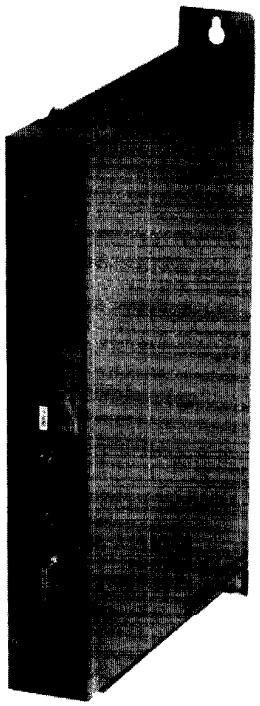
BALDOR®
MOTORS AND DRIVES

AC BRUSHLESS SERVO CONTROL
SBSC 1000/1100 SERIES



Installation and Operating Manual

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MN1204

TABLE OF CONTENTS

WARRANTY ii
FORWARD iii

SECTION I - INTRODUCTION

1.1 GENERAL INFORMATION 1-1
1.2 MODEL INFORMATION 1-2

SECTION II - PRE-SETS

2.1 DIP SWITCH SETTINGS 2-2
2.1.1 DIP Switch 5 2-3
2.1.2 Current-limiting DIP Switches 2-3
2.2 JUMPERS (E-POINTS) 2-4
2.2.1 Single/Multi Axis Set-Up 2-5
2.3 J1 COMPONENT FUNCTIONS 2-5
2.3.1 it-Switching Threshold Adjustment (R22) 2-6

SECTION III - INSTALLATION AND WIRING

3.1 MECHANICAL INSTALLATION 3-1
3.2 GENERAL WIRING CONSIDERATIONS 3-1
3.2.1 SBSC 1100 Connector Locations 3-2
3.3 POWER WIRING 3-3
3.4 SIGNAL WIRING 3-4
3.5 CONTROL WIRING 3-6
3.6 GROUNDING 3-12
3.7 ELECTRICAL NOISE SUPPRESSION 3-12

SECTION IV - START UP

4.1 START UP PROCEDURE 4-1
4.2 TUNING ADJUSTMENT 4-3

SECTION V - TROUBLESHOOTING

5.1 STATUS MONITOR 5-1
5.2 FRONT PANEL LEDs 5-1
5.3 TROUBLESHOOTING TABLE 5-2

APPENDICES

APPENDIX A - SBSC 1000/1100 SERIES SPECIFICATIONS A-1
APPENDIX B - MOUNTING DIMENSIONS B-1
APPENDIX C - CONDENSED INSTALLATION INSTRUCTIONS C-1
APPENDIX D - FACTORY i-PARAMETER SETTINGS D-1
APPENDIX E - INPUT/OUTPUT SCHEMATICS E-1

WARRANTY

Limited Warranty and Service Policy

Warranty

Baldor Products are warranted against defects in workmanship and materials for a period of one (1) year, from the date of shipment from the factory, providing the company receives immediate notice of such defects.

Baldor will not be responsible for: the cost of removal or reinstallation of any products from any equipment, cost of delivery to the Baldor factory or authorized service center, nor the cost of any incidental or consequential damages resulting from the claimed defects. Any implied warranty given by law shall be limited to the duration of the warranty period hereunder. Baldor has no liability for any repairs or modifications made outside Baldor's factory. Any disassembly or modifications will void the warranty. Any recommendations offered by Baldor's engineers or sales representatives are to be considered as their best judgement and as matters of opinion, without liability to Baldor. Under no circumstances shall Baldor be liable for damage to good will, loss of profits or for any type of consequential damage.

In-Warranty Service

Baldor will, at its option, repair or replace, without charge, within a reasonable period of time, products which fail due to defects in workmanship of materials during the limited warranty period if:

1. The purchaser delivers the defective product, freight prepaid, to the Baldor factory or authorized (servo electronics) service center only after obtaining a written or verbal return authorization (RA) number.

2. The purchaser gives written notification concerning the product and the claimed defect, including the purchase date, the task performed by the product, and the problem encountered.

Out-of-Warranty Service

Baldor does not recommend field repair of motors or electronic items by the customer. Defective items should be returned to the Baldor factory or authorized (servo electronics) service center. All returns must be first authorized, and then accompanied by a written or verbal return authorization (RA) number.

FORWARD

The purpose of this Baldor SBSC 1000/1100 Series AC Brushless Servo Control manual is to provide the necessary information for installation and operation.

IMPORTANT: **This manual is intended to be used only by personnel familiar with the SBSC 1000/1100 and associated machinery. The user should be familiar with the contents of this manual before any connections are made.**

This manual does not intend to cover every possible contingency to be met in connection with installation, operation, or troubleshooting. Should further information be desired or should particular problems arise which are not detailed in this manual, contact your sales representative or equipment supplier.

The information contained in this manual is only a guide for proper installation. The National Electric Code and any regional or local codes will supersede information in this manual.

SECTION I - INTRODUCTION

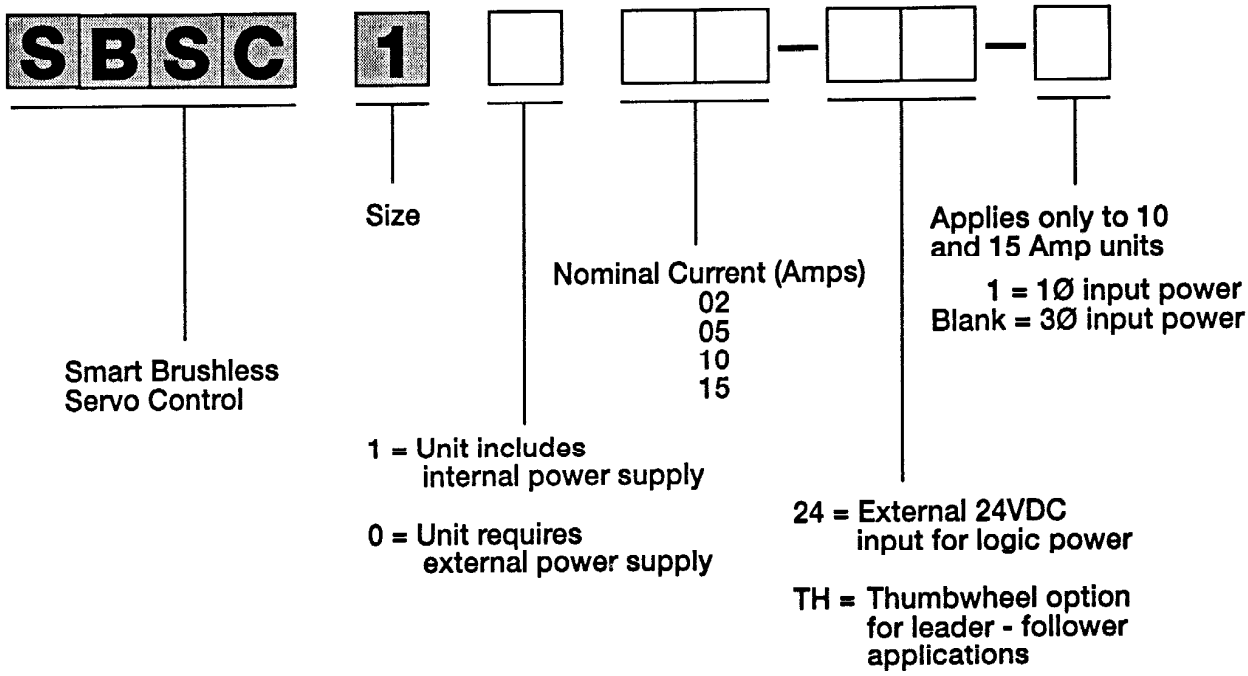
1.1 General Information

The SBSC 1000/1100 is a single axis programmable servo control designed to be used with resolver based brushless servo motors. The standard SBSC 1100 series includes an internal power supply; the standard SBSC 1000 series requires an external supply. Externally the two units are identical.

Standard features include:

- Single (direct) or three phase (with transformer) input voltage
- 4 available output current versions (2A, 5A, 10A, 15A)
- 2:1 ratio of peak:nominal current (both values independently adjustable)
- Short circuit protection
- Output power up to 6.5 kVA
- Protection class IP20 (meets DIN40 050/IEC144)
- Self-ventilated cooling
- Internal power supply in SBSC 1100 consists of rectification, regeneration circuit, and surge current protection
- Brushless servo motors with 2 to 8 poles can be connected (resolver feedback: 2 pole resolver)
- Power wiring via terminal screws
- Control wiring via Phoenix connectors
- Control inputs for general functions
- Program status information
- Programmable machine inputs and outputs
- 1 analog input (+10V/8bit)
- 1 handwheel (encoder) input
- Serial interface (RS232C) for communication and programming
- Daisy-chaining for synchronization of up to 16 SBSC axes
- Diagnostic display and testpoint standard
- Velocity and acceleration feedforward gain
- Software tuning
- PI current controller

1.2 Model Information



SECTION II - PRE-SETS

Before applying power, the DIP switches and Jumpers (E-Points) on the positioning card (μSMCC) must be pre-set (refer to Figure 2-1 for locations). At the factory, the DIP switches are pre-set as Card Address A0, 9600 Baud, and Program Save enabled. Jumpers (E-Points) are pre-set as indicated in Table 2-4. If these factory settings are acceptable, skip this section, and go to Section 2.2.1.

To access the positioning card (μSMCC), follow these steps:

1. Remove all connectors from the SBSC and remove all wires from Voltage Connector X7.
2. Remove the 5 screws from the cover plate of the SBSC.
3. Remove the cover plate.
4. Gently grasp the lower exposed printed circuit boards (NOT the circuit board with Connector X7) and slide them out. The top circuit board is the μSMCC card.

The DIP switches must be set to assign each SBSC 1000/1100 to its proper address as indicated in Table 2-1 and to establish its baud rate as shown in Table 2-2. DIP switch 5 is used to determine whether programs and software initialization parameters (i-parameters) can be saved into EEROM memory (see Section 2.1.1).

The jumpers (E-Points) may be used to enable certain options of the SBSC 1100 (refer to Table 2-4) and to initialize units for either single or multi axis applications.

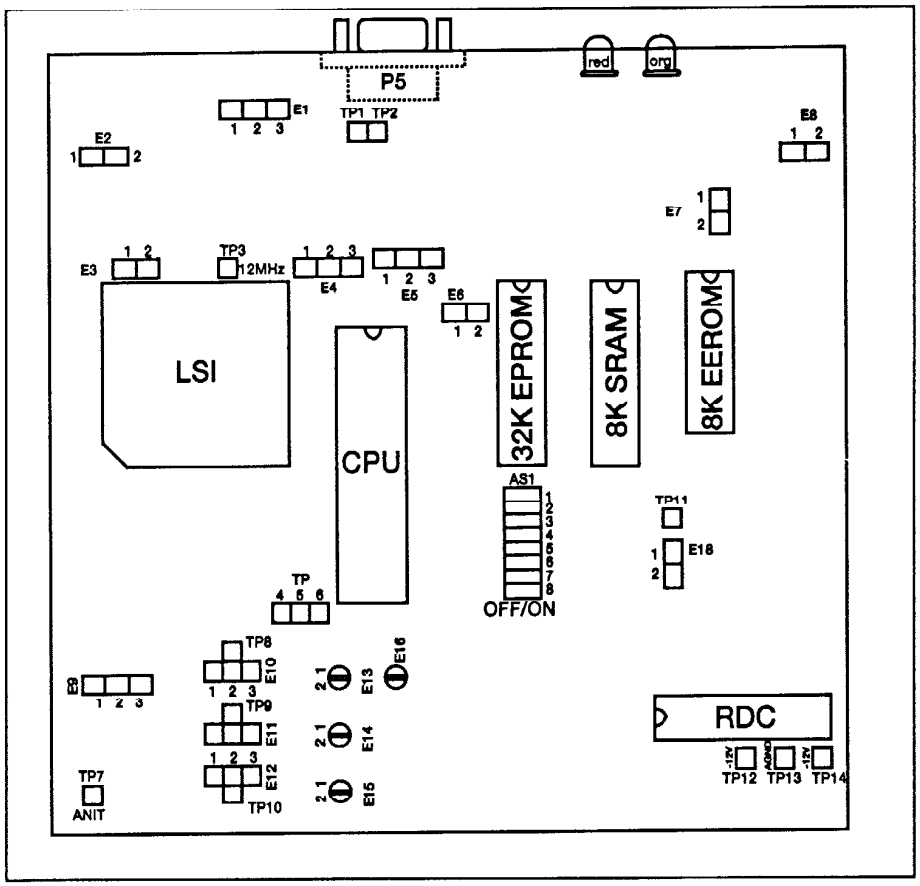


Figure 2-1 μSMCC Card Component Locations

2.1 DIP Switch Settings

The DIP switches are used to assign each SBSC 1000/1100 to its proper address as indicated in Table 2-1 and to establish its baud rate as shown in Table 2-2. DIP switch 5 us used to determine whether programs and software initialization parameters (i-parameters) can be saved into EEROM memory.

NOTE: The DIP switches are marked with numbers at the top. Depress a DIP switch toward the numbers for the "On" position and away from the numbers for the "Off" position.

NOTE: When any DIP switch setting is changed, the power to the SBSC must be cycled (turned off and then back on), or the control reset, to activate the new setting(s).

Table 3-1 Card Address

Card Address	Switch			
	1	2	3	4
0	ON	ON	ON	ON
1	OFF	ON	ON	ON
2	ON	OFF	ON	ON
3	OFF	OFF	ON	ON
4	ON	ON	OFF	ON
5	OFF	ON	OFF	ON
6	ON	OFF	OFF	ON
7	OFF	OFF	OFF	ON
8	ON	ON	ON	OFF
9	OFF	ON	ON	OFF
10 (hex a)	ON	OFF	ON	OFF
11 (hex b)	OFF	OFF	ON	OFF
12 (hex c)	ON	ON	OFF	OFF
13 (hex d)	OFF	ON	OFF	OFF
14 (hex e)	ON	OFF	OFF	OFF
15 (hex f)	OFF	OFF	OFF	OFF

Table 3-2 Baud Rate

Baud Rate	Switch		
	6	7	8
9600	ON	ON	ON
4800	OFF	ON	ON
2400	ON	OFF	ON
1200	OFF	OFF	ON
n/a (disables RS232)	ON	ON	OFF
300	OFF	ON	OFF
38400	ON	OFF	OFF
19200	OFF	OFF	OFF

2.1.1 DIP Switch 5

DIP switch 5 is used to determine whether new programs and software initialization parameters (i-parameters) can (OFF) or cannot (ON) be saved into EEROM memory. The contents of the EEROM are always uploaded each time the SBSC is turned on or reset, regardless of the position of this switch.

2.1.2 Current-limiting DIP Switches

Four DIP switches on the back of the SBSC 1000/1100 (refer to Figure 2-2) are used to reduce both the continuous current and the peak current in the same ratio (refer to Table 2-3). Refer to Table 2-6 to limit the continuous current without affecting the peak current.

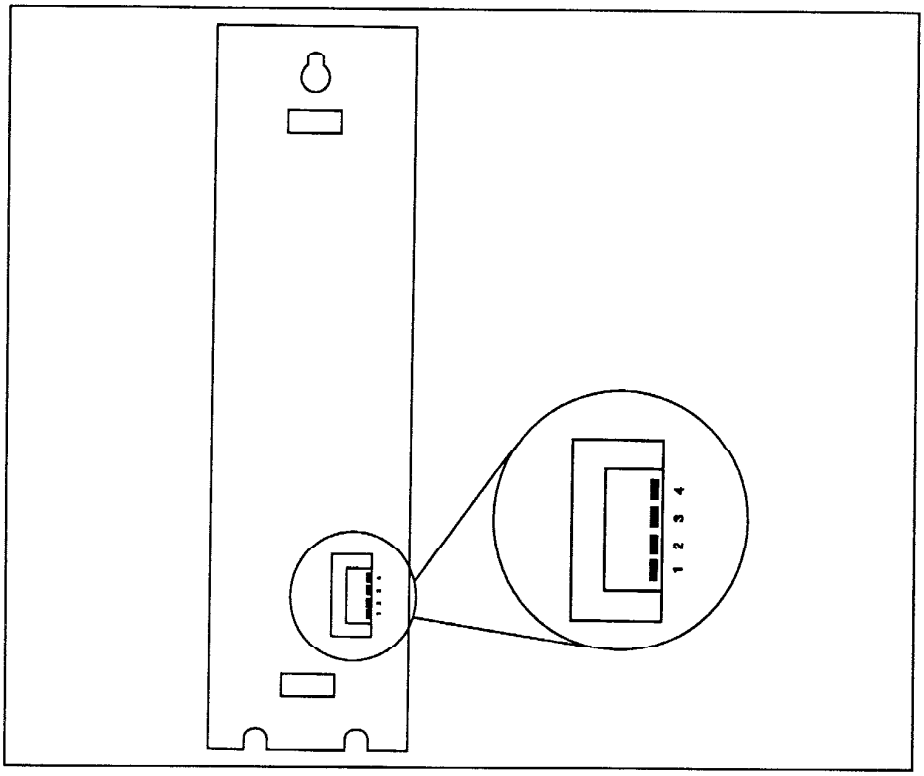


Figure 2-2 Back view of SBSC 1000/1100 (Connector X7 up)
All switches shown in "ON" position

Table 2-3 Continuous and Peak Current Output

	% OF FULL RATED OUTPUT CURRENT			
	100%	75%	50%	25%
1	ON	OFF	ON	OFF
2	ON	OFF	ON	OFF
3	ON	ON	OFF	OFF
4	ON	ON	OFF	OFF

2.2 Jumpers (E-Points)

The jumpers (E-Points) may be used to enable certain options of the SBSC 1100 (refer to Table 2-4) and to initialize units for either single or multi axis applications. For jumper locations, refer to Figure 2-1.

Table 2-4 Jumpers (E-Points)

Jumper	Position	Description	Factory Setting
E1	1 2 3	For test purposes only	1-2
E2	1 2	For test purposes only	no jumper
E3	1 2	For test purposes only	1-2
E4	1 2 3	For test purposes only	2-3
E5	1 2 3	For test purposes only	1-2
E6	1 2 3	For test purposes only	no jumper
E7	1 2	Jumper pins 1-2 to activate SYNC- output on card A0. If this jumper is installed, remove jumper E18.	1-2
E8	1 2	For test purposes only	no jumper
E9	1 2 3	Jumper pins 2-3 for non-differential encoder input mode. This will bias encoder negative inputs to ½ Vcc = 2.5V	1-2
E10, 11, 12	1 2 3	For resolver feedback, jumper pins 2-3. For encoder feedback, jumper pins 1-2.	2-3
E13, 14, 15	Solder Pad	For test purposes only	no jumper
E16	Solder Pad	For test purposes only	jumper installed
E18	1 2	Jumper pins 1-2 for input SYNC (use on all cards except A0). If this jumper is installed, remove jumper E7.	no jumper

2.2.1 Single/Multi Axis Set-Up

SBSC 1000/1100 units are delivered ready for single axis applications, where E7 is installed and E18 is removed.

To convert SBSC 1000/1100 units for use in multi-axis applications:

1. On the first axis, A0, install jumper E7 and remove jumper E18.
2. On all other axes, install jumper E18 and remove jumper E7.
3. Connect all pins of the Daisy Chain Connector X4 of A0 (the first axis) to the Daisy Chain Connector X4 of all the other axes (refer to Figure 3-1 for connector locations).
4. Tie the RESET inputs (Control Signals Connector X2, pin 19) of all the axes together (refer to Figure 3-1 for connector locations).

2.3 J1 Component Functions

J1 is a personality module (for location, refer to Figure 2-3) with one after factory adjustable setting used to adjust the It-switching threshold (refer to Section 2.3.1). The function of other components on J1 is explained in Table 2-5.

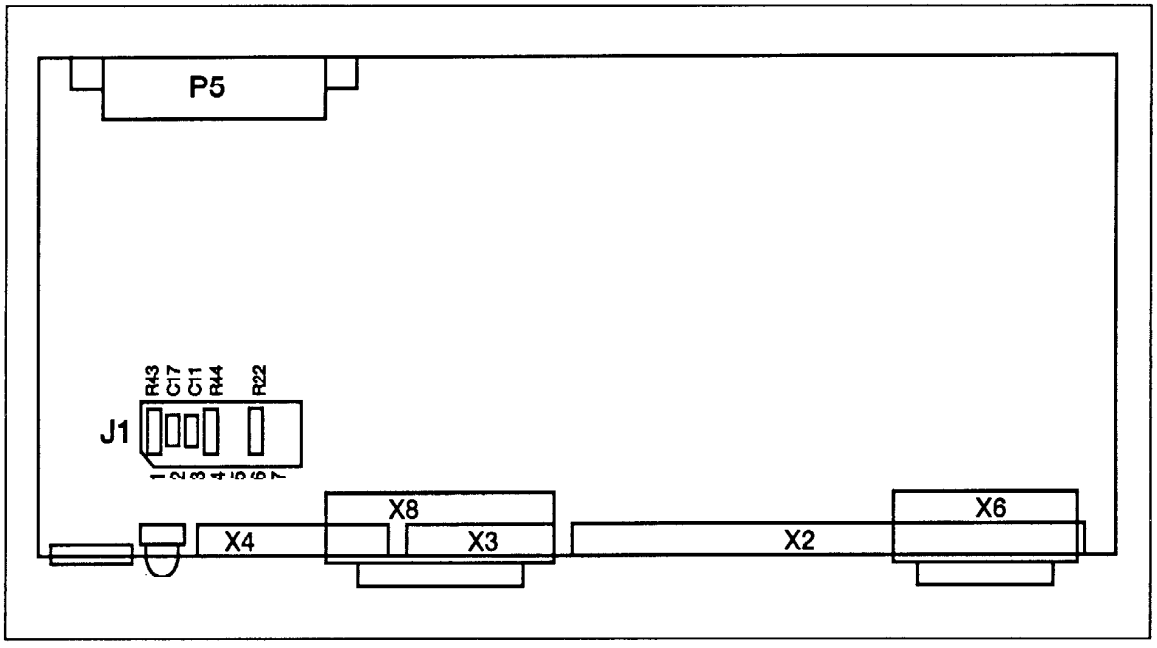


Figure 2-3 Control Card Component Layout

Table 2-5 J1 Component Functions

Component	Function	Factory Value
R22	It-Switching Threshold	open
R43	P-Gain for Current Loop, Phase U	150kΩ
C17	I-Gain for Current Loop, Phase U	4.7nF
R44	P-Gain for Current Loop, Phase V	150kΩ
C11	I-Gain for Current Loop, Phase V	4.7nF

2.3.1 It-Switching Threshold Adjustment (R22)

R22 is used to limit the continuous current without affecting the peak current. Table 2-6 shows the relation between continuous (nominal or RMS) current and peak current for different values of R22.

Table 2-6 It-Switching Threshold Adjustment (R22)

R22	SBSC 1002 SBSC 1102 I_{peak} = 4A	SBSC 1005 SBSC 1105 I_{peak} = 10A	SBSC 1010 SBSC 1110 I_{peak} = 20A	SBSC 1015 SBSC 1115 I_{peak} = 30A
-	I_{nom} = 2.0A	I_{nom} = 5.0A	I_{nom} = 10.0A	I_{nom} = 15.0A
20kΩ	I_{nom} = 1.6A	I_{nom} = 4.0A	I_{nom} = 8.0A	I_{nom} = 12.0A
10kΩ	I_{nom} = 1.3A	I_{nom} = 3.3A	I_{nom} = 6.7A	I_{nom} = 10.0A
5kΩ	I_{nom} = 1.0A	I_{nom} = 2.5A	I_{nom} = 5.0A	I_{nom} = 7.5A

SECTION III - INSTALLATION AND WIRING

These installation instructions are intended to be used only by personnel familiar with the SBSC 1000/1100 and associated machinery. The user should be familiar with the contents of this manual before any connections are made to the servo control or any supporting equipment.

CAUTION: DO NOT APPLY POWER TO THE UNIT AT THIS TIME.

3.1 Mechanical Installation

- Install the SBSC unit in a cabinet with a protection class to meet the requirements of the environmental conditions.
- Protect against corrosive chemical substances, oil vapor and steam, metal particles and dust.
- Provide adequate air ventilation for cooling.
- Mount the unit vertically with Connector X7 at the top.
- Cover the top of the unit during installation to prevent particles from falling into the unit.

NOTE: See Appendix B for mounting dimensions.

3.2 General Wiring Considerations

The information contained in this section is only a guide for proper installation. The National Electric Code and any regional or local codes will supersede information in this section.

Mating connector kits for the SBSC 1000/1100 are available from your distributor. Refer to Table 3-1 for part numbers.

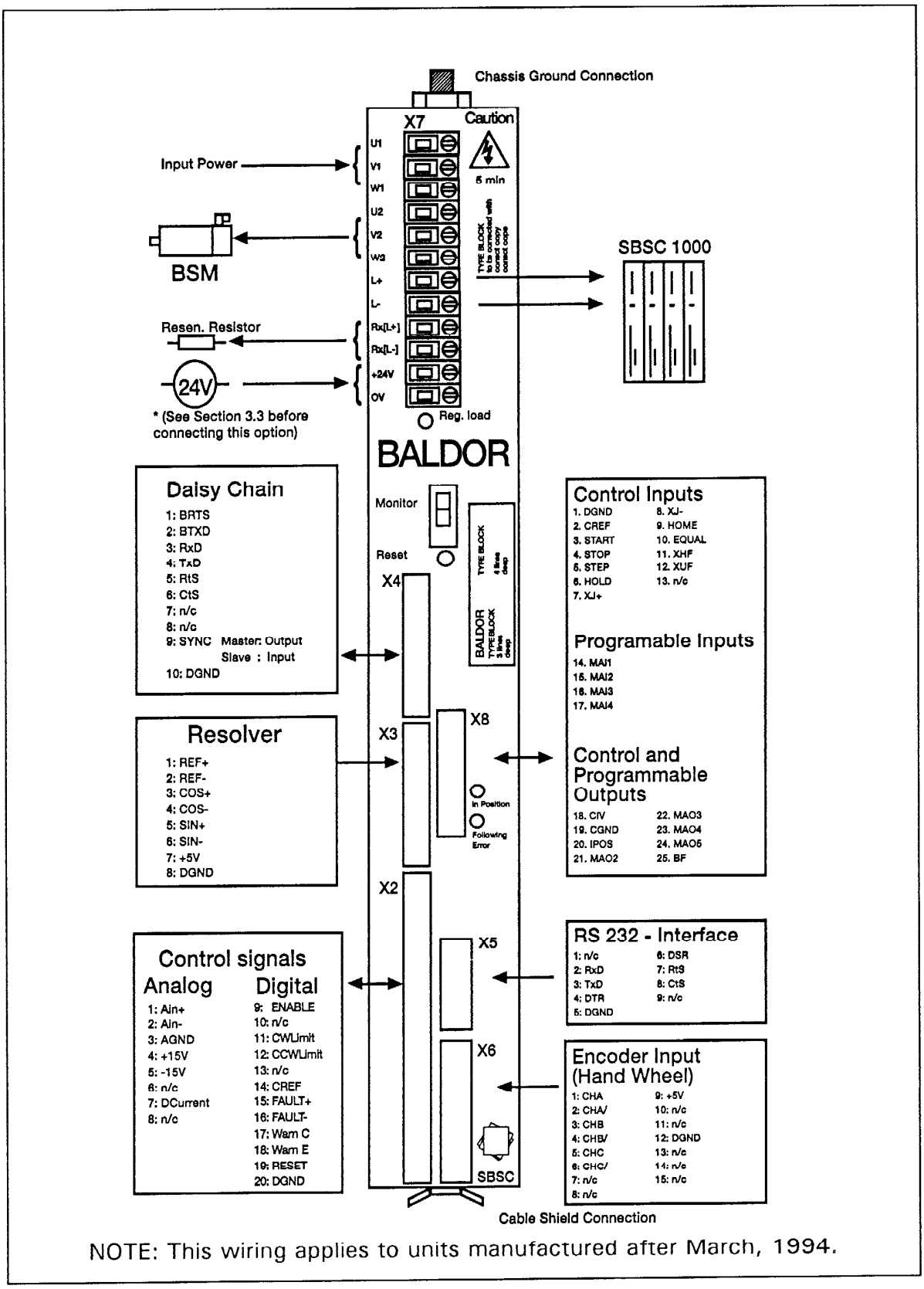
Table 3-1

Control Connector	Function	Connector Kit
X2	control signals	16000
X3	resolver	20506
X4	daisy chain	17934
X5	RS 232 interface	16215
X6	encoder input (handwheel)	20739
X8	control/programmable inputs & outputs	21742

CAUTION: Every SBSC 1100 MUST be fused separately. See Appendix A for recommended fuse sizes.

CAUTION: An external regeneration resistor must be connected to every SBSC 1100. See Section 3.3 for proper hook-up.

3.2.1 SBSC 1100 Connector Locations



NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-1 SBSC 1000/1100 Connectors

3.3 Power Wiring

CAUTION: Every SBSC 1100 MUST be fused separately. See Appendix A for recommended fuse sizes.

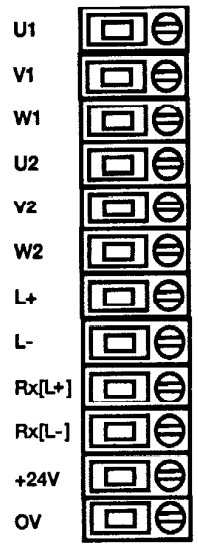
All Power wiring for the SBSC 1000/1100 should be no less than 12 AWG or equivalently rated wire. All power wiring connections are made to Voltage Connector X7 (Refer to Fig 3-2) via the following steps:

- For Input Power, connect Line 1 to U1, Line 2 to V1, and Line 3 to W1. **Note: For single-phase input voltage, do not connect W1. Do not ground W1.**
- For Motor Phase, connect Phase 1 to U2, Phase 2 to V2, and Phase 3 to W2.
- For multi-axis applications, it is possible for an SBSC 1100 control to provide input power to one or more SBSC 1000 controls by connecting the Positive DC bus (L+) terminal and Negative DC bus (L−) terminal to the L+ and L− terminal of the next control (refer to Appendix A for SBSC 1100 power supply ratings). In this application, **connect input power (U1, V1, and W1) only to the SBSC 1100.**
- An external regenerative resistor (order separately) should be connected to the SBSC 1100 terminals marked Rx(L+) and Rx(L−). See Appendix A for resistor sizes and part numbers.
- A separate +20 to +60 VDC (nominally +24 VDC) power supply may be connected to the terminals marked +24V and 0V to maintain voltage on the logic circuits at all times. **CAUTION: Though all units have the terminal marked, apply +24V only if the unit has this option (the unit's part number includes "-24"); otherwise, damage to the unit will occur.**

CAUTION: DO NOT APPLY POWER TO THE SBSC UNIT AT THIS TIME.

NOTE: For single-phase input voltage, do not connect W1. Do not ground W1.

terminal	
U1	Input Voltage Line 1 [L_1]
V1	Input Voltage Line 2 [L_2]
W1	Input Voltage Line 3 [L_3]
U2	Motor Voltage Phase 1 [ϕ_1]
V2	Motor Voltage Phase 2 [ϕ_2]
W2	Motor Voltage Phase 3 [ϕ_3]
L+	DC bus connection to SBSC 1000
L−	for multi-axis application
Rx(L+)	Regenerative resistor terminals
Rx(L−)	(Used as DC bus connection on SBSC 1000)
+24V	Optional logic power supply inputs
0V	See above text for warnings and proper connection information.



NOTE: This wiring applies to units manufactured after March, 1994.

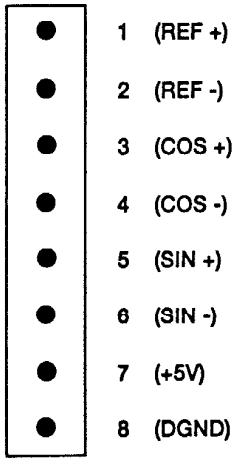
Figure 3-2 Voltage Connector X7

3.4 Signal Wiring

All Signal wiring for the SBSC 1000/1100 need not be larger than 20 AWG or equivalently rated wire. All signal wiring connections are made to Connectors X3, X4, X5, and X6 (Refer to Figures 3-3 to 3-6).

- Connect pins 1-6 from Connector X3 to the motor's Resolver output. (Refer to Figure 3-3).
- Connector X4 can be used to Daisy Chain to the next axis, if more than one SBSC will be used (Refer to Figure 3-4).
- To communicate between the SBSC and a PC-type computer, use a standard (straight through) DB9 cable to connect Connector X5 to the PC's serial port (Refer to Figure 3-5).
- If an encoder handwheel will be used, connect pins from Connector X6 to the handwheel's inputs (Refer to Figure 3-6).

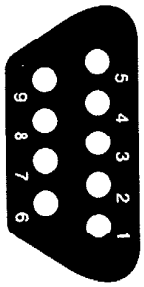
pin		
1	(REF+)	Positive Reference Signal
2	(REF−)	Negative Reference Signal
3	(COS+)	Resolver Cosine Input (+)
4	(COS−)	Resolver Cosine Input(−)
5	(SIN+)	Resolver Sine Input (+)
6	(SIN−)	Resolver Sine Input (−)
7	(+5V)	+5V output (I_{max} = 250mA)
8	(DGND)	Digital ground



NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-3 Resolver Connector X3

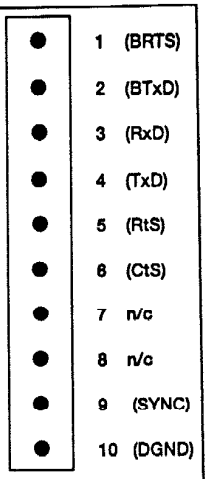
pin		
1	n/c	not connected
2	(RxD)	Receive Data
3	(TxD)	Transmit Data
4	(DTR)	Data Terminal Ready
5	(DGND)	Digital ground
6	(DSR)	Data Send Ready
7	(RtS)	Request to Send
8	(CtS)	Clear to Send
9	n/c	not connected



NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-4 RS 232 Interface Connector X5

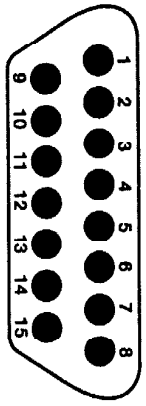
pin		
1	(BRTS)	Buffered Request to Send
2	(BTXD)	Buffered Transmit Data
3	(RxD)	Receive Data
4	(TxD)	Transmit Data
5	(RtS)	Request to Send
6	(CtS)	Clear to Send
7	n/c	not connected
8	n/c	not connected
9	(SYNC)	Synchronizing pulse. This is an output when the control is a leader, and an input when the control is a follower.
10	(DGND)	Digital ground



NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-5 Daisy Chain Connector X4

pin		
1	(CHA)	Encoder Channel A
2	(CHA/)	Encoder Channel A (inverted)
3	(CHB)	Encoder Channel B
4	(CHB/)	Encoder Channel B (inverted)
5	(CHC)	Encoder Channel C
6	(CHC/)	Encoder Channel C (inverted)
7	n/c	not connected
8	n/c	not connected
9	(+5V)	+5V output (I_{max} = 250mA)
10	n/c	not connected
11	n/c	not connected
12	(DGND)	Digital ground
13	n/c	not connected
14	n/c	not connected
15	n/c	not connected



NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-6 Encoder Input (Handwheel) Connector X6

3.5 Control Wiring

All Control wiring for the SBSC 1000/1100 need not be larger than 20 AWG or equivalently rated wire. All control wiring connections are made to Connectors X2 and X8 (Refer to Figures 3-7 to 3-9).

- Control Signal Connector X2 includes input signals that can be set active high or active low. (Refer to Table 3-2)

Active High: *Reference signals* to CREF. Tie CREF (pin 14) to common of customer provided external power supply ranging between +12 to +29 VDC.
To activate signals, apply a voltage ranging between +12 to +29 VDC to the appropriate signal pin as indicated in Table 3-2.
To inactivate signals, tie the signal to the common of the customer provided external power supply.
NOTE: An alternate method is to reference signals to CREF by tying CREF (pin 14) to AGND (pin 3) or DGND (pin 20). Note that AGND and DGND are internally tied together. Activate signals by applying the +15 VDC output (pin 4), and inactivate signals by tying them to AGND (pin 3) or DGND (pin 20).

Active Low: *Reference signals* to a voltage. Tie CREF [pin 14] to a customer provided external power supply ranging between +12 to +29 VDC.
To activate signals, apply the common of the customer provided external power supply to the appropriate signal pin as indicated in Table 3-2.
To inactivate signals, tie the signal to a voltage ranging between +12 to +29 VDC.
NOTE: An alternate method is to reference signals to a voltage by tying CREF (pin 14) to the +15 VDC output (pin 4). Activate signals by applying AGND (pin 3) or DGND (pin 20). Note that AGND and DGND are internally tied together. Inactivate signals by tying them to the +15 VDC output (pin 4).

Table 3-2

Signal	Active Condition	Inactive Condition
ENABLE (pin 9)	Control Enabled	Control Disabled
CW Limit (pin 11)	CW Rotation Enabled	CW Rotation Disabled
CCW Limit (pin 12)	CCW Rotation Enabled	CCW Rotation Disabled

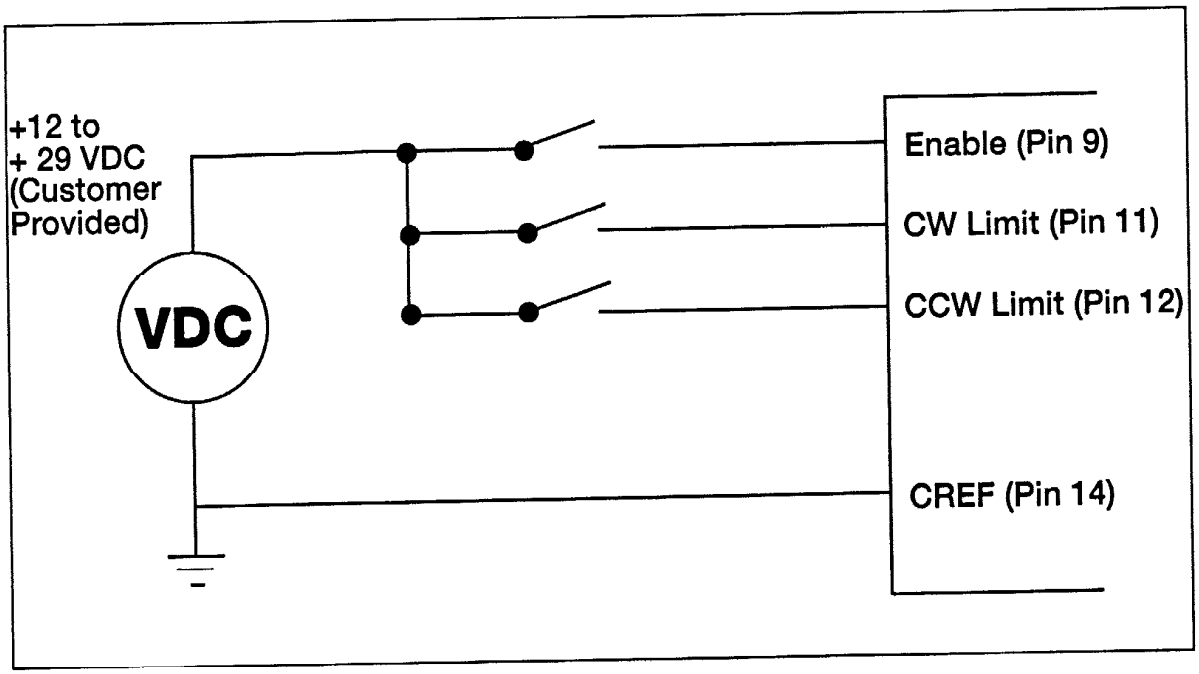
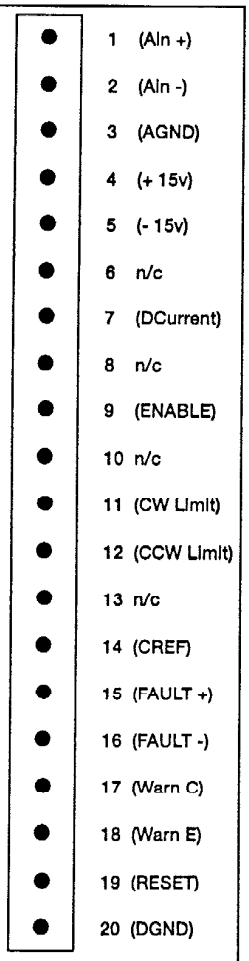


Figure 3-7 Typical Active High Control Wiring for Control Signal Connector X2

□ Refer to Figure 3-8 to complete connections to Control Signal Connector X2.

CAUTION: DO NOT APPLY POWER TO THE SBSC UNIT AT THIS TIME.

pin		
1	(Ain+)	Analog input (+) (See Note 1)
2	(Ain−)	Analog input (−) (See Note 1)
3	(AGND)	Analog ground. (See Note 2)
4	(+15V)	Positive 15V output (I_{max} − 100mA).
5	(−15V)	Negative 15V output (I_{max} = 100mA).
6	n/c	not connected
7	(DCurrent)	Actual output current test point (0 to +10V; 10V = I_p)
8	n/c	not connected
9	(ENABLE)	Enables control
10	n/c	not connected
11	(CW Limit)	Clockwise rotation disabled when pin is inactive.
12	(CCW Limit)	Counterclockwise rotation disabled when pin is inactive.
13	n/c	not connected
14	(CREF)	Command reference voltage. See Appendix E for input schematic.
15	(FAULT+)	Optional fault current breaker terminal (+).
16	(FAULT−)	Optional fault current breaker terminal (−).
17	(Warn C)	Current Limit Warning output can be connected to an external alarm.
18	(Warn E)	Overtemperature Warning output can be connected to an external alarm.
19	(RESET)	Short to DGND (pin 20) to reset an overvoltage, undervoltage, resolver fault, or electronic fusing fault condition.
20	(DGND)	Digital ground. (See Note 2)



Notes: 1. Refer to description of i14 in SMCC Operations manual to enable.
2. Analog and Digital ground are internally tied together.

NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-8 Control Signal Connector X2

- Control/Programmable Inputs and Outputs Connector X8 includes input signals that can be set active high or active low (Refer to Table 3-4).

Active High: *Reference signals* to CREF. Tie CREF (pin 2) to the common of a customer provided external power supply ranging between +12 to +29 VDC.
To activate signals, apply a voltage ranging between +12 to +29 VDC to the appropriate signal pin as indicated in Table 3-4.
To inactivate signals, tie the signal to the common of the customer provided external power supply.
NOTE: An alternate method is to reference signals to CREF by tying CREF (pin 2) to DGND (pin 1). Activate signals by applying the +15 VDC output of Control Signal Connector X2 (pin 4), and inactivate signals by tying them to DGND (pin 1).

Active Low: *Reference signals* to a voltage. Tie CREF (pin 2) to a voltage ranging between +12 to +29 VDC).
To activate signals, apply the common of the customer provided external power supply to the appropriate signal pin as indicated in Table 3-4.
To inactivate signals, tie the signal to a voltage ranging between +12 to +29 VDC.
NOTE: An alternate method is to reference signals to a voltage by tying CREF (pin 2) to the +15 VDC output of Control Signal Connector X2 (pin 4). Activate signals by applying DGND (pin 2), and inactivate them by tying them to the +15 VDC output of Control Signal Connector X2 (pin 4).

Table 3-4

Signal	Active Condition	Inactive Condition
START (pin 3)	control starts program	no effect on program
STOP (pin 4)	control stops program	no effect on program
STEP (pin 5)	control steps through program	no effect on program
HOLD (pin 6)	freezes program execution	no effect on program
XJ+ (pin 7)	motor jogs clockwise	no effect on motor
XJ− (pin 8)	motor jogs counterclockwise	no effect on motor
HOME (pin 9)	motor moves to home position	no effect on motor
EQUAL (pin 10)	motor returns to pre-jog position	no effect on motor
XHF (pin 11)	triggers a program interrupt	no effect on program
XUF (pin 12)	triggers a program interrupt	no effect on program
MAI1 (pin 14)	machine input 1 enabled	machine input 1 disabled
MAI2 (pin 15)	machine input 2 enabled	machine input 2 disabled
MAI3 (pin 16)	machine input 3 enabled	machine input 3 disabled
MAI4 (pin 17)	machine input 4 enabled	machine input 4 disabled

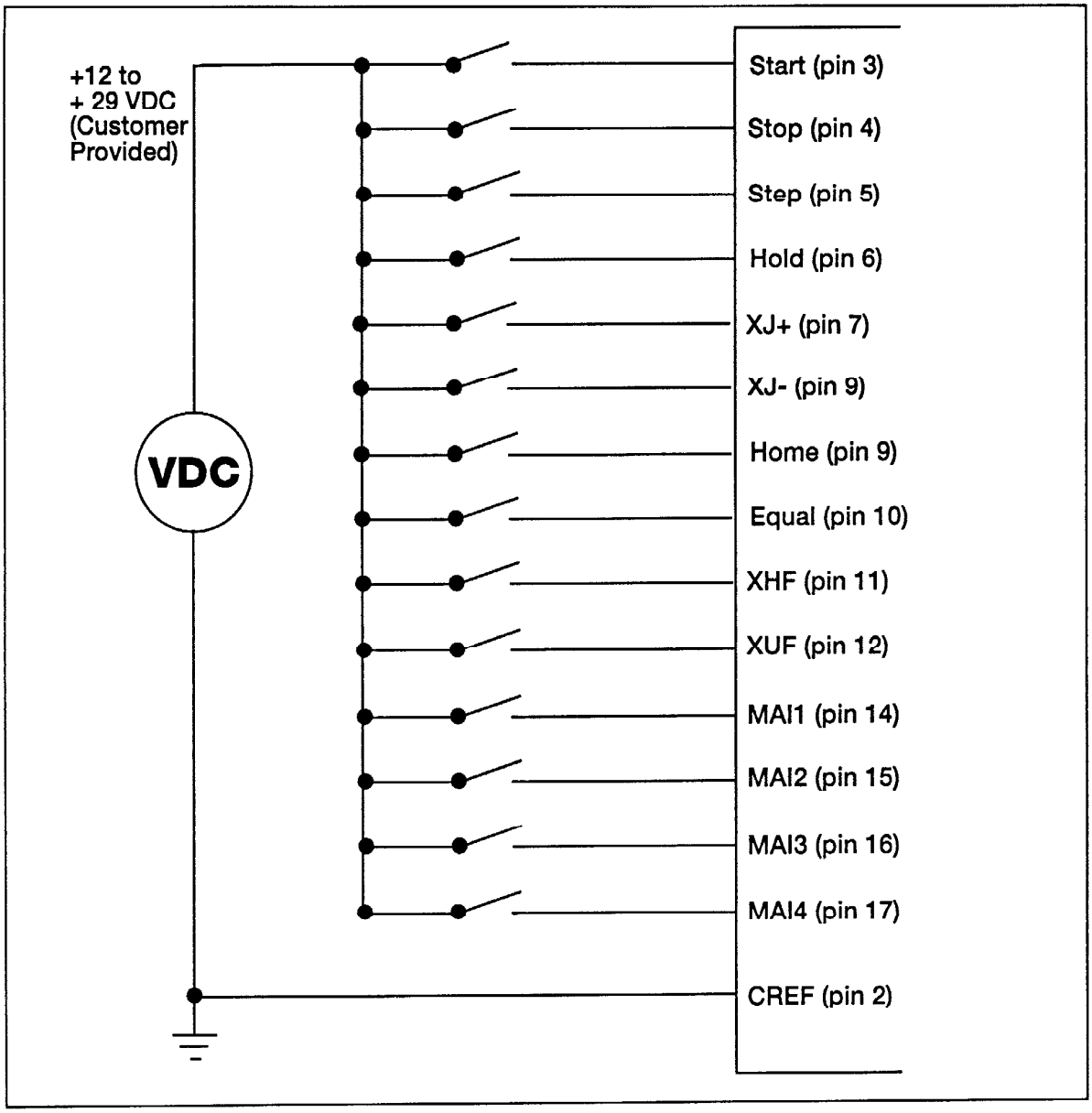
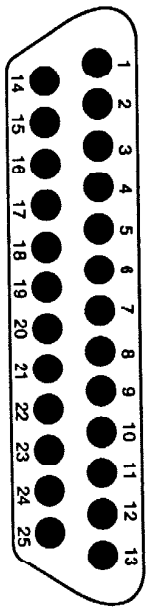


Figure 3-9 Typical Active High Control Wiring for Control/Programmable Inputs and Outputs Connector X8

□ Refer to Figure 3-10 to complete connections to Control Signal Connector X8.

CAUTION: DO NOT APPLY POWER TO THE SBSC UNIT AT THIS TIME.

pin		Control Inputs
1	(DGND)	Digital ground.
2	(CREF)	Command reference voltage. See Appendix E for input schematic.
3	(START)	Program Start. Once the SBSC is programmed, activating this pin will start the program.
4	(STOP)	Program Stop. Activating this pin will stop a program that is running.
5	(STEP)	Program Step. Once the SBSC is programmed, activating this pin will step through the program at the rate of one program instruction per step (activating) pulse.
6	(HOLD)	Program Hold. Freezes program execution at current instruction.
7	(XJ+)	Jog (+). Activating this pin will cause the motor to jog clockwise.
8	(XJ−)	Jog (−). Activating this pin will cause the motor to jog counterclockwise.
9	(HOME)	Activating this pin will send a "home" command to the motor.
10	(EQUAL)	Activating this pin will send a "return to pre-jog position" command to the motor.
11	(XHF)	X Home Flag. Used to trigger program interrupts. (See Note 1)
12	(XUF)	X User Flag. Used to trigger program interrupts. (See Note 1)
13	n/c	not connected
		Programmable Inputs
14	(MAI1)	Machine Input 1 (V_{in} = 12-29 VDC; I_{max} = 13.2 mA)
15	(MAI2)	Machine Input 2 (V_{in} = 12-29 VDC; I_{max} = 13.2 mA)
16	(MAI3)	Machine Input 3 (V_{in} = 12-29 VDC; I_{max} = 13.2 mA)
17	(MAI4)	Machine Input 4 (V_{in} = 12-29 VDC; I_{max} = 13.2 mA)
		Control and Programmable Outputs
18	(CIV)	Customer Input Voltage. (See Note 2)
19	(CGND)	Control ground. (See Note 2)
20	(IPOS)	In Position. To enable, refer to schematic in Appendix E.
21	(MAO2)	Machine Output 2 (I_{max} = 200mA; See Note 2)
22	(MAO3)	Machine Output 3 (I_{max} = 200mA; See Note 2)
23	(MAO4)	Machine Output 4 (I_{max} = 200mA; See Note 2)
24	(MAO5)	Machine Output 5 (I_{max} = 200mA; See Note 2)
25	(BF)	Buffer Full. To enable, refer to schematic in Appendix E.



Notes: 1. Refer to the description of i26[i46] in the SMCC Operations Manual.
2. If CIV and CGND are not connected, MAO2-5, IPOS, and BF cannot be enabled. Connect a +12 to +29 VDC source to CIV and connect its return to CGND. The +15 VDC output of Control Signal Connector X2 (pin 4) and DGND of Control/Programmable Inputs and Outputs Connector X8 (pin 1) may be used for this purpose.

NOTE: This wiring applies to units manufactured after March, 1994.

Figure 3-10 Control/Programmable Inputs and Outputs Connector X8

3.5 Grounding

Proper grounding reduces the possibility of electrical shock to personnel and can assist in suppression of electrical noise. Chassis ground connections should be made using the post at the top of the control. Digital ground (DGND) connections can be made to either Control Signal Connector X2, pin 20; Resolver Connector X3, pin 8; Daisy Chain Connector X4, pin 10; RS 232 Interface Connector X5, pin 5; Encoder Input (Handwheel) Connector X6, pin 12; or Control/Programmable Inputs & Outputs Connector X8, pin 1. Analog ground (AGND) connections can be made to Control Signal Connector X2, pin 3.

3.6 Electrical Noise Suppression

All external signal wiring to the SBSC 1000/1100 should be run in a separate conduit. It is strongly recommended that all signal wiring be run in twisted, shielded pairs and be isolated from power wiring. The end of the shield **closest to the control** should be grounded at the control; the other end of the shield should not be connected at all, to avoid ground-loop problems. All wiring should be kept as short as possible. The customer must supply suppression of transient voltages in his equipment which may occur.

SECTION IV - START UP

4.1 Start Up Procedure

CAUTION: Perform the initial system start up with no load applied to the motor to avoid damaging your equipment.

CAUTION: Every SBSC 1100 MUST be fused separately. See Appendix A for recommended fuse sizes.

NOTE: If using an isolation transformer, switch the primary side only, and check that secondary voltage meets the requirements specified in Appendix A.

- ☐ After all of the presets have been made, and all of the desired power, signal, and control wiring has been completed, temporarily disconnect the motor power from Voltage Connector X7 terminals U2, V2, and W2. **Do not disconnect the motor resolver.**

- ☐ Connect the serial port of a host computer to RS232 Interface Connector X5 of the SBSC.

- ☐ Turn on the main power to the SBSC. The Seven Segment "Monitor" Display and the LEDs on the front panel (refer to Figure 3-1 for locations) should coincide with Table 4-7. If not, refer to Section V Troubleshooting.

Table 4-7 Initial LED and Monitor Display Conditions

LED/DISPLAY	Condition
Reg. load LED	OFF
Monitor Display	"zero" displayed and decimal point at bottom right
Ready LED	GREEN
In position LED	GREEN
Following error LED	OFF

- ☐ Follow the directions that came with the MONITOR software to install and load the MONITOR program on your computer.

- ☐ Monitor is initially loaded in the Main Menu Mode. If an "Unrecognizable Response" or a "<<<TIMEOUT>>>" message is displayed, press F2. If the condition persists:
  1. Check that the SBSC has power and is enabled.
  2. Check that RS 232 Interface Connector X5 wiring is correct and that the communications cable is <u>not</u> a null modem cable.

- ☐ Press the ALT and F3 keys at the same time to go to the Editor Option Menu.
- ☐ Type "1" and press ENTER to load the editor with the program already stored in the SBSC's μSMCC memory.
- ☐ When prompted for a disk file name, type "TEMP" and press ENTER.
- ☐ When prompted for a card address, type the address of the SBSC which is being set up, and press ENTER. **NOTE: An SBSC set up as a single axis will always have the address A0.**
- ☐ When prompted for i-parameters, type "Y" and press ENTER.
- ☐ The next screen that will appear is the Editor Screen. Displayed will be a list of the factory set software initialization parameters (i-parameters) and the listing of a short program. **NOTE: There is no space between an i-parameter and its value. For example, if the value of i-parameter 20 is 300, it will appear as "i20300".**
- ☐ Check i20, i39, i40, and i50. Refer to Table 4-8 for the proper values for these i-parameters. **WARNING: IF YOU ARE USING A BSM 63A, i20 MUST NOT BE SET HIGHER THAN 300.**

Table 4-8 Motor Selection

Motor Type	i20	i39	i40	i50
BSM 63A	300	3	2048	0
BSM 4R/80A/80B	1000	3	2048	0
BSM 6R	1000	3	4096	1
BSM 4F/6F/8F/90A/90B/100A/100B	1000	3	1024	0

- ☐ Press F10 to exit the Editor Screen.
- ☐ If prompted to save the file, type "Y".
- ☐ Type "0" and press ENTER to return to the Main Menu Mode.
- ☐ Type "s" and press ENTER to save the new i-parameters.
- ☐ Turn off the main power to the SBSC and reconnect the motor power wiring to Connector X7 (refer to Section 3.3 Power Wiring).
- ☐ Turn on the main power to the SBSC. The motor will do a short phasing routine (a short turn in each direction) and come to rest. In some applications, this phasing routine is undesirable. To disable the phasing routine, set i54 and i72 according to Table 4-9, then type "s" and press ENTER to save the new parameters.

Table 4-9 Start-Up Phasing Routine Prevention

Motor Type	i54	i72
BSM 4R/63A/80A/80B	180	3
BSM 6R	780	3
BSM 4F/6F/8F/90A/90B/100A/100B	80	3

- The SBSC has a short program that was loaded into its μSMCC memory at the factory. The program causes the motor to move 100,000 counts, stop for 1 second, return to zero, and stop for 1 second before repeating. Type "R" to run the program, and type "q" or "Q" to stop it.

- To jog the motor using the Monitor software, type "J" or "j" and press ENTER. To stop the motor, type "J" or "j" again and press ENTER. "J" will make the shaft rotate counterclockwise, and "j" will make the shaft rotate clockwise. **CAUTION: The motor may tend to run away, out of control, if the resolver wires are reversed.**

4.2 Tuning Adjustment

The factory set software initialization parameters (i-parameters), except as noted in Table 4-8 and 4-9, should ensure stable but not optimal operation. Table 4-10 gives a list of the parameters that should be fine tuned for individual systems. **CAUTION: IF THE MOTOR OSCILLATES OR "BUZZES", DECREASE THE VALUE OF i20 (PROPORTIONAL GAIN). HIGH FREQUENCY OSCILLATION WILL CAUSE THE MOTOR TO OVERHEAT.**

Table 4-10 Tuning Parameters

Parameter	Description[1]
i20	Set Proportional Gain Constant
i21	Set Differential Gain Constant (Feedback Term)
i22	Velocity Feedforward Gain
i23	Set Integral Gain Constant
i30	Acceleration Feedforward Gain

Note: 1. Refer to the SMCC Software Manual for more detail.

To fine tune the SBSC:

1. Observe the waveform of Control Signals Connector X2, pin 7 (DCurrent) with an oscilloscope.

2. Send a step command ("j" or "J") to the SBSC.

3. To change the value of an i-parameter, type "ixxvalue" and press ENTER. For example, to change the value of i20 to 300, type "i20300" and press ENTER.

4. The SBSC is fine tuned when the waveform on the oscilloscope shows either no overshoot or a single overshoot when the step command is sent (Refer to Figure 4-3). At constant velocity, the AC component of the waveform should be kept as low as possible and should not exceed $2V_{pp}$.

5. Additional performance analysis can be done by using the tuning feature of the Monitor software. Refer to the Monitor software manual, which can be printed from the Monitor disk, for more detail.

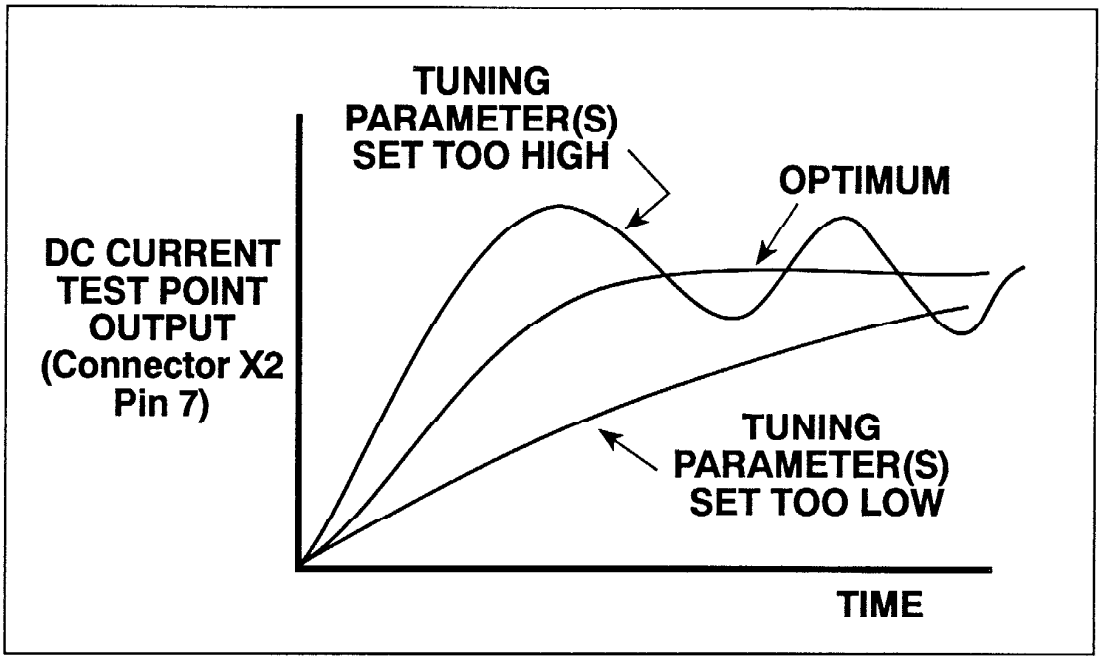


Figure 4-3 Typical Responses

SECTION V - TROUBLESHOOTING

5.1 Status Monitor

For monitoring and troubleshooting the SBSC 1100, there is a seven-segment display Status Monitor located on the front of the control (For location, see Figure 3-1). Table 5-1 allows quick interpretation of the Status Monitor.

Table 5-1 Status Monitor

"Ready" LED	Monitor	Status
Green	dark	Control disabled or Program running
Green	decimal point at bottom right	Control enabled
Red	1	Overvoltage error
Red	2	Undervoltage error
Red	3	Overcurrent error
Red	4	Overtemperature error
Red	5	Resolver fault
Red	6	Electronic fusing
Green	7	It (Current-time) warning. After 4 seconds (±0.8 s), control switches off, and monitor shows status "6".

5.2 Front Panel LEDs

LEDs on the front panel of the SBSC (Refer to Section 3-1 for locations) also indicate the control's status. Refer to Table 5-2 for interpretation of the LEDs.

Table 5-2 Status LEDs

LED	Color	Description[1]
Ready	OFF/GREEN/RED	OFF = No power to the control GREEN = Control enabled RED = Control disabled (Fault)
Reg. load	RED	Power is being dissipated into the regeneration resistor
In position	GREEN	Motor is in position
Following error	RED	Indicates following error has exceeded i10

Note: 1. Description refers to when the LED is lit, except were otherwise noted.

5.3 Troubleshooting Table

Most problems that occur with the SBSC 1100 can be solved using Table 5-3.

Table 5-3 Troubleshooting

SYMPTOM	CORRECTIVE ACTION
Decimal point does not appear.	Make sure that power is applied to the unit. Check wiring and polarity of the ENABLE line (Connector X2, pin 9, pin 14). Make sure that STOP pin (Connector X8, pin 4) is not enabled.
Motor shaft accelerates when main power is switched on.	Check wiring of the Resolver (Connector X3).
Motor has no holding torque.	Check the wiring and polarity of the Connector X2 pins (refer to Section 3.5): CW limit (pin 11) CCW limit (pin 12) ENABLE (pin 9) Reference (pin 14)
Motor does not reach rated speed.	Check Motor Voltage Phase connections (Connector X3 terminals U2, V2, W2). Refer to Table 2-3 and Table 2-6 and check the DIP Switch settings.
Motor oscillates or "buzzes".	Decrease the value of i20 (Proportional Gain). **CAUTION: High frequency oscillation will cause the motor to overheat.**
No output from Machine Outputs	Connect +12 to +29 VDC source to CIV (Connector X8, pin 18), and connect the source's ground return to CGND (Connector X8, pin 19). Refer to Figure 3-10 .

All questions about the SBSC 1000/1100 should be directed to your distributor or your local BALDOR office.

APPENDIX A - SBSC 1000/1100 SERIES SPECIFICATIONS

SERVO CONTROL	UNIT	1102	1105	1110-1	1110	1115-1	1115
Input Voltage Range 50/60 Hz	V_{AC}	110-250		100-120	200-250	110-120	200-250
Input Phase		1φ/3φ		1φ	3φ[1]	1φ	3φ[1]
Output Bus Voltage Nominal	V_{DC}	320		160	320	160	320
Output Bus Voltage Range	V_{DC}	155-350		140-170	280-350	140-170	280-350
Continuous Current Output (± 10%)	A_{RMS}	2	5	10		15	
Peak Current Output (± 10% for 3 sec ± 0.5 sec)	A_{RMS}	4	10	20		30[2]	

Notes: 1. When these units are connected to 1φ input, derate the power stage to $5A_{RMS}$, to avoid excessive ripple.
2. For SBSC 1015 and SBSC 1115, 1.5 sec. ± 0.5 sec.

INTERNAL POWER SUPPLY	UNIT	1102	1105	1110-1	1110	1115-1	1115
Continuous Output Current[1]	A_{RMS}	15					
Peak Output Current[1]	A_{RMS}	30					
Continuous Output Current[2] (V_{RIPPLE} = 50 V_{pp} ± 20%)	A_{RMS}	5		15	5	15	5
Peak Output Current[2] (V_{RIPPLE} = 90 V_{pp} ± 20%)	A_{RMS}	10		30	10	30	10

Notes: 1. With 3φ input voltage.
2. With 1φ input voltage.

BUS VOLTAGES	UNIT	1002	1005	1010	1015
Nominal Input Voltage	V_{DC}	320			
Nominal Input Range	V_{DC}	155-350			
Absolute Min/Max Input Voltage Range	V_{DC}	50-350			
Absolute Min/Max Input Voltage Range with 24V Input Option	V_{DC}	0-350			

SERVO CONTROL	UNIT	1002 1102	1005 1105	1110-1	1010 1110	1115-1	1015 1115
Recommended Fuse Size[1]	A	6	10	15		20	
Continuous Output Power	kVA	0.87	2.17	4.33		6.51[2]	
Efficiency	%	>95					
Minimum Load Inductance	μH	200					
Nominal Switching Frequency	kHz	8.5					
Mounting		Panel					
Dimensions	in	2.17 x 15.76 x 10.44[3]					
Weight	lb	9.92					
Operating Range	°C	5-45					
Derating	%/°C	2.9 (Range: 45°C to 55°C)					
Storage	°C	−25 to +70					
Humidity		10%-90%; not condensating; according to DIN 40 040, Class F					
Class of Protection (Enclosure)		IP 20; according to DIN 40 050/IEC 144					
Max. Altitude over Mean Sea Level	m	1000[4]					
Shock		10G; according to DIN IEC 68-2-6/29					
Vibration		1G; 10-150 Hz; according to DIN IEC 68-2-6/29					

Notes: 1. Standard fuse sizes (for single unit) are determined by the formula: $I_{FUSE} = 1.25 \times I_{CONT}$. For multiple units the same formula applies where I_{CONT} = the sum of the I_{CONT} of all the linked units.
2. For SBSC 1115, 5.2 kVA.
3. With option -TH (thumbwheel), 2.96 x 15.76 x 10.44.
4. Above 1000m, derate temperature 1°C for every 200m.

REGENERATION RESISTOR - EXTERNAL	UNIT	1102	1105	1110-1	1110	1115-1	1115
Switching Threshold	V_{DC}	370-410					
Nominal/Peak Power	kW	1.0/15.0					
Maximum Inductive Load	μH	100					
Regeneration Switching Current (maximum)	A	40					
Regeneration Resistor	Ω	18	18	10[1]	18[1]	4.7	10[1]
Resistor Part Number		RG 18	RG 18	RG 10[1]	RG 18[1]	RG 4.7	RG 10[1]

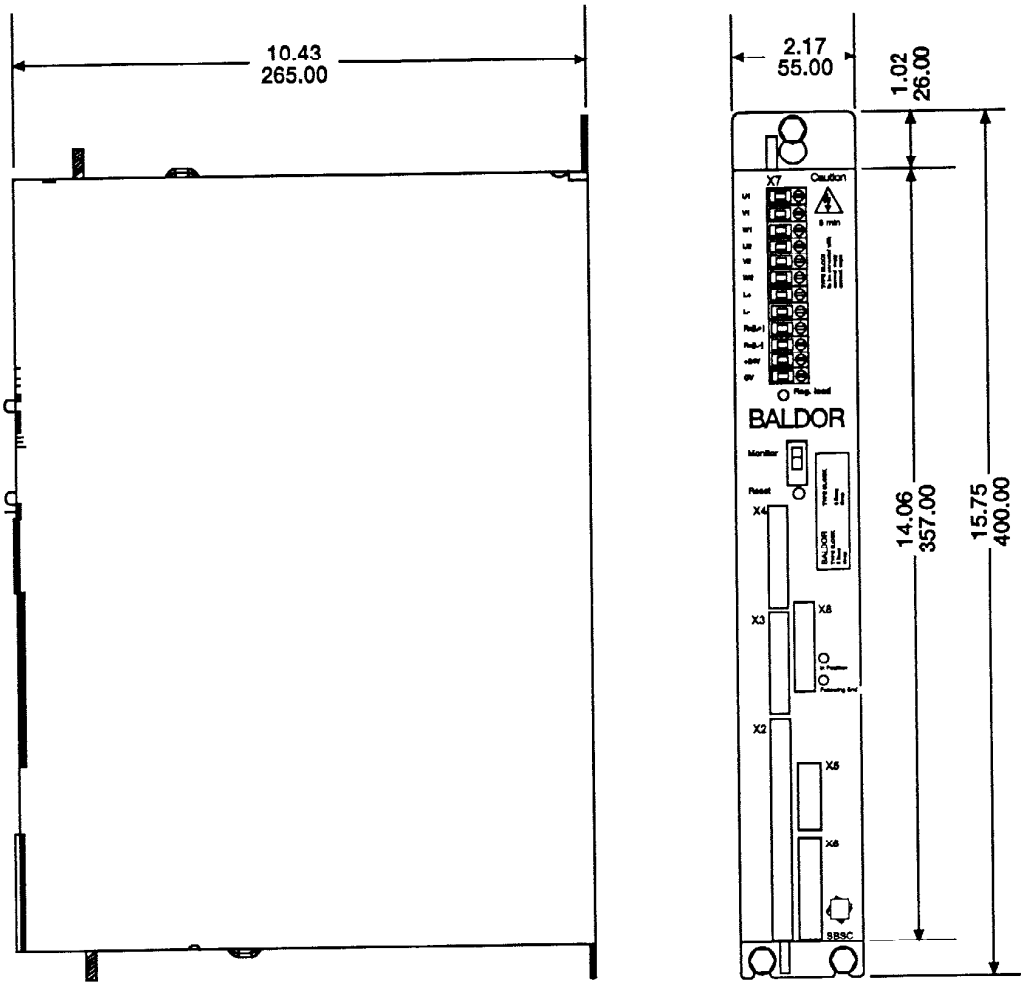
Notes: 1. Recommended regeneration resistor/part number for single axis operation only.

SERVO CONTROL	UNIT	1002 1102	1005 1105	1110-1	1010 1110	1115-1	1015 1115
Normal Position & Velocity Mode Update Time	µs	976					
Handwheel Mode Update Time	µs	500					
Execution Rate		typically 50 Blocks/second					
Positioning Range		± 67,000,000 Encoder Counts					
Positioning Accuracy		± 1 Encoder Count					
Velocity Range		0.005-400,000 Encoder Counts/second					
Velocity Accuracy[1] Long Term Short Term	 % %	 0.002 0.5-1.0					
Velocity Repeatability[1]	%	0.001					
Feedback Resolution		4096 Counts/revolution					
Feedback Accuracy		typically ± 14 arcmin					
Feedback Max. Input Frequency	MHz	1					
Handwheel Input Signal		5V TTL; Differential					
Handwheel Max. Input Frequency	kHz	600					
Control In- and Output Interfaces		opto isolated 12-29 V_{DC}					
Programmable In- and Output Interfaces		opto isolated 12-29 V_{DC}					
Interface Communication		RS232 C					
ROM Capacity	kByte	32					
RAM Capacity	kByte	8					
EEROM Capacity	kByte	8					

Note: 1. Current loop, motor, and load influences are not taken into account.

24V INPUT OPTION (REFER TO SECTION 3.3)	UNIT	1002 1102	1005 1105	1110-1	1010 1110	1115-1	1015 1115
Input Voltage Range (absolute min/max; V_{RIPPLE} = ± 10%)	V_{DC}	20-60					
Input Current at $24V_{DC}$	A_{RMS}	1.4					
Surge Current at Power On at $24V_{DC}$ (for 100ms)	A_{RMS}	2.5					

APPENDIX B - MOUNTING DIMENSIONS

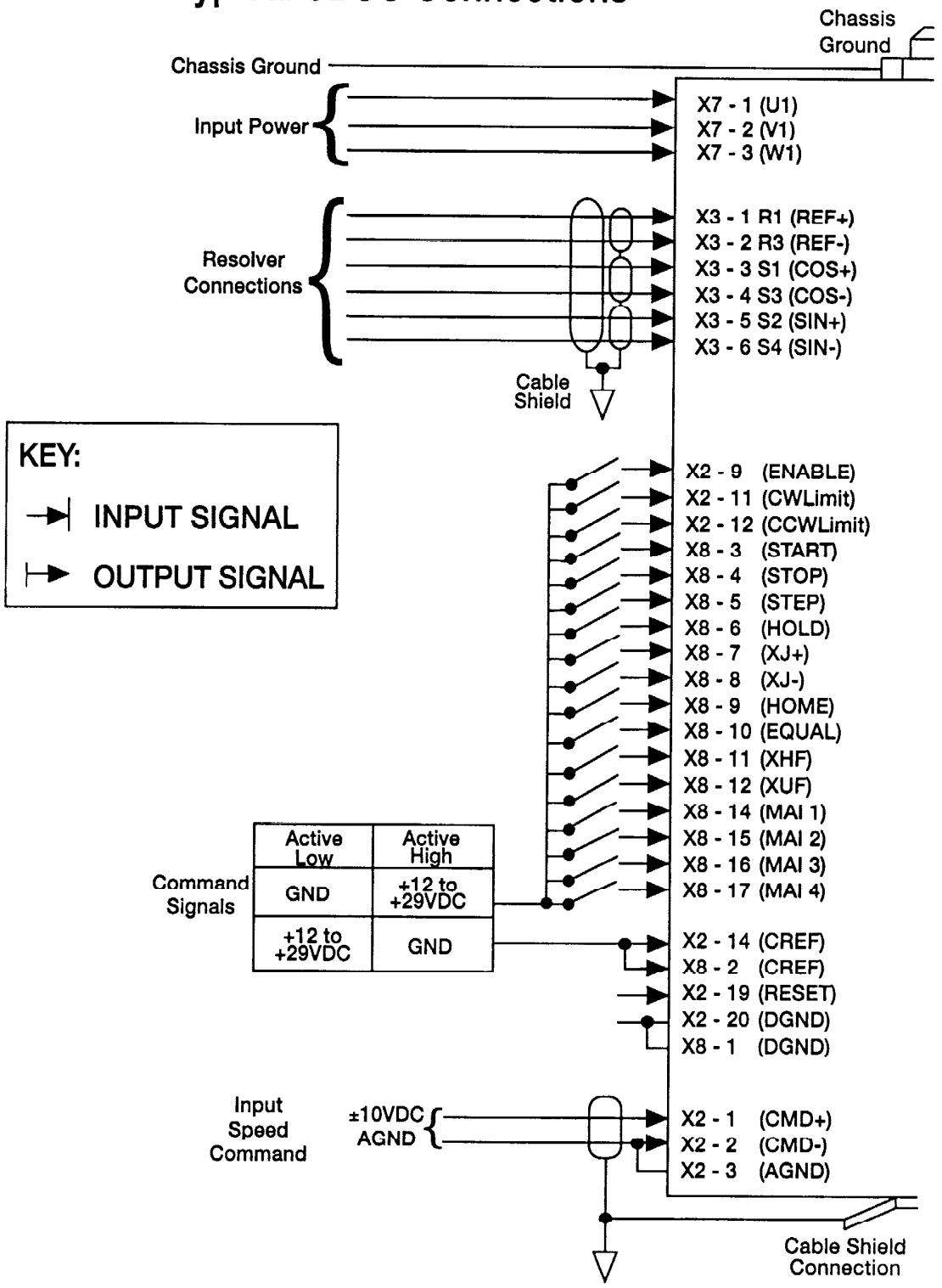


All dimensions are in inches/mm.

Model Number	1002 1102	1005 1105	1010-1 1110-1	1010 1110	1015-1 1115-1	1015 1115
Weight (Lbs.)	10	10	10	10	10	10

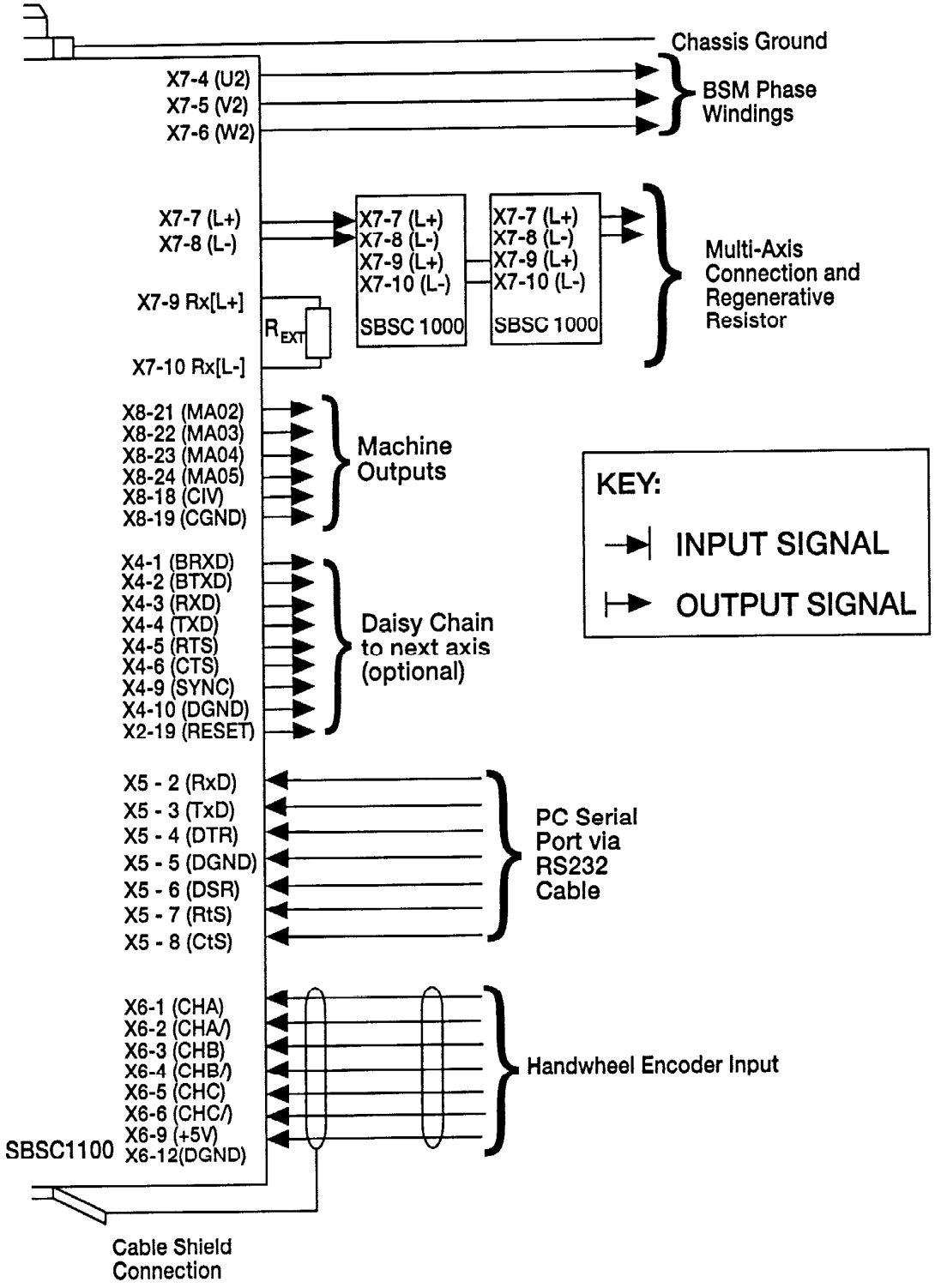
APPENDIX C - CONDENSED INSTALLATION INSTRUCTIONS

Typical SBSC Connections



Note: This wiring applies to units manufactured after March, 1994

Typical SBSC Connections



Note: This wiring applies to units manufactured after March, 1994

APPENDIX D - FACTORY i-PARAMETER SETTINGS

Parameter	Description	Factory Settings
i00	Set Following Error Limit (FAULT)	0
i01	Set In-Position Band	100
i02	Set Manual Data Input Mode	0
i03	Set Handshake Enable in Host Communication	1
i04	Set Home Feed Rate	100
i05	Set Servo Time Period	487[1]
i06	Set Reference (Maximum) Feed Rate	100,000
i07	Set Time Scale	65,498
i08	Set Acceleration/Deceleration Time	100
i09	Set Position Integration Mode	1
i10	Set Limit for Following Error Indicator	1000
i11	Set Feed Hold Slew Control	1
i12	Move Delay Time	40
i13	Enable Commutation for Brushless Motor	1[1]
i14	Select Processor A/D Converter Mode	0
i15	Select Sinusoidal or Trapezoidal Mode	0
i16	Select Handwheel Mode 1 Control	0
i17	Set Velocity Display Time Base	14648
i18	Select Display Format to be Used	3
i19	Set Highest Card Address	0
i20	Set Proportional Gain Constant	1000[2]
i21	Set Differential Gain Constant	10
i22	Velocity Feedforward Gain	10
i23	Set Integral Gain Constant	0
i24	Select Home Direction	0
i25	Set Home Offset	0
i26	Set Home Flag and User Flag Control	5
i27	Set Handwheel Scale Factor	4096
i28	Select Handwheel Mode Control	3
i29	Set Handwheel Encoder Control	3

Note: 1. No other values allowed.
2. See Table 4-8

Parameter	Description	Factory Setting
i30	Acceleration Feedforward Gain	0
i31	Set Jog Feed Rate	128
i32	Set Normal PWM Limit Control	255
i33	Set Protective PWM Limit Control	128[1]
i34	Set Backlash Compensation	0
i35	Set Software Positive Position Limit	−1
i36	Set Software Negative Position Limit	−1
i37	Set Position Range	0
i38	Set Position and Display Scale and Format	1:1:0
i39	Encoder Control	3[2]
i40	Encoder Counts per Revolution	2048[2]
i41	Phase Advance Scale Factor	12
i42	Induction Motor Magnetization PWM	0[1]
i43	Set Lookup Table Address	130
i44	Select 3/4 Phase	1[1]
i45	Set Hall Sensor Phase Offset	0[1]
i46	Y User Flag	0
i47	n/a	4096[1]
i48	Star-Delta Connection	0[1]
i49	n/a	3[1]
i50	Enable Triple-Cycle Motor Definition	0[2]
i51	n/a	200[1]
i52	Phase Finding Time	40
i53	Phasing PWM Value	10
i54	Phase Offset	0
i55	n/a	−1[1]
i56	n/a	−1[1]
i57	n/a	0[1]
i58	n/a	1:1:0[1]
i59	n/a	3[1]
i60	Deadband X	0
i61	Deadband Y	0[1]

Notes: 1. No other values allowed.
2. See Table 4-8

Parameter	Description	Factory Setting
i62	PLC Enable	0
i63	Parabolic Mode Control	0
i64	X Encoder/Resolver Base Add	65464[1]
i65	Y Encoder/Resolver Base Add	0[1]
i66	Speed of Second X Resolver	0
i67	Speed of Second Y Resolver	0[1]
i68	Second X Resolver Base Address	0
i69	Second Y Resolver Base Address	0[1]
i70	X Encoder/Resolver Bias	0
i71	Y Encoder/Resolver Bias	0[1]
i72	X Encoder/Resolver Size	0
i73	Y Encoder/Resolver Size	0[1]
i74	Second X Resolver Size	0
i75	Second Y Resolver Size	0[1]
i76	X Encoder Data/Strobe Logic Level	1[1]
i77	Y Encoder Data/Strobe Logic Level	0[1]
i78	X Range Mode Control	0
i79	Y Range Mode Control	0[1]

Notes: 1. No other values allowed.

APPENDIX E - INPUT/OUTPUT SCHEMATICS

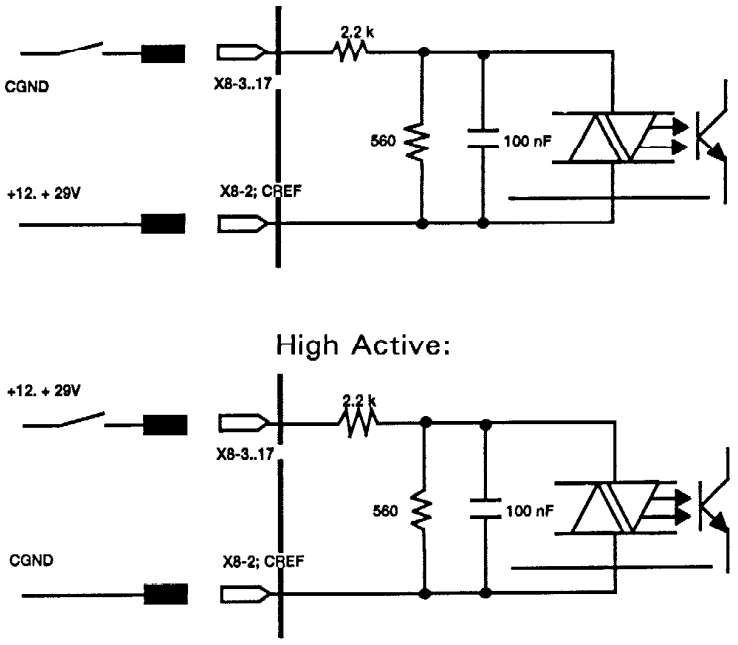
KEY:

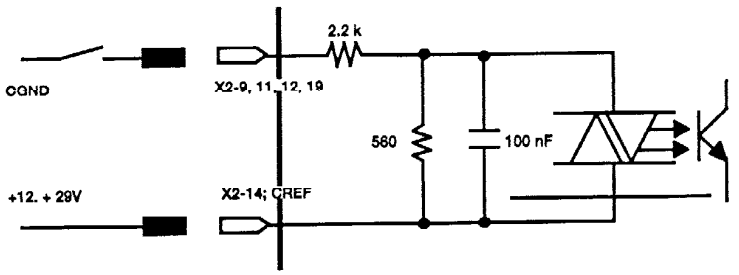
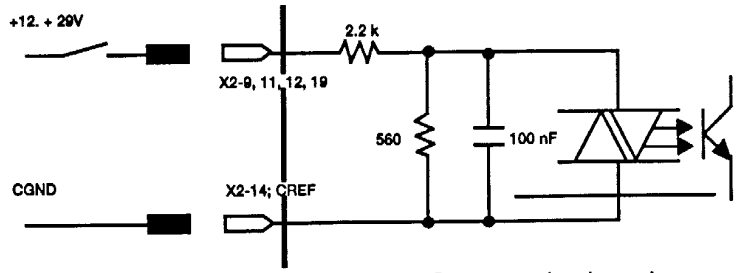
Input Signal
Output Signal
Bi-directional Signal
Connector

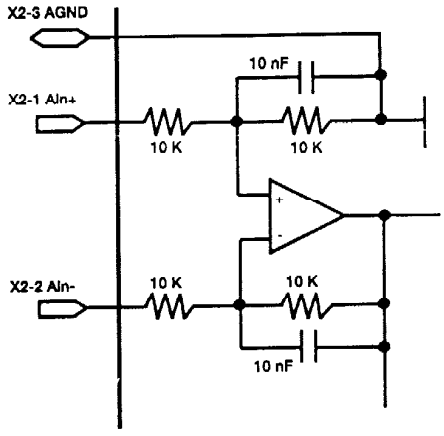
NOTE: All wiring in this appendix applies to units manufactured after March, 1994.

Input Signals

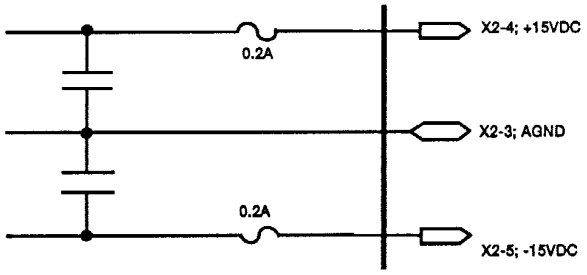
CONTROL SIGNAL CONNECTOR X8 (DIGITAL INPUTS)			
Function	Signal	Pin	Schematic
Start Program	START	3	Low Active:
Stop Program	STOP	4	
Step Program	STEP	5	
Hold Program	HOLD	6	
Home Position	HOME	9	
Pre-Jog Position	EQUAL	10	
JOG +	XJ +	7	
JOG –	XJ –	8	High Active:
X-Home-Flag	XHF	11	
X-User-Flag	XUF	12	
Machine-Input 1	MAI1	14	
Machine-Input 2	MAI2	15	
Machine-Input 3	MAI3	16	
Machine-Input 4	MAI4	17	Min. Input Impedance R_{IN} = 2.2 KΩ; opto isolated; V_{IN} = 12-29 V_{DC}; max. current at 24 VDC; I = 10 mA
Reference	CREF	2	

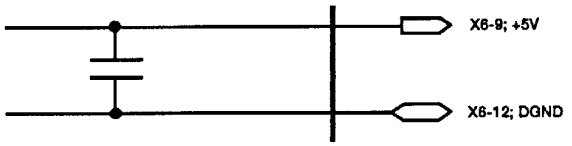


CONTROL SIGNAL CONNECTOR X2 (DIGITAL INPUTS)			
Function	Signal	Pin	Schematic
Enable	ENABLE	9	Low Active:  High Active:  Min. input resistor R_{IN} = 2.2 KΩ; opto isolated; V_{IN} = 12-29 V_{DC}; max. current at 24 VDC; I = 10 mA
Clockwise Limit	CWLimit	11	
Counter-Clockwise Limit	CCWLimit	12	
Reset	RESET	19	
Reference	CREF	14	

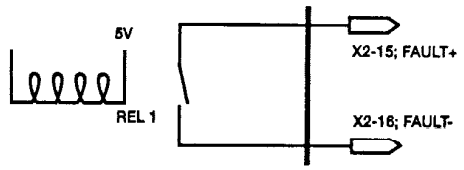
CONTROL SIGNAL CONNECTOR X2 (ANALOG INPUTS)			
Function	Signal	Pin	Schematic
Signal Input Signal Return	Ain + Ain – AGND	1 2 3	V_{in} (max) = + 10 VDC 
Refer to description of i14 in SMCC Software Manual for use of Analog Inputs			

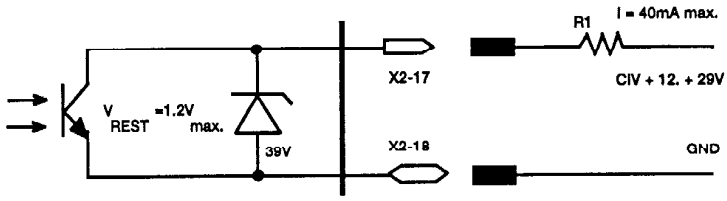
Output Signals

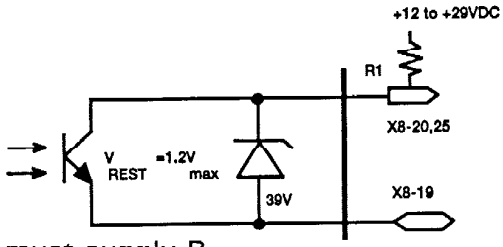
CONTROL SIGNAL CONNECTOR X2 (± 15V OUTPUT)			
Function	Signal	Pin	Schematic
± 15 V_{DC} Output	+15 V_{DC} AGND −15 V_{DC}	4 3 5	 Fuses are thermal fuses; not customer replaceable. I_{MAX} = 100 mA

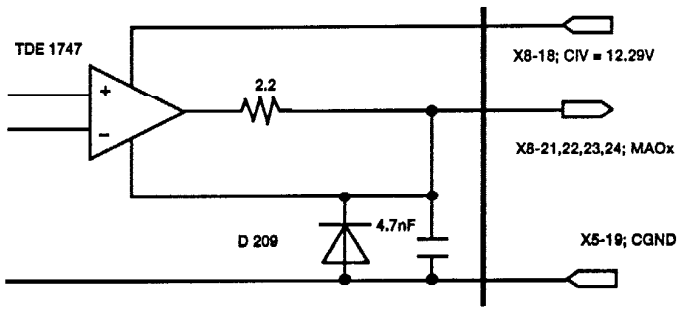
ENCODER INPUT (HANDWHEEL) CONNECTOR X6 (+5V OUTPUT)			
Function	Signal	Pin	Schematic
+ 5V Output	+5V DGND	9 12	 I_{MAX} = 250 mA

CONTROL SIGNAL CONNECTOR X2 (ANALOG TEST SIGNALS)			
Function	Signal	Pin	Schematic
Testpoint	DCurrent	7	All test signals are terminated with a resistor (4.7 kΩ) and scaled to 10V. Load resistor ≥ 100 kΩ. (Refer to Section 3.5)

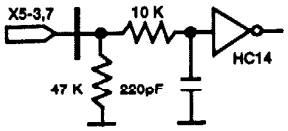
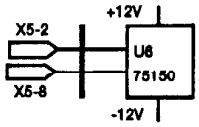
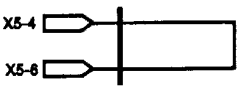
CONTROL SIGNAL CONNECTOR X2 (FAULT RELAY SIGNALS)			
Function	Signal	Pin	Schematic
Fault Relay	Fault + Fault –	15 16	 Contact is normally closed; opens upon fault. V_{AC} = 110V I_{MAX} = 0.3A V_{DC} = 24V I_{MAX} = 0.8A

CONTROL SIGNAL CONNECTOR X2 (It WARNING SIGNAL)			
Function	Signal	Pin	Schematic
It Warning	Warn C Warn E	17 18	 Customer must supply R_1. Warning occurs before control switches off with It-Limit or Overtemperature.

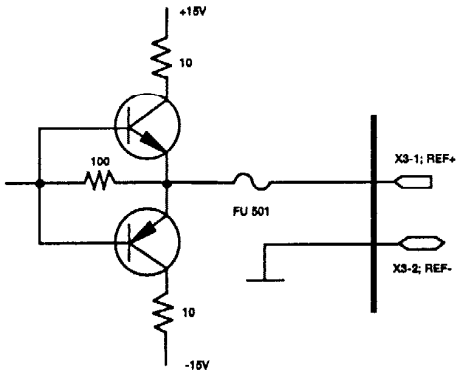
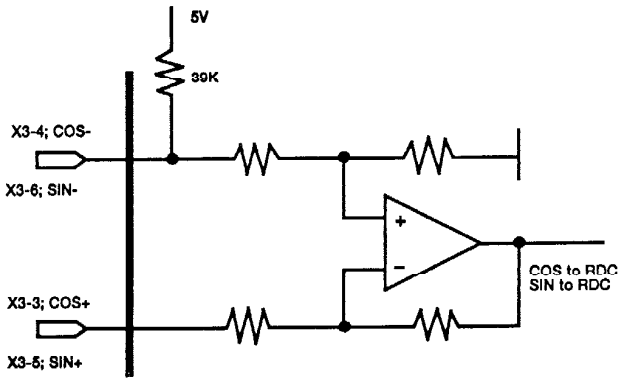
CONTROL/PROGRAMMABLE INPUTS & OUTPUTS CONNECTOR X8 (IPOS AND BF)			
Function	Signal	Pin	Schematic
In Position Buffer Full Return	IPOS BF CGND	20 25 19	 Customer must supply R_1

CONTROL/PROG. INPUTS & OUTPUTS CONNECTOR X8 (MACHINE OUTPUTS)			
Function	Signal	Pin	Schematic
Reference Voltage	CIV	18	
Machine Output 2	MAO2	21	
Machine Output 3	MAO3	22	
Machine Output 4	MAO4	23	
Machine Output 5	MAO5	24	
Return	CGND	19	
			Current limiting to 0.3A opto isolated; V_{IN} = 12-29 V_{DC}; Max. current at 24V; I = 200mA

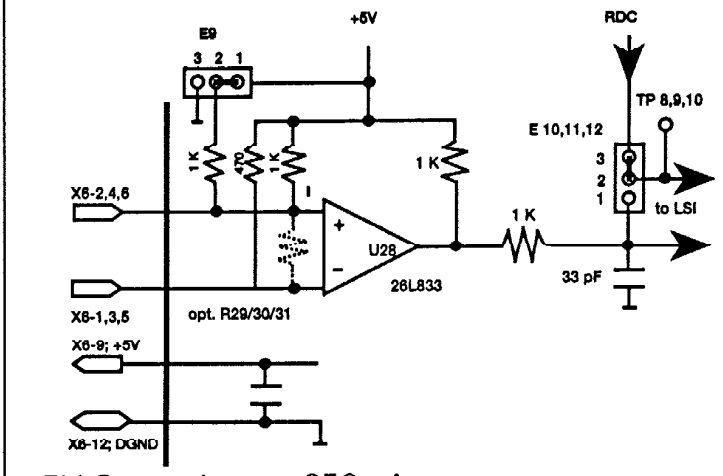
RS232 Signals

RS232 INTERFACE CONNECTOR X5			
Function	Signal	Pin	Schematic
TXD RTS	TXD RTS	3 7	
RXD CTS	RXD CTS	2 8	
DTR DSR	DTR DSR	4 6	
Data Format: 1 Start Bit - 8 Data Bits - 1 Stop Bit - no Parity			

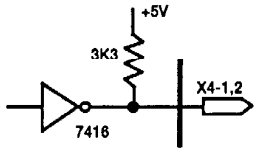
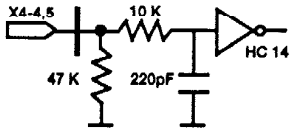
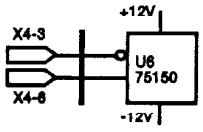
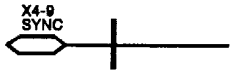
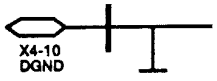
Resolver Signals

RESOLVER CONNECTOR X3			
Function	Signal	Pin	Schematic
Reference Signal	REF +	1	 Sinusoidal signal waveform; f = 7.2 to 8 kHz V_{OUT} = 21V_{pp} ± 10%; Short-circuit proof
	REF –	2	
COSINE Input	COS +	3	 Input impedance about 17kΩ; Sinusoidal signal waveform; V_{IN} = 10V_{pp} ± 10%; f – 7.2 to 8.0 kHz
	COS –	4	
SINE Input	SIN +	5	
	SIN –	6	

Encoder Signals

ENCODER INPUT (HANDWHEEL) CONNECTOR X6			
Function	Signal	Pin	Schematic
Encoder Channel A	CHA	1	
	CHA/	2	
Encoder Channel B	CHB	3	
	CHB/	4	
Encoder Channel C	CHC	5	
	CHC/	6	
+5V Output	+5V	9	
Return	DGND	12	+5V Output I_{MAX} = 250mA

Daisy Chain Signals

DAISY CHAIN CONNECTOR X4			
Function	Signal	Pin	Schematic
Buffered RTS	BRTS	1	
Buffered TXD	BTXD	2	
TXD	TXD	4	
RTS	RTS	5	
RXD	RXD	3	
CTS	CTS	6	
Synchronizing Pulse	SYNC	9	
Digital Ground	DGND	10	

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