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Operation/Maintenance

Manual

for

Model 5300

Synchro/Resolver Standard

TM-I-6005

1. In section 1, Table 1-1 (Specifications), update table to reflect new accuracy specifications as shown below. NOTE: Parameters not specified below are unchanged.

SPECIFICATION	VALUE		
Angular accuracy vs. Frequency[a]:			
SYNCHRO MODE	6-11.8 V_{L-L}	>11.8 - 50 V_{L-L}	>50 - 90 V_{L-L}
47-360 Hz	--------	±3 arc-sec	±3.5 arc-sec
>360-600 Hz	±2 arc-sec[d]	±2 arc-sec[d]	±3 arc-sec[d]
>600-800 Hz	±2 arc-sec[d]	±3 arc-sec	±4 arc-sec
>800-1200 Hz	±2 arc-sec[d]	±4 arc-sec	±5 arc-sec
>1200-20,000 Hz	--------	--------	--------
RESOLVER MODE	6-26 V_{L-L}	>26 - 90 V_{L-L}	
47-360 Hz	--------	--------	
>360-600 Hz	±2 arc-sec[d]	±2 arc-sec[d]	
>600-800 Hz	±2 arc-sec[d]	±2 arc-sec	
>800-1200 Hz	±2 arc-sec[d]	±5 arc-sec	
>1200-10,000 Hz	±2 - 15 arc-sec[b][d]	--------	
>10,000-20,000 Hz	±15 - 60 arc-sec[b][d]	--------	

[a] Applies over the full voltage range unless otherwise indicated and includes resolution uncertainty

[b] Accuracy varies logarithmically with frequency

[c] 0° to 70° inductive load; outputs are overload and short-circuit protected

[d] Accuracy de-rates logarithmically from the 6V rating to the 1V rating with a 50% increase in specification at 1V

1. In section 1, Table 1-1 (Specifications), update table to reflect new accuracy specifications as shown below. NOTE: Parameters not specified below are unchanged.

SPECIFICATION	VALUE		
Angular accuracy vs. Frequency[a]:			
SYNCHRO MODE	6-11.8 V_{L-L}	>11.8 - 50 V_{L-L}	>50 - 90 V_{L-L}
47-360 Hz	--------	±3 arc-sec	±3 arc-sec
>360-600 Hz	±2 arc-sec[d]	±2 arc-sec[d]	±2 arc-sec[d]
>600-800 Hz	±2 arc-sec[d]	±3 arc-sec	±4 arc-sec
>800-1200 Hz	±2 arc-sec[d]	±4 arc-sec	±5 arc-sec
>1200-20,000 Hz	--------	--------	--------
RESOLVER MODE	6-26 V_{L-L}	>26 - 90 V_{L-L}	
47-360 Hz	--------	--------	
>360-600 Hz	±2 arc-sec[d]	±2 arc-sec[d]	
>600-800 Hz	±2 arc-sec[d]	±2 arc-sec	
>800-1200 Hz	±2 arc-sec[d]	±5 arc-sec	
>1200-10,000 Hz	±2 - 15 arc-sec[b][d]	--------	
>10,000-20,000 Hz	±15 - 60 arc-sec[b][d]	--------	

[a] Applies over the full voltage range unless otherwise indicated and includes resolution uncertainty

[b] Accuracy varies logarithmically with frequency

[c] 0° to 70° inductive load; outputs are overload and short-circuit protected

[d] Accuracy derates logarithmically from the 6-volt rating to the 1 V rating with a 50% increase in specification at 1 V

A 5300-S3456 is configured for CE conformance. The following parts have been added or changed:

1. Front panel assembly P/N 784043, which has varistors (NAI P/N 807699, GE P/N V130LA10A) from each binding post to chassis ground.
2. Varistors (NAI P/N 807699, GE P/N V130LA10A) have been added to the rear panel terminal block T1 from REF: IN+, IN- and OUT terminals to ground.

A. Assemblies and revision levels affected:

SYSTEM BOARD ASSEMBLY; NAI P/N 784009 Revision G

B. Changes:

1. In **Table 6-2** (System Board Assy. A1 Parts list), the following changes have been implemented:

   a. Delete U37

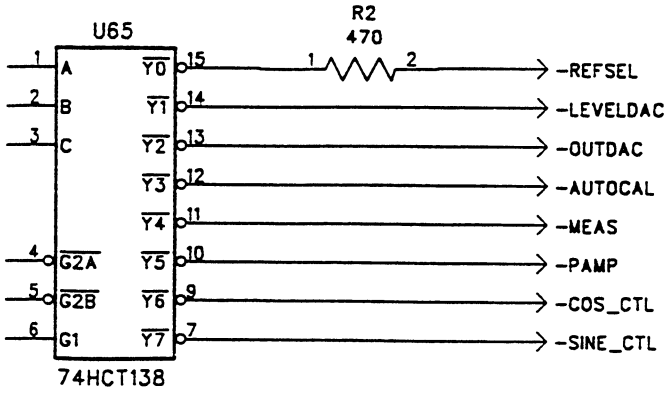
   b. Add the following components:

Ref. Des.	Description	NAI P/N	Mfr. Code	Mfr. P/N	Total Qty
R1	Resistor, Composition, 470 ohms, 5%, 1/8W	RCR05G471JS	01121	RCR05G471JS	2
R2	Same as R1				

   c. Change the following NAI PART NO.'s in Table 6-2:

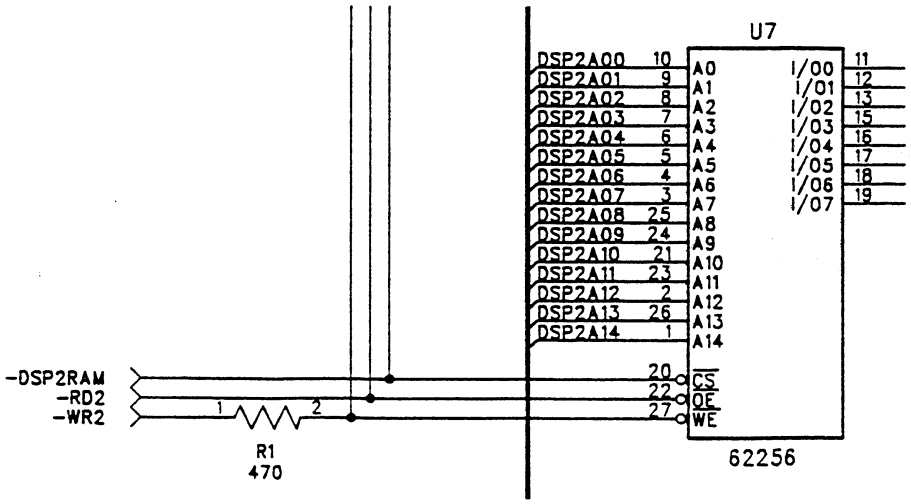
a. D1, D2	From:	805805
	To:	883449
b. U21	From:	600018
	To:	600018-5
c. U22	From:	600019
	To:	600019-5

2. In Fig 7-1, page 2 of 13 add R2 as per 1(b) above:



Note: This Errata sheet is per 33882, 34108, 34110, 34113 (NAI use only)

3. In Fig 7-1, page 10 of 13 add R1 as per 1(b) above:



4. On page 6-5, Fig. 6.2, the following items have not been assembled:

   a. U37, 42, 43, 44, 50, 51, 52

Note: This Errata sheet is per 33882, 34108, 34110, 34113 (NAI use only)

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WARNING

High Voltage exists at several points in the instrument. Normal precautions consistent with good practice should be taken to reduce shock hazard.

A potential shock hazard exists when ungrounded power source or ungrounded case operation is employed. Persons operating the instrument should be made aware of and take precautions against this condition.

North Atlantic Instruments, Inc. cannot be held responsible for damage to person or property in the process of or as a result of maintenance, calibration, or setting up of the instrument.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL

This technical manual provides description, operation, and servicing instructions for the model 5300 programmable Resolver/Synchro Standard (RSS), manufactured by North Atlantic Instruments, Inc. (NAI), of Bohemia, New York. This manual is intended for maintenance personnel who operate and/or maintain the RSS.

1.2 SCOPE

The technical manual consists of seven chapters. Chapter 1, Introduction, introduces and describes the RSS, its purpose and capabilities. Figure 1-1 shows the major assemblies of the RSS, and table 1-1 lists their reference designations. Table 1-2 lists the RSS specifications and table 1-3 lists equipment and materials supplied with the RSS. Chapter 2, Installation, provides instructions for unpacking and inspecting the RSS prior to installation. The Installation procedures include bench mounting and mounting the RSS to a standard 19-inch equipment rack using the rack adapters provided. Repacking instructions for shipment or storage, and tables listing pin-outs for panel terminals and the IEEE-488 I/O connector are included. Setup and power turn-on procedures follow installation procedures. Chapter 3, Operation, is divided into two sections. Section I describes and locates each control, switch, and indicator on the RSS. Section II describes the standard (NAI) programming language used to operate the RSS via the interface connector on the rear panel. Chapter 4, Principals of Operation, provides an overview of synchro and resolver conventions, software overview, and a system and functional block diagram description written to support an intermediate maintenance level. Chapter 5, Maintenance, consists of five sections. Section I contains a list of material and procedures for performing preventive maintenance. Section II contains the performance test used to check the accuracy and function of the RSS. Section III contains a fault isolation table used to detect and isolate defective shop replaceable assemblies (SRA) within the RSS. Section IV contains removal and replacement procedures for the SRA's. Section V contains test and adjustment procedures. Chapter 6, Parts List, contains illustrations to locate parts on the RSS, and detail part lists contain component description, part number, and quantity used. Chapter 7, Diagrams, contain the schematic diagrams for the RSS. Following chapter 7 is Appendix A, Update Information. This appendix contains service bulletins, Tech-Tips, and repair data furnished periodically by the manufacturer to enhance RSS performance and facilitate service and repair.

1.3 INTRODUCTION

The RSS is a laboratory-grade instrument capable of simulating the output of a synchro or resolver. As such, the RSS may be used as a standard for calibrating or testing automatic test equipment (ATE), or used to measure angle position indicators (API) and synchro-to-digital converters. The output parameters can be varied and modulated over a wide range as determined by the operator. The RSS is self-contained and can be remotely controlled by a computer via the interface connector on the rear panel. The RSS has provision for sensing its applied output at the load and comparing it to its set output. In this manner, the RSS can automatically compensate for differences due to line losses.

The RSS may also use an external reference waveform. The external inputs utilize protected autoranging technology that make connection and setup safe, easy, and efficient. The RSS outputs completely isolate the load in the event of an overload.

1.4 DESCRIPTION

The RSS is a self-contained instrument within a

metal enclosure and consists of a front and rear panel assembly, system board, sine/cosine board, analog board, main power supply board, isolation transformer, two isolation/tapped transformers, an interconnect board assembly, and two isolated power supply assemblies. The front panel houses the display/keyboard assembly, power on/off switch, and binding posts whereby synchro/resolver and external inputs and outputs may be connected. The rear panel assembly houses the power entry module, cooling fan and filter assembly, main power transformer, terminal block, calibration bridge transformer, and IEEE-488 interface connector. Figure 1-1 locates the main assemblies of the RSS, and table 1-1 lists their assigned reference designation and NAI part number. The assembly reference designation is used to distinguish between components having the same designation on each assembly. For example, R1 on the sine/cosine board is designated A2R1 whereas R1 on the analog board is designated A3R1.

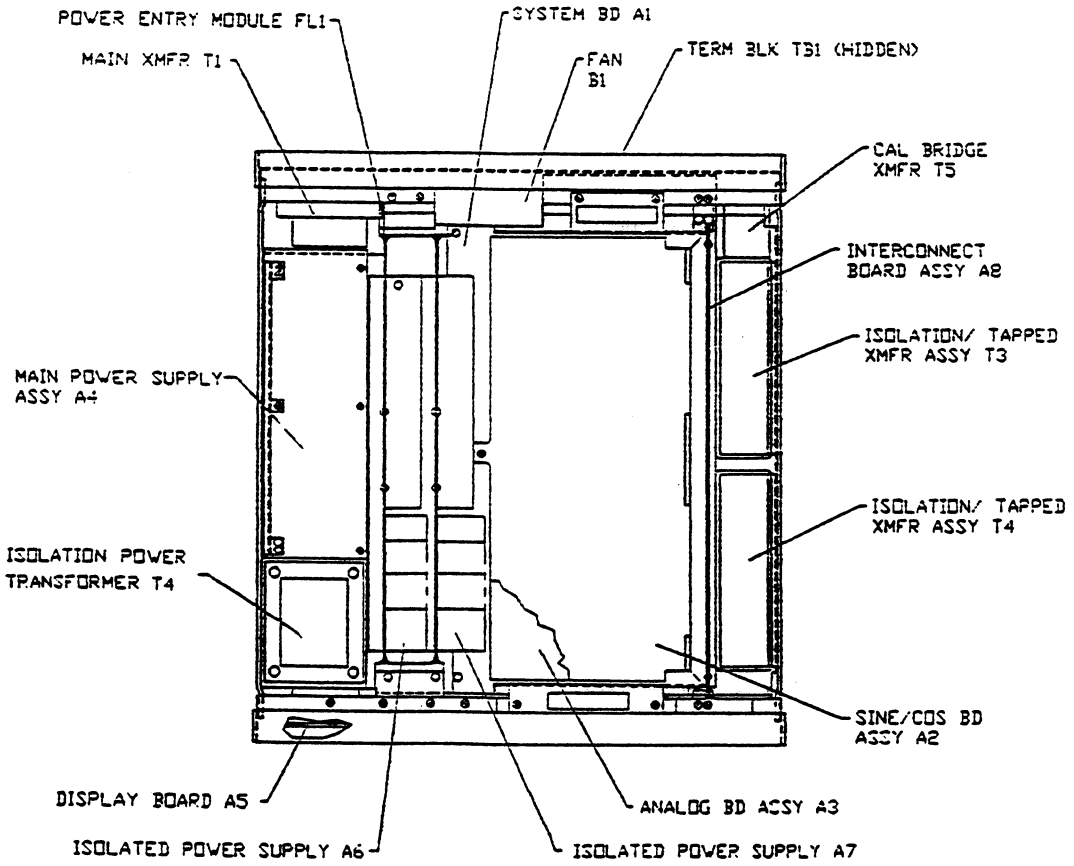


Figure 1-1. RSS Assembly Location

Table 1-1. RSS Assemblies and Reference Designations

REF DES	NOMENCLATURE	NAI P/N
A1	System Board Assembly	784009
A2	Sine/Cosine Board Assembly	784003
A3	Analog Board Assembly	784008
A4	Main Power Supply Board Assembly	784012
A5	Display Board Assembly	784006
A6, A7	Isolated Power Supply Assembly	784007
A8	Interconnect Board Assembly	784011
B1	Fan Assembly	784020
FL1	Power Entry Module Assembly	784019
TB1	Rear Terminal Block	549004
T1	Main Transformer Assembly	810117
T2	Isolation Power Transformer Assembly	810104
T3, T4	Isolation/Tapped Transformer Assembly	784021
T5	Calibration Bridge Transformer Assembly	784018

1.5 SAFETY

The RSS uses power that can cause physical injury or death if contacted. The following is a list of general safety precautions that should be observed when performing maintenance on the RSS. Observe all WARNINGS and CAUTIONS when they appear in this manual.

WARNING

INDICATES THAT PERSONAL INJURY OR DEATH MAY RESULT IF THE PROCEDURE IS NOT CORRECTLY FOLLOWED OR SAFETY PRECAUTIONS ARE NOT OBSERVED.

CAUTION

INDICATES THAT THE RSS MAY BE DAMAGED IF THE PROCEDURE IS NOT CORRECTLY FOLLOWED.

Observe the following general safety precautions:

LIVE CIRCUITS

USE EXTREME CAUTION WHEN PERFORMING MAINTENANCE OR MAKING ADJUSTMENTS WHEN POWER IS ON. NEVER TOUCH THE EQUIPMENT CHASSIS WITH YOUR FREE HAND WHILE TESTING, ADJUSTING, OR PERFORMING FAULT ISOLATION.

WORKING ALONE

IT IS UNSAFE TO WORK ALONE. ALWAYS ENSURE THAT SOMEONE IS PRESENT TO PERFORM FIRST AID OR BE ABLE TO CALL FOR HELP SHOULD AN EMERGENCY OCCUR.

The following WARNINGS and CAUTIONS appear in the manual and are repeated here for emphasis.

WARNING

DO NOT PLUG LINE CORD INTO AC RECEPTACLE AT THIS TIME. CONNECTION TO THE WRONG VOLTAGE SOURCE WILL CAUSE DAMAGE TO THE RSS AND MAY CAUSE INJURY OR DEATH OF THE OPERATOR (Chapt. 2, p. 1).

WARNING - DANGEROUS VOLTAGE!

TURN FRONT PANEL SWITCH OFF AND UNPLUG LINE CORD BEFORE PERFORMING THE PROCEDURES LISTED IN THIS SECTION (Chapt. 5, pp. 3, 57).

WARNING - DANGEROUS VOLTAGE!

DANGEROUS VOLTAGES ARE PRESENT WITHIN THE RSS. BE CAREFUL WHEN WORKING AROUND HIGH-VOLTAGE CIRCUITS. TO PREVENT ELECTRICAL SHOCK, DO NOT TOUCH THE RSS CHASSIS WITH ANY PART OF YOUR BODY. DO NOT PERFORM THESE PROCEDURES ALONE. MAKE SURE SOMEONE IS AVAILABLE TO GIVE YOU ASSISTANCE OR CALL FOR HELP (Chapt. 5, pp. 47, 63).

WARNING

DANGEROUS VOLTAGES PRESENT! USE EXTREME CARE WHEN PERFORMING THIS PROCEDURE (Chapt. 5, pp. 64 and 65).

CAUTION

THIS EQUIPMENT IS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALWAYS USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING EQUIPMENT (Chapt. 5, pp. 3, 47, 57, 63.

CAUTION

GRASP CONNECTOR, NOT RIBBON CABLE IN FOLLOWING STEP (Chapt. 5, pp. 59, 60, 61).

1.6 SPECIFICATIONS

Table 1-2 lists the specifications for the RSS.

Table 1-2. RSS Specifications

SPECIFICATION	SYNCHRO MODE	RESOLVER MODE
Reference Input		
Operating frequency range	47 Hz to 1.2 kHz	360 Hz to 20 kHz
Voltage Range:		
47 Hz to 1.2 kHz	2 to 115 V_{RMS}	
> 1.2 kHz to 20 kHz	—	2 to 26 V_{RMS}
Input impedance	200 kohms minimum	
Reference Output		
Voltage range vs Frequency:		
47 Hz to 1.2 kHz	2 to 115 V_{RMS}	

Table 1-2. RSS Specifications

(Cont'd.)

SPECIFICATION	SYNCHRO MODE	RESOLVER MODE
> 1.2 kHz to 20 kHz	2 to 26 V_{RMS}	
Output impedance	< 0.2 ohms < 2 KHz, < 0.4 ohms < 10 KHz, < 1.0 ohm 10 KHz to 20 KHz	
Voltage Accuracy	±3 % of setting	
Voltage resolution	3 digits	
Output current:		
2 to 26 V_{RMS}	100 mA_{RMS} maximum	
>26 to 115 V_{RMS}	25 mA_{RMS} maximum	
DC Offset	5 mV maximum	
Phase shift range	0 to ±180° to 0.001° resolution	
Phase shift accuracy:		
47 to 2 kHz	±0.5°	
>2 kHz to 20 KHz	±5°	
Outputs (isolated)		
Voltage Accuracy	2% of setting	
Voltage resolution	1% of setting minimum	
DC Offset	5 mV maximum	
Voltage range (line-to-line)	1 to 90 V_{RMS}	
Angular accuracy vs F[a]:		
47 Hz to 360 Hz (11.8 - 90 V_{L-L})	±3 arc-sec	—
>360 Hz to 600 Hz (6 - 90 V_{L-L})	±2 arc-sec[d]	
>600 Hz to 1.2 kHz (6 - 70 V_{L-L})	±2 arc-sec[d]	±2 arc-sec[d]
>600 Hz to 1.2 kHz (70 - 90 V_{L-L})	±2 - 3 arc-sec[b]	±2 arc-sec
>1.2 kHz to 10 kHz (6 - 26 V_{L-L})	—	±2 - 15 arc-sec[b][d]
>10 kHz to 20 kHz (6 - 26 V_{L-L})	—	±15 - 60 arc-sec[b][d]
Angular Accuracy vs load (remote sensing capability):		
47 Hz to 2 kHz	±2 arc-sec/VA	±1.5 arc-sec/VA

Table 1-2. RSS Specifications

(Cont'd.)

SPECIFICATION	SYNCHRO MODE	RESOLVER MODE
> 10 kHz to 20 kHz	—	±12 arc-sec/VA
Angular resolution	0.0001° (0.36 arc-sec)	
Angular accuracy vs temperature	±0.2 arc-sec/°C maximum	
Output drive capability(6):		
2 to 26 V_{RMS}	4 VA maximum limited to 330 mA_{RMS} maximum	
>26 to 90 V_{RMS}	4 VA maximum limited to 33 mA_{RMS} maximum	
Output impedance (maximum):		
47 to 2 kHz	< 0.2 ohms	
>2 kHz to 10 kHz	—	< 0.40 ohms
> 10 kHz to 20 kHz	—	< 1.0 ohms
Radius (sinusoidal) accuracy	±0.005 % typical	
Dynamic angular modulation		
Continuous (CW or CCW)	To 100,000°/sec (278 rps)	
Cyclical	Sine, triangle or square wave to 1 kHz or between preset angles	
Incremental	Successive equal angles on command	
Other		
Front panel control	Push buttons; additional rotary control for manual angular positioning	
Remote control	IEEE-488	
Temperature	0° C to 50° C operating,-40° C to 71° C storage per MIL-T-28800E, Type III, Class 6, Style E	
Dimensions	19" (48.3 cm) W x 3.5" (8.9 cm) H x 18 7/16" (48.8 cm) D, bench or rack mounting	
Power	115/220 VAC ±10%, 47 to 440 Hz, 115 VA	

[a] Applies over the full voltage range unless otherwise indicated and includes resolution uncertainty

[b] Accuracy varies logarithmically with frequency

[c] 0° to 70° inductive load; outputs are overload and short-circuit protected

[d] Accuracy derates logarithmically from the 6-volt rating to 1 V with a 50% increase in specification at 1 V

1.7 EQUIPMENT/MATERIALS SUPPLIED

Table 1-3 list the equipment and materials supplied with the RSS. Table 1-4 list the optional equipment and materials that are not supplied but required to perform maintenance and testing of the RSS.

Table 1-3. Equipment/Materials Supplied

DESCRIPTION	NAI MODEL/PART NUMBER
Resolver/Synchro Standard	Model 5300
Line cord	870165
Technical manual	TM-I-6005
115 V line fuse (2 A slo-blo)	800935
230 V line fuse (1 A slo-blo)	800118
Rack mounting handles (2)	210079

Table 1-4. Optional Test Equipment, Tools, and Materials Required

DESCRIPTION	MANUFACTURER/PART NUMBER*
Extender frame assembly	NAI 784014
Digital multimeter	Fluke 8506A
Oscillator	Krohn-Hite Model 4000AR
75-Watt amplifier	Krohn-Hite Model 7500
Ratio box	Electro Scientific Industries, Inc. - Model 73
Bridge transformer	NAI Model TFI-0010
Synchro/resolver bridge	NAI - Model 540/11
Oscilloscope	Tektronix 465
Digital Analyzing Voltmeter (DAV)	NAI Model 2250-F1

1.8 STATEMENT OF WARRANTY

The RSS is warranted by NAI (seller) to the purchaser in accordance with the following terms and conditions.

1.8.1 LIMITED WARRANTY

The seller warrants products against defects in material and workmanship for twelve months from the date of original shipment. The seller's liability is limited to the repair or replacement of products which prove to be defective during the warranty period. There is no charge under the warranty except for transportation charges. The purchaser shall be responsible for products shipped until received by the seller.

The seller specifically excludes from the warranty 1) calibration, 2) fuses, 3) source mechanical wear, e.g., end-of-life on assemblies such as switches, print heads, recording heads, etc., is dependent upon number of operations or hours of use, and end-of-life may occur within the warranty period.

The seller is not liable for consequential damage or for any injury or damage to persons or property resulting from the operation or application of products. The warranty is voided if there is evidence that products have been operated beyond their design range, improperly installed, improperly maintained, or physically mistreated. The seller reserves the right to make changes and improvements to products without any liability for incorporating such changes or improvements in any products previously sold, or for any notification to the purchaser prior to shipment. In the event the purchaser should require substantially manufactured lots to be identical to those covered by this quotation, the seller will, upon written request, provide a quotation upon a change control program.
No other warranty expressed or implied is offered by the seller other than the foregoing.

1.8.2 CLAIMS FOR DAMAGE IN SHIPMENT

The purchaser should inspect and functionally test the product(s) in accordance with the instruction manual as soon as it is received. If the product is damaged in any way, including concealed damage, a claim should be filed immediately with the carrier, or if insured separately, with the purchaser's insurance company.

1.8.3 SHIPPING

On products to be returned under warranty, await receipt of shipping instructions then forward the instrument prepaid to the destination indicated. The original shipping containers with their appropriate blocking and isolating material is the preferred method of packing. Any other suitably strong container may be used provided the product is wrapped in a sealed plastic bag and surrounded with at least four inches of shock absorbing material to cushion firmly, preventing movement inside the container.

CHAPTER 2
INSTALLATION

2.1 GENERAL

This section describes the installation of the Model 5300 Resolver/Synchro Standard (RSS).

2.2 UNPACKING AND INSPECTION

The RSS has been thoroughly tested, inspected and evaluated at the factory. Care has been taken in the design of the wrapping and packaging material to insure that no damage results from mishandling. To unpack the RSS, perform the following:

1. Remove RSS from the shipping container. Save container for future use in storing or shipping.

2. Visually check contents of the shipping container against the packing list.

3. Check for damage to RSS and notify the carrier if damage is discovered.

2.3 MECHANICAL

The RSS is designed for bench use or rack mounting. An outline and dimension drawing is shown in figure 2-1.

2.4 LINE VOLTAGE SELECTION

The RSS operates from either 115 Vrms (10%, 2 A slo-blo) or 230 Vrms (10%, 1 A slo-blo fuse), 47 Hz to 440 Hz. Each RSS is set for 115 VAC operation at the factory.

The rotary voltage selection switch is located inside the rear panel power entry module. To select the desired voltage switch position, perform the following:

WARNING

DO NOT PLUG LINE CORD INTO AC RECEPTACLE AT THIS TIME. CONNECTION TO THE WRONG VOLTAGE SOURCE WILL CAUSE DAMAGE TO THE RSS AND MAY CAUSE INJURY OR DEATH OF THE OPERATOR.

1. Place on/off switch to off (O) position.

2. Disconnect line cord from RSS.

3. Using a flat screwdriver blade, pry open the fuse guard cover on power entry module .

4. Rotate the selection switch until the desired voltage indicator appears.

5. Replace existing fuse with appropriate size fuse (115V = 2 A slo lo; 230V = 1 A slo-blo).

6 . Close fuse guard cover.

2.5 FRONT PANEL TERMINALS

All front panel terminals accept double prong banana type plugs or stripped wire. Table 2-1 shows the signals available via the front panel terminals.

2.6 REAR PANEL TERMINALS

The rear panel contains connector J23 (and J22, optional) and a terminal block. J23 is used to connect to an IEEE-488 controller, and J22 (when present) allows access to the analog signals and digital angle output. The terminal block allows access to the analog signals.

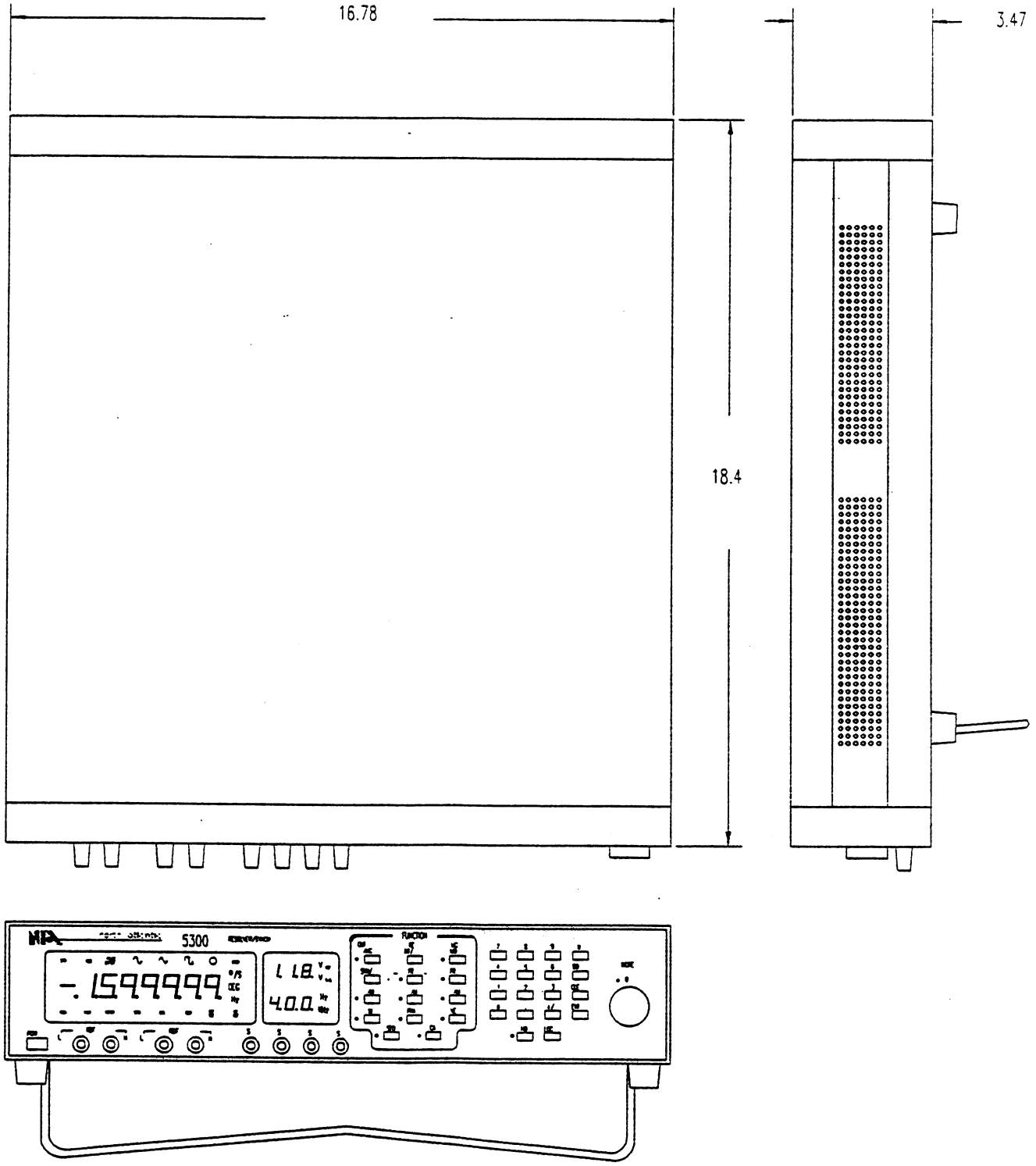


Figure 2-1. RSS Outline and Dimension Drawing

Table 2-1. Front Panel Terminals

SIGNAL	FUNCTION
S1	Synchro/Resolver S1
S2	Synchro/Resolver S2
S3	Synchro/Resolver S3
S4	Resolver S4
REF INPUT - HI	External Reference input +
REF INPUT - LO	External Reference input -
REF OUTPUT - HI	Internal Reference output +
REF OUTPUT - LO	Internal Reference ground

Table 2-2 Terminal Block Connections

SIGNAL	FUNCTION
S1	Synchro/Resolver S1
S2	Synchro/Resolver S2
S3	Synchro/Resolver S3
S4	Resolver S4
SENSE1	Remote sense for S1
SENSE2	Remote sense for S2
SENSE3	Remote sense for S3
SENSE4	Remote sense for S4
REF IN+	External Reference input +
REF IN -	External Reference input -
REF	Internal Reference output
REF GND	Internal Reference ground
AGND	Analog Ground
CHASSIS	Chassis Ground

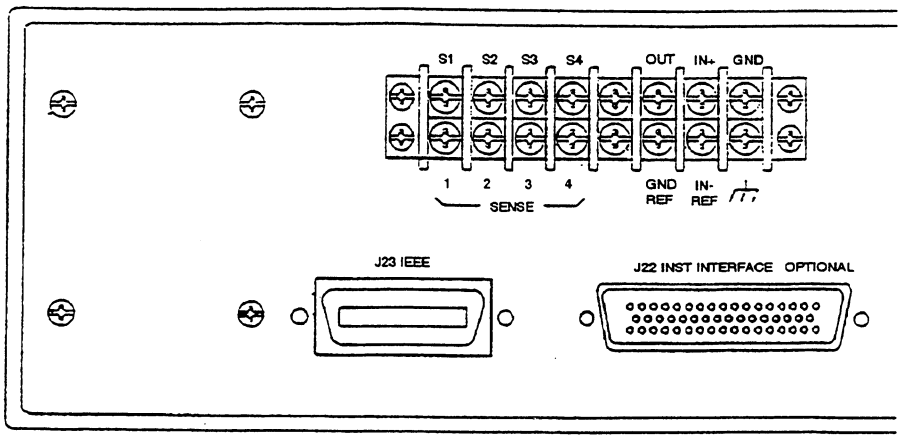


Figure 2-2. RSS Rear Panel Terminals

2.6.1 TERMINAL BLOCK

A terminal block is provided to allow access from the rear panel to the analog signals (see figure 2-2). Refer to table 2-2 for a description of the signals on the terminal block.

2.6.2 J23 IEEE-488 CABLE INSTALLATION

The IEEE-488 interface connector, J23 is used to control the RSS from an external IEEE-488 controller. Table 2-3 lists the pin designations.

To attach this connector perform the following:

1. Place power on/off switch to the off (O) position.

2. Insert 24-pin IEEE-488 interface connector into J23 rear panel connector.

3. Tighten IEEE-488 interface connector screws using a small screwdriver.

4. Connect opposite end of I/O connector to host or computer.

2.6.3 J22 INST. INTERFACE CABLE INSTALLATION (OPTIONAL)

The RSS interface cable allows access from the rear panel to the analog signals and digital angle outputs. Table 2-4 lists the pin designations.

1. Place power on/off switch to the off (O) position.

2. Insert 50-pin I/O connector into J22 rear panel connector.

3. Tighten I/O connector screws using a small screwdriver.

4. Connect opposite end of I/O connector as required.

2.7 GROUNDING

In a high accuracy RSS, it is necessary for chassis and signal (AGND) ground to be tied together. The RSS is shipped from the factory with a shorting link, on the rear panel terminal

block, making this connection.

Note

Ground loops should be avoided in system applications.

2.8 INSTALLATION

The RSS is designed for either bench or equipment rack mounting. To install the RSS, select one of the following options and perform the procedure:

2.8.1 BENCH INSTALLATION

To install the RSS on a bench, perform the following:

1. Select an appropriate area that permits access to front and rear panels of RSS. Check that air flow into RSS rear panel fan is not restricted.

2. Place RSS on bench and attach interface cables (paragraph 2.6)

3. Turn front panel on/off switch on (I) and check that RSS powers up.

4. Refer to Chapter 5, Maintenance, Section II, and run performance test.

2.8.2 RACK MOUNT INSTALLATION

The RSS is shipped with two rack attachment handles to facilitate attaching the RSS to an equipment rack. To attach the handles, perform the following.

1. Remove handles and attaching hardware from shipping container.

2. Attach a handle to each side of RSS using hardware supplied.

Note

The rack mounting method used is the responsibility of the user (slides, tray, etc.).

3. Place RSS in rack and attach to rack through mounting handles.

4. Attach interface cables (paragraph 2.6).

5. Turn front panel on/off switch on (I) and check that RSS powers up.

6. Refer to Chapter 5, Maintenance, Section II, and run performance test.

Table 2-3. J23 IEEE-488 Interface Connector Pin Assignments

PIN	SIGNAL	PIN	SIGNAL
1	DIO1	13	DIO5
2	DIO2	14	DIO6
3	DIO3	15	DIO7
4	DIO4	16	DIO8
5	EOI	17	REN
6	DAV	18	GND (6)
7	NRFD	19	GND (7)
8	NDAC	20	GND (8)
9	IFC	21	GND (9)
10	SRQ	22	GND (10)
11	ATN	23	GND (11)
12	SHIELD	24	GND LOGIC

Table 2-4 Optional J22 Pin Designations

PIN	SIGNAL	PIN	SIGNAL
1	S1	13	BIT 12 *
2	S3	14	BIT 13 *
3	S3 Sense	15	BIT 18 *
4	RL Out	16	BIT 19 *
5	S1 Sense	17	DGND
6	RH In	18	S1, S3 GND
7	RH In	19	S2, S4 GND
8	RL In	20	CASE
9		21	
10	BIT 1 *	22	
11	BIT 6 *	23	
12	BIT 7 *	24	SYNC 2 *

Table 2-4 Optional J22 Pin Designations

(Cont'd.)

PIN	SIGNAL	PIN	SIGNAL
25	SYNC 1 *	38	S2 SENSE
26		39	
27	BIT 2 *	40	
28	BIT 5 *	41	
29	BIT 8 *	42	
30	BIT 11 *	43	BIT 3 *
31	BIT 14 *	44	BIT 4 *
32	BIT 17 *	45	BIT 9 *
33	BIT 20 *	46	BIT 10 *
34	S2	47	BIT 15 *
35	S4	48	BIT 16 *
36	S4 SENSE	49	BIT 21 *
37	RH OUT	50	BIT 22 *

* NOTE: These signal are optional.

CHANGE 1 (Table 2-4)

CHAPTER 3
OPERATION

SUPPLEMENTAL INFORMATION

IMPORTANT

INTERNAL MODE. After changing the internal frequency or L-L voltage (below 200 Hz) via the front panel or computer interface, wait approximately 8 seconds before initiating a calibration.

EXTERNAL MODE. After applying (or changing) an external reference signal to the REF INPUT terminals, or changing the L-L voltage below 200 Hz, wait approximately 8 seconds before initiating a calibration or measurement.

IF THIS DELAY IS NOT OBSERVED, AN ERROR MAY OCCUR.

SETTING L-L VOLTAGE AFTER AN OVERLOAD. If an overload occurs (OVLD and 0.0 V_{L-L} displayed), wait approximately 5 seconds before resetting the L-L voltage.

CHAPTER 3
OPERATION

Section I. Controls and Indicators

3.1 INTRODUCTION

This section contains general operating procedures, descriptions of controls and indicators and practical applications for the Model 5300 Resolver/Synchro Standard (RSS).

3.2 NUMERIC DISPLAYS

The RSS has three numeric displays which indicate the reference frequency, output Line-to-Line amplitude or reference amplitude, and the current shaft angle. Refer to figure 3-1 for the location of each display.

3.2.1 MAIN DISPLAY

The main display normally indicates the current shaft angle being generated. This display is also used during data entry for the following keys:

- Increment
- Phase
- Modulation Frequency
- Modulation Amplitude
- Modulation Velocity

Normally after entering data the main display will switch back to displaying the current shaft angle. If HOLD mode is active, then the main display will remain in data entry mode.

3.2.2 AMPLITUDE DISPLAY

The Amplitude display can display one of the following:

- Output Line-to-Line Amplitude
- External Reference Amplitude
- Internal Reference Amplitude

The value displayed depends on whether the RSS is in Internal or External Reference mode and whether Reference Amplitude or Output Amplitude key was selected last.

Data entry for the above is also accomplished on the Amplitude display.

3.2.3 FREQUENCY DISPLAY

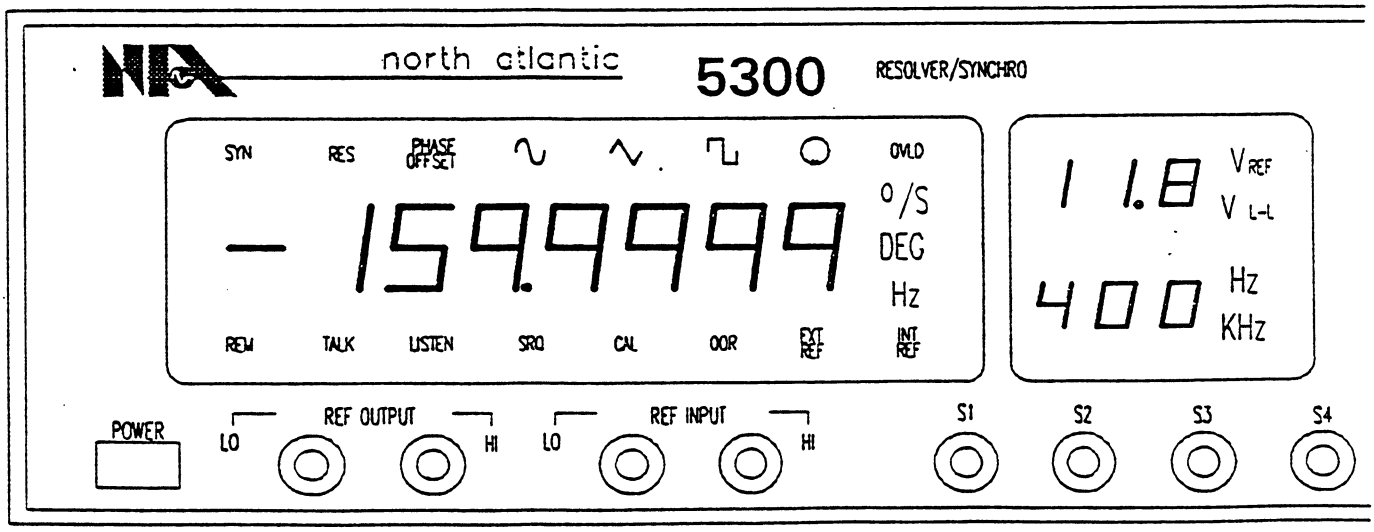
The Frequency display shows the frequency of the Internal or External reference signal. When the RSS is in External Reference mode the incoming reference signal's frequency is measured and displayed. In Internal Reference mode this display indicates the internal oscillator's programmed frequency.

3.3 INDICATORS

Indicators are located near the main display, amplitude display, frequency display and the keyboard to indicate a mode, unit or warning. Refer to figure 3-1 for the location of each indicator.

3.3.1 *SYN* INDICATOR

Figure 3-1
Front Panel Displays and Indicators



When lit, the RSS is generating 3 wire Synchro signals. S1, S2 and S3 are active. S4 is not active.

3.3.2 *RES* INDICATOR
When lit, the RSS is generating 4 wire Resolver signals. S1, S2, S3 and S4 are active.

3.3.3 *PHASE OFFSET* INDICATOR
When lit, the Synchro or Resolver output signals have a programmed phase offset from the internally generated reference signal.

3.3.4 *SINE WAVE* INDICATOR
When lit, the RSS is performing Sine Wave modulation.

3.3.5 *TRIANGLE WAVE* INDICATOR
When lit, the RSS is performing Triangle Wave modulation

3.3.6 *SQUARE WAVE* INDICATOR
When lit, the RSS is performing Square Wave modulation

3.3.7 *ROTATION* INDICATOR
When lit, the output shaft angle is rotating in a CW or CCW direction.

3.3.8 *OVERLOAD* INDICATOR
When flashing, either the reference or signal amplifiers are overloaded. When an overload is detected the amplifier outputs are disconnected and the output level is turned down to its minimum value. To reset this condition, program a new output amplitude.

3.3.9 *°/S* INDICATOR
When lit, the value in the main display is modulation velocity in degrees per second.

3.3.10 *DEG* INDICATOR
When lit, the value in the main display is the output shaft angle or phase offset in degrees.

3.3.11 *Hz* INDICATOR
When lit, the value in the main display is the modulation frequency in Hertz.

3.3.12 *INT REF* INDICATOR
When lit, the RSS is operating in Internal Reference mode.

3.3.13 *EXT REF* INDICATOR
When lit, the SRS is operating in the External Reference mode. In this mode an external reference signal must be applied to the REF INPUT terminals.

3.3.14 *OOR* INDICATOR
When lit, the RSS is operating outside of the published limits. When the OOR indicator is on, accuracy is not guaranteed.

3.3.15 *CAL* INDICATOR
This indicator lights when a Calibration is in progress.

3.3.16 *SRQ* INDICATOR
When lit, the RSS is requesting service over the IEEE 488 interface bus.

3.3.17 *LISTEN* INDICATOR
When lit, the RSS is addressed to listen over the IEEE 488 interface bus.

3.3.18 *TALK* INDICATOR
When lit, the RSS is addressed to talk over the IEEE 488 interface bus.

3.3.19 REM INDICATOR
When lit, the RSS is in remote mode. To exit remote mode hit the LOCAL pushbutton.

3.3.20 *V REF* INDICATOR
When lit, the Voltage display is showing either the Reference amplitude in volts.

3.3.21 *V L-L* INDICATOR
When lit, the Voltage display is showing the Output Line-to-Line voltage.

3.3.22 *Hz* INDICATOR
When lit, the Frequency display is indicating the Reference frequency in Hertz.

3.3.23 *KHz* INDICATOR
When lit, the Frequency display is indicating the Reference frequency in kilohertz.

3.4 KEYBOARD CONTROLS

The Keyboard controls consist of three functional groups; OUTPUT, REFERENCE and MODULATION, and a numeric keypad and other miscellaneous controls.

3.4.1 OUTPUT CONTROLS

The Output group controls the major parameters of the shaft angle generation. These controls allow the operator to set the shaft angle, select Synchro or Resolver, set the output Line-to-Line Voltage and enter Increment values. Refer to figure 3-2 for the location of each control.

3.4.1.1 *ANGLE* Switch. When the ANGLE button is pressed, the unit enters angle input mode. This mode is indicated by the LED adjacent to the ANGLE button being on.

When the ANGLE button is first hit, the last programmed angle appears in the main display. A new angle may now be entered. To enter the new angle, use the numeric keypad and follow the angle with the ENTER key.

The new angle is applied to the unit when the ENTER key or any other function key is hit. If HOLD mode is off, The ANGLE LED will go off and the new output angle will appear in the main display. To change the angle again press the ANGLE key and repeat the process again. If HOLD mode is on, it is not necessary to hit the ANGLE key for each angle change.

The output angle can also be changed with the Increment knob when the ANGLE switch led is on. Turning the Increment knob clockwise will add the programmed increment angle to the current angle for each detent. Turning the Increment knob counterclockwise will subtract the programmed from the current angle for each detent.

The UP and DOWN keys function the same as the Increment Knob. Pressing the UP Key adds the programmed increment angle to the current angle. Pressing the DOWN key subtracts the programmed increment angle from the current angle.

The output angle entry range is ± 360.0000°.

3.4.1.2 *SYN/RES* Switch. This key alternately selects a 3 wire Synchro output or a four wire Resolver output.

3.4.1.3 *AMPL* Switch. The AMPL switch is used to change the output Line-to-Line voltage.

When the AMPL button is pressed, the unit enters output amplitude input mode. This mode is indicated by the LED adjacent to the AMPL button being on.

new Line-to-Line voltage may now be entered. To enter the new Line-to-Line voltage, use the numeric keypad and follow the voltage with the ENTER key.

The new Line-to-Line voltage is set when the ENTER key is hit. If HOLD mode is off, The Output AMPL LED will go off and the new Output Line-to-Line voltage will appear in the voltage display. To change the Line-to-Line voltage again press the AMPL key and repeat the process again. If HOLD mode is on, it is not necessary to hit the AMPL key for each Line-to-line change.

The allowable range of the output Line-to-Line is 0 or 1 to 90V. At power-up the Line-to-Line defaults to 0V.

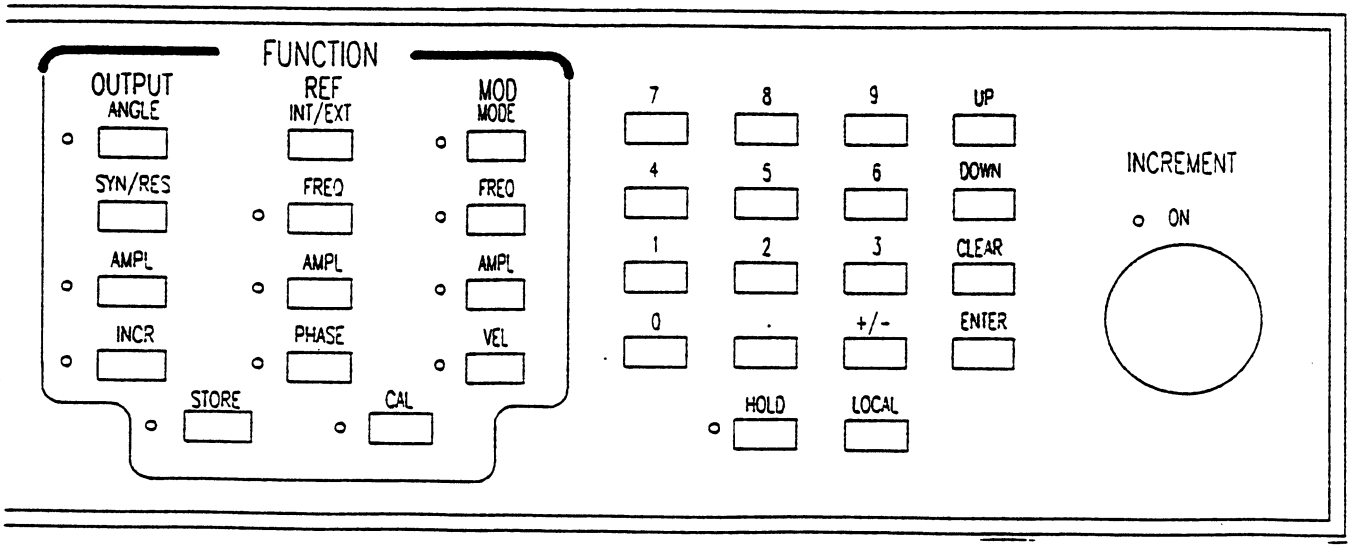
3.4.1.4 *INCR* Switch. The INCR switch is used to change the Increment variable. The increment variable is added or subtracted when the INCREMENT Knob is turned or when the UP and DOWN keys are hit. The Increment function works in the following data entry modes:

- ANGLE
- Modulation Velocity
- Modulation Frequency

Each mode has its own Increment variable. To use, press the INCR key followed by the mode (ANGLE, MOD VEL, MOD FREQ) and then the desired Increment value followed by the ENTER key. The Increment is set when the ENTER key is pressed.

When the INCR and a mode key are hit, the last

Figure 3-2
Front Panel Controls



When the AMPL button is first hit, the last programmed Line-to-Line voltage appears in the Voltage display. A programmed increment is shown on the main display. The unit is now in Increment entry mode. This mode is

indicated by the LED adjacent to the INCR button being on.

3.4.2 REFERENCE CONTROLS

The REF group controls the Reference mode and the operating characteristics of the internal reference source.

3.4.2.1 ***INT/EXT* Switch.** This key alternately selects the signal applied to the REF INPUT terminals or the Internally generated reference as input to the simulator.

When the unit is in EXT mode the EXT REF indicator will illuminate and the REF OUTPUT terminal are disconnected.

In INT mode the INT REF indicator will light and the internal reference signal will appear at the REF OUTPUT terminals.

3.4.2.2 ***FREQ* Switch.** The FREQ switch is used to change the frequency of the internally generated reference signal. This switch only works when the instrument is in Internal reference mode.

When the FREQ button is pressed, the unit enters reference frequency input mode. This mode is indicated by the LED adjacent to the REF FREQ button being on.

When the FREQ button is first hit, the last programmed frequency appears in the Frequency display. A new frequency may now be entered. To enter the new frequency use the numeric keypad and follow the frequency with the ENTER key.

The new frequency is set when the ENTER key is hit. If HOLD mode is off, The REF FREQ LED will go off and the new frequency will appear in the frequency display. To change the frequency again press the FREQ key and repeat the process again. If HOLD mode is on, it is not necessary to hit the FREQ key for each frequency change.

The allowable range of the internal reference frequency is 47 to 20,000 Hz. At power-up the frequency defaults to 400 Hz.

3.4.2.3 ***AMPL* Switch.** The AMPL switch performs two functions depending on the current reference mode.

If the current reference mode is EXT, hitting this key displays the External reference voltage measurement in the voltage display.

When the reference mode is INT, the AMPL switch is used to change the output voltage of the internal reference.

When the AMPL button is pressed and the unit is in INT REF mode, the unit enters reference amplitude input mode. This mode is indicated by the LED adjacent to the REF AMPL button being on.

When the AMPL button is first hit and the unit is in INT REF mode, the last programmed reference voltage appears in the Voltage display. A new reference voltage may now be entered. To enter the new reference voltage, use the numeric keypad and follow the voltage with the ENTER key.

The new reference voltage is set when the ENTER key is hit. If HOLD mode is off, The REF AMPL LED will go off and the new reference voltage will appear in the voltage display. To change the reference voltage again press the AMPL key and repeat the process again. If HOLD mode is on, it is not necessary to hit the AMPL key for each reference voltage change.

The allowable range of the reference voltage is 0 or 2 to 115V. At power-up the reference voltage defaults to 0V.

3.4.2.4 ***PHASE* Switch.** The PHASE switch is used to change the phase shift between the internally generated reference signal and the Synchro or Resolver output signals. This key is active only when the unit is in INT REF mode.

When the PHASE button is pressed, the unit enters reference phase input mode. This mode is indicated by the LED adjacent to the PHASE button being on.

When the PHASE button is first hit, the last programmed Phase shift voltage appears in the main display. A new Phase shift may now be entered. To enter the new Phase shift, use the numeric keypad and follow the phase with the ENTER key.

The new Phase shift is set when the ENTER key is hit. If HOLD mode is off, The REF PHASE LED will go off and the new Phase shift voltage will appear in the main display. To change the Phase shift again press the PHASE key and repeat the process again. If HOLD mode is on, it is not necessary to hit the PHASE key for each Phase shift change.

The allowable range of the output Phase shift is ±180°. At power-up the Phase shift defaults to 0.0000°.

NOTE

When the reference mode is changed to EXT REF mode, the phase shift is set back to 0.0000°.

3.4.3 MODULATION CONTROLS

The MOD group selects the modulation mode and the modulation parameters. Four modulation modes are provided, Sine Wave, Triangle Wave, Square Wave and Continuos Rotation.

3.4.3.1 ***MODE* Switch.** This key allows the selection of the desired modulation mode. The first time the MODE key is pressed the SINE indicator light up. Repeatedly

pressing the MODE key cycles the modulation indicators in the following sequence:

SINE - TRIANGLE - SQUARE - ROTATION - OFF

To start the desired mode press ENTER when the desired mode indicator is illuminated. If ENTER is not pressed within 5 seconds the modulation mode is canceled and the unit will return to static operation.

3.4.3.2 ***FREQ*** **Switch.** The FREQ switch is used to change the frequency of the modulation.

When the FREQ button is pressed, the unit enters modulation frequency input mode. This mode is indicated by the LED adjacent to the MOD FREQ button being on.

When the FREQ button is first hit, the last programmed modulation frequency appears in the main display. A new frequency may now be entered. To enter the new frequency use the numeric keypad and follow the frequency with the ENTER key.

The new frequency is set when the ENTER key is hit. If HOLD mode is off, The MOD FREQ LED will go off and the new frequency will appear in the main display. To change the frequency again press the FREQ key and repeat the process again. If HOLD mode is on, it is not necessary to hit the FREQ key for each frequency change.

The allowable range of the modulation frequency is 0 to 1,000 Hz. At power-up the frequency defaults to 0 Hz.

The modulation frequency can also be changed with the Increment Knob or the UP and DOWN keys.

3.4.3.3 ***AMPL*** **Switch.** The AMPL switch is used to change the peak modulation amplitude in degrees.

When the AMPL button is pressed, the unit enters modulation amplitude input mode. This mode is indicated by the LED adjacent to the MOD AMPL button being on.

When the AMPL button is first hit, the last programmed modulation amplitude appears in the main display. A new modulation amplitude may now be entered. To enter the new modulation amplitude, use the numeric keypad and follow the amplitude with the ENTER key.

The new modulation amplitude is set when the ENTER key is hit. If HOLD mode is off, The MOD AMPL LED will go off and the modulation amplitude will appear in the main display. To change the modulation amplitude again press the AMPL key and repeat the process again. If HOLD mode is on, it is not necessary to hit the AMPL key for each modulation amplitude change.

The allowable range of the modulation amplitude is 0 to 180 degrees. At power-up the modulation defaults to 0°.

3.4.3.4 ***VEL*** **Switch.** The VEL switch is used to change the peak modulation Velocity in degrees/sec.

When the VEL button is pressed, the unit enters modulation Velocity input mode. This mode is indicated by the LED adjacent to the MOD VEL button being on.

When the VEL button is first hit, the last programmed modulation Velocity appears in the main display. A new modulation Velocity may now be entered. To enter the new modulation Velocity, use the numeric keypad and follow the Velocity with the ENTER key.

The new modulation Velocity is set when the ENTER key is hit. If HOLD mode is off, The MOD VEL LED will go off and the modulation Velocity will appear in the main display. To change the modulation Velocity again press the VEL key and repeat the process again. If HOLD mode is on, it is not necessary to hit the VEL key for each modulation Velocity change.

The allowable range of the modulation Velocity is 0 to 100,000 degrees/second. At power-up the modulation defaults to 0 °/sec.

3.4.4 MISCELLANEOUS CONTROLS

3.4.4.1 ***CAL*** **Switch.** This key initiates a self calibration allowing the unit to achieve it's full accuracy. A calibration should be performed anytime the frequency or the output Line-to-Line voltage changes by more than 5%.

Calibration can be performed in either Internal or External Reference mode, however when in External Mode a reference signal must be connected to the REF INPUT terminals before calibration is started

NOTE

Calibration is not permitted if an overload condition exists (OVLD and 0.0 VL-L displayed) or L-L voltage is set to zero.

When the CAL key is pressed, the CAL indicators illuminates indicating a Calibration is in progress. During Calibration the signal outputs (S1, S2, S3, and S4) are isolated. Calibration requires approximately 12 seconds to complete. When completed the CAL indicator goes off.

3.4.4.2 ***STORE*** **Switch.** This switch does not function.

3.4.4.3 ***HOLD*** **Switch.** The HOLD switch alternately turns on and off Hold mode. Hold mode is active when the HOLD LED is turned on. When the unit is not in Hold mode, the main display reverts back to displaying the current shaft angle after any data entry. When Hold mode is active, instead of the main display switching back to the shaft angle, the unit remains in data entry mode. This allows the data to changed again without having to hit the appropriate function switch.

3.4.4.4 ***LOCAL* Switch.** This key requests a return from IEEE 488 control to local control. If local lockout was set by the IEEE 488 controller third request will be ignored.

The REM indicator shows if the request was accepted.

3.4.4.5 ***UP* Switch.** This key adds a stored increment value to the displayed parameter. This key is active only in the following modes.

- Angle
- Modulation Velocity
- Modulation Frequency

3.4.4.5 ***DOWN* Switch.** This key subtracts a stored increment value to the displayed parameter. This key is active only in the following modes.

- Angle
- Modulation Velocity
- Modulation Frequency

3.4.4.5 ***INCREMENT* Knob.** This control performs the same function as the UP and DOWN keys. Turning the knob clockwise increments the parameter and turning the knob counter clockwise decrements the parameter by the stored increment value. The INCREMENT knob is active only in the following modes.

- Angle
- Modulation Velocity
- Modulation Frequency

3.4.4.6 ***ENTER* Switch.** This key causes keyboard numeric data to be applied to the unit.

3.4.4.7 ***CLEAR* Switch.** This key clears any numeric enter prior to hitting the ENTER key.

3.4.4.8 **+/- Switch.** This key changes the sign of the data currently being entered.

3.4.4.6 ***0- 9 and .* Switch.** These keys are used to enter numeric data.

3.5 SETTING UP THE REFERENCE

Before the RSS can be used the reference source must be specified. If an external reference source is to be used, connect it to the REF INPUT terminals and press

REF [INT/EXT]

one or two times until the EXT REF indicator illuminates.

If the Internal reference oscillator is to be used, three items must be programmed. First Internal reference mode must be selected. Then the frequency and output voltage must be set. Set the mode to internal reference by pressing

REF [INT/EXT]

one or two times until the INT REF indicator illuminates.

Next set the oscillators frequency. For example, to set the frequency to 1000 Hz. press the following keys:

REF [FREQ]
[1]
[0]
[0]
[0]
[ENTER]

Finally, set the reference oscillator's output voltage. For example, for 115V output , press the following keys:

REF [AMPL]
[1]
[1]
[5]
[ENTER]

3.6 PHASE SHIFTING THE OUTPUT SIGNALS

The Model RSS's phase shifting capability provides for a more accurate simulation of a real Synchro or Resolver. The output signals may be phase shifted ±180 degrees with respect to the reference. The phase shift is independent of the programmed frequency of output voltage level.

Phase shifting works only when the unit is set to Internal Reference mode.

Example: Simulate a phase lag of 7.5 degrees. Press:

REF [PHASE]
[-]
[7]
[.]
[5]

ENTER

3.7 SETTING THE LINE-TO-LINE VOLTAGE

The Line-to-Line voltage setting determines the maximum RMS voltage that will appear across the outputs. To set the output Line-to-Line voltage to 11.8 volts, press:

OUTPUT AMPL

1

1

.

8

ENTER

3.8 SETTING THE OUTPUT ANGLE

The static output shaft angle can be changed 3 different ways. Method 1 is the direct entry of the angle on the keypad. For example, set the simulator to 135.0001 degrees. Press:

OUTPUT ANGLE

1

3

5

.

0

0

0

1

ENTER

If HOLD mode is active, the ANGLE key does not have to be hit when changing the angle again.

The second method of changing the angle involves the use of the UP and DOWN keys. This method saves a lot of keystrokes if the desired angles are a fixed increment apart.

For example: If we wish to simulate the angles 0, 45, 90, 135 etc. Fist program an angle increment of 45 degrees by pressing:

OUTPUT INCR

OUTPUT ANGLE

4

5

ENTER

Next set the static angle to 0.0000 degrees

OUTPUT ANGLE

0

ENTER

The simulator is now set to 0.0000 degrees.

OUTPUT ANGLE

UP

The simulator is now set to 45.0000 degrees.

UP

The simulator is now set to 90.0000 degrees.

UP

The simulator is now set to 135.0000 degrees.

DOWN

The simulator is now set to 90.0000 degrees.

The third method is similar, first program the desired increment as above and hit the

ANGLE

key. Now rotate the increment knob. Each clockwise detent increases the angle by the increment and each counterclockwise detent decrements the angle by the programmed increment.

3.9 SINE WAVE MODULATION

When sine wave modulation is active, the output angle is sinusoidal modulated about the current static angle.

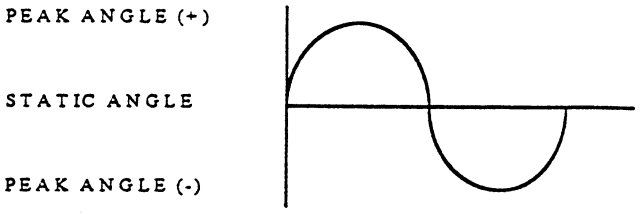


Figure 3-3. Sine Wave Modulation

The modulation characteristics are set using any two of the following parameters:

- Modulation Frequency
- Modulation Velocity
- Modulation Amplitude

These parameters can be modified dynamically while the unit is modulating. Modulation Velocity specifies the peak velocity and Modulation Amplitude specifies the peak deviation from the current angle.

The last two parameters entered determine the output waveform. These three parameters are related by the following formula:

$$A = \frac{V}{2 * \pi * F}$$

where A is the peak amplitude in degrees
V is the peak velocity in degrees/sec
F is the modulation frequency in Hz

Example: Program sine modulation at 15 Hz , 20° peak centered about 30°.

First set the static angle to 30 degrees

OUTPUT [ANGLE]

[3]

[0]

[ENTER]

Set the modulation frequency

MOD [FREQ]

[1]

[5]

[ENTER]

Set the modulation amplitude

MOD [AMPL]

[2]

[0]

[ENTER]

Finally, turn on sine modulation mode. Hit

MOD [MODE]

until the SINE indicator lights, then

[ENTER]

within 5 seconds to start sine modulation.

To turn sine wave mode off, hit

MOD [MODE]

until all modulation indicators are off , then

[ENTER]

3.10 TRIANGLE MODULATION

In triangle mode the output angle traverses back and forth between two angles at a constant velocity. The starting angle is the static angle, the angle then increases linearly to the static angle + the modulation amplitude, to the static angle - the modulation amplitude and back to the static angle.

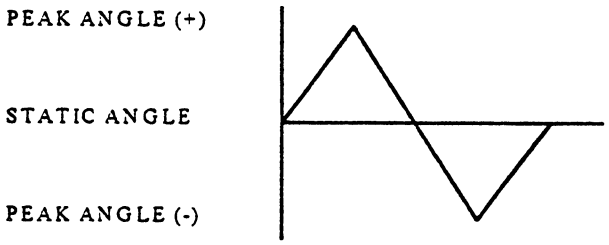


Figure 3-4. Triangle Wave Modulation

The modulation characteristics are set using any two of the following parameters:

- Modulation Frequency
- Modulation Velocity
- Modulation Amplitude

These parameters can be modified dynamically while the unit is modulating. Modulation Velocity specifies the peak velocity and Modulation Amplitude specifies the peak deviation from the current static angle.

The last two parameters entered determine the output waveform. These three parameters are related by the following formula:

$$A = \frac{V}{F}$$

where A is the peak amplitude in degrees
V is the peak velocity in degrees/sec
F is the modulation frequency in Hz

Example: Program triangle modulation at 100 °/sec , 10° peak centered about 90°.

First set the static angle to 90 degrees

OUTPUT [ANGLE]

[9]

[0]

[ENTER]

Set the modulation velocity

MOD [VEL]

[1]

[0]

[0]

[ENTER]

Set the modulation amplitude

MOD [AMPL]

[1]

[0]

[ENTER]

Finally, turn on triangle modulation mode. Hit

MOD [MODE]

until the TRIANGLE indicator lights, then

[ENTER]

within 5 seconds to start triangle modulation.

To turn triangle wave mode off, hit

MOD [MODE]

until all modulation indicators are off , then

[ENTER]

3.11 SQUARE WAVE MODULATION

In square wave mode the output angle switches back and forth between the static angle and the static angle + peak angle.

The modulation characteristics are set by specifying the following parameters:

- Modulation Frequency
- Modulation Amplitude

These parameters can be modified dynamically while the unit is modulating. Modulation Velocity specifies the peak velocity and Modulation Amplitude specifies the peak deviation from the current static angle.

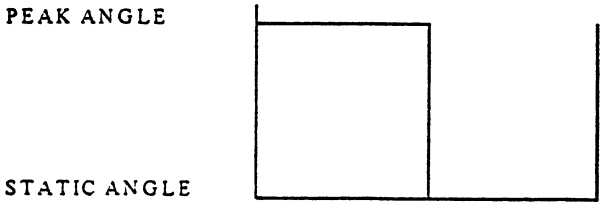


Figure 3-5. Square Wave Modulation

Example: Set the unit to square wave modulation mode, switch between 0 ° and 180 ° at a 1 Hz rate.

First set the static angle to 0.0000 degrees

OUTPUT [ANGLE]

0

ENTER

Set the modulation frequency

MOD FREQ

1

ENTER

Set the modulation amplitude

MOD AMPL

1

8

0

ENTER

Finally, turn on square wave modulation mode. Hit

MOD MODE

until the SQUARE indicator lights, then

ENTER

within 5 seconds to start sine modulation.

To turn square wave mode off, hit

MOD MODE

until all modulation indicators are off , then

ENTER

3.12 CONTINUOUS ROTATION

In Rotation mode the output angle advances Clockwise or Counter Clockwise at a constant velocity. If the velocity is specifies as positive, Counter Clockwise rotation occurs. Negative velocities cause a clockwise rotation.

Example: Program the unit to run at 1000 °/sec in a counter clockwise direction.

First set the modulation velocity

MOD VEL

1

0

0

0

ENTER

Finally, turn on rotation mode. Hit

MOD MODE

until the ROTATION indicator lights, then

ENTER

within 5 seconds to start rotation.

To turn rotation off, hit

MOD MODE

until all modulation indicators are off , then

ENTER

Section II. NAI Native Mode Programming

3.13 GENERAL

This section describes the remote operation of the Model 5300 Resolver/Synchro Standard (RSS) using the ANSI/IEEE-STD 488.1-1987, Standard Digital Interface for Programmable Instrumentation.

3.14 INTERFACE FUNCTIONS SUPPORTED

The RSS provides two-way communication (listen and talk) with the computer. The interface functions and subsets that the RSS responds to are listed in table 3-1.

Table 3-1. IEEE-488 Interface Functions and Descriptions

INTERFACE FUNCTION	SUBSET	FUNCTION
Source Handshake	SH1	Complete Capability
Acceptor Handshake	AH1	Complete Capability
Talker	T6	Basic talker with serial poll
Extended Talker	TE0	No Capability
Listener	L4	Basic Listener, Un-address if MLA
Extended Listener	LE0	No Capability
Service Request	SR0	No Capability
Remote Local	RL1	Complete Capability
Parallel Poll	PP0	No Capability
Device Clear	DC1	Complete Capability
Device Trigger	DT0	No Capability
Controller	C0	No Capability

3.15 SETTING IEEE 488-BUS ADDRESS

The device address that the RSS will respond to is set by the following sequence of front panel keystrokes:

With the RSS in local mode, press LOCAL key on front panel. The main display shows:
IEEE 6

This indicates that the current IEEE address is set to address 6. To change this to another address, press the UP key to increment the address, or press the DOWN key to decrement the address. For example, to set IEEE address 10 from address 6 previously entered, press the following key sequence:

LOCAL, UP, UP, UP, UP, ENTER

The IEEE address is stored in EEPROM when the ENTER key is pressed. Once set to the desired address, it is not necessary to set it each time the RSS is powered up.

If a mistake is made when changing the IEEE address, press the CLEAR key on the front panel to exit without modifying the address.

3.16 EXAMPLES

Programming the RSS involves issuing commands to the RSS when the RSS is in remote mode. Commands are either: Parameter Set commands, Parameter Query commands, System Query commands, Calibration command, Measurement Query commands or Test Query commands. Parameter Set commands are used to configure the RSS to operate in a particular manner, whereas Query commands direct the RSS to examine its operational mode and send a response to the computer that answers the query. Commands may be sent individually, or linked to form complex commands. When commands are linked to form complex commands, they must be delimited by a semicolon. Command strings are terminated by a line feed or a carriage return line feed combination.

Commands must not conflict with a preexisting mode. An example of such a conflict is requesting an internal reference voltage when the RSS is in External Mode. Table 3-2 lists the syntax used in this section, and table 3-3 lists general command definitions.

Table 3-4 provides the command grammar and lists all commands currently available. Tables 3-5 (Parameter Set commands) and tables 3-6 through 3-10 (Query commands) describes the commands. Following are examples which illustrate how programming is accomplished.

3.16.1 VALUES

Values are entered following specific commands and may be a scientific number, decimal number, or integer.

Note

- A *crlf* is placed at the end of a command string to execute the command.
- A decimal number must contain a decimal point.

EXAMPLE	INPUT	DISPLAY
To set a SIM frequency of 15000 Hz using a scientific number, input the SIM frequency command SF followed by the scientific number for the frequency. See table 3-3 for scientific number command definition.	*SF 1.5E4 crlf*	*15.0 KHZ*

EXAMPLE	INPUT	DISPLAY
To set a SIM line-line voltage of 11.8 V, input the SIM line-to-line voltage command SLV followed by the decimal number for the voltage. See table 3-3 for decimal number command definition.	*SLV 11.8 crlf*	*11.8* $V_{L\text{-}L}$

Change 2

EXAMPLE	INPUT	DISPLAY
To set an angle of 45°, input the SIM Angle command SA followed by the integer for the angle. See table 3-3 for integer command definition.	*SA 45 crlf*	*45.0000 DEG*

3.16.2 PARAMETER SET COMMANDS

The following are several examples of how parameter set commands are programmed. The examples are representative of commands listed in table 3-5.

EXAMPLE	INPUT	DISPLAY
Reset the RSS to default values.	**RST crlf*	*SEt-UP*

EXAMPLE	INPUT	DISPLAY
Set the RSS to synchro mode.	*SS crlf*	*SYN*

The following example demonstrates how several commands and values are linked. The example follows the protocol described in table 3-4 (Command string) and uses several commands from table 3-5. This example is representative of the method used to link parameter set commands.

EXAMPLE	INPUT
Set the RSS to resolver mode, internal reference mode, output angle 45°, continuous CW rotation at a velocity of 100°/second.	*SR;SIRM;SA 45; SMV - 100; SMM CONTINUOUS crlf*

3.16.3 QUERY COMMANDS

The following are examples of how query commands are programmed. Each example is representative of the commands listed in the table referenced in the example.

EXAMPLE	INPUT	RESPONSE
Query the RSS modulation mode.	*SMM? crlf*	RSS sends the appropriate response listed in table 3-6.

EXAMPLE	INPUT	RESPONSE
Query the error status.	*SYST:ERR? crlf*	RSS sends the appropriate response listed in table 3-7.

EXAMPLE	INPUT	RESPONSE
Query calibration.	**CAL? crlf*	RSS sends the appropriate response listed in table 3-8.

EXAMPLE	INPUT	RESPONSE
Query the external reference voltage.	*SMERV? crlf*	RSS sends the appropriate response listed in table 3-9.

EXAMPLE	INPUT	RESPONSE
Query self-test.	**TST? crlf*	RSS sends the appropriate response listed in table 3-10.

EXAMPLE	INPUT	RESPONSE
Set the RSS to resolver mode, internal reference mode, output angle 45°, continuous CW rotation at a velocity of 100°/second and query the RSS that the commands were correctly executed.	*SR;SIRM;SA 45; SMV -100; SMM CONTINUOUS;SRS?;SRM?;SA?;SMV?; SMM? crlf*	RESOLVER; INTERNAL; 45.0000; -100.0000; CONTINUOUS ;

Table 3-2. Formal Syntax Notation

NOTATION	DESCRIPTION
¦	Alteration, Exclusive OR
< >	The boundaries of a field of inseparable and mandatory items
[ ]	The boundaries of a field of optional items
( )	Grouping braces
::=	"Is defined to be"
...	Optional repetition of immediately preceding item or group

Table 3-3. General Command Definitions

NOTATION	DEFINITION
Value ::=	(Scientific number ¦ decimal number ¦ integer)
Scientific Number ::=	[+¦-][<digit>...]<dp><digit>...E<+¦-><digit>[<digit>]
Decimal Number ::=	([+¦-][<digit>...]<dp><digit>...] ¦ [+¦-][<digit>...)
Integer ::=	[+¦-][<digit>...
Digit ::=	(0 ¦ 1 ¦ 2 ¦ 3 ¦ 4 ¦ 5 ¦ 6 ¦ 7 ¦ 8 ¦ 9)
Mod Mode ::=	("CONT" ¦ "CONTINUOUS" ¦ "SQU" ¦ "SQUARE" ¦ "TRI" ¦ "TRIANGLE" ¦ "SINE" ¦ "OFF")
b ::=	One or more blank space characters
dp ::=	Decimal point character (period) "."
cr :=	Carriage return character
lf :=	Line feed character

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Table 3-4. RSS NATIVE Mode Command Grammar

COMMAND	COMMAND FORMAT
Command String ::= <RSS Command>[<;><RSS Command>]... [*cr*]<*lf*>	
RSS Command ::=	(<Parameter set command> | <Parameter Query Command> | <System Query Command> | <Calibration Command> | <Measurement Query Command> | <Test Command>
Parameter Set Command ::= *See Table 3-5 for definitions*	(*RST | SS | SR | SIRM | SERM | SA<*b*><value> | SLV<*b*><value> | SRV<*b*><value> | SF<*b*><value> | SPO<*b*><value> | SMA<*b*><value> | SMV<*b*><value> | SMF<*b*><value> | SMM<*b*><mod mode>)
Parameter Query Command ::= *See Table 3-6 for definitions*	(SRS? | SRM? | SA? | SDA? | SLV? | SRV? | SF? | SPO? | SMA? | SMV? | SMF? | SMM?)
System Query Command ::= *See Table 3-7 for definitions*	(*IDN? | SYST:ERR?)
Calibration Command ::= *See Table 3-8 for definition*	(*CAL?)
Measurement Query Command ::= *See Table 3-9 for definitions*	(SMERV? | SMERF?)

Table 3-4. RSS NATIVE Mode Command Grammar

(Cont'd.)

COMMAND	COMMAND FORMAT
Test Command ::= *See Table 3-10 for definition*	(*TST?)

Table 3-5. Parameter Set Command Definitions

COMMAND	DEFINITION
*RST	Reset. All parameters set to their power-up default values
SS	SIM synchro mode
SR	SIM resolver mode
SIRM	SIM internal reference mode.
SERM	SIM external reference mode. **Note** Placing the RSS in external reference mode causes the phase offset value to be set to zero.
SA value	SIM angle. The output angle is set to the value. **Note** If the RSS is currently modulating, this command causes the modulation center angle to be dynamically modified.
SLV value	SIM line-to-line voltage. The output line-to-line voltage is set to the value. **Note** The line voltage range is $1 \leq \text{value}(V_{RMS}) \leq 90$
SRV value	SIM reference voltage. The reference voltage is set to the value. This command is valid only in internal reference mode. Attempting to set the reference voltage while in external reference mode will cause a -221 Settings Conflict error (table 5-5) to be generated. **Note** The reference voltage range is $2 \leq \text{value}(V_{RMS}) \leq 115$

Table 3-5. Parameter Set Command Definitions

(Cont'd.)

COMMAND	DEFINITION
SF value	SIM frequency. The internal reference frequency is set to the value. This command is valid only in internal reference mode. Attempting to set the frequency while in external reference mode will cause a -221 Settings Conflict error (table 5-5) to be generated. **Note** The frequency range is 47 ≤ value (Hz) ≤ 20000
SPO value	SIM phase offset. The phase offset is set to this value. This command is valid only in internal reference mode. Attempting to set the phase offset while in external reference mode will cause a -221 Settings Conflict error (table 5-5) to be generated. The phase offset value is reset to zero when the RSS is set to external reference mode. **Note** The phase offset range is -180 ≤ value (Degrees) ≤ 180
SMA value	SIM modulation amplitude. The modulation value is set to the value. **Note** The modulation amplitude range is 0 ≤ value (degrees peak-to-peak) ≤ 360
SMV value	SIM modulation velocity. The modulation velocity is set to the value. **Note** The modulation velocity range is -100000 ≤ value (degrees/second) ≤ 100000
SMF value	SIM modulation frequency. The modulation frequency is set to the value. **Note** The modulation frequency range is 0 ≤ value (Hz) ≤ 1000

Table 3-5. Parameter Set Command Definitions

(Cont'd.)

COMMAND	DEFINITION
SMM mode	SIM modulation mode. This command is used to select dynamic angle operation mode. **SINE**: The RSS is placed in sine wave modulation mode. The two most recent modulation parameter values are used to completely describe the modulating parameters. **TRIANGLE**: The RSS is placed in triangle wave modulation mode. The two most recent modulation parameter values are used to completely describe the modulating parameters. **SQUARE**: The RSS is placed in square wave modulation mode. The modulation amplitude and frequency determine the modulation characteristics. **CONTINUOUS**: The RSS is placed in continuous rotation. The velocity parameter determines the speed of rotation. Positive velocity causes CCW rotation; negative velocities cause CW rotation. **OFF**: The RSS is returned to the static angle operation mode.

Table 3-6. Parameter Query Command Definitions

COMMAND	DEFINITION
SRS?	Query SIM Resolver / Synchro Mode. The response will either be: " SYNCHRO" or " RESOLVER"
SRM?	Query SIM Reference Mode. The response will either be: " INTERNAL" or " EXTERNAL"
SA?	Query SIM Static Angle. The command returns the currently programmed static angle with 4 decimal digits of resolution. **Note** See the SDA? command to query the current dynamic angle.
SDA?	Query SIM Dynamic Angle. If the RSS is currently in dynamic operational mode, this command will return the current dynamic angle with 4 decimal digits of resolution. **Note** If the RSS is NOT currently in dynamic operational mode, this command will return the same value as the SA? query.

Table 3-6. Parameter Query Command Definitions

(Cont'd.)

COMMAND	DEFINITION
SLV?	Query SIM Line-to-Line Voltage. The response will be the current output line-to-line voltage with 3 decimal digits of resolution.
SRV?	Query SIM reference voltage. If the RSS is in internal reference mode, The response will be the current reference voltage with 3 decimal digits of resolution. If the RSS is in external reference mode, the response will be: -221,"Settings conflict " **Note** See the SMERV? Command (table 3-8) for measuring the external reference voltage.
SF?	Query SIM Frequency. If the RSS is in internal reference mode, The response will be the current reference frequency with 3 decimal digits of resolution. If the RSS is in external reference mode, the response will be: -221,"Settings conflict " **Note** See the SMERF? Command (table 3-8) for measuring the external reference frequency.
SPO?	Query SIM Phase Offset. The response will be the current phase offset value, in degrees, with 4 decimal digits of resolution.
SMA?	Query SIM Modulation Amplitude. The response will be the currently programmed modulation amplitude, regardless of the current modulation mode, with 3 decimal digits of resolution.
SMV?	Query SIM Modulation Velocity. The response will be the currently programmed modulation velocity, regardless of the current modulation mode, with 4 decimal digits of resolution.
SMF?	Query SIM Modulation Frequency. The response will be the currently programmed modulation frequency, regardless of the current modulation mode, with 3 decimal digits of resolution.
SMM?	Query SIM Modulation Mode. The response will indicate the current modulation state, and be: " OFF" or "SINE" or "SQUARE" or "TRIANGLE" or "CONTINUOUS"

Table 3-7. System Query Command Definitions

COMMAND	DEFINITION
*IDN?	Identification Query. The RSS responds with a message indicating the manufacturer, model number, and firmware version. For example: "North Atlantic,5300,0,X.X" X.X indicates firmware revision level.
SYST:ERR?	Error Status Command. The RSS responds with the next error in the error queue. Error messages contain an error number followed by a comma and an error description in quotes. The absence of error is indicated by the 0,"No error" message. 500,"Reference DSP PGM Download Error" 501,"Angle DSP PGM Download Error" 502,"Reference DSP Table Download Error" 503,"Angle DSP Table Download Error" 504,"Error Setting DSP Mode" 505,"User Disallowed from setting outputs for 15 Secs" 506,"System Bus Error" 507,"Error Setting Resolver Mode" 508,"Error Setting Synchro Mode" 509,"Error Setting Calibration Factors" 510,"Error Clearing Modulation During Calibration" 511,"Error Setting Static Angle" 512,"Error Connecting Calibration Circuits" 513,"Initial Sub Optimum Gain Error" 514,"Error Setting Calibration Gain" 515,"Error Measuring Voltage" 516,"Calibration Factor 1 Limit Error" 517,"Calibration Factor 2 Limit Error" 518,"Calibration Factor 3 Limit Error" 519,"Calibration AC Sig Error" 520,"Error Disconnecting Calibration Circuits" 521,"RAM Test Failure" 522,"ROM Test Failure" 523,"EEPROM Test Failure" 524,"Calibration Factor 4 Limit Error" 525,"DSP Angle Query Error" 526,"DSP DATA RAM Test Failure" 527,"Calibration disallowed - overload" 528,"Calibration disallowed - setup" 529,"Overload condition present" 530,"Internal overload failure" 599,"Undefined Error"

Table 3-8. Calibration Command Definition

COMMAND	DEFINITION
*CAL?	Calibration Query. The RSS will perform a full calibration procedure and generate a response that indicates whether or not the RSS completed the self-calibration without any errors. The CAL enunciator is illuminated during the calibration process. After the calibration process has been completed the CAL enunciator is extinguished and the instrument is returned to its previous operational state with the new correction factors loaded into the Angle DSP. A "0" response indicates the self calibration completed without an error being detected. Any other response indicates the self calibration failed and the response message will indicate the failure. **Note** Calibration is not permitted when an overload condition exists (OVLD and 0.0 V_{L-L} displayed) or if the L-L voltage is set to zero. The presence of an error during calibration is indicated by an error code being displayed on the main display, and an error message being generated. The possible error response messages are a subset of the Instrument Dependent Error Codes as defined in the error status query command.

Table 3-9. Measurement Query Command Definitions

COMMAND	DEFINITION
SMERV?	Measure External Reference Voltage. If the RSS is in external reference mode, the voltage value, in Volts RMS, of the external reference signal is returned rounded to 4 decimal places. This command is invalid in internal reference mode and will cause a -221 Settings Conflict error (table 5-5) to be returned. **Note** See the SRV? Command (table 3-6) to query the current internal mode reference voltage.

SMERF?	Measure External Reference Frequency. If the RSS is in external reference mode, the frequency value in Hz, of external reference signal is returned rounded to 2 decimal places. This command is invalid in internal reference mode and will cause a -221 Settings Conflict error (table 5-5) to be returned. **Note** See the SF? Command (table 3-6) to query the current internal mode reference frequency.

Table 3-10. Test Command Definition

COMMAND	DEFINITION
*TST?	Self Test Query. The self-test query causes an internal self-test and generates a response message indicating whether or not the RSS completed the self test without any detected errors. A "0" response indicates the self test completes without an error detected. Any other response indicates the self-test failed and the response message will indicate the failure. The possible error response messages are a subset of the Instrument Dependent Error Codes as defined in the error status query command.

Table 3-11. Service Request Command Definition

COMMAND	DEFINITION
*SRE value	Service Request Enable. This command is used to determine which instrument conditions will cause an IEEE Service Request. The value is a decimal representation of the binary bits in the Status Register that, when set, will cause a Service Request. For all bits, except bit 6, a one value indicates an enabled condition. A bit value of zero indicates a disable condition. The value for bit 6, the service request bit, will be ignored. This value is set to zero on powerup, disabling service request generation. 0 < = value < = 255
*SRE?	Service Request Enable Query. The 5300 responds with a decimal representation of the bits in the Status Register that, when set, will cause an IEEE Service Request. The value of Bit 6 will always be sent with a value of zero. The response will be in the range 0-63 or 128-191.

The status register value can be read via the IEEE serial poll. The status bit positions are defined as follows:

BIT	MEANING	BINARY REPRESENTATION	DECIMAL REPRESENTATION
0	1 = Hard Overload (Internal Hardware Failure)	0000 0001	1
1	Not Used, Always 0	0000 0010	2
2	Not Used, Always 0	0000 0100	4
3	Not Used, Always 0	0000 1000	8
4	1 = Message Available	0001 0000	16
5	1 = Soft Overload (External and Resettable)	0010 0000	32
6	1 = Service Request	0100 0000	64
7	Not Used, Always 0	1000 0000	128

*SRE Examples:

*SRE 1 - Enable Hard Overload to cause a service request. A subsequent *SRE? will return "1".

*SRE 33 - Enable Hard Overload and Soft Overload to cause a service request. A subsequent *SRE? will return "33".

*SRE 255 - Enable any allowable condition above to cause a service request. A subsequent *SRE? will return "191".

*SRE 0 - Disable service request generation. A subsequent *SRE? will return "0".

CHAPTER 4
PRINCIPLES OF OPERATION

4.1 SCOPE

This chapter contains the principles of operation for the Model 5300 Resolver/Synchro Standard (RSS). The principles are prefaced by an overview of synchro and resolver conventions.

The principles of operation for the RSS are described in two levels. The system level description uses a system block diagram that shows the overall tie-in between the major functional assemblies of the RSS. The functional level description uses block diagrams of each functional assembly and describes the essential control and data signals that the assembly processes.

The principles of operation support an intermediate maintenance level wherein defective shop replaceable assemblies (SRA) are fault-isolated and the RSS is repaired by removal and replacement of the defective SRA.

4.2 SYNCHRO AND RESOLVER CONVENTIONS

Conventions for polarities, terminal designation and direction of shaft rotation for synchros and resolvers are most frequently defined in accordance with military specifications MIL-S-20708 (synchros) and MIL-R-2153 (resolvers). The RSS is provided with terminal designations and electrical characteristics to these specifications.

Note

- In applying the conventions, exercise caution that the manufacturer has followed the MIL convention.
- Check that the system use has not dictated a change in convention for a different characteristic (for example, direction reversal or angular offset).

4.2.1 SYNCHRO TRANSMITTER CONVENTIONS

$E(S1\text{-}S3) = -NE(R1\text{-}R2) \sin \theta$
$E(S3\text{-}S2) = -NE(R1\text{-}R2) \sin (\theta + 120°)$
$E(S2\text{-}S1) = -NE(R1\text{-}R2) \sin (\theta + 240°)$

Where E(S1-S3) is the stator voltage S1 with respect to S3. Other stator and rotor voltages are similarly defined. N is the ratio of the maximum voltage across a pair of stator terminals to the voltage across the rotor terminals. θ is the shaft angle displacement from electrical zero which satisfies these equations. A schematic of the synchro transmitter is shown in figure 4-1.

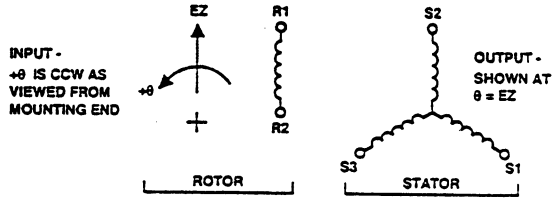


Figure 4-1. Synchro Transmitter, Schematic

4.2.2 RESOLVER TRANSMITTER CONVENTIONS

For rotor energized resolvers, the following equations apply:

$E(S1\text{-}S3) = -NE(R1\text{-}R3)\cos \theta - NE(R2\text{-}R4)\sin \theta$
$E(S2\text{-}S4) = -NE(R2\text{-}R4)\cos \theta - NE(R1\text{-}R3)\sin \theta$

A rotor energized resolver transmitter schematic is shown in figure 4-2. Input and output may be reversed for stator energized devices.

Because the NAI standard assumes an R2R4

energized resolver, the resolver outputs become:

$E(S1\text{-}S3) = -NE(R2\text{-}R4)\sin\theta$
$E(S2\text{-}S4) = +NE(R2\text{-}R4)\cos\theta$

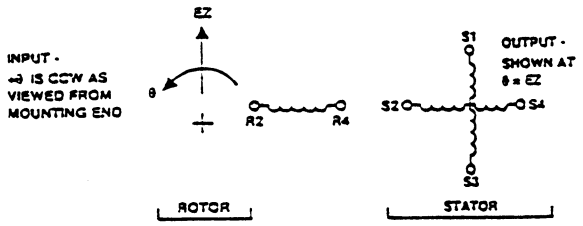


Figure 4-2. Resolver Transmitter, Schematic

4.3 SYSTEM LEVEL PRINCIPLES OF OPERATION

The RSS system block diagram is shown in figure 4-3. The RSS consists of five major functional assemblies; the analog board, the sine/cosine board, the system board, the display/keyboard assembly, and the power supply system. These functional assemblies and an overview of the software are described in the following paragraphs.

4.3.1 ANALOG BOARD

The analog board generates a precise reference waveform that drives isolation/tapped transformers T3 and T4 for the sine and cosine channels of the sine/cosine board. The analog board also provides an externally generated reference output to jacks on the front panel and terminals on the rear panel terminal block whereby a reference voltage may be applied to simulate the rotor of a synchro or resolver.

The input to the analog board may be from an external source, in which case the internal reference circuits are not selected. The external reference is precisely level adjusted with the (protected) autoranging and AGC circuits. Control of the analog board is provided by the system board. The analog board also contains the measurement circuits, fine level and electrical phase control circuits, and the calibration circuits.

4.3.2 SINE/COSINE BOARD

The sine/cosine board consists of two similar (but isolated) channels enabled by the analog board to provide precise, low impedance outputs to simulate the stator windings of a synchro or resolver. Precision, 21-bit resolution, for the dynamic rotational angles for each channel is achieved with fast-switched transformers/MUX circuits and an MDAC circuit. The tapped transformer/MUX circuit provides the upper four most significant bits (MSB), the MDAC circuits provide the lower 16-bits, and the isolation transformer/MUX circuit provides the sign bit. The isolation transformer/MUX circuit feeds the tapped transformer which subsequently feeds the MDAC circuit. The combination of outputs from the tapped transformer/MUX circuit and the MDAC circuit are summed and provide the input for a power amplifier. The outputs for the power amplifier are accessible from front panel jacks and the rear panel terminal block. The sine/cosine board is controlled by the system board.

4.3.3 SYSTEM BOARD

The system board provides microprocessor control over all functions of the RSS. Programmed by firmware residing in an Erasable Programmable Read Only Memory (EPROM), the system board drives the display board and samples the keyboard assembly, performs digital signal processing to compute angle and reference data, samples IEEE-488 connector J23 on the rear panel, and provides handshaking with an external computer during remote operation. The system board functions as a distribution bus for all dc power supplies, and as a mother board for the interconnect board. The interconnect board functions as a daughter board for the analog and sine/cosine boards mounted in the card file.

4.3.4 DISPLAY/KEYBOARD ASSEMBLY

The display/keyboard assembly consists of a

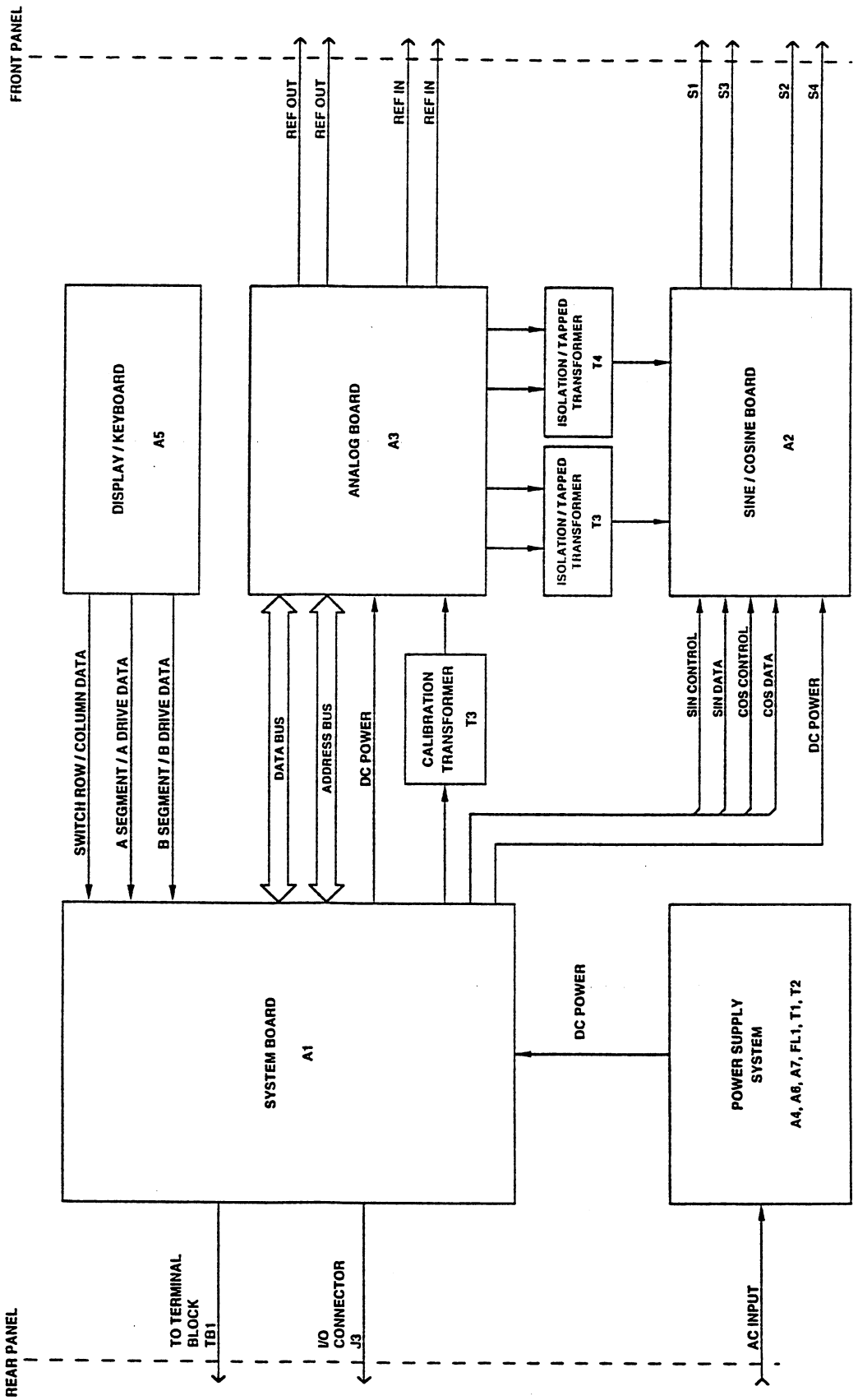


Figure 4-3. System Block Diagram

Light Emitting Diode (LED) display and a keyboard assembly. The display indicates operating conditions of the RSS, and the keyboard provides the operator with a means of entering data into the RSS. The display consists of two panels; a primary 8-digit numerical panel with 19 LED indicators (SYN, RES, PHASE OFFSET, Sine wave symbol, Triangle wave symbol, Square wave symbol, Rotational symbol, OVLD, °/S, DEG, Hz, INT REF, EXT REF, OOR, CAL, SRQ, LISTEN, TALK, and REM) and a secondary numerical panel displaying 3-digit voltage and frequency with four LED indicators (V_{REF}, V_{L-L}, Hz, and KHz).

The keyboard assembly contains 20 push button switches, a 12-key (see following note) numeric pad (digits 0 through 9, ±, and decimal point), and an optical encoder.

Note

The front panel STORE push button switch, if installed, does not function.

4.3.5 **POWER SUPPLY SYSTEM**

The power supply system consists of a main power supply board and two, identical, isolated power supply assemblies.

4.3.5.1 **Main Power Supply Board**. The main power supply board receives AC input from main transformer T1 and performs rectification, filtering, and regulation to provide continuous +5 Vdc and ±15 Vdc power to the system board and analog board.

Note

The system board acts as a distribution bus for all dc power.

The main power supply board also provides, after a turn-on delay, ±48 Vdc and ±175 Vdc to the RSS circuits. These outputs are switched from the RSS system by relays. The main power supply board has a hi-voltage overload sense circuit that detects reference output overloads and subsequently relay-isolates all outputs upon overload. The main power supply board switches ac power to the isolated power transformer via a relay.

4.5.3.2 **Isolated Power Supply**. The isolated power supplies are identical and provide separate ±15 Vdc, ±20 Vdc, ±48 Vdc, and ±150 Vdc to each channel of the sine/cosine board. Similar to the main power supply board, each isolated power supply has a hi-voltage overload sense circuit that detects simulator output S1 through S4 overloads and isolates all the outputs. The main power supply board is attached to the chassis, whereas the isolated power supplies plug into connectors on the system board. The isolated power supplies are identical and may be used in either connector location.

4.3.6 **SOFTWARE OVERVIEW**

This overview describes the two major sections of the software; the Startup Code and the Operational Code.

4.3.6.1 **STARTUP CODE**. The startup code is responsible for determining operability of the basic hardware components, initializing the hardware, and starting the operating system. When the RSS is turned on, the startup code causes the RSS signals to be isolated, runs the power-up tests to test the display, CPU, RAM, ROM, EEPROM, and two digital signal processors (DSP). If the power-up test detects an error, an error message is displayed, if possible, and processing is halted.

Assuming that an error has not occurred, the startup code next initializes the system stack and heap, programmable timer, keyboard and remote interface hardware, main display, voltage display and frequency displays.

The RSS is then set to its default values, the signals are connected, and the main loop is entered.

4.3.6.2 **OPERATIONAL CODE**. The operational code is a system of tasks that are run in a real-time, multitasking environment. These tasks are the timer, overload handler, keystroke

processor, remote interrupt processor, and the main loop.

The timer task is a synchronous task that runs in response to the programmable timer interrupt. This task handles interprocess synchronization and the main system coordination.

The overload handler task is a high priority asynchronous task that runs in response to a RSS detected overload condition. The handler turns down and isolates the output to prevent harm to the RSS and possible injury to the operator.

The keystroke processor is an asynchronous task that runs in response to a key being depressed. The handler debounces the key, and decodes and buffers the keystroke. Keystroke buffer status is tracked by the operating system.

The remote interrupt processor is an asynchronous task that runs in response to a remote command or a status change at the IEEE-488 interface. The remote command processor buffers incoming command characters, sends outgoing message characters, and informs the operating system of remote status changes.

The main loop is a background task that monitors the status of the keystroke buffer and remote processor buffer. If a remote command has been buffered, the command processor is called. If a keystroke has been buffered, the keystroke processor is called. The main loop also coordinates the measurement and display of the reference voltage and frequency, and auto-ranging when the RSS is operating in external reference mode.

The keystroke processor interprets local inputs using lower level data input routines, and calls the appropriate RSS interface routines. If the interface routine returns an error status, the error number is posted on the main display of the RSS.

The remote interpreter interprets commands and returns status via the IEEE-488 interface. As the syntax is checked and parameters are converted, an error message is queued if an invalid command is detected. The error message is returned on the next error query command. hen a valid command is parsed, the RSS routine is called with the input parameters. If the interface routine returns an error status, an error message is queued and returned for the next error query command. In the case of a query command, the RSS interface routine is called to obtain the RSS setting returned by the IEEE-488 interface.

The RSS interface routines provide a common interface to the remote command and keystroke processors and are used to set or query RSS parameters. Parameters are tested for limit errors and settings conflicts.

The lower level instrument drivers and DSP interface routines are called to carry out the intended process. These routines return an integer value that indicates success or failure status.

Note

The instrument drivers are at the lowest level and handle the details of writing values to the RSS registers.

4.4 FUNCTIONAL LEVEL PRINCIPLES OF OPERATION

The functional block diagrams for the RSS are shown in figure 4-4 through 4-9. The analog board, the sine/cosine board, the system board, the display/keyboard assembly, and the power supply system are described in the following paragraphs.

Note

For reference, the corresponding schematic diagram figure number (Chapter 7) is shown with the figure for the block diagram.

4.4.1 ANALOG BOARD (Figure 4-4, 7-1)

The analog board produces two types of output waveforms: One output drives isolation/tapped transformers for the sine/cosine board, enabling it to produce signals to drive, or simulate, the stator windings of a.synchro or resolver; the

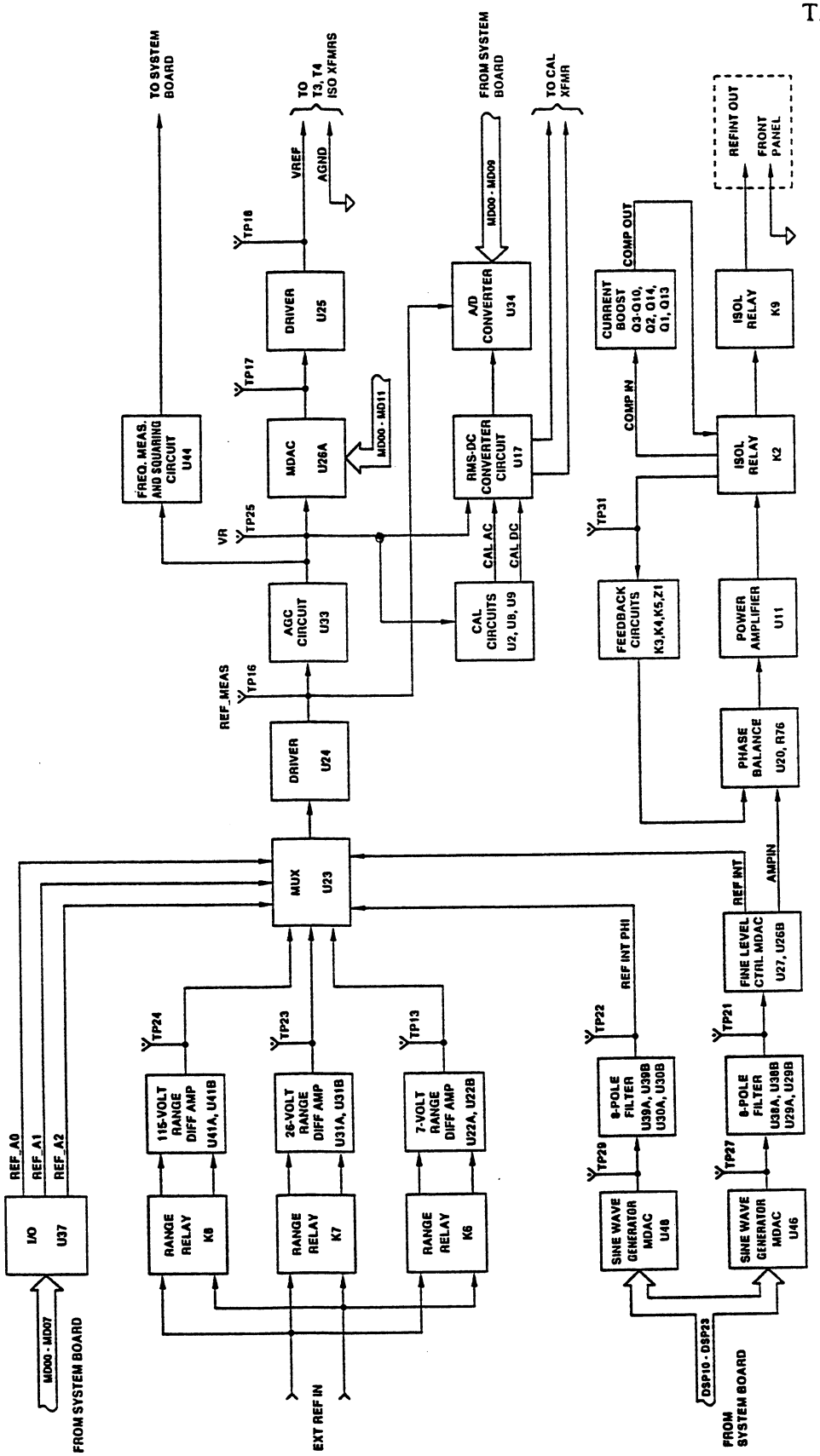


Figure 4-4. Analog Board, Block Diagram

second output is an internal generated reference waveform used to drive, or simulate, the rotor windings of a synchro or resolver. The analog board is controlled by the system board data and Reference DSP bus. In addition to the output waveforms, the analog board has the means to measure and calibrate the sine/cosine board simulator outputs

Note

The waveform that drives the sine/cosine board is internally generated or provided from an external reference source via jacks on the front panel of the RSS or the terminal block on the rear panel of the RSS.

4.4.1.1 Internal Reference Output. A reference voltage produced by MDAC U48 and signals from the system board DSP bus drive the input of sine generator MDAC U46 and U48 to produce two pseudo sine waveforms consisting of voltage level steps. The waveforms are processed by 8-pole, low pass filter circuits to remove the high frequency components and the results are two sine waveforms. The output of U29B is applied to fine level control MDAC U26B and MUX U23 via U27. The phase shifted waveform (REFINT_PHI) is applied to MUX U23 only.

MDAC U26B provides a programmable fine level control (AMPIN) to the input of the phase balance circuits. The output of the phase balance circuits is applied to power amplifier U11. The output amplitude range is determined by the feedback and attenuation/compensation select circuits in the power amplifier, and the output level is determined by the combination of the range selected and the fine level control MDAC U26B. With the power amplifier in the highest range (26V to 115V), the output of U11 is connected to the front panel REF OUTPUT jacks and rear terminal block and may be used to drive or simulate the rotor winding of a synchro or resolver.

Note

For operation below 26 V, the output of U11 is switched to the complimentary pair/driver circuits by relay K2 (COMPIN). The output of this circuit (COMPOUT) provides a current boost to the device connected to the outputs.

4.4.1.2 Sine/Cosine Board Input. MUX U23 selects one of three input waveforms; the normal reference waveform (REFINT), the phase shifted reference waveform (REFINT_PHI), or an external input waveform applied via the front panel REF INPUT jacks or terminal block on the rear panel.

Note

The range for the external input waveform is automatically selected (autoranging) by range relays and difference amplifiers shown on figure 4-4.

The selected input waveform (REF_MEAS) is applied to the AGC circuits to develop a constant amplitude waveform (VR) to MDAC U26A. REF_MEAS is also applied to the measurement/calibration circuits (paragraph 4.4.1.3).

The output amplitude of MDAC U26A is adjusted by data (MD00 - MD11) from the system board data bus and connected in parallel (via driver U25) to the primary winding of isolation/tapped transformers T3 and T4. The secondary winding of T3 and T4 drive each channel of the sine/cosine board. MDAC U26A provides programmable fine level control of the L-L output.

4.4.1.3 Measurement/Calibration Circuits. In external reference mode, the REF_MEAS signal is processed by RMS-to-DC converter U17 and applied to A/D converter U34. The output of U34 is placed on the data bus to drive the amplitude display on the front panel. When calibration is selected, switch U16A connects CAL_AC from the calibration circuits to RMS-to-DC converter U17 and processes the data with A/D converter U34. Optimal ranging of the sine, cosine null signal is performed. CAL_DC is applied directly to A/D converter U34 to measure the in-phase null with respect to VR and subsequentially determine optimal

correction. REF_MEAS is also applied to frequency measurement (hard squaring) circuit U44 to drive the frequency display on the front panel.

4.4.2 SINE/COSINE BOARD (Figure 4-5, 7-2)

The sine/cosine board contains two identical, galvanic isolated channels that provide outputs

that drive or simulate the stator windings of a synchro or resolver.

Note

The sine channel has an additional phase balance adjustment.

The sine/cosine board receives its input from the isolation/tapped transformers as previously described. The sine/cosine board is controlled by the sine register, cosine register, and sine/cosine control register located on the system board.

Note

Since the two channels are identical, only the sine channel function will be discussed. The reference designation for cosine channel components are enclosed in a bracket [ ].

Inputs from the secondary of isolation/tapped transformer T4 [T3] are applied to the quadrant select circuit where the correct polarity is assigned. The output of the quadrant select circuit is applied to the tapped secondary of T4 [T3]. This 15-tapped (positive) winding is used with MUX U47 [U58] to provide 4-bit (coarse) resolution for the selected angle. The tapped secondary has an additional negative tap winding used by MDAC U23 [U28] to provide 16-bit (fine) resolution of the selected angle. The output of the MUX and MDAC are added by summation circuit U22 [U27] an together provide 20-bit resolution plus sign (or 21-bits) of the selected sine [cosine] of the angle.

As an example, if a particular angle and voltage range is selected with no modulation applied, the system board Angle DSP circuitry determines the appropriate data and applies it, via the system board sine and cosine registers, to MUX U47 [U48] and MDAC U23 [U28]. The MUX selects the appropriate tap, and the MDAC output is adjusted to provide the correct value for that angle. One bit also select the proper polarity.

When the signal is modulated, the system board Angle DSP circuitry rapidly computes each data value and applies it in real time, selecting various transformer taps and MDAC outputs.

To prevent glitches on the output when switching between different taps of the transformer, as well as switching the MDAC, a track and hold (T/H) circuit is used to hold the output a short period of time through the transition. The output from the T/H circuit is applied to power amplifier U38 [U14]. The output of this amplifier is connected (via isolation relays) to the rear panel terminal block and front panel jacks S1 - S3 [S2 - S4] and may be used to drive or simulate the stator windings of a synchro or resolver.

Note

Sense data SS1 - SS3 [SS2 - SS4] at the load may be connected to corresponding inputs to the rear panel terminal board to enable the sine/cosine circuits to compensate for line losses.

4.4.3 SYSTEM BOARD (Figure 4-6, 7-3)

The system board circuits are responsible for controlling the entire operation of the RSS and are described in the following paragraphs.

4.4.3.1 CPU. The CPU U34 runs the program (firmware) stored in EPROM U21, 22 at 10 MHz and controls RSS hardware components via its address bus (MA01 - MA23) and data bus (MD00-MD15). Upon turn on, the start up code in firmware runs the power-up tests to check the display FPGA's (U29, 48), CPU (U34), RAM (U15), EPROM (U21, 22), and two DSP's (U2, 4). After power-up tests are completed and no errors are detected, the CPU sets the RSS to its default values and polls the interface and keyboard assembly for inputs. The system board

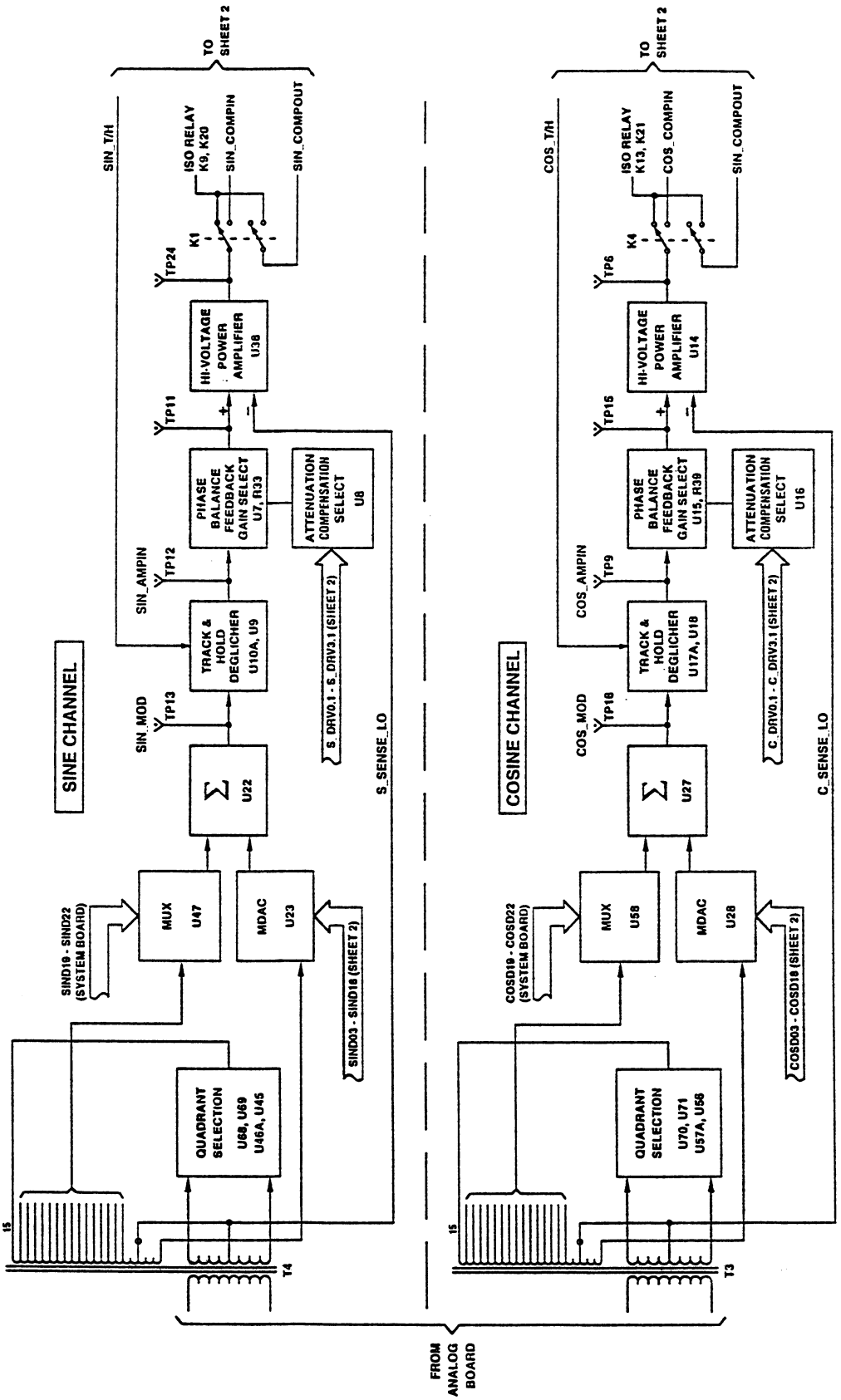


Figure 4-5. Sine/Cosine Board, Block Diagram (Sheet 1 of 2)

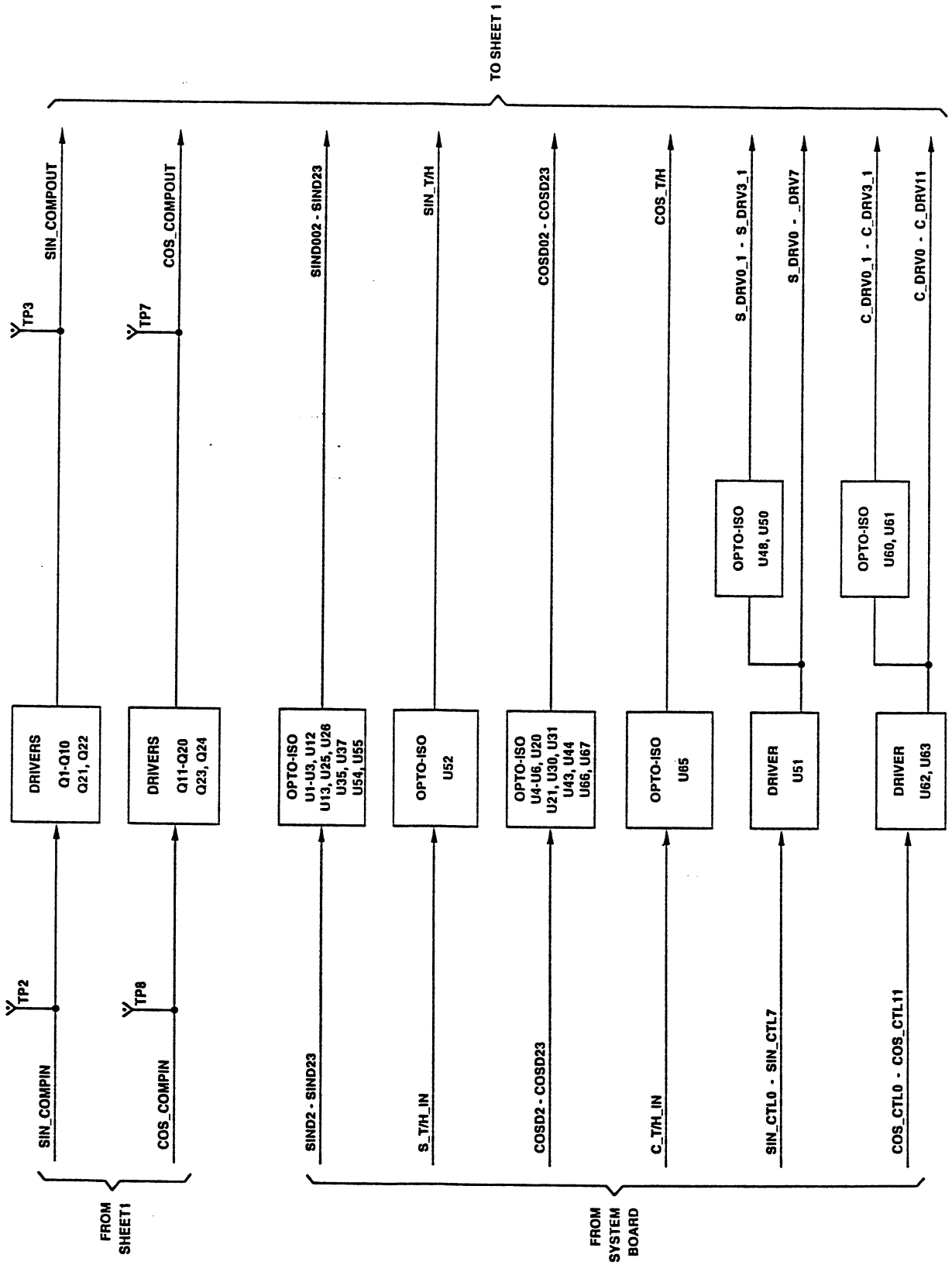


Figure 4-5. Sine/Cosine Board, Block Diagram (Sheet 2 of 2)

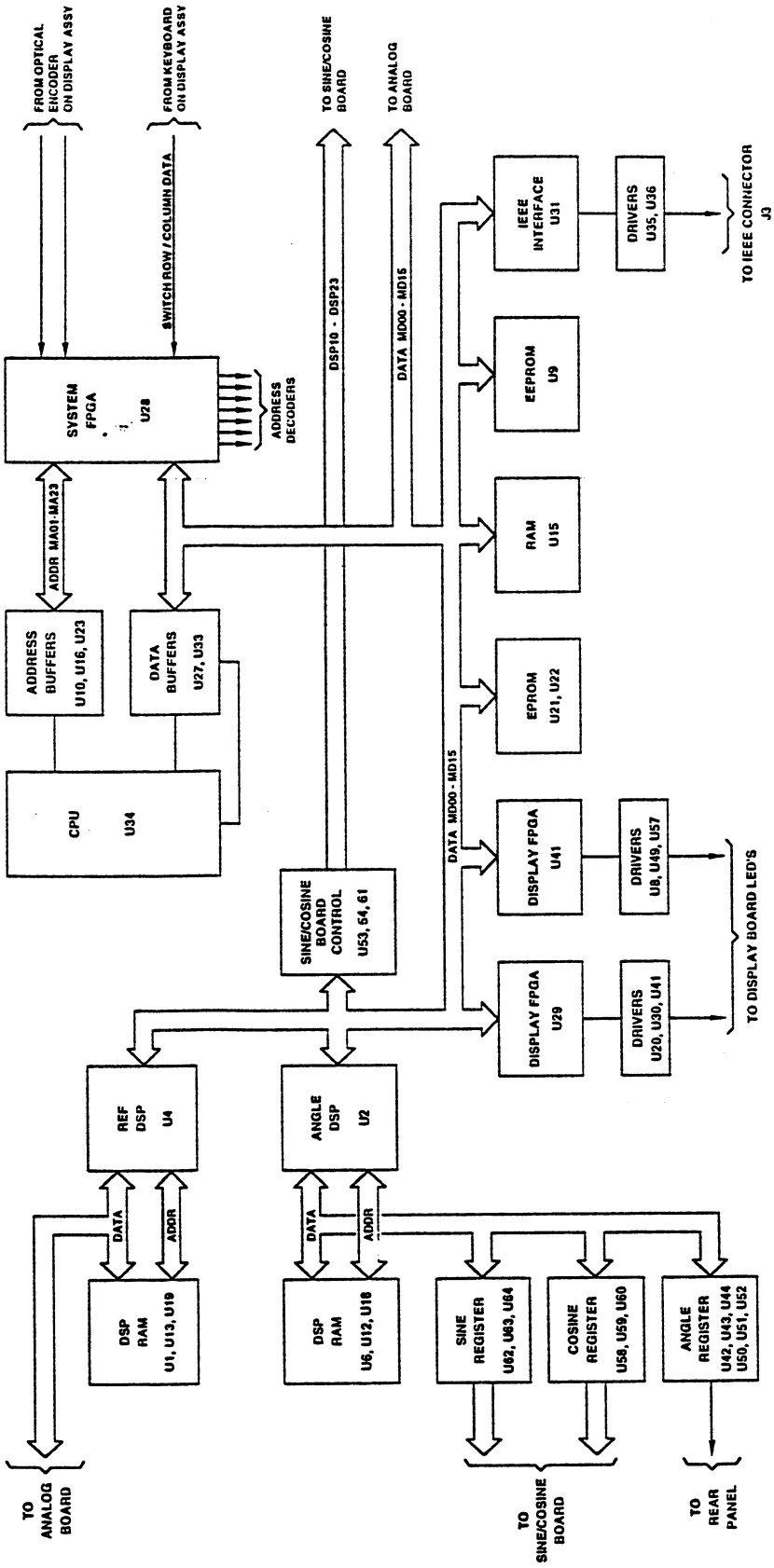


Figure 4-6. System board, block diagram

controls the sine/cosine board via the sine register (U62, 63, 64), cosine register (U58, 59, 60), and sine/cosine control register (U53,54, 61). The system board controls the analog board via reference DSP U4 and DSP RAM U7, 13, 19).

4.4.3.2 System FPGA. The system FPGA U28 is connected to the CPU address and data busses. The system FPGA samples keyboard and optical encoder outputs and provides address decodes [list here].

4.4.3.3 Interface U31. With drivers U35 and U36, interface U31 enables communication between the RSS and an external computer using IEEE-488 interface protocol.

4.4.3.4 EPROM U21, U22. These chips contain the firmware for CPU U34.

4.4.3.5 EEPROM U9. The EEPROM stores the IEEE-488 address entered via the front panel.

Figure 4-6. System Board, Block Diagram

4.4.3.6 RAM U1, U14. The RAM is used by the CPU as a scratch-pad memory to store temporary data.

4.4.3.7 Display FPGA U29, U48. The display FPGA's are connected to data bus (MD00 - MD07) and address bus (MA01 - MA04). With LED drivers U20, U30 U41, (U29), and U8, U49, U57 (U48), the display FPGA's control operation of the LED segments on the display/keyboard assembly.

4.4.3.8 Angle DSP U2. Angle DSP U2 is connected to address bus (MA01 - MA03) and data bus (MD00 - MD07). Upon initialization, the CPU writes sine and cosine subtables to DSP RAM U6, 12, 18. Using data from the RAM subtable, the DSP calculates the sine and cosine of the entered angle and writes the values to the sine/cosine board. The DSP also performs modulation when enabled. The 24-bit output word (BDSP1D00 - BDSP1D23) is bussed to sine register (U62, U63, U64), cosine register (U58, U59, U60), and angle register (U42, U43, U44, U50, U51, U52) via bus drivers U5, U11, U17. The sine, cosine, and angle registers are enabled by -SINE, -COSINE, and -DSPANGLE, respectively.

4.4.3.9. Reference DSP U4. Reference DSP U4 is connected to address bus (MA01 - MA03) and data bus (MD00 - MD07). Upon initialization, the CPU writes sine and cosine subtables to DSP RAM U7, 13, 19. Using data from the RAM subtable, the DSP generates the internal reference waveform. A 14-bit output word (DSP2D10 - DSP2D13) is bussed to the analog board.

4.4.3.10 Sine/Cosine Board Control Registers U53, U54, U61.

The CPU controls operation of the sine/cosine board by storing sine control data (MD00 - MD07) and cosine control data (MD00 - MD15) into the sine/cosine control register U53, 54 61).

4.4.3.11 Sine Register. The sine register (U62,63, 64) stores sine data from the angle DSP for use by the sine/cosine board circuits.

4.4.3.12 Cosine Register. The cosine register (U58, 59, 60) stores cosine data from the angle DSP for use by the sine/cosine board circuits.

4.4.3.13 Angle Register. The angle register (U42-44, 50-52) stores data from the angle DSP and presents it to the RSS rear panel.

4.4.4 DISPLAY/KEYBOARD ASSEMBLY (Figure 4-7, 7-4)

The display/keyboard assembly consists of a main display, voltage display, and keyboard assembly.

Note

Refer to Chapter 3, section I for a description of push button switches and indicators.

The display segments are turned on by the application of ASEG9-ASEG24 (main display) or BSEG9-BSEG24 (voltage display) signals with a ADRAIN1-ADRAIN4 (main display) or BDRAIN1-BDARIN4 (voltage display) pulse. As the segments share common ASEG## or

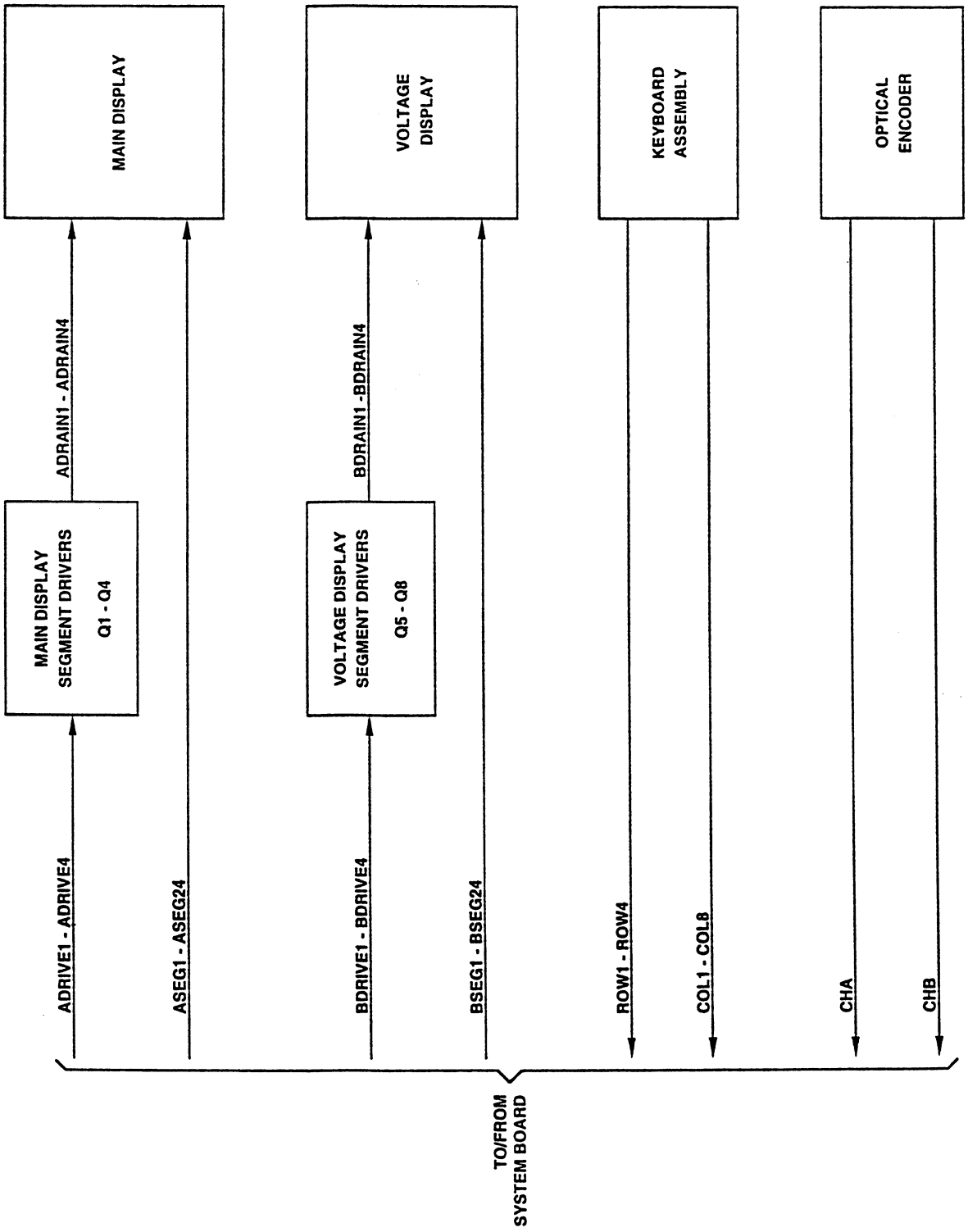


Figure 4-7. Display/Keyboard Block Diagram

BSEG## connections, the DRAIN signals are multiplexed to enable selection of individual LED's. The system board DISPLAY_FPGA U48 provides the segment signals and Drain signals are provided by system board SYSFPGA U28.

The remaining indicators on the main display, voltage display, and keyboard are individual LED's and are controlled in the same manner as the segmented displays (see figure 7-4 for specific LED's.

The keyboard assembly consists of 32 push button switches and an optical encoder. System board SYSFGPA U28 polls the keyboard and detects a specific push button by its ROW and COL position. As an example (see fig 7-4), if the OUTPUT ANGLE push button is pressed, U28 detects continuity between ROW1 and COL1 and initiates the function of the push button.
System board SYSFPGA U28 monitors the optical encoder and responds to pulses generated when the encoder is rotated.

4.4.5 MAIN POWER SUPPLY BOARD (Figure 4-8, 7-5)

The main power supply board provides +5 Vdc, ±15 Vdc, ±48 Vdc, and ±175 Vdc to the system and analog boards. With the exception of the +5 Vdc and ± 15 Vdc outputs, all other outputs of the main power supply board are switched by relay K1 and K3. This feature allows the analog and sine/cosine boards to be set up during power-up before turning on the high voltages.

4.4.5.1 **+5 Vdc Circuits**. When power is applied to the RSS, 115 (or 230) Vac is applied to the primary of main transformer T1. As excitation appears at the secondary winding of T1, full wave rectification is accomplished by bridge rectifier CR9. At the positive (+) output of CR9, the unregulated voltage is filtered by C9, C10, C11 and applied to the input of voltage regulator U3. The regulated +5 Vdc output is filtered by C14, C15, and C16 and applied to the system and analog boards.

4.4.5.2 **± 15 Vdc Circuits**. As excitation appears at the secondary winding of T1, full wave rectification is accomplished by CR1 and CR2 (+), and CR3 and CR4 (-). The positive (+) unregulated output of CR1 and CR2 is filtered by C1 and C3 and applied to the input of regulator U1. The regulated + 15 Vdc is filtered by C5 and C7 and applied to the system and analog boards. The negative (-) unregulated output of CR3 and CR4 is filtered by C2 and C4 and applied to the input of regulator U2. The regulated -15 Vdc is filtered by C6 and C8 and applied to the system and analog boards.

4.4.5.3 **Time Delay**. After a short delay following turn-on, PWR_CTL is received from the system board and turns on Q3 and K3. When K3 contacts close, excitation is applied to the ± 48 Vdc circuits via contacts C and D, and to the ± 175 Vdc circuits via contacts A and B. PWR_CTL also turns on Q4 and K1 to apply excitation to the primary of isolation transformer T2 (contacts 13 and 12).

Note

Isolation transformer T2 provides excitation for the isolated power supplies.

4.4.5.4 **± 48 Vdc Circuits**. After a time delay (previously described), full wave rectification is accomplished by CR13 and CR14 (+), and CR15 and CR16 (-). The positive (+) unregulated output of CR13 and CR14 is filtered by C17 and C20 and applied to the input of regulator U4. The regulated +48 Vdc output is filtered by C22, C24, and C26 and applied to the reference power amplifier complimentary pair driver.

Note

CR12 acts as a half wave rectifier to energize relay K2 and provide input to the high voltage overload sense circuits. When power is turned off, K2 deenergizes and causes the high voltage to bleed to ground.

The negative (-) unregulated output of CR15 and CR16 is filtered by C18 and C21 and applied to

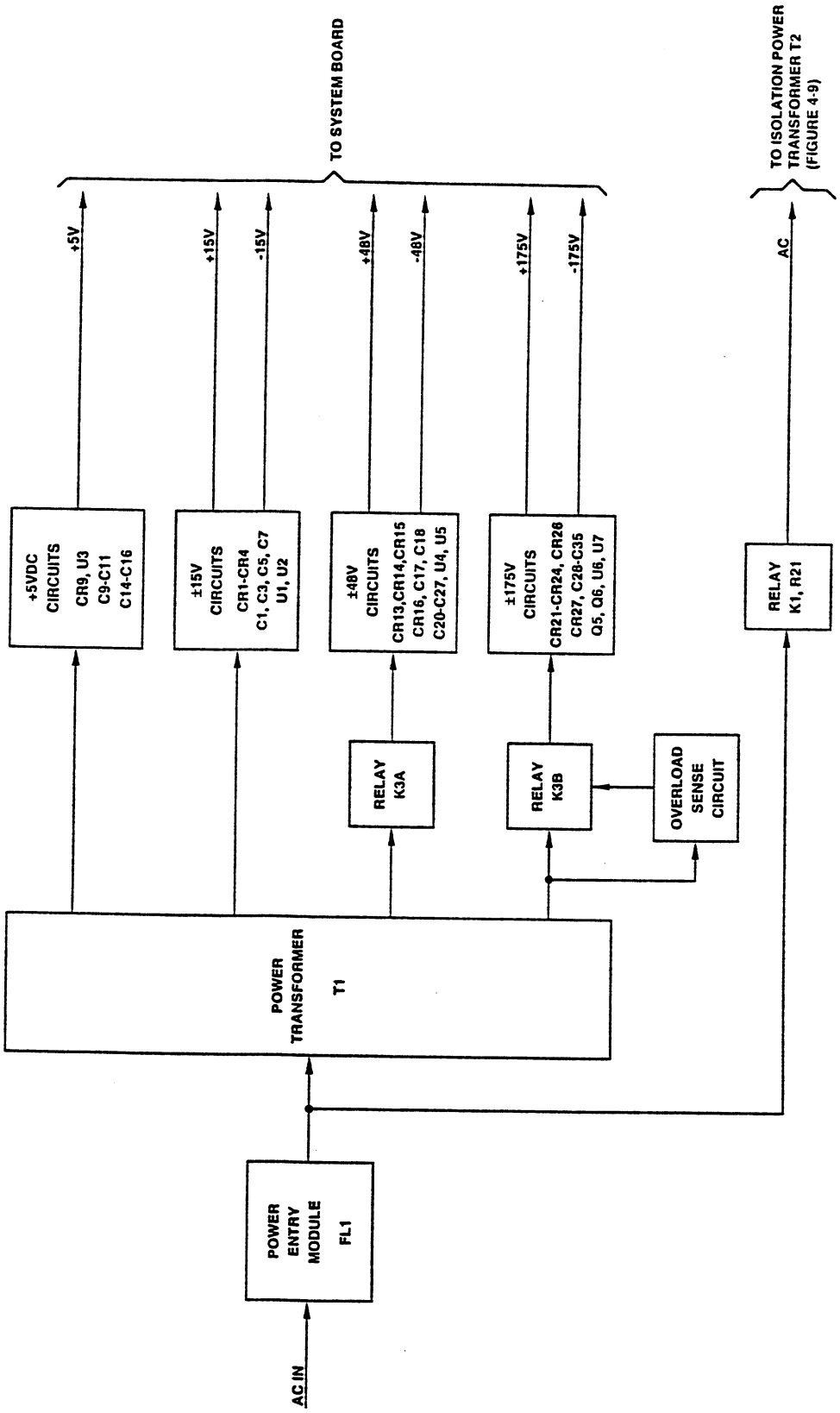


Figure 4-8. Main Power Supply Board, Block Diagram

the input of regulator U5. The regulated -48 Vdc output is filtered by C23, C25, and C27 and applied to the reference power amplifier complimentary pair driver.

4.4.5.5 ± 175 Vdc Circuits. After a time delay (previously described), full wave rectification is accomplished by CR21 and CR22 (+) and CR23 and CR24 (-). The positive (+) unregulated output of CR21 and CR22 is filtered by C28 and C30 and applied to the cathode of zener diode CR25 and the collector of pass transistor Q5. The zener diodes provide approximately +200 Vdc reference to the base of pass transistor Q5, thereby applying a semi-regulated +200 Vdc to the input of regulator U6. The regulated +175 volt output is filtered by C32 and C34 and used for reference channel high voltage operational amplifier U11. The negative (-) unregulated output of CR23 and CR24 is filtered by C29 and C31 and applied to the anode of zener diodes CR28 and the collector of pass transistor Q6. The zener diodes provide approximately -200 Vdc reference to the base of pass transistor Q6, thereby applying a semi-regulated -200 Vdc to the input of regulator U7. The regulated -175 Vdc output is filtered by C33 and C35 and used for reference channel high voltage operational amplifier U11.

4.4.5.6 High Voltage Overload Sense Circuit.

In the case of an overload, the ground current sensed by overload resistor R21 reaches a predetermined value and the overload sense circuits trip and output a low to digital circuits on the system board.

4.4.6 ISOLATED POWER SUPPLIES (Figure 4-9, 7-6)

The RSS uses two identical isolated supplies to provide separate ±15, ± 48, ± 20, and ± 150 Vdc to each channel of the sine/cosine board. Unless otherwise indicated, isolated power supply A6 is described.

4.4.6.1 ± 15 Vdc Circuits. When ac power is applied to the primary of isolation transformer T2, excitation appears at the secondary winding. Full wave rectification is accomplished by CR1 and CR2 (+), and CR3 and CR4 (-). The positive (+) unregulated output is filtered by C1 and C3 and applied to the input of regulator U1. The regulated +15 Vdc output is filtered by C5 and C7 and applied to the sine channel of the sine/cosine board. The negative (-) unregulated output is filtered by C2 and C4 and applied to the input of regulator U2. The regulated -15 Vdc output is filtered by C6 and C8 and applied to the sine channel of the sine/cosine board.

Isolated supply A7 functions identically and provides regulated ±15 Vdc to the cosine channel of the sine/cosine board.

4.4.6.2 ± 48 Vdc Circuits. When ac power is applied to the primary of isolation transformer T2, excitation appears at the secondary winding. Full wave rectification is accomplished by CR9 and CR10 (+), and CR11 and CR12 (-). The positive (+) unregulated output from the rectifiers is filtered by C25 and C27 and applied to the input of regulator U7. The regulated +48 Vdc output is filtered by C29, C31, and C35 and applied to the sine channel of the sine/cosine board. The negative (-) unregulated output from the rectifiers is filtered by C26 and C28 and applied to the input of regulator U8. The regulated -48 Vdc output is filtered by C30, C32, and C36 and applied to the sine channel of the sine/cosine board.

Isolated supply A7 functions identically and provides ±48 Vdc to the cosine channel of the sine/cosine board.

Note

The ±48 Vdc outputs power the complimentary pair drivers on the sine/cosine board assembly and provide the input for the ±20 Vdc circuits.

4.4.6.3 ± 20 Vdc Circuits. +48 Vdc is applied to the input of regulator U9. The regulated +20 volt output is filtered by C37 and C39 and applied to the sine channel of the sine/cosine board.

-48 Vdc is applied to the input of regulator U10. The regulated -20 Vdc output is filtered by C38

and C40 and applied to the sine channel of the sine/cosine board.

Isolated supply A7 functions identically and provides regulated ±20 Vdc to the cosine channel of the sine/cosine board.

4.4.6.4 ± **150 Vdc Circuits**. When ac power is applied to the primary of isolation transformer T2, excitation appears at the secondary winding. Full wave rectification is accomplished by CR5 and CR6 (+), and CR7 and CR8 (-). The positive (+) unregulated output from the rectifiers is filtered by C9 and applied to the collector of pass transistor Q1, R5, and the cathode of zener diode CR17. The zener diodes provide a +150 volt reference to the base of pass transistor Q1, thereby regulating the +150 Vdc level at the emitter. The regulated +150 Vdc is filtered by C15, C17, and C19 and applied to the sine channel of the sine/cosine board. The negative (-) unregulated output from the rectifiers is filtered by C10 and applied to the collector of pass transistor Q2, R6, and the anode of zener diode CR20. The zener diodes provide a -150 volt reference to the base of pass transistor Q2, thereby regulating the -150 Vdc level at the emitter. The regulated -150 Vdc is filtered by C16, C18, and C20 and applied to the sine channel of the sine/cosine board. The regulated ±150 Vdc outputs connect the overload circuits.

Isolated supply A7 functions identically and provides regulated ±150 Vdc to the cosine channel of the sine/cosine board.

4.4.6.5 **High Voltage Overload Sense Circuit**.

In the case of an overload, the ground current sensed by overload resistor R9 reaches a predetermined value and the overload sense circuits trip and output a low to digital circuits on the system board.

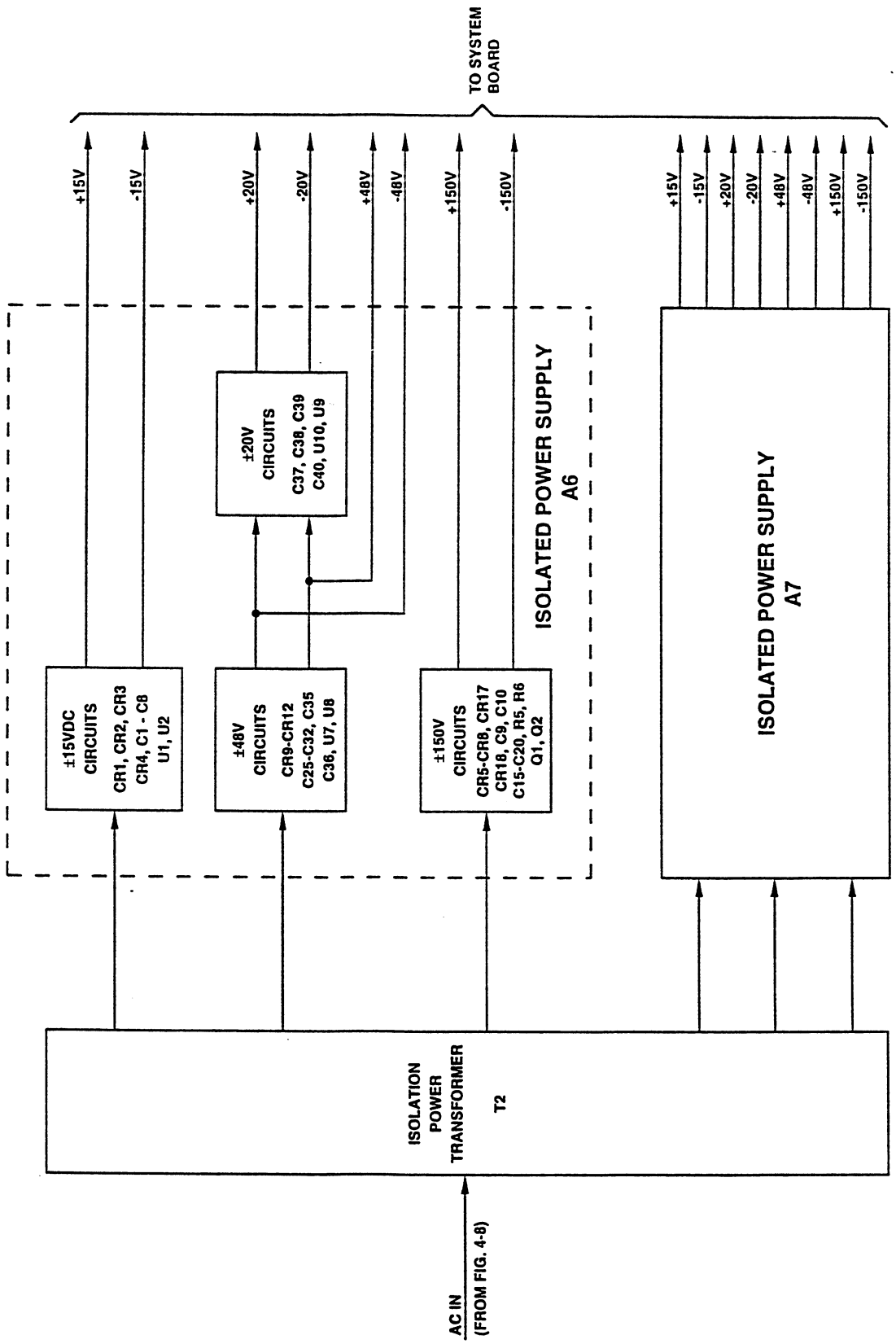


Figure 4-9. Isolated Power Supply, Block Diagram

CHAPTER 5
MAINTENANCE

5.1 GENERAL

This chapter contains maintenance procedures for the Resolver/Synchro Standard (RSS) and consists of five sections. Section I contains the schedule and preventive maintenance procedures for the RSS. Section II contains the performance test whereby the overall operation of the RSS can be verified. Section III contains a fault isolation table to locate defective shop replaceable assemblies (SRA) of the RSS. Section IV contains removal/replacement procedures. Section V contains test and adjustment procedures for the RSS.

5.2 EQUIPMENT/MATERIALS REQUIRED

Table 5-1 lists the equipment and materials required to perform the maintenance procedures in this chapter.

Table 5-1. Equipment/Materials Required for Maintenance

EQUIPMENT/MATERIALS *	MODEL/PART NO.	PARAGRAPH NO.
Sash brush	-	5.5.1, 5.5.2
Lint-free cloth	-	5.5.1, 5.5.2
Mild detergent	-	5.5.1, 5.5.2
Shop vacuum cleaner	-	5.5.2
Oscillator	Krohn-Hite Model 4000AR	5.7.1, 5.7.2
75-Watt Amplifier	Krohn-Hite Model 7500	5.7.1, 5.7.2
Ratio Box (Optional - See table 5-3, part 3).	Electro Scientific Industries, Inc. - Model 73 with 2.5 V/Hz option.	5.7.1
Bridge Transformer	NAI Model TFI-0010	5.7.1
Synchro/Resolver bridge	NAI - Model 540/11	5.14.1
Digital analyzing voltmeter (DAV)	NAI - Model 2250	5.14.1, 5.14.2, 5.7.1, 5.7.2
Extender Frame Assembly	NAI - P/N 784014	5.14.2
Oscilloscope	Tektronix - Model 465	5.14.3, 5.14.4, 5.7.1, 5.7.2
Thermal RMS Digital multimeter	Fluke - Model 8506A	5.14.3, 5.14.4, 5.7.1, 5.7.2

* Equivalent material and equipment is acceptable

5.3 SCOPE OF SECTION I

This section describes the preventive maintenance (PM) procedures for the RSS.

5.4 SCHEDULE

Table 5-2 lists the schedule to perform PM.

5.5 CLEANING

Cleaning procedures consist of general cleaning of the external surfaces of the RSS including the Display panel. Specific cleaning consists of cleaning the filter element in the fan assembly and any dust accumulated within the RSS.

5.5.1 GENERAL CLEANING

Perform general cleaning as follows:

1. Remove dust on exterior surfaces of RSS with a dry, lint-free cloth. To remove stubborn areas, clean with water and mild detergent.

2. Clean the display panels with a clean cloth moistened with water.

5.5.2 SPECIFIC CLEANING

The filter element of the fan assembly should be cleaned every 500 operating hours (minimum). To accomplish specific cleaning, perform the following:

WARNING

TURN FRONT PANEL SWITCH OFF AND UNPLUG LINE CORD BEFORE PERFORMING THE PROCEDURES LISTED IN THIS SECTION.

CAUTION

THIS EQUIPMENT IS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALWAYS USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING EQUIPMENT.

1. Turn power switch off and disconnect power cable.

2. Remove six screws securing top cover to sides of chassis and remove cover.

3. Remove six screws securing bottom cover to sides of chassis and remove cover.

4. With covers removed, inspect cleanliness of internal components. If cleaning is required, brush dust into vacuum cleaner nozzle with sash brush or wipe with clean cloth.

5. Vacuum filter element retainer of fan assembly using shop vacuum cleaner.

6. Remove fan, filter bracket, and filter element from rear panel by removing four screws and nuts.

7. Wash filter element in solution of water and mild detergent. Rinse filter element in clean water and allow to dry before installation.

8. Install filter element.

9. Secure fan, filter bracket, and filter to rear panel with four screws and nuts.

10. Secure bottom cover to sides of chassis with six screws.

11. Secure top cover to sides of chassis with six screws.

12. Connect power cable.

Table 5-2. PM Schedule

PM ACTION	SCHEDULE
General Cleaning (Paragraph 5.5.1)	Monthly
Specific Cleaning (Paragraph 5.5.2)	Every 500 operating hours or as required
Performance test (Paragraph 5.7)	Annually

Section II. Performance Test

5.6 SCOPE OF SECTION II

This section provides the performance test for the RSS and consists of four parts. Part one involves turning the RSS on and observing specific actions that the RSS performs during power-up, operator inputs to verify operation of the display/keyboard assembly, and a check of the interface circuitry. Part two checks that the RSS is functioning properly. Part three uses a ratio box to test the accuracy of the RSS . Part four provides procedures to test the accuracy of the RSS if a ratio box is not available. The performance test shall be performed as scheduled (table 5-2) or whenever the performance or accuracy of the RSS is questionable.

Note

If the performance test fails or cannot be run, refer to Section III, Fault Isolation.

5.7 PERFORMANCE TESTING

5.7.1 PERFORMANCE TEST PROCEDURE

Figure 5-1 is a flow chart that shows how the performance test is organized. To run the performance test, see tables 5-1 and 5-3 and perform the following:

Table 5-3. Performance Test

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
Part 1. Power-Up Test			
1. Connect power cable and IEEE interface cable to RSS.	-	-	-
2. Turn power switch on (I). Observe that each display panel and keyboard function LED is on, and that main display and voltage display sequence is as shown.			
	N.NN		This is the version of the system board EPROM
	111111.11	*11.1*	
	22222.222	*2.22*	
	3333.3333	*33.3*	
	444.44444	*4.44*	

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
	55.555555	*55.5*	
	6.6666666	*6.66*	
	77.777777	*77.7*	
	888.88888	*8.88*	
	9999.9999	*99.9*	
3. Observe that all function LED's are off.	*00000.000*	*0.00*	
4. Observe that main display INT REF indicator is on. Main display as shown.	*SEt-UP* *INT REF*		
5. Observe that main display RES and INT REF indicators are on. Main display as shown.	*RES* *SEt-UP* *INT REF*		
6. Observe that main display RES and INT REF indicators are on. Main and voltage displays as shown.	*RES* *0.0000 DEG* *INT REF*	*0.00 V_{REF}* *400 Hz*	

Note

- **The following tests check the function of each push button**
- **Display data are shown as italic characters.**
- **Press push buttons in order listed.**

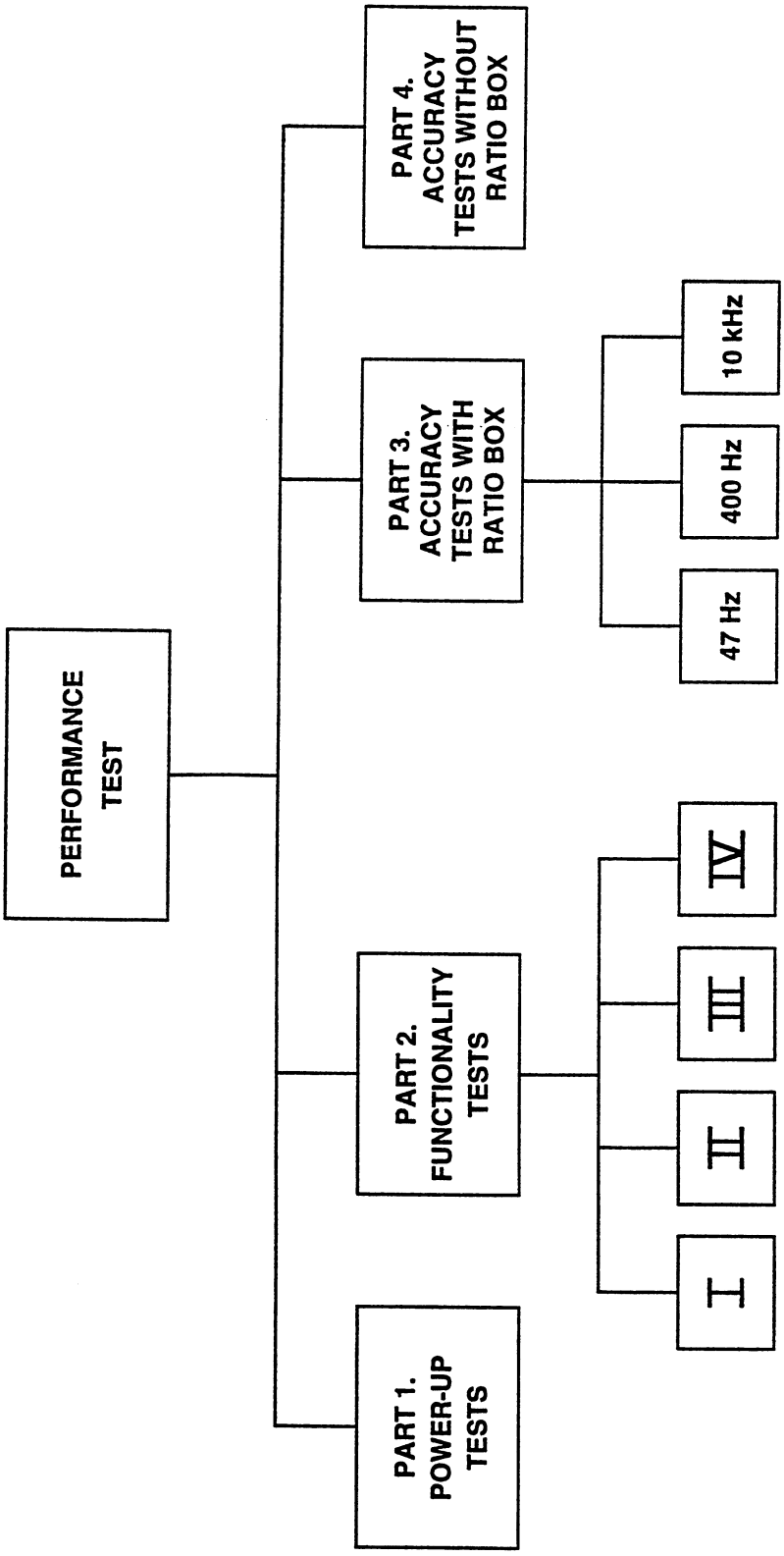


Figure 5-1. Performance Test Flow Chart (Sheet 1 of 2)

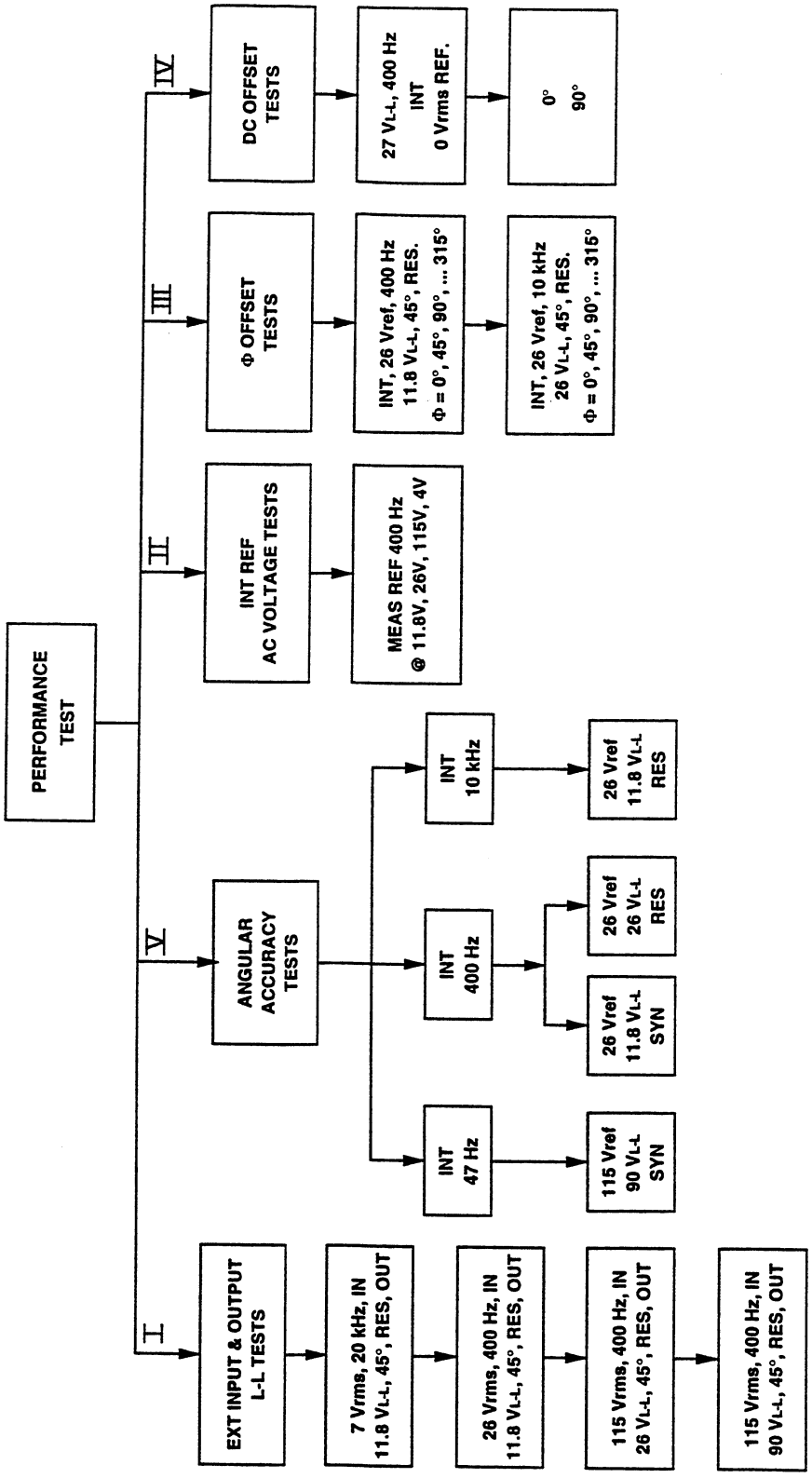


Figure 5-1. Performance Test Flow Chart (Sheet 2 of 2)

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
7. Press OUTPUT ANGLE push button.	*RES* *0.0000 DEG* *INT* *REF*	*0.00 V_{REF}* *400 Hz*	OUTPUT ANGLE push button LED and INCREMENT knob LED on.
8. Rotate INCREMENT knob CW and CCW.	For CW rotation, observe that the display changes one (1) positive increment for each increment of the INCREMENT knob. For CCW rotation, observe that the display changes one (1) negative increment for each increment of the INCREMENT knob.	*0.00 V_{REF}* *400 Hz*	
9. Press UP push button.	Observe that the display increases one (1) positive increment.	No Change	
10. Press DOWN push button. Leave setting at 0.0000.	Observe that the display decreases one (1) negative increment.	No Change	
11. Press 1 2 . 3 4 5 6 7 push buttons.	*RES* *12.34567 DEG* *INT* *REF*		
12. Press CLEAR push button.	*RES* *0.0000 DEG* *INT* *REF*	No Change	

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
13. Press 1 2 . 3 4 8 9 0 push buttons.	*RES* *12.34890 DEG* *INT* *REF*	No Change	
14. Press +/- push button.	*RES* *-12.34890 DEG* *INT* *REF*	*0.00 V_{REF}* *400 Hz*	
15. Press CLEAR push button.	*RES* *0.0000 DEG* *INT* *REF*	No Change	
16. Press 1 2 . 3 4 5 6 7 and ENTER push buttons.	*RES* *12.3457 DEG* *INT* *REF*	No Change	OUTPUT ANGLE push button LED and INCREMENT LED off.
17. Press OUTPUT SYN/RES push button.	*SYN* *12.3457 DEG* *INT* *REF*	No Change	OUTPUT AMPL LED off
18. Press REF INT/EXT push button.	*SYN* *12.3457 DEG* *EXT* *REF*	*0.00 V_{REF}* *0.00 Hz*	*SEt-UP* is momentarily displayed in main display.

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
19. Press REF INT/EXT push button.	*SYN* *12.3457 DEG* *INT* *REF*	*0.00 V_{REF}* *400 Hz*	*SEt-UP* is momentarily displayed in main display.
20. Press REF FREQ push button	No Change	No Change	FREQ push button LED on.
21. Press REF AMPL push button.	No Change	*0.00 V_{REF}* *400 Hz*	REF AMPL push button LED on.
22. Press REF PHASE push button.	*SYN* *0.0000 DEG* *INT* *REF*	No Change	PHASE push button LED on.
23. Press MOD MODE push button repeatedly.	Observe that Sine, Triangle, Square, and Rotational indicators sequentially light.	No Change	MODE LED turns off approximately five seconds after last position selected
24. Press MOD FREQ push button.	*SYN* *0.0000 Hz* *INT* *REF*	No Change	MOD FREQ LED on.
25. Press MOD AMPL push button.	*SYN* *0.0000 DEG* *INT* *REF*	No Change	MOD AMPL LED on.

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
26. Press MOD VEL push button.	*SYN* *0.0000 °/SEC* *INT* *REF*	No Change	MOD VEL LED on.
27. Press MOD MODE push button.	*SYN* *12.3457 DEG* *INT* *REF*	*0.00 V_{REF}* *400 Hz*	Wait for MOD MODE push button LED to go off before proceeding to next step.
28. Press LOCAL push button.	*IEEE 6*	No Change	
29. Press UP push button repeatedly to display IEEE addresses 0 through 31. Leave setting at 6.	*IEEE 0* through *IEEE 31*	No Change	
30. Press ENTER push button.			
31. Set IEEE address to 6 on computer.			
32. Press CLEAR push button.	*SYN* *12.3457 DEG* *INT* *REF*		
33. Send *RST command to RSS from computer.	*RES* 0.0000 DEG REM INT REF	*0.0 V_{L-L}* *400 Hz*	*SEt-UP* is displayed in main display for a few seconds. LISTEN flashes momentarily.

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
Part 2. Functionality Tests			
1. With RSS and test equipment power off, see figure 5-2 and connect test equipment as shown. 2. Turn test equipment outputs down and turn power on. Allow test equipment to warm-up for 15 minutes.			
3. Turn RSS power on and set RSS to 4 V_{L-L}, 45°, RES, EXT REF.	***RES*** ***45.0000 DEG*** ***EXT REF***	***4 V_{L-L}*** ***0.00 HZ***	
4. Adjust output of oscillator and power amplifier for 7 V_{RMS}, 20 KHZ.		***4 V_{L-L}*** ***20 KHZ***	
5. Connect oscilloscope and RMS multimeter to RSS terminals S1 (LO) and S3 (HI). 6. Check for sine wave and that multimeter reading is between 2.7718 and 2.8850. 7. Connect oscilloscope and multimeter to RSS terminals S4 (LO) and S2 (HI) and check for sine wave and that multimeter reading is between 2.7718 and 2.8850.			
8. Adjust output of oscillator and power amplifier for 26 V_{RMS}, 400 HZ.		***4 V_{L-L}*** ***400 HZ***	
9. Set RSS to 11.8 V_{L-L}.	***RES*** ***45.0000 DEG*** ***EXT REF***	***11.8 V_{L-L}*** ***400 HZ***	
10. Check for sine wave and that multimeter reading is between 8.1770 and 8.5108. 11. Connect oscilloscope and RMS multimeter to RSS terminals S1 (LO) and S3 (HI) and check or sine wave and that multimeter reading is between 8.1770 and 8.5108. 12. Adjust output of oscillator and power amplifier for 115 V_{RMS}, 400 HZ.			

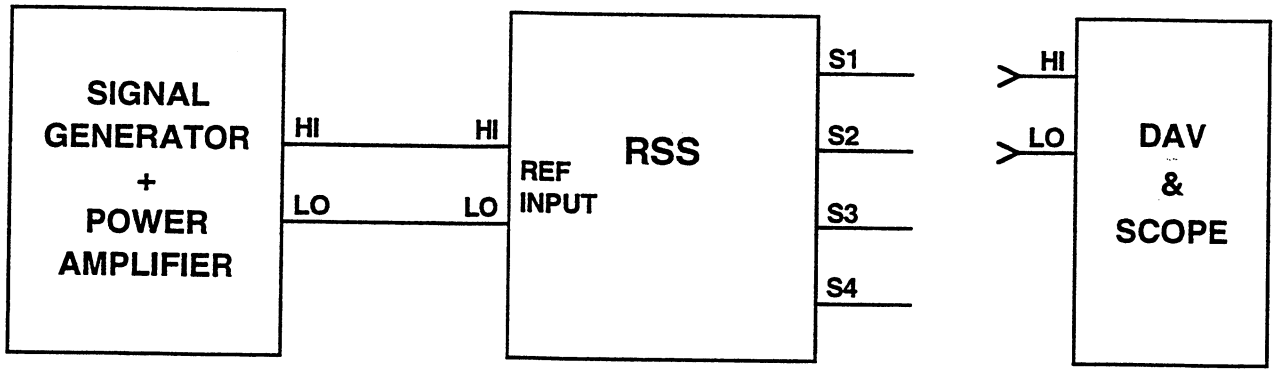


Figure 5-2. Test Setup, External Input/Output L-L Tests

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
13. Set RSS to 26 V_{L-L}.	*RES* *45.0000 DEG* *EXT REF*	*26.0 V_{L-L}* *400 HZ*	
14. Check for sine wave and that multimeter reading is between 18.0171 and 18.7525. 15. Connect oscilloscope and RMS multimeter to RSS terminals S4 (LO) and S2 (HI) and check for sine wave and that multimeter reading is between 18.0171 and 18.7525.			
16. Set RSS to 90 V_{L-L}.	*RES* *45.0000 DEG* *EXT REF*	*90.0 V_{L-L}* *400 HZ*	
17. Check for sine wave and that multimeter reading is between 62.3668 and 64.9124. 18. Connect oscilloscope and RMS multimeter to RSS terminals S1 (LO) and S3 (HI) and check for sine wave and that multimeter reading is between 62.3668 and 64.9124. 19. With power off, see figure 5-3 and connect test equipment as shown.			
20. Turn power on and set RSS to 4 V_{REF}, 400 HZ, INT REF.	*RES* *0.0000 DEG* *INT REF*	*4.00 V_{REF}* *400 Hz*	
21. Check that multimeter reading is between 3.88 and 4.12.			
22. Set RSS to 11.8 V_{REF}.	*RES* *0.0000 DEG* *INT REF*	*11.8 V_{REF}* *400 Hz*	
23. Check that multimeter reading is between 11.446 and 12.154.			

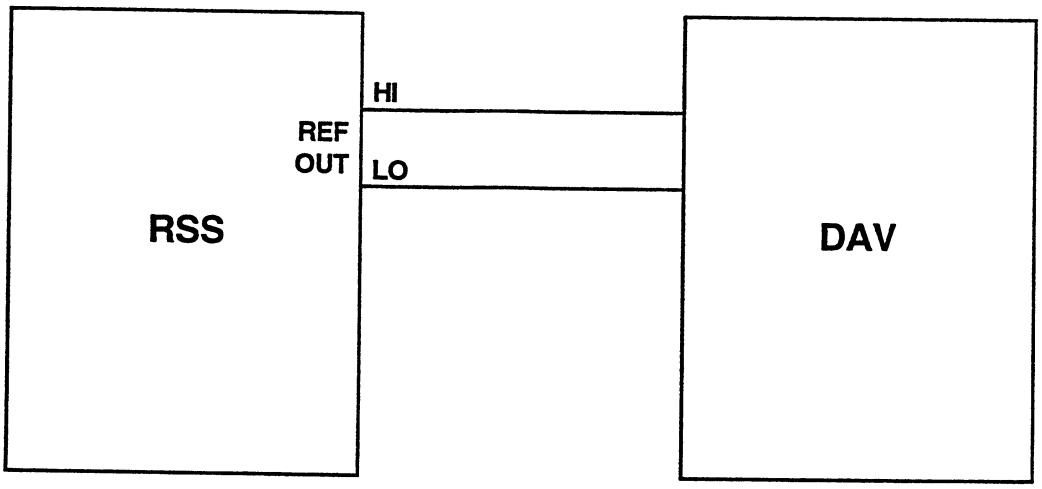


Figure 5-3. Test Setup, Internal Reference AC Voltage Tests

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
24. Set RSS to 26 V_{REF}.	*RES* *0.0000 DEG* *INT REF*	*26 V_{REF}* *400 Hz*	
25. Check that multimeter reading is between 25.22 and 26.78.			
26. Set RSS to 115 V_{REF}.	*RES* *0.0000 DEG* *INT REF*	*115 V_{REF}* *400 Hz*	
27. Check that multimeter reading is between 111.55 and 118.45.			
28. With power off, see figure 5-4 and connect test equipment as shown.			
29. Turn power on and set RSS to 26 V_{REF}, 11.8 V_{L-L}, 45°, 400 HZ, Phase offset 0, RES, INT REF.	*RES* *45.0000 DEG* *INT REF*	*11.8 V_{L-L}* *400 Hz*	
Note: Data within brackets in following steps applies to step 56. Use unbracketed data for steps 33 through 49. 30. Press ±180° PHASE push button on DAV and connect S1 of RSS to LO SIG terminal of DAV set to measure phase angle ± 180°. Connect S3 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between -0.5°[-5°] and 0.5°[5°]. 31. Connect S4 of RSS to LO SIG terminal of DAV. Connect S2 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between -0.5°[-5°] and 0.5°[5°]. 32. Set RSS phase offset to 45. 33. Check that angle displayed on DAV is between 44.5°[40°] and 45.5°[50°].			

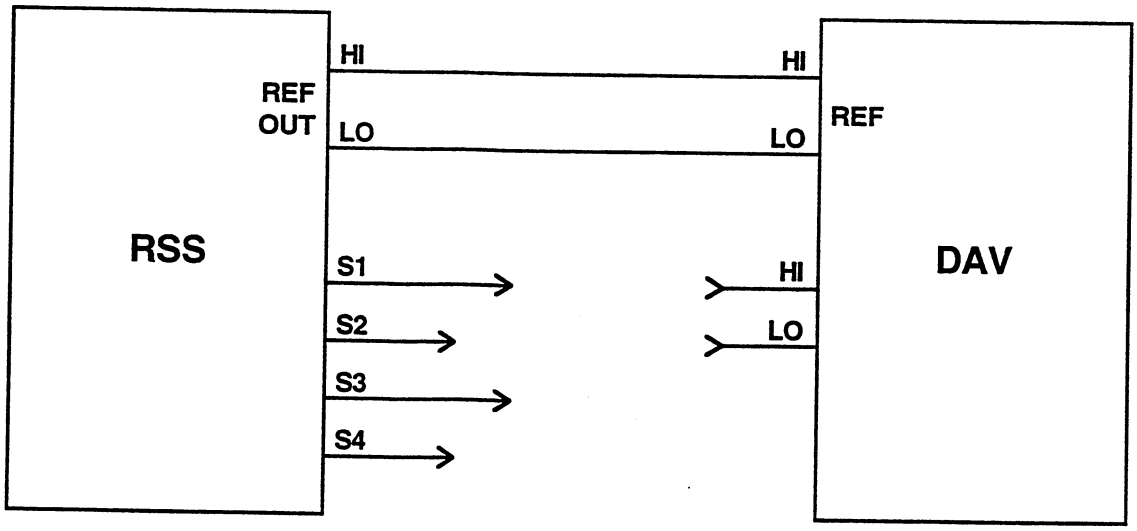


Figure 5-4. Test Setup, Phase Offset Tests

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
34. Connect S1 of RSS to LO SIG terminal of DAV. Connect S3 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between 44.5°[40°] and 45.5°[50°].			
35. Set RSS phase offset to 90.			
36. Check that angle displayed on DAV is between 89.5°[85°] and 90.5°[95°].			
37. Connect S4 of RSS to LO SIG terminal of DAV. Connect S2 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between 89.5°[85°] and 90.5°[95°].			
38. Set RSS phase offset to 135.			
39. Check that angle displayed on DAV is between 134.5°[130°] and 135.5°[140°].			
40. Connect S1 of RSS to LO SIG terminal of DAV. Connect S3 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between 134.5°[130°] and 135.5°[140°].			
41. Set RSS phase offset to 180.			
42. Check that angle displayed on DAV is between 179.5°[175°] and -179.5°[-175°].			
43. Connect S4 of RSS to LO SIG terminal of DAV. Connect S2 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between 179.5°[175°] and -179.5°[-175°].			
44. Set RSS phase offset to -45°.			
45. Check that angle displayed on DAV is between -44.5°[-40°] and -44.5°[-50°].			
46. Connect S1 of RSS to LO SIG terminal of DAV. Connect S3 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between -44.5°[-40°] and -45.5°[-50°].			
47. Set RSS phase offset to -90°.			
48. Check that angle displayed on DAV is between -90.5°[-95°] and -89.5°[-85°].			
49. Connect S4 of RSS to LO SIG terminal of DAV. Connect S2 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between -90.5°[-95°] and -89.5°[-85°].			
50. Set RSS phase offset to -135°.			
51. Check that angle displayed on DAV is between -134.5° and -135.5°.			
52. Connect S1 of RSS to LO SIG terminal of DAV. Connect S3 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between -134.5° and -135.5°.			

Table 5-3. Performance Test

(Cont'd.)

ACTION	MAIN DISPLAY	VOLTAGE DISPLAY	NOTES
53. Set RSS to 26 V_{REF}, 26 V_{L-L}, 45°, 10 KHZ, RSS, INT REF.	*RES* *45.0000 DEG* *INT REF*	*26.0 V_{L-L}* *10 KHZ*	
54. Check that angle displayed on DAV is between 310° and 320°. 55. Connect S4 of RSS to LO SIG terminal of DAV. Connect S2 of RSS to HI SIG terminal of DAV and check that angle displayed on DAV is between 310° and 320°. 56. Repeat steps 29 through 49, substituting data within brackets. 57. With power off, see figure 5-5 and connect test equipment as shown. Begin DC offset tests.			
58. Turn power on and set RSS to 27 V_{L-L}, 0 V_{REF}, 0°, 400 HZ, INT REF.	*RES* *0.0000 DEG* *INT REF*	*27 V_{L-L}* *400 Hz*	
59. Connect digital multimeter (DMM) HI and LO inputs to RSS REF OUT HI and LO terminals, respectively, and check that DMM reading is between -5 mV and +5 mV. 60. Connect DMM HI and LO inputs to RSS S3 and S1 terminals, respectively, and check that DMM reading is between -5 mV and + 5 mV.			
61. Set RSS to 90°.	*RES* *90.0000 DEG* *INT REF*		
62. Connect DMM HI and LO inputs to RSS S2 and S4 terminals, respectively, and check that DMM reading is between -5 mV and + 5 mV.			

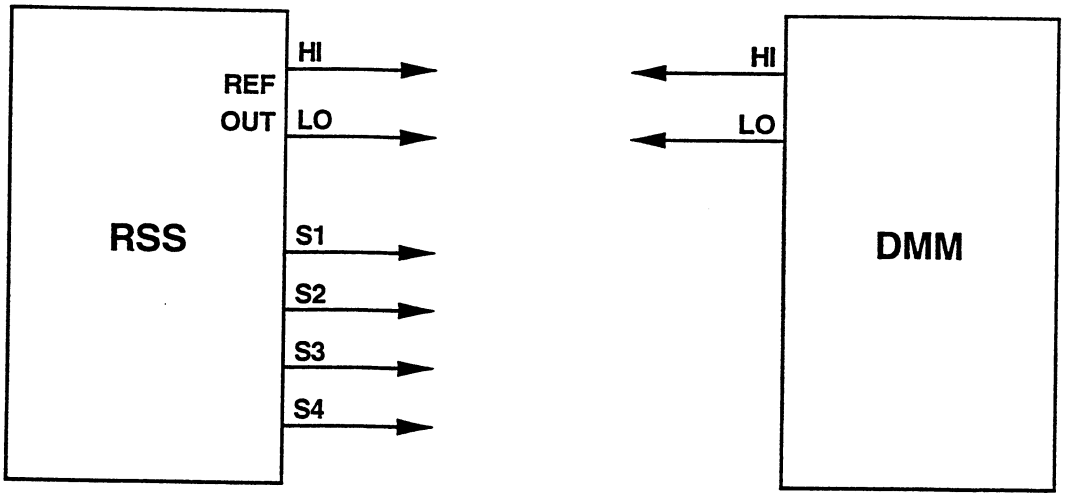


Figure 5-5. Test Setup, DC Offset Tests

Table 5-3. Performance Test

(Cont'd.)

Part 3. Accuracy Tests

1. With power off, see figure 5-6A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

   Note: If an overload occurs during the following tests, wait approximately 5 seconds before resetting the L-L voltage.

2. Turn power on and set RSS to 47 Hz, 115 V_{REF}, 90 V_{L-L}, INT REF, and SYN mode.

   Note: Calibration (CAL) is not permitted during an overload condition (OVLD and 0.0 V_{L-L} displayed) or if the line-to-line voltage is set to zero.

3. Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.

   Note: Steps 4 through 7 configure the DAV to read voltages that are in-phase with the reference.

4. If setup is fig 5-6A or C then set ratio box to 0.000000 else set ratio box to 1.000000.

5. Set RSS to 60°.

6. Press PHASE ANGLE push button on DAV.

7. Press PHASE OFFSET and ENTER push buttons on DAV.

8. Set RSS angle and ratio box setting to first value specified in following table for applicable test set-up.

9. Compare DAV in-phase reading to values listed in Test Limits column of table.

10. Repeat steps 8 and 9 for other angles listed under Test Set-Up.

11. With power off, see figure 5-6B and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

12. Repeat steps 2 - 10.

13. With power off, see figure 5-6C and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

14. Repeat steps 2 - 10.

15. Press CLEAR VAR push button on DAV.

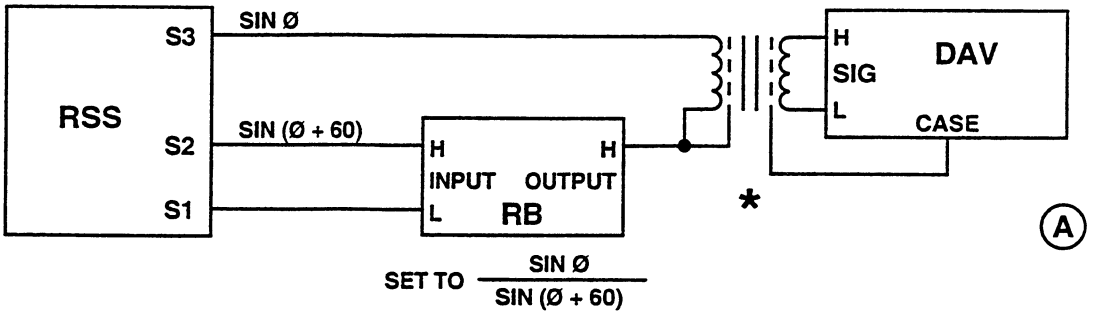
Table 5-3. Performance Test

(Cont'd.)

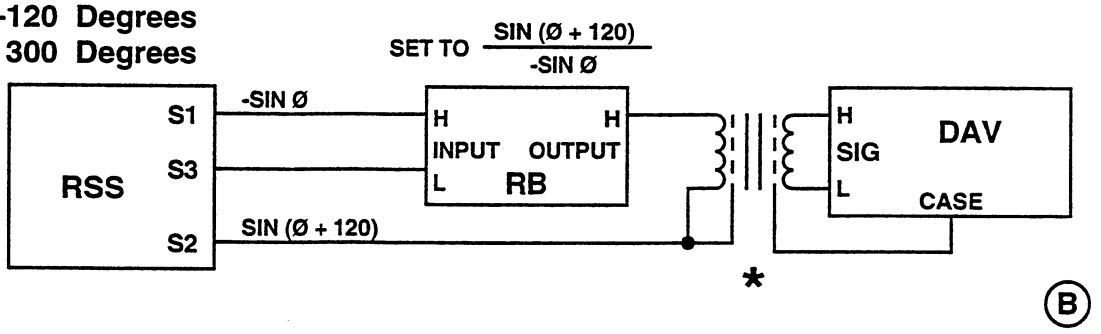
	TEST SET-UP	ANGLE	RATIO BOX SETTING	TEST LIMITS	DATA
47 HZ 115 V_{REF} 90 V_{L-L} INT REF SYN MODE	Figure 5-6A	0°	0.0000000	±1309 μV	
		22.5°	0.3859856	±1143 μV	
		45°	0.7320508	±1174 μV	
		202.5°	0.3859856	±1143 μV	
		225°	0.7320508	±1174 μV	
	Figure 5-6B	67.5°	0.1412805	±1227 μV	
		90°	0.5000000	±1134 μV	
		112.5°	0.8587195	±1227 μV	
		247.5°	0.1412805	±1227 μV	
		270°	0.5000000	±1134 μV	
		292.5°	0.8587195	±1227 μV	
	Figure 5-6C	135°	0.7320508	±1174 μV	
		157.5°	0.3859856	±1143 μV	
		180°	0.0000000	±1309 μV	
		315°	0.7320508	±1174 μV	
		337.5°	0.3859856	±1143 μV	

Note: If different angles are used, see figure 5-6 for test equipment set-up and formulas to calculate new ratio box settings. See figure 5-7 and calculate new test limits. If different frequencies are used (≥ 1 KHz), perform procedure in paragraph 5.7.2 to determine if bridging transformer is required in set-up. Perform steps 3 - 7 after changing angles and/or frequency to configure RSS and DAV.

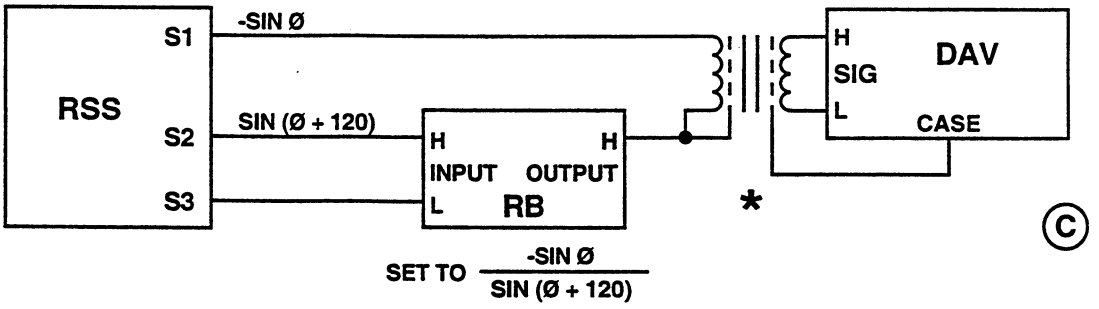
0 - 60 Degrees
180 - 240 Degrees



60 -120 Degrees
240 - 300 Degrees



120 - 180 Degrees
300 - 360 Degrees



*** BRIDGING TRANSFORMER AND CASE CONNECTION REQUIRED FOR FREQUENCIES ≥ 1 kHz IF COMMON MODE REJECTION IS NOT ADEQUATE FOR THIS MEASUREMENT. REFER TO PARAGRAPH 5.7.2 FOR PROCEDURE TO MAKE THIS DETERMINATION.**

Figure 5-6. Test Setup, Synchro Tests

$$\text{DAV TOLERABLE ERROR } (\mu V) = \left| \frac{\text{SIN } (\phi) \times \text{COS } (30)}{\text{SIN } (120 - \theta)} \right| \times 10^6 \times V_{L\text{-}L} \left\{ \begin{array}{c} 0 \le \theta \le 60 \\ 180 \le \theta \le 240 \end{array} \right\}$$

$$= \left| \frac{\text{SIN } (\phi) \times \text{COS } (30)}{\text{SIN } (\theta)} \right| \times 10^6 \times V_{L\text{-}L} \left\{ \begin{array}{c} 60 \le \theta \le 120 \\ 240 \le \theta \le 300 \end{array} \right\}$$

$$= \left| \frac{\text{SIN } (\phi) \times \text{COS } (30)}{\text{SIN } (60 - \theta)} \right| \times 10^6 \times V_{L\text{-}L} \left\{ \begin{array}{c} 120 \le \theta \le 180 \\ 300 \le \theta \le 360 \end{array} \right\}$$

θ = STATIC ANGLE (DEGREES)
ϕ = TOLERABLE ERROR (DEGREES)

Figure 5-7. Synchro Equations (A)

Table 5-3. Performance Test

(Cont'd.)

16. With power off, see figure 5-6A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

17. Turn power on and set RSS to 400 Hz, 26 V_{REF}, 11.8 V_{L-L}, INT REF, and SYN mode.

18. Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.

    Note: Steps 19 through 22 configure the DAV to read voltages that are in-phase with the reference.

19. Set ratio box to 0°.

20. Set RSS to 60°.

21. Press PHASE ANGLE push button on DAV.

22. Press PHASE OFFSET and ENTER push buttons on DAV.

23. Set RSS angle and ratio box setting to first value specified in following table for applicable test set-up.

24. Compare In-Phase reading of DAV to values listed in Test Limits column of table.

25. Repeat step 23 and 24 for other angles listed under Test Set-Up.

26. With power off, see figure 5-6B and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

27. Repeat steps 17 - 25.

28. With power off, see figure 5-6C and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).

29. Repeat steps 17 - 25.

30. Press CLEAR VAR push button on DAV.

Table 5-3. Performance Test

(Cont'd.)

	TEST SET-UP	ANGLE	RATIO BOX SETTING	TEST LIMITS	DATA
400 HZ 26 V_{REF} 11.8 V_{L-L} INT REF SYN MODE	Figure 5-6A	0°	0.0000000	±114 μV	
		22.5°	0.3859856	±100 μV	
		45°	0.7320508	±103 μV	
		202.5°	0.3859856	±100 μV	
		225°	0.7320508	±103 μV	
	Figure 5-6B	67.5°	0.1412805	±107 μV	
		90°	0.5000000	±99 μV	
		112.5°	0.8587195	±107 μV	
		247.5°	0.1412805	±107 μV	
		270°	0.5000000	±99 μV	
		292.5°	0.8587195	±107 μV	
	Figure 5-6C	135°	0.7320508	±103 μV	
		157.5°	0.3859856	±100 μV	
		180°	0.0000000	±114 μV	
		315°	0.7320508	±103 μV	
		337.5°	0.3859856	±100 μV	

Note: If different angles are used, see figure 5-6 for test equipment set-up and formulas to calculate new ratio box settings. See figure 5-7 and calculate new test limits. If different frequencies are used (≥ 1 KHz), perform procedure in paragraph 5.7.2 to determine if bridging transformer is required in set-up. Perform steps 18 - 22 after changing angles and/or frequency to configure RSS and DAV.

Table 5-3. Performance Test

(Cont'd.)

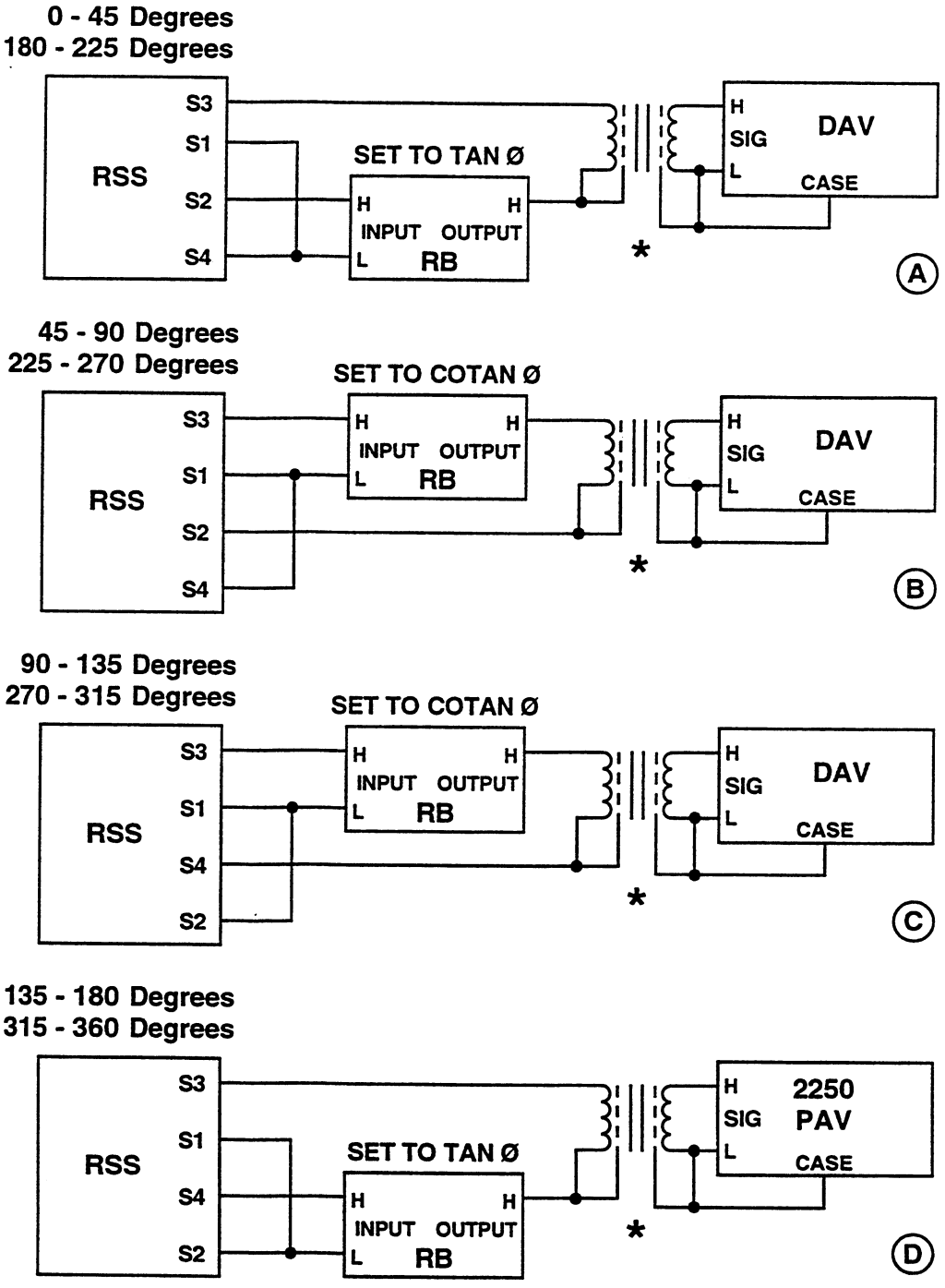
31.	With power off, see figure 5-8A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
32.	Turn power on and set RSS to 400 Hz, 26 V_{REF}, 26 V_{L-L}, INT REF, and RES mode.
33.	Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.
	Note: Steps 34 through 37 configure the DAV to read voltages that are in-phase with the reference.
34.	Set ratio box to 0°.
35.	Set RSS to 60°.
36.	Press PHASE ANGLE push button on DAV.
37.	Press PHASE OFFSET and ENTER push buttons on DAV.
38.	Set RSS angle and ratio box setting to first value specified in following table for applicable test set-up.
39.	Compare In-Phase reading of DAV to values listed in Test Limits column of table.
40.	Repeat steps 38 and 39 for other angles listed under Test Set-Up.
41.	With power off, see figure 5-8B and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
42.	Repeat steps 32 - 40.
43.	With power off, see figure 5-8C and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
44.	Repeat steps 32 - 40.
45.	With power off, see figure 5-8D and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
46.	Repeat steps 32 - 40.
47.	Press CLEAR VAR push button on DAV.

Table 5-3. Performance Test

(Cont'd.)

	TEST SET-UP	ANGLE	RATIO BOX SETTING	TEST LIMITS	DATA
400 HZ 26 V_{REF} 26 V_{L-L} INT REF RES MODE	Figure 5-8A	0°	0.0000000	±252 μV	
		22.5°	0.4142136	±273 μV	
		180°	0.0000000	±252 μV	
		202.5°	0.4142136	±273 μV	
	Figure 5-8B	45°	1.0000000	±357 μV	
		67.5°	0.4142136	±273 μV	
		225°	1.0000000	±357 μV	
		247.5°	0.4142136	±273 μV	
	Figure 5-8C	90°	0.0000000	±252 μV	
		112.5°	0.4142136	±273 μV	
		270°	0.0000000	±252 μV	
		292.5°	0.4142136	±273 μV	
	Figure 5-8D	135°	1.0000000	±357 μV	
		157.5°	0.4142136	±273 μV	
		315°	1.0000000	±357 μV	
		337.5°	0.4142136	±273 μV	

Note: If different angles are used, see figure 5-8 for test equipment set-up and formulas to calculate new ratio box settings. See figure 5-9 and calculate new test limits. If different frequencies are used (≥ 1 KHz), perform procedure in paragraph 5.7.2 to determine if bridging transformer is required in set-up. Perform steps 33 - 37 after changing angles and/or frequency to configure RSS and DAV.



* BRIDGING TRANSFORMER AND CASE CONNECTION REQUIRED FOR FREQUENCIES ≥ 1 KHz IF COMMON MODE REJECTION IS NOT ADEQUATE FOR MEASUREMENT. REFER TO PARAGRAPH 5.7.2 FOR PROCEDURE TO MAKE THIS DETERMINATION.

Figure 5-8. Test Setup for Resolver

$$\text{DAV TOLERABLE ERROR } (\mu V) = \left\{ \begin{array}{l} \pm 10^6 \times \left| \dfrac{\text{SIN } (\phi)}{\text{COS } (\theta)} \right| \times V_{L\text{-}L} \left\{ \begin{array}{l} -45^\circ \le \theta \le 45^\circ \\ 135^\circ \le \theta \le 225^\circ \end{array} \right\} \\ \\ \pm 10^6 \times \left| \dfrac{\text{SIN } (\phi)}{\text{SIN } (\theta)} \right| \times V_{L\text{-}L} \left\{ \begin{array}{l} 45^\circ \le \theta \le 135^\circ \\ 225^\circ \le \theta \le 315^\circ \end{array} \right\} \end{array} \right\}$$

WHERE:

θ = STATIC ANGLE (DEGREES)

ϕ = TOLERABLE ERROR (DEGREES)

Figure 5-9. Resolver Equations (A)

Table 5-3. Performance Test

(Cont'd.)

48.	With power off, see figure 5-8A and connect RSS to test equipment. See paragraph 5.7.2 and perform procedure to determine if bridging transformer is required.
49.	Turn power on and set RSS to 10 KHz, 26 V_{REF}, 11.8 V_{L-L}, INT REF, and RES mode.
50.	Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.
	Note: Steps 51 through 54 configure the DAV to read voltages that are in-phase with the reference.
51.	Set ratio box to 0°.
52.	Set RSS to 60°.
53.	Press PHASE ANGLE push button on DAV.
54.	Press PHASE OFFSET and ENTER push buttons on DAV.
55.	Set RSS angle and ratio box setting to first value specified in following table for applicable test set-up.
56.	Compare In-Phase reading of DAV to values listed in Test Limits column of table.
57.	Repeat steps 55 and 56 for other angles listed under Test Set-Up.
58.	With power off, see figure 5-8B and connect RSS to test equipment. Use bridging transformer if required - step 48).
59.	Repeat steps 49 - 57.
60.	With power off, see figure 5-8C and connect RSS to test equipment. Use bridging transformer if required - step 48).
61.	Repeat steps 49 - 57.
62.	With power off, see figure 5-8D and connect RSS to test equipment. Use bridging transformer if required - step 48).
63.	Repeat steps 49 - 57.
64.	Press CLEAR VAR push button on DAV.

Table 5-3. Performance Test

(Cont'd.)

	TEST SET-UP	ANGLE	RATIO BOX SETTING	TEST LIMITS	DATA
10 KHZ 26 V_{REF} 11.8 V_{L-L} INT REF RES MODE	Figure 5-8A	0°	0.0000000	±858 μV	
		22.5°	0.4142136	±929 μV	
		180°	0.0000000	±858 μV	
		202.5°	0.4142136	±929 μV	
	Figure 5-8B	45°	1.0000000	±1214 μV	
		67.5°	0.4142136	±929 μV	
		225°	1.0000000	±1214 μV	
		247.5°	0.4142136	±1214 μV	
	Figure 5-8C	90°	0.0000000	±858 μV	
		112.5°	0.4142136	±929 μV	
		270°	0.0000000	±858 μV	
		292.5°	0.4142136	±929 μV	
	Figure 5-8D	135°	1.0000000	±1214 μV	
		157.5°	0.4142136	±929 μV	
		315°	1.0000000	±1214 μV	
		337.5°	0.4142136	±929 μV	

Note: If different angles are used, see figure 5-8 for test equipment set-up and formulas to calculate new ratio box settings. See figure 5-9 and calculate new test limits. If different frequencies are used (≥ 1 KHz), see paragraph 5.7.2 and perform procedure to determine if bridging transformer is required in set-up. Perform steps 50 - 54 after changing angles and/or frequency to configure RSS and DAV.

Table 5-3. Performance Test

(Cont'd.)

Part 4. Accuracy Tests if Ratio Box not available	
1.	With power off, see figure 5-10A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
2.	Turn power on and set RSS to 47 Hz, 115 V_{REF}, 90 V_{L-L}, INT REF, and SYN mode.
3.	Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.
4.	Set RSS angle to first angle listed in following table for applicable test set-up.
5.	Compare In-Phase reading of DAV to value listed in applicable Test Limits column of table.
6.	Set RSS angle to second angle listed in following table for applicable test set-up and repeat step 5.
7.	With power off, see figure 5-10B and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
8.	Repeat steps 2 - 6.
9.	With power off, see figure 5-10 C and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
10.	Repeat steps 2 - 6.
11.	With power off, see figure 5-10A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
12.	Turn power on and set RSS to 400 Hz, 26 V_{REF}, 11.8 V_{L-L}, INT REF, and SYN mode.
13.	Repeat steps 3 - 6.
14.	Connect RSS to figure 5-10B and repeat steps 3 - 6.
15.	Connect RSS to figure 5-10C and repeat steps 3 - 6.

Table 5-3. Performance Test

(Cont'd.)

	TEST SET-UP	ANGLE	TEST LIMITS	DATA
47 HZ 115 V_{REF} 90 V_{L-L} INT REF SYN MODE	Figure 5-10A	0°	±1309 μV	
		180°	±1309 μV	
	Figure 5-10B	120°	±1309 μV	
		300°	±1309 μV	
	Figure 5-10C	60°	±1309 μV	
		240°	±1309 μV	
400 HZ 26 V_{REF} 11.8 V_{L-L} INT REF SYN MODE	Figure 5-10A	0°	±114 μV	
		180°	±114 μV	
	Figure 5-10B	120°	±114 μV	
		300°	±114 μV	
	Figure 5-10C	60°	±114 μV	
		240°	±114 μV	

Note: If different angles are used, see figure 5-11 and calculate new test limits.

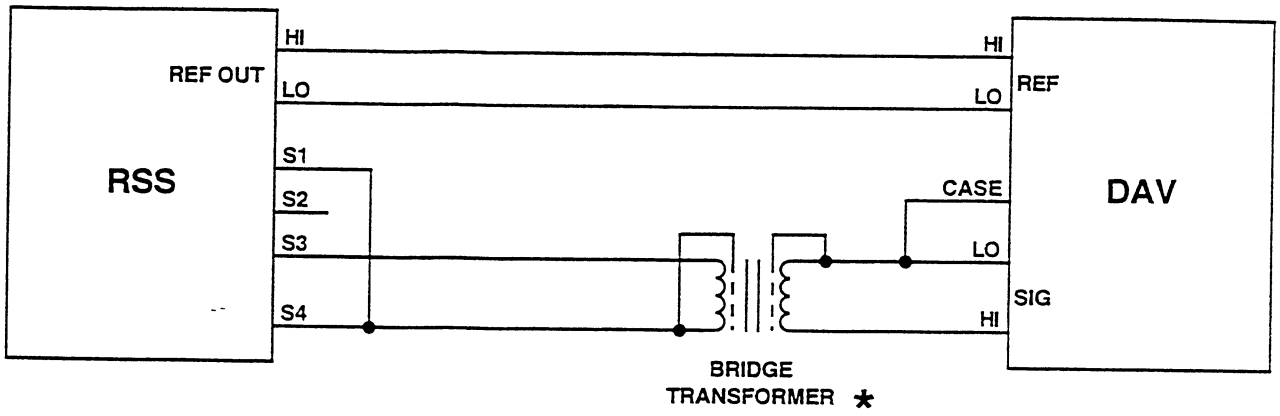


FIG 5-10A Resolver & Synchro 0° & 180°

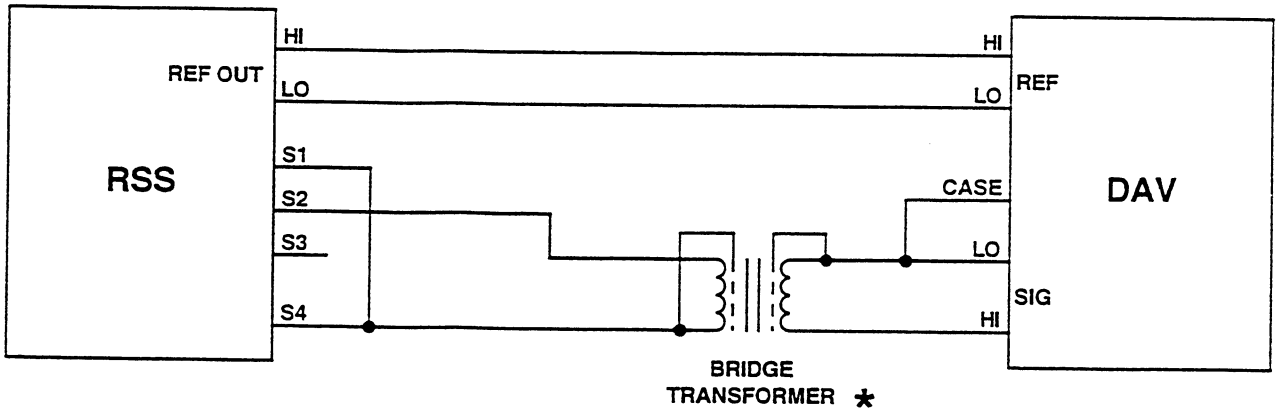


FIG 5-10B Resolver 90° & 270°
Synchro 120° & 300°

* BRIDGING TRANSFORMER AND CASE CONNECTION REQUIRED FOR FREQUENCIES ≥ 1 KHz IF COMMON MODE REJECTION IS NOT ADEQUATE FOR MEASUREMENT. REFER TO PARAGRAPH 5.7.2 FOR PROCEDURE TO MAKE THIS DETERMINATION.

Figure 5-10. Test Setup, Static Angular Tests (Sheet 1 of 2)

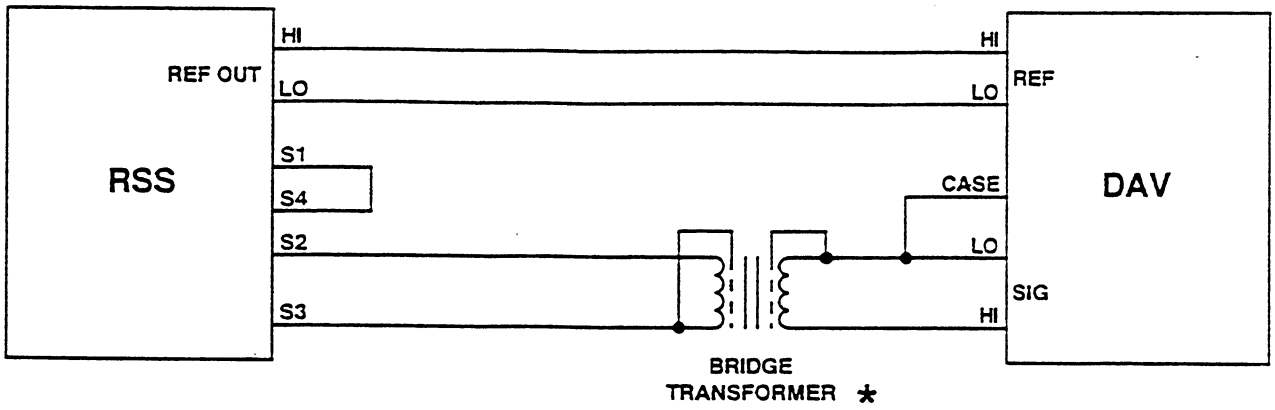


FIG 5-10C Resolver 45° & 225°
Synchro 60° & 240°

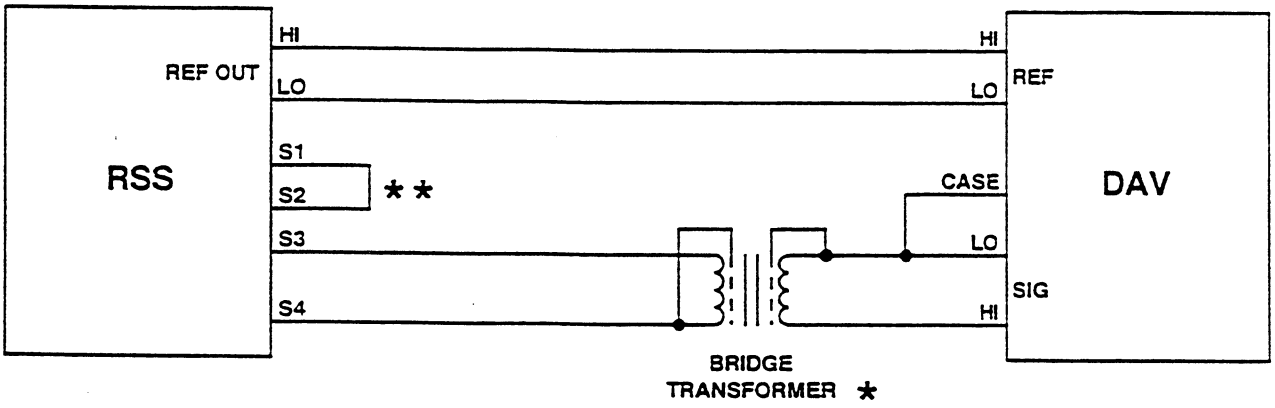


FIG 5-10D Resolver Only 135° & 315°

* BRIDGING TRANSFORMER AND CASE CONNECTION REQUIRED FOR FREQUENCIES ≥ 1 KHz IF COMMON MODE REJECTION IS NOT ADEQUATE FOR MEASUREMENT. REFER TO PARAGRAPH 5.7.2 FOR PROCEDURE TO MAKE THIS DETERMINATION.

* * DO NOT CONNECT SHORTING JUMPER BETWEEN S1 & S2 IN SYNCHRO MODE.

Figure 5-10. Test Setup, Static Angular Tests (Sheet 2 of 2)

Table 5-3. Performance Test

(Cont'd.)

16.	With power off, see figure 5-10A and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
17.	Turn power on and set RSS to 400 Hz, 26 V_{REF}, 26 V_{L-L}, INT REF, and RES mode.
18.	Press CAL push button. Wait for calibration to complete (approximately 12 seconds) before proceeding.
19.	Set RSS angle to first angle listed in following table for applicable test set-up.
20.	Compare DAV In-Phase reading to value listed in applicable Test Limits column of table.
21.	Set RSS angle to second angle listed in following table for applicable test set-up and repeat step 18.
22.	See figure 5-10B and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
23.	Repeat steps 18 - 21.
24.	See figure 5-10C and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
25.	Repeat steps 18 - 21.
26.	See figure 5-10D and connect RSS to test equipment (bridging transformer not required; connect RSS and ratio box outputs directly to DAV).
27.	Repeat steps 18 - 21.
28.	With power off, see figure 5-10A and connect RSS to test equipment. See paragraph 5.7.2 and perform procedure to determine if bridging transformer is required.
29.	Turn power on and set RSS to 10 KHz, 26 V_{REF}, 11.8 V_{L-L}, INT REF, and RES mode.
30.	Repeat steps 18 - 27. Disregard note concerning bridging transformer if transformer is required - step 26.

Table 5-3. Performance Test

(Cont'd.)

	TEST SET-UP	ANGLE	TEST LIMITS	DATA
400 HZ 26 V_{REF} 26 V_{L-L} INT REF RES MODE	Figure 5-10A	0°	±252 μV	
		180°	±252 μV	
	Figure 5-10B	90°	±252 μV	
		270°	±252 μV	
	Figure 5-10C	45°	±359 μV	
		225°	±359 μV	
	Figure 5-10D	135°	±359 μV	
		315°	±359 μV	
10 KHZ 26 V_{REF} 11.8 V_{L-L} INT REF RES MODE		0°	±858 μV	
	Figure 5-10A	180°	±858 μV	
	Figure 5-10B	90°	±858 μV	
		270°	±858 μV	
	Figure 5-10C	45°	±1221 μV	
		225°	±1221 μV	
	Figure 5-10D	135°	±1221 μV	
		315°	±1221 μV	

Note: If different angles are used, see figure 5-12 and calculate new test limits.

SYNCHRO:

1) 0°, 120°, 180° & 300°

$$\beta\ (\mu V) = \pm 17{,}460 \times V_{L\text{-}L} \times \text{SPECIFICATION ANGULAR ACCURACY (DEGREES)}$$

2) 60° & 240°

$$\beta\ (\mu V) = \pm 17{,}460 \times V_{L\text{-}L} \times \text{SPECIFICATION ANGULAR ACCURACY (DEGREES)}$$

β = TOLERABLE IN-PHASE VOLTAGE MEASUREMENT

Figure 5-11. Synchro Equations

RESOLVER:

1) 0°, 90°, 180° & 270°

$$\beta\ (\mu V) = \pm 17{,}460 \times V_{L\text{-}L} \times \text{SPECIFICATION ANGULAR ACCURACY (DEGREES)}$$

2) 45°, 135°, 225° & 315°

$$\beta\ (\mu V) = \pm 24{,}840 \times V_{L\text{-}L} \times \text{SPECIFICATION ANGULAR ACCURACY (DEGREES)}$$

Figure 5-12. Resolver Equations

5.7.2 COMMON MODE REJECTION MEASUREMENTS

To determine if a bridging transformer is required for the test set-ups, perform the following procedure to measure the common mode rejection of the DAV:

1. Apply a signal between REF HI and LO/GUARD terminals of the DAV having amplitude and frequency characteristics equal to the line-to-line voltage and frequency of measurement specified in the RSS set-up.

2. Short-circuit the DAV SIG HI and LO/GUARD terminals with a test lead.

3. Apply same signal as in step 1 between SIG HI and CASE terminals.

4. Record in-phase and quadrature voltages displayed on 20 mV and 200 mV ranges of DAV, respectively.

5. Compute in-phase voltage using following formula: In-phase voltage = 0.2 x RSS tolerable error (See figure 5-7 or figure 5-9).

6. Compute quadrature voltage using following formula:

Quadrature voltage = 4 x RSS tolerable error (See figure 5-7 or figure 5-9).

7. Compare computed data with applicable data recorded in step 4. Use bridging transformer in test set-ups if measured data exceeds computed data.

Section III. Fault Isolation

5.8 SCOPE OF SECTION III

Table 5-4 lists fault isolation procedures for the RSS and shall be used whenever the Performance Test cannot be run, or a suspected or known failure of the RSS occurs.

IMPORTANT - READ FIRST!

Perform fault isolation in the sequence given in table 5-4 because certain conclusions are made based on previous actions and observations. Work from beginning to end of table and acknowledge or disregard each malfunction listed. Malfunctions that cannot be resolved using the suggested procedures, and any problem not covered in this table should be referred to depot or NAI factory service.

Fault Isolation for the RSS is based on an intermediate maintenance philosophy that assumes that only one failure has occurred, and that the failure can be repaired by replacement of chassis mounted SRA's or certain IC's on the system board assembly.

The table is divided into three columns. The MALFUNCTION column lists symptoms that a failure may exhibit. The PROBABLE CAUSE column recommends the most probable SRA or IC that may be causing the failure. In the case of multiple causes, the most probable cause is listed first followed by the next most probable, etc. The CORRECTIVE ACTION column refers the maintenance technician to table 5-5, Error Codes, a removal/replacement procedure in Section IV, or a test or adjustment procedure in Section V. See table 5-7 if test equipment is specified.

WARNING - DANGEROUS VOLTAGE!

DANGEROUS VOLTAGES ARE PRESENT WITHIN THE RSS. BE CAREFUL WHEN WORKING AROUND HIGH-VOLTAGE CIRCUITS. TO PREVENT ELECTRICAL SHOCK, DO NOT TOUCH THE CHASSIS WITH ANY PART OF YOUR BODY. DO NOT PERFORM THESE PROCEDURES ALONE. MAKE CERTAIN SOMEONE IS AVAILABLE TO GIVE YOU ASSISTANCE OR CALL FOR HELP.

CAUTION

THIS EQUIPMENT IS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALWAYS USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING EQUIPMENT.

Table 5-4. Fault Isolation

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1. No response from RSS when power switch turned on (both displays dark, fan not working, etc.)	1. Power cord plug pulled out of RSS power entry module connector	Connect power cord plug to RSS power entry module connector
	2. RSS not connected to power source	Connect RSS to ac power source
2. RSS power entry module fuse blows when power turned on	1. Voltage select switch on power entry module incorrectly set	Check that voltage select switch on power entry module is correctly set (paragraph 2.4)
	2. Main power supply assembly A4 input rectifier shorted	Replace main power supply assembly A4 (paragraph 5.11.9).
	3. Fan assembly shorted internally or to chassis	Unplug fan connector from harness and check that resistance between fan connector pins is greater than 200 ohms, and that resistance from each pin to chassis is greater than 10 megohms. Replace fan (paragraph 5.11.13) if resistance in either check is out of range.
	4. Main power transformer T1 shorted	Unplug main transformer T1 connector P2 from main power supply assembly and check resistance of all transformer pins to chassis. Replace main transformer T1 (paragraph 5.11.10) if resistance is less than 10 megohms.
	5. Varistor shorted on Power entry module assembly	Replace power entry module assembly (paragraph 5.11.11)

Table 5-4. Fault Isolation

(Cont'd.)

	MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
3.	Status of main power supply not determined. You must verify before proceeding to next step in table.	-	Perform power supply checks (paragraph 5.14.3, 5.14.4).
4.	No outputs from main power supply	Main power transformer T1	Replace T1 (paragraph 5.11.10)
5.	One or more outputs missing or out of range from main power supply	Main power supply	Replace main power supply assembly A4 (paragraph 5.11.9)
6.	No outputs from either isolated power supply	1. Isolated power transformer T2	Replace T2 (paragraph 5.11.8)
		2. Main power supply	Replace main power supply assembly A4 (paragraph 5.11.9)
7.	One or more outputs missing or out of range from isolated power supply	Isolated power supply	Replace isolated power supply assembly (paragraph 5.11.6)
8.	Fan running but no response from RSS (both displays dark).	1. Microprocessor chip on system board A1	Replace U34 on system board A1 (paragraph 5.11.15)
		2. EPROM chips on system board A1	Replace U21, U22 on system board A1 (paragraph 5.11.15)
		3. System board A1	Replace system board A1 (paragraph 5.11.12)
9.	All or some indicators (except °/S, DEG, and Hz) on main display panel fail performance test	1. Display FPGA chip on system board A1	Replace U29 on system board A1 (paragraph 5.11.15)
		2. Drivers Q1 - Q4 on Display assembly A5	Replace display assembly A5 (paragraph 5.11.7)
		3. System board A1	Replace system board A1 (paragraph 5.11.12).

Table 5-4. Fault Isolation

(Cont'd.)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
10. All or some indicators on voltage numerical display (or °/S, DEG, or Hz indicator on main display panel) fail performance test	1. Display FPGA chip on system board A1	Replace U48 on system board A1 (paragraph 5.11.15)
	2. Drivers Q5 - Q8 on display assembly A5	Replace display assembly A5 (paragraph 5.11.7)
	3. System board A1	Replace system board A1 (paragraph 5.11.12).
11. Individual indicator fails performance test	1. Defective indicator	Replace display assembly A5 (paragraph 5.11.7)
	2. System board A1	Replace system board A1 (paragraph 5.11.12).
12. Unable to enter data via multiple keyboard switches as specified in performance test.	1. FPGA chip on system board A1	Replace U28 on system board A1 (paragraph 5.11.15)
	2. System board A1	Replace system board A1 (paragraph 5.11.12).
13. Individual switch fails performance test	Defective switch	Replace display assembly A5 (paragraph 5.11.7)
14. Optical encoder on display assembly A5 fails performance test	1. Defective optical encoder on display assembly A5	Replace display assembly A5 (paragraph 5.11.7)
	2. FPGA chip on system board A1	Replace U28 on system board A1 (paragraph 5.11.15)
	3. System board A1	Replace system board A1 (paragraph 5.11.12).
15. IEEE Interface check fails performance test	1. Interface cable not connected to RSS rear panel.	Check that interface cable is connected to RSS rear panel connector J23.
	2. Interface cable connector pins damaged	Repair or replace interface cable
	3. System board A1	Replace system board A1 (paragraph 5.11.12).

Table 5-4. Fault Isolation

(Cont'd.)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
SETUP	**SETUP**	**SETUP**
16. Set up (Chapter 3, section I.) RSS for 11.8 V_{L-L}, 45°, 400 Hz, RES, INT mode. Check output for following:	-	-
17. No output on REF OUTPUT or S1 - S4 front panel binding posts.	1. Analog board A3	Replace analog board (paragraph 5.11.5)
	2. System board A1	Replace system board (paragraph 5.11.12)
18. Output good on REF OUTPUT and S1, S3 binding posts but bad for S2, S4	1. Sine/cosine board A2	With oscilloscope, check U70-3 on sine/cosine board for 4.0 V_{P-P} sine waveform. If present, replace sine/cosine board (paragraph 5.11.4). If waveform missing, go to next probable cause.
	2. Iso/tapped transformer T3	Replace iso/tapped transformer T3 (paragraph 5.11.3)
	3. System board	Replace system board (paragraph 5.11.12)
19. Output good on REF OUTPUT and S2, S4 binding posts but bad for S1, S3	1. Sine/cosine board A2	With oscilloscope, check U68-3 on sine/cosine board for sine waveform. If present, replace sine/cosine board (paragraph 5.11.4). If waveform missing, go to next probable cause.
	2. Iso/tapped transformer T4	Replace iso/tapped transformer T4 (paragraph 5.11.3)
	3. System board	Replace system board (paragraph 5.11.12)

Table 5-4. Fault Isolation

(Cont'd.)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
SETUP 20. Setup for EXT mode and connect oscillator to RSS REF IN binding posts. Set oscillator for 5 V_{P-P}, 400 Hz sine wave. Check outputs for following:	**SETUP** -	**SETUP**
21. No output at S1, S3 and S2, S4 front panel binding posts. If outputs present, proceed to next step.	1. Analog board A3 2. System board A1	Replace analog board (paragraph 5.11.5) Replace system board (paragraph 5.11.12)
SETUP 22. Change oscillator output to 15 V_{P-P} and repeat step 21.	**SETUP** -	**SETUP** -
SETUP 23. Change oscillator output to 90 V_{P-P} and repeat step 21.	**SETUP** -	**SETUP** -
24. Error code displayed	-	See table 5-5, Error Codes, for maintenance recommendations.

5.9 ERROR CODE MESSAGES

The RSS tests its circuits during power-up, calibration, and remote modes. If an error is detected, an error code is shown in the RSS main display or sent over the interface. See table 5-5 for a description of error code messages and a recommended action or replacement SRA or integrated circuit chip (on the system board assembly).

Note

Error codes in the 100 to 400 range are not displayed by the RSS but sent over the interface to the remote PC. These errors are defined in IEEE specification 488.2, 11.5.1.1.4, 11.5.1.1.5, 11.5.1.1.6, and 11.5.1.1.7, 6.3, respectively.

Table 5-5. Error Codes

CODE	DESCRIPTION	PROBABLE CAUSE
100	Command Error	Syntax error was detected in RSS parser
109	Missing parameter.	Not enough parameters received for header
200	Execution error	Error detected by RSS execution control block
220	Parameter error	Program data element related error has occurred
221	Settings conflict	Program element could not be executed because of current RSS state
222	Data out of range	Value outside legal range of RSS
240	Hardware error	Program command or query could not be executed because of a hardware problem in RSS.
300	Device-specific error	Error occurred which is not a command, query, or execution.
310	System error	Perform fault isolation (table 5-4).
350	Queue overflow	An error occurred but could not be recorded because the queue was full.
400	Query error	Message exchange protocol problem.
420	Query undetermined	See IEEE-488.2, IEEE-488 6.3.2.2
500	Reference DSP PGM download error	U2, U28
501	Angle DSP PGM download error	U2, U28

Table 5-5. Error Codes

(Cont'd.)

CODE	DESCRIPTION	PROBABLE CAUSE
502	Reference DSP table download error	U4, U28
503	Angle DSP table download error	U2, U28
504	Error setting DSP mode	U2, U28
505	User disallowed for setting outputs for 15 seconds	Data re-entered too soon after overload
506	System bus error	U28
507	Error setting resolver mode	U2, U28
508	Error setting synchro mode	U2, U28
509	Error setting calibration factors	U2, U28
510	Error clearing modulation during calibration	U2, U28
511	Error setting static angle	U2, U28
512	Error connecting calibration circuits	1. Sine/cosine board 2. Analog board 3. System board
513	Initial suboptimum gain error	1. Sine/cosine board 2. Analog board 3. System board
514	Error setting calibration gain	1. Analog board 2. Sine/cosine board 3. System board
515	Error measuring voltage	1. Analog board 2. System board
516	Calibration factor 1 limit error	1. Analog board 2. Sine/cosine board 3. System board
517	Calibration factor 2 limit error	1. Analog board 2. Sine/cosine board 3. System board
518	Calibration factor 3 limit error	1. Analog board 2. Sine/cosine board 3. System board
519	Calibration AC signal error	1. Analog board 2. Sine/cosine board 3. System board

Table 5-5. Error Codes

(Cont'd.)

CODE	DESCRIPTION	PROBABLE CAUSE
520	Error disconnecting calibration circuits	1. Sine/cosine board 2. Analog board
521	RAM test failure	U28
522	ROM test failure	U28
523	EEPROM test failure	U28
524	Calibration factor 4 limit error	1. Analog board. 2. Sine/cosine board. 3. System board.
525	DSP angle query error	U2, U28
526	DSP data RAM test failure	U2, U28
527	Calibration disallowed - overload	-
528	Calibration disallowed - setup	-
529	Overload condition present	Perform fault isolation (table 5-4).
530	Internal overload failure	Perform fault isolation (table 5-4).
599	Undefined failure	Perform fault isolation (table 5-4).
FAILUrE	Hardware failure	Perform fault isolation (table 5-4).

Section IV. Corrective Maintenance

5.10 SCOPE OF SECTION IV

This section provides removal/replacement procedures for the RSS. Special tools are not necessary to perform the procedures of this section.

5.11 REMOVAL AND REPLACEMENT

Unless otherwise indicated, replacement procedures are the reverse of removal procedures. See figure 5-13 for SRA location.

WARNING - DANGEROUS VOLTAGE!

TURN FRONT PANEL SWITCH OFF AND UNPLUG LINE CORD BEFORE PERFORMING THE PROCEDURES LISTED IN THIS SECTION.

CAUTION

THIS EQUIPMENT IS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING EQUIPMENT.

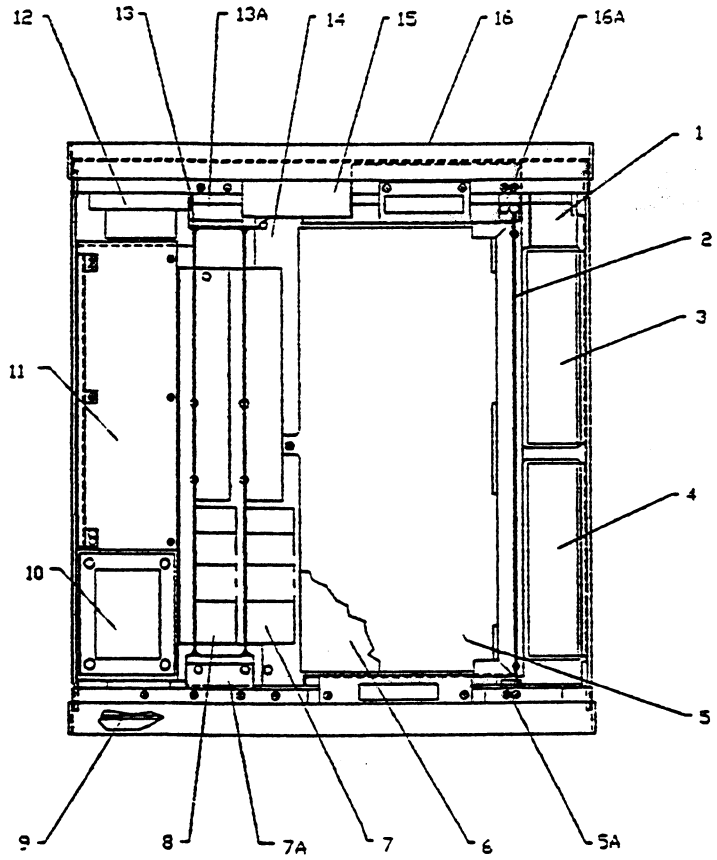


Figure 5-13. SRA Location

5.11.1 CALIBRATION BRIDGE TRANSFORMER ASSEMBLY

To replace the calibration bridge transformer assembly (1, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Unplug calibration bridge transformer assembly connector J1 on interconnect board assembly.

3. Remove rear panel (paragraph 5.11.10, steps 4 - 7) and pull away from chassis to allow removal of calibration bridge transformer assembly .

4. Remove four screws and lock washers securing calibration bridge transformer assembly to rear panel.

5.11.2 INTERCONNECT BOARD ASSEMBLY

To replace the interconnect board assembly (2, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove two screws securing card file to bottom of chassis.

4. Remove screw located in tab on sine/cosine board assembly.

5. Unplug connectors J1, J2, J3, J4, and J5 on interconnect board assembly .

6. Remove four screws securing card file to top of chassis and remove card file from chassis using ejectors on interconnect board.

7. Remove sine/cosine and analog board assemblies (paragraph 5.11.4, 5.11.5).

8. Remove eight screws securing interconnect board assembly to card file and remove interconnect board assembly from card file.

5.11.3 ISOLATION/TAPPED TRANSFORMER ASSEMBLY

To replace either isolation/tapped transformer assembly (3, 4, figure 5-13), perform the following (NOTE STEP 7):

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove six screws securing right side cover to chassis.

4. Unplug isolation/tapped transformer assembly connectors on interconnect board assembly.

5. Unplug Faston connector from sine/cosine board assembly.

6. Remove four screws securing isolation/tapped transformer assembly to chassis.

7. If isolation/tapped transformer T3 replaced, perform sine/cosine board and analog board adjustment procedures (paragraph 5.14.1 and 5.14.2, respectively). If T4 replaced, perform sine/cosine procedure only.

5.11.4 SINE/COSINE BOARD ASSEMBLY

To replace the sine/cosine board assembly (5, figure 5-13), perform the following:

1. Remove card file assembly, paragraph 5.11.2, steps 1 through 6.

2. Operate eject levers and remove sine/cosine board assembly from card file.

3. Install replacement sine/cosine board assembly. Perform sine/cosine board assembly

adjustment procedure (paragraph 5.14.1).

5.11.5. **ANALOG BOARD ASSEMBLY**

To replace the analog board assembly (6, figure 5-13), perform the following:

1. Remove card file assembly, paragraph 5.11.2, steps 1 through 6.

2. Operate eject levers and remove analog board assembly from card file.

3. Install replacement analog board assembly. Perform analog board assembly adjustment procedure (paragraph 5.14.2)

5.11.6 **ISOLATED POWER SUPPLY**

To replace an isolated power supply (7, 8, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Lift ejector tabs on isolated power supply and remove from system board assembly connector J4 or J5.

5.11.7 **DISPLAY/KEYBOARD ASSEMBLY**

To replace the display/keyboard assembly (9, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove screws (total 12) securing right and left side cover to chassis and remove covers.

4. Remove six screws on sides of front panel securing front panel to chassis.

5. Remove screws securing bottom flange of panel to chassis.

6. Remove four screws (5A, figure 5-13) securing card file guide bar from top and bottom of front panel.

7. Remove two screws (7A, figure 5-13) securing isolated power supply assembly guide bracket from top of rear panel.

8. Remove any wire retaining device as required and lay panel flat to gain access to display/keyboard assembly.

CAUTION

GRASP CONNECTOR, NOT RIBBON CABLE IN FOLLOWING STEP.

9. Unplug ribbon cable connectors from display/keyboard assembly.

10. Remove nine screws and washers securing display/keyboard assembly to front panel.

5.11.8 **ISOLATED POWER TRANSFORMER ASSEMBLY**

To replace the isolated power transformer assembly (10, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Unplug connectors J2 and J3 on system board assembly.

3. Unplug connector J4 on main power supply board assembly.

4. Cut ties securing harness on main power supply board assembly heat sink.

5. Remove four screws and lock washers securing isolated power transformer assembly to chassis.

5.11.9 **MAIN POWER SUPPLY BOARD ASSEMBLY**

To replace the main power supply board assembly (11, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove six screws securing left side cover

4. Remove six screws securing main power supply board assembly heat sink to side of chassis.

5. Cut two ties securing isolated power transformer assembly cable to power supply board assembly heat sink.

6. Remove isolated power supply A6 (8, figure 5-13) to facilitate performing next procedure.

CAUTION

GRASP CONNECTOR, NOT RIBBON CABLE IN FOLLOWING STEP.

6. Unplug ribbon connector J1 and connectors J2, J3, and J4 on main power supply board assembly.

7. Remove six screws and lock washers securing main power supply board assembly to chassis and remove main power supply board assembly .

8. Install replacement main power supply board assembly. Perform main power supply assembly adjustment procedure (paragraph 5.14.4).

5.11.10 MAIN TRANSFORMER ASSEMBLY

To replace the main transformer assembly (12, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove screws (total 12) securing right and left side cover to chassis and remove covers.

4. On right rear of RSS, remove two screws securing top of card file to rear panel.

5. Remove two screws (16A, figure 5-13) securing card file guide bar from top of rear panel.

6. Remove two screws (13A, figure 5-13) securing isolated power supply guide bracket from top of front panel.

7. Remove 11 screws securing rear panel to chassis.

8. Pull rear panel away from chassis to permit main transformer assembly removal.

9. Unplug connector J2 on main power supply board assembly.

10. Remove four nuts, lock washers and spacers securing main transformer assembly to rear panel.

5.11.11 POWER ENTRY MODULE ASSEMBLY

To replace the power entry module assembly (13, figure 5 -1), perform the following:

1. Remove card file with boards installed (paragraph 5-11.2, steps 1-6).

2. Remove isolated power supply assemblies (paragraph 5-11.6). Cut ties on harness going to front panel.

4. Tag and remove terminals on front panel on/off switch.

5. Unplug connector J3 on main power supply board assembly .

6. Unplug two-pin Molex connector from power entry module assembly to Fan assembly on rear panel.

7. Push in locking tabs on sides of power entry module assembly and remove power entry module assembly with attaching harness

assemblies from rear panel.

5.11.12 SYSTEM BOARD ASSEMBLY

To replace the system board assembly (14, figure 5-13), perform the following:

1. Remove card file with boards installed (paragraph 5.11.2, steps 1-6).

2. Remove isolated power supply assemblies (paragraph 5.11.6).

3. Unplug connectors J2 and J3 on system board assembly.

4. Unplug connector J1 from main power supply board assembly.

5. Tag and remove terminals on system board assembly terminal posts J12, 1-8.

6. Unplug connector J11 from TB1 on rear panel.

7. Remove hardware securing connectors J23 and J22 (if installed) on rear panel.

CAUTION

GRASP CONNECTOR, NOT RIBBON CABLE IN FOLLOWING STEP.

8. Unplug ribbon connectors J6 and J9 on system board assembly.

9. Remove four screws securing each support.

10. Remove 15 screws securing system board assembly to chassis.

5.11.13 FAN ASSEMBLY

To replace the fan assembly (15, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove rear panel assembly (paragraph 5.11.10, steps 4 - 7).

4. Unplug fan from harness connector.

5. Remove four screws and nuts securing fan, filter bracket, and filter to chassis.

Note

Clean filter element if necessary before reassembly (paragraph 5.5.2).

5.11.14 TERMINAL BLOCK

To replace the terminal block (16, figure 5-13), perform the following:

1. Remove six screws securing top cover to sides of chassis.

2. Remove six screws securing bottom cover to sides of chassis.

3. Remove four screws securing terminal block mounting plate to rear panel.

4. Pull terminal block away from rear panel to expose wiring to terminal block.

5. Tag wiring and remove solder attaching wiring to terminals.

6. Remove four threaded spacers securing terminal block to mounting plate.

5.11.15 SYSTEM BOARD INTEGRATED CIRCUIT REMOVAL/REPLACEMENT

The system board contains eight integrated circuit (IC) chips mounted in sockets. When removing or installing these chips, see table 5-6 to select the proper tool. IC location is shown in figure 6-2, Chapter 6. To access IC's on the system board assembly, remove six screws securing bottom cover to sides of chassis

and remove cover.

5.11.16 **EXTENDER FRAME ASSEMBLY INSTALLATION**

To install the extender frame assembly (not illustrated), perform the following:

1. Remove card file assembly (paragraph 5.11.2, steps 1 - 6).

2. Position extender frame such that connector faces outside RSS and carefully install extender frame assembly into system board connectors.

3. Attach extender frame assembly to chassis with three screws, lock washers, and flat washers.

4. Plug entire card file assembly with boards into extender frame assembly.

5. Connect wiring and connectors previously removed.

5.11.17 **FUSE REPLACEMENT**

1. Place on/off switch to off (O) position.

2. Disconnect line cord from RSS.

3. Using a flat screwdriver blade, pry open the fuse guard cover on power entry module to expose fuse.

4. Replace existing fuse with appropriate size fuse (115V = 2 A slo lo; 230V = 1 A slo-blo).

5 . Close fuse guard cover.

Table 5-6. IC Insertion/Extraction Tools

IC REFERENCE DESIGNATION	TOOL PART NO.
U2, U4	AMP/822253-2
U28, U29, U34, U48	MES/291
U21, U22	OK/Model EX-2

Section V. Testing and Adjustment

5.12 SCOPE OF SECTION V

This section provides test and adjustment procedures for the sine/cosine board assembly, analog board assembly, isolated power supply assemblies, and the main power supply board assembly. These procedures shall be used when installing a new assembly following a maintenance action, or whenever it is desired to verify the function of the assembly.

WARNING - DANGEROUS VOLTAGE!

DANGEROUS VOLTAGES ARE PRESENT WITHIN THE RSS. BE CAREFUL WHEN WORKING AROUND HIGH-VOLTAGE CIRCUITS. TO PREVENT ELECTRICAL SHOCK, DO NOT TOUCH THE CHASSIS WITH ANY PART OF YOUR BODY. DO NOT PERFORM THESE PROCEDURES ALONE. MAKE CERTAIN SOMEONE IS AVAILABLE TO GIVE YOU ASSISTANCE OR CALL FOR HELP.

CAUTION

THIS EQUIPMENT IS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALWAYS USE ESD PRECAUTIONARY PROCEDURES WHEN HANDLING EQUIPMENT.

5.13 TOOLS AND TEST EQUIPMENT

Table 5-7 lists the special material and test equipment required to perform the test and adjustment procedures in this section.

Note

Equivalent material and equipment is acceptable.

Table 5-7. Special Material and Test Equipment

DESCRIPTION	MANUFACTURER/MODEL	REF. PARAGRAPH
Digital analyzing voltmeter (DAV)	NAI - Model 2250	5.14.1, 5.14.2
Oscilloscope	Tektronix - Model 456	5.14.3, 5.14.4
Synchro/Resolver bridge	NAI - Model 540/11	5.14.1
Extender Frame Assembly	NAI - P/N 784014	5.14.2
Digital multimeter	Fluke - Model 8506	5.14.3, 5.14.4

5.14 TEST AND ADJUSTMENT PROCEDURES

Perform the following procedures to test and adjust the RSS shop replaceable assemblies (SRA).

Note

When set-up is specified in this section, refer to Chapter 3, Section I, for set-up procedures.

5.14.1 SINE/COSINE BOARD ADJUSTMENT

WARNING

DANGEROUS VOLTAGES PRESENT! USE EXTREME CARE WHEN PERFORMING THIS PROCEDURE.

To adjust the sine/cosine board assembly, perform the following:

1. Turn on all test equipment and allow RSS and test equipment to warm up for at least 20 minutes. Do not calibrate RSS.

2. Set θ angle to 45° (refer to Chapter 3, Operation), both RSS reference amplitude and $V_{L\text{-}L}$ voltage to 26 volts, internal frequency to 15000 Hz.

3. Connect RSS output S2 and S3 to the DAV SIG HI and LO inputs, respectively.

4. Connect a shorting jumper between RSS S1 and S4 front panel binding posts.

5. Connect RSS REF OUT HI and LO outputs to DAV REF HI and LO inputs, respectively.

6. Offset the RSS angle to obtain as close to an *in-phase* reading of 0.0000 on the DAV as possible. (If desired, use the RSS INCREMENT knob.)

7. Adjust R47 for 0.0000 ± 100 μV reading of *quadrature* on the DAV.

8. Set RSS to 11.8 $V_{L\text{-}L}$, 400 HZ, resolver, and an angle of 86.4166°.

9. Connect RSS S1 through S4 outputs to bridge input.

10. Connect bridge output to DAV SIG channel. (DAV set to read in-phase).

11. Set RSS to 86.4166°.

12. Set bridge for 86.4166° and record in-phase error.

13. Set bridge and RSS to 86.4167°.

14. Adjust R63 for same reading recorded in step 10.

Note

If desired, use the RSS INCREMENT knob to alternate between angles to check adjustment.

15. Set RSS to 3.5834°.

16. Set the bridge to 3.5834° and record the in-phase error.

17. Set RSS to 3.5833°.

18. Set bridge to 3.5833.

19. Adjust R52 for same reading recorded in step 15.

5.14.2 ANALOG BOARD ADJUSTMENT

WARNING

DANGEROUS VOLTAGES PRESENT! USE EXTREME CARE WHEN PERFORMING THIS PROCEDURE.

To adjust the analog board assembly, perform the following:

1. With RSS power off, install extender frame assembly (paragraph 5.11.16).

2. Place analog board in extender frame and connect wiring and connectors previously removed.

3. Turn on all external test equipment and allow to warm up for 20 minutes.

4. Connect RSS output S2 and S4 to the DAV SIG HI and LO inputs, respectively.

5. Connect RSS REF OUT HI and LO outputs to DAV REF HI and LO inputs, respectively.

6. Set θ angle to 45° (refer to Chapter 3, Operation), V_{REF} to 26 volts, $V_{L\text{-}L}$ to 11.8 volts, internal frequency to 15000 Hz.

CHANGE 3

7. Adjust R76 for 0.46 degrees.

5.14.3 ISOLATED POWER SUPPLY VOLTAGE CHECK

To test the isolated power supply assembly, perform the following:

WARNING

DANGEROUS VOLTAGES PRESENT! USE EXTREME CARE WHEN PERFORMING THIS PROCEDURE.

1. Install isolated power supply (paragraph 5.11.6) into RSS.

2. Turn power on/off switch on (I).

3. See figure 5-14 and use a digital multimeter set to DC and an AC coupled oscilloscope to check outputs listed in table 5-8:

Table 5-8. Isolated Power Supply Voltage Checks

OUTPUT	MEAS. POINT	VOLTAGE RANGE	AC RIPPLE *
REF GND	TP1	-	-
+15	U1, Pin 2	14.2 to 16.0	5 mV_{P-P}
-15	U2, Pin 3	-14.2 to -16.0	5 mV_{P-P}
+20	U9, Pin 2	19.6 to 21.9	5 mV_{P-P}
-20	U10, Pin 3	-19.6 to -21.9	5 mV_{P-P}
+48	U9, Pin 3	45.5 to 49.8	10 mV_{P-P}
-48	U10, Pin 2	-45.5 to -49.8	10 mV_{P-P}
+150	Q1, Pin 1	147 to 164	15 mV_{P-P}
-150	Q2, Pin 1	-147 to -164	15 mV_{P-P}

* Maximum

5.14.4 MAIN POWER SUPPLY BOARD ASSEMBLY VOLTAGE CHECK AND ADJUSTMENT

To check and adjust the main power supply board assembly, perform the following:

WARNING

DANGEROUS VOLTAGES PRESENT! USE EXTREME CARE WHEN PERFORMING THIS PROCEDURE.

1. Install main power supply board assembly (paragraph 5.11.9) in RSS.

2. Turn power on/off switch on (I).

3. See figure 5-15 and use a digital multimeter set to DC and an AC coupled oscilloscope to check the following outputs listed in table 5-9:

Table 5-9. Initial Main Power Supply Voltage Checks

OUTPUT	MEAS. POINT	VOLTAGE RANGE	AC RIPPLE *
REF GND	TP4	-	-
+5 Vdc	TP3	5.1 to 5.4 Vdc	5 mV_{P-P}
+15 Vdc	TP1	14.2 to 16.0 Vdc	5 mV_{P-P}
-15 Vdc	TP2	-14.2 to -16.0 Vdc	5 mV_{P-P}
+48 Vdc	TP5	45.5 to 49.8 Vdc	10 mV_{P-P}
-48 Vdc	TP6	-45.5 to -49.8 Vdc	10 mV_{P-P}

* Maximum

4. Set digital multimeter to DC and connect to TP7 (+175V output).

5. Adjust R17 until 174 Vdc is displayed by digital multimeter.

6. Set digital multimeter to DC and connect to TP8 (-175V output).

7. Adjust R16 until -174 Vdc is displayed by digital multimeter.

8. After RSS has warmed up for at least 10 minutes, see figure 5-15 and use a digital multimeter set to DC and a AC coupled oscilloscope to check that the outputs listed in table 5-10 are within tolerance.

Table 5-10. Final Voltage Checks

OUTPUT	MEAS. POINT	VOLTAGE RANGE	AC RIPPLE *
REF GND	TP4	-	-
+175 Vdc	TP7	173.6 to 174.4 Vdc	15 mV_{P-P}
-175 Vdc	TP8	-173.6 to -174.4 Vdc	15 mV_{P-P}

* Maximum

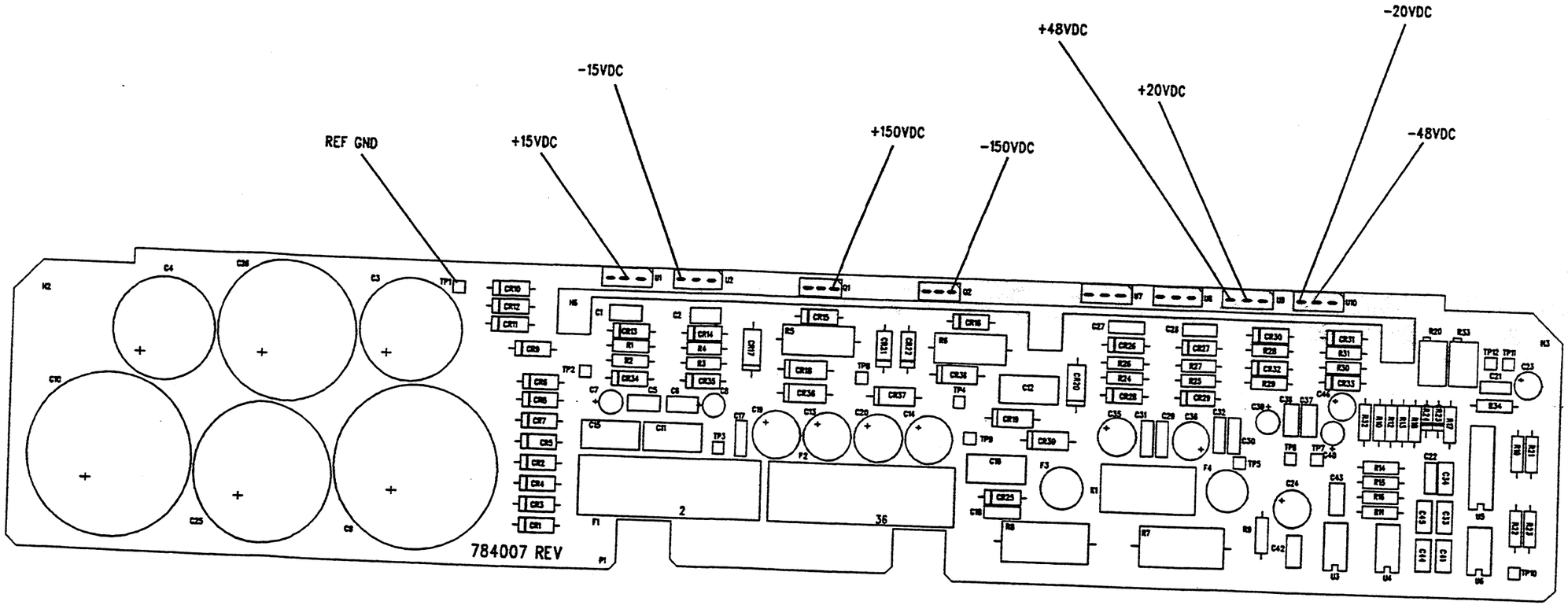


Figure 5-14. Voltage Measurement Points, Isolated P.S.

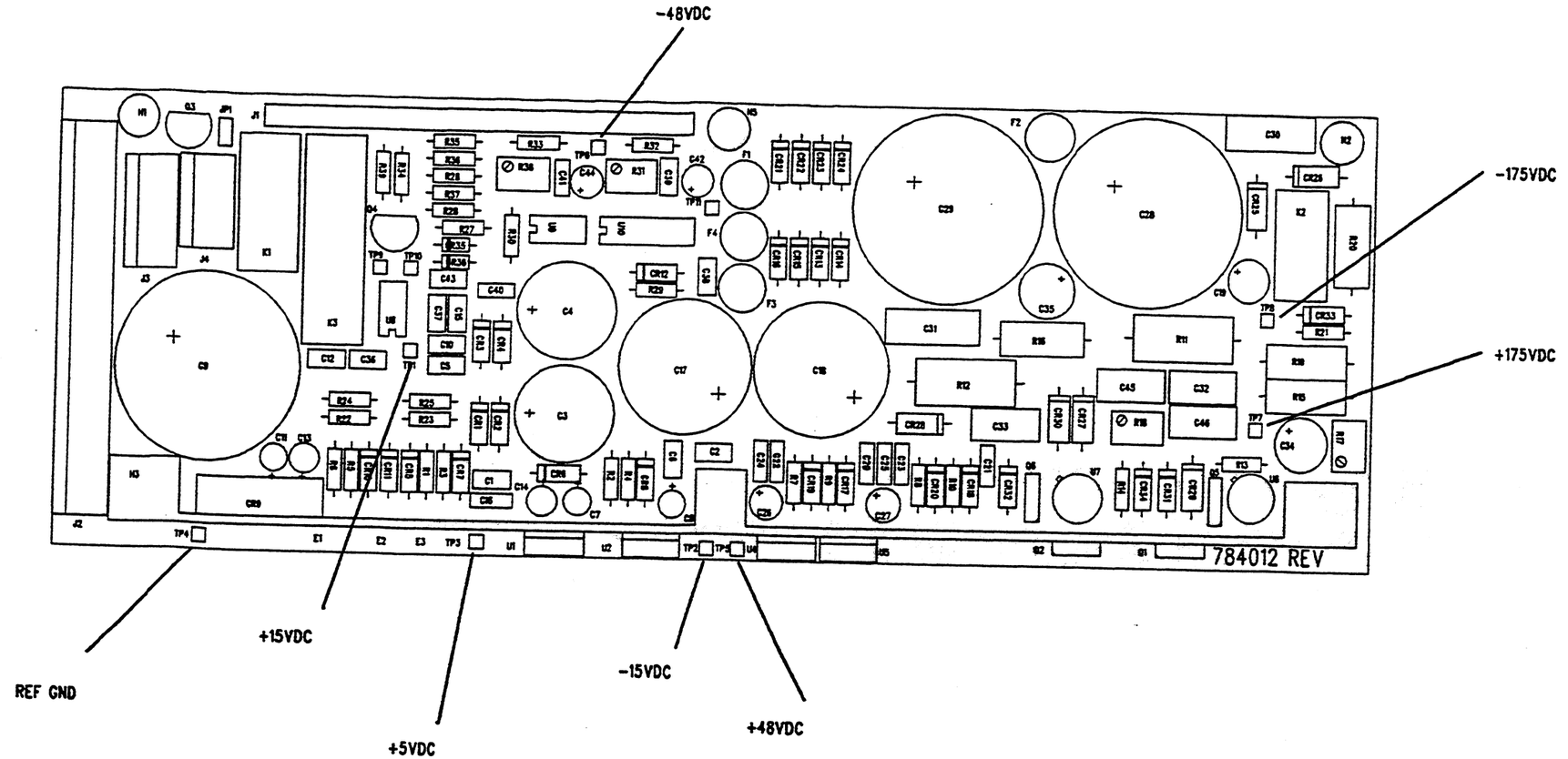


FIGURE 5-3

Figure 5-15. Voltage Measurement Points, Main P.S.

Table 6-1. Chassis Assembly Parts

REFERENCE DESIGNATIONS	DESCRIPTION / VENDOR PART NO.	NAI P/N	QTY
A1	System board assembly. See Table 6-2 for breakdown.	784009	1
A2	Sine/cosine board assembly. See Table 6-3 for breakdown.	784003	1
A3	Analog board assembly. See Table 6-4 for breakdown.	784008	1
A4	Main power supply board assembly. See Table 6-5 for breakdown.	784012	1
A5	Display/Keyboard assembly. See Table 6-6 for breakdown.	784006	1
A6, A7	Isolated power supply assembly. See Table 6-7 for breakdown.	784007	2
A8	Analog interconnection board assembly. See Table 6-8 for breakdown.	784011	1
B1	Fan assembly	784020	1
FL1	Power entry module assembly	784019	1
TB1	Terminal block assembly	549004	1
T1	Main transformer assembly	810117	1
T2	Isolation power transformer assembly	810104	1
T3, T4	Isolation/tapped transformer assembly	784021	2
T5	Calibration bridge transformer assembly	784018	1

CHAPTER 6
PARTS LIST

6.1 GENERAL

This chapter contains illustrations (figures 6-1 through 6-8) to locate replaceable parts used on the Resolver/Synchro Standard (RSS). The part lists for each illustration (table 6-1 through 6-8) contain reference designation (ref des), description/vendor part number, North Atlantic Instruments (NAI) part number, and quantity.

6.2 PARTS LIST

The parts list contains only replaceable parts for the RSS. Hardware, covers, panels, and other sheet metal parts are not listed. If parts of this type are required, contact NAI for assistance and pricing.

The parts list is prepared in a tabular format divided into four columns as follows:

6.2.1 REF DES (Reference Designation)

Provides the alphanumerical reference designations for replaceable parts shown on schematic and part location illustrations.

6.2.2 DESCRIPTION/VENDOR PART NO.

Provides a description of the replaceable part and a vendor part number, if applicable.

6.2.3 NAI P/N

Provides the NAI part number of the replaceable part.

6.2.4 QTY (Quantity)

Provides the total quantity used on the assembly.

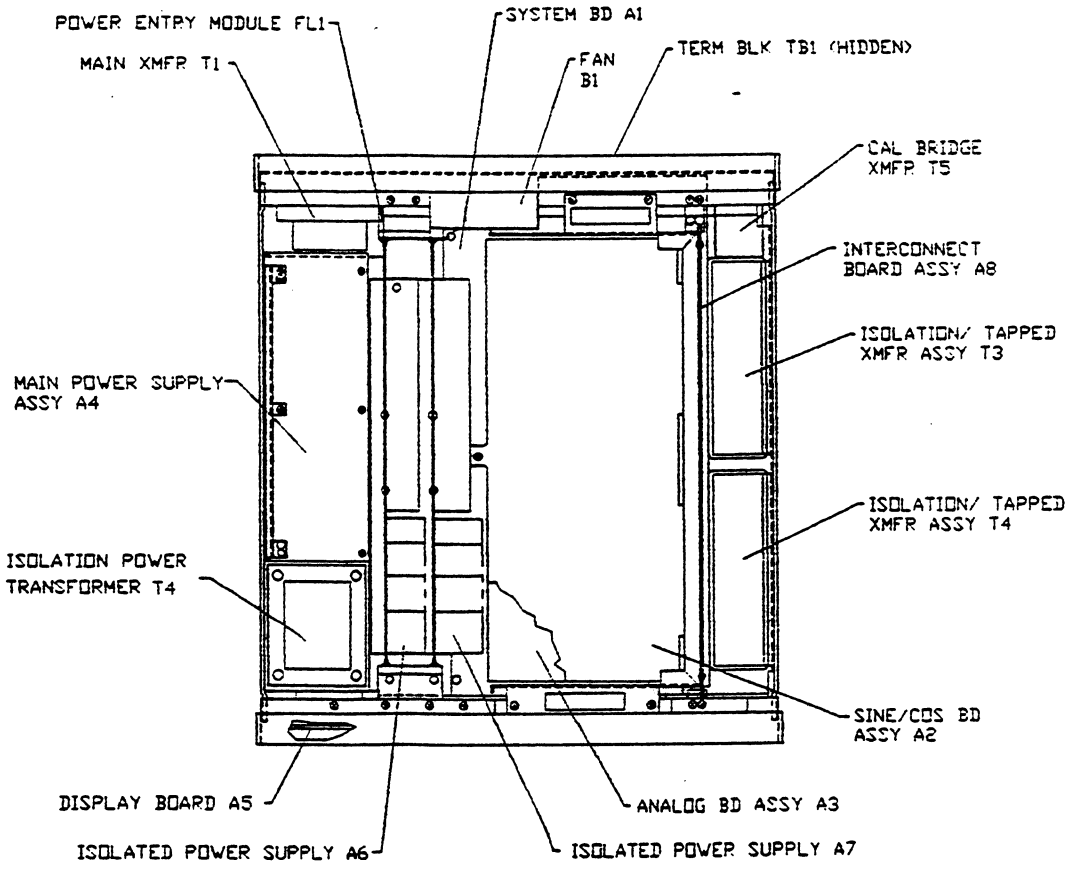


Figure 6-1. Chassis Assembly

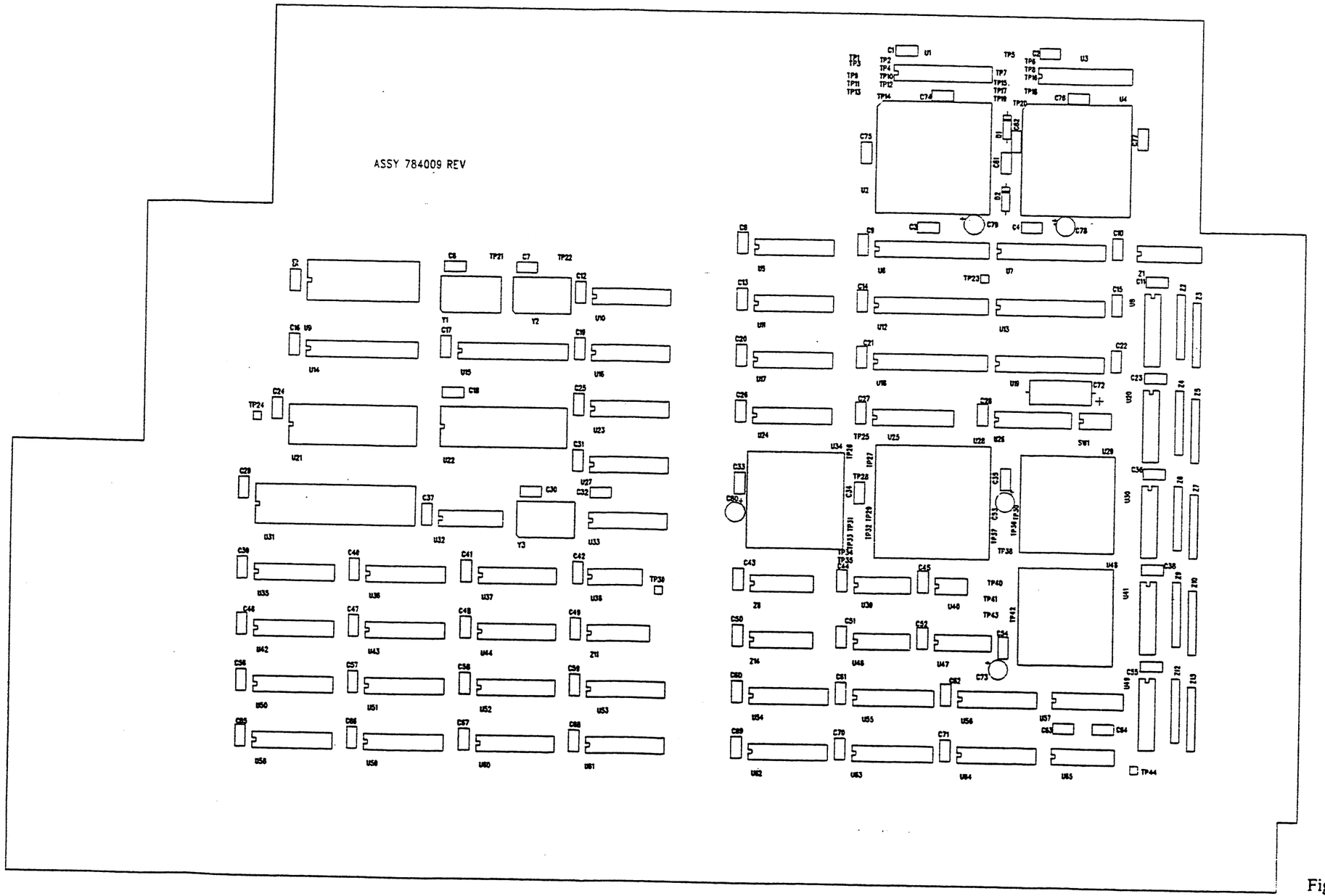


Fig. 6-2. System Board Assembly
Sheet 1 of 2

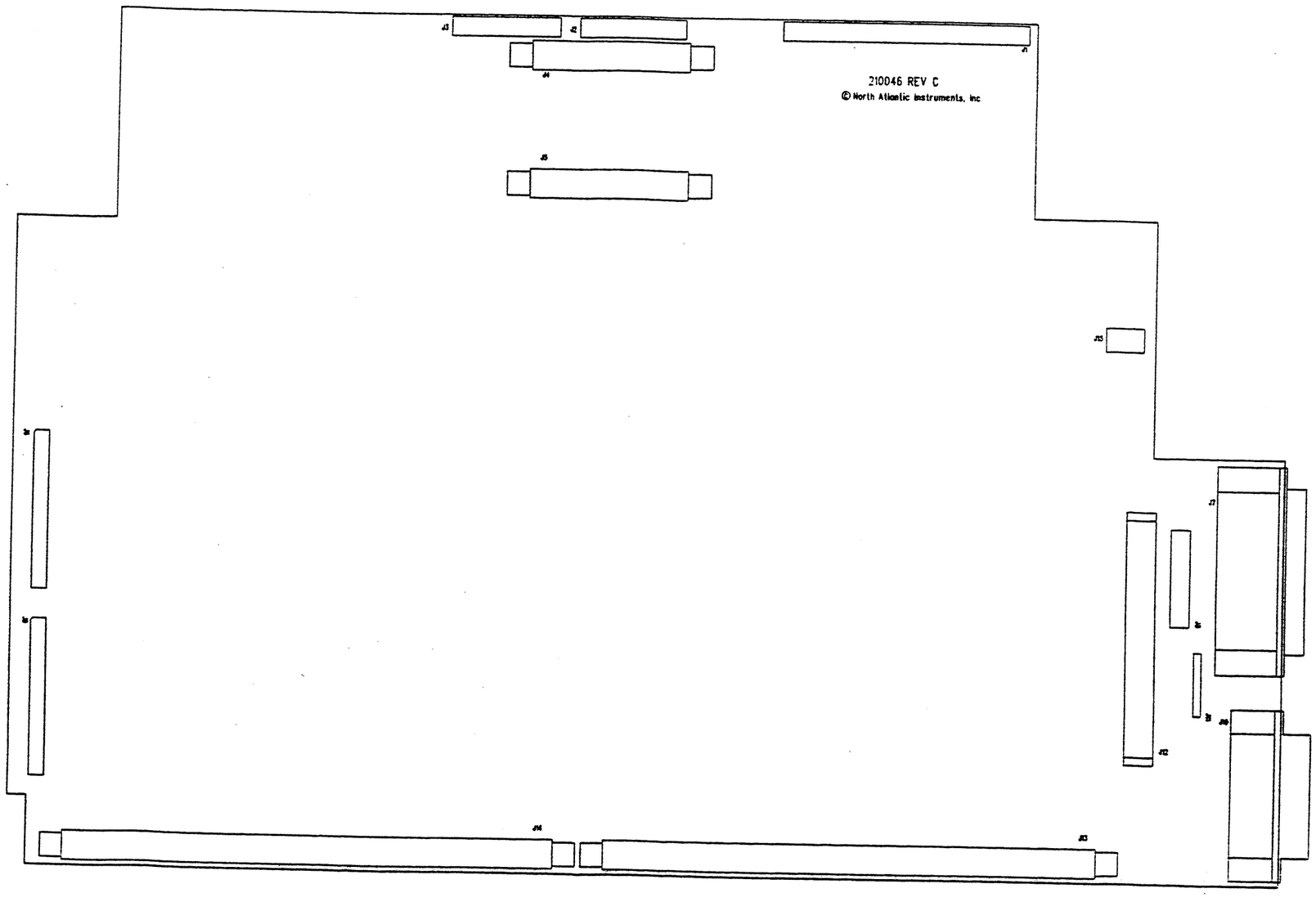


Fig. 6-2. System Board Assembly
Sheet 2 of 2

6-7/6-8 (blank)

Table 6-2. System Board Assembly A1, Parts List
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1-52,54-71,74-77,81,82	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	76
C53,C73,78-80	CAP,TANT-POL,10UF,25V, +-20% NDTM106K25,NIC OR EQUAL	886060	5
C72	CAP,AL-EL,100UF,16VDC, +-20% 500D107M016CB2,SPRAGUE	889028	1
D1,2	DIODE,SIG,PIV60V,0.015A 1N6263	883449	2
J1	CONN,HDR,20-POS,1-ROW,156CTR 2-87160-0 NC/NR,AMP	810301	1
J10	CONN,IEEE,RCPT,PCB,RT.A,REV.OR 552740-2,AMP	810331	1
J12,J15	TERMINAL,MISC MAGNUM ELECTRIC # 1011-04	883071	9
J13,J14	CONN,EDGE,60-POS,DBL.READ,100C EZC60DRXH,SULLINS,(LO-PROFILE)	810232	2
J2,J3	CONN,HDR,9-POS,1-ROW,156CENTER 1-87160-0,AMP	810302	2
J4,J5	CONN,EDGE,18-POS,DBL.READ,100C EZC18DRXH,SULLINS,(LO-PROFILE)	810233	2
J6,J9	CONN,HDR,40-POS,DBL.ROW,100CTR TSW-120-07-L-D,SAMTEC	810235	2
R1,2	RES,CMPSN,470 OHM,5%,1/8W RLR05C4700GS	RCR05G471JS	2
SW1	SW,DIP,ROCKER,RAISED,4POS,SEAL 76SB04S,GRAYHILL	810090	1
TP1-TP44,J11	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	52
U1	IC, PAL, PROGRAMMED FR 888855	600020	1
U14,U15	IC,RAM,8Kx8,20 OR 25ns,28PIN 7164,IDT7164S25TP(20TP),IDT	888797	2
U2,U4	IC,DSP,PROCESSOR,24-BIT 56001,DSP56001FC20 (OBSOLETE)*	889878	2

Table 6-2. System Board Assembly A1, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
U21	IC,PROGRAMMED,EPROM REV.A FROM 889939	600018-5	1
U22	IC,PROGRAMMED EPROM REV.A FROM 889939	600019-5	1
U24	IC,CMOS,LATCH,OCTAL D,3 STATE 373,SN74HCT373N,TI OR =	810228	1
U27,33,55,56	IC,CMOS,TRANSCVR,OCTAL,3STATE 245,SN74HCT245N/AN	889157	4
U28	IC. FPGA, PROGRAMMED FR 889920	600017	1
U29,U48	IC, FPGA, PROGRAMMED FR 889938	600016	2
U3	IC, PAL, PROGRAMMED FR 888855	600021	1
U31	IC,INTERFACE,IEEE488CONTROLLER 9914,NAT9914APD,NAT INST	885996	1
U32	IC,CMOS,CNTR,BINARY,4-BIT,SYNC 161,SN74HCT161N,TI OR =	810227	1
U34	IC,MICROPROC,16/32BIT,8MHzPLCC 000,MC68HC000FN10,MOT	810007	1
U35	IC,INTERFACE,TRANSCVR,OCTAL,GP 160,SN75160A/BN	885997	1
U36	IC,INTERFACE,TRANSCVR,OCTAL,GP 161,SN75161A/BN	885998	1
U38	IC,CMOS,AND GATE,QUAD,2-INPUT 08,SN74HCT08N,	886198	1
U39	IC,TTL,INVERTER,HEX,1-INPUT 05,SN74ALS05N	888775	1
U40	IC,VOLTAGE MONITOR,FOR uP 1232,CS1232P,(DALLAS-DS1232P)	889922	1
U46	IC,TTL,INVERTER,HEX,SCHMITT 14,SN74LS14N	883703	1
U47	IC,CMOS,NAND GATE,QUAD,2-INPUT 00,SN74HCT00N	889155	1

Table 6-2. System Board Assembly A1, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
U5,10,11,16,17,23,25,26	IC,CMOS,BUFFER,OCTAL,TRI-STATE 244,SN74HCT244N,orSN74HCT244E	886192	8
U53,54,58,59,60,61,62,63,64	IC,CMOS,FLIP-FLOP,D,OCTAL,EDGE 574,SN74HCT574N,SN74HCT574E,TI	889011	9
U6,7,12,13,18,19	IC,RAM,32Kx8,15ns 2568,MT5C2568-15,MICRON	810223	6
U65	IC,CMOS,DECODER/DMUX,3TO8 LINE 138,SN74HCT138N,	886189	1
U8,20,30,41,49,57	IC,INTERFACE,DRIVER,8-CH,C/TTL 2985,UDN2985A,ALLEGRO	810229	6
U9	IC,EEPROM,8KX8,28PINDIP,CMOS 28,AT28C64-25PC,ATMEL OR =	889272	1
XU2,XU4	SOCKET,PLCC,132-POS,SQUARE 821949-5,AMP,FOR DSP56001	889520	2
XU21,XU22	SOCKET,IC,32-POS,DIP,100x600CT 2-644018-1,AMP	810112	2
XU28	SOCKET,PLCC,84-POS,SQUARE 821573-3,AMP	890059	1
XU29,XU34,XU48	SOCKET,PLCC,68-POS,SQUARE QILE68P-410T,BURNDY,B-068-PS-T	888847	3
Y1,Y2	OSC,20MHz,4 PIN IN 14 PIN,DIP KXO-01-1-20M,AVX	810297	2
Y3	OSC,10MHZ,CMOS,4P DIP SG51P-10.000,EPSON,SE1708ND	890039	1
Z1,Z8,Z14	RES,NET,BUS,DIP,3.30KX15,16P 4116R-002-332 DALE MDP1601332G	885964	3
Z11	RES,NET,BUS,DIP,15KX15,16P 4116R-002-153,BOURNS	810231	1
Z2-Z7,9,10,12,13	RES,NET,ISO,SIP,47X4,8P,1W 4608M-102-470 or 4608X-102-470	810230	10

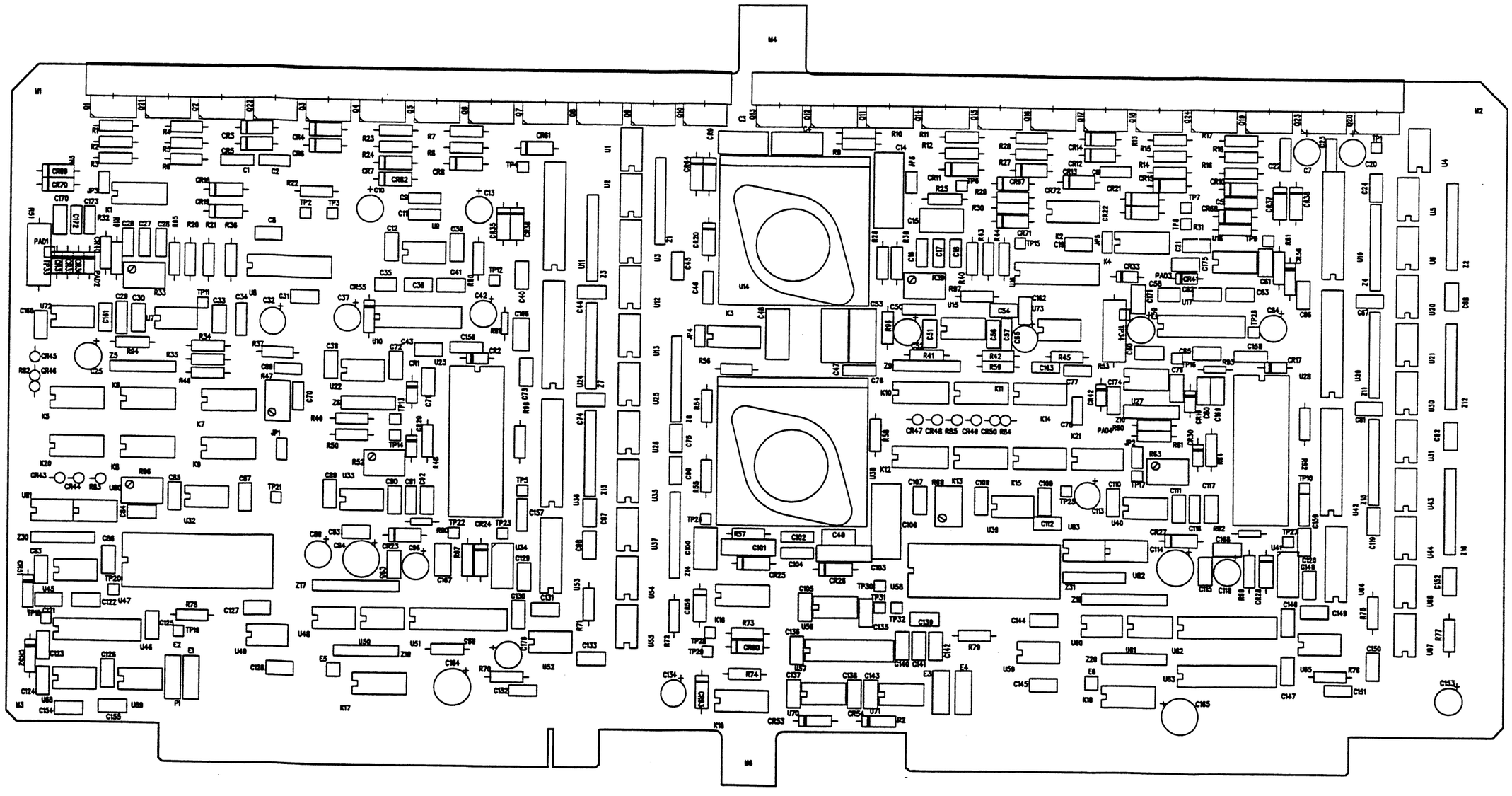


Fig. 6.3 Sine/cosine
Board Assembly

Table 6-3. Sine/Cosine Board Assembly A2, Parts List
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1,2,5,6,9,11,22,23	CAP,CER,.1UF,100V,+-10% CK06BX104K or 882188	880640	8
C132,C151	CAP,CER,120PF,10%,200V C052C121K2X5CA, CCR05CG121JR	810159	2
C14,C106	CAP,FILM,.1UF,400V,10%,POLYSTR 104MSR400K,ILLINOIS CAP	810166	2
C15,C100	CAP,MICA,220PF,500V,+-5% DM 10-221 J,ELMENCO	802448	2
C156,158	CAP,CER,1UF,50V,+-10% CK06BX105K	805155	2
C157,159	CAP,CER,.47UF,50V,10%,X7R,RADI CK06BX474K,MALLORY	882449	2
C16,C26	CAP,CER,3300PF,100V,5% C052C332J1X5CA sub CK05BX332J	810161	2
C170,C171	CAP,CER,.022UF,200V, 5% MR062C223JAA	810403	2
C18,C28	CAP,CER,4700PF,100V,5% C052C472J1X5CA KEMET OR EQUAL	810163	2
C25,32,37,42,52,55,59,64,88,96,113, 118,134,153	CAP,TANT-NON,10UF,35V,10% TDC106K035NSF,MALLORY	810168	14
C29,34,46,50,57,76,102,104	CAP,CER,.01UF,200V,10% C062C103K2X5CA KEMET OR EQUAL	810164	8
C3,C48	CAP,MICA,330PF,500V,+-5% DM 15-331 J,ELMENCO	802242	2
C35,C58	CAP,CER,2200PF,50V,5% SR205A222JAA AVX OR EQUAL	810167	2
C4,C49	CAP,MICA,20PF,500V, + - .5pf DM15D200D4CR,ELMENCO OR EQUAL	807526	2
C47,53,101,103	CAP,FILM,.1UF,250V,10%,POLYSTR 104MSR250K,ILLINOIS CAP	810165	4
C69,C77,91,116	CAP,CER,12PF,200V,5% C052C120J2X5CA KEMET OR EQUAL	810160	2
C7,10,13,20	CAP,AL-EL,10UF,100V,20% 106CKR100M,ILLINOIS	810158	4

Table 6-3. Sine/Cosine Board Assembly A2, Parts List (Cont'd)
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C70,C78	CAP,CER,47PF,100V,5% C052C470J1X5CA KEMET OR EQUAL	810162	2
C8,12,19,21,24,30,31,33,36,38-41, 43-45,51,54,56,60-63,65-68,71-75, 79-87,89,90,92,93,95,97-99,105, 107-112,115,117,119-131,133, 135-150,152,154,155,160,161,162, 163	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	95
C94,C114,164,165	CAP,TANT-NON,22UF,35V,+-20% 199D226X9035EE4,SPRAGUE	883783	4
CR1,2,16,17,29,30	DIODE,SIG,PIV60V,0.015A 1N6263	883449	6
CR23,27	DIODE,ZENER,5.10V,0.4W,5% 1N751A OR 1N751B	804066	2
CR3-6,10,12,14,15,24,28	DIODE,SIG,PIV400V,1A 1N4004	803735	10
CR31-34	DIODE,ZENER,5.60V,1W,5% 1N4734A	803552	4
CR35,36,37,38	DIODE,ZENER,3.90V,0.5W,5% 1N5228B MOT OR EQUAL	810397	4
CR39-42	XSTR,JFET,N.CH,30V,-0.5VgsDEPL 2N5246,TEX INST. OR =,TO-92	806213	4
CR51-56	DIODE,SIG,PIV85V,0.010A,10nS 1N4607,LOW CAPACITANCE	810406	6
CR57,58,65,66	DIODE,PROTECTION,5V,300W,SOT23 SL05,SEMTECH	810504	4
CR59,60,63,64	TVS,154-171V,PP1.50KW 1.5KE180A	810493	4
CR61,62,67,68	TVS,53-58.9V,PP1.5KW 1.5KE62A	810485	4
CR7-9,11,13,18-22,25,26	DIODE,RECT,PIV600V,1A,ULTRAFAS MUR160,MOTOROLA,AXIAL,59-04	810487	12
E1-4	TERMINAL,FAST-ON,PC MOUNT 1212 KEYSTONE	810579	4
H1,H2	HEAT SINK, SINE/COSINE BOARD PWB,REV B	210040	2
H3,H4	CONDUCTOR,PAD,SMALL,HEATSINK REV A	301117	2

Table 6-3. Sine/Cosine Board Assembly A2, Parts List (Cont'd)
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
H3,H4	HEATSINK,POWER AMP REV A	301082	2
JP1,JP2,JP3,JP5	JUMPER,100CTR,MINI,2-POS,W/HSG 65474-001,BREG	884691	4
K1-K21	RELAY,2 FORM C,5V,1A EA2-5NJ,NEC ONLY	889575	21
Q1,3,4,5,6,15,16,17,18,20-24	XSTR,PWR,PNP,150V,30MHZ,50W,8A MJE15031,MOTOROLA,TO-220AB	810140	14
Q2,7,8,9,10,11,12,13,14,19	XSTR,PWR,NPN,150V,30MHZ,50W,8A MJE15030,MOTOROLA,TO-220AB	810139	10
R1,R4,R13,R17	RES,MF,8.25K,1%,1/8W,100PPM RN55D8251F	807017	4
R10,R57	RES,MF,2.21K,1%,1/8W,100PPM RN55D2211F	810172	2
R19,R38	RES,MF,200 OHM,1%,1/8W,100PPM RN55D2000F	810174	2
R2,5,9,15,18,56,90-93	RES,MF,100 OHM,1%,1/8W,50PPM RN55C1000F	808143	10
R20,R44	RES,MF,4.99K,1%,1/8W,50PPM RN55C4991F	880045	2
R21,R40	RES,MF,2.49K,1%,1/8W,200PPM RN55D2491F	808317	2
R22,R31	RES,WW,100 OHM,1%,2W RW80U1000F	807648	2
R25,R54	RES,MF,3.09K,1%,1/8W,100PPM RN55D3091F OR EQUAL	810208	2
R26,R32	RES,MF,3.83K,1%,1/10W,100PPM RN55D3831F	807127	2
R29,R55	RES,MF,69.80K,1%,1/8W,100PPM RN55D6982F	810179	2
R3,R16	RES,MF,280 OHM,1%,1/8W,100PPM RN55D2800F	810175	2
R30,R58	RES,MF,34 OHM,1%,1/8W,100PPM RN55D34R0F OR EQUAL	810177	2

Table 6-3. Sine/Cosine Board Assembly A2, Parts List (Cont'd)
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R33,39,66,68	RES,VAR,10K,10%,1/2W,TRIM,25TU 3299W-1-103,BOURNS	883144	4
R34,R41	RES,MF,1.21M,1%,1/8W,100PPM RN55D1214F OR EQUAL	810170	2
R35,42,70,76	RES,MF,1.10K,1%,1/4W RL07C1101FS,TYPE C4	805144	4
R36,R43	RES,MF,909 OHM,1%,1/8W,100PPM RN55D9090F	886500	2
R37	RES,MF,2.67K,1%,1.10W,100PPM RN55D2671F	887987	1
R45	RES,MF,3.65K,1%,1/10W CC3651F,ALLEN BRADLEY	807632	1
R46,R59	RES,MF,2.74K,1%,1/8W,100PPM RN55D2741F	810173	2
R47	RES,VAR,2K, 3299W-1-202 RJ24FW202,BOURNS OR EQUAL	810192	1
R48,R64,65,67,69	RES,CMPSN,10K,5%,1/4W, NCF25-10K or RL07S1002G	880092	5
R49,R60	RES,MF,8.87 OHM,1%,1/8W,100PPM CMF-55-8R87FT-1,DALE	810180	2
R50,R61	RES,MF,1.47K,1%,1/8W,100PPM RN55D1471F OR EQUAL	810171	2
R51,53	RES,MF,18K,5%,2W,100PPM CPF-2183JT-1 DALE OR EQUAL	810468	2
R52,R63	RES,VAR,20 OHM,10%,1/2W,TRIM 3299W-1-200,BOURNS,25 TURN	890040	2
R6,R14	RES,MF,432 OHM,1%,1/8W,100PPM RN55D4320F	810178	2
R62,98	RES,CMPSN,7.5OHM,5%,1/8W RC05GF7R5J	805874	2
R7,8,11,12,23,24,27,28	RES,MF,1 OHM,5%,1/3W 5063J1R000J,MEPCO	889019	8
R71,R75	RES,CMPSN,4.70K,5%,1/4W NCF25-4.7K,NIC or RL07S4701G	880088	2

Table 6-3. Sine/Cosine Board Assembly A2, Parts List (Cont'd)
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R72,R77	RES,CMPSN,220 OHM,5%,1/4W RLR07C2200GS or COMMERCIAL =	880078	2
R73,R74	RES,CMPSN,68K,5%,1/4W ORDER BY DESCRIPTION	805390	2
R78,79,80,81	RES,CMPSN,270 OHM,5%,1/4W NCF25-270 ohm	880079	4
R82,83,84,85	RES,MF,243 OHM,1%,1/4W,100PPM RN55D2430F DALE	810348	4
R94-97	RES,MF,49.90K,1%,1/8W,50PPM RN55C4992F	807635	4
TP1-TP32,TP33,34,JP1,JP2,JP3,JP5	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	42
U1,2,3,4,5,6,12,13,20,21,25,26,30,31, 35,37,43,44,54,55,66,67	IC,OPTOCOUPLER,DUAL HCPL2530,HP NC/NR	810295	22
U10,17,46,57	IC,SW,2-SPST,1-N.C.,1-N.O. 613,DG613DJ,SILICONIX	810132	4
U11,19,24,29,36,42	IC,CMOS,FLIP-FLOP,D,OCTAL,EDGE 574,SN74HCT574N,SN74HCT574E,TI	889011	6
U14,U38	IC,OPAMP,HI-VOLT,SR40V/us,TO-3 41,PA41,APEX	810137	2
U22,27,32,33,39,40,45,49,56,59,68, 69,70,71,72,73	IC,OPAMP,SR2.8V/usGBW8M,Vos10u 27,OP27EP,PMI	810135	14
U23,U28	IC,MDAC,16-BIT,HIGH SPEED 9371,HS9371J,SIPEX ONLY	810134	2
U34,U41	IC,REG,+5V,1A,TO-220,3-TERMINL 7805,LM7805TC,NAT	808389	2
U47,U58	IC,SW,MUX,16-1,ANALOG 406,DG406DJ,SILICONIX	810130	2
U48,50,60,61	IC,INTERFACE,OPTOCPLR,DUAL8PIN 6,MCT6,GI OR =	885991	4
U51,62,63	IC,INTERFACE,DRIVER,8-CHANNEL 2803,ULN2803A,MOT	889911	3
U52,65	IC,OPTOCOUPLER,DUAL,HI-SPEED 2231,HCPL-2231,HP	810133	2

Table 6-3. Sine/Cosine Board Assembly A2, Parts List (Cont'd)
Rev. E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
U53,U64	IC,TTL,INVERTER,HEX 04,SN74ALS04N	886134	2
U7,U15	IC,OPAMP,SR60V/us,GBW30MHz,DIP 17,OP17EZ,PMI	810289	2
U8,U16	IC,SW,4-SPST,0-OFF,1-ON 445,DG445DJ,SILICONIX	810131	2
U80-83	IC,OPTOCOUPLER,LOGIC OUT,8 PIN 2731,HCPL-2731,HP	810409	4
U9,18	IC,OPAMP,SR100V/us,GBW16MHz 845,AD845KN,AD	810129	2
Z1,2,8,12,14,16	RES,NET,BUS,SIP,220X7,8P 4308H-101-221 or 4308R-101-221	810183	6
Z17,Z19	RES,NET,BUS,SIP,100KX7,8P 4308R-101-104,BOURNS OR EQUAL	810182	2
Z18,Z20	RES,NET,BUS,SIP,330 OHMX5,3/4W 4306H-101-331,BOURNS or EQUAL	810181	2
Z3,4,7,11,13,15	RES,NET,BUS,SIP,4.70KX7,8P,1W 4308R-101-472,BOURNS or EQUAL	810296	6
Z30,31	RES,NET,BUS,SIP,220X5,6P,0.75W 4306M-101-221,BOURNS	810410	2
Z5,Z9	RES,NET,NAI DWG REV B OHMTEC P/N 105-431	810105	2
Z6,Z10	RES,NET,2-4.4444K,.005% NAI DRAWING REV OHMTEC 103-361	888808	2

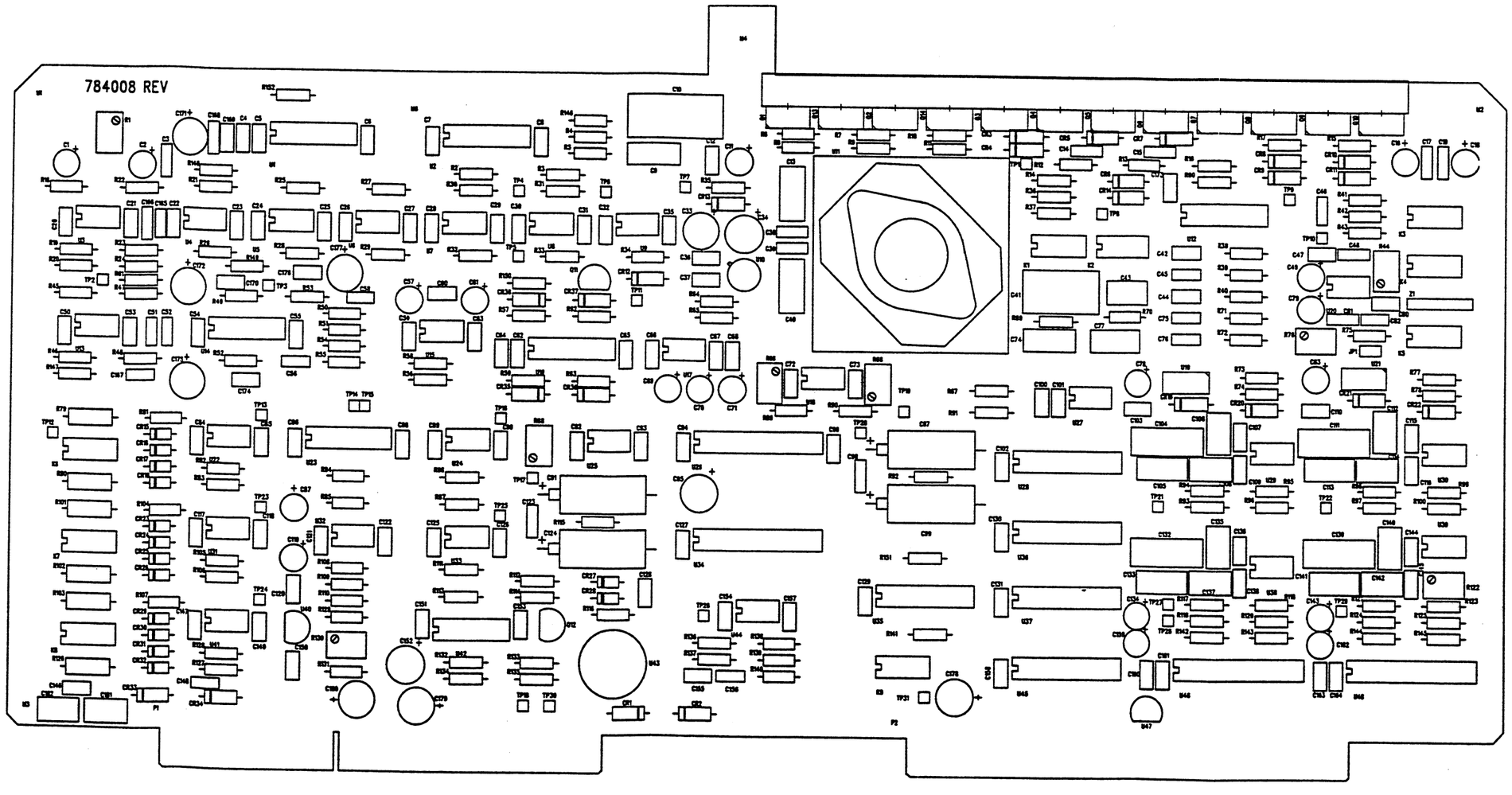


Fig. 6-4 Analog Board Assembly

Table 6-4. Analog Board Assembly A3, Parts List
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1,2,11,49,57,61,78,79,83,119,134, 143,159,162	CAP,TANT-NON,10UF,35V,10% TDC106K035NSF,MALLORY	810168	14
C10	CAP,FILM,1.5UF,100V,10%,POLYS 155MSR100K,ILLINOIS CAP	810290	1
C104,111,132,139	CAP,MICA,2400PF,100V,1% DM15FY242F03 OR CM06FD242F03	810189	4
C105,113,133,141	CAP,MICA,1200PF,100V,1% DM15FA122F03,CDE	810188	4
C106,112,135,140	CAP,MICA,180PF,500V,+-1% DM15-181F,ELMENCO	807433	4
C108,114,137,142,185	CAP,MICA,330PF,100V,1% DM10FA331F03,CDE OR EQUAL	810187	5
C13,C40	CAP,FILM,.1UF,250V,10%,POLYSTR 104MSR250K,ILLINOIS CAP	810165	2
C14,15,17,19	CAP,CER,.1UF,100V,+-10% CK06BX104K or 882188	880640	4
C148	CAP,CER,270PF,200V,10%,X7R,RAD CK05BX271K,MALLORY	885595	1
C156	CAP,CER,1000PF,200V,+-10% CK05BX102K	805788	1
C16,C18	CAP,AL-EL,10UF,100V,20% 106CKR100M,ILLINOIS	810158	2
C165,C167	CAP,CER,68PF,200V,1%NPO,RADIAL CCO5CG680F,AVX	810344	2
C169,170,173,174,176,183,186-190	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	11
C182	CAP,MICA,68PF,500V,+-5% SCDM 10-680 J,ELMENCO	802171	1
C3,C166,168	CAP,CER,1UF,50V,+-10% CK06BX105K	805155	3
C33,171,172,175,177,178,179,180	CAP,TANT-NON,22UF,35V,+-20% 199D226X9035EE4,SPRAGUE	883783	8
C34,95,152,184	CAP,TANT-NON,47UF,25VDC+-10% 199D476X9025EE2,SPRAGUE	884614	3
C38,39,48,81	CAP,CER,.01UF,200V,10% C062C103K2X5CA KEMET OR EQUAL	810164	4

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C4-8,12,20-32,35-37,42,44,47,50, 53-55,59,60,62-68,72,73,80, 84-86, 88-90,9294,96,100103,107,109,110, 115-118,120-122,125-131,136,138, 144-147,149-151,153-155,157,158, 160,161,163,164	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	95
C41	CAP,FILM,.1UF,630V,10%,POLYSTR 104MSR630K EQUAL,ILLINOIS CAP	810190	1
C43,C181	CAP,MICA,220PF,500V,+-5% DM 10-221 J,ELMENCO	802448	2
C46	CAP,CER,12PF,200V,5% C052C120J2X5CA KEMET OR EQUAL	810160	1
C69,70,71	CAP,TANT-NON,4.7UF,25V,10% TDC475K025NSF,MALLORY OR EQUAL	810191	3
C74	CAP,MICA,330PF,500V,+-5% DM 15-331 J,ELMENCO	802242	1
C75	CAP,CER,3300PF,100V,5% C052C332J1X5CA sub CK05BX332J	810161	1
C76	CAP,CER,4700PF,100V,5% C052C472J1X5CA KEMET OR EQUAL	810163	1
C77	CAP,MICA,20PF,500V, + - .5pf DM15D200D4CR,ELMENCO OR EQUAL	807526	1
C82	CAP,CER,100PF,200V,+-10% 11015-45, CK05BX101K	805210	1
C87	CAP,AL-EL,100UF,25v 107CKR025M,ILLINOIS CAP	810274	1
C9	CAP,FILM,.22UF,100V,10%,POLYS 224MSR100K,ILLINOIS	810169	1
C91,97,99,124	CAP,TANT-NON,100UF,20V,+-10% CSR13E107KM, T110D107K020AS	805628	4
C98,C123	CAP,CER,.47UF,50V,10%,X7R,RADI CK06BX474K,MALLORY	882449	2
CR1,2	DIODE,ZENER,4.30V,0.5W,5% 1N5229B,MOTOROLA	810449	2
CR13	DIODE,ZENER,10V,0.4W,10% 1N758	800658	1
CR15,16,17,18,23,24,25,26,27,28,29, 30,31,32	DIODE,SIG,PIV75V,0.010A,4nS 1N4148,SUB 808974, 882195	805805	14
CR3,4,6,8,10,14	DIODE,RECT,PIV600V,1A,ULTRAFAS MUR160,MOTOROLA,AXIAL,59-04	810487	6

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
CR35,36,37,38	DIODE,ZENER,3.30V,0.5W,20% 1N5226	807063	4
CR39,40	TVS,171-190V,PP1.50KW 1.5KE200A	810483	2
CR45,46	TVS,53-58.9V,PP1.5KW 1.5KE62A	810485	2
CR47-48	DIODE,PROTECTION,5V,300W,SOT23 SL05,SEMTECH	810504	2
CR,5,7,9,11,12,19,20,21,22	DIODE,SIG,PIV400V,1A 1N4004	803735	9
H1	HEAT SINK, SINE/COSINE BOARD PWB,REV B	210040	1
H2	HEATSINK,8PIN,TO-3 HS09,APEX	810221	1
JP1,2	JUMPER,100CTR,MINI,2-POS,W/HSG 65474-001,BREG	884691	2
K1,K2,K3,K4,K5,K6,K7,K8,K9	RELAY,2 FORM C,5V,1A EA2-5NJ,NEC ONLY	889575	9
Q1,3,4,5,6,13,14	XSTR,PWR,PNP,150V,30MHZ,50W,8A MJE15031,MOTOROLA,TO-220AB	810140	7
Q11	TRANSISTOR N-CHANNEL JFET NATIONAL PN5434	890058	1
Q12	TRANSISTOR,MOSFET,VN300N VN0300M - SILICONIX ONLY	886496	1
Q2,7,8,9,10	XSTR,PWR,NPN,150V,30MHZ,50W,8A MJE15030,MOTOROLA,TO-220AB	810139	5
R1,R68	RES,VAR,1K,10%,1/2W,TRIM,25TRN 3299W-1-102,BOURNS	807227	2
R10	RES,MF,432 OHM,1%,1/8W,100PPM RN55D4320F	810178	1
R104,105,106	RES,MF,20K,0.1%,1/8W,25PPM RN55E2002B	808226	3
R109	RES,MF,75 OHM,1%,1/8W,100PPM RN55D75R0F OR EQUAL	810215	1
R110	RES,MF,316 OHM,1%,1/8W,50PPM RN55C3160F OR EQUAL	810211	1
R114	RES,MF,3.32K,1%,1/8W,50PPM RN55C3321F	807631	1

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R116	RES,MF,40.20K,1%,1/8W,100PPM RN55D4022F	806987	1
R12	RES,WW,100 OHM,1%,2W RW80U1000F	807648	1
R122	RES,VAR,5K,10%,1/2W,TRIM,25TRN 3299W-1-502,BOURNS	883066	1
R123	RES,MF,12.40K,1%,1/8W,100PPM RN55D1242F OR EQUAL	810202	1
R129	RES,MF,24.90 OHMS,1%,1/8W,100P RN55D24R9F OR EQUAL	810207	1
R13,15,16,17	RES,MF,1 OHM,1%,1/4W,100PPM CMF-55-39-1-F-T1,DALE OR =	810195	4
R130	RES,VAR,50OHM,10%100PPM,25TURN 3299W-1-500,BOURNS eff 3/27/95	810193	1
R132	RES,MF,931K,1%,1/8W,50PPM RN55C9313F OR EQUAL	810218	1
R134	RES,MF,3.57K,1%,1/8W,50PPM RN55C3571F OR EQUAL	810209	1
R136	RES,MF,4.22K,1%,1/8W,50PPM RN55C4221F	808100	1
R139	RES,MF,1M,1%,1/8W,100PPM RN55D1004F	808262	1
R14	RES,MF,34 OHM,1%,1/8W,100PPM RN55D34R0F OR EQUAL	810177	1
R141	RES,CMPSN,68K,5%,1/4W NCF25-68K,NIC	880098	1
R142,143,144,145	RES,CMPSN,10 OHM,5%,1/4W NCF25-10 OHM	883106	4
R146	RES,MF,113K,0.1%,1/8W,50PPM RN55C1133B OR RNC55H1133BS	810220	1
R147	RES,MF,56.20K,1%,1/8W,100PPM RN55D5622F,DALE	810343	1
R153,154	RES,MF,49.90K,1%,1/8W,50PPM RN55C4992F	807635	2
R155	RES,15 OHM,1/4W ORDER BY DESCRIPTION	802461	1
R156,157	RES,MF,2.80K,1%,1/2W,100PPM RN55D2801 DALE OR EQUAL	810466	2

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R18,R22	RES,MF,4.75K,1%,1/8W,100PPM RN55D4751F	888693	2
R19,26,28,29,32,46,86,111,131,	RES,MF,1K,1%,1/10W,50PPM CORNING/NC55 (RN55C1001F)	808213	9
R2,84,151	RES,CMPSN,3.30K,5%,1/4W CB3325,RCO7GF332J,RLR07C3301GS	803388	3
R20,24,56,58,148,149	RES,CMPSN,100 OHM,5%,1/4W NCF25-100 ohm RL07S1000G	880077	6
R21	RES,MF,1.62K,1%,1/10W,100PPM RN55D1621F	807019	1
R23	RES,MF,59K,1%,1/8W,50PPM RN55C5902F	808184	1
R25,72,108	RES,MF,2.49K,1%,1/8W,200PPM RN55D2491F	808317	3
R27	RES,MF,1.21K,1/8W,+-1% RN55D1211F	807796	1
R3,R31,R33	RES,MF,11.50K,1%,1/8W,100PPM RN55D1152F OR EQUAL	810201	3
R30	RES,MF,1.91K,1%,1/8W,100PPM RN55D1911F	810198	1
R34	RES,CMPSN,11K,5%,1/4W RC07GF113J	802255	1
R35	RES,MF,100K,1%,1/10W,100PPM RN55D1003F sub 806492	806992	1
R36	RES,MF,3.09K,1%,1/8W,100PPM RN55D3091F OR EQUAL	810208	1
R37	RES,MF,69.80K,1%,1/8W,100PPM RN55D6982F	810179	1
R38	RES,MF,909 OHM,1%,1/8W,100PPM RN55D9090F	886500	1
R39,85,87,135	RES,MF,4.99K,1%,1/8W,50PPM RN55C4991F	808182	4
R4	RES,MF,46.40K,0.1%,1/8W,100PPM RN55D4642B	810293	1
R40	RES,MF,3.83K,1%,1/10W,100PPM RN55D3831F	807127	1
R41	RES,MF,1.21M,1%,1/8W,100PPM RN55D1214F OR EQUAL	810170	1

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R42	RES,MF,1.10K,1%,1/4W RLO7C1101FS,TYPE C4	805144	1
R43	RES,MF,2.74K,1%,1/8W,100PPM RN55D2741F	810173	1
R44,88	RES,VAR,10K,10%,1/2W,TRIM,25TU 3299W-1-103,BOURNS	883144	2
R45	RES,MF,2K,1%,1/8W,100PPM RN55D2001F	808352	1
R49	RES,CMPSN,270K,5%,1/4W CB2745,ALLEN BRADLEY	804400	1
R5	RES,MF,221K,0.1%,1/8W,100PPM RN55D2213B OR RNC55H2213BS	810206	1
R50	RES,CMPSN,22K,5%,1/4W NCF25-22K	880368	1
R52	RES,CMPSN,1K,5%,1/4W NCF25-1K	880084	1
R53	RES,CMPSN,1.80K,5%,1/4W CB1825,ALLEN/B OR RL07S1801J G	810219	1
R55	RES,MF,82K,2%,1/4W,100PPM C4,CORNING	806752	1
R57	RES,MF,19.10K,0.1%,1/8W,50PPM RN55C1912B OR RNC55H1912BS	810214	1
R59	RES,MF,21.30K,0.1%,1/8W,50PPM RN55C2132B OR RNC55H2132BS	810205	1
R6,11,69,138	RES,MF,100 OHM,1%,1/8W,50PPM RN55C1000F	808143	4
R60,150,152	RES,CMPSN,270 OHM,5%,1/4W NCF25-270 ohm	880079	3
R61	RES,MF,5.11K,1%,1/8W,100PPM RN55D5111F	806729	1
R62	RES,MF,1.15K,0.1%,1/8W,50PPM RN55C1151B	810196	1
R63	RES,MF,768 OHM,0.1%,1/8W,50PPM RN55C7680B OR RNC55H7680BS	810217	1
R64,92,112,113,115,133	RES,MF,10K,1%,1/8W,50/100PPM RN55C OR D, 1002F,CORNING	806108	6
R66,76	RES,VAR,2K, 3299W-1-202 RJ24FW202,BOURNS OR EQUAL	810192	2

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R67	RES,MF,3.83K,0.1%,1/8W,100PPM RN55D3831B OR RNC55H3831BS	810210	1
R7,9,65	RES,MF,8.25K,1%,1/8W,100PPM RN55D8251F	807017	3
R70	RES,MF,2.21K,1%,1/8W,100PPM RN55D2211F	810172	1
R71	RES,MF,200 OHM,1%,1/8W,100PPM RN55D2000F	810174	1
R73,R77	RES,MF,1.37K,1%,1/8W,100PPM RN55D1371F	810197	2
R74,R78	RES,MF,20K,1%,1/8W,100PPM RN55D2002F	889585	2
R75	RES,MF,2.67K,1%,1.10W,100PPM RN55D2671F	887987	1
R79,80,101,102,103,126	RES,MF,100K,0.1%,1/4W,50PPM RN60C1003B	810194	6
R8	RES,MF,280 OHM,1%,1/8W,100PPM RN55D2800F	810175	1
R81,82,83	RES,MF,80.60K,0.1%,1/8W,50PPM RN55C8062B OR RNC55H8062BS	810216	3
R89,137,140	RES,MF,1.00K,1%,1/8W,100PPM RN55D1001,DALE or EQUAL	810292	3
R90	RES,MF,11K,0.1%,1/8W,100PPM RN55D1102B or RNC55H1102BS	810200	1
R91,107,127,128	RES,MF,4.75K,0.1%,1/8W,50PPM RN55C4751B OR RNC55H4751BS	810212	4
R93,97,119,124	RES,MF,1.96K,1%,1/8W,100PPM RN55D1961F	810199	4
R94,98,117,121	RES,MF,17.80K,1%,1/8W,100PPM RN55D1782F	886174	4
R95,99,118	RES,MF,14.70K,1%,1/8W,100PPM RN55D1472F OR EQUAL	810203	3
R96,100,120,125	RES,MF,2.26K,1%,1/8W,100PPM RN55D2261F OR EQUAL	810204	4
TP1-TP31,JP1	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	33
U1	IC,SW,4-SPST,Ron175,W/DRIVERS 211,DG211CJ,HAR	886001	1

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
U10	IC,REF,+2.5V,10PPM/C,TO-52 580,AD580LH,AD	810142	1
U11	IC,OPAMP,HI-VOLT,SR40V/us,TO-3 41,PA41A,APEX	810151	1
U12	IC,SW,4-SPST,0-OFF,1-ON 445,DG445DJ,SILICONIX	810131	1
U14	IC,COMP,DUAL,HI-SPEED 319,LM319N,NAT	883244	1
U15	IC,OPAMP,SR300V/us,LO-PWR 847,AD847JN,AD	810146	1
U16	IC,SW,2-SPST,1-N.C.,1-N.O. 613,DG613DJ,SILICONIX	810132	1
U17,U32	IC,RDC,DIP,8-PIN 736,AD736JN,AD	810145	2
U19	IC,REG,-ADJ,1.5A,TO-220,3TERM 337,LM337T,NAT	889941	1
U2,U23	IC,SW,MUX,8-1,ANALOG,16PINDIP 408,DG408DJ,SILICONIX	810149	2
U20	IC,OPAMP,SR60V/us,GBW30MHz,DIP 17,OP17EZ,PMI	810289	1
U21	IC,REG,+ADJ,1.5A,TO-220,3TERM 317,LM317T,NAT	889940	1
U22,31,41	IC,OPAMP,DUAL,SR3V/us,Vos.5mV 5102,HA3-5102-5,HAR	889008	3
U26	IC,MDAC,12-BIT,PAR-LOAD,DIP24P 7847,AD7847AN,AD	810148	1
U28,36,37,45	IC,CMOS,FLIP-FLOP,D,OCTAL,EDGE 574,SN74HCT574N,SN74HCT574E,TI	889011	4
U29,30,38,39	IC,OPAMP,DUAL,SR16V/us,Vos.3mV 712,AD712JN,AD	810144	4
U3,U33	IC,OPAMP,SR17V/usGBW63M,Vos10u 37,OP37EP,PMI	810136	2
U34	IC,ADC,10-BIT,SAMPLING,20us 7580,AD7580KN,AD	810147	1
U35	IC,INTERFACE,DRIVER,8-CHANNEL 2803,ULN2803A,MOT	889911	1
U4,5,6,7,13,24,25,27,50	IC,OPAMP,SR2.8V/usGBW8M,Vos10u 27,OP27EP,PMI	810135	9

Table 6-4. Analog Board Assembly A3, Parts List (Cont'd)
Rev.G

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
U40	IC,REG,+5V,0.1A,TO-92,3-TERM 05,LM78L05ACZ,NAT OR EQUAL	810141	1
U42	IC,OPAMP,QUAD,SR35V/us,GBW6.4M 404,OPA404KP,BB ONLY	887660	1
U43	VACTROL (RAYSISTOR) VTL3A44,EG&G	810451	1
U44	IC,COMP,Vos2m,Ios6mA 311,LM311N,NAT OR =	808302	1
U46,U48	IC,DAC,14-BIT,COMPLETE,LC^2MOS 7840,AD7840KN,AD	810288	2
U47	IC,REG,-5V,TO-92 79L05,UA79L05ACZ	884919	1
U49	IC,SW,2-SPDT,LO-PWR,HI-SPD 403,DG403DJ,SILICONIX	810381	1
U8	IC,OPAMP,SR100V/us,GBW16MHz 845,AD845KN,AD	810129	1
U9,U18	IC,OPAMP,SR.3V/us,Vos50uV 707,AD707JN,AD	810143	2
Z1	RES,NET,NAI DWG REV B OHMTEC P/N 105-431	810105	1

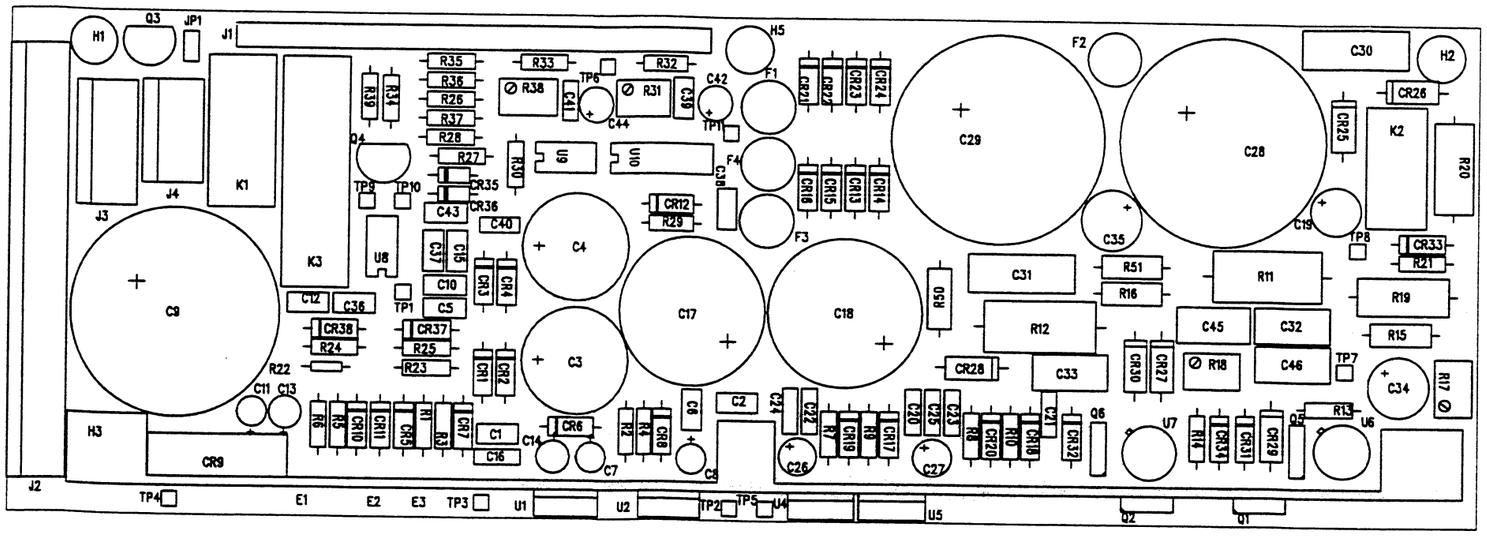


Fig. 6-5. Main Power Supply Assembly

Table 6-5. Main Power Supply Assembly A4, Parts List
Rev.E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1,2,5,6,10,12,15,36,37,38,39,43	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	12
C11	CAP,TANT-POL,4.7UF,25V,+-20% NDTM475K25N,NIC	886059	1
C13,C14	CAP,TANT-POL,10UF,25V,+-20% NDTM106K25,NIC OR EQUAL	886060	2
C16,24,25	CAP,CER,.01UF,200V,10% C062C103K2X5CA KEMET OR EQUAL	810164	3
C17,C18	CAP,AL-EL,2200UF,100V30x50SNAP ECES2A222N,PANASONIC *	810309	2
C19	CAP,AL-EL,3.3UF,160V,RADIAL 335CKR160M,ILLINOIS CAP	810240	1
C20,21,22,23	CAP,CER,.1UF,100V,10%,X7R,RADI CK06BX104K,MALLORY or 880640	882188	4
C26,C27	CAP,AL-EL,10UF,100V,20% 106CKR100M,ILLINOIS	810158	2
C28,C29	CAP,AL-EL,470UF,400V,35x40SNAP LPX471M400H7P3,MALLORY	810308	2
C3,C4	CAP,AL-EL,3300UF,50V18x40RADIA NRSS332M50V,NIC	810310	2
C30,31	CAP,FILM,.1UF,400V,10%,POLYSTR 104MSR400K,ILLINOIS CAP	810166	2
C32,33,45	CAP,FILM,.1UF,250V,10%,POLYSTR 104MSR250K,ILLINOIS CAP	810165	3
C34,C35	CAP,AL-EL,10UF,250V,+-10% sub 885188 106CKR250MPX	808189	2
C40,41	CAP,CER,27PF,200WVDC,+-10% CK05BX270K	808401	2
C42,C44	CAP,TANT-NON,6.8UF,35V,+-10% 199D685X9035DA1 SPRAGUE	884420	2
C7,C8	CAP,AL-EL,10UF,50V,RADIAL 106CKR050M,ILLINOIS CAP	810239	2
C9	CAP,AL-EL,47000UF,25V,40x50 ECO_S1EP473EA,PANASONIC	810345	1

Table 6-5. Main Power Supply Assembly A4, Parts List (Cont'd)
Rev.E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
CR1,2,3,4,5,6,7,8,10,11,12,13,14,15, 16,17,18,19,20,21,22 23,24,31, 32, 33,34	DIODE,SIG,PIV400V,1A 1N4004	803735	27
CR25,CR27	DIODE,ZENER,91V,5W,5% 1N5377B,MOTOROLA OR EQUAL	810311	2
CR26,CR28	DIODE,ZENER,100V,5W,5% 1N5378B,MOTOROLA OR EQUAL	810258	2
CR29,CR30	DIODE,ZENER,47V,5W,5% 1N5368B,MOTOROLA OR EQUAL	810260	2
CR35,CR36	DIODE,SIG,PIV75V,0.010A,4nS 1N4148,SUB 808974, 882195	805805	2
CR37,CR38	DIODE,RECT,PIV50V,1A 1N4001,MOTOROLA,SAME AS 808787	804477	2
CR9	DIODE,BRIDGE,RECT,PIV50V,4A MDA970A1,DIODES INC.- RS601	884735	1
F1,2	FUSE,0.125A,250V,FAST-BLO 263.125,LITTLEFUSE	810405	2
F3,F4	FUSE,0.75A,125V,MICRO,VERYFAST 273.750,LITTLEFUSE	810350	2
J1	CA.RIBBON,156CENT,20CKT 1/5300 CABLE/ASSY	549006	1
J2	CONN,HDR,18-POS,LKG.W/KEY,156C 26-60-4180,MOLEX	810314	1
J3	CONN,HDR,5-POS,LKG.W/KEY,156CN 26-60-4050,MOLEX	810315	1
J4	CONN,HDR,4-POS,LKG.W/KEY,156CN 26-60-4040,MOLEX	810316	1
K1	RELAY,2 FORM C,5VDC,5A,FLATPAK NC2D-P-DC5,AROMAT OR =	810262	1
K2	RELAY,2 FORM C,48V,1A,PCB MR602-48USR,RA-48W-K,NEC,ITT*	810243	1
K3	RELAY,4 FORM C,5VDC,5A,FLATPAK NC4D-P-DC5,AROMAT OR EQUAL	810263	1
Q1,Q5 -	XSTR,PWR,NPN,300V,20W,0.5A MJE340,MOTOROLA,TO-225AA	810156	2

Table 6-5. Main Power Supply Assembly A4, Parts List (Cont'd)
Rev.E

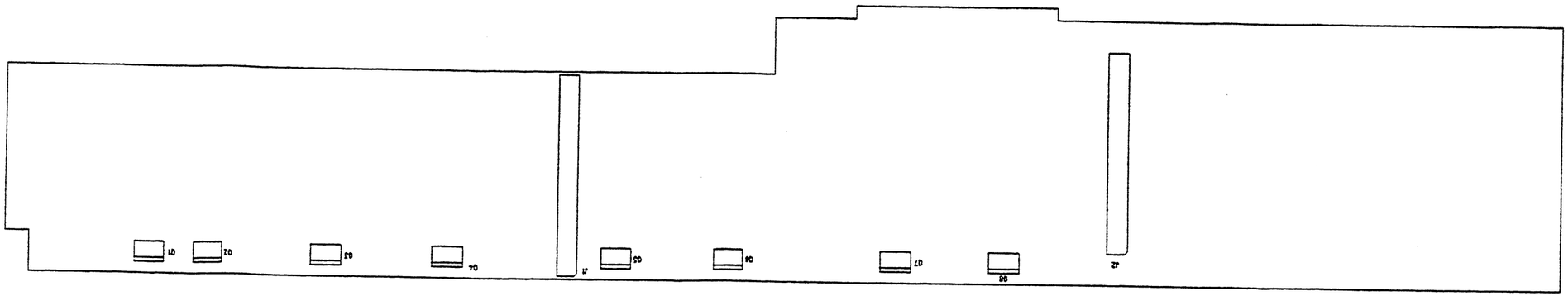
REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
Q2,Q6	XSTR,PWR,PNP,300V,20W,0.5A MJE350,MOTOROLA,TO-225AA	810157	2
Q3,Q4	TRANSISTOR,MOSFET,VN300N VN0300M - SILICONIX ONLY	886496	2
R1,R2	RES,MF,14K,1%,1/8W,100PPM RN55D1402F	810357	2
R11,R12	RES,CMPSN,18K,5%,2W HB1835,ALLEN BRADLEY OR EQUAL	810313	2
R13,R14	RES,MF,182 OHM,1%,1/8W,100PPM RN55D1820F	810312	2
R15,R16,R50,R51	RES,MF,23.20K,1%,2W,100PPM CPF-2-2322F-T-1,DALE OR =	810265	4
R17,R18	RES,VAR,2K, 3299W-1-202 RJ24FW202,BOURNS OR EQUAL	810192	2
R19,R20	RES,WW,7.50K,5%,3W VC3D-7500or3X7500 W/L,CLAROSTA	802271	2
R21	RES,MF,0.10,OHM,2%,1/8W,200PPM CMF-55-R10-G-T-00,DALE OR =	810244	1
R23	RES,MF,2.74K,1%,1/8W,100PPM RN55D2741F	810173	1
R24	RES,MF,59K,1%,1/8W,50PPM RN55C5902F	808184	1
R25	RES,MF,374 OHM,1%,1/8W,100PPM RN55D3740F	803557	1
R26	RES,MF,340 OHMS,1%,1/8W,100PPM RN55D3400F,DALE OR =	810246	1
R27,R28	RES,MF,5.90K,1%,1/8W,50PPM RN55C5901F	805861	2
R29,R30	RES,CMPSN,62K,5%,1/4W CB 6235,A/B, RCO1GF623J	802082	2
R3,R4,R22	RES,MF,1.37K,1%,1/8W,100PPM RN55D1371F	810197	3
R31,R38	RES,VAR,5K,10%,1/2W,TRIM,25TRN 3299W-1-502,BOURNS	883066	2

Table 6-5. Main Power Supply Assembly A4, Parts List (Cont'd)
Rev.E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R32,R36	RES,MF,27.40K,1%,1/8W,50PPM RN55C2742F	808098	2
R33,R35	RES,MF,115K,1%,1/8W,100PPM RN55D1153F	886128	2
R34	RES,MF,1.30K,1%,1/4W,100PPM RN60D1301F	805640	1
R37	RES,CMPSN,3.30K,5%,1/4W CB3325,RCO7GF332J,RLR07C3301GS	803388	1
R39	RES,MF,3.74K,1%,1/8W,100PPM RN55D3741F	810352	1
R5	RES,MF,120 OHM,0.5%,1/4W,100PP RN60D1200D or RNC60H1200BS	886168	1
R6	RES,MF,0.383 OHM,0.5%,1/4W,50P RN60C3830D or RNC60H3830BS	886169	1
R7,R8	RES,MF,30.90K,1%,1/10W,100PPM RN55D3092F	807423	2
R9,R10	RES,MF,866 OHMS,1%,1/8W,100PPM RN55D8660F	810247	2
TP1-TP11,JP1	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	13
U1,U4	IC,REG,+ADJ,1.5A,TO-220,3TERM 317,LM317T,NAT	889940	2
U10	IC,COMP,QUAD,LO-PWR,LO-Vos 339,LM339N,NAT	807626	1
U2,U5	IC,REG,-ADJ,1.5A,TO-220,3TERM 337,LM337T,NAT	889941	2
U3	IC,REG,+ADJ,10A,TO-3 1038,LT1038MK,LT	810155	1
U6	IC,REG,+ADJ,1.5A,TO-39,3-TERM 317,LM317HVH,NAT	810153	1
U7	IC,REG,-ADJ,1.5A,TO-39,3TERM 337,LM337HVH,NAT	810154	1
U8,U9	IC,OPAMP,SR17V/usGBW63M,Vos10u 37,OP37EP,PMI	810136	2

Table 6-5. Main Power Supply Assembly A4, Parts List (Cont'd)
Rev.E

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
XF1,XF2,XF3,XF4	FUSEHOLDER,MICRO/SUB-MIN,PC MT 281.008,LITTLEFUSE	810351	4



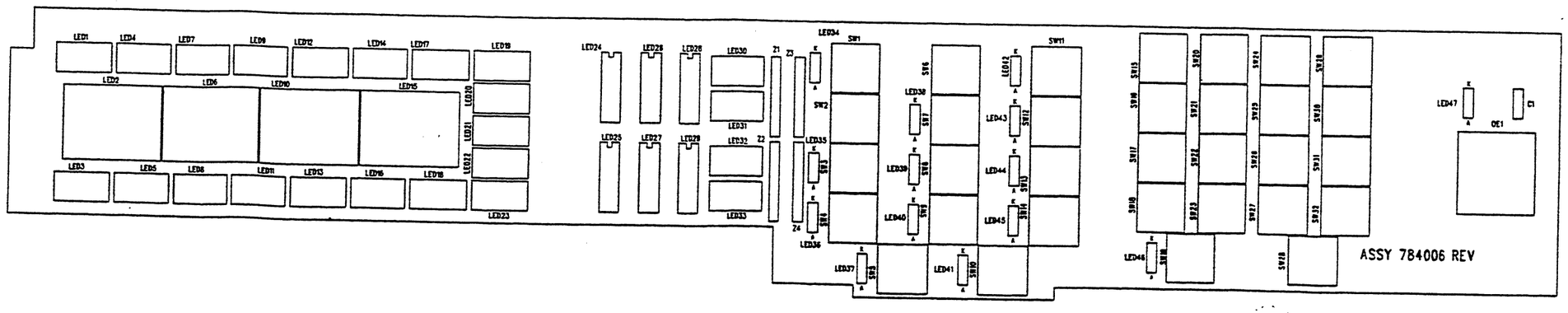


Fig. 6-6. Display/Keyboard Assembly

Table 6-6. Display/Keyboard Assembly A5, Parts List
Rev.D

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1	CAP,CER,1UF,50V, +-10% CK06BX105K	805155	1
J1,J2	CONN,HDR,40-POS,DBL.ROW,100CTR TSW-120-07-L-D,SAMTEC	810235	2
LED1,3,4,5,7-14,16-23,30-33	DGTL/DSPL,LED,10,RED LTL-57173,LITTON,MV57173,QT	886043	24
LED2,6,10,15	LED DISPLAY,.56 DUAL,LED METROTECH LTD6940HR	887339	4
LED24-29	LED,0.3IN SINGLE,SEE DWG I/A/W NAI DRAWING	887340	6
LED34-47	LED,HER,RECTANGULAR,5V@20mA HLMP-0301,HP	810282	14
OE1	OPTICAL ENCODER HRGP-AD32-16F,HP	810281	1
Q1-8	XSTR,MOSFET,N.CH,40W,Vbr60 MTP3055EL,MOTOROLA,TO-220AB	810283	8
SW1-32	SW,PB,MOMEMTARY DSKA03A,GRAYHILL	810285	32
XLED24-29	SOCKET,IC,14-POS,DIP,100x300SP ICT-143-SP122-TT,R. NUGENT	810413	6
Z1-4	RES,NET,ISO,SIP,33 OHMX4,8P,1W 4608M-102-330 or 4608X-102-330	810284	4

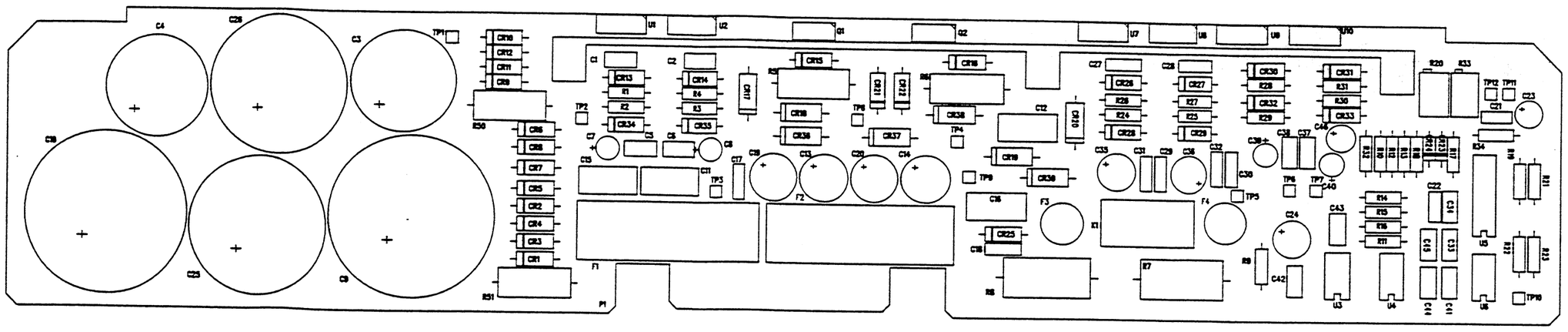


Fig. 6-7. Isolated Power Supply Assembly

Table 6-7. Isolated Power Supply Assembly A6,A7, Parts List
Rev.C

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
C1,2,5,6,33,34,37,38,41,42,43,44,45	CAP,CER,.1UF,50V,20%,Z5U,RADIA SR215E104MAA - AVX ONLY	886063	13
C11,12,15,16	CAP,FILM,.1UF,250V,10%,POLYSTR 104MSR250K,ILLINOIS CAP	810165	4
C13,14,19,20	CAP,AL-EL,10UF,250V,+-10% sub 885188 106CKR250MPX	808189	4
C17,18,31,32	CAP,CER,.01UF,200V,10% C062C103K2X5CA KEMET OR EQUAL	810164	4
C21,C22	CAP,CER,27PF,200WVDC,+-10% CK05BX270K	808401	2
C23,C46	CAP,TANT-NON,6.8UF,35V,+-10% 199D685X9035DA1 SPRAGUE	884420	2
C24	CAP,AL-EL,3.3UF,160V,RADIAL 335CKR160M,ILLINOIS CAP	810240	1
C25,C26	CAP,AL-EL,2200UF,100V30x30SNAP ECO_S2AP222DA,PANASONIC	810325	2
C27,28,29,30	CAP,CER,.1UF,100V,10%,X7R,RADI CK06BX104K,MALLORY or 880640	882188	4
C3,C4	CAP,AL-EL,3300UF,50V,22x35SNAP ECO_S1HA332BA,PANASONIC *	810324	2
C35,C36	CAP,AL-EL,10UF,100V,20% 106CKR100M,ILLINOIS	810158	2
C7,8,39,40	CAP,AL-EL,10UF,50V,RADIAL 106CKR050M,ILLINOIS CAP	810239	4
C9,C10	CAP,AL-EL,820UF,250V,35x35SNAP 827LBA250M2EE,ILLINOIS CAP	810276	2
CR1-CR16,CR21,CR22,CR25-CR35	DIODE,SIG,PIV400V,1A 1N4004	803735	29
CR17,18,19,20	DIODE,ZENER,39V,5W,5% 1N5366B,MOTA	810347	4
CR23,CR24	DIODE,SIG,PIV75V,0.010A,4nS 1N4148,SUB 808974, 882195	805805	2
CR36,37,38,39	DIODE,ZENER,36V,5W,5% 1N5365B,MOTA	810346	4

Table 6-7. Isolated Power Supply Assembly A6,A7, Parts List (Cont'd)
Rev.C

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
F1,F2	FUSE,0.1A,250V,3AG,FAST ACTING 312.100,LITTLEFUSE OR EQUAL	810261	2
F3,F4	FUSE,0.75A,125V,MICRO,VERYFAST 273.750,LITTLEFUSE	810350	2
K1	RELAY,2 FORM C,48V,1A,PCB MR602-48USR,RA-48W-K,NEC,ITT*	810243	1
Q1	XSTR,PWR,NPN,300V,20W,0.5A MJE340,MOTOROLA,TO-225AA	810156	1
Q2	XSTR,PWR,PNP,300V,20W,0.5A MJE350,MOTOROLA,TO-225AA	810157	1
R1,4,28,31	RES,MF,1.37K,1%,1/8W,100PPM RN55D1371F	810197	4
R10	RES,MF,1.65K,1%1/10W,50PPM RNC55H1651FS	807075	1
R11	RES,MF,1.07K,1%,1/8W,100PPM RN55D1071F	810395	1
R12,R14,R15	RES,MF,14.70K,1%,1/8W,100PPM RN55D1472F OR EQUAL	810203	3
R13	RES,MF,374 OHM,1%,1/8W,100PPM RN55D3740F	803557	1
R16	RES,MF,340 OHMS,1%,1/8W,100PPM RN55D3400F,DALE OR =	810246	1
R17,R18	RES,CMPSN,62K,5%,1/4W CB 6235,A/B, RCO1GF623J	802082	2
R19,R32	RES,MF,115K,1%,1/8W,100PPM RN55D1153F	886128	2
R2,R3	RES,MF,13.70K,1%,1/10W,100PPM RN55D1372F	885969	2
R20,R33	RES,VAR,5K,10%,1/2W,25TURN,TRM 3299X-1-502,BOURNS OR EQUAL	810248	2
R21,R34	RES,MF,27.40K,1%,1/8W,50PPM RN55C2742F	808098	2
R22	RES,CMPSN,51K,5%,1/4W NCF25-51K,NIC	880559	1

Table 6-7. Isolated Power Supply Assembly A6,A7, Parts List
Rev.C

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
R23	RES,CMPSN,10K,5%,1/4W, NCF25-10K or RL07S1002G	880092	1
R24,R25	RES,MF,30.90K,1%,1/10W,100PPM RN55D3092F	807423	2
R26,R27	RES,MF,866 OHMS,1%,1/8W,100PPM RN55D8660F	810247	2
R29,R30	RES,MF,20K,1%,1/8W,50PPM RN55C2002F,NC55, CMF55	806544	2
R5,R6	RES,CMPSN,1.50K,10%,1W RCR32G152J	803208	2
R50,51	RES,MF,23.20K,1%,2W,100PPM CPF-2-2322F-T-1,DALE OR =	810265	2
R7,R8	RES,WW,7.50K,5%,3W VC3D-7500or3X7500 W/L,CLAROSTA	802271	2
R9	RES,MF,0.10,OHM,2%,1/8W,200PPM CMF-55-R10-G-T-00,DALE OR =	810244	1
TP1,2,3,4,5,6,7,8,9,10,11	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	11
U1,U7,U9	IC,REG,+ADJ,1.5A,TO-220,3TERM 317,LM317T,NAT	889940	3
U2,U8,U10	IC,REG,-ADJ,1.5A,TO-220,3TERM 337,LM337T,NAT	889941	3
U3,U4	IC,OPAMP,SR17V/usGBW63M,Vos10u 37,OP37EP,PMI	810136	2
U5	IC,COMP,QUAD,LO-PWR,LO-Vos 339,LM339N,NAT	807626	1
U6	IC,OPTOCOUPLER,HI-GAIN DARLNGT 6N139,HP	884460	1
XF1,XF2	FUSE-BLOCK,3AG,1POLE,PC15A300V 354.101.GY,LITTLEFUSE	810349	2
XF3,XF4	FUSEHOLDER,MICRO/SUB-MIN,PC MT 281.008,LITTLEFUSE	810351	2

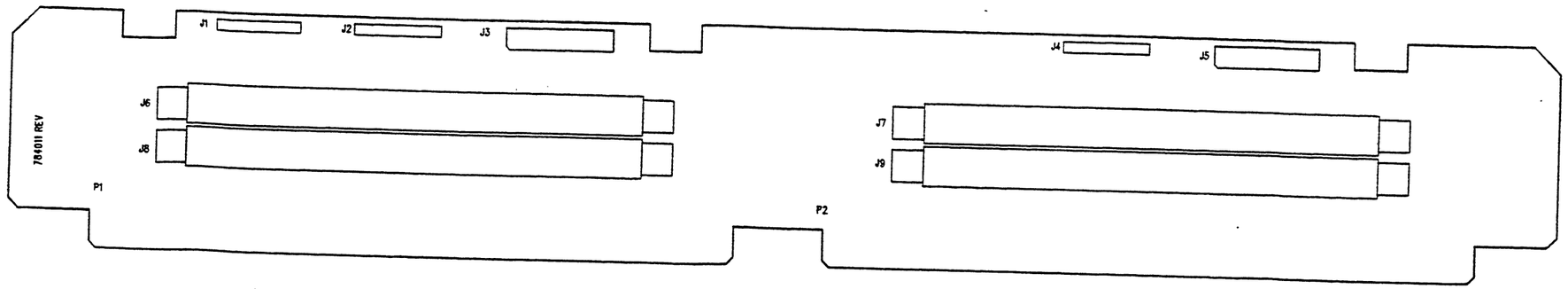


Fig. 6-8. Interconnect Board Assembly

Table 6-8. Analog Interconnection Board Assembly A8, Parts List
Rev.C

REFERENCE DESIGNATORS	DESCRIPTION / VENDOR PART NO.	NAI PART NO.	QTY
J1,J2,J3,J4,J5	CONN,HDR,POST,.025 SQUARE * 87022-9,AMP ONLY,MOD2MACH.APPL	880007	64
J6,J7,J8,J9	CONN,EDGE,40-POS,DBL.READ,100C EZC40DCSD or EZC40DCWD,SULLINS	810236	4

CHAPTER 7
DIAGRAMS

7.1 GENERAL

This chapter contains the schematic diagrams for the Resolver/Synchro Standard (RSS). These diagrams supplement Chapter 4, Principles of Operation, and are used when performing maintenance for the RSS.

7.2 DIAGRAMS

Table 7-1 lists and describes the diagrams for the RSS.

Note

The upper R/H corner of the drawing contains the revision of the drawing. Refer to this revision if you need to discuss maintenance with the manufacturer.

Table 7-1. RSS Synchro/Resolver Standard Diagrams

FIGURE NO.	NOMENCLATURE	NAI DRAWING NO.
7-1	System Board A1, Schematic Diagram	770007
7-2	Sine/Cosine Board A2, Schematic Diagram	770001
7-3	Analog Board A3, Schematic Diagram	770006
7-4	Main Power Supply Assembly A4, Schematic Diagram	770009
7-5	Display/ Keyboard Assembly A5, Schematic Diagram	770000
7-6	Isolated Power Supply A6, A7, Schematic Diagram	770010
7-7	Analog Interconnect Board A8, Schematic Diagram	770008
7-8	Analog Card Cage Extender, Schematic Diagram	770011

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	FIRST DRAFT	2/8/94	D.A.
	B	RELEASE FOR MANUFACTURE	7/19/94	PVR
	C	ADDED BYPASS TO DSP	8/29/94	PVR
	D	REV PER PCR 33199	12/12/94	MDP

+5V
16
Z8A
Z8B
Z8C
Z8D
1
2
3
4

10MHZ/4
U46F
74LS14
J14-12 B10MHZ/4

Y3
OSC14PIN
EN
OUT
10MHZ
TP29
TP34
10MHZ
ECLK

+5V
16
Z8E
5
U47A
74HCT00
J14-66 -RD

+5V
16
Z8I
9

U40
CS1232
-AS
ST
PBRST
TD
TOL
RST1
RST2
U39C
74HCT05
U39B
74HCT05
-RESET

U34
CLK
E
-IPL0
-IPL1
-IPL2
IPL0
IPL1
IPL2
HALT
RESET
-VPA
VPA
VMA
BR
BG
BGACK
-DTACK
-BERR
DTACK
BERR
TP33 TP35 TP31
-UDS
-LDS
R/W
UDS
LDS
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
68HC000
TP32
FC0
FC1
FC2
-AS
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
A17
A18
A19
A20
A21
A22
A23

U10
74HCT244
U16
74HCT244
U23
74HCT244
1G
2G
1A1
1A2
1A3
1A4
2A1
2A2
2A3
2A4
1Y1
1Y2
1Y3
1Y4
2Y1
2Y2
2Y3
2Y4
R/W
MA01
MA02
MA03
MA04
MA05
MA06
MA07
MA08
MA09
MA10
MA11
MA12
MA13
MA14
MA15
MA16
MA17
MA20
MA21
MA22
MA23
MA[01:23]

U33
U27
74HCT245
74HCT245
R/W
OE
DIR
A1
A2
A3
A4
A5
A6
A7
A8
B1
B2
B3
B4
B5
B6
B7
B8
MD00
MD01
MD02
MD03
MD04
MD05
MD06
MD07
MD08
MD09
MD10
MD11
MD12
MD13
MD14
MD15
MD[00:15]

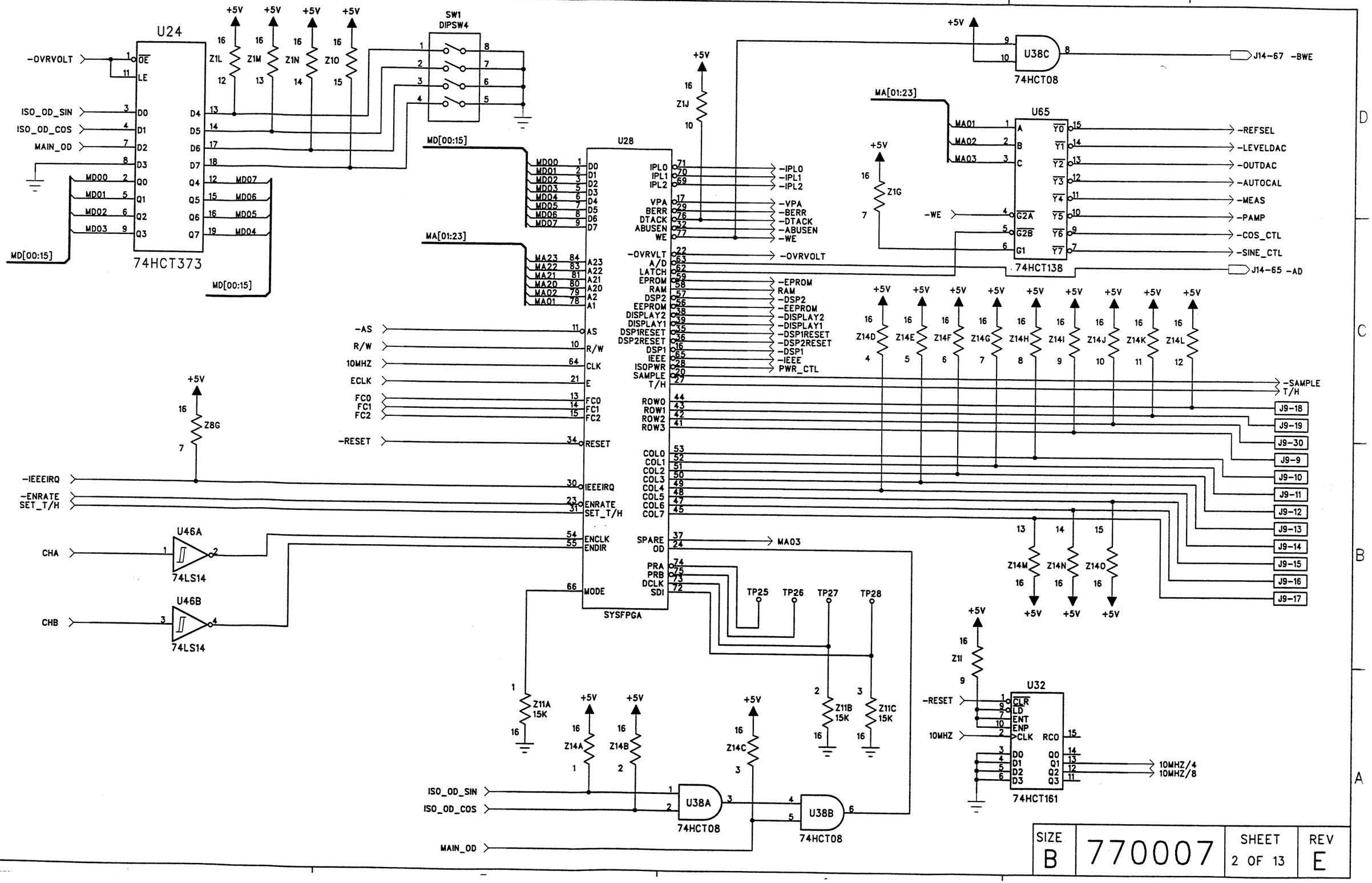
+5V
C80
10uF

784009	5300
NEXT ASSY	USED ON

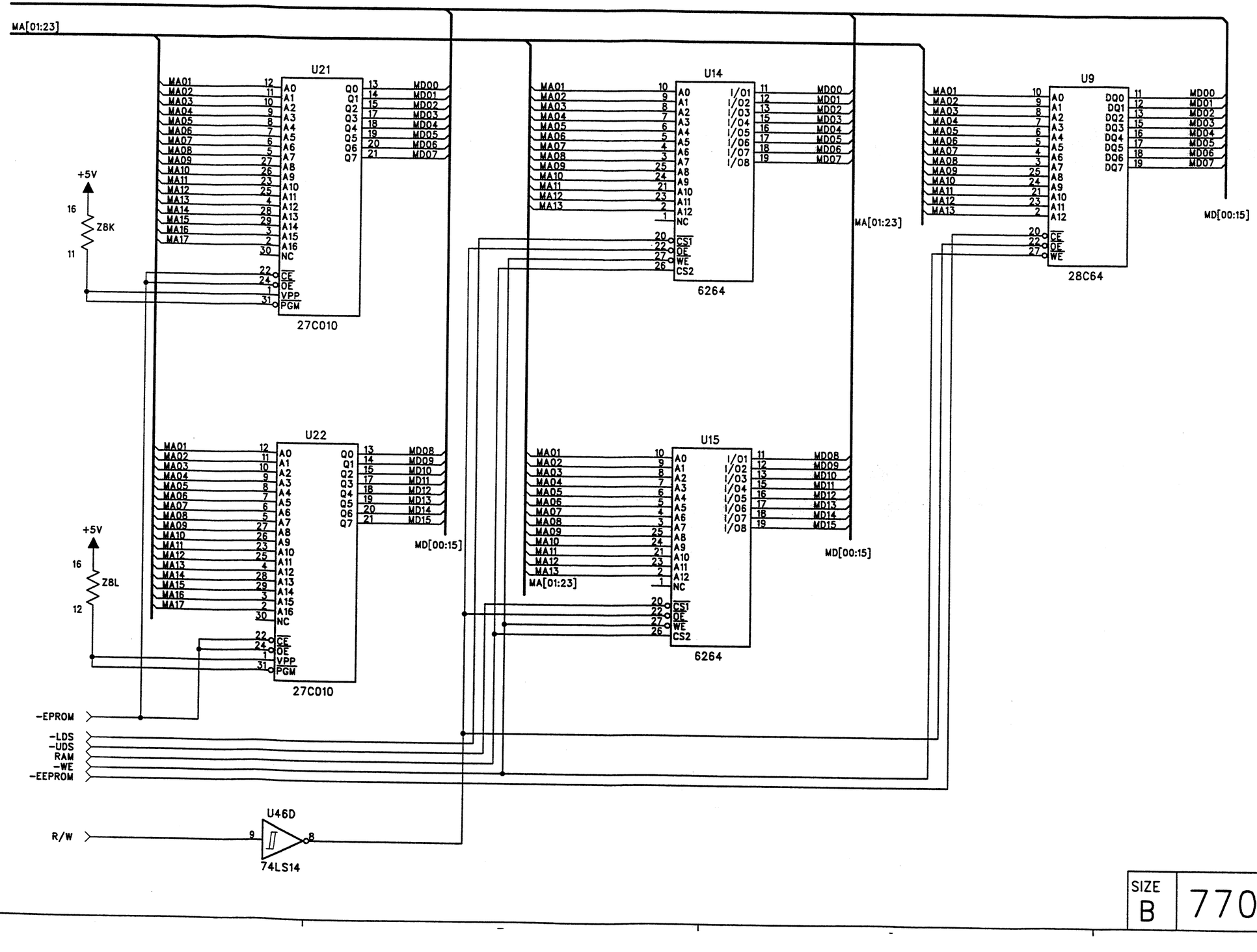
NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC DIAGRAM
5300 SYSTEM BOARD

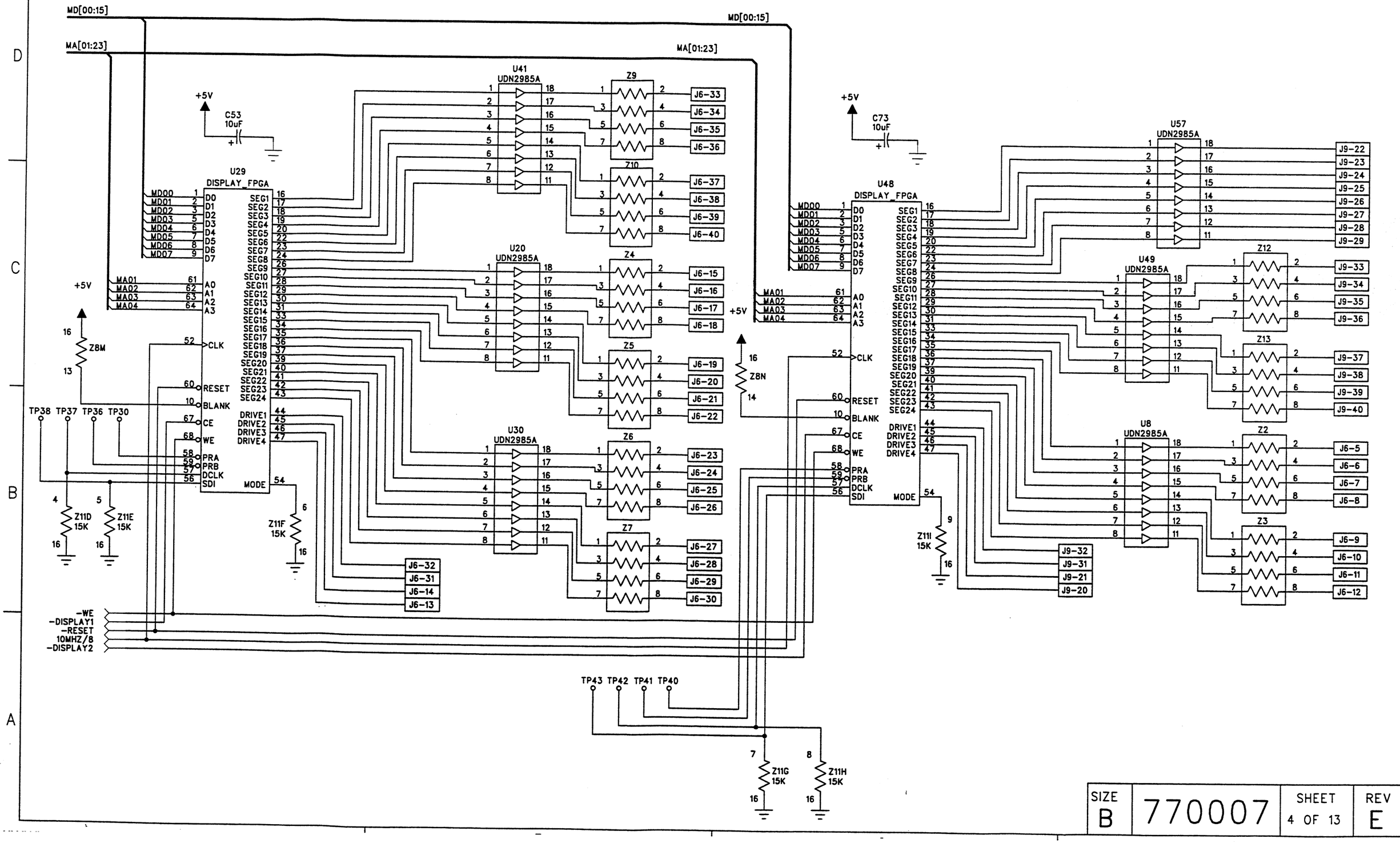
SIZE		SHEET	REV
B	770007	1 OF 13	E



SIZE		SHEET	REV
B	770007	2 OF 13	E

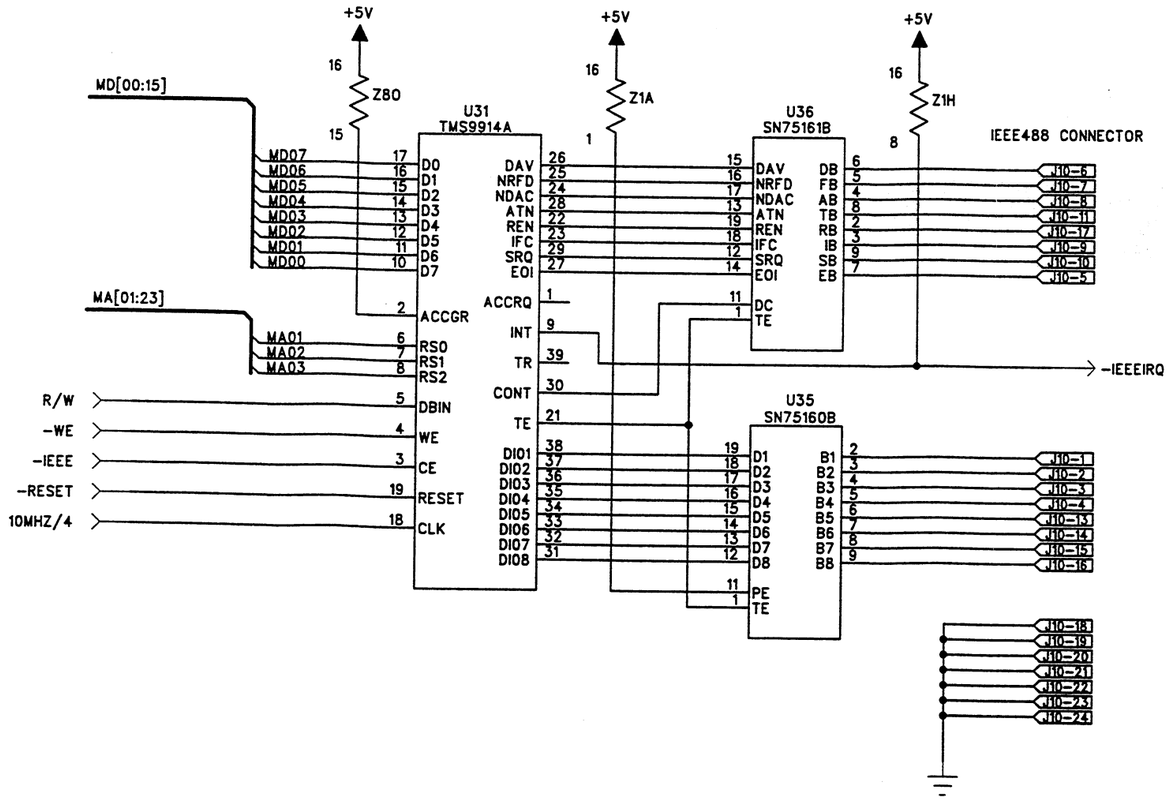


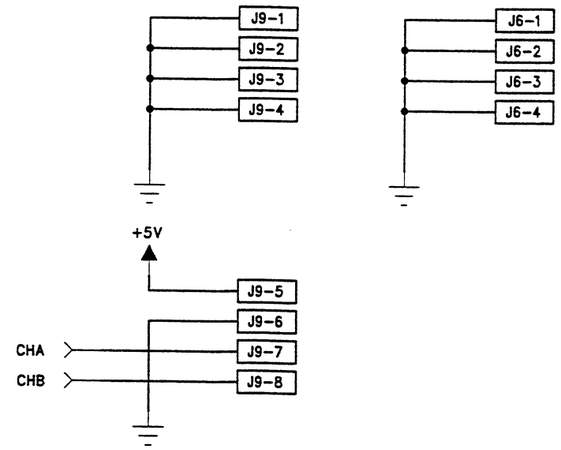
SIZE		SHEET	REV
B	770007	3 OF 13	E



SIZE		SHEET	REV
B	770007	4 OF 13	E

IEEE488 INTERFACE





SIZE		SHEET	REV
B	770007	5 OF 13	E

ANGLE DSP

Y1
OSC14PIN
1 EN OUT 8
20MHZ
TP21
DSP1CLK

+5V +5V +5V
Z1C 16 3
Z1D 16 4
Z1E 16 5
D1 1N4148
TP10
TP14
-SAMPLE
-DSP1RESET

U2
DSP56001
124 RESET
127 EXTAL
126 XTAL
45 BR
123 MODA/-IRQA
121 MODB/-IRQB
PS 52
DS 49
BG 43
WR 46
RD 47
X/-Y 48
TP11 TP4 TP3 TP1 TP2
-PS1
-DS1
-WR1
-RD1
X/-Y1

TP12 TP9
SC0 31
SC1 40
SC2 37
SCK 32
SRD 42
STD 39
RXD 27
TXD 28
SCLK 29
-ENRATE
SET_T/H
SYNCA
SYNCB

+5V
Z1B 16 2
TP13
HACK 6
HREQ 10
HEN 8
HR/-W 9
-DSP1 R/W

MA[01:23]
MA01 MA02 MA03
HA0 5
HA1 2
HA2 1

MD[00:15]
MD00 MD01 MD02 MD03 MD04 MD05 MD06 MD07
H0 25
H1 22
H2 20
H3 19
H4 16
H5 15
H6 14
H7 11

D0 81 DSP1D00
D1 82 DSP1D01
D2 85 DSP1D02
D3 86 DSP1D03
D4 87 DSP1D04
D5 88 DSP1D05
D6 92 DSP1D06
D7 93 DSP1D07
D8 94 DSP1D08
D9 96 DSP1D09
D10 97 DSP1D10
D11 99 DSP1D11
D12 102 DSP1D12
D13 104 DSP1D13
D14 105 DSP1D14
D15 106 DSP1D15
D16 108 DSP1D16
D17 109 DSP1D17
D18 113 DSP1D18
D19 114 DSP1D19
D20 115 DSP1D20
D21 118 DSP1D21
D22 119 DSP1D22
D23 120 DSP1D23
DSP1D23
Z11J 10 15K 16

A0 53 DSP1A00
A1 54 DSP1A01
A2 57 DSP1A02
A3 58 DSP1A03
A4 60 DSP1A04
A5 61 DSP1A05
A6 65 DSP1A06
A7 67 DSP1A07
A8 68 DSP1A08
A9 70 DSP1A09
A10 71 DSP1A10
A11 75 DSP1A11
A12 76 DSP1A12
A13 77 DSP1A13
A14 79 DSP1A14
A15 80 DSP1A15

VCC PINS: 12,13,35,36,63,64
100,101,128,129
GND PINS: 23,24,33,34,55,56,
73,74,90,91,111,112,130,131
NO CONNECTION PINS:
3,4,7,17,18,21,26,30,38,
41,44,50,51,59,62,66,69,
72,78,83,84,89,95,98,103,107,
110,116,117,122,125,132

+5V
C79 10uF
C74 .1UF
C75 .1UF
C81 .1UF

DSP1A[00:15]

DSPD[00:23]

U6
DSP1A00 10 A0
DSP1A01 9 A1
DSP1A02 8 A2
DSP1A03 7 A3
DSP1A04 6 A4
DSP1A05 5 A5
DSP1A06 4 A6
DSP1A07 3 A7
DSP1A08 25 A8
DSP1A09 24 A9
DSP1A10 21 A10
DSP1A11 23 A11
DSP1A12 2 A12
DSP1A13 26 A13
DSP1A14 1 A14
20 CS
22 OE
27 WE
I/00 11 DSP1D00
I/01 12 DSP1D01
I/02 13 DSP1D02
I/03 15 DSP1D03
I/04 16 DSP1D04
I/05 17 DSP1D05
I/06 18 DSP1D06
I/07 19 DSP1D07
62256

U5
74HCT244
DSP1D00 DSP1D01 DSP1D02 DSP1D03 DSP1D04 DSP1D05 DSP1D06 DSP1D07
1A1 2 1A2 4 1A3 6 1A4 8 2A1 11 2A2 13 2A3 15 2A4 17
1Y1 18 1Y2 16 1Y3 14 1Y4 12 2Y1 9 2Y2 7 2Y3 5 2Y4 3
BDSP1D00 BDSP1D01 BDSP1D02 BDSP1D03 BDSP1D04 BDSP1D05 BDSP1D06 BDSP1D07
1G 1
2G 19

U12
DSP1A00 10 A0
DSP1A01 9 A1
DSP1A02 8 A2
DSP1A03 7 A3
DSP1A04 6 A4
DSP1A05 5 A5
DSP1A06 4 A6
DSP1A07 3 A7
DSP1A08 25 A8
DSP1A09 24 A9
DSP1A10 21 A10
DSP1A11 23 A11
DSP1A12 2 A12
DSP1A13 26 A13
DSP1A14 1 A14
20 CS
22 OE
27 WE
I/00 11 DSP1D08
I/01 12 DSP1D09
I/02 13 DSP1D10
I/03 15 DSP1D11
I/04 16 DSP1D12
I/05 17 DSP1D13
I/06 18 DSP1D14
I/07 19 DSP1D15
62256

U11
74HCT244
DSP1D08 DSP1D09 DSP1D10 DSP1D11 DSP1D12 DSP1D13 DSP1D14 DSP1D15
1A1 2 1A2 4 1A3 6 1A4 8 2A1 11 2A2 13 2A3 15 2A4 17
1Y1 18 1Y2 16 1Y3 14 1Y4 12 2Y1 9 2Y2 7 2Y3 5 2Y4 3
BDSP1D08 BDSP1D09 BDSP1D10 BDSP1D11 BDSP1D12 BDSP1D13 BDSP1D14 BDSP1D15
1G 1
2G 19

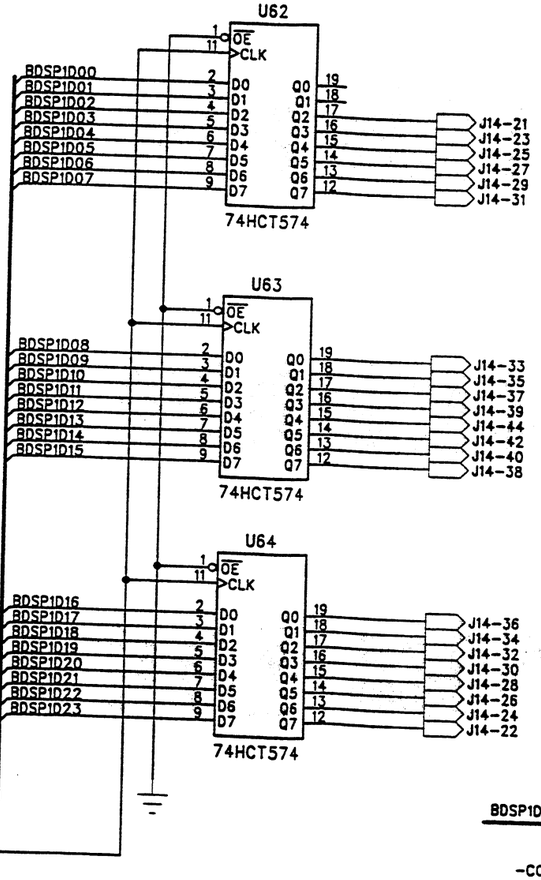
U18
DSP1A00 10 A0
DSP1A01 9 A1
DSP1A02 8 A2
DSP1A03 7 A3
DSP1A04 6 A4
DSP1A05 5 A5
DSP1A06 4 A6
DSP1A07 3 A7
DSP1A08 25 A8
DSP1A09 24 A9
DSP1A10 21 A10
DSP1A11 23 A11
DSP1A12 2 A12
DSP1A13 26 A13
DSP1A14 1 A14
-DSP1RAM 20 CS
-RD1 22 OE
-WR1 27 WE
I/00 11 DSP1D16
I/01 12 DSP1D17
I/02 13 DSP1D18
I/03 15 DSP1D19
I/04 16 DSP1D20
I/05 17 DSP1D21
I/06 18 DSP1D22
I/07 19 DSP1D23
62256

U17
74HCT244
DSP1D16 DSP1D17 DSP1D18 DSP1D19 DSP1D20 DSP1D21 DSP1D22 DSP1D23
1A1 2 1A2 4 1A3 6 1A4 8 2A1 11 2A2 13 2A3 15 2A4 17
1Y1 18 1Y2 16 1Y3 14 1Y4 12 2Y1 9 2Y2 7 2Y3 5 2Y4 3
BDSP1D16 BDSP1D17 BDSP1D18 BDSP1D19 BDSP1D20 BDSP1D21 BDSP1D22 BDSP1D23
1G 1
2G 19

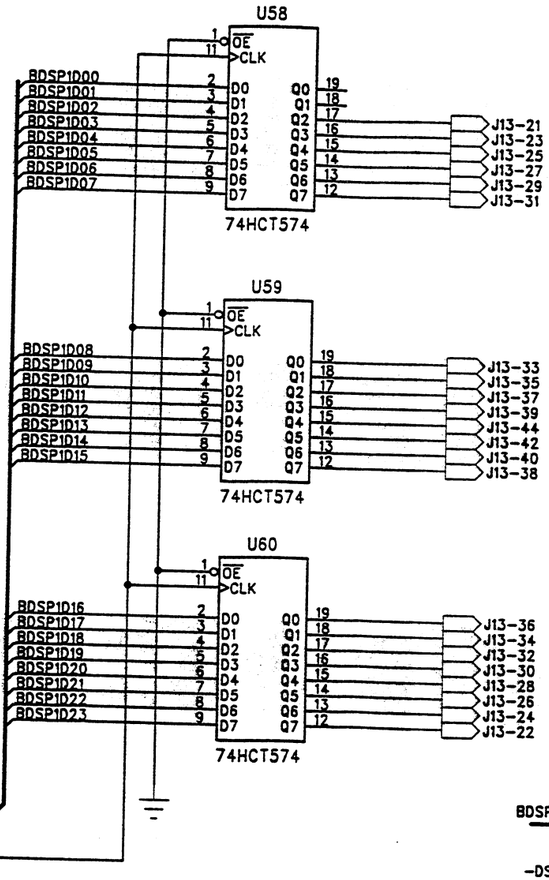
DSP1D[00:23]
BDSP1D[00:23]

SIZE		SHEET	REV
B	770007	6 OF 13	E

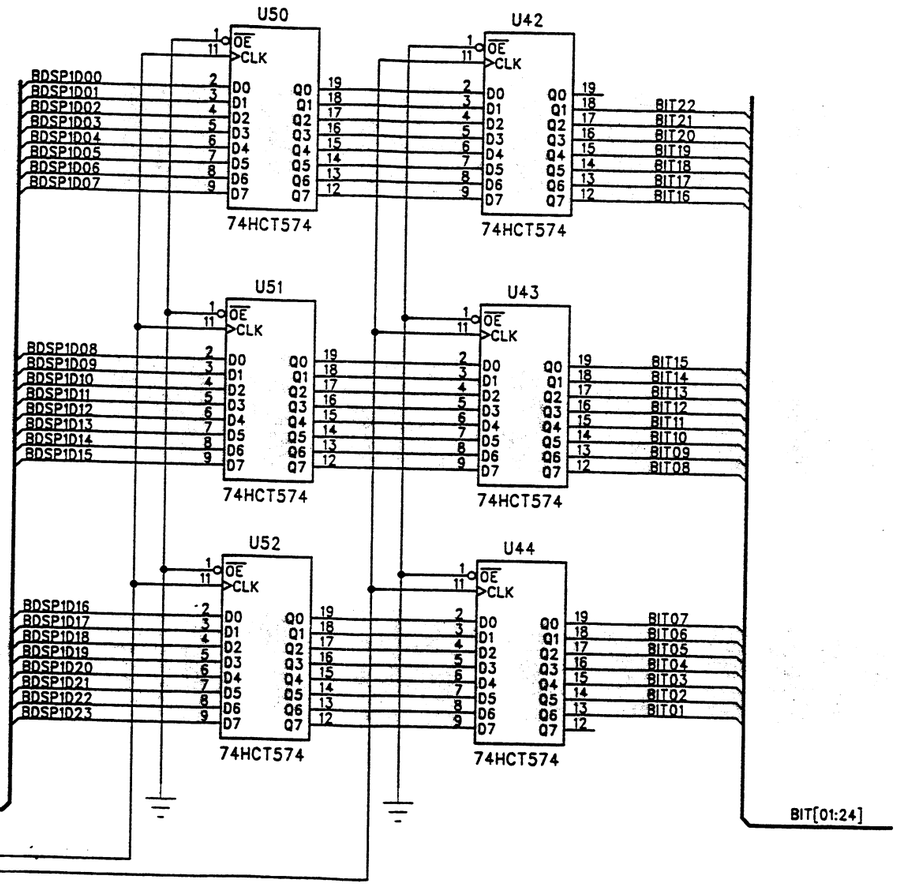
SINE REGISTER



COSINE REGISTER



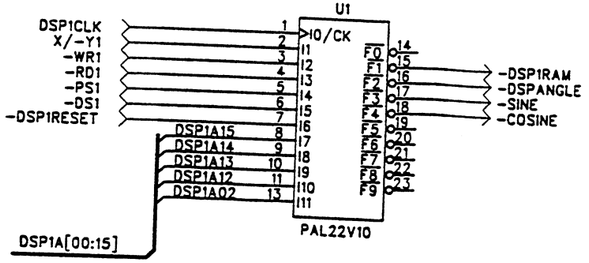
ANGLE REGISTER

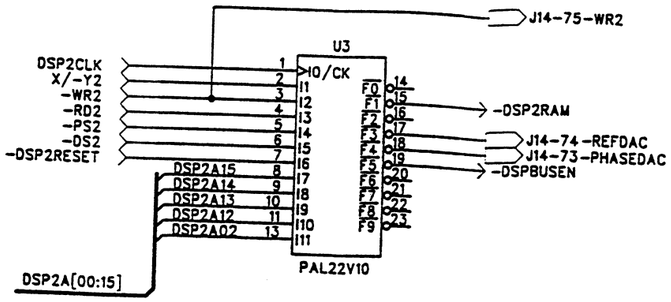


NOTE: U42-U44 AND U50-U52 ARE OPTIONAL.

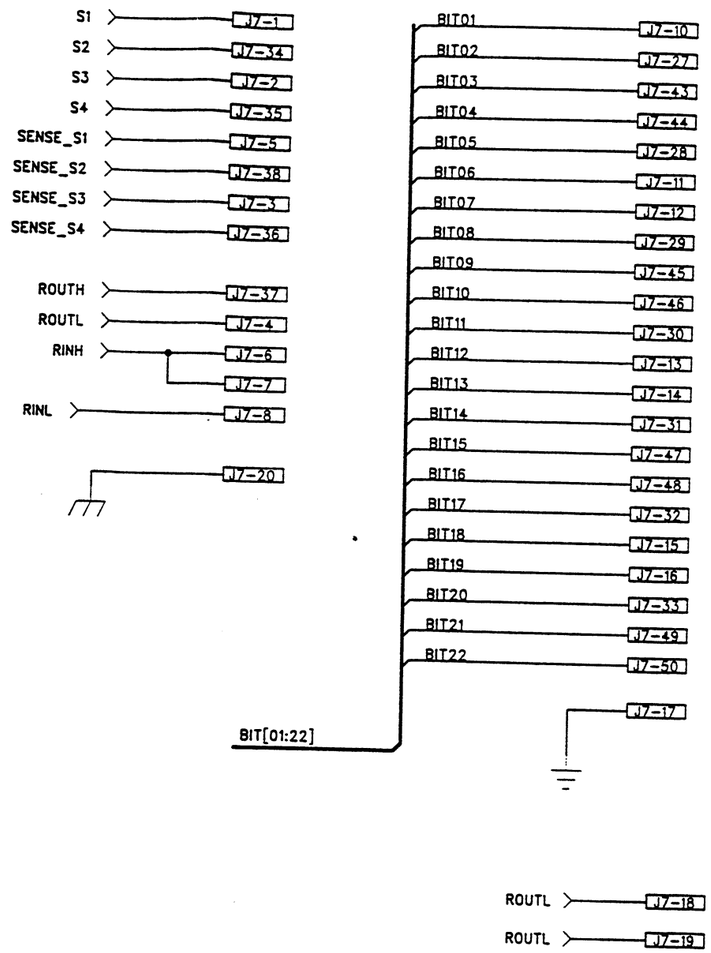
CHANGE 1

SIZE		SHEET	REV
B	770007	7 OF 13	E

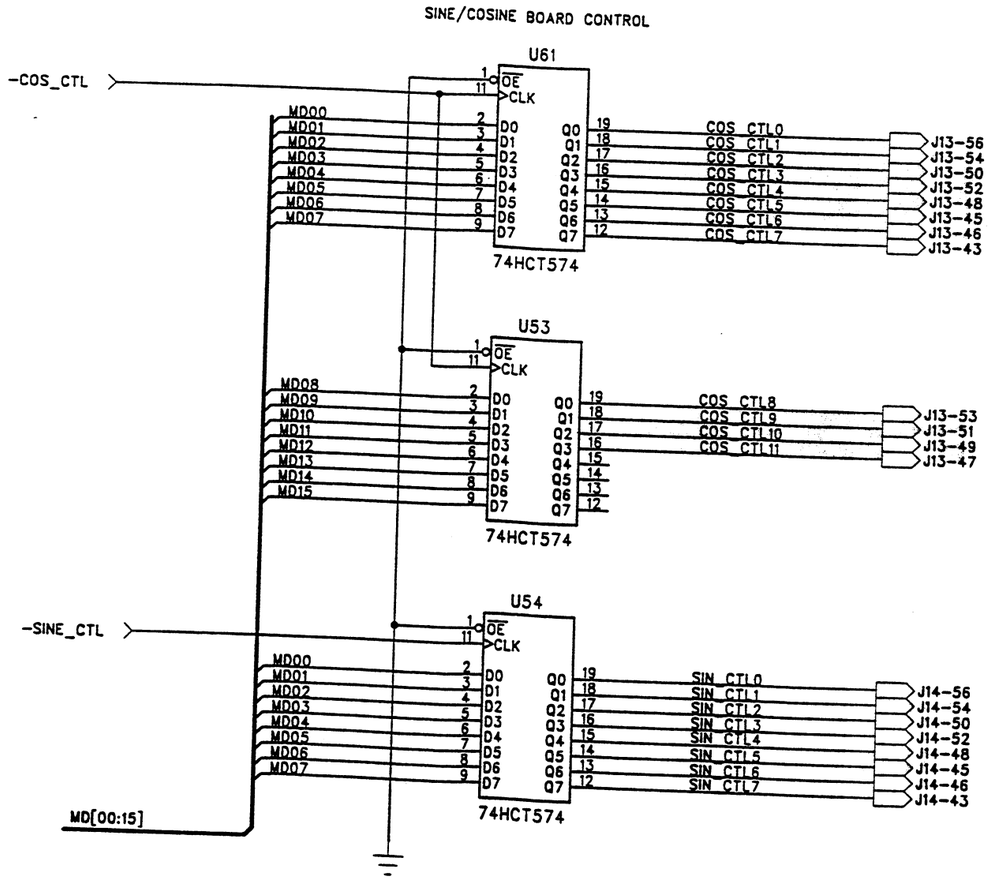




DB50 OUTPUT CONNECTOR



SINE/COSINE BOARD CONTROL

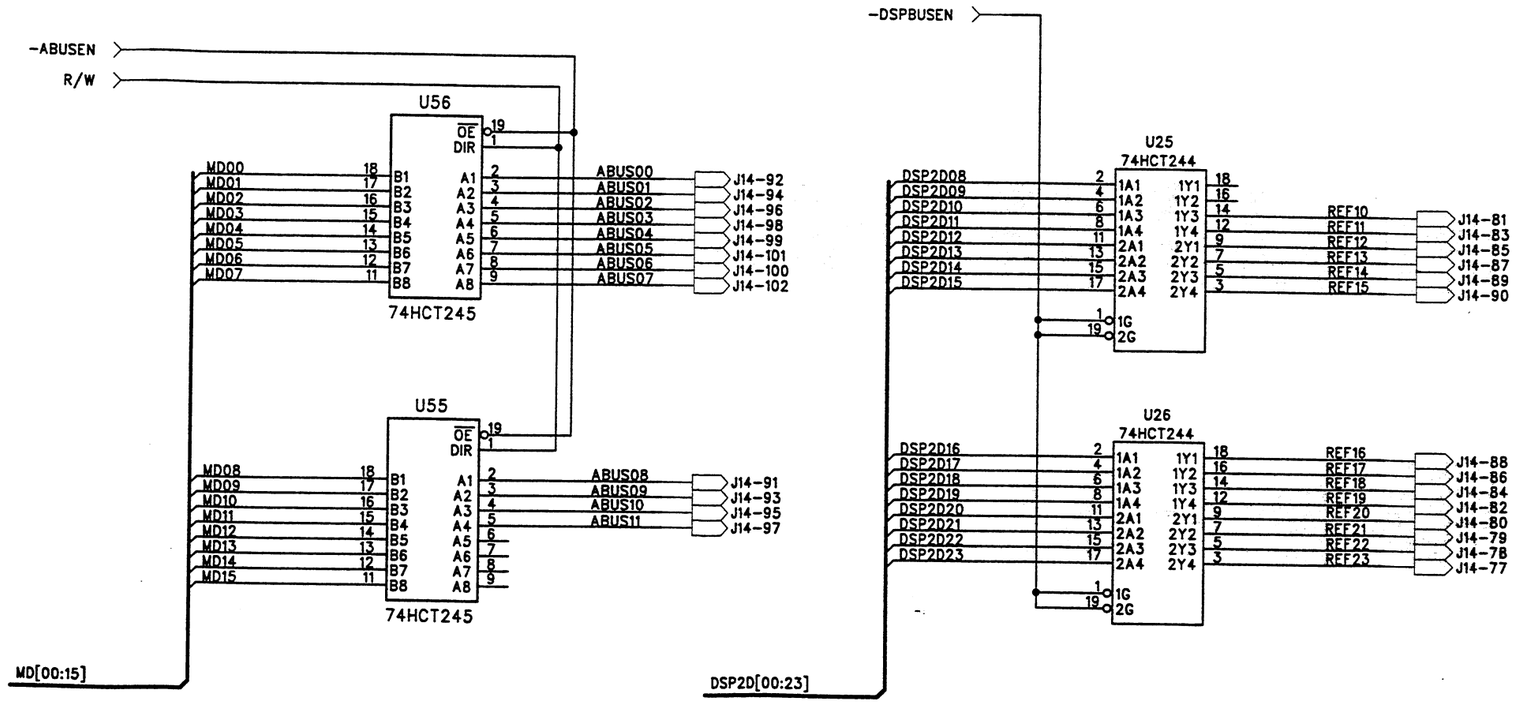


NOTE: U37 IS OPTIONAL.

J7 IS OPTIONAL AND USED ON S3412.

CHANGE 1

SIZE		SHEET	REV
B	770007	8 OF 13	E



SIZE		SHEET	REV
B	770007	9 OF 13	E

REFERENCE DSP

Y2
OSC14PIN
20MHZ
TP22
DSP2CLK

U4
DSP56001

+5V
Z8H 16 8
Z8J 16 10
Z1F 16 6
D2 1N4148
TP20
TP8
TP7 TP18 TP16 TP6 TP5
TP15 TP19
TP17

RESET
EXTAL
XTAL
BR
MODA/-IRQA
MODB/-IRQB
PS
DS
BG
WR
RD
X/-Y
-PS2
-DS2
-WR2
-RD2
X/-Y2
-DSP2RESET
IDLE
-LDAC
SC0
SC1
SC2
SCK
SRD
STD
RXD
TXD
SCLK
Z8F 16 6
HACK
HREQ
HEN
HR/-W
-DSP2 R/W

D0–D23 → DSP2D00–DSP2D23
DSP2D23
Z11K 15K 11 16

MA01 MA02 MA03 → HA0 HA1 HA2
MA[01:23]

MD00–MD07 → H0–H7
MD[00:15]

A0–A15 → DSP2A00–DSP2A15

DSP2D[00:23]

U19
U13
U7
62256
A0–A14
I/00–I/07
CS
OE
WE

-DSP2RAM
-RD2
-WR2

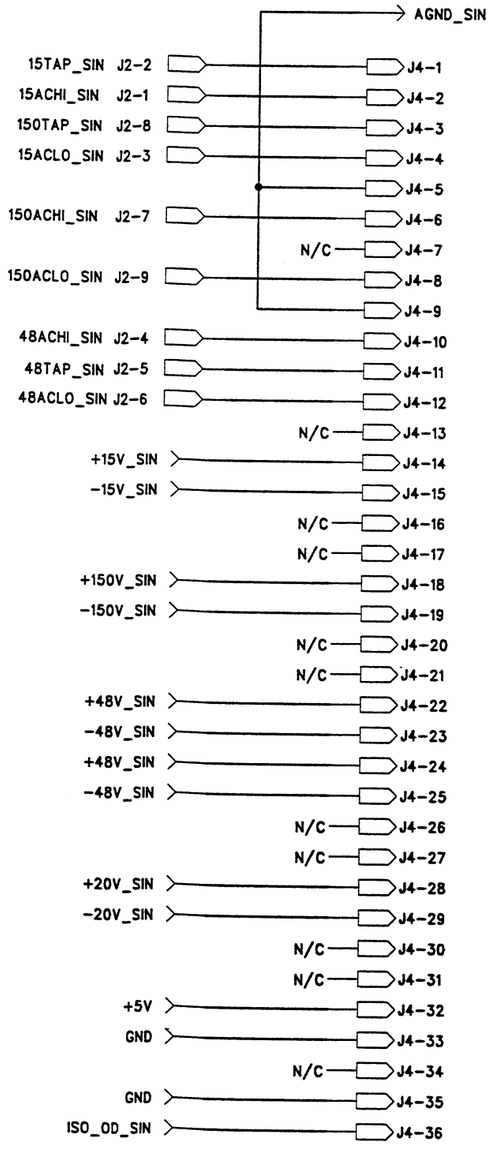
DSP2D[00:23]
DSP2A[00:15]
DSP2A[00:15]

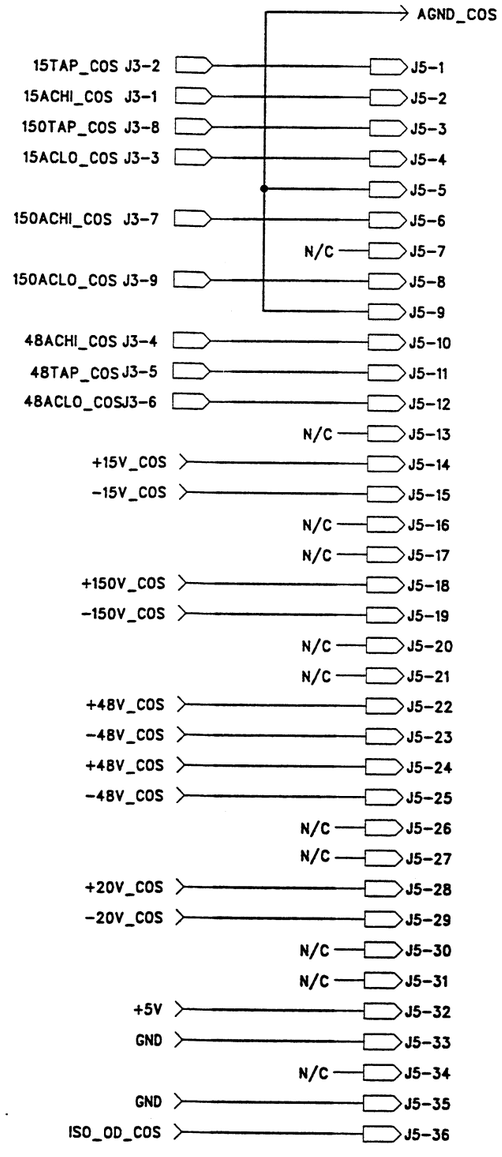
VCC PINS: 12,13,35,36,63,64
100,101,128,129
GND PINS: 23,24,33,34,55,56,
73,74,90,91,111,112,130,131
NO CONNECTION PINS:
3,4,7,17,18,21,26,30,38,
41,44,50,51,59,62,66,69,
72,78,83,84,89,95,98,103,107,
110,116,117,122,125,132

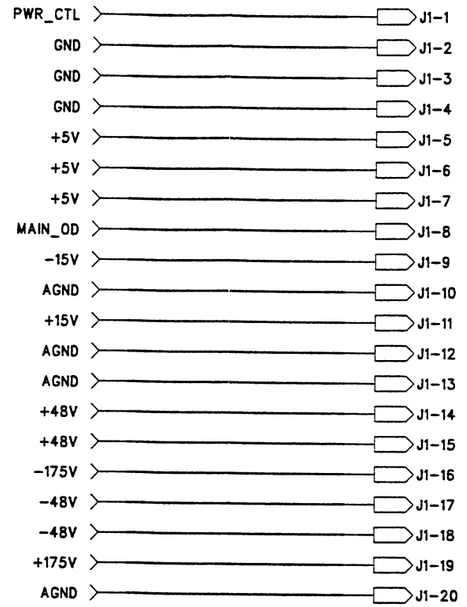
+5V
Z1K 16 11
74HCT00
U47B
-DSP2RESET
CNT

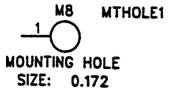
+5V
C78 10uF
C76 .1UF
C77 .1UF
C82 .1UF

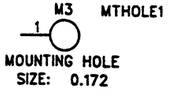
SIZE		SHEET	REV
B	770007	10 OF 13	E

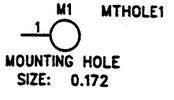


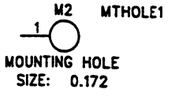


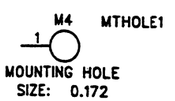


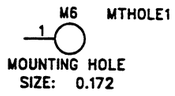


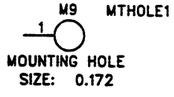


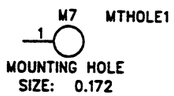


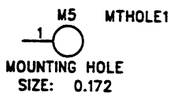


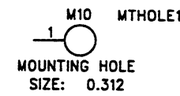


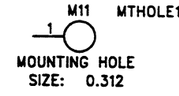


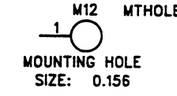




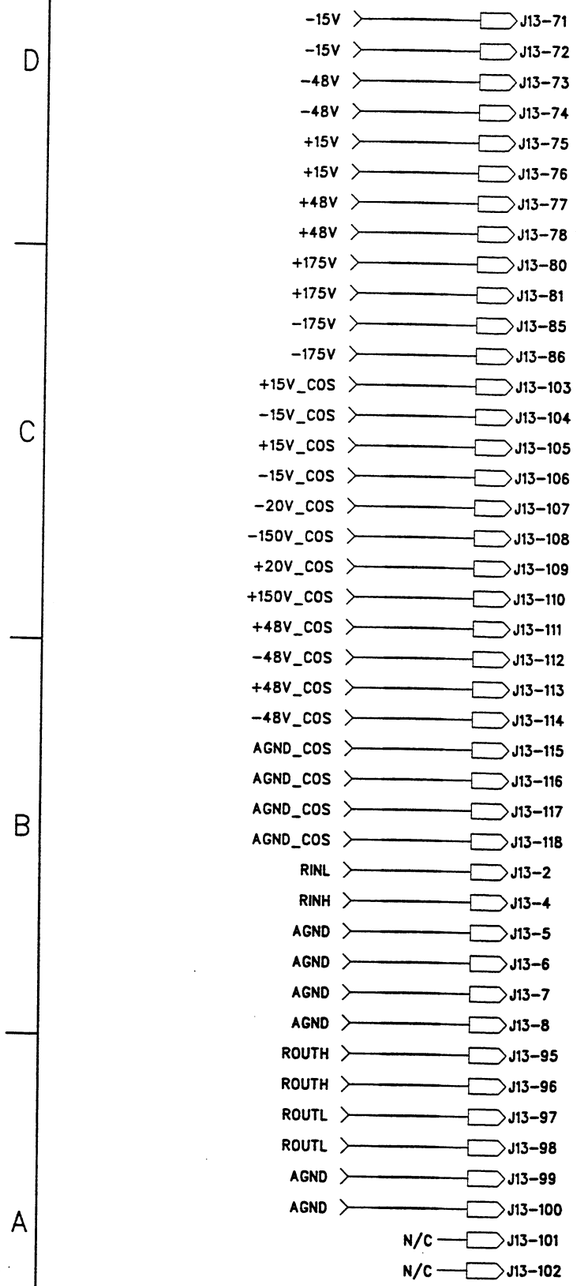


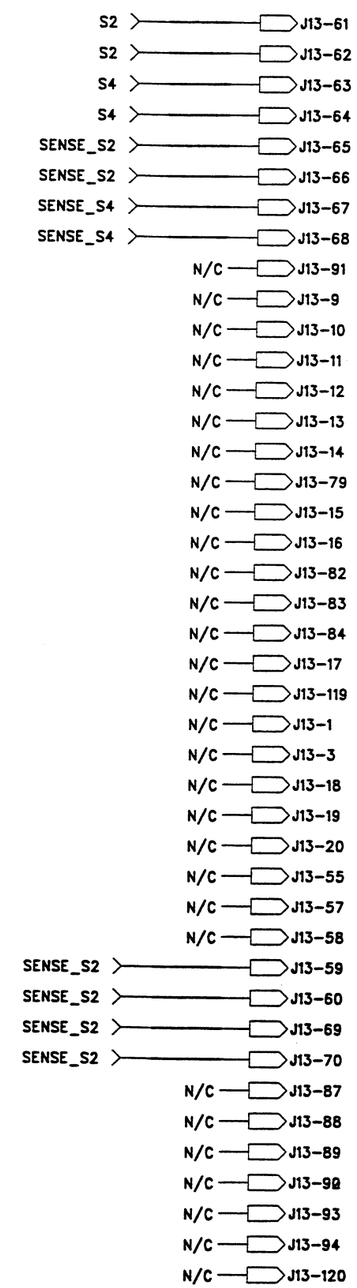


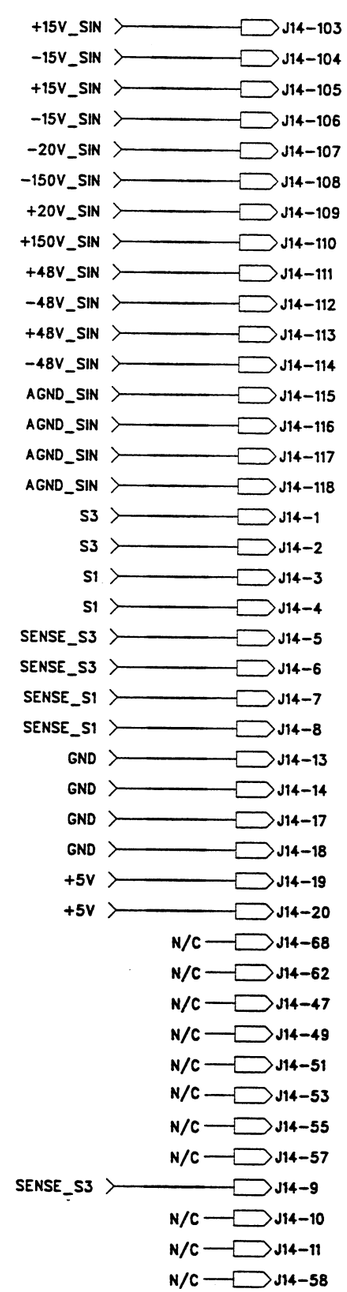


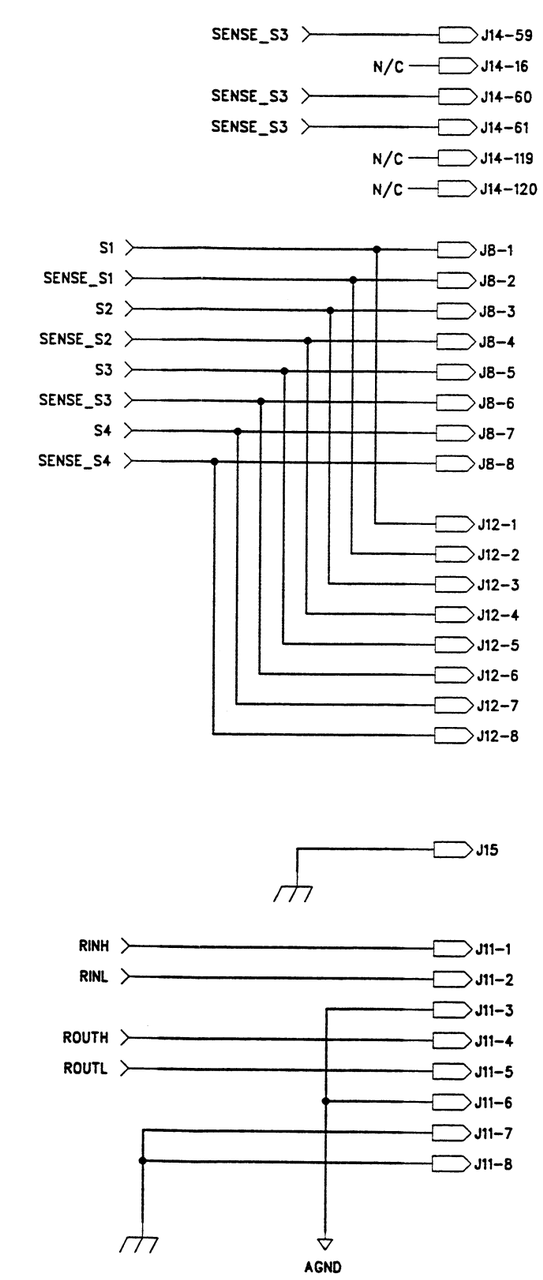


SIZE		SHEET	REV
B	770007	11 OF 13	E

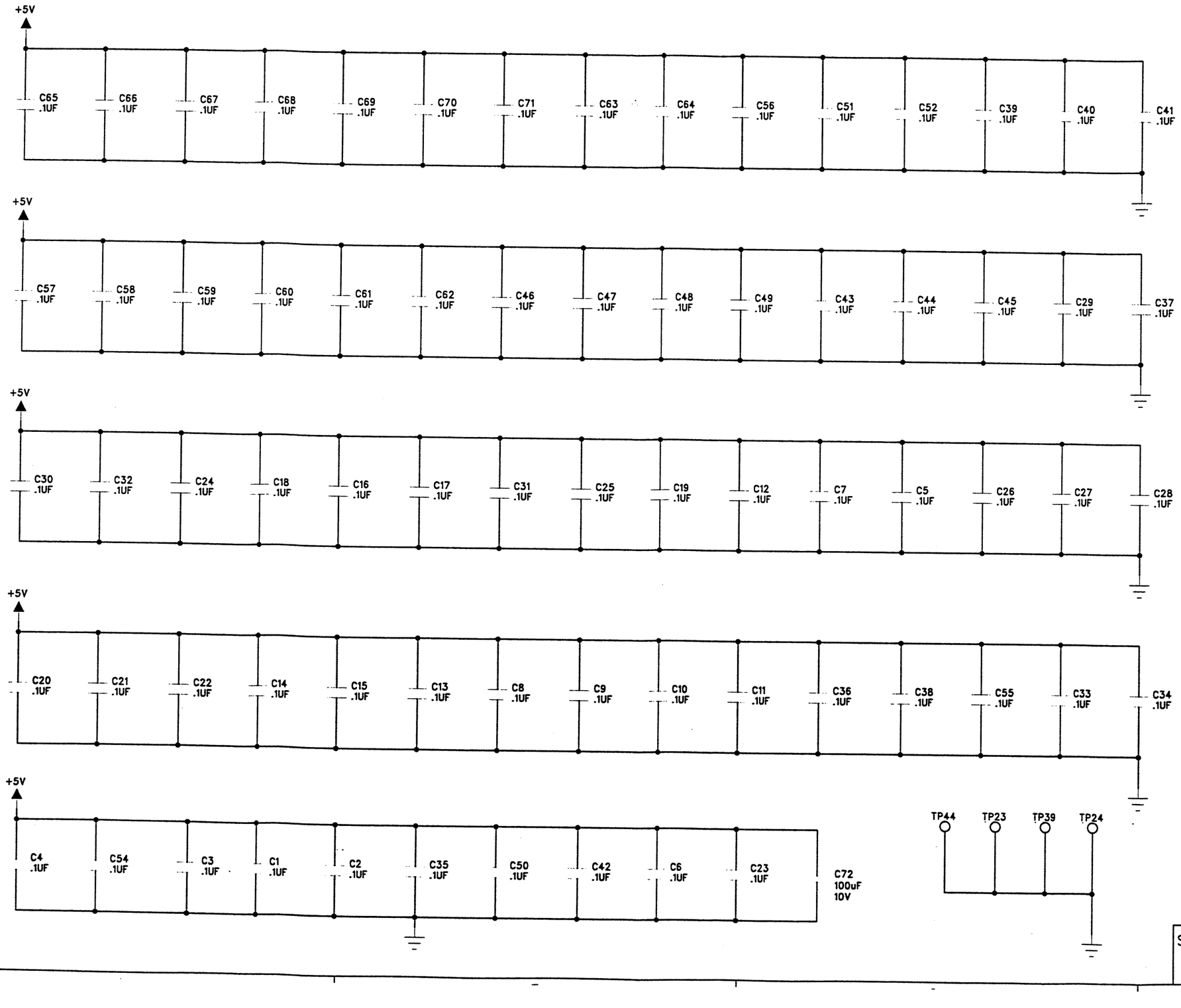






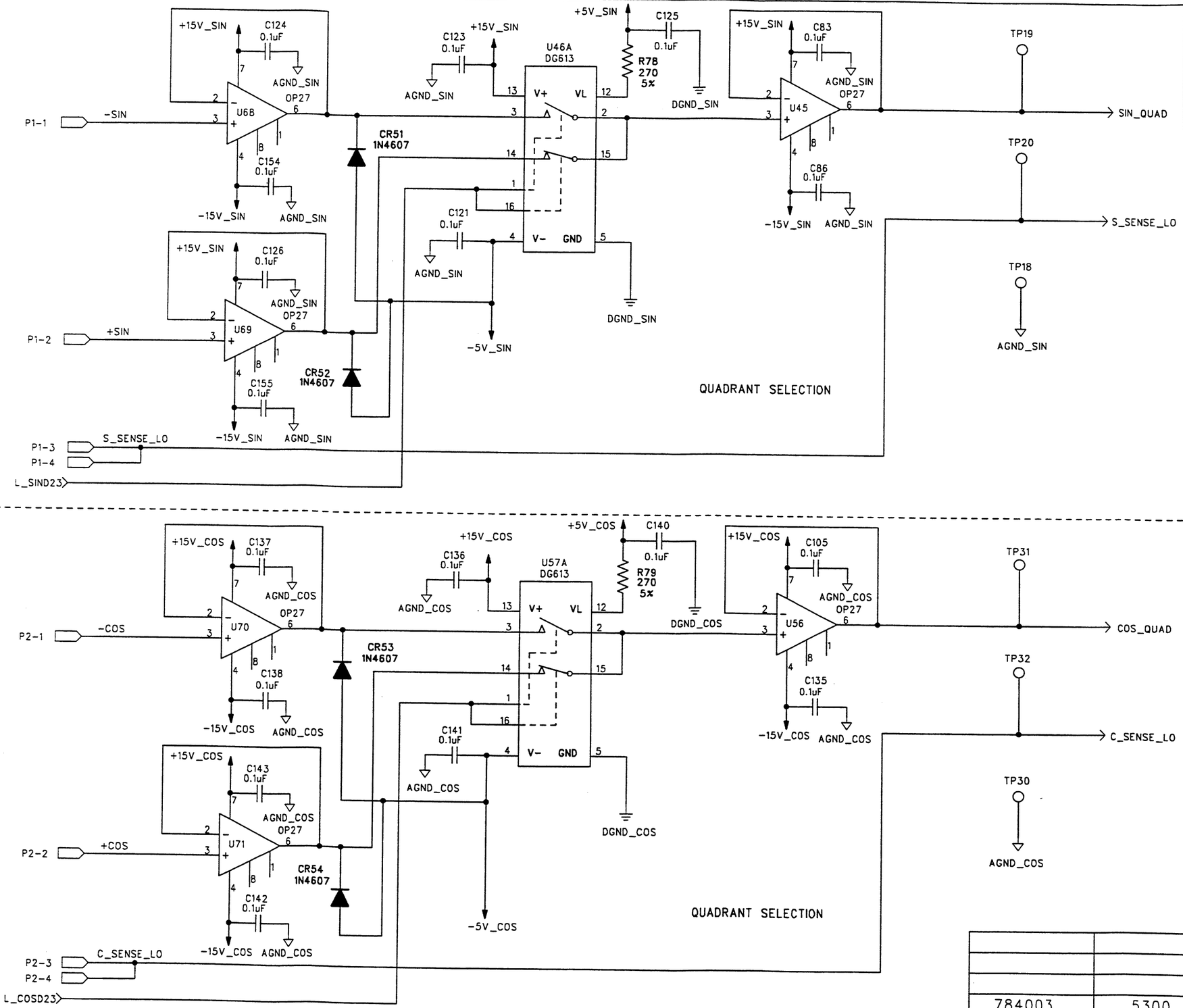


SIZE		SHEET	REV
B	770007	12 OF 13	E



SIZE		SHEET	REV
B	770007	13 OF 13	E

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	ECN 33156, PINK BOOK UPDATES	8/1/94	
	C	REVISED PER ECR 33213	1/17/95	PVR
	D	REVISED PER ECR 33654	8/17/95	WD
	E	REVISED PER ECR 34109	4/17/96	PVR



784003	5300
NEXT ASSY	USED ON

NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC
MODEL 5300 SIN/COS BOARD

SIZE		SHEET	REV
B	770001	1 OF 13	E

MDAC MODULATION SECTION

P1-13 → SIN_QUAD

U47 DG406

P1-26 S_TAP16 4 S16
P1-15 S_TAP15 5 S15
P1-17 S_TAP14 6 S14
P1-19 S_TAP13 7 S13
P1-21 S_TAP12 8 S12
P1-23 S_TAP11 9 S11
P1-25 S_TAP10 10 S10
P1-27 S_TAP9 11 S9
P1-12 S_TAP8 26 S8
P1-14 S_TAP7 25 S7
P1-16 S_TAP6 24 S6
P1-18 S_TAP5 23 S5
P1-20 S_TAP4 22 S4
P1-22 S_TAP3 21 S3
P1-24 S_TAP2 20 S2
19 S1

S_SENSE_LO
E1-1
E2-1
L_SIND[02:23]
E1-2
E2-2

L_SIND22 14 A3
L_SIND21 15 A2
L_SIND20 16 A1
L_SIND19 17 A0
18 EN

D 28
V+ 1
V- 27
GND 12

+15V_SIN: 2, 3, 13
C122 0.1uF
C84 0.1uF
-15V_SIN AGND_SIN

+15V_SIN
C85 0.1uF
AGND_SIN
U32 OP27
R66 10K
C87 0.1uF
-15V_SIN AGND_SIN
R49 8.87
TP21
TP13

Z6A 888808
4.4444K 4.4444K

Z6B 888808
4.4444K
R50 1.47K

+15V_SIN
C38 0.1uF
AGND_SIN
U22 OP27
SIN_MOD

-15V_SIN AGND_SIN
C72 0.1uF

+15V_SIN
C127 0.1uF
AGND_SIN
U49 OP27
S_TAP_NEG
P1-11
C128 0.1uF
-15V_SIN AGND_SIN

U23 HS9371

L_SIND18 2 D1 (MSB)
L_SIND17 3 D2
L_SIND16 4 D3
L_SIND15 5 D4
L_SIND14 6 D5
L_SIND13 7 D6
L_SIND12 8 D7
L_SIND11 9 D8
L_SIND10 27 D9
L_SIND09 26 D10
L_SIND08 25 D11
L_SIND07 24 D12
L_SIND06 23 D13
L_SIND05 22 D14
L_SIND04 21 D15
L_SIND03 20 D16 (LSB)

L_SIND[02:23]

10 LDAC
17 LBE
19 HBE
18 -CS

13 VREF
15 RF
12 OUT1
11 OUT2
14 +15V
16 AGND
1 +5V
28 DGND

+5V_SIN
R48 10K
DGND_SIN

+15V_SIN
C91 33pF
C89 0.1uF
AGND_SIN
U33 AD707
C90 0.1uF
-15V_SIN AGND_SIN
+5V_SIN
TP14

R52 20
R90 100
R91 100
R98 7.5
C157 .47uF
C92 0.1uF
AGND_SIN

C166 0 *
C167 0 *
C71 0.1uF
CR1 1N6263
CR2 1N6263
C156 1.0uF
DGND_SIN

CR29 1N6263

MDAC MODULATION SECTION

P2-13 → COS_QUAD

U58 DG406

P2-26 C_TAP16 4 S16
P2-15 C_TAP15 5 S15
P2-17 C_TAP14 6 S14
P2-19 C_TAP13 7 S13
P2-21 C_TAP12 8 S12
P2-23 C_TAP11 9 S11
P2-25 C_TAP10 10 S10
P2-27 C_TAP9 11 S9
P2-12 C_TAP8 26 S8
P2-14 C_TAP7 25 S7
P2-16 C_TAP6 24 S6
P2-18 C_TAP5 23 S5
P2-20 C_TAP4 22 S4
P2-22 C_TAP3 21 S3
P2-24 C_TAP2 20 S2
19 S1

C_SENSE_LO
E3-2
E4-2
L_COSD[02:23]
E3-1
E4-1

L_COSD22 14 A3
L_COSD21 15 A2
L_COSD20 16 A1
L_COSD19 17 A0
18 EN

D 28
V+ 1
V- 27
GND 12

+15V_COS: 2, 3, 13
C139 0.1uF
C107 0.1uF
-15V_COS AGND_COS

+15V_COS
C108 0.1uF
AGND_COS
U39 OP27
R68 10K
C109 0.1uF
-15V_COS AGND_COS
R60 8.87
TP25
TP16

Z10A 888808
4.4444K 4.4444K

Z10B 888808
4.4444K
R61 1.47K

+15V_COS
C60 0.1uF
AGND_COS
U27 OP27
COS_MOD

-15V_COS AGND_COS
C79 0.1uF

+15V_COS
C144 0.1uF
AGND_COS
U59 OP27
C_TAP_NEG
P2-11
C145 0.1uF
-15V_COS AGND_COS

U28 HS9371

L_COSD18 2 D1 (MSB)
L_COSD17 3 D2
L_COSD16 4 D3
L_COSD15 5 D4
L_COSD14 6 D5
L_COSD13 7 D6
L_COSD12 8 D7
L_COSD11 9 D8
L_COSD10 27 D9
L_COSD09 26 D10
L_COSD08 25 D11
L_COSD07 24 D12
L_COSD06 23 D13
L_COSD05 22 D14
L_COSD04 21 D15
L_COSD03 20 D16 (LSB)

L_COSD[02:23]

10 LDAC
17 LBE
19 HBE
18 -CS

13 VREF
15 RF
12 OUT1
11 OUT2
14 +15V
16 AGND
1 +5V
28 DGND

+5V_COS
R64 10K
DGND_COS

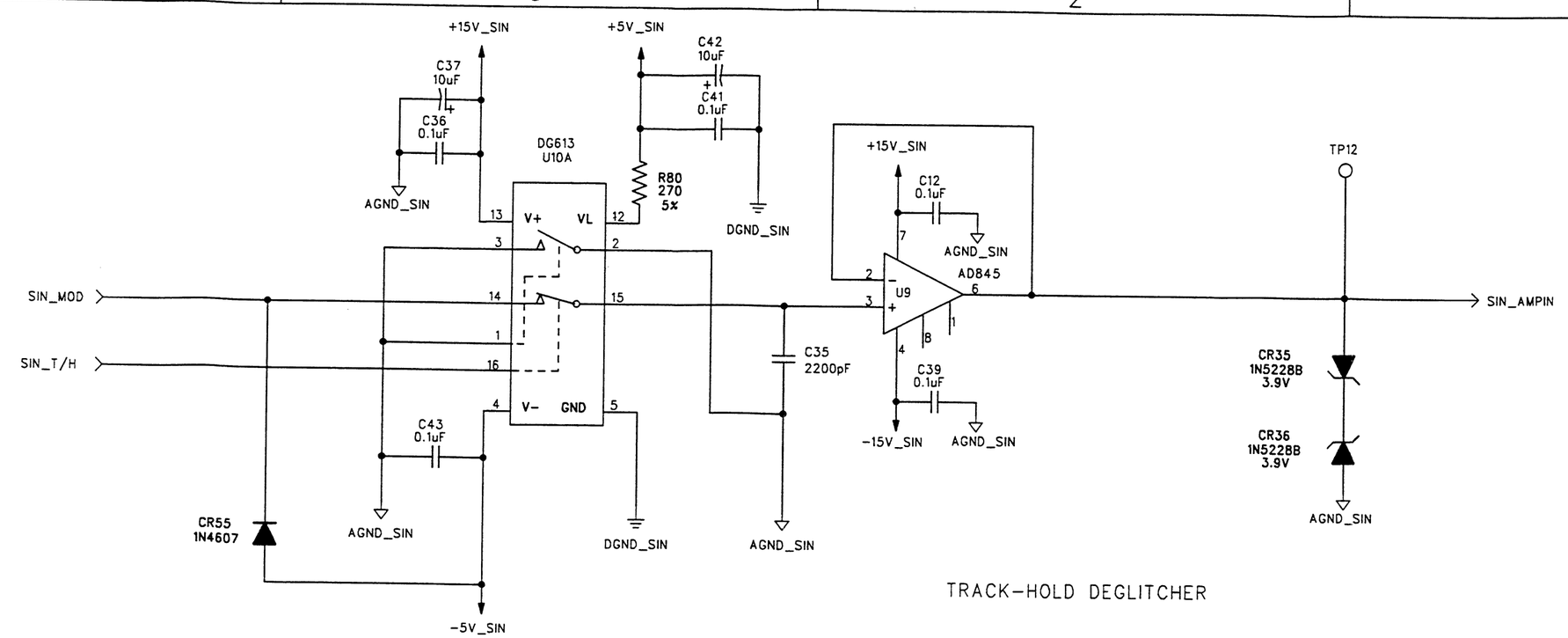
+15V_COS
C116 33pF
C110 0.1uF
AGND_COS
U40 AD707
C111 0.1uF
-15V_COS AGND_COS
TP17

R63 20
R92 100
R93 100
R62 7.5
C159 .47uF
C117 0.1uF
AGND_COS

C168 0 *
C169 0 *
CR16 1N6263
CR17 1N6263
C80 0.1uF
C158 1.0uF
DGND_COS

CR30 1N6263

SIZE		SHEET	REV
B	770001	2 OF 13	E



SIZE		SHEET	REV
B	770001	3 OF 13	E

SEE PAGE 12 FOR ACTUAL ELECTRICAL CIRCUIT REWORK ON P.C.B.

Z5 810105
100.0K
35.938K
11.253K
3.4482K
1.162BK
90V
26V
11.8V
4V

FEEDBACK (GAIN OR FS L-L) SELECT
SS_DRV4
SS_DRV5
SS_DRV2
K7 EA2
K6 EA2
K5 EA2
+5V_SIN

ISOLATION AND INT/EXT SENSE SELECT
S_DRV7
K9 EA2
K20 EA2
CR45
CR46
R82 243
R83 243
CR43
CR44
AGND_SIN
NOTE: K9 AND K20 WIRED IN PARALLEL

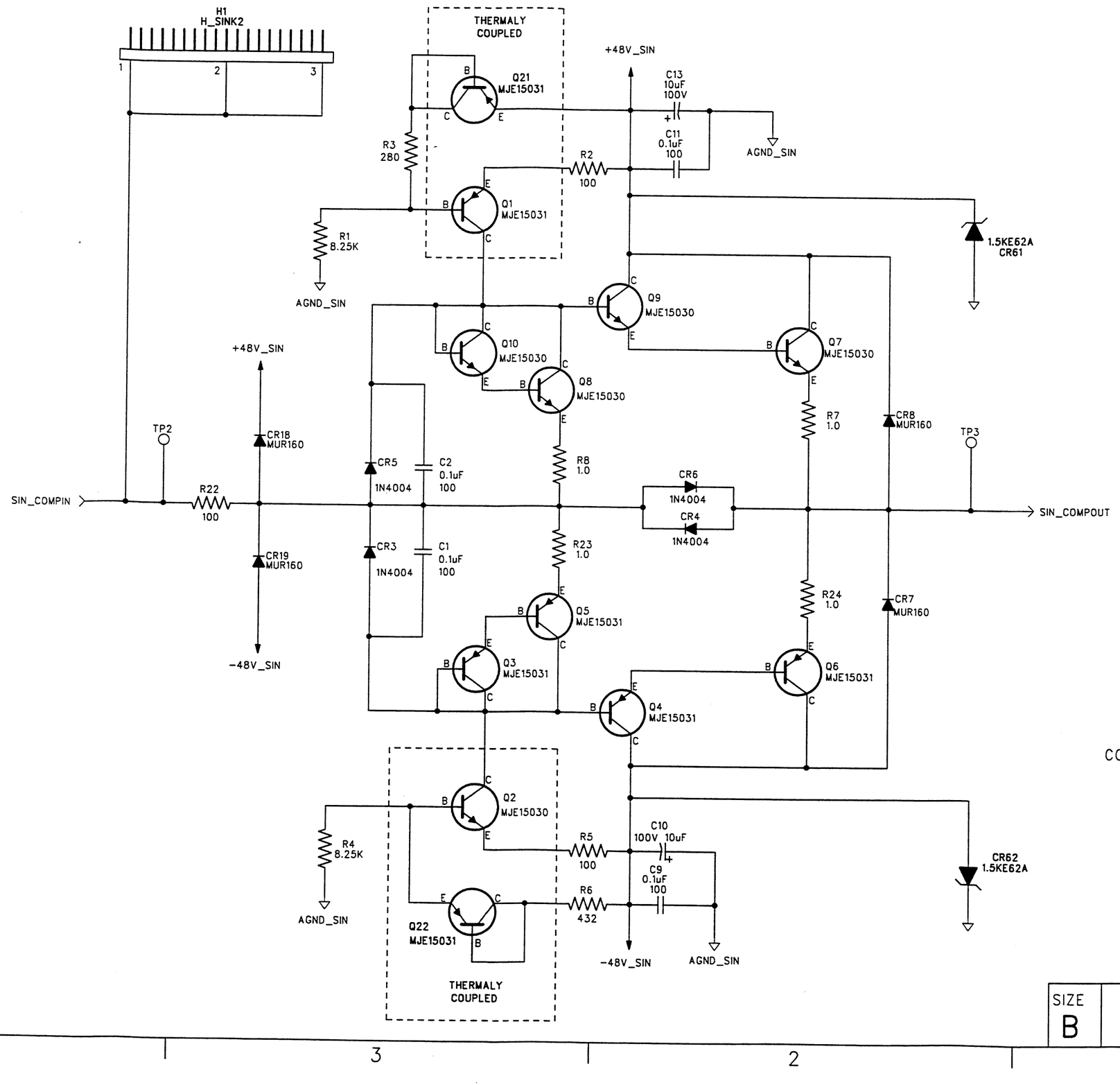
ISOLATION SELECT
K8 EA2
K17 EA2
P1-35 SENSE_S3
P1-36 SENSE_S1
P1-37 S3
P1-38 S1
E5
P1-8
P1-28
TP28
AS3
R73 68K
-150V_SIN
JP1

PA41 STAGE GAIN SELECT
S_DRV2
K3 EA2
R54 3.09K
C100 220pF 500V
R55 69.8K
CR58 SL05
SL05 CR57
CR59 1.5KE180A
COMPLIMENTARY PAIR / DRIVER OUTPUT SELECT
JP3
S_DRV6
K1 EA2
+150V_SIN
C102 0.01uF
C101 0.1uF 250V
C48 330pF 500V
R56 100
R58 34.0
LIM
PA41 U38
COMP
C49 20pF 500V
R57 2.21K
CR25 MUR160
CR26 MUR160
C106 0.1uF 400V
C104 0.01uF
C103 0.1uF 250V
1.5KE180A CR60
-150V_SIN
SIN_COMPIN
SIN_COMPOUT

+15V_SIN
C172 820pF
CR39 1N645
C160 0.1uF
DRIVEN SHIELD
CR31 1N4607
OP27 U72
R51 18K 5%
C170 0.022uf
CR32 1N4607
C161 0.1uF
CR40 1N645
C173 820pF
-15V_SIN
AGND_SIN
TP33
C69 12pF
R46 2.74K
R34 1.21M
R35 1.10K
C29 0.01uF
+20V_SIN
C25 10uF
C30 0.1uF
CR70 * 1N4738
CR69 * 1N4738
PAD1
PAD2
JP4
S_SENSE_LO
C70 47pF
PHASE BALANCE ADJ.
SIN_AMPIN
R47 2K
R37 2.67K
OP17 U7
TP11
R20 4.99K
C34 0.01uF
10uF C32
C33 0.1uF
-20V_SIN
R95 49.9K
R94 49.9K
R33 10K
U8 DG445
R32 3.83K 26V L-L
C26 3300pF
R19 200 4V L-L
C28 4700pF
R21 2.49K 90V L-L
C27 0pF
R36 910 11.8V L-L
V+ VL V- GND
C8 0.1uF
C31 0.1uF
S_DRV0_I 26V L-L
S_DRV3_I 4V L-L
S_DRV2_I 90V L-L
S_DRV1_I 11.8V L-L
ATTENUATION/COMPENSATION SELECT
H107 H109 H100 H111 H110 H108

* CURRENTLY NOT INSTALLED.

SIZE		SHEET	REV
B	770001	4 OF 13	E



COMPLIMENTARY PAIR DRIVER

SIZE		SHEET	REV
B	770001	5 OF 13	E

SEE PAGE 13 FOR ACTUAL ELECTRICAL CIRCUIT REWORK ON P.C.B.

Z9 810105

FEEDBACK (GAIN OR FS L-L) SELECT

SYNCRO SENSE LO CONNECT SELECT

ISOLATION & INT/EXT SENSE SELECT

S_SENSE_LO ISOLATION AND INT/EXT SENSE SELECT

PA41 STAGE GAIN SELECT

COMPLIMENTARY PAIR / DRIVER OUTPUT SELECT

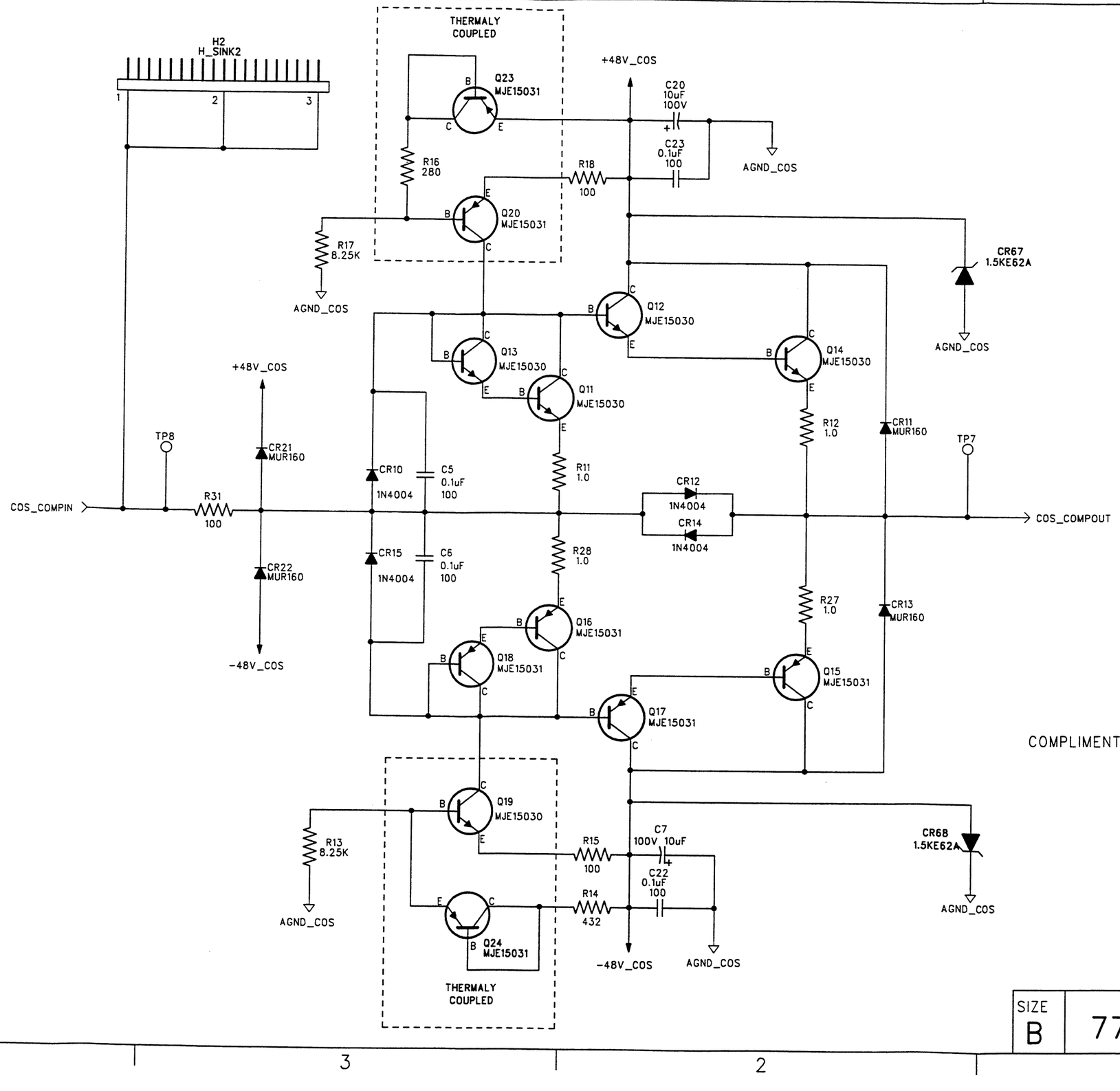
S4 ISOLATION SELECT

ATTENUATION/COMPENSATION SELECT

NOTE: K13 AND K21 WIRED IN PARALLEL

* CURRENTLY NOT TO BE INSTALLED

SIZE		SHEET	REV
B	770001	6 OF 13	E



SIZE		SHEET	REV
B	770001	7 OF 13	E

SIND2 P1-79
SIND3 P1-77
SIND4 P1-75
SIND5 P1-73
SIND6 P1-71
SIND7 P1-69
SIND8 P1-67
SIND9 P1-65
SIND10 P1-63
SIND11 P1-61
SIND12 P1-58
SIND13 P1-60
SIND14 P1-62
SIND15 P1-64
SIND16 P1-66
SIND17 P1-68
SIND18 P1-70
SIND19 P1-72
SIND20 P1-74
SIND21 P1-76
SIND22 P1-78
SIND23 P1-80
S_T/H_IN P1-59

+5V_SYS
+5V_SIN
R72 220
R71 4.7K
C99 0.1uF
C75 0.1uF
C45 0.1uF
C98 0.1uF
C74 0.1uF
C44 0.1uF
Z14 220
Z8 220
Z1 220
4.7K Z13
4.7K Z7
4.7K Z3
U55 U54 U37 U35 U26 U25 U13 U12 U3 U2 U1
HCPL2530
VCC GND
DGND_SYS
DGND_SIN

U36
OE CLK
D0 D1 D2 D3 D4 D5 D6 D7
Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
74HCT574
L_SIND02 L_SIND03 L_SIND04 L_SIND05 L_SIND06 L_SIND07 L_SIND08 L_SIND09
L_SIND[02:23]
TP5
L_SIND02

U24
L_SIND10 L_SIND11 L_SIND12 L_SIND13 L_SIND14 L_SIND15 L_SIND16 L_SIND17

U11
L_SIND18 L_SIND19 L_SIND20 L_SIND21 L_SIND22 L_SIND23

U53E U53D U53C U53B U53A
74ALS04
SIN_T/H
U53F
TP4

+5V_SYS
C132 120PF
R70 1.1K
C133 0.1uF
C134 10uF
DGND_SYS

U52
HCPL2231
VCC GND
C131 0.1uF
+5V_SIN
DGND_SIN

SIZE		SHEET	REV
B	770001	8 OF 13	E

COSD2 P2-79
COSD3 P2-77
COSD4 P2-75
COSD5 P2-73
COSD6 P2-71
COSD7 P2-69
COSD8 P2-67
COSD9 P2-65
COSD10 P2-63
COSD11 P2-61
COSD12 P2-58
COSD13 P2-60
COSD14 P2-62
COSD15 P2-64
COSD16 P2-66
COSD17 P2-68
COSD18 P2-70
COSD19 P2-72
COSD20 P2-74
COSD21 P2-76
COSD22 P2-78
COSD23 P2-80
C_T/H_IN P2-59

+5V_SYS
+5V_COS
R77 220
R75 4.7K
C152 0.1uF
C82 0.1uF
C68 0.1uF
C119 0.1uF
C81 0.1uF
C24 0.1uF
Z16 220
Z12 220
Z2 220
4.7K Z15
4.7K Z11
4.7K Z4
U67 U66 U44 U43 U31 U30 U21 U20 U6 U5 U4
HCPL2530
VCC GND
DGND_SYS
DGND_COS

U42
U29
U19
74HCT574
OE CLK D0 D1 D2 D3 D4 D5 D6 D7 Q0 Q1 Q2 Q3 Q4 Q5 Q6 Q7
L_COSD02 L_COSD03 L_COSD04 L_COSD05 L_COSD06 L_COSD07 L_COSD08 L_COSD09
L_COSD10 L_COSD11 L_COSD12 L_COSD13 L_COSD14 L_COSD15 L_COSD16 L_COSD17
L_COSD18 L_COSD19 L_COSD20 L_COSD21 L_COSD22 L_COSD23
L_COSD[02:23]
TP10
L_COSD02

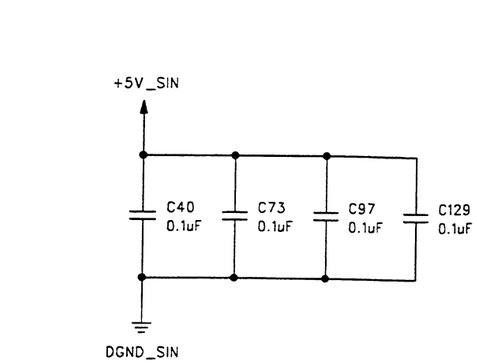
U64E U64D U64C U64B U64A
74ALS04

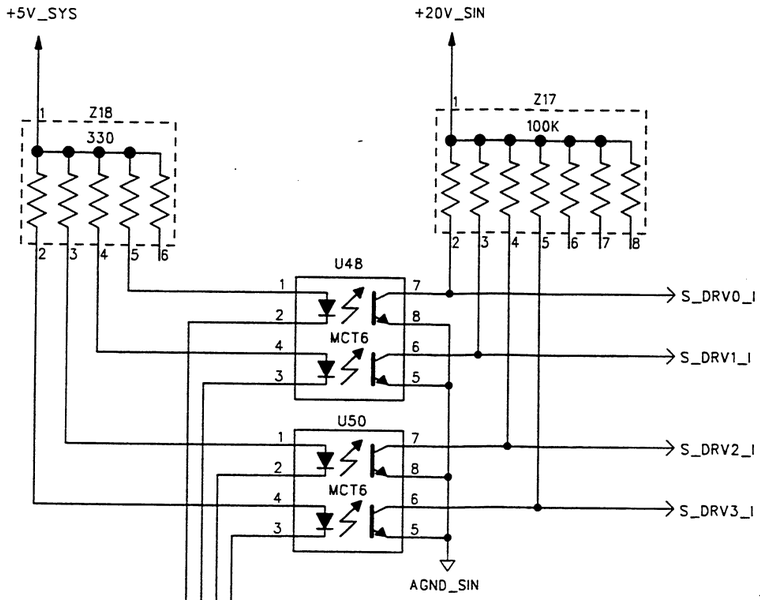
COS_T/H
U64F
TP1

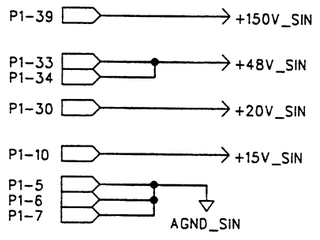
+5V_SYS
C151 120PF
R76 1.1K
C150 0.1uF
C153 10uF
DGND_SYS

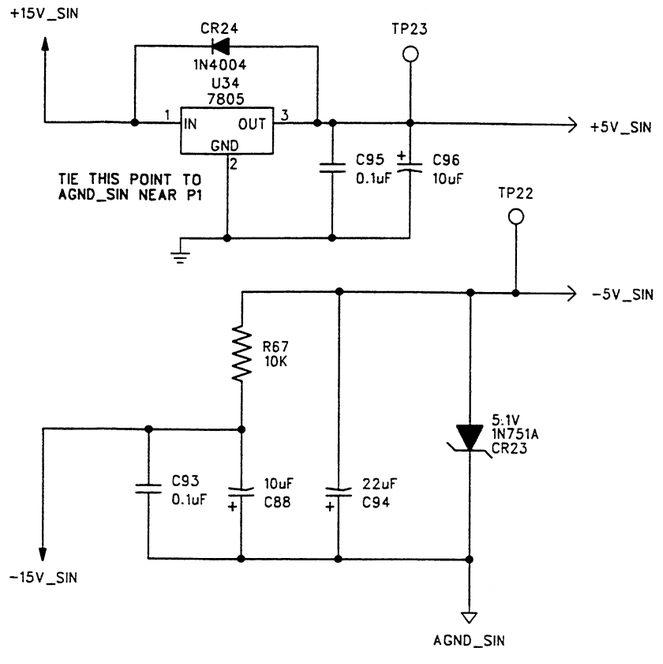
+5V_COS
U65
HCPL2231
C149 0.1uF
DGND_COS

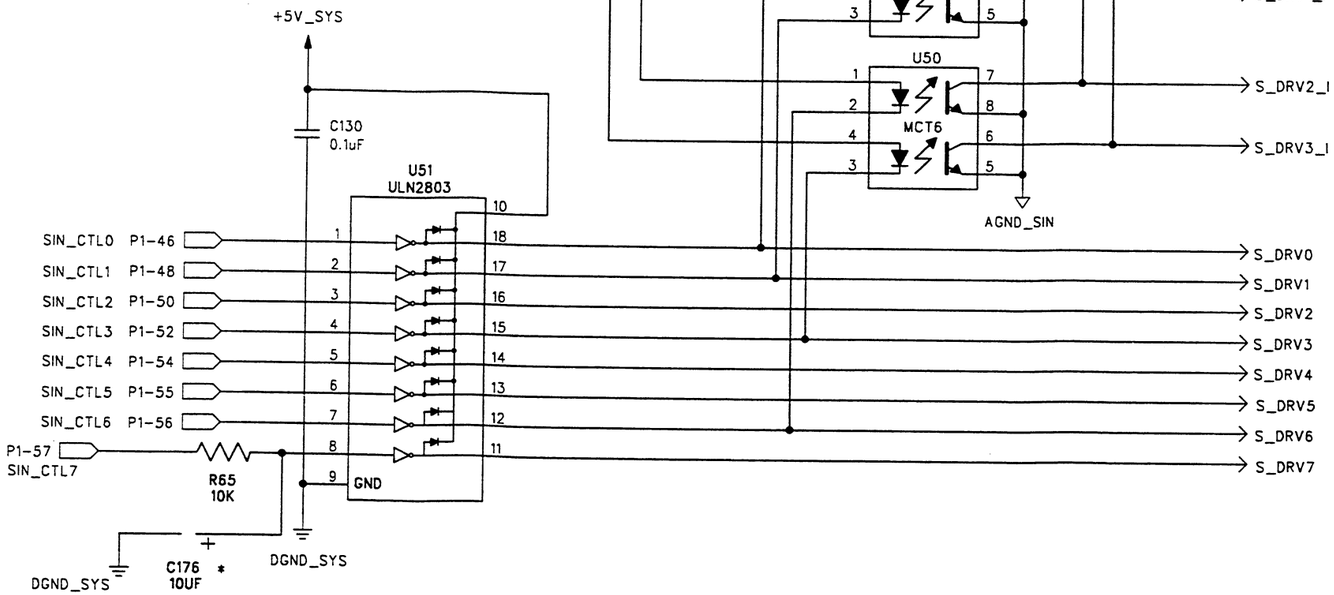
SIZE		SHEET	REV
B	770001	9 OF 13	E

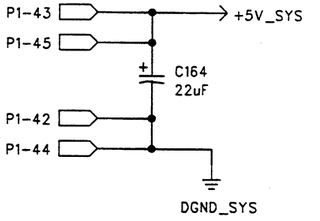


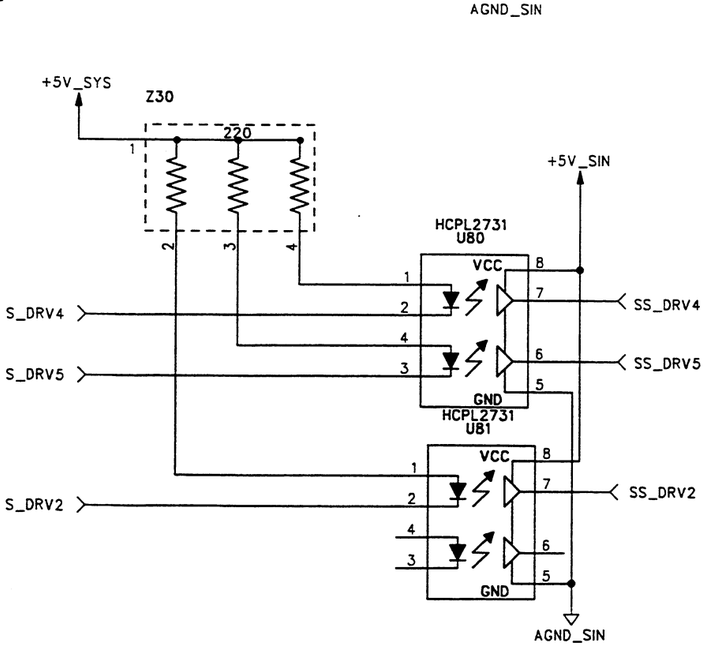




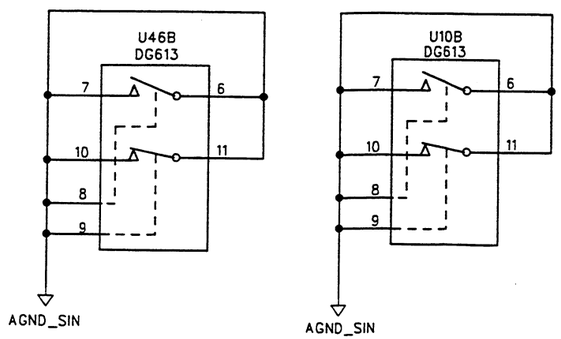






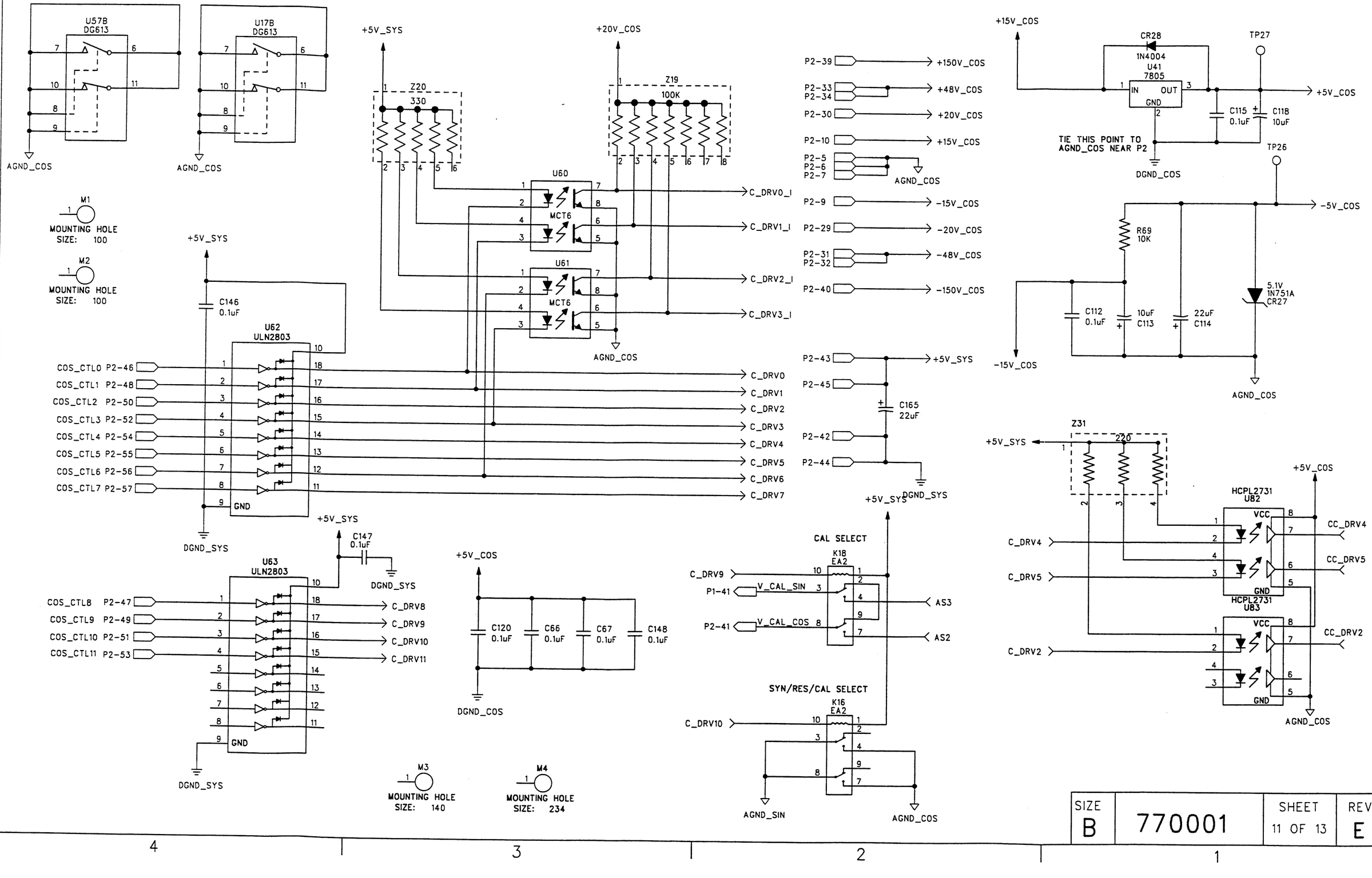


P1-47 N/C
P1-49 N/C
P1-51 N/C
P1-53 N/C



* CURRENTLY NOT INSTALLED.

SIZE		SHEET	REV
B	770001	10 OF 13	E



SIZE		SHEET	REV
B	770001	11 OF 13	E

FEEDBACK (GAIN OR FS L-L) SELECT

ISOLATION AND INT/EXT SENSE SELECT

ISOLATION SELECT

PA41 STAGE GAIN SELECT

COMPLIMENTARY PAIR / DRIVER OUTPUT SELECT

PHASE BALANCE ADJ.

ATTENUATION/COMPENSATION SELECT

NOTE: K9 AND K20 WIRED IN PARALLEL

* CURRENTLY NOT INSTALLED.

SIZE		SHEET	REV
B	770001	12 OF 13	E

FEEDBACK (GAIN OR FS L-L) SELECT

SYNCRO SENSE LO CONNECT SELECT

ISOLATION & INT/EXT SENSE SELECT

S_SENSE_LO ISOLATION AND INT/EXT SENSE SELECT

PA41 STAGE GAIN SELECT

S4 ISOLATION SELECT

COMPLIMENTARY PAIR / DRIVER OUTPUT SELECT

ATTENUATION/COMPENSATION SELECT

NOTE: K13 AND K21 WIRED IN PARALLEL

* CURRENTLY NOT TO BE INSTALLED

SIZE		SHEET	REV
B	770001	130F 13	E

INTERNAL REFERENCE CIRCUITS

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	C	REVISED PER PINK BOOK NOTES	6/07/94	
	D	REVISED PER ECR 33247	1/3/95	
	E	REVISED PER ECN 33440	5/31/95	
	F	REVISED PER ECN 33743	9/19/95	T.D

DSPD[10:23]

SIN GEN. MDAC

8 POLE LOWPASS FILTER

P2-61 DSPD10
P2-63 DSPD11
P2-65 DSPD12
P2-67 DSPD13
P2-69 DSPD14
P2-70 DSPD15
P2-68 DSPD16
P2-66 DSPD17
P2-64 DSPD18
P2-62 DSPD19
P2-60 DSPD20
P2-58 DSPD21
P2-56 DSPD22
P2-54 DSPD23

TP28
U48 AD7840
REFIN 23
REFOUT 22
AGND 19
VOUT 20
VDD 18
VSS 21
DGND 12
DSPD10 17 D0
DSPD11 16 D1
DSPD12 15 D2
DSPD13 14 D3
DSPD14 13 D4
DSPD15 11 D5
DSPD16 10 D6
DSPD17 9 D7
DSPD18 8 D8
DSPD19 7 D9
DSPD20 6 D10/JSTFY
DSPD21 5 D11/FRMT
DSPD22 4 D12/SCLK
DSPD23 3 D13/SDATA
P2-47 DSP_DAC2 1 -CS/SERIAL
2 -WR/-SYNC
24 -LDAC

TP29
R124 1.96K 1%
C141 1200pF 100V
R121 17.8K 1%
C142 330pF 100V
U39A AD712
C144 0.1uF
C145 0.1uF
+15V
-15V
R125 2.26K 1%
C139 2400pF 500V
R123 12.4K 1%
R122 5K
PHASE ADJUST
U39B AD712
C140 180pF 100V
R97 1.96K 1%
C113 1200pF 100V
R98 17.8K 1%
C114 330pF 100V
U30A AD712
C115 0.1uF
C116 0.1uF
R100 2.26K 1%
C111 2400pF 500V
R99 14.7K 1%
C112 180pF 100V
U30B AD712
TP22
REFINT_PHI

+5V_SYS
R145 10 5%
C163 0.1uF
C143 10uF
C164 0.1uF
C162 10uF
R144 10 5% -5V

R67 3.83K 0.1%
REFINT

FINE LEVEL CTRL MDAC
R91 4.75K 0.1%
C101 0.1uF
U27 OP27
C100 0.1uF
U26B AD7847
VREFB VOUTB AGNDB
TP20
C97 100uF
C99 100uF
C98 0.47
AMPIN
R92 10K 1%
TP21

P2-49 DSP_WR
P2-50 DSP_LDAC

SIN GEN. MDAC

8 POLE LOWPASS FILTER

U46 AD7840
REFIN 23
REFOUT 22
AGND 19
VOUT 20
VDD 18
VSS 21
DGND 12
DSPD10 17 D0
DSPD11 16 D1
DSPD12 15 D2
DSPD13 14 D3
DSPD14 13 D4
DSPD15 11 D5
DSPD16 10 D6
DSPD17 9 D7
DSPD18 8 D8
DSPD19 7 D9
DSPD20 6 D10/JSTFY
DSPD21 5 D11/FRMT
DSPD22 4 D12/SCLK
DSPD23 3 D13/SDATA
DSP_DAC3 P2-48 1 -CS/SERIAL
2 -WR/-SYNC
24 -LDAC

TP27
R119 1.96K 1%
C133 1200pF 100V
R117 17.8K 1%
C137 330pF 100V
U38A AD712
C136 0.1uF
C138 0.1uF
+15V
-15V
R120 2.26K 1%
C132 2400pF 500V
R118 14.7K 1%
C135 180pF 100V
U38B AD712
R93 1.96K 1%
C105 1200pF 100V
R94 17.8K 1%
C108 330pF 100V
U29A AD712
C107 0.1uF
C109 0.1uF
R96 2.26K 1%
C104 2400pF 500V
R95 14.7K 1%
C106 180pF 100V
U29B AD712

+5V_SYS
R143 10 5%
C160 0.1uF
C159 10uF
C161 0.1uF
C134 10uF
R142 10 5% -5V

U47 79L05
IN OUT GND
-5V

784008	5300
NEXT ASSY	USED ON

NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC
MODEL 5300 ANALOG BD

SIZE		SHEET	REV
B	770006	1 OF 10	F

REFERENCE POWER AMPLIFIER

FEEDBACK SELECT

Z1
810105
100.0K
35.938K
11.253K
3.4482K
1.1628K
115V
26V
15V
5V
K3 EA2
K4 EA2
K5 EA2
-GAIN2
-GAIN1
-GAIN0
26V
11.8V
4V
+5V_SYS
C46 12pF
R43 2.74K
R41 1.21M
R42 1.10K
C48 0.01uF
C49 10uF
C47 0.1uF
+20V
TP10
R39 4.99K
C82 100pF
PHASE BALANCE ADJ.
R76 2K
R75 2.67K
AMPIN
U20
OP17
-20V
CB1 0.01uF
10uF C79
CB0 0.1uF
R153 49.9K
R154 49.9K
R44 10K
+20V
ATTENUATION/COMPENSATION SELECT
U12 DG445
V+ VL V- GND
R40 3.83K 26V
C75 3300pF
R71 200 5V
C76 4700pF
R72 2.49K 115V
C45 0pF
R38 909 15V
FREQCOMP3 26V
FREQCOMP2 5V
FREQCOMP1 115V
FREQCOMP0 15V
C173 0.1uF
C42 0.1uF
R60 270 5%
C44 0.1uF
-20V
+5V_SYS

ISOLATION SELECT

K9 EA2
-REF_ON
+5V_SYS
P1-75 REFINT_OUT
P1-76 REFINT_OUT
P1-77 AGND
P1-78 AGND
JP1
TP31
R141 68K
-175V

PA41 STAGE GAIN SELECT

K1 EA2
-GAIN0
+5V_SYS
R36 3.09K
C43 220pF 500V
R37 69.8K
CR39 1.5KE200A
AGND
+175V
C38 0.01uF
C13 0.1uF 250V
SL05 CR48
CR47 SL05
PA41 U11
LIM
COMP
CASE
C77 20pF 500V
R70 2.21K
C74 330pF 500V
R69 100
R14 34
C41 0.1uF 630V
C39 0.01uF
C40 0.1uF 250V
-175V
CR40 1.5KE200A
AGND
CR6 MUR160
CR14 MUR160
CR41 1.5KE200CA
AGND -175V
TP8
K2 EA2
COMPIN
COMPOUT

COMPLIMENTARY PAIR / DRIVER OUTPUT SELECT

JP2
-COMP_SEL

H2
HEATSINK2

SIZE		SHEET	REV
B	770006	2 OF 10	F

CURRENT BOOST COMPLEMENTARY PAIR

H1
H_SINK2

THERMAL COUPLED

Q13 MJE15031

C16 10uF 100V

CR45 1.5KE62A

C17 0.1uF 100

R8 280

R6 100

Q1 MJE15031

R7 8.25K

+48V

Q9 MJE15030

Q10 MJE15030

Q8 MJE15030

Q7 MJE15030

TP1

CR3 MUR160

R15 1.0

CR8 MUR160

TP9

CR7 1N4004

C15 0.1uF 100

R16 1.0

CR11 1N4004

CR9 1N4004

COMPIN

R12 100

COMPOUT

CR5 1N4004

C14 0.1uF 100

R13 1.0

CR42 1.5KE43CA

R17 1.0

CR10 MUR160

Q5 MJE15031

Q3 MJE15031

Q6 MJE15031

CR43 1N4004

CR44 1N4004

AGND

CR4 MUR160

-48V

Q4 MJE15031

Q2 MJE15030

R9 8.25K

R11 100

C18 100V 10uF

C19 0.1uF 100

R10 432

CR46 1.5KE62A

AGND

Q14 MJE15031

THERMAL COUPLED

-48V

* CURRENTLY NOT USED

SIZE		SHEET	REV
B	770006	3 OF 10	F

REFERENCE SELECTION AND EXTERNAL REFERENCE RANGE ATTENUATION

-RRANGE_115
-RRANGE_26
-RRANGE_7
TP12
+5V_SYS
K8 EA2
K7 EA2
K6 EA2
5V
REFIN_HI P1-3
REFIN_LO P1-1
AGND P1-2
AGND P1-4
C181 220pF 500V
C182 68pF 500V
C146 0.1uF

115 VOLT RANGE DIFFERNECE AMP
26 VOLT RANGE DIFFERNECE AMP
7 VOLT RANGE DIFFERNECE AMP

R107 4.75K 0.1%
R126 100K 0.1%
R127 4.75K 0.1%
R103 100K 0.1%
R128 4.75K 0.1%
R104 20.0K 0.1%
R102 100K 0.1%
R105 20.0K 0.1%
R101 100K 0.1%
R106 20.0K 0.1%
R81 80.6K 0.1%
R80 100K 0.1%
R82 80.6K 0.1%
R79 100K 0.1%
R83 80.6K 0.1%

CR32 1N914
CR31 1N914
CR30 1N914
CR29 1N914
CR26 1N914
CR25 1N914
CR24 1N914
CR23 1N914
CR18 1N914
CR17 1N914
CR16 1N914
CR15 1N914

+15V
-15V
C147 0.1uF
C149 0.1uF
C117 0.1uF
C118 0.1uF
C84 0.1uF
C85 0.1uF

U41A HA-5102
U41B HA-5102
U31A HA-5102
U31B HA-5102
U22A HA-5102
U22B HA-5102

TP24
TP23
TP13
TP14
TP15
TP16

U23 DG408
REFINT
REFINT_PHI
+5V_SYS
REF_A0
REF_A1
REF_A2
R84 3.3K 5%
S1
S2
S3
S4
S5
S6
S7
S8
A0
A1
A2
EN

U24 OP27
C89 0.1uF
C90 0.1uF
C86 0.1uF
C88 0.1uF
V+
V-
GND
REF_MEAS

SIZE		SHEET	REV
B	770006	4 OF 10	F

AGC CIRCUITS

RMS-DC CONVERTER

FINE L-L LEVEL CONTROL

C186 0.1uF
C187 0.1uF
C189 0.1uF
C185 330pf
R157 2.8K 1%
R156 2.8K 1%
C188 0.1uF
DG403 U49A
+15V
+5V_SYS
AGND
FROM (U37 PIN 13)
-EXTPHS
-15V
OP27
U50
REF_MEAS
R86 1.00K 1%
C190 0.1uF
R87 4.99K 1%
R111 1.00K 1%
C125 0.1uF
OP37
U33
TP25
VR
C126 0.1uF
C121 0.1uF
C122 0.1uF
R85 4.99K 1%
R108 2.49K 1%
U32 AD736
C119 10uF
R109 75.0 1%
C87 100uF
U43 VTL3A44
C152 47uF
R134 3.57K 50PPM
R132 931.0K 50PPM
C151 0.1uF
U40 78L05
IN OUT GND
C150 0.1uF
C120 0.1uF
R110 316.0 50PPM
R130 50 50PPM
R129 24.9 50PPM
R131 1.00K 50PPM
OPA404
U42A
C153 0.1uF
R135 4.99K 1%
R133 10.0K 1%
U42B
R114 3.32K 1%
R113 10.0K 1%
U42C
R112 10.0K 1%
CR27 1N914
CR28 1N914
C128 0.1uF
R116 40.2 1%
Q12 VN0300L
U26A AD7847
VREFA VOUTA AGNDA VDD VSS DGND
DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 DB8 DB9 DB10 DB11
MD00 MD01 MD02 MD03 MD04 MD05 MD06 MD07 MD08 MD09 MD10 MD11
MD[00:11]
-WR -CSA -CSB
-WE P2-17
-DAC1A P2-13
-DAC1B P2-14
-WE
TP17
C91 100uF
C124 100uF
C123 0.47
R115 10K 1%
C94 0.1uF
C96 0.1uF
C92 0.1uF
C93 0.1uF
U25
R88 10K
TP18
TP30
P1-69 VREF
P1-70 VREF
P1-71 AGND
P1-72 AGND
CR1 1N5229B 4.3V
CR2 1N5229B 4.3V

SIZE		SHEET	REV
B	770006	5 OF 10	F

CAL/NULL CIRCUITS

* = NOT USED

V_CAL_SIN P1-7
V_CAL_COS P1-8
CR34 1N4004 *
1N4004 CR33 *
C148 270pF

U2 DG408
G60 G157.2 G548.63 G1212.5 G3528.3
S1 S2 S3 S4 S5 S6 S7 S8
CALGAIN0 CALGAIN1 CALGAIN2
A0 A1 A2 EN
+5V_SYS
R2 3.3K 5%
D GND V+ V-
C7 0.1uF
C8 0.1uF
+15V -15V

PHASE DETECTOR
R33 11.5K 1%
R31 11.5K 1%
R3 11.5K 1%
C30 0.1uF
U8 AD845
TP6
CAL_AC
R4 46.4K 0.1%
C31 0.1uF
R5 221K 0.1%
U9 AD707
CAL_DC
C32 0.1uF
C35 0.1uF
R146 113K 0.1%
C10 1.5uF 100V
C9 0.22uF 100V
FILTER
Q11

R61 5.11K 1%
C165 68pF 1%
R19 1.00K 1%
R23 59.0K 0.1%
R20 100 5%
C1 10uF
C20 0.1uF
U3 OP37
C5 0.1uF
C4 0.1uF
R152 270 5%
C22 0.1uF
U1A DG211
R26 1.00K 1%
R21 1.62K 1%
R148 100 5%
C171 22uF
C169 0.1uF
U4 OP27
C168 1.0uF
C172 22uF
C170 0.1uF
R149 100 5%
C23 0.1uF
U1B DG211
R28 1.00K 1%
R25 2.49K 1%
C24 0.1uF
U5 OP27
C25 0.1uF
U1C DG211
R29 1.00K 1%
R27 1.21K 1%
C26 0.1uF
U6 OP27
C27 0.1uF
U1D DG211
R32 1.00K 1%
R30 1.91K 1%
C28 0.1uF
U7 OP27
C29 0.1uF
TP4

XFMR_1 P1-12
XFMR_2 P1-11
C166 1.0uF
R18 4.75K 1%
R1 1K
R22 4.75K 1%
C2 10uF
C21 0.1uF
C3 1.0uF
R24 100 5%
C6 0.1uF
CALAMP0
CALAMP1
CALAMP2
CALAMP3

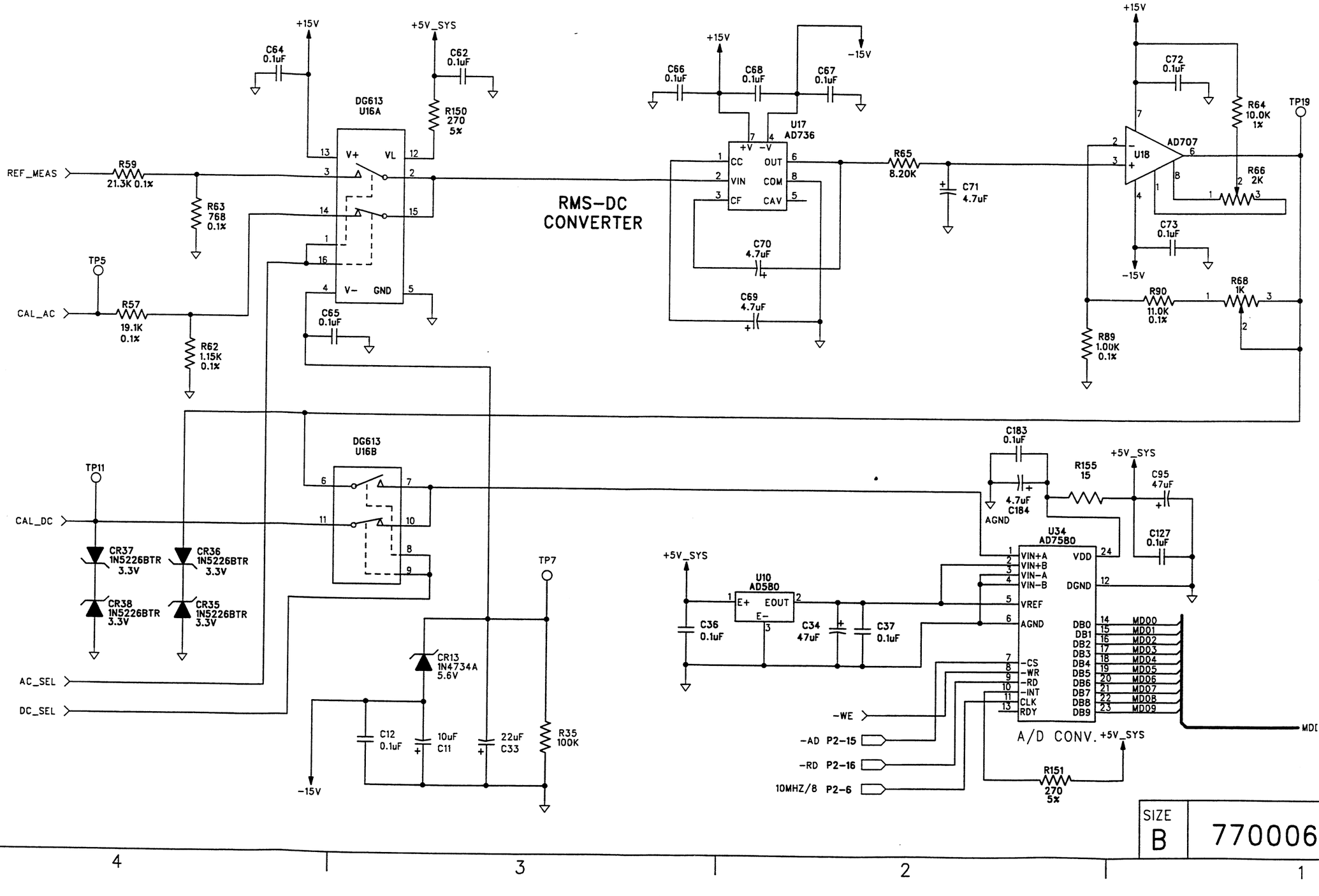
C52 0pF
R48 0K 1%
R47 0K 1%
C51 0pF
R46 1.00K 1%
R45 2.00K 1%
C50 0.1uF
U13 OP27
VR
R147 56.2K 1%
C167 68pF 1%
C53 0.1uF
TP2
R52 1K 5%

C176 0.1uF
C177 22uF
TP3
C54 0.1uF
U14A LM319
R53 1.8K 5%
R50 22K 5%
R51 0K 1%
C58 0pF
C174 0.1uF
C175 22uF
R54 0K 1%
R55 82K 5%
C56 0pF
C55 0.1uF
R49 270K 5%

R58 100 5%
C57 10uF
C59 0.1uF
U15 AD847
CR12 1N4004
C60 0.1uF
R56 100 5%
10uF C61
C63 0.1uF
R34 11K 5%

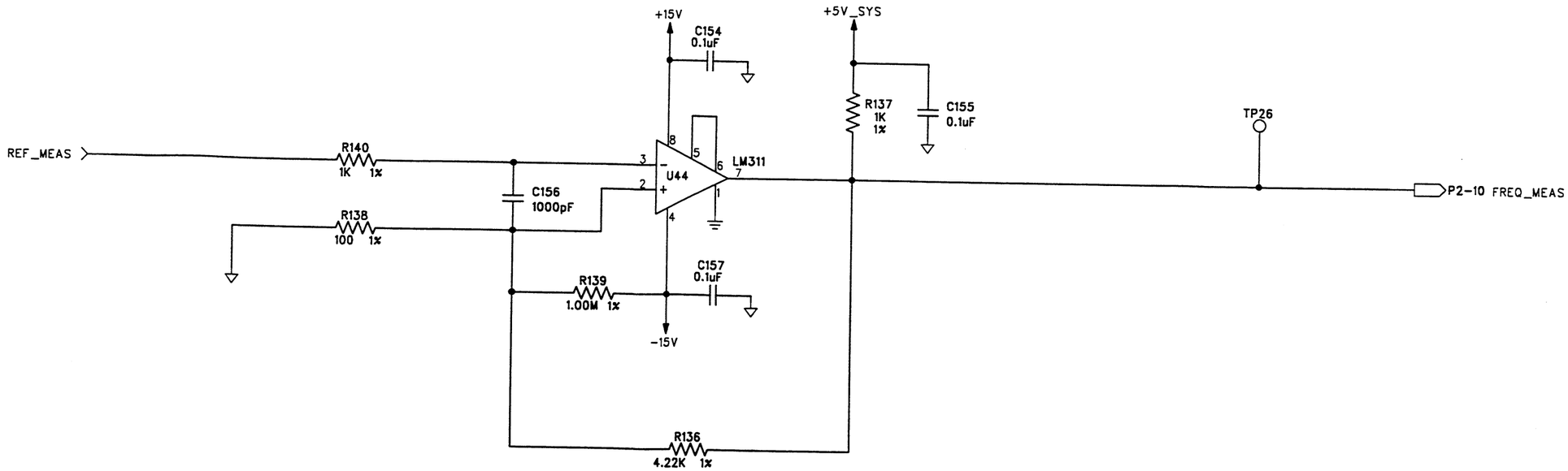
SIZE		SHEET	REV
B	770006	6 OF 10	F

MEASUREMENT CIRCUITS



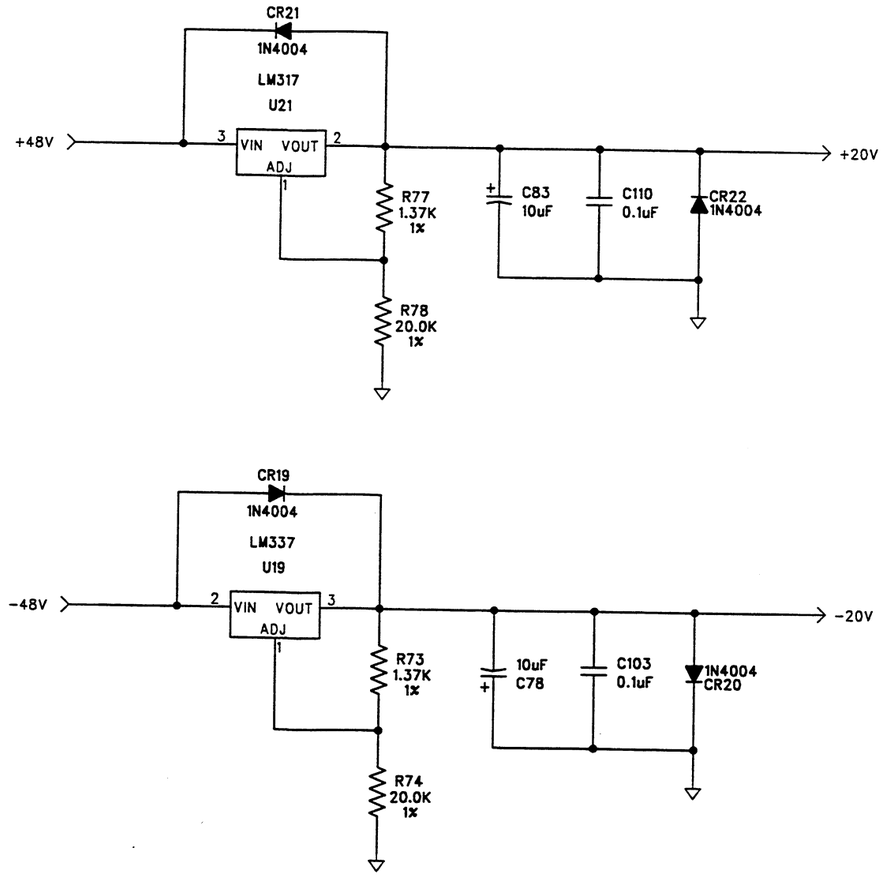
SIZE		SHEET	REV
B	770006	7 OF 10	F

FREQUENCY MEASUREMENT
SQUARING (HARD LIMIT) CIRCUIT



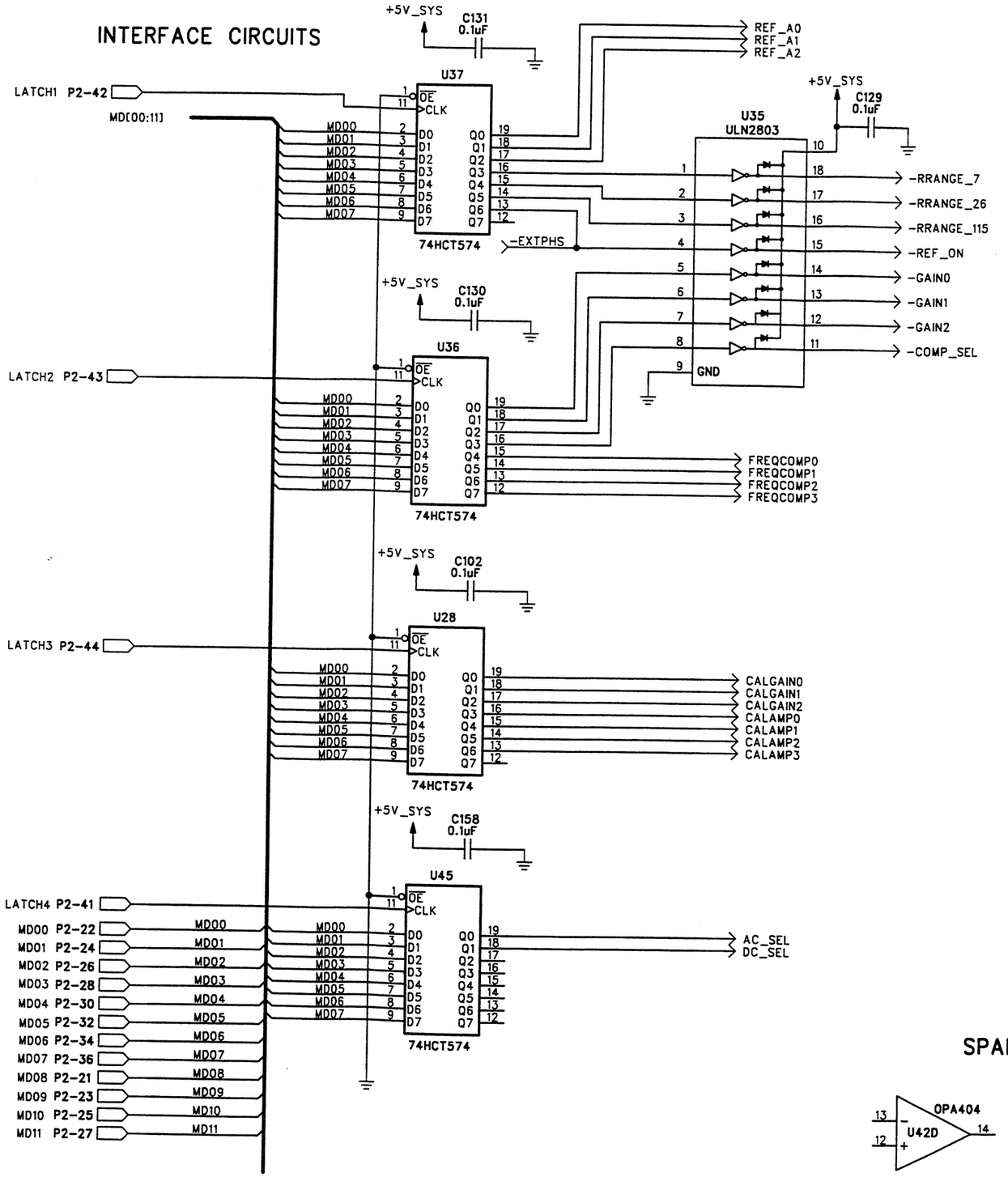
SIZE		SHEET	REV
B	770006	8 OF 10	F

20 VOLT POWER SUPPLIES

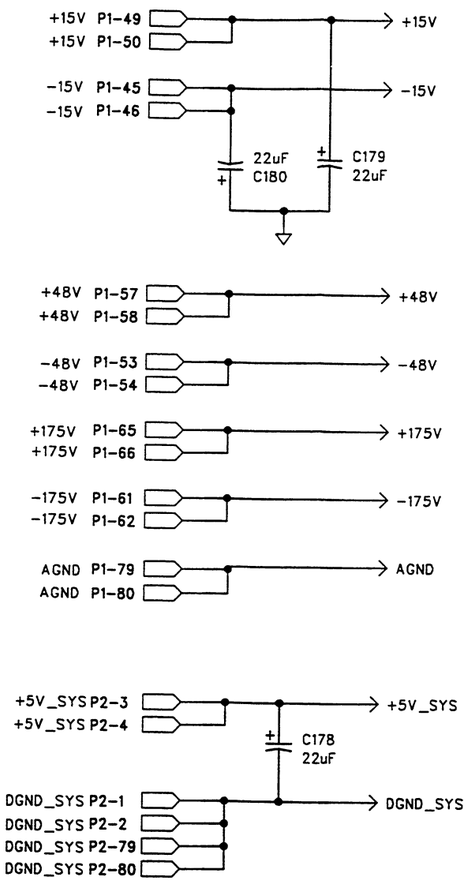


SIZE		SHEET	REV
B	770006	9 OF 10	F

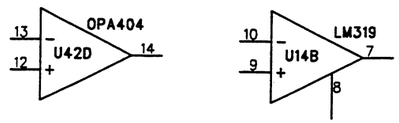
INTERFACE CIRCUITS



POWER SUPPLY INPUTS



SPARE GATES



MOUNTING HOLES

M2 — MOUNTING HOLE SIZE: 100

M1 — MOUNTING HOLE SIZE: 100

M3 — MOUNTING HOLE SIZE: 140

M4 — MOUNTING HOLE SIZE: 281

SIZE		SHEET	REV
B	770006	10 OF 10	F

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	PRELIMENARY	3/10/94	
	B	RELEASE FOR MANUFACTURE	10/28/94	
	C	ECN# 33183	10/31/94	
	D	ECN# 33258	2/23/95	

J3-5 NC

J2-10

J2-9

J2-11

J2-2

J2-1

J2-4

J2-3

J2-16 NC

CR1 1N4004

CR2 1N4004

CR3 1N4004

CR4 1N4004

CR5 1N4004

CR6 1N4004

CR10 1N4004

CR9 RS601

U1 LM317T ADJ

U2 LM337T ADJ

LT1038

C1 0.1uf

C2 0.1uf

C3 3300uf 50V

C4 3300uf 50V

C5 0.1uf

C6 0.1uf

C7 10uf 50V

C8 10uf 50V

C9 47,000uf 25V

C10 0.1uf

C11 4.7uf 25V

C12 0.1uf

C13 10uf 25V

C14 10uf 25V

C15 0.1uf

C16 0.01uf

R1 14.04K

R2 14.04K

R3 1.37K

R4 1.37K

R5 120 .5% 1/4W

R6 383 .5% 1/4W

CR7 1N4004

CR8 1N4004

CR11 1N4004

TP1

TP2

TP3

TP4

+15V

-15V

+5V

DGND_SYS

J1-11

J1-10

J1-9

J1-5

J1-6

J1-7

J1-2

J1-3

J1-4

JP1

CR37 1N4001

CR38 1N4001

Q4 VN0300

Q3 VN0300

K3E NC4D-P-DC5

K1 NC2D-P-DC5

R37 3.3K

PWR_CTL

TP10

J2-14

J2-15

J3-2

J3-3

J4-3

J4-4

J2-12

J3-1

J4-1

J4-2

J3-4

J2-13

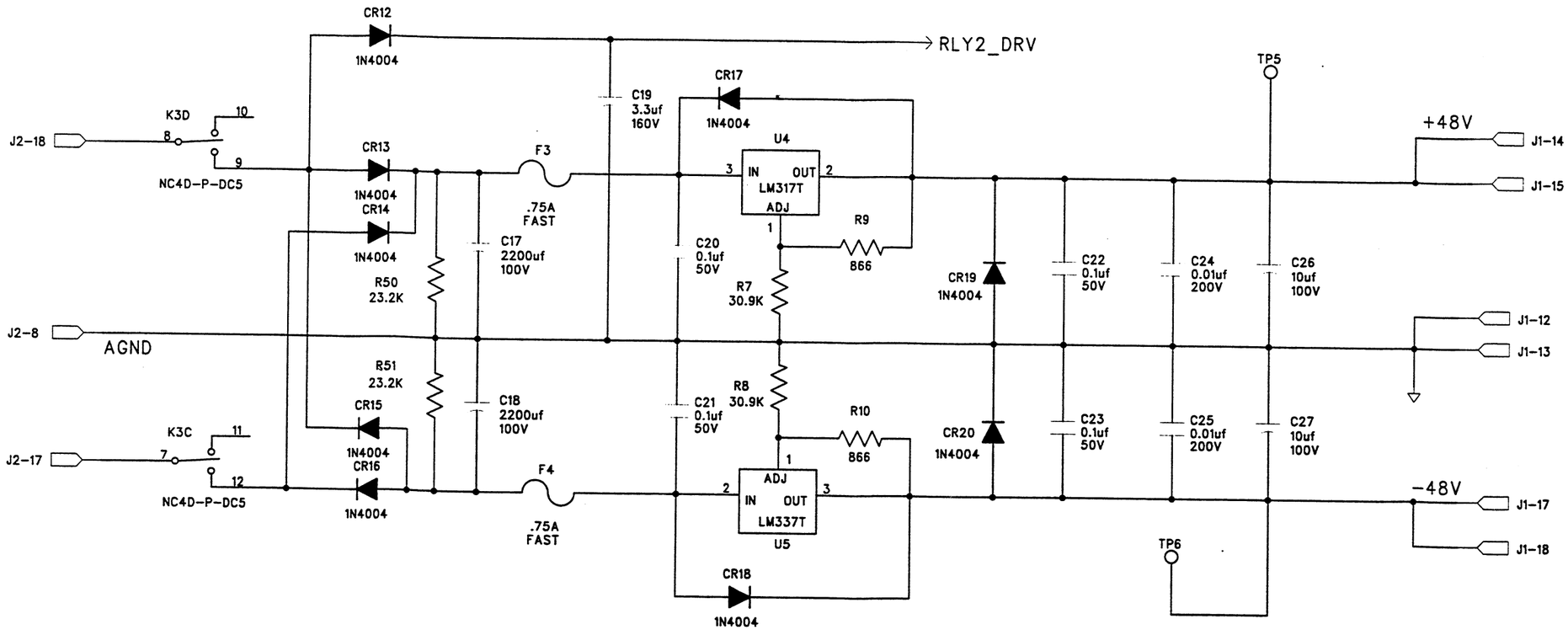
J1-1

784003	5300
NEXT ASSY	USED ON

NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC
MODEL 5300 MAIN POWER SUPPLY

SIZE		SHEET	REV
B	770009	1 OF 3	D



SIZE		SHEET	REV
B	770009	2 OF 3	D

J2-6
K3B
NC4D-P-DC5
CR21 1N4004
CR22 1N4004
F2 1/8A FAST
Q5 MJE340
Q1 MJE340
CR29 1N5368B 47V
CR31 1N4004
U6
IN OUT LM317HVH ADJ
R11 18K
R13 182
R15 23.2K 2W
R17 2K
C46 0 *
CR33 1N4004
C32 0.1uF 250V
C34 10uf 250V
R19 7.5K 3W
TP7
+175V
J1-19
RLY2_DRV
K2
MR602-48USR
R21 0.1 2%
J1-20
J2-7
C28 470uf 400V
C30 0.1uF 400V
CR25 1N5377B 91V
CR26 1N5378B 100V
CR27 1N5377B 91V
CR28 1N5378B 100V
C29 470uf 400V
C31 0.1uF 400V
R18
R16 23.2K 2W
R14 182
C45 0.1uF 250V
CR34 1N4004
C33 0.1uF 250V
C35 10uf 250V
R20 7.5K 3W
CR23 1N4004
J2-5
K3A
NC4D-P-DC5
CR24 1N4004
F1 1/8A FAST
R12 18K
CR30 1N5368B 47V
CR32 1N4004
MJE350 Q6
MJE350 Q2
TP8
-175V
J1-16

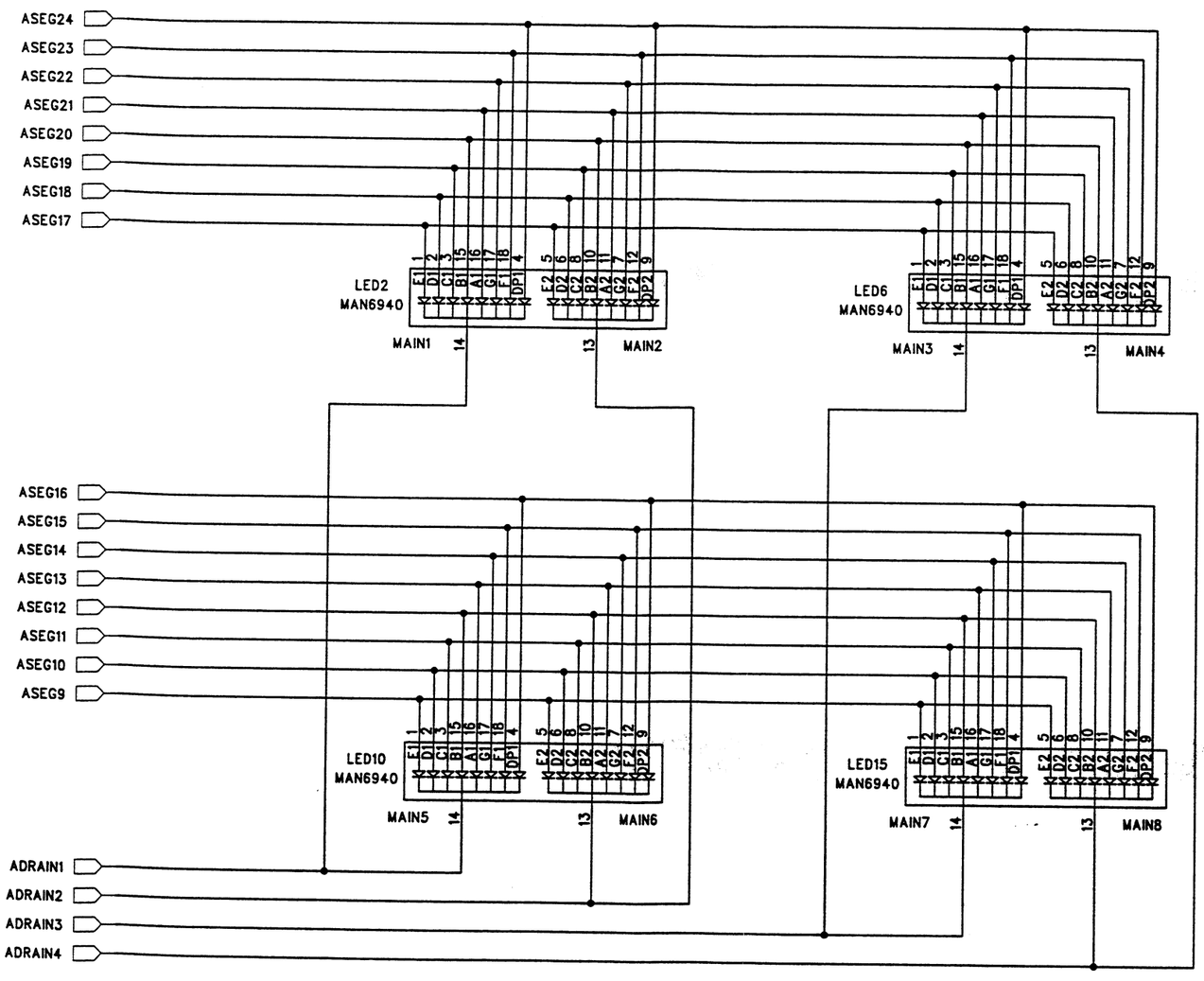
R24 59K
R22 909
C36 0.1uf
U8 OP37
R23 1.37K
C37 0.1uf
R25 374
R26 340
C38 0.1uf
U9 OP37
C39 0.1uf
R27 5.9K
CR35 1N914
R28 5.9K
CR36 1N914
R29 62K
R30 62K
R33 115K
R31 5K
C40 27pf 200V
C41 27pf 200V
R32 27.4K
R35 115K
R38 5K
C42 6.8uf 35V
R36 27.4K
35V 6.8uf C44
U10D LM339
U10A LM339
C43 0.1uf
R34 1.3K
R39 3.74K
TP9
J1-8 MAIN_OD
TP11
+15V
-15V
+5V

* CURRENTLY NOT INSTALLED.

SIZE		SHEET	REV
B	770009	3 OF 3	D

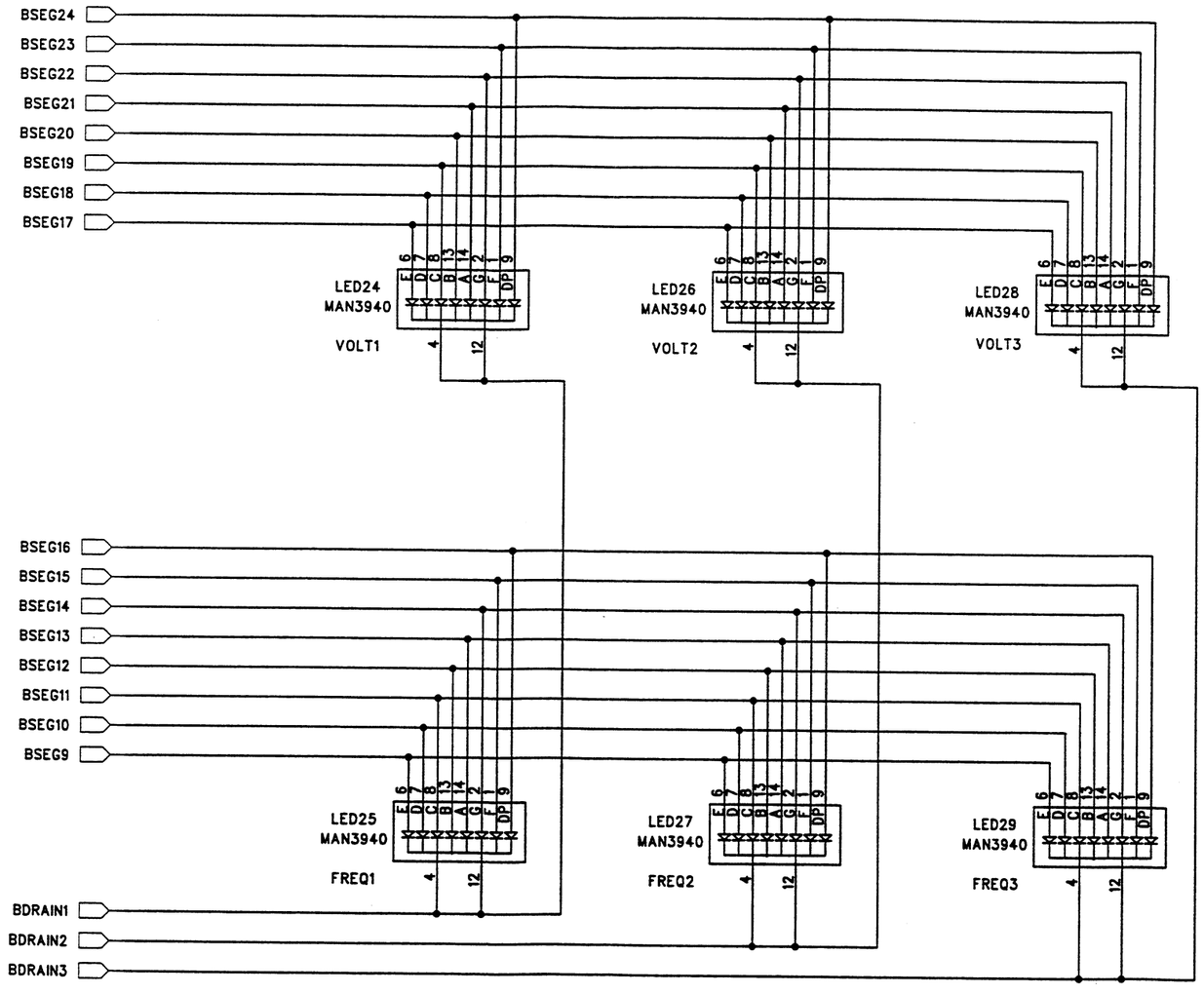
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASE FOR MFG.		

MAIN DISPLAY



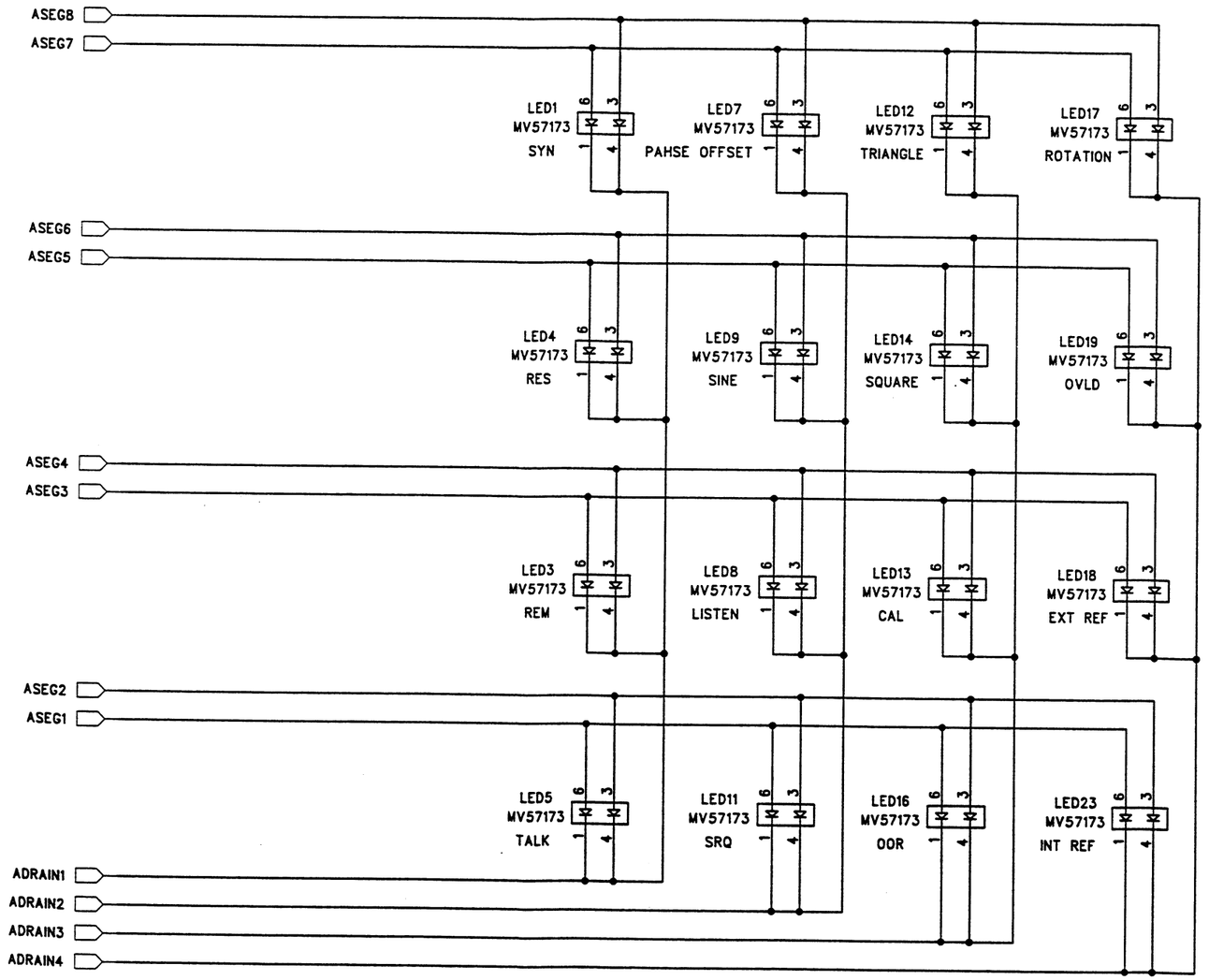
NOTH ATLANTIC INSTRUMENTS INC.			
SCHEMATIC DIAGRAM 5300 DISPLAY/KEYBOARD			
SIZE B	770000	SHEET 1 OF 6	REV B

VOLTAGE DISPLAY



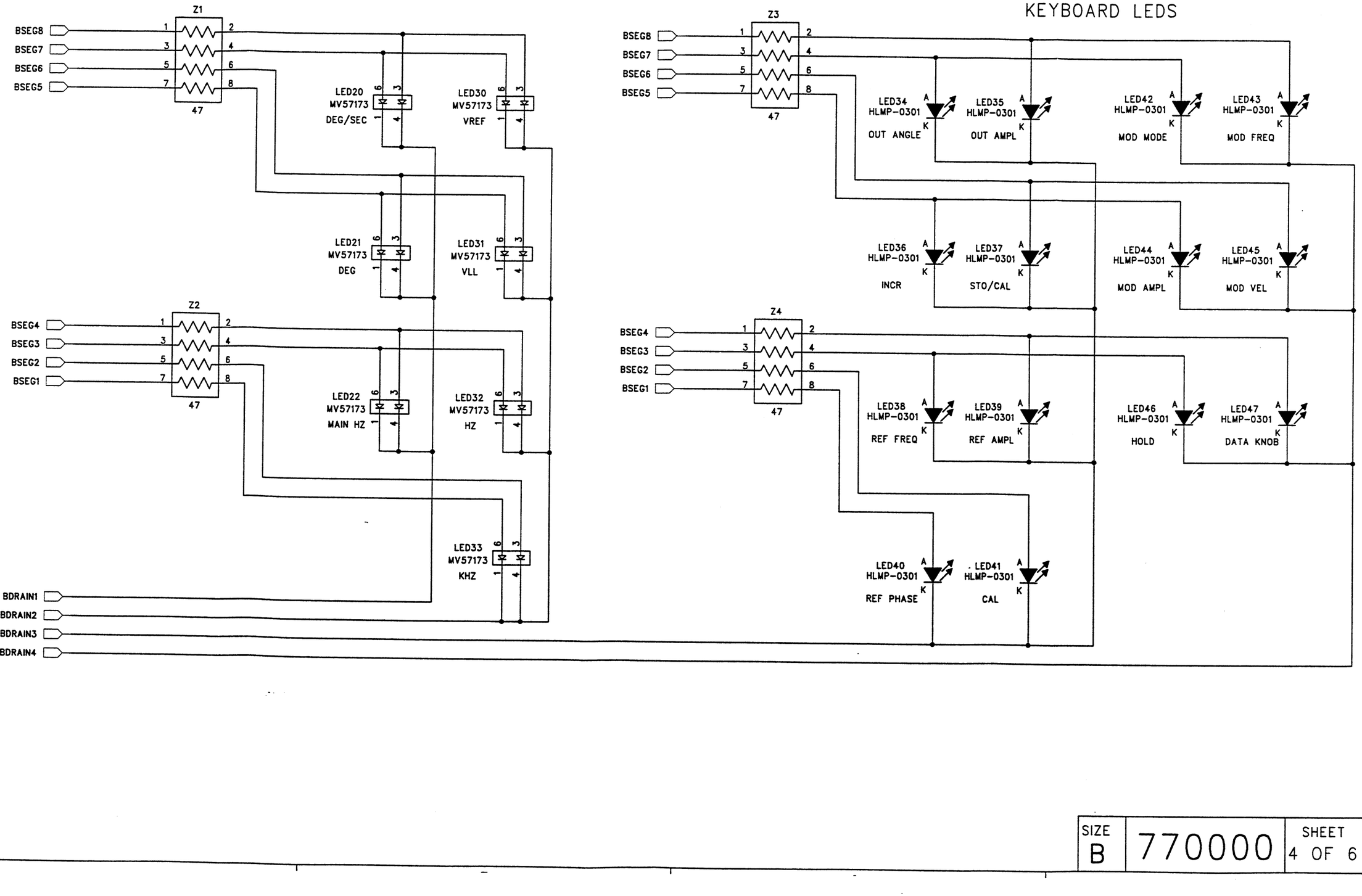
FREQUENCY DISPLAY

SIZE		SHEET	REV
B	770000	2 OF 6	B



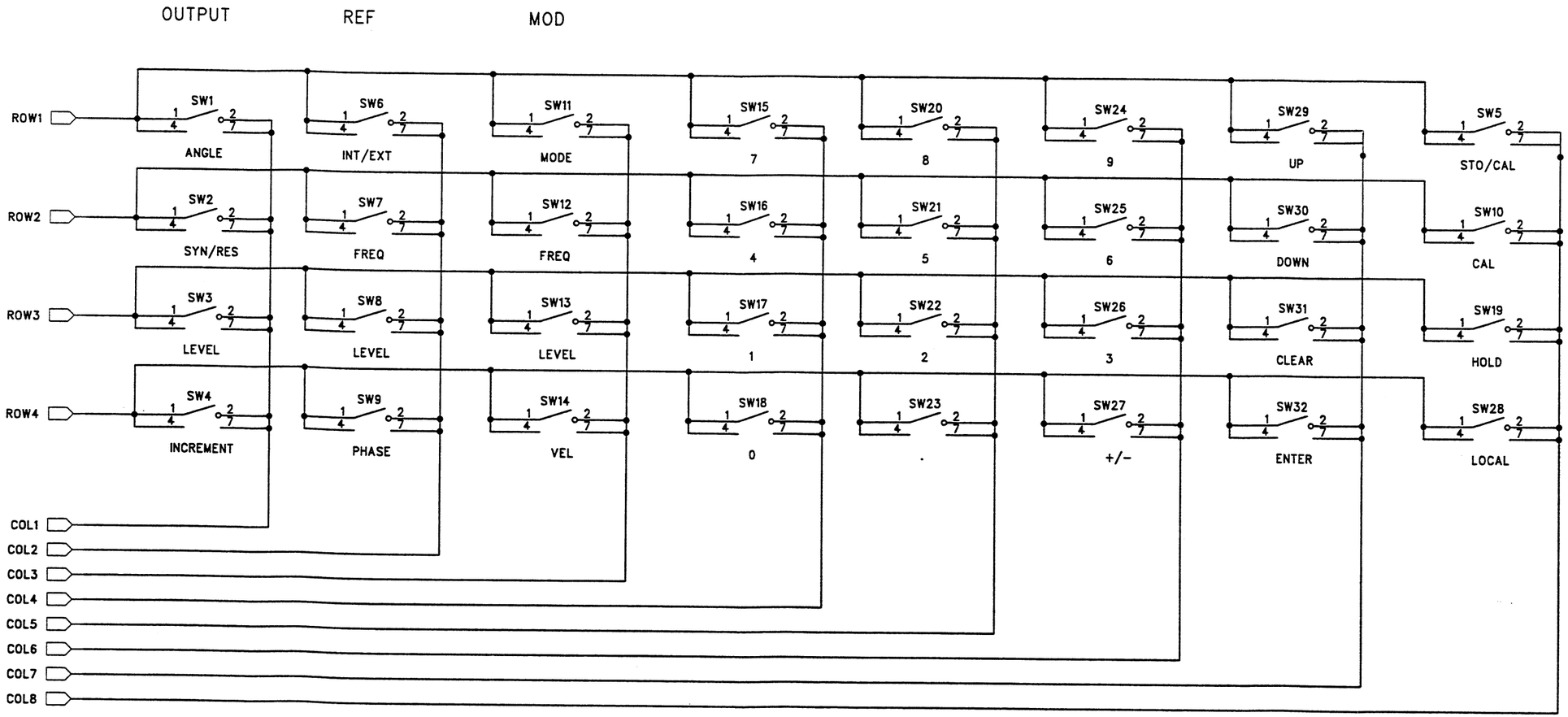
SIZE		SHEET	REV
B	770000	3 OF 6	B

KEYBOARD LEDS



SIZE		SHEET	REV
B	770000	4 OF 6	B

KEYBOARD



SIZE		SHEET	REV
B	770000	5 OF 6	B

J1-33 ASEG1
J1-34 ASEG2
J1-35 ASEG3
J1-36 ASEG4
J1-37 ASEG5
J1-38 ASEG6
J1-39 ASEG7
J1-40 ASEG8
J1-15 ASEG9
J1-16 ASEG10
J1-17 ASEG11
J1-18 ASEG12
J1-19 ASEG13
J1-20 ASEG14
J1-21 ASEG15
J1-22 ASEG16
J1-23 ASEG17
J1-24 ASEG18
J1-25 ASEG19
J1-26 ASEG20
J1-27 ASEG21
J1-28 ASEG22
J1-29 ASEG23
J1-30 ASEG24

J2-22 BSEG1
J2-23 BSEG2
J2-24 BSEG3
J2-25 BSEG4
J2-26 BSEG5
J2-27 BSEG6
J2-28 BSEG7
J2-29 BSEG8
J2-33 BSEG9
J2-34 BSEG10
J2-35 BSEG11
J2-36 BSEG12
J2-37 BSEG13
J2-38 BSEG14
J2-39 BSEG15
J2-40 BSEG16
J1-5 BSEG17
J1-6 BSEG18
J1-7 BSEG19
J1-8 BSEG20
J1-9 BSEG21
J1-10 BSEG22
J1-11 BSEG23
J1-12 BSEG24

J2-18 ROW1
J2-19 ROW2
J2-30 ROW3
J2-9 ROW4
J2-10 COL1
J2-11 COL2
J2-12 COL3
J2-13 COL4
J2-14 COL5
J2-15 COL6
J2-16 COL7
J2-17 COL8

J1-1
J1-2
J1-3
J1-4
GND1

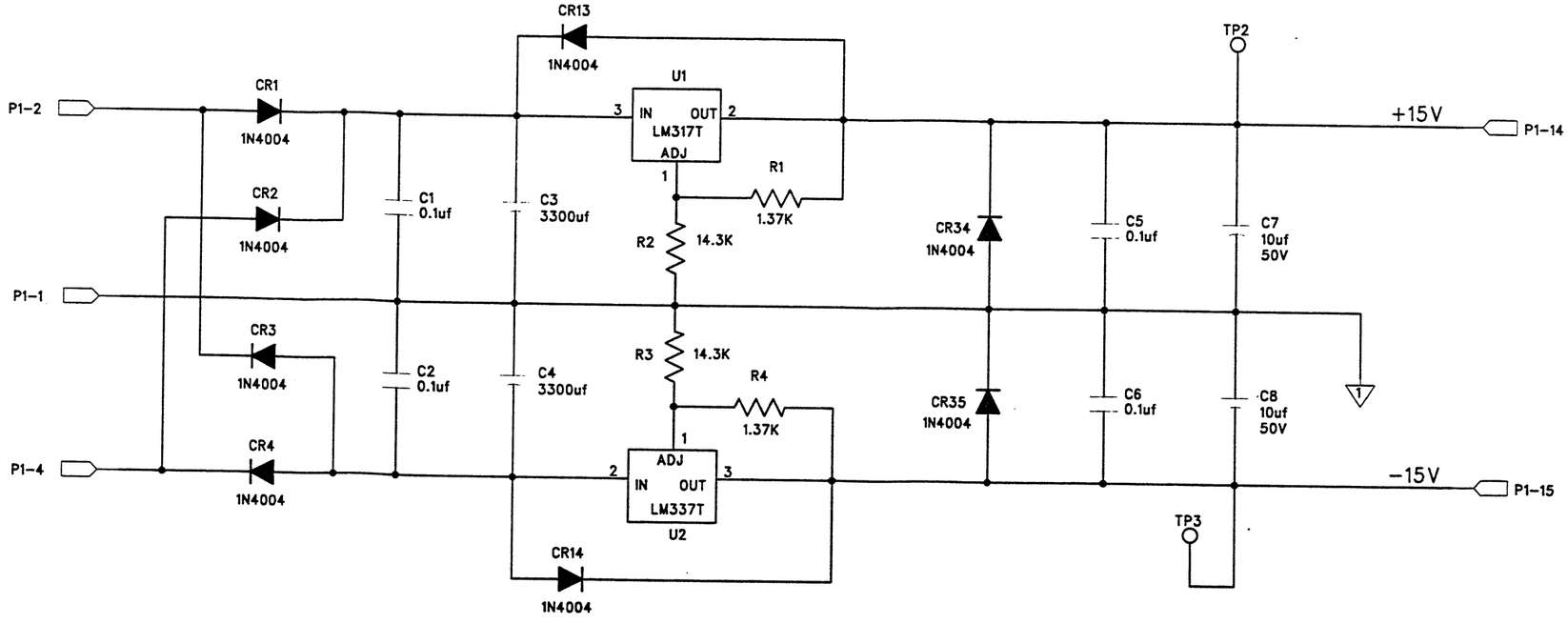
J2-1
J2-2
J2-3
J2-4
GND2

J1-32 ADRIVE1 — Q1 (D: ADRAIN1, S: GND1)
J2-32 BDRIVE1 — Q5 (D: BDRAIN1, S: GND2)
J1-31 ADRIVE2 — Q2 (D: ADRAIN2, S: GND1)
J2-31 BDRIVE2 — Q6 (D: BDRAIN2, S: GND2)
J1-14 ADRIVE3 — Q3 (D: ADRAIN3, S: GND1)
J2-21 BDRIVE3 — Q7 (D: BDRAIN3, S: GND2)
J1-13 ADRIVE4 — Q4 (D: ADRAIN4, S: GND1)
J2-20 BDRIVE4 — Q8 (D: BDRAIN4, S: GND2)

OE1
HPRGF
OPTICAL ENCODER
J2-5 → 3 VCC
J2-6 → 5 GND
1 CASE
4 CHA → J2-7
2 CHB → J2-8
C1 1uf

SIZE		SHEET	REV
B	770000	6 OF 6	B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	PRILIMINARY SCHEMATIC	1-17-94	
	B	RELEASE FOR MANUFACTURE		



NOTE: ALL CAPS ARE

50V UNLESS SPECIFIED

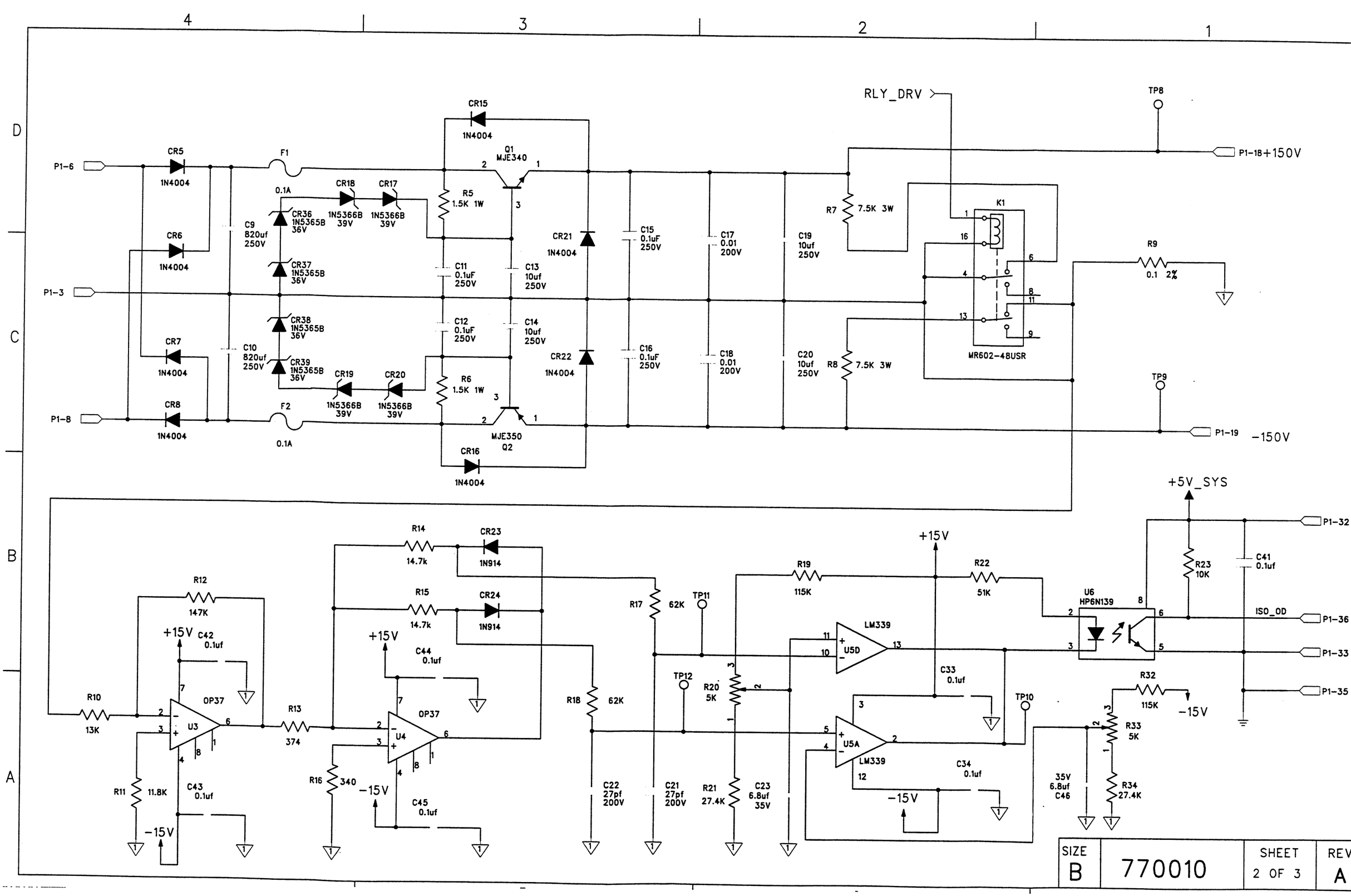
784003	5300
NEXT ASSY	USED ON

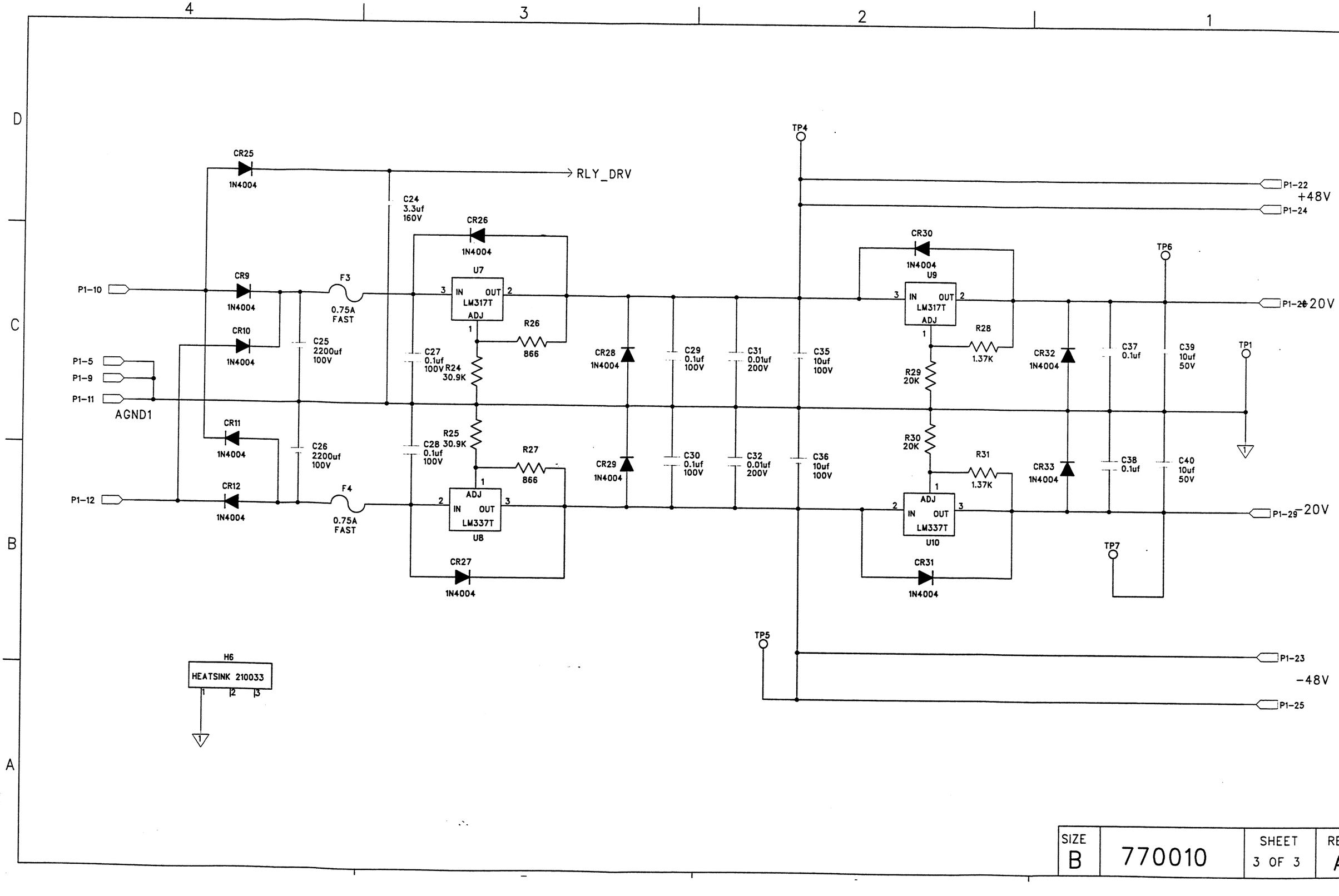
NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC

MODEL 5300 ISOLATED POWER SUPPLY

SIZE		SHEET	REV
B	770010	1 OF 3	B


RLY_DRV
TP8
P1-18 +150V
P1-6
P1-3
P1-8
CR5
1N4004
CR6
1N4004
CR7
1N4004
CR8
1N4004
F1
0.1A
F2
0.1A
CR15
1N4004
CR16
1N4004
Q1
MJE340
Q2
MJE350
R5
1.5K 1W
R6
1.5K 1W
CR18
1N5366B
39V
CR17
1N5366B
39V
CR19
1N5366B
39V
CR20
1N5366B
39V
CR36
1N5365B
36V
CR37
1N5365B
36V
CR38
1N5365B
36V
CR39
1N5365B
36V
C9
820uf
250V
C10
820uf
250V
C11
0.1uF
250V
C12
0.1uF
250V
C13
10uf
250V
C14
10uf
250V
CR21
1N4004
CR22
1N4004
C15
0.1uF
250V
C16
0.1uF
250V
C17
0.01
200V
C18
0.01
200V
C19
10uf
250V
C20
10uf
250V
R7
7.5K 3W
R8
7.5K 3W
K1
MR602-48USR
R9
0.1 2%
TP9
P1-19
-150V
+5V_SYS
P1-32
R23
10K
C41
0.1uf
U6
HP6N139
ISO_OD
P1-36
P1-33
P1-35
R14
14.7k
CR23
1N914
R15
14.7k
CR24
1N914
R12
147K
R10
13K
R13
374
R16
340
R17
62K
R18
62K
TP11
TP12
R19
115K
R22
51K
+15V
LM339
U5D
U5A
R20
5K
R21
27.4K
C33
0.1uf
C34
0.1uf
TP10
R32
115K
R33
5K
R34
27.4K
35V
6.8uf
C46
C23
6.8uf
35V
+15V
C42
0.1uf
C44
0.1uf
C43
0.1uf
C45
0.1uf
OP37
U3
U4
R11
11.8K
C22
27pf
200V
C21
27pf
200V
-15V
SIZE
B
770010
SHEET
2 OF 3
REV
A



SIZE		SHEET	REV
B	770010	3 OF 3	A

J6-1	+COS
J6-2	-COS
J6-3	C_SENSE_LO
J6-4	C_SENSE_LO
J6-5	AGND_COS
J6-6	AGND_COS
J6-7	AGND_COS
J6-8	SENSE_S2
J6-9	-15V_COS
J6-10	+15V_COS
J6-11	C_TAP_NEG
J6-12	C_TAP8
J6-13	COS_QUAD
J6-14	C_TAP7
J6-15	C_TAP15
J6-16	C_TAP6
J6-17	C_TAP14
J6-18	C_TAP5
J6-19	C_TAP13
J6-20	C_TAP4
J6-21	C_TAP12
J6-22	C_TAP3
J6-23	C_TAP11
J6-24	C_TAP2
J6-25	C_TAP10
J6-26	C_TAP16
J6-27	C_TAP9
J6-28	SENSE_S2
J6-29	-20V_COS
J6-30	+20V_COS
J6-31	-48V_COS
J6-32	-48V_COS
J6-33	+48V_COS
J6-34	+48V_COS
J6-35	SENSE_S2
J6-36	SENSE_S4
J6-37	S2
J6-38	S4
J6-39	+150V_COS
J6-40	-150V_COS
J6-41	V_CAL_COS
J6-42	DGND_SYS
J6-43	+5V_SYS
J6-44	DGND_SYS
J6-45	+5V_SYS
J6-46	COS_CTL0
J6-47	COS_CTL8
J6-48	COS_CTL1
J6-49	COS_CTL9
J6-50	COS_CTL2
J6-51	COS_CTL10
J6-52	COS_CTL3
J6-53	COS_CTL11
J6-54	COS_CTL4
J6-55	COS_CTL5
J6-56	COS_CTL6
J6-57	COS_CTL7
J6-58	COSD12
J6-59	C_T/H
J6-60	COSD13
J6-61	COSD11
J6-62	COSD14
J6-63	COSD10
J6-64	COSD15
J6-65	COSD9
J6-66	COSD16
J6-67	COSD8
J6-68	COSD17
J6-69	COSD7
J6-70	COSD18
J6-71	COSD6
J6-72	COSD19
J6-73	COSD5
J6-74	COSD20
J6-75	COSD4
J6-76	COSD21
J6-77	COSD3
J6-78	COSD22
J6-79	COSD2
J6-80	COSD23

J7-1	+SIN
J7-2	-SIN
J7-3	S_SENSE_LO
J7-4	S_SENSE_LO
J7-5	AGND_SIN
J7-6	AGND_SIN
J7-7	AGND_SIN
J7-8	SENSE_S3
J7-9	-15V_SIN
J7-10	+15V_SIN
J7-11	S_TAP_NEG
J7-12	S_TAP8
J7-13	SIN_QUAD
J7-14	S_TAP7
J7-15	S_TAP15
J7-16	S_TAP6
J7-17	S_TAP14
J7-18	S_TAP5
J7-19	S_TAP13
J7-20	S_TAP4
J7-21	S_TAP12
J7-22	S_TAP3
J7-23	S_TAP11
J7-24	S_TAP2
J7-25	S_TAP10
J7-26	S_TAP16
J7-27	S_TAP9
J7-28	SENSE_S3
J7-29	-20V_SIN
J7-30	+20V_SIN
J7-31	-48V_SIN
J7-32	-48V_SIN
J7-33	+48V_SIN
J7-34	+48V_SIN
J7-35	SENSE_S3
J7-36	SENSE_S1
J7-37	S3
J7-38	S1
J7-39	+150V_SIN
J7-40	-150V_SIN
J7-41	V_CAL_SIN
J7-42	DGND_SYS
J7-43	+5V_SYS
J7-44	DGND_SYS
J7-45	+5V_SYS
J7-46	SIN_CTL0
J7-47	N/C
J7-48	SIN_CTL1
J7-49	N/C
J7-50	SIN_CTL2
J7-51	N/C
J7-52	SIN_CTL3
J7-53	N/C
J7-54	SIN_CTL4
J7-55	SIN_CTL5
J7-56	SIN_CTL6
J7-57	SIN_CTL7
J7-58	SIND12
J7-59	S_T/H
J7-60	SIND13
J7-61	SIND11
J7-62	SIND14
J7-63	SIND10
J7-64	SIND15
J7-65	SIND9
J7-66	SIND16
J7-67	SIND8
J7-68	SIND17
J7-69	SIND7
J7-70	SIND18
J7-71	SIND6
J7-72	SIND19
J7-73	SIND5
J7-74	SIND20
J7-75	SIND4
J7-76	SIND21
J7-77	SIND3
J7-78	SIND22
J7-79	SIND2
J7-80	SIND23

J8-1	REFIN_LO
J8-2	AGND
J8-3	REFIN_HI
J8-4	AGND
J8-5	N/C
J8-6	N/C
J8-7	V_CAL_SIN
J8-8	V_CAL_COS
J8-9	N/C
J8-10	N/C
J8-11	XFMR_2
J8-12	XFMR_1
J8-13	N/C
J8-14	N/C
J8-15	N/C
J8-16	N/C
J8-17	N/C
J8-18	N/C
J8-19	N/C
J8-20	N/C
J8-21	N/C
J8-22	N/C
J8-23	N/C
J8-24	N/C
J8-25	N/C
J8-26	N/C
J8-27	N/C
J8-28	N/C
J8-29	N/C
J8-30	N/C
J8-31	N/C
J8-32	N/C
J8-33	N/C
J8-34	N/C
J8-35	N/C
J8-36	N/C
J8-37	N/C
J8-38	N/C
J8-39	N/C
J8-40	N/C
J8-41	N/C
J8-42	N/C
J8-43	N/C
J8-44	N/C
J8-45	-15V
J8-46	-15V
J8-47	SENSE_S2
J8-48	SENSE_S2
J8-49	+15V
J8-50	+15V
J8-51	N/C
J8-52	N/C
J8-53	-48V
J8-54	-48V
J8-55	N/C
J8-56	N/C
J8-57	+48V
J8-58	+48V
J8-59	N/C
J8-60	N/C
J8-61	-175V
J8-62	-175V
J8-63	N/C
J8-64	N/C
J8-65	+175V
J8-66	+175V
J8-67	N/C
J8-68	N/C
J8-69	VREF
J8-70	VREF
J8-71	REF_GND
J8-72	REF_GND
J8-73	N/C
J8-74	N/C
J8-75	REFINT_OUT
J8-76	REFINT_OUT
J8-77	AGND
J8-78	AGND
J8-79	AGND
J8-80	AGND

J9-1	DGND_SYS
J9-2	DGND_SYS
J9-3	+5V_SYS
J9-4	+5V_SYS
J9-5	N/C
J9-6	B10MHZ/4
J9-7	N/C
J9-8	N/C
J9-9	N/C
J9-10	FREQ_MEAS
J9-11	N/C
J9-12	N/C
J9-13	DAC1A
J9-14	DAC1B
J9-15	-AD
J9-16	-RD
J9-17	-WE
J9-18	N/C
J9-19	N/C
J9-20	N/C
J9-21	MD08
J9-22	MD00
J9-23	MD09
J9-24	MD01
J9-25	MD10
J9-26	MD02
J9-27	MD11
J9-28	MD03
J9-29	N/C
J9-30	MD04
J9-31	N/C
J9-32	MD05
J9-33	N/C
J9-34	MD06
J9-35	N/C
J9-36	MD07
J9-37	N/C
J9-38	N/C
J9-39	SENSE_S3
J9-40	SENSE_S3
J9-41	LATCH4
J9-42	LATCH1
J9-43	LATCH2
J9-44	LATCH3
J9-45	N/C
J9-46	N/C
J9-47	DSP_DAC2
J9-48	DSP_DAC3
J9-49	DSP_WR
J9-50	DSP_LDAC
J9-51	N/C
J9-52	N/C
J9-53	
J9-54	DSPD23
J9-55	N/C
J9-56	DSPD22
J9-57	N/C
J9-58	DSPD21
J9-59	N/C
J9-60	DSPD20
J9-61	DSPD10
J9-62	DSPD19
J9-63	DSPD11
J9-64	DSPD18
J9-65	DSPD12
J9-66	DSPD17
J9-67	DSPD13
J9-68	DSPD16
J9-69	DSPD14
J9-70	DSPD15
J9-71	N/C
J9-72	N/C
J9-73	N/C
J9-74	N/C
J9-75	N/C
J9-76	N/C
J9-77	N/C
J9-78	N/C
J9-79	DGND_SYS
J9-80	DGND_SYS

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	FIRST DRAFT	2/1/94	
	A	RELEASE FOR MANUFACTURE	2/10/94	PVR
	B	REVISED SENSE CONNECTIONS	7/21/94	PVR

784011	5300
NEXT ASSY	USED ON

NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC DIAGRAM, 5300 ANALOG INTERCONNECT BOARD

SIZE		SHEET	REV
B	770008	1 OF 3	B

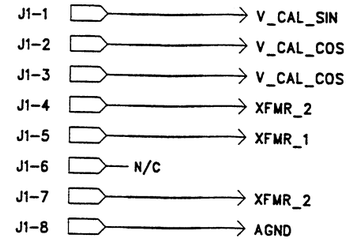
P1-1	N/C
P1-2	REFIN_LO
P1-3	N/C
P1-4	REFIN_HI
P1-5	AGND
P1-6	AGND
P1-7	AGND
P1-8	AGND
P1-9	N/C
P1-10	N/C
P1-11	N/C
P1-12	N/C
P1-13	N/C
P1-14	N/C
P1-15	N/C
P1-16	N/C
P1-17	N/C
P1-18	N/C
P1-19	N/C
P1-20	N/C
P1-21	COSD2
P1-22	COSD23
P1-23	COSD3
P1-24	COSD22
P1-25	COSD4
P1-26	COSD21
P1-27	COSD5
P1-28	COSD20
P1-29	COSD6
P1-30	COSD19
P1-31	COSD7
P1-32	COSD18
P1-33	COSD8
P1-34	COSD17
P1-35	COSD9
P1-36	COSD16
P1-37	COSD10
P1-38	COSD15
P1-39	COSD11
P1-40	COSD14
P1-41	C_T/H
P1-42	COSD13
P1-43	COS_CTL7
P1-44	COSD12
P1-45	COS_CTL5
P1-46	COS_CTL6
P1-47	COS_CTL11
P1-48	COS_CTL4
P1-49	COS_CTL10
P1-50	COS_CTL3
P1-51	COS_CTL9
P1-52	COS_CTL2
P1-53	COS_CTL8
P1-54	COS_CTL1
P1-55	N/C
P1-56	COS_CTL0
P1-57	N/C
P1-58	N/C
P1-59	SENSE_S2
P1-60	SENSE_S2

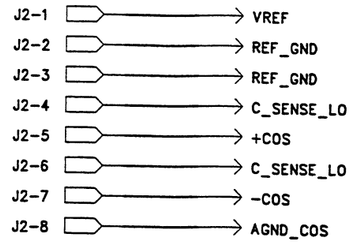
P1-61	S2
P1-62	S2
P1-63	S4
P1-64	S4
P1-65	SENSE_S2
P1-66	SENSE_S2
P1-67	SENSE_S4
P1-68	SENSE_S4
P1-69	SENSE_S2
P1-70	SENSE_S2
P1-71	-15V
P1-72	-15V
P1-73	-48V
P1-74	-48V
P1-75	+15V
P1-76	+15V
P1-77	+48V
P1-78	+48V
P1-79	N/C
P1-80	+175V
P1-81	+175V
P1-82	N/C
P1-83	N/C
P1-84	N/C
P1-85	-175V
P1-86	-175V
P1-87	N/C
P1-88	N/C
P1-89	N/C
P1-90	N/C
P1-91	N/C
P1-92	N/C
P1-93	N/C
P1-94	N/C
P1-95	REFINT_OUT
P1-96	REFINT_OUT
P1-97	AGND
P1-98	AGND
P1-99	AGND
P1-100	AGND
P1-101	N/C
P1-102	N/C
P1-103	+15V_COS
P1-104	-15V_COS
P1-105	+15V_COS
P1-106	-15V_COS
P1-107	-20V_COS
P1-108	-150V_COS
P1-109	+20V_COS
P1-110	+150V_COS
P1-111	+48V_COS
P1-112	-48V_COS
P1-113	+48V_COS
P1-114	-48V_COS
P1-115	AGND_COS
P1-116	AGND_COS
P1-117	AGND_COS
P1-118	AGND_COS
P1-119	C_SENSE_LO
P1-120	C_SENSE_LO

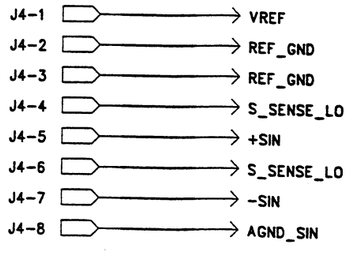
P2-1	S3
P2-2	S3
P2-3	S1
P2-4	S1
P2-5	SENSE_S3
P2-6	SENSE_S3
P2-7	SENSE_S1
P2-8	SENSE_S1
P2-9	SENSE_S3
P2-10	N/C
P2-11	N/C
P2-12	B10MHZ/4
P2-13	DGND_SYS
P2-14	DGND_SYS
P2-15	FREQ_MEAS
P2-16	N/C
P2-17	DGND_SYS
P2-18	DGND_SYS
P2-19	+5V_SYS
P2-20	+5V_SYS
P2-21	SIND2
P2-22	SIND23
P2-23	SIND3
P2-24	SIND22
P2-25	SIND4
P2-26	SIND21
P2-27	SIND5
P2-28	SIND20
P2-29	SIND6
P2-30	SIND19
P2-31	SIND7
P2-32	SIND18
P2-33	SIND8
P2-34	SIND17
P2-35	SIND9
P2-36	SIND16
P2-37	SIND10
P2-38	SIND15
P2-39	SIND11
P2-40	SIND14
P2-41	S_T/H
P2-42	SIND13
P2-43	SIN_CTL7
P2-44	SIND12
P2-45	SIN_CTL5
P2-46	SIN_CTL6
P2-47	N/C
P2-48	SIN_CTL4
P2-49	N/C
P2-50	SIN_CTL3
P2-51	N/C
P2-52	SIN_CTL2
P2-53	N/C
P2-54	SIN_CTL1
P2-55	N/C
P2-56	SIN_CTL0
P2-57	N/C
P2-58	N/C
P2-59	SENSE_S3
P2-60	SENSE_S3

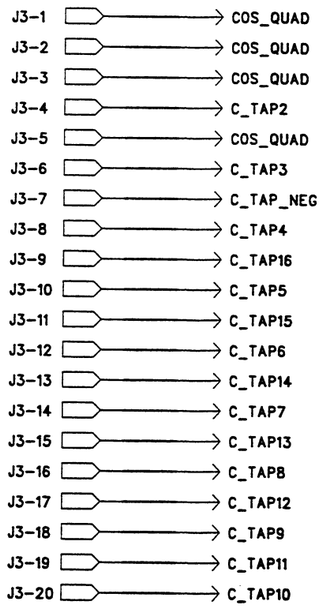
P2-61	SENSE_S3
P2-62	N/C
P2-63	DAC1A
P2-64	DAC1B
P2-65	-AD
P2-66	-RD
P2-67	-WE
P2-68	N/C
P2-69	LATCH4
P2-70	LATCH1
P2-71	LATCH2
P2-72	LATCH3
P2-73	DSP_DAC2
P2-74	DSP_DAC3
P2-75	DSP_WR
P2-76	DSP_LDAC
P2-77	DSPD23
P2-78	DSPD22
P2-79	DSPD21
P2-80	DSPD20
P2-81	DSPD10
P2-82	DSPD19
P2-83	DSPD11
P2-84	DSPD18
P2-85	DSPD12
P2-86	DSPD17
P2-87	DSPD13
P2-88	DSPD16
P2-89	DSPD14
P2-90	DSPD15
P2-91	MD08
P2-92	MD00
P2-93	MD09
P2-94	MD01
P2-95	MD10
P2-96	MD02
P2-97	MD11
P2-98	MD03
P2-99	MD04
P2-100	MD06
P2-101	MD05
P2-102	MD07
P2-103	+15V_SIN
P2-104	-15V_SIN
P2-105	+15V_SIN
P2-106	-15V_SIN
P2-107	-20V_SIN
P2-108	-150V_SIN
P2-109	+20V_SIN
P2-110	+150V_SIN
P2-111	+48V_SIN
P2-112	-48V_SIN
P2-113	+48V_SIN
P2-114	-48V_SIN
P2-115	AGND_SIN
P2-116	AGND_SIN
P2-117	AGND_SIN
P2-118	AGND_SIN
P2-119	S_SENSE_LO
P2-120	S_SENSE_LO

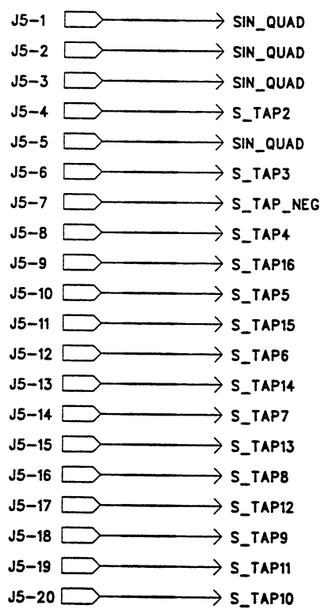
SIZE		SHEET	REV
B	770008	2 OF 3	B

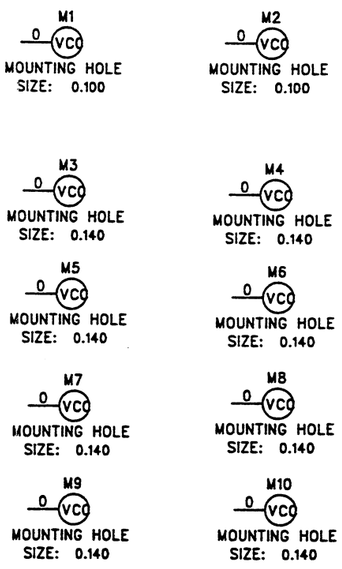












SIZE		SHEET	REV
B	770008	3 OF 3	B

TO SIN/COS BOARD

J6-1	+COS
J6-2	-COS
J6-3	C_SENSE_LO
J6-4	C_SENSE_LO
J6-5	AGND_COS
J6-6	AGND_COS
J6-7	AGND_COS
J6-8	SENSE_S2
J6-9	-15V_COS
J6-10	+15V_COS
J6-11	C_TAP_NEG
J6-12	C_TAP8
J6-13	COS_QUAD
J6-14	C_TAP7
J6-15	C_TAP15
J6-16	C_TAP6
J6-17	C_TAP14
J6-18	C_TAP5
J6-19	C_TAP13
J6-20	C_TAP4
J6-21	C_TAP12
J6-22	C_TAP3
J6-23	C_TAP11
J6-24	C_TAP2
J6-25	C_TAP10
J6-26	C_TAP16
J6-27	C_TAP9
J6-28	SENSE_S2
J6-29	-20V_COS
J6-30	+20V_COS
J6-31	-48V_COS
J6-32	-48V_COS
J6-33	+48V_COS
J6-34	+48V_COS
J6-35	SENSE_S2
J6-36	SENSE_S4
J6-37	S2
J6-38	S4
J6-39	+150V_COS
J6-40	-150V_COS
J6-41	V_CAL_COS
J6-42	DGND_SYS
J6-43	+5V_SYS
J6-44	DGND_SYS
J6-45	+5V_SYS
J6-46	COS_CTL0
J6-47	COS_CTL8
J6-48	COS_CTL1
J6-49	COS_CTL9
J6-50	COS_CTL2
J6-51	COS_CTL10
J6-52	COS_CTL3
J6-53	COS_CTL11
J6-54	COS_CTL4
J6-55	COS_CTL5
J6-56	COS_CTL6
J6-57	COS_CTL7
J6-58	COSD12
J6-59	C_T/H
J6-60	COSD13
J6-61	COSD11
J6-62	COSD14
J6-63	COSD10
J6-64	COSD15
J6-65	COSD9
J6-66	COSD16
J6-67	COSD8
J6-68	COSD17
J6-69	COSD7
J6-70	COSD18
J6-71	COSD6
J6-72	COSD19
J6-73	COSD5
J6-74	COSD20
J6-75	COSD4
J6-76	COSD21
J6-77	COSD3
J6-78	COSD22
J6-79	COSD2
J6-80	COSD23

J7-1	+SIN
J7-2	-SIN
J7-3	S_SENSE_LO
J7-4	S_SENSE_LO
J7-5	AGND_SIN
J7-6	AGND_SIN
J7-7	AGND_SIN
J7-8	SENSE_S3
J7-9	-15V_SIN
J7-10	+15V_SIN
J7-11	S_TAP_NEG
J7-12	S_TAP8
J7-13	SIN_QUAD
J7-14	S_TAP7
J7-15	S_TAP15
J7-16	S_TAP6
J7-17	S_TAP14
J7-18	S_TAP5
J7-19	S_TAP13
J7-20	S_TAP4
J7-21	S_TAP12
J7-22	S_TAP3
J7-23	S_TAP11
J7-24	S_TAP2
J7-25	S_TAP10
J7-26	S_TAP16
J7-27	S_TAP9
J7-28	SENSE_S3
J7-29	-20V_SIN
J7-30	+20V_SIN
J7-31	-48V_SIN
J7-32	-48V_SIN
J7-33	+48V_SIN
J7-34	+48V_SIN
J7-35	SENSE_S3
J7-36	SENSE_S1
J7-37	S3
J7-38	S1
J7-39	+150V_SIN
J7-40	-150V_SIN
J7-41	V_CAL_SIN
J7-42	DGND_SYS
J7-43	+5V_SYS
J7-44	DGND_SYS
J7-45	+5V_SYS
J7-46	SIN_CTL0
J7-47	N/C
J7-48	SIN_CTL1
J7-49	N/C
J7-50	SIN_CTL2
J7-51	N/C
J7-52	SIN_CTL3
J7-53	N/C
J7-54	SIN_CTL4
J7-55	SIN_CTL5
J7-56	SIN_CTL6
J7-57	SIN_CTL7
J7-58	SIND12
J7-59	S_T/H
J7-60	SIND13
J7-61	SIND11
J7-62	SIND14
J7-63	SIND10
J7-64	SIND15
J7-65	SIND9
J7-66	SIND16
J7-67	SIND8
J7-68	SIND17
J7-69	SIND7
J7-70	SIND18
J7-71	SIND6
J7-72	SIND19
J7-73	SIND5
J7-74	SIND20
J7-75	SIND4
J7-76	SIND21
J7-77	SIND3
J7-78	SIND22
J7-79	SIND2
J7-80	SIND23

TO ANALOG BOARD

J8-1	REFIN_LO
J8-2	AGND
J8-3	REFIN_HI
J8-4	AGND
J8-5	N/C
J8-6	N/C
J8-7	V_CAL_SIN
J8-8	V_CAL_COS
J8-9	N/C
J8-10	N/C
J8-11	XFMR_2
J8-12	XFMR_1
J8-13	N/C
J8-14	N/C
J8-15	N/C
J8-16	N/C
J8-17	N/C
J8-18	N/C
J8-19	N/C
J8-20	N/C
J8-21	N/C
J8-22	N/C
J8-23	N/C
J8-24	N/C
J8-25	N/C
J8-26	N/C
J8-27	N/C
J8-28	N/C
J8-29	N/C
J8-30	N/C
J8-31	N/C
J8-32	N/C
J8-33	N/C
J8-34	N/C
J8-35	N/C
J8-36	N/C
J8-37	N/C
J8-38	N/C
J8-39	N/C
J8-40	N/C
J8-41	N/C
J8-42	N/C
J8-43	N/C
J8-44	N/C
J8-45	-15V
J8-46	-15V
J8-47	SENSE_S2
J8-48	SENSE_S2
J8-49	+15V
J8-50	+15V
J8-51	N/C
J8-52	N/C
J8-53	-48V
J8-54	-48V
J8-55	N/C
J8-56	N/C
J8-57	+48V
J8-58	+48V
J8-59	N/C
J8-60	N/C
J8-61	-175V
J8-62	-175V
J8-63	N/C
J8-64	N/C
J8-65	+175V
J8-66	+175V
J8-67	N/C
J8-68	N/C
J8-69	VREF
J8-70	VREF
J8-71	REF_GND
J8-72	REF_GND
J8-73	N/C
J8-74	N/C
J8-75	REFINT_OUT
J8-76	REFINT_OUT
J8-77	AGND
J8-78	AGND
J8-79	AGND
J8-80	AGND

J9-1	DGND_SYS
J9-2	DGND_SYS
J9-3	+5V_SYS
J9-4	+5V_SYS
J9-5	N/C
J9-6	B10MHZ/4
J9-7	N/C
J9-8	N/C
J9-9	N/C
J9-10	FREQ_MEAS
J9-11	N/C
J9-12	N/C
J9-13	DAC1A
J9-14	DAC1B
J9-15	-AD
J9-16	-RD
J9-17	-WE
J9-18	N/C
J9-19	N/C
J9-20	N/C
J9-21	MD08
J9-22	MD00
J9-23	MD09
J9-24	MD01
J9-25	MD10
J9-26	MD02
J9-27	MD11
J9-28	MD03
J9-29	N/C
J9-30	MD04
J9-31	N/C
J9-32	MD05
J9-33	N/C
J9-34	MD06
J9-35	N/C
J9-36	MD07
J9-37	N/C
J9-38	N/C
J9-39	SENSE_S3
J9-40	SENSE_S3
J9-41	LATCH4
J9-42	LATCH1
J9-43	LATCH2
J9-44	LATCH3
J9-45	N/C
J9-46	N/C
J9-47	DSP_DAC2
J9-48	DSP_DAC3
J9-49	DSP_WR
J9-50	DSP_LDAC
J9-51	N/C
J9-52	N/C
J9-53	
J9-54	DSPD23
J9-55	N/C
J9-56	DSPD22
J9-57	N/C
J9-58	DSPD21
J9-59	N/C
J9-60	DSPD20
J9-61	DSPD10
J9-62	DSPD19
J9-63	DSPD11
J9-64	DSPD18
J9-65	DSPD12
J9-66	DSPD17
J9-67	DSPD13
J9-68	DSPD16
J9-69	DSPD14
J9-70	DSPD15
J9-71	N/C
J9-72	N/C
J9-73	N/C
J9-74	N/C
J9-75	N/C
J9-76	N/C
J9-77	N/C
J9-78	N/C
J9-79	DGND_SYS
J9-80	DGND_SYS

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	1	FIRST DRAFT	4/28/94	

REF: P.W. BOARD 210072

784014	5300
NEXT ASSY	USED ON

NORTH ATLANTIC INSTRUMENTS INC.

SCHEMATIC DIAGRAM,

5300 ANALOG CARD CAGE EXTENDER

SIZE		SHEET	REV
B	770011	1 OF 4	A

CARD EDGE TO PLUG INTO SYSTEM BOARD

P1-1	N/C
P1-2	REFIN_LO
P1-3	N/C
P1-4	REFIN_HI
P1-5	AGND
P1-6	AGND
P1-7	AGND
P1-8	AGND
P1-9	N/C
P1-10	N/C
P1-11	N/C
P1-12	N/C
P1-13	N/C
P1-14	N/C
P1-15	N/C
P1-16	N/C
P1-17	N/C
P1-18	N/C
P1-19	N/C
P1-20	N/C
P1-21	COSD2
P1-22	COSD23
P1-23	COSD3
P1-24	COSD22
P1-25	COSD4
P1-26	COSD21
P1-27	COSD5
P1-28	COSD20
P1-29	COSD6
P1-30	COSD19
P1-31	COSD7
P1-32	COSD18
P1-33	COSD8
P1-34	COSD17
P1-35	COSD9
P1-36	COSD16
P1-37	COSD10
P1-38	COSD15
P1-39	COSD11
P1-40	COSD14
P1-41	C_T/H
P1-42	COSD13
P1-43	COS_CTL7
P1-44	COSD12
P1-45	COS_CTL5
P1-46	COS_CTL6
P1-47	COS_CTL11
P1-48	COS_CTL4
P1-49	COS_CTL10
P1-50	COS_CTL3
P1-51	COS_CTL9
P1-52	COS_CTL2
P1-53	COS_CTL8
P1-54	COS_CTL1
P1-55	N/C
P1-56	COS_CTL0
P1-57	N/C
P1-58	N/C
P1-59	SENSE_S2
P1-60	SENSE_S2

P1-61	S2
P1-62	S2
P1-63	S4
P1-64	S4
P1-65	SENSE_S2
P1-66	SENSE_S2
P1-67	SENSE_S4
P1-68	SENSE_S4
P1-69	SENSE_S2
P1-70	SENSE_S2
P1-71	-15V
P1-72	-15V
P1-73	-48V
P1-74	-48V
P1-75	+15V
P1-76	+15V
P1-77	+48V
P1-78	+48V
P1-79	N/C
P1-80	+175V
P1-81	+175V
P1-82	N/C
P1-83	N/C
P1-84	N/C
P1-85	-175V
P1-86	-175V
P1-87	N/C
P1-88	N/C
P1-89	N/C
P1-90	N/C
P1-91	N/C
P1-92	N/C
P1-93	N/C
P1-94	N/C
P1-95	REFINT_OUT
P1-96	REFINT_OUT
P1-97	AGND
P1-98	AGND
P1-99	AGND
P1-100	AGND
P1-101	N/C
P1-102	N/C
P1-103	+15V_COS
P1-104	-15V_COS
P1-105	+15V_COS
P1-106	-15V_COS
P1-107	-20V_COS
P1-108	-150V_COS
P1-109	+20V_COS
P1-110	+150V_COS
P1-111	+48V_COS
P1-112	-48V_COS
P1-113	+48V_COS
P1-114	-48V_COS
P1-115	AGND_COS
P1-116	AGND_COS
P1-117	AGND_COS
P1-118	AGND_COS
P1-119	C_SENSE_LO
P1-120	C_SENSE_LO

P2-1	S3
P2-2	S3
P2-3	S1
P2-4	S1
P2-5	SENSE_S3
P2-6	SENSE_S3
P2-7	SENSE_S1
P2-8	SENSE_S1
P2-9	SENSE_S3
P2-10	N/C
P2-11	N/C
P2-12	B10MHZ/4
P2-13	DGND_SYS
P2-14	DGND_SYS
P2-15	FREQ_MEAS
P2-16	N/C
P2-17	DGND_SYS
P2-18	DGND_SYS
P2-19	+5V_SYS
P2-20	+5V_SYS
P2-21	SIND2
P2-22	SIND23
P2-23	SIND3
P2-24	SIND22
P2-25	SIND4
P2-26	SIND21
P2-27	SIND5
P2-28	SIND20
P2-29	SIND6
P2-30	SIND19
P2-31	SIND7
P2-32	SIND18
P2-33	SIND8
P2-34	SIND17
P2-35	SIND9
P2-36	SIND16
P2-37	SIND10
P2-38	SIND15
P2-39	SIND11
P2-40	SIND14
P2-41	S_T/H
P2-42	SIND13
P2-43	SIN_CTL7
P2-44	SIND12
P2-45	SIN_CTL5
P2-46	SIN_CTL6
P2-47	N/C
P2-48	SIN_CTL4
P2-49	N/C
P2-50	SIN_CTL3
P2-51	N/C
P2-52	SIN_CTL2
P2-53	N/C
P2-54	SIN_CTL1
P2-55	N/C
P2-56	SIN_CTL0
P2-57	N/C
P2-58	N/C
P2-59	SENSE_S3
P2-60	SENSE_S3

P2-61	SENSE_S3
P2-62	N/C
P2-63	DAC1A
P2-64	DAC1B
P2-65	-AD
P2-66	-RD
P2-67	-WE
P2-68	N/C
P2-69	LATCH4
P2-70	LATCH1
P2-71	LATCH2
P2-72	LATCH3
P2-73	DSP_DAC2
P2-74	DSP_DAC3
P2-75	DSP_WR
P2-76	DSP_LDAC
P2-77	DSPD23
P2-78	DSPD22
P2-79	DSPD21
P2-80	DSPD20
P2-81	DSPD10
P2-82	DSPD19
P2-83	DSPD11
P2-84	DSPD18
P2-85	DSPD12
P2-86	DSPD17
P2-87	DSPD13
P2-88	DSPD16
P2-89	DSPD14
P2-90	DSPD15
P2-91	MD08
P2-92	MD00
P2-93	MD09
P2-94	MD01
P2-95	MD10
P2-96	MD02
P2-97	MD11
P2-98	MD03
P2-99	MD04
P2-100	MD06
P2-101	MD05
P2-102	MD07
P2-103	+15V_SIN
P2-104	-15V_SIN
P2-105	+15V_SIN
P2-106	-15V_SIN
P2-107	-20V_SIN
P2-108	-150V_SIN
P2-109	+20V_SIN
P2-110	+150V_SIN
P2-111	+48V_SIN
P2-112	-48V_SIN
P2-113	+48V_SIN
P2-114	-48V_SIN
P2-115	AGND_SIN
P2-116	AGND_SIN
P2-117	AGND_SIN
P2-118	AGND_SIN
P2-119	S_SENSE_LO
P2-120	S_SENSE_LO

SIZE		SHEET	REV
B	770011	2 OF 4	A

CALIBRATION
BRIDGE TRANSFORMER

J1-1	V_CAL_SIN
J1-2	V_CAL_COS
J1-3	V_CAL_COS
J1-4	XFMR_2
J1-5	XFMR_1
J1-6	N/C
J1-7	XFMR_2
J1-8	AGND

COSINE
ISOLATION TRANSFORMER

J2-1	VREF
J2-2	REF_GND
J2-3	REF_GND
J2-4	C_SENSE_LO
J2-5	+COS
J2-6	C_SENSE_LO
J2-7	-COS
J2-8	AGND_COS

SINE
ISOLATION TRANSFORMER

J4-1	VREF
J4-2	REF_GND
J4-3	REF_GND
J4-4	S_SENSE_LO
J4-5	+SIN
J4-6	S_SENSE_LO
J4-7	-SIN
J4-8	AGND_SIN

COSINE
TAPPED TRANSFORMER

J3-1	COS_QUAD
J3-2	COS_QUAD
J3-3	COS_QUAD
J3-4	C_TAP2
J3-5	COS_QUAD
J3-6	C_TAP3
J3-7	C_TAP_NEG
J3-8	C_TAP4
J3-9	C_TAP16
J3-10	C_TAP5
J3-11	C_TAP15
J3-12	C_TAP6
J3-13	C_TAP14
J3-14	C_TAP7
J3-15	C_TAP13
J3-16	C_TAP8
J3-17	C_TAP12
J3-18	C_TAP9
J3-19	C_TAP11
J3-20	C_TAP10

SINE
TAPPED TRANSFORMER

J5-1	SIN_QUAD
J5-2	SIN_QUAD
J5-3	SIN_QUAD
J5-4	S_TAP2
J5-5	SIN_QUAD
J5-6	S_TAP3
J5-7	S_TAP_NEG
J5-8	S_TAP4
J5-9	S_TAP16
J5-10	S_TAP5
J5-11	S_TAP15
J5-12	S_TAP6
J5-13	S_TAP14
J5-14	S_TAP7
J5-15	S_TAP13
J5-16	S_TAP8
J5-17	S_TAP12
J5-18	S_TAP9
J5-19	S_TAP11
J5-20	S_TAP10

MOUNTING HOLES (NO ELECTRICAL CONNECTION)

M11 MOUNTING HOLE SIZE: 0.156
M12 MOUNTING HOLE SIZE: 0.156
M13 MOUNTING HOLE SIZE: 0.156
M14 MOUNTING HOLE SIZE: 0.156
M15 MOUNTING HOLE SIZE: 0.156
M16 MOUNTING HOLE SIZE: 0.156
M17 MOUNTING HOLE SIZE: 0.156
M18 MOUNTING HOLE SIZE: 0.156
M19 MOUNTING HOLE SIZE: 0.156
M20 MOUNTING HOLE SIZE: 0.156
M21 MOUNTING HOLE SIZE: 0.156
M22 MOUNTING HOLE SIZE: 0.156
M23 MOUNTING HOLE SIZE: 0.156
M24 MOUNTING HOLE SIZE: 0.156

M1
LOGO
NAI ™

SIZE		SHEET	REV
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CARD CAGE EXTENDER SOCKETS
(SAME CONNECTIONS AS SYSTEM BOARD SOCKETS)

J10-1	N/C	J10-61	S2
J10-2	REFIN_LO	J10-62	S2
J10-3	N/C	J10-63	S4
J10-4	REFIN_HI	J10-64	S4
J10-5	AGND	J10-65	SENSE_S2
J10-6	AGND	J10-66	SENSE_S2
J10-7	AGND	J10-67	SENSE_S4
J10-8	AGND	J10-68	SENSE_S4
J10-9	N/C	J10-69	SENSE_S2
J10-10	N/C	J10-70	SENSE_S2
J10-11	N/C	J10-71	-15V
J10-12	N/C	J10-72	-15V
J10-13	N/C	J10-73	-48V
J10-14	N/C	J10-74	-48V
J10-15	N/C	J10-75	+15V
J10-16	N/C	J10-76	+15V
J10-17	N/C	J10-77	+48V
J10-18	N/C	J10-78	+48V
J10-19	N/C	J10-79	N/C
J10-20	N/C	J10-80	+175V
J10-21	COSD2	J10-81	+175V
J10-22	COSD23	J10-82	N/C
J10-23	COSD3	J10-83	N/C
J10-24	COSD22	J10-84	N/C
J10-25	COSD4	J10-85	-175V
J10-26	COSD21	J10-86	-175V
J10-27	COSD5	J10-87	N/C
J10-28	COSD20	J10-88	N/C
J10-29	COSD6	J10-89	N/C
J10-30	COSD19	J10-90	N/C
J10-31	COSD7	J10-91	N/C
J10-32	COSD18	J10-92	N/C
J10-33	COSD8	J10-93	N/C
J10-34	COSD17	J10-94	N/C
J10-35	COSD9	J10-95	REFINT_OUT
J10-36	COSD16	J10-96	REFINT_OUT
J10-37	COSD10	J10-97	AGND
J10-38	COSD15	J10-98	AGND
J10-39	COSD11	J10-99	AGND
J10-40	COSD14	J10-100	AGND
J10-41	C_T/H	J10-101	N/C
J10-42	COSD13	J10-102	N/C
J10-43	COS_CTL7	J10-103	+15V_COS
J10-44	COSD12	J10-104	-15V_COS
J10-45	COS_CTL5	J10-105	+15V_COS
J10-46	COS_CTL6	J10-106	-15V_COS
J10-47	COS_CTL11	J10-107	-20V_COS
J10-48	COS_CTL4	J10-108	-150V_COS
J10-49	COS_CTL10	J10-109	+20V_COS
J10-50	COS_CTL3	J10-110	+150V_COS
J10-51	COS_CTL9	J10-111	+48V_COS
J10-52	COS_CTL2	J10-112	-48V_COS
J10-53	COS_CTL8	J10-113	+48V_COS
J10-54	COS_CTL1	J10-114	-48V_COS
J10-55	N/C	J10-115	AGND_COS
J10-56	COS_CTL0	J10-116	AGND_COS
J10-57	N/C	J10-117	AGND_COS
J10-58	N/C	J10-118	AGND_COS
J10-59	SENSE_S2	J10-119	C_SENSE_LO
J10-60	SENSE_S2	J10-120	C_SENSE_LO

J11-1	S3	J11-61	SENSE_S3
J11-2	S3	J11-62	N/C
J11-3	S1	J11-63	DAC1A
J11-4	S1	J11-64	DAC1B
J11-5	SENSE_S3	J11-65	-AD
J11-6	SENSE_S3	J11-66	-RD
J11-7	SENSE_S1	J11-67	-WE
J11-8	SENSE_S1	J11-68	N/C
J11-9	SENSE_S3	J11-69	LATCH4
J11-10	N/C	J11-70	LATCH1
J11-11	N/C	J11-71	LATCH2
J11-12	B10MHZ/4	J11-72	LATCH3
J11-13	DGND_SYS	J11-73	DSP_DAC2
J11-14	DGND_SYS	J11-74	DSP_DAC3
J11-15	FREQ_MEAS	J11-75	DSP_WR
J11-16	N/C	J11-76	DSP_LDAC
J11-17	DGND_SYS	J11-77	DSPD23
J11-18	DGND_SYS	J11-78	DSPD22
J11-19	+5V_SYS	J11-79	DSPD21
J11-20	+5V_SYS	J11-80	DSPD20
J11-21	SIND2	J11-81	DSPD10
J11-22	SIND23	J11-82	DSPD19
J11-23	SIND3	J11-83	DSPD11
J11-24	SIND22	J11-84	DSPD18
J11-25	SIND4	J11-85	DSPD12
J11-26	SIND21	J11-86	DSPD17
J11-27	SIND5	J11-87	DSPD13
J11-28	SIND20	J11-88	DSPD16
J11-29	SIND6	J11-89	DSPD14
J11-30	SIND19	J11-90	DSPD15
J11-31	SIND7	J11-91	MD08
J11-32	SIND18	J11-92	MD00
J11-33	SIND8	J11-93	MD09
J11-34	SIND17	J11-94	MD01
J11-35	SIND9	J11-95	MD10
J11-36	SIND16	J11-96	MD02
J11-37	SIND10	J11-97	MD11
J11-38	SIND15	J11-98	MD03
J11-39	SIND11	J11-99	MD04
J11-40	SIND14	J11-100	MD06
J11-41	S_T/H	J11-101	MD05
J11-42	SIND13	J11-102	MD07
J11-43	SIN_CTL7	J11-103	+15V_SIN
J11-44	SIND12	J11-104	-15V_SIN
J11-45	SIN_CTL5	J11-105	+15V_SIN
J11-46	SIN_CTL6	J11-106	-15V_SIN
J11-47	N/C	J11-107	-20V_SIN
J11-48	SIN_CTL4	J11-108	-150V_SIN
J11-49	N/C	J11-109	+20V_SIN
J11-50	SIN_CTL3	J11-110	+150V_SIN
J11-51	N/C	J11-111	+48V_SIN
J11-52	SIN_CTL2	J11-112	-48V_SIN
J11-53	N/C	J11-113	+48V_SIN
J11-54	SIN_CTL1	J11-114	-48V_SIN
J11-55	N/C	J11-115	AGND_SIN
J11-56	SIN_CTL0	J11-116	AGND_SIN
J11-57	N/C	J11-117	AGND_SIN
J11-58	N/C	J11-118	AGND_SIN
J11-59	SENSE_S3	J11-119	S_SENSE_LO
J11-60	SENSE_S3	J11-120	S_SENSE_LO

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GLOSSARY

Term	*Definition*
A	Assembly
A	Ampere
b	Blank
AC	Alternating current
AGC	Automatic gain control
AMPL	Amplitude
API	Angle position indicator
ATE	Automatic test equipment
C	Centigrade
C	Capacitor, reference designation
CA	Cable
CAL	Calibrate
CAP	Capacitor
CASS	Consolidated automatic support system
CCW	Counter clockwise
CHAPT.	Chapter
CONN	Connector
COS	Cosine
CR	Diode, signal; reference designation
cr	Carriage return
D	Diode, reference designation
DAV	Digitizing analog voltmeter
DC	Direct current
DEG	Degree
dp	Decimal point character
DSP	Digital signal processing
DSP#A##	DSP ADDRESS
DSP#D##	DSP DATA
EEPROM	Electrically erasable programmable read only memory
EPROM	Erasable programmable read only memory
ERR	Error
ESD	Electrostatic sensitive discharge
EXT	External
FL	Filter, reference designation
FPGA	Field programmable gate array
FREQ	Frequency
H	Height
HZ	Hertz
I/O	Input/output
IC	Integrated circuit
IEEE	Institute of Electrical, Electronic Engineers
INCR	Increment
INT	Internal
ISO	Isolated
J	Connector, reference designation
K	Relay, reference designation
KHZ	Kilohertz
L-L	Line-to-line
LED	Light emitting diode
lf	Line feed
LSB	Least significant bit
MA	milliampere
MA##	microprocessor address
MD##	microprocessor data
MDAC	Multiplying digital-to-analog converter
MFR	Manufacturer
MIL	Military

GLOSSARY (Cont'd.)

Term	*Definition*
MOD	Modulation
NAI	North Atlantic Industries
OOR	Out of range
OVLD	Overload
P	Page
P	Plug, reference designation
P-P	Peak-to-peak
PC	Personal computer
PGM	Program
PO	Phase offset
PP	Pages
PS	Power supply
Q	Transistor, reference designation
QTY	Quantity
R	Resistor, reference designation; Reference; Resolver
RAM	Random access memory
REF	Reference
REFDES	Reference designation
REM	Remote
RES	Resolver
RES	Resistor
RMS	Root-mean-square
ROM	Read only memory
RPS	Revolutions per second
RSS	Resolver/Synchro Standard
RST	Reset
MSB	Most significant bit
MUX	Multiplexer
MV	Millivolt
SCPI	Standard commands for programmable instruments
SECT.	Section
SIM	Simulate
SIN	Sine
SRA	Shop replaceable assembly
SRQ	Service request
SYN	Synchro
T	Transformer, reference designation
T/H	Track/hold
TFI	test fixture
TP	Test point, reference designation
TST	Test
U	Integrated circuit, reference designation
UOC	Usable-on-code
V	Volt; Velocity
VAC	Volts, alternating current
VDC	Volts, direct current
VEL	Velocity
VR	Zener diode, reference designation
vs	Versus
W	Width
XTAL	Crystal

WARRANTY

A. The seller warrants products against defects in material and workmanship for one year from the date of original shipment. The seller's liability is limited to the repair or replacement of products which prove to be defective during the warranty period. There is no charge under the warranty except for transportation charges. The purchaser shall be responsible for products shipped until received by the seller.

B. The seller specifically excludes from the warranty 1) calibration, 2) fuses, and 3) normal mechanical wear, e.g.: end-of-life on assemblies such as switches, relays, gear trains, etc. is dependent upon number of operations or hours of use, and end-of-life may occur within the warranty period.

C. The seller is not liable for consequential damages or for any injury or damage to persons or property resulting from the operation or application of products.

D. The warranty is voided if there is evidence that products have been operated beyond their design range, improperly installed, improperly maintained or physically mistreated.

E. The seller reserves the right to make changes and improvements to products without any liability for incorporating such changes or improvements in any products previously sold, or for any notification to the purchaser prior to shipment. In the event the purchaser should require subsequently manufactured lots to be identical to those covered by this quotation, the seller will, upon written request, provide a quotation upon a change control program.

F. No other warranty expressed or implied is offered by the seller other than the forgoing.

CLAIMS FOR DAMAGE IN SHIPMENT

The purchaser should inspect and functionally test the product(s) in accordance with the instruction manual as soon as it is received. If the product is damaged in any way, including concealed damage, a claim should be filed immediately with the carrier, or if insured separately, with the purchaser's insurance company.

SHIPPING

On products to be returned under warranty, await receipt of shipping instructions then forward the instrument prepaid to the destination indicated. The original shipping container with their appropriate blocking and isolating material is the preferred method of packaging. Any other suitable strong container may be used providing the product is wrapped in a sealed plastic bag and surrounded with at least four inches of shock absorbing material to cushion firmly, preventing movement inside the container.