UNION SWITCH & SIGNAL INC.
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SERVICE MANUAL 6421-2

Shop Maintenance

TRAIN-TO-WAYSIDE COMMUNICATION TWC-1000

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ANSALDO Trasporti

REVISION INDEX

Revised pages of this manual are listed below by page number and date of revision. The black bar in the page margin indicates the area of change.

Page Number	Date of Revision
3-1	1/1999
3-3	1/1999

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SECTION I

GENERAL INFORMATION

1.1 PURPOSE OF MANUAL

This manual provides bench level maintenance procedures for the TWC-1000 Unit printed circuit boards (Section II), a complete detail parts list (Section III), and applicable diagrams (Section IV). The information contained in this manual will enable experienced maintainers to test, troubleshoot, repair, and generally restore the TWC-1000 Unit to an operable state.

1.2 EQUIPMENT PURPOSE

In conjunction with other wayside and carborne equipment, the TWC-1000 microprocessor unit is used to translate system data being communicated between the central office and the train.

1.3 EQUIPMENT DESCRIPTION (See Figure 1-1)

The TWC-1000 components are housed in a roll-out drawer assembly designed for installation in a standard 19-inch equipment rack. Internal components are accessible from the top of the unit.

The bottom printed circuit board (Interface PCB) is fastened through insulated standoffs to the base of the unit. The top PCB (CPU PCB) is hinged to permit access to the Interface PCB and other components.

A Display PCB is mounted parallel to and directly behind the front panel. It provides a 16-bit alphanumeric LED display. The alphanumeric display provides messages in clear direct-reading text. The discrete LEDs on the interface PCB identify the following as they are transmitted or received:

a. XMIT (Transmit)

1. CTR FREQ (Center Frequency - 9800 Hz)
2. SPC (Space - 9650 Hz)
3. MRK (Mark - 9950 Hz)

b. REC (Receive)
1. CARR DET (Carrier Detect - 9800 ± 250 Hz)
2. SPC (Space - 9650 ± 70 Hz)
3. MRK (Mark - 9950 ± 70 Hz

The rear panel contains all of the unit's communication, line input and output, and power connections. These include two industry standard 25-pin D connectors (P1 and P2) for serial

communications, one 24-way terminal connector for the line connections, and a five-pin (male) socket for power input. The terminal connector is edge connected to the Interface PCB.

A single dc/dc power converter module is mounted on the right side of the unit. The converter module regulates the input power and converts it to +5 volt, +12 volt, and -12 volt levels that power the PCB electronics and selected communication interfaces.

1-4 PRINTED CIRCUIT BOARDS

1.4.1 CPU Printed Circuit Board (N451657-2701)

1.4.1.1 General

The CPU PCB (Figures 1-1 & 4-3) within the TWC-1000 makes logical decisions based on pre-programmed instructions. These instructions are typically application specific and are contained in replaceable EPROM memory devices installed on the board. DIP switches are used to select various operating parameters and hardware configurations. While some integrated circuit devices are socketed, the board is typically serviced in the field by board replacement.

1.4.1.2 Microprocessor

The microprocessor component of the CPU board is a Motorola 68A09 8/16 bit device operating with a 1.5MHz clock. It resides in socket IC1.

1.4.1.3 Memory

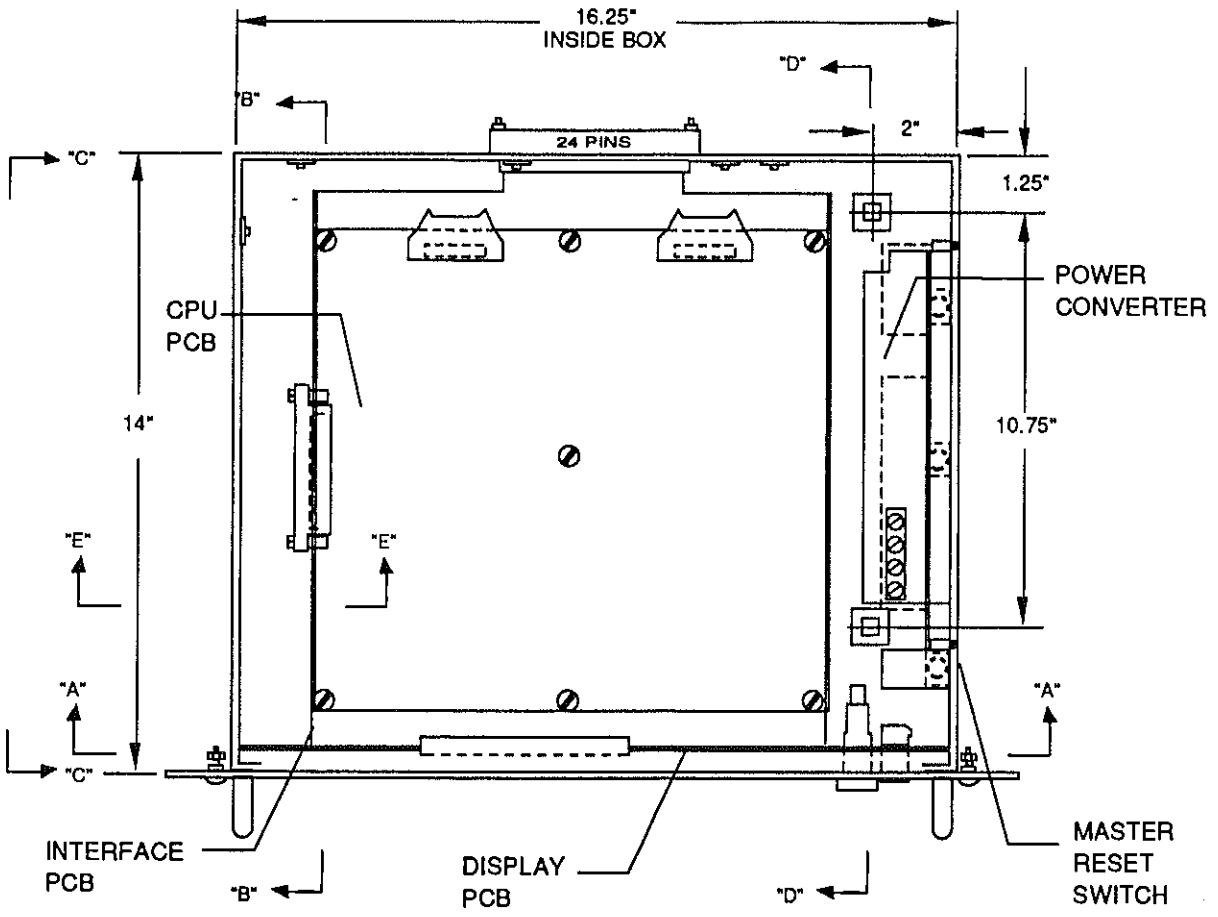
The CPU board uses EPROM (erasable programmable read only memory) and RAM (random access memory) memory ICs. The EPROM ICs are type 2764 and have a capacity of 8 x 8K bytes. These devices are pre-programmed for each application. The RAM ICs are type 4364 and have a capacity of 8 x 8K bytes. These devices serve as read/write memory for run-time data storage.

1.4.1.4 Communication Interfaces

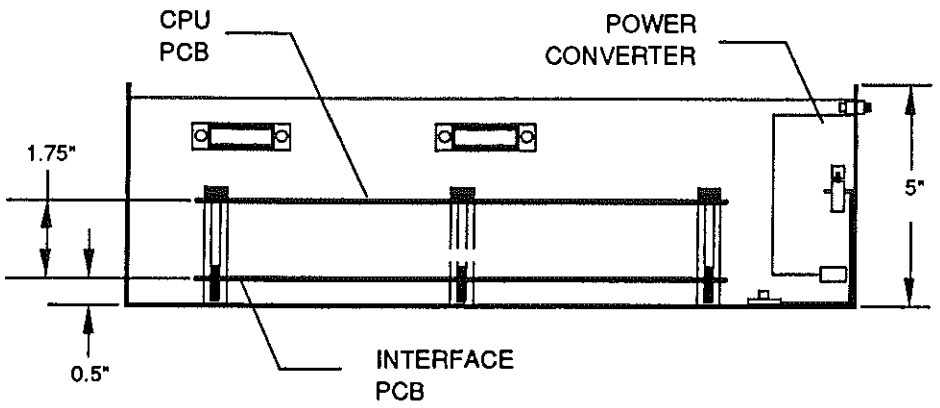
Three 6551 ACIAs (Asynchronous Communication Interface Adapters) are provided on the CPU board. The ACIA's in sockets IC28 and IC29 enable communication with devices external to the TWC-1000. Each of these devices interrupts the processor on the IRQ line.

1.4.1.5 Programmable Timers

Two 6840 programmable timers are provided on the CPU board. These devices are installed in sockets IC24 and IC25. Each contains three independent timers. These timers may interrupt the processor on the FIRQ line and primarily provide the timebase for application logic. The device in socket IC25 provides a timer output for use by the CPU watchdog circuit.

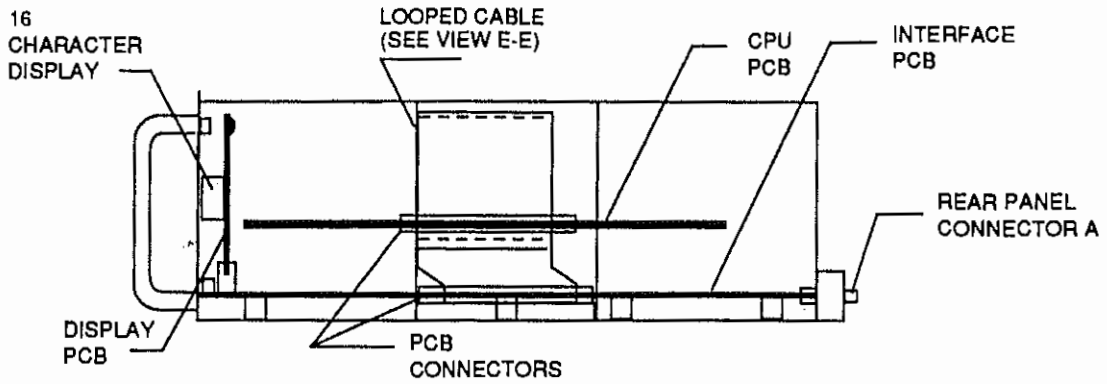


TOP-DOWN VIEW

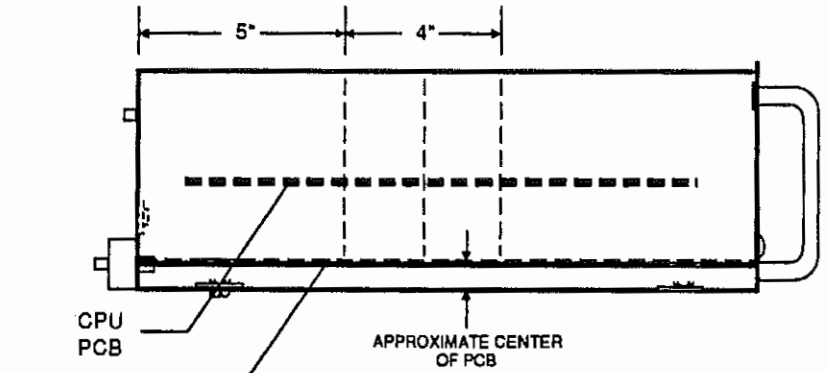


VIEW A-A

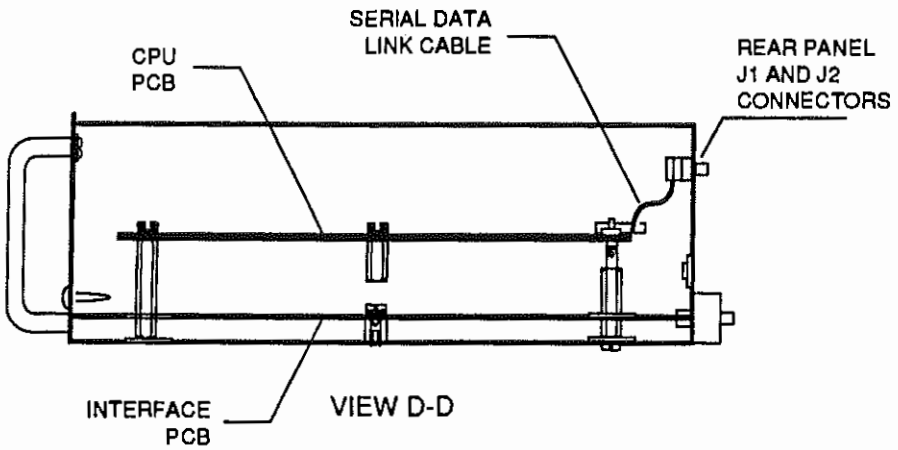
Figure 1-1 TWC-1000 Unit, Major Components and Dimensions
(Sheet 1 of 3)



VIEW B-B

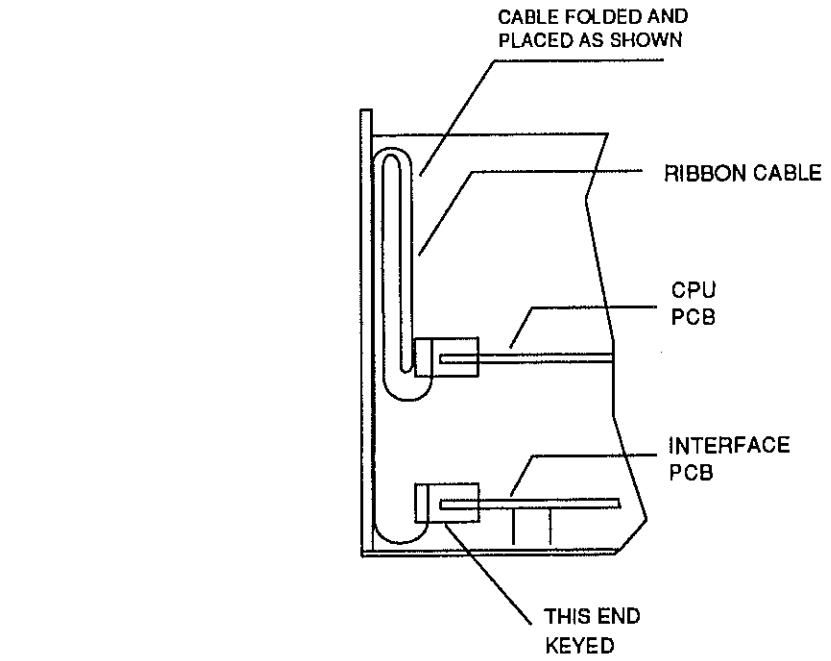


VIEW C-C

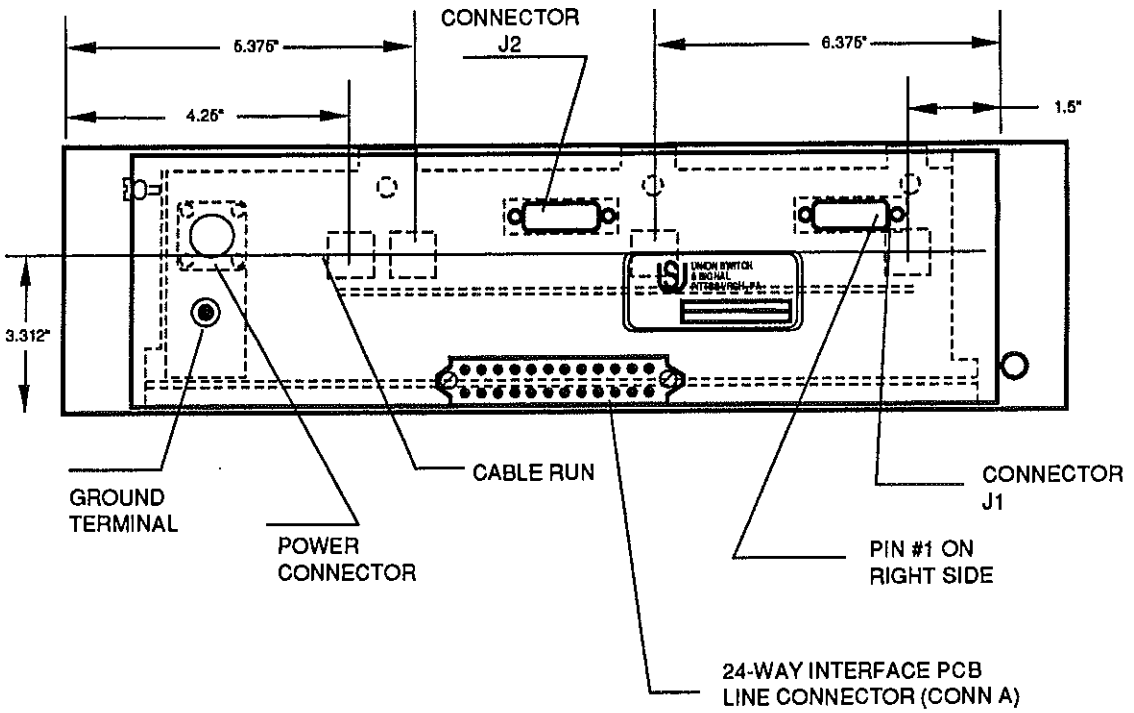


VIEW D-D

Figure 1-1 TWC-1000 Unit, Major Components and Dimensions
(Sheet 2 of 3)



VIEW E-E



BACK VIEW

Figure 1-1. TWC-1000 Unit, Major Components and Dimensions (Sheet 3 of 3)

1.4.1.6 CPU Watchdog Circuit

The CPU watchdog circuit primarily consists of a free running counter (operating at 1.8MHz) that is periodically reset by an output from an onboard programmable timer. A single output from this counter is gated with the onboard reset switch. Either input to the gate going low forces the board reset line to be taken low.

The application logic is responsible for the control of the timer output that resets the counter. In the event the logic fails to control the timer, or the timer output fails to reset the counter, the triggering of the watchdog circuit will force the application logic to attempt initialization.

1.4.1.7 Programmable Dip Switches

DIP switches SW7, SW8 and SW9 select operating parameters and characteristics as determined by the application. DIP switches SW1 through SW select whether A RAM OR EPROM is supplied as the memory device in IC10 through IC15. Unless dictated by application, these switches must be placed in the RAM position.

1.4.1.8 Jumpers

There are eight 2-position jumpers on each CPU board that select various hardware configurations.

1.4.2 Interface Board (N451657-7501)

1.4.2.1 General

The TWC-1000 Interface PCB (Figure 1-1 & 4-1) provides the CPU board with a physical interface to the line inputs and outputs as well as the alphanumeric display and discrete status LEDs. Connection to the CPU is through a 50-conductor ribbon cable attached at the left side of both boards. Connection to the display board is through a 44-way connector mounted on the forward center area.

The Interface PCB is used to convert information between the train and the wayside Central Processor Unit (CPU). Digital data from the CPU is converted on the Interface PCB to modulated RF data. The RF data is presented via a power amplifier to a track bond used to communicate with a train. RF data is also accepted from the train via the track bond. The bond when receiving this RF data, sends it to the Interface PCB. At the Interface PCB, the RF received data from the train is demodulated and converted to digital data which is then presented to the CPU.

Light-emitting diodes (LEDs) on the front of the PCB indicate the transmitted and received data. In addition to the above functions, the Interface PCB acts as an electrical and mechanical carrier for the TWC-1000 Display PCB assembly, Part No. N451657-4101.

1.4.2.2 Peripheral Interface Adapter

The 6821 PIA (Peripheral Interface Adapter) is an IC device in socket IC1. Its function is to read and write data between the CPU and the interface circuits.

1.4.3 Display PCB

The Display PCB (Figure 1-1 & 4-2) consist of a 16 Character Alphanumeric Readout and some logic conversion. Information from the Central Processor Unit (CPU) is transmitted via the Interface PCB, (which acts as an electrical and mechanical carrier for the System), to the Display PCB. This information contains useful data that is necessary to the functional operation of the System. The Display PCB obtains its power from the power bus on the Interface PCB on which it plugs into.

1.5 STATUS LEDs

There are 7 discrete LEDs on the front panel of the TWC-1000. Three on the left side are OUTPUTS, reading from left to right: Center Frequency, Space and Mark. On the right side of the panel are INPUTS, reading from left to right: Carrier Detect, Space and Mark. The remaining LED on the far right the "POWER On" indicator.

1.6 RESET SWITCH

The master reset switch is located (see Figure 1-1) inside the drawer on the right hand side between the power supply and the power switch. The reset switch will reset the CPU and interface board. Turning the "ON-OFF" switch OFF and ON will produce a master reset conditon also.

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SECTION II

SHOP LEVEL MAINTENANCE

2.1 GENERAL

This section presents shop level maintenance procedures for TWC-1000 Units found to be defective during field maintenance operations. Covered in this section are printed circuit board test and adjustment procedures which can be used to determine if a board is good or bad, and further used to isolate board faults and assists in restoring boards to normal operation. Also included is a final unit test to determine if the TWC-1000 Unit is operating properly.

2.2 RECOMMENDED TEST EQUIPMENT, COMPONENTS, AND MATERIAL FOR SHOP MAINTENANCE

A composite listing of all the test equipment, components, and material required are provided in Table 2-1. Test equipment, etc. required for a specific procedure is given in that procedure, along with set-up instructions and use. Test equipment with equivalent specifications may be substituted, but under no circumstance shall equipment with inferior specifications be used.

To properly perform the procedures in this section, maintenance personnel must be thoroughly familiar with the use and application of microprocessor test equipment.

2.3 TROUBLESHOOTING AND REPAIR

The procedures following are performance tests which can be used to isolate a PCB malfunction to a replaceable component. Servicing of the PCBs should be performed by qualified maintenance personnel who have a thorough understanding of TWC-1000 System operation and, specifically, the circuit operation of the PCBs that are part of the TWC-1000 System.

2.3.1 Troubleshooting Philosophy

In the following subparagraphs, PCBs are serviced, adjusted and/or tested on the bench using appropriate test equipment and bench test setups. These procedures include applicable adjustments and calibration information, since all that may be wrong with a PCB is the need for alignment. If the proper indications are observed when checking the PCB in question, calibration and/or adjustment may be unnecessary. Performing these procedures, using the test equipment and normal indications specified at respective test points, maintenance personnel can isolate a fault to a PCB component (transistor, integrated circuit, transformer, etc.) by the logical process of elimination. When the fault has been isolated to a particular component, or group of components, the faulty component(s) is replaced. The PCB is then rechecked for normal operation to make sure the fault has been corrected.

Table 2-1 Composite List of Recommended Test Equipment, Components, and Materials Required.

DESCRIPTION	MFG.	MODEL/ PART NO.	QTY.
Micro-System Troubleshooter	Fluke	9010A	1
Interface Pod (for use with 9010A)	Fluke	6809	1
Frequency Counter	Fluke	1952B	1
Oscilloscope	Tektronix	465	1
Digital Voltmeter	Fluke	806A	1
Power Supply	US&S	J725709-0108	1
Dual Plug Assembly, Power	US&S	N451458-9601	1
Plug Assembly, Data, 50-Way	US&S	N451458-9403	1
Test Tape for PCB N451657-7501 (Programmed for Fluke 9010A)	US&S	--	1
Test Tapes for PCB N451657-4101 and N451657-3901 (Programmed for Fluke 9010A)	US&S	--	2
Test Tape for PCB N451657-2701 (Programmed for Fluke 9010A)	US&S	--	1
Resistor Decade Box, 1K to 100K	--	Commercial	1
CPU PCB	US&S	N451657-2701	1
Display PCB	US&S	N451657-4101	1
Interface PCB	US&S	N451657-3901	1
Connector, 24-way	US&S	J709146-0357	1
Switch, Toggle, SPST	--	Commercial	1
Resistor, 2K ohm, ± 5%, 1/2W	US&S	J721080	1
Test Fixture (for N451657-2701)	US&S	(See Fig. 2-6)	1
Test EPROM	US&S	N451575-0983	1
Integrated Circuits:			
RAM for IC15	US&S	J715029-0519	1
Test Prom for IC16	US&S	N451575-0977	1
25 Pin "D" Plug:	--	--	2
Receptacle	US&S	J709146-0102	2
Shell	US&S	J793024	2
Socket	US&S	J709576-0008	2
Buchanan Connector	US&S	J709146-0357	1
Power Supply	Hewlett Packard	HP6267B	1

2.3.2 Bench Setups

Each test procedure requires a unique test setup. In some cases special test fixtures must be fabricated to complete the test setup. If this be the case, this must be done in advance to performing the tests called for in the specific procedure. Insure that all test equipment, fixtures, components, and material are available prior to performing the procedure. Refer to test equipment lists and illustrations in the applicable procedure.

2.4 PHYSICAL INSPECTION AND DISASSEMBLY

2.4.1 TWC-1000 Assembly

Carefully inspect the external parts of the assembly. Note any damage. Refer to Figure 3-2, and dismantel the assembly removing the printed circuit boards. Refer to Figure 4-4 for internal cabling and wiring connections.

Inspect PCBs in accordance with paragraph 2.4.2 and repair as required. Repair any damage noted to the assembly. Refer to Section III for detail part location and ordering references.

2.4.2 Printed Circuit Boards

Prior to performing any tests, examine the printed circuit board for any signs of damage or faulty components. Check for the following:

a. Poor or open solder connections.
b. Breaks or cracks in the track foil.
c. Burnt or damaged components.
d. Broken or bent connector pins.
e. Loose components.

If any component is suspect, check components for opens, shorts, and proper values. Repair damage and/or replace faulty components and proceed with test procedures. If none of the components replaced were select-on-test components, generally proceed with final test procedure. This will tell if the board is acceptable for use. It is does not pass this test, then proceed with all test and adjustment procedures for the particular PCB.

2.5 BENCH TESTS AND ADJUSTMENTS

2.5.1 Interface PCB (Part No. N451657-7501)

2.5.1.1 Test Equipment, Material, and Components Required

DESCRIPTION	MFG.	MODEL/ PART NO.	QTY.
Micro-System Troubleshooter	Fluke	9010A	1
Interface Pod (for use with 9010A)	Fluke	6809	1
Frequency Counter	Fluke	1952B	1
Oscilloscope	Tektronix	465	1
Digital Voltmeter	Fluke	806A	1
Power Supply	US&S	*J725709-0108	1
Dual Plug Assembly, Power	US&S	N451458-9601	1
Plug Assembly, Data, 50-way	US&S	N451458-9403	1
Test Tape for PCB N451657-7501 (Programmed for Fluke 9010A)	US&S	--	1
Resistor Decade Box, 1K to 100K	--	Commercial	1
CPU PCB	US&S	N451657-2701	1
Display PCB	US&S	N451657-4101	1
Connector, 24-way	US&S	J709146-0357	1
Switch, Toggle, SPST	--	Commercial	1
Resistor, 2K ohm, ± 5%, 1/2W	US&S	J721080	1

*J725709-0109 (DC/DC Converter) may be substituted, It is the supply furnished with the TWC-1000 unit.

2.5.1.2 Tests and Adjustments

NOTE

Read all procedures first before performing tests. Perform test in order given.

a. Fluke 9010A Set-up

Assemble items listed in paragraph 2.5.1.1 and connect as shown in Figure 2-1. NOTE: Most of this wiring already exits in the box.Proceed as follows:

(1) With all the equipment turned "OFF", plug the 40 pin cable from the POD into the CPU PCB; make sure that pin 1 of the cable matches that of IC1 on the PCB.

NOTE

It is a good idea to keep a spare 40 pin socket on the end of the 9010A's cable to protect it from damage.

(2) Turn "on" the 9010A.

(3) Insert the test tape into the 9010A's tape drive, with the tape side of the cassette pointing away from you, and the side labeled EU-7640 "UP".

(4) Close the door and press "READ TAPE". The 9010A will display "READ TAPE - ARE YOU SURE?", (this is because the act of reading a tape will erase the present memory of the 9010A).

(5) Press the "ENTER/YES" button. The 9010A will display "READ TAPE WAIT". When it is finished it will display "READ TAPE OK".

The 9010A is now ready to begin testing the printed circuit board. So long as the 9010A is not turned "OFF", you will not have to re-load the tape program.

b. PCB Test Set-up

Arrange a set-up similar to that shown on Figures 2-1 and 2-2. The display characters should face the front towards the technician. All jumper plugs on the Interface PCB should be across the B-C posts. Follow all steps in order given. Proceed as follows:

(1) Connect a voltmeter across test points TS15 (+) and TS4 (-) on the CPU PCB.

(2) Turn "on" the power supply. The volt meter should read + 5.0 ±0.1vdc. At this point, the Display characters and LEDs are of no particular pattern with the exception of LED 7. LED 7 is the Power "ON" indicator for the Interface PCB.

(3) Move the (+) lead of the voltmeter from TS15 to TS8 on the Interface PCB. The meter should read +12 vdc ± 5%.

(4) Move the (+) lead of the voltmeter to TP9. The meter should read -12 vdc ± 5%.

The following instructions are to be performed in conjunction with the "Tape for N451657-7501". All measurement instruments should be referenced (-) to TP10, or DC Common (See Figure 2-2).

In the following procedure *(asterisk) indicates function performed by the Fluke program.

c. PCB Test Procedure

(1) Output Balance
* Program 1

(a) Connect the (+) lead of the voltmeter to TP6 and adjust R34 so that the meter reads zero vdc ± 10 millivolts. This voltage may drift slightly (± 50 mv); this is normal (Record on Data Sheet, Figure 2-3). The frequency counter should read zero Hz (Record on Data Sheet). LEDs 1 thru 6 should be "OFF", and LED 7 "ON". Remove the (+) lead of the voltmeter from TP6.

(2) Tx Frequency Settings (Record values on Data Sheet)
* Program 5

(a) Center Frequency --- Adjust R8 so that the frequency counter reads 9800 ± 1 Hz. LED 1 should be "ON", and LEDs 2 and 3 "OFF".

* Program 6

(b) Space --- Adjust R9 so that the frequency counter reads 9650 ± 1 Hz. LED 2 should be "ON", and LEDs 1 and 3 "OFF".

* Program 7

(c) Mark --- Adjust R10 so that the frequency counter reads 9950 ± 1 Hz. LED 3 should be "ON", and LEDs 1 and 2 "OFF".

(3) Output Level Adjustment
* Program 5

(a) Connect the voltmeter probe to TP6 and adjust R17 for a voltage level of 1.00 volts ± 0.5 volts rms.

(4) Receiver Adjustments
* Program 5

(a) Connect the (+) lead of the voltmeter to TP12. Adjust R58 so that the meter reads a voltage level of 7 millivolts rms ± 0.03mV.

(b) Connect the scope probe to TP14. Using R117, start at 10 turns from either end and adjust it for maximum p-p voltage on the scope. This level should not exceed 4 volts p-p.

(c) Connect the (+) lead of the voltmeter to TP18 and adjust R65 so that the meter reads +3.00 vdc ± .02 volts (Record on Data Sheet).

(d) Vary the slug in L1 for maximum reading on the meter (within ± .02 volts).

* Program 6

(e) Place the scope probe on TP16. Using both R91 and R98, start both pots set at 10 turns from either end, and vary each one for maximum p-p voltage on the scope. This level should not exceed 4 volts p-p. When accomplished, remove the scope.

(f) Connect the (+) lead of the voltmeter to TP19 and adjust R69 so that the meter reads +4.00 vdc ± .02 volts (Record on Data Sheet).

* Program 7

(g) Place the scope probe on TP15. Using both R78 and R85, start both pots set at 10 turns from either end, and vary each one for maximum p-p voltage on the scope. This level should not exceed 4 volts p-p. When accomplished, remove the scope.

(h) Connect the (+) lead of the voltmeter to TP20 and adjust R71 so that the meter reads +4.00 vdc ± .02 volts (Record on Data Sheet). LEDs 3, 4, 6, and 7 should be "ON", and LEDs 1,2, and 5 "OFF".

(5) Automatic Gain Control (AGC)
*Program 8

(a) Set the jumper plug for JUMP3 onto the "A-B" posts.

(b) A message format is checked for minimum input signal. During this check, if the PCB should fail, slowly turn R65 counter clockwise until the PCB passes. Proper indications are as follows: When LED 2 is ON, LED 4 and 5 should be ON. When LED 3 is ON, LED 4 and 6 should be ON. LED 4 will be ON if LED 1, 2, or 3 is ON.

(c) Turn R17 and R58 fully clockwise so that a message format can be checked for high input level.

(d) The message format can be repeated by request of the troubleshooter for failures. The message format must pass both level type inputs for acceptance.

(6) Input and Output Level Settings
*Program 5

(a) Connect the (+) lead of the voltmeter to TP6 and adjust R17 until the meter reads 3.00 Vrms ± .02 volts.

(b) Move the (+) lead of the meter to TP12 and adjust R58 to read 140 mv rms ± 0.1 mv on the meter.

(c) Move the (+) lead of the voltmeter back to TP6 and adjust R17 until the meter reads 4.20 Vrms ± .01 volts.

(6) Conclusion

Seal the top of L1 and all potentiometers with the exception of R17 and R58.

d. Test Using the Fluke 9010A

To perform the programmed operations on the Fluke 9010A, the cassette tape must be inserted as explained in paragraph a, above. Start the operation by pressing the following buttons:

"EXEC"
"0"
"ENTER/YES"

This is the Executive Program for the TWC Interface PCB (N451657-7501). It begins with an initial statement that gives the operator three choices of Test Mode Selections. The first choice, (0 = "SET UP") is used to set the electrical requirements. The second choice, (1 = "AUTOMATIC") lets the Fluke 9010A Program control the testing of the PCB. The third choice, (2 = "MANUAL") is provided to give the operator control of a program and run it independently.

NOTE

Any program can be stopped by simply pressing the "STOP" button on the 90101A.

(1) The "SET UP" procedure (0), **must** be performed on all printed circuit boards. This program is used to correctly set up the modulation frequencies, voltage levels, and band-pass networks necessary for proper system operation.

(2) The "AUTOMATIC" choice (1), steps through pre-programmed tests and will prompt the operator. The program will also stop itself at certain points and allow the operator to perform certain tasks. While the program is in this state, the 9010A will illuminate it's stopped indicator lamp, located next to the alphanumeric display. To resume the program simply press the "CONT" button. The 9010A can also stop if the text in the display is too long. When this happens, the "MORE" indicator will be illuminated. To go on, press the "MORE" button. Make this choice if you want the 9010A to begin automatic testing of the N451657-7501 PCB.

NOTE

When all the Tests have been completed, it will have satisfied the requirements for the TWC Interface printed circuit board.

At the beginning of any choice, the operator is asked "DID YOU DO THE SET UP PROCEDURE"? This is used as a reminder to the operator that the "SET UP" procedure ***must*** be completed before venturing beyond this point. The following tests or checks will be made during the "AUTOMATIC" sequence:

(a) Display – This program is set up to display all characters necessary for use with this system. Verification is performed by observing the display and comparing it against Table 2-2. The character will appear on the Display PCB and the "CODE" on the 9010A readout (See Table 2-2). The basic function of this test is to make sure all segments of the display work correctly.

(b) PIA – The first part of this program statically checks each of the transmitted and received frequencies, and the LEDs. The next portion dynamically sends a message to the output connector and verifies the return message. Finally, the last test is to verify that the Inhibit circuits function properly.

(3) The "MANUAL" choice (2) allows the operator to select any of the TEST PROGRAMS and run them independently. This choice is meant as a trouble-shooting aid for the Technician who has some knowledge of the 9010A and microprocessor based systems. (See paragraph e following for further explanation of Manual Selection of Programs).

In addition to the Manual Selection for an aid, the 9010A Fixture can be used in what is called the Immediate Mode. This Mode lets the operator directly command the microprocessor bus of the CPU PCB. This Mode needs no program tape and is very useful in trouble-shooting bad printed circuit boards.

NOTE

This is the mode that the 9010A "POWER UP" in. When using programs, the 9010A is placed in the Executive Mode as explained above. Refer to the Fluke 9010A operator manual, and programming manual for additional instructions on trouble-shooting.

(4) To Summarize:

(a) Start with the equipment "OFF"
(b) Turn on the 9010A
(c) Load tape, press "READ TAPE", then "YES"
(d) Connect cables as shown in Figures 2-1 and 2-2
(e) Press the following buttons on the 9010A: "EXEC", "0", "ENTER/YES"
(f) When the 9010A prompts you with "TEST MODE SELECTION", "SELECT 0, 1, or 2", press 0, 1, or 2.

NOTE

For a PCB to pass, it must make it all the way through the automatic test mode without a failure. If PCB passes test, record on DATA Sheet.

e. Manual Selection of the Programmed Tape

When a choice of "2" (MANUAL) is made for the "TEST MODE SELECTION", the 9010A displays "MANUAL TEST MODE". The 9010A then asks the operator to make a Program Number Selection (see Table 2-3). Upon entry of the Program Number, the 9010A will proceed to check or verify that particular program. After program execution, the 9010A will say "END OF MANUAL TEST". It will then ask if the operator wants to "CONTINUE MANUAL MODE?" YES, will take the operator back to the Manual Program Selection, and NO, will take the operator back to the "TEST MODE SELECTION". To exit or break away from a program, press the "STOP" button on the 9010A.

The Display Program (3), has a special feature for troubleshooting specific characters. In the event that "3" was chosen for Manual Test, the next prompt will ask if the operator would like to "CHECK ALL CHARACTERS?" If a selection of YES (0) is made, the Display PCB will commence with the character "@" on all the readouts, and the "CODE 00" on the 9010A display (see Table 2-2). The next character will be "A" (Code 01) followed by "B" (CODE 02). The sequence will continue in hexidecimal progression. If NO (1) is the response to "CHECK ALL CHARACTERS?", the operator will get a prompt of "ENTER DISPLAY CODE". Insert the preferred character code number from Table 2-2 for the character to be displayed. This method gives the operator direct access to that particular character.

2.5.1.3 Test Conclusions

Disconnect and remove all test equipment. The jumper plugs on JMP1, 2 & 3 should be across the "A-B" posts. If board passes all tests, return to storage. If board does not pass, perform standard troubleshooting based on test data and repair. Retest after making any repairs to the PCB.

Table 2-2. Display Characters

DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE
	00		10	BLANK	20		30
	01		11		21		31
	02		12		22		32
	03		13		23		33
	04		14		24		34
	05		15		25		35
	06		16		26		36
	07		17		27		37
	08		18		28		38
	09		19		29		39
	0A		1A		2A		3A
	0B		1B		2B		3B
	0C		1C		2C		3C
	0D		1D		2D		3D
	0E		1E		2E		3E
	0F		1F		2F		3F

Table 2-3. Programs on Tape

PROGRAM NO.	NAME	PERFORMANCE
0	Executive	Normal operational program tests
1	PIA	Initiates the PIA for data direction
2	SET UP	Sets the level and frequency adjustments
3	Display	Checks the display character readouts
4	Communication	Verifies the communication channels
5	Center Freq.	9800 Hz Generator
6	Space	9650 Hz Generator
7	Mark	9950 Hz Generator
8	Format	Checks a message format
9	Inhibit	Checks the Inhibit Circuits
10	Delay #1	Long delay used in program
11	Delay #2	Medium delay used in program
12	Delay #3	Short delay used in program
13	Message	Special continuous communication message
14	Format	Special message format for test

NOTE

To pass, the PCB under test must not fail any of the verifications stated in this manual.

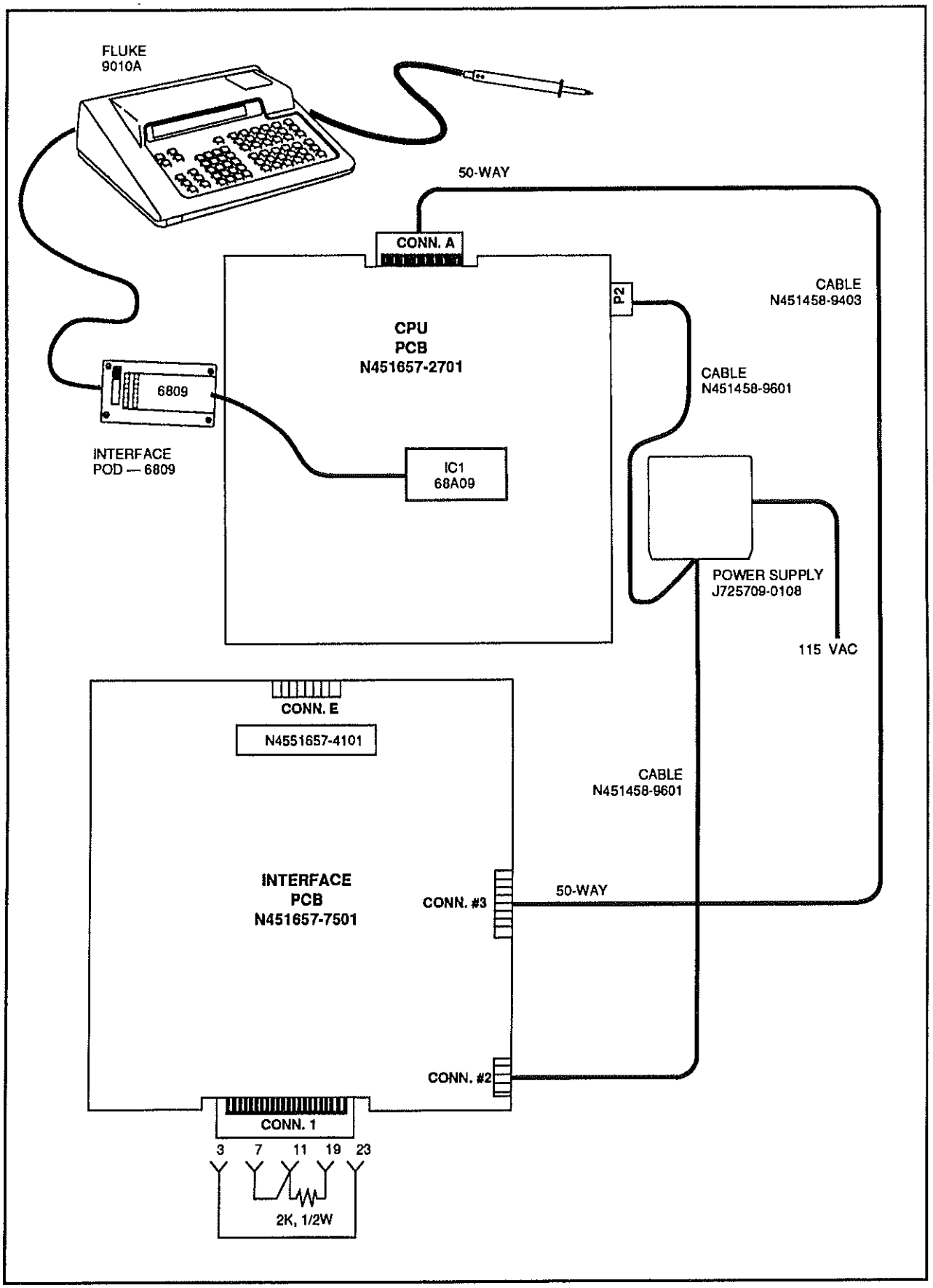


Figure 2-1. Test Setup for Testing Interface PCB N451657-7501

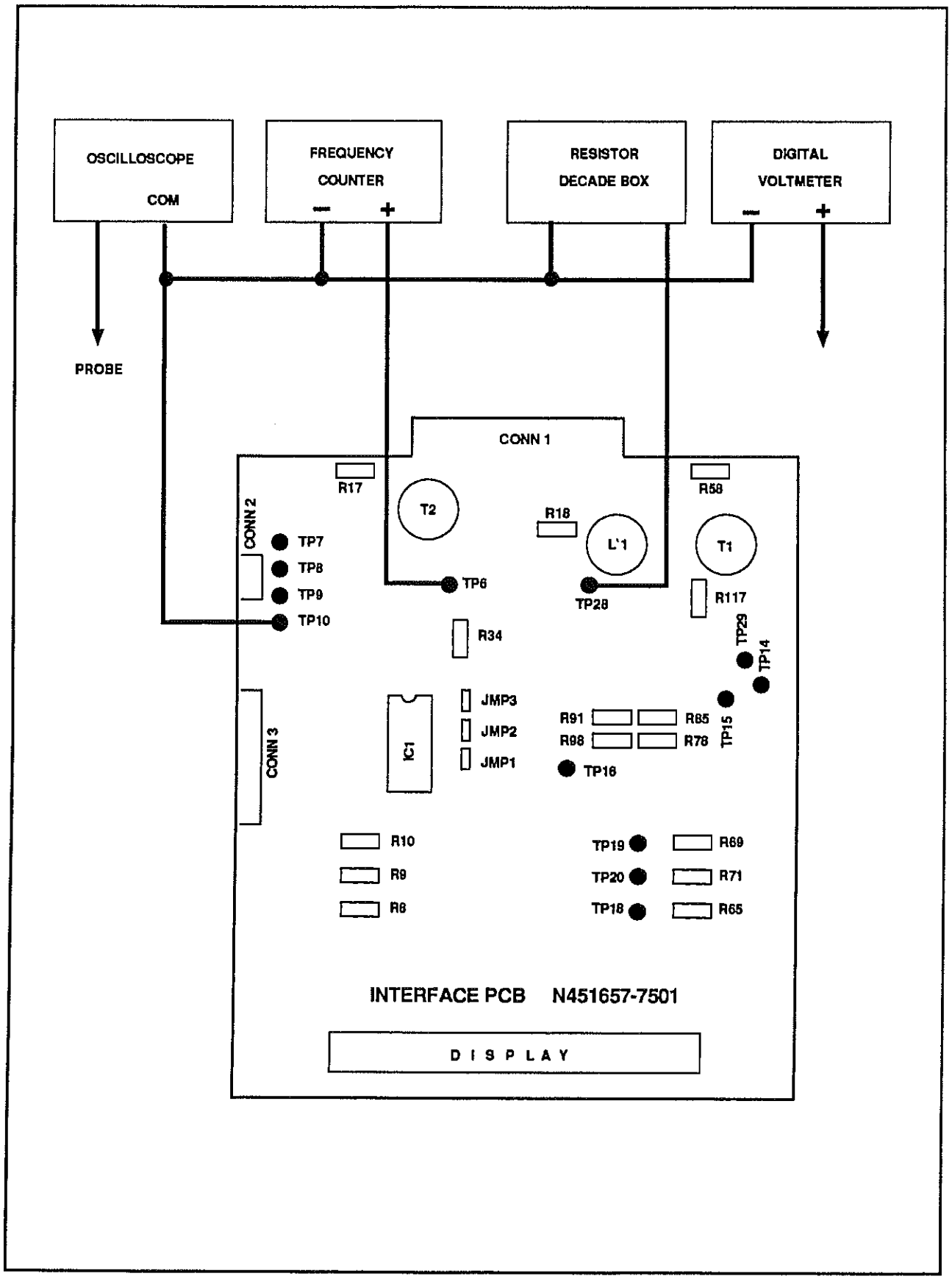


Figure 2-2. Test Equipment Connections for Interface PCB N451657-7501

DATA SHEET FOR
INTERFACE PCB N451657-7501

SN _____

Paragraph 2.5.1.2.c

(1) (a) Output Balance
0 vdc ± 10 mV _____vdc
Freq, Counter Reading _____Freq. Hz

(2) Tx Freq. Settings
(2) (a) Center Freq.
9800 ± 1 Hz _____Hz

(2) (b) Space
9650 ± 1 Hz _____Hz

(2) (c) Mark
9950 ± 1 Hz _____Hz

(4) (c) Adj. R65
3.00 vdc, ± .02 Volts _____vdc

(4) (f) Adj. R69
4.0 vdc, ± .02 Volts _____vdc

(4) (h) Adj. R71
4.0 vdc, ± .02 Volts _____vdc

(6) (b) Input & Output Settings
140 mv rms ± 0.1mv _____ ____mv rms

(6) (c) 4.2 vrms ± 0.1v _____V rms

2.5.1.2.d
Automatic Test _____Pass

Technician's Signature _____ Date_____

Figure 2-3. Typical Data Sheet for Interface PCB N451657-7501

2.5.2 Display PCB (Part No. N451657-4101)

2.5.2.1 Test Equipment, Material, and Components Required

DESCRIPTION	MFG	MODEL/ PART NO.	QTY
Micro-system Troubleshooter	Fluke	9010A	1
Interface Pod (for use with 9010A)	Fluke	6809	1
Power Supply	US&S	*J725709-0108	1
Digital Voltmeter (3.5 characters or more, ± 1% accuracy)	Fluke	806A	1
Plug Assembly, Power	US&S	N451458-9601	1
Plug Assembly, Data, 50-way	US&S	N451458-9403	1
CPU PCB	US&S	N451657-2701	1
Interface PCB	US&S	N451657-7501	1
Test Tapes for PCB N451657-4101 (Programmed for Fluke 9010A)	US&S		2

*J725709-0109 (DC/DC Converter) may be substituted. It is the supply furnished with the TWC-1000 unit.

2.5.2.2 Tests and Adjustments

NOTE

Read all procedures first before performing any tests.

a. Fluke 9010A Set-up

Assembly items listed in paragraph 2.5.2.1 and connect as shown in Figure 2-1. Proceed as follows:

(1) With all the equipment turned "OFF", plug the 40 pin cable from the POD into the CPU PCB. Make sure that pin 1 of the cable matches that of IC1 on the PCB.

NOTE

It is a good idea to keep a spare 40 pin socket on the end of the 9010A's cable to protect it from damage.

(2) Turn "on" the 9010A.

(3) Insert the test tape into the 9010A's tape drive, with the tape side of the cassette pointing away from you, and the side labeled EU-7056 "UP".

(4) Close the door and press "READ TAPE". The 9010A will display "READ TAPE - ARE YOU SURE?", (this is because the act of reading a tape will erase the present memory of the 9010A).

(5) Press the "ENTER/YES" button. The 9010A will display "READ TAPE WAIT". When it is finished it will display "READ TAPE OK".

The 9010A is now ready to begin testing the printed circuit boards. So long as the 9010A is not turned "OFF", you will not have to re-load the tape program.

b. Initial Check

(1) Insert the Display PCB, Part No. N451657-4101, into Connector "E" of Interface PCB in the location shown in Figure 2-1. The Display characters must face the front, the same direction as the LEDs.

(2) Connect a voltmeter across test points TS4 (-) and TS15 (+) on the CPU PCB.

(3) Turn "on" the power supply. The voltmeter should read +5 vdc ± 2%. (Record voltage on Data Sheet, Figure 2-5.) At this point, the Display characters and LEDs are of no particular pattern with the exception of LED 7. LED 7 is the Power "ON" indicator for the Interface PCB.

c. PCB Test Procedure

To perform the programmed operations on the Fluke 9010A, the cassette tape must be inserted as explained in Paragraph 2.5.2.2 a above. Start the operation by pressing the following buttons: "EXEC", "41", "ENTER/YES"

This is the Executive Program for the Display PCB (N451657-4101). It begins with an initial statement that gives the operator 2 choices of Test Modes. The first choice, (1 = "AUTOMATIC") lets the Fluke 9010A Program control the testing of the PCB with minor operation being performed by the operator. The second choice, (2 = MANUAL") is provided to give the operator more control of the operating functions.

NOTE

Any program can be stopped by simply pressing the "STOP" button on the 9010A.

(1) The AUTOMATIC MODE choice (1), steps through pre-programmed tests and will prompt the operator. The program will also stop itself at certain points and allow the operator to perform certain tasks. While the program is in this state, the 9010A will illuminate it's stopped indicator lamp, located next to the alphanumeric display. To resume the program simply press the "CONT" button. The 9010A can also stop if the text in the display is too long. When this happens, the "MORE" indicator will be illuminated. To go on, press the "MORE" button. Make this choice if you want the 9010A to begin automatic testing of the N451657-4101 PCB.

NOTE

When the Test Spec has been performed, it will have satisfied the requirements for the Display printed circuit board.

(a) The "DISPLAY TEST" will be the test made by the 9010A. The program is set up to display all characters necessary for use with this system. Verification is performed by observing the display and comparing it against Table 2-4. The character will appear on the Display PCB and the "CODE" on the 9010A readout (see Table 2-4). The basic principal is to make sure all segments of the display function correctly.

(2) The "MANUAL MODE" (2) allows the operator to select the TEST PROGRAM and run it. This choice is meant as a troubleshooting aid for the Technician who has some knowledge of the 9010A and microprocessor based systems. (See paragraph d following for further explanation of Manual Selection of Programs).

In addition to the Manual Selection for an aid, the 9010A Fixture can be used in what is called the Immediate Mode. This Mode lets the operator directly command the microprocessor bus of the CPU PCB. This Mode needs no program tape and is very useful in troubleshooting bad printed circuit boards.

NOTE

This is the mode that the 9010A "POWER UP" in. When using programs, the 9010A is placed in the Executive Mode as explained above. Refer to the Fluke 9010A operator manual, and programming manual for additional instructions on troubleshooting.

(3) To summarize:

(a) Start with the equipment "OFF".
(b) Turn on the 9010A.
(c) Load tape, press "READ TAPE", then "YES".
(d) Connect the equipment as shown in Figure 2-1.
(e) Press the following buttons on the 9010A: "EXEC", "41", "ENTER/YES".
(f) When the 9010A prompts you with "SELECT TEST MODE", "MODE NUMBER 1, OR 2", press 1 or 2, then "ENTER/YES".

NOTE

For a PCB to pass, it must make it all the way through the Automatic Test Mode without a failure. If PCB passes test, record on Data Sheet.

d Manual Selection of the Programmed Tape

(1) When a choice of "2" (MANUAL) is made for the "SELECT TEST MODE", the 9010A displays "MANUAL MODE" and proceed to readout the first hexidecimal "CODE" notation ("00"). The Display PCB Readout should display "@" for all characters (see Table 2-4). The 9010A comes to a stop and waits for the operator to press the "CONT" button. Upon pressing the button, the next hexidecimal notation, "01" comes up on the 9010A readout. The Display PCB readout should now display "A" for all characters. This sequence will continue in numerical progression until all 64, (3F in hexidecimal notation), steps have been executed. The Manual Test will then come to an end.

(2) A special ** program exist on the programmed tape for troubleshooting specific characters. This program number is "40". Its function is to access directly at a Character CODE as shown on Table 2-4. To initiate "PROGRAM 40", press the following buttons:

"EXEC",
"40",
"ENTER/YES"

The program will prompt the operator to first select the test or circuit that is to be tested. ("1" for Display, "2" for Output to Input, or "3" for Status Indications). Make selection 1, and press "ENTER/YES". The program will then ask for the "CODE". Insert the preferred Code Number from Table 2-4 for the Display Character. Press "ENTER/YES" and the program will immediately access that code and execute the request. When the "CONT" button is now pressed, the

**This program is common to both the Interface and Display PCBs.

Table 2-4. Display Characters

DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE	DISPLAY CHAR.	CODE
	00		10	BLANK	20		30
	01		11	!	21	1	31
	02		12	"	22	2	32
	03		13	#	23	3	33
	04		14	$	24	4	34
	05		15	%	25	5	35
	06		16	&	26	6	36
	07		17	'	27	7	37
	08		18	(	28	8	38
	09		19	)	29	9	39
	0A		1A	*	2A	.	3A
	0B		1B	+	2B	/	3B
	0C		1C	,	2C		3C
	0D		1D	-	2D	=	3D
	0E		1E	.	2E		3E
	0F		1F	/	2F	?	3F

program will again ask the operator to select the circuit to be tested ("DPLY=1, I/O=2, STAT=3 ENTER ___"). PRESS THE "stop" button twice to exit from the program.

e. Programs on Tape

The following programs have been pre-recorded for this Test Spec:

PROGRAM NO.	NAME	PERFORMANCE
30	Auto-Manual	Initiation of Auto-Manual Selection
32	Display	Operations for the Display Test
33	Output to Input	Operations for the Output to Input Test
34	Status Ind.	Operations for the Status Indications Test
35	PIA Initiation	Opens Communication to the PIA Registers
36	Short Delay	Short Delay in the Program Operation
37	Delay	Delay in the Program Operation
39	EU-7055 Start-Up	Initiation of the EU-7055 Test
40	Code Access	Direct Code for Character or Location
41	EU-7056 Start-Up	Initiation of the EU-7056 Test

NOTE

To pass, the PCB under test must not fail any of the verifications stated in this manual.

2.5.2.3 Test Conclusions

Disconnect and remove all test equipment. If board passes all tests, return to storage. If board does not pass, perform standard troubleshooting based on test data and repair. Retest after making any repairs to the PCB.

DATA SHEET
FOR DISPLAY PCB N451657-4101

Serial No._____

Step 2.5.2.2.b.(3)

Voltage @ TS15; 5.0 vdc ± 2% _____ vdc

LED 7 Power "ON" Indicator OK _____ Yes _____ No

Passed "Display Test" _____ Yes _____ No

Technician's Signature _____ Date _____

Figure 2-5. Typical Data Sheet for Display PCB N451657-4101

2.5.3 Programmable CPU PCB (Part No. N451657-2701)

2.5.3.1 Test Equipment, Materials, and Components Required

DESCRIPTION	MFG	PART NO.	QTY.
Micro-System Troubleshooter	Fluke	9010A	1
Interface Pod (for use with 9010A)	Fluke	6809	1
Digital Voltmeter	Fluke	806A	1
Oscilloscope	Tektronic	465	1
Frequency Counter	Fluke	1952B	1
Test Tape for N451657-2701 (Control Program for the 9010A)	US&S	--	1
Integrated Circuits:			
Ram for IC15	US&S	J715029-0519	1
Test Prom for IC16	US&S	N451575-0977	1
Test Fixture: Fabricated Per Figure 2-6	--	--	1

2.5.3.2 Tests and Adjustments

a. Initial Test Setup

(1) Start with all power turned OFF.

(2) Remove IC1 from the -2701 PCB and install it into the 9010A's INTERFACE POD.

NOTE

Use the socket under the sliding door on the pod. The exposed socket is for self testing the pod and its cable.

(3) Check that all IC's are installed in the PCB.

(4) Turn "On" the 9010A.

(5) Insert the test tape into the 9010A's tape drive, with the tape side of the cassette pointing away from you, and the side labeled EU-7026 (2701 CPU) up.

(6) Close the door and press "READ TAPE". The 9010A will display: "READ TAPE -- ARE YOU SURE?" (This is because the act of reading a tape will erase the present memory of the 9010A.

(7) Press the "ENTER/YES" button. The 9010A will display "READ TAPE WAIT". When it is finished, it will display "READ TAPE OK".

NOTE

The 9010A is now ready to begin testing PCB's. So long as the 9010A is not turned off, you will not have to re-load the program from tape.

(8) Plug the 40 pin cable from the POD into IC1 of the -2701 PCB. Make sure that pin 1 of the cable matches that of IC1 on the PCB.

NOTE

It is a good idea to keep a spare 40 pin socket on the end of the 9010A's cable to protect it from damage.

(9) Connect cables and peripheral test fixture to the PCB as shown in Figures 2-6 and 2-7.

(10) Set switches 1 through 6 by pressing down on the side labeled C2. Set all bits of switches 7, 8, and 9 to closed. Set jumpers as follows:

J1 = BC J2 = AB J3 = AB J5 = BC J6 = BC J7 = BC J8 = BC

(11) Remove the EPROMS at locations IC15 and IC16. Insert RAM J715029-0519 in IC15, and TEST PROM N451575-0977 in IC16.

Proceed with following procedures:

b. Test and Adjustment of Level Detection for Battery Back Up Circuit

PROCEDURE	PROBALE CAUSE OF PROBLEM
1. Configure the system as shown in Figure 2-7.	
2. Turn on the Power Switch of the TEST FIXTURE, and the 5 volt supply. (Do Not connect 5 volt supply to test fixture until the voltage is set to 5.0 vdc ± 0.2).	If the Power ON light does not come on, check the voltages at the test points.

PROCEDURE	PROBALE CAUSE OF PROBLEM
3. Connect a voltmeter between TS15 (+) and TS4 (-). Vary the 5 volt supply so that this point reads 4.85 volts. (See slot on side of power supply.)	
4. On the PCB, adjust pot R7 (Diagram A) so that the "RUN" LED on the TEST FIXTURE comes on.	If RUN LED does not light, check to see that the voltage on TS14 swings when R7 is adjusted. If it does, Q3 may be bad.
5. Reduce the 5 volt supply so that TS15 reads 4.60 ± 0.03 volts. The "RUN" LED should go off. If it is still on, adjust R7 and repeat steps 2, 3, and 4.	
NOTE Record readings of steps 6 - 9 on Data Sheet, Figure 2-8.	
6. Increase the 5 volt supply until the "RUN" LED goes on. TS15 should read less than 4.85 volts.	
7. Connect a voltmeter to TS16. It should read 4.70 ± 0.2 volts.	If TS16 is not right, check D3.
8. Turn off the TEST FIXTURE and 5 volt supply, and check TS16 for 0 volts. Move Jumper J1 to the AB position. The voltage on TS16 should read greater than 3.20 volts.	If polarity or voltage is wrong, check the 3.6 volt lithium battery.
9. Move jumper J1 back to the BC position, and turn the supplies back on. Set the 5 volts supply to read 5 ± 0.1V.	
10. Seal the top of R7 to prevent any tampering.	

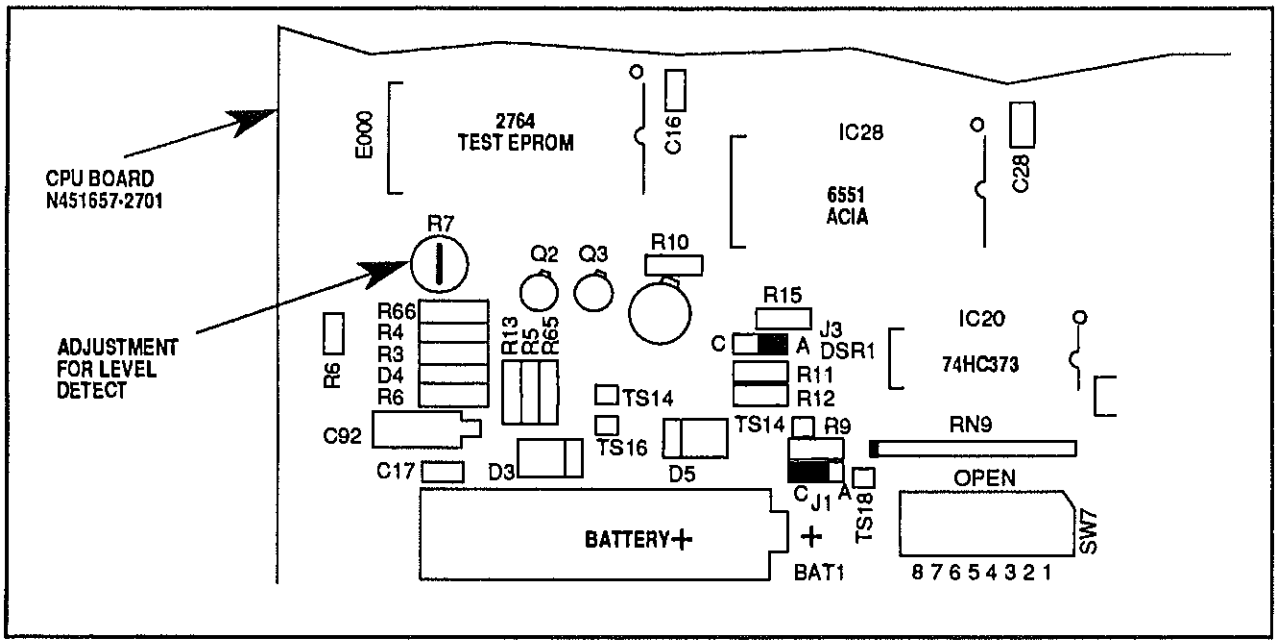


Diagram A

c. Clock Frequencies and Reset Test

PROCEDURE	PROBALE CAUSE OF PROBLEM
1. Hold PB1 (reset) in on the -2701 PCB, and check that the "RESET" LED on the TEST FIXTURE and PCB goes ON. Release the button. The lights should go off. Record on Data Sheet.	If reset will not work, check PB1, D1, IC's 4, 40, 41, and 42 and LED 1.
2. With frequency counter (using TS4 as common), check for a 1.4985 to 1.5015 MHz signal at the "E" CLOCK test point on the Test Fixture. Record on Data Sheet.	If frequency is wrong or not present, check: XTAL 1, C97, C104, and IC1 and IC31. There could also be a short on the "E" CLOCK line.
3. With frequency counter check for a 1.8414 to 1.8450 MHz signal at TS19 (CLOCK) on the -2701 PCB. Record on Data Sheet.	If frequency is wrong or not present, check: OCS 1, R16, IC's 45, 26, 27, 28, and 29.

d. Tests Using the Fluke 9010A

To perform the programmed operations on the Fluke 9010A, the cassette tape must be inserted as explained in 2.5.3.2.a above. Start the operation by pressing the following buttons:

"EXEC",
"0",
"ENTER/YES"

This EXECUTIVE program will give you 3 choices: the first (0 = "START UP TEST") is some text to help you get the -2701 PCB set up correctly. The second (1 = "AUTOMATIC TEST SEQUENCE") is to let the EXECUTIVE program control the testing, and the third (2 = "MANUAL SELECTION") is to manually select the program you wish to run.

(1) The START UP TEXT choice (0) is used to check various points and set up the unit under test correctly. Make this choice if you have not used this procedure before.

(2) The AUTOMATIC TEST SEQUENCE choice (1) steps through pre-programmed test and will prompt the operator. The program will also stop itself at certain points and allow the operator to perform certain tasks. While the program is in this state, the 9010A will illuminate it's stopped indicator lamp, located next to the alphanumeric display. To resume the program simply press the "CONT" button. The 9010A can also stop if the text in the display is too long. When this happens, the "MORE" indicator will be illuminated. To go on, press the "MORE" button. Make this choice if you want the 9010A to begin automatic testing of the N451657-2701 PCB.

(3) The MANUAL SELECTION choice (2) allows the operator to select any of the programs and run it independently if feasible. This choice is meant as a troubleshooting aid for the technician who has some knowledge of the 9010A and microprocessor based systems. (See paragraph e following for further explanation of Manual Selection of programs).

In addition to the Manual Selection for an aid, the 9010A fixture can be used in what is called the immediate mode which lets the operator directly command the microprocessor bus of the PCB under test. This mode needs no program tape and is very useful in troubleshooting bad PCB's.

NOTE

This is the mode that the 9010A "powers up" in. When using programs, the 9010A is placed in the execute mode as explained above. Refer to the Fluke 9010A Operator Manual, and Programming Manual for additional instructions on trouble-shooting.

(4) To summarize:

a. Start with the TEST FIXTURE "OFF".

b Turn on the 9010A.

c. Load tape (press "READ TAPE" and then "YES").

d. Check that all IC's are installed on the PCB. (Refer to Part List section.)

e. Set switches and jumpers as per paragraph 2.5.3.2.a.(10).

f. Connect cables as shown in Figures 2-6 and 2-7.

g. Adjust R7 as explained in Section 2.5.3.2, paragraph b.

h. Check frequencies and reset circuit as explained in paragraph c.

i. Press the following buttons on the 9010A: "EXEC", "0", "ENTER/YES".

j. When the 9010A prompts you with "SELECT MODE NUMBER 0, 1, OR 2", press "0", "1", or "2" then "ENTER/YES".

NOTE

For a PCB to pass, it must make it all the way through the automatic test sequence without failure of any test

e. Manual Selection Test Provided on the Programmed Tape

When a choice of "2" is made for MANUAL SELECTION, the 9010A will prompt the operator with the following:

"MANUAL SELECTION OF PROGRAMS"
"SEE EU-SPEC (MANUAL) FOR PROGRAM LIST"
"ENTER PROGRAM NUMBER _____"

Insert the number as shown below for program selection. An * indicates that the test is very short and no visual display will be seen by the operator.

PROGRAM. NO.	NAME	PERFORMANCE
0	(EXEC)	Set up automatic mode; normal program to start with
1	(START)	Start up text
2	(BUSMEM)	Tests the micro-bus, ROM, RAM and peripheral bus
3	(PERIFTST)	Tests IRQ, NMI, and Peripheral Interrupt lines
*4	(PT)	Short test
5	(SW7)	Tests DIP switch #7
6	(SW8)	Tests DIP switch #8
7	(SW9)	Tests DIP switch #9
8	(SWITCH)	Tests DIP switch #8
9	(TIMERS)	Sets up the 6 timers in continuous mode so they can be checked with an oscilloscope and counter
10	(TFIRQ)	Tests the fast interrupt request lines on the timers
*11	(SETTIME)	Short Test
12	(ACIATEST)	Checks IC27, IC28, and IC29 (ACIA)
13	(HSTEST)	Checks control lines
*14	(STDECODE)	Short test
15	(LINECOND)	Checks line condition (see Table 2-5)
*16	(DPYSTAT)	Short test
17	(ACMANSEL)	ACIA - Serial link test (see Table 2-6)
*18	(DELAY10)	Short test
19	(AUTOCTS)	Test Port 1

Most of the above tests are self explanatory, however, Table 2-5 is to be used when running Program 15.

Table 2-5

Code	Line Condition
0	RTS = HI, DTR = HI, DSR = HI, DCD = HI
1	RTS = LOW, DTR = HI, DSR = LOW, DCD = HI
2	RTS = HI, DTR = LOW, DSR = HI, DCD = LOW
3	RTS = LOW, DTR = LOW, DSR = LOW, DCD = LOW
4	PORT 1 and PORT 2 CTS LINES
5	EXIT

Program 17 is also an exception; this program is called ACMANSEL for ACIA-Manual-Select, and is not part of the automatic sequence, since it is only used in troubleshooting. When this program is executed, it prompts the operator to select which ACIA test is to be run. There are six possible choices available as shown below in Table 2-6 (ACIA Test Selection). Set the PCB jumpers as follows for Program 17 test: J1 = BC, J2 = AB, J3 = AB, J4 = AB, J5 = BC, J6 = BC, J7 = BC, J8 = BC.

Table 2-6

Sel.	ACIA Test
0	PORT 1 to PORT 2 -- Link & Ctrl Lines (IC's 28, 45, 32, 33, 35, 37, 46, 29.)
1	PORT 2 to PORT 1 -- Link & Ctrl Lines (IC's 29, 46, 36, 38, 34, 35, 45, 28.)
2	Link ACIA self test - link & ctrl lines (IC 27 only)
3	PORT 1 Current Loop Self Test (IC's 28, 46, OCI, Q4, D6, OC2.)
4	PORT 1 CTS Test (IC's 28, 45, 35.)
5	PORT 2 CTS Test (IC's 29, 46, 38.)
6	EXIT

When manually testing the ACIA links, the baud rate can be specified to the 9010A.

Below is a list of baud rates and their ID's for use with the 9010A.

0 = NOT USED
1 = 50
2 = 75
3 = 109.92
4 = 134.58
5 = 150
6 = 300
7 = 600
8 = 1200
9 = 1800
A = 2400
B = 3600
C = 4800
D = 7200
E = 9600
F = 19200 (Will not work on current loop self test.)

NOTE

To pass, the PCB under test must pass all the tests for this board in this manual.

f. Check that the jumpers are set as follows: J1-BC, J2-AB, J3-AB, J4-AB, J5-BC, J6-BC, J7-BC, J8-AB. Check that SW1-SW6 are set to RAM position. Record on Data Sheet.

2.5.3.3 Test Conclusion

Disconnect and remove all test equipment. Replace IC1 on -2701 PCB. Remove test PROMS from IC15 and IC16 and replace with EPROMS previously removed. If board passes all tests, return to storage. If board is bad, troubleshoot and repair using applicable test data from the procedures.

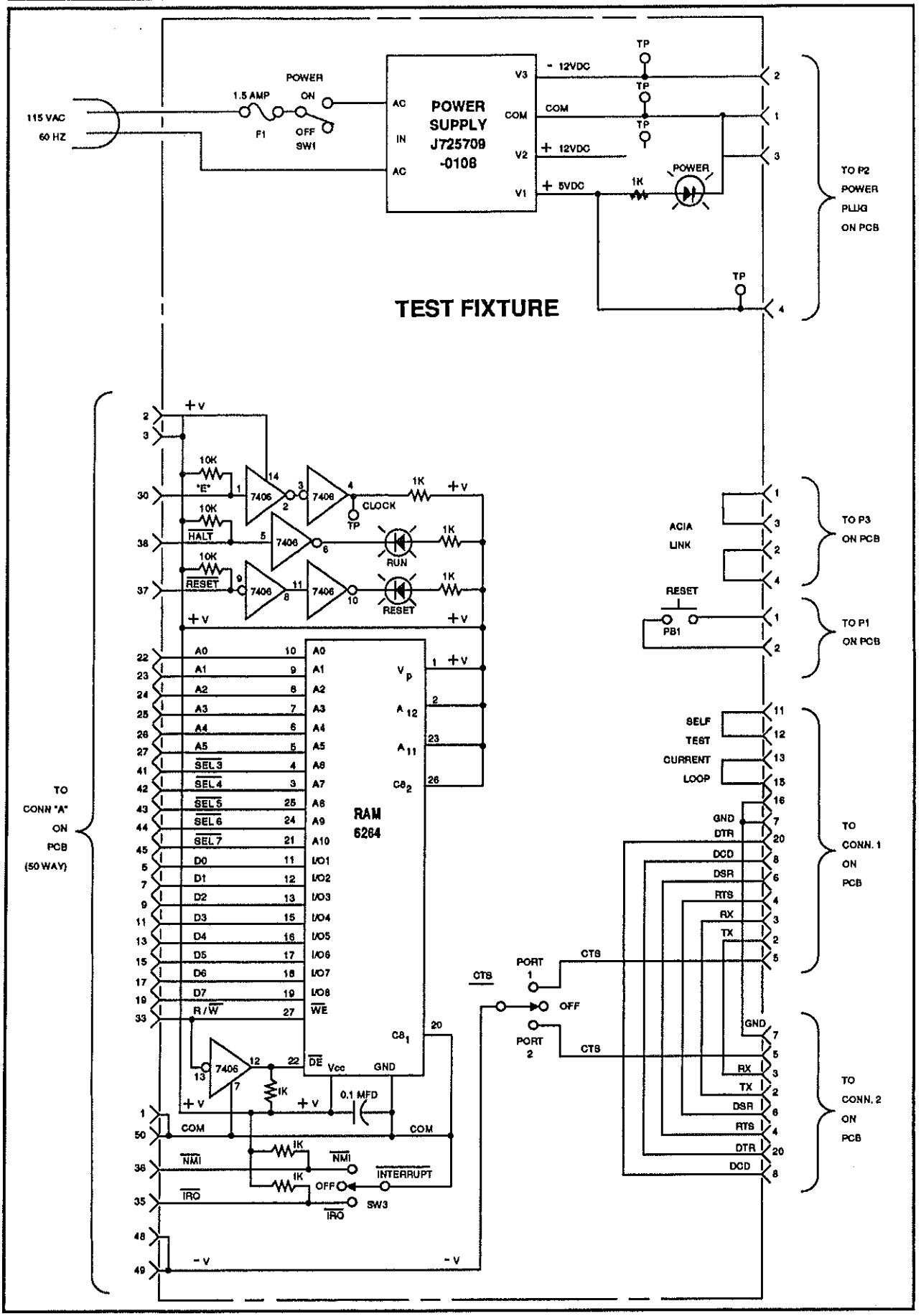


Figure 2-5. Schematic Diagram for CPU Test Fixture

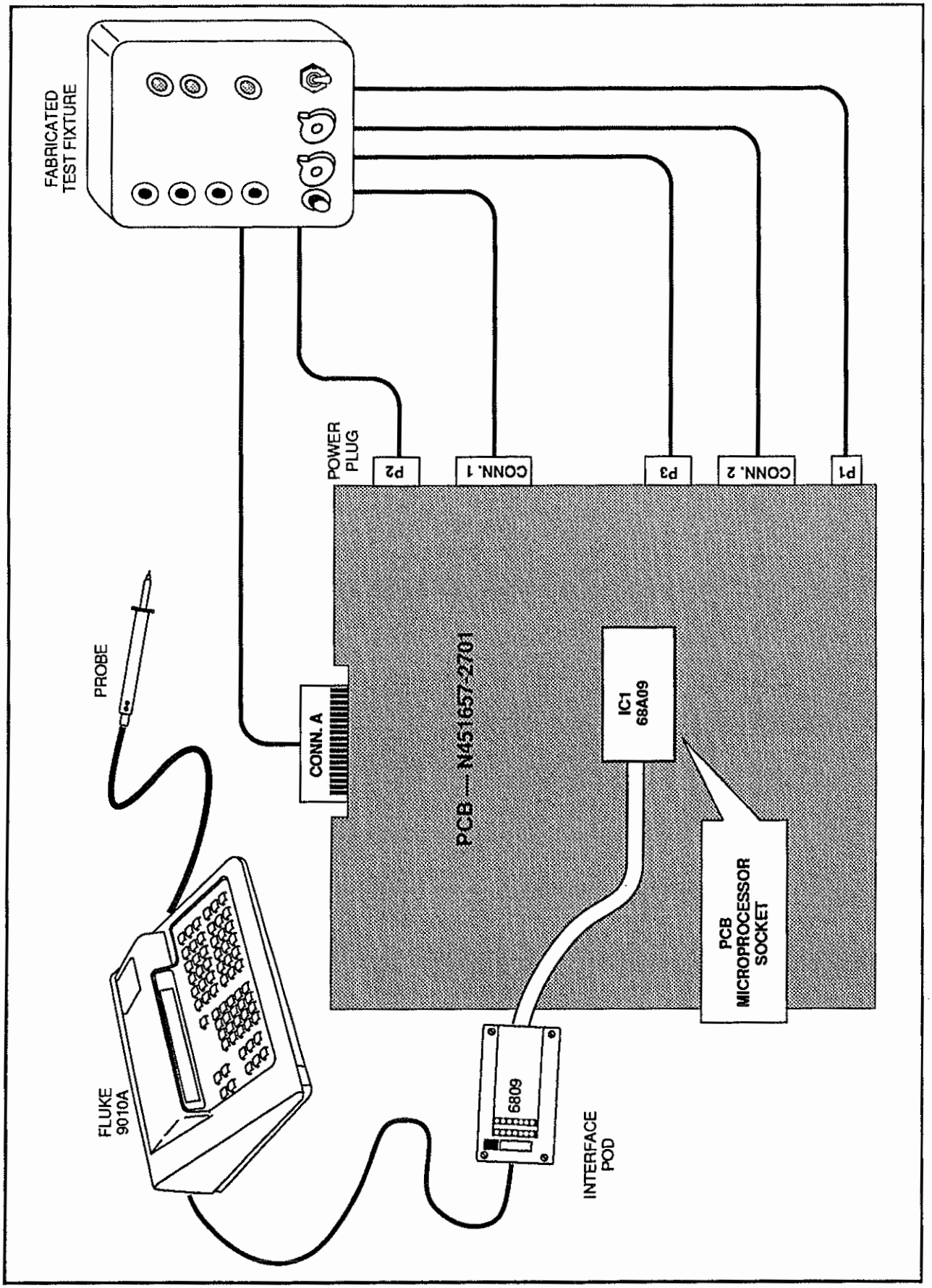


Figure 2-6. Test Setup for Testing CPU (N451657-2701)

DATA SHEET
FOR CPU PCB N451657-2701

Serial No. _____

Step	Verify	Actual
b.6.	TS15 < 4.85 vdc	_____vdc
7.	TS16 4.50 - 4.90 vdc	_____vdc
8.	TS16 = Ovdc (approx.)	_____vdc
	J1 in AB position: TS16 > 3.20 vdc	_____vdc
9.	Power on, J1 in BC position: TS15 4.90 - 5.10 vdc	_____vdc
c.1.	Reset (PB1) OK	_____
2.	"E" clock freq. between 1.4985 – 1.5015 MHz	_____MHz
3.	TS19 1.8414 - 1.8450 MHz	_____MHz
f.	All jumpers and switches set properly	_____

All verifications were made in accordance with these procedures and no failures were encountered.

Technician'S Signature _____ Date _____

Figure 2-7. Typical Data Sheet for CPU PCB N451657-2701

2.5.4 Final TWC-1000 System Check

Make up the two "D" plugs and one Buchanan plug per Tables 2-7 and 2-8 as called for in list of Test Equipment, Materials, and Components. Prepare the TWC-1000 Unit for test by following procedure of 2.5.4.2.a. Follow with all procedures in the order given. Do all steps.

2.5.4.1 Test Equipment, Material, and Components Required

DESCRIPTION	MFG	PART NO./ MODEL	QTY
Test Prom	US&S	N451575-0983	1
25 Pin Wired "D" plugs per Table 2-7,	--	--	2
consisting of:	--	--	2
Receptacle	US&S	J709146-0102	2
Shell	US&S	J793024	2
Socket	US&S	J709576-0008	2
#24 AWG Wire	--	Commercial	AR
Buchanan Wired Connector per Table 2-8	US&S	J709146-0357	1
#22 AWG Wire	--	Commercial	AR
Power Supply	Hewlett Packard	HP6267B	1
Digital Voltmeter	Fluke	806A	1
Resistor, 3K ± 5%, 1/4W	--	J725052	1

Table 2-7 "D" Connector Run Connections

PIN 2 TO PIN 3 PIN 4 TO PIN 5* PIN 5* TO PIN 6* PIN 6* TO PIN 8 *Indicates two wires on PIN	PIN 11 TO PIN 12 PIN 13 TO PIN 15 PIN 16 TO PIN 7

Table 2-8 Buchanan Connecter Run Connections

PIN 3 TO PIN 23 PIN 7 to PIN 11 Place a 3K resistor (J735052) between Pin 11 and Pin 19.

2.5.4.2 Tests and Adjustments

a. Initial Setup

(1) With power off, remove application PROM (N451575-0982) from IC16 on CPU board (N451657-2701).

(2) Install TEST PROM (N451575-0983) in position IC16 on CPU board.

(3) Make certain that all IC's are inserted properly.

(4) Make certain that all cables are connected according to Assembly Drawing, Figure 4-4.

(5) On back of TWC-1000 Unit, install the two 25 pin wired "D" plugs into J1 & J2. (See Figure 2-9.)

(6) On back of TWC-1000 Unit, install the Buchanan connector into cardedge Connector 1.

(7) Install the power cable to the power connector at the back of the unit per Figure 2-9. Turn on the power supply switch.

(8) Place jumpers on the N451657-2701 CPU board as follows: J1 - BC, J2- BC, J3 - BC, J4 - AB, J5 - BC, J6 - BC, J7- BC, J8 - AB.

(9) Check jumpers on the N451657-7501 Interface board as follows: JMP1 - BC, JMP2 - BC, JMP3 - AB.

NOTE

The test is automatic and once the power is turned on all the test messages are shown on the 16 character display.

(10) Set the TWC-1000 power switch "PWR" to ON. The dc external supply input voltage should be set to +24 vdc ± 5%.

(11) Using a DVM, measure the 5 volt supply at test points (+)TS15 and (—)TS4 on the top of the CPU N451657-2701 PCB. Adjust the pot in the system power supply to achieve 5.00 vdc ± 0.01 on the DVM.

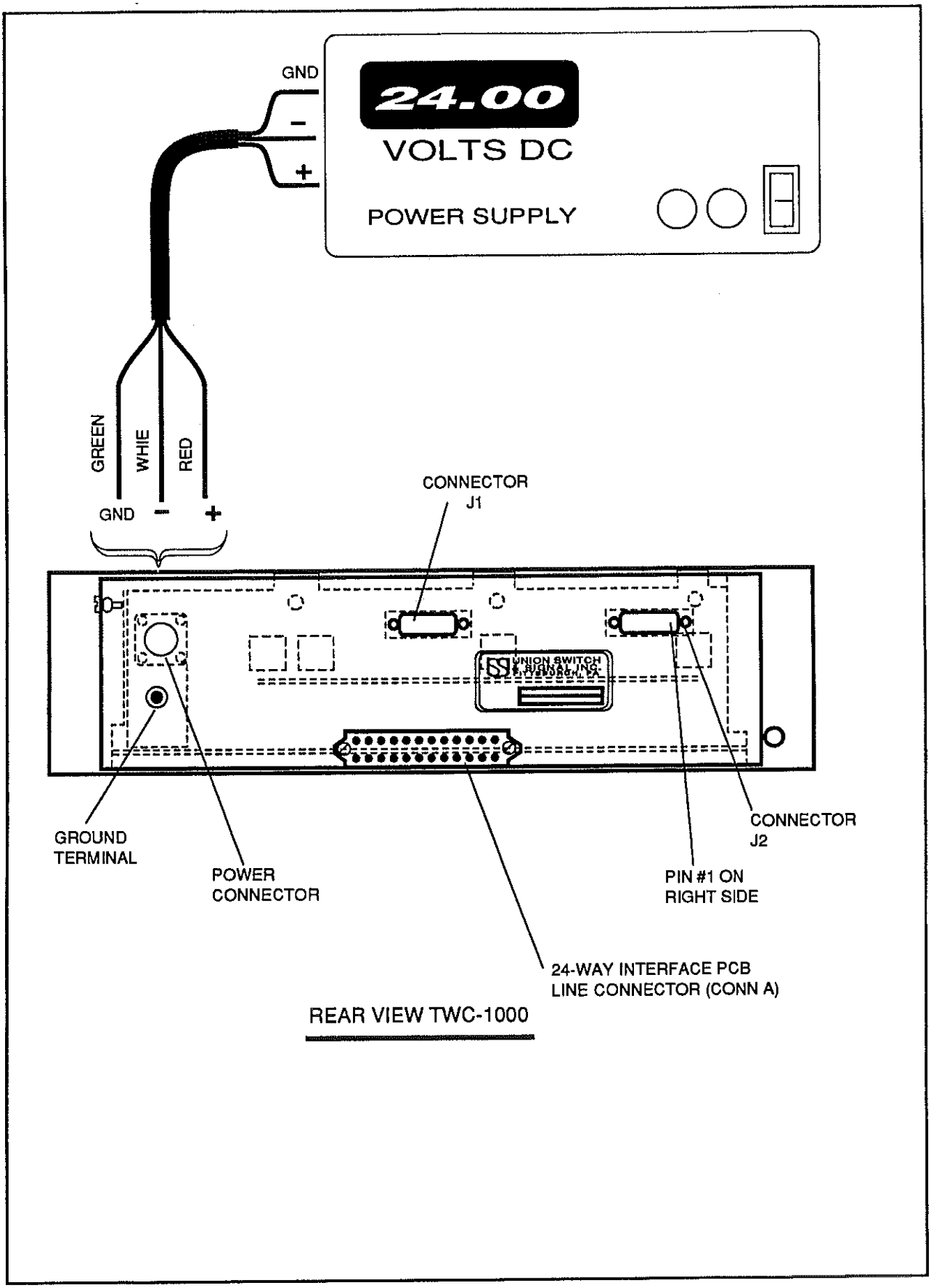


Figure 2-8. Power Supply Connections

NOTE

This pot is located in the hole on the power supply end nearest the front of the TWC-1000 unit.

b. Initial Check of Test PROM

(1) Set the TWC-1000 power switch "PWR" to OFF and then ON again.

(2) On power UP - the TEST PROM (N451575-0893) in IC16 is checked for the correct TEST PROM checksum.

(3) If checksum of the TEST PROM is okay, then "TWC CHECKSUM GOOD" should appear on the display.

(4) If a checksum is not correct, then "TWC CHECKSUM BAD" will appear on the display. No further TWC-1000 tests will be performed.

(5) In the event that the unit fails, check that all IC's and cables are seated properly. Set the TWC-1000 "PWR" switch to OFF and then to ON. If the test fails again, remove the CPU PCB and perform the CPU PCB test, paragraph 2.5.3.

c. TWC-1000 System Test

Once the initial check of the TEST PROM has been completed then the full system test of the TWC-1000 unit can begin.

NOTE

The system tests will be prefaced with "TWC TESTING" on the display followed by a number. Each number will define a specific test. This number will be displayed until the test has been completed.

TEST NUMBER	TEST	GOOD	BAD
1. Check ALL RAMS on CPU, IC9 through IC15	RAM	RAM passed	RAM failed
2. Checks ACIA #1 (J1 - Normal Port) on CPU board, IC28	ACIA #1	ACIA "1" passed	ACIA "1" failed
3. Checks ACIA #2 (J2 - Test Port on CPU board, IC29	ACIA #2	ACIA "2" passed	ACIA "2" failed

TEST NUMBER	TEST	GOOD	BAD
4. Cycles functions as per Table 2-9 through all display readouts on Display PCB N451657-4101	Display		
5. OUTPUT/INPUT OUT=XX IN=XX Where XX = current state of OUT's/IN's	Output/ Input	PIA Test Passed	

Cycles through output LED's and input LED's on the front panel in the following sequence:

Center Frequency LED, Carrier LED.
Space Transmit LED, Carrier LED and Space Receive LED
Mark Transmit LED, Carrier LED and Mark Receive LED

Interface PCB (N451657-7501)

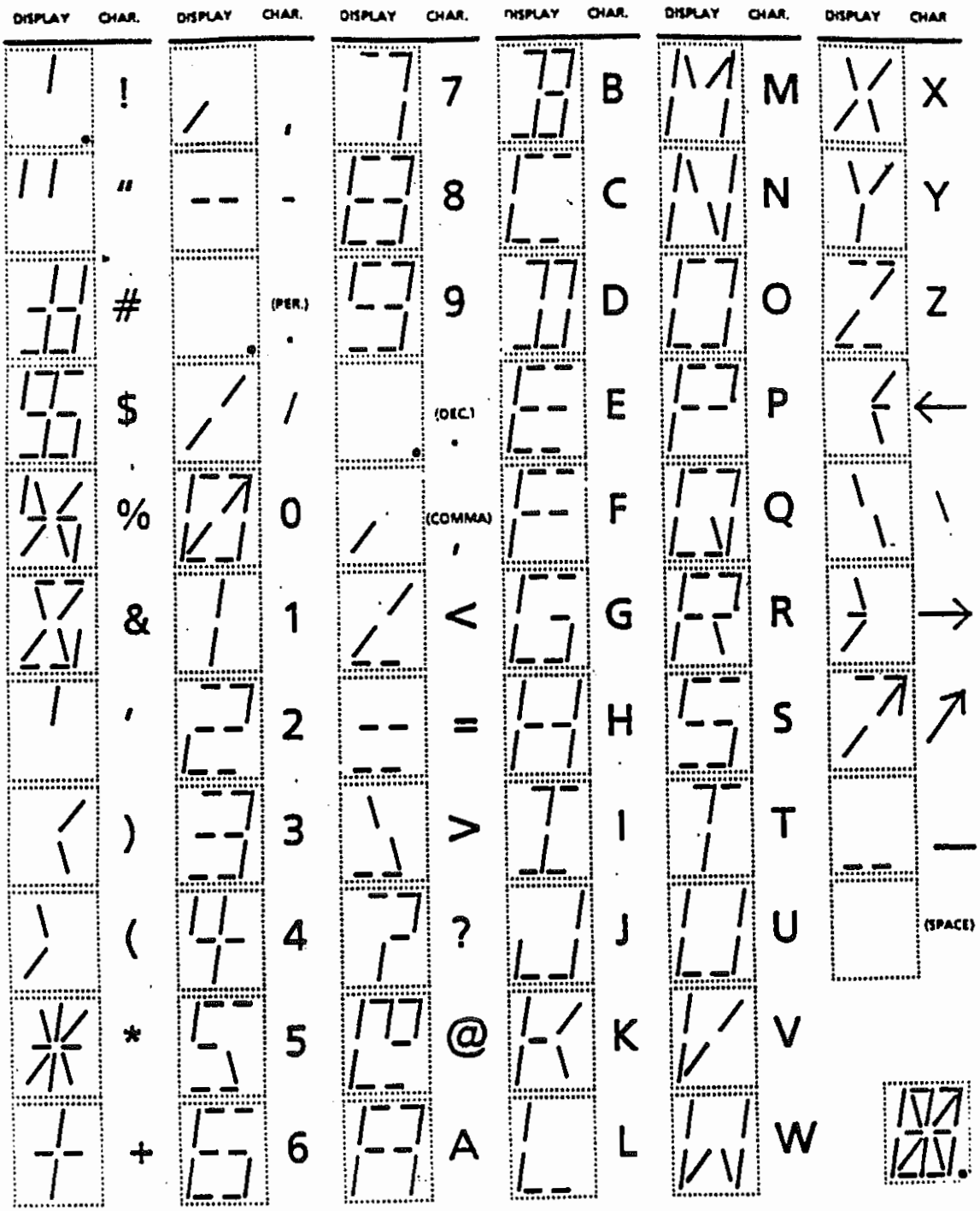
*ON ERROR; Display OUT may show F6 (ctr-freq), F5 (spc), F3 (mrk) and IN may show 00 (no data), 01 (carr), 03 (spc), 05 (mrk).

6. Checks Timer #1 on CPU board, IC24	TIMER #1	TIMER "1" passed	TIMER "1" failed
7. Checks Timer #2 on CPU board, IC25	TIMER #2	TIMER "2" passed	TIMER "2" failed

2.5.4.3 Test Conclusion

If the TWC-1000 unit passes all requirements of this test disconnect and remove all test equipment. Remove TEST PROM from IC16 on the CPU board and replace with Application PROM, N451575-0982. Jumpers on CPU PCB N451657-2701 shall be per paragraph a (8) above. Jumpers on Interface PCB shall be as follows: JMP1 - AB, JMP2 - AB, and JMP3 - AB.

Table 2-9. Character Display



SECTION III

PARTS LIST

3.1 INTRODUCTION

This section contains a complete listing of all detail parts for the TWC-1000 Train-to-Wayside Communications Unit. Included in this section are the following.

3.2 USING THE PARTS LIST

Mechanical and certain electrical parts are identified by an item number that is keyed to an illustration. Determine part to be replaced and order by part number and description for that item number.

Electronic parts are identified by Reference Designations. These designations are used on the schematic diagrams to identify the specific part. This same designation is used to identify and locate that part on the applicable printed circuit board. Determine the part to be replaced, and order by part number and description for that Reference Designation.

All parts may be ordered directly from Union Switch & Signal Inc. Commercially available hardware may be ordered directly from your local supplier. Because this equipment contains vital safety circuits, all electronic parts should be ordered through US&S. Substitutions can compromise the safe performance of circuits. If parts are ordered from any source other than US&S, the exact duplicate must be ordered.

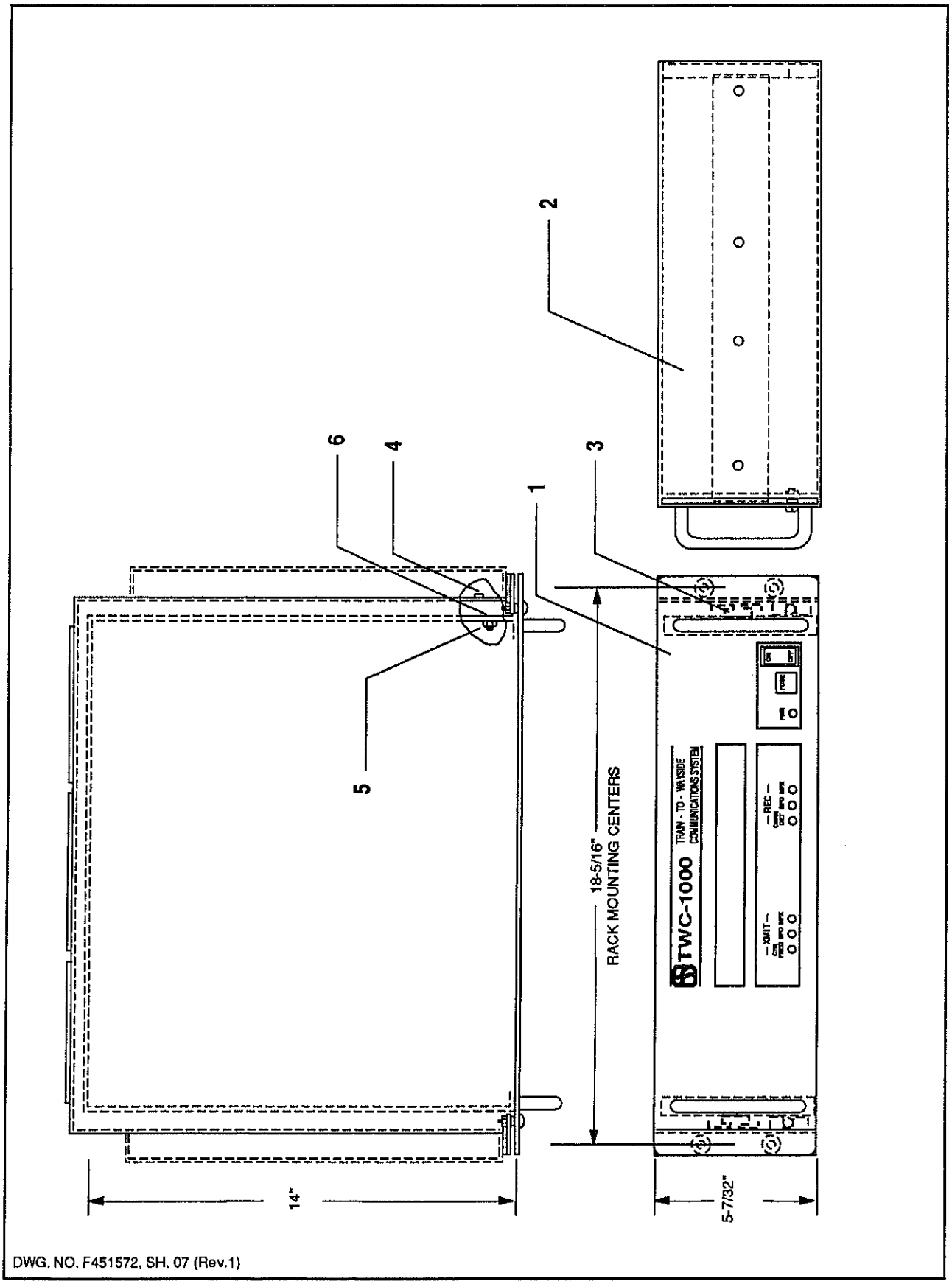


Figure 3-1. TWC-1000 DC Input Unit Top Assembly Parts Location Diagram

TWC-1000 DC INPUT UNIT TOP ASSEMBLY (N451572-0701)
(See Figure 3-1)

ITEM	DESCRIPTION	PART NO.	QTY.
1	Assembly, Unit Enclosure, DC Input (See Figure 3-2 for breakdown)	N451573-1802	1
2	Retainer	N451573-1101	1
3	Slide, Chassis, Premier Metal Products, No. LFE-50-14	J056422-0001	1
4	Screw, Filister Hd., steel, No. 6-32 x 3/8"	J521096	4
5	Nut, Hex, thin, No. 6-32	J048213	4
6	Rivet, Pop, 5/32"	J490020	8

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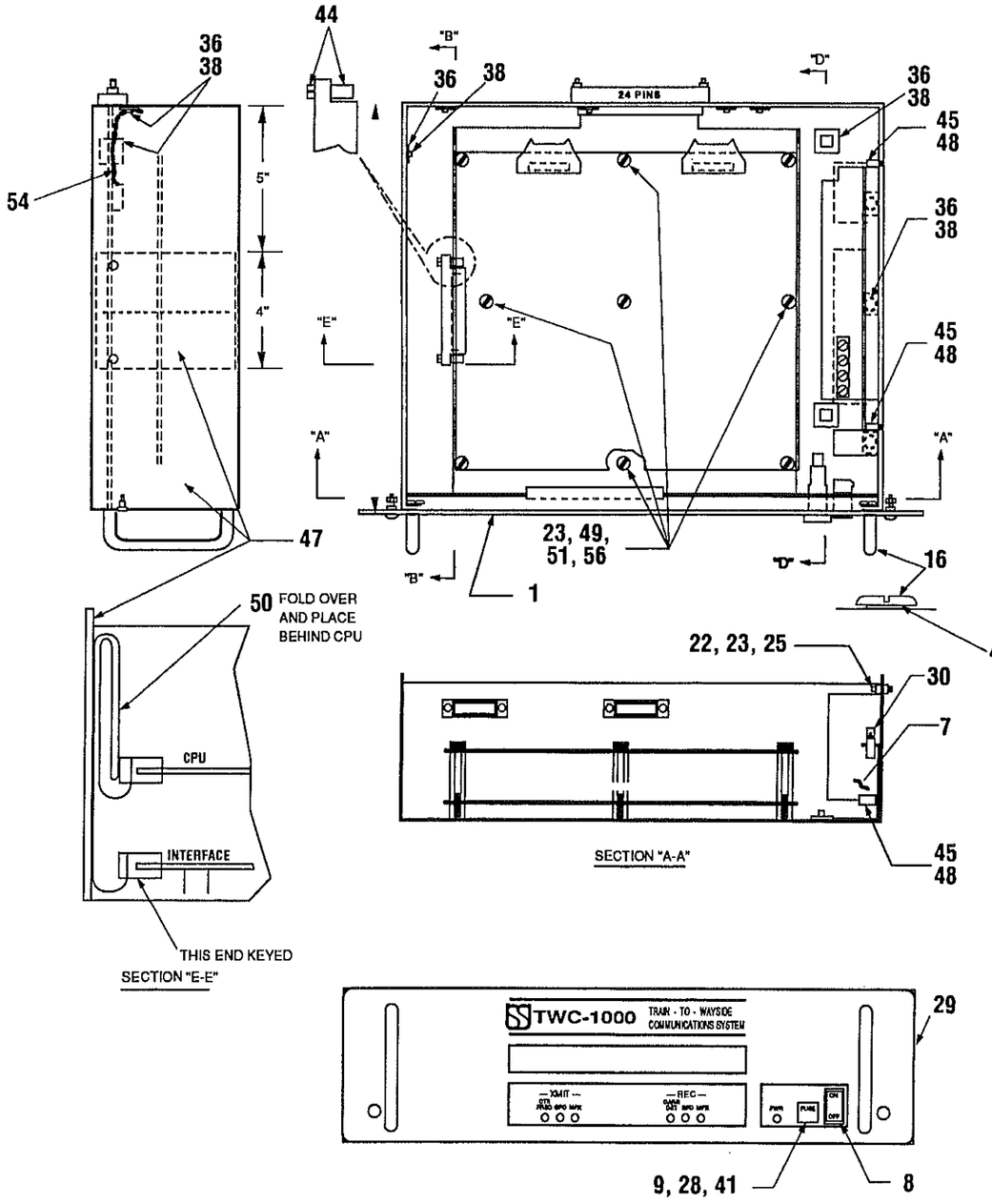
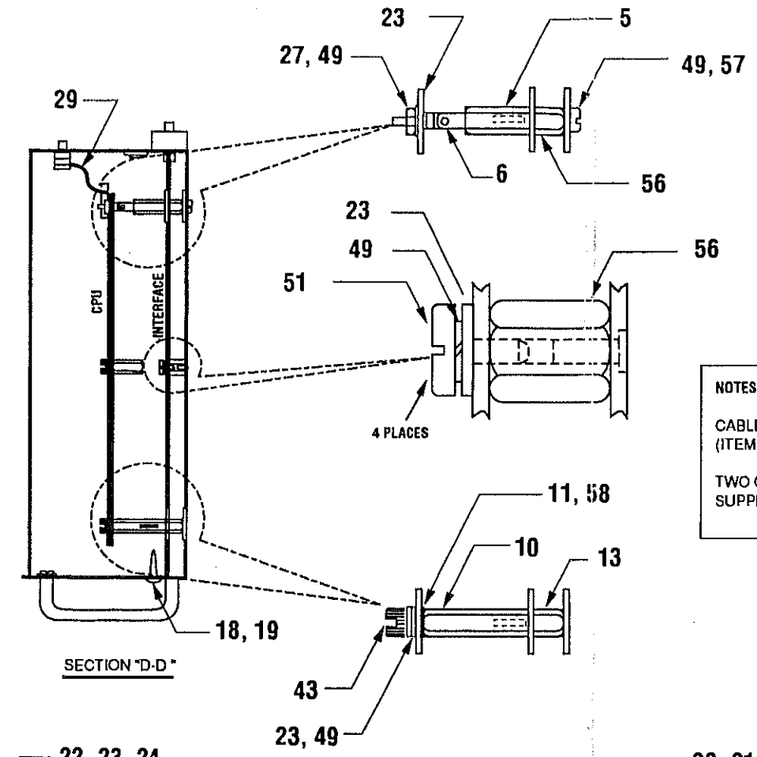
TWC-1000 DC INPUT UNIT ENCLOSURE ASSEMBLY (N451573-1802)
(See Figure 3-2)

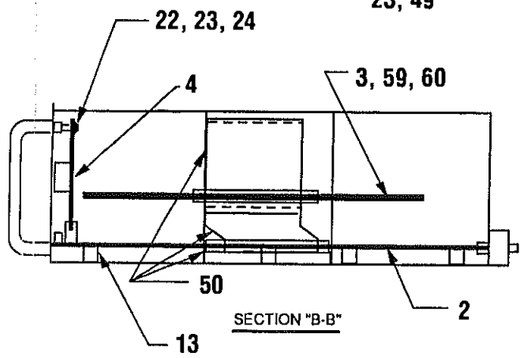
ITEM	DESCRIPTION	PART NO.	QTY.
1	Case	N451573-1901	1
2	PCB, TWC-1000 Interface (See Figure 3-4 for breakdown)	N451657-7501	1
3	PCB, CPU (See Figure 3-3 for breakdown)	N451657-2701	1
4	Display Board (See Figure 3-5 for breakdown)	N451657-4101	1
5	Standoff, Hex, No. 8-32 x 3/8"	J792775-0007	2
6	Hinge, No. 8-32, male/male	J056141	2
7	Power Supply, DC/DC Converter	J725709-0109	1
8	Switch, Rocker	J725707-0359	1
9	Holder, Fuse, Type 348	J071889-0001	1
10	Standoff, Hex, No. 8-32 x 3/8"	J792775-0009	3
11	Washer, Split, No. 8	J475220	3
12	Connector, Edge, 24 pin	J709146-0357	1
13	Standoff, Hex, No. 8-32 x 3/8"	J792775-0008	3
14	Connector, Rectangular, box mounting	J700866	1
15	Cable, 25 Pin, "D"	N451458-9406	2
16	Handle, Drawer, steel	J561107	2
17	Tag, Name plate	J451665-1901	1
18	Stud Fastener, Southco	J791760	2
19	Grommet	J071249	2
20	Screw, Binding hd, No. 4-40 x 5/16"	J050996	4
21	Nut, Self locking, No. 4-40, NC-2	J048207	6
22	Screw, Filister Hd., No. 8-32 x 1/2"	J052256	5
23	Washer, Plain, flat steel, No. 8	J047745	17
24	Washer, Lock, No. 8	J047681	3
25	Nut, Hex, steel, No. 8-32	J048173	2
26	Screw, Pan head, No. 8-32 x 3/8"	J050985	1
27	Nut, Hex, steel, No. 8-32	J048166	2
28	Cap, Fuse holder,	J071889-0002	1
29	Nameplate, Front, TWC-1000	J451573-1601	1
30	Switch, Pushbutton, mini, SPST	J072822	1
31	Wire, AWG #20, PVC, Red	A045663-0002	4
32	Wire, AWG #20, PVC, White	A045663-0009	1
33	Wire, AWG #20, PVC, Green	A045663-0005	1
34	Keying Plug Connector	J709146-0359	1
35	Cord, Power, DC	N451458-9702	1
36	Tie, Cable	J792669-0001	9
37	Tubing, Insulated, 1/4" dia.	A578567	1
38	Tie, Cable, self-locking	J703310	9
39	Pre-insulated Terminal Spade, No.2	J731399-0044	3
40	Tubing, Insulated, 1/8" dia.	A578438	1
41	Fuse, No. 7, 1/2 amp, 32 volts	J710083	1
42	Screw Lock-Assembly	J507358	4
43	Screw, Captive, No. 8-32 x 5/8"	J052285	3
44	Kit, Mounting block	J792993	1

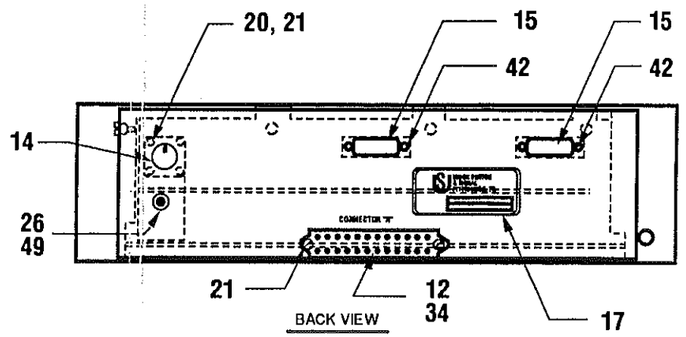
TWC-1000 DC INPUT UNIT ENCLOSURE ASSEMBLY (N451573-1802)
(Continued)
(See Figure 3-2)

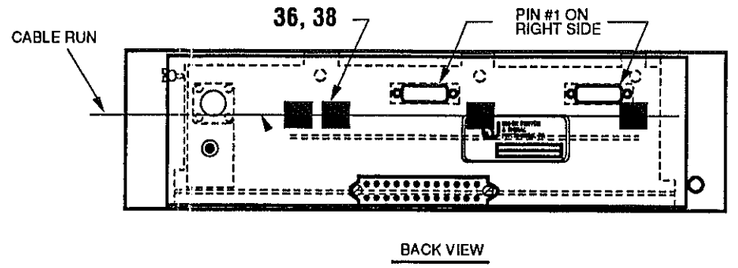
ITEM	DESCRIPTION	PART NO.	QTY.
45	Chase, Rubber channel	A075114	-
46	Washer, Lock, shakeproof, steel, No. 10	J047942	4
47	Tape, Scotch, 2 in.	A773128	1
48	Adhesive, Contact	A041988	-
49	Washer, Lock, shakeproof, steel, No. 8	J047714	10
50	Cable, 50 way	N451458-9403	1
51	Screw, Pan head, No. 8-32 x 1/4"	J050989	4
52	Cable, Reset	N451458-9901	1
53	Cable, Power, CPU	N451458-9902	1
54	Cable, Sense lines	N451458-9904	1
55	Sealant, Threadlock	A041608	—
56	Standoff, Hex, steel, 3/8"	J731474	6
57	Screw, Stainless steel, pan hd. No. 8-32 x 1/4"	J507295-0104	2
58	Packing O-Ring, 0.128" ID	J067453	3
59	PROM, Integrated Circuit	N451575-0982	1
60	Integrated Circuit, No. HM6264LP-12	N715029-0519	1











NOTES

CABLE (ITEM 50) TO GO FROM INTERFACE PCB (ITEM 2) TO CPU (ITEM 3). SEE SECTION "E-E".

TWO CABLES (ITEMS 53 & 54) TO GO FROM POWER SUPPLY (ITEM &) TO PCB'S (ITEMS 2 & 3).

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Figure 3-2. TWC-1000 DC Input Unit Enclosure Assembly Parts Location Diagram

CENTRAL PROCESSOR UNIT PCB (N451657-2701)
(See Figure 3-3)

ITEM	DESCRIPTION	PART NO.
BAT1	Battery, Lithium, 3.6 V	J705151
C1 thru C47, C91 C93	Capacitor, 0.1 Mfd, 50 VDC	J709145-0330
C92	Capacitor, 4.7 Mfd, 35 VDC	J706422
C97, C104	Capacitor, 22 Pfd, 500 VDC	J706525
C98, C101	Capacitor, 47 Mfd, 50 VDC	J709053
C99, C100 C103	Capacitor, 0.01 Mfd, 100 VDC	J709145-0166
C102	Capacitor, 100 Mfd, 25 VDC	J706904
CONN 1, CONN 2	Connector, 26 pin	J709146-0351
D1, D6	Diode, 1N4003, 200V	J723555
D3	Diode, Rectifier, 1N5822	J726150-0173
D5	Diode, Rectifier	J726150-0168
IC1	Integrated Circuit, HMOS, 68A09	J715029-0428
—	Socket, Mounting, 40 pin (for IC1)	J725840-0001
IC2, IC3, IC4, IC31	Integrated Circuit, 74HC244J/N	J715029-0393
IC5, IC30	Integrated Circuit, 74HC245	J715029-0391
IC6, IC7	Integrated Circuit, CMOS, 74HC138	J715029-0395
IC8	Integrated Circuit, CMOS, 74HC27	J715029-0407
IC9, IC10, IC11, IC12 IC13, IC14	Integrated Circuit, HM6264LP-12	J715029-0519
IC16	Test Prom	N/A
IC17	Integrated Circuit, ICL8212MTY	J715029-0354
—	Pad, Mounting, 8 pin (for IC17)	J792668
IC18, IC19 IC40	Integrated Circuit, MM74HCTOON	J715029-0507
IC20, IC21 IC22	Integrated Circuit, 74HC373	J715029-0398
IC23	Integrated Circuit, CMOS, 74HC10	J715029-0401
IC24, IC25	Integrated Circuit, Timer, 68A40	J715029-0431
IC26	Integrated Circuit, CMOS, 4521B	J715029-0405
IC27, IC28 IC29	Integrated Circuit, ACIA, 6551A	J715029-0432
—	Socket, Mounting 28 pin (for IC9 thru IC16, IC24, IC25, IC27, IC28, IC29)	J725840-0002
IC32, IC33 IC36	Integrated Circuit, UA9636ATC	J715029-0377
IC34, IC35 IC37, IC38	Integrated Circuit, UA9637ATC	J715029-0378
IC39	Integrated Circuit, 74HC32J	J715029-0394
IC41	Integrated Circuit, 74HC14N	J715029-0520
IC42	Integrated Circuit, 74HC04J	J715029-0396
IC43, IC44 IC45, IC46	Integrated Circuit, 74HCT04	J715029-0463
IC47	Integrated Circuit, CMOS, 74HC08N	J715029-0406

CENTRAL PROCESSOR UNIT PCB (N451657-2701) (Continued)
(See Figure 3-3)

ITEM	DESCRIPTION	PART NO.
J1 thru J8	Jack, Shorting	J713343
—	Strip, Connecting for jumpers J1 thru J8	J725912
LED 1	Diode, Light Emitting, Red	J713344
OC1, OC2	Integrated Circuit, Opto Coupler/ Isolator	J715029-0236
OSC1	Oscillator, Crystal Clock	J718302
P1	Plug	J793015-0006
P2, P3	Plug	J793015-0007
PB1	Switch, Pushbutton, SPDT, snap action	J725707-0138
Q3	Transistor, 2N3906, PND, Silicon	J731280
Q4	Transistor, 2N3904, NPN, Silicon	J731281
—	Pad, Mounting, 7117-7 DAP (for Q3, Q4)	J792437
R1	Resistor, 1 Megohm, 1/4W	J735300
R2	Resistor, 10 ohm, 1/4W	J735057
R3	Resistor, 47K ohm, 1/4W	J735035
R4	Resistor, 510K ohm, 1/4W	J735405
R5	Resistor, 150K ohm, 1/4W	J735040
R7	Potentiometer, 20K ohm, 1/2W	J620850-0106
R8	Resistor, 2K ohm, 1/4W	J735048
R9	Resistor, 75 ohm, 1/4W	J735519-0043
R10, R11 R25, R30, R31	Resistor, 100K ohm, 1/4W	J735137
R12, R14 R15, R16 thru R21, R28, R67	Resistor, 10K ohm, 1/4W	J735053
R13	Resistor, 510 ohm, 1/4W	J735159
R22	Resistor, 200 ohm, 1/4W	J735217
R23, R63	Resistor, 1K ohm, 1/4W	J735031
R24	Resistor, 100 ohm, 1/2W	J721194
R26, R27	Resistor, 47 ohm, 1/2W	J721189
R29	Resistor, 51K ohm, 1/4W	J735067
RN1 thru RN5, RN9, RN10, RN11, RN15	Resistor, Network, 10K ohm	J735519-0546
RN6, RN7 RN8, RN12 RN13, RN14	Resistor, Network, 100K ohm	J735519-0513
SW1 thru SW6	Switch, DIP, snap action	J725707-0355
SW7, SW8, SW9	Switch, DIP, 8 array, SPST	J725707-0128

CENTRAL PROCESSOR UNIT PCB (N451657-2701) (Continued)
(See Figure 3-3)

ITEm	DESCRIPTION	PART NO.
TP1 thru TP5, TP7 TP10, TP14 thru TP19	Pin, Formed, 60803-2	J713824
XTAL1	Crystal, Quartz, 6.00 MHz	J709605

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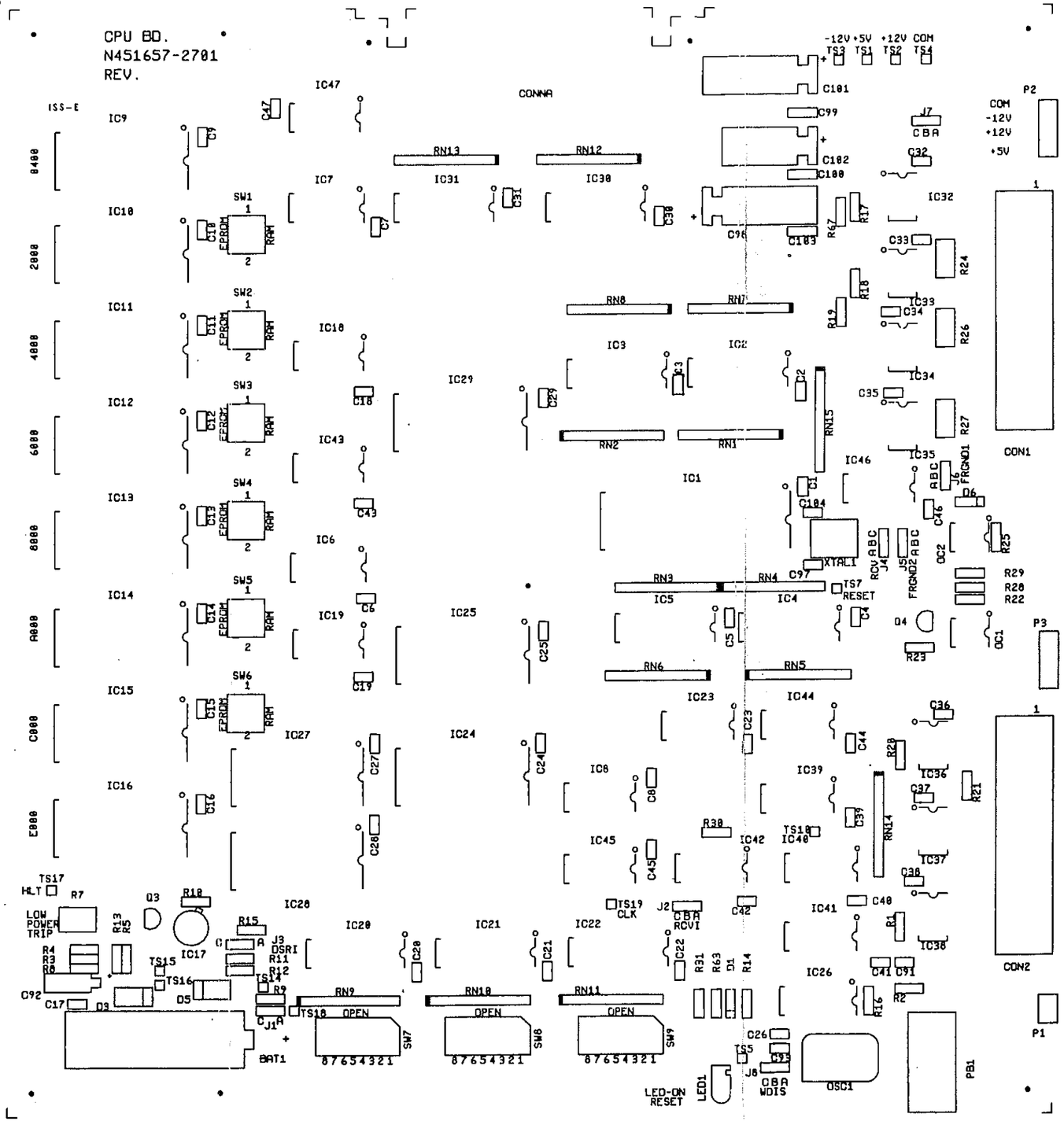

DWG. NO. 451657, SH. 27 (REV. 4)

Figure 3-3. Central Processing Unit Printed Circuit Board Parts Location Diagram

INTERFACE PRINTED CIRCUIT BOARD (N451657-7501)
(See Figure 3-4)

ITEM	DESCRIPTION	PART NO.
C1, C3, C9, C10, C15, C28, C31, C32, C33, C35, C36, C37, C38, C40, C41, C44, C49, C52 thru C56	Capacitor, 0.1 Mfd, 50 VDC	J709145-0330
C2, C17, C19, C21, C23	Capacitor, 10 Mfd, 20 WVDC	J706373
C4	Capacitor, 0.0018 Mfd	J709145-0124
C5, C6, C7, C8	Capacitor, 0.001 Mfd, 500 VDC	J700612
C11, C12, C58, C59	Capacitor, 4.7 Mfd, 35 VDC	J706422
C13	Capacitor, 47 Mfd	J706419
C14	Capacitor, 10 Mfd	J706625
C16, C18, C20	Capacitor, 0.01 Mfd, 100 VDC	J709145-0166
C22	Capacitor, 0.0018 Mfd, 500 VDC	J702817
C24, C26, C27, C29, C34, C39, C57	Capacitor, 33 Pfd, 500 VDC	J706524
C25, C30, C42, C43, C45, C46, C47, C48, C50, C51	Capacitor, 0.0022 Mfd, 500 VDC	J702803
CONN 2	Connector, 4 position	J793015-0007
CONN 4	Connector, PCB, 22-way	J709146-0125
D1	Diode, 6.4 VZ, 400 MW	J726150-0181
D2 thru D12, D15, D16, D19, D20, D22 thru D29	Diode,1N4003, 200 V	J723555
IC1	Integrated Circuit, PIA, 68A21	J715029-0430
—	Socket, Mounting, 40 pin (for IC1)	J725840-0001
IC2	Integrated Circuit, CMOS, 4001	J715029-0089
IC3, IC7, IC14	Integrated Circuit, CMOS, 4049UB	J715029-0141
IC4	Integrated Circuit, ICM7555IPA	J715029-0296
IC5, IC8, IC9 IC10	Integrated Circuit, TL084MJ	J715029-0579
IC6, IC11	Integrated Circuit, Opto Amp, 3303	J715029-0385
IC12, IC13	Integrated Circuit, CMOS, 4050B	J715029-0130
JMP1, JMP2, JMP3	Jack, Shorting	J713343
—	Strip, 36 post	J725912
L1	Inductor, Pot Core	N451030-7109

INTERFACE PRINTED CIRCUIT BOARD (N451657-7501)
(Continued) (See Figure 3-4)

ITEM	DESCRIPTION	PART NO.
LED 1 thru LED 7	Diode, LED, Red	J726150-0204
Q1, Q2, Q3	Transistor, VN10	J731398-0098
Q5	Transistor, NPN, Silicon, 2N6290	J731398-0087
Q6	Transistor, PNP, Silicon, 2N6109	J731398-0086
—	Screw, Pan hd, No. 4-40 x 3/8" (for Q5, Q6)	J050997
—	Washer, Lock, shakeproof, No. 4 (for Q5, Q6)	J047729
—	Nut, Hex, steel, No. 4-40 (for Q5, Q6)	J480006
Q7	Transistor, 2N3904-5	J731398-0033
Q8	Transistor, MPF105/2N5459	J731398-0019
—	Pad, Mounting, No. 100032 (for Q1, Q2, Q3, Q7, Q8)	J792072
R1, R2, R3, R4, R37, R42, R62, R67, R74, R120, R121	Resistor, 1K ohm, 1/4W	J735031
R5, R11 thru R14, R16, R19, R20, R29, R45, R47, R54, R56, R64, R70, R103, R105, R107, R108, R119	Resistor, 10K ohm, 1/4W	J735053
R6	Resistor, 3480 ohm, 1/8W	J735323
R7	Resistor, 4.22K ohm, 1/8W	J735519-0294
R8, R9, R10, R17	Potentiometer, 5K ohm, 1/2W	J620850-0103
R15	Resistor, 38.3K ohm, 1/8W	J735519-0292
--	Terminal, Solder, non-insulating (for R18)	J731399-0029
R21, R22, R23, R26	Resistor, 13K ohm, 1/4W	J735388
R24	Resistor, 2.2K ohm, 1/4W	J735237
R25, R31, R110, R111	Resistor, 15K ohm, 1/4W	J735061
R27, R57, R79, R92, R112, R118	Resistor, 33 ohm, 1/4W	J735519-0057
R28	Resistor, 18K ohm, 1/4W	J735069
R30, R61, R73, R76, R18	Resistor, 100K ohm, 1/4W	J735137
R32	Resistor, 300 ohm, 1/4W	J735519-0073

INTERFACE PRINTED CIRCUIT BOARD (N451657-7501)
(Continued) (See Figure 3-4)

ITEM	DESCRIPTION	PART NO.
R33	Resistor, 47 ohm, 1/4W	J735248
R34, R65, R69, R71	Potentiometer, 100K ohm, 1/2W	J620850-0086
R35, R39	Resistor, 30 ohm, 1/2W	J723586
R36, R48	Resistor, 4.7K ohm, 1/4W	J735034
R38	Resistor, 20 ohm, 1W	J721207
R40	Resistor, 2K ohm, 1/2W	J721080
R41	Resistor, 22K ohm, 1/4W	J735093
R43	Resistor, 270 ohm, 1W	J721120
R44, R60, R66, R72	Resistor, 100 ohm, 1/4W	J735050
R46	Resistor, 20K ohm, 1/4W	J735054
R49, R50, R51, R53, R77, R80, R82, R83, R84, R86, R87, R89, R90, R93, R95, R96, R97, R99, R100, R102	Resistor, 43.2K ohm, 1/8W	J735519-0395
R52, R81, R88,R94, R101	Resistor, 23.2K ohm, 1/8W	J735387
R55	Resistor, 51K ohm, 1/4W	J735067
R58, R78, R85, R91, R98, R117	Potentiometer, 2K ohm, 1/2W	J620850-0105
R59	Resistor, 130K ohm, 1/4W	J735452
R63, R68, R75	Resistor, 510K ohm, 1/4W	J735405
R104, R106, R109	Resistor, 30K ohm, 1/4W	J735068
RN1, RN2, RN3	Resistor Network, 100K ohm	J735519-0513
RN8	Resistor Network, 10K ohm,	J735519-0546
T1	Inductor, Pot Core	N451030-7107
T2	Inductor, Pot Core	N451030-7108
TP1 thru TP29	Pin, Formed	J713824

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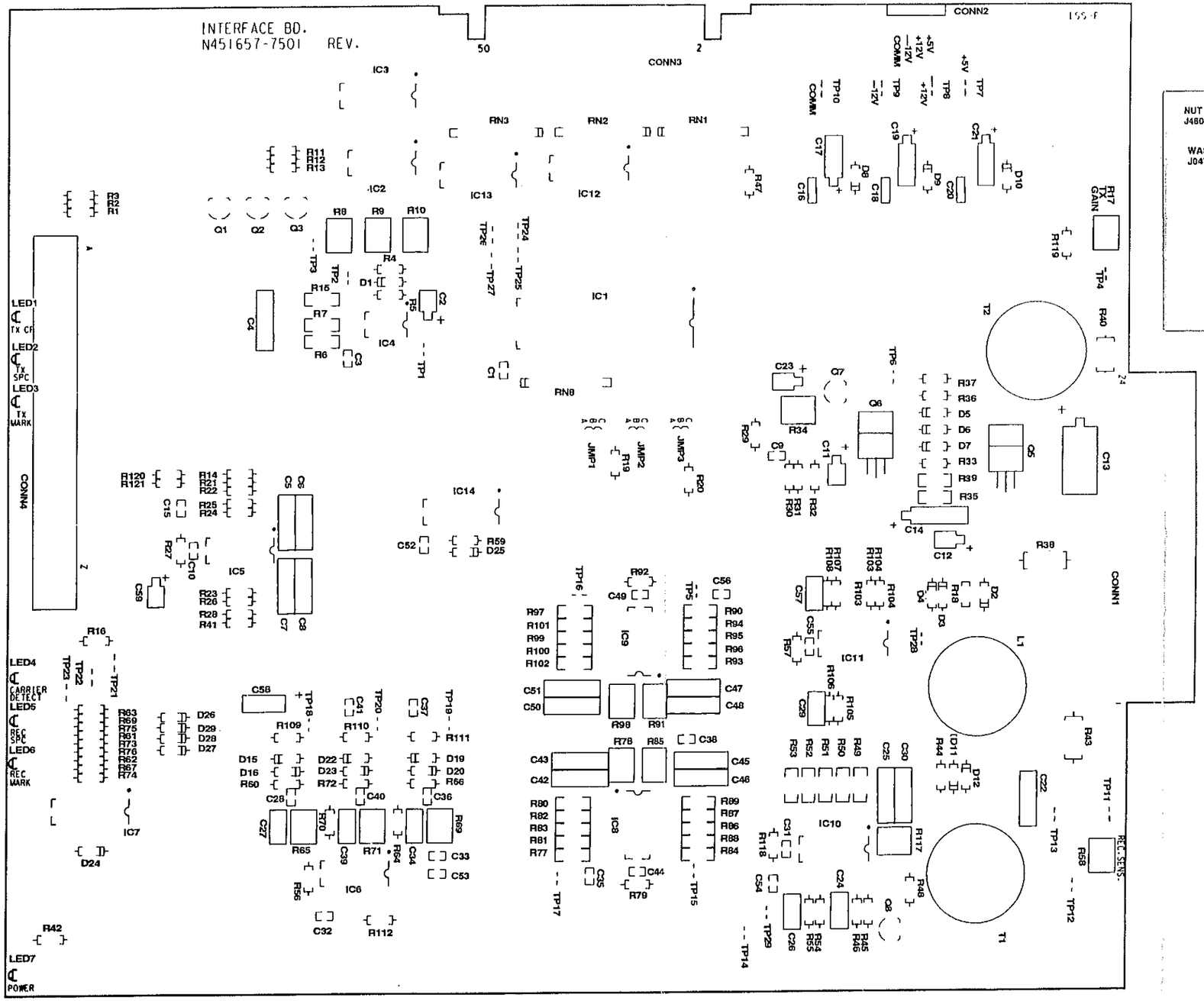
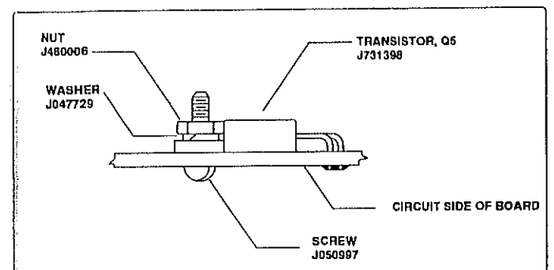




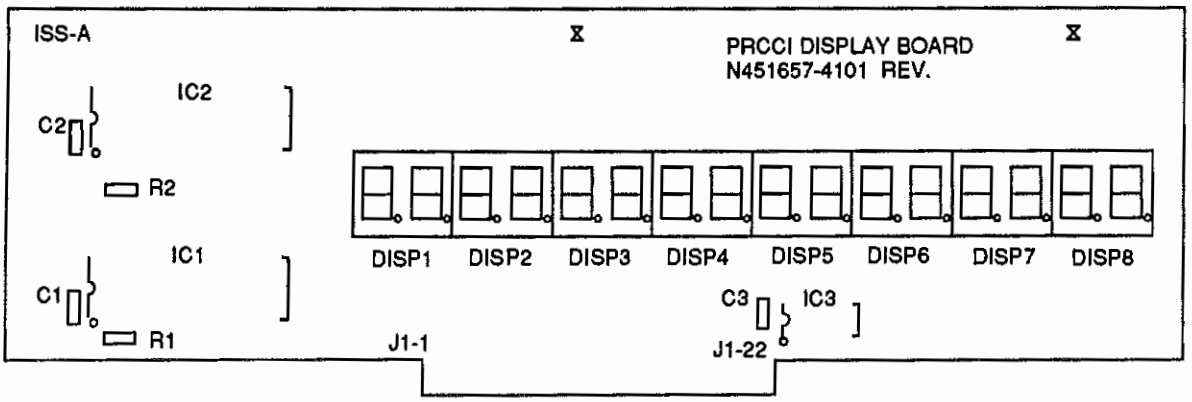
APPLICATION OF TRANSISTOR TO PCB

DWG. NO. 451657, SH. 75 (REV. 2)

Figure 3-4. Interface Printed Circuit Board Part Location Diagram
6421-2, 3-19/3-20

DISPLAY PRINTED CIRCUIT BOARD (N451657-4101)
((See Figure 3-5)

ITEM	DESCRIPTION	PART NO.
C1, C2, C3	Capacitor, 0.1 Mfd, 50 VDC	J709145-0517
DISP1 thru DISP8	Display, 2 Digit LED	J792696-0005
–	Socket, Mounting (for DISP1 thru DISP8)	J725840-0023
IC1, IC2	Integrated Circuit, No. ICM7243BIPL	J715029-0517
–	Socket, Mounting (for IC1, IC2)	J725840-0001
IC3	Integrated Circuit, No. MM74HCTOON	J715029-0507
R1, R2	Resistor, 10K ohm, 1/4W	J735053



DWG. NO. N451657-0041, Rev. 0

Figure 3-5. Display Printed Circuit Board Parts Location Diagram

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SECTION IV

DIAGRAMS

4.1 General

This section contains the schematic diagrams for the three printed circuit boards used in the TWC-1000 Unit.

Figure No.	Description	Dwg. No.
4-1	Interface PCB Schematic Diagram	D451657-75E
4-2	Display PCB Schematic Diagram	D451657-41A
4-3	Central Processor Unit (CPU) PCB Schematic Diagram (4 sheets)	F451626-8001 F451626-8002 F451626-8003 F451626-8004
4-4	Interface Wiring Diagram	F451573-18A

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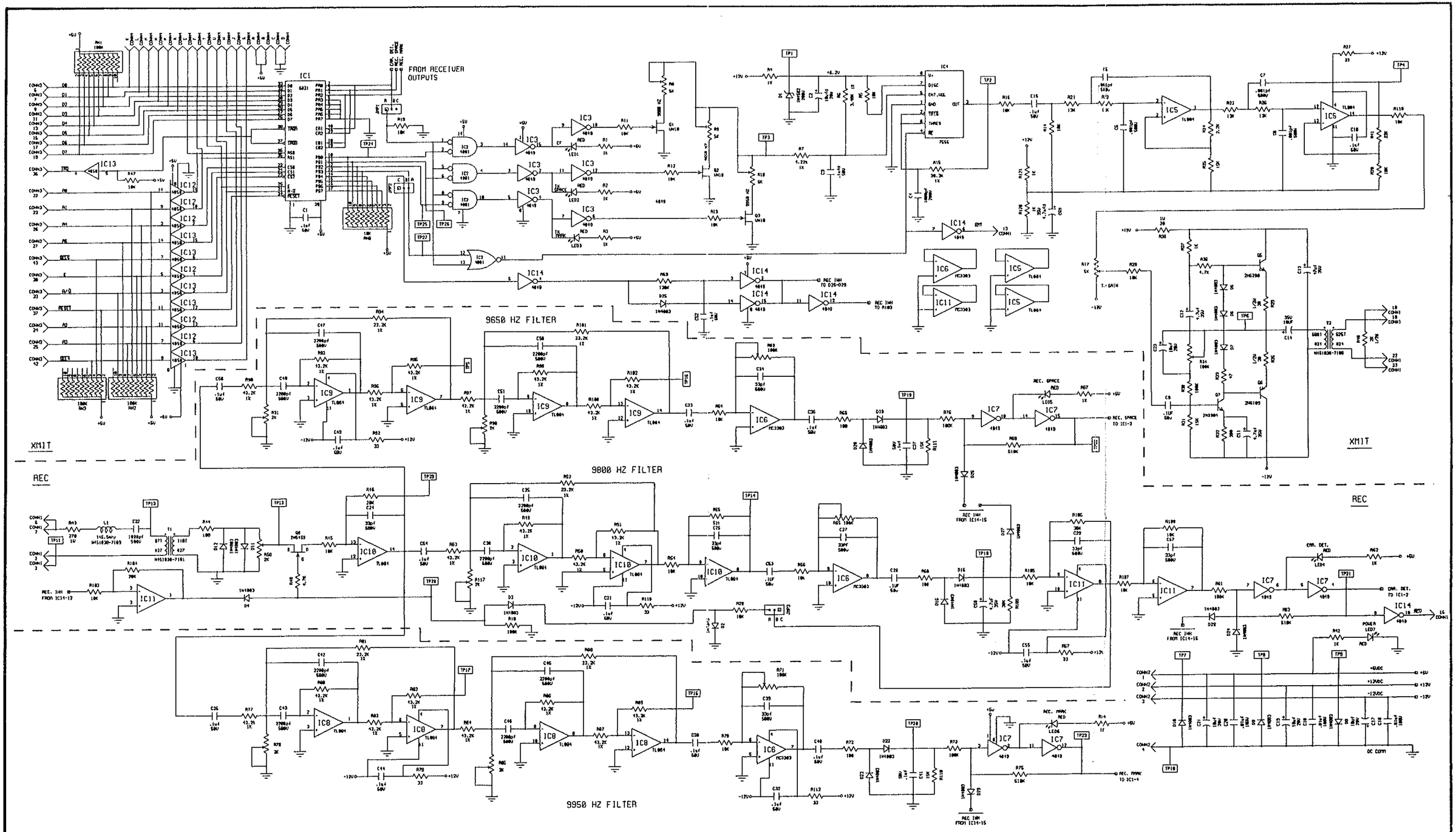
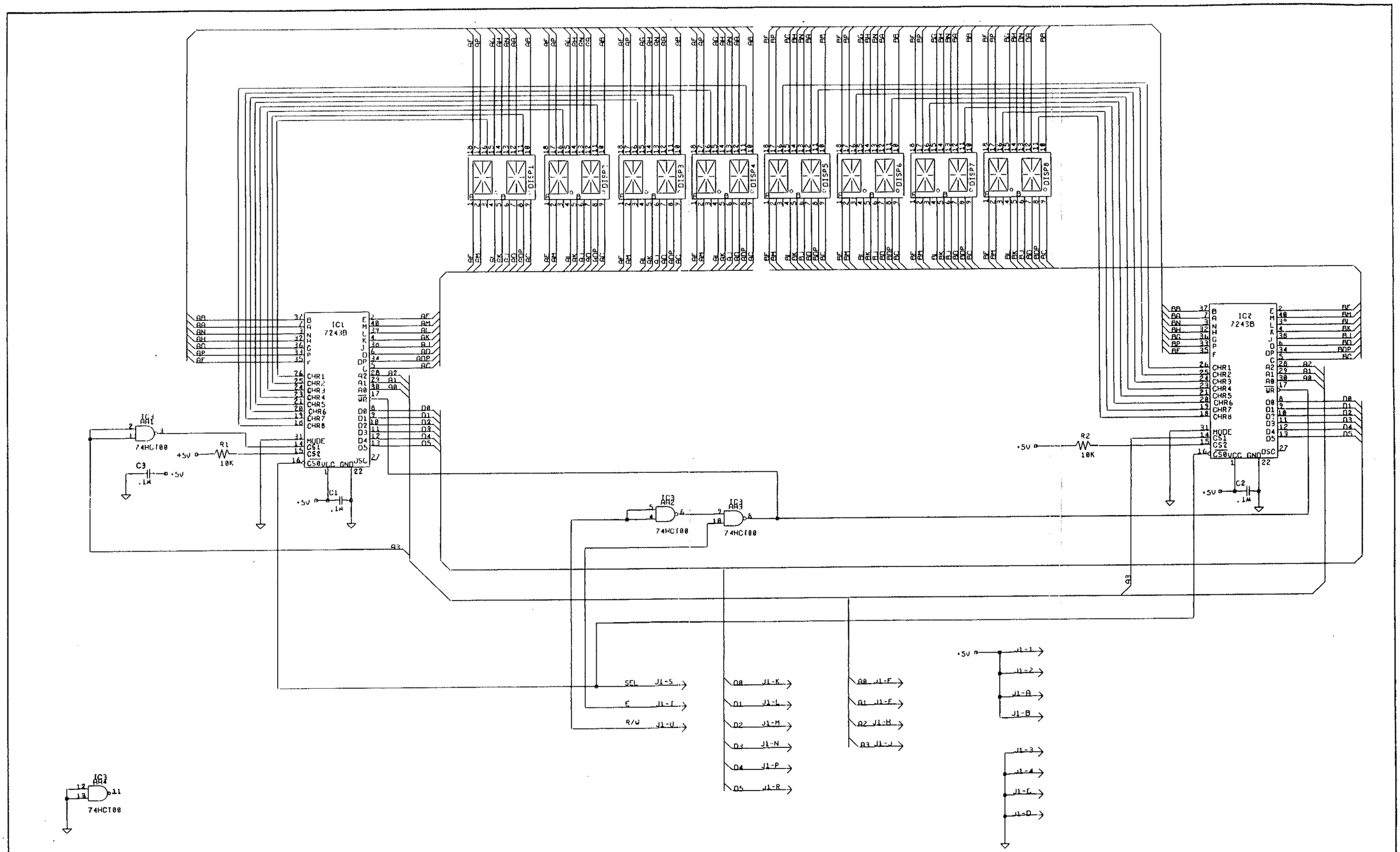


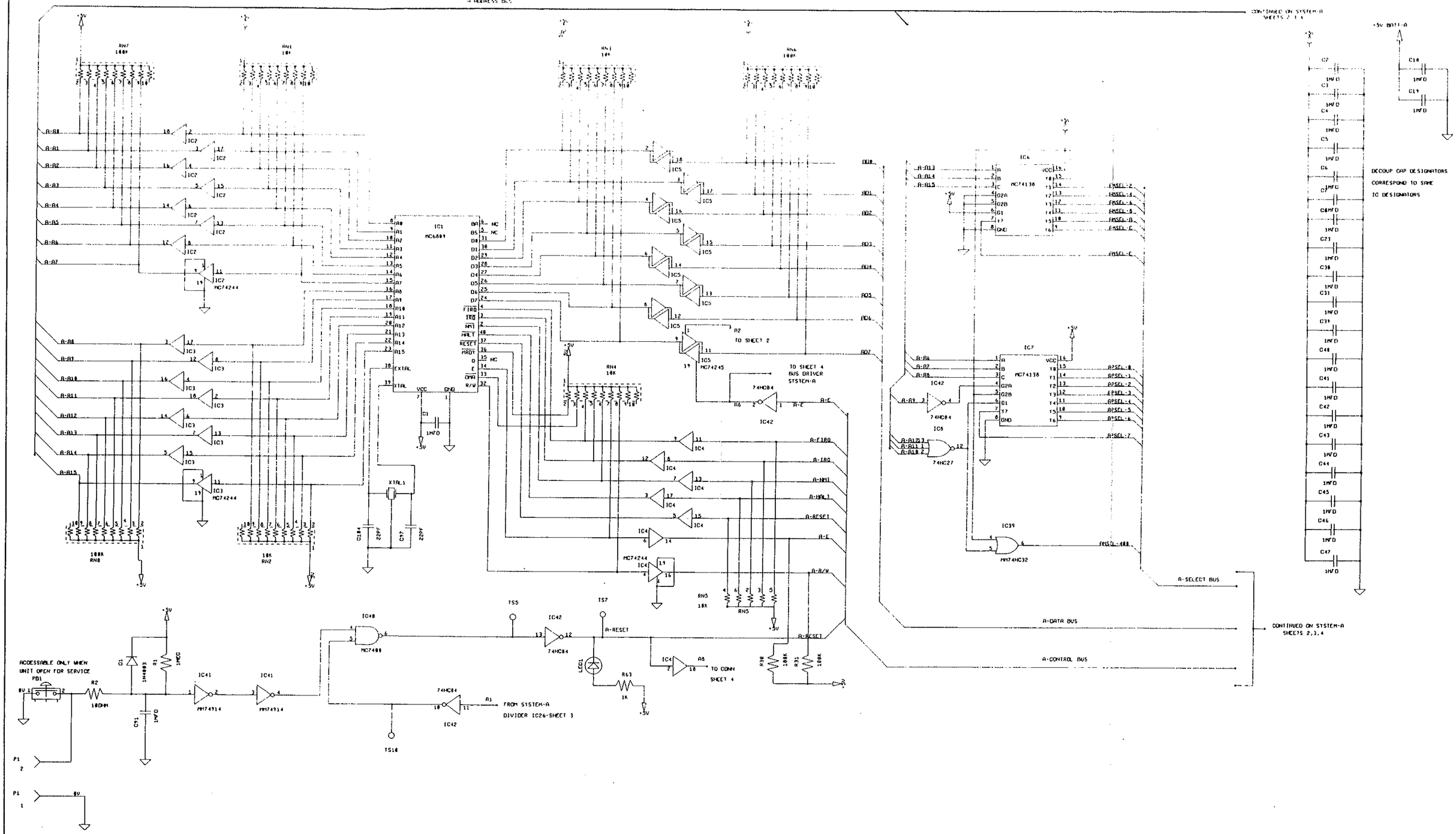
DWG. NO. D451657, SH. 75E (REV. 3)

Figure 4-1. Interface PCB Schematic Diagram



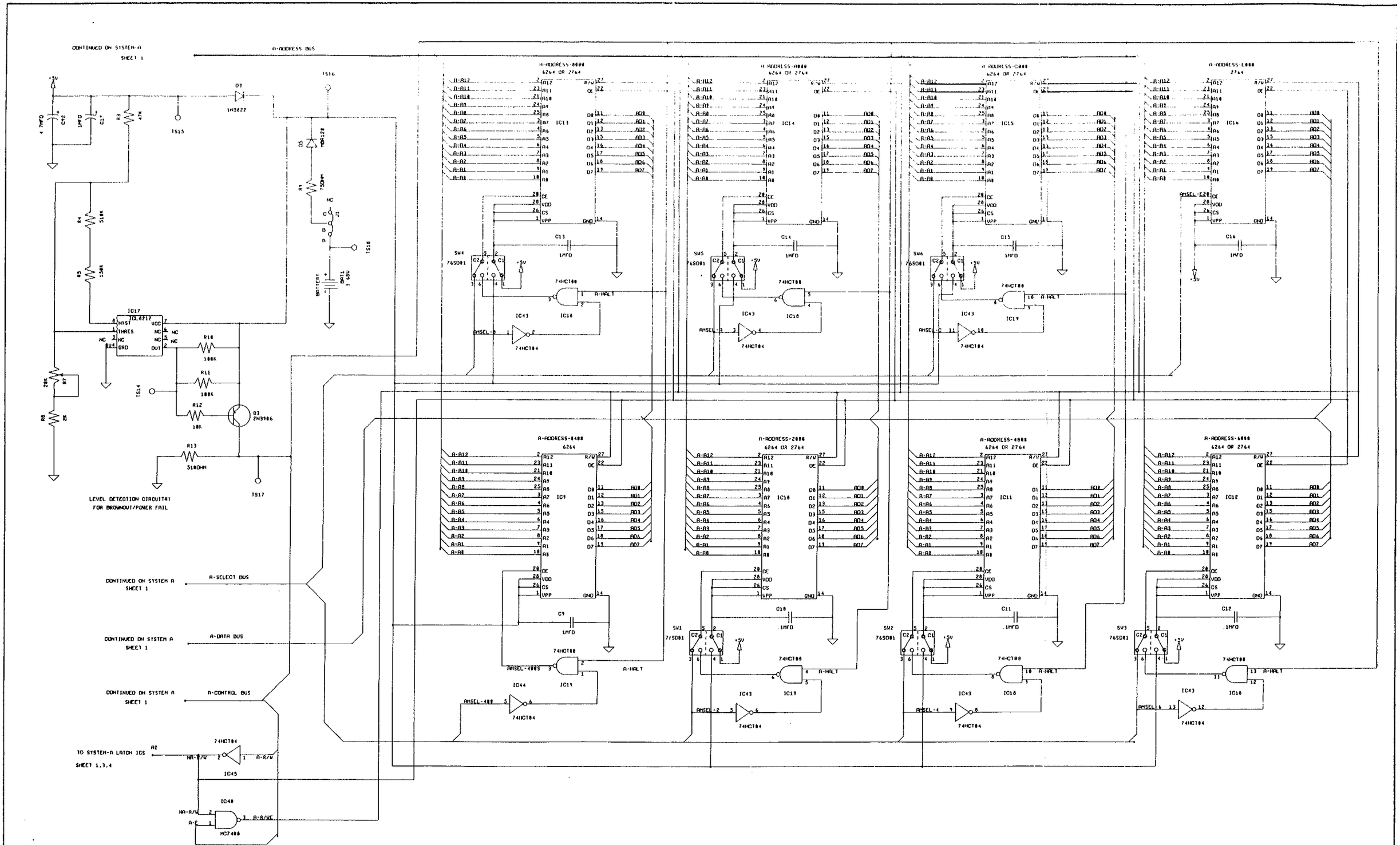
DWG. NO. D451657, SH. 41A (REV. OB)

Figure 4-2. Display PCB Schematic Diagram



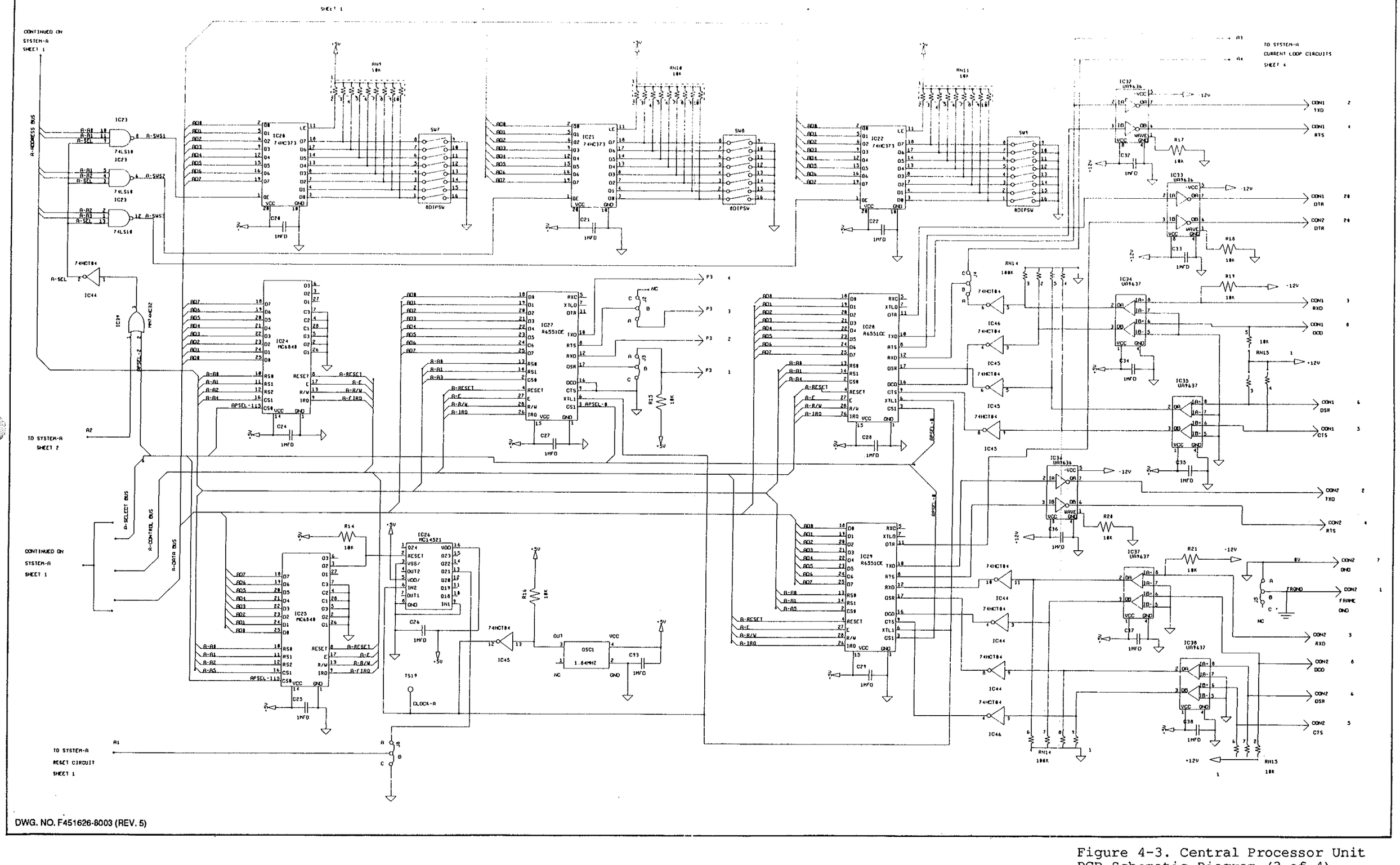
DWG. NO. F451626-8001 (REV. 5)

Figure 4-3. Central Processor Unit PCB Schematic Diagram (1 of 4)



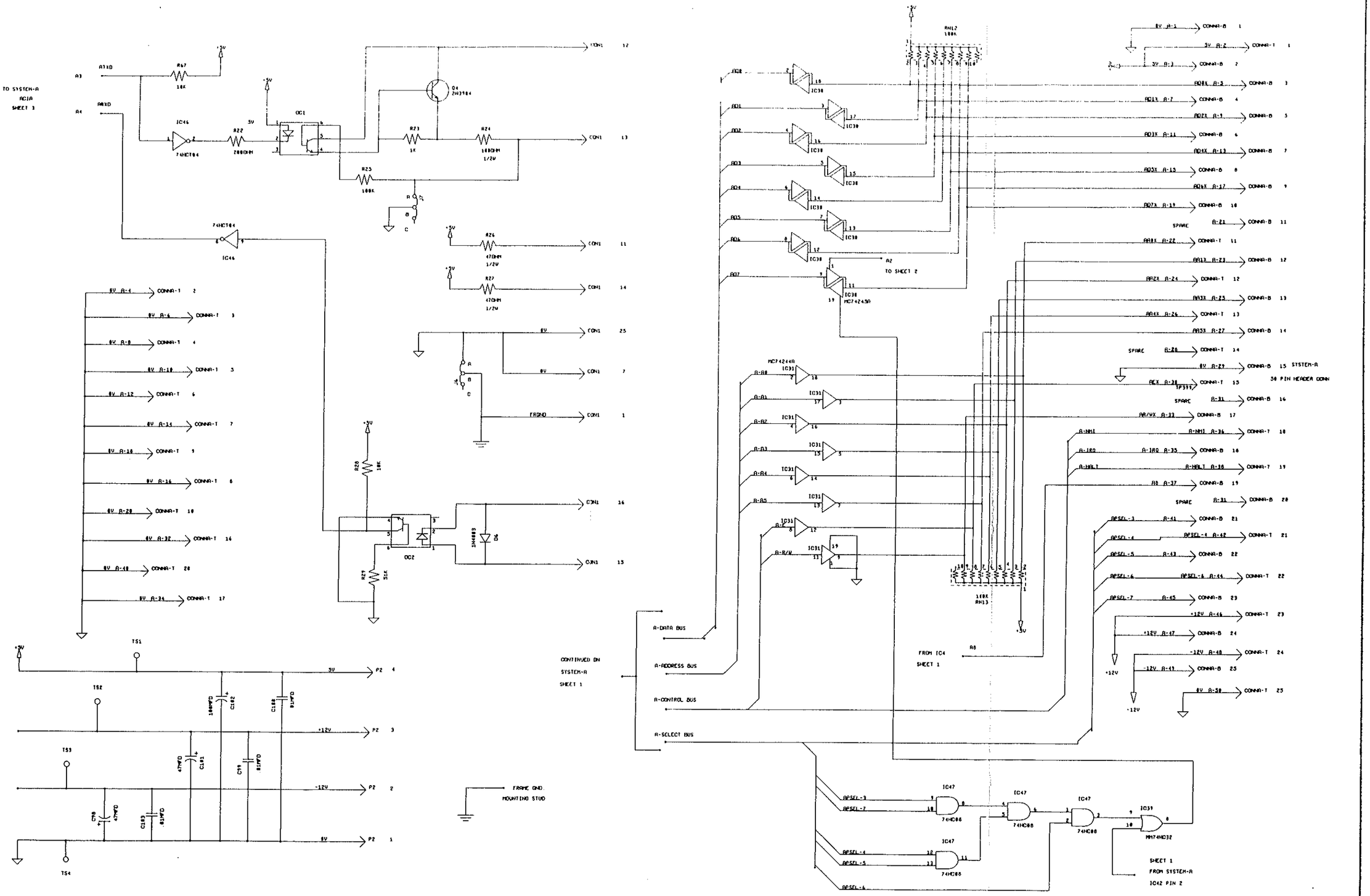
DWG. NO. F451626-8002 (REV. 5)

Figure 4-3. Central Processor Unit PCB Schematic Diagram (2 of 4)
SM6421-2, 4-9/4-10



DWG. NO. F451626-8003 (REV. 5)

Figure 4-3. Central Processor Unit PCB Schematic Diagram (3 of 4)

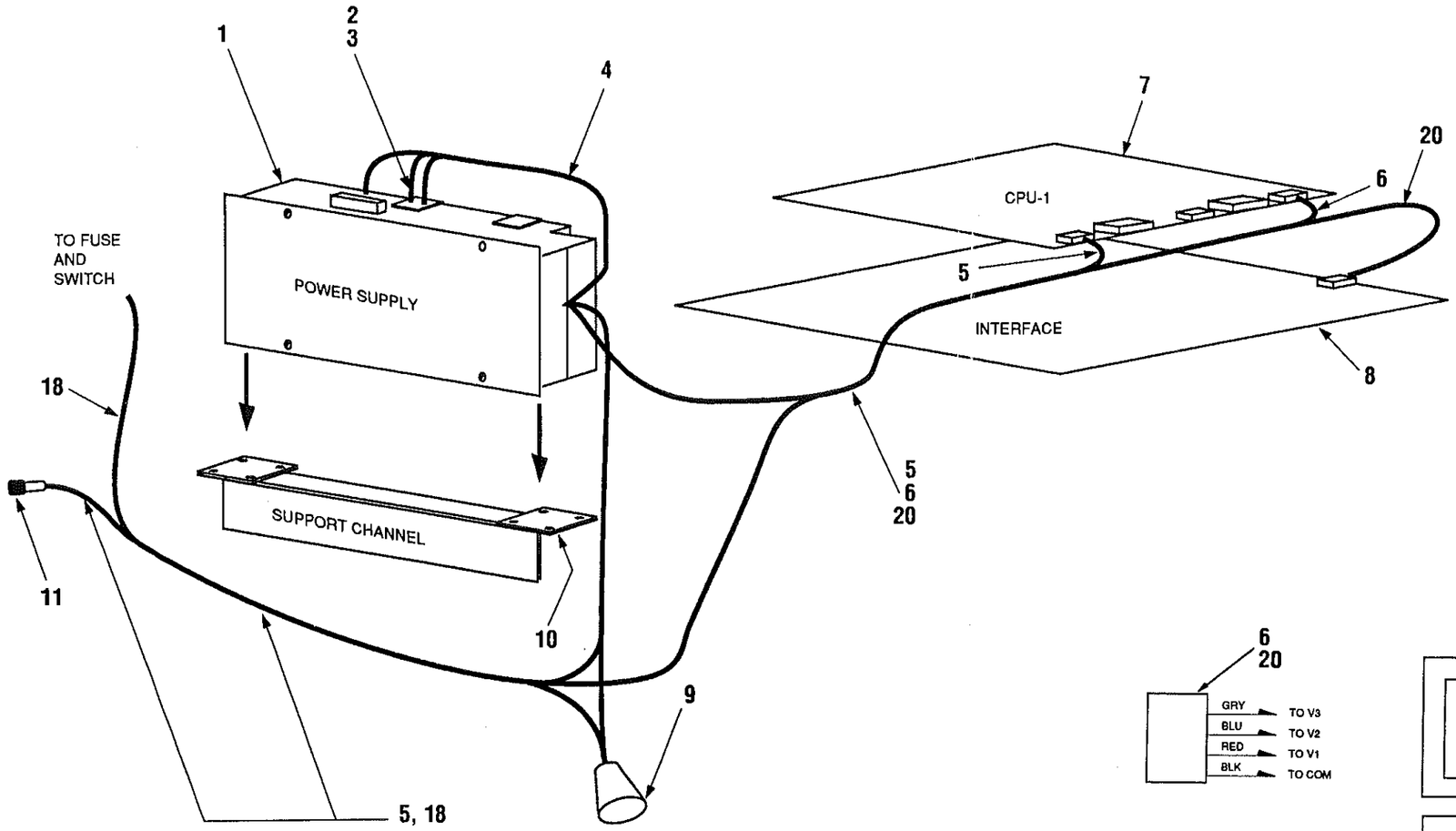


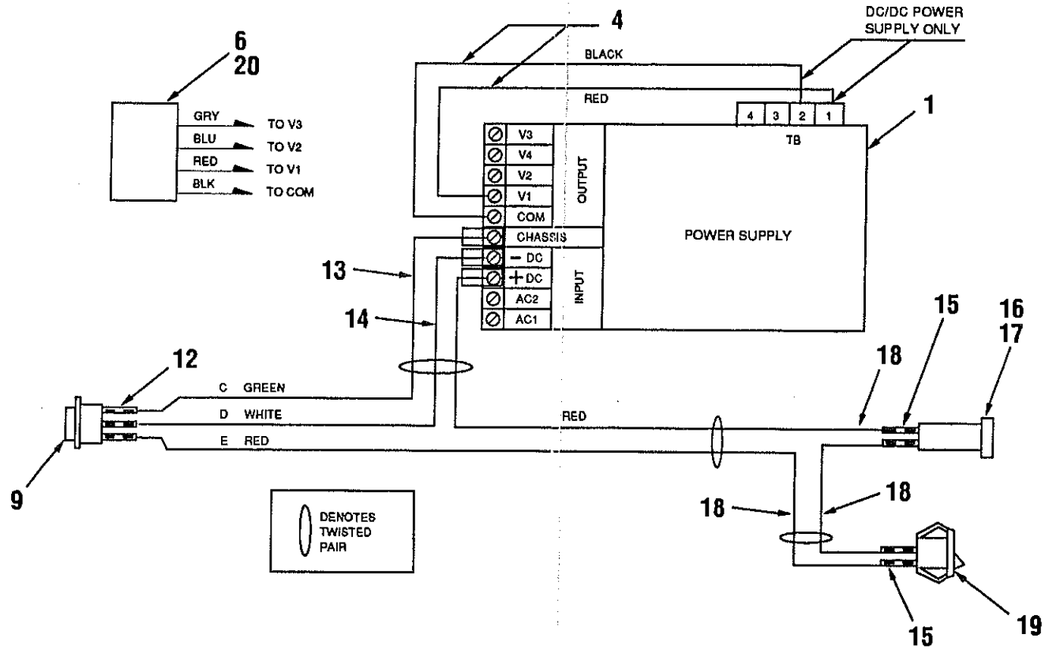
DWG. NO. F451626-8004 (REV. 5)

Figure 4-3. Central Processor Unit PCB Schematic Diagram (4 of 4)

LEGEND

1. POWER SUPPLY	11. PUSHBUTTON SWITCH
2. BASE CABLE TIE ADHESIVE	12. INSULATING TUBING, 1/8" DIA.
3. CABLE TIE	13. #20 AWG WIRE, GREEN
4. SENSE LINE CABLE	14. #20 AWG WIRE WHITE
5. RESET CABLE	15. INSULATING TUBING, 1/4" DIA.
6. CPU POWER CABLE	16. FUSE HOLDER
7. CPU PCB	17. FUSE HOLDER CAP
8. INTERFACE PCB	18. #20 AWG WIRE, RED
9. RECTANGULAR BOX CONNECTOR	19. ROCKER SWITCH
10. CHANNEL	20. INTERFACE PWR. CABLE





DWG: NO. F451573, SH. 18A (REV. 0)

Figure 4-4. TWC-1000 Wiring Diagram
6421-2, 4-15/4-16