JOHN FLUKE MFG. CO., INC.

P. O. Box 7428

Seattle, Washington 98133

MODEL

4210A

BCD PROGRAMMABLE VOLTAGE SOURCE

MODEL 4210A SERIAL NO. ______________________ AND ON.

APRIL 1971

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 operation, 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 forewarded 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 of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express 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.

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MODEL 4210A BCD PROGRAMMABLE VOLTAGE SOURCE

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 4210A is a programmable bipolar dc voltage source. Output voltage range is from 0 to 16.665 vdc and is available in 1 mv increments. Output accuracy is 0.01% of the programmed level, after a 30 usec settling time. A READY/NOT READY flag output indicates when the output has settled. Maximum output current is 100 ma and is short-circuit protected. Current sinking capability is 50 ma with a 10 volt output. It is also overload protected. An OVERLOAD flag output indicates when either a source or sink current limit condition exists.

1-3. Programming requirements are compatible with DTL or TTL logic using BCD or four bit binary 8-4-2-1 coding per decade. Contact or relay closures can also be used. All programming inputs and flag outputs are made through a 50 terminal Amphenol, Blue Ribbon connector at the rear panel. A +5 vdc ±10% output is provided at this connector for use as an external programming bias source. Logic levels are as follows:

Logic "0" = +2.8 to +5.5 vdc or open circuit.
Logic "1" = 0 ± 0.4 vdc or short circuit to LOGIC GRD.

1-4. Five options are available and provide tailoring of the power source to fit application requirements. These options are identified by corresponding -01 through -05 designations. Each option is described in Table 1-1. Installation combinations are given in Table 1-2. The -03, option can be installed at any time, as desired. The other options are installed during manufacture.

1-5. Physically, the power source is completely solid-state. Plug-in printed circuit boards are used for ease in servicing. The chassis is designed for bench-top use, or it can be installed in a standard equipment rack. Accessory Rack Mounting Brackets permit offset or side-by-side rack installation.

Table 1-1. OPTIONS (Sheet 1 of 2)

OPTIONS	TITLE	DESCRIPTION
−01	ISOLATED CONTROL LOGIC	Separates the external digital interface logic and attendant noise from the Model 4210A analog circuitry. Impedance between the interface logic and the analog circuitry is greater than 10^9 ohms, in parallel with 3 pf. It also provides a data storage that allows multiplexing of several voltage sources from one system interface register or data bus.

Table 1-1. OPTIONS (Sheet 2 of 2)

OP-TIONS	TITLE	DESCRIPTION
–02	FRONT PANEL DISPLAY	Lamps installed on the front panel which indicate the programmed level, SIGN, CURRENT LIMIT, EXT REF, POWER ON and STDBY conditions.
–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 and a frequency from dc to 100 kHz. Input impedance is 100K, in parallel with 15 pf.
–04	DIRECT COUPLED CONTROL LOGIC	Provides the required buffering between Model 4210A and the programming ground is directly connected to the low sense terminal.
–05	BLANK FRONT PANEL	Only a POWER lamp is installed on the front panel.

Table 1-2. OPTION COMBINATIONS

OPTIONS	COMBINATIONS				
	01	02	03	04	05
01	X	■	■	□	■
02	■	X	■	■	□
03	■	■	X	■	■
04	□	■	■	X	■
05	■	□	■	■	X

■ *Compatible* □ *Not Compatible*

1-6. SPECIFICATIONS

OUTPUT VOLTAGE	0 to ±9.999 vdc (BCD inputs) 0 to ±16.665 vdc (4 bit binary, by decade)
OUTPUT VOLTAGE RESOLUTION	1 mv
OUTPUT CURRENT	0 to 100 ma (short-circuit protected).
CURRENT SINK CAPABILITY	I_{SINK} = 100 ma – 4 E_{OUT}
ACCURACY (15° to 35°C)	±(0.01% of called output + 100 uv)
STEADY STATE RIPPLE AND NOISE . . . . . . (10 Hz to 10 MHz bandwidth)	1 mv peak-to-peak, 300 uv rms
PROGRAMMING NOISE AND TRANSIENTS	Any programmed increment will cause less than a 50 mv peak noise transient during the first 8 usec of the programming interval.
DIGITAL NOISE REJECTION (–01 Option Only) . .	The noise between digital ground and analog output is rejected 1000:1 at 1 MHz.
OUTPUT IMPEDANCE	0.0001 ohms @ dc; 1.4 ohms @ 100 kHz; 7 ohms @ 500 kHz
EXTERNAL REFERENCE (Option –03)	
Voltage Range	0 to ± 14.5 vdc or peak ac
Input Impedance	100k ohms in parallel with 10 pf

Output Voltage	0 to 10v rms; ±17v peak
Output Current	70 ma rms; 100 ma peak
Frequency Range	dc to 100 kHz
Accuracy (15°C to 35°C, 90 days with respect to the External Reference, E_{XR})	±(0.01% of setting +0.0001% $\left(\frac{75}{E_{XR}}\right)$ +100 uv) at dc
DC Stability (With respect to External Reference, E_{XR})	±(0.001% +.0001% $\left(\frac{15}{E_{XR}}\right)$ + 20 uv) for 24 hours ±(0.001% + .0001% $\left(\frac{45}{E_{XR}}\right)$ + 60 uv) for 90 days
Programming Resolution (Least significant bit weight)	E_{XR} x 10^{-4} volts Example: If E_{XR} = 5 volts, resolution = .5 mv
SPEED	Settles to within 0.01% of programmed change is 30 usec. (Includes selection time of internal/external reference, Option –03) for a resistive load.
OUTPUT STABILITY (15° to 35°C) (Constant load, line and temperature)	+(10 ppm of setting + 20 uv) for 24 hours +(30 ppm of setting + 60 uv) for 90 days
TEMPERATURE COEFFICIENT (35°C <T <15°C)	±(10 ppm of output +15 uv)°C
LOAD REGULATION	An output current change of 100 ma causes the output to change less than 100 uv.
LOAD RECOVERY	The output will settle to within 0.01% of final value in 30 usec after an output current change of 100 ma.
LINE REGULATION	A ±10% change in line voltage causes less than a 100 uv change in output.
OUTPUT TERMINALS	HIGH, LOW, HIGH SENSE, LOW SENSE, CHASSIS, GUARD. Terminals located on rear panel. The GUARD terminal can be floated up to 1000 volts above chassis ground.
PROGRAM CONTROL CONNECTOR (See Table 1-3)	50 terminal input connector on rear panel. Mating connector is Amphenol, Blue Ribbon, Part No. 57-30500.
INPUT POWER	115/230 vac, ±10%, 48-62 Hz single phase, 20 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 msec half-sine wave
Vibration	4.5g, 10-55 Hz
Altitude	0-10,000 ft – Operating; 50,000 ft – Non-Operating
SIZE	5-¼" high x 8½" wide x 15-11/16" deep.
WEIGHT	12 lbs. fully loaded
ACCESSORIES	
Manual Control Unit	Allows manual checkout, calibration, and control. FLUKE Model A4200
Rack Mounting Brackets	■ Offset Mounting; M05-203-601 ■ Center Mounting; M05-203-602 ■ Dual Rack Mounting; M05-200-603 ■ Chassis Slides; M00-260-610 (18") ■ Chassis Slides; M00-280-610 (24")
Mating Connector	Amphenol, Blue Ribbon 57-30500 — FLUKE PART NO. 266056
Extender Card	FLUKE PART NO. 292623

Table 1-3. 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.
LOGIC LEVELS:	Logic "1" = 0 ±.4 VDC or contact closure; Logic "0" = +2.8 to +5.5 VDC 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 NOTE: Decade numbers greater than 9 (i.e. 10 thru 15 will be accepted and converted to an equivalent analog value. The maximum full scale output is 16.665 VDC.
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 OV transition) is required. When using the Direct Coupled Control Logic Option –04, the Data Strobe may be used to hold the output constant while programming the systems interface register. Upon release of the Data Strobe, the output will go to the programmed value. If the Data Strobe is not used in the Direct Coupled mode, the output will follow any command data perturbations. Logic "1" = "hold" condition.
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 at zero volts.
RESPONSE SIGNALS CURRENT OVERLOAD FLAG:	Connector Pin 49; Logic "1" represents a current overload condition.
READY/NOT READY FLAG:	Connector Pin 37; Logic "0" = "Ready" condition, the output is within 0.01% of the programmed increment for a resistive load. 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 +5 vdc at 125 ma for use by the external system interface logic.
LOGIC GROUND:	Connector Pins 17 thru 24: It is recommended that a large ground strap be used between the interface logic and the power source to reduce the digital programming noise on the system ground.

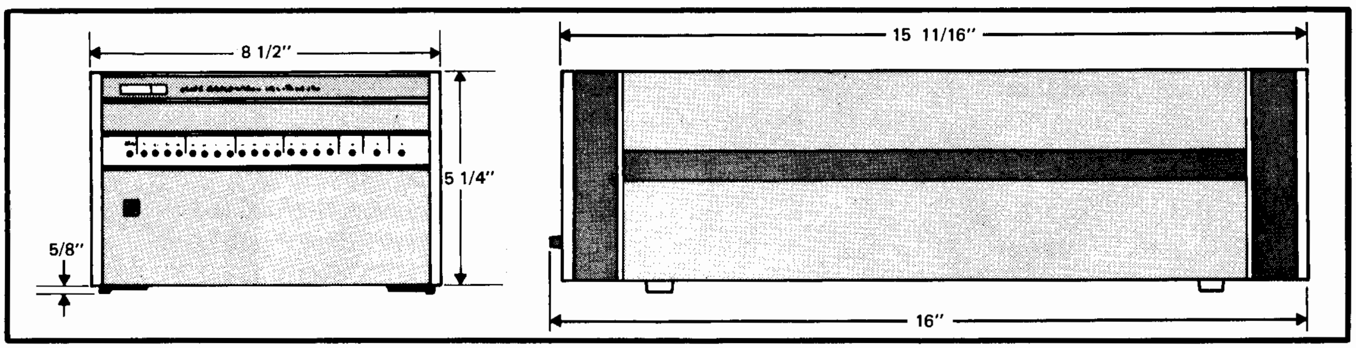


Figure 1-1. OUTLINE DRAWING

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding installation and operation of the Model 4210A. It is recommended that the contents of this section be thoroughly 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 7428, Seattle, Washington 98133, telephone (206) 774-2211. A list of Sales Representatives is located at the rear of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 4210A was packaged and shipped in a foam packed cardboard carton. Upon receipt, a thorough inspection should be performed to reveal any damage in transient. 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 either a 115 or 230 vac, 48 to 62 Hz power line. A decal on the rear panel indicates which power line input is required. If it becomes necessary to change from one power line voltage to the other, proceed as follows:

a. Disconnect the power cord from the rear panel of the power source.

b. Remove the top dust cover and inner cover.

c. Remove the four screws shown in Figure 2-1 from the rear panel.

d. Pull the Power Supply Assembly shown in Figure 2-1 out from the rear panel until the 115/230 slide switch is accessible.

e. Set the slide switch to the desired line voltage position. Positions are labeled on the printed circuit board.

f. Slide the Power Supply Assembly back into the power source making sure that the connector at the front panel is correctly mated.

g. Install the four screws removed from the rear panel, and then replace the inner cover and top dust cover.

h. Install the following rated value fuse in the rear panel fuse holder.

115 VAC	230 VAC
1/4A, AGC	1/8A, AGC

i. Reconnect the power cord at the rear panel and then energize the power source with the toggle switch on the rear panel. The POWER lamp on the front panel should illuminate.

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 Kits shown in Figure 2-2. When two power sources of the same size are side-by-side mounted, Accessory chassis slides can also be installed to better facilitate rack installation. Information regarding installation of these Accessories is given into the Section VI, Rack Installation subsection.

2-10. OPERATING FEATURES

2-11. The location and function of all connectors and indicators is given in Figure 2-3.

2-12. OPERATING NOTES

2-13. The following paragraph describe various conditions which should be considered before operating the Model 4210A.

2-14. AC Line Connection

2-15. The input power cord plug is a three prong, polarized connector. This plug allows connection to either a 115 or 230 vac, 48 to 62 Hz, power line (see Input Power, paragraph 2-6), while at the same time connects the power source chassis to earth ground. Always ensure that the round pin is connected to a high quality earth ground. The power source is energized through a toggle switch on the rear panel.

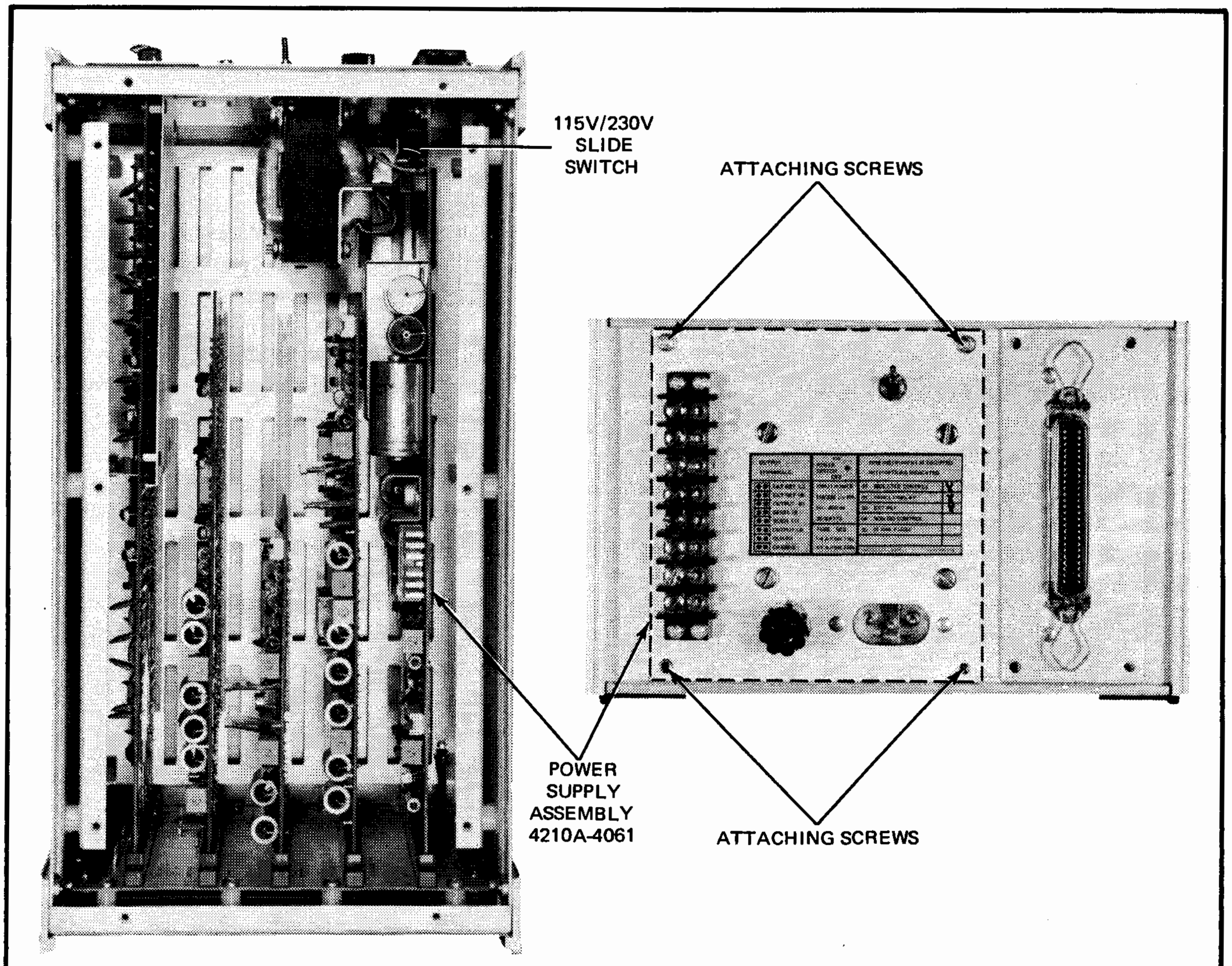


Figure 2-1. 115/230 VAC POWER CONVERSION

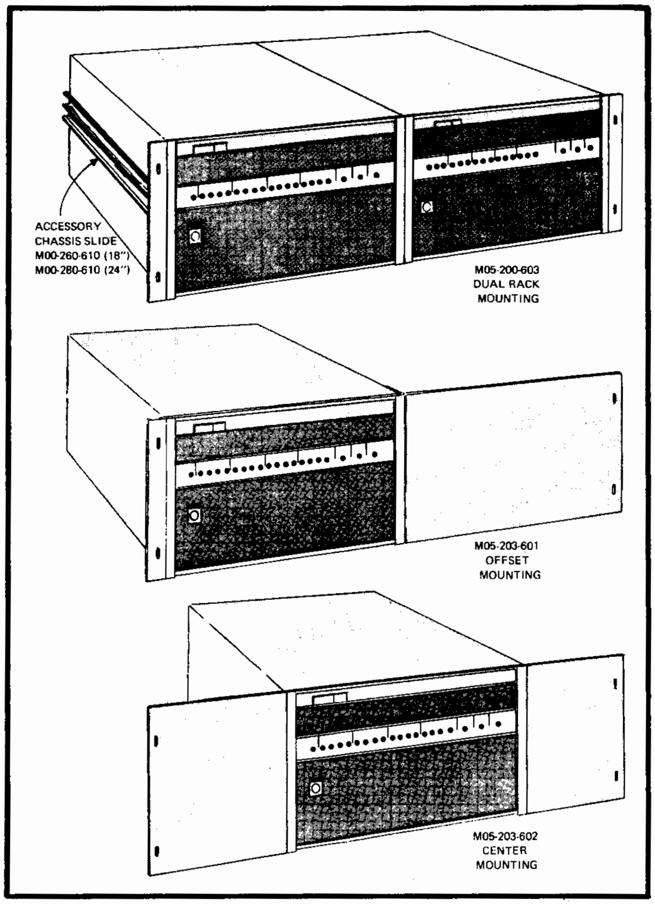


Figure 2-2. ACCESSORY RACK MOUNTING KITS

2-16. Load Connections

2-17. An eight terminal barrier strip located on the rear panel contains the output connectors of the power source. The ±OUTPUT terminals are connected to respective sections of the load. Regulation of the programmed output is done through the ±SENSE terminals. These terminals can be bussed through jumpers installed at the factory to the OUTPUT terminals, or they allow remote sensing at the load. In either case, NEVER operate the power supply with the SENSE terminals disconnected. The CHASSIS terminal is connected directly to the chassis and allows grounding of the load, if desired. The GUARD terminal allows load connections that can greatly reduce common mode-to-normal mode signals. This guard connection should always be used if optimum noise free performance is to be achieved.

2-18. Remote Sensing

2-19. Whenever a load is connected to the OUTPUT terminals, there may be an appreciable voltage drop in the connecting cable. This voltage drop is caused by the resistance of the cable leads and can be excessive in some applications. For this reason, SENSE terminals are provided to allow the output to be sensed directly at the load, thus eliminating any voltage drop in the connecting cable. Figure 2-4 shows an example of remote sensing load connections.

NOTE!

Always use a twisted pair of insulated wires between the SENSE terminals and the load.

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 round 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 explained 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 any common mode-to-normal mode conversion. Figure 2-5 shows a simplified diagram of a guarded load connections.

2-24. PROGRAMMING INFORMATION

2-25. Control of all functions except POWER ON is done through a 50 pin Amphenol, Blue Ribbon connector on the rear panel. The power source is energized through a toggle switch on the rear panel. Interface between the programming equipment and the power source requires an Amphenol, Blue Ribbon 57-30500 mating connector. This mating connector is available as an accessory for the power source. It can be obtained from FLUKE under PART NO. 266056. Installation information regarding this connector is located in Section VI. Table 2-1 lists and describes each terminal on the Programming Connector.

2-26. Programming input requirements are compatible with either DTL or TTL logic using BCD or binary four bit per decade coding. Logic "0" is +2.8 to +5.5 vdc or open circuit to logic ground. Logic "1" is 0 ±0.4 vdc or short circuit to logic ground. Logic ground is available at pins 17 through 24 of the programming connector. Shorting these

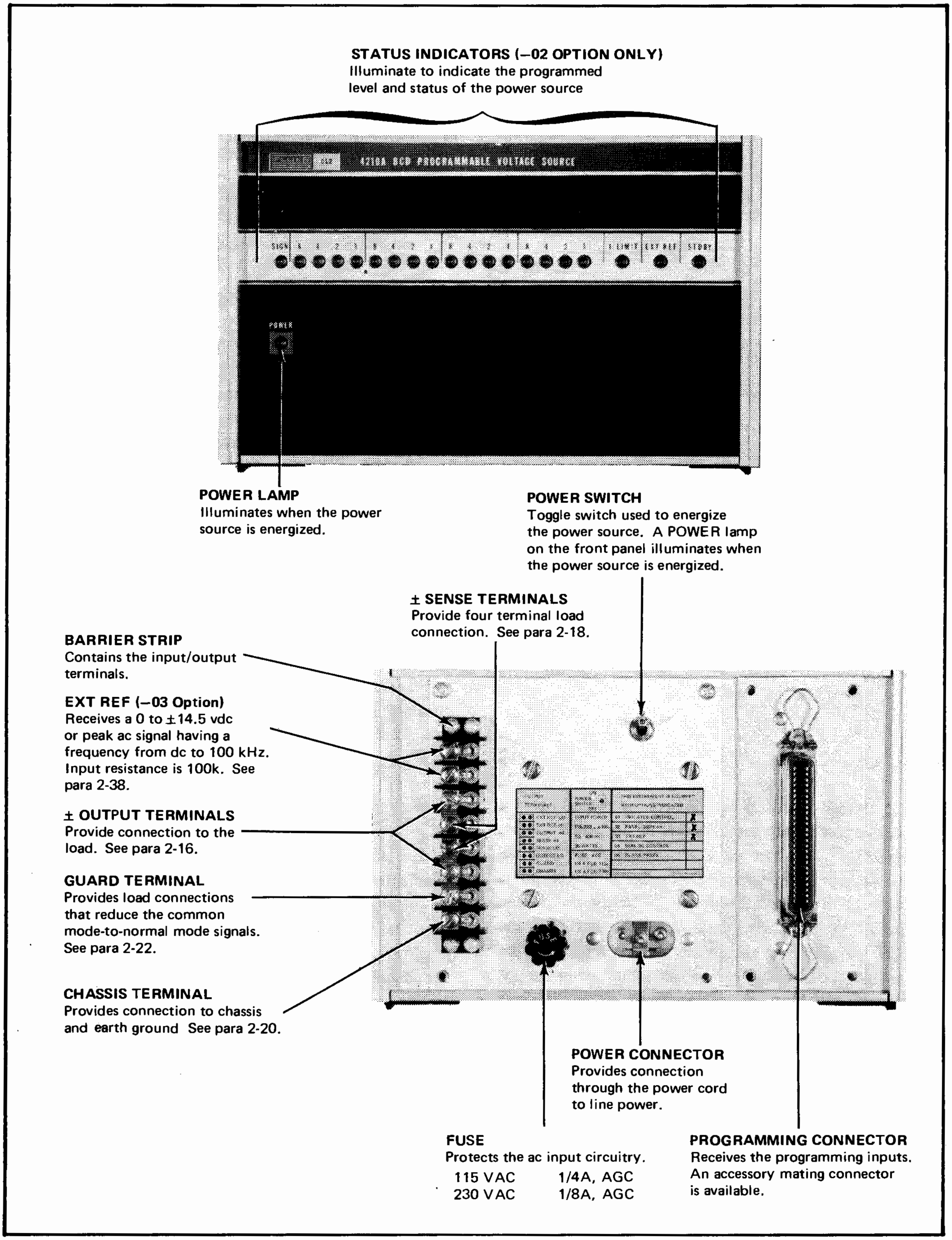


Figure 2-3. OPERATING FEATURES

Table 2-1. PROGRAMMING INPUT/OUTPUTS

LOGIC "0" = +2.8 to +5.5 vdc or open circuit
LOGIC "1" = 0 ±0.4 vdc or short circuit to LOGIC GRD

PIN NO.	CODE	FUNCTION
1	8	A DECADE (1V)
2	4	
3	2	
4	1	
5	8	B DECADE (.1V)
6	4	
7	2	
8	1	
9	8	C DECADE (.01V)
10	4	
11	2	
12	1	
13	8	D DECADE (.001V)
14	4	
15	2	
16	1	
17, 18, 20, 21, 22, 23, 24		LOGIC GRD
25		LOGIC PWR (+5 vdc at 0 to 125 ma)
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, 43, 44, 45, 46, 47, 48		NOT USED
49		CURRENT OVERLOAD FLAG: LOGIC "0" = NORMAL; LOGIC "1" = OVERLOAD
50		NOT USED

lines to the appropriate pins of the programming connector using contact closures also allows control of the power source. A +5 vdc ±10% output at up to 125 ma is available at pin 25 for use by the external programming logic.

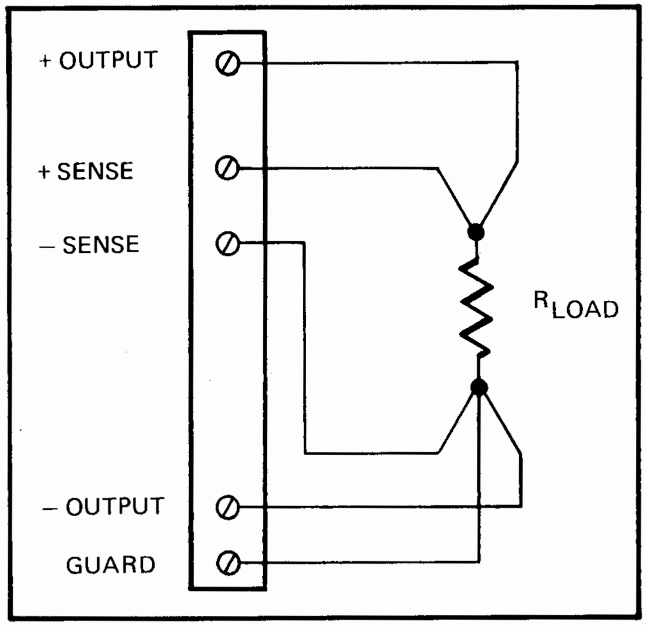


Figure 2-4. REMOTE SENSING CONNECTIONS

2-27. Standby

2-28. The STANDBY mode can be invoked by applying a Logic "1" to pin 34 of the Programming Connector. When this condition exists, the output will be zero volts. Application of a Logic "0" at this pin returns the output voltage to the programmed level.

2-29. Output Magnitude/Polarity

2-30. The magnitude of the output is controlled with binary by decade coded inputs at pins 1 through 16 of the Programming Connector. Four decades are available; each receives a four bit 8-4-2-1 coded input. The maximum output that can be called from any decade is 15 (8+4+2+1), which provides a total output range of 0 to ±16.665 volts. It should be noted, however, that any decade word above 9 violates the definition of BCD coding.

2-31. Polarity of the output is controlled by a single line input at pin 35. A Logic "0" will produce a positive output. A Logic "1" will produce a negative output.

2-32. Data Strobe

2-33. The data strobe shown in Figure 2-6 is required to initiate programming inputs when the Isolated Control Logic (–01 Option) is installed. This pulse is applied to pin 33 of the Programming Connector. Upon its negative transition, digital inputs are simultaneously transferred as shown in Figure 2-6, and, after a 30 usec time-out, the output is

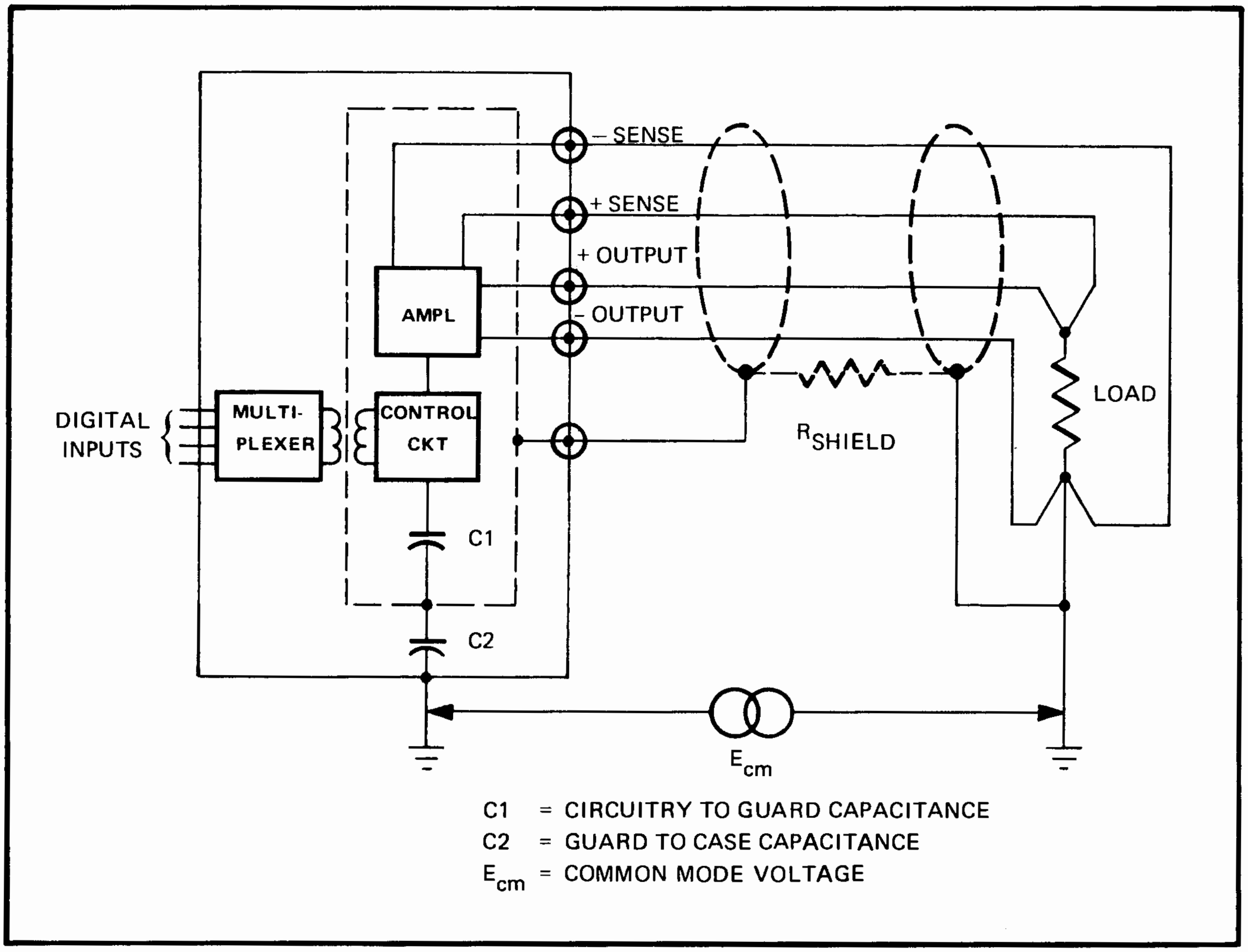


Figure 2-5. GUARDED LOAD CONNECTION

then within ±0.01% of the programmed change for a resistive load.

2-34. The data strobe can also be used to hold the output constant while calling changes in magnitude when the Direct Coupled Control Logic (–04 Option) is installed. However, the period of the data strobe must match the program change interval. If this is not done, the output will follow any program changes, which is normal for direct programming.

2-35. Flag Outputs

2-36. Two flag outputs are provided to indicate when a current overload exists and when the output voltage has settled. A current OVERLOAD is indicated by a Logic "1" at pin 49 of the Programming Connector. Normal operation is indicated by a Logic "0". Settling of the output is provided by a READY/NOT READY flag at pin 37. A Logic "0" indicates a READY condition when the output voltage is within ±0.01% of the programmed change for a resistive load. A Logic "1" indicates a NOT READY condition.

2-37. The OVERLOAD flag and the NOT READY flags will both be activated when a current overload occurs. After the overload is removed, the NOT READY flag will remain for 30 usec until the output voltage has settled. Figure 2-7 shows the timing relationship of these flags.

2-38. External Reference

2-39. When the External Reference (–03 Option) is installed, the power source can be used as a programmable amplitude source through the use of an external reference signal. The output accuracy, however, is then relative to the accuracy and stability of the external reference. Frequency range of this feature is from dc to 100 kHz.

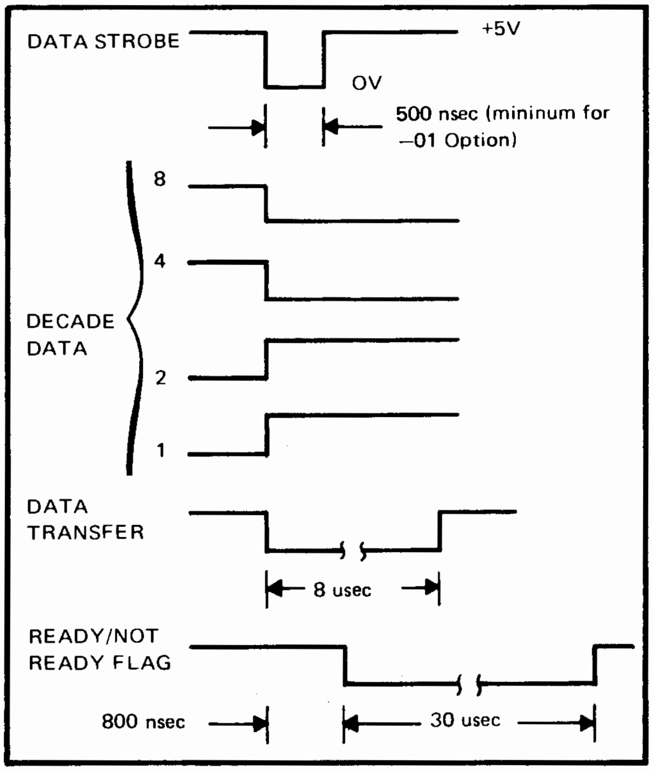


Figure 2-6. ISOLATED CONTROL LOGIC TIMING

2-40. The external reference signal can have an amplitude of 0 to 14.5 vdc or peak ac (volts rms x 1.414). It is applied to ± EXT REF terminals located on the rear panel barrier strip. Input impedance at these terminals is 100k in parallel with 15 pf. The external reference feature is activated by applying a Logic "1" to pin 36 of the Programming Connector. When BCD coding is used, the resulting dc or peak output of the power source can be calculated as follows:

$$E_{OUT} = (ABCD \times 10^{-4})(E_{EXT\ REF})$$

Where:

E_{OUT} = dc or peak output voltage

ABCD = Decade BCD coding

$E_{EXT\ REF}$ = external reference dc level or peak ac (volts rms x 1.414) value.

NOTE!

In binary coding per decade is used, the maximum output that can be specified is 16.665 volts. The calculation for BCD coded inputs can be used to determine the output voltage; however, the maximum binary output that can be called with a 14.5 volt external reference is 11493 mv. If a 16665 mv output is called, the maximum external reference that can be used is 10 volts.

2-41. Front Panel Indicators

2-42. When the Front Panel Display (–02 Option) is installed, status lamps are provided on the front panel. These lamps indicate the programmed output level, output polarity, current overload, external reference, and standby status of the internal register. None of these lamps are provided when the BLANK FRONT PANEL (–05 Option) is installed. A POWER lamp is included with either option to indicate that the power source is energized.

2-43. Dynamic Characteristics

2-44. The power source output can be changed quite rapidly with high speed programming information. However, a 30 usec period must be allowed before the output has settled to its stated accuracy for a resistive load. A typical example of this settling period is shown in Figure 2-8. If a capacitive load is driven by the power source, the settling time may have to be extended beyond the nominal 30 usec period, depending on the magnitude of the capaci-

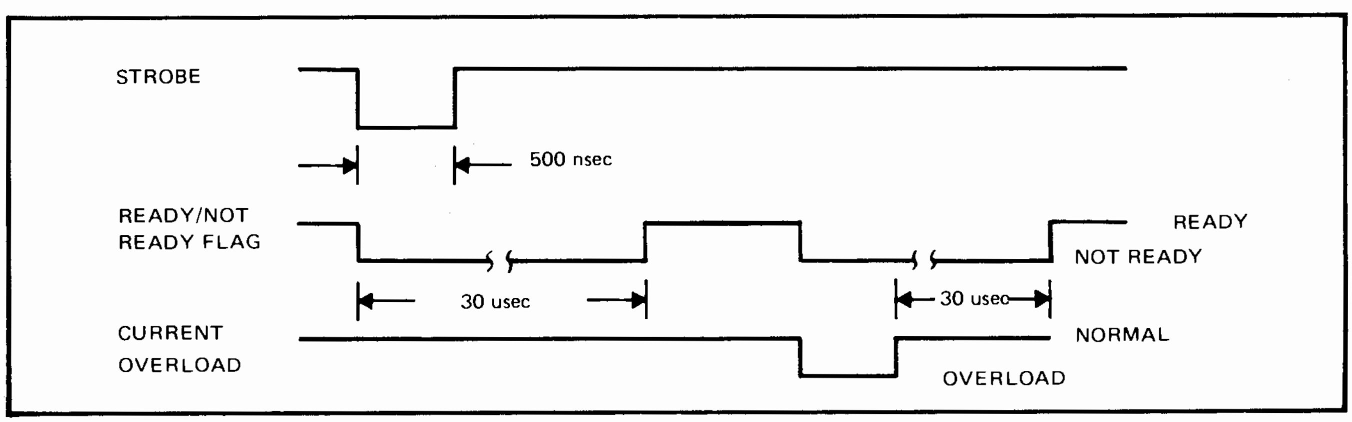


Figure 2-7. FLAG TIMING RELATIONSHIP

tance. Figure 2-9 shows a typical settling time versus capacitive load plot.

2-45. 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 Figures 2-10 through 2-13.

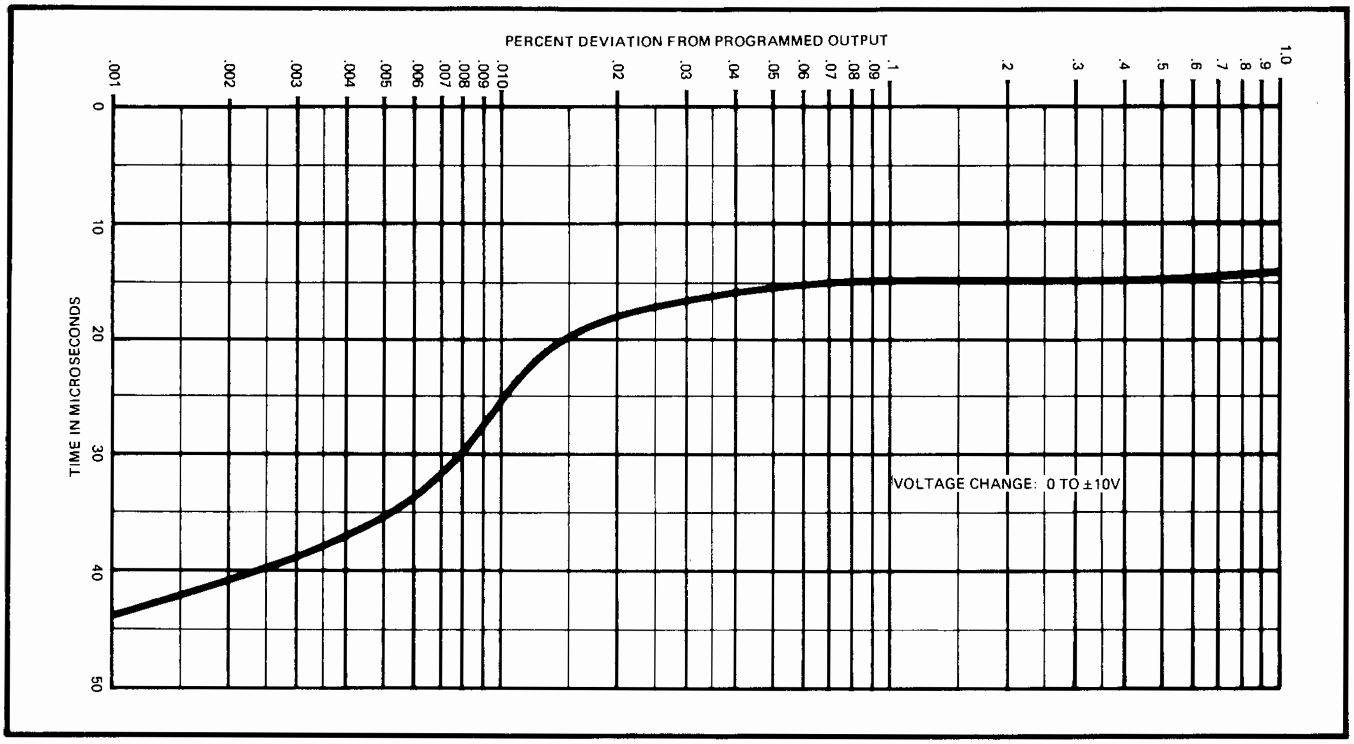


Figure 2-8. ACCURACY VERSUS SETTLING TIME (RESISTIVE LOAD)

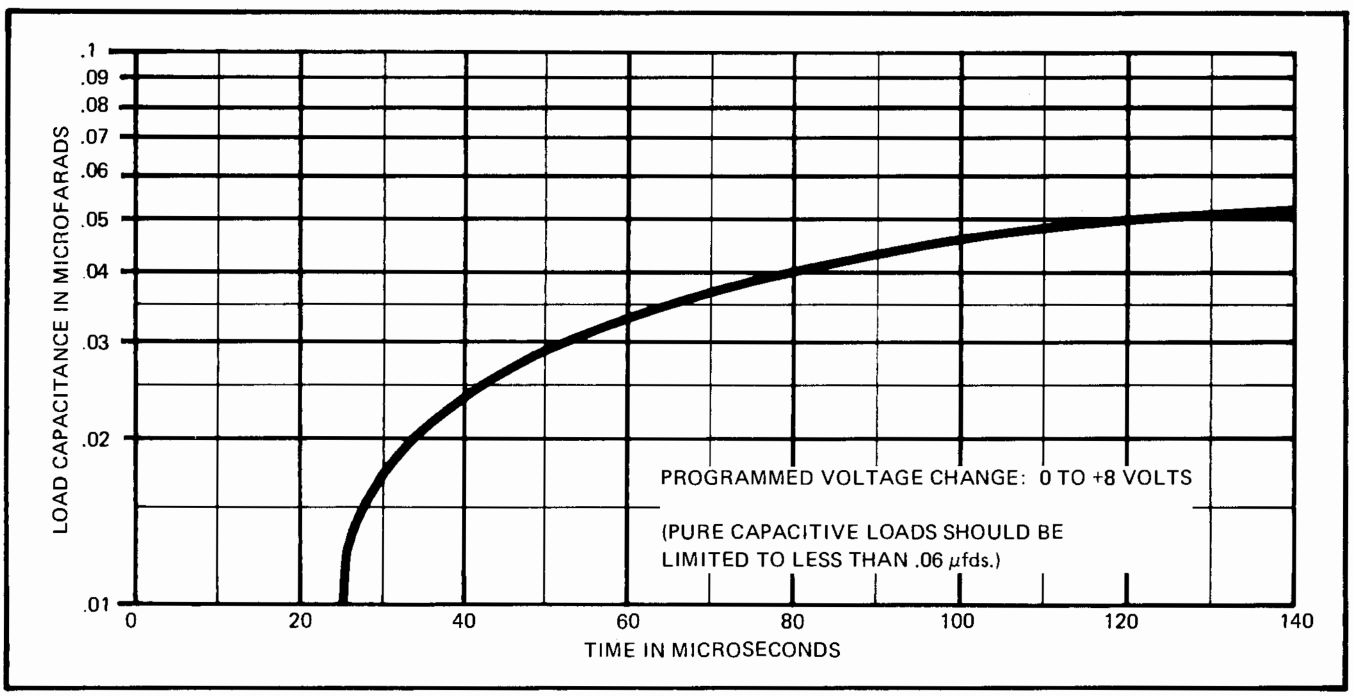


Figure 2-9. SETTLING TIME TO 0.01% ACCURACY (CAPACITIVE LOAD)

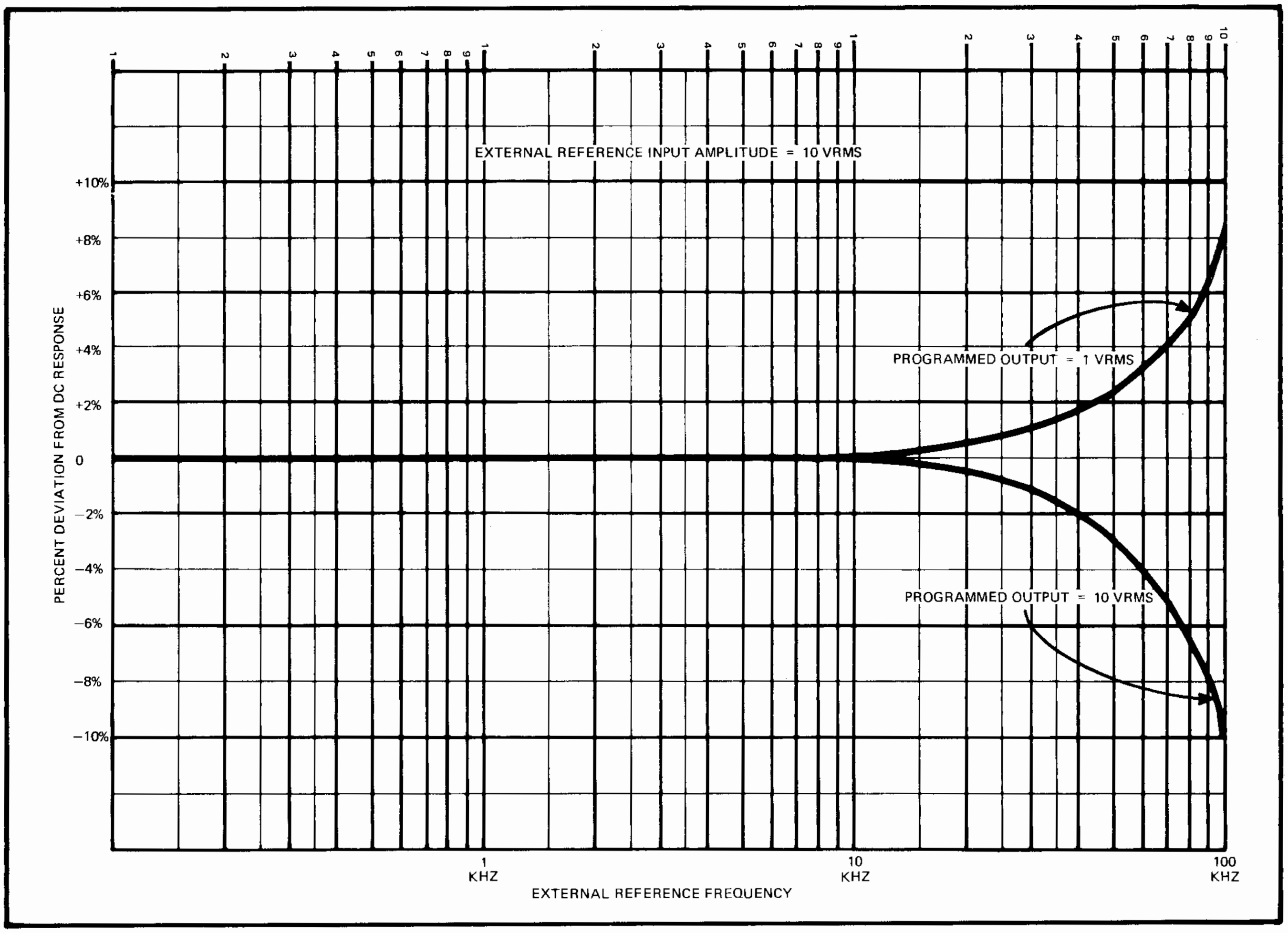


Figure 2-10. ACCURACY VERSUS EXTERNAL REFERENCE FREQUENCY

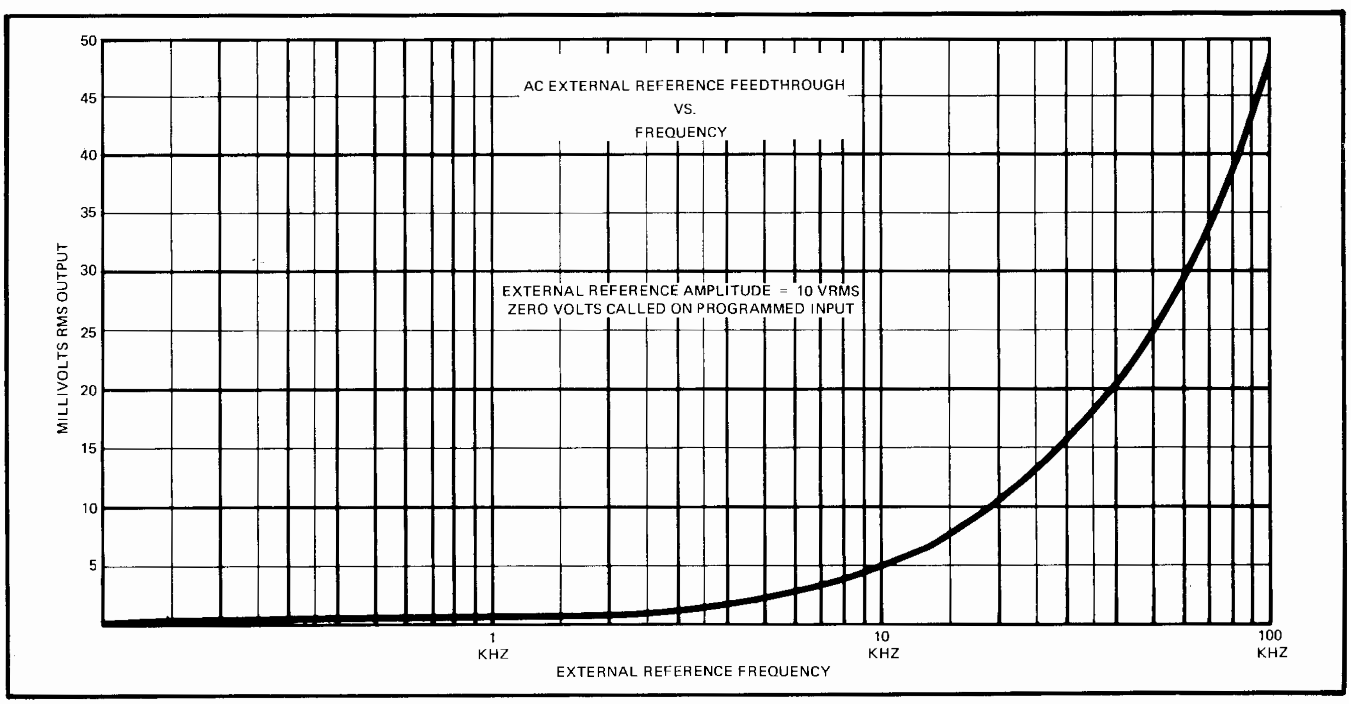


Figure 2-11. AC EXTERNAL REFERENCE FEEDTHROUGH (0V OUTPUT)

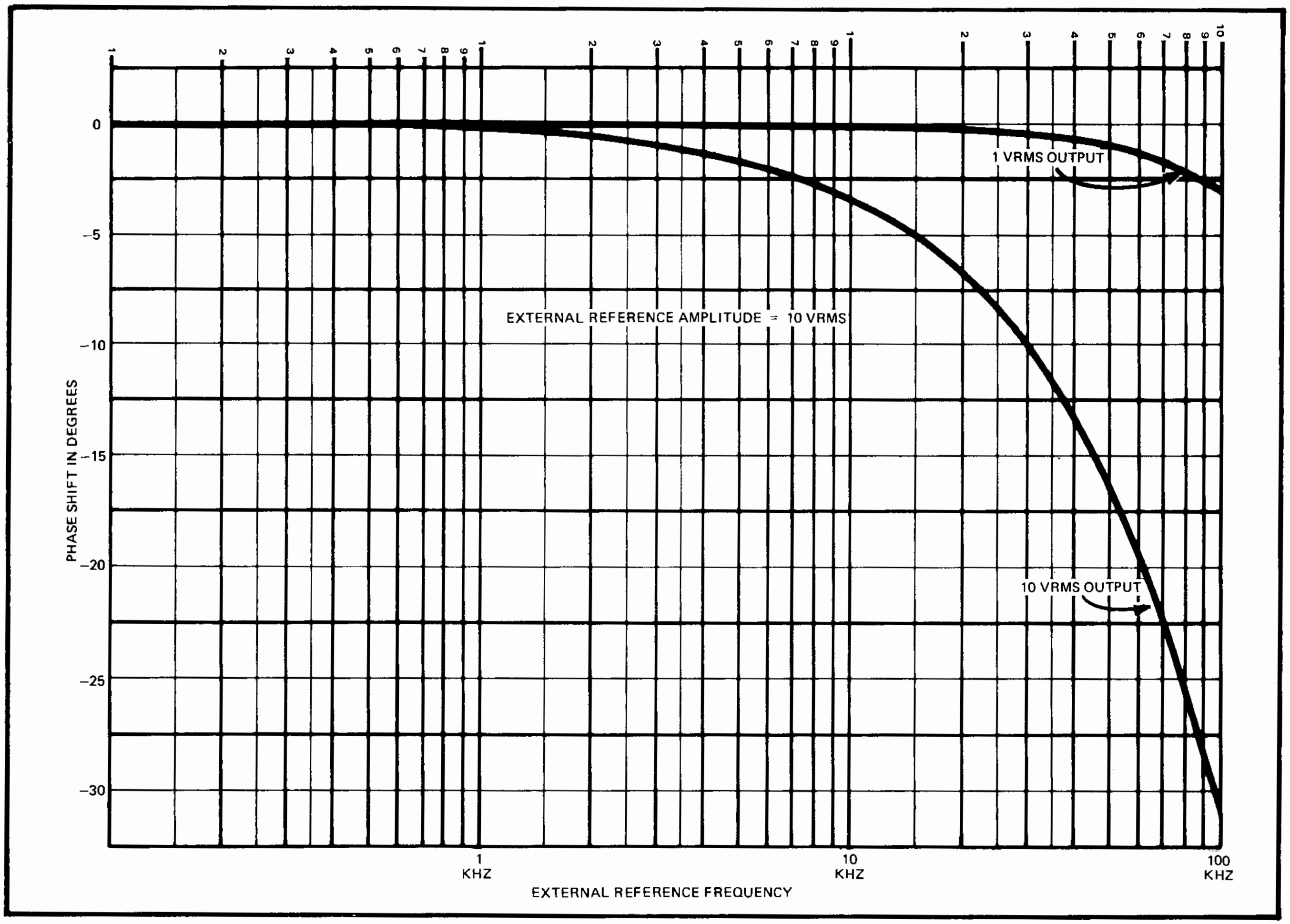


Figure 2-12. AC EXTERNAL REFERENCE PHASE SHIFT VERSUS FREQUENCY

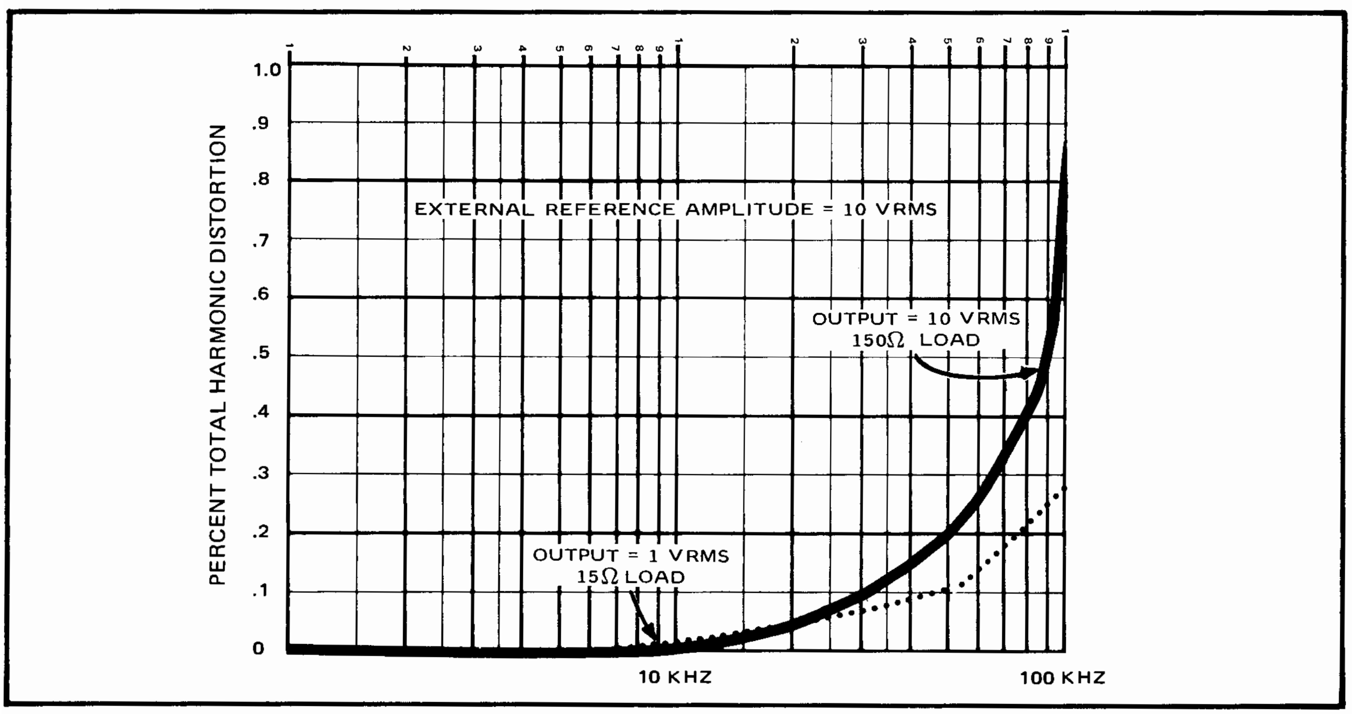


Figure 2-13. AC EXTERNAL REFERENCE HARMONIC DISTORTION VERSUS FREQUENCY

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 4210A. The information is arranged under headings of "FUNDAMENTAL CIRCUIT DESCRIPTION, BLOCK DIAGRAM ANALYSIS and CIRCUIT DESCRIPTIONS." An equivalent circuit is shown in Figure 3-1. Figure 3-2 is a simplified block diagram of the power source that includes all options.

3-3. FUNDAMENTAL CIRCUIT DESCRIPTION

3-4. The circuitry of the power source consists basically of a high-gain operational amplifier such as shown in Figure 3-1. Digital to analog conversion is accomplished by using a ladder network driven by a bi-polar reference voltage. The differential amplifier, by holding the summing junction at virtual ground, produces an output voltage (V_o) that is maintained by a current through R_f as determined by $\frac{V_{REF}}{R_o}$.

3-5. BLOCK DIAGRAM ANALYSIS

3-6. A simplified block diagram of the power source and options is shown in Figure 3-2. The basic function is to convert digital program words into a representative dc output voltage. One of two A6 Logic assemblies receives and processes the digital inputs. The Isolated Control Logic (–01 Option) provides both isolation and storage for digital inputs. The Direct Coupled Control Logic (–04 Option) provides only level shifting of digital inputs. The resulting output commands from the A6 Logic assembly then determines the polarity of V_{REF}, condition of the A through D ladder networks, and selection of reference voltage. The commands are also applied to the A7 Display assembly where, if the –02 Option is installed, visual indication of the command word is made available. The A through D ladder networks in the A3 DAC Amplifier and A5 BCD Ladder scale the selected V_{REF} to a level which

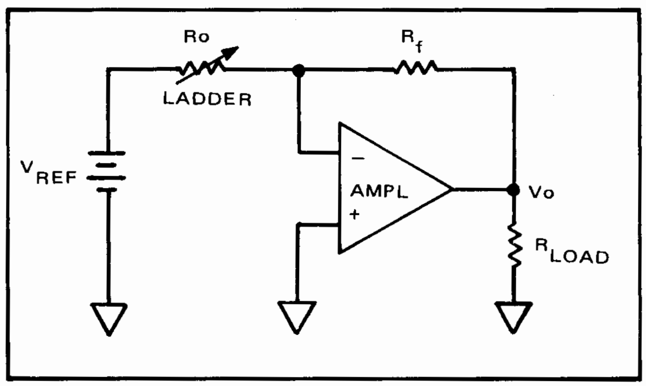


Figure 3-1. POWER SOURCE EQUIVALENT CIRCUIT

then causes the A3 DAC Amplifier to produce an output voltage proportional to the digital input program. The maximum output current capability is limited by the I Limit circuit in the output of the A3 DAC Amplifier to prevent damaging the power source.

3-7. If the A4 External Reference (–03 Option) is installed, an external reference voltage can be used in place of the internal V_{REF}. The magnitude of the external reference can be from 0 to ±14.5 Vdc or peak ac and have a frequency from dc to 100 kHz. The external reference is processed in the A4 External Reference assembly and applied to the V_{REF} bus in the power source where it is scaled by

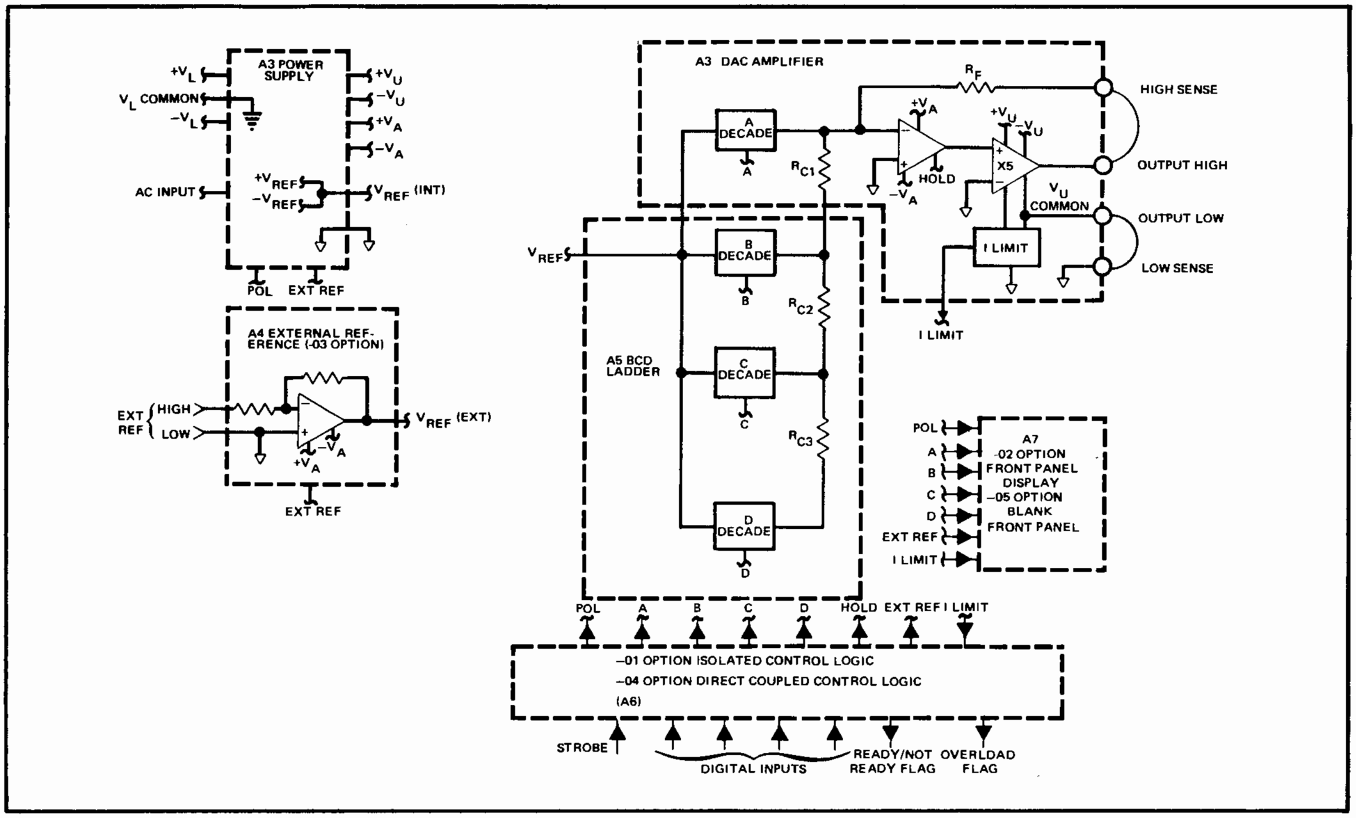


Figure 3-2. BLOCK DIAGRAM

the ladder network under control of the magnitude program word. The A3 DAC Amplifier then produces the appropriate output voltage; however, this output is now proportional to the combined effects of the external reference magnitude and the digital program word. The actual output is determined as follows:

$$E_{Out} = (E_{Ext\ Ref})\ (ABCD \times 10^{-4})$$

Where: $E_{Ext\ Ref}$ = External reference dc level or peak ac (V rms x 1.414) value.

ABCD = Decade digital coding (8-4-2-1)

3-8. CIRCUIT DESCRIPTIONS

3-9. The following paragraphs describe the circuitry in the power source. Each description, unless otherwise noted, is keyed to the appropriate schematic diagram located at the rear of the manual.

3-10. A2 Power Supply (4210A-1061)

3-11. All operating voltages, as well as the internal reference voltage upon which the power source accuracy and stability relies, are produced in the A2 Power Supply. The designation and magnitude of each voltage is given in Table 3-1.

Table 3-1. OPERATING VOLTAGE

DESIGNATION	VOLTAGE (VDC)
$+V_L$	+5V
$-V_L$	−5V
$\pm V_U$	±25V
$\pm V_A$	+23.4, −25.1V
V_{REF}	±10V

3-12. INPUT POWER. AC power from J1 is applied to T1 through the 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 230 Vac line. S1 provides a parallel connection for 115 Vac line operation and a series connection for 230 Vac line operation. The four secondary windings of T1 supply ac voltages to the associated power supplies.

3-13. $+V_L$ SUPPLY. The $+V_L$ Supply composed of CR19 and Q21 through Q24 produces a regulated +5 Vdc 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 Q21 and 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.

3-14. $-V_L$ SUPPLY. The $-V_L$ Supply composed of CR14 and Q16 through Q18 produces the regulated -5V 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 Q16 and Q17, producing a regulated -5 Vdc output.

3-15. $\pm V_A$ SUPPLY. The $\pm V_A$ Supply produces the regulated +23.4V and −25.1V operating voltages that are used to provide power for all analog circuitry except the power amplifier in the A3 DAC Amplifier board. 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.

3-16. The $+V_A$ regulator consists of Q12, Q13 and U4. Reference voltage for this regulator is derived from U2 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 U4, which controls the base drive to Q12, producing a regulated +23.4 Vdc output. Q13 together with R33 function to limit the maximum output current of this supply to 125 ma. Should the current through R33 exceed 125 ma, the voltage across R33 will turn on Q13 which limits the conduction and power dissipation of Q12.

3-17. 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 reference current through R41, and thus produces a regulated output of −25.1 volts.

3-18. $\pm V_U$ SUPPLY. The $\pm V_U$ Supply produces unregulated ±25 Vdc operating voltages for the power source. Diode CR10 is connected as a full-wave rectifier to produce the $\pm V_U$ voltages from the tapped secondary of T1. C11 and C12 filter the resulting outputs. R42 and R43 are bleeders for each power supply.

3-19. V_{REF} SUPPLY. The V_{REF} Supply produces an extremely stable ±10V reference upon which the 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.

3-20. The reference amplifier U2 contains matched zener and amplifier elements which produce a stable reference voltage with time and temperature. 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 $+V_{REF}$ output line through CR34, CR35 and FET gate Q25 (if Q25 is switched on). The FET gates of Q2 and Q3 provide separate output and sense connections when a positive V_{REF} is called. Should any variation occur on the $+V_{REF}$ 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 R17. U1, in turn, amplifies the change and alters the conduction of Q1 to maintain a constant +10V output for $+V_{REF}$. Variable resistor R9 allows adjustment of the sense line input to U2 and subsequently the $+V_{REF}$ output level.

3-21. The inverter amplifier composed of U3 and Q4 produces a −10V 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 adjusts this feedback level and subsequently the resultant $-V_{REF}$ output level. Resistors R6 and R21 compensate for TC factors associated with FET gates in the ladder section driven by V_{REF}.

3-22. GATE DRIVERS. The Gate Drivers of Q7 through Q11 control the conduction of the FET switches associated with the V_{REF} Supply. Whenever the power source has a positive output programmed, the command at pin 18 will be low (–5V), thus turning on Q8, Q11 and switching off FET gates Q2, Q3. With Q8 on, the E-B 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 will be high (OV), 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 will 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.

3-23. RELAY DRIVER. The Relay Driver composed of Q19 and Q20 is used to energize K1 whenever the power source is turned on. The contacts of K1 then complete the connections to the OUTPUT connector. Should the power source be shut off for any reason the connections are broken so that the load will not be subjected to any voltage not programmed.

3-24. A4 External Reference (4210A-1041)

3-25. The A4 External Reference is installed as the –03 Option. It receives and processes an external reference input having a frequency of dc to 100 kHz and a level from 0 to ±14.5 Vdc or peak ac. The circuitry consists of three differential amplifiers and an emitter follower which form an operational amplifier. FET gates controlled by drivers apply the amplifier output and sense line to the V_{REF} lines.

3-26. DIFFERENTIAL AMPLIFIER. The Differential Amplifier consists of three individual amplifiers; Q1 through Q8, and the emitter follower, Q13. The external reference input is applied through R1 and C9 to one 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 range compensation for R6. Further balancing of the output is done through selection of R_N or R_P in the collector circuit of Q1. A constant current source for Q1 is provided through Q2, while TC compensation is provided through 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 differential amplifier of 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 in the event Q9 and Q10 are switched off.

3-27. FET GATES. Q9 and Q10 control application of the external reference to the internal V_{REF} lines. 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 $\overline{\text{STANDBY}}$ commands at terminals 13 and M.

3-28. When an EXT REF command (OV) 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 $\overline{\text{STANDBY}}$ command (OV) exists at terminal M. Diodes CR3 and CR4 provide isolation between the input command lines.

3-29. Should a STANDBY or $\overline{\text{EXT REF}}$ command (–5V) exist, 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.

3-30. A5 BCD Ladder (4210A-1031)

3-31. 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.

3-32. 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 drivercircuits. Output impedance is sufficiently low from dc to 100 kHz to prevent loading by ladder switching currents.

3-33. LADDERS. The three lower decade ladders consist of R1 through R18. 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 3-3.

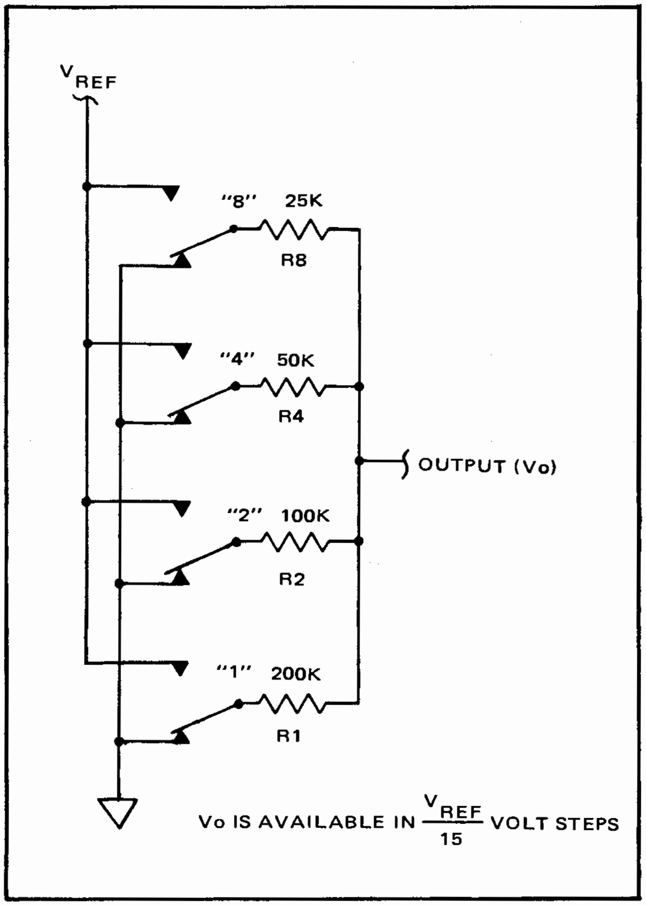


Figure 3-3. LADDER DECADE (SIMPLIFIED)

3-34. DRIVERS. 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 (OV), 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. Absence of a bit command will apply a low (−5V) to the base of QA which causes it to conduct. The resulting OV 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.

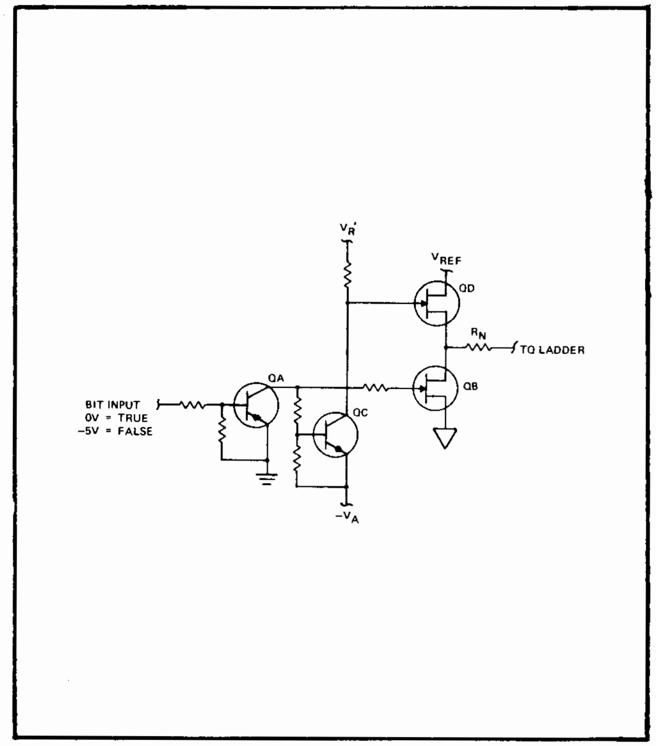


Figure 3-4. LADDER DRIVER (SIMPLIFIED)

3-35. A6 Isolated Control Logic (4210A-1021)

3-36. The A6 Isolated Control Logic is installed as the −01 Option. This 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. Timing relationship of all events is shown in Figure 3-6.

3-37. LOGIC DIAGRAM ANALYSIS. Serial to parallel conversion is done using the circuitry shown in Figure 3-5. Presetting of all counter circuits upon initial turn-on is provided using two separate Preset generators in the input and output sections. After presetting, the STROBE input is required to initiate any programming changes that will affect the output. The STROBE input triggers the Delay One-Shot U23 into operation which produces an 800 nsec gate. The positive Q output goes to the Ready One-Shot U8 and is also inverted by U7B. The Ready One-Shot, which triggers on the lagging edge of the Q output, produces a 30 μsec READY flag output through U6A and U7A. The output of U7B is differentiated and the positive going spike triggers the Start/Stop Flip-Flop U10 into operation. The low $\overline{Q}$ output of U23 is inverted by the Hold Driver U11B, Q20 and coupled across the GUARD where it triggers the Hold One-Shot U15 into operation. The resulting HOLD command lasts for 8 μsec and prevents any change in output voltage through a sample and hold circuit in the A3 DAC Amplifier.

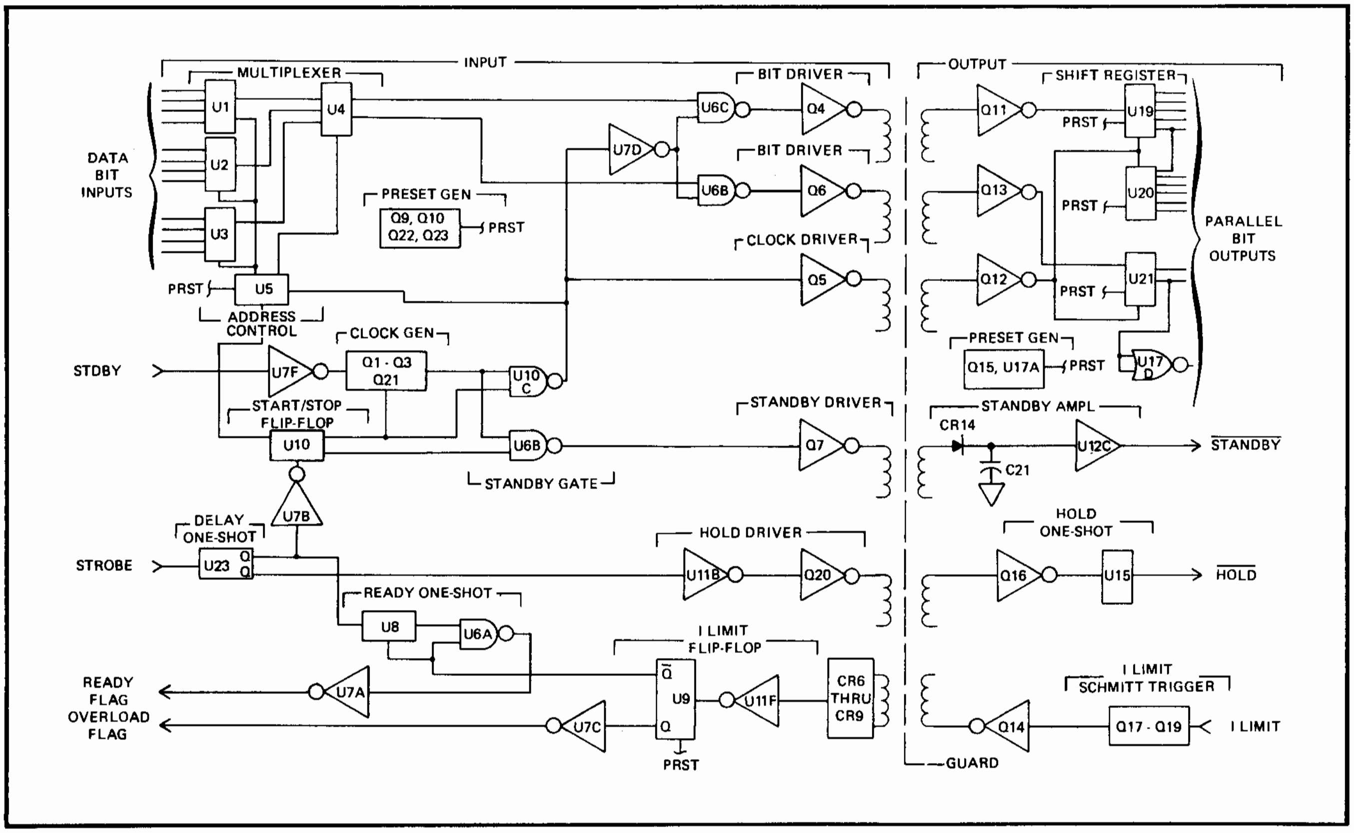


Figure 3-5. ISOLATED CONTROL LOGIC (SIMPLIFIED)

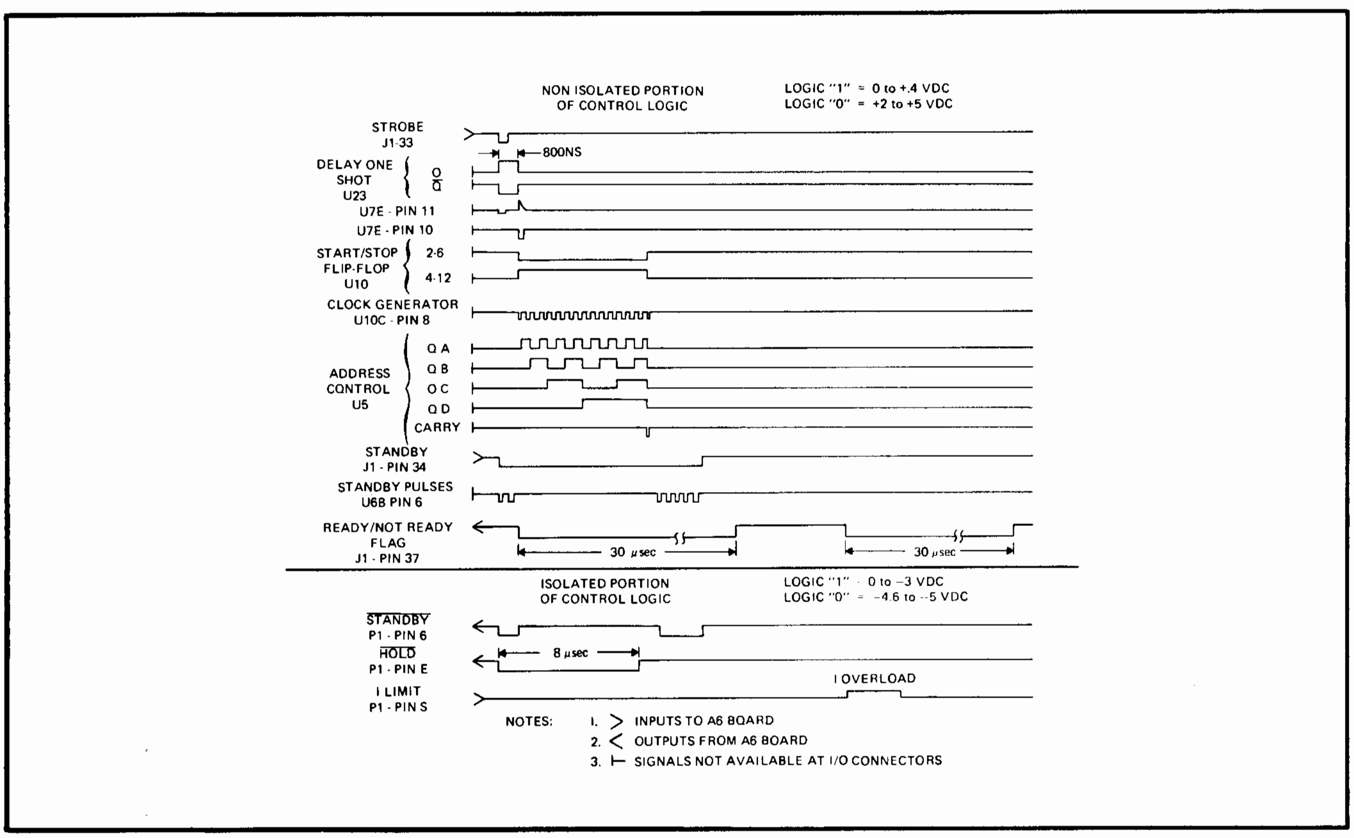


Figure 3-6. ISOLATED CONTROL LOGIC TIMING

3-38. The Start/Stop Flip-Flop U10 generates complementary pulses which last for 1.6 μsec. One of these pulses enable the Clock Generator and the NAND gate, U10C. The Clock Generator produces 16 pulses at a 10 MHz rate which are gated through U10C. This clock signal then initiates serial to parallel conversion. In the event a STANDBY command exists, the output of U7F will continuously enable the Clock Generator, and, when the Start/Stop Flip-Flop period of 1.6 μsec ends, the clock signal is gated through U6B. This signal is then amplified by Q7 and coupled across the GUARD where CR14 and C21 rectify the pulses. The resulting voltage is inverted by U12C to provide a $\overline{\text{STANDBY}}$ command until the next STROBE input.

3-39. The clock signal output of U10C advances the Address Control U5 which supplies sixteen 4 bit addresses to the Multiplexer composed of U1 through U4. The two serial bit outputs of U4 are gated through U6C and U6B in sequence with the clock signal and amplified by Bit Drivers, Q4 and Q6. This information and the clock are then coupled across the GUARD to the Shift Register of U19 through U21. The Shift Register performs the serial to parallel conversion necessary to produce the internal commands. At the end of the HOLD command described previously, these commands establish the programmed output of the power source.

3-40. Should a source or sink current limit condition occur, the resulting I LIMIT command will first be shaped by the Schmitt Trigger of Q17 through Q19 and then amplified by Q14. The resulting step output of Q14 is coupled across the GUARD where CR6 through CR9 rectify the differentiated portion of the squarewave and supply a positive spike at the leading and lagging edge of the I LIMIT command. These spikes are inverted by U11F and are used to trigger the I LIMIT Flip-Flop at the beginning and at the end of an overload. The positive going Q output of U9 is inverted by U7C and becomes the OVERLOAD flag output. The $\overline{\text{Q}}$ output of U9 forces the output of U6A high which produces a $\overline{\text{READY}}$ flag output through U7A that lasts for the duration of the I LIMIT command. This $\overline{\text{Q}}$ output of U9 also triggers the Ready One-Shot when it reverts to its high state, thus providing a $\overline{\text{READY}}$ flag for an additional 30 μsec. As a result, the $\overline{\text{READY}}$ flag lasts for the duration of the OVERLOAD flag plus 30 μsec.

3-41. CIRCUIT DESCRIPTION. Two Preset Generators are used in the Isolation Control Logic (–01 Option). 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 Q9, Q10, Q22, and Q23. When input power is applied, the $+V_L$ supply rises to its regulated level of +5 volts. The +5V allows sufficient current through R72 and R73 to drive Q23 into saturation. With Q23 saturated, R70 and R71 form a voltage divider which determines the current level of a constant current source formed by R69 and Q22. At this point C16 has not been charged, and Q9 and Q10 are turned off, leaving the preset line high. C16, driven by the constant current from the collector of Q22, then begins to charge at a linear rate. The voltage divider composed of R29 and R30 provides a ±4V reference to the gate of a Programmable Unijunction Transistor, Q9. When the charge on C16 reaches approximately +4.5V, the gate to anode of Q9 is forward biased causing it to turn on and latch. C16 now begins to rapidly discharge through Q9 and R31. The voltage developed across R31 is sufficient to turn on Q10, which causes the preset line to go low, thereby presetting all input programming circuitry. When the discharge of C16 is almost complete, the voltage drop across R31 can no longer supply base drive to Q10; it therefore turns off, allowing the preset line to return to its high state. Q9, however, receives enough current from the collector of Q22 to remain in the latched condition, but not enough to cause Q10 to conduct.

3-42. The second Preset Generator is used to preset the shift registers in the isolated portion of the logic circuitry. It is composed of Q15 and U17A 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 Q15 is not conducting, C22 is not charged, and the output of U17A is 0 to –1V. C22 now begins to charge at an exponential rate through R51. R50 and R52 form a voltage which provides a –1V reference to the gate of a Programmable Unijunction Transistor, Q15. When the charge on C22 reaches approximately –.5V, the gate to anode of Q15 is forward biased causing it to turn on and latch. C22 now begins to rapidly discharge through Q15 and R53. The voltage developed across R53 drives the input of U17A toward 0V, causing its output to drive close to –5V and clear shift registers U19, U20 and U21. As the discharge of C22 is almost complete, the voltage drop across R53 approaches zero volts allowing the input of U17A to return to a –5V level. The output of U17A then returns to 0V, completing the preset pulse. Q15, however, remains latched because of the small holding current supplied through R51.

3-43. Parallel input data present on pins 4 through 7 and 9 through 12 of U1, U2, and U3 may now be transferred serially to the isolated shift registers U19 through U21, where it will be stored and presented in parallel form. Data transfer is initiated by a data STROBE pulse applied at terminal 33 of J1. This STROBE triggers a Delay One-Shot U23 into operation. U23 triggers on the lagging edge of the data STROBE as shown in Figure 3-6 and generates a fixed time delay of 800 nsec, which is determined by the RC network composed of R74 and C49. The Q output, which goes high when U23 is triggered, is inverted by U7B and sent to a differentiator composed of C1, R1, and CR1. The negative transition is clamped to –.5V by CR1. The Q output of U23 also goes to the trigger input of the Ready One-Shot U8, which is not triggered until Q goes low. The $\overline{Q}$ output, which goes low when U23 is triggered, is inverted by U11B and turns on Q20 by supplying base current through R64 and C43. Q20 draws collector current through R66, R67 and the primary winding of T3 which then couples a voltage pulse across the GUARD to the secondary of T3. This voltage pulse is of the proper polarity to cause the emitter-base junction of Q16 to be forward biased through R55, thereby turning on Q16 and supplying the lagging edge trigger required to operate the Hold-One Shot, U15. The RC network composed of R43 and C20 allows U15 to generate an 8 μsec $\overline{\text{HOLD}}$ pulse at the Q output, which is applied to terminal E of P1. The Q output of U23, which went high for 800 nsec after receiving a data STROBE, now does low, triggering the Ready One-Shot, U8. This causes its $\overline{Q}$ output to go low for 30 μsec as determined by the RC network composed of R8 and C4. The Q output of U8 goes to an input of gate U6 where it is inverted. The output is supplied to U7 which again inverts the signal and applies it to terminal 37 of J1 as the READY/NOT READY flag. (Figure 3-6). The Q output of U23 also goes to U7B where it is inverted and sent to a differentiator composed of R1, C1, CR1. Since the output of U7B is a positive transition, the diode CR1 is reversed biased, allowing the signal to be differentiated across R1; thereby supplying a narrow spiked input to U7E where it is inverted and sent as a negative going pulse to trigger the Start/Stop Flip-Flop, U10. When the $\overline{Q}$ output of U23 goes high, it causes the output of U11B to go low, removing the base drive from Q20, turning it off. As the field collapses at the primary of T3, a voltage is coupled across the GUARD to its secondary and clamped to –5.5V by CR19. Q16 is not affected since the polarity of the voltage reverse biases its base-emitter junction.

3-44. The Start/Stop Flip-Flop, U10, is used to start an oscillator, which forms the Clock Generator, and gate clock pulses to the circuitry which will accomplish the parallel to serial to parallel conversion of input data. When the data conversion is complete, the Start/Stop Flip-Flop is reset, inhibiting the clock and stopping the oscillator. The Start/Stop Flip-Flop consists of two 3 input NAND gates which are cross coupled to form an RS FLIP-FLOP. A momentary low at pin 1 of U10 will cause the output at pins 4 and 12 to go high and the output at pins 2 and 6 to go low. They will remain in that state until a momentary low is applied to pin 5, which will reset the latch to its original state. The 10 MHz Clock Generator is a multivibrator composed of Q2 and Q3 and is controlled by Q1 and Q21. The output of the multivibrator is taken from the collector of Q3 and sent to an input of U10C and U6B where it is gated by the outputs of the Start/Stop Flip-Flop. Clock Pulses are formed at the output of U10C, or stand-by pulses at the output of U6B. The control transistors Q1 and Q21 are normally turned off allowing the emitter of Q2 to float, thus stopping the multivibrator and forcing the collector of Q3 low as a result of the base current supplied by R5. When the STANDBY input (J1 - Pin 34), is commanded (see Figure 3-6), the output of inverter U7F will go high and supply base current through R68 to Q21 causing it to saturate. With Q21 saturated, the emitter of Q2 is close to logic ground and the multivibrator will start. The output of the multivibrator is gated through U6B and sent to the Standby Driver. The input of U10C is inhibited by the Start/Stop Flip-Flop forcing its output high.

3-45. The Standby Driver composed of U11C and Q7 will cause the primary of T1 to be driven at the same frequency as the Clock Generator. This signal is coupled across the GUARD to the secondary of T1, where it is rectified by CR14 and stored by C21. This charge on C21 will cause the output of U12C to drive toward –5V, producing a STANDBY output at pin 6 of P1. If a data STROBE is now applied to terminal 33 of J1, the Start/Stop Flip-Flop will trigger causing the cathode of CR2 and the input of U10C to go high. The input of Gate U6B goes low, inhibiting the standby pulses which were going to the Standby Driver. When the anode of CR2 goes high, the current it was drawing through R13 is gated through CR3, R2, and the emitter base junction of Q1. Both Q1 and Q21 are now turned on, and the multivibrator output is gated through U10C to produce clock pulses. The data STROBE will therefore override the STANDBY command during the data transfer period.

3-46. The Address Control is accomplished by U5, a leading edge triggered, synchronous 4-bit binary counter. The outputs of this counter were preset to zero when line power was applied. The counter is advanced from 0 to 15 by clock pulses received from U10C. The negative transition of the 16th clock pulse will produce a low Carry output at U5, resetting the Start/Stop Flip-Flop, which, in turn, inhibits the inputs of U10C and turns Q1 off. When the input of U10C is inhibited, its output is forced high, causing the 16th clock pulse to make a position transition and return the counter, U5, to zero. The 4-bit binary outputs of U5 are used to supply 16 address codes to the address inputs of the Input Multiplexer.

3-47. Multiplexing of input data is accomplished by four dual, 4 input multiplexers, U1 through U4. Since only 16 address codes are available and 18 data inputs must be scanned, it is necessary to use 2 parallel lines to transfer serial data. The first output of U4 (pin 15) will present serially the 16-bits of parallel magnitude data present at J1 (terminals 1 through 16). The second output of U4 (pin 1), will present POLARITY data with an address code of 14, and EXT REF data with an address code of 15. Table 3-2 shows the address codes required for input multiplexing by U1 through U4. Data available at the non-inverting outputs of U4 is in the inverted form since the inverted outputs of U1 through U3 supply the input of U4.

Table 3-2. TRUTH TABLE

ADDRESS INPUTS		DATA INPUTS				OUTPUTS	
S_0	S_1	1_0	1_1	1_2	1_3	$1_{and_{15}}$	$2_{and_{14}}$
L	L	L	X	X	X	L	H
L	L	H	X	X	X	H	L
H	L	X	L	X	X	L	H
H	L	X	H	X	X	H	L
L	H	X	X	L	X	L	H
L	H	X	X	H	X	H	L
H	H	X	X	X	L	L	H
H	H	X	X	X	H	H	L

3-48. Two lines of serial data and the clock must now be transferred across the GUARD to the inputs of the isolated Shift Registers. Because the operation of the Bit Drivers and the Clock Driver are the same, only the Clock Driver will be described. The Clock Driver is composed of Q5, Q12, U11A, U12A and T2. When the Clock Driver is not operating, the output of U10C is high, holding the output of U11A low. Q5 and Q12 are not conducting and the output of U12A is low (−5V). When a clock pulse is generated, the output of U11A goes high and supplies enough base current through R14 and C56 to drive Q5 into saturation. The collector current drawn through the primary of T2, R15 and R16 causes a voltage to be coupled across the GUARD to the secondary of T2. This voltage is of the proper polarity to forward bias the emitter base junction of Q12 through R37. With Q12 turned on, the input of U12A is pulled low causing its output to go high. When the first clock is completed, the input to U11A returns high, driving its output low. Base current is no longer supplied to Q6 causing collector current through the primary of T2 to cease. As the field collapses at the primary of T2, a voltage is coupled across the GUARD to its secondary. The polarity of this voltage is such that the emitter base junction of Q12 is reverse biased allowing the inputs of U12 to go high and its output to go low. (Note that capacitor C42 in the Clock Driver circuit is replaced with clamping diodes CR10 and CR12 in the Bit Driver circuits). C42 creates a small time delay in the clock pulse. This allows the data from the Bit Drivers to set up the data inputs of the Shift Registers before the positive transition of the clock pulse arrives.

3-49. Data transferred across the GUARD is derived from the clock pulse. An inverted clock from U7D is gated through U6B and U6C by the data outputs of U4. When the data outputs of U4 are high a clock pulse is sent to the Bit Drivers, coupled across the GUARD, and sent to the data inputs of the Shift Registers. When the data outputs of U4 are low the inputs of U6B and U6C are inhibited, preventing the clock pulse from reaching the input of the Bit Drivers. This will cause a low input to be present at the data inputs of the Shift Registers. Data is transferred across the GUARD when the clock at the output of U10C goes low, and the address to the Multiplexer is advanced when this clock goes high.

3-50. The isolated Shift Registers which restores the serial data to its parallel form are U19, U20 and U21. The 16 bits of serial magnitude data are sent to the data inputs SA and SB of U19. The POLARITY and EXT REF data is sent to the data inputs SA and SB of U21. Data present at these inputs is shifted in when the clock input goes high. The parallel data from these registers is routed to P1.

3-51. When a current limit occurs in the power supply, it is detected by a Schmitt Trigger and coupled across the GUARD where it is stored in a Flip Flop which produces an OVERLOAD flag at terminal 49 of J1. The Schmitt Trigger composed of Q17 through Q19 is used to create the sharp leading-and-lagging edges required for T4 to transfer a pulse reliably across the GUARD. Under normal operating conditions Q17 is turned off and Q18, Q19 are conducting. The voltage divider formed by R59, R60, and R61 supply +2.5 volts to the base of Q18. Q18 will draw sufficient collector current to cause Q19 to saturate and to maintain its own emitter at a −3.1 volt level. When a current overload occurs, terminal 5 of P1 will be driven to near 0V, forward biasing Q17. As Q17 begins to conduct its collector goes negative while its emitter is driven more positive. This action causes the emitter base junction of Q18 to be rapidly reverse biased, thus turning both Q18 and Q19 off. When the overload is removed, terminal 5 on P1 will be driven to nearly −5V, and the Schmitt Trigger will return to its original state. Q14, the drive transistor for the primary of T4, receives its base drive from the collector of Q19 through R48 and R49 and is normally biased on. In the event of an overload, base drive is rapidly removed from Q14 allowing the field around the primary of T4 to collapse. This causes a voltage to be coupled across the GUARD to the secondary of T4. The voltage is passed through a full wave bridge, CR6 through CR9, and emerges as a positive voltage drop across R27. The voltage is then differentiated by C8 and R26 and sent as a positive spike to the input of inverter U11F. The output of U11F supplies the negative going pulse required to trigger the J-K Flip Flop, U9. The Q output of U9 goes high and is sent to the inverter U7C which supplies an OVERLOAD flag to terminal 49 of J1. The $\overline{Q}$ output of U9 goes low, forcing the output of NAND gate U6 high. The output of U7 goes low producing a $\overline{\text{READY}}$ flag at terminal 37 of J1. As long as the overload is present, the OVERLOAD flag and the $\overline{\text{READY}}$ flag will be maintained. When the overload is removed Q14 will be turned on, causing a pulse to again be coupled across the GUARD, rectified, differentiated, and sent as a trigger to the I LIMIT Flip Flop, U9. The Q output of U9 returns low, removing the OVERLOAD flag. The $\overline{Q}$ output of U9 returns high, causing the 30 μs Ready One-Shot to be triggered and its low output to be gated through U6, maintaining a high input to U7. The output of U7 continues to supply a $\overline{\text{READY}}$ flag for 30 μsec after the overload is removed.

3-52. A6 Direct Coupled Control Logic (4210A-1022)

3-53. The A6 Direct Coupled Control Logic is installed as the −04 Option. It provides only level shifting of all input and output data at the programming connector. The circuitry consists of 26 identical level shifters, a ready one-shot and two driver amplifiers.

3-54. LEVEL SHIFTERS. The Level Shifters receive and process all digital inputs. A Logic "1" input (0 ±0.4V or logic ground) turns off the driver QA which produces an internal 0V command at its collector. When a Logic "0" input (+2 to +5V or open circuit) exists, QA is switched on and produces an internal −5V command. The zener CRA allows a Logic "1" input to turn QA off, thus providing compatibility with DTL or TTL logic inputs.

3-55. READY ONE-SHOT. The Ready One-Shot composed of U3 produces the READY/NOT READY flag output available at terminal 37 of J1. This circuit is activated by the STROBE input or an I LIMIT condition. Timing information is shown in Figure 3-7.

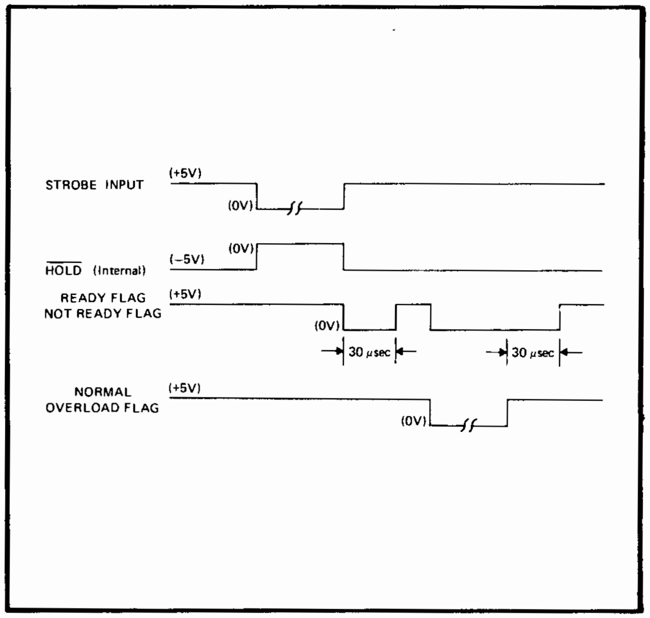


Figure 3-7. DIRECT COUPLED LOGIC TIMING

3-56. The STROBE input at terminal 35 is shown in Figure 3-7. The negative going portion of this input is inverted by U2 and turns on LS18, which generates a HOLD command equal to the duration of the STROBE input. The HOLD command is applied to the A3 DAC Amplifier to prevent any programming changes from affecting the power source output.

3-57. At the end of the STROBE input, the positive to negative transition at the output of U2 triggers U3 into operation. The resulting 30 μsec signal is gated through U1 and becomes the $\overline{\text{READY}}$ flag at terminal 37. Should a current limit condition occur, an I LIMIT command will be present at terminal 5 of P1. This command will turn on Q1 and generate the OVERLOAD flag available at terminal 49 of J1. U1 serves a buffer for the flag output. The output of U2 also triggers the Ready One-Shot into operation which produces a $\overline{\text{READY}}$ flag for the duration of the OVERLOAD flag, plus an additional 30 μsec.

3-58. A3 DAC Amplifier (4210A-1051)

3-59. The A3 DAC Amplifier produces a buffered output voltage proportional to the output of the digital to analog converter. Circuitry consists of the "A" decade ladder and associated ladder drivers, an inverting amplifier, a X5 amplifier, a power amplifier, and an overload detector.

3-60. "A" DECADE LADDER. The "A" Decade Ladder is formed essentially of R8, R16, R24 and R32. Their combined values weight the division of V_{REF} in fifteenths for control by 8-4-2-1 coded digital inputs. Variable resistors located in the 4-2-1 segments allow precise scaling to the 8 segment. The resulting scaled V_{REF} is combined with the A5 BCD Ladder output through R1 and applied to one input of Q18. Feedback from the power source output through R33 drives this point to virtual analog common, thus forming a zero voltage summing junction. Diodes CR13 through CR16 limit the maximum summing junction voltage during programming changes.

3-61. LADDER DRIVERS. The Ladder Drivers of Q1 through Q16 apply V_{REF} or analog common to the ladder resistors under control of the A1 through A8 digital commands. Each Ladder Driver functions in the same manner with the only difference being the use of two parallel FET gates in the A8 driver. For this reason, only the operation of the A8 driver is discussed.

3-62. The A8 Ladder Driver switches the input to the ladder resistor R8 through the FET gates Q1, Q2, and Q3. V_{REF} is switched by Q1, Q2, and V_{REF} common is switched by Q3. When an A8 bit command (0V) exists at terminal 18, both Q4 and Q5 will be switched off which applies $-V_A$ to the gate of Q3 and V_R' to the gates of Q1 and Q2. This condition switches Q3 off and Q1, Q2 on, thus applying V_{REF} to R8. Absence of the A8 command will apply a –5V signal to terminal 18 which will switch both Q4 and Q5 on, and produce a 0V collector signal at Q4 and a $-V_A$ collector signal at Q5. This condition switches Q3 on and switches Q1, Q2 off, thus applying analog common to R8.

3-63. INVERTER AMPLIFIER. The Inverter Amplifier consists of three differential amplifiers designated Q18, Q24, and Q25. This circuitry amplifies the summing junction signal in respect to analog common and provides a drive signal to the X5 amplifier. It also contains a hold circuit which prevents the output from changing during the presence of a HOLD command.

3-64. The summing junction input is first amplified by the J FET Q18. A constant current source is provided through Q19. Temperature compensation is provided by Q20. Variable resistor R40 provides an adjustment to compensate for the input offset voltage of the amplifier. Jumper selection of R37 through R42 provides range compensation for R40. Further balancing of the output is done through selection of R_N or R_P in the collector circuit of Q18. Diodes CR9 through CR12 limit the maximum voltage swing during programming changes. The differential output of Q18 is applied to the inputs of Q24 through MOSFET gates Q21 and Q22. These gates are controlled by the driver Q23 and are switched on except when a HOLD command (–5V) is present at terminal P. Normally a $\overline{\text{HOLD}}$ command (0V) exists at terminal P holding Q23 on, which applies $-V_L$ to Q21 and Q22, thus turning them on. However, when a program change is called using a STROBE input, the presence of a HOLD command (–5V) turns Q21, Q22 and Q23 off. Capacitors C6, C7, and C8, which are connected to the inputs of Q24, hold a sample of the last input level and force the output voltage to remain constant for the duration of the HOLD command. This is only true, however, for an 8 μsec HOLD period. Longer periods will cause the output to drift beyond the specified accuracy limits. The resulting output of the differential darlington composed of Q24 and Q25 drives the X5 Amplifier. Q26 functions as a high impedance constant current source for Q25B.

3-65. X5 AMPLIFIER. The X5 Amplifier consists of Q27 through Q29. It amplifies the output of the Inverter Amplifier and produces the drive signal for the Power Amplifier. Q29 is a unity gain emitter follower. Q27 and Q28 form a X5 voltage amplifier.

3-66. POWER AMPLIFIER. The Power Amplifier composed of Q30 through Q38 produces the power source output. It also provides both sourcing and sinking current limit protection. J FET's Q35 through Q37 function as constant current sources. The current through CR3 and CR4 provides the bias voltage required for Q32 and Q33 to operate as a Class AB amplifier. Q30 and Q31 provide current limiting for sink and source conditions. Q34 and Q38 detect current overloads.

3-67. The output amplifiers of Q32 and Q33 form a complementary, emitter follower stage. Q32 is used for positive output currents and Q33 for negative. Base drive for Q31 and Q32 is supplied by the X5 amplifier through diodes CR1 through CR4. Maximum output current (sourcing) is limited to 100 ma by Q30 and Q31. Normally, these transistors are cut-off; however, should the output current through R77 or R78 exceed 100 ma, the resulting voltage between the base and emitter of Q30 or Q31 will turn it on. Its conduction through CR5 or CR7 then shunts any additional base drive current to the Power Amplifier, thus limiting the output current. Should the power source begin drawing (sinking) power from the load, the maximum current will also be limited by Q30 or Q31. However, since this current is now flowing in a direction opposite to the load current, its path is through the opposite output transistor. Polarity sensing through CR6 and CR8 ensures proper turn-on of Q30 or Q31 during a sink condition. These diodes connect the base of Q30 or Q31 through R76 or R81 to the common side of the load. The resulting value of R76 or R81 in conjunction with R75 or R79 then causes Q30 or Q31 to turn on in a sink condition equal to the maximum sourcing output minus four times the output voltage or: MAX. $I_{Sink(ma)} = 100 - 4E_{Out}$.

3-68. OVERLOAD DETECTOR. The Overload Detector produces an I LIMIT command at terminals N and 12 whenever a source or sink limit condition occurs. The circuitry consists of driver Q39 and the detectors Q34, Q38 in the Power Amplifier.

3-69. Under normal conditions Q34 is not conducting and no current is flowing through the divider composed of R74 and R69. Q38 is cut-off during this time, which switches Q39 on and produces a –5V $\overline{\text{I LIMIT}}$ command at terminals N and 12. Should a source or sink condition turn on Q30, the resulting current through R72 and R73 switches on Q34 and increases the current through R69 and R74. If Q31 is turned on, current through R69 is increased in the same manner through R80. Q38 is switched on during this time and turns off Q39, which then produces an I LIMIT command (0V) at terminals N and 12.

3-70. A1 Mother Board and A7 BCD Display (4210A-1011, 4210A-1013)

3-71. The A1 Mother Board serves to interconnect the A2 through A7 assemblies. No component circuitry other than connectors and amp pins are contained on this assembly. The A7 BCD Display is available in two forms, depending on whether the –02 or –05 Option is ordered. The –02 Option 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 U4 and turn on the associated LED of CR1 through CR20. Power on is indicated through direct application of $-V_L$ to CR21. A blank front panel is provided when the –05 Option is installed. This Option contains only CR21 which indicates a power on state.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains servicing information for the Model 4210A. Table 4-1 lists the required test equipment. If the recommended equipment is not available, substitute equipment with equivalent specifications can be used.

4-3. SERVICE 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 service is available at various world-wide locations. A complete list of Factory Authorized Service Centers is located at the rear 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 power source should be cleaned periodically to remove dust, grease, or other contaminates. The exterior can be cleaned with a cloth moistened with anhydrous ethyl alcohol or Freon T.F. Degreaser (MS 180 Miller Stephensen Chemical Co., Inc.) If either of these cleaning agents are not readily available, soap and water applied sparing to a cloth can be used. Cleaning of the interior sections is done using clean, dry air at low pressure.

4-9. Fuse Replacement

4-10. The input power fuse is located on the rear section of the power source. If replacement is necessary, use the following related fuse:

115 VAC LINE	230 VAC LINE
1/4A, AGC	1/8A, AGC

4-11. MAINTENANCE ACCESS

4-12. Access to the interior sections of the power source is done in the following manner:

a. Disconnect the power cord from line power.

b. Remove the top dust cover. Access is now provided to all calibration adjustments which are labeled on the inner guard cover.

c. Remove the inner guard cover. Access is now provided for removal of the A3 through A4 pcb assemblies shown in Figure 4-1.

d. Removal of the A3 through A5 assembly is done using a gentle rocking motion and even pulling force.

NOTE!

The A2 through A6 assemblies can be mounted on an Accessory Extender Card for servicing. Information regarding this Accessory is given in Section 6.

e. Removal of the A2 or A6 assembly is done from the rear panel. First, remove the four mounting screws at the rear panel and then pull the assembly out through the rear panel.

f. Access to the A1 and A7 assemblies is possible after removing the front panel. First, remove the bottom dust cover and then peel the decals from the front side panels. Next, remove the mounting screws from the front corners and pull the front panel free of the power source. Separation of the A1 and A7 assemblies from the front panel is done by removing the large mounting screws located on the A1 Mother Board. The A1 and A7 assemblies can be separated by removing the small mounting screws on the A1 Mother Board and then pulling the assemblies apart.

4-13. CALIBRATION PROCEDURES

4-14. The power source should be calibrated every 90 days or whenever repairs have been made. Recommended test equipment is listed in Table 4-1. If the recommended equipment is not available, substitute equipment having equivalent specifications can be used. Assembly and adjustment locations are shown in Figure 4-1.

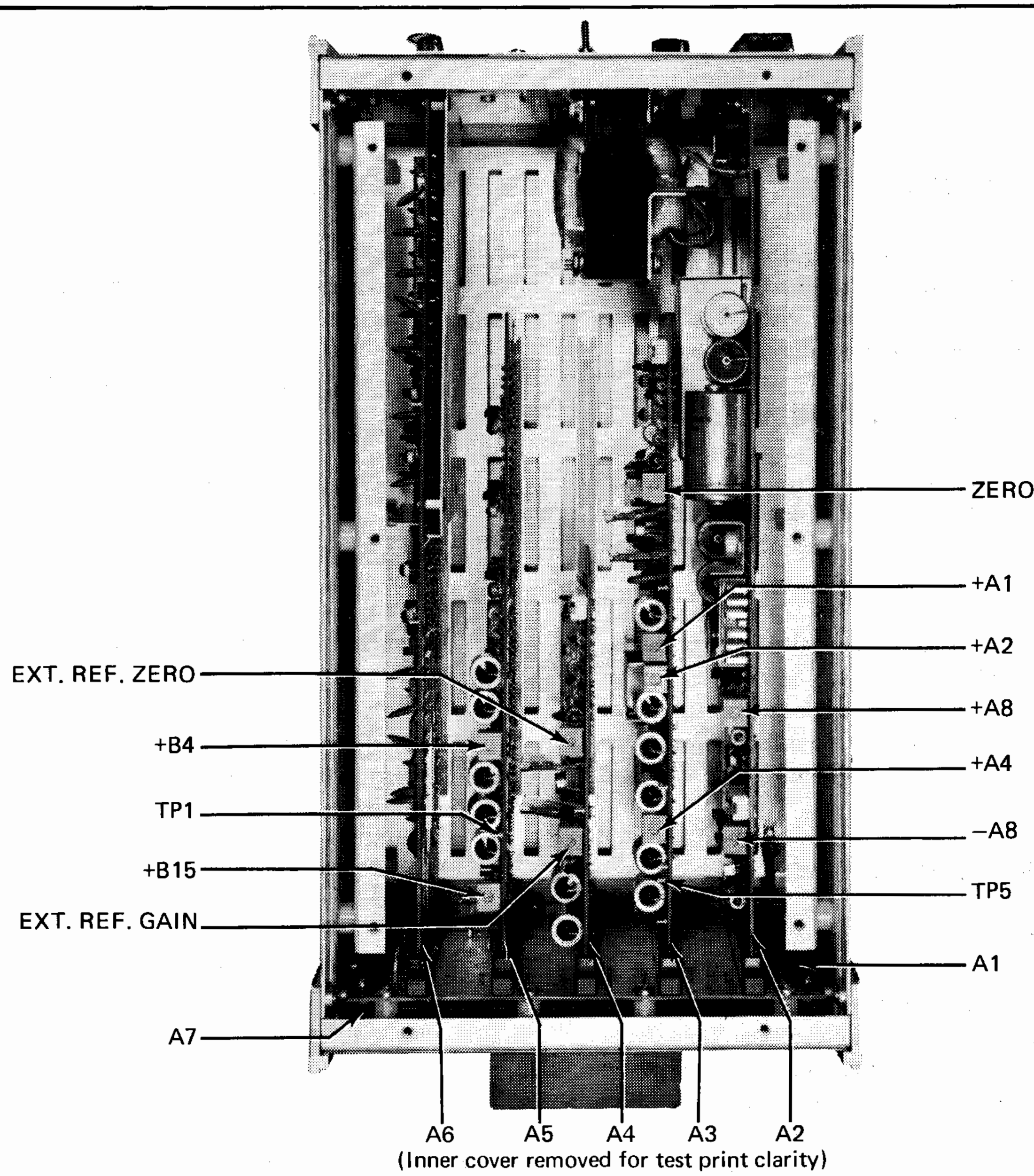


Figure 4-1. ASSEMBLY, ADJUSTMENT, AND TEST POINT LOCATIONS

Table 4-1. RECOMMENDED TEST EQUIPMENT

EQUIPMENT NOMENCLATURE	RECOMMENDED EQUIPMENT
AC/DC Voltmeter	FLUKE Model 8400A–01
AC Source	FLUKE Model 510A
Manual Control Unit (MCU)	FLUKE Model A4200

4-15. Initial Procedures

a. Turn off the power source and then remove the top dust cover screws. Leave the cover in place.

b. Interconnect the Manual Control Unit (MCU) with the power source.

c. Connect a DVM to the OUTPUT terminals on the rear panel of the power source, observing proper polarity.

d. Turn on the power source and select a positive, 0v output on the MCU.

e. Allow the power source to operate for half an hour and then remove the top dust cover.

4-16. "0.4" Bit Adjustments

a. Connect a jumper between A3TP5 and A5TP1. These test points are accessible through the slots in the inner cover.

CAUTION!

The jumper used in step (a) must be fully insulated to avoid contact with the inner GUARD cover.

b. Call a +0v output and adjust A3, ZERO for a 0 vdc ±10 uv output.

c. Call a +0.8v output and record the output voltage. Divide the recorded value by two (2).

d. Call a +0.4v output and adjust A5, +B4 for an output voltage that is within ±100 uv of the divided value recorded in step c. For example, if the recorded voltage was $\frac{0.80040}{2}$, then +B4 is adjusted for a 0.40020 vdc output.

e. Call a +0v output and disconnect the jumper between TP1 and TP5.

4-17. Reference Adjustment

a. Call a +0v output and adjust A3, ZERO for a 0 vdc ±10 uv output.

b. Call a –8v output and adjust A2, –A8 for a –8 vdc ±100 uv output.

c. Call a +8v output and adjust A2, +A8 for a +8 vdc ±100 uv output.

4-18. Bit Adjustments

a. Call a +4v output and adjust A3, +A4 for a +4 vdc ±100 uv output.

b. Call a +2v output and adjust A3, +A2 for a +2 vdc ±100 uv output.

c. Call a +1v output and adjust A3, +A1 for a +1 vdc ±10 uv output.

d. Call a +1.1v output in the second decade (B8, B2, B1) and adjust A5, +B15 for a +1.1 vdc ±10 uv output.

e. Call a +0v output.

4-19. External Reference Adjustments (–03 Option)

4-20. If the A4 Assembly is installed, perform following adjustments:

a. Connect a jumper between the EXT REF input terminals on the rear panel.

b. Call EXT REF and a +15v output.

c. Adjust A4, EXT REF ZERO for a 0 vdc ±10 uv output.

d. Disconnect the jumper from the EXT REF input terminals.

e. Apply a 10 vac signal having a frequency of 100 Hz to the EXT REF input terminals. Record the signal level with the DVM used at the OUTPUT terminals.

f. Call EXT REF and a +10v output.

g. Adjust A4, EXT REF GAIN for e_i vac ±1 mv output (e_i = voltage at EXT REF input terminals).

h. Call a +0v output.

4-21. Output Checks

a. Perform the Linearity Checks in Table 4-2, observing that the specified outputs are obtained.

Table 4-2. 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	+111 mv ±120 uv
+	0	2	2	2	+222 mv ±120 uv
+	0	3	3	3	+333 mv ±130 uv
+	0	4	4	4	+444 mv ±140 uv
+	0	5	5	5	+555 mv ±150 uv
+	0	6	6	6	+666 mv ±160 uv
+	0	7	7	7	+777 mv ±180 uv
+	0	8	8	8	+888 mv ±190 uv
+	0	9	9	9	+999 mv ±200 uv
+	0	10	10	10	+1.111v ±200 uv
+	1	0	0	0	+1v ±0.2 mv
+	2	0	0	0	+2v ±0.3 mv
+	3	0	0	0	+3v ±0.4 mv
+	4	0	0	0	+4v ±0.5 mv
+	5	0	0	0	+5v ±0.6 mv
+	6	0	0	0	+6v ±0.7 mv
+	7	0	0	0	+7v ±0.7 mv
+	8	0	0	0	+8v ±0.8 mv
+	9	0	0	0	+9v ±0.9 mv
+	10	0	0	0	+10 ±1 mv
+	15	15	15	15	+16.665v ±1 mv
–	15	15	15	15	–16.665v ±1 mv

b. If the A4 External Reference (–03 Option) is installed, call a +0v output and then connect a jumper between the EXT REF input terminals.

c. Call EXT REF and a +10v output. The output voltage should be 0 vdc ±0.1 mv.

d. Remove the jumper from the EXT REF input terminals.

e. Apply the EXT REF input signals in Table 4-3, observing that the specified ac output voltage is obtained. Ensure that the called output is EXT REF and +10v during each check.

f. Turn off the power source and disconnect the test equipment.

g. Install the top dust cover. Calibration is complete.

Table 4-3. EXT REF CHECKS

EXT. REF INPUT VAC	FREQ	POWER SOURCE OUTPUT (VAC)
10	100 Hz	EXT REF Input ±0.015v
10	10 kHz	EXT REF Input ±0.05v
10	100 kHz	EXT REF Input ±3v

NOTE: Verify each EXT REF signal level with the DVM used to check the OUTPUT.

Section 5

List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown list of the instrument and a Cross Reference List of FLUKE stock numbers to original MANUFACTURERS' part numbers. It also lists recommended spare parts and contains part ordering information. The starting page number of each major listing is given in the Table of Contents.

5-3. The parts list shows the location of all assemblies and the replaceable components. Major assemblies are identified by a designation beginning with the letter A followed by a number (e.g., A1 etc). Subassemblies are identified in the same manner; however, the parent assembly designator precedes this designator (e.g., A1A1 etc.). Electrical components are identified by their schematic diagram designator and listed hardware parts are identified by the FLUKE stock number. All listed components are described, and the FLUKE stock number is given. The original MANUFACTURER'S part number for each listed item is given in the Cross Reference List at the rear of this section.

5-4. PARTS LIST COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, refer to Appendix B located at the rear of the manual.

c. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives. In the case where a flag note is used, special ordering is required. Flag note explanations are located as close as possible to the flag note.

d. The TOT QTY column lists the total quantity of the item used in each particular assembly. This quantity reflects only the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF.

e. Entries in the REC QTY column indicate the recommended 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 of 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.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Effectivity List, paragraph 5-9. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part.

5-5. MANUFACTURERS' CROSS REFERENCE LIST COLUMN DESCRIPTIONS

a. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the FLUKE STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

b. The Federal Supply Code for the item manufacturer is listed in the MFG column. An abbreviated list of Federal Supply Codes is included in Appendix A.

c. The part number which uniquely identifies the item to the original manufacturer is listed in the MFG PART NO. column. If a component must be ordered by description, the type number is listed.

5-6. HOW TO OBTAIN PARTS

5-7. Standard components have been used whenever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered 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.

5-8. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co., Inc. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 215897, Transistor, 2N4126 A2A1Q1 & Q2 for 645A, S/N 123.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument is helpful.

5-9. SERIAL NUMBER EFFECTIVITY

5-10. 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 for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

USE CODE	SERIAL NUMBER EFFECTIVITY
A	Model 4210A serial number 123 thru 127.
B	Model 4210A serial number 128 and on.

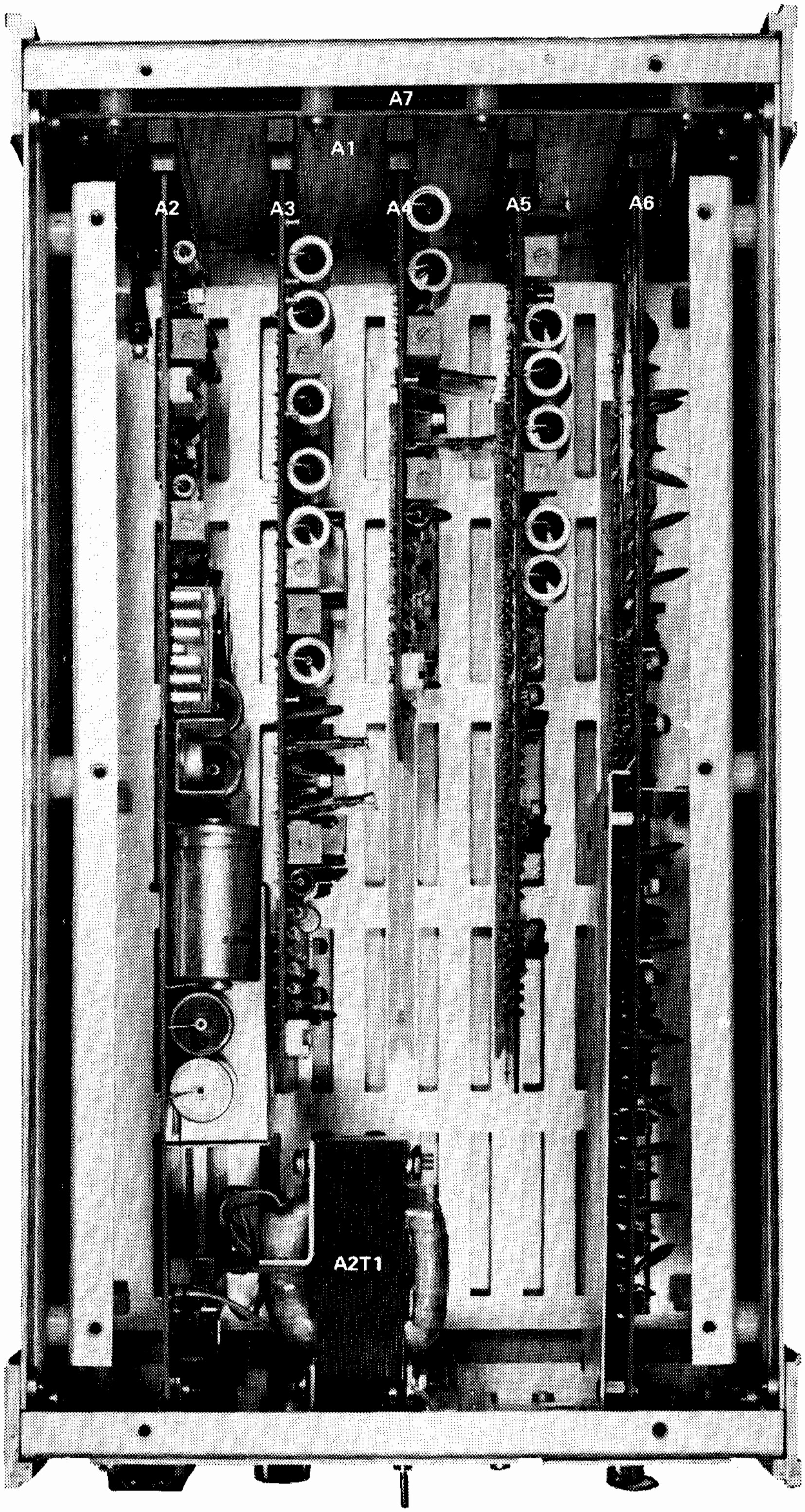


Figure 5-1. MODEL 4210A BCD PROGRAMMABLE VOLTAGE SOURCE

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	BCD PROGRAMMABLE VOLTAGE SOURCE - Figure 5-1	4210A			
A1	Mother PCB Assembly (See Figure 5-2)	292607	1		
A2	Power Supply PCB Assembly (See Figure 5-3)	292599	1		
A3	DAC Amplifier PCB Assembly (See Figure 5-4)	292573	1		
A4	External Reference PCB Assembly (–03 External Reference Option) (See Figure 5-5)	292581	1		
A5	BCD Ladder PCB Assembly (See Figure 5-6)	292565	1		
A6	BCD Logic PCB Assembly (–01 Isolated Control Logic Option) (See Figure 5-7)	292540	1		
A6	Non-Isolated Logic PCB Assembly (–04 Direct Coupled Control Option) (See Figure 5-8)	292557	1		
A7	BCD Display PCB Assembly (–02 Front Panel Display Option) (See Figure 5-9)	292615	1		
A7	No Display PCB Assembly (–05 Blank Front Panel Option) (See Figure 5-10)	301804	1		
	Cover, bottom	303826	1		
	Cover, top	303818	1		
	Foot	292870	4		
	Line cord with plug	284174	1		
	Panel, rear	296939	1		
	Panel, front	296921	1		
	Decal, front panel (–02 Option)	296533	1		
	Decal, front panel (–05 Option)	296541	1		
	ACCESSORIES (Not included with the instrument. Order separately):				
	Connector, Programming, male, 50 contact	266056			
	Extender Card	292623		1	
	Chassis Slides, 18"	308940			
	Chassis Slides, 24"	308957			
	Rack Mounting Kit, offset mounting	304485			
	Rach Mounting Kit, dual rack mounting	304808			
	Rack Mounting Kit, center mounting	304410			
	Model A4200 Manual Control Unit	A4200			

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	**MOTHER PCB ASSEMBLY - Figure 5-2**	292607	REF		
J1 thru J5	Connector, female, 50 contact	284604	5	1	

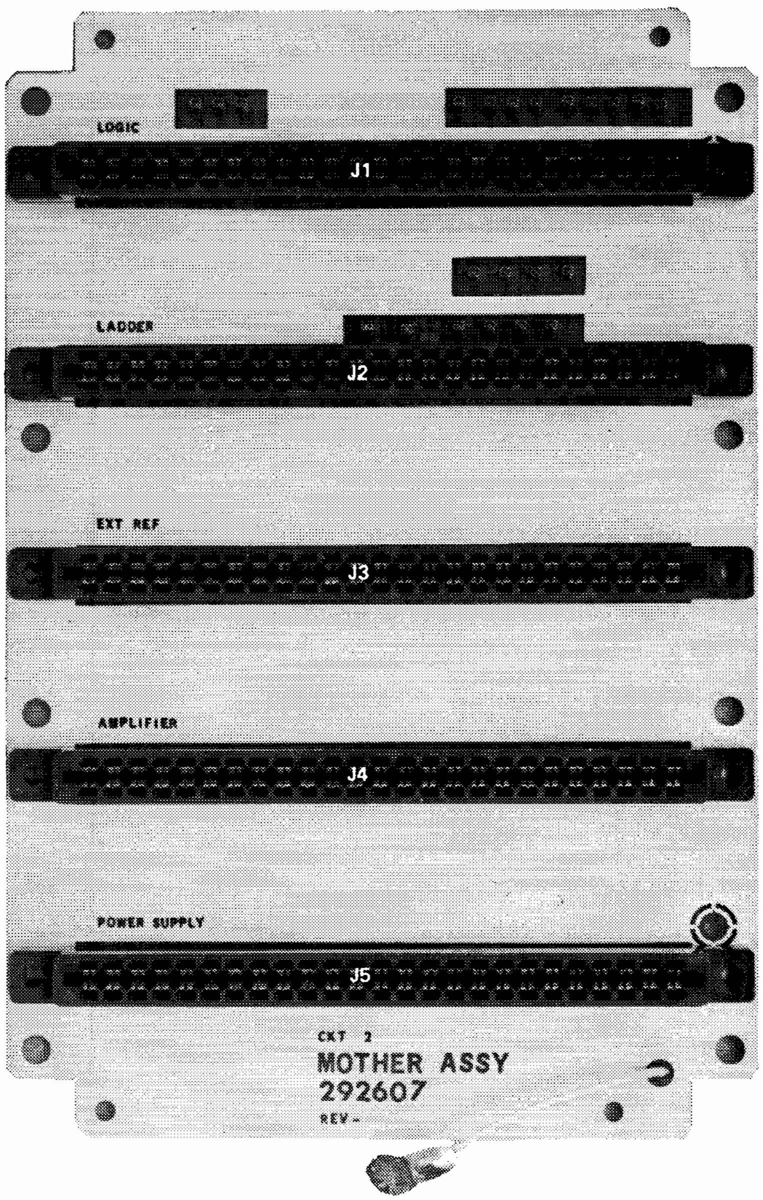


Figure 5-2. MOTHER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**POWER SUPPLY PCB ASSEMBLY - Figure 5-3**	292599	REF		
C1, C14, C17	Cap, cer, 0.05 uf +80/–20%, 25v	148924	3		
C2, C5, C9, C10, C19,	Cap, mica, 33 pf ±5%, 500v	160317	5		
C3	Cap, mica, 100 pf ±5%, 500v	148494	1		
C4	Not used				
C6	Cap, cer, 500 pf ±10%, 1 kv	105692	1		
C7, C8	Cap, elect, 250 uf +50/–10%, 64v	185850	2		
C11, C12	Cap, elect, 400 uf +50/–10%, 40v	185868	2		
C13, C16	Cap, elect, 8500 uf +100/–10%, 12v	292854	2		
C15	Not used				
C18	Cap, Ta, 1.0 uf ±20%, 35v	161919	1		
C20	Cap, cer, 2000 pf, gmv, 1 kv	105569	1		
C21	Cap, cer, 0.1 uf +80/–20%, 500v	105684	1		
C22, C23	Cap, plstc, 0.1 uf ±10%, 400v	289744	2		
CR1, CR25, CR26	Diode, silicon, 1 amp, 600 piv	112383	3		
CR2, CR3, CR27 thru CR35	Diode, silicon, 150 ma	203323	11	2	
CR4, CR10, CR14, CR19	Diode bridge, 2 amp	296509	4	1	
CR5 thru CR8, CR11 thru CR13, CR15 thru CR18, CR20 thru CR22, CR24	Not used				
CR9, CR23	Diode, zener, 4.3v	180455	2		
CR36	Diode, zener, 36v	284364	1		
F1	Fuse, fast acting, 1/4 amp, 250v (For 115v operation)	109314	1		
F1	Fuse, fast acting, 1/8 amp, 250v (For 230v operation)	196790			
J1	Connector, male, 3 contact, power	222612	1		

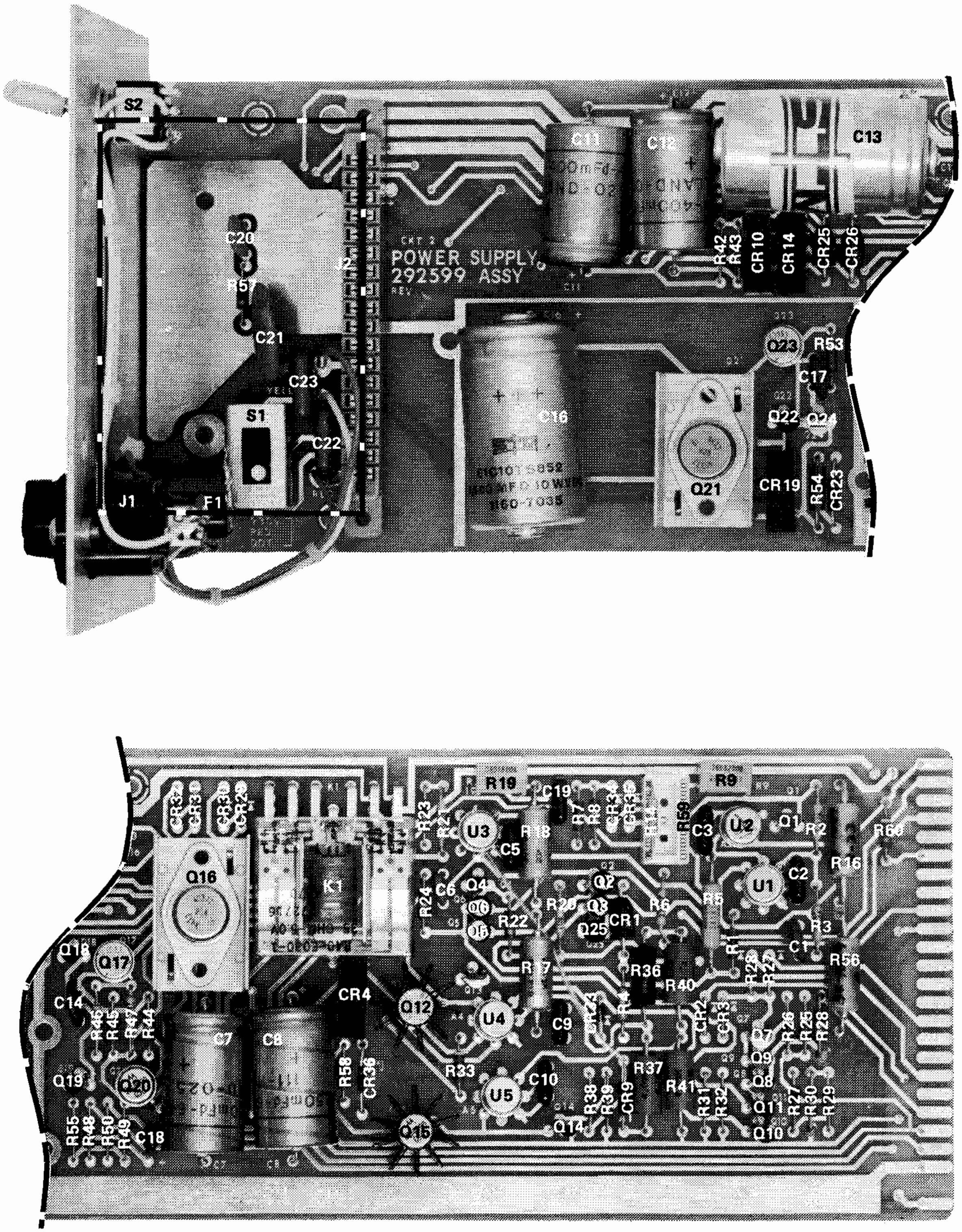


Figure 5-3. POWER SUPPLY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
J2	Connector, female, 36 contact	285247	1		
K1	Relay, 4PDT, 5v Coil	272716	1	1	
Q1, Q10, Q11, Q13, Q18, Q19, Q24	Tstr, silicon, NPN	218396	7		
Q2, Q3, Q5, Q6	Tstr, J-FET, N-channel	261578	4	2	
Q4, Q7, Q8, Q9, Q14	Tstr, silicon, PNP	195974	5		
Q12, Q17, Q23	Tstr, silicon, NPN	150359	3		
Q15, Q20	Tstr, silicon, PNP	269076	2		
Q16, Q21	Tstr, silicon, NPN	288381	2	1	
Q22	Tstr, J-FET, N-channel	271924	1		
Q25	Tstr, J-FET, N-channel	288324	1	1	
R1, R55	Res, comp, 1k ±5%, 1/4w	148023	2		
R2	Res, met flm, 2.87k ±1%, 1/8w	185629	1		
R3, R46	Res, met flm, 17.4k ±1%, 1/8w	236802	2		
R4	Res, met flm, 5.76k ±1%, 1/8w	260349	1		
R6	Res, met flm, 13.7k ±1%, 1/8w	236752	1		
R7, R8, R22, R24, R28, R30	Res, comp, 22k ±5%, 1/4w	148130	6		
R9	Res, var, cermet, 20Ω ±20%, 1/2w	285114	1		
R10 thru R13	Not used				
R14	Res, met flm, 40.2Ω ±1%, 1/8w	245373	1		
R15	Not used				
R17	Res, ww, 20.02k ±0.1% } Matched Set	291674	1	1	
R18	Res, ww, 20k ±0.1% } Matched Set				
R19	Res, var, cermet, 50Ω ±10%, 1/2w	285122	1		
R20	Res, met flm, 10k ±1%, 1/8w	168260	1		
R21	Res, met flm, 30.1k ±1%, 1/8w	168286	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R23, R42, R43, R44	Res, comp, 10k ±5%, 1/4w	148106	4		
R25, R26, R48	Res, comp, 3.9k ±5%, 1/4w	148064	3		
R27, R29	Res, comp, 2k ±5%, 1/4w	202879	2		
R31, R32, R38	Res, comp, 2.7k ±5%, 1/4w	170720	3		
R33, R39	Res, comp, 4.7Ω 5%, 1/4w	193359	2		
R34, R35	Not used				
R36	Res, ww, 10k ±0.1%, 1/4w	240945	1		
R37, R41	Res, ww, 4.02k ±0.1%, 1/4w	240937	2		
R40	Res, ww, 3.74k ±0.1%, 1/4w	246173	1		
R45, R49, R50, R53, R58, R60	Res, comp, 470Ω ±5%, 1/4w	147983	6		
R47	Res, met flm, 3.74k ±1%, 1/8w	272096	1		
R51, R52	Not used				
R54	Res, comp, 22Ω ±5%, 1/2w	169847	1		
R57	Res, comp, 10Ω ±5%, 1/4w	147868	1		
R59	Res, factory selected value, may not be installed				
S1	Switch, slide, dpdt, line voltage	226274	1		
S2	Switch, toggle, dpdt, power	115113	1		
T1	Transformer, power (See Figure 5-1)	299602	1		
U1, U4, U5	IC, operational amplifier	271502	3		
U2	IC, reference amplifier } Matched Set	301846	1		
R5	Res, met flm, selected value } Matched Set				
R16	Res, ww, 12k ±0.05%, 1/4w } Matched Set				
R56	Res, ww, 1/4w, selected value } Matched Set				
U3	IC, operational amplifier, selected	225961	1		
TB1	Terminal barrier strip	295212	1		
XF1	Fuse holder	160846	1		
	Socket, IC, 14 contact	276527	1		
	Heat sink, Q12 & Q15	104646	2		
	Jumper, terminal barrier strip	283713	3		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	**DAC AMPLIFIER PCB ASSEMBLY - Figure 5-4**	292573	REF		
C1, C2	Cap, cer, 0.1 uf ±20%, 100v	149146	2		
C3	Cap, elect, 20 uf +75/–10%, 50v	106229	1		
C4	Cap, elect, 50 uf +75/–10%, 50v	105122	1		
C5	Cap, mica, 33 pf ±5%, 500v	160317	1		
C6	Cap, mica, 820 pf ±1%, 500v	226167	1		
C7	Cap, mica, 750 pf ±1%, 500v	284158	1		
C8	Cap, mica, 100 pf ±5%, 500v	148494	1		
C9	Cap, mica, 180 pf ±5%, 500v	148460	1		
C10, C11, C14	Cap, cer, 0.05 uf ±20%, 100v	149161	3		
C12, C13	Cap, cer, 300 pf ±10%, 500v	105734	2		
C15	Cap, mica, 22 pf ±5%, 500v	148551	1		
C16, C17	Cap, cer, 1.0 uf, gmv, 3v	106567	2		
C18	Cap, mica, 68 pf ±5%, 500v	148510	1		
CR1 thru CR16	Diode, silicon, 150 ma	203323	16	2	
Q1, Q2, Q3 Q6, Q7, Q10, Q11, Q14, Q15	Tstr, J-FET, N-channel, U2366E, Matched Set	298281	1		
Q4, Q8, Q12, Q16, Q31	Tstr, silicon, PNP	195974	5		
Q5, Q9, Q13, Q17, Q19, Q20, Q26, Q30, Q38, Q39	Tstr, silicon, NPN	218396	10		
Q18	Tstr, J-FET, dual, N-channel, selected	225987	1		
Q21, Q22	Tstr, MOS-FET, P-chan	306142	2	1	
Q23	Tstr, silicon, NPN	159855	1	1	
Q24, Q25	Tstr, silicon, PNP, dual	242016	2	1	
Q27, Q28	Tstr, silicon, NPN	269084	2		

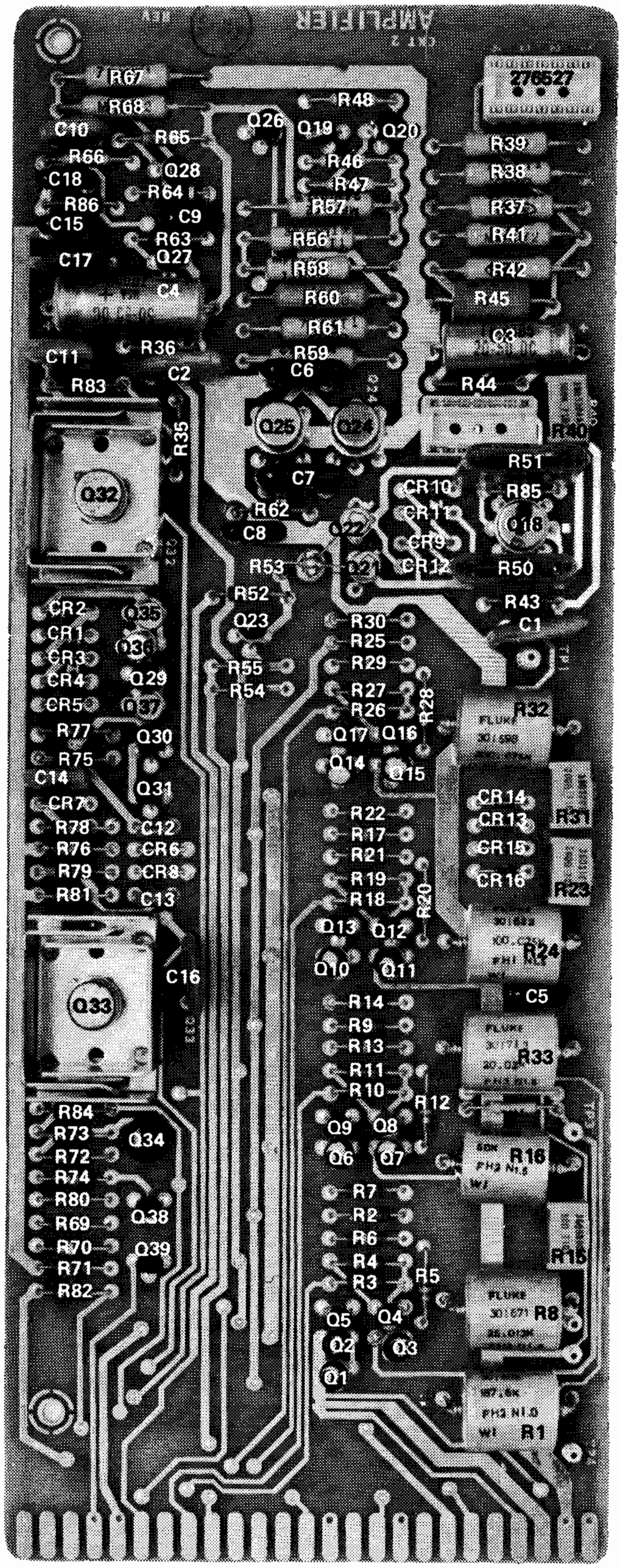


Figure 5-4. DAC AMPLIFIER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q29	Tstr, silicon, PNP	225599	1	1	
Q32	Tstr, silicon, NPN	289819	1	1	
Q33	Tstr, silicon, PNP	295188	1	1	
Q34	Tstr, silicon, PNP	266619	1		
Q35, Q36, Q37	Diode, Field-Effect, current regulator	285106	3	1	
R1	Res, ww, 108k ±0.1% (Matched Set)	289793	1		
R8	Res, ww, 25.013k ±0.1% (Matched Set)				
R16	Res, ww, 50k ±0.1% (Matched Set)				
R24	Res, ww, 100.025k ±0.1% (Matched Set)				
R32	Res, ww, 200.075k ±0.1% (Matched Set)				
R33	Res, ww, 20.02k ±0.1% (Matched Set)				
R2, R5, R6, R9, R12, R13, R17, R20, R21, R25, R28, R29	Res, comp, 51k ±5%, 1/4w	193334	12		
R3, R7, R10, R14, R18, R22, R26, R30	Res, comp, 2.7k ±5%, 1/4w	170720	8		
R4, R11, R19, R27	Res, comp, 560Ω ±5%, 1/4w	147991	4		
R15	Res, var, cermet, 50Ω ±10%, 1/2w	285122	1		
R23	Res, var, cermet, 100Ω ±10%, 1/2w	285130	1		
R31	Res, var, cermet, 200Ω ±10%, 1/2w	285148	1		
R34	Not used				
R35, R36, R43, R44, R83, R84	Res, comp, 10Ω ±5%, 1/4w	147868	6		
R37	Res, met flm, 187k ± 1%, 1/2w	296376	1		
R38	Res, met flm, 374k ±1%, 1/2w	262105	1		
R39	Res, met flm, 750k ±1%, 1/2w	155192	1		
R40	Res, var, cermet, 100k ±10%, 1/2w	288308	1		
R41	Res, met flm, 1.27M ±1%, 1/2w	229252	1		
R42	Res, met flm, 107k ±1%, 1/2w	296384	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R45	Res, ww, 45Ω ±0.1%, 1/8w	111815	1		
R46, R47	Res, met flm, 2k ±1%, 1/8w	277137	2		
R48	Res, met flm, 10k ±1%, 1/8w	291633	1		
R49	Not used				
R50, R51	Res, ww, 6.8k ±0.03%, 1/2w	254359	2		
R52	Res, comp, 20k ±5%, 1/4w	221614	1		
R53, R85	Res, comp, 100k ±5%, 1/4w	148189	2		
R54, R82	Res, comp, 5.1k ±5%, 1/4w	193342	2		
R55, R76, R81	Res, comp, 10k ±5%, 1/4w	148106	3		
R56, R68	Res, met flm, 3.92k ±1%, 1/2w	160713	2		
R57	Res, met flm, 2.49k ±1%, 1/2w	193995	1		
R58, R67	Res, met flm, 11k ±1%, 1/2w	222216	2		
R59, R61	Res, met flm, 49.9k ±1%, 1/2w	182980	2		
R60	Res, met flm, 2.67k ±1%, 1/2w	161430	1		
R62, R63	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R64	Res, comp, 910Ω ±5%, 1/4w	203851	1		
R65	Res, met flm, 634Ω ±1%, 1/8w	223560	1		
R66	Res, met flm, 4.99k ±1%, 1/8w	168252	1		
R69, R72	Res, comp, 1k ±5%, 1/4w	148023	2		
R70	Res, comp, 150k ±5%, 1/4w	182212	1		
R71	Res, comp, 68k ±5%, 1/4w	148171	1		
R73, R80	Res, comp, 6.2k ±5%, 1/4w	221911	2		
R74	Res, comp, 22k ±5%, 1/4w	148130	1		
R75, R79	Res, comp, 270Ω ±5%, 1/4w	160804	2		
R77, R78	Res, comp, 5.6Ω ±5%, 1/4w	208033	2		
R86	Res, comp, 2k ±5%, 1/4w	202879	1		
	Socket, IC, 14 contact	276527	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4	**EXTERNAL REFERENCE PCB ASSEMBLY (—03 EXTERNAL REFERENCE OPTION) - Figure 5-5**	292581	REF		
C1, C3	Cap, elect, 20 uf +75/—10%, 50v	106229	2		
C2	Cap, mica, 390 pf ±5%, 500v	148437	1		
C4, C6	Cap, mica, 82 pf ±5%, 500v	148502	2		
C5	Cap, mica, 270 pf ±5%, 500v	148452	1		
C7, C11	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C8, C9	Cap, mica, 5 pf ±10%, 500v	148577	2		
C10	Cap, mica, 22 pf ± 5%, 500v	148551	1		
CR1 thru CR4	Diode, silicon, 150 ma	203323	4		
Q1	Tstr, J-FET, dual, N-channel, selected	225987	1		
Q2, Q3, Q6, Q12	Tstr, silicon, NPN	218396	4		
Q4, Q5	Tstr, silicon, PNP, dual	242016	2		
Q7, Q8	Tstr, silicon, NPN	269084	2		
Q9, Q10	Tstr, J-FET, N-channel	261578	2		
Q11	Tstr, silicon, PNP	195974	1		
Q13, Q14	Tstr, silicon, NPN	150359	2		
R1 R16	Res, ww, 100.025k Res, ww, 99.955k } Matched Set	291682	1		
R2, R11	Res, comp, 10Ω ±5%, 1/4w	147868	2		
R3, R4	Res, ww, 6.8k ±0.03%, 1/2w	254359	2		
R5	Res, met flm, 107k ±1%, 1/2w	296384	1		
R6	Res, var, cermet, 100k ±10%, 1/2w	288308	1		
R7	Res, met flm, 1.27M ±1%, 1/2w	229252	1		
R8	Res, met flm, 750k ±1%, 1/2w	155192	1		
R9	Res, met flm, 374k ±1%, 1/2w	262105	1		
R10	Res, met flm, 187k ±1%, 1/2w	296376	1		
R12	Res, ww, 45Ω ±0.1%, 1/8w	111815	1		
R13, R15	Res, met flm, 2k ±1%, 1/8w	277137	2		

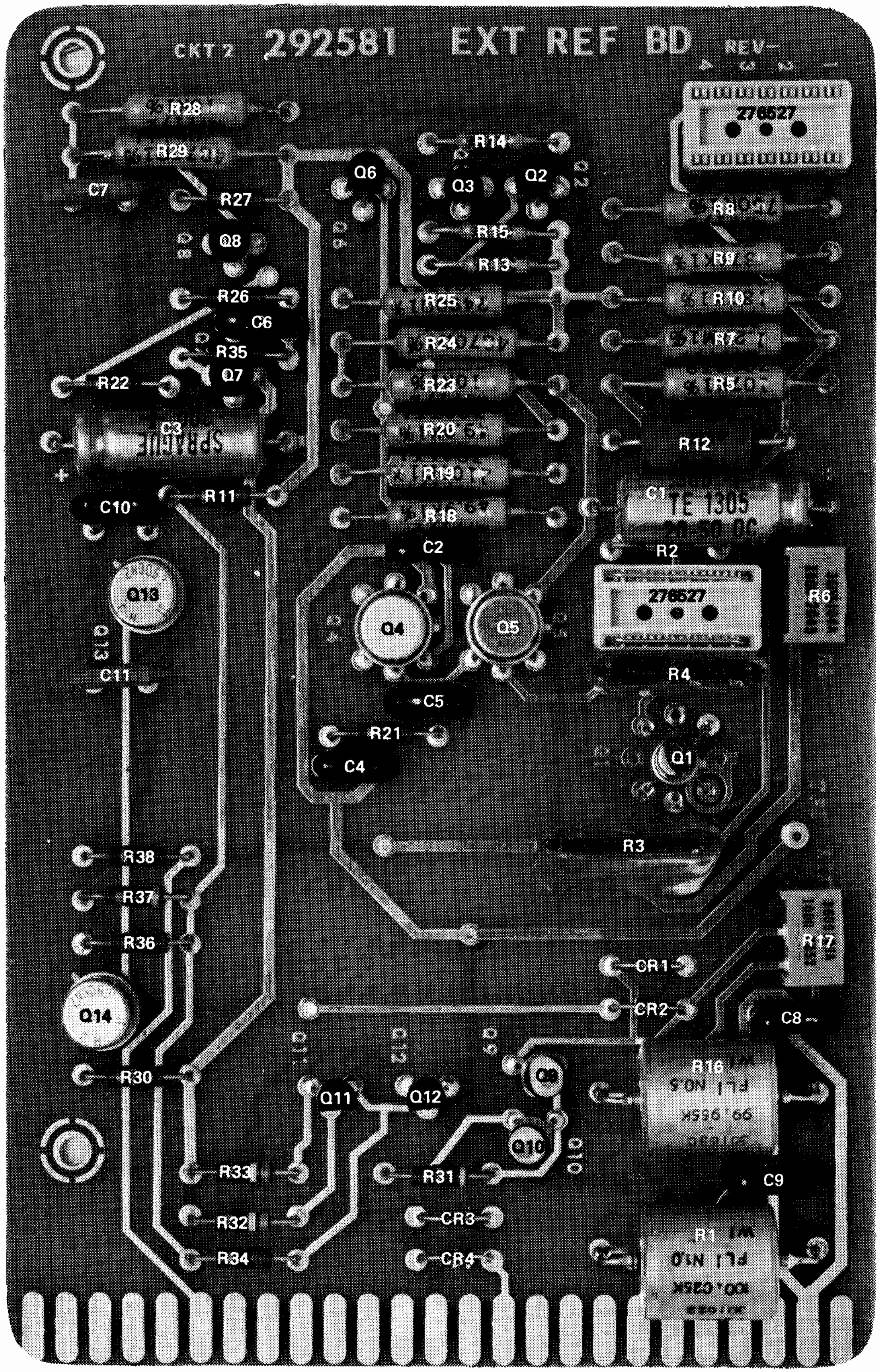


Figure 5-5. EXTERNAL REFERENCE PCB ASSEMBLY (–03 EXTERNAL REFERENCE OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, met flm, 10k ±1%, 1/8w	291633	1		
R17	Res, var, cermet, 100Ω ±10%, 1/2w	285130	1		
R18, R20	Res, met flm, 49.9k ±1%, 1/2w	182980	2		
R19	Res, met flm, 2.1k ±1%, 1/2w	193276	1		
R21, R35	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R22	Res, comp, 5.1k ±5%, 1/4w	193342	1		
R23, R28	Res, met flm, 10k ±1%, 1/2w	151274	2		
R24, R29	Res, met flm, 4.87k ±1%, 1/2w	247775	2		
R25	Res, met flm, 2.49k ±1%, 1/2w	193995	1		
R26	Res, comp, 1k ±5%, 1/4w	148023	1		
R27, R36	Res, comp, 820Ω ±5%, 1/4w	148015	2		
R30	Res, comp, 18k ± 5%, 1/4w	148122	1		
R31	Res, comp, 47k ±5%, 1/4w	148163	1		
R32, R33	Res, comp, 3.9k ±5%, 1/4w	148064	2		
R34	Res, comp, 2.7k ±5%, 1/4w	170720	1		
R37	Res, comp, 4.7k ±5%, 1/4w	148072	1		
R38	Res, comp, 270Ω ±5%, 1/4w	160812	1		
	Socket, IC, 14 contact	276527	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5	**BCD LADDER PCB ASSEMBLY - Figure 5-6**	292565	REF		
C1, C2	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
CR1	Diode, silicon, 150 ma	203323	1		
Q1	Diode, Field Effect, current regulator	285106	1		
Q2	Tstr, silicon, NPN	218396	13		A
Q2	Tstr, silicon, NPN	168716	1		B
Q7, Q11, Q15, Q19, Q23, Q27, Q31, Q35, Q39, Q43, Q47, Q51	Tstr, silicon, NPN	218396	12		
Q3	Tstr, silicon, PNP	269076	1		
Q4	Not used				
Q5, Q9, Q13, Q17, Q21, Q25, Q29, Q33, Q37, Q41, Q45, Q49	Tstr, silicon, PNP	195974	12		
Q6, Q8	Tstr, J-FET, N-channel, U2366E, Matched Pair	306399	1		
Q10, Q12,	Tstr, J-FET, N-channel, U2366E, Matched Pair	306381	1		
Q14, Q16, Q18, Q20	Tstr, 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	Tstr, J-FET, N-channel, U2366E, Matched Set	298299	1		
Q38, Q40, Q42, Q44	Tstr, J-FET, N-channel	288324	4		
R1	Res, var, cermet, 200Ω ±10%, 1/2w	285148	1		
R2	Res, ww, 24.987k				
R3	Res, ww, 49.975k				
R5	Res, ww, 100.025k — Matched Resistor Set (R2, R3, R5, R6, R7)	289827	1		
R6	Res, ww, 200.075k				
R7	Res, ww, 108k				

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
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	Res, met flm, 108.06k ±0.1%, 1/8w	290114	1		
R14	Res, met flm, 49.9k ±0.1%, 1/8w	291070	1		
R15	Res, met flm, 24.9k ±0.1%, 1/8w	290106	1		
R16	Res, met flm, 100k ±0.5%, 1/8w	291054	1		
R17	Res, met flm, 200k ±1%, 1/8w	261701	1		
R18	Res, met flm, 120k ±1%, 1/8w	291062	1		
R19	Res, comp, 560Ω ±5%, 1/4w	147991	13		A
R19	Res, comp, 1.8k ±5%, 1/4w	175042	1		B
R24, R30, R36, R42, R48, R54, R60, R66, R72, R78, R84, R90	Res, comp, 560Ω ±5%, 1/4w	147991	12		
R20	Res, comp, 51k ±5%, 1/4w	193334	35		A
R20	Res, comp, 20k ±5%, 1/4w	221614	1		B
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, R79, R81, R85, R87, R88, R91, R93, R94	Res, comp, 51k ±5%, 1/4w	193334	34		
R21, R22	Not used				

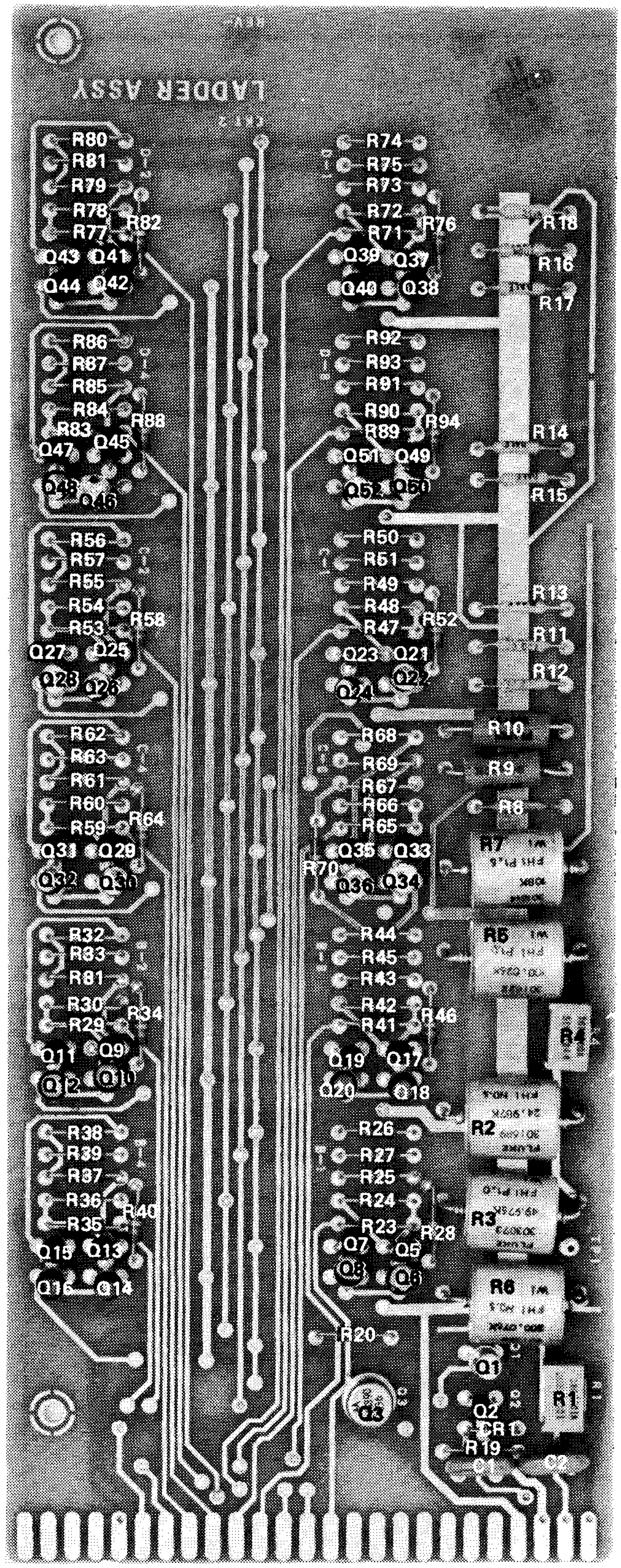


Figure 5-6. BCD LADDER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
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%, 1/4w	170720	24		
R76, R82	Res, comp, 100k ±5%, 1/4w	148189	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**BCD LOGIC PCB ASSEMBLY (–01 ISOLATED CONTROL LOGIC OPTION) - Figure 5-7**	292540	REF		
C1	Cap, mica, 200 pf ±5%, 500v	170423	1		
C2, C3	Cap, mica, 12 pf ±5%, 500v	175224	2		
C4	Cap, plstc, 3300 pf ±2%, 100v	168344	1		
C5, C6, C7, C36, C40, C42, C43,	Cap, mica, 56 pf ±5%, 500v	148528	7		
C8 thru C15, C23 thru C30, C32, C33, C34, C37, C38, C44 thru C48	Cap, cer, 0.025 uf ±2%, 100v	168435	26		
C16	Cap, Ta, 0.68 uf ±10%, 35v	182790	1		
C17, C31	Cap, elect, 200 uf +50/–10%, 10v	236935	2		
C18, C19	Not used				
C20	Cap, mica, 330 pf ±1%, 500v	226142	1		
C21	Cap, mica, 430 pf ±5%, 500v	177980	1		
C22	Cap, plstc, 0.1 uf ±10%, 50v	271866	1		
C35, C39	Not used				
C41	Cap, mica, 390 pf ±5%, 500v	148437	1		
C49	Cap, mica, 220 pf ±5%, 500v	237008	1		
CR1, CR2, CR3, CR6 thru CR10, CR12, CR14, CR19	Diode, silicon, 150 ma	203323	11	2	
CR4, CR5	Diode, high speed switching	256339	2		
CR11, CR13, CR15 thru CR18	Not used				
J1	Connector, female, 50 contact	267252	1		
Q1 thru Q7, Q10 thru Q14, Q16, Q20, Q21, Q23	Tstr, silicon, NPN	159855	16		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q8	Not used				
Q9, Q15	Tstr, silicon, unijunction	268110	2	1	
Q17, Q18	Tstr, silicon, NPN	269084	2		
Q19, Q22	Tstr, silicon, PNP	195974	2		
R1, R26, R31, R44, R53	Res, comp, 390Ω ±5%, 1/4w	147975	5		
R2, R49, R68, R72, R75	Res, comp, 680Ω ±5%, 1/4w	148007	5		
R3, R69	Res, comp, 1.3k ±5%, 1/4 w	234252	2		
R4, R7, R9, R13, R17, R22, R65,	Res, comp, 510Ω ±5%, 1/4w	218032	7		
R5, R6	Res, met flm, 6.98k ±1%, 1/8w	261685	2		
R8	Res, met flm, 29.4k ±1%, 1/8w	235135	1		
R10, R15, R19, R23, R46, R66	Res, comp, 51Ω ±5%, 1/4w	221879	6		
R11, R12, R14, R16, R18, R20, R21, R24, R27, R38, R47, R48, R64, R67, R70	Res, comp, 1k ±5%, 1/4w	148023	15		
R25	Not used				
R28	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
R29, R50	Res, comp, 10k ±5%, 1/4w	148106	2		
R30, R52	Res, comp, 39k ±5%, 1/4w	188466	2		
R32	Res, comp, 100Ω ±5%, 1/4w	147926	1		
R33	Not used				
R34, R36, R42, R56, R57, R71, R73	Res, comp, 3.3k ±5%, 1/4w	148056	7		

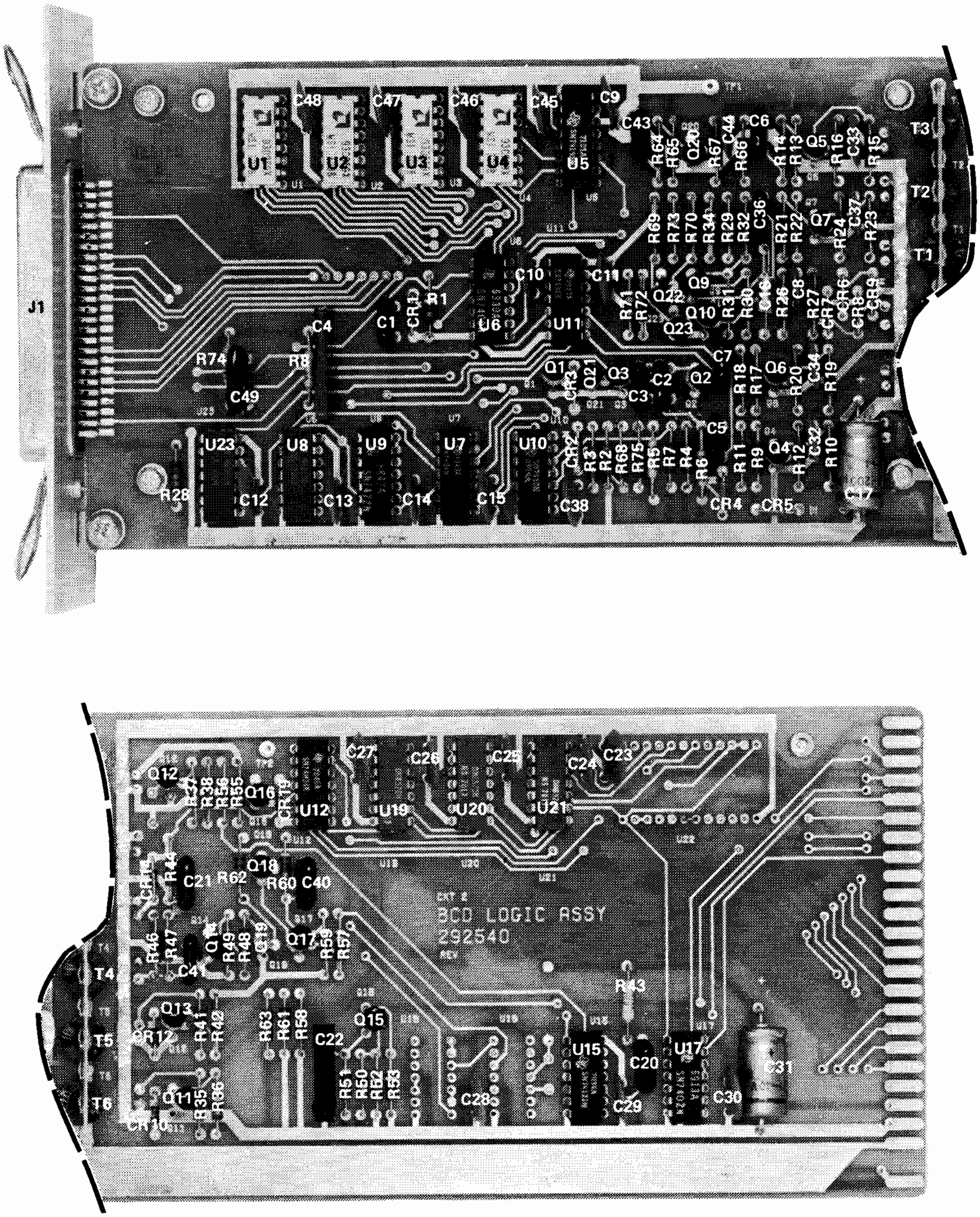


Figure 5-7. BCD LOGIC PCB ASSEMBLY (–01 ISOLATED CONTROL LOGIC OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R35, R37, R41, R55	Res, comp, 200Ω ±5%, 1/4w	193482	4		
R39, R40	Not used				
R43	Res, met flm, 30.9k ±1%, 1/8w	235275	1		
R45	Not used				
R51	Res, comp, 27k ±5%, 1/4w	148148	1		
R54	Not used				
R58	Res, comp, 330Ω ±5%, 1/4w	147967	1		
R59	Res, comp, 910Ω ±5%, 1/4w	203851	1		
R60	Res, comp, 4.7k ±5%, 1/4w	148072	1		
R61	Res, comp, 5.6k ±5%, 1/4w	148080	1		
R62	Res, comp, 110Ω ±5%, 1/4w	193474	1		
R63	Res, comp, 220Ω ±5%, 1/4w	147959	1		
R74	Res, met flm, 10k ±1%, 1/8w	168260	1		
T1 thru T6	Transformer, pulse	299594	6	1	
U1 thru U4	IC, TTL, Dual 4-Input Multiplexer	293209	4		
U5	IC, TTL, 4-Bit Up Down Counters	293183	1	1	
U6	IC, TTL, Quad 2-Input NAND Gate	292953	1		
U7, U11	IC, TTL, Hex Inverter	292979	2		
U8, U23	IC, TTL, Retriggerable Monostable Multivibrator	293134	2		
U9	IC, TTL, J-K Flip Flop	296491	1		
U10	IC, TTL, Triple 3-Input +NAND Gates	292995	1		
U12	IC, TTL, Hex Inverter	293076	1		
U13, U14	Not used				
U15	IC, TTL, Monostable Multivibrator	293050	1		
U16	Not used				
U17	IC, TTL, Quad 2-Input NOR Gates	288845	1		
U18, U22	Not used				
U19, U20 U21	IC, TTL, 8-Bit Shift Register	272138	3		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**NON-ISOLATED LOGIC PCB ASSEMBLY (–04 DIRECT COUPLED CONTROL OPTION) - Figure 5-8**	292557	REF		
C1	Cap, plstc, 3300 pf ±2%, 100v	168344	1		
C2, C3	Cap, elect, 200 uf +50/–10%, 10v	236935	2		
CR1 thru CR26	Diode, zener, 5.6v	277236	26	2	
J1	Connector, female, 50 contact	267252	1		
Q1 thru Q28	Tstr, silicon, NPN	159855	28		
R1	Res, met flm, 29.4k ±1%, 1/8w	235135	1		
R2	Res, comp, 1k ±5%, 1/4w	148023	1		
R3	Res, comp, 390Ω ±5%, 1/4w	147975	1		
R4, R7, R10, R13, R16, R19, R22, R25, R28, R31, R34, R37, R40, R43, R46, R49 R52, R55, R58, R61, R64, R67, R70, R73, R76, R80, R85	Res, comp, 3.3k ±5%, 1/4w	148056	27		
R5, R8, R11, R14, R17, R20, R23, R26, R29, R32, R35, R38, R41, R44, R47, R50, R53, R56, R59, R62, R65, R68, R71, R74, R77, R81, R84	Res, comp, 1.5k ±5%, 1/4w	148031	27		
R6, R9, R12, R15, R18, R21, R24, R27, R30, R33, R36, R39, R42, R45, R48, R51, R54, R57, R60, R63, R66, R69, R72, R75, R78, R82	Res, comp, 470Ω ±5%, 1/4w	147983	26		

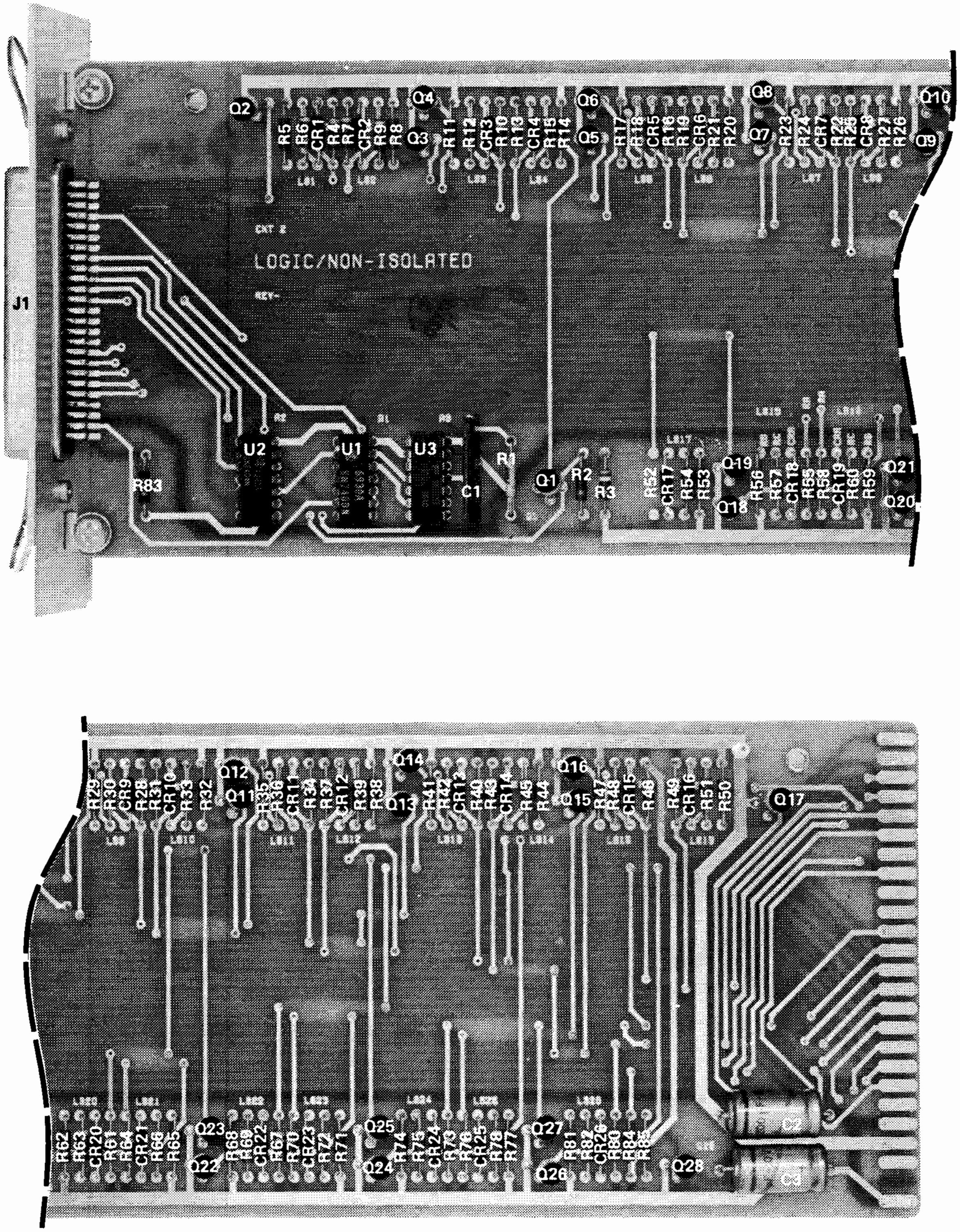


Figure 5-8. NON ISOLATED LOGIC PCB ASSEMBLY (–04 DIRECT COUPLED CONTROL OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R83	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
U1	IC, TTL, Quad 2-Input NAND Gate	292953	1		
U2	IC, TTL, Hex Inverter	292979	1		
U3	IC, TTL, Retriggerable Monostable Multivibrator	293134	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A7	**BCD DISPLAY PCB ASSEMBLY (–02 FRONT PANEL DISPLAY OPTION) - Figure 5-9**	292615	REF		
CR1 thru CR21	Diode, light emitting	293381	21		
R1 thru R21	Res, comp, 270Ω ±5%, 1/4w	160804	21		
U1 thru U4	IC, TTL, Hex Inverter	292979	4		

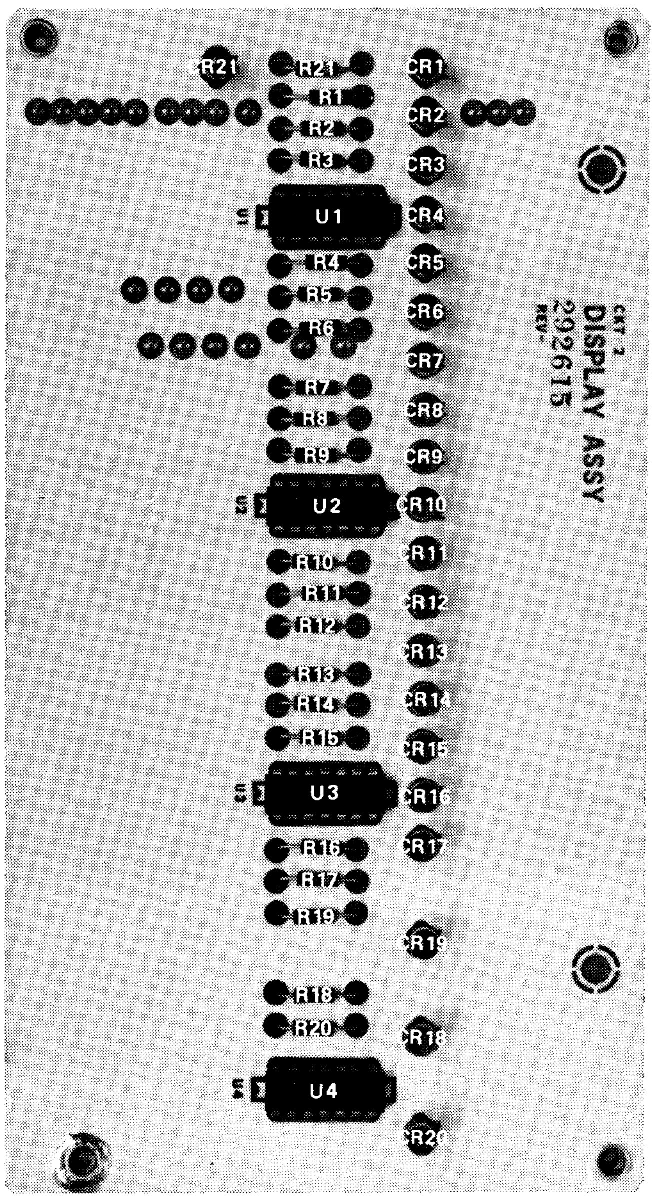


Figure 5-9. BCD DISPLAY PCB ASSEMBLY (–02 FRONT PANEL DISPLAY OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A7	**NO DISPLAY PCB ASSEMBLY (–05 BLANK FRONT PANEL OPTION) - Figure 5-10**	301804	REF		
CR21	Diode, light emitting	293381	1		
R21	Res, comp, 270Ω ±5%, 1/4w	160804	1		

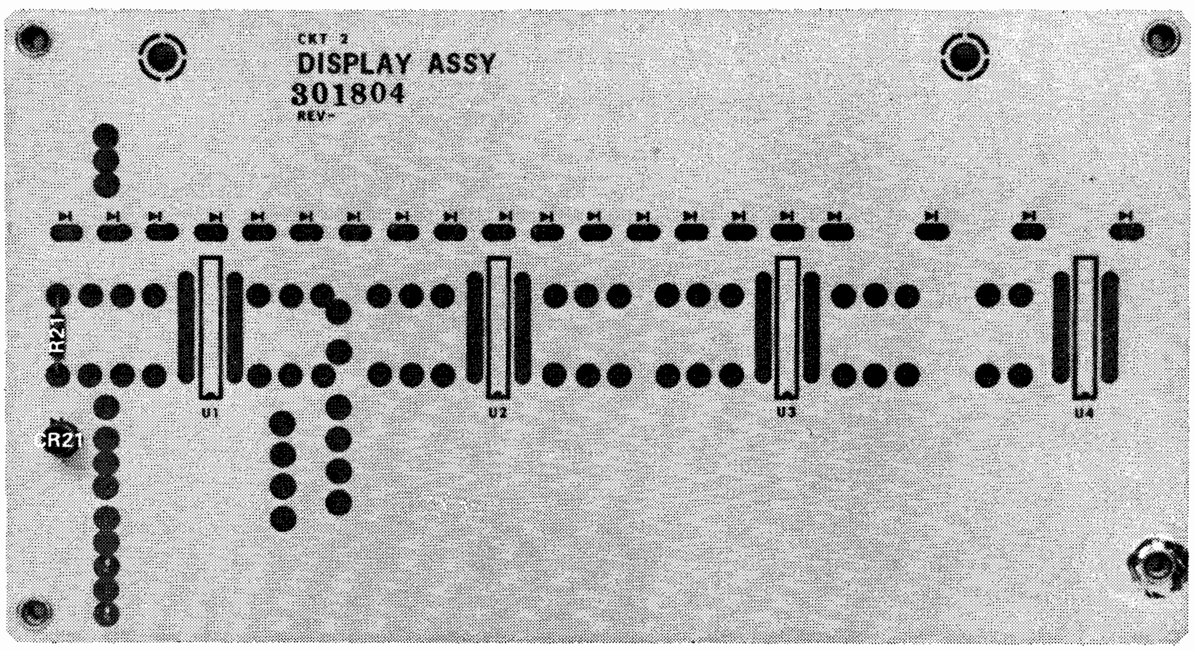


Figure 5-10. NO DISPLAY PCB ASSEMBLY (–05 BLANK FRONT PANEL OPTION)

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
A4200	89536	A4200	148130	01121	CB2235
104646	05820	NF207	148148	01121	CB2735
105122	56289	30D506G050DD4	148163	01121	CB4735
105569	71590	DA140-139CB	148171	01121	CB6835
105684	56289	41C92	148189	01121	CB1045
105692	71590	2DDH60N501K	148437	14655	CD15F391J
105734	71590	BB60301KW7W	148452	14655	CD15F271J
106229	56289	30D206G050CC4	148460	14655	CD15F181J
106567	71590	UK105	148494	14655	CD15F101J
109314	71400	Type AGC	148502	14655	CD15F820J
111815	01686	Type R1250	148510	14655	CD15F680J
112383	05277	1N4822	148528	14655	CD15F560J
115113	95146	MST215N	148551	14655	CD15E220J
147868	01121	CB1005	148577	14655	CD15C050K
147926	01121	CB1015	148924	72982	5855-Y5U-503Z
147959	01121	CB2215	149146	56289	33C41B6
147967	01121	CB3315	149161	56289	55C23A1
147975	01121	CB3915	150359	95303	2N3053
147983	01121	CB4715	151274	91637	Type MFF1/2
147991	01121	CB5615	155192	91637	Type MFF1/2
148007	01121	CB6815	159855	07910	CS23030
148015	01121	CB2815	160317	14655	CD15E330J
148023	01121	CB1025	160713	91637	Type MFF1/2
148031	01121	CB1525	160804	01121	CB2715
			160812	01121	CB2705
148056	01121	CB3325	160846	75915	342004
148064	01121	CB3925	161430	91637	Type MFF1/2
148072	01121	CB4725	161919	56289	196D105X0035
148080	01121	CB5625	168252	91637	Type MFF1/2
148106	01121	CB1035	168260	91637	Type MFF1/8
148122	01121	CB1835	168286	91637	Type MFF1/8

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
168344	84171	PE332G	221879	01121	CB5105
168435	56289	C128B101H253M	221911	01121	CB6225
168716	07263	S19254			
169847	01121	EB2205	222216	91637	Type MFF1/2
170423	14655	CD15F221J	222612	82389	AC3G
170720	01121	CB2725	223560	91637	Type MFF1/8
175042	01121	CB1825			
175224	14655	CD15E120J	225599	07263	S22650
177980	14655	CD15F431J	225961	89536	225961
180455	07910	1N749A	225987	89536	225987
182212	01121	CB1545	226142	14655	CD15F331F
182790	56289	150D684X9035A2	226167	14655	CD19F821F
182980	91637	Type MFF1/2	226274	82389	46256LF
185629	91637	Type MFF1/8	229252	91637	Type MFF1/2
185850	73445	C437ARH250	234252	01121	CB1325
185868	73445	C437ARG400	235135	91637	Type MFF1/8
188466	01121	CB3935	235275	91637	Type MFF1/8
193276	91637	Type MFF1/2	235366	91637	Type MFF1/8
193334	01121	CB5135	236752	91637	Type MFF1/8
193342	01121	CB5125	236802	91637	Type MFF1/8
193359	01121	CB47G5	236935	73445	C426ARD200
193474	01121	CB1115	237008	14655	CD19F221J
193482	01121	CB2015	240937	89536	240937
193995	91637	Type MFF1/2	240945	89536	240945
195974	04713	2N3906	242016	07263	SE4901
196790	71400	Type AGC	245373	91637	Type MFF1/8
202879	01121	CB2025	246173	89536	246173
203323	03508	DHD1105	246744	01121	CB27G5
203851	01121	CB9115	247775	91637	Type MFF1/2
208033	01121	CB56G5	254359	89536	254359
218032	01121	CB5115	256339	28480	5082-2900
218396	04713	2N3904	260349	91637	Type MFF1/8
221614	01121	CB2035	261578	15818	U2366E

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
261685	91637	Type MFF1/8	288381	95303	40372
261701	91637	Type MFF1/8	288845	01295	SN7402N
262105	91637	Type MFF1/2	289744	73445	C280CF/A100K
266056	02660	57-30500	289769	89536	289769
266619	07263	2N4888	289777	89536	289777
267252	02660	57-40500	289793	89536	289793
268110	03508	2N6027	289819	95303	40409
269076	95303	2N4037	289827	89536	289827
269084	07910	CS2484	290106	91637	Type MFF1/8
271502	12040	LM301A	290114	91637	Type MFF1/8
271866	06001	75F2R5A104	290122	91637	Type MFF1/8
271924	07910	CFE13041	291054	91637	Type MFF1/8
272096	91637	Type MFF1/8	291062	91637	Type MFF1/8
272138	12040	DM8570	291070	91637	Type MFF1/8
272716	24796	R40-E030-1	291088	91637	Type MFF1/8
276527	23880	TSA-2900-14W	291633	91637	Type MFF1/8
277137	91637	Type MFF1/8	291674	89536	291674
277236	07910	1N752A	291682	89536	291682
283713	71785	422-13-11-013	292540	89536	292540
284158	14655	CD19D751F	292557	89536	292557
284174	70903	KHS-7041	292565	89536	292565
284364	12969	UZ8736	292573	89536	292573
284604	02660	225-22521-110	292581	89536	292581
285106	07910	CRE3021	292599	89536	292599
285114	71450	360S-200B	292607	89536	292607
285122	71450	360S-500A	292615	89536	292615
285130	71450	360S-101A	292623	89536	292623
285148	71450	360S-201A	292854	99392	61C12TS852
285247	02660	225-21821-110	292870	89536	292870
288308	71450	360S-104A	292953	01295	SN7400N
288324	15818	U1994E	292979	01295	SN7404N

MANUFACTURERS' CROSS REFERENCE LIST					
FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
292995	01295	SN7410N	306399	89536	306399
293050	01295	SN74121N	308940	89536	308940
293076	01295	SN74H04N	308957	89536	308957
293134	07263	U6A960159X			
293183	01295	SN74193N			
293209	07263	U6B930959X			
293381	28480	5082-4403			
295188	95303	40410			
295212	71785	Type 140Y			
296376	91637	Type MFF1/2			
296384	91637	Type MFF1/2			
296491	01295	SN7472N			
296509	09423	FB100			
296533	89536	296533			
296541	89536	296541			
296921	89536	296921			
296939	89536	296939			
298281	89536	298281			
298299	89536	298299			
299594	89536	299594			
299602	89536	299602			
301804	89536	301804			
301846	89536	301846			
303818	89536	303818			
303826	89536	303826			
304410	89536	304410			
304485	89536	304485			
304808	89536	304808			
306142	05397	3N173			
306373	89536	306373			
306381	89536	306381			

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. OPTION INFORMATION

6-4. Each of the options available for this instrument, if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and field installation procedures. A complete list of replaceable parts for each option is contained at the end of that option description.

6-5. ACCESSORY INFORMATION

6-6. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

Accessory

Model A4200

6-1. INTRODUCTION

6-2. The Model A4200 Manual Control Unit (MCU) shown in Figure 6-1 allows manual control of the FLUKE 4200 series power sources. An interface cable is included with the MCU. All internal operating voltages are derived from the power source through the interface cable.

6-3. INSTALLATION

6-4. The Model A4200 is connected to the power source as follows:

a. Turn off the power source and then disconnect the Programming Connector from the rear panel.

b. Connect the interface cable to the Programming Connectors on the power source and the MCU.

c. Turn on the power source and select the desired operating condition on the MCU.

6-5. OPERATING FEATURES

6-6. The location and function of all controls, indicators, and connectors of the Model A4200 are shown in Figure 6-2.

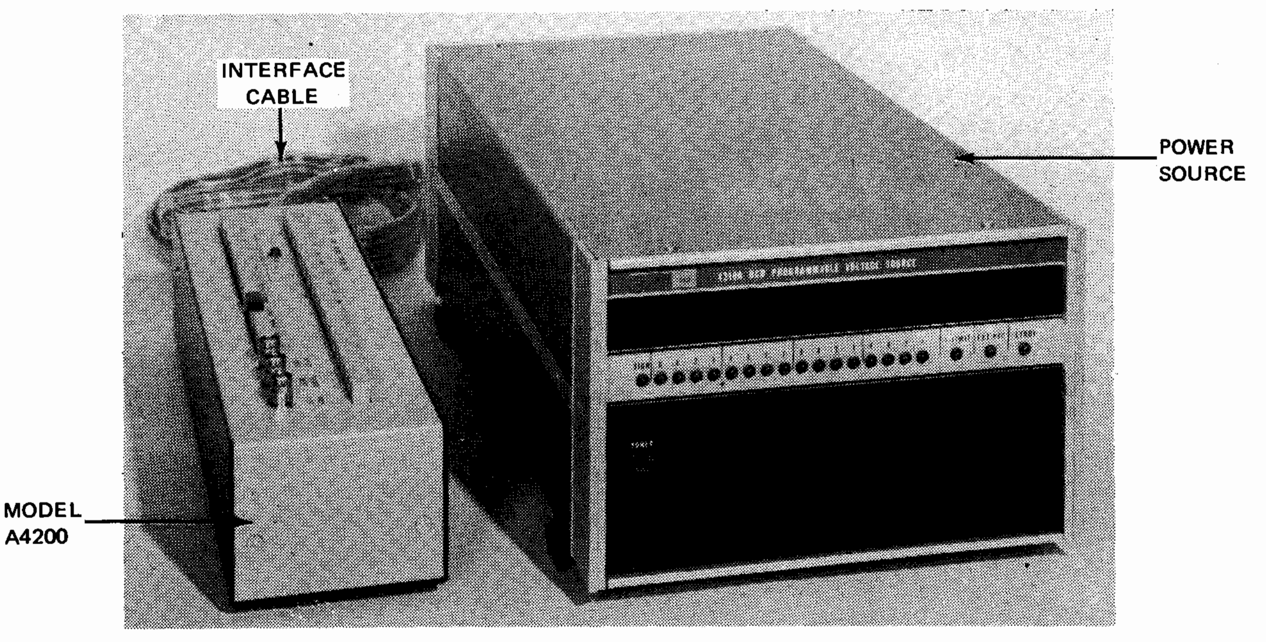


Figure 6-1. MODEL A4200 MANUAL CONTROL UNIT AND POWER SOURCE

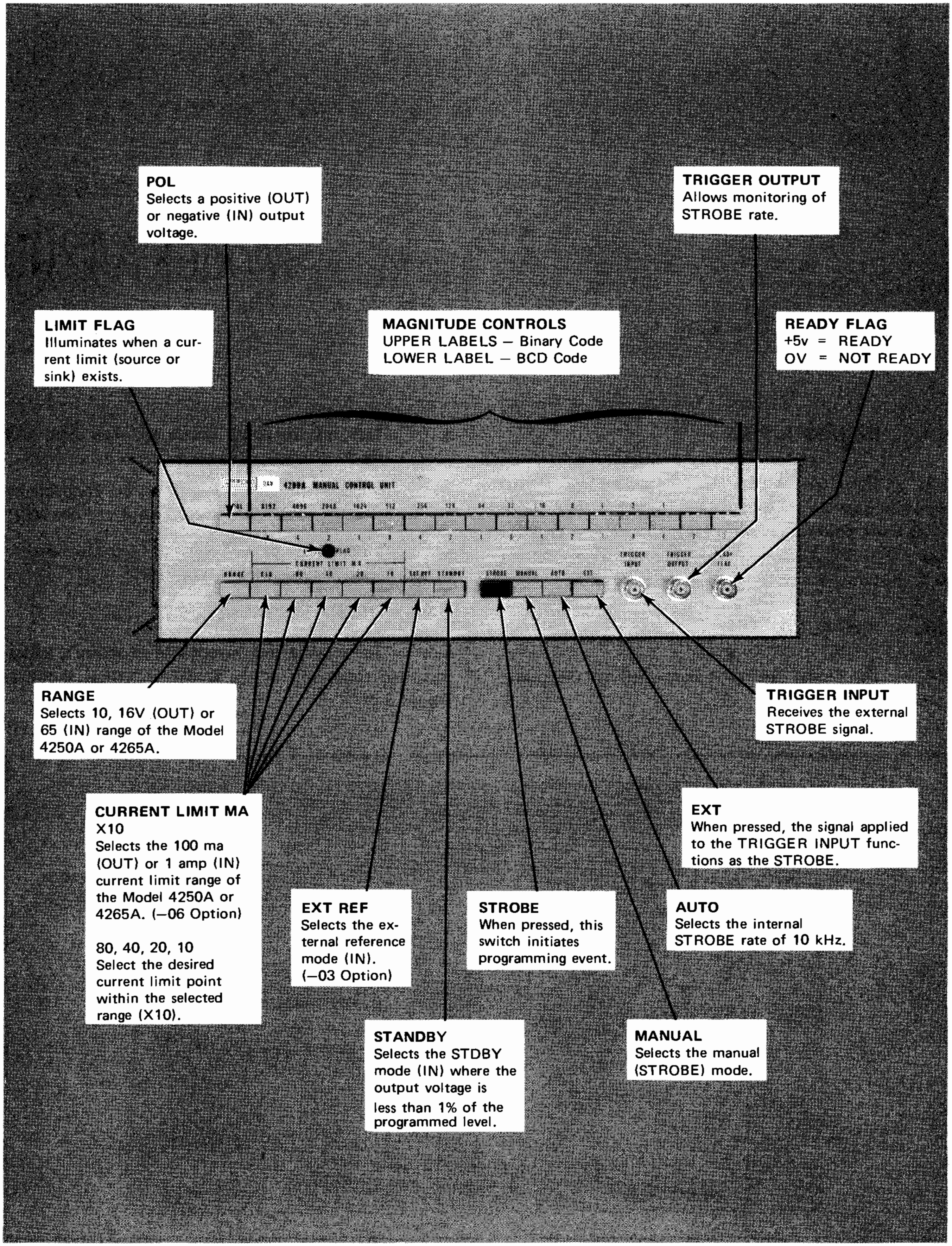
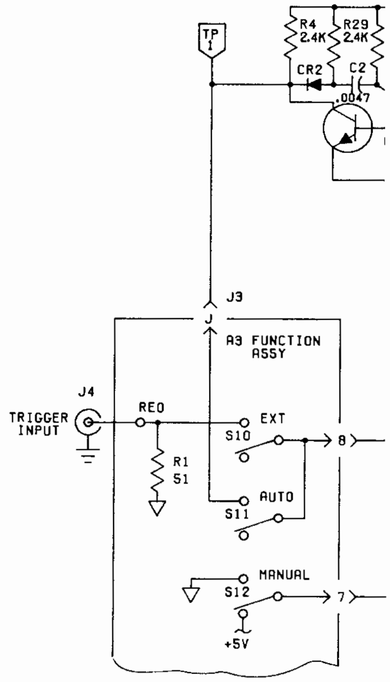


Figure 6-2. CONTROLS, INDICATORS AND CONNECTORS



NOTES

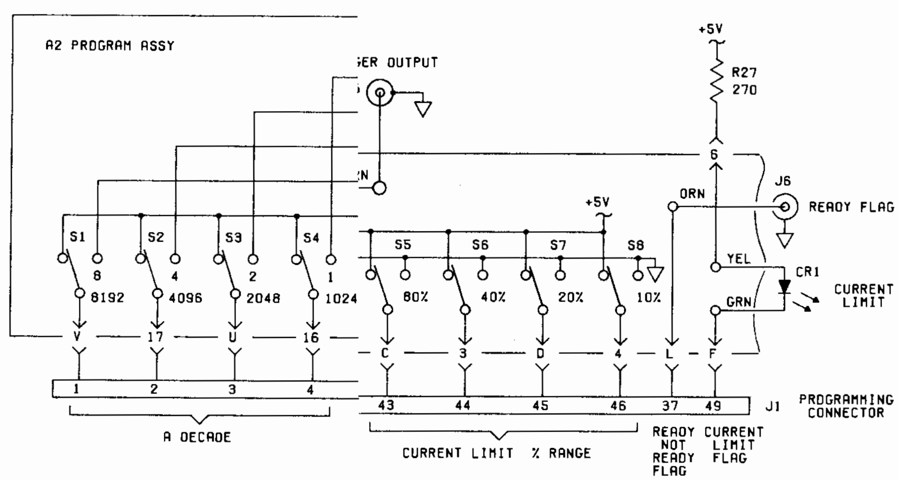
1. ALL SWITCHES SHOWN IN 'OUT' POSITION.
2. U1,U2,U3 PIN 14 CONNECTED TO +5V.
3. U1,U2,U3 PIN 7 CONNECTED TO LOGIC GND.
4. U1,U2,U3 PIN LOCATIONS

1	14
2	13
3	12
4	11
5	10
6	9
7	8

5. U3

DECODING LOGIC

0	$\overline{Q1}$	$\overline{Q2}$	$\overline{Q3}$	$\overline{Q4}$
1	Q1	$\overline{Q2}$	$\overline{Q3}$	$\overline{Q4}$
2	$\overline{Q1}$	Q2	$\overline{Q3}$	$\overline{Q4}$
3	Q1	Q2	$\overline{Q3}$	$\overline{Q4}$
4	$\overline{Q1}$	$\overline{Q2}$	Q3	$\overline{Q4}$
5	Q1	$\overline{Q2}$	Q3	$\overline{Q4}$
6	$\overline{Q1}$	Q2	Q3	$\overline{Q4}$
7	Q1	Q2	Q3	$\overline{Q4}$
8	$\overline{Q1}$	$\overline{Q2}$	$\overline{Q3}$	Q4
9	Q1	$\overline{Q2}$	$\overline{Q3}$	Q4
10	$\overline{Q1}$	Q2	$\overline{Q3}$	Q4
11	Q1	Q2	$\overline{Q3}$	Q4
12	$\overline{Q1}$	$\overline{Q2}$	Q3	Q4
13	Q1	$\overline{Q2}$	Q3	Q4
14	$\overline{Q1}$	Q2	Q3	Q4
15	Q1	Q2	Q3	Q4



FUNCTIONAL SCHEMATIC DIAGRAM

MODEL A4200
MANUAL CONTROL UNIT

DRAWING NO. A4200-1000

REV.

—

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

Accessory

Rack Mounting Fixtures

6-1. INTRODUCTION

6-2. The Fluke 4200 series power sources can be installed in a 19 inch equipment rack using one of the Accessory Rack Mounting Kits shown in Figure 6-1. Chassis Slide Kits can also be installed on full rack width units and the side-by-side mounted units.

6-3. INSTALLATION PROCEDURES

6-4. Center, Offset, Full Rack Bracket Installation

6-5. Installation of all Rack Mounting Brackets is done in essentially the same manner. To install these components and mount the power source in the equipment rack, 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.

d. Remove the feet from the bottom dust cover.

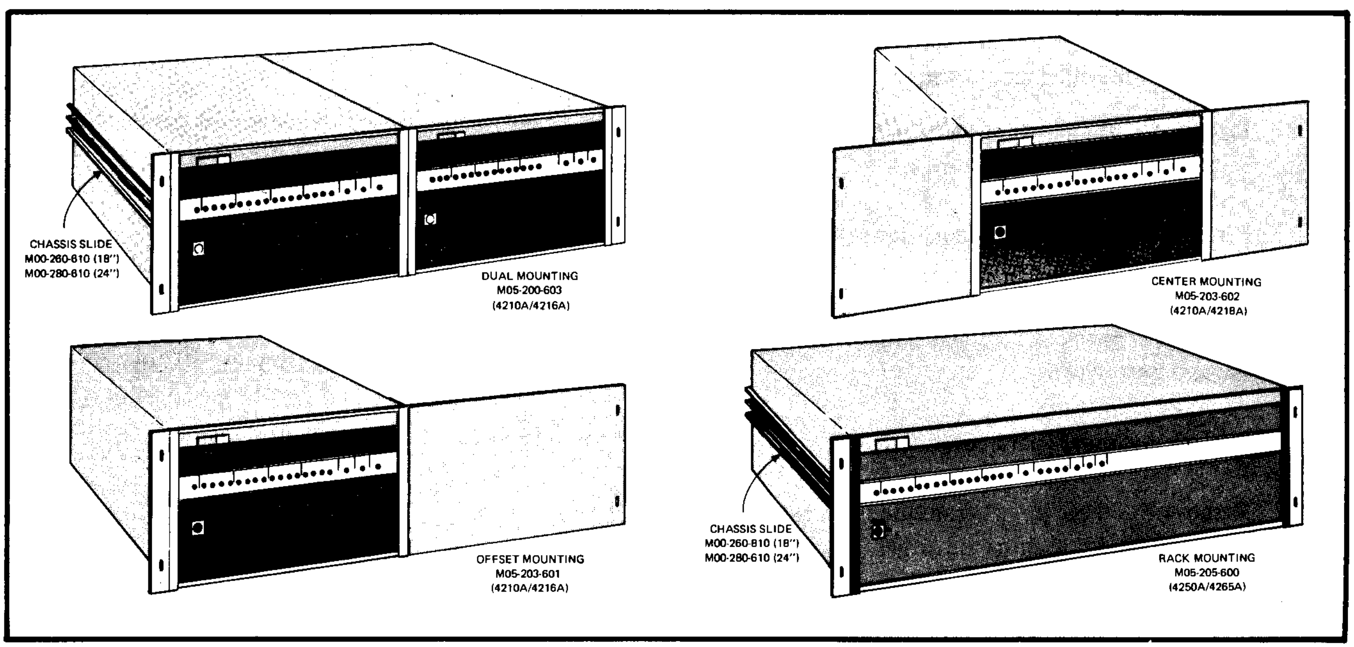


Figure 6-1. ACCESSORY RACK MOUNTING KITS

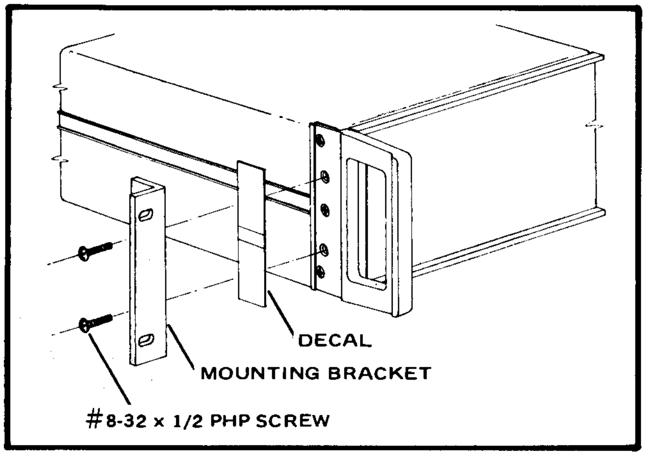


Figure 6-2. RACK MOUNTING BRACKET INSTALLATION

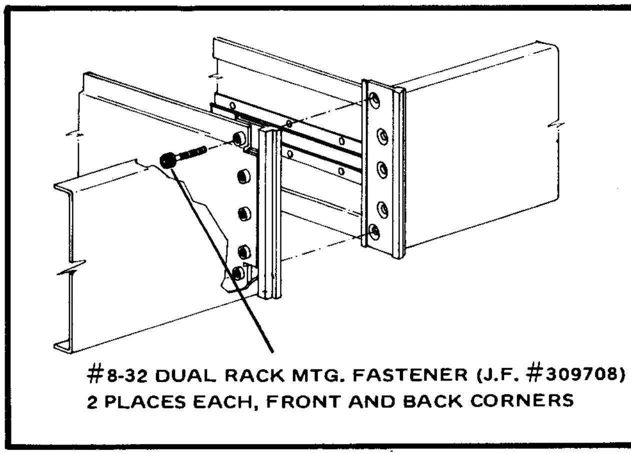


Figure 6-3. DUAL RACK MOUNTING

e. Slide the power source 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.

f. Connect the power cord to line power.

6-6. Dual Rack Installation

6-7. Two half-rack width power sources 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 power source is disconnected from line power.

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

c. Select one power source and remove the top and bottom dust covers.

d. Remove the inner guard cover.

e. Remove the three screws from the front side panel that will make against the other power source.

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 make against the other power source.

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

j. Install the inner guard cover removed in step d.

k. Remove the feet from the bottom dust cover of each power source.

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

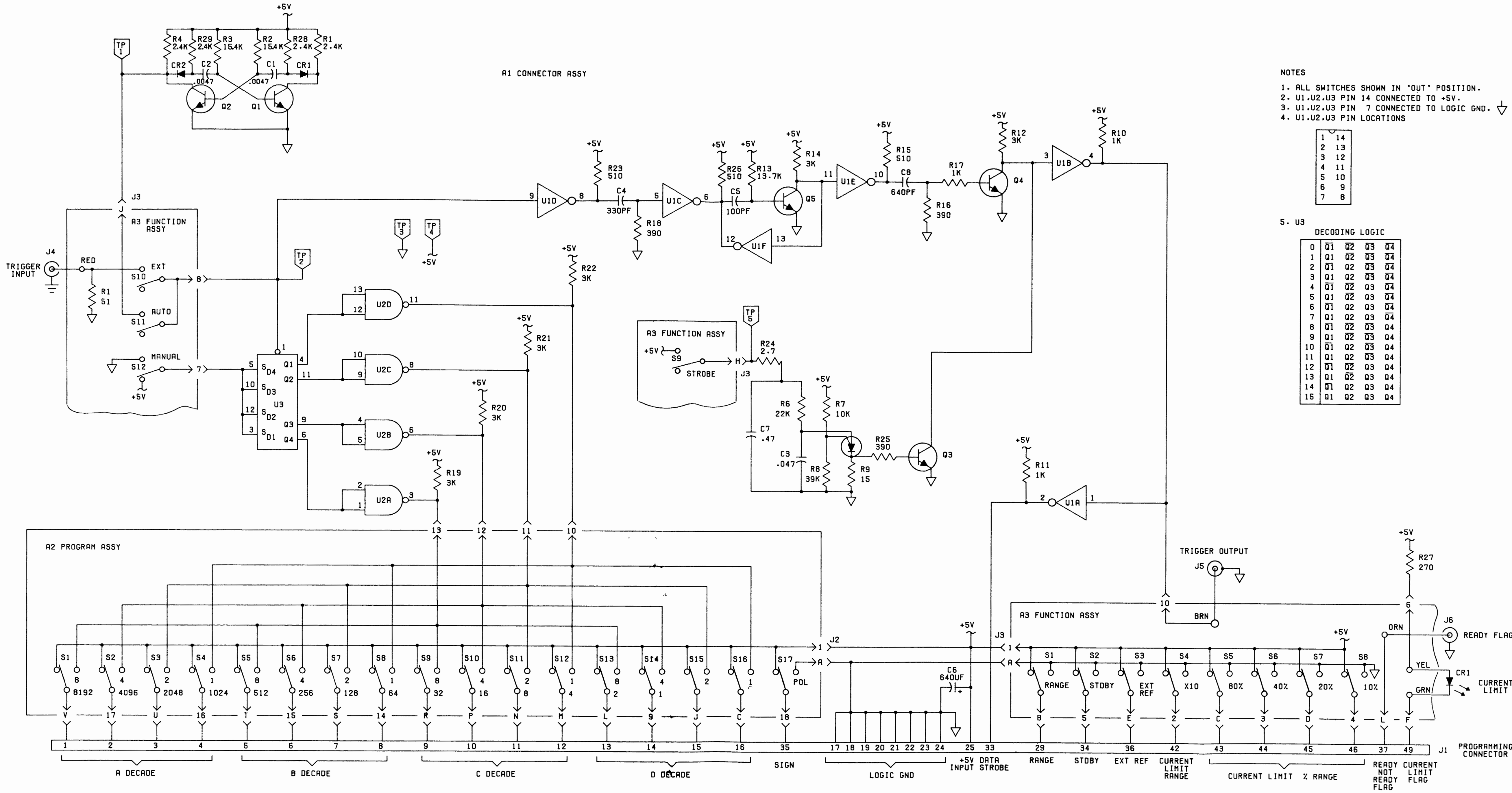
m. Install the mounting brackets shown in Figure 6-2 on the outer front side panels. Use the # 8-32 x 1/2" PHP screws provided in the kit.

n. Slide the two power sources 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.



NOTES

1. ALL SWITCHES SHOWN IN 'OUT' POSITION.
2. U1.U2.U3 PIN 14 CONNECTED TO +5V.
3. U1.U2.U3 PIN 7 CONNECTED TO LOGIC GND.
4. U1.U2.U3 PIN LOCATIONS

1	14
2	13
3	12
4	11
5	10
6	9
7	8

5. U3

DECODING LOGIC

0	$\overline{Q1}$	$\overline{Q2}$	$\overline{Q3}$	$\overline{Q4}$
1	Q1	$\overline{Q2}$	$\overline{Q3}$	$\overline{Q4}$
2	$\overline{Q1}$	Q2	$\overline{Q3}$	$\overline{Q4}$
3	Q1	Q2	$\overline{Q3}$	$\overline{Q4}$
4	$\overline{Q1}$	$\overline{Q2}$	Q3	$\overline{Q4}$
5	Q1	$\overline{Q2}$	Q3	$\overline{Q4}$
6	$\overline{Q1}$	Q2	Q3	$\overline{Q4}$
7	Q1	Q2	Q3	$\overline{Q4}$
8	$\overline{Q1}$	$\overline{Q2}$	$\overline{Q3}$	Q4
9	Q1	$\overline{Q2}$	$\overline{Q3}$	Q4
10	$\overline{Q1}$	Q2	$\overline{Q3}$	Q4
11	Q1	Q2	$\overline{Q3}$	Q4
12	$\overline{Q1}$	$\overline{Q2}$	Q3	Q4
13	Q1	$\overline{Q2}$	Q3	Q4
14	$\overline{Q1}$	Q2	Q3	Q4
15	Q1	Q2	Q3	Q4

FUNCTIONAL SCHEMATIC DIAGRAM

MODEL A4200
MANUAL CONTROL UNIT

DRAWING NO. A4200-1000 REV. —

FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

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 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 power source.

b. Peel the rear side panel decals from the power source.

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 power source.

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 power source between the extended center sections (D) on the cabinet.

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

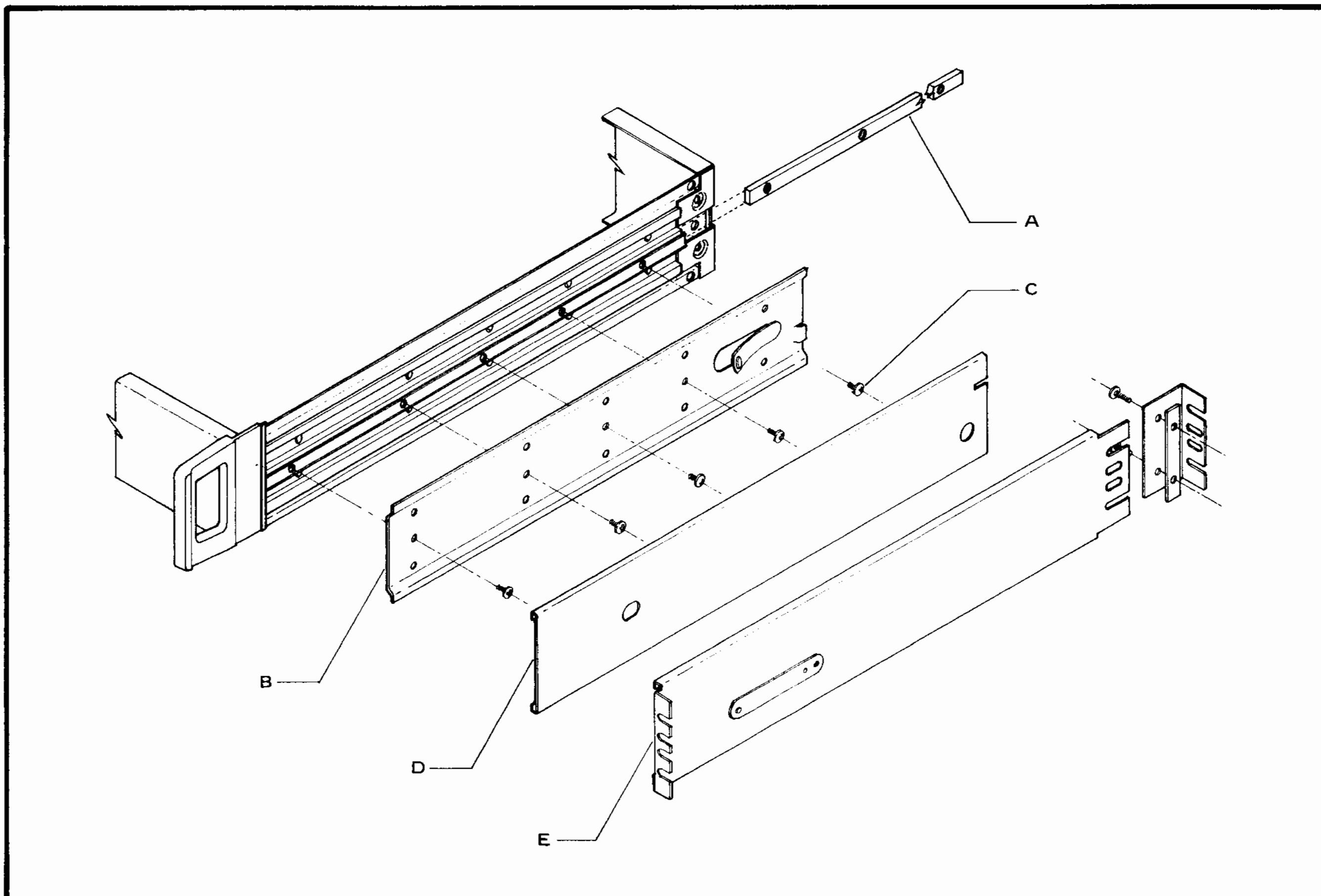


Figure 6-4. CHASSIS SLIDE INSTALLATION

Accessory

Programming Connector

6-1. INTRODUCTION

6-2. The mating connector shown in Figure 6-1 is required for interface between the Remote connector and the programming equipment. This connector can be obtained directly from Amphenol under PART NO. 57-30500, or from the factory by referencing FLUKE PART NO. 266056.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Wiring connections to the mating connector are done as follows:

a. Remove the screws from the cover of the mating connector and remove the cover.

b. Remove the screws from the restraining clamp on the cover and then remove the clamp.

c. Thread the wiring through the cover. Maximum size is #24.

d. Solder the wiring to the appropriate terminals of the connector. Refer to Figure 6-1 for terminal locations.

e. slide the cover in place and install the attaching screws.

f. Install the restraining clamp and screws. If necessary, wrap the wiring bundle to provide a proper diameter for the restraining clamp.

g. Connect the mating connector to the Remote connector, J1. Fasten it securely in place with the side clips.

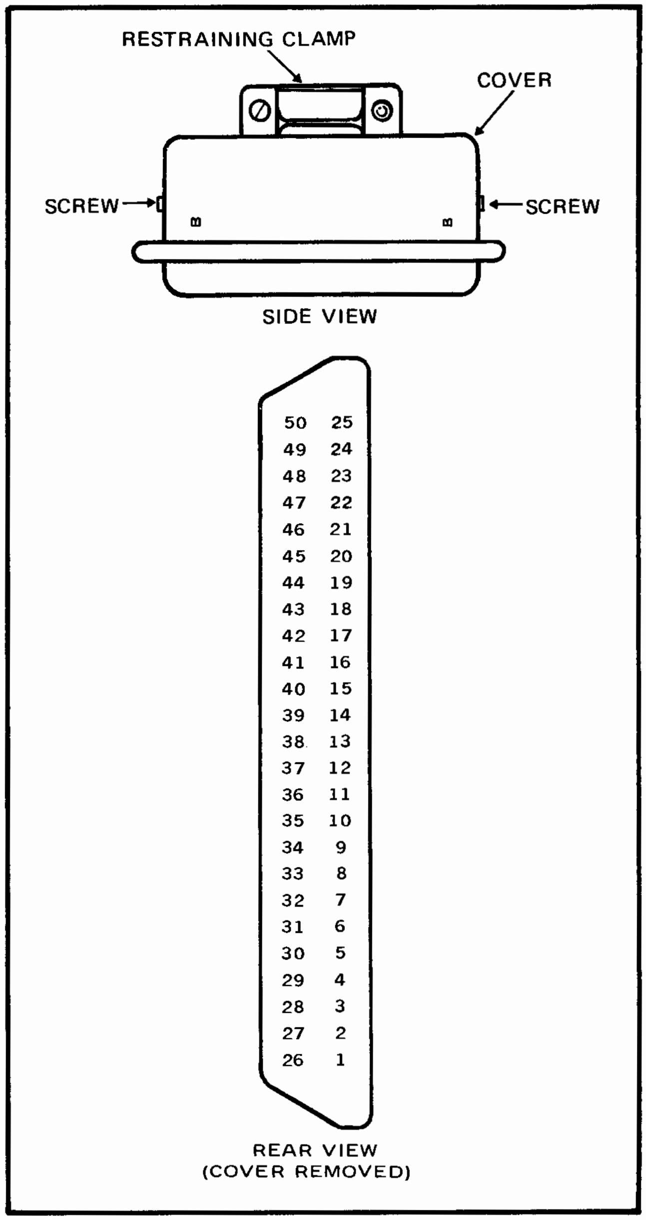


Figure 6-1. PROGRAMMING MATING CONNECTOR

Accessory
Extender Card

6-1. INTRODUCTION

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

6-3. INSTALLATION

6-4. To install a printed circuit board on the Extender Card as shown in Figure 6-2, proceed as follows:

a. Turn off the power source and then remove the top dust cover and inner guard cover.

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

c. Install the Extender Card in the Mother Board connector as shown in Figure 6-2.

d. Install the printed circuit board in the Extender Card connector as shown in Figure 6-2.

e. Turn on the power source. The printed circuit board can now be serviced.

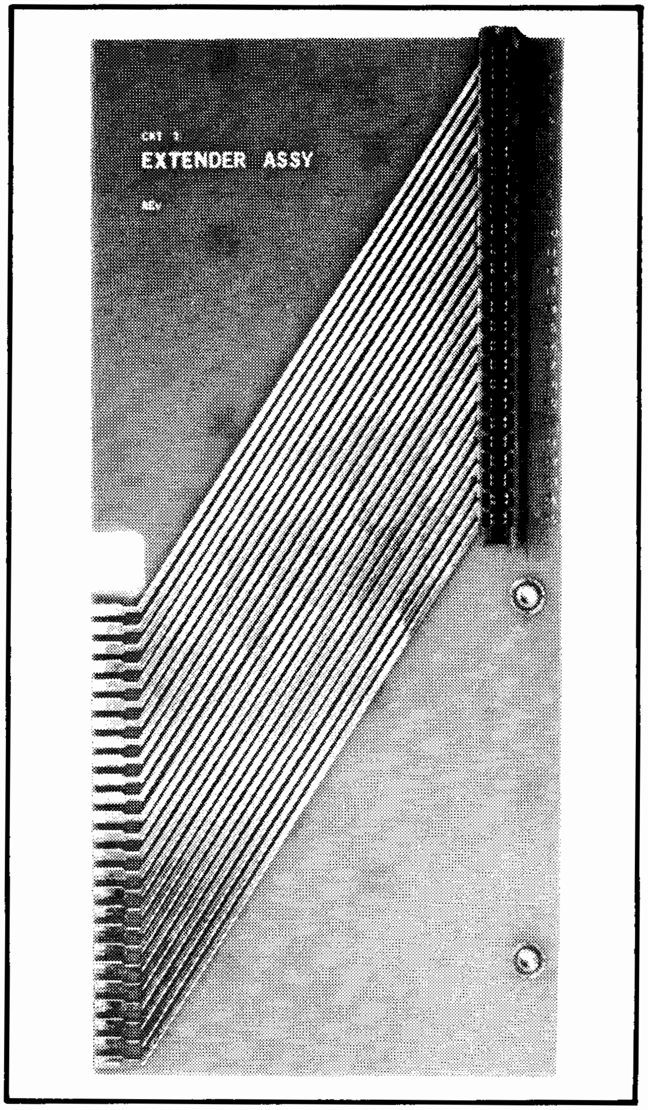


Figure 6-1. ACCESSORY EXTENDER CARD

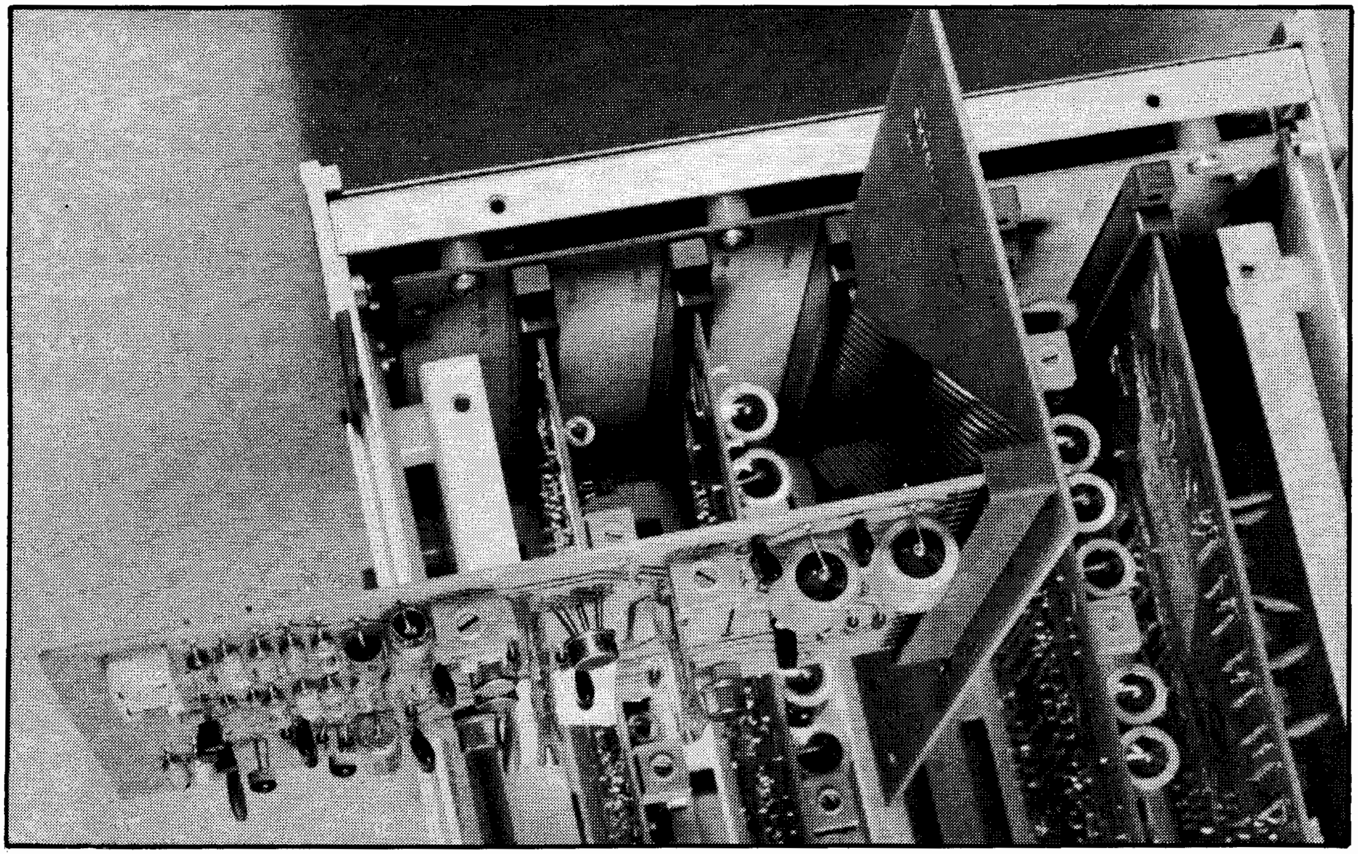


Figure 6-2. EXTENDER CARD INSTALLATION

Appendix A

Federal Supply Code for Manufacturers

A-1. CODE TO NAME

A-2. The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp. New Bedford, Massachusetts
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
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp. Saugerties, New York
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Arco Capacitors, Inc. Los Angeles, California
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transitron 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
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 Corp. Electronics Div. Cleveland, Ohio
05571	Sprague Electric Co Pacific Div. Los Angeles, 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
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Corp. Littletown, Colorado
06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div. Components Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Eitel-McCullough, Inc. San Carlos, California
07115	Replaced by 14674
07138	Westinghouse Electric Corp. Electronic Tube Div. Elmira, 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	Continental Device Corp. Hawthorne, California
08530	Reliance Mica Corp. Brooklyn, New York
08792	CBS Electronics Semiconductor Operations-Div. of CBS Inc. Lowell, Massachusetts
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09922	Burndy Corp. Norwalk, Connecticut
11237	Chicago Telephone of Calif. Inc. South Pasadena, California
11358	CBS Electronics Div. of CBS Inc. Newburyport, Massachusetts
11403	Best Products Co. Chicago, Illinois
11503	Keystone Mfg. Div. of Avis Industrial Corp. Warren, Michigan
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
12323	Presin Co., Inc. Shelton, Connecticut
12327	Freeway Washer & Stamping Co. Cleveland, Ohio
12400	Replaced by 75042
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
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 Corning Glass Works
Corning, New York

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

15909 Replaced by 17870

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

17069 Circuit Structures Lab.
Upland, California

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

18736 Voltronics Corp.
Hanover, New Jersey

19429 Montronics, Inc.
Seattle, Washington

19451 Perine Machinery & Supply Co.
Seattle, Washington

19701 Electra Mfg. Co.
Independence, Kansas

20584 Enochs Mfg. Co.
Indianapolis, Indiana

22767 ITT Semiconductors
Div. of ITT
Palo Alto, California

23732 Tracor
Rockville, Maryland

24248 Southco
Div. of South Chester Corp.
Lester, Pennsylvania

24655 General Radio Co.
West Concord, Massachusetts

25403 Amperex Electronic Corp
Semiconductor & Receiving
Tube Division
Slatersville, Rhode Island

28478 Deltrol Controls Corp.
Milwaukee, Wisconsin

28520 Heyman Mfg. Co.
Kenilworth, New Jersey

30323 Illinois Tool Works Inc.
Chicago, Illinois

33173 General Electric Co.
Tube Dept.
Owensboro, Kentucky

37942 Mallory, P. R., & Co., Inc.
Indianapolis, Indiana

38315 Honeywell Inc.
Precision Meter Div.
Manchester, New Hampshire

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

53021 Sangamo Electric Co.
Springfield, Illinois

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

71400 Bussmann Mfg.
Div. of McGraw-Edison Co.
St. 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

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.
Willimantic, 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.
Chicago, Illinois

72982 Erie Tech. Products Inc.
Erie, Pennsylvania

73138 Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293 Hughes Aircraft Co.
Electron Dynamics Div.
Newport Beach, 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.
Philadelphia, Pennsylvania

75376 Kurz-Kasch, Inc.
Dayton, Ohio

75382 Kulka Electric Corp.
Mt. 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

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.
St. Marys, Pennsylvania

78553 Tinnerman Products
Cleveland, Ohio

79136 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 Sprague Products
North Adams, Massachusetts

80294 Bourns Inc.
Riverside, California

80583 Hammarlund Co., Inc.
Mars Hill, North Carolina

80640 Stevens, Arnold Inc.
Boston, Massachusetts

81073 Grayhill Inc.
La Grange, Illinois

81312 Winchester Electronics
Div. of Litton Industries
Oakville, Connecticut

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp.
El Segundo, California

81590 Korry Mfg. Co.
Seattle, Washington

82376 Deleted

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

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

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	91934	Miller Electric Co., Inc. Pawtucket, Rhode Island	95354	Methode Mfg. Corp. Rolling Meadows, Illinois	97966	Replaced by 11358
90303	Mallory Battery Co. Tarrytown, New York	93332	Sylvania Electric Products Semiconductor Products Div. Woburn, Massachusetts	95712	Dage Electric Co., Inc. Franklin, Indiana	98094	Replaced by 49956
91293	Johanson Mfg. Co. Boonton, New Jersey	94145	Replaced by 49956	95987	Weckesser Co., Inc. Chicago, Illinois	98278	Microdot Inc. Pasadena, California
91407	Replaced by 58474	94154	Tung-Sol Div. of Wagner Electric Corp. Newark, New Jersey	96733	San Fernando Electric Mfg. Co. San Fernando, California	98291	Sealectro Corp. Conhex Div Mamaroneck, New York
91637	Dale Electronics Inc. Columbus, Nebraska	95146	Alco Electronics Products Inc. Lawrence, Massachusetts	96853	Rustrak Instrument Co. Manchester, New Hampshire	98388	Accurate Rubber & Plastics Culver City, California
91662	Elco Corp. Willow Grove, Pennsylvania	95263	Leecraft Mfg. Co. Long Island City, New York	96881	Thomson Industries, Inc. Manhasset, New York	98743	Replaced by 12749
91737	Gremar Mfg. Co., Inc. Wakefield, Massachusetts	95264	Replaced by 98278	97540	Master Mobile Mounts Div. of Whitehall Electronics Corp. Los Angeles, California	98925	Deleted
91802	Industrial Devices, Inc. Edgewater, New Jersey	95275	Vitramon Inc. Bridgeport, Connecticut	97913	Industrial Electronic Hdware Corp. New York, New York	99120	Plastic Capacitors, Inc. Chicago, Illinois
91836	King's Electronics Tuckahoe, New York	95303	Radio Corp. of America Solid State & Receiving Tube Div. Cincinnati, Ohio	97945	White, S. S. Co. Plastics Div. New York, New York	99217	Southern Electronics Corp. Burbank, California
91929	Honeywell Inc. Micro Switch Div. Freeport, Illinois					99515	Marshall Industries Capacitor Div. Monrovia, California

Appendix B

List of Abbreviations

A,amp	ampere	m	milli or 10^{-3}
ampl	amplifier	mm	millimeter
ac	alternating current	n	nano or 10^{-9}
assy	assembly	neg	negative
BCD	binary coded decimal	Ω	ohm
cap	capacitor	osc	oscilloscope
car	carbon	ppm	parts per million
cm	centimeter	piv	peak inverse voltage
C	centigrade	p-p	peak to peak
cer	ceramic	p	pico or 10^{-12}
cw	clockwise	plstc	plastic
CMRR	common mode rejection ratio	±	plus or minus
comp	composition	pos	positive
CCW	counterclockwise	pps	pulses per second
conn	connector	PCB	printed circuit board
CRT	cathode ray tube	QTY	quantity
cps	cycles per second	rf	radio frequency
db	decibel	rfi	radio frequency interference
dvm	digital voltmeter	REC	recommended
dc	direct current	REF	reference
dpdt	double-pole, double-throw	RH	relative humidity
dpst	double-pole, single-throw	res	resistor
elect	electrolytic	rms	root mean square
ext	external	rtry	rotary
f	fahrenheit	sec	second
F	farad	sect	section
FET	field effect transistor	S/N	serial number
flm	film	Si	silicon
Ge	germanium	scr	silicon controlled rectifier
g	giga or 10^{9}	spdt	single-pole, double-throw
gnd	ground	spst	single-pole, single-throw
gmv	guaranteed minimum value	sw	switch
grd	guard	Ta	tantalum
h	henry	TC	temperature coefficient
Hz	hertz	t	tera or 10^{12}
hf	high frequency	xfmr	transformer
IC	integrated circuit	tstr	transistor
if	intermediate frequency	tvm	transistor voltmeter
int	internal	uhf	ultra high frequency
kc	kilocycle	vtvm	vacuum tube voltmeter
k	kilo (10^{3})	var	variable
lf	low frequency	vhf	very high frequency
mc	megacycle	vlf	very low frequency
M	meg or mega (10^{6})	V	volt
met	metal	VCO	voltage controlled oscillator
MOS	metal oxide silicon	w	watt
μ	micro or 10^{-6}	ww	wire wound

Appendix C

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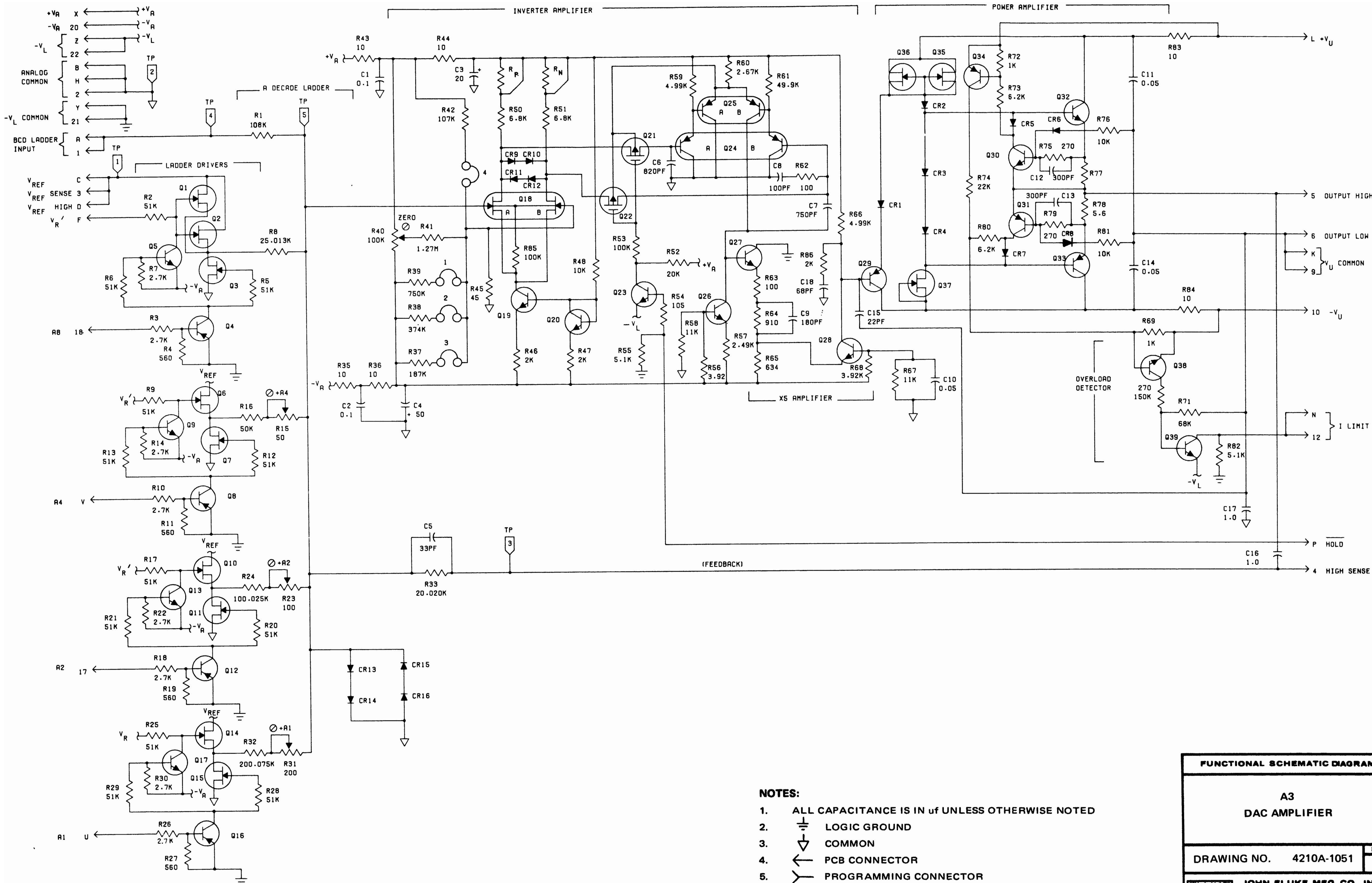

NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. LOGIC GROUND
3. COMMON
4. PCB CONNECTOR
5. PROGRAMMING CONNECTOR

FUNCTIONAL SCHEMATIC DIAGRAM	
A3 DAC AMPLIFIER	3
DRAWING NO. 4210A-1051	REV. a
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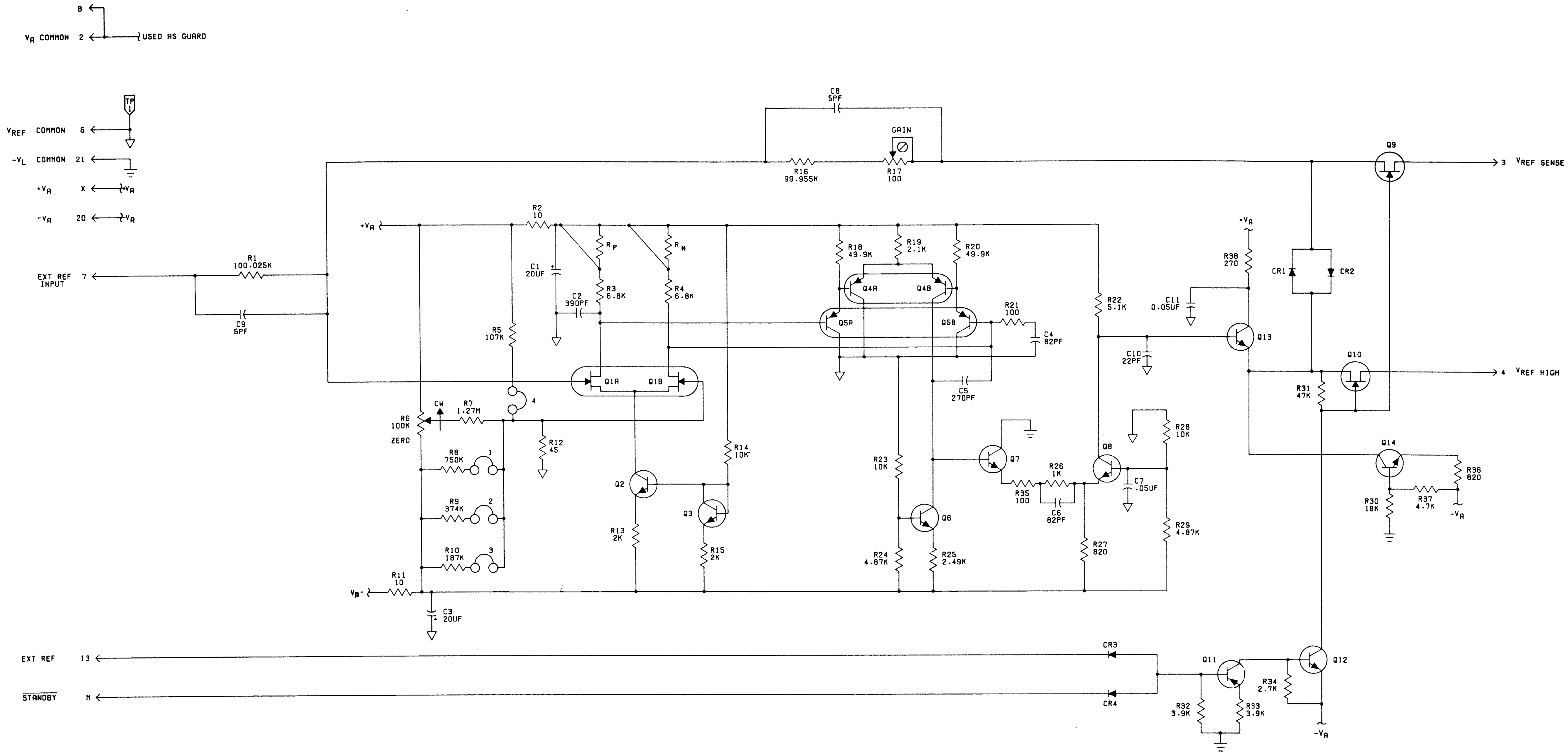

NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. LOGIC GROUND
3. COMMON
4. PCB CONNECTOR
5. PROGRAMMING CONNECTOR

FUNCTIONAL SCHEMATIC DIAGRAM	
A4 OPTION –03 EXTERNAL REFERENCE	4
DRAWING NO. 4210A-1041	REV. B
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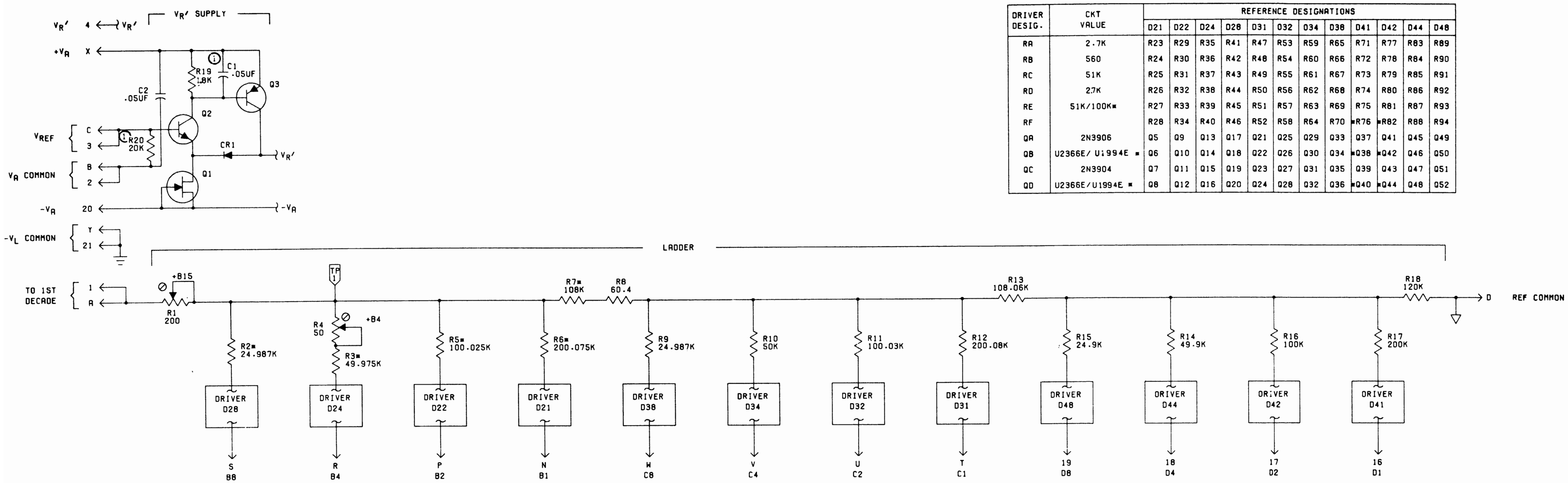
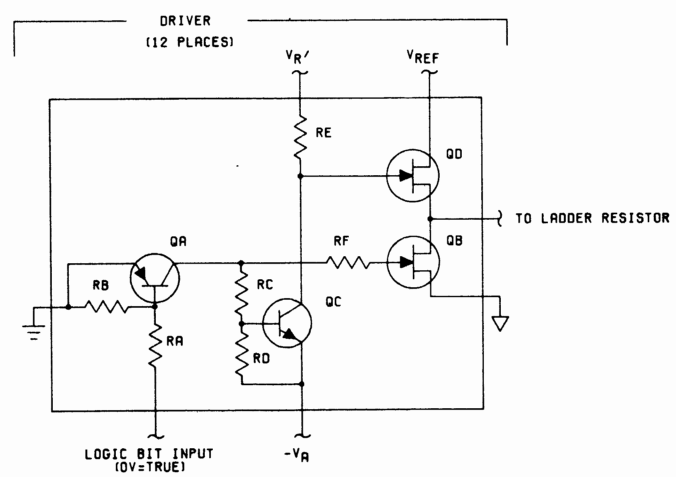


DRIVER DESIG.	CKT VALUE	REFERENCE DESIGNATIONS											
		D21	D22	D24	D28	D31	D32	D34	D38	D41	D42	D44	D48
RA	2.7K	R23	R29	R35	R41	R47	R53	R59	R65	R71	R77	R83	R89
RB	560	R24	R30	R36	R42	R48	R54	R60	R66	R72	R78	R84	R90
RC	51K	R25	R31	R37	R43	R49	R55	R61	R67	R73	R79	R85	R91
RD	2.7K	R26	R32	R38	R44	R50	R56	R62	R68	R74	R80	R86	R92
RE	51K/100K*	R27	R33	R39	R45	R51	R57	R63	R69	R75	R81	R87	R93
RF		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/ U1994E *	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/U1994E *	Q8	Q12	Q16	Q20	Q24	Q28	Q32	Q36	*Q40	*Q44	Q48	Q52

CHANGES:

1. FOR S/N 123 THRU 127
   R19 WAS 560Ω
   R20 WAS 51K



NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. LOGIC GROUND
3. COMMON
4. ← PCB CONNECTOR
5. * FACTORY SELECTED

FUNCTIONAL SCHEMATIC DIAGRAM

5

A5
BCD LADDER

DRAWING NO. 4210A-1031 REV. a

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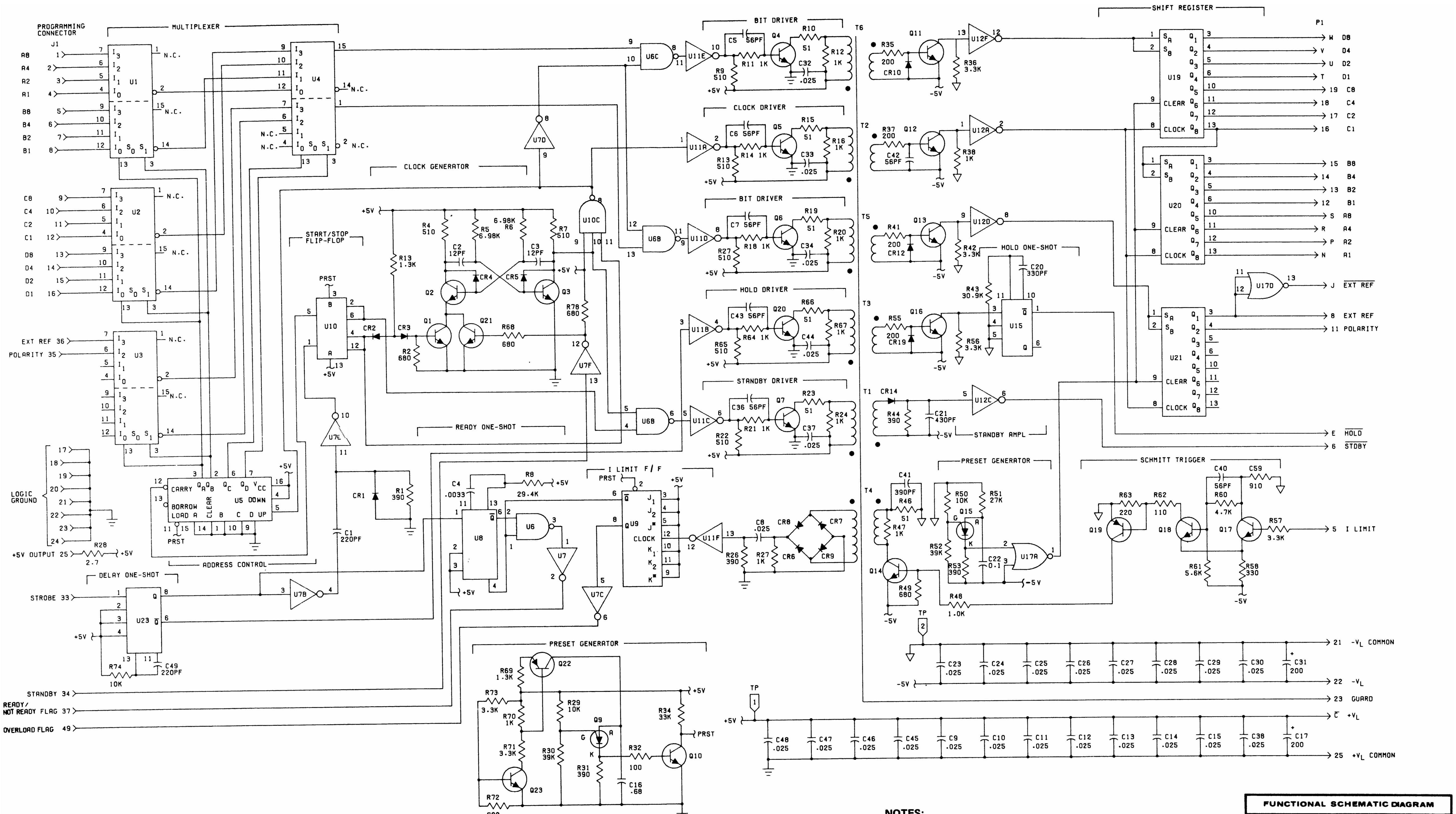

NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. LOGIC GROUND
3. COMMON
4. PCB CONNECTOR
5. PROGRAMMING CONNECTOR

FUNCTIONAL SCHEMATIC DIAGRAM

6

A6
OPTION –01
ISOLATED CONTROL LOGIC

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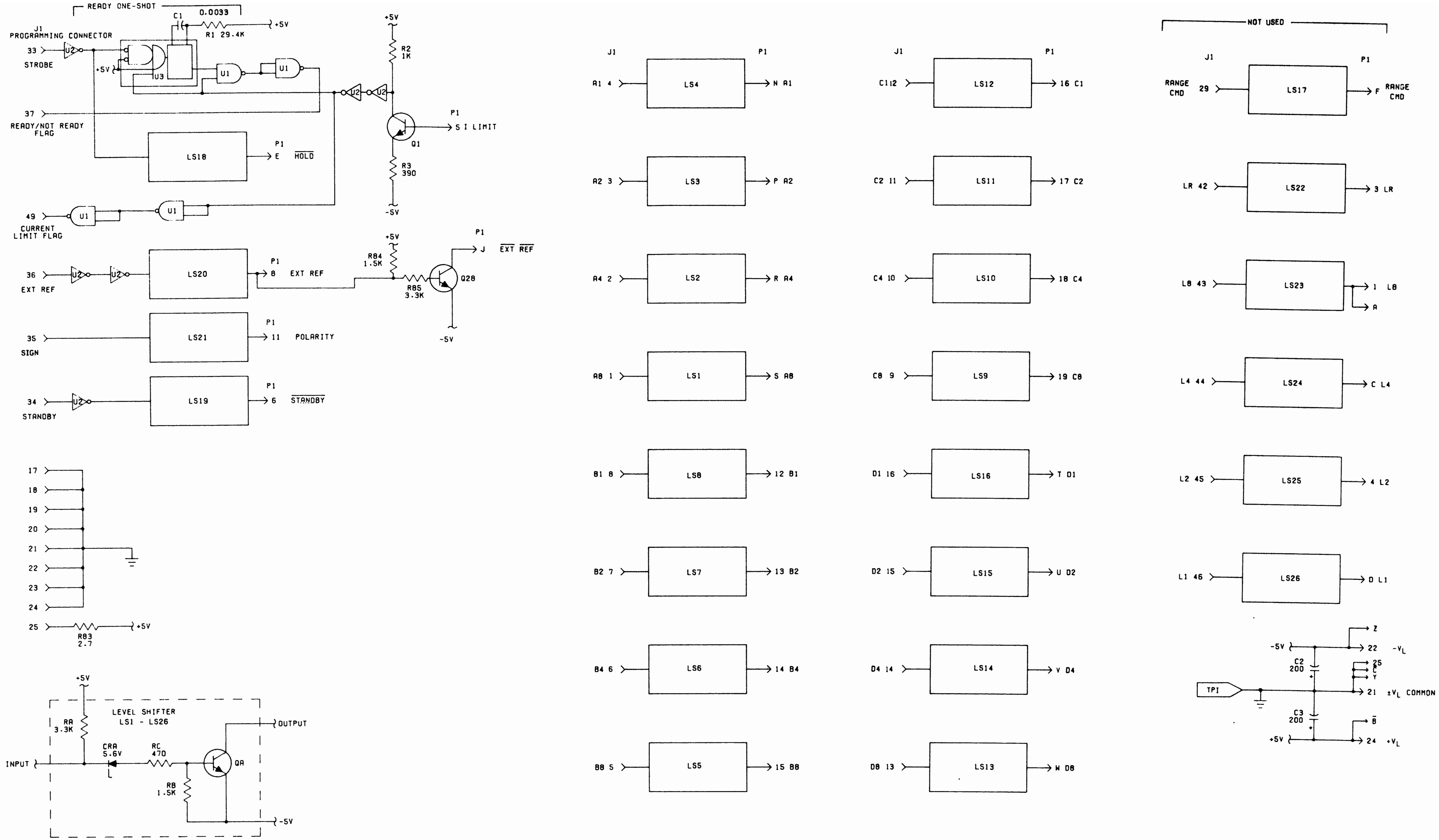

REF DES	TYPE	LS 1	LS 2	LS 3	LS 4	LS 5	LS 6	LS 7	LS 8	LS 9	LS 10	LS 11	LS 12	LS 13	LS 14	LS 15	LS 16	LS 17	LS 18	LS 19	LS 20	LS 21	LS 22	LS 23	LS 24	LS 25	LS 26
QA	CS23030	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
RA	3.3K	R4	R7	R10	R13	R16	R19	R22	R25	R28	R31	R34	R37	R40	R43	R46	R49	R52	R55	R58	R61	R64	R67	R70	R73	R76	R80
RB	1.5K	R5	R8	R11	R14	R17	R20	R23	R26	R29	R32	R35	R38	R41	R44	R47	R50	R53	R56	R59	R62	R65	R68	R71	R74	R77	R81
RC	470	R6	R9	R12	R15	R18	R21	R24	R27	R30	R33	R36	R39	R42	R45	R48	R51	R54	R57	R60	R63	R66	R69	R72	R75	R78	R82
CRA	IN752A	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12	CR13	CR14	CR15	CR16	CR17	CR18	CR19	CR20	CR21	CR22	CR23	CR24	CR25	CR26

NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. ⏚ LOGIC GROUND
3. ▽ COMMON
4. ← PCB CONNECTOR
5. ≻ PROGRAMMING CONNECTOR

FUNCTIONAL SCHEMATIC DIAGRAM

7

A6
OPTION --04
DIRECT COUPLED CONTROL LOGIC

DRAWING NO. 4210A-1022 REV. C

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