Scientific Atlanta

Model 1885
Position Indicator

Model 1886 Position
Data Processor

Instruction Manual

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CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

This is the complete instruction manual for the Scientific-Atlanta Model 1885 Digital Position Indicator and the optional Model 1886 Position Data Processor units (Figure 1.1). This manual also provides information on the optional Scientific-Atlanta Encoder Processor Module.

For easier reference, this manual is divided into several sections. Chapters 1, 2 and 3 provide functional-type information for the operator/installer. Chapters 4, 5, 6 and 7, contain more technical information and are intended for Scientific-Atlanta trained service personnel.

Occasionally, updates are necessary to the contents of this manual. To help keep your manual as up-to-date as possible, an Update Information Envelope inside the rear cover contains any information regarding recent changes made to the instruction manual prior to shipment of your equipment.

1.2 PURPOSE OF EQUIPMENT

The Model 1885 Digital Position Indicator is a microprocessor-based unit designed to process and digitally display angular and/or linear position information while simultaneously interfacing to other antenna test system instrumentation.

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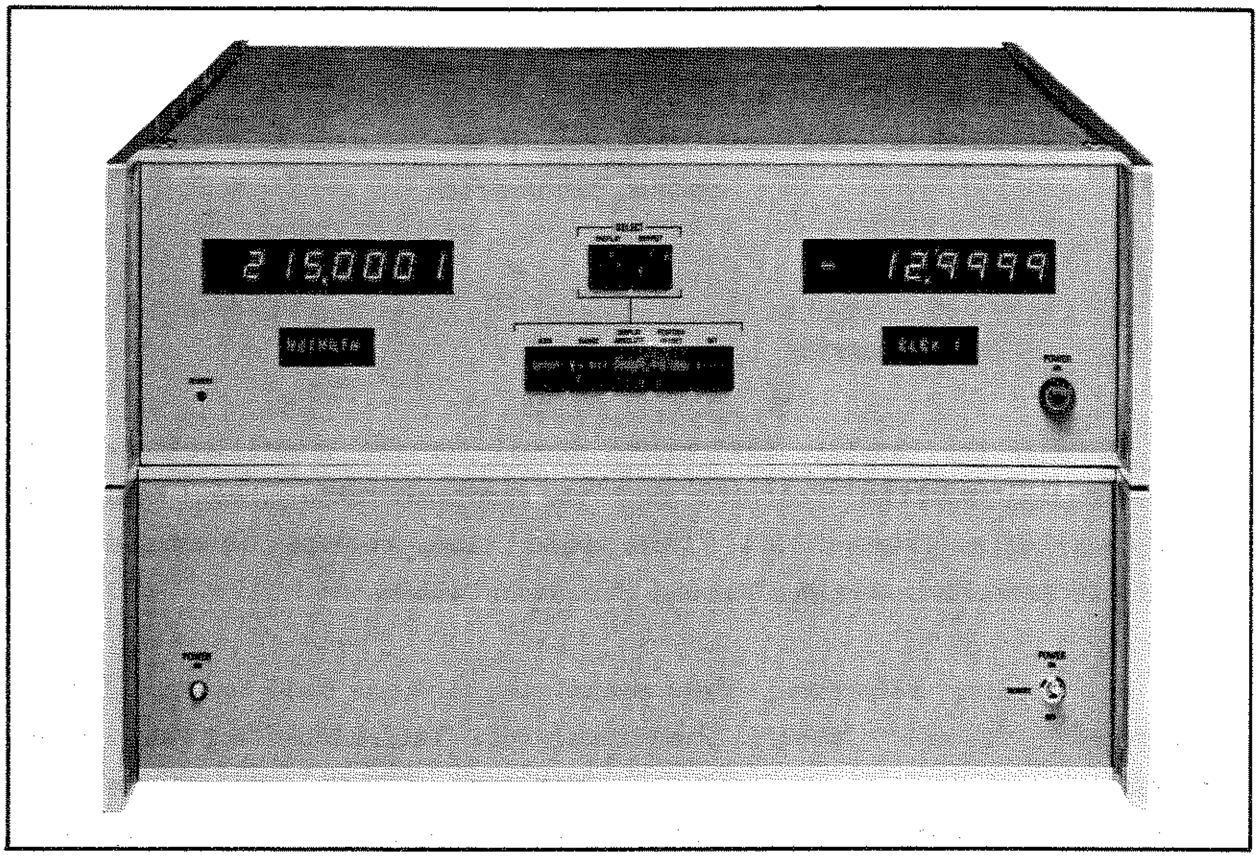

Figure 1.1. The Standard Model 1885 and Optional Model 1886

The Model 1885 Digital Position Indicator processes single speed (1:1) and dual speed (36:1 and 1:1) analog synchro data from most position transducers used in antenna test positioners and tracking systems. In conjunction with a 1:1 synchro, the Model 1885 also accepts precision 256:1 data (with the optional Scientific-Atlanta Encoder Processor Module) from an Inductosyn® transducer and/or serial data from the Model 1886 Position Data Processor.

The optional Model 1886 Position Data Processor permits data input to the Model 1885 from a remote location by multiplexing up to three axes of single-speed, dual-speed, and/or precision dual-speed data.

The Model 1885 provides separate BCD digital outputs for interfacing to the Scientific-Atlanta Model 1580 Antenna Pattern Recorder and to a Model

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2012A Programmable Positioner Controller. A special output port for the Scientific-Atlanta Model 2013 Synchro Select unit is also provided. An IEEE-488 Interface allows programmable operation through a system computer/controller.

1.3 FEATURES

The Model 1885 Digital Position Indicator is available as a stand-alone display unit consisting of the Model 1885 only, or as a combination package including both the Model 1885 and the optional Model 1886 Position Data Processor.

The Model 1885 Digital Position Indicator has three separate inputs accepting single-speed, dual-speed, and/or precision dual-speed position data directly from a position transducer or through a Scientific-Atlanta Model 2013 Synchro Select unit (single and dual speed only through the Model 2013). In addition, two separate inputs can each accept serial data from a Model 1886. A separate set of rear panel connectors provides the input/output for the Scientific-Atlanta Model 2013 Synchro Select unit.

Each Model 1886 Position Data Processor added to the system provides up to 3 inputs of either standard position data from a synchro transmitter or precision-dual speed data from an Inductosyn® transducer (see Section 2.4.2 for suggested interfacing configurations).

Two front panel LED displays on the Model 1885, each containing eight characters, show rotary and/or linear quantities representing the position of a particular axis. The resolution of the display varies according to the type of position transducer input. Single speed (1:1) synchro data produces a display resolution of 0.1 degrees with rotary-type axes, and 0.01 units with linear-type axes, while dual speed (1:1 and 36:1) produces a display resolution of 0.001 degrees with rotary-type and 0.0001 units with linear-type axes. Data from an Inductosyn® precision transducer (256:1) result in display resolutions of 0.0001 degrees (rotary) and 0.00001 units (linear).

Two smaller displays, located beneath the main position indicators, act as axis identification labels. Each time a new axis is displayed, the labels change accordingly. Because these displays are programmable, the labels can easily be customized for any eight-character message desired.

Control of the Model 1885 is accomplished manually through front panel pushbuttons, automatically by a system controller through the IEEE-488 bus interface, or through one of two serial ports. Functions include:

- determining the axis for Display and/or Output
- determining Display and/or Output ranges
- entering axis identification labels
- adjusting offset angles for Display and/or Output

High-speed update rates (approximately 400 nanoseconds) of the Position Indicator position outputs provide the ability to acquire data quickly. Therefore, efficiency of measurement periods may be increased significantly as compared to other displays.

Two separate parallel BCD digital outputs allow direct interface to Scientific-Atlanta system equipment including the Model 2012A Positioner Programmer and the Series 1580 Antenna Pattern Recorder. An IEEE-488 standard bus interface is also provided for interfacing to a system controller.

A serial interface connector on the Model 1886 Position Data Processor allows remote data input to the Model 1885 Digital Position Indicator through any RS-232 compatible link (cables, landlines, fiber optics, etc.).

The Model 1885 and the optional Model 1886 are both designed for mounting in a standard nineteen-inch wide rack configuration, or within individual cabinets. Fan-forced air cooling with rear panel intake maintains a safe internal operating temperature under varying environmental conditions.

1.4 TECHNICAL SPECIFICATIONS

This section provides a summary of technical specifications for the Model 1885 Digital Position Indicator and the optional Model 1886 Position Data Processor.

Characteristic	Description
Accuracy:	
Single Speed (1:1) -	±0.5 degrees
Dual Speed (1:1, 36:1) -	±0.01 degrees
Precision Dual Speed (1:1, 256:1) -	±0.001 degrees
Resolution:	
Single Speed (1:1) -	0.1 degrees
Dual Speed (1:1, 36:1) -	0.001 degrees
Precision Dual Speed (1:1, 256:1) -	0.0001 degrees
Front Panel Displays:	
Position -	Two LED displays each consisting of 8 characters; seven segment sections. Digits are 0.43 inches high.
Axis Identification -	Two LED displays each consisting of 8 characters; fourteen segment sections. Digits are 0.135 inches high.
Range Selection:	
Linear -	
Single Speed	-17.99 to +18.00 or 00.00 to 35.99
Dual Speed	-17.9999 to +18.0000 or 00.0000 to 35.9999
Precision Dual Speed	-17.99999 to +18.00000 or 00.00000 to 35.99999

Characteristic	Description
Rotary -	
Single Speed	-179.9 to +180.0 or 000.0 to 359.9
Dual Speed	-179.999 to +180.000 or 000.000 to 359.999
Fine Speed	-179.9999 to +180.0000 or 000.0000 to 359.9999
Model 1885:	
Position Input -	Three separate analog inputs; accepts single-speed (1:1) or dual-speed (36:1, 1:1) data directly from size 15 or 23 synchros, or precision dual-speed data (1:1, 256:1) from the Encoder Processor/Inductosyn option. Also, one input accepts multi-axis synchro only data from Model 2013 Synchro Select unit. Possible input variations are: 1. Size 15 synchro, single speed, 50/60 Hz, 6V RMS. 2. Size 15 synchro, dual speed, 50/60 Hz, 6V RMS. 3. Size 23 synchro, single speed, 50/60 Hz, 90V RMS. 4. Size 23 synchro, dual speed, 50/60 Hz, 90V RMS. 5. Inductosyn® transducer, precision dual speed, with either 6V or 90V 1:1 synchro.
Serial Interface Port -	Two separate serial ports; each accepts data from Model 1886 Position Data Processor through RS-449 EIA Standard (RS-232C compatible) interface link.
Axis Select Input -	Single input; accepts DTL/TTL compatible positive (true) control logic data (1 = 5V, 0 = 0V).
Synchro Excitation Input -	Single input; accepts 115V ac, 50/60 Hz.

Characteristic	Description
Model 1885:	
Position Output -	Two separate byte or parallel digital outputs for use with Series 1580 Antenna Pattern Recorder and Model 2012 and Model 2012A Programmable Positioner Controller (or compatible). Output update rate of 2.5 MHz (400 nanoseconds) maximum.
IEEE-488 Interface -	ANSI/IEEE Standard (488-1978), IEEE Standard Digital Interface for programming instrumentation.
Axis Select Output -	Provides three TTL output signals for selecting desired axis; +5.0V (±5%) at 200 mA and +12V (±5%) at 500 mA.
Model 1886:	
Position Input -	Three separate analog inputs; accepts single-speed (1:1) or dual-speed (36:1, 1:1) data directly from size 15 or 23 synchros, or precision dual-speed data (1:1, 256:1) from the Encoder Processor/Inductosyn option. Also, one input accepts multi-axis synchro only data from Model 2013 Synchro Select unit. Possible input variations are: 1. Size 15 synchro, single speed, 50/60 Hz, 6V RMS. 2. Size 15 synchro, dual speed, 50/60 Hz, 6V RMS. 3. Size 23 synchro, single speed, 50/60 Hz, 90V RMS. 4. Size 23 synchro, dual speed, 50/60 Hz, 90V RMS. 5. Inductosyn® transducer, precision dual speed, with either 6V or 90V 1:1 synchro.
Synchro Excitation Input -	Accepts 115V ac, 50/60 Hz.
Serial Interface Port -	Two serial ports; one sends data to Model 1885 through RS-449 EIA Standard (RS-232C compatible) interface link.

Characteristic	Description
Dimensions: Model 1885 -	5.25"H x 17"W x 21"D (13.4 cmH x 43.6 cmW x 53.8 cmD) 19-inch rack mountable
Model 1886 -	5.25"H x 17"W x 21"D (13.4 cmH x 43.6 cmW x 53.8 cmD) 19-inch rack mountable
Power Requirements:	115V,6A/230V,3A ac ± 10%, 50/60 Hz ±5%, maximum
Weight: Model 1885 -	27 lbs. (13 kg)
Model 1886 -	27 lbs. (13 kg)
Operating Temperature Range: Model 1885 -	0°C to 50°C
Model 1886 -	0°C to 55°C

CHAPTER 2
INSTALLATION AND SETUP

2.1 UNPACKING AND INSPECTION

Carefully unpack the equipment and inspect for any damage possibly occurring in transit. If damage is evident, contact both the carrier and the nearest Scientific-Atlanta representative immediately. Be sure to save the packing materials and shipping papers as evidence for inspection by the carrier's representative. Do not return the equipment to Scientific-Atlanta without specific return shipment instructions.

The shipping cartons and packing material will also prove valuable should there ever be occasion to transport or ship the unit. The carton and internal pack are specifically designed for protecting the unit during transit.

An inventory checklist is provided in Section 2.2 for accessories supplied with your unit. Should an item be missing (or damaged) from the kit, contact your local Scientific-Atlanta representative for assistance.

2.2 ACCESSORIES SUPPLIED

Both the Model 1885 Digital Position Indicator and the optional Model 1886 Position Data Processor come complete with:

- Instruction Manual (Part No. 311665)
- Power Cord (Part No. 89672)
- Fuses: - 6.25A Slo Blo (Part No. 87843)
  - 3A Slo Blo (Part No. 71228)
  - .5A Slo Blo (Part No. 71217)
  - 1.5A Reg Blo (Part No. 71221)
- Rubber Feet (Part No. 172795)
- Extender Cards (Part No. 314856)
- Card Puller (Part No. 254439)
- Rack Mtg. Kit (Part No. 315473)

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2.3 SAFETY PRECAUTIONS

Observe the following list of safety precautions with the Model 1885 Digital Position Indicator (and Model 1886 Position Data Processor):

- This equipment contains potentially harmful voltages when connected to the designated power source, and/or to high-voltage position transducers. Never remove the covers except for maintenance or internal adjustments.

- Installation, maintenance, and/or service of this equipment should be performed only by Scientific-Atlanta trained personnel.

- To prevent shock or fire hazard, do not expose the equipment to rain or moisture. When using the Model 1886 Position Data Processor at a remote outdoor location, employ a weatherproof enclosure with proper ventilation for the internal cooling fan.

- Metal parts accessible to the operator are grounded to the ac power cord ground (third wire) to prevent shock or fire hazard from lightning and similar hazards. Note the following warning:

  WARNING

  THE AC POWER CORD GROUND (THIRD WIRE) MUST NOT BE REMOVED OR DEFEATED. MAKE AN APPROPRIATE POWER SYSTEM GROUND TO ENSURE THE ENCLOSURE IS AT GROUND POTENTIAL.

- Interfacing this equipment requires the use of high quality connectors and cables. Consult your Scientific-Atlanta representative for assistance in cable/connector selection.

- Protect external range cables (cables connected to the rear panel) against lightning by enclosing the cables in a grounded metal conduit. Additional lightning protection may be required for certain installations, particularly when employing remote configurations. Use a computer data line protector device (such as the Model CDP 42, made by General Semiconductor Industries, Inc.) for Serial I/O protection.

- Always operate the equipment within the specified voltage tolerances (±10%) and frequency tolerances (±5%).

- If external fuse replacement becomes necessary or line voltage alterations are required, refer to Figure 2.1. Before replacing a fuse, be sure the Power switch is in the "OFF" mode.

- Request only factory authorized parts for repair.

- Tampering with or making unauthorized modifications to the circuitry voids the warranty.

2.4 INSTALLATION PROCEDURES

2.4.1 Selecting the Proper Operating Voltage

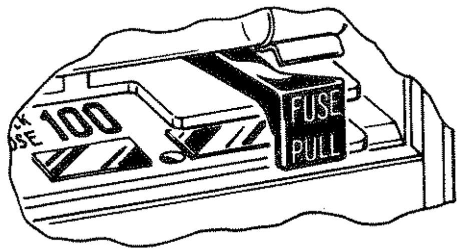
Before connecting the ac power cord to the rear panel connector (JFL1) of the Model 1885 and/or Model 1886, be sure the front panel POWER switch is in the OFF (down) position. Also be sure no other cables are attached to the rear panel connectors.

Measure the ac power at the source receptacle making certain it is compatible with the operating voltages of these units. The operating voltage has been factory selected and is marked for visual verification through the sliding plastic window adjacent to the power cord connector. If changes are necessary, follow the instructions in Figure 2.1. Be sure all fuse ratings agree with the selected voltage as shown in the following list:

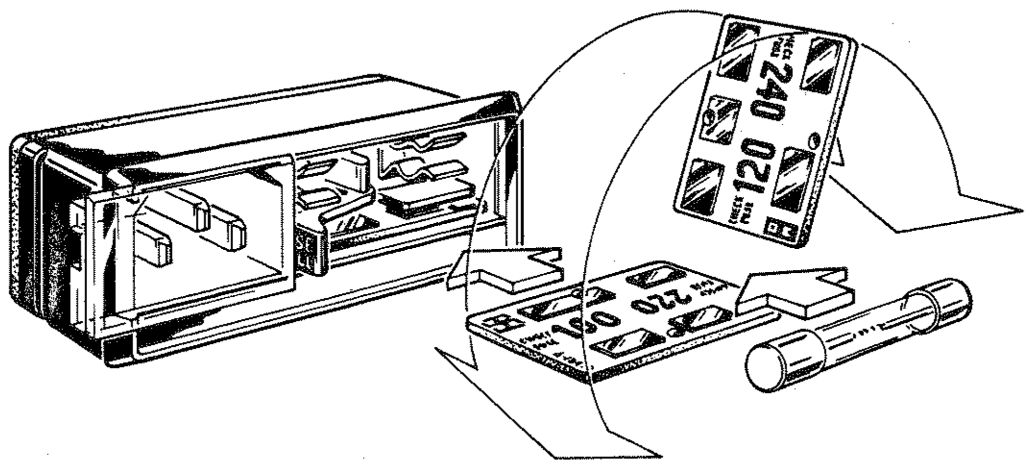
Model 1885/1886

- For 115V ac operation, select printed circuit card position 100 or 120 with a 6.25 Amp fuse.

- For 230V ac operation, select printed circuit card position 220 or 240 with a 3 Amp fuse.



Operating voltage is shown through the sliding plastic window.



HOW TO SELECT OPERATING VOLTAGE

1. Remove the ac power cord connector.
2. Slide the plastic window to the left.
3. Carefully operate FUSE PULL tab to the left.
4. Carefully remove both the fuse and printed circuit board. A small hole is provided to accommodate a wire pull if necessary.
5. Correctly orient the printed circuit board so the desired voltage is located on the top left side.
6. Carefully return the printed circuit board to the original location. Be sure it is securely seated.
7. Return FUSE PULL tab to the normal position.
8. Replace the original fuse with one selected for correct fuse value.

Illustrations courtesy of Corcom Corp., Chicago, Ill.

Figure 2.1. Selecting the Proper Operating Voltage

2.4.2 Suggested Interfacing Configurations

The Model 1885 and optional Model 1886 normally operate in a system with other external equipment. All interfacing is made through the rear panel connectors as shown in Figures 2.2 through 2.4. Figure 2.4 represents the general interfacing possibilities. More detailed system diagrams appear in Sections 2.4.2.1 and 2.4.2.2.

Suggested interfacing configurations in this section describe the majority of possible methods of interfacing the Model 1885 and Model 1886 to external system equipment. Even though only Scientific-Atlanta equipment is shown and recommended, other manufacturers' products may be compatible with the Model 1885/1886 depending primarily on their interfacing connector schemes. Consult Section 2.4.4 for detailed information on the Model 1885/1886 rear panel connectors and cables.

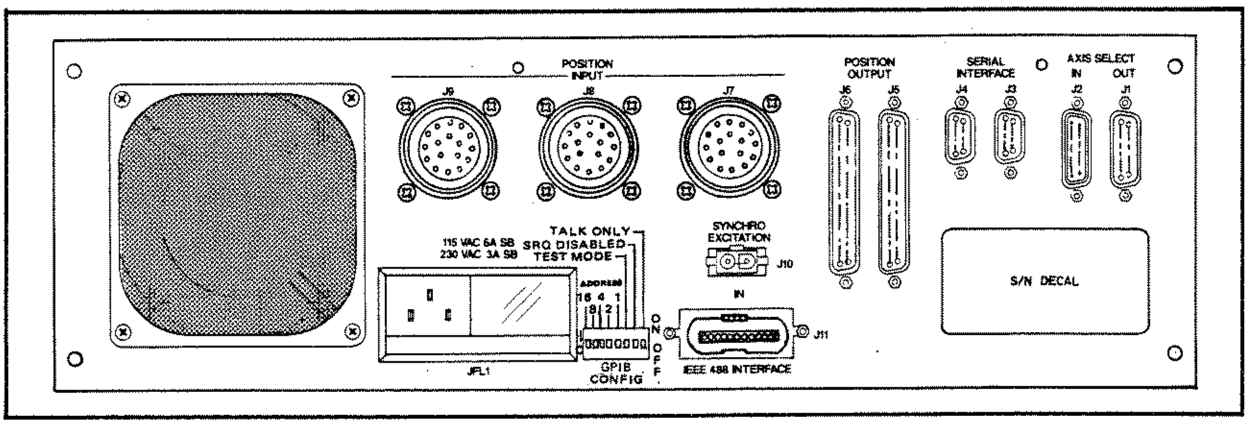


Figure 2.2. Model 1885 Digital Position Indicator Rear Panel

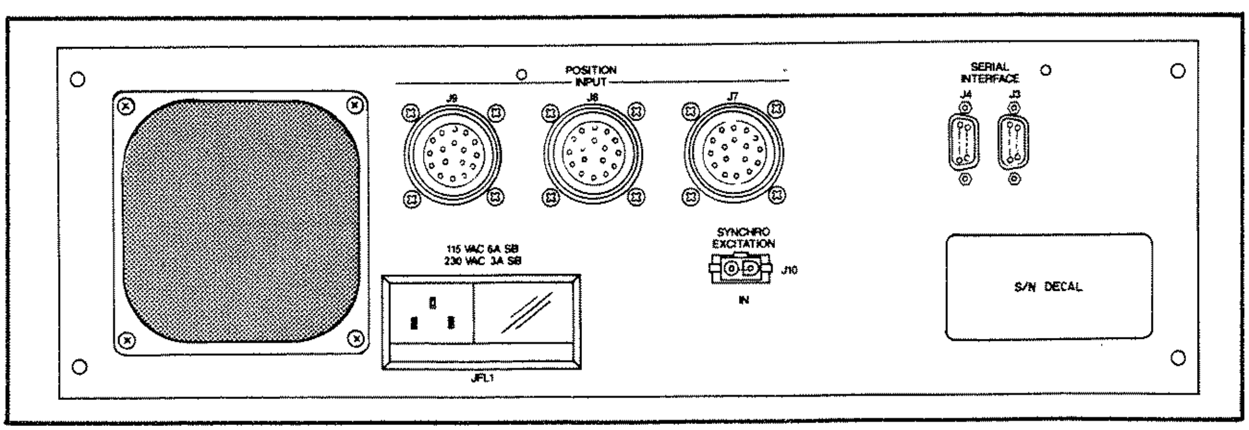


Figure 2.3. Model 1886 Position Data Processor Rear Panel

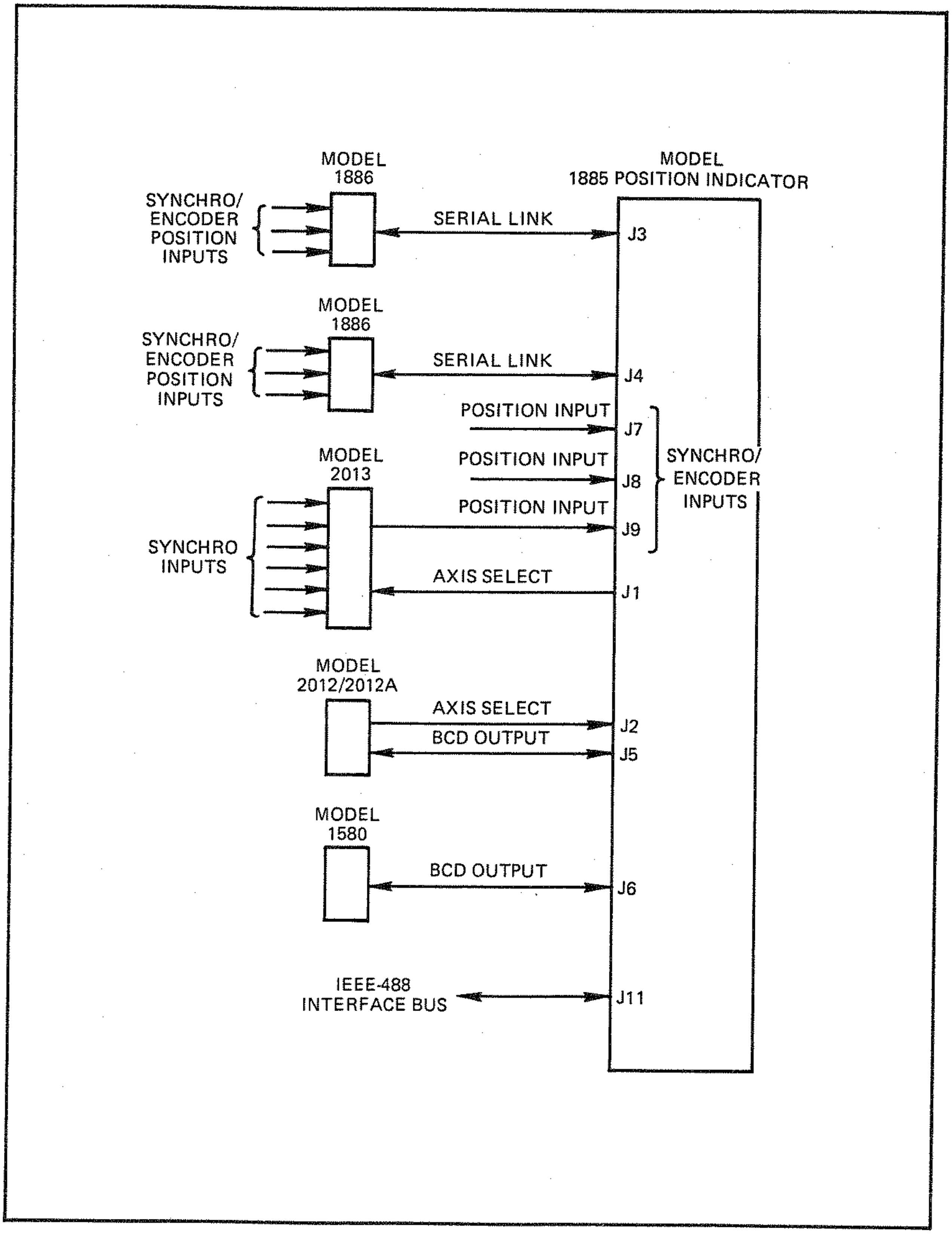


Figure 2.4. General Interfacing Possibilities

2.4.2.1 Configuration No.1

In this configuration (Figure 2.5), two unique positioner systems are located near the Model 1885 Display. A Synchro Select unit accepts three axes of position data (axes A and B from Positioner 1 and axis E from Positioner 2). The Synchro Select unit sends position data for a particular axis, as determined by the Model 1885 Axis Select Output, to the Model 1885. The Model 1885 also receives 2 axes of position data (axes C and D) directly from Positioner 2.

2.4.2.2 Configuration No.2

In this configuration (Figure 2.6), single-axis Positioner 1 (and optional Model 1886) is located down-range from five-axis Positioner 2 and the Model 1885/1886 combination. The two optional Model 1886 units each serve different purposes in this system. The Remote Model 1886 is used primarily to extend the range by way of a serial link, while the local Model 1886 simply serves to increase the number of local axis inputs beyond the three provided by the Model 1885.

2.4.3 Proper Placement and Mounting

The Model 1885 is specifically designed for standard 19-inch rack mounting. Additionally, it can be self-supporting when installed in a 5.25-inch cabinet (Scientific-Atlanta Model 2256-5) and placed atop a secure flat surface, or stacked above another unit comparable in size and shape.

The optional Model 1886 Position Data Processor also mounts in a 19-inch rack configuration or in a weatherproof cabinet for remote applications.

When operating the optional Model 1886 remotely, place it near the antenna positioner in a weatherproof enclosure. In this manner, the Model 1886 accepts position data from the antenna positioner, digitizes the data, and sends it down a serial link to the Model 1885. Possible serial links

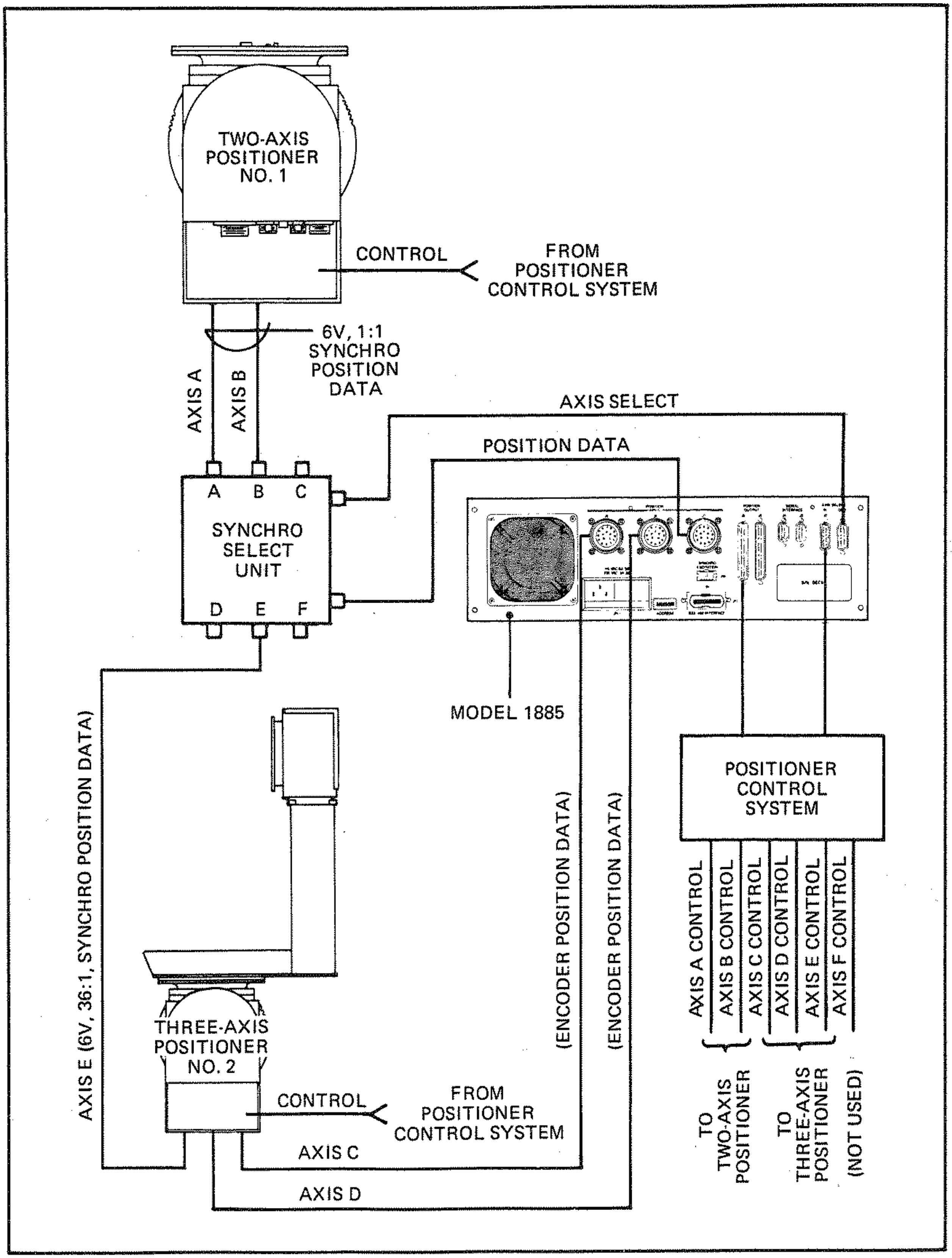


Figure 2.5. Typical Model 1885 System Hook-Up Configuration

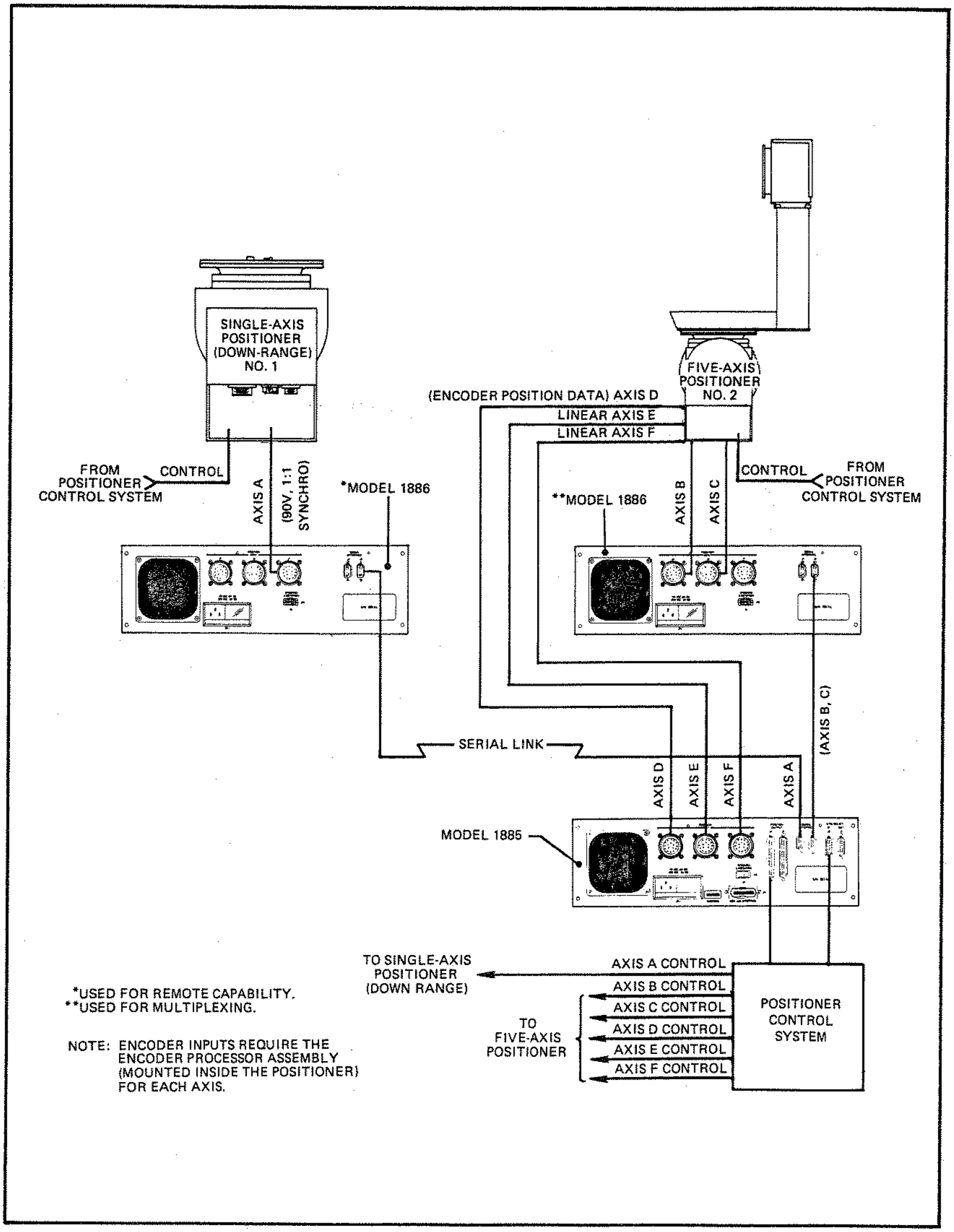


Figure 2.6. Typical Model 1885 with Optional Model 1886 System Hook-Up Configuration

include cables, phone lines, fiber optic lines, or any other RS-232C/RS-449 compatible medium. Figure 2.7 shows a typical remote application using both the Model 1885 and the Model 1886.

Be sure to observe the related Safety Precautions listed in Section 2.3 when mounting these units. Also provide proper ventilation to the rear panel cooling fan intake vents by making sure they are not blocked.

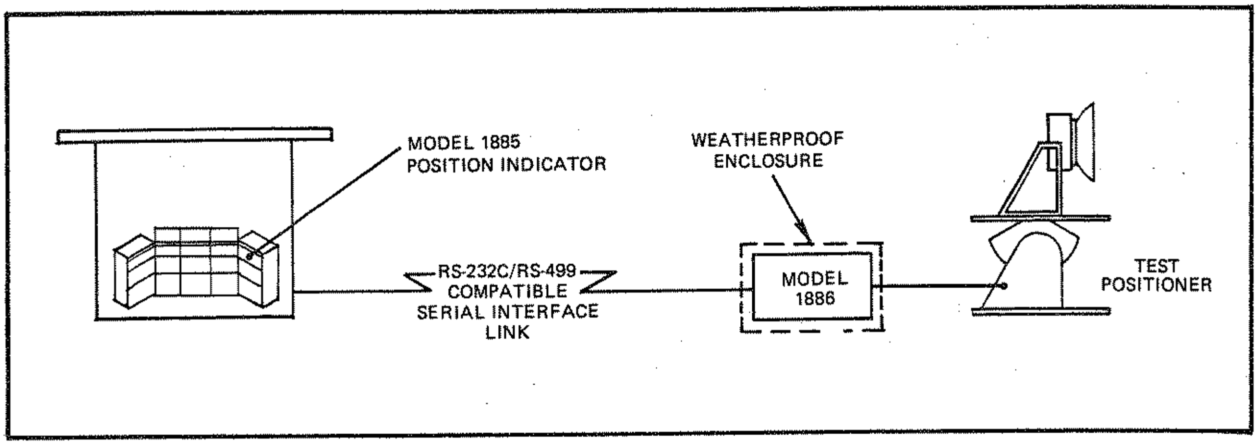


Figure 2.7. A Typical Remote Configuration for the Model 1885 and Model 1886

2.4.4 Detailed Connection Information

2.4.4.1 Position Input Connectors (Model 1885 and Model 1886)

Model 1885 and Model 1886 Position Input connectors J7, J8 and J9 accept any one of three different speeds of position data depending on the type of position transducer. These three speeds are:

- Single Speed (1:1)
- Dual Speed (1:1, 36:1)
- Precision Dual Speed (1:1, 256:1).

Table 2.1 gives the Position Input connector details, while Figure 2.8 shows details of the cables used between the Model 1885/Model 1886 and various speed position transducers.

Table 2.1
J7, J8, and J9 Connector Details

Reference: J7, J8, J9
Title: Position Input

Connector J7:

Pin	Description	Pin	Description
A	S1A1 Synchro Stator Outputs	J	GND
B	S3A1	K	ECKA + Encoder Processor
C	S1A36	L	ECKA - Clock
D	S3A36	M	ECK SHIELD
E	SDA + Serial Data From Encoder Processor	N	S2 Synchro Common
		P	S2 Synchro Common
		R	SDA - Serial Data From Encoder Processor
F	SDA SHIELD		
G	R2A Synchro Rotor Excitation	S	+12A DC Power to Encoder Processor
H	R1A	T	-12A

Connector J8:

Pin	Description	Pin	Description
A	S1B1 Synchro Stator Outputs	J	GND
B	S3B1	K	ECKB + Encoder Processor
C	S1B36	L	ECKB - Clock
D	S3B36	M	ECK SHIELD
E	SDB + Serial Data from Encoder Processor	N	S2 Synchro Common
		P	S2 Synchro Common
F	SDB SHIELD	R	SDB - Serial Data from Encoder Processor
G	R2B Synchro Rotor Excitation		
H	R1B	S	+12B DC Power to Encoder Processor
		T	-12B

Connector J9:

Pin	Description	Pin	Description
A	S1C1 Synchro Stator Outputs	J	GND
B	S3C1	K	ECKC + Encoder Processor
C	S1C36	L	ECKC - Clock
D	S3C36	M	ECK SHIELD
E	SDC + Serial Data from Encoder Processor	N	S2 Synchro Common
		P	S2 Synchro Common
F	SDC SHIELD	R	SDC - Serial Data from Encoder Processor
G	R2C Synchro Rotor Excitation		
H	R1C	S	+12C DC Power to Encoder Processor
		T	-12C

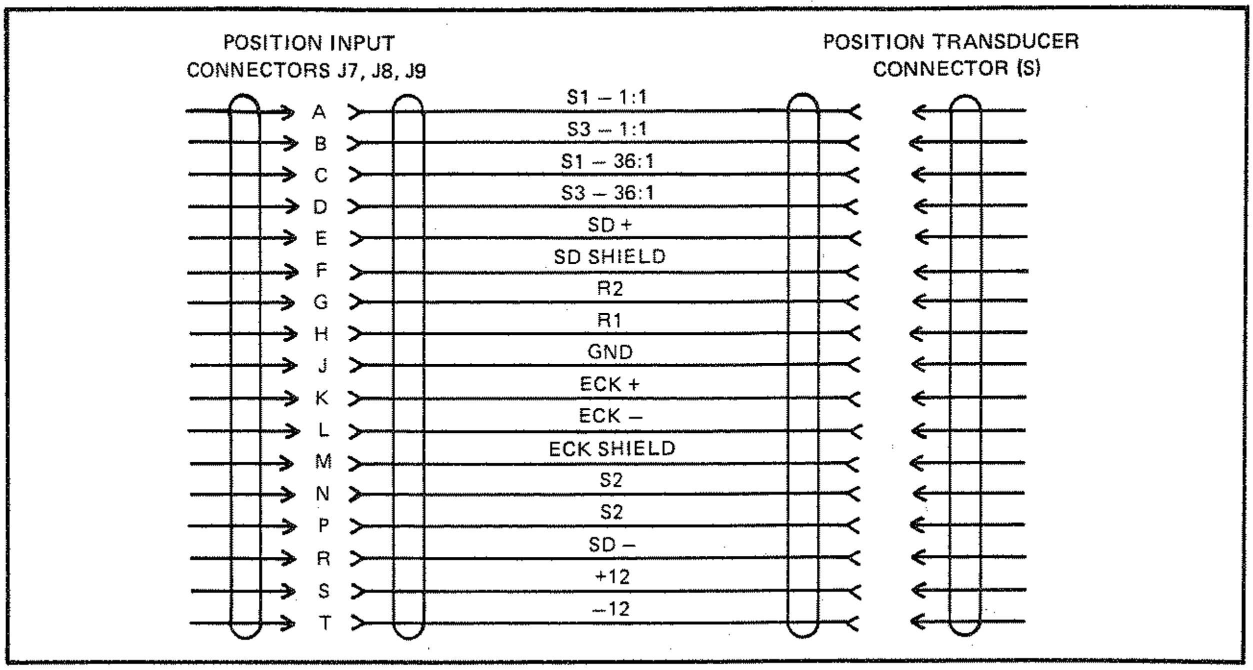


Figure 2.8. Details Of Cable Used Between the Model 1885/ Model 1886 Position Inputs and Position Transducer

2.4.4.2 Position Output Connectors (Model 1885)

Model 1885 Position Output connectors J5 and J6 provide digital output position data for the following Scientific-Atlanta (or equivalent) equipment:

- Series 1580 Antenna Pattern Recorder
- Model 2012 Positioner Programmer
- Model 2012A Programmable Positioner Controller

Table 2.2 gives the Position Output connector details, while Figures 2.9 and 2.10 show details of the cables used between the Model 1885 and various external equipment.

Table 2.2
J5 and J6 Connector Details

Title: Position Output
Reference: J5 and J6

Pin	Description	Pin	Description
1	BYTE SEL 1-	20	BYTE SEL 2-
2	BYTE SEL 3-	21	BYTE SEL 4-
3	INHIBIT-	22	UPDATE
4	EXT. TRIG-	23	POS CTRLR (2012)
5	GND	24	RANGE
6	SIGN (+ = high)	25	200
7	100	26	80
8	40	27	20
9	10	28	8
10	4	29	2
11	1	30	0.8
12	0.4	31	0.2
13	0.1	32	0.08
14	0.04	33	0.02
15	0.01	34	.008
16	.004	35	.002
17	.001	36	.0008
18	.0004	37	.0002
19	.0001		

Additional J5 and J6 Details:

Pin	Name	Description
1	BYTE SEL 1 -	Active Low Enable input for Byte 1 (RANGE, SIGN, 200, 100)
20	BYTE SEL 2 -	Active Low Enable input for Byte 2 (80, 40, 20, 10, 8, 4, 2, 1)
2	BYTE SEL 3 -	Active Low Enable input for Byte 3 (0.8, 0.4, 0.2, 0.1, 0.08, 0.04, 0.02, 0.01)
21	BYTE SEL 4 -	Active Low Enable input for Byte 4 (0.008, 0.004, 0.002, 0.001, 0.0008, 0.0004, 0.0002, 0.0001)
3	INHIBIT -	Active Low input; prevents update of output data; output data becomes valid within 100 nseconds after this signal goes low, and remains stable until this signal goes high.

Additional J5 and J6 Details: - continued

Pin	Name	Description
22	UPDATE	Output which provides present state of the output latches; goes low for 200 nseconds when the output latches are being updated and returns high, and remains high while the data from the output latches is valid.
4	EXT TRIG-	Active Low External Trigger input; output data becomes valid within 285 nseconds after this signal goes low. This pulse must be greater than 22 nseconds and be less than 200 nseconds wide.
23	POS CTRLR (2012)	Active Low Input Signal; identifies this output port as being connected to a position controller (such as a Model 2012, 2012A); forces this output to always contain data for the "selected" axis for added safety.
5	GND	Provides Signal Common.
24	RANGE	Output Signal; high for bipolar and low for unipolar ranges.
6	SIGN	Output Signal; high for positive output data and low for negative data.
7-19 25-37	200-0.0001	Output Data Lines; high impedance unless enabled by the Byte Select inputs.

2.4.4.3 Serial Interface Input Connectors (Model 1885)

Model 1885 Serial Interface Input connectors J3 and J4 accept serial position data from the optional Model 1886 Position Data Processor through various RS-232C or RS-449 compatible interfacing methods (must meet EIA Standards). A common method is direct connection through an RS-422 interface cable. However, indirect connection through Data Communications Equipment (or DCE) such as a modem, fiber optic link or microwave link is allowed. Additional considerations for selecting the proper DCE are provided in Section 4.2.3.

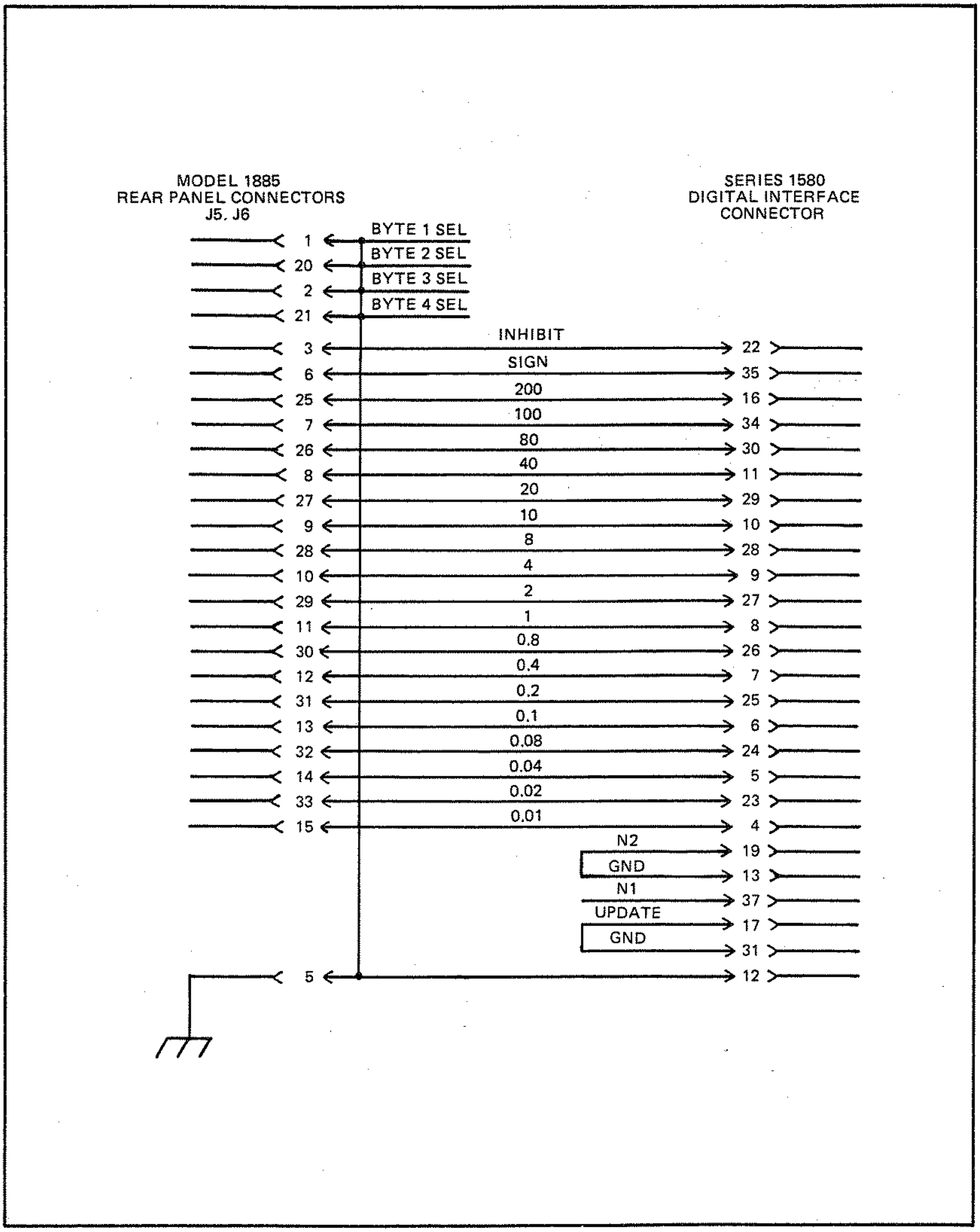


Figure 2.9. Details Of Cable Used Between Model 1885 Position Outputs and the Series 1580 Antenna Pattern Recorder (Parallel BCD-Type Output)

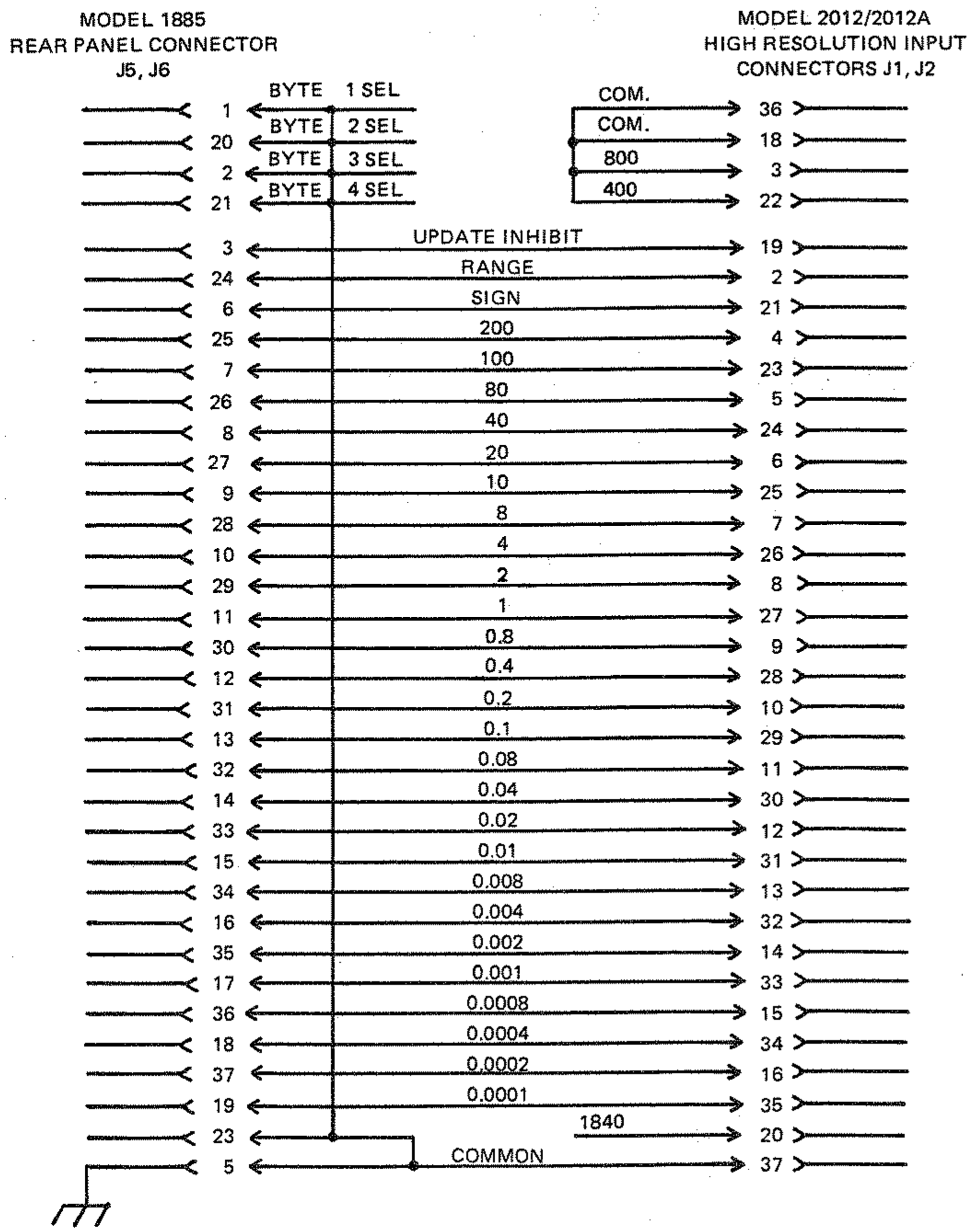


Figure 2.10. Details Of Cable Used Between the Model 1885 and the Model 2012/2012A Programmable Positioner Controller

Table 2.3 gives the Serial Interface Input connector details with recommended interfacing standards, while Figures 2.11 through 2.14 show details of various cables used between the Model 1885 and the DCE and/or Model 1886.

Table 2.3
J3 and J4 Connector Details

Reference: J3 and J4
Title: Serial Interface Inputs

			RS-449 Signals		
Pin	Signal	RS-232C Signals	RS-423 Type DT	RS-423 (With CS,RS)	RS-422 Type DT
1	Shield	AB	Shield	Shield	Shield
2	Request to Send (RTS)	*CA	-	RS	-
3	Balanced Transmit Data (BTXD)	-	-	-	SD+
4	RCV Data (RXD)	BB	RD+	RD	RD+
5	Ground - SG	AA	SG/SD-	SG/SC/SD/RS	SG
6	RCV Common (RXC)		RD-	RC/RD/CS	RD-
7	Unbalanced Transmit Data (UTXD)	BA	SD+	SD	-
8	Clear to Send (CTS)	*CB	-	CS	-
9	Balanced TX Common (TXC)	-	-	-	SD-

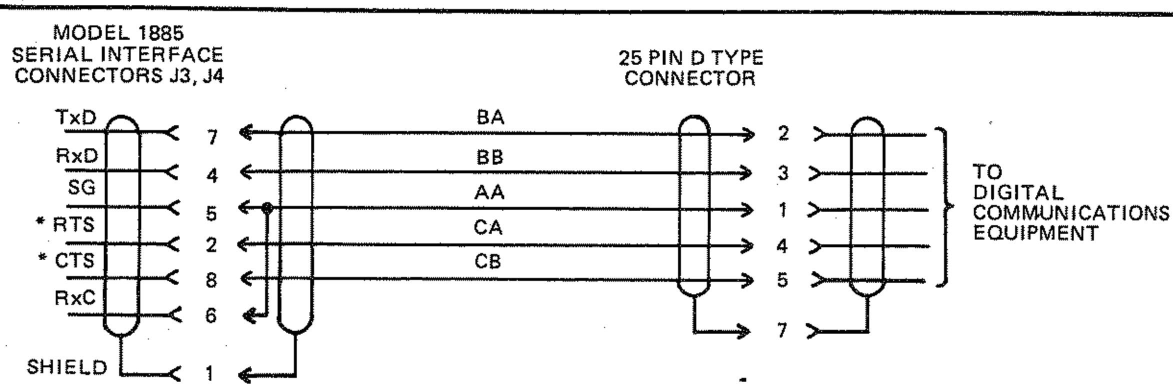
*** Indicates optional signal; varies with DCE type**

NOTE

These cables may contain shields. Shield is normally grounded in the Model 1886 through a switch on its Rear Panel Interface Assembly. This switch is open on the Model 1885 when the two units are connected directly.

2.4.4.4 Axis Select Input Connector (Model 1885)

Model 1885 Axis Select Input connector, J2, accepts DTL/TTL compatible control logic data from the Model 2012A Programmable Positioner Controller (or equivalent).



NOTE

Pin 1 of J3 and J4 is internally jumpered to ground (when appropriate) on the Model 1885/Model 1886 Rear Panel Interface Assembly

* designates optional (Model 1886 may be configured to use the signal for power control; see Section 2.4.6.5).

Figure 2.11. Details Of Cable Used Between the Model 1885 and the DCE with an RS-232C Type Interface

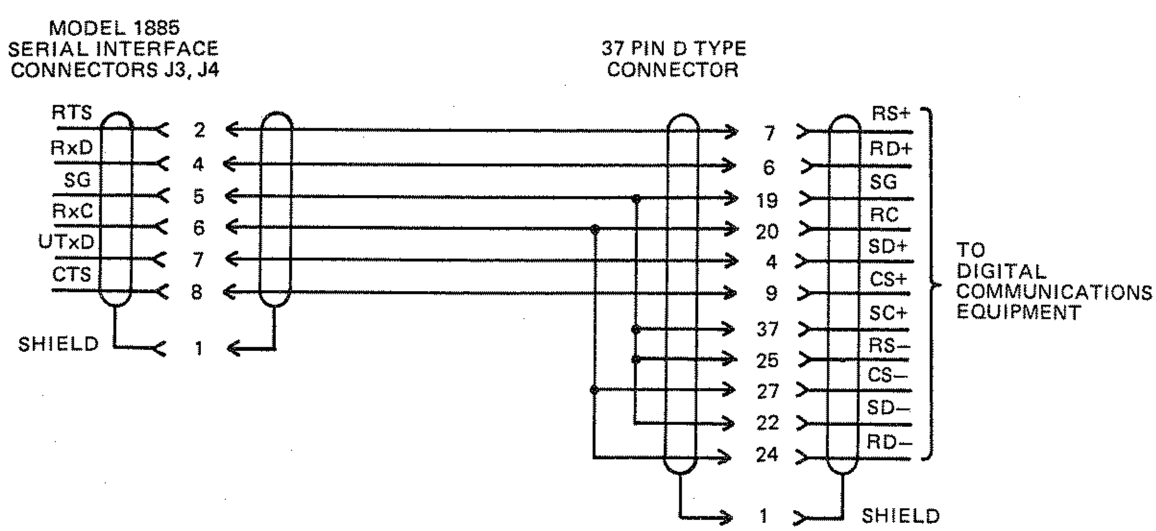


Figure 2.12. Details Of Cable Used Between the Model 1885 and the DCE with an RS-449 with RS, CS (with RS-423 Electrical Spec) Interface

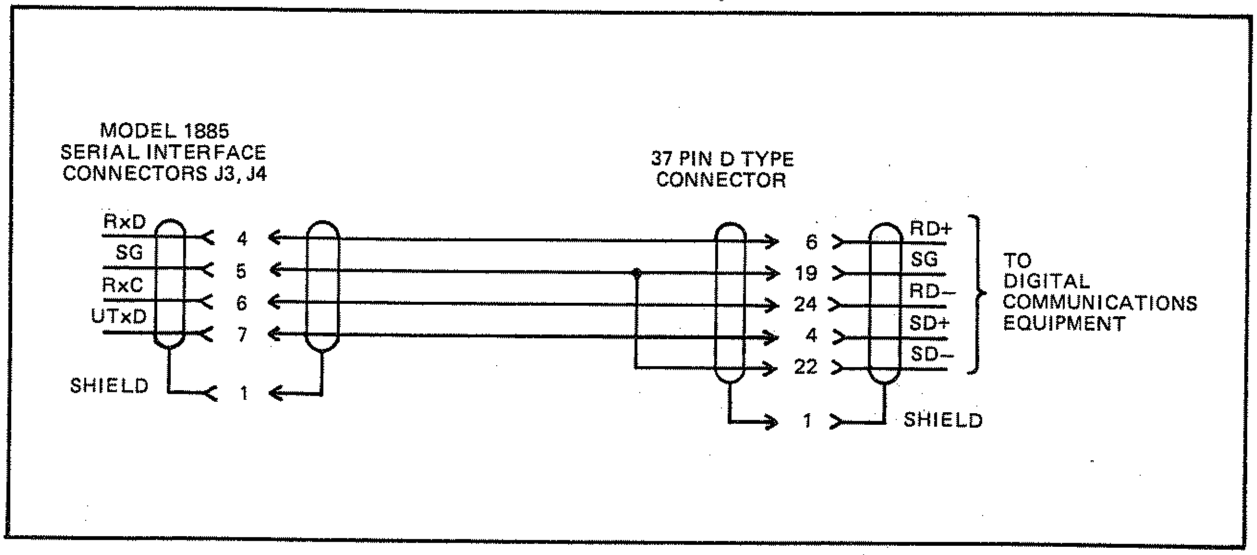


Figure 2.13. Details Of Cable Used Between the Model 1885 and the DCE with an RS-449 Type DT (with RS-432 Interface

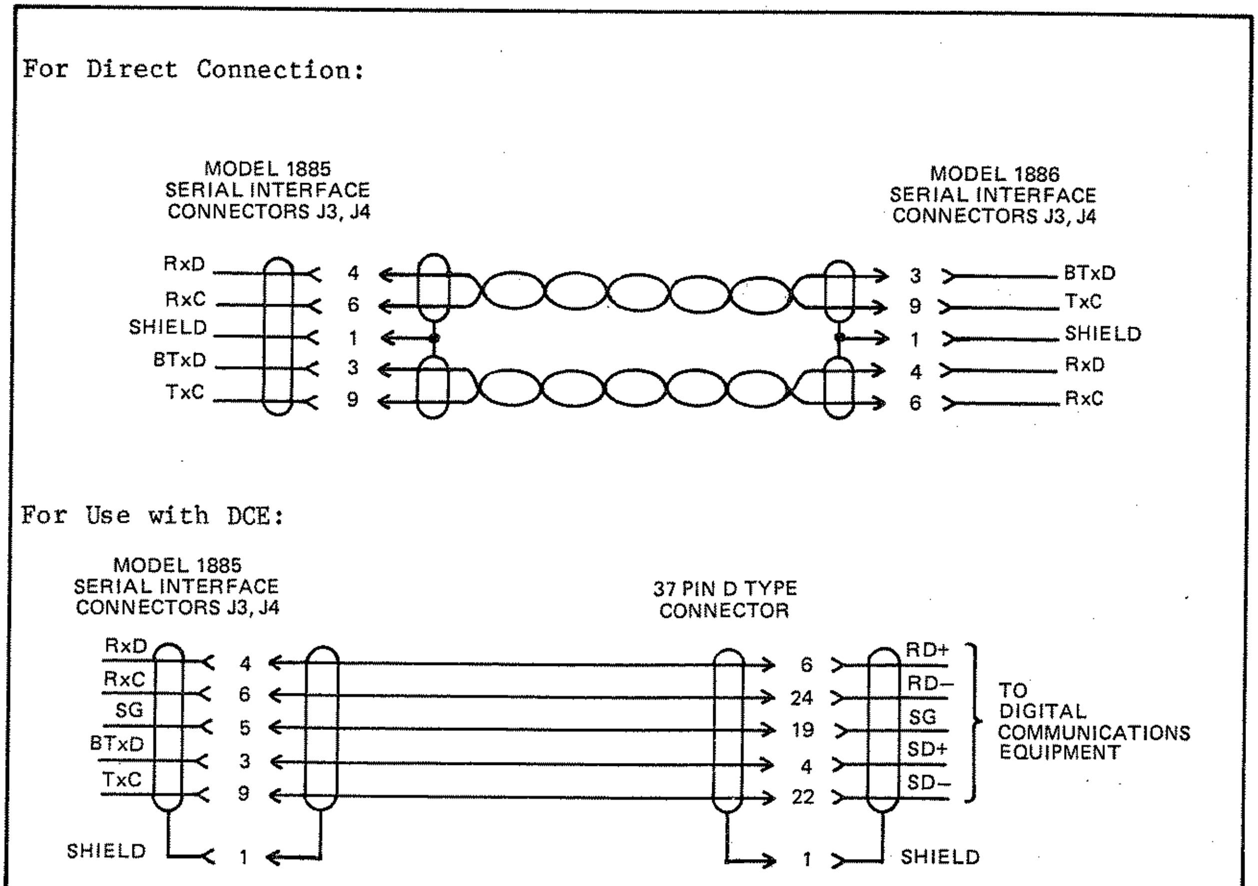


Figure 2.14. Details Of Cable Used Between the Model 1885 and the Model 1886 or DCE with an RS-449 Type DT (with RS-422) Interface

Table 2.4 gives the Axis Select Input connector details, while Figure 2.15 shows details of the cable used between the Model 1885 and the Model 2012A.

Table 2.4
J2 Connector Details

Reference: J2 Title: Axis Select Input					
Pin	**Description**				
1	+12V				
2	+5V				
6	Select A	Axis Select Truth Table			
		Select A	B	C	Selected Axis
5	Select B	0	0	0	None
		1	0	0	A
		0	1	0	B
		1	1	0	C
		0	0	1	D
		1	0	1	E
		0	1	1	F
4	Select C	1	1	1	None
9-15		GND			

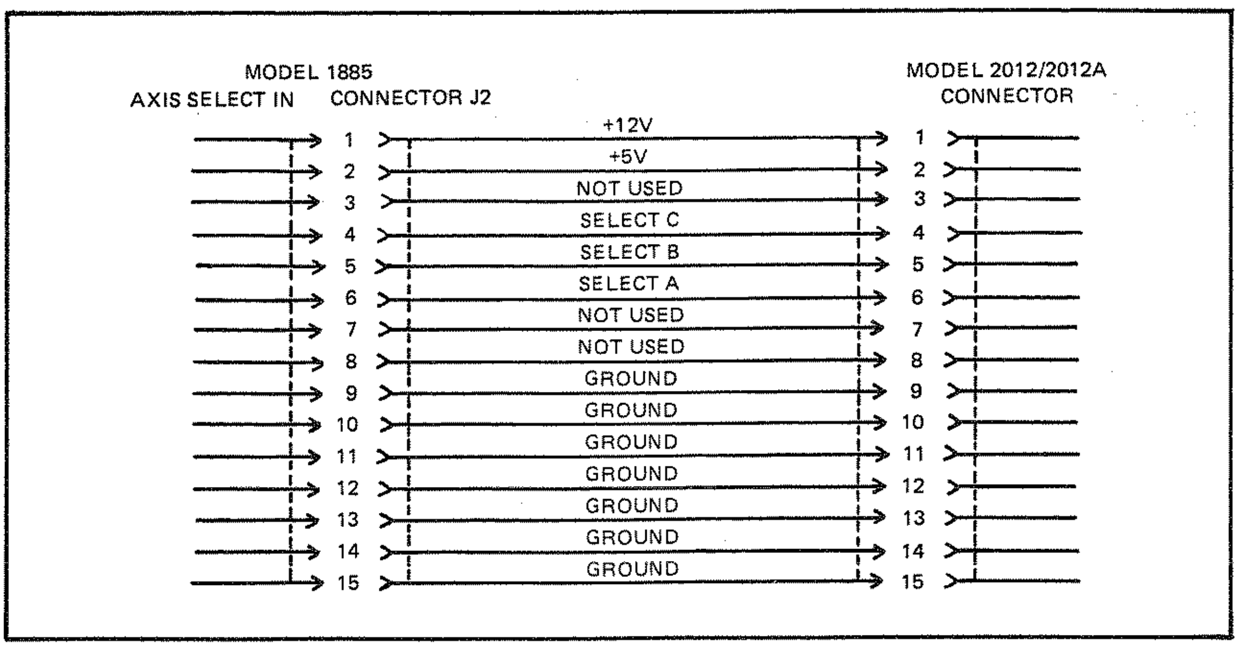


Figure 2.15. Details Of Cable Used Between the Model 1885 Axis Select Input and the Model 2012A

2.4.4.5 Axis Select Output Connector (Model 1885)

The Model 1885 Axis Select Output connector, J1, provides a three-bit TTL-type output signal for choosing a desired axis from the Model 2013 Synchro Select unit (or equivalent unit).

Table 2.5 gives the Axis Select Output connector details, while Figure 2.16 shows details of the cable used between the Model 1885 and the Model 2013.

Table 2.5
J1 Connector Details

<table>
<tr><td colspan="4">Reference: J1
Title: Axis Select Output</td></tr>
<tr><td>Pin</td><td colspan="3">Description</td></tr>
<tr><td>1</td><td colspan="3">+12V</td></tr>
<tr><td>2</td><td colspan="3">+5V</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Select A</td><td colspan="2">Axis Select
Truth Table</td></tr>
<tr><td>Select
A B C</td><td>Selected
Axis</td></tr>
<tr><td rowspan="7">5</td><td rowspan="7">Select B</td><td>0 0 0</td><td>None</td></tr>
<tr><td>1 0 0</td><td>A</td></tr>
<tr><td>0 1 0</td><td>B</td></tr>
<tr><td>1 1 0</td><td>C</td></tr>
<tr><td>0 0 1</td><td>D</td></tr>
<tr><td>1 0 1</td><td>E</td></tr>
<tr><td>0 1 1</td><td>F</td></tr>
<tr><td>4</td><td>Select C</td><td>1 1 1</td><td>None</td></tr>
<tr><td>9-15</td><td></td><td>GND</td><td></td></tr>
</table>

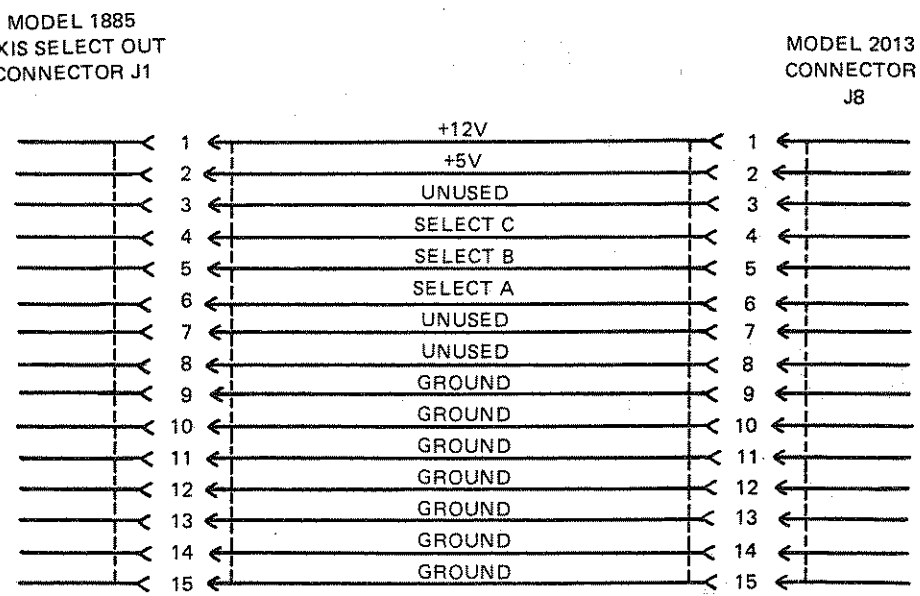


Figure 2.16. Details Of Cable Used Between the Model 1885 and the Model 2013 Synchro Select Unit

2.4.4.6 Synchro Excitation Connector (Model 1885)

The Model 1885 Synchro Source connector, J10, accepts external synchro 115V ac rotor excitation voltage.

Table 2.6 gives the Synchro Excitation connector details, while Figure 2.17 shows details of the cable used between the Model 1885 and an external voltage source--in this case a Scientific-Atlanta Series 4180 Positioner Control unit.

Table 2.6
J10 Connector Details

Reference: J10 Title: Synchro Excitation Input	
Pin	**Description**
1	AC Hot
2	AC Common (Neutral)

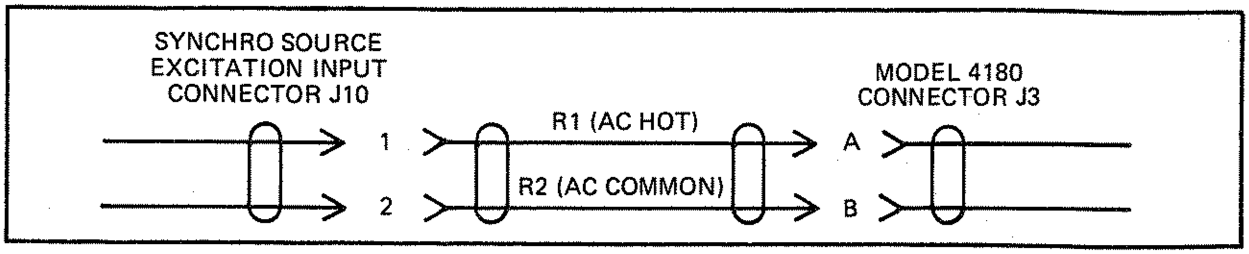


Figure 2.17. Details Of the Cable Used Between the Model 1885 Synchro Source Input Connector and Series 4180

2.4.4.7 IEEE-488 Interface Connector (Model 1885)

The Model 1885 IEEE-488 Interface connector, J11, provides a standard digital interface for automatic control of front panel functions through a controller device.

Table 2.7 gives the IEEE-488 Interface connector details, while Figure 2.18 shows details of the cable used between the Model 1885 and controller.

Table 2.7
J11 Connector Details

Reference: J11
Title: IEEE-488 Interface

Pin	Description	Pin	Description	Pin	Description
1	DIO 1	9	IFC	17	REN
2	DIO 2	10	SRQ	18	GND
3	DIO 3	11	ATN	19	GND
4	DIO 4	12	SHIELD	20	GND
5	EOI	13	DIO 5	21	GND
6	DAV	14	DIO 6	22	GND
7	NRFD	15	DIO 7	23	GND
8	NDAC	16	DIO 8	24	GND (Logic)

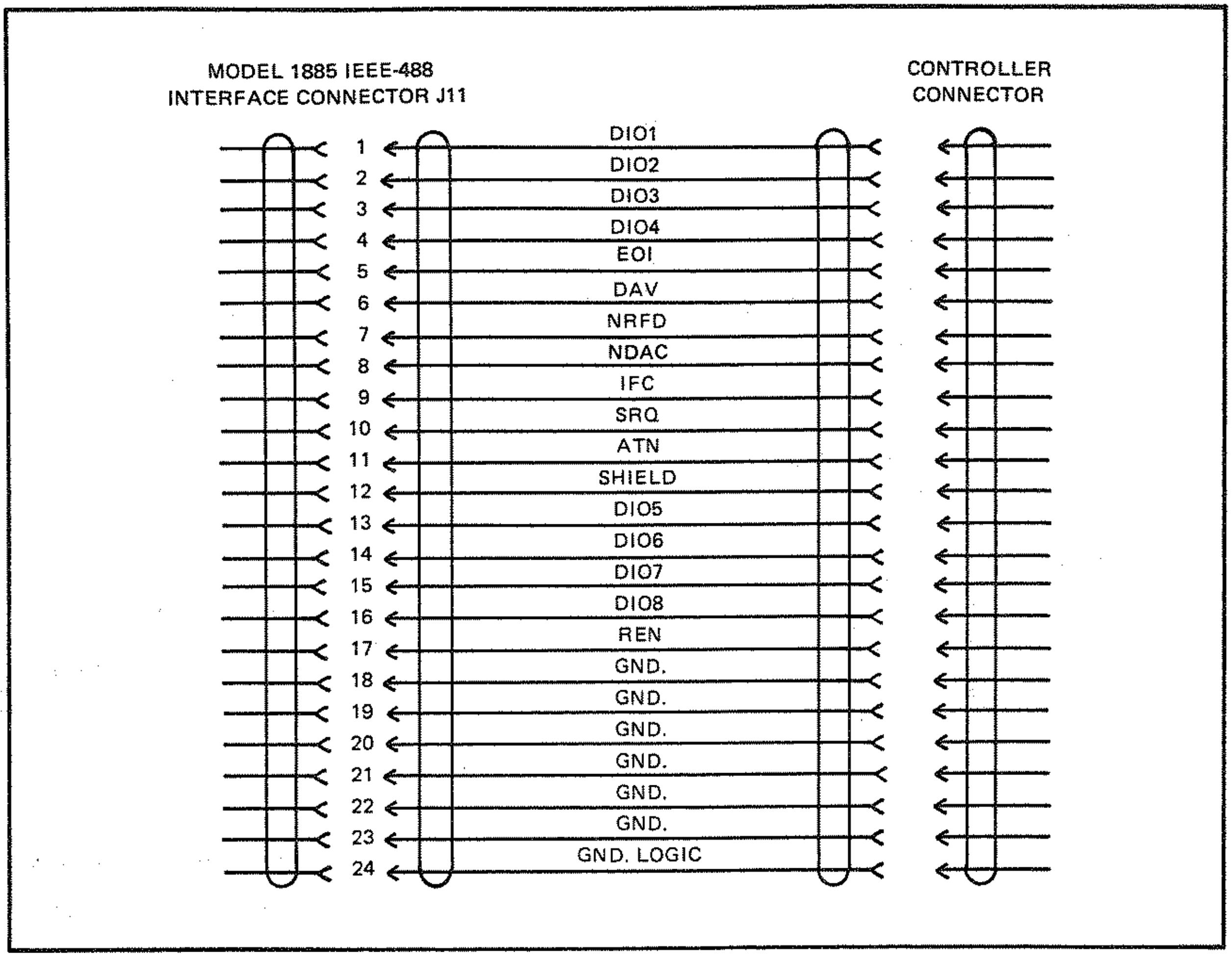


Figure 2.18. Details Of the Cable Used Between the Model 1885 IEEE-488 Interface Connector and a Computer/Controller

2.4.5 Setup Mode Procedures

Before operating the Model 1885 under actual test conditions, several preliminary setup procedures must be performed. These procedures are implemented in a special mode of operation--the Setup Mode. Setup Mode permits selection and entry of:

- the range of Position Display data for each axis (linear or rotary)
- input connector for each axis
- a unique alphanumeric label for the Axis Identification Display of each input axis.

As an aid to understanding Setup Mode, refer to the front panel control explanation (specifically for Setup Mode) shown in Figure 2.19 and described in Table 2.8. Also refer to Suggested Interfacing Configurations, Section 2.4.2.

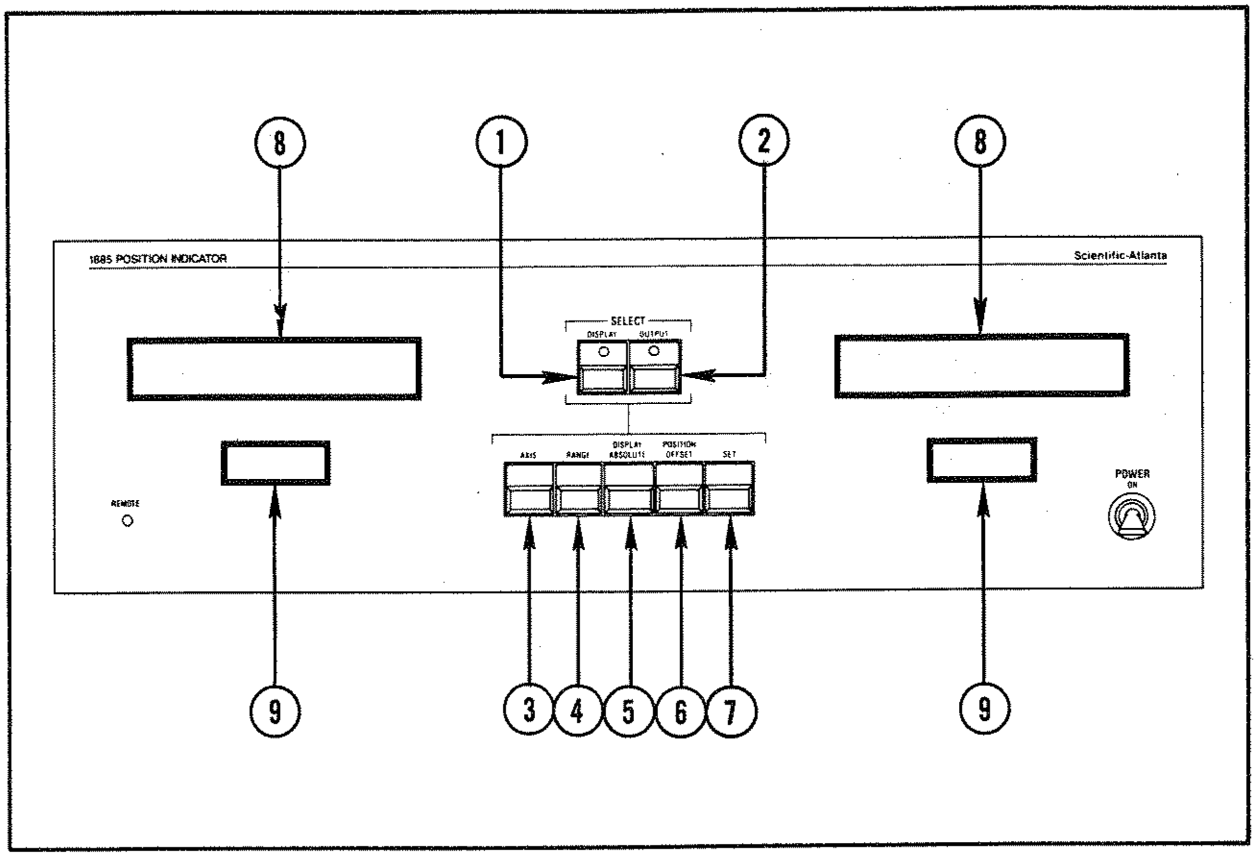


Figure 2.19. Model 1885 Front Panel Controls

Table 2.8
Front Panel Control Operation in Setup Mode

Pushbutton Label	Function
1. DISPLAY (SELECT)	Exit Setup Mode
2. OUTPUT (SELECT)	Exit Setup Mode
3. AXIS	When pressed with SET simultaneously, activates the Setup Mode. In Setup Mode, advances setup to the next axis
4. RANGE	Shifts cursor position to the left.
5. DISPLAY ABSOLUTE	Shifts cursor position to the right.
6. POSITION OFFSET	Cycles in a backward direction through allowable values for the cursor position.
7. SET	Cycles in a forward direction through allowable values for the cursor position.
8. POSITION DISPLAY	Shows the axis designator, range, input source, and precision.
9. AXIS IDENTIFICATION DISPLAY	Shows the axis label.

NOTE

- Pressing and holding the pushbuttons described in Table 2.8 repeats the operation at a rate of about 10 times per second.
- If error messages appear on the front panel display, refer to Section 3.1.4.

2.4.5.1 How to Enter Setup Mode

1. Apply ac power to the Model 1885 by moving the POWER toggle switch to the ON (or up) position and observe the following sequence of events if the unit is functioning properly:

   - the internal cooling fan begins operating
   - a lamp test begins on the Position displays for verifying proper operation of each display segment.

In addition, each LED indicator (DISPLAY, OUTPUT, and REMOTE) illuminates to verify proper operation. This process lasts about two seconds.

- Assuming Setup Mode procedures have not yet been completed, the message "SETUP REQUIRED" appears on the Axis Identification displays.

2. Press AXIS and SET pushbuttons simultaneously. The left Position Display and the Axis Identification Display show default messages (right displays are blank).

3. Note the default message of the Position Display; it consists of an eight-character alphanumeric display arranged as shown here:

	A	A	J	0	–	7	E
(X_1	X_2	$X3$	X_4	X_5	X_6	X_7	X_8)

where:

X_1 = blank

X_2 = Axis designator; possible values are A, b, C, d, E, or F

X_3 = Angular/Linear range indicator: A or L

Input Source Code: (input connector designation or "none")

X_4 = Model 1885 Input connector prefix: J

X_5 = Model 1885 Input connector number: 0, 3, 4, 7, 8, or 9. A value of zero indicates the axis is not used.

X_6 = Dash indicates additional input information follows.

X_7 =
- If X_5 is 3 or 4, then X_7 is the Model 1886 Input connector number 7, 8, or 9.
- If X_5 is 7, 8, or 9, X_7 is b (2013, blank), H (2013, hold) or 0 (direct input).

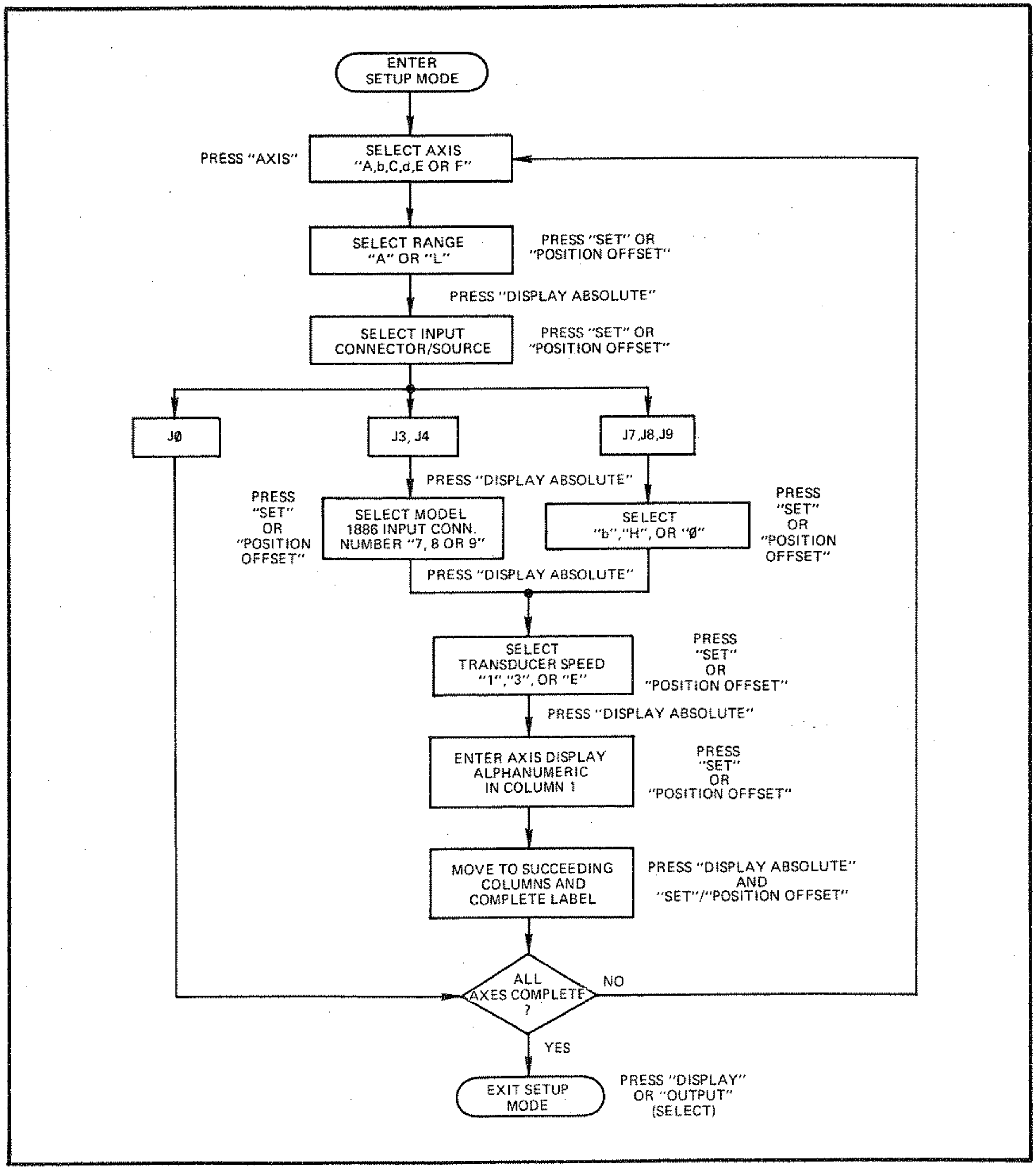
X_8 = Input Precision: possible values are 1 (1:1), 3 (36:1), and E (256:1 encoder).

2.4.5.2 How to Perform Setup Procedures

This section describes how to enter Setup Mode data for both general and specific system configurations. In Section 2.4.5.2.1 a quick-reference flow chart provides step-by-step procedures for general setup. Section 2.4.5.2.2

and 2.4.5.2.3, however, provide more specific instructions and apply to the configurations shown earlier (Section 2.4.2) in Figures 2.6 and 2.7. We recommend thoroughly reading all of the following explanations and then choosing one of the examples as a guide for setting up your specific configuration.

2.4.5.2.1 Setup Mode Flow Chart (for general set up)



2.4.5.2.2 Example #1 (Refer to Figure 2.5)

1. Choose the first axis you wish to set up--A, b, C, d, E, or F (these axis designators correspond with those of the positioner control system). Axis A is the logical axis to begin with since its setup values are displayed when you first enter the setup mode. To choose an axis other than A, press AXIS repeatedly until the desired designator is displayed. The AXIS shown will follow the sequence A, b, C, d, E, F, A, b and so on. Assuming you chose axis A, observe the following Position Display default message:

```
A   A   J   0   -   7   E
```

2. Enter the range (either angular or linear) for Axis A by pressing SET or POSITION OFFSET. Note the alternating sequence of "A" and "L" in display column X_3.

3. In this configuration, leave "A" on the display. Press DISPLAY ABSOLUTE once. The Position Display shows this message:

```
A   A   J   0   -   7   E
```

4. Select the rear panel input connector where axis A enters the Model 1885. In this configuration, axis A enters by way of the Synchro Select unit at connector J7. Go through the various rear panel connector choices by pressing SET (forward cycle) or POSITION OFFSET (reverse cycle) in successive steps--J3, J4, J7, J8, J9, J0, J3, J4. J3 and J4 are Serial Interface Inputs, accepting data only from an optional Model 1886. Position Inputs J7, J8, and J9 accept synchro transmitter and encoder transducer data. J0 indicates the currently displayed axis is not used, and eliminates this axis from the axis sequence during normal operation. Leave J7 flashing in this column and observe this message on the Position Display:

```
A   A   J   7   -   0   E
```

Press DISPLAY ABSOLUTE once and observe column X_7 flashing.

5. Any time J7, J8, or J9 is chosen, as it is in this example, the Model 1885 acknowledges that the potential exists for input connection from an Synchro Select Unit. "b", "H", or "0" in column X_7 stand for "blanking", "holding", and "not applicable" respectively. Essentially, the Model 1885 provides the option of either displaying (holding) or not displaying (blanking) position data when the data are not present at the Model 2013

Synchro Select unit Synchro Output connector. One of three options ("b", "h", or "0") must be chosen in this column. If using a Synchro Select unit with the axis, choose "b" or "h". Until you become more familiar with the Model 1885, and thoroughly understand this option, enter a "b" for blanking. If not using a Synchro Select unit, choose "0".

Press SET or POSITION OFFSET in repeated steps noting the alternating sequence of "b", "H", and "0". Choose "b" on the display. The Position Display now displays this message:

A	A	J	7	-	-	b	E

6. Press DISPLAY ABSOLUTE. Note the flashing synchro speed ratio designator (in this case "E") in column X_8. "E" indicates the 256:1 speed ratio is currently selected. Press SET or POSITION OFFSET in repeated steps noting the alternating sequence of "1"(1:1), "3" (36:1), "E" (encoder 256:1), "1", "3", and so on. Select "1" and observe the following display:

A	A	J	7	-	b	1

7. Press DISPLAY ABSOLUTE. This action completes Position Display entry and begins Axis Identification Display entry.

8. Enter the eight-character alphanumeric message for the Axis Identification Display. In this configuration, Axis A is the elevation axis on Positioner 1. Therefore, a likely axis identification label might be:

E L 1

9. Note the default character in column 1 (leftmost position) of the Axis Identification Display begins flashing as shown here:

X X X X X X X X

10. Press SET or POSITION OFFSET in successive steps to obtain the first character of the Axis Identification Display, in this case "E". Available characters are:

A through Z, blank, 0 through 9, _, !, ', *, +, -, =, period, /, ?, <, >

NOTE

> By holding down the SET or POSITION OFFSET button the available characters cycle through the sequence more rapidly.

11. Press DISPLAY ABSOLUTE again. The character in column 2 (to the right) of the Axis Identification Display begins flashing.

12. Press SET or POSITION OFFSET until you obtain the desired character. In this case, locate the letter "L".

13. Repeat this process until the message is complete.

14. Enter the Position Display and Axis Identification Display data for Axis B as described in steps 1 through 13. On completion, observe this or a similar display message:

b	A	J	7	-	b	1

A	Z	M	T	H	1

15. Enter the Position Display and Axis Identification Display data for Axis C. On completion, observe this or a similar display message:

C	A	J	9	-	0	E

E	L	2

16. Enter the Position Display and Axis Identification Display data for Axis D. On completion, observe this or a similar display message:

d	A	J	8	-	0	E

A	Z	M	T	H	2

17. Enter the Position Display and Axis Identification Display data for Axis E. On completion, observe this or a similar display message:

E	A	J	7	-	b	3

P	L	Z	N	2

18. Enter the Position Display and Axis Identification Display data for Axis F (because Axis F is not used in this configuration, choose "JØ" in step 4).

F	A	J	Ø	-	7	E

19. To exit the Setup Mode, press either DISPLAY (SELECT) or OUTPUT (SELECT).

NOTE

On exiting Setup Mode, the displays may be blank. For additional details concerning blank displays refer to Chapter 3, Section 3.1.2.

2.4.5.2.3 Example #2 (Refer to Figure 2.6)

1. Choose the first axis you wish to set up, preferably Axis A (the default value). To choose an axis other than A, press AXIS in repeated steps until the desired designator is displayed. The AXIS pushbutton cycle is A, b, C, d, E, F, A, b, and so on. Assuming you chose Axis A, observe the following Position Display default message:

A	A	J	0	-	7	E

2. Enter the range (angular or linear) for Axis A by pressing SET or POSITION OFFSET in repeated steps. Note the alternating sequence of "A" and "L" in Display column X_3. For this axis, choose "A" for angular. The Position Display still shows:

A	A	J	0	-	7	E

3. Enter the input connector where Axis A enters the Model 1885. In this configuration, Axis A enters by way of the optional Model 1886 Position Data Processor at Serial Interface Input connector J4 (Model 1885). Press DISPLAY ABSOLUTE.

4. Go through the various rear panel connector choices by pressing SET (forward cycle) or POSITION OFFSET (reverse cycle) in successive steps--J3, J4, J7, J8, J9, J0, J3, J4, and so on. J3 and J4 are Serial Interface Inputs, accepting data only from the Model 1886. Position Inputs J7, J8, and J9 accept either synchro transmitter or Encoder transducer data. "J0" indicates the currently displayed axis is not used, and eliminates this axis from the axis sequence during normal operation. For Axis A, select J4 in this column and observe the following message:

A A J 4 - 7 E

5. Because J4 (and J3) is connected to the optional Model 1886 in this configuration, additional input source information must be entered as indicated by the dash in column X_6. Enter the Model 1886 input connector number in column X_7 by pressing SET or POSITION OFFSET in successive steps--7, 8, 9, 7, 8. In this configuration, choose 7 (default value) and observe the following Position Display:

A A J 4 - 7 E

6. Press DISPLAY ABSOLUTE. Note the flashing synchro speed ratio designator (in this case "E") in column X_8. "E" indicates that the 256:1 speed ratio is currently chosen. Press SET or POSITION OFFSET in repeated steps noting the alternating sequence of "1"(1:1), "3" (36:1), "E" (encoder 256:1), "1", "3", and so on. Choose "1" and observe the following display:

A A J 4 - 7 1

7. Press DISPLAY ABSOLUTE. Enter an eight-character alphanumeric message for the Axis Identification Display. In this configuration, Axis A is the azimuth axis on Positioner 1. Therefore, a likely axis identification label for Axis A is:

A Z M T H 1

8. Note the default character in column 1 (leftmost position) begins flashing as shown here:

X X X X X X X

9. Press SET or POSITION OFFSET in successive steps to obtain the first character of the Axis Identification Display, in this case "A". Available characters are:

   A through Z, blank, 0 through 9, ____, !, ', *, +, -, =, period, /, ?, <, >.

NOTE

By holding down the SET OR POSITION OFFSET button the available characters cycle through the sequence more rapidly.

10. Press DISPLAY ABSOLUTE again. The character in column 2 (to the right) of the Axis Identification Display begins flashing.

11. Press SET or POSITION OFFSET until you obtain the desired character. In this case, find the letter "Z".

12. Repeat this process until the message is complete.

13. Enter the Position Display and Axis Identification Display data for Axis B in a similar manner as described previously for Axis A in steps 1 through 12. In this configuration, Axis B is the azimuth axis for Positioner 2. Axis B position data enters the Model 1885 at J3 by way of the optional Model 1886 (J9). On completion of Axis B setup, observe this or a similar Position and Axis Identification Display:

b A J 3 - 9 1

A Z M T H 2

14. Enter the Position Display and Axis Identification Display data for Axis C. In this configuration, Axis C is the elevation axis for Positioner 2. Axis C position data enters the Model 1885 at J3 by way of the optional Model 1886 (J8). On completion of Axis C setup, observe this or a similar Position and Axis Identification Display:

```
C  A  J  3  -  8  1
```

```
E L 2
```

15. Enter the Position Display and Axis Identification Display data for Axis D. In this configuration, Axis D is the roll tower axis for Positioner 2. Axis D position data enters the Model 1885 at J9. On completion of Axis D setup, observe this or a similar Position and Axis Identification Display:

```
d  A  J  9  -  0  E
```

```
R O L L 2
```

16. Enter the Position Display and Axis Identification Display data for Axis E. In this configuration, Axis E is a linear tracking cart for Positioner 2. Axis E position data enters the Model 1885 at J8. On completion of Axis E setup, observe this or a similar Position and Axis Identification Display:

```
E  L  J  8  -  0  3
```

```
C T R A V E L 2
```

17. Enter the Position Display and Axis Identification Display data for Axis F. In this configuration, Axis F is a linear slide for Positioner 2. Axis F position data enters the Model 1885 at J7. On completion of Axis F setup, observe this or a similar Position and Axis Identification Display:

```
F  L  J  7  -  0  3
```

```
S L I D E 2
```

18. To exit the Setup Mode, press either DISPLAY (SELECT) or OUTPUT (SELECT).

NOTE

After exiting Setup Mode, the displays may be blank. For additional details concerning blank displays, refer to Chapter 3, Section 3.1.2.

2.4.6 Additional Setup Procedures

Several additional setup procedures to the Model 1885/1886 are required depending on your system configuration. These include:

- Output triggering selection
- Serial interface baud rate selection
- Synchro input voltage selection
- IEEE address selection
- Rear panel configuration

All of the setup procedures in this section, excluding IEEE address selection, are internal adjustments and require removing the unit top cover to access the appropriate circuitry. However, before removing the top cover of the unit(s), observe the following safety precautions:

- Unplug the ac power cord from the rear of the unit(s), making sure the front panel power switch is in the OFF position.
- Make certain all synchro cables attached to the rear panel Position Input connectors are disconnected from the unit(s).
- Remove synchro excitation input cable, if attached.

2.4.6.1 Output Triggering Selection (Model 1885 Only)

Two output triggering methods are provided internally on each Position Tracking/Output assembly (A6, A7). The jumper on J4 (P4) selects either an internal or external source for obtaining the triggering signal necessary to insure valid data during sampling periods (refer to Chapter 4 for a more detailed discussion regarding this signal).

Figure 2.20 shows the location of jumper P4 on the Position Output/

NOTE

Be sure to select a baud rate compatible with the link connected to the Serial Interface connector. Also be sure to match the baud rate selected in the unit at the opposite end of the link.

2.4.6.3 Synchro Input Voltage Selection

Synchro input voltage selection is accomplished by configuring the connections to J14 through J19, located beneath the safety shield of the Motherboard assembly. The Model 1885/1886 accepts either low voltage (size 15, 20V) or high voltage (size 23, 115V) synchro transmitters.

To gain access to the synchro input voltage selection circuitry of the Motherboard assembly, first remove the top cover of the unit. The safety shield should now easily be located toward the rear portion of the Motherboard assembly as shown in Figure 2.22. Remove five mounting screws securing the safety shield and lift the shield away from the Motherboard to expose the selection circuitry.

WARNING

120V STATOR VOLTAGE MAY BE PRESENT ON POSITION INPUT CONNECTORS J7, J8, AND J9. REMOVE AC LINE VOLTAGE AND DISCONNECT ALL EXTERNAL POSITION INPUT CABLES AND EXCITATION INPUT CABLE (J10) BEFORE PERFORMING WORK IN THIS AREA.

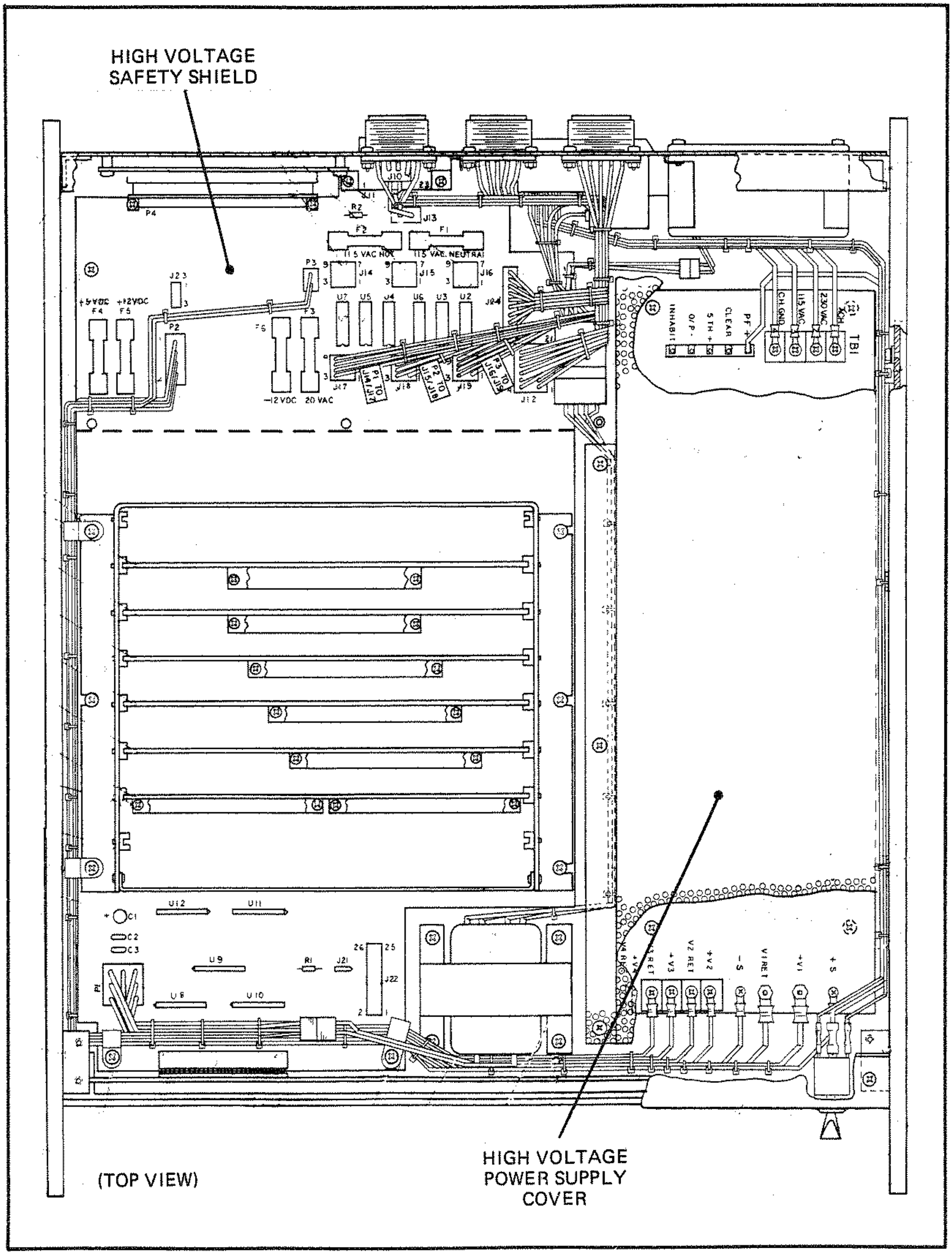


Figure 2.22. Motherboard Safety Shield Location

NOTE

Both low and high synchro input voltages may be used simultaneously with one unit. For example, Position Input connectors J7 and J8 may be set for high voltage synchro input, while J9 may be set for low voltage synchro input. For proper operation, configure the inputs for the type of synchro connected.

2.4.6.3.1 How to Select Low Voltage Synchro Input

To select low synchro input voltage for all three Position Input connectors, follow these procedures:

1. Assuming the top cover and safety shield are removed, locate connectors J17, J18, and J19 on the Motherboard assembly. These three connectors correspond to Position Input connectors J7, J8, and J9 respectively.

2. Locate connectors P1 through P3 connected to the Position Input connector harness (refer to Figure 2.22). Connect plug P1 to J17, P2 to J18, and P3 to J19, as shown in Table 2.10.

3. Place shorting plugs in high voltage connectors J14, J15, and J16.

NOTE

The unit will not operate properly without the shorting plugs in place.

4. Replace the safety shield and top cover.

2.4.6.3.2 How to Select High Voltage Synchro Input

To select high synchro input voltage synchro for all three Position Input connectors, follow these procedures:

1. Assuming the top cover and safety shield are removed, locate connectors J14, J15, and J16 on the Motherboard assembly. These three connectors correspond to Position Input connectors J7, J8, and J9 respectively.

2. Locate cables P1 through P3 connected to the Position Input connector harness (refer to Figure 2.22). Connect plug P1 to J14, P2 to J15, and P3 to J16, as shown in Table 2.10.

3. Place shorting plugs in low voltage connectors J17, J18, and J19.

NOTE

The unit will not operate properly without the shorting plugs in place.

4. Replace the safety shield and top cover.

Table 2.10
Synchro Input Configuration

Low Voltage	High Voltage	Corresponding Rear Panel Connector
P1 to J17	P1 to J14	J9
P2 to J18	P2 to J15	J8
P3 to J19	P3 to J16	J7

2.4.6.4 Setting the IEEE Address (Model 1885 Only)

Before using the IEEE-488 Interface, an appropriate address must be selected and set. This address is set by way of rear panel IEEE address switches on the rear panel of the Model 1885 (see Figure 2.23). These switches, located next to IEEE Interface connector J11, are labeled 1 through 8 with only the first five used to set the address. Thirty-one address combinations are possible as shown in Table 2.11. Switch 1 is the most significant bit, corresponding to address line A4. Switch 5 is the least significant bit, corresponding to AØ.

After selecting the desired address from Table 2.11, place switches 1 through 5 in their proper position. "Zero" represents OFF and "One" represents ON.

Switch 6 is reserved for testing purposes and is normally OFF. Switch 8, also normally OFF, configures the unit as a "talk only" when ON. Switch 7, when OFF, allows SRQ to be used.

Table 2.11
IEEE-488 Interface Bus Address Codes

Bus Address		A4	A3	A2	A1	AØ
HEX	DEC	Switch Number				
		1	2	3	4	5
01H	01	0	0	0	0	1
02H	02	0	0	0	1	0
03H	03	0	0	0	1	1
04H	04	0	0	1	0	0
05H	05	0	0	1	0	1
06H	06	0	0	1	1	0
07H	07	0	0	1	1	1
08H	08	0	1	0	0	0
09H	09	0	1	0	0	1
0AH	10	0	1	0	1	0
0BH	11	0	1	0	1	1
0CH	12	0	1	1	0	0
0DH	13	0	1	1	0	1
0EH	14	0	1	1	1	0
0FH	15	0	1	1	1	1
10H	16	1	0	0	0	0
11H	17	1	0	0	0	1
12H	18	1	0	0	1	0
13H	19	1	0	0	1	1
14H	20	1	0	1	0	0
15H	21	1	0	1	0	1
16H	22	1	0	1	1	0
17H	23	1	0	1	1	1
18H	24	1	1	0	0	0
19H	25	1	1	0	0	1
1AH	26	1	1	0	1	0
1BH	27	1	1	0	1	1
1CH	28	1	1	1	0	0
1DH	29	1	1	1	0	1
1EH	30	1	1	1	1	0
1FH	31	1	1	1	1	1

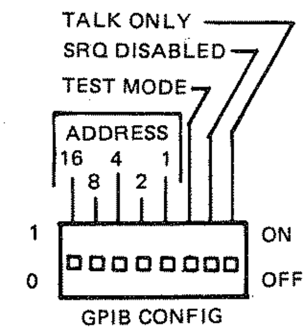


Figure 2.23. Model 1885 IEEE-488 Switch

2.4.6.5 Rear Panel Configuration

To permit flexible application of the Model 1885/1886 serial ports, and of the remote power control in the Model 1886, the Rear Panel Assembly (A12) must be configured using DIP switch S1. This switch performs the following functions:

S1-a	Connects Received Data Common (J3) to Power Control Input A
S1-b	Connects Signal Ground (J3) to Power Control Input A
S1-c	Connects Received Data (J3) to Power Control Input B
S1-d	Connects Clear-to-Send (J3) to Power Control Input B
S1-e	Connects Shield (J3) to Chassis Ground
S1-f	Connects Shield (J4) to Chassis Ground
S1-g	Not Used
S1-h	Not Used

Table 2.12 shows recommended positions for switches a through h on S1 on the Rear Panel Assembly (A12) for a specific application.

Table 2.12
Recommended Switch Positions for S1

Application	Switch S1							
	S1a	S1b	S1c	S1d	S1e	S1f	S1g	S1h
1885 direct connect	OFF	OFF	OFF	OFF	OFF	OFF		
1885 modem	OFF	OFF	OFF	OFF	ON	ON	-	-
1886, direct connect	ON	OFF	ON	OFF	ON	ON	-	-
1886, modem	OFF	ON	OFF	ON	ON	ON	-	-

CHAPTER 3
OPERATION

3.1 OPERATING MODES

3.1.1 Power-up

After verifying the installation and setup procedures described in Chapter 2, apply ac power to the Model 1885 and move the POWER toggle switch to the ON (or up) position. If the unit is functioning properly, observe one of the following three display responses:

1. The message "SETUP REQUIRED" appears on the Axis Identification displays indicating Setup Mode procedures have not been completed (see Section 2.4.5). In addition, this message may appear if a non-volatile memory failure has occurred.

NOTE

If error messages appear on the front panel display, refer to Section 3.1.4.

2. The displays are blank indicating Setup Mode procedures are complete, but no axes have been assigned to the display (see Section 3.1.2.3 for instructions on assigning axes).

3. Position information appears on the display indicating axes have been assigned previously to Position Displays and to the Axis Identification Displays.

The unit now awaits operating commands manually from the front panel, or automatically by a controller over the IEEE-488 bus.

3.1.2 Front Panel Controls and Indicators

All controls and indicators for the Model 1885 Digital Position Indicator and the Model 1886 Position Data Processor are located on the front panel. Figure 3.1 shows the location of the indicators and controls, while Table 3.1 briefly describes the function of each pushbutton/display as used during normal operation.

A more detailed discussion of the front panel controls follows in Sections 3.1.2.1 through 3.1.2.9. Be sure you read and understand these sections thoroughly before using the equipment under actual operating conditions.

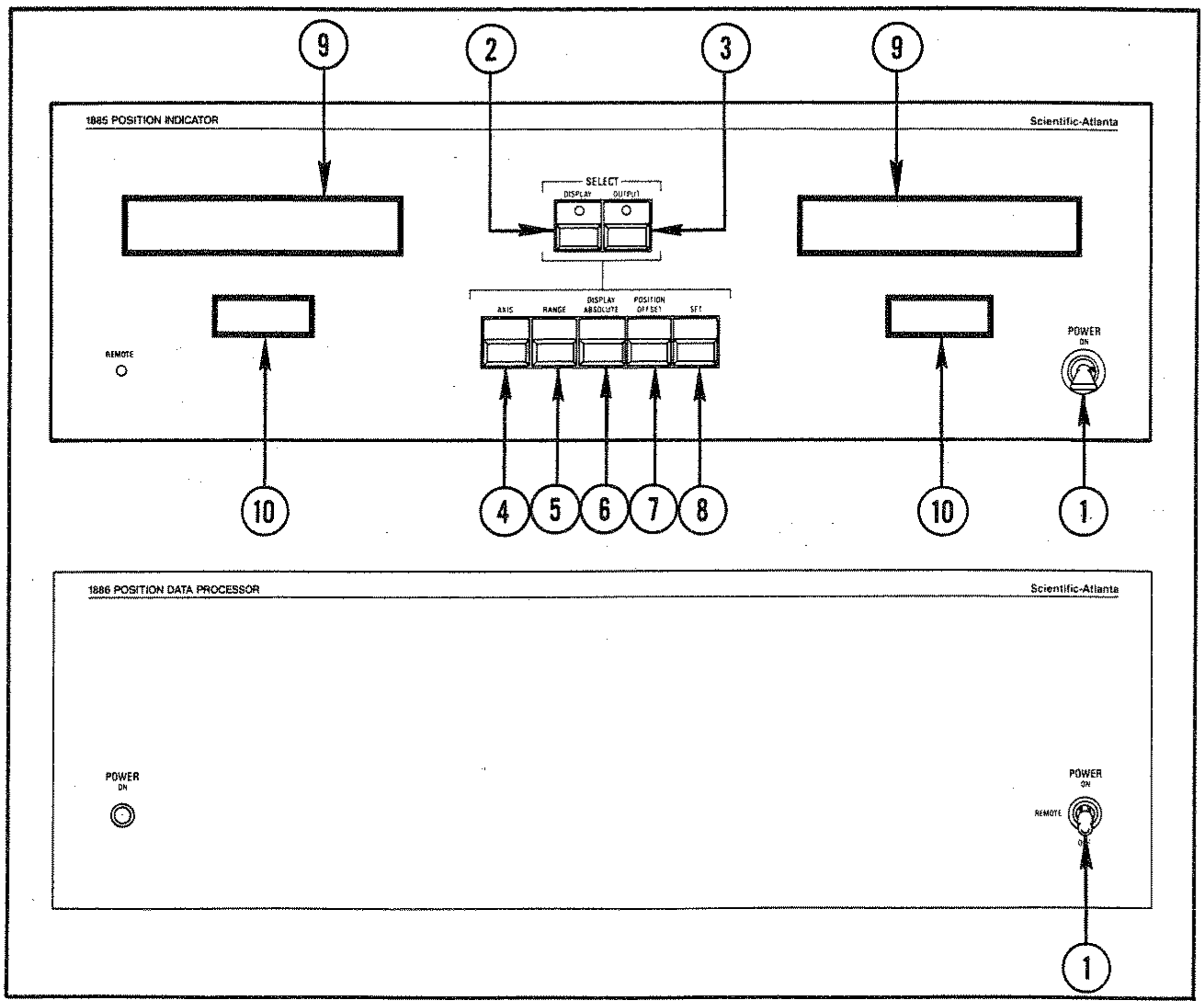


Figure 3.1. Model 1885/1886 Front Panels

Table 3.1
Model 1885 Front Panel Controls and Indicators

Pushbutton/Display	Function
1. POWER	Allows application of ac power to the Model 1885/1886.
2. DISPLAY (SELECT)	Selects the right or left Position Display for modification.
3. OUTPUT (SELECT)	Selects Position Outputs J5 or J6 for modification.
4. AXIS	Assigns the axis for Output or Display.
5. RANGE	Selects bipolar vs. unipolar operation (Angular mode: 0-360 vs. ±180, Linear mode: 0-36 vs. ±18).
6. DISPLAY ABSOLUTE	Allows temporary or permanent display of the absolute angle (no offsetting angle added) of a particular axis.
7. POSITION OFFSET	Allows entry of the desired angle for a particular axis.
8. SET	In the DISPLAY ABSOLUTE mode, displays the true or "absolute" angle (no offsetting angle added); in the POSITION OFFSET mode, increments the digits for changing the offset angle value.
9. POSITION DISPLAYS	Shows position data; also used in Setup Mode. LED in the upper left corner indicates selected display/output.
10. AXIS IDENTIFICATION DISPLAYS	Two programmable displays; act as labels for identifying an axis; also used in Setup Mode.

The front panel pushbuttons, indicators, and displays on the Model 1885, provide a convenient method for viewing and manipulating position data. The Position Displays provide readouts representing various positioning conditions. Examples of data manipulation include changing the axes presently displayed or altering the display range of an axis.

The DISPLAY (SELECT) and OUTPUT (SELECT) pushbuttons allow selecting which display or output (and corresponding axis) to change. Once you select a display or output, the lower pushbuttons become operable. The AXIS pushbutton changes the axis assigned to the selected display or output, while the other pushbuttons modify various attributes of the assigned axis. Their operation affects the axis wherever it appears and not solely the display or output.

For example, suppose a position offset were entered for an axis. Everywhere that particular axis is displayed (or sent to an output), the data contain that offset. Also, if any other axis is subsequently displayed or sent to the output, it contains its own offset (as well as other display parameters).

Therefore, the AXIS pushbutton (4) operates on the presently-selected display or output, while the other pushbuttons (5-8) operate on the axis assigned to the display or output.

In each of the following descriptions, assume the unit has been powered-up by placing the ON/OFF toggle switch in the "up" or ON position. The unit first performs preliminary operating checks and then enters a normal operating state.

3.1.2.1 Display (Select)

DISPLAY SELECT allows selecting either of the two front panel Position Displays for the purpose of manipulating the data presently shown. This function automatically places the Model 1885 into the Data Update mode from a normal operating state. An example of the DISPLAY SELECT pushbutton function cycle is illustrated in Figure 3.2. This cycle consists of the following choices:

- selecting Position Display No. 1 (left side as viewed from the front),
- selecting Position Display No. 2 (right side),
- or selecting neither display.

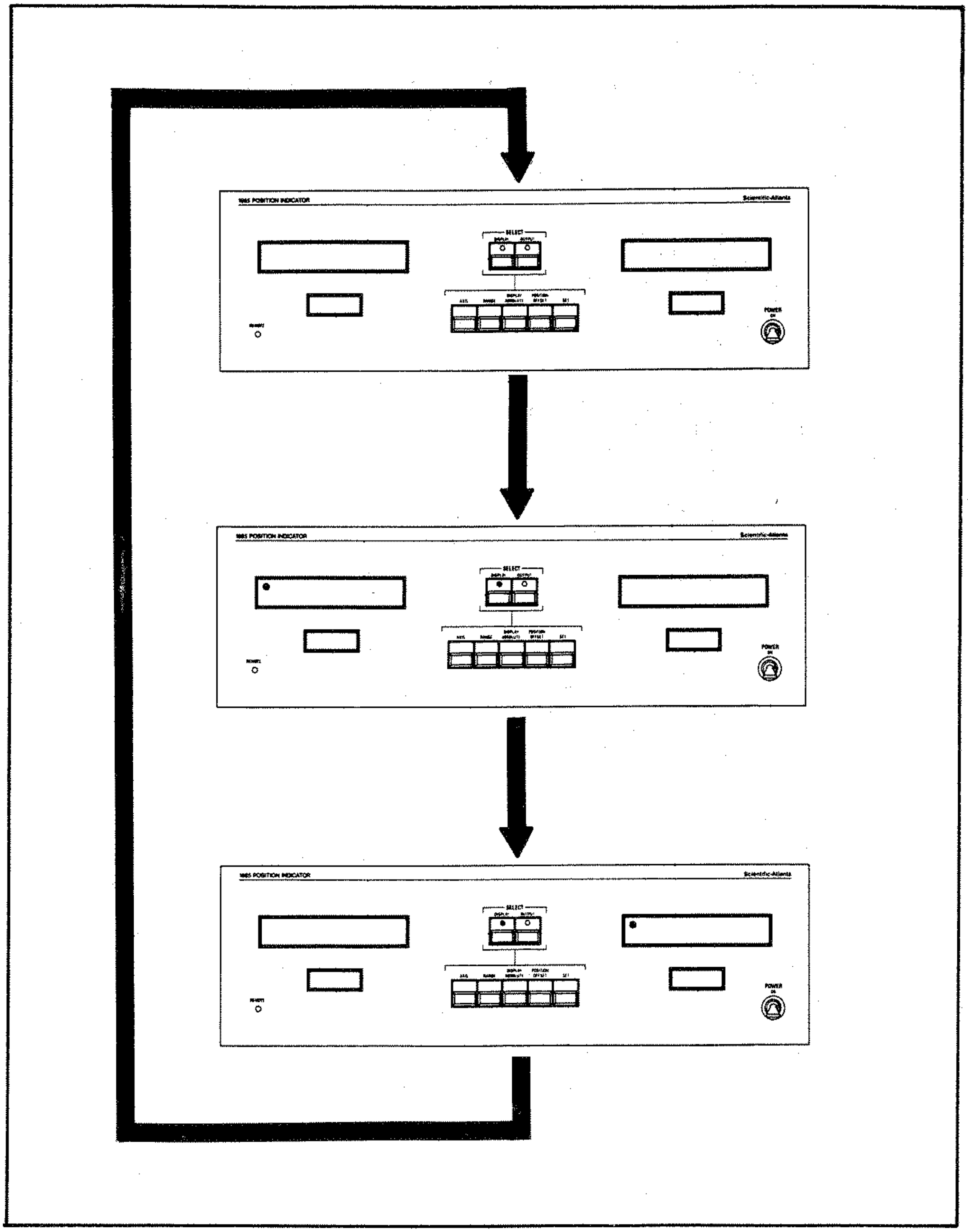


Figure 3.2. DISPLAY (SELECT) Pushbutton Cycle

An LED indicator in the upper left-hand corner of each display window illuminates when selected. An additional indicator, integrated directly into the pushbutton, designates display data (and not output data) is presently being shown.

After choosing the right or left display, the other front panel pushbuttons become active.

EXAMPLE:

1. Press DISPLAY (SELECT); the unit enters the Data Update mode for Position Display data as indicated by the DISPLAY pushbutton LED. Also, the left Position Display is selected as verified by the LED indicator in the first column of the display window. The remaining five lower pushbuttons are now active.

2. Press DISPLAY (SELECT) again; the right Position Display is selected as verified by the LED indicator the first column of the display window. The remaining five lower pushbuttons are still active.

3. Press DISPLAY (SELECT) again; the unit exits the Data Update mode and returns to the normal operating mode as represented by no illuminated LEDs. The five lower pushbuttons are not active.

3.1.2.2 Output (Select)

Pressing OUTPUT (SELECT) chooses Position Output data at either connector J5 or J6 for the purpose of manipulating data. The same LED indicator used to show selected Position Display data (upper left-hand corner of the display window) also acts as an indicator for the selected Position Output data. However, in this mode, the OUTPUT (SELECT) pushbutton LED glows to indicate output data are presently being shown on the Position Displays rather than display data. An example of the OUTPUT (SELECT) pushbutton function cycle is illustrated in Figure 3.3. After selecting output data, all front panel pushbuttons are active.

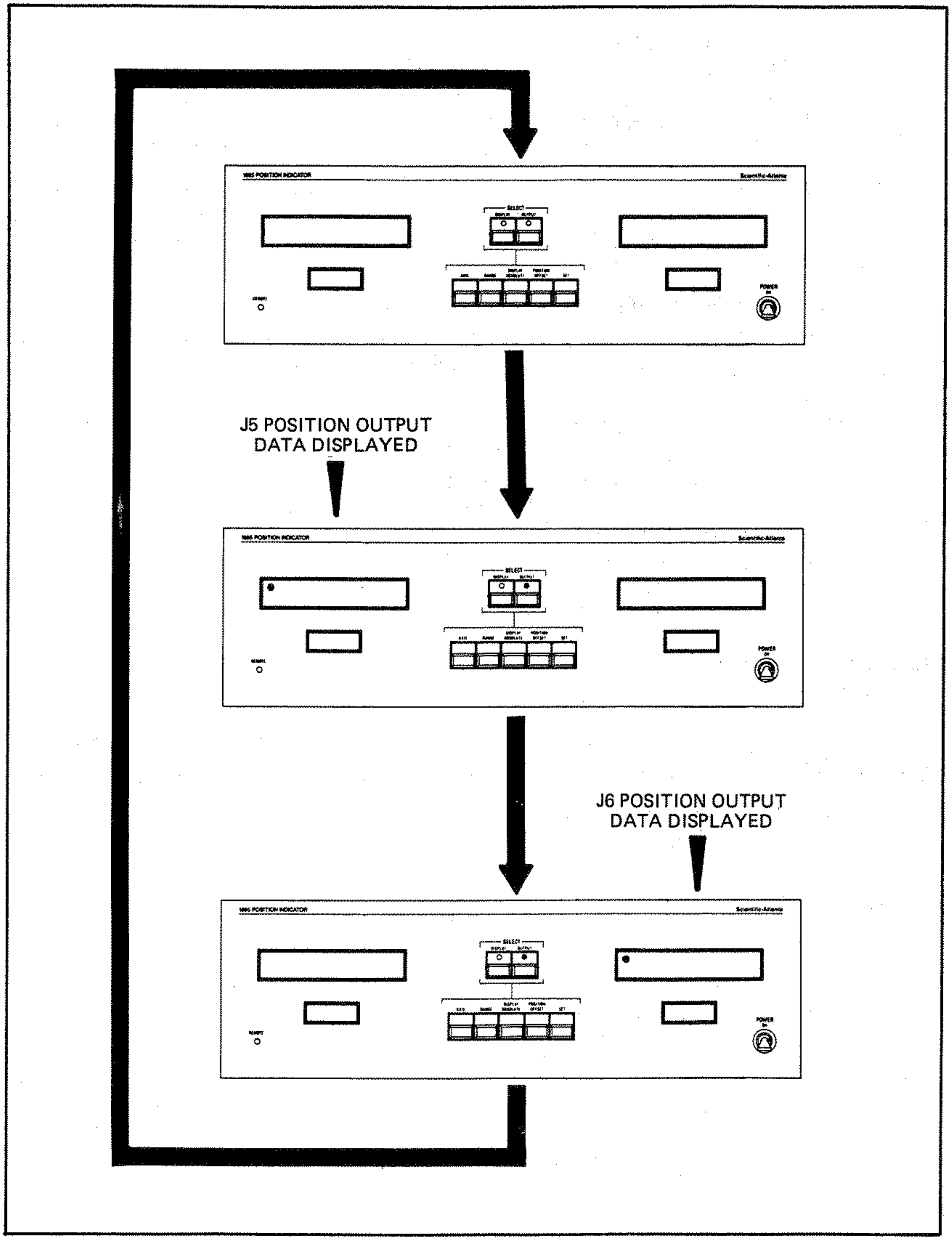


Figure 3.3. OUTPUT (SELECT) Pushbutton Cycle

EXAMPLE:

1. Press OUTPUT (SELECT); the unit enters the Data Update mode for Position Output data as indicated by the OUTPUT pushbutton LED. Also, J5 output data are shown on the left Position Display as verified by LED indicator in the first column of the display window. The remaining five lower pushbuttons are now active.

2. Press OUTPUT (SELECT) again; J6 output data are shown on the right display as verified by the LED indicator in the first column of the display window. The remaining five lower pushbuttons are still active.

3. Press OUTPUT (SELECT) again; the unit exits the Data Update mode and returns to the normal operating mode as represented by no illuminated LEDs. The five lower pushbuttons are not active.

NOTE

On returning to normal operating mode, the unit reverts to its previously programmed state, displaying the appropriate position data.

3.1.2.3 Axis

Pressing AXIS changes which axis is displayed or sent to the output for the presently selected display or output. Each time AXIS is pressed, a different axis is chosen as indicated by the Axis Identification Display label.

NOTE

If a display or output is not selected, the AXIS pushbutton remains inactive.

NOTE

> Axis selection may be performed through Axis Select input connector J2 by such instruments as the Scientific-Atlanta Model 2012/2012A Programmable Positioner Controller unit. The AXIS pushbutton is disabled when attempting to change an output going to the Model 2012A. In addition, unused inputs are removed from the axis sequence as described in Section 2.4.5, Setup Mode Procedures.

EXAMPLE:

1. Press either DISPLAY or OUTPUT (SELECT).

2. Press AXIS in consecutive steps. If six axes are active and no axis has been previously assigned to the currently selected display or output, observe the following response:

	Blank; no axes assigned
1st Press:	Display/Output data for Axis A assigned
2nd Press:	Display/Output data for Axis b assigned
3rd Press:	Display/Output data for Axis C assigned
4th Press:	Display/Output data for Axis d assigned
5th Press:	Display/Output data for Axis E assigned
6th Press:	Display/Output data for Axis F assigned
7th Press:	Display/Output data for the "selected" axis. Axis Identification Display shows SELECTED.
8th Press:	Blank; no axes assigned

3. Return to the normal operating mode by pressing DISPLAY/OUTPUT (SELECT) pushbuttons.

3.1.2.4 Range

Pressing the RANGE pushbutton selects either 0-360 or -180 to +180 for the rotary display range, or selects 0 to 36 or -18 to +18 for the linear display range. The decimal point for linear ranges automatically shifts one place to the left. Rotary or linear mode for each axis is configured as described in Section 2.4.5, Setup Mode Procedures.

Like the AXIS pushbutton, RANGE is not active unless a display or output has been previously selected. To return the unit to the normal operating mode, use DISPLAY and/or OUTPUT (SELECT) pushbuttons as described in the previous sections.

A "+" or "-" sign preceding the digits designates the ±180 or ±18 range, while "no sign" designates the 0-360 or 0-36 range. Table 3.2 provides samples of the possible display ranges.

Table 3.2
Possible Display Ranges

Speed Ratio	Rotary Mode 0 to 360	Rotary Mode -180 to +180	Linear Mode 0 to 36	Linear Mode -18 to +18
Single Speed (1:1)	90.0 180.0 180.1 270.0	+90.0 +180.0 -179.9 - 90.0	9.00 18.00 18.01 27.00	+ 9.00 +18.00 -17.99 - 9.00
Dual Speed (36:1, 1:1)	90.000 180.000 180.100 270.000	+90.000 +180.000 -179.900 -90.000	9.0000 18.0000 18.0100 27.0000	+ 9.0000 +18.0000 -17.9900 - 9.0000
Precision Dual Speed (256:1, 1:1)	90.0000 180.0000 180.1000 270.0000	+90.0000 +180.0000 -179.9000 -90.0000	9.00000 18.00000 18.01000 27.00000	+9.00000 +18.00000 -17.99000 - 9.00000

3.1.2.5 Display Absolute

Pressing DISPLAY ABSOLUTE forces the unit to display axis position data without the addition of an offset angle (or zero offset). This function is commonly used to momentarily (or permanently, if desired) remove previously-entered offset data from the present Position Display.

NOTE

DISPLAY ABSOLUTE is not active unless a display or output has been previously selected.

Initially, position data flashes on the display for about five seconds. If no further operations are performed during this five-second interval, the display returns to normal mode. However, if during the five-second interval other pushbuttons are pressed, the unit reacts as described in Table 3.3.

Table 3.3
Pushbutton Functions in Display Absolute Mode

Pushbutton/Display	Model 1885 Response
SET	Continuously displays absolute position data (no flashing) and returns to normal mode.
RANGE	Changes range of the absolute position data.
DISPLAY/OUTPUT (SELECT)	Terminates Display Absolute mode; unit returns to normal mode.
DISPLAY ABSOLUTE	Absolute position data continues flashing for an additional five-second interval.
POSITION OFFSET	Enters Position Offset mode (see Section 3.1.2.6).

3.1.2.6 Position Offset

The POSITION OFFSET pushbutton is used in conjunction with the SET pushbutton to enter offset position data for a particular axis. Each axis may have a separately-programmed offset.

NOTE

POSITION OFFSET is not active unless a display or output has been previously selected.

The first time POSITION OFFSET is pressed, the unit displays a flashing "zero" for five seconds. If no other operations are performed during this period, the display will return to normal mode. Zero entry is commonly desired when an antenna positioner is rotated to an offset position. If SET is pressed while the zero is flashing, the zero entry is retained on the display and the offset angle is automatically calculated. If a different angle is desired, pressing POSITION OFFSET an additional time causes the present angle plus the offset angle to display with the left-most field flashing (may not be a digit). If the axis is bipolar, the sign field ("+" or "-") can be edited as well. The new "net" angle may now be entered as described in the example of Figure 3.4.

Other pushbutton responses for the Position Offset mode are described in Table 3.4.

Table 3.4
Pushbutton Functions in Position Offset Mode

Pushbutton/Display	Model 1885 Response
DISPLAY/OUTPUT (SELECT)	Exit Position Offset mode; a new offset angle calculated and unit returns to normal mode.
RANGE	Shifts cursor position to the left.
DISPLAY ABSOLUTE	Shifts cursor position to the right.
POSITION OFFSET	Cycles in a backward direction through allowable character set.
SET	Cycles in a forward direction through allowable character set.

EXAMPLE: (±180 Display Range, Dual speed; 0.001 Resolution)

0. After pressing POSITION OFFSET while in position offset mode, the present angle plus any offset displays with the left-most field flashing.

1. Press DISPLAY ABSOLUTE. The most significant digit of the combined data flashes, indicating the new cursor position.

2. Press DISPLAY ABSOLUTE. The cursor moves one place to the right. (Pressing POSITION OFFSET moves the cursor to the left).

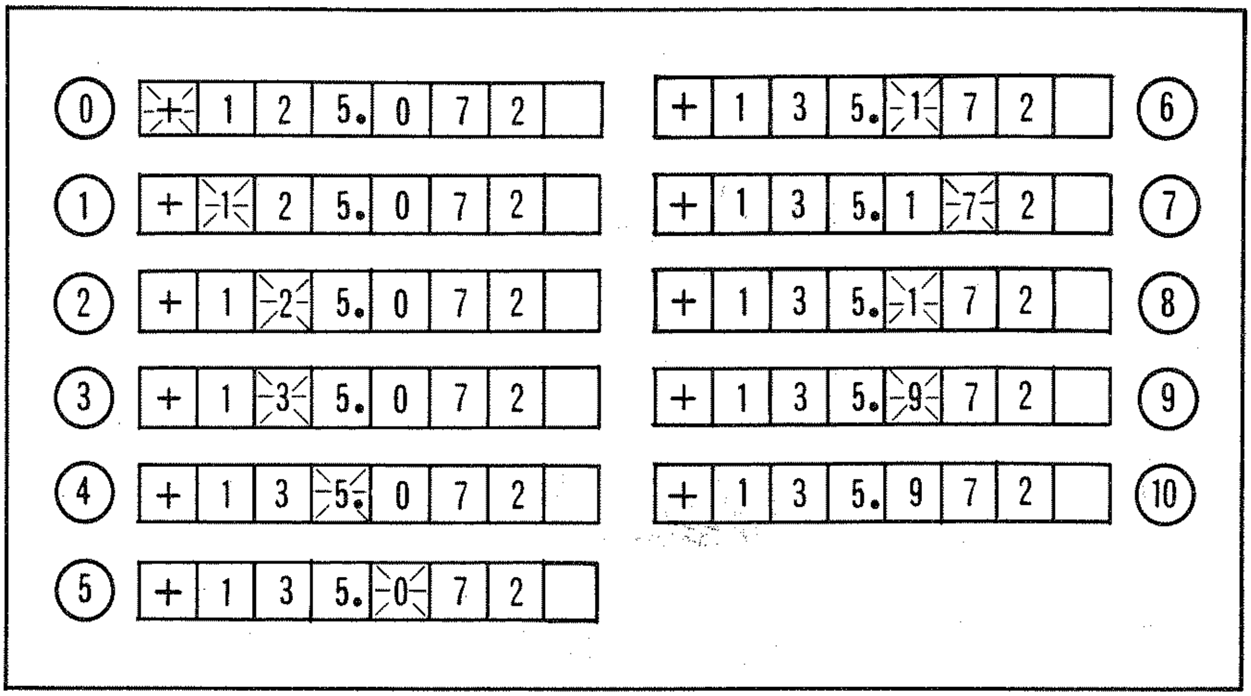


Figure 3.4. Entering Position Offset Information

3. Press SET. The flashing digit advances to the succeeding value.

4. Press DISPLAY ABSOLUTE. The cursor moves one place to the right.

5. Press DISPLAY ABSOLUTE again. The cursor moves one place to the right.

6. Press SET. The flashing digit advances to the succeeding value.

7. Press DISPLAY ABSOLUTE. The cursor advances one place to the right.

8. Oops! You meant to decrease the last digit. Press RANGE. The cursor moves back one place.

9. Press POSITION OFFSET twice. The flashing digit decreases by two.

10. Everything selected? If so, press DISPLAY OUTPUT (SELECT). The new offset angle is entered and the unit returns to normal operating mode.

3.1.2.7 Set

The function of the SET pushbutton varies depending on the Model 1885 mode of operation. Because the function of the SET button is described in the Display Absolute, Position Offset, and Setup Mode (Chapter 2) discussions, only a short summary is provided here:

- Display Absolute mode: pressing SET forces the display to show the true or absolute angle (no offsetting angle added).
- Position Offset mode: pressing SET increments the digital display when changing the offset angle value, or sets the offset angle equal to "zero".
- Setup mode: pressing SET (with AXIS) places the unit in Setup mode; also used to "toggle" through alphanumeric choices for Position display and Axis Identification Display.

3.1.2.8 Position Displays

The two front panel Position Displays on the Model 1885 Digital Position Indicator unit each contain eight 7-segment alphanumeric characters. The primary function of the Position Displays is to show the position angle or absolute angle data of an axis in angular or linear units. In addition, these displays are capable of showing the data present at the Position Output connectors on the rear panel (J5 and J6).

The first character, either a + sign, - sign, or blank, indicates the range as described in the following list:

- + sign indicates either ±180 or ±18 range
- - sign indicates either ±180 or ±18 range
- no sign indicates either 0-360 or 0-36 range.

The remaining characters are the actual position digits. An example position display is shown in Figure 3.5.

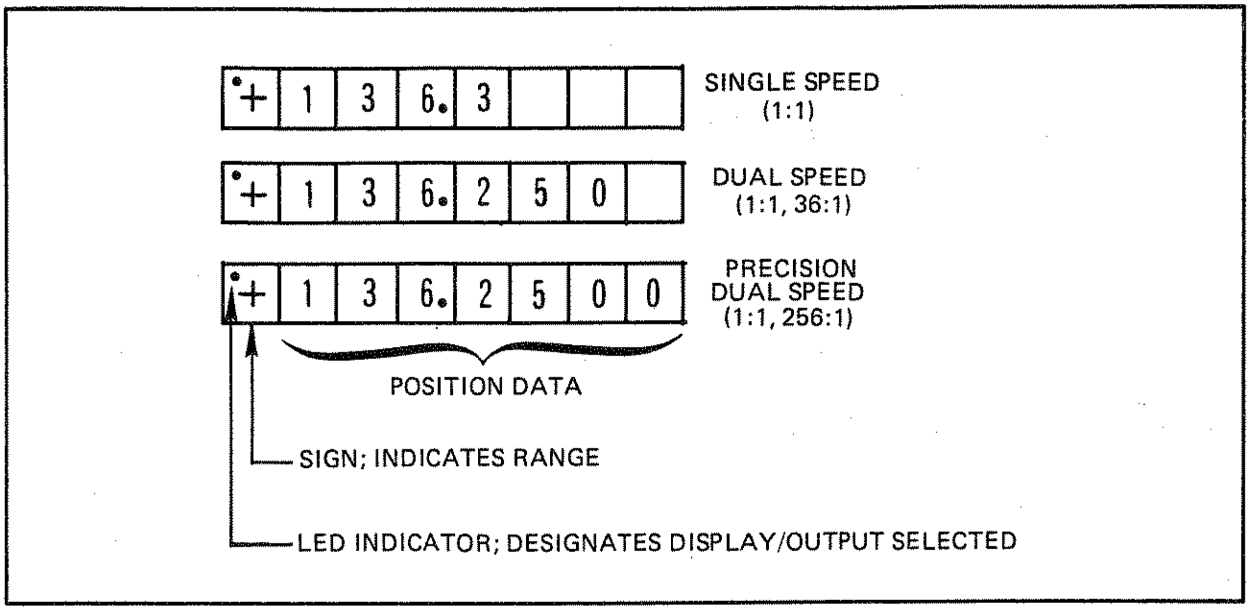


Figure 3.5. Example of a Model 1885 Position Display

Depending on the type of input, the resolution of the display varies as shown in Table 3.5. Because synchro transmitter-type inputs are less accurate by nature, the least significant digits are "blanked". When a single speed (1:1) synchro input is used alone, the lower three digits appear blank.

Details concerning the initial setup of the Position displays, are provided in Chapter 2, Section 2.4.5.

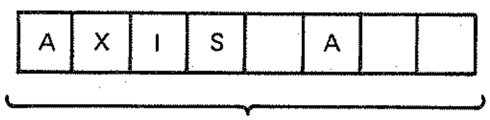
Table 3.5
Display Resolution

Input	Display Resolution	
	Rotary	Linear
Single Speed (1:1), Synchro Transmitter	0.1	0.01
Dual Speed (1:1, 36:1), Synchro Transmitter	0.001	0.0001
Dual Speed (1:1, 256:1), Precision Transducer	0.0001	0.00001

3.1.2.9 Axis Identification Displays

The two Axis Identification Displays act as labels for the Position Displays. These 14 segment eight-character displays are programmable, meaning unique label names may be entered using a wide range of available alphanumeric characters. A typical Axis Identification Display label is shown in Figure 3.6.

These displays are programmed during Setup Mode procedures. For Setup Mode details, refer to Chapter 2, Section 2.4.5.



PROGRAMMABLE ALPHANUMERIC CHARACTERS
Choices include:

- A through Z
- blank
- 0 through 9
- _, !, ', *, +, -, =, period, /, ?, <, >

Figure 3.6. Typical Axis Identification Display

3.1.3 How to Operate the Model 1885 Over the IEEE-488 Interface

3.1.3.1 General

Operating the Model 1885 over the IEEE-488 interface allows remote operation of all front panel pushbutton functions by way of a system controller. Special functions, particularly useful in automatic systems, are also provided.

3.1.3.2 General Purpose Interface Bus (GPIB)

Commands issued to the Model 1885 over the General Purpose Interface Bus (GPIB) are a series of ASCII characters (see Section 3.1.3.5) with each command separated by a delimiter. Both upper and lower case characters may be used. Acceptable delimiters are comma (,), semicolon (;), carriage return, and line feed.

Commands requiring specified positions must supply the information in one of the two position input formats. If position is read from the Model 1885, it will be in one of the five position output formats determined by the last valid format command (see Section 3.1.3.4). When a command causes the Model 1885 to prepare data for transmission, the system controller must subsequently read the data before issuing any additional commands to the Model 1885.

Table 3.6 lists the capability codes for the Model 1885 along with their corresponding meanings. (Refer to the ANSI/IEEE Std. 488-1978 for detailed information on operating characteristics of the bus.)

3.1.3.3 How to Select the Address

Before using the IEEE-488 Interface, an appropriate address must be selected. The procedure for selecting and setting this address is described in Section 2.4.6.4.

3.1.3.4 Position Formats

The Model 1885 provides four types of output formats:

- Series 2020 binary
- ASCII decimal
- Binary fraction
- ASCII hex.

Table 3.6

Model 1885 GPIB Capability Codes

Code	Description
SH1	Complete source handshake capability
AH1	Complete acceptor handshake capability
T5	Basic talker, serial poll, talk only, unaddress if MLA
L4	Basic listener, unaddress if MTA
SR1	Complete service request capability
RL2	No local lockout (rtl always false)
PP2	Local parallel poll configure
DC1	Complete device clear capability
DT1	Complete device trigger capability
CØ	No controller capability
E1	Open collector drives

The Model 1885 also supports two types of position input formats for commands requiring position information with the command (see B, E, I, O, X, and P commands). These two formats are ASCII decimal and ASCII hex.

The two input formats differ slightly from the respective output formats with the same name. The output formats provide angular/linear information, while the input formats do not. The only difference between angular and linear information (as far as the Model 1885 is concerned) is that the front panel displays the data for linear with the decimal point shifted left one digit. Input and output data do not have a shifted decimal point. However, the output data do have an angular/linear flag to signify when scaling may be required.

Observe the following list of format definitions. Sections 3.1.3.4.1 through 3.1.3.4.7 provide a more detailed explanation of each format.

- 2020 binary output
- ASCII decimal output
- ASCII decimal input
- Binary fraction of full scale output
- ASCII hex output
- ASCII hex input.

3.1.3.4.1 2020 Binary Output Format

Select this format for output data by using the F1 command. The bits are defined according to Table 3.7. The first two bytes contain the integer portion of the position data, the sign of the integer portion, and a bit to indicate whether the position is angular or linear. The integer is an unsigned 11-bit binary integer with the least significant bit weighted at 1°. The last two bytes contain the fractional portion of the position data with its sign. The fraction is an unsigned 14-bit binary integer with the least significant bit weighted at 0.0001°. The sign bits in these two bytes refer only to the fractional portion of the angle. The integer sign and fractional sign are always identical except between 0 and -1. At these positions, the integer portion is zero with a positive sign, and the fractional portion is negative.

Table 3.7
2020 Binary Output Format

Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	inter sign	Ø=ang 1=lin	Ø	Ø	Ø	2^{10}	2^9	2^8
2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
3	fraction sign	fraction sign	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
4	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Sign: (Ø = +, 1 = -)

EXAMPLE:

Angular position of +171.6614°.

Byte 1: ØØØØØØØØ   Byte 2: 1Ø1Ø1Ø11
Byte 3: ØØØ11ØØ1   Byte 4: 11Ø1Ø11Ø

Therefore, in this format, the overall angle is defined as:

$$\text{Angle} = \text{integer} + \frac{\text{fraction}}{10000}$$

3.1.3.4.2. ASCII Decimal Output Format

Select this format for output data by using the F2 command. The output data are sent in a fixed length format of 11 bytes:

Byte 1: A(Angular) or L(Linear)
Byte 2: Sign (+ or -)
Byte 3: 100's digit
Byte 4: 10's digit
Byte 5: 1's digit
Byte 6: decimal point
Byte 7: tenths digit
Byte 8: hundredths digit
Byte 9: thousandths digit
Byte 10: ten-thousandths digit
Byte 11: "," (comma)

EXAMPLE:

A+171.6614,
For angular position of +171.6614°

3.1.3.4.3. ASCII Decimal Input Format

Use this format for sending position information to the Model 1885. This format is identical to the ASCII Decimal Output Format except the input format may vary in length according to the following rules:

1. A or L is not needed; ignored if sent.
2. Sign may be dropped for positive numbers.
3. Leading zeroes are optional to the left of the decimal point.
4. Trailing zeroes are optional to the right of the decimal point.
5. Decimal point is optional if the position is an integer.
6. At least one digit is required.
7. Range is -180 to +360.

EXAMPLE:

Each of the following examples refers to the angle +15.05°.

A+015.0500
+15.0500
+15.05
15.05

3.1.3.4.4 Binary Fraction of Full Scale Output Format

Select this format for output data by using the F3 command. Table 3.8 provides bit definition.

This format includes a 22-bit binary number whose range is 0 to (2^{22}-1). The weight of the least significant bit is 2^{-22} times full scale and the most significant bit is 1/2 full scale. For angular data, the full scale is 360°, which gives the least significant bit a weight of 8.583 x 10^{-5} degrees (360°/2^{22}) and the most significant bit a weight of 180° (360°/2).

Table 3.8
Bit Definition

Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}	Ø	Ø=angular 1=linear
2	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}	2^{-15}	2^{-16}
3	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}

EXAMPLE:

Angular position of +171.6614°

Byte 1: ØØØØØØØØ Byte 2: ØØØ1ØØ1Ø Byte 3: Ø1111Ø1Ø

3.1.3.4.5 ASCII Hex Output Format

Select this format for output data by using the F4 command. This format is the ASCII hex equivalent of the Binary Fraction of Full Scale Output format described in the previous section.

The first byte is an ASCII x (lower case) followed by six ASCII characters each representing 4 bits of the Binary Fraction of Full Scale Format. Table 3.9 provides a definition of this format. Each ASCII hex character is 0-9 or A-F.

Table 3.9
ASCII Hex Output Format

BYTE 1:	x
BYTE 2:	hex digit representing bits 8-5 of BYTE 3 (see Table 3.8)
BYTE 3:	hex digit representing bits 4-1 of BYTE 3
BYTE 4:	hex digit representing bits 8-5 of BYTE 2
BYTE 5:	hex digit representing bits 4-1 of BYTE 2
BYTE 6:	hex digit representing bits 8-5 of BYTE 1
BYTE 7:	hex digit representing bits 4-1 of BYTE 1
BYTE 8:	"," (comma)

EXAMPLE:

ASCII hex for angular position of +171.6614°
x7A12ØØ,

3.1.3.4.6. ASCII Hex Input Format

Use this format for sending position information to the Model 1885. This format is identical to the ASCII Hex Output Format except the input format may have the following variations:

- Byte 1 may be upper or lower case
- Hex digits may be 0-9, A-F, or a-f. (leading and trailing zeroes must be included)
- the value of the angular/linear bit is irrelevent.

EXAMPLE:

Each of the following examples represent an angular position of +171.6614°:

x7A12ØØ
X7A12ØØ
x7a12ØØ

3.1.3.5 IEEE-488 At a Glance

Table 3.10 provides a quick-reference listing of IEEE-488 commands with detailed descriptions following in Table 3.11.

Table 3.10
IEEE-488 Quick Reference

Command	Description
A	Assigns axes to displays/outputs.
B	Enters record increment start position.
C	Enters installation configuration data.
D	Requests absolute position display data.
E	Enters record increment end position.
F	Sets format of data for output.
G	Defines response to GET (Group Execute Trigger).
I	Determines record increment size.

Table 3.10 - continued

Command	Description
J	Starts the record increment generation process.
K	Dumps error message buffer.
L	Configures response to parallel poll over the IEEE bus.
M	Determines whether events cause SRQ.
O	Provides offset entry for an axis.
P	Sets up angle preset for an axis.
Q	Requests position data in current format for specified axis.
R	Sets range for an axis.
S	Sets the record increment axis.
T	Defines the "selected" axis.
V	Verifies parameters.
WY	Identification request.
Xn	Used for testing or special modes of operation.
Y	Acknowledge/Not Busy message.
Znt	Starts ASCII or binary output on one of the two serial connectors (J3 or J4).

Table 3.11
IEEE-488 Bus Command Details

Command	Detailed Description
	NOTE The examples do not show the required delimiter. Every command to the Model 1885 must end with one of the following delimiters: comma (,), semicolon (;), carriage return, or line feed.
Aan	Assigns axes to Position Displays and/or Position Output connectors. a = axis A, B, C, D, E, F, S, Ø where: S = "selected" axis Ø = no axis n = 1; left display n = 2; right display n = 3; left output (J5) n = 4; right output (J6) If a = S, the display/output shows the "selected" axis. When a = Ø, the display/output is locked-out, meaning no axis to display/output. **NOTE** If attempting to assign an axis to an output currently tracking the "selected" axis for the Model 2012A, the unit generates an error message and ignores the command. Example: **AD2** Right display shows Axis D position data.
Bx	Enters the record increment start position angle, or angle where first record increment occurs, for the record increment axis (see command S). x = position data in one of the position data input formats (see Model 1885 position formats in Section 3.1.3.4).

Table 3.11 - continued

Command	Detailed Description
Bx (cont)	Example: **B1Ø.5** Enters the record increment start position of 10.5° for the record increment axis.
Catspl	Enters the installation configuration command. a = axis A, B, C, D, E, or F t = type A (angular) or L (linear) s = source code (defines from which input the axis is available. See the following table.) p = precision where: 1 = 1:1 3 = 36:1 E = 256:1 l = label (optional, 0 - 8 characters). See Section 3.1.2.9 for a complete listing of available characters.

SOURCE CODE	SOURCE OF INPUT
00	Axis not used (default)
37	Connector J3 on Model 1885 Connector J7 on Model 1886
38	Connector J3 on Model 1885 Connector J8 on Model 1886
39	Connector J3 on Model 1885 Connector J9 on Model 1886
47	Connector J4 on Model 1885 Connector J7 on Model 1886
48	Connector J4 on Model 1885 Connector J8 on Model 1886
49	Connector J4 on Model 1885 Connector J9 on Model 1886
*70	Connector J7 on Model 1885
*7B	Connector J7 on Model 1885 Blank for data hold

Table 3.11 - continued

Command	**Detailed Description**
	SOURCE CODE — SOURCE OF INPUT
Catspl (cont)	*7H — Connector J7 on Model 1885 Indicates data hold
	*80 — Connector J8 on Model 1885
	*8B — Connector J8 on Model 1885 Blank for data hold
	*8H — Connector J8 on Model 1885 Indicates data hold
	*90 — Connector J9 on Model 1885
	*9B — Connector J9 on Model 1885 Blank for data hold
	*9H — Connector J9 on Model 1885 Indicates data hold
	Labels are left justified and may be any 8 characters of the 64-character ASCII subset (Hex value 2Ø to 5F). However, commas (,) and semi-colons (;) are not allowed.
	Example:
	CAA7B3AZMTH 1
	Axis A, angular, data at Connector J7 on the Model 1885, blank for data hold, 36:1 precision. Label reads AZMTH 1.

* "0" indicates only one axis applied to the Position Input connector.

"B" and "H" indicate more than one axis applied to the Position Input connector (as with the Scientific-Atlanta Model 2013 Synchro Select unit; see Section 2.4.2.1).
When using a Model 2013 Synchro Select unit, only one input axis is applied at its output (other axes are not read). However, the Model 1885 stores the position data last read from the other inputs and is capable of displaying this data. Therefore, the "B" parameter "BLANKS" this position data on the display whenever specifying the currently-input axis. The "H" parameter specifies the position data be displayed with an "H" as the right-most character, indicating a data "HOLD" condition.

Table 3.11 - continued

Command	Detailed Description
Da	Requests display of absolute Position data for an axis. Zeroes the offset of the specified axis. a = axis A, B, C, D, E, F Example: **DF** Absolute position data displayed for Axis F.
Ex	Enters record increment end position (specifies position beyond which record increments will not be generated). x = position to set record increment end in position input format. (See Model 1885 position formats in Section 3.1.3.4.) Example: **EA+179.999Ø** Record increment end position 179.999Ø for specified axis.
Fn	Sets the default format for output positions. n = 1; Series 2020 binary (default format) n = 2; ASCII decimal n = 3; binary fraction of full scale n = 4; hex fraction of full scale Example: **F2** Format 2 selected. All subsequent data output will be in Format 2.
G[a]...	GET configuration command a = axis A, B, C, D, E, F, S S = "selected" axis This command defines the order for sending position data in response to a GET (Group Execute Trigger) command over the IEEE-488 bus. Nothing is actually sent at the time this command is issued. However, response instructions are stored for later use. The "selected" axis is defined as the selected axis at the time the GET occurs. If no axis is supplied with the command, error 6Ø, "no defined GET response", will be generated at the time of a GET.

Table 3.11 - continued

Command	Detailed Description
G[a]...(cont)	**NOTE** The unit responds to a GET command by sampling and preparing position data for output of the designated axes. ASCII positions are sent individually with delimiters. Binary position formats are transmitted as one message with no delimiters. An "end" (EOI) is transmitted on the last byte. Example: **GDSA** Specifies position information be sampled for Axis D, the currently "selected" axis, Axis A, and sent out in same order when requested.
Ix	Determines record increment size. x = increment size in the position data input format (see Model 1885 position formats in Section 3.1.3.4). Example: **IØ.Ø1** Specifies a record increment generation every .01° of motion.
J	Starts the record increment generation process. Parameters of B, E, I, and S commands are used in generating record increments. **NOTE** Only "tracked" axes may be used to generate record increments. The tracking model operates on output connectors J4 and J5. If the record increment axis (set through the "S" command) is not assigned to one of the two output connectors at the time of this command, the unit generates an error and does not begin record increments. Example: **J**

Table 3.11 - continued

<table>
<tr><th>Command</th><th>Detailed Description</th></tr>
<tr><td>K</td><td>Implements "dump error message buffer" where the contents of the error message queue (up to 32 bytes) are transmitted and the buffer is "flushed". If the queue is empty, the unit generates a "no_error" error, placing one error on the queue (see Section 3.1.4 for error message definition). An "end" (EOI) is transmitted on the last byte.

<u>Example</u>:

K

<u>Response</u>:

BYTE CONTENTS MEANING
1 33 Bad Command
. . .
. . .
. . .
n 48 Untimely Acknowledge</td></tr>
<tr><td>Lxy</td><td>Implements parallel poll configuration.

x,y = ASCII value of Ø to 8 indicates flag bit assignment (Ø equals not assigned).
x = assign SRQ (service request) flag bit.
y = assign record increment flag bit.

<u>Example</u>:

L37

Assigns SRQ flag to bit 3, record increment flag to bit 7.</td></tr>
<tr><td>Mn</td><td>Service Request Disable
where:
n = Ø Don't generate SRQ.
n = 1 Generate SRQ when any of bits 1-6 in the serial poll byte goes true.</td></tr>
</table>

Table 3.11 - continued

Command	Detailed Description
Mn (cont)	The default for this command is determined by the rear panel SRQ disable switch. If the rear panel switch is set to disable SRQ, then M command is also disabled. (See Serial Poll Bit Assignment). Example: **M1** Sets SRQ on 0 to 1 transition for any serial poll bit.
Oax	Provides offset entry or bias for an axis. The number of degrees specified in the command is added to all position data obtained on the axis. The offset replaces any previous offset associated with the axis. a = axis A, B, C, D, E, F x = position data in the position input format Example: **OCx7A1200** or **OC171.6614** Current position displayed for Axis C is the absolute position plus 171.6614°.
Pax	Allows entering preset angle for an axis. a = axis A, B, C, D, E, F x = position data in position input format Example: **PEx800000** or **PE180** Current position displayed for Axis E becomes 180°.
Qa	Requests Position data in the current format (see Fn) for the axis specified by "a". a = axis A, B, C, D, E, F, or S S = "selected" axis

Table 3.11 - continued

Command	Detailed Description
Qa (cont)	Example: **QB** Requests data for Axis B. Response: Determined by last valid format command (see command "F"). **NOTE** If "S" is undefined or request of invalid axis, unit returns to a position of Ø° and generates an error message.
Ran	Sets range for an axis. a = axis A, B, C, D, E, F n = 1; unipolar n = 2; bipolar Example: **RE1** Unipolar selected for Axis E.
Sa	Sets the record increment axis. a = record increment axis A, B, C, D, E, F. (See commands B, E, I, and J for other record increment parameters.) Example: **SD** Sets Axis D as the record increment axis.
Ta	Provides axis selection by way of the IEEE-488 interface. a = axis A, B, C, D, E, or F

Table 3.11 - continued

Command	Detailed Description
Ta (cont)	Under normal conditions, the Model 2012A determines the "selected" axis. However, if not using a Model 2012A, axis selection may be performed over the IEEE-488 bus with this command. The unit responds by changing the position data axis for all displays/outputs currently assigned at Axis S. (See Figure 4.1 to determine the currently "selected" axis.) If the "selected" axis enters the Model 1885 by way of the Model 2013, the 1885 will insure the axis is selected on the Axis Select Input to the Model 2013. Example: **TB** Axis B selected. **NOTE** This command will not override an Axis Select Input request entering through rear panel connector J2, and is not intended to be used under such conditions.
Vn	Verifies parameters, returning status information to the IEEE bus. n = 1; verify setup information Status information is in a format which could later be sent to the Model 1885 to restore its present configuration. Format: CAtspl,OAx,RAn CBtspl,OBx,RBn CCtspl,OCx,RCn CDtspl,ODx,RDn CEtspl,OEx,REn CFtspl,OFx,RFn Ta,Aa1,Aa2,Aa3,Aa4

Table 3.11 - continued

Command	**Detailed Description**
Vn (cont)	<u>Example</u>: **V1** <u>V1 Response</u>: CAA903AXIS A ,0Ax000000,RA1 CBA703AXIS B ,0Bx000000,RA1 CCA07EAXIS C ,0Cx000000,RC1 CDA07EAXIS D ,0Dx000000,RD1 CEA07EAXIS E ,0Ex000000,RE1 CFA07EAXIS F ,0Fx000000,RF1 TB,AA1,AS2,AB3,AS4 n = 2; transmit last error message <u>Example</u>: **V2** <u>V2 Response</u>: 49 (1 byte decimal) Axis must be tracked error.
WY	Identification string request (Who Are You?) (No parameters). <u>Response</u>: SA 1885 FIRMWARE # Axxxxxxx where x = firmware part number
Xn	Used for testing or "special" modes of operation. There are two sub-commands as follows: X1ax a = axis -- (A-F),0 0 = no axis x = position expressed in one of the two position input formats. 0.0000 <= x <=359.9999. This command instructs the Model 1885 to simulate movement of an axis. The Model 1885 ignores the true position input source of the axis and instead adds x units of position to the axis each second. Therefore, x is the degrees/second at which to move the axis. The position update rate of the axis does not change in this mode. Only one axis may be "moved" at a time.

Table 3.11 - continued

Command	Detailed Description
Xn (cont)	X2v v = 0 or 1 0 = Cancel verbose mode 1 = Start verbose mode This command changes the method by which the Model 1885 reports errors. If "verbose" mode is choosen, the Model 1885 attempts to report errors as they happen rather than waiting until the controller requests errors through the "K" or "V2" commands. Also, the errors are descriptive ASCII strings instead of error codes. When verbose mode is cancelled, the Model 1885 returns to the normal mode of error reporting where up to 32 errors are queued for later dump of the controller. **NOTE** See Section 3.1.6.1 for details on the effect of this command on operation over the serial ports J3 or J4.
Znt	Start ASCII or binary output on one of the two serial connectors (J3 or J4). n = 3, 4, or 0 If 3 or 4, n corresponds to connectors J3 and J4 respectively t = A for ASCII output B for binary output 0 for no ouput (stop output) Used to instruct the Model 1885 to continuously send to the output axis positions on one of its two serial channels. The unit sends data for each configured axis in ascending order of input connectors. That is, the axis position entering connector J7 will transmit before the axis entering J9. Binary output is valid only on connector J3 in a Model 1886, or on J3 in a Model 1885 in "1886 mode". See section 5.5.3.11 for more information on "1886 mode". The unit transmits data only for axes assigned to connectors J7,J8 or J9. ASCII data are transmitted in the standard ASCII output format. Each position is preceded by the connector designation and an "=" (equals) character. Each line of position data is terminated by a carriage return/line feed sequence. The data are transmitted using XON/XOFF protocol. Observe the following example of ASCII output:

Table 3.11 - continued

Command	**Detailed Description**
Znt (cont)	<u>Example</u>: **7=A+357.2938,9=L-179.9999** This line indicates that an angular axis is assigned to connector J7 whose position is 357.2938, and a linear axis is assigned to connector J9 whose position is -179.9999. The binary output format begins with the binary value FEh. The format of the following data include a 24 bit binary fraction for each configured axis, followed by a CCITT 16 bit CRC computed over the position data only. The binary fraction is the same as the standard binary fraction output format with the exception that the least significant two bits are position data. Therefore, the weight of the least significant bit is $360/2^{24}$. Binary data are transmitted with no "handshake". At 4800 baud, a complete position sample for each configured axis is transmitted every 33 ms at 60 Hz line frequency--each 40 ms at 50 Hz line frequency. The period over which data are transmitted at slower baud rates is doubled at each progressively slower supported rate. Observe the following example of binary output: <u>Example</u>: Byte 1: FEh Byte 2: Least significant byte of axis assigned to J7. Byte 3: Next most significant byte of axis assigned to J7. Byte 4: Most significant byte of axis assigned to J7. Byte 5: Least significant byte of axis assigned to J8. Byte 6: Next most significant byte of axis assigned to J8. Byte 7: Most significant byte of axis assigned to J8. Byte 8: Least significant byte of CCITT 16 bit CRC. Byte 9: Most significant byte of CCITT 16 bit CRC. This example shows an axis configured on J7 and J8, with no axis assigned to connector J9.

Table 3.11 - continued

Command	Detailed Description
Znt (cont)	**NOTE** During serial position output, any message received consisting of a delimiter preceded by no other characters will have the same effect as a command to stop serial output for the channel on which the message is received.
Y	Acknowledge/Not Busy message for record increment. As the Model 1885 generates a record increment, the host system sends an acknowledge by way of this command, indicating the system received the position data properly. If another increment is triggered before the host sends this commnad, the unit generates an overspeed error. **NOTE** The IEEE bus messages BEL and ETB may also be used for acknowledge of the record increment.

3.1.3.5.1 Multiline Interface Messages

Multiline interface messages (shown in Table 3.12) are defined in the IEEE-488 specification, or in the Model 1885 Digital Position Indicator. Other multiline interface messages are not defined. If undefined multiline messages are received in the addresses command group, an invalid command error is generated. However, if undefined universal command group messages are received, they will be ignored and will not generate an error message. (The word "multiline" is used as defined by the IEEE-488 interface specification.)

Table 3.12
Multiline Interface Messages

Command	Group	Detailed Description
GTL (01H)	ADDRESSED	Go to local; unit exits remote state and reverts to local operation with front panel switches active.
LLO (11H)	UNIVERSAL	Lock out unit's return to local switch; not applicable to the Model 1885 since there is no switch.
SDC (04H)	ADDRESSED	Selected device clear; resets the Model 1885 to the power-up state.
DCL (14H)	UNIVERSAL	Device clear; resets the Model 1885 to the power-up state.
PPC (05H)	ADDRESSED	Parallel poll configure (not applicable). Use the "L" command to configure parallel poll.
PPU (15H)	UNIVERSAL	Parallel poll unconfigure (not applicable). Use the "L" command to unconfigure parallel poll.
(06H)	ADDRESSED	ACK; Defined in the Model 1885 as serial poll acknowledge when SRQ is disabled.
(16H)	UNIVERSAL	SYN; Defined in the Model 1885 as serial poll acknowledge when SRQ is disabled.
(07H)	ADDRESSED	BEL; Defined in the Model 1885 as record increment acknowledge. Same as the "Y" command.
(17H)	UNIVERSAL	ETB; Defined in the Model 1885 as record increment acknowledge. Same as the "Y" command
GET (08H)	ADDRESSED	Group execute trigger; forces sample of all axes. Axes being tracked are sampled by the hardware tracking circuit. Formats and buffers data for output per the last valid "F" and "G" commands.
TCT (09H)	ADDRESSED	Take control (not applicable); The Model 1885 cannot be in control of the bus.

Table 3.12 - continued

Command	Group	Detailed Description
SPE (18H)	UNIVERSAL	Serial poll enable; enables the output of the serial poll byte if the unit is a talker.
SPD (19H)	UNIVERSAL	Serial poll disable; disables output of the serial poll byte.

3.1.3.5.2 <u>Serial Poll Byte</u>

Table 3.13 provides a breakdown for serial poll bits. A description of each bit follows the table.

Table 3.13
Serial Poll Byte

Command	Detailed Description
Serial Poll	MSB 8 7 6 5 4 3 2 1 LSB Data Pending (8) Service Request (7) GPIB error message available (6) Not used (5) Overspeed (4) Serial link error at J3 (3) Serial link error at J4 (2) Record increment detected (1)

Bit 1: <u>Record Increment Detected</u>
This bit is set whenever the record increment position is detected. The bit is cleared by one of the serial poll acknowledge operations as defined in Section 3.1.3.5.4.

Bit 2: <u>Serial Link Error at J4</u>
If an axis is configured for input over the serial link connector J4, the bit will set whenever a communications error occurs. If no axis is configured for this connector, the bit will not set. The bit is cleared by one of the serial poll acknowledge operations as defined in Section 3.1.3.5.4.

Bit 3: <u>Serial Link Error at J3</u>
If an axis is configured for input over serial link connector J3, this bit will set whenever a communications error ocurs. If no axis is configured for this connector, the bit will not set. The bit is cleared by one of the serial poll acknowledge operations as defined in Seciton 3.1.3.5.4.

Bit 4: <u>Overspeed</u>
This bit is set whenever a record increment is detected if a record increment acknowledge has not been processed since the last record increment occurred. The bit is cleared by one of the serial poll acknowledge operations as defined in Seciton 3.1.3.5.4.

Bit 5: <u>Not Used</u>
This bit is reserved for future application. Do not make any assumptions concerning the state of this bit.

Bit 6: <u>GPIB Error Message Available</u>
This bit is set whenever an error message is available to the bus. No data will be buffered for output until a request has been made for the error message (see the "K" and "V2" commands). This bit remains set until the error message is read and a serial poll acknowledge operation has been performed as defined in Section 3.1.3.5.4.

Bit 7: <u>Service Request</u>
If SRQ is enabled, this bit is set when any one of the earlier described bits makes a "low" to "high" transition. This bit is cleared when a serial poll read is done if no other bits have been set. If SRQ is disabled, this bit will always be cleared.

Bit 8: <u>Data Pending</u>
This bit is set whenever the Model 1885 has data in its output buffer ready for transmitting over the bus. If the Model 1885 is placed in the talker active state, it will transmit the data. No other input commands can be received by the Model 1885 until the data are read (or device clear occurs). This bit is cleared whenever the Model 1885 currently has no data in its output buffer. However, this bit may not remain set for the entire transmission of a message (particularly if it is a long message). This bit will not set SRQ, even if SRQ is enabled.

3.1.3.5.3 <u>Parallel Poll Bit Operation</u>

The record increment bit is set whenever the record increment position is detected. The bit is cleared by a record increment acknowledge command ("Y", addressed command BEL, or universal command ETB).

The SRQ bit is set whenever this unit has requested service by way of the SRQ function (using bit 7 of the serial poll byte) and is cleared when the SRQ serial poll bit is cleared. This bit will not set if SRQ is disabled.

3.1.3.5.4 Serial Polling Operation

Two methods exist for proper serial polling operation. Choosing the method depends on whether SRQ is enabled or disabled. If SRQ is enabled, whenever an event occurs (which causes one of the bits in the serial poll byte to be set) an SRQ occurs and the current state of the serial poll byte will be saved for the next serial poll read operation. The serial poll byte will not be updated again until the serial poll acknowledge occurs. With SRQ enabled, the serial poll acknowledge occurs whenever the serial poll byte is read. When the serial poll byte is updated, if any other bits have been set, another SRQ is generated for those bits, otherwise the SRQ will be cleared.

If SRQ is disabled, a software serial poll acknowledge is required for each change in state of the GPIB error message bit. However, the record increment, serial link error, and overspeed bits only require a software serial poll acknowledge when they have been set. The safest way to implement controller software to serial poll the Model 1885 when SRQ disabled is to perform a software serial poll acknowledge after every serial poll read operation. The software serial poll acknowledge is performed using one of the multiline messages (SYN or ACK) for serial poll acknowledge. The software serial poll acknowledge cannot be used if SRQ is enabled.

3.1.3.6 Talk Only Mode

In the Talk Only Mode, the Model 1885 attempts to send output data over the GPIB (General Purpose Interface Bus) without any prompts. The unit responds by sending messages as if it had received the following commands:

WY, V1, F2, GABCDEF

The unit then sends output data continuously as if it were receiving GET (Group Execute Triggers).

See Section 2.4.6.5 for details concerning set up of Talk Only Mode.

3.1.4 Error Messages

This section provides an explanation of errors which may be reported when operating the Model 1885 over the GPIB interface, through the serial ports, or at the front panel. Some errors may be generated internally and not occur as a direct result of remote or local operation.

Each time errors occur, the Model 1885 flashes an error code on the right Axis Identification Display for a short period. If in local mode, most of the errors stop flashing after a period of 5 seconds. Some errors, however, require an acknowledge from the operator. If the error requires an acknowledge, the DISPLAY and OUTPUT pushbutton LEDs illuminate while the error message is flashing. This condition indicates the operator must acknowledge the error by pressing either DISPLAY or OUTPUT pushbuttons.

If an error requiring operator acknowledgement is flashing, and a subsequent error occurs, the unit will queue the error for display. After acknowledging the error currently flashing, the error previously queued displays, requiring an additional acknowledge. The Model 1885 remembers up to four errors in this fashion, advancing to the next error after each is acknowledged. If more than four errors occur during the period in which operator acknowledge is pending, a special error code (listed in Table 3.14) is generated for the fifth error. This error indicates more errors happened than the unit is capable of storing.

If operating the Model 1885 over the IEEE-488 bus, all errors require an acknowledge. However, the method of acknowledgement differs. In this mode, the error flashes on the display until the controller does a serial poll of the Model 1885. At that time ALL errors in the Model 1885 are acknowledged and the front panel is restored to normal condition. Note that errors are not queued for display in this mode; only the first error flashes on the front panel display. If the unit is switched into local mode while errors are pending, the errors may be acknowledged individually through the procedure described earlier.

NOTE

In this context, "acknowledge" of an error only has to do with error displays on the front panel. When errors are acknowledged through a serial poll, the errors stop flashing on the front panel, but remain queued for retrieval by the IEEE-488 controller.

Table 3.14
Error Messages

Decimal Value	Message	Description
33	Invalid Command	Occurs when the first character of the command cannot be recognized by the parser. If valid, send the command again.
34	Invalid Display Output	Indicates the display or output code for assigning an axis, was not in the valid range of 1-4.
35	Can't Deselect 2012	Indicates a Model 2012/2012A is monitoring the output where the command is attempting to assign an axis, and the axis assigned is not the same axis the Model 2012/2012A is selecting. In this case, the Model 2012/2012A prevails for safety reasons, and the command is ignored.
36	Invalid Axis	Indicates the axis parameter supplied with this command is not one of the valid selections (see the command used for more information).
37	Bad Angular Linear	Indicates the "t" field of configuration command "C" is not one of the valid choices ("A" or "L" for angular and linear respectively). Correct the command and send it again.
38	Bad Source Code	Indicates the source code supplied with command "C" is not valid. Refer to the description of command C for the rules used in constructing a valid source code.
39	Bad Precision	Indicates the "p" field of the configuration command "C" is not valid. Must be: "E", "3", or "1" for encoder, 36:1, and 1:1 respectively.

Table 3.14 - continued

Decimal Value	Message	Description
40	Conflicting Devices	With the "C" command, indicates an attempt to assign two different axes to the same connector. The connector must be flagged as a Model 2013 input and the newly-assigned axis must have a "B" or "H" in the second character of the source code. If neither of these conditions exists, the unit generates a "Conflicting Devices" message and nothing changes. If changing from the Model 2013 input to a direct synchro-type input, the other axes currently assigned to the connector must first be removed. (Make them unused, or move to other connectors.)
41	Only One 2013	With the "C" command, indicates that if an axis has a "B" or "H" in the second character of the source code (indicating input from a Model 2013), and at least one axis already is set up for a Model 2013 on a different connector, an illegal condition exists. Because only one Model 2013 may be connected to the Model 1885, the Model 2013 axes must be on the same connector.
42	No 2013 Encoders	With the "C" command, an axis cannot be set up as an encoder input and as a Model 2013 input simultaneously. Therefore, having "E" in the p field, and "B" or "H" in the second character of the source code is illegal.
43	Bad Pos Data Format	Indicates the position data code supplied with the "F" command is not in the valid range. Refer to the description of the "F" command for more information.
44	Can't Mask Bit 7 or 8	Indicates when configuring the SRQ mask for the status byte, bits 7 or 8 can't be used.
45	Invalid Range	Indicates the range parameter supplied with the command is not valid. Refer to command "R" for additional details.
46	Model 2012 Connected	Indicates the "T" command may be used to define the "selected" axis only if no Model 2012/2012A is connected to the Model 1885. If a Model 2012/2012A exists, it has privileges in axis select functions and the command is ignored.
47	Unimplemented	A command was used which has not yet been implemented. Wait till its done.

Table 3.14 - continued

Decimal Value	Message	Description
48	Untimely Acknowledge	Indicates a "Y" command was sent to acknowledge the record increment trigger but no record increment trigger has yet been generated.
49	Axis Must Be Tracked	Indicates the "J" command sent to start record increment generation, but the record increment axis is not assigned to one of the two tracking outputs. Record increments are generated only for axes assigned to one of the two output connectors (J4 or J5). Use the "A" to assign the axis to one of those two connectors, or use the "S" command to change the record increment axis.
50	S Undefined	Occurs in conjunction with the "Q" command. If the host asks for position data on Axis S ("selected" axis) and Axis S is undefined, this error message is sent. Zero degrees is sent as the position to avoid silence.
51	Bad Input Format	(See Section 3.1.3.4 for a description of Input formats.)
52	Connector Used	Indicates an attempt was made to assign an axis to a connector already being used for another axis for non-Model 2013 input. The only time more than one axis may be assigned to the same connector is when all axes assigned to the connector are flagged as Model 2013 input axes (using a "B" or "H" in the second character of the source code).
53	Internal 1	This error code should never be reported by the Model 1885. If this code is generated, report it to Scientific-Atlanta.
54	Internal 2	This error code should never be reported by the Model 1885. If this code is generated, report it to Scientific-Atlanta.
55	No Error	A no error condition. This code is sent when a request is made for error, and no errors have happened.
56	Invalid Par Poll	Occurs with the "L" command. Bit numbers supplied with the command must be in the range of 0-8 (0 means none).

Table 3.14 - continued

Decimal Value	Message	Description
57	Invalid Hex	Occurs with the "M" command. Requires two digit hex numbers with no extra tag characters on the data (such as leading "X" or trailing "H").
58	Axis Not Used	Indicates an operation was attempted involving an axis currently unconfigured (see "C" command). For example, this error may occur when an unused axis is assigned to a display or output.
59	Data Transmit Pending	Occurs when the Model 1885 has been prompted to send data but receives another command before the data can be sent. Controller software must be designed in such a way as to input pending data from the Model 1885 before sending more commands.
60	No Defined GET Response	Occurs due to performing a GET (Group Execute Trigger) over the bus without first executing the "G" command to define the response to the GET. Also occurs if the response string provided to the "G" command is empty.
61	Consecutive GETs	Occurs when a GET is received by the Model 1885 before it has processed the last GET. When a GET is sent, the data generated by the the GET must be input by the controller before another GET is sent.
62	Record Increment Active	Indicates a "J" command was received to enter Record Increment Mode when the unit was already trying to generate record increments.
63	Just Started Tracking	Indicates a "J" command was received too soon after the Model 1885 began tracking the axis on which the record increments are desired. When an output channel first begins tracking a particular axis, a period of about 200 mS is required for initialization.
64	Too Many Record Increments	Indicates too many record increments determined from the scan parameters (maximum allowable is 65,535). To correct this problem, reduce the scan width or increase the record increment size.
65	Velocity Unstable	Indicates the velocity of the tracking card changed direction during a record increment scan. The positioning system must move at a near constant velocity during a record increment scan for the Model 1885 to produce record increments properly.

Table 3.14 - continued

Decimal Value	Message	Description
66	Invalid SIO Connector	Occurs in conjunction with the "Z" command, indicating the contents of the connector field of that command is invalid. Valid choices are "3" for J3 and "4" for J4.
67	Binary or ASCII	Indicates the binary/ASCII selection field of the "Z" command was invalid. Valid choices are "A" for ASCII, "B" for binary, or "0" for none. Binary data may only be sent on J3 in Model 1886 or in Model 1885 in "1886 mode".
68	J3 J4 Setup in 1886	Indicates an attempt was made to configure an axis with its position data source on J3 or J4. This setup is invalid in the Model 1886. Only the Model 1885 may have remote position data available through the serial connectors.
69	Invalid Verbose Flag	Indicates in using the verbose mode command, the flag specifying verbose or non-verbose was not one of the valid values, "0" or "1". The format of the command is X2n where n = "0", or "1".
70	Already Xmiting	Occurs in response to the "Z" command to start binary of ASCII output on one of the two serial channels. If the unit is already transmitting data on the channel subject to modification by the command, this error is generated. To stop transmission of position data on that channel, a command must first be sent.
71	Binary in 1886 Only	Indicates a Model 1885 was asked to output binary data on one of its serial channels. This may only be done with a Model 1886 or with a Model 1885 in "1886 mode".
72	Binary On J3 Only	Indicates a Model 1886 or a Model 1885 in "1886 mode" was asked to output binary data on a serial connector other than J3. Binary data may only be transmitted on J3.
73	SRQ Disabled	Indicates the rear panel GPIB configuration switch is set up such that SRQ's are to be disabled and a command was received to generate an SRQ on some condition.
74	No Tracking in 1886	The Model 1886 Position Data Processor generates this error if asked to track an axis. Tracking function does not work in the Model 1886.

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Table 3.14 - continued

Decimal Value	Message	Description
75	Invalid Axis Label	Occurs as a result of the "C" command to configure an axis. The Model 1885 does not allow the definition of an Axis Identification label which contains characters not in the valid character set used during front panel operation. The set of characters which may be used in an Axis Identification label are: ABCDEFGHIJKLMNOPQRSTUVWXYZ (blank) 0123456789 _!'*+-=./?<>.
76	Invalid Switch Press	Occurs when pressing a front panel pushbutton which has no meaning for the current mode of operation. For instance, when after pressing AXIS, no display or output is selected.
77	ERR Bad Front Panel	Indicates the Model 1885 is unable to properly initialize and communicate with the 8279 front panel controller. Since the Axis Identification Displays are controlled separately, this error may be displayed in spite of the 8279 problem. If this error occurs, the Model 1885 will not be polling the 8279 for switch presses and releases, and the front panel update job will not be scheduled. Therefore, those functions are guaranteed not to work until the problem is corrected.
78	First Acknowledge Error	Begin list requiring acknowledge.
79	Break False	Represents a hardware failure. Occurs when the Model 1885 goes from a break true condition to a break false condition on the serial link. The "true" error occurred when break went true, since the Model 1885/1886 does not detect break.
80	More Errors	May display during an error acknowledge sequence indicating more errors were generated than the software will queue for display. At least one error happened for which you have no access.
81	Break True	Represents a hardware failure of the Model 1885/1886. The Model 1885 serial hardware does not detect break. Therefore, this error should never happen if the hardware is functioning properly.

Table 3.14 - continued

Decimal Value	Message	Description
82	Framing Error	Serial communications error detected by the 2681 DUART. The Model 1885 re-initializes the channel on which the error occurred.
83	Parity Error	Indicates the 2681 flagged an error in the parity of data received. The channel on which the error occurred is re-initialized.
84	Overrun Error	Indicates the 2681's input FIFO (First-In, First-Out) was overrun before being serviced by the software. Normally this error will not occur. If it does, the Model 1885 re-initializes the serial channel on which the error occurred.
85	Lazy 1886	Generated when the Model 1885 gets a lack of response from the Model 1886 during binary data transfers.
86	Bad Pos Bufr	Occurs when the Model 1885 receives a position data sample from the Model 1886 containing bad data. The Model 1885 unit checks a CRC associated with the data to detect errors.
87	Invalid 1886 Response	Occurs when the Model 1885 gets an invalid response to a command or inquiry to the Model 1886. The Model 1885 attempts to re-initialize the Model 1886 under these conditions.
88	Bad Baud Select	Indicates a baud rate switch setting was used on the Encoder/Timing Assembly which is not supported. Choose a valid rate and power-up the unit again.
89	Asked For Unused Axis	Occurs when the Model 2012 selects an axis by way of the Axis Select Input, and the selected axis has not been configured at the Model 1885. To correct the situation, configure the axis in set-up mode, and reselect the axis at the Model 2012.
90	Last Acknowledge Error	End list requiring acknowledge.

3.1.5 Sample Program

This section provides a printed sample program to use as a guideline for setting up and using the Model 1885 Digital Position Indicator over the IEEE-488 bus with a Hewlett-Packard Model 9836 calculator/controller. The computer language is shown for the Model 9836 only and may not be applicable to other type controllers.

```
10    ! IEEE DEMONSTRATION PROGRAM
11    ! VER 1.10, 12-16-85
12    ! THIS PROGRAM DEMONSTRATES SOME OF THE
13    ! MORE ELEMENTARY FEATURES OF 1885 REMOTE
14    ! OPERATION VIA IEEE BUS.
19    !
20    ! SOME WORDS ABOUT THIS HP BASIC...
21    ! K$[X;Y] MEANS THE SUBSTRING OF K$,
22    ! STARTING AT POSITION X AND OF LENGTH
23    ! Y; WHERE THE FIRST POSITION OF K$ IS
24    ! POSITION 1.
25    !
26    ! ASSIGN @BOX TO 704 - MEANS EQUATE @BOX
27    ! WITH DEVICE NUMBER 7 (IEEE BUS), AT
28    ! DEVICE ADDRESS 4 (SETTING OF SWITCH ON
29    ! 1885 REAR PANEL)
30    !
31    Ateenat5=4  ! 1885 REAR PANEL IEEE ADDRESS
32    Total_errors=56
34    DIM Error$(56)[30] ! RESERVE SPACE FOR ERRORS
35    DIM A$[100],B$[100],C$[100]
36    ! THESE DATA STATEMENTS DESCRIBE THE
37    ! ERRORS DELIVERED BY THE 1885
38    !
168   DATA INVALID COMMAND
178   DATA INVALID DISPLAY/OUTPUT
188   DATA CAN'T DESELECT 2012
198   DATA INVALID AXIS
208   DATA BAD ANGULAR/LINEAR
218   DATA BAD SOURCE CODE
228   DATA BAD PRECISION
238   DATA CONFLICTING DEVICES
248   DATA ONLY ONE 2013
258   DATA NO 2013 ENCODERS
268   DATA BAD POSITION FORMAT
278   DATA CAN'T MASK BIT 7 OR 8
288   DATA INVALID RANGE
298   DATA 2012 CONNECTED
308   DATA UNIMPLEMENTED
```

```
318   DATA UNTIMELY ACKNOWLEDGE
328   DATA AXIS MUST BE TRACKED
329   DATA S UNDEFINED
330   DATA BAD INPUT FORMAT
331   DATA CONNECTOR USED
332   DATA INTERNAL 1
333   DATA INTERNAL 2
334   DATA NO ERROR
335   DATA INVALID PARALLEL POLL
336   DATA INVALID HEX
337   DATA AXIS NOT USED
338   DATA DATA TRANSMIT PENDING
339   DATA NO DEFINED GET RESPONSE
340   DATA CONSECUTIVE GETS
341   DATA RECORD INCREMENT ACTIVE
342   DATA JUST STARTED TRACKING
343   DATA TOO MANY RECORD INCREMENTS
344   DATA VELOCITY UNSTABLE
345   DATA INVALID SIO CONNECTOR
346   DATA BAD BINARY OR ASCII
347   DATA J3 OR J4 SETUP IN 1886
348   DATA INVALID VERBOSE FLAG
349   DATA ALREADY XMITTING
350   DATA BINARY IN 1886 ONLY
351   DATA BINARY ON J3 ONLY
352   DATA SRQ DISABLED
353   DATA NO TRACKING IN 1886
354   DATA INVALID AXIS LABEL
355   DATA INVALID SWITCH PRESS
356   DATA BAD FRONT PANEL
357   DATA 1886 OK
358   DATA BREAK FALSE
359   DATA MORE ERRORS
360   DATA BREAK TRUE
361   DATA FRAMING ERROR
362   DATA PARITY ERROR
363   DATA OVERRUN ERROR
364   DATA LAZY 1886
365   DATA BAD 1886 POSITION CRC
366   DATA INVALID 1886 RESPONSE
367   DATA BAD BAUD RATE
368   DATA ASKED FOR UNUSED AXIS
370   READ Error$(*)  ! READ DATA TILL ARRAY FULL
470   ASSIGN @Box TO 700+Ateenat5 ! BOX=IEEE BUS
480   PRINT CHR$(12); ! CLEAR SCREEN
481   !
482   ! DISPLAY MAIN MENU OF PROGRAM OPTIONS
483   !
484   PRINT "   * * * IEEE DEMONSTRATION * * *"
485   PRINT "           FOR 1885 UNIT"
```

```
486   PRINT
487   PRINT
489   PRINT
490   PRINT "1) CONFIGURE AN AXIS"
491   PRINT "2) UNCONFIGURE ALL AXES"
492   PRINT "3) DISPLAY AXIS CONFIGURATION"
494   PRINT "4) ASSIGN AXIS TO DISPLAY OR OUTPUT"
495   PRINT "5) PRESET POSITION FOR AXIS"
496   PRINT "6) OFFSET POSITION FOR AXIS"
497   PRINT "7) SAMPLE POSITION OF AXIS"
498   PRINT "8) SEND RAW COMMAND TO 1885"
499   PRINT "9) INPUT STRING FROM 1885"
501   PRINT ! BLANK LINE MAKES FOR PRETTY SCREEN
506   INPUT "YOUR SELECTION ",X
507   PRINT CHR$(12);          ! CLEAR SCREEN
508   IF X<1 THEN 480
509   IF X>9 THEN 480
510   IF X>6 THEN 519
516   ON X GOSUB 1000,2000,3000,4000,5000,6000
517   GOTO 480
519   ON X-6 GOSUB 7000,8000,9000
526   GOTO 480 ! CLEAR SCREEN AND DISPLAY AGAIN
1000  !
1010  ! THIS ROUTINE CONFIGURES AN AXIS.  THE
1011  ! 'C' AND 'R' COMMANDS ARE SENT TO 1885.
1012  !
1020  PRINT CHR$(12) ! CLEAR SCREEN
1030  LINPUT "AXIS, A-F TO CONFIGURE ",A$
1040  LINPUT "A=ANGULAR, L=LINEAR ",T$
1050  LINPUT "SOURCE CONNECTOR 3-4, OR 7-9 ",S1$
1060  X=VAL(S1$)    ! DETERMINE WHAT CONNECTOR
1070  IF X<7 THEN 1200    ! ASSUME 3 OR 4 THERE
1100  ! THIS ROUTINE HANDLES THE CASE OF DIRECT
1110  ! INPUTS TO J7-J9 TO THE 1885
1120  !
1130  PRINT "SELECT TYPE OF INPUT:"
1140  PRINT "0 = DIRECT SYNCHRO OR ENCODER"
1150  PRINT "H = 2013, HOLD WHEN NO POSITION"
1160  PRINT "B = 2013, BLANK WHEN NO POSITION"
1170  PRINT
1180  LINPUT "SELECT ONE OF THE ABOVE ",S2$
1190  GOTO 1300
1200  ! THIS ROUTINE HANDLES THE CASE OF REMOTE
1210  ! INPUTS THROUGH THE 1886 UNIT
1220  LINPUT "CONNECTOR 7-9 AT 1886 ",S2$
1300  PRINT "SELECT PRECISION OF INPUT:"
1310  PRINT "E = 256:1 ENCODER WITH 1:1 SYNCHRO"
1320  PRINT "3 = 36:1 AND 1:1 SYNCHROS"
1330  PRINT "1 = 1:1 SYNCHRO"
1350  LINPUT "SELECT ONE OF THE ABOVE ",P$
```

```
1351  PRINT
1353  PRINT "SELECT RANGE OF POSITION DATA:"
1354  PRINT "1 = UNIPOLAR"
1355  PRINT "2 = BIPOLAR"
1356  LINPUT "CHOOSE ONE OF THE ABOVE ",N$
1360  LINPUT "UP TO 8 CHARACTER AXIS LABEL ",L$
1400  !
1410  ! THIS SECTION OUTPUTS THE CONFIGURATION
1420  ! PARAMETERS TO THE 1885.  THE VARIABLES
1430  ! USED TO GATHER THE PARAMETERS CORRESPOND
1440  ! CLOSELY WITH THE SYNTAX OF THE COMMAND
1450  ! DESCRIPTION IN THE MANUAL.
1460  !
1470  OUTPUT @Box;"C";A$;T$;S1$;S2$;P$;L$;",";
1471  OUTPUT @Box;"R";A$;N$;",";
1490  GOSUB 10000 ! SERIAL POLL TO CHECK ERRORS
1500  RETURN
2000  !
2010  ! THIS ROUTINE UNCONFIGURES ALL THE
2020  ! AXES.  YOU SHOULD DO THIS BEFORE DOING
2030  ! CONFIGURATIONS IF YOU WANT TO AVOID
2040  ! ERRORS CAUSED BY INCOMPATABILITES
2050  ! BETWEEN YOUR NEW CONFIGURATIONS AND
2060  ! THE PRESENT CONFIGURATIONS
2070  !
2080  OUTPUT @Box;"CAA07EAXIS-A,";
2090  OUTPUT @Box;"CBA07EAXIS-B,";
2100  OUTPUT @Box;"CCA07EAXIS-C,";
2110  OUTPUT @Box;"CDA07EAXIS-D,";
2120  OUTPUT @Box;"CEA07EAXIS-E,";
2130  OUTPUT @Box;"CFA07EAXIS-F,";
2140  !
2150  ! THE DISPLAY ON THE 1885 SHOULD NOW
2160  ! BE BLANK.  IF YOU POWER IT UP IN THIS
2170  ! STATE IT WILL SAY "SETUP REQUIRED" ON
2180  ! THE FRONT PANEL
2190  !
2200  GOSUB 10000        ! CHECK FOR ERRORS
2210  RETURN
3000  !
3010  ! THIS ROUTINE DISPLAYS THE CONFIGURATION
3020  ! OF AN AXIS.  IT USES THE V1 COMMAND TO
3030  ! GET THE CONFIGURATION OF EACH AXIS, AND
3040  ! THEN SCANS THE CONFIGURATION FOR THE
3050  ! AXIS REQUESTED BY THE OPERATOR
3060  !
3070  OUTPUT @Box;"V1,";
3080  GOSUB 10000         ! CHECK FOR ERRORS
3090  IF X=-1 THEN GOTO 3999 !    ERROR HAPPNED
3100  IF X<>1 THEN GOTO 3900 ! NO DATA PENDING
```

```
3110  !
3120  ! ASK OPERATOR WHICH AXIS TO GET
3130  !
3140  LINPUT "AXIS, A-F ",A$
3170  !
3180  ! INPUT EACH LINE, LOOKING FOR THE AXIS
3190  !
3200  FOR X=1 TO 6   ! 6 LINES OF AXIS INFO
3210  ENTER @Box USING "K";B$ ! GET NEXT LINE
3220  !
3230  ! CHECK 2ND CHAR OF LINE - ITS THE AXIS
3240  !
3250  IF B$[2;1]=A$ THEN C$=B$     ! SAVE LINE
3260  NEXT X
3261  ENTER @Box USING "K";B$ ! GET LAST LINE
3270  !
3280  ! NOW THE AXIS CONFIGURATION IS IN C$
3290  !
3300  PRINT
3310  PRINT "CONFIGURATION OF AXIS ";C$[2;1]
3311  PRINT "AXIS LABEL -> ";C$[7;8]
3320  PRINT "AXIS IS ";
3321  IF C$[4;1]<>"0" THEN 3330
3322  PRINT "UNCONFIGURED."
3323  GOTO 3990
3330  IF C$[3;1]="A" THEN GOTO 3360
3340  PRINT "LINEAR"       ! NOT ANGULAR IS LINEAR
3350  GOTO 3370
3360  PRINT "ANGULAR"      ! 'A' MEANS ANGULAR
3370  IF C$[4;1]>="7" THEN 3500
3400  !
3410  ! SINCE THE 1ST CHAR OF SOURCE CODE IS
3420  ! LESS THAN '7', IT IS '3' OR '4'.  THIS
3430  ! MEANS IT COMES FROM THE 1886.
3440  !
3450  PRINT "REMOTE INPUT AT J";C$[4;1];" ON"
3460  PRINT "1885, CONNECTED TO J";C$[5;1];" ON"
3470  PRINT "1886."
3480  GOTO 3700
3500  !
3510  ! SINCE 1ST CHAR OF SOURCE CODE IS => '7'
3520  ! THE AXIS IS A DIRECT INPUT TO THE 1885
3530  !
3540  PRINT "AXIS IS A DIRECT INPUT TO 1885"
3550  PRINT "ON J";C$[4;1];"."
3560  IF C$[5;1]="0" THEN 3700
3570  !
3580  ! SINCE 2ND CHAR OF SOURCE CODE IS NOT
3590  ! '0', IT IS A 2013 INPUT AS WELL
3600  !
3610  PRINT "COMES THROUGH 2013 - ";
```

```
3620  IF C$[5;1]<>"B" THEN 3650
3630  PRINT "BLANK"
3640  GOTO 3660
3650  PRINT "HOLD"
3660  PRINT "POSITION WHEN DATA UNAVAILABLE."
3700  !
3710  ! NEXT, SHOW PRECISION OF POSITION DATA
3720  ! ON THE AXIS
3730  !
3740  PRINT "POSITION IS SAMPLED FROM"
3741  PRINT "1:1 SYNCHRO ";
3750  IF C$[6;1]<>"E" THEN 3780
3760  PRINT "AND 256:1 ENCODER."
3770  GOTO 3800
3780  IF C$[6;1]<>"3" THEN 3800
3790  PRINT "AND 36:1 SYNCHRO."
3800  PRINT "RANGE OF AXIS IS ";
3810  IF C$[LEN(C$)-1;1]="1" THEN 3840
3820  PRINT "BIPOLAR"
3830  GOTO 3850
3840  PRINT "UNIPOLAR"
3850  GOTO 3990
3900  !
3910  ! THIS SHOULD NEVER HAPPEN.  ITS AN ERROR
3920  ! IN YOUR TEST PROGRAM.
3930  !
3940  PRINT "IMPOSSIBLE..."
3950  GOTO 3950
3990  LINPUT "KEY <RETURN> TO CONTINUE",A$
3999  RETURN
4000  !
4010  ! THIS ROUTINE ASSIGNS AN AXIS FOR
4020  ! DISPLAY OR OUTPUT ON THE 1885
4030  !
4040  LINPUT "AXIS TO ASSIGN, A-F,S,0 ",A$
4050  PRINT "ASSIGN AXIS TO:"
4060  PRINT "1 = LEFT DISPLAY"
4070  PRINT "2 = RIGHT DISPLAY"
4080  PRINT "3 = LEFT OUTPUT (J5)"
4090  PRINT "4 = RIGHT OUTPUT (J6)"
4100  PRINT
4110  LINPUT "CHOOSE ONE OF THE ABOVE ",N$
4120  !
4130  ! SEND THE ASSIGN COMMAND TO THE 1885
4140  !
4150  OUTPUT @Box;"A";A$;N$;",";
4160  GOSUB 10000           ! CHECK FOR ERRORS
4999  RETURN
5000  !
5010  ! THIS ROUTINE SENDS A PRESET COMMAND
```

```
5020  ! TO THE 1885.  THE POSITION IN THE 1885
5030  ! WILL BE SET TO THE VALUE ENTERED BY
5040  ! THE OPERATOR.
5050  !
5060  LINPUT "AXIS TO PRESET, A-F,S=SELECTED ",A$
5070  LINPUT "VALUE +/-XXX.XXXX DEGREES ",B$
5080  OUTPUT @Box;"P";A$;B$;",";
5090  GOSUB 10000          ! CHECK FOR ERRORS
5999  RETURN
6000  !
6010  ! THIS ROUTINE SENDS AN OFFSET COMMAND
6020  ! TO THE 1885.  THE POSITION IN THE 1885
6030  ! WILL BE OFFSET BY THE VALUE SPECIFIED
6040  !
6050  LINPUT "AXIS TO OFFSET, A-F,S=SELECTED ",A$
6060  LINPUT "VALUE +/-XXX.XXXX DEGREES ",B$
6070  OUTPUT @Box;"O";A$;B$;",";
6080  GOSUB 10000          ! CHECK FOR ERRORS
6999  RETURN
7000  !
7010  ! THIS ROUTINE SAMPLES POSITION DATA
7020  ! ON AN AXIS.  IT USES THE "Q" COMMAND
7030  ! TO GET THE DATA IN ASCII DECIMAL DEGREES
7040  !
7050  LINPUT "AXIS TO SAMPLE, A-F,S",A$
7060  OUTPUT @Box;"F2,Q";A$;",";
7070  GOSUB 10000 ! WAIT TILL DATA PENDING
7080  IF X=-1 THEN 7999      ! AN ERROR HAPPND
7090  IF X=1 THEN 7200       ! SAW DATA PENDING
7100  PRINT "SOFTWARE ERROR, NO DATA PENDING"
7110  LINPUT "KEY <RETURN> TO CONTINUE",A$
7120  GOTO 7999
7200  ENTER @Box USING "K";B$ !ENTER STRING
7210  PRINT "POSITION = ";B$
7220  LINPUT "KEY <RETURN> TO CONTINUE",A$
7999  RETURN
8000  !
8010  ! THIS ROUTINE WILL LET THE OPERATOR
8020  ! DIRECTLY ENTER A COMMAND OR COMMANDS
8030  ! FOR THE 1885.
8040  !
8050  PRINT "ENTER COMMAND(S) FOR 1885,"
8060  PRINT "SEPARATING THE COMMANDS BY"
8070  PRINT "DELIMITERS (,;)"
8080  LINPUT A$
8090  OUTPUT @Box;A$;END  ! SEND STRING W/EOI
8091  PRINT
8100  GOSUB 10000         ! CHECK FER ERRORS
8999  RETURN
9000  !
```

```
9010   ! THIS ROUTINE ENTERS DATA FROM THE 1885
9020   ! IF THE 1885 HAS NOTHING TO SEND, AN
9030   ! ERROR IS REPORTED
9040   !
9050   GOSUB 10000       ! CHECK FER DATA PENDING
9060   IF X=1 THEN 9100
9070   PRINT "NO DATA PENDING!"
9080   GOTO 9990
9100   ENTER @Box USING "K";A$
9110   PRINT "DATA STRING FROM 1885:"
9120   PRINT A$
9990   LINPUT "KEY <RETURN> TO CONTINUE",A$
9999   RETURN
10000 !
10010 ! THIS SERIAL POLLS THE 1885 AFTER A
10020 ! DELAY OF ABOUT 250MS.  IF THE 1885
10030 ! RETURNS 0 IN THE SERIAL POLL REGISTER,
10040 ! 0 IS RETURNED IN X BY THIS ROUTINE.
10050 ! IF THE ERROR BIT IS SET IN THE SERIAL
10060 ! POLL, THE ERROR CAUSE IS DETERMINED
10070 ! AND REPORTED AND -1 IS RETURNED.  IF
10080 ! DATA PENDING BIT IS SET, 1 IS RETURNED.
10090 !
10100 WAIT .25 ! WAIT ABOUT 250 MILLISECONDS
10110 X=SPOLL(@Box)     ! SERIAL POLL AT 1885
10120 IF X=0 THEN GOTO 10999
10130 !
10140 ! THE BINAND(X,Y) FUNCTION DOES A BINARY
10150 ! AND OF THE TWO OPERANDS AND RETURNS
10160 ! THE BINARY RESULT OF THE OPERATION
10170 ! THE CASE BELOW TESTS BIT 5, THE ERROR
10180 ! BIT IN THE 1885.
10190 !
10200 IF BINAND(X,32)<>0 THEN GOTO 10300
10210 !
10220 ! NOW TEST THE DATA PENDING BIT, IF SET
10230 ! RETURN 1
10240 !
10250 IF BINAND(X,128)=0 THEN GOTO 10999
10260 X=1
10270 GOTO 10999
10300 !
10310 ! AN ERROR HAS HAPPENED IN THE 1885.
10320 ! SEND THE "K" COMMAND TO DETERMINE
10330 ! WHAT ERRORS, AND REPORT THEM TO THE
10340 ! OPERATOR.
10350 !
10360 ! FIRST DUMP ANY DATA PENDING AT THE 1885
10370 !
10371 WAIT .25            ! WAIT FOR DATA PENDNG
```

```
10380 X=SPOLL(@Box)        ! CHECK FOR DATA PENDING
10390 IF X<128 THEN GOTO 10500    ! BIT 7 NOT SET
10400 ENTER @Box USING "#,B";B    ! INPUT ONE BYTE
10410 GOTO 10380           ! KEEP ON TILL ALL INPUT
10500 OUTPUT @Box;"K,";    ! SEND K WITH DELIMITER
10510 ENTER @Box USING "#,B";B    ! GET NEXT ERROR
10520 IF B=55 THEN GOTO 10900     ! GOT ALL ERRORS
10530 IF B<=33+Total_errors THEN GOTO 10535
10531 PRINT "UNRECOGNIZED ERROR CODE"
10535 PRINT "ERROR -> ";B;" = ";Error$(B-33)
10540 X=SPOLL(@Box)        ! SEE IF MORE ERRORS
10550 IF X>=128 THEN 10510 ! YES, GET 'EM
10900 X=-1                 ! MEANS AN ERROR HAPPNED
10910 LINPUT "KEY <RETURN> TO CONTINUE",X$
10999 RETURN
20000 END
```

3.1.6 Model 1885/1886 Serial Communications

During normal operation, serial connectors J3 and J4 provide communication between the Model 1885 Digital Position Indicator and the Model 1886 Position Data Processor. Each time power is applied to the Model 1885, it checks for any axis configurations which require position data from Model 1886. If any exist, the Model 1885 sends commands to the Model 1886 on the appropriate serial connector, initializing parameters in the Model 1886 and starting transfer of binary position data for the axes assigned to that Model 1886. The Model 1886 sends out ASCII position data on connector J4 after receiving configuration commands from 1885. (See Table 3.11, Command "Z" in the the IEEE-488 bus command descriptions for the format of the ASCII output.)

If there are no axes configured in the Model 1885 requiring position data from a serial connector, that connector will not be used. In this configuration it is possible to connect a "dumb terminal" to the serial port and gain access to information similar to that provided over the IEEE-488 interface. The following section is dedicated to describing this mode of operation.

3.1.6.1 Command Processing Using Serial Connectors

All commands made available through the IEEE-488 bus are also available on the serial connectors. This facility can be used at the same time as the IEEE-488 bus is active. However, if modes of operation are selected which conflict with those selected over the IEEE-488 bus, you may see unexpected behavior in the Model 1885.

Each serial port will be configured for 8 data bits/no parity, and 1 stop bit. XON/XOFF protocol is used, so output in the Model 1885 may be suspended and resumed by using the control keys 'S' and 'Q' respectively. As described in Section 2.4.6.2, baud rates are configured using the rotary switches on the Encoder/Timing Assembly. Switch values in the range of 8-D parallel the baud rates defined for switch values in the range of 0 - 5. The difference is the high range of numbers provides an 'echo' of each received character during "verbose mode".

In verbose mode, the Model 1885 or Model 1886 provides a more interactive environment than normally provided to an IEEE-488 bus controller. Errors are reported as they happen, with descriptive error messages instead of error codes. In the Model 1885, verbose mode is selected as soon as the first command delimiter is received. The Model 1885 will announce initialization of the serial channel at that time by sending the output of the "WY" (who are you) command. This announcement looks something like this:

SA 1885 FIRMWARE #A316358D

In Model 1886 on connector J3, verbose mode is controlled a little differently. The Model 1886 will not go into verbose mode on receiving the first delimiter. Instead, the command for selecting verbose mode must be sent serially to the unit. See Table 3.11 on the X2 command for a description of verbose mode selection.

NOTE

Since neither unit is in verbose mode until a delimiter is received, a terminal setup to receive an echo will not show what you're typing until the Model 1885 receives the first delimiter.

One command available through the serial interface, not available over the IEEE-488 bus, is the "HELP" command. If you type HELP, terminated by a delimiter, the Model 1885 and Model 1886 will send a single line description of each command. Each line contains the syntax of the command followed by a brief description of the command.

CHAPTER FOUR
THEORY OF OPERATION

4.1 INTRODUCTION

A circuit operation discussion for the Model 1885 Digital Position Display, the Model 1886 Position Data Processor, and the Encoder Processor, is provided in this chapter in two basic sub-sections: a general and a detailed circuit description. Of these two subsections, the more basic material is provided in the General section, whereas more technical information (a description of each internal circuit assembly) is provided in the Detailed Circuit Description section.

NOTE

This chapter provides sufficient technical details to aid in understanding the equipment's suitability for potential applications and to aid in maintaining the equipment. Some explanations and technical details have been simplified where appropriate.

4.2 GENERAL

4.2.1 Firmware

The firmware for the Model 1885 and the Model 1886 exists in EPROMS located on the CPU assembly. When power is applied to the unit, the 8088 microprocessor resets and begins executing the instructions contained in the EPROMS. The first functions executed initialize the software and the hardware to prepare the unit for operation. With the Model 1885, this includes restoring the setup parameters saved in non-volatile memory.

In both units, the firmware is "interrupt-driven". In other words, the unit remains in an idle loop until an interrupt occurs. When an interrupt occurs, the unit performs the appropriate task to respond to the particular event which caused the interrupt. The idle loop task triggers the watchdog timer to prevent a reset of the CPU. If the idle loop is not run (an overload condition), the timer resets the CPU causing the power-up sequence to run again. Encoder data ready, synchro data ready, and serial I/O interrupts occur in both the Model 1885 and Model 1886. The Model 1886 has an additional interrupt associated with the serial interface. The Model 1885 has two additional interrupts--one for GPIB I/O and one for record increments.

Encoder data ready and synchro data ready interrupts occur at a rate dependent on line frequency and indicate that a new set of position data is available. The respective inputs are read and stored in separate axis structures according to the definitions provided by the user in Setup Mode. The input data are converted only when needed for some type of display or output (such as front panel, GPIB, tracking output, or serial output). The inputs are converted to 32-bit binary fraction of a circle format which is used internally (see Section 3.1.3.4). If another format is needed for output (such as with GPIB operation), the binary fraction of circle is converted to the desired format.

The serial interface is used primarily to transfer data from the Model 1886 to the Model 1885. The Model 1886 reads and converts encoder and synchro information for its three inputs and transmits it to the Model 1885 over the serial link. The Model 1885 receives these three positions and saves them in the axis structures defined by the user in Setup Mode.

The tracking algorithm uses the local or remote inputs to control the position tracking/output hardware. The program computes a velocity based on the change in input position over time and the differences between the input position and the output position. This velocity is applied to the hardware which changes the position at the specified rate.

The front panel interface runs on a timed basis to sense the switch presses and releases and update the displays. The position information displayed may originate locally or remotely. Front panel operation is described in greater detail in Section 4.3.7.

The GPIB interface driver firmware receives an interrupt whenever bus servicing is required (such as byte input, output, and control signals). The firmware saves the data in an input buffer until a valid delimiter is received, at which time the data are transferred to a command processor. This command processor performs whatever actions are necessary as a result of the information received over the GPIB. If an output message is necessary, the command processor sends the message to the driver firmware, which in turn sends the message over the bus through the GPIB hardware at the proper time. Since the output buffer is of finite length, it must be read by the system controller before it becomes full. In practice, when the system controller asks for data from the Model 1885, it must allow the Model 1885 to talk over the bus before requesting more data.

The axis select function is also controlled by the firmware. It reads the axis select input to determine which is the selected axis. If no axis is selected by the axis select input, the selected axis is determined by the process represented in the flowchart of Figure 4.1. The axis select output to the Model 2013 Axis Select unit (or equivalent type unit) is determined on a priority basis. If the selected axis comes from the Model 2013, then the axis select output is equal to the axis select input. However, if the selected axis does not come from a Model 2013, the program examines the right output (J6), the left output (J5), the right display, and the left display in that order to determine which (if any) is currently assigned an axis from the Model 2013. As soon as a requirement is found, the axis select output selects whichever axis is required. If no display or output needs an axis from the Model 2013, the axis select output selects no axis.

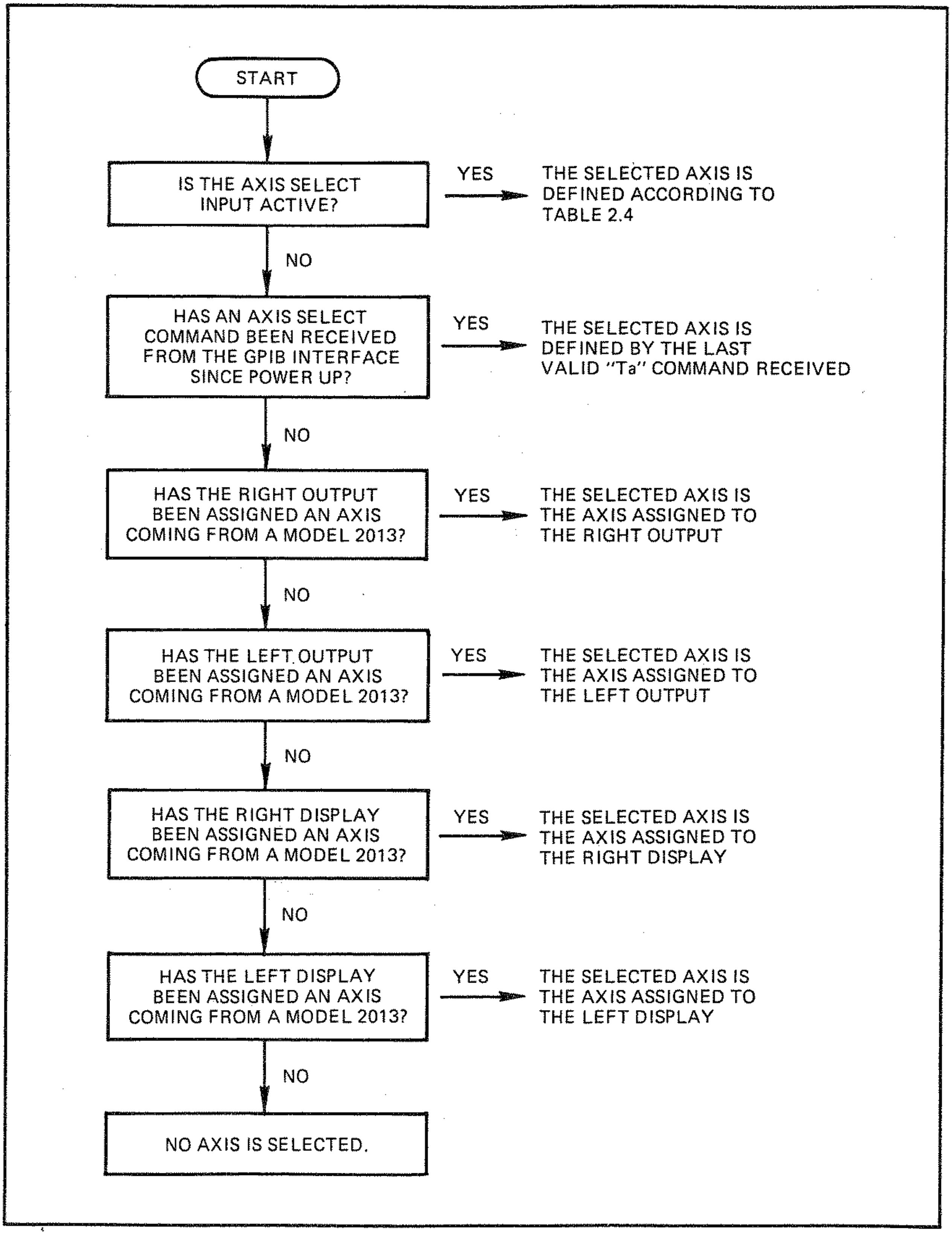


Figure 4.1. Axis Selection Process

Non-volatile memory, contained in the Model 1885, remembers all setup and configuration information. This memory is updated once per second to keep up-to-date information. When power is removed from the unit, the hardware retains the information stored. When power is reapplied (if the contents of NV memory are valid, verified through a cyclic redundancy check), the stored information is used to restore the instrument to its pre-power loss state. If an error is detected in non-volatile memory, the unit resets and setup information is lost.

Model 1886 operation is very similar to the Model 1885 operation except the Model 1886 has no tracking outputs, front panel display, GPIB interface, axis select I/O, or non-volatile memory. The Model 1886 primarily performs synchro and encoder input and conversion, and transmits the data serially to the Model 1885 as previously described.

4.2.2 Axis Definition

Axes A through F are defined for the Model 1885 as described in Section 2.4.5. These definitions must correspond with the actual system configuration. Each axis has specific information which it is assigned to in Setup Mode (or over the GPIB). This information (the angular/linear flag, the input source, the input type, and the label) is all associated with each axis called A, B, C, D, E, or F. By allowing the user to define these axes, many different system configurations are possible.

4.2.3 Serial Interface Considerations

Some additional considerations are necessary when using the serial interface with a modem or any other means of transmission besides a direct cable. Even though Request to Send and Clear to Send signals are provided, the Model 1886 must always be allowed to send data whenever it is ready. If Clear to Send is ever false, the possibility exists for an error. However, the Model 1885 does not have this same constraint.

Another consideration is group delay through the transmission medium. The Model 1885 assumes zero group delay and will not correct for constant or variable group delay which may exist in the link. (Group delay in this situation is defined as the time between when a Model 1886 bit transition occurs and when the corresponding bit transition arrives at the Model 1885.) Any delays produce a position lag equal to the group delay multiplied by the the positioner speed. This lag will be seen as a dynamic error in the system. If the group delay is constant and the positioner speed is constant, a constant position offset will occur, which will affect not only accuracy but may affect system data acquisition speed. For example, a constant group delay of 10 milliseconds and a positioner speed of 1 RPM produces a position offset of 0.060 degrees.

4.2.4 **Position Tracking***

Before discussing the hardware details of the Model 1885 and 1886, this section provides a functional explanation of the heart of the Indicator's operation--position tracking. Most position indicator units simply accept, process, and output position data providing no compensation for the time lag due to delays in signal processing. This phenomenon causes inaccurate and/or obsolete position data to be sent out as compared to the actual status of the positioner. The Model 1885, however, uses a position tracking algorithm to accurately simulate positioner movement. In this manner, position output data are always up-to-date and simultaneous with actual positioner movement. Tracking is particularly helpful in remote systems where a serial link couples the display unit to the optional Model 1886, potentially adding delays in position data processing.

The internal circuit primarily responsible for simulating positioner motion is the Position Tracking/Output circuit, controlled by the 8088 microprocessor. The tracking process is based on the assumption that velocity will be constant during the succeeding measurement periods and equal in value to the previous period. First, the microprocessor samples positions at the

* Patent Pending, October 1985

beginning and end of a time period and determines the overall tracking velocity. The microprocessor adjusts this velocity value to correct any position error already present in the tracking model, and sends the result to the Position Tracking/Output assembly. The position data for output are then changed and corrected accordingly over the next sample period. Tracking velocity for a succeeding period is calculated as shown here:

$$V_{Tn,n+1} = V_p - \frac{P_e}{\Delta t}$$

where:

$V_{Tn,n+1}$ = tracking velocity for the period from $n\Delta t$ to $(n+1)\Delta t$

V_p = calculated positioner velocity

P_e = position error at end of period

Δt = length of time period

Therefore:

$$V_{Tn,n+1} = \left(\frac{P_n - P_{n-1}}{\Delta t} \right) - \left(\frac{P_{sn} - P_n}{\Delta t} \right)$$

where: P_n = last sample point of the period

P_{n-1} = original sample point of the period

P_{sn} = simulated position

For the sake of simplifying this discussion, we are first presenting a somewhat hypothetical example of how the Model 1885 performs delay compensation. Afterwards, an example closer to actual operating conditions is presented.

Refer to the graph in Figure 4.2 and to the related data in Table 4.1. The two components in calculating velocity, position and time, are plotted with position units on the vertical axis and time units on the horizontal axis. The solid lines represent actual position and velocity, while the dashed lines represent simulated position and velocity. Note the velocity, as shown in Figure 4.2. During the initial start-up period of the system (period Z), the positioner is at zero velocity. At time = 0, the actual velocity changes abruptly to a value of "1" and remains at this velocity throughout the remaining periods.

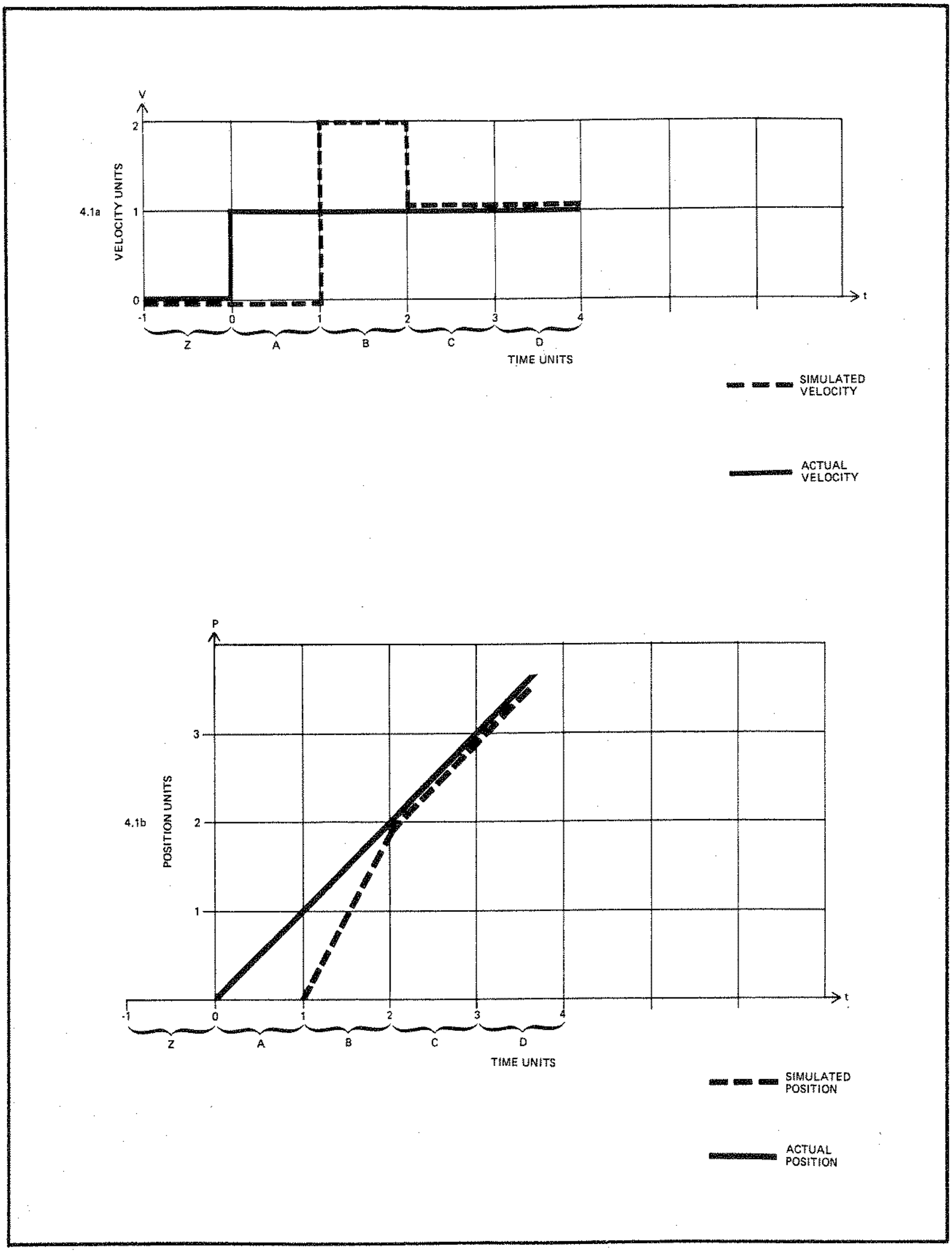


Figure 4.2. Model 1885 Time Delay Compensation

Table 4.1
Tracking Error Data for Figure 4.1

Period	Average Positioner Velocity	Simulated Velocity	Position Error At End Of Period	Calculated Tracking Velocity Applied To The Next Period
Z	0	0	0	0
A	1	0	-1	2
B	1	2	0	1
C	1	1	0	1
D	1	1	0	1

As Figure 4.2a shows for period Z, assume the initial simulated velocity is zero, meaning the simulated velocity equals actual velocity. The microprocessor takes the beginning and ending points in period Z and calculates a tracking velocity of "zero" for the next period (or A) as indicated in two columns of the chart in Table 4.1. (Note the value underneath the heading **Calculated Tracking Velocity Applied to the Next Period** of one period becomes the **Simulated Velocity** of the next period.) However, as indicated on the graph, the actual velocity of the positioner during period A is not zero. Instead, it has changed to "1". This means the assumption made previously by the Position Tracking/Output simulator circuit (that the tracking velocity would be zero during period A) is incorrect, resulting in a position error of -1 by the end of the period. Correction and compensation of this error is now necessary in order to have accurate position display/output data. This is accomplished by the microprocessor calculating a corrected tracking velocity.

The actual tracking compensation value is calculated during period A and implemented during period B as indicated by the dashed line on the graphs. The tracking velocity calculation made in period A (for period B) is shown in the following expression:

$$V_{Tn,n+1} = \left(\frac{P_n - P_{n-1}}{\Delta t}\right) - \left(\frac{P_{sn} - P_n}{\Delta t}\right)$$

$$V_{T1,2} = \left(\frac{P_1 - P_0}{\Delta t}\right) - \left(\frac{P_{s1} - P_1}{\Delta t}\right)$$

$$V_{T1,2} = \frac{1 - 0}{1} - \frac{0 - 1}{1}$$

$$V_{T1,2} = 1 - (-1)$$

$$V_{T1,2} = 2$$

Therefore in period B, the Simulated Velocity must increase by twice the velocity error to "catch-up" and reduce the position error to zero by period C. The error continues to be zero throughout the remaining periods of this example because the velocity of the positioner remains constant.

The graphs in Figure 4.3 show a more realistic example of tracking error correction. In this case, constant velocity follows constant acceleration (Figure 4.3). At point zero, the positioner is not active, as indicated by "zero" values for position and velocity. Immediately following point zero, the positioner begins moving at a constant acceleration while the velocity increases linearly. When acceleration decreases to zero (at t=5), the velocity becomes a constant (5 velocity units). Meanwhile, positioner position begins a slow ascent up to t=5 where it becomes linear. Note in Figure 4.3 that it takes two full periods after reaching constant velocity (from t=5 to t=7) before the simulated position "catches-up" to the actual position.

The tracking velocity (V_t) necessary to correct errors is calculated using the the same equations expressed in the first example. The calculation in period A (for period B) for this example is shown below. The calculated results of periods B through H appear in Table 4.2.

Period A:

$$V_{Tn,n+1} = \left(\frac{P_n - P_{n-1}}{\Delta t}\right) - \left(\frac{P_{sn} - P_n}{\Delta t}\right)$$

$$V_{T1,2} = \frac{P_1 - P_{-0}}{\Delta t} - \left(\frac{P_{s1} - P_1}{\Delta t}\right)$$

$$V_{T1,2} = \frac{.5 - 0}{1} - \frac{0 - .5}{1}$$

$$V_{T1,2} = .5 - (-.5) = 1 \text{ position unit per time unit}$$

Table 4.2
Tracking Error Data for Figure 4.2

Period	Average Positioner Velocity	Simulated Velocity	Position Error At End Of Period	Calculated Tracking Velocity Applied To The Next Period
A	.5	0	-.5	1
B	1.5	1	-1	2.5
C	2.5	2.5	-1	3.5
D	3.5	3.5	-1	4.5
E	4.5	4.5	-1	5.5
F	5	5.5	-.5	5.5
G	5	5.5	0	5
H	5	5	0	5

By observing the graphs in Figure 4.3 and the data in Table 4.2, two conclusions result:

- The position error lag remains nearly constant during sampling periods of constant acceleration.
- After reaching constant velocity, tracking error compensation requires two full sampling periods before the simulated position tracks in an identical manner to the actual position.

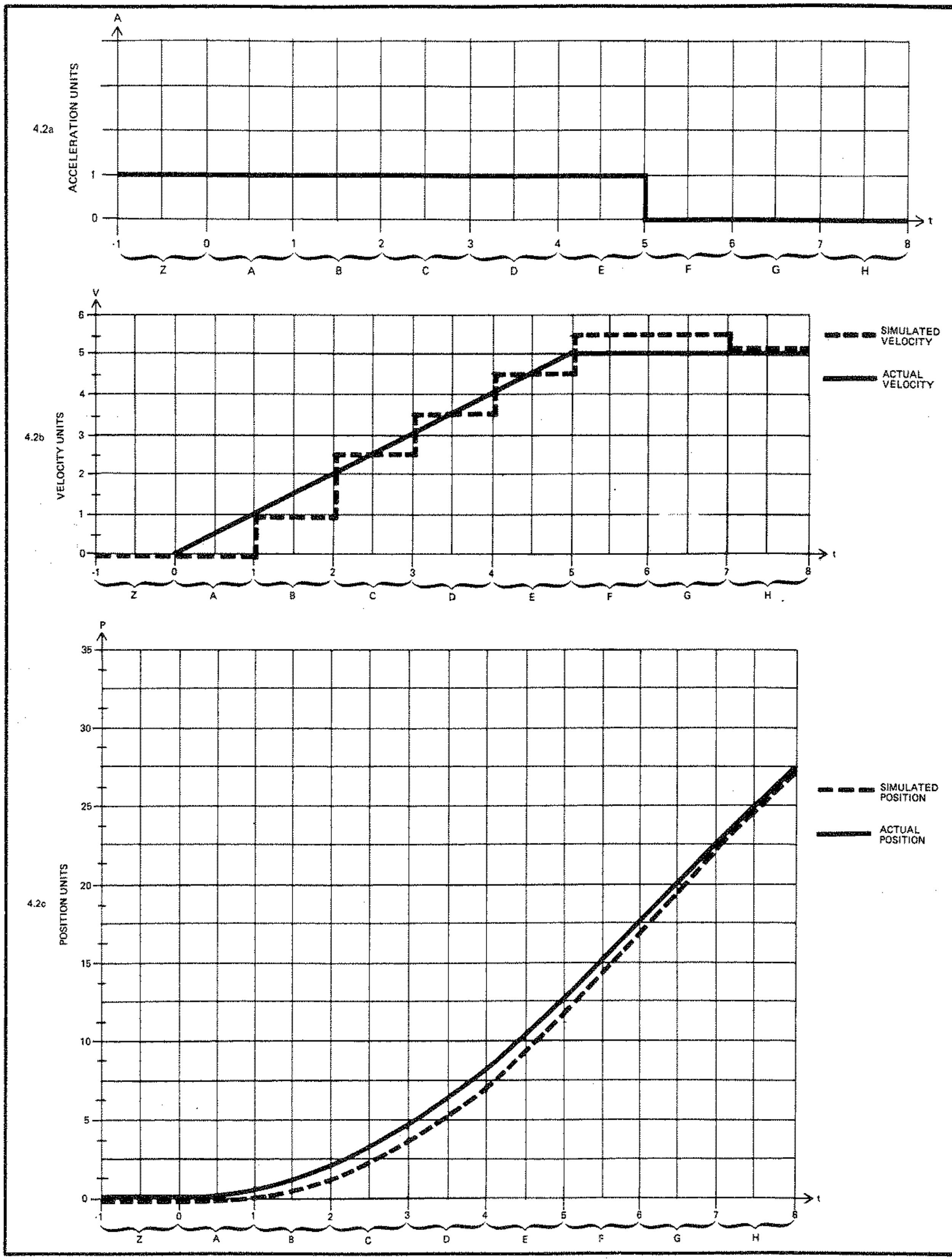


Figure 4.3. Constant Acceleration/Velocity Graph

The periods following t=7 will remain error-free as long as the velocity remains constant. In most cases, this means significant error correction will not occur again until deceleration of the positioner.

4.2.5 Model 1885 Block Diagram Explanation

The following discussion refers to the Model 1885 block diagram provided in Figure 4.4.

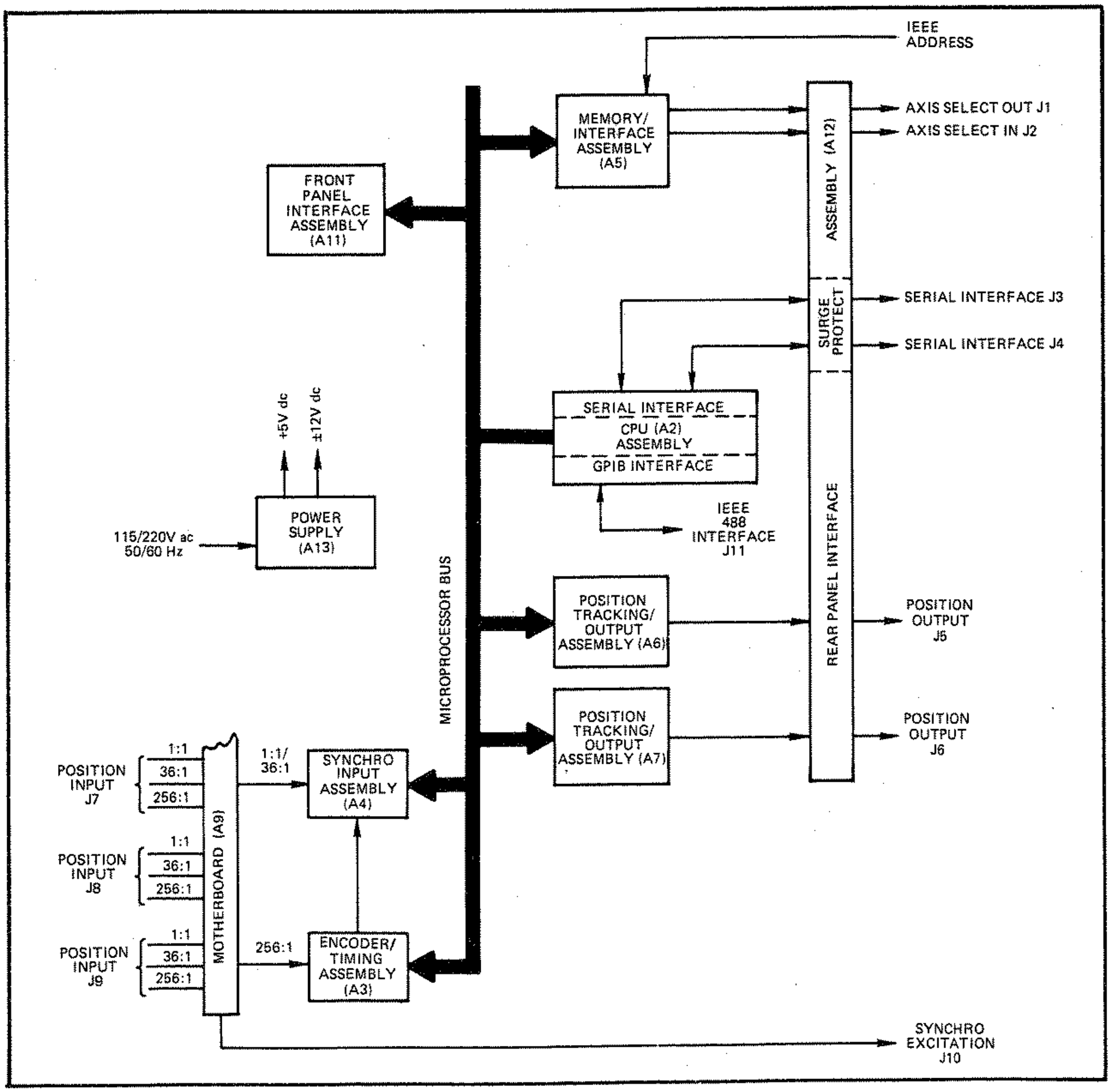


Figure 4.4. Model 1885 Digital Position Indicator Block Diagram

The Model 1885 Digital Position Indicator is capable of processing and displaying single speed (1:1), dual speed (1:1 and 36:1) and/or precision dual speed (1:1, 256:1) position transducer data. The CPU (central processing unit) assembly (A2) controls operation of the Model 1885. In addition to an 8088 microprocessor and bus interface, the CPU assembly includes a Serial Interface and a GPIB (General Purpose Interface Bus) interface. All other Model 1885 assemblies interface to the CPU Assembly to either accept control commands from the microprocessor, or provide information to the microprocessor.

The Model 1885 processes position data through multiple operations of the CPU assembly. The CPU accepts data from the output of position transducers and determines the actual or "absolute" positioner angle. The angle value is stored in the CPU until required by the Front Panel Interface Assembly and/or IEEE Interface. At the same time, the CPU also accepts feedback data from both Position Tracking/Output assemblies (one assembly for each Position Output) to compute velocity values.

Position data from either synchro or encoder position transducers enter the Model 1885 by two possible methods: directly at the Position Inputs (J7, J8 and J9), or indirectly through a remote Model 1886 Position Data Processor Unit at the Serial Interface inputs (J3 and J4). Position data from the output of synchros (1:1, 36:1) are analog in nature. As this analog output data reaches the Synchro Input assembly (A4), an A/D (analog-to-digital) conversion takes place. Encoder data (256:1), however, arrive at the Model 1885 previously converted to digital format by the Encoder Processor mounted inside the positioner. The Encoder/Timing assembly (A3) synchronizes the precise triggering of "take-sample" commands for the Synchro Input assembly, the Position Tracking/Output assemblies and the Encoder Processor. After the Synchro Input assembly receives a triggering pulse from the Encoder/Timing assembly, it samples, holds, converts the analog data to a digital format, and notifies the microprocessor that new "absolute" position data are available for reading.

The Serial Interface inputs (J3 and J4) accept position data from a remote Model 1886 through a serial link. In addition, certain control data are sent to the Model 1886 from the Model 1885 over this serial link. A surge protection circuit on the Rear Panel Interface assembly (A12) acts as secondary input protection helping to prevent damage to the CPU and other sensitive circuitry in case lightning strikes near the outdoor serial link cable. Primary protection should be provided by using external computer line protection devices such as a General Semiconductor Industries, Model CDP 42.

Regardless of the input path, the absolute position data are fed to the CPU. Here the data are processed further and distributed to the front panel displays, GPIB Interface and the Position Tracking/Output assemblies.

The IEEE-488 interface input (J11) connects to the GPIB interface on the CPU assembly to allow manipulation of the front panel control functions (including Setup Mode) by an external system controller. The IEEE interface may also be used to gather position data.

The Front Panel Interface assembly (A12) interfaces the front panel display and pushbutton switches to the CPU. During local operation, the CPU sends display data to the front panel and also receives switch data from the front panel. This process controls the operating characteristics of the Model 1885. Data updates for front panel occur every 1/5th second.

The Memory/Interface assembly (A5) provides these circuit functions:

- the Axis Select input/output and buffers
- IEEE address switch reading
- non-Volatile Memory
- Tracking Timers

Axis Select data to/from an axis select unit are buffered through latched buffers on the Memory/Interface assembly. During power-up, the CPU reads the rear panel IEEE address switch to determine proper bus operation. Non-Volatile memory provides storage of Setup Mode data of up to 2K bytes. Two tracking timers, one for each Position Tracking/Output assembly, measure the time interval between position samples. These timers are triggered simultaneously with the position feedback latches on the Position Tracking/Output assembly and with the input data sample.

The Model 1885 Power Supply, manufactured by Standard Power, Inc., provides +5V and ±12V dc from either 115V or 230V ac, 50/60 Hz to various circuit locations.

4.2.6 Model 1886 Block Diagram Explanation

The Model 1886 operates as a remote unit for the Model 1885 by multiplexing up to three axes of single, dual, and/or precision-dual speed data. The assemblies used in the Model 1886 are identical to several of the assemblies used in the Model 1885. For this reason, no additional discussion is provided here. A block diagram of the Model 1886 appears in Figure 4.5.

The Model 1886 Position Data Processor consists of the following assemblies:

- CPU Assembly (A2)
- Encoder/Timing Assembly (A3)
- Synchro Input Assembly (A4)
- Motherboard Assembly (A9)
- Rear Panel Interface Assembly (A12)
- Power Supply Assembly (A13)

4.3 DETAILED DESCRIPTION

The discussion in the following sections refer to the complete schematic diagrams located in Chapter 7.

4.3.1 Motherboard Assembly (A9)

4.3.1.1 Detailed Discussion

The Motherboard assembly, in addition to performing general interfacing duties, also provides these functions:

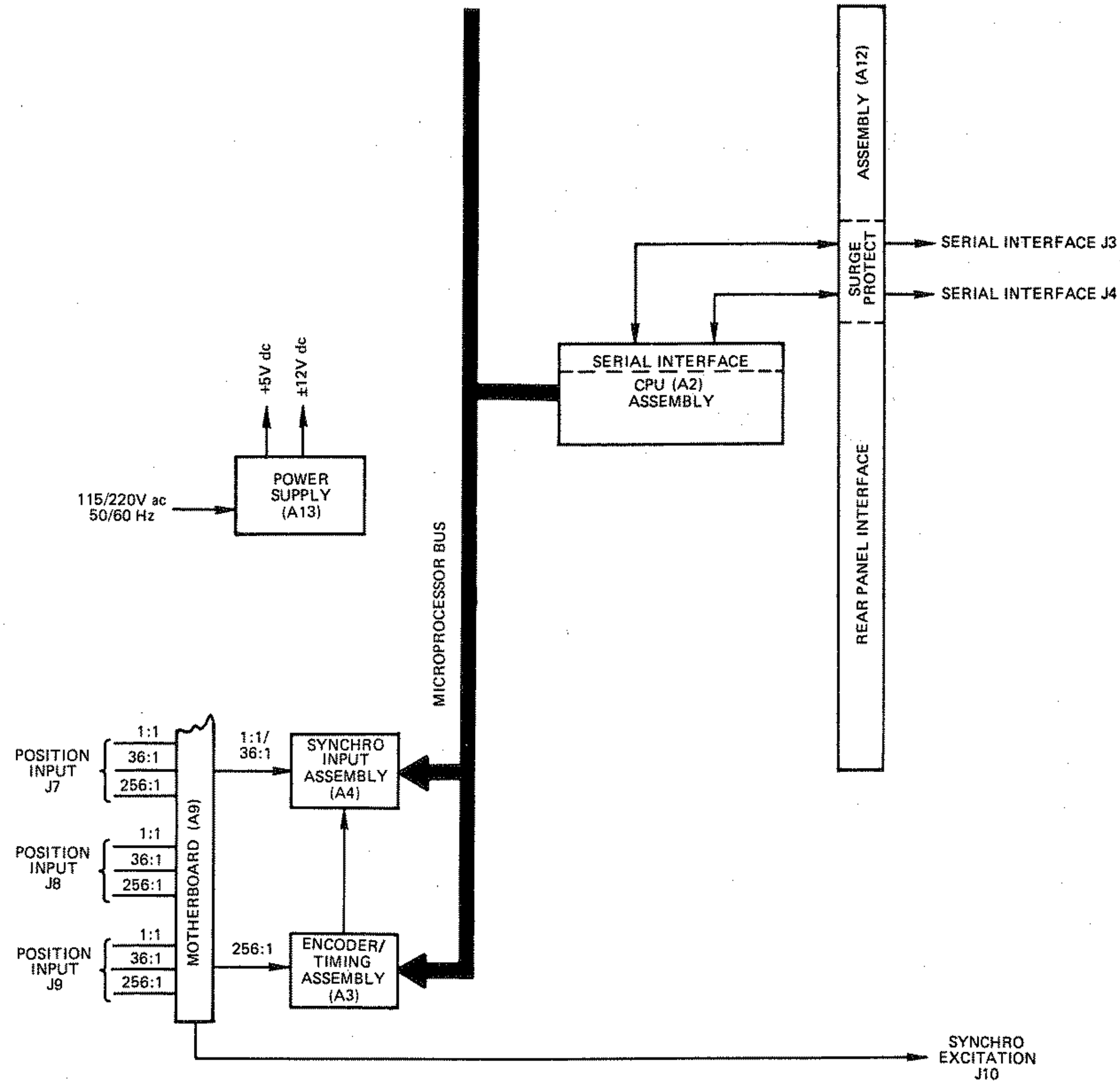


Figure 4.5. Model 1886 Position Data Processor Block Diagram

Axis Select signals, Serial Interface signals, and Position Output data all tie to the Motherboard by way of P4. P4 connects to the Rear Panel assembly (A12). Axis Select signals go to the Memory/Interface assembly (A5), Serial Interface signals go to the CPU assembly (A2), and Position Output data originates on the two Position Tracking/Output assemblies (A6 and A7).

The Motherboard also distributes power to the respective assemblies. +5V enters the Motherboard through P1, while ±12V enters through P2. Capacitors C1, C2, and C3 decouple the +5V. The Motherboard also routes power to external users; +12V and +5V to the Synchro Select unit (Model 2013) if present, and ±12V to any Encoder Processor assemblies used.

Low voltage synchro excitation (20V ac) also routes through the Motherboard. Entering at P3, it goes through fuse F3 and on to the synchro harness by way of J17, J18, and J19. High voltage synchro excitation can be routed by the user either directly to the synchros or through the Model 1885. In the latter case, the excitation enters the Motherboard through J13, through fuses F1 and F2, and enters the synchro harness through J14, J15, and J16.

All of these voltage outputs are protected by fuses to prevent damage due to external shorts. The fuse functions and types are shown in Table 4.4.

Table 4.4
Fuse Types and Functions

Reference Designation	Function	Rating
F1	115V ac Neutral	1.5 Amp
F2	115V ac Hot	1.5 Amp
F3	20V ac	1.5 Amp
F4	+5V dc	.5 Amp, Slo-Blo
F5	+12V dc	6.25 Amp, Slo-Blo
F6	-12V dc	6.25 Amp, Slo-Blo

Synchro input signals enter the Motherboard 1885 through connectors J14, J15, and J16 (high voltage synchros), or through J17, J18, and J19 (low voltage synchros). Shorting plugs, installed in the unused connectors, provide proper signal conditioning. Resistor networks U2 through U7 process the synchro inputs for compatibility with the Synchro Input assembly (A4) input requirements.

In the Model 1886, R1 and connector J21 provide power to the front panel POWER ON LED.

4.3.2 CPU Assembly (A2)

4.3.2.1 Overview

The CPU assembly consists of the following functions/stages:

- 8088 processing unit
- Resource decode circuitry
- User-configurable memory
- GPIB interface
- RS-232C/423 serial interface
- SAMBUS interface.

A block diagram of the CPU assembly appears in Figure 4.7.

4.3.2.2 Detailed Discussion

Complete schematics of the CPU assembly appear in Figures 7.3 and 7.33.

The CPU assembly interfaces to other Model 1885/1886 printed circuit board assemblies over a multiplexed bus structure through connectors J3 and J4 to Motherboard socket XA2.

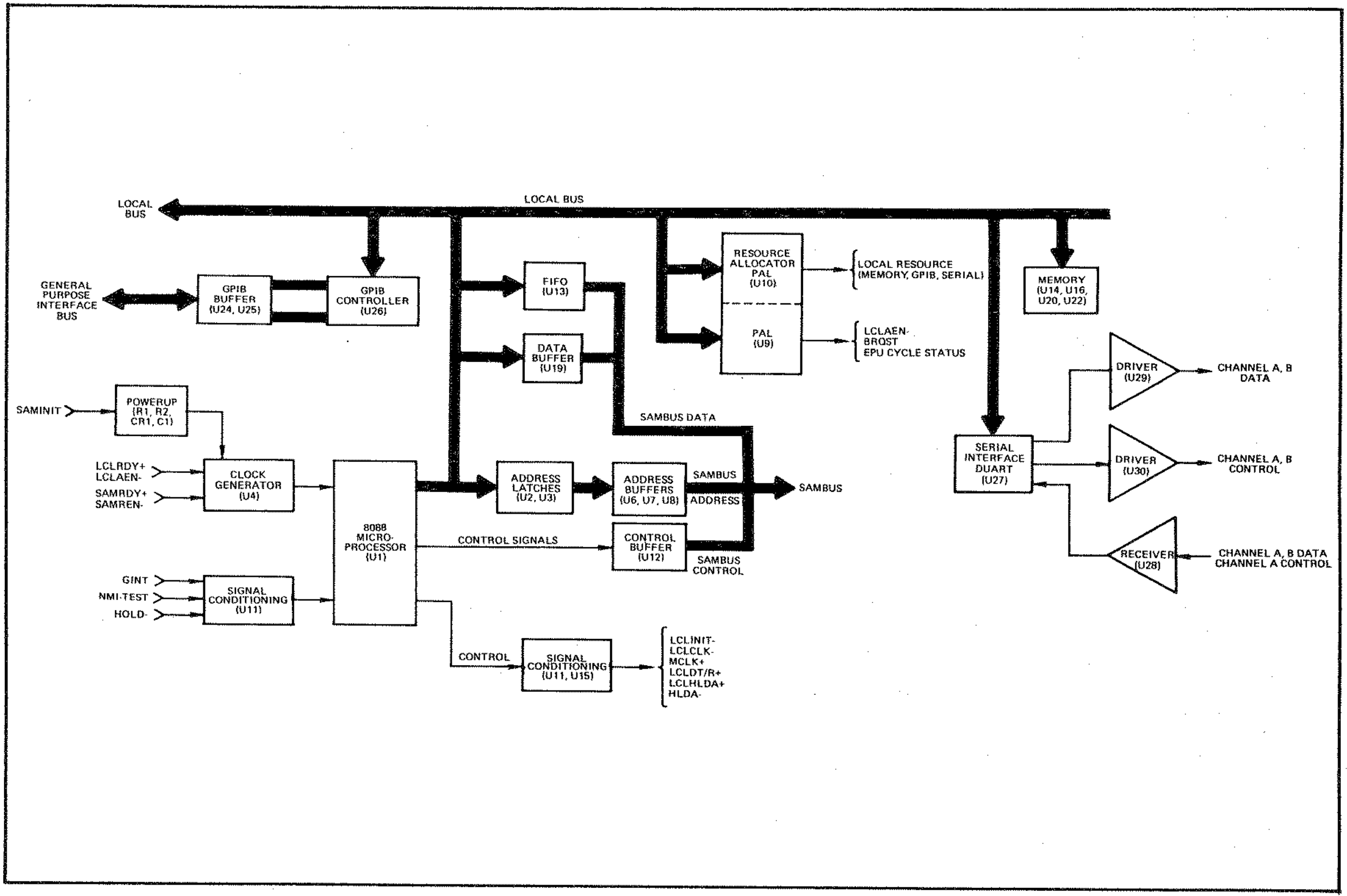


Figure 4.7. CPU Assembly Block Diagram

Clock Generator U4 provides a 5 MHz clock signal (pin 8), a RESET signal (pin 10), and a READY signal (pin 5) for supporting operation of the 8088 microprocessor IC (U1). On initial power-up, R1, R2, C1, CR1 and U4 provide a synchronized reset pulse. At pin 2 of U4, a peripheral clock (PCLK) output of 2.5 MHz is provided.

The 8088 microprocessor IC (U1) uses a 16-bit internal architecture and an 8-bit external data bus structure. U1 also provides a 20-bit address structure for supporting 1 megabyte of directly-accessible memory space. On the falling edge of control line signal ADDRESS LATCH ENABLE (or ALE at U1, pin 25), address latches U2 and U3 capture address signals A0-A7 and A16-A19. Address signals A8 through A15 are not multiplexed, and therefore are not latched. The outputs of U1, U2 and U3 form the local address LCLAØ through LCLA19.

Signal conditioning circuitry (U11, U15) provides the logic "glue" for the 8088 microprocessor. This includes providing the proper logic level and buffering for 8088 inputs (GINT, NMI, TEST, HOLD), 8088 outputs (DT/R, HLDA), and timing signals (LCLCLK, MCLK, LCLINIT).

Programs for executing the unit algorithms are stored in the user-configurable memory, U16, U20, and U22. Each of these devices is a 32K by 8 Erasable Programmable Read Only Memory (EPROM) IC chip. The memory capacity of these devices totals 96K bytes. Random Access Memory (RAM) is contained in U14, an 8K by 8 RAM IC chip.

U9, U10, and related components provide cycle synchronization and form a resource allocator to ease allocating resources both ON and OFF the CPU assembly. This circuit allocates address space for the following functions:

- Local vs. Shared Resources
- CPU/IO memory devices (U14, U16, U20, and U22)
- GPIB interface (U26)
- Serial interface (U27).

MODEL 1885

Local resources are those items which do not communicate by way of the Shared Bus Interface (SAMBUS). This includes all resources located on the CPU assembly and any resource off the CPU asembly accessed by way of the Local Bus. Shared resources are items accessed off the CPU assembly by way of the Shared Bus Interface. The resource allocation circuit asigns an exclusive set of addresses to the local resources and a separate set of addresses to the shared resources. Shared resources are accessed by way of SAMBUS, a buffered extension of the local bus. The SAMBUS buffers U6, U7, U8, U12, and U19 are enabled by the SAMAEN (U9-U23) and SAMCEN (U9-U17) signals when the CPU accesses an address in the shared resource space. When the CPU accesses an address in the local resource space, the SAMBUS buffers are disabled, which isolates shared resources from local bus activity.

The GPIB Interface circuitry consists of controller U26 and octal GPIB transceiver/buffers U24 and U25. U26 provides the CPU interface to the GPIB by way of functions such as GPIB data access, interrupt monitoring, serial and parallel poll operations, GPIB handshake control, and GPIB addressing. U24 provides the signal interface (TTL to GPIB) for GPIB data signals DI01 through DI08. U25 provides the signal interface (TTL to GPIB) for the data transfer byte control signals DAV, NRFD, NDAC, and the general interface management signals IFC, ATN, SRQ, REN, and EOI.

The Serial Interface circuitry consists of DUART U27, line receiver U28, line drivers U29 and U32, and 3.6864 MHz crystal Y2. U27 is a multi-function device supplying an interface to two asynchronous serial communication channels, while also providing a 16-bit counter/timer and programmable bit I/O. U28 is an RS422/RS423 line receiver providing RS232C/RS423/RS422-to-TTL signal conversion. U29 and U32 are RS232C/RS423 line drivers providing channel A data and control signals and channel B data signal.

Table 4.5 shows the 8088 CPU assembly I/O configuration switches and their proper operating positions. Refer to the CPU assembly component location diagrams (Figure 7.2 and 7.32) and schematics (Figure 7.3 and 7.31) for jumper location.

Table 4.5
I/O Switch Configuration Positions

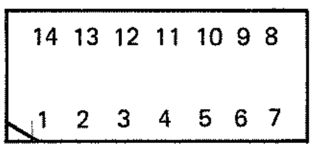
Switch No.	Name	Function/Position
S1	Master Clock Select	Equates the SAMBUS master clock to the processor clock (S1 jumpered; 5 MHz clock provided to SAMBUS).
S2	Master CBRQST; BUSY PULL-UP Select	Provides the pull-up resistors for the open collector COMMON BUS REQUEST (CBRQST) signal and the BUSY signal (S2 no connection; single CPU system).
S3	SAMBUS Request Select	Selects the SAMBUS request option for the bus arbitration circuitry. (S3 jumpered P2-P3; single CPU system).
S4-S7	Memory Configuration 	Configures the JEDEC memory sockets for devices U14, U16, U20 and U22. The devices appearing in the following list can be placed in any of the four sockets and will function correctly as long as the proper jumper configuration is followed. Consult the CPU diagrams in Chapter 7 for the selected devices used with your particular unit. Also observe the socket pinout diagram shown at the left. S4-S7: • 4K by 8 EPROM (2732a) jumper P5-P6 (1cla11) jumper P13-P14 (vcc) • 8K by 8 EPROM (2764) jumper P1-P2 (pull-up) jumper P5-P6 (1cla11) jumper P10-P11 (pull-up) • 16K by 8 EPROM (27128) jumper P1-P2 (pull-up) jumper P5-P6 (1cla11) jumper P12-P13 (1cla13) jumper P10-P11 (pull-up) • 32K by 8 EPROM (27256) jumper P1-P2 (pull-up) jumper P5-P6 (1cla11) jumper P12-P13 (1cla13) jumper P7-P8 (1cla14)

Table 4.5 - continued

Switch No.	Name	Function/Position
		• 8K by 8 iRAM (2186) jumper P2-P3 (lclrdy) jumper P5-P6 (lclall) jumper P8-P9 (write enable) • 2K by 8 RAM (6116) jumper P4-P5 (write enable) jumper P13-P14 (vcc) • 8K by 8 RAM (6264) jumper P1-P2 (pull-up) jumper P5-P6 (lclall) jumper P13-P14 (vcc) jumper P8-P9 (write enable) S4 jumpered as 8K x 8RAM S5, S6, S7 jumpered as 32K x 8 EPROM
S8	GPIB Interrupt Select	Connects the INTERRUPT from the TMS9914A to the GROUP INTERRUPT signal (S8 jumpered P1-P2; interrupt enabled).
S9	Serial Port Interrupt Select	Connects the INTERRUPT from the SC2681 to the GROUP INTERRUPT signal (S9 jumpered P1-P2; interrupt enabled).
S10	Serial Port Configuration Select	Configures the input port of the SC2681 (S10 jumpered P1-P3; channel A control signals).
S11	FIFO DMA Select	Allows generating a DMA request signal when the FIFO is ready to receive data on the SAMBUS side of the FIFO interface (S11, no connection; no DMA request).
S12	FIFO Interrupt Select	Connects the INTERRUPT from the SAMBUS FIFO interface to the GROUP INTERRUPT SIGNAL (S12 no connection; software poll).
S13	Single Processor Select	Configures the 8088 CPU I/O for either multiprocessor or single processor systems (S13 jumpered P2-P3; single processor system).
S14	Hold Acknowledge Arbritration Select	Allows enabling data transfer onto the local bus from the SAMBUS when hlda is active (S14, no connection; disable hlda SAMBUS-local bus transfer).

Table 4.5 - continued

Switch No.	Name	Function/Position
S15	GPIB Controller Option Select	Defines the GPIB controller configuration for U26 to operate as a controller in a multiple-controller GPIB configuration (S15 jumpered P2-P3; single controller).
S16	Master/Slave Bus Grant Select	Provides the proper signal source for the Bus Grant SAMBUS signal (S16 no connection; single CPU system).

4.3.3 Encoder/Timing Assembly (A3)

4.3.3.1 Overview

The main function of the Encoder/Timing assembly is interfacing the Encoder Processor assembly(ies) to the Model 1885/1886. However, this assembly also provides address decoding, signal conditioning for the serial interface, baud rate selection for the serial ports, and produces the BXCAR (or boxcar) and TEDGE (trigger edge) signals for the Synchro Input and Position Output/Tracking circuitry respectively. A block diagram of the Encoder/Timing assembly appears in Figure 4.8.

4.3.3.2 Detailed Discussion

Complete schematics of the Encoder/Timing assembly are provided in Figures 7.5 and 7.35.

One of the major responsibilities of the Encoder/Timing assembly is to interface the Encoder Processor (see Section 4.4) to the Model 1885/1886. U19, U20, and U21 are bi-directional buffers, each corresponding to one of the three possible Encoder Processors. U18 provides clock drive signals ECK+ and ECK- for the Encoder Processors. The bi-directional operating characteristics of U19, U20, and U21 are controlled by PAL U31. When U31 places these buffers

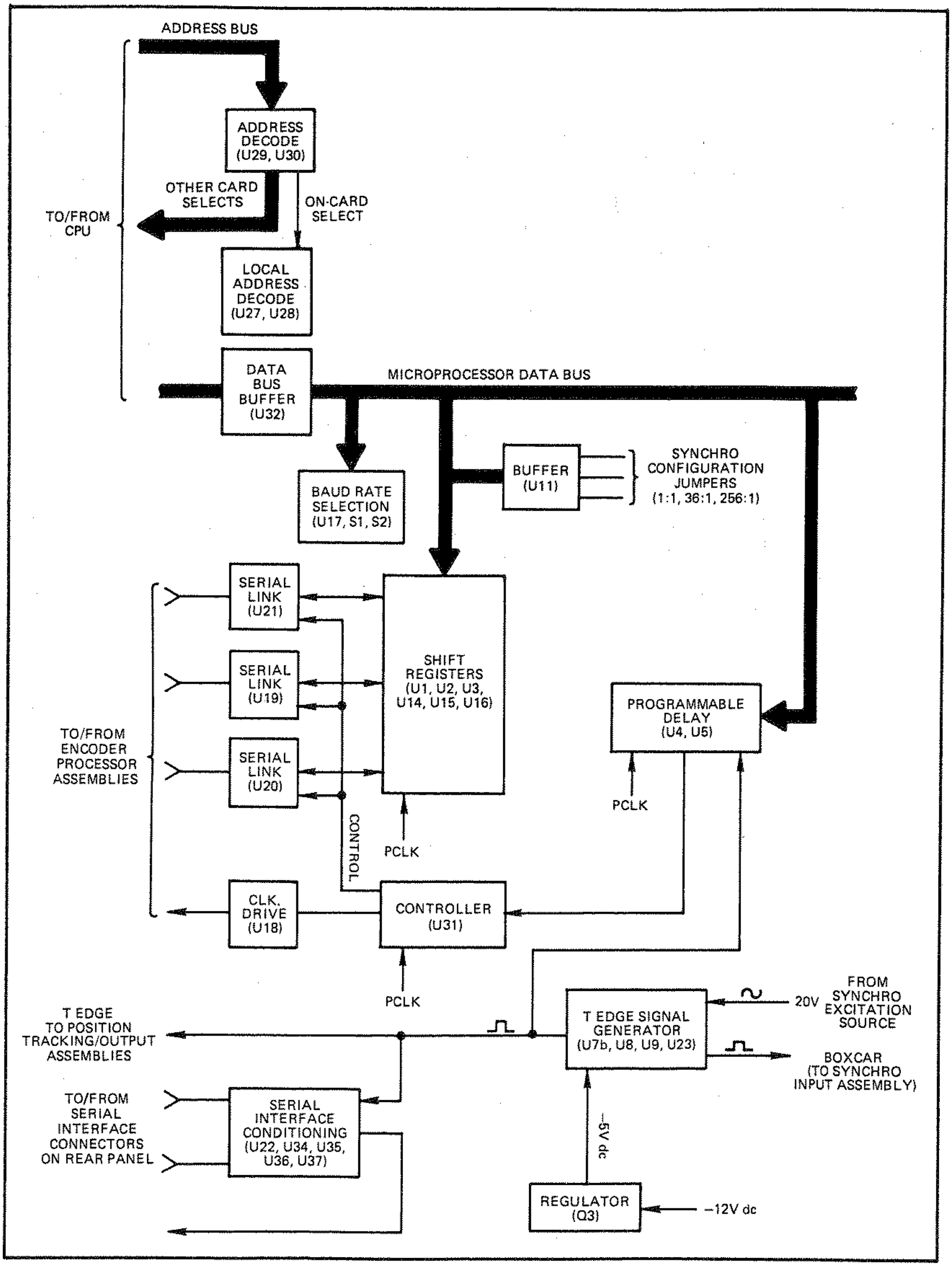


Figure 4.8. Encoder/Timing Assembly Block Diagram

in the transmit mode to trigger data sampling, a trigger pulse sequence goes to the Encoder Processors. Immediately following, U31 reverses the buffers to receive incoming 16-bit data from the Encoder Processors and enables the shift registers to store the data.

U1, U2, U3, U14, U15, and U16 form three 16-bit shift registers. These registers accept 16-bit data from the Encoder Processors over the serial links. In this manner, the CPU may read the data over the microprocessor data bus. PAL U31 also requests a "calibration conversion" from the Encoder Processor at the proper time periods determined by the CPU. Output lines CØ and C1 of latch U4 transfer these commands from the microprocessor data bus to U31.

Another important function of the Encoder/Timing assembly is to generate an integration boxcar (BXCAR) control signal for the Synchro/Input assembly and a related timing edge (TEDGE). TEDGE corresponds to the center of the boxcar interval. Since the synchro signal integration must be in phase with the synchro excitation, BXCAR and TEDGE are generated by a phased-locked loop (U7, U8, and U9) which locks onto the line frequency.

The Model 1885/1886 is designed to minimize group delay error (the difference between the time a certain position is indicated and when it actually occurs). Such errors can be significant and troublesome since they vary directly with axis velocity. TEDGE provides the sample timing information required to synchronize the indicated position data to the actual position. A description of the use of TEDGE is provided in Section 4.3.6.2.

When a Model 1886 is used in the system, TEDGE must be made available to the Model 1885 by way of the serial link. The circuitry for injecting a special synchronization byte consists of U24 and U25 and associated components. This circuit is disabled under CPU control in the Model 1885.

Another source of group delay is the inherent processing delay of the Encoder Processor assemblies. Programmable delay, U5, looks at a signal derived from TEDGE through flipflop U10. This signal forces U5 to create a delay which compensates for the roughly 250 microsecond group delay inherent in each Encoder Processor.

J1, J2, and J3 are synchro configuration jumpers providing selection of 1:1/256:1, 1:1/36:1, or 1:1 only synchro speeds for each of the three rear panel inputs. Buffer U11 allows the CPU to read the six synchro speed bits from these jumpers. However, these jumpers are not used in the present implementation of the Model 1885 and Model 1886.

Flipflops U13a and U13b act as interrupt devices. Control lines C6 and C7 from U4 are inputs to these flipflops, serving to enable and disable specific interrupt functions. U13a provides the interrupt function EDR (Encoder Data Ready), deriving its input signal from RCLK (register clock) of the shift registers. U13b provides the interrupt function ESB (End of Synchronization Byte), which indicates the availability of Serial Channel A subsequent to transmission of a synchronizing byte (Model 1886 only).

Both onboard and offboard address decoding are performed on the Encoder/Timing assembly by decoders U27, U28, U29, and U30. U27 and U28 decode the address bus for the Encoder/Timing assembly itself, while U29 and U30 provide additional address decoding for various circuitry throughout the unit. Data bus buffering is accomplished through U32.

U17, S1, and S2 form the baud rate configuration selection circuitry. S1 and S2 are rotary DIP switches for selecting 8 bits of data for baud rate configuration of the serial ports to be read by the CPU. (See Section 2.4.6.2 for additional information.)

U22, U34, U35, U36, U37, and associated components, make up the serial interface conditioning circuitry. Here, signal conditioning on two channels of serial I/O data is performed.

U38 regulates -5V dc from -12V dc for use in the line frequency signal conditioning circuitry (U9).

4.3.4 Synchro Input Assembly (A4)

4.3.4.1 Overview

The Synchro Input assembly accepts and conditions single or dual speed synchro analog position data received through the rear panel Position Input connectors. A block diagram of the Synchro Input assembly appears in Figure 4.9.

4.3.4.2 Detailed Discussion

Three identical stages comprise the input channel circuitry of the Synchro Input assembly. To simplify the discussion of the input stages, only circuit components in Axis A input stage are discussed. Complete schematics of the Synchro Input assembly appear in Figurea 7.7 and 7.37.

Up to three separate axes of analog position data enter the Synchro Input assembly by way of precision-matched resistors, U21. Each Position Input accepts S1 and S3 analog signals from both 1:1 and 36:1 synchro transmitters.

The 1:1 Axis A, S1 input signal enters through resistors U21e and U21f. Both of these resistors match 1:1 Axis A, S3 input resistors U21a and U21b. This matching insures identical processing to both signals applied to the Position Inputs. U17 through U20 along with corresponding switches U15 and U16 form four integrators for the Axis A input signals. BOXCAR, a signal originating at the Encoder/Timing assembly (see Section 4.3.3) and buffered through U37, controls switches U15 and U16, causing signal integration or hold to take place.

During the first half-cycle of BOXCAR, a logic "high" at pins 10 and 15 of switches U15 and U16 puts the circuits in the integrate mode. This causes C3, C5, C7, and C8 to integrate analog signals S1 and S3 for both the 36:1 and the 1:1 inputs. During the second half-cycle of BOXCAR signal, the circuits are in the hold mode, allowing a charge transfer to C15 and C29.

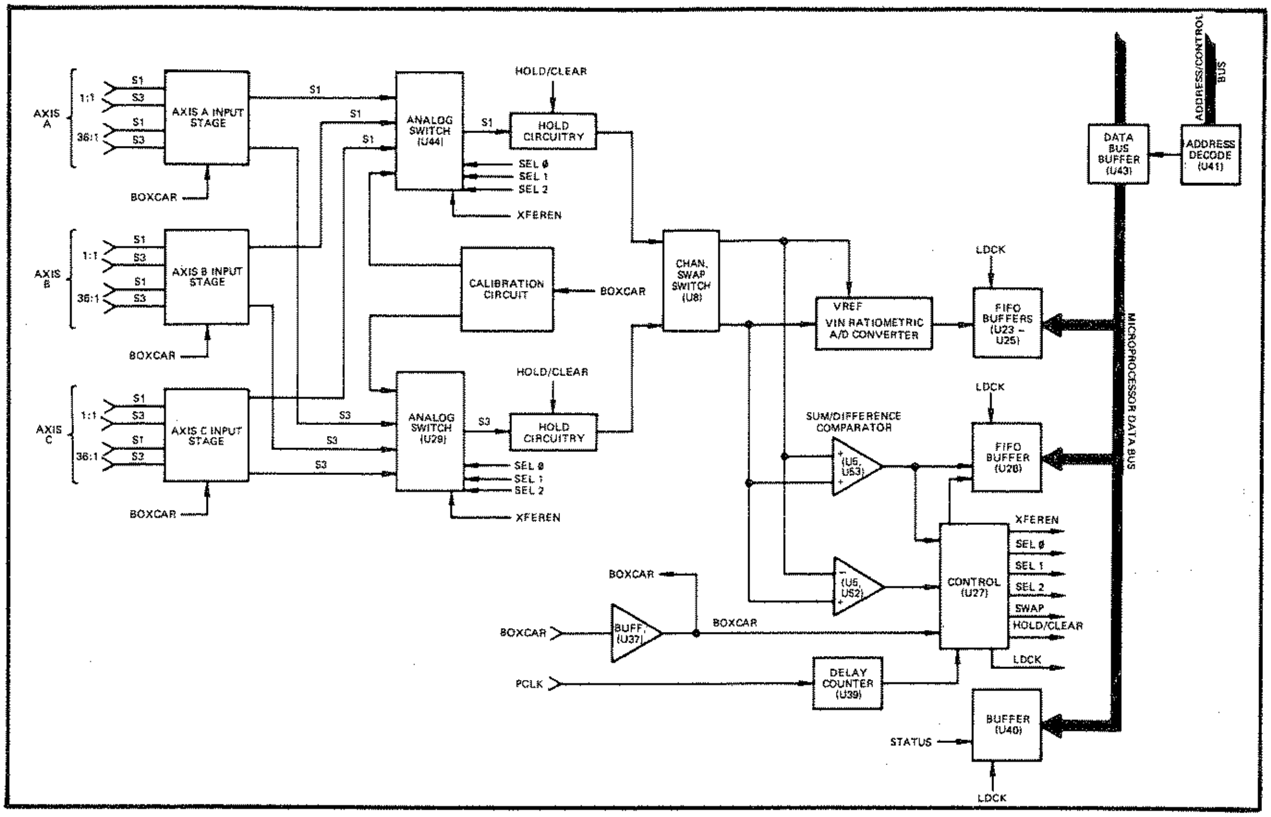


Figure 4.9. Synchro Input Assembly Block Diagram

Integration is performed simultaneously on all S1 and S3 input signals. When integration is complete, the signals are multiplexed sequentially through analog switches U29 and U44. These switches select one of the six S1 input signals and the corresponding S3 input signal as output signals (at pin 12) into hold circuitry U11/C29/U28b and U13/C15/U28a. Address lines AØ, A1, and A2 from PAL U27 control the selection process for these analog switches. XFEREN (transfer enable) signal, also from U27, informs U29 and U44 as to the proper time to enable the selected output signal. After the measurement is complete, the HOLD/CLEAR signal commands U28a and U28b to short capacitors C29 and C15 and dump the previously transferred charge.

The signal from each axis goes through a 4-step process after BOXCAR is complete:

1. Charge transfers to holding capacitors C29 and C15 from respective integration capacitors (in Axis A 1:1, C7 and C8).

2. Control logic (U27) decides if channel swapping is necessary (U8a and U8b), then initiates the A/D process.

3. The voltages on C29 and C15 are ratiometrically converted to digital form.

4. Charge is cleared from C29 and C15.

Consider, for example, the 1:1 Axis A, S1 analog signal path. C8 transfers its contents to C29 through U44 and R26 during a period of about 820 microseconds. This process results in an output voltage representative of S1. During the same time period, the charge present at C7 transfers to C15, resulting in a voltage representative of S3.

Channel swapping switches, U8a and U8b, couple the output signals from U11/U13 (pin 6) to U6 and U7. Sum-and-difference comparators (U52, U53, and U5) and logic control circuitry (U27) determine which of the two output signals from U11/U13 is larger and applies it to buffer U6. This larger signal acts as the reference signal for the ratiometric converter (U4, U1, U2, U3, and U22).

The ratiometric A/D conversion is performed by successive approximation. U22 generates a series of "guesses" as to the valid result which are compared with the actual signals by way of D/A converter U4 and U1, and U2 and U3. These guesses rapidly converge to an accurate 12-bit result.

When FIFO (First-In-First-Out) buffers U23, U24, U25, and U26 receive the LDCK (load clock) command from U27, resultant 12-bit parallel data from U22 is strobed into the FIFOs. In addition, U26 accepts the resultant data of associated status lines (SWAP, AGTB) and select lines SEL Ø and SEL 1. Additional status information is available to the CPU through U40.

A calibration circuit consisting of U9, U10, U12, U14, and related circuitry provides a calibration signal to the analog switch and hold circuitry. This calibration signal provides the correction factor necessary to compensate for the difference in value between C29 and C15. The calibration cycle is the seventh conversion, performed after the six input channel conversions have been done.

As mentioned previously, U27 provides the control for the Synchro Input assembly. Control functions provided include:

- control signals XFEREN, SEL Ø, SEL 1, and SEL 2 for U44 and U29
- control signal SWAP for U8a and U8b
- control signal START/ for U22
- control signal HOLD/CLEAR (LDCK) for U28a, U28b, and U23-U26
- control signal to clear delay counter U39.

Delay counter, U39, assists U27 in determining adequate charge and discharge intervals for C29 and C15. U27 clears delay counter U39 at the beginning of each transfer operation to provide a delay reference point.

U38a provides an interrupt signal (GINT). GINT informs the CPU that all seven conversions are complete and the results are available in the FIFOs.

U43 is a read-only data bus buffer isolating the on-board data bus from other circuitry. U41 provides address decoding and other functions.

4.3.5 Memory/Interface Assembly (A5)*

4.3.5.1 Overview

The Memory/Interface assembly provides:

- non-volatile memory
- interface circuitry
- sample interval timers
- buffers for MCLK signal
- address decoding and data bus buffering.

Figure 4.10 provides a detailed block diagram of the Memory/Interface Assembly. A complete schematic appears in Figure 7.9.

* Model 1885 Only

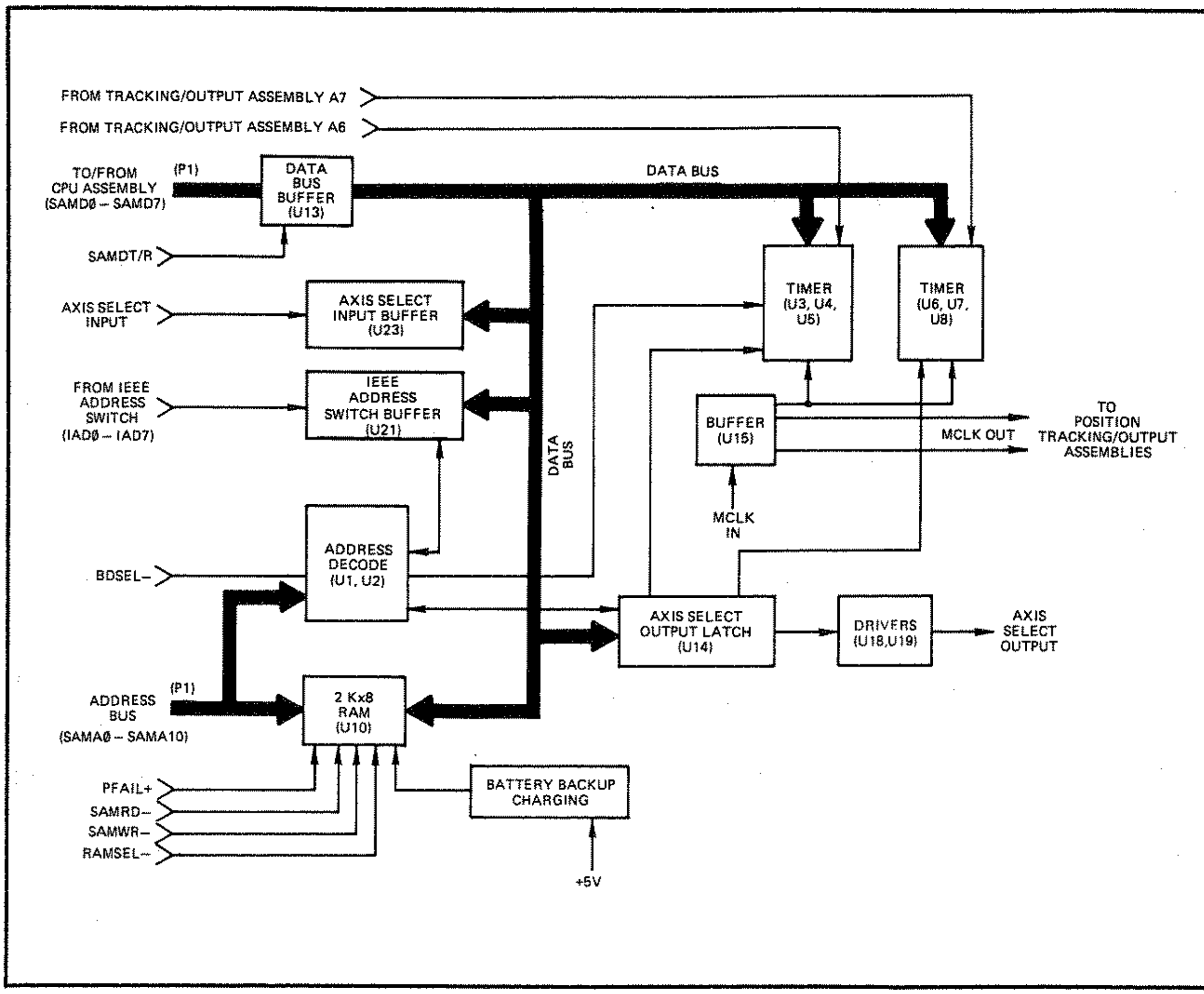


Figure 4.10. Memory/Interface Assembly Block Diagram

The non-volatile memory circuitry consists of 2K by 8 Random Access Memory (RAM) with battery back-up. Interfacing circuitry allows appropriate circuit assemblies of the Model 1885 to read data from the rear panel IEEE-488 address switch, Axis Select Input, control lines of the Position Output, and write data to the Axis Select Output.

Also on this assembly, two timers measure the interval between position samples for each Position/Tracking Output assembly. A buffering stage for MCLK+ provides buffering before MCLK+ goes to the Position Tracking/Output assemblies. Address decoding and buffering for the data bus completes the list of duties for the Memory/Interface assembly.

4.3.5.2 Detailed Discussion

The Memory/Interface assembly connects to other Model 1885 assemblies through connector P1. Data between the microprocessor data bus and the Memory/Interface assembly are buffered through U13, a bi-directional buffer. The data flow direction for U13 is determined by the SAMDT/R signal at the DIR input (pin 1) of U13. Data bits are labeled SAMDØ through SAMD7.

U1 and U2 perform address decoding for data operations other than memory access. U1 handles the writing function while U2 handles the reading. The Encoder/Timing assembly (A3) generates the BDSEL (board select) signal by decoding upper address lines SAMA4 through SAMA19. The lower four address lines (SAMA0 through SAMA3) feed directly into U1 and U2.

The primary component making up the memory circuitry is a low-power, CMOS RAM integrated circuit (U10). U10 obtains power from battery BT1 when ac power is removed. The RAM chip select line ($\overline{CS}$) function at pin 18 of U10 is controlled by the PFAIL+ (power fail) signal through transistor Q3. The PFAIL+ signal originates from the Power Supply assembly (A13). Under normal operating conditions, the PFAIL+ signal to Q3 is logic "high". This action turns Q3 ON and shorts pin 18 to ground, enabling U10. However, if ac power to the unit is removed (either intentionally or non-intentionally), the PFAIL+ line becomes logic "low" placing Q3 in an OFF mode. In this case, the chip select line disables U10 forbidding any read or write transactions to take place. Power from the battery back-up and charging circuit takes over to retain the memory contents. Because this circuit operates without a dependency on the CPU assembly, memory contents are retained whether the unit is powering up, powering down, or powered completely down.

OR-GATEs U12A and U12D select either read (SAMRD-) or write (SAMWR-) functions for the RAM from the data bus. Pins 20 and 21 of U10 are the $\overline{OE}$ (output enable) and $\overline{WE}$ (write enable) lines. When $\overline{OE}$ is active, U10 places data onto the data bus for reading by the CPU assembly, while when $\overline{WE}$ is active, U10 accepts data from the bus for storage in the RAM location specified by the address lines. The Encoder/Timing assembly generates the

RAMSEL- (RAM select) input signal. RAMSEL- determines which address blocks will specify RAM U10 by decoding the upper order address lines (SAMA11-SAMA19).

Components R1-R5, Q1, Q2, CR1, RT1 and BT1 form the battery back-up and charging circuit mentioned earlier. BT1, a 3.6V nickel-cadmium (NiCad) battery, maintains power on the memory circuit when power is removed. Typically, memory contents are maintained for 4 to 6 months without powering-up the unit. During normal operation, the Power Supply Assembly sends +5V to Q1 and Q2, completely re-charging the battery after approximately ten hours.

The rear panel IEEE-488 address switch, A9-U1, contains eight mini-switches. Of these eight switches, five allow manual setting of the IEEE address. The decoder circuit (U2) enables buffer U21 and places the switch data (IADØ through IAD7) onto the bus for reading by the CPU.

Buffer U23 allows the CPU to read data from the Axis Select Input rear panel connector (INPUTA, INPUTB, and INPUTC) and from status lines (PCTLR1 and PCTLR2) of the Position Output rear panel connectors. The status lines inform the CPU of the presence of a programmable positioner controller unit (such as a Scientific-Atlanta Model 2012A) coupled to the Position Output connectors so that the unit will only allow the selected axis to be assigned to those outputs. In the presence of axis select inputs, they define the selected axis; otherwise refer to Figure 4.1 to determine the selected axis. Refer to Table 2.4 for the definition of axis select inputs.

The Axis Select output bits are controlled through latch U14. This latch contains the data written from the CPU and provides the axis select output to U18 and U19. Peripheral drivers U18 and U19 provide TTL-compatible output signals SELECTA, SELECTB, and SELECTC to the rear panel output connectors. In addition, U14 provides control signals for timers U3/U4/U5 and U6/U7/U8. EN1 and EN2 (enable) signals at pins 2 and 6, and CLR1 and CLR2 (clear) signals at pins 5 and 9 provide the necessary control of the timers during power-up initialization.

Counters U3, U4, and U5 form one timer while U6, U7, and U8 form a second timer. The timer measures the time period between sample pulses for a corresponding Position Tracking/Output Assembly discussed in Section 4.3.6. Each timer consists of three 8-bit counters driven by the 5 MHz MCLK+ signal through buffer U15. Resistors R7 and R8, also connected to the MCLK line, help minimize ringing due to impedance mismatches. Since the timer counters clock at a 5 MHz rate, each "count" corresponds to a 200 nanosecond time period. When a FBLTRIG (feedback latch trigger) signal from the Position Tracking/Output assemblies trigger RCK input (pins 13), the timer data is latched and is held to be read by the CPU. (Remember from earlier discussions that FBLTRIG signal synchronizes with the falling edge of MCLK+, and that the timer updates on the positive edge of MCLK+ to provide valid timer data when the triggers occur.) After the CPU reads the timer, it subtracts the previously-read value and multiplies the difference by 200 nanoseconds to determine the elapsed time. This time is used in calculating the tracking velocity value sent to the Position Tracking/Output assembly (see Section 4.2.4).

OR-GATE U12B accepts a record increment interrupt input from each Position Tracking/Output assembly and sends this interrupt to the CPU (through PPI2). The output of U12B also drives the record increment trigger signal (RINCTR+) for future use.

4.3.6 Position Tracking/Output Assemblies (A6 and A7)*

4.3.6.1 Overview

The Position Tracking/Output assemblies provide high speed position output data for the Model 1885. These assemblies operate by simulating actual positioner movement for a position output that is always up-to-date and simultaneous with actual positioner movement. Figure 4.11 provides a detailed block diagram of the Position Tracking/Output assembly.

*** Model 1885 Only**

The Position Tracking/Output assembly interfaces to the CPU assembly at various locations. Control latches accept data from the microprocessor data bus to provide the binary rate multipliers with digital velocity data. The binary rate multipliers produce a corresponding output signal of 0 to 5 MHz, depending on the value of the input data. The output from the binary rate multipliers acts as a clock input for the 8-decade BCD counter chain. Therefore, the rate of the BCD counter chain is proportional to the velocity and direction of a positioner's actual movement. For example, a higher frequency rate (f) indicates rapidly changing position, while a lower frequency indicates slower movement. The frequency is determined by the following equation:

$$f = \frac{\text{input}}{2^{18}} \times 5 \text{ MHz}$$

The main device of the counter chain control logic is a PAL (programmable array logic). The PAL determines the direction of positioner movement for the counter chain and also senses critical position data rollover points (for

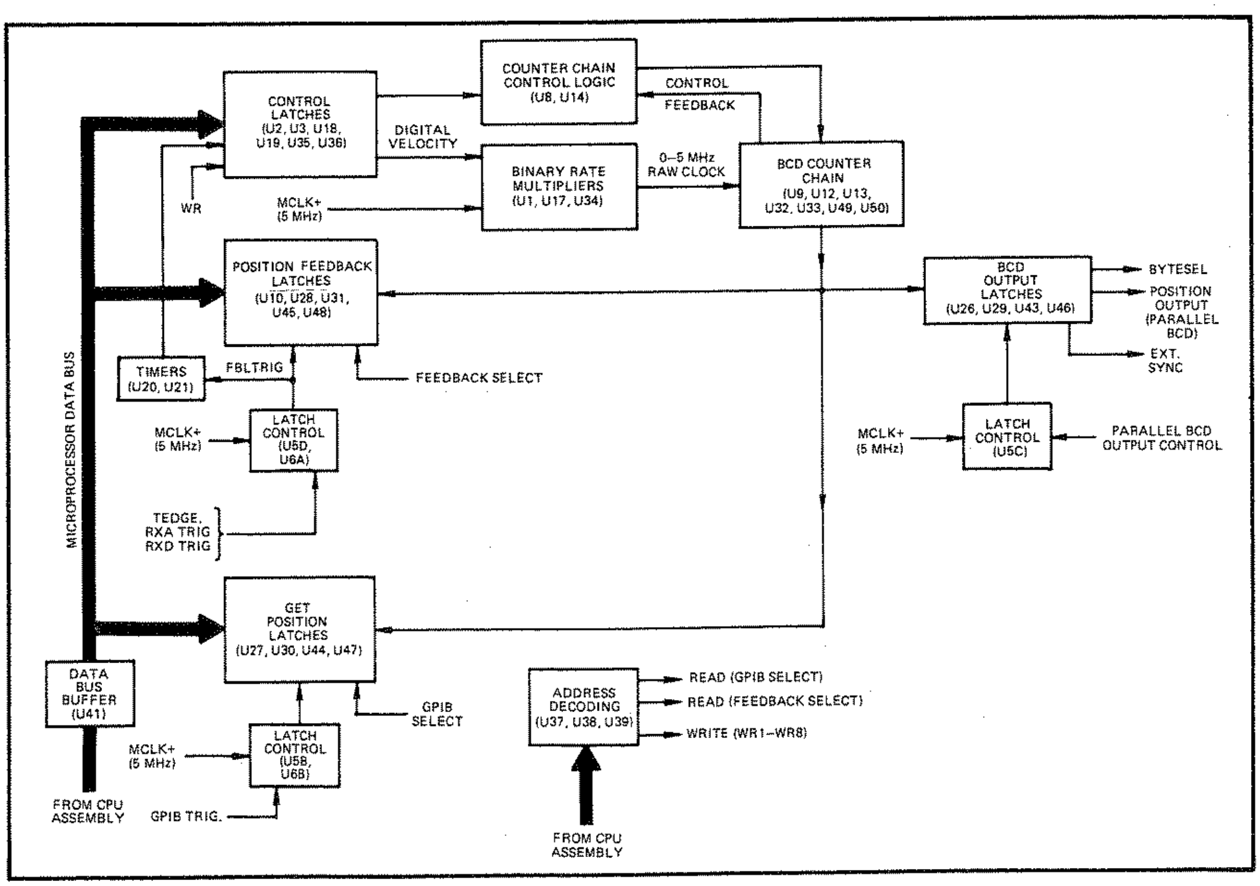


Figure 4.11. Position Tracking/Output Assembly (A6 and A7), Block Diagram

example, when the position data must go from 359.9999 to 000.0000).

The output of the BCD counter chain drives three sets of latches: the BCD output latches, the position feedback latches, and the GET position latches. The BCD output latches provide the signal for the Position Output connectors on the rear panel by sampling the BCD counter chain output any time a "take-sample" trigger command is received through the EXT TRIG input (assuming an INHIBIT signal is not applied). The BCD output latch control circuitry synchronizes the EXT TRIG signal with a 5 MHz clock signal to assure data at the output of the counter chain are valid. Because of this synchronization, the output latch update pulse may occur up to 200 nanoseconds after the EXT TRIG is applied.

The position feedback latches provide the CPU with the value of the position data at the output of the counter chain. The Encoder/Timing circuit strobes these latches simultaneously with the input sample. The CPU compares the BCD counter chain output with the absolute position data from the Position Inputs, calculates the velocity value, and sends this value back to the control latches. When the positioner is moving at a constant velocity, as it should be during data collection, these two values are the same. If these values are not the same, the CPU corrects the error by adding or subtracting from the calculated velocity.

To guarantee accurate data results, the position feedback latches must sample the position simultaneously with the input sample. To insure this synchronization when data enters through a Position Input (J7, J8, or J9), the latch control circuit enables the position feedback latches on a trigger edge (TEDGE) signal provided by the Encoder/Timing assembly (A3). When TEDGE occurs, the position feedback latches sample the BCD counter chain within 200 nanoseconds. At the same time, the samples from the Position Inputs take place. The CPU reads data from both the Position Inputs and from the position feedback latches, comparing the data for velocity calculations. During velocity calculations, the CPU also reads a timer on the Memory/Interface assembly. This timer, activated by a feedback latch trigger (FBLTRIG), measures the length of each sample period. FBLTRIG is synchronized with TEDGE and to the 5 MHz clock as are the output latches.

When input data enters through a Serial Interface input (J3 or J4) from a Model 1886, the sampling process becomes more complex. A serial I/O synchronizing byte (RX TRIG) sent to the position feedback latch control circuitry from the Model 1886 Encoder/Timing assembly triggers the position feedback latches. Timing for this triggering signal is accomplished in the following manner.

Assume the Model 1886 has sent data from the previous sample point to the Model 1885 over the serial interface and is now idle. The Model 1885 recognizes this condition and waits to receive a trigger for the next sample point by enabling the position feedback latch control circuitry. While no data are being sent, the serial line is logic "high". When the Model 1886 timing circuitry produces a synchronizing byte, the serial interface line goes logic "low" and remains low for several bit-times. This process triggers the position feedback latch control circuitry. After synchronizing with the 5 MHz clock, the latch control circuitry triggers the feedback latches sampling the position data. After the time has expired, the serial interface line goes logic "high" again, and remains high until after the stop bit. (Remember: serial data consists of 8-bit data groups, with an additional START bit which is always low and a STOP bit which is always high.) In other words, position data samples are taken by the Model 1886, while simultaneously, the Model 1885 samples the position feedback latches. The Model 1885 CPU reads these latches. After the short period of processing and receiving data from the Model 1886 expires, the CPU performs velocity calculations and determines the necessary error compensation corrections. The new velocity is then sent to the velocity control latches as described previously.

The GET (Group Execute Trigger) position latches respond to a GPIB command appropriately named "GET". Whenever a GET signal appears on the GPIB, the CPU assembly sends a logic "high" trigger signal to the GET position latch control circuitry. The latch control circuit synchronizes this signal to the 5 MHz clock. Within 200 nanoseconds, the GET latches sample the output of the counter chain. Therefore, by carefully controlling the implementation of the GET signal, precision data is obtained over the bus.

4.3.6.2 Detailed Discussion

A schematic of the Position Tracking/Output assembly is provided in Figure 7.11.

Data between the microprocessor data bus and the Position Tracking/Output assemblies are buffered through U41, a bi-directional buffer. Data bits are labeled SAMDØ through SAMD7.

Control latches U36, U35, U19, U18, U3, and U2 are configured in a double-buffered stage. The first stage, consisting of latches U36, U19, and U3, accepts and stores updated velocity data from the microprocessor data bus. On a later signal, the latches transfer the complete 3-byte data set simultaneously to the second control latch stage consisting of the U35, U18, and U2. When binary rate multipliers U34, U17, and U1 detect the rising edge of the 5 MHz MCLK+ timing signal at pin 9, they begin counting at the new velocity rate. The "Z" output at pin 5 of U34, U17 and U1, combine at NAND-gate U7C to produce another output timing signal called RAWCLOCK. RAWCLOCK, through gates U15A, U15C, and flipflop U16B, provides the count clock and load signals for the BCD counter chain (U9, U13, U12, U49, U50, U32, U33 and U11).

Latch U2 has several control bits that also change during the process of transferring data to the control latches. The NEGVEL (negative velocity) line at pin 9 determines the direction (up/down) and sign (+,-) for the BCD counter chain, while RNGE (range) line selects the 360 or ±180 range. SPCTRL-A, B and C are speed control bits responsible for selecting the counting speed for the BCD counter chain. Position changes in 0.001°, 0.0001° or 0.00001° increments, depending on tracking velocity and mode of operation.

Figure 4.12 shows the relationship of the various timing signals used on this assembly. MCLK+ is a 5 MHz, 1/3-2/3 duty cycle signal generated by the CPU assembly. MCLK+ is used primarily by the binary rate generators to produce the positive count clock signal (RAWCLOCK) for the BCD counter chain. RAWCLOCK is inverted with respect to MCLK+ to provide proper timing control of the counters and various latches.

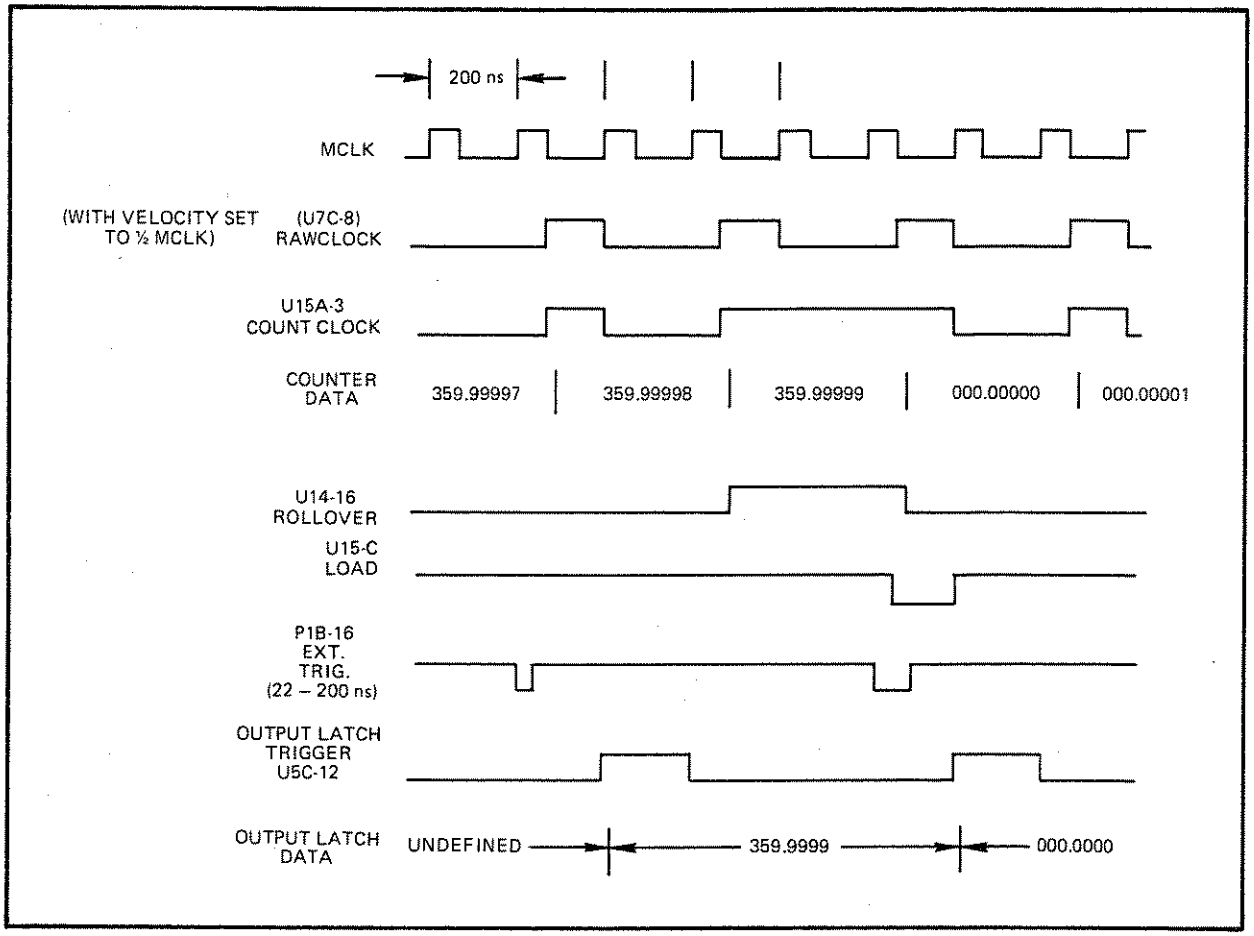


Figure 4.12. Position Tracking/Output Timing Signals

The rising edge of RAWCLOCK occurs when counter chain data require changing by one least significant bit. Two signals, COUNT CLOCK (U15A-3) and LOAD (U15C-8), accomplish this task. The COUNT CLOCK signal feeds the clock input of the counters, acting as the usual mechanism for changing the data in them. However, when a ROLLOVER condition occurs, the data are changed by the LOAD signal. (A ROLLOVER condition occurs with a range of 0-360 when counter data is one count below zero and the counter chain is counting up, or when data are zero and the counter chain is counting down.) Note that LOAD and COUNT CLOCK signals are the only signals responsible for changing counter data. These signals change data only on the rising edge of RAWCLOCK (or in effect, the falling edge of MCLK+).

Each individual counter of the BCD counter chain is a synchronous-type (or having a common clock) counter responsible for one of the eight decades of position data. The following example shows the role of each counter in the case of BCD output data:

Position Data: 359.99999

Counter	Digit	Resolution
U29	3	100°
U32	5	10°
U34	9	1.0°
U36	9	0.1°
U40	9	0.01°
U41	9	0.001°
U45	9	0.0001°
*U46	9	0.00001°

* for internal use only

The counter chain is controlled through U14 and U8, two programmable array logic (PAL) integrated circuits. U14 controls the sign, direction, count clock, and load signals, and U8 controls the speed range. A brief description of each signal follows.

$\overline{\text{CHANGE DIR}}$ (U14, pin 19) provides proper counting for the BCD Counter Chain during counting sequences where, for example in the ±180 mode, counting is in an upward direction from + 170 to +179.99999. Immediately after 180, the counters must count downward beginning with -179.99999. $\overline{\text{CHANGE DIR}}$ clocks flipflop U16A forcing the output at pin 5 to toggle. This is the RAWSIGN input to U14, pin 9 which is used to determine the SIGN of the data.

DN/UP (down/up, U14, pin 12) determines the count direction for the counter chain by evaluating input signals RAWSIGN (pin 9) and NEGVEL (pin 11). If the absolute position value is becoming larger, the counter chain receives a count "up" command from U14. If the absolute value is decreasing, the counter chain receives a count "down" command.

SIGN (U14, pin 18) is determined by RAWSIGN and RANGE. For example, SIGN is always "+" for data in the 0-360 and 0 to +180 range, and "-" for data in the -179.99999 to 0.0000 range.

ROLLOVER and $\overline{\text{ROLLOVER}}$ (U14, pins 15 and 16 respectively) respond to the input signals to determine when a rollover point is necessary (for instance when going from 359.99999 to 000.00000). The output at pin 16 is shown in the timing diagram of Figure 4.12. Two conditions cause these signals to become active:

- when RANGE is 0-360 and the counters are counting up and the position is 359.99999
- or when RANGE is 0-360 and the counters are counting down and the position is 0.00000.

PRST (preset) signal at pin 17 of U14 controls some of the input bits A, B, C and D (pins 15, 1, 10 and 9 respectively) of the individual counter chain counters. Two preset conditions require loading the data into these counters, both occurring in the 0-360° range. One condition is when the next number counting downward from "0" is a 359.99999. The PRST line goes logic "high" for the load. In this case, U9 becomes digit "3" of 359.99999, U13 becomes digit "5", U12 a "9" and all remaining counters become "9". The other preset condition requiring data loading is when counting upward to zero from 359.99999 on the next clock edge. In this case, PRST line is "low" and all of the counters load "0".

MAX/MIN (maximum/minimum) is the counter output signal used to indicate when the counters have reached either their maximum or minimum counting capacity (at nine and counting up, or zero and counting down for example). When this happens, a carry or borrow to the next stage is necessary. PAL U8 accepts four Max/Min input signals: M/M1, M/M2, M/M3 and M/MA. Each come from their respective counters--M/M1 (pin 8) from U11, M/M2 (pin 2) from U33, and M/M3 (pin 3) from U32. M/MA, however, is a signal from U7A which is the combination of Max/Min outputs of U12, U49 and U50. U8 accepts all four of the Max/Min signals and sends one COMB M/M output signal (at pin 12) to PAL U14 (pin 1). U14 combines the signal at pin 1 with M/M7 (pin 2) from U13. Observe the only Max/Min signal not used--pin 12 of U9, the most significant digit counter. Data for A1 and A2 (one-hundreds and two hundreds bits at pins 4 and 5 of U14) enter PAL U14 to generate an equivalent Max/Min for U9.

REC INC CLK EN (Record Increment Clock Enable) output signal at U8 (pin 15) enables the record increment counter (U23 and U24) through input commands from SP CTRL (speed control) inputs and the Max/Min inputs.

The enable outputs, $\overline{EN2}$, $\overline{EN3}$, and $\overline{EN4}$ of U8 (pins 19, 18, and 17 respectively), activate specific counters to allow them to count at the appropriate time. At low speeds (less than 8.33 RPM), the enable outputs are equal to the corresponding ripple carry output from the previous counter stage. For example, $\overline{EN2}$ is equivalent to the ripple output from U11, pin 13. Under these conditions, U11, the least significant counter, provides an overall resolution of 0.00001°. So each positive edge of COUNT CLOCK (U15A-3) causes the counter chain to change by 0.00001°. Therefore, at a rate of 5 MHz, only speeds with velocities of up to 8.33 rpm are possible (5 MHz x .00001 = 50°/sec or 8.33 rpm). Therefore, at speeds greater than 8.33 rpm, U33 is always enabled by $\overline{EN2}$ and becomes the least significant digit rather than U11. This process slightly lowers the accuracy of the data but allows input velocities of up to 83.3 rpm. Faster speeds are possible using $\overline{EN3}$ and $\overline{EN4}$ outputs of U8 in a similar fashion. Binary operation is similar but the counters have a different weight. Enable signals are produced by combining SP CTRL (speed control) inputs and $\overline{CARRY}$ inputs. Table 4.6 shows how the speed control bits affect position counter resolution and speed as well as the record increment counter resolution.

Table 4.6
Speed Control Bits

Position Cntr. Rresoltn.					Record Increment Cntr. Resolutn.	
C	**B**	**A**	**BCD**	**Binary**	**BCD**	**Binary**
0	0	0	0.00001	30 bits	0.0001	26 bits
0	0	1	0.0001	26 bits	0.0001	26 bits
0	1	0	0.001	22 bits	0.001	22 bits
0	1	1	0.01	18 bits	0.01	18 bits
1	0	0	0.00001	30 bits	0.001	22 bits
1	0	1	0.0001	26 bits	0.001	22 bits
1	1	0	0.001	22 bits	0.001	22 bits
1	1	1	0.01	18 bits	0.01	18 bits

Expected normal usage is for C, B, A to be 0,0,0 or 0,0,1 for BCD (depending on the speed) and 1,0,1 or 1,1,0 for binary. This gives 0.0001 or 22 bits resolution for record increments at speeds up to 70 RPM.

Table 4.6 - continued

Maximum Speed (RPM)			
B	A	BCD	BINARY
0	0	8.333	0.27
0	1	83.33	4.47
1	0	833.3	71.5
1	1	8333	1114

For the remaining counter stages, the RIP CLK (ripple clock) output at pin 13 (U50, U49, U12 and U13) connects to the enable input (EN G, pin 4) of the succeeding counter stages (U49, U12, U13, U9). RIP CLK output designates whether the counter is at nine and counting up, or zero and counting down. As mentioned previously, DN/UP (down/up) signal at pin 5 tells whether the counter is going up or down. For example, if the counter is at nine and counting upward, the enable pin of the next counter stage is activated. On the edge of the following clock pulse, it counts up while the initial counter moves to zero.

The output of the BCD Counter Chain connects in parallel to three different sets of latches:

- BCD Output Latches
- Position Feedback Latches
- GET Latches.

The BCD output latches, U43, U26, U46 and U29, provide counter data for the 37-pin rear panel Position Output connectors. The data output type depends on the connection scheme of the cable attached to the connectors (see Connector Detail, Chapter 2). BYTESEL (byte-select) lines to each of the output latches (pin 1) act as "enable" lines. If all the BYTESEL lines are logic "low", the output latches produce a parallel BCD-type data output. However, if the lines are logic "high" but enable (or go low) one at a time, the latch outputs go to the state determined during the previous clock edge and produce a byte-serial type data. In either case, the data are positive true. Other signals produced at the Output Latches include RANGE and SIGN.

Refer to the timing diagram of Figure 4.12. The OUT LATCH TRIGGER (OLT) signal at U5C-12 is generated by either an external triggering source or by an internal triggering source, depending on the position of triggering jumper J4. The rising edge of OLT, responsible for forcing the latches to sample the counter data, is synchronized to the rising edge of MCLK+. This action guarantees valid data since the counter data only changes on the falling edge of MCLK+. This same technique is also used for triggering the position feedback latches and the GPIB latches.

Position feedback latches U45, U28, U48, and U31, are used by the CPU to read the position for velocity calculations. These latches are triggered by the TEDGE signal from the Encoder/Timing card, or by the start bit of a synchronizing byte from a Model 1886.

The latch control circuitry for the position feedback latches produces a FBLCHTRG triggering signal from the Q output of U5A (pin 4). Latch U6D accepts the triggering signal from one of three sources: RXATRIG, RXBTRIG, or TEDGE (from Encoder/Timing assembly) at U42. The Encoder/Timing assembly provides the trigger for direct position inputs and the Serial Interface inputs. If the signal enters through the Position Inputs, the TEDGE signal is used by selecting INPUT1TR. If the input signal enters through Serial Interface inputs, either RXATRIG or RXBTRIG is chosen depending on the input channel.

Latch U40 controls U42 to select the input trigger. STROBE (U42-7) causes the output at W (U42-6) to go "high". When the STROBE line is "low", the selected input goes to U6D. For example, if D1 is chosen, the strobe looks at the receiver RXATRIG signal which remains "high" until the trigger occurs. When the trigger condition happens, the line is pulled "low", and the latch is set. U5A toggles the Q output "high" on the next rising edge of MCLK, producing the FBLCHTRG signal within 200 nanoseconds. This signal triggers the feedback latches U45, U28, U48, U31, and U10 storing position for later use. Further triggers applied to U42 are ignored until the velocity update strobe occurs.

At the same time the position feedback latches are triggered, timers U21 and U20 are activated. When a trigger occurs, the timers begin counting. On completion of the timing cycle, the timers strobe latches U35, U18, and U2 through U22-C, which transfers the new velocity data from U36, U19 and U3. This strobe also clears U6D and U5A so that subsequent triggers may be received.

GET position latches U44, U27, U47, and U30 provide an additional method of gathering position data for the controller by using the GPIB bus. GET latches are triggered by a GPIB trigger signal originating from the CPU assembly. The GPIB latch control circuitry consists primarily of flipflops U6B and U5B. This stage is capable of sensing a trigger pulse for the GET latches (U44, U27, U47 and U30) and synchronizing the pulse with the clock to prevent latching data until the counter chain has stabilized. The GPIB latches are controlled by the GPIBLCHTR (latch trigger) signal from U5B, pin 5. As a GET signal is received, the bus interface hardware on the CPU assembly generates a positive-going pulse and sets the output of U6B. On the next positive edge of MCLK, U5B (pin 5) goes "high" which activates the GET latches. Data are held in these latches until the CPU reads the data and resets U6B (through latch U40) to accept the next trigger.

Two types of triggering, internal and external, are available as selected by the position of jumper P4. For internal triggering, the jumper is installed forcing pin 3 of flipflop U6A "low". The output at pin 4 (Q) drives the OUT TRIG HOLD of U8 (pin 16). When this line are active, the OUT LATCH TOGGLE (pin 13) sets, forcing the input of U5C (J) "high". This condition means the output toggles with the clock as shown in the timing diagram of Figure 4.13. Under these conditions, the output data are latched every 400 nanoseconds producing up-to-date data. If the INHIBIT line (pin 14) of U8 is pulled logic "low", the OUTPUT LATCH TOGGLE signal goes "low", and the output latches stop changing and remain in this present state. At this time, the output data are valid and will not change until the inhibit line goes high.

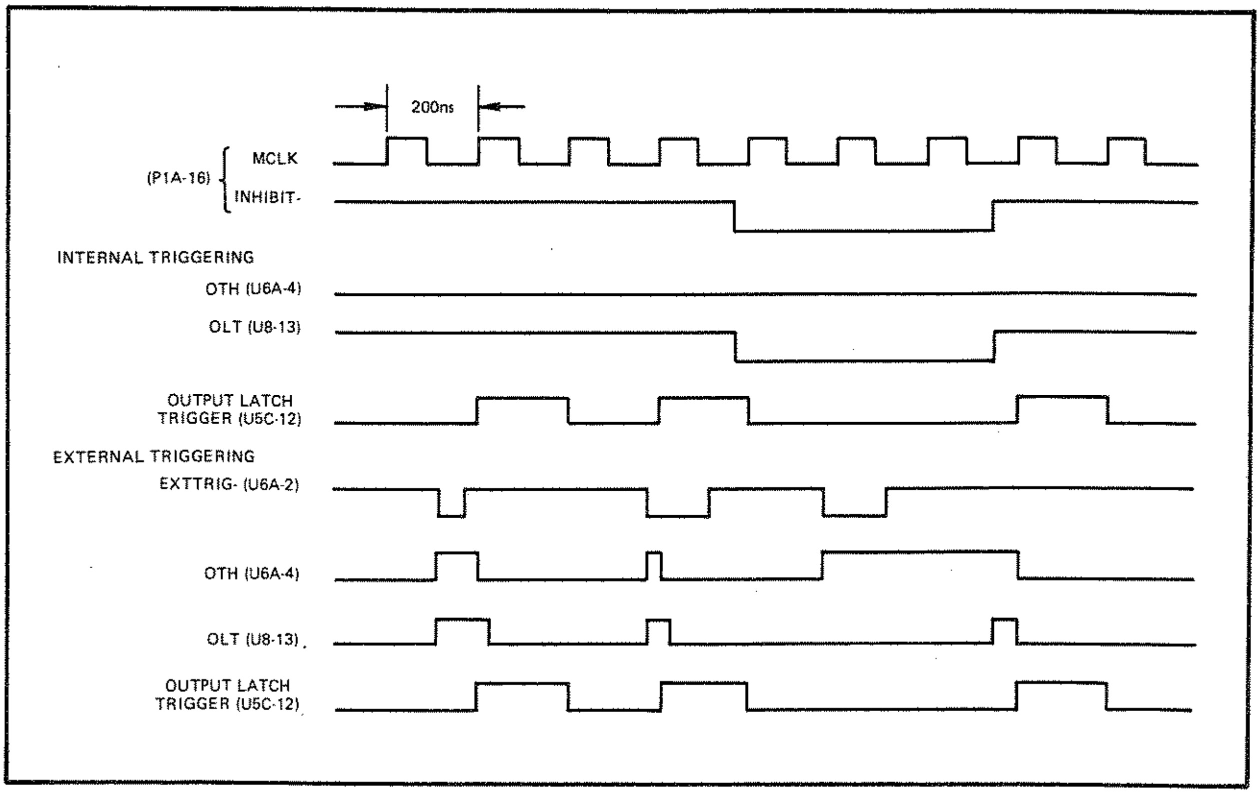


Figure 4.13. Output Latch Internal and External Triggering

With external triggering, the jumper is not installed. The $\overline{S2}$ input to U6A is always high, effectively disabling that input. The $\overline{S1}$ input (EXTTRIG line) sets the flipflop. If triggering has not occurred recently, the OUTPUT LATCH TOGGLE (OLT) and OUTPUT TRIG HOLD (OTH) are zero. Output Q of U5C is low, so that through inverter U22 the reset (R) input of U6A is high. An active low EXTTRIG- signal will then cause OTH (U6A-4) to be set. This causes OLT to set as long as INHIBIT- is not active. When OLT is set, the output latch trigger will occur on the next positive edge of MCLK. If an external trigger occurs during the time INHIBIT- is active, the output latches will not be updated until INHIBIT- becomes inactive.

The address decoding circuitry consists primarily of U39, U38, and U37. PAL U39 provides the address decoding for line FBS5, while all other lines are decoded through U38 and U37. U38 and U37 each have three address lines, A, B and C (SAMA0, SAMA1, and SAMA2). The SAMIO/M (I/O memory) line goes to G1 (pin 6) of U38 and U37, to enable them only during I/O operations and not during memory operations. The SAMWR (write) line goes to U37 while SAMRD (read) line goes to U38 of the G2A input (pin 4). The "Y" outputs of U38 occur during read operations to the assembly, while the "Y" outputs of U37 occur during write operations to the assembly. FBS5 is a read signal which comes directly from the PAL. Only three of the many I/O lines (SAMAØ, SAMA1, and SAMA2) go to U38 and U37. Therefore, additional decoding is required. Higher order address lines (SAMA3, SAMA4/5, SAMA5/4, and SAMA6) go to U39 where it combines the data to give proper enable signals (for the correct address block). BDSEL (board select) signal comes from a PAL on the Encoder/Timing assembly and decodes SAMA7 through SAMA19.

The "write" signals WR1 through WR8 at the output of U37 connect to U40, U23, U24, U3, U19, U36, U21 and U20 respectively. The "write" signals go into clock inputs (pin 13) of the latches, which allow the microprocessor to send and latch data over the data bus.

The GPIB and FBS "read" signals at the output of U38 go to the Position Feedback latches and to the GET latches to enable the data in the latches to be read. FBS1 through FBS4 connect to position feedback latches, while GPIBS1 through GPIBS4 connect to the GET latches. "Read" signals force the Output Control (OC, pin 1) pins of the control latches "low" to allow data to come onto the bus and be read by the microprocessor. When the microprocessor is not reading data, the OC lines are "high" with the output latches in a high impedance state.

U23 and U24 are the record increment counters. These two devices count the number of position increments which have occurred and generate an interrupt through U39 and U6C to the microprocessor whenever the specified change in position is detected. These position increments are 0.0001° for BCD, and $1/2^{22}$ for binary position tracking cards. The record increment parameters (including size) must be specified through the GPIB (see Section 4.3.2).

U15D-11, whose inputs are RICOUNT and RICKEN, enables the counters to count, or disables the counters. RICKEN synchronizes starting and stopping the record increment function with the velocity update so that no increments

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are missed. RICOUNT determines which RAWCLOCK edges are to be counted and which are to be ignored. This process is controlled by PAL U8 (see Table 4.6).

The record increment counters form a 16-bit "up counter" whose maximum value is $2^{16} - 1$. They are preset to the maximum value minus the number of increments to be counted by the microprocessor. The counters then count the number of increments which occur as position changes and therefore the amount which the positioner has moved. When the maximum value is reached, the programmed number of increments has occurred. At this point, the counters generate an interrupt and are automatically reloaded to their previous state to begin counting over the next interval. This assures that record increment interrupts happen precisely when the position counter chain reaches the angle desired for the record increment.

4.3.7 Front Panel Interface Assembly (All)*

4.3.7.1 Overview

In addition to the front panel displays and pushbutton keyboard panel, the Front Panel Interface assembly consists of the circuitry responsible for interfacing the same displays/keyboard to the CPU assembly. A block diagram of the Front Panel Interface assembly appears in Figure 4.14.

The left and right front panel Position Displays each consist of a 7-segment, common cathode, LED display. A single integrated circuit drives both Position Displays and accepts commands from the pushbutton keyboard panel. The left and right Axis Identification front panel displays, however, each have a separate driver IC. All display drivers connect to the CPU through the data bus. Because of the keyboard interface of the Position display driver IC, two-way communication (or read/write) with the CPU is required, whereas the Axis Identification Display drivers only accept data from the CPU.

* Model 1885 Only

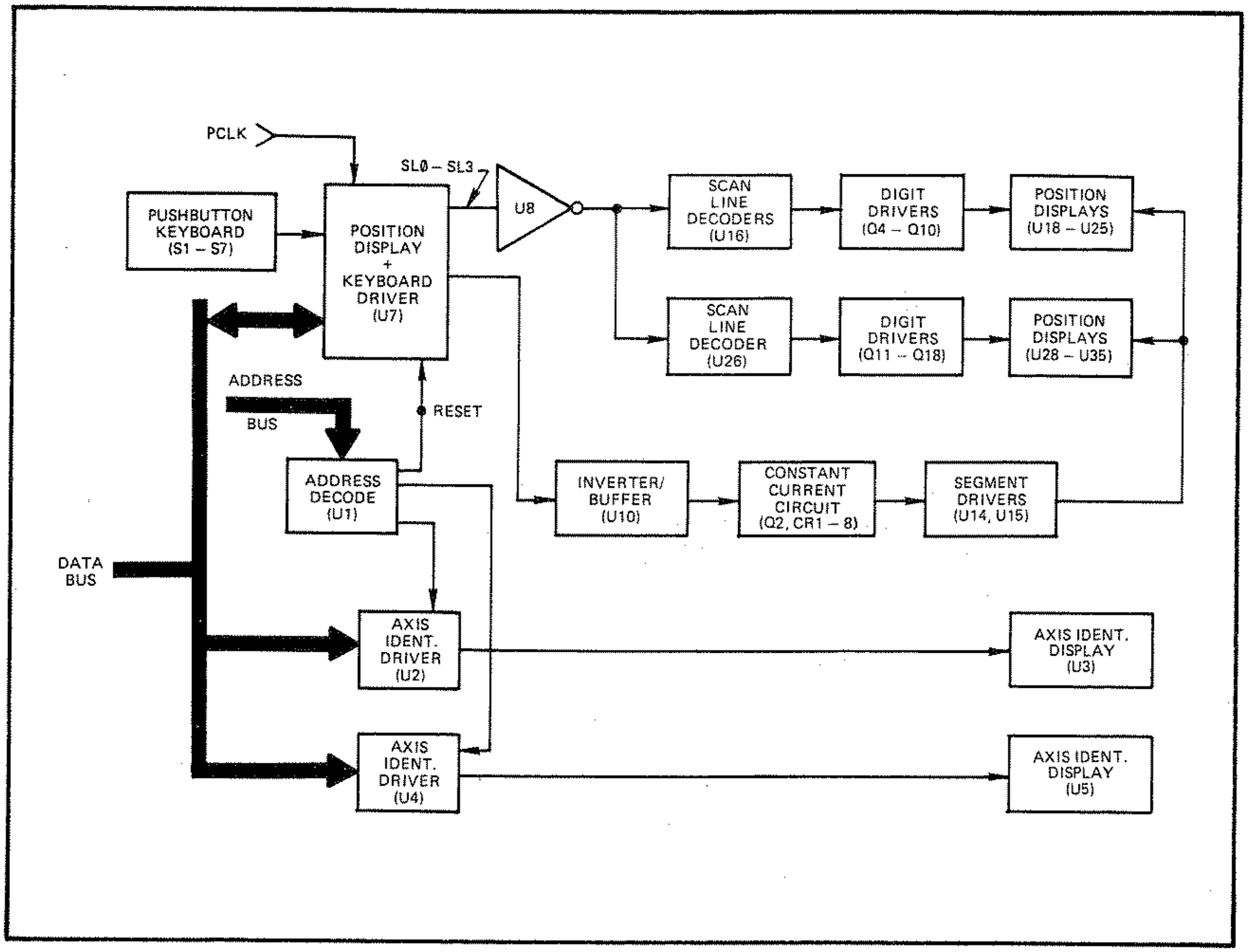


Figure 4.14. Front Panel Interface Assembly Block Diagram

4.3.7.2 Detailed Discussion

A complete schematic of the Front Panel Interface assembly is provided in Figure 7.17.

The Position Output display and keyboard driver stage consists primarily of U7. U7, a programmable keyboard/display interface device, accepts and provides data and control signals for the CPU over the data bus. In addition, U7 multiplexes data for the display segment drivers (U14 and U15) and scans the keyboard pushbutton switches (S1 through S7) for any changes. A 2.5 MHz clock signal (PCLK) enters U7 at pin 3 and is divided into a 100 kHz scan rate for the front panel switches. After pressing any one of the front panel pushbuttons, a switch closure/release code is latched into U7 for reading by the CPU by way of the data bus.

Data for displaying enter U7 as seven-segment bit patterns. This data includes decimal digits, sign, and decimal locations for each LED assembly (U18 through U25, and U28 through U35). Data represents the bit pattern applied to the anodes of each LED. U7 sends anode data through the segment drivers while the cathode of the desired display is enabled. This procedure is repeated for each LED in a scanning fashion at a 100 kHz rate.

Scan Line output signals (SLØ through SL3) are inverted through U8 before being decoded by scan line decoders U16 and U26. On decoding the output from U7, U16 and U26 enable the selected cathode digit driver transistors Q3 through Q18. These transistors select one cathode from the bank of LED devices for conduction. Decoder U16 handles address data from Ø through 7 while decoder U26 handles 8 through 15.

Anode segment driver signals AØ through A3, and BØ through B3 at pins 24 through 31 of U7 are buffered and inverted through U10. Resistor network U11 acts as a pull-up line for U10 to maintain reverse bias on anode segment drivers U14 and U15. Resistor network U12 limits base current to U14 and U15. Emitter-follower Q2 and diodes CR1 through CR8 establish a constant base voltage for U14 and U15. This provides a constant current drive to anode segment LEDs in the display devices for a more even lighting effect.

Two LEDs, part of the DISPLAY and OUTPUT pushbuttons (S1 and S2), illuminate to provide visual verification for the operator of whether the presently-active selection is for a display or output. A third LED, CR9, acts as a REMOTE mode indicator, glowing when the unit operates with a system controller through the IEEE-488 bus.

The Axis Identification Displays consist of eight-character, 14-segment, alphanumeric display devices U3 and U5. U2 and U4 drive U3 and U5 respectively. The CPU writes display data into specific RAM locations inside drivers U2 and U4, corresponding to specific characters on displays U3 and U5. The display data must be a code corresponding to one of the 64 characters contained in the dense ASCII subset (see Table 4.7). The driver decodes this data and sends an output signal consisting of the proper pattern to the display.

Like the Position displays, data are multiplexed by the drivers through a process of selecting one character at a time and providing segment data to the Axis Identification Displays.

Address data and I/O memory line data are decoded by single decoder, U1. However, the WRITE line (SAMWR-) does not go through U1, but rather feeds directly into the drivers.

Address lines AØ, A1, and A2 go directly into U2 and U4. Address Ø indicates the writing of data for the leftmost character, while 7 indicates the writing for the rightmost character of each display.

U1 decodes the upper address lines to select one (or none) of the three drivers by activating chip select for the appropriate driver.

4.3.8 Rear Panel Interface Assembly (A12)

4.3.8.1 Overview

The Rear Panel Interface assembly, as its name implies, interfaces signals from the Model 1885/1886 rear panel connectors to the appropriate internal circuitry. In addition, this assembly provides secondary surge protection for the rear panel Serial Interface connectors. A block diagram of the Rear Panel Interface assembly appears in Figure 4.15. Schematics of this assembly are provided in Figure 7.21 and 7.45.

Table 4.7
Dense ASCII Subset Characters

B6 B5	Ø Ø	Ø 1	1 Ø	1 1
BITS				
B4 B3 B2 B1				
Ø Ø Ø Ø	@	P	SP	O
Ø Ø Ø 1	A	Q	!	1
Ø Ø 1 Ø	B	R	"	2
Ø Ø 1 1	C	S	#	3
Ø 1 Ø Ø	D	T	$	4
Ø 1 Ø 1	E	U	%	5
Ø 1 1 Ø	F	V	&	6
Ø 1 1 1	G	W	'	7
1 Ø Ø Ø	H	X	(	8
1 Ø Ø 1	I	Y	)	9
1 Ø 1 Ø	J	Z	*	:
1 Ø 1 1	K	[	+	;
1 1 Ø Ø	L	\	,	<
1 1 Ø 1	M	]	—	=
1 1 1 Ø	N	∧	.	>
1 1 1 1	O	_	/	?

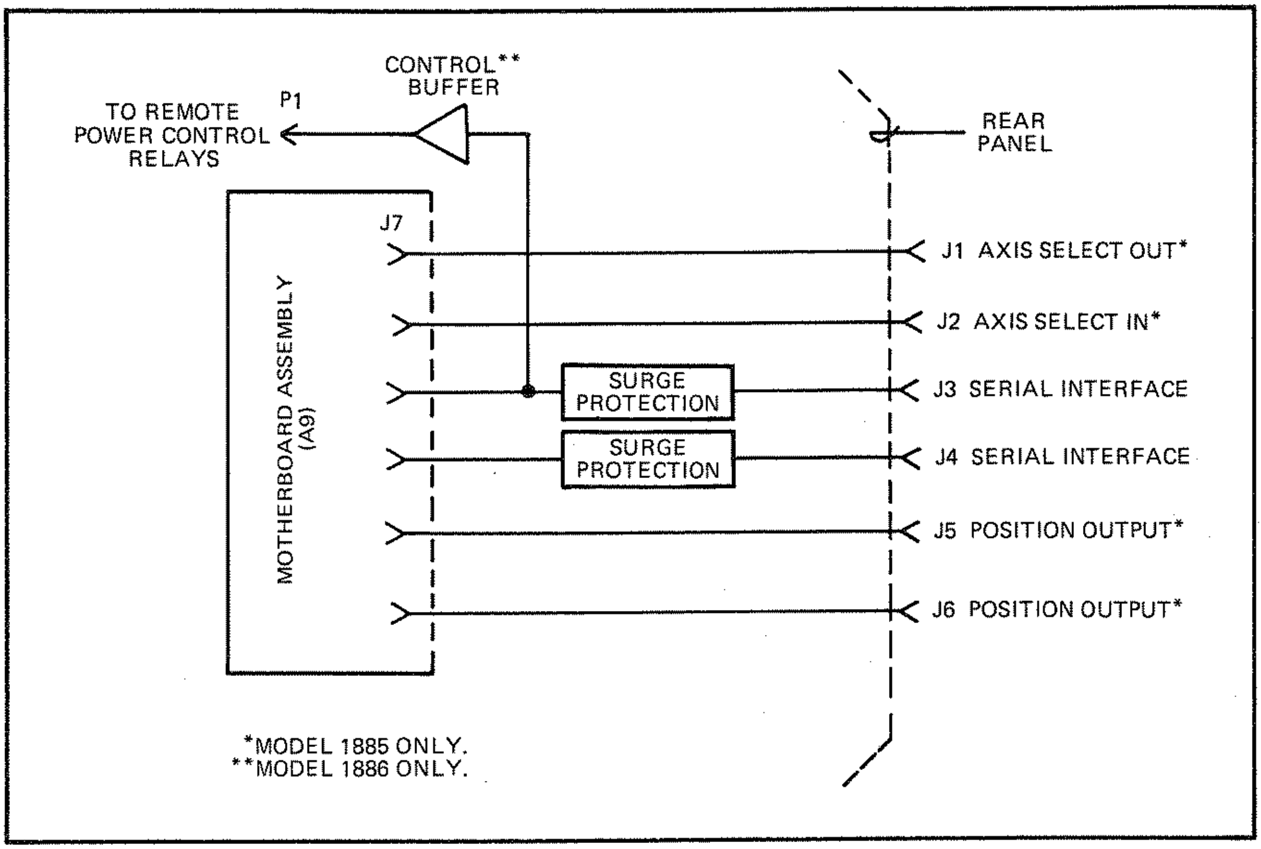


Figure 4.15. Rear Panel Interface Assembly Block Diagram

4.3.8.2 Detailed Discussion

J1 and J2 are the Axis Select Output and Axis Select Input rear panel connectors, respectively, while J5 and J6 are the Position Output connectors. No signal conditioning is performed between the Motherboard assembly and these rear panel connectors.

The Rear Panel Interface assembly includes a secondary surge protection circuit for Serial Interface connectors J3 and J4 (against lightning for example). This protection circuit consists of back-to-back zener devices V1 through V8 and resistor networks U1, U2, and U3. These components are arranged in a configuration to back-up the primary protection device used over the serial interface link. This circuit is capable of absorbing relatively large current surges, but is not sufficient for primary protection.

The Remote Power Control Buffer (Model 1886 only) allows the unit to be turned ON and OFF remotely, provided the power switch is in the "REMOTE" position. Switch S1 on the Rear Panel Interface assembly determines which signal in the serial input will be used to drive the control buffer. If the Model 1886 is connected directly by way of a cable to the Model 1885, the presence of a valid serial signal can be used to turn the unit ON. If a modem is involved in the link, the modem should be configured to indicate the detection of carrier on the CTS (Clear To Send) input to the Model 1886, permitting the presence of carrier to drive the control buffer. Table 4.8 shows the correct configurations of S1 to achieve these operating modes. (Also see Table 2.12.)

Table 4.8
S1 Configurations

Directly Cabled (valid serial signals power ON the Model 1886)	Conected By Way of Modem (Clear To Send powers ON the Model 1886)
S1a and S1c ON S1b and S1d OFF	S1b and S1d ON S1a and S1c OFF
Switches S1e and S1f should normally be ON also, providing shield ground for serial cables at the Model 1886 end.	

4.3.9 Power Supply Assembly (A13)

4.3.9.1 Overview

Power Supply assembly A13, consists of a commercial unit from Standard Power, Inc., Model SWS 252 T-5/12/12. Supporting data such as parts lists and schematics from the manufacturer are provided in Figures 7.28 and 7.29.

The Model SWS 252 T provides the required source of both the ±12V dc and +5V dc from either 115V and 220V ac, 50/60 Hz. The supply is constructed on a single chassis and mounted into the Model 1885/1886 as assembly A2.

4.4 ENCODER PROCESSOR UNIT

4.4.1 Overview

The Encoder Processor unit provides the following functions:

- supplies appropriate excitation signal to a precision position encoder
- amplifies and conditions low-level, high-accuracy position data signals from the output of a precision position encoder.

The Encoder Processor is designed for remote mounting inside the antenna positioner. Two individual assemblies, the Encoder Control and the Encoder Preamplifier, together form the Encoder Processor. A block diagram of the Encoder Processor assembly appears in Figure 4.16.

The typical encoder used in Scientific-Atlanta positioning systems is an Inductosyn® precision rotary transducer. The encoder windings require approximately a 6V peak-to-peak, 10kHz sine wave excitation signal. A 10kHz oscillator and amplifier on the Encoder Control assembly produce the proper excitation signal for the precision encoder.

The precision encoder provides two low-level output signals corresponding to position (sin and cos Θ). Both output signals are amplified, demodulated, sampled, integrated, and converted to digital form.

During the conversion and sampling processes, the output data from the precision encoder are ratiometrically converted. This means the larger absolute value of the two signals, proportional to either sin Θ or cos Θ, becomes the reference voltage, while the lower of the two signals is converted as a fraction of the reference voltage. The result, either sin/cos = tan Θ or cos/sin = cotan Θ (depending on which is less than 1), is digitally converted to a 13-bit tan or cotan Θ and is transmitted serially uprange to the Model 1885 or 1886 Encoder/Timing assembly. The Encoder/Timing assembly accepts the data stream and performs the triggering process (see Section 4.3.3).

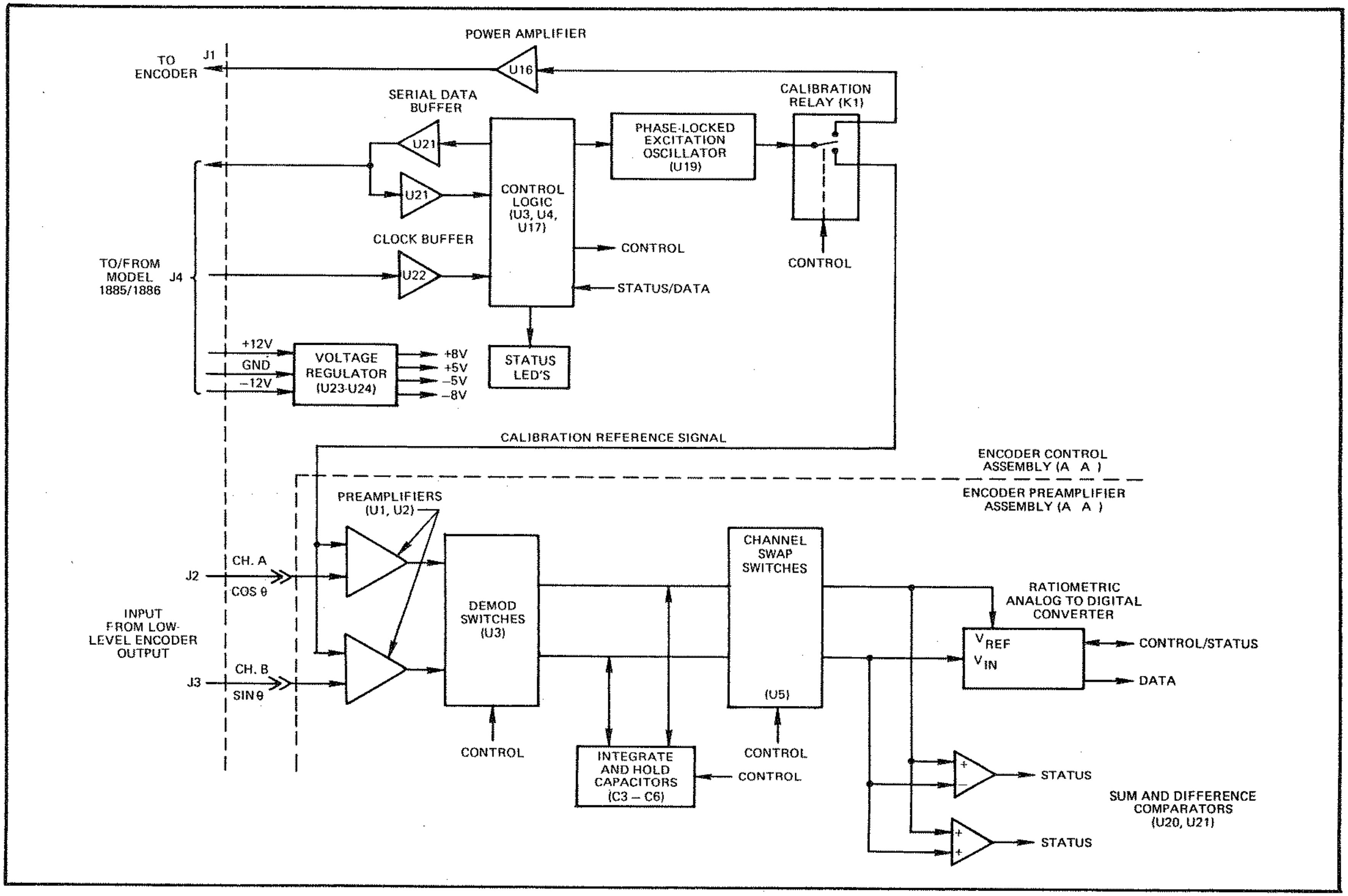


Figure 4.16. Encoder Processor Assembly Block Diagram

Two additional bits of the data stream provide information to the Model 1885/1886. One bit indicates whether a tan or cotan value was generated. The other bit indicates the sign of sin Θ + cos Θ.

4.4.2 Detailed Discussion

4.4.2.1 Encoder Control Assembly (A1)

A complete schematic of the Encoder Control Assembly is provided in Figure 7.54.

Data transfer between the Encoder Processor and the Model 1885/1886 is over a RS-422-type serial link through connector J4 to U2. A 38.4 kHz clock signal from the Model 1885/1886 Encoder/Timing assembly (A3) drives U1 to determine the data transfer rate.

The control circuitry consists primarily of PALs U3, U4, and divide-by-four IC, U5. U3 acts as a state machine with the main responsibility of controlling serial data and recognizing trigger pulses at U2. As U2 receives a trigger signal from the Model 1885/1886, the control circuitry forces an analog sample of the incoming data. The Encoder Preamplifier assembly performs an analog-to-digital conversion and sends the serial data stream back through the Encoder Control assembly to the Model 1885/1886 for processing. (The data are sent out by way of U2, a bi-directional device of the Encoder Control assembly.)

U5 divides the clock input by 4 resulting in a synchronized signal for the excitation oscillator, U6. U6, a phase-locked-loop (PLL) oscillator, generates the 10 kHz sine wave excitation signal for the precision encoder. U8 is an 8-watt power amplifier for driving the excitation signal. PALs U3 and U4 control the excitation oscillator as well.

Calibration relay, K1, switches the calibration signal injected at the input of the Encoder Preamplifier assembly ON and OFF. The excitation oscillator, U6, generates the calibration signal, while U7 buffers the signal before it goes to the relay. While the calibration process takes place, the excitation signal is removed from the output connector (J1) by K1. The calibration sequence occurs periodically under commands from the Model 1885/1886.

The Encoder Control assembly also provides power supply voltage conditioning. ±12V enters through J4 from the Model 1885/1886 and is regulated to ±5V and ±8V by U11, U12, U13, and U14.

On the edge of the Encoder Control assembly, a set of six red LEDs provide visual verification to the service technician of signal interface status to/from the Encoder Processor. This circuit monitors these functions:

1. operation (blinks to indicate conversions are taking place)
2. incoming serial bit stream
3. outgoing serial bit stream
4. the calibration function
5. integration and holding of the signal
6. the swapping of channels A and B.

4.4.2.2 Encoder Preamplifier Assembly (A2)

A complete schematic of the Encoder Preamplifer assembly is provided in Figure 7.56.

Input transformers T1 and T2 match the impedance of the precision encoder with the higher impedance of the preamplifier circuitry. They also provide a voltage gain of about 50 dB. Resistors R1 and R2 define the input impedance for the circuitry beyond the transformers. On the input side of T1 and T2, the impedance is 4Ω. On the output side of T1 and T2, the impedance is 10KΩ. U16 consists of two 1.8K precision resistors used for injecting the calibration signal into the inputs of T1 and T2.

The low-level signals from the precision encoder (sin Θ and cos Θ) are designated channel A and channel B in the block diagram. Operational amplifiers U1 and U2 amplify the signals from T1 and T2 by a factor of 40. Demodulation is performed by U3 and C3 through C6. C3 through C6 are stable precision capacitors charged through matched resistors in U18. Switch U3 selects one of the two pair of capacitors to be charged at a time synchronous with the excitation waveform. Each pair of capacitors corresponds to channel A and channel B input. Therefore, during the positive half-cycle of the sine-wave C3 and C6 charge, while during the negative half-cycle C4 and C5 charge. This process produces a resultant complimentary-type output signal eliminating any dc offset voltages while also doubling the gain.

Switch U5 selectively reverses or "swaps" the two channels before they reach U6 and U7. U6 and U7 are high input impedance amplifiers, serving to buffer the signals for further processing while also minimizing signal droop. U8 and U9 form the sum and difference of the two channels, allowing U10a and U10b to determine the sign of A+B and A-B. This information is used by U3 and U4 to properly control the conversion process. For example, the signal with the larger absolute value must be used as the reference input to the ratiometric A-to-D converter. Also, if this reference voltage is negative, the converter feedback signal must be inverted. U3 makes these decisions.

U11, a 12-bit digital-to-analog converter, works with CMOS successive approximation register, U15, to make successive "guesses" of the ratio of the reference voltage and signal voltage. These guesses are successively evaluated as U11 accepts the guess value from U15 and multiplies it by the reference voltage value. Hence, the output signal at U11 is a product of the larger value of the two channels (the reference voltage), multiplied by an unknown value (the guess is always <1), and is compared with the smaller value of the two channels. For example, if channel A is equal to a value of 1 and channel B is equal to .5, channel A is considered the reference voltage because it is the larger of the two. Successive approximation register U10 asks itself, "What number times channel A would produce a value equal to B?" or:

$$
\begin{aligned}
A \times ? &= B \\
? &= B \div A \\
? &= .5 \div 1 \\
? &= .5
\end{aligned}
$$

U15 uses a 13-bit binary search algorithm to calculate the final value. High performance amplifiers U12, U13, and U14, accurately evaluate the conversion process, providing serial data to U15 by way of PAL U4.

CHAPTER 5
MAINTENANCE

5.1 INTRODUCTION

The information contained in this chapter is intended to assist qualified personnel in maintaining the Model 1885 High Speed Digital Indicator and the optional Model 1886 Position Data Processor unit. Included are equipment requirements, troubleshooting tips, and service mode explanations.

These units are designed for many years of reliable performance. Therefore, frequent repair should not be necessary. However, we recommend periodic inspection to ensure the units are operating within factory specifications.

NOTE

Maintenance or service of this equipment must be performed only by trained instrumentation service personnel. Assistance may be obtained from your local Scientific-Atlanta representative. A complete list of Scientific-Atlanta Regional Service Centers is located at the end of this chapter.

5.2 REQUIRED TEST EQUIPMENT

The equipment necessary to perform maintenance/service work to the Model 1885 and Model 1886 are listed in Table 5.1. The REQUIREMENTS column provides information to allow an alternate selection of substitutes should the SUGGESTED MODEL not be available. Be sure all test equipment is properly connected (particularly ac grounding wires if applicable). Periodically calibrate all test equipment according to the manufacturer's recommended specifications to ensure accurate test results.

Table 5.1
Recommended Test Equipment

Equipment	Requirements	Application	Suggested Model
Tool Kit	Include standard tools: screwdriver set, nut drivers, allen and conventional wrenches, socket set.	For removing covers, making adjustments, tightening hardware.	-
Oscilloscope	200 MHz Bandwidth, dual-trace	Observing waveform patterns.	Tektronix® Model 475
Digital Volt-Ohm Meter	100mΩ-20MΩ range 1μV-1000V dc 10μV-500V ac	For measuring resistance values; checking semi-conductor junctions; measuring ac/dc voltages.	Hewlett-Packard 3645A or Fluke 8000A
Card Extenders		Provides easier access to printed circuit boards during testing or service.	Scientific-Atlanta Part No. 314856

5.3 SAFETY PRECAUTIONS

We assume all Scientific-Atlanta trained technical personnel are familiar with the standard safety precautions normally followed while performing service procedures. However, several precautions worth repeating are:

- Refer all maintenance and service work to qualified personnel.
- Use only factory authorized component parts for repair.
- Thoroughly familiarize yourself with the detailed circuit operation (Chapter 4), noting especially areas of potential shock hazards (the power supply circuitry for example).
- Remember that high voltage synchro input may inject potentially harmful voltage levels into the unit even if the unit is powered "OFF".

5.4 TROUBLESHOOTING THE MODELS 1885 AND 1886

Before attempting any actual repair procedures, perform a thorough visual inspection using the suggestions listed here:

1. Check all external hardware (screws, washers, nuts) making sure none are missing or damaged.

2. Inspect the ac line cord for possible damage.

3. Check all fuses.

4. Check all front panel controls.

5. Remove the top cover and check all attaching parts of the internal circuits (ICs, jumper wires) making sure they're tight and that none are missing.

6. Inspect all wiring for charred insulation, or for discoloration as evidence of previous overheating.

7. Check all electrical connections including wire terminals and soldered connections. Make sure all are secure.

8. Check for obvious destruction of internal component parts. Disfigurement of any of these parts could indicate the unit has been subjected to severe physical shock.

Signals received and generated by the Model 1885 and Model 1886 during normal operation are routed by the microcomputer circuits through various internal printed circuit assemblies. While it is not possible to describe every potential failure mode, several basic steps can be followed to locate and isolate malfunctions:

1. Perform the pertinent Service Mode procedures located in Section 5.5.

2. If you encounter a problem during the Service Mode procedures, try to isolate the problem to a specific printed circuit board assembly and/or component part. Because many of the Model 1885/1886 assemblies are complex in nature, we recommend substituting these assemblies with ones known to be functioning properly (stocked in your repair parts bin) for problem isolation and/or repair. However, with this method of troubleshooting, older units may use earlier version software and may not function properly with the latest replacement boards from current production units (or vice-versa). Pretested printed circuit board assemblies for the Model 1885 and the

Model 1886 assemblies may be obtained from Scientific-Atlanta.

3. Quick-reference troubleshooting suggestions appear in Table 5.2. This table is a compilation of several typical problems you may encounter with these units along with recommended action.

Table 5.2
Troubleshooting Suggestions

Symptom	Possible Cause	Recommended Action
1. Unit appears dead after POWER switch is turned "ON": blank display and no fan motion.	Unit unplugged. Main unit fuse blown.	Connect to 120/240V ac as configured. Replace with 6.25A SB/3A SB fuse as configured.
2. Fan runs but no front panel display activity.	Power supply shutdown. Front Panel interconnect not connected properly.	Measure power supply voltages (See Table 5.3). Inspect and repair.
3. Display is blank after power-up lamp test.	No axis has been assigned to either display.	Assign an axis to each display (See Section 3.1.2).
4. Continual random segments after powerup (Model 1885 only).	CPU Assembly (A2) defective. Front Panel Assembly (A11) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis. Same as above.
5. Continual lamp test after powerup (Model 1885 only).	Synchro Input Assembly (A4) defective. CPU Assembly (A2) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis. Same as above.
6. Occasional or repeated lamp tests during normal operation (Model 1885 only).	Encoder Timing Assembly (A3) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.

Table 5.2 - continued

Symptom	Possible Cause	Recommended Action
7. "SETUP REQUIRED" message appears at every powerup (previous setup information lost, Model 1885).	Memory/ Interface Assembly (A5) defective (battery, RAM, or Non-volatile power control circuit).	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
8. Unit not responding to front panel keystrokes (Model 1885).	Unit in GPIB remote state as indicated by front panel REMOTE light.	Refer to Section 3.1.3.
	Front Panel Interface Assembly (A11) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
9. Position data displayed is not stable: varies widely (Model 1885).	Display assigned to unconnected axis.	Connect or re-assign axis.
	Axis configured for encoder input when encoders are not present.	Correctly configure axis.
	Rotor voltage absent.	Apply synchro excitation (for 115V system); check internal fuses.
	Wrong synchro voltage selected.	See Section 2.4.6.3.
	Synchro Input Assembly (A4) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
	Encoder Timing Assembly (A3) defective.	Same as above.
	Encoder Processor defective (axes with Encoder Option only).	Same as above.

Table 5.2 - continued

Symptom	Possible Cause	Recommended Action
10. Position data displayed not stable: varies slightly* (Model 1885).	Display assigned to unconnected axis.	Connect or re-assign.
	Synchro Input Assembly (A4) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
	Encoder Timing Assembly (A3) defective.	Same as above.
	Encoder Processor defective (axes with Encoder Option only).	Same as above.
11. Position data displayed does not change, even during axis motion (Model 1885).	If "H" character is present, the axis is deselected through a Model 2013.	Refer to Section 2.4.5.
	Displayed axis is not the axis in motion.	Check the configuration of the displayed axis.
	Faulty cabling of synchro signals.	Verify good synchro signals present at rear of unit.
	Synchro Input Assembly (A4) faulty.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
12. Parallel Data Out is unstable (glitchy), or does not agree with displayed data.	Output assigned to unconnected axis, or axis different from intended.	Connect or re-assign.

* Some jitter in the last column is normal, but should not exceed a range of ±1 (2 peak-to-peak) in the least significant digit.

Table 5.2 - continued

Symptom	Possible Cause	Recommended Action
	Tracking Output Assembly (A6 or A7) jumpers not configured correctly for application.	See Section 2.4.6.1.
	Tracking Output Assembly (A6 and A7) defective.	Swap A6 and A7 to verify if fault is here.
	External parallel data cabling error.	Check cables against cable diagrams in Section 2.4.4.
13. Unit remains "ON" regardless of POWER switch position.	Defective POWER Switch and/or anti-surge thermistors.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
14. Unit remains "OFF" whenever POWER switch is in "REMOTE" position (Model 1886).	Serial Interface cable at J3 open or not connected.	Connect or repair cable.
	Unit connected to J3 has power off or faulty serial drivers.	Turn "ON" power or repair unit.
	S1 on Rear Panel Assembly (A12) not configured properly.	See Section 2.4.6.5.
	Rear Panel Assembly (A12) defective.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
	Power control relays on front panel open.	Same as above.
15. Unit remains "ON" whenever POWER switch is in "REMOTE" position (Model 1886).	S1 on the Rear Panel Assembly (A12) not configured properly.	See Section 2.4.6.5.

Table 5.2 - continued

Symptom	Possible Cause	Recommended Action
	Rear Panel Assembly (A12) defective.	Verify condition persists even when serial cable is disconnected but stops when control cable to front panel is disconnected (P1 on Rear Panel Assembly).
	Power control relays on the Front Panel shorted.	Verify the problem persists when the control cable to the Front Panel is disconnected. Consult Scientific-Atlanta.
16. Position data originating in the Model 1886 does not change (even during axis motion). Model 1885 displays serial link failure message on powerup or on remote axis configuration attempt.	The Model 1885 and 1886 set to differing baud rates.	Verify baud rate setup (see Section 2.4.6.2).
	Serial link between units not operating.	Check cabling and link/modem integrity. See Section 2.4.4.3.
	Drivers, receivers or terminating components faulty.	Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
17. Position data originating in the Model 1886 is "jittery" or otherwise in error. Model 1885 does not display serial link failure message. (Also see symptoms 8 and 9.)	Position input disconnected at the Model 1886.	Check connections to the Model 1886.
	Axis configured for encoders when encoders are not present.	Reconfigure for selected synchros.
	Wrong synchro voltage selected in the Model 1886.	See Section 2.4.6.3.
	Serial link noise corrupting data.	Model 1885 indicates this with an error message if any remote axes are configured. Link noise sources must be eliminated. Use shorter runs of better cable. Use a modem or repeater.

Table 5.2 - continued

Symptom	Possible Cause	Recommended Action
	Synchro Input Assembly (A4) or the Encoder Timing Assembly (A3) in the Model 1886 faulty.	Verify by supplying with corresponding assemblies in the Model 1885. Problem will follow the faulty assembly. Contact Scientific-Atlanta for replacement instructions or for confirmation of diagnosis.
	Signal corruption on the Model 1886 Motherboard Assembly (A9).	Verify problem persists when the Model 1885 and Model 1886 are operated back-to-back (i.e., with a short cable between them), and remains in the Model 1886 despite assembly "swaps" with the Model 1885. Salt, NO_x, SO_x environments may be particularly susceptible. Contact Scientific- Atlanta for replacement instructions or for confirmation of diagnosis.

Table 5.3
Power Supply Voltage

Measure Between	Proper Voltage
Chassis and F4	+5V dc ±0.2V
Chassis and F5	+12V dc ±0.4V
Chassis and F6	-12V dc ±0.4V
Chassis and F3	20V ac ±3V

5.5 SERVICE MODES

5.5.1 Purpose

The Model 1885 Service Modes provide special features and maintenance functions helpful when servicing and troubleshooting both the Model 1885 and the Model 1886. In Service Mode, the Model 1885 front panel pushbuttons and displays operate in modes and submodes different from normal operation. Figure 5.1 shows the Model 1885 front panel pushbuttons and their alternate functions in Service Mode, followed by a brief description in Table 5.4.

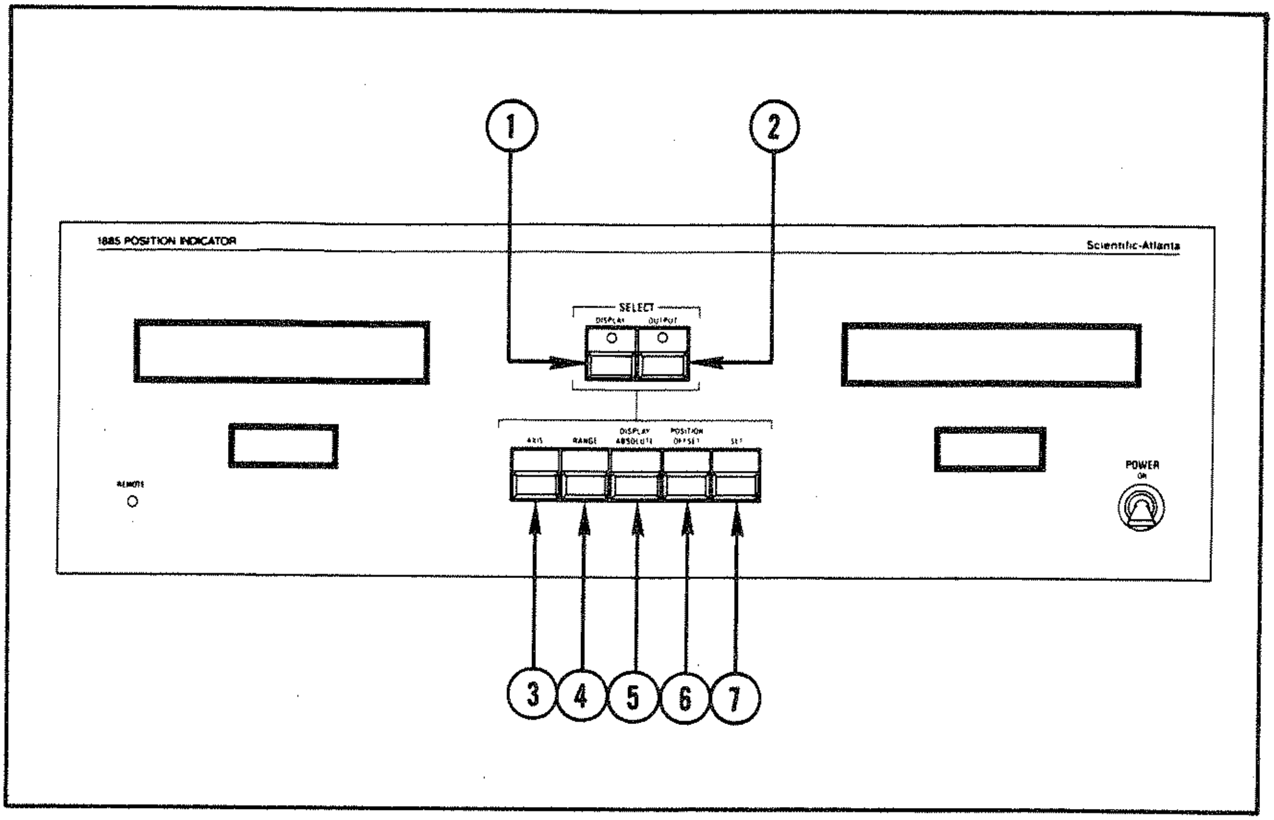


Figure 5.1. Model 1885 Front Panel Operation in Service Mode

Table 5.4
Front Panel Pushbutton Operation in Service Mode

Pushbutton	Service Mode Function	Description
1. DISPLAY	EXIT/STOP	Exit a mode or submode, or stop a test.
2. OUTPUT	EXIT/STOP	Exit a mode or submode, or stop a test.
3. AXIS	ENTER/START	Enter a mode or submode, start a test, or update data.
4. RANGE	LEFT	Select the field to the left.
5. DISPLAY ABSOLUTE	RIGHT	Select the field to the right.
6. POSITION OFFSET	DOWN	Decrement the value in the field.
7. SET	UP	Increment the value in the field.

Service Mode assists in service and troubleshooting the Model 1885 and Model 1886 but does not provide detailed diagnostic information for isolating specific defective component parts. However, the Service Mode does assist in isolating problems to general areas of the unit.

Each submode (see Table 5.5), accessed from the Service Mode, has an assigned number. Take note of this number (column 1) because you'll use it when requesting a specific submode operation. Certain submodes require one or more fields of information to determine the parameters associated with a submode.

Table 5.5
Submode Listing

No.	Submode Name	Description
1	Firmware Test	Display firmware part no. and Cyclic Redundancy Checks.
2	Lamp Test	Performs front panel lamp test.
3	Baud Rates	Displays serial port baud rates.
4	GPIB Address	Displays GPIB address switch information.
5	Bus History	Provides control and display of GPIB history.
6	Serial Loopback	Performs serial I/O tests and displays results.
7	Position Formats	Allows control of special position display formats.
8	Tracking Control	Allows control of tracking/output hardware.
9	Tracking Display	Displays tracking/output feedback data.
10	Internal Errors	Displays contents of the internal error buffers.
11	1886 Mode	Allows a Model 1885 to operate as a Model 1886.
12	Pristine Reset	Clears non-volatile RAM and causes the program reset.

5.5.2 How to Enter Service Mode and Select Submodes

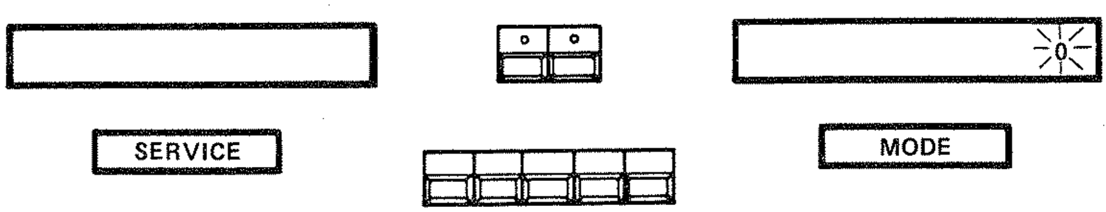
Figure 5.2 provides a visual explanation of how to enter Service Mode and to select the various submodes of Service Mode. Use this flowchart along with the written explanation which follows Figure 5.2.

1. Apply ac power to the Model 1885 by moving the front panel POWER switch to ON (or UP position) and observe the following sequence of events if the unit is functioning properly:

   - The internal cooling fan begins operating.

   - A lamp test begins on the Position Displays for verifying proper operation of each display segment. Additionally, each LED indicator (DISPLAY, OUTPUT, and REMOTE) illuminates to verify proper operation. This process lasts about two seconds.

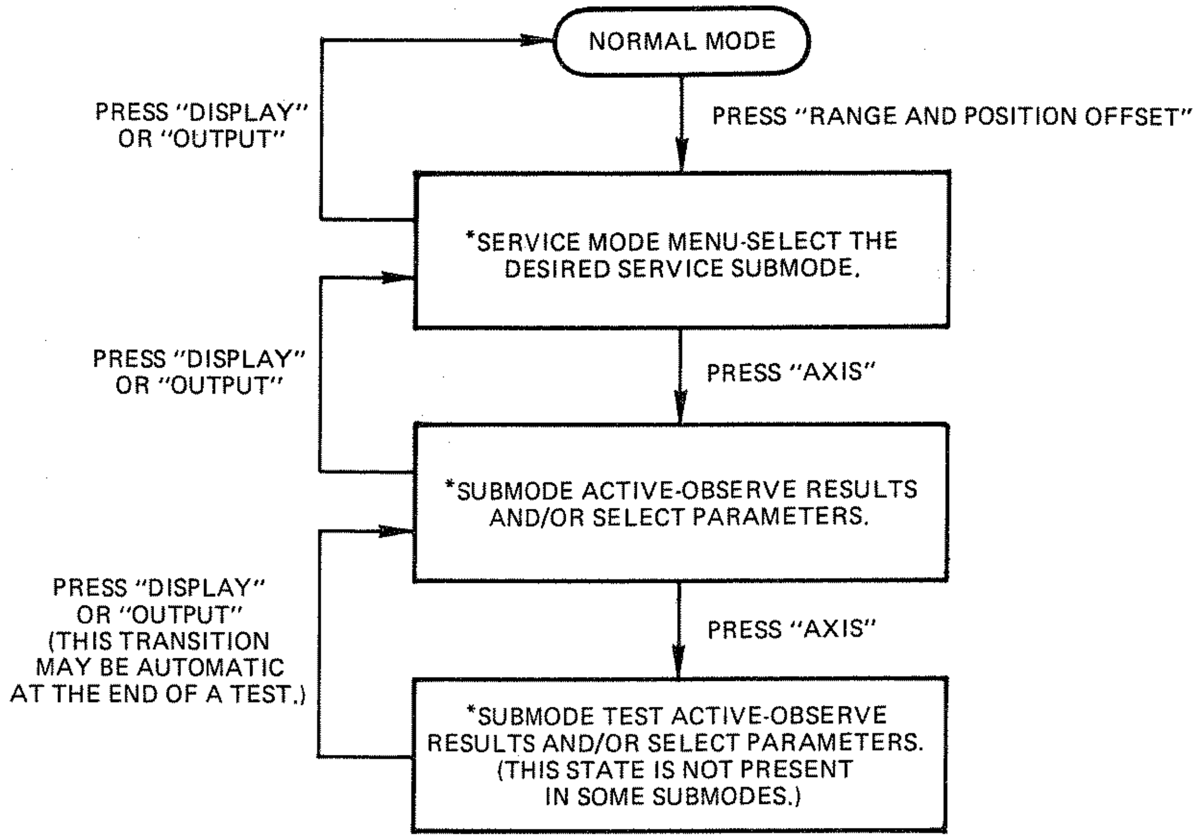
2. Press RANGE and POSITION OFFSET pushbuttons simultaneously. The unit displays the Submode Menu as shown in the following sample display:



   The flashing "zero" indicates a submode test number must be selected next.

3. Press POSITION OFFSET (DOWN) and/or SET (UP) pushbuttons until the desired submode test number (1 through 12) and name appear on the display. (Refer to Table 5.5 for submode test numbers/names.)

4. Press AXIS (ENTER/START) to enter the submode. Certain submode tests begin operation immediately, while others require selecting additional information. If additional information is required (indicated by one or more flashing front panel displays), proceed to the next step. Otherwise, omit the next step.



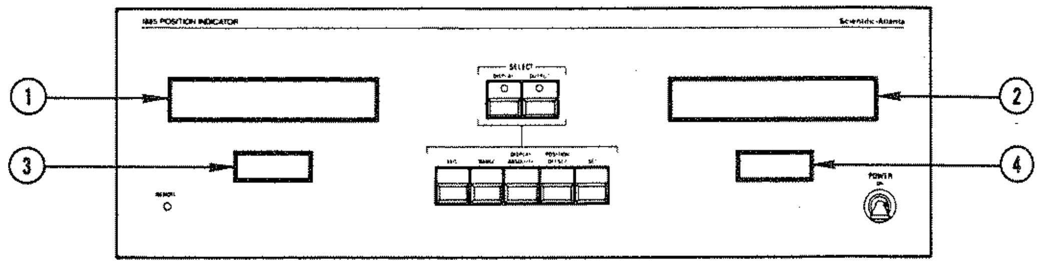
*SELECTIONS MAY BE MADE USING "RANGE", "DISPLAY ABSOLUTE", "POSITION OFFSET", AND "SET".

Figure 5.2. How to Enter/Operate Service Mode

5. Modify the submode test parameters as required using the RANGE (LEFT), DISPLAY ABSOLUTE (RIGHT), POSITION OFFSET (DOWN), and SET (UP) pushbuttons. Press RANGE and DISPLAY ABSOLUTE to sequence through the displays, and POSITION OFFSET and SET to alter the information in the chosen display. Figure 5.3 shows the display sequence using the RANGE and DISPLAY ABSOLUTE pushbuttons.

6. If necessary, press AXIS (ENTER/START) to start the particular submode test.

7. When the submode test is complete, press DISPLAY or OUTPUT (EXIT/STOP) pushbutton to exit the submode and return to the Submode Menu.



Pushbutton	Active Display Sequence*
Display Absolute	1, 2, 3, 4, 1, 2, 3, 4, 1, etc.
Range	4, 3, 2, 1, 4, 3, 2, 1, 4, etc.

* Certain submodes are pre-programmed to skip unused display positions. This means you may need only press the pushbutton once to move two or more display positions.

Figure 5.3. Display Sequence Using RANGE and DISPLAY ABSOLUTE Pushbuttons

5.5.3 Submode Procedures

5.5.3.1 Submode No. 1 - Firmware Test

The Firmware Test provides two convenient methods of firmware verification: displaying the firmware part number, and displaying the Cyclic Redundancy Check (or CRC) number. This submode is helpful in verifying that the EPROMs contain proper firmware information.

The unit performs the firmware part number test by reading the Scientific-Atlanta firmware part number contained in the EPROMs and displays it on the left Axis Identification Display. In a similar manner, during the

CRC firmware test, the unit computes and displays the CRC number for each EPROM in the unit. The CRC number appears on the right Position Display allowing comparison of this value with the CRC on the internal EPROM label.

Table 5.6 shows the various display functions for Submode 1.

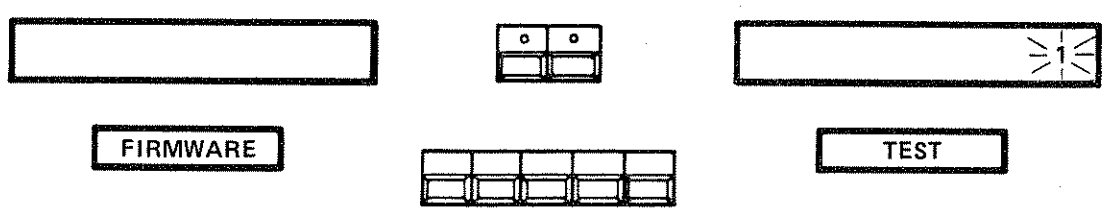
Table 5.6
Submode No. 1 Display Functions

Left Position Display	**Right Position Display**
Blank	Select EPROM for CRC computation: U16, U20, or U22.
Left Axis Ident. Display	**Right Axis Ident. Display**
Firmware part number.	Last CRC computation. Format: Uxx=YYYY where xx is the selected EPROM, and YYYY is the CRC.

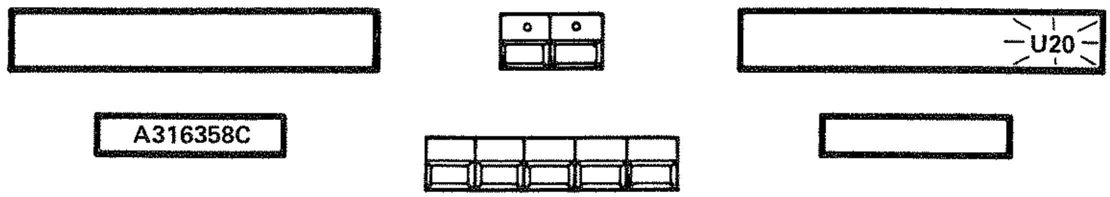
5.5.3.1.1 <u>How to Select and Execute Submode No. 1</u>

Select and execute the Firmware Test by performing the following steps:

1. Select Submode No.1 using POSITION OFFSET and SET (DOWN/UP) pushbuttons as described earlier in Section 5.5.2. Observe this display message:

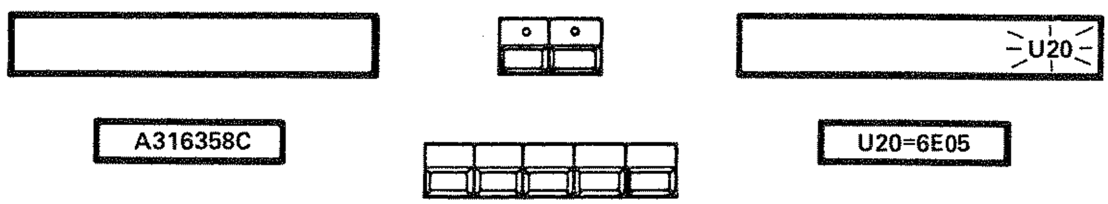


2. Press AXIS (ENTER/START) to activate this submode. Immediately the left Axis Identification Display indicates the Scientific-Atlanta EPROM firmware part number, while the right Position Display flashes. Observe this or a similar display message:



3. The flashing right Position Display indicates you need to select EPROMs U16, U20, or U22 to perform the CRC test. Sequence through these ICs by pressing POSITION OFFSET (DOWN) and SET (UP).

4. To compute the CRC for the EPROM corresponding with the flashing reference designator, press the AXIS (ENTER/START) pushbutton. A "BUSY" message appears in the right Axis Identification Display indicating the unit is reading the designated EPROM. After a short delay, the reference designator and resultant CRC appears in the right Axis Identification Display. In addition, the right Position Display flashes indicating a new IC may be selected for the next CRC calculation. Observe the following sample display:



5. If necessary, compare the front panel display CRC number to the internal label number affixed to the EPROMs.

6. When this submode test is complete, press DISPLAY or OUTPUT (EXIT/STOP) to exit. The unit returns to the submode menu mode.

5.5.3.2 Submode No. 2 - Lamp Test

Selecting the Lamp Test initiates the powerup lamp test for the Axis Identification Displays. During this test, the seven segment Position Display segments and LEDs remain "ON" while the Axis Identification Displays show a choice of either all decimal points, letter "O"'s, or asterisks. These characters serve to exercise all segments in the display for detecting faulty displays or drivers.

Table 5.7 shows the various submode display functions for Submode No. 2.

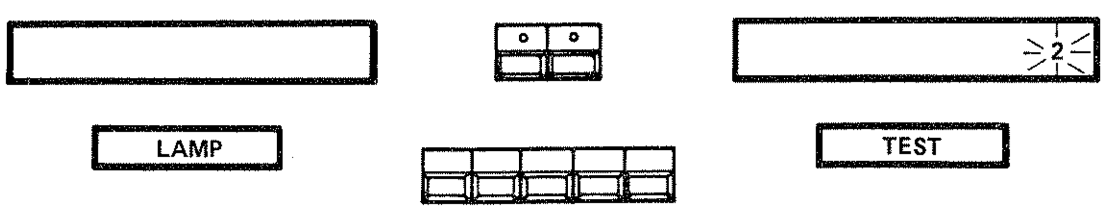
Table 5.7
Submode No.2 Display Functions

Left Position Display	**Right Position Display**
All segments light.	All segments light.
Left Axis Ident. Display	**Right Axis Ident. Display**
Choice of decimal points, letter "O", or asterisks.	Choice of decimal points, letter "O", or asterisks.

5.5.3.2.1 <u>How to Select and Execute Submode No. 2</u>

Select and execute the Lamp Test by performing the following steps:

1. Select Submode No. 2 using POSITION OFFSET and SET pushbuttons as described earlier in Section 5.5.2. Observe this display message:



2. Press AXIS (ENTER/START) to enter this submode. Immediately decimal points appear on both Axis Identification Displays. Press POSITION OFFSET or SET (DOWN/UP) to cycle through available display characters: decimal points, letter O, asterisks, decimal points ... and so on.

3. When this submode test is complete, press DISPLAY or OUTPUT (EXIT/STOP) to exit and return to the Submode Menu.

5.5.3.3. Submode No. 3 - Display Baud Rates

Submode No. 3 provides a convenient method of displaying baud rates of the two serial channels by reading the baud rate selection switches. The left Position and Axis Identification Displays indicate channel A (or J3), while the right displays indicate channel B (or J4).

Table 5.8 shows the various display functions for Submode No. 3.

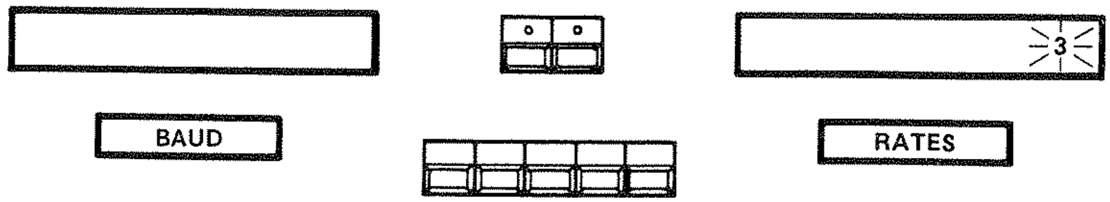
Table 5.8
Submode No. 3 Display Functions

Left Position Display	**Right Position Display**
Channel A (connector J3) information.	Channel B (connector J4) information.
Left Axis Ident. Display	**Right Axis Ident. Display**
Baud Rate for Channel A. Format: **X=YYYY $** where X is the switch value, YYYY is the baud rate, and $ is either "E" or "N" for Echo and No Echo, respectively.	Baud Rate for Channel B. See Left Axis Ident. for identical format.

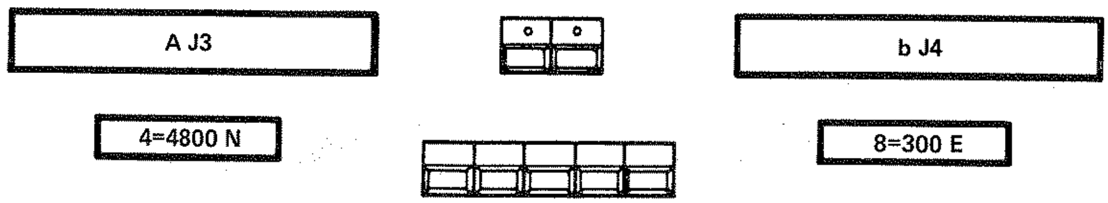
5.5.3.3.1 <u>How to Select and Execute Submode No. 3</u>

Select and execute the "Display Baud Rates" test by performing the following steps:

1. Select Submode No. 3 using POSITION OFFSET and SET (DOWN/UP) pushbuttons as described earlier in Section 5.5.2. Observe this display message:



2. Press AXIS (ENTER/START) to start this submode. Immediately the unit displays this or a similar message:



3. When this submode test is complete, press DISPLAY or OUTPUT (EXIT/STOP) to exit and return to the Submode Menu.

5.5.3.4 Submode No. 4 - Display GPIB Address

This submode assists in verifying the General Purpose Interface Bus (GPIB) by reading the rear panel GPIB Address switch, and displaying the address assigned to the unit, the status of Talk Only, SRQ disabled, and test mode bits.

Table 5.9 shows the various display functions for Submode No. 4.

5.5.3.4.1 How to Select and Execute Submode No. 4

Select and execute "Display GPIB Address" by performing the following steps:

1. Select Submode No. 4 using the POSITION OFFSET and SET (DOWN/UP) pushbuttons as described in Section 5.5.2. Observe this display message:

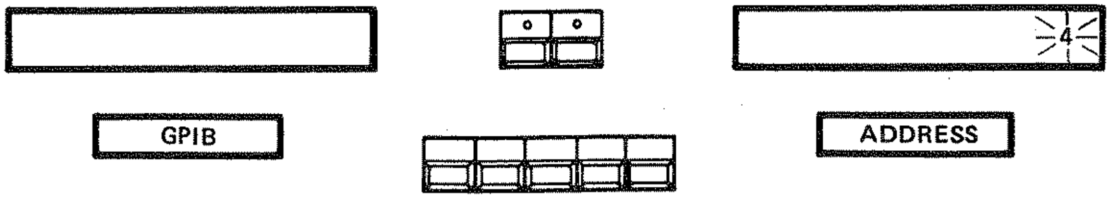
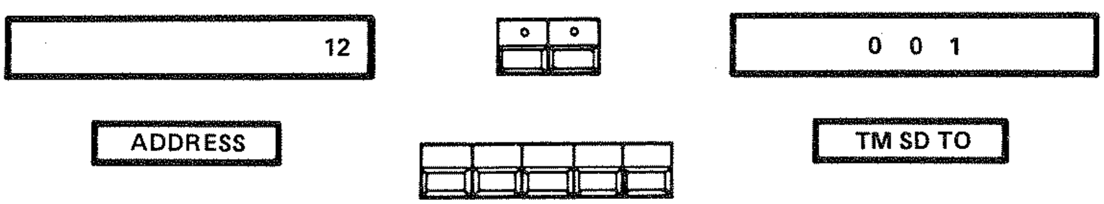


Table 5.9
Submode No. 4 Display Functions

Left Position Display	**Right Position Display**
Decimal value of the GPIB address assigned.	Binary value for the Test Mode, SRQ disabled, and Talk Only mode switches (1=ON).
Left Axis Ident. Display	**Right Axis Ident. Display**
Address	TM, SD, TO (for Test Mode, SRQ Disabled, Talk Only).

2. Press AXIS (ENTER/START) to start this submode. The unit automatically displays this or a similar display message:



The address appears in decimal format on the left Position Display, while the binary state of the Test Mode, SRQ Disabled, and Talk Only switches appear on the right Position Display. Note the correlation between the right Position Display message and the right Axis Identification Display message; the first zero corresponds with TM (Test Mode), the second zero with SD (SRQ disabled), and number "1" to TO (Talk Only).

3. To update the displayed information, press AXIS (ENTER/START).

4. When this submode is complete, press DISPLAY or OUTPUT (EXIT/STOP) to exit and return to the Submode Menu.

5.5.3.5 Submode No. 5 - GPIB Bus History

This submode accesses the buffer responsible for containing the GPIB sequence of events. This test is helpful in capturing bus activity as well as verifying proper bus operation. The primary operation of this submode is toggling the capture ON and OFF followed by selecting the age of a byte and observing the contents of the buffer.

Table 5.10 shows the display functions for Submode No. 5.

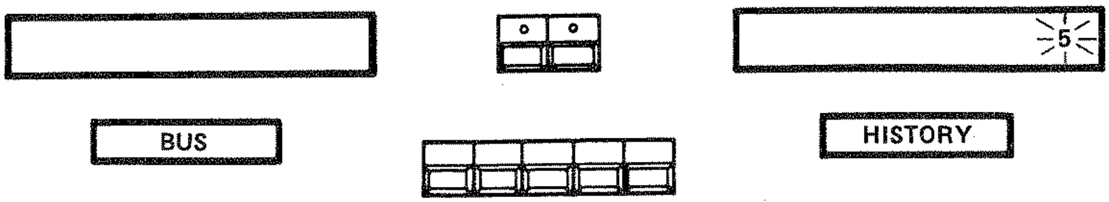
Table 5.10
Submode No. 5 Display Functions

Left Position Display	**Right Position Display**
Age of byte (from 0 to 127).	Hex value of the byte.
Left Axis Ident. Display	**Right Axis Ident. Display**
Selectable modes (ON or OFF).	Event type (Listen, Talk, or Empty) and ASCII description.

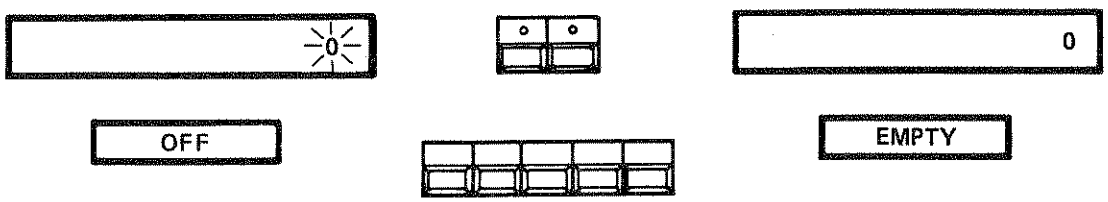
5.5.3.5.1 How to Select and Execute Submode No. 5

Select and execute "GPIB Bus History" by performing the following steps:

1. Select Submode No. 5 using the POSITION OFFSET and SET (DOWN/UP) pushbuttons as described in Section 5.5.2. Observe the following display:

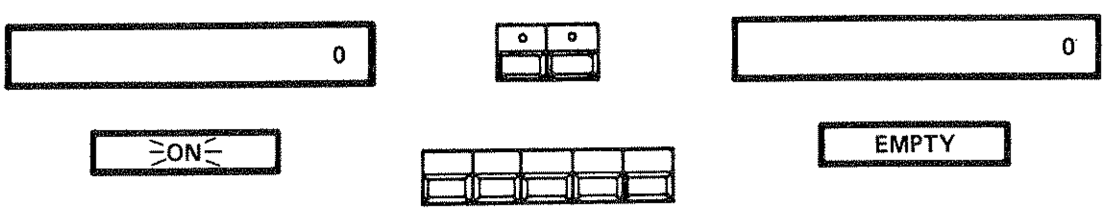


2. Press AXIS (ENTER/START). Immediately the left Position Display begins flashing. Observe this or a similar display message:



3. Press DISPLAY ABSOLUTE (RIGHT). Observe movement of the flashing cursor to the left Axis Identification display. This position allows selecting the state of the test (ON/OFF).

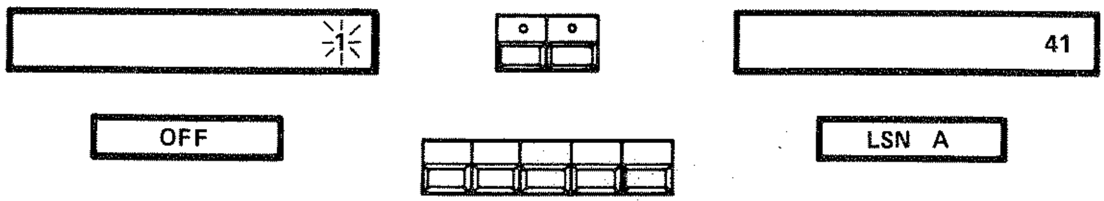
4. Press POSITION OFFSET or SET to change the state to ON. This clears the bus history buffer and begins capturing GPIB events. Observe this or a similar display message:



5. Press DISPLAY or OUTPUT pushbuttons to exit this submode and continue capturing bus events, or press POSITION OFFSET or SET to change the test state to OFF and stop capture.

6. Assuming the test state has now been changed to OFF, press RANGE or DISPLAY ABSOLUTE to move the cursor to the left Position Display. To examine the contents of the buffer, toggle-through the "age" fields (0 through 127) using the POSITION OFFSET and SET (DOWN and UP)

pushbuttons. The right Position Display shows the hex value for the selected byte while the right Axis Identification Display shows the event-type and the ASCII description. Possible events are LSN (listen), TLK (talk), REMOTE, LOCAL, GET (group execute trigger), DCL (device clear), SPAS (Serial poll), UNC-DAC (unrecognized command, data accepted), UNC-NDAC (unrecognized command, data not accepted), UNKNOWN and EMPTY (no data in buffer). Observe this or a similar display message:



7. When this submode is completed, press DISPLAY or OUTPUT to exit and return to the Submode Menu.

5.5.3.6 Submode No. 6 - Serial Loopback Test

The Serial Loopback Test assists in verifying proper operation of the serial link by displaying the number of errors detected. This submode provides three variations of the loopback test:

1. No Loopback Test (Monitor errors only)
2. Local Loopback Test
3. Remote Loopback Test.

Local Loopback checks the interface from the microprocessor to the serial interface IC and general operation of the IC itself. Remote Loopback checks the interface between the serial interface IC and a point in the system where a shorting plug is connected, such as the rear panel interface connector (ties the receive data to the transmit data lines). If errors occur during normal operation, they can be displayed by not running either loopback test.

Table 5.11 shows the various display functions for Submode No. 6.

5.5.3.6.1 How to Select and Execute Submode No. 6

Select and execute "Serial Loopback Test" by performing these steps:

1. Select Submode No. 6 using POSITION OFFSET and SET (DOWN/UP) pushbuttons as described in Section 5.5.2. Observe this display message:

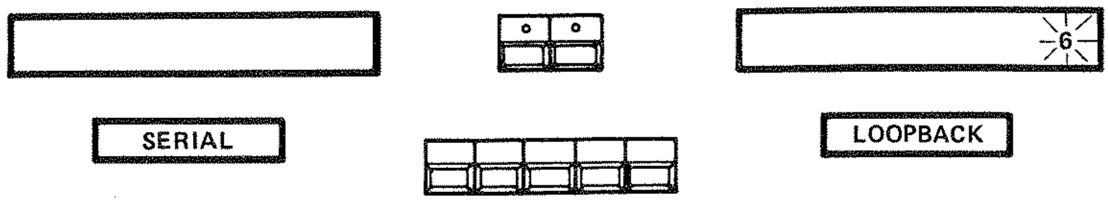
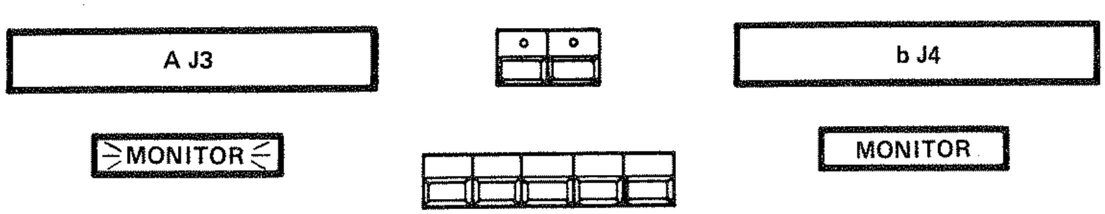


Table 5.11
Submode No. 6 Display Functions

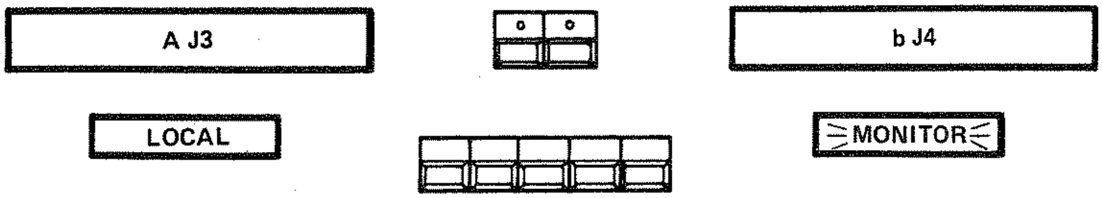
Left Position Display	**Right Position Display**
Channel A designator A J3	Channel B designator B J4
Left Axis Ident. Display	**Right Axis Ident. Display**
Channel A (MONITOR, LOCAL, REMOTE)	Channel B test type (MONITOR, LOCAL, OR REMOTE)

2. Press AXIS (ENTER/START). Observe the left Axis Identification Display flashing as shown in this sample display message:



3. Press POSITION OFFSET or SET (DOWN and UP) pushbuttons to select the channel A test type in the left Axis Identification Display.

4. Press DISPLAY ABSOLUTE (RIGHT). This moves the flashing cursor to the right Axis Identification Display for selecting the type of test (for channel B). Observe the following sample display:



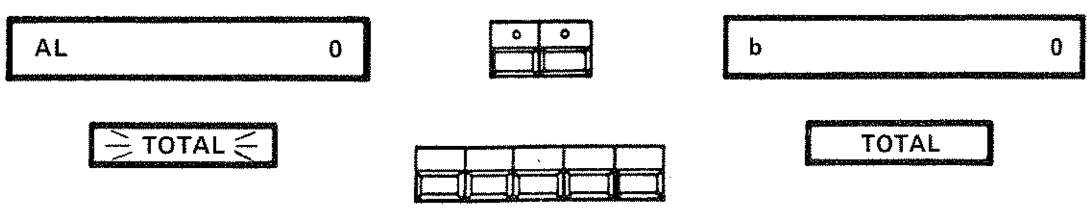
5. Repeat step 3 for channel B.

6. Press AXIS to start the test. If a loopback test was selected for A and/or B, it begins execution. Otherwise the unit continues to monitor serial interface errors for normal operation. The display format changes as shown in Table 5.12.

Table 5.12
Display Functions

Left Position Display	**Right Position Display**
AX Y where: A designates channel A; X is r,L, or blank for REMOTE, LOCAL, or MONITOR Modes; Y is the number of occurences of this type of error.	BX Y where: B designates channel B; X is r,L, or blank for REMOTE, LOCAL, or MONITOR Modes; Y is the number of occurences of this type of error.
Left Axis Ident. Display	**Right Axis Ident. Display**
Channel A error type (TOTAL, PARITY, BREAK T(rue), BREAK F(alse), FRAMING, TIMEOUT, OVERRUN, DATA)	Channel B error type (TOTAL, PARITY, BREAK T(rue), BREAK F(alse), FRAMING, TIMEOUT, OVERRUN, DATA)

Observe this or a similar display:



7. Press POSITION OFFSET or SET pushbuttons to select the type of errors displayed for channel A.

8. Press DISPLAY ABSOLUTE to move the flashing cursor to the right Axis Identification Display. Press POSITION OFFSET or SET to select the type of errors displayed for channel B.

9. To stop the test, press DISPLAY or OUTPUT. The display format now functions as described in Table 5.11.

10. When the submode test is complete, press DISPLAY or OUTPUT (EXIT/STOP) to exit and return to the Submode Menu.

5.5.3.7 **Submode No. 7 - Alternate Position Display Formats**

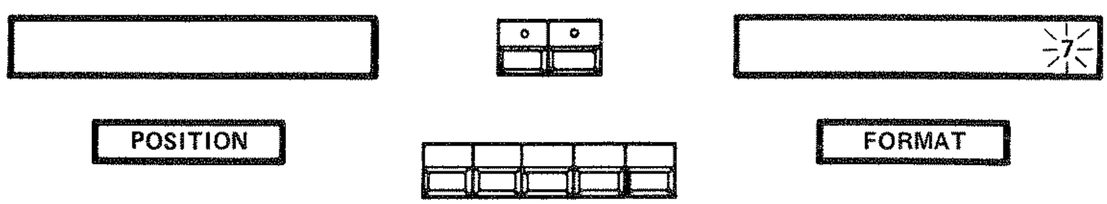
This submode allows the unit to display Binary Fraction of Circle (or BFC) position data, raw position input data directly from the position transducer, and calibration data, <u>during normal</u> operation (as opposed to the normal display format). The display format is saved in NV RAM and remembered even when power is removed from the unit.

Table 5.13 shows the various display functions of Submode No. 7.

5.5.3.7.1 <u>How to Select and Execute Submode No. 7</u>

Select and execute "Alternate Position Display Formats" by performing the following steps:

1. Select Submode No. 7 by pressing POSITION OFFSET and SET (DOWN and UP) pushbutton as described previously in Section 5.5.2. Observe this display message:



2. Press AXIS (ENTER/START). Immediately note the left Axis Identification Display flashing:

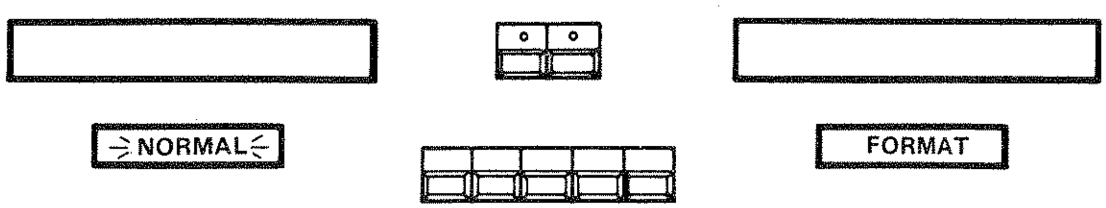


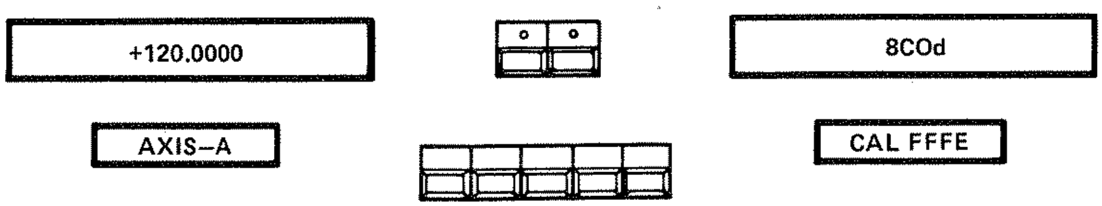
Table 5.13
Submode No. 7 Display Functions

Left Position Display	**Right Position Display**
RAW: ASCII number for assigned axis. BFC: Binary fraction of a circle position for the assigned axis displayed in hex.	Fine raw position input for the axis assigned to the left display. Binary fraction of a circle position for the assigned axis displayed in hex.
Left Axis Ident. Display	**Right Axis Ident. Display**
Label for assigned axis. Label for assigned axis.	Calibration input associated with the raw position input. Label for assigned axis.

3. Select RAW or BFC (or NORMAL) display format using POSITION OFFSET/ SET pushbuttons.

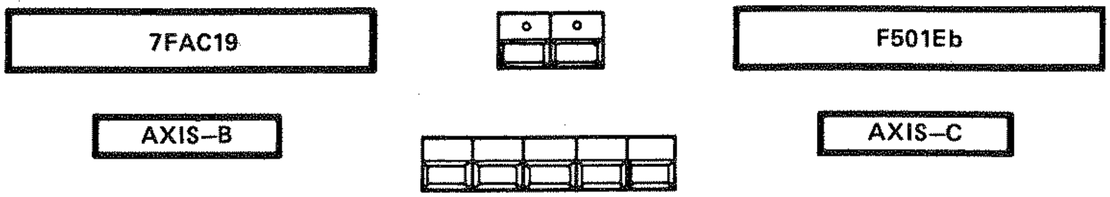
4. Press DISPLAY or OUTPUT to exit the submode and return to the Submode Menu.

5. Press DISPLAY or OUTPUT to return to the normal operating mode. If you selected RAW in step 3, the front panel displays appear similar to the following display message:



The left Position Display shows the ASCII number for the assigned axis (same as NORMAL mode). The left Axis Identification label shows the label for the assigned axis (also same as NORMAL mode). The right Position Display shows the fine raw position input for the axis assigned to the left display (in this example, the encoder data). The right Axis Identification Display shows the calibration input associated with the raw position input.

6. If you selected BFC in step 3, the front panel displays appear similar to the following display message:



The Position Displays show the binary fraction position for the assigned axis. The Axis Identification Displays show the label for the assigned axis.

7. To return the display format to the NORMAL mode, repeat steps 1 through 4.

5.5.3.8 Submode No. 8 - Track At A Constant Velocity

This submode allows the operator to request a constant velocity output for the Tracking Output assemblies, regardless of the feedback or input data. This process is helpful in testing the Position/Tracking Output assemblies. The velocity is a positive or negative 18-bit binary value with a separate speed control selection (LOW, MED LOW, MED HIGH, and HIGH). This feature determines which counter on the Tracking/Output assembly is the least significant stage. This submode must be must be OFF for the Tracking/Output assemblies to provide the correct data at outputs J5 and J6.

NOTE

For this submode to operate, an axis must be assigned to the controlled output.

Table 5.14 shows the display functions for Submode No. 8.

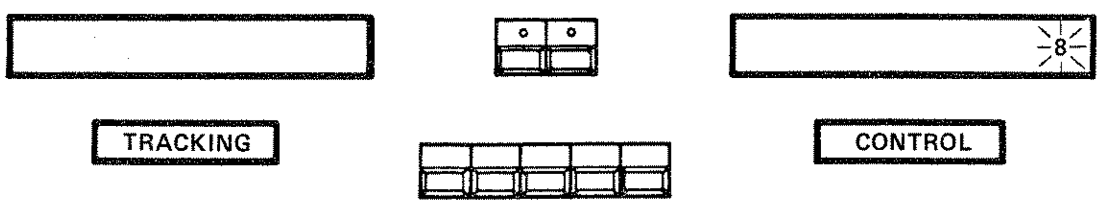
Table 5.14
Submode No. 8 Display Functions

Left Position Display	Right Position Display
Selectable channel; assembly number and rear panel connector designation (A6J5 or A7J6)	Programmable bipolar hex number proportional to velocity applied to tracking hardware (-3FFFF or +3FFFF).
Left Axis Ident. Display	**Right Axis Ident. Display**
Selectable speed control (LOW, MED LOW, MED HIGH, HIGH) determines which counter on the Tracking/Output assembly is the least significant stage.	Status of submode (ON or OFF).

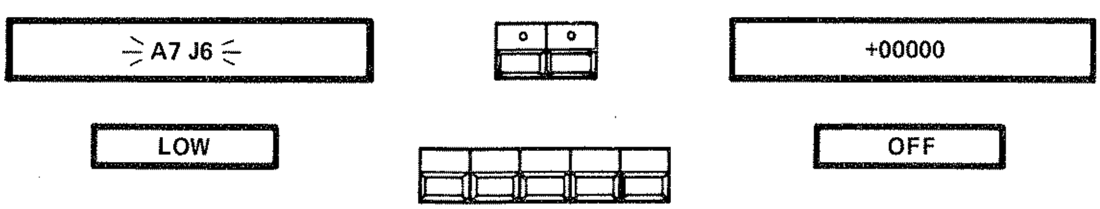
5.5.3.8.1 How To Select and Execute Submode No. 8

Select and execute "Track At a Constant Velocity" by performing the following steps:

1. Select Submode No. 8 using POSITION OFFSET and SET (DOWN and UP) pushbuttons as described earlier in Section 5.5.2. Observe the following display message:



2. Press AXIS (ENTER/START) to start this submode. Immediately the left Position Display flashes. Observe this or a similar display message:

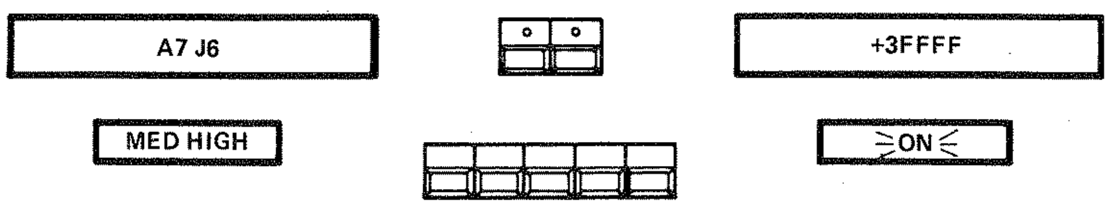


3. In the left Position Display, select the channel for the specific Tracking/Output assembly using the POSITION OFFSET and SET push-buttons. Choices in this mode are A6 J5 or A7 J6 ("A" designates which Tracking/Output assembly; "J" designates the rear panel connector numbers).

4. Move the flashing cursor to each digit of the right Position Display using the RANGE or DISPLAY ABSOLUTE pushbuttons. Program each display digit of the Position Display with the bipolar hex number proportional to the velocity to be applied to the tracking hardware (-3FFFF to +3FFFF) using the POSITION OFFSET and SET pushbuttons.

5. Move the flashing cursor to the left Axis Identification Display using the RANGE or DISPLAY ABSOLUTE pushbuttons. Select the speed control in the left Axis Identification Display using the POSITION OFFSET and SET pushbuttons. Choices include LOW, MED LOW, MED HIGH, or HIGH (see Table 5.15).

6. Move the flashing cursor to the right Axis Identification Display using DISPLAY ABSOLUTE (RIGHT) pushbutton. Select ON using SET and POSITION OFFSET pushbuttons to begin the test. The message "ON" appears in the right Axis Identification Display as shown in the following sample:



7. Select OFF in the right Axis Identification Display using SET and POSITION OFFSET pushbuttons to stop the test.

8. When this submode test is completed, press DISPLAY or OUTPUT (EXIT/STOP) to exit and return to the Submode Menu. The test state may be "ON" or "OFF"; however, the test must be "OFF" for the Tracking/Output assemblies to provide the correct position data at the output of J5 and J6.

Table 5.15
Effect of Speed Control On Tracking/Output Assemblies

Speed Control	Least Significant Counter Stage
LOW	U11
MED LOW	U33
MED HIGH	U32
HIGH	U50

5.5.3.9 Submode No. 9 - Display Tracking Feedback Data

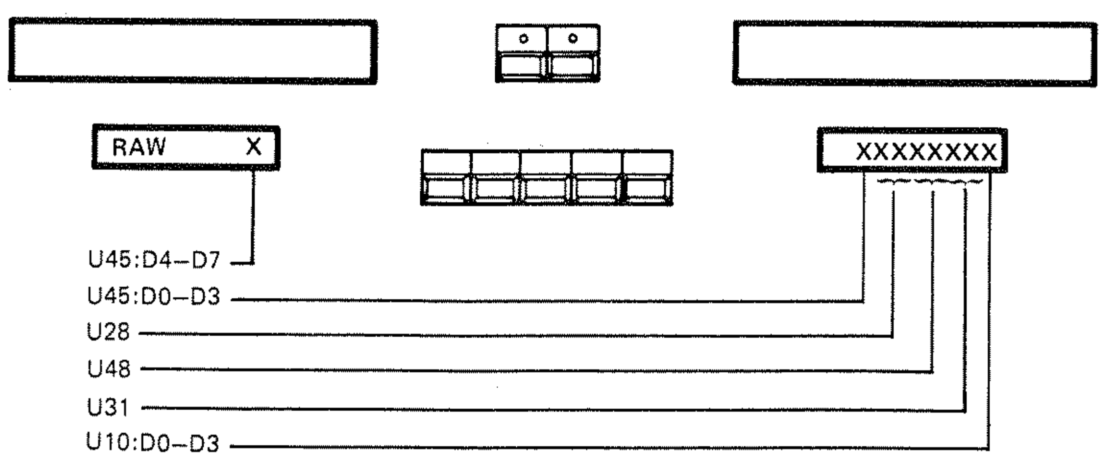
This submode tests the Position Tracking/Output assemblies by displaying the raw or converted tracking feedback data on the front panel for either Tracking/Output assembly during Service Mode. Raw feedback data originates from the Tracking/Output feedback latches U10, U28, U31, U45 and U48. Converted feedback data is a translation of the raw data into the standard format. (To better understand this submode, you may wish to refer to the discussion of position/tracking process in Chapter 4, Section 4.2.4 and Section 4.3.6.)

Table 5.16 shows the display functions for Submode No. 9.

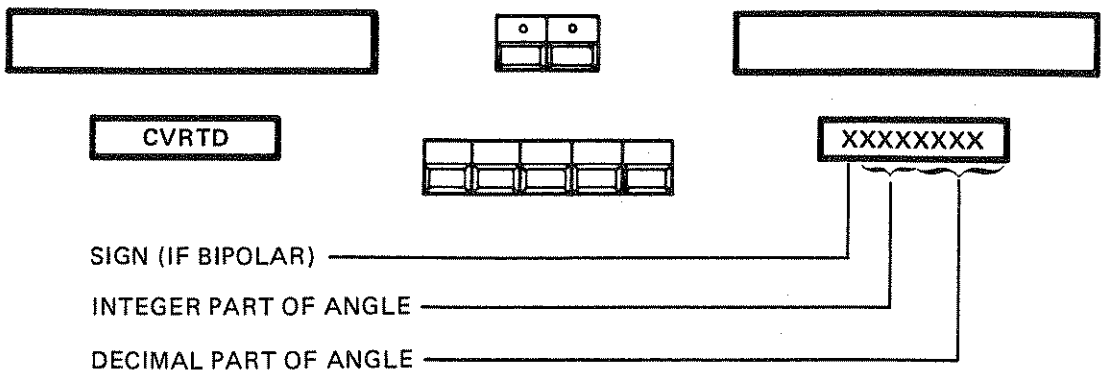
Table 5.16
Submode No. 9 Display Functions

Left Position Display	**Right Position Display**
Selected assembly number and rear panel connector number.	Corresponding ASCII input data for the selected output.
Left Axis Ident. Display	**Right Axis Ident. Display**
Selected format (RAW or CONVERTED).	Feedback data for the output of selected format.

RAW Format:



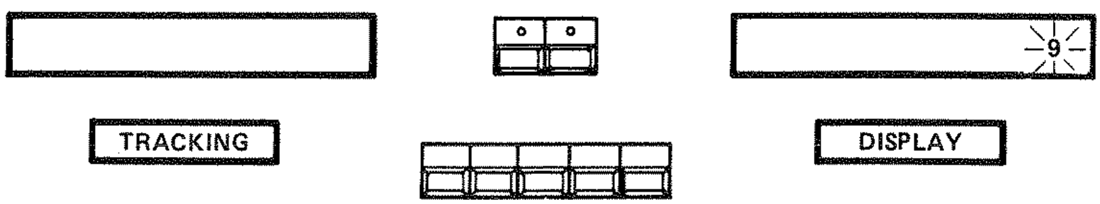
CVRTD Format:



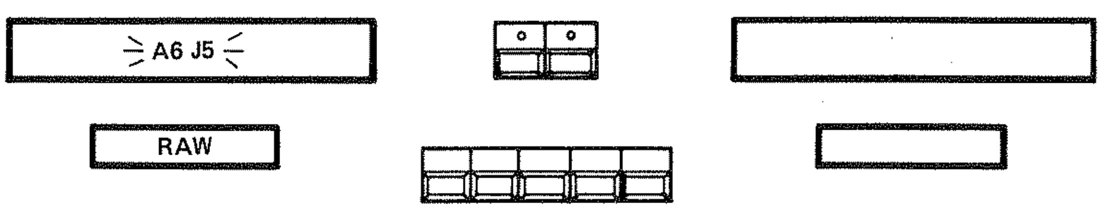
5.5.3.9.1 <u>How To Select and Execute Submode No. 9</u>

Select and execute "Display Tracking Feedback Data" by performing these steps:

1. Select Submode No. 9 by pressing POSITION OFFSET and SET pushbuttons as described previously in Section 5.5.2. Observe this display:

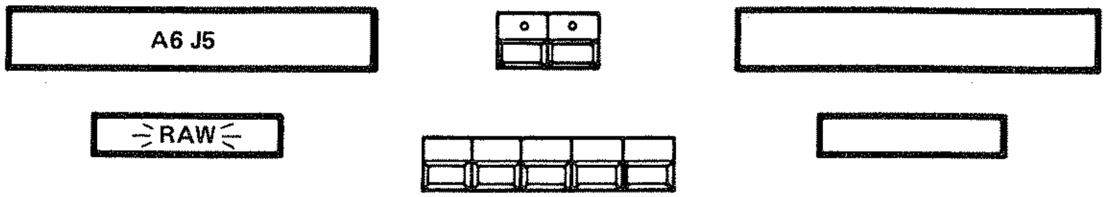


2. Press AXIS (ENTER/START) to enter this submode. Immediately the left Position Display flashes:

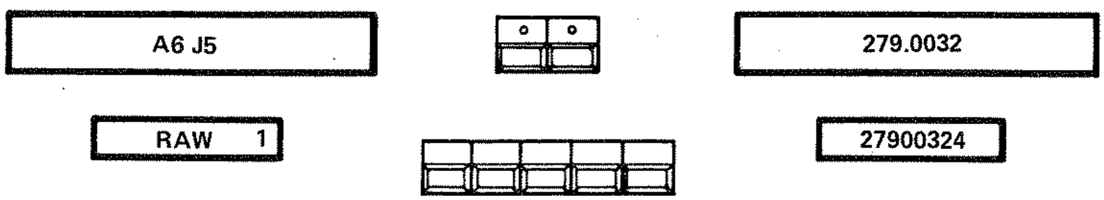


3. Select the channel in the left Position Display using the POSITION OFFSET and SET pushbuttons. Choices are A6 J5 and A7 J6.

4. Move the flashing cursor to the left Axis Identification Display using the RANGE and DISPLAY ABSOLUTE pushbuttons. Select the format using the POSITION OFFSET and SET pushbuttons. Choices are RAW and CVRTD (converted). Observe this or similar display message:



5. To start the test, press AXIS (ENTER/START). The two right displays now become active. The right Position Display shows the ASCII input data for the selected output, while the right Axis Identification Display shows the feedback data for the selected output channel in the selected format:



6. To stop the test, press DISPLAY or OUTPUT. Flashing message returns to the display.

7. When the test is completed, press DISPLAY or OUTPUT (EXIT/STOP) to exit this submode and return to the Submode Menu.

5.5.3.10 Submode No. 10 - Display Internal Error Buffer

This submode reads the internal error queue, displays the values on the front panel display, and clears the buffer after it is read. The first error occurring is the first error displayed, assuming the buffer has not been overwritten. Internal error code descriptions are provided in Table 5.17. Table 5.18 shows display functions for Submode No. 10.

Table 5.17
Error Codes

Decimal Value	Message	Description
0	No Error	Displays when no errors are in the queue.
1	Not Used	
2	Stack Full	The push function throws away the argument pushed.
3	No Key Exist	The function sdecode () tried to decode a bad key value.
4	Key Out Range	The function sdecode () found a key out of 0-15 range.
5	FIFO Status Error	An overrun/underrun error from the 8279 switch input was detected.
6	Bad Display	The front panel driver was passed bad code for which display to write.
7	Bad Num Chars	The offset for a cursor change was invalid.
8	Invalid Axis	An invalid axis code was used.
9	No Axis to Select	An attempt was made to select an axis when no axes are setup.
10	No Axis Selected	An attempt was made to change output/display with no axis.
11	Bad CMD Token	The switch command processor saw a bad token.
12	Impossible Condition	A general fatal software error occurred.
13	Invalid Format	The format module passed a bad format code.
14	Unimplemented Function	A call was made to a dummy version of a function.
15	Bad Display Code	A front panel update function found a bad display code.

Table 5.17 - continued

Decimal Value	Message	Description
16	Can't Have Flag	A system flag was requested which is already in use.
17	Do CMD Flag Not Set	The stack's flag for the function do_fp_cmd was not set when run.
18	Illegal Char in Edit Buf	The step data function found a bad character in an edit.
19	Can't Cancel Job	A turn off job call produced an error.
20	Can't Recognize Interrupt	The isr received an interrupt it can't handle.
21	Raw Data Not CVRTD	The raw input was not converted in time for tracking.
22	Invalid Axis Ptr	The tracked axis pointer is uninitialized.
23	No Axis For Offset	The offset entry mode lost its axis.
24	Can't Deselect 2012	An attempt was made to change from 's' while 2012 is there.
25	Asked for Unused	The 2012 asked for axis data on an unused axis.
26	Unused Sel Output	The software chose an output axis select for an unused axis.
27	SDREDR Event Alloc	The sdredr module can't allocate its flags.
28	Bad Calibrate Mode	The sdredr module found an illegal value for calibrate mode.
29	Bad GPIB Event Alloc	The function init_GPIBSS could not allocate event flag.
30	Can't Make Queue	The function init_GPIBSS was denied a queue by SAMOS.
31	Invalid MSG Size	A mail reading function did not read 2 bytes.
32	Can't Free Space	A memory deallocation failed.
33	Invalid Mailbox Type	The gp_user_write_mail function got a bad mailbox number.

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Table 5.17 - continued

Decimal Value	Message	Description
34	Can't Write 2 Queue	The gp_user_write_mail function could not write a message.
35	Bad Track State	The tracking state is not within the defined range.
36	Not Used	
37	Not Used	
38	Main Loop Returned	SAMOS ran out of things to do.
39	Buffer MSG Received	The GPIB software package asked for buffer space.
40	Bad Pos Format Code	The send_position_format function saw a bad code.
41	Divide By Zero	A divide by zero operation was attempted.
42	Data Input Error	A GPIB data input error occurred.
43	Invalid Device Msg	A GPIB device message error was detected.
44	Invalid Driver Msg	A GPIB driver message error was detected.
45	No GP Ring Buff	The GPIB input ring buffer is not allocated.
46	Invalid Mail Type	The GPIB mail type was not as expected.
47	No Memory	An attempt was made to allocate memory, but none was available.
48	No Sys Flag	An attempt was made to get a system flag, but was not received.
49	Queue Read Error	The wrong number of bytes was read from a queue.
50	Not Used	
51	Not Used	
52	Data Xmit Pending	An attempt was made to send an output message illegally.

Table 5.17 - continued

Decimal Value	Message	Description
53	Invalid Increment Interrupt	A record increment interrupt was detected when not expected.
54	Zero Synchro Calibrate	A synchro input card failure - calibration data is zero.
55	RI INTRPT Stuck	Software can't clear the record increment interrupt.
56	RI Input Low	A record increment going away caused an interrupt.
57	Undefined Input Change Intrpt	An unprogrammed input caused an interrupt at the 2681.
58	Write Failure	A SAMOS put_msg call failed.
59	SIO Jobs Active	The mode can't be changed because of active jobs.
60	SIO Out Buffer Busy	There are no output buffers to send data in 1886.
61	Device Read Failure	There was an error when an attempt was made to read a device.
62	Invalid Tracking Structure	The tracking software was given an invalid pointer to a trk structure.
63	SIO Complaint	The serial software received an invalid control message.
64	SIO Ring Overflow	The serial input ring buffer overflowed.
65	SIO Not Driver Comm	SIO control mail was received that was not a driver message.

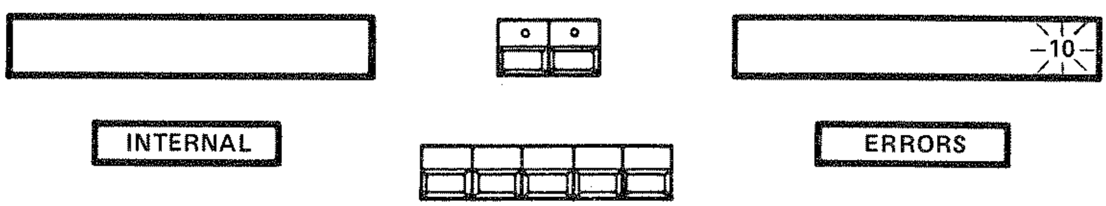
Table 5.18
Submode No. 10 Display Functions

Left Position Display	Right Position Display
Blank	Decimal Error Code
Left Axis Ident. Display	**Right Axis Ident. Display**
"INTERNAL"	"ERROR"

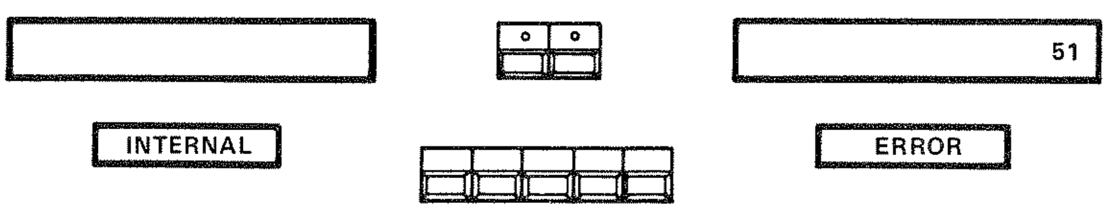
5.5.3.10.1 How to Select and Execute Submode No. 10

Select and execute "Display Internal Error Buffer" submode by performing the following steps:

1. Select Submode No. 10 using the POSITION OFFSET and SET (DOWN/UP) pushbuttons as described previously in Section 5.5.2. Observe this display:



2. Press AXIS (ENTER/START) to enter this submode. Observe the first buffer error code appearing in the right Position Display.



3. Clear the presently-shown error code and display the next error by pressing the AXIS (ENTER/START) pushbutton. Continue this process until all errors have been displayed.

NOTE

You may exit this submode at any time by pressing DISPLAY or OUTPUT push-buttons.

4. When this submode is complete, press DISPLAY or OUTPUT pushbuttons to exit and return to the Submode Menu.

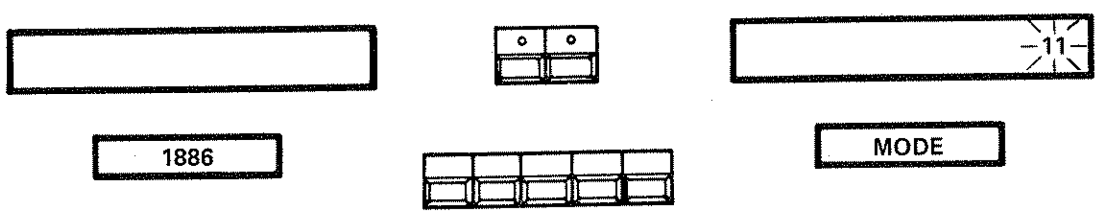
5.5.3.11 Submode No. 11 - Simulate Model 1886 Operation

This submode provides the same software for the Model 1886 as is used in the Model 1885. This feature is helpful in determining whether Non-volatile RAM exists in the unit and in making features of the Model 1886 available in the Model 1885.

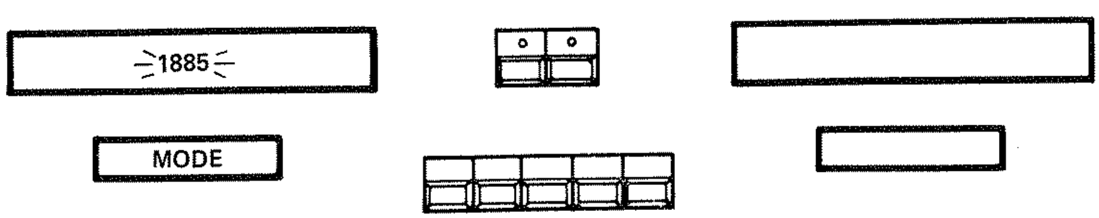
5.5.3.11.1 How to Execute Submode No. 11

To execute "Simulate Model 1885" submode, perform the following steps:

1. Select Submode No. 11 using POSITION OFFSET and SET pushbuttons as described previously in Section 5.5.2. Observe this display:



2. Press AXIS (ENTER/START) to enter this submode. The left Position Display begins flashing:



CHAPTER 6
PARTS LIST

6.1 GENERAL

The parts lists for the Model 1885 Digital Position Indicator, the optional Model 1886 Position Data Processor, and the Encoder Processor unit are provided in this chapter. Special modifications, if any, are enclosed in the envelope in the rear of this manual.

6.2 EXPLANATION OF COLUMN HEADINGS

REF. DESIG The column identifying the assigned reference designation of a component part or printed circuit board assembly.

PART NUMBER A five or six digit identification number assigned by Scientific-Atlanta.

DESCRIPTION A brief electrical and/or mechanical description of the component or assembly.

VENDOR PART NO. The column listing the number assigned to a part by an outside supplying manufacturer.

FSCM CODE The column identifying the proper Federal Supply Code for manufacturers. The code numbers are from the Federal Supply Code for Manufacturers Handbook H4-1 (Name-to-Code) and H4-2 (Code-to-Name) in effect as of the publication date of this manual.

6.3 ORDERING PARTS

When ordering parts from Scientific-Atlanta, always include the unit name, the unit serial number, the component part number, the description, the vendor part number, and the FSCM code number.

6.4 PARTS SUBSTITUTION

Common component parts may differ from those identified in the parts list. This difference is due to the substitution of a more current part. When this occurs, the replacement part may be either identical to the type removed or to the description given in the parts list.

6.4.1 Model 1885 Parts List Index

6.4.2 **Model 1886 Parts List Index**

6.4.3 **Encoder Processor Parts List Index**

MODEL 1885 TOP ASSEMBLY - 314040

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
A2	0314865	PWB ASSY CPU 1885		
A3	0315462	PWB ASSY ENCDR TMG 1885/86		
A4	0315463	PWB ASSY SYNC INPUT 1885/86		
A5	0312218	PWB ASSY,MEMORY/IFC,1885		
A6	0315464	PWB ASSY TRCK OUTPUT 1885		
A7	0315464	PWB ASSY TRCK OUTPUT 1885		
A9	0314070	PWB ASSY,MOTHERBOARD,1885		
A10	0314048	ASSY,TRANSFORMER,1885/1886		
A11	0314042	ASSY,FRONT PANEL,1885		
A12	0314044	ASSY,REAR PANEL,1885		
A13	0315455	ASSY,POWER SUPPY,1885		

MODEL 1885 CPU ASSEMBLY - 314865
REF DESIGNATION PREFIX: A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304104	PWB ASSY 8088 CPU/10 MDL 1885		
3	0316181	EPROM & LABEL ASSY CPU 1885		
U9	0314859	PRGRMD ASSY SEWQ CNTLR CPU1885		
U10	0314860	PRGRMD ASSY ADRS DCDR CPU 1885		

Subassembly - 304104

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C2	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C3	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C4		NOT ASSIGNED		
C5		NOT ASSIGNED		
C6	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C7	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C8	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C9	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C101	0173736	CAPACITR IC BYPASS FOR 8088 CPU .07MF	UQ-808X.07	
C102	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C103	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C104	0173730	CAPACITR IC BYPASS FOR .3W 18L-DIP .03MF	UQ-18.03	
C106	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C107	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C108	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C109	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C110	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C111	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C112	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C114	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C115	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C116	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C117	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C119	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C120	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C122	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C124	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C125	0173732	CAPACITR IC BYPASS FOR .4W 22L-DIP .03MF	UQ-22.03	
C126	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
J2	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
R1	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R7	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R8	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
U1	0171589	IC MICROPROCESSOR 8-BIT HMOS 5 MHZ	D8088	
U2	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U3	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U4	0171588	IC CLOCK GENERATOR FOR 8088 CPU	D8284A	
U5	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
U6	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U7	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U8	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U11	0173633	IC TTL BUFFER INVERT OCTAL 3-STATE	74F240PC	
U12	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	

Subassembly - 304104 (cont.)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U15	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U17	0170207	IC TTL GATE OR 2-IN QUAD	74F32PC	
U19	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U24	0173636	IC BUS TRANSCVR IEEE 488 INTERFACE	SN75160AN	
U25	0173638	IC NUS TRANSCVR IEEE 488 INTERFACE MULTI	SN75162AN	
U26	0173644	IC BUSS TRANSCVR IEEE 488 INTERFACE	TMS9914ANL	
U27	0173642	IC COMM INTERFACE UART DUAL	SC2681CSI40	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U31	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
U32	0174696	IC LINE DRIVER DUAL	UA9636ACP	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU2	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086650	SOCKET 18 PIN DIP PC MT	ICT-183-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU10	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU11	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU12	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU15	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU16	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU17	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU19	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU20	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU22	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU24	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU25	0089605	SOCKET 22 PIN DIP PC MT	ICT-224-S-T	
XU26	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
Y1	0171590	CYRSTAL 15.000 MHZ .015% H3W HOLDER	MP150	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES		

MODEL 1885 ENCODER/TIMING ASSEMBLY - 315462
REF DESIGNATION PREFIX: A3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0312215	PWB SUBASSY ENCDR TMG 1885/86		
U29	0314072	PRGRMD ASSY ADRS DCDR ETA 1885		
U30	0314071	PRGRMD ASY,ADRS DCDR,ETA 1885		
U31	0314073	PRGRMD ASY,SEQ CNTLR,ETA 1885		

Subassembly - 312215

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C2	0081808	CAPACITR 2.2 MF 50V CER MONO 20%	8141-050-651-225M	72982
C3	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C4	0081095	CAPACITR 3.3 MF 50V CER MONO 20%	8151-050-651-335M	72982
C5	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C6	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C7	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C8	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C9	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C10	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C11	0076882	CAPACITR .22 MF 50V CER MONO 20%	5CZ5U224X0050C5	80183
C12	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C13	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C14	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C15	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C16	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C17	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C18	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C19	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C20	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C21	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C22	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C23	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C24	0081098	CAPACITR .47 MF 50V CER MONO 20%	8131-050-651-474M	72982
C25	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C26	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C27	0070501	CAPACITR 47 PF 1 KV CER DISC S2L 10%	DD-470	71590
C28	0070501	CAPACITR 47 PF 1 KV CER DISC S2L 10%	DD-470	71590
C29	0070501	CAPACITR 47 PF 1 KV CER DISC S2L 10%	DD-470	71590
C30	0070501	CAPACITR 47 PF 1 KV CER DISC S2L 10%	DD-470	71590
C31	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C32	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C33	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	DDM-103	71590
J1	0089596	CONN HEADER DBL ROW RT ANGLE 6-PIN PC	1-86479-5	
J2	0089596	CONN HEADER DBL ROW RT ANGLE 6-PIN PC	1-86479-5	
J3	0089596	CONN HEADER DBL ROW RT ANGLE 6-PIN PC	1-86479-5	
P1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0074722	RESISTOR 4.7K OHM 1/4W 5% COMP	RCR07G472JS	01121
R2	0079071	RESISTOR 121K OHM RN55C 1% MTL FLM	RN55C1213F	
R3	0078934	RESISTOR 15.0K OHM RN55C 1% MTL FLM	RN55C1502F	
R4	0083935	RESISTOR 46.4K OHM RN55C 1% MTL FLM	RN55C4642F	
R5	0083932	RESISTOR 34.8K OHM RN55C 1% MTL FLM	RN55C3482F	
R6	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R7	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R9	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R10	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R11	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R12	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R13	0085788	RESISTOR 220K OHM 1/4 5% COMP	RCR07G224JS	01121
R14	0074735	RESISTOR 22K OHM 1/4W 5% COMP	RCR07G223JS	01121
R15	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121

Subassembly - 312215 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R16	0075584	RESISTOR 47 OHM 1/4W 5% COMP	RCR07G470JS	01121
R17	0075584	RESISTOR 47 OHM 1/4W 5% COMP	RCR07G470JS	01121
R18	0075584	RESISTOR 47 OHM 1/4W 5% COMP	RCR07G470JS	01121
R19	0075584	RESISTOR 47 OHM 1/4W 5% COMP	RCR07G470JS	01121
R20	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
S1	0174661	SWITCH 2P HEXADECIMAL 16 POS BOTTOM SEAL	230057GB	
S2	0174661	SWITCH 2P HEXADECIMAL 16 POS BOTTOM SEAL	230057GB	
U1	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U2	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U3	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U4	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U5	0174632	IC TTL COUNTER BIN 20-MHZ	SN74LS592N	
U6	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U7	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U8	0086219	IC PHASE/FREQ DET CMOS FOR PLL 16L-DIP	MC14046BCL	
U9	0172179	IC COMPARATOR - VOLTAGE 8L - DIP DUAL	LM393N	
U10	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U11	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U12	0087087	RESISTOR NETWORK 7 10K OHM 2% 8 SIP	764-1-R10K	
U13	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U14	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U15	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U16	0174655	IC TTL REGISTER SHIFT 8-BIT S-IN P-OUT	SN74LS595N	
U17	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U18	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U19	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U20	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U21	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U22	0172242	IC LINE RECEIVER QUAD DIFF 3-STATE	AM26LS32PC	
U23	0084279	IC TTL GATE NAND 2-IN QUAD	SN74LS00N	01295
U24	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U25	0170785	IC TTL COUNTER BIN 20-MHZ UP/DOWN	SN74LS191J	
U26	0173419	IC TTL MULTI MONO RETRIG DUAL	SN74LS123N	
U27	0086646	IC TTL DECODER 2-BIT TO 1 OF 4 DUAL	SN74LS139N	
U28	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U29		NOT ASSIGNED		
U30		NOT ASSIGNED		
U31		NOT ASSIGNED		
U32	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U33	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U34	0174658	IC LINE DRIVER QUAD RS-423 OR DUAL 422	AM26LS30PC	
U35	0174658	IC LINE DRIVER QUAD RS-423 OR DUAL 422	AM26LS30PC	
U36	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U37	0172242	IC LINE RECEIVER QUAD DIFF 3-STATE	AM26LS32PC	
U38	0087235	IC VLTG RGLTR NEG 5V 0.04A TYP TO92	MC79L05ACP	
XU8	0084530	SOCKET 16 PIN DIP PC MT	516-AG11D	91506
XU18	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU19	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU20	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU21	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU29	0086897	SOCKET 20 PIN DIP PC MT	1CT-203-S-T	
XU30	0086897	SOCKET 20 PIN DIP PC MT	1CT-203-S-T	
XU31	0086897	SOCKET 20 PIN DIP PC MT	1CT-203-S-T	
XU32	0086897	SOCKET 20 PIN DIP PC MT	1CT-203-S-T	

MODEL 1885 SYNCHRO INPUT ASSEMBLY - 315463
REF DESIGNATION PREFIX: A4

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0312212	PWB SUBASSY SYNC INPUT 1885/86		
U27	0314074	PAL,SEQ CONTROLLER,SIU27,16R8		
U41	0314614	PAL,ADDRESS DECODER,SIU41,16L8		

Subassembly - 312212

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C2	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C3	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C4	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C5	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C6	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C7	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C8	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C9	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C10	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C11	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C12		NOT ASSIGNED		
C13	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C14	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C15	0174878	CAP .1 MF 250V MET POLPRN 5%	104J25MP700L1	
C16	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C17	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C18	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C19	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C20	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C21	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C22	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C23	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C24	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C25	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C26	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C27		NOT ASSIGNED		
C28	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C29	0174878	CAP .1 MF 250V MET POLPRN 5%	104J25MP700L1	
C30	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C31	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C32	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C33	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C34	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C35	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C36	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C37	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C38	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	T362B106M020AS	80183
C39	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C40	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C41	0073492	CAPACITR 15 PF 500V SILVER MICA 5%	CD15CD150J03	00656
C42	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7R-102K	72982
C43	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7R-102K	72982
C44	0081934	CAPACITR 18 PF CER DISC COG 5%	835-COGC-180J	
C45	0081934	CAPACITR 18 PF CER DISC COG 5%	835-COGC-180J	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR2	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR4	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR5	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR6	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR7	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR10	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR11	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR12	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR13	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR14	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR15	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR16	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368

Subassembly - 312212 (cont.)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
CR17	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR18	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR19	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR20	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR21	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR22	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR23	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR24	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR25	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR26	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR27	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR28	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR29	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR30	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR31	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
P1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1		NOT ASSIGNED		
R2	0074706	RESISTOR 1.5K OHM 1/4W 5% COMP	RCR07G152JS	01121
R3	0074698	RESISTOR 560 OHM 1/4W 5% COMP	RCR07G561JS	01121
R4	0074706	RESISTOR 1.5K OHM 1/4W 5% COMP	RCR07G152JS	01121
R5	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R6	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R7	0074687	RESISTOR 220 OHM 1/4W 5% COMP	RCR07G221JS	01121
R8	0074687	RESISTOR 220 OHM 1/4W 5% COMP	RCR07G221JS	01121
R9		NOT ASSIGNED		
R10	0074706	RESISTOR 1.5K OHM 1/4W 5% COMP	RCR07G152JS	01121
R11	0074698	RESISTOR 560 OHM 1/4W 5% COMP	RCR07G561JS	01121
R12	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R13	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R14	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R15	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R16	0074706	RESISTOR 1.5K OHM 1/4W 5% COMP	RCR07G152JS	01121
R17	0074698	RESISTOR 560 OHM 1/4W 5% COMP	RCR07G561JS	01121
R18	0074698	RESISTOR 560 OHM 1/4W 5% COMP	RCR07G561JS	01121
R19	0078077	RESISTOR 39K OHM 1/4W 5% COMP	RCR07G393JS	01121
R20	0071937	RESISTOR 680 OHM 1/4W 5% COMP	RCR07G681JS	01121
R21	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R22	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R23	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R24	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R25	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R26	0071937	RESISTOR 680 OHM 1/4W 5% COMP	RCR07G681JS	01121
R27	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R28	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R29	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R30	0083944	RESISTOR 86.6K OHM RN55C 1% MTL FLM	RN55C8662F	
R32	0081996	RESISTOR 56 OHM 1/4W 5% COMP	RCR07G560JS	01121
R33	0081996	RESISTOR 56 OHM 1/4W 5% COMP	RCR07G560JS	01121
R34	0075687	RESISTOR 47K OHM 1/4W 5% COMP	RCR07G473Js	01121
U1	0315460	RESISTOR NETWORK,10K X 2,PRECISION		
U2	0174803	IC OP AMP DFET 8L-TO99 85C COMP	OPA111BM	
U3	0174803	IC OP AMP DFET 8L-TO99 85C COMP	OPA111BM	
U4	0174802	IC CMOS A/D CONV 12-BIT MULTI	AD7541AGCQ	
U5	0086693	IC COMPARATOR-VOLTAGE 14L - DIP	LM339J	
U6	0174794	IC OP AMP 8LTO99 85C UNCOMP LO NOISE	OP-37ET	
U7	0174794	IC OP AMP 8LTO99 85C UNCOMP LO NOISE	OP-37ET	
U8	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U9	0174796	RES NTWK 8 10K OHM 0.1% 16DIP	F16B103A	
U10	0174660	IC OP AMP 8L-TO99 125C UNCOMP714	UA714HM	
U11	0174803	IC OP AMP DFET 8L-TO99 85C COMP	OPA111BM	
U12	0174660	IC OP AMP 8L-TO99 125C UNCOMP714	UA714HM	
U13	0174803	IC OP AMP DFET 8L-TO99 85C COMP	OPA111BM	
U14	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U15	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U16	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U17	0174660	IC OP AMP 8L-TO99 125C UNCOMP714	UA714HM	
U18	0174660	IC OP AMP 8L-TO99 125C UNCOMP714	UA714HM	

Subassembly - 312212 (cont.)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U19	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U20	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U21	0174970	RES NTWK 8 39K OHM .1% 16 DIP	F16B393A	
U22	0174653	IC CMOS A/D CONVERTER REGISTER 12-BIT	MM74C905D	
U23	0174654	IC MEMORY TTL FIFO 16X4 ASYNC 3- STATE	SN74LS224N	
U24	0174654	IC MEMORY TTL FIFO 16X4 ASYNC 3- STATE	SN74LS224N	
U25	0174654	IC MEMORY TTL FIFO 16X4 ASYNC 3- STATE	SN74LS224N	
U26	0174654	IC MEMORY TTL FIFO 16X4 ASYNC 3- STATE	SN74LS224N	
U27		NOT ASSIGNED		
U28	0174919	IC CMOS ANLG SW DPST D 16L-DIP	DG384ABK	
U29	0174969	IC CMOS MUXR 3-BIT/8-CHNL TO 1	AD7501KD	
U30	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U31	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U32	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U33	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U34	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U35	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U36	0174970	RES NTWK 8 39K OHM .1% 16 DIP	F16B393A	
U37	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U38	0084283	IC TTL FLIP-FLOP TYPE-D DUAL	SN74LS74AN	01295
U39	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U40	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U41		NOT ASSIGNED		
U43	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U44	0174969	IC CMOS MUXR 3-BIT/8-CHNL TO 1	AD7501KD	
U45	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U46	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U47	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U48	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U49	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U50	0174660	IC OP AMP 8L-T099 125C UNCOMP714	UA714HM	
U51	0174970	RES NTWK 8 39K OHM .1% 16 DIP	F16B393A	
U52	0174794	IC OP AMP 8LT099 85C UNCOMP LO NOISE	OP-37ET	
U53	0174794	IC OP AMP 8LT099 85C UNCOMP LO NOISE	OP-37ET	
XU21	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU27	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU29	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU36	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU41	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU43	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU44	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU51	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	

MODEL 1885 MEMORY/INTERFACE ASSEMBLY - 312218
REF DESIGNATION PREFIX: A5

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
BT1	0089604	BATTERY NICKEL-CADMIUM 3.6V 70 MA HRS	405333-003	
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C8	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C9	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C16	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C17	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
CR1	0083983	DIODE 1N5226B SI ZEN 3.3V 5% .5W	1N5226B	13715
P1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q3	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0071897	RESISTOR 150 OHM 1/4W 10% COMP	RCR07G151KS	01121
R2	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R3	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	RCR07G222KS	01121
R4	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	RCR07G472KS	01121
R5	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R6	0071982	RESISTOR 2.7K OHM 1/4W 10% COMP	RCR07G272KS	01121
R7	0071926	RESISTOR 470 OHM 1/4W 10% COMP	RCR07G471KS	01121
R8	0071938	RESISTOR 680 OHM 1/4W 10% COMP	RCR07G681KS	01121
R9	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
RT1	0083617	THERMSTR 100 OHM DISC 25 DEG C 10%	FD21J1	15801
U1	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U2	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U3	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U4	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U5	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U6	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U7	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U8	0174693	IC TTL CNTR BIN 20-MHZ 3STATE	SN74LS590N	
U9	0087086	RESISTOR NETWORK 7 4.7K OHM 2% 8 SIP	4308R-101-472	
U10	0171581	IC CMOS RAM 2048X8 200 NS STATIC	HM6116L-4	
U11	0087086	RESISTOR NETWORK 7 4.7K OHM 2% 8 SIP	4308R-101-472	
U12	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	01295
U13	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U14	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U15	0170207	IC TTL GATE OR 2-IN QUAD	74F32PC	
U16	0084282	IC TTL GATE AND 2-IN QUAD	SN74LS08N	01295
U17	0087319	RESISTOR NETWORK 7 2.2K OHM 10% 8 SIP	4308R-101-222L	
U18	0080971	IC DRIVER PERIPHERAL DUAL	SN75451BP	01295
U19	0080971	IC DRIVER PERIPHERAL DUAL	SN75451BP	01295
U20	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
U21	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
U22	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
U23	0085949	IC TTL BUFFER OCTAL 3-STATE	SN74LS244N	
XU10	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	

MODEL 1885 TRACKING/OUTPUT ASSEMBLY - 315464
REF DESIGNATION PREFIX: A6, A7

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0312206	PWB SUBASSY TRCK OUT 1885		
U8	0314079	PAL, SP CONTROLLER, TOU8, 16L8		
U14	0314078	PAL CNTR CONTLER TOU25 16L8		
U39	0314077	PAL ADDRESS DECODER TOU2 16L8		

Subassembly - 312206

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C8	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C9	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C10	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C11	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C12	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C13	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C14	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C15	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C16	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C17	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C18	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C19	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C20	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C21	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C22	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C23	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
P1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
P2	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P3	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
P4	0086884	JUMPER FEMALE INSULATED .10 SPACING	65474-004	
Q1	0078600	NOT ASSIGNED		
R1	0078600	NOT ASSIGNED		
R2	0071960	RESISTOR 1.2K OHM 1/4W 10% COMP	RCR07G122KS	01121
R3	0071938	RESISTOR 680 OHM 1/4W 10% COMP	RCR07G681KS	01121
U1	0172411	IC TTL MULTIPLIER SYNCH 6-BIT BIN RATE	SN7497N	
U2	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U3	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U4	0170785	IC TTL COUNTER BIN 20-MHZ UP/DOWN	SN74LS191J	
U5	0174631	IC TTL FLIP-FLOP TYPE-JK QUAD	SN74376N	
U6	0087073	IC TTL LATCH NAND R/S QUAD	SN74LS279N	
U7	0085946	IC TTL GATE NAND 3-IN TRIPLE	SN74LS10N	
U8	0078600	SEE ABOVE		
U9	0316359	DECADE UP/DN COUNTER		
U10	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U11	0316359	DECADE UP/DN COUNTER		
U12	0316359	DECADE UP/DN COUNTER		
U13	0316359	DECADE UP/DN COUNTER		
U14		(SEE ABOVE)		
U15	0084285	IC TTL GATE OR 2-IN QUAD	SN74LS32N	?
U16	0172413	IC TTL FLIP FLOP TYPE JK DUAL	SN74LS113AN	
U17	0172411	IC TTL MULTIPLIER SYNCH 6-BIT BIN RATE	SN7497N	
U18	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U19	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U20	0174632	IC TTL COUNTER BIN 20-MHZ	SN74LS592N	
U21	0174632	IC TTL COUNTER BIN 20-MHZ	SN74LS592N	
U22	0084281	IC TTL GATE INVERTER HEX	SN74LS04N	01295
U23	0174632	IC TTL COUNTER BIN 20-MHZ	SN74LS592N	
U24	0174632	IC TTL COUNTER BIN 20-MHZ	SN74LS592N	
U25	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
U26	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U27	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	

Subassembly - 312206 (cont.)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U28	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U29	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U30	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U31	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U32	0316359	DECADE UP/DOWN COUNTER		
U33	0316359	DECADE UP/DOWN COUNTER		
U34	0172411	IC TTL MULTIPLIER SYNCH 6-BIT BIN RATE	SN7497N	
U35	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U36	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U37	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U38	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U39		SEE MAIN ASSEMBLY DESCRIPTION		
U40	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U41	0086898	IC BUS TRANSCVR 8-BIT	SN74LS245N	
U42	0087686	IC TTL MULTIPLEXER 8-BIT/1-CHNL TO 1	SN74LS151J	
U43	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U44	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U45	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U46	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U47	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U48	0087889	IC TTL FLIP-FLOP TYPE-D OCTAL 3-STATE	SN74LS374N	
U49	0316359	DECADE UP/DOWN COUNTER		
U50	0316359	DECADE UP/DOWN COUNTER		
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU26	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU29	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU39	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU41	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU43	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU46	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	

MODEL 1885 MOTHERBOARD ASSEMBLY - 314070
REF DESIGNATION PREFIX: A9

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0316345	PWB,MOTHERBOARD,1885/1886	PER SA DWG	
2	0174636	CONN CONTACT FEM PC MT .040 HOLE SIZE	02-06-7103	
3	0086347	CONN CONTACT MALE PC MT .060 HOLE SIZE	02 09 2133	
4	0174635	CONN CONTACT FEM PC MT .060 HOLE SIZE	02 09 1133	
5	0174816	CONN CONT FITS .062 BDY PC	02-06-8103	
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C3	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
F1	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F2	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F3	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F4	0071217	FUSE 1/2 AMP SLO BLO	3AG 313.500	75915
F5	0087843	FUSE 6 1/4 AMP SLO BLO	3AG 3136.25	
F6	0087843	FUSE 6 1/4 AMP SLO BLO	3AG 3136.25	
J3	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J4	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J5	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J6	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J7	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J8	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J9	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J11	0173933	CONNECTR 24 PIN DOUBLE READOUT RT ANGLE	552791-1	
J12	0173678	CONN RECT BODY W/O CONTRACTS 24 POS RECE	03-06-1242	
J13	0088687	CONN RECT BOBY W/O CONTACTS 2 POS RECEP	MOL 03-09-1022	
J14	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J15	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J16	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J17	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J18	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J19	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J20	0174801	CONN RT ANGLE DBL ROW 50 POS PC BD MT	1-85930-9	
J24	0089462	CONN HEAD SGL ROW STR 9PIN PC	09-65-1091	
P1	0086348	CONN RECT BODY W/O CONTACTS 9 POS PLUG	03-09-2092	
P2	0086558	CONN RECT BODY W/O CONTACTS 4 POS PLUG	03-09-2042	
P3	0082617	CONN RECT BODY W/O CONTACTS	03-06-2023	27264
P4	0173712	CONN RECT 96-COND FEM PNL MT RT ANGLE PC	10-8457-096-002-097	
R2	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
U1	0173960	SWITCH SPST 8 POS DIP RT ANGLE W/ SEAL	206-8RAST	
U2	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U3	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	6B753A	
U4	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U5	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U6	0174796	RES NTWK 8 10K OHM 0.1% 16DIP	F16B103A	
U7	0174796	RES NTWK 8 10K OHM 0.1% 16DIP	F16B103A	
U8	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
U11	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
U12	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
XF1	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF2	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF3	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF4	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF5	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF6	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XU2	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU3	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU4	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU5	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU6	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU7	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	

MODEL 1885 TRANSFORMER ASSEMBLY - 314048
REF DESIGNATION PREFIX: A10

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SST1M	06383
2	0087460	CONN CONTACT PIN FOR SA PN 87458	350547-2	
3	0087459	CONN CONTACT SOCKET FOR SA PN 87457	350550-2	
P1	0087823	CONN RECT PLUG HOUSING 4 CIRCUITS	1-480702-0	
P2	0037150	CONN HOUSING FEMALE 2 CIRCUITS	1-480699-0	
T1	0256074	TRANSFORMER POWER	SX1583	

MODEL 1885 FRONT PANEL ASSEMBLY - 314042
REF DESIGNATION PREFIX: A11

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
A1	0312123	PWB ASSY,FRONT PANEL IFC,1885		
S1	0088393	SWITCH TOG DPST AC 10A 250V FLAT TOGGLE	7561K55C	

MODEL 1885 FRONT PANEL INTERFACE ASSEMBLY - 312123
REF DESIGNATION PREFIX: A11A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C3	0170208	CAPACITR 4700 MF 10V	500D478M01GK2	
C4	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C5	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C6	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
C7	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	8131-050-651-104Z	72982
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR2	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR3	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR4	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR5	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR6	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR7	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR9	0087070	LAMP LED RED .125 DIA .200 LNG 3.0V 40MA	TIL209A	
J1	0087038	CONN HEADER DBL ROW STRAIGHT 50-PIN PC	2-87215-5	
J2	0084000	VARIES WITH MODEL,SEE HIGHER ASSY FOR PN	PER SA DWG	
L1	0081740	INDUCTOR 250 UH FILTER CHOKE 1.3A	6310-9	04213
Q1	0084000	VARIES WITH MODEL,SEE HIGHER ASSY FOR PN	PER SA DWG	
Q2	0086505	TRANSSTR 2N2222A/JAN NPN SIL	2N2222A/JAN	
Q3	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q4	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q5	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q6	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q7	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q8	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q9	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q10	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q11	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q12	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q13	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q14	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q15	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q16	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q17	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
Q18	0084815	TRANSSTR 2N6427 NPN SIL DARLINGTON PAIR	2N6427	04713
R1	0084000	VARIES WITH MODEL,SEE HIGHER ASSY FOR PN	PER SA DWG	
R2	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R3	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R4	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R5	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R6	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R7	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R8	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R9	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
R10	0071836	RESISTOR 10 OHM 1/4W 10% COMP	RCR07G100KS	01121
S1	0174704	SW PUCHB SPDT MON BLK BTN RED LED	SEAU0A0I05R	
S2	0174704	SW PUCHB SPDT MON BLK BTN RED LED	SEAU0A0I05R	
S3	0174703	SW PUCHB SPDT MOM BLK BTN RECT	SEAU0A0104	
S4	0174703	SW PUCHB SPDT MOM BLK BTN RECT	SEAU0A0104	
S5	0174703	SW PUCHB SPDT MOM BLK BTN RECT	SEAU0A0104	

MODEL 1885 FRONT PANEL INTERFACE ASSEMBLY - 312123 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
S6	0174703	SW PUCHB SPDT MOM BLK BTN RECT	SEAU0A0104	
S7	0174703	SW PUCHB SPDT MOM BLK BTN RECT	SEAU0A0104	
U1	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U2	0174630	IC DRIVER ALPHANUMERIC LED DISPLAY 14SEG	ICM7243BIJL	
U3	0087884	DISPLAY LED 8 CHAR 14 SEG RED .135 INCH	MAN2815	
U4	0174630	IC DRIVER ALPHANUMERIC LED DISPLAY 14SEG	ICM7243BIJL	
U5	0087884	DISPLAY LED 8 CHAR 14 SEG RED .135 INCH	MAN2815	
U6	0085943	IC TTL DECODER 3-BIT TO 1 OF 8	SN74LS138N	
U7	0088053	IC INTERFACE CPU TO KEYBOARD AND DISPLAY	P8279-5	
U8	0086205	IC TTL BUFFER INVERT OCTAL 3-STATE	SN74LS240N	
U9	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 DIP	4310R-101-472	
U10	0086205	IC TTL BUFFER INVERT OCTAL 3-STATE	SN74LS240N	
U11	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 DIP	4310R-101-472	
U12	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP	898-3-k220	
U13		NOT ASSIGNED		
U14	0088935	IC TRANSSTR ARRAY 4-PNP 2N2907 FAMILY	TPQ2907	
U15	0088935	IC TRANSSTR ARRAY 4-PNP 2N2907 FAMILY	TPQ2907	
U16	0083621	IC CMOS DECODER BCD TO DEC OR BIN/OCTL	MC14028BCL	04713
U17	0089504	RESISTOR NETWORK 8 3.3K OHM 2% 16 DIP	4116R-001-332	
U18	0087299	DISPLAY LED 7 SEG RED ±1 OVRFL .43 IN.	5082-7656	
U19	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U20	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U21	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U22	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U23	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U24	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U25	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U26	0083621	IC CMOS DECODER BCD TO DEC OR BIN/OCTL	MC14028BCL	04713
U27	0089504	RESISTOR NETWORK 8 3.3K OHM 2% 16 DIP	4116R-001-332	
U28	0087299	DISPLAY LED 7 SEG RED ±1 OVRFL .43 IN.	5082-7656	
U29	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U30	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U31	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U32	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U33	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U34	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
U35	0087300	DISPLAY LED 7 SEG RED RHDP .43 IN.	5082-7653	
XU3	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	
XU5	0086651	SOCKET 24 PIN DIP PC MT	ICT-246-S-T	

MODEL 1885 REAR PANEL ASSEMBLY - 314044
REF DESIGNATION PREFIX: A12

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0312938	PANEL,REAR,1885		
2	0089520	FAN FILTER SCREEN FOR MINI BOX	06007	
13	0087843	FUSE 6.25 AMP SLO BLO	3AG 3136.25	
A1	0314061	FAN ASSY		
A2	0312225	PWB ASSY, REAR PNL INTFC, 1885		
W1	0314618	HARNESS ASSY, AC POWER, 1885	PER DWG	
W2	0314862	CABLE ASSY, ROTOR VOLTAGE		
W3	0314059	HARNESS ASY,SYNC IN 1885/1886		

AC POWER HARNESS ASSEMBLY - 314618
REF DESIGNATION PREFIX: A12W1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0037153	CONN PIN FEM #18-24 AWG	350689-1	
2	0073373	WIRE 20 STRANDED GRAY	PER MIL-W-16878D	12515
3	0073384	WIRE 20 STRANDED WHITE/GRAY	PER MIL-W-16878D	12515
4	0078680	TERMINAL SPADE INS FLNGD 22-18AWG #6	A-215-06	98410
5	0073365	WIRE 18 STRANDED WHITE/GRAY	PER MIL-W-16878D	12515
6	0073355	WIRE 18 STRANDED GRAY	PER MIL-W-16878D	12515
7	0075949	WIRE 18 STRANDED BLACK	PER MIL-W-16878D	12515
8	0083140	TERMINAL QUICK DISC INS 22-18 FEM	DV18-250F1-M	06383
9	0171517	TERMINAL QUICK DISC INS 12-10 FEM .25	IMD-N-550-250-03FA	
10	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SST1M	06383
11	0077041	MARKER WIRE WITH NUMBER 1	43-001	85480
12	0077042	MARKER WIRE WITH NUMBER 2	43-002	85480
13	0077043	MARKER WIRE WITH NUMBER 3	43-003	85480
14	0077044	MARKER WIRE WITH NUMBER 4	43-004	85480
15	0078679	TERMINAL SPADE INS FLNGD 16-14AWG #6	B-216-06	98410
JFL1	0083759	CONN AC MALE 3-COND 3A W/FUSE BLK & FILT	6J4	
P1	0087824	CONN RECT CAP HOUSING 4 CIRCUITS	1-480703-0	
P2	0037150	CONN HOUSING FEMALE 2 CIRCUITS	1-480699-0	

SYNC IN HARNESS ASSEMBLY - 314059
REF DESIGNATION PREFIX: A12W3

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0073394	WIRE 22 STRANDED WHITE	PER MIL-W-16878D	12515
2	0174901	CONN CONT .062D M CRP 18-24AWG	02-06-6103	
3	0089487	CONN RECT M TERM COV FOR 9POS	EC156F-9	
4	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SST1M	06383
5	0315775	LABEL SET,SYNC INPUT HARN 1880		
J7	0070912	CONNECTR 3102A 20 29S	MS3102A-20-29S	02660
J8	0070912	CONNECTR 3102A 20 29S	MS3102A-20-29S	02660
J9	0070912	CONNECTR 3102A 20 29S	MS3102A-20-29S	02660
P1	0173671	CONN RECT BODY W/O CONTACTS 9 POS PLUG	03-06-2092	
P2	0173671	CONN RECT BODY W/O CONTACTS 9 POS PLUG	03-06-2092	
P3	0173671	CONN RECT BODY W/O CONTACTS 9 POS PLUG	03-06-2092	
P4	0088907	CONN RECT BODY W_O CONTACTS 24 POS PLUG	MOL 03-06-2242	
P5	0174881	CONN RECT M TERM 9P 22AWG .156	CE156F22-9	

FAN ASSEMBLY - 314061
REF DESIGNATION PREFIX: A12A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SST1M	06383
2	0037152	CONN PIN MALE #18-24 AWG	350690-1	
B1	0089519	FAN 3 5/8 IN. BOXER 115VAC 50/60 HZ .24A	MWS2107FL	
P1	0037151	CONN HOUSING MALE 2 CIRCUITS	1-480698-0	

MODEL 1885 REAR PANEL INTERFACE - 312225
REF DESIGNATION PREFIX: A12A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
J1	0174921	CONN RECT 15-COND F TYPE D PC	H2R15SW29C1	
J2	0174909	CONN RECT 15-COND M TYPE D PC	H2M15SW29C1	
J3	0174922	CONN RECT 9-COND F TYPE D PC	H2R09SW29C1	
J4	0174922	CONN RECT 9-COND F TYPE D PC	H2R09SW29C1	
J5	0174923	CONN RECT 37-COND F TYPE D PC	H2R37SW29C1	
J6	0174923	CONN RECT 37-COND F TYPE D PC	H2R37SW29C1	
J7	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	0-8257-096-649-123	
S1	0083296	SWITCH SPST 8 POS PC MT DIP	435166-5	00779
U1	0174745	RESISTOR NETWORK 4 27 OHM 2% 8SIP	4308R-102-270	
U2	0087319	RESISTOR NETWORK 7 2.2K OHM 10% 8 SIP	4308R-101-222L	
U3	0174746	RESISTOR NETWORKK 7 3.3K OHM 2% 14 DIP	4114R-001-332	
V1	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V2	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V3	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V4	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V5	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V6	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V7	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V8	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	

MODEL 1885 POWER SUPPLY ASSEMBLY - 315455
REF DESIGNATION PREFIX: A13

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0314616	ASSY,POWER SUPPLY,1885/1886	PER SA DWG	
W1	0315457	HARN ASSY,PWR SUPPLY 1885/1886		

POWER SUPPLY HARNESS ASSEMBLY - 315457
REF DESIGNATION PREFIX: A13W1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0174880	CONN RECT M TERM COV FOR 5 P	EC156F-5	
2	0078605	TERMINAL RECT INS 12-10AWG #10	C-212-10	98410
3	0083688	TERMINAL RING INS 22-18AWG #10	PN18-10R	06383
4	0078680	TERMINAL SPADE INS FLNGD 22-18AWG #6	A-215-06	98410
5	0084999	CONN CONTACT #18-24AWG FEM FOR PN 84997	02-06-1103	27264
6	0087460	CONN CONTACT PIN FOR SA PN 87458	350547-2	
7	0084020	CONN CONTACT #18-22AWG FEM FOR PN 84015	02-09-1118	27264
8	0315776	LABEL SET,DC PWR SPLY HARN		
9	0073356	WIRE 18 STRANDED WHITE	PER MIL-W-16878D	12515
10	0075949	WIRE 18 STRANDED BLACK	PER MIL-W-16878D	12515
11	0073354	WIRE 18 STRANDED VIOLET	PER MIL-W-16878D	12515
12	0073349	WIRE 18 STRANDED RED	PER MIL-W-16878D	12515
13	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SSTIM	06383
P1	0086349	CONN RECT 9 POS RECEP	03 09 1094	
P2	0086309	CONN RECT BODY W/O CONTACTS 4 POS RECEP	03-09-1042	
P3	0037151	CONN HOUSING MALE 2 CIRCUITS	1-480698-0	
P4	0082619	CONN RECT BDY W/O CONT 2P RECP	03-06-1023	27264
P5	0174879	CONN RECT M TERM 5P 22AWG .156	CE156F22-5	

MODEL 1886 POSITION DATA PROCESSOR TOP ASSEMBLY - 314041

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
A2	0314866	PWB ASSY, CPU 1886		
A3	0315462	PWB ASSY ENCDR TMG 1885/86		
A4	0315463	PWB ASSY SYNC INPUT 1885/86		
A9	0314868	PWB ASSY,MOTHERBOARD,1886		
A10	0314048	ASSY,TRANSFORMER,1885/1886		
A11	0314043	ASSY,FRONT PANEL,1886		
A12	0314045	ASSY,REAR PANEL,1886		
A13	0315456	ASSY,POWER SUPPY,1886		
W1	0315472	CABLE ASSY PWR,INDICATOR,LED		
W2	0315461	CABLE ASSY REM PWR RELAY CTL		

MODEL 1886 CPU ASSEMBLY - 314866
REF DESIGNATION PREFIX: A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
01	0304103	PWB ASSY 8088 CPU/10 MDL 1886		
03	0316181	EPROM & LABEL ASSY CPU 1886		
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
U9	0314859	PRGRMD ASSY SEWQ CNTLR CPU1885		
U10	0314860	PRGRMD ASSY ADRS DCDR CPU 1885		
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	
U27	0173642	IC COMM INTERFACE UART DUAL	SC268ICSI40	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U30	0173940	RES. NTWK 3.9K OHM 2% 10 SIP	4310R 101 392	
U32	0174696	IC LINE DRIVER DUAL	UA9636ACP	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES	PER S A DWG	

8088 CPU/10 MODEL 1886 PWB ASSEMBLY - 304103
REF DESIGNATION PREFIX: 01

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C2	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C3	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C6	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C7	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C8	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C9	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C101	0173736	CAPACITR IC BYPASS FOR 8088 CPU.07MF	UQ-808X.07	
C102	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C103	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C104	0173730	CAPACITR IC BYPASS FOR .3W 18L-DIP .03MF	UQ-18.03	
C106	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C107	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C108	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C109	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C110	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C111	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C112	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C114	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C115	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C116	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C117	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C119	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C120	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C122	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
J2	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
R1	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R8	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121

304103 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
S1	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
S3	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
U1	0171589	IC MICROPROCESSOR 8-BIT HMOS 5 MHZ	D8088	
U2	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U3	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U4	0171588	IC CLOCK GENERATOR FOR 8088 CPU	D8284A	
U5	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
U6	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U7	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U8	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U11	0173633	IC TTL BUFFER INVERT OCTAL 3-STATE	74F240PC	
U12	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	
U15	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U17	0170207	IC TTL GATE OR 2-IN QUAD	74F32PC	
U19	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U27	0173642	IC COMM INTERFACE UART DUAL	SC2681CSI40	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U30	0173940	RES. NTWK 3.9K OHM 2% 10 SIP	4310R 101 392	
U31	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU2	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086650	SOCKET 18 PIN DIP PC MT	ICT-183-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU10	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU11	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU12	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU15	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU16	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU17	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU19	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU20	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU22	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
Y1	0171590	CRYSTAL 15.000 MHZ .015% H3W HOLDER	MP150	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES		

MODEL 1886 ENCODER TIMING ASSEMBLY - 315462
REF DESIGNATION PREFIX: A3

(See Model 1885 Parts List Assembly A3)

MODEL 1886 SYNCHRO INPUT ASSEMBLY - 315463
REF DESIGNATION PREFIX: A4

(See Model 1885 Parts List Assembly A4)

MODEL 1886 MOTHERBOARD ASSEMBLY - 314868
REF DESIGNATION PREFIX: A9

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
01	0316345	PWB,MOTHERBOARD,1885/1886	PER SA DWG	
02	0174636	CONN CONTACT FEM PC MT .040 HOLE SIZE	02-06-7103	
03	0086347	CONN CONTACT MALE PC MT .060 HOLE SIZE	02 09 2133	
04	0174635	CONN CONTACT FEM PC MT .060 HOLE SIZE	02 09 1133	
05	0174816	CONN CONT FITS .062 BDY PC	02-06-8103	
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
C3	0083385	CAPACITR .1 MF 50V CER MONO X7R 10%	8131-050-X7R-104K	72982
F1	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F2	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F3	0071221	FUSE 1.5 AMP	3AG 31201.5	75915
F4	0071217	FUSE 1/2 AMP SLO BLO	3AG 313.500	75915
F5	0087843	FUSE 6 1/4 AMP SLO BLO	3AG 3136.25	
F6	0087843	FUSE 6 1/4 AMP SLO BLO	3AG 3136.25	
J3	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J4	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J5	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J6	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
J12	0173678	CONN RECT BODY W/O CONTRACTS 24 POS RECE	03-06-1242	
J13	0088687	RECT BOBY W/O CONTACTS 2POS RECEP	MOL 03-09-1022	
J14	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J15	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J16	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J17	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J18	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J19	0173679	CONN RECT BODY W/O CONTACTS 9 POS RECEP	03-06-1092	
J21	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
J24	0089462	CONN HEAD SGL ROW STR 9PIN PC	09-65-1091	
P1	0086348	CONN RECT BODY W/O CONTACTS 9 POS PLUG	03-09-2092	
P2	0086558	CONN RECT BODY W/O CONTACTS 4 POS PLUG	03-09-2042	
P3	0082617	CONN RECT BODY W/O CONTACTS	03-06-2023	27264
P4	0173712	CONN RECT 96-COND FEM PNL MT RT ANGLE PC	10-8457-096-002-097	
R1	0074687	RESISTOR 220 OHM .25W 5% COMP	RCR07G221JS	
R2	0074727	RESISTOR 10K OHM .25W 5% COMP	RCR07G103JS	
U2	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U3	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U4	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U5	0174799	RES NTWK 8 75K OHM 0.1% 16DIP	F16B753A	
U6	0174796	RES NTWK 8 10K OHM 0.1% 16DIP	F16B103A	
U7	0174796	RES NTWK 8 10K OHM 0.1% 16DIP	F16B103A	
U8	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
U9	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
U10	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
U11				
U12	0173758	RESISTOR NETWORK 8 220 + 8 330 10 SIP	MSP10A05-221/331G	
XF1	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF2	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF3	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF4	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF5	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XF6	0080798	FUS HLDR CLIP FOR 3AG OR 3AB PC MT	3600-2	84613
XU2	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU3	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU4	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU5	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU6	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU7	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	

MODEL 1886 TRANSFORMER ASSEMBLY - 314048
REF DESIGNATION PREFIX: A10

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SSTIM	06383
2	0087460	CONN CONTACT PIN FOR SA PN 87458	350547-2	
3	0087459	CONN CONTACT SOCKET FOR SA PN 87457	350550-2	
P1	0087823	CONN RECT PLUG HOUSING 4 CIRCUITS	1-480702-0	
P2	0037150	CONN HOUSING FEMALE 2 CIRCUITS	1-480699-0	
T1	0256074	TRANSFORMER, POWER	SX1583	

MODEL 1886 FRONT PANEL ASSEMBLY - 314043
REF DESIGNATION PREFIX: A11

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0313054	FRONT PANEL,PDP,MDL 1886		
K1	0170221	RELAY SOLID STATE SPST 240V 10A CONTACTS	TD2410	
K2	0170221	RELAY SOLID STATE SPST 240V 10A CONTACTS	TD2410	

MODEL 1886 REAR PANEL ASSEMBLY - 314045
REF DESIGNATION PREFIX: A12

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0313942	PANEL,REAR,1886	MOW 313942	
2	0255140	SCREEN FILTER	PER SA DWG 255140	
A1	0314061	FAN ASSY		
A2	0315467	PWB ASSY,REAR PANEL INTFC,1886		
W1	0314871	HARNESS ASSY AC POWER 1886		
W2	0314862	CABLE ASSY, ROTOR VOLTAGE		
W3	0314059	HARNESS ASY,SYNC IN 1885/1886		

MODEL 1886 AC POWER HARNESS ASSEMBLY - 314871
REF DESIGNATION PREFIX: A12W1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0037153	CONN PIN FEM #18-24 AWG	350689-1	
2	0073373	WIRE 20 STRANDED GRAY	PER MIL-W-16878D	12515
3	0073384	WIRE 20 STRANDED WHITE/GRAY	PER MIL-W-16878D	12515
4	0078680	TERMINAL SPADE INS FLNGD 22-18AWG #6	A-215-06	98410
5	0073365	WIRE 18 STRANDED WHITE/GRAY	PER MIL-W-16878D	12515
6	0073355	WIRE 18 STRANDED GRAY	PER MIL-W-16878D	12515
7	0075949	WIRE 18 STRANDED BLACK	PER MIL-W-16878D	12515
9	0078679	TERMINAL SPADE INS FLNGD 16-14AWG #6	B-216-06	98410
10	0073045	CABLE TIE - MINIATURE - 4 IN. LONG	SSTIM	06383
11	0077041	MARKER WIRE WITH NUMBER 1	43-001	85480
12	0077042	MARKER WIRE WITH NUMBER 2	43-002	85480
13	0077043	MARKER WIRE WITH NUMBER 3	43-003	85480
14	0077044	MARKER WIRE WITH NUMBER 4	43-004	85480
JFL1	0083759	CONN AC MALE 3-COND 3A W/FUSE BLK & FILT	6J4	
P1	0087824	CONN RECT CAP HOUSING 4 CIRCUITS	1-480703-0	
P2	0037150	CONN HOUSING FEMALE 2 CIRCUITS	1-480699-0	
RT1	0173980	THERMSTR 16 OHM DISC 25 DEG C I LIMITER	CL-180	
RT2	0173980	THERMSTR 16 OHM DISC 25 DEG C I LIMITER	CL-180	
S1	0174709	SW TOG 4PDT ON-ON-ON LOCK LEVER	7411-K-G-E	

MODEL 1886 FAN ASSEMBLY - 314061
REF DESIGNATION PREFIX: A12A1

(See Model 1885 Parts List Assembly A12A1)

MODEL 1886 REAR PANEL INTERFACE ASSEMBLY - 315467
REF DESIGNATION PREFIX: A12A2

1	0312224	PWB,REAR PANEL INTFC,1885/1886	PER DWG 312224	
C1	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
CR1	0089538	DIODE 1N6267A ZEN TRAN SUPPRESSOR 6.8 V	1N6267A	
CR2	0089538	DIODE 1N6267A ZEN TRAN SUPPRESSOR 6.8 V	1N6267A	
J3	0174922	CONN RECT 9-COND F TYPE D PC	H2R09SW29C1	
J4	0174922	CONN RECT 9-COND F TYPE D PC	H2R09SW29C1	
J7	0173711	CONN RECT 96-COND FEM PNL MT STRAIGHT PC	00-8257-096-649-123	
P1	0174930	CONN HD SGL ROW STR 3-PIN LK	HLSS100-3	
Q1	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q2	0077148	TRANSSTR 2N3251 PNP SIL	2N3251	04713
Q3	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q4	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0074733	RESISTOR 18K OHM 1/4W 5% COMP	RCR07G183JS	01121
R2	0074733	RESISTOR 18K OHM 1/4W 5% COMP	RCR07G183JS	01121
R3	0074733	RESISTOR 18K OHM 1/4W 5% COMP	RCR07G183JS	01121
R4	0074733	RESISTOR 18K OHM 1/4W 5% COMP	RCR07G183JS	01121
S1	0083296	SWITCH SPST 8 POS PC MT DIP	435166-5	00779
U1	0174745	RES NETWK 4 27 OHM 2% 8SIP	4308R-102-270	
U2	0087319	RESISTOR NETWORK 7 2.2K OHM 10% 8 SIP	4308R-101-222L	
U3	0174746	RES.NETWK 7 3.3K OHM 2% 14 DIP	4114R-001-332	
V1	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V2	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V3	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V4	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V5	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V6	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V7	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	
V8	0174612	VARISTOR 13.3-14.7V 5W BIDIRECTIONAL	SCM12CA	

MODEL 1886 POWER SUPPLY ASSEMBLY - 315456
REF DESIGNATION PREFIX: A13

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0315455	ASSY,POWER SUPPY,1885		

ENCODER PROCESSOR TOP ASSEMBLY - 314068

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
A1	0317613	PWB ASSY, ENCODER CONTROL		
A2	0314067	PWB ASSY, ENCODER PREAMP		
J1	0315912	CONNECTOR, HDR-2S-6, MICROTECH	MIT HDR-2S-6 CONN	
J2	0315912	CONNECTOR, HDR-2S-6, MICROTECH	MIT HDR-2S-6 CONN	
J3	0315912	CONNECTOR, HDR-2S-6, MICROTECH	MIT HDR-2S-6 CONN	

ENCODER CONTROL ASSEMBLY - 317613
REF DESIGNATION PREFIX: A1

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	314064	PWB, ENCODER CONTROL		
U3	314075	PAL SEQ CONTROLLER ECU3 16R8		
U4	314076	PAL DEMOD CONTROLLER ECU4 16L8		

ENCODER CONTROL SUBASSEMBLY - 314064

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C3	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C4	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C5	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C6	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C7	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C8	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C9	0081808	CAPACITR 2.2 MF 50V CER MONO 20%	8141-050-651-225M	72982
C10	0081021	CAPACITR 33 MF 10V SOLID TANT POL 20%	150D336X0010B2	80183
C11	0081095	CAPACITR 3.3 MF 50V CER MONO 20%	8151-050-651-335M	72982
C12	0084214	CAPACITR .0015 MF 100V CER MONO X7R 10%	8121-100-X7R-152K	72982
C13	0081095	CAPACITR 3.3 MF 50V CER MONO 20%	8151-050-651-335M	72982
C14	0081021	CAPACITR 33 MF 10V SOLID TANT POL 20%	150D336X0010B2	80183
C15	0076882	CAPACITR .22 MF 50V CER MONO 20%	5CZ5U224X0050C5	80183
C16	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C17	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C18	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C19	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C20	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C21	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C22	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C23	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C24	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C25	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C26	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C27	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C28	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C29	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C31	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C32	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C33	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C34	0035656	CAPACITR 100 MF 20V SOLID TANT POL 20%	T362D107K020AS	05397
C35	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C36	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C37	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C38	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
CR1	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR2	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR3	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR4	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR5	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR6	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR7	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173674	CONN RECT BODY W/O CONTACTS 4 POS RECEP	03-06-1042	
J2	0173670	CONN RECT BODY W/O CONTACTS 3 POS RECEP	03-06-1032	
J3	0173670	CONN RECT BODY W/O CONTACTS 3 POS RECEP	03-06-1032	
J4	0084997	CONN RECT BODY W/O CONTACTS 12 POS PLUG	03-06-2122	27264
J5	0173955	CONN 40 PIN FWM DOUBLE ROW BOTTOM MT	86418 2	
K1	0174810	RELAY 5VDC DPDT REED DIP	195TE2C1E-5G	
L1	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
L2	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
L3	0081977	CORE BEAD FERRITE 7D.260x.125x.375L	57-1555	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
R1	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R2	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R3	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121

ENCODER CONTROL SUBASSEMBLY - (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R4	0080382	RESISTOR 11.0K OHM RN55C 1% MTL FLM	RN55C1102F	
R5	0080382	RESISTOR 11.0K OHM RN55C 1% MTL FLM	RN55C1102F	
R6	0074729	RESISTOR 12K OHM 1/4W 5% COMP	RCR07G123JS	01121
R7	0075692	RESISTOR 82K OHM 1/4W 5% COMP	RCR07G823JS	01121
R8	0074735	RESISTOR 22K OHM 1/4W 5% COMP	RCR07G223JS	01121
R9	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R10	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R11	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	RCR07G222JS	01121
R12	0074687	RESISTOR 220 OHM 1/4W 5% COMP	RCR07G221JS	01121
R13	0074718	RESISTOR 3.9K OHM 1/4W 5% COMP	RCR07G392JS	01121
R14	0075668	RESISTOR 8.2K OHM 1/4W 5% COMP	RCR07G822JS	01121
R15	0074679	RESISTOR 150 OHM 1/4W 5% COMP	RCR07G151JS	01121
R16	0078110	RESISTOR 180 OHM 1/4W 5% COMP	RCR07G181JS	01121
R17	0083136	RESISTOR 2.2 OHM 1/2W 5% COMP	RCR20G2R2JS	01121
R18	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R19	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
U1	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U2	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U5	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U6	0174807	IC OSC VCO 0.001-0.3 MHZ 14-DIP	ICL8038BMJD	
U7	0084890	IC OP AMP 8L-DIP 70C COMP 741C	MC1741CP1	04713
U8	0174809	IC AMPL AUDIO 5L-TO220	LM383T	
U9	0080979	IC TTL BUFFER INVERT HEX OPEN-COL	SN7406N	01295
U10	0173354	RESISTOR NETWORK 7 220 OHM 2% 8 SIP	108A221	
U11	0083235	IC VLTG RGLTR POS 5V 0.5A TYP TO220	MC7805CT	04713
U12	0084915	IC VLTG RGLTR NEG 5V 0.5A TYP TO220	MC7905CT	04713
U13	0088131	IC VLTG RGLTR POS 8V 0.5A TYP	MC7808CT	
U14	0085034	IC VLTG RGLTR NEG 8V 0.8A TYP TO220	MC7908CT	12040
U15	0083806	IC TIMER 8L-DIP	NE555N	18324
U16	0084982	IC VLTG RGLTR NEG 15V 0.35A TYP TO39	79M15AHC	13715
XU1	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU2	0087983	SOCKET 8 PIN DIP PC MT	1CT-083-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	

ENCODER PREAMPLIFIER - 314067
REF DESIGNATION PREFIX: A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0082431	CAPACITR 22 PF 100V CER DISC COG 5%	835-024-COGO-220J	18796
C2	0082431	CAPACITR 22 PF 100V CER DISC COG 5%	835-024-COGO-220J	18796
C3	0174815	CAP .068 MF 50V MET POLYCARB 1%	X440	
C4	0174815	CAP .068 MF 50V MET POLYCARB 1%	X440	
C5	0174815	CAP .068 MF 50V MET POLYCARB 1%	X440	
C6	0174815	CAP .068 MF 50V MET POLYCARB 1%	X440	
C7	0070495	CAPACITR 33 PF 1 KV CER DISC S2L 10%	DD330	71590
C8	0070495	CAPACITR 33 PF 1 KV CER DISC S2L 10%	DD330	71590
C9	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C10	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C11	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C12	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C13	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C14	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C15	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C16	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C17	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C18	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C19	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
C20	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	8121-050-X7R-103K	72982
CR1	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR2	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR3	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR4	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR5	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
CR6	0083618	DIODE 5082-2800 DET UHF SCHOTTKY	5082-2800	28480
J1	0174932	CONN HDR SGL ROW STR 20-PIN PC	2-87465-1	
R1	0078933	RESISTOR 10.0K OHM RN55C 1% MTL FLM	RN55C1002F	
R2	0078933	RESISTOR 10.0K OHM RN55C 1% MTL FLM	RN55C1002F	
R3	0083876	RESISTOR 499 OHM RN55C 1% MTL FLM	RN55C4990F	
R4	0083876	RESISTOR 499 OHM RN55C 1% MTL FLM	RN55C4990F	
R5	0078924	RESISTOR 20.0K OHM RN55C 1% MTL FLM	RN55C2002F	
R6	0078924	RESISTOR 20.0K OHM RN55C 1% MTL FLM	RN55C2002F	
R7	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	RCR07G222JS	01121
R8	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	RCR07G222JS	01121
R9	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R10	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R11	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R12	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R13	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	RCR07G222JS	01121
R14	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R15	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R16	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
T1	0174813	XFMR PRI 10KCT IMADC SEC 4.0 40MW	PCT-11	
T2	0174813	XFMR PRI 10KCT IMADC SEC 4.0 40MW	PCT-11	
U1	0088555	IC OP AMP 8L-DIP 125C UNCOMP LO NOISE	SE5534AN	
U2	0088555	IC OP AMP 8L-DIP 125C UNCOMP LO NOISE	SE5534AN	
U3	0175308	IC CMOS ANLG SW SPST QUAD 16L	AN7510DIKD	
U4	0174812	IC JFET ANLG SW SPDT DUAL 16L-DIP	DG189BP	
U5	0174657	IC CMOS ANALOG SW SPDT DUAL 16L-DIP	DG390ABK	
U6	0174803	IC OP AMP DFET 8L-T099 85C COMP	OPA111BM	
U7	0174803	IC OP AMP DFET 8L-T099 85C COMP	OPA111BM	
U8	0174794	IC OP AMP 8LT099 85C UNCOMP LO NOISE	OP-37ET	
U9	0174794	IC OP AMP 8LT099 85C UNCOMP LO NOISE	OP-37ET	
U10	0086693	IC COMPARATOR-VOLTAGE 14L - DIP	LM339J	
U11	0174802	IC CMOS A/D CONV 12-BIT MULTI	AD7541AGCQ	
U12	0174803	IC OP AMP DFET 8L-T099 85C COMP	OPA111BM	
U13	0174803	IC OP AMP DFET 8L-T099 85C COMP	OPA111BM	
U14	0174794	IC OP AMP 8LT099 85C UNCOMP LO NOISE	OP-37ET	
U15	0174653	IC CMOS A/D CONVERTER REGISTER 12-BIT	MM74C905D	
U16	0315459	RESISTOR NETWORK,1.8K X 2,PRECISION	PER SA DWG	
U17	0315460	RESISTOR NETWORK,10K X 2,PRECISION	PER SA DWG	
U18	0174862	RESISTOR NETWORK 42.0K OHM .5% 8DIP	694-3-R2.0K(D)	
U19	0315460	RESISTOR NETWORK,10K X 2,PRECISION	PER SA DWG	

CHAPTER 7
DIAGRAMS

7.1 GENERAL

Component location diagrams and schematics for the Model 1885 Digital Position Indicator, the optional Model 1886 Position Data Processor, and the optional Encoder Processor Unit, are provided in this chapter. These diagrams are arranged in alphanumeric order by assembly designation number. Throughout the index, the Assembly number (or "A" number) is printed in bold to aid in identifying a particular assembly or group of related diagrams.

Also in these diagrams, unless otherwise specified, all capacitors are in microfarads and all resistors are in ohms (±10%, .25 watt).

7.2 INDEX

7.2.1 Model 1885

7.2.2 **Model 1886**

7.2.3 Encoder Processor

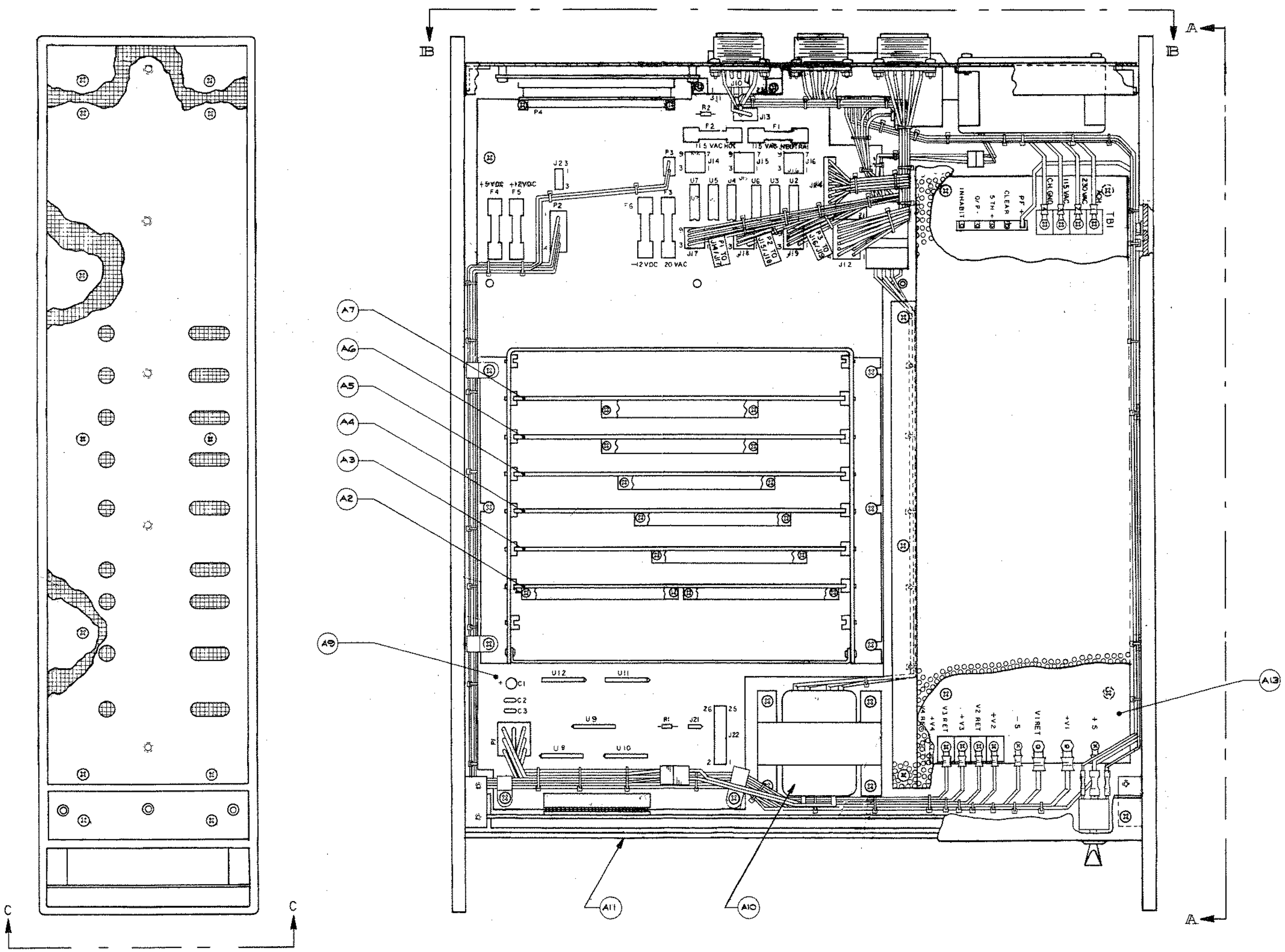
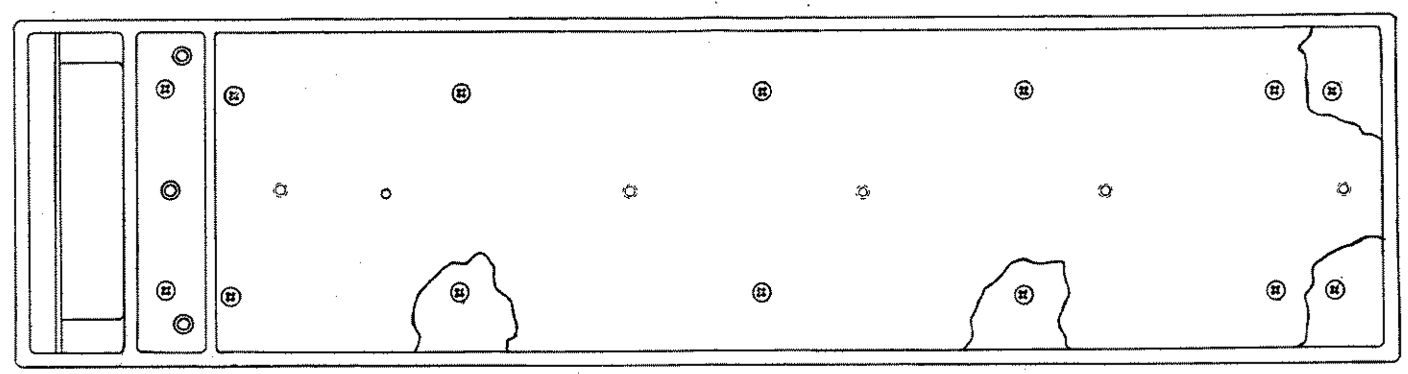


Figure 7.1 Model 1885 Unit Assembly and Wiring Diagram (Sheet 1 of 3)



VIEW A-A

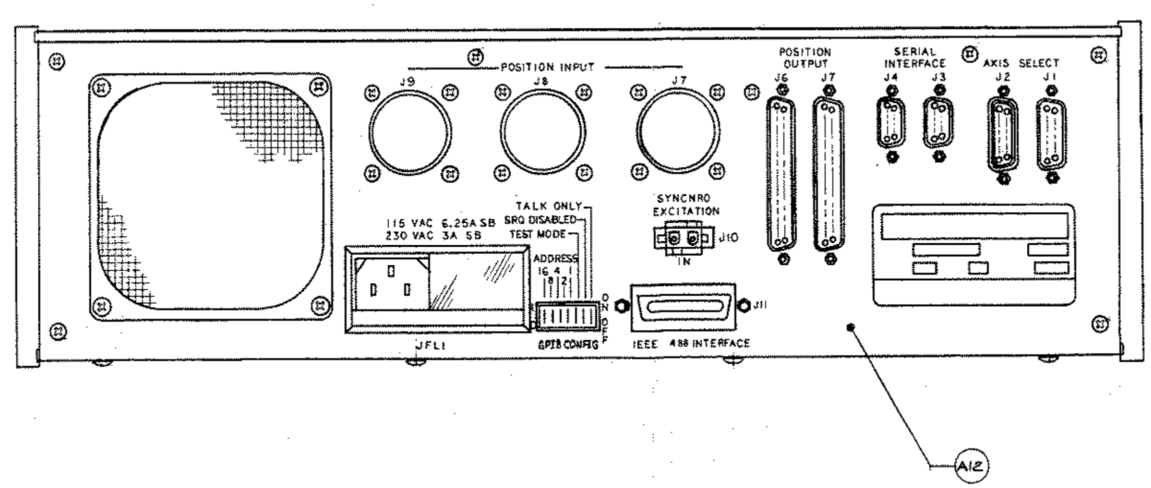
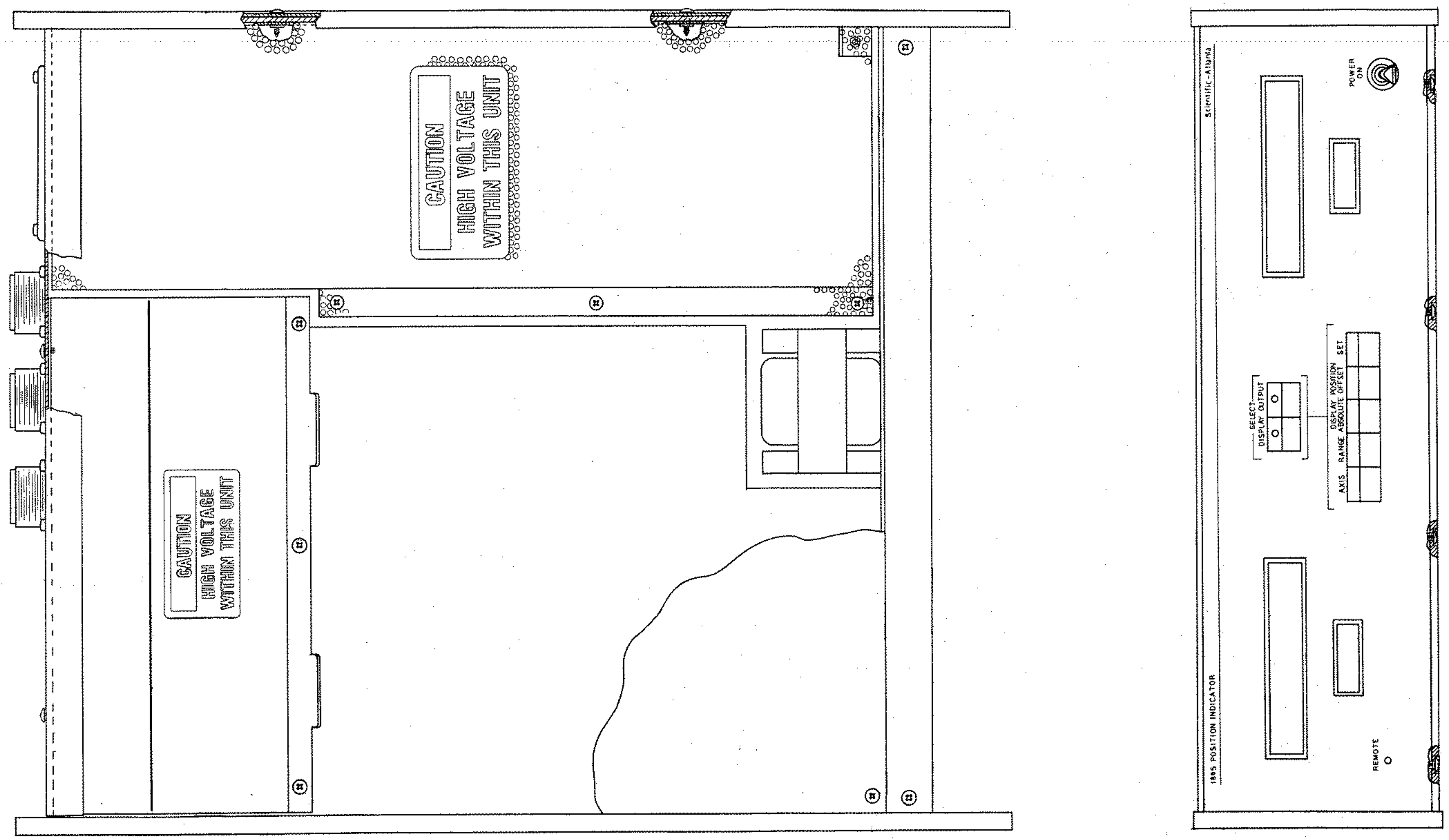


Figure 7.1 Model 1885 Unit Assembly and Wiring Diagram (Sheet 2 of 3)



VIEW C-C

Figure 7.1 **Model 1885 Unit Assembly and Wiring Diagram (Sheet 3 of 3)**

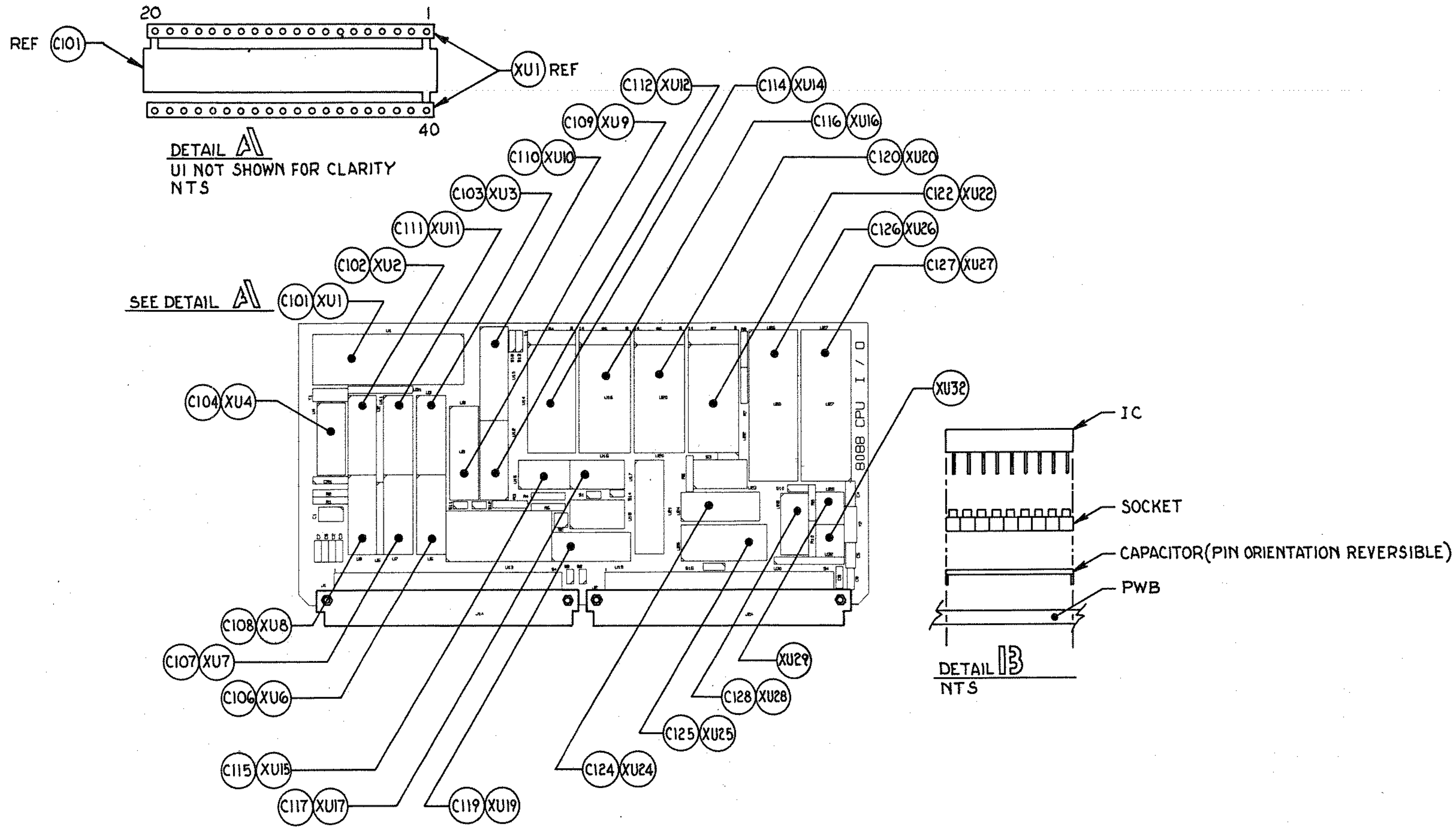


Figure 7.2 CPU Assembly (A2), Component Location

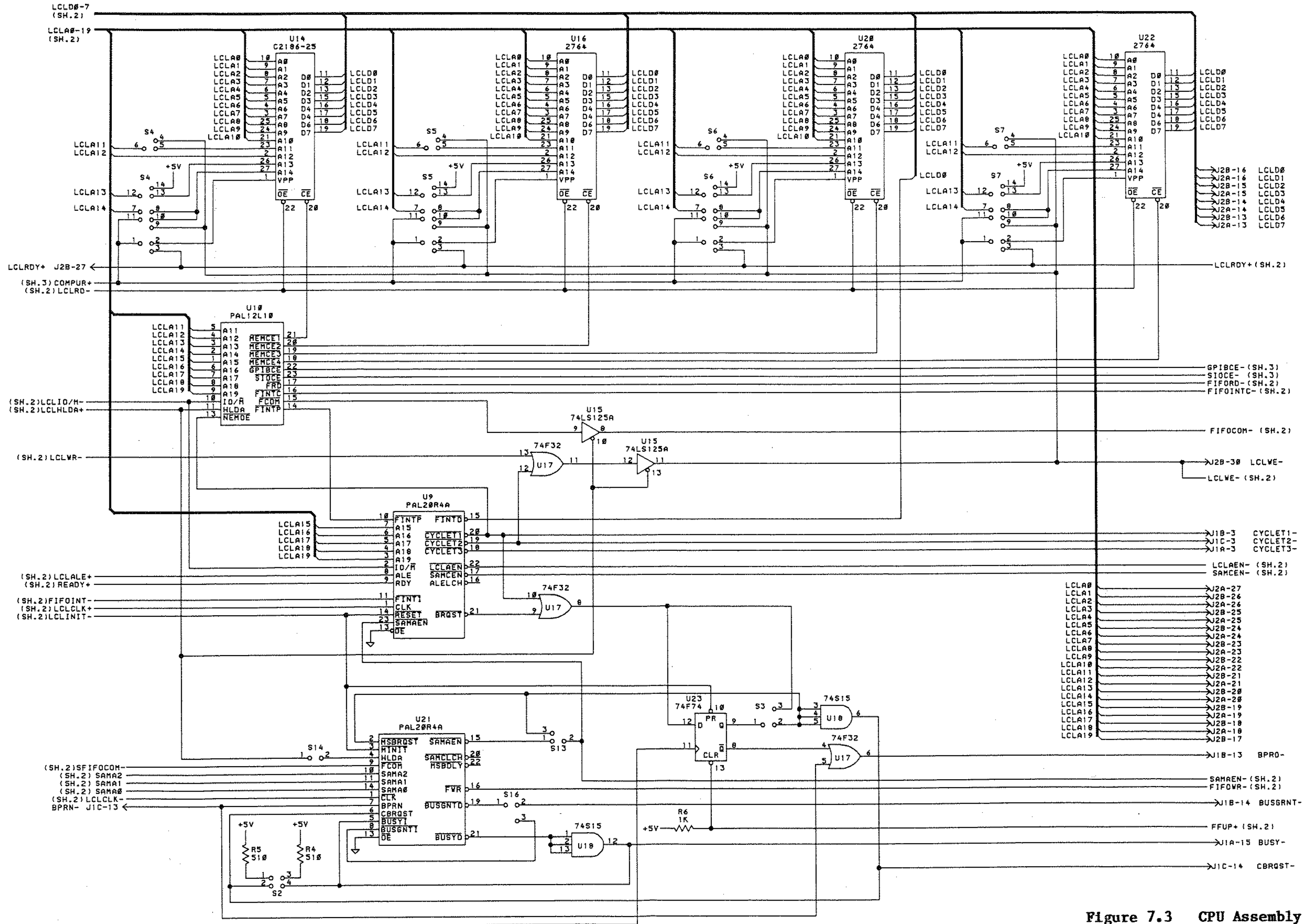


Figure 7.3 CPU Assembly (A2), Schematic (Sheet 1 of 3)

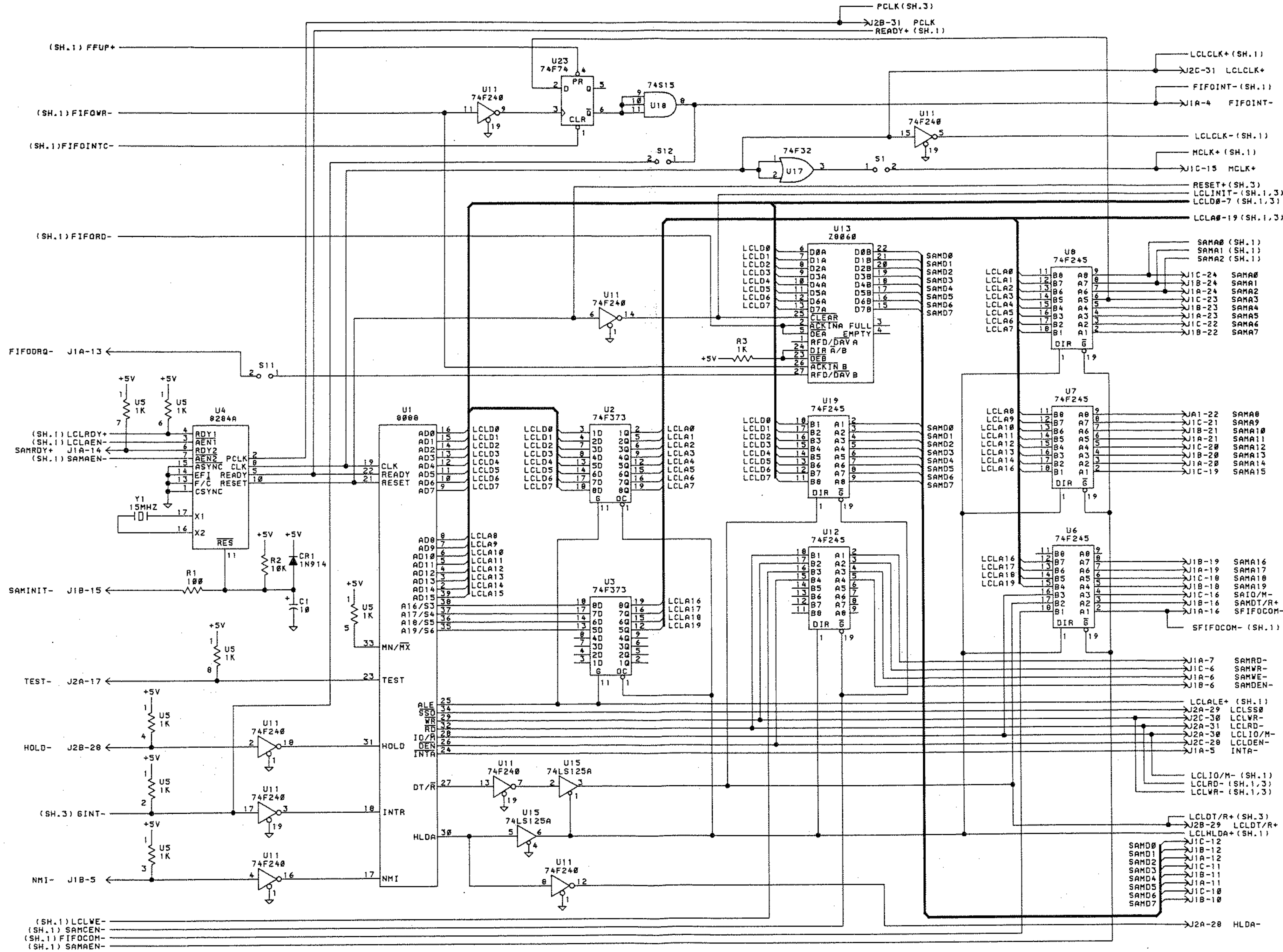
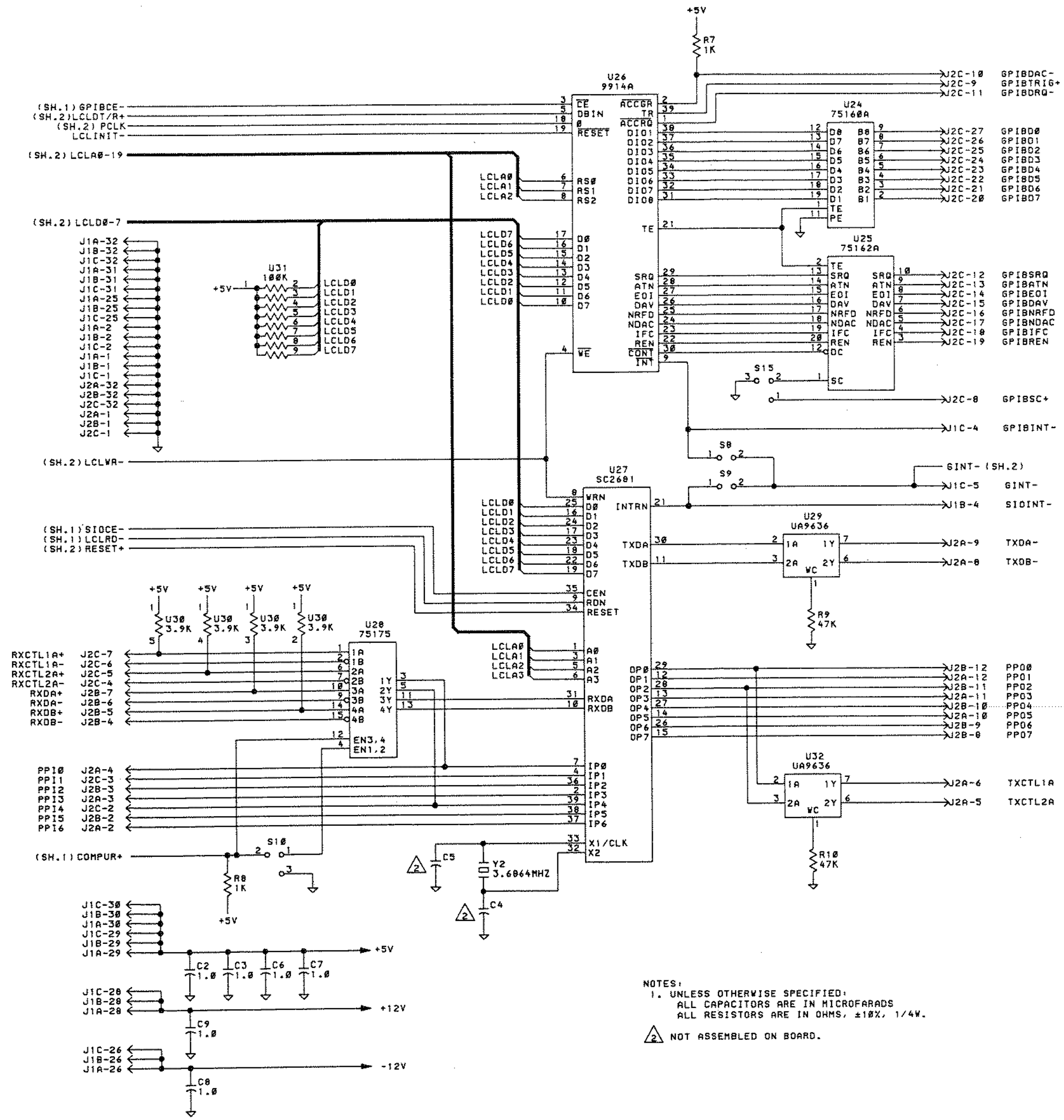


Figure 7.3 CPU Assembly (A2), Schematic (Sheet 2 of 3)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

2 NOT ASSEMBLED ON BOARD.

TYPE NO.	REF	GND	+5V
8088	U1	1,20	40
74F373	U2	10	20
74F373	U3	10	20
8284A	U4	9	18
	U5		1
74F245	U6	10	20
74F245	U7	10	20
74F245	U8	10	20
PAL20R4A	U9	12	24
PAL12L10	U10	12	24
74F240	U11	10	20
74F245	U12	10	20
Z8060	U13	14	28
C2186-25	U14	14	28
74LS125	U15	7	14
2764	U16	14	28
74F32	U17	7	14
74S15	U18	7	14
74F245	U19	10	20
2764	U20	14	28
PAL20R4A	U21	12	24
2764	U22	14	28
74F74	U23	7	14
75160A	U24	10	20
75162A	U25	11	22
9914A	U26	20	40
SC2681	U27	20	40
75175	U28	8	16
	U30		1
	U31		1

TYPE NO.	REF	GND	+12V	-12V
UA9636	U29		8	5
UA9636	U32		8	5

Figure 7.3 CPU Assembly (A2), Schematic (Sheet 3 of 3)

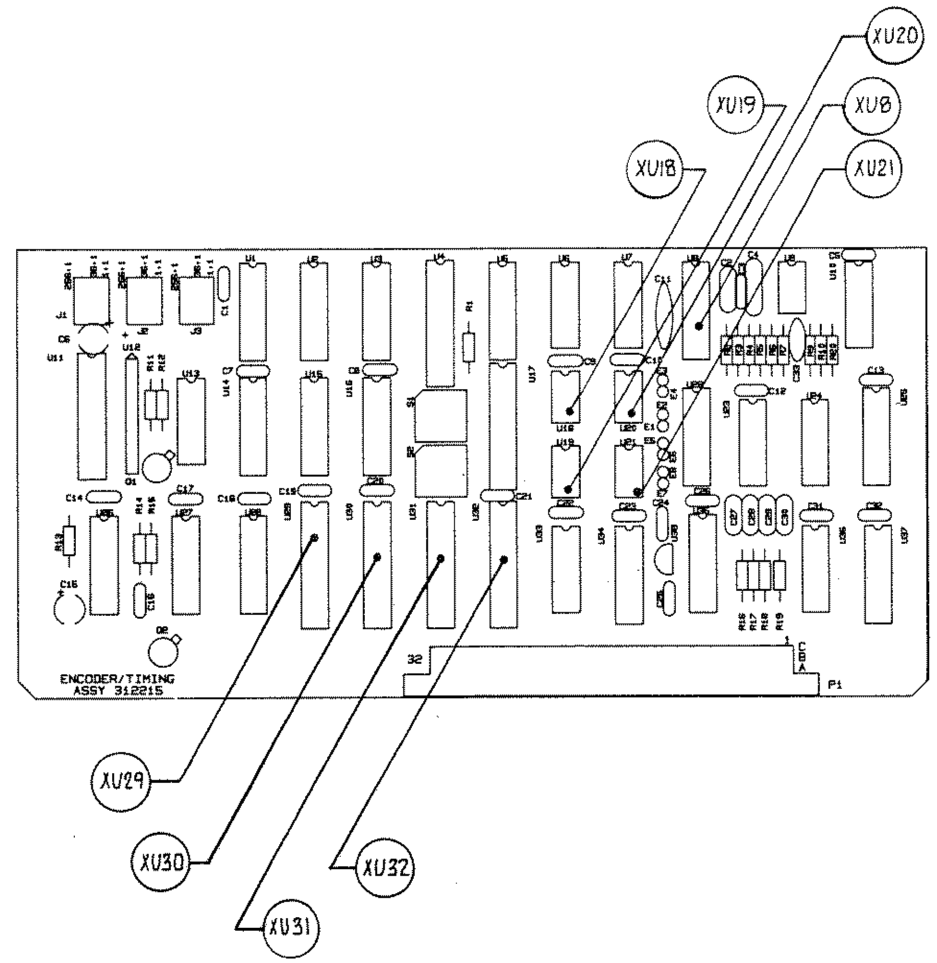
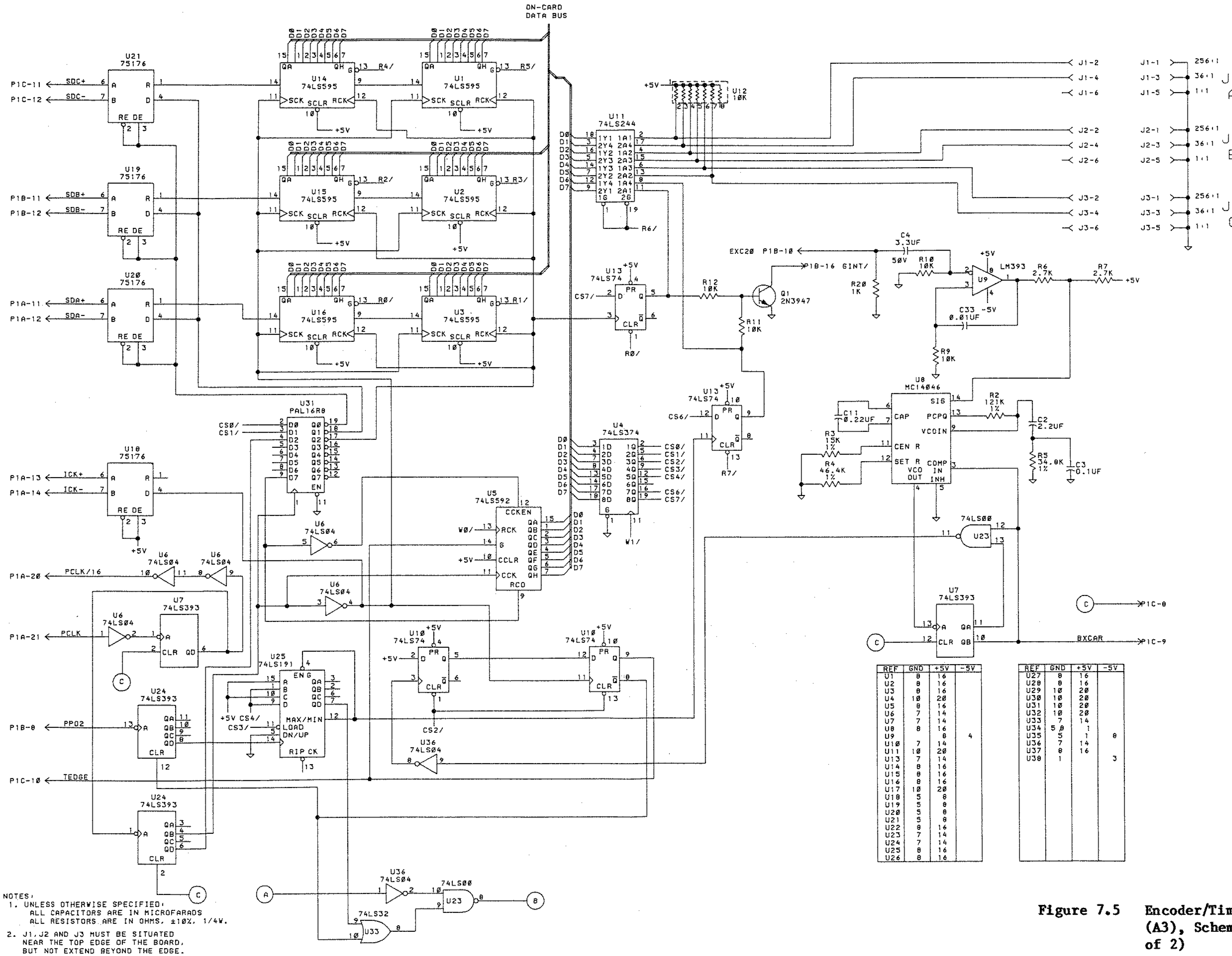


Figure 7.4 Encoder/Timing Assembly (A3), Component Location



REF	GND	+5V	-5V
U1	8	16	
U2	8	16	
U3	8	16	
U4	10	20	
U5	8	16	
U6	7	14	
U7	7	14	
U8	8	16	
U9		8	4
U10	7	14	
U11	10	20	
U13	7	14	
U14	8	16	
U15	8	16	
U16	8	16	
U17	10	20	
U18	5	8	
U19	5	8	
U20	5	8	
U21	5	8	
U22	8	16	
U23	7	14	
U24	7	14	
U25	8	16	
U26	8	16	

REF	GND	+5V	-5V
U27	8	16	
U28	8	16	
U29	10	20	
U30	10	20	
U31	10	20	
U32	10	20	
U33	7	14	
U34	5 8	1	
U35	5	1	8
U36	7	14	
U37	8	16	
U38	1		3

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MICROFARADS
   ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.
2. J1, J2 AND J3 MUST BE SITUATED NEAR THE TOP EDGE OF THE BOARD, BUT NOT EXTEND BEYOND THE EDGE.

Figure 7.5 Encoder/Timing Assembly (A3), Schematic (Sheet 1 of 2)

312213C
41I042Z

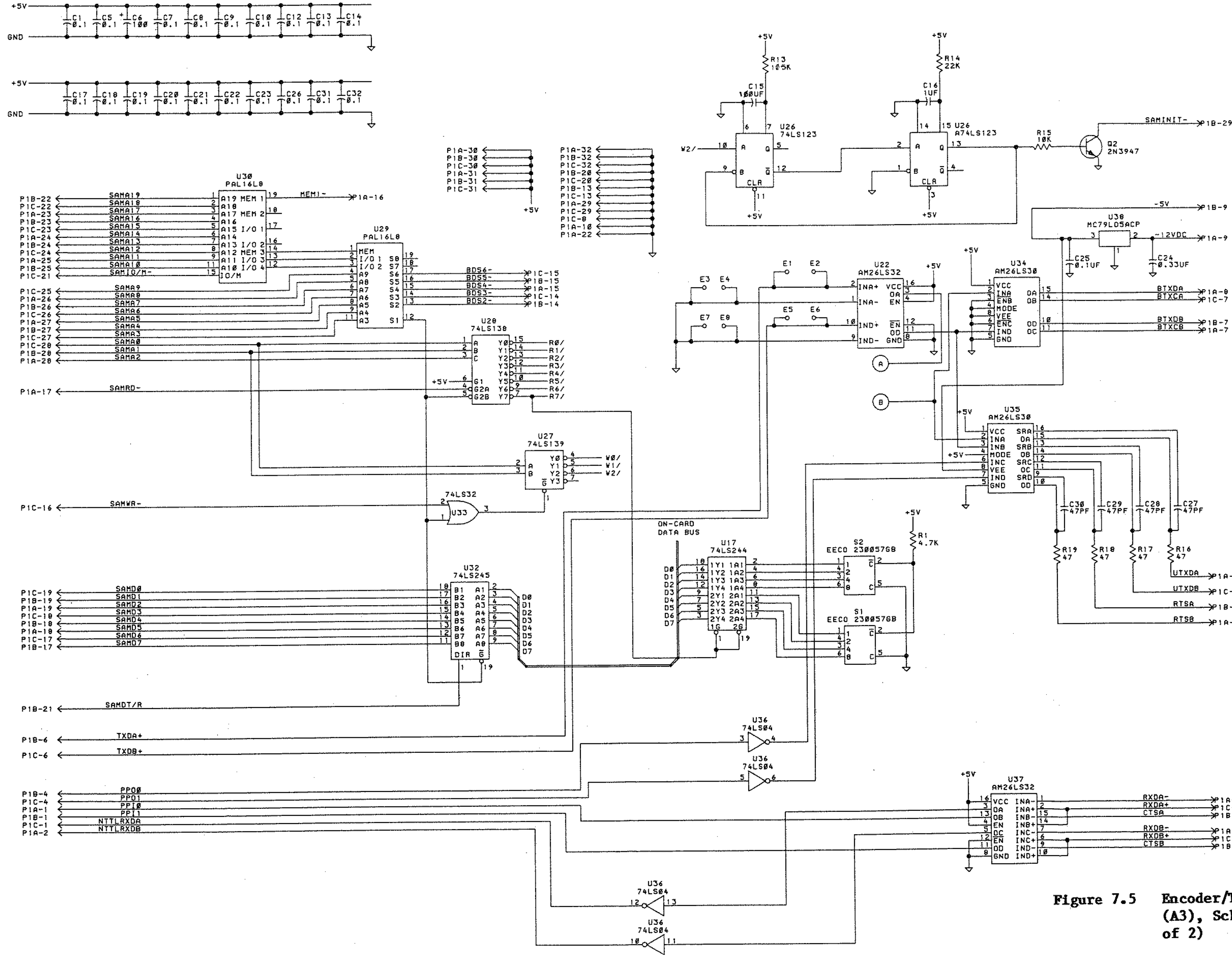


Figure 7.5 **Encoder/Timing Assembly (A3), Schematic (Sheet 2 of 2)**

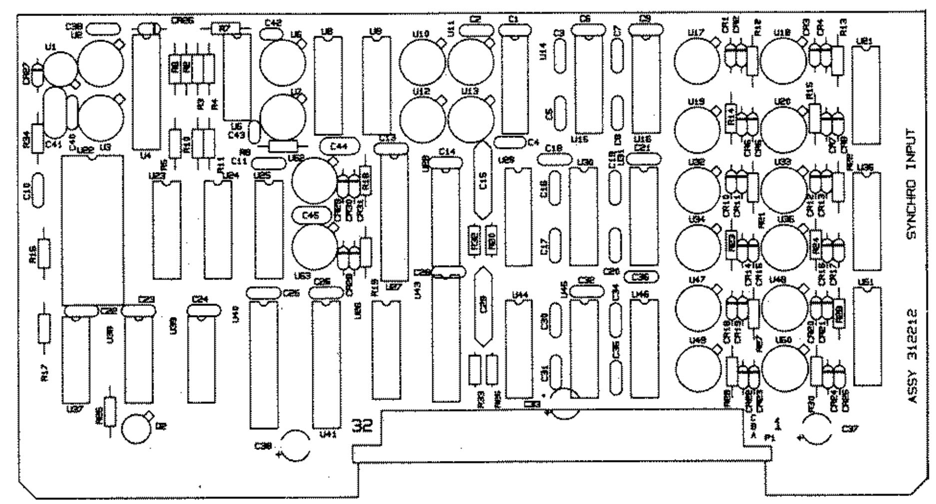


Figure 7.6 Sync Input Assembly (A4), Component Location

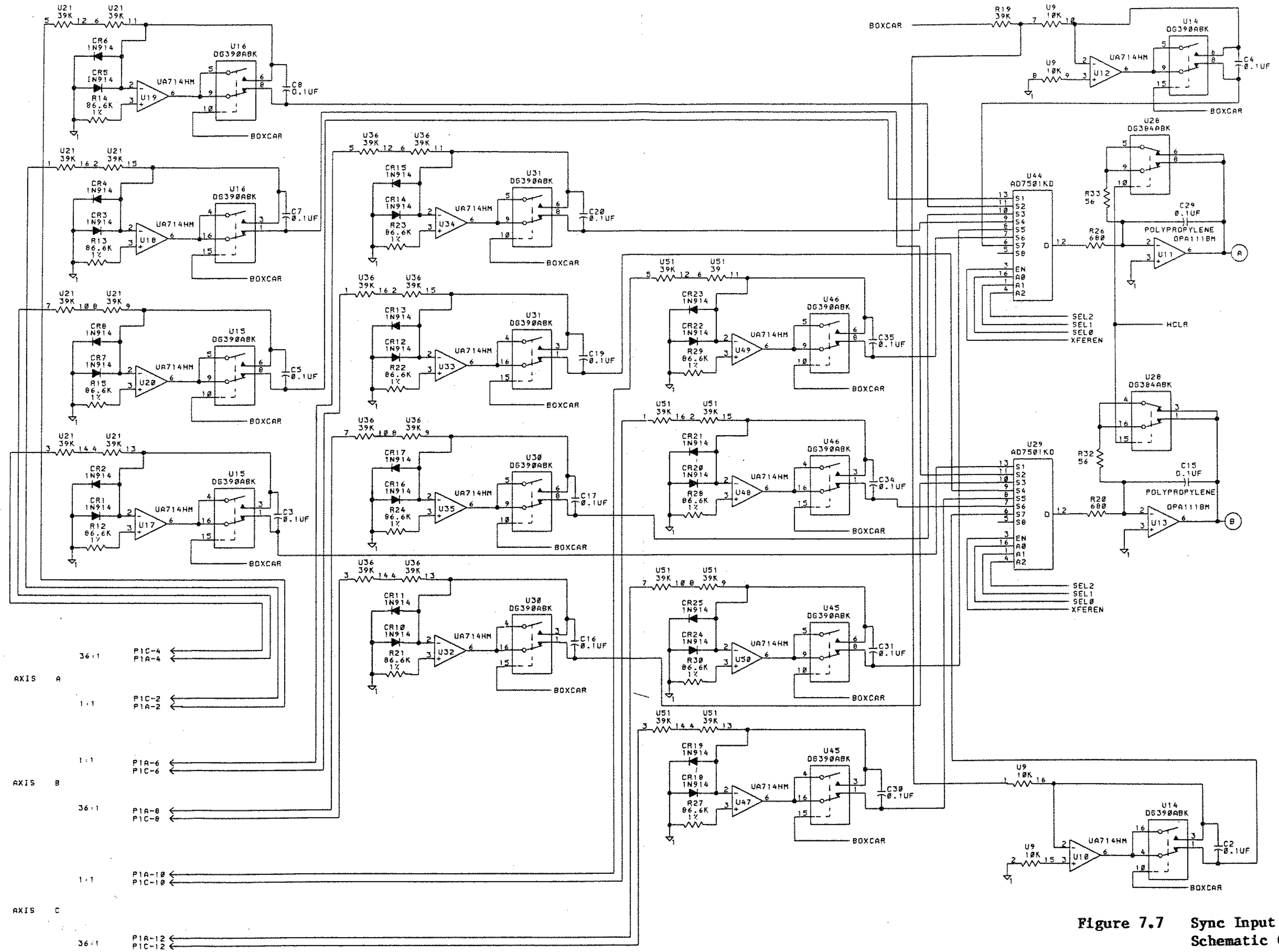
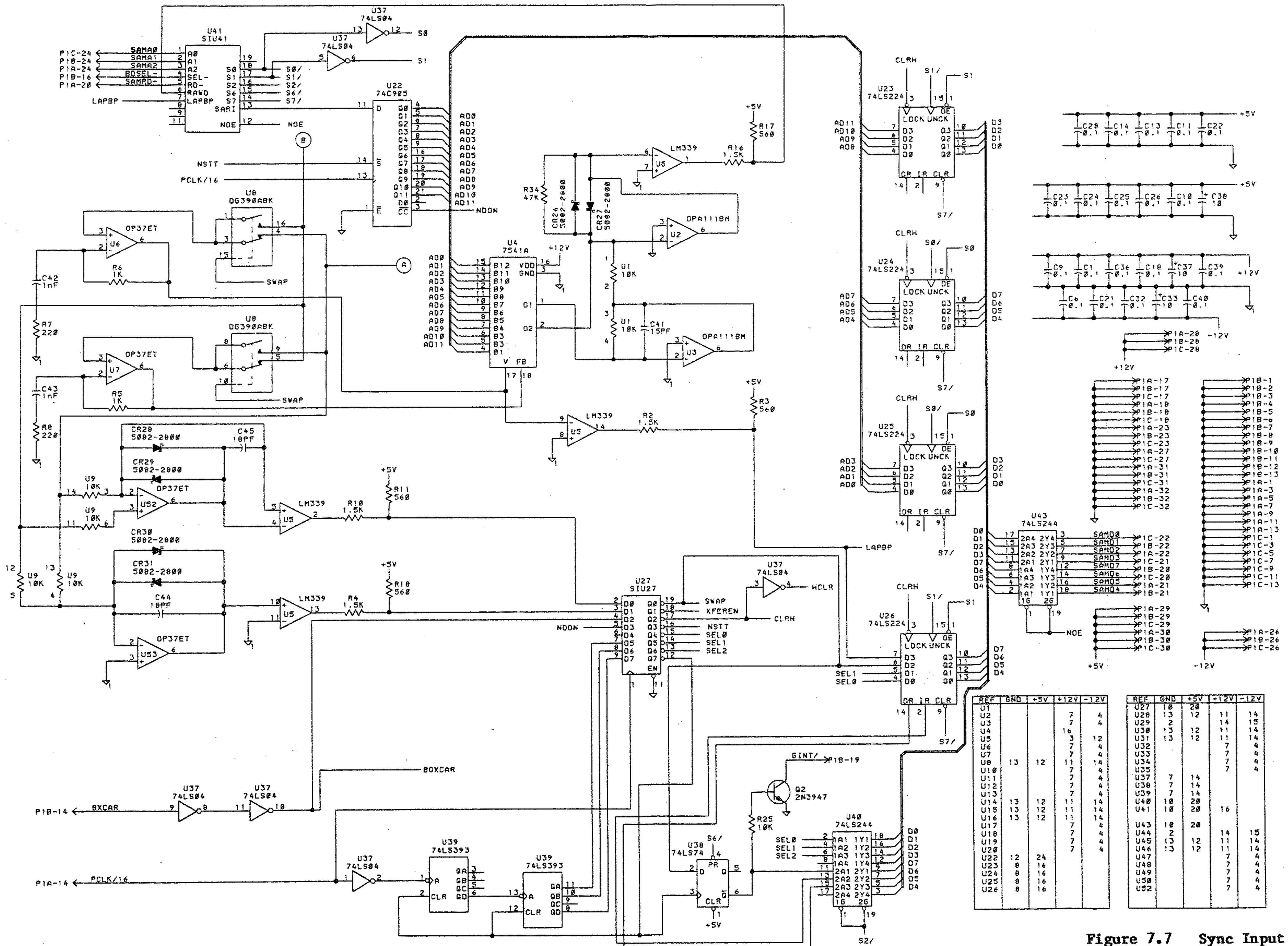


Figure 7.7 Sync Input Assembly (A4), Schematic (Sheet 1 of 2)



REF	GND	+5V	+12V	-12V
U1				
U2			7	4
U3			7	4
U4			16	
U5			3	12
U6			7	4
U7			7	4
U8	13	12	11	14
U10			7	4
U11			7	4
U12			7	4
U13			7	4
U14	13	12	11	14
U15	13	12	11	14
U16	13	12	11	14
U17			7	4
U18			7	4
U19			7	4
U20			7	4
U22	12	24		
U23	8	16		
U24	8	16		
U25	8	16		
U26	8	16		

REF	GND	+5V	+12V	-12V
U27	10	20		
U28	13	12	11	14
U29	2		14	15
U30	13	12	11	14
U31	13	12	11	14
U32			7	4
U33			7	4
U34			7	4
U35			7	4
U37	7	14		
U38	7	14		
U39	7	14		
U40	10	20		
U41	10	20	16	
U43	10	20		
U44	2		14	15
U45	13	12	11	14
U46	13	12	11	14
U47			7	4
U48			7	4
U49			7	4
U50			7	4
U52			7	4

Figure 7.7 Sync Input Assembly (A4), Schematic (Sheet 2 of 2)

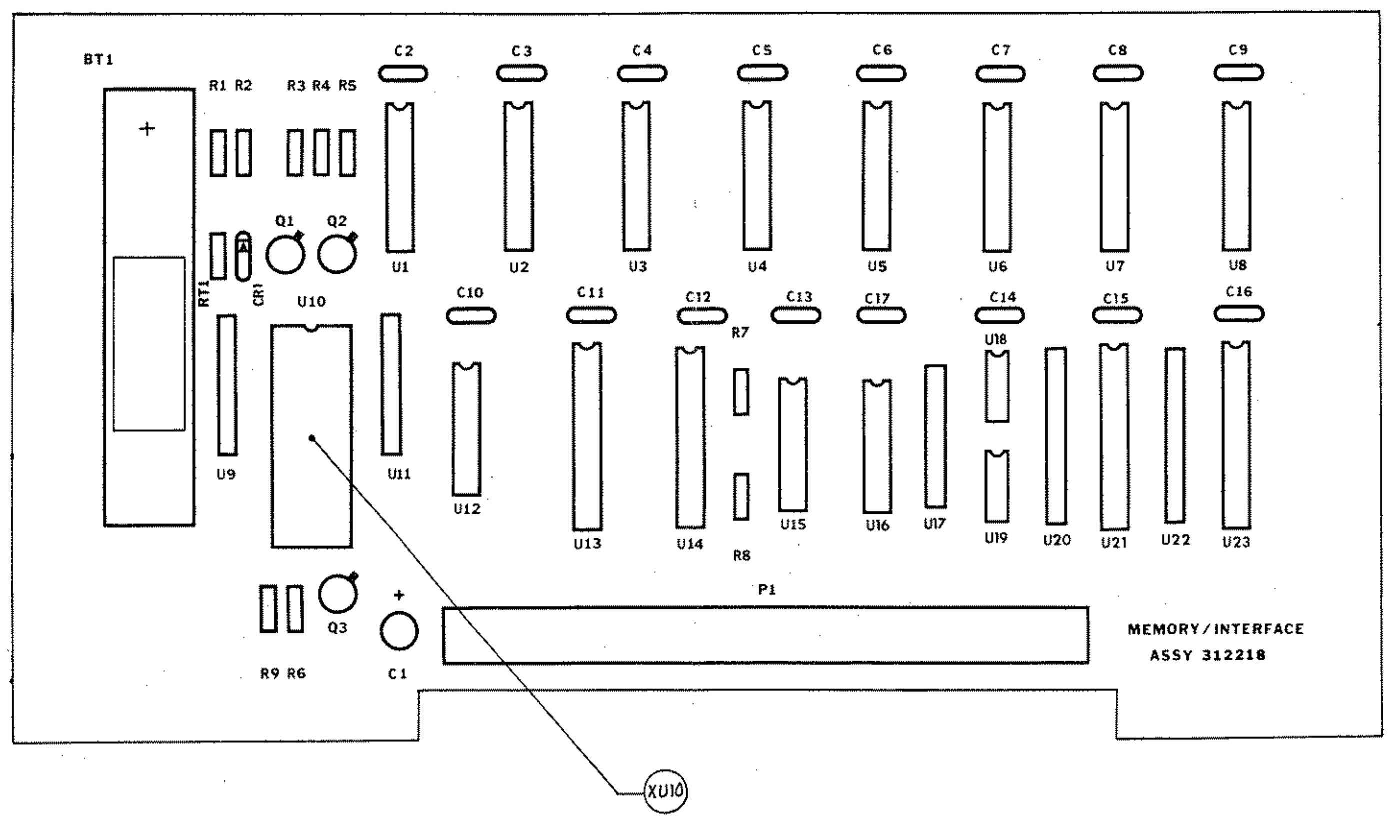
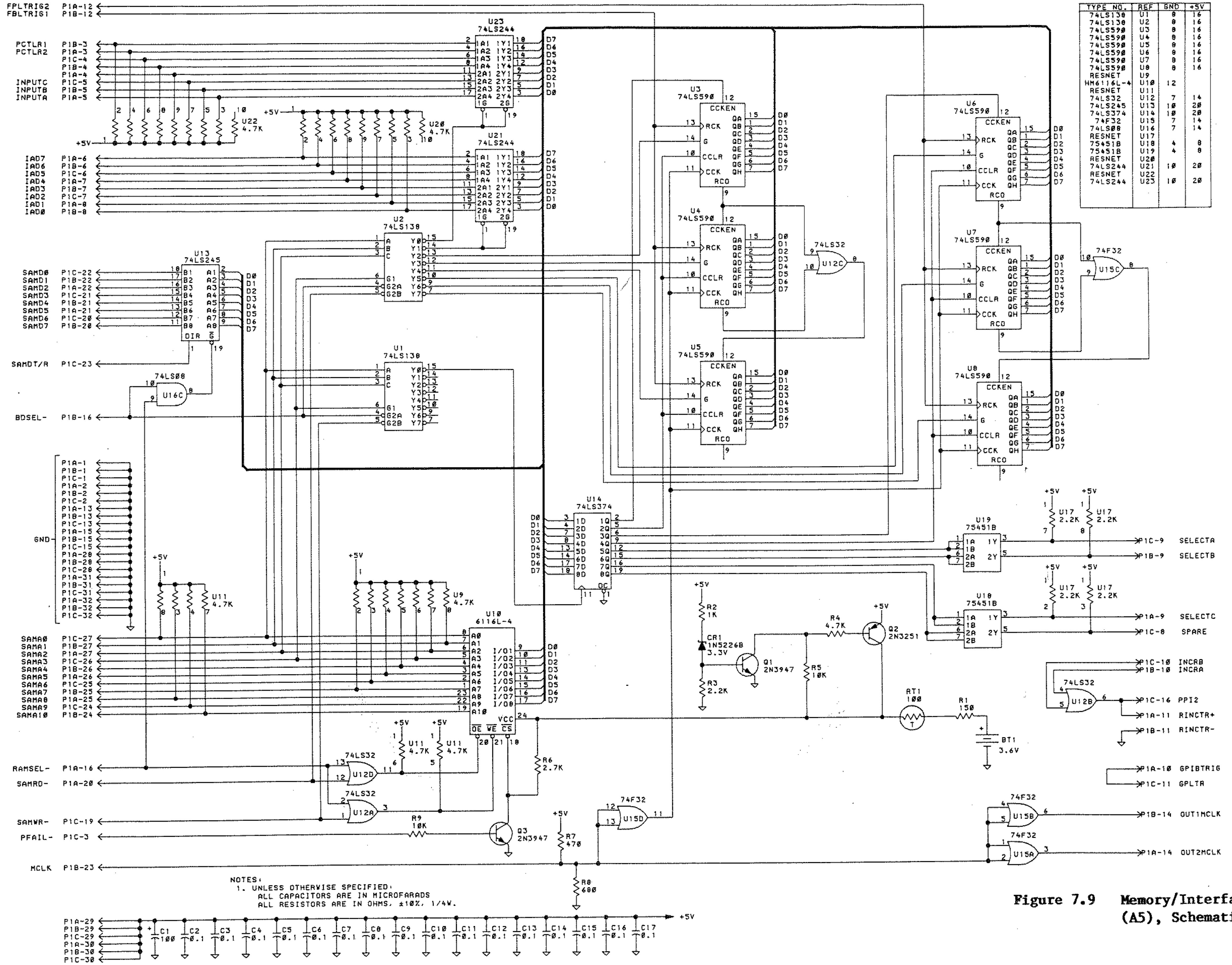


Figure 7.8 Memory/Interface Assembly (A5), Component Location



TYPE NO.	REF	GND	+5V
74LS138	U1	8	16
74LS138	U2	8	16
74LS590	U3	8	16
74LS590	U4	8	16
74LS590	U5	8	16
74LS590	U6	8	16
74LS590	U7	8	16
74LS590	U8	8	16
RESNET	U9		
HM6116L-4	U10	12	
RESNET	U11		
74LS32	U12	7	14
74LS245	U13	10	20
74LS374	U14	10	20
74F32	U15	7	14
74LS08	U16	7	14
RESNET	U17		
75451B	U18	4	8
75451B	U19	4	8
RESNET	U20		
74LS244	U21	10	20
RESNET	U22		
74LS244	U23	10	20

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

Figure 7.9 Memory/Interface Assembly (A5), Schematic

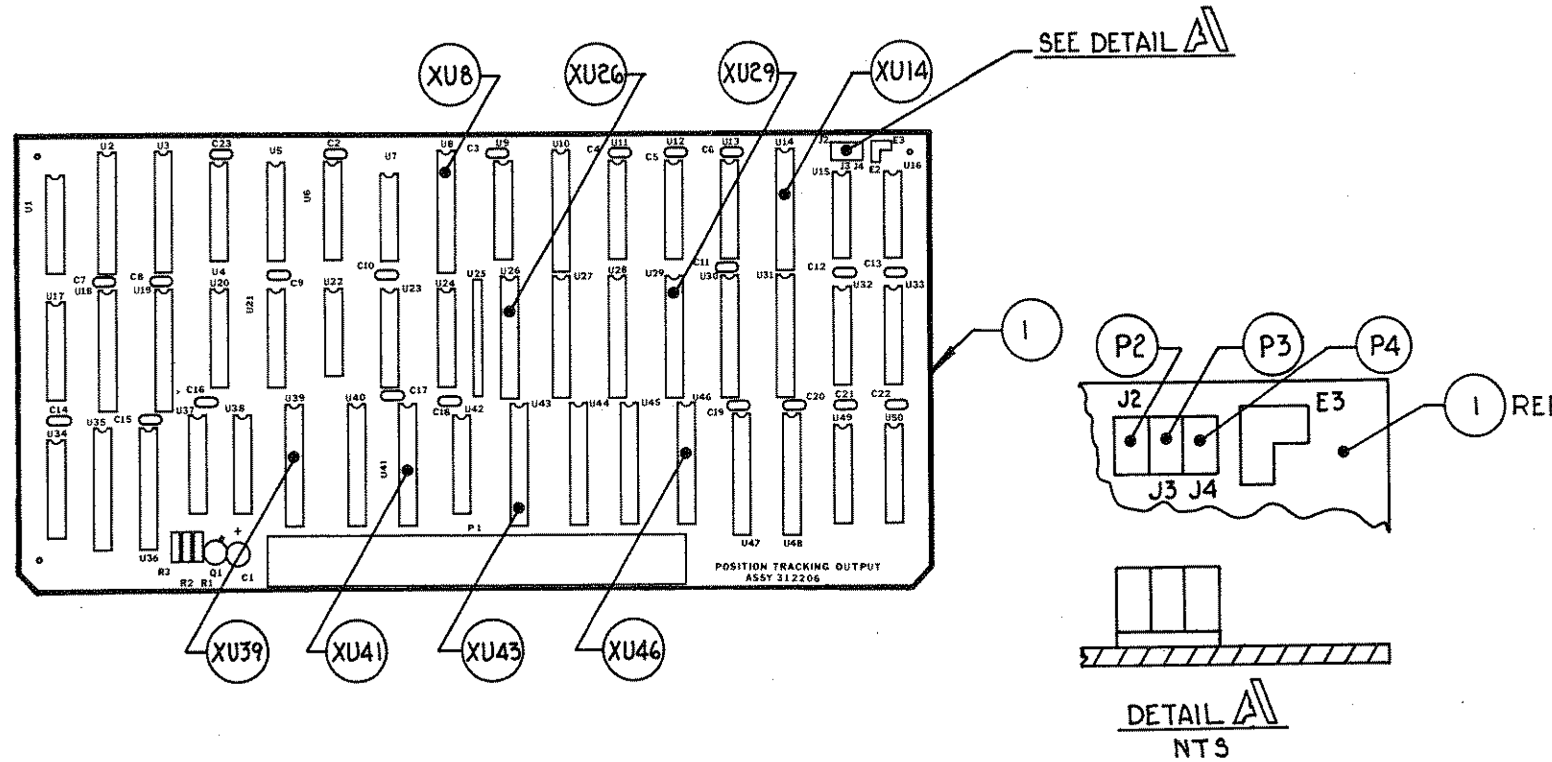
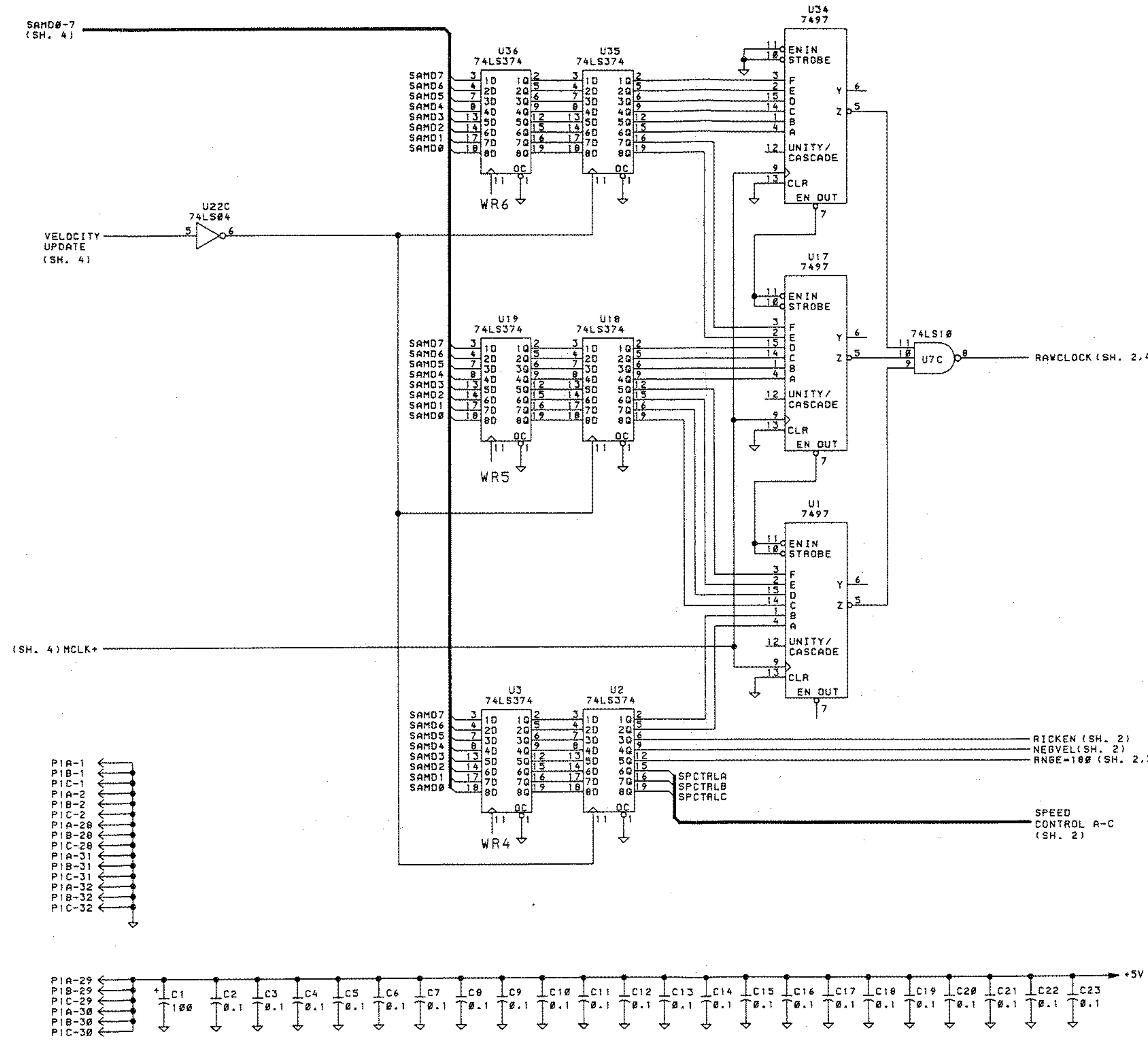


Figure 7.10 Position Tracking/Output Assembly (A6, A7), Component Location



TYPE NO.	REF	GND	+5V
7497	U1	8	16
74LS374	U2	1Ø	2Ø
74LS374	U3	1Ø	2Ø
74LS191	U4	8	16
74376	U5	8	16
74LS279	U6	8	16
74LS1Ø	U7	7	14
PAL16L8	U8	1Ø	2Ø
74F19Ø	U9	8	16
74LS374	U1Ø	1Ø	2Ø
74F19Ø	U11	8	16
74F19Ø	U12	8	16
74F19Ø	U13	8	16
PAL16L8	U14	1Ø	2Ø
74LS32	U15	7	14
74LS113A	U16	7	14
7497	U17	8	16
74LS374	U18	1Ø	2Ø
74LS374	U19	1Ø	2Ø
74LS592	U2Ø	8	16
74LS592	U21	8	16
74LSØ4	U22	7	14
74LS592	U23	8	16
74LS592	U24	8	16
RESNET	U25		

TYPE NO.	REF	GND	+5V
74LS374	U26	1Ø	2Ø
74LS374	U27	1Ø	2Ø
74LS374	U28	1Ø	2Ø
74LS374	U29	1Ø	2Ø
74LS374	U3Ø	1Ø	2Ø
74LS374	U31	1Ø	2Ø
74F19Ø	U32	8	16
74F19Ø	U33	8	16
7497	U34	8	16
74LS374	U35	1Ø	2Ø
74LS374	U36	1Ø	2Ø
74LS138	U37	8	16
74LS138	U38	8	16
PAL16L8	U39	1Ø	2Ø
74LS374	U4Ø	1Ø	2Ø
74LS245	U41	1Ø	2Ø
74LS151	U42	8	16
74LS374	U43	1Ø	2Ø
74LS374	U44	1Ø	2Ø
74LS374	U45	1Ø	2Ø
74LS374	U46	1Ø	2Ø
74LS374	U47	1Ø	2Ø
74LS374	U48	1Ø	2Ø
74F19Ø	U49	8	16
74F19Ø	U5Ø	8	16

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±1Ø%, 1/4W.

2 COMPONENTS NOT INSTALLED.

Figure 7.11 Position Tracking/Output Assembly (A6, A7), Schematic (Sheet 1 of 4)

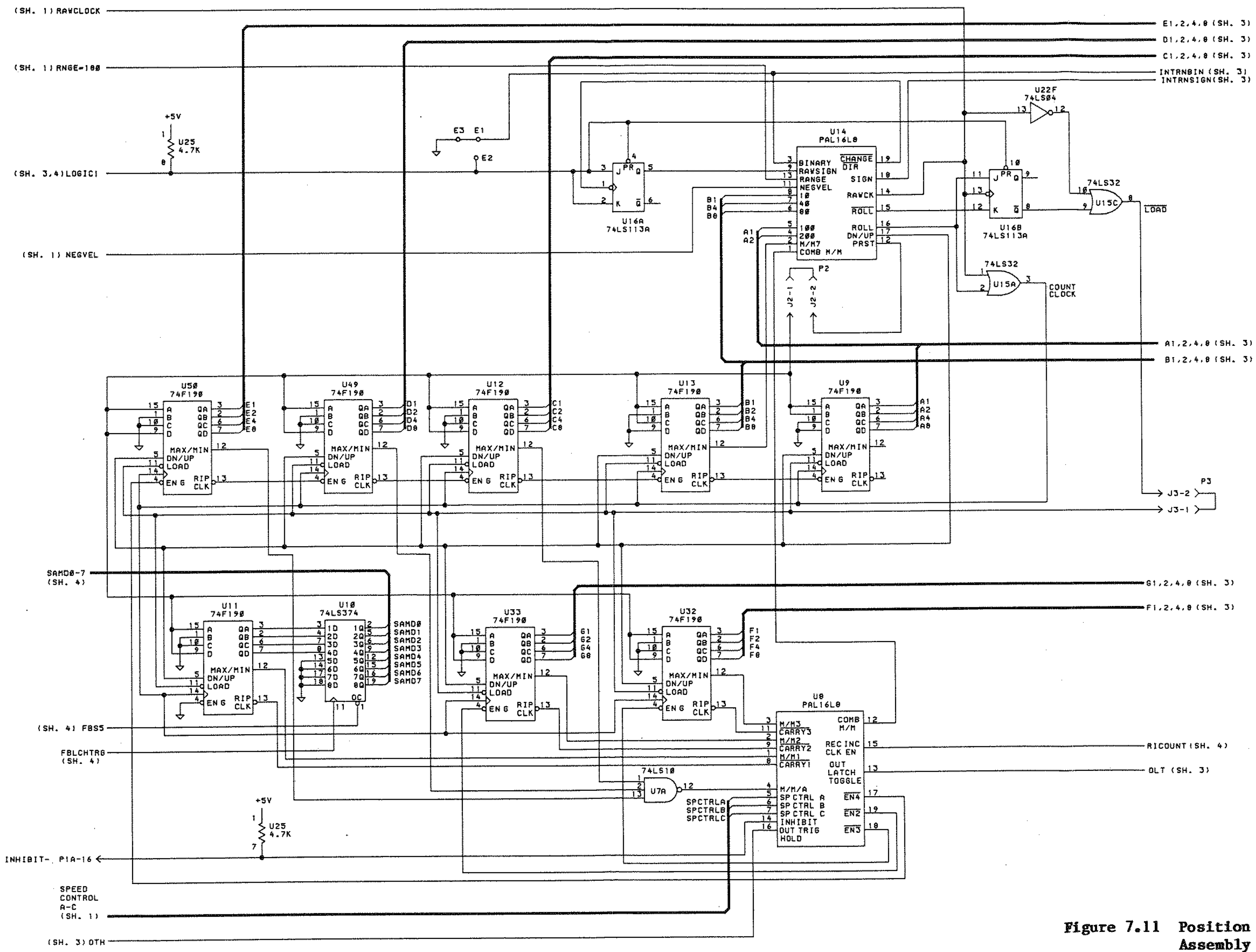


Figure 7.11 Position Tracking/Output Assembly (A6, A7) Schematic (Sheet 2 of 4)

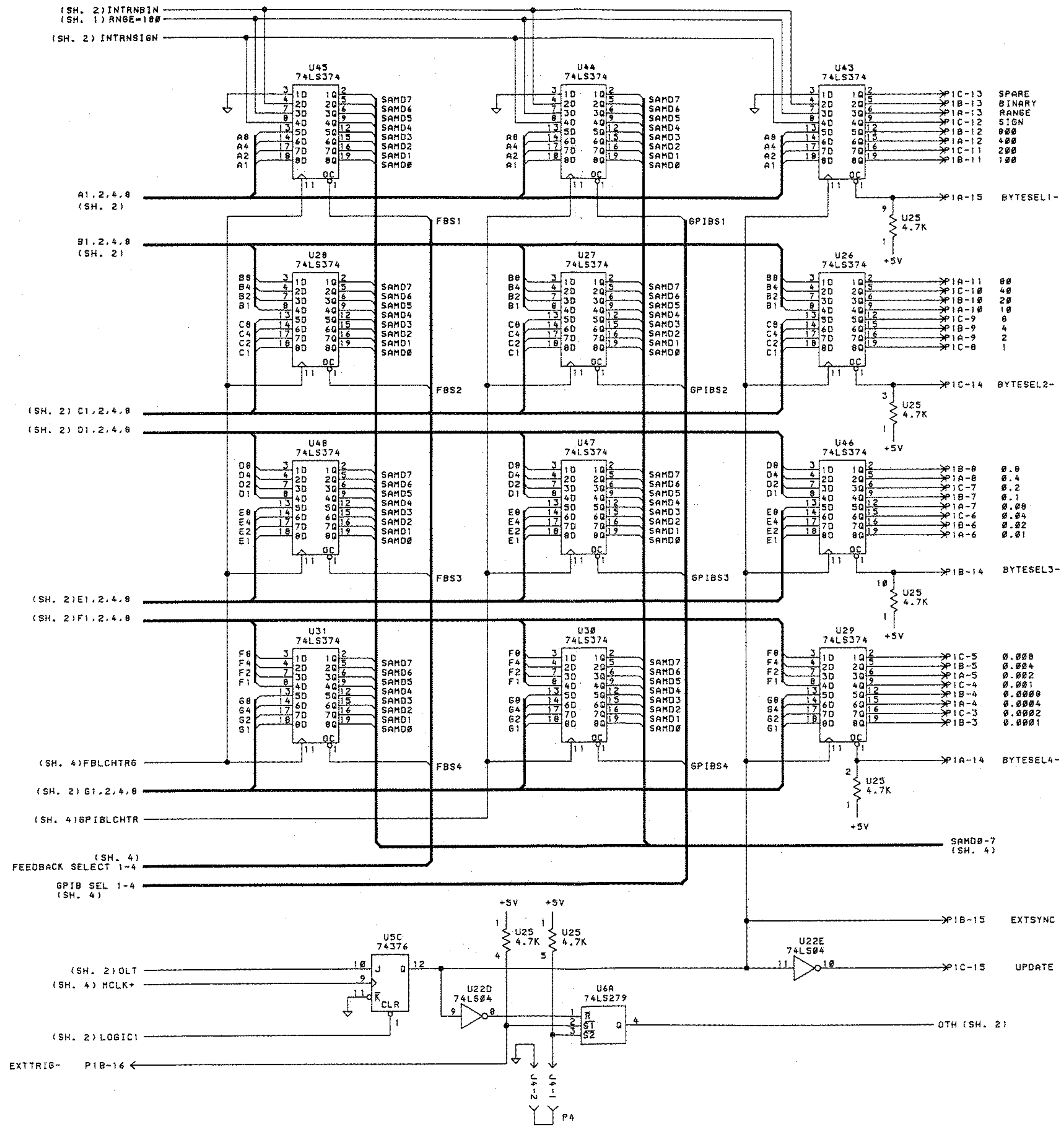


Figure 7.11 Position Tracking/Output Assembly (A6, A7) Schematic (Sheet 3 of 4)

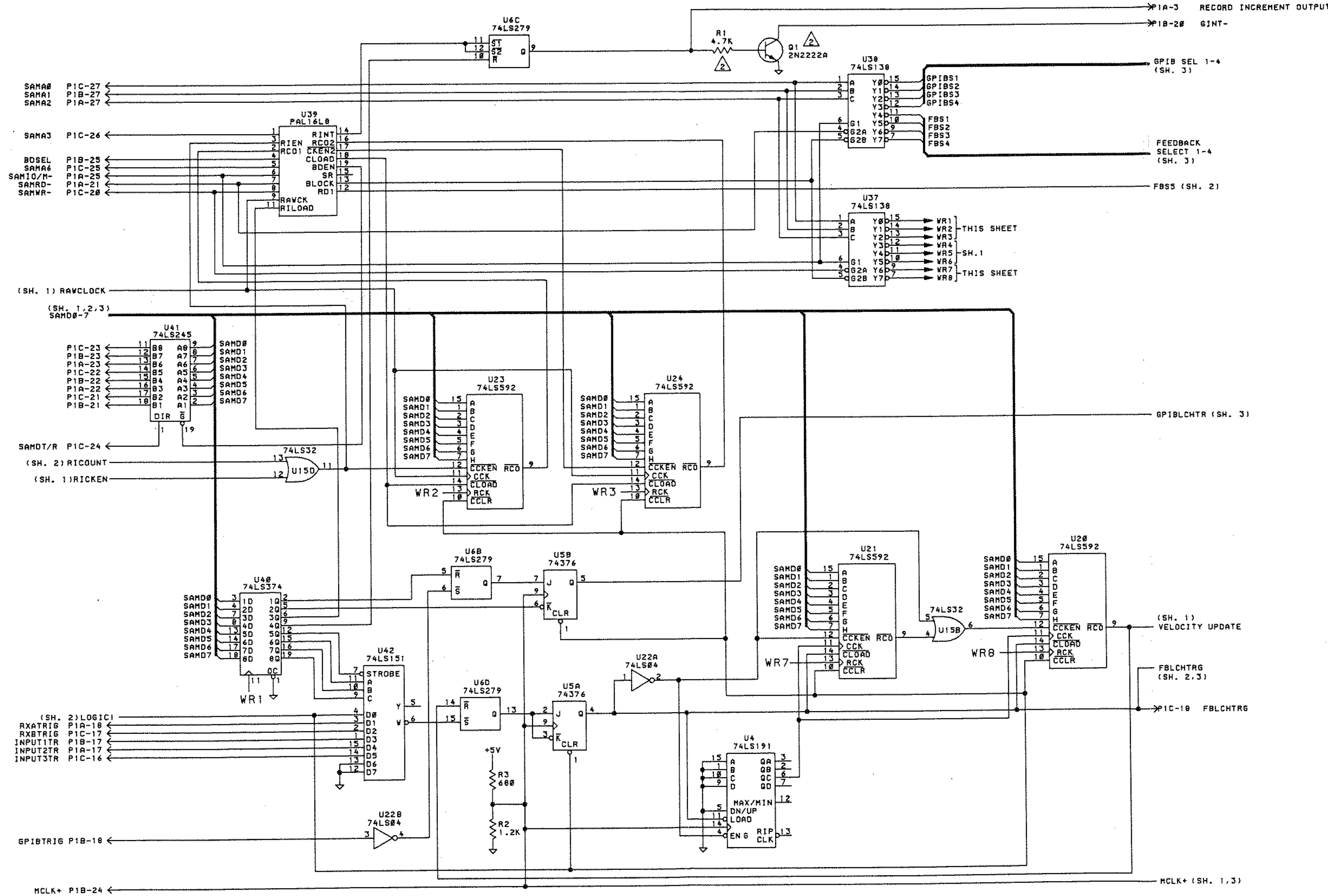


Figure 7.11 Position Tracking/Output Assembly (A6, A7) Schematic (Sheet 4 of 4)

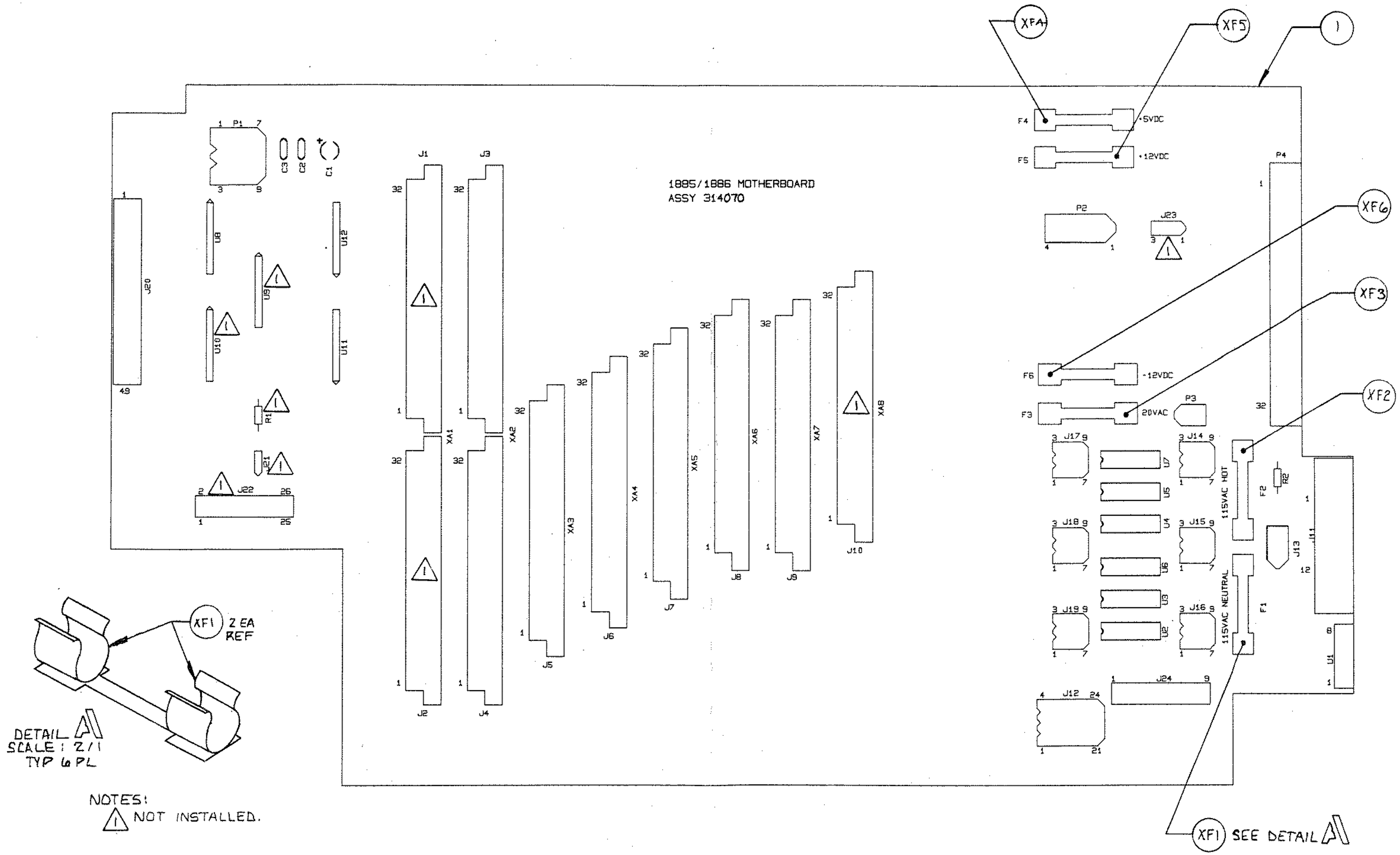


Figure 7.12 Motherboard Assembly (A9), Component Location

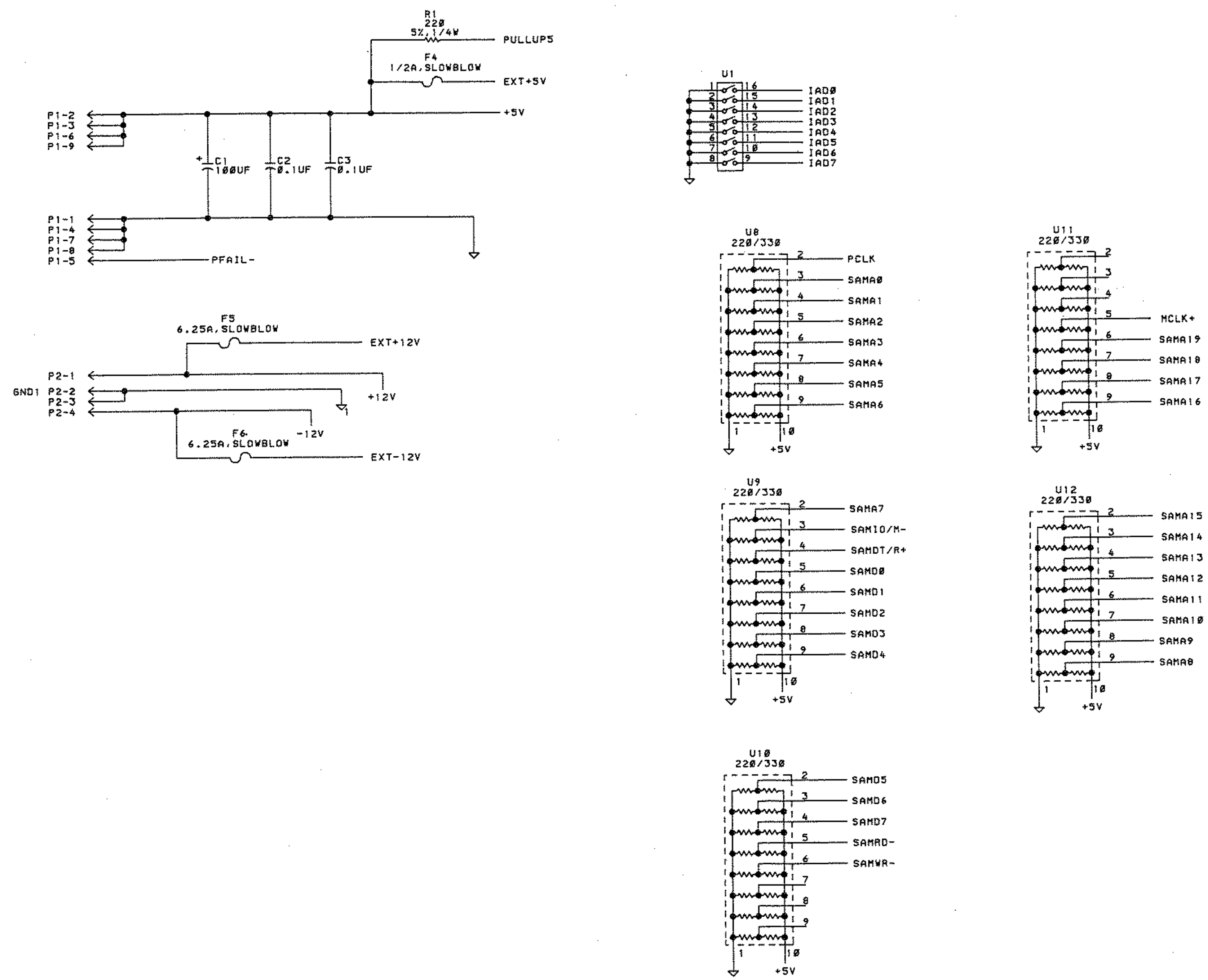
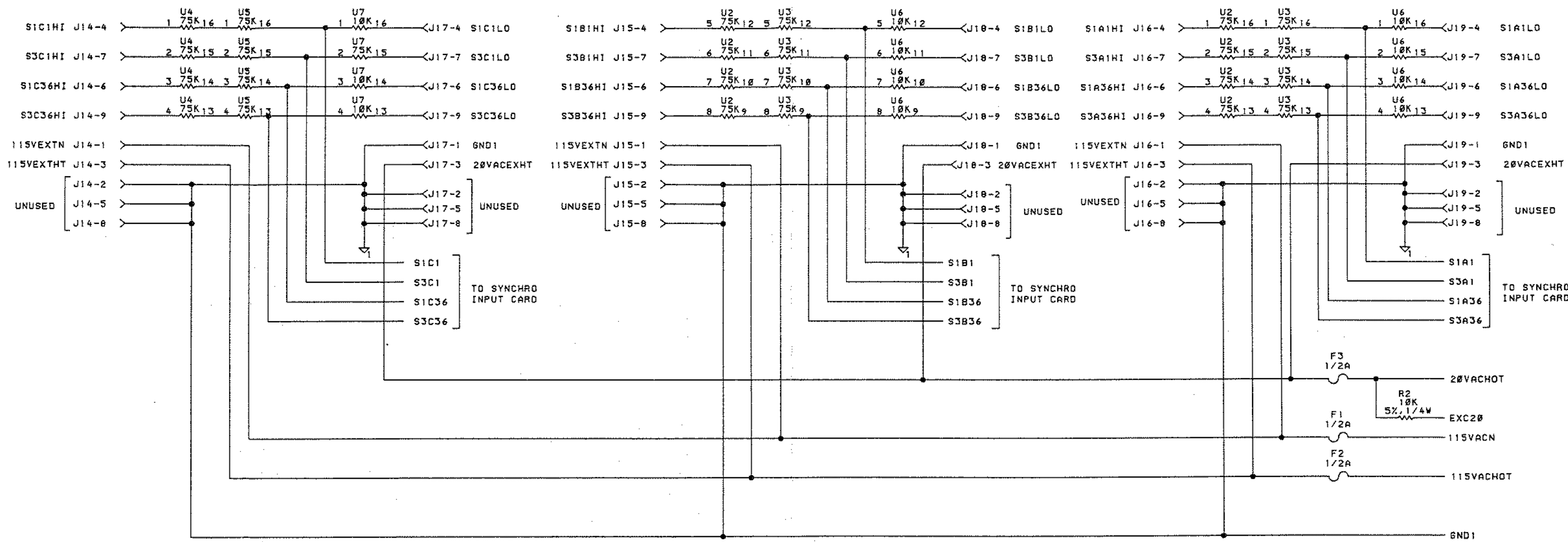


Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 1 of 15)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

2. THIS IS NOT A COMPLETE SCHEMATIC OF THE MOTHERBOARD. FOR ADDITIONAL INTERCONNECT INFORMATION, REFER TO THE NETLIST.

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 2 of 15)

C1 - C3 (CAPACITORS)

Component/Pin	Signal Name
C1-1	+5V
C1-2	GND
C2-1	+5V
C2-2	GND
C3-1	+5V
C3-2	GND

F1 - F6 (FUSES)

Component/Pin	Signal Name
F1-1	115VACN
F1-2	115VEXTN
F2-1	115VACHOT
F2-2	115VEXTHOT
F3-1	20VACHOT
F3-2	20VACEXTHOT
F4-1	+5V
F4-2	EXT+5VDC
F5-1	+12VDC
F5-2	EXT+12VDC
F6-1	-12VDC
F6-2	EXT-12VDC

J11 - (GPIB)

Connector/Pin	Signal Name
J11-1	GPIBD0
J11-2	GPIBD1
J11-3	GPIBD2
J11-4	GPIBD3
J11-5	GPIBEOI
J11-6	GPIBDAV
J11-7	GPIBNRFD
J11-8	GPIBNDAC
J11-9	GPIBIFC
J11-10	GPIBSRQ
J11-11	GPIBATN
J11-12	GND
J11-13	GPIBD4
J11-14	GPIBD5
J11-15	GPIBD6
J11-16	GPIBD7
J11-17	GPIBREN
J11-18	GND
J11-19	GND
J11-20	GND

J11 (GPIB) - continued

Connector/Pin	Signal Name
J11-21	GND
J11-22	GND
J11-23	GND
J11-24	GND
J11-25	(N.C.)
J11-26	(N.C.)

J12 (SERIAL LINK)

Connector/Pin	Signal Name
J12-1	ICK+
J12-2	SDA+
J12-3	(N.C.)
J12-4	EXT+12VDC
J12-5	ICK-
J12-6	SDA-
J12-7	(N.C.)
J12-8	EXT-12VDC
J12-9	ICK+
J12-10	SDB+
J12-11	(N.C.)
J12-12	EXT+12VDC
J12-13	ICK-
J12-14	SDB-
J12-15	(N.C.)
J12-16	EXT-12VDC
J12-17	ICK+
J12-18	SDC+
J12-19	(N.C.)
J12-20	EXT+12VDC
J12-21	ICK-
J12-22	SDC-
J12-23	(N.C.)
J12-24-6	EXT-12VDC

J13 (SYNC. EXCITATION)

Connector/Pin	Signal Name
J13-1	115VACN
J13-2	115VACHOT

J14 (SYNC. INPUT)

Connector/Pin	Signal Name
J14-1	115VEXTN
J14-2	GNDA
J14-3	115VEXTHOT
J14-4	S1C1HI
J14-5	GNDA
J14-6	S1C36HI
J14-7	S3C1HI
J14-8	GNDA
J14-9	S3C36HI

J15 (SYNC. SELECT)

Connector/Pin	Signal Name
J15-1	115VEXTN
J15-2	GNDA
J15-3	115VEXTHOT
J15-4	S1B1HI
J15-5	GNDA
J15-6	S1B36HI
J15-7	S3B1HI
J15-8	GNDA
J15-9	S3B36HI

J16 (SYNC. SELECT)

Connector/Pin	Signal Name
J16-1	115VEXTN
J16-2	GNDA
J16-3	115VEXTHOT
J16-4	S1A1HI
J16-5	GNDA
J16-6	S1A36HI
J16-7	S3A1HI
J16-8	GNDA
J16-9	S3A36HI

J17 (SYNC. SELECT)

Connector/Pin	Signal Name
J17-1	GNDA
J17-2	GNDA
J17-3	20VACEXTHOT
J17-4	S1C1LO

J17 (SYNC. SELECT) - continued

Connector/Pin	Signal Name
J17-5	GNDA
J17-6	S1C36LO
J17-7	S3C1LO
J17-8	GNDA
J17-9	S3C36LO

J18 (SYNC. SELECT)

Connector/Pin	Signal Name
J18-1	GNDA
J18-2	GNDA
J18-3	20VACEXTHOT
J18-4	S1B1LO
J18-5	GNDA
J18-6	S1B36LO
J18-7	S3B1LO
J18-8	GNDA
J18-9	S3B36LO

J19 (SYNC. SELECT)

Connector/Pin	Signal Name
J19-1	GNDA
J19-2	GNDA
J19-3	20VACEXTHOT
J19-4	S1A1LO
J19-5	GNDA
J19-6	S1A36LO
J19-7	S3A1LO
J19-8	GNDA
J19-9	S3A36LO

J20 (FRONT PANEL INTERFACE)

Connector/Pin	Signal Name
J20-1	GND
J20-2	PCLK
J20-3	GND
J20-4	SAMA0
J20-5	GND
J20-6	SAMA1
J20-7	GND
J20-8	SAMA2
J20-9	GND

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 3 of 15)

J20 (FRONT PANEL INTERFACE) - continued

Connector/Pin	Signal Name
J20-10	SAMA3
J20-11	GND
J20-12	SAMA4
J20-13	GND
J20-14	SAMA5
J20-15	GND
J20-16	SAMA6
J20-17	GND
J20-18	SAMA7
J20-19	GND
J20-20	SAMIO/M-
J20-21	GND
J20-22	SAMD0
J20-23	GND
J20-24	SAMD1
J20-25	GND
J20-26	SAMD2
J20-27	GND
J20-28	SAMD3
J20-29	GND
J20-30	SAMD4
J20-31	GND
J20-32	SAMD5
J20-33	GND
J20-34	SAMD6
J20-35	GND
J20-36	SAMD7
J20-37	GND
J20-38	SAMRD-
J20-39	GND
J20-40	SAMWR-
J20-41	GND
J20-42	GINT
J20-43	+5V
J20-44	+5V
J20-45	+5V
J20-46	+5V
J20-47	+5V
J20-48	+5V
J20-49	+5V
J20-50	+5V

J21 (FRONT PANEL LEDs)

Connector/Pin	Signal Name
J21-1	PULLUP5
J21-2	GND
J21-3	PULLUP5

J22 (N.C.)

Connector/Pin	Signal Name
J22-1	(N.C.)
J22-2	AUXTXDB+
J22-3	AUXTXDA+
J22-4	AUXTXCTL2A+
J22-5	AUXRXDA-
J22-6	AUXRXDB-
J22-7	AUXTXCTL1A+
J22-8	AUXRXCTL2A-
J22-9	AUXRXCTL1A-
J22-10	(N.C.)
J22-11	(N.C.)
J22-12	(N.C.)
J22-13	GND
J22-14	(N.C.)
J22-15	(N.C.)
J22-16	(N.C.)
J22-17	(N.C.)
J22-18	(N.C.)
J22-19	(N.C.)
J22-20	(N.C.)
J22-21	(N.C.)
J22-22	(N.C.)
J22-23	(N.C.)
J22-24	(N.C.)
J22-25	(N.C.)
J22-26	(N.C.)

J23 (RECORD INCR. TRIGGER)

Connector/Pin	Signal Name
J23-1	RINCTR+
J23-2	RINCTR-
J23-3	(N.C.)

J24 (GND A)

Connector/Pin	Signal Name
J24-1	GNDA
J24-2	GNDA
J24-3	GNDA
J24-4	GNDA
J24-5	GNDA
J24-6	GNDA
J24-7	GNDA
J24-8	GNDA
J24-9	GNDA

XA1-1 (SPARE)

Connector/Pin	Signal Name
XA1(J1)-1A	GND
XA1(J1)-2A	GND
XA1(J1)-3A	(N.C.)
XA1(J1)-4A	(N.C.)
XA1(J1)-5A	(N.C.)
XA1(J1)-6A	SAMWE-
XA1(J1)-7A	SAMRD-
XA1(J1)-8A	(N.C.)
XA1(J1)-9A	(N.C.)
XA1(J1)-10A	(N.C.)
XA1(J1)-11A	SAMD5
XA1(J1)-12A	SAMD2
XA1(J1)-13A	FIFODRQ-
XA1(J1)-14A	SAMRDY+
XA1(J1)-15A	BUSY-
XA1(J1)-16A	SFIFOCOM-
XA1(J1)-17A	(N.C.)
XA1(J1)-18A	(N.C.)
XA1(J1)-19A	SAMA17
XA1(J1)-20A	SAMA14
XA1(J1)-21A	SAMA11
XA1(J1)-22A	SAMA8
XA1(J1)-23A	SAMA5
XA1(J1)-24A	SAMA2
XA1(J1)-25A	GND
XA1(J1)-26A	-12VDC
XA1(J1)-27A	-5VDC
XA1(J1)-28A	+12VD
XA1(J1)-29A	+5V
XA1(J1)-30A	+5V
XA1(J1)-31A	GND
XA1(J1)-32A	GND
XA1(J1)-1B	GND
XA1(J1)-2B	GND
XA1(J1)-3B	(N.C.)
XA1(J1)-4B	(N.C.)
XA1(J1)-5B	(N.C.)
XA1(J1)-6B	SAMDEN
XA1(J1)-7B	(N.C.)
XA1(J1)-8B	(N.C.)
XA1(J1)-9B	(N.C.)
XA1(J1)-10B	SAMD7
XA1(J1)-11B	SAMD4
XA1(J1)-12B	SAMD1
XA1(J1)-13B	BPRO-
XA1(J1)-14B	BUSGRNT-

XA1-1 (SPARE) - continued

Connector/Pin	Signal Name
XA1(J1)-15B	SAMINIT-
XA1(J1)-16B	SAMDT/R+
XA1(J1)-17B	(N.C.)
XA1(J1)-18B	SAMA19
XA1(J1)-19B	SAMA16
XA1(J1)-20B	SAMA13
XA1(J1)-21B	SAMA10
XA1(J1)-22B	SAMA7
XA1(J1)-23B	SAMA4
XA1(J1)-24B	SAMA1
XA1(J1)-25B	GND
XA1(J1)-26B	-12VDC
XA1(J1)-27B	-5VDC
XA1(J1)-28B	+12VDC
XA1(J1)-29B	+5V
XA1(J1)-30B	+5V
XA1(J1)-31B	GND
XA1(J1)-32B	GND
XA1(J1)-1C	GND
XA1(J1)-2C	GND
XA1(J1)-3C	(N.C.)
XA1(J1)-4C	(N.C.)
XA1(J1)-5C	(N.C.)
XA1(J1)-6C	SAMWR-
XA1(J1)-7C	(N.C.)
XA1(J1)-8C	(N.C.)
XA1(J1)-9C	(N.C.)
XA1(J1)-10C	SAMD6
XA1(J1)-11C	SAMD3
XA1(J1)-12C	SAMD0
XA1(J1)-13C	BPRN-
XA1(J1)-14C	CBRQST-
XA1(J1)-15C	MCLK+
XA1(J1)-16C	SAMIO/M-
XA1(J1)-17C	(N.C.)
XA1(J1)-18C	SAMA18
XA1(J1)-19C	SAMA15
XA1(J1)-20C	SAMA12
XA1(J1)-21C	SAMA9
XA1(J1)-22C	SAMA6
XA1(J1)-23C	SAMA3
XA1(J1)-24C	SAMA0
XA1(J1)-25C	GND

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 4 of 15)

XA2(J3) (continued)

Connector/Pin	Signal Name
XA2(J3)-15C	MCLK+
XA2(J3)-16C	SAMIO/M-
XA2(J3)-17C	(N.C.)
XA2(J3)-18C	SAMA18
XA2(J3)-19C	SAMA15
XA2(J3)-20C	SAMA12
XA2(J3)-21C	SAMA9
XA2(J3)-22C	SAMA6
XA2(J3)-23C	SAMA3
XA2(J3)-24C	SAMA0
XA2(J3)-25C	GND
XA2(J3)-26C	-12VDC
XA2(J3)-27C	-5VDC
XA2(J3)-28C	+12VDC
XA2(J3)-29C	+5V
XA2(J3)-30C	+5V
XA2(J3)-31C	GND
XA2(J3)-32C	GND

XA2(J4)

Connector/Pin	Signal Name
XA2(J4)-1A	GND
XA2(J4)-2A	(N.C.)
XA2(J4)-3A	PFAIL-
XA2(J4)-4A	PPI0
XA2(J4)-5A	(N.C.)
XA2(J4)-6A	(N.C.)
XA2(J4)-7A	(N.C.)
XA2(J4)-8A	TXDB+
XA2(J4)-9A	TXDA+
XA2(J4)-10A	(N.C.)
XA2(J4)-11A	(N.C.)
XA2(J4)-12A	PPO1
XA2(J4)-13A	(N.C.)
XA2(J4)-14A	(N.C.)
XA2(J4)-15A	(N.C.)
XA2(J4)-16A	(N.C.)
XA2(J4)-17A	(N.C.)
XA2(J4)-18A	(N.C.)
XA2(J4)-19A	(N.C.)
XA2(J4)-20A	(N.C.)
XA2(J4)-21A	(N.C.)
XA2(J4)-22A	(N.C.)
XA2(J4)-23A	(N.C.)
XA2(J4)-24A	(N.C.)
XA2(J4)-25A	(N.C.)
XA2(J4)-26A	(N.C.)

XA2(J4) (continued)

Connector/Pin	Signal Name
XA2(J4)-27A	(N.C.)
XA2(J4)-28A	(N.C.)
XA2(J4)-29A	(N.C.)
XA2(J4)-30A	(N.C.)
XA2(J4)-31A	(N.C.)
XA2(J4)-32A	GND
XA2(J4)-1B	GND
XA2(J4)-2B	(N.C.)
XA2(J4)-3B	PPI2
XA2(J4)-4B	RXDB-
XA2(J4)-5B	RXDB+
XA2(J4)-6B	RXDA-
XA2(J4)-7B	RXDA+
XA2(J4)-8B	(N.C.)
XA2(J4)-9B	(N.C.)
XA2(J4)-10B	(N.C.)
XA2(J4)-11B	PPO2
XA2(J4)-12B	PPO0
XA2(J4)-13B	(N.C.)
XA2(J4)-14B	(N.C.)
XA2(J4)-15B	(N.C.)
XA2(J4)-16B	(N.C.)
XA2(J4)-17B	(N.C.)
XA2(J4)-18B	(N.C.)
XA2(J4)-19B	(N.C.)
XA2(J4)-20B	(N.C.)
XA2(J4)-21B	(N.C.)
XA2(J4)-22B	(N.C.)
XA2(J4)-23B	(N.C.)
XA2(J4)-24B	(N.C.)
XA2(J4)-25B	(N.C.)
XA2(J4)-26B	(N.C.)
XA2(J4)-27B	(N.C.)
XA2(J4)-28B	(N.C.)
XA2(J4)-29B	(N.C.)
XA2(J4)-30B	(N.C.)
XA2(J4)-31B	PCLK
XA2(J4)-32B	GND
XA2(J4)-1C	GND
XA2(J4)-2C	(N.C.)
XA2(J4)-3C	PPI1
XA2(J4)-4C	(N.C.)
XA2(J4)-5C	(N.C.)
XA2(J4)-6C	(N.C.)
XA2(J4)-7C	(N.C.)
XA2(J4)-8C	(N.C.)
XA2(J4)-9C	GPIBTRIG
XA2(J4)-10C	(N.C.)

XA2(J4) - continued

Connector/Pin	Signal Name
XA2(J4)-11C	(N.C.)
XA2(J4)-12C	GPIBSRQ
XA2(J4)-13C	GPIBATN
XA2(J4)-14C	GPIBEOI
XA2(J4)-15C	GPIBDAV
XA2(J4)-16C	GPIBNRFD
XA2(J4)-17C	GPIBNDAC
XA2(J4)-18C	GPIBIFC
XA2(J4)-19C	GPIBREN
XA2(J4)-20C	GPIBD7
XA2(J4)-21C	GPIBD6
XA2(J4)-22C	GPIBD5
XA2(J4)-23C	GPIBD4
XA2(J4)-24C	GPIBD3
XA2(J4)-25C	GPIBD2
XA2(J4)-26C	GPIBD1
XA2(J4)-27C	GPIBD0
XA2(J4)-28C	(N.C.)
XA2(J4)-29C	(N.C.)
XA2(J4)-30C	(N.C.)
XA2(J4)-31C	(N.C.)
XA2(J4)-32C	GND

XA3(J5)

Connector/Pin	Signal Name
XA3(J5)-1A	PPI0
XA3(J5)-2A	NTTLRXDB
XA3(J5)-3A	RXDB-
XA3(J5)-4A	RXDA-
XA3(J5)-5A	RTSB
XA3(J5)-6A	UTXDA
XA3(J5)-7A	BTXDB-
XA3(J5)-8A	BTXDA+
XA3(J5)-9A	-12VDC
XA3(J5)-10A	GND
XA3(J5)-11A	SDA+
XA3(J5)-12A	SDA-
XA3(J5)-13A	ICK+
XA3(J5)-14A	ICK-
XA3(J5)-15A	BDS4-
XA3(J5)-16A	MEM1-
XA3(J5)-17A	SAMRD-
XA3(J5)-18A	SAMD5
XA3(J5)-19A	SAMD2
XA3(J5)-20A	PCLK/16
XA3(J5)-21A	PCLK
XA3(J5)-22A	GND

XA3(J5) - continued

Connector/Pin	Signal Name
XA3(J5)-23A	SAMA17
XA3(J5)-24A	SAMA14
XA3(J5)-25A	SAMA11
XA3(J5)-26A	SAMA8
XA3(J5)-27A	SAMA5
XA3(J5)-28A	SAMA2
XA3(J5)-29A	GND
XA3(J5)-30A	+5V
XA3(J5)-31A	+5V
XA3(J5)-32A	GND
XA3(J5)-1B	PPI1
XA3(J5)-2B	CTSB
XA3(J5)-3B	CTSA
XA3(J5)-4B	PPO0
XA3(J5)-5B	RTSA
XA3(J5)-6B	TXDA+
XA3(J5)-7B	BTXDB+
XA3(J5)-8B	PPO2
XA3(J5)-9B	-5VDC
XA3(J5)-10B	EXC20
XA3(J5)-11B	SDB+
XA3(J5)-12B	SDB-
XA3(J5)-13B	GND
XA3(J5)-14B	BDS2-
XA3(J5)-15B	BDS5-
XA3(J5)-16B	GINT
XA3(J5)-17B	SAMD7
XA3(J5)-18B	SAMD4
XA3(J5)-19B	SAMD1
XA3(J5)-20B	GND
XA3(J5)-21B	SAMDT/R+
XA3(J5)-22B	SAMA19
XA3(J5)-23B	SAMA16
XA3(J5)-24B	SAMA13
XA3(J5)-25B	SAMA10
XA3(J5)-26B	SAMA7
XA3(J5)-27B	SAMA4
XA3(J5)-28B	SAMA1
XA3(J5)-29B	SAMINIT-
XA3(J5)-30B	+5V
XA3(J5)-31B	+5V
XA3(J5)-32B	GND
XA3(J5)-1C	NTTLRXDA
XA3(J5)-2C	RXDB+
XA3(J5)-3C	RXDA+
XA3(J5)-4C	PPO1
XA3(J5)-5C	UTXDB
XA3(J5)-6C	TXDB+

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 6 of 15)

XA3(J5) - continued

Connector/Pin	Signal Name
XA3(J5)-7C	BTXDA-
XA3(J5)-8C	GND
XA3(J5)-9C	BXCAR
XA3(J5)-10C	TEDGE
XA3(J5)-11C	SDC+
XA3(J5)-12C	SDC-
XA3(J5)-13C	GND
XA3(J5)-14C	BDS3-
XA3(J5)-15C	BDS6-
XA3(J5)-16C	SAMWR-
XA3(J5)-17C	SAMD6
XA3(J5)-18C	SAMD3
XA3(J5)-19C	SAMD0
XA3(J5)-20C	GND
XA3(J5)-21C	SAMIO/M-
XA3(J5)-22C	SAMA18
XA3(J5)-23C	SAMA15
XA3(J5)-24C	SAMA12
XA3(J5)-25C	SAMA9
XA3(J5)-26C	SAMA6
XA3(J5)-27C	SAMA3
XA3(J5)-28C	SAMA0
XA3(J5)-29C	GND
XA3(J5)-30C	+5V
XA3(J5)-31C	+5V
XA3(J5)-32C	GND

XA4(J6)

Connector/Pin	Signal Name
XA4(J6)-1A	GNDA
XA4(J6)-2A	S1A1
XA4(J6)-3A	GNDA
XA4(J6)-4A	S1A36
XA4(J6)-5A	GNDA
XA4(J6)-6A	S1B1
XA4(J6)-7A	GNDA
XA4(J6)-8A	S1B36
XA4(J6)-9A	GNDA
XA4(J6)-10A	S1C1
XA4(J6)-11A	GNDA
XA4(J6)-12A	S1C36
XA4(J6)-13A	GNDA
XA4(J6)-14A	PCLK/16
XA4(J6)-15A	(N.C.)
XA4(J6)-16A	(N.C.)
XA4(J6)-17A	GND
XA4(J6)-18A	GND

XA4(J6) - continued

Connector/Pin	Signal Name
XA4(J6)-19A	(N.C.)
XA4(J6)-20A	SAMRD-
XA4(J6)-21A	SAMD5
XA4(J6)-22A	SAMD2
XA4(J6)-23A	GND
XA4(J6)-24A	SAMA2
XA4(J6)-25A	GND
XA4(J6)-26A	-12VDC
XA4(J6)-27A	GND
XA4(J6)-28A	+12VDC
XA4(J6)-29A	+5V
XA4(J6)-30A	+5V
XA4(J6)-31A	GND
XA4(J6)-32A	GND
XA4(J6)-1B	GNDA
XA4(J6)-2B	GNDA
XA4(J6)-3B	GNDA
XA4(J6)-4B	GNDA
XA4(J6)-5B	GNDA
XA4(J6)-6B	GNDA
XA4(J6)-7B	GNDA
XA4(J6)-8B	GNDA
XA4(J6)-9B	GNDA
XA4(J6)-10B	GNDA
XA4(J6)-11B	GNDA
XA4(J6)-12B	GNDA
XA4(J6)-13B	GNDA
XA4(J6)-14B	BXCAR
XA4(J6)-15B	(N.C.)
XA4(J6)-16B	BDS2-
XA4(J6)-17B	GND
XA4(J6)-18B	GND
XA4(J6)-19B	GINT
XA4(J6)-20B	SAMD7
XA4(J6)-21B	SAMD4
XA4(J6)-22B	SAMD1
XA4(J6)-23B	GND
XA4(J6)-24B	SAMA1
XA4(J6)-25B	GND
XA4(J6)-26B	-12VDC
XA4(J6)-27B	-5VDC
XA4(J6)-28B	+12VDC
XA4(J6)-29B	+5V
XA4(J6)-30B	+5V
XA4(J6)-31B	GND
XA4(J6)-32B	GND
XA4(J6)-1C	GNDA
XA4(J6)-2C	S3A1

XA4(J6) - continued

Connector/Pin	Signal Name
XA4(J6)-3C	GNDA
XA4(J6)-4C	S3A36
XA4(J6)-5C	GNDA
XA4(J6)-6C	S3B1
XA4(J6)-7C	GNDA
XA4(J6)-8C	S3B36
XA4(J6)-9C	GNDA
XA4(J6)-10C	S3C1
XA4(J6)-11C	GNDA
XA4(J6)-12C	S3C36
XA4(J6)-13C	GNDA
XA4(J6)-14C	(N.C.)
XA4(J6)-15C	(N.C.)
XA4(J6)-16C	(N.C.)
XA4(J6)-17C	GND
XA4(J6)-18C	GND
XA4(J6)-19C	(N.C.)
XA4(J6)-20C	SAMD6
XA4(J6)-21C	SAMD3
XA4(J6)-22C	SAMD0
XA4(J6)-23C	GND
XA4(J6)-24C	SAMA0
XA4(J6)-25C	GND
XA4(J6)-26C	-12VDC
XA4(J6)-27C	GND
XA4(J6)-28C	+12VDC
XA4(J6)-29C	+5V
XA4(J6)-30C	+5V
XA4(J6)-31C	GND
XA4(J6)-32C	GND

XA5(J7)

Connector/Pin	Signal Name
XA5(J7)-1A	GND
XA5(J7)-2A	GND
XA5(J7)-3A	PCTLRA
XA5(J7)-4A	(N.C.)
XA5(J7)-5A	INPUT A
XA5(J7)-6A	IAD7
XA5(J7)-7A	IAD4
XA5(J7)-8A	IAD1
XA5(J7)-9A	SELECT C
XA5(J7)-10A	GPIBTRIG
XA5(J7)-11A	RINCTR+
XA5(J7)-12A	FBLTRA
XA5(J7)-13A	GND
XA5(J7)-14A	OUTAMCLK

XA5(J7) - continued

Connector/Pin	Signal Name
XA5(J7)-15A	GND
XA5(J7)-16A	MEM1-
XA5(J7)-17A	(N.C.)
XA5(J7)-18A	(N.C.)
XA5(J7)-19A	(N.C.)
XA5(J7)-20A	SAMRD-
XA5(J7)-21A	SAMD5
XA5(J7)-22A	SAMD2
XA5(J7)-23A	(N.C.)
XA5(J7)-24A	SAMIO/M-
XA5(J7)-25A	SAMA8
XA5(J7)-26A	SAMA5
XA5(J7)-27A	SAMA2
XA5(J7)-28A	GND
XA5(J7)-29A	+5V
XA5(J7)-30A	+5V
XA5(J7)-31A	GND
XA5(J7)-32A	GND
XA5(J7)-1B	GND
XA5(J7)-2B	GND
XA5(J7)-3B	PCTLRB
XA5(J7)-4B	(N.C.)
XA5(J7)-5B	INPUT B
XA5(J7)-6B	IAD6
XA5(J7)-7B	IAD3
XA5(J7)-8B	IAD0
XA5(J7)-9B	SELECT B
XA5(J7)-10B	INCRA
XA5(J7)-11B	RINCTR-
XA5(J7)-12B	FBLTRB
XA5(J7)-13B	GND
XA5(J7)-14B	OUTBMCLK
XA5(J7)-15B	GND
XA5(J7)-16B	BDS3-
XA5(J7)-17B	(N.C.)
XA5(J7)-18B	(N.C.)
XA5(J7)-19B	GINT
XA5(J7)-20B	SAMD7
XA5(J7)-21B	SAMD4
XA5(J7)-22B	SAMD1
XA5(J7)-23B	MCLK+
XA5(J7)-24B	SAMA10
XA5(J7)-25B	SAMA7
XA5(J7)-26B	SAMA4
XA5(J7)-27B	SAMA1
XA5(J7)-28B	GND
XA5(J7)-29B	+5V
XA5(J7)-30B	+5V

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 7 of 15)

XA5(J7) - continued

Connector/Pin	Signal Name
XA5(J7)-31B	GND
XA5(J7)-32B	GND
XA5(J7)-1C	GND
XA5(J7)-2C	GND
XA5(J7)-3C	PFAIL-
XA5(J7)-4C	(N.C.)
XA5(J7)-5C	INPUT C
XA5(J7)-6C	IAD5
XA5(J7)-7C	IAD2
XA5(J7)-8C	(N.C.)
XA5(J7)-9C	SELECT A
XA5(J7)-10C	INCRB
XA5(J7)-11C	GPLTR
XA5(J7)-12C	INCLDA
XA5(J7)-13C	GND
XA5(J7)-14C	INCLDB
XA5(J7)-15C	GND
XA5(J7)-16C	PPI2
XA5(J7)-17C	(N.C.)
XA5(J7)-18C	(N.C.)
XA5(J7)-19C	SAMWR-
XA5(J7)-20C	SAMD6
XA5(J7)-21C	SAMD3
XA5(J7)-22C	SAMD0
XA5(J7)-23C	SAMDT/R+
XA5(J7)-24C	SAMA9
XA5(J7)-25C	SAMA6
XA5(J7)-26C	SAMA3
XA5(J7)-27C	SAMA0
XA5(J7)-28C	GND
XA5(J7)-29C	+5V
XA5(J7)-30C	+5V
XA5(J7)-31C	GND
XA5(J7)-32C	GND

XA6(J8)

Connector/Pin	Signal Name
XA6(J8)-1A	GND
XA6(J8)-2A	GND
XA6(J8)-3A	INCRA
XA6(J8)-4A	A/0.0004
XA6(J8)-5A	A/0.002
XA6(J8)-6A	A/0.01
XA6(J8)-7A	A/0.08
XA6(J8)-8A	A/0.4
XA6(J8)-9A	A/2
XA6(J8)-10A	A/10

XA6(J8) - continued

Connector/Pin	Signal Name
XA6(J8)-11A	A/80
XA6(J8)-12A	(N.C.)
XA6(J8)-13A	A/RANGE
XA6(J8)-14A	A/BYTE4-
XA6(J8)-15A	A/BYTE1-
XA6(J8)-16A	A/INHIBIT-
XA6(J8)-17A	(N.C.)
XA6(J8)-18A	NTTLRXDA
XA6(J8)-19A	INCLDA
XA6(J8)-20A	(N.C.)
XA6(J8)-21A	SAMRD-
XA6(J8)-22A	SAMD5
XA6(J8)-23A	SAMD2
XA6(J8)-24A	(N.C.)
XA6(J8)-25A	SAMIO/M-
XA6(J8)-26A	SAMA5
XA6(J8)-27A	SAMA2
XA6(J8)-28A	GND
XA6(J8)-29A	+5V
XA6(J8)-30A	+5V
XA6(J8)-31A	GND
XA6(J8)-32A	GND
XA6(J8)-1B	GND
XA6(J8)-2B	GND
XA6(J8)-3B	A/0.0001
XA6(J8)-4B	A/0.0008
XA6(J8)-5B	A/0.004
XA6(J8)-6B	A/0.02
XA6(J8)-7B	A/0.1
XA6(J8)-8B	A/0.8
XA6(J8)-9B	A/4
XA6(J8)-10B	A/20
XA6(J8)-11B	A/100
XA6(J8)-12B	(N.C.)
XA6(J8)-13B	(N.C.)
XA6(J8)-14B	A/BYTE3-
XA6(J8)-15B	(N.C.)
XA6(J8)-16B	A/EXTTRIG-
XA6(J8)-17B	TEDGE
XA6(J8)-18B	GPLTR
XA6(J8)-19B	(N.C.)
XA6(J8)-20B	(N.C.)
XA6(J8)-21B	SAMD7
XA6(J8)-22B	SAMD4
XA6(J8)-23B	SAMD1
XA6(J8)-24B	OUTAMCLK
XA6(J8)-25B	BDS4-
XA6(J8)-26B	SAMA4

XA6(J8) - continued

Connector/Pin	Signal Name
XA6(J8)-27B	SAMA1
XA6(J8)-28B	GND
XA6(J8)-29B	+5V
XA6(J8)-30B	+5V
XA6(J8)-31B	GND
XA6(J8)-32B	GND
XA6(J8)-1C	GND
XA6(J8)-2C	GND
XA6(J8)-3C	A/0.0002
XA6(J8)-4C	A/0.001
XA6(J8)-5C	A/0.008
XA6(J8)-6C	A/0.04
XA6(J8)-7C	A/0.2
XA6(J8)-8C	A/1
XA6(J8)-9C	A/8
XA6(J8)-10C	A/40
XA6(J8)-11C	A/200
XA6(J8)-12C	A/SIGN
XA6(J8)-13C	(N.C.)
XA6(J8)-14C	A/BYTE2-
XA6(J8)-15C	A/UPDATE
XA6(J8)-16C	(N.C.)
XA6(J8)-17C	NTTLRXDB
XA6(J8)-18C	FBLTRA
XA6(J8)-19C	(N.C.)
XA6(J8)-20C	SAMWR-
XA6(J8)-21C	SAMD6
XA6(J8)-22C	SAMD3
XA6(J8)-23C	SAMD0
XA6(J8)-24C	SAMDT/R+
XA6(J8)-25C	SAMA6
XA6(J8)-26C	SAMA3
XA6(J8)-27C	SAMA0
XA6(J8)-28C	GND
XA6(J8)-29C	+5V
XA6(J8)-30C	+5V
XA6(J8)-31C	GND
XA6(J8)-32C	GND

XA7(J9)

Connector/Pin	Signal Name
XA7(J9)-1A	GND
XA7(J9)-2A	GND
XA7(J9)-3A	INCRB
XA7(J9)-4A	B/0.0004
XA7(J9)-5A	B/0.002
XA7(J9)-6A	B/0.01

XA7(J9) - continued

Connector/Pin	Signal Name
XA7(J9)-7A	B/0.08
XA7(J9)-8A	B/0.4
XA7(J9)-9A	B/2
XA7(J9)-10A	B/10
XA7(J9)-11A	B/80
XA7(J9)-12A	(N.C.)
XA7(J9)-13A	B/RANGE
XA7(J9)-14A	B/BYTE4-
XA7(J9)-15A	B/BYTE1-
XA7(J9)-16A	B/INHIBIT-
XA7(J9)-17A	(N.C.)
XA7(J9)-18A	NTTLRXDA
XA7(J9)-19A	INCLDB
XA7(J9)-20A	(N.C.)
XA7(J9)-21A	SAMRD-
XA7(J9)-22A	SAMD5
XA7(J9)-23A	SAMD2
XA7(J9)-24A	(N.C.)
XA7(J9)-25A	SAMIO/M-
XA7(J9)-26A	SAMA4
XA7(J9)-27A	SAMA2
XA7(J9)-28A	GND
XA7(J9)-29A	+5V
XA7(J9)-30A	+5V
XA7(J9)-31A	GND
XA7(J9)-32A	GND
XA7(J9)-1B	GND
XA7(J9)-2B	GND
XA7(J9)-3B	B/0.0001
XA7(J9)-4B	B/0.0008
XA7(J9)-5B	B/0.004
XA7(J9)-6B	B/0.02
XA7(J9)-7B	B/0.1
XA7(J9)-8B	B/0.8
XA7(J9)-9B	B/4
XA7(J9)-10B	B/20
XA7(J9)-11B	B/100
XA7(J9)-12B	(N.C.)
XA7(J9)-13B	(N.C.)
XA7(J9)-14B	B/BYTE3-
XA7(J9)-15B	(N.C.)
XA7(J9)-16B	B/EXTTRIG-
XA7(J9)-17B	TEDGE
XA7(J9)-18B	GPLTR
XA7(J9)-19B	(N.C.)
XA7(J9)-20B	(N.C.)
XA7(J9)-21B	SAMD7
XA7(J9)-22B	SAMD4

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 8 of 15)

XA7(J9) - continued

Connector/Pin	Signal Name
XA7(J9)-23B	SAMD1
XA7(J9)-24B	OUTBMCLK
XA7(J9)-25B	BDS5-
XA7(J9)-26B	SAMA5
XA7(J9)-27B	SAMA1
XA7(J9)-28B	GND
XA7(J9)-29B	+5V
XA7(J9)-30B	+5V
XA7(J9)-31B	GND
XA7(J9)-32B	GND
XA7(J9)-1C	GND
XA7(J9)-2C	GND
XA7(J9)-3C	B/0.0002
XA7(J9)-4C	B/0.001
XA7(J9)-5C	B/0.008
XA7(J9)-6C	B/0.04
XA7(J9)-7C	B/0.2
XA7(J9)-8C	B/1
XA7(J9)-9C	B/8
XA7(J9)-10C	B/40
XA7(J9)-11C	B/200
XA7(J9)-12C	B/SIGN
XA7(J9)-13C	(N.C.)
XA7(J9)-14C	B/BYTE2-
XA7(J9)-15C	B/UPDATE
XA7(J9)-16C	(N.C.)
XA7(J9)-17C	NTTLRXDB
XA7(J9)-18C	FBLTRB
XA7(J9)-19C	(N.C.)
XA7(J9)-20C	SAMWR-
XA7(J9)-21C	SAMD6
XA7(J9)-22C	SAMD3
XA7(J9)-23C	SAMD0
XA7(J9)-24C	SAMDT/R+
XA7(J9)-25C	SAMA6
XA7(J9)-26C	SAMA3
XA7(J9)-27C	SAMA0
XA7(J9)-28C	GND
XA7(J9)-29C	+5V
XA7(J9)-30C	+5V
XA7(J9)-31C	GND
XA7(J9)-32C	GND

XA8(J10)

Connector/Pin	Signal Name
XA8(J10)-1A	GND
XA8(J10)-2A	GND
XA8(J10)-3A	(N.C.)
XA8(J10)-4A	(N.C.)
XA8(J10)-5A	(N.C.)
XA8(J10)-6A	(N.C.)
XA8(J10)-7A	(N.C.)
XA8(J10)-8A	(N.C.)
XA8(J10)-9A	(N.C.)
XA8(J10)-10A	(N.C.)
XA8(J10)-11A	(N.C.)
XA8(J10)-12A	(N.C.)
XA8(J10)-13A	(N.C.)
XA8(J10)-14A	(N.C.)
XA8(J10)-15A	(N.C.)
XA8(J10)-16A	(N.C.)
XA8(J10)-17A	(N.C.)
XA8(J10)-18A	(N.C.)
XA8(J10)-19A	(N.C.)
XA8(J10)-20A	(N.C.)
XA8(J10)-21A	SAMRD-
XA8(J10)-22A	SAMD5
XA8(J10)-23A	SAMD2
XA8(J10)-24A	SAMINIT-
XA8(J10)-25A	SAMIO/M-
XA8(J10)-26A	SAMA5
XA8(J10)-27A	SAMA2
XA8(J10)-28A	GND
XA8(J10)-29A	+5V
XA8(J10)-30A	+5V
XA8(J10)-31A	GND
XA8(J10)-32A	GND
XA8(J10)-1B	GND
XA8(J10)-2B	GND
XA8(J10)-3B	(N.C.)
XA8(J10)-4B	(N.C.)
XA8(J10)-5B	(N.C.)
XA8(J10)-6B	(N.C.)
XA8(J10)-7B	(N.C.)
XA8(J10)-8B	(N.C.)
XA8(J10)-9B	(N.C.)
XA8(J10)-10B	(N.C.)
XA8(J10)-11B	(N.C.)
XA8(J10)-12B	(N.C.)
XA8(J10)-13B	(N.C.)

XA8(J10) - continued

Connector/Pin	Signal Name
XA8(J10)-14B	(N.C.)
XA8(J10)-15B	(N.C.)
XA8(J10)-16B	(N.C.)
XA8(J10)-17B	(N.C.)
XA8(J10)-18B	(N.C.)
XA8(J10)-19B	BDS6-
XA8(J10)-20B	GINT
XA8(J10)-21B	SAMD7
XA8(J10)-22B	SAMD4
XA8(J10)-23B	SAMD1
XA8(J10)-24B	(N.C.)
XA8(J10)-25B	SAMA7
XA8(J10)-26B	SAMA4
XA8(J10)-27B	SAMA1
XA8(J10)-28B	GND
XA8(J10)-29B	+5V
XA8(J10)-30B	+5V
XA8(J10)-31B	GND
XA8(J10)-32B	GND
XA8(J10)-1C	GND
XA8(J10)-2C	GND
XA8(J10)-3C	(N.C.)
XA8(J10)-4C	(N.C.)
XA8(J10)-5C	(N.C.)
XA8(J10)-6C	(N.C.)
XA8(J10)-7C	(N.C.)
XA8(J10)-8C	(N.C.)
XA8(J10)-9C	(N.C.)
XA8(J10)-10C	(N.C.)
XA8(J10)-11C	(N.C.)
XA8(J10)-12C	(N.C.)
XA8(J10)-13C	(N.C.)
XA8(J10)-14C	(N.C.)
XA8(J10)-15C	(N.C.)
XA8(J10)-16C	(N.C.)
XA8(J10)-17C	(N.C.)
XA8(J10)-18C	(N.C.)
XA8(J10)-19C	(N.C.)
XA8(J10)-20C	SAMWR-
XA8(J10)-21C	SAMD6
XA8(J10)-22C	SAMD3
XA8(J10)-23C	SAMD0
XA8(J10)-24C	SAMDT/R+
XA8(J10)-25C	SAMA6
XA8(J10)-26C	SAMA3
XA8(J10)-27C	SAMA0
XA8(J10)-28C	GND
XA8(J10)-29C	+5V
XA8(J10)-30C	+5V

XA8(J10) - continued

Connector/Pin	Signal Name
XA8(J10)-31C	GND
XA8(J10)-32C	GND

+5V (POWER)

Connector/Pin	Signal Name
P1-1	GND
P1-2	+5V
P1-3	+5V
P1-4	GND
P1-5	PFAIL-
P1-6	+5V
P1-7	GND
P1-8	GND
P1-9	+5V

±12V (POWER)

Connector/Pin	Signal Name)
P2-1	+12VDC
P2-2	GNDA
P2-3	GNDA
P2-4	-12VDC

20 VAC (POWER)

Connector/Pin	Signal Name
P3-1	GNDA
P3-2	20VACHOT

(P4 (REAR PANEL)

Connector/Pin	Signal Name
P4A-1	EXT+12VDC
P4A-2	SELECT B
P4A-3	INPUT A
P4A-4	GND
P4A-5	UTXDA
P4A-6	RXDA-
P4A-7	RTSB
P4A-8	CTSB

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 9 of 15)

P4 (REAR PANEL) - continued

Connector/Pin	Signal Name
P4A-9	A/BYTE1-
P4A-10	A/BYTE4-
P4A-11	A/EXTTRIG-
P4A-12	A/SIGN
P4A-13	A/80
P4A-14	A/10
P4A-15	A/2
P4A-16	A/0.4
P4A-17	A/0.08
P4A-18	A/0.01
P4A-19	A/0.002
P4A-20	A/0.0004
P4A-21	B/BYTE1-
P4A-22	B/BYTE4-
P4A-23	B/EXTTRIG-
P4A-24	B/SIGN
P4A-25	B/80
P4A-26	B/10
P4A-27	B/2
P4A-28	B/0.4
P4A-29	B/0.08
P4A-30	B/0.01
P4A-31	B/0.002
P4A-32	B/0.0004
P4B-1	EXT+5VDC
P4B-2	SELECT C
P4B-3	INPUT B
P4B-4	RXDA+
P4B-5	BTXDA+
P4B-6	BTXDA-
P4B-7	UTXDB
P4B-8	RXDB-
P4B-9	A/BYTE2
P4B-10	A/INHIBIT
P4B-11	PCTLRA
P4B-12	A/200
P4B-13	A/40
P4B-14	A/8
P4B-15	A/1
P4B-16	A/0.2
P4B-17	A/0.04
P4B-18	A/0.008
P4B-19	A/0.001
P4B-20	A/0.0002
P4B-21	B/BYTE2-
P4B-22	B/INHIBIT
P4B-23	PCTLRB
P4B-24	B/200

P4 (REAR PANEL) - continued

Connector/Pin	Signal Name
P4B-25	B/40
P4B-26	B/8
P4B-27	B/1
P4B-28	B/0.2
P4B-29	B/0.04
P4B-30	B/0.008
P4B-31	B/0.001
P4B-32	B/0.0002
P4C-1	SELECT A
P4C-2	GND
P4C-3	INPUT C
P4C-4	RTSA
P4C-5	CTSA
P4C-6	RXDB+
P4C-7	BTXDB+
P4C-8	BTXDB-
P4C-9	A/BYTE3-
P4C-10	A/UPDATE
P4C-11	A/RANGE
P4C-12	A/100
P4C-13	A/20
P4C-14	A/4
P4C-15	A/0.8
P4C-16	A/0.1
P4C-17	A/0.02
P4C-18	A/0.004
P4C-19	A/0.0008
P4C-20	A/0.0001
P4C-21	B/BYTE3-
P4C-22	B/UPDATE
P4C-23	B/RANGE
P4C-24	B/100
P4C-25	B/20
P4C-26	B/4
P4C-27	B/0.8
P4C-28	B/0.1
P4C-29	B/0.02
P4C-30	B/0.004
P4C-31	B/0.0008
P4C-32	B/0.0001

Component/Pin	Signal Name
R1-1	+5V
R1-2	PULLUP5

Component/Pin	Signal Name
R2-1	20VACHOT
R2-2	EXC20

Component/Pin	Signal Name
U1-1	GND
U1-2	GND
U1-3	GND
U1-4	GBD
U1-5	GND
U1-6	GND
U1-7	GND
U1-8	GND
U1-9	IAD7
U1-10	IAD6
U1-11	IAD5
U1-12	IAD4
U1-13	IAD3
U1-14	IAD2
U1-15	IAD1
U1-16	IAD0

Component/Pin	Signal Name
U2-1	S1A1HI
U2-2	S3A1HI
U2-3	S1A36HI
U2-4	S3A36HI
U2-5	S1B1HI
U2-6	S3B1HI
U2-7	S1B36HI
U2-8	S3B36HI
U2-9	S3B36MID
U2-10	S1B36MID
U2-11	S3B1MID
U2-12	S1B1MID
U2-13	S3A36MID
U2-14	S1A36MID
U2-15	S3A1MID
U2-16	S1A1MID

Component/Pin	Signal Name
U3-1	S1A1MID
U3-2	S3A1MID
U3-3	S1A36MID
U3-4	S3A36MID
U3-5	S1B1MID
U3-6	S3B1MID
U3-7	S1B36MID
U3-8	S3B36MID
U3-9	S3B36
U3-10	S1B36
U3-11	S3B1
U3-12	S1B1
U3-13	S3A36
U3-14	S1A36
U3-15	S3A1
U3-16	S1A1

Component/Pin	Signal Name
U4-1	S1C1HI
U4-2	S3C1HI
U4-3	S1C36HI
U4-4	S3C36HI
U4-5	(N.C.)
U4-6	(N.C.)
U4-7	(N.C.)
U4-8	(N.C.)
U4-9	(N.C.)
U4-10	(N.C.)
U4-11	(N.C.)
U4-12	(N.C.)
U4-13	S3C36MID
U4-14	S1C36MID
U4-15	S3C1MID
U4-16	S1C1MID

Component/Pin	Signal Name
U5-1	S1C1MID
U5-2	S3C1MID
U5-3	S1C36MID
U5-4	S3C36MID
U5-5	(N.C.)
U5-6	(N.C.)
U5-7	(N.C.)
U5-8	(N.C.)
U5-9	(N.C.)
U5-10	(N.C.)
U5-11	(N.C.)
U5-12	(N.C.)
U5-13	S3C36
U5-14	S1C36
U5-15	S3C1
U5-16	S1C1

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 10 of 15)

Component/Pin	Signal Name
U6-1	S1A1
U6-2	S3A1
U6-3	S1A36
U6-4	S3A36
U6-5	S1B1
U6-6	S3B1
U6-7	S1B36
U6-8	S3B36
U6-9	S3B36LO
U6-10	S1B36LO
U6-11	S3B1LO
U6-12	S1B1LO
U6-13	S3A36LO
U6-14	S1A36LO
U6-15	S3A1LO
U6-16	S1A1LO

Component/Pin	Signal Name
U7-1	S1C1
U7-2	S3C1
U7-3	S1C36
U7-4	S3C36
U7-5	(N.C.)
U7-6	(N.C.)
U7-7	(N.C.)
U7-8	(N.C.)
U7-9	(N.C.)
U7-10	(N.C.)
U7-11	(N.C.)
U7-12	(N.C.)
U7-13	S3C36LO
U7-14	S1C36LO
U7-15	S3C1LO
U7-16	S1C1LO

Component/Pin	Signal Name
U8-1	GND
U8-2	PCLK
U8-3	SAMA0
U8-4	SAMA1
U8-5	SAMA2
U8-6	SAMA3
U8-7	SAMA4
U8-8	SAMA5
U8-9	SAMA6
U8-10	+5V

Component/Pin	Signal Name
U9-1	GND
U9-2	SAMA7
U9-3	SAMIO/M-
U9-4	SAMDT/R+
U9-5	SAMD0
U9-6	SAMD1
U9-7	SAMD2
U9-8	SAMD3
U9-9	SAMD4
U9-10	+5V

Component/Pin	Signal Name
U10-1	GND
U10-2	SAMD5
U10-3	SAMD6
U10-4	SAMD7
U10-5	SAMRD-
U10-6	SAMWR-
U10-7	(N.C.)
U10-8	(N.C.)
U10-9	(N.C.)
U10-10	+5V

Component/Pin	Signal Name
U11-1	GND
U11-2	(N.C.)
U11-3	(N.C.)
U11-4	(N.C.)
U11-5	MCLK+
U11-6	SAMA19
U11-7	SAMA18
U11-8	SAMA17
U11-9	SAMA16
U11-10	+5V

Component/Pin	Signal Name
U12-1	GND
U12-2	SAMA15
U12-3	SAMA14
U12-4	SAMA13
U12-5	SAMA12
U12-6	SAMA11
U12-7	SAMA10
U12-8	SAMA9
U12-9	SAMA8
U12-10	+5V

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 11 of 15)

BY SIGNAL NAME:

Signal Name	Connector/Pin	Signal Name	Connector/Pin
A/0.0001	XA6(J8)-3B,P4-20C	A/200	XA6(J8)-11C,P4-12B
A/0.0002	XA6(J8)-3C,P4-20B	A/BYTE1-	XA6(J8)-15A,P4-9A
A/0.0004	XA6(J8)-4A,P4-20A	A/BYTE2-	XA6(J8)-14C,P4-9B
A/0.0008	XA6(J8)-4B,P4-19C	A/BYTE3-	XA6(J8)-14B,P4-9C
A/0.001	XA6(J8)-4C,P4-19B	A/BYTE4-	XA6(J8)-14A,P4-10A
A/0.002	XA6(J8)-5A,P4-19A	A/EXTTRIG-	XA6(J8)-16B,P4-11A
A/0.004	XA6(J8)-5B,P4-18C	A/INHIBIT-	XA6(J8)-16A,P4-10B
A/0.008	XA6(J8)-5C,P4-18B	A/RANGE	XA6(J8)-13A,P4-11C
A/0.01	XA6(J8)-6A,P4-18A	A/SIGN	XA6(J8)-12C,P4-12A
A/0.02	XA6(J8)-6B,P4-17C	A/UPDATE	XA6(J8)-15C,P4-10C
A/0.04	XA6(J8)-6C,P4-17B	AUXRXCTL1A-	XA1(J2)-6C,J22-9
A/0.08	XA6(J8)-7A,P4-17A	AUXRXCTL2A-	XA1(J2)-4C,J22-8
A/0.1	XA6(J8)-7B,P4-16C	AUXRXDA-	XA1(J2)-6B,J22-5
A/0.2	XA6(J8)-7C,P4-16B	AUXRXDB-	XA1(J2)-4B,J22-6
A/0.4	XA6(J8)-8A,P4-16A	AUXTXCTL1A+	XA1(J2)-6A,J22-7
A/0.8	XA6(J8)-8B,P4-15C	AUXTXCTL2A+	XA1(J2)-5A,J22-4
A/1	XA6(J8)-8C,P4-15B	AUXTXDA+	XA1(J2)-9A,J22-3
A/2	XA6(J8)-9A,P4-15A	AUXTXDB+	XA1(J2)-8A,J22-2
A/4	XA6(J8)-9B,P4-14C	B/0.0001	XA7(J9)-3B,P4-32C
A/8	XA6(J8)-9C,P4-14B	B/0.0002	XA7(J9)-3C,P4-32B
A/10	XA6(J8)-10A,P4-14A	B/0.0004	XA7(J9)-4A,P4-32A
A/20	XA6(J8)-10B,P4-13C	B/0.0008	XA7(J9)-4B,P4-31C
A/40	XA6(J8)-10C,P4-13B	B/0.001	XA7(J9)-4C,P4-31B
A/80	XA6(J8)-11A,P4-13A	B/0.002	XA7(J9)-5A,P4-31A
A/100	XA6(J8)-11B,P4-12C	B/0.004	XA7(J9)-5B,P4-30C

Signal Name	Connector/Pin	Signal Name	Connector/Pin
B/0.008	XA7(J9)-5C,P4-30B	B/SIGN	XA7(J9)-12C,P4-24A
B/0.01	XA7(J9)-6A,P4-30A	B/UPDATE	XA7(J9)-15C,P4-22C
B/0.02	XA7(J9)-6B,P4-29C	BDS2-	XA3(J5)-14B,XA4(J6)-16B
B/0.04	XA7(J9)-6C,P4-29B	BDS3-	XA3(J5)-14C,XA5(J7)-16B
B/0.08	XA7(J9)-7A,P4-29A	BDS4-	XA3(J5)-15A,XA6(J8)-25B
B/0.1	XA7(J9)-7B,P4-28C	BDS5-	XA3(J5)-15B,XA7(J9)-25B
B/0.2	XA7(J9)-7C,P4-28B	BDS6-	XA3(J5)-15C,XA8(J10)-19B
B/0.4	XA7(J9)-8A,P4-28A	BPRN-	XA1(J1)-13C,XA2(J3)-13C
B/0.8	XA7(J9)-8B,P4-27C	BPRO-	XA1(J1)-13B,XA2(J3)-13B
B/1	XA7(J9)-8C,P4-27B	BTXDA+	XA3(J5)-8A,P4-5B
B/2	XA7(J9)-9A,P4-27A	BTXDA-	XA3(J5)-7C,P4-6B
B/4	XA7(J9)-9B,P4-26C	BTXDB+	XA3(J5)-7B,P4-7C
B/8	XA7(J9)-9C,P4-26B	BTXDB-	XA3(J5)-7A,P4-8C
B/10	XA7(J9)-10A,P4-26A	BUSGRNT-	XA1(J1)-14B,XA2(J3)-14B
B/20	XA7(J9)-10B,P4-25C	BUSY-	XA1(J1)-15A,XA2(J3)-15A
B/40	XA7(J9)-10C,P4-25B	BXCAR	XA3(J5)-9C,XA4(J6)-14B
B/80	XA7(J9)-11A,P4-25A	CBRQST-	XA1(J1)-14C,XA2(J3)-14C
B/100	XA7(J9)-11B,P4-24C	CTSA	XA3(J5)-3B,P4-5C
B/200	XA7(J9)-11C,P4-24B	CTSB	XA3(J5)-2B,P4-8A
B/BYTE1-	XA7(J9)-15A,P4-21A	EXC20	XA3(J5)-10B,R2-2
B/BYTE2-	XA7(J9)-14C,P4-21B	FBLTRA	XA5(J7)-12A,XA6(J8)-18C
B/BYTE3-	XA7(J9)-14B,P4-21C	FBLTRB	XA5(J7)-12B,XA7(J9)-18C
B/BYTE4-	XA7(J9)-14A,P4-22A	FIFODRQ-	XA1(J1)-13A,XA2(J3)-13A
B/EXTTRIG-	XA7(J9)-16B,P4-23A	GINT	XA2(J3)-5C,XA3(J5)-16B, XA4(J6)-19B,XA5(J7)-19B, XA8(J10)-20B,J20-42
B/INHIBIT-	XA7(J9)-16A,P4-22B		
B/RANGE	XA7(J9)-13A,P4-23C	GPIBATN	XA1(J2)-13C,XA2(J4)-13C, J11-11

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 12 of 15)

Signal Name	Connector/Pin
GPIBD0	XA1(J2)-27C,XA2(J4)-27C, J11-1
GPIBD1	XA1(J2)-26C,XA2(J4)-26C, J11-2
GPIBD2	XA1(J2)-25C,XA2(J4)-25C, J11-3
GPIBD3	XA1(J2)-24C,XA2(J4)-24C, J11-4
GPIBD4	XA1(J2)-23C,XA2(J4)-23C, J11-13
GPIBD5	XA1(J2)-22C,XA2(J4)-22C, J11-14
GPIBD6	XA1(J2)-21C,XA2(J4)-21C, J11-15
GPIBD7	XA1(J2)-20C,XA2(J4)-20C, J11-16
GPIBDAV	XA1(J2)-15C,XA2(J4)-15C, J11-6
GPIBEOI	XA1(J2)-14C,XA2(J4)-14C, J11-5
GPIBIFC	XA1(J2)-18C,XA2(J4)-18C, J11-9
GPIBNDAC	XA1(J2)-17C,XA2(J4)-17C, J11-8
GPIBNRFD	XA1(J2)-16C,XA2(J4)-16C, J11-7
GPIBREN	XA1(J2)-19C,XA2(J4)-19C, J11-17
GPIBSRQ	XA1(J2)-12C,XA2(J4)-12C, J11-10
GPIBTRIG	XA2(J4)-9C,XA5(J7)-10A
GPLTR	XA5(J7)-11C,XA6(J8)-18B, XA7(J9)-18B
IAD0	XA5(J7)-8B,U1-16

Signal Name	Connector/Pin
IAD1	XA5(J7)-8A,U1-15
IAD2	XA5(J7)-7C,U1-14
IAD3	XA5(J7)-7B,U1-13
IAD4	XA5(J7)-7A,U1-12
IAD5	XA5(J7)-6C,U1-11
IAD6	XA5(J7)-6B,U1-10
IAD7	XA5(J7)-6A,U1-9
ICK+	XA3(J5)-13A,J12-1,J12-9, J12-17
ICK-	XA3(J5)-14A,J12-5,J12-13,J12-21
INCLDA	XA5(J7)-12C,XA6(J8)-19A
INCLDB	XA5(J7)-14C,XA7(J9)-19A
INCRA	XA5(J7)-10B,XA6(J8)-3A
INCRB	XA5(J7)-10C,XA7(J9)-3A
INPUT A	XA5(J7)-5A,P4-3A
INPUT B	XA5(J7)-5B,P4-3B
INPUT C	XA5(J7)-5C,P4-3C
MCLK+	XA1(J1)-15C,XA2(J3)-15C, XA5(J7)-23B,U11-5
MEM1-	XA3(J5)-16A,XA5(J7)-16A
NTTLRXDA	XA3(J5)-1C,XA6(J8)-18A, XA7(J9)-18A
NTTLRXDB	XA3(J5)-2A,XA6(J8)-17C, XA7(J9)-17C
OUTAMCLK	XA5(J7)-14A,XA6(J8)-24B
OUTBMCLK	XA5(J7)-14B,XA7(J9)-24B
PCLK	XA2(J4)-31B,XA3(J5)-21A, J20-2,U8-2

Signal Name	Connector/Pin
PCLK/16	XA3(J5)-20A,XA4(J6)-14A
PCTLRA	XA5(J7)-3A,P4-11B
PCTLRB	XA5(J7)-3B,P4-23B
PFAIL-	XA2(J4)-3A,XA5(J7)-3C, P1-5
PPI0	XA2(J4)-4A,XA3(J5)-1A
PPI1	XA2(J4)-3C,XA3(J5)-1B
PPI2	XA2(J4)-3B,XA5(J7)-16C
PPO0	XA2(J4)-12B,XA3(J5)-4B
PPO1	XA2(J4)-12A,XA3(J5)-4C
PPO2	XA2(J4)-11B,XA3(J5)-8B
PULLUP5	J21-1,J21-3,R1-2
RINCTR+	XA5(J7)-11A,J23-1
RINCTR-	XA5(J7)-11B,J23-2
RTSA	XA3(J5)-5B,P4-4C
RTSB	XA3(J5)-5A,P4-7A
RXDA+	XA2(J4)-7B,XA3(J5)-3C, P4-4B
RXDA-	XA2(J4)-6B,XA3(J5)-4A, P4-6A
RXDB+	XA2(J4)-5B,XA3(J5)-2C, P4-6C
RXDB-	XA2(J4)-4B,XA3(J5)-3A, P4-8B
S1A1	XA4(J6)-2A,U3-16,U6-1
S1A1HI	J16-4,U2-1
S1A1LO	J19-4,U6-16
S1A1MID	U2-16,U3-1
S1A36	XA4(J6)-4A,U3-14,U6-3

Signal Name	Connector/Pin
S1A36HI	J16-6,U2-3
S1A36LO	J19-6,U6-14
S1A36MID	U2-14,U3-3
S1B1	XA4(J6)-6A,U3-12,U6-5
S1B1HI	J15-4,U2-5
S1B1LO	J18-4,U6-12
S1B1MID	U2-12,U3-5
S1B36	XA4(J6)-8A,U3-10,U6-7
S1B36HI	J15-6,U2-7
S1B36LO	J18-6,U6-10
S1B36MID	U2-10,U3-7
S1C1	XA4(J6)-10A,U5-16,U7-1
S1C1HI	J14-4,U4-1
S1C1LO	J17-4,U7-16
S1C1MID	U4-16,U5-1
S1C36	XA4(J6)-12A,U5-14,U7-3
S1C36HI	J14-6,U4-3
S1C36LO	J17-6,U7-14
S1C36MID	U4-14,U5-3
S3A1	XA4(J6)-2C,U3-15,U6-2
S3A1HI	J16-7,U2-2
S3A1LO	J19-7,U6-15
S3A1MID	U2-15,U3-2
S3A36	XA4(J6)-4C,U3-13,U6-4
S3A36HI	J16-9,U2-4
S3A36LO	J19-9,U6-13

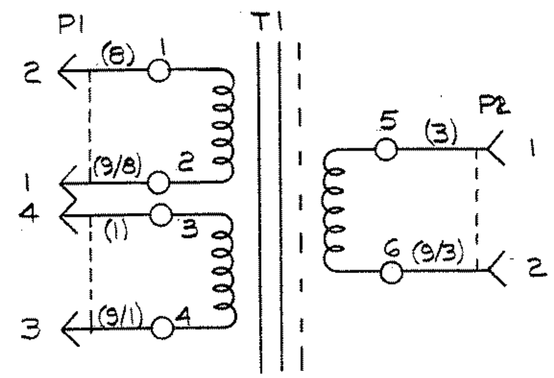
Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 13 of 15)

Signal Name	Connector/Pin
S3A36MID	U2-13,U3-4
S3B1	XA4(J6)-6C,U3-11,U6-6
S3B1HI	J15-7,U2-6
S3B1LO	J18-7,U6-11
S3B1MID	U2-11,U3-6
S3B36	XA4(J6)-8C,U3-9,U6-8
S3B36HI	J15-9,U2-8
S3B36LO	J18-9,U6-9
S3B36MID	U2-9,U3-8
S3C1	XA4(J6)-10C,U5-15,U7-2
S3C1HI	J14-7,U4-2
S3C1LO	J17-7,U7-15
S3C1MID	U4-15,U5-2
S3C36	XA4(J6)-12C,U5-13,U7-4
S3C36HI	J14-9,U4-4
S3C36LO	J17-9,U7-13
S3C36MID	U4-13,U5-4
SAMA0	XA1(J1)-24C,XA2(J3)-24C, XA3(J5)-28C,XA4(J6)-24C, XA5(J7)-27C,XA6(J8)-27C, XA7(J9)-27C,XA8(J10)- 27C,J20-4,U8-3
SAMA1	XA1(J1)-24B,XA2(J3)-24B, XA3(J5)-28B,XA4(J6)-24B, XA5(J7)-27B,XA6(J8)-27B, XA7(J9)-27B,XA8(J10)- 27B,J20-6,U8-4
SAMA2	XA1(J1)-24A,XA2(J3)-24A, XA3(J5)-28A,XA4(J6)-24A, XA5(J7)-27A,XA6(J8)-27A, XA7(J9)-27A,XA8(J10)- 27A,J20-8,U8-5
SAMA3	XA1(J1)-23C,XA2(J3)-23C, XA3(J5)-27C,XA5(J7)-26C, XA6(J8)-26C,XA7(J9)-26C, XA8(J10)-26C,J20-10,U8-6
SAMA4	XA1(J1)-23B,XA2(J3)-23B, XA3(J5)-27B,XA5(J7)-26B, XA6(J8)-26B,XA7(J9)-26A, XA8(J10)-26B,J20-12,U8-7
SAMA5	XA1(J1)-23A,XA2(J3)-23A, XA3(J5)-27A,XA5(J7)-26A, XA6(J8)-26A,XA7(J9)-26B, XA8(J10)-26A,J20-14,U8-8
SAMA6	XA1(J1)-22C,XA2(J3)-22C, XA3(J5)-26C,XA5(J7)-25C, XA6(J8)-25C,XA7(J9)-25C, XA8(J10)-25C,J20-16,U8-9
SAMA7	XA1(J1)-22B,XA2(J3)-22B, XA3(J5)-26B,XA5(J7)-25B, XA8(J10)-25B,J20-18,U9-2
SAMA8	XA1(J1)-22A,XA2(J3)-22A, XA3(J5)-26A,XA5(J7)-25A, U12-9
SAMA9	XA1(J1)-21C,XA2(J3)-21C, XA3(J5)-25C,XA5(J7)-24C, U12-8
SAMA10	XA1(J1)-21B,XA2(J3)-21B, XA3(J5)-25B,XA5(J7)-24B, U12-7
SAMA11	XA1(J1)-21A,XA2(J3)-21A, XA3(J5)-25A,U12-6
SAMA12	XA1(J1)-20C,XA2(J3)-20C, XA3(J5)-24C,U12-5
SAMA13	XA1(J1)-20B,XA2(J3)-20B, XA3(J5)-24B,U12-4
SAMA14	XA1(J1)-20A,XA2(J3)-20A, XA3(J5)-24A,U12-3
SAMA15	XA1(J1)-19C,XA2(J3)-19C, XA3(J5)-23C,U12-2
SAMA16	XA1(J1)-19B,XA2(J3)-19B, XA3(J5)-23B,U11-9
SAMA17	XA1(J1)-19A,XA2(J3)-19A, XA3(J5)-23A,U11-8
SAMA18	XA1(J1)-18C,XA2(J3)-18C, XA3(J5)-22C,U11-7
SAMA19	XA1(J1)-18B,XA2(J3)-18B, XA3(J5)-22B,U11-6
SAMD0	XA1(J1)-12C,XA2(J3)-12C, XA3(J5)-19C,XA4(J6)-22C, XA5(J7)-22C,XA6(J8)-23C, XA7(J9)-23C,XA8(J10)- 23C,J20-22,U9-5
SAMD1	XA1(J1)-12B,XA2(J3)-12B, XA3(J5)-19B,XA4(J6)-22B, XA5(J7)-22B,XA6(J8)-23B, XA7(J9)-23B,XA8(J10)- 23B,J20-24,U9-6
SAMD2	XA1(J1)-12A,XA2(J3)-12A, XA3(J5)-19A,XA4(J6)-22A, XA5(J7)-22A,XA6(J8)-23A, XA7(J9)-23A,XA8(J10)- 23A,J20-26,U9-7
SAMD3	XA1(J1)-11C,XA2(J3)-11C, XA3(J5)-18C,XA4(J6)-21C, XA5(J7)-21C,XA6(J8)-22C, XA7(J9)-22C,XA8(J10)- 22C,J20-28,U9-8
SAMD4	XA1(J1)-11B,XA2(J3)-11B, XA3(J5)-18B,XA4(J6)-21B, XA5(J7)-21B,XA6(J8)-22B, XA7(J9)-22B,XA8(J10)- 22B,J20-30,U9-9
SAMD5	XA1(J1)-11A,XA2(J3)-11A, XA3(J5)-18A,XA4(J6)-21A, XA5(J7)-21A,XA6(J8)-22A, XA7(J9)-22A,XA8(J10)- 22A,J20-32,U10-2
SAMD6	XA1(J1)-10C,XA2(J3)-10C, XA3(J5)-17C,XA4(J6)-20C, XA5(J7)-20C,XA6(J8)-21C, XA7(J9)-21C,XA8(J10)- 21C,J20-34,U10-3
SAMD7	XA1(J1)-10B,XA2(J3)-10B, XA3(J5)-17B,XA4(J6)-20B, XA5(J7)-20B,XA6(J8)-21B, XA7(J9)-21B,XA8(J10)- 21B,J20-36,U10-4
SAMDEN	XA1(J1)-6B,XA2(J3)-6B
SAMDT/R+	XA1(J1)-16B,XA2(J3)-16B, XA3(J5)-21B,XA5(J7)-23C, XA6(J8)-24C,XA7(J9)-24C, XA8(J10)-24C,U9-4
SAMINIT-	XA1(J1)-15B,XA2(J3)-15B, XA3(J5)-29B,XA8(J10)-24A
SAMIO/M-	XA1(J1)-16C,XA2(J3)-16C, XA3(J5)-21C,XA5(J7)-24A, XA6(J8)-25A,XA7(J9)-25A, XA8(J10)-25A,J20-20,U9-3
SAMRD-	XA1(J1)-7A,XA2(J3)-7A, XA3(J5)-17A,XA4(J6)-20A, XA5(J7)-20A,XA6(J8)-21A, XA7(J9)-21A,XA8(J10)- 21A,J20-38,U10-5
SAMRDY+	XA1(J1)-14A,XA2(J3)-14A
SAMWE-	XA1(J1)-6A,XA2(J3)-6A
SAMWR-	XA1(J1)-6C,XA2(J3)-6C, XA3(J5)-16C,XA5(J7)-19C, XA6(J8)-20C,XA7(J9)-20C, XA8(J10)-20C,J20-40, U10-6
SDA+	XA3(J5)-11A,J12-2
SDA-	XA3(J5)-12A,J12-6
SDB+	XA3(J5)-11B,J12-10
SDB-	XA3(J5)-12B,J12-14
SDC+	XA3(J5)-11C,J12-18
SDC-	XA3(J5)-12C,J12-22
SELECT A	XA5(J7)-9C,P4-1C
SELECT B	XA5(J7)-9B,P4-2A

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 14 of 15)

Signal Name	Connector/Pin
SELECT C	XA5(J7)-9A,P4-2B
SFIFOCOM-	XA1(J1)-16A,XA2(J3)-16A
TEDGE	XA3(J5)-10C,XA6(J8)-17B,XA7(J9)-17B
TXDA+	XA2(J4)-9A,XA3(J5)-6B
TXDB+	XA2(J4)-8A,XA3(J5)-6C
UTXDA	XA3(J5)-6A,P4-5A
UTXDB	XA3(J5)-5C,P4-7B
+5VDC	C1-1,C2-1,C3-1,F4-1,XA1(J1)-29A,XA1(J1)-29B,XA1(J1)-29C,XA1(J1)-30A,XA1(J1)-30B,XA1(J1)-30C,XA2(J3)-29A,XA2(J3)-29B,XA2(J3)-29C,XA2(J3)-30A,XA2(J3)-30B,XA2(J3)-30C XA3(J5)-30A,XA3(J5)-30B,XA3(J5)-30C,XA3(J5)-31A,XA3(J5)-31B,XA3(J5)-31C,XA4(J6)-29A,XA4(J6)-29B,XA4(J6)-29C,XA4(J6)-30A,XA4(J6)-30B,XA4(J6)-30C,XA5(J7)-29A,XA5(J7)-29B,XA5(J7)-29C,XA5(J7)-30A,XA5(J7)-30B,XA5(J7)-30C,XA6(J8)-29A,XA6(J8)-29B,XA6(J8)-29C,XA6(J8)-30A,XA6(J8)-30B,XA6(J8)-30C,XA7(J9)-29A,XA7(J9)-29B,XA7(J9)-29C,XA7(J9)-30A,XA7(J9)-30B,XA7(J9)-30C,XA8(J10)-29A,XA8(J10)-29B,XA8(J10)-29C,XA8(J10)-30A,XA8(J10)-30B,XA8(J10)-30C,J20-43,J20-44,J20-45,J20-46,J20-47,J20-48,J20-49,J20-50,P1-2,P1-3, P1-6,P1-9,R1-1,U8-10,U9-10,U10-10,U11-10,U12-10
+12VDC	F5-1,XA1(J1)-28A,XA1(J1)-28B,XA1(J1)-28C,XA2(J3)-28A,XA2(J3)-28B,XA2(J3)-28C,XA4(J6)-28A,XA4(J6)-28B,XA4(J6)-28C,P2-1
-5VDC	XA1(J1)-27A,XA1(J1)-27B,XA1(J1)-27C,XA2(J3)-27A,XA2(J3)-27B,XA2(J3)-27C,XA3(J5)-9B,XA4(J6)-27B
-12VDC	F6-1,XA1(J1)-26A,XA1(J1)-26B,XA1(J1)-26C,XA2(J3)-26A,XA2(J3)-26B,XA2(J3)-26C,XA3(J5)-9A,XA4(J6)-26A,XA4(J6)-26B,XA4(J6)-26C,P2-4
20VACEXTHOT	F3-2,J17-3,J18-3,J19-3
20VACHOT	F3-1,P3-2,R2-1
115VACHOT	F2-1,J13-2
115VACN	F1-1,J13-1
115VEXTHOT	F2-2,J14-3,J15-3,J16-3
115VEXTN	F1-2,J14-1,J15-1,J16-1
EXT+5VDC	F4-2,P4-1B
EXT+12VDC	F5-2,P4-1A,J12-4,J12-12,J12-20
EXT-12VDC	F6-2,J12-8,J12-16,J12-24
GND	C1-2,C2-2,C3-2,XA1(J1)-1A,XA1(J1)-1B,XA1(J1)-1C,XA1(J1)-2A,XA1(J1)-2B,XA1(J1)-2C,XA1(J1)-25A,XA1(J1)-25B,XA1(J1)-25C,XA1(J1)-31A,XA1(J1)-31B,XA1(J1)-31C,XA1(J1)-32A,XA1(J1)-32B,XA1(J1)-32C,XA1(J2)-1A,XA1(J2)-1B,XA1(J2)-1C,XA1(J2)-5B,XA1(J2)-5C,XA1(J2)-7B,XA1(J2)-7C,XA1(J2)-32A,XA1(J2)-32B,XA1(J2)-32C,XA2(J3)-1A,XA2(J3)-
GND - continued	1B,XA2(J3)-1C,XA2(J3)-2A,XA2(J3)-2B,XA2(J3)-2C,XA2(J3)-25A,XA2(J3)-25B,XA2(J3)-25C,XA2(J3)-31A,XA2(J3)-31B,XA2(J3)-31C,XA2(J3)-32A,XA2(J3)-32B,XA2(J3)-32C,XA2(J4)-1A,XA2(J4)-1B,XA2(J4)-1C,XA2(J4)-32A,XA2(J4)-32B,XA2(J4)-32C,XA3(J5)-8C,XA3(J5)-10A,XA3(J5)-13B,XA3(J5)-13C,XA3(J5)-20B,XA3(J5)-20C,XA3(J5)-22A,XA3(J5)-29A,XA3(J5)-29C,XA3(J5)-32A,XA3(J5)-32B,XA3(J5)-32C,XA4(J6)-17A,XA4(J6)-17B,XA4(J6)-17C,XA4(J6)-18A,XA4(J6)-18B,XA4(J6)-18C,XA4(J6)-23A,XA4(J6)-23B,XA4(J6)-23C,XA4(J6)-25A,XA4(J6)-25B,XA4(J6)-25C,XA4(J6)-27A,XA4(J6)-27C,XA4(J6)-31A,XA4(J6)-31B,XA4(J6)-31C,XA4(J6)-32A,XA4(J6)-32B,XA4(J6)-32C,XA5(J7)-1A,XA5(J7)-1B,XA5(J7)-1C,XA5(J7)-2A,XA5(J7)-2B,XA5(J7)-2C,XA5(J7)-13A,XA5(J7)-13B,XA5(J7)-13C,XA5(J7)-15A,XA5(J7)-15B,XA5(J7)-15C,XA5(J7)-28A,XA5(J7)-28B,XA5(J7)-28C,XA5(J7)-31A,XA5(J7)-31B,XA5(J7)-31C,XA5(J7)-32A,XA5(J7)-32B,XA5(J7)-32C,XA6(J8)-1A,XA6(J8)-1B,XA6(J8)-1C,XA6(J8)-2A,XA6(J8)-2B,XA6(J8)-2C,XA6(J8)-28A,XA6-1-28B,XA6(J8)-28C,XA6(J8)-31A,XA6(J8)-31B,XA6(J8)-31C,XA6(J8)-32A,XA6(J8)-32B,XA6(J8)-32C,XA7(J9)-1A,XA7(J9)-1B,XA7(J9)-1C,XA7(J9)-2A,XA7(J9)-2B,XA7(J9)-2C,XA7(J9)-28A,XA7(J9)-28B,XA7(J9)-28C,XA7(J9)-31A,XA7(J9)-31B,XA7(J9)-31C,XA7(J9)-32A,XA7(J9)-32B,XA7(J9)-32C,XA8(J10)-1A,
GND - continued	XA8(J10)-1B,XA8(J10)-1C,XA8(J10)-2A,XA8(J10)-2B,XA8(J10)-2C,XA8(J10)-28A,XA8(J10)-28B,XA8(J10)-28C,XA8(J10)-31A,XA8(J10)-31B,XA8(J10)-31C,XA8(J10)-32A,XA8(J10)-32B,XA8(J10)-32C,J11-12,J11-18,J11-19,J11-20,J11-21,J11-22,J11-23,J11-24,J20-1,J20-3,J20-5,J20-7,J20-9,J20-11,J20-13,J20-15,J20-17,J20-19,J20-21,J20-23,J20-25,J20-27,J20-29,J20-31,J20-33,J20-35,J20-37,J20-39,J20-41,J21-2,J22-13,P1-1,P1-4,P1-7,P1-8,P4-2C,P4-4A,U1-1,U1-2,U1-3,U1-4,U1-5,U1-6,U1-7,U1-8,U8-1,U9-1,U10-1,U11-1,U12-1
AGND	XA4(J6)-1A,XA4(J6)-1B,XA4(J6)-1C,XA4(J6)-2B,XA4(J6)-3A,XA4(J6)-3B,XA4(J6)-3C,XA4(J6)-4B,XA4(J6)-5A,XA4(J6)-5B,XA4(J6)-5C,XA4(J6)-6B,XA4(J6)-7A,XA4(J6)-7B,XA4(J6)-7C,XA4(J6)-8B,XA4(J6)-9A,XA4(J6)-9B,XA4(J6)-9C,XA4(J6)-10B,XA4(J6)-11A,XA4(J6)-11B,XA4(J6)-11C,XA4(J6)-12B,XA4(J6)-13A,XA4(J6)-13B,XA4(J6)-13C,J14-2,J14-5,J14-8,J15-2,J15-5,J15-8,J16-2,J16-5,J16-8,J17-1,J17-2,J17-5,J17-8,J18-1,J18-2,J18-5,J18-8,J19-1,J19-2,J19-5,J19-8,P2-2,P2-3,P3-1

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 15 of 15)



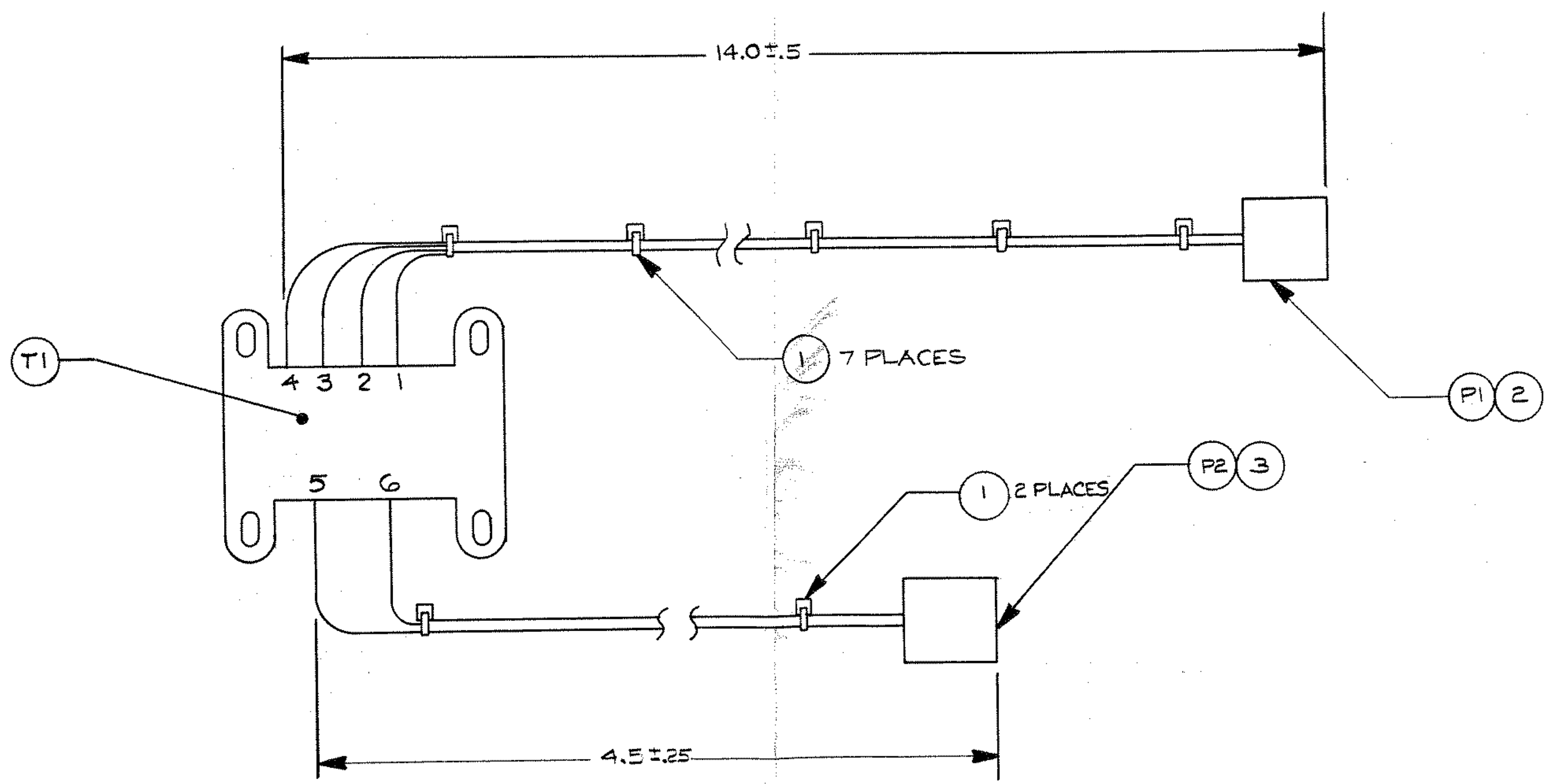


Figure 7.14 Transformer Assembly (A10), Component Location/Schematic

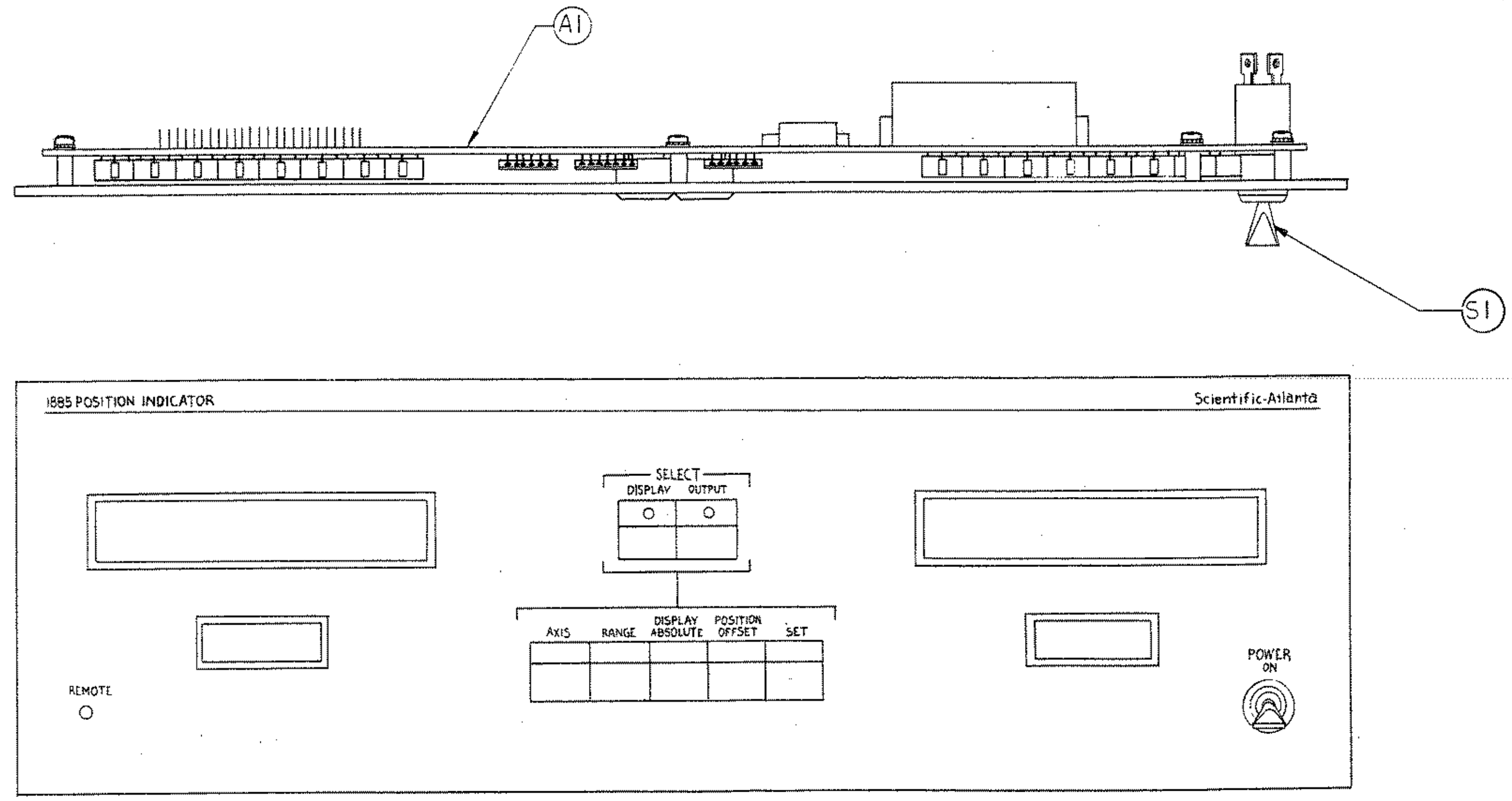


Figure 7.15 Front Panel Assembly (A11)

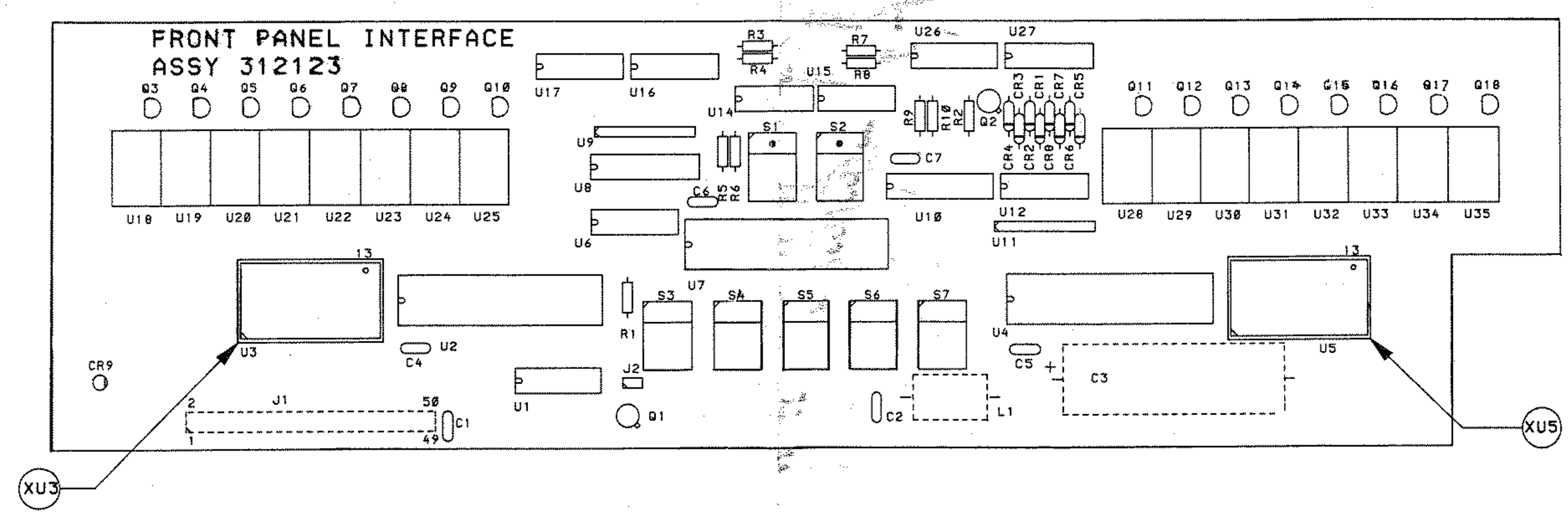
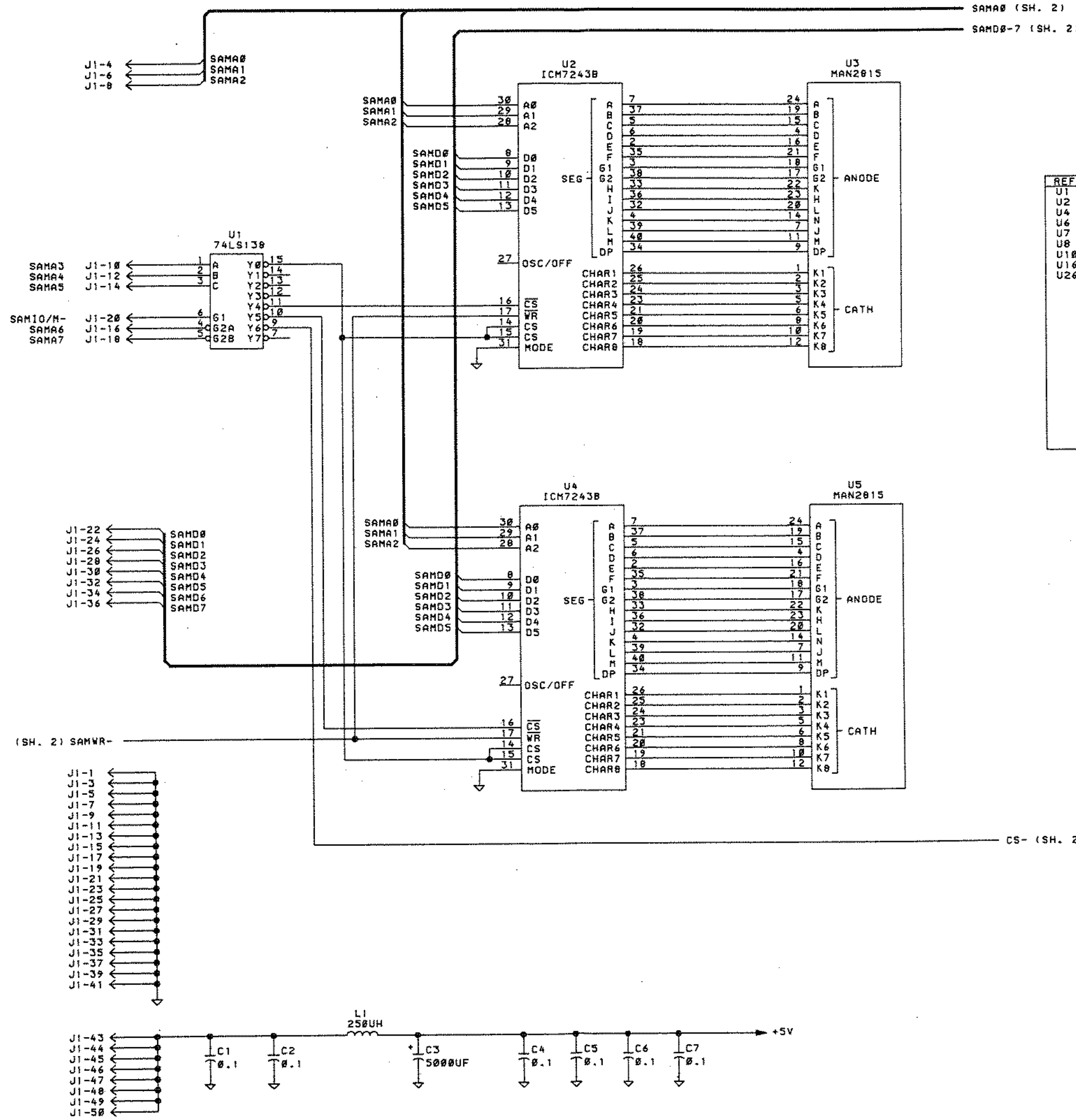


Figure 7.16 Front Panel Interface Assembly, Component Location



REF	GND	+5V
U1	8	16
U2	22	1
U4	22	1
U6	8	16
U7	2Ø	4Ø
U8	1Ø	2Ø
U1Ø	1Ø	2Ø
U16	8	16
U26	8	16

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MICROFARADS
   ALL RESISTORS ARE IN OHMS, ±1Ø%, 1/4W.

Figure 7.17 Front Panel Interface Assembly (A11A1), Schematic (Sheet 1 of 3)

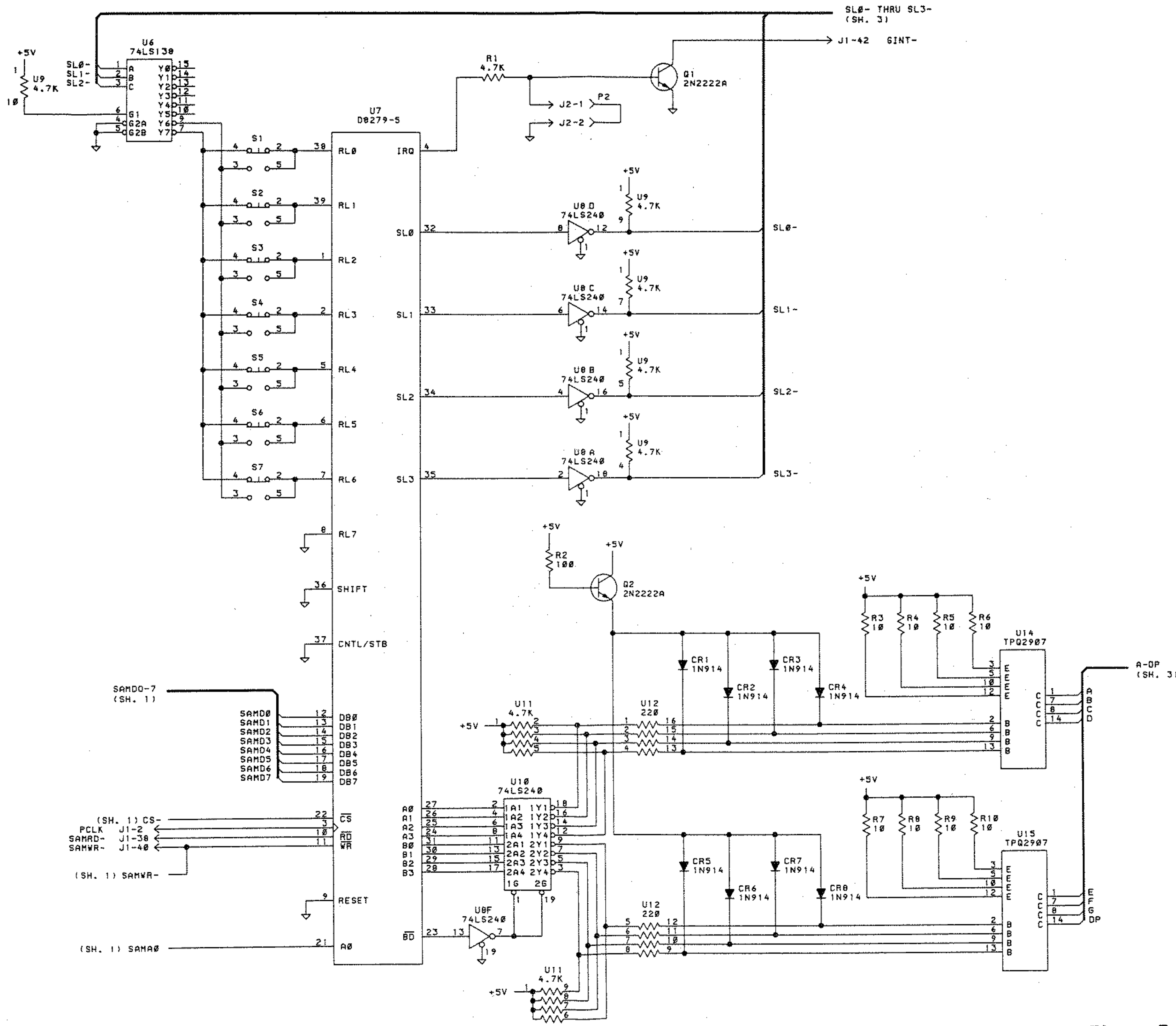


Figure 7.17 **Front Panel Interface Assembly (A1A1), Schematic (Sheet 2 of 3)**

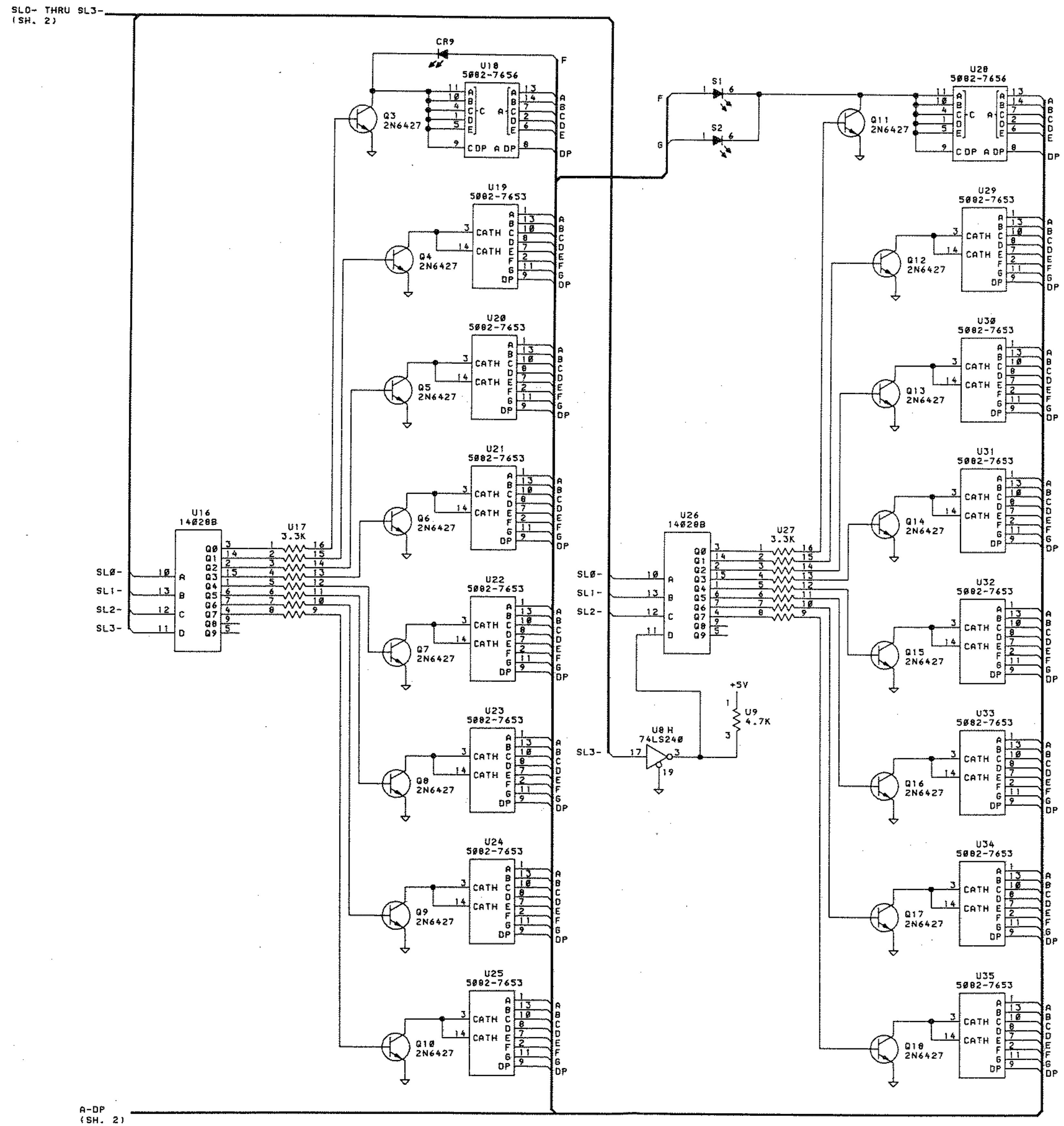


Figure 7.17 Front Panel Interface Assembly (A1A1), Schematic (Sheet 3 of 3)

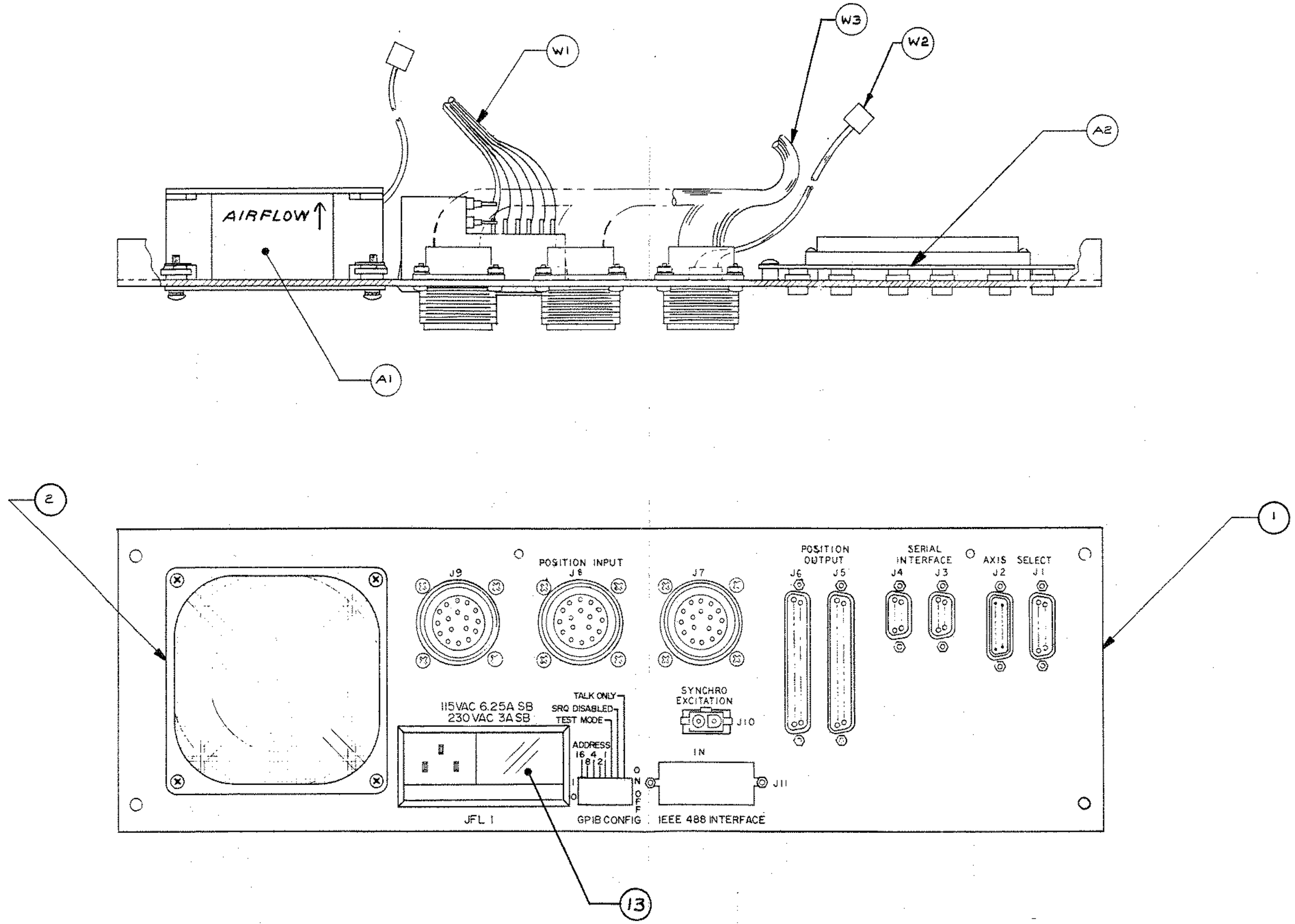
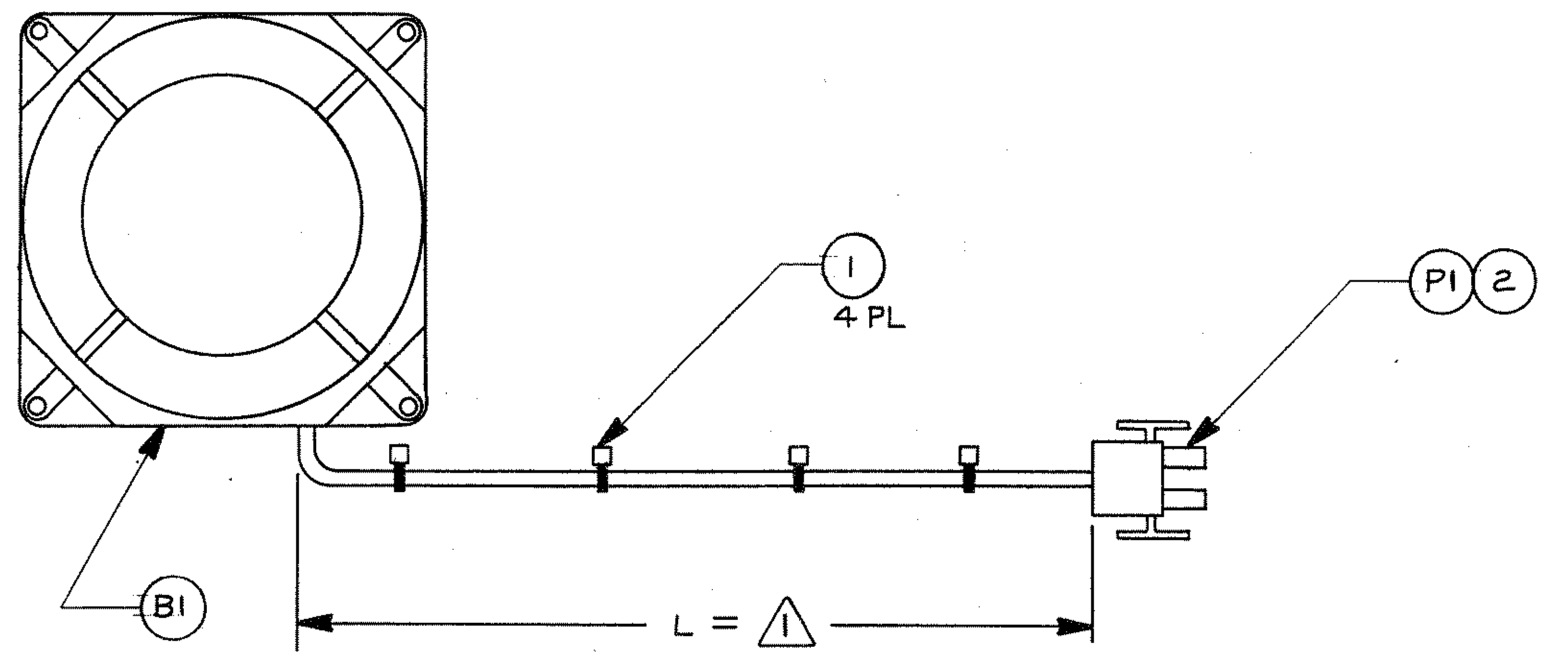


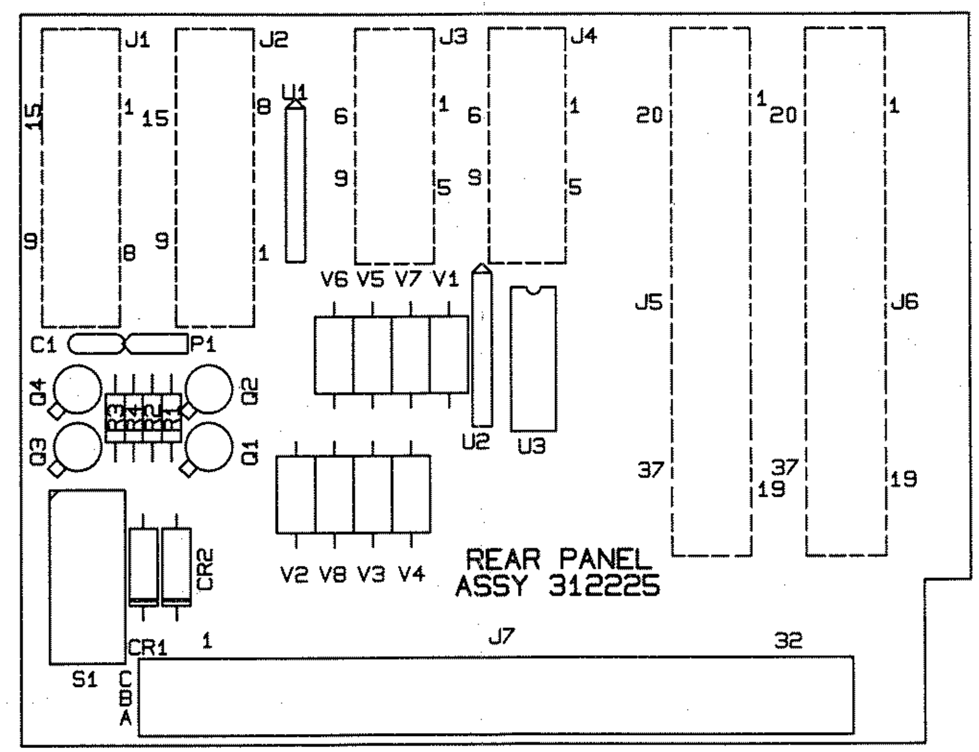
Figure 7.18 Rear Panel Assembly (A12), Component Location



NOTES:
1. CABLE LENGTH CAN VARY BETWEEN 6.0 IN (MIN) TO 12.0 IN (MAX) AFTER INSTALLING ITEM 2 AND P1 TO EXISTING CABLE.

ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
P1	1	37151	CONNECTOR	MALE, 2 CIRCUITS		
B1	1	89519	FAN			
2	2	37152	CONTACT, CONN	18-24 AWG		
1	4	73045	CABLE TIE	4 IN		

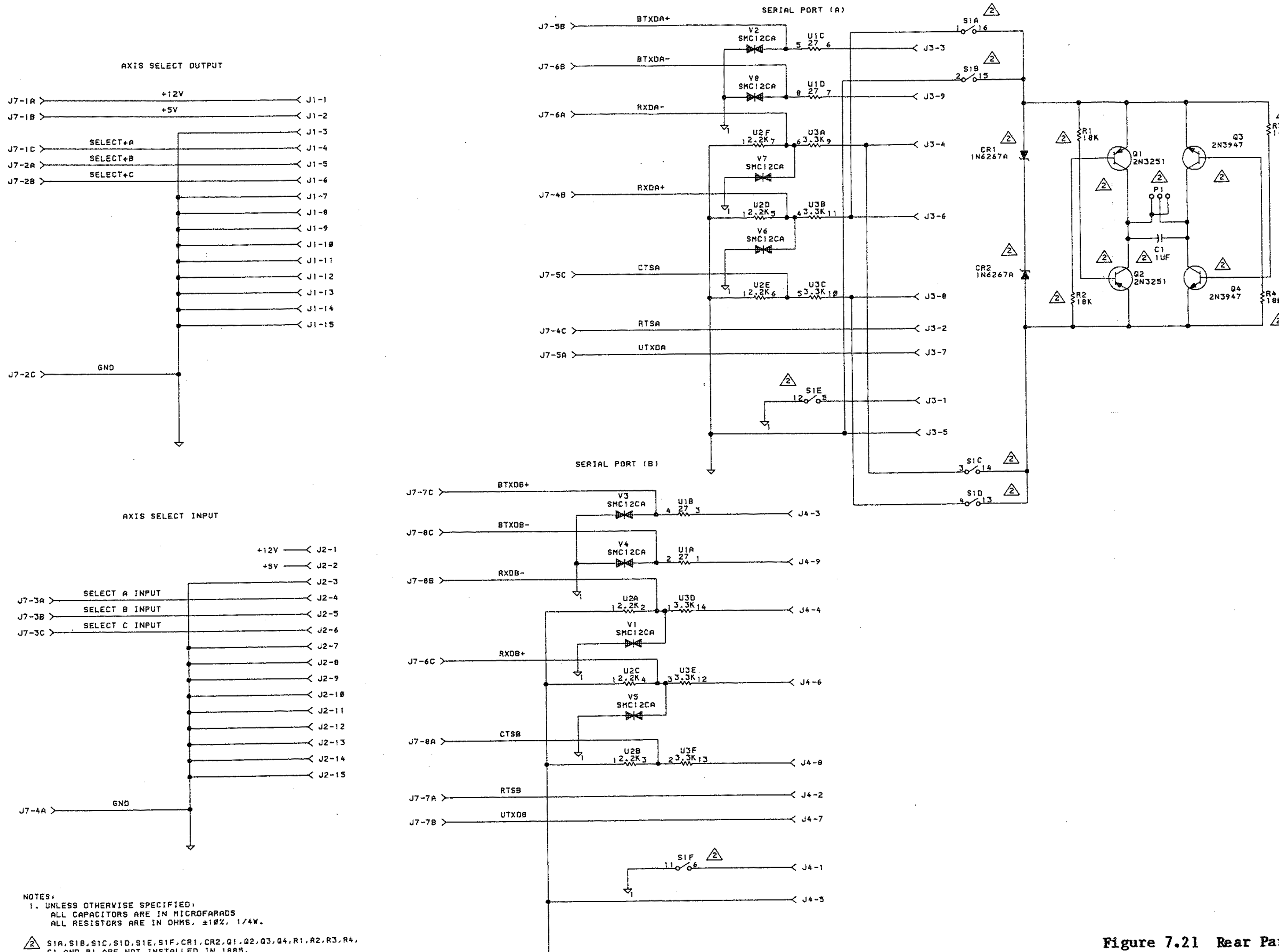
Figure 7.19 Fan Assembly (A12A1)



NOTES:

1. NOT USED: CR1,CR2,P1,Q1,Q2, Q3,Q4,R1,R2,R3,R4, AND C1.

Figure 7.20 Rear Panel Interface Assembly (A12A2)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MICROFARADS
   ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

⚠2 S1A, S1B, S1C, S1D, S1E, S1F, CR1, CR2, Q1, Q2, Q3, Q4, R1, R2, R3, R4, C1 AND P1 ARE NOT INSTALLED IN 1885.

Figure 7.21 Rear Panel Interface Assembly (A12A2), Schematic (Sheet 1 of 2)

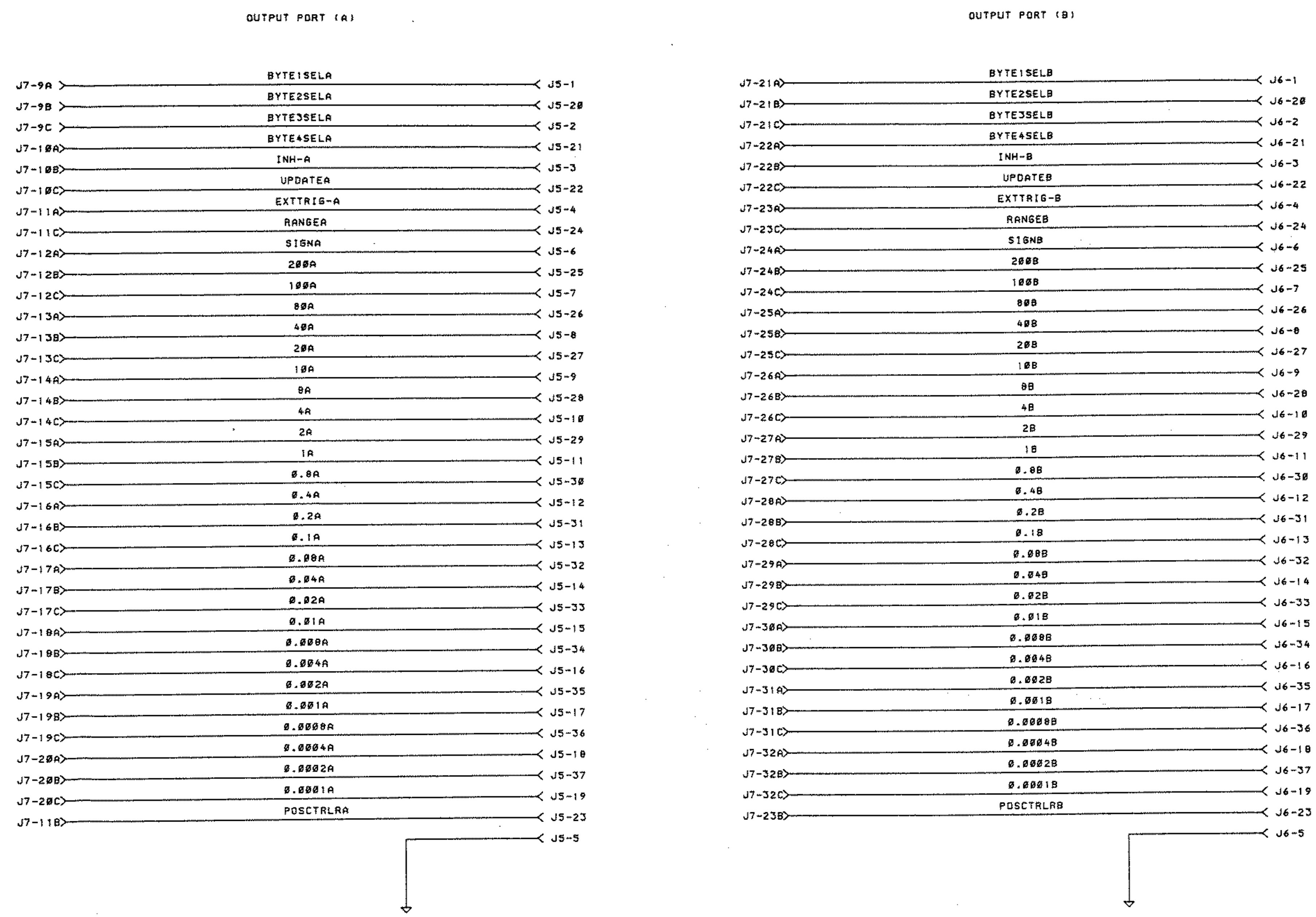


Figure 7.21 Rear Panel Interface Assembly (A12A2), Schematic (Sheet 2 of 2)

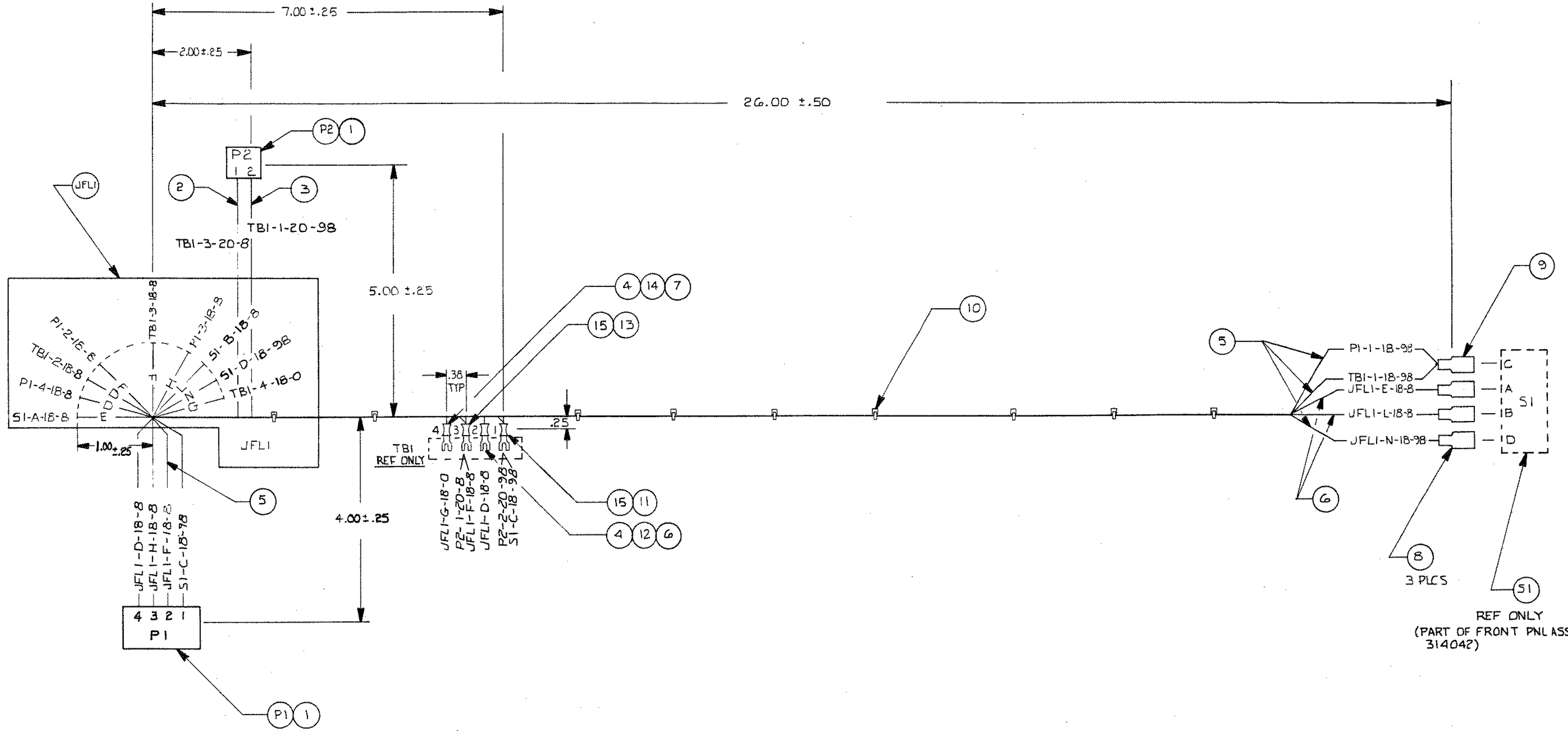


Figure 7.22 Cable Assembly (A12W1), AC Power Harness

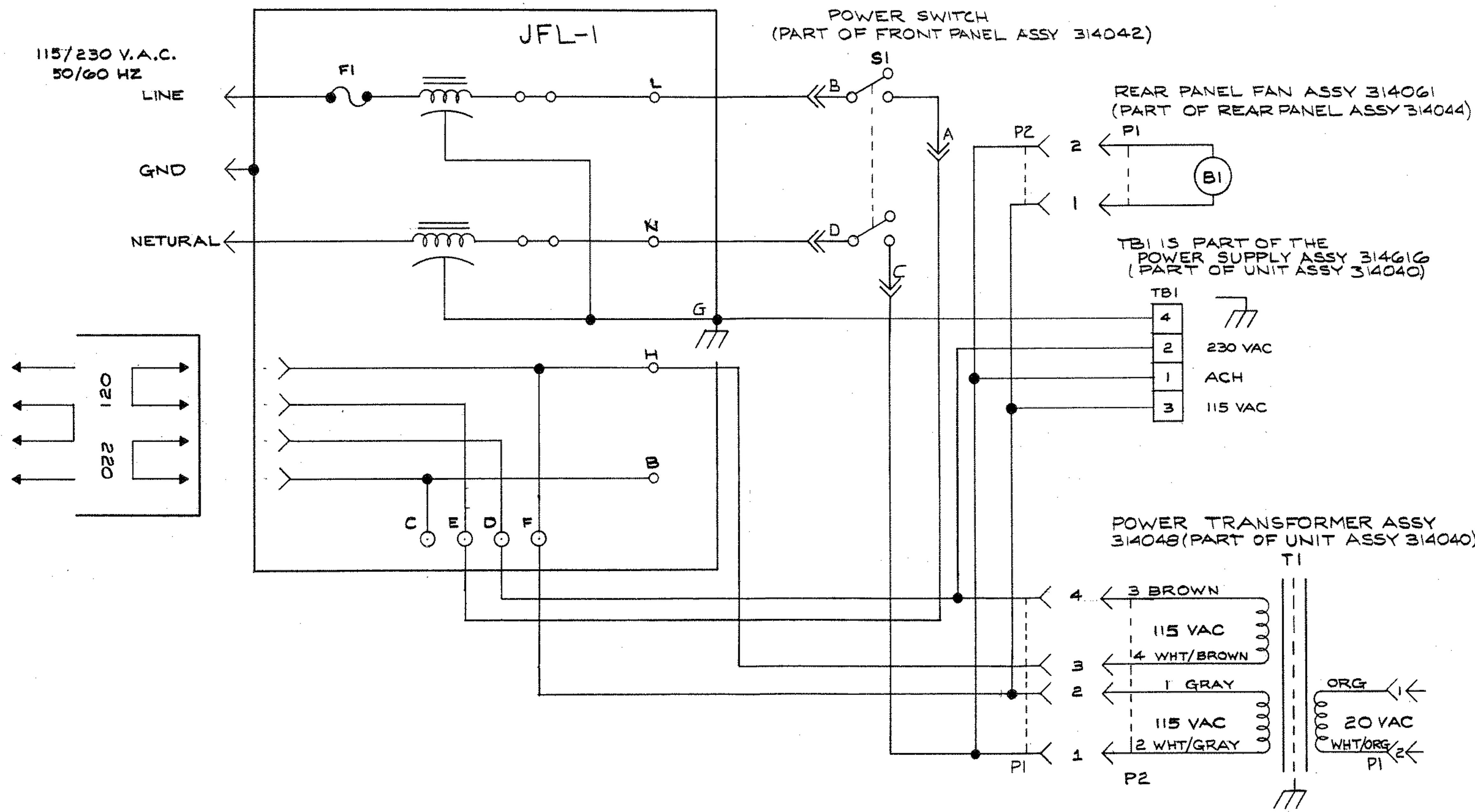
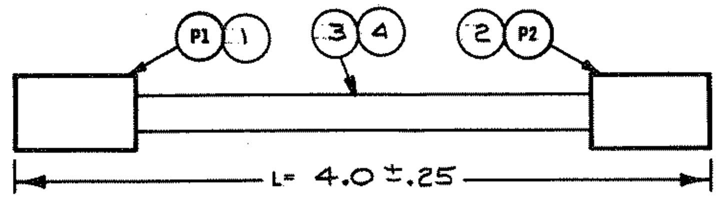


Figure 7.23 Cable Assembly (A12W1), AC Power Harness Schematic

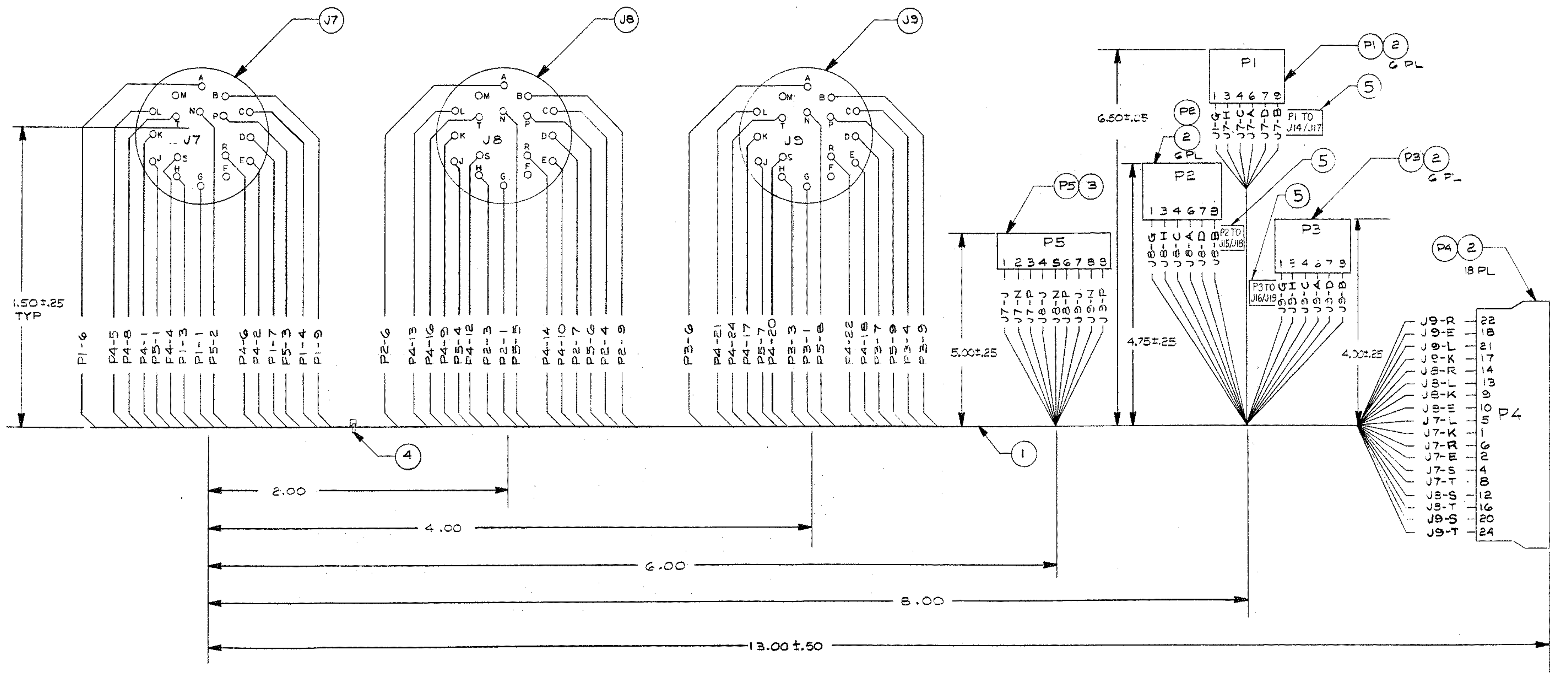


UNLESS OTHERWISE SPECIFIED
REFER TO APPLICABLE
CABLING DIAGRAM FOR LENGTH

ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
P2	1	88688	CONN HOUSING		03-09-2022	
P1	1	174791	CONN HOUSING		19-09-2028	
4	.3FT	73365	WIRE, INSULATED	18 AWG STRD	W/GRAY	
3	.3FT	73355	WIRE, INSULATED	18 AWG STRD	GRAY	
2	2	84019	CONTACT, MALE		02-09-2118	
1	2	84020	CONTACT, FEM		02-09 1118	

PARTS LIST

Figure 7.24 Cable Assembly (A12W2), Rotor Voltage



NOTES:

1. REFERENCE DWG–314046 SCHEMATIC DIAGRAM.

Figure 7.25 Harness Assembly (A12W3), Sync In

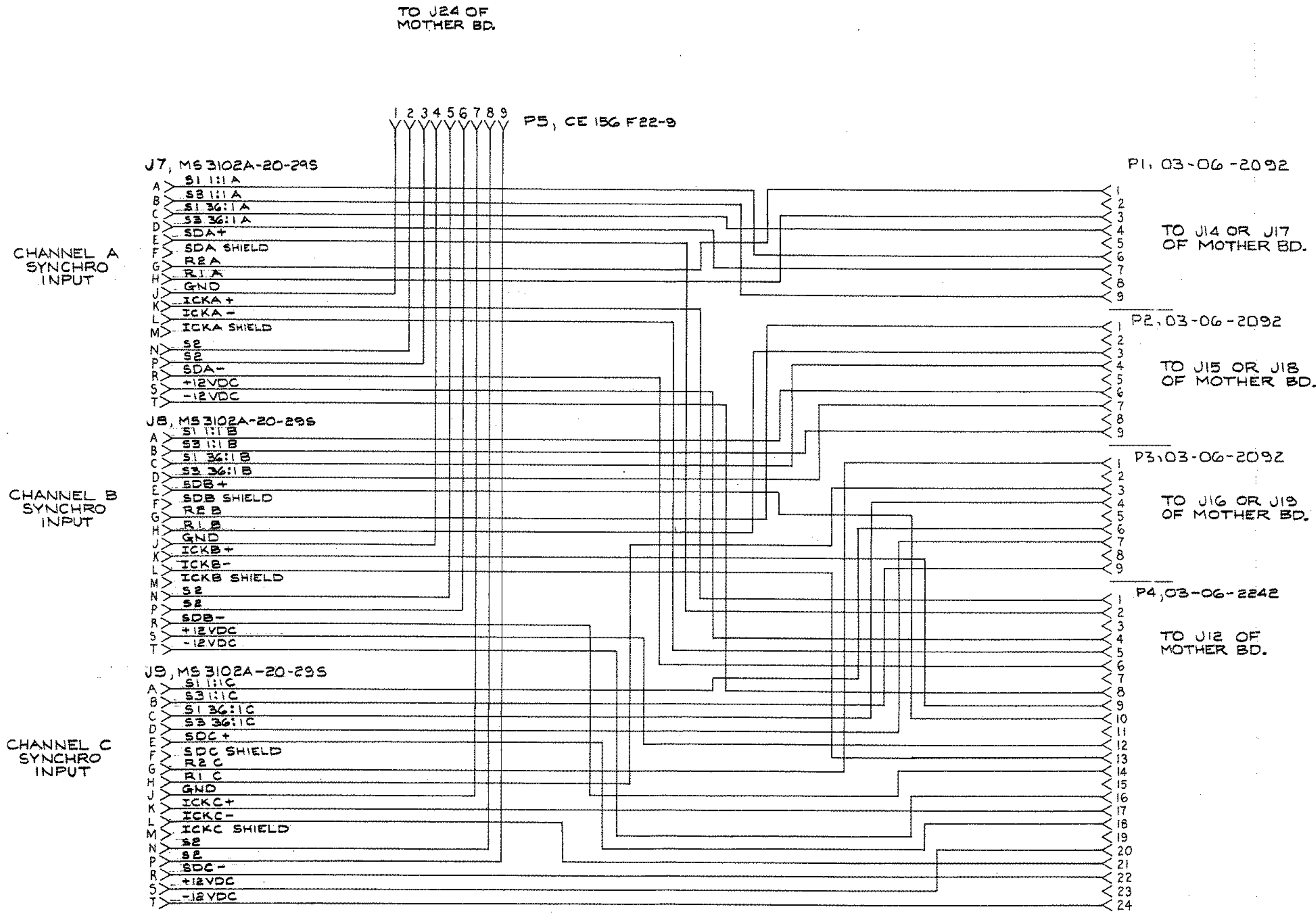


Figure 7.26 Harness Assembly (A12W3), Sync In Schematic

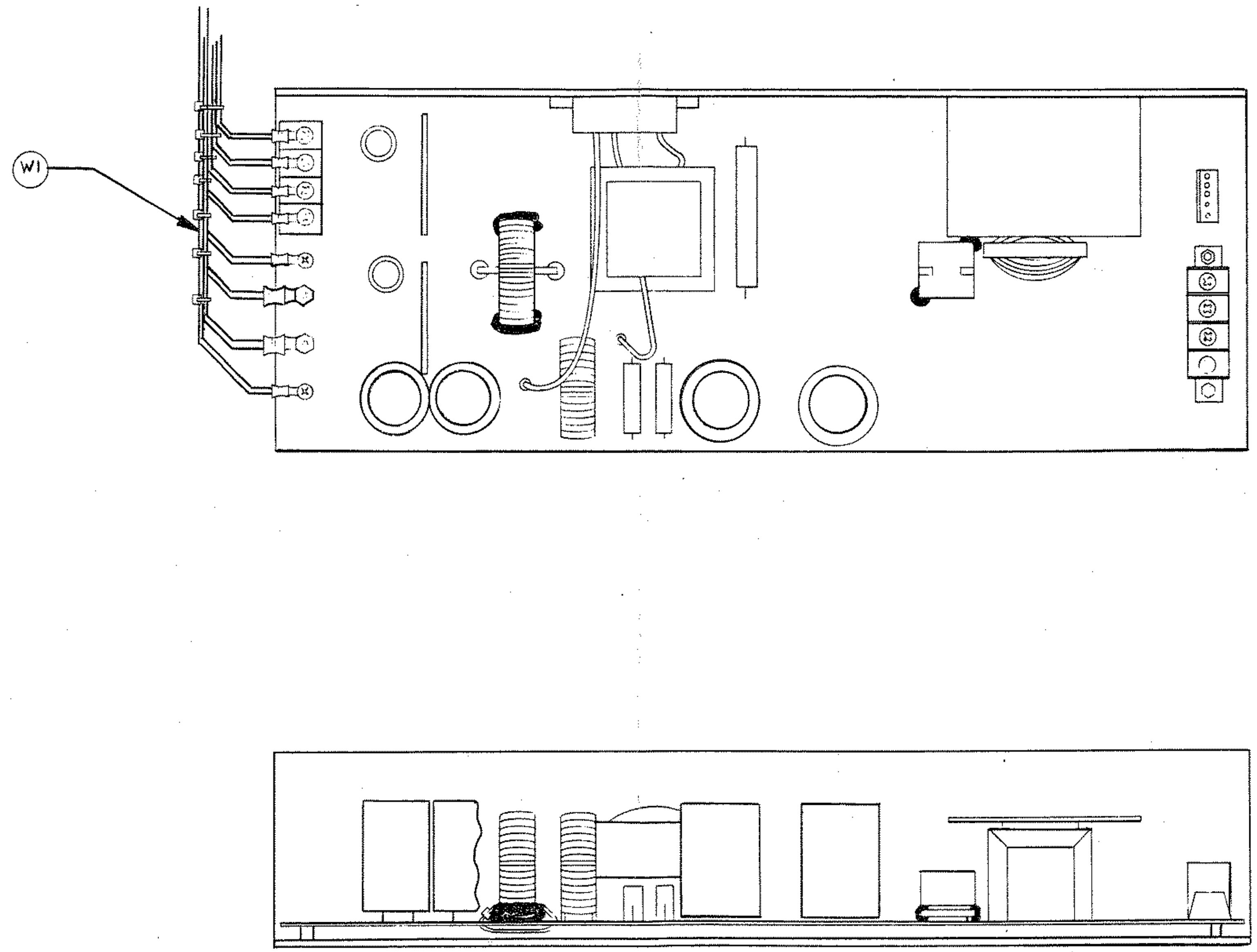
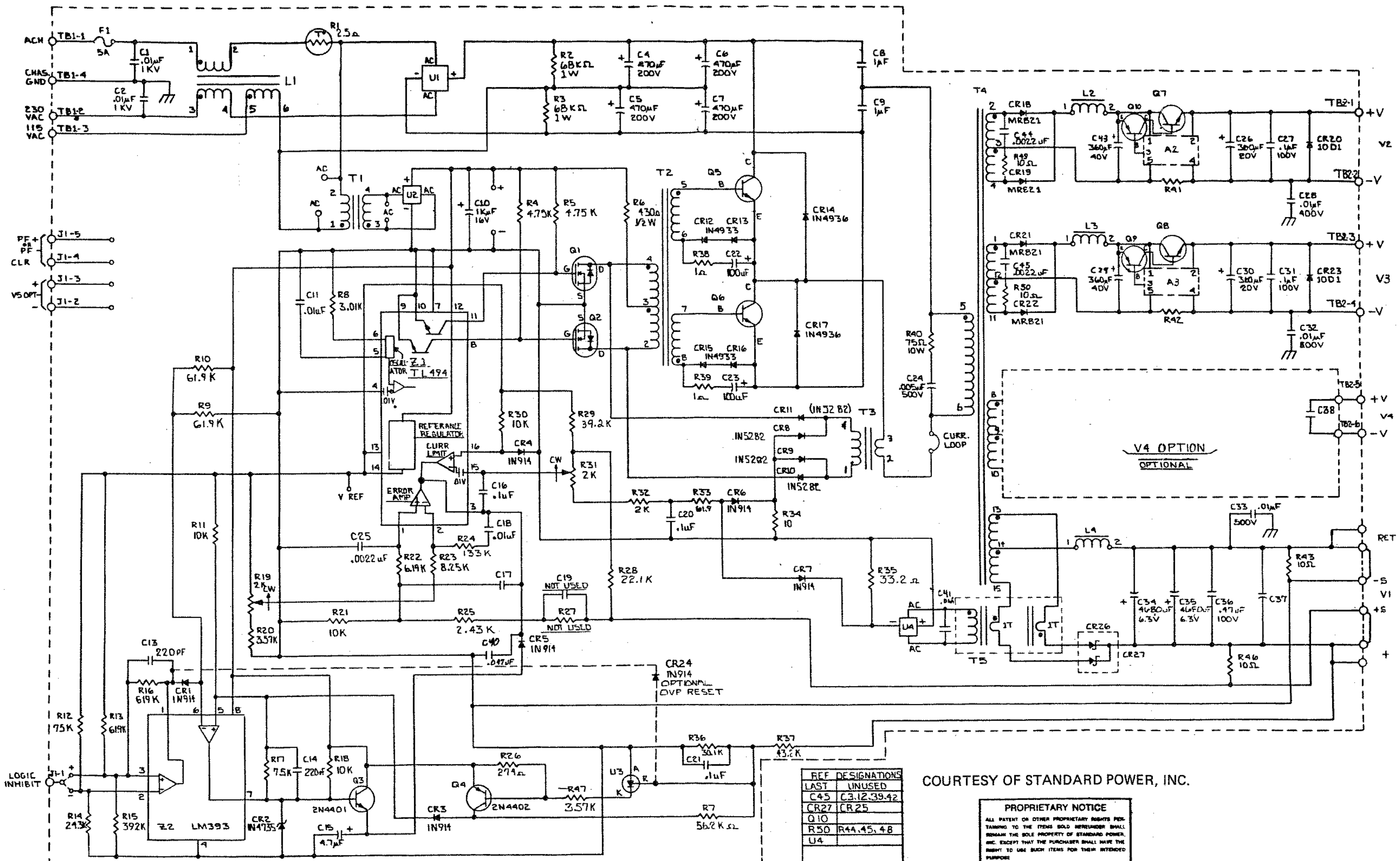


Figure 7.27 Power Supply Assembly (A13), Component Location

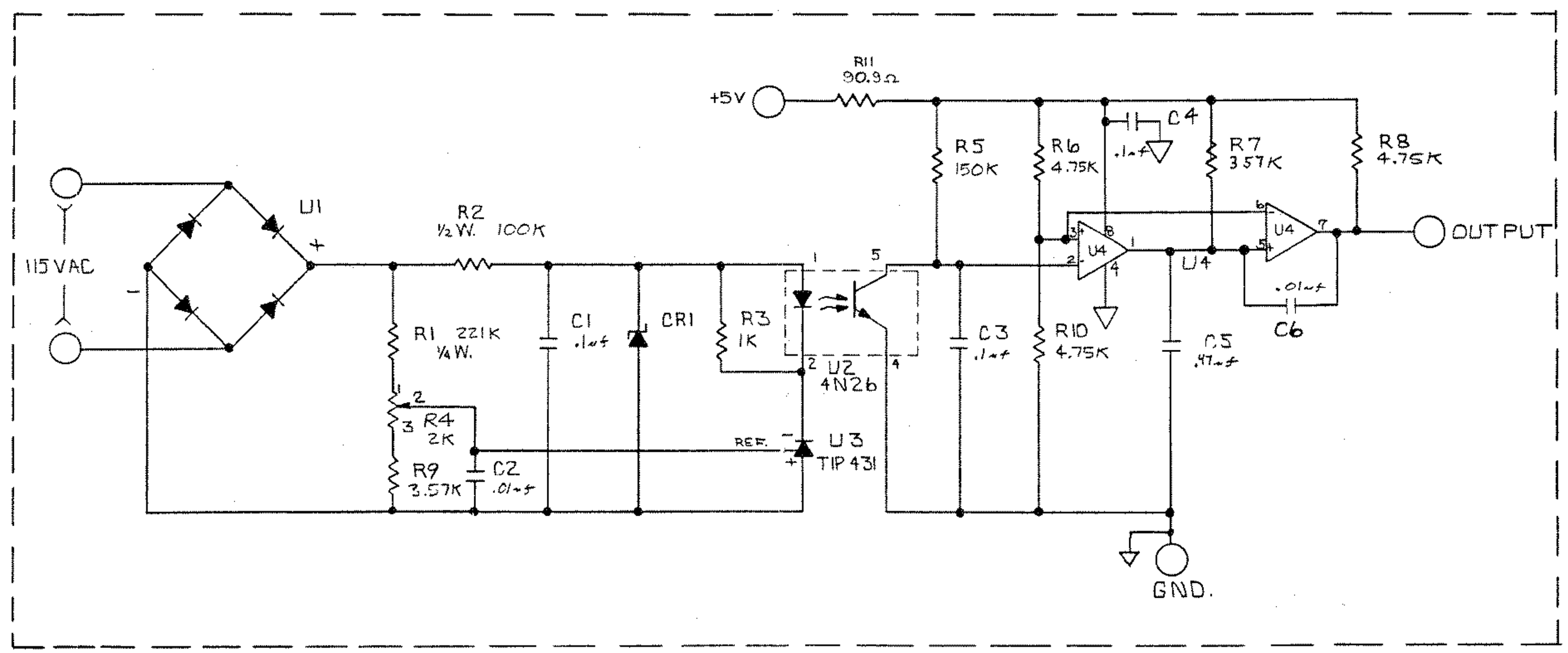


REF DESIGNATIONS	
LAST	UNUSED
C45	C3,12,39,42
CR27	CR25
Q10	
R50	R44,45,48
U4	

COURTESY OF STANDARD POWER, INC.

NOTES:
1. REF ASSY: 01-302453-00
2. RESISTORS ARE IN OHMS, ±1%, 1/4W.
3. CAPACITORS ARE IN MICRO-FARADS.

Figure 7.28 Power Supply Assembly (A13), Schematic



REF DESIGNATIONS	
LAST	UNUSED
C6	
CR1	
R11	
U4	

COURTESY OF STANDARD POWER, INC.

Figure 7.29 Power Fail Assembly, Schematic

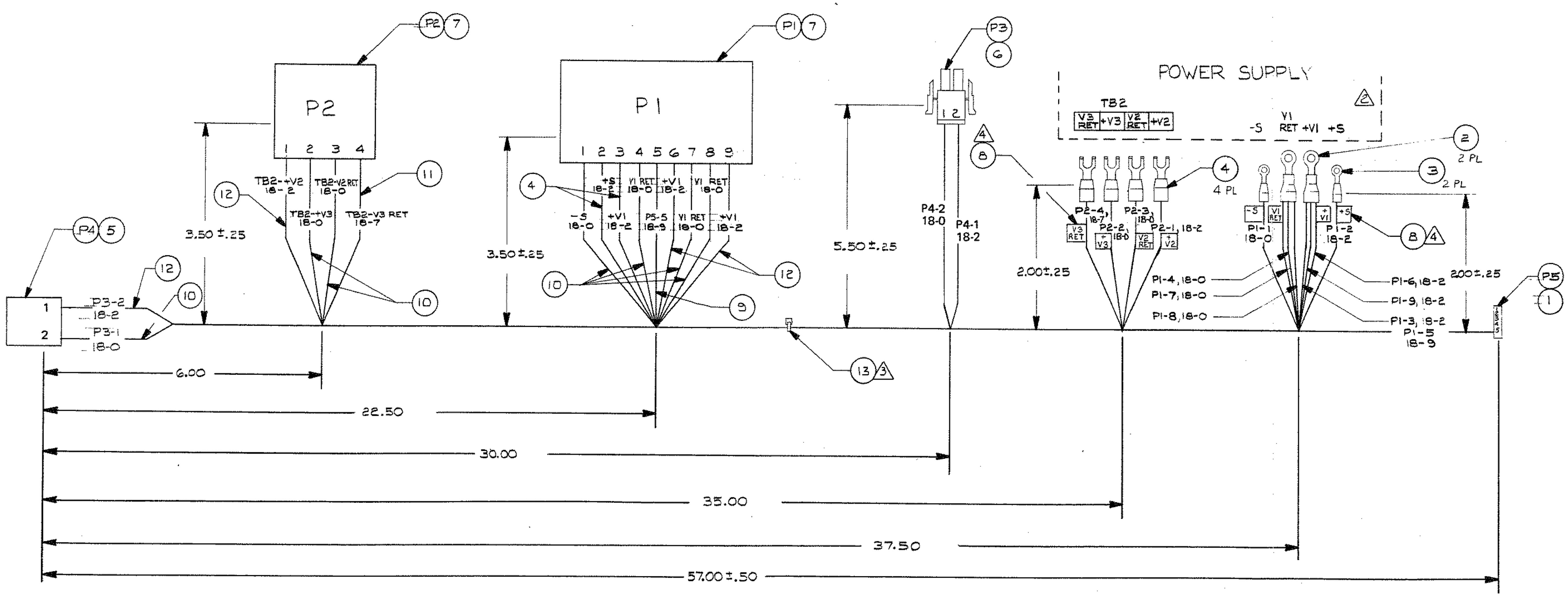


Figure 7.30 Harness Assembly (A13W1), Power Supply

MODEL 1886
POSITION DATA PROCESSOR

XA1-1 (SPARE) - continued

Connector/Pin	Signal Name
XA1(J1)-26C	-12VDC
XA1(J1)-27C	-5VDC
XA1(J1)-28C	+12VDC
XA1(J1)-29C	+5V
XA1(J1)-30C	+5V
XA1(J1)-31C	GND
XA1(J1)-32C	GND

XA1(J2)

Connector/Pin	Signal Name
XA1(J2)-1A	GND
XA1(J2)-2A	(N.C.)
XA1(J2)-3A	(N.C.)
XA1(J2)-4A	(N.C.)
XA1(J2)-5A	AUXTXCTL2A+
XA1(J2)-6A	AUXTXCTL1A+
XA1(J2)-7A	(N.C.)
XA1(J2)-8A	AUXTXDB+
XA1(J2)-9A	AUXTXDA+
XA1(J2)-10A	(N.C.)
XA1(J2)-11A	(N.C.)
XA1(J2)-12A	(N.C.)
XA1(J2)-13A	(N.C.)
XA1(J2)-14A	(N.C.)
XA1(J2)-15A	(N.C.)
XA1(J2)-16A	(N.C.)
XA1(J2)-17A	(N.C.)
XA1(J2)-18A	(N.C.)
XA1(J2)-19A	(N.C.)
XA1(J2)-20A	(N.C.)
XA1(J2)-21A	(N.C.)
XA1(J2)-22A	(N.C.)
XA1(J2)-23A	(N.C.)
XA1(J2)-24A	(N.C.)
XA1(J2)-25A	(N.C.)
XA1(J2)-26A	(N.C.)
XA1(J2)-27A	(N.C.)
XA1(J2)-28A	(N.C.)
XA1(J2)-29A	(N.C.)
XA1(J2)-30A	(N.C.)
XA1(J2)-31A	(N.C.)
XA1(J2)-32A	GND

XA1(J2) - continued

Connector/Pin	Signal Name
XA1(J2)-1B	GND
XA1(J2)-2B	(N.C.)
XA1(J2)-3B	(N.C.)
XA1(J2)-4B	AUXRXDB-
XA1(J2)-5B	GND
XA1(J2)-6B	AUXRXDA-
XA1(J2)-7B	GND
XA1(J2)-8B	(N.C.)
XA1(J2)-9B	(N.C.)
XA1(J2)-10B	(N.C.)
XA1(J2)-11B	(N.C.)
XA1(J2)-12B	(N.C.)
XA1(J2)-13B	(N.C.)
XA1(J2)-14B	(N.C.)
XA1(J2)-15B	(N.C.)
XA1(J2)-16B	(N.C.)
XA1(J2)-17B	(N.C.)
XA1(J2)-18B	(N.C.)
XA1(J2)-19B	(N.C.)
XA1(J2)-20B	(N.C.)
XA1(J2)-21B	(N.C.)
XA1(J2)-22B	(N.C.)
XA1(J2)-23B	(N.C.)
XA1(J2)-24B	(N.C.)
XA1(J2)-25B	(N.C.)
XA1(J2)-26B	(N.C.)
XA1(J2)-27B	(N.C.)
XA1(J2)-28B	(N.C.)
XA1(J2)-29B	(N.C.)
XA1(J2)-30B	(N.C.)
XA1(J2)-31B	(N.C.)
XA1(J2)-32B	GND
XA1(J2)-1C	GND
XA1(J2)-2C	(N.C.)
XA1(J2)-3C	(N.C.)
XA1(J2)-4C	AUXRXCTL2A-
XA1(J2)-5C	GND
XA1(J2)-6C	AUXRXCTL1A-
XA1(J2)-7C	GND
XA1(J2)-8C	(N.C.)
XA1(J2)-9C	(N.C.)
XA1(J2)-10C	(N.C.)
XA1(J2)-11C	(N.C.)
XA1(J2)-12C	GPIBSRQ
XA1(J2)-13C	GPIBATN
XA1(J2)-14C	GPIBEOI
XA1(J2)-15C	GPIBDAV
XA1(J2)-16C	GPIBNRFD
XA1(J2)-17C	GPIBNDAC
XA1(J2)-18C	GPIBIFC

XA1(J2) (continued)

Connector/Pin	Signal Name
XA1(J2)-19C	GPIBREN
XA1(J2)-20C	GPIBD7
XA1(J2)-21C	GPIBD6
XA1(J2)-22C	GPIBD5
XA1(J2)-23C	GPIBD4
XA1(J2)-24C	GPIBD3
XA1(J2)-25C	GPIBD2
XA1(J2)-26C	GPIBD1
XA1(J2)-27C	GPIBD0
XA1(J2)-28C	(N.C.)
XA1(J2)-29C	(N.C.)
XA1(J2)-30C	(N.C.)
XA1(J2)-31C	(N.C.)
XA1(J2)-32C	GND

XA2(J3)

Connector/Pin	Signal Name
XA2(J3)-1A	GND
XA2(J3)-2A	GND
XA2(J3)-3A	(N.C.)
XA2(J3)-4A	(N.C.)
XA2(J3)-5A	(N.C.)
XA2(J3)-6A	SAMWE-
XA2(J3)-7A	SAMRD-
XA2(J3)-8A	(N.C.)
XA2(J3)-9A	(N.C.)
XA2(J3)-10A	(N.C.)
XA2(J3)-11A	SAMD5
XA2(J3)-12A	SAMD2
XA2(J3)-13A	FIFODRQ-
XA2(J3)-14A	SAMRDY+
XA2(J3)-15A	BUSY-
XA2(J3)-16A	SFIFOCOM-
XA2(J3)-17A	(N.C.)
XA2(J3)-18A	(N.C.)
XA2(J3)-19A	SAMA17
XA2(J3)-20A	SAMA14
XA2(J3)-21A	SAMA11
XA2(J3)-22A	SAMA8
XA2(J3)-23A	SAMA5
XA2(J3)-24A	SAMA2
XA2(J3)-25A	GND
XA2(J3)-26A	-12VDC
XA2(J3)-27A	-5VDC
XA2(J3)-28A	+12VDC
XA2(J3)-29A	+5V
XA2(J3)-30A	+5V

XA2(J3) (continued)

Connector/Pin	Signal Name
XA2(J3)-31A	GND
XA2(J3)-32A	GND
XA2(J3)-1B	GND
XA2(J3)-2B	GND
XA2(J3)-3B	(N.C.)
XA2(J3)-4B	(N.C.)
XA2(J3)-5B	(N.C.)
XA2(J3)-6B	SAMDEN
XA2(J3)-7B	(N.C.)
XA2(J3)-8B	(N.C.)
XA2(J3)-9B	(N.C.)
XA2(J3)-10B	SAMD7
XA2(J3)-11B	SAMD4
XA2(J3)-12B	SAMD1
XA2(J3)-13B	BPRO-
XA2(J3)-14B	BUSGRNT-
XA2(J3)-15B	SAMINIT-
XA2(J3)-16B	SAMDT/R+
XA2(J3)-17B	(N.C.)
XA2(J3)-18B	SAMA19
XA2(J3)-19B	SAMA16
XA2(J3)-20B	SAMA13
XA2(J3)-21B	SAMA10
XA2(J3)-22B	SAMA7
XA2(J3)-23B	SAMA4
XA2(J3)-24B	SAMA1
XA2(J3)-25B	GND
XA2(J3)-26B	-12VDC
XA2(J3)-27B	-5VDC
XA2(J3)-28B	+12VDC
XA2(J3)-29B	+5V
XA2(J3)-30B	+5V
XA2(J3)-31B	GND
XA2(J3)-32B	GND
XA2(J3)-1C	GND
XA2(J3)-2C	GND
XA2(J3)-3C	(N.C.)
XA2(J3)-4C	(N.C.)
XA2(J3)-5C	GINT
XA2(J3)-6C	SAMWR-
XA2(J3)-7C	(N.C.)
XA2(J3)-8C	(N.C.)
XA2(J3)-9C	(N.C.)
XA2(J3)-10C	SAMD6
XA2(J3)-11C	SAMD3
XA2(J3)-12C	SAMD0
XA2(J3)-13C	BPRN-
XA2(J3)-14C	CBRQST-

Figure 7.13 Motherboard Assembly (A9), Schematic/Net List (Sheet 5 of 15)

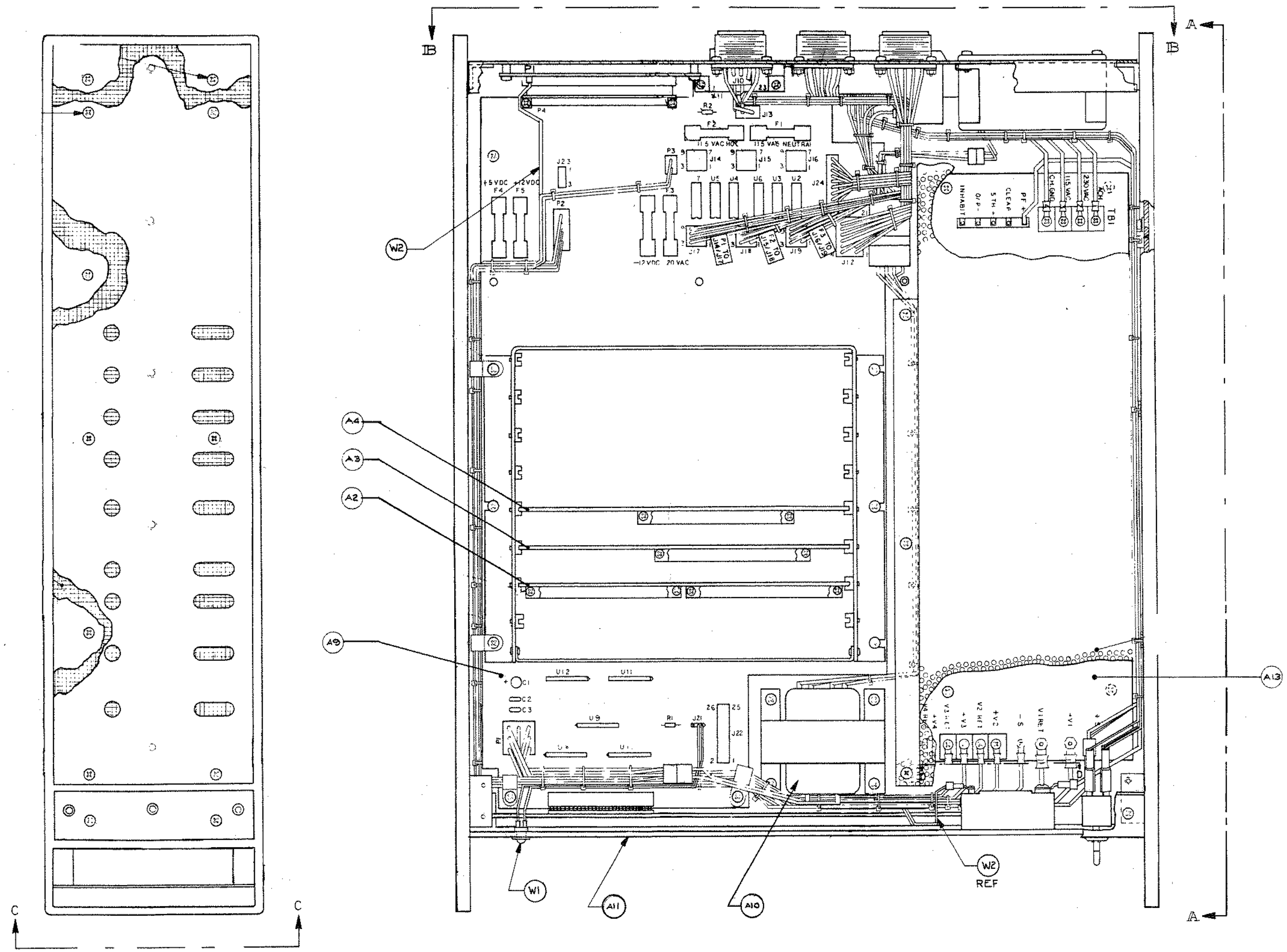
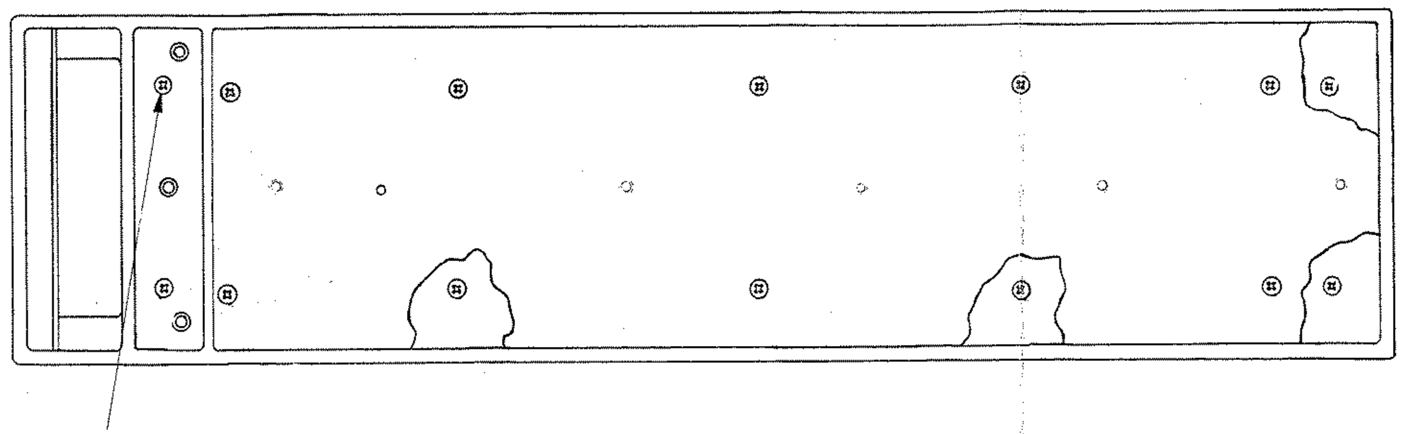
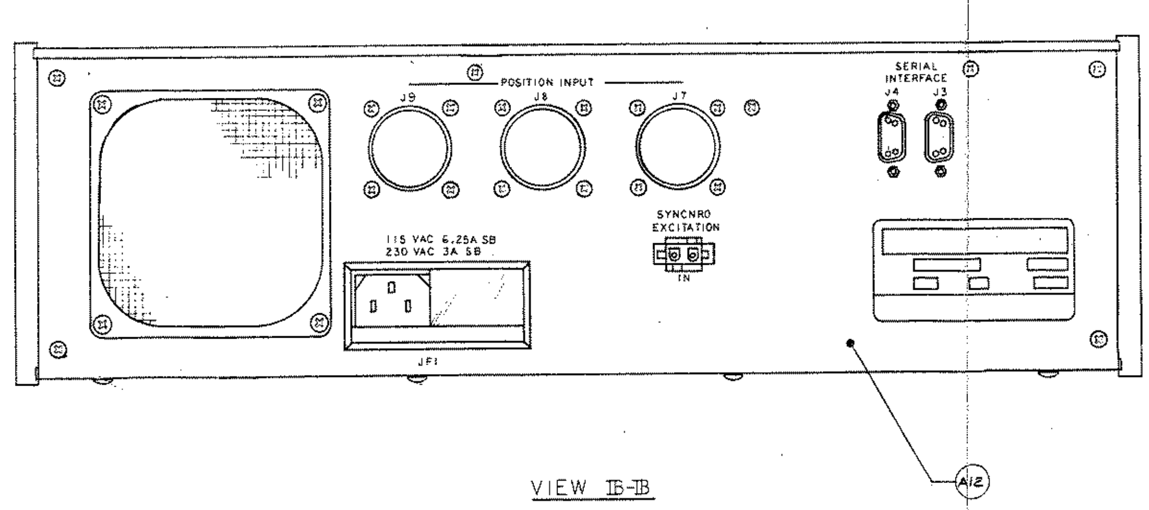


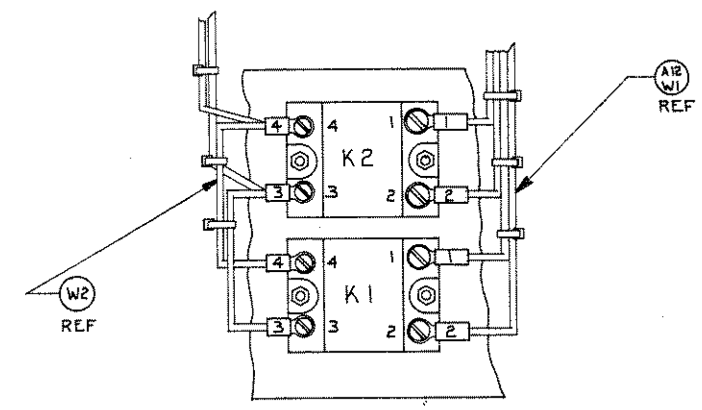
Figure 7.31 Model 1886 Unit Assembly and Wiring Diagram (Sheet 1 of 3)



VIEW A-A



VIEW B-B



VIEW D-D

Figure 7.31 Model 1886 Unit Assembly and Wiring Diagram (Sheet 2 of 3)

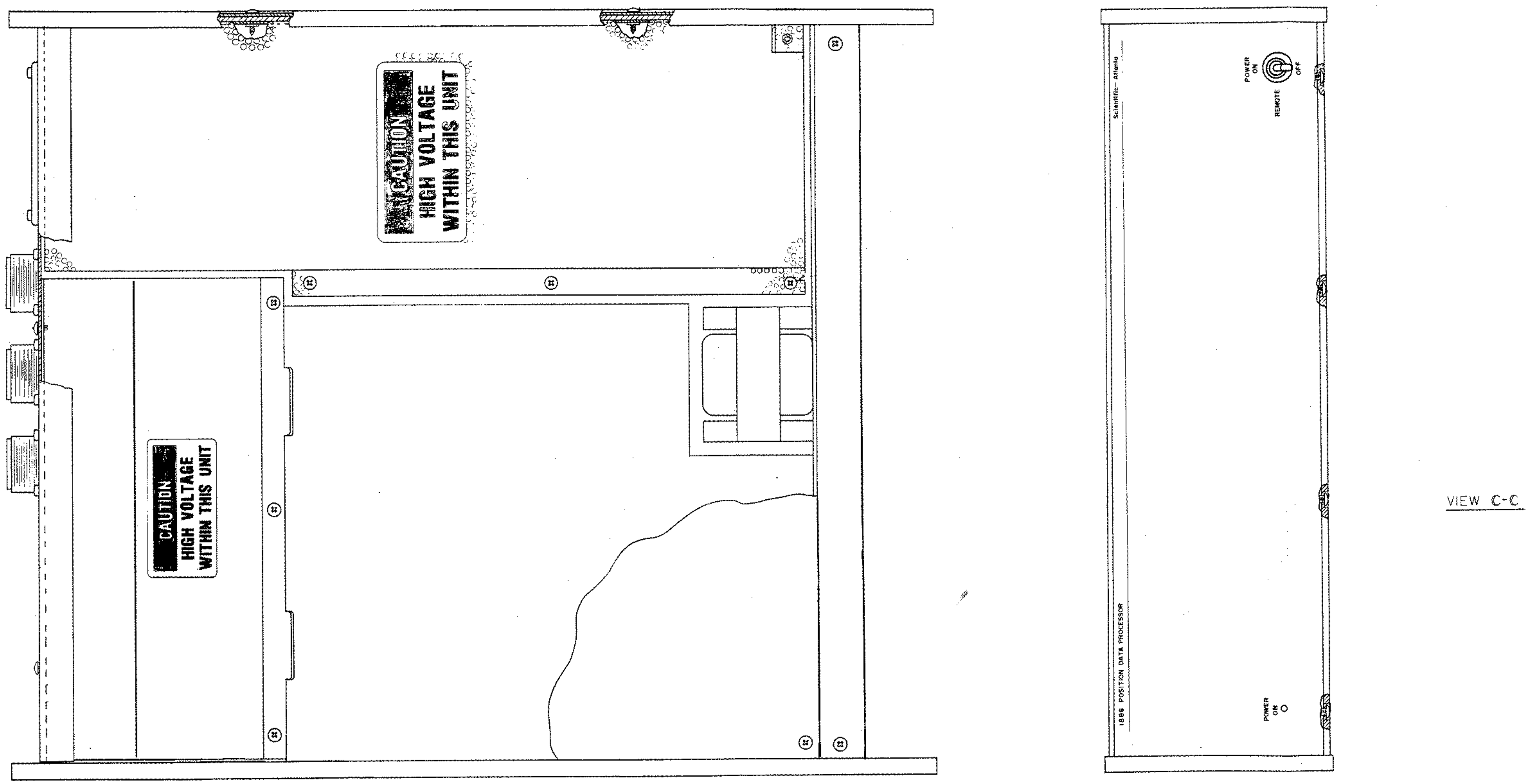


Figure 7.31 Model 1886 Unit Assembly and Wiring Diagram (Sheet 3 of 3)

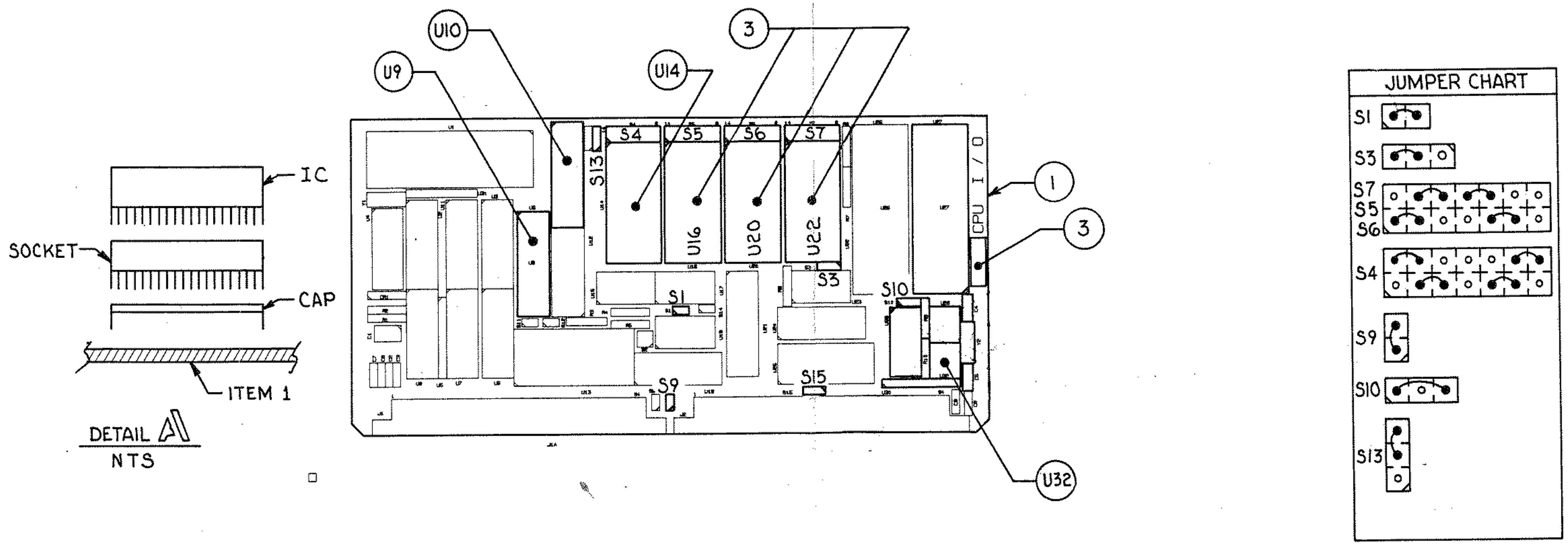


Figure 7.32 CPU Assembly (A2), Component Location

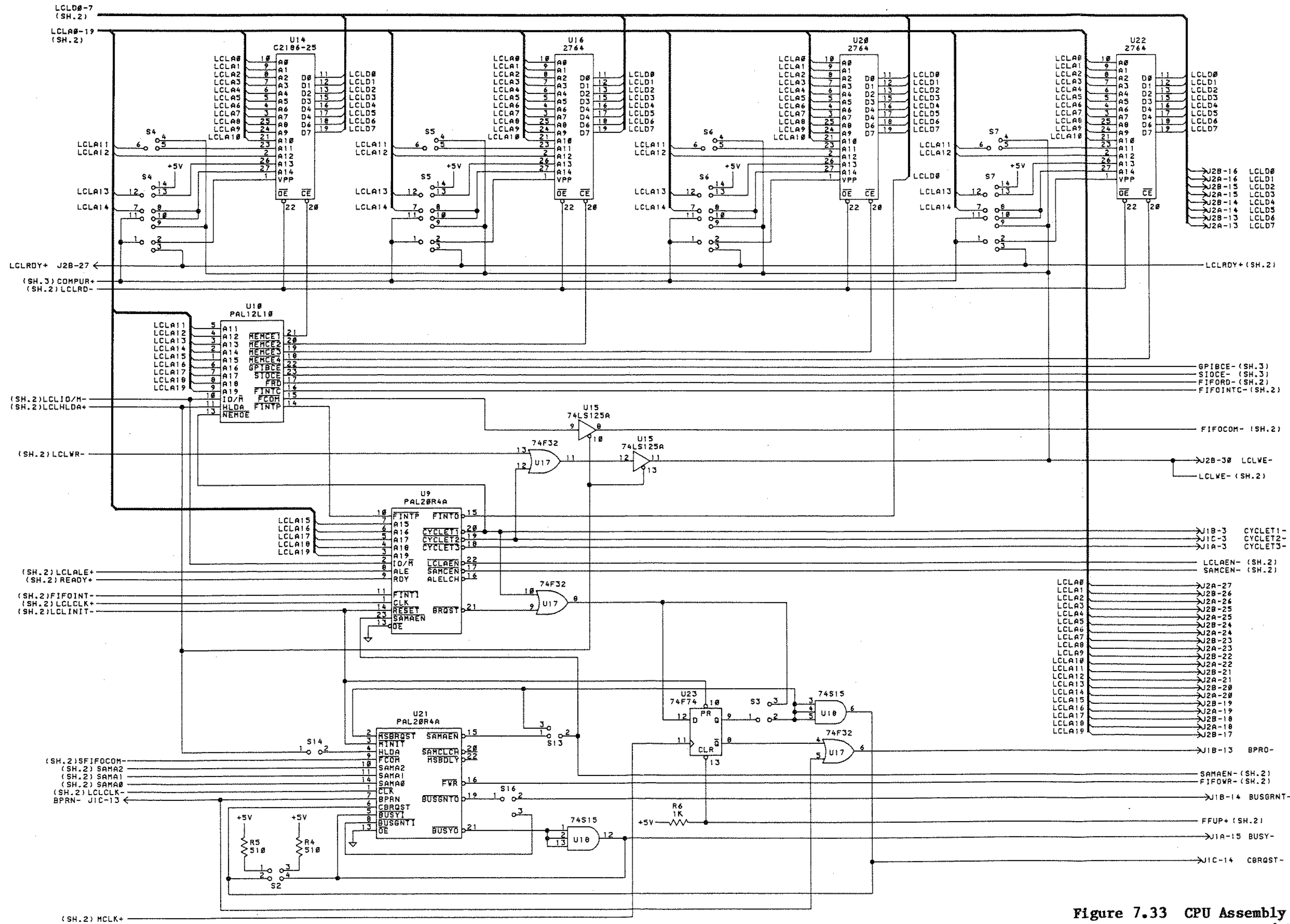


Figure 7.33 CPU Assembly (A2), Schematic (Sheet 1 of 3)

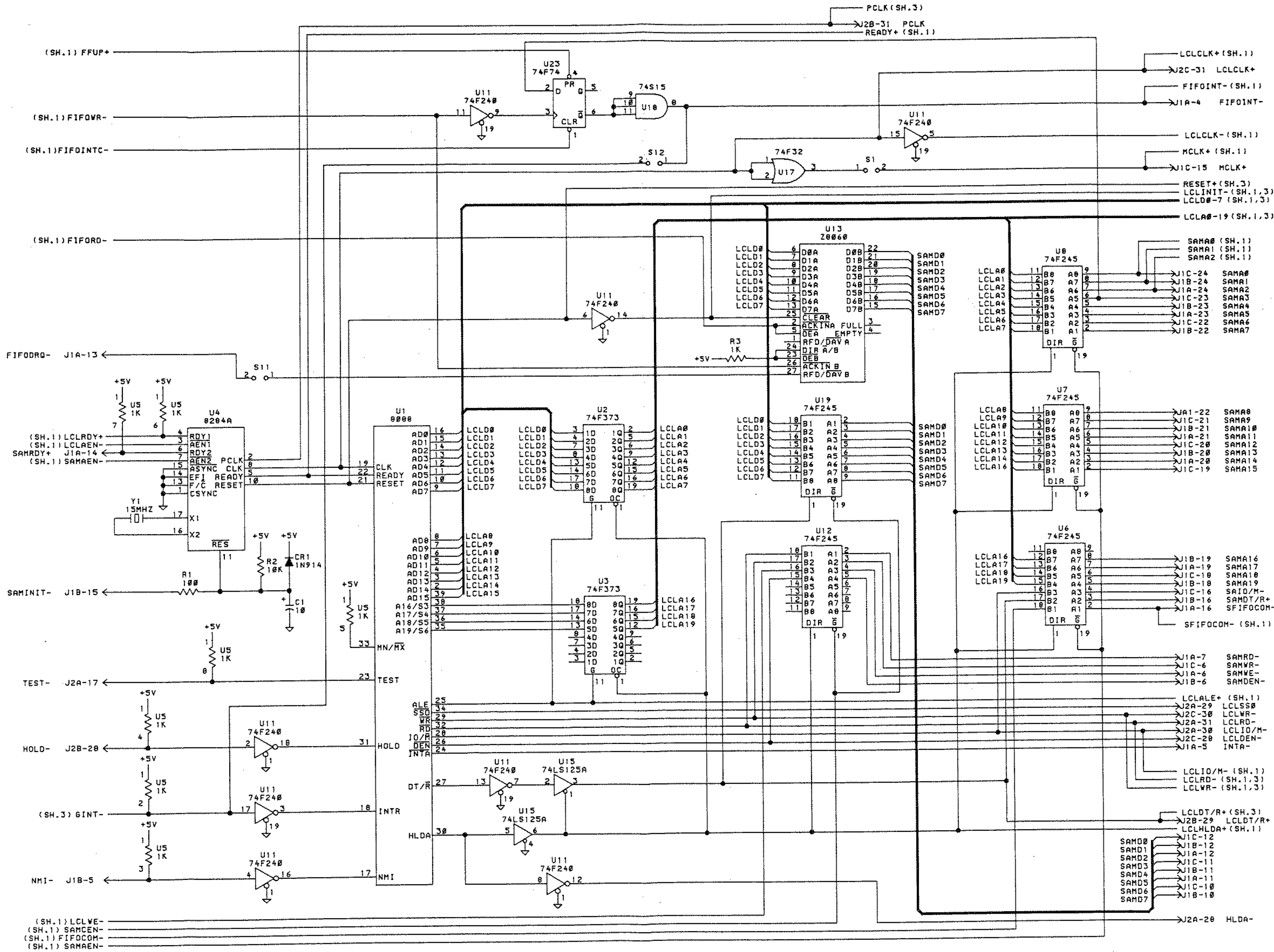
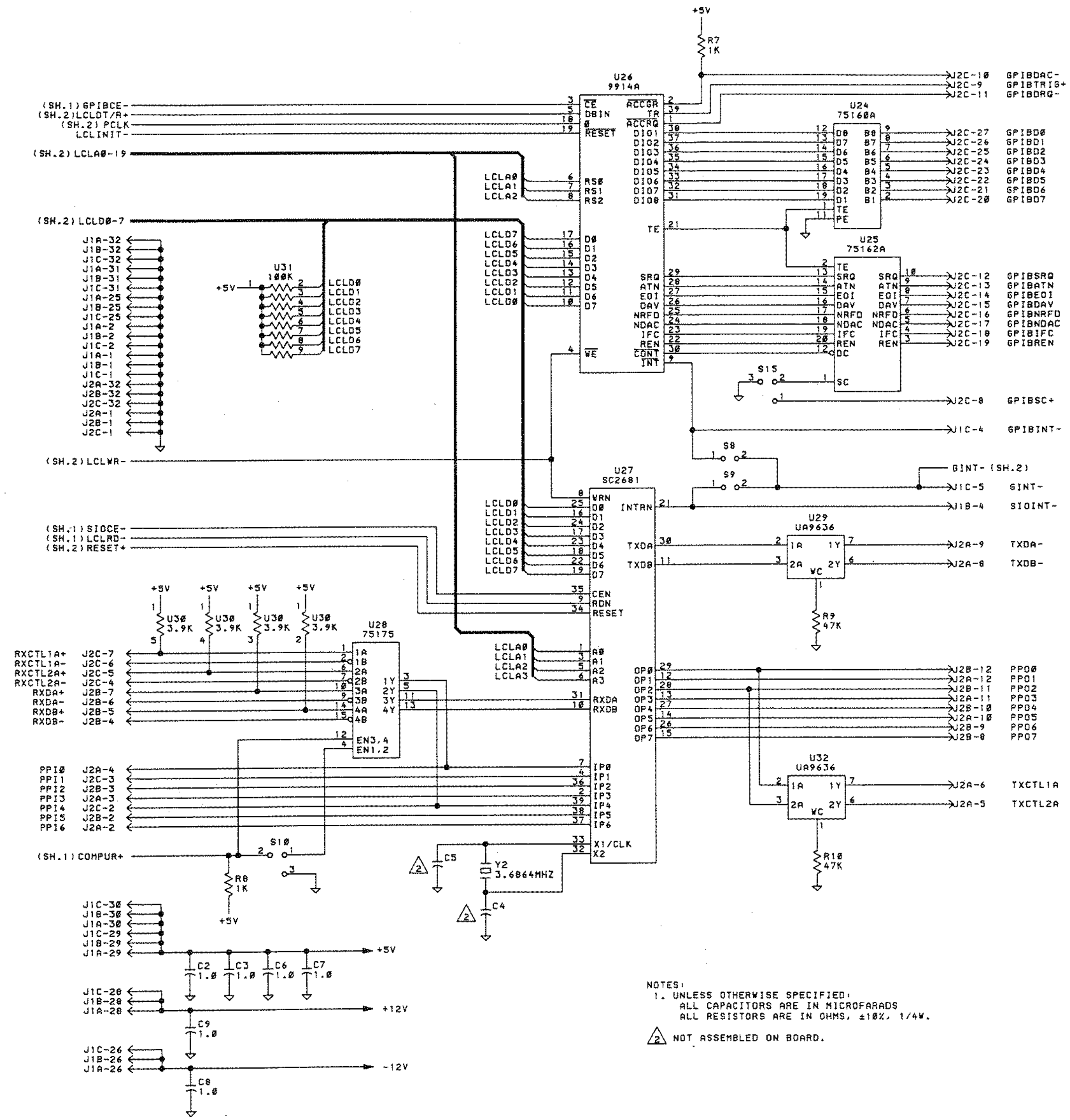


Figure 7.33 CPU Assembly (A2), Schematic (Sheet 2 of 3)



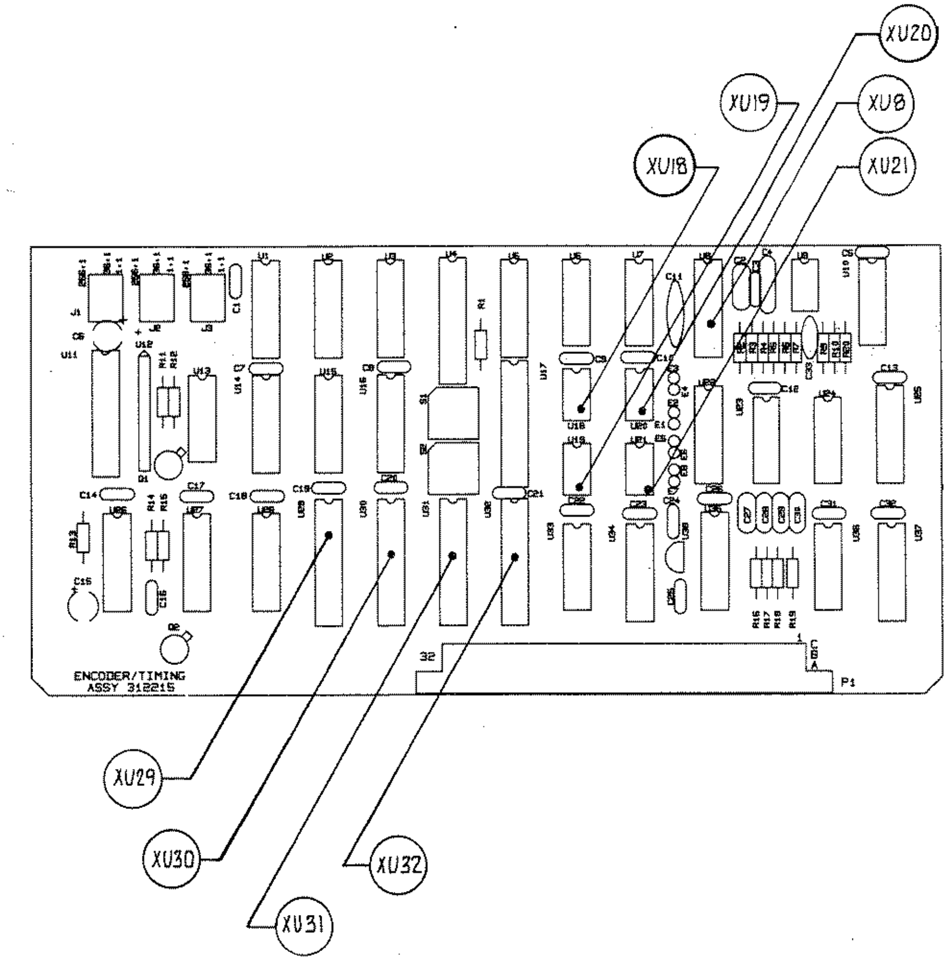
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

2 NOT ASSEMBLED ON BOARD.

TYPE NO.	REF	GND	+5V
8088	U1	1,20	40
74F373	U2	10	20
74F373	U3	10	20
8284A	U4	9	18
	U5		1
74F245	U6	10	20
74F245	U7	10	20
74F245	U8	10	20
PAL20R4A	U9	12	24
PAL12L10	U10	12	24
74F240	U11	10	20
74F245	U12	10	20
Z8060	U13	14	28
C2186-25	U14	14	28
74LS125	U15	7	14
2764	U16	14	28
74F32	U17	7	14
74S15	U18	7	14
74F245	U19	10	20
2764	U20	14	28
PAL20R4A	U21	12	24
2764	U22	14	28
74F74	U23	7	14
75160A	U24	10	20
75162A	U25	11	22
9914A	U26	20	40
SC2681	U27	20	40
75175	U28	8	16
	U30		1
	U31		1

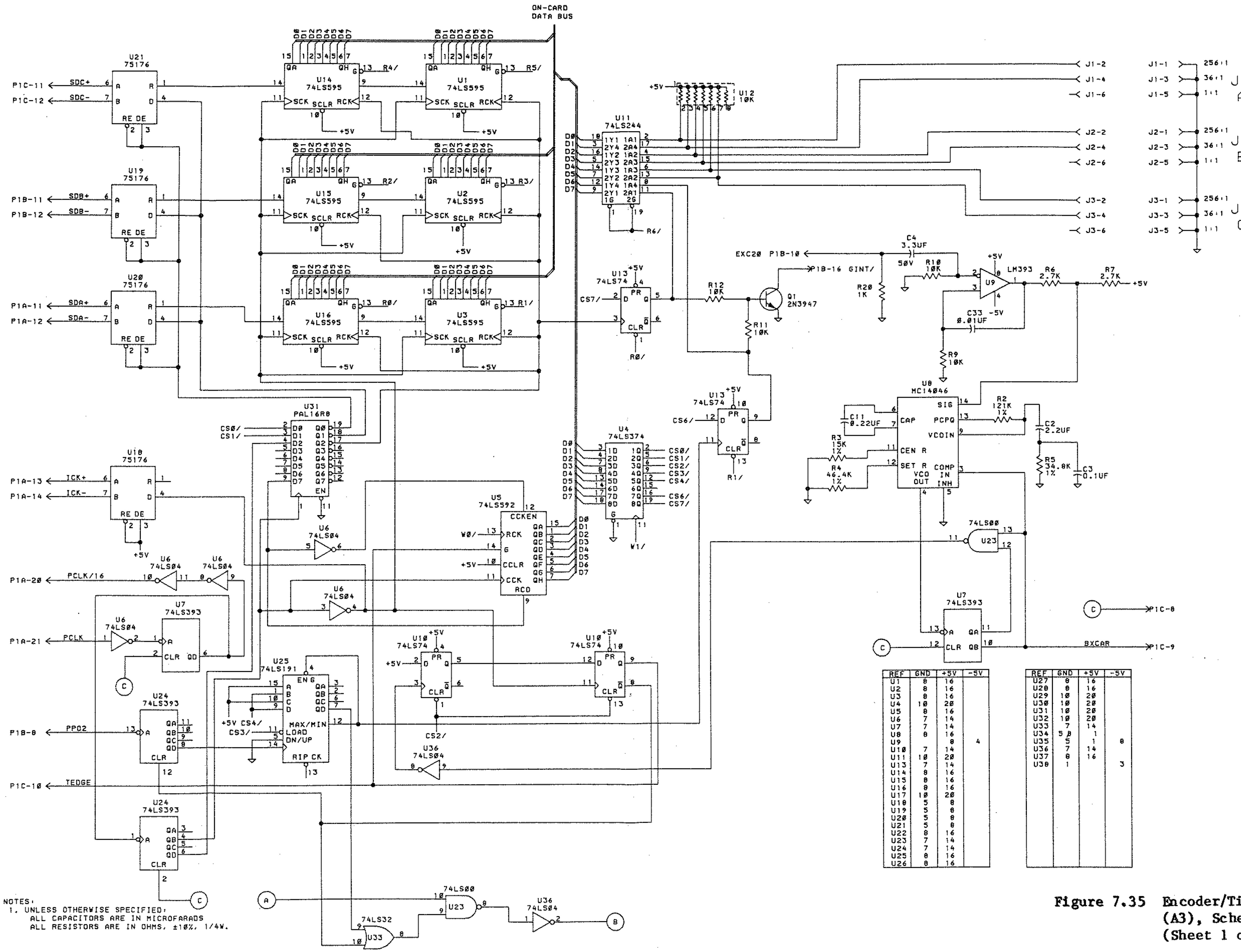
TYPE NO.	REF	GND	+12V	-12V
UA9636	U29		8	5
UA9636	U32		8	5

Figure 7.33 CPU Assembly (A2), Schematic (Sheet 3 of 3)



NOTES:
1. NOT INSTALLED: U29, U30, U31

Figure 7.34 Encoder/Timing Assembly (A3), Component Location



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

REF	GND	+5V	-5V
U1	8	16	
U2	8	16	
U3	8	16	
U4	10	20	
U5	8	16	
U6	7	14	
U7	7	14	
U8	8	16	
U9		8	4
U10	7	14	
U11	10	20	
U13	7	14	
U14	8	16	
U15	8	16	
U16	8	16	
U17	10	20	
U18	5	8	
U19	5	8	
U20	5	8	
U21	5	8	
U22	8	16	
U23	7	14	
U24	7	14	
U25	8	16	
U26	8	16	

REF	GND	+5V	-5V
U27	8	16	
U28	8	16	
U29	10	20	
U30	10	20	
U31	10	20	
U32	10	20	
U33	7	14	
U34	5 8	1	
U35	5	1	8
U36	7	14	
U37	8	16	
U38	1		3

Figure 7.35 Encoder/Timing Assembly (A3), Schematic (Sheet 1 of 2)

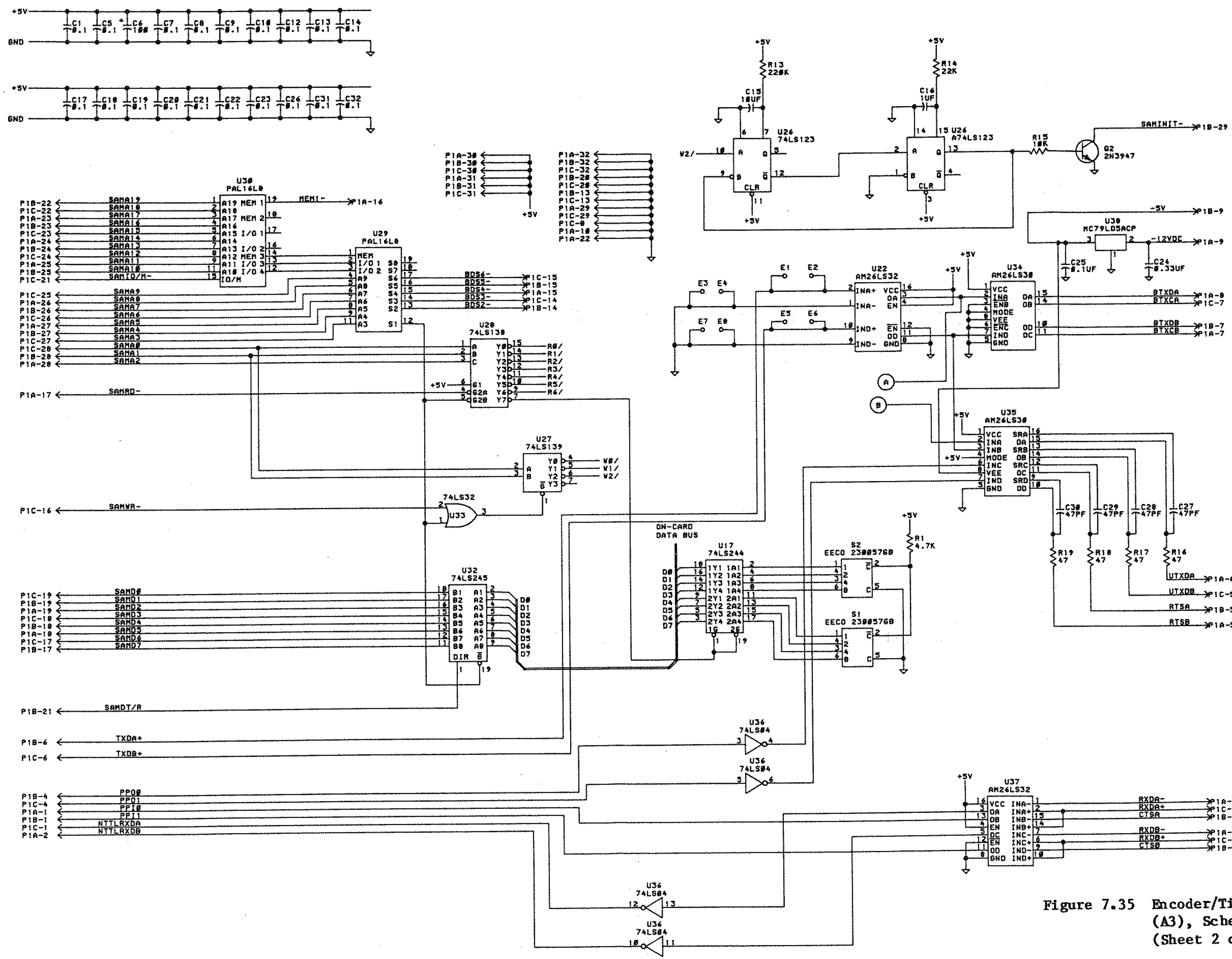
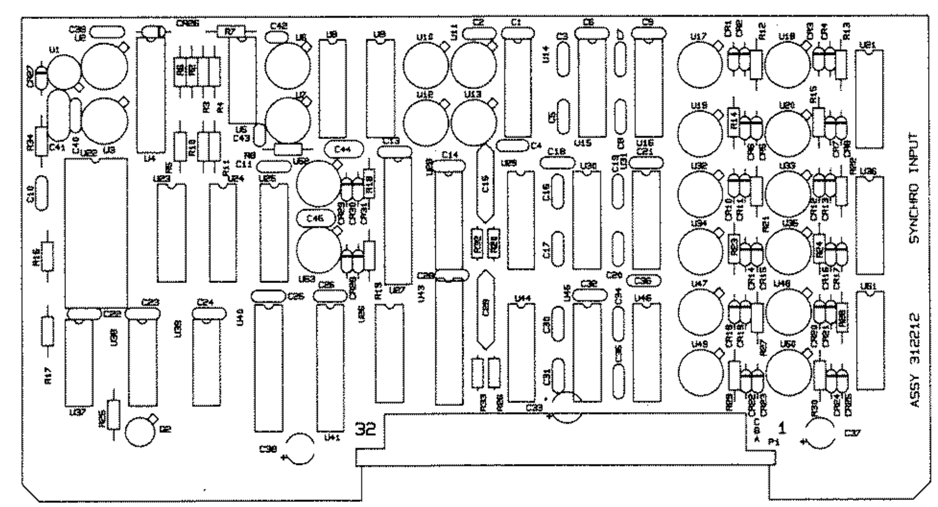


Figure 7.35 Encoder/Timing Assembly (A3), Schematic (Sheet 2 of 2)



NOTES:

1. NOT INSTALLED: U27, U41, C12, C27, R1, R9.

Figure 7.36 Sync Input Assembly (A4), Component Location

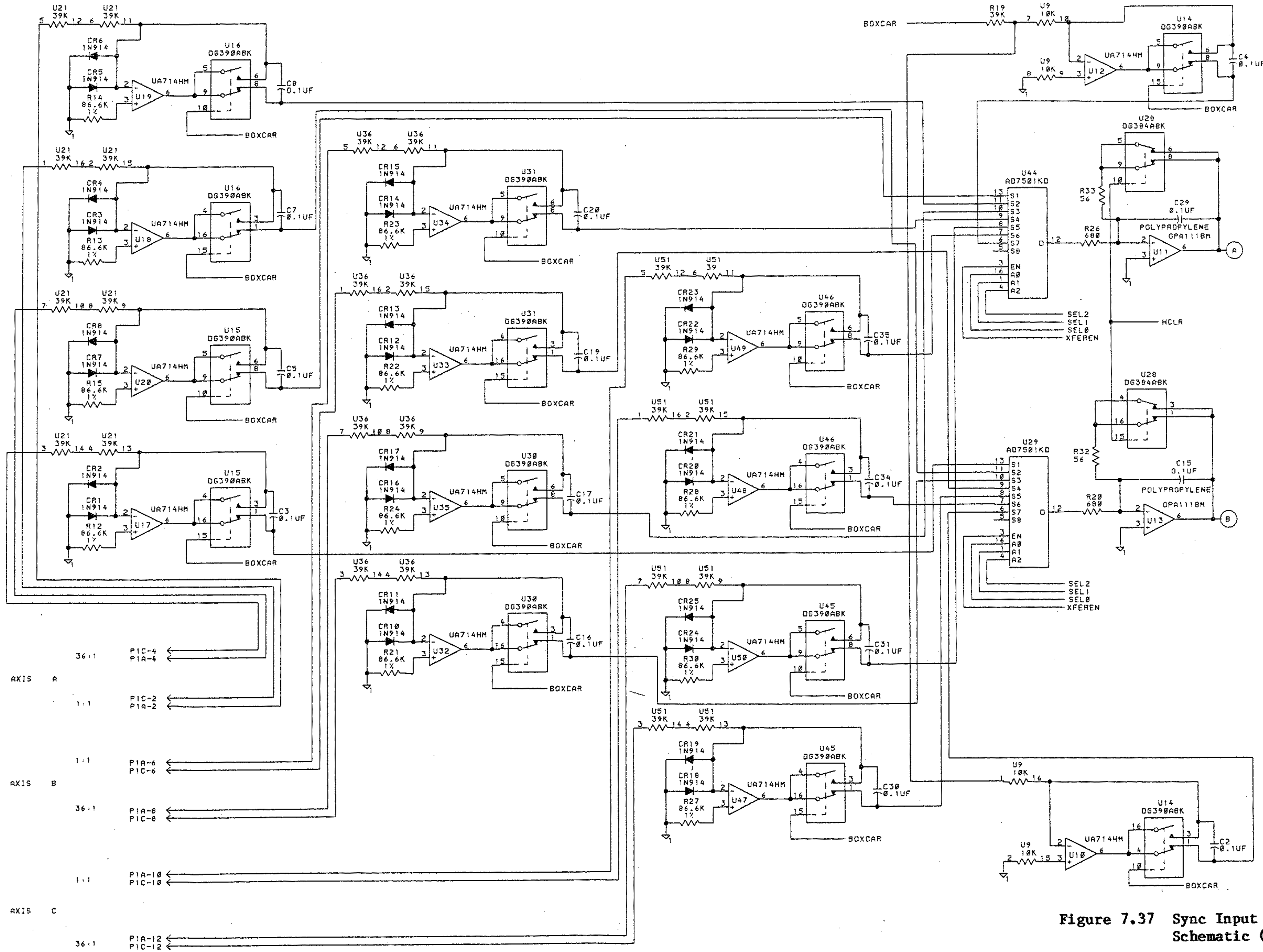
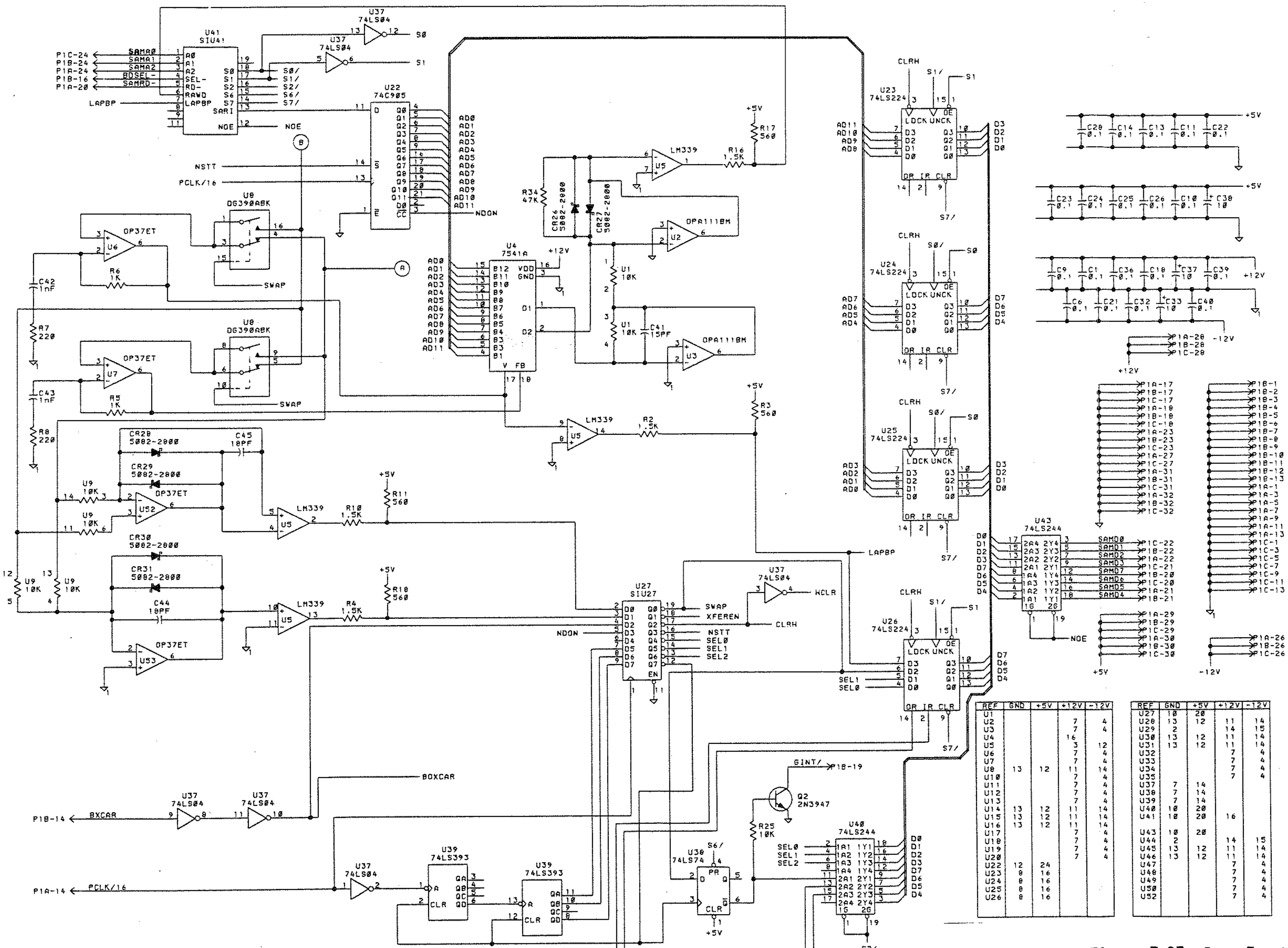


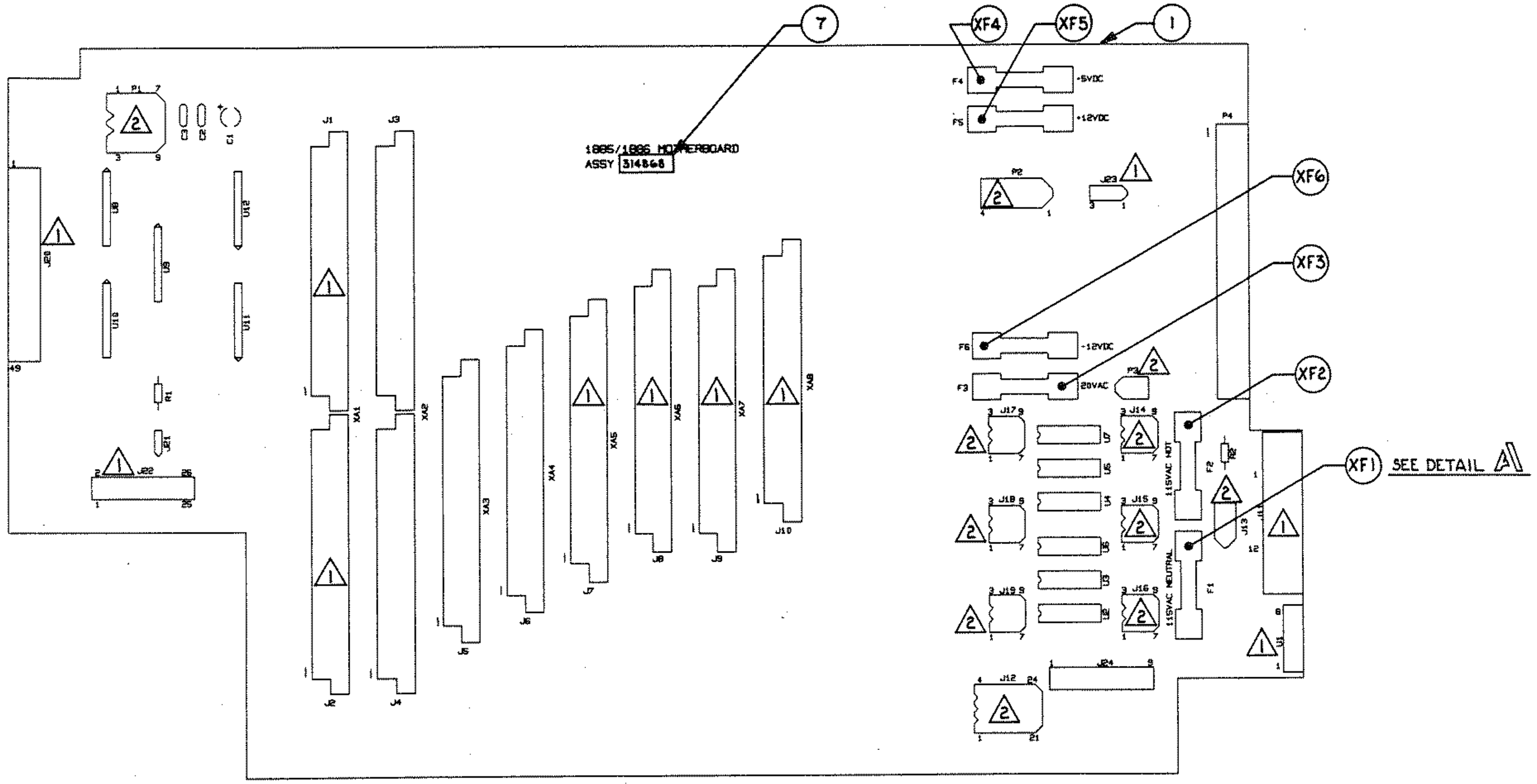
Figure 7.37 Sync Input Assembly (A4), Schematic (Sheet 1 of 2)

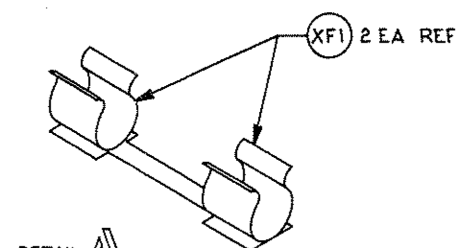


REF	GND	+5V	+12V	-12V
U1				
U2			7	4
U3			7	4
U4			16	
U5			3	12
U6			7	4
U7			7	4
U8	13	12	11	14
U10			7	4
U11			7	4
U12			7	4
U13			7	4
U14	13	12	11	14
U15	13	12	11	14
U16	13	12	11	14
U17			7	4
U18			7	4
U19			7	4
U20			7	4
U22	12	24		
U23	8	16		
U24	8	16		
U25	8	16		
U26	8	16		

REF	GND	+5V	+12V	-12V
U27	10	20		
U28	13	12	11	14
U29	2		14	15
U30	13	12	11	14
U31	13	12	11	14
U32			7	4
U33			7	4
U34			7	4
U35			7	4
U37	7	14		
U38	7	14		
U39	7	14		
U40	10	20		
U41	10	20	16	
U43	10	20		
U44	2		14	15
U45	13	12	11	14
U46	13	12	11	14
U47			7	4
U48			7	4
U49			7	4
U50			7	4
U52			7	4

Figure 7.37 Sync Input Assembly (A4), Schematic (Sheet 2 of 2)





DETAIL A
SCALE: 2/1
TYP 6 PL

NOTES:

1. NOT TO BE INSTALLED.
2. THESE MOLEX CONNECTORS REQUIRE ASSEMBLY OF CONNECTORS AND PINS BEFORE INSTALLATION. THE CONNECTORS, PINS, AND QUANTITIES OF PINS ARE AS FOLLOWS:

CONN	PIN QTY	PIN ITEM NO.	INSERTION TOOL	EXTRACTION TOOL
P1	9	3	NONE	MOLEX 11-03-0015
P2	4	3	NONE	MOLEX 11-03-0015
P3	2	5	MOLEX 11-02-0001	MOLEX 11-03-0009
J13	2	4	NONE	MOLEX 11-03-0015
J14	9	2	MOLEX 11-02-0001	MOLEX 11-03-0009
J15	9	2		
J16	9	2		
J17	9	2		
J18	9	2		
J19	9	2		
J12	24	2		

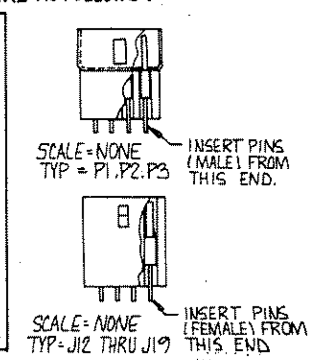
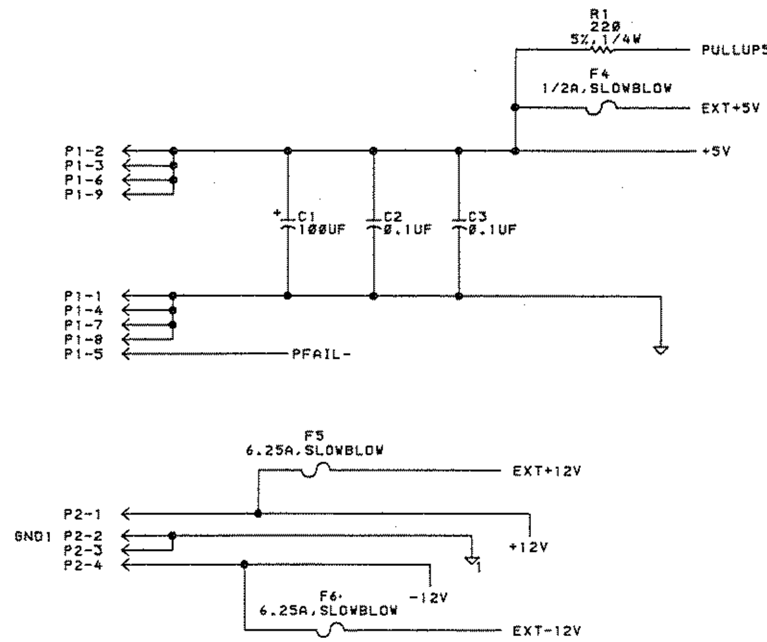


Figure 7.38 Motherboard Assembly (A9), Component Location



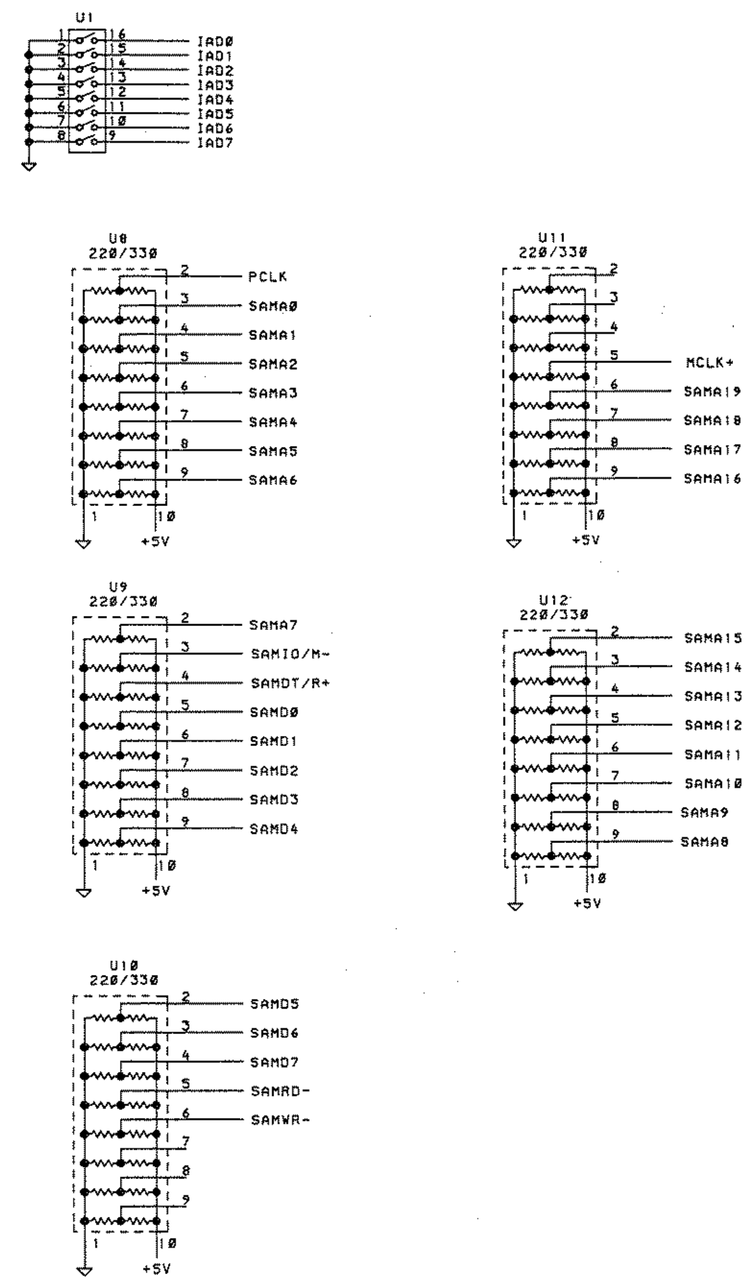
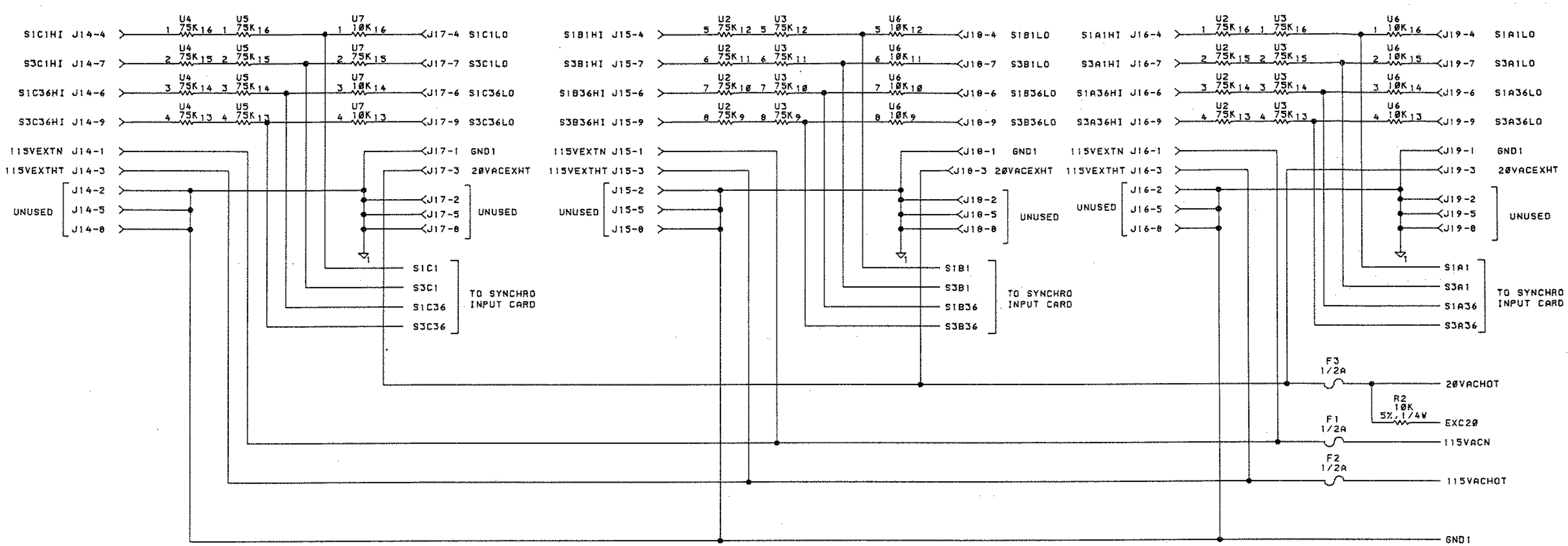


Figure 7.39 Motherboard Assembly (A9), Schematic/Net List (Sheet 1 of 2)



NOTES:

1. UNLESS OTHERWISE SPECIFIED,
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ± 10%, 1/4W.

2. THIS IS NOT A COMPLETE SCHEMATIC OF THE MOTHERBOARD. FOR ADDITIONAL INTERCONNECT INFORMATION, REFER TO THE MODEL 1885 MOTHERBOARD NETLIST.

Figure 7.39 Motherboard Assembly (A9), Schematic/Net List (Sheet 2 of 2)

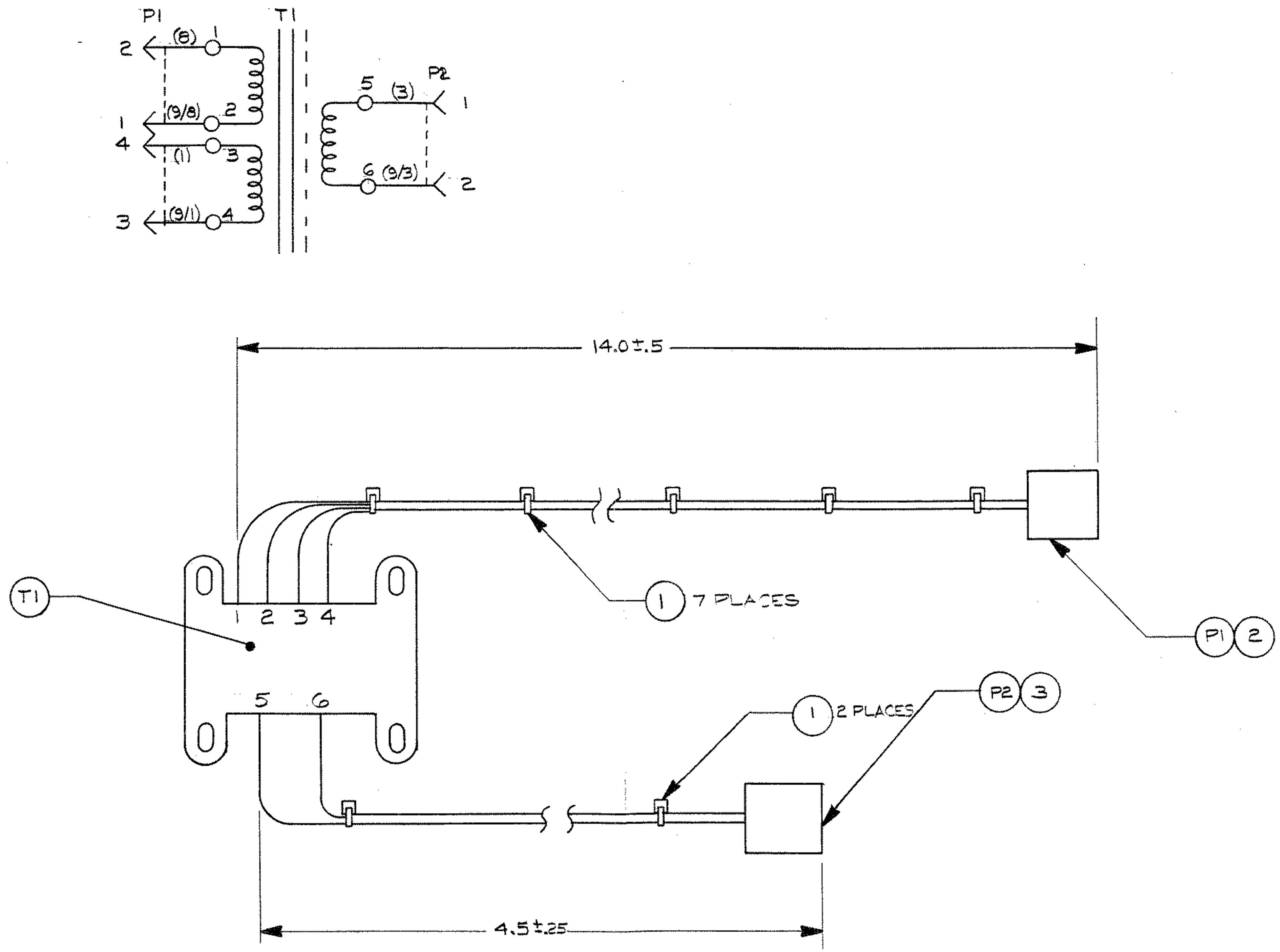


Figure 7.40 Transformer Assembly (A10), Component Location

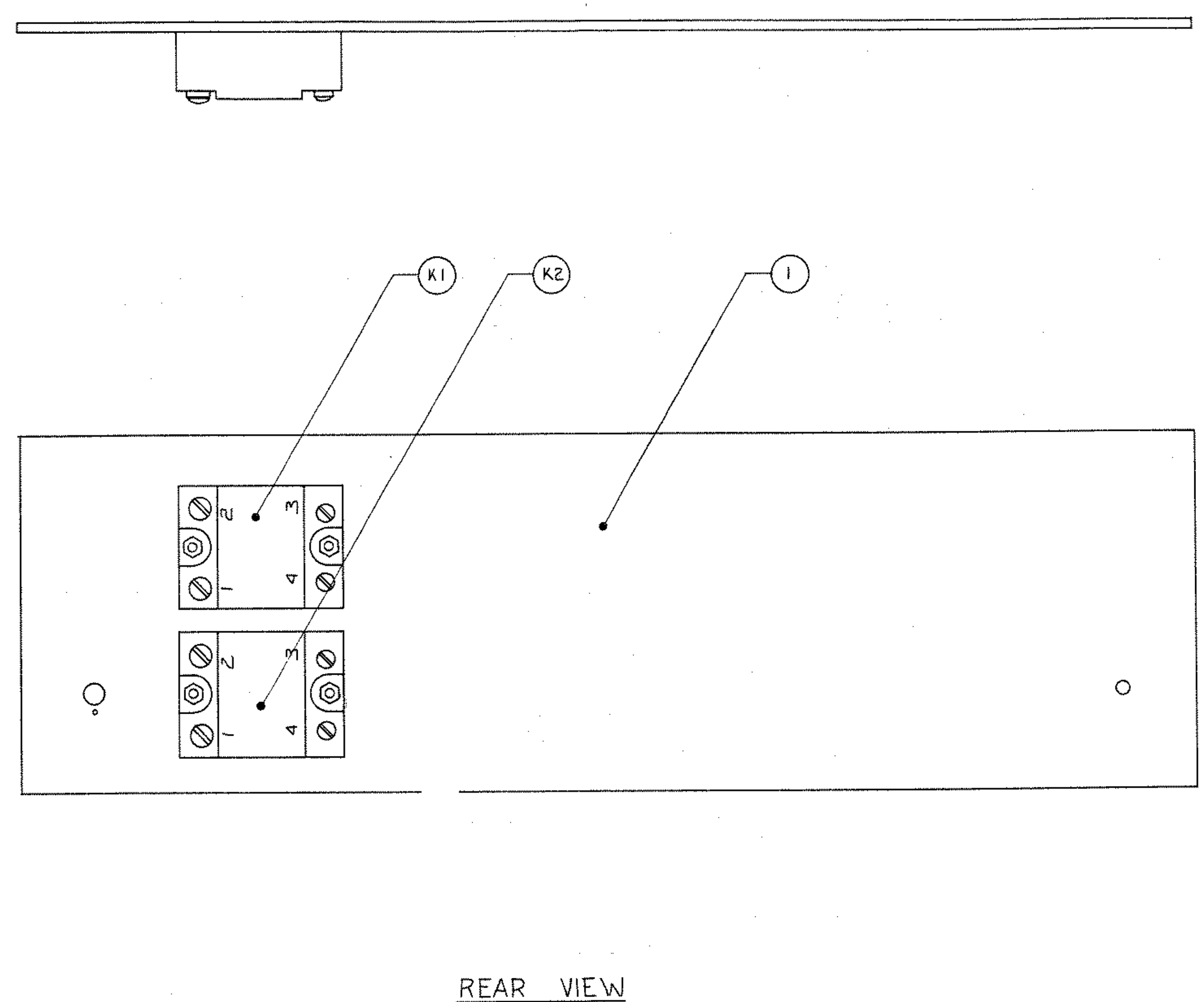


Figure 7.41 Front Panel Assembly (All), Component Location

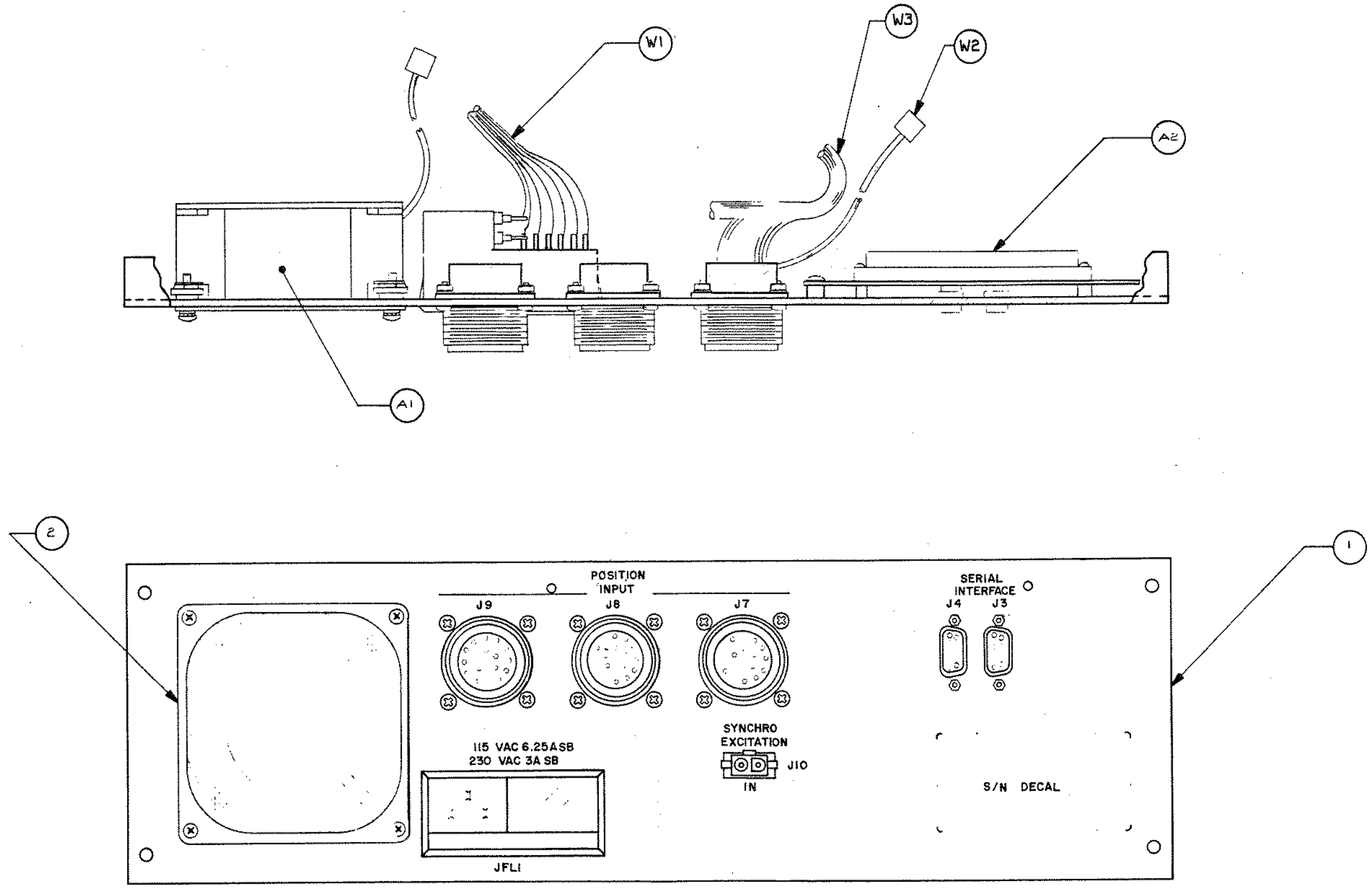
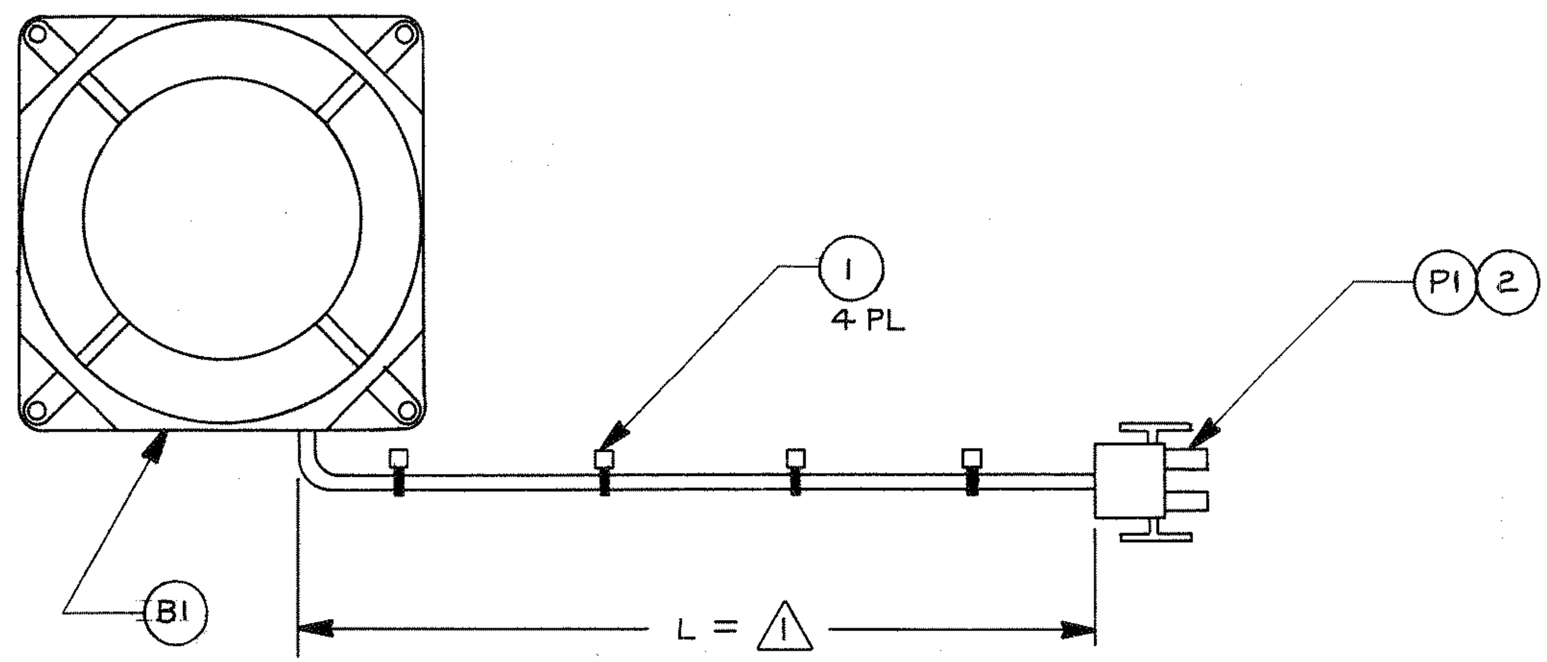


Figure 7.42 Rear Panel Assembly (A12), Component Location



NOTES:

1. CABLE LENGTH CAN VARY BETWEEN 6.0 IN (MIN) TO 12.0 IN (MAX) AFTER INSTALLING ITEM 2 AND P1 TO EXISTING CABLE.

ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE
P1	1	37151	CONNECTOR	MALE, 2 CIRCUITS
B1	1	89519	FAN	
2	2	37152	CONTACT, CONN	18-24 AWG
1	4	73045	CABLE TIE	4 IN

PARTS LIST

Figure 7.43 Fan Assembly (A12A1)

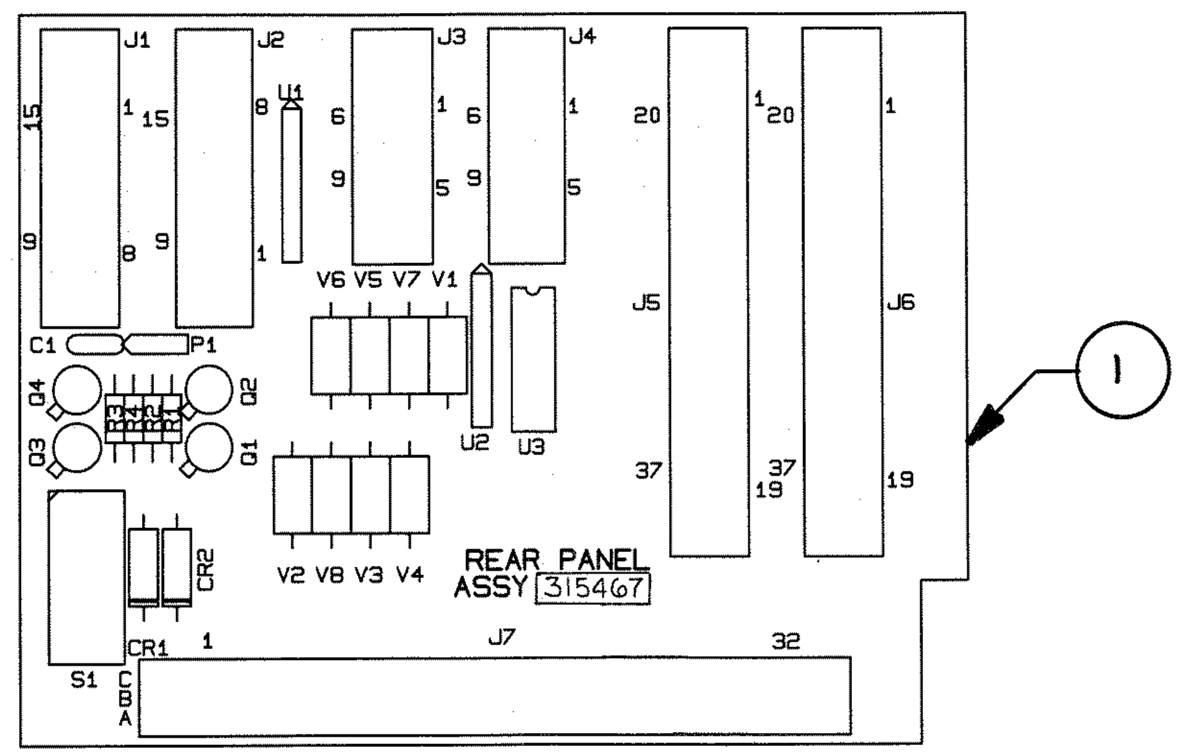
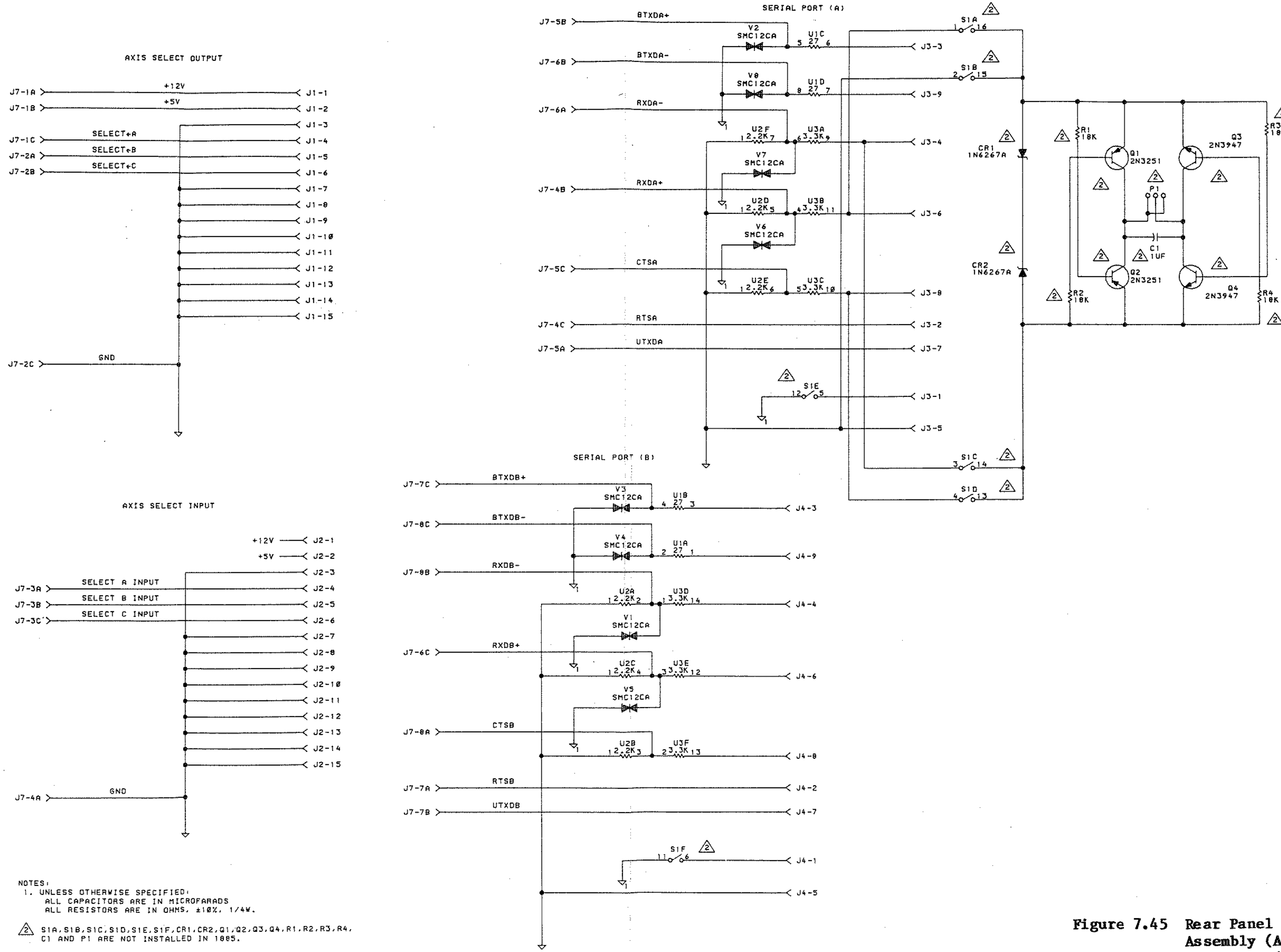


Figure 7.44 Rear Panel Interface Assembly (A12A2)



NOTES:
1. UNLESS OTHERWISE SPECIFIED:
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

2. S1A, S1B, S1C, S1D, S1E, S1F, CR1, CR2, Q1, Q2, Q3, Q4, R1, R2, R3, R4, C1 AND P1 ARE NOT INSTALLED IN 1885.

Figure 7.45 Rear Panel Interface Assembly (A12A2), Schematic (Sheet 1 of 2)

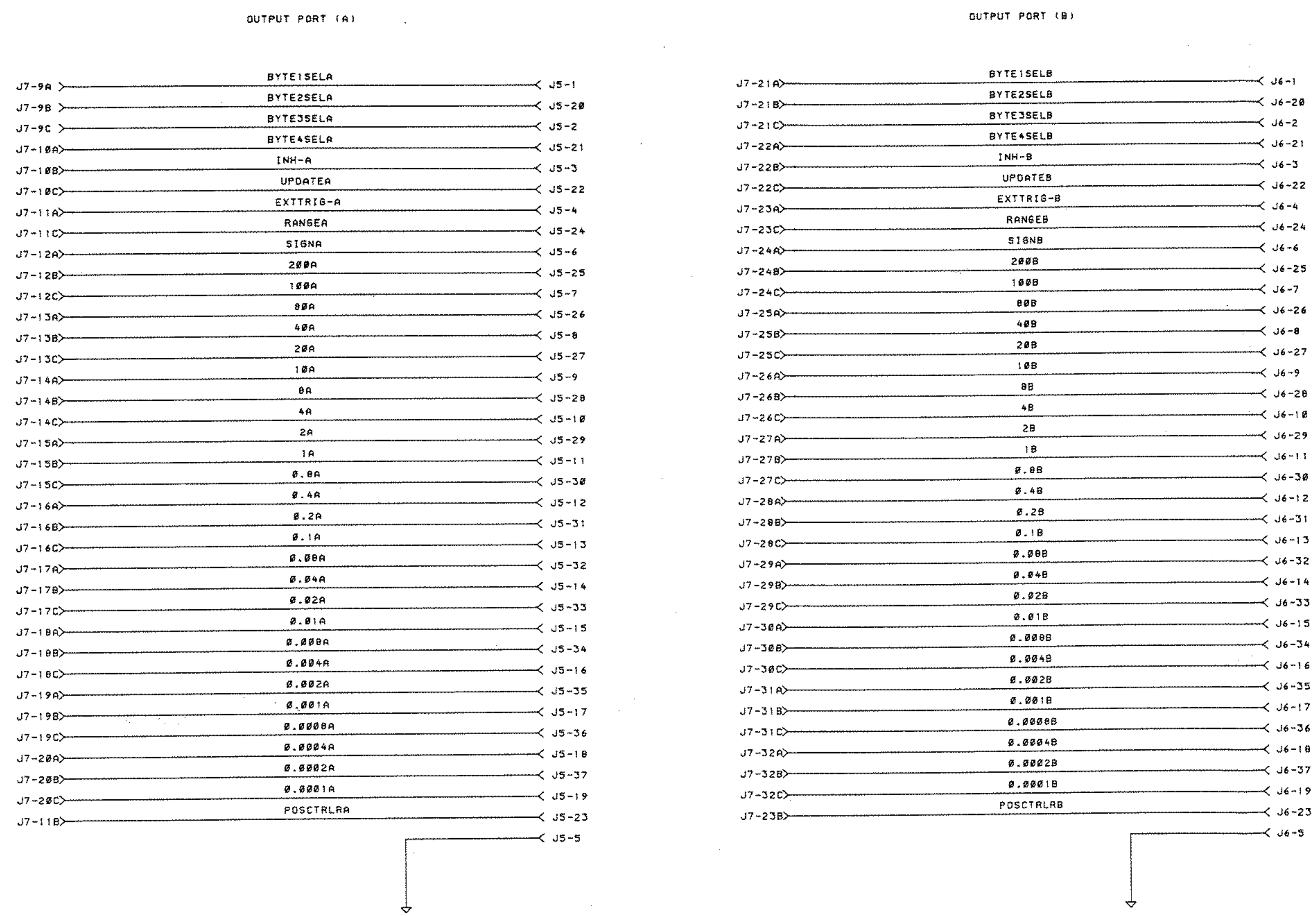
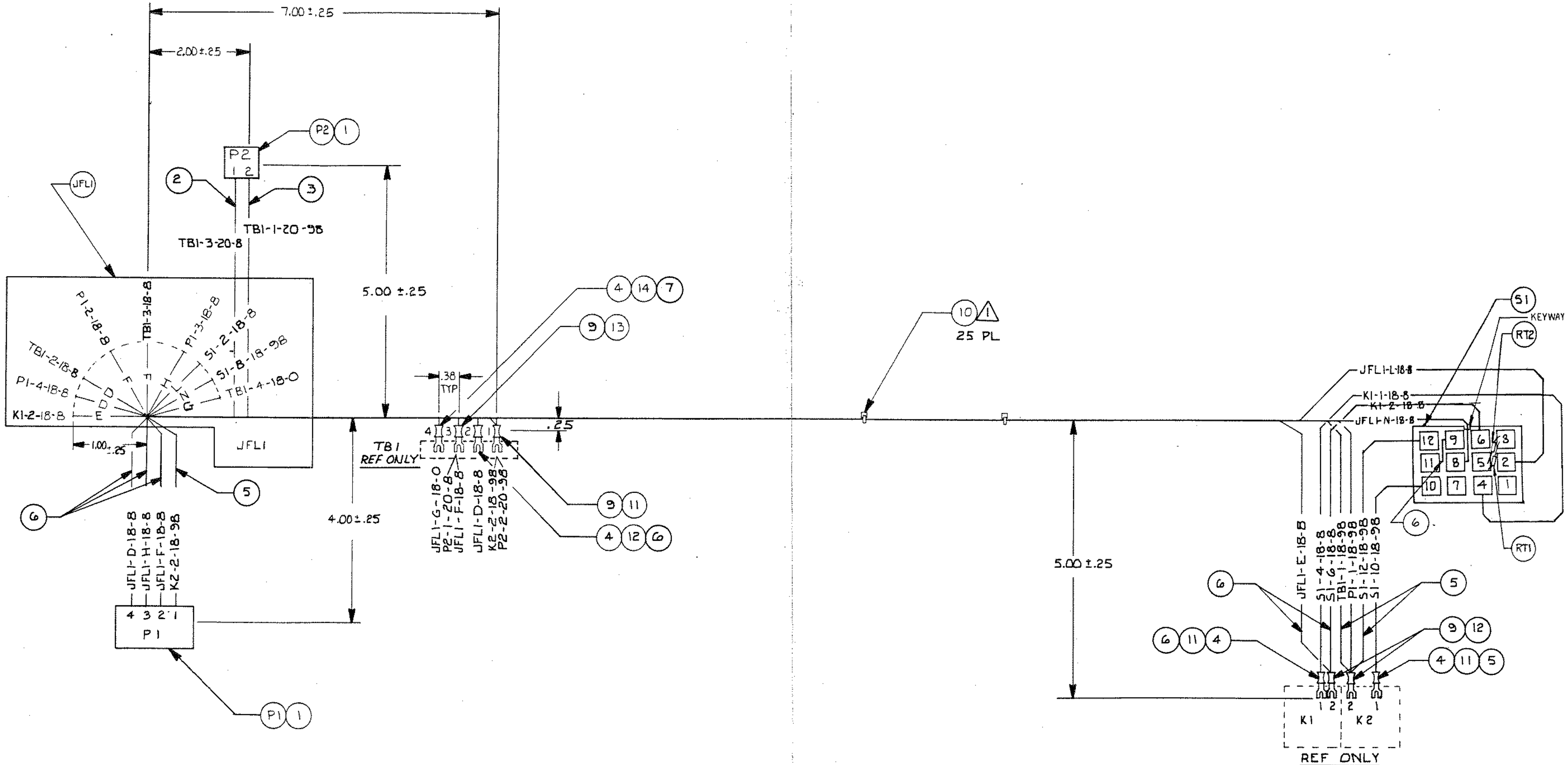


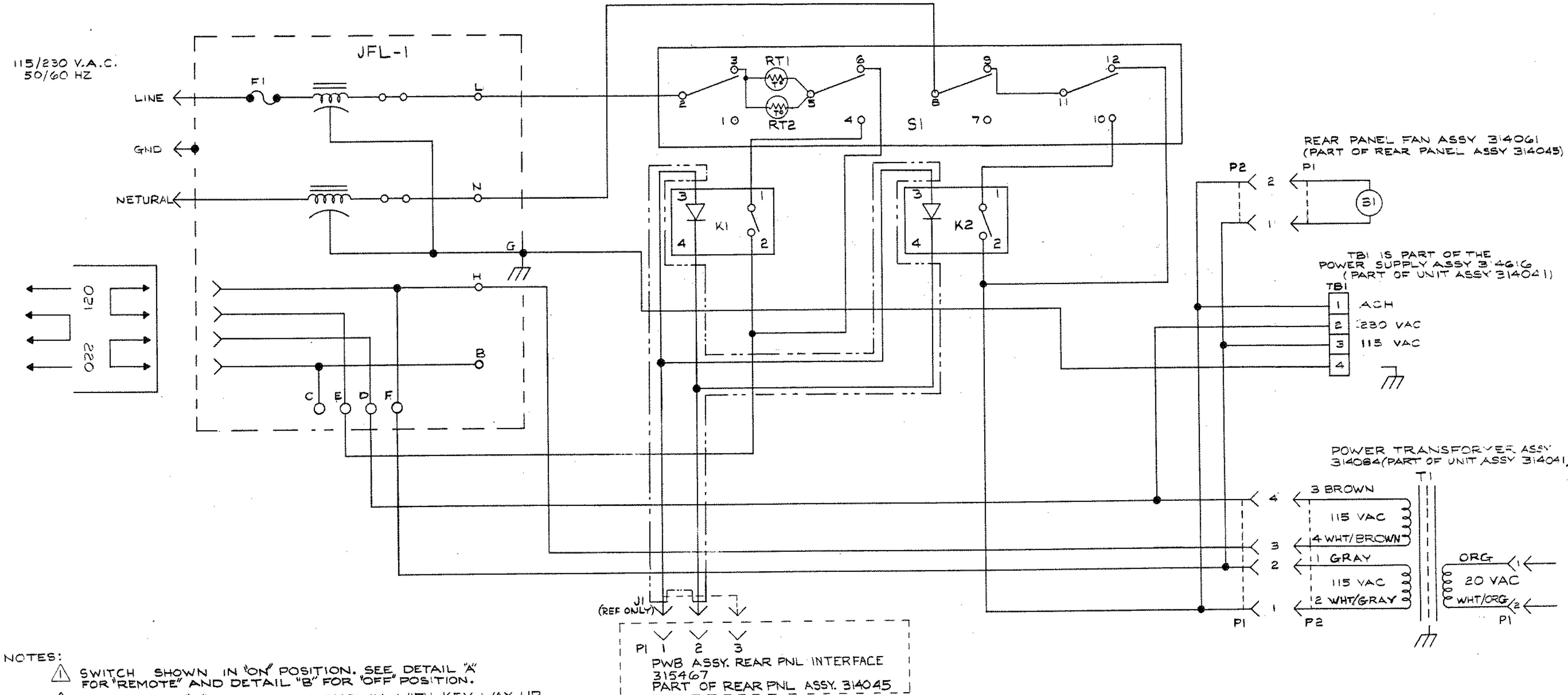
Figure 7.45 Rear Panel Interface Assembly (A12A2), Schematic (Sheet 2 of 2)



NOTES:

1. CABLE TIES SPACED APPROXIMATELY 2 IN. APART.

Figure 7.46 Harness Assembly (A12W1), AC Power



NOTES:

1. SWITCH SHOWN IN "ON" POSITION. SEE DETAIL "A" FOR "REMOTE" AND DETAIL "B" FOR "OFF" POSITION.
2. SEE DETAIL "C" FOR SWITCH SHOWN WITH KEY WAY UP.

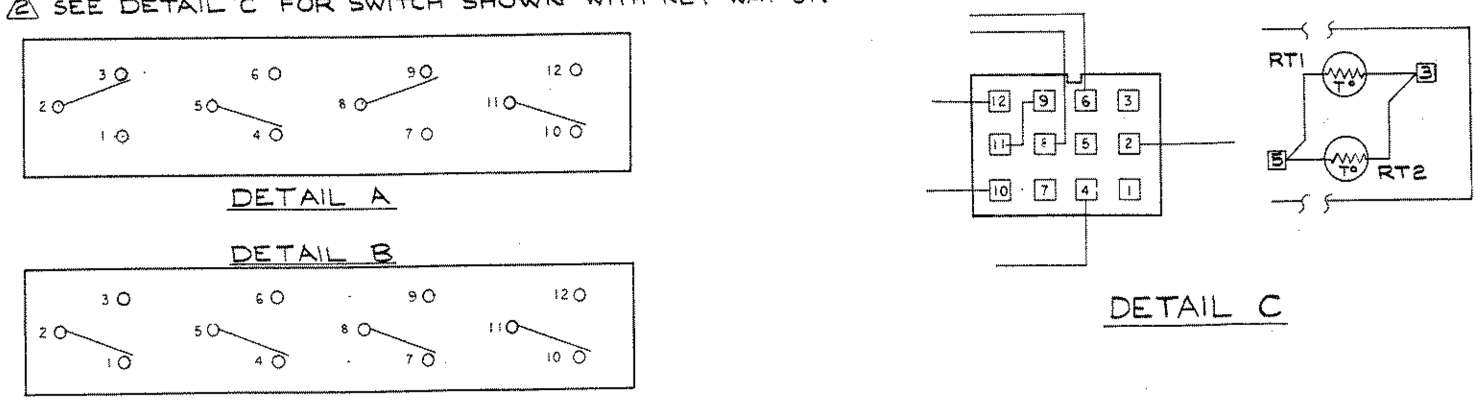


Figure 7.47 Harness Assembly (A12W1), Schematic

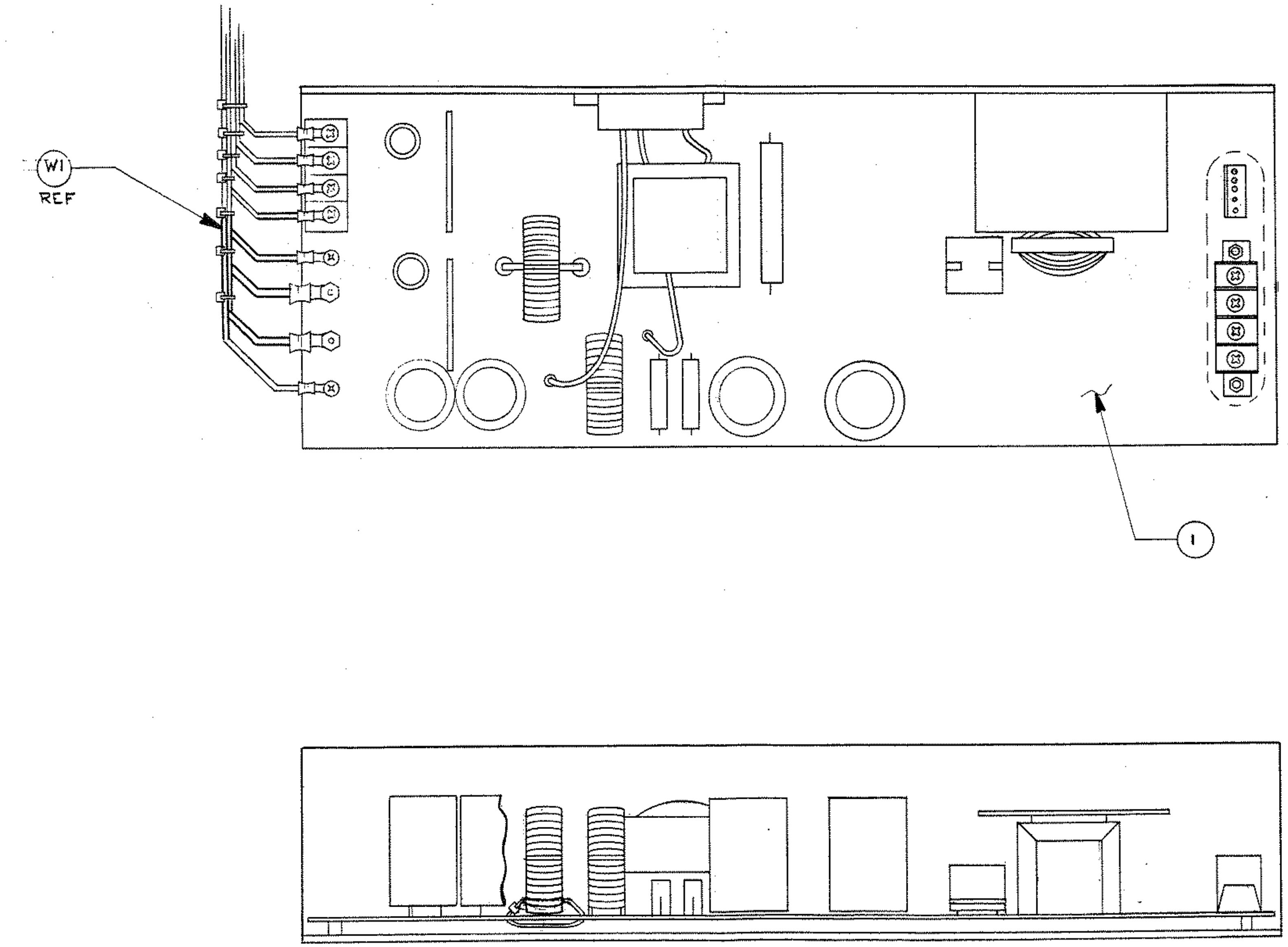
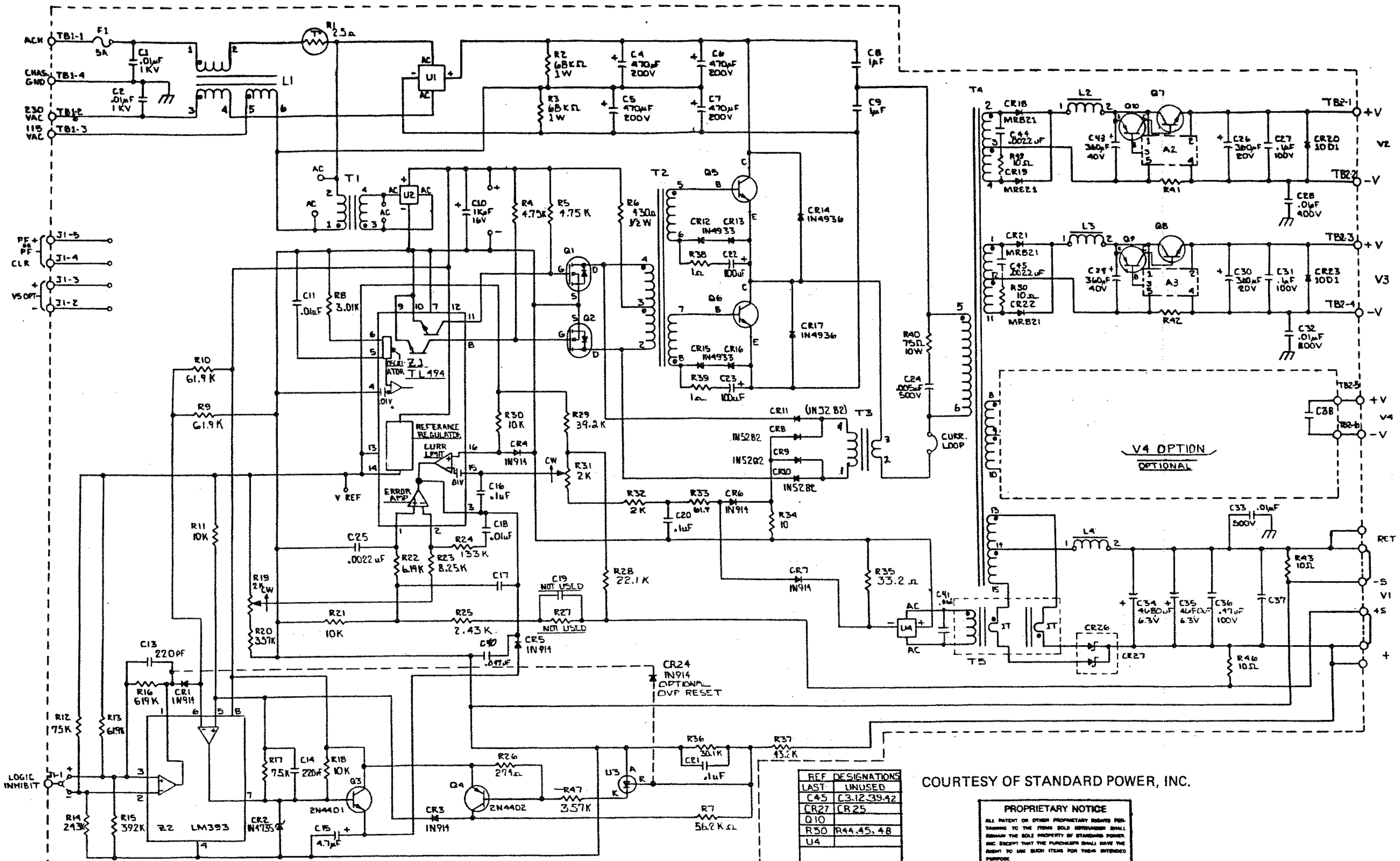


Figure 7.48 Power Supply Assembly (A13), Component Location

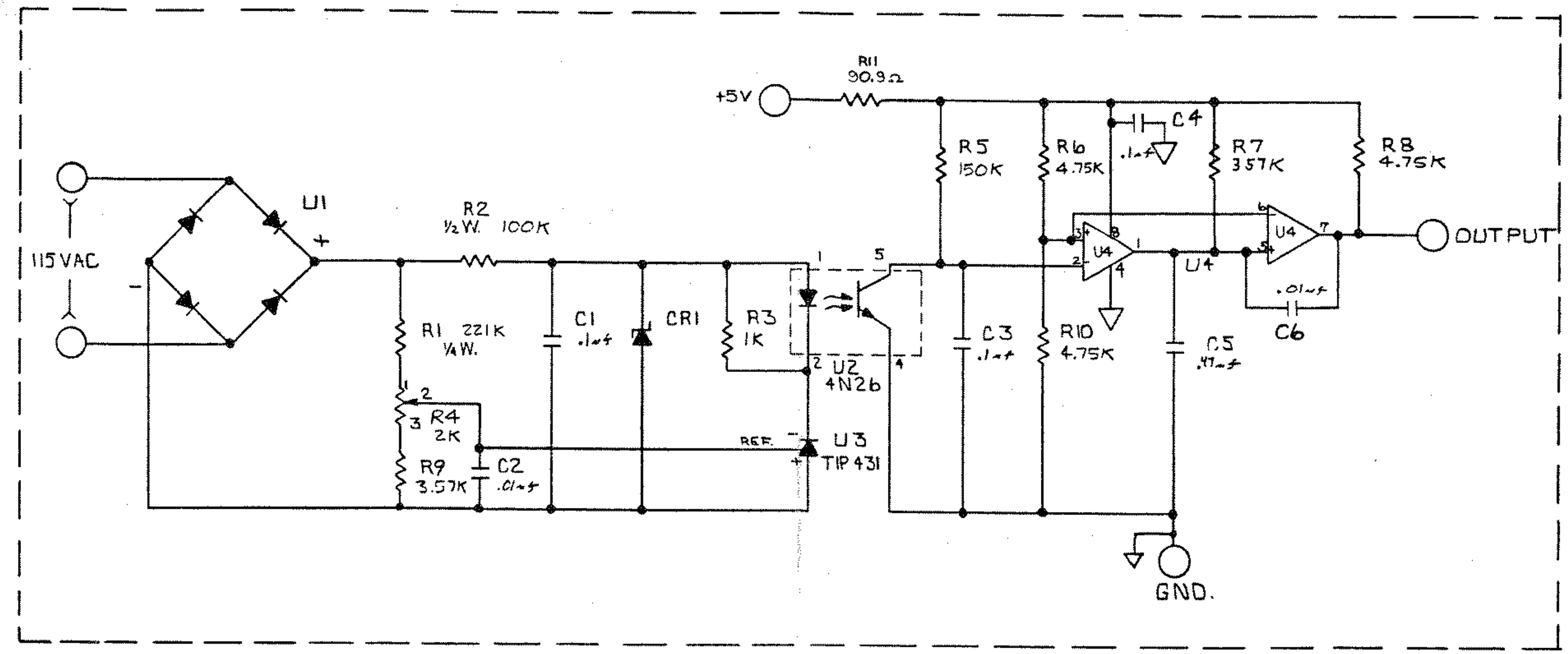


3. CAPACITORS ARE IN MICRO-FARADS.
2. RESISTORS ARE IN OHMS, ±1%, 1/4W.
NOTES: 1. REF ASSY: 01-302453-00

REF DESIGNATIONS	
LAST	UNUSED
C45	C3.12.39.42
CR27	CR25
Q10	
R50	R44.45.48
U4	

COURTESY OF STANDARD POWER, INC.

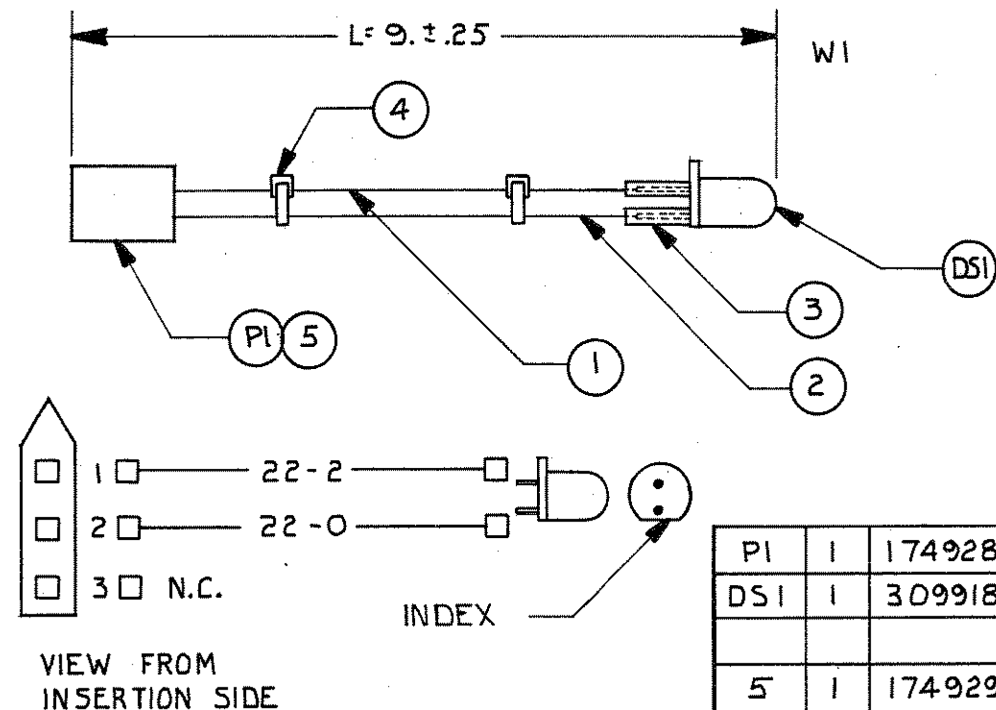
Figure 7.49 Power Supply Assembly (A13), Schematic



REF DESIGNATIONS	
LAST	UNUSED
C6	
CR1	
R11	
U4	

COURTESY OF STANDARD POWER, INC.

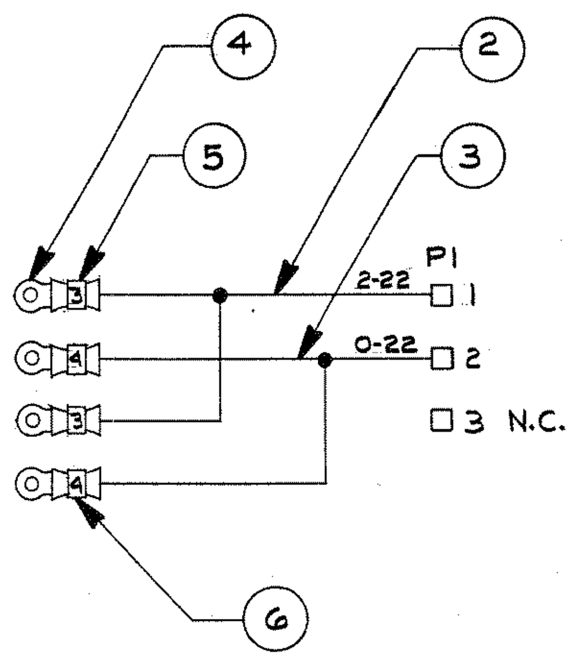
Figure 7.50 Power Fail Assembly (A13), Schematic

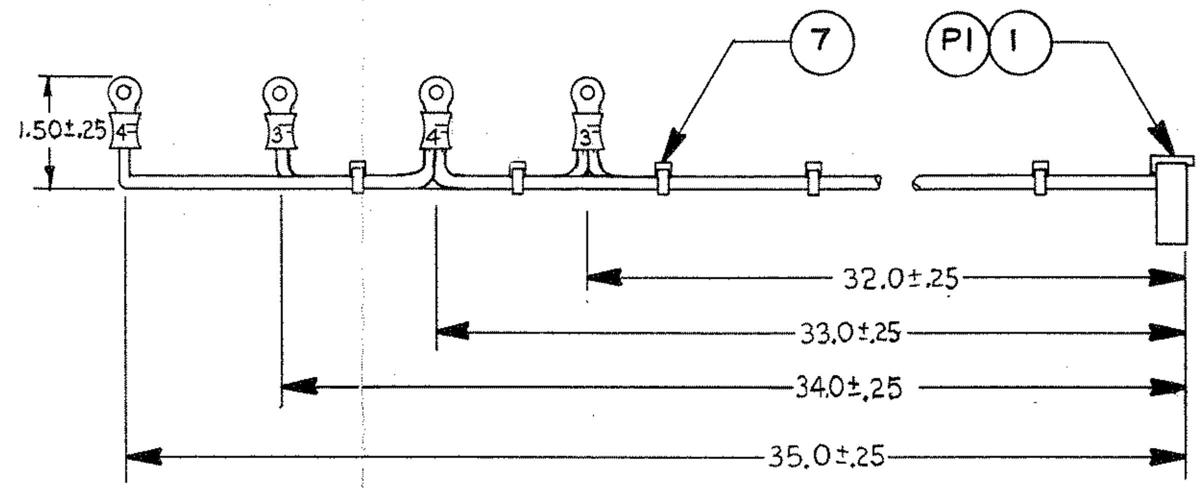


ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
P1	1	174928	CONN.	3 POS	CE100F-22-3	
DS1	1	309918	LED, RED		5054	
5	1	174929	COVER, CONN.		EC100F-3	
4	7	73045	CABLE, TIE	4 IN.		
3	.1	77551	TUBING, HTSK	.061 ID TO .031		
2	.75	73385	WIRE, BLK	22 AWG		
1	.75	73387	WIRE, RED	22 AWG		

PARTS LIST

Figure 7.51 Cable Assembly (A13W1), Power Indicator LED





ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
P1	1	174928	CONN.		CE100F22-3	
7	18	73045	CABLE TIE	4 IN. LG	SST1M	
6	2	77044	MARKER WIRE		NO. 4	
5	2	77043	MARKER WIRE		NO. 3	
4	4	78681	TERMINAL RING INSL	18-22 AWG NO.6		
3	5.75	73385	WIRE INSULATED BLK	22 AWG STRANDED		
2	5.50	73387	WIRE INSULATED RED	22 AWG STRANDED		
1	1	174929	CONN. COVER		EC100-3	

PARTS LIST

Figure 7.52 Cable Assembly (A13W2), Relay Control

ENCODER PROCESSOR

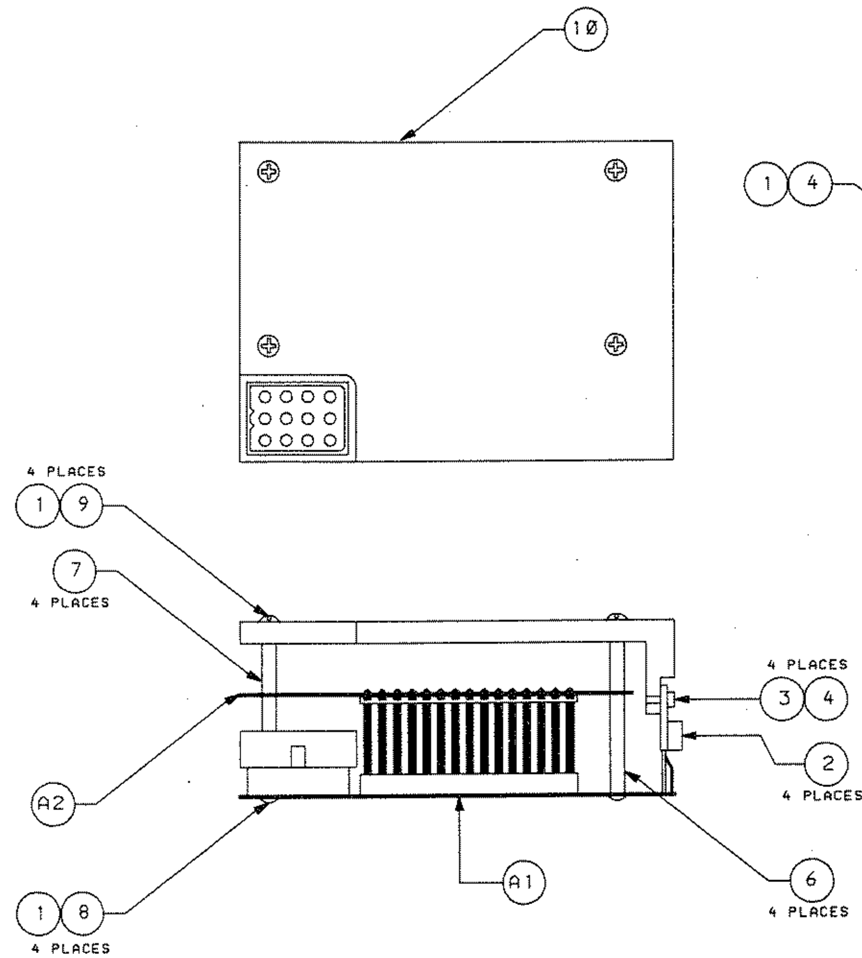


FIGURE 1.3

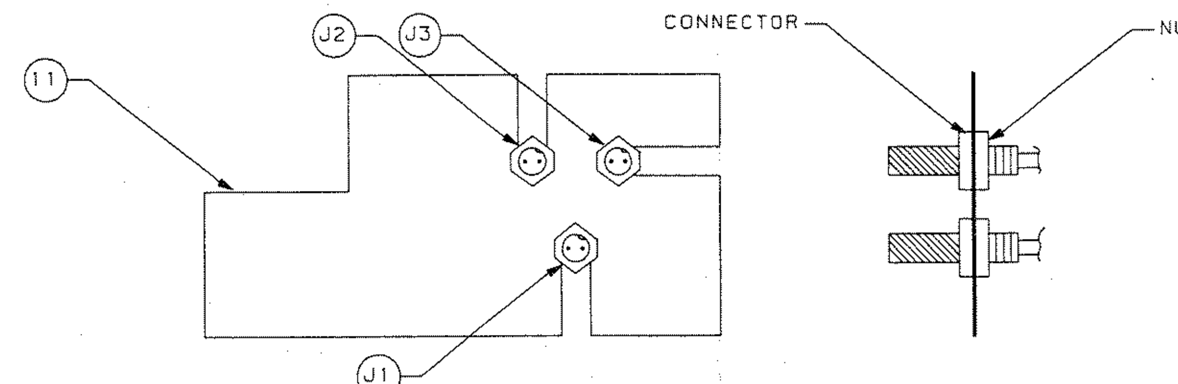


FIGURE 1.4

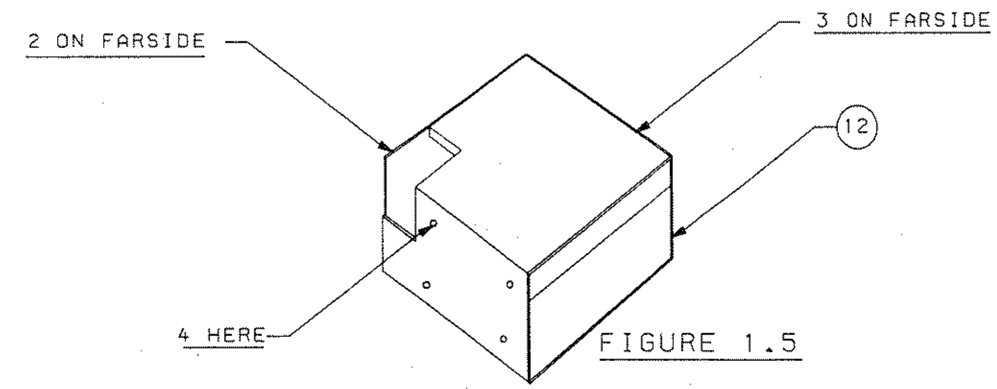
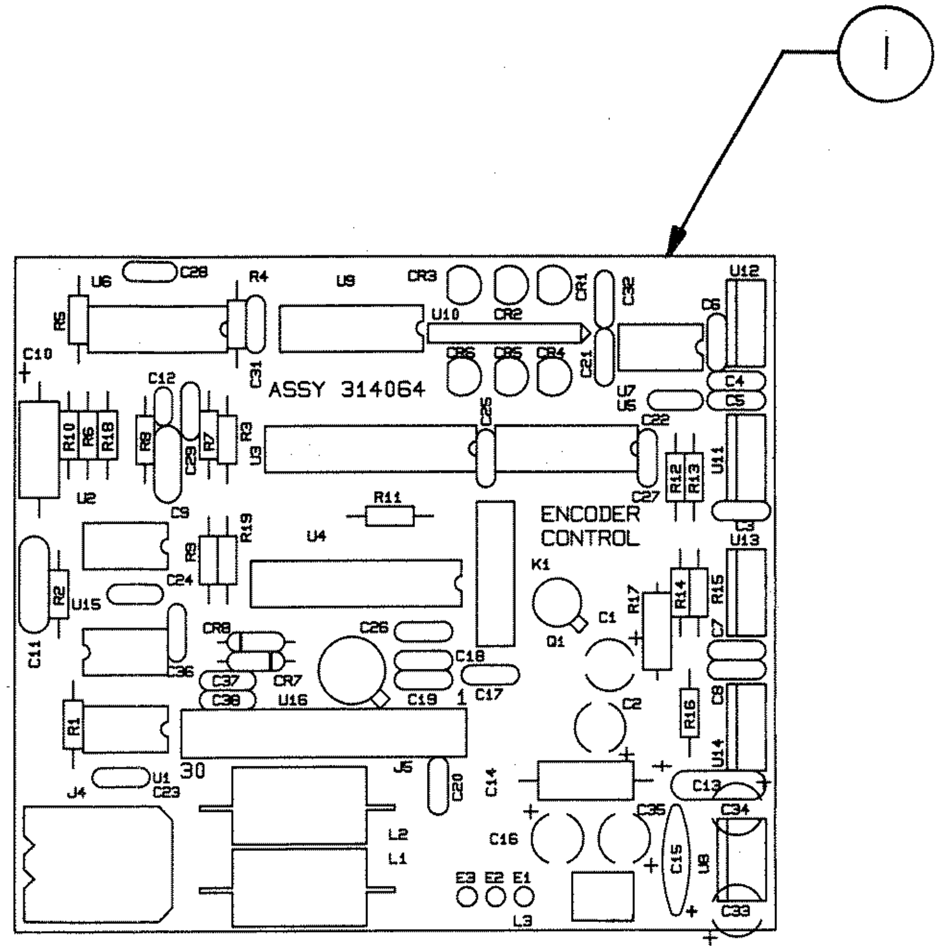
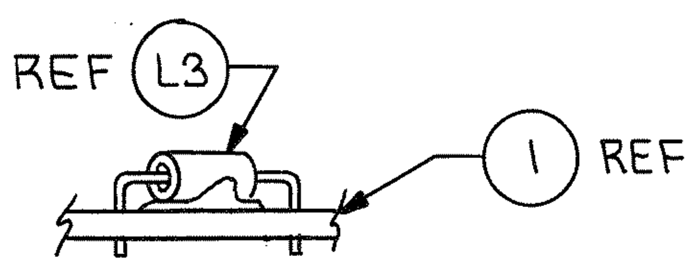


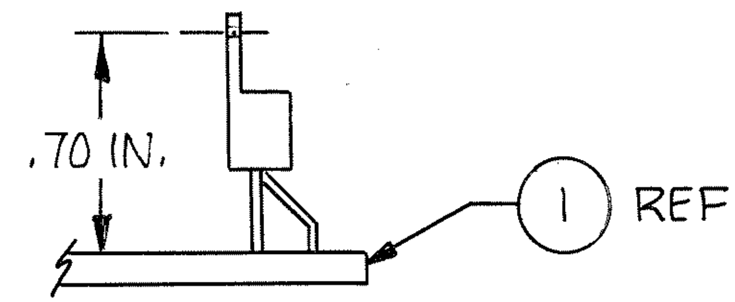
FIGURE 1.5

Figure 7.53 Encoder Processor Chassis Assembly





DETAIL A



DETAIL B
TYP 5 PL

NOTES:

1. NOTE THAT C1, C2, C16, C33, C34, AND C35 ARE POLARIZED. INSTALL AS INDICATED.

Figure 7.54 Encoder Control Assembly (A1), Component Location

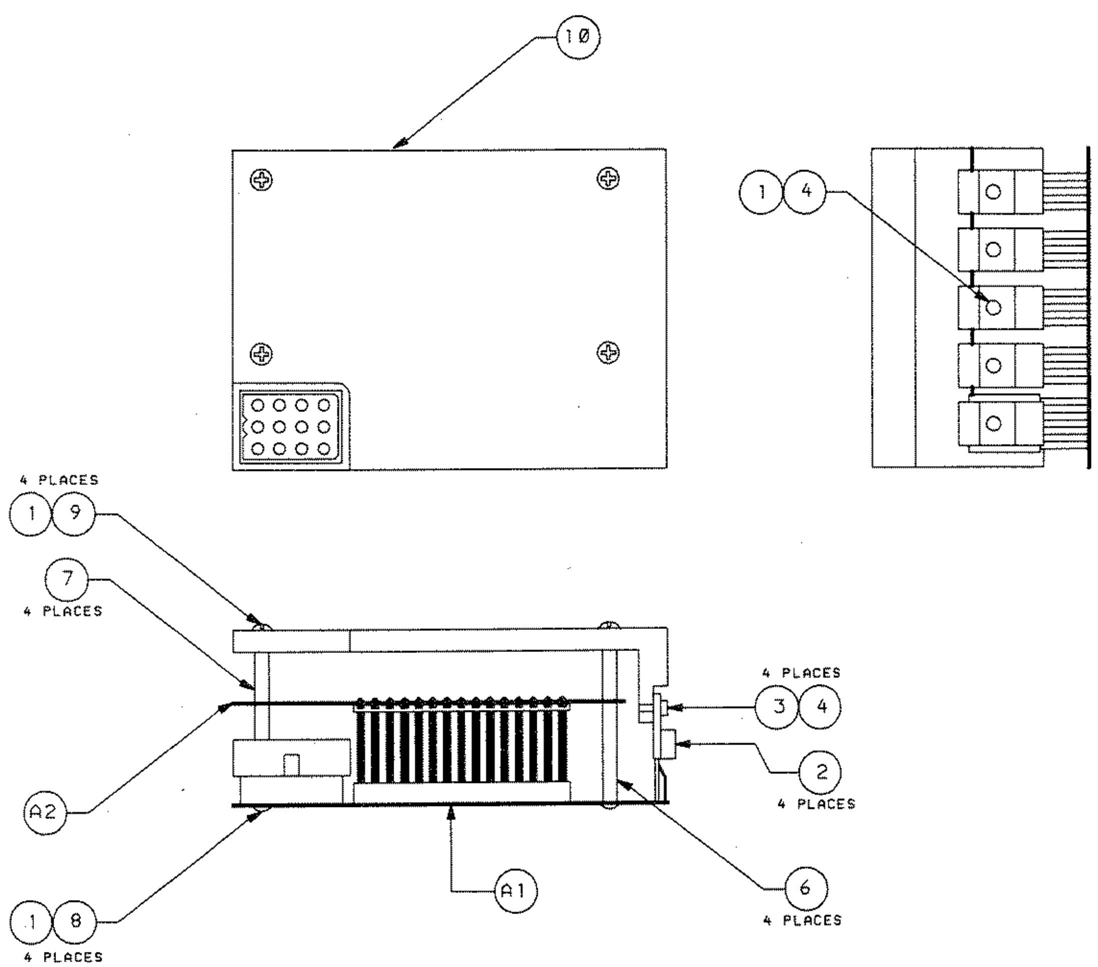


FIGURE 1.3

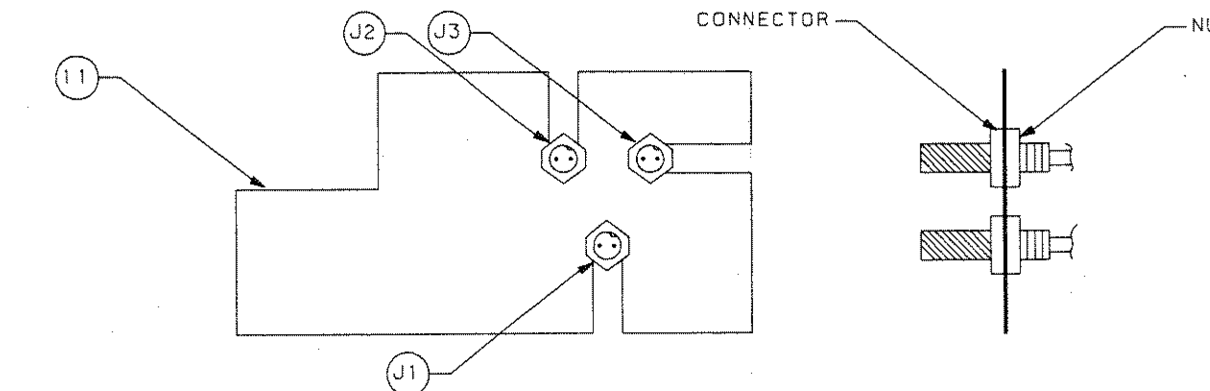


FIGURE 1.4

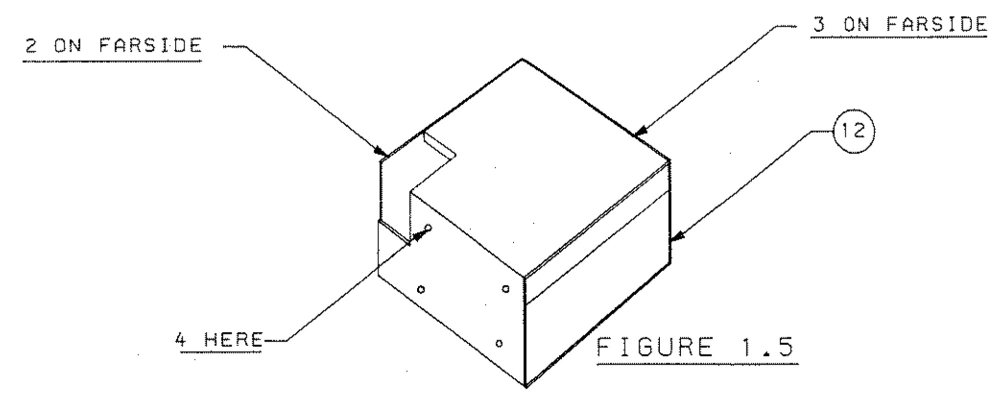
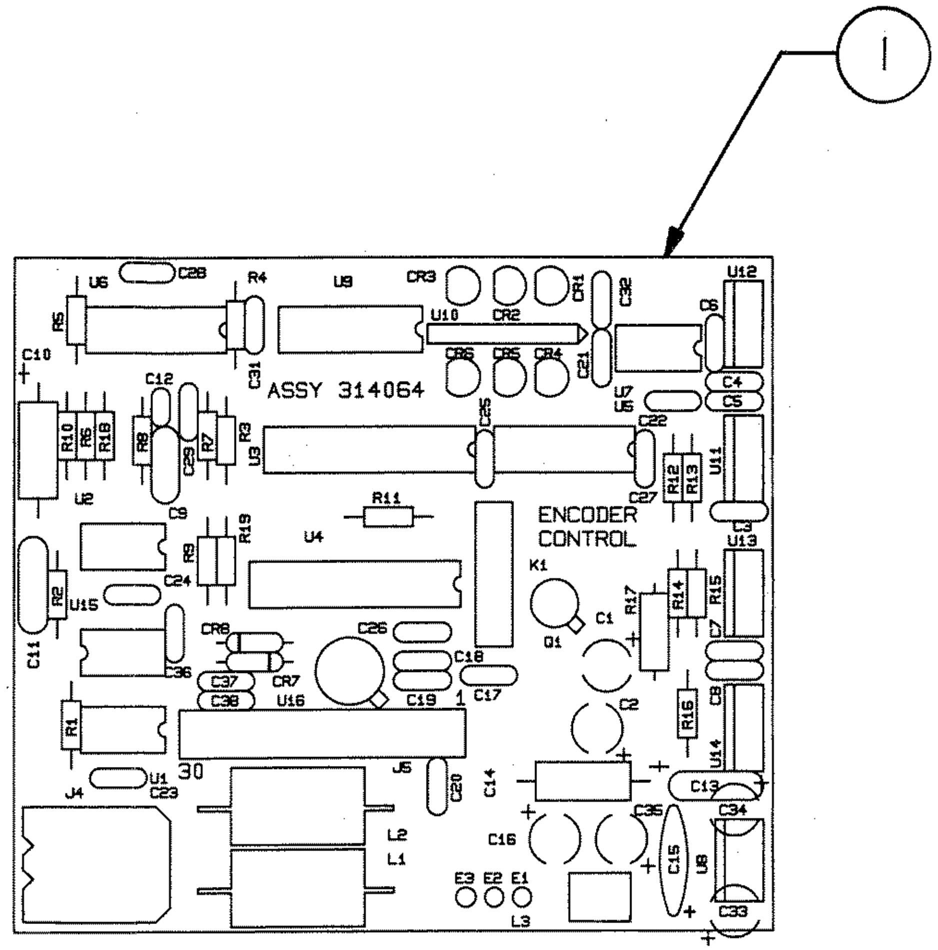
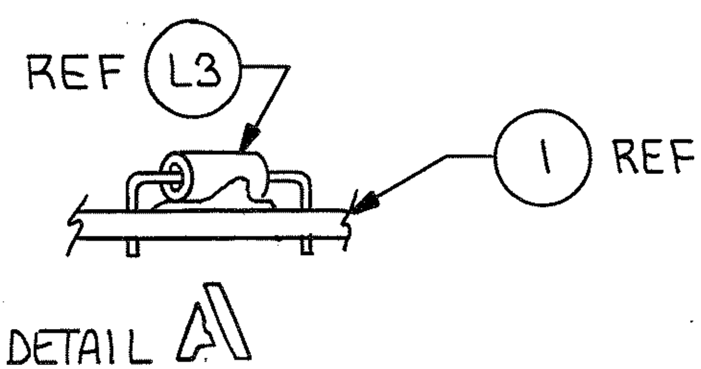
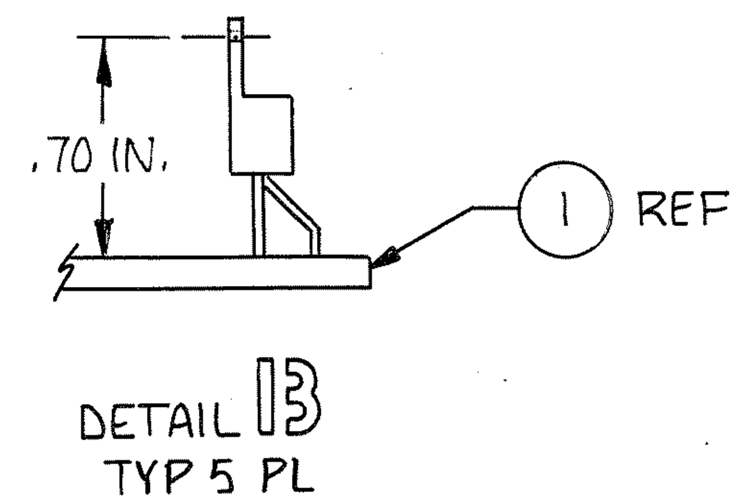


FIGURE 1.5

Figure 7.53 Encoder Processor Chassis Assembly



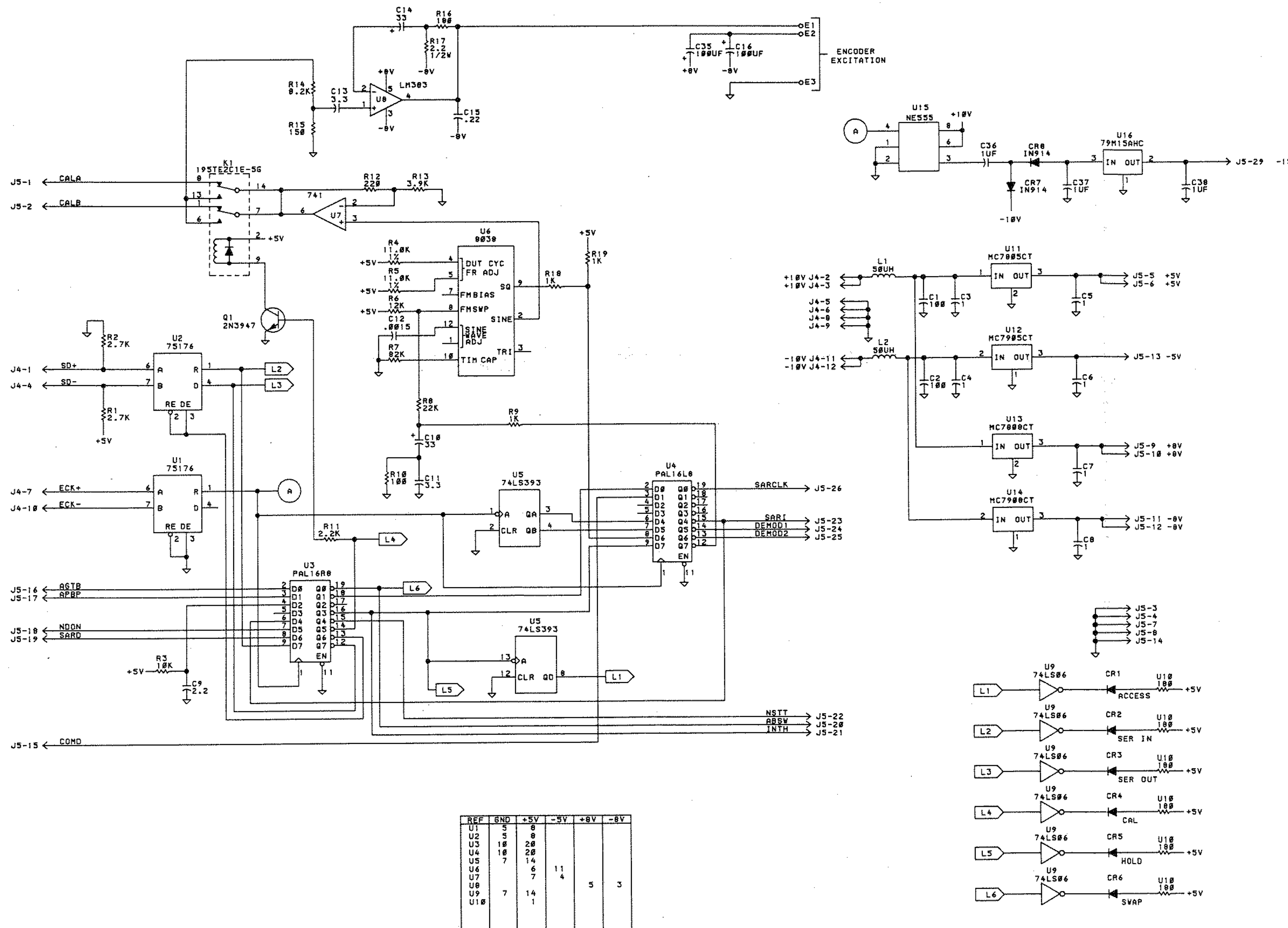




NOTES:

1. NOTE THAT C1,C2,C16,C33,C34, AND C35 ARE POLARIZED. INSTALL AS INDICATED.

Figure 7.54 Encoder Control Assembly (A1), Component Location



REF	GND	+5V	-5V	+8V	-8V
U1	5	8			
U2	5	8			
U3	10	20			
U4	10	20			
U5	7	14			
U6		6	11		
U7		7	4		
U8				5	3
U9	7	14			
U10		1			

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MICROFARADS
   ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

Figure 7.55 Encoder Control Assembly (A1), Schematic

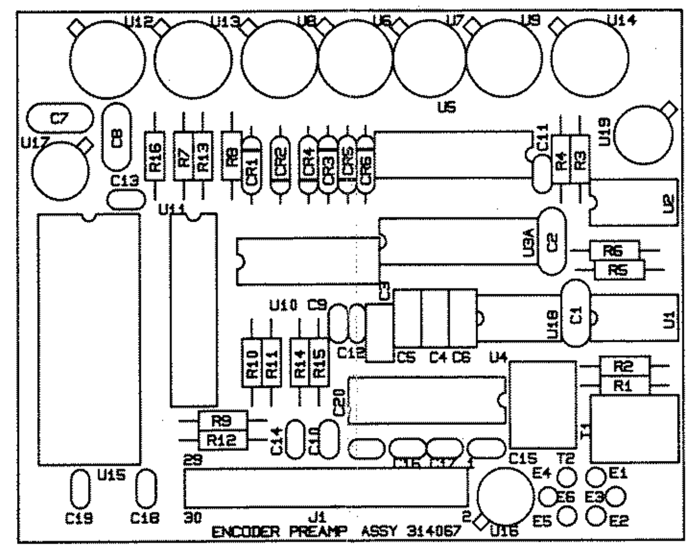
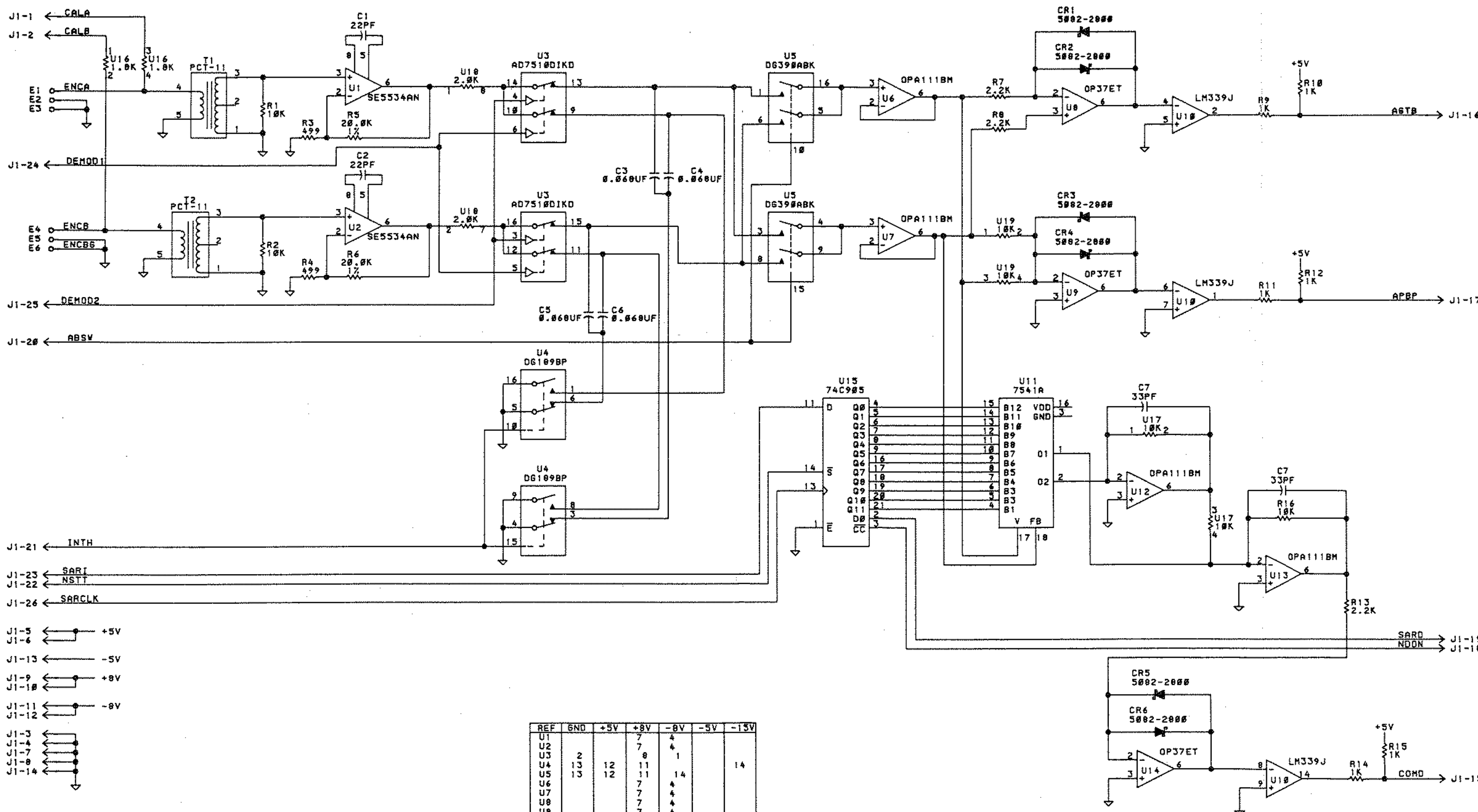


Figure 7.56 Encoder Preamp Assembly (A2), Component Location



REF	GND	+5V	+8V	-8V	-5V	-15V
U1			7	4		
U2			7	4		
U3	2		8	1		
U4	13	12	11			14
U5	13	12	11	14		
U6			7	4		
U7			7	4		
U8			7	4		
U9			7	4		
U10		3			12	
U11	3		16			
U12			7	4		
U13			7	4		
U14			7	4		
U15	12	24				

Figure 7.57 Encoder Preamp Assembly (A2), Schematic

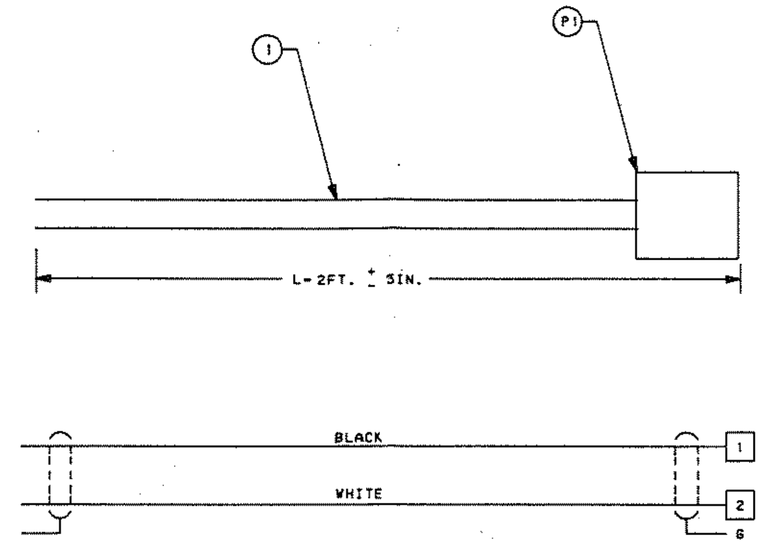


FIG. 1

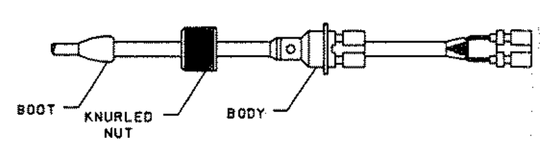


FIG. 2

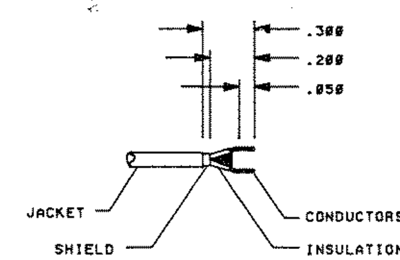
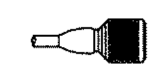
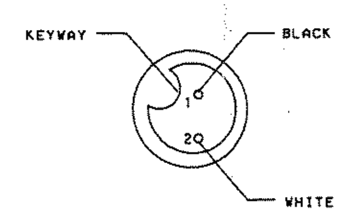


FIG. 3





INSERTION SIDE VIEW

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES

1	2FT	175332	CABLE, BRAIDSHIELD	2-24 AWG	44A1121-24 -9/6-9
P1	1	315922	CONN., MICROTECH	HDP-2S-1	
ITEM	QTY	SA STK NO.	DESCRIPTION	SPEC AND SIZE OR VALUE	IDENTIFYING NO.

PARTS LIST

Figure 7.58 Cable Assembly, Encoder to Preamp

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of −20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: To convert a power ratio of 2,000:1 to dB, express 2,000 as 2×10^3; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 dB + 3 dB = 33 dB. In the lower righthand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*	*Voltage Ratio*	*Power Ratio*	*−dB+*	*Voltage Ratio*	*Power Ratio*
1.000	1.000	0	1.000	1.000	.447	.200	7.0	2.239	5.012	.200	.0398	14.0	5.012	25.12
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.026	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	.794	1.0	1.122	1.259	.398	.159	8.0	2.512	6.310	.178	.0316	15.0	5.623	31.62
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	.631	2.0	1.259	1.585	.355	.126	9.0	2.818	7.943	.159	.0251	16.0	6.310	39.81
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	.501	3.0	1.413	1.995	.316	.100	10.0	3.162	10.000	.141	.0200	17.0	7.079	50.12
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.140	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	.398	4.0	1.585	2.512	.282	.0794	11.0	3.548	12.59	.126	.0159	18.0	7.943	63.10
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	.316	5.0	1.778	3.162	.251	.0631	12.0	3.981	15.85	.112	.0126	19.0	8.913	79.43
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	.251	6.0	1.995	3.981	.224	.0501	13.0	4.467	19.95	.100	.0100	20.0	10.000	100.00
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42					
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89					
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38					
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88					
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39					
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91					
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44					
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99					
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55					
											10^{-3}	30		10^{3}
										10^{-2}	10^{-4}	40	10^{2}	10^{4}
											10^{-5}	50		10^{5}
										10^{-3}	10^{-6}	60	10^{3}	10^{6}
											10^{-7}	70		10^{7}
										10^{-4}	10^{-8}	80	10^{4}	10^{8}
											10^{-9}	90		10^{9}
										10^{-5}	10^{-10}	100	10^{5}	10^{10}
											10^{-11}	110		10^{11}
										10^{-6}	10^{-12}	120	10^{6}	10^{12}

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Manual Update Information

This envelope is provided for filing manual update information such as corrections to text, tables, procedures, new or revised drawings, or special application notes. Please use your own filing method to list the update entries in the blank space below.

This is an interim step to provide our customers with both errata and new information for this equipment while the manual is being corrected.

Instruction Manual Update

DATE January, 1986

MANUAL NAME Model 1885 Position Indicator
Model 1886 Position Data Processor

Changes have occurred since the last printing of this manual. The attached pages are updated versions of those appearing in this book.

ECO NO. 7794I, 7900I & 7959I

Scientific Atlanta

6.3 ORDERING PARTS

When ordering parts from Scientific-Atlanta, always include the unit name, the unit serial number, the component part number, the description, the vendor part number, and the FSCM code number.

6.4 PARTS SUBSTITUTION

Common component parts may differ from those identified in the parts list. This difference is due to the substitution of a more current part. When this occurs, the replacement part may be either identical to the type removed or to the description given in the parts list.

6.4.1 Model 1885 Parts List Index

6.4.2 Model 1886 Parts List Index

6.4.3 Encoder Processor Parts List Index

MODEL 1885 CPU ASSEMBLY - 316365 (1)
REF DESIGNATION PREFIX: A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	0304104	PWB ASSY 8088 CPU/10 MDL 1885		
(2) 3	0316364	EPROM & LABEL ASSY CPU 1885		
U9	0314859	PRGRMD ASSY SEWQ CNTLR CPU1885		
U10	0314860	PRGRMD ASSY ADRS DCDR CPU 1885		

Subassembly - 304104

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C2	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C3	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C4		NOT ASSIGNED		
C5		NOT ASSIGNED		
C6	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C7	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C8	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C9	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C101	0173736	CAPACITR IC BYPASS FOR 8088 CPU .07MF	UQ-808X.07	
C102	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C103	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C104	0173730	CAPACITR IC BYPASS FOR .3W 18L-DIP .03MF	UQ-18.03	
C106	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C107	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C108	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C109	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C110	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C111	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C112	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C114	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C115	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C116	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C117	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C119	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C120	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C122	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C124	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C125	0173732	CAPACITR IC BYPASS FOR .4W 22L-DIP .03MF	UQ-22.03	
C126	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
J2	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
R1	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R7	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R8	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
U1	0171589	IC MICROPROCESSOR 8-BIT HMOS 5 MHZ	D8088	
U2	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U3	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U4	0171588	IC CLOCK GENERATOR FOR 8088 CPU	D8284A	
U5	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
U6	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U7	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U8	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U11	0173633	IC TTL BUFFER INVERT OCTAL 3-STATE	74F240PC	

(1) & (2) See Page 6-6

Subassembly - 304104 (cont.)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
U12	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	
U15	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U17	0170207	IC TTL GATE OR 2-IN QUAD	74F32PC	
U19	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U24	0173636	IC BUS TRANSCVR IEEE 488 INTERFACE	SN75160AN	
U25	0173638	IC NUS TRANSCVR IEEE 488 INTERFACE MULTI	SN75162AN	
U26	0173644	IC BUSS TRANSCVR IEEE 488 INTERFACE	TMS9914ANL	
U27	0173642	IC COMM INTERFACE UART DUAL	SC2681CSI40	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U31	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
U32	0174696	IC LINE DRIVER DUAL	UA9636ACP	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU2	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086650	SOCKET 18 PIN DIP PC MT	ICT-183-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU10	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU11	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU12	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU15	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU16	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU17	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU19	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU20	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU22	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU24	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU25	0089605	SOCKET 22 PIN DIP PC MT	ICT-224-S-T	
XU26	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
Y1	0171590	CYRSTAL 15.000 MHZ .015% H3W HOLDER	MP150	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES		

*SERIAL NUMBER FROM	TO	① PWB ASSEMBLY NUMBER	② ITEM 3 PART NUMBER
1	33	314865	316181
34		316365	316364

* SERIAL NUMBERS ARE APPROXIMATE.

MODEL 1886 CPU ASSEMBLY - 316366 (1)
REF DESIGNATION PREFIX: A2

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
01	0304103	PWB ASSY 8088 CPU/10 MDL 1886		
(2) 03	0316364	EPROM & LABEL ASSY CPU 1886		
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
U9	0314859	PRGRMD ASSY SEWQ CNTLR CPU1885		
U10	0314860	PRGRMD ASSY ADRS DCDR CPU 1885		
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	
U27	0173642	IC COMM INTERFACE UART DUAL	SC2681CSI40	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U30	0173940	RES. NTWK 3.9K OHM 2% 10 SIP	4310R 101 392	
U32	0174696	IC LINE DRIVER DUAL	UA9636ACP	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES	PER S A DWG	

8088 CPU/10 MODEL 1886 PWB ASSEMBLY - 304103
REF DESIGNATION PREFIX: 01

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035654	CAPACITR 10 MF 25V SOLID TANT POL 10%	T362B106K025AS	05397
C2	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C3	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C6	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C7	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C8	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C9	0077920	CAPACITR 1 MF 50V CER MONO 20%	5CZ5U105X0050C5	80183
C101	0173736	CAPACITR IC BYPASS FOR 8088 CPU.07MF	UQ-808X.07	
C102	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C103	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C104	0173730	CAPACITR IC BYPASS FOR .3W 18L-DIP .03MF	UQ-18.03	
C106	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C107	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C108	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C109	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C110	0173733	CAPACITR IC BYPASS FOR .3W 24L-DIP .03MF	UQ-24.S03	
C111	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C112	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C114	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C115	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C116	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C117	0173728	CAP IC BYP .3W 14L-DIP .02MF	UQ-14.02	
C119	0173731	CAPACITR IC BYPASS FOR .3W 20L-DIP .03MF	UQ-20.03	
C120	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C122	0173734	CAPACITR IC BYPASS FOR .6W 28L-DIP .03MF	UQ-28.03	
C127	0173735	CAPACITR IC BYPASS FOR .6W 40L-DIP .03MF	UQ-40.03	
C128	0173729	CAPACITR IC BYPASS FOR .3W 16L-DIP .03MF	UQ-16.03	
CR1	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
J2	0173712	CONN RECT 96-COND MALE PNL MT RT ANGL PC	10-8457-096-002-097	
R1	0071887	RESISTOR 100 OHM 1/4W 10% COMP	RCR07G101KS	01121
R2	0072026	RESISTOR 10K OHM 1/4W 10% COMP	RCR07G103KS	01121
R8	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	RCR07G102KS	01121
R9	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121
R10	0072077	RESISTOR 47K OHM 1/4W 10% COMP	RCR07G473KS	01121

(1) & (2) SEE PAGE 6-24

304103 (continued)

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
3 S1	0087229	CONN HEADER SGL ROW STRAIGHT 2-PIN PC	87220-2	
S3	0087366	CONN HEADER SGL ROW STRAIGHT 3-PIN PC	87220-3	
U1	0171589	IC MICROPROCESSOR 8-BIT HMOS 5 MHZ	D8088	
U2	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U3	0173613	IC TTL LATCH 8-BIT TRANSPARENT 3-STATE	74F373PC	
U4	0171588	IC CLOCK GENERATOR FOR 8088 CPU	D8284A	
U5	0087091	RESISTOR NETWORK 9 1K OHM 2% 10 SIP	4310R-101-102	
U6	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U7	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U8	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U11	0173633	IC TTL BUFFER INVERT OCTAL 3-STATE	74F240PC	
U12	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U14	0174947	IC MEM CMOS RAM 8192X8 150NS	HM6264LP-15	
U15	0087981	IC TTL BUFFER QUAD 3-STATE	SN74LS125N	
U17	0170207	IC TTL GATE OR 2-IN QUAD	74F32PC	
U19	0173634	IC BUS TRANSCVR 8-BIL	74F245PC	
U27	0173642	IC COMM INTERFACE UART DUAL	SC2681CS140	
U28	0173639	IC LINE RECEIVER QUAD DIFF 3-STATE	SN75175J	
U29	0174696	IC LINE DRIVER DUAL	UA9636ACP	
U30	0173940	RES. NTWK 3.9K OHM 2% 10 SIP	4310R 101 392	
U31	0089252	RESISTOR NETWORK 9 4.7K OHM 2% 10 SIP	4310R-101-472	
XU1	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU2	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086650	SOCKET 18 PIN DIP PC MT	ICT-183-S-T	
XU6	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU7	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU8	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU9	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU10	0173737	SOCKET 24 PIN DIP PC MT LOW PROFILE OPEN	610-24-CC-D	
XU11	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU12	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU14	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU15	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU16	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU17	0086648	SOCKET 14 PIN DIP PC MT	ICT-143-S-T	
XU19	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU20	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU22	0086652	SOCKET 28 PIN DIP PC MT	ICT-286-S-TG30	
XU27	0086653	SOCKET 40 PIN DIP PC MT	ICT-406-S-T	
XU28	0086649	SOCKET 16 PIN DIP PC MT	ICT-163-S-T	
XU29	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU32	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
Y1	0171590	CRYSTAL 15.000 MHZ .015% H3W HOLDER	MP150	
Y2	0172589	CRYSTAL 3.6864 MHZ .015% SERIES RES		

*SERIAL NUMBER FROM	TO	1 PWB ASSEMBLY NUMBER	2 ITEM 3 PART NUMBER
1	2	314866	316181
3		316366	316364

* SERIAL NUMBERS ARE APPROXIMATE.

3 APPLIES ONLY TO SERIAL NUMBER 4 AND BELOW (APPROXIMATELY).

ENCODER CONTROL ASSEMBLY - 317613
REF DESIGNATION PREFIX: A1

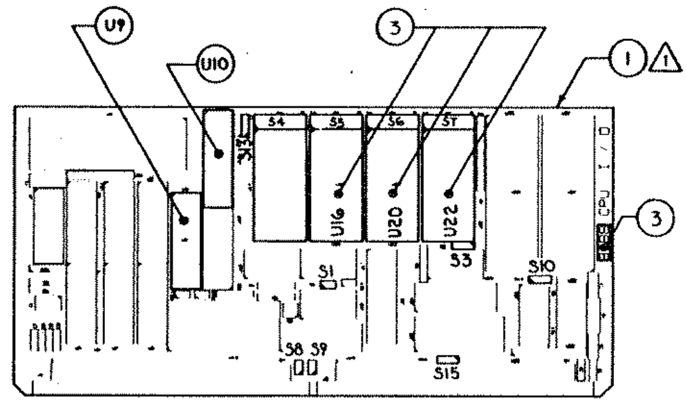
REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
1	314064	PWB, ENCODER CONTROL		
U3	314075	PAL SEQ CONTROLLER ECU3 16R8		
U4	314076	PAL DEMOD CONTROLLER ECU4 16L8		

ENCODER CONTROL SUBASSEMBLY - 314064

REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
C1	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C2	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C3	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C4	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C5	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C6	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C7	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C8	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C9	0081808	CAPACITR 2.2 MF 50V CER MONO 20%	8141-050-651-225M	72982
C10	0081021	CAPACITR 33 MF 10V SOLID TANT POL 20%	150D336X0010B2	80183
C11	0081095	CAPACITR 3.3 MF 50V CER MONO 20%	8151-050-651-335M	72982
C12	0084214	CAPACITR .0015 MF 100V CER MONO X7R 10%	8121-100-X7R-152K	72982
C13	0081095	CAPACITR 3.3 MF 50V CER MONO 20%	8151-050-651-335M	72982
C14	0081021	CAPACITR 33 MF 10V SOLID TANT POL 20%	150D336X0010B2	80183
C15	0076882	CAPACITR .22 MF 50V CER MONO 20%	5CZ5U224X0050C5	80183
C16	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C17	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C18	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C19	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C20	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C21	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C22	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C23	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C24	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C25	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C26	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C27	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C28	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C29	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C31	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C32	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C33	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C34	0035656	CAPACITR 100 MF 20V SOLID TANT POL 20%	T362D107K020AS	05397
C35	0035656	CAPACITR 100 MF 20V SOLID TANT POL 10%	T362D107K020AS	05397
C36	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C37	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C38	0081101	CAPACITR 1 MF 50V CER MONO 20%	8131-050-651-105M	72982
C39	0081995	CAPACITR .001 MF 100V CER MONO X7R 10%	8121-100-X7P102X	72982
CR1	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR2	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR3	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR4	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR5	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR6	0084692	LAMP LED RED .185 DIA .313 LNG 2.4V 20MA	5082-4658	28480
CR7	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
CR8	0071122	DIODE 1N914 SIL 75V 75MA	1N914	80368
J1	0173674	CONN RECT BODY W/O CONTACTS 4 POS RECEP	03-06-1042	
J2	0173670	CONN RECT BODY W/O CONTACTS 3 POS RECEP	03-06-1032	
J3	0173670	CONN RECT BODY W/O CONTACTS 3 POS RECEP	03-06-1032	
J4	0084997	CONN RECT BODY W/O CONTACTS 12 POS PLUG	03-06-2122	27264
J5	0173955	CONN 40 PIN FWM DOUBLE ROW BOTTOM MT	86418 2	
K1	0174810	RELAY 5VDC DPDT REED DIP	195TE2C1E-5G	
L1	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
L2	0089683	INDUCTOR 50 UH UNSHLD 10%	6310-6	
L3	0081977	CORE BEAD FERRITE 7D.260x.125x.375L	57-1555	
Q1	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713
Q2	0077147	TRANSSTR 2N3947 NPN SIL	2N3947	04713

ENCODER CONTROL SUBASSEMBLY - (continued)

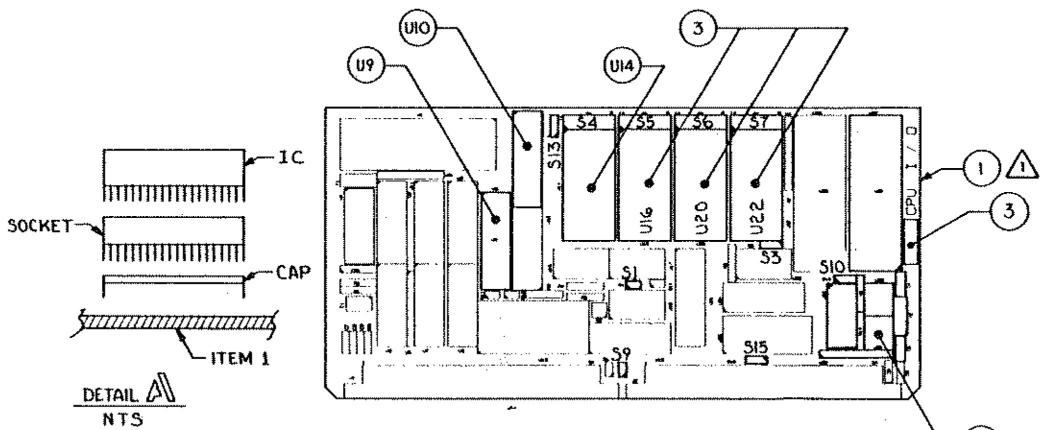
REF DESIG	PART NO.	DESCRIPTION	VENDOR PART NUMBER	FSCM CODE
R1	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R2	0074711	RESISTOR 2.7K OHM 1/4W 5% COMP	RCR07G272JS	01121
R3	0074727	RESISTOR 10K OHM 1/4W 5% COMP	RCR07G103JS	01121
R4	0080382	RESISTOR 11.0K OHM RN55C 1% MTL FLM	RN55C1102F	
R5	0080382	RESISTOR 11.0K OHM RN55C 1% MTL FLM	RN55C1102F	
R6	0074729	RESISTOR 12K OHM 1/4W 5% COMP	RCR07G123JS	01121
R7	0075692	RESISTOR 82K OHM 1/4W 5% COMP	RCR07G823JS	01121
R8	0074735	RESISTOR 22K OHM 1/4W 5% COMP	RCR07G223JS	01121
R9	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R10	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R11	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	RCR07G222JS	01121
R12	0074687	RESISTOR 220 OHM 1/4W 5% COMP	RCR07G221JS	01121
R13	0074718	RESISTOR 3.9K OHM 1/4W 5% COMP	RCR07G392JS	01121
R14	0075668	RESISTOR 8.2K OHM 1/4W 5% COMP	RCR07G822JS	01121
R15	0074679	RESISTOR 150 OHM 1/4W 5% COMP	RCR07G151JS	01121
R16	0078110	RESISTOR 180 OHM 1/4W 5% COMP	RCR07G181JS	01121
R17	0083136	RESISTOR 2.2 OHM 1/2W 5% COMP	RCR20G2R2JS	01121
R18	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R19	0074702	RESISTOR 1.0K OHM 1/4W 5% COMP	RCR07G102JS	01121
R20	0074675	RESISTOR 100 OHM 1/4W 5% COMP	RCR07G101JS	01121
R21	0074722	RESISTOR 4.7K OHM 1/4W 5% COMP	RCR07G472JS	01121
U1	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U2	0174814	IC LINE XCVR DIFF 3-STATE	SN75176JG	
U5	0087804	IC TTL COUNTER BIN 35-MHZ DUAL	SN74LS393J	
U6	0174807	IC OSC VCO 0.001-0.3 MHZ 14-DIP	ICL8038BMJD	
U7	0084890	IC OP AMP 8L-DIP 70C COMP 741C	MC1741CP1	04713
U8	0174809	IC AMPL AUDIO 5L-T0220	LM383T	
U9	0080979	IC TTL BUFFER INVERT HEX OPEN-COL	SN7406N	01295
U10	0173354	RESISTOR NETWORK 7 220 OHM 2% 8 SIP	108A221	
U11	0083235	IC VLTG RGLTR POS 5V 0.5A TYP T0220	MC7805CT	04713
U12	0084915	IC VLTG RGLTR NEG 5V 0.5A TYP T0220	MC7905CT	04713
U13	0088131	IC VLTG RGLTR POS 8V 0.5A TYP	MC7808CT	
U14	0085034	IC VLTG RGLTR NEG 8V 0.8A TYP T0220	MC7908CT	12040
U15	0083806	IC TIMER 8L-DIP	NE555N	18324
U16	0084982	IC VLTG RGLTR NEG 15V 0.35A TYP T039	79M15AHC	13715
XU1	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU2	0087983	SOCKET 8 PIN DIP PC MT	ICT-083-S-T	
XU3	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	
XU4	0086897	SOCKET 20 PIN DIP PC MT	ICT-203-S-T	



ASSEMBLY NUMBER	*SERIAL NUMBER	
	FROM	TO
314865	1	33
316365	34	

*SERIAL NUMBERS ARE APPROXIMATE.

Figure 7.2 CPU Assembly (A2), Component Location



ASSEMBLY NUMBER	*SERIAL NUMBER	
	FROM	TO
314866	1	2
316366	3	

*SERIAL NUMBERS ARE APPROXIMATE.

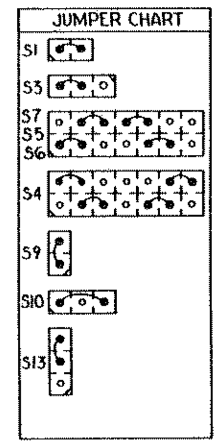
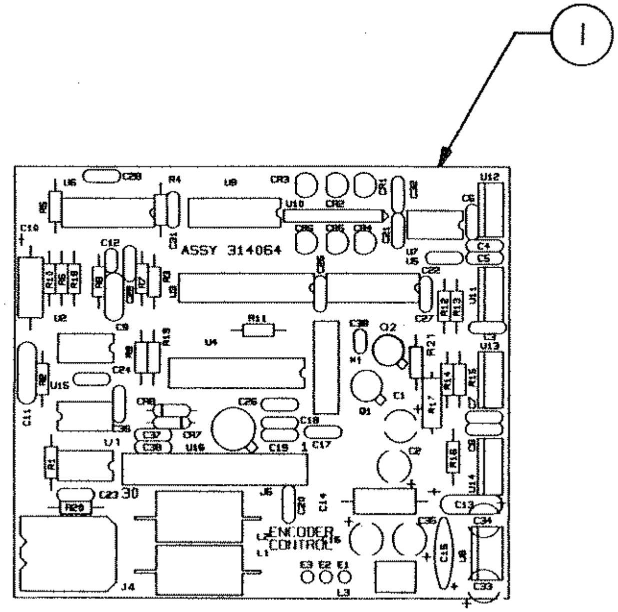
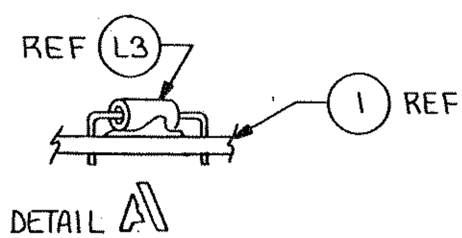
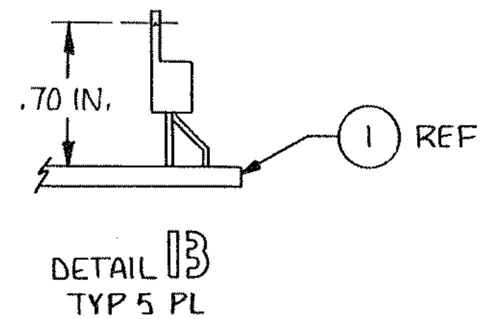


Figure 7.32 CPU Assembly (A2), Component Location



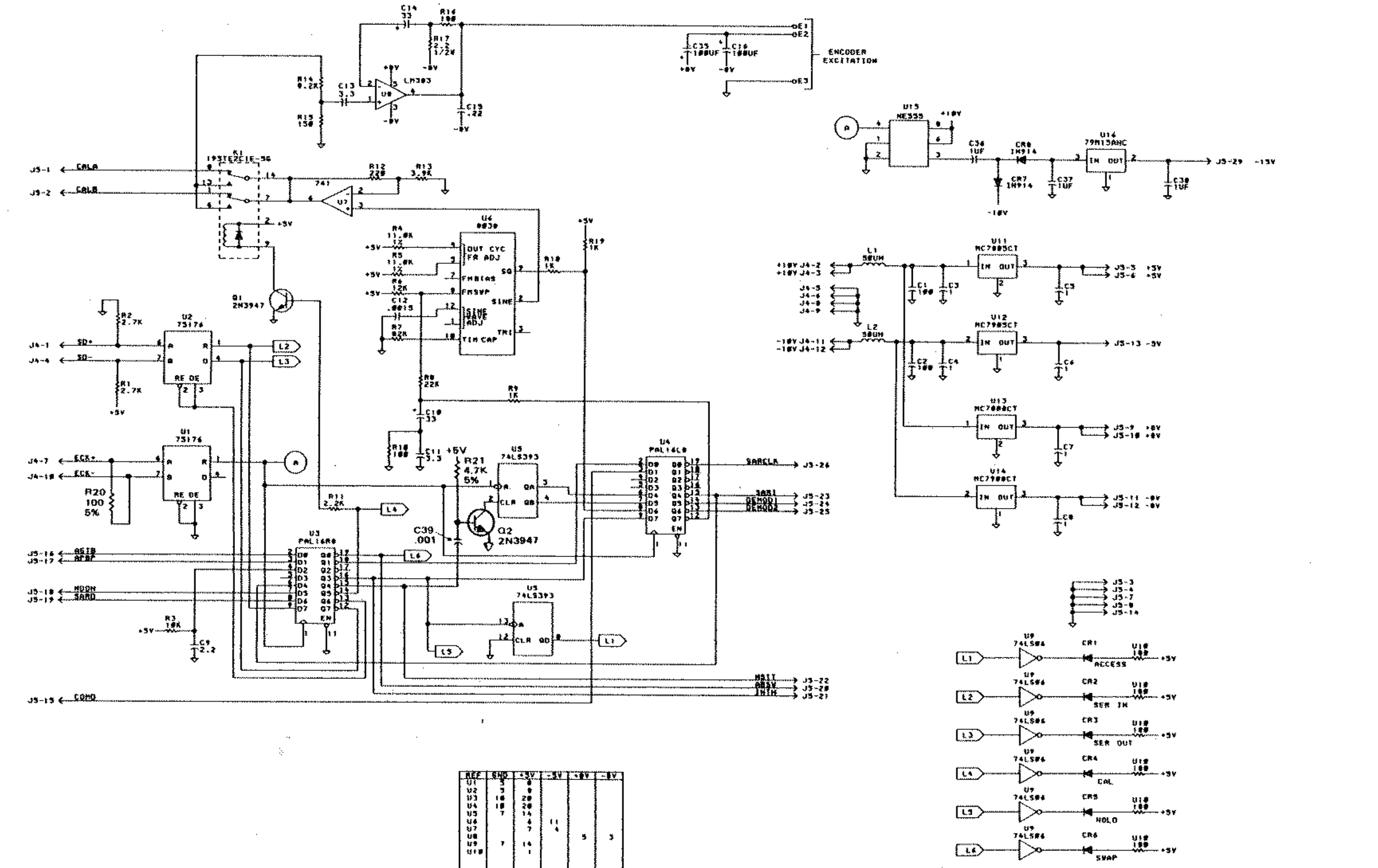




NOTES:

1. NOTE THAT C1,C2,C16,C33,C34, AND C35 ARE POLARIZED. INSTALL AS INDICATED.

Figure 7.54 Encoder Control Assembly (A1), Component Location



REF	GND	+5V	-5V	+8V	-8V
U1	5	8			
U2	5	8			
U3	10	20			
U4	10	20			
U5	7	14			
U6		6	11		
U7		7	4		
U8				5	3
U9	7	14			
U10		1			

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS ARE IN MICROFARADS
   ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.

Figure 7.55 Encoder Control Assembly (AI), Schematic