Instruction Manual

for

Model 8200

6½ - Digit
Voltage & Current
CALIBRATOR

ANALOGIC ■

DATA PRECISION

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installation, operation, and maintenance of the equipment
described herein.

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INTRODUCTION

1.1 GENERAL

The Data Precison Model 8200 Calibrator is a precision
6½-digit (1,048,575 counts), microcomputer-controlled,
voltage and current standard, providing a completely
isolated analog signal from 0.1µV to 100V (or up to 1000V
with the 1KV option), or 1µA to 100mA, for the test and
calibration of high-precision analog circuits. When
enhanced with the optional IEEE488 bus interface, the
Model 8200 may be remotely programmed as a voltage or
current standard for ATE applications. The Model 8200
is configured in a standard 3½-inch high, 19-inch wide
metal case, suitable for rack mounting (with the rack
mounting option, A6. Its light weight of less than 17
pounds, and its universal powering capability (115 or
230Vac) make the Model 8200 a convenient, portable
standard for use in a variety of test/inspection en-
vironments.

1.2 FEATURES

The Model 8200 provides three selectable full scale
ranges for dc voltage generation (100mV, 10V, and 100V)
and one range scale for dc current generation (100mA).
Polarity for each is independently selected by front-panel
control, while the decimal point is positioned
automatically in the 6½-decade display. A field-
installable **1KV** option provides an extended range up to
1000V.

Accuracy of the analog voltage output is within 10ppm
of the reading + 1ppm of the full scale range. Accuracy
of the current output is within 0.01% of the reading +
1µA.

High speed settling is compatible with the designed use
of the Model 8200 as part of a computer-controlled ATE
system. Output values settle from one level to the other
in the same range within 1ms, and within 15ms when a
range change has been made.

Stable outputs are designed for long periods of unat-
tended use. Long-term drift of less than 10ppm may be
expected over 60 days. Temperature coefficients over an
operating range from 15°C to 35°C introduce 1ppm/°C of
reading +0.2ppm of full scale range on the 10V scale,
and 2ppm/°C of reading + 0.2ppm of full scale range on
either 100mV or 100V ranges. The dc current
temperature coefficient is 10ppm of reading and 2ppm of
range.

Front-panel controls and the display operate in a "full
duplex" mode. That is, the operator indicates his
desired change in output to the microcomputer, while
the display is controlled **directly** by the microcomputer,
*after the change in value has been verified to be a valid
one and then transmitted by the microcomputer to the
display.*

Front-panel setup of varying output magnitudes is
designed for optimum human-engineered convenience.
Each of the 6 decade selectors at the front panel may be
operated in either clockwise or counterclockwise (incre-
ment or decrement action) without limit so that the out-
put value may be changed by the selected incremental
resolution **without having to change decade selectors**
The instrument performs full carry or full borrow to or
from higher decades to the limits of the selected full
scale range.

Fail-safe operating modes protect the tested com-
ponents from inadvertent high signals. The Model 8200
returns to 0 when a change in polarity is commanded, or
when a range scale is changed.

Remote programming is field installable. The IEEE488
bus interface assembly may be installed within the
Model 8200 chassis as a user-installable procedure. The
assembly is plug-connected within the Calibrator, and
the programming has been installed for the remote
operation.

1.3 INSTALLATION

Model 8200 Calibrator is wrapped in a plastic water-proof
bag, placed between foam shock isolators, and shipped
in a protective carton. You will find the documentation
inside the shipping carton. This includes the Certificate
of Conformance, Warranty registration, Final Acceptance
Test Data, and this Instruction Manual. The instrument
is shipped, ready for use. Ordered options have been in-
stalled, and the ac line cord is included. Ordered ac-
cessories will be shipped in their own containers as
separate items.

After unpacking, examine the contents carefully. Inspect
the packing case and the instrument for any signs of
damage during shipment and report immediately to the
carrier. Fill out and return the warranty card in order to
register your instrument and to establish your warranty
service interval.

Retain the packing material for reshipment. When shipping the Model 8200 Calibrator, use foam shock isolators and pack in the original shipping carton, if available. If original shipping material is no longer available, use some shock isolators, such as bubble plastic, and wrap securely within a suitable carton.

1.4 INSTALLING & POWERING THE MODEL 8200

The Model 8200 Calibrator is designed for bench-top or rack-mounted installations (with the rack mount option). Figure 1-1 indicates the space required for the instrument in any application. The bottom cover of the calibrator is fitted with "feet" for non-skid bench use, and a built-in tilt stand may be extended for convenient viewing and front-panel operation. No cooling fan is used, and no special temperature controls are needed. The ambient, however, should remain fairly stable during use in order to obtain the full benefits of the instrument accuracies and stability.

The Model 8200 Calibrator is designed for 115 and 230 volt rms sourcing. A rear-panel switch configures the input transformer primary for the available power.

CAUTION

Check the rear panel and confirm the switch setting for the available power. See Chapter 2, Figure 2-2, for further details and information.

Connect the ac line cord to the rear-panel power receptacle.
Refer to Chapter 2, Operating Instructions, for instructions on connecting the 8200 to instruments under test. Allow at least ½ hour for warmup before using the Calibrator in any application.

16.832

11.250

3.500

(DIMENSIONS IN INCHES)
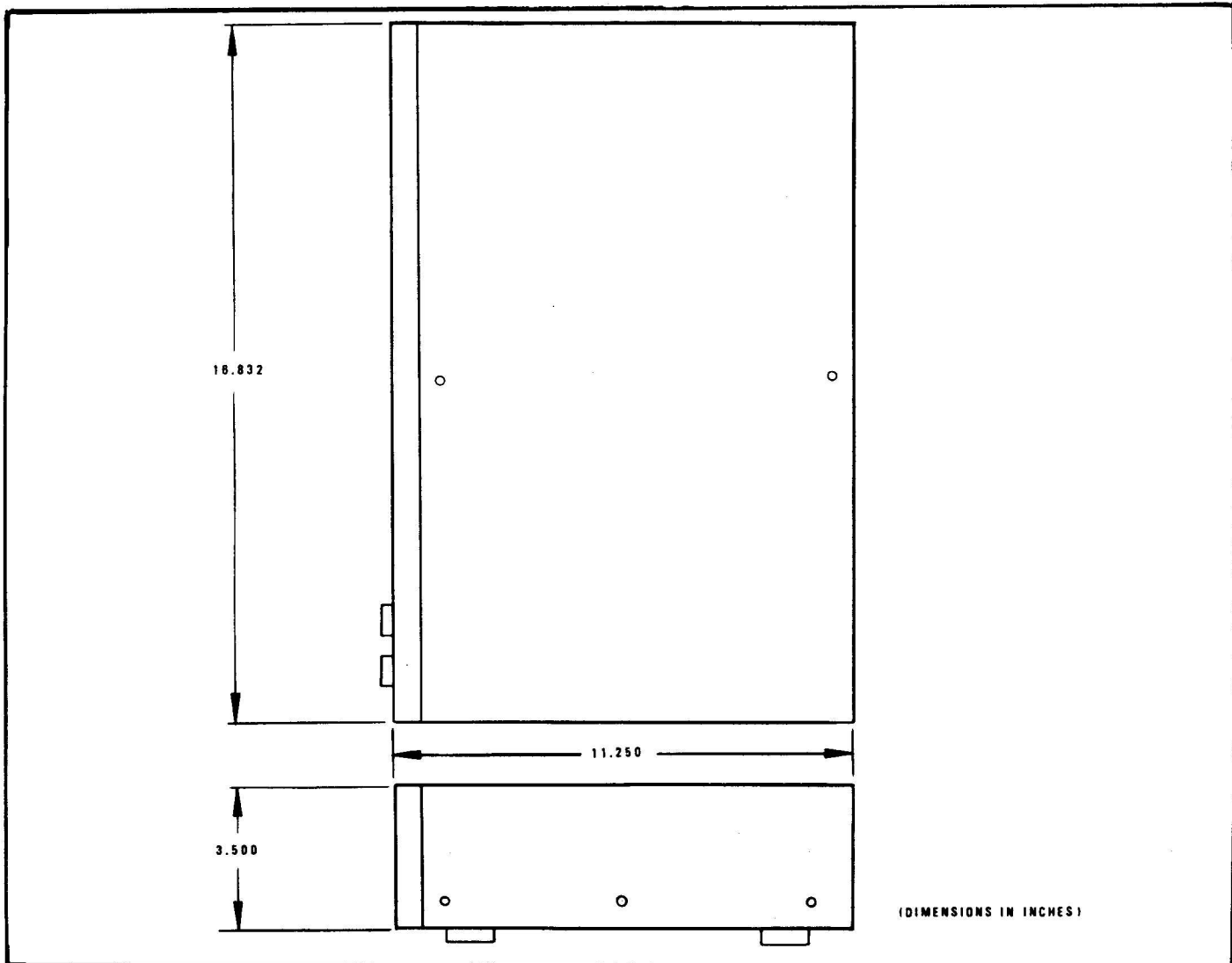
1-1. Outline & Mounting Dimensions

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SPECIFICATIONS
&
OPERATION

2.1 SPECIFICATIONS

2.1.1 Voltage Mode

Range	Full Scale	Resolution	Current	Accuracy	Output Impedance
± 100 mV	± 104.8575 mV	0.1 μV	-----	± (60ppm rdg + 1μV)	100 ohms
± 10 V	± 10.48575 V	10 μV	100 mA, max	± (10ppm rdg + 10μV)	10 milliohms
± 100 V	± 104.8575 V	100μV	10 mA, max	± (10ppm rdg + 100μV)	20 milliohms

Noise (dc · 10 kHz):

10V Range: 10μV rms
100V Range: 100μV rms

Settling Time:

1 msec to rated accuracy (without range change)

Stability:

10ppm 60 days

20ppm 6 months

Temperature Coefficient (15°C to 35°C):

10V: ± (1ppm/°C rdg + 0.2ppm/°C range)

100V: ± (2ppm/°C rdg + 0.2ppm/°C range)

2.1.2 Current Mode

Range	Full Scale	Resolution	Compliance Voltage	Accuracy
± 100 mA	± 100.000 mA	1μA	10V	± (0.01% rdg + 1μA)

Temperature Coefficient:

± (10ppm/°C + 2ppm/°C range)

2.1.3 Voltage/Current Mode Performance

Warmup Time

1 hour to rated accuracy

Output:

10V and 100V Ranges: Floating, 4-terminal, with remote sensing and guard.
100mV Range: Rear-panel, shielded, connector; 2 terminals plus guard.
100mA Range: Floating, 2-terminal, plus guard.

Common Mode Voltage:

500V max, guard to case

Calibration Interval:

6 months 20ppm

60 days 10ppm

Power:

115/230V, 50 - 60 Hz, 25 Watts

Controls and Indicators:

6 rotary decade selector switches, unlimited travel, clockwise or counter clockwise, with carry and borrow, as required
1 rotary range and mode selector switch
1 rotary polarity selector switch
7 LED display indicators, 0.8 in high; 6 full decades, overflow, + , − .
4 Annunciators: **mV, mA, REM,** and ¹ᐟᵥ (for 1000V selection). **V** is understood when no other selection is made.
1 pushbutton power switch

2.1.4 Options

IEEE488 Interface (GPIB)

Rack Mounting

Rear Terminals

1kV Amplifier

2.1.5 IEEE488 OPTION

Address:

Address is determined by five dip switches mounted on the option assembly board.

Local - Remote:

When addressed to **listen**, and when sent a character, the 8200 assumes **REMOTE** operating status, and can no longer be programmed from the front panel. The instrument retains its previous output setting until receipt of a valid character string as specified below. **LOCAL** operating status is resumed on receipt of an **L** at any time, or by a power **OFF/ON** cycle.

Character Strings:
All characters are **ASCII.**
Parity bit is ignored.

Voltage Mode:

1st character	V	Voltage mode
2nd character	0	100mV range
	1	10V range
	2	100V range
	3	1000V range
3rd character	+	Plus polarity
	−	Minus polarity
4th through 10th characters	0 to 9	Magnitude (*NUL*, . , or *SPACE* is ignored after polarity is received.)

Current Mode:

1st character	A	100mA range
2nd character	+	Plus polarity
	−	Minus polarity
3rd through 8th character		Magnitude (As above, for voltage mode)

Characters received before a **V** or **A** are ignored. Once a **V** or **A** is received, the string must conform to the format specified above.
Invalid characters reset the pointer, and they must be followed by a complete new string.
Receipt of the last character in the string initiates an output.
Out-of-range values cause a zero output.

2.2 OPERATION

2.2.1 Front Panel Features

Table 2-1 describes the front panel features that are indicated in Figure 2-1.

2.2.2 Rear Panel Features

Table 2-2 describes the features of the rear panel indicated in Figure 2-2.

*All capitals or bold type letters are used for names as they appear on the front panel.
Reference designations in parentheses correspond to designations used in schematic diagrams.

Table 2-1
FRONT PANEL CONTROLS & INDICATORS

Ref	Name*	Description / Function
1	POWER (SW200)	Push-push switch. Connects fused main power to transformer primary. See rear panel description for power source information.
2	Polarity +, 0, − (SW201)	3-Position rotary switch. Selects positive, or negative polarity for analog output signal. Center position (0) is default for positive polarity.
3	Decade Selectors (SW202-SW207)	6 decade rotary selector switches. Unlimited travel in either clockwise or counterclockwise direction. Applies +5V through "interrupter" wafer to contact brushes that provide indications of movement and direction (cw or ccw) to microporcessor.
4	Range 100mA, 100mV, 10V, 100V, 1000V (SW208)	5-Position rotary switch. Selects operating mode (voltage or current) and full scale range of the output signal. If selected 1000V range is not supported by installed option, **Error** message is displayed.
5	Output HI, LO, HI SENSE, LO SENSE, GUARD	5 five-way binding posts. Installed to accept standard banana-plug connectors. Jumper straps are provided to connect output to sense terminals and GUARD to LO terminals. See rear panel description for 100mV full scale output.
6	Annunciators mV, mA, REM, ⚡	4 LED lamps that are operated in response to the commanded range selection (100mV, 100mA, or 1000V) or when control is being exercised over the IEEE488 bus (**REM**).
7	Display	6½-digit display. All are driven by computer control. Polarity sign is incorporated in MSD. Decimal point is positioned automatically by selection of the full scale range.
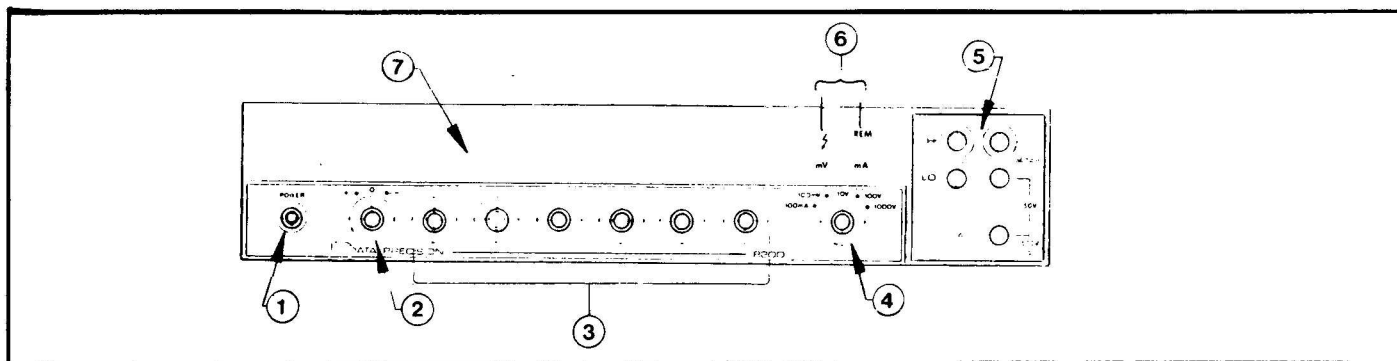
2-1. Front Panel Features
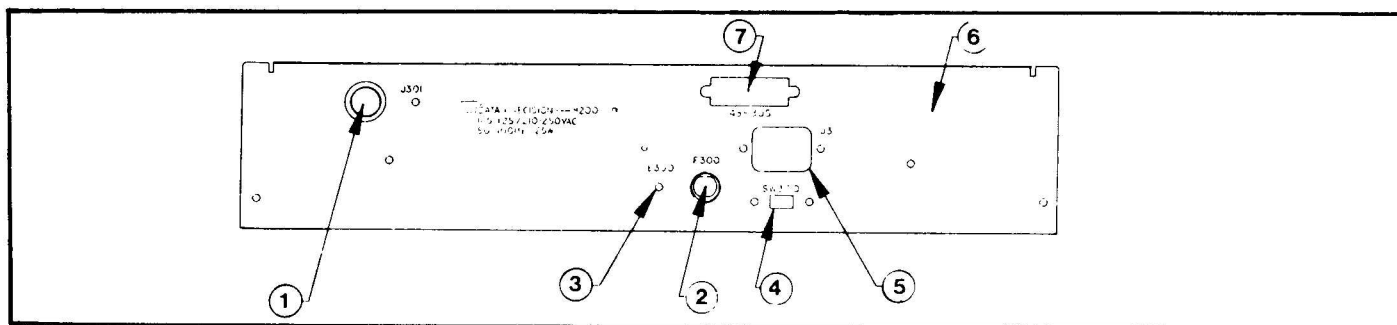
2-2. Rear Panel Features.

Table 2-2
REAR PANEL FEATURES

Ref	Name*	Description / Function
1	100mV Connector (J301)	3-terminal, shielded, connector. For calibrator 100mV full scale range output.
2	Fuse (F300)	½-Amp, Slo-Blo Fuse. Fuses line connection to primary of power transformer.
3	Earth Ground	Binding post for chassis or power-line grounding connection in addition to the 3rd wire in the power cord.
4	Power Select Switch (SW300)	Slide switch. Configures power transformer primary for 115 or 230Vac input. Window in rear panel provides visibility of the selected power configuration.
5	Connector (J300)	Recessed male connector for 3-wire (power plus neutral) power cord. Power cord furnished with instrument.
6	Label	Identifying label for Model 8200 Calibrator. Nameplate data includes serial number.
7	Connector	IEEE488 interface connector, when option is installed.

Note: Rear-Panel Terminals are not shown. They parallel
the connections at the front panel.

2.3 OPERATING PROCEDURES

2.3.1 Powering the Calibrator

The Model 8200 must be connected to a source of ac power via a 3-conductor cable furnished as part of the standard instrument. Source power may be nominal 115 or 230Vac, nominal 50 or 60 Hz. A slide switch in the rear-panel assembly configures the instrument for the power to be applied.

WARNING

Before connecting power, check the line voltage available, and see that the visible numbers are in accord with the available supply.

Configure the power transformer for the available line power.

Connect the power cable.

Make appropriate earth ground connections to the rear-panel binding post (see Table 2-2).

Turn power on at the front panel (Table 2-1) and allow the calibrator at least 1 hour to warm up.

2.3.1.1 Power Up/Shut Down

During these abnormal periods it is recommended to disconnect the load from the output binding post (HI, LO, HI-SENSE, GUARD) on the front panel and/or RT-2 rear terminal output connector.

2.3.2 Application Setups (Fig. 2-3, 2-4)

1. Make connections to the front panel for voltages over 100mV, and for any current source applications. Connect output **HI** to load positive terminal. Connect **LO** to load negative terminal. Connect **HI SENSE** to load positive or to **HI** at front panel by jumper strap (supplied). Similarly, connect the output **LO SENSE** to load negatve terminal or to **LO** at front panel by jumper strap (furnished). Connect the **GUARD** to the application instrument chassis or to the front-panel **LO SENSE** terminal by a jumper strap.

2. If the 100mV full scale range is to be used, make connections at the rear-panel connector, J301. A 3-conductor mating connector for the rear-panel input is supplied with the instrument. The third conductor within the mating connector is connected to the calibrator GUARD. A separate earth ground terminal, E301, is provided in the rear panel connector for additional power or chassis grounding applications.

WARNING

If the rear panel output option is installed in the 8200, be sure that connections at front and rear panel are not incompatible. It is recommended that a cover plate be used to protect the front terminals when the rear terminals are in use

2.3.3 Local Control

1. At the front panel, select the polarity (SW201), and range (SW208).

The calibrator's response to any selection of a new polarity or range will display a zero value in the display. This will prevent an unwanted value from being applied to the instrument under test when changing the test conditions.
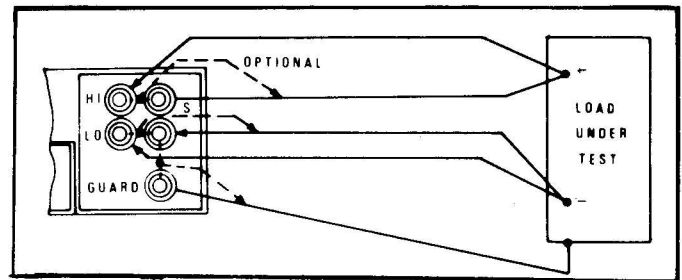
2-3. Setup for Use as a Voltage Standard
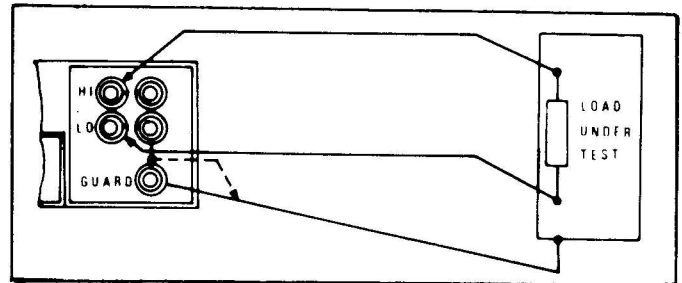
2-4. Setup for Use as a Current Standard

2. Operate the rotary decade switches until the desired magnitude of the output signal is displayed.

The front panel switches and display are related in what is known as a "full duplex" mode. That is, the display digits are not hardware-linked to the respective switches. Instead, the switches are used to signal the microprocessor to modify the value, and the processing action updates the display digits, *only as a result of the programmed development of the output analog value.*

Each rotary decade switch is capable of unlimited travel in either a clockwise (incrementing) or counterclockwise (decrementing) direction. The microprocessor responds to these commands by incrementing or decrementing the value up to the maximum limit of the selected range scale (see specifications), or to zero.

A change through zero requires the change in polarity sign, and this must be accomplished by the use of polarity switch SW201. This design feature prevents you from applying an unwanted value to the instrument under test.

Six rotary decade switches are provided to signal the modification of $6^1{}_2$ decades of analog output. The MSD is "controlled" as a carry from the major front-panel decade switch.

The designed capability of unlimited carry (or borrow) to (or from)the next higher decade greatly simplifies the use of the 8200 in applying a varying stimulus to a system under test. A desired increment or decrement in any one of the decades may be "stepped" into the output *simply by continuous rotation of that one decade switch corresponding to the desired resolution. It is not necessary to operate more than one decade switch for any desired output value.*

Consider, for example, how easily the transition is made through a major carry when using the 8200. If you were checking the threshold performance around 3 volts, and expected the value to be between 2.800 and 3.200, you would set the 8200 to an initial value of 2.80000 and increment the third decade (from the least). The value would step from 2.80000 to 2.80100, to 2.80200, etc. At 2.80900, the next step would be 2.81000. At 2.89900 and at 2.99900 the next steps would be 2.90000 and 3.00000, respectively, **with only one step of the decade switch**. In most other test instrumentation, on the other hand, the change from 2.99900 to 3.00000 would require changing all 4 decades (2999).

2.3.4 Shut Down Procedures

To shut down the Model 8200, do the following:
1. Disconnect the load from the output binding posts (HI, LO, HISENSE, LOSENSE, GUARD) on the front panel of the Model 8200.
2. Press the POWER pushbutton and observe the 6½ digit display to go out (extinguish).

The Model 8200 is now shut down.

2.4 REMOTE CONTROL

2.4.1 IEEE488 Setup

The IEEE488 option board contains a 5-section dip switch which must be set with the listen address of the 8200 before it can be controlled by an external source.

The Model 8200 IEEE488 option board is shipped from the factory with the dip switches set for address 20 (10100).

To obtain access to this switch, remove the top cover by removing 6 side fastening screws (3 on each side) and 2 top fastening screws (front and back). See Figure 2-3. The IEEE488 option board is mounted on standoffs towards the rear of the chassis, and its connection to the external bus is accomplished by a standard connector mounted in the rear panel.

Determine the address to be used for this 8200 Calibrator, and set the 5 sections of the dip switch accordingly. Table 2-3 lists the binary-to-decimal conversions for the 5 selectable sections.

2.4.2 Procedure

1. Address the 8200 to **listen**.
2. Send a string in ASCII, beginning with character **V**, for voltage output, or **A**, for current output.
    Any characters transmitted before the **V** or **A** will be ignored.
3. Transmit the appropriate string, as defined in the specifications, paragraph 2.1.5, and repeated below.
    When the last character in the string has been received, the 8200 will generate an Interrupt to the microprocessor, and will change the complete stored decimal value to that transmitted by the remote controller (as distinct from the incrementing process described for operation under local control.
    When the 8200 receives a valid remote command (as defined above), it locks out the front-panel and displays the annunciator **REM**. It remains in Remote control, until commanded to return to local, or until power is turned off, and then on again.
    When the 8200 receives an invalid command, or invalid character, the transmission string must be retransmitted.

2.4.3 Returning to Local Control

The 8200 Calibrator may be commanded to return to local control by transmitting the single character **L** following a valid address to listen.

Table 2-3
CHARACTER STRINGS
All characters are **ASCII**.
Parity bit is ignored.

Voltage Mode:

1st character	V	Voltage mode
2nd character	0	100mV range
	1	10V range
	2	100V range
	3	1000V range
3rd character	+	Plus polarity
	–	Minus polarity
4th through 10th characters	0 to 9	Magnitude (NUL, . , or SPACE is ignored after polarity is received.)

Current Mode:

1st character	A	100mA range
2nd character	+	Plus polarity
	–	Minus polarity
3rd through 8th character		Magnitude (As above, for voltage mode)

3
PRINCIPLES OF OPERATION

3.1 SYSTEM BLOCK DIAGRAM

Figure 3-1 is a simplified block diagram of the Model
8200 Calibrator. It illustrates the major functional blocks
that are instrumented in the equipment, and highlights
the role of the microprocessor in the design. As shown
in the illustration, communications among some blocks
are carried out via the 8-bit **DATA BUS**, connected to
Port C of the microprocessor (Z26). Decoded control
signals from Port B of the microprocessor and hardware
connections complete the interunit communications
within the Model 8200.

Inputs to the equipment are set up by front-panel control
switches (or by signals from a remote control unit such
as a minicomputer when the Model 8200 is equipped
with the IEEE488 option). The input selection of
operating mode determines the binary values of 5 lines
connected to the **DATA BUS** that are read by the
microprocesor and produce appropriate control signals
(also transmitted on the **DATA BUS**) to the **STATUS
REGISTER & RELAY DRIVERS**. That functional block
generates the relay driver signals that set up the con-
figuration of the **OUTPUT AMPLIFIER & RANGE SWIT-
CHES** so as to deliver the selected parameter (voltage or
current) at the selected range. These signals also drive
annunciators in the display to indicate the selected
operating mode.
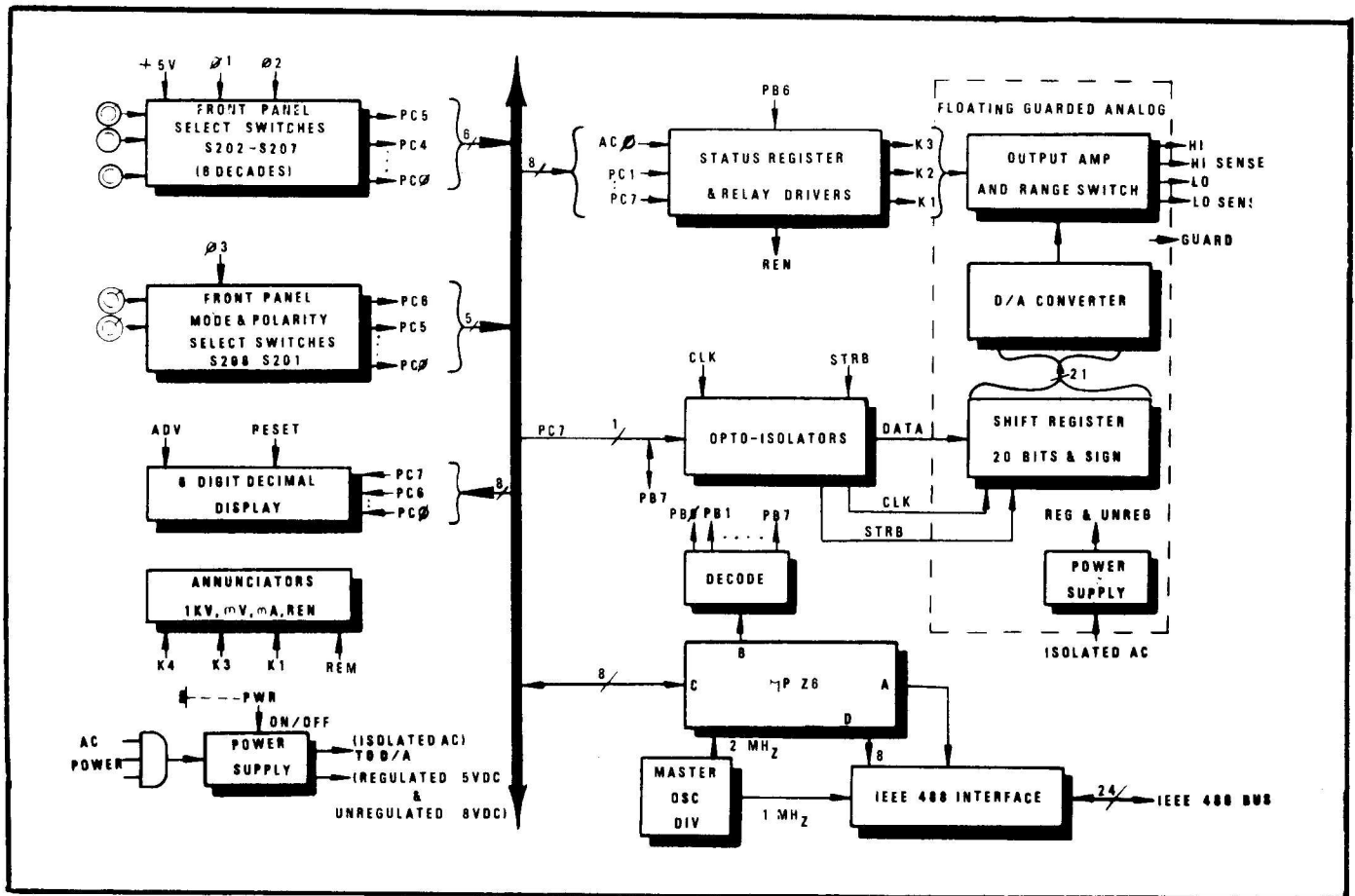
3-1. Model 8200 Block Diagram

Control of the output values is accomplished at the front panel by operating the "decade in-crementers/decrementers". The Model 8200 permits the operator to change the value of calibrator voltage (or current) by any desired decade resolution for an unlimited number of steps in either direction (up to the full scale range of the instrument) with a single input front-panel control knob for that decade. Change of polarity (decrementing or incrementing through 0) requires a change in the polarity selection. The Model 8200 microprocessor "reads" the selected change (increment or decrement) via the **DATA BUS** and modifies the stored value accordingly. The new value is translated into a 21-bit (20 bits plus sign bit) code that is transmitted in serial form via the **OPTO-ISOLATORS** to the **SHIFT REGISTER** in the **FLOATING, GUARDED ANALOG** unit.

The **SHIFT REGISTER** sets up a parallel 21-bit value to be converted by the **D/A CONVERTER** into a proportional part of a nominal 10.48575-volt precision reference. That value is then conditioned for the proper output mode and scale by the **OUTPUT AMP & RANGE SWITCH**, and the result is available at the 4-terminal-plus-guard output, or at the rear-panel connector, if the 100mV scale is selected.

The **6½-DIGIT DISPLAY** is driven by the microprocessor to indicate the decimal equivalent of the generated output value. Thus, the value selector switches and the display operate in a "full duplex" mode. That is, the displayed value is the result of the processing of the input selection, and not a direct coupling to the selector switches.

In addition to the digital display value, the front panel includes the annunciators that display the selected mode of calibrator opertion. These annunciators also operate in the full duplex mode, because their states are set by the micropressor, and not directly by the input front-panel selection.

The **POWER SUPPLY** block is really a multiple unit. The input transformer primary may be set up to receive any one of the universally available power mains values. It delivers both an isolated and non-isolated ac supply for use in the equipment. The isolated ac supply is used in the floating analog to develop appropriate regulated and unregulated supplies for that block. The non-isolated supply from the input tranformer is similarly used to develop an unregulated 8V and and regulated 5V supply for the remainder of the calibrator.

The calibrator may also be equipped with an **IEEE488 IN-TERFACE** that, as shown in the illustration, communicates with the calibrator via the microprocessor. Two 8-bit ports of the microprocessor are used with the installed option circuitry to interface with the 24-bit **IEEE488 BUS**.

3.2 PROGRAM CONTROL

3.2.1 General

The 8200 Calibrator operation is controlled via microprocessor (R6500/1), a 4-port unit that incorporates a masked ROM and "scratchpad memory" RAM for use during the program execution. Ports A and D are reserved for use with the IEEE488 option; port B is used to communicate command and control signals for the hardware compnonents; port C is used for the data bus.

The main program flow essentially refreshes the displayed digits, one at a time, with the value stored in memory. This value has also been latched into the shift register from where the appropriate output drive is developed via the digital-to-analog conversion. The display routine "polls" the front-panel switches between each digit update to sense any change in the front-panel switches (LOCAL) or by an interrupt received via the IEEE488 (REMOTE). If any change is detected, the program is branched to operate on the change information and to modify the value that it stores in BCD format. The new value is then converted to binary, shifted out, and latched into the shift register, from where it causes a new value of voltage (or current) to be applied to the output terminals of the instrument.

The main program flow is illustrated in the simplified chart of Figure 3-2, in which the subroutines and storage registers are identified by appropriate mnemonics. These subroutines and storage registers are described in the tabulation that follows.

3.2.2 Program Subroutines

PON: Power On
    1. Initializes stack pointer.
    2. Clears the RAM variables. (Sets values to zero).
    3. Reads **MODE** and **POLARITY** switches and stores in status registers.
    4. Calls **DECBI** subroutine.
    5. Calls **SHIFT** subroutine.
    6. Initializes the IEEE488 Bus.
    7. Clears Interrupt Disable.

DISPL: Display Routine
    1. Multiplexes appropriate seven-segment drives to the display LED's.
    2. Calls **SCANS** routine after each digit is loaded to the display.

INDEC: Increment or Decrement routine
    1. Increments or decrements the decade as determined by the decoded movement of the switch.
        Does not decrement below 0.
        Does not increment above 100.000 when in **mA** Mode.
        Does not increment above 1048575 in **V** or **mV** Mode; decimal point is determined by range selection.
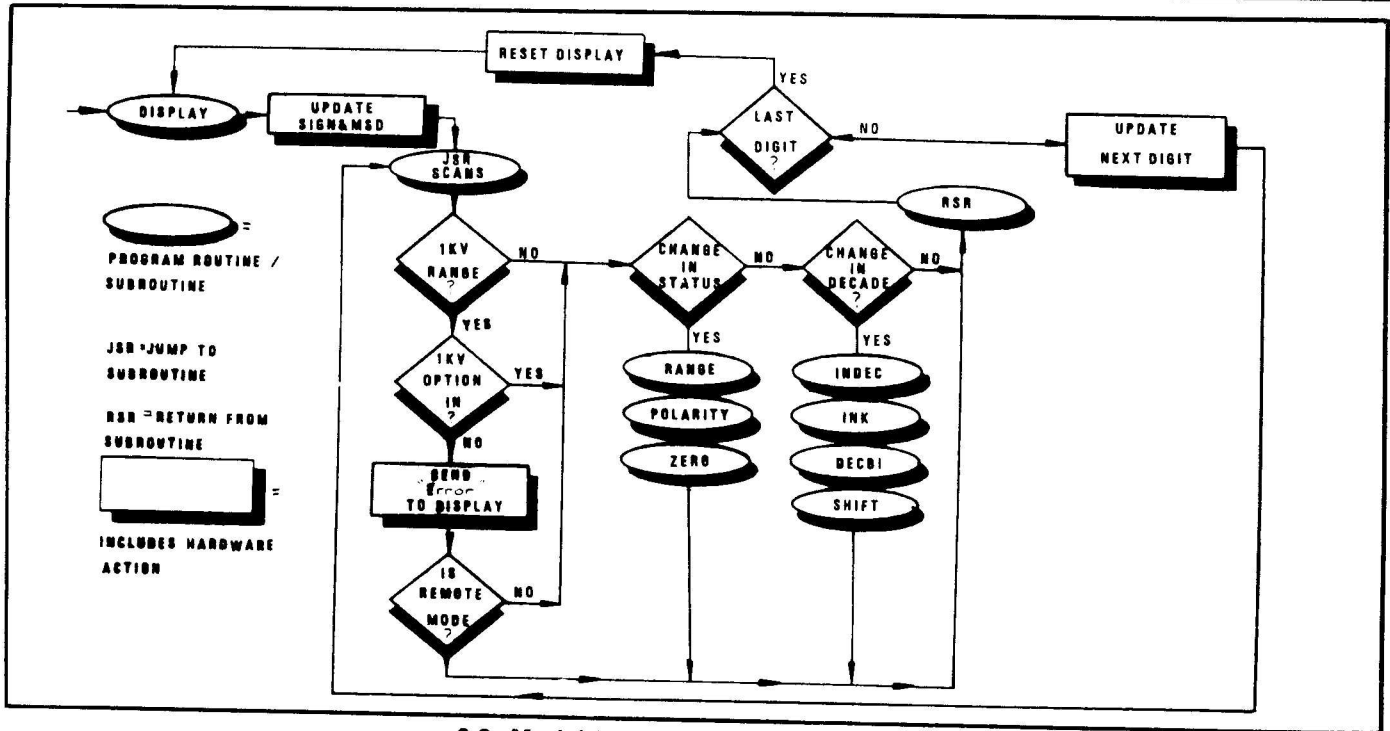
3-2. Model 8200 Program Flow Chart

DECBI: Decimal-to-Binary Conversion routine
1. Converts BCD value to binary.
2. Stores binary value and sign in 3 bytes of RAM storage.
3. Generates 1's complement for negative value.

SHIFT: Shift routine
1. Shifts sign and 20 bits through opto-isolators.
2. Generates strobe to dump shift register contents into buffer register.

POLSTR: Polarity Store routine
1. Reads polarity value in **STATUS** register.
2. Stores polarity in **SIGN** register.

RANGE: Range routine
1. Reads range value in **STATUS** register.
2. Stores range value in **DP** register for use by **DISPL** routine.

SCANS: Scan Switches
1. Checks for **1KV** range selection. If selected, and 1KV Option is not installed, generates **Error** mesage for display.
2. Checks Local/Remote bit in **STATUS** register. If Remote, returns to **DISPL** routine.
3. Checks Polarity and Range switches and compares with previous settings as stored in **STATUS** register. If changed, stores new values in the register.
4. Checks for 0 selection in **STATUS**. If 0, returns to **DISPL** routine.

5. Checks digit incrementer switches for change.
   If change is detected:
   Calls **INDEC** routine;
   Calls **DECBI** routine;
   Calls **SHIFT** routine.
6. Restores digit pointer and returns to **DISPL** routine.

ZERCLD: Zero cold routine
1. Sets zero values in unpacked BCD form in 7 bytes of RAM storage.
2. Calls **DECBI** routine.
3. Calls **SHIFT** routine.

BUX: Bus exit routine
1. Restores **A, X,** and **Y** registers to values that were saved at the start of the interrupt.
2. Returns to **DISPL** routine.

3.2.3 Port Addresses

The RAM storage locations that are addressed through the microprocessor ports are identified in the tables that follow.

Table 3-1
PORT A (IEEE488) ADDRESSES

Address*	Mnemonic	Description / Comment
$0B	PIP	PIP Switch
$C3	INST	Interrupt Status Register
$CB	COMST	Command Status Register
$FB	DATIN	Data Input Register
$43	INMAS	Interrupt Mask Register
$53	ADMOD	Address Mode Register
$63	ADREG	Address Register
$5B	AUXCM	Auxilliary Command Register

*Hexadecimal notation.

Table 3-2
PORT B (HARDWARE COMMANDS) ADDRESSES

Address*	Mnemonic	Description / Comment
$91	CLK	Transfer **DATA** to shift register. Does not de-address **DATA**.
$92	STROBE	Dump contents of shift register into buffer register.
$10	DATA	Apply **PC7** to **DATA** opto-isolators.
$84	RST	Reset display.
$0F	ADVNCE	Transfer **PC** and advance display.
$03	A01	Digit switch enable into **PC**.
$05	A02	Digit direction enable into **PC**.
$06	A03	Range and polarity switch enable into **PC**.
$47	STATAD	Hardware status register and drivers from **PC**.
$07	NOAD	No device addressed.

3.2.4 RAM Storage

Addressed bytes of RAM storage are assigned for the specified functions as shown in Table 3-3.

Table 3-3
RAM VARIABLES

Location*	Mnemonic	Description / Comment	Location*	Mnemonic	Description / Comment
$00	B2	Buffer registers that contain sign	$0C	T6	
$01	B1	(+ = 1) and 20 binary bits. First 3	$0D	T5	Scratchpad for rotary incrementer
$02	B0	bits of B2 are not used. B0 contains LSB.	$0E	T4	switch increment and decrement **IN-**
			$0F	T3	**DEC** routine use.
			$10	T2	Also used as temporary storage by
			$11	T1	**BUSIN** Bus interrupt routine.
$03	SIGN	Sign, in ASCII code ($2B = +)	$12	T0	
$04	D6	MSD			
$05	D5	7 digits in unpacked BCD			
$06	D4	format (0000xxxx); MSD is	$13	W01	Stored status of the rotary switches;
$07	D3	either 00000000 or	$14	W02	
$08	D2	00000001.			W01 determines which digit is
$09	D1				changed;
$0A	D0	LSD			W02 determines the direction of change.
$0B	STATUS	b7 = **REMOTE**			b7 and b6 = 0.
		b6 = **mA**			b5 through b0 assigned MSD to LSD
		b5 = **mV**			positions.
		b4 = Unused; default to **10V** Range			
		b3 = **100V**			
		b2 = **1KV**	$15	DP	Decimal point position determined
		b1 = **+**			from **STATUS** by **RANGE** routine.
		b0 = **0**	$16	BSTAT	Bus Status
			$17	BSIN	Bus Sign
			$18	PTR	Bus Character Pointer

3.3 GENERATING THE CALIBRATOR OUTPUT

3.3.1 Implementation Sequence

Paragraph 3.3 and its subparagraphs describe the overall translation from the stored binary value of the desired output (voltage or current) to the analog signal available at the calibrator terminals. Subsequent paragraphs describe the method for updating the stored value in response to any detected changes introduced via the front panel or the IEEE488 bus.

As indicated in Figure 3-3, the stored magnitude of 20 binary values plus 1 sign value are first translated into equivalent octal values. This is a direct translation; every three binaries translate into an octal. Then the translated octal is weighted according to its "octade" position into an increment of the analog value, and the seven "octades" are summed in a buffer amplifier. The summed value is then scaled according to the selected full scale range for the desired output voltage. (Only one range is instrumented for current outputs.) The variation introduced for positive and negative outputs is described in detail in later paragraphs of this chapter.

The translation to an octal equivalent, and then the weighting of each of the seven octades reduces the number of high precision components needed to obtain the precision of a 6½-digit calibrator performance. The Model 8200 develops a precise division of the reference voltage into the eight binary-related values for any "octade", instead of the 20 binary-related reference divisions normally used for digital-to-analog conversion.

3.3.2 Generating the "Octade" States

The full scale range represented by 20 binary values is resolved into $2^{20} - 1 = 1048575$ levels. An appropriate nominal full scale voltage is chosen for direct translation for this resolution; namely: 10.48575 volts. This voltage is used as the basic reference for generating the calibrator output.

Each octade may assume one of eight distinct values, (0 and 7 others) corresponding to the range of binary codes from 000 to 111. Figure 3-4 illustrates the development of the 8 voltage levels, V0 through V7, from the basic reference of 10.48575 volts. A temperature-stabilized reference diode (Z5) provides a stable reference of 7.0 ± 0.1 volts, that is used in a voltage divider network to obtain a precision reference for the servoing of the current through the octade divider network.

The 8 values, V0 through V7, require dividing the reference into 7 equal segments, and the value at the fourth segment, 5.991856, is the servoed value.
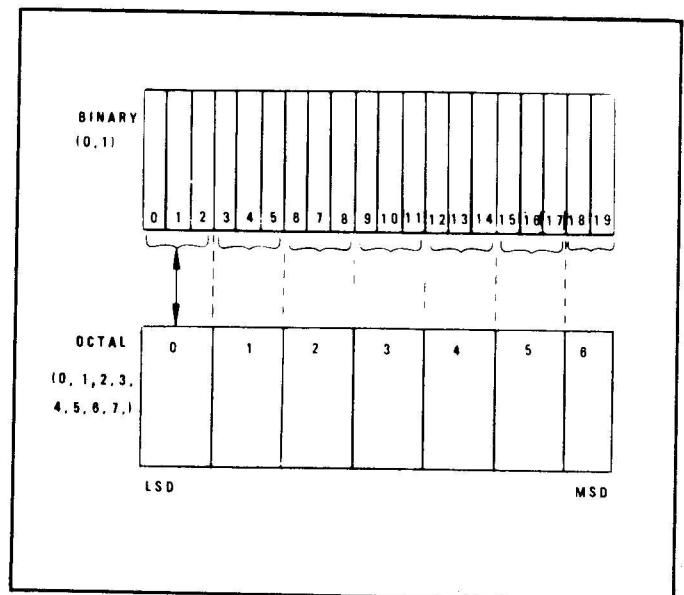
3-3. Translating a 20-Bit Binary to 7 Octal Codes
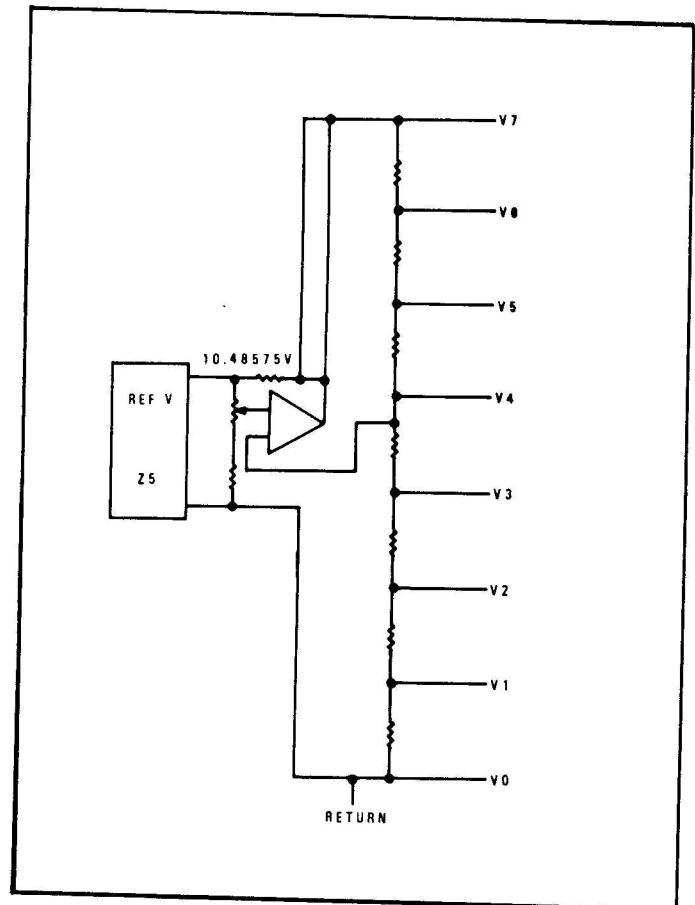
3-4. Generating the Voltage Levels for an Octade

3.3.3 Binary-to-Octal Conversion

Figure 3-5 illustrates the conversion of three binary-coded values into a corresponding octal value. This requires the selection of one of the 8 voltage states, V0 through V7, for the binary code 000 through 111. As shown in the illustration, this is accomplished by using an 8-channel multiplexer for each of the octades in the result. Each multiplexer is programmed by the binary values on the three control lines. The output of each multiplexer will be one of the eight states according the the octal translation of the binary codes presented to the control lines.

Each successive octade in the sequence is weighted by appropriate powers of the radix (8). The summing network introduces the appropriate weighting by the resistors 1K, 8K, 64K, 512K. Note that R44 in the summing applies an appropriate scaling for the three less-significant octades so that very large individual resistor weighting values will not be necessary.

3.3.4 Scaled Voltage Output
Positive and Negative Values

The summed octade equivalents are buffered and amplified, as shown in Figure 3-6, where a gain factor of 10 may be introduced if required by the front-panel selection. The 100mV range output at the rear panel is obtained by a precision voltage divider inserted at the terminals of the output connector.

The summed output of the seven octades is buffered in a differential amplifier, Z19, so that the output is directly proportional to the voltage difference presented at the input terminals (adjusted for unity gain). When the desired calibrator output is a positive value, the return for the differential amplifier is connected to the V0 level (zero value), and the output is the positive displacement from zero.
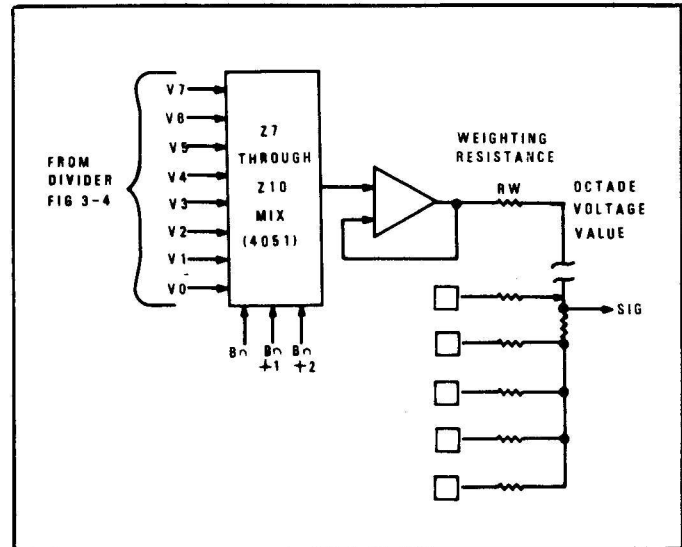
3-5. Converting 3 Binary Codes to Equivalent Octral Value

When the desired calibrator output is a negative value, two operations are required:

• The reference return is connected to the V7 level (10.48575V).
• The binary code is translated to a 1's complement.

The differential buffer output will be a negative value, less negative than full scale (– 10.48575) by the ammount of the summed octal equivalents. By using the 1's complement for the binary code, the magnitude will correctly represent the displayed value on the front panel.

When the 100mV full scale range is selected, the calibrator actuates relay K2. This connects a feedback path around the buffer and power amplifier that introduces a gain of 10 in the buffer output. In addition, a 100V power amplifier is used to drive the output terminals.
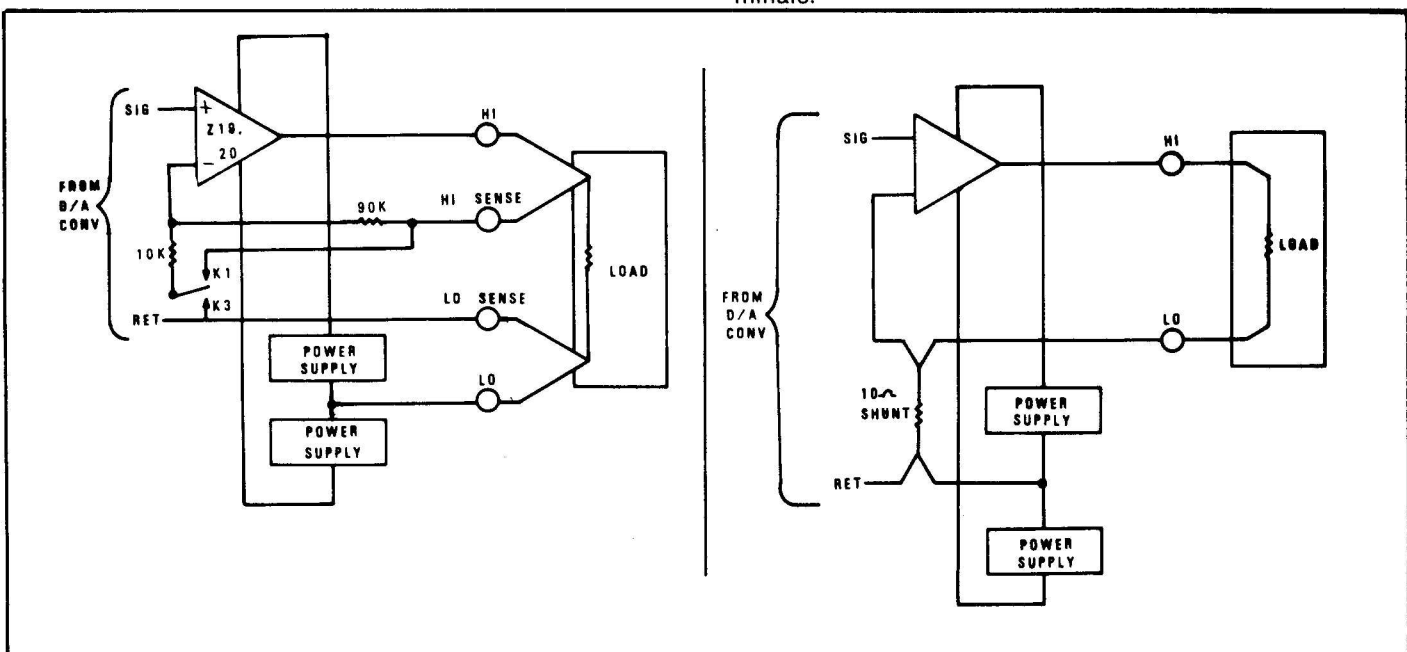
3-6. Producing a Proportional Output

3.3.5 Generating a Current Output

Figure 3-6 illustrates the internal configuration of the analog output
circuitry when a front-panel selection is made of the CUR-RENT OUT-
PUT Mode of the calibrator. Relay K1 connects a precision 10-ohm
resistor in the feedback path to the return level of the buffer amplifier
and in series with the load. The driver will supply the current
necessary to make the voltage across the 10-ohm resistor equal to
the voltage from the summed octades. At full scale, the
microprocessor limits the commanded binary code to an equivalent
value of ± 1V, so that the current through this 10-ohm resistor will
be limited to 100mA (100 mA x 10 ohms = 1 V).

3.4 CHANGING THE OUTPUT VALUE

3.4.1 Program Control

As described earlier (para 3.2), the microprocessor pro-
gram checks the status of the front panel switches be-
tween each digit update. This is frequent enough to
detect any movement between detents of a front panel
digit selector switch, or, of course, if the latched status
of the polarity or range (mode) switch has been changed.
The **SCANS** routine that checks front panel switches:

1. Checks for the selection of the 1000V range. The
high voltage warning annunciator, / ʲ is lighted. If the
1KV option is not installed, then the **Error** message is
displayed.

2. Checks if the Calibrator is under remote control. If
so, the control returns from this routine, omitting any fur-
ther check of the front-panel status or switch actions.
When in remote control, an interrupt on the bus initiates
the change operation.

3. Checks range and polarity switches for changes in
status. If so, the routine forces the stored value to zero.
This protects the user from an inadvertent application of
unwanted values, or of improper test conditions
(voltage/current). If no range or polarity change is
detected, the program branches to the check of the
decade selector switches.

4. If a decade switch has been operated, the
subroutine determines which decade, and in which direc-
tion; checks that the resulting magnitude will be in
range;increments (or decrements) the BCD value; con-
verts to appropriate binary value (true binary or 1's com-
plement); shifts the binary coded value through opto-
isolators; and then latches the new value into shift
registers for conversion to analog input as described
earlier.

3.4.2 Hardware Implementation to Detect Switch Changes.

Refer to reference drawings D65-1030 and -1031.
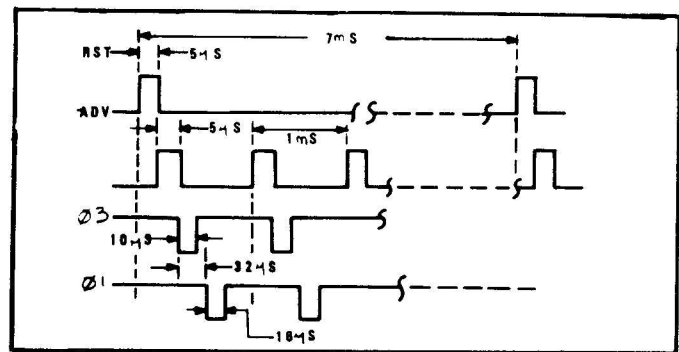
3-7. Approximate Control Timing Waveforms

The program generates enabling pulses Φ1, Φ2, and Φ3 in the
approximate time sequence shown in Figure 3-7.

Φ1 enables the sensing amplifiers of one brush of the
decade switches, while Φ2 enables the sensing amplifiers
of the other brush of these switches. The brushes are so
arranged with respect to an interrupter disc and a switch
detent that movement and direction will be decoded.
The physical arrangement is illustrated in D65-1031.

Converter

As shown in Figure 3-8, the microprocessor transmits a
series of pulses through opto-isolator Z2 to the shift
register consisting of Z21, Z22, and Z23. The shifting is
synchronized by the clock pulses that are also transmit-
ted by the microprocessor through opto-isolator Z3. At
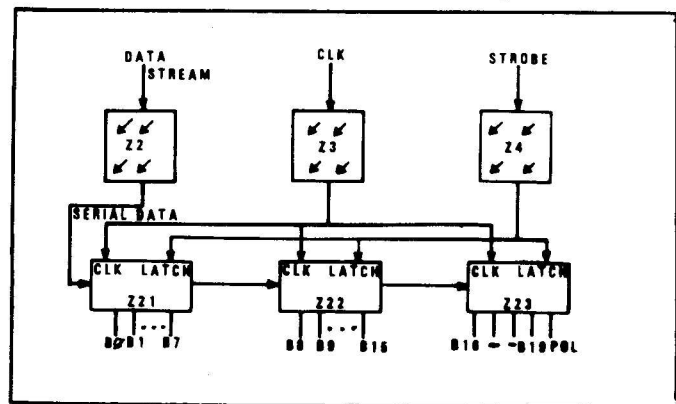
3-8. Transferring Isolated Digital Signals to D/A Converter

the end of 21 data bits (as controlled by the clock), the
microprocessor transmits a strobe signal (again via an
opto-isolator, Z4) to latch the 20 data bits and 1 sign bit
into the shift register. The excess 3 bits in the shift
register are not used.

These values are now available at the parallel outputs of
Z2, Z3, and Z4. As described previously, these bit values
are the program controls for the 8-channel multiplexers,
Z7 through Z13, to be converted into appropriate octal
states, and thereafter, into octade equivalents of the
analog signal.

3.5 DISPLAY

Refer to drawing D65-1032.

As shown in the reference schematic, the display value for each digit is transmitted on the data bus from the microprocessor as a byte consisting of the seven segments and 1 decimal point signals. They are the Port C outputs, PC0 through PC7. These values are latched into Z202 by the **ADVANCE** pulse, derived from the decoded address output from Port B of the microprocessor. The **ADVANCE** pulse also selects the appropriate digit enabling line from Z201. Thus, the appropriate 7 segments and 1 decimal point control lines are high for one digit at a time, resulting in that digit's decade display. The MSD in the display is limited to the polarity sign and a "1" or blank, as appropriate.

The display annunciators, DS208 through DS211, are controlled by the same signals that actuate the relays for the different operating mode configurations. Each of these is controlled independently by drivers enabled by decoded addresses transmitted by the microprocessor from Port B.

3.6 DIGITAL CONTROL IMPLEMENTATION

Refer to drawing D65-1030.

Program control for all functions of the calibrator originate in the circuitry shown in the reference drawing. The drawing also indicates the IEEE488 bus interconnections, although these are present only when that option is installed. Principles of operation of these program control circuits have been deferred until this paragraph, trusting that the earlier circuit descriptions have provided a basis for understanding the applications of the output control signals from this assembly.

The microprocessor, Z6, is clocked by a 2MHz signal derived from a 4MHz resonator, Y1, divided by 2 in flip-flop Z3A. The 1MHz clock signal for the IEEE488 circuitry is also derived from the 2MHz signal by a further division in the other half of the flip flop, Z3B.

RESET of the microprocessor, Z6, and of the IEEE488 circuitry is generated by Z4A, and is controlled in time by the delay network R8C4 at the D and RESET inputs to Z4A. This delay generates the **RESET** pulse until after the +5V has been established, and until after the circuitry powered by that supply has stabilized.

Steady-state control signals (as opposed to the pulse type) are developed by storing appropriate values in **Status Register** Z7. The register is loaded in parallel by the data bus and latched by a control pulse from Port B of Z6. The Status Register outputs enable the drivers in Z8 that actuate operating mode relays and also provide annunciator control signals in parallel with the relay operation.

The seven pulse control signals, **CLK, STROBE, AD-VANCE, RST,** $\Phi1$, $\Phi2$, and $\Phi3$, are derived from gated combinations of Port B outputs, as shown in the illustration.

Their destinations are indicated on the drawing, and their application in these circuits has been described in previous chapters.

3.7 POWER SUPPLIES

As in the case of the program control, principles of operation of the power supply circuitry have been deferred, trusting that the previous circuit descriptions have provided a basis for understanding the requirements placed on the power supply performance.

3.7.1 Main Power

Refer to drawing D65-1030.

The main power is supplied through a 3-wire connector at the rear panel, J300, and RFI filtered before being switch-connected to the primary of the main power transformer. The transformer primary is configured by rear-panel switch SW300 so that either nominal 115V or 230V sources may be used. The input is fused by rear-panel-mounted F300 for ½A, slo-blo conditions. Front-panel switch SW200 connects the fused main line to the transformer primary.

The transformer secondaries are configured for two isolated supplies: one supplying all the dc power for the digital circuitry; and an isolated one supplying the power for the isolated analog circuitry. Internal transformer shielding reduces any coupling between the two supplies.

3.7.2 Digital Control Power

As shown in the reference drawing, a full wave rectifier, CR2, CR3, CR4, and CR5, on the transformer secondary provides +8V supply for use in powering the display digits and operating mode control relays. Voltage regulator Z9 then develops the +5V supply for all the integrated circuits on the digital pc-boards, as well as the high and low signal levels for the decade selector switches.

3.7.3 Isolated Analog Circuit Power

The isolated secondaries of the power transformer deliver a center-tapped 30V and a center-tapped 200V ac supply to the analog board. The latter supply also provides additional take-offs for a center-tapped 15V ac supply. The use of these ac supplies to generate appropriate isolated dc supplies is illustrated in schematic reference drawing D65-1029.

The center-tapped 200V ac (100-0-100) supply is full-wave rectified by CR3 to provide the ± 130V with respect to its floating center tap for the 100V power amplifier. The center-tapped 30Vac (15-0-15) within the 100-0-100 source is also full-wave rectified to provide ± 20V with respect to the same center tap. Each of the latter supplies is then regulated (VR2 and VR3), providing ± 15V with respect to the floating center tap. The floating return for these two supplies is connected to V0 or V7, as described earlier, to accommodate the generation of positive or negative analog outputs, respectively.

The remaining 15Vac supply is rectified by CR1 and CR2 and then regulated in VR1 to provide the + 15V for the regulated temperature-controlled reference from which the octade increments are developed.

4
CALIBRATION & MAINTENANCE

4.1 GENERAL

The Model 8200 Calibrator is designed for reliable, precision performance over an extended life. In addition to the higher reliability resulting from a reduced parts count, performance-sensitive components are burned in as part of rigorous incoming inspection procedures, and final assemblies are power-cycled while at elevated temperatures. Exhaustive operational tests are performed before and after final burn-in, and complete acceptance data are included as part of the documentation furnished with each instrument.

Recalibration should be attempted only after instrument improper performance can be verified by comparing with the factory acceptance data. And then, only qualified technical personnel, using metrology-laboratory grade instruments, should attempt a complete recalibration. Field Recalibration, using stable standards with a precision and accuracy equivalent to the specifications of the suggested equipment listed in paragraph 4.2, may be performed to adjust the full scale ranges of each of the operating modes.

Do not attempt to calibrate the octal divider network unless a precision divider network and null detector are used.

4.2 FIELD RECALIBRATION

4.2.1 Test Equipment Required

A precision digital voltmeter, with resolution and accuracy of $\pm 5\mu V$, is required for the offset adjustment of the 10V Range scale. Adjustment of the current output requires a precision resistance load in addition to the digital voltmeter.

4.2.2 Obtaining Access to the Adjustments

All adjustments are accessible through the top of the shield covering the analog assembly, after the top cover is removed.

To remove the top cover:
    Remove the 6 screws from the side (3 on a side) and the 2 screws from the top (front and back).
    Lift the top cover.

Figure 4-1 indicates the access provided by slots in the cover shield, and the relative location of the adjusting potentiometers.

CAUTION

Do not remove the shield cover.
Do not readjust any of the octal divider network potentiometers, R19 through R26, in a FIELD RECALIBRATION.

4.2.3 Procedure

    NOTE: *All calibration/recalibration should be accomplished in a controlled temperature environment at 23°C ± 1°C.*

    1.   Connect calibrator output voltage to the precision voltmenter. Use straps to connect sense terminals to output terminals, and to connect GUARD to LO.
    2.   Turn power on, and allow ½ hour for warmup.
    3.   Select **10V** Range.
    4.   Select + Polarity.
    5.   Operate decade switches to set up 10.00000 on display.
    6.   Adjust R12 until measured output is within $10\mu V$ of + 10.00000V.

    7.   Select **100V** Range.
    8.   Operate decade switches to set up 70.0000 on the display.
    9.   Adjust R66 until measured output is within $100\mu V$ of + 70.0000V.

    10. Disconect the test voltmeter.
    11. Select the **100mA** Range. (The display value will change to 000.000.)
    12. Connect a current shunt of 100 ohms nominal value, but whose precise value is known to within $\pm 2ppm$.
    13. Operate decade switches to set up 070.0000 on display.
    14. Calculate the voltage that should appear across the shunt [0.07 x R(shunt resistance in ohms)] = Volts. For the nominal 100 ohms, the voltage would be 7.0000 volts.
    15. Measure voltage across the current shunt.
    16. Adjust R69 until the measured voltage across the shunt is within $10\mu V$ of the calculated value.

The Field Calibration is complete.
Turn off power. Disconnect the shunt. Replace top cover and refasten to side and top with the fastening screws.
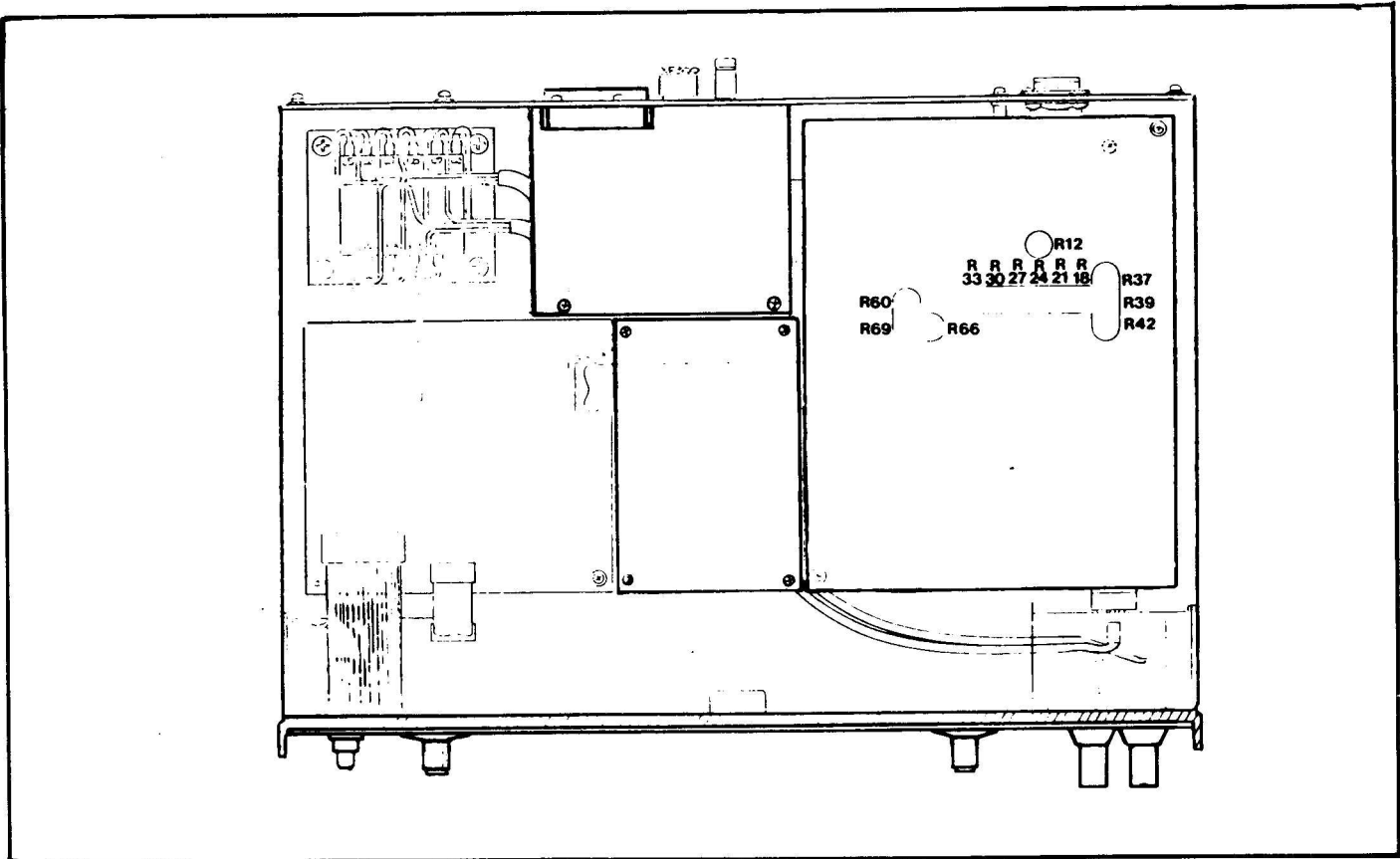
4-1. Obtaining Access to Calibration Adjustments
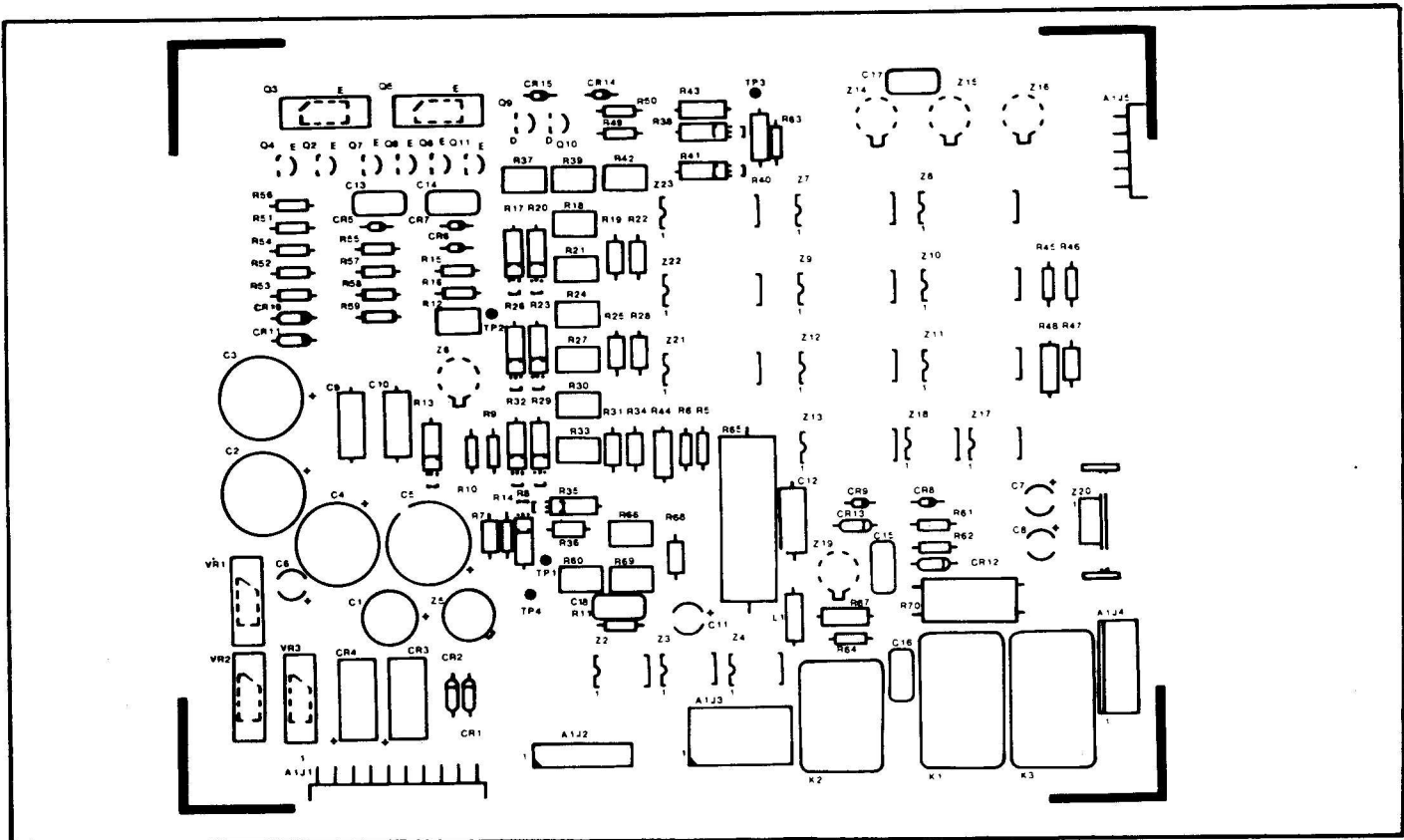
4-2. Isolated D/A Assembly Test Points

4.3 COMPLETE RECALIBRATION (METROLOGY STANDARDS)

4.3.1 Equipment Required

Precision Divider Network:
Julie Research Labs JRL DMR105, or equivalent.

Null Meter:
Hewlett Packard HP3465A, or equivalent.

Transfer Standard:
Model 8200 Calibrator, or equivalent.

Precision Digital Voltmeter
Data Precision Model 3600 or equivalent.

4.3.2 Test Setup and Preliminary Operations

1. Remove top cover (see paragraph 4.2).
2. Remove cover shield by removing the 4 fastening screws in top.
3. Locate TP3 (Test Point 3) on pc-board as indicated in Figure 4-2.
4. Turn power on and allow 1 hour for warmup.
5. Select + Polarity; **10V** Range.
6. Operate decade switches for 0.000000 on display.
7. Measure voltage between TP3 and **LO SENSE** at front panel.
8. Adjust R37 until measure value is within $\pm 2\mu V$ of zero. This adjusts the offset of the buffer amplifier in the most significant octade.
9. Replace the shield cover.
10. Allow an additional 1 hour for warmup before proceeding.

4.3.3 Offset Adjustment

1. Select + Polarity; **100V** Range.
2. Operate decade switches for 00.0000 on display.

3. Measure voltage between **HI SENSE** and **LO SENSE** on front panel.
4. Adjust R60 for measured value of less than $10\mu V$.
5. Select **10V** Range. (Display now reads + 00.0000.)

4.3.4 Linearization Adjustments

1. Connect the unit under test to a null meter, and connect the transfer standard to a precision divider as shown in Figure 4-3. Observe all precautions noted on the illustration for the use of copper leads in order to reduce any thermocouple effect on the results.
2. Set transfer standard to 10.48572V.
3. Select + Polarity; **10V** Range.
4. Operate the front-panel decade selector switches for the values shown in Table 4-1. For each setting, connect the null meter to the specified tap on the precision divider, and adjust the specified potentiometer until the null meter is within $\pm 2\mu V$ of zero. See Figure 4-1 for the location of the potentiometer through the access slot in the shield cover.
Do not remove the shield cover.

Table 4-1
LINEARITY ADJUSTMENTS

8200 Setting	Measure Null At	Adjust
1.49796	TAP 1	R12
2.99592	TAP 2	R33
4.49388	TAP 3	R30
5.99184	TAP 4	R27
7.48980	TAP 5	R24
8.98776	TAP 6	R21
10.48572	TAP 7	R18
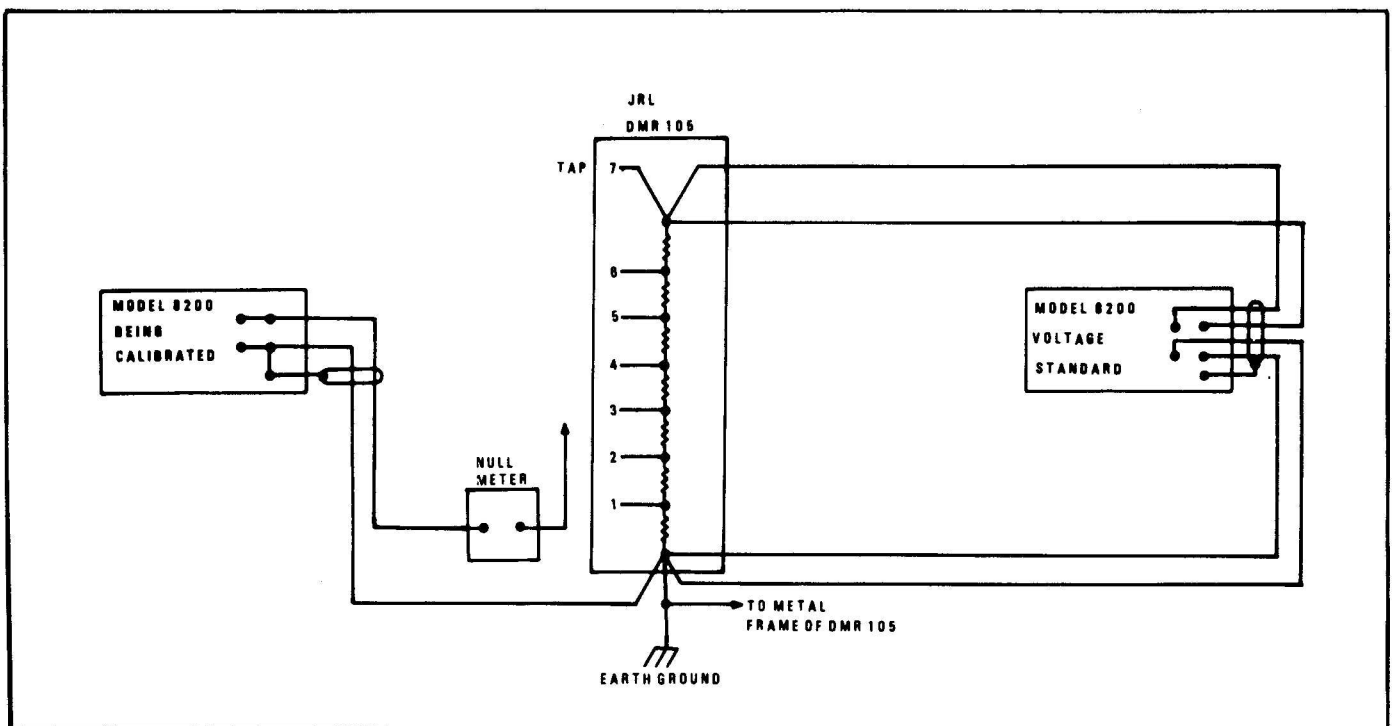
4-3. Calibration Test Setup

4.3.5 Carry Adjustment

1. Connect the unit under test to a null meter, and the null meter to a precision divider driven by a transfer standard, as shown previously in Figure 4-3.
2. Attach null meter clip lead to TAP 7.
3. Set the transfer standard and the 8200 to a value of + 0.16384V.
4. Record reading on the null meter. It should be within 10μV of zero.
5. Operate decade switches for a value of 0.16383.
6. Adjust R42 until the null detector reads 10μV more than the value recorded in step 4.
7. Set both the transfer standard and the 8200 to a value of + 1.31072V.
8. Record reading on the null meter. It should be within 20μV of zero.
9. Operate decade switches for a value of 1.31071.
10. Adjust R39 until the null detector reads 10μV more positive than the value recorded in step 8.

4.3.6 Final Calibration.

Repeat the procedure described in paragraph 4.2 for the Field Calibration.

4.4 MAINTENANCE

4.4.1 General

Model 8200 Calibrator is covered under a limited warranty against defects in workmanship and material for a period of 12 months. If any maintenance is required within the warranty period, the instrument should be returned to the factory or to one of the authorized service centers.

CAUTION

Attempts to make any extensive repairs or maintenance within the warranty period may invalidate the warranty. When repairs are required after the warranty period, they should be accomplished by qualified technical personnel only

4.4.2 Troubleshooting Strategy

Signs of an apparently faulty calibration should not be interpreted immediately as indicative of a malfunctioning calibrator. Double check all connections; inspect the interconnecting cabling; confirm the operating mode (range selection) and polarity selection at the front panel; and verify that case-to-ground common mode voltages are within specifications. It may be a simple operation to disconnect the calibrator and check its performance with a voltmeter at the terminals. This is usually sufficient to isolate the cause of the apparent malfunction to the calibrator or to its application setup.

The mechanical assembly of the Model 8200 Calibrator corresponds, in general, to the functional blocks, and this greatly simplifies the troubleshooting and

maintenance procedures. Manipulation of the front-panel controls and evaluation of the responding display is very useful in confirming the **proper** performance of major circuit assemblies. In any case, the purpose of a good troubleshooting strategy is to prevent the repair or replacement of **good** components, and to minimize the interruption of circuit connections in isolating the cause of the malfunction.

4.5 POWER SUPPLY DISTRIBUTION

Distribution of power in the 8200 Calibrator is illustrated in Figure 4-4. If the cause of a malfunction is power related, it may be isolated very quickly to the source, the internal power supplies, or to a major assembly. If there is no evidence of any power reaching the 8200, check F300. If the fuse is not blown, then check the power source, the interconnecting power cord, and the components of the RFI circuit on TB301. Repair as necessary.

If fuse F300 is blown,
1. Disconnect the cable connections to A1 (D/A Converter), A2 (Display), and A6 (Control Switching).
2. Replace the fuse. Turn power on.
3. If the replaced fuse blows, the problem is either in the transformer or A4 (Digital Control).
4. Disconnect the power to A4 at terminal E400.
5. Replace the fuse. Turn power on.
6. If the replaced fuse blows, the wiring and transformer T1 should be checked very carefully. Replace and repair as necessary.
7. If the replaced fuse does not blow (after step 5), the problem is probably in the Digital Control (A4). Examine that board carefully for signs of overheated components, burn spots on the pc-board, etc. Check the impedance to ground at the power supply rails (+ 5V, + 8V). Repair and replace any faulty component or wiring.

If the replaced fuse does not blow in step 2 above, then reconnect the cables to A6 (Control Switching), A2 (Display), and A1(D/A Converter), in sequence, checking the fuse after each separate connection.

4.6 POWER AND TIMING CHECKS

Upon verification that the apparent malfunction does not cause a catastrophic failure of the power supply, the next logical step in the troubleshooting process is to assure that the supplies are delivering the specified voltages , and that the master oscillator is delivering the correct timing pulses. This is accomplished by checking the voltage regulator outputs on the digital and analog boards and the resonator circuit outputs on the digital board.

On the digital control board, A4, monitor the outputs with respect to ground at the points specified below. Check for the specified tolerances on the output values. If the values are outside of tolerances, check the noted components.
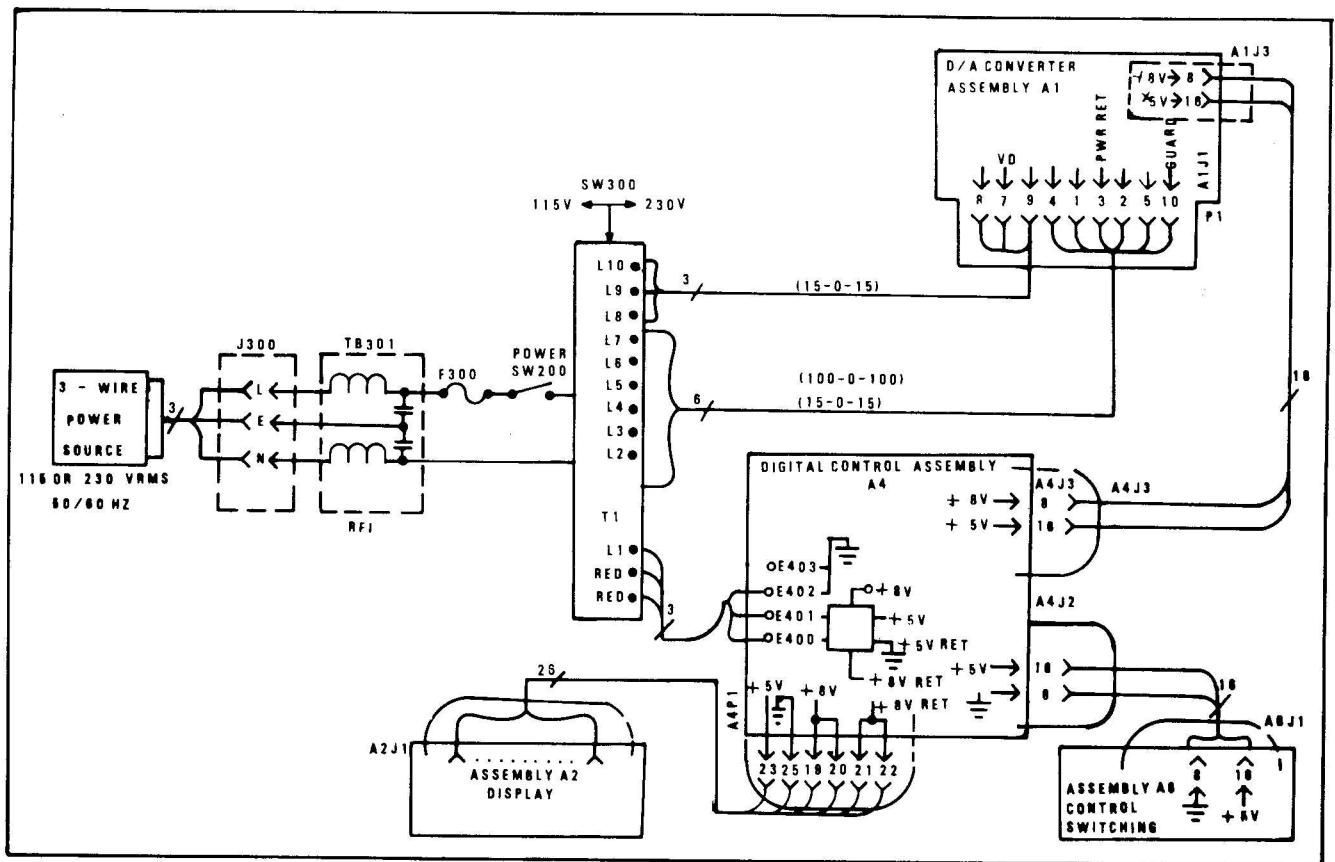
4-5. Model 8200 Power Distribution Schematic.

Disconnect other assemblies, removing loads on the supply.

Turn on power.

Ground Reference: Z9, pin
+ 5V: Z9, pin   , + 5V ± 0.25V.
+ 8V: Z9, pin   , + 10V ± 1v.

2MHz: Z3, pin 8, 2MHz ± 5%.
1MHz: Z3, pin 6, 1MHz ± 5%.

Turn off power.
Reconnect the analog board, A1.
Turn on power.

On the Analog Board A1,

Ground Reference: TP1 (See Figure 4-2)
+ 15V Precision Source: VR1 output, + 15V ± 0.75V.

Analog Output Reference: **LO SENSE** terminal.
+ 15VF (Filtered): C2 + , + 15V ± 0.75V.
− 115VF (Filtered): C3 − − 15V ± 0.75V.
+ 130VF(Filtered): VR2 output, + 130V − 10 + 20V.
− 130VF(Filtered): VR3 output, − 130V + 10 − 20V.

4.7 DIGITAL CONTROL BOARD MAINTENANCE

Once the correct power supply values and master oscillator timing have been confirmed, troubleshooting the digital board, A4, may be performed in conjunction with selective operation of the front-panel controls.

Operate the front-panel range switch while monitoring the annunciators in the display. If the annunciators do not respond to the selected range (mode) switching, signal trace from the Port B output of Z6, through the status register Z7, and the drivers, Z8. If the new levels are present , but the annunciators do not respond, the malfunction is most likely in the Display asembly. If the annunciators respond properly, but the analog outputs do not change scale, the malfunction is most likely in the D/A assembly. If a correct value appears on one range, but not on others, then the malfunction most likely is traceable to a faulty relay.

Check the generation of the scanning pulses Φ3 and Φ1 **by synchronizing with the reset pulse RST** at Z2-pin 6. Scanning pulses should appear in every conversion cycle. Signal trace through OR gates Z5 to Port B of Z6. Scanning pulse Φ2 will be present only when there has been a changed setting on the front panel. Detecting a Φ2 signal is difficult because of the transient nature of that response.

Check the generation of the **ADVANCE** pulse at pin 16 of the connector P1 to the Display assembly with respect to the **RST** pulse. This should occur in every conversion cycle to refresh the display. If it is satisfactory, but the display does not function, the malfunction is most likely in the Display assembly.

Replacement of parts on the A4 assembly is limited, and complete board replacement is recommended.

4.8 D/A CONVERTER BOARD MAINTENANCE

Troubleshooting the D/A Converter assembly A1 is great-
ly simplified by the apparent isolation of its function
from the other assemblies. Once the proper power levels
are confirmed as in paragraph 4.6, the analog output
generation may be traced from the latched binary values
through to the front-panel terminals.

CAUTION

Final values of any measurements should be obtained
only after the shield has been replaced and the instru-
ment has warmed up to a stable temperature of 23°C
± 1°C.

Check the reference voltage divider outputs at the input
terminals of any one of the programmed multiplexers,
A14 through Z19 for the divisions of the reference
voltage of 10.48575. Signal trace any incorrect value to
the operational amplifier and to the divider element.
Observe the CAUTION with regard to "minor" deviations
from tolerances.

Operate the front-panel controls for a non-zero value and
check the levels of the bits at the output of the series-to-
parallel shift register. Incorrect bit values may be traced
to malfunctioning opto-isolators, shift register com-
ponents, or microcomputer outputs.

Check the "raw" buffered multiplexer outputs (before the
octade weighting). These voltages should be directly
correlated with the bit levels at the shift register outputs.

If the correct voltage is present at **TP3** for a set of binary
levels, check Z19 for the buffering of that value. If the
buffered value is correct, signal trace through Z20 for
10V range, and through Q3 through Q8 for 100V range.
Verify the relay operation as ranges are changed.

Repair of the D/A Converter assembly may be ac-
complished at the component level.
*Be sure to reclibrate after any repairs to the D/A Con-
verter assembly.*

5

PARTS LISTS

5.1 MODEL 8200 CALIBRATOR ASSEMBLIES

Figure 5-1 illustrates the breakdown of the calibrator into its major assemblies within the case. The two option assemblies (IEEE488 and 1KV) may be field-installed at any time. Their installation requires mounting some standoffs on the bottom chassis plate and connecting the assembly board to related assemblies with flat cables, supplied with each option. The mating boards have been instrumented to mate with the option connectors as part of the standard, basic instrument.

5.2 PARTS LISTS

5.2.1 Ordering Requirements

When replacement parts are required, the order whould specify:

The part **Reference Designation** (R1, C200, etc) as shown on the schematic or assembly board;

The complete **Part Description** as in the tabular listing;

The **Data Precision Part Number** (DP Part No. 22-021029, etc.) as shown in the listings that follow.; and

The **Part Number and Revision Letter** of the pc-board on which the part is located.

5.2.2 Display Assembly (A2)

Ref. Des.	Description	DP Part No
A201-203	Resistor Network, 680	22-741003
C201-203	Capacitor, 0.1uF, 20%,50V, Cerm	23-142003
DS201	Display, HDSP3406	25-223406
DS202-207	Display HDSP3400	25-223400
DS208-211	Lamp, Panel Indicator	25-201006
Q201-207	Transistor, MPS U45	24-230U45
Q208-215	Transistor, GES 5818	24-235818-A
R201-208	Resistor, 10, ½W, 5%, C.C.	22-031009
R209-212	Resistor, 150, ¼W, 5%, C.C.	22-021519-C
Z201	I.C., 4017B	24-L04017B
Z202	I.C., 74C374	24-G74C374

5.2.3 20-Bit D/A Converter (Assembly A1)

Ref. Des.	Description	DP Part No.
C1	Capacitor, 220uF, 35V, RAD, AIEI	23-620006
C2,3	Capacitor, 47uF, 250V, RAD	23-620016
C4,5	Capacitor, 1000uF, 35V, RAD, AIEI	23-620009
C6,7,8,11	Capacitor, 6.8uF, 20%, 20V, Tant	23-441005
C9,10	Capacitor, 1uF, 10%,50V, Psty	23-550001
C12	Capacitor, 0.01uF, 2%, 50V	23-550108
C13,14,15	Capacitor, 100pF, 5%, DM15, Mica	23-311001
C16,17	Capacitor, 1000pF, 5%, DM15	23-311036
C18	Capacitor, 470pF, 5%, DM15	23-311028
CR1,2,10-13	Diode, 1N4004	24-104004
CR3,4	Diode, KBPPO4	24-100021
CR5-9,14,15	Diode, 1N4148	24-110001
K1,3	Relay, 4C	25-171009
K2	Relay, 2C	25-171008
L1	Inductor, 220uH, 5%	25-100002
Q2,7,8	Transistor, PNP, MPSA92	24-240A92
Q3,5	Transistor, Power, D40N5	24-226177
Q4,6	Transistor, NPN, 2N3903	24-233903
Q9	Transistor, FET, P CHAN	24-210104-P
Q10	Transistor, FET, N Chan	24-210104-N
Q11	Transistor, NPN, 2N3904	24-233904
R7	Resistor, 3.01K, RN55E	22-253R01
R9,10	Resistor, F.S.V. ¼W, 5%, C.C.	22-02***-C
R5,6,11,-49,50,55,63	Resistor, 10K, ¼W, 5%, C.C.	22-021039-C
R12	Resistor, Pot, 20, 3299Y	22-680002
R56,59	Resistor, 43, ¼W, 5%, C.C.	22-024309-C
R14	Resistor, 1K, ¼W, 5%, C.C.	22-021029-C
R15	Resistor, , 100, ¼W, 5%, C.C.	22-021019
R16	Resistor, 220, ¼W, 5%, C.C.	22-022219-C
R17,20,-23,26,29,-32,35	Resistor, Matched, 500 each	22-68-1048
R18	Resistor, Pot, 100K, 3299Y	22-680013
R19	Resistor, 182K, RN55E	22-351823
R21,24,-27,30,33	Resistor, Pot, 100, 3299Y	22-680004
R22,25,-28,31,36	Resistor, 301K, RN55E	22-353013
R34	Resistor, 335K, RN55E	22-353353
R37,39,60	Resistor, Pot, 50K, 3299Y	22-680012
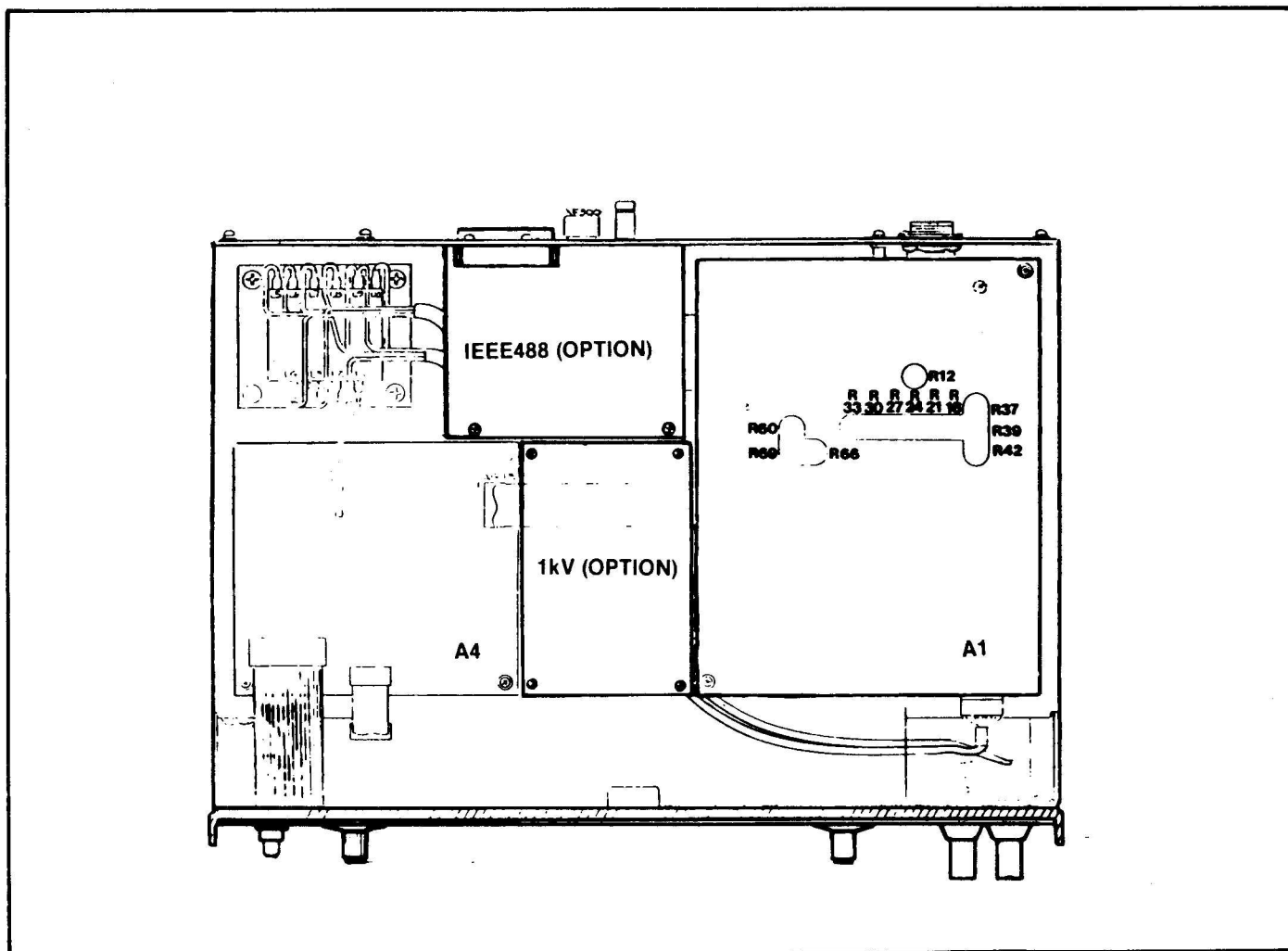
5-1. Model 8200 Major Assemblies

Ref. Des.	Description	DP Part No.
R38	Resistor, 1000.0 Matched with R41	22-68-1049-1
R41	Resistor, 8063.0 Matched with R38	22-68-1049-1
R8	Resistor, 5.3896K Matched with R13	22-68-1049-3
R13	Resistor, 40K Matched with R8	22-68-1049-3
R40	Resistor, 1M, 0.1%, 15ppm	22-406000
R42,66	Resistor, Pot, 50, 3299Y	22-680003
R43	Resistor, 63.980K, 0.01%,	22-409000
R44	Resistor, 447.23K, 0.02%, 10ppm	22-404000
R45	Resistor, 1K, 0.1%, 15ppm, Mar 5	22-407000
R46	Resistor, 8K, 0.1%, 15ppm, Mar 5	22-407001
R47	Resistor, 64K, RN55E	22-356402
R48	Resistor, 511K, RN60D	22-365113
R51	Resistor, 68K, ¼W, 5%, C.C.	22-026389-C
R52	Resistor, 5.6K, ¼W, 5%, C.C.	22-025629-C
R53,58,61	Resistor, 2.2K, ¼W, 5%, C.C.	22-022229
R54	Resistor, 510K, ¼W, 5%, C.C.	22-025149-C
R62	Resistor, 3.9, ¼W, 5%, C.C.	22-023R99-C
R64	Resistor, 10, ¼W, 5%, C.C.	22-021009-C
R68	Resistor, 931. RN55E	22-359310
R69	Resistor, Pot, 200, 3299Y	22-680005
R57	Resistor, 91K, ¼W, 5%, C.C.	22-029139-C
R65	Resistor, 89,980 Matched with R67	A68-1052
R67	Resistor, 10,000 Matched with R65	A68-1052
R70	Resistor, 10.1, Current Shunt	A68-1047
VR1, 2	I.C. Voltage Reg, + 15V, LM342	24-370342
VR3	Voltage Reg, − 15V, LM320	24-370320
Z2-4	I.C., 6N136	24-N6N136
Z5	I.C., LM299	24-420299
Z7-13	I.C., CMOS. 4051B	25-L04051
Z14, 19	I.C., Op Amp, 517L	24-420517-L
Z6,15	I.C., Op Amp, 517K	22-420517-K
Z16	I.C., Op Amp, 542L	24-420542-L
Z17,18	I.C., Op Amp, TL062 DIL	24-400062
Z20	I.C., Powr Op Amp, uA 759U	24-37A759
Z21-23	I.C., CMOS, 4094B	24-CD4094

5.2.4 Digital PCB Assembly (A4)

Ref. Des.	Description	DP Part No.
C1	Capacitor, 0.02uF, 150V, Cerm	23-118210
C2	Capacitor, 1000pF, DM15, Mica	23-311036
C3	Capacitor, 470pF, DM15	23-311028
C4.5	Capacitor, 15uF, 20%, 10V, Tant	23-441003
C6,7	Capacitor, 4700uF, 16U RAD	23-620015
C8	Capacitor, 0.01uF, 10%,250V, Mylar On power transformer.	23-210013
CR1	Diode, 1N4148	24-110001
CR2-5	Diode, Rect, 50V, 3A, S3A05F	23-10225-030
R1.2	Resistor, 2.2K, ¼W, 5%, C.C.	22-022229-C
R3,7,9	Resistor, 10K, ¼W, 5%, C.C.	22-021034-C
R4,5,6	Resistor, 390, ¼W, 5%, C.C.	22-023919-C
R8	Resistor, 15K, ¼W, 5%, C.C.	22-021539-C
T1	Transformer, power	D68-1055
Y1	Resonator, 4MHz	25-141001
Z1	I.C., 74LS00	24-E0LS00
Z2	I.C., 74LS08N	24-E0LS08
Z3	I.C., 74LS74	24-E0LS74
Z4	I.C., 74C74	24-G74C74
Z5	I.C., 4071B, CMOS	24-L04071
Z6	I.C., R6500/1	A68-1056
Z7	I.C., 74C374	24-G74C374
Z8	I.C., ULN2003A	24-330001
Z9	I.C., 7805, Volt Reg	24-307805

5.2.5 Switch Card Assembly (A6)

Ref. Des.	Description	DP Part No.
A1-4	Resistor Network, 47K	22-740002
CR1	Diode, 1N4148	24-110001
SW200	Switch, POWER, (Front Panel)	25-431003
SW201	Switch, POLARITY, 3-pos	B68-1051
SW202-207	Switch, DECADE, rotary	B68-1046
SW208	Switch, RANGE, 5-pos	B68-1050
Z1-3	I.C., MM80C97N	24-G80C97

5.2.6 Rear Panel Assemblies

Ref. Des.	Description	DP Part No.
C301,302	Capacitor, 0.005uF, Class II	23-118010
J301	Receptacle, Female	25-321036
L301,302	Inductor, 100uH, 5%	25-100024
R301	Resistor, 10,000 Matched with R302	22-68-1049-2
R302	Resistor, 101.010 Matched with R301	22-68-1049-2

WHT

6

6

GRY.

RED

E201

E200

P200

E202

9

E203

E204

ORN

BLK

5

3

HDWR SUPPLIED W/
ITEMS 5 & 6. INSTALL
AS SHOWN, 5 PLACES

7

1 REF.
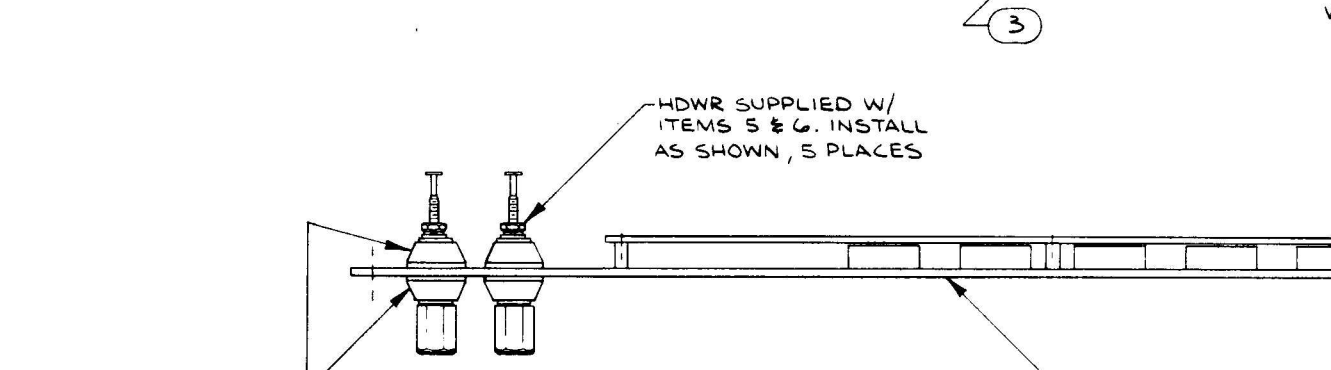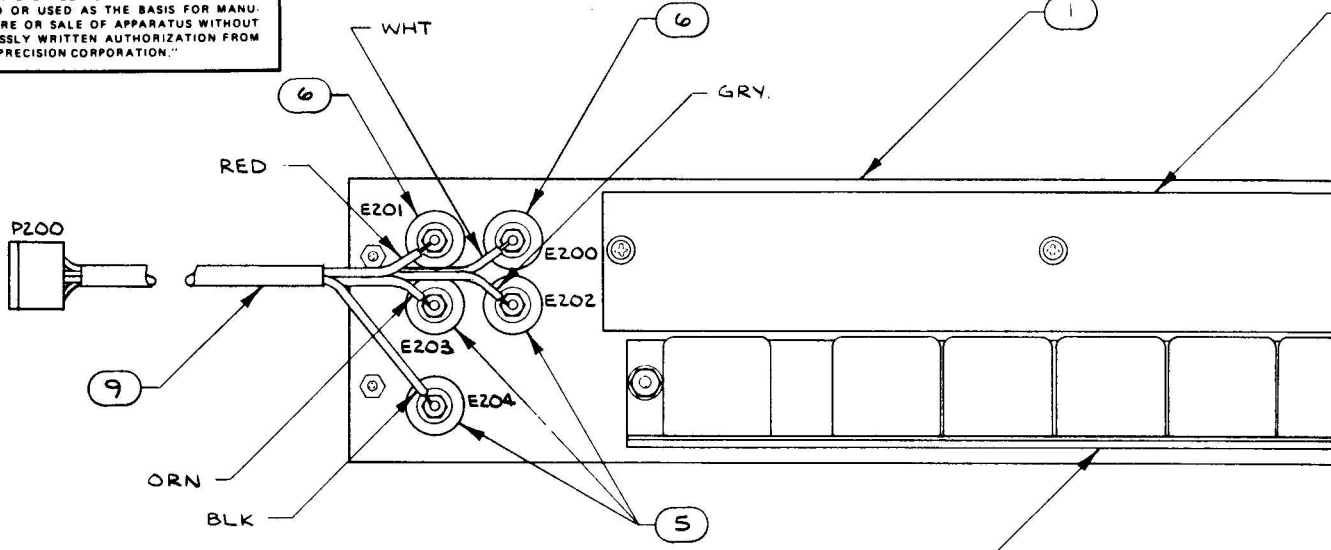
INSTALL INSULATORS
FRONT & REAR
5 PLACES.

NOTES:
1. FOR SEPARATE PARTS LIST, SEE PL 60-1095.
2. REF. DWGS. : WIRE RUN LIST : B65-1033,
               SCHEMATIC : D65-1029.

(2)

4 REQ'D (12)
4 REQ'D (13)
4 REQ'D (14)

— TWISTED PAIR

W200 (10)
(WHT.)

(11) W201
(RED)

(4) HEATSHRINK TO FIT
3 PLACES

(8) SW200

3
2
1

—LOCKNUT SUPPLIED W/
ITEM 8. INSTALL
AS SHOWN.

(15) 2 REQ'D
(16) 2 REQ'D
(17) 2 REQ'D

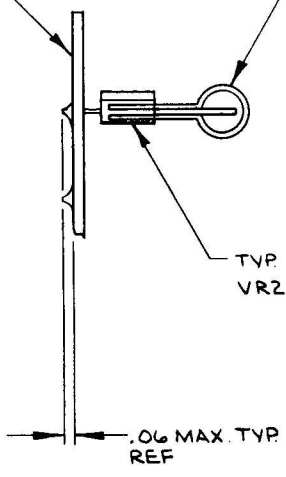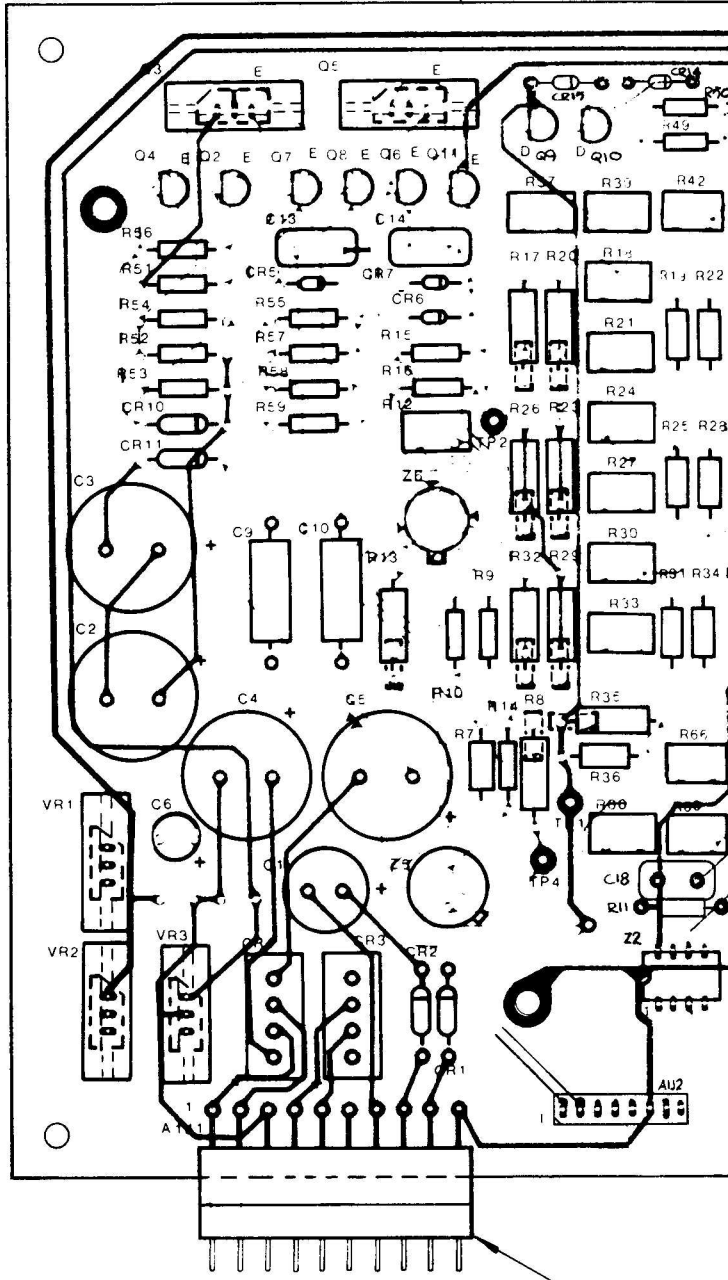|			DRAWN BRW	DATE 5-27-80		
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	CHECKED		DATA PRECISION CORP. Data Precision Corporation, Danvers, Mass. 01923	
		MATERIAL	DESIGNER			
			ENGINEER PI	5-80	ASSEMBLY	
		FINISH	APPROVED		FRONT PANEL	
PL60-1097	8200	APPLICABLE SPECIFICATIONS	RELEASED 8-11-80		CODE IDENT NO 51692	SIZE D	67-1095	REV —
NEXT ASSY	USED ON		WEIGHT			
APPLICATION			SCALE FULL	ACCOUNT NO.		SHEET 1 OF 1

REF. (1)

(78) 5 REQ'D
INSTALL AS SHOWN

(1)

TYP Q3, Q5, VR1,
VR2 & VR3

.06 MAX. TYP.
REF

NOTES:
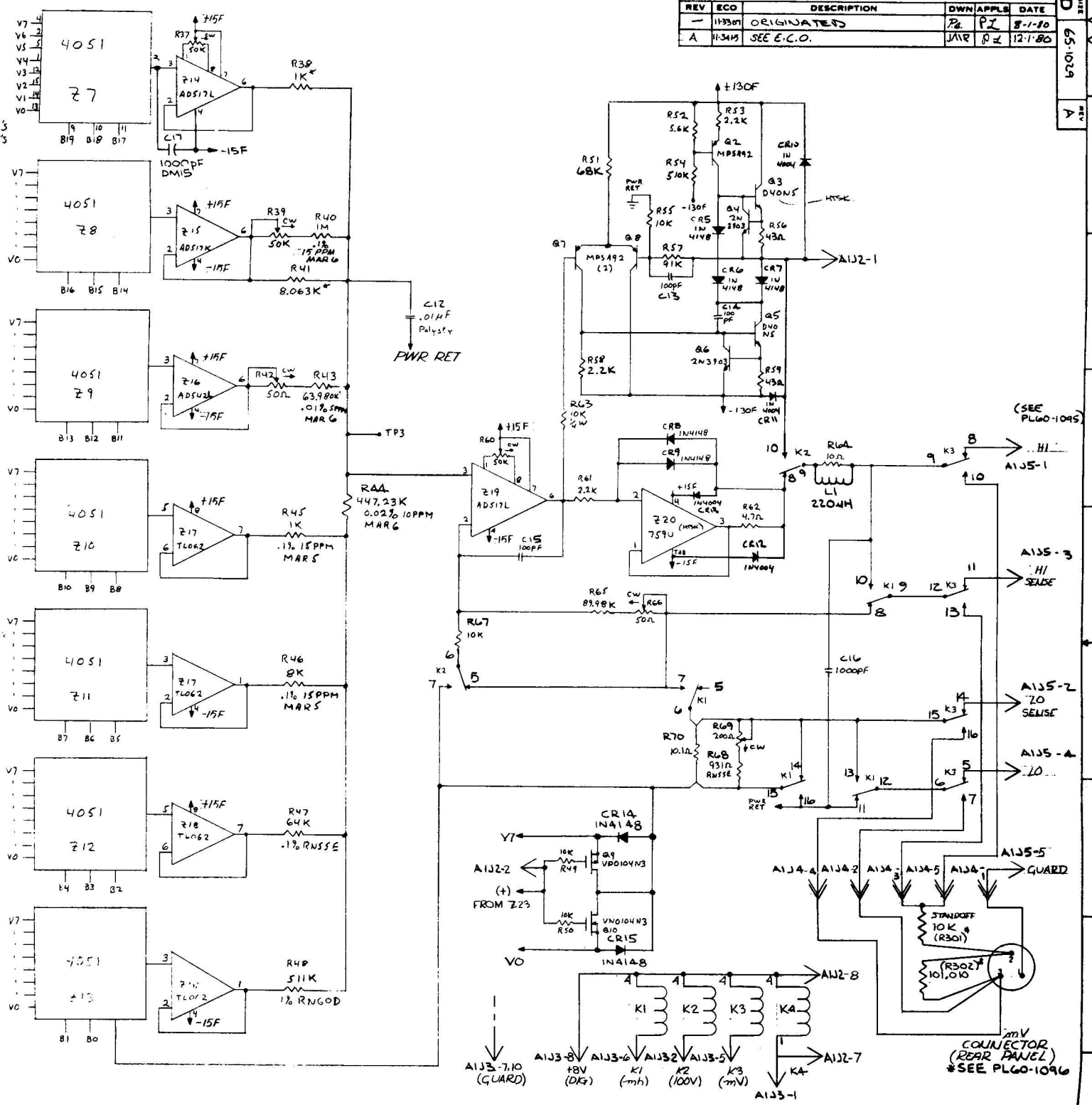1. FOR SEPARATE PARTS LIST, SEE PL60-1090.
2. FOR SCHEMATIC, SEE D65-1029.

DASHED LINES INDICATE
OPTIONAL COMPONENT MTG.
PER A68-1048 & A68-1049
TYP R17, R20, R23, R26, R29, R32
R35, R38, R41, R13 & R8.

REV	ECO	DESCRIPTION	DWN	APPLS	DATE
—	11-307	ORIGINATED	BRW	PJ	8-1-80
A	11-345	SEE E.C.O.	JWR	PZ	12-2-80

REVISIONS

82 A1J5

79

86
77
76
68

84 3 REQ'D
85 3 REQ'D

83 A1J4

1
REF

15 K3, REF

VIEW SHOWING ASSY OF
RELAY HARDWARE
TYP. K1-K3

87

80 A1J3

81 A1J1

DATA PRECISION

ASSEMBLY
20 BIT DAC (A1)

		DRAWN BRW	DATE 8-2-80		
		CHECKED			
		DESIGNER			
		ENGINEER PZ	8-11-80		
		PROJECT			
PL60-1097		RELEASED	8-11-80		
NEXT ASSY		WEIGHT			
APPLICATION					

CODE IDENT NO 51692	SIZE D	67-1090	REV A
SCALE 2/1	ACCOUNT NO		SHEET 1 OF 1

16 15 14 13 12 11 10 9

J I H I H G F E D C B A

+15V
R15 100Ω
R14 1K
Q11 2N3904
R16 220Ω
VDD
PIN 16 OF 4051's
PIN 15,16 OF 4094B's
TP2

R7 3.01K RNSSE

R18 100K ↑CW V7
R17 500Ω R17
R19 182K RNSSE

Z6 AD517K

TP4
R8 5.3896K
R9 FA1
R10 FA2
R12 20Ω ↑CW
R13 40K

C10 1μF

R20 500Ω R20
R21 100Ω ↑CW V6
R22 301K RNSSE

R23 500Ω R23
R24 100Ω ↑CW V5
R25 301K RNSSE

C9 1μF

GND

R27 100Ω ↑CW V4
R26 500Ω R26
R28 301K RNSSE

R30 100Ω V3
R29 500Ω R29
R31 301K RNSSE

R33 100Ω V2
R32 500Ω R32
R34 335K RNSSE

R36 301K RNSSE V1
R35 500Ω R35

V0
TP1

FROM POWER XFMR (SEE PL60-1097)
(L10) A1J1-8
CR1 1N4004
(L8) A1J1-9
CR2 1N4004
15V RMS
C1 220μF 35V
VR1 LM342-15
IN
G
C6 68μF 20V

Z5 LM299

(L9) A1J1-7

To pins 6,7,8 of 4051's
pin 8 of 4094B's

(L7) A1J1-4
CR3 KBP04
AC
+130F
C2 47μF 250V
C3 47μF 250V
100-0-100 RMS (CT LS)
CR3 KBP04
AC
(L3) A1J1-5
-130F

(L6) A1J1-1
CR4 KBP04
AC
A1J2-5
15V RMS
C4 1000μF 35V
VR2 LM342-15 (HTSK)
IN G
+15F
C7 68μF 20V
A1J2-4
(L5) A1J1-3
PWR RET
C8 68μF 20V
15V RMS
C5 1000μF 35V
VR3 LM320 MLP-15 (HTSK)
G IN
-15F
AC
(L4) A1J1-2
A1J2-3
(L2) A1J1-10
GUARD

VDD
R5
C18 470pf DM15
R6 10K R 10K
C11 26V
A1J3-16
GN136
ZA
A1J3-14 STROBE
4094B Z23
4 (1+)
2 B19
6 B18
5 B17
4 B16
10

A1J3-3 CLK
GN136
Z3
4094B Z22
11 B15
12 B14
13 B13
14 B12
2 B11
6 B10
5 B9
4 B8
10

A1J3-4 DATA
GN136
Z2
10K R11
4094B Z21
11 B7
12 B6
13 B5
14 B4
2 B3
6 B2
5 B1
4 B0

OF 4051'S
OF 4094B'S

4051 Z7
V7 V6 V5 V4 V3 V2 V1 V0
B19 B18 B17

R37 50K +15F
Z14 ADS17L
C17 1000PF DM15
-15F
R38 1K

4051 Z8
V7 V0
B16 B15 B14

Z15 ADS17K +15F -15F
R39 50K CW
R40 1M -15 PPM MAR 6
R41 8.063K*

4051 Z9
V7 V0
B13 B12 B11

Z16 ADS42L +15F -15F
R42 50Ω CW
R43 63.980K* -.01% 5PPM MAR 6
TP3

4051 Z10
V7 V0
B10 B9 B8

Z17 TL062 +15F -15F
R45 1K .1% 15PPM MAR 5

4051 Z11
V7 V0
B7 B6 B5

Z17 TL062 +15F -15F
R46 8K .1% 15PPM MAR 5

4051 Z12
V7 V0
B4 B3 B2

Z18 TL062 +15F -15F
R47 64K -.1% RN55E

4051 Z13
V7 V0
B1 B0

Z19 TL062 +15F -15F
R48 511K 1% RNGOD

C12 .01µF Polyster
PWR RET

R44 447.23K 0.02% 10PPM MAR 6

R60 50K CW +15F
Z19 ADS17L +15F -15F
C15 100PF
R61 2.2K

CR8 1N4148
CR9 1N4148
CR8 1N4004 +15F
Z20 759U (HTSK)
R62 4.7Ω
CR12 1N4004 -15F

R63 10K ¼W

R65 89.98K CW R66 50Ω
R67 10K

R70 10.1Ω
R69 200Ω
R68 931Ω RN55E CW

K2 R64 10Ω
L1 220µH
K3 9 8 → HI A1J5-1

K19 12 K3 11 → HI SENSE A1J5-3

K3 14 → LO SENSE A1J5-2
15

K3 5 → LO A1J5-4
7

C16 1000PF

+130F
R52 5.6K R53 2.2K
R51 68K
PWR RET
R54 510K
R55 10K -130F CR5 1N4148
Q2 MPS492
CR10 1N 400V
Q3 D40N5 HTSK
Q4 2N3903 R56 43Ω
Q7 Q8 MPS492 (2)
R57 91K
CR6 1N4148 CR7 1N4148
C13 100PF
→ A1J2-1
C14 100PF
Q5 D40N5
R58 2.2K
Q6 2N3903
R59 43Ω
-130F CR11 1N 400V

(SEE PL60-1095)

CR14 1N4148
Y7
A1J2-2
R49 10K Q9 VP0104N3
(+) FROM Z23
R50 10K VN0104N3 Q10 CR15 1N4148
VO

STANDOFF 10K* (R301)
(R302) 101,010

A1J4-4 A1J4-2 A1J4-3 A1J4-5 A1J4-1 → GUARD A1J5-5

mV CONNECTOR (REAR PANEL) *SEE PL60-1096

A1J3-7,10 (GUARD)

K1 K2 K3 K4
A1J3-8 A1J3-6 A1J3-2 A1J3-5
+8V (DKG) K1 (-mh) K2 (100V) K3 (mV)
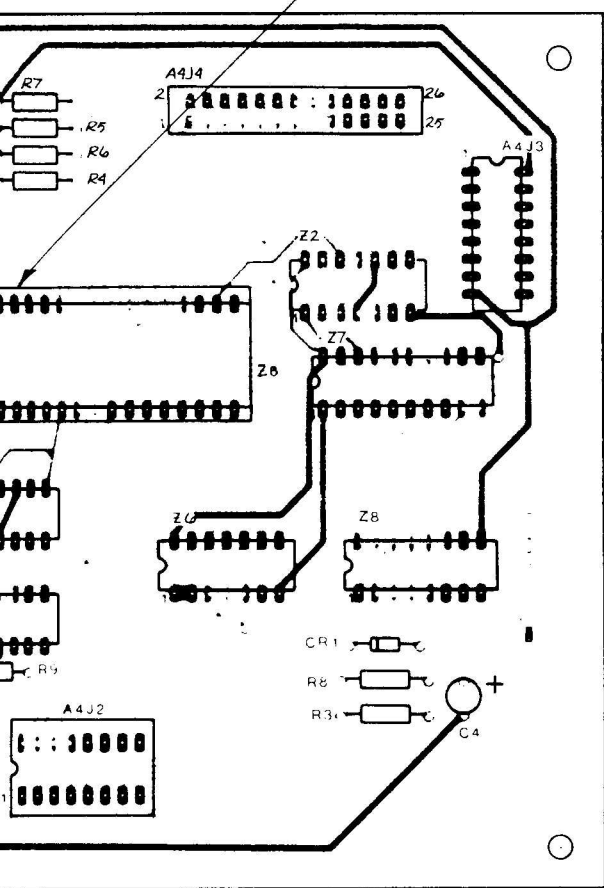→ A1J2-8
K4
→ A1J2-7
A1J3-1

FROM RELAY DRIVERS SEE PL60-1091

NOTES:
1. FOR SEPARATE PARTS LIST, SEE PL60-1091
2. FOR SCHEMATIC, SEE D65-1030
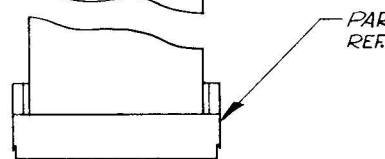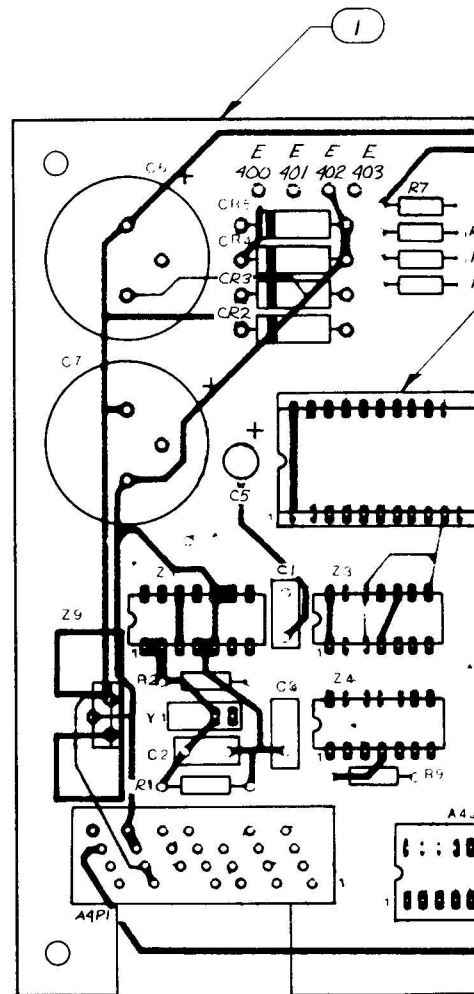
VIEW SHOWING ASS'Y
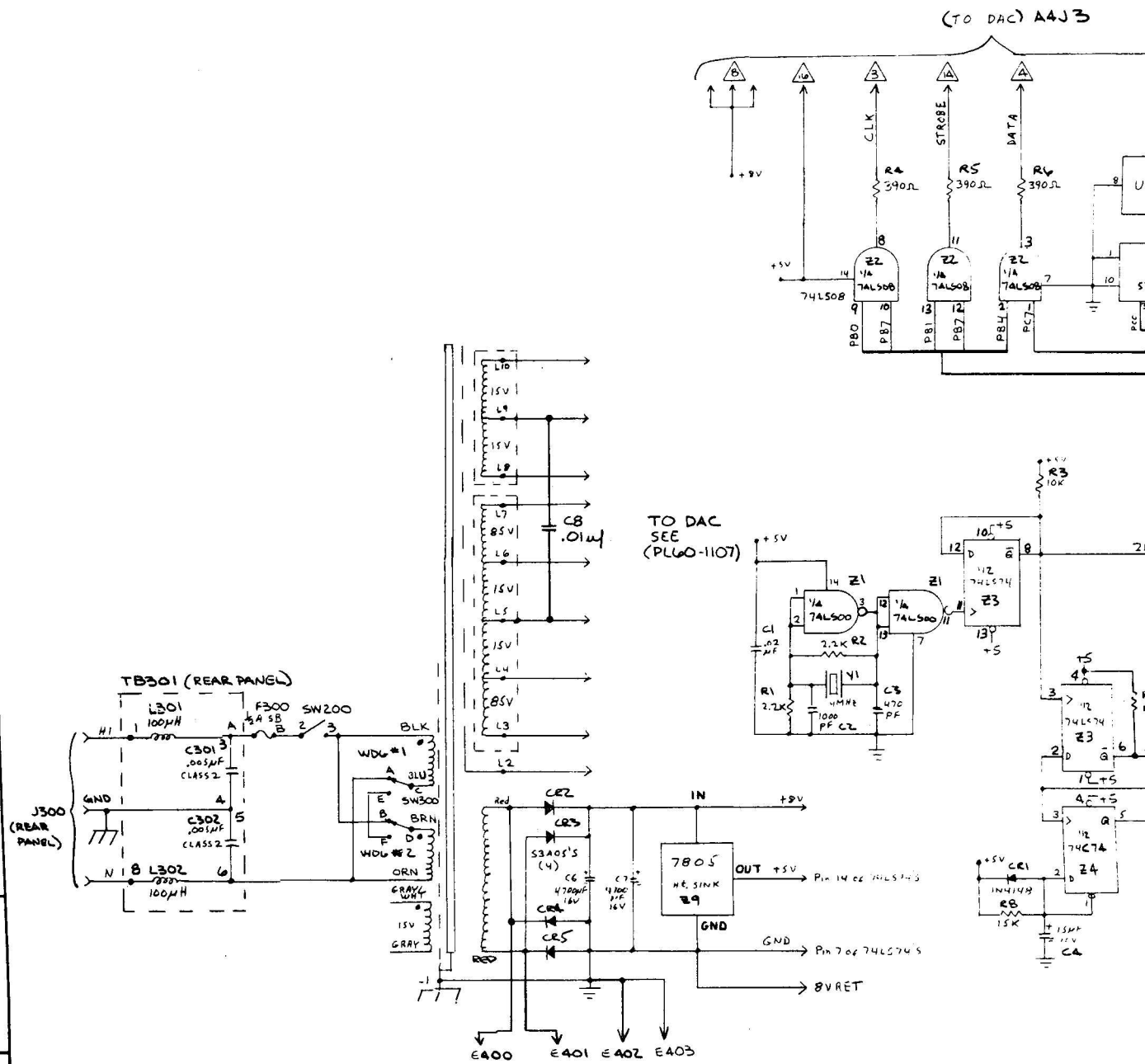OF ITEM 29 (HEATSINK),
AND ITEM 17 (Z9).

29 INSTALL AS SHOWN.

17 REF. INSTALL AS SHOWN.
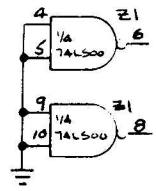
.06 MAX. TYP

1 REF.
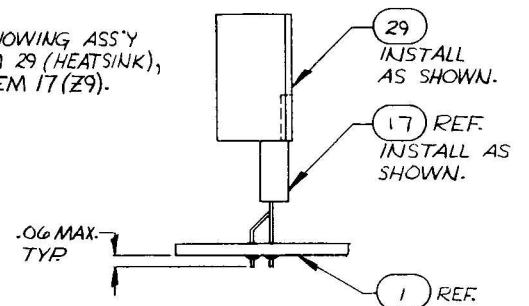
X1
INSTALL UNDER
Z6 AS SHOWN.

A4J4
2   26
1   25

A4J3

R7
R5
R6
R4

Z2
Z7
Z6

Z8

CR1
R8
R3
C4
+

R9

A4J2

PART OF A4P1
REF.

(TO DAC) A4J3

+8V

CLK   STROBE   DATA

R4 390Ω   R5 390Ω   R6 390Ω

+5V

Z2 1/4 74LS08   Z2 1/4 74LS08   Z2 1/4 74LS08

74LS08

PB0 PB7   PB1 PB7   PB4 PC7

R3 10K

TO DAC
SEE
(PL60-1107)

+5V

C8 .01µ

L10
15V
L9
15V
L8

L7
85V
L6
15V
L5
15V
L4
85V
L3
L2

Z1 1/4 74LS00   Z1 1/4 74LS00   Z3 1/2 74LS74

C1 .02µF   R2 2.2K   C3 470 PF

R1 2.2K   Y1 4MHz   1000 PF C2

Z3 1/2 74LS74

Z3 1/2 74LS74

Z4 1/2 74LS74

+5V CR1   1N414H   R8 15K   15µF 12V C4

TB301 (REAR PANEL)

L301 100µH   F300 5A SB   SW200

C301 .005µF CLASS 2

H1

GND

C302 .005µF CLASS 2

J300 (REAR PANEL)

N   L302 100µH

BLK

WDG #1

SW300

BRN

WDG #2

ORN

GRAY WHT

15V

GRAY

Red

CR2
CR3
S3A0S'S (4)
CR4
CR5

C6 4700µF 16V   C7 4700µF 16V

IN   +8V

7805 HT. SINK Z9

OUT +5V   Pin 14 of 74LS74's

GND   Pin 7 of 74LS74's

8V RET

RED

E400   E401 E402 E403

NOTES: UNLESS OTHERWISE SPECIFIED:
1. RESISTORS ARE 1/4W, 5%, C.C., VALUES SPECIFIED IN OHMS
2. ADDITIONAL GND CONNECTION: Z3, Z4, PIN 7
   +5V CONNECTION Z3, Z4, PIN 14
3. REF. DWGS.:
   PL60-1107 TRANSFORMER ASSY.
   PL60-1096 REAR PANEL ASSY.
   B65-1033 WIRE RUN LIST.

Z1 1/4 74LS00

Z1 1/4 74LS00

SPARE GATES

16 15 14 13 12 11 10 9

(TO DISPLAY)
A4P1

(TO CONTROL SWITCHING)
A4J2

Z8
ULN 2003A
DRIVERS

Z7
74C374
STATUS REGISTER

Z2
74LS08

Z5
1/4
4071

PORT B ADDRESS ASSIGNMENTS

	HEX	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
CLK	91	1	X	X	X	X	X	X	1
STROBE	92	1	X	X	X	X	X	1	X
DATA	10	X	X	X	1	X	X	X	X
RST	84	1	X	X	X	X	1	X	X
ADVNCE	0F	X	X	X	1	X	X	X	X
ϕ1	03	0	X	X	X	X	0	X	X
ϕ2	05	0	X	X	X	X	X	0	X
ϕ3	06	0	X	X	X	X	X	X	0
STATAD	47	X	1	X	X	X	X	X	X
NOAD	07	0	0	X	0	0	1	1	1

TP1   TP2

Z6
R6500/1   μ-PROCESSOR

2MHz

A4J4
IEEE 488 INTERFACE LOGIC

BUS CONNECTOR

R7 10K

R9 10K

15 μF 10V
+5V

1MHz

Z3

Z4

Z5
1/4
4071

D 1/2
74C74
Z4

SPARE GATES

SPARE F.F.

NOTES:
1. FOR SEPARATE PARTS LIST, SEE PL60-1092.
2. FOR SCHEMATIC, SEE D65-1031.

REVISIONS					
REV		DESCRIPTION	DWN	APPLS	DATE
—		ORIGINATED	BRW	PI	8-1-80

SW205   SW206   SW207   SW208

A4   Z3

				BRW	7-17-80	DATA PRECISION
						ASSEMBLY
						MODEL 8200
				PI	8-1-80	SWITCH BANK PCB A6
PL60·1094				8-11-80	51692 D	67-1092 -
APPLICATION					2/1	SHEET 1 OF 1

DECADE SELECTOR
SWITCHES

MSD

Z1
80C97

A1 27K   A1 27K

Z2
80C97

⌀2
⌀1

SW
202

B
A
C

PC5

Z1
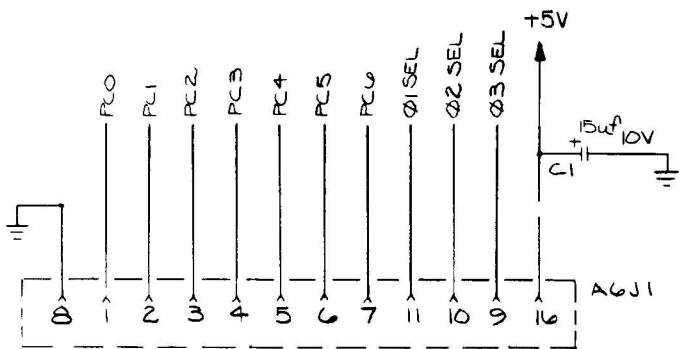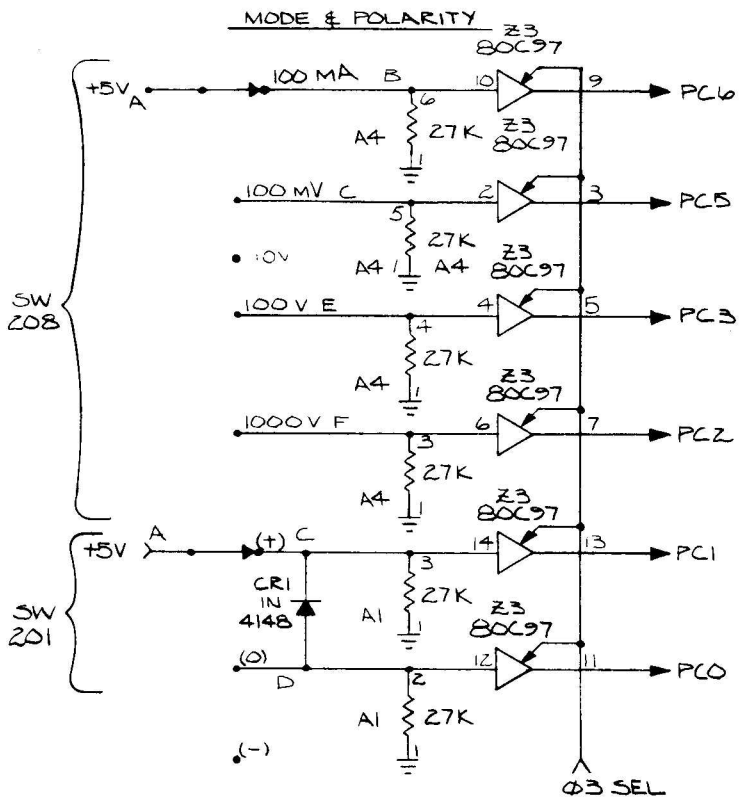80C97

A1 27K   A2 27K

Z2
80C97

SW
203

B
A
C

PC4

NOTES:
1.) ALL RESISTORS ARE 22-730003.
2.) ADDITIONAL +5 CONNECTIONS
    PIN 16 OF Z1, Z2, & Z23.
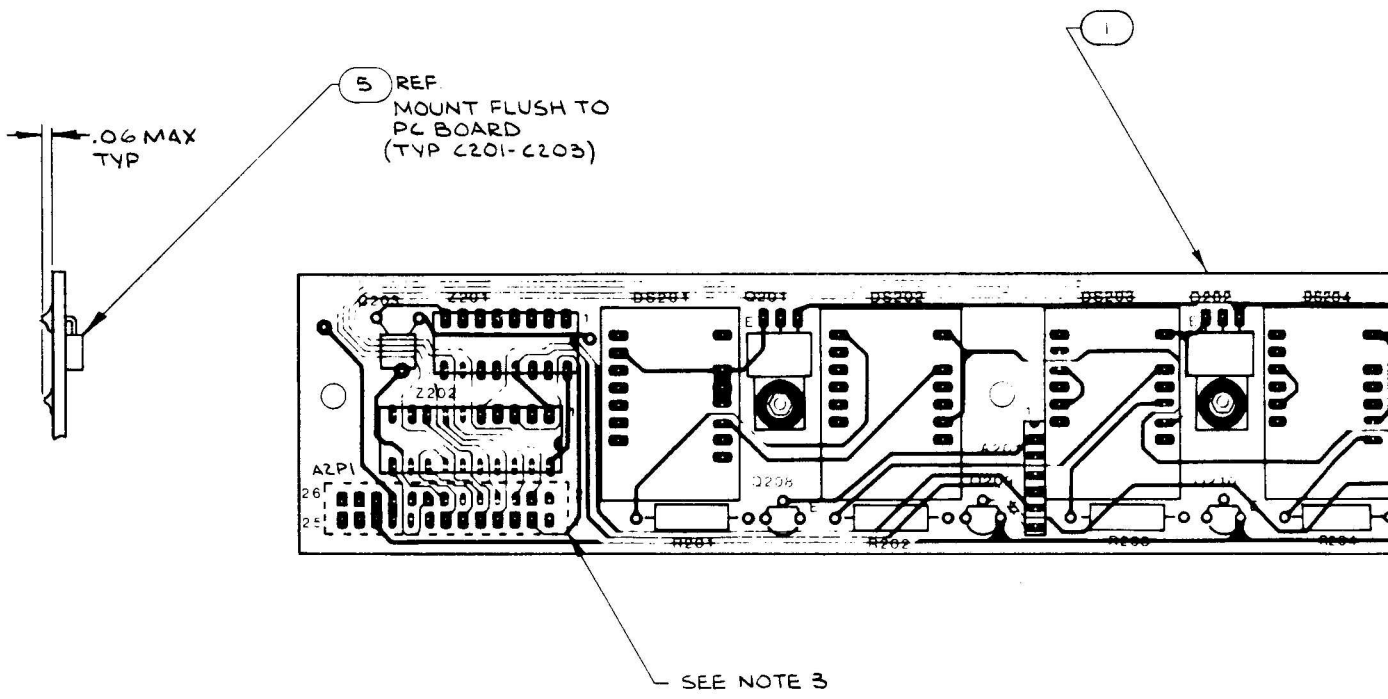3.) ADDITIONAL GND CONNECTIONS
    PIN 8 OF Z1, Z2, & Z3.

Z1
80C97

A2 27K   A2 27K

Z2
80C97

SW
204

B
A
C

PC3

Z1
80C97

A3 27K   A3 27K

Z2
80C97

SW
205

B
A
C

PC2

Z1
80C97

A3 27K   A3 27K

Z2
80C97

SW
206

B
A
C

PC1

LSD

Z1
80C97

A3 27K   A4 27K   A4 14

Z2
80C97

SW
207

B
A
C

PC0

+5V

⌀1 SEL   ⌀2 SEL

⌀2
OUT

⌀1
OUT

CENTER OF DETENT
CW ROTATION ⟶
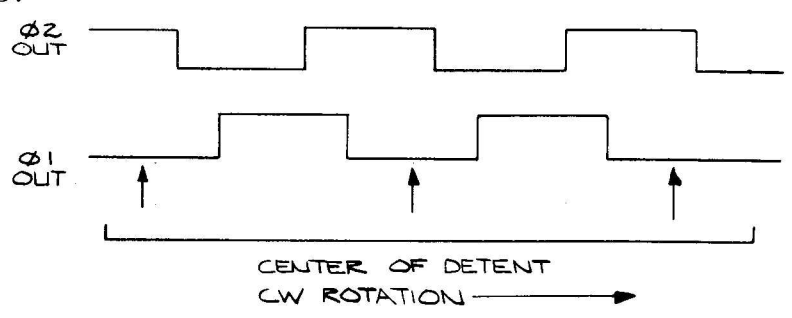
REVISIONS

REV	ECO	DESCRIPTION	DWN	APPLS	DATE
—	11-3317	ORIGINATED	KJN	PL	8-11-80

SIZE D   65-1031   REV —

→ PC5

→ PC4

→ PC3

→ PCZ

→ PC1

→ PCO

MODE & POLARITY

+5V A   100 MA B   Z3 80C97 10 ⟩ 9 → PC6

A4 27K

100 MV C   5   Z3 80C97 2 ⟩ 3 → PC5

• IOV   A4   A4

100 V E   4   Z3 80C97 4 ⟩ 5 → PC3

A4 27K

1000 V F   6   Z3 80C97 6 ⟩ 7 → PCZ

A4 27K

SW 208

SW 201

+5V A   (+) C   Z3 80C97 14 ⟩ 13 → PC1

CRI IN 4148   A1 27K   Z3 80C97

(O) D   12 ⟩ 11 → PCO

A1 27K

(−)

Ø3 SEL

+5V

PC0 PC1 PC2 PC3 PC4 PC5 PC6 Ø1 SEL Ø2 SEL Ø3 SEL

15uf 10V
C1

A6J1

8 1 2 3 4 5 6 7 11 10 9 16

.06 MAX
TYP

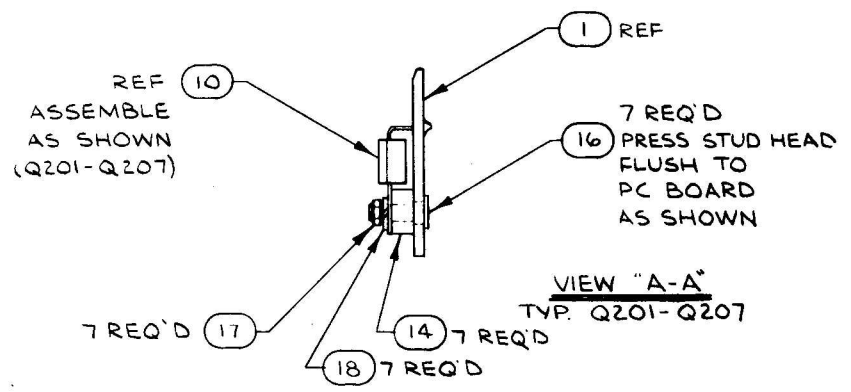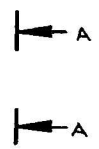5 REF.
MOUNT FLUSH TO
PC BOARD
(TYP C201-C203)

1

SEE NOTE 3
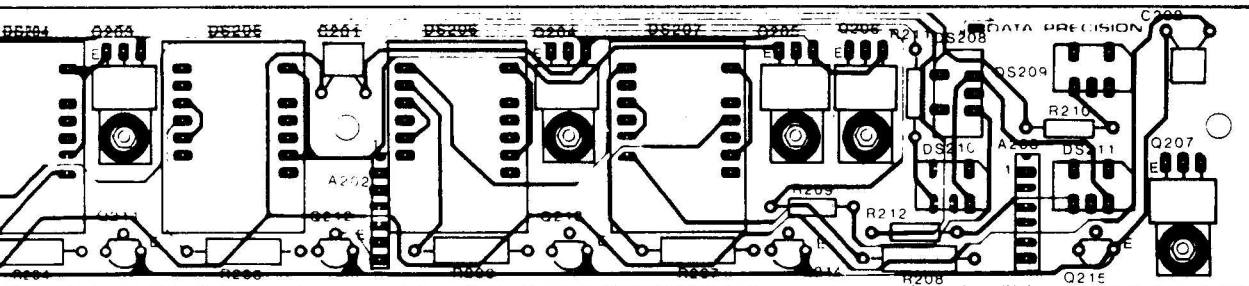
NOTES:
1. FOR SEPARATE PARTS LIST, SEE PL60-1093
2. FOR SCHEMATIC, SEE D65-1032
3. FOR ASSY. OF A2P1, SEE SECONDARY OP. ASSY.: PL60-1109

D 67-1093 —
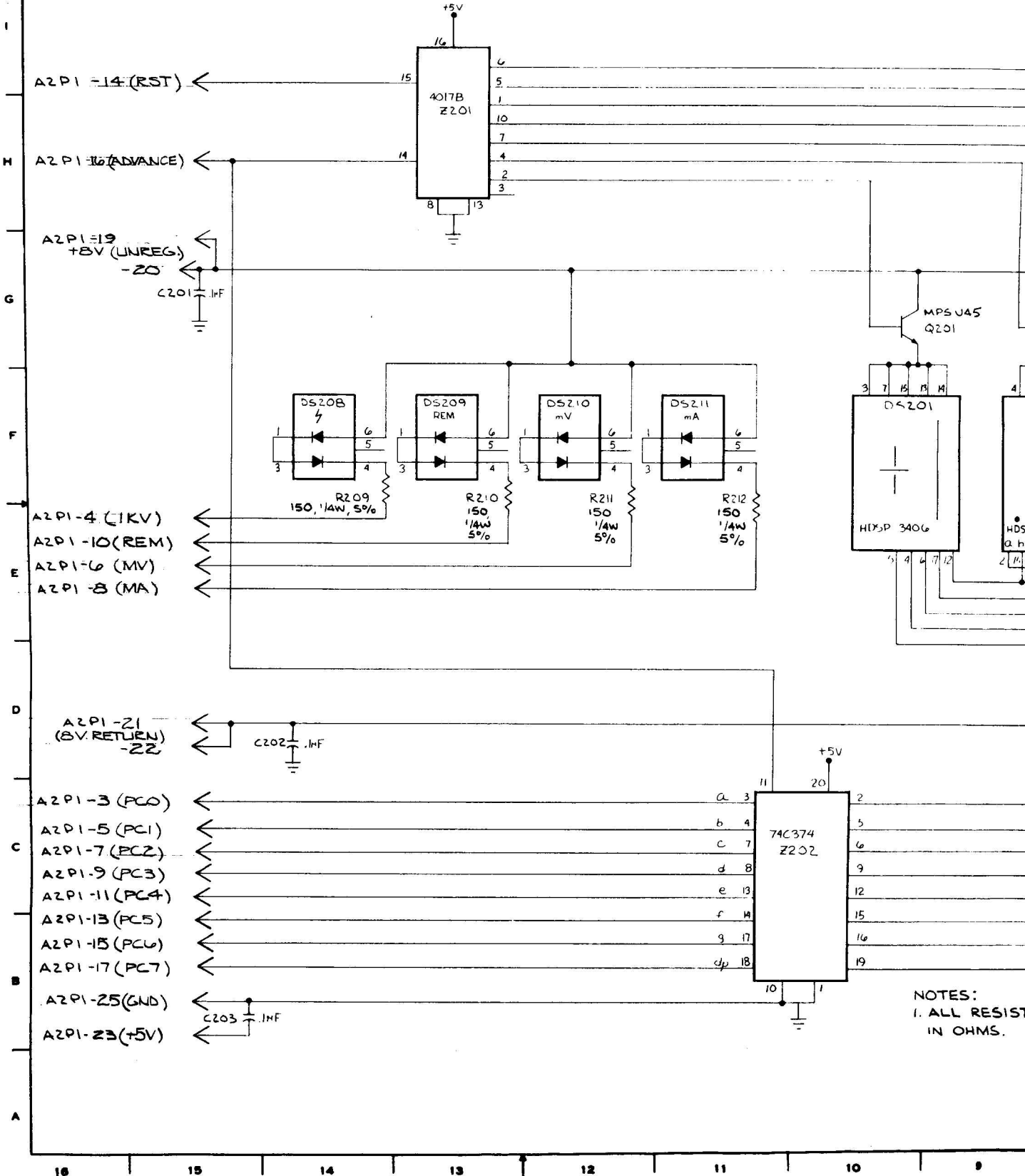

① REF

REF ⑩
ASSEMBLE
AS SHOWN
(Q201-Q207)

7 REQ'D
⑯ PRESS STUD HEAD
FLUSH TO
PC BOARD
AS SHOWN

VIEW "A-A"
TYP. Q201-Q207

7 REQ'D ⑰

⑭ 7 REQ'D

⑱ 7 REQ'D

A2P1 -14 (RST)

+5V

16

15 4017B
    Z201

A2P1 -16 (ADVANCE)

A2P1 -19
+8V (UNREG.)
   -20

C201 .1nF

MPS U45
Q201

DS208   DS209   DS210   DS211
  ⚡   REM   mV   mA

R209   R210   R211   R212
150, 1/4W, 5% 150   150   150
              1/4W   1/4W   1/4W
              5%   5%   5%

DS201

HDSP 3406

A2P1 -4 (-1KV)
A2P1 -10 (REM)
A2P1 -6 (MV)
A2P1 -8 (MA)

A2P1 -21
(8V. RETURN)
    -22

C202 .1nF

+5V

A2P1 -3 (PC0)   a 3
A2P1 -5 (PC1)   b 4
A2P1 -7 (PC2)   c 7   74C374
A2P1 -9 (PC3)   d 8   Z202
A2P1 -11 (PC4)   e 13
A2P1 -13 (PC5)   f 14
A2P1 -15 (PC6)   g 17
A2P1 -17 (PC7)   dp 18

A2P1 -25 (GND)

C203 .1nF

A2P1 -23 (+5V)

NOTES:
1. ALL RESIST
   IN OHMS.

REV	ECO	REVISIONS DESCRIPTION	DWN	APPLS	DATE
—	11330.7	ORIGINATED	JMR	PZ	8-1-80

SIZE D
65-1032
REV —

MPSU45 Q104

MPSU45 Q202

MPSU45 Q203

MPSU45 Q205

MPSU45 Q206

MPSU45 Q207

4 6 12 17

DS202
HDSP 3400
a b c d e f g dp

DS203
HDSP 3400
a b c d e f g dp

DS204
HDSP 3400
a b c d e f g dp

DS205
HDSP 3400
a b c d e f g dp

DS206
HDSP 3400
a b c d e f g dp

DS207
HDSP 3400
a b c d e f g dp

R201 10, 1/2W, 5%
R202 10, 1/2W, 5%
R203 10, 1/2W, 5%
R204 10, 1/2W, 5%
R205 10, 1/2W 5%
R206 10, 1/2W 5%
R207 10, 1/2W, 5%
R208 10, 1/2W, 5%

Q208 Q209 Q210 Q211 Q212 Q213 Q214 Q215

A201 680
A201 680
A201 680
A202 680
A202 680
A203 680
A203 680
A203 680

NOTES:
RESISTOR VALUES ARE SPECIFIED
OHMS.

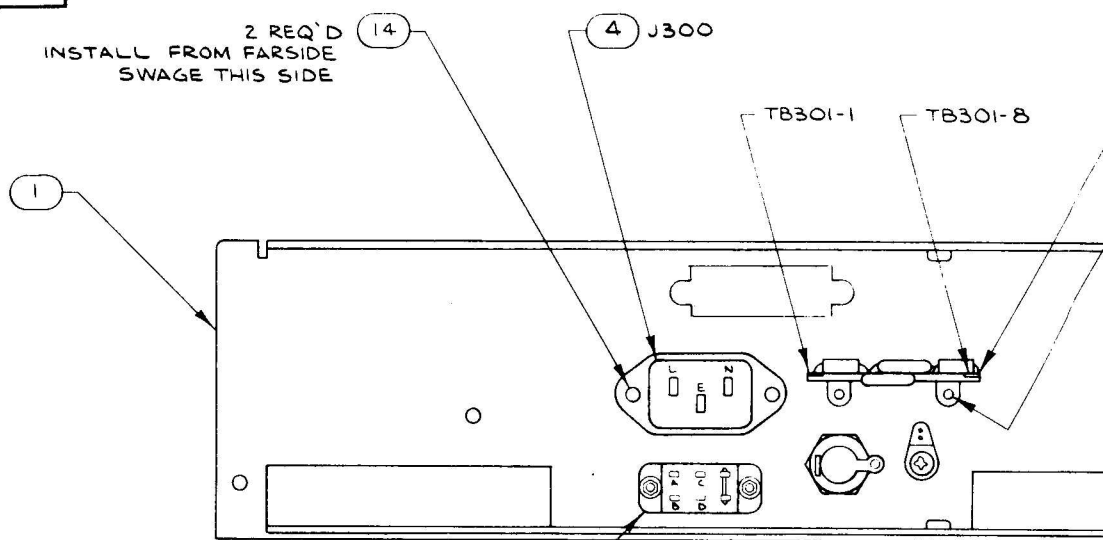|		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ± ± ±	DRAWN JMR	DATE 6-25-80	DATA PRECISION CORP. Data Precision Corporation, Danvers, Mass 01923
			CHECKED		
		MATERIAL	DESIGNER		SCHEMATIC DISPLAY PCB MODEL 8200 (A2)
			ENGINEER PZ	8-1-80	
		FINISH	APPROVED		
P-65-1045 8200		APPLICABLE SPECIFICATIONS	RELEASED	8-11-80	CODE IDENT NO. 51692	SIZE D	65-1032	REV —
NEXT ASSY	USED ON		WEIGHT					
APPLICATION					SCALE	ACCOUNT NO.	SHEET 1 OF 1	

2 REQ'D (14)
INSTALL FROM FARSIDE
SWAGE THIS SIDE

(4) J300

TB301-1   TB301-8

(1)

(8) SW300

8 REQ'D (23)
SEE NOTE 4

F300-B   F300-A

J300
REF. (4)

(11) SE

(17)
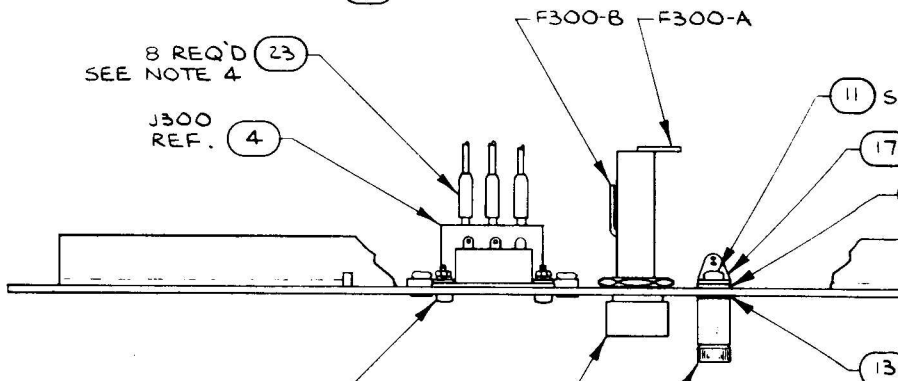
(19) 2 REQ'D
(20) 2 REQ'D
(21) 2 REQ'D
(22) 2 REQ'D

(5) XF300
(6) F300

(7) E300-A
INSTALL AS SHOW
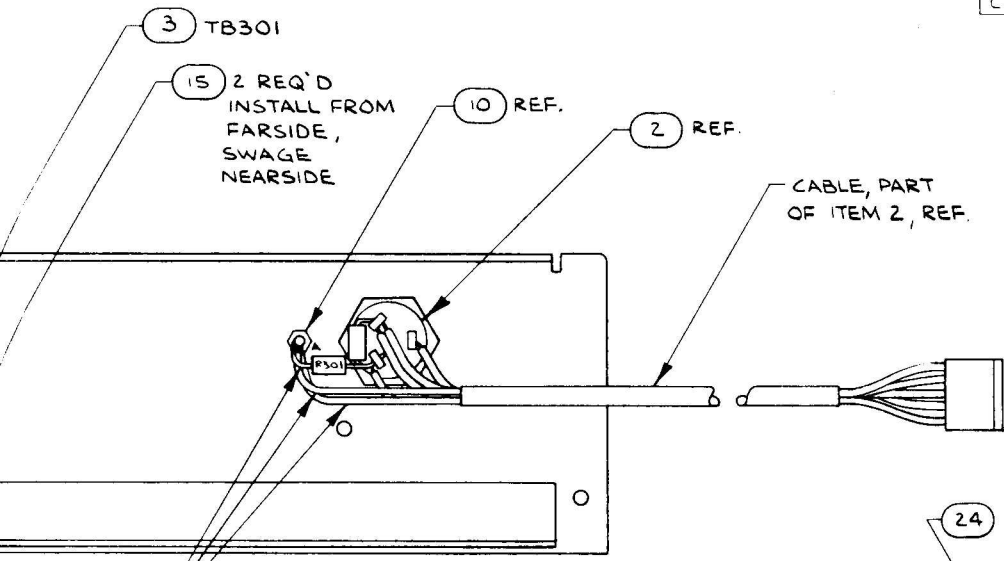
(13)

NOTES:
1. FOR SEPARATE PARTS LIST, SEE PL60-1096
2. REF. DWGS.: WIRE RUN LIST: B65-1033.
           SCHEMATIC: D65-1029.
3. TORQUE ITEM 11, SCREW, TO 60LBS ± 10LBS.
4. INSTALL ITEM 23, SHRINK TUBING, & HEATSHRINK TO FIT
   ALL J300 & TB301 WIRING CONNECTIONS.

③ TB301

⑮ 2 REQ'D
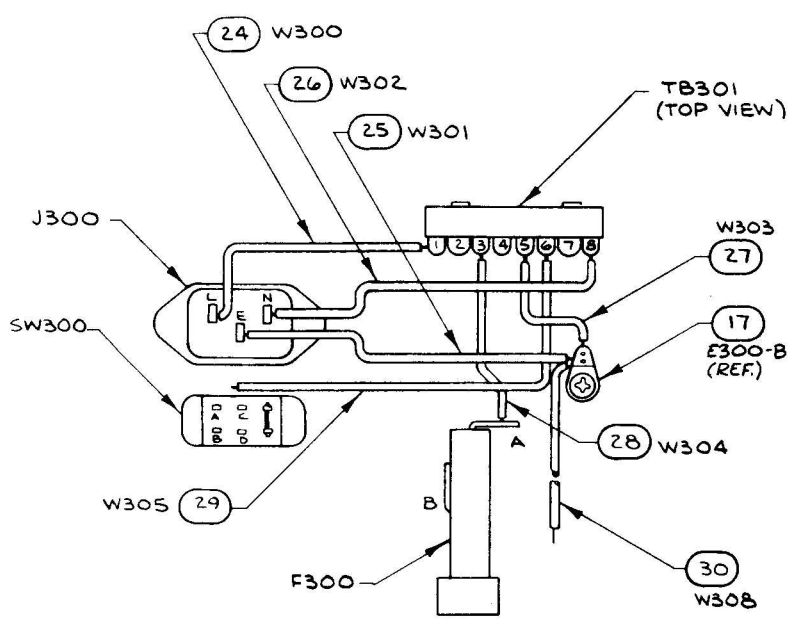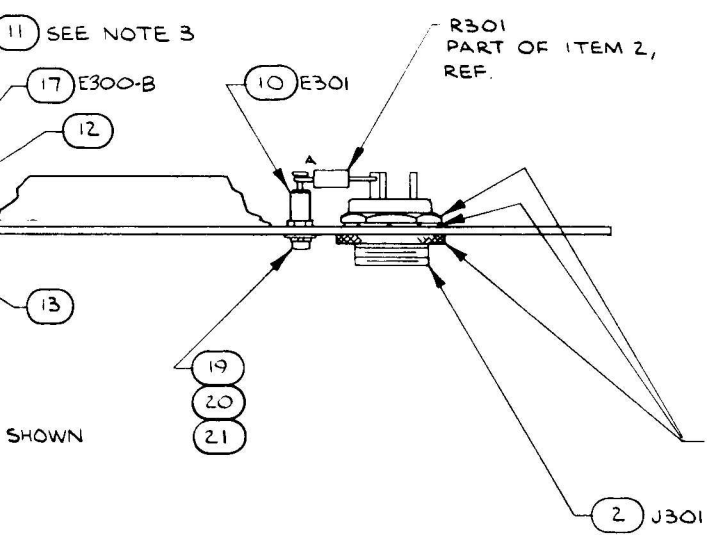INSTALL FROM
FARSIDE,
SWAGE
NEARSIDE

⑩ REF.

② REF.

CABLE, PART
OF ITEM 2, REF.

SOLDER R301-"A" AND RED & BLACK
WIRES (W306 & W307) FROM ITEM 2, J301, TO
E301 AS SHOWN

⑪ SEE NOTE 3

⑰ E300-B

⑩ E301

⑫

R301
PART OF ITEM 2,
REF.

SHOWN

⑬

⑲
⑳
㉑

HARDWARE SUPPLIED WITH
ITEM 2, INSTALL AS SHOWN

② J301

㉔ W300

㉖ W302

㉕ W301

J300

SW300

W305 ㉙

F300

TB301
(TOP VIEW)

W303

㉗

⑰
E300-B
(REF.)

㉘ W304

㉚
W308

WIRING DIAGRAM
SEE NOTE 4

REV	ECO	DESCRIPTION	DWN	APPLS	DATE
—	11-3307	ORIGINATED	BRW	PZ	8-1-80
A	11-3374	SEE E.C.O.	JMR	PZ	9-10-80
B	11-3415	SEE E.C.O	JMR	PZ	12-1-80
C	11-3434	SEE E.C.O.	JMR	L.KERR	1/5/80

REVISIONS

D
67-1096
C

ASSEMBLY
REAR PANEL

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	DRAWN BRW	DATE 5-19-80
			CHECKED	
		MATERIAL	DESIGNER	
			ENGINEER PZ	8-1-80
		FINISH	APPROVED	
PL60-1097	8200	APPLICABLE SPECIFICATIONS	RELEASED	8-11-80
NEXT ASSY	USED ON		WEIGHT	
APPLICATION				

CODE IDENT NO. 51692
SIZE D
67-1096
REV C
SCALE FULL
ACCOUNT NO.
SHEET 1 OF 1