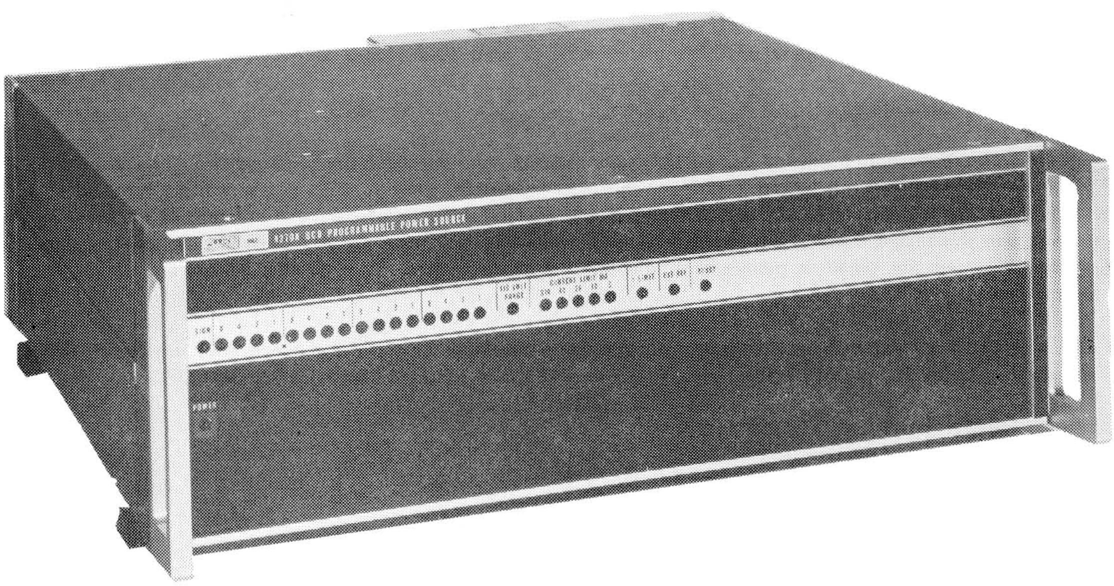
GB

JOHN FLUKE MFG. CO., INC.

P. O. Box 43210
Mountlake Terrace, Washington 98043



MODEL

4270A

BCD PROGRAMMABLE POWER SOURCE

P/N 338418
AUG. 1975

WARRANTY

The JOHN FLUKE MFG. CO., INC.* warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operations, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken:

1. Notify the John Fluke Mfg. Co., Inc.,* giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.
2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate will be made before the work begins, provided the instrument is not covered by the Warranty.

> "The foregoing warranty is in lieu of all other warranties, express or implied, including but not limited to, any implied warranty of merchantability, fitness or adequacy for any particular purpose or use. Fluke shall not be liable for any special, incident or consequential damages."

SHIPPING

All shipments of John Fluke Mfg. Co., Inc.* instruments should be made via United Parcel Service or "Best Way"** prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc.* Upon receipt of this report, you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc.* will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to: JOHN FLUKE MFG. CO., INC., P. O. Box 7428, SEATTLE, WASHINGTON 98133*.

* For European customers: FLUKE (Nederland) B.V.
Ledeboerstraat 27
Tilburg, Netherlands

**For European customers, Air Freight prepaid.

FLUKE TECHNICAL SERVICE CENTERS

Fluke Western Technical Center
Mike Nagy, Service Manager
2020 North Lincoln St.
Burbank, CA 91504
Tel. 213-849-4641
TWX: 910-497-2086

Fluke Western Technical Center
Tom Marshall, Service Manager
4805 Mercury St.
San Diego, CA 92111
Tel. 714-565-4455
TWX: 910-337-1273

Fluke Western Technical Center
Attn: Tom Marshall
2359 De La Cruz Blvd
Santa Clara, CA 95050
Tel. 408-244-1505
TWX: 910-338-0121

Fluke S.W. Technical Center
Mel Suelzle, Service Manager
Unit 4
1980 South Quebec Street
Denver, CO 80231
Tel. 303-750-1228

Fluke S.E. Technical Center
Jesse Morse, Service Manager
P.O. Box 6578
940 North Fern Creek Avenue
Orlando, FL 32803
Tel. 305-896-2296
TWX: 810-850-0185

Fluke Midwestern Tech Center
Bruce Hunt, Service Manager
1287 North Rand Road
Des Plaines, IL 60016
Tel. 312-298-7470
TWX: 910-233-4978

Fluke Mideastern Tech Center
John Hines, Service Manager
11501 Huff Court
Kensington, MD 20795
Tel. 301-881-5300
TWX: 710-825-9645

Fluke N.E. Technical Center
Dick Zemba, Service Manager
109 Massachussetts Ave.
Lexington, MA 02173
Tel. 617-861-8620
TWX: 710-826-1715

Fluke Midwestern Tech Center
Robert Wayne, Service Mgr.
10800 Lyndale Avenue South
Minneapolis, MN 55420
Tel. 612-884-4541
TWX: 910-576-3141

Fluke Eastern Technical Center
Bernard Ciongoli, Service Mgr.
101 Berkshire Ave.
Paterson, NJ 07502
Tel. 201-742-3215
TWX: 710-988-5945

Fluke Eastern Technical Center
Frank Forte, Service Manager
4515 Culver Road
Rochester, NY 14622
Tel. 716-342-6940
TWX: 510-253-6145

Fluke S.E. Technical Center
Dwain Cox, Service Manager
P.O. Box 9619
1310 Beaman Place
Greensboro, NC 27408
Tel. 919-273-1918
TWX: 510-925-1173

John Fluke Mfg. Co., Inc.
Bill Fetrow, Tech. Services Spvr.
7001 - 220th S.W.
Mountlake Terrace, WA 98043
Tel. 206-774-2238
TWX: 910-449-2850

Fluke Canadian Technical Center
Tony Unser, Service Manager
640 11th Ave. S.W.
Calgary, Alberta
Tel. 403-261-0780
TWX: 610-821-2233

Fluke Canadian Technical Center
Herb Duval, Service Manager
6427 Northam Drive
Mississauga, Ontario
Tel. 416-678-1500
TWX: 610-492-2119

Rev. 5/75

Table of Contents

(continued on page ii)

TABLE OF CONTENTS, *continued*

List of Illustrations

(continued on page iv)

LIST OF ILLUSTRATIONS, *continued*

(continued on page v)

LIST OF ILLUSTRATIONS, *continued*

List of Tables

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 4270A is a programmable, bipolar dc voltage source and ac power amplifier. Output voltage is from 0 to ±110Vdc in two ranges, 10 and X10Vdc. Programming resolution using the internal reference voltage is 1mV on the 10 volt range and 10mV on the X10 volt range. Output accuracy is given in paragraph 1-6. After a 100μs settling time, a READY flag indicates that the output has settled to ±0.01% of the programmed level for a resistive load. The output current is rated at ±0.5 ampere maximum and is limited to approximately ±0.6 ampere in the event of an overload or short circuit. The sink current (milliamps) is rated at 500–4.5E_{OUT} maximum. A Programmable Current Limiter (Option –06) is available to allow programming the maximum output current to a lower level. A current limit flag indicates when a sink or source current overload exists with or without the –06 Option.

1-3. Programming requirements are compatible with DTL or TTL logic levels. Contact or relay closures can also be used. The voltage source is programmable using BCD or binary-per-decade coding, using 8-4-2-1 format. All programming inputs and flag outputs are made through a 50-pin Amphenol, Blue Ribbon connector located on the rear panel. A +5Vdc output is also available at this connector and is used to provide power for external programming circuitry. Negative logic is employed for programming. The logic levels are as follows:

Logic "0" = +2.0Vdc to +5.0Vdc or open circuit.
Logic "1" = 0 to +0.4Vdc or short circuit to LOGIC GND.

1-4. Four options are available and provide tailoring of the power supply to fit application requirements. These options are identified by numeric designations –03, –06, –07, and –09. Each option is described in Table 1-1. The options can be installed at the factory when the instrument is ordered or in the field at a later time.

1-5. This power source is completely solid state. Plug-in printed circuit boards, with accessible test points and adjustments, are provided for ease in servicing. The unit is forced-air cooled. This results in lower component temperatures and higher reliability than would normally be obtained in a source of this power capability. The chassis is designed for bench top use, or it can be installed in a standard equipment rack by using the Accessory Rack Mounting Fixtures.

Table 1-1. OPTIONS

OPTIONS	TITLE	DESCRIPTION
–03	EXTERNAL REFERENCE (Field Installable)	Allows the use of an external signal source in place of the internal reference voltage. Any dc or ac signal can be used that has an amplitude from 0 to ±14.5 volts dc or peak ac and a frequency from dc to 30 kHz. Input impedance is 100k, in parallel with 70pF.
–06	PROGRAMMABLE CURRENT LIMIT (Field Installable)	Programmable current limit is provided in two ranges, 50mA and 0.5 ampere. Each range may be programmed in 10% increments from 10% to 110% of range.
–07	100μV RESOLUTION (Field Installable)	The –07 Option provides 100μV resolution on the 10V range and 1mV on the X10V range.
–09	MULTI-STROBE ISOLATED LOGIC (Field Installable)	Permits any of the Fluke 4200 series Programmable Voltage Sources to be remotely controlled by a large variety of program sources such as a computer, a system coupler, as well as a Fluke Automatic Test Equipment System. Refer to Section 6 for details.

1-6. SPECIFICATIONS

OUTPUT VOLTAGE . . . . 0 to ±9.999Vdc (BCD inputs)
0 to ±16.665Vdc (4-bit binary, by decade)
±99.99Vdc (BCD inputs)
±1100Vdc (4-bit binary, by decade)
(Maximum output terminal voltage = ±1100V)

OUTPUT VOLTAGE RESOLUTION . . . . . 10V range: 1.0mV (100μV option –07)
X10V range: 10mV (1mV option –07)

OUTPUT CURRENT . . . . 0 to ±0.5
(Short circuit protected at 0.6 ampere)

CURRENT SINK CAPABILITY . . . . I_{sink} (mA) = 500 - 4.5E_{out} (Overload protected)
Maximum voltage = ±110V

ACCURACY (15°C to 35°C, 90 days) . . . . . 10V range: ±(0.01% of program +100μV)
X10V range: ±(0.01% of program +700μV)

STEADY STATE RIPPLE AND NOISE . . . . 10V range: 2.1mV p-p 500μV rms
(10 Hz to 10 MHz bandwidth) . . . . . . X10V range: 3.6mV p-p 1.2mV rms

SPEED . . . . Settles to 0.1% of the programmed change in 80μs
Settles to 0.01% of the programmed change in 110μs. A range change does not increase settling time.

DIGITAL NOISE REJECTION . . . . Noise between digital programming ground and the analog output is rejected 1000:1 (60db) at 1MHz

OUTPUT IMPEDANCE . . . . 0.04 milliohms @ dc; 1 phm @ 30 kHz

EXTERNAL REFERENCE (Option –03)

Voltage Range . . . . 0 to ±14.5Vdc or peak ac
Input Impedance . . . . 100k ohms in parallel with 70 pF
Output Voltage . . . . 10V range: 0 to 12V rms, ±17V peak
X10V range: 0 to 78V rms, ±110V peak
Output Current . . . . 350mA rms, 0.5 amp peak
Frequency Range . . . . dc to 30 kHz

Accuracy (15°C to 35°C, 90 days with respect to the External Reference, E_{XR})	10V range: $\pm(0.01\%$ of program $+.0001\% \frac{75}{E_{XR}} + 100\mu V)$ at dc X10V range: $\pm .0001\% \frac{75}{E_{XR}} + 700\mu V$ at dc.
Programming Resolution	10V range: $E_{XR} \times 10^{-4}$ volts X10V range: $E_{XR} \times 10^{-3}$ volts
PROGRAMMABLE CURRENT LIMIT (Option –06)	50mA range: ±5mA to ±55mA in 5mA increments 0.5 amp range: ±50mA to ±0.55 amp in 50mA increments Minimum program possible: ±5mA
OUTPUT STABILITY	10V range: ±(10ppm of program +40μV) for 24 hours ±(30ppm of program + 70μV) for 90 days X10V range: ±(10 ppm of program +280μV) for 24 hours ±(30ppm of program +490μV) for 90 days
TEMPERATURE COEFFICIENT (Temperatures between 15° and 35°C)	10V range: ±(10ppm of program +5μV per °C) X10V range: ±10ppm of program +35μV per °C)
LOAD REGULATION	An output current change of 0.5 ampere causes the output voltage to change less than 0.001% of range
LOAD RECOVERY	The output voltage will settle to within 0.01% of final value in 110μs after an output current change of 0.5 ampere
LINE REGULATION	The output voltage will change less than 0.001% of range for a ±10% change in line voltage
BARRIER STRIP TERMINALS	EXT REF LO, EXT REF HI, OUTPUT HI, SENSE HI, SENSE LO, OUTPUT LO, GUARD and CHASSIS. Terminals are located on the rear panel. The GUARD terminal can be floated up to 1000 volts above chassis ground.
PROGRAMMING CONNECTOR (See Table 1-3)	A 50-pin connector is located on the rear panel. Mating connector is Amphenol, Blue Ribbon, Part No. 57-30500, and is included with each power source.
INPUT POWER	100/115/125/200/230/250Vac ±10% 50 to 60 Hz, 200 watts fully loaded
ENVIRONMENTAL	
Temperature	0°C to 50°C operating; –40°C to 75°C storage
Relative Humidity	0 to 80%
Shock	20G, 11 millisecond half-sine wave
Vibration	4.5G, 10 to 55 Hz
Altitude	0 to 10,000 feet operating 50,000 feet and above-non-operating
SIZE (See Figure 1-1)	5 ¼" high x 17" wide x 19 7/16" (Max.) deep
ACCESSORIES	
Manual Control Unit	Allows manual checkout, calibration, and control FLUKE Model A4200
Rack Mounting Brackets	■ M05-205-600 ■ M00-260-610 (18") ■ M00-280-610 (24")
Programming Mating Connector	Amphenol, Blue Ribbon 57-30500 FLUKE PART NO. 266056
Extender PCB Assembly	FLUKE PART NO. 292623
Cable Extender Assembly	FLUKE PART NO. 337584

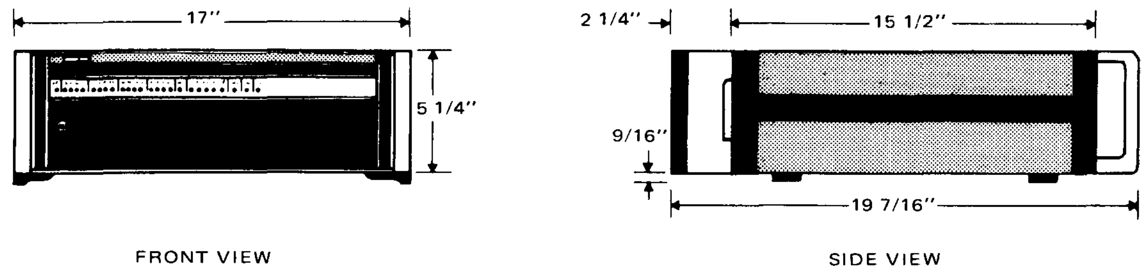


Figure 1-1. OUTLINE DRAWING

Table 1-2. PROGRAMMING INPUT/OUTPUTS

PROGRAM CONTROL:	All program control and response lines are compatible with DTL and TTL logic Programming lines are brought out on the rear panel on Amphenol connector J1. See Figure 1-2.
LOGIC LEVELS:	Logic "1" = 0 +.4Vdc or contact closure Logic "0" = +2.0 to +5.0Vdc or open circuit
SIGN:	Connector Pin 35 Logic "1" = Negative output voltage
MAGNITUDE:	Bit Wt. / Conn. Pin: A^8 1, A^4 2, A^2 3, A^1 4, B^8 5, B^4 6, B^2 7, B^1 8 C^8 9, C^4 10, C^2 11, C^1 12, D^8 13, D^4 14, D^2 15, D^1 16 E^8 43, E^4 44, E^2 45, E^1 46 (–07 Option) NOTE: Decade numbers greater than 9 (10 thru 15) will be accepted and converted to an equivalent analog value. The maximum full scale output is ±110Vdc.
DATA STROBE:	Connector pin 33. When using the Isolated Control Logic Option –01, a strobe pulse is required to start the digital-to-analog conversion process after a valid command is present. Minimum pulse width is 500 nanoseconds. A negative leading slope (+5V to 0V transition) is required.
RANGE:	Connector Pin 29; Logic "0" = Low Voltage Range, Logic "1" = High Voltage Range.
EXTERNAL REFERENCE:	Connector Pin 36; Logic "0" = Internal DC Reference, Logic "1" = External Reference.
STANDBY:	Connector Pin 34; Logic "0" = Operate Mode, Logic "1" = Standby; Output is ≈ 1% of programmed value.

Table 1-2. PROGRAMMING INPUT/OUTPUTS

CURRENT LIMIT:	Connector Pin — Function — Logic "1" — Logic "0" 42 — Range — 0.5 amp — 50mA 43 — Magnitude — 80% of Range — 0 All "0"s = 44 — Magnitude — 40% of Range — 0 10% of range 45 — Magnitude — 20% of Range — 0 46 — Magnitude — 10% of Range — 0
RESPONSE SIGNALS:	
CURRENT LIMIT FLAG:	Connector Pin 49; Logic "1" represents a current limit condition.
READY/NOT READY FLAG:	Connector Pin 37; Logic "0" = "Ready" condition following a 110μs delay to allow the output to settle to within 0.01% of the programmed increment for a resistive load.
READY/NOT READY FLAG:	Logic "1" = "Not Ready" condition, the power source is in the process of settling to the programmed value.
POWER CONNECTIONS:	Connector Pin 25; An internal, isolated power supply furnishes +5Vdc current limited by 2.7 ohms for use by the external system interface logic.
LOGIC GROUND:	Connector Pins 17 thru 24; It is recommended that a large logic ground strap be used between the interface logic and the power source to reduce the digital programming noise on the system ground.

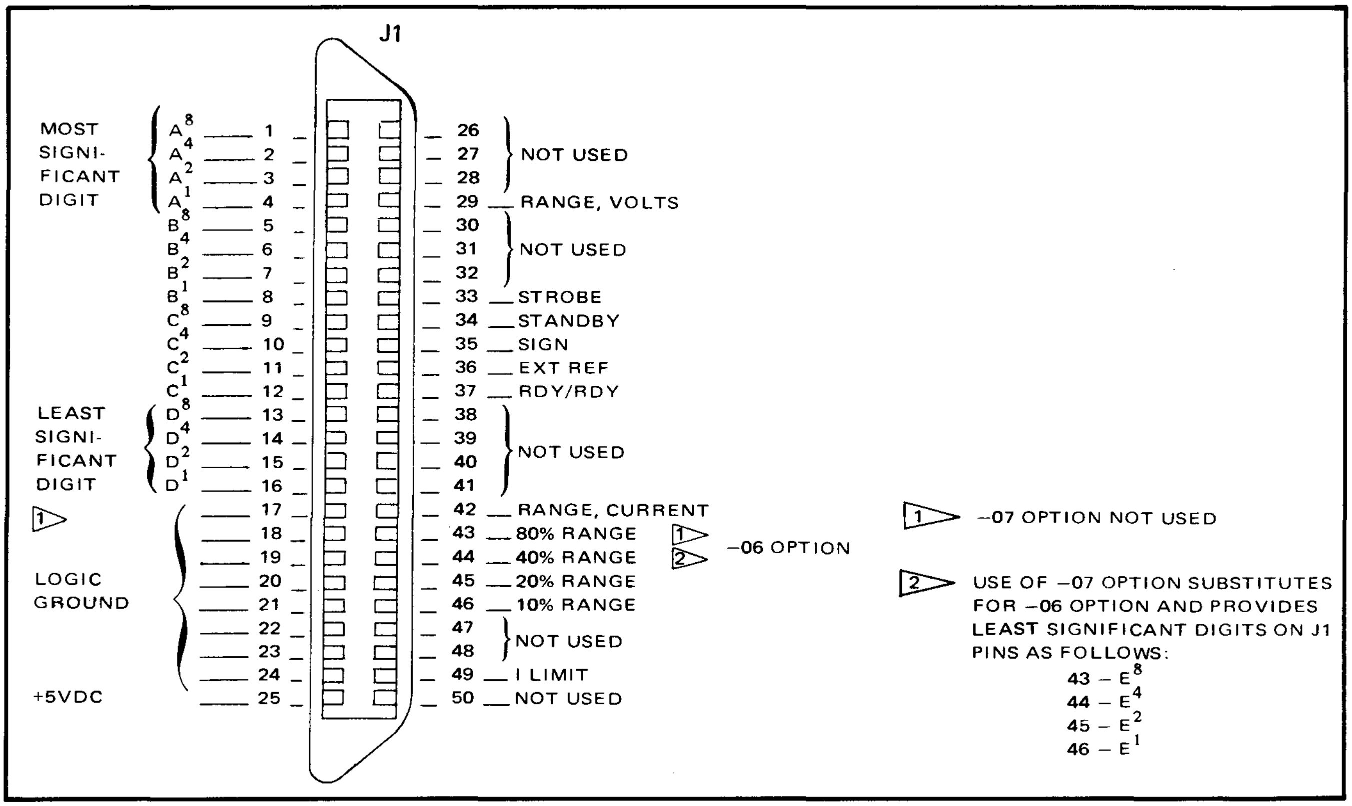


Figure 1-2. PROGRAMMING CONNECTOR PIN ASSIGNMENTS

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding installation and operation of the Model 4270A. It is recommended that the contents of this section be read and understood before any attempt is made to operate this power source. Should any difficulties be encountered during operation, please contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, Washington 98043, telephone (206) 774-2211. A list of Sales Representatives is located in Section 7 of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 4270A was packaged and shipped in a foam-packed cardboard carton. Upon receipt, a thorough inspection should be performed to reveal any instrument damage incurred in transit. Special instructions for inspection and claims are included in the carton.

2-5. If reshipment of this power source is necessary, the original container should be used. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the Model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. This power source can be operated from a 50 to 60 Hz power line ranging from 100 to 250 volts ac. A decal on the rear panel indicates the power input limits. Specific power line voltages require that slide switches internal of the instrument be set as indicated in Figure 2-1 or on the lower left corner of the guard cover. To accommodate the instrument to the specific power line voltage, proceed as follows:

LINE VOLTAGE	SWITCH POSITIONS		
	PWR SPLY	H – V PWR SUPPLY	
	(A2) S1	(A10) S1	(A10) S2
100	WHT	WHT	RED
115	WHT	RED	WHT
125	WHT	RED	RED
200	RED	WHT	RED
230	RED	RED	WHT
250	RED	RED	RED

Figure 2-1. INPUT POWER SWITCHING

a. Determine the ac line voltage and relate its value to the closest value shown in Figure 2-1. Remove the power cord.

b. Remove the top cover of the instrument.

c. Remove the top inner guard cover.

d. Refer to Figure 2-2 and locate the three slide switches in the instrument.

e. Refer to Figure 2-1 and set the three power switches such that the color dot showing corresponds to the color given for the specific line voltage that was selected in step a.

f. Refer to the decal on the rear panel of the instrument, determine the appropriately rated fuse for the line power selected in step a., and install the fuse in the fuse holder.

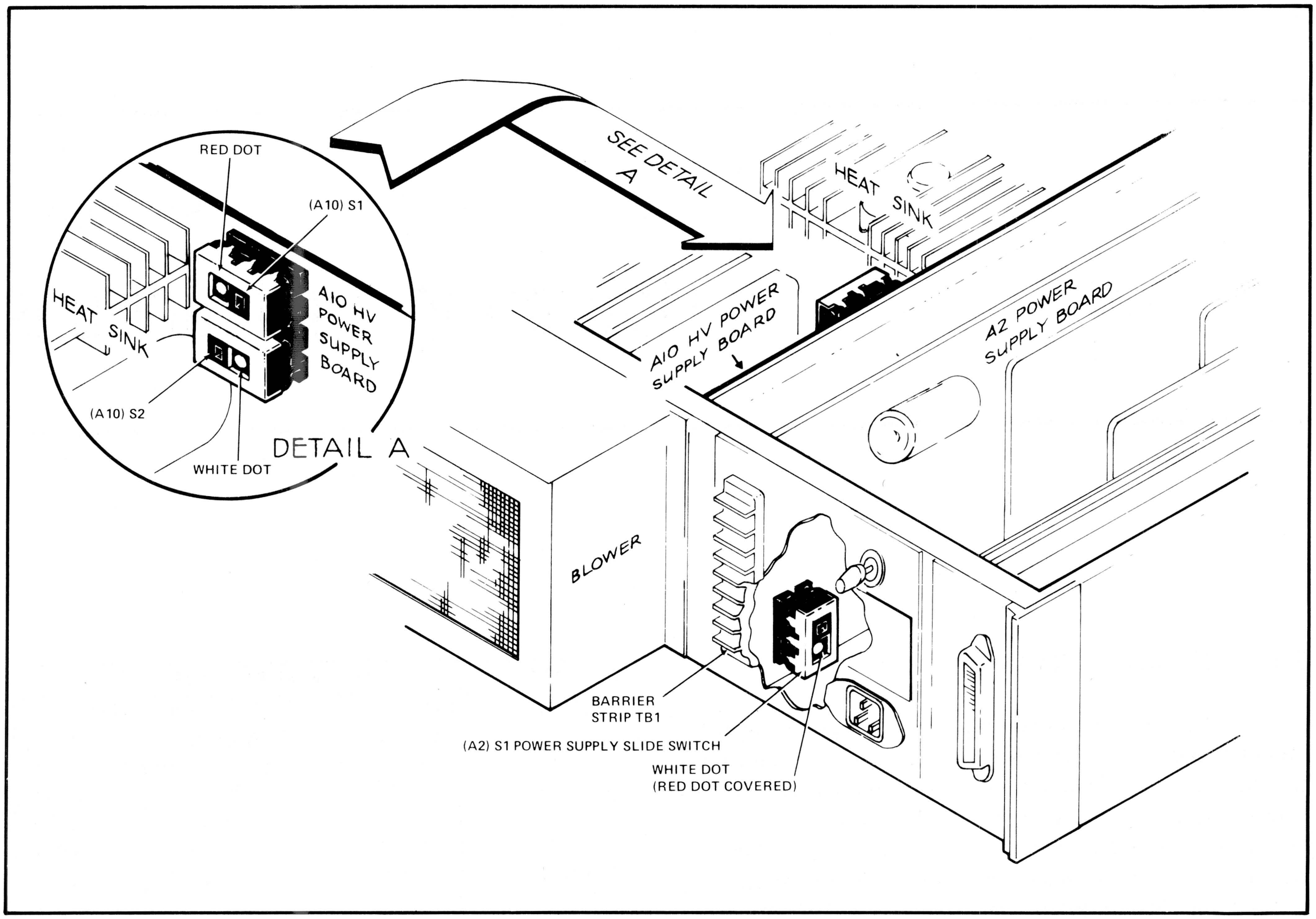


Figure 2-2. POWER SUPPLY SWITCH LOCATION

g. With the power switch off (down), connect the ac power cord and turn on the power switch. Check that the POWER indicator on the front panel illuminates.

h. Turn off power switch and assemble guard and top cover in reverse order of removal.

2-8. RACK INSTALLATION

2-9. The power source is designed for bench-top use or for installation in a 19-inch equipment rack using the accessory rack mounting kit shown in Figure 2-3. Accessory chassis slides can also be installed to better facilitate rack installation. Information regarding installation of these accessories is given into the Section 6, Accessory Rack Mounting Fixtures.

2-10. OPERATING FEATURES

2-11. The location and function of all connectors and indicators is given in Figures 2-4 and 2-5.

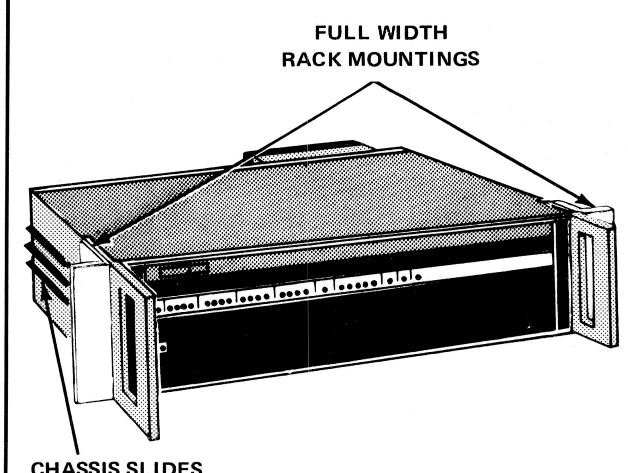


Figure 2-3. ACCESSORY RACK MOUNTING KITS

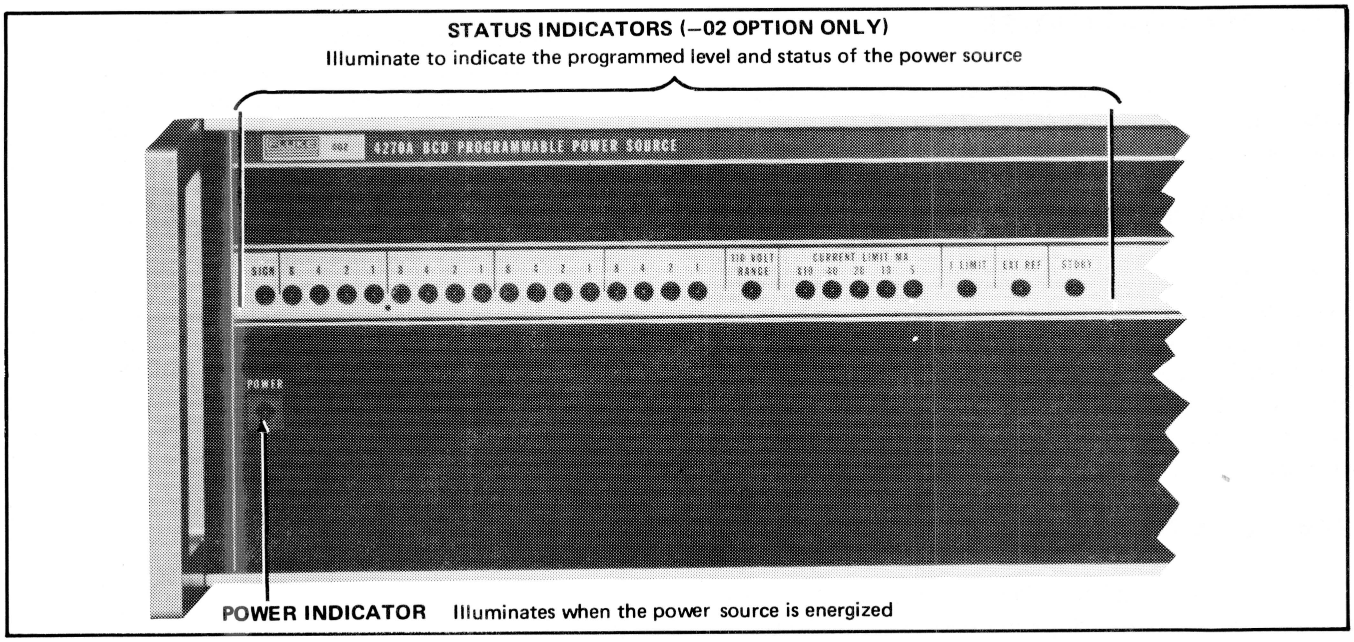


Figure 2.4 FRONT PANEL OPERATING FEATURES

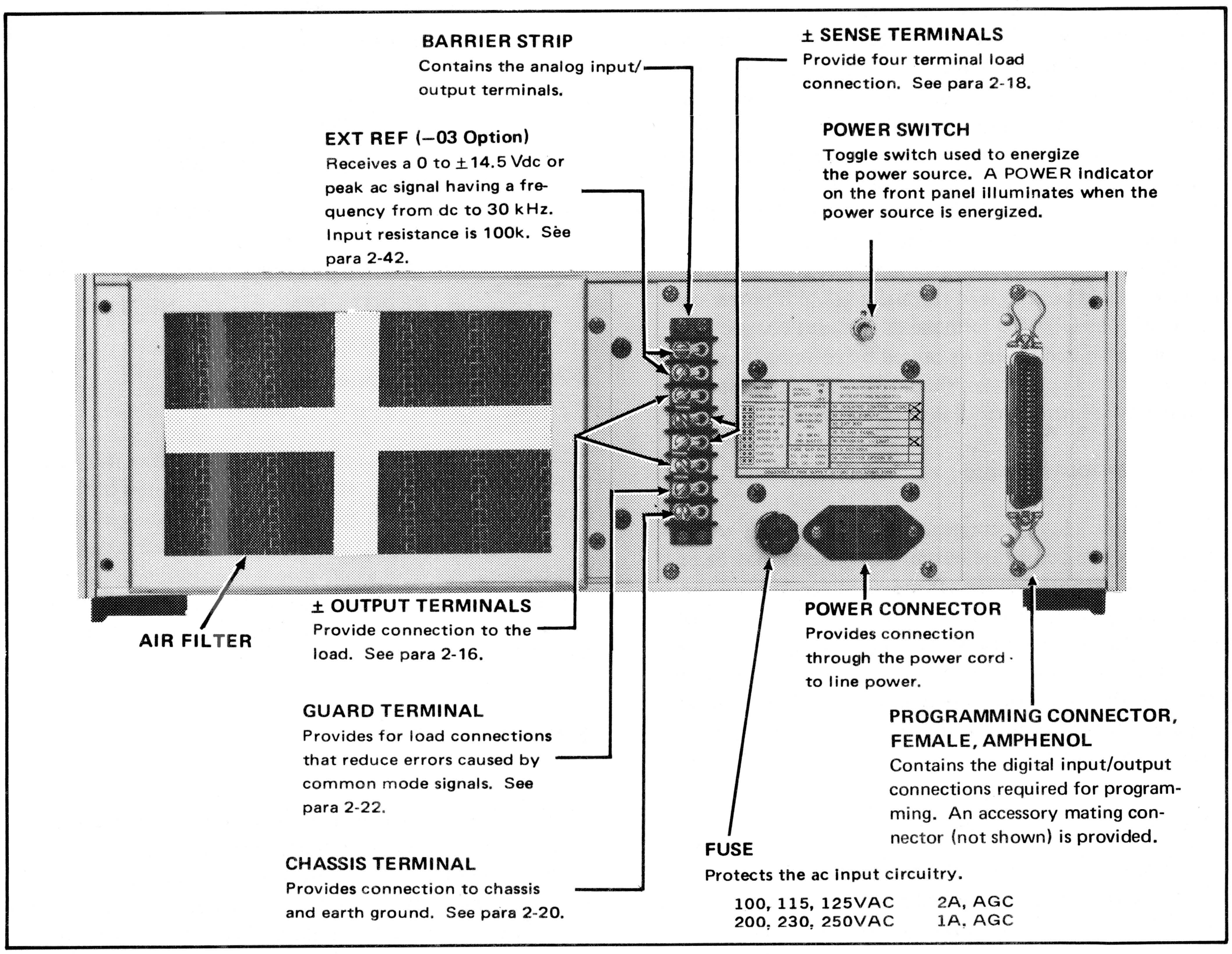


Figure 2-5. REAR PANEL OPERATING FEATURES

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the Model 4270A.

2-14. AC Line Connection

2-15. The input power cord plug is a three prong, polarized connector. This plug allows connection to a 100 to 250 volts ac, 50 to 60 Hz, power line (see Input Power, paragraph 2-6), and connects the power source chassis to earth ground. Always ensure that the ground pin is connected to a high quality earth ground. The power source is energized through a toggle switch on the rear panel.

2-16. Load Connections

2-17. An eight terminal barrier strip, located on the rear panel, serves as an analog input/output connector for the power source. The ± power output terminals (OUTPUT HI and LO) provide connection to the load. The ±sense terminals (SENSE HI and LO) are provided to allow remote sensing at the load. The sense terminals are bussed through jumpers installed at the factory to the output terminals. If remote sensing is not required,the load is connected to the respective ± output terminals and the sensing busses are not removed. If remote sensing is required, the busses must be removed and separate sense lines provided between the sense terminals and the load. In either case, NEVER operate the power source with the sense terminals disconnected. The CHASSIS terminal is connected directly to the chassis and allows grounding of the load through the input power cord, if desired. The GUARD terminal allows load connections that can greatly reduce errors caused by common mode signals. This guard connection should always be used if optimum noise free performance is to be achieved.

2-18. Remote Sensing

2-19. When a load is connected to the OUTPUT terminals, the I-R drop across the output power leads may be excessive in some applications. If the rated accuracy of the power supply is required at the load, remote sensing must be used. For this reason, SENSE HI and SENSE LO terminals are provided to allow the power supply output to be sensed directly at the load, thus compensating for any I-R drop in the output power leads. Figure 2-6 shows an example of remote sensing load connections.

NOTE!

The two jumpers on the barrier strip which bus ± output must be removed for remote sensing. When remote sensing, always use a twisted pair P of insulated wire from the output and sense terminals to the load. A maximum of 0.35 volts (at 25°C, decreasing 0.002 volts per degree C at higher temperatures) is allowable between either output terminal and its corresponding sense terminal. The leads between the output and sense terminals and the load must be large enough to carry the load current of up to 0.5 ampere and the sense current of about 1mA without exceeding this voltage.

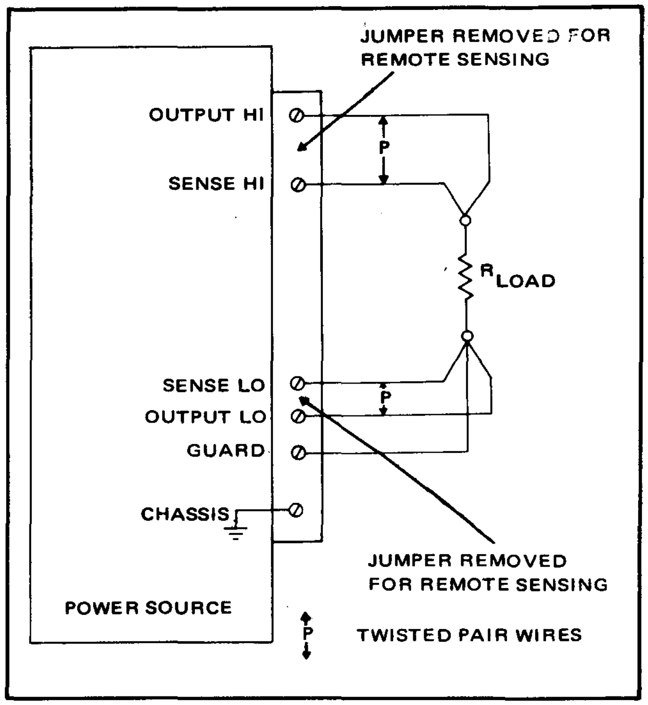


Figure 2-6. REMOTE SENSING CONNECTIONS

2-20. Ground Connections

2-21. A CHASSIS terminal is provided at the rear panel. This terminal is directly connected to the chassis of the power source and earth ground through the ground pin on the input power plug. If grounding of the load is desired, this terminal provides a convenient connection to earth ground. When a guarded output (explain in paragraph 2-22) is not desired, this terminal should be connected to the GUARD terminal.

2-22. Guard Connections

2-23. The power source is equipped with a guard shield that isolates its internal circuitry from the chassis and ground. A GUARD terminal at the rear panel is connected to this shield and allows load connections that greatly reduce errors caused by common mode signals. The guard may be driven to a maximum of 1000 volts above chassis ground. Figure 2-7 shows a simplified diagram of a guarded load connection.

2-24. PROGRAMMING INFORMATION

2-25. All instrument functions, with the exception of ac power switching and control, are controlled via a mating pair of 50-pin Amphenol connectors located on the instrument rear panel. The female Amphenol connector is rigidly attached to the rear panel and a mating male connector, less cabling, is supplied with each instrument as a separate accessory. These Amphenol connectors establish the interface between the instrument and the programming equipment. Cabling is to be provided by the instrument user who determines pin utilization and cable length to satisfy his individual requirements. The instrument is powered via a rear panel toggle switch and not through the programming connector. Table 2-1 is a tabular listing that functionally describes each connector pin. Cable/connector assembly data is given in Section 6, Accessory Programming Connector.

2-26. Programming input requirements are compatible with either DTL or TTL logic levels. Logic "0" is +2.0 to 5.0Vdc or open circuit to logic ground. Logic "1" is 0 to +0.4Vdc or short circuit to logic ground. Logic ground is available at pins 17 through 24 of the programming connector. Shorting these lines to the appropriate pins of the programming connector using contact closures also allows control of the power source. The internal +5Vdc output, current limited by 2.7 ohms, is available at pin 25 for use by the external programming logic.

2-27. Standby

2-28. The STANDBY mode can be programmed by applying a Logic "1" to pin 34 of the programming connector. When this condition exists, the output of the power source will be driven to less than 1% of the programmed value. Application of a logic "0" at this pin returns the output voltage to the programmed level.

2-29. Range/Output Magnitude/Polarity

2-30. Two voltage ranges are available; ±10 volts and ±X10 volts. The RANGE is programmed by a single binary input at pin 29 of the programming connector. A Logic "0" applied to this pin will program the ±10 volt range, and a Logic "1" will program the ±X10 volt range. The power supply is capable of an output of ±110Vdc minimum at ±0.55 ampere.

2-31. The magnitude of the output voltage is programmed by applying either BCD or four bit binary-per-decade coding, using 8-4-2-1 format, to pins 1 through 16 of the program connector. Four decades of programmable voltage are available; each receives a four-bit 8-4-2-1 coded input. The maximum program of any decade is (8+4+2+1) 15, which provides a total output program of ±16.665 volts on the 10 volt range with a programmable resolution of 1mV. If BCD coding is used, the maximum programmable output on the 10 volt range is ±9.999 volts. When using the X10

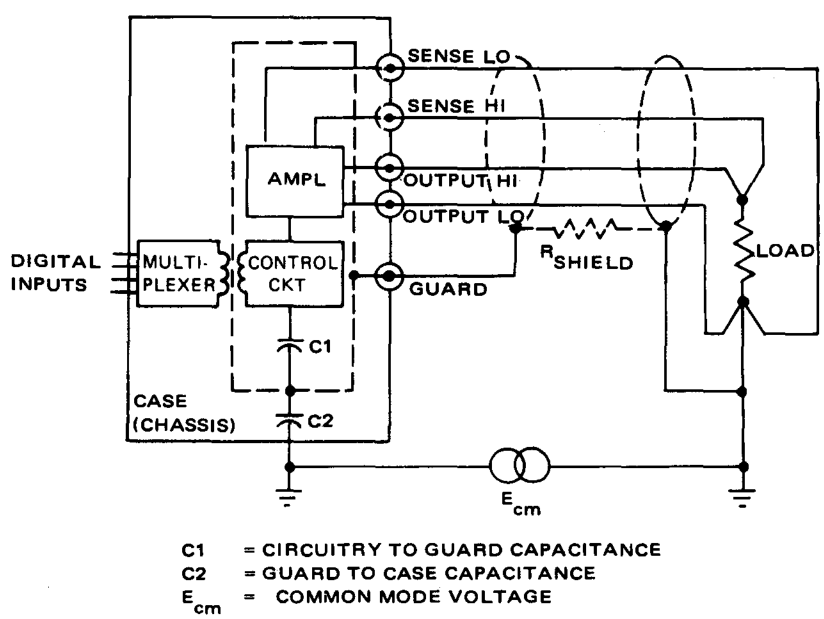


Figure 2-7. GUARDED LOAD CONNECTION

Table 2-1. PROGRAMMING CONNECTOR DATA

LOGIC "0" = +2.0 to +5.0Vdc or open circuit
LOGIC "1" = 0 to +0.4Vdc or short circuit to LOGIC GRD

PIN NO.	FUNCTION		
	CODE		
1	8	A DECADE:	1V-10V range
2	4		10V-100V range
3	2		
4	1		
5	8	B DECADE:	1V-10V range
6	4		1V-100V range
7	2		
8	1		
9	8	C DECADE:	0.01V-10V range
10	4		0.1V-100V range
11	2		
12	1		
13	8	D DECADE:	0.001D-10V range
14	4	[1]	0.01V-100Vrange
15	2		
16	1		
17			
18			
20			
21	LOGIC GRD		
22			
23			
24			
25	LOGIC PWR (+5Vdc, current limited by 2.7 ohms internally)		
26			
27	NOT USED		
28			
29	RANGE: LOGIC "0" = 10 VOLT Range (±16.665V max) LOGIC "1" =100 VOLT Range (±110V max)		
30			
31	NOT USED		
32			
33	DATA STROBE (–01 Option) (See Figure 2-8) INITIATES DIGITAL TO ANALOG CON-VERSION		
34	STANDBY/OPERATE: LOGIC "0" = OPERATE LOGIC "1" = STANDBY		
36	EXTERNAL REFERENCE (-03 Option): LOGIC "0" = INTERNAL REFERENCE LOGIC "1" = EXTERNAL REFERENCE		
37	READY/NOT READY FLAG: LOGIC "0" = READY LOGIC "1" = NOT READY		
38			
39	NOT USED		
40			

PIN NO.	FUNCTION		
41	CURRENT LIMIT: (–06 Option) [2]		
42	Function	Logic "0"	Logic "1"
43	Range	100mA	1 amp
44	Magnitude	0 (All "0"s =	80% of range
45	Magnitude	0 10% of range)	40% of range
45	Magnitude	0	20% of range
46	Magnitude	0	10% of range
47			
48	NOT USED		
49	CURRENT OVERLOAD FLAG: LOGIC "0" = NORMAL LOGIC "1" = OVERLOAD (Over-Current)		
50	NOT USED		

[1] Least significant digit when –07 Option (100µV Resolution) is not used.

[2] Use of –07 Option substitutes for –06 Option and provides least significant digits in an E Decade; i.e., E^8, E^4, E^2, E^1.

volt range, which has a program resolution of 10mV, it should be noted that the maximum input program can exceed the output voltage capability of the power source. The maximum program using four bit binary-per-decade coding in 8-4-2-1 format is ±166.65 volts, while BCD coding provides a maximum program of ±99.99 volts. The maximum output voltage, however, is ±110 volts.

2-32. Polarity of the output is controlled by a single input (SIGN) at pin 35 of the program connector. A Logic "0" will produce a positive output. A Logic "1" will produce a negative output.

2-33. Data Strobe

2-34. The DATA STROBE shown in Figure 2-8 is required to initiate the transfer of the data present at the programming inputs to the internal memory of the Isolated Control Logic (–01 Option). The DATA STROBE is applied to pin 33 of the programming connector. Upon its negative transition, program data transfer begins. At the same time, two pulses are generated; 15µs and 110µs. The 15µs pulse holds the power supply output at its previously programmed level while new data is transferred into memory and allowed to settle. At the end of the 15µs pulse the power source is allowed to respond to the new program data. The 110µs pulse provides a NOT READY flag output that indicates the power source has not had time to respond to new program data and for the output to be within ±0.01% of the programmed change for a resistive load. Program data must be present and settled for a minimum of 2.4µs after the negative transition of the DATA STROBE.

NOTE!

When the power supply is initially turned on or if a power interruption occurs, the power supply is programmed to zero volts, where it will remain until new data is transferred.

2-35. Flag Outputs

2-36. Two flag outputs are provided to indicate when a current overload exists and when the output voltage has had time to settle. A current limited condition (I LIMIT) is indicated by a Logic "1" at pin 49 of the programming connector. Normal operation is indicated by a Logic "0". Output settling time is indicated by a NOT READY flag at pin 37. Logic "0" is the ready condition and indicates that the output voltage has had time to settle to within 0.01% of the programmed change for a resistive load. A Logic "1" indicates a not ready condition.

2-37. The I LIMIT flag and the NOT READY flag sill both be activated when a sink or source current overload occurs. After the overload is removed, the I LIMIT flag will return to normal but the NOT READY flag will remain for 110μs to allow for output settling time. Figure 2-8 and 2-9 show the timing relations of these flags. If the Programmable Current Limiting (–06 Option) is installed, the I LIMIT flag will also be activated when current limiting occurs.

2-38. Programmable Current Limiting

2-39. When the Programmable Current Limiter (–06 Option) is installed, two ranges of current limiting are available; ±0.5 amp and ±50mA. The CURRENT LIMIT MA range is programmed by a single binary input at pin 42 of the programming connector. A Logic "0" applied to this pin programs the 50mA range and a Logic "1" programs the 0.5 amp range.

2-40. The magniutde of the output current is programmed by applying either BCD or binary coding to pins 43 through 46 of the programming connector. Current magnitude programming is in increments of 10% of the programmed range. If all current magnitude inputs are programmed to Logic "0", the current limit is still 10% of the programmed range. The maximum current limit that can be programmed is 110% of the programmed range. When current limiting occurs, the I LIMIT flag changes from Logic "0" to Logic "1" as described in paragraph 2-37.

NOTE!

A sink capability greater than the programmed current limit value cannot be realized.

2-41. External Reference

2-42. When the External Reference (–03 Option) is installed, a single programming bit is used to remove the in-

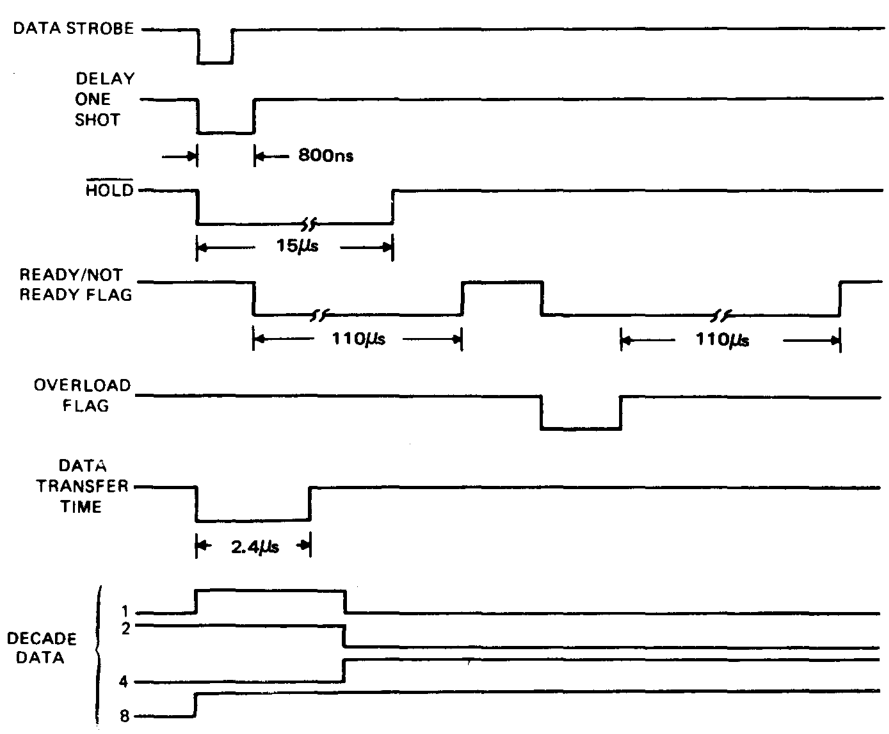


Figure 2-8. ISOLATED CONTROL LOGIC TIMING (–01 OPTION)

ternal 10Vdc reference from the D-to-A ladder network and switch in an external signal source to replace it. The output accuracy and stability of the power source, however, is then relative to the accuracy and stability of the external signal source.

2-43. The external reference may be any dc or ac signal with an amplitude between 0 and ±14.5Vdc or peak ac (volts rms x 1.414) and have a frequency between dc and 30kHz. It is applied to the external reference terminals located on the rear panel barrier strip. The input impedance at these terminals is 100k ohms in parallel with 70pF. The external reference is programmed by applying a Logic "1" to pin 36 of the programming connector. It should be noted that the polarity of the output will be the same as the external reference regardless of the SIGN (polarity) programmed.

2-44. Programming the magnitude of the output voltage with a ±10 volt external reference is accomplished by the same method used for programming with the internal reference voltage. (See paragraph 2-31). However, if the external reference is not exactly ±10 volts, the magnitude of the programming word required to obtain a specified output voltage must be calculated as follows:

MPW = Magnitude of the programming word

Eout = Output voltage (Vdc)

EXT REF = External reference voltage.

10 volt range:
$$MPW = \frac{Eout}{EXT\ REF} \times 10^4$$

Programming resolution = EXT REF ÷ 10

100 volt range:
$$MPW = \frac{Eout}{EXT\ REF} \times 10^4$$

Programming resolution = EXT REF ÷ 10^3 Note: Eout $\leqslant$ 110V

It should be noted that the rated output of the power supply is ±110V maximum at 0.55 ampere. It therefore becomes obvious that when using the X10 volt range, the programming word can easily exceed the output capability of the power supply. The following example, using the previously shown formula for the X10 volt range, illustrates this.

Example:

Find: Eout

Given:	EXT REF = 14.5Vdc	EXT REF @ 14.5Vac
	MPW (BCD) = 9999.	MPW (BCD) = 9999
	Range = 110 volts	Range = 110 volts

$$MPW = \frac{Eout}{EXT\ REF} \times 10^3$$
$$\therefore Eout = MPW \times EXT\ REF \div 10^3$$
$$Eout = 9999 \times +14.5Vdc \div 10^3$$
$$Eout = +144.9855Vdc$$

Eout in this example greatly exceeds the rated 110 volt output capability of the power supply. To avoid this situation always calculate MPW with Eout < 110Vdc or peak ac.

2-45. Front Panel Indicators

2-46. When the Front Panel Display (–02 Option) is installed, status indicators (light emitting diodes) are provided on the front panel. They indicate the programmed output voltage level, output polarity, current overload, current limit levels, external reference, and standby status of the internal register. None of these indicators are provided when the Blank Front Panel (–05 Option) is installed. A POWER indicator is included with either option to indicate that the power is on.

2-47. Dynamic Characteristics

2-48. The power source output can be changed quite rapidly with high speed programming information. However, a 100μs period must be allowed before the output has settled to its stated accuracy for a resistive load.

2-49. When an external signal is used as the reference for the power source, the output accuracy is dependent upon the characteristics of the external signal. If a dc voltage is used, the output accuracy is related to the accuracy and stability of the external voltage. However, if an ac signal is used, the output accuracy is not only dependent upon the external signal stability, but also its frequency. Typical examples of accuracy versus frequency are shown in Figure 2-9 through 2-12.

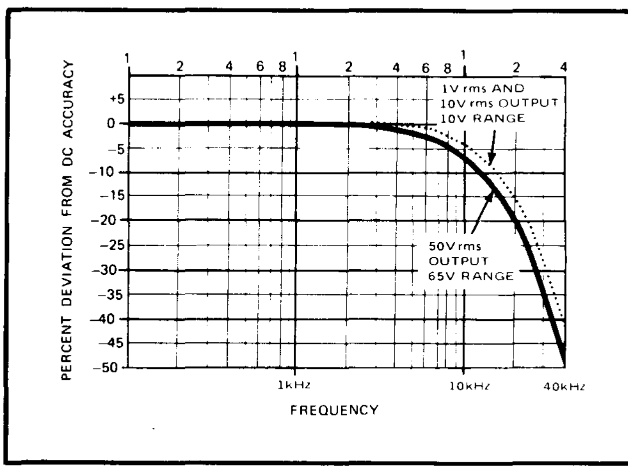


Figure 2-9. ACCURACY VERSUS EXTERNAL RE-REFERENCE FREQUENCY

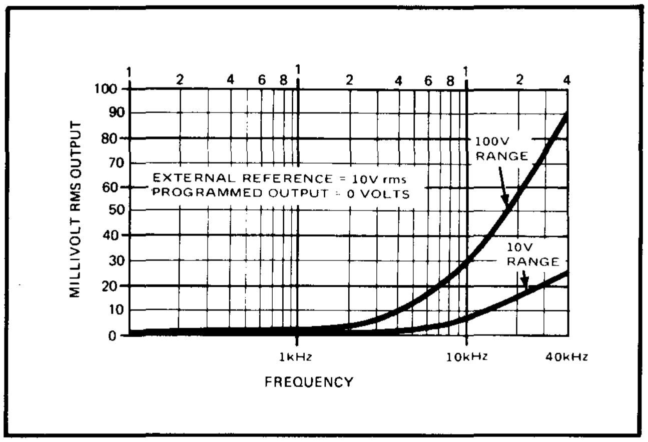


Figure 2-10. AC EXTERNAL REFERENCE FEED-THROUGH VERSUS FREQUENCY (0V OUTPUT)

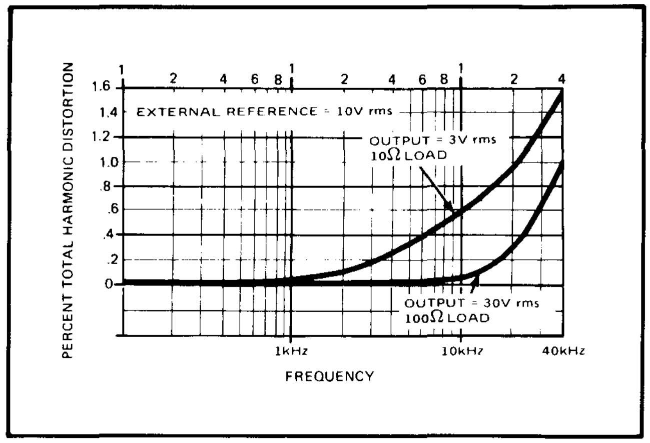


Figure 2-12. AC EXTERNAL REFERENCE HAR-MONIC DISTORTION VERSUS FREQUENCY

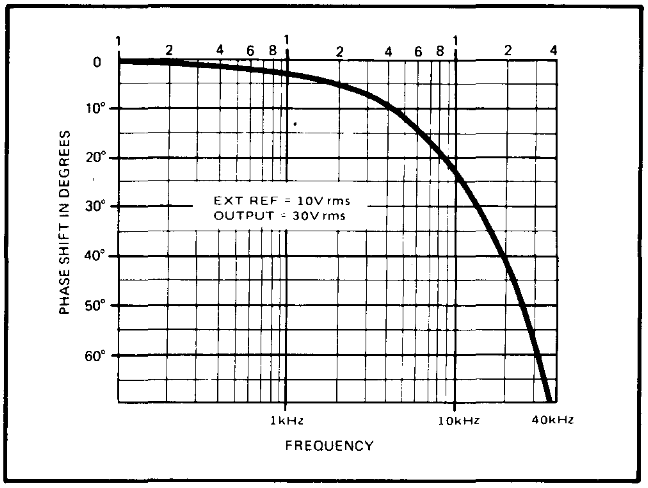


Figure 2-11. AC EXTERNAL REFERENCE PHASE SHIFT VERSUS FREQUENCY

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 4270A. The information is arranged under headings of "FUNDAMENTAL CIRCUIT DESCRIPTIONS, BLOCK DIAGRAM ANALYSIS, and CIRCUIT DESCRIPTIONS." An equivalent circuit of the power source is shown in Figure 3-1. Figure 3-2 is a simplified block diagram.

3-3. FUNDAMENTAL CIRCUIT DESCRIPTION

3-4. The Model 4270A converts a digital program word into a representative dc output voltage. Basically, the circuitry consists of a high gain operational amplifier shown in Figure 3-1. Digital to analog conversion is done using a ladder network driven by a bi-polar reference voltage. The differential amplifier then produces an output voltage (Vo) that is maintained by the current through R_f as determined by the ratio of V_{REF} over $R_o \left(\frac{V_{REF}}{R_o}\right)$

3-5. BLOCK DIAGRAM ANALYSIS

3-6. The following paragraphs describe the major circuit functions of the Model 4270A. A block diagram of the power source, including all options, is shown in Figure 3-2.

3-7. The Isolated Control Logic provides isolation and storage of the digital inputs. A STROBE input is required for any data transfer. The assembly also provides READY/ NOT READY and CURRENT LIMIT FLAG outputs. Internal commands from the A6 LOGIC control polarity, range, magnitude, sample and hold, and current limiting of the output. These commands (except sample and hold) are also applied to the A7 Display where visual status is provided on the front panel.

3-8. All operating voltages as well as the internal reference voltage (V_{REF}) are produced in the A2 Power Supply and the A10 Connector Board. Commands from the A6 Logic determine the polarity of V_{REF} applied to V_{REF} bus line. A +POL command produces a $-V_{REF}$ and a −POL command a $+V_{REF}$. Presence of either or both EXT REF and STDBY commands disable the internal V_{REF}.

3-9. The A4 External Reference (−03 Option) processes the external reference input voltage. The magnitude of this voltage can be from 0 to ±14.5V dc or peak ac and have a frequency from dc to 30 kHz. Presence of an EXT REF command disables the previously described internal V_{REF} and applies the output of the A4 External Reference to the V_{REF} bus line. If a STDBY command exists, the external V_{REF} is disabled.

3-10. BCD ladder networks in the A3 Preamplifier and A5 BCD Ladder scale the selected internal or external V_{REF}

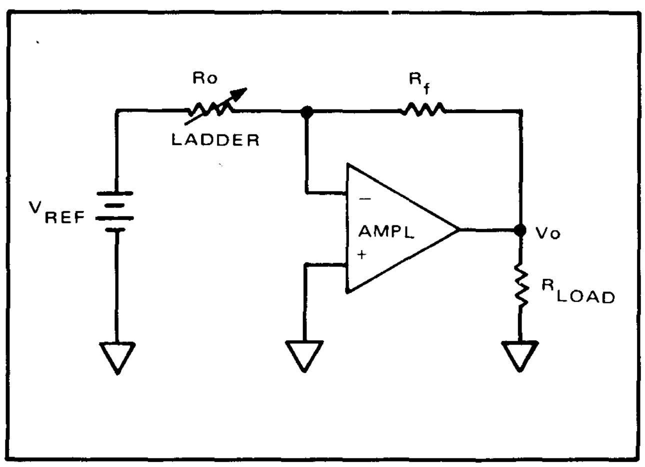


Figure 3-1. POWER SOURCE EQUIVALENT CIRCUIT

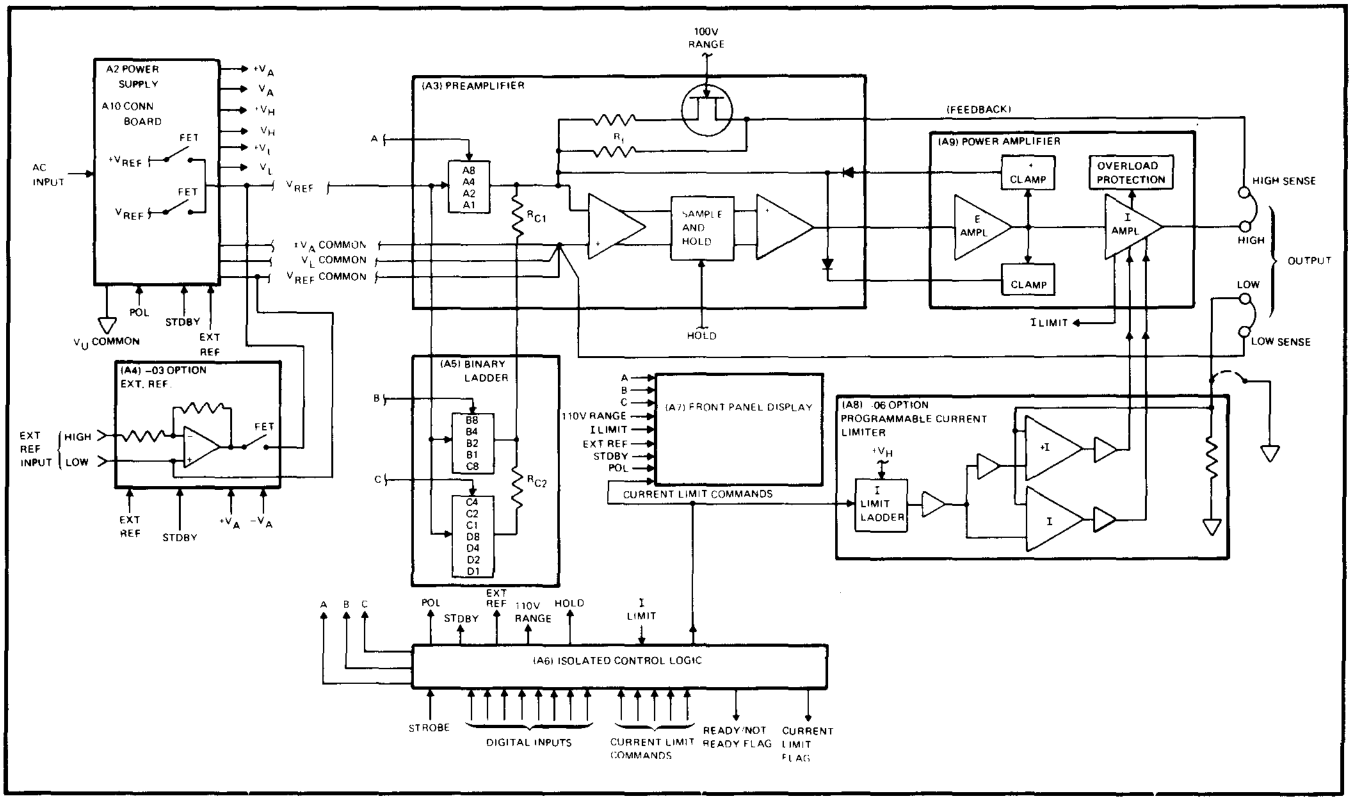


Figure 3-2. MODEL 4270A BLOCK DIAGRAM

to a level determined by the A, B, and C commands. This scaled voltage is then inverted and amplified by voltage and power amplifier in the A3 Preamplifier and A9 Power Amplifier. Current through R_f in the A3 Preamplifier maintains a proportional output voltage dependent upon the value of R_f, ladder, and polarity of V_{REF}. In the 10V range the total parallel value of R_f in combination with an internal V_{REF} establishes an output in millivolts directly proportional to the digital input word. The value of R_f is increased by four times in the 100V range by disconnecting one of the R_f resistors. Subsequently, outputs in the 100V range are four times the digital input word. When the external V_{REF} is selected, the output is proportional to the combined effects of the external reference magnitude and the digital input word. Actual output is determined as follows:

10V Range: Eout = (MPW x 10^{-4}) (EXT REF)
100V Range: Eout = (4MPW x 10^{-4}) (EXT REF)
Where: MPW = Magnitude of digital input word
EXT REF = External reference voltage (V dc or peak ac):

3-11. Programming changes are prevented from appearing at the output until the entire digital input word is stored. This is provided through the sample and hold circuit in the A3 Preamplifier. Presence of a STROBE input to the A6 Logic produces a HOLD command which activates the sample and hold circuit. The sample and hold disconnects and stores the last input to the voltage amplifier, thus providing a memory condition for the duration of the HOLD command. The HOLD command has a duration of 15μsec.

3-12. Overload protection circuitry in the A9 Power Amplifier automatically limits the maximum output current to 0.6A. Whenever a current limit occurs, an I LIMIT command is applied to the A6 Logic which then produces a CURRENT LIMIT FLAG output. Current limiting at less than 0.6A is also possible using the A8 Programmable Current Limiter (–06 Option) described later. Clamp circuits in the A9 Power Amplifier limit voltage transients at the output during a current limit condition when the load is disconnected.

3-13. Current limiting at less than 0.6A is provided upon installation of the A8 Programmable Current Limiter (–06 Option). Maximum bipolar output current can be limited to a level between 10 ma and 0.55 ampere in 10 percent steps on two separate reanges. In the event the output current is clamped at that level by action of the A8 Programmable Current Limiter. During periods of current limiting, an I LIMIT command is generated in the A9 Power Amplifier and is applied to the A6 Control Logic and to the A7 Front Panel. The I LIMIT command applied to the A6 Control Logic produces a CURRENT LIMIT FLAG at pin 49 of the Programming Connector. The I LIMIT command applied to the A7 Front Panel illuminates the I LIMIT indicator on the front panel.

3-14. CIRCUIT DESCRIPTIONS

3-15. The following paragraphs describe the circuitry in the power source. Each description is keyed to a schematic diagram located at the rear of the manual.

3-16. A1 Mother Board and A7 BCD Display (4270A-1011)

3-17. The A1 Mother Board serves to interconnect the A2 through A9 assemblies. No component circuitry other than connectors and amp pins are contained on this assembly. The A7 BCD Display provides light emitting diode (LED) indicators which display the internal command data and power on state. Internal commands of 0V (true) are inverted by U1 through U5 and turn on the associated LED of Q1 through Q27. Power on is indicated through direct application of $-V_L$ to Q1.

3-18. A2 Power Supply and A10 Connector Board (4270A-1061 and 4270A-1012)

3-19. All operating voltages, as well as the internal reference voltage upon which the power source accuracy and stability relies, are produced in the A2 and A10 assemblies. Designations and nominal magnitudes of each voltage is given in Table 3-1.

Table 3-1. OPERATING VOLTAGES

DESIGNATION	VOLTAGE (VDC)
$+V_L$	+5V
$-V_L$	−5V
$\pm V_H$	±136V *
$\pm V_A$	+23.4V, −25.1V
V_{REF}	±10V
* Approximate (at 115V line voltage, no load)	

3-20. INPUT POWER

3-21. Ac line power at J1 is applied to the primary of T1 through POWER switch S2 and the 115/230 switch S1. The primary of T1 consists of two windings which allow operation from either a 115 or 230V ac line. S1 provides a parallel primary winding connection for 115V ac line operation. A series connection is provided for 230V ac line operation. AC power for the blower (M1) is provided from the primary windings of T1. The four secondary windings of T1 supply ac voltages to associated power supplies.

3-22. $+V_L$ SUPPLY

3-23. The $+V_L$ Supply, composed of CR19 and Q21 through Q24, produces a regulated +5V dc for use by the A6 Logic and external programming equipment. Diode bridge CR19 rectifies the secondary voltage of T1 and supplies the series regulator of Q21 through Q24 with a dc voltage. C16 filters the voltage applied to the regulator. Q22 functions as a constant current source, supplying base drive to Q23. The resulting +5V output of the regulator is developed across CR23 and R54 which supplies a sample of the output voltage to the base of Q24. The conduction of Q24 will limit the base drive to Q21 and Q23 producing a regulated +5V output. This supply is completely isolated from all other supplies in the instrument and is electrically external of the guard. All other supplies are electrically inside the guard.

3-24. $-V_L$ SUPPLY

3-25. The $-V_L$ Supply composed of CR14 and Q16 through Q18 produces the regulated −5V dc required to operate the internal logic circuits. Diode bridge CR14 rectifies the secondary voltage of T1 and supplies the series regulator of Q16 through Q18 with a dc voltage. C13 filters the rectified voltage. The base drive for Q18 and Q17 is derived from the $+V_A$ Supply through R44. Reference voltage for the base of Q18 is derived from the $-V_A$ Supply through the divider consisting of R46 and R47. Any variation in the −5V output is then sensed by Q18, which controls the base drive to A17 and thus Q16, producing a regulated −5V dc output.

3-26. $\pm V_A$ SUPPLY

3-27. The $\pm V_A$ Supply produces the regulated +23.4 and −25.1V dc operating voltages that are used to provide power for most analog circuitry. Diode bridge CR4 rectifies the tapped secondary voltage of T1 and supplies positive and negative voltages for the respective $\pm V_A$ regulators. C7 and C8 filter these rectified voltages.

3-28. The $+V_A$ regulator consists of Q12, Q13 and U4. Reference voltage for this regulator is derived from A2 in the V_{REF} supply and is applied to the non-inverting input of U4. The inverting input of U4 receives a sample of the output voltage from the divider, R36 and R37. Any variations in the $+V_A$ output are thus sensed by A4, which controls the base drive to Q12, producing a regulated +23.4V dc output. Q13 together with R33 function to limit the maximum output current of this supply to 125 ma. Should the current through R33 exceed 125ma, the voltage across R33 will turn on Q13 which limits the base current to Q12.

3-29. The $-V_A$ regulator consists of Q14, Q15, and U5. R40 and the $+V_A$ supply establish the reference current for the feedback resistor R41. U5 supplies the base drive required by Q15 to maintain the regulated output of −25.1V dc. Q14 and R39 limit the output current in a similar manner to Q13 and R33 described previously.

3-30. $\pm V_H$ SUPPLY

3-31. The $\pm V_H$ Supply (on A10) produces unregulated $\pm$136 volts dc operating voltages for the A9 Power Amplifier. Diodes CR1 and through CR4 are connected as two full-wave rectifiers with C2 and C3 acting as filters. Resistors R2 and R3 function as discharge resistor for C2 and C3, respectively. Positive voltage regulation is accomplished by series pass element Q1 which is controlled by driver Q2. Reference voltage for the positive supply is established by Zener diodes CR5 and CR6. Regulation of the negative supply is accomplished by Q3, Q4, CR7, and CR8 which function in a similar manner as the positive supply.

3-32. V_{REF} SUPPLY

3-33. The V_{REF} Supply produces an extremely stable $\pm$10V dc reference upon which the accuracy and stability of the power source is based. Circuitry of this supply consists of a stable reference amplifier U2, a differential amplifier U1, a series-pass element Q1, an inverter amplifier U3, and an emitter follower Q4.

3-34. The reference amplifier U2 contains matched zener and transistor elements which produce a time and temperature stabilized reference voltage. The zener element receives a portion of its bias current from the +23.4V supply through R4 and CR1. The amplifier element receives collector current from the same source through R5. Base current for this amplifier is provided through a divider composed of R9, R14, R16, R56 and R59. This divider is connected to the $+V_{REF}$ sense line. The FET switches, Q2 and Q3, provide separate output and sense connections when a positive V_{REF} is called. Should any variations occur on the $+V_{REF}$ sense line, U2 will amplify them with respect to the zener element reference. The change is then applied to one input of U1 which also receives a sample of the $+V_{REF}$ line from the divider composed of R2 and R3. U1 in turn amplifies the change and alters the conduction of Q1 to maintain a constant +10V output for $+V_{REF}$ sense. Variable resistor R9 allows adjustment of the sense line input to U2 and subsequently the $+V_{REF}$ sense level.

3-35. The inverter amplifier composed of U3 and Q4 produces a $-V_{REF}$. U3 is connected as an inverting, unity gain, amplifier. Emitter follower Q4 functions as an output buffer. Feedback through R19 and R18 controls the overall gain of both amplifiers. Variable resistor R19 adjust this feedback level and subsequently the resultant $-V_{REF}$ sense output level. Resistors R6 and R21 compensate for TC factors associated with FET gates in the ladder section driven by V_{REF}.

3-36. GATE DRIVERS

3-37. The Gate Drivers of Q7 through Q11 control the conduction of the FET switches associated with the V_{REF} Supply. When the power source has a positive output programmed, the command at pin 18 is low (−5V), thus turning on Q8, Q11 and switching off FET gates Q2, Q3. With Q8 on, the emitter-base junction of Q9 is reverse biased causing Q9 and Q10 to turn off, thus turning on FET gates Q5, Q6, and Q25. The V_{REF} output applied to pin D is therefore −10V when a positive output is programmed. Should a negative output be programmed, the command at pin 18 is high (0V), which turns off Q8 and Q11 and switches the FET gates Q2 and Q3 on. With Q8 cut-off, Q9 conducts and turns on Q10, thus switching the FET gates Q5, Q6, and Q25 off. As a result, the voltage at pin D is +10V when a negative output is called. Should the STANDBY or EXT REF mode be programmed, low (−5V) commands exist at pins S or V. These low inputs will turn on Q7 and Q8, thus turning on both Q10 and Q11 and switch all FET gates off. As a result the V_{REF} supply is completely disconnected from the V_{REF} output terminals, B and D.

3-38. RELAY DRIVER

3-39. The Relay Driver composed of Q19 and Q20 is used to energize K1 when the power source is turned on. The contacts of K1 then complete the connections to the OUTPUT connector. Whould the power source be shut off for any reason, the connections are broken and the load is not subjected to any unprogrammed voltage.

3-40. A3 Preamplifier (4275A-1051)

3-41. The A3 Preamplifier produces a drive signal proportional to the input programming commands. This drive signal is applied to the A9 Power Amplifier which, in turn, produces the power source output. The circuitry consists of the four most significant bits of the binary ladder and associated switches and drivers, ladder clamps, voltage range switches, high impedance input stage, sample and hold, and output stage.

3-42. BINARY LADDER

3-43. The four most significant bits of the Binary Ladder consist essentially of R26, R27, R29 and R31. Their individual resistance values weigh the division factor necessary to scale V_{REF} in respective A8, A4, A2, and A1 bit weights. Selection of individual ladder resistors in done through associated ladder switches. Variable resistors R28, R30, and R32 allow precise calibration of the A4, A2, and A1 ladder bits to the A8 bit. The resulting scaled V_{REF} from these ladder bits is combined with the A5 Binary Ladder input through R25 and applied to the input of Q18A. Feedback from the HIGH SENSE terminal at the output of the power source through resistances selected by the Voltage Range Switches drives the input to Q18 to virtual analog common, in the manner of a high-gain operation amplifier.

3-44. LADDER SWITCHES AND DRIVERS

3-45. The Ladder Switches and Drivers Q1 through Q16, apply V_{REF} or analog common V_A common, to the ladder resistors under control of the A8, A4, A2, and A1 bit commands. Each Ladder Switch-Driver combination functions in the same manner; thus only operation of the A8 bit is described.

3-46. The A8 ladder resistor is connected to V_{REF} or analog common through Q1 and Q2 or Q3, respectively. When an A8 command (0V) exists at terminal 18 of P1, bot Q4 and Q5 will be siwtched off. Q3 is switched off by its resulting $-V_A$ gate voltage and Q1, Q2 are switched on by the resulting V_R, gate voltage. With Q1 and Q2 conducting, V_{REF} is applied to R26. Absence of an A8 command applies −5V to terminal 18 of P1 and switches Q4 and Q5 on. The resulting 0V gate voltage at Q3 switches it on and applies analog common to R26. Q1 and Q2 are switched off by conduction of Q5, which applies $-V_A$ by their gates.

3-47. LADDER CLAMPS

3-48. The Ladder Clamps consisting of CR5, CR6, R47 and R48 limit the summing junction voltage at the input of Q18. Clamp signals at terminals 7, 19, and W of P1 turn on CR5 or CR6 during a current limit condition. This minimizes any output voltage transients at the output of A9 Power Amplifier if the load causing the current-limit condition is suddenly removed.

3-49. VOLTAGE RANGE SWITCHES

3-50. The Voltage Range Switches and Drivers consisting of Q30 through Q34 select the appropriate feedback resistance and frequency compensation for the 10V and 100V range. In the 10V range, a −5V command is present at terminal 14 of P1. This voltage turns off Q34 and Q33, which, in turn, switch on FET gates Q30 through Q32. Conduction of Q31 and Q32 connects R39, R40, R42, and R43 across R36 and R35. The end of this network that connects to pin 4 of P1 ultimately becomes the HIGH SENSE terminal at the output of the power source. The frequency response of the Preamplifier in both voltage ranges is controlled by Q31. In the 32V range, conduction of Q30 by-passes R34 and C2, thus connecting only R33 and C1 to the Preamplifier output. In the 100V range, a 0V command at terminal 14 of P1 turns on Q34 and Q33 which turns off Q30 through Q32. With Q31 and Q32 off, only R35 and R36 are connected to the power source output (HIGH SENSE), thus increasing the total feedback resistance by four. The resulting output voltage is subsequently four times the binary input commands. By connecting the MSB jumpers across R36 and R39 alters the feedback such that only output voltages corresponding to the most significant bit appear at the output. With Q30 off in the 100V range, R33, C1 and R34, C2 are connected in series to establish the desired frequency response.

3-51. HIGH IMPEDANCE INPUT STAGE

3-52. Differential amplifier Q18 amplifies the Binary Ladder output with respect to analog common, V_A common, such that feedback through resistance selected by the Voltage Range Switches produces a virtual analog common at the input of Q18A. Transistor Q19 functions as a constant current source, and Q20 provides temperature compensation. Variable resistor R61 provides adjustment to compensate for the input offset of Q18. Jumper selection of R57 through R59 and R62 provides coarse offset adjutment. Selection of R_P and R_N in the drain circuit of Q18 is done to provide a low temperature coefficient of input offset voltage. Diodes CR7 through CR12 limit the maximum voltage swing applied to the following stage.

3-53. SAMPLE AND HOLD

3-54. The Sample and Hold circuitry consists of MOSFET gates Q21, Q22, driver Q23, and capacitors C10 and C11. These capacitors provide memory during programming changes. Normally, a HOLD command (0V) is present at terminal P of P1 and Q23 is conducting. This condition turns on Q21 and Q22 and the output of Q18 is amplified by Q24, Q25. During programming changes, however, presence of a HOLD command (−5V) at terminal P of P1 turns off Q23 and Q21, Q22. Capacitors C10 and C11, which are connected to the inputs of Q24, then hold a sample of the last input from Q18 and hold the output voltage relatively constant for the duration of the HOLD command. The HOLD period is short enough and the circuit constants are chosen so that negligible output voltage change occurs. A secondary HOLD circuit composed of U1 and Q35 through Q37 provides a clamp to analog ground at the input of Q18 during the HOLD command. Presence of a HOLD command (−5V) presets J-K flip-flop U1 to provide a low Q output, which turns on Q37. Q36 is switched on by the resulting $-V_L$ common base signal and turns on Q35, which applies analog common to the base of Q18.

3-55. Transistor Q26 functions as high impedance constant current source for Q25B. Q27 and Q28 amplify the output of Q25B and furnish a drive signal to Q29.

3-56. OUTPUT STAGE

3-57. Emitter follower Q29 provides a low impedance output signal at terminal 5 of P1. This signal is applied to the A9 Power Amplifier which then produces the power source output.

3-58. A4 External Reference (4210A-1041)

3-59. The A4 External Reference is installed as the −03 Option. It receives and processes an external reference input having a frequency of dc to 30 kHz and a level from 0 to ±14.5V dc or peak ac. The circuitry consists of three differential amplifiers and an emitter follower which form an operational amplifier. FET gates Q9 and Q10 controlled by drivers Q11 and Q12 apply the amplifier output and sense line to the V_{REF} line in the A3 Preamplifier.

3-60. DIFFERENTIAL AMPLIFIER

3-61. The differential Amplifier consists of three individual amplifiers: Q1 through Q8 and the emitter follower of Q13. The external reference input is applied through R1 and C9 to tone input of the differential FET, Q1. This stage amplifies the input in respect to V_{REF} common and provides a differential input to Q5. Feedback through R16 and R17 maintains the input of Q1 at virtual V_{REF} common. Adjustment of R17 controls the overall gain and subsequently the output V_{REF} high at terminal 4. Variable resistor R6 allows zero offset adjustment of the output, V_{REF} high. Jumper selection of R5 and R8 through R10 provides coarse adjustment of offset. Selection of R_N and R_P in the drain circuit of Q1 is done to provide a low temperature coefficient for the offset voltage. A constant current source for Q1 is provided by Q2, while TC compensation of the current source is provided by Q3. The differential Darlington composed of Q4 and Q5 amplifies the output of Q1 and furnishes a single-ended drive signal to Q7. This drive signal is developed across Q6 which functions as a high impedance, constant current source for Q4B. The final quasi-differential amplifier Q7 and Q8 supplies a drive signal to the emitter-follower output stage of Q13. This stage provides a low impedance output to drive the V_{REF} high line. Q14 functions as a high impedance current source for Q13. Diodes CR1 and CR2 provide connection to the feedback line when Q9 and Q10 are turned off.

3-62. FET GATES

3-63. The application of the external reference to the internal stet lines is controlled by Q9 and Q10. Q9 connects the feedback line to V_{REF} sense, and Q10 connects the external reference to the internal V_{REF} high line. Drivers Q11 and Q12 control the on/off condition of Q9 and Q10 in conjunction with the EXT REF and STANDBY commands at terminals 13 and M.

3-64. When an EXT REF command (0V) exists at terminal 13, Q11 is turned off, and $-V_A$ is applied to both the emitter and base of Q12. This condition turns off Q12 and switches FET gates Q9 and Q10 on, thus applying the external reference to the internal V_{REF} line. The same condition occurs when a STANDBY command (0V) exists at terminal M. Diodes CR3 and CR4 provide isolation between the input command lines.

3-65. Should a STANDBY or EXT REF command (–5V) exists, Q11 will be switched on and turn on Q12. Conduction of Q12 applies $-V_A$ to the gates of Q9 and Q10 which turns them off. This condition then disconnects the external reference from the internal V_{REF}lines.

3-66. A5 BCD Ladder (4210A-1031)

3-67. The A5 BCD Ladder contains a buffer amplifier for V_{REF} and the three lower decade segments of a ladder network. The buffer amplifier produces a V_R signal from V_{REF} to prevent loading of V_{REF} by ladder switching currents. The ladder decades are voltage dividers weighted in fifteenths for control by digital words from 1 to 15 (8 + 4 + 2 + 1). The relative position of each decade with respect to the ladder output determines the significance of each decade's contribution to the total ladder network output.

3-68. BUFFER AMPLIFIER

3-69. The Buffer Amplifier composed of Q1 through Q3 is a unity gain amplifier connected through CR1 to function as a voltage follower. This circuit produces a V_R Signal that is applied to the ladder driver circuits. Output impedance is sufficiently low from dc to 100 kHz to prevent loading by ladder switching currents.

3-70. LADDERS

3-71. The three lower decade ladders consists of R1 through R18. Each decade of the ladder is formed essentially by four resistors which in combination weigh the division factor of each decade in fifteenths. A simplified diagram of a typical decade ladder is shown in Figure 3-3.

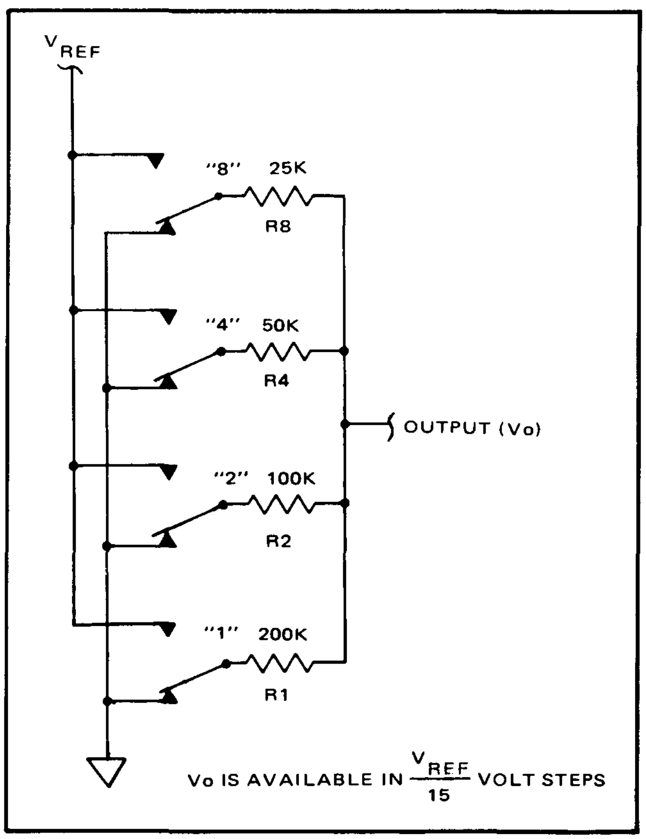


Figure 3-3. LADDER DECADE (SIMPLIFIED)

3-72. DRIVERS

3-73. Each ladder resistor is connected to V_{REF} common using a driver such as the one shown in Figure 3-4. When the bit command is high (0V), QA and QC are both turned off, which applies $-V_A$ to the gate of QB and V_R, to the gate of QD. This condition switches QD on and QB off, thus applying V_{REF} through QD to the ladder resistor R_N. Absense of a bit command will apply a low (–5V) to the base of QA which causes it to conduct. The resulting 0V collector signal switches on gate QB and the driver QC. Conduction of QC applies $-V_A$ to the gate of QD, turning it off. As a result, V_{REF} common is applied through QB to the ladder resistor R_N.

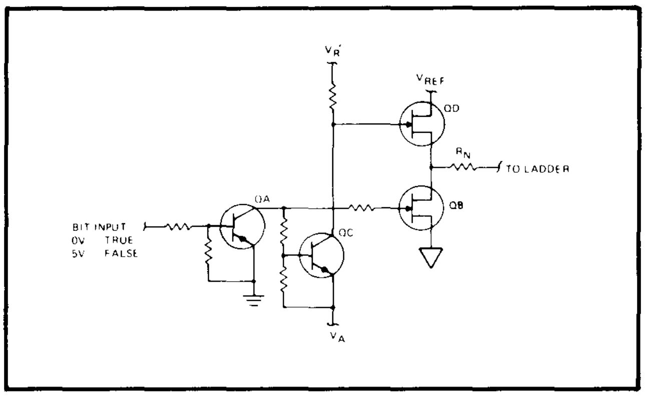


Figure 3-4. LADDER DRIVER (SIMPLIFIED)

3-74. A6 Isolated Control Logic (4275A-1021)

3-75. The A6 Isolated Control Logic assembly receives and processes all input and output data at the Programming Connector, J1. A logic diagram in simplified form is shown in Figure 3-5.

3-76. PRESET GENERATORS

3-77. Two Preset Generators are used in the Isolated Control Logic. Their purpose is to preset all counters, flip-flops, and registers to their proper state when the supply is first turned on. This is to insure that the output of the power source is programmed to its minimum value, and that all logic is in the proper state to accept input data and process it properly upon command. One Preset Generator is used to preset the input programming circuitry and is composed of Q8 and Q5. When input power is applied the $+V_L$ supply rises to its regulated level of +5 volts. At this point C5 has not been charged, and Q8 and Q5 are turned off, leaving the preset line high. C5, driven by the current from the +5V supply begins to charge C5 at a linear rate. The voltage divider composed of R9 and R10 provides a +4V reference to the gate of a Programmable Unijunction Transistor, Q8. When the charge on C5 reaches approximately +4.5V, the gate of anode Q8 is forward biased causing it to turn on and latch. C5 now begins to rapidly discharge through Q8 and R11. The voltage developed across R11 is sufficient to turn on Q5, which causes the preset line to go low, thereby presetting all input programming circuitry. When the discharge of C5 is almost complete, the voltage drop across R11 can no longer supply base drive to Q5; it therefore turns off, allowing the preset line to return to its high state.

3-78. The second Preset Generator is used to preset the shift registers in the isolated portion of the logic circuitry. It is composed of Q16 and Q15 and is less complex than the preset generator previously described. When input power is applied, the $-V_L$ supply rises to its regulated level of–5V. At this time Q16 is not conducting, C33 is not charged, and the output of U15 is –1V. C33 now begins to charge at an exponential rate through R57. R54 and R55 form a voltage divider which provides a –1V reference to the gate of a Programmable Unijunction Transistor, Q16. When the charge on C33 reaches approximately –0.5V, the gate to anode of Q16 is forward biased causing it to turn on and latch. C33 now begins to rapidly discharge through Q16 and R58. The voltage developed across R58 drives the input of Q15 toward 0V, causing its output to drive close to –5V and clear shift registers U20, U21 and U22. As the discharge of C33 is almost complete, the voltage drop across R58 approaches zero volts allowing the input of Q15 to return to a –5V level. The output of Q15 then returns to 0V, completing the preset pulse. Q16, however, remains latched because of the small holding current supplied through R57.

3-79. DATA TRANSFER SEQUENCE

3-80. The parallel program data (output voltage magnitude, sign, output voltage range, current limit magnitude and external reference function) is applied to the inputs of a series of multiplexing circuits as shown in Figure 3-5. When the data is settled at the multiplexer inputs, the program source generates a strobe signal having a duration of nanoseconds or longer. The strobe pulse is fed via an integrator to the trigger input of a delay one-shot. The integrator provides noise immunity, and triggers the delay one-shot when it receives a pulse having a width of 800 nanoseconds or greater. The delay one-shot produces an 800 nanosecond pulse, the leading edge of which triggers the hold one-shot (via T5) to produce an eight or 16 microsecond pulse to the hold input of the power source. The width of the hold one-shot output pulse depends upon the particular power source model. That is, the 4210A and 4216A require an eight microsecond hold pulse, while the remaining models require a 16 microsecond hold pulse. In either case, the hold pulse is used within the A3 assembly to hold the output voltage magnitude constant while programming is underway.

3-81. The trailing edge of the delay one-shot output triggers the not ready one-shot and sets the start/flip-flop. The not ready one-shot generates a 100 microsecond pulse which becomes the not ready flag output to the program source. The not ready flag indicates that the 4200-09 is busy and not available to accept program data or strobe signals from the program source. When the start/stop flip-flop becomes set, the Q output provides a start signal (voltage level) to the start/stop input of a 10 MHz clock. The Q output of the start/stop flip-flop is also fed to an input of gate U12-8 to gate the clock output pulses to various portions of the control logic to transfer the program data across the guard. Concurrently, the Q output of the start/stop flip-flop inhibits gate U14-3 to prevent clock pulses from reaching the primary winding of T4. (This function is described in later paragraphs.)

3-82. The 10 MHz clock pulses gated by U12-8 are fed to the input of a ÷ 16 (four-bit binary) counter. At the time of the sixteenth clock pulse, the counter reaches full count and generates a carry pulse to the reset input of the start/stop flip-flop (and also to the reset input of the ocmplement flip-flop described later). As the counter advances through its 16 states, the four binary weighted (1, 2, 4 and 8) outputs address the multiplexer channels and move the bits of data applied to the parallel inputs over to the multiplexer output. For example, the first clock pulse to the counter advances it from the zero state to the first state in which the "1" output is true and the "2", "4" and "8" outputs are false. As a result, the second channel of U1 and U4 is addressed, and the second bit of data appears at the multiplexer outputs. As the counter advances the subsequent inputs of U1 and U4 appear at the multiplexer outputs, until the count of eight is reached. At this point, the "8" output becomes true to inhibit U1 and enable U2. The eight inputs of U2 are sequentially addressed in the same manner as U1 and the program data appears in serial format at the U2 output, and is commonly connected with the U1 output. During the 16-state cycle of the counter, U1 and U2 are each cycled once, while U4 is cycled through its eight addresses twice. This is of no consequence since input data has not changed during the generation of the 16 clock pulses.

3-83. The 16 clock pulses are fed to inputs of gates U13-3 and U13-5 to gate the serial program data appearing at the multiplexer outputs to the primaries of T1 and T3. The clock pulses are also fed directly to the primary of T2. The transformers couple the signals across the guard. On the inside of the guard, the clock pulses are applied to three eight-bit shift registers causing the registers to load the serial program data. Shift registers U20 load the 16 bits of output magnitude data while U22 loads (twice) up to eight bits of control data. The parallel outputs of U20 and U21 are applied directly to the ladder network assembly (A5), while the parallel outputs of U22 are applied to a series of latch circuits. To load the control data into the latch circuits, the first of the 16 clock pulses triggers a latch-timing one-shot which has a period of two microseconds. This one-shot is not re-triggerable by the subsequent clock pulses, and the trailing edge of the output pulse occurs after the clock pulses and serial transfer of data into the shift registers is complete. The trailing edge triggers the latch load one-shot to parallel load the eight bits of control data from the shift register into the latch circuits for application to the control circuits within the power source.

NOTE!

Complementing magnitude data occurs only in binary-type power sources.

3-84. COMPLEMENTING BINARY DATA

3-85. Binary-type power sources require that negative value of magnitude data be two's complemented since binary program sources usually indicate polarity by means of a single bit and supply two's complemented magnitude data for negative outputs. The binary-type power sources require non-complemented binary data plus a polarity bit. As a result, negative binary magnitude data, consisting of complemented data, must be re-complemented to satisfy the requirements of the power source. When the binary program source indicates negative sign, gate U9-8 is enabled to pass the output of the complementing logic. The complementing logic receives the serial output of U1 and U2, complements it, and passes it across the guard via T1.

3-86. Operation of the two's complementing logic (U9 and U10) is such that the first bit of serial data (multiplex address zero) is present at the output of multiplexer, U1, before the ÷ 16 counter and complement flip-flop (U10) receives the first of 16 clock pulses. At this time, the ÷ 16 counter is in its zero state to address channel zero of U1, and the complementing flip-flop is still reset (as a result of the carry pulse generated by the ÷ 16 counter at the end of the previous data transfer sequence). With the complement flip-flop reset, the complement logic is not enabled and no inversion of serial data takes place. This condition permits the first binary magnitude data to be transferred without being complemented. However, after the first clock pulse, the complement flip-flop may be allowed to go set (to enable the complement logic) depending upon the state of the J input, which is derived from the serial data. As a result, the complement flip-flop goes set at the time of the first true bit of serial data is enable the inverting logic and complement the remaining bits of serial data. After the 16th bit of data, the complementing flip-flop is reset by the carry output of the ÷ 16 counter.

3-87. STANDBY OPERATION

3-88. The power source can be commanded to standby or operate mode at any time by the program source. As shown in Figure 3-5, the standby command (dc) is gated to the start input of the 10 MHz clock. The clock is turned on and generates pulses as long as the standby signal is present. The start/stop flip-flop remains reset from the last transfer sequence to enable gate U14-3 and pass the clock pulses

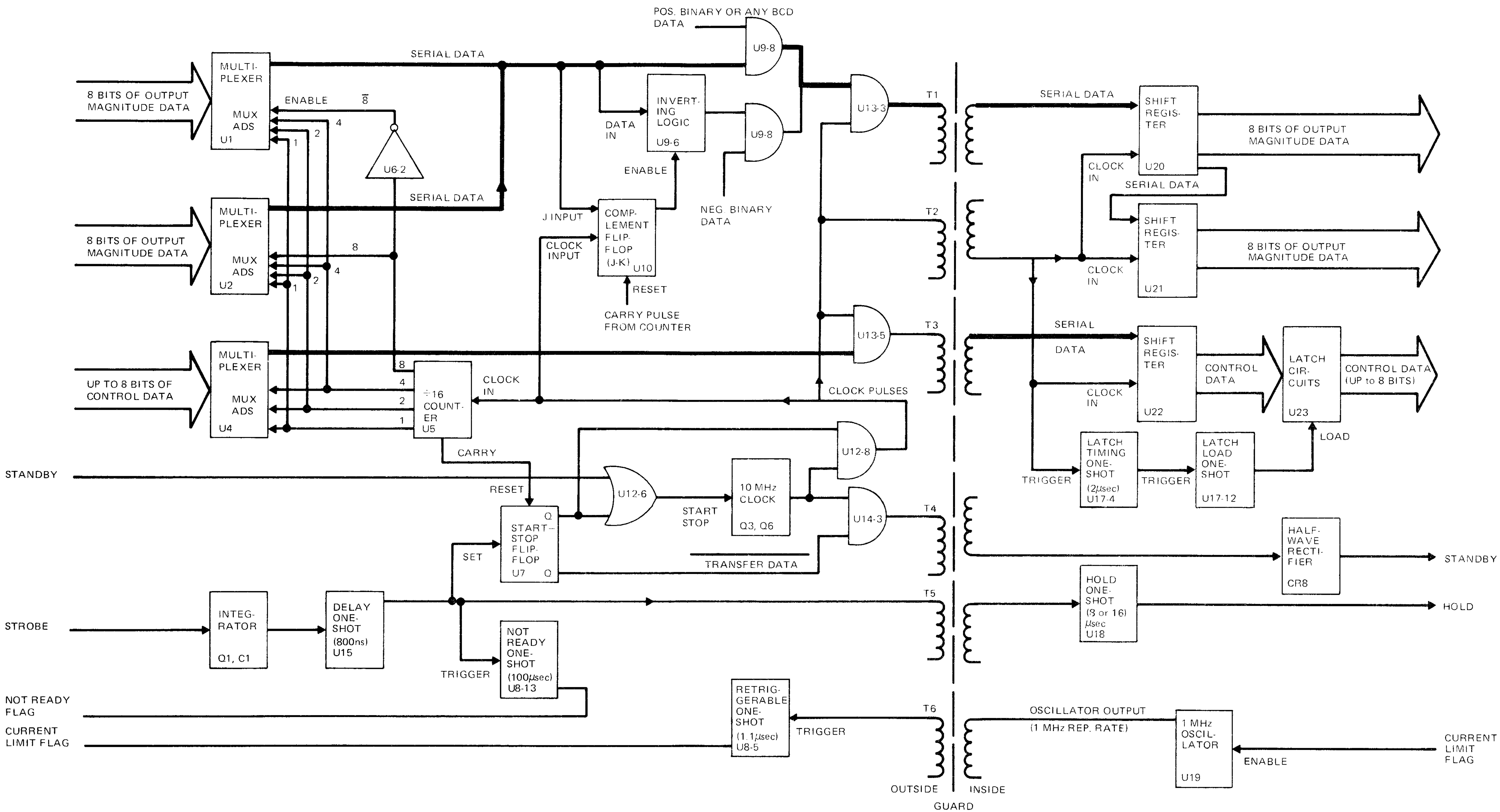


Figure 3-5. ISOLATED CONTROL LOGIC (Simplified)

via T4 to a half-wave rectifier on the inside of the guard. The dc output of the rectifier becomes the standby signal for control of the power source. During standby operation, data transfer does not take place due to the start/stop flip-flop being reset and gate U12-8 being inhibited.

3-89. CURRENT LIMIT FLAG

3-90. The current limit flag produced by the A9 Power Amplifier whenever the power source is in the current limit mode, is used to enable a 1MHz oscillator (U19) which produces pulses at a 1MHz rate. The pulses are fed via T6 to the trigger input of a re-triggerable one-shot having a period of 1.1 microseconds. As long as the 1MHz pulses occur, the output of the re-triggerable one-shot is held at dc level which becomes the current limit flag to the program source.

3-91. A8 Programmable Current Limiter (4270A-1081)

3-92. The A8 Programmable Current Limiter is installed as the –06 Option. It compares the voltage from a ladder network to an input voltage proportional to the output current. When the output current exceeds the ladder network reference, a clamp signal is produced that is used to limit the output current of the A9 Power Amplifier. The A8 Programmable Current Limiter contains the following circuitry: an 8-4-2-1 to 4-4-2-1 binary code converter, FET drivers, a ladder voltage reference, ladder switches and a ladder, a programmable reference and programmer reference inverter, and two current limit comparators – one positive and the other negative. Auxiliary circuits are a ground isolator and two power supplies, one 15 volts and the other –16 volts. A two-ohm current sampling resistor is tied to the input of the two current limit comparators.

3-93. 8-4-2-1 to 4-4-2-1 CONVERTER

3-94. This logic converter consists of two, digital integrated circuit, hex-inverters U1A through U1F and U2A through U2F. They convert the input 8-4-2-1 code to 4-4-2-1 code, and in the absence of any programmed inputs, program the ladder to the lowest current limit, 10 milliamps. This is the quiescent state of the limiter in which ladder swtich Q4 and the current range switch Q26 are turned on, placing operational amplifier U4 in low range. This ensures that the Model 4275A current limits at the lowest current, limits at the lowest current, 10 milliamps, as a safety feature. In the event a programmed input for 80 milliamps is applied to the converter, the logic input is applied to two circuits, one directly to the base of FET Driver Q13 and the other indirectly through two inverters U2F and U1A to the base of FET Driver Q10. These two drivers turn on ladder switches Q9 and Q12 and two code 4 ladder resistors, thereby applying an equivalent 8 to the Programmable Reference amplifier and establishing a current limit of 80 milliamps.

3-95. FET DRIVERS

3-96. The ladder FET DRIVERS consist of PNP-NPN Transistor pairs Q3-Q5, Q7-Q8, Q13-Q14, and Q10-Q11. The emitters of these pairs as well as the current range FET drivers Q15-Q16, are returned to V_L common through a ground isolator network is described later. The purpose of the drivers is to increase the voltage output of the converters to a level required by the FET switches.

3-97. LADDER VOLTAGE REFERENCE

3-98. The Ladder Voltage Reference consists of a temperature compensated, 6.3 volt zener diode CR7 and produces a stable reference voltage that is reduced to 0.1 volt at TP3 by resistors R4, R6, and R59. This voltage reference is supplied by the regulated +15 volts power supply (TP2) consisting of 16 volt zener CR1, transistor Q28, and associated components.

3-99. LADDER SWITCHES AND LADDER

3-100. The Ladder Switches and Ladder, respectively, consist of FET switches Q4, Q6, Q12, and Q9 and resistors R52, R55, R54, and R15. The ladder resistors are weighted in a ratio of 1, 2, 4, and 4. The ladder operation is best explained in conjunction with the Programmable Reference. (See paragraph 3-121.)

3-101. PROGRAMMABLE REFERENCE AMPLIFIER

3-102. Programmable Reference Amplifier U4 is monolithic IC operational amplifier. Assuming current range switch Q26 is on, then U4 output voltage varies between –0.01 volt and –0.11 volt as the ladder resistors are switched into the circuit by the FET switches. That is, with only Q4 on, the output voltage is –0.01 volt. With Q4, Q6, Q12, and Q9 on, the output voltage is –0.11 volt. The range is set by R31 in parallel with R30 and is the 10 ma to 110 ma current range. With Q26 turned off, the range is determined by R30 alone. This is the 100 ma to 1.1 ampere range (Current Limit x 10 command) in which the ladder resistors produce an output from U4 of –0.1 volt to 1.0 volt. Amplifier U3, also a monolithic integrated circuit, together with resistors R24 and R25, forms a unity gain, inverting amplifier. The output of U3 is the same magnitude as that of U4, but of opposite polarity.

3-103. POSITIVE AND NEGATIVE I LIMIT COMPARATORS

3-104. Since the comparators function in the same manner, except for polarities, only the positive comparator is described. The output current from the Model 4275A flows through a one-ohm resistor, R51. A *positive* output current through this resistor produces a positive voltage that is compared to the output of U3 by action of transistor Q17.

When the positive output of U3 is greater than the positive voltage developed across R51, Q17B is on and Q17A is off, as are Q18, Q19, and Q17. This corresponds to the Model 4275A output current being less than the programmed I-limit. When the positive output of U3 is less than the positive voltage developed across R51, Q17A, Q18, Q19, and Q27 are all on and conducting. The greater the difference between the R51 and U3 voltages, the greater these transistors conduct. The collector of Q27 connects, by way of pin 2 of P1, to the base of Q31 on the A9 Power Amplifier. When the Q27 collector conducts, it shunts base current drive away from Q31, limiting the 4275A output current to the programmed level. Transistors Q18 and Q27 are common-base stages used as voltage translators: Q18 from the −10 volts level of Q17A to Q19 which is referred to V_H (about −100 volts), and Q27 from Q19 are essentially the OUTPUT HIGH terminal voltage. Transistor Q19 provides current gain and Q20 is used as a temperature compensating diode for Q19. Capacitor C4 and resistor R40 are the primary frequency response determining components. Transistor Q25A and Q25B compares a negative reference voltage to negative voltages produced across resistor R51 by the output current in a manner similar to Q17A and Q17B. Transistors Q24, Q21, Q23, and Q22 correspond in function to Q18 through Q20 and Q27, respectively.

3-105. GROUND ISOLATOR

3-106. The Ground Isolator circuit, composed of transistors Q1 and Q2 isolate the ground currents flowing in V_H COMMON from those in V_L COMMON. The input logic lines driving the first transistor of each pair of FET Drivers (the emitters of the drivers) are referenced to V_L COMMON indirectly through transistors Q1 and Q2. Thus, the only current through the point of commonality of $V_L - V_A - V_H$ is base current of Q1 and this has but a negligible effect in the OUTPUT LOW sense line.

3-107. MINUS 16 VOLTS POWER SUPPLY

3-108. Diode CR2, a 16 volt zener, produces −16 volts at test point 4. This voltage is used in the Ground Isolator, the FET Drivers, and U3 and U4.

3-109. A9 Power Amplifier (4270A-1071)

3-110. The A9 Power Amplifier produces the final output voltage and current of the power source. It also provides both source and sink current limit protection of the bipolar output. The circuitry consists of an input amplifier, driver, clamp circuitry, current sources, output stage, and current limit detector.

3-111. INPUT AMPLIFIER

3-112. The Input Amplifier composed of Q9 through Q11 and Q20 through Q25 amplifies the input appearing at terminal D of P1. The resulting voltage at the emitter of Q11 corresponds closely to the programmed output voltage. A closed-loop dc gain of five is established by feedback through R62 and R21. Overall frequency response is controlled to 6 db per octave by C6. Amplifiers Q22 and Q23 link V_H common to the A3 Preamplifier common (V_{REF} common) such that current flow between these two points is minimized. Q20 and Q21 provide current with respect to the common established by Q23, Q22 emitters. Emitter follower Q9 and amplifier Q10 provide voltage gain and a drive signal to the output emitter follower Q11. Overall frequency response to this point is controlled with feedback through C6. The resulting emitter voltage of Q11 is close to the final output voltage of the power source. Transistors Q24 and Q25 function as current sources of Q10 and Q11, respectively.

3-113. DRIVER

3-114. The Driver consisting of Q12 and Q26, form complementary current amplifiers. These amplifiers receive a bipolar drive voltage from Q11 and together with the CURRENT SOURCES produce respective drive currents for the output stage. The voltage drops across Q13, CR33, Q17 and CR27 together with variable resistor R51 set the bias current required for the output transistors Q32, Q33, Q41 and Q42. Q13 collector current is turned off when a (+) current limit condition exists and Q17 is affected similarly for a (−) current limit. These collectors drive the CURRENT LIMIT DETECTOR.

3-115. CLAMP CIRCUITRY

3-116. Voltage transients that would occur during a current limit and abrupt load removal are limited by the Clamp Circuitry. Two circuits titled + Clamp and − Clamp limit the bipolar transients. The + Clamp consists of Q1 through Q4. Transistors Q5 through Q8 form the − Clamp. Since operation of each circuit is the same, except for polarity, only the + Clamp is described.

3-117. The + Clamp monitors the voltage between the emitter of Q11 and that on the anode of CR33. Normally, Q1 and Q2 are cut-off and Q3 is conducting; however, when a current limit occurs, the anode voltage of CR33 decreases through action of either the built-in current limiter (overload protection) or the A8 Programmable Current Limiter (optional) and subsequently turns off Q3. The voltage at the emitter of Q11, will increase toward $+V_H$ during current limiting and this turns on Q2. Conduction of Q2 turns on Q1 and produces a clamp signal at terminal 6 of P1. This clamp signal then limits the summing junction voltage in the A3 Preamplifier and causes the emitter voltage of Q11 to be clamped to a voltage slightly above that of the base drive to the Output Stage. Transistor Q4 functions as a current source for Q2 and Q3. Frequency and phase characteristics of the + Clamp circuitry is determined by C1, C2, C26 and R65.

3-118. CURRENT SOURCES

3-119. Constant current for the Output Stage is provided by the Positive and Negative Constant Current Sources. Transistor Q30 forms the Positive Constant Current Source. The Negative Constant Current Source consists of Q38. The positive and negative constant current sources produce a constant reference current for the bases of Q31 and Q37, respectively.

3-120. OUTPUT STAGE

3-121. The Output Stage consisting of Q31 through Q35 and Q37 through Q42 produces the power source output. It also provides both sourcing and sinking current limit protection.

3-122. Transistors Q31 through Q33 and Q37, Q41, Q42, form a complementary, emitter follower stage. Q31 through Q33 produce the positive output and Q37, Q41, Q42 the negative. Total output current flows through R43, R44 (positive) and R47, R48 (negative).

3-123. Both sourcing and sinking current limit protection is provided for each section of the output amplifier. Q34 protects the positive output section and Q35 the negative. Maximum output current (sourcing) is limited to 1.2A. Sinking current is limited at a lesser value depending on the programmed output voltage. Since operation of each current limiter is the same, only the positive output section protected by Q34 is described.

3-124. Output current passes through R43. This current produces a bias voltage for A34. When the output current (sourcing) exceeds 0.6A, the resulting potential turns on Q34. Conduction of Q34 via CR34 shunts any further base drive current to Q31, thus limiting the maximum sourcing output current at 0.6A. In the sinking mode, output current will pass through R43 to the output as above, but the output voltage polarity is zero or negative by definition. Under this condition, negative voltage more than –0.6V at the output will turn on CR25 which supplies base current for Q34 through R41 from common and adds to that supplied from the voltage drop across R43. Therefore, the base current is dependent on both sinking voltage magnitude and output current. Current limiting in milliamperes is equal to $500 - 4.5E_{out}$.

3-125. When the A8 Programmable Curremt Limiter –06 Option is installed, ±I LIMIT inputs are applied to terminals 2 and U of P1. These inputs clamp the maximum base drive to both sections of the Output Stage in a similar manner to Q34, thus limiting the maximum output current at a level determined by the input limit commands.

3-126. CURRENT LIMIT DETECTOR

3-127. The Current Limit Detector produces an I LIMIT (0V) command at terminal 14 of P1 whenever a source of sink limit condition exists. Circuitry consists of Q14 through Q16, Q18 and Q19. Positive output section limiting is detected by Q14. Limiting in the negative output section is detected by Q18. Transistors Q15, Q16 and Q19 are drivers.

3-128. Under normal operating conditions Q14 and Q18 are turned on by conduction of Q13 and Q17 in the Driver. Transistors Q15 and Q19 are switched off by conduction of Q14 and Q18, thus turning Q16 on and producing an I LIMIT (–5V) command at terminal 14 of P1. Should a current limit occur in the positive or negative section of the Output Stage, the associated Q13 or Q17 in the Driver will be turned off. This turns off Q14, Q15 or Q18, Q19, thus turning Q16 off and producing an I LIMIT (0V) command at terminal 14 of P1.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains servicing information for the instrument. Table 4-1 lists the recommended test equipment. If the recommended equipment is unavailable, use test equipment of equivalent or superior specifications.

4-3. SERVICING INFORMATION

4-4. All products manufactured by the John Fluke Mfg. Co., Inc. are warranted for a period of one year. Complete warranty information is located in the WARRANTY at the front of the manual

4-5. Factory authorized calibration and services is available at various world-wide locations. A list of authorized service centers is located at the front of the manual. If requested, an estimate will be provided before repair work is done on an instrument that is beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning

4-8. This instrument should be cleaned periodically to remove dust, grease, or other contaminates. The exterior of the instrument can be cleaned with a clean cloth moistened with anhydrous ethyl alcohol or Freon T.F. Degreaser (MS 180) available from the Miller Stephensen Chemical Co., Inc. If neither cleaning agent is readily available, soap and water applied sparingly to a clean cloth is usable. Interior sections of the instrument are cleaned using clean, dry air at low pressure.

4-9. Air Filter Cleaning

4-10. A removeable air filter is attached to the rear panel and against the blower by a covering bracket that is held in place by four screws. This air filter should be removed and cleaned frequently to remove accumulations of dust and grease. The air filter is removed by unscrewing the four covering bracket screws, removing the bracket, and separating the bracket and filter. Cleaning is done by rinsing the filter in hot detergent solution frequntly for best results. After the filter is dry, install it as indicated by the air flow arrow scribed on the frame of the filter. Secure the filter bracket to the rear panel with four screws.

4-11. Fuse Replacement

NOTE

Turn off power switch and disconnect instrument from power supply (line power) before replacing fuse.

4-12. The power fuse is located on the rear panel of the instrument. If replacement is necessary, use the following rated fuses:

AC LINE VOLTAGE		AC LINE VOLTAGE	
100	2A, AGC	200	1A, AGC
115	Slo Blo	230	Slo Blo
125		250	

4-13. MAINTENANCE ACCESS

4-14. Access to the interior of the instrument shown in Figure 4-1 is as follows:

a. Turn off the power switch and disconnect the power cord from line power.

b. Remove the top dust cover and the underlying guard cover to gain access to all of the calibration adjustments, test points, and most of the PCB assemblies. Note that most of the calibration adjustments are labeled on the guard cover.

c. Removal of the A10 PCB requires prior removal of the A2 PCB, the bottom dust cover, and the A9 Power Amplifier PCB and heat sink. However, if A10 PCB removal is not desired, proceed to step k.; otherwise continue as follows. The A9 heat sink is secured to the bottom guard tray by two screws accessible from the upper surface of the guard tray. The A9 PCB assembly and attached heat sink are removed from the A1 PCB as a unit following disconnection of the A9S1 thermostatic switch cable A9W1 from the A10 PCB at A10P2. Refer to Interconnect Diagram 4270A/4275A-1000.

d. Following removal of the A9 PCB, the machine screws securing the two longitudinal cross braces to the guard tray must be removed. Next, four large machine screws securing the lateral cross bracket to the front panel at the rear of the A1 PCB (two high and two low) must be removed.

e. The lateral and longitudinal cross braces with attaching A10 PCB, A10 heat sink, and 1A1T1 power transformer, may be displaced obliquely internal of the instrument following removal of two machine screws through the rear panel of the instrument and disconnection of the A10A1 connector PCB from the A2 PCB receptacle J1. In addition, the blower power cable A10W3 must be either unsoldered from the A10 PCB or disconnected from the blower motor at the blower itself. The latter requires removal of the blower filter bracket, filter, and fan as outlined in paragraph 4-10. The blower cable is then removed, within a protective grommet, from a rear panel slot to free it from the instrument chassis.

f. This step is readily accomplished providing that the A2 PCB assembly is previously removed from the instrument, since greater freedom of movement is allowed. Remove the overall assemblage described in previous step by lifting vertically out of the instrument while simultaneously rotating the assemblage obliquely to clear the rear panel overhang. Exercise care in withdrawing the flatwire cable A10W1 and connector PCB A10A1 with the assemblage to prevent damage.

g. With the assemblage removed from the instrument and placed on a level, clean surface and the power transformer being farthest away, remove the two machine screws securing the shorter longitudinal brace to the lateral cross brace.

h. Remove the six machine screws from the longer longitudinal brace. These screws secure the A10 PCB to the brace. Hold the power transformer steady and withdraw the A10 PCB with attaching parts from the transformer cable receptacle 1A1J1.

i. Separation of the short longitudinal brace from the A10 heat sink and filter capacitors is accomplished by releasing the heat sink alignment clip screw and the two screws in the capacitor support brackets, these latter two being hidden beneath the heat sink. The brace may then be separated from the A10 components by a firm, even pulling force.

NOTE

PCB's can be mounted on an accessory extender PCB assembly for servicing. See Section 6 for use of the extender and associated extender cable.

j. Removal of the A2 through A6, A8 and A9 PCB's is done by pulling rearward with a firm rocking motion on each PCB. However, those PCB's with rear panel brackets (A2 and A6) must be freed of attaching rear panel screws.

k. The A9 PCB is secured to the bottom guard tray through the A9 heat sink. Hence, A9 PCB removal requires prior removal of heat sink attaching screws accessible from the upper surface of the bottom guard. The A9 PCB and heat sink are withdrawn from the instrument as a unit following disconnection of the A9S1 thermostatic switch cable from the A10 PCB at A10P2. Refer to Interconnect Diagram 4270A/4275A-1000.

l. In the event the A2 PCB is removed from the A1 PCB and reconnected via the extender PCB assembly, as in servicing or troubleshooting, an accessory cable extender assembly must be used to tie the A2 and A10 PCB's together electrically. The recommended installation is depicted in Section 6 of the manual.

m. Access to the A1 and A7 PCB pair is possible after removal of the front panel. To remove the front panel, remove the bottom dust cover and then remove the rack mountings, if installed, from the front corners. If no rack mountings are installed, peel the decals from the sides of the front handles. Place the instrument face down on its handles and remove the four mounting screws (two upper and two lower) which secure the lateral cross bracket to the front panel at the rear of the A1 PCB.

n. Disconnect the A1 PCB guard wire from the lower guard by removing the lug screw.

o. Place the instrument normal side down and remove all the screws from the sides of both front handles, or from the front corner panels in the event the instrument was rack mounted.

p. Pull the entire front panel assemblies free of the instrument, and at the same time, dislodge those PCB's which may be still inserted into the A1 motherboard.

q. To separate the A1 and A7 PCB pair from the front panel, remove the large screws that secure the PCB pair to the front panel by means of the teflon standoffs.

r. To separate the A1 and A7 PCB pair from each other after they are removed from the front panel, remove all the small screws from the A1 PCB. Separate the A1 and A7 PCB by pulling the two boards perpendicularly apart.

s. Assembly of the instrument is accomplished by reversal of the order of disassembly, with attention to connection of the A2 PCB guard wire that was removed in step o.

t. The air filter and blower are removed from the rear panel by removing the filter cover screws, the filter cover, the filter, the blower screws, and the blower line power plug.

u. Instructions for cleaning and installation of the air filter are given on the frame of the filter itself. See paragraph 4-10.

4-15. INVERTED CONTROL LOGIC

4-16. The Isolated Control Logic PCB can be altered to provide inverted logic levels. This is accomplished by jumpering to appropriate PCB pads. Refer to the table on the A6 Isolated Control Logic Schematic Diagram (4275A-1021, sheet 1 of 2). The table indicates the proper jumper configuration for normal and inverted logic levels for each model of the 4200 series instruments. Jumper locations are identified by alphabetical designations which appear on the schematic diagram and the PCB.

NOTE

The same Isolated Control Logic PCB Assembly is used in all models of the 4200 series instruments. However, the PCB's are not interchangeable until the jumper configuration is changed in accordance with the table on the 4275A-1021 schematic diagram. Therefore, insure that any control logic assemblies used as replacements conform to the jumper configuration shown in the table before installing the assembly in the instrument.

4-17. CALIBRATION PROCEDURES

4-18. The recommended period between successive calibrations for this instrument is 90 days or annually. The instrument must be calibrated following repairs. Use the test equipment defined in paragraph 4-2. Table 4-1. Assembly, adjustment, and test point locations are shown in Fgirue 4-1. Table 4-2 shows binary by decade coding for output magnitude control.

Table 4-1. RECOMMENDED TEST EQUIPMENT

NOMENCLATURE	EQUIPMENT
AC/DC Voltmeter	FLUKE Model 887A
Manual Control Unit (MCU)	FLUKE Model A4200
*AC Source, ±0.02% of output, 400 Hz	FLUKE Model 510A, Option –04
**Resistive Load	10 ohm ±1%. 20w
*Required only if –03 Option is installed.	
**Required only if –06 Option is installed.	

4-19. Initial Procedure

a. Turn off the instrument and remove the top dust cover screws. Leave the dust cover in place.

b. Connect the Model A4200 Manual Control Unit (MCU) to the programming connector on the rear of the instrument.

CAUTION!

The Model A4200 Manual Control Unit (MCU) is not compatible with 4200 series instruments equipped with the –09 Option. DO NOT connect the MCU to these instruments.

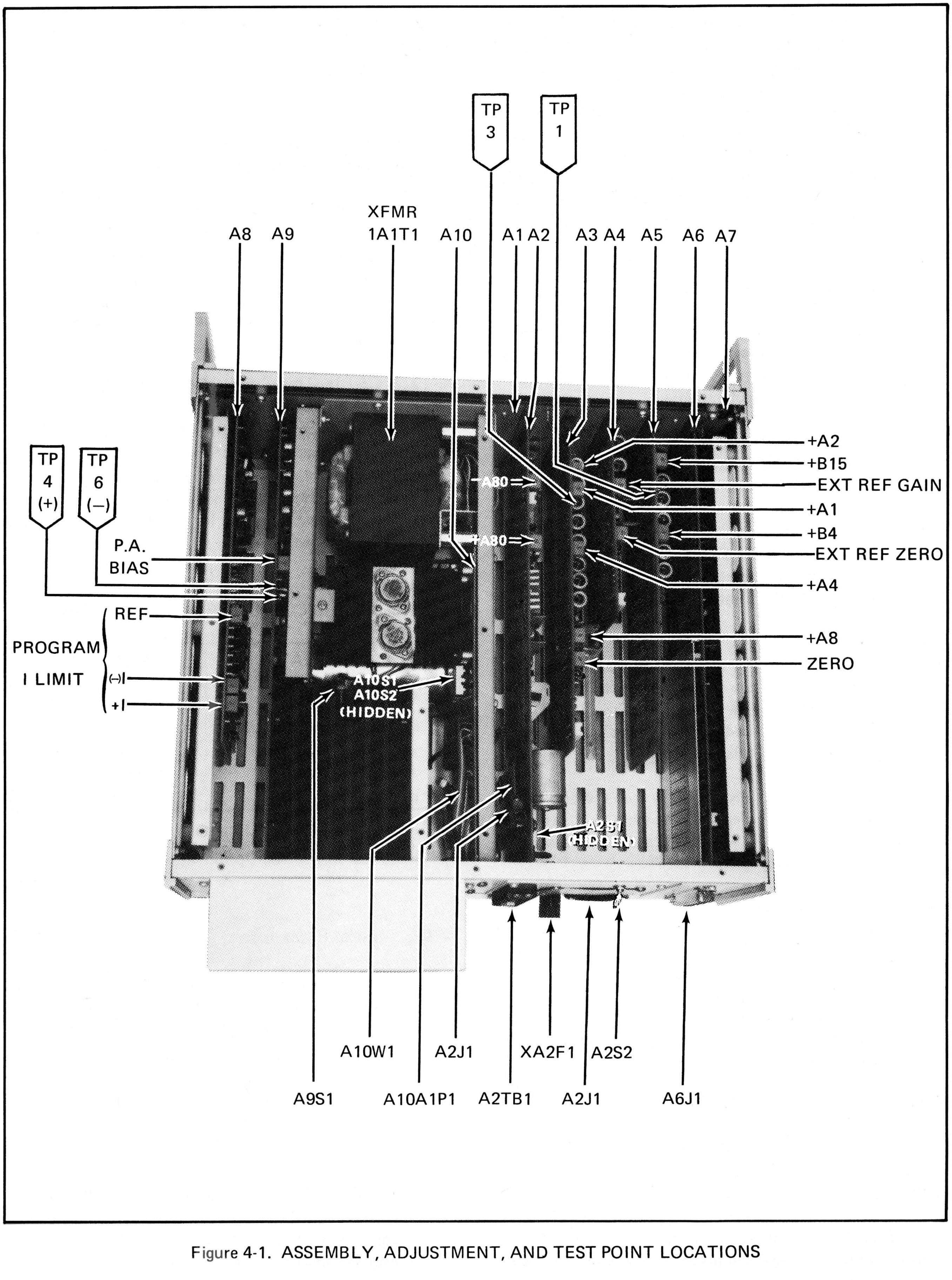


Figure 4-1. ASSEMBLY, ADJUSTMENT, AND TEST POINT LOCATIONS

Table 4-2. BINARY BY DECADE CODING

DECADE CODING		OUTPUT VOLTAGE (VDC) 10V RANGE	x10V RANGE
D DECADE	1	.001	.01
	2	.002	.02
	4	.004	.04
	8	.008	.08
C DECADE	1	.01	.1
	2	.02	.2
	4	.04	.4
	8	.08	.8
B DECADE	1	.1	1
	2	.2	2
	4	.4	4
	8	.8	8
A DECADE	1	1	10
	2	2	20
	4	4	40
	8	8	80

CAUTION!

On the rear panel barrier strip the following terminals must be jumpered: OUTPUT HI to SENSE HI and SENSE LO to OUTPUT LO to GUARD.

c. Turn on the instrument in accordance with Operating Instructions, paragraphs 2-6 and 2-7. Depress the MANUAL button on the MCU and release all other buttons that may be depressed.

NOTE!

In an instrument containing an A6 Inverted Isolated Control Logic PCB (−08 Option) all instructions reading depress shall mean release and all instructions reading release shall mean depress. This note, however, is not applicable to EXT REF, STANDBY, STROBE, MANUAL AUTO or EXT functions.

d. Depress the STROBE button on the MCU (0 volt, positive, low range) and allow the instrument to warm up for one-half hour.

4-20. Power Amplifier Bias Adjustment

a. Remove the top dust cover. Depress RANGE and STROBE buttons to call a 0V output, high range. Check that the 110 VOLT RANGE indicator illuminates.

NOTE!

If the A8 Current Limiter PCB is installed (−06 Option), depress the following buttons for a current limit condition of 0.55 amperes: X10, 80, 20, 10, and STROBE. Check that these indicators illuminate: CURRENT LIMIT MA X10, 40, and 5.

b. Remove the guard cover and connect a dc voltmeter to A9TP4 (+) and A9TP6 (−). See Figure 4-1 for location of test points.

c. Adjust P.A. BIAS, as necessary, to obtain a meter reading in the range of 70mV to 278mVdc.

d. Disconnect the voltmeter from A9TP4 and A9TP6.

4-21. Bit Adjustment (0.4)

a. Connect a dc voltmeter to the OUTPUT HI (+) and LO (−) terminals on the rear panel barrier strip.

b. Connect an insulated shorting jumper between A3TP3 and A5TP1.

c. Release the RANGE button and depress the STROBE button to select 0V output on the 10 volt range. Check that the 110 VOLT RANGE indicator goes out.

d. Adjust A3, ZERO for a 0Vdc $\pm 10\mu$V output.

e. Depress the B decade 8 and STROBE buttons. Check that the output voltage is about +8Vdc and that the B decade 8 indicator is on.

f. Record the exact dc voltage read in step e. and then divide the recorded value by 2 for a final value; e.g. 8.00383Vdc ÷ 2 = 4.00192Vdc.

Recorded value ____________________

÷ 2 = ____________________ Final Value

g. Release the B8 button and depress the B4 and STROBE buttons. Check that the output voltage is about 4Vdc and that only the B decade 4 indicator is on.

h. Adjust A5, +B4 for an output that is within $\pm 100\mu$V of the final value computed in step f.; e.g., 4.00192Vdc $\pm 100\mu$V.

i. Release the B4 button, depress STROBE, and remove the jumper between A3TP1 and A5TP1. Install the guard cover and insert all guard cover screws. Check that the B decade 4 indicator is out.

4-22. Zero, Reference, and Bit Adjustments

a. Release all MCU buttons except MANUAL, and depress RANGE and STROBE to obtain 0V output in the high range. Check that the 110 VOLT RANGE indicator is on and that the dc voltmeter is connected as defined in step 4-19. a.

b. Adjust A3, ZERO for 0Vdc $\pm 70\mu V$ output, using an insulated screwdriver or tuning tool.

c. Release RANGE and depress STROBE. Check that 110 VOLT RANGE is out and that the output is 0Vdc $\pm 10\mu V$. Repeat steps a., b., and c. to achieve this tolerance, if necessary.

d. Depress RANGE, POL, A decade 8 and STROBE for a –80V, high range output. Check that 110 VOLT RANGE and SIGN indicators are on.

e. Adjust A2, –A80 for an output of –80Vdc $\pm$1mV.

f. Release POL and depress STROBE for a +80V high range output. Check that SIGN goes out and the A decade 8 stays on.

g. Adjust A2, +A80 for an output of +80Vdc $\pm$1mV.

h. Release RANGE, depress STROBE, and check that 110 VOLT RANGE goes out and the A decade 8 stays on.

i. Adjust A3, +A8 for an output of +8Vdc $\pm 100\mu V$.

j. Release A decade 8, depress A decade 4 and STROBE. Check that only A decade 4 indicator light is on.

k. Adjust A3, +A4 for an output of +4Vdc $\pm 100\mu V$.

l. Release 4, depress 2 and STROBE. Check that only A decade 2 indicator light is on.

m. Adjust A3, +A2 for an output of +2Vdc $\pm 100\mu V$.

n. Release 2, depress 1 and STROBE. Check that only A decade 1 indicator light is on.

o. Adjust A3 +A1 for output of +1Vdc $\pm 10\mu V$.

p. Release 1, depress B decade 8, 2, and 1, and STROBE. Check that B decade indicators 8, 2, and 1 come on.

q. Adjust A3, +B15 for an output of +1.1Vdc $\pm 10\mu V$.

r. Release all MCU buttons except MANUAL and depress STROBE. Check that output reads zero volts and that only the POWER indicator is on.

4-23. External Reference Adjustments (–03 Option)

4-24. If the A4 External Reference PCB Assembly is installed, perform the following adjustments:

a. Connect a shorting jumper between the EXT REF HI and EXT REF LO input terminals on the rear panel barrier strip.

b. Depress EXT REF, A decade 8, 4, 2, 1 and STROBE buttons. Check that EXT REF and A decade 8, 4, 2 and 1 indicators are on.

c. Adjust A4, EXT REF ZERO for an output of 0V $\pm 10\mu$Vdc.

d. Remove the shorting jumper from the rear panel barrier strip.

e. Apply a 10Vac $\pm$0.02%, 400 Hz signal to the EXT REF HI and LO terminals. Measure and record the actual ac voltage applied to these terminals with an ac voltmeter.

Recorded value

f. Disconnect the ac voltmeter and connect it to the OUTPUT HI and LO terminals on the same barrier strip.

g. Release A decade 4 and 1 buttons and check that the A decade 8 and 2 indicators are on.

h. Adjust A4, EXT REF GAIN for an ac output that is within $\pm 500\mu V$ of the value recorded in step e.

i. Release A decade 8 and 2 buttons and depress STROBE. Check that the output is 0V and that all decade indicators are out.

j. Disconnect the ac signal source and set the ac voltmeter to measure dc volts.

4-25. Current Limiter Adjustment (–06 Option)

4-26. Adjustment of the A8 current limiter, when installed, is performed as follows:

a. Turn off the instrument and install a $10\Omega \pm 1\%$, 20W resistor between the OUTPUT HI and LO terminals. Leave the dc voltmeter connected.

b. Set the top dust cover in place, turn on the instrument, and release all MCU buttons that were depressed, except MANUAL.

c. Allow the instrument to operate for about one-half hour and then remove the top dust cover.

d. Depress POL, A decade 8, 2, 1, CURRENT LIMIT MA or % X10, 80, 20, and then STROBE. An −11Vdc output with a 100% current limit is called. Check that the following indicators are on: A decade 8, 2, 1, CURRENT LIMIT MA X10, 40, 10, and I LIMIT.

e. Adjust A8, REF for an output of −5Vdc ±15mV. Check that the I LIMIT indicator is on.

f. Release CURRENT LIMIT MA or % buttons X10, 80, and 20; depress 10 and STROBE. Check that CURRENT LIMIT MA or %5 indicator and I LIMIT indicator are on. This action calls the 5mA current limit (10 percent current limit).

g. Adjust A8, −I for output of −50mVdc ±0.5mV.

h. Release POL button, depress STROBE, and check that SIGN indicator goes out. This action calls a +11Vdc output.

i. Adjust A8, +I for an output of 50mVdc ±0.5mV.

j. Release CURRENT LIMIT MA or % 10 button and depress X10, 80, 20, and STROBE buttons. This action calls the 0.5A current limit (100 percent current limit). Check that the output is +5Vdc ±100mV, and that the following indicators are on: X10, 40, 10 and I LIMIT. Repeat the procedure starting at step d. if output is not within tolerance.

k. Release all MCU buttons and depress STROBE to call a 0V output. Also remove the 10 ohm resistor.

4-27. Final Zero Adjustment

4-28. The following adjustments must be performed only after the instrument has been operating for a minimum period of one-half hour with all covers in place.

a. Connect a dc voltmeter to OUTPUT HI and LO terminals on the rear panel barrier strip. Release all MCU buttons, except MANUAL, and depress STROBE. This action calls for a 0V output, positive in the low range. Check that only the POWER indicator is on.

b. Adjust AMPLIFIER ZERO (A3, ZERO) for an output of 0Vdc ±10μV.

c. Depress the RANGE and STROBE buttons. Check that the 100 VOLT RANGE indicator is on. This action calls the high or X10 range and 0V ±70μVdc output. If the output reading is not within tolerance, repeat steps a. through c.

d. If the A4 External Reference is installed (−03 Option), depress EXT REF, A decade 8, 4, 2, and 1 buttons and release RANGE. Depress STROBE and check that A decade indicators 8, 4, 2, 1 and EXT REF indicator illuminate.

e. Connect a shorting jumper between EXT REF HI and EXT REF LO terminals on the rear panel barrier strip.

f. Adjust EXT REF ZERO (A4, EXT REF ZERO) for an output of 0V ±10μV.

g. Remove the shorting jumper, release all MCU buttons, except MANUAL, depress STROBE, and check that the only indicator remaining on is POWER.

4-29. Output Checks

a. Perform the linearity checks given in Table 4-3, and check that the specified outputs are obtained. Connect an ac/dc voltmeter as described in step 4-26. a.

Table 4-3. LINEARITY CHECKS

CALLED OUTPUT					POWER SOURCE OUTPUT VOLTAGE (VDC)
SIGN (POLARITY)	DECADE A	B	C	D	
+	0	0	0	0	0V ±100 uv
+	0	1	1	1	+111mV ±120μV
+	0	2	2	2	+222mV ±120μV
+	0	3	3	3	+333mV ±130μV
+	0	4	4	4	+444mV ±140μV
+	0	5	5	5	+555mV ±150μV
+	0	6	6	6	+666mV ±160μV
+	0	7	7	7	+777mV ±180μV
+	0	8	8	8	+888mV ±190μV
+	0	9	9	9	+999mV ±200μV
+	0	10	10	10	+1.111V ±200μV
+	1	0	0	0	+1V ±0.2mV
+	2	0	0	0	+2V ±0.3mV
+	3	0	0	0	+3V ±0.4mV
+	4	0	0	0	+4V ±0.5mV
+	5	0	0	0	+5V ±0.6mV
+	6	0	0	0	+6V ±0.7mV
+	7	0	0	0	+7V ±0.7mV
+	8	0	0	0	+8V ±0.8mV
+	9	0	0	0	+9V ±0.9mV
+	10	0	0	0	+10 ±1mV
+	15	15	15	15	+16.665V ±1mV
−	15	15	15	15	−16.665V ±1mV

b. If the A4 External Reference PCB Assembly (−03 Option) is installed disconnect the ac/dc voltmeter, release all MCU buttons except MANUAL, and depress EXT REF and STROBE. Check that the EXT REF indicator comes on.

c. Apply a 10Vac, ±0.02%, 400 Hz signal and connect an ac/dc voltmeter to the EXT REF HI and LO input terminals on the rear panel barrier strip. Record the ac voltage indicated on the ac voltmeter.

Recorded value________________________

d. Remove the ac voltmeter from the EXT REF HI and LO input terminals and connect it to the OUTPUT HI and LO terminals.

e. Depress A decade 1 button and STROBE; check that the A decade 1 indicator comes on and that the ac voltmeter reads within ±500μV of the level recorded in step c.

f. Depress RANGE, A decade 4, 2, 1; B decade 4, 2, 1; and STROBE buttons. The output should be 77Vac ±0.1V. Check that the 110 VOLT RANGE indicator is on, and that the 4, 2, and 1 indicators in both A and B decades are on.

g. Turn off the instrument and disconnect all test equipment.

h. Install the top dust cover. Calibration is complete and the instrument is ready for use.

Section 5

Lists of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphnumerically by assembly. Electrical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number

b. Description of each part

c. Fluke Stock Number

d. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

e. Manufacturer's Part Number or Type.

f. Total Quantity per assembly of component.

g. Recommended Quantity: This entry indicates the recommending number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, of from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information:

a. Quantity

b. FLUKE Stock Number

c. Description

d. Reference Designation or Item Number

e. Printed Circuit Board Part Number

f. Instrument Model and Serial Number

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	BCD PROGRAMMABLE POWER SOURCE	4270A	89536	4270A			
	Figure 5-1						
A1	Mother PCB Assembly (Figure 5-2)	332908	89536	332908	1		
A2	Power Supply PCB Assembly (Figure 5-3)	332940	89536	332940	1		
A3	Pre-Amplifier PCB Assembly (Figure 5-4)	332924	89536	332924	1		
A4	External Reference PCB Assembly (–03 Option) (Figure 5-5)	292581	89536	292581	1		
A5	BCD Ladder Assembly (Figure 5-6)	292565	89536	292565	1		
A6	Isolated Control Logic (Figure 5-7)	365692	89536	365692			
A7	BCD Display PCB Assembly (Figure 5-8)	302257	89536	302257	1		
A8	Current Limit PCB Assembly (–06 Option) (Figure 5-9)	332965	89536	332965	1		
A9	Power Amp PCB Assembly (Figure 5-10)	332957	89536	332957	1		
A10	High Voltage Power Supply Assembly Figure 5-11)	333005	89536	333005	1		
	Card Guide	229047	89536	229047	6		
	Card Guide	256461	89536	256461	1		
	Chassis, Side	296962	89536	296962	2		
	Connector, programming, male, 50 contact	307017	89536	307017	1		
	Cover, bottom	308122	89536	308122			
	Cover, guard	331884	89536	331884	1		
	Decal, corner	296269	89536	296269	1		
	Decal, Handle trim	295493	89536	295493	1		
	Decal, front panel	302034	89536	302034	1		
	Decal, rear panel	334516	89536	334516	1		
	Decal, side trim	295386	89536	295386	1		
	Fan, muffin, venturi	103374	89536	103374	1		
	Filter	313056	89536	313056	1		
	Handle, corner front	295667	89536	295667	2		
	Housing, filter	314047	89536	314047	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Panel, front	302034	89536	302034	1		
	Panel, rear	302042	89536	302042	1		
	Tray, guard	337493	89536	337493	1		

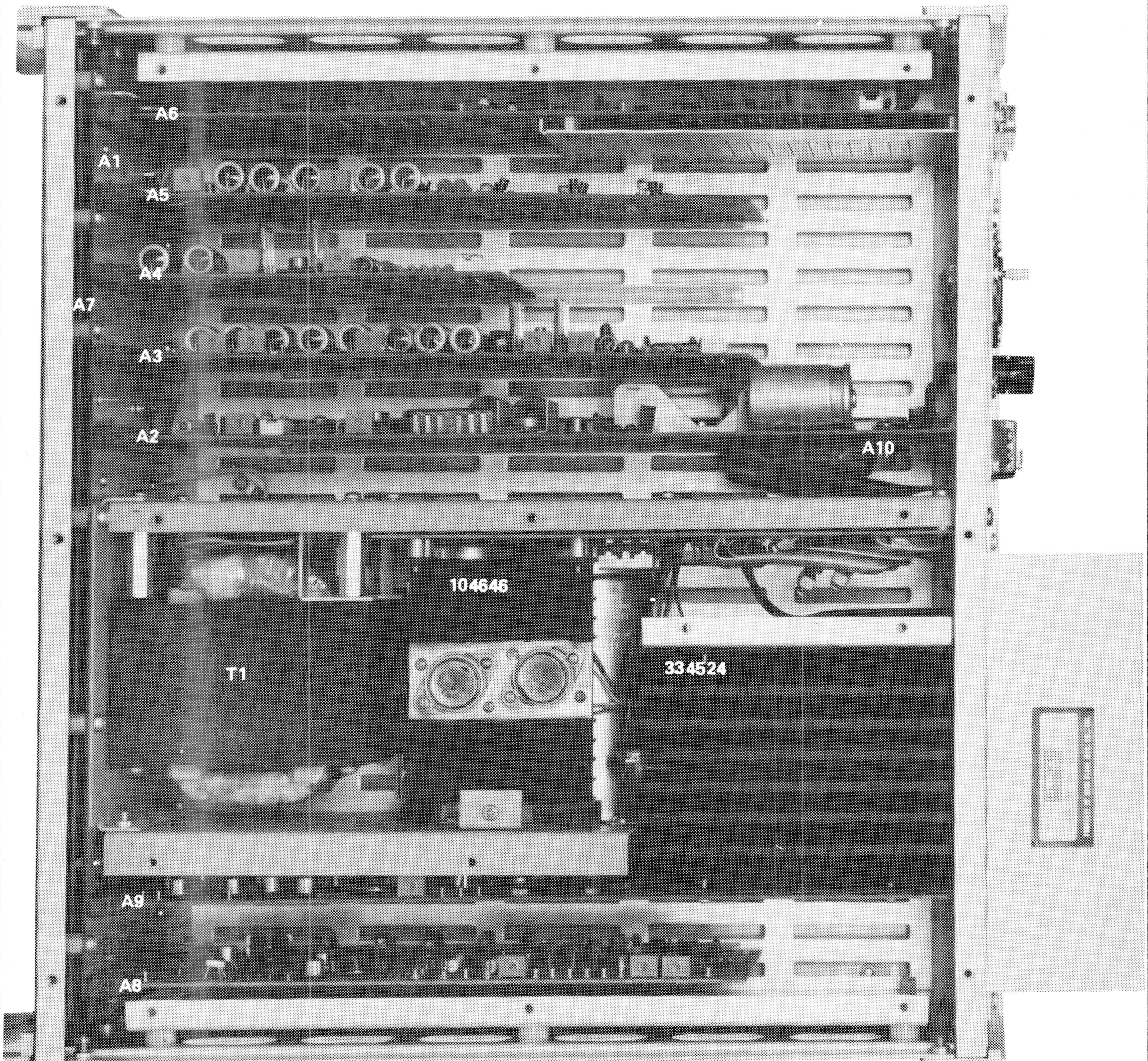


Figure 5-1. BINARY PROGRAMMABLE POWER SOURCE

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	**MOTHER PCB ASSEMBLY** **Figure 5-2**	332908	89536	332908	REF		
J1 thru J7	Connector, femal, 50 contact	284604	02660	222-22501-110	7		

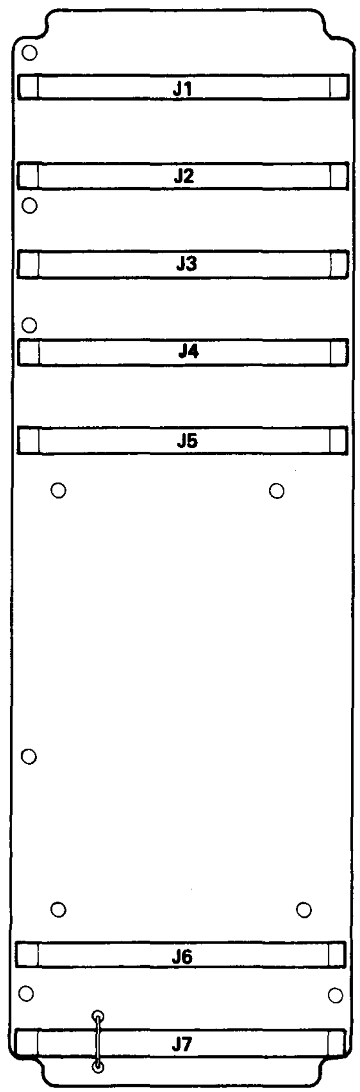


Figure 5-2. MOTHER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	**POWER SUPPLY PCB ASSEMBLY Figure 5-3**	332940	89536	332940	REF		
C1,C14, C17	Cap, cer, 0.05 uf +8-/–20%, 25V	148924	72982	5855-Y50-503Z	3		
C2,C5, C10,C19	Cap, mica, 33 pf± 5%, 500V	160317	71236	DM15E330J	5		
C3	Cap, mica, 100 pf± 5%, 500V	148494	71236	DM15F101J	1		
C4	Not used						
C6	Cap, cer, 500 pf ±10%, 1 kV	105692	71580	2DDH60N501K	1		
C7, C8	Cap, elect, 250 uf +50/–10%, 64V	185850	73445	C437ARH250	2		
C11,C12	Not Used						
C13,C16	Cap, elect, 8000 uf +100/–10%, 15V	309245	99392	61C15AS83	2		
C15	Not Used						
C18	Cap, Ta, 1.0 uf ±20%, 35V	161919	56289	196D105X0035	1		
C20	Cap, cer, 2000 pf, gmv, 1 kV	105569	71590	DA140-139CB	1		
C21	Cap, cer, 0.1 uf +80/–20%, 500V	105684	56289	41C92	1		
C22	Cap, plstc, 0.1 uf ±10%, 400V	289744	73445	C280CF/A100K	1		
C23,C24	Cap, cer, 1 uf ±gmv, 3V	106567	71590	UK105	2		
CR1, CR25, CR26	Diode, silicon, 1 amp, 600 piv	112383	05277	1N4822	3		
CR2, CR3, CR27, CR28, CR33, CR34, CR35	Diode, silicon, 150 ma	203323	03508	DHD1105	7	2	
CR4, CR14, CR19	Diode bridge, 2 amp	296509	09423	FB100	3	1	
CR5 thru CR8, CR10, thru CR13 CR15	Not Used						

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR16 thru CR18 CR20 thru CR22, CR24	Not used						
CR9, CR23	Diode, zener, 4.3V	180455	07910	1N749A	2		
CR29 thru CR32	Diode, Rectifier	329672	03508	1N5059	4		
F1	Fuse, slow blow, 2 amp, 250V (For 115V operation)	109181	71400	MDX	1		
J1	Connector, male, 3 contact, power	284166	82839	EAC301	1		
J2	Connector, female, 36 contact	236885	13511	225-21821-105	1		
K1	Relay, 4PDT, 5V Coil	272716	24796	R40-E030-1	1	1	
Q1,Q10, Q11,Q13, Q18,Q19, Q24	Xstr, silicon, NPN	218396	04713	2N3904	7		
Q2,Q3, Q5,Q6	Xstr, J-FET, N-channel	261578	15818	U2366E	4	2	
Q4,Q7, Q8,Q9, Q14	Xstr, silicon, PNP	195974	04713	2N3906	5		
Q12,Q17, Q23	Xstr, silicon, NPN	150359	95303	2N3053	3		
Q15,Q20	Xstr, silicon, PNP	269076	95303	2N4037	2		
Q16,Q21	Xstr, silicon, NPN	288381	95303	40372	2	1	
Q22	Xstr, J-FET, N-channel	271924	07910	CFE13041	1		
Q25	Xstr, J-FET, N-channel	288324	12040	SF50070	1	1	
R1,R55	Res, comp, 1 k ±5%, ¼W	148023	01121	CB1025	2		
R2	Res, met flm, 2.87k ±1%, 1/8W	185629	91637	MFF1-82R87F	1		
R3,R46	Res, met flm, 17.4k ±1%, 1/8W	236802	91637	MFF1-817R4F	2		
R4	Res, met flm, 5.76k ±1%, 1/8W	260349	91637	MFF1-85R76F	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R6	Res, met flm, 13.7k ±1%, 1/8W	236752	91637	MFF1-813R7F	1		
R7,R8, R22, R24, R28, R30	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	6		
R9	Res, var, cermet, 20Ω ±20%, ½W	285114	71450	360S-200B	1		
R10 thru R13	Not used						
R14	Res, met flm, 40.2Ω ±1%, 1/8W	245373	91637	MFF1-840-250	1		
R15	Not used						
R17	Res, ww, 20.02k ±0.1% Matched Set	291674	89536	291674	1	1	
R18	Res, ww, 20k ±0.1%						
R19	Res, var, cermet, 50Ω ±10%, ½W	285122	71450	360S-500A	1		
R20	Res, met flm, 10k ±1%, 1/8W	168260	91637	MFF1-8102F	1		
R21	Res, met flm, 30.1k ±1%, 1/8W	168286	91637	MFF1-830R1F	1		
R23,R44	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	2		
R25,R26, R48	Res, comp, 3.9k ±5%, ¼W	148064	01121	CB3925	3		
R27,R29	Res, comp, 2k ±5%, ¼W	202879	01121	CB2025	2		
R31,R32, R38	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	3		
R33,R39	Res, comp, 4.7 5%, ¼W	193359	01121	CB47G5	2		
R34,R35	Not Used						
R36	Res, ww, 10k ±0.1%, ¼W	240945	89536	240945	1		
R37,R41	Res, ww, 4.02k ±0.1%, ¼W	240937	89536	240937	2		
R40	Res, ww, 3.74k ±0.1%, ¼W	246173	89536	246173	1		
R45,R49, R50,R53, R58,R60	Res, comp, 470 ±5%, ¼W	147983	01121	CB4715	6		
R47	Res, met flm, 3.74k ±1%, 1/8W	272096	91637	MFF1-83R74F	1		
R51,R52	Not Used						
R54	Res, comp, 22 ±5%, ½W	169847	01121	EB2205	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R57,R61	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	2		
R59	Res, factory selected value, may not be installed						
R62	Res, met flm, 7.15k ±1%, 1/8W	260356	91637	MFF1-87R15	1		
S1	Switch, slide, dpdt, line voltage	234278	82389	XW1649	1		
S2	Switch, toggle, dpdt, power	115113	95146	MST215N	1		
T1	Transformer, power (See Figure 5-1)	308239	89536	308239	1		
U1	IC, operational amplifier	271502	12040	LM301A	1		
U2	IC, reference amplifier						
R5	Res, met flm, selected value						
	Matched Set	301846	89536	301846	1		
R16	Res, ww, 12k ±0.05%, ¼W						
R56	Res, ww, ¼W, selected value						
U3	IC, operational amplifier, selected	225961	89536	225961	1		
U4, U5	IC, operational amplifier	321224	34333	SG8178T	2		
TB1	Terminal barrier strip	295212	71785	TYPE 140Y	1		
XF1	Fuse holder	160846	75915	342004	1		
	Guard	297044	89536	297044	1		
	Socket, IC, 14 contact	276527	23880	TSA-2900-14W	1		
	Heat sink, Q12 & Q15	104646	05820	NF207	2		
	Jumper, terminal barrier strip	283713	71785	422-13-11-013	3		
U2,R5, R16,R56	Ref Amp Set	301846	89536	301846	1		

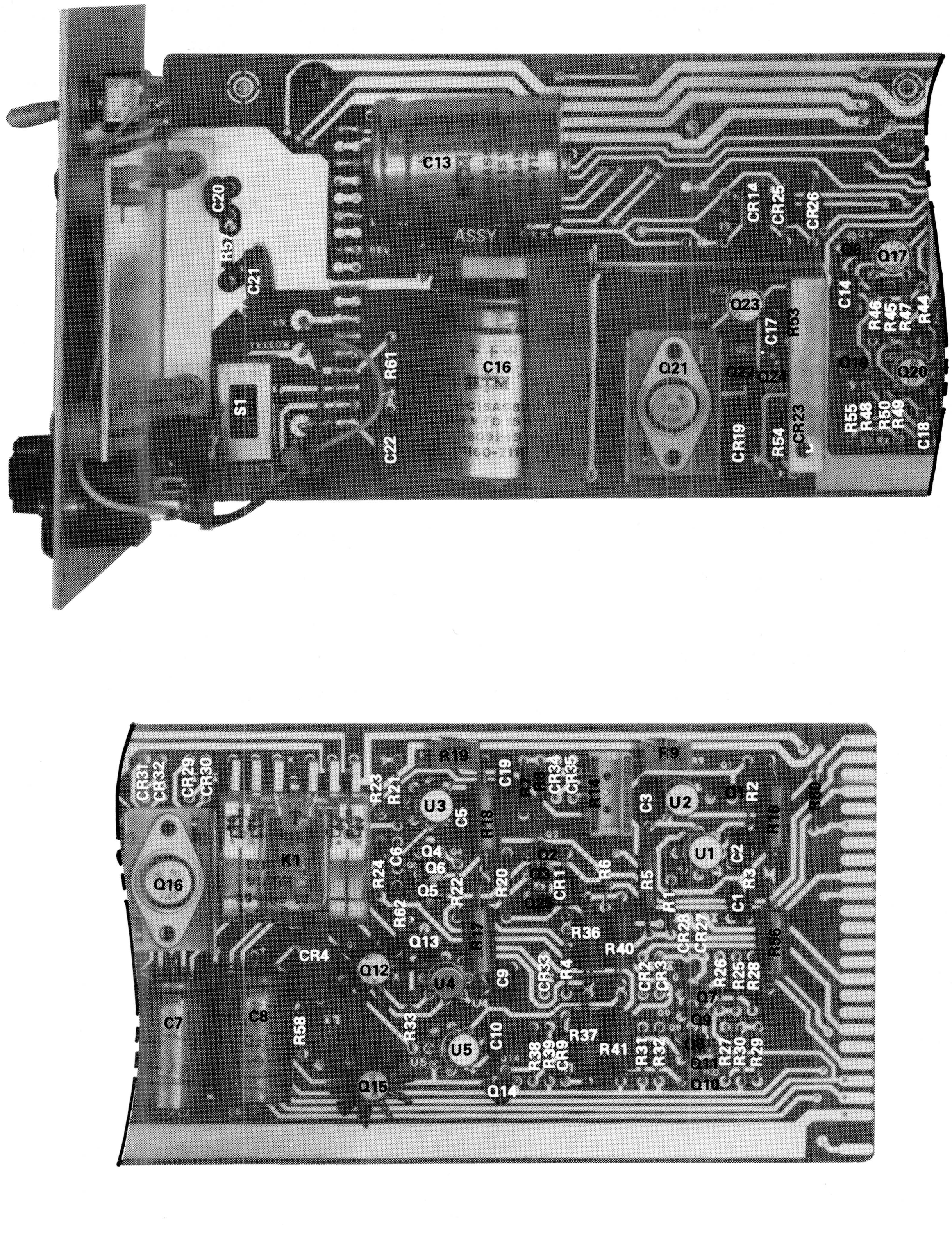


Figure 5-3. POWER SUPPLY PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	**PRE-AMPLIFIER PCB ASSEMBLY** **Figure 5-4**	332924	89536	332924	REF		
C1	Cap, mica 1300 pF ±5%, 500	182881		DM195132J	1		
C2	Cap, mica 130 pF ±5%, 500V	266205	71236	DM15F131J	1		
C3	Cap, mica, 43 pF ±1%, 500V	277202	71236	DM15E430F	1		
C4	Not used						
C5	Cap, mica, 1000 pF ±5%, 500V	148387	71236	DM19F101J	1		
C6, C12	Cap, mica, 330 pF ±5%, 500V	148445	71236	DM15F331F	2		
C7, C8	Cap, elect, 20 uF +25/−10%, 50V	106229	56289	30D206G05CC4	2		
C9	Cap, elect, 50 uF +50/−10%, 25V	168823	56289	ET470X25A7	1		
C10	Cap, mica, 3600 pF ±2%, 500V	176644	71236	DM19F360G	1		
C11	Cap, mica, 3300 pF ±2%, 500V	192518	71236	DM19F330G	1		
C13	Cap, mica, 150 pF ±5%, 500V	148478	71236	DM15F151J	1		
C14,C16	Cap, cer, 0.05 ±20%, 100V	149161	56289	55C23A1	2		
C15	Cap, mica, 22 pF ±5%, 500V	148551	71236	DM15E220J	1		
CR1, CR2, CR5, CR6	Diode, silicon, 75 ma, 90 piv	260554	07910	CD55105	4		
CR3, CR4, CR7 thru CR12	Diode, silicon, 150 ma	203323	03508	DHD1105	8		
CR13, CR14	Diode, zener	342527	07910	TD333719	2		
Q1, Q2, Q3, Q6, Q7,Q10, Q11,Q14, Q15,Q31, Q32	Xstr, FET-SET, N-channel	256487	89536	256487	11		
Q4, Q8, Q12,Q16, Q34,Q37	Xstr, silicon, PNP	195974	04713	2N3906	6		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q5, Q9, Q13,Q17, Q19,Q20, Q26,Q33, Q36	Xstr, silicon, NPN	218396	04713	2N3904	9		
Q18	Xstr, FET, dual, N-channel, selected	225987	89536	225987	1		
Q21, Q22, Q35	Xstr, FET, P-channel	306142	05397	3N173	3		
Q23	Xstr, silicon, NPN	159855	07910	CS23030	1		
Q24,Q25	Xstr, silicon, PNP, dual	242016	07263	SE4901	2		
Q27,Q28	Xstr, silicon, NPN	269084	07910	CS2484	2		
Q29	Xstr, silicon, NPN	150359	95303	2N3053	1		
Q30	Xstr, J-FET, N-channel	288324	12040	SF50070	1		
R1, R3, R7, R9, R13,R15, R19,R21, R38,R41	Res, comp, 51k ±5%, ¼W	193334	01121	CB5135	10		
R2, R8, R14,R20, R47 thru R50,R70, R91	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	10		
R4, R6, R10,R12, R16,R18, R22,R24, R44,R46	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	10		
R5, R11 R17,R23	Res, comp, 560 ±5%, ¼W	147991	01121	VN5615	4		
R25	Res, ww, 108k ±0.1%, ½W						
R26	Res, ww, 25.013k ±0.1%, ½W						
R27	Res, ww, 50k ±0.1%, ½W						
R29	Res, ww, 100.025k ±0.1%, ½W — Matched Set	333575	89536	333575	1		
R31	Res, ww, 200.075k ±0.1%, ½W						
R35	Res, ww, 200.20k ±0.1%, ½W						
R42,R43	Res, ww, 11.104k ±0.1%, ½W						

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R28,R40	Res, var, cermet, 50 ±5%, 1W	285122	71450	360S-500A	2		
R30	Res, var, cermet, 100 ±10%, 1W	285130	71450	360S-101A	1		
R31	Not used						
R32	Res, var, cermet, 200 ±10%, 1W	285148	71450	360S-201A	1		
R33	Res, met flm, 3.32k ±1%, 1/8W	312652	91637	MFF1-83R32F	1		
R34	Res, met flm, 30.9k ±1%, 1/8W	235275	91637	MFF1-830R9F	1		
R36	Not used						
R37	Res, comp, 100m ±10%, ½W	190520	01121	EB1071	1		
R39	Not used						
R45	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	1		
R51	Res, comp, 1.5k ±5%, ¼W	148031	01121	CB1525	1		
R52,R53, R83,R86, R88	Res, comp, 5.1k ±5%, ¼W	193342	01121	CB5125	5		
R54	Res, met flm, 40.2k ±1%, 1/8W	235333	91637	MFF1-840R2F	1		
R55, R56, R63, R87	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	4		
R57	Res, met flm, 187k ±1%, 1/8W	296376	91637	MFF1-81873F	1		
R58	Res, met flm, 374k ± 1%, ½W	262105	91637	MFF1-23743F	1		
R59	Res, met flm, 750k ±1%, ½W	155192	91637	MFF1-2753F	1		
R60	Res, met flm, 1.27M ±1%, ½W	229252	91637	MFF1-21R27A1 F	1		
R61	Res, var, cermet, 100k ±10%, 1W	288308	71450	360S-104A	1		
R62	Res, met flm, 107k 1%, ½W	296384	91637	MFF1-21073F	1		
R64,R65	Res, ww, 6.8k ±0.03%, ½W	254359	89536	244359	2		
R67,R69	Res, met flm, 2k ±1%, 1/8W	277137	91637	MFF1-8202F	2		
R68	Res, met flm, 10k ±1%, 1/8W	291633	91637	MFF1-8103F	1		
R71	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	1		
R72	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	1		
R73,R75	Res, met flm, 49.9k ±1%, ½W	182890	91637	MFF1-249R9F	2		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R74	Res, met flm, 2.1k ±1%, ½W	193276	91637	MFF1-22R1F	1		
R76,R80	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	2		
R77,R84	Res, met flm, 10k ±1%, ½W	151274	91637	MFF1-2103F	2		
R78,R85	Res, met flm, 4.87k ±1%, ½W	247775	91637	MFF1-24R87F	2		
R79	Res, met flm, 2.49k ±1%, ½W	193995	91637	MFF1-22R49F	1		
R81	Res, comp, 910 ±5%, ¼W	203851	01121	CB9115	1		
R82	Res, comp, 680 ±5%, ¼W	148007	01121	CB6815	1		
R89	Res, ww, 45 ±1%, 1/8W	111815	01686	TYPE R1250	1		
R90	Res, comp, 20k ±5%, ¼W	22164	01121	CB2035	1		
U1	IC, TTL, Monostable Multivibrator	293050	01295	SN74121N	1		
	Socket, IC, 14 contact	276527	23880	TSA-2900-14W	2		

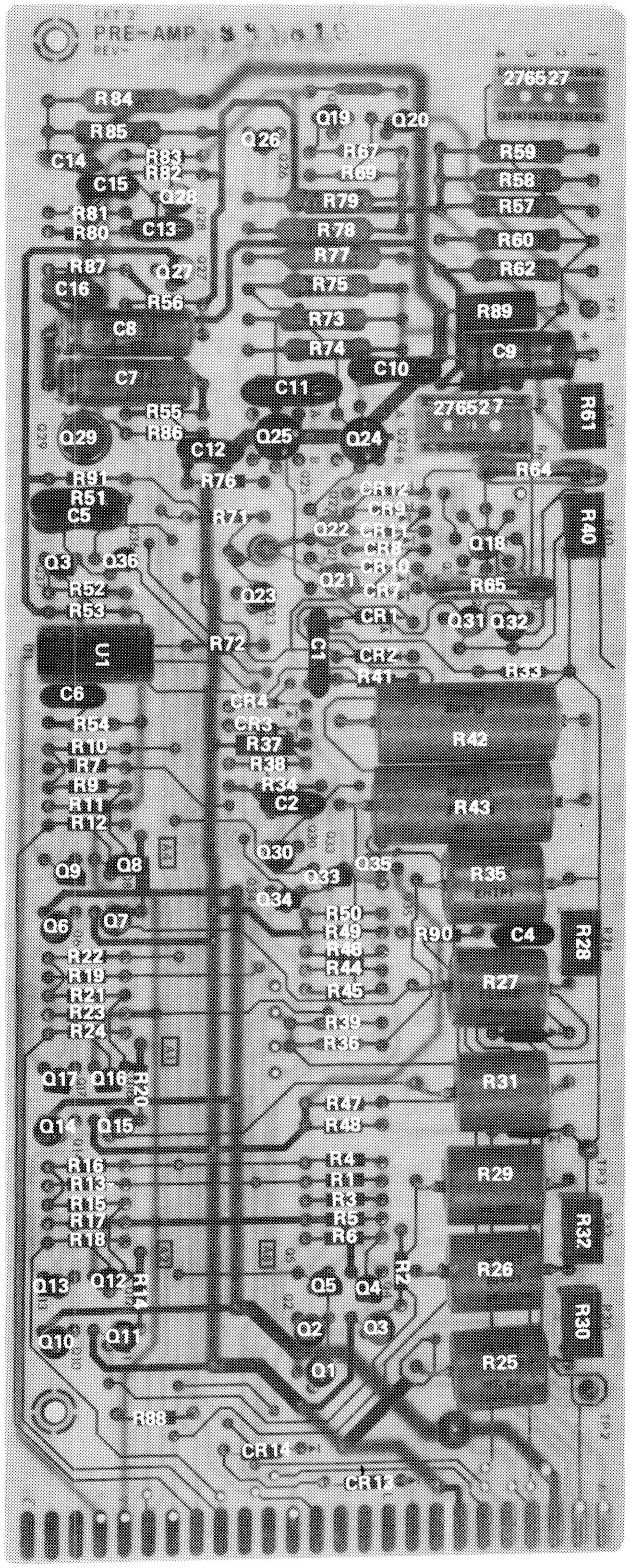


Figure 5-4. PRE–AMPLIFIER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	**EXTERNAL REFERENCE PCB ASSY. EXTERNAL REFERENCE**	292581	89536	292581	REF		
	Figure 5-5 (—03 Option)						
C1, C3	Cap, elect, 20 uf +75/–10%, 50V	106229	56289	30D206G05CC4	2		
C2	Cap, mica, 390 pf±5%, 500V	148437	71236	DM15F391J	1		
C4, C6	Cap, mica, 82 pf ±5%, 500V	148502	71236	DM15F820J	2		
C5	Cap, mica, 270 pf ±5%, 500V	148452	71236	DM15F271J	1		
C7, C11	Cap, cer, 0.05 uf ±20%, 100V	149161	56289	55C23A1	2		
C8, C9	Cap, mica, 5 pf ±10%, 500V	148577	71236	DM15C050K	2		
C10	Cap, mica, 22 pf ±5%, 500V	148551	71236	DM15E220J	1		
CR1 thru CR4	Diode, silicon, 150 ma	203323	03508	DHD1105	4		
Q1	Tstr, J-FET, dual, N-channel, selected	225987	89536	225987	1		
Q2, Q3, Q6,Q12	Tstr, silicon, NPN	218396	04713	2N3904	4		
Q4, Q5	Tstr, silicon, PNP, dual	242016	07263	SE4901	2		
Q7, Q8	Tstr, silicon, NPN	168716	07263	S19254	2		
Q9, Q10	Tstr, J-FET, N-channel	261578		U1897E	2		
Q11	Tstr, silicon, PNP	195974	04713	2N3906	1		
Q13,Q14	Tstr, silicon, NPN	150359	95303	2N3053	2		
R1	Res, ww, 100.025k						
R16	Res, ww, 99.955k Matched Set	291682	89536	291682	1		
R2,R11	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	2		
R3, R4	Res, ww, 6.8k ±0.03%, ½W	254359	89536	254359	2		
R5	Res, met flm, 107k ±1%, ½W	296384	91637	MFF1-21073F	1		
R6	Res, var, cermet, 100k ±10%, ½W	288308	71450	360S-104A	1		
R7	Res, met flm, 1.27M ±1%, ½W	229252	91637	MFF1-21275	1		
R8	Res, met flm, 750k ±1%, ½W	155192	91637	MFF1-2754F	1		
R9	Res, met flm, 374k ±1%, ½W	262105	91637	MFF1-23743F	1		
R10	Res, met flm, 187k ±1%, ½W	296376	91637	MFF1-21873F	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R12	Res ww, 45 ±0.1%, 1/8W	111815	01686	TYPE 1250	1		
R13,R15	Res, met flm, 2k ±1%,1/8W	277137	91637	MFF1-8202F	2		
R14	Res, met flm, 10k ±1%, 1/8W	291633	91637	MFF1-8103F	1		
R17	Res, var, cermet, 100 ±10%, ½W	285130	71450	360S-101A	1		
R18,R20	Res, met flm, 49.9k ±1%, ½W	182980	91637	MFF1-249R9F	2		
R19	Res, met flm, 2.1k ±1%, ½W	193276	91637	MFF1-2212F	1		
R21,R35, R39	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	3		
R22	Res, comp, 5.1k ±5%, ¼W	193342	01121	CB5125	1		
R23,R28	Res, met flm, 10k ±1%, ½W	151274	91637	MFF1-2103F	2		
R24,R29	Res, met flm, 4.87k ±1%, ½W	247775	91637	MFF1-24R87F	2		
R25	Res, met flm, 2.49k ±1%, ½W	193995	91637	MFF1-22R49F	1		
R26	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	1		
R27,R36	Res, comp, 820 ±5%, ¼W	148015	01121	CB8215	2		
R30	Res, comp, 18k ±5%, ¼W	148122	01121	CB1835	1		
R31	Res, comp, 47k ±5%, ¼W	148163	01121	CB4735	1		
R32,R33	Res, comp, 3.9k ±5%, ¼W	148064	01121	CB3925	2		
R34	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	1		
R37	Res, comp, 4.7k ±5%, ¼W	148072	01121	CB4725	1		
R38	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	1		
	Socket, IC, 14 contact	276527	23880	TSA-2900-14W	2		

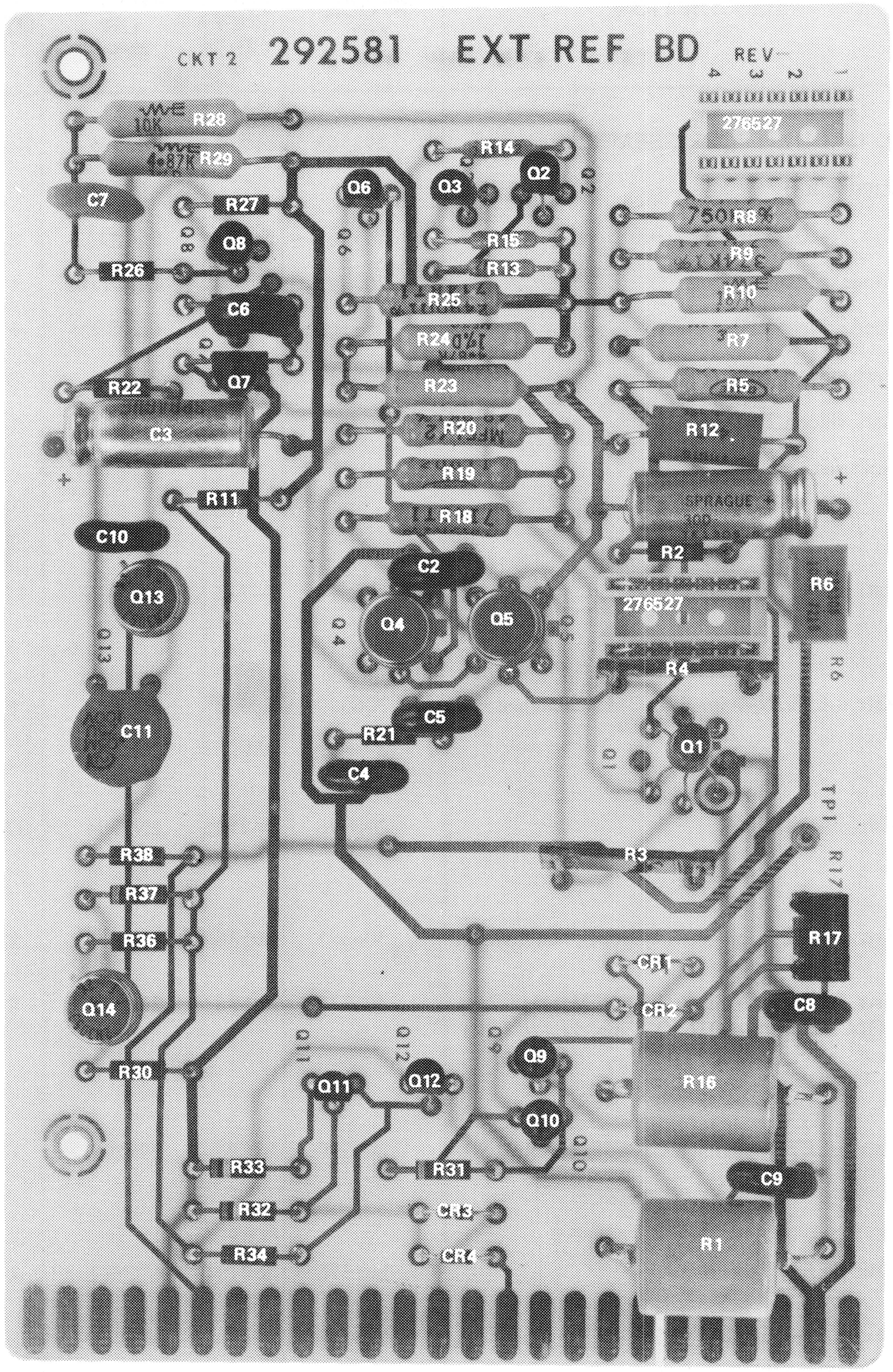


Figure 5-5. EXTERNAL REFERENCE PCB ASSEMBLY (–03 OPTION)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	**BCD LADDER PCB ASSEMBLY**	292565	89536	292565	REF		
	Figure 5-6						
C1, C2	Cap, cer, 0.05 uf ±20%, 100V	149161	56289	55C23A1	2		
CR1	Diode, silicon, 150 ma	203323	03508	DHD1105	1		
Q1	Diode, Field Effect, current regulator	285106	07910	CRE3021	1		
Q2	Xstr, silicon, NPN	168716	07263	S19254	1		
Q3	Xstr, silicon, PNP	269076	95303	2N4037	1		
Q4	Not used						
Q5, Q9, Q13, Q17, Q21, Q25, Q29, Q33, Q37, Q41, Q45, Q49	Xstr, silicon, PNP	195974	04713	2N3906	12		
Q6, Q8	Xstr, J-FET, N-channel, U2366E, Matched Pair	306399	89536	306399	1		
Q7, Q11, Q15, Q19, Q23, Q27, Q31, Q35, Q39, Q43, Q47, Q51	Xstr, silicon, NPN	218396	04713	2N3904	12		
Q10, Q12	Xstr, J-FET, N-channel, U2366E, Matched Pair	306381	89536	306381	2		
Q14, Q16 Q18, Q20	Xstr, J-FET N-channel, U2366E Matched Pairs (Q14 matched to Q16; Q18 matched to Q20)	306373	89536	306373	2		
Q22, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q46, Q48, Q50, Q52	Xstr, J-FET, N-channel, U2366E, Matched Set	298299	89536	298299	1		
Q38, Q40, Q42, Q44	Xstr, J-FET, N-channel	261578	15818	U2366E	4		
R1	Res, var, cermet, 200 ±10%, ½W	285148	71450	360S-201A	1		
R2 R3 R5 R6 R7	Res, ww, 24.987k Res, ww, 49.975k Res, ww, 100.025k Matched Resistor Set Res, ww, 200.075k Res, ww, 108k	289827	89536	289827	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R4	Res, var, cermet, 50 ±10%, ½W	285122	71450	360S-500A	1		
R8	Res, met flm, 60.4 ±1%, 1/8W	235366	91637	MFF1-860.4F	1		
R9	Res, ww, 24.987k ±0.03%, ¼W	289769	89536	289769	1		
R10	Res, ww, 50k ±0.03%, ¼W	289777	89536	289777	1		
R11	Res, met flm, 100.03k ±0.1%, 1/8W	291088	91637	MFF1-810032B	1		
R12	Res, met flm, 200.08k ±0.1%, 1/8W	290122	91637	MFF1-8200R08 B	1		
R13	Res, met flm, 108.06k ±0.1%, 1/8W	290114	91637	MFF1-8108R06 B	1		
R14	Res, met flm, 49.9k ±0.1%, 1/8W	291070	91637	MFF1-849R9B	1		
R15	Res, met flm, 24.9k ±0.1%, 1/8W	290106	91637	MFF1-824R9B	1		
R16	Res, met flm, 100k ±0.5%, 1/8W	291054	91637	MFF1-8104	1		
R17	Res, met flm, 200k ±1%, 1/8W	261701	91637	MFF1-8204F	1		
R18	Res, met flm, 120k ±1%, 1/8W	291062	91637	MFF1-8124F	1		
R19	Res, comp, 1.8k ±5%, ¼W	175042	01121	CB1825	1		B
R20	Res, comp, 20k ±5%, ¼W	221614	01121	CB2035	1		B
R23,R26, R29,R32, R35,R38, R41,R44, R47,R50, R53,R56, R59,R62, R65,R68, R71,R74, R77,R80, R83,R86, R89,R92	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	24		
R24,R30, R36,R42, R48,R54, R60,R66, R72,R78, R84,R90	Res, comp, 560 ±5%, ¼W	147991	01121	CB5615	12		B

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R25,R27, R28,R31, R33,R34, R37,R39, R40,R43, R45,R46, R49,R51, R52,R55, R57,R58, R61,R63, R64,R67, R69,R70, R73,R75, R76,R79, R81,R82, R85,R87, R88,R91, R93,R94	Res, comp, 51k ±5%, ¼W	193334	01121	CB5135	36		B
R21,R22	Not used						

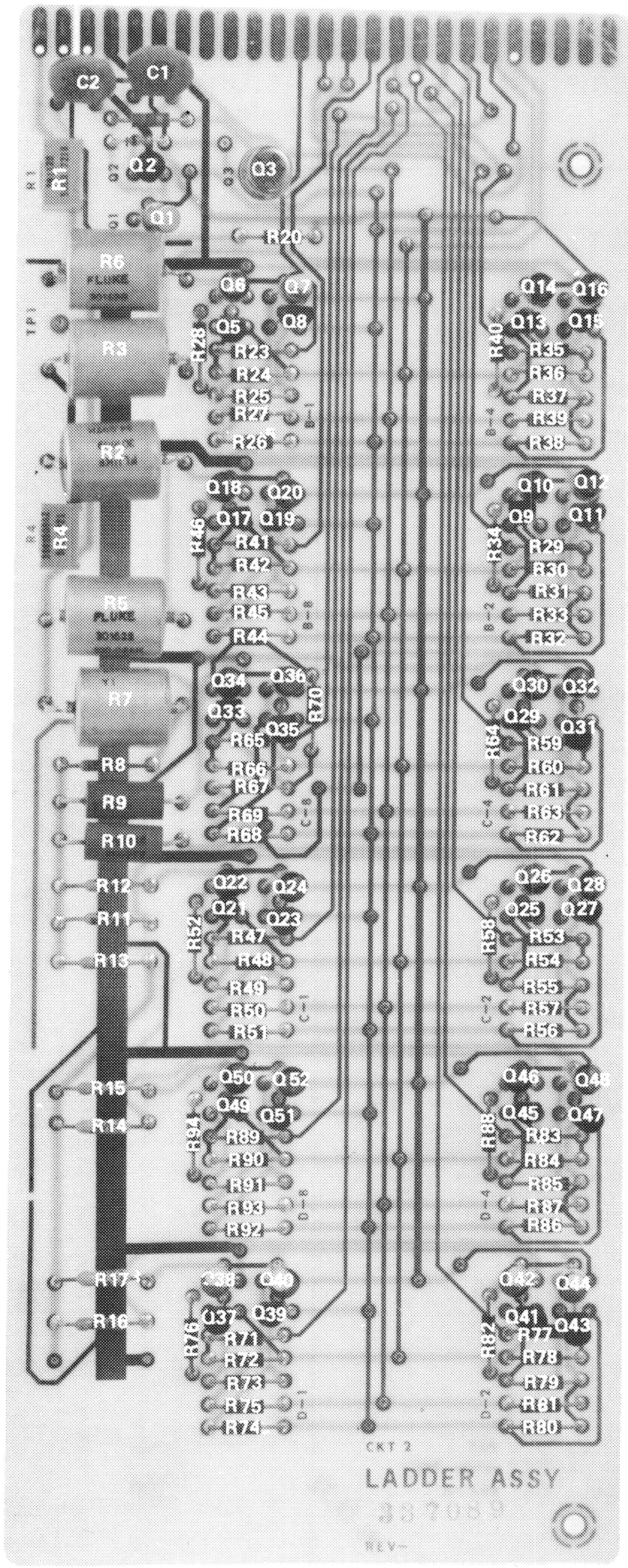


Figure 5-6. BINARY LADDER PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	**LOGIC ASSEMBLY**	365692	89536	365692	REF		
	Figure 5-7						
C1	Cap, mylar, 0.001 uF ±10%, 200V	159582	56289	10292	1		
C2, C3	Cap, mica, 12 pF ±5%, 500V	175224	71232	DM15C120J	2		
C4, C47	Cap, mica, 100 pF ±1%, 500V	226126	71236	DM15F101F	2		
C5	Cap, Ta, 0.68 uF ±10%, 35V	182790	56289	150D684X935A	1		
C6	Cap, polyst, .0033 uF ±2%, 100V	168344	02799	PE-332-G	1		
C7, C8, C9, C29, C50	Cap, mica, 56 pF ±5%, 500V	148528	71236	DM15F560J	5		
C10	Cap, mica, 270 pF ±5%, 500V	148452	71236	DM15F271J	1		
C11 thru C15, C16 thru C25, C28, C34 thru C40, C43 thru C46	Cap, cer, 0.025 uF ±20%, 50V	168435	56289	C023B101H253 M	27		
C26, C42	Cap, elect, 220 uF −10/+50%, 10V	236935	25403	ET221X010A5	2		
C27	Cap, cer, .0027 uF ±GMV, 600V	106211	56289	5GA-D33	1		
C30	Cap, mica, 620 pF ±5%, 500V	215244	71236	DM19F621J	1		
C31, C49	Cap, mica, 360 pF ±1%, 500V	170407	71236	DM15F361F	2		
C32	Cap, mica, 220 pF ±5%, 500V	170423	71236	DM15F221J	1		
C33	Cap, plstc, 0.10 uF ±10%, 500V	271866	06001	75F2R5A104	1		
C41	Not Used						
C48	Cap, polyst, 0.0075 uF ±2%, 100V	168369	02799	PE-752-G	1		
CR3, CR4	Diode, Hi-speed switching	256339	28480	5082-2900	2		
CR5 thru CR9	Diode, Si, 150 mA	203323	03508	DHD1105	5		
Q1, Q3 thru Q15	Xstr, Si, NPN	159855	07910	CS23030	14		
Q2, Q16	Xstr, Si, uni-junction	268110	03508	2N6027	2		
R1	Res, met film, 523 ±1%, 1/8W	294835	91637	MFF1-85230F	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R2, R13, R23,R24, R27,R29, R31,R33, R41,R44, R46,R50	Res, comp, 1.0k ±5%, ¼W	148023	01121	CB1025	12		
R3	Res, comp, 2.7 ±5%, ¼W	246744	01121	CB2705	1		
R4	Res, comp, 1.5k ±5%, ¼W	148031	01121	CB1525	1		
R5, R6, R7	Not used						
R8	Res, met film, 11.5k ±1%, 1/8W	267138	91637	MFF1-81152F	1		
R9,R54	Re, comp, 100k ±5%, ¼W	148189	01121	CB1045	2		
R10,R55	Res, comp, 390k ±5%, ¼W	193383	01121	CB3945	2		
R11,R58	Res, comp, 390 ±5%, ¼W	147975	01121	CB3915	2		
R12	Res, comp, 1.3k ±5%, ¼W	234252	01121	CB1325	1		
R14	Res, met film, 32.4k ±1%, 1/8W	182956	91637	MFF1-83242F	1		
R15	Res, comp, 12k ±5%, ¼W	159731	01121	CB1235	1		
R16,R37 thru R40 R42,R60	Res, comp, 200 ±5%, ¼W	193482	01121	CB2015	7		
R17,R21, R25,R51	Res, comp, 510 ±5%, ¼W	218032	01121	CB5115	4		
R18,R36, R45,R47, R48,R49, R59	Res, comp, 3.3k ±5%, ¼W	148056	01121	CB3325	7		
R19,R20	Res, met film, 6.98k ±1%, 1/8W	261685	91637	MFF1-86981F	2		
R22,R26, R28,R30, R32,R43	Res, comp, 51 ±5%, ¼W	221879	01121	CB5105	6		
R34	Res, met film, 13k ±1%, 1/8W	335539	91637	MFF1-8133F	1		
R35	Not used						
R52,R56	Res, met film, 10k ±1%, 1/8W	168260	91637	MFF1-8103F	2		
R53	Res, met film, 28k ±1%, 1/8W	291385	91637	MFF1-8283F	1		
R57	Res, comp, 27k ±5%, ¼W	148148	01121	CB2735	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R61	Res, comp, 5.1k ±5%, ¼W	193342	01121	CB5125	1		
T1 thru T6	Xfmr	299594	89536	299594	6		
U1, U2	IC, TTL, MSI, 8-Input Multiplexer	326165	07263	9313	2		
U3, U16	IC, TTL, Hex Inverter	293076	01295	SN74H04N	2		
U4	IC, TTL, MSI, Digital Multiplexer	288852	04713	MC8312	1		
U5	IC, TTL, MSI, Synchronous 4-bit up-down counter	293183	01295	SN74193N	1		
U6, U26	IC, TTL, Hex Inverter	292979	01295	SN7404N	2		
U7	IC, TTL, JK Master-Slave Flip-Flop	296491	01295	SN7472N	1		
U8, U17	IC, TTL, Dual Retriggerable Monostable Multivibrator	310235	01295	SN74123N	2		
U9	IC, TTL, Dual 2 Wide, 2-Input and-or-inverter gate	293084	01295	SN74H51N	1		
U10	IC, TTL, JK Negative Edge Triggered Flip-Flop with AND Inputs	293092	01295	SN74H102N	1		
U11	IC, TTL, Quadruple, 2-Input Positive AND gate	292987	01295	SN7408N	1		
U12	IC, TTL, Quad, 2-Input NAND Gate	292953	01295	SN7400N	1		
U13,U14	IC, TTL, Dual Peripheral Pos NAND Driver	329706	01295	SN75452P	2		
U15,U18	IC, TTL, Monostable, Multivibrator	293050	01295	SN74121N	2		
U19	IC, TTL, Retriggerable Monostable Multivibrator	293134	07263	U6A960159X	1		
U20,U21, U22	IC, TTL, 8-bit Parallel outshift register	272138	01295	SN74164N	3		
	Connector, female	267252	13511	57-40360	1		
	Guard, logic	331785	89536	331785	1		

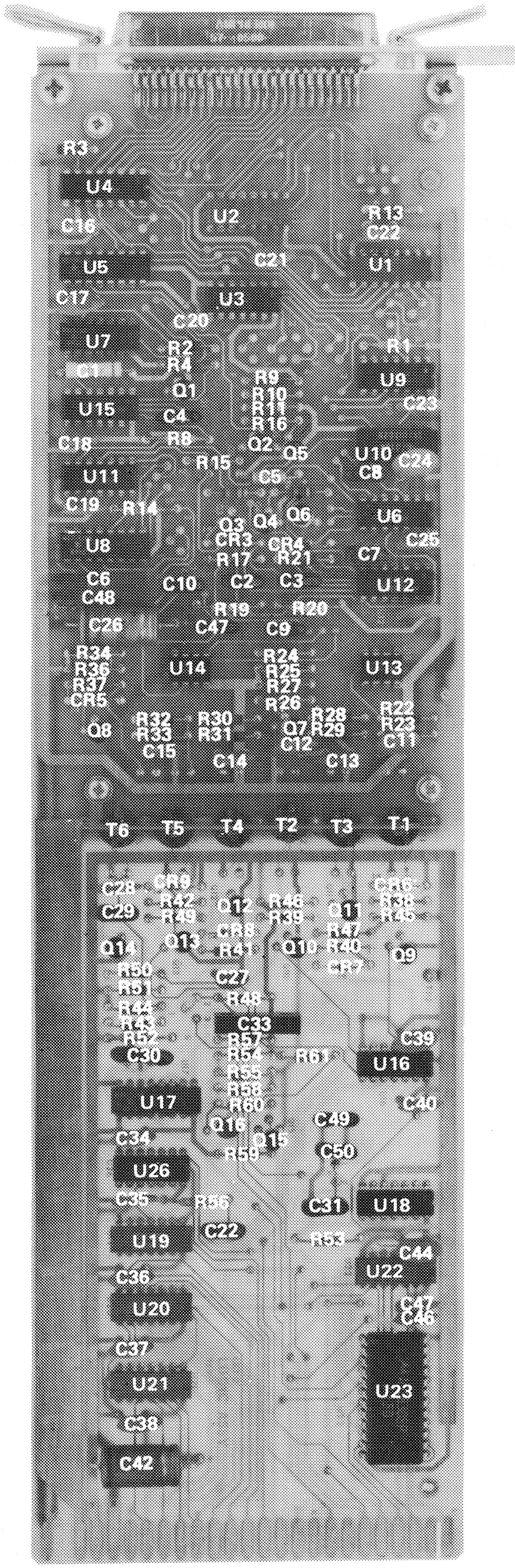


Figure 5-7. ISOLATED CONTROL LOGIC

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	**BCD DISPLAY PCB ASSEMBLY PANEL DISPLAY OPTION Figure 5-8**	302257	89536	302257	REF		
CR1 thru CR27	Diode, light emitting	309617			27		
R1 thru R27	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	27		
U1 thru U5	IC, TTL, Hex Inverter	292979	01295	SN7404N	5		

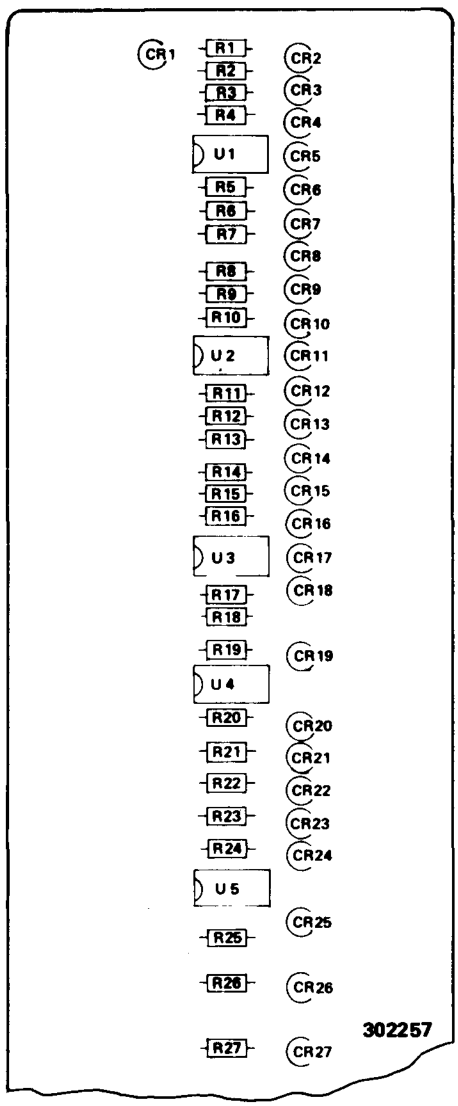


Figure 5-8. BCD DISPLAY PCB ASSEMBLY

CURRENT LIMIT PCB ASSEMBLY (–06 Option)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	**CURRENT LIMIT PCB ASSEMBLY (–06 Option) Figure 5-9**	332973	89536	332973	REF		
C1, C2, C12	Cap, plstc, 0.1 μf $\pm$10%, 250V	161992	73445	C280AE/ A100K	3		
C3	Cap, mica, 10 pf $\pm$10%, 500V	175216	71236	DM15C100K	1		
C4, C5	Cap, plstc, 0.033 μf $\pm$10%, 200V	106062	56289	192P33392	2		
C6	Cap, mica, 4 pf $\pm$5%, 500V	190397	73236	DM15C040J	1		
C7	Cap, mica, 27 pf $\pm$5%, 500V	177998	71236	DM15E270J	1		
C8, C9, C13, thru C16	Cap, cer, 0.0012 μf $\pm$10%, 500V	106732	71590	CP122	6		
C10, C11	Cap, mica, 33 pf $\pm$5%, 500V	160317	71236	DM15E330J	2		
C17	Cap, plstc, 0.022 μf $\pm$10%, 250V	234484	73445	C280AE/A22K	1		
CR1, CR2	Diode, zener, 16V	113332	07910	1N966A	2		
CR3, CR5, CR10, CR11	Diode, zener, 20 mA, 3.9V	113316	07910	1N748	4		
CR4, CR8,	Diode, zener, 12.5 mA	246611	07910	1N961B	2		
CR6, CR9	Diode, zener, 36V	186163	07910	1N974B	2		
CR7	Diode, zener, 6.3V, 7.5 mA	172148	03877	1N3496	1		

CURRENT LIMIT PCB ASSEMBLY (–06 Option) Cont.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q1,Q2, Q5,Q8, Q11,Q14, Q16, Q19, Q20	Xstr, Si, NPN	218396	04713	2N3904	9		
Q3,Q7, Q10,Q13, Q15, Q21, Q23	Xstr, Si, PNP	195974	04713	2N3906	7		
Q4,Q6, Q9, Q12, Q26	Xstr, J-FET, N-channel	261578	07910	U2366E	5		
Q17	Xstr, semicon, Si, PNP, dual	242016	07263	SE 4901	1		
Q18	Xstr, Si, PNP	276899	95303	2N5415	1		
Q22	Xstr, Si, PNP	284448	95303	2N5416	1		
Q24, Q28	Xstr, Si, NPN	218511	95303	60994	2		
Q25	Xstr, Si, NPN	220087	24355	00/17	1		
Q27	Xstr, Si, NPN	335067	04713	2N3439	1		
R1	Res, comp, 39k ±5%, 1W	236729	01121	GB3935	1		
R2, R58	Res, comp, 8.2k ±5%, 2W	330555	01121	HB8225	2		
R3	Res, met flm, 649 ±1%, 1/8W	309955	91637	MFF1-8649F	1		
R4	Res, met flm, 750 ±1%, 1/8W	312801	91637	MFF1-8751F	1		
R5	Res, var, cermet, 500 ±10%, 1W	291120	71450	3608-501A	1		
R6	Res, met flm, 15 ±1%, 1/8W	296434	91637	MFF1-8151F	1		
R7, R56, R57	Res, comp, 2.7k ±5%, 2W	330548	01121	HB2725	3		

CURRENT LIMIT PCB ASSEMBLY (–06 Option) Cont.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R8	Res, comp, 47k ±5%, ¼W	148163	01121	CB4735	1		
R9	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	1		
R10, R12, R16, R19, R22	Res, comp, 24k ±5% , ¼W	193425	01121	CB2435	5		
R11, R13, R17, R21, R23, R33	Res, comp, 12k ±5%, ¼W	159731	01121	CB1235	6		
R14, R18, R20, R32, R50	Res, comp, 27k ±5%, ¼W	148148	01121	CB2725	5		
R15, R54	Res, met flm, 6.19k ±1%, 1/8W	283911	91637	MFF1-86R19F	2		
R24, R25	Res, met flm, 10k ±1%, 1/8W	168260	91637	MFF1=8103F	2		
R26, R35	Res, comp, 5.1M ±5%, ¼W	294467	01121	CB5155	2		
R27	Res, comp. 5.1k ±5%, ¼W	193342	01121	CB5125	1		
R28, R34	Res, comp, 10M ±5%, ¼W	194944	01121	CB1065	2		
R29, R53	Res, var, cermet, 20k ±10%, ½W	291609	71450	360S-203A	2		
R30, R52	Res, met flm, 24.9k ±1%, 1/8W	291369	91637	MFF1-824R9F	2		
R31	Res, met flm, 2.74k ±1%‘ 1/8W	293761	91637	MFF1-82R74F	1		
R36, R49	Res, comp, 22k ±5%, 1W	330530	01121	GB 2235	2		

CURRENT LIMIT PCB ASSEMBLY (–06 Option)Cont.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R37, R48	Res, comp 36k ±5%, ¼W	221929	01121	CB3635	2		
R38, R46	Res, comp, 39k ±5%, ¼W	188466	01121	CB3935	2		
R39, R47	Res, comp, 36k ±5%, 1W	109736	01121	CB3635	2		
R40, R45	Res, comp. 120 ±5%, ¼W	170712	01121	CB1215	2		
R41, R44, R59	Res, comp. 1.2k ±5%, ¼W	190371	01121	CB1225	3		
R42, R43	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	2		
R51	Res, ww, 2 ±1%, 2W	229542	56289	223E	1		
R55	Res, met flm, 12.4k ±1%, 1/8W	261644	91637	MFF1-812$4F	1		
R60, R61, R62	Res, comp 50 ±5%, ¼W	147900	01121	CB5605	3		
U1, U2	IC, Hex Inverter	268367	04713	MC 836P	2		
U3, U4	IC, Operational Amplifier	271502	12090	LM301A	2		

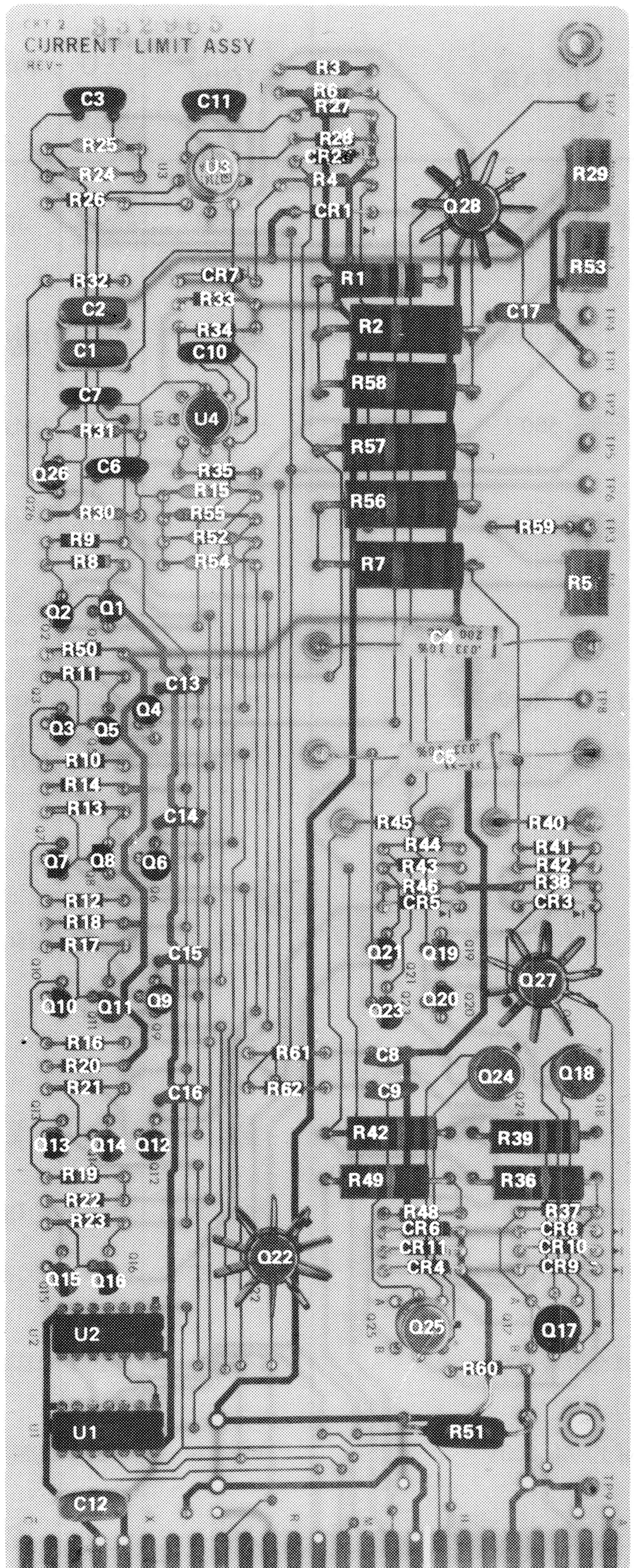


Figure 5-9. PROGRAMMABLE CURRENT LIMIT (–06 OPTION)

POWER AMPLIFIER ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	**POWER AMPLIFIER ASSEMBLY Figure 5-10**	332957	89536	332957	REF		
C1, C4	Cap, mica, 330 pf ±1%, 500V	226142	71236	DM15F331F	2		
C2, C3	Cap, mica 33 pf ±5%, 500V	160317	71236	DM15E330J	2		
C5, C9, C10, C16, C22	Cap, mica, 100 pf ±5%, 500V	148894	71236	DM15F101J	5		
C6	Cap, mica, 51 pf ±5%, 500V	277210	71236	DM15E510J	1		
C7, C15	Cap, elect, 10 μf +50/–10%, 150V	106351	56289	30D397F150 DD4	2		
C8	Not used						
C11, C13, C21	Cap, plstc, 0.47 μf ±10%, 250V	184366	73445	C280AE/A470K	3		
C12, C14, C17 thru C20	Not used						
C23	Cap, mica, 150 pf ±5%, 500V	148478	71236	DM15F151J	1		
C24, C25	Cap, cer, 0.005 μf ±20%, 50V	175232	56289	C023B101H253H	2		
C26, C27	Cap, cer, 0.01 μf ±20%, 100V	149153	56289	C023B101F103M	2		
C28, C29	Cap, mica, 10 pf ±10%, 500V	175216	71236	DM15C100K	2		

POWER AMPLIFIER ASSEMBLY (Cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR1 thru CR10, CR19, CR20, CR35, CR36, CR37	Diode, Si, 150 mA	203323	03508	DHD1105	15		
CR11	Not used						
CR12	Diode, zener, 6.8V	260695	07910	1N754A	1		
CR13	Not Used						
CR14, CR16, CR24, CR25, CR27 thru CR30, CR33, CR34, CR38, CR39	Diode, Si, 1 amp, 600 piv	112383	05277	1N4822	12		
CR15, CR17, CR18, CR21, CR22, CR23, CR26, CR31, CR32	Not Used						
CR40, CR41	Diode, FET	334714	07910	TCR 5315	2		
Q1	Xstr, Si, PNP	276899	95303	2N5415	1		
Q2, Q3, Q8, Q11, Q13, Q18, Q26, Q38	Xstr, Si, NPN	335067	04713	2N3439	8		

POWER AMPLIFIER ASSEMBLY (Cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q4, Q20, thru Q25	Xstr, Si, NPN	218511	95303	60994	6		
Q5, Q6, Q7, Q9, Q10, Q12, Q14, Q17, Q30	Xstr, Si, PNP	284448	05303	2N5416	9		
Q15, Q35	Xstr, Si, PNP	195974	04713	2N3906	2		
Q16, Q19, Q34	Xstr, Si, NPN	218396	04713	2N3904	3		
Q27, Q28, Q29	Not used						
Q31	Xstr, Si, NPN	190710	04713	2N3739	1		
Q32, Q33, Q41, Q42	Xstr, Si, NPN, power (on Heatsink)	313213	95303	2N5240	4		
Q36	Not used						
Q37	Xstr, Si, PNP, power	309302	04713	2N5345	1		
Q39, Q40	Not used						
R1, R2, R9, R10, R23	Res, comp, 2k ±5%, ¼W	202879	01121	CB2025	5		
R3, R8, R69, R73	Res, comp, 20k ± 5%, ¼W	221614	01121	CB2035	4		
R4, R6	Res, comp,62k ±5%, ¼W	220053	01121	CB6235	2		
R5, R7	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	2		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R11	Res, met flm, 4.12k ±1%, 1/8W	235341	91637	MFF1-84R12F	1		
R12, R65, R67	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	3		
R13, R31, R40	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	3		
R14,R18	Res, comp, 250k ±5%, ¼W	218016	01121	CB2445	2		
R15, R19, R63	Res, comp, 330k ±5%, ¼W	192948	01121	CB3345	3		
R16,R17	Res, comp, 6.2k ±5%, ¼W	221911	01121	CB6225	2		
R20,R22	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	2		
R21	Res, met flm, 10k ±1%, 1/8W	168260	91637	MFF1-8103F	1		
R24	Res, met flm, 6.04k ±1%, 1/8W	285189	91637	MFF1-86R04F	1		
R25	Res, met flm, 15.8k ±1%, 1/8W	293688	91637	MFF1-815R8F	1		
R26,R33	Res, comp, 7.5k ±5%, ¼W	193326	01121	CB7525	2		
R27,R32	Res, comp, 130k ±5%, ½W	108852	01121	EB1345	2		
R28,R29	Res, comp, 180 ±5%, ¼W	147942	01121	CB1815	2		
R30	Res, comp, 33k ±5%, 1W	109538	01121	GB3335	1		
R34,R35	Not Used						
R36,R50, R60,R61, R68,R70, R71,R72	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	8		
R37,R53	Res, comp, 68 ±5%, ¼W	147918	01121	CB6805	2		
R38,R39, R56,R57	Res, comp, 1 ±5%, ¼W	218693	01121	EB10G5	4		
R41	Res, met flm, 23.7k ±1%, 1W	330506	91637	MFF1-23R7F	1		
R42,R45	Res, met flm, 127 ±1%, 1/8†	330944	91637	MFF1-8127F	2		
R43,R47	Res, comp, 1.1 ±5%, ½W	163717	01121	EB11G5	2		
R44,R46, R48	Not used						
R49	Res, comp, 51 ±5%, ½W	144717	01121	EB5105	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R51	Res, var, cermet, 100 ±10%, 1W	285130	71450	360S-101A	1		
R52,R54, R55	Not used						
R58	Res, comp, 20k ±5%, 1W	330951	01121	GB2035	1		
R59	Not used						
R62	Res, met flm, 54.8k ±1%, 1/8W	271353	91637	MFF1-854R9F	1		
R64,R66	Res, comp, 1M ±5%, ¼W	182204	01121	CB1055	2		
	Heat Sink	302141	89536	302141	1		
	Conn, assy.	310771	89536	310771	5		

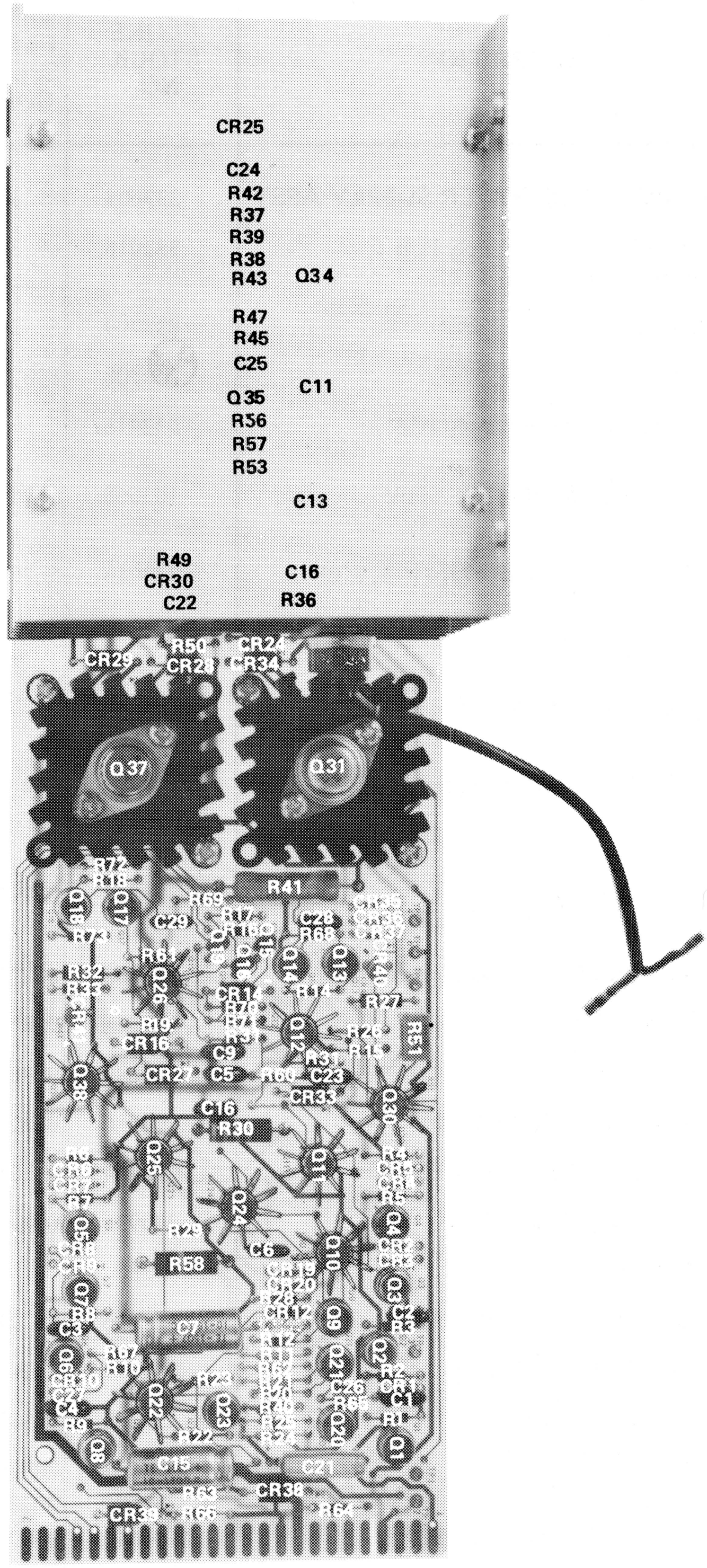


Figure 5-10. POWER AMPLIFIER

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	**HIGH VOLTAGE POWER SUPPLY ASSY**	333005	89536	333005	REF		
A10A1	High Voltage Power Supply PCB (Figure 5-11)	332916	89536	332916	1		
T1	Xfmr, power	333799	89536	333799	1		
	Cord Set	248708	82877	16415	1		
A10A1	High Voltage Power Supply PCB	332916			REF		
C1, C4, C6	Cap, cer, 0.01 uF ±20%, 500V	105668	56289	C023B501J103 M	3		
C2, C3	Cap, elect, 1200 uF +75/–10%, 250V	329953	56289	36D122G250BC 2B	2		
C5	Not used						
C7, C8	Cap, plstc, 0.47 uF ±10%, 250V	184366	56289	C280AE/A470K	2		
CR1 thru CR4	Diode, Si, 1 amp, 600 piv	112383	05277	1N4822	4		
CR5 thru CR8	Diode, zener	328820	04713	1N3040B	4		
Q1, Q4	Xstr, Si, NPN (located on Heatsink)	223602	05277	2N3773	2		
Q2	Xstr, Si, NPN	218511	95303	65120	1		
Q3	Xstr, Si, PNP	276899	95303	2N5415	1		
R1	Res, comp, 4.7k ±5%, ½W	108886	01121	EB4725	1		
R2, R3	Res, comp, 33k ±10%, 2W	158964	01121	HB3331	2		
R4, R6	Res, comp, 8.2k ±5%, 1S	330936	01121	GB8225	2		
R5	Not used						
R7, R8	Res, comp, 6.8k ±5%, ½W	187906	01121	EB6825	2		
R9	Res, comp, 51 ±5%, ½W	144717	01121	EB5105	1		
S1, S2	Switch, slide, dpdt	234278	82389	XW1649	2		
	Conn, recpt, amp	267534	00779	85884-3	6		
	Conn, Post	267500	00779	86144-2	8		
	Heatsink (use with Q2, Q3)	104646	05820	207-AB	2		
	Heatsink	334524	89536	334524	1		
	Socket, Xstr	342816	91506	X8080-1G10	2		

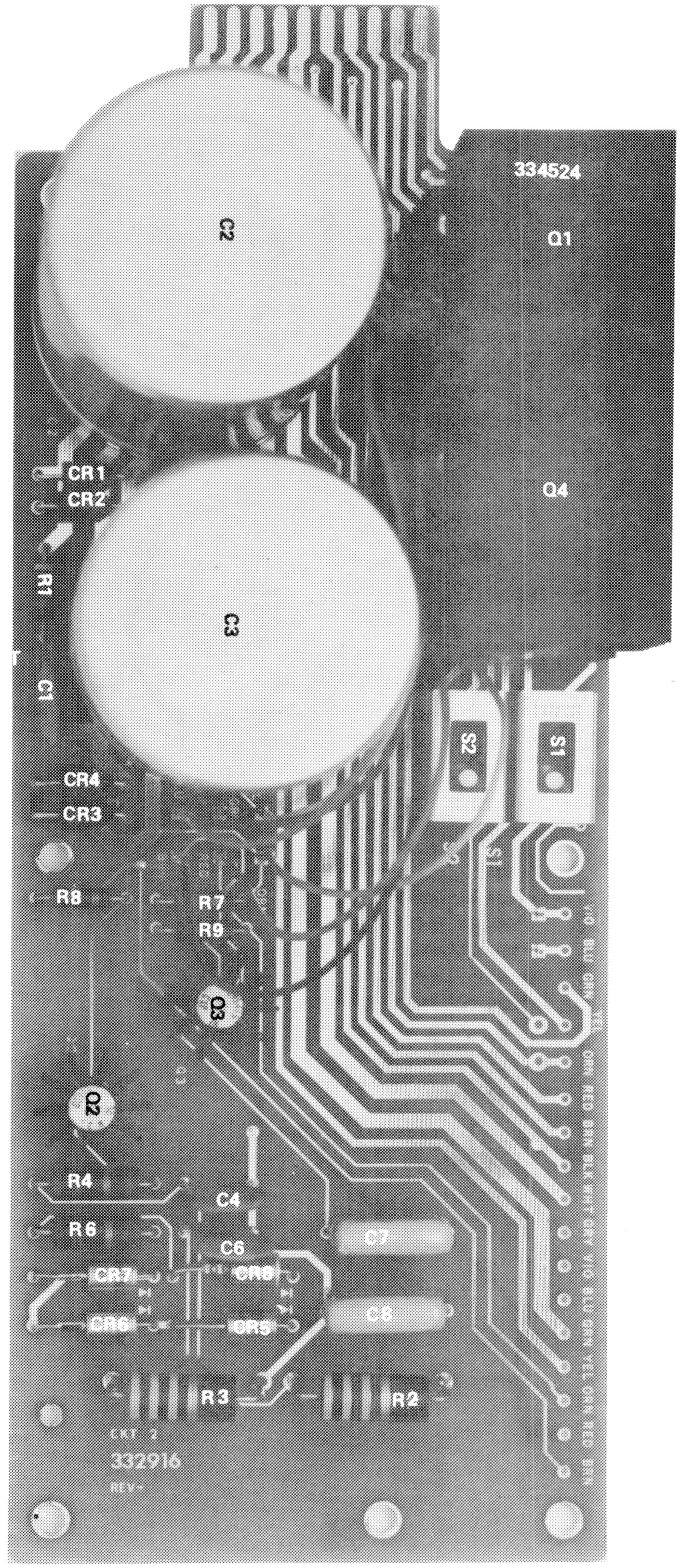


Figure 5-11. H. V. POWER SUPPLY AND CONNECTOR BOARD

Option –07

100µV Resolution

6-1. INTRODUCTION

6-2. The –07 Option provides 100µV resolution (E Decade) throughout the voltage range of 0 to 16.6665V dc in the Model 4210A. Status of the E decade is not provided on the front panel display.

6-3. SPECIFICATIONS

6-4. Specifications for the –07 Option are located in Section 1 of the manual.

6-5. INSTALLATION

6-6. Use the following procedure to install the –07 Option into the Model 4210A.

a. Disconnect the power cord from line power.

b. Remove the top dust cover and the inner guard cover.

c. Remove the A5 BCD LADDER ASSY by using a gentle rocking motion and an even, rearward pulling force.

d. Remove four mounting screws on rear panel adjacent to Programming Connector, J1.

e. Insert the –07 Option, A5 BCD Ladder into LADDER receptacle (J2) on MOTHER ASSY.

f. Attach Programming Connector J1 panel to rear panel of instrument using the four screws removed in step d.

g. Replace inner guard and top dust cover.

h. Reconnect power cord to line power.

6-7. OPERATING INSTRUCTIONS

6-8. Programming Information

6-9. Operation of the 4210A with the –07 Option is done in a manner similar to operation with the –01 Option, Isolated Control Logic, described in Section 2. Programming input/output lines for the Programming Connector are given in Table 6-1.

Table 6-1. PROGRAMMING INPUT/OUTPUTS

LOGIC "0" = 2.8 to +5.5Vdc or open circuit LOGIC "1" = 0 ±0.4Vdc or short circuit to LOGIC GRD.		
PIN NO.	FUNCTION	
	CODE	
1	8	A DECADE (1V)
2	4	
3	2	
4	1	
5	8	B DECADE (0.1V)
6	4	
7	2	
8	1	
9	8	C DECADE (0.01V)
10	4	
11	2	
12	1	
13	8	D DECADE (0.001V)
14	4	
15	2	
16	1	
43	8	E DECADE (0.0001V)
44	4	
45	2	
46	1	
17 18 20 21 22 23 24	LOGIC GRD	
25	LOGIC PWR (+5 vdc at 0 to 125mA)	
26 27 28 29 30 31 32	NOT USED	
33	DATA STROBE (–01 Option) (See Figure 2-6) INITIATES DIGITAL TO ANALOG CONVERSION	
34	STANDBY/OPERATE: LOGIC "0" = OPERATE LOGIC "1" = STANDBY	
35	SIGN: LOGIC "0" = POSITIVE OUTPUT LOGIC "1" = NEGATIVE OUTPUT	
36	EXTERNAL REFERENCE (–03 Option): LOGIC "0" = INTERNAL REFERENCE LOGIC "1" = EXTERNAL REFERENCE	
37	READY/NOT READY FLAG: LOGIC "0" = READY LOGIC "1" = NOT READY	
38 39 40 41 42 47 48	NOT USED	
49	CURRENT OVERLOAD FLAG: LOGIC "0" = NORMAL LOGIC "1" = OVERLOAD	
50	NOT USED	

6-10. Manual Operation

6-11. Operation of the 4210A–07 with the Accessory A4200 is done as follows:

a. Ensure that all push buttons on the A4200 are in the non-depressed condition.

b. Attach mating connector on A4200 cable to Programming Connector (J1) on rear of Model 4210A –07.

c. To obtain E decade output voltage ranging from 100 to 1500μV, depress CURRENT LIMIT MA press-buttons *10, 20, 40,* and *80* sequentially. The STROBE push-button must be depressed following each of the above. Depression of a current limit button followed by a STROBE calls an output voltage in microvolts that is ten times the button legend (s). A second depression followed by a STROBE removes the call.

6-12. THEORY OF OPERATION

6-13. General

6-14. A5 BCD Ladder (4210A-1032)

6-15. The A5 BCD Ladder contains a buffer amplifier for V_{REF} and the four lower decade segments of a ladder network. The buffer amplifier produces a V_R' signal from V_{REF} to prevent loading of V_{REF} by ladder switching currents. The ladder decades are voltage dividers weighted in fifteenths for control by digital words from 0 to 15 (8 + 4 + 2 + 1). The relative position of each decade with respect to the ladder output determines the significance of each decade's contribution to the total ladder network output.

6-16. BUFFER AMPLIFIER. The Buffer Amplifier composed of Q1 through Q3 is a unity gain amplifier connected through CR1 to function as a voltage follower. This circuit produces a V_R' signal that is applied to the ladder driver circuits. Output impedance is sufficiently low from dc to 100 kHz to prevent loading by ladder switching currents.

6-17. LADDERS. The four lower decade ladders consist of R1 through R18 and R119 through R12. Each decade of the ladder is formed essentially by four resistors which, in combination, weight the division factor of each decade in fifteenths. A simplified diagram of a typical decade ladder is shown in Figure 6-1.

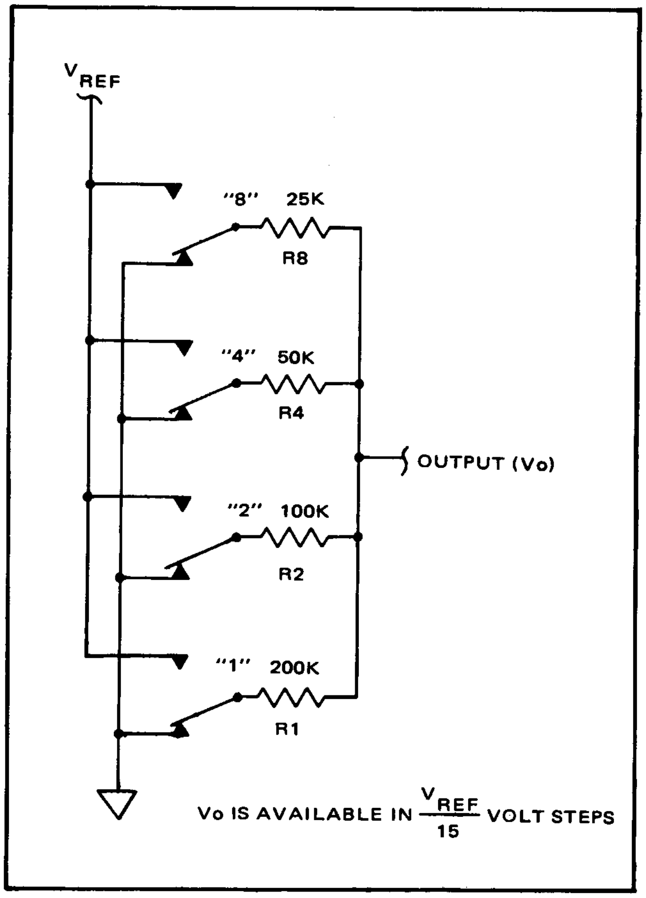


Figure 6-1. LADDER DECADE (SIMPLIFIED)

6-18. MAINTENANCE PROCEDURES

6-19. Maintenance procedures for the Model 4210A–07 are the same as those given in Section 4 of the manual. A resolution check of the –07 Option is given in the following paragraphs.

6-20. This procedure provides a resolution check on the E decade. Required equipment is a FLUKE Model 8400A –01 AC/DC Voltmeter, or equivalent, and a FLUKE Model A4200 Manual Control Unit (MCU).

a. Connect Model A4200 MCU as described in steps 6-11., a. and b.

b. Connect Model 8400A–01 Voltmeter to ±OUTPUT TERMINALS of barrier strip on rear of Model 4210A–07.

c. With all decades set to zero, perform steps 1 through 5 in Table 6-3. Each push-button on the A4200 MCU must be released for each succeeding step following step 2. Each step also must be followed by a STROBE.

Table 6-3. RESOLUTION CHECK

STEPS	DECADE E	OUTPUT VOLTAGE (μV)
1	0	0 ±100 (Record voltage)
2	1	100μV > Step 1 Voltage
3	2	200μV > Step 1 Voltage
4	4	400μV > Step 1 Voltage
5	8	800μV > Step 1 Voltage

6-21. LIST OF REPLACEABLE PARTS

6-22. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5, paragraphs 5-1 through 5-10. See paragraph 6-40, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

6-23. SERIAL NUMBER EFFECTIVITY

6-24. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 4210A. Each part in this option for which a use code has been assigned may be identified with a particular serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all serial numbers 123 and on. NOTE: These Use Codes and Serial Number Effectivity apply to this option only. For the standard instrument configuration, see Section 5, paragraph 5-9, and for additional options, see the appropriate option subsection.

USE CODE	SERIAL NUMBER EFFECTIVITY

REF DES	DESCRIPTION	SNO	TOT QTY	RECM QTY	USE CODE
A5	**BCD LADDER PCB ASSEMBLY –07 Option FIGURE 6-2.**	322602	REF		
C1, C2	Cap, cer, 0.05 uF ±20%, 100V	149161	2		
CR1	Dio, silicon, 150 mA	203323	1		
Q1	Dio, FET, current regulator	285106	1		
Q2	Xstr, silicon, NPN	269084	1		
Q7, Q11, Q15, Q19, Q23, Q27, Q31, Q35, Q39, Q43, Q47, Q51, Q55, Q59, Q63, Q67	Xstr, silicon, NPN	218396	16		
Q3	Xstr, silicon, PNP	269076	1		
Q4	Not used				
Q5, Q9, Q13 Q17, Q21, Q25, Q29, Q33, Q37, Q41, Q45, Q49, Q53, Q57, Q61, Q65	Xstr, silicon, PNP	195974	16		
Q6, Q8	Xstr, J-FET, N-channel, U2366E, Matched Pair	306399	1		
Q10, Q12	Xstr, J-FET, N-channel, U2366E, Matched Pair	306381	1		
Q14, Q16, Q18, Q20	Xstr, J-FET N-channel, U2366e, Matched Pairs (Q14 matched to Q16; Q18 matched to Q20)	306373	2		
Q22, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q46, Q48, Q50, Q52	Xstr, J-FET, N-channel, U2366E, Matched Set	298299	1		
Q38, Q40, Q42, Q44, Q54, Q56, Q58, Q60, Q62, Q64, Q66, Q68	Xstr, J-FET, N-channel	288324	12		
R1	Res, var, cermet, 200Ω ±10%, 1/2w	285148	1		
R2	Res, ww, 24.987k				
R3	Res, ww, 49.975k Matched Resistor Set	289827	1		
R5	Res, ww, 100.025k				

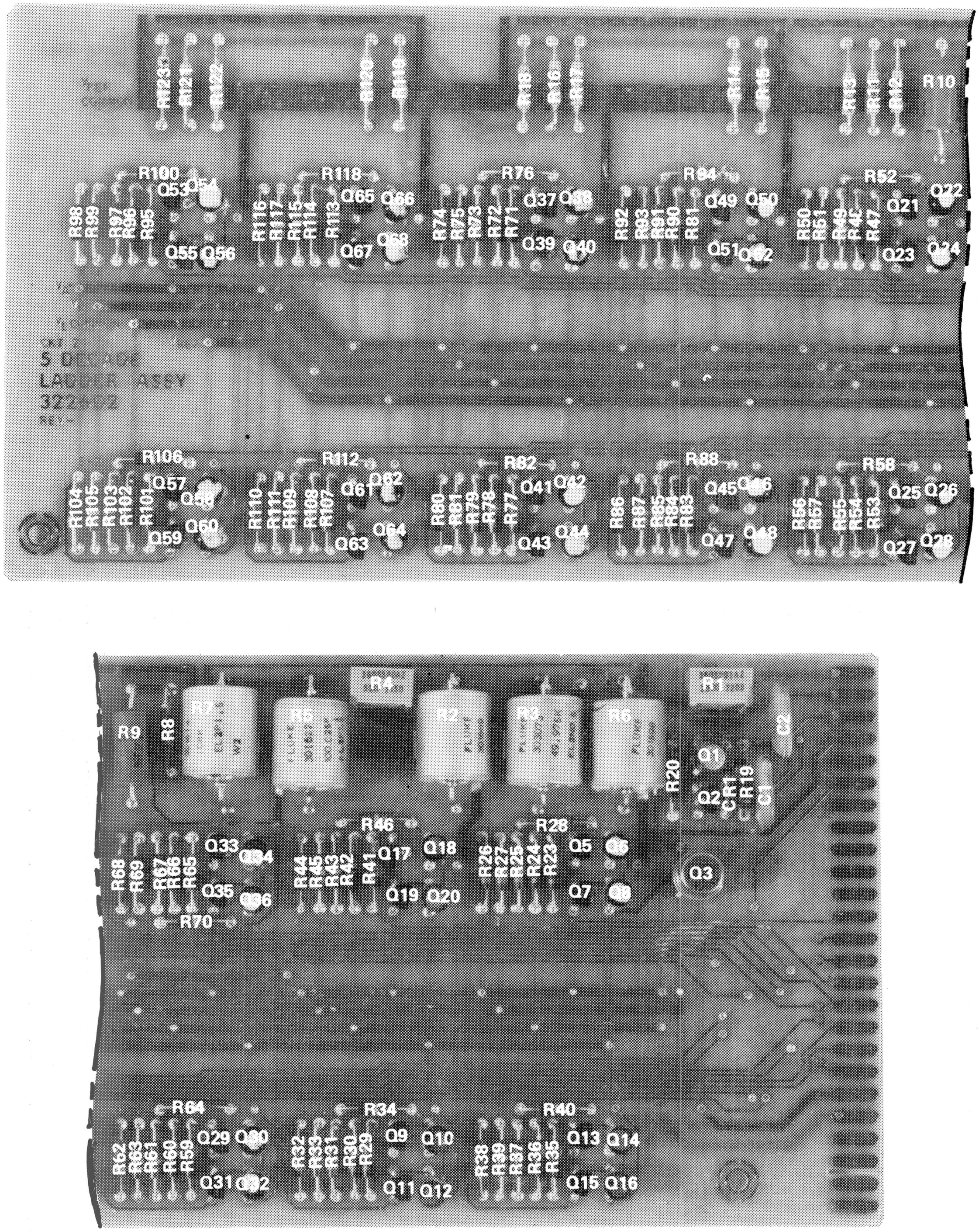
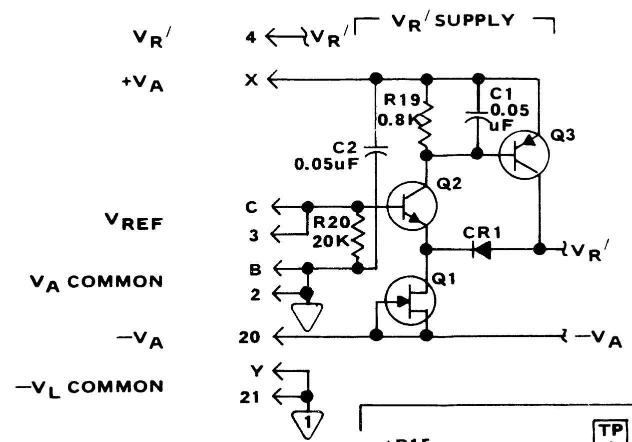


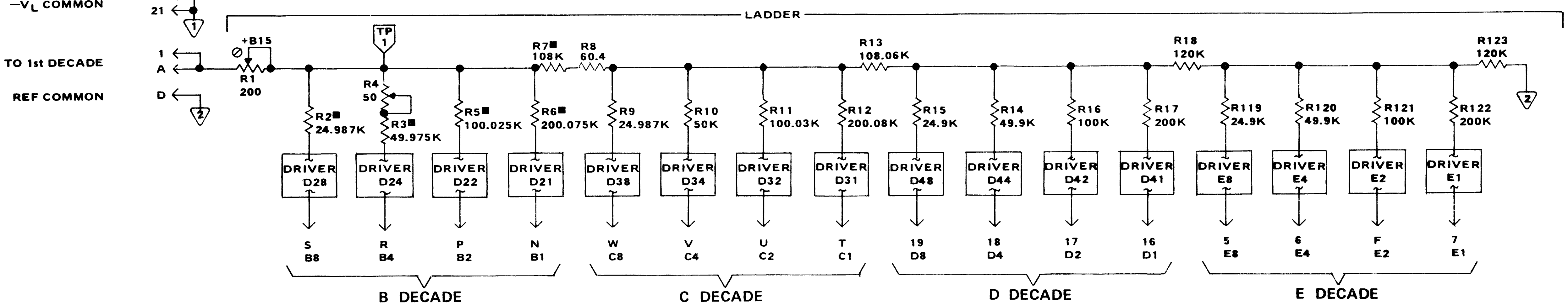
Figure 6-2. BCD LADDER PCB ASSEMBLY

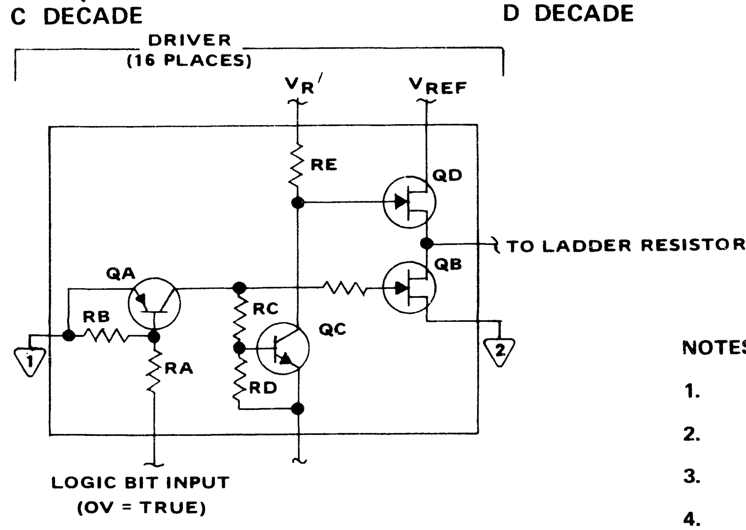
REF DES	DESCRIPTION	SNO	TOT QTY	RECM QTY	USE CODE
R6 R7	Res, ww, 200.075k Res, ww, 108k } Matched Resistor Set	289827	1		
R4	Res, var, cermet, 50Ω ±10%, 1/2w	285122	1		
R8	Res, met flm, 60.4Ω ±1%, 1/8w	235366	1		
R9	Res, ww, 24.987k ±0.03%, 1/4w	289769	1		
R10	Res, ww, 50k ±0.03%, 1/4w	289777	1		
R11	Res, met flm, 100.03k ±0.1%, 1/8w	291088	1		
R12	Res, met flm, 200.08k ±0.1%, 1/8w	290122	1		
R13, R18	Res, met flm, 108.06k ±0.1%, 1/8w	290114	2		
R14, R120	Res, met flm, 49.9k ±0.1%, 1/8w	291070	2		
R15, R119	Res, met flm, 24.9k ±0.1%, 1/8w	290106	2		
R16, R121	Res, met flm, 100k ±0.5%, 1/8w	291054	2		
R17, R122	Res, met flm, 200k ±1%, 1/8w	261701	2		
R19	Res, cmpsn, 1.8k ±5%, 1/4w	175042	1		
R24, R30, R36, R42, R48, R54, R60, R66, R72, R78, R84, R90, R96, R102, R108, R114	Res, cmpsn, 560Ω ±5%, 1/4w	147991	16		
R20	Res, cmpsn, 20k ±5%, 1/4w	221614	1		
R25, R27, R28, R31, R33, R34, R37, R39, R40, R43, R45, R46, R49, R51, R52, R55, R57, R58, R61, R63, R64, R67, R69, R70, R73, R75, R76, R79, R81, R82, R85, R87, R88, R91, R93, R94, R97, R99,	Res, cmpsn, 51k ±5%, 1/4w	193334	48		

REF DES	DESCRIPTION	SNO	TOT QTY	RECM QTY	USE CODE
R100, R103, R105, R106, R109, R111, R112, R115, R117, R118	Res, cmpsn, 51k ±5%, 1/4w	193334	48		
R21, R22	Not used				
R23, R26, R29, R32, R35, R38, R41, R44, R47, R50, R53, R56, R59, R62, R65, R68, R71, R74, R77, R80, R83, R86, R89, R92, R95, R98, R101, R104, R107, R110, R113, R116	Res, cmpsn, 2.7k ±5%, 1/4w	170720	32		
R123	Res, met flm, 120k ±1%, 1/8w	291062	1		

DRIVER DESIG.	CKT. CKT	REFERENCE DESIGNATIONS															
		D21	D22	D24	D28	D31	D32	D34	D38	D41	D42	D44	D48	E-1	E-2	E-4	E-8
RA	2.7K	R23	R29	R35	R41	R47	R53	R59	R65	R71	R77	R83	R89	R95	R101	R107	R113
RB	560	R24	R30	R36	R42	R48	R54	R60	R66	R72	R78	R84	R90	R96	R102	R108	R114
RC	51K	R25	R31	R37	R43	R49	R55	R61	R67	R73	R79	R85	R91	R97	R103	R109	R115
RD	2.7K	R26	R22	R38	R44	R50	R56	R62	R68	R74	R80	R86	R92	R98	R104	R110	R116
RE	51K/100K■	R27	R33	R39	R45	R51	R57	R63	R69	R75	R81	R87	R93	R99	R105	R111	R117
RF		R28	R34	R40	R46	R52	R58	R64	R70	■R76	■R82	R88	R94	R100	R106	R112	R118
QA	2N3906	Q5	Q9	Q13	Q17	Q21	Q25	Q29	Q33	Q37	Q41	Q45	Q49	Q53	Q57	Q61	Q65
Qb	U2366E/U1994E■	Q6	Q10	Q14	Q18	Q22	Q26	Q30	Q34	■Q38	■Q42	Q46	Q50	*Q54	*Q58	*Q62	*Q66
QC	2N3904	Q7	Q11	Q15	Q18	Q23	Q27	Q31	Q35	Q39	Q43	Q47	Q51	Q55	Q59	Q63	Q67
QD	U2366E/U1994E■	Q8	Q12	Q16	Q20	Q24	Q28	Q32	Q36	■Q40	■Q44	Q48	Q52	*Q56	*Q60	*Q64	*Q68







NOTES:

1. ALL CAPACITANCE IN uF UNLESS OTHERWISE NOTED
2. (1) LOGIC GROUND
3. COMMON
4. ← PCB CONNECTOR
5. * FACTORY INSTALLED
6. (2) REF COMMON

FUNCTIONAL SCHEMATIC DIAGRAM
A5 OPTION—07 BCD LADDER
DRAWING NO. 4210A-1032
FLUKE JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133

Option–09

Multi-Strobe Isolated Logic

6-1. INTRODUCTION

6-2. The 4200-09 Multi-Strobe Isolated Logic permits any of the Fluke 4200 Series Programmable Voltage Sources (hereafter referred to as the 4200) to be remotely controlled by a large variety of program sources such as a computer, a system coupler, as well as a Fluke Automatic Test Equipment System. The 4200-09 consists of a pair of printed circuit boards mounted as one assembly and connected together by means of a ribbon-type cable. The entire assembly mounts within the 4200 and is accessed through an opening in the rear panel and a 50-pin connector. Up to eight 4200 series power sources equipped with the –09 option (4200-09) may be connected to and addressed by a single program source.

6-3. Programming the 4200 series voltage sources requires that the program source provide certain information to the 4200-09. Such program information required to generate specific output voltages, includes:

a. Output voltage magnitude.

b. Output voltage range.

c. Output voltage polarity.

d. Current limit magnitude.

e. Strobe pulse (s).

f. Voltage source mainframe address.

g. Operate/Standby signal.

CAUTION!

The Model A4200 MCU is NOT compatible with the –09 option.

6-4. In addition to providing signals to the voltage source, the program source should also have the capability to receive status information from the voltage source. By means of unique voltage source mainframe addresses, the program source can determine the status of any particular voltage source in the system. (Refer to Status Checking for details.)

6-5. CONNECTION TO PROGRAM SOURCE

6-6. Connection of the program source to the 4200 is made by means of an interconnecting cable and a 50-pin connector on the rear panel of the 4200. (Refer to Figure 6-1.) The mating connector used on the interconnecting cable is an Amphenol Blue Ribbon 57-30500, Fluke stock number 266056. Up to eight 4200's may be connected to a single program source as shown in Figure 6-2. The first 4200 connects to the program source interface, the second 4200 connects to the first, the third to the second, etc. The cable assemblies used to connect the 4200's are Fluke Stock Number

6-7. INPUT/OUTPUT SIGNALS

6-8. Details of the interface siganls between the 4200-09 and the program source are listed in the following Tables 6-1 and 6-2. Table 6-2 describes those interface signals between the 4200-09 and a program source interface which communicates in binary format. (Positive-true logic employs +5 volts for a logic 1 and zero volts for a logic 0.)

NOTE!

Not all the signals listed in Tables 6-1 and 6-2 apply to all 4200 series voltage sources. For specific programming requirements, refer to the Programming Information given in Section 2 of the technical manual for the particular model voltage source.

NOTE!

The following paragraphs provide jumpering instructions for the 4200-09. Table 6-3 provides abbreviated jumpering instructions with reference to the appropriate text.

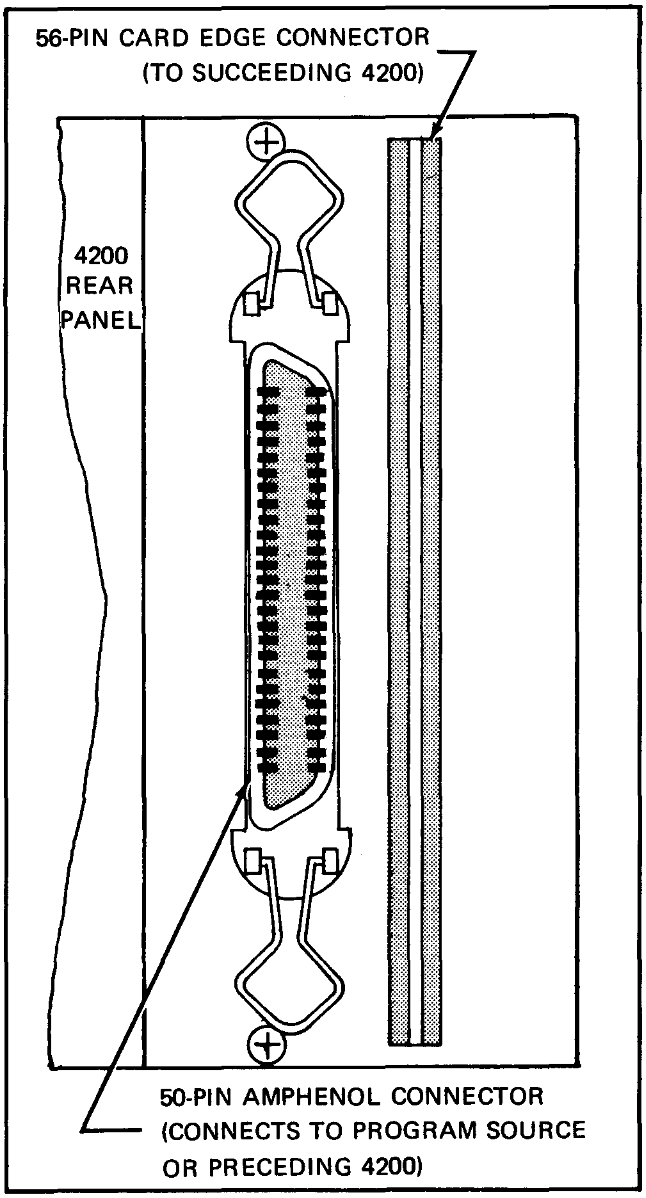


Figure 6-1. 4200-09 CONNECTORS

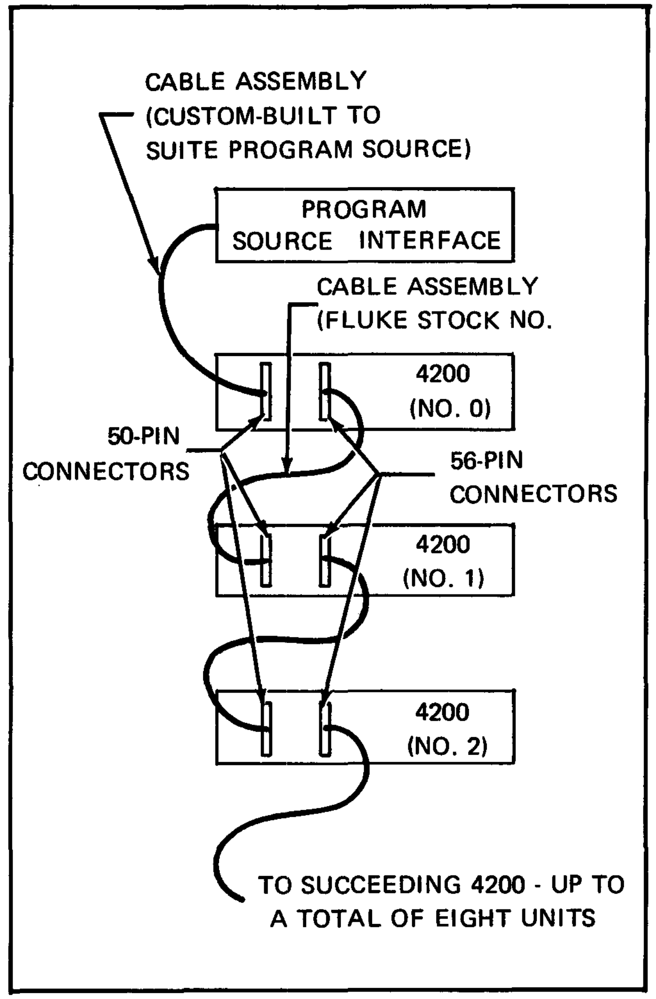


Figure 6-2. MULTIPLE 4200 CONNECTIONS

6-9. DATA WORD/CONTROL WORD LENGTHS

6-10. BCD – Type Voltage Sources

6-11. Program data for BCD-type 4200 voltage sources consists of a 16-bit or a 18-bit data word, and if necessary a control word (up to eight bits in length). Figure 6-3 shows a typical 16-bit data word and an eight-bit control word used to program a BCD-type voltage source. By keeping the four BCD digits of output magnitude data separate from the range, polarity and current limit functions, output voltage can be changed without affecting functions established by a previous control word. To obtain a 16-bit data word and an eight-bit control word, jumper pad T to pad U.

NOTE!

The first bit of the control word may be either the polarity bit or the standby/operate bit. Refer to paragraph 6-22.

Table 6-1. INPUT/OUTPUT SIGNALS, BCD PROGRAM SOURCE (Sheet 1 of 2)

PIN NUMBER		SIGNAL NAME	DESCRIPTION
50 - PIN CONN.	56 - PIN CONN.		
43, 44, 19, & 42	44, 43, 42 & 41	Voltage output magnitude – MSD	Four BCD lines to program the most-significant digit of the output voltage. (Refer also to the schematic diagram for pin number assignments.)
38, 8, 25 & 24	40, 39, 38 & 37	Voltage output magnitude – 2SD	Four BCD lines to program the second most-significant digit of the output voltage.
39, 40, 11 & 10	36, 35 34 & 33	Voltage output magnitude – 3SD	Four BCD lines to program the third most-significant digit of the output voltage.
13, 15, 12 & 14	32, 31, 30 & 29	Voltage output magnitude – LSD	Four BCD lines to program the least significant digit of the output voltage.
26	53	Polarity (Sign)	Single line to program output polarity. Either polarity can be programmed by either logic level as selected by jumpers at PCB pads, W, X, and Y.
1	27	Output Magnitude Range	Single line to program output magnitude range on those voltage sources requiring range selection. (Logic 1 = high range, Logic 0 = low range)
31	55	External Reference	Single line to program external reference mode on those voltage sources equipped with the external reference option. (Logic 1 = ext. reference, Logic 0 = int. reference.)
2	28	Current Limit range	Single line to program range of current output limiting on those voltage sources equipped current limit selection. (Logic 1 = 1 amp range, logic 0 = 100 mA range)
37, 35, 5 & 3	4, 3, 2 & 1	Current Limit Magnitude	Four lines to select the current limit value, expressed as a percentage of the programmed range. Up to 120% can be programmed. Any attempt to program 0% results in 10%. (Refer also to the schematic diagram for pin number assignments.)
17	45	Standby/operate (address zero)	Single line used to select the standby or operate mode of the voltage source. Either mode can be programmed by either logic level as selected by jumpers at PCB pads 18 and 19.
23, 22, 34, 7, 6 & 4	46 thru 52	Standby/operate (addresses one through seven)	Seven lines (through connections) used to select the standby or operate mode of up to seven succeeding voltage sources. (Refer to schematic diagram for pin number assignments.)

Table 6-1. INPUT/OUTPUT SIGNALS, BCD PROGRAM SOURCE (Sheet 2 of 2)

PIN NUMBER		SIGNAL NAME	DESCRIPTION
50 - PIN CONN.	56 - PIN CONN.		
20	12	Instrument mainframe (address zero)	Single line used to address the voltage source in order to perform any programming function. The addressing signal must be present in order for any strobe signal to be recognized by the 4200-09 logic. Addressing may be by either logic level as selected by jumpers at PCB pads 8, 9, and 10. Refer also to Addressing Multiple Mainframes.
21 & 45 thru 50	5 thru 11	Instrument mainframe addresses one through seven.	Seven lines (through connections) used to address up to seven succeeding voltage sources.
18	13	Control word strobe	Single line which accepts a 500 ns, or longer, pulse to load the control word portion of the program data into the 4200-09 assembly. (Refer also to Dual-Strobe Operation) Either logic level may be used as selected by jumpers on PCB pads, 5, 6 and 7.
36	14	Data word strobe	Single line which accepts a 500 ns, or longer, pulse to load the data word portion of the program data into the 4200-09 assembly. (Refer also to Dual-Strobe Operation) Either logic level may be used as selected by jumpers on PCB pads 22, 23 and 24.
9	12	Poll status	Single line used to poll status (Vcc failure and current limit mode). A logic 0 causes the generation of Vcc and current limit status of their respective outputs.
29	22	Polled current limit flag	Single line which generates a logic 0 when the polled 4200 is in the current limit mode.
28	21	Polled power-off flag	Single line which generates a logic 0 when the Vcc supply of the polled 4200 fails (power off).
	23	Abnormal status	Single line which generates a logic 0 whenever the 4200 goes to the current limit mode or the Vcc supply fails (power off). This status lines does not need to be polled.
30	27	Vcc	Single line which provides Vcc to the status logic on the 4200-09. (This is necessary in order to obtain polled power-off status when power is off.) Current requirement is two milliamperes per power source.
16	25	Ready Flag	Single line which provides a logic 0 when any 4200-09 is not ready to receive a strobe signal. This signal is present while the 4200 is changing output voltage as result of a previous strobe signal.

Table 6-2. INPUT/OUTPUT SIGNALS, BINARY PROGRAM SOURCE (Sheet 1 of 2)

PIN NUMBER		SIGNAL NAME	DESCRIPTION
50-PIN CONN.	56-PIN CONN.		
42, 19, 44, 43, 24, 25, 8, 38, 10, 11, 40, 39, 14 & 12		Voltage output magnitude	Fourteen lines used to program the output voltage with a binary word. The least significant bit (pins 12 and B) is 2^0; the most significant bit (pins 42 and P) is 2^{13}.
13	32	Strobe control	Single line used to steer the control strobe signal to transfer either the control word portion of the program data or the data portion of the program data. (Refer also to Single Strobe Operation) Either logic level may be used to strobe either portion of the program data, as selected by jumpers on PCB pads 2, 3 and 4.
26	53	Polarity (Sign)	Single line to program output polarity. Either polarity can be programmed by either logic level as selected by jumpers on PCB pads W, X and Y.
1	27	Output magnitude range	Single line to program output magnitude range on those voltage sources requiring range selection. (Logic 1 = high range, Logic 0 = low range)
31	55	External reference	Single line to program external reference mode on those voltage sources equipped with the external reference option. (Logic 1 = ext reference, Logic 0 = int reference.)
2	28	Current limit range	Single line to program range of current output limiting on those voltage sources equipped current limit selection. (Logic 1 = 1 amp range, Logic 0 = 100 mA range.)
37, 35, 5 & 3	4, 3, 2 & 1	Current limit magnitude	Four lines to select the current limit value, expressed as a percentage of the programmed range. Up to 120% can be programmed. Any attempt to program 0% results in 10%.
17	45	Standby/operate (address zero)	Single line used to select the standby or operate mode of the voltage source. Either mode can be programmed by either logic level as selected by jumpers at PCB pads 18 and 19.
23, 22, 34	46 thru 52	Standby/operate (addresses one through seven)	Seven lines (through connections) used at select the stand-by or operate mode of up to seven succeeding voltage sources.
20	12	Instrument mainframe (address zero)	Single line used to address the voltage source in order to perform any programming function. The addressing signal must be present in order for any strobe signal to be recognized by the 4200-09 logic. Addressing may be by either logic level as selected by jumpers at PCB pads 8, 9 and 10. Refer also to Addressing Multiple Mainframes.

Table 6-2. INPUT/OUTPUT SIGNALS, BINARY PROGRAM SOURCE (Sheet 2 of 2)

PIN NUMBER		SIGNAL NAME	DESCRIPTION
50 - PIN CONN.	56-PIN CONN.		
21 & 45 thru 50	5 thru 11	Instrument mainframe addresses one thru seven	Seven lines (through connections) used to address up to seven succeeding voltage sources.
18	13	Control Word Strobe	Single line which accepts a 500 ns, or longer, pulse to load the control word portion of the program data into the 4200-09 assembly. In a single-strobe system, also loads the data word portion of the program data when the Strobe Control level is in the opposite state. (Refer also to Single-Strobe and Dual-Strobe operation) Either logic level may be used, as selected by jumpers at PCB pads 5, 6 and 7.
36	14	Data word strobe	Single line which accepts a 500ns, or longer, pulse to initiate the transfer of the data word portion of the program data. (Refer also to Multi-Strobe Operation) Either logic level may be used as selected by jumpers on PCB pads 22, 23 and 24.
9	12	Poll status	Single line used to poll status (Vcc failure and current limit mode). A logic 0 causes the generation of Vcc and current limit status at their respective outputs.
29	22	Polled current limit flag	Single line which generates a logic 0 when the polled 4200 is in the current limit mode.
28	21	Polled power-off flag	Single line which generates a logic 0 when the Vcc supply of the polled 4200 fails (power off).
27	23	Abnormal status	Single line which generates a logic 0 whenever the 4200 goes to the current limit mode or the Vcc supply fails (power off). This status line does not need to be polled.
30	24	Vcc	Single line which provides Vcc to the status logic on the 4200-09. (This is necessary in order to obtain polled power-off status when power is off.)
16	25	Ready flag	Single line which provides a logic 0 when the 4200-09 is not ready to receive any strobe signals. This signal is present while the 4200 is changing output voltage as a result of a previous strobe signal.

TABLE 6-3. 4200-09 JUMPER REQUIREMENTS (Sheet 1 of 2)

DESIRED CONDITION	REFERENCE TEST (paragraph number)	MAKE JUMPER CONNECTIONS
Sixteen-bit data word; eight-bit control word	6-9	T to U
Eighteen-bit data word; six-bit control word	6-9	T to S
BCD data word - positive true	6-15	W to V, J to L, M to K
BCD data word - negative true	6-15	W to V, J to K, M to L
Binary data word - positive true	6-15	W to X, J to L, M to K
Binary data word - negative true	6-15	W to Y, J to K, M to L
Control word - positive true	6-19	N to R
Control word - negative true	6-19	N to P
Polarity bit in 18-bit BCD data word; or in eight-bit control word (see pads S, T and U)	6-21	14 to 15, 16 to 17, H to F, E to B, D to C
Polarity bit in 16-bit binary data word as last bit (see Figure 6-5)	6-21	17 to 14, H to G, A to B
Standby/operate bit synchronous and positive-true (standby = true)	6-23	19 to 16, N to R
Standby/operate bits synchronous and negative-true (operate = true)	6-23	20 to 16, N to P
Standby/operate bit asynchronous and positive-true (standby = true)	6-23	19 to 20
Standby/operate bit asynchronous and negative-true (operate = true)	6-23	18 to 20
Single-strobe operation (binary data only) with true (pos.) strobe control to load control word	6-26	2 to 4, 11 to 12
Single-strobe operation (binary data only) with true (pos.) strobe control to load data word	6-26	3 to 4, 11 to 12
Dual-strobe operation (BCD or binary data)	6-26	1 to 4, 11 to 13
Control word strobe - positive	6-30	5 to 7

Table 6-3. 4200-09 JUMPER REQUIREMENTS (Sheet 2 of 2)

DESIRED CONDITION	REFERENCE TEST (paragraph number)	MAKE JUMPER CONNECTIONS
Control word strobe - negative	6-30	22 to 23
Data word strobe - positive	6-30	23 to 24
Data word strobe - negative	6-30	8 to 10
Mainframe address line enable-positive	6-37	8 to 10
Mainframe address line enable-negative	6-37	9 to 10
Data transferred by control word strobe	6-39	$\overline{G}$ to $\overline{H}$, $\overline{D}$ to $\overline{E}$
Data transferred by data word strobe	6-39	$\overline{E}$ to $\overline{F}$, $\overline{H}$ to $\overline{J}$
Data transferred by data word strobe or control word strobe	6-39	$\overline{E}$ to $\overline{F}$, $\overline{G}$ to $\overline{H}$
Complement last bit of data word	6-48	$\overline{A}$ to $\overline{B}$
Not-complement last bit of data word	6-48	$\overline{A}$ to $\overline{B}$

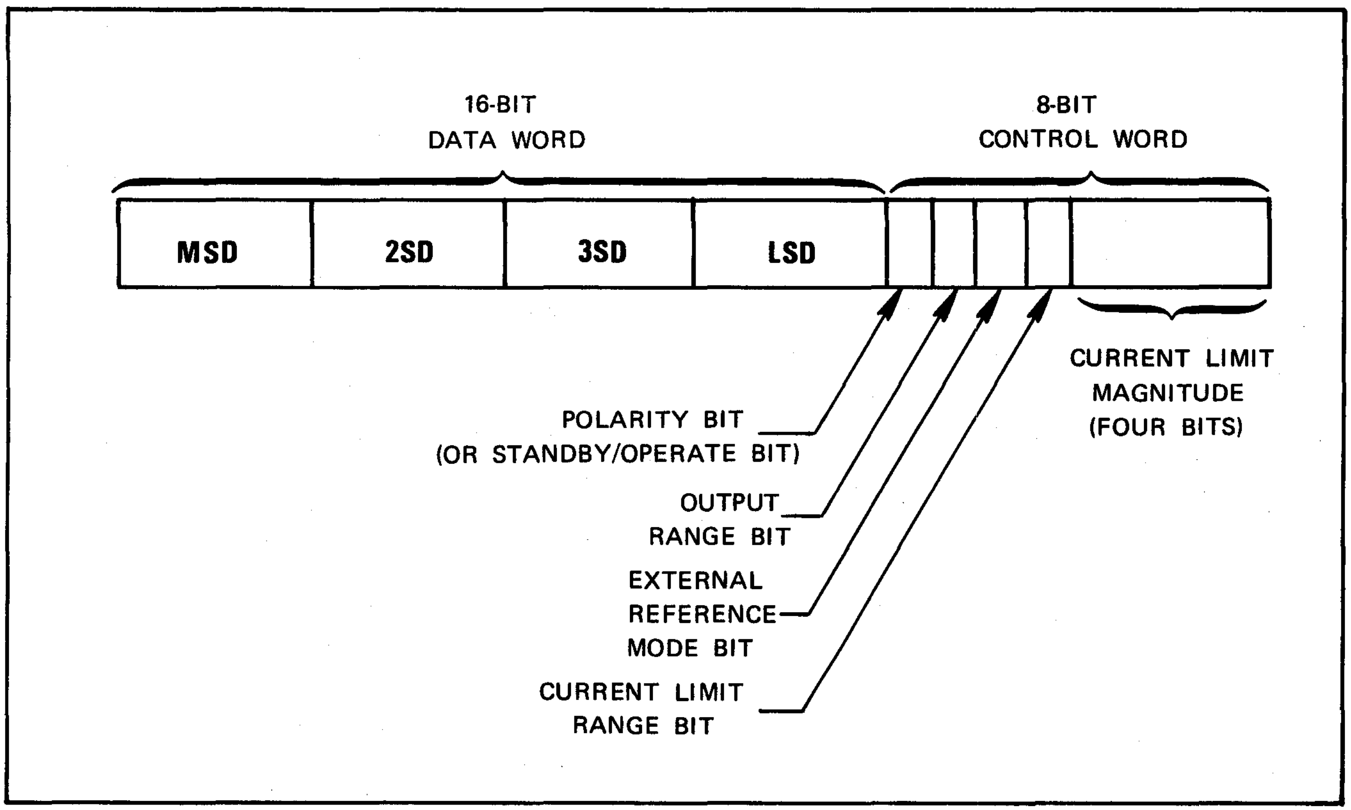


Figure 6-3. BCD PROGRAM DATA, TYPICAL 16-BIT DATA WORD, 8-BIT CONTROL WORD

6-12. When the power source to be programmed requires only output magnitude, polarity and range data, an 18-bit data word, as illustrated in Figure 6-4, can be used without the control word. The control word is necessary when it is required to program the external reference function and current limiting. To obtain an 18-bit data word, jumper pad T to pad S.

6-13. Binary-Type Voltage Sources

6-14. As shown in Figure 6-5, both 16-bit and 18-bit data words may be used with binary-type voltage sources. As described for the BCD-type voltage sources, either the 16-bit or 18-bit data word may be selected, depending upon the system and voltage source requirements. That is, if the voltage source is not equipped with external reference and current limit magnitude selection, the six-bit control word is of no value and an 18-bit data word provides sufficient program data.

6-15. DATA WORD POLARITY

6-16. BCD –Type Voltage Sources

6-17. The 16 or 18 bits which make up the data word portion of the program data may be either positive-true or negative-true as determined by jumpering pads J, K, L, M, V and W. For either logic polarity of BCD data, pad V is jumpered to pad W. For positive-true logic, jumper pad J to pad L and pad M to pad K. For negative-true logic, jumper pad J to pad K and pad L to pad M. (Refer also to Table 6-3.)

NOTE!

Positive-true logic employs +5 volts for a logic 1 and zero volts for a logic 0.

6-18. Binary-Type Voltage Sources

6-19. The logic polarity (i.e. positive-true or negative-true) of the binary data word is determined in much the same manner as that described for the BCD data word. However, pad W is jumpered to pads X or Y (Refer to Table 6-3) instead of pad V.

6-20. CONTROL WORD POLARITY

6-21. The logic polarity for the control word, in either BCD or binary voltage sources, is determined by jumpers at pads N, P and R. If the control word uses positive-true logic, jumper pad N to pad R. If the control word uses negative-true logic, jumper pad N to pad P.

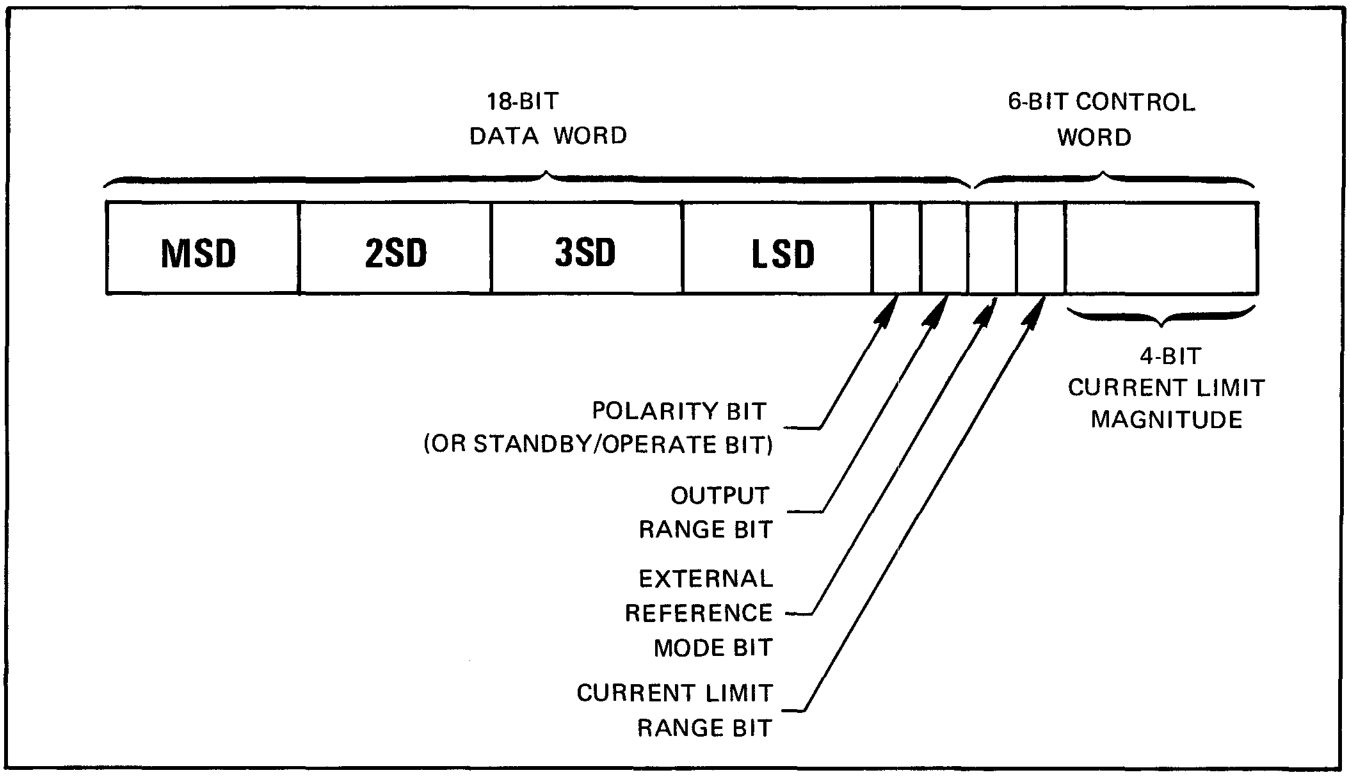


Figure 6-4. BCD PROGRAM DATA, TYPICAL 18-BIT DATA WORD, 6-BIT CONTROL WORD

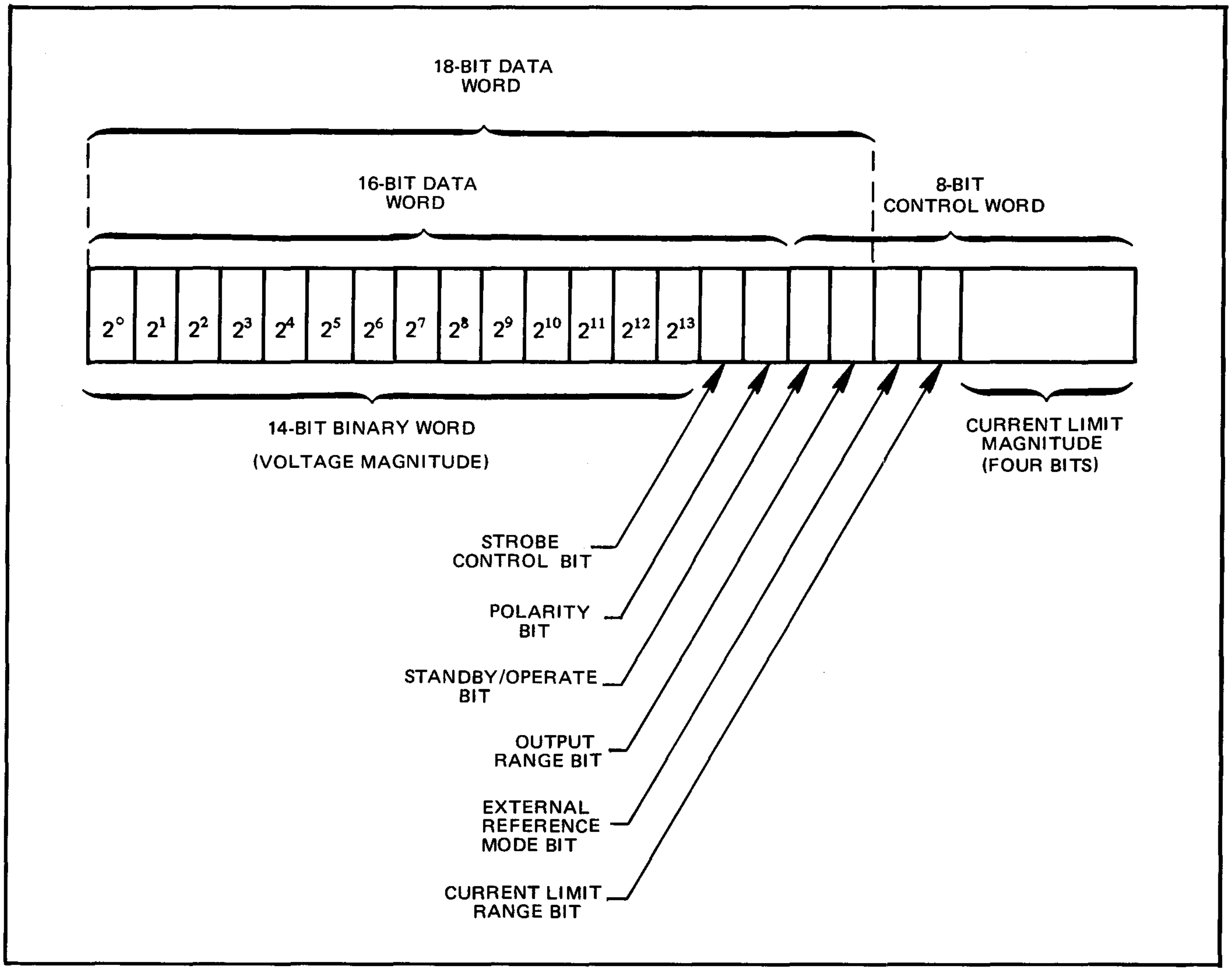


Figure 6-5. BINARY PROGRAM DATA, TYPICAL 16-BIT AND 18-BIT DATA WORDS

6-22. OUTPUT VOLTAGE POLARITY BIT LOCATION

6-23. Selection of the voltage source output polarity (positive or negative) is made by means of a polarity bit which may be placed in an 18-bit BCD data word, an eight-bit control word, or a 16-bit binary data word. The placement of the polarity bit in the 18-bit BCD data word or the eight-bit control word (BCD or binary programming) is determined by the Data Word/Control Word Length assignment; i.e. pads S, T and U. Refer to Table 6-3 for pad jumpering details to place the polarity bit in the 18-bit BCD data word or the 16-bit binary data word.

6-24. STANDBY/OPERATE – SYNCHRONOUS OR ASYNCHRONOUS

6-25. Each of the 4200 series power sources can be commanded to the operate and standby modes by means of a unique standby/operate line from the program source. The standby/operate command can be jumpered so that it is synchronous with the transfer of the data word and/or control word. The standby/operate command can also be jumpered so that it is asynchronous. That is, the particular power source goes to the standby or operate mode immediately upon command by the program source, without waiting for a program data transfer function (strobe pulse).

6-26. To make the standby/operate command synchronous, a standby/operate bit crosses the guard as the first bit of an eight-bit control word, as shown in Figure 6-5. To make the standby/operate command synchronous, jumper pad 19 to pad 16 and pad N to pad R (for standby true) or pad 20 to pad 16 and pad N to pad P (for operate true). To make the standby/operate command asynchronous (independent of program data transfers), jumper pad 19 to pad 20 for standby-true, or pad 18 to pad 20 for operate true.

6-27. SINGLE/DUAL – STROBE OPERATION

6-28. The 4200-09 can program output voltages in both single-strobe and dual-strobe modes. BCD-type voltage sources are usually operated in the dual-strobe mode, while binary-type voltage sources may be operated in either mode. The single-strobe mode refers to the use of a single strobe line (but two strobe pulses) to load both the data word and the control word from the program source into the 4200-09 assembly. Which of the two words (data or control) loaded depends upon the logic level applied to the strobe control line. In single-strobe operation, the binary data word is into the 4200-09 storage resistors (in preparation for transfer to the voltage source) by placing the proper logic level on the strobe control line (Refer to Table 6-3 for strobe control line logic levels) and placing a strobe pulse on the control word strobe line (pin 18). The control word is loaded into storage registers by placing the opposite logic level on the strobe control line and placing a second strobe pulse on the control word strobe line. In this manner, a single strobe line is used to load both the data and control words into storage registers by changing the logic level on the strobe control line. This system is usually used with binary program and voltage sources.

6-29. The dual-strobe mode refers to the use of two separate strobe pulses on two separate lines to load the data word and control word from the program source into storage registers in preparation for transfer to the voltage source. This mode is usually used when the data word is BCD. The data word strobe line (pin 36) is used to load the 16-bit or 18-bit data word, while the control word strobe line is used to load the control word.

6-30. To operate the 4200-09 in the single-strobe mode, jumper pad 2 to pad 4 and pad 11 to pad 12, if a positive strobe control signal level is used to load the control word; or jumper pad 3 to pad 4, and pad 11 to pad 12, if a positive strobe control signal level is used to load the data word. To operate in the dual-strobe mode, jumper pad 1 to pad 4, and pad 11 to pad 13.

6-31. CONTROL/DATA WORD STROBE SIGNALS

6-32. Control Word Strobe, Single-Strobe Mode

6-33. The control word strobe signal is a 500 nanosecond, or longer, pulse which is issued by the program source after the control word and/or data word has been applied to the parallel data inputs of the 4200-09 assembly. In the single-strobe mode, the control word strobe is used to load the control word from the program source into the 4200-09 storage registers when the strobe control line is at the appropriate logic level (determined by pads 2, 3 and 4). When the strobe control line is at the other logic level, the control word strobe loads the data word into the registers. If the control word strobe is a positive-going (zero to +5Vdc) pulse, jumper pad 5 to pad 7. If the control word strobe is a negative-going (+5Vdc to zero) pulse, jumper pad 6 to pad 7.

6-34. Control Word Strobe, Dual-Strobe Mode

6-35. As in the single-strobe mode, the control word strobe is a 500 nanosecond, or longer, pulse which is issued by the program source, the program data is applied to the parallel inputs of the 4200-09 assembly. In the single-strobe mode, the control word strobe load the control word only, into the storage registers. (The data word is transferred by a data word strobe signal.) If the control word strobe is a positive-going pulse, jumper pad 5 to pad 7. If the control word strobe is a negative-going pulse, jumper pad 6 to pad 7.

6-36. Data Word Strobe

6-37. The data word strobe signal is used in the dual-strobe mode to load the data word, applied to the parallel data word inputs of the 4200-09 assembly, into the storage registers. The data word strobe is a 500 nanosecond, or longer, pulse which is issued by the program source after the data word has been applied to the parallel inputs of the 4200-09 assembly. If the data word strobe is a positive-going (zero to +5Vdc) pulse, jumper pad 8 to pad 10. If the data word strobe is a negative-going (+5Vdc to zero) pulse, jumper pad 9 to pad 10.

6-38. MAINFRAME ADDRESS SIGNAL LEVEL

6-39. In order for the 4200-09 to receive and program data, it must be addressed at the time of the strobe signal (s). The mainframe address signal is a +5 volt or ground level signal applied to the address line number zero of the 4200-09 to be addressed (Refer also to paragraph 6-53). If a +5 volt signal is to be used for mainframe addressing, jumper pad 8 to pad 10. If a ground level is to be used, jumper pad 9 to pad 10.

6-40. PROGRAM DATA TRANSFER

6-41. General

6-42. The generation of the control word strobe and data word strobe signals by the program source loads the program data into storage registers within the 4200-09 assembly. From the storage registers, the program data (control word and data word) is transferred in serial fashion (bit-by-bit) across the guard shield to the digital-to-analog converter within the voltage source. The serial transfer of program data is initiated after a short delay by the trailing edge of the control word strobe, or the data word strobe, or both, as determined by pads D, E, F, G, H and J.

NOTE!

The power source output voltage does not change to the newly programmed value until data transfer is completed.

6-43. Data Transfer By Control Word Strobe

6-44. To initiate the transfer of the program data (the control word and the data word) from the storage registers to the digital-to-analog converter within the power source by means of the control word strobe, jumper pad G to pad H. To prevent data transfer at the occurance of a data word strobe, jumper pad D to E.

6-45. Data Transfer By Data Word

6-46. To initiate transfer of the program data by means of the data word strobe, jumper pad E to pad F. To prevent data transfer at the occurance of a control word strobe, jumper pad H to pad J.

6-47. Data Transfer By Control Word Or Data Word Strobe

6-48. To initiate transfer of the program data by means of either the control word strobe or the control word strobe, jumper pad E to pad F, and pad G to pad H.

6-49. COMPLEMENTING BINARY PROGRAM DATA

6-50. Binary data words supplied by the program source which represent negative voltage outputs are two's complemented, and must be re-complemented in order to obtain the required output polarity at the power source. When jumpering is performed to receive binary data from the program source (pads J, K, L, M, W, X, Y), complementing to accomodate data word polarity is automatically performed. However, additional jumpering is required in order to properly handle the polarity indication for the binary data word (power source output magnitude). The polarity (positive or negative) of the power source output may be indicated by means of:

a. the last (16th) bit of the binary data word.

b. a polarity bit as part of the control word.

6-51. If the polarity is indicated in the last bit of the binary data word, following the 14-bit magnitude data and strobe control bit (as shown in Figure 6-5), it must not be complemented along with the data word. To prevent this last bit of the data word from being complemented, jumper pad A to pad B. If the polarity is indicated by a bit within the control word, the entire data word should be complemented (when necessary) by jumpering pad A to pad C. (This is only necessary when transferring all 16 bits of binary data to a 4275A.)

6-52. ADDRESSING MULTIPLE MAINFRAMES

6-53. Up to eight separately addressable 4200 series power sources may be connected to a single program source when each are equipped with the 4200-09. Figure 6-2 shows the method of multiple power source connections using factory-manufactured cable assemblies. The power source electrically closest to the program source is numbered zero, and the succeeding power sources are numbered in ascending order, up to seven. The mainframe address signals, which are +5 volts or ground levels, are supplied to the power sources for the duration of the programming sequence. All mainframe address signals must be applied to the mainframe address inputs of the first power source (number zero). That is, the program source is only connected directly to the first power source, and connection to subsequent power sources is handled by means of through connections on the 4200-09 assembly.

6-54. The mainframe address signals may be either +5 volts or ground as determined by jumpers 8, 9 and 10. All signals are applied to the mainframe address lines of the first 4200-09 mainframe, address line number zero enables the first 4200-09 mainframe, to accept program data and strobe signals. As shown in Figure 6-6, mainframe address line number one is fed through the first 4200-09 to exit at its zero address output for application to the next power source. The mainframe address lines are shifted by one position each time they pass through a 4200-09. In this manner, each power source is directly addressed at its zero address input although the program source selects the

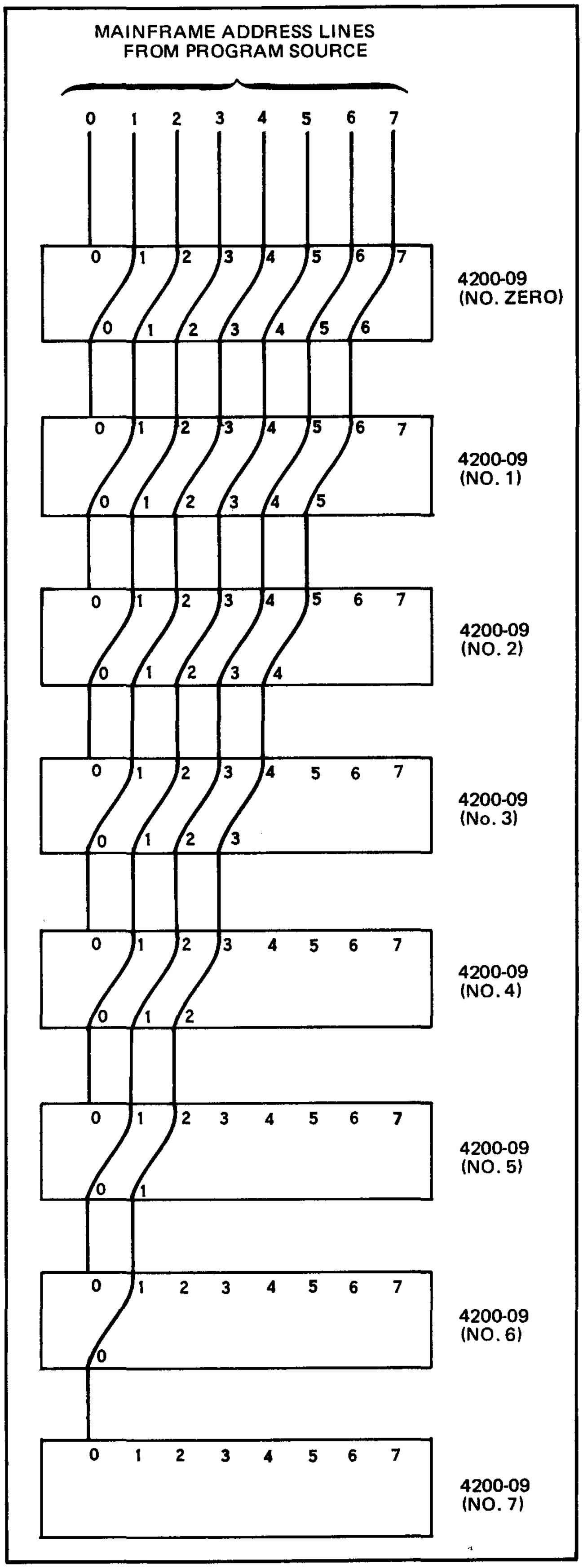


Figure 6-6. MULTIPLE MAINFRAME ADDRESSING

different 4200-09 assemblies at the mainframe address lines on the first 4200-09 (number zero). Several power sources may be addressed at one time, and each will receive the program data. Table 6-4 lists the pin numbers of the 50-pin connector (located on the rear panel of the first power source) on which the different 4200-09 assemblies are addressed by the program source.

Table 6-4. MAINFRAME ADDRESSES – PIN ASSIGNMENTS

POWER SOURCE MAINFRAME ADDRESS	PIN NUMBER (50-pin connector on power source no. zero)
0	20
1	50
2	49
3	48
4	47
5	46
6	45
7	21

NOTE!

In single-strobe binary operation, the mainframe address need only be present when transferring the control word. When transferring the data word, the power source which last received a control word is automatically addressed, unless another mainframe address is specified.

6-55. CHECKING STATUS

6-56. Introduction

6-57. The 4200-09 provides four separate status indicators (flags) which are bussed with the status flags from all other power sources in the system, back to the program source. The four status flags are provided on four separate lines and include the following:

a. Abnormal status (power-off or current limit) flag.

b. Polled current limit flag.

c. Polled power-off flag.

d. Not ready flag.

NOTE!

All flag lines are wire-ored to an open collector bus. Pull-up resistors are required in the program source interface to enable the flags to reach +5 volts.

6-58. Status checking the 4200-09 is typically handled by the program source in such a manner that the abnormal status flag is allowed to interrupt. As a result of the interrupt, the program source may poll each 4200-09 in the system while monitoring the polled current limit flag bus and polled power-off flag bus for a flag indication. The not ready flag is not polled, and when present, indicates that one or more power sources is still acting on program commands, and is not yet ready to receive further commands.

6-59. Polled Current Limit Flag

6-60. As shown in Figure 6-7, the polled current limit flag bus appears on pin 29 (on the 50-pin connector) of any 4200-09 in the system. The flag is polled by placing a ground level on the poll status input (pin 9) of the particular 4200-09 being polled. If the current limit flag bus responds with +5 volts, the current limit condition for the polled power source does not exist. However, if the current limit flag bus responds with a ground level, the current limit condition does exist, and an overloaded power source is indicated.

6-61. As illustrated in Figure 6-7, the poll status inputs to several 4200-09 in a system are not normally bussed together, but may be individually polled by the program source. A typical method of polling the status is to jumper the mainframe address line (number zero) from pin number 20 to the poll status input at pin number 9. In this manner, status is available at the current limit flag bus (and the power-off flag bus) whenever the particular 4200-09 is addressed.

6-62. Polled Power-Off Flag

6-63. Polling the power-off flag is identical to that described for the current limit flag except some external source of +5 volts must be applied to pin number 30. The +5 volt source is required in order to obtain the power-off status indication when the power to the polled unit has actually failed. The power-off status indication is a ground level on the power-off flag bus.

6-64. INPUT LOADING

6-65. Each input to each 4200-09 used in the system represents a single TTL input load. With a full complement

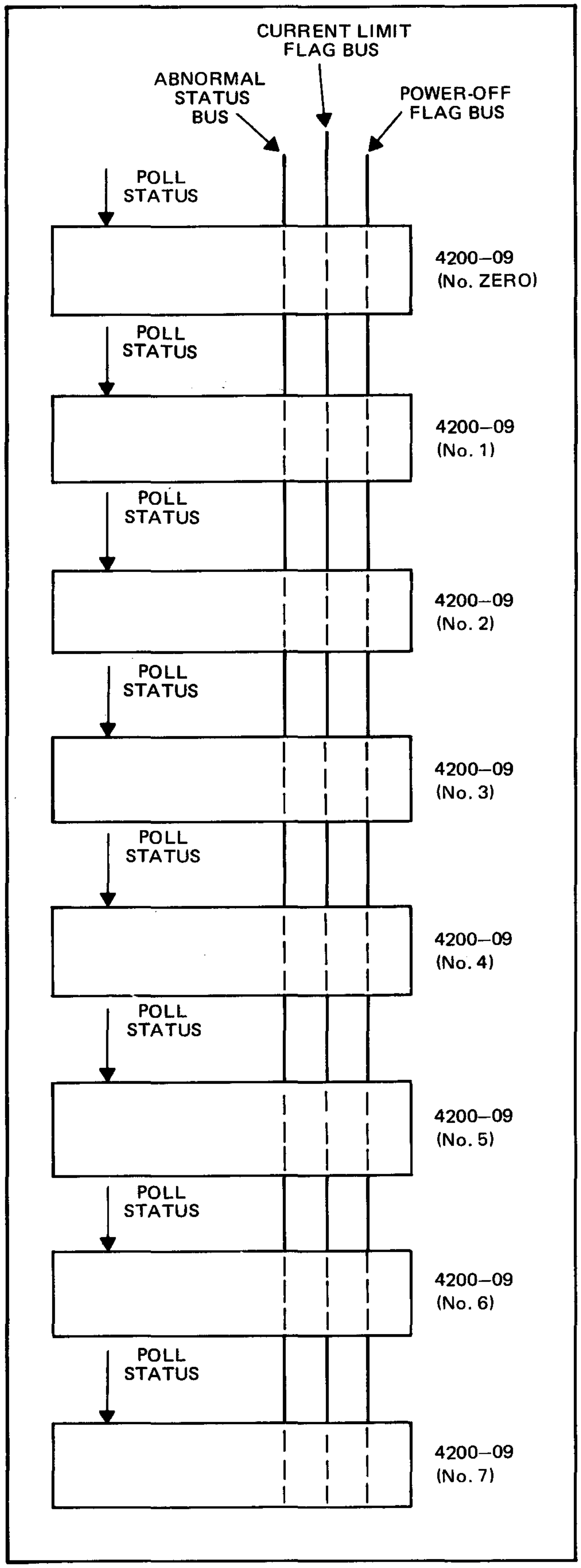


Figure 6-7. STATUS BUSSES LAYOUT

of eight power sources in the system, the power requirements for each input of the first power source are increased by a factor of eight, except for the Mainframe Address and the Standby/Operate which are always single loads.

6-66. THEORY OF OPERATION

6-67. General Description

6-68. The 4200-09 can be configured (by means of jumpers) to accomodate a large number of program environments. Consequently, theory discussions are somewhat generalized, since all configurations cannot be described. In any application, the main function of the 4200-09 is to receive output magnitude and control data from a program source in parallel form, transfer the data across the power source guard shield, and present the data to the power source digital-to-analog converter. Figure 6-8 shows a simplified block diagram of the 4200-09 and how the data and control words, generated by the program source in parallel form, are applied to shift registers which perform a parallel-to-serial conversion.

6-69. Upon the receipt of a data word strobe or control word strobe, the control logic generates a load command to one or both shift registers. The data word and control word supplied by the program source, and present at the shift register inputs, is loaded into the shift registers. When the shift registers are loaded with the program data, the control logic starts a 10 MHz clock and issues a hold command to the power source.

6-70. The output pulses from the clock are fed to the shift registers to move the program data out of the registers, bit-by-bit, to the coupling transformers at the guard shield. The data word is shifted out of its respective storage register via two's complementing logic which is enabled when the program source indicates that the data word is a negative binary number. This action is necessary since the 4200 binary power source requires positive binary numbers (in conjunction with a positive or negative polarity indicator). The control word undergoes no complementing at any time.

6-71. While the program data is being shifted across the guard shield by the clock pulses, the clock pulses are also being fed across the guard shield, and the hold one-shot is triggered as a result of the hold command issued by the control logic. On the inside of the guard shield, the clock pulses are used to shift the serial program data into shift registers which provide the necessary serial -to-parallel conversion. (The 4200 power sources require parallel program data.) The output of the hold one-shot is present for the duration of the serial data transfer across the guard shield. This action is necessary to inhibit any change in power source output magnitude while the data word is being serially loaded into the shift register.

6-72. The control word portion of the program data is also loaded into a shift register, and is double-buffered to prevent any change in power source output while loading is taking place. The double-buffering is provided by a series of latch circuits which receive a load pulse from a latch timing circuit. The latch timing circuit issues the load pulse to the latch circuits sometime after the last clock pulse when all data has been shifted into the registers. As the load pulse occurs, the latch circuits are loaded with the control word and present it in parallel form to the 4200 power source. (Double-buffering for the data word is not required since the hold signal "freezes" the power source output magnitude until the data word is completely loaded into the shift register.)

6-73. The shifting and loading of the program data is performed by the clock pulses. The start of the clock pulses is a function of the control logic. The stopping of the clock is also performed by the control logic, but after the generation of 16 pulses. When the clock is stopped, all shifting action ceases; and after the fold signal disappears and the load pulse to the latch occurs, all program data is presented to the digital-to-analog converter within the 4200 power source. At this time, the power source assumes its newly programmed output.

6-74. BLOCK DIAGRAM ANALYSIS

6-75. Input Sequence

6-76. Figure 6-9 shows that the parallel program data, supplied by the program source, is applied to a pair of shift registers as well as to the succeeding 4200 power source (s) in the system. The data is loaded into the register (s) when the appropriate strobe signal is received from the program source.

6-77. In a device configured for single-strobe operation, the control word strobe signal (in conjunction with the strobe control line) is used to load both the data word and control word into their respective registers. The strobe signal gating accepts the control word strobe from the program source, and depending upon the state (+5 volts or ground) of the strobe control line, directs the strobe signal to either the control word one-shot or the data word one-

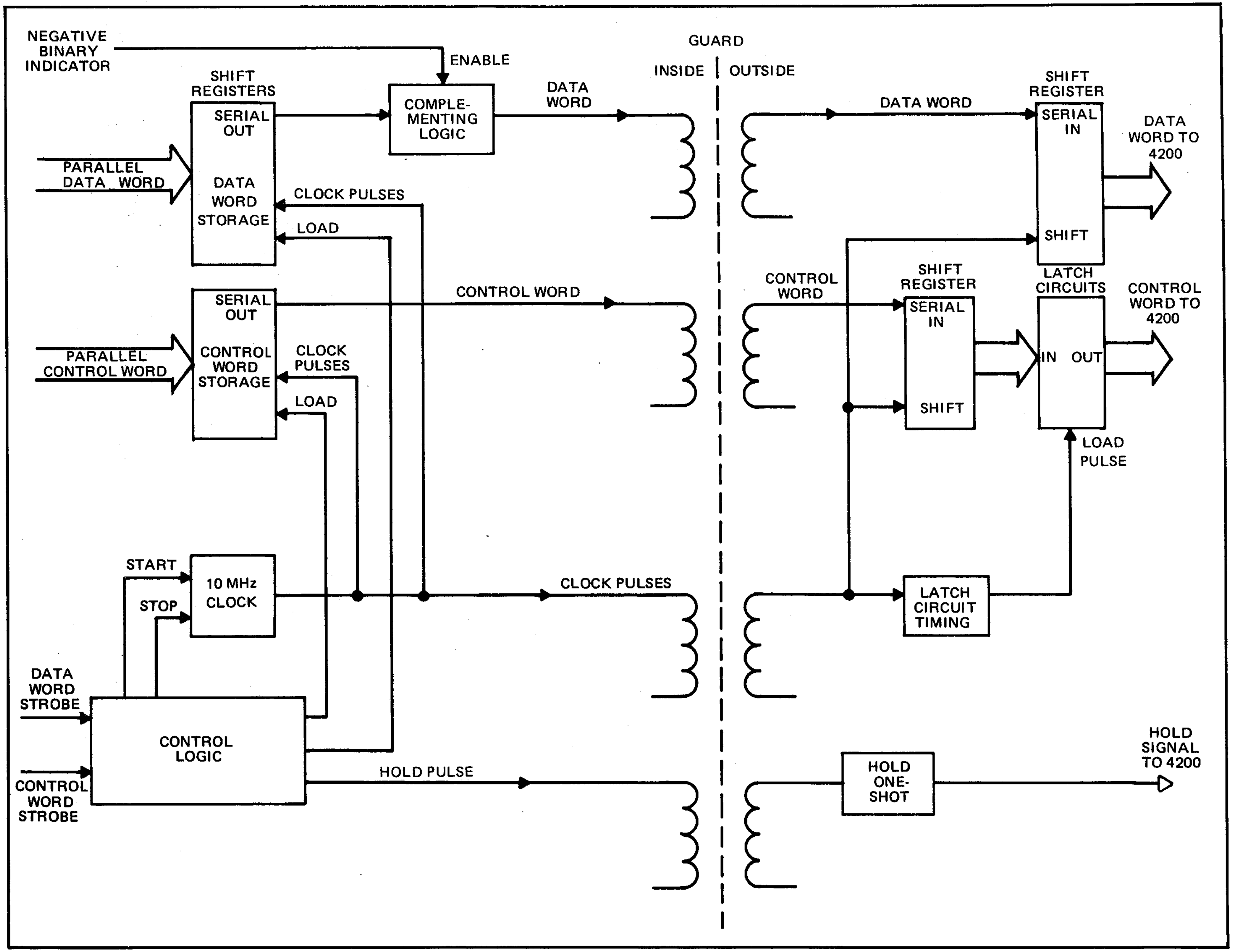


Figure 6-8. 4200-09, SIMPLIFIED BLOCK DIAGRAM

shot. If the strobe control line directs the control strobe pulse to the control word one-shot, a pulse is generated and fed to the parallel-load input of the control word shift register. The pulse causes the shift register to load the parallel control word supplied by the program source. If the strobe control line directs the control strobe pulse to the data word one-shot, a pulse is fed to the parallel-load input of the data word shift register.

NOTE!

In order for the control word strobe (or the data word strobe) to trigger either of the one-shots, the mainframe address line must be enabled.

6-78. In a device configured for dual-strobe operation, both the control word strobe and data word strobe signals are used to load the program data from the program source. In this configuration, the control word strobe triggers the control word one-shot to load the control word into its shift register, and the data word strobe triggers the data word one-shot to load the data word. (Refer also to Figure 6-10.)

6-79. Data Transfer

6-80. Whenever the control word one-shot or data word one-shot is triggered, the resulting output triggers a first hold one-shot. (Refer also to Figure 6-10.) One output of the hold one-shot produces a hold pulse which is fed across the guard shield (via T2) to trigger a second hold one-shot. The second hold one-shot generates a hold pulse required by the power source to hold the output magnitude at the current value while magnitude data is being re-programmed.

NOTE!

The duration of the hold pulse depends upon the particular power source being used.

6-81. The trailing edge of the other first hold one-shot output (triggered by the strobe signal), sets a data transfer flip-flop. The Q output of the data transfer flip-flop starts a 10 MHz clock, if not already operating (refer to Standby Sequence), and gates the clock pulses to the serial shift inputs of the control word and data word shift registers. (The clock pulses are also gated to the input of a ÷ 16 counter and to the primary winding of T4.) As each clock pulse is received by the shift registers, the previously loaded program data is shifted, serial-by-bit out of the shift registers to the coupling transformers (T3 and T5) at the guard shield. On the inside of the guard shield, the serial data and control words are loaded into a second set of shift registers which are clocked by the pulses at the secondary of T4.

6-82. The clock pulses gated by the data transfer flip-flop are also fed to a 4-bit binary counter which produces a carry pulse at the time of the sixteenth clock pulse. The carry pulse resets the data transfer flip-flop to inhibit the gating of the clock pulses and stop the clock, if the standby mode is not present. (Refer to Standby Sequence.) After the generation and gating of 16 clock pulses the data word has shifted completely around the data word shift register while being transformer-coupled across the guard and into the second shift register for application to the 4200 power source. The control word, since it contains eight bits or less, is actually shifted around the control word register, across the guard and into the second control word register two complete times.

6-83. The control word is double-buffered for application to the 4200 power source. This is necessary since the hold signal, provided during data transfer by the second hold one-shot, does not "freeze" the output range of the 4200 power source, just the output magnitude. To parallel shift the control word from the shift register to a set of latch circuits, the first of the 16 clock pulses triggers a latch timing one-shot which has a pulse width slightly greater the serial data transfer time (16 clock pulses). The trailing edge of the latch timing one-shot output is fed to a pulse generator which provides a load pulse to the latch circuits. At the time of the load pulse, the latch circuits are parallel loaded with the control word for application to the 4200 power source.

6-84. Complementing Binary Data

NOTE!

Complementing magnitude data occurs only in binary-type power sources.

6-85. Binary-type power sources require that negative values of magnitude data be two's complemented since binary program sources usually indicate polarity by means of a single bit and supply two's complemented magnitude data for negative outputs. The binary-type power sources require non-complemented binary data plus a polarity bit. As a result, negative binary magnitude data, consisting of complemented data, must be re-complemented to satisfy the requirements of the power source. When the binary program source indicates negative sign, U14 is enabled to pass the output of the complementing logic. The complementing logic receives the serial output of the shift registers, complements it, and passes it across the guard via T1.

6-86. Operation of the two's complementing logic is such that the first bit of serial data is present at the output of the shift registers before the ÷ 16 counter and a complement flip-flop receives the first of 16 clock pulses. At this time, the ÷ 16 counter is in its zero state and the complementing flip-flop is still reset (as a result of the carry pulse generated by the ÷ 16 counter at the end of the previous data transfer sequence). With the complement flip-flop reset, the complement logic is not enabled and no inversion of serial data takes place. This condition permits the first bit of binary magnitude data to be transferred without being complemented. However, after the first clock pulse, the complement flip-flop may be allowed to go set (to enable the complement logic), depending upon the state of the J input, which is derived from the serial data. As a result, the complement flip-flop goes set at the time of the first true bit of serial data to enable the inverting logic and complement the remaining bits of serial data. After the 16th bit of data, the complementing flip-flop is reset by the carry output of the ÷ 16 counter.

6-87. Programming the 4200 power source to standby (zero output, but no change in programmed magnitude and range) may be performed in a synchronous or asynchronous manner, depending on jumper configuration. With synchronous standby operation, (not shown in Figure 6-9) the standby bit supplied by the program source becomes part of the control word and is serially shifted across the guard for application to the standby input of the 4200 power source. This mode is referred to as synchronous standby because commanding the 4200 power source to standby or operate is always synchronous with a strobe signal from the program source.

6-88. Asynchronous Standby Operation

6-89. With asynchronous standby operation, the 4200 power source can be commanded to standby or operate at any time by the program source. As shown in Figure 6-9, the standby signal (dc) is gated to the start input of the 10 MHz clock to initiate the generation of clock pulses (if not already being generated during a data transfer sequence of 16 clock pulses). As long as a data transfer sequence is not in progress, the data transfer flip-flop is in its reset state. When the data transfer flip-flop resets the clock pulses are gated through to the primary winding of T6 and are inhibited (by the Q output) from the shift registers and ÷ 16 counter. The secondary winding, located inside the guard, feeds the clock pulses to a half-wave rectifier. The dc output of the rectifiers is fed to the 4200 power source standby/operate input.

6-90. Status Logic

6-91. Two separate status conditions are indicated by the power source equipped with the 4200-09, i.e. current limit mode status and power failure. The current limit status flag is furnished by the 4200 power source whenever an overload condition exists and the current limit function is being used. The power failure indication is provided by the 4200-09.

6-92. The current limit flag is fed from the 4200 power source to enable a current limit oscillator on the 4200-09 (Refer to Figure 6-9). The oscillator output signal is coupled to the outside of the guard via T1, and to the input of a half-wave rectifier. The dc output of the rectifier indicates the current limit condition and appears at the abnormal status output. The current limit flag is also available at the current limit flag output when the program source addresses the unit with a status enable signal.

6-93. The power fail flag results from the failure of the +5 volt supply to the 4200-09, which is indicative of a general power failure within the power source. As in the current limit flag, the power fail flag appears on the abnormal status line, and on the power fail flag output when the unit is addressed with a status enable signal.

6-94. Not Ready Signal

6-95. The 4200-09 generates a not-ready signal to the program source whenever it is not ready to accept program data or strobe signal (s) from the program source. As shown in Figure 6-9 and 6-10, the not ready flag one-shot is triggered by the trailing edge of the first hole one-shot output to generate the not ready flag. The duration of the not ready flag is through the data input sequence to notify the program source that the data is being transferred to the power source and no strobe signal should be generated at this time. The duration of the not ready flag depends upon the type of power source being programmed. The table included on the schematic diagram lists the different component values used and the one-shot periods provided

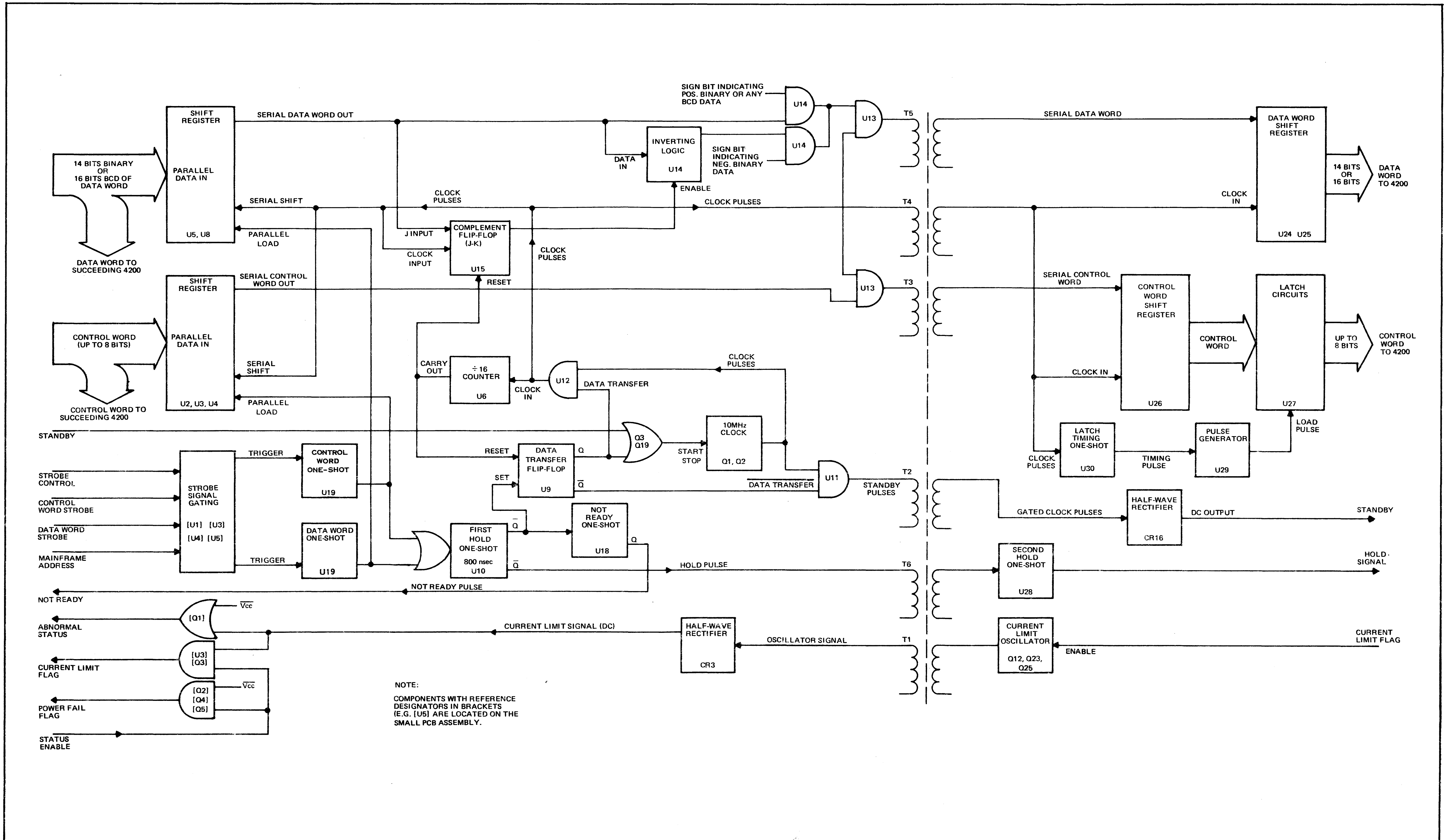


Figure 6-9. 4200-09 BLOCK DIAGRAM

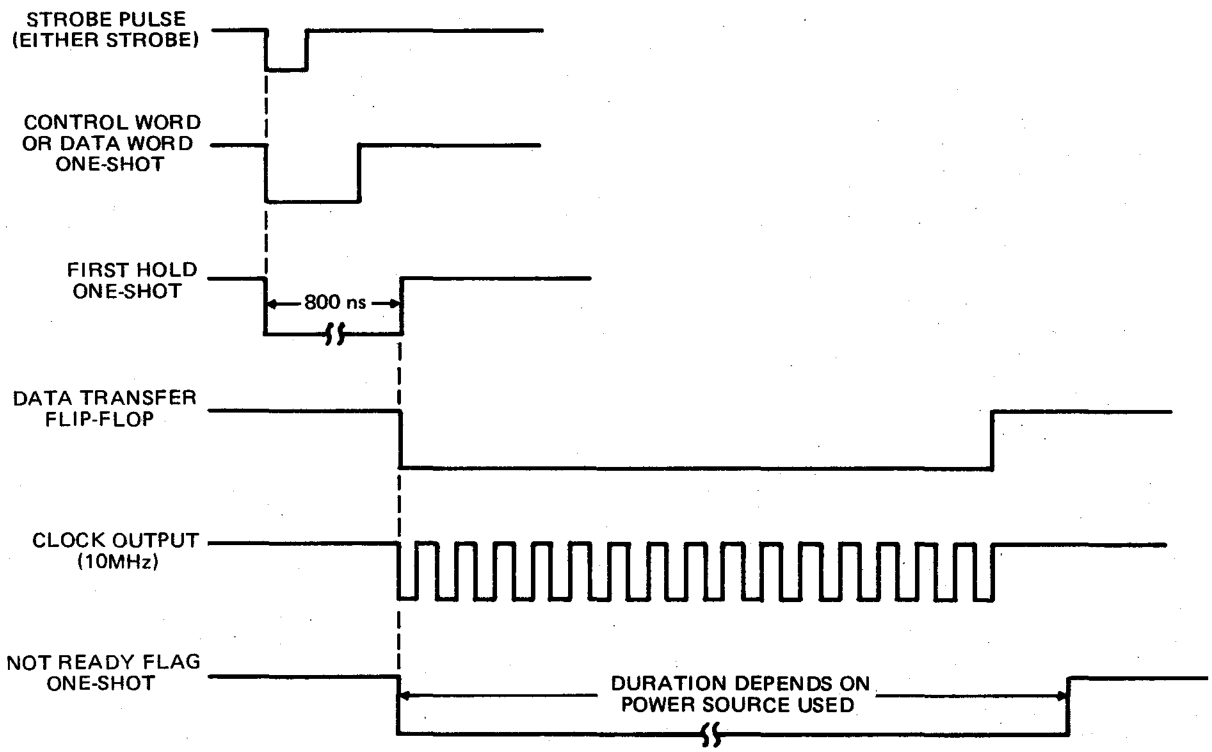


Figure 6-10. INPUT SEQUENCE – TIMING DIAGRAM

for the different 4200 series power sources being programmed.

6-96. MAINTENANCE

6-97. Performance Checks

6-98. Proper operation of the 4200-09 is best verified while in its normal operating environment, i.e. while installed in the power source and connected to the program source. In the system environment, operation of the 4200-09 is typically verified by means of diagnositc routines, or by manually-entered statements at the operator interface, i.e. crt console, teletypewriter, control console, etc. The actual procedure employed to check the 4200-09 depends upon the particular system configuration and is beyond the scope of this manual.

6-99. Calibration

6-100. The 4200-09 requires no periodic or repair calibration.

6-101. Troubleshooting

6-102. The troubleshooting information in the following tables is provided to assist in isolating 4200-09 malfunctions, and is presented in flow chart form. Following the chart from beginning to end will usually identify and localize any malfunction. It is suggested that the preceeding theory of operation be read and the block and schematic diagrams be referenced prior to troubleshooting.

NOTE!

Prior to troubleshooting, place the 4200-09 PCB assembly on an extender card (Fluke part no. 292263).

Table 6-5. TROUBLESHOOTING CHART, INACTIVE PCB ASSEMBLY (Sheet 1 of 2)

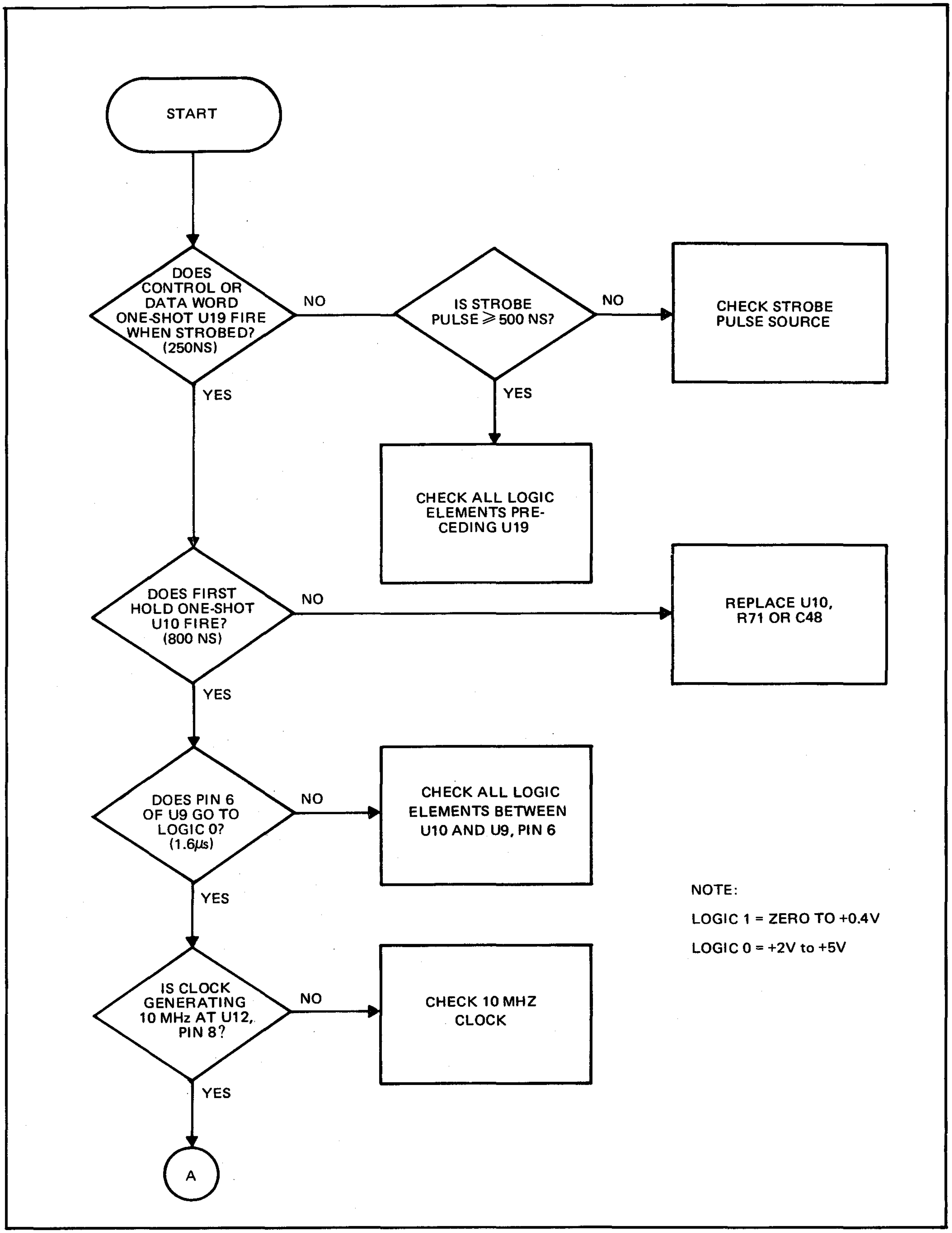


Table 6-5. TROUBLESHOOTING CHART, INACTIVE PCB ASSEMBLY (Sheet 2 of 2)

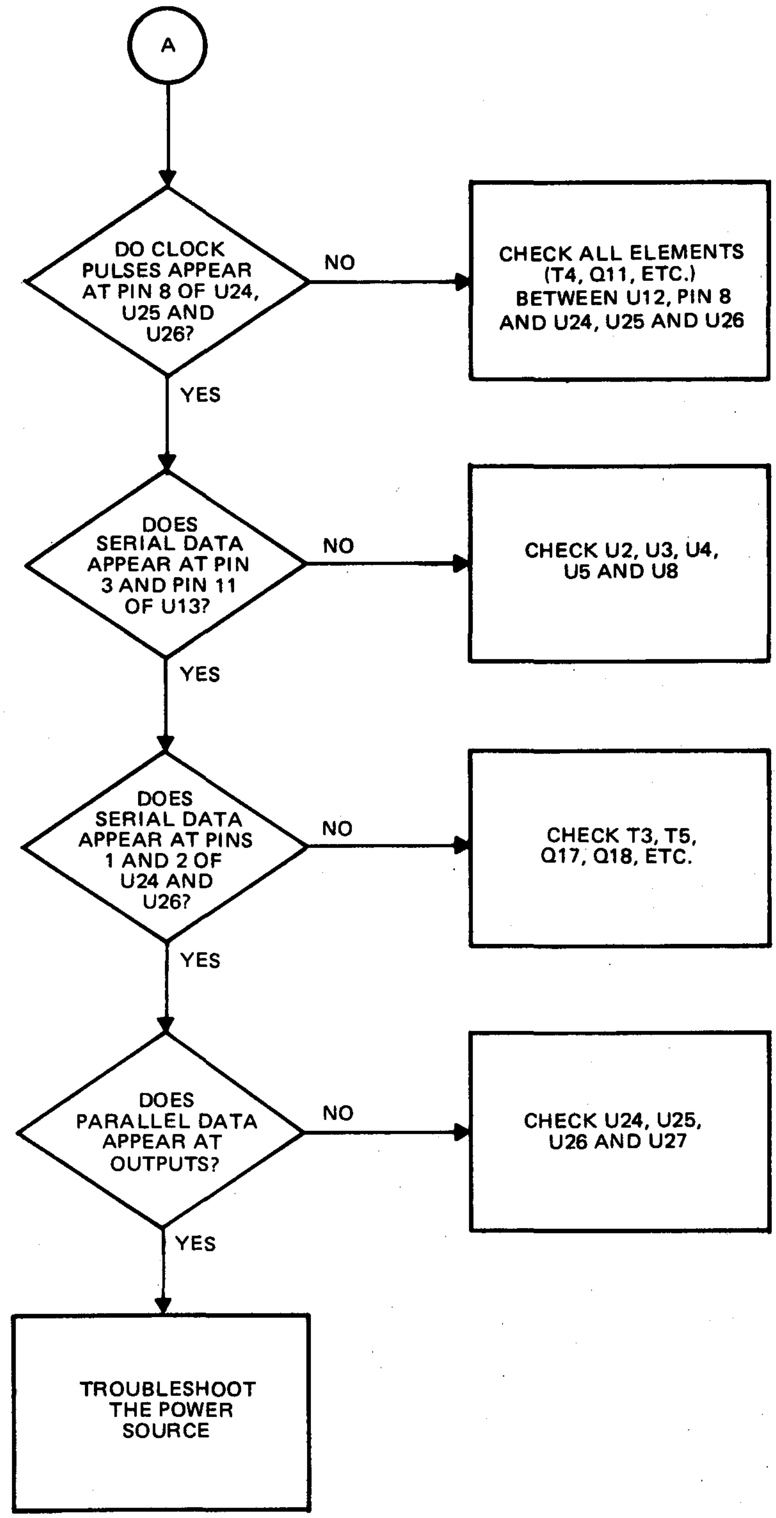


Table 6-6. TROUBLESHOOTING CHART, DATA ERRORS AT PARALLEL OUTPUTS

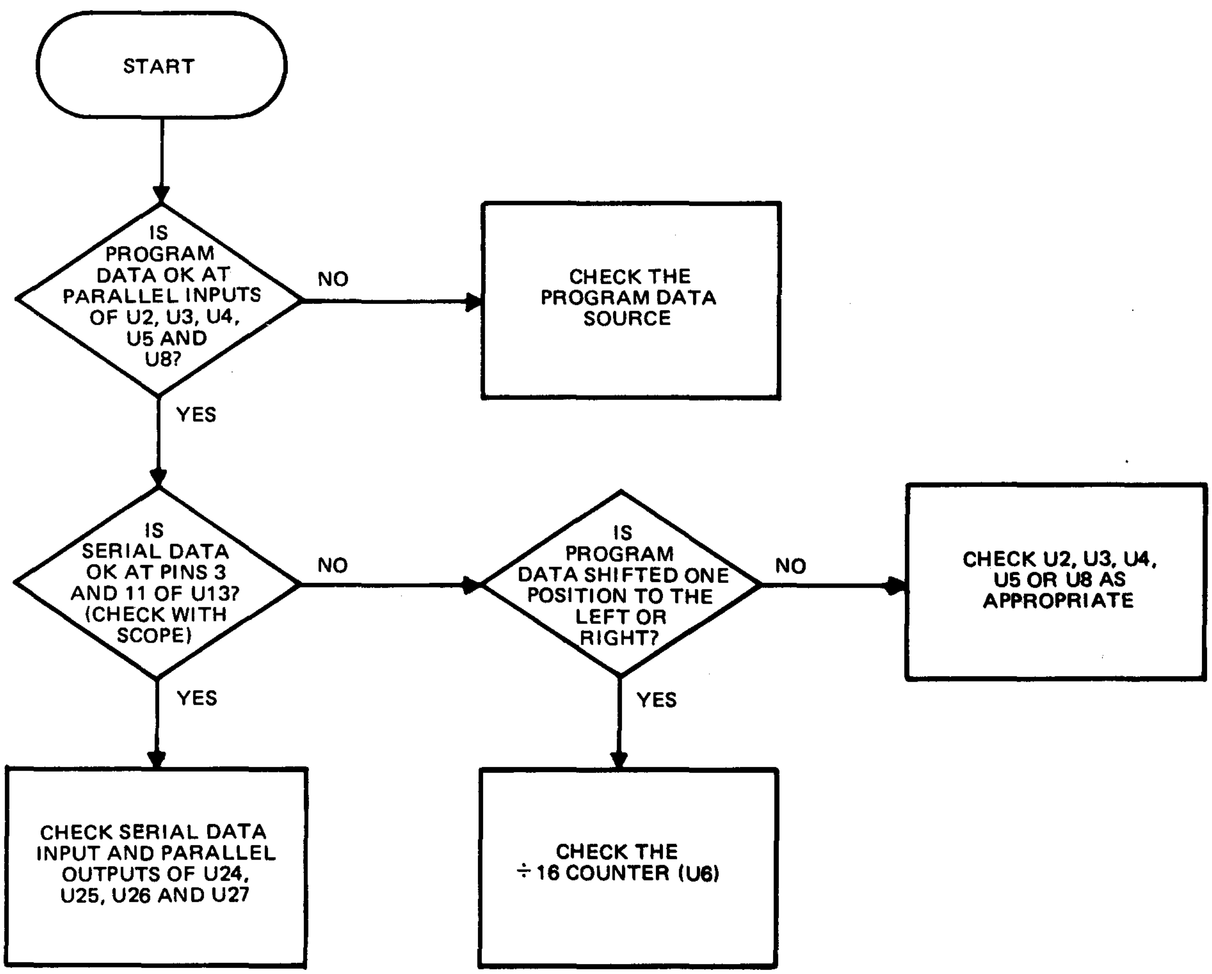


Table 6-7. TROUBLESHOOTING CHART, NO COMPLEMENTING OF BINARY DATA

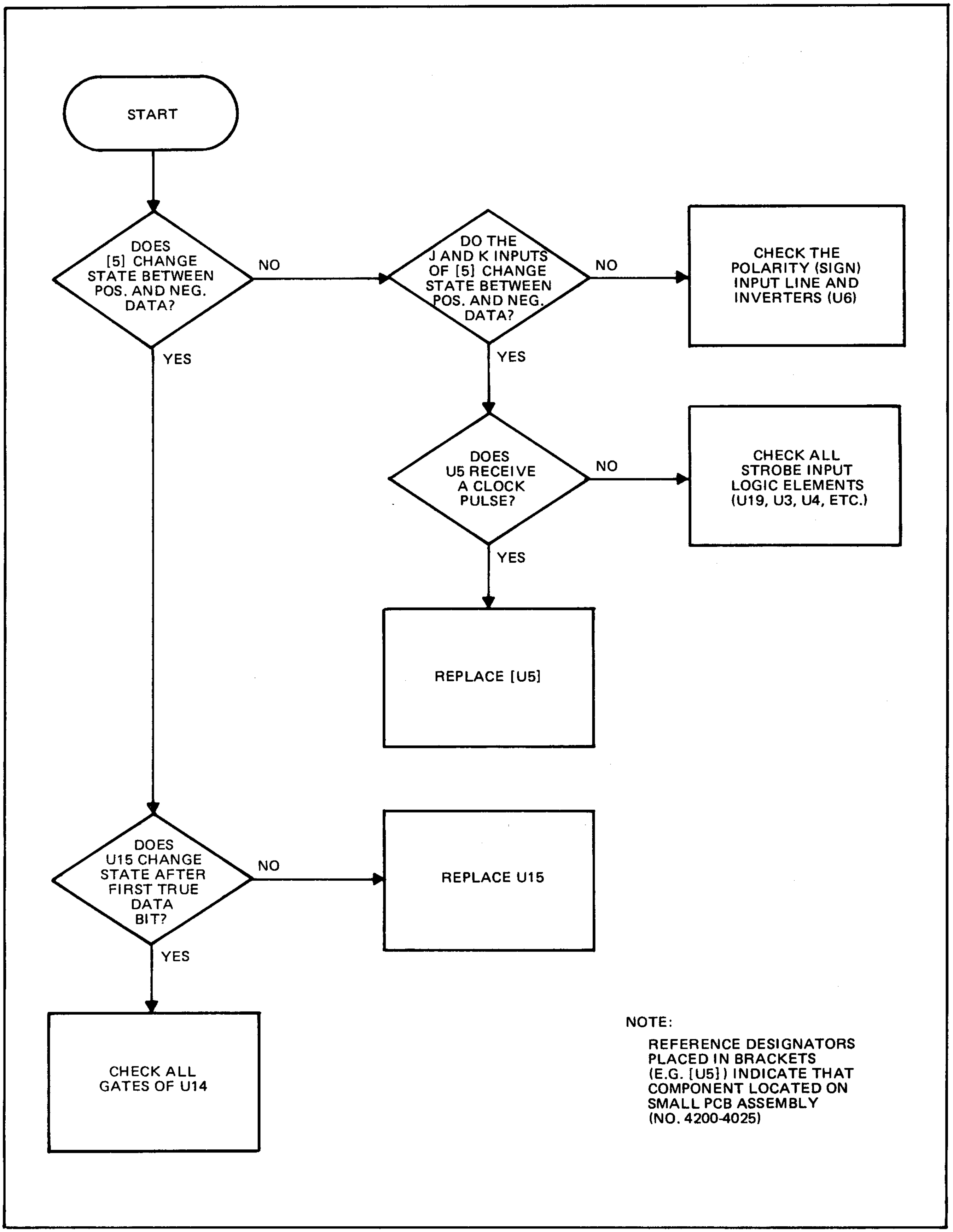


Table 6-8. TROUBLESHOOTING CHART, NO ASYNCHRONOUS STANDBY

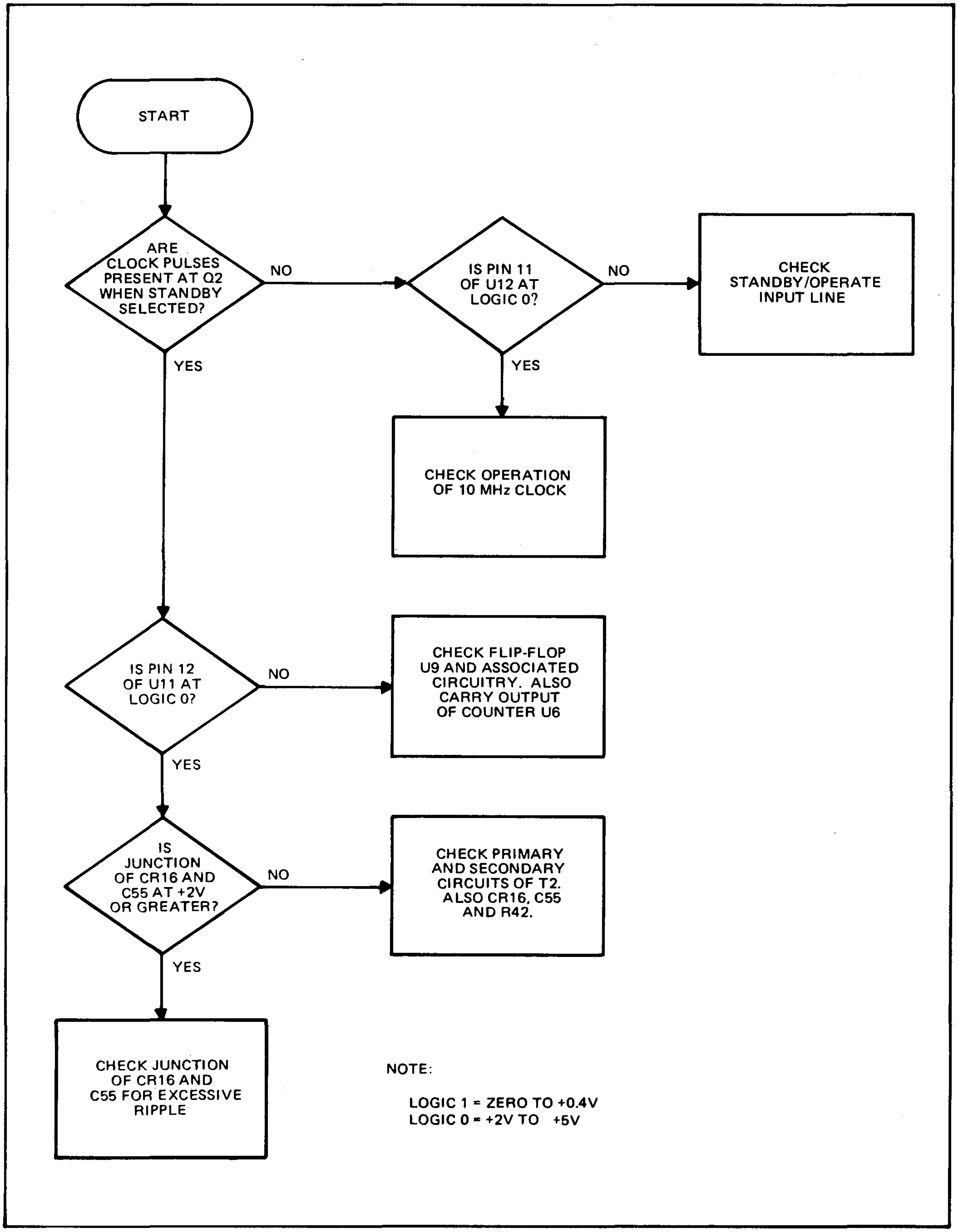


Table 6-9. TROUBLESHOOTING CHART, NO CURRENT LIMIT FLAG

NOTE:

REFERENCE DESIGNATORS PLACED IN BRACKETS (E.G. [U5]) INDICATE THAT COMPONENT LOCATED ON SMALL PCB ASSEMBLY (NO. 4200-4025)

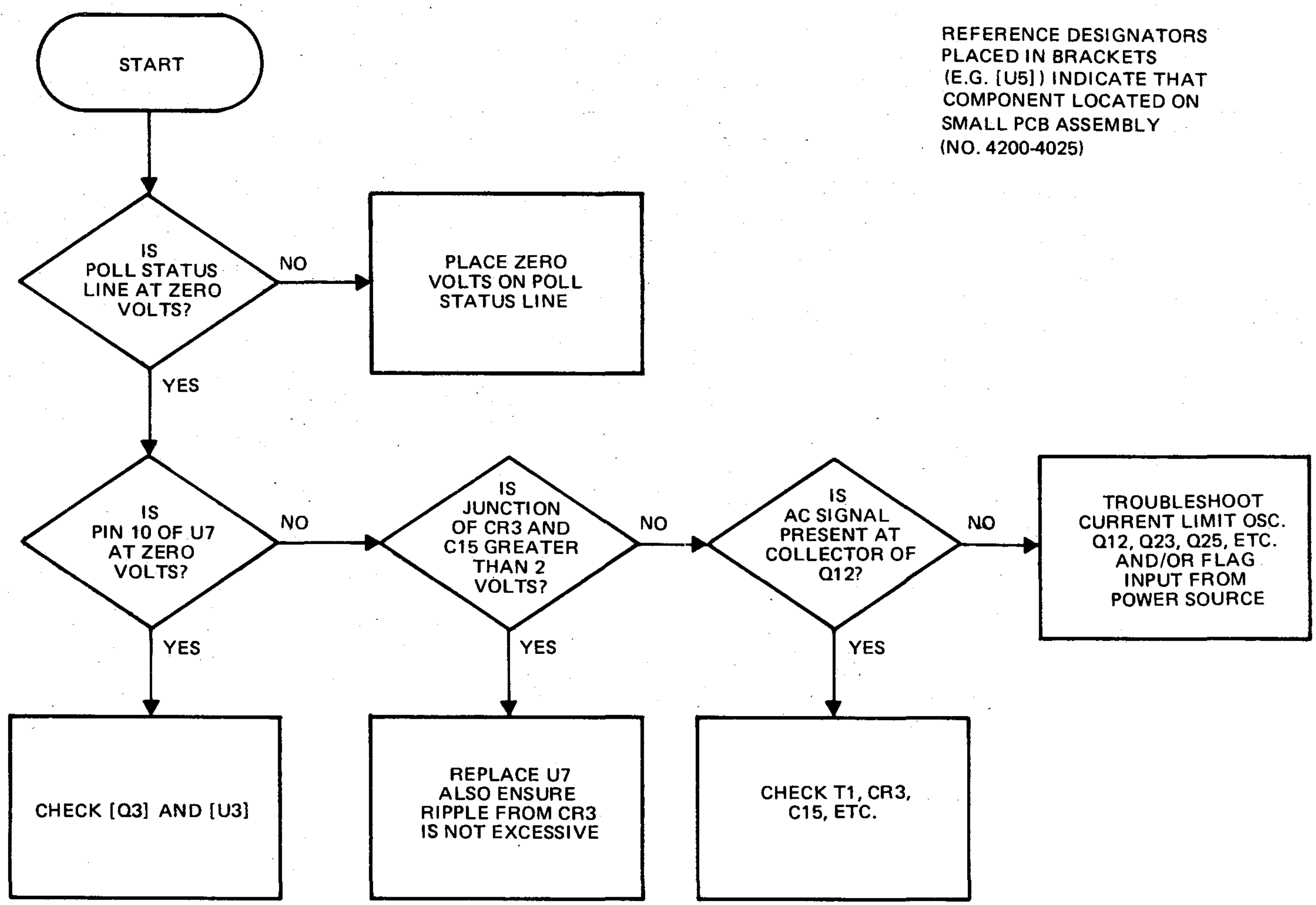
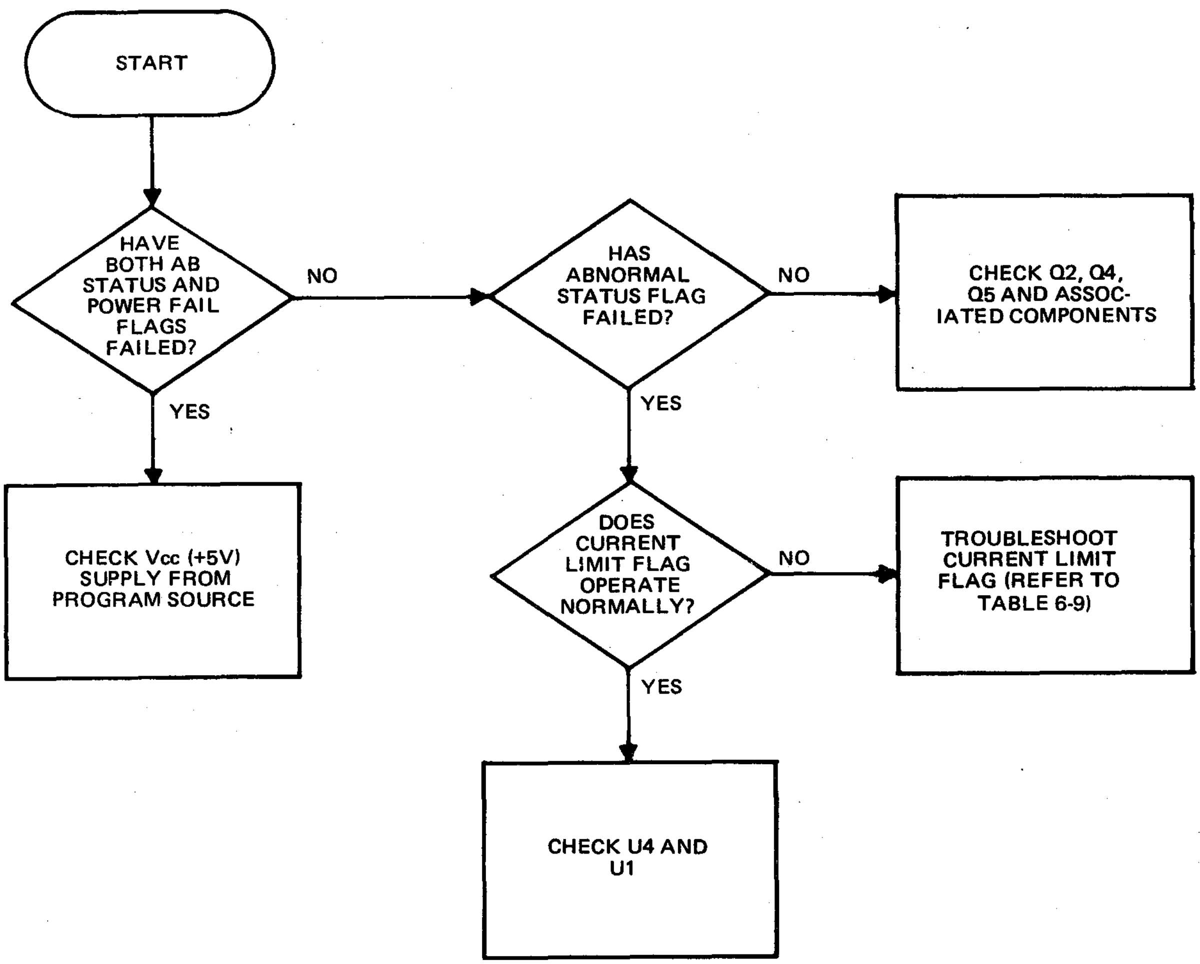


Table 6-10. TROUBLESHOOTING CHART, NO POWER FAIL AND/OR ABNORMAL STATUS FLAGS



6-103. LIST OF REPLACEABLE PARTS

6-104. For column entry explanation, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5.

MULTI-STROBE ISOLATED LOGIC PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MULTI-STROBE ISOLATED LOGIC PCB ASSY Figure 6-11	345660	89536	345660			
C1, C2	Cap, mica, 12pf ±5%, 500V	175224	14655	CD15E120J	2		
C3	Cap, mica, 750pf ±5%, 500V	208983	14655	CD19F751J	1		
C4	Cap, Ta, 10μf ±20%, 15V	193623	56289	196D106X0015	1		
C5, C48	Cap, mica, 220pf ±5%, 500V	170423	14655	CD15F221J	2		
C6	Cap, mica, 470pf ± 5%, 500V	148429	14655	CD19F471J	1		
C7	Cap, mica, 1000pf ±5%, 500V	148387	14655	CD19F102J	1		
C8, C9, C21	Cap, mica, 70pf ±5%, 500V	148494	14655	CD15F101J	3		
C10	Cap, mica, 270pf ±5%, 500V	148452	14655	CD15F271J	1		
C11	Cap, fxd flm, 0.0033 ±2%, 150V	168344	84171	PE332G	1		
C12, C13, C14	Not Used						
C15, C53	Cap, fxd, cer, 0.01μf ±20%, 100V	149153	56289	C023B101F103 M	2		
C20	Cap, mica, 330pf ±1%, 500V	226142	14655	CD15F331F	1		
C22	Cap, fxd mylar, 0.1μf ±10%, 50V	271866	06001	75F2R5A104	1		
C23 thru C33	Not Used						
C34 thru C41, C56, C58 thru C67	Cap, fxd, cer, 0.025μf ±20%, 100V	168435	56289	C023B101H-253M	19		
C42, C43	Cap, elect, 200μf ±50%, 10V	236935	73445	ET221X010A5	2		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C44 thru C47, C49	Cap, mica, 56pf ±5%, 500V	148528	14655	CD15F560J	5		
C50, C51, C52, C54	Not Used.						
C55	Cap, fxd, cer, .0027pf ±GMV, 600V	106211	72982	851.000Z5U0-272P	1		
C57	Cap, fxd cer, .0033μf ±GMV, 600V	106674		CO23B102F-332M	1		
CR1, CR7 thru CR10, CR15, CR16	Diode, Si, 150mA	203323	03508	DHD1105	7		
CR2, CR4, CR5, CR6, CR13, CR14	Not Used						
CR3, CR11, CR12	Diode, hot carrier	313247	28480	2811	3		
Q1,Q2, Q3,Q6, Q7,Q8, Q10, Q11, Q12, Q14, Q16, Q17, Q18, Q19, Q20, Q26, Q27	Xstr, Si, NPN	159855	07910	CS23030	17		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q4,Q5 Q9, Q15, Q21, Q22, Q24	Not Used						
Q13	Xstr, Si, Unijunction	268110	03508	2N6027	1		
Q23	Xstr, Si, NPN	168716	12040	SM07154			
Q25	Xstr, Si, PNP	195974	04713	2N3906	1		
R1, R20, R22, R24, R28, R36, R45, R59, R60, R61, R70, R73, R75	Res, Comp, 1KΩ ± 5%, ¼w	148023	01121	CB1025	13		
R2,R4	Res, Comp, 10KΩ ± 5%, ¼w	148106	01121	CB1035	2		
R3, R9, R10, R13, R21, R23, R69, R72	Res, comp, 510 ± 5%, ¼w	218032	01121	CB5115	8		
R5	Res, comp, 470 ± 5%, ¼w	147983	01121	CB4715	1		
R6	Res, comp, 1.3KΩ ± 5%, ¼w	234252	01121	CB1325	1		
R7,R8 R14 R42 R50	Res, comp, 390 ± 5%, ¼w	147975	01121	CB3915	5		
R11 R12	Res, met flm, 6.98KΩ ± 1%, 1/8w	261685	91637	MFF1-86-98K-PORM 1 PCT			

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R15, R17	Res, met flm, 4.99KΩ ± 1%, 1/8w	168252	91637	MFF1-84-99K PORM 1 PCT	2		
R16, R43	Res, comp 11 ± 5%, ¼w	221861	01121	CB1105	2		
R18, R26, R63, R64, R65, R91	Res, comp, 51 ± 5%, ¼w	221879	01121	CB5105	6		
R19	Res, met flm, 29.4KΩ ± 1%, 1/8w	235135	91637	MFF1-829-4K PORM 1 PCT	1		
R25, R27, R29, R33, R34, R41, R44, R46, R52 thru R58, R66, R76 thru R80, R82 thru R85, R90	Not Used						
R30	Res, comp, 430 ± 5%, ¼w	203869	01121	CB4315	1		
R32, R37, R38, R88	Res, comp, 200 ± 5%, ¼w	193482	01121	CB2015	4		
R35, R39, R48, R54, R81, R89	Res, comp, 3.3KΩ ± 5%, ¼w	148056	01121	CB3325	6		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R40	Res, met flm, 30.9KΩ ± 1%, 1/8w	235275	91637	MFF1-830-9K PORM 1 PCT	1		
R47	Res, comp 27KΩ ± 5%, ¼w	148148	01121	CB2735	1		
R49	Res, comp, 39KΩ ± 5%, ¼w	188466	01121	CB3935	1		
R51	Res, comp 100 ± 5%, ¼w	147926	01121	CB1015	1		
R62, R67, R68	Res, comp, 680 ± 5%, ¼w	148007	01121	CB6815	3		
R71	Res, met flm, 10KΩ ± 1%, 1/8w	168260	91637	MFF1-810K PORM 1 PCT	1		
R86	Res, comp, 1.6KΩ ± 5%, ¼w	234252	01121	CB1025	1		
R87	Res, comp, 2KΩ ± 5%, ¼w	202879	01121	CB2025	1		
T1 thru T6	Xfmr	299594	89536	299594			
U1, U7, U16	IC, TTL Hex inverter	292979	01295	SN7404N	3		
U2, U3, U4	IC, TTL, 4 bit Right-shift, left-shift register	342691	01295	SN7495N	3		
U5, U8	IC, TTL, MSI 8-bit shift register	293118	01295	SN74165N	2		
U6	IC, TTL, MSI, Syn 4-bit up down counters	293183	01295	SN74193N	1		
U9, U17	IC, TTL, 3 input positive NAND Gates	292995	01295	SN7410N	2		
U10, U18	IC, TTL, MSI, retriggerable monostable multivibrator	293134	07263	MC8601P	2		
U11, U12, U13, U20	IC, TTL, quad 2-input NAND gate	292953	01295	SN7400N	4		
U14	IC, TTL, dual, 2-wide 2-input AND-OR Invert high speed	293084	01295	SN74H51N	1		
U15	IC, TTL, J-K edge triggered Flip-Flops with	293092	01295	SN74H102N	1		

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U15	IC, TTL, J-K edge triggered Flip-Flops with AND inputs	293092	01295	SN74H102N	1		
U19	IC, TTL, Dual retriggerable monostable multivibrator	310235	01295	SN74123	1		
U21	IC, TTL, Hex inverter	293076	01295	SN74H04N	1		
U22, U23	Not Used						
U24, U25, U26	IC, TTL, 8-bit serial-in-parallel-out shift register	272138	01295	DM8570	3		
U27	IC, TTL, Dual four-bit latch	293191	07263	MC8308P	1		
U28, U30	IC, TTL, monostable multivibrator	293050	01295	SN74121N	2		
U29	IC, TTL, J-K master slave Flip-Flop	296491	01295	SN7472N	1		

ISOLATED LOGIC PIGGY BACK PCB ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ISOLATED LOGIC PIGGY BACK PCB ASSEMBLY	341222	89536	341222			
C1,C3	Cap, mica, 330pf ± 5%	148445	14655	CD15F331J	2		
C2,C4	Cap, ceramic, 0.22μf ± 5%	309849	32897	8131-050-651-224M	2		
CR1, CR2, CR3	Diode, Si, 150 mA	203323	03508	DHD1105	3		
Q1 thru Q5	Xstr, NPN, Si	159855	07910	CS23030	5		
R1, R7	Res, comp, 470 ± 5%, ¼w	147983	01121	CB4715	2		
R2	Res, comp, 2KΩ ± 5%, ¼w	202879	01121	CB2025	1		
R3 thru R6	Res, comp 10KΩ ± 5%, ¼w	148106	01121	CB1035	4		
R8	Res, comp, 20KΩ ± 5%, ¼w	221614	01121	CB2035	1		
R9	Res, comp, 4.7KΩ ± 5%, ¼w	148072	01121	CB4725	1		
U1	IC, DTL, hex inverter	268367	01295	SN15836N	1		
U2, U6	IC, TTL, hex inverter	292979	01295	SN7404N	2		
U3	IC, TTL, quad 2-input NOR gate	288845	01295	SN7402N	1		
U4	IC, TTL, quad 2-input NAND gate	292953	01295	SN7400N	1		
U5	IC, TTL, dual J-K Flip-Flops	293043	01295	SN74107N	1		

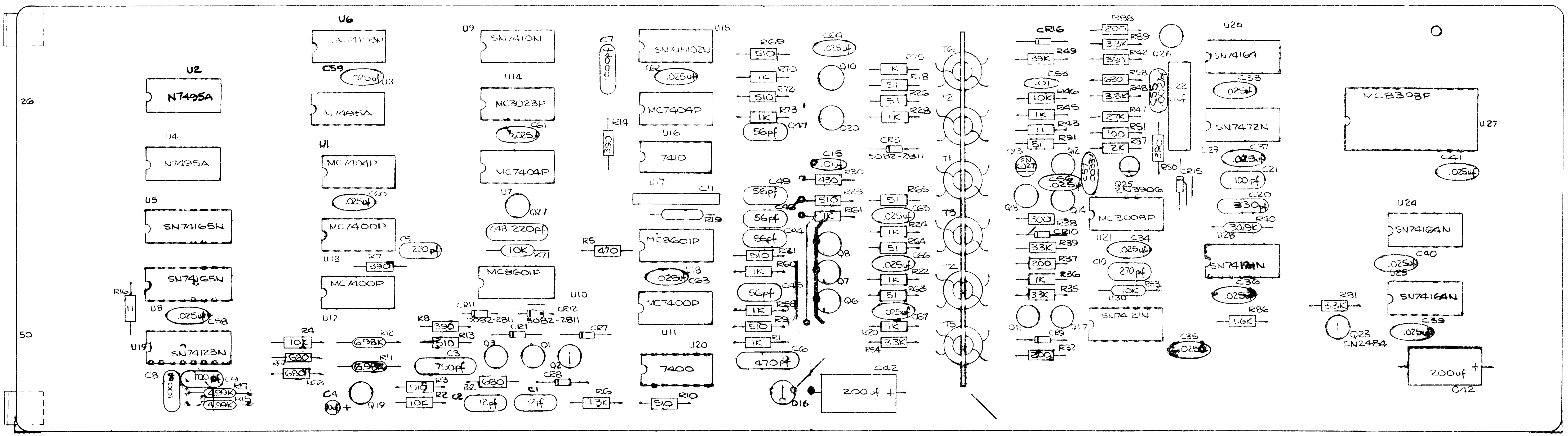
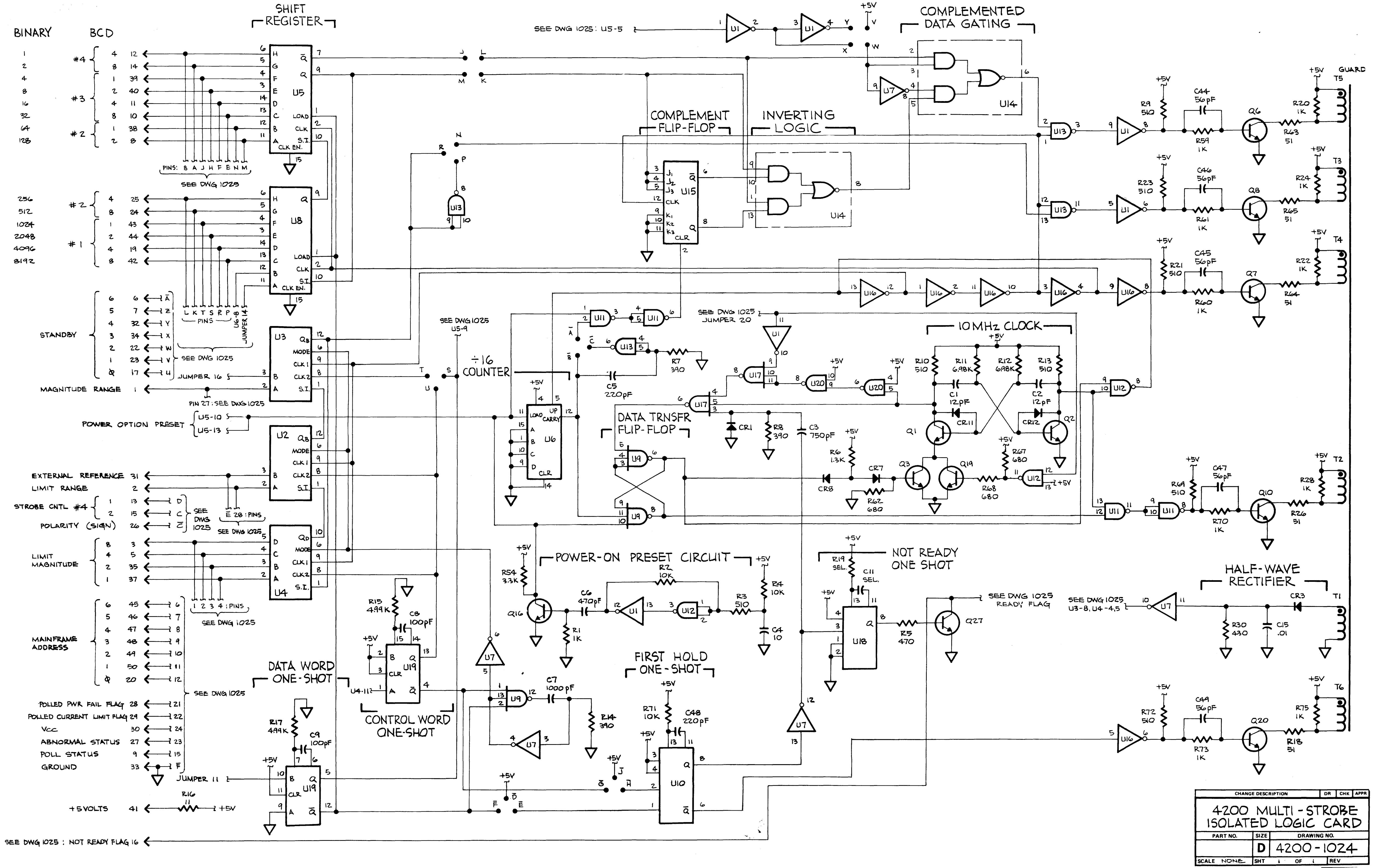
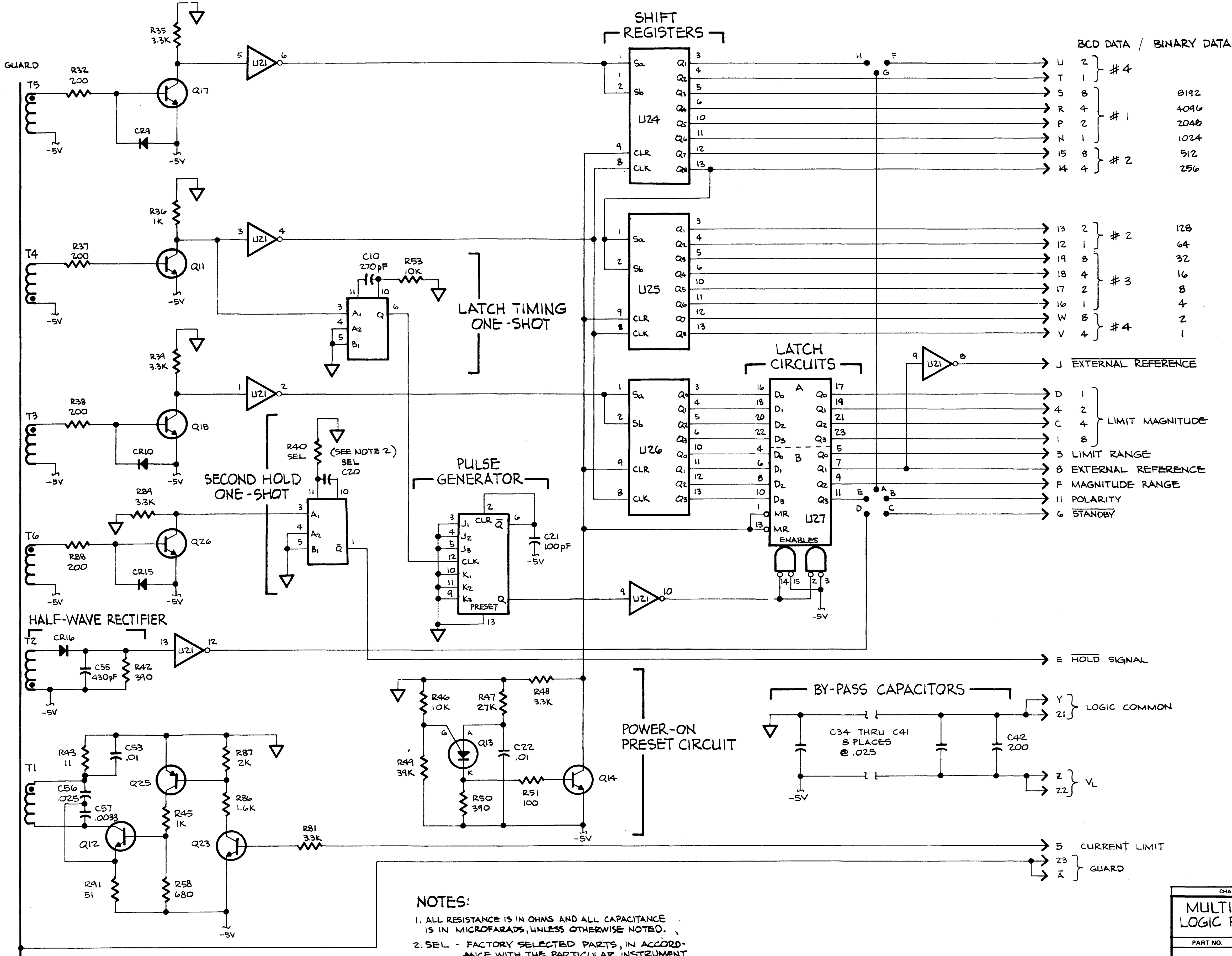


Figure 6-11. 4200 MULTI-STROBE ISOLATED LOGIC CARD



BINARY
BCD
SHIFT REGISTER
U5
U8
U3
U2
U4
PINS: B A J H F E N M
SEE DWG 1025
L K T S R P
PINS
U6-8
JUMPER 14
STANDBY
MAGNITUDE RANGE
JUMPER 16
PIN 27: SEE DWG 1025
POWER OPTION PRESET
U5-10
U5-13
EXTERNAL REFERENCE
LIMIT RANGE
STROBE CNTL #4
POLARITY (SIGN)
SEE DWG 1025
E 28: PINS
LIMIT MAGNITUDE
1 2 3 4: PINS
MAINFRAME ADDRESS
POLLED PWR FAIL FLAG
POLLED CURRENT LIMIT FLAG
Vcc
ABNORMAL STATUS
POLL STATUS
GROUND
JUMPER 11
+5 VOLTS
SEE DWG 1025 : NOT READY FLAG 16
SEE DWG 1025: U5-5
COMPLEMENTED DATA GATING
U14
COMPLEMENT FLIP-FLOP
U15
INVERTING LOGIC
SEE DWG 1025 U5-9
÷16 COUNTER
U16
SEE DWG 1025 JUMPER 20
10 MHz CLOCK
DATA TRNSFR FLIP-FLOP
POWER-ON PRESET CIRCUIT
NOT READY ONE SHOT
SEE DWG 1025 READY FLAG
HALF-WAVE RECTIFIER
SEE DWG 1025 U3-8, U4-4,5
DATA WORD ONE-SHOT
CONTROL WORD ONE-SHOT
FIRST HOLD ONE-SHOT
GUARD
T1
T2
T3
T4
T5
T6
CHANGE DESCRIPTION
DR
CHK
APPR
4200 MULTI-STROBE ISOLATED LOGIC CARD
PART NO.
SIZE
DRAWING NO.
D
4200-1024
SCALE NONE
SHT 1 OF 1
REV



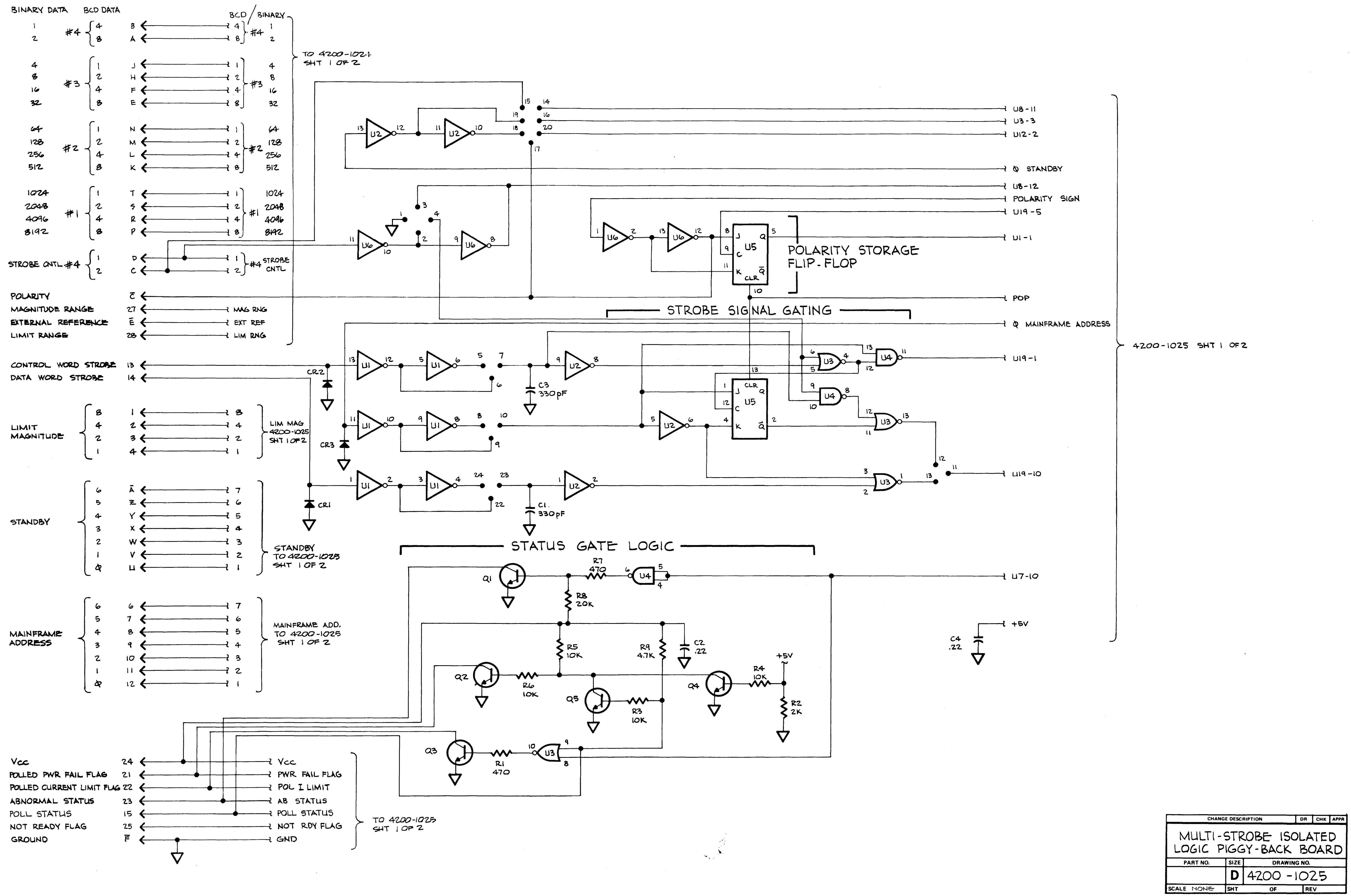
NOTES:

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS, UNLESS OTHERWISE NOTED.
2. SEL - FACTORY SELECTED PARTS, IN ACCORDANCE WITH THE PARTICULAR INSTRUMENT MODEL USING THE -09 OPTION.

CHANGE DESCRIPTION	DR	CHK	APPR

MULTI-STROBE ISOLATED LOGIC BRD: INSIDE GUARD

PART NO.	SIZE	DRAWING NO.
	D	4200-1024
SCALE NONE	SHT 2 OF 2	REV


BINARY DATA
BCD DATA
BCD / BINARY
TO 4200-1021 SHT 1 OF 2
STROBE CNTL #4
POLARITY
MAGNITUDE RANGE
EXTERNAL REFERENCE
LIMIT RANGE
CONTROL WORD STROBE
DATA WORD STROBE
LIMIT MAGNITUDE
LIM MAG 4200-1025 SHT 1 OF 2
STANDBY
STANDBY TO 4200-1025 SHT 1 OF 2
MAINFRAME ADDRESS
MAINFRAME ADD. TO 4200-1025 SHT 1 OF 2
POLARITY STORAGE FLIP-FLOP
STROBE SIGNAL GATING
STATUS GATE LOGIC
Q STANDBY
POLARITY SIGN
POP
Q MAINFRAME ADDRESS
4200-1025 SHT 1 OF 2
Vcc
POLLED PWR FAIL FLAG
POLLED CURRENT LIMIT FLAG
ABNORMAL STATUS
POLL STATUS
NOT READY FLAG
GROUND
TO 4200-1025 SHT 1 OF 2
MULTI-STROBE ISOLATED LOGIC PIGGY-BACK BOARD
PART NO.
SIZE D
DRAWING NO. 4200-1025
SCALE NONE

Accessory

Model A4200

6-1. INTRODUCTION

6-2. The Model A4200 Manual Control Unit (MCU) with attaching interface cable and connectors is a manually operated program source for the 4200A series power sources. Figure 6-1 shows the MCU connected to a typical FLUKE power source. The purpose of the MCU is to permit an operator to fully exercise the programmable functions of any 4200A series power source, primarily for manual programming, calibration and adjustment, or for trouble-shooting. Secondly, a synchronized oscilloscope display of a 4200A series power source output may be established and controlled with an MCU.

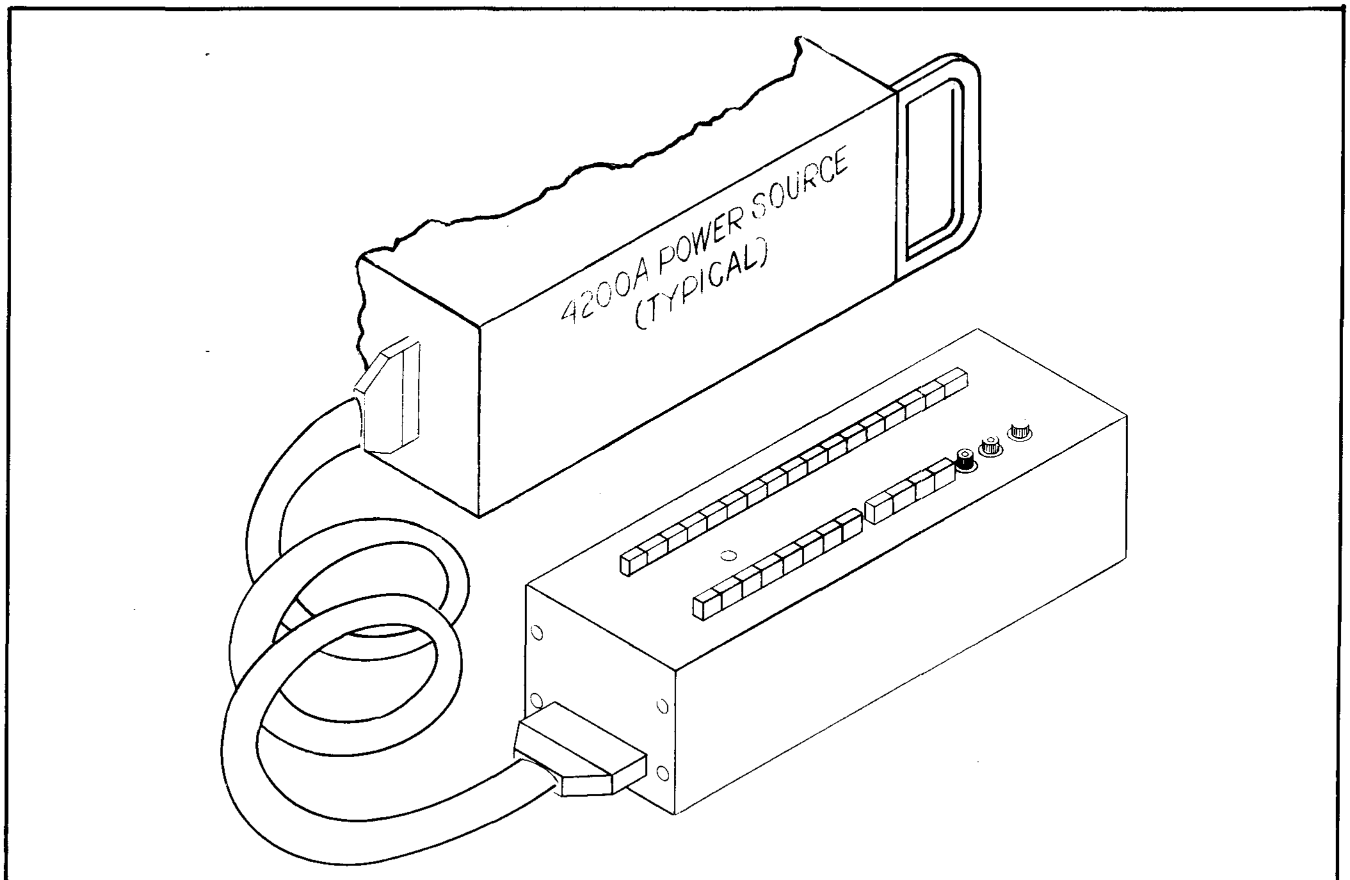


Figure 6-1. MODEL A4200 MANUAL CONTROL UNIT CONNECTED TO TYPICAL POWER SOURCE.

6-3. SPECIFICATIONS

6-4. There are no specifications for the Model A4200 MCU.

6-5. INSTALLATION

6-6. The MCU is supplied with an interface cable and connectors designed to fit any of the 4200A series power sources. The operating voltages for the MCU are supplied from the associated power source through the interface cable. The interface cable also supplies the power source with all programming inputs initiated by the MCU. Connection of the MCU to the power source via the interface cable is done as follows:

CAUTION!

The Model A4200 MCU is NOT compatible with the –09 option.

a. Turn off the power source and disconnect the programming connector from the rear panel of the power source.

b. Connect the interface cable connectors to both the programming connector on the power source and on the MCU.

c. Select the desired operating configuration on the top panel of the MCU and then turn on the power source. The power source is now ready for operation with the MCU.

6-7. OPERATING INSTRUCTIONS

6-8. The location and function of the MCU controls, indicators and connectors are described in Figure 6-2. The active or high level logic state of the pushbutton switches on the MCU is the depressed or *in* state. However, in the event the associated power source is equipped with the inverted logic option (08 Option), the logic level states of all pushbuttons defined below is high when the pushbuttons are extended or *out*. When depressed or *in*, the logic level state is low. This condition applies to all pushbuttons except STROBE, MANUAL, AUTO, and EXT. Figure 6-2 functionally describes the MCU controls, indicators, and connectors related to an associated power source that is not equipped with an –08 Option.

6-9. OPERATING FEATURES

6-10. The following paragraphs describe operating features relating the MCU to power sources and should be read prior to operating the MCU.

6-11. Isolated Control Logic (–01 Option)

6-12. The MCU provides the digital input programming, including the STROBE pulse, necessary to test and control an associated 4200A power source equipped with an isolated control logic option (–01 Option) or with an inverted isolated control logic option (–08 Option). When using either option, a STROBE pulse is required to start the digital-to-analog conversion process after a valid digital input program is entered. In MANUAL mode, the STROBE pulse is generated by manual depression of the STROBE pushbutton. In AUTO/EXTERNAL REFERENCE mode, the STROBE pulse is generated automatically following a 1.5μs delay that terminates the last programmed bit. The STROBE pulse is 0.5μ sec wide with a minimum width of 500 ns. A negative slope (+5V to 0 transition) is required.

6-13. Direct Coupled Control Logic (–04 Option)

6-14. Power sources using the direct coupled control logic option do not require use of the STROBE pulse. When used in the AUTO mode the performance is limited by the timing format of the STROBE pulse. Ideally, the STROBE pulse should precede the input data change and last until the input data is settled. The STROBE pulse, however, occurs about 1.5μs after the change of input data and lasts about 0.5μs. Consequently, voltage spikes may occur (going to 0 volts) when voltage levels are stepped. These spikes may be observed on an oscilloscope when monitoring the power source output and do not indicate a fault in the power source.

6-15. Coax Jack Cluster

6-16 Three BNC coaxial cable connectors located on the top panel of the MCU provide connections for test instruments. The common of these connectors is tied to logic ground.

6-17. Trigger Input

6-18. TRIGGER INPUT jack provides an input connection for an external trigger generator to produce a remote, manually controlled STROBE pulse when the MCU is in the AUTO EXT mode. The external trigger generator replaces a 10kHz multivibrator when the EXT pushbutton is depressed. An external 51Ω termination resistor is provided in the MCU for the external trigger generator. For optimum performance the trigger generator should have an output pulse impedance of 50Ω and be capable of producing the waveform shown in Figure 6-3.

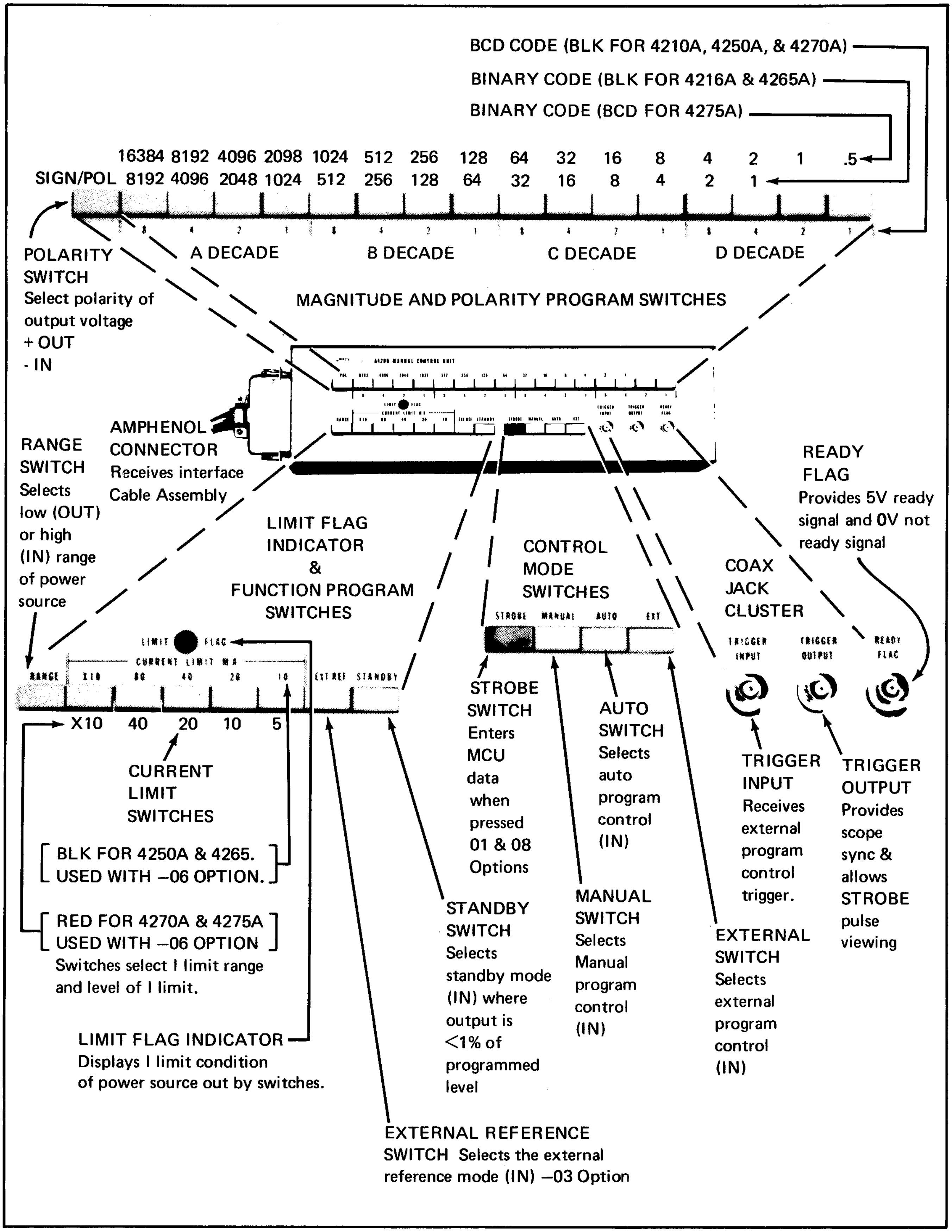
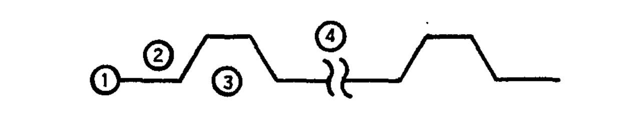


Figure 6-2 CONNECTORS, CONTROLS, AND INDICATORS

CAUTION

Application of trigger voltages higher than the recommended value will damage the MCU.



①	DC OFFSET	–	±0.4	Vdc
②	AMPLITUDE	+2.8	+5.5	Vdc
③	WIDTH	0.5	–	μs
④	PRF	DC	10K	Hz
		MIN	MAX	UNITS
		LIMITS		

Figure 6-3. External Trigger Generator Requirements

6-19. Trigger Output

6-20. TRIGGER OUTPUT jack provides an output connection for monitoring the inverse of the MCU generated STROBE pulse. The output trigger is a positive-going pulse that occurs each time a STROBE pulse is generated. It is useful in synching a scope to the MANUAL-STROBE mode. However, when using the AUTO or EXT modes, which generate an automatic internal or external STROBE, the output trigger provides a valid scope sync for the ready or not ready flag output only. It cannot be used to monitor the power source output voltage in the AUTO or EXT modes.

6-21. Ready Flag

6-22. READY FLAG jack provides an output connection for monitoring the ready or not ready flag voltage. In the three control modes (MANUAL, AUTO, or EXT) the output trigger provides a valid scope sync for displaying the flag voltage.

6-23. PROGRAMMING SWITCHES

6-24. Of the twenty-nine program switches located on the MCU top panel, all but three are used to enter programming inputs into the 4200A series power sources. These three are AUTO, MANUAL, and EXT. Figure 6-2 divides these switches into three groups of control mode switches, magnitude and polarity program switches, and function program switches.

6-25. Control Mode Switches

6-26. The four control mode switches provide manual or automatic control of the manually selected input data program. MANUAL, AUTO, or EXT are the three control modes selectable on the MCU.

6-27. Manual Mode

6-28. The MANUAL mode allows manual manipulation of the input programming data as well as manual generation of the STROBE pulse. This mode is selected by depressing the Manual pushbutton. Each push of the STROBE pushbutton generates a 0.5μs STROBE pulse which transfers the previously selected manual program to the internal registers of the isolated control logic option (–01 Option). In the event the power source is equipped with a direct coupled control logic option (–04 Option) rather than the isolated control logic option, the power source output voltage changes as the program pushbuttons are pressed. No STROBE is necessary.

6-29. Auto Mode

6-30. The AUTO mode of operation provides automatic and sequential scanning of a previously selected magnitude program. The power source output is thusly stair-stepped or pulsed in a manually selected pattern, the sequence of which is governed by an internal 10kHz multivibrator. The multivibrator also initiates the STROBE pulse for the isolated control logic option. If a direct coupled control logic option is used in lieu of the isolated control logic option in the associated power source, then the timing of the STROBE is incorrect.

6-31. External Mode

6-32. EXT mode operation is similar to the auto mode of operation. The difference is that the internal 10kHz multivibrator is switched out and an external pulse generator is substituted at the TRIGGER INPUT jack. The sequence frequency is thereby remotely controlled by the trigger generator.

6-33. Magnitude Program Switches

6-34. Sixteen magnitude program switches provided on the MCU are used to program the BCD or binary magnitude inputs into an associated power source. Each pushbutton is labeled with one or more bit values depending upon unit serialization. Units bearing serial No. 224 and below are labeled entirely in black. Units bearing higher serial numbers are labeled in black and red. The red coding applies to (1) the binary magnitude used to program the 4275A power source, and (2) to the current magnitude used to program the current limit option (when installed) in the 4270A and 4275A power sources. The black coding applies to both binary and BCD magnitude power sources with the location and format of the magnitude bits identifying related power source effectivity as follows: The black binary magnitude bits above the pushbuttons apply to the 4216A and 4265A power sources. The black BCD magnitude bits below the pushbuttons apply to the 4210A, 4250A, and 4270A power sources. In MANUAL mode the magnitude inputs are programmed directly by depressing a single or combination of magnitude pushbuttons. In AUTO mode an internal binary counter controls the manually selected magnitude inputs in a four-bit binary pattern. Each output of the binary counter is parallel connected to the four corresponding BCD or binary magnitude programming switches shown in Table 6-1. The power source input program is sequenced in a pattern that is determined by the selected magnitude program switches and the binary counter outputs. Figure 6-4 shows the power source output voltage patterns available by programming a single decade in the 4210A, the 4250A, or the 4270A power source.

6-35. Polarity or Sign/Polarity

6-36. The polarity program for the power sources is controlled by the program switch marked POL or SIGN/POL. Depressing this switch commands the negative programmed output voltage. The non-depressed or *out* position commands the positive programmed output voltage.

6-37. External Reference

6-38. The EXT REF switch, when depressed, programs the External Reference Option (–03 Option) of the 4200A series power sources.

6-39. Standby

6-40. The STANDBY switch, when depressed, programs the 4200A series power sources to the standby condition. This condition permits a single bit on a given control line to clear the output to about 1 percent of the programmed level without disturbing the previous command word. Upon returning to the operational condition by releasing the STANDBY pushbutton, the output reverts to the preprogrammed level.

6-41. Range

6-42. When the RANGE switch is depressed, the high range of the associated power source is programmed. When not depressed and in the *out* position, the RANGE switch programs the low range of the power source. The low and high ranges of the 4200A series power sources are given in Table 6-2.

6-43. Current Limit

6-44. The five CURRENT LIMIT MA switches labeled in black or in black and red numbers, depending upon serial No. effectivity, program the Programmable Current Limit Option (–06 Option) in the 4250A, 4265A, 4270A, and 4275A power sources. The black numbered pushbuttons are used with the 4250A and 4265A power sources and the red numbered pushbuttons are used with the 4270A and 4275A power sources. Pushbutton switches labeled in black enable selection of the desired current limit point in increments of 10mA low range or 100mA high range (X10) for the 4250A and 4265A power sources (Table 6-3). The red labeled pushbutton switches enable selection of the desired current limit point in increments of 5 mA low range or 50 mA high range (X10) for the 4270A and 4275A (Table 6-4). When none of the pushbuttons are depressed, the current limit is 10 percent of selected range; i.e., 10 mA and 100 mA for the 4250A and 4265A; 5 mA and 50 mA for the 4270A and 4275A. The 4210A and 4216A power sources do not utilize the programmable current limit

TABLE 6-1
PROGRAMMING SWITCHES CONTROLLED BY
THE BINARY COUNTER.

Binary Counter outputs	PROGRAMMING SWITCHES		
	4210A-4250A	4216A-4265A	4270A-4275A
1	1,1,1,1	4, 64,1024	.5, 8, 128, 2048
2	2,2,2,2	8,128,2048	1, 16, 256, 4096
4	4,4,4,4	1,16,256,4096	2, 32, 512, 8192
8	8,8,8,8	2,32,512,8192	4, 64, 1024, 16384

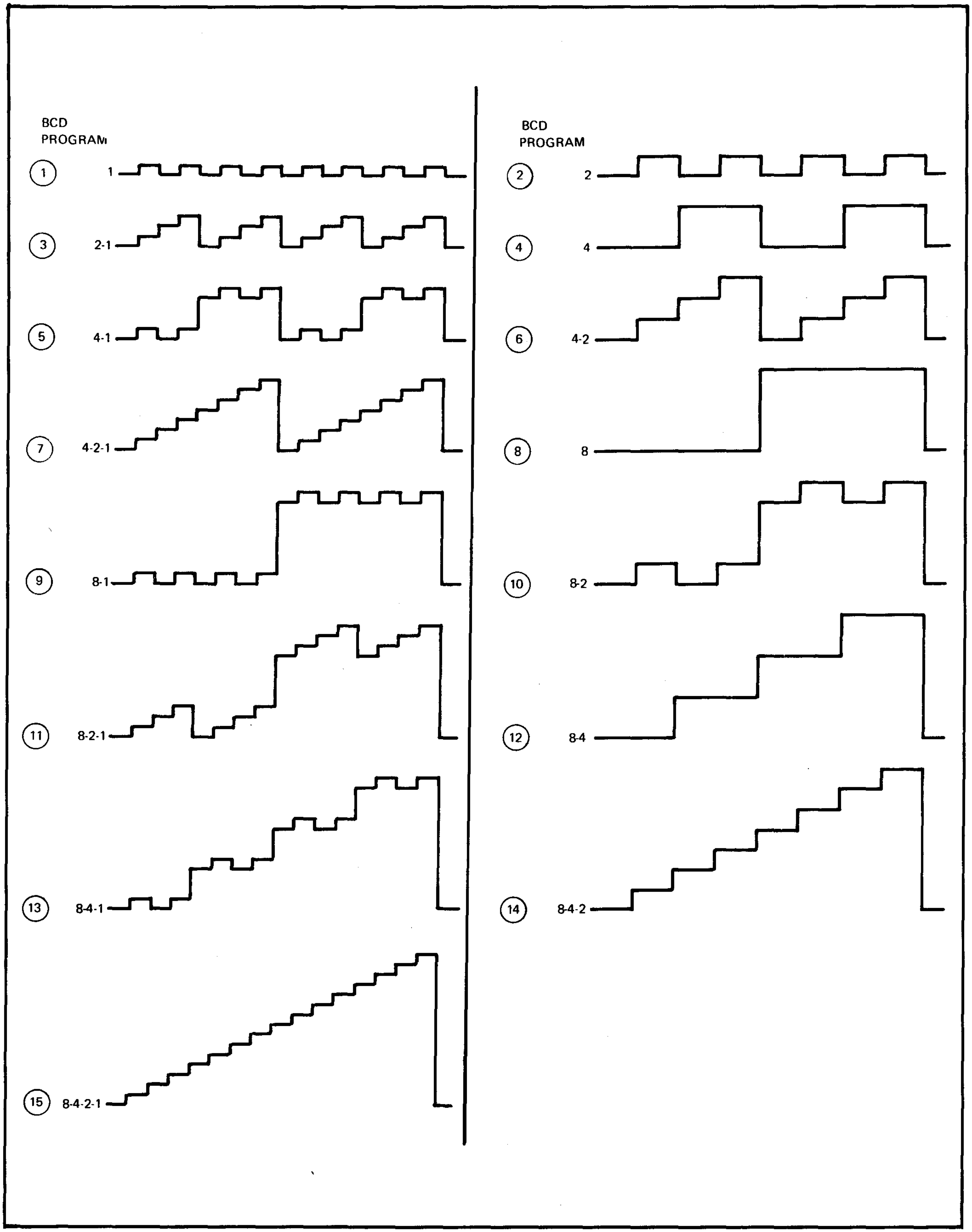


Figure 6-4. VOLTAGE PATTERNS OBTAINABLE BY DECADE PROGRAMMING IN THE AUTO MODE (4210A, 4250A, AND 4270A)

TABLE 6-2. 4200A SERIES INSTRUMENT RANGES

RANGE		INSTRUMENT										
PUSH-BUTTON	STATE	4210A 4216A	4250A		50 VOLT RANGE INDICATOR	4265A	65 VOLT RANGE INDICATOR	4270A	110 VOLT RANGE INDICATOR	4275A	110 VOLT RANGE INDICATOR
OUT	LOW	16V	BCD 10V	BINARY 16V	OFF	16V	OFF	10V	OFF	32V	OFF
IN	HIGH	16V	65V	65V	ON	65V	ON	X10	ON	X4	ON

TABLE 6-3. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

4250A • 4265A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED	RANGE (mA)	
	LOW	X10
NONE	10	100
10	10	100
20	20	200
20 • 10	30	300
40	40	400
40 • 10	50	500
40 • 20	60	600
40 • 20 • 10	70	700
80	80	800
80 • 10	90	900
80 • 20	100	1000
INCREMENTAL CHANGE	10	100
• AND CURRENT LIMIT WITHOUT –06 OPTION IS 1200mA		

TABLE 6-4. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

4270A • 4275A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED		RANGE (mA)	
RED	BLACK	LOW	X10
NONE	NONE	5	50
5	10	5	50
10	20	10	100
10 • 5	20 • 10	15	150
20	40	20	200
20 • 5	40 • 10	25	250
20 • 10	40 • 20	30	300
20 • 10 • 5	40 • 20 • 10	35	350
40	80	40	400
40 • 5	80 • 10	45	450
40 • 10	80 • 20	50	500
INCREMENTAL CHANGE		5	50
• AND CURRENT LIMIT WITHOUT –06 OPTION IS 600mA			

option, but do have a basic current limit of 100 mA. The basic current limit of the 4250A and 4265A power sources when not using the current limit option is 1.2 amp and, similarly, for the 4270A and 4275A is 0.6 amp.

6-45. Front Panel Indicator

6-46. The indicator labeled LIMIT FLAG on the MCU top panel is illuminated when a current overload (sink or source) condition occurs in the associated power source.

6-47. THEORY OF OPERATION

6-48. General

6-49. The A4200 MCU contains manually controlled switching circuits, internal, fixed-frequency triggered switching circuits, and provisions for externally controlled, variable frequency triggered switching circuits that provide the logic signals to control an associated programmable power source. These switching circuits permit manual control of the power source output voltage as well as an automatically triggered, repetitive and manually variable program for controlling the power source output voltage. The MCU is also provided with input-output circuits that, with the aid of a supplemental scope, permit the visual presentation of the ready or not ready status of the power source, the trigger output signal, and a means of connecting an external trigger.

6-50. Block Diagram Analysis

6-51. A simplified block diagram of the MCU is shown in Figure 6-5. The primary function of the MCU is to pro-

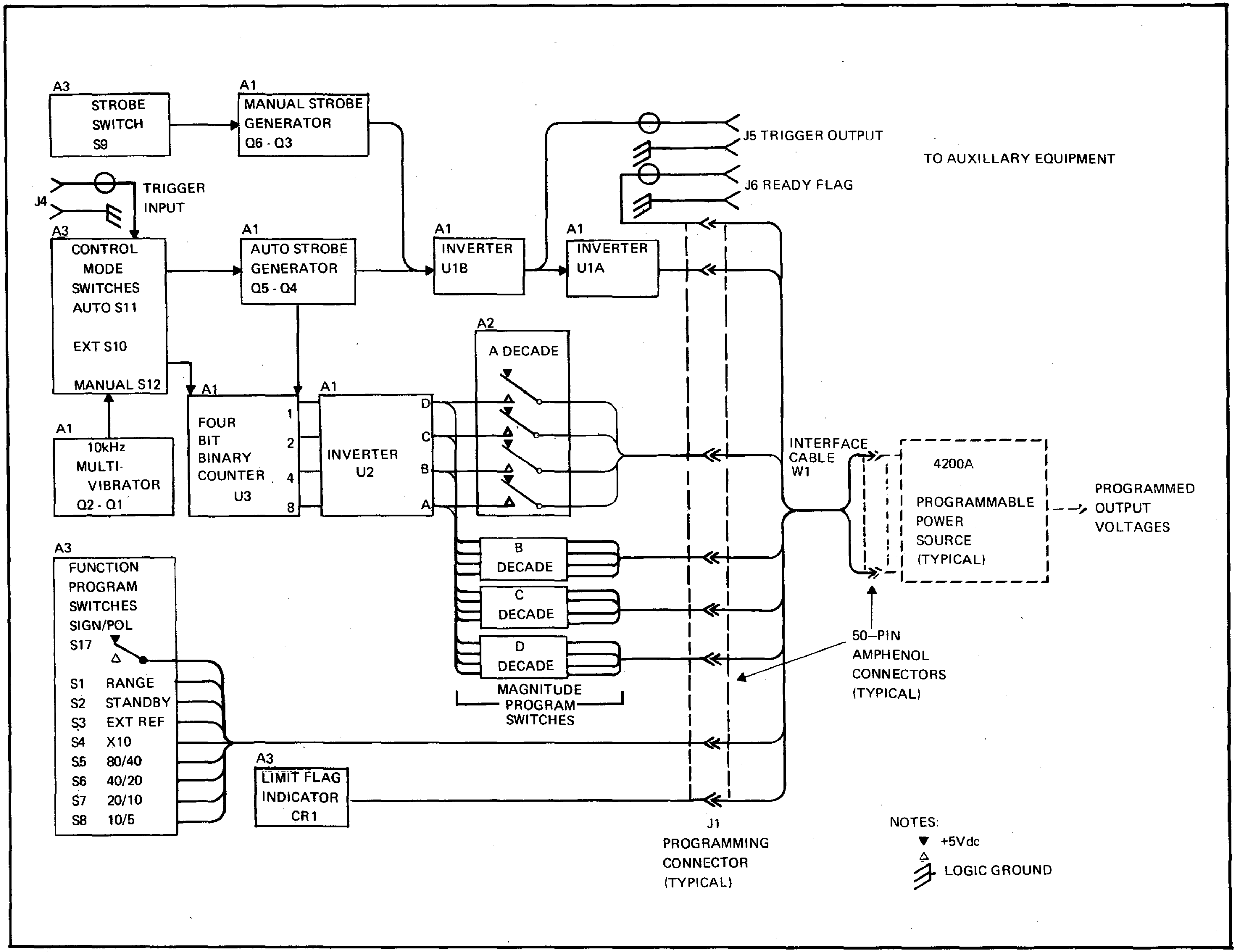


FIGURE 6-5. A4200 MANUAL CONTROL UNIT BLOCK DIAGRAM

vide manual control of the programming inputs into the 4200A series power sources. Switching by the following groupings of switches accomplishes this purpose: control groupings of switches accomplishes this purpose: control mode switches, magnitude program switches, and function program switches. The secondary function of the MCU is to provide an automatic mode of operation that applies a manually selected and manually variable magnitude program repetitively at a fixed or variable rate to a power source. This is accomplished by the following: a 10kHz oscillator, the control mode switches, and a 4-bit binary counter. The manual and auto strobe generators provide control of the strobing pulse for both the manual and automatic modes of operation.

6-52. With manual mode selected by A3 control mode switch S12, the four-bit counter is supplied with a logic 0 (low). This sets all four outputs of the counter to a logic 1 (high). Inverter U2 reverses the logic 1 on all four counter output lines to a logic 0, and then applies them in parallel through all closed magnitude program switches to the programmable power source via the interface cable and programming connectors. However, before the power source can act on the logic levels present on each of the 16 data lines, a logic level 0 manual strobe pulse must be entered. This is accomplished by manual depression of the strobe pushbutton switch S9, applying a logic 1 to the manual strobe generator Q6-Q3, which, in turn, supplies a logic 0 to inverter U1B. The dual inversion of inverters U1B and U1A then supplies the programmable power source with a logic 0 and the programmed output voltage appears at the output of the power source when the power source is equipped with the isolated control logic option.

6-53. With auto mode selected by A3 control mode switch S11, the previously selected manual mode switch is disconnected through interlock action. This removes the logic 0 applied to the set lines of binary counter U3. Simultaneously, the 10kHz multivibrator output is applied to two places: to the clock input of binary counter U3 and to the input of the auto strobe generator, Q5-Q4. The 10kHz multivibrator input to the binary counter U3 clocks it low initially and triggers the repetitive waveform pattern shown in Figure 6-6. The multivibrator input to auto strobe generator Q5-Q4 produces a 10kHz strobe pulse at its output, approximately half a microsecond wide, that is negative going, descending from +5 to OVdc. The pulse is inverted once through inverter U1B, to be used as a trigger output pulse at J5, and is inverted a second time through inverter U1A to be applied to the programmable power source via the interface cable W1 and programming connectors. The sequential output of the 10kHz driven binary counter is applied to the power source through any closed magnitude program switch in each decade following inversion through inverter U2.

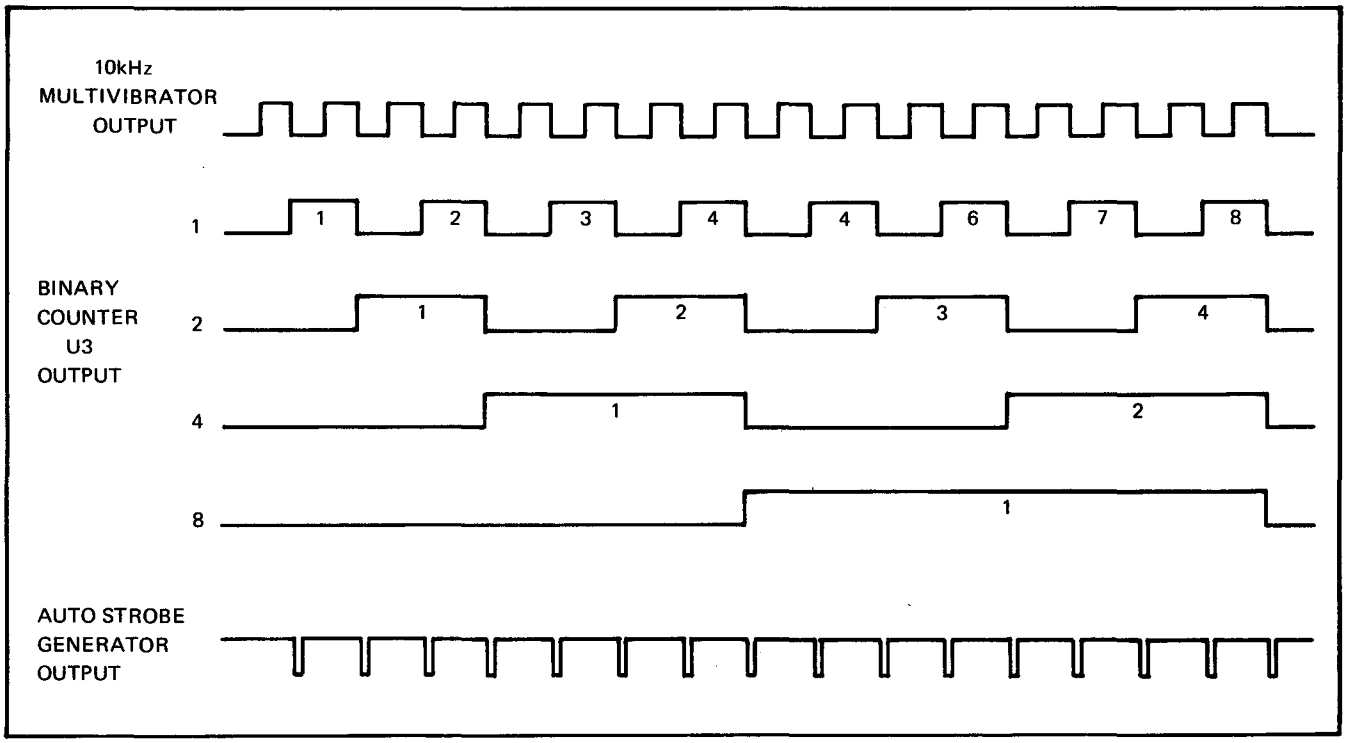


FIGURE 6-6. MODEL A4200 MCU TIMING DIAGRAM

6-54. With external mode selected by the A3 control mode switch, S10, the previously selected auto mode switch is disconnected through interlock action. This removes the 10kHz multivibrator output from the input to the binary counter and from the input to the auto strobe generator. Switched into these two input circuits is trigger input jack J4. Hence, use of an externally controllable trigger generator is possible, providing the parameters are generally as follows: output pulse frequency of 10kHz, 0.5μs pulse width, and having an output pulse impedance of about 50 ohms. The external trigger generator substitutes for the internal 10kHz multivibrator in the external mode, and circuit activity is essentially the same as discussed in auto mode.

6-55. The A3 function program switches provide a logic level low signal on the appropriate line to the connected power source when a given function switch is depressed. The SIGN/POL switch, S17, is shown as an example typical of these switches.

6-56. The indicator light LIMIT FLAG on the MCU top panel is essentially a duplication of the I LIMIT indicator on the front panel of a 4200A series power source. Hence, these two indicators can be expected to illuminate together when a specified current limit point is reached.

6-57. Circuit Description

6-58. The following paragraphs briefly describe the circuitry in the MCU. Each description, unless otherwise noted, is referenced to the schematic diagram A4200-1000 located at the end of this section.

6-59. CONTROL MODE SWITCHES. The control mode switches consist of three single pole, double-throw switches on the A3 Function Assembly, S10 through S12. These switches are the ganged, interlock, pushbutton type and only one switch at a time can be closed and latched. Switch S12, the MANUAL mode switch, when depressed and latched, applies a logic low (0 volts) to the four set input lines of the four-bit binary counter U3, pins 3,5,10, and 12. This forces the counter outputs on pins 4,6,9, and 11 to a logic high (5 volts). When the AUTO mode switch S11 is depressed and latched, the MANUAL mode switch is interlock released to its non-depressed state. This applies 5 volts to the binary counter previously held low by the latched, but now released MANUAL mode switch, and permits the counter to be advanced by the 10kHz multivibrator input at pin 1 of U3. The 10kHz MV output, supplied to the counter through the closed contacts of switch S11, is also applied to the input of the auto strobe generator at pin 9 of U1D. When the EXT mode switch S10 is depressed and latched, the AUTO mode switch is released. This removes the 10kHz MV output from the input of the auto strobe generator and from the clock input of the binary counter. The closed EXT mode switch connects the TRIGGER INPUT jack J4 to the counter and strobe generator inputs. An external 50 ohm pulse generator can be used to replace the 10kHz MV pulse. A 51 ohm resistor R1, provides the input termination for the external generator.

6-60. MAGNITUDE PROGRAM SWITCHES

6-61. The magnitude program switches consist of sixteen single pole, double-throw, push-push switches on the A2 Program Assembly, S1 through S16. The arms of these switches are wired directly to pins 1 through 16 of the J1 programming connector. The normally closed contacts of these switches are bussed to the 5Vdc power input, pin 25 of the programming connector. Hence, in their normally closed condition, which is the non-depressed state, these switches apply 5Vdc to pins 1 through 16 of the programming connector.

6-62. The normally open contacts of the switches are bussed in fours to one switch each in each of four groups, as S1 to S5 to S9 to S13, as S2 to S6, to S10, to S14, etc. In one case, these switches can be considered to be bussed in four BCD groups as determined by the weighting assigned each switch; i.e., 8, 4, 2, and 1. Thus, in the four decades, all similar weighted switches are paralleled on their normally open contacts.

6-63. Binary counter U3 supplies 1-2-4-8 logic levels through inverting gates U2D through A to the 1-2-4-8 switch busses, respectively. The logic levels are dependent on the state of the binary counter. In manual mode, the outputs of U3 are forced high (5 volts). Therefore, the outputs of the inventory gates supply a low (0 volts) to the switch busses. However, in auto or external mode, the switch busses are switched between high and low in a binary sequence and at a frequency determined by the 10kHz multivibrator, or by an external frequency applied at the trigger input jack J4.

6-64. FOUR-BIT BINARY COUNTER

6-65. The four-bit binary counter U3 is an asynchronous negative-edge triggered counter. The outputs (1-2-4-8) of the counter are connected to the correspondingly weighted busses of the sixteen magnitude program switches through the inverting gates of U2. The outputs of the counter are low at zero and go high in binary sequence. The clock required to advance the counter is supplied through the control mode switches by the 10kHz multivibrator, or by an external pulse generator connected to trigger input jack J4.

6-66. TEN KILOHERTZ MULTIVIBRATOR

6-67. The 10kHz multivibrator is a simple, dual transistor (Q1-Q2) multivibrator designed to free run at approximately 10kHz. The square wave output is used in the auto control mode to clock the binary counter and to trigger the auto strobe generator.

6-68. AUTO STROBE GENERATOR

6-69. The A1 auto strobe generator is composed of transistors Q4-Q5 and inverter amplifiers U1A through U1E, plus related circuit components. It is an active pulse shaping network that is used to supply a strobe pulse in the auto and external modes of MCU operation. The negative descent of each 10kHz pulse from the 10kHz MV triggers the auto strobe generator. Following an approximate delay of 1.5 microseconds, a strobe pulse of half a microsecond, approaching 0 volts from a 5 Vdc reference, is produced at the input of inverter amp U1B. The output of U1B produces a positive-going pulse that is applied as a trigger at trigger output jack J5. Inverter amp U1A returns the strobe pulse to its original excursion and presents it at pin 33 of the programming connector.

6-70. MANUAL STROBE GENERATOR

6-71. The A1 manual strobe generator is composed of transistors Q6 - Q3, A3 control mode switch S9 (STROBE), and related circuit components. The manual strobe pulse generator is built around a programmable unijunction transistor (PUT) Q6 which is effectively anode gated by the application of a positive voltage through the momentary closed contacts of the STROBE pushbutton switch S9. The firing of Q6 turns on gating transistor Q3, which effectively applies a logic 0 pulse at the input of inverter amp U1B. Pulse processing through the two inverters, U1B and U1A, is the same as described in the previous paragraph.

6-72. FUNCTION PROGRAM SWITCHES

6-73. The function program switches consist of nine spot push-push switches (with one exception - the momentary contact STROBE switch S9) on the A3 Function Assembly, S1 through S9. The arms of these switches are wired directly to their corresponding pins on the J1 programming connector. These switches are independent and are not controlled by any other switches or any other circuitry, with the exception of the 5 volt 1ns line which is paralleled to the normally closed contacts of switches S1 through S8. Switch S9 is the opposite configuration with the 5 volt bus line tied to the normally open momentary contact. Switches S1 through S8, when depressed, latch to logic 0.

6-74. READY FLAG

6-75. Ready flag connector J6, mounted on the MCU top panel, produces an output of 5Vdc to indicate that the related power source is ready to accept programming inputs, or produces a 0 volt output to indicate that the power source is not ready to accept programming inputs. This output jack is tied directly to the power source through the interface cable and programming connectors on Pin 37.

6-76. LIMIT FLAG

6-77. Limit flag indicator CR1, mounted on the MCU top panel, is a red-light emitting diode. It illuminates when forward biased by a logic 1 (logic ground) on its cathode. A logic 1 is applied to the cathode from the programmable power source via the interface cable and programming connectors on Pin 49 when an overload (overcurrent) condition exists in the power source.

6-78. MAINTENANCE

6-79. Introduction

6-80. The maintenance procedures given in the following paragraphs describe maintenance access, pushbutton replacement, LIMIT FLAG indicator replacement, and troubleshooting.

6-81. Maintenance Access

6-82. Remove six Phillips Head screws from sides of channel bottom. Remove four Phillips Head screws securing rubber feet to bottom of unit.

6-83. Withdraw V-shaped channel bottom from MCU. Test points 1 through 5 are now accessible at bottom of unit on the component side of the motherboard, connector PCB Assembly.

6-84. Remove two Phillips Head screws from rear, left side of unit.

6-85. Remove motherboard, Connector PCB Assembly from the unit with a gentle rocking and pulling motion to separate motherboard from the two other PCB's in the unit.

6-86. Disconnect coaxial jack cluster connectors at the underside of the Function Assembly PCB. These four connectors may be colored BLK, RED, BRN and ORN.

6-87. Disconnect leads to LIMIT FLAG light emitting diode - also on the same PCB. These two leads may be colored ORN and YEL.

6-88. Remove two Phillips Head screws from the right side of the unit and two remaining screws from the left side of the unit.

6-89. Remove the switch panel from the MCU top panel. Each of the individual pushbutton switches are accessible for individual continuity checks. The upper switch bank is mounted on the Program PCB Assembly and the lower switch bank is mounted on the Function PCB Assembly. Prior to further disassembly, note the relationship of the program PCB and function PCB to the end flanges of the MCU top panel. Viewed from the rear, with program PCB uppermost, the cluster of four P-nuts must be on the right flange.

6-90. Removal of two Phillips Head screws from each of the ends of the program and function PCB's permit removal of these two boards with attached pushbutton switch banks.

6-91. Assembly of the MCU is done in reverse order of disassembly with attention to the proper locating of the program and function PCB's on the switch panel as noted in step 6-89. Reversal of these two PCB's is possible, but will not permit final assembly of the top panel.

6-92. Switch Maintenance

6-93. The following eleven paragraphs describe the procedure to be followed when a defective switch is to be replaced in the MCU.

6-94. Remove the PCB assembly that contains the defective switch using the maintenance access procedures given in the previous paragraphs.

6-95. Since individual pushbutton switches are not replaceable, an entire switch set that contains the defective switch must be replaced as a unit.

6-96. Refer to the List of Replaceable Parts to determine the FLUKE part number for the switch set to be replaced and order the switch set in conformance with part ordering instructions.

6-97. Following receipt of the correct replacement switch set, determine that it is operating correctly and then remove the switch set containing the defective switch as follows:

a. Using a small soldering iron and a solder removing tool, unsolder all of the switch set mounting tabs from the circuit board pads and remove as much liquified solder as possible with the solder removing tool.

b. Prevent adherence of the cooling tabs to the pads by vibrating each tab in its pad with a pair of needlenose pliers or a similar tool.

c. After all tabs are unsoldered from the PCB pads, remove the entire switch set from the PCB and exercise care to remove the PCB spacers that are attached to the switch tabs. Make a layout sketch of the positions of the spacers on the switch set.

d. Remove the spacers from the defective switch set and install them, each one on the new switch set in accordance with the layout sketch made in the previous step. Press the spacers tightly against the switches, cleaning out any flowed solder that prevents full surface contact between the spacers, switches, and PCB.

e. Insert the new switch set into the PCB in the same orientation as the adjacent switch set, top side up.

f. Solder all tabs into the PCB pads and be careful to press each switch tightly against the PCB. The installed switch set must be aligned with the adjacent switch set and with the PCB evenly, or else the switch assembly will not fit through the slots on the top panel at final assembly.

g. Check that the newly installed switch set is operating correctly and install the PCB into the MCU as defined under maintenance access.

6-98. Limit Flag Indicator Replacement

6-99. The following eleven paragraphs describe the procedure to be followed when a defective indicator is to be replaced in the MCU.

6-100. Refer to the List of Replaceable Parts to determine the FLUKE part number for the indicator to be replaced and order it in conformance with the part ordering instructions.

6-101. Install replacement indicator in the MCU as follows:

a. Perform maintenance access procedures to the step that removes the motherboard connector PCB Assembly from the MCU.

b. Locate insulating sleeving that covers one of the wires leading into the rear of the defective indicator and slide it back along the wire until the amp connector it covers is fully exposed. Observe color coding of wires for later hook-up.

c. With a long pointed soldering tool, unsolder the amp connector uncovered in the previous step from an indicator lead. Repeat with the other indicator lead and clean both amp connectors internally of any residual solder.

d. Using a blunt instrument or rod of sufficient diameter to clear the inside of the indicator retaining cup, push the indicator out the retaining cup from the rear. Observe orientation upon removal for later installation of replacement.

e. Using the removed indicator as a guide for the new indicator, clip the correct lead at the base and the other two leads to the proper length.

f. Insert the indicator into the cup in the same exact orientation as observed during removal of the defective indicator.

g. Connect both amp connectors identically to the earlier observed hook-up and solder connectors to the indicator leads using minimal heat and solder.

h. Slide the insulating sleeving over the amp connector to insulate the bare indicator leads from each other.

i. Assemble the MCU in accordance with procedures given under maintenance access.

6-102. TROUBLESHOOTING

6-103. The troubleshooting of an improperly responding and defective power source, when under control of an MCU, is not covered in this section. Troubleshooting the power source is covered, however, in the basic instrument maintenance section of the manual, and may not include use of the MCU as a troubleshooting aid. On the other hand, the first indication that troubleshooting is necessary will be an improperly responding power source that is under control of an MCU. Consequently, the first step in using these troubleshooting procedures is to determine that the MCU is faulty and not the associated power source.

6-104. The MCU and power source are tied together for one of three purposes: (1) for manual control of the programming inputs to a valid power source, (2) for calibration and adjustment of an out-of-tolerance or repaired power source, and (3) for troubleshooting an improperly operating power source. In the first two cases when malfunctions are observed in the response of the power source to MCU programming inputs, other than obvious mechanical faults on the MCU, such as a stuck switch, a bent or misaligned programming connector, or a servered cable wire - all of which are readily identified and repaired - isolation of the fault to the MCU is accomplished by disconnecting the MCU at the power source programming connector and connecting another programming source, known to be good, to the power source. In the third case where an MCU is used to troubleshoot an improperly operating power source and the MCU becomes suspect, the MCU must be considered defective and checked separately. A troubleshooting procedural outline is given on the reverse side of the foldout page which faces the schematic diagram of the MCU.

6-105. Equipment required for troubleshooting the MCU is a multimeter, an oscilloscope, and a 7-inch insulated shorting jumper terminated with midget alligator clips. Additionally, a 5 volt dc power supply is required for troubleshooting the MCU when it is disconnected from the power source.

6-106. With the interface cable attached and locked to the J1 programming connector on the MCU, gain access to the motherboard A1 Connector Assembly and locate test points 1 through 5. See maintenance access procedures, paragraph 6-81. Proceed with troubleshooting procedures given on drawing No. A4200-1800.

MODEL A4200

TROUBLESHOOTING PROCEDURES

Power Off Checks

1. Inspect MCU for improperly seated plug-in assemblies, loose or broken wires, damaged or burned components, or other obvious problems.

2. Check that switches are aligned and that no broken switch return springs are evident.

3. Check that connectors are properly attached to motherboard A1 Connector Assembly from coaxial jacks and from LIMIT FLAG indicator.

Power on Checks

1. Apply 5 Vdc to MCU in either of two ways to determine that power input and distribution circuits are continuous. Either apply power by connecting interface cable connector to power source and turning on power switch, or by locating test points 4 (+) and 3 (-) and applying +5Vdc to these test points from the and applying +5Vdc to these test points from the 5Vdc power supply.

2. If MCU is connected to a power source as defined above, check for +5Vdc between test points 4 (+) and 3 (-). If MCU is connected to the 5Vdc power supply at test points 4 (+) and 3 (-), check for +5Vdc between pin 25 (+) and any pin of the group number 17 through 24 (-) on the unconnected interface cable connector.

3. Failure to measure the required voltage at the places specified above indicates a defective interface cable/ connectors or a defective A1 motherboard A1 Connector PCB Assembly. Refer to the schematic diagram and localize the fault to either the interface cable/ connectors or to the A1 PCB, as appropriate.

   10kHz MULTIVIBRATOR CHECK. Check the output of the 10kHz multivibrator by measuring between test points 1 (+) and 3 (-) either with a multimeter set to 2.5Vdc for full scale deflection, or, if a waveform inspection is desired, connect the input of the scope to these test points and observe the square wave output as shown in Figure 6-6. If neither voltage nor waveform is present, the multivibrator may be locked up. In this case, remove power from the MCU and reapply as a step function to initiate flip-flop action of the multivibrator. Check output again, and, if none is observed, the multivibrator circuit is defective.

MANUAL SWITCH, FOUR-BIT BINARY COUNTER, AND GATED INVERTER U2. Locate pins 9 through 12 on the rear of the interface cable connector attached to the A1 motherboard. Select one of the four pins for +5Vdc full scale deflection measurement on the meter. Use test point 3 (-) for ground reference. Depress and latch the C decade pushbuttons. Depress and latch the MANUAL pushbutton and check that the multimeter reads about 0Vdc. Check for 0Vdc on the other three pins. Release MANUAL and check that the multimeter reads +5Vdc on each pin. Failure to read any one voltage indicates that inverter U2 is probably defective. Failure to read all voltages indicates that the four-bit binary counter or MANUAL switch is probably defective. To isolate the MANUAL switch from the counter, proceed as follows: Confirm that 5Vdc exists on pin 9 at the rear of the interface cable connector attached to the A1 motherboard. Attach the shorting jumper between test points 1 and 2 and check that the multimeter reads less than the previous dc voltage. If less, then the MANUAL switch is probably defective. If dc voltage does not decrease after the shorting jumper is attached then the four-bit counter is defective. This condition can be confirmed by viewing absence of waveform on scope at pin 9 after the shorting jumper is attached.

STROBE SWITCH, MANUAL STROBE GENERATOR, AND INVERTERS U1A–U1B. Connect oscilloscope input between pin 33 and test point 3. Set up scope for display of 0.5μs pulse (s) descending to 0 from +5Vdc. Depress STROBE pushbutton switch repeatedly and observe more than one decending pulse of the extent and magnitude given above. If no pulse is obtained, repeatedly attach shorting jumper between test points 4 and 5 and check scope for pulses. If pulses are obtained, STROBE switch is defective. If no pulses, take scope input from TRIGGER OUTPUT jack J5, and look for ascending pulses. If pulses are obtained, integrated circuit inverter U1A is defective. If no pulses are obtained either the manual strobe generator or the auto strobe generator is defective. To check the auto strobe generator, remove the previously attached shorting jumper and attach it between test points 1 and 2. Check for previously defined output pulse(s) from TRIGGER OUTPUT jack J5. If pulses are present, manual strobe generator is defective. If pulses absent, integrated circuit inverter U1B, which is part of the auto strobe generator, is defective.

AUTO STROBE GENERATOR AND AUTO SWITCH: The previous paragraph defined the procedures for checking part of the autostrobe generator that is common to the manual strobe generator. This paragraph gives the procedure for checking that portion of the auto strobe generator upstream of inverter U1B as well. Set up the scope as defined in first two sentences of the previous paragraph. Remove shorting jumper from test points 1 and 2 if previously attached. Depress and latch AUTO pushbutton on top panel of MCU. Check for repeated pulses as defined above. If pulses are present, the circuitry from the 10kHz multivibrator to AUTO switch to auto strobe generator to output at pin 33 is valid. If pulses are not present, determine from a previous paragraph that 10kHz multivibrator is valid and then apply the shorting jumper between test points 1 and 2. If pulses are present, the AUTO switch is defective. If pulses are absent, the auto strobe generator is defective. To determine which pulse forming stage in the pulse generator is defective, refer to the schematic and, using the scope, check each stage regressively from the base circuit of transistor Q4 until a waveform synched to 10kHz is found. This point defines the input to the defective stage.

SWITCHES AND INDICATOR: Troubleshooting of the pushbutton switches and indicator is done using a multimeter for either continuity or volrage checks.

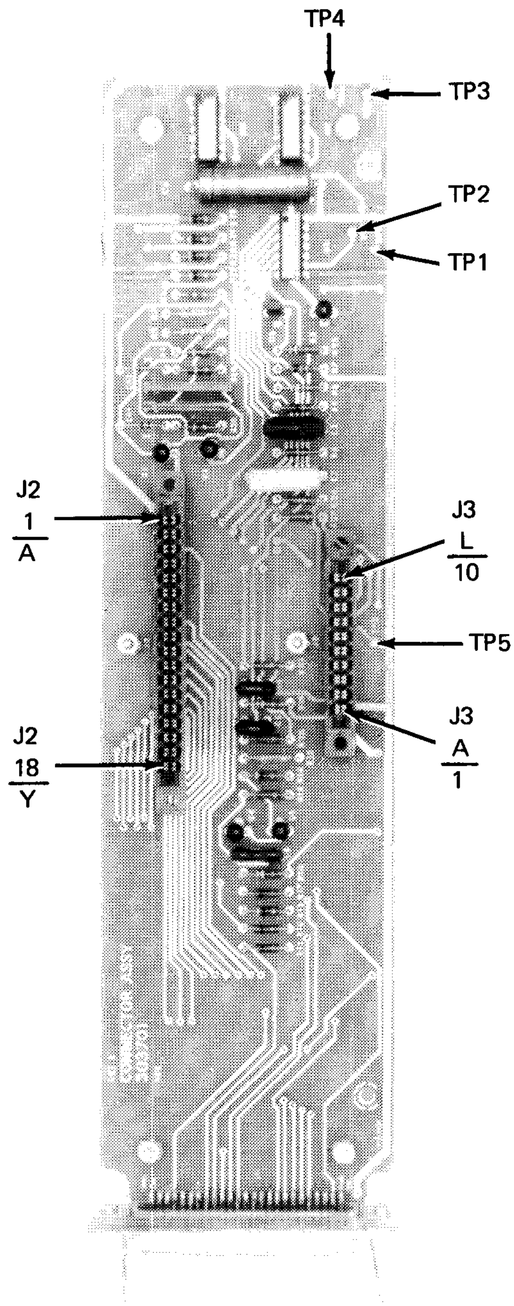


Figure 6-7. MOTHER BOARD A1
CONNECTOR ASSEMBLY PCB

TROUBLESHOOTING PROCEDURES
DRAWING NO. A4200–1800

6-107. LIST OF REPLACEABLE PARTS

6-108. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5. See paragraph 6-109, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

6-109. SERIAL NUMBER EFFECTIVITY

6-110. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model A4200. Each part in this option for which a use code has been assigned may be identified with a particular serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all serial numbers 123 and on. NOTE: These Use Codes and Serial Number Effectivity apply to this option only.

USE CODE	SERIAL NUMBER EFFECTIVITY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	MANUAL CONTROL UNIT (Figure 6–8)	A4200			
A1	CONNECTOR ASSEMBLY, PCB Figure 6-9.	303701	1		
A2	PROGRAM SWITCH ASSEMBLY, PCB Figure 6-10.	303727	1		
A3	FUNCTION ASSEMBLY, SWITCH PCB Figure 6-11.	303719	1		
	PANEL, TOP, SCREENED Figure 6-8.	303743	1		
	Connector, BNC, level cont. input.	152033	3		
CR1	Diode, Light Emitting	309617	1		
W1	Cable Assembly, Interface	303354	1		
XCR1	Clip, Snap-in, (diode) black Panel Switch (Panel Switch (interior)	309625 303768	1 1		
	Foot, Rubber Button, black	130138	4		
	Channel, bottom	303750	1		
	Switch Assemblies (see A2/Figure 6-9. and A3/Figure 6-10.)				

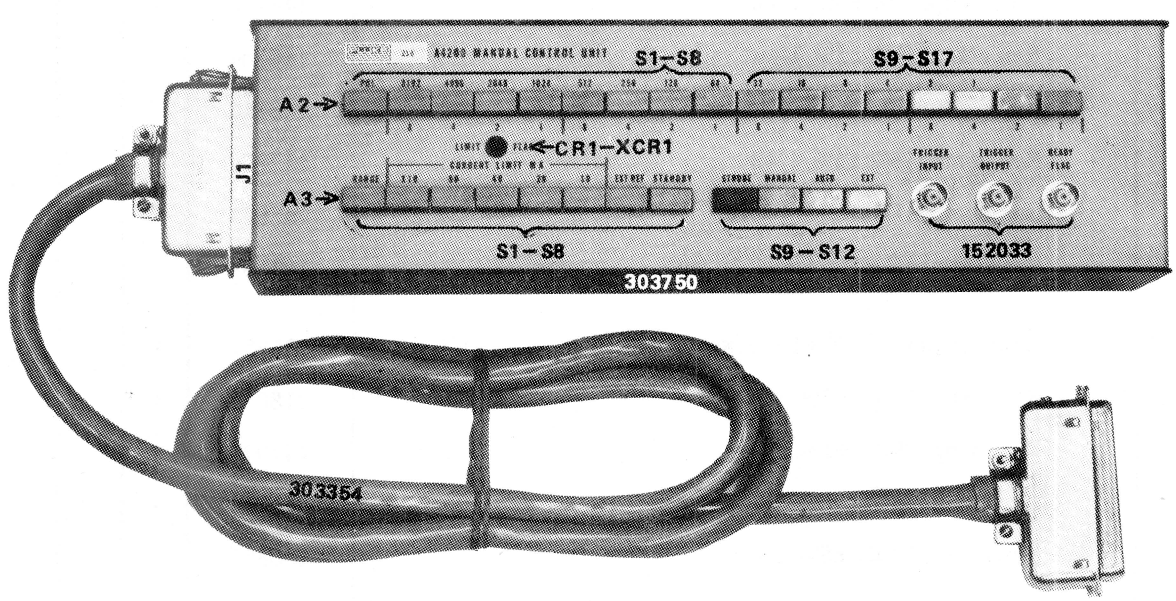


Figure 6-8 MANUAL CONTROL UNIT

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	**CONNECTOR ASSEMBLY, PCB Figure 6–9.**	REF			
C1,C2	Cap, fxd flm, .0047 uf ±2% 150v	182972	2		
C3	Cap, plstc .047 uf ±10%, 200v	207555	1		
C4	Cap, mica, 330 pf ±5%, 500v	148445	1		
C5	Cap, mica, 100 pf ±5%, 500v	148494	1		
C6	Cap, fxd, elect, 640 uf + 50/–10%, 6.4v	178608	1		
C7	Cap, plstc, .47 uf ±10%, 250v	184366	1		
C8	Cap, mica, 640 pf ± 5%, 500v	215251	1		
CR1,CR2	Diode, sil, 150 ma	203323	2		
J1	Connector, female, 50 contact	267252	1		
J2	Connector, female, 36 contact	285247	1		
J3	Connector, female, 20 contact	292912	1		
Q1 thru Q5	Xstr, Si, NPN	159855	5		
Q6	Xstr, Si, unijunction	268110	1		
R1,R4,R28, R29	Res, comp, 2.4K ±5%, 1/4w	193433	4		
R2,R3	Res, met flm 15.4K ±1%, 1/8w	261651	2		
R5	Not used				
R6	Res, comp, 22K ±5%, 1/4w	148130	1		
R7	Res, comp, 10K ±5%, 1/4w	148106	1		
R8	Res, comp, 39K ±5%, 1/4w	188466	1		
R9	Res, comp, 15Ω ±5%, 1/4w	147876	1		
R10,R11,R17	Res, comp, 1K	148023	3		
R12,R14,R19 thru R22	Res, comp, 3K ±5%, 1/4w	193508	6		
R13	Res, met flm, 13.7K ±1%, 1/8w	236752	1		
R15,R23,R26	Res, comp, 510Ω ±5%, 1/4w	218032	1		
R16,R18,R25	Res, comp, 390Ω ±5%, 1/4w	147975	3		
R24	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
R27	Res, comp, 270Ω ±5%, 1/4w	160804	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
U1	I.C., TTL, Hex inverter, Buffer/Driver	288605	1		
U2	I.C., DTL, Quad 2–Input NAND Gate	268375	1		
U3	I.C., DTL, Binary Counter	267153	1		

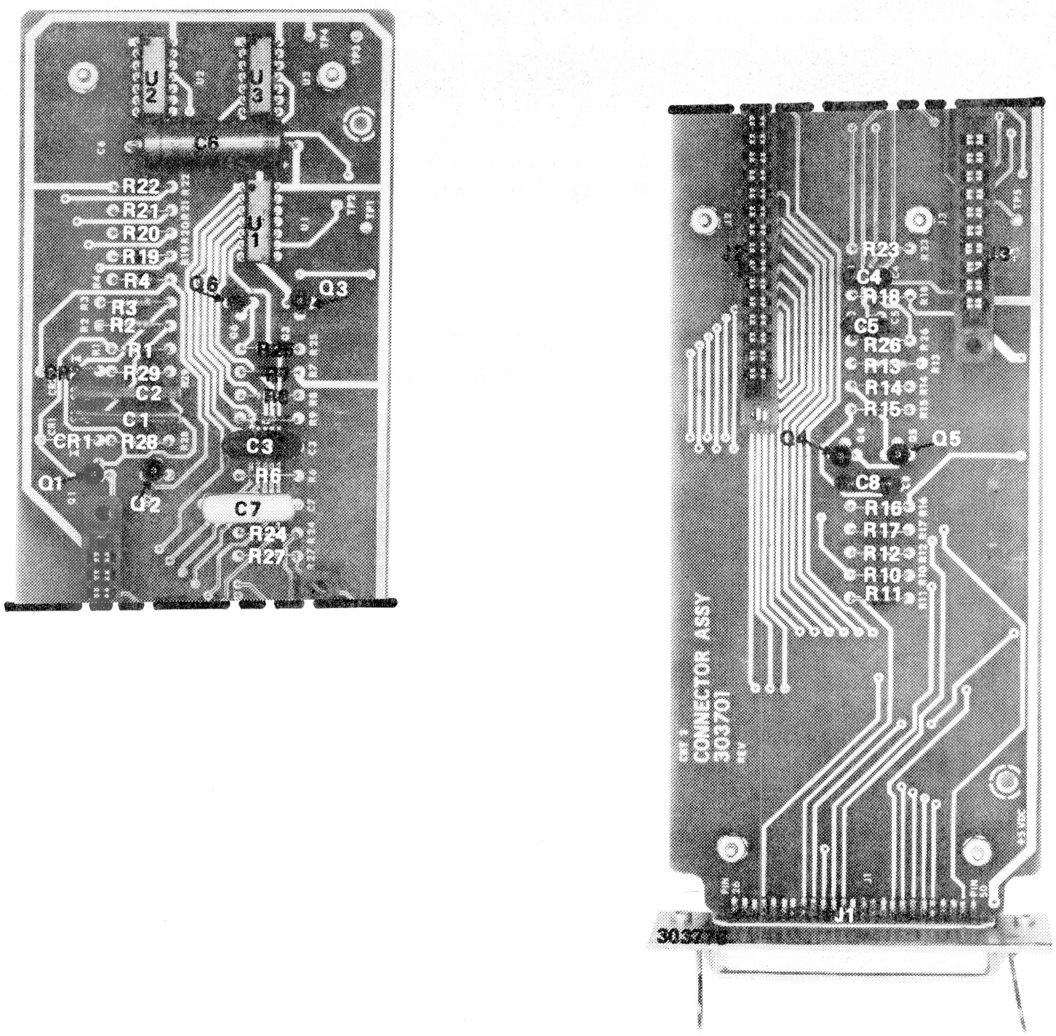


Figure 6-9. CONNECTOR ASSEMBLY PCB (A4200-4001)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**PROGRAM ASSEMBLY** **Figure 6–10.**	REF			
S1 thru S8	Switch Assembly (8 pushbutton)	306589	1		
S9 thru S17	Switch Assembly (9 pushbutton)	306571	1		

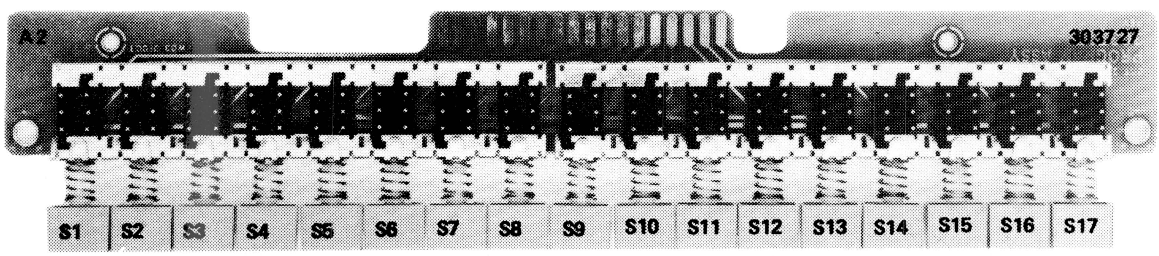


Figure 6-10. PROGRAM ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	**FUNCTION ASSEMBLY PCB Figure 6–11.**	REF			
R1	Res, comp, 51Ω ±5%, 1/4w	221879	1		
S1 thru S8	Switch Assembly (8 pushbutton)	306589	1		
S9 thru S12	Switch Assembly (4 pushbutton)	306597	1		
	Connector pin	267500	6		

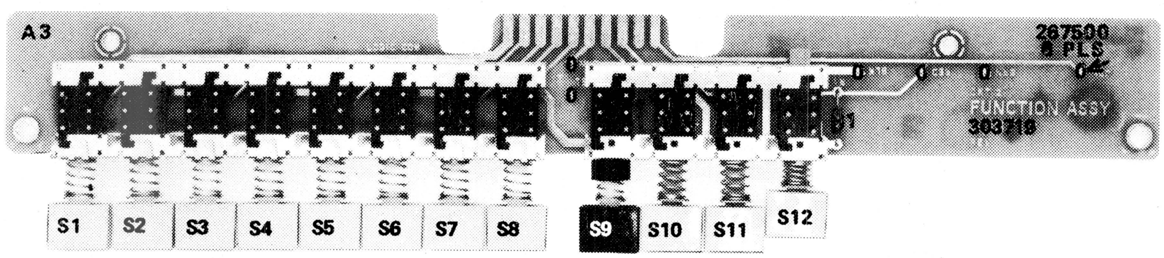
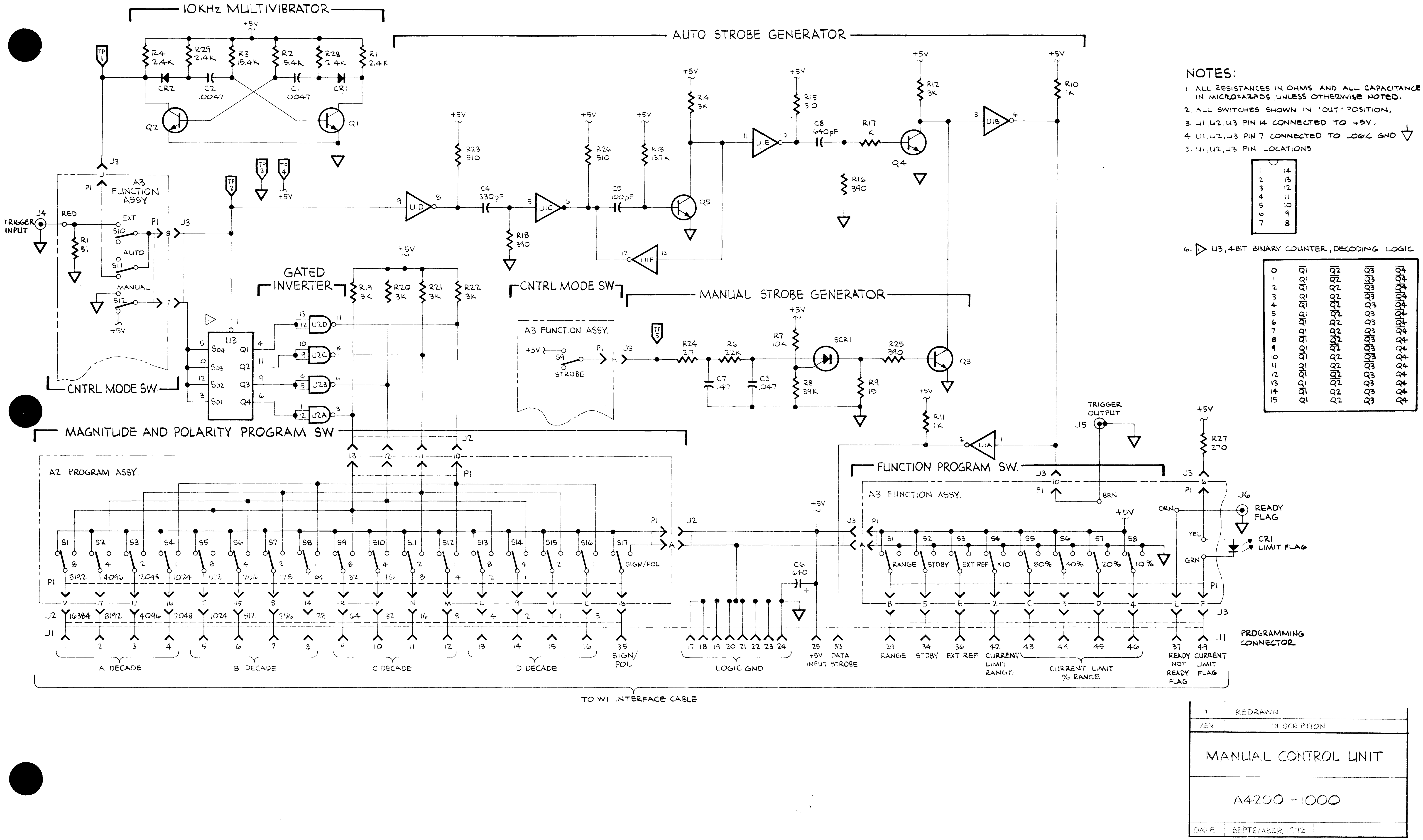


Figure 6-11. FUNCTION ASSEMBLY

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
130138	70485	366	268375	04713	MC846P
147876	01121	CB1505	285247	02660	225-21821-110
147975	01121	CB3915	288605	01295	SN7416N
148023	01121	CB1025	292912	02660	225–21021–110
148106	01121	CB1035	303354	89536	303354
148130	01121	CB2235	303701	89536	303701
148445	14655	CD15F330J	303743	89536	303743
148494	14655	CD15F101J	303750	89536	303750
152033	02660	UG1094A/U	303719	89536	303719
159855	07910	CS23030	303727	89536	303727
160804	01121	CB2715	303768	89536	303768
178608	73445	C437ARC640	306571	89536	306571
182972	02799	PE–472–G	306597	89536	306597
184366	73445	C280AE/A470K	306589	89536	306589
188466	01121	CB3935	309617	71318	FLV102
193433	01121	CB2425	309625	07263	FVC 001T
193508	01121	CB3025			
203323	03508	DHD1105			
207555	14655	DMF2S47			
215251	14655	CD19F641J			
218032	01121	CB5115			
221879	01121	CB5105			
236752	91637	Type MFF 1/8			
246744	01121	CB27G5			
261651	91637	Type MFF 1/8			
267153	04713	MC839P–6921			
267252	02660	57–40500			
267500	00779	86144–2			
268110	03508	D13T1			



10KHz MULTIVIBRATOR
AUTO STROBE GENERATOR
GATED INVERTER
CNTRL MODE SW
MANUAL STROBE GENERATOR
A3 FUNCTION ASSY
TRIGGER INPUT
MAGNITUDE AND POLARITY PROGRAM SW
A2 PROGRAM ASSY
FUNCTION PROGRAM SW
TRIGGER OUTPUT
READY FLAG
CR1 LIMIT FLAG
PROGRAMMING CONNECTOR
A DECADE
B DECADE
C DECADE
D DECADE
SIGN/POL
LOGIC GND
+5V INPUT
DATA STROBE
RANGE
STDBY
EXT REF
CURRENT LIMIT RANGE
CURRENT LIMIT % RANGE
READY NOT READY FLAG
CURRENT LIMIT FLAG
TO W1 INTERFACE CABLE
NOTES:
1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCE IN MICROFARADS, UNLESS OTHERWISE NOTED.
2. ALL SWITCHES SHOWN IN "OUT" POSITION.
3. U1, U2, U3 PIN 14 CONNECTED TO +5V.
4. U1, U2, U3 PIN 7 CONNECTED TO LOGIC GND
5. U1, U2, U3 PIN LOCATIONS
6. U3, 4 BIT BINARY COUNTER, DECODING LOGIC
REDRAWN
REV
DESCRIPTION
MANUAL CONTROL UNIT
A4200-1000
DATE
SEPTEMBER 1972

Accessory
Rack Mounting Fixtures

6-1. INTRODUCTION

6-2. The Accessory Rack Mounting Kits are of two general types: half-rack width and full-rack width. The half-rack width mountings are further divided into dual mountings, center mountings, and offset mountings. Chassis Slide Kits, which enable withdrawl of the rack mounted instrument for inspection and servicing, can be installed on full-width rack instruments and on half-rack width instruments when in the dual mounting configuration. Figure 6-1 shows the variations possible in rack mountings and the configurations which can use chassis slides, all variations related to the standard 19-inch equipment rack.

6-3. INSTALLATION PROCEDURES

6-4. Half-Rack Width Mountings

6-5. The half-rack width mountings are shown in Figure 6-1 as A, B, and C. The full-rack mounting is shown as D. To install the mountings shown in Figure 6-1 B through D, proceed as follows:

a. Disconnect the line power cord.

b. Peel the decal shown in Figure 6-2 from each front side panel.

c. Install the mounting brackets on each front side panel using the #8-32 x 1/2" PHP screws provided in the kit. The mounting brackets for offset installation can be installed on either side, as desired.

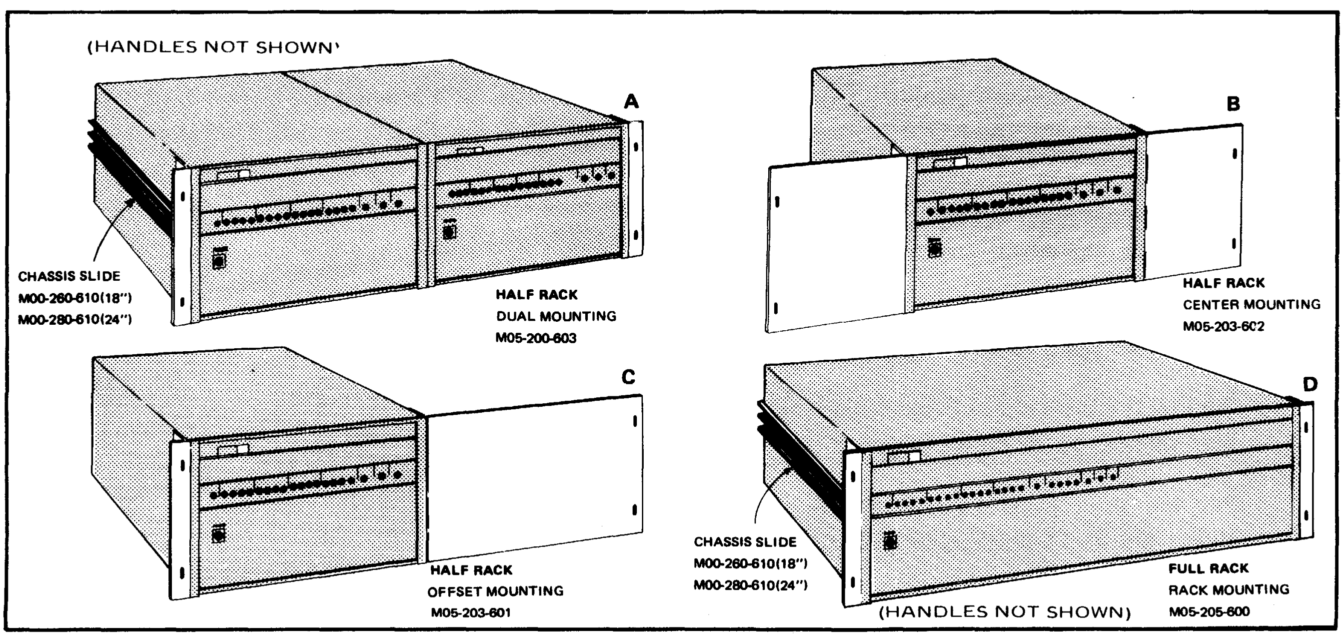


Figure 6-1. ACCESSORY RACK MOUNTING KITS

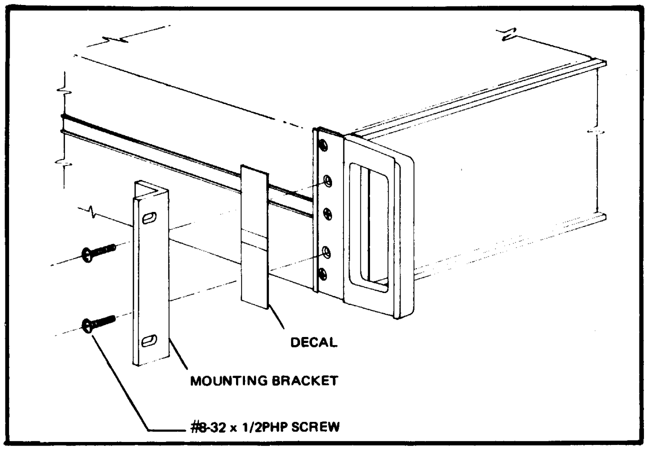


Figure 6-2. RACK MOUNTING BRACKET INSTALLATION

d. Remove the feet from the bottom dust cover.

e. Slide the instrument into the equipment rack and secure it in place with fasteners through the mounting brackets.

NOTE!

Chassis slides should be installed on the full-rack width units. See Figure 6-1, A.

f. Connect the power cord to line power.

6-6. Half-Rack Dual Units Installation

6-7. Two half-rack width instruments can be installed side-by-side in an equipment rack using the M05-200-603 Rack Mounting Kit. To install these components and mount the units in the equipment rack, proceed as follows:

a. Ensure that the power cord of each instrument is disconnected from line power.

b. Peel the front and rear side panel decals from each instrument.

c. Select one instrument and remove the top and bottom dust covers.

d. Remove the guard cover.

e. Remove the three screws from the front side panel that will mate to the other instrument.

f. Pull the front panel forward slightly and then thread the #8-32 fasteners into the P-nuts shown in Figure 6-3.

g. Push the front panel into position, making sure that each PCB is correctly mated into the mother board PCB, and then install the three screws in the front side panel.

h. Thread the #8-32 fasteners into the P-nuts located on the inner rear side panel that will mate to the other instrument.

i. Bolt the two instruments together as shown in Figure 6-3.

j. Install the guard cover removed in step d.

k. Remove the feet from the bottom dust cover of each instrument.

l. Install the top and bottom dust covers removed in step b.

m. Install the mounting brackets shown in Figure 6-2 on the outer front side panels. Use the #8-32 x 1/2" PHP screws provided in the kit.

n. Slide the two instruments into the equipment rack and secure them in place with fasteners through the mounting brackets.

NOTE!

Refer to paragraph 6-8 for chassis slide installation.

o. Connect the power cords to line power.

6-8. Chassis Slide Installation

6-9. The M00-260-610 (18") or M00-280-610 (24") Chassis Slide Kit should be installed to better facilitate dual rack mounting or installation of full-width rack units. To

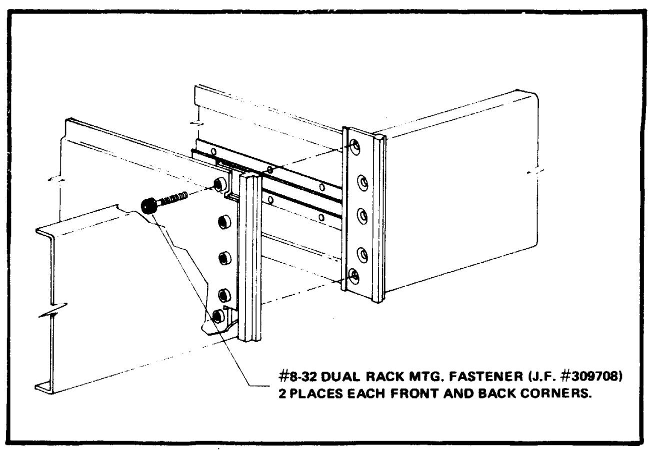


Figure 6-3. DUAL RACK MOUNTING

install these components and mount the units or unit in the equipment rack, proceed as follows:

a. Peel the center side panel decals from the instrument.

b. Peel the rear side panel decals from the instrument.

c. Remove the six screws from the rear panel corner brackets and then remove the brackets.

d. Slide the spacer (A) into the center section of the side panel until the tapped holes are aligned with the holes in the side panels.

e. Scribe a line on spacer where it protrudes from the rear of the side panel and then remove it from the instrument.

f. Cut off the spacer at the scribe mark and then install it in the side panel.

g. Install the rear panel corners.

h. Attach the chassis section (B) to the side panels with the screws (C) provided in the kit.

i. Install the cabinet sections (E) and center sections (D) in equipment rack. The extension angle brackets, which are part of section (E), are mounted at the rear of the cabinet.

j. Slide the center sections (D) toward the front of the cabinet until they lock in place.

k. Depress the spring locks on the chassis sections (B) and insert the instrument between the extended center sections (D) on the cabinet.

l. Slide the instrument completely into the equipment rack and secure in place with fasteners through the mounting brackets.

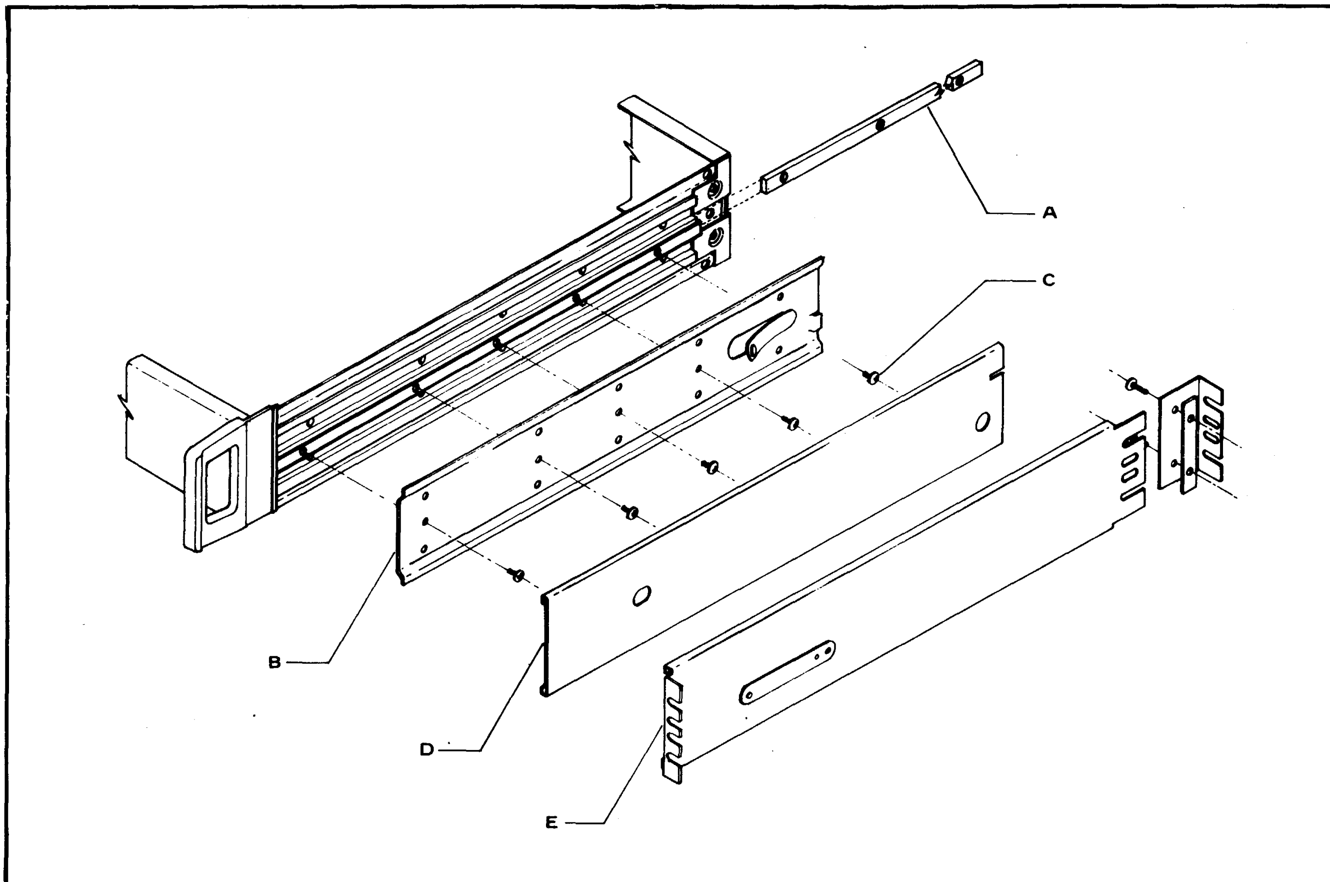


Figure 6-4. CHASSIS SLIDE INSTALLATION

Accessory
Programming Connector

6-1. INTRODUCTION

6-2. The Amphenol, male, programming connector shown in Figure 6-1 is used to interface the instrument to a programming source. This male programming connector mates with the female programming connector that is mounted on the rear panel of the instrument. A male connector is normally supplied with each instrument, less cabling, but may also be ordered directly from Amphenol under PART NO. 57-30500, or from the John Fluke Mfg. Co., Inc., by referencing FLUKE PART NO. 266056.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Cabling connections to the male programming connector are done as follows:

a. Remove the screws from the terminal cover of the male connector and remove the cover and numbered terminal/pin insert.

b. Remove the screws from the restraining clamps on the cover and spread the clamps.

c. Thread the cable wiring through the terminal cover. Maximum size is #22.

d. Solder the wiring to the appropriate terminals of the numbered insert. Refer to Figure 6-1 for terminal locations. Use pin cover to support insert during soldering.

e. Slide the covers together and install the attaching screws.

f. Close the restraining clamp around the cable and install the screws. If necessary, wrap the wiring bundle to provide a proper diameter for the restraining clamp.

g. Connect the male programming connector to the female connector on the rear panel of the instrument. Fasten them securely with the end clips.

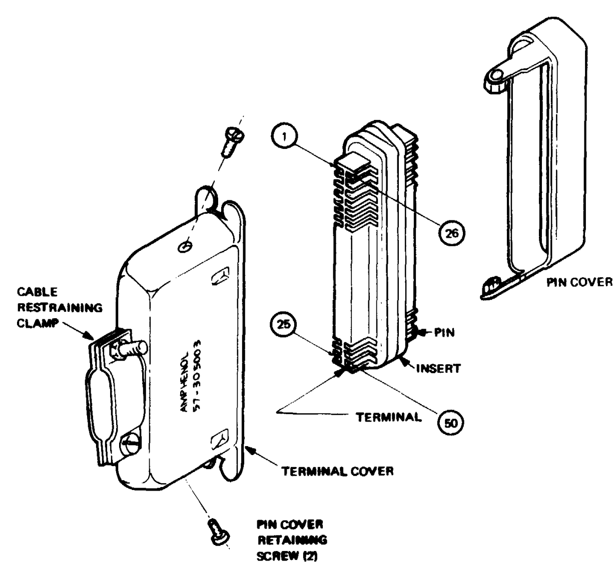


Figure 6-1. MALE PROGRAMMING CONNECTOR

Accessories

Extender PCB Assembly and Cable Extender Assembly

6-1. INTRODUCTION

6-2. The Extender PCB Assembly shown in Figure 6-1 is available as an accessory for the FLUKE series of 4200 power sources. This accessory permits the printed circuit boards in the power source to be extended for servicing. The Extender PCB Assembly can be obtained by ordering FLUKE PART NO. 292623.

6-3. INSTALLATION

6-4. Extender PCB Assembly

6-5. To install a printed circuit board on the extender as shown in Figure 6-2, proceed as follows:

a. Turn off the power source, remove the line power cord, and then remove the top dust cover and guard cover.

b. Locate the printed circuit board to be serviced and remove it using the information given in Section 4, MAINTENANCE ACCESS.

c. Install the extender into the mother board connector as shown in Figure 6-2.

d. Support the extender and install the printed circuit board into the extender connector as shown in Figure 6-2.

CAUTION!

THE COMPONENT SIDE OF THE PRINTED CIRCUIT BOARD THAT IS INSERTED INTO THE EXTENDER CONNECTOR MUST FACE THE FRONT OF THE INSTRUMENT.

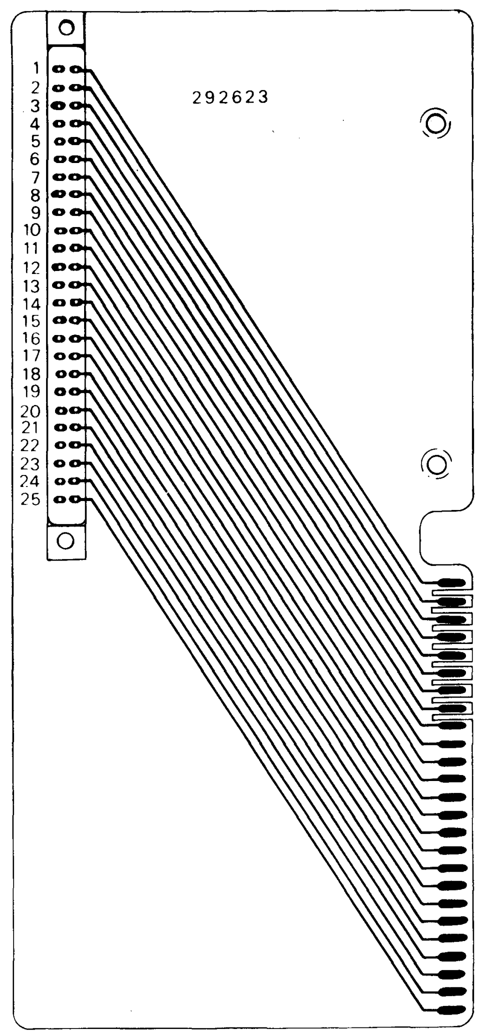


Figure 6-1. PCB ASSEMBLY EXTENDER

6-6. Cable Extender Assembly

a. The removal of certain interconnected printed circuit boards requires the use of a cable extender assembly to reconnect the board to its original electrical configuration after the board is inserted into the extender PCB. The cable extender assembly is shown in Figure 6-3, and is obtained by ordering FLUKE PART NO. 337584.

b. Usage of the cable extender assembly is shown in Figures 6-4 and 6-5 for the instruments requiring its use. Normally the cable extender assembly is not used with the 4210A/4216A instruments unless troubleshooting of the power supply PCB would require separating and remotely locating the ac input power controls and input transformer. The cable extender assembly would join the ac input power controls and input transformer to the power supply PCB.

c. After the extender PCB assembly and test PCB and, where required, the cable extender assembly are connected, the power can be applied.

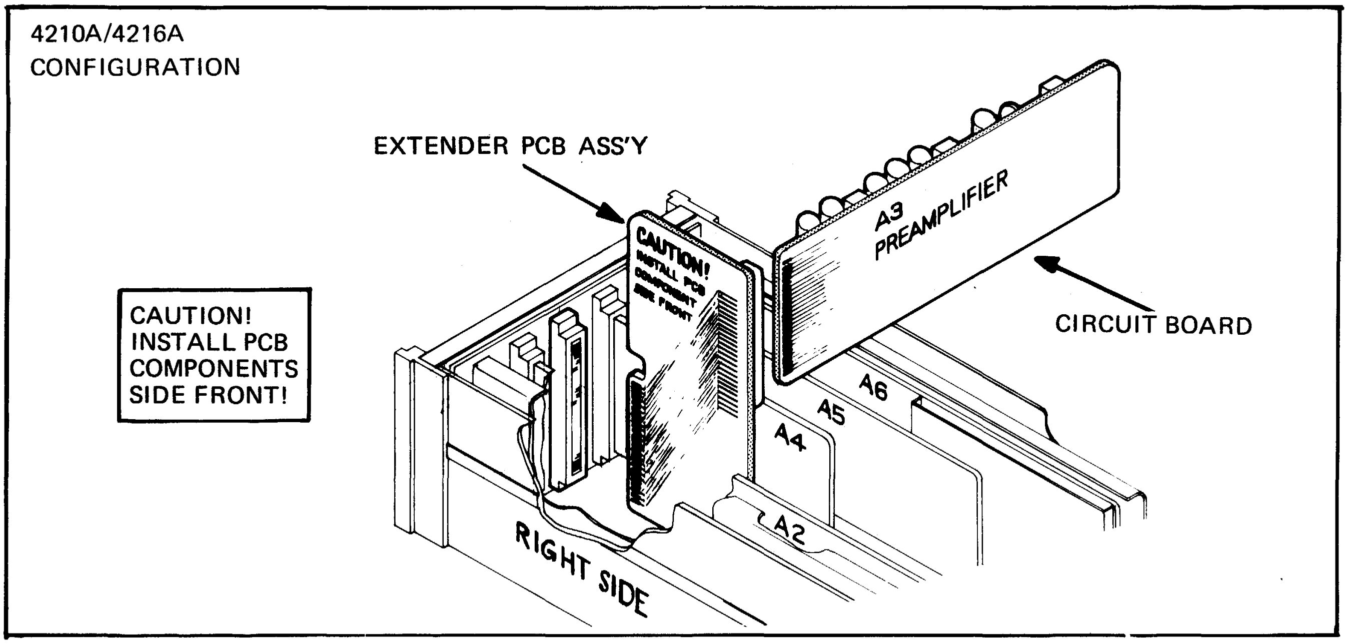


Figure 6-2. EXTENDER PCB ASSEMBLY INSTALLED IN 4210A/4216A INSTRUMENT

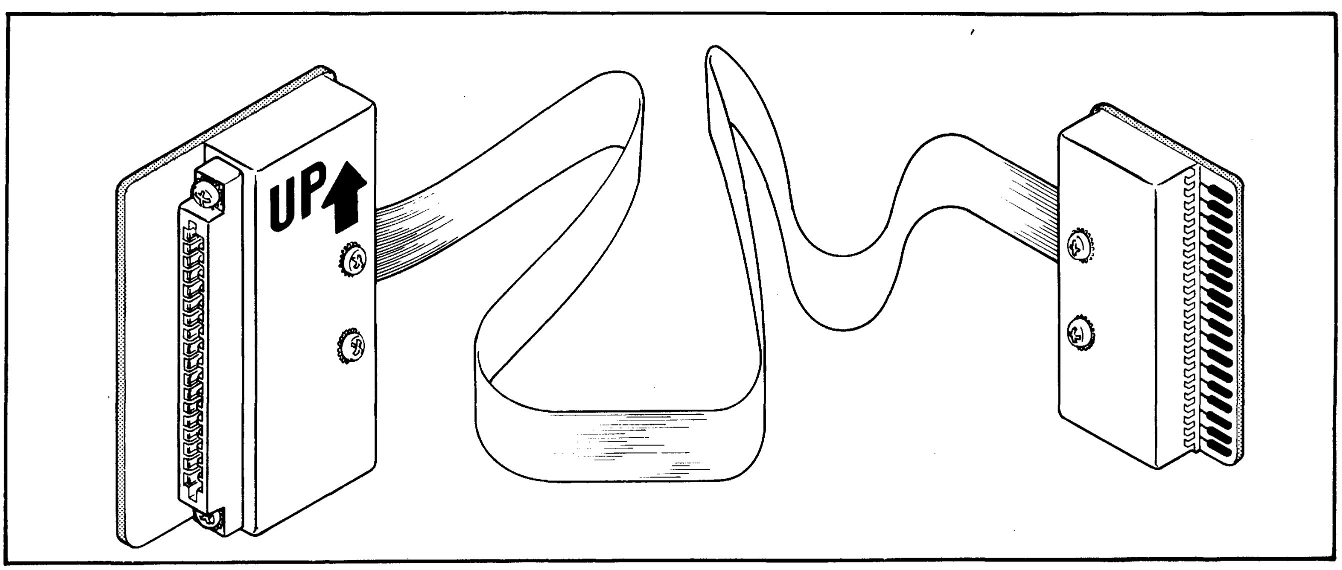


Figure 6-3. CABLE EXTENDER ASSEMBLY

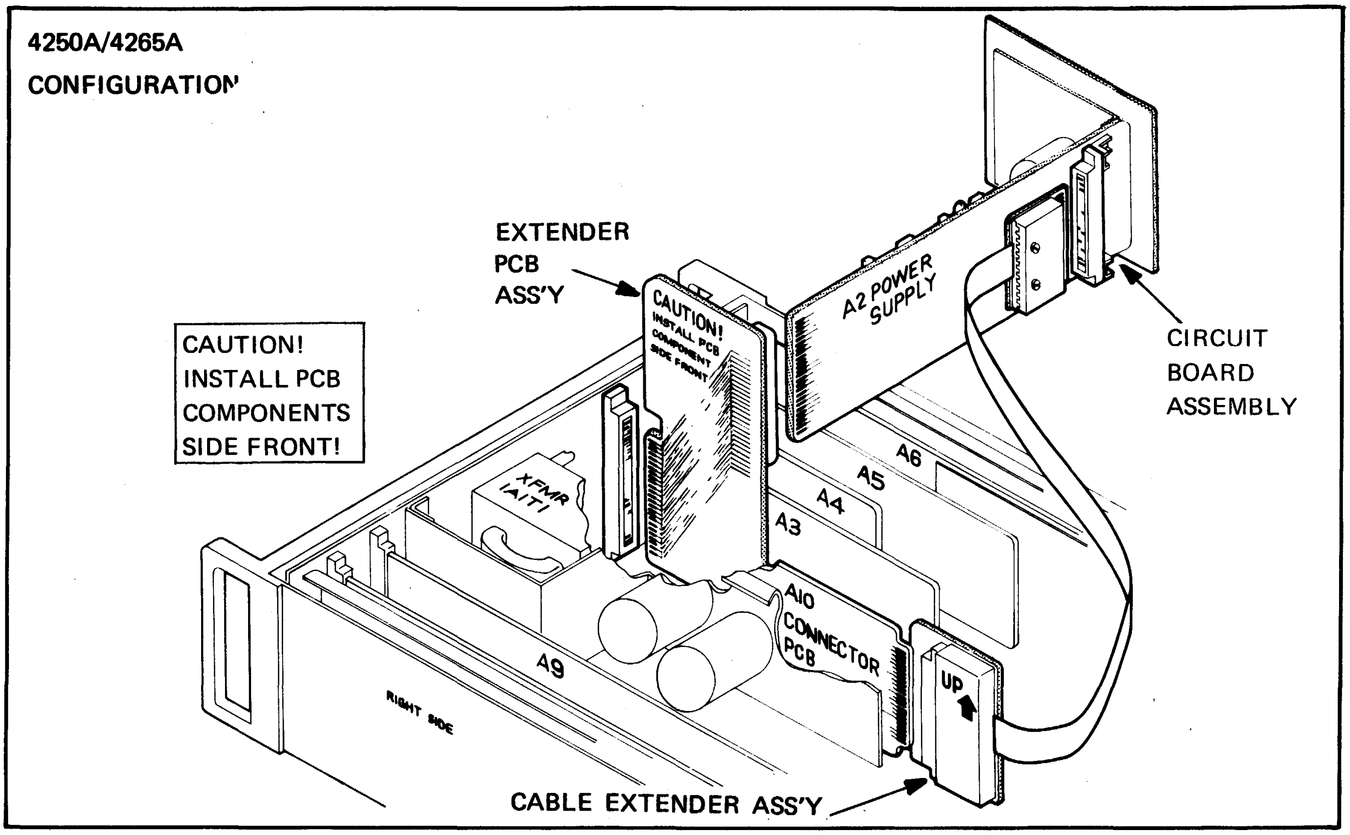


Figure 6-4. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4250A/4265A INSTRUMENTS

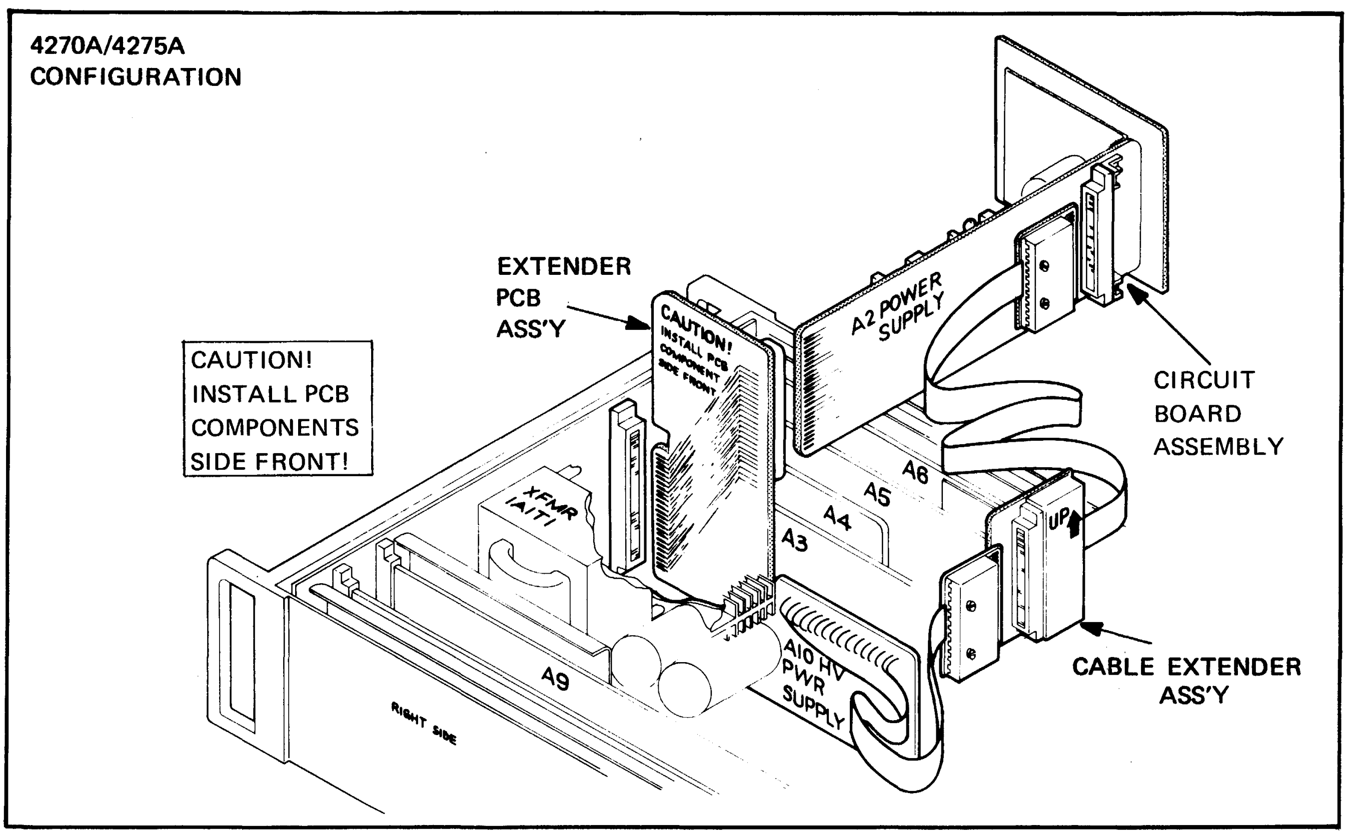


Figure 6-5. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4270A/4275A INSTRUMENTS

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the Lists of Replaceable parts contained in Section 5. The following information is presented in this section:

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

A or amp	ampere	cont	continue
ac	alternating current	crt	cathode-ray tube
af	audio frequency	cw	clockwise
a/d	analog-to-digital	d/a	digital-to-analog
assy	assembly	dac	digital-to-analog converter
AWG	american wire guage	dB	decibel
B	bel	dc	direct current
bcd	binary coded decimal	dmm	digital multimeter
°C	Celsius	dvm	digital voltmeter
cap	capacitor	elect	electrolytic
ccw	counter clockwise	ext	external
cer	ceramic	F	farad
cermet	ceramic to metal (seal)	°F	Fahrenheit
ckt	circuit	FET	field-effect transistor
cm	centimeter	ff	flip-flop
cmrr	common mode rejection ratio	freq	frequency
comp	composition	FSN	federal stock number

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS (Continued)

g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp. New Bedford, Massachusetts
00686	Film Capacitors Passaic, New Jersey
00779	AMP Inc. Harrisberg, Pennsylvania
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01281	TRW Semiconductors Lawndale, California
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01537	Motorola Communications & Electrical Inc. Franklin Park, Illinois
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp. Saugerties, New York
02395	Rason Mfg. Co. Brooklyn, New York
02533	Snelgrove, C.R. Co., Ltd. Don Mills, Ontario, Canada M3B 1M2
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Areo Capacitors, Inc. Torrence, California
03508	General Electric Co. Semiconductor Products Syracuse, New York
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transistron Electronic Corp. Wakefield, Massachusetts
03888	Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey
03911	Clairex Corp. New York, New York
03980	Muirhead Instruments, Inc. Mountainside, New Jersey
04009	Arrow Hart and Hegemen Electronic Company Hartford, Connecticut
04062	Replaced by 72136
04202	Replaced by 81312
04217	Essex Wire Corp. Wire & Cable Div. Anaheim, California
04221	Aemco, Div. of Midtex Inc. Mankato, Minnesota
04222	Aerovox Corp. (H-Q) Myrtle Beach, South Carolina
04645	Replaced by 75376
04713	Motorola Semiconductor Products Inc. Phoenix, Arizona
05082	Replaced by 94154
05236	Jonathan Mfg. Co. Fullerton, California
05277	Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania
05278	Replaced by 43543
05397	Union Carbide Crop. Electronics Div. Cleveland, Ohio
05279	Southwest Machine & Plastic Co. Los Angeles, California
05397	Union Carbide Corp. Electronics Div. New York, New York
05571	Sprague Electric Co. Pacific Div. Los Angeles, California
05574	Viking Industries Chaisworth, California
05704	Alac, Inc. Glendale, California
05820	Wakefield Engineering Ind. Wakefield, Massachusetts
06001	General Electric Company Capacitor Department Irmo, South Carolina
06136	Replaced by 63743
06383	Panduit Corp Tinley Park, Illinois
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Crop. Littletown, Colorado

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div., Components, Inc. Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Varian-Eimac San Carlos, California
07047	Ross Milton, Co., The South Hampton, Pennsylvania
07115	Replaced by 14674
07138	Westinghouse Electric Corp., Electronic Tube Division Elmira, New York
07233	TRW Electronic Components Cinch Graphic City of Industry, California
07256	Silicon Transistor Corp. Garden City, New York
07263	Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
07344	Bircher Co., Inc. Rochester, New York
07792	Lerma Engineering Corp. Northampton, Massachusetts
07910	Teledyne Corp. (Continental Device) Hawthorne, California
08225	Industro Transistor Corp. Long Island City, New York
08261	Spectra Strip Corp Garden Grove, California
08530	Reliance Mica Corp. Brooklyn, New York
08792	Discontinued
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09214	G.E. Semi-Conductor Products Dept. Auburn, New York
09353	C and K Components Watertown, Massachusetts
09423	Scientific Components, Inc. Santa Barbara, California
09922	Burndy Corp. Norwalk, Connecticut
09969	Dale Electronics Inc. Yankton, S Dakota
11236	CTS of Berne Berne, Indiana
11237	Chicago Telephone of Calif. Inc., (CTC) Paso Robles, California
11358	Discontinued
11403	Best Products Co. Chicago, Illinois
11503	Keystone Mfg. Div. of Avis Industrial Crop. Warren, Michigan
11711	General Instrument Corp Rectifier Division Hickville, New York
11726	Qualidyne Corp. Santa Clara, California
12014	Chicago Rivet & Machine Co. Bellwood, Illinois
12040	National Semiconductor Corp. Danburry, Connecticut
12060	Diodes, Inc. Chatsworth, California
12136	Philadelphia Handle Co. Camden, New Jersey
12300	Potter-Brumfield Division AMF Canada LTD. Guelph, Ontario, Canada
12323	Presin Co., Inc. Shelton, Connecticut
12327	Freeway Washer & Stamping Co. Cleveland, Ohio
12400	Replaced by 75042
12615	U.S. Terminals Inc. Cincinnati, Ohio
12617	Hamlin Inc. Lake Mills, Wisconsin
12697	Clarostat Mfg. Co. Dover, New Hampshire
12749	James Electronics Chicago, Illinois
12856	Micrometals Sierra Madre, California
12954	Dickson Electronics Corp. Scottsdale, Arizona
12969	Unitrode Corp. Watertown, Massachusetts
13103	Themalloy Co. Dallas, Texas
13327	Solitron Devices Inc. Tappan, New York

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

13511	Amphenol Corp. Los Gatos, California
13606	Sprague Electric Co. Transistor Div. Concord, New Hampshire
13839	Replaced by 23732
14099	Semtech Corp. Newbury Park, California
14193	California Resistor Corp. Santa Monica, California
14298	American Components, Inc. Conshohocken, Pennsylvania
14655	Cornell-Dubilier Electronics Newark, New Jersey
14674	Discontinued, see 16299
14752	Electro Cube Inc. San Gabriel, California
14869	Replaced by 96853
15636	Elec-Trol Inc. Northridge, California
15801	Fenwal Electronics Inc. Framingham, Massachusetts
15818	Amelco Semiconductor Div. of Teledyne Inc. Mountain View, California
15849	USECO, Inc. Mt. Vernon, New York
15898	International Business Machines (IBM) Essex Junction, Vermont
15909	Replaced by 17870
16299	Corning Glass Raleigh, North Carolina
16332	Replaced by 28478
16473	Cambridge Scientific Ind. Inc. Cambridge, Maryland
16742	Paramount Plastics Downey, California
16758	Delco Radio Div. of General Motors Kokomo, Indiana
17001	ITT Cannon Santa Ana, California
17069	Circuit Structures Lab. Upland, California
17338	High Pressure Eng. Co., Inc. Oklahoma City, Oklahoma
17856	Siliconix, Inc. Sunnyvale, California
17870	Daven Div. of Thomas A. Edison Ind. - McGraw - Edison Co. Manchester, New Hampshire
18083	Deleted
18178	Vactec Inc. Maryland Heights, Missouri
18324	Signetics Corp. Sunnyvale, California
18612	Vishay Intertechnology Inc. Malvern, Pennsylvania
18736	Voltronics Corp. Hanover, New Jersey
18927	G T E Sylvania Inc. Precision Material Group Parts Division Titusville, Pennsylvania
19429	Discontinued, use 89536
19451	Perine Machinery & Supply Co. Seattle, Washington
19701	Electra Mfg. Co. Independence, Kansas
25084	Enochs Mfg. Co. Indianapolis, Indiana
20891	Self-Organizing Systems, Inc. Dallas, Texas
21604	Buckeye Stamping Co. Columbus, Ohio
21845	Solitron Devices Inc. Transistor Division Riveria Beach, Florida
22767	ITT Semiconductors Div. of ITT Palo Alto, California
23050	Product Comp. Corp. Mount Vernon, New York
23732	Tracor Rockville, Maryland
23880	Stanford Applied Engrng. Santa Clara, California
23936	Pamotor Div., Wm. J. Purdy Co. Burlingame, California
24248	Southco Div. of South Chester Corp. Lester, Pennsylvania
24355	Analog Devices Inc. Norwood, Massachusetts
24655	General Radio Co. West Concord, Massachusetts
24759	Lenox-Fugle Electronics Plainfield, New Jersey
25088	Siemen Corp. Isilen, New Jersey
25403	Amperex Electronic Corp. Semiconductor & Receiving Tube Division Slatersville, Rhode Island

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

27014	National Semiconductor Corp. Santa Clara, California
27264	Molex Products Downers Grove, Illinois
28213	Minnesota Mining & Mfg. Co. Consumer Products Div. St. Paul, Minnesota
28425	Bohannan Industries Fort Worth, Texas
28478	Deltrol Controls, Corp. Milwaukee, Wisconsin
28480	Hewlett Packard Co. Palo Alto, California
28520	Heyman Mfg. Co. Kenilworth, New Jersey
29083	Monsanto, Co., Inc. Santa Clara, California
29604	Stackpole Components Co. Raleigh, North Carolina
30148	A B Enterprise Inc. ahoskie, North Carolina
30323	Illinois Tool Works, Inc. Chicago, Illinois
31091	Optimax Inc. Colmar, Pennsylvania
32539	Mura Corp. Great Neck, New York
32767	Griffith Plastic Products Co. Burlingame, California
32879	Advanced Mechanical Components Northridge, California
32897	Erie Technological Products, Inc. Frequency Control Div. Carlisle, Pennsylvania
32997	Bourns Inc. Trimpot Products Division Riverside, California
33173	General Electric Co. Tube Dept. Owensboro, Kentucky
34333	Silicon General Westminister, California
34335	Advanced Micro Devices Sunnyvale, California
37942	Mallory, P.R. & Co., Inc. Indianapolis, Indiana
42498	National Company Melrose, Massachusetts
43543	Nytronics Inc. Transformer Co. Div. Alpha, New Jersey
44655	Ohmite Mfg. Co. Skokie, Illinois
49671	Radio Corp. of America New York, New York
49956	Raytheon Company Lexington, Maine
50088	Mostek Corp. Carrollton, Texas
50579	Litronix Inc. Cupertino, California
51605	Scientific Components Inc. Linden, New Jersey
53021	Sanamo Electric Co. Springfield, Illinois
54294	Shallcross, A Cutler-Hammer Co. Selma North Carolina
55026	Simpson Electric Company Chicago, Illinois
56289	Sprague Electric Co. North Adams, Massachusetts
58474	Superior Electric Co. Bristol, Connecticut
60399	Torrington Mfg. Co. Torrington, Connecticut
62460	Deleted
63743	Ward Leonard Electric Co. Mount Vernon, New York
64834	West Mfg. Co. San Francisco, California
65092	Weston Instruments Inc. Newark, New Jersey
66150	Winslow Tele-Tronics Inc. Asbury Park, New Jersey
70563	Amperite Company Union City, New Jersey
70903	Belden Mfg. Co. Chicago, Illinois
71002	Birnbach Radio Co., Inc. New York, New York
71236	"ELMENCO" Willimantic, Connecticut
71400	Bussmann Mfg. Div. of McGray - Edison Co. Saint Louis, Missouri
71450	CTS Corp. Elkhart, Indiana
71468	ITT Cannon Electric Inc. Los Angeles, California
71482	Clare, C.P. & Co. Chicago, Illinois
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wisconsin

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

71707	Coto Coil Co., Inc. Providence, Rhode Island
71744	Chicago Miniature Lamp Works Chicago, Illinois
71785	Cinch Mfg. Co. & Howard B. Jones Div. Chicago, Illinois
72005	Driver, Wilber B., Co. Newark, New Jersey
72092	Replaced by 06980
72136	Electro Motive Mfg. Co. Williamantic, Connecticut
72259	Nytronics Inc. Berkeley Heights, New Jersey
72354	Deleted
72619	Dialight Corp. Brooklyn, New York
72653	G. C. Electronics Rockford, Illinois
72665	Replaced by 90303
72794	Dzus Fastener Co., Inc. West Islip, New York
72928	Gudeman Co. (Gulton Ind.) Chicago, Illinois
72982	Erie Tech. Products Inc. Erie, Pennsylvania
73138	Beckman Instruments Inc. Helipot Division Fullerton, California
73293	Hughes Aircraft Co. Electron Dynamics Div. Torrence, California
73445	Amperex Electronic Corp. Hicksville, New York
73559	Carling Electric Inc. Hartford, Connecticut
73586	Circle F Industries Trenton, New Jersey
73734	Federal Screw Products, Inc. Chicago, Illinois
73743	Fischer Special Mfg. Co. Cincinnati, Ohio
73899	JFD Electronics Co. Brooklyn, New York
73949	Guardian Electric Mfg. Co. Chicago, Illinois
74199	Quam Nichols Co. Chicago, Illinois
74217	Radio Switch Corp. Marlboro, New Jersey
74276	Signalite Inc. Neptune, New Jersey
74306	Piezo Crystal Co. Carlisle, Pennsylvania
74542	Hoyt Elect. Instr. Works Penacook, New Hampshire
74970	Johnson. E. F., Co. Waseca, Minnesota
75042	IRC Inc. (Div. of TRW) Philadelphia, Pennsylvania
75376	Kurz-Kasch. Inc. Dayton, Ohio
75378	CTS Knights Inc. Sandwich, Illinois
75382	Kulka Electric Corp. Mount Vernon, New York
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
77342	Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana
77638	General Instrument Corp. Rectifier Division Brooklyn, New York
77969	Rubbercraft Corp. of Calif. LTD. Torrance, California
78189	Shakeproof Div. of Illinois Tool Works Elgin, Illinois
78277	Sigma Instruments, Inc. South Braintree, Massachusetts
78488	Stackpole Carbon Co. Saint Marys, Pennsylvania
78553	Tinnerman Products Cleveland, Ohio
78136	Waldes Kohinoor Inc. Long Island City, New York
79497	Western Rubber Company Goshen, Indiana
79963	Zierick Mfg. Corp. New Rochelle, New York
80031	Mepco Div. of Sessions Clock Co. Morristown, New Jersey
80145	API Instruments Co. Chesterland, Ohio
80183	Spraque Products North Adams, Massachusetts
80294	Bourns Inc. Riverside, California
80583	Hammarlund Co., Inc. Mars Hill, North Carolina
80640	Stevens, Arnold Inc. Boston, Massachusetts

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

81073	Grayhill, Inc. La Grange, Illinois
81590	Korry Mfg. Co. Seattle, Washington
81312	Winchester Electronics Div. of Litton Industries Oakville, Connecticut
81439	Therm-O-Disc Inc. Mansfield, Ohio
81483	International Rectifier Corp. Los Angeles, California
81741	Chicago Lock Corp. Chicago, Illinois
82305	Palmer Electronics South Gate, California
82389	Switchcraft Inc. Chicago, Illinois
82415	Price Electric Corp. Frederick, Maryland
82872	Roanwell Corp. New York, New York
82877	Rotron Mfg. Co., Inc. Woodstock, New York
82879	ITT Wire & Cable Div. Pawtucket, Rhode Island
83003	Varo Inc. Garland, Texas
83298	Bendix Corp. Electric Power Division Eatontown, New Jersey
83330	Smith, Herman H., Inc. Brooklyn, New York
83478	Rubbercraft Corp. of America New Haven, Connecticut
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
83740	Union Carbide Corp. Consumer Products Div. New York, New York
84171	Arco Electronics, Inc. Great Neck, New York
84411	TRW Ogallala, Nebraska
84613	Fuse Indicator Corp. Rockvillw, Maryland
86577	Precision Metal Products Stoneham, Massachusetts
86684	Radio Corp. of America Electronic Components & Devices Harrison, New Jersey
86689	Deleted
87034	Marco-Oak Inc. Anaheim, California
88245	Litton Products Inc. Van Nuys, California
88419	Use 14655
88690	Replaced by 04217
89536	Fluke, John Mfg. Co., Inc. Seattle, Washington
89730	Replaced by 08806
90201	Mallory Capacitor Co. Indianapolis, Indiana
90215	Best Stamp & Mfg. Co. Kansas City, Missouri
90211	Square D Co. Chicago, Illinois
90303	Mallory Battery Co. Tarrytown, New York
91293	Johanson Mfg. Co. Boonton, New Jersey
91407	Replaced by 58474
91502	Associated Machine Santa Clara, California
91506	Augat Attleboro, Massachusetts
91637	Dale Electronics Inc. Columbus, Nebraska
91662	Elco Corp. Willow Grove, Pennsylvania
91737	Gremar Mfg. Co., Inc. (ITT) Woburn, Massachusetts
91802	Industrial Devices, Inc. Edgewater, New Jersey
91833	Keystone Electronics Corp. New York, New York
91836	King's Electronics Tuckahoe, New York
91929	Honeywell Inc. Micro Switch Div. Freeport, Illinois
91934	Miller Electric Co., Inc. Pawtucket, Rhode Island
93332	Sylvania Electric Products Semiconductor Products Div. Woburn, Massachusetts
94145	Replaced by 49956
94154	Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey
95146	Alco Electronics Products Inc. Lawrence, Massachusetts
95263	Leecraft Mfg. Co. Long Island City, New York
95264	Replaced by 98278

Table 7-2. FEDERAL SUPPLY CODES FOR MANUFACTURERS (Continued)

95275	Vitramon Inc. Bridgeport, Connecticut	98278	Microdot Inc. Pasadena, California
95303	Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio	98291	Sealectro Corp. Conhex Div. Mamaroneck, New York
95354	Methode Mfg. Corp. Rolling Meadows, Illinois	98388	Accurate Rubber & Plastics Culver City, California
95712	Dage Electric Co., Inc. Franklin, Indiana	98743	Replaced by 12749
95987	Weckesser Co. Inc. Chicago, Illinois	98925	Deleted
96733	San Fernando Electric Mfg. Co. San Fernando, California	99120	Plastic Capacitors, Inc. Chicago, Illinois
96853	Rustrak Instrument Co. Manchester, New Hampshire	99217	Southern Electronics Corp. Burbank, California
96881	Thomson Industries, Inc. Manhasset, New York	99392	STM Oakland, California
97540	Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California	99515	Marshall Industries Capacitor Div. Monrovia, California
97913	Industrial Electronic Hdware Corp. New York, New York	99779	Barnes Corp. Lansdowne, Pennsylvania
97945	White, S.S. Co. Plastics Div. New York, New York	99800	American Precision Industries Inc. Delevan Division East Aurora, New York
97966	Replaced by 11358		Toyo Electronics (R-Ohm Corp.) Irvine, California
98094	Replaced by 49956		
98159	Rubber-Teck, Inc. Gardena, California		National Connector Minneapolis, Minnesota

Table 7-3. FLUKE TECHNICAL CENTERS

Fluke Western Technical Center
2020 North Lincoln St.
Burbank, CA 91504
Tel. 213-849-4641
TWX: 910-497-2086

Fluke Western Technical Center
2359 De La Cruz Blvd.
Santa Clara, CA 95050
Tel. 408-244-1505
TWX: 910-338-0121

Fluke S.W. Technical Center
Unit 4
1980 South Quebec Street
Denver, CO 80231
Tel. 303-750-1228

Fluke S.E. Technical Center
P.O. Box 6578
940 North Fern Creek Avenue
Orlando, FL 32803
Tel. 305-896-2296
TWX: 810-850-0185

Fluke Midwestern Technical Center
1287 North Rand Road
Des Plaines, IL 60016
Tel. 312-298-7470
TWX: 910-233-4978

Fluke Mideastern Technical Center
11501 Huff Court
Kensington, MD 20795
Tel. 301-881-5300
TWX: 710-825-9645

Fluke N.E. Technical Center
109 Massachusetts Ave.
Lexington, MA 02173
Tel. 617-861-8620
TWX: 710-826-1715

Fluke Midwestern Technical Center
10800 Lyndale Avenue South
Minneapolis, MN 55420
Tel. 612-884-4541
TWX: 910-576-3141

Fluke Eastern Technical Center
101 Berkshire Ave.
Paterson, NJ 07502
Tel. 201-742-3215
TWX: 710-988-5945

Fluke Eastern Technical Center
4515 Culver Road
Rochester, NY 14622
Tel. 716-342-6940
TWX: 510-253-6145

Fluke S.E. Technical Center
P.O. Box 9619
1310 Beaman Place
Greensboro, NC 27408
Tel. 919-273-1918
TWX: 510-925-1173

John Fluke Mfg. Co., Inc.
7001 - 220th S.W.
Mountlake Terrace, WA 98043
Tel. 206-774-2238
TWX: 910-449-2850

Fluke Canadian Technical Center
640 11th Ave. S.W.
Calgary Alberta
Tel. 403-261-0780
TWX: 610-821-2233

Fluke Canadian Technical Center
6427 Northam Drive
Mississauga, Ontario
Tel. 416-678-1500
TWX: 610-492-2119

Table 7-4. SALES REPRESENTATIVES – DOMESTIC

ALABAMA
HUNTSVILLE
BCS Associates, Inc.
3322 S. Memorial Parkway
P.O. Box 1273
Tel. (205) 881-6220
Zip 35801

ALASKA
ANCHORAGE
Harry Lang & Associates
1406 W. 47th Ave.
Tel. (907) 279-5741
Zip 99503

ARIZONA
PHOENIX
Barnhill Associates
7319 E. Stetson Dr.
Tel. (602) 947-7841
Scottsdale, AZ 85251

CALIFORNIA
LOS ANGELES
Instrument Specialists, Inc.
2020 N. Lincoln Street
Burbank, CA 91504
Tel. (213) 849-7181

NEWPORT BEACH
Instrument Specialists, Inc.
4120 Birch Street
Suite 119
Tel. (714) 752-6200
Zip 92660

SANTA CLARA
Instruments Specialists, Inc.
2359 De La Cruz Blvd.
Tel. (408) 244-1505
Zip 95050

SAN DIEGO
Instrument Specialists, Inc.
4805 Mercury St., Ste. 1
Tel. (714) 565-2555
Zip 92111

COLORADO
DENVER
Barnhill Associates, Inc.
1980 South Quebec St.
Tel. (303) 750-1228
Zip 80231

CONNECTICUT
HARTFORD
Instrument Representatives, Inc.
P.O. Box 165
Glastonbury, CT 06033
Tel. (203) 633-0777

FLORIDA
ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
Tel. (305) 896-4881
(305) 843-1510
Zip 32803

GEORGIA
DECATUR
BCS Associates, Inc.
2522 Tanglewood Road
Tel. (404) 321-0980
Zip 30033

HAWAII
HONOLULU
Industrial Electronics, Inc.
646 Queen Street
P.O. Box 135
Tel. (808) 533-6095
Zip 96817

ILLINOIS
CHICAGO
Cozzens & Cudahy, Inc.
1301 N. Rand Road
Des Plaines, IL 60016
Tel. (312) 298-3600

INDIANA
INDIANAPOLIS
Cozzens & Cudahy, Inc.
Port O'Call Executive Ctr.
21 Beachway Drive
Tel. (317) 244-2456
Zip 46244

KENTUCKY
VALLEY STATION
BCS Associates, Inc.
4506 Freda Way
Tel. (502) 935-9634
Zip 40272

MARYLAND
BALTIMORE
Electronic Marketing Assoc.Inc.
11501 Huff Court
Kensington, MD 20795
Tel. (301) 881-5300,744-7700

MASSACHUSETTS
BOSTON
Instrument Representatives, Inc.
109 Massachusetts Ave.
Lexington, MA 02173
Tel. (617) 861-8620

MICHIGAN
DETROIT
WKM Associates, Inc.
1474 East Outer Dr.
Tel. (313) 892-2500
Zip 48234

MINNESOTA
MINNEAPOLIS
Cozzens & Cudahy, Inc.
10800 Lyndale Ave. S.
Tel. (612) 884-4336
Zip 55420

MISSOURI
KANSAS CITY
Cozzens & Cudahy, Inc
4404 Chouteau Traffic Way
Tel. (816) 454-5836
Zip 64117

ST. LOUIS
Cozzens & Cudahy Inc.
P.O. Box 10013
Lambert Field - Zip 63145
Tel. (314) 423-1234

NEW JERSEY
NEWARK
SBM Representatives
1519 Stuyvesant Avenue
Union, NJ 07083
Tel. (201) 687-8737

NEW MEXICO
ALBUQUERQUE
Barnhill Associates
1410 - D Wyoming N.E.
Tel. (505) 299-7658
Zip 87112

NEW YORK
NEW YORK
SBM Representatives
28 Hobby Street
Pleasantville, NY 10570
Tel. (914) 769-1811

ROCHESTER
SBM Representatives
4515 Culver Road
Tel. (716) 226-1400
Zip 14622

NORTH CAROLINA
GREENSBORO
BCS Associates, Inc.
P.O. Box 9619
1310 Beaman Place
Tel. (919) 273-1918
Zip 27408

OHIO
CLEVELAND
WKM Associates, Inc.
16141 Puritas Ave.
Tel. (216) 267-0445
Zip 44135

DAYTON
WKM Associates, Inc.
6073 Far Hills Ave.
Tel. (513) 434-7500
Zip 45459

OREGON
BEAVERTON
Showalter Instruments, Inc.
13485 S.W. Hargis Road
Tel. (503) 646-3004
Zip 97005

PENNSYLVANIA
PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd., Ste. 100
King of Prussia, PA
Tel. (215) 248-5050
Zip 19406

PITTSBURGH
WKM Associates, Inc.
90 Clairton Blvd.
Tel. (412) 892-2953
Zip 15236

Table 7-4. SALES REPRESENTATIVES — DOMESTIC (Continued)

TEXAS

DALLAS
Barnhill Associates
908 Business Parkway
Richardson, TX 75080
Tel. (214) 231-2573

HOUSTON
Barnhill Associates
10606 Hempstead Hwy.
Suite 132
Tel. (713) 688-9971
Zip 77018

VIRGINIA

WILLIAMSBURG
BCS Associates
107 Rich Neck Road
Tel. (703) 229-5108
Zip 23185

WASHINGTON

SEATTLE
Showalter Instruments, Inc.
1521 - 130 N.E.
Bellevue, WA 98005
Tel. (206) 455-4922
(206) 624-4035

CANADA

BRITISH COLUMBIA

NORTH VANCOUVER
Allan Crawford Associates, Ltd.
234 Brooksbank Ave.
Tel. (604) 980-4831

ALBERTA

CALGARY
Allan Crawford Associates, Ltd.
640 - 11th Ave. S.W.
Tel. (403) 261-0780

ONTARIO

MISSISSAUGA
Allan Crawford Associates, Ltd.
6427 Northam Drive
Tel. (416) 678-1500

OTTAWA, 3
Allan Crawford Associates, Ltd.
1299 Richmond Road
Tel. (613) 829-9651

QUEBEC

LONGUEUIL
Allan Crawford Associates, Ltd.
1330 Marie Victorian Blvd. East
Tel. (514) 670-1212

NOVA SCOTIA

DARTMOUTH
Allan Crawford Associates, Ltd.
St. 201, Townsend Pl.
800 Wind Mill Road
Burns Industrial Park
Dartmouth, N.S. B3B 1L1
Tel. (902) 469-7865

Table 7-5. SALES REPRESENTATIVES – INTERNATIONAL

Argentina
Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina
Tel. 523185

Australia
Elmaesco Instruments Pty. Ltd.
P.O. Box 334
Brookvale, N.S.W. Australia 2100
Tel. 939-7944

Austria
Kontron GmbH & Co. KG
Lederergasse 16
1080 Vienna, Austria
Tel. 425667

Belgium
C.N. Rood S/A
37 Place de Jamblinne de Meux
B-1040 Brussels, Belgium
Tel. 352135

Brazil
Ambriex S.A.
Rue Ceara, 104-2° . e 3° . Andares
ZC - 29
Rio de Janeiro GB, Brazil
Tel. 2647406

Ambriex S.A.
Rua Tupi, 535
01233 Sao Paulo, SP Brazil
Tel. 527806

Caribbean
West Indies Sales Co.
606 Calle Aboy
San Juan, Puerto Rico 00907
Tel. (809) 723-3743

Central America
Intermetra, Corporation
11 Park Place, Suite 2003
New York, NY 10007
Tel. (212) 349-7630

Chile
Coasin Chile Ltd.
Casilla 14588
Correo 15
Santiago, Chile
Tel. 396713

Columbia
Marones Ltda.
Apartado Aero 90687
Bogota 8, Colombia
Tel. 364731

Cyprus
Chris Radiovision Ltd.
P.O. Box 1989
Nicosia, Cyprus
Tel. 66121

Denmark
Tage Olsen A/S
Teglvaerksgade 37
2100 Copenhagen 0, Denmark
Tel. 294800

Ecuador
Proteco Coasin CIA, Ltda.
Apartado 228A
Quito, Ecuador
Tel. 526759

Finland
Oy Findip AB
Teollisuustie 7
02700 Kauniainen, Finland
Tel. 502255

France
M.B. Electronique S.A.
29 Rue Emile Duclaux
92, Suresnes, France
Tel. 7723108

Greece
Hellenic Scientific Representations Ltd.
10, Nympheou Street
Athens, 615 Greece
Tel. 7792320

Hong Kong
Gilman & Co. Ltd.
P.O. Box 56
Hong Kong
Tel. 227011

India
Hinditron Services Pvt. Ltd.
69/A L. Jagmohandas Marg
Bombay 400006, India
Tel. 365344

Indonesia
P.T. United Dico-Citas Co., Ltd.
JLN Penjaringan 39A
Jakarta, Indonesia

Iran
Berkeh Company, Ltd.
20 Salm Road, Roosevelt Ave.
Tehran, Iran
Tel. 828294

Italy
Sistrel S.p.A.
Via Giorgio da Sebenico 11/13
00143 Roma, Italy
Tel. 06-500-1860

Japan
Toyo Trading Company, Ltd.
P.O. Box 5014
Tokyo International
Tokyo 100-31, Japan
Tel. 2790771

Toyo Trading Company, Ltd.
Suzuki Bldg.
2-38 Junkeicho-dori
Minami-ku, Osaka
Tel. (06) 262-3471

Korea
Asia Science & Co
International P.O. Box 1250
Seoul, Korea
Tel. 76-2761

Lebanon
General Marketing Trading &
Contracting Company
Anis Nsouli Street
Nsouli Bldg.
P.O. Box 155.655
Beirut, Lebanon
Tel. 319383

Malaysia
O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu, Sabah
East Malaysia
Tel. 54082

P.O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel. 51563

Mexico
Mexitek, S.A.
Eugenia 408
Departments 1 y 5
Mexico 12, D.F.
Tel. 5360910

Table 7-5. SALES REPRESENTATIVES – INTERNATIONAL (Continued)

The Netherlands
C.N. Rood, B.V.
P.O. Box 42
13 - Cort van der Lindenstraat
Rijswijk (Z.H.) 2100
Netherlands
Tel. 996360

Fluke (Nederland) B.V.
P.O. Box 5053
Ledeboerstraat 27
Tilburg, Netherlands
Tel. (13) 673973

New Zealand
Elmeasco Instruments Pty. Ltd.
P.O. Box 30515
Lower Hutt, New Zealand
Tel. 63976

Nigeria
Deemtee Electrotechnics Ltd.
P.O. Box 3073
Lagos, Nigeria

Norway
Morgenstierne & Co. A/S
P.B. 6688 Rodelokka
Oslo 5, Norway
Tel. 372940

Pakistan
Pak International Operations
P.O. Box 5323
505 Muhammadi House
McLeod Rd.
Karachi, Pakistan

Peru
Importaciones y Representaciones
Electronicos S.A.
Avda, Franklin D. Roosevelt 105
Lima 1, Peru
Tel. 272078

Portugal
Equipamentos De Laboratorio Lda.
P.O. Box 1100
Lisbon 1, Portugal
Tel. 976551

Singapore
O'Connor's (Pte) Ltd.
98 Pasir Panjang Road
Singapore 5, Singapore
Tel. 637944

South Africa
Elairco (Pty.) Ltd.
P.O. Box 13091
Northmead 1511
Benoni, Transvaal
Republic of South Africa
Tel. 545513

Spain
Ataio Ingenieros S.A.
Enrique Larreta 12
Madrid 16, Spain
Tel. 7330562

Sweden
Teleinstrument AB
P.O. Box 490
Maltesholmvagen 490
S-162 04 Vallingby - 4
Sweden
Tel. 380370

Switzerland
Kontron Electronic A.G.
Bernerstrasse (Sud) 169
8048 Zurich, Switzerland
Tel. 628282

Taiwan - Republic of China
Heighten Trading Co., Ltd.
P.O. 1408 - Taipei, Taiwan 104
Republic of China
Tel. 518324

Thailand
G. Simon Radio Ltd.
30 Patpong Ave.
Suriwong
Bangkok, Thailand
Tel. 30991-3

Turkey
M. Suheyl Erkman
Necatibey Cad. 92/2
Karakoy/Istanbul
Turkey
Tel. 441546

The United Kingdom
Fluke International Corp.
Garnett Close
Watford, WD24TT, England
Tel. 33066

Uruguay
Coasin Uruguaya S.R.L.
Cerrito 617 4° Piso
Montevideo, Uruguay

Venezuela
Coasin C.A.
APDO Postal 50939
Sabana Grande No. 1
Caracas 105, Venezuela
Tel. 722311

West Germany
Fluke (Deutschland) GmbH
4-DUSSELDORF
Meineckestrasse 53
Tel. (0211) 450831
Telex: 8585576 Flk D

Fluke (Deutschland) GmbH
8 MUNCHEN 40
Imhofstrasse 3
Tel. (089) 369086
Telex: 052-16087

In Europe, contact FLUKE NEDERLAND, B.V., P.O. Box 5053, Industrieterrein Noord, Tilburg, The Netherlands

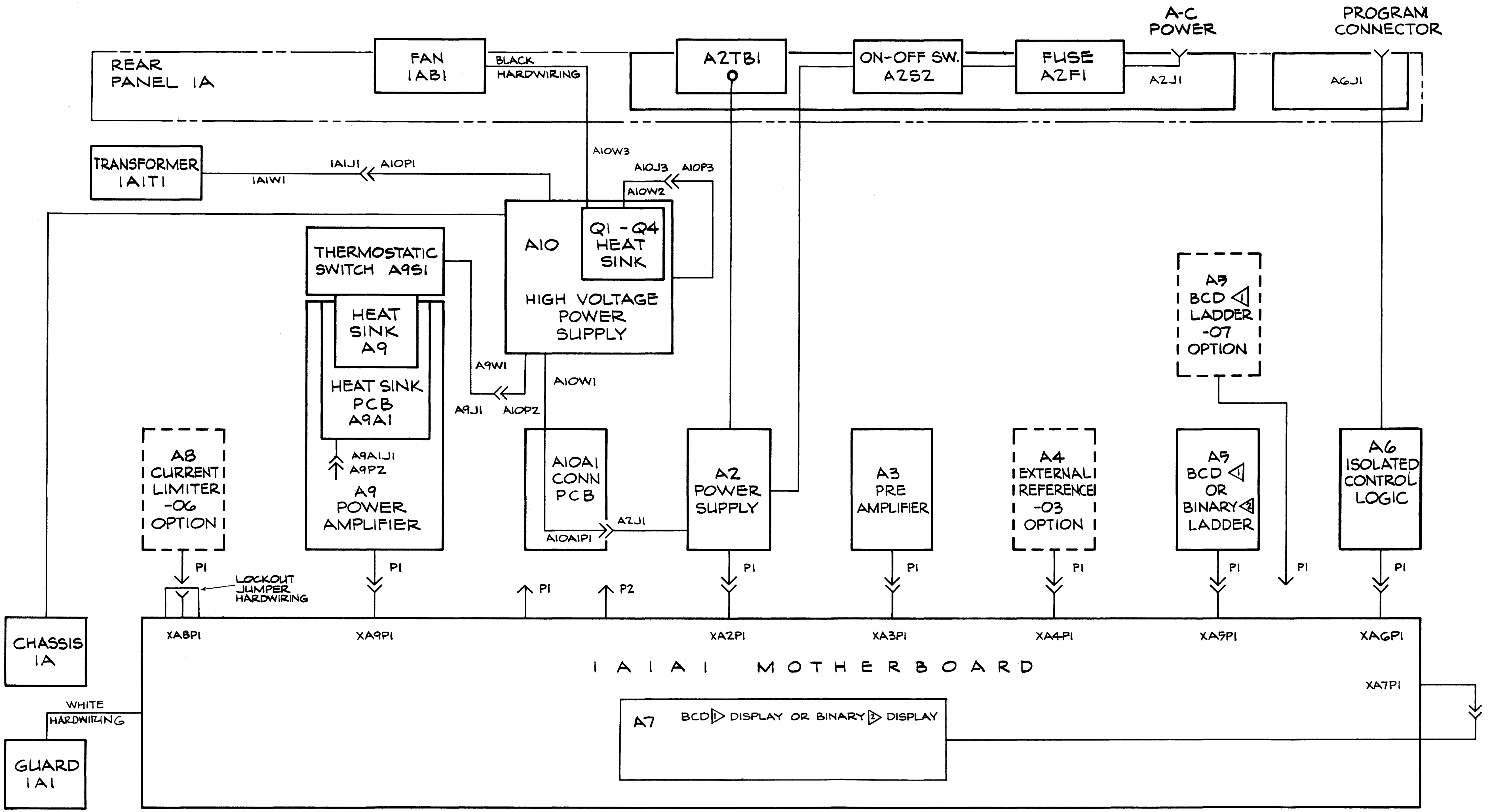
FLUKE REGIONAL SERVICE CENTER:THE NETHERLANDS
FLUKE (NEDERLAND) B.V.
P.O. BOX 5053
TILBURG, THE NETHERLANDS

FLUKE REGIONAL SERVICE CENTER, UNITED KINGDOM
FLUKE INTERNATIONAL CORP.
GARNETT CLOSE
WATFORD, WD24TT ENGLAND

AUTHORIZED SERVICE LABORATORIES INTERNATIONAL

EACH INTERNATIONAL REPRESENTATIVE IS EQUIPPED WITH AN AUTHORIZED SERVICE LABORATORY. PLEASE REFER TO THE INTERNATIONAL REPRESENTATIVE LISTING FOR YOUR SERVICE NEEDS.

Section 8
Schematic Diagrams



NOTES:

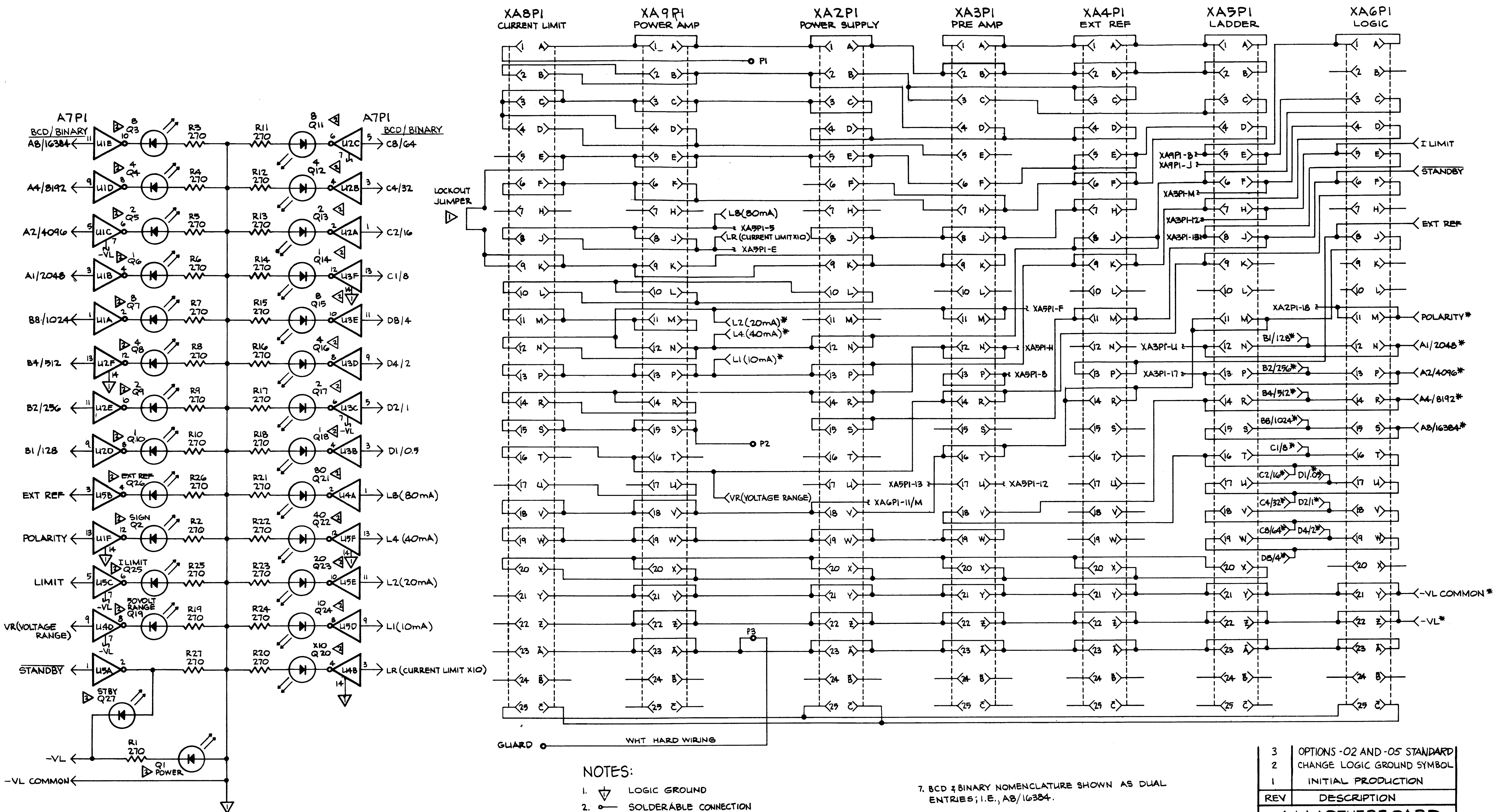
1. MODEL 4270A CONFIGURATION.
2. MODEL 4275A CONFIGURATION.
3. - - - INDICATES FIELD/FACTORY INSTALLABLE OPTION.
4. SOME REFERENCE DESIGNATORS ARE ABBREVIATED: I.E., A3 IS 1A1A3. SEE SECTION 5 LIST OF REPLACEABLE PARTS.

REV	DESCRIPTION
2	OPTIONS -01,-02,-05; STANDARD
1	INITIAL PRODUCTION

INTERCONNECT DIAGRAM

4270A-1000
4275A-1000

DATE MAY, 1972



NOTES:

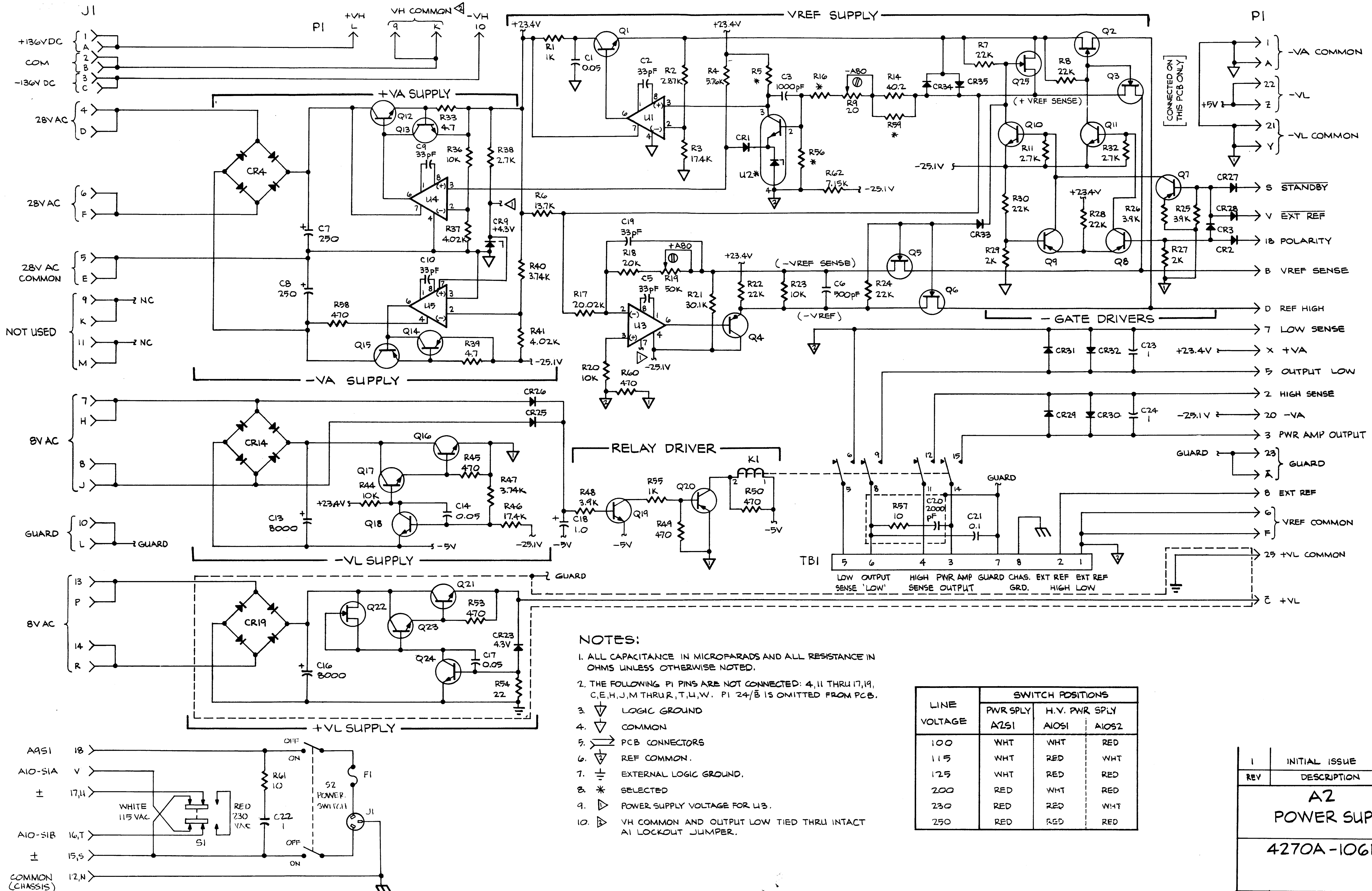
1. ⏚ LOGIC GROUND
2. o— SOLDERABLE CONNECTION
3. ◁ JUMPER TO BE REMOVED WHEN A8 PROGRAMMABLE LIMITER (-06 OPTION) IS INSTALLED.
4. CONNECTOR JACK CODING OMITS LETTERS G, I, O, Q.
5. ◁ LIGHT EMITTING DIODES ARE DESIGNATED CR ON PCB.
6. * XA7P1 (CONNECTS TO BCD/BINARY DISPLAY AT A7P1)
7. BCD & BINARY NOMENCLATURE SHOWN AS DUAL ENTRIES; I.E., A8/16384.

REV	DESCRIPTION
3	OPTIONS -02 AND -05 STANDARD
2	CHANGE LOGIC GROUND SYMBOL
1	INITIAL PRODUCTION

A1 MOTHERBOARD & BCD/BINARY DISPLAY

4270A-1011
4250A-1013

DATE MAY, 1972



NOTES:

1. ALL CAPACITANCE IN MICROFARADS AND ALL RESISTANCE IN OHMS UNLESS OTHERWISE NOTED.
2. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 4, 11 THRU 17, 19, C, E, H, J, M THRU R, T, U, W. P1 24/B IS OMITTED FROM PCB.
3. LOGIC GROUND
4. COMMON
5. PCB CONNECTORS
6. REF COMMON.
7. EXTERNAL LOGIC GROUND.
8. ✳ SELECTED
9. POWER SUPPLY VOLTAGE FOR U3.
10. VH COMMON AND OUTPUT LOW TIED THRU INTACT A1 LOCKOUT JUMPER.

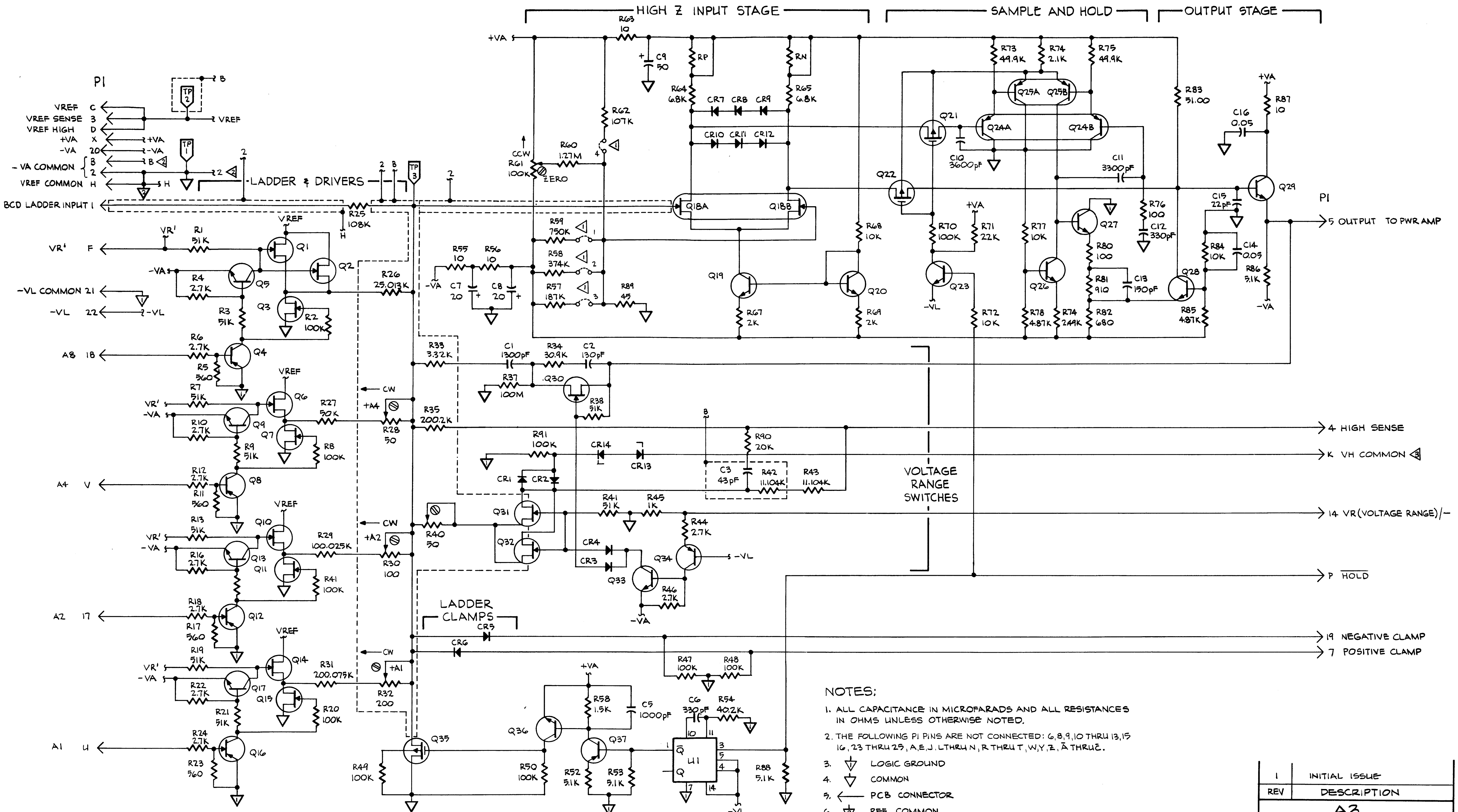
LINE VOLTAGE	SWITCH POSITIONS		
	PWR SPLY A2S1	H.V. PWR SPLY A10S1	A10S2
100	WHT	WHT	RED
115	WHT	RED	WHT
125	WHT	RED	RED
200	RED	WHT	RED
230	RED	RED	WHT
250	RED	RED	RED

REV	DESCRIPTION
1	INITIAL ISSUE

A2
POWER SUPPLY

4270A-1061

DATE . MAY, 1972



NOTES:

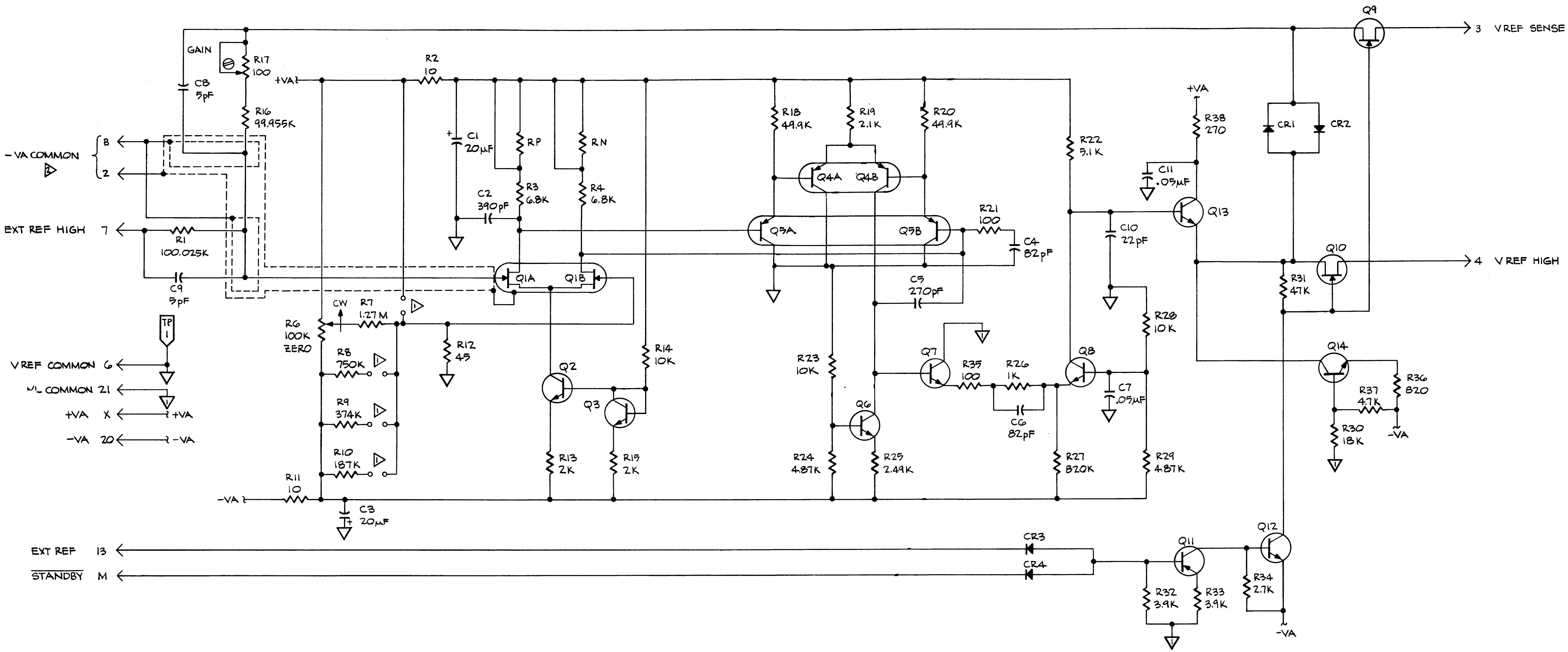
1. ALL CAPACITANCE IN MICROFARADS AND ALL RESISTANCES IN OHMS UNLESS OTHERWISE NOTED.
2. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 6, 8, 9, 10 THRU 13, 15, 16, 23 THRU 25, A, E, J, L THRU N, R THRU T, W, Y, Z, Ā THRU Ē.
3. LOGIC GROUND
4. COMMON
5. ← PCB CONNECTOR
6. REF. COMMON
7. INSTALL PROPER JUMPER TO ZERO INSTRUMENT.
8. 2 AND B ON OPPOSITE SIDES OF PCB.
9. VH COMMON AND OUTPUT LOW TIED THRU INTACT A1 LOCKOUT JUMPER.

REV	DESCRIPTION
1	INITIAL ISSUE

A3 PREAMPLIFIER

4270A-1031

DATE MAY, 1972



NOTES:

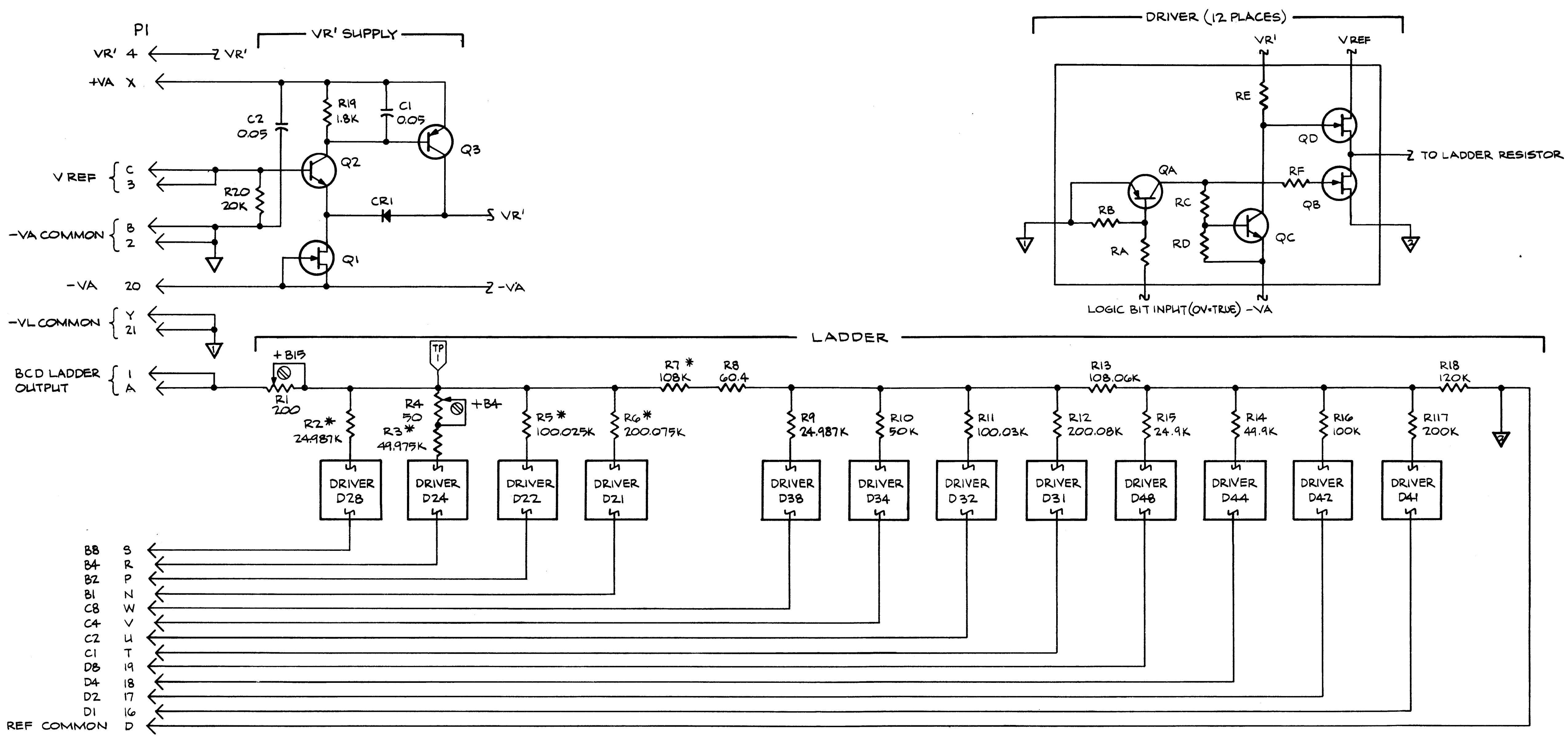
1. ALL CAPACITANCE IS IN MICROFARADS AND ALL RESISTANCE IS IN OHMS UNLESS OTHERWISE NOTED.
2. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 1,5, 8 THRU 12, 14 THRU 19, 22 THRU 25, A, C THRU F, H THRU L, N THRU W, Y, Z, AND Ā THRU Z̄.
3. ▽ LOGIC GROUND
4. ▽ COMMON
5. < PCB CONNECTOR
6. > PROGRAMMING CONNECTOR
7. ▷ INSTALL PROPER JUMPERS TO ZERO INSTRUMENT.
8. ▷ 2 AND B ON OPPOSITE SIDES OF PCB.

1	INITIAL ISSUE
REV	DESCRIPTION

A4 OPTION -03
EXTERNAL
REFERENCE

4210A-1041

DATE MAY 1972



DRIVER DESIG.	CIRCUIT VALUE	REFERENCE DESIGNATIONS											
		D21	D22	D24	D28	D31	D32	D34	D38	D41	D42	D44	D48
RA	2.7K	R23	R29	R35	R41	R47	R53	R59	R65	R71	R77	R83	R89
RB	560	R24	R30	R36	R42	R48	R54	R60	R66	R72	R78	R84	R90
RC	51K	R25	R31	R37	R43	R49	R55	R61	R67	R73	R79	R85	R91
RD	2.7K	R26	R32	R38	R44	R50	R56	R62	R68	R74	R80	R86	R92
RE	51K	R27	R33	R39	R45	R51	R57	R63	R69	R75	R81	R87	R93
RF	51K	R28	R34	R40	R46	R52	R58	R64	R70	R76	R82	R88	R94
QA	2N3906	Q5	Q9	Q13	Q17	Q21	Q25	Q29	Q33	Q37	Q41	Q45	Q49
QB	U2366E	Q6	Q10	Q14	Q18	Q22	Q26	Q30	Q34	Q38	Q42	Q46	Q50
QC	2N3904	Q7	Q11	Q15	Q19	Q23	Q27	Q31	Q35	Q39	Q43	Q47	Q51
QD	U2366E	Q8	Q12	Q16	Q20	Q24	Q28	Q32	Q36	Q40	Q44	Q48	Q52

NOTES:

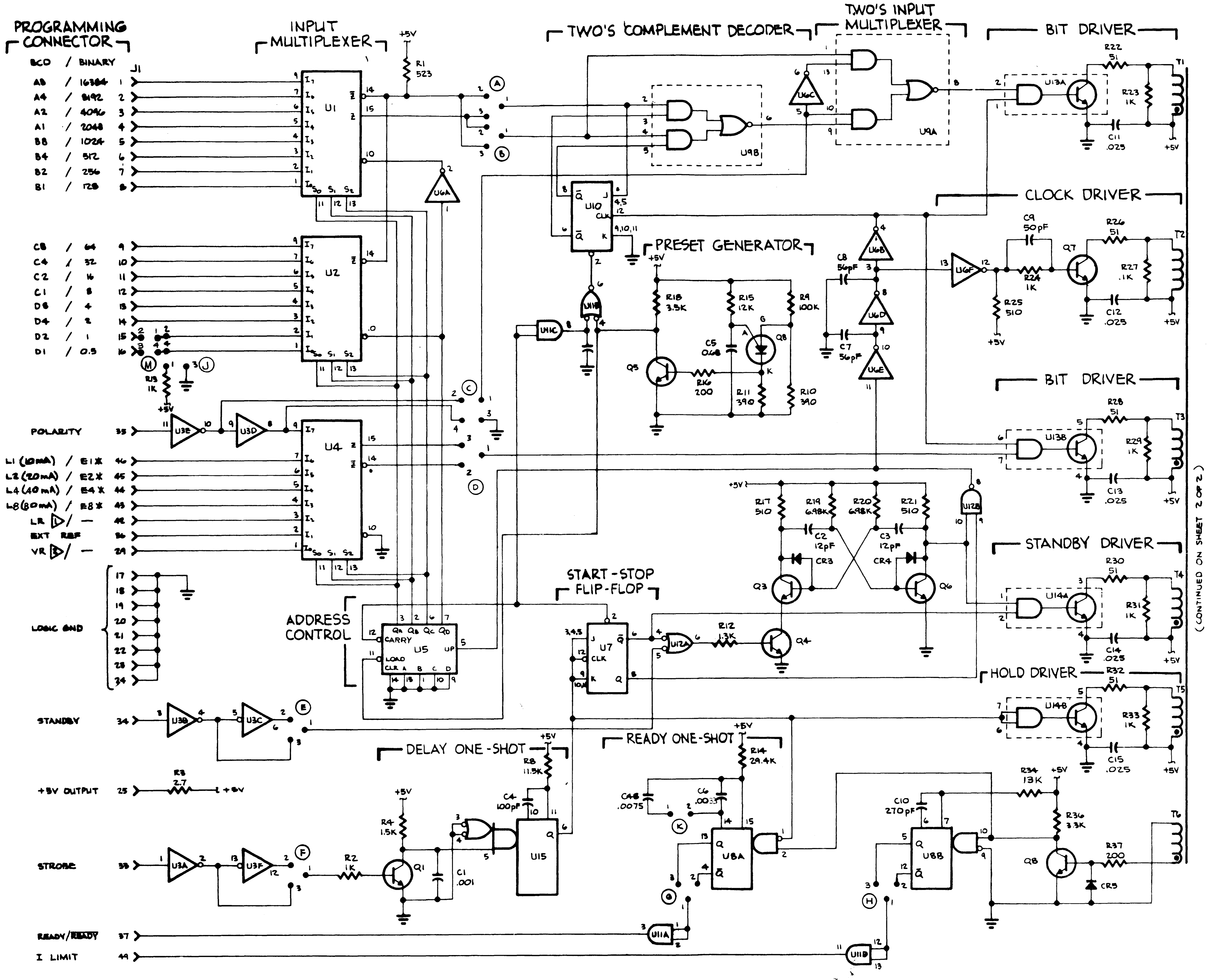
1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE INDICATED.
2. ▽ LOGIC GROUND
3. ▽ COMMON
4. ⟵ PCB CONNECTOR
5. * FACTORY SELECTED
6. ▽ REF COMMON
7. ⊘ INDICATES INTERNAL ADJUSTMENT.
8. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 5 THRU 15, 22 THRU 25, E, F, H, J THRU M, Z, $\bar{A}$, $\bar{B}$, AND $\bar{C}$.

REV	DESCRIPTION
1	INITIAL ISSUE

A5
BCD LADDER

4210A-1031

DATE MAY, 1972



LOGIC CONTROL CONFIGURATION	JUMPER POSITION A	B	C	D	E	F	G	H	J	K	L	M
4210A-01	1-2	1-2	1-3	1-2	1-2	1-2	1-2	1-2	—	—	—	1-2 3-4
4210A-01 *	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	—	—	—	1-2 3-4
4216A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2 2-4	—	—	—
4216A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	1-3	2-4 3-4	—	—	—
4250A/4270A-01	1-2	1-2	1-3	1-2	1-2	1-2	1-2	1-2	—	1-2	1-2	1-2 3-4
4250A/4270A-01*	1-3	1-3	1-3	1-3	1-3	1-3	1-3	1-3	—	1-2	1-2	1-2 3-4
4265A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2 2-4	1-2	1-2	—
4265A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	1-3	2-4 3-4	1-2	1-2	—
4275A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	—	1-2	1-2		1-2 3-4
4275A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	1-3	—	1-2	1-2	1-2 3-4

* INVERTED LOGIC LEVELS

NOTES:

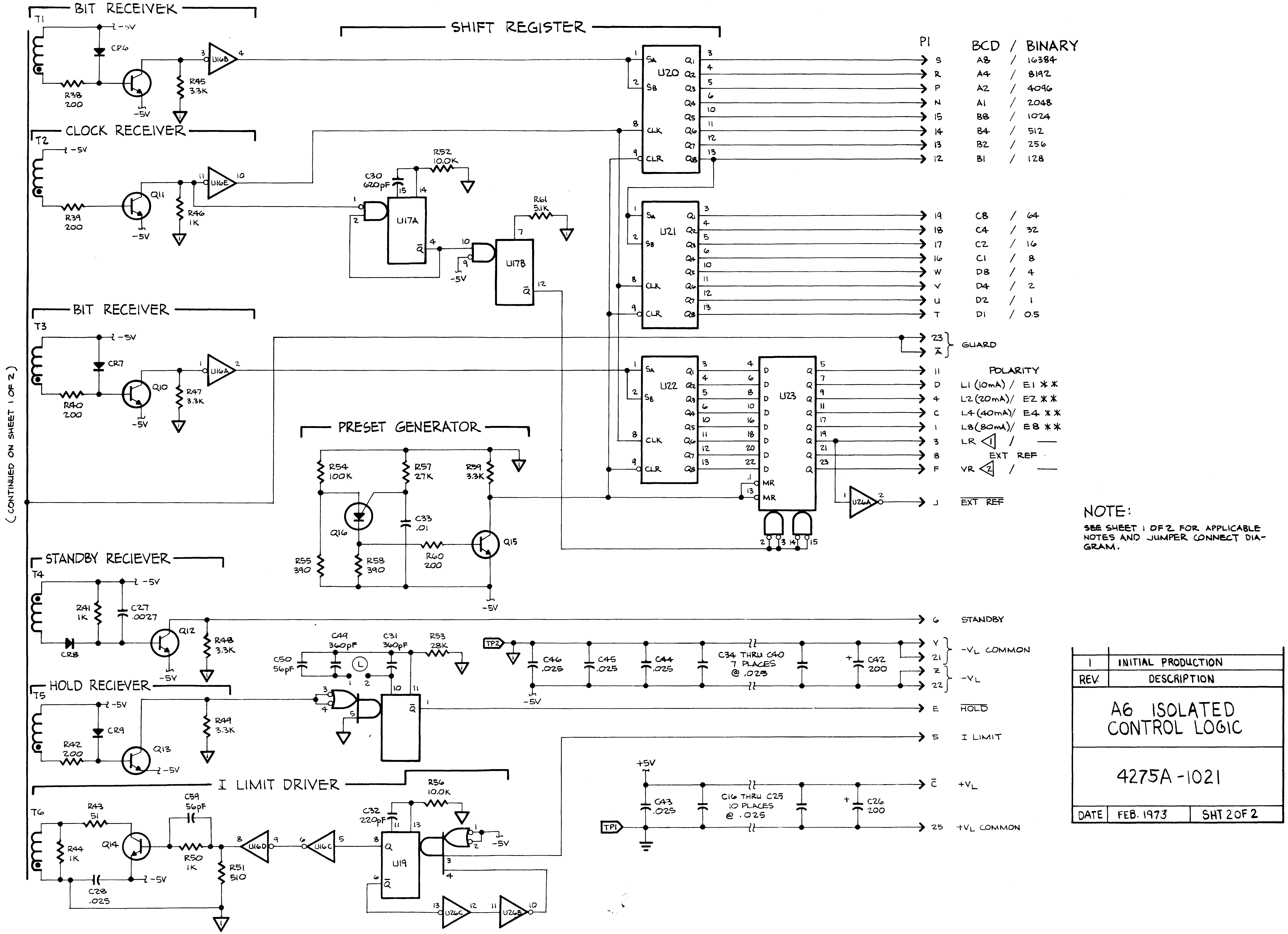
1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE NOTED.
2. EXTERNAL LOGIC GROUND
3. LOGIC GROUND
4. * 'E' DECADE INPUT WHEN A5 BCD LADDER (100 µV RESOLUTION) - 07 OPTION IS USED.
5. ** SHIFT REGISTER OUTPUT WHEN A5 BCD LADDER (100µV RESOLUTION) - 07 OPTION IS USED.
6. 1 LR (CURRENT LIMIT X10)
7. 2 VR (VOLTAGE RANGE)
8. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 2,7,9,10,20,24, A, B, H, K, L, M, X AND $\bar{B}$.
THE FOLLOWING J1 JACKS ARE NOT CONNECTED: 26,27,28,30,31,32,38,39,40,41,47,48 AND 50.

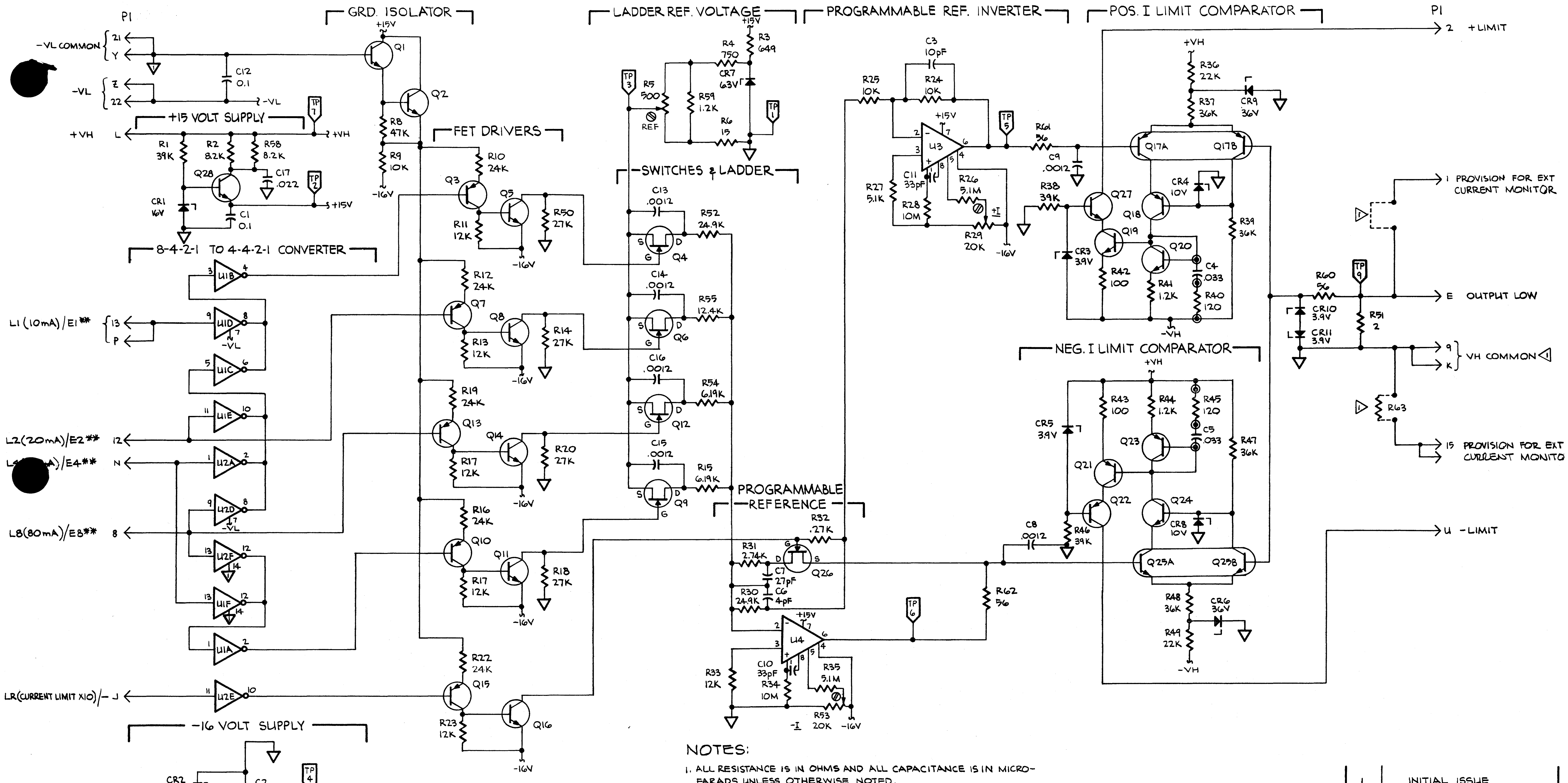
REV.	DESCRIPTION
A	(ECO'S 7435 & 7955) R34 WAS 10.10K. ADDED JUMPER POSITION CHART, REVISED ZONES C7 & A4
2	JUMPER POSITION CORRECTION
1	INITIAL PRODUCTION

A6 ISOLATED CONTROL LOGIC

4275A-1021

DATE FEB. 1973 | SHT 1 OF 2


BIT RECEIVER
CLOCK RECEIVER
BIT RECEIVER
SHIFT REGISTER
PRESET GENERATOR
STANDBY RECIEVER
HOLD RECIEVER
I LIMIT DRIVER
(CONTINUED ON SHEET 1 OF 2)
P1
BCD / BINARY
A8 / 16384
A4 / 8192
A2 / 4096
A1 / 2048
B8 / 1024
B4 / 512
B2 / 256
B1 / 128
C8 / 64
C4 / 32
C2 / 16
C1 / 8
D8 / 4
D4 / 2
D2 / 1
D1 / 0.5
GUARD
POLARITY
L1 (10mA) / E1 ✱✱
L2 (20mA) / E2 ✱✱
L4 (40mA) / E4 ✱✱
L8 (80mA) / E8 ✱✱
EXT REF
STANDBY
-VL COMMON
-VL
HOLD
I LIMIT
+VL
+VL COMMON
C34 THRU C40 7 PLACES @ .025
C16 THRU C25 10 PLACES @ .025
NOTE:
SEE SHEET 1 OF 2 FOR APPLICABLE NOTES AND JUMPER CONNECT DIAGRAM.
1 INITIAL PRODUCTION
REV. DESCRIPTION
A6 ISOLATED CONTROL LOGIC
4275A-1021
DATE FEB. 1973 SHT 2 OF 2



NOTES:

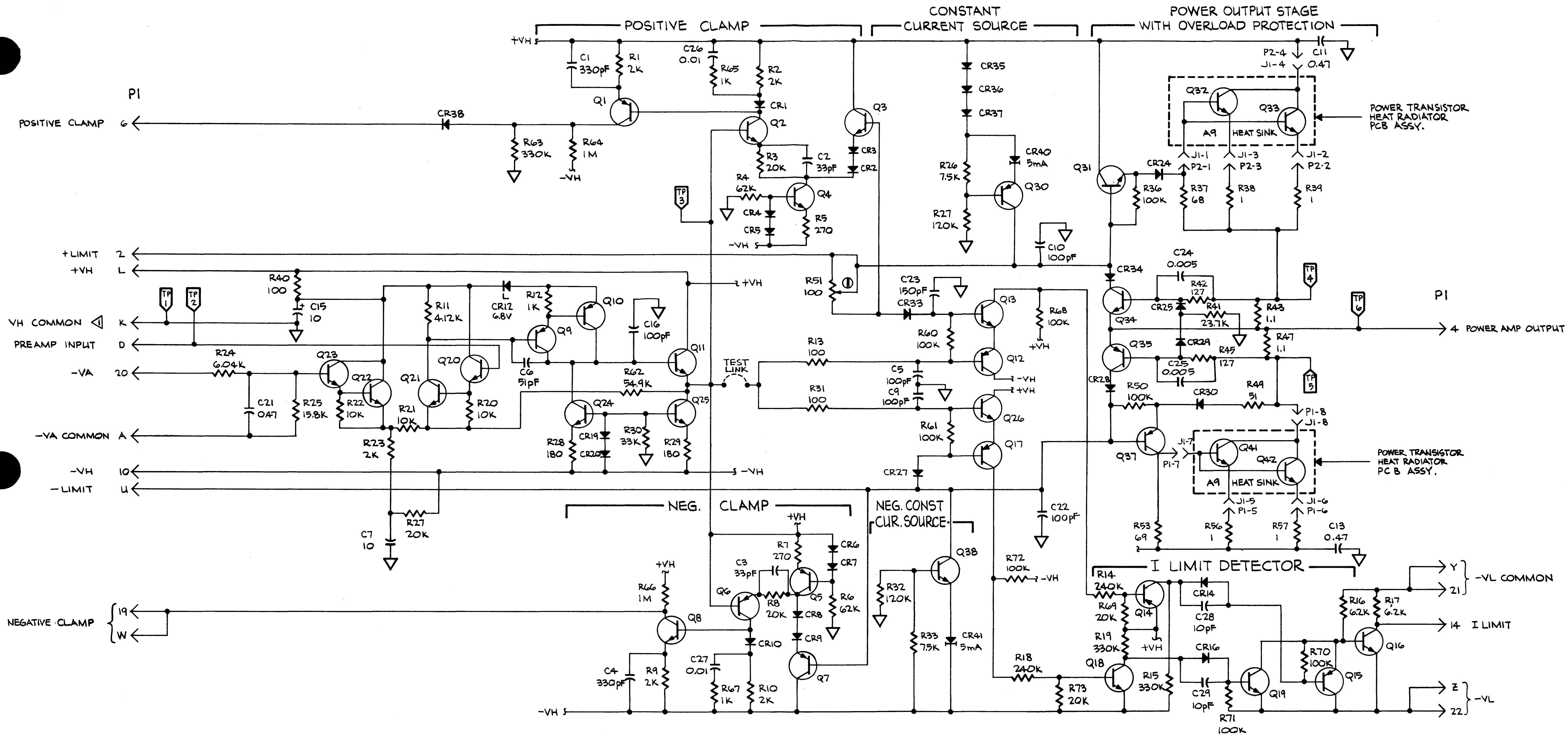
1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICRO-FARADS UNLESS OTHERWISE NOTED.
2. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 3 THRU 7, 11, 14, 16 THRU 20, 23 THRU 25, A THRU D, F, H, M, R THRU T, V THRU X, Ā, B̄, C̄.
3. LOGIC GROUND
4. COMMON
5. PCB CONNECTOR
6. PCB TERMINAL
7. ** SHIFT REGISTER INPUT WHEN A5 BCD LADDER (100µV RESOLUTION) -07 OPTION IS USED
8. PROVISIONS FOR FACTORY INSTALLABLE OPTION ENABLING EXTERNAL CURRENT MONITORING.

REV	DESCRIPTION
1	INITIAL ISSUE

A8 OPTION-06 PROGRAMMABLE CURRENT LIMITER

4270A-1081

DATE MAY, 1972



NOTES:

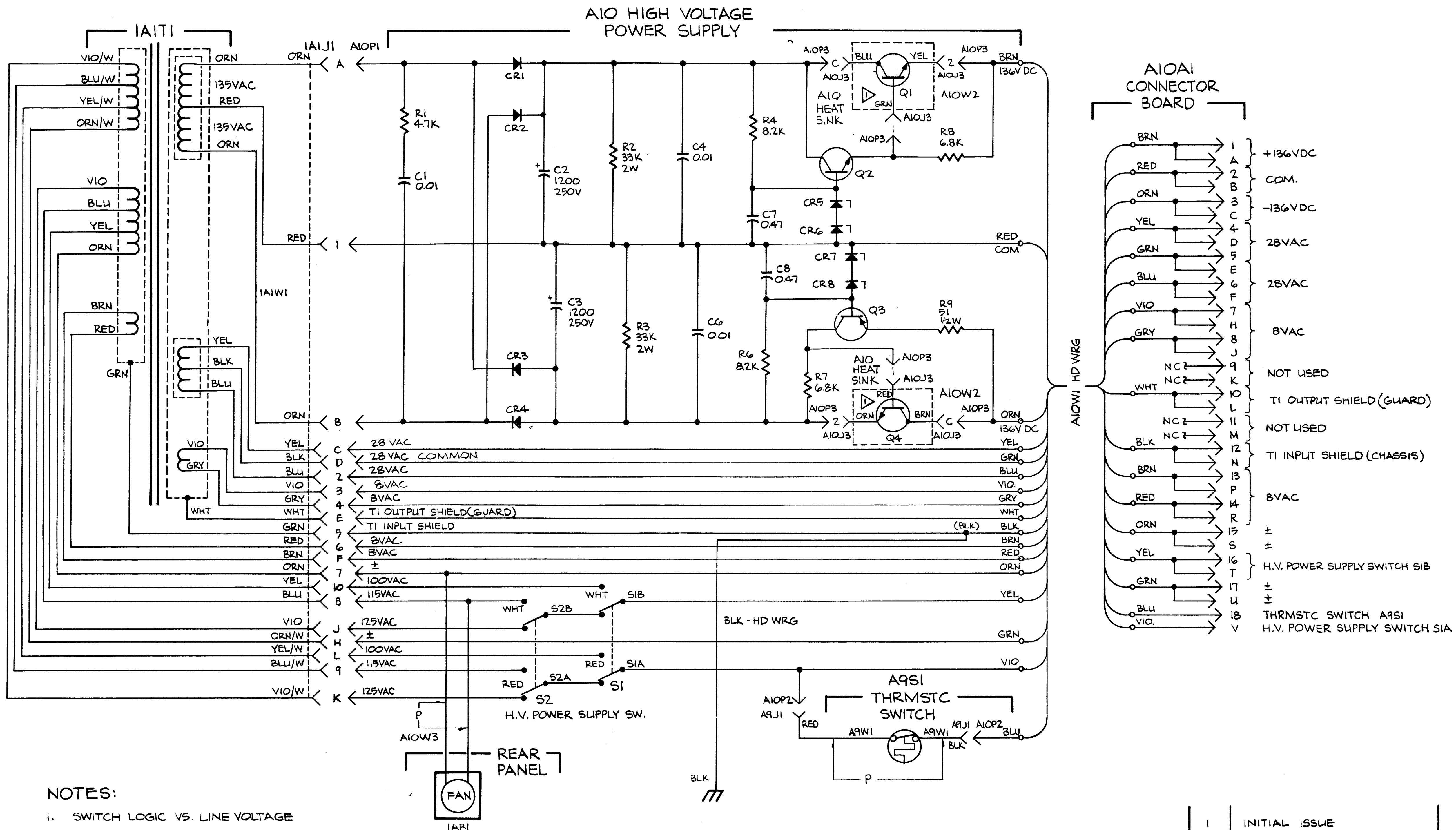
1. THE FOLLOWING P1 PINS ARE NOT CONNECTED; B,C,E THRU J, M THRU T, V, X, Ā THRU C̄, 1, 3, 5, 7 THRU 9, 11 THRU 13, 15 THRU 18, Ā THRU C̄.
2. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE NOTED.
3. ⟵ PCB CONNECTOR
4. ▷ VH COMMON & OUTPUT LOW TIED THRU INTACT A1 LOCKOUT JUMPER.

1	INITIAL ISSUE
REV	DESCRIPTION

A9
POWER AMPLIFIER

4270A-1071

DATE MAY, 1972



NOTES:

1. SWITCH LOGIC VS. LINE VOLTAGE

LINE VOLTAGE	SWITCH POSITIONS		
	PWR SPLY A2S1 ✗	H.V. POWER SUPPLY A10S1	A10S2
100	WHITE	WHITE	RED
115	WHITE	RED	WHITE
125	WHITE	RED	RED
200	RED	WHITE	RED
230	RED	RED	WHITE
250	RED	RED	RED

✗ A2S1 MOUNTED ON A2 POWER SUPPLY

2. ▷ Q1 AND Q4 MOUNTED ON A10 HEAT SINK AND CONNECTED TO A10 PCB VIA CABLE A10W2.
3. ALL RESISTANCE IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS, UNLESS OTHERWISE NOTED.
4. ⏚ CHASSIS GROUND

REV	DESCRIPTION
1	INITIAL ISSUE

A10
H.V. POWER SUPPLY
& CONNECTOR BOARD

4270A-1012

DATE MAY, 1972