ END OF PROCEDURE ◆◆◆◆

28.10.10 SMA1/4CP Rack Mounting

Figure 28.12 shows the SMA1/4CP rack mounting kit of parts, which allows the SMA1/4CP and any associated expansion units to be mounted in a 19 inch rack assembly.

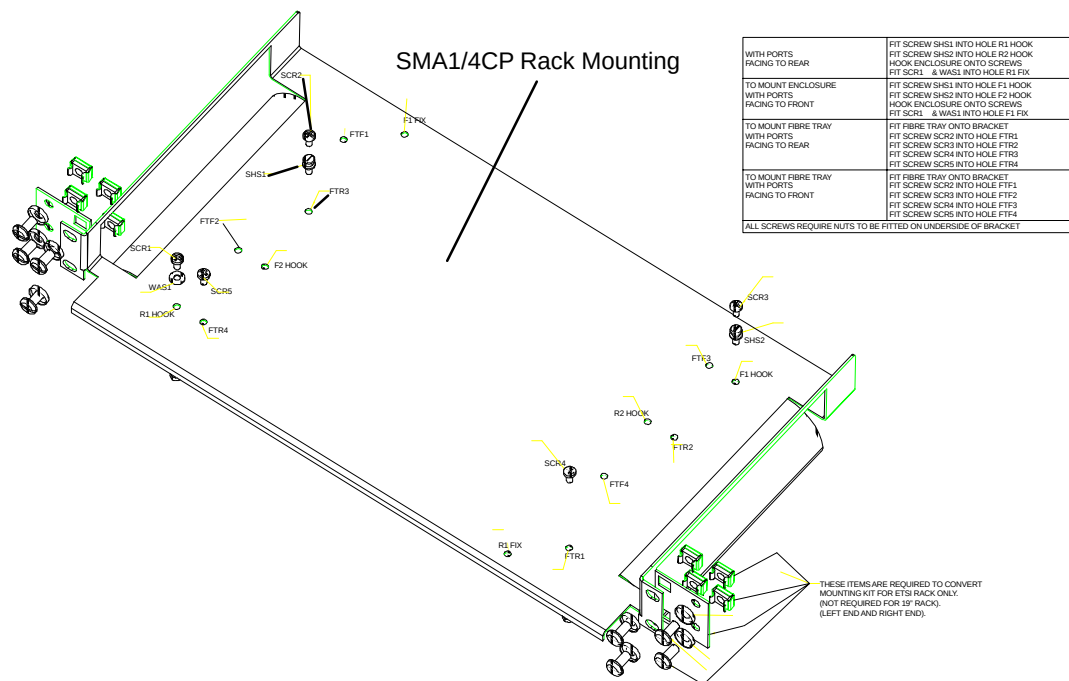


Figure 28.12 SMA1/4CP Rack Mounting Kit of Parts.

Procedure 9: Installing Expansion Modules

This procedure describes the installation of an expansion module onto an SMA1/4CP which is already in service.

1. Remove the cover on the rear of the SMA1/4CP main unit (if fitted) which will expose a row of connectors. (The backplane will plug onto these connectors).
2. Fit the two "SMA1/4CP interlink screws" into the front face of the SMA1/4CP base unit. (The expansion module will hang off these)
3. Place the expansion module against the SMA1/4CP so that the two screws enter the locating keyholes on the module. Pull down the module to lock it into position.

Note: It is easier to slide the expansion module on if it is lifted by approximately 1mm above the SMA1/4CP case.

4. Connect the earth cable to the earth stud.
5. Offer the backplane up squarely to the expansion module and SMA1/4CP, and push it on. Note that some force will be required to do this.
6. Fit the four backplane retaining screws in rotation. ie tighten each screw a little at a time. Do NOT over tighten.

7. Clip the double width cover over the backplane.
8. Discard the old backplane cover.
9. On the opposite side to the backplane, fit connectors to ports as required using appropriate connectors.

28.10.11 SMA-1/4CP Fan Module (1HAM61048AAU)

The SMA-1/4CP fan module (including installation procedure) is shown in Figure 28.13. A fan module must be fitted if the unit is to be mounted horizontally, in either a rack or on a desktop. A fan module does not need to be fitted if the unit is to be wall-mounted according to the procedures given in this chapter.

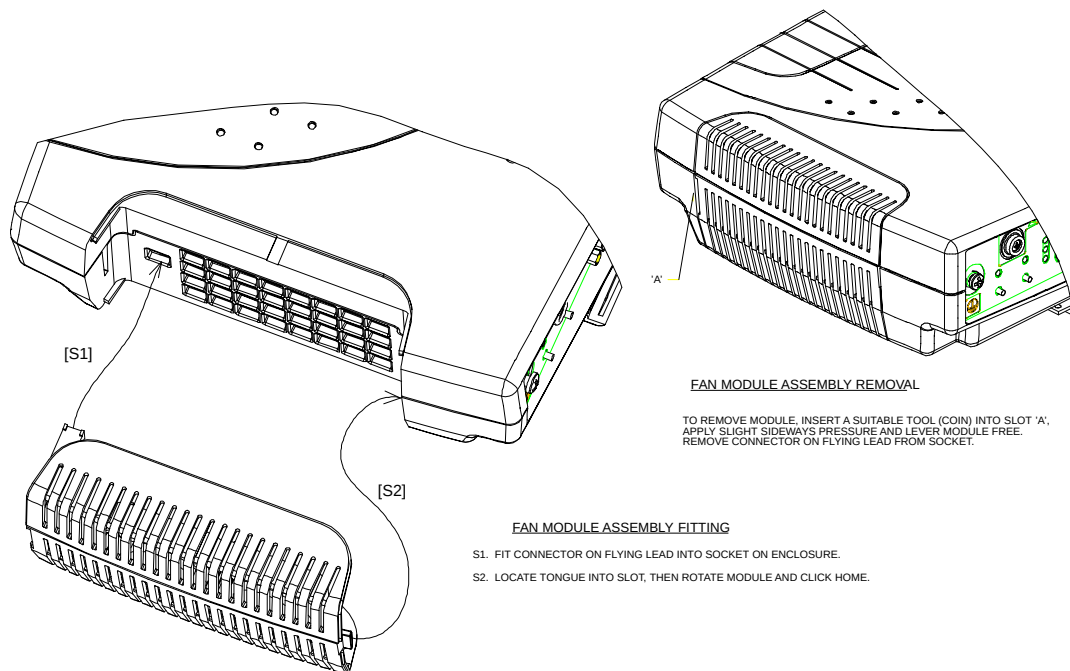


Figure 28.13 SMA-1/4CP Fan Module

◆◆◆◆ END OF PROCEDURE ◆◆◆◆

28.11 COMMS/CONTROLLER FUNCTIONS

The Comms/Controller functions for the SMA-1/4CP are contained within the base ADM unit. This is in contrast with SMA-1/4c, SMA-1/4(4+4) and SMA-1/4(8) where these functions are contained on a separate card. The functions operate, however, in the same way in all Series 4 equipment.

The Comms/Controller functions include System Memory. The Comms/Controller functions receive commands and status requests from one of three sources:

- From a Local Terminal connected via the 'F' interface

- From messages carried in the embedded DCC control channels of an STM1 line signal via the overhead access buses (Qecc I/F) (passed to the Mux Controller function via the Comms function).
- From an Element Manager via the 'Q' interface and the message passing interfaces which reside between the Mux Controller function and Comms function.

28.12 SWITCHING FUNCTIONS

Switching functions and switching protection are provided within the SMA-1/4CP base ADM unit. This includes all switch core processing, tributary interface conversion, synchronisation and microprocessor dc to dc conversion.

Routeing functions are also provided on the base ADM unit. The base unit also provides the multiplexer timing generator, timing synchronisation source selection and timing distribution for both the internal traffic interfaces and the outgoing STM-N Line signals.

28.13 SMA-1/4CP SOFTWARE

SMA-1/4CP base units are programmed with the latest software as indicated in Table 28.4. A Software Upgrade Information document is supplied with each Series 4 release. Table 28.4 also shows LCT software. Note that LCT software is common to all Series 4 products.

Table 28.4: SMA-1/4CP Software			
Code	Release	Name	Comments
1HGC60865AAU 02	R1.1.2	SMA-1/4CP Software	
1HGC60916AAC	R1.1.3	SMA-1/4CP Software	
1HGC60923DAB	R1.1.2	LCT Software	
1HGC60921DAW	R1.1.3	LCT Software	
1QDE61748AAJ		Software Upgrade Information	For all Series 4 products

28.13.1 System Backup Software

System Backup Software (ordered specific to release and alarm requirements) is available on CD-ROM, containing the System Memory Software for downloading from the Local Terminal or EMOS (VC-AM software is included).

28.13.2 Local Terminal Software

The Local Terminal Software is executed from the hard-disc on the PC to provide the Local Terminal functions for the SMA. The software is supplied on CD-ROM and should be ordered specific to requirements.

28.14 ETHERNET CONNECTIONS

28.14.1 Ethernet Network Specifications

The following table gives the 10Base5, 2 and T network specifications.

Table 28.5: 10Base5, 10Base2 and 10BaseT specifications			
Item/parameter	10Base5 (thick)	10Base2 (thin)	10BaseT
Data rate	10Mbit/s baseband	10Mbit/s baseband	10Mbit/s baseband
Segment length max	500m	185m	100m
Network span max	2500m	925m	–
Nodes per segment max	100	30	–
Node spacing	2.5m	0.5min	–
Capacitance per node	4pF max	8pF max	–
Cable	0.4" dia, 50Ω, double shielded, rugged	0.2" dia, 50Ω, single shielded, flexible	24 AWG telephone wire, twisted pair (x2)
Connectors	Beesting or N series	BNC	RJ45

28.14.2 'Thick Ethernet'

'Thick' Ethernet – uses coaxial cable, tapped by 'Beesting' junctions or 'N' series interconnectors, mounted on 10Base5 Transceivers at each 'drop' point. The drop cables connect directly into the AUI port of the SMA or Element Manager.

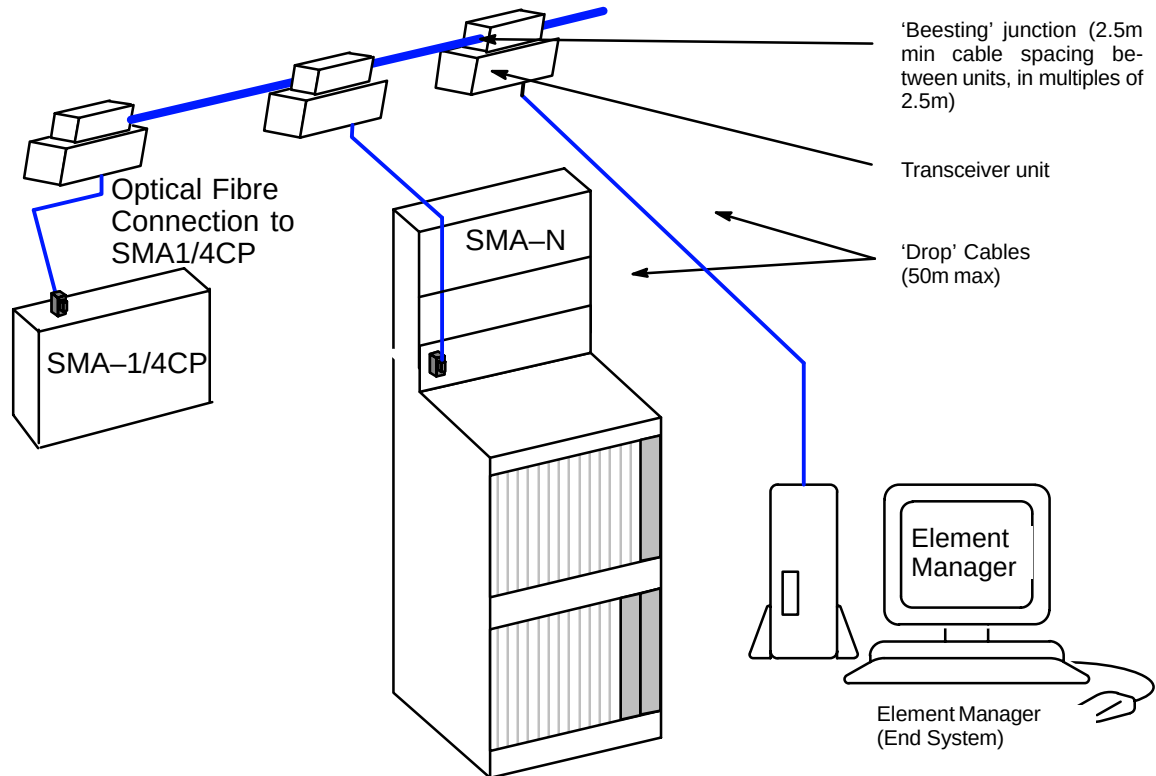


Figure 28.14 'Thick' Ethernet Connections

28.14.3 'Thin' Ethernet

'Thin' Ethernet – uses coaxial cable interconnected by BNC 'T' junctions, on 10Base2 Micro-transceivers which are connected directly to the element AUI port.

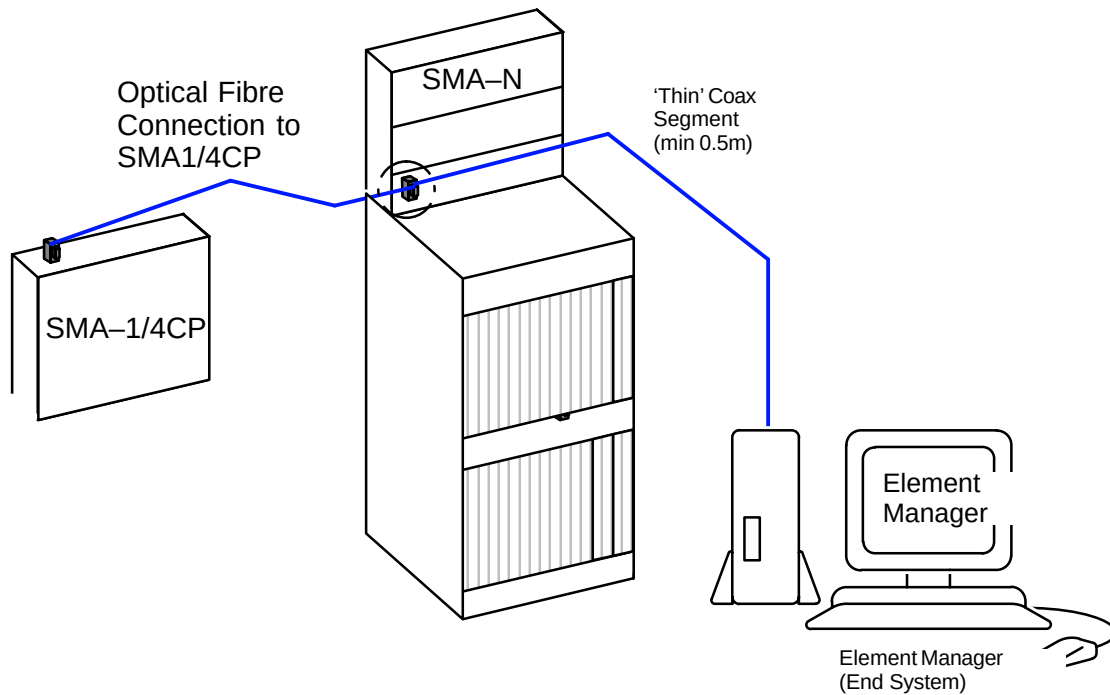


Figure 28.15 'Thin' Ethernet Connections

28.14.4 10BaseT Ethernet

10BaseT Ethernet – All NEs on Ethernet Link connected in star configuration via Network Hub using UTP cables terminated with RJ45 connectors

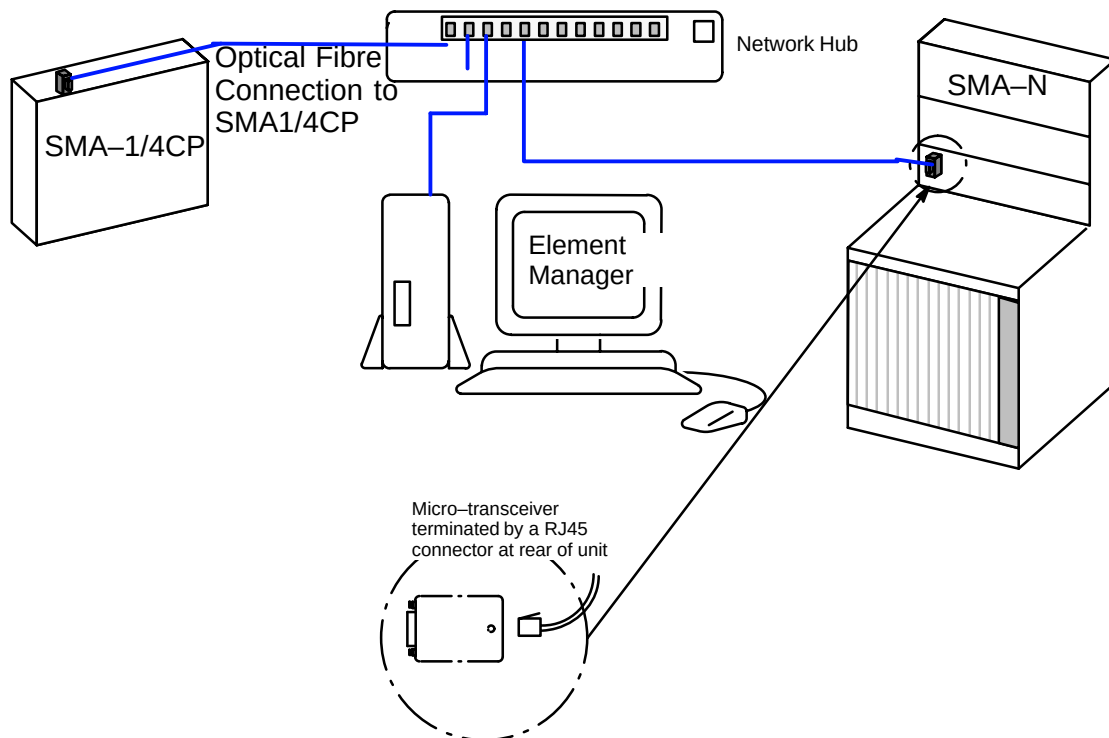


Figure 28.16 10BaseT Ethernet using UTP cables and a Network Hub

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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CHAPTER 29: INSTALLATION – SMA1/4C and SMA1/4UC SUB-RACKS

WARNING

Do not equip the sub-rack with cards before fitting it into the rack. The weight of a sub-rack fully equipped with cards will exceed 10 kg.

29.1 INTRODUCTION

29.1.1 Equipment Complement

The sub-rack, with a selection of cards, is installed using the procedure outlined in this chapter. In this context, 'installing' means equipping the assembly with cards, making all necessary external connections, and generally readying the equipment for commissioning.

29.2 EQUIPMENT RACK

The SMA subrack was designed to be fitted into a ETSI or 19" rack. Other racks may be used but consideration must be given to the provision of mounting brackets, co-axial/fibre optic cable access and adequate ventilation air flow.

The rack chosen must allow for the SMA to have rack front covers fitted in normal operation to provide ESD protection and assist air flow through the rack for natural convection cooling.

29.2.1 Multiple Subrack Mounting

It is possible to mount more than one SMA-1/4c/uc subrack in one framework (up to two shelves can be fitted in one rack), however consideration must be given to the following:

- a) The maximum permissible power dissipation in the equipment rack.
- b) The maximum rise in temperature under which the upper SMA will operate.
- c) The ETS Climatic limits. (This equipment has been tested as compliant with ETS 300 019-2 Class 3.1)

Note: The combined power dissipation of all equipment in a rack should be checked against Marconi and customer installation rules.

29.3 SUB-RACK DETAILS

29.3.1 Variations

Variations to the basic Series 4 subrack version for SMA–1/4c/uc (**1HAG60595AAR**) are achieved using a combination of optional Cards and LTUs.

29.3.2 Construction

The subrack is a card cage mechanical design meeting the ETSI standard ETS 300 119 Part–4 and screened for EMC according to ETSI requirements ETS 300 119 Part2/4.

29.3.2.1 Mechanical Details

Dimensions Max Height: 311mm (side plate maximum height)
 Width: 444mm nominal (including rear cover)
 Depth: 280mm nominal

Weight (Without Cards) 5kg (approx)

WARNING

The subrack should only be lifted by hand with all cards removed.

29.3.2.2 Slide–in Cards

Card Type DIN 41494 Extended Eurocard
 Height: 233mm
 Depth: 220mm
 Edge Connector Metral (2mm pitch)

29.4 EXTERNAL SUB-RACK CONNECTIONS

29.4.1 Slide–In Cards

Details on the range of slide–In card units which can be fitted are listed in the chapter on Slide–In Card Units.

29.4.2 Ancillary LTUs

All external sub–rack connections, except those made to the cards themselves, are made via a series of Line Termination Units (LTUs) These are contained on the right hand side of the subrack. Details of the LTUs which may be fitted in the SMA–1/4c subrack can be found in the chapter on LTUs.

29.4.3 Power LTUs

Dual Feed with either:

- 2 off 'D'–type 3W3 connectors, one for each input.
- 2 off 'D'–type 3W3A connectors, one for each input.

- 1 off type 273B 4 way 'Trident' connector for both inputs.

29.5 SUB-RACK BASIC ASSEMBLY

The sub-rack is supplied as a metal framework and Backplane assembly (see Figure 29.1) consisting of:

- **Card-cage** – with slots for plug-in cards.
- **Fibre management area** – mounted above the card cage.
- **Tributary LTU area** – with slots for plug-in Traffic LTUs (left hand side of LTU Area marked in Figure 1).
- **Core LTU Area** – this is located on the top right of the LTU Area marked in Figure 1. A dedicated Core LTU is required to access the 32x2M traffic capability supported by the core configuration. Note that there are 2 variants of the Core LTU, an unbalanced 2M traffic unit and a balanced 2M traffic unit. See the chapter on LTUs for further details.
- **Ancillary LTU area** – this is located on the bottom right of the LTU Area marked in Figure 1. The basic ancillary LTU 1 provides access to User I/O, external sync, local terminal (LCT) power input, auxiliary and EOW. The enhanced ancillary LTU 2 provides access to Sync In, Sync Out, 2M Test and AUI functions. See the chapter on LTUs for further details of the basic and enhanced ancillary LTUs for the SMA-1/4c.

29.5.1 Card-Cage Area

The card-cage can house up to 9 plug-in cards. Card slots are identified by numbers shown in Figure 29.1, counting from the left, when facing the front of the sub-rack. Each slot is dedicated to a particular function and, with the exception of 'Tributary' slots, to a particular type of card. A mechanical keying arrangement prevents the insertion of invalid card types (slot numbers are used for identification purposes in commissioning, monitoring, and control procedures).

Card front plates are an integral part of the EMC screening. If the equipment configuration dictates any slot is not populated then an appropriate sized dummy cover must be fitted. A range of such covers are available and are included in the parts coding system.

29.5.2 Fibre Management Area

Fitted above the card-cages are fibre guides and retaining clips for mounting the optical fibre cable guides. These guides are included in the rack mounting KOP. Additional guides can be ordered.

29.6 SYSTEM MEMORY

System Memory is no longer located within the sub-rack frame on SMCs. It now resides on the Controller function of the Comms/Controller Card.

29.6.1 SMA–1/4c Subrack (1HAG60557AAK)

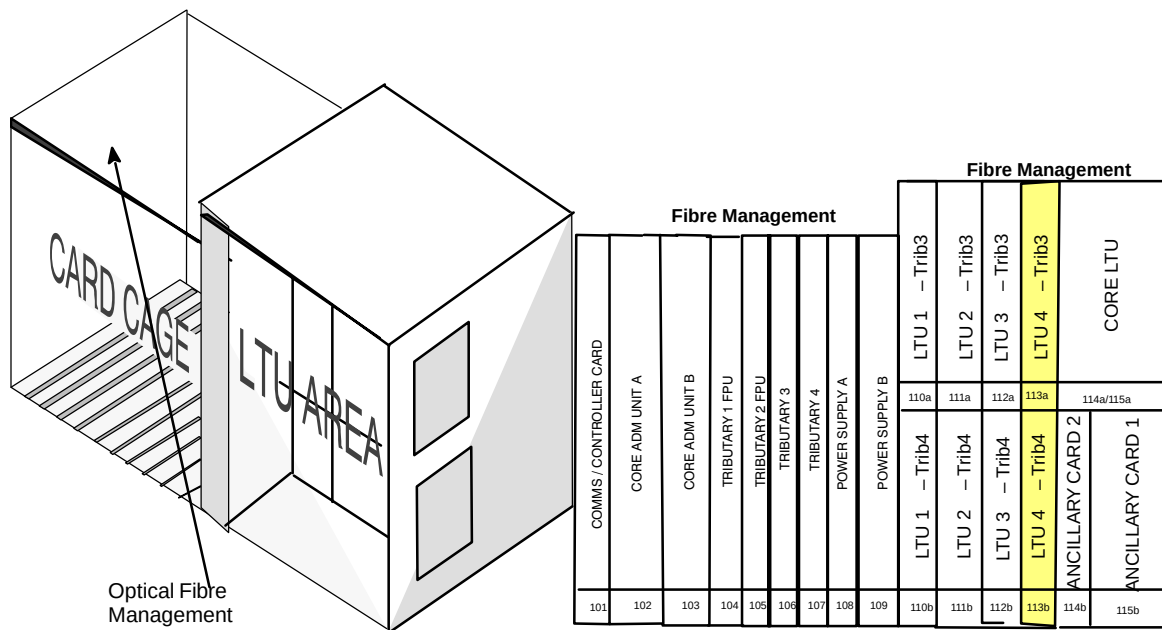


Figure 29.1 SMA–1/4c Sub-Rack Layout

29.7 BASIC INSTALLATION SEQUENCE

For reasons associated with safety and access it is recommended that the following restrictions on the sequence of installation operations are observed:

- Fit the sub-rack into the main rack (or wherever it is to be located) before equipping the sub-rack with cards. The weight of a sub-rack fully equipped with cards will exceed 10kg.
- Fit the Power/LCT LTU before connecting external power. The battery supplies must be disconnected before removal of this LTU.

Note: PSUs do not require external connection. It should be noted however, that the PSUs have a mechanical interlock device which ensures that the unit cannot be inserted (or withdrawn) unless the On/Off switch is in the Off position.

- Make the Power, Traffic interface and Ancillary area connections before equipping the sub-rack with cards.

29.7.1 Fitting the Sub-Rack

A subrack mounting Kit of parts for the SMA–1/4c is available depending on the type of equipment rack used. 1MBB60887AAS is the preferred option for ETSI racks and 1MBB60888AAU for 19 inch racks

The sub-rack should be positioned and aligned with the rack locating pegs on the rack and fixed to it by M6 screws. All of the cards and cables are supplied separately, and should be fitted/connected as explained in this chapter.

Note: Before installing any cards into the shelf, connect the external power supply leads. The external cables should then be connected.

29.7.2 Ancillary Connections

All external sub-rack connections, except those made to the cards themselves, are made via a series of separate Ancillary Line Termination Units (LTUs). See the beginning of this section above, and the chapter on LTUs for further details.

Note: When populating a subrack for the first time, it is advisable to ensure that all units are fully inserted before tightening any of the knurled securing screws.

29.7.3 Fuses and Circuit Breakers

The fuses for each of the –48V supply feeds to the equipment sub-rack should be rated at 10A (anti-surge). Alternatively a circuit breaker with a rating of 10A is available, the GPT code is 1CFB20019AAW or a Siemens circuit breaker with a rating of 8A may be used if appropriate, the Siemens code is V42278–Z52–A10.

Note: A 20A fuse rating is recommended for a dual feed LTU when the rack is fully loaded using appropriate connecting cables.

29.8 CARD CONFIGURATION

Table 29.1: SMA–1/4c Subrack Configuration		
Slot Position	Slot Name	Card Options
101	COMMS/CONTROLLER SLOT	Comms/Controller Card
102	CORE CARD SLOT A	Core ADM Card (any variant)
103	CORE CARD SLOT B	Core ADM Card (any variant)
104	TRIB 1 (Trib Position 1)	Any appropriate Series 4 tributary card not requiring LTUs (ie Front Plug Up tributary)
105	TRIB 2 (Trib Position 2)	Any appropriate Series 4 tributary card not requiring LTUs (ie Front Plug Up tributary)
106	TRIB3 (Trib Position 3)	Any appropriate Series 4 tributary card.
107	TRIB4 (Trib Position 4)	Any appropriate Series 4 tributary card.
108	PSU A (Power A)	PSU
109	PSU B (Power B)	PSU
110a/b	LTU (Tributary)	Any appropriate tributary LTU.
111a/b	LTU (Tributary)	Any appropriate tributary LTU.
112a/b	LTU (Tributary)	Any appropriate tributary LTU.
113a/b	LTU (Tributary)	Any appropriate tributary LTU.
114a/115a	CORE LTU	Core LTU 2Mbit/s Traffic Unit (32 x 2M traffic capability). Fit either Balanced or Unbalanced Unit.
114b	ANCILLARY LTU	The enhanced (optional) ancillary LTU provides access to Sync In, Sync Out, 2M Test and AUI functions.
115b	CORE ANCILLARY LTU	The Core ancillary LTU provides access to User I/O, external sync, local terminal (LCT) power input, auxiliary and EOW.
115b	Bw7R ANCILLARY LTU	The Bw7R LTU provides access to LCT, Sync Out, Aux 1 and Aux2

- Note:**
1. See the chapter on Slide-In Card Units for further information on cards.
 2. See the chapter on Optical Modules for further information on optical modules which can be fitted to Core Cards and Dual STM–1 Cards.
 3. See the chapter on LTUs for further information on SMA–1/4c LTUs.

29.9 PSU, COMMS/CONTROLLER CARD, CORE CARD SWITCHING AND ROUTEING FUNCTIONS

29.9.1 Power Supply Units

The core configuration provides for 32x2M traffic capability (accessed via the Core LTU 2Mbit/s traffic unit). A Power Supply Unit (PSU) is required when a tributary card is fitted. The PSU for the SMA–1/4c is **1HAK60729AAS**. This PSU should be fitted in slots 108 or 109 depending on the degree of protection required. If PSU protection is required, two PSU's should be fitted.

29.9.1.1 Power LTU

The power LTU for the SMA–1/4c is provided on the Core Ancillary LTU 1HAM61038ABW. Power connectors are not required.

29.9.2 Comms/Controller Card (1HAT60876AAP)

One Comms/Controller Card is required per SMA shelf. The card also carries the System Memory (previously held on SMCs (System Memory Cards). The microprocessor based controller card carries out the core control functions within the SMA–1/4c equipment. It also carries out the communications functions previously carried out by separate communications cards. The card receives commands and status requests from one of three sources:

- From a Local Terminal connected via the 'F' interface
- From messages carried in the embedded DCC control channels of an STM1 line signal via the overhead access buses (Qecc I/F).
- From an Element Manager via the 'Q' interface and the message passing interfaces which reside between the Controller and Comms functions on the Card.

CAUTION

The Comms/Controller Card must not be removed from the sub-rack when its amber LED is flashing (i.e. when it is performing a write sequence), this can cause EEPROM corruption.

There are no external connections. If the sub-rack power supply is on at the time the card is inserted, the Comms/Controller Card will go into a start-up process which may take up to ten minutes. For the duration of this process the amber LED on the card will be flashing then lit steady when completed.

A Comms/Controller card may be removed and the original card immediately replaced with no additional action other than resetting of the time clock. All communications will be lost on removal of the card, re-fitting the card will restore the communications. Should a replacement card be fitted then the procedure detailed in the Card Replacement section of the Maintenance Manual should be followed.

29.9.3 Core Card Switching and Routeing Functions

Switching functions and switching protection are provided on the Core Card and not on separate switch cards. This includes all switch core processing, tributary interface conversion, synchronisation and microprocessor dc to dc conversion.

Routeing functions (eg between Line cards and tributary cards) are also provided on the Core Card. The Core Card also provides the multiplexer timing generator, timing synchronisation source selection and timing distribution for both the internal traffic interfaces and the outgoing STM–N Line signals.

**ALERT/CAUTION**

The Core Card must not be removed from the subrack when its amber LED is flashing. Following the insertion of a protection core card, the worker card must not be removed while the amber LEDs on either the Controller Card or the Protection Core Card are flashing.

**ALERT/CAUTION**

Following an insertion of a Cord Card with Automatic Laser Shutdown (ALS) enabled, it will take >90sec for the laser to switch on and be capable of carrying traffic. Therefore, due care should be taken when extracting either the Core Worker or Core Protection Card. The laser start time period can be shortened by pressing the Laser Restart button on the front panel – refer to section 24.7.5.

29.10 SMA–1/4C and SMA-1/4UC SOFTWARE

29.10.1 SMA–1/4c and SMA-1/4uc Software

Details of SMA–1/4c/uc software are given in Table 29.2. A Software Upgrade Information document is supplied with each Series 4 release. Table 29.2 also shows LCT software. Note that LCT software is common to all Series 4 products.

Table 29.2: SMA–1/4c Software			
Code	Release	Name	Comments
1HGC60866AAW	R1.1.2	SMA–1/4c/uc Software	
1HGC60932AAY	R1.1.2r2	SMA–1/4c/uc Software	
1HGC60917AAE	R1.1.3	SMA–1/4c/uc Software	
1HGC60868AAB	R1.1.2	SMA–1/4c/uc Software	Bw7R
1HGC60934AAD	R1.1.2r2	SMA–1/4c/uc Software	Bw7R
1HGC60920AAE	R1.1.3	SMA–1/4c/uc Software	Bw7R
1HGC60923DAB	R1.1.2	LCT Software	
1HGC60921DAW	R1.1.3	LCT Software	
1QDE61748AAJ		Software Upgrade Information	For all Series 4 products

29.10.2 System Memory KOP

Software for all cards (excepting VC–AM) is held on a System Memory Card (SMC), which is programmed in the factory and is supplied as the System Memory KOP within the Core. The code for the SMA–1/4c/uc SMC is **1HBA60716AAW**. For VC–AM, the software is held on the VC–AM card and not on the System Memory card.

Application Firmware is downloaded to Traffic cards from the System Memory Card when the subrack is commissioned,. A Software Upgrade Information document is supplied with each release which covers all the Series 4 SMAs.

29.10.3 System Backup Software

System Backup Software (ordered specific to release and alarm requirements) is available on CD-ROM, containing the System Memory Software for downloading from the Local Terminal or EMOS (VC-AM software is included).

29.10.4 Local Terminal Software

The Local Terminal Software is executed from the hard-disc on the PC to provide the Local Terminal functions for the SMA. The software is supplied on CD-ROM and should be ordered specific to requirements.

29.11 EMC COVERS

To maintain EMC screening integrity, a range of dummy covers, in sizes to fit specific card-cage slots, and a Traffic LTU Dummy for use in the traffic interface area, are available. Details are given in the following table:

Table 29.3: EMC Panels			
Position to Fit	Size	Plain	With Grey/Silver Grey Facia
Card EMC Covers			
Slot 101: Comms/Controller Card Slots 104 to 109: Tributary and PSU Cards	24.7mm.(1.0")	1MBA61103AAA	1MBA61103 ABS/ACK
Slots 102 and 103: Core Cards	55.2mm.(1.4")	1MBA61104AAC	1MBA61104 ABU/ACM
Traffic LTU EMC Covers			
Slots 110a/b to 113a/b: Tributary LTUs	24.7mm.(1.0")	1MBA61366BGM	1MBA61366 BLG/CRQ
Slots 114a/115a: Core LTU	81.2mm.(3.2")	1MBA61724ACG	1MBA61724 ADY/AER

29.12 ETHERNET CONNECTIONS

29.12.1 Ethernet Network Specifications

The following table gives the 10Base5, 2 and T network specifications.

Table 29.4: 10Base5, 10Base2 and 10BaseT specifications			
Item/parameter	10Base5 (thick)	10Base2 (thin)	10BaseT
Data rate	10Mbit/s baseband	10Mbit/s baseband	10Mbit/s baseband
Segment length max	500m	185m	100m
Network span max	2500m	925m	–
Nodes per segment max	100	30	–
Node spacing	2.5m	0.5min	–
Capacitance per node	4pF max	8pF max	–
Cable	0.4" dia, 50Ω, double shielded, rugged	0.2" dia, 50Ω, single shielded, flexible	24 AWG telephone wire, twisted pair (x2)
Connectors	Beesting or N series	BNC	RJ45

29.12.2 'Thick Ethernet'

'Thick' Ethernet – uses coaxial cable, tapped by 'Beesting' junctions or 'N' series interconnectors, mounted on 10Base5 Transceivers at each 'drop' point. The drop cables connect directly into the AUI port of the SMA or Element Manager.

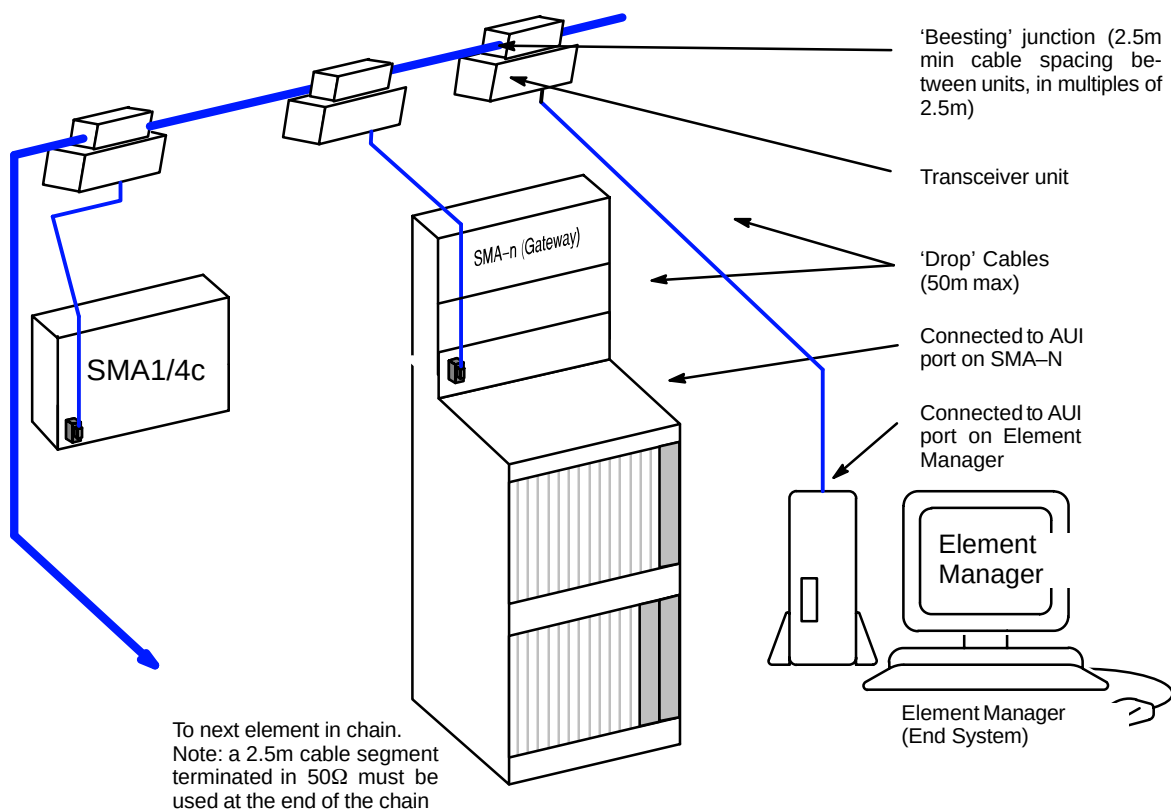


Figure 29.2 'Thick' Ethernet Connections

29.12.3 'Thin' Ethernet

'Thin' Ethernet – uses coaxial cable interconnected by BNC 'T' junctions, on 10Base2 Micro-transceivers which are connected directly to the element AUI port.

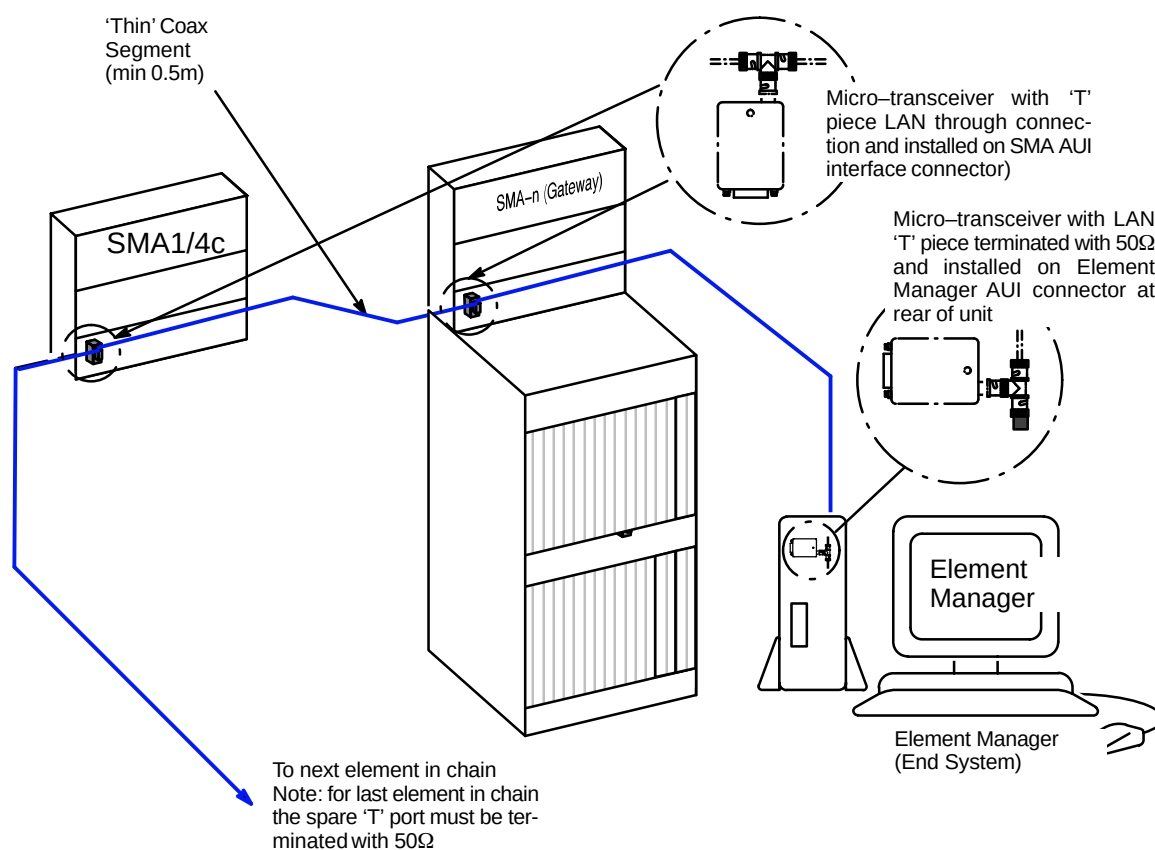


Figure 29.3 'Thin' Ethernet Connections

29.12.4 10BaseT Ethernet

10BaseT Ethernet – All NEs on Ethernet Link connected in star configuration via Network Hub using UTP cables terminated with RJ45 connectors

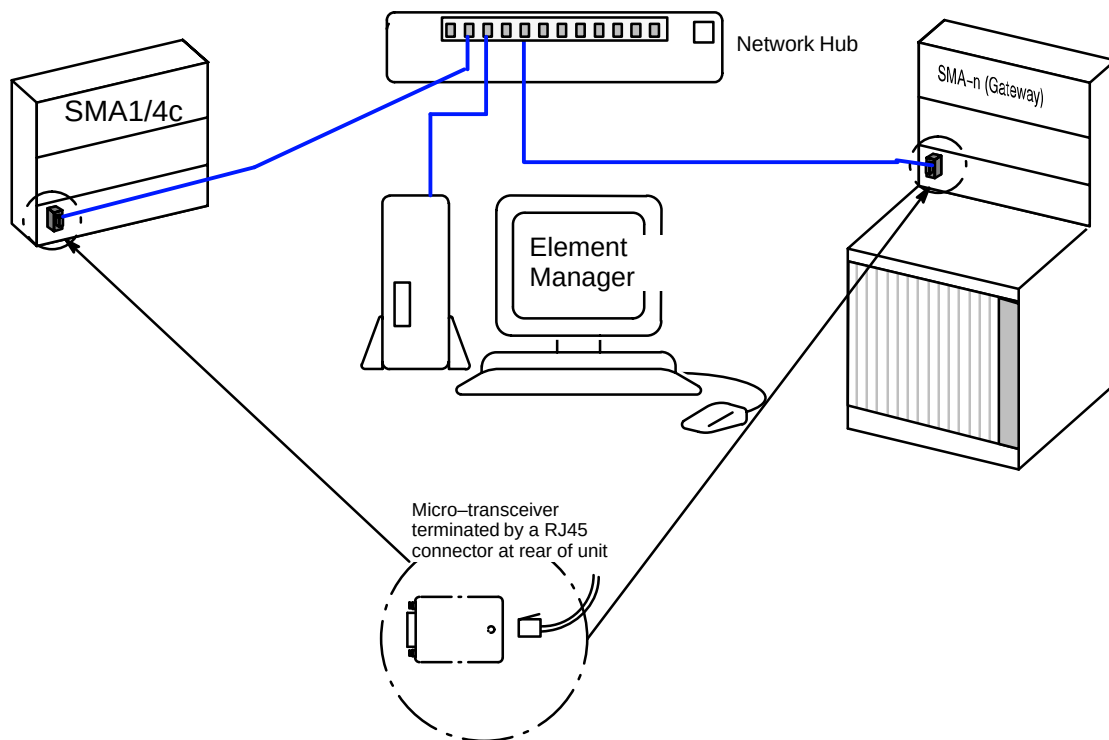


Figure 29.4 10BaseT Ethernet using UTP cables and a Network Hub

CHAPTER 30: INSTALLATION–SMA1/4(4+4) AND SMA1/4(8) SUBRACKS

WARNING

Do not attempt to fit cards into the sub-rack prior to fixing the sub-rack into a rack, as the weight of an equipped sub-rack exceeds 18kg.

30.1 INTRODUCTION

30.1.1 Equipment Complement

The sub-rack with a selection of cards (listed in Chapter 3 of this section) is installed in the rack using the procedure outlined in this chapter. The information provided is that needed when installing a sub-rack into a main rack. In this context, 'installing' means fitting the sub-rack assembly into the rack, equipping the assembly with cards, making all necessary external connections, and generally readying the equipment for commissioning.

30.2 EQUIPMENT RACK

The SMA subrack was designed to be fitted into an ETSI or 19" rack. Other racks may be used but consideration must be given to the provision of mounting brackets, co-axial/fibre optic cable access and adequate ventilation air flow.

The rack chosen must allow for the SMA to have rack front covers fitted in normal operation to provide ESD protection and assist air flow through the rack for natural convection cooling.

30.2.1 Multiple Subrack Mounting

It is possible to mount up to two SMA–1/4(4+4) or up to two SMA–1/4(8) subracks in one framework, however consideration must be given to the following:

- a) The maximum permissible power dissipation in the equipment rack.
- b) The maximum rise in temperature under which the upper SMA will operate.
- c) The ETS Climatic limits. (This equipment has been tested as compliant with ETS 300 019–2 Class 3.1)

Note: The use of two SMA–1/4(4+4) or two SMA–1/4(8) subrack/s with power dissipations exceeding 350W should not normally be used without forced air cooling or thermal modelling verification, Mean Time Before Failure (MTBF) could be reduced as a result.

30.3 SUBRACK DETAILS

30.3.1 Variations

Variations to the basic subrack are achieved using a combination of optional Cards and LTUs.

30.3.2 Construction

The subrack is a card cage mechanical design meeting the ETSI standard ETS 300 119 Part-4 and screened for EMC according to ETSI requirements ETS 300 119 Part2/4.

30.3.2.1 Mechanical Details

SMA-1/4(4+4) Dimensions Height: 499.6mm (side plate maximum height)
 Width: 444mm nominal including rear cover (subrack will fit into a 444mm opening)
 Depth: 280mm nominal

SMA-1/4(8) Dimensions Height: 638mm (side plate maximum height)
 Width: 444mm nominal including rear cover (subrack will fit into a 444mm opening)
 Depth: 280mm nominal

WARNING

The subrack should only be lifted by hand with all cards removed.

SMA-1/4(4+4) Weight Exceeds 18.0 kg

SMA-1/4(8) Weight Exceeds 18.0 kg

30.3.2.2 Slide-in Cards

Card Type DIN 41494 Eurocard Extended Double Euro
 Height: 234mm
 Depth: 220mm
 Edge Connector: Metral (2mm pitch)

30.4 EXTERNAL SUB-RACK CONNECTIONS

30.4.1 Slide In Cards

Details on the range of slide in card units which can be fitted are listed in the chapter on Slide-In Card Units.

30.4.2 Ancillary LTUs

All external sub-rack connections, except those made to the cards themselves, are made via a series of Ancillary Line Termination Units (LTUs). All functions and interfaces previously carried out by the Ancillary Unit are now carried out by a dedicated LTU. Details of the LTUs which may be fitted in SMA Sub-racks can be found in the chapter on LTUs.

30.4.3 Power LTUs

Power LTUs can be Dual Feed with 2 x D-type 3W3A or Triple feed with D-type 8W8A connectors.

30.5 SUB-RACK BASIC ASSEMBLY

The sub-rack is supplied as a metal framework and Backplane assembly with pre-fitted Local Terminal LTU (see Figure 30.1) .

The sub-rack assembly consists of:

- **Card-cage** – with slots for plug-in cards.
- **Fibre management area** – mounted above the card cage.
- **Tributary LTU area** – with slots for plug-in Traffic LTUs.
- **Ancillary LTU area** – mounted between the card cage and the Traffic LTUs are the external interfaces for local alarm, external sync, local terminal (LCT) power input, alarm, auxiliary and EOW. These are provided on separate plug-in LTUs (see Figure 30.1).

30.5.1 Card-Cage Areas

The card-cages can house up to twenty six plug-in cards of DIN 41494 Eurocard Dimensions standard. Card slots are identified by numbers shown in Figure 1, counting from the left when facing the front of the sub-rack. Each slot is dedicated to a particular function and, with the exception of 'Tributary' slots, to a particular type of card. A mechanical keying arrangement prevents the insertion of invalid card types (slot numbers are used extensively for identification purposes in commissioning, monitoring, and control procedures).

Card front plates are an integral part of the EMC screening. If the equipment configuration calls for any slot to be vacant, an appropriate sized dummy cover must be fitted. A range of such covers are available and are included in the parts coding system.

30.5.2 Fibre Management Area

Fitted above the card-cages are fibre guides and retaining clips for mounting the optical fibre cable guides. These guides are included in the rack mounting KOP. Additional guides can be ordered.

Note: If a fibre tray is fitted into a rack containing SMA sub-racks, care must be taken to avoid any blocking of air flow from the rack intakes past the sub-rack to the exhaust. If blocking is unavoidable, then consideration should be given to its effect on increased sub-rack operating temperatures.

30.6 SYSTEM MEMORY

System Memory is no longer located within the sub-rack frame on SMCs. It now resides on the Controller function of the Comms/Controller Card and must be ordered specific to the alarm scheme employed.

30.6.1 SMA–1/4(4+4) Subrack (1HAG60596AAT)

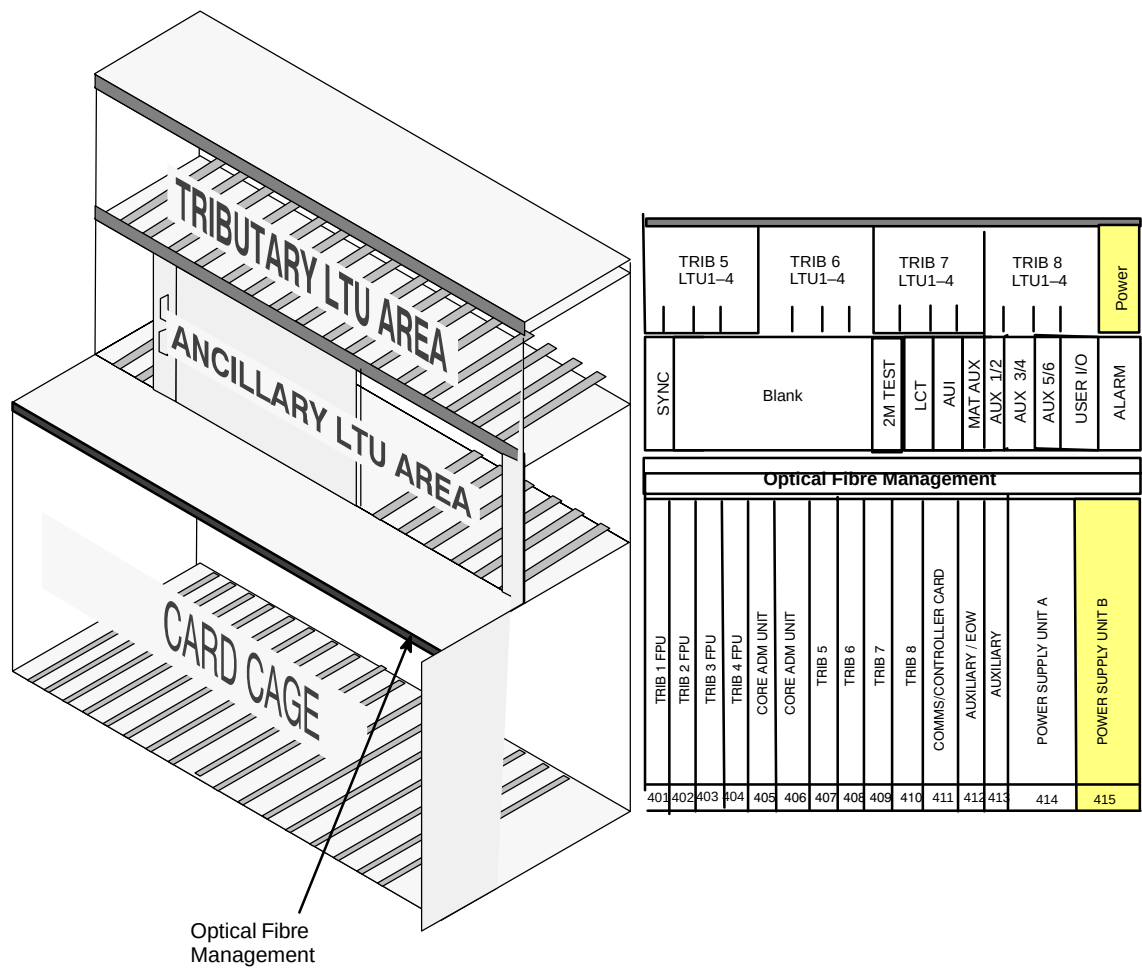


Figure 30.1 SMA–1/4(4+4) Sub-Rack Arrangement

30.6.2 SMA–1/4(8) Subrack (1HAG60594AAP)

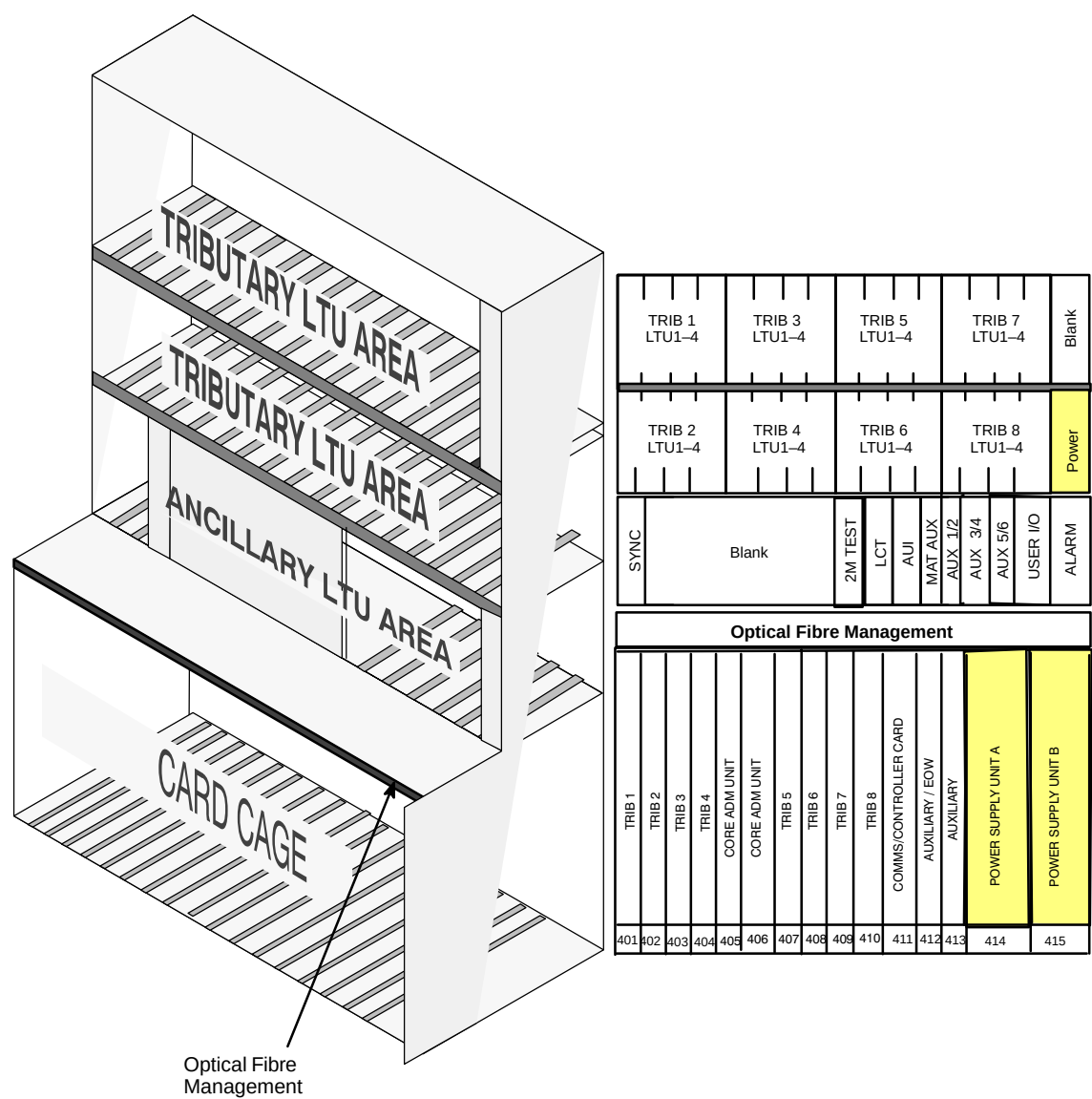


Figure 30.2 SMA–1/4(8) Sub–Rack Arrangement
Note: Unless otherwise stated, all connectors referred to are on separate Ancillary LTUs.

30.7 BASIC INSTALLATION SEQUENCE

For reasons associated with safety and access it is recommended that the following restrictions on the sequence of installation operations are observed:

- Fit the sub–rack into the main rack before equipping the sub–rack with cards. The weight of a sub–rack fully equipped with cards will exceed 18 kg.

- Fit the power LTU before connecting external power. The battery supplies must be disconnected before removal of this LTU.

Note: PSUs do not require external connection. It should be noted however, that the PSUs have a mechanical interlock device which ensures that the unit cannot be inserted (or withdrawn) unless the On/Off switch is in the Off position.

- Make the Power, Traffic interface and Ancillary area connections before equipping the sub-rack with cards.

30.7.1 Fitting the Sub-Rack

A subrack mounting kit of parts for the SMA–1/4(4+4) and SMA–1/4(8) is available depending on the type of equipment rack used. 1MBB60887AAS is the preferred option for ETSI racks and 1MBB60888AAU for 19 inch racks.

The sub-rack should be positioned and aligned with the rack locating pegs on the rack and fixed to it by M6 screws. All of the cards and cables are supplied separately, and should be fitted/connected as explained in this chapter.

Note: Before installing any cards into the shelf, connect the external power supply leads, and the Rack Alarm cable (TEP1E only) to the alarm connector. They should be fitted in the connector area. The external cables should then be connected.

30.7.2 Ancillary Connections

All external sub-rack connections, except those made to the cards themselves, are made via a series of separate Ancillary Line Termination Units (LTUs).

Note: When populating a subrack for the first time, it is advisable to ensure that all units are fully inserted before tightening any of the knurled securing screws.

30.7.3 Ancillary and Traffic Blanking LTU Facias

Ancillary and/or traffic blanking LTU facias need to be fitted as appropriate to the areas labelled “Blank” in Figure 30.1 and Figure 30.2. These facias are listed in Table 30.1.

Table 30.1: Ancillary and Traffic Blanking LTU Facias				
Position to Fit	Size	Description	Code	Subrack
Slot 117	1.2"	Grey Facia	1MAE61753AEY	SMA1/4(8)
Slot 117	1.2"	Silver Grey Facia	1MAE61933ACW	SMA1/4(8)
Slots 302–307	6.0"	Grey Facia	1MAE61767ABV	SMA1/4(4+4)(8)
Slots 302–307	6.0"	Silver Grey Facia	1MAE62791AAG	SMA1/4(4+4)(8)

30.7.4 Fuses and Circuit Breakers

The fuses for each of the –48V supply feeds to the equipment sub-rack should be anti-surge, rated at 10A (GPT code 1CFA20033AHY), or a circuit breaker with a rating of 10A (GPT code 1CFB20019AAW). The 10A rating type II circuit breaker should be used with a DIN to G rail adapter (GPT code 1MAA20442AAV).

Alternatively or a Siemens circuit breaker with a rating of 8A may be used if appropriate, the Siemens code is V42278–Z52–A10. The connecting cables should have a minimum 10A continuous rating.

Note: A 20A fuse rating is recommended for a dual feed LTU when the rack is fully loaded using appropriate connecting cables.

30.8 CARD CONFIGURATION

Table 30.2: SMA–1/4(4+4) and SMA–1/4(8) Subrack Configuration		
Slot Position	Slot Name	Card Options
401	TRIB1 (Trib Position 1)	For SMA–1/4(8), any Series 4 tributary card. For SMA–1/4(4+4), any Series 4 tributary card not requiring LTUs (ie Front Plug Up tributary)
402	TRIB2 (Trib Position 2)	For SMA–1/4(8), any Series 4 tributary card. For SMA–1/4(4+4), any Series 4 tributary card not requiring LTUs (ie Front Plug Up tributary)
403	TRIB3 (Trib Position 3)	For SMA–1/4(8), any Series 4 tributary card. For SMA–1/4(4+4), any tributary card not requiring LTUs (ie Front Plug Up tributary)
404	TRIB4 (Trib Position 4)	For SMA–1/4(8), any Series 4 tributary card. For SMA–1/4(4+4), any Series 4 tributary card not requiring LTUs (ie Front Plug Up tributary)
405	CORE CARD SLOT	Core ADM Card (any variant)
406	CORE CARD SLOT	Core ADM Card (any variant)
407	TRIB5 (Trib Position 5)	Any Series 4 tributary card.
408	TRIB6 (Trib Position 6)	Any Series 4 tributary card.
409	TRIB7 (Trib Position 7)	Any Series 4 tributary card.
410	TRIB8 (Trib Position 8)	Any Series 4 tributary card.
411	COMMS/CONTROLLER SLOT	Comms/Controller Card
412	AUX 1 (Auxiliary Card 1)	Auxiliary 0/0.1
413	AUX / EOW (Auxiliary Card 2)	Auxiliary 0/0.1/EOW
414	PSU A (Power A)	PSU
415	PSU B (Power B)	PSU

Note: 1. See the chapter on Slide–In Card Units for further information on cards.

2. See the chapter on Optical Modules for further information on optical modules which can be fitted to Core Cards and Dual STM–1 Cards.

30.9 PSU, COMMS/CONTROLLER CARD, CORE CARD SWITCHING AND ROUTEING FUNCTIONS

30.9.1 Power Supply Unit (1HAK60669AAW)

Power Supply Units are fitted in slots 414 and 415. In the case of Power Supply Units the terms 'operational' and 'standby' are not strictly applicable, all units are used in parallel and if one fails the other(s) can maintain the supply. Power LTUs must be fitted according to the equipping scheme. A PSU is illustrated in Figure 30.3.

30.9.1.1 PSU Protection

PSU protection is provided as standard on SMA–1/4(4+4) and SMA–1/4(8).

30.9.1.2 Power LTUs

A Triple Feed Power LTU 1HAM60778ABH is supplied as standard, featuring a Power D–Type 8W8 connector for triple power inputs and three station supply green LEDs.

A Dual Feed Power LTU 1HAM60779ABK containing 2 off Power D–Type 3W3A connectors for both power inputs, there are two station supply green LEDs.

Note: Should a Dual Feed Power LTU be used, the current drawn will be higher in each power lead than a corresponding Triple Feed Power LTU.

30.9.2 Comms/Controller Card (1HAT60876AAP)

One Comms/Controller Card (illustrated in Figure 30.3) is required per SMA shelf. The Card also carries the System Memory (previously held on SMCs (System Memory Cards)). The microprocessor based controller card carries out the core control functions within the SMA–1/4(4+4) and SMA–1/4(8) equipment. It also carries out the communications functions previously carried out by separate communications cards. The Card receives commands and status requests from one of three sources:

- From a Local Terminal connected via the 'F' interface
- From messages carried in the embedded DCC control channels of an STM1 line signal via the overhead access buses (Qecc I/F)
- From an Element Manager via the 'Q' interface and the message passing interfaces which reside between the Mux Controller function and Comms function.

CAUTION

The Comms/Controller Card must not be removed from the sub-rack when its amber LED is flashing (i.e. when it is performing a write sequence), this can cause EEPROM corruption.

There are no external connections. If the sub-rack power supply is on at the time the card is inserted, the Comms/Controller Card will go into a start-up process which may take up to ten minutes. For the duration of this process the amber LED on the card will be flashing then lit steady when completed.

A Comms/Controller card may be removed and the original card immediately replaced with no additional action other than resetting of the time clock. All communications will be lost on removal of the card, re-fitting the card will restore the communications. Should a replacement card be fitted then the procedure detailed in the Card Replacement section of the Maintenance Manual should be followed.

Note: The User Alarms LTU, 1HAM60782AAS, (if required) should be inserted into a shelf **before** powering up. (If it is inserted into a live shelf it will cause the Comms/Controller Card to reset. See section 23.4.7.)

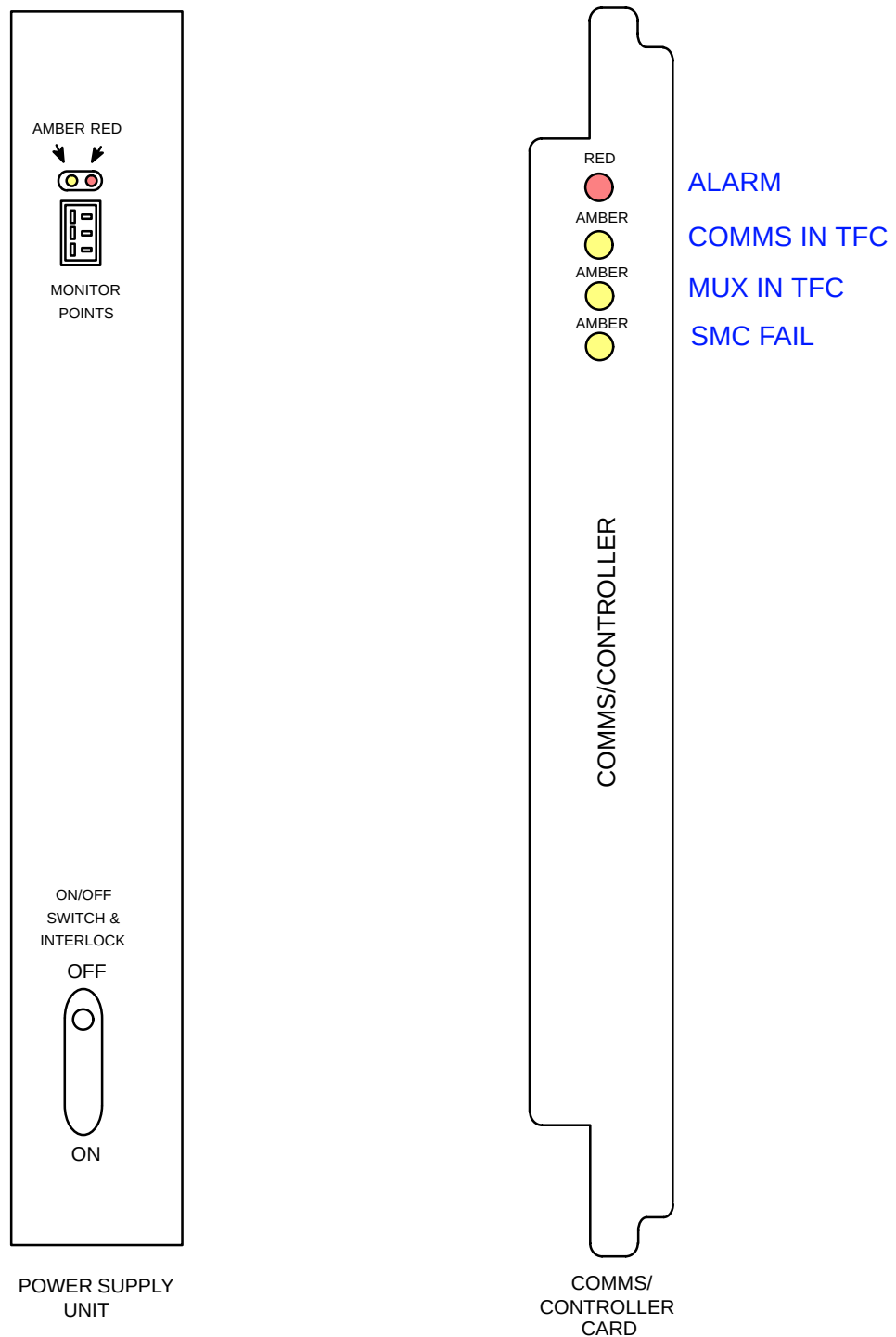


Figure 30.3 PSU and Comms/Controller Card Front Layout

30.9.3 Core Card Switching and Routeing Functions

Switching functions and switching protection are provided on the Core Card and not on separate switch cards. This includes all switch core processing, tributary interface conversion, synchronisation and microprocessor dc to dc conversion.

Routing functions (eg between Line cards and tributary cards) are also provided on the Core Card. The Core Card also provides the multiplexer timing generator, timing synchronisation source selection and timing distribution for both the internal traffic interfaces and the outgoing STM–N Line signals.

30.10 SMA–1/4 (4+4) AND SMA–1/4(8) SOFTWARE

30.10.1 Software

Details of SMA–1/4(4+4) and SMA–1/4(8) software are given in Table 30.3. A Software Upgrade Information document is supplied with each Series 4 release. Table 30.3 also shows LCT software. Note that LCT software is common to all Series 4 products.

Table 30.3: SMA–1/4(4+4) and SMA–1/4(8) Software			
Code	Release	Name	Comments
1HGC60867AAY	R1.1.2	SMA–1/4(4+4) and SMA–1/4(8) Software	TEP1E Alarm Scheme
1HGC60933AAB	R1.1.2r2	SMA–1/4(4+4) and SMA–1/4(8) Software	TEP1E Alarm Scheme
1HGC60919AAJ	R1.1.3	SMA–1/4(4+4) and SMA–1/4(8) Software	TEP1E Alarm Scheme
1HGC60868AAB	R1.1.2	SMA–1/4(4+4) and SMA–1/4(8) Software	BW7R Alarm Scheme
1HGC60934AAD	R1.1.2r2	SMA–1/4(4+4) and SMA–1/4(8) Software	BW7R Alarm Scheme
1HGC60920AAE	R1.1.3	SMA–1/4(4+4) and SMA–1/4(8) Software	BW7R Alarm Scheme
1HGC60923DAB	R1.1.2	LCT Software	
1HGC60921DAW	R1.1.3	LCT Software	
1QDE61748AAJ		Software Upgrade Information	For all Series 4 products

30.10.2 System Memory KOP

Software for all cards (excluding VC–AM, CellSpan, PacketSpan) is held on a System Memory Card (SMC), which is programmed in the factory and is supplied as the System Memory KOP within the Core. For VC–AM, the software is held on the VC–AM card and not on the System Memory card.

A different KOP is required, one per subrack, depending on the alarm scheme employed (Bw7R or TEP1E) and is ordered specific to release and alarm requirements. All the parts are fitted during factory or site installation. Application software is downloaded to Traffic cards from the System Memory Card when the subrack is commissioned,. A Software Upgrade Information document is supplied with each release which covers all the Series 4 SMAs.

30.10.3 System Backup Software

System Backup Software (ordered specific to release and alarm requirements) is available on CD-ROM, containing the System Memory Software for downloading from the Local Terminal or EMOS (VC-AM software is included).

30.10.4 Local Terminal Software

The Local Terminal Software is executed from the hard-disk on the PC to provide the Local Terminal functions for the SMA. The software is supplied on CD-ROM and should be ordered specific to requirements.

30.11 EMC COVERS

To maintain EMC screening integrity, a range of dummy covers, in sizes to fit specific card-cage slots, and a Traffic LTU Dummy for use in the traffic interface area, are available. Details are given in the following table:

Table 30.4: EMC Panels			
Position to Fit	Size	Plain	With Grey/Silver Grey Facia
Card EMC Covers			
Slot 412: Aux Card Slot 413: Aux/EOW Card	19.62mm (0.8")	1MBA61102AAX	1MBA61102 ABQ/ACH
Slot 401 to 404: Tributary Cards Slot 407 to 410: Tributary Cards Slot 411: Comms/Controller Card	24.7mm (1.0")	1MBA61103AAA	1MBA61103 ABS/ACK
Slots 405 and 406: Core Cards Slots 414 and 415: PSU A and B	55.2mm.(1.4")	1MBA61104AAC	1MBA61104 ABU/ACM
Traffic LTU EMC Covers			
All associated Trib LTU slots	24.7mm.(1.0") Same size as one traffic LTU.	1MBA61366BGM	1MBA61366 BLG/CFR
All associated Trib LTU slots	50.1mm.(2.0") Same size as two single traffic LTUs.	1MBA61395BAB	1MBA61395 BBT/BCL
Completely unused Trib position	100.9mm.(4.0") Same size as four single traffic LTUs.	1MBA61396BAD	1MBA61396 BBV/BCN
Ancillary LTU EMC Covers			
Auxiliary, EOW, Sync and User Alarms LTU.	24.7mm.(1.0") Same size as one traffic LTU.	1MBA61366BHE	1MBA61366 BMY/CEY
Rack Alarms LTU	55.2mm.(2.2") Same size as one traffic LTU.	1MBA61381BBU	1MBA61381 BCM/BDE

30.12 ETHERNET CONNECTIONS

30.12.1 Ethernet Network Specifications

The following table gives the 10Base5, 2 and T network specifications.

Table 30.5: 10Base5, 10Base2 and 10BaseT specifications			
Item/parameter	10Base5 (thick)	10Base2 (thin)	10BaseT
Data rate	10Mbit/s baseband	10Mbit/s baseband	10Mbit/s baseband
Segment length max	500m	185m	100m
Network span max	2500m	925m	–
Nodes per segment max	100	30	–
Node spacing	2.5m	0.5min	–
Capacitance per node	4pF max	8pF max	–
Cable	0.4" dia, 50Ω, double shielded, rugged	0.2" dia, 50Ω, single shielded, flexible	24 AWG telephone wire, twisted pair (x2)
Connectors	Beesting or N series	BNC	RJ45

30.12.2 'Thick Ethernet'

'Thick' Ethernet – uses coaxial cable, tapped by 'Beesting' junctions or 'N' series interconnectors, mounted on 10Base5 Transceivers at each 'drop' point. The drop cables connect directly into the AUI port of the SMA or Element Manager.

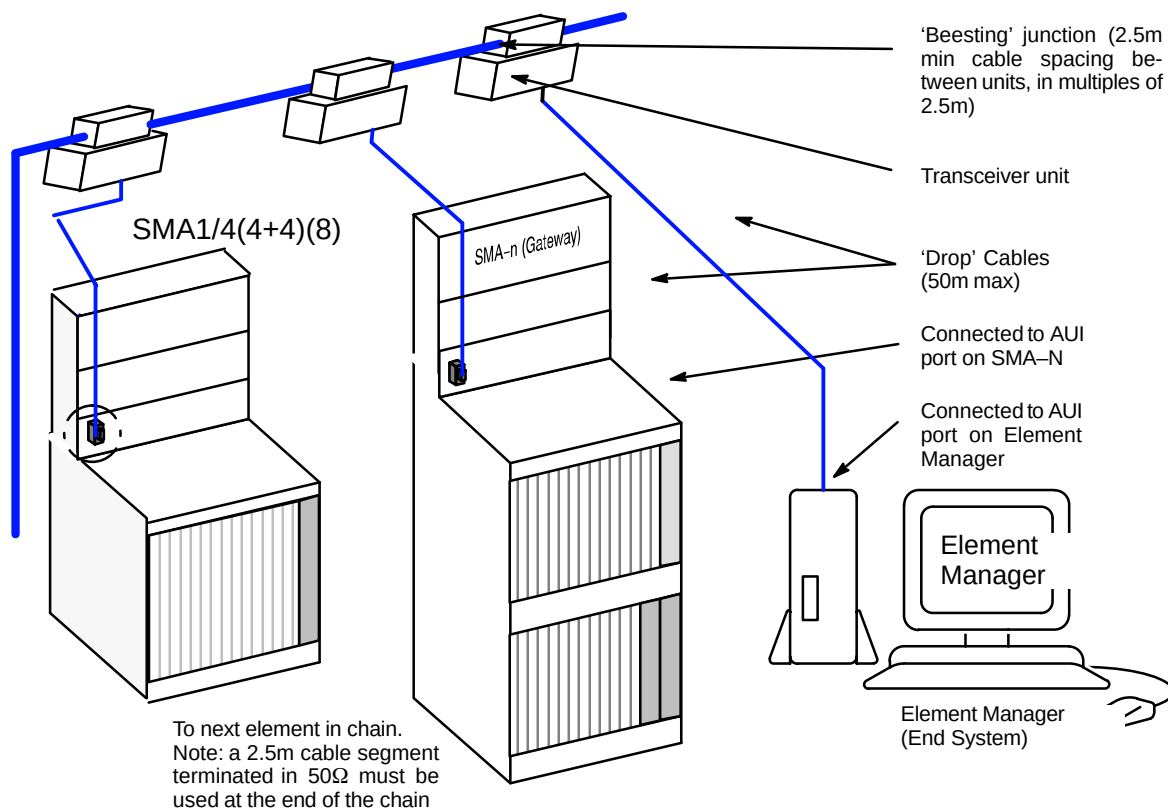


Figure 30.4 'Thick' Ethernet Connections

30.12.3 'Thin' Ethernet

'Thin' Ethernet – uses coaxial cable interconnected by BNC 'T' junctions, on 10Base2 Micro-transceivers which are connected directly to the element AUI port.

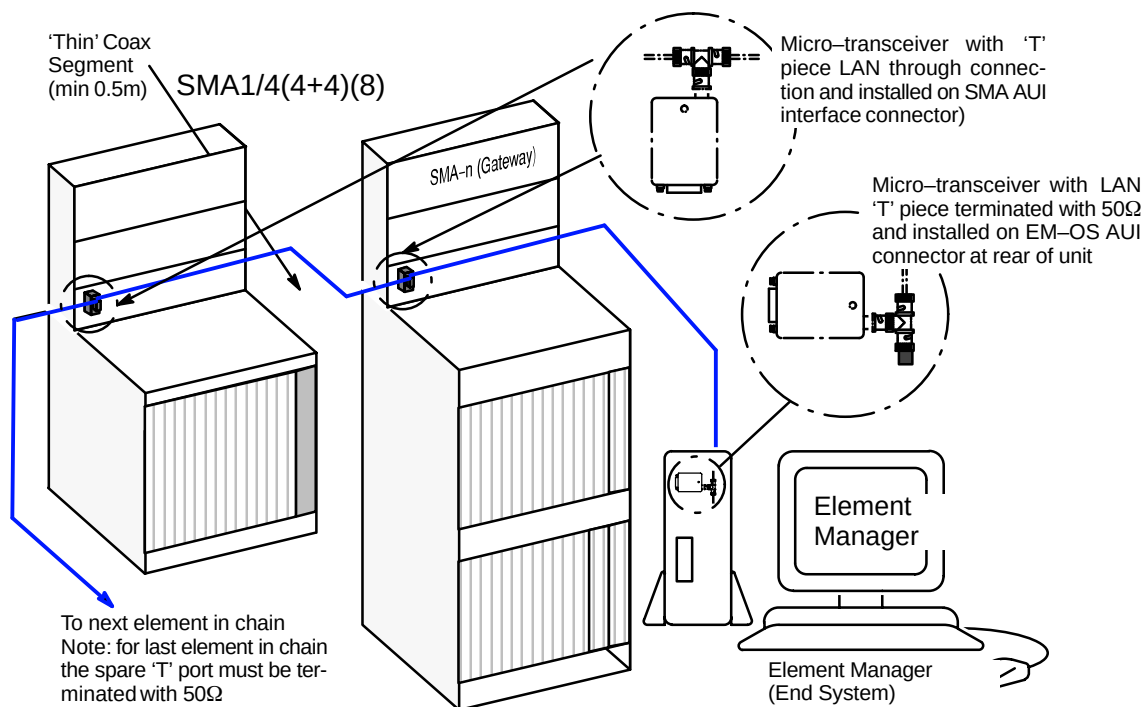


Figure 30.5 'Thin' Ethernet Connections

30.12.4 10BaseT Ethernet

10BaseT Ethernet – All NEs on Ethernet Link connected in star configuration via Network Hub using UTP cables terminated with RJ45 connectors

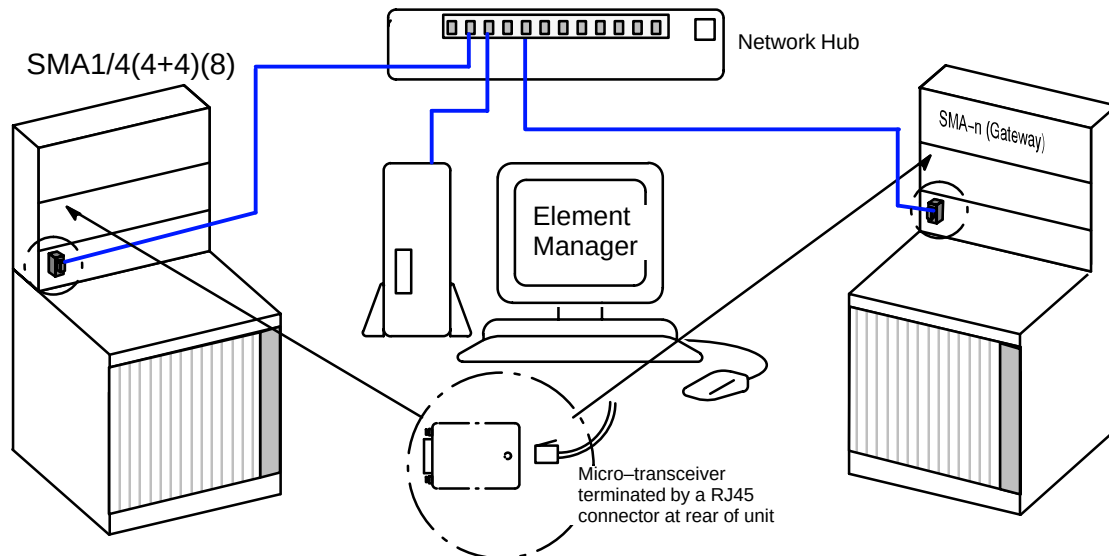


Figure 30.6 10BaseT Ethernet using UTP cables and a Network Hub

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

CHAPTER 31: SMA UPGRADE INFORMATION

CAUTION

The whole of the relevant procedure for the task to be performed, as given in this chapter, must be read and fully understood before any upgrade (or downgrade) is performed.

To upgrade equipment requires the installation and commissioning of replacement Slide-in Card Units. It may also require the fitting of a further Power Supply Unit. This information should be supplied by the network planning authority. Care should also be taken to ensure, wherever possible, the following occurs:–

- The time that the equipment is left without the EMC dummy covers is minimised
- Traffic down time is minimised by re-routeing traffic during the upgrade process.

31.1 STM–1 OPTICAL MULTIPLEXER, STM–4 OPTICAL INTERFACE CARD SAFETY

CAUTION

The STM Optical Multiplexer or Optical Interface Cards **must** not be removed from the sub-rack or disconnected without firstly taking into consideration the Optical Safety rules outlined in Safe Working Practices section of this manual and relevant Card Replacement details in the associated Local Terminal (LCT) Operator Manual. Optical Safety precautions and relevant information which is outlined in the Card Installation section must also be observed before performing an upgrade or downgrade.

The area that is to be used must have:–

- Sufficient grounding points to provide a safe ESD environment.
- Suitable mains power supply.
- Suitable dc supply (60V 5A).

31.2 PROTECTION

Where 1+1 MSP line protection has been utilised this **must** be disabled, the protection cards unconfigured and removed at both ends of the line section before upgrade commences.

31.3 SMA–1/4CP STM–N UPGRADE



WARNING

For safety reasons, the power supply for the SMA–1/4CP must be switched off before the following optical module upgrade procedure is carried out. The power supply must only be reconnected after the optical module has been changed – see Figure 31.1.

The EM/LT allows an STM–N section to be upgraded, not in service, between STM–1 and STM–4 operation.

The user can upgrade whilst maintaining the existing cross–connection configuration i.e. without having to logically delete all associated cross–connections and then having to re–apply them.

The upgrade, carried out on a per section basis, is achieved as follows:

- a. Divert traffic from the STM–N ports forming the section to be upgraded.
 - If possible, the user should re–route the traffic, via spare (i.e. unused) capacity or protection capacity (e.g. through the application of forced/manual switching), onto a physically diverse section. The module cannot be protecting traffic, so the user must remove all protection configuration for that line. If MSP is configured for that Line, then the Upgrade option is not allowed. However, if SNCP is supported on that line, the Upgrade option is allowed.
- b. Physically replace the STM–N Card/Unit.
- c. Configure the STM–N Card/Unit.
 - If the STM–N card/unit is selected as a source in any of the synchronisation priority tables then the user is required to reconfigure the priority tables as part of the upgrade procedure.
 - The user has the option to upgrade the slot(s) for the new STM–N card/unit. That is, the user can upgrade between STM–1/4 modules without having to logically delete all associated cross–connections, delete cards/unit, add cards/units and add cross–connections. The upgrade allows the user to maintain existing cross–connection configuration.
 - The mappings used are fixed as follows:
 - East/West module
 ⇒
 STM–1
 - Alternatively, the user can reconfigure cross–connections.
 - Alarms are identified to the STM–1 stream, within the STM–N signal to which it pertains, through the use of alarm descriptors.

d.Restore traffic to new STM–N section.

Note the following points:

- There is one build of software for STM–1 and STM–4 line modules.
- The Line modules are not in–service replaceable, but field replaceable. The Unit has to be powered down before the modules are replaced.
- The operation of mixed STM–N line interfaces is allowed (e.g. Line East operating at STM–1 and Line West operating at STM–4).

Figure 31.1 highlights the process for performing a Line module upgrade.

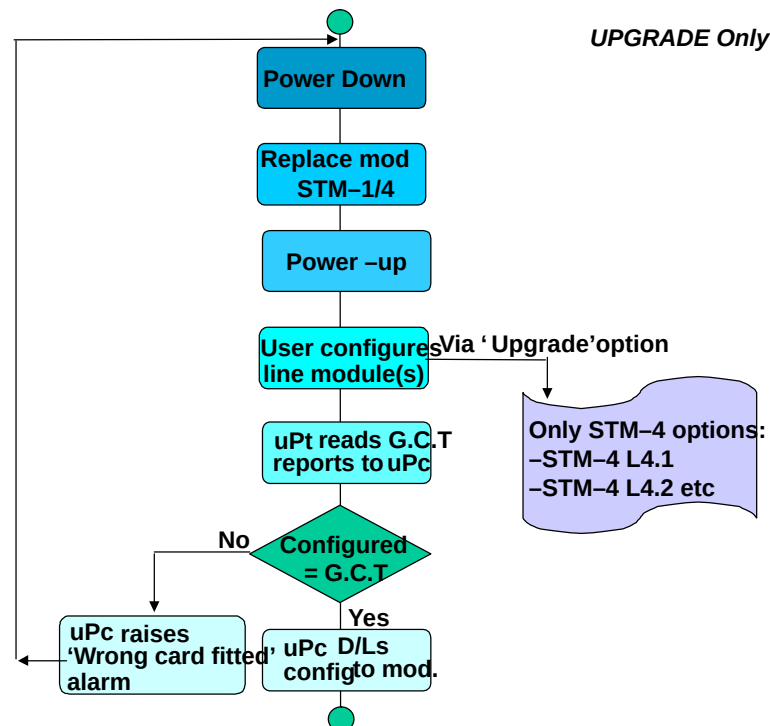


Figure 31.1 Process for Performing Line Module Upgrade

Note: MSP needs to be disabled before an 'Upgrade' can be configured. The CCF will reject the upgrade message if MSP is enabled.
Upgrade shall be allowed if SNC protection is configured.
The upgrade option is only available from LT.

31.4 SMA–1/4C, /UC AND SMA–1/4(4+4)(8) STM–N UPGRADE

In contrast to SMA–1/4CP, SMA–1/4(4+4)(8) and SMA–1/4c/uc can be upgraded in–service from STM–1 to STM–4.

The user can upgrade, whilst maintaining the existing cross–connection configuration i.e. without having to logically delete all associated cross–connections and then having to re–apply them. Upgrade from STM–1 to STM–4 results in existing connections being in STM–1.

Note the following points:

- There is one build of software for STM–1 and STM–4 line modules. This is required for upgrade.
- The Line modules are 'service' replaceable. The Core Cards have to be removed from the shelf before the modules are replaced but traffic continues on the protection card.
- The operation of mixed STM–N line interfaces is allowed (e.g. Line East operating at STM–1 and Line West operating at STM–4). This also applies between the A and B interfaces.
- Any MSP or Core Card protection must be removed before the Upgrade sequence can begin.

In outline the upgrade procedure is shown below.

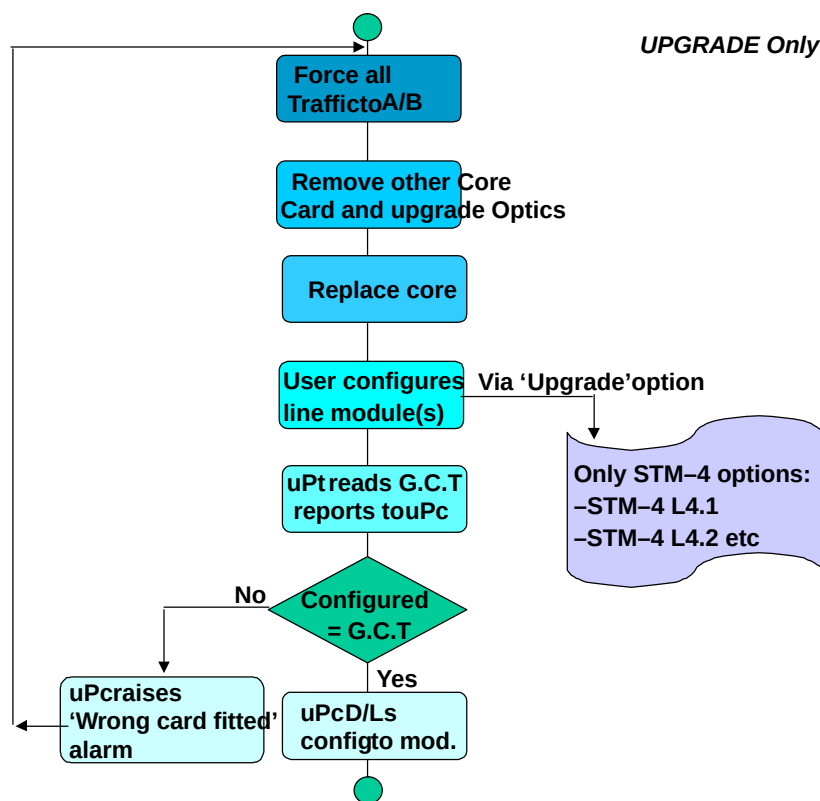


Figure 31.2 STM–N Upgrade Procedure

After upgrade any existing traffic will be in STM–1 of the STM–4.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

SECTION 6: COMMISSIONING PROCEDURE

CHAPTER 32 COMMISSIONING PROCEDURE Page 467

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CHAPTER 32: COMMISSIONING PROCEDURE

32.1 INTRODUCTION AND SCOPE

This chapter details the tests to be performed when commissioning a Marconi SMA type Synchronous Digital Multiplexer.

The tests detailed are intended to demonstrate that the equipment is functionally operational and no damage has occurred during transportation or installation.

32.2 SAFE WORKING PRACTICES

Safe working practices as described at the beginning of the section on Installation Information must be adopted when working on this equipment.

32.3 CLEANING PROCEDURES FOR OPTICAL CONNECTORS

It is essential that all fibre optic mating surfaces are kept scrupulously clean. If the optical couplers are disconnected for any length of time ie more than a simple disconnect/reconnect, then the instructions for cleaning optical connectors detailed in the section on Maintenance Procedures should be carried out. Contamination of the mating surfaces can have serious detrimental effects on performance.

32.3.1 Optical Measurements

It is important to use only calibrated non-attenuating SM optical fibre test leads fitted with the appropriate connectors.

32.3.2 Static Sensitive Warning

Equipment referred to in this specification contains static sensitive devices therefore an **ESP** wristband **MUST** be worn and clipped to the rack at all times.

32.4 TEST EQUIPMENT

The following items of test equipment will be required during commissioning tests.

- a) A PDH Pattern Generator/Error Detector, with bit by bit comparison, capable of operating at 2, 34, 45 and 140 Mbit/s. Suitable instruments are the Wandel & Goltermann PF4 or ANT-20, or the Hewlett Packard 3764A.

Note: The instrument in (a) should be capable of monitoring errors over a 24 hour period with an associated printout of the result.

- b) A Single Mode Optical Power Meter with a wide area sensor capable of operating in the range 0 to –50 dbm at 1300nm–1550nm, such as the Photodyne 2250XF. It should also have a suitable optical patch cord.
- c) A Single Mode, Variable or Fixed Optical Attenuator capable of operating in the range 12dBm $\pm$ 2dBm at a wavelength of 1300nm–1550nm.
- d) A Personal Computer to be used as the LCT and as specified in the LCT Operator Manual, together with suitable LCT cable
- e) One optical patch cord per Optical Multiplexer fitted in the shelf.
- f) Suitable coaxial test cords.

Note: All instruments must conform to the appropriate safety regulations and have valid calibration certification.

32.5 PRELIMINARY SMA EQUIPMENT CHECKS

CAUTION

The following checks assume that the SMA rack is yet to be powered up. **Do not** power up the rack until instructed to do so in the following text.

32.5.1 Visual Inspection

The equipment is to be visually inspected to ensure that it has not suffered any obvious damage during transportation or installation.

32.5.2 Card/LTU Link and Switch Settings

Check that the link and switch settings are as detailed in the sections on Line Termination Units and Slide-in Card Units.

32.6 POWER SUPPLY CHECK

32.6.1 Fuse Rating

The fuses for each of the –48V supply feeds to the equipment sub-rack should be rated at 10A (anti-surge). Alternatively a circuit breaker with a rating of 10A is available, the GPT code is 1CFB20019AAW or a Siemens circuit breaker with a rating of 8A may be used if appropriate, the Siemens code is V42278–Z52–A10.

Note: A 20A fuse rating is recommended for a dual feed LTU when the rack is fully loaded using appropriate connecting cables.

32.6.2 Power Connector Wiring

Check that the shelf power connector is wired correctly.

32.7 SHELF CONFIGURATION

The shelf should only be populated with such cards and LTUs as required in accordance with the shelf configuration tables listed in the section on Slide-In Card Units.

32.8 SYSTEM POWER-UP

CAUTION

The following restrictions, regarding switching the Power Supply Units on or off, should be observed during system power-up:

- A PSU must not be switched off (whether or not one of a group) when the Comms/Controller Card amber LED is still flashing (i.e. during the period it is performing a write sequence). Such an action is likely to result in corruption of the Controller EEPROM data.
- When more than one Power Supply Unit is fitted, they should not be switched between the On/Off states in rapid succession as such action can cause a 'Laser Trip' condition on the Optical Cards.
- **The power-up sequence MUST be followed ie A,B,C.** Failure to use the correct sequence may result in partial powering of unsupplied cards through logic connections and the Local Terminal (LCT) failing to communicate with the Comms/Controller card. Should this occur, a re-commissioning sequence, as detailed in the LCT Operators manual should be undertaken. This will cause all previous connections to be lost.

Procedure 1: Powering up an SMA

To power-up the SMA correctly, take the following steps:

1. Apply power to the Sub-rack and check that the primary supplies are present, this is indicated by the Green LEDs on the Power LTU.
2. Switch PSU A on.
3. Check that the Amber power LED is lit and the Red LED extinguishes. If the Red LED remains lit and the Power LTU indications are correct, switch the unit off immediately and remove it from the shelf.
Do not leave a Power Supply Unit in the shelf if the Red LED remains lit after switching on.
4. If the LED indications for PSU A are good, switch PSU B on (if fitted) and repeat the LED checking procedure for PSU B as in 3.

Note: Where there is more than one PSU specified in the rack configuration, ensure that all the PSUs are powered-up within ten minutes of each other; i.e., whenever possible, do not leave a single PSU powering the whole rack for any longer than is required to correctly follow this powering-up procedure.

Note: Immediately after power-up, the sub-rack cards will undergo an initialisation period controlled by the Comms/Controller Card. During this period, it is normal for a number of the card LEDs to flash on and off. This process stops when the Comms/Controller Card has completed its initialisation cycle.

32.8.1 Power Supply Monitor Points

! ALERT/CAUTION

Early models of the SMA-1/4c PSU (1HAK60729AAS) may have the monitor points inverted ie facia reads +12.5V actual measured -12.5V.

Measure the voltage level at the PSU monitor points and ensure that they meet the limits given in Table 32.1.

Table 32.1: Voltage Limits	
Supply	Limit
+5.5V	$\pm 0.1V$
-5.7V	$\pm 0.1V$
+12.4V	$\pm 0.2V$

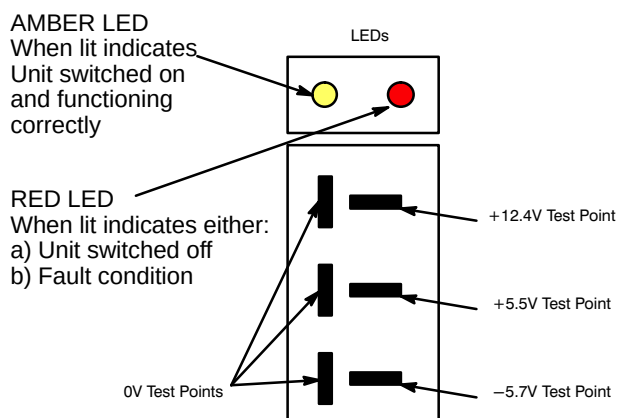


Figure 32.1 PSU Front Panel LED Indications and Monitor Point

32.9 EQUIPMENT CONFIGURATION

The shelf and cards should be logically configured and brought to the operational state by use of the LCT (Refer to the LCT Operator Manual for the correct procedures). Configuration can also be carried out remotely from any other SMA element on the same network (provided the Comms/Controller Card has previously been commissioned locally).

Note: During commissioning the **Sync Mode** defaults to **Freerun**.

Note: The Comms/Controller must be initially configured in order to recognise the presence of cards in the shelf. If a card is being configured with the Comms/Controller in the off-line state then a 'Card missing' message will be displayed even if the card is present in the shelf. The Comms/Controller is brought 'on line' at the end of commissioning by bringing the N.E. 'on-line'.

32.10 FUNCTIONAL CHECKS AT SMA NODES

The followings checks should be made on each SMA, prior to connection into the network.

Procedure 2: Alarm Checks

Refer to the relevant LCT Operator and Maintenance Manual for instructions on displaying and interpreting system alarms.

32.10.1 Alarm Clear Check

Set the date and time for the SMA.

The following alarms will need to be inverted to make the SMA appear 'Alarm Free'.

- a) Invert all equipped Tributary 'Loss Of Trib Input' alarms.
- b) Invert the 'LAPD Disconnected alarms'.

The SMA should now appear 'Alarm Free', any alarms that are still raised should be investigated and cleared before proceeding further.

Procedure 3: Traffic Path Integrity

In order to check for traffic path integrity PRBS signal can be injected into a Tributary LTU input and monitored at the Tributary output.

This test should be carried out on at least one port from each of the equipped Tributary Cards.

1. Using suitable optical test leads, loop the LINE WEST A Transmit and the LINE WEST A Receive optical ports via a **12dBm ± 2dBm** attenuator .

2. Referring to the LCT Operator Manual, make cross-connections from Line West to the Trib port under test.
3. Apply an HDB3 2¹⁵–1 PRBS (2/34Mbit/s Tribs) or CMI 2²³–1 PRBS (140Mbit/s Trib) to a Tributary I/P appropriate to the card under test and set the appropriate 'Loss of Trib Input' alarm to normal.
4. Check that error free PRBS is present at the port O/P.
5. Repeat the procedure for each of the Trib/Line cards fitted.

Procedure 4: Stability Period

With the SMA set up as in Procedure 3, monitor the error performance of the PRBS signal for a period of one hour. There should be no errors.

The PRBS signal should remain error free for the duration of the 1 hour stability period and no alarms should occur.

If any alarms or errors occur, the cause should be investigated and cleared and the stability run repeated.

32.11 NETWORK CHECKS

Following the completion of the functional checks, the SMA node should now be interconnected into the network configuration as required by the customer (refer to the network diagram applicable to the contract). The SMA will be configured as per the customer requirement by referring to the information supplied by the appropriate Network Operating Authority.

6. Reconnect the Rx optical fibre tail to the Optical I/P of the card.

32.11.1 Information Required from the Network Operating Authority

The appropriate Network Operating Authority are responsible for providing the following information prior to interconnecting the SMA into the network:

- a) The Ethernet MAC address if the SMA node is a Gateway.
- b) The Local NSAP Address for the SMA node.
- c) The timing and synchronisation information for the SMA node.
- d) The LAPD configuration for the SMA node.
- e) If applicable, fibre loss figures for the network that the SMA node is to be connected into.

32.11.2 Element Manager

Refer to the Element Manager User Manual as necessary for the following checks.

32.11.2.1 Remote SMA Communication

Verify that the Element Manager can remotely communicate with and exercise the SMA.

32.11.2.2 Remote SMA Alarm

Verify that an alarm is raised at the element manager in response to a failure at an SMA in the system.

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SECTION 7: MAINTENANCE

CHAPTER 33 GENERAL MAINTENANCE INFORMATION ... PAGE 477

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CHAPTER 33: GENERAL MAINTENANCE INFORMATION

33.1 INTRODUCTION

The procedure for identifying and replacing faulty cards is located in the associated Maintenance manual. The rest of this chapter covers cleaning procedures for optical connectors.

33.2 CLEANING PROCEDURES FOR OPTICAL CONNECTORS

33.2.1 General

All optical fibre connectors must be treated with the utmost care and a very high standard of cleanliness maintained, otherwise their performance may be seriously affected.

As soon as a connector is disconnected the free ends must be protected with dust caps.

All optical connectors must be inspected immediately before a connection or re-connection is made and cleaned if necessary.

WARNING

Before any inspection of an optical connector it is essential that the electrical power supply to the laser is disconnected. This is achieved by removing the optical unit concerned. This must be confirmed by using an optical power meter to ensure there is no optical power present at the connector before using the microscope.

33.2.2 Materials Required

- Microscope with adapter suitable for connector type.
- Suitable Optical Power Meter capable of measuring 1300nm–1550nm (± 50 nm). The optical interfaces on the cards conform to those outlined in G.957 and G.958.
- Appropriate Optical Test Leads.
- Optical Cleaning Kit.
- Lint Free Anti-static Lens Tissues
- Cotton Buds
- Approved Cleaning Solvent
- Anti-static Aerosol Dust Remover

33.2.3 Cleaning Procedures

33.2.3.1 Inspection

Inspect the connector using the microscope.

The two main dirt problems affecting optical connectors are dust and the grease to which dust can stick. Dust appears as lumps, flakes or possibly fibres (from clothes or hair). Grease appears as smears or 'blobs' and is most commonly introduced from the fingertips.

Where possible the sides as well as the end of the ferrule should be inspected for serious scores or scratches (visible to the naked eye). The ferrule end should then be inspected using the microscope.

Particular attention should be given to the core area of the fibre. If the fibre end is generally smooth and free from cracks the ferrule is acceptable. Slight chipping in the cladding is permissible, but not obvious cracks or any damage that extends into the core area.

There will always be some score marks present on the ferrule end-face since all of these connectors are of the epoxy/polish type. However, obvious deep score marks are usually evidence of damage by foreign bodies. If these marks are pronounced or extend near to or into the fibre then the connector should be rejected and the fibre end re-terminated.

33.2.4 Cleaning of Optical Connector

Blow dust clear from the connector using the aerosol dust remover.

Inspect the connector again. In the case of persistent dirt or grease (finger marks etc) apply a small amount of solvent from a dispenser onto a tissue then wipe the plug with the tissue.

Blow the connector dry and clear of dust using the aerosol dust remover.

Re-inspect connector and repeat the cleaning procedure if necessary.

33.2.5 Cleaning of Optical Coupler – Where Practical

Blow dust clear from the coupler using the aerosol dust remover.

Inspect the coupler again. In the case of persistent dirt or dust use a clean dry tissue (or cotton bud) to remove.

Note: Do not use solvent on couplers

Blow the coupler dry and clear of dust using the aerosol dust remover then re-inspect the coupler.

Repeat the cleaning procedure if necessary.

◆◆◆◆◆ END OF CHAPTER ◆◆◆◆◆

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GLOSSARY OF TERMS

A

Access Network	A system implemented between the Local Exchange(LE) and user, replacing part or whole of the local line distribution network
Access SDH	The general term applied to the range of new SDH multiplexers which includes: SMA–1/4CP (Customer ADM), SMA–1/4c (Compact ADM), SMA–1/4(4+4) (midsize ADM) and SMA–1/4(8) (fullsize ADM).
Acknowledge	Alarm state applied to individual alarms from the Local Terminal (LCT) or EMOS Receive attention is applied to all other unserved alarms as a secondary action.
Add–Drop Multiplexer	(ADMUX) –Transmission equipment through which a number of lower–bit rate channels may be passed in two directions, as a single higher bit–rate channel in each direction. Lower bit–rate channels may be added or removed via local traffic interfaces.
Adjacency	A relationship formed between selected neighbouring routers and end nodes for the purpose of exchanging routing information.
Administration	Functions which permit the management of human and other resources.
Administrative Unit	The information structure which adapts between the higher–order path and the multiplex section layer. It consists of an information payload and a pointer which indicates the offset of the start of the payload frame relative to that of the multiplex frame.
Administrative Unit Group	One or more Administrative Units occupying fixed, defined positions within an STM payload. An AUG consists of a homogeneous, byte–interleaved assembly of AU–3s or an AU–4.
Alarm	Indication given to an operator to indicate the existence of a fault condition either within or detected by the Multiplexer.
Alarm Bit Image	String of binary digits (bits), each bit representing the processed output from an individual fault detector. The identity of the originating fault detector is implied by the position of the bit in the string.
Alarm Configuration	Priority, inversion status and category of each possible fault as well as overall configuration.
Alarm Destination	Ultimate sink of alarm information. Can be Element Manager, Local Terminal or alarm log.
Alarm Indication Signal	An alarm condition indicating that the source equipment has detected a failure of the transmitted traffic.
Alarm Log	Historical store showing changes of state of alarms together with a time stamp.
Alarm Management	Functions of the system in which the detection, correction of network failures and real–time detection are managed such that threats to the normal operation of the network are avoided.
Alarm Severity	The category which defines the impact of an alarm on the network.
Alarm Source	The identity of the monitored entity with which the fault detector causing the alarm indication is associated; e.g. STM–1 West, AU/VC–3 number 2 West.
Alarm State	The defined state within the alarm life–cycle.
Alarm Type	The fault type detected by the fault detector which causes that alarm indication to be given.
AP Title	Part of the Communications Address.
Archive	This means to move to a long–term storage medium, rather than copy, which implies back–up.
Available Time	Any time not deemed Unavailable Time (UAT)

B

Bidirectional	When used in the context of protection, the switching of traffic in both directions of transmission for the section or trail. Also known as double-ended.
Binary Interleaved Parity	(BIP) – An error monitoring code.
Block	A set of consecutive bits associated with a path; each bit belongs to one and only one block (ITU-T Recommendation G.826).
Block Error	A Block Error is counted whenever there are one or more BIP–n Errors detected in a BIP Check Block, a REI Count of one or more is detected, one or more CRC–n errors are detected in a CRC Check Block or a Frame word is detected as being in error.
Broadcast Address	A group address that by convention means 'everyone.
Broadcast Trail	A type of trail originating from a single source, which may be terminated at one or more trail sinks. Broadcast is achieved by fanning out from connection Termination Points, along the trail, which have the capability to support broadcast cross-connections. The return direction of a broadcast trail is blocked and unavailable for use.

C

Cacoethes Telecomia	Occasional tendency of data in some systems to follow inadvisable routeing paths.
Card Protection Group	A group of protected cards.
Category	Attribute assigned by an operator to each possible fault. This attribute is used by the local alarm scheme to determine the visual indication to be given to the operator with respect to the type of maintenance action required. This attribute is also used to determine whether a particular fault is monitored by the entire alarm processing scheme.
Channel Associated Signalling	(CAS) – Call control signalling transmitted within the bandwidth of the call it controls; also known as in-band signalling. In T1 transmission, channel associated signalling is performed by bit-robbing. Each channel has its own dedicated signalling sub-channel.
Clear	Change of state from active to inactive of an alarm that has been serviced. also The clearing of a protection switching command.
Client/Server	Defines the recursive dependency which exists between paths managed by the NCL. A section or trail may be referred to as a server. A server is able to support one or more client trails which are hierarchically dependent on that server.
Code Violation	An error that is counted whenever there are one or more BIP–n Errors detected in a BIP.
Commissioning	Bringing a new Multiplexer into a state where it is ready to be provisioned.
Common Channel Signalling (CCS)	Out-of-band signalling protocol for signalling between processor equipped switches using signalling channels that are separate from the from the users voice (or data) channels.
Concatenation	A procedure whereby a number of virtual containers are associated, with the result that their combined capacity can be used as a single container across which the bit-sequence is maintained.
Connection	A Transport-entity which is capable of transferring information between connection termination-points.
Connectionless Network Protocol	Connectionless Network Protocol CLNP (ISO8473), has been evolved for packet data transfer in network architectures that have multiple distributed paths. Data transfers between nodes have transient relationships one to another, that only last for the transfer of any particular Protocol Data Unit (PDU).
Connection Orientated	A service in which a connection set up procedure must be implemented before data can be exchanged between the same pair of users.

Container	The information structure which forms the network–synchronous information payload for a virtual container.
Control Bus	A bus which connects the Mux. Controller to the traffic (i.e. line, tributary and switch) cards and the auxiliary card.
Cross–connection	A logical connection between two connection termination points on the same Network Element. Cross–connections may be fixed (as for some PDH multiplexers) or switchable (as in an SMA– and/or C–MUX).
Consecutive Severely Errored Seconds	A series of consecutive seconds in available time in which the number of Block Errors or Code Errors exceeds the threshold for SES. During Performance Monitoring, Severely Errored Seconds are a 'subset' of Errored Seconds, i.e. ES are still counted if the second is declared a SES.
Data Communications Channel	Channel within the section overhead which is dedicated to data communications between network elements.
Datagram	A self–contained, entity of data carrying sufficient information to be routed from the source to the destination without reliance on earlier exchanges between the source and destination devices and/or the transporting network
De–commission	The process by which the user can reset the system parameters to a default, non–functional system state.

D

DEG Performance	A user configurable condition which may be generated when the number of consecutive Severely Errored Seconds (SES) for a particular Error Performance Monitored Entity exceeds a preset threshold. The DEG defaults are a half of SES default value used for USE.
Disabled Alarm	Traffic alarm the source of which is a monitored entity which is not carrying traffic or a card fault which has not been added to the equipment configuration.
Disconnected	A category which can be assigned to an alarm which prevents that alarm raising indications on the end–of–shelf and rack alarm units.
Domain Specific Part	(DSP) – In DECnet, the part of an NSAP address assigned by the addressing authority identified by the Inter–Domain Policy (IDP).

E

Element Manager	Prime method of controlling an NE. A workstation which may communicate with and control all elements within a network,
Element Manager Interface	An interface (also known as 'Q' interface) provided by the communications card for the comms link between the equipment and the Element Manager.
EMOS LAN	The LAN used to interconnect EM–OS to Gateway Elements.
Enabled Alarm	Traffic fault the source of which is a monitored entity which is carrying traffic or a card fault from a card which has been added to the multiplexer configuration.
End of Shelf Display	Module located at right hand end of the shelf containing alarm indicators and receive attention button.
Erorred Second	Any Second in Available Time in which Block Errors (BEs) are detected.
Erorred Seconds Clear	This defines a threshold for the ES count. In the particular Threshold Crossing Notification scheme where this is used ES threshold crossing Exception reporting is done only once until the ES count falls below this threshold in a 15 minute reporting period containing no UATs.
Erorred Second Count	A cumulative count Indicating the number of seconds of Available Time or a particular errored performance data reporting period.
Erorred Second Ratio	The long term ratio of the number of Errored Seconds (In Available Time) to the total number of seconds in a measurement period.

Engineer Order Wire	A channel between NEs over which communication between maintenance staff is carried.
Entity	A logical partition, either of a traffic processing path or SMA hardware (i.e. STM-N, AU, HO Path, TU, LO Path, Port, Slot or Card).
Ethernet	A Carrier Sense Multiple Access/Collision Detect (CSMA/CD) LAN, developed by Xerox and standardised by Digital, Intel and Xerox.
ES-IS Protocol	As defined in ISO 9542, the protocol for handshaking between routers and end nodes and for mapping network layer addresses to data link layer addresses.
Extender II	Current VCTM product.
External Network	A source and sink of traffic not under the control of EM-OS.

F

Fallback Mode	Stand-alone operation due to absence or failure of Element Manager. In this mode, the Local Terminal (LCT) assumes the control of the Network Element.
Fallback Working Mode	One of two equipment working modes. It indicates that either the communications link between the equipment and the Element Manager has failed or the Element Manager has read only access (i.e. EM_Control is disabled).
Far End Block Error	The occurrence of errors (CV's) in a BIP Check Block signalled back to the remote end as a count (Higher Order Path) or as a single bit flag (Lower Order).
Far End Receive Fail	An Indication sent over Multiplex Section, Higher Order and Lower Order Paths to indicate failure of the receive data.
Fault Detector	A circuit which detects either the occurrence or subsidence of a particular fault condition.
Fault Event	A condition, detected by a Network Element, which is indicative of a fault.
Fault Signal	The output of a fault detector.
Fault Source	That attribute of a fault which identifies the entity being monitored by a particular fault detector.
Fault Type	A specific condition which requires a unique type of fault detector to detect it. e.g. LOS, AIS etc
F Interface	Communications interface between a network element and its Local Terminal (LCT) or workstation.
Fixed Window Processing	Performance processing in which the aggregation period is of fixed length and starts at fixed times. Examples of these are the 15Min and 24Hr Performance Records.

G

Gateway	The network element which provides a physical interface to the Element Manager and hence can act as a path (communications gateway) routing messages between the EM and other NEs via the DCC interfaces.
Gateway Network Element	See Gateway.

H

Hello	Identifies multiple simultaneous recipients of data. Used when the Elements of a network wish to identify all users in that network and maintain neighbour relationships
Higher Order	Traffic path which provides transport for lower order paths; Pertaining to the VC-3/4 monitored entity.
Holdover	A timing mode in which an outgoing signal is maintained accurately at the frequency and phase of its designated timing source after loss of that timing source.

Hop	The passage of a packet through one router.
Hop count	A routing metric used to measure the distance between a source and a destination.
I	
Importance	The significance of a particular fault in relation to all others as perceived by an operator. This can be configured into the Multiplexer and used to characterise the display of alarms to an operator.
Incoming VC Monitoring	Incoming VC Monitoring is the unobtrusive monitoring of BIP errors for a selected VC within and STM-n signal without termination.
Inter-Domain Resilience	Resilience between Domains is achieved by providing and configuring, more than one point of interconnection between the Domains. First and second choice routes between IS-IS Domains and ISRA Domains are given the names Internal and External. All IS-IS Boundary Nodes should be internally interconnected with two Level-2 routes to reinforce Inter Domain Resilience.
Initial Domain Identifier	(IDI) – In DECnet, the part of an NSAP address which identifies the authority responsible for the assignment of the DSP.
Initial Domain Part	(IDP) – In DECnet, the part of an NSAP address assigned by the first level of the addressing authority.
In-Traffic	One of two traffic states for traffic cards. It indicates that extraction of this card may result in a loss of this traffic.
Initial System Parameters	The basic equipment configurations (i.e. multiplexing method, card and slot allocation and synchronisation modes and priorities) required by the Multiplexer Controller to enable it to set-up the working environment of the multiplexer.
Inoperative	One of two operation states of the Mux. Controller. It indicates that the Mux. Controller does not have the initial system parameters configured.
Inversion State	The nominated state of a fault signal which is to be interpreted as a no fault condition. The nominated state can be either active or inactive, a fault only being raised upon a change to the complementary state
IS-IS Block	An IS-IS Block is said to be formed when IS-IS Boundary Nodes of IS-IS Composites are interconnected. The IS-IS Block prevents IS-IS protocols being exchanged over the link, whilst still allowing communication to take place between the IS-IS Boundary Nodes. The block is not essential but sometimes needed to enable IS-IS networks to be constructed. The block circumvents a limitation with IS-IS that only allows two RAPs to a single destination under complex situations. The block is introduced into the IS-IS network by marking the communication interface as 'external'.
IS-IS Boundary Node	IS-IS Boundary Nodes define the entry and exit points of IS-IS Centre Nodes at Level-1/2 routing, and form the boundary between IS-IS Areas, Interim Static Routing Algorithm elements and the EM-OS LAN.
IS-IS Centre & Boundary Composite	Consists of a single IS-IS Centre with one or more Boundary Nodes. If more than one Boundary Node is incorporated there must be a resilient Level-2 connection between every Boundary Node.
IS-IS Centre Node or IS-IS Area	A collection of IS-IS network elements that share the same Area address.
IS-IS Domain	A collection of connected Areas. Routing Domains provide full connectivity to all End Systems within them.

IS-IS Element Routeing	Intermediate System (IS) elements route inter-network information one to another using a dynamic routeing protocol (ISO 10589). IS-IS Element Routeing takes place when one IS element communicates with others, and each element creates routeing tables within themselves containing information about the Network Topology these elements are interconnected into. Routeing Tables constructed in this manner are said to be dynamic.
IS-IS Multiple Area Working	IS-IS routeing allows the use of multiple Area addresses for any individual Network Element. Therefore Network Elements can have multiple NSAP addresses. Interconnected IS-IS elements each containing multiple NSAP addresses, and sharing at least one Area address one to another, will adopt or share all of the Area addresses, forming a common set of area
IS-IS Partition Repairs	The IS-IS Partition Repair function allows Level-1 communication to be maintained following a Level-1 break, between two isolated islands of the same Area. This Level-1 communication repair uses a 'Virtual' Level-1 path, which is actually between Level-2 elements. A Level-2 path must however be made available between the isolated islands.
IS-IS Routeing Domain	When IS-IS Centre Nodes are directly interconnected they form an IS-IS Routeing Domain. IS-IS protocols are exchanged within an IS-IS Routeing Domain.
IS-IS Routeing Metrics	IS-IS uses the concept of assigning a positive integral numerical value to every circuit, link or path. These numerical metric values are added to determine the 'cost' of an overall route. Only one metric type (default metric) is supported by GPT SDH products. Routes are selected on a lowest overall 'cost' basis.
IS-IS Protocol	The ISO standard intra-domain routeing protocol, documented in ISO 10589.

L

Lamp-lock	Method by which transient alarms may be latched.
Level 1 Routeing	IS-IS Routeing within an Area.
Level 1 Routeing Table	A Level-1 Routeing Table contains all the System IDs of the IS-IS network elements that share the same Area, plus topological information of the readability of these network elements.
Level 2 Routeing	IS-IS Routeing between Areas.
Level 2 Routeing Table	A Level-2 Routeing Table contains all Area addresses and address Prefixes that can be reached from that network element. A Level-2 Routeing Table also contains information of all routes over which Areas/Prefixes can be reached, plus these routes cost or metric.
Link Connection	A logical connection between connection termination points on two different Network Elements.
Link State Package	LSP – A packet that is generated by a router operating a link state routeing protocol (e.g. ISO 10589) listing the routers neighbours.
Local Alarm Indication	State of rack alarm Buses coupled with visual display provided by LEDs on end-of-shelf unit and cards.
Local Alarm Scheme	The hardware used to indicate local alarms. This includes end of shelf indicators and on-card fail indicators.
Local Craft Terminal Interface	An interface provided by the Multiplex Controller for the communications link between the equipment and the Local Terminal (LCT).
Local Alarm Status	Indicates what local alarm scheme actions have been performed on a specific alarm.
Local Exchange (LE)	An exchange on which user lines are terminated by an AN.
Locked	An operator-controlled administrative state indicating that a resource is being used, i.e. carrying traffic and, therefore, is not to be amended.
Loop Timing	A mode in which the Multiplexer uses the recovered line timing from a given direction to time the outgoing signal in the same direction.

Loss-of-Frame	Alarm condition indicating loss of alignment of the data received.
Loss-of-Signal	Alarm condition indicating a detected loss of an incoming line signal.
Lower Order	SDH traffic-path which cannot be further sub-divided. Pertaining to the VC-1/2 monitored entity.

M

Mapping	Distribution of data from one multiplexing frame structure into defined positions in another frame of the same rate.
Man-Machine Interface	The mechanism by which an operator may communicate with one or more network elements.
Manual Adjacency (MA)	A method of interworking between an IS-IS Domain and an ISRA Domain, where the ISRA Domain nodes share the same Area Address as the IS-IS Border Node the Manual Adjacency originates from. A Manual Adjacency is therefore a Level-1 static route.
Maximum Transmission Unit	MTU – the largest packet size that can be transmitted between source and destination.
Medium Access Control	MAC – a sub-layer of the data link layer, defined by the IEEE 802 committee, that deals with issues specific to a particular type of LAN. The identity of the GPT 'EM-OS' product within a network will have a designated 'MAC' address, as its link with the network will always be via an Ethernet LAN.
Message Passing Bus	This is a bus which connects the Mux. Controller to the communications card. It is used for all communications between these two cards.
Metric	A measure, as in 'Routeing Metric', where the measure (eg. reliability, delay, bandwidth, load, hop count) is used by a routeing algorithm to determine whether one route is better than another.
Monitored Entity	(ME) – An entity within the Multiplexer with which faults can be associated. The identifiable entities are :- slot card, port, STM-N, AU-3/4, VC-3/4, TU-1/2 or VC-1/2.
Multicast	To poll or transmit common information to a known group of recipients, usually with a single message transmission. Sometimes referred to as 'Hello' messages.
Multiplex Section	A Multiplex Section is the part of a line system between two Multiplex Section Terminations.
Multiplex Section Overhead	The Multiplex Section Overhead comprises of rows 5 to 9 of the Overhead of the STM-n signal.

N

Negative Pointer Justification Event	A Negative Pointer Justification Event is defined when the frame rate of the VC is too fast with respect to the associated AU/TU requiring an extra data byte to be transmitted and the pointer values decremented.
Network Element	A multiplexer, line system terminal, regenerator, or any equipment which switches, multiplexes or regenerates traffic.
Network Management Interface	An interface between a network element or gateway network element and the element manager or Local Terminal (LCT).
Network Service Access Point	NSAP – the ISO term for the quantity that specifies a client of a network layer running at a particular node.
Non-worker	Card which is in 'Standby' mode (i.e. not carrying traffic) in a protected arrangement.
Normal Working Mode	This is one of two equipment working modes. It indicates that communications link between the equipment and the Element Manager has been established and the Element Manager has read/write access (i.e. EM_Control is enabled).
Not-in-Traffic	This is one of two traffic states for traffic cards. It indicates that extraction of this card will not result in a loss of traffic.

O

On-Card Fault LED	An LED on a particular card that is lit, either autonomously or under control of the Mux. Controller, to indicate that the card is detecting a Fault Condition. It is not necessarily an indication that the card itself is faulty.
On-line	This is one of two control states of the Mux. Controller. It indicates that the Mux. Controller recognises the SMC as belonging to the Shelf. Communication between the Mux. Controller, traffic cards and comms cards is enabled.
Open Systems Interconnection	(OSI) – The OSI model provides the basis for connecting 'open' systems for distributed applications processing, where the term 'open' denotes the ability of any two systems conforming to the reference model and the associated standards to connect.
Operative	This is one of two operation states of the Mux. Controller. It indicates that the Mux. Controller has the initial system parameters configured.
Operator	The user of an Element Manager or Local Terminal (LCT).
Overhead Buses	Buses between the various SMA-n cards carrying Overhead (STM-n and some HO VC overhead) information in a proprietary frame at a data rate of 6.48Mbit/s.

P

Parked	The state of an alarm in which it will cause no indication (other than receive attention or acknowledged) to be given on the end of shelf and rack alarm Buses.
Path Overhead	Provides for integrity of communication between the point of assembly of a virtual container and that of its disassembly.
Path Trace	A mechanism provided for the purpose of confirming that an SDH trail is provisioned between desired end-points. The NEs at each end of the trail inject and monitor an operator provided byte sequence into the path overhead.
Performance Primitive	A particular aspect of the System Performance monitored by the Equipment, used as the basic data for the generation of performance parameters and data reports.
Performance Record	Stored Performance Data Report pertaining to a performance data reporting period that has expired.
Ping	Packet Internet Groper, an echo message and its reply, used to test the reachability of a network device.
Ping Techniques	Ping Techniques use the principle of sending and receiving test messages to determine routing paths, and the response to test messages by interconnecting and target nodes.
Pointer (SDH)	Provides the off-set of the start of the SDH traffic signal from the start of the frame.
Point-to-point	A connection, usually a trail, with exactly two ends (as opposed to a point-to-multi-point connection, which may have three or more ends, e.g. Multi-drop or Broadcast).
Positive Pointer Justification Event	A positive pointer justification event is defined when the frame rate of the VC is too slow with respect to the associated AU/TU requiring a data byte to be omitted and the pointer values incremented.
Presentation Service Access point	(PSAP) – An addressable point at which the presentation service (sixth layer of the OSI model) is made available.
Primary Multiplexer	An element (SMA, SLT, C-Mux) in which traffic is multiplexed/demultiplexed up to 2Mbit/s.
Priority	Numeric value reflecting the importance attached to a fault. Can be in the range 1 (highest) to 255 (lowest).
Protection Card	Card which provides an alternative path to the worker under fail or forced switch conditions.

Q

Q-interface	The interface between the gateway network element and the element manager. Only available at the gateway network element.
Qecc Interface	The data communications interface which uses the embedded data communications channels within the STM-1 section overhead.

R

RAP Metrics	Reachable Address Prefix Metrics, is the metric associated with the Level-2 Static Data, which in mixed ISRA/IS-IS routed networks would normally be produced by the RTC. The metrics are associated with a route, as opposed to a link. The metric types are referred to as 'Internal' and 'External' which are terms relating to the associated IS-IS Domain.
Re-provisioning	Altering the configuration of an Multiplexer to accommodate different or new traffic.
Receive Attention	Alarm state, invoked by pressing a button on the end-of-shelf unit, applied to all currently unserved alarms.
Regenerator Section	A Regenerator section is the part of a Line System between two Regenerator Section Terminations (RST).
Regenerator Section Overhead	The Regenerator Section overhead comprises of rows of 1 to 3 of the Section Overhead of the STM-n signal.
Remote Defect Indication	This term replaces 'FERF' in later versions of ITU-T recommendations.
Remote Error Indication	This term replaces 'FEBE' in later versions of ITU-T recommendations.
Ringmaster	One Multiplexer providing synchronisation for a number of Multiplexers connected together to form a ring.
Route	One or more traffic-sections between the same two NEs or sub-networks. The constituent sections may or may not take the same geographical path.
Routeing Junction	Any node (SMA/SLA) connected to a LAN or has more than two DDC connections. Has a routeing table.

S

Section	A single connection between two Network Elements which supports a client link connection. It can be a traffic section, or a management section (the latter may possibly be a digital user-loop section). It can be used to build a Trail.
Service Access Point	SAP – the address of a user of a service, a field that further defines an address (hence 'NSAP').
Section Overhead	Contains information added to the information payload to create an STM-N, and comprises of rows 1 to 3, columns 1 to 9xn, and rows 5 to 9, columns 1 to 9xn, of the STM-N signal. Used for checking traffic integrity and to provide the data comms channels.
Serial Event Hand off Facility	A facility to monitor the logged asynchronous alarm data available at the serial interface port of an Element Manager work station.
Serviced	Referring to an alarm in either the receive attention or acknowledged state.
Severity	The significance of a particular fault in relation to all others as perceived by an operator. This can be configured into the Network Element and used to characterise the display of alarms to an operator.
Severely Errored Second	Any second in available time in which the number of Block Errors or Code Errors exceeds the threshold for SES. During Performance Monitoring, Severely Errored Seconds are a 'subset' of Errored Seconds, i.e. ES are still counted if the second is declared a SES.

Severely Errored Second Count	A cumulative count Indicating the number of seconds of Available Time in a particular performance data reporting period that were deemed to be Severely Errored.
Severely Errored Second Ratio	The long term ratio of a number of Severely Errored Seconds of Available Time in a measurement period.
Severely Errored Second Threshold	The presettable threshold for the number of Block Errors recorded in a second that will lead to the second being declared a Severely Errored Second and the SESC incremented.
Shelf Alarm Status	A summary of the states of all the alarm sources in the Multiplexer, suitable for display on the end of shelf display and rack alarm units.
Shelf Local Alarm I/F	The interface via which access may be gained to the shelf and rack alarm Buses.
Shelf Local Alarm O/P	Outputs available for driving external alarm indicator circuitry.
Sliding Window Processing	Performance processing in which the aggregation period is of fixed length but can start at any time. Examples of these are the SUE and TUE window processing.
SMA–1/4CP	Customer located SDH add–drop multiplexer.
SMA–1/4c	A compact shelf based SDH add–drop multiplexer in the Access SDH range, which accepts different Trib card options and protected Core cards.
SMA–1/4(4+4)	A shelf based SDH add–drop multiplexer in the Access SDH range, with a single row of LTUs, limited LTU access for Trib cards, and protected Core cards.
SMA–1/4(8)	A shelf based SDH add–drop multiplexer in the Access SDH range, with two rows of LTUs, full LTU access for Trib cards, and protected Core cards.
Start of Unavailability Event Count	A count kept of the number of SUEs in a particular period.
Subside	Change of state from active to inactive of an alarm that is unserviced.
Synchronous Digital Hierarchy	Set of digital transport structures, standardised for the transport of suitably adapted payloads over physical transmission networks.
Synchronous Multiplexer Add/Drop	(SMA) Transmission equipment through which a number of lower–bit rate channels may be passed in two directions, as a single higher bit–rate channel in each direction. Lower bit–rate channels may be added or removed via local traffic interfaces.
Synchronous Transport Module	The information structure used to support section–layer connections in the synchronous digital hierarchy. Comprises of the information payload and the section overhead information.

T

Termination of Unavailability Event	An event which occurs when the threshold for consecutive non–SES is reached.
Through Timing	A timing mode in which the line timing is passed through a Multiplexer from west to east and /or east to west.
Time slot	A 64kbit/s channel within a framed 2Mbit/s signal (ITU–T Recommendation G.704).
Time slot number	This identifies a 64kbit/s time slot within the 2048kbit/s V5.1 interface (ref. ETS 300 167 [2]).
Trail	An end–to–end path of a specified type across a network and is made up of one or more link connections connected together by cross–connections.
Traffic Cards	Those cards occupying the line, switch and tributary card slots.
Tributary Unit	Information structure which adapts between the lower–order path–layer and the higher–order path–layer.
Tributary Unit Group	One or more Tributary Units occupying fixed positions within a higher–order virtual container payload.
Turnaround	A timing mode in which the line timing of the output is derived from that of the received line in a Network Element.

U

Unacceptable Short-term Errors	A event occurring when the number ('n') of consecutive SES for a particular Error Performance Monitored Entity exceeds a preset threshold.
Unserviced	State of a new alarm prior to being receive attention or acknowledged.
Unavailable Seconds Count	A cumulative count Indicating the number of seconds of a particular performance data reporting period during which the entity being monitored was deemed Unavailable.
UnAvailable Time	A period starting at the beginning of the first second of a period of SES that exceeds the SUE threshold and ending at the beginning of the first second of a period of non-SES which exceeds the TUE threshold.

V

Validated Faults	Fault signals that have been validated by alarm inversion and have not been forced to inactive either by an operator or by the Multiplexer.
Virtual Container	Information structure used to support the path-layer connections in the synchronous digital hierarchy.
Virtual State	Description of the Network Element as set up in EM-OS but communications with real NE have not been established.

W

Watchdog	Circuitry which monitors for correct operation of the operating software.
Windows	A graphical user interface implemented on Microsoft MS-DOS.
Worker Card	Card which is carrying data in a protected arrangement.
Worker Section	A section, either a protected or protection section, which is currently carrying traffic.

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LIST OF ABBREVIATIONS

A

ADC	Auxiliary Data Channel
ADMX	Add-Drop Multiplexer
AFI	Authority and Format Identifier
AIC	Auxiliary Interface Card for a C2000 Shelf
AIS	Alarm Indication Signal
ASIC	Application Specific Integrated Circuit
ATM	Asynchronous Transfer Mode
AU	Administrative Unit
AUI	Access Unit Interface

B

BCD	Binary Coded Decimal
BE	Block Error
BER	Bit Error Rate
BSHR	Bidirectional Self Healing Ring
BIP	Bit Interleaved Parity
BSI	British Standards Institute

C

C2000	The 'Century 2000' range of PDH Multiplexer and Transmission Equipment
CAS	Channel associated signalling in TS16
CC	Communications Card
CCITT (now ITU-T)	Comite Consultatif International Telegraphique et Telephonique.(International Telegraph and Telephone Consultative Committee)
CLE	Customer Located Equipment
CLK	Clock
CLNP	Connectionless Network Protocol
CLNS	Connectionless Network Layer Service
CMI	Coded Mark Inversion
CRC	Cyclic Redundancy Check
CS	Chip Select
CSES	Consecutive Severely Errored Seconds
CTP	Connection Termination Point
CV	Code Violation
C-MUX2	Backplane version of compact multiplexer
C-MUX+OLTE	2Mbit/s OLTE derived from C-MUX+

D

DAT	Digital Audio Tape (4mm)
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D

DCC	Data Communications Channel
DCC(M)	Data Communication Channel (Multiplexer)
DCC(R)	Data Communication Channel (Regenerator)
DCN	Data Communication Network
DEG	Degrade
DFB	Distributed Feedback
DFW	Dual Fibre Working
DGNE	Domain Gateway Network Element
DIN	Deutsche Industrie–Norm
DIT or D&IT	Data and Information Technology Limited
DMA	Direct Memory Access
DNIC	Data Network Identification Code
DRA	Data Rate Adapter (ASIC)
DSP	Domain Specific Part
DTE	Data Terminal Equipment
DTMX	Dual Terminal Multiplexer
DU	Display Unit

E

EBER	Equivalent Binary Error Rate
ECC	Embedded Communications Channel
EFS	Error Free Second
EISA	Extended Industry Standard Architecture
EM	Element Manager
EMC	Electromagnetic Compatibility
EML	Element Management Layer
EM–OS	Equipment Management Operations System
EOS	End Of Shelf
EOW	Engineering Order Wire
EPROM	Erasable Programmable Read Only Memory
ES	Errored Seconds
ESC	Errored Second Count
ESD	Electrostatic Discharge
ESSD	Electrostatic Sensitive Device
ESO	Elastic Store Overflow
ESP	Electrostatic Protection
ETSI	European Telecommunications Standards Institute

F

FEBE	Far End Bit Error
FERF	Far End Receive Failure
FTAM	File Transfer and Access Management

G

GNE	Gateway Network Element
GUI	Graphical User Interface

H

HB	High Bandwidth
HCI	Human–Computer Interface
HDLC	High–level Data Link Control
HMI	Human–Machine Interface
HDB3	High Density Bipolar 3
HO	High Order
HO–DSP	High Order – Domain Specific Part
HP	Hewlett Packard

I

Id or ID	Identifier
DI	Initial Domain Identifier
IDP	Initial Domain Part
IEEE	Institute of Electrical and Electronic Engineers
I/F	Interface
IP	Internet Protocol
IPS	Integrated Planning System
ISDN	Integrated Digital Services Network
ISE	Intermediate Station Equipment, alternative term for SLR
ISO	International Standards Organisation
ITU–TS	International Telecommunication Union, Telecommunications Sector (formerly CCITT)

L

LAN	Local Area Network
LCN	Local Communications Network
LCT	Local Craft Terminal
LED	Light Emitting Diode
LOA	Loss of Alignment
LOF	Loss of Frame
LOI	Loss of Input
LOP	Loss of Pointer
LOPP	Lower Order Path Processor
LOS	Loss of Signal
LT or LCT	Local Craft Terminal
LTE or LTU	Line Termination Equipment (Unit)

M

M

m	Metre
MAC	Media Access Control
MAU	Media Access Unit
MC	Multiplex Controller
MCC	Management Communications Card
MCU	Management Communications Unit
ME	Manufacturable Entity
MIB	Management Information Base
MM	Multimode
MMI	Man-machine Interface
MO	Managed Object
MOFTE	Multiplexer/Optical Fibre Terminating Equipment
MS	Multiplex Section
MSOH	Multiplex Section Overhead
MST	Multiplex Section Termination
MSP	Multiplex Section Protection
MTBF	Mean Time Between Failures

N

NACC	Network Administration Computer Centre
NB	Narrow bandwidth
NCL	Network Control Layer
NE	Network Element
NEC	Network Element Controller
NM	Network Management (or Manager)
NMI	Network Management Interface
NPDU	Network Protocol Data Unit
NSDU	Network Service Data Unit
NRZ	Non-Return to Zero
NSAP	Network Service Access Point
NT	Network Terminal
NTE	Network Termination Equipment
NTU	Network Terminating Unit
NUA	Network User Address
NVM	Non-Volatile Memory

O

OFTE	Optical Fibre Terminating Equipment, or:
OH/POH	Overhead/Path Overhead
OLTE	Optical Line Terminating Equipment (alternative term for SLT)
OLTU	Optical Line Transmission Unit
OOS	Out Of Service

O

OSI	Open Systems Interconnection
OTRU	Optical Transmit/Receive Unit

P

PAD	Packet Assembler/Disassembler
PC	Personal Computer (IBM compatible)
PCB	Printed Circuit Board
PDH	Plesiochronous Digital Hierarchy
PJE	Pointer Justification Event
PLP	Packet Layer Protocol
PM	Process Manager
POH	Path Overhead
PRAI	Path Remote Alarm Indication
PRBS	Pseudo Random Bit Sequence
PSTN	Public Switched Telephone Network
PSU	Power Supply Unit
P-SWITCH	Primary Rate Switch

Q

Q Interface	Interface designation for network management, often Q1, Q2 or Q3
Qecc	Interface designation for Embedded Data Comms Channel
QoS	Quality of Service

R

RMF	Receive Multiframe
RNW	Read / Not Write
ROM	Read Only Memory
RSOH	Regenerator Section Overhead
RS(T)	Regenerator Section (Termination)
RTU	Remote Terminal Unit
REI	Remote Error Indication
RTB	Recovered Timing Bus
Rx	Receive or Receiver

S

SA	System Administrator (for EM-OS).
SAIS	Section AIS
SCADA	Supervisory Control and Data Acquisition
SD	Signal Degrade
SDH	Synchronous Digital Hierarchy
SE	Saleable Entity

S

SEM	System Error Monitor
SETG	Synchronous Equipment Timing Generator
SEMF	Synchronous Equipment Management Function
SES	Severely Errored Seconds
SF	Signal Fail
SFW	Single Fibre Working
SID	System Identity
SISA	Supervisory & Information System for Local & Remote Areas
SIU	Slide In Unit
SL	Synchronous Line Apparatus (also used to refer to a Synchronous Line System)
SLR	Synchronous Line Regenerator
SLT	Synchronous Line Terminal
SMA	Synchronous Multiplexer – Add/Drop
SMC	System Memory Card
SMLT	Single-ended Maintenance Local Terminal
SMN-OS	SDH Management Network Operations System
SMT	Synchronous Multiplexer, Terminal
STM	Synchronous Transport Module
SNC	Subnetwork Connection
SNPA	Subnetwork Point of Attachment
SNCP	Subnetwork Connection Protection
SO	System Operator (for EM-OS).
SOH	Section Overhead
SPN	Service Protection Network
SPS-155	155.52 Mbit/s Radio Protection Equipment
SRA	Synchronous Radio, Access
SRT	Synchronous Radio, Trunk
SRT-1	Synchronous Radio, Terminal (155.52Mbit/s)
STM-1	Synchronous Transport Module (155.52Mbit/s)
STM-4	Synchronous Transport Module (622 Mbit/s)
STM-16	Synchronous Transport Module (2.5 Gbit/s)
SUE	Start of Unavailability Event

T

TCM	Tandem Connection Monitoring
TCP/IP	Transmission Control Protocol/InternetProtocol
TP	Termination Point
TMF	Transmit Multiframe
TMX	Terminal Multiplexer
TNS	Transmission Network Surveillance
TS	Timeslot
TSAP	Transport Service Access Point

T

TSS	Telecommunications Standardisation Sector
TTP	Trail Termination Point
TU	Tributary Unit
TUG	Tributary Unit Group

U

UAS	Unavailable Second
UITS	Unacknowledged Information TransferService
USE	Unacceptable Short-term Errors

V

V.11	UK primary mux management interface for C-Mux
VC	Virtual Container
VCAM	Virtual Container Access Module
VCTS	Virtual Container Transport System
VPN	Virtual Private Network

W

WAN	Wide Area Network
WIMP	Windows, Icons, Menus, Pointer

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