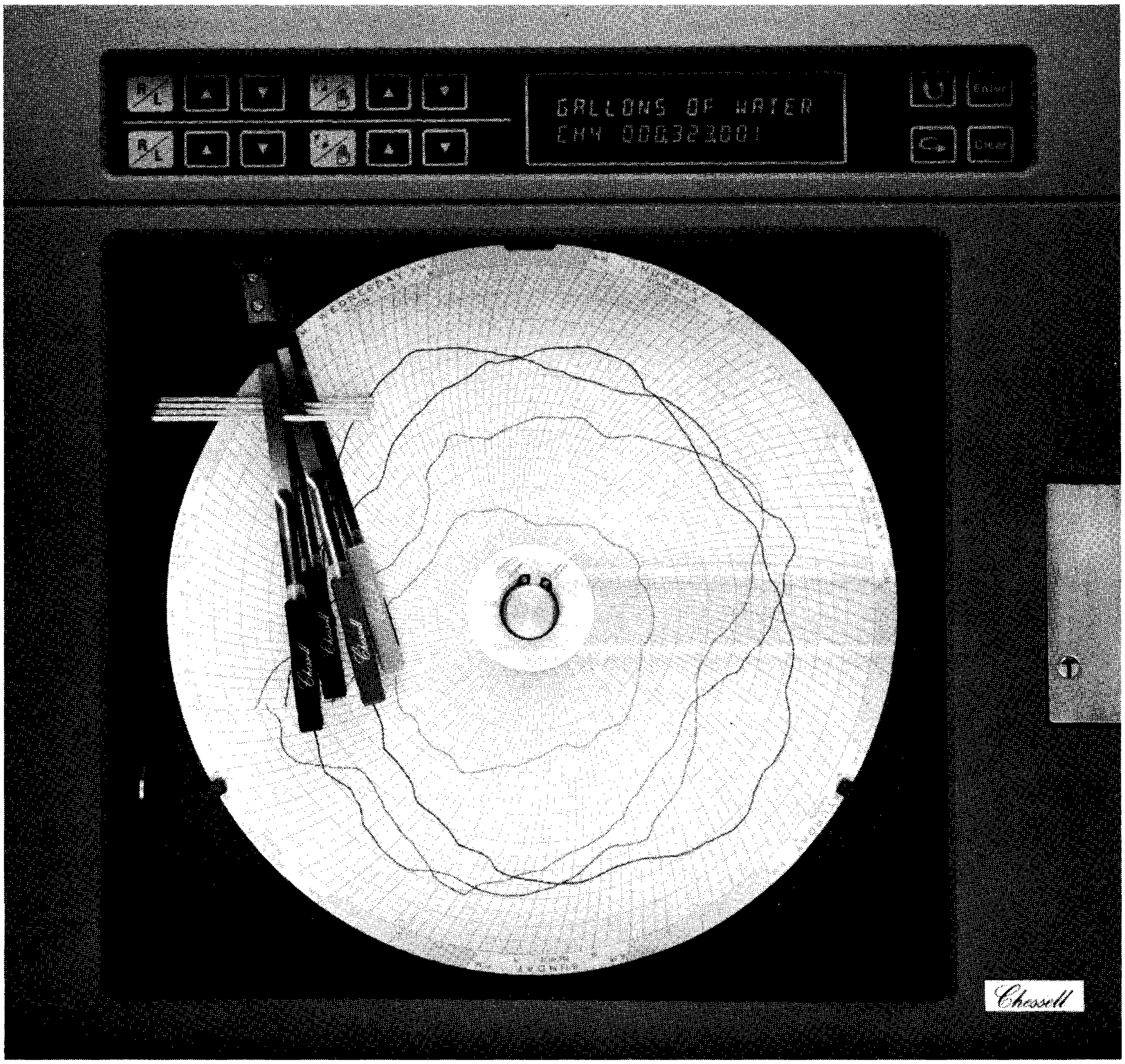
CHESSELL MODEL 390

CIRCULAR CHART RECORDER

CONFIGURATION, OPERATION & MAINTENANCE MANUAL



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1. Warranty Statement

This product is warranted against defects in materials and workmanship for twelve months from the date of shipment. During the warranty period the manufacturer will, at its option, either repair or replace products which prove to be defective.

Warranty service at the buyer's facility can be provided only upon prior agreement by the manufacturer or its representative, and the buyer may be required to pay round-trip travel expenses.

In all cases the buyer has the option of returning the product for Warranty service to a facility designated by the manufacturer or its representatives. The buyer shall prepay shipping charges for products returned to a service facility, and the manufacturer or its representatives shall pay for return of the products to the buyer.

Limitation of Warranty

The foregoing warranty shall not apply to defects arising from:

Improper or inadequate maintenance by the user

Improper or inadequate site preparation

Unauthorized modification or misuse

Operation of the product in unfavorable environments, especially high temperature, high humidity, corrosive or other damaging atmospheres

Disclaimer

No other warranty is expressed or implied. The manufacturer specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

Exclusive Remedies

The remedies provided above are the buyer's sole and exclusive remedies. The manufacturer shall not be liable for any direct, indirect, special incidental, or consequential damages.

Calibration Accuracy

This product was thoroughly tested to ensure compliance with published specifications. All instruments used in production and final test are regularly inspected to maintain accuracy of calibration, traceable to the National Bureau of Standards. The user should be satisfied that the performance of the product as received meets expectations and, as part of a program of planned maintenance, should periodically check calibration accuracy against reliable standards.

CAUTION

The product cover(s) should not be removed by other than qualified service personnel. High or lethal voltages may be present at exposed points on the chassis if power is applied. The manufacturer shall not be liable for personal injury or property damage suffered in servicing the product. The product should not be modified or repaired in a manner at variance with procedures established by the manufacturer.

2. General Description

This Circular Chart Recorder measures, displays and records signals from Thermocouples, RTDs, Pneumatic signals, Square Root, 3/2 power, 5/2 power or linear transducers. The actual signal inputs may be in the form of either millivolts, volts, milliamps or ohms. The configuration and ranging of the Recorder are set up by the repositioning of links and the entry of the desired scaling into the Recorder's battery-backed memory.

The Recorder display is a 32 character alphanumeric unit. Each display is updated once per second with the Measured Variable (or the status of any Control, Setpoint Generator or Totalizer option available in the Recorder). The alphanumeric display also serves as the programming interface for entry of the configuration data using a simple prompt guided menu.

The Recorder is available in 1, 2, 3 or 4 pen versions with two alarm setpoints per channel and up to 4 alarm relay contact outputs. The status of the alarms is indicated by 4 front panel indicators.

2.1 PERFORMANCE SPECIFICATIONS

Writing system:	1 to 4 Pens Continuous (closed loop servo)
Pen Response Time:	5 Sec Minimum (0 to 90% Full Scale)
Input Filter:	Programmable for: 0, 2.5, 5, 10, 20, 40, or 80 Sec.
Chart Size:	10 inch diameter 4 inch (100 mm) span
Chart Speed:	Programmable in 1 Hr/Rev increments to a maximum of 4096 Hr/Rev (170 days)
Measurement Accuracy:	Better than ± 0.25% for spans greater than: 3 mV on 0–20 mV range 8 mV on 0–80 mv range 0.50V on 0–5V range
Measurement Resolution:	1 Deg F or Deg C for Thermocouple Inputs 0.1 Deg F or Deg C for RTD Inputs 0.01% for Linear Inputs
Input Ranges:	0–5V, 0–20 mV, 0–80 mV Thermocouples B,E,J,K,R,S and T RTD 100 Ohm Pt DIN (α = 0.00385 Ohms/Ohm/°C) and ANSI (α = 0.00392 Ohms/Ohm/°C) Pneumatic Inputs between 0 and 100 PSIG
Common Mode Rejection:	120 db Mininimum (100 Ohm unbalance at 50–60 Hz)
Normal Mode Rejection:	45 db Minimum at 50 Hz
Alarm Relays:	2 Amps at 30 Vdc* or 1 Amp at 120 Vac RMS with a resistive load
Operative Temperature Range:	0 to 50 Deg C (without optional Heater) -20 to 50 Deg C (with optional Heater)
Mounting:	Wall, Panel or Optional Pipe
Case:	General Purpose, NEMA 3*, 4* or 4X* 14.17"H × 14.96"W × 5.75"D (360 mm × 380 mm × 146 mm)
Power Supply:	Selectable for: 100/115 Vac 50 to 60 Hz -50 VA 220/240 Vac 50 to 60 Hz -50 VA Optional 12 or 24 Vdc

Thermocouple and RTD Ranges:

	Deg C	Deg F
Type B	+200 . . +1820	+392 . . +3308
Type E	−260 . . +1000	−436 . . +1832
Type J	−200 . . +1200	−328 . . +2192
Type K	−270 . . +1370	−454 . . +2498
Type R	− 50 . . +1750	− 58 . . +3182
Type S	− 50 . . +1760	− 58 . . +3200
Type T	−270 . . + 400	−454 . . + 752
ANSI RTD	−180 . . + 800	−292 . . +1472
DIN RTD	−220 . . + 850	−364 . . +1562

The accuracy of the linearization is ±1 Deg F except for type B which is ±2 Deg F below 400 Deg F.

**Not covered by CSA certification*

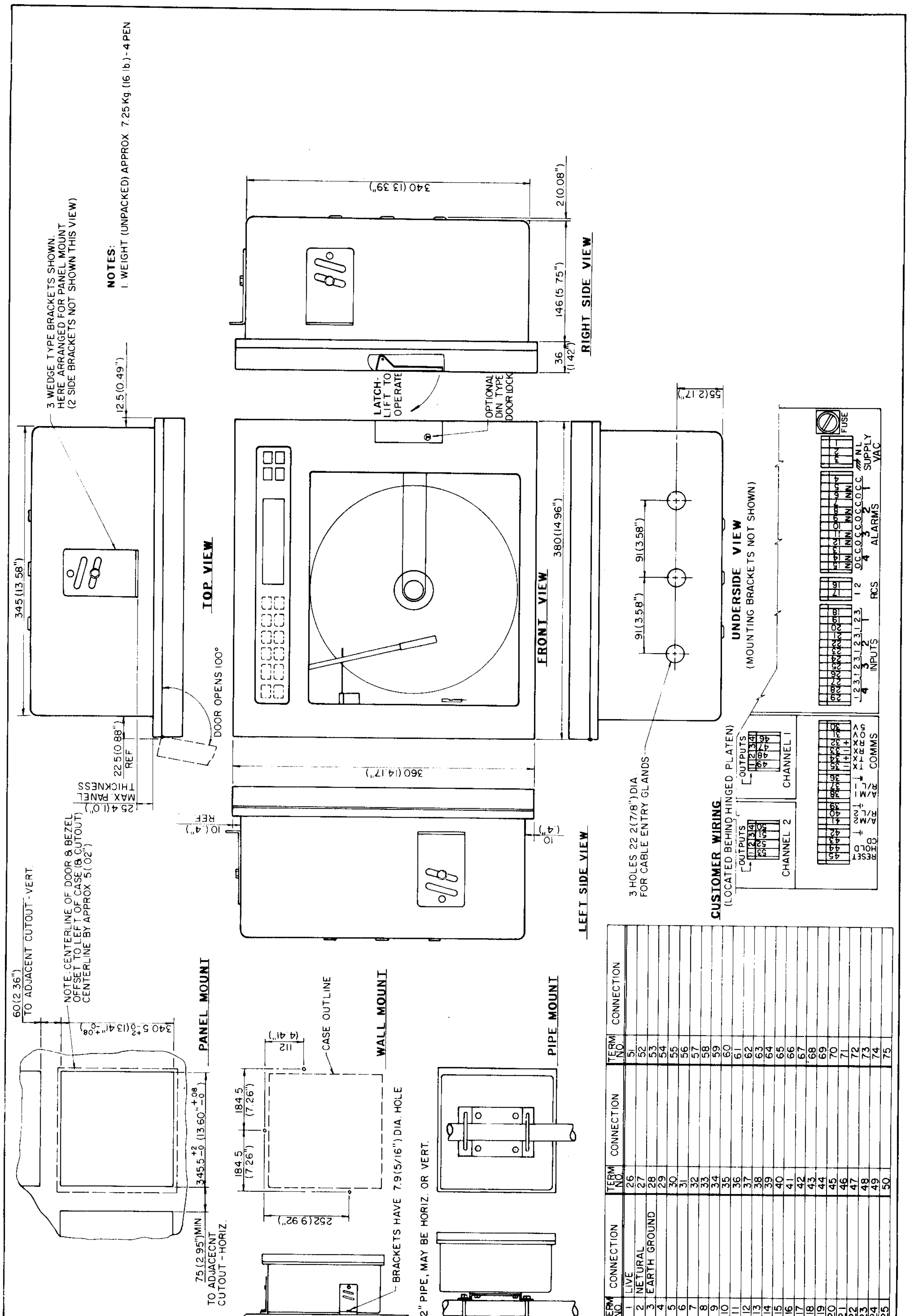


Figure 1. Installation Details

3. Installation

The following sections describe the procedures required for proper installation of the Recorder.

3.1 MOUNTING INSTRUCTIONS

The standard unit is designed to be mounted vertically using the supplied brackets for either wall or panel mounting. An optional mounting bracket is also available for securing the unit to a pipe stand.

3.1.1 Panel Mounting

The Recorder can be panel mounted using the supplied mounting brackets as shown in Figure 1. The panel cutout requirements are also shown in Figure 1. When panel mounting is used, it is recommended that the minimum vertical spacing be 2.4 inches (60 mm) between cutouts and the minimum horizontal spacing be 3.0 inches (75 mm) between cutouts).

The unit is inserted through the front of the panel and the case flange is clamped to the panel using the mounting brackets supplied. The mounting brackets are secured in place by tightening the bolts holding them to the side of the instrument case.

3.1.2 Wall Mounting

The instrument can be wall mounted by attaching the mounting brackets supplied to the instrument case as shown in Figure 1. The mounting brackets should be secured to the case so that they are flush with the back of the surface case.

The unit can then be attached to the wall using three bolts inserted through the mounting brackets. See Figure 1.

3.1.3 Pipe Mounting

The pipe mounting option consists of one clamping plate and two "U" bolts, which attach to the back of the instrument case as shown in Figure 1. The pipe mounting fixtures can be used for mounting the unit to horizontal or vertical stands by rotating the attachment of the plate to the back of the instrument case.

The clamping plate is secured to the back of the instrument using four bolts. The unit is attached to the pipe by securing the clamping plate to the pipe with the two "U"bolts.

3.2 WIRING

The case bottom has provisions for three 1/2" conduit entries. In order to reduce stray signal pick-up, the signal input wires should be kept separate from the power wires.

3.2.1 AC Power

AC line power is supplied to the Recorder via the terminal connections mounted on the main printed circuit board assembly. The proper terminal identifications are shown in Figure 2. "E" is earth ground; "N" is the neutral side of the power line and "L" is the "hot" side of the power line.

The terminal strip cover (if present) must be removed to make these connections and should be re-installed when connections are complete.

Local standards for proper grounding and connection of power to the unit should be strictly adhered to.

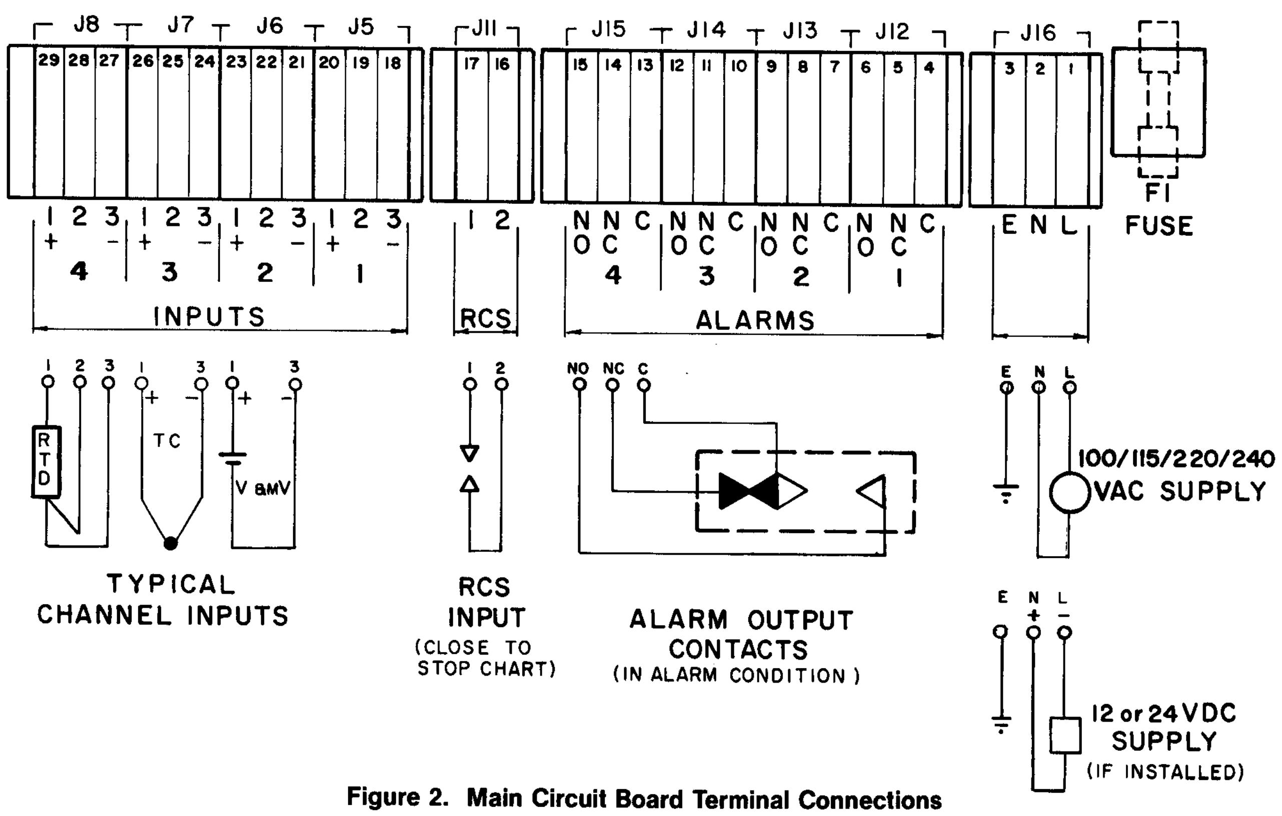


Figure 2. Main Circuit Board Terminal Connections

Operating line voltage is selected by switches SW1 and SW2 (locations shown on Figure 9). The fuse rating and switch position can be determined by consulting the following table:

LINE VOLTAGE	SW 1 POSITION	SW 2 POSITION	F 1 RATING
100 VAC	115	LOW	1/2A
115 VAC	115	NORMAL	1/2A
200 VAC	230	LOW	1/4A
230 VAC	230	NORMAL	1/4A

3.2.2 DC Power

The Recorder can be supplied with an option for operation on 12 Vdc or 24 Vdc as specified when ordered. Connections are shown in Figure 2. Positive voltage is connected to the "N" terminal and Negative to the "L" terminal. Make these connections ONLY if the Recorder was ordered for DC OPERATION.

3.2.3 Remote Chart Switch (RCS)

A dry contact input is provided for Halting Chart Rotation from an external event. The two terminals for this function are located to the right of the signal input terminals. The chart will Stop when the terminals are Shorted together.

3.3 SIGNAL INPUTS

The Circular Chart Recorder can be connected and configured to operate with a variety of signal sources such as: Thermocouples, RTDs, Pneumatic Signals, DC Volts or DC Current. The configuration of the unit for each type of input also requires the proper placement of hardware jumper links on the Main CPU printed circuit board and proper entry of Channel Configuration Data.

CAUTION — All channel negative inputs (terminal 3) are connected to a single, ungrounded common point.

3.3.1 Thermocouple Inputs

Thermocouples are connected directly to the input terminals at the bottom of the main circuit board as shown on Figure 2.

3.3.2 RTD Inputs

The Recorder will supply power for and measure the value of 3-wire 100 ohm Platinum Resistance Temperature Detectors (RTDs). Figure 2 shows proper RTD connection. Leadwire sizes and lengths from the RTD to terminals 1 and 2 *must be equal* and not exceed 20 ohms.

3.3.3 Voltage Inputs (Up to 5 Vdc)

Voltage inputs up to a *MAXIMUM value of* 5 *Vdc* may be directly connected to the input terminals as shown in Figure 2. For maximum accuracy three voltage ranges are provided (0–5V, 0–20 mV and 0–80 mV).

3.3.4 Voltage Inputs (Greater than 5 Vdc)

Inputs greater than 5V can only be accommodated by the addition of an attenuator board at the input terminals. This board is factory installed when ranges greater than 5 Vdc are ordered. The attentuator board selections are as follows:

Input 5V up to 10V — divider ratio =	125:1	divider
Input 10V up to 15V — divider ratio =	187.5:1	resistance
Input 15V up to 20V — divider ratio =	250:1	> 100K

For all inputs greater than 5V, the 0–80 mV range is selected. The channel may then be scaled properly by dividing the divider ratio into the actual voltage being input to the Recorder. The result is then used to enter the low and high millivolt values which correspond to the endpoints of the input.

Example: A linear voltage of 2 to 10 volts is to be used as input to the Recorder. This corresponds to a scale of 1000 to 2000 PSI. The divider ratio is found to be 125:1 from the above table. Therefore,

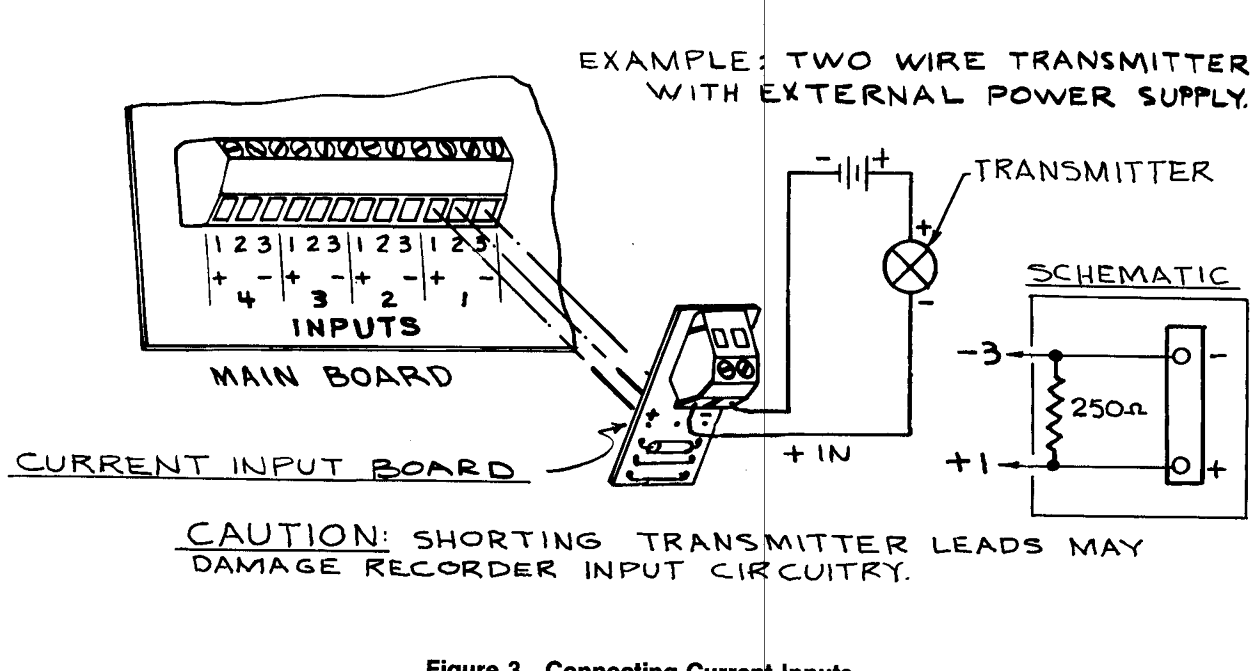


Figure 3. Connecting Current Inputs

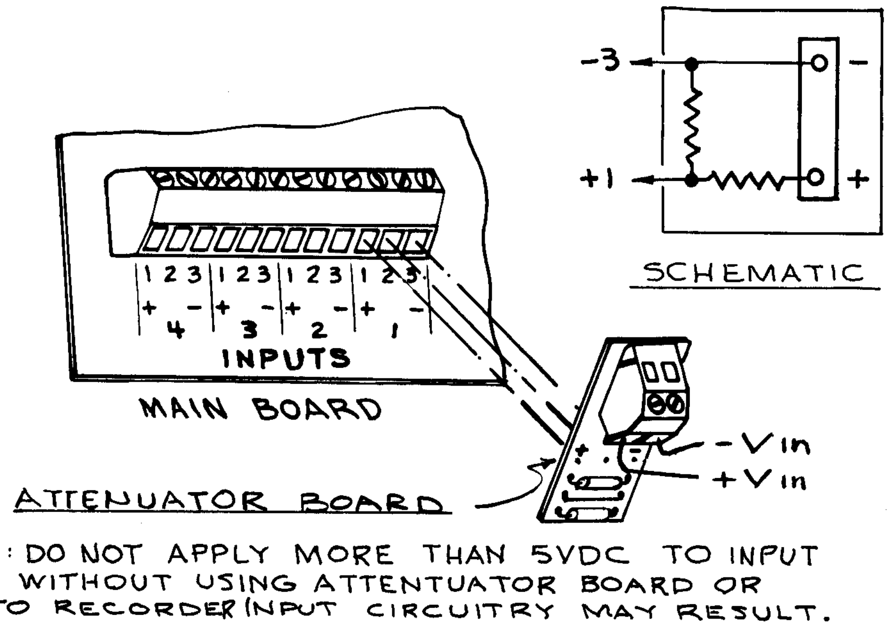


Figure 4. Connecting Attenuated Inputs

the attenuated zero and span voltages can be determined as follows:

$$\text{zero} = \frac{2 \text{ volts}}{125} = 16 \text{ mV}$$

$$\text{span} = \frac{10 \text{ volts}}{125} = 80 \text{ mV}$$

Refer to Sections 4 and 5 for instructions on configuring a 16 mV to 80 mV range.

Voltage connections to the external Attenuator Board are shown in Figure 4.

3.3.5 Current Inputs

The connection of 4 to 20 mA devices to the instrument requires the attachment of a 250 Ohm shunt resistor across the voltage input terminals. The input range selection jumpers should be positioned for 0–5V inputs as shown in Section 4.

Instruments ordered with Current Inputs are delivered with shunt resistors already installed on a small PC board attached to the input terminals. No additional resistor is necessary in this case. See Figure 3. If current inputs are ordered for use with 2-wire transmitters using an external power supply, NEVER connect the power supply across the input without a transmitter in the loop or DAMAGE TO INPUT CIRCUITS may result.

3.3.6 Direct Connected 2-Wire Transmitters

The Recorder Transmitter Power Supply option provides an isolated common 24 Vdc, 100 mA power supply for up to four 2-wire transmitters. Instruments ordered with the Transmitter Power Supply option are delivered with 250Ω shunt resistors and power supply connections already installed on small PC boards attached to the input terminals. Transmitters are directly connected to the terminals on these small PC boards as shown in Figure 6. NEVER SHORT THE TRANSMITTER LEADS or DAMAGE TO INPUT CIRCUITS may result.

3.3.7 Pneumatic Inputs

The connection of Pneumatic Inputs to the Recorder is provided by 1/8 inch female NPT fittings located at the bottom of the instrument case. See Figure 5.

Pneumatic Inputs between 0 and 100 PSI are converted to electrical signals by a series of precision transducers for each channel. Channels ordered for Pneumatic Inputs can be converted to normal TC/RTD/MV inputs by disconnecting the transducer leads and reconfiguring the individual Recorder channel.

This feature is intended for use only with instrument grade air as the pressure input. The pneumatic input option is NOT designed for use in applications that require a direct process wetted pressure measurement.

3.3.8 Event Inputs

Any pen may be used to indicate a Contact Closure by setting up the following conditions:

1. Connect the external contact across the appropriate pen's input terminations 1 and 3.
2. Select linerization type LINEAR
3. Select 0–5V input range
4. Set HI volts = 5V, LO volts = 0V
5. Set HI units, LO units to any arbitrary span. For example, 0 VOLTS–5 VOLTS
6. Set Chart Span to place event on chart in desired region
   (closed contact = lo units)
   (open contact = hi units)

Example: A chart span of –45V to 5V (50 volt span) places the 0–5V range over the outside 10% of the chart.

Set the circuit card links described in Section 4 as follows for Event Pen action:

Event on:	Pen 4	Pen 3	Pen 2	Pen 1	
Set Link:	16	12	8	4	in 'D' pos.
Set Link:	14	10	6	2	in 'RTD' pos.
Set Link:	15	11	7	3	in 'TC' pos.

3.4 SIGNAL OUTPUT

3.4.1 Relay Outputs

The connection terminals for the output relays are shown in Figure 2. The terminal strip cover (if present) must be removed to make these connections and should be re-installed when connections are complete. These relays provide a Form C (both normally open and normally closed) contact. The relay pictured in Figure 2

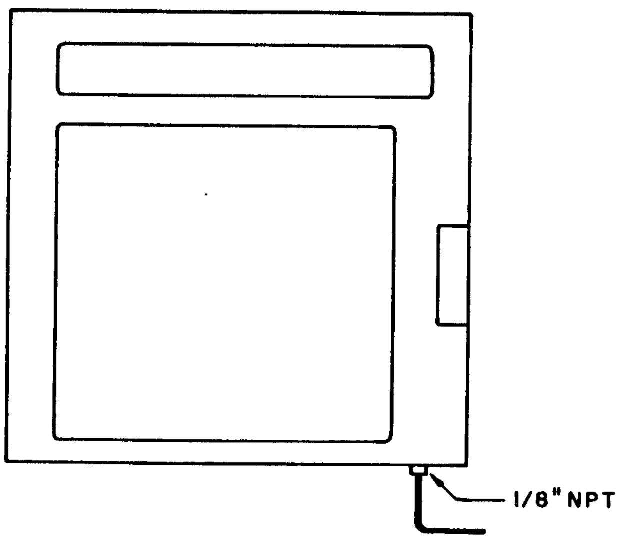


Figure 5. Connecting Pneumatic Input

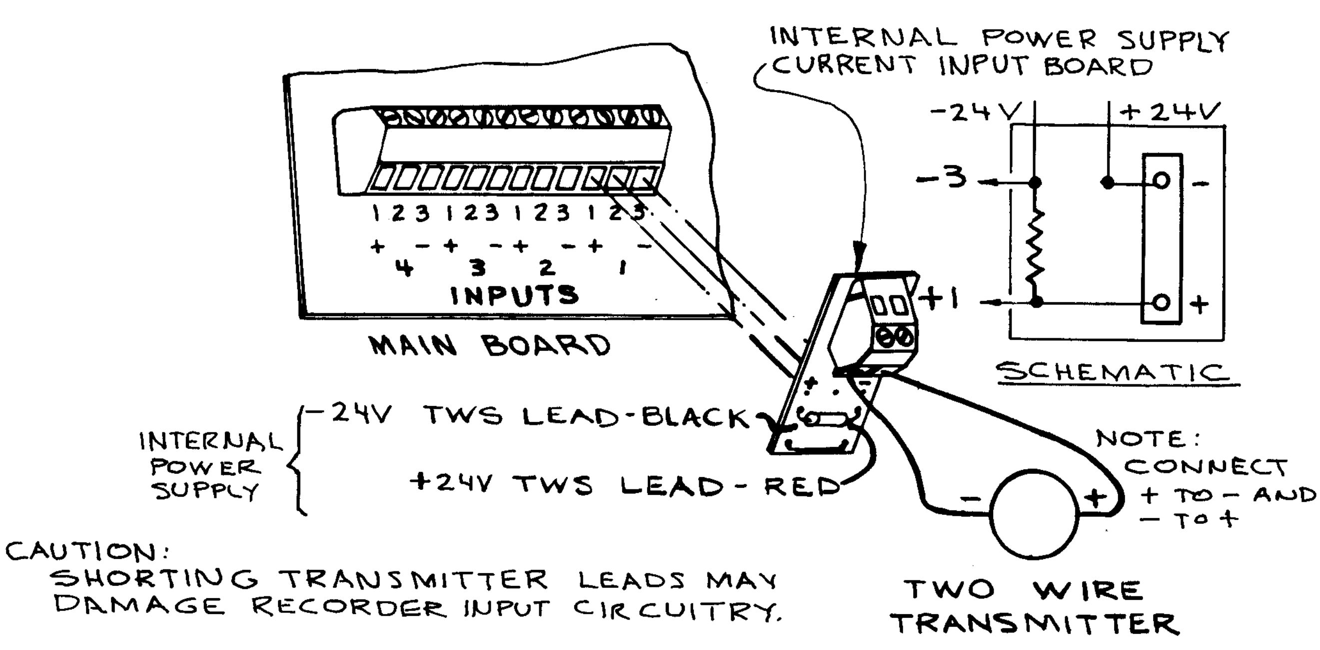


Figure 6. Connecting Two-Wire Transmitter

is shown in the De-energized condition. When used for alarms, these relays are normally Energized in the non-alarm state and De-energized in the alarm state. *In the event that power to the Recorder is off, the relays will indicate an Alarm Condition.*

It is important to note that the relays can be used for multiple purposes, and it is possible to configure the relays with conflicting activation sources. BE CAREFUL IN CONFIGURING RELAY ASSIGNMENTS. The following functions can *all* be configured to control a relay simultaneously:

> both alarms on all input channels
> a setpoint generator event output
> both controller deviation alarms

In addition to the above, if an Integrator Output is installed on a channel, and that output is configured ON, then the relay will *only* react to the integrator value, and none of the functions listed above will change its state.

3.5 CHARTS AND PENS

The following sections describe how to perform the routine maintenance of changing charts and pens.

3.5.1 Changing Charts

The instrument *is* equipped with a Penlift Feature to ease the replacement of the chart. To activate the Penlift, push the Penlift Lever (lower left side of Recorder platen) left and up to the top of its slot. When the Penlift is activated, the pens will move to the full scale position providing easy access to the chart.

The chart is removed by unscrewing the chart retaining nut from the chart drive shaft and lifting the chart from the platen. The new chart can then be insta lled and the chart time line aligned with the time mark on the platen. The time mark is located next to the Penlift Lever. The paper should be installed under the three paper hold down ears on the platen. After the chart is aligned, the chart retaining nut should be reattached and secured.

The pens are repositioned on the paper by moving the Penlift Lever down slightly to the stop on the right side of its slot. In this position the pens will move to their balanced position, but still be off the paper and no trace will result. After the pens have reached their final position the Penlift Lever should be moved left and down to its lowest position. The pens will now be in contact with the paper.

3.5.2 Changing Pens

The instrument provides a Pen Fanning Feature to ease the replacement of spent pens. To activate the Pen Fanning Feature, use the Penlift Lever to lift the pens off the paper and, with the display in the RUN MODE of operation (see 5.3) press the "Clear" key. The pens will remain in the fanned out position as long as the lever remains lifted.

The instrument uses disposable fiber tip pens. The fiber tip pens are removed from the pen arms by lifting the back of the pen cartridge away from the pen arm. The new pen is installed by sliding the pen cartridge up into the pen arm holder from the bottom. When proper position is attained the pen will clip into place.

Pens are repositioned and lowered as described in 3.5.1 above.

4. Initial Setup/Link Selection

There are three sets of hardware Links that are used to match the Recorder circuitry to the type and value of each input. All three sets operate by shorting together two of three adjacent pins:

The locations for these links can be found on Figure 2. They are all in the lower left-hand section of the main board above the signal input connections. Each input channel has a set of similar links.

4.1 INPUT TYPE

Links LK 2 & 3, 6 & 7, 10 & 11, 14 & 15 are located in a horizontal row about 2 inches above the input terminals. Each channel has two links which are set per the following table. Links for Pneumatic Inputs are preset and need no setting.

INPUT TYPE	CH 1	CH 2	CH 3	CH 4
2 WIRE DC or TC INPUT	LK 2 TC LK 3 TC	LK 6 TC LK 7 TC	LK 10 TC LK 11 TC	LK 14 TC LK 15 TC
3 WIRE RTD INPUT	LK 2 RT LK 3 RT	LK 6 RT LK 7 RT	LK 10 RT LK 11 RT	LK 14 RT LK 15 RT

Figure 7. Input Type Link Selection

4.2 TC BURNOUT

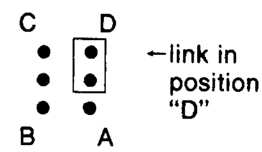
Links LK 1, 5, 9 & 13 are located immediately above the Input Type links. They are set to select the direction a TC input will be driven with an Open Thermocouple. Each channel has one link which is set per the table in Figure 7A.

TC BURNOUT	CH 1	CH 2	CH 3	CH 4
UP SCALE BREAK	LK 1 UP	LK 5 UP	LK 9 UP	LK 13 UP
DOWN SCALE BREAK	LK 1 DOWN	LK 5 DOWN	LK 9 DOWN	LK 13 DOWN

Figure 7A. TC Burnout Link Selection

4.3 INPUT RANGE

Links LK 4, 8, 12 & 16 are located above the Input Type and TC Burnout links. See Figure 8. Each link is associated with *two* sets of three pins:



This link selects the proper amplifier gain for the type of input signal connected. The link position is chosen by the highest input value normally expected on the input:

Example: The upper limit for TC types B, R & S is approximately 20 mV — so link position "A" is used. The upper limit for the other TC types is above 20 mV — so link position "B" for 80 mV is used.

Each channel has one link which is set per the table in Figure 8.

INPUT RANGE	CH 1	CH 2	CH 3	CH 4
0-20 MILLIVOLTS, TC-B,R,S	LK 4A	LK 8A	LK 12A	LK 16A
0-80 MILLIVOLTS, TC-E,J,K,T	LK 4B	LK 8B	LK 12B	LK 16B
0-5 VOLTS & 4-20 mA	LK 4D	LK 8D	LK 12D	LK 16D
RTD RANGES or PNEUMATIC	LK 4C	LK 8C	LK 12C	LK 16C

Figure 8. Input Range Link Selection

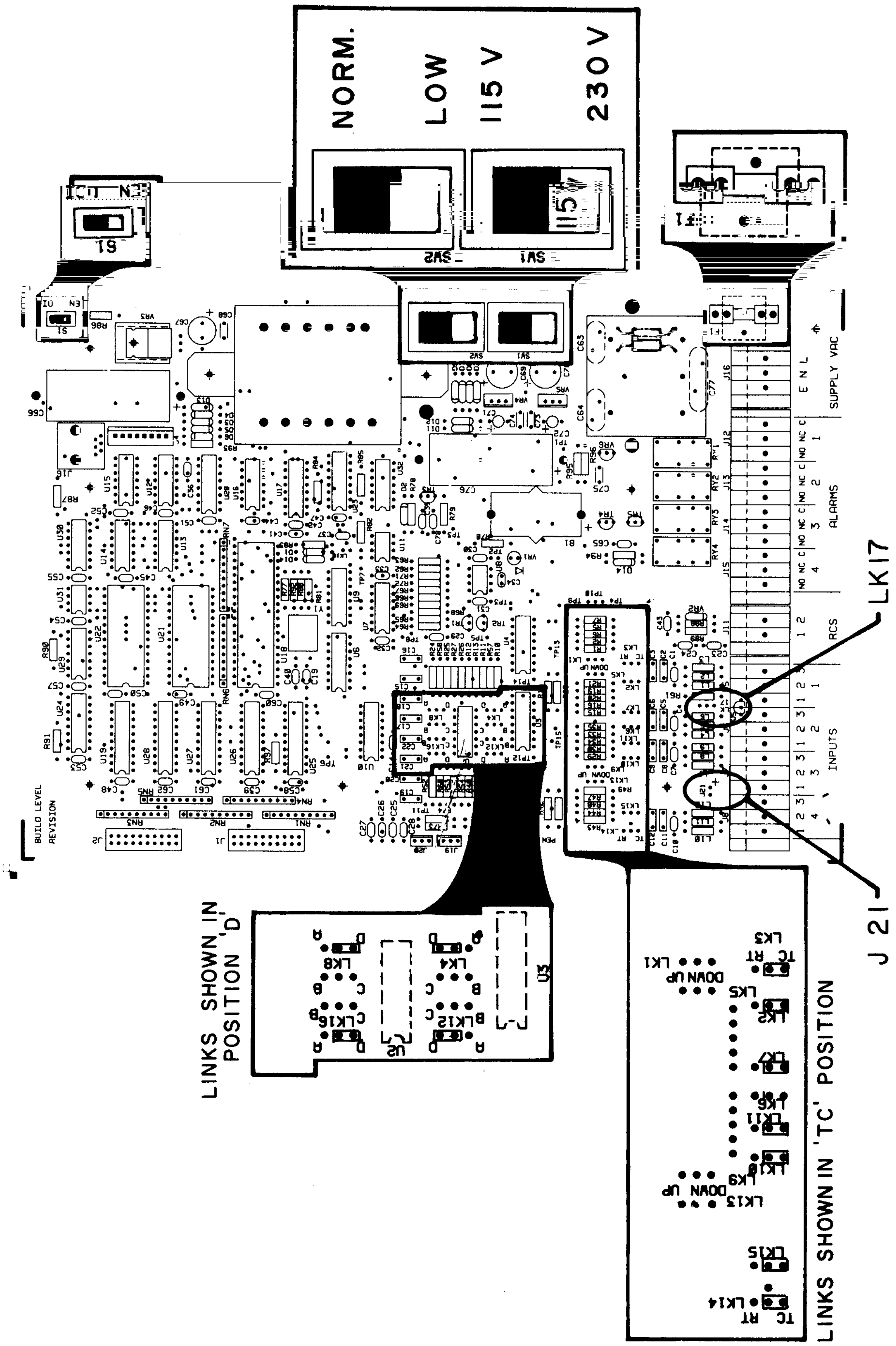


Figure 9. Main Circuit Board Configuration

5. Operational Displays and Configuration

The following sections decribe the operation and function of the Recorder's keypad and operational displays.

5.1 DISPLAYS AND PENS

The instrument displays consist of a 32 character alphanumeric display and four channel alarm indicator lights.

The 32 character alphanumeric display has two operational modes:

RUN MODE - This Mode lists each Channel and associated functions in sequence, showing the Channel Number, the Channel Tag Name and the measured value in Engineering Units. The measured value is updated once per second. The Channel Number is incremented every 5 seconds. If the Totalization option is installed and activated, the totalizer display is added to the sequence. Limited access to a selected set of configuration entries is also provided.

CONFIGURATION MODE - This mode is used to configure all installed Recorder functions. A prompted menu selection format is used for entering the required configuration data.

The Cannel Alarm indicators are located to the right of the Recorder display window. The Channel Alarm indicators light when an alarm is detected on their respective channel. The indicators *do not necessarily* indicate the status of the alarm relays since the relays maybe assigned to *any* of several functions.

The Recorder pens are assigned to the Input Channels in a fixed sequence. Input Channel 1 is assigned to the pen closest to the platen. Input Channel 2 is the next pen position up from the platen. This sequence continues up to Channel 4.

5.2 KEYPAD OPERATION

The operating controls of the Circular Chart Recorder consist of four keys. The key descriptions and the functions assigned to each key are:

Up Arrow — In RUN MODE, causes the display to cycle through all selections. In CONFIGURATION MODE, selects the next menu choice, the next number or digit and confirms most numeric entries.

Right Arrow — Used to advance the Cursor to the next digit for Numeric entry or next character position for Alphabetic entry. The key is also used to enter the CONFIGURATION MODE from the RUN MODE.

Enter ENTER — Causes the selected display parameter or numeric value to be entered. Also used to select a menu category.

Clear CLEAR — Used to undo the last operation. Numeric entries will return to the last valid value entered. Except where multiple entries are needed to completely define a function, menu selections will "backup" one level in the menu.

5.2.1 Entering Numbers via the Keypad

Numeric entries are made using the Up Arrow and Right Arrow Keys. When a numeric entry is required, the display will prompt for an entry and display the current value of the selected parameter. To change a value, use the Right Arrow Key to select the digit that is to be modified. The selected digit is indicated on the display by a comma on either side of the digit. To change a digit value, press the Up Arrow Key. The digit value will scroll through the numbers 0 to 9 and polarity symbols + and –.

5.2.2 Entering Words from the Keypad

Where Alpha Characters are appropriate (tag names and engineering units), they are entered as described for numbers in 5.2.1. For these entries, the complete alphabet and a number of Special Characters (+, –, %, #, etc.) will be added to the numbers in the scroll.

5.3 RUN MODE DISPLAYS

The RUN MODE display provides a digital readout in engineering units of the various values associated with each input channel. The RUN MODE can provide two types of display updating, scrolling automatically through all active displays or holding on a single selected display.

The scrolling mode is selected by pressing the Up Arrow key. When the key is released the instrument will start sequencing through the measured values on each channel. Each display is held for a period of 5 seconds before advancing to the next display.

The Single Channel display mode is selected by pressing the ENTER key when the desired display is visible. The display will stop advancing the channel number and will update the display of the measured value once per second. To advance the display to the next channel, press the Up Arrow key until the desired display is selected. Press the ENTER key again to hold the display.

Displays of a function are present in the RUN MODE *ONLY IF* that function is active. A four pen Recorder with all options can have up to 15 displays if all functions on all four pens are active.

Display No.	Channel No.	Run Mode Display Description	
1	CH1	PROCESS VARIABLE - with Tag Name and Units	
2	CH1	*TOTALIZER - with Tag Name and Current Total	
3	CH1	*CONTROL - with Setpoint, Process Variable, Output and Units	
4	CH2	PROCESS VARIABLE	Same Displays as CH 1 if Channels are present
5	CH2	*TOTALIZER	
6	CH2	*CONTROL	
7	CH3	PROCESS VARIABLE	
8	CH3	*TOTALIZER	
9	CH4	PROCESS VARIABLE	
10	CH4	*TOTALIZER	
11	SPG	*SETPOINT GENERATOR with Program Number, Status and Remaining Segment Time	
12	SPG	*PROGRAM ELASPED TIME IN Mo, Da & Hr and Status	
13	SPG	*CURRENT OUTPUT of the Trace 1 Segment and of the Trace 2 Segment	
14	SPG	*EVENT STATUS of the current program	
15	HOST	*ENABLE or DISABLE control of the Recorder by a Computer Host	
		These displays will appear only if the options are present	

The RUN MODE also provides a limited access to selected configuration data items such as Alarm Setpoints and Totalizer Resets. Access to alarm setpoints is enabled in the RUN MODE by:

1. Stopping the display scroll on the input channel whose alarm setpoints you want to access by pressing the ENTER Key.
2. Pressing the CLEAR Key followed by the ENTER Key.
3. Selecting the Alarm Number (1 or 2) using the Up Arrow Key followed by the ENTER Key.
4. The Alarm Setpoint can be changed as required using the Right and Up Arrow keys.
5. Press the ENTER and Up Arrow keys to confirm new Setpoint.

This procedure and the one following allow acess to alarm setpoints in the RUN MODE only if access or reset has been enabled by the configuration for the channel.

Resetting the Totalizer to zero is performed by:

1. Stopping the display scroll on the totalizer value you want to reset by pressing the ENTER Key.
2. Pressing the CLEAR Key. The instrument will display the prompt "PRESS ENTER TO RESET."
3. Press the ENTER Key to reset. Press any other key to return to RUN MODE without resetting the totalizer.

5.4 CONFIGURATION MODE OPERATION

The CONFIGURATION MODE is entered by switching S1 in the upper right-hand corner of the main circuit board to the EN (enable) position, stopping the display scroll on an input channel display by pressing the ENTER Key and then pressing the Right Arrow Key. The location of S1, not to be confused with SW1, is shown in Figure 9.

The entry of Configuration Data is simplified by the menu selection sequence used. The menu input of Configuration Data is organized into a sequence of categories. Each category is indicated on the display with an appropriate descriptor or prompt. Pressing the Up Arrow Key advances the selection sequence to the next category. Pressing the ENTER Key selects the category you want to change. THE VALUES OR SELECTIONS DISPLAYED AT EACH STEP REFLECT THE CURRENT CONFIGURATION OF THE INSTRUMENT.

The top level category selections and the information they access are:

CONFIGURE CHAN.? - Pressing the ENTER Key when this prompt is on the display provides access to the Channel Configuration Data. Configuration selections that are set under this menu selection are items such as, Channel Input Range, Channel Engineering Units descriptors, Linearization selection, Chart Range, Input Filter time constant and Alarm Setpoints.

NEW CHART SPEED? - Pressing the ENTER Key when this prompt is on the display provides access to the current chart rotation speed. Chart speed can be entered in increments of one hour per revolution up to a maximum of 4096 hours.

CALIBRATE PEN? - Pressing the ENTER Key when this prompt is on the display provides access to the pen calibration function. This feature allows the pens to be precisely positioned on the chart paper.

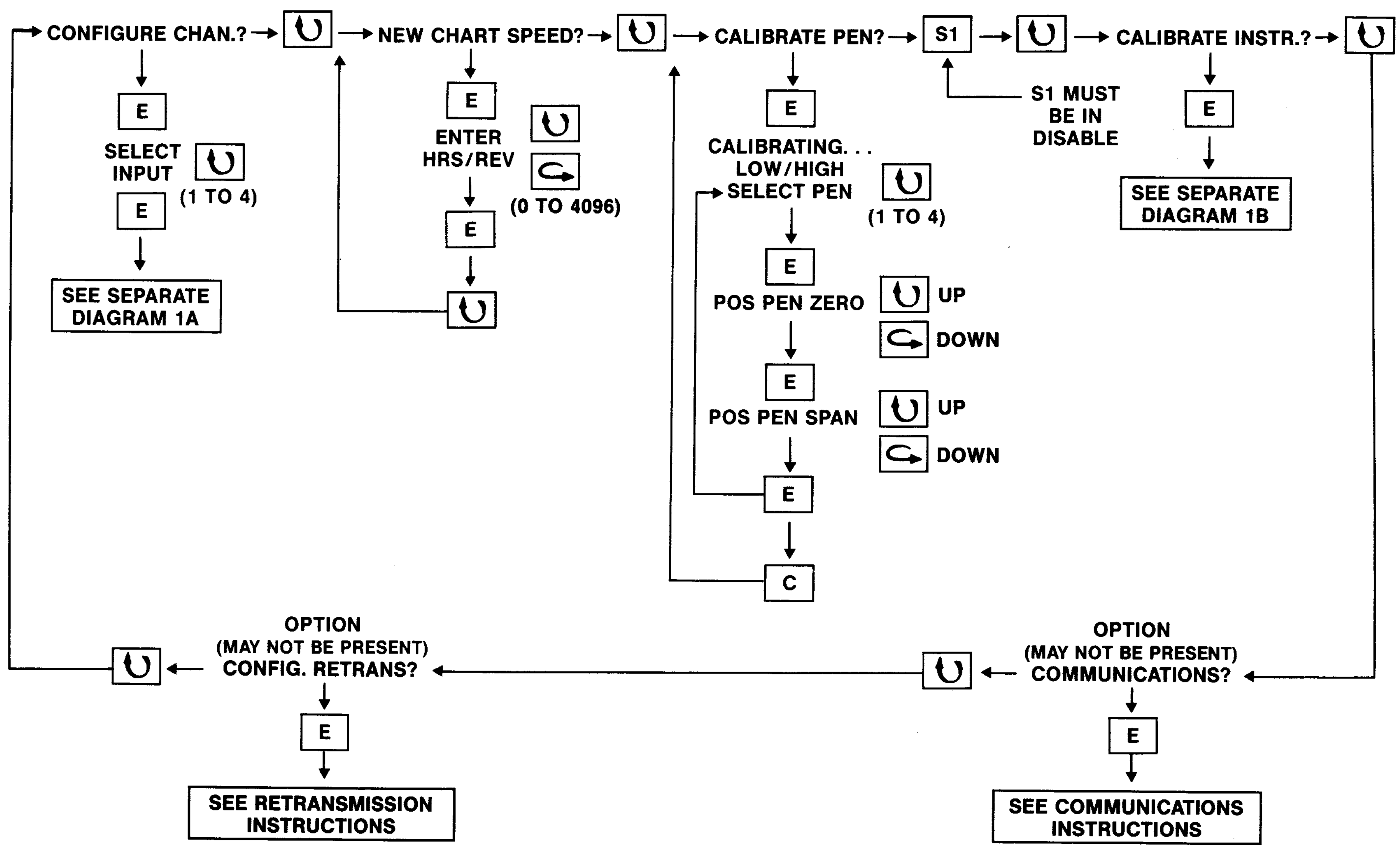
CALIBRATE INSTR.? - This prompt does not appear in the scroll sequence unless the calibration selection procedure is performed (Refer to Section 6 Calibration). When the prompt does appear, pressing the ENTER Key enables acess to the instrument calibration functions.

Configuration Diagram 1 shows these Top Level Choices.

DIAGRAM 1

TO SCROLL THE DISPLAYS	↻
TO FREEZE ON A DISPLAY	Enter
TO ENTER CONFIGURATION (S1 must be in Enable)	↪
TO MOVE BACKWARD IN CONFIG.	Clear

BASIC CONFIGURATION
TOP LEVEL MENU
(access from any frozen Channel Display)



5.4.1 Channel Configuration

The configuration of an Input Channel is initiated by entering the CONFIGURATION MODE and pressing the ENTER Key in response to the display prompt CONFIGURE CHAN.? Select the Input Channel to be configured by using the Up Arrow Key to scroll to the desired Input Channel, then press the ENTER Key.

The configuration Prompts and the required data entry after pressing the ENTER Key in response to the SELECT INPUT prompt are:

CHANGE IP RANGE? – Using the Up Arrow Key to scroll through the selections, select the Input Range to match the hardware jumper selected input range (0–20 mV, 0–80 mV, 100 ohm, 0–5V or Pneumatic per Section 3, Installation). Pressing the ENTER key enters the selection. The 0–20 mV range should be used for Thermocouple types B, R, or S and the 0–80 mV range for Thermocouple types E, J, K or T.

Note: RTD and Pneumatic input types are mutually exclusive, since the calibration data for each is stored in one location. A channel calibrated for Pneumatic inputs must be recalibrated before RTDs can be used.

Input voltage ranges greater than 5V should be set for an IP Range of 0–80 mV. These ranges use a resistive divider mounted to the input terminals that scales the input voltage to the instrument down to values that can be measured on the 0–80 mV range. See Section 3.3.4 for an example of how to calculate voltage divided inputs.

ENG UNITS? – Using the Up Arrow Key select the Engineering Units desired for the display. If an Engineering Unit other than DEG F or DEG C is required, select OTHER and enter the desired alphanumeric descriptor using the Up Arrow Key to scroll through the available characters and the Right Arrow Key to move to the next character position. Press the ENTER Key to enter the Engineering Units descriptor. (5 Characters Maximum.)

IF THERMOCOUPLE/RTD LINEARIZATION HAS BEEN SELECTED THEN ONLY DEG F OR DEG C WILL FUNCTION.

LINEARIZATION? – Select the Linearization type desired (Direct Connected Thermocouple/RTD, Retransmitted Thermocouple/RTD, Square Root, Power 3/2, Power 5/2, or Linear) using the Up Arrow Key to scroll through the possible selections and the ENTER Key to enter the selection in response to the prompt SELECT LIN TYPE.

If Direct Connected Thermocouple or RTD input is selected, the entry of the type of Thermocouple linearization must also be made. The standard Thermocouple and RTD types supplied are:

	Deg C	Deg F
Type B	+200 . . +1820	+392 . . +3308
Type E	−260 . . +1000	−436 . . +1832
Type J	−200 . . +1200	−328 . . +2192
Type K	−270 . . +1370	−454 . . +2498
Type R	− 50 . . +1750	− 58 . . +3182
Type S	− 50 . . +1760	− 58 . . +3200
Type T	−270 . . + 400	−454 . . + 752
ANSI RTD (PA)	−180 . . + 800	−292 . . +1472
DIN RTD (PD)	−220 . . + 850	−364 . . +1562

If input from a Retransmitted Thermocouple or RTD is selected, the voltage input High and Low values and their corresponding temperature mV or Ohm equivalents must be entered.

All other choices of Input Type require the entry of:

Decimal point position

Low and High Volts of input signal range (i.e. 1V and 5V for 4–20 mA input)

Low and High Engineering Units that correspond to the entered Low and High Volt input signal

The following examples are provided as a guide to configuration of Linear and Square Root inputs. Other input types are configured in a similar manner.

Linear

This linearization type is used when the input signal is linearly proportional to the parameter being measured. This linearization type is the most accurate, with resolution of 1 in 10,000 and accuracy of 1 in 5,000 or 0.02%. The input ranges available are 0–20 mV, 0–80 mV, and 0–5V. The largest number that can be entered is 50,000.

Example: A transducer outputs 0–5 Volts corresponding to a range of 200–10,000 psig. To configure the Input, select and enter the Range of 0–5V, select Engineering Units type OTHER, and enter PSIG as the Engineering Units. Select Linearization Type LINEAR, enter 0V for Low Volt input, 5V for High Volt input, 200 for Low Engineering Units and 10,000 for High Engineering Units.

The display reading that results from a 2.3 volt input is:

$$\text{Pressure} = \text{Pressure Span} \times \text{Input Increment/Input Span} + \text{Low End Value}$$

$$= (10{,}000-200) \times \frac{2.3-0}{5-0} + 200 = 4708 \text{ PSIG}$$

Square Root

Typically this will be used with flow meters. Square Root extraction is performed as follows. The input signal is measured and converted directly into volts or millivolts. The Square Root of the voltage is then taken. The result is then linearly scaled to give the correct Engineering Units. The equation used by the Recorder is shown in the example below.

Example: A transducer has the range 1 to 5 volts, corresponding to 0 to 10,000 gallons/hour. To configure the Input, select Input Range 0–5V, select Engineering Units type OTHER and enter GPH as the Engineering Units. Select Linearization Type SQUARE ROOT, enter 1V for Low Volt entry, enter 5V for the High Volt entry, enter 0 for the Low Engineering Units and 10,000 for the High Engineering Units.

The display that results from a 3 volt input signal is:

$$\text{Flow} = \text{Flow Span} \times \frac{\sqrt{\text{Input Increment}}}{\sqrt{\text{Input Span}}} + \text{Low End Flow Value}$$

$$= (10{,}000-0)\frac{\sqrt{3-1}}{\sqrt{5-1}} + 0 = 7071 \text{ GPH}$$

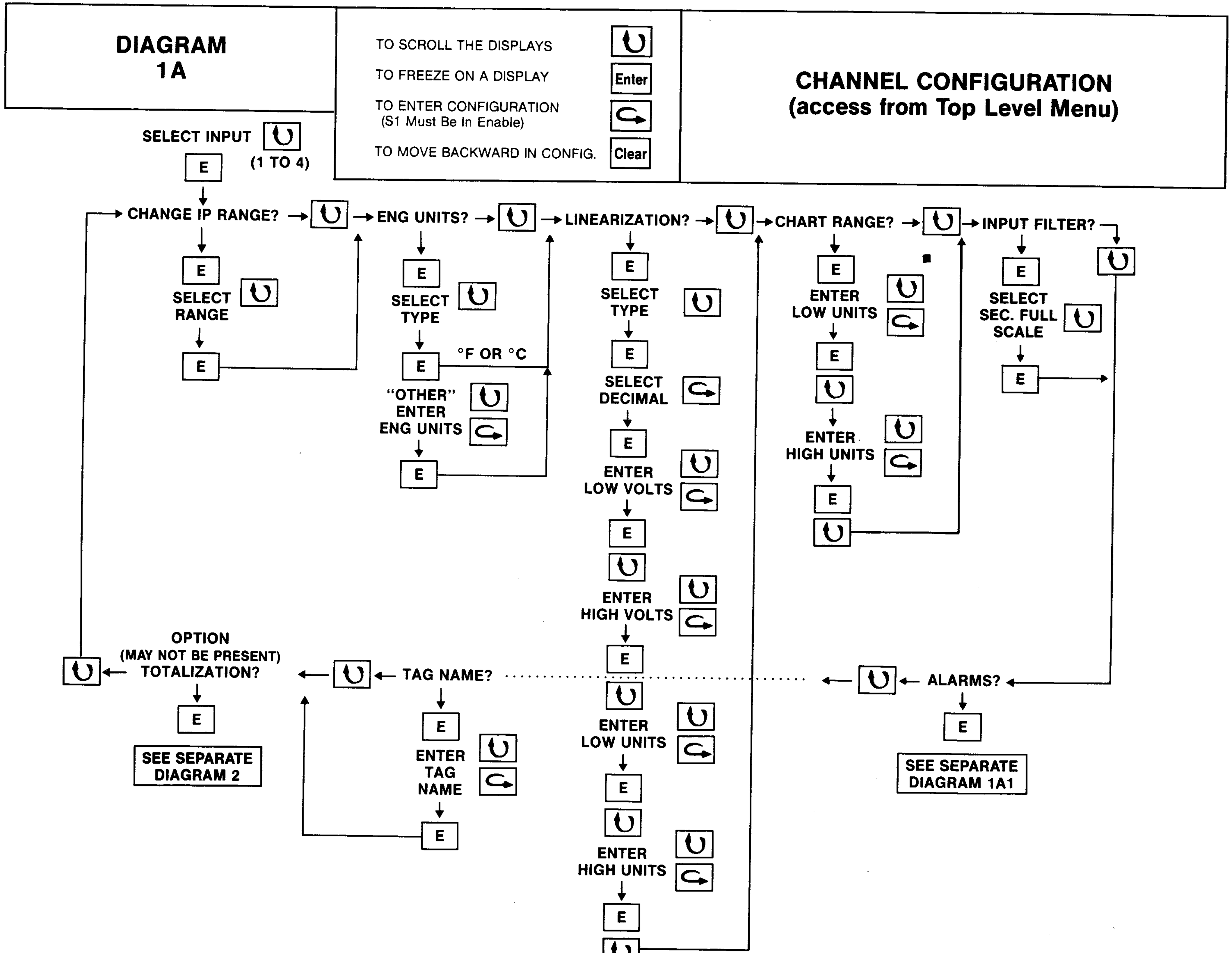


DIAGRAM
1A
TO SCROLL THE DISPLAYS
TO FREEZE ON A DISPLAY
Enter
TO ENTER CONFIGURATION
(S1 Must Be In Enable)
TO MOVE BACKWARD IN CONFIG.
Clear
CHANNEL CONFIGURATION
(access from Top Level Menu)
SELECT INPUT
(1 TO 4)
E
CHANGE IP RANGE?
SELECT RANGE
ENG UNITS?
SELECT TYPE
°F OR °C
"OTHER" ENTER ENG UNITS
LINEARIZATION?
SELECT TYPE
SELECT DECIMAL
ENTER LOW VOLTS
ENTER HIGH VOLTS
ENTER LOW UNITS
ENTER HIGH UNITS
CHART RANGE?
ENTER LOW UNITS
ENTER HIGH UNITS
INPUT FILTER?
SELECT SEC. FULL SCALE
ALARMS?
SEE SEPARATE DIAGRAM 1A1
TAG NAME?
ENTER TAG NAME
OPTION
(MAY NOT BE PRESENT)
TOTALIZATION?
SEE SEPARATE DIAGRAM 2

The Square Root function reverts to a straight line function for inputs below 1.0% of input range. In the example above, a voltage input of 1.02V would read: Flow = (10,000 – 0) (1.02 – 1.00)/(5 – 1) + 0 = 50 gal./hr.

CHART RANGE? – Enter the numeric values desired for Zero and Full Scale on the chart record in Engineering Units in response to the prompts ENTER LOW UNITS and ENTER HIGH UNITS. These settings allow the Chart Range to be set independently of the input scaling.

INPUT FILTER? – Select the desired Pen Damping Time-constant, using the Up Arrow Key to cycle through the available selections. Press the ENTER Key to activate the selection.

TAG NAME? – Enter the 16 character Tag String to be assigned as the Channel Descriptor, using the Up Arrow to scroll through the character set to select each individual character and the Right Arrow Key to move to the next character position. Press the ENTER Key to enter the complete Tag Name.

Configuration Diagram 1A shows all channel choices (except alarms).

ALARMS? – Enable or Disable access to the alarm setpoints from the RUN MODE and configure other alarm parameters, using the Up Arrow Key to scroll through the choices and the ENTER key to enter the selection. Select the alarm number (1 or 2). Each channel may have up to two alarms assigned.

There are five Alarm Types that may be selected:

- Low Alarm – activates the alarm when the Measured Value is less than the Alarm Setpoint.
- High Alarm – activates the alarm when the Measured Value is greater than the Alarm Setpoint.
- Rate of Change – activates the alarm when the change in the Measured Value per unit of time is greater than the Alarm Setpoint.
- Dead Band Alarm – activates the alarm when the Measured Value differs from the Alarm Setpoint by more than the set dead band.
- Alarm Off – disables the selected Alarm.

Selection of High or Low Alarm Types requires the entry of:

- Alarm Setpoint value in Engineering Units
- Alarm Hysteresis value in Engineering Units
- Relay Output activation (yes or no)
- Output Relay number assignment (if relay is active)

Selection of rate of change alarm requires the entry of:

- Rate limit in Engineering Units
- Time units (Hours, Minutes, or Seconds)
- Alarm Hysteresis in Engineering Units
- Relay Output activation (yes or no)
- Output Relay assignment (if relay is active)

Selection of Dead Band Alarm requires the entry of:

- Dead Band in Engineering units
- Alarm Setpoint in Engineering Units
- Alarm Hysteresis in Engineering Units
- Relay Output activation (yes or no)
- Output Relay assignment (if relay is active)

The Output Relay assignment entry selects which one of the 4 optional Relay Outputs will activate when an Alarm condition is detected. Multiple alarms may be assigned to the same Relay Output. When this is done, the Relay will remain activated as long as any one of the Alarms assigned to this relay has exceeded its setpoint.

Configuration Diagram 1A1 shows Alarm Configuration Choices.

TOTALIZATION? – Configuration of the Totalization option requires the following entries in response to the prompts displayed:

ON/OFF – Used to enable or disable the Totalizer function.

The nine-digit Totalizer operates from the range configured for its associated Input Channel. Each reading of the Channel Input is divided by the Time Period from the range (e.g., 10,000 gal. per *hour*). This Time Period is then expressed in *seconds*. (e.g., 3,600 seconds for a "per hour" input).

TOTALIZER FAC. – The Totalization Time Period is entered as the Totalizer Factor. This factor is a "powers of 10" shorthand entry:

	1 sec. =	1×10^0	entered as:	1 E 0
1 min. =	60 sec. =	6×10^1	entered as:	6 E 1
1 hour =	3,600 sec. =	3.6×10^3	entered as:	3.6 E 3
1 day =	86,400 sec. =	8.64×10^4	entered as:	8.64 E 4

Example: 0-10,000 gal./hr.
1 hr. = 3600 sec., entered as 3.6 E 3.
Each second the input value is divided by 3,600. At 7,200 GPH flow, 2 counts are added to the Totalizer each second $\frac{7200}{3600} = 2$

Ranges with High End Values requiring more than 5 digits (0–3,000,000 gal./day) must be configured using a multiplier (which may be entered into the Channel Tag Name):

0–3,000 GPD (× 1000)
0–3 GPD (× 1,000,000)

In these cases the Totalizer reading obtained by using the Time Period in seconds from the Engineering Units (1 day = 86,400 seconds) would also be in 1,000s or 1,000,000s of gallons. To correct for this difference and have the Totalizer read in gallons:

1. Calculate the Totalizer Factor from the Time Period as previously described
2. Divide this factor by the multiplier used for the input range

Example: 0–3,000,000 gal./day is configured as —
0-3 MGPD and a 1,000,000 Multiplier is entered into the Tag Name.
The Totalizer Factor for a "per day" reading is 8.64 E 4. In order to totalize in gallons (rather than in millions of gallons) 8.64 E 4 must be divided by 1,000,000 (1 E 6). Division is done by *subtracting* exponents

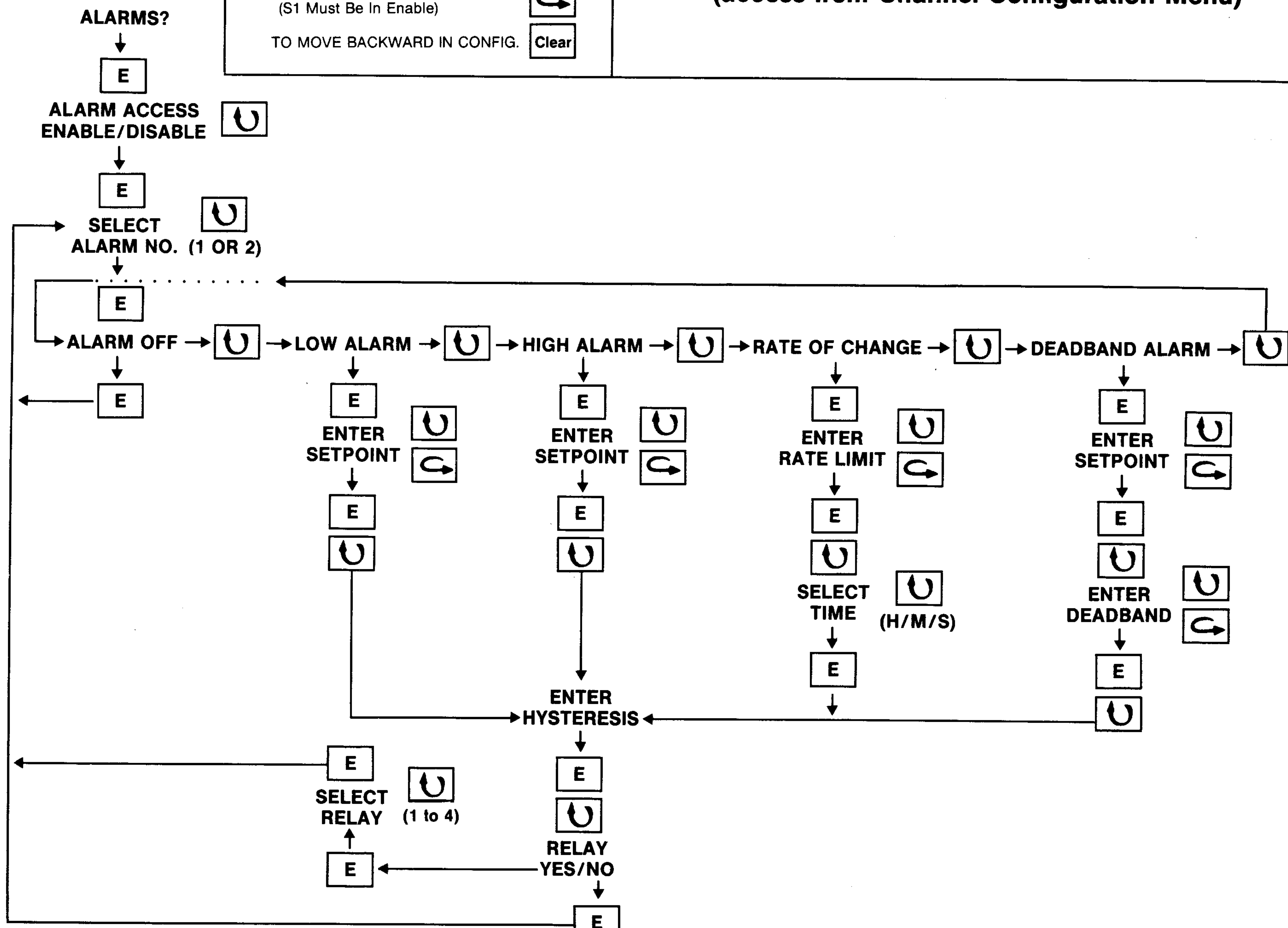
$$\frac{8.64\ E4}{1E6} = 8.64\ E(4-6) = 8.64\ E(-2)$$

Negative exponents *are* permitted in the Totalization Factor.

DIAGRAM 1A1

TO SCROLL THE DISPLAYS	↻
TO FREEZE ON A DISPLAY	Enter
TO ENTER CONFIGURATION (S1 Must Be In Enable)	↪
TO MOVE BACKWARD IN CONFIG.	Clear

ALARM CONFIGURATION
(access from Channel Configuration Menu)



LOW CUTOFF - Value in Engineering Units below which the Totalization accumulation stops. Accumulation will automatically resume when the Measured Input Signal becomes greater than the Low Cutoff Setpoint. This cutoff *does not* affect the channel display. If 4 mA represents a 0 input, the input *will* read negative when the signal falls below 4 mA.

RESETTABLE - Used to configure the Totalizer for either Resettable or Non-resettable operation. The Totalizer can be reset during the Run Mode display by pressing the ENTER Key to stop the display scrolling at the totalized value to be reset, followed by the CLEAR Key. The instrument will request confirmation. Press the ENTER Key to zero the count. If configured Non-resettable, the Totalizer cannot be reset without entering Configuration Mode and changing this choice.

Configuration Diagram 2 shows Totalizer Configuration Choices.

TOT TAG STRING - Using the procedure described for entry of the Channel Tag name, enter the desired 16 character alphanumeric Tag String for display when the totalized value is displayed.

Totalizer Output Option

The Output Option will produce a 50 millsecond contact closure for each external count. If the Totalizer Output Option is installed the following additional two displays will appear after the LOW CUTOFF entry.

TOTALIZER OUTPUT - ON/OFF - If "ON" is selected the Relay corresponding to the Channel Number will be used for that Output (e.g., Channel 1 will Output on Relay 1, Channel 2 will Output on Relay 2, etc.) THUS DISABLING ALL OTHER FUNCTIONS ASSIGNED TO THAT RELAY. The Totalizer will have control of the relay until the "OFF" selection is made.

OUTPUT FAC. - This number is the Scale Factor between the Displayed Counter and the External Counter. For example if the Output Factor is 10 then the External Counter would count 1 for every 10 counts of the Displayed Counter. This factor should be selected so that the External Counter rate does not exceed 8 counts per second.

5.4.2 Chart Speed

Enter the CONFIGURATION MODE. Changing of the Recorder Chart Speed is performed by pressing the ENTER Key in response to the NEW CHART SPEED? prompt, which is one of the Top Level Menu selections. Enter the new Chart Speed in response to the ENTER HRS/REV prompt. The value entered should be the number of hours desired for 1 complete revolution of the chart.

Chart speeds are programmable in 1 hour per revolution increments within the range of 1 to 4096 hours (over 170 days) per revolution. Entering 0 will cause the chart to stop rotating.

5.4.3 Pen Calibration

Enter the CONFIGURATION MODE. The Pen Calibration is initiated by pressing the ENTER Key in response to the prompt "CALIBRATE PEN?", which is one of the Top Level Menu selections.

The instrument will automatically slew all pens to the Inner mechanical stop and then to the Full Scale mechanical stop to establish the internal electronic stops.

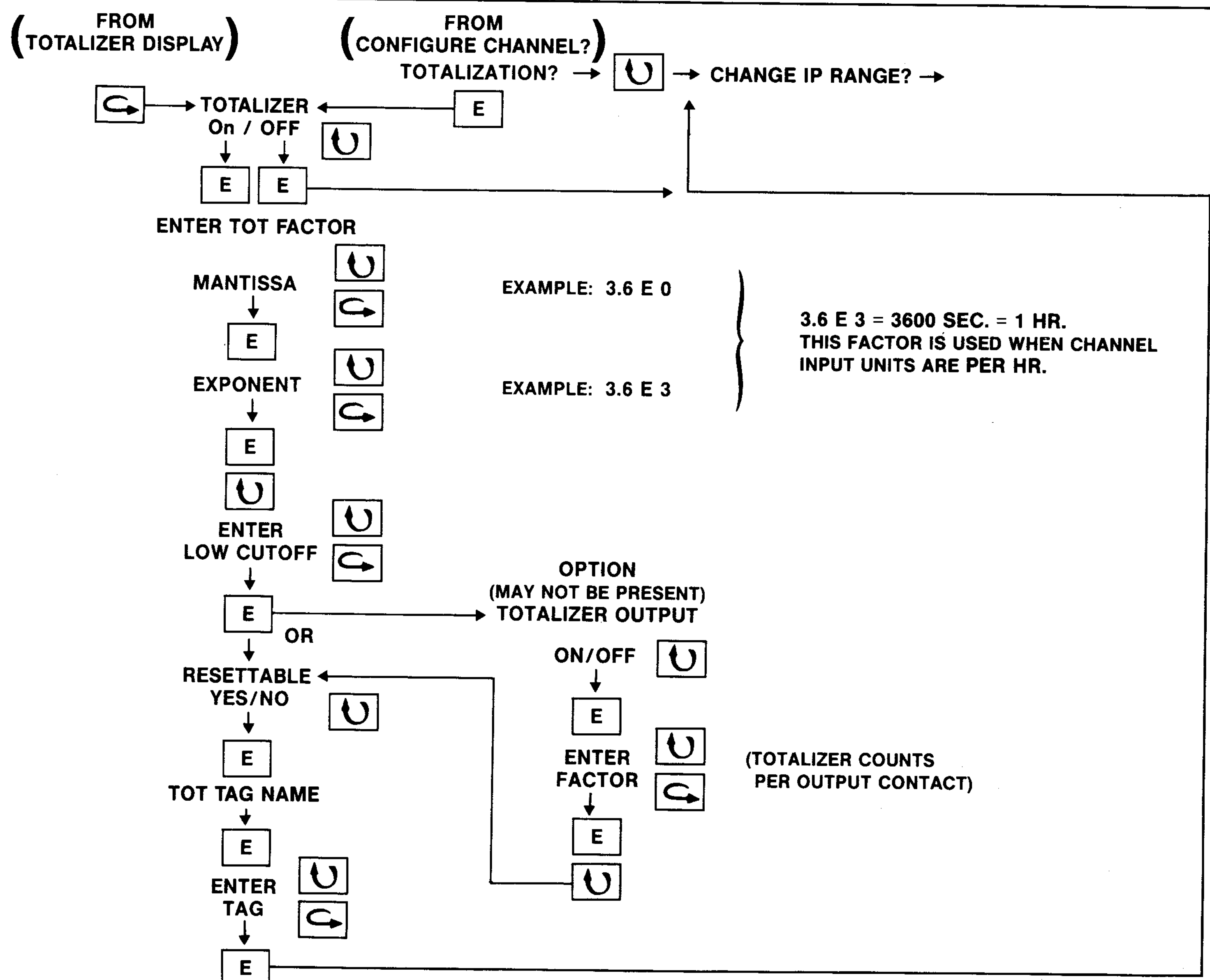
The instrument will then request the entry of the Pen Number (Channel Number) that you want to calibrate. Select the pen number by using the Up Arrow Key and press the ENTER Key.

The instrument will then position that pen to the location on the chart that corresponds to the CHART low value in Engineering Units. To adjust the pen to the desired position on the chart paper, press and hold down the Up Arrow Key (to increase) or Right Arrow Keys (to decrease) the pen positioning as required.

Pressing the ENTER Key will set the Chart Low Pen Position. The instrument will respond by moving the pen to the location on the chart that corresponds to the chart high value in Engineering Units. Use the same procedure previously described to complete the pen calibration.

Example: It is not necessary that the pens use the whole chart for recording the Chart Range set during Channel Configuration. Calibrate Pen can be used to position Channel 1 low end at the chart low end and Channel 1 high end at the middle of the chart. Channel 2 could then be positioned between the middle and high end of the chart. Each pen would then operate over its own half of the chart.

DIAGRAM 2		TOTALIZER CONFIGURATION (access under "Totalization" in Configure Ch. Menu *or* directly from frozen Totalizer Display)
	TO SCROLL THE DISPLAYS [↻]	
	TO FREEZE ON A DISPLAY [Enter]	
	TO ENTER CONFIGURATION (S1 Must Be In Enable) [↪]	
	TO MOVE BACKWARD IN CONFIG. [Clear]	



6. Calibration

The instrument is factory calibrated using standards traceable to the National Bureau of Standards and should not require recalibration prior to installation.

The following sections describe the procedures required to recalibrate the instrument when required as part of periodic maintenance and calibration checks.

To gain access to Instrument Calibration:

1. Enter the CONFIGURATION MODE as described in Section 5.4.
2. Change the position of switch S1 on the main circuit board to the DIsable position while still in the CONFIGURATION MODE.
3. Use the Up Arrow Key to access the prompt "CALIBRATE INST.?". This prompt is one of the Top Level Menu category selections. Refer to section 4 Operational Displays and Configuration.
4. Press the ENTER Key followed by the Up Arrow Key to access the calibration entry menus and procedures.

THE CALIBRATION OF THE RECORDER REQUIRES A PRECISION VOLTAGE SOURCE (0.025% OR BETTER) OVER THE INPUT RANGE OF INTEREST. THE INPUT SOURCE SHOULD BE CONNECTED TO THE INPUT TERMINALS IN PLACE OF THE NORMAL SIGNAL SOURCE.

6.1 COLD JUNCTION COMPENSATION

There are two operations involved in calibrating the Cold Junction Compensator in the Recorder. There is a Voltage Calibration and a Reading Adjustment. The Voltage Calibration sets up the internal channel used to measure the output of the CJ sensor. The Reading Adjustment biases the temperature units output of the CJC system. The Reading Adjustment, 'ADJUST CJC?' should not be performed unless there is a need to 'line-up' the reading of the Recorder with other temperature measuring instruments.

To access these operations, enter the Calibrate Instrument Mode, and scroll to the following selections.

6.1.1 Cold Junction Compensation (Voltage Calibration)

To access this operation, press ENTER on the CALIBRATE CJC? selection.

Before performing this calibration, move LK17 (above terminals, see Figure 9) to the bottom and middle posts position. Then, connect a 0.1%, 0.0 to 1.0V source to J21 (located above the Channel 3 input). Follow the display prompts to perform the Low and High Volt calibrations. Return LK17 to the top and middle posts position.

6.1.2 Cold Junction Compensation (Reading Adjustment)

To access this operation, press ENTER on the Reading ADJUST CJC? selection.

The adjustment of the internal Automatic Cold Junction Compensation requires Channel 1 to be configured for any Direct Thermocouple input with degrees C Engineering Units. Refer to Sections 4 and 5 for setting up Channel 1 before attempting to adjust the Cold Junction Compensation. The Channel 1 input should be connected using the proper Thermocouple wire or extension wire to an Ice Point Reference Source or its equivalent. The cold junction temperature is adjusted by entering the numeric value of temperature signal being applied through the Channel 1 input in degrees C.

6.2 CALIBRATE CHANNEL

6.2.1 Voltage and Thermocouple Inputs

The calibration sequence for the instrument is initiated in the Calibration Mode by pressing the ENTER Key in response to the "CALIBRATE CHAN?" prompt. The instrument will then request the number of the Channel you desire to recalibrate. After entry of the Channel Number is complete, select the Input Voltage Range to be calibrated. The display will prompt with the range for which the Channel has been configured (0–5, 0–20 mV, 0–80 mV, 100 Ohm, or PNEUMATIC).

The unit will prompt for the entry of the value of the Low End Voltage that is being applied to the Input Terminals. ADJUST the voltage source to the desired value and enter the *same value* into the instrument. Pressing the Up Arrow Key after the ENTER Key will start the instrument calibrating as indicated by the display prompt "CALIBRATING . . .".

NOTE, THE REQUIRED VOLTAGE MUST BE PRESENT AT THE INPUT TERMINALS *BEFORE THE ENTER KEY IS PRESSED.*

The channel calibration is completed by repeating the above precedure for the High End Voltage for the input channel.

6.2.2 RTD Inputs

The RTD Input Calibration procedure is the same as for voltage inputs except a Precision Resistance Source is used (10.000 to 390.000 Ohms) and values for the High and Low Inputs to the instrument are entered in Ohms. Note that the Pneumatic and RTD calibration values are stored in the same memory space. Therefore, never calibrate the Pneumatic range on an Input using an RTD.

6.2.3 Pneumatic Inputs

The Pneumatic input calibration procedure is done with a precision dead-weight tester (+/- 0.1 % of range) at the factory. Use a similar precision pressure source. The Recorder's Pneumatic Input sensors are sized for the operating range ordered, and therefore should be calibrated over that range (0–15 PSIG, 0–30 PSIG, 0–60 PSIG, or 0–100 PSIG). The calibration Low and High Values are entered in units of PSIG. Make sure that the Range Link for this input (LK4, 8, 12, or 16) is in the 'C' position. Note that the Pneumatic and RTD calibration values are stored in the same memory space. Therefore, never calibrate the RTD range on an input with a Pneumatic signal.

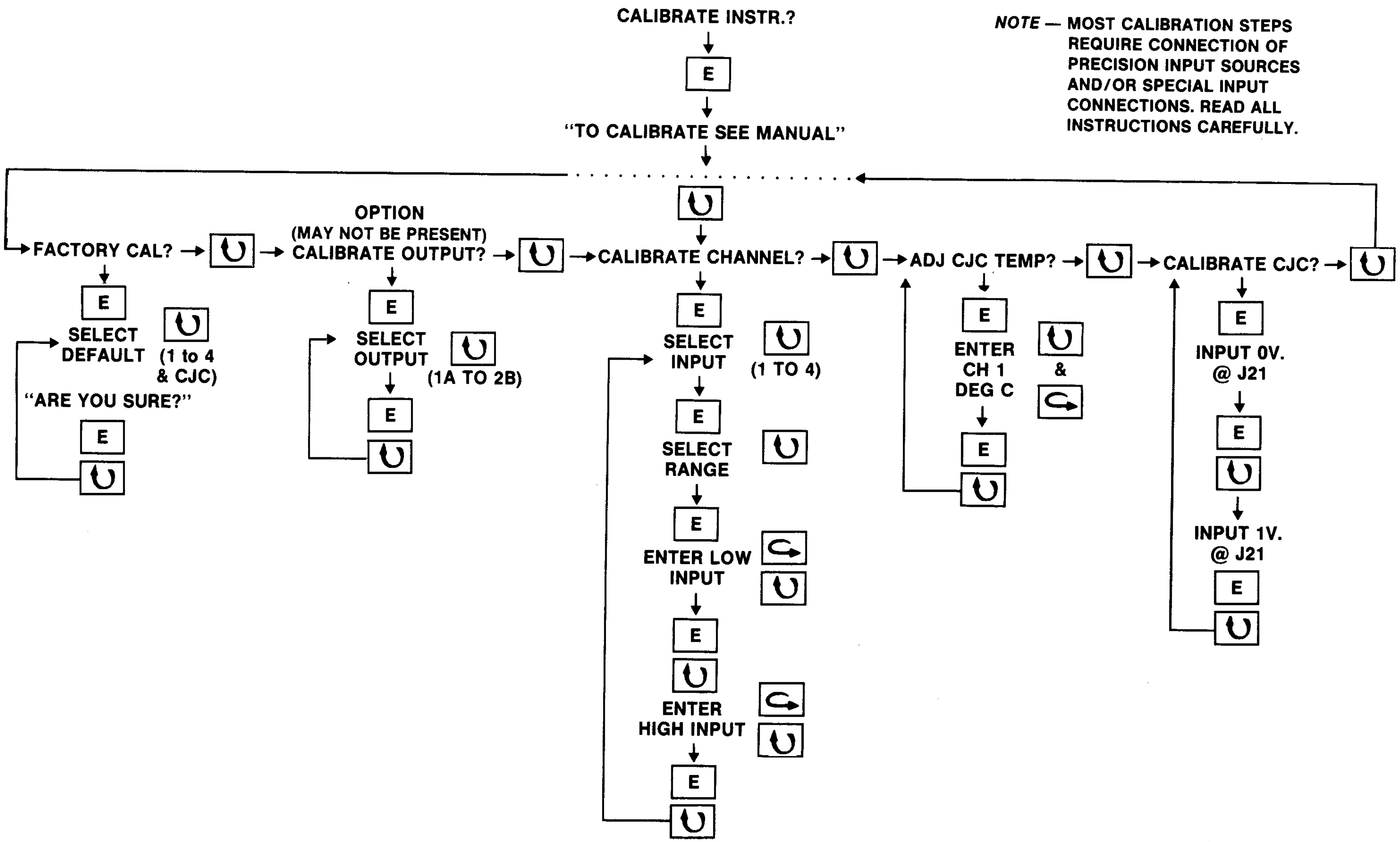
Configuration Diagram 1B shows Calibration Choices.

DIAGRAM 1B

TO SCROLL THE DISPLAYS	[scroll key]
TO FREEZE ON A DISPLAY	Enter
TO ENTER CONFIGURATION (S1 Must Be In Enable)	[configuration key]
TO MOVE BACKWARD IN CONFIG.	Clear

INSTRUMENT CALIBRATION
(access from Top Level Menu after moving S 1 to the Disable Position)

NOTE — MOST CALIBRATION STEPS REQUIRE CONNECTION OF PRECISION INPUT SOURCES AND/OR SPECIAL INPUT CONNECTIONS. READ ALL INSTRUCTIONS CAREFULLY.



7. Fault Messages and Dealing With Memory Loss

Mechanisms have been incorporated into the instrument to detect the rare occurrence of a memory loss. The most probable cause of such an event is a low battery voltage. The 3.4 Lithium battery should be replaced yearly to assure secure memory retention if live power is removed from the instrument. The instrument has been designed so that only data entered through the keypad must be replaced if the battery backup does not function. Calibration data will automatically be restored from a secondary non-volatile source. The following sections describe the memory loss indication and the calibration memory scheme.

7.1 MEMORY LOSS INDICATORS

When the instrument's power is turned ON, a check is done of the programmed and calibrated data. If a fault is detected, one of two messages will appear in the Channel 1 RUN MODE display. The DEFAULT message will appear if a programming loss occurred or a calibration fault was corrected (see Calibration in next section). The RECALIBRATE message will appear if the integrity of the EEPROM calibration values are faulty (again, see next section).

The message will remain in the RUN MODE scroll until the first time a Configuration entry is made. It will not reappear until power is cycled OFF then ON.

RECALIBRATE HHHH (or) DEFAULT HHHH

The faulty data base is indicated by the 4 hexidecimal digits HHHH. The most significant digit codes are:

- 8 = EEPROM fault
- 4 = Cold Junction Comp. Calibration memory loss
- 2 = Chart Drive Speed Memory loss
- 1 = Loop 1, Loop 2, Setpoint Generator, or Output Calibration Loss

The next digit codes are:

- 8 = Channel 4 Alarms memory loss
- 4 = Channel 3 Alarms memory loss
- 2 = Channel 2 Alarms memory loss
- 1 = Channel 1 Alarms memory loss

The next digit codes are:

- 8 = Pen 4 Calibration or Configuration data loss
- 4 = Pen 3 Calibration or Configuration data loss
- 2 = Pen 2 Calibration or Configuration data loss
- 1 = Pen 1 Calibration or Configuration data loss

The next digit codes are:

- 8 = Channel 4 Calibration or Configuration data loss
- 4 = Channel 3 Calibration or Configuration data loss
- 2 = Channel 2 Calibration or Configuration data loss
- 1 = Channel 1 Calibration or Configuration data loss

If multiple errors are detected the code that appears will be the SUM OF THE INDIVIDUAL CODES for that digit position. For example, the code *0C00* indicates the alarms on Channels 4 and 3 were lost (8 + 4 = 12, which is a hexidecimal "C"). Zero (0) indicates no fault.

SUM OF FAULTS	1 . . . 9	10	11	12	13	14	15
CODE DIGIT	1 . . . 9	A	B	C	D	E	F

7.2 ERRONEOUS ENTRY OR LOSS OF CALIBRATION

There are two types of non-volatile storage in this instrument. The largest type is the battery backed-up CMOS static RAM. This memory holds all of the data programmed from the front of the instrument, plus the most recent calibration data. The other type of memory is the Electrically Erasable Programmable Read Only Memory (EEPROM). This memory holds the calibration data entered when the instrument was manufactured. A new instrument holds a copy of the EEPROM calibration in the RAM. An instrument which has been re-calibrated in the field holds the re-calibration data in its RAM (the most recent), and retains its factory calibration in the EEPROM. The factory calibration can be restored to the RAM.

There are three possible causes of faulty calibration data in the instrument. Each is treated separately below.

The first case (most probable), is the erroneous entry of calibration programming without reference sources attached to the instrument. The operator has a way to recover from this mistake. Perform the following:

1. Follow the procedure in Section 6 to enter CALIBRATION MODE.
2. Scroll to the entry FACTORY CAL.?
3. Press ENTER and then select the desired Channel to default.
4. Press ENTER. Now press ENTER to defaut or CLEAR if you're not sure.
5. PRESS UP ARROW and the calibration stored in the EEPROM will be loaded into the RAM to replace the erroneous calibration entry.

The second cause of bad calibration is loss of memory in the RAM. When the instrument's power is turned ON, the memory is checked. If faulty calibration on a Channel is detected, the factory calibration for that Channel is automatically restored, and the indicators described in Section 7.1 appear.

The third case is faulty electronics. When the instrument's power is turned ON, and a fault in the RAM is detected, the instrument checks the integrity of the EEPROM before loading the factory calibration. If the EEPROM is faulty, the indicator described in Section 7.1 appears. The unit may be re-calibrated using reference inputs, but probably needs maintenance attention.

8. Technical Information

ng sections describe the functions and ration of the electrical and mechanical es of the instrument.

MENT BLOCK DIAGRAM

agram depicted in Figure 10 shows the main cks and circuit board assemblies:

Board Assembly (AH 203009)

ver Board Assembly (AH 203012)

oard Assembly (AH 203011)

'U Board Contains:

al Conditioning — An auto-zeroed preampli- hannel with selectable gains is used to e channel input signal to the common -1 to el needed by the high level analog to digital

Digital Converter — The outputs of the are multiplexed into a common analog to verter that convert the analog input signal e width modulated signal.

oprocessor — The instrument uses the it CMOS microprocessor to control all within the unit. The program firmware is 32K bytes of PROM with 8K of battery MOS RAM providing the storage of operator able parameters and working memory.

Power Supply — The instruments' digital and analog power supplies are mounted on this assembly.

The Motor Driver Board contains:

Motor Drivers — The latches and stepper motor drive circuits for all four channels are contained on this assembly.

Keypad Interface — The keypad matrix interface is contained on this assembly.

The Display Board contains:

Display — The instrument uses a vacuum fluorescent display, which provides two lines of 16 characters per line. The display latches and drivers are contained on this assembly.

Indicator lights — The indicator light latches and drivers are contained on this assembly.

8.2 ELECTRONIC ASSEMBLIES

The following sections describe the basic operation of the electronic circuit board assemblies in the instrument.

8.2.1 Main CPU Board Assembly

The main CPU board is mounted in the case and contains the power supply, non-isolated analog inputs, and the digital control electronics. Refer to Figures 11, 12 & 13 for the following discussion.

The followir general ope subassembli

8.1 INSTRU

The block dia function bloc

Main CPU

Motor Driv

Display Bo

The Main CP

Input Signa fier per c amplify the +5 Volt lev converter.

Analog to preamps a digital con into a puls

6303 Micr 6303 8 b functions stored in backed CN programm.

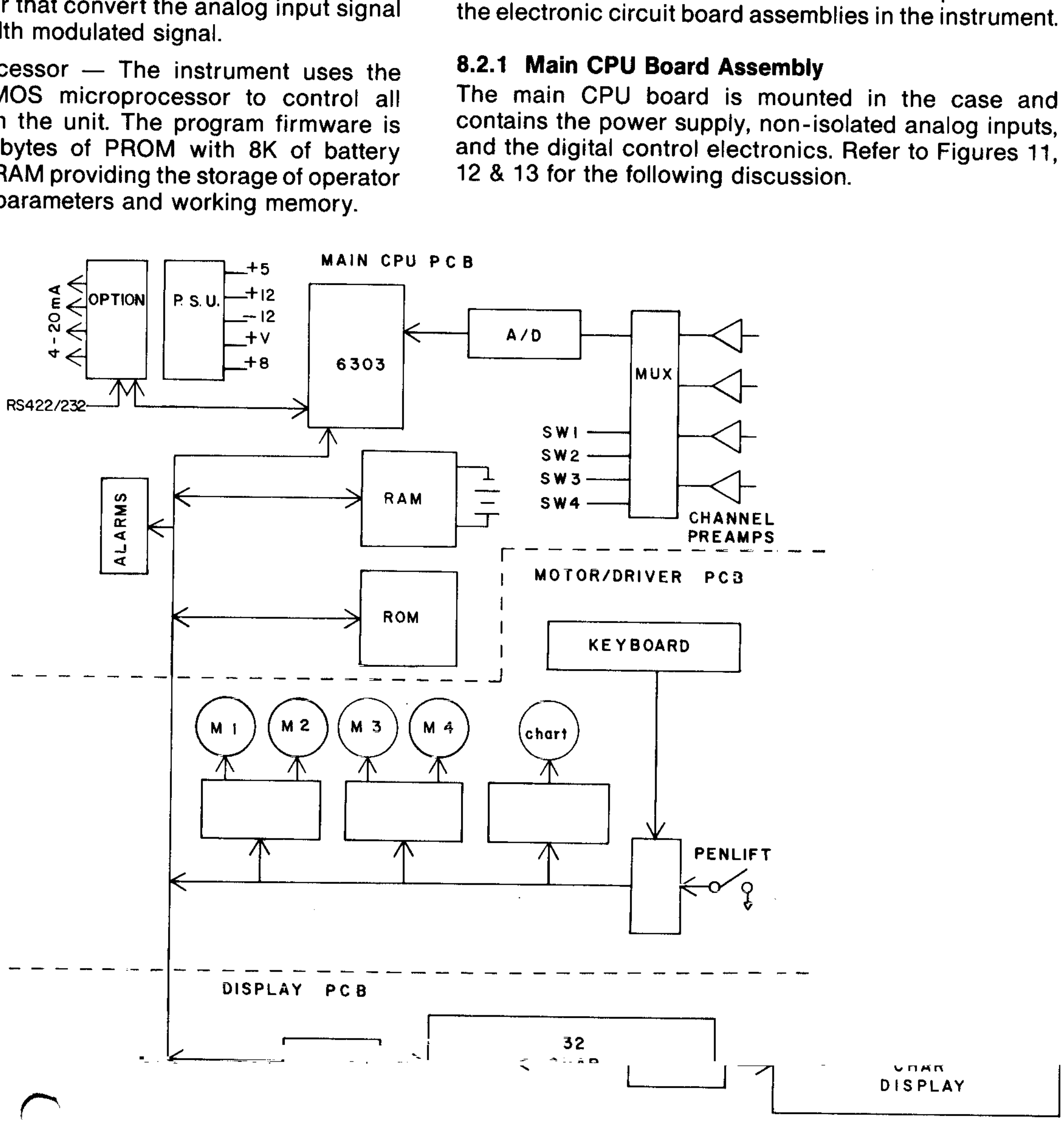


Figure 10. Block Diagram

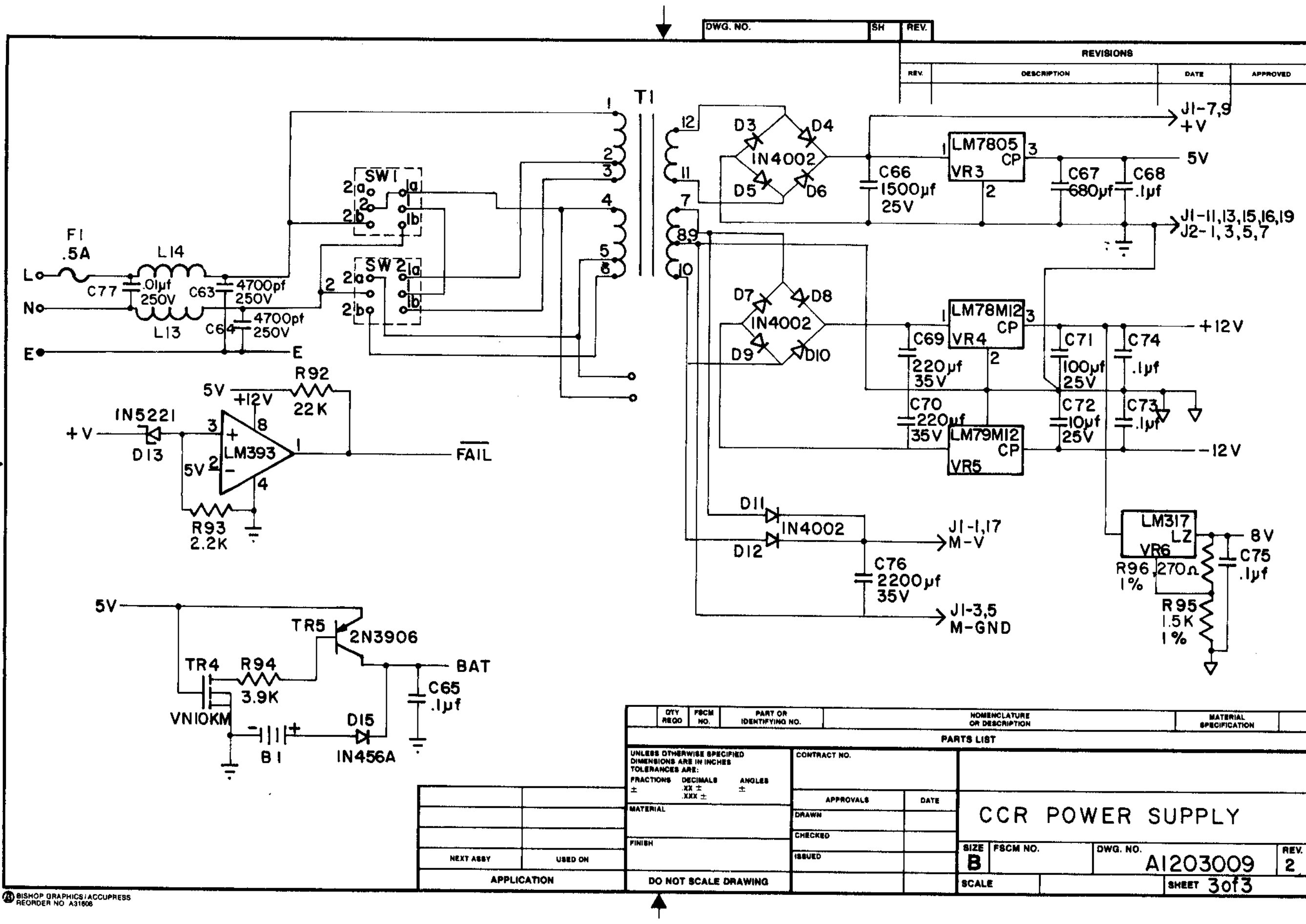


Figure 11. Main Circuit Board Power Supply

The power supply:

The power supply converts the AC line voltage to a 9 volt RMS source and a 30 volt RMS center taped source. Line voltage selection is performed by SW1 and SW2. The 9V source is rectified by D7, 8, 9, & 10 and fed to J1, J4, and VR3 to supply the digital 5 volts. The 30V source is rectified by D7, 8, 9, 10 to produce the analog power rails +12, +8, -12 volts and also rectified by D11, 12 to produce an unregulated 18 volts, which is distributed through J1 to the rest of the circuit.

Analog inputs:

The analog section has five high level inputs (0-5 volts) and 4 preamplified inputs. The four channel inputs have a preamplifier (U2) with four jumper selectable gains and are auto-zeroed by U1, U2, and U3. The four input channels, the feedback element inputs, and CJC input (U5) are multiplexed, by U6 and part of U3, converted into a pulse width modulated signal, by U7 and U8, which is again multiplexed by U13A, U14A, and U15A, then converted into a digital number by the microprocessor (U18).

The digital section:

The microprocessor (U18) interfaces to all parts of the circuit via a standard multiplexed address-data bus architecture except for the analog inputs, which are controlled by port 1 on the processor. Port 1 directly controls the input multiplexing of the nine onboard channels and four offboard channels through J4.

The microprocessor bus architecture consists of eight data lines, 16 address lines, and four control lines (e, as, rd, wr). The data and the lower eight address lines are multiplexed out of the processor. The bus is buffered and extended offboard by U25, U26, U27, U28, via J1 & J2. This extended bus is used for peripheral control of a number of devices (motors, display, options). The bus is decoded by U20 and the device assignment to a memory space is enabled.

Memory space is assigned as follows:

The EPROM program memory (8000-FFFF) is assigned the upper half of the memory space. The on board RAM, U22, (4000-7FFF) is assigned an 8K block under program memory. The offboard options (2000-3FFF) are assigned this 4K block. The next 4K block is the miscellaneous IO block. In this block U24 decodes strobes for the motors and onboard miscellaneous bit lines. U23 controls such functions as EEPROM select, watchdog strobe, alarm relay IO, and RAM enable. The last block (0-0FFF) is assigned to the keyboard to control all functions within the unit. The program firmware is stored in U21.

There are two hardware monitor circuits onboard. The first is the watchdog timer. R78 & C35 will trip U11B if not strobed every 60 msec through TR3 resulting in a reset signal to the microprocessor. The second circuit is the power supply monitor U11A, which will trip the reset through D14 when the voltage is insufficient to regulate the 5 volt rail.

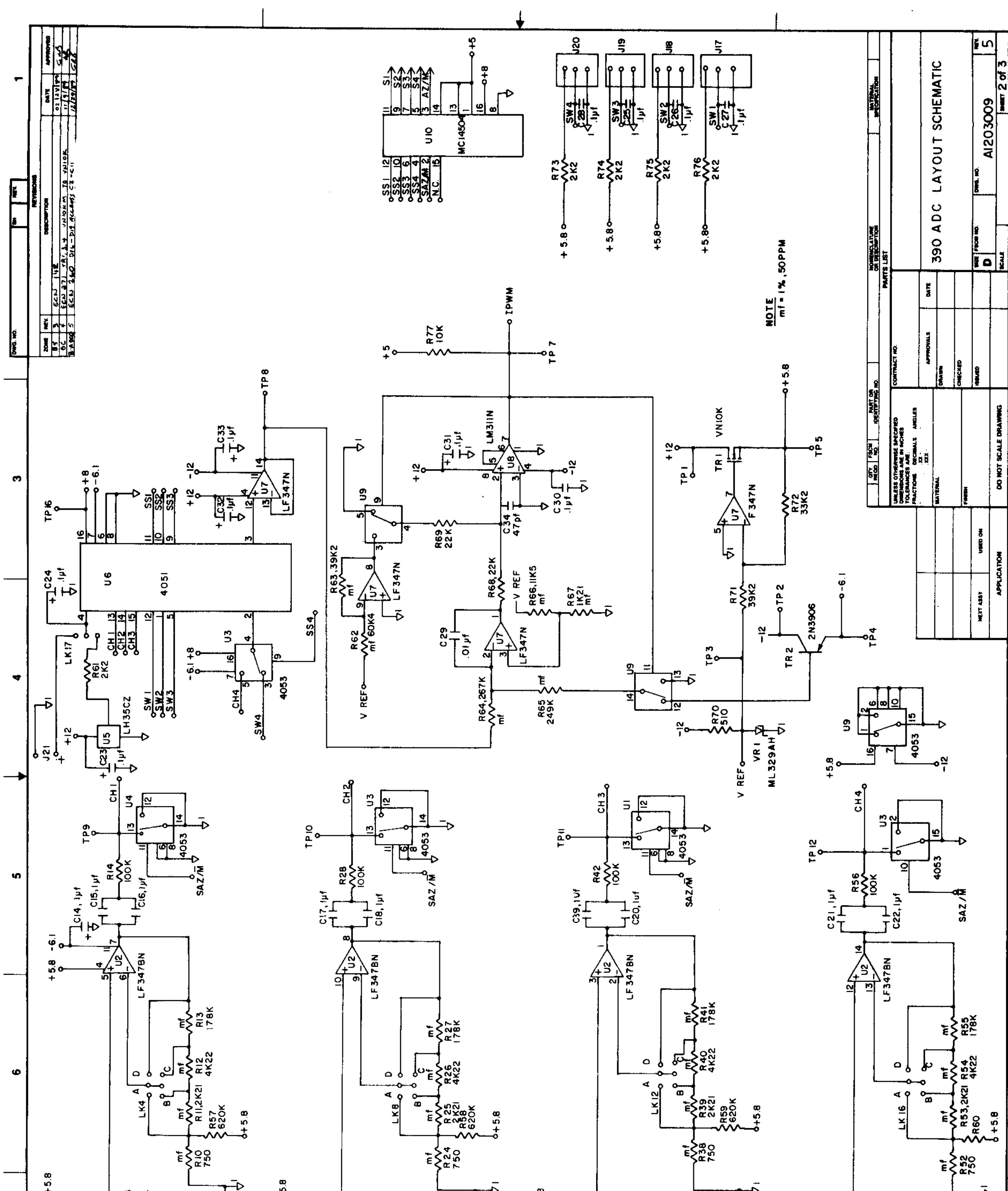


Figure 12. Analog-to-Digital Converter

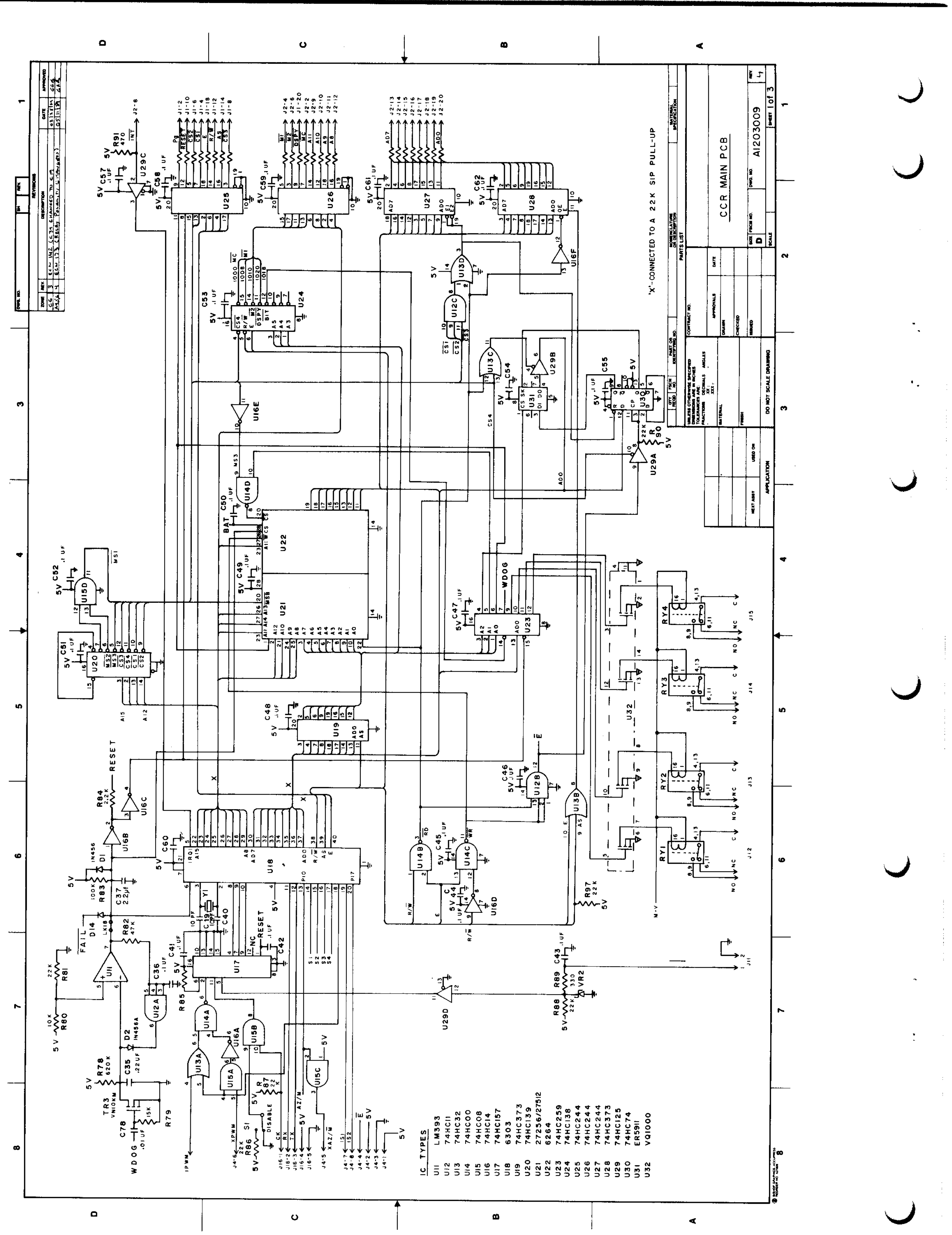


Figure 13. Main Circuit — Digital Circuit

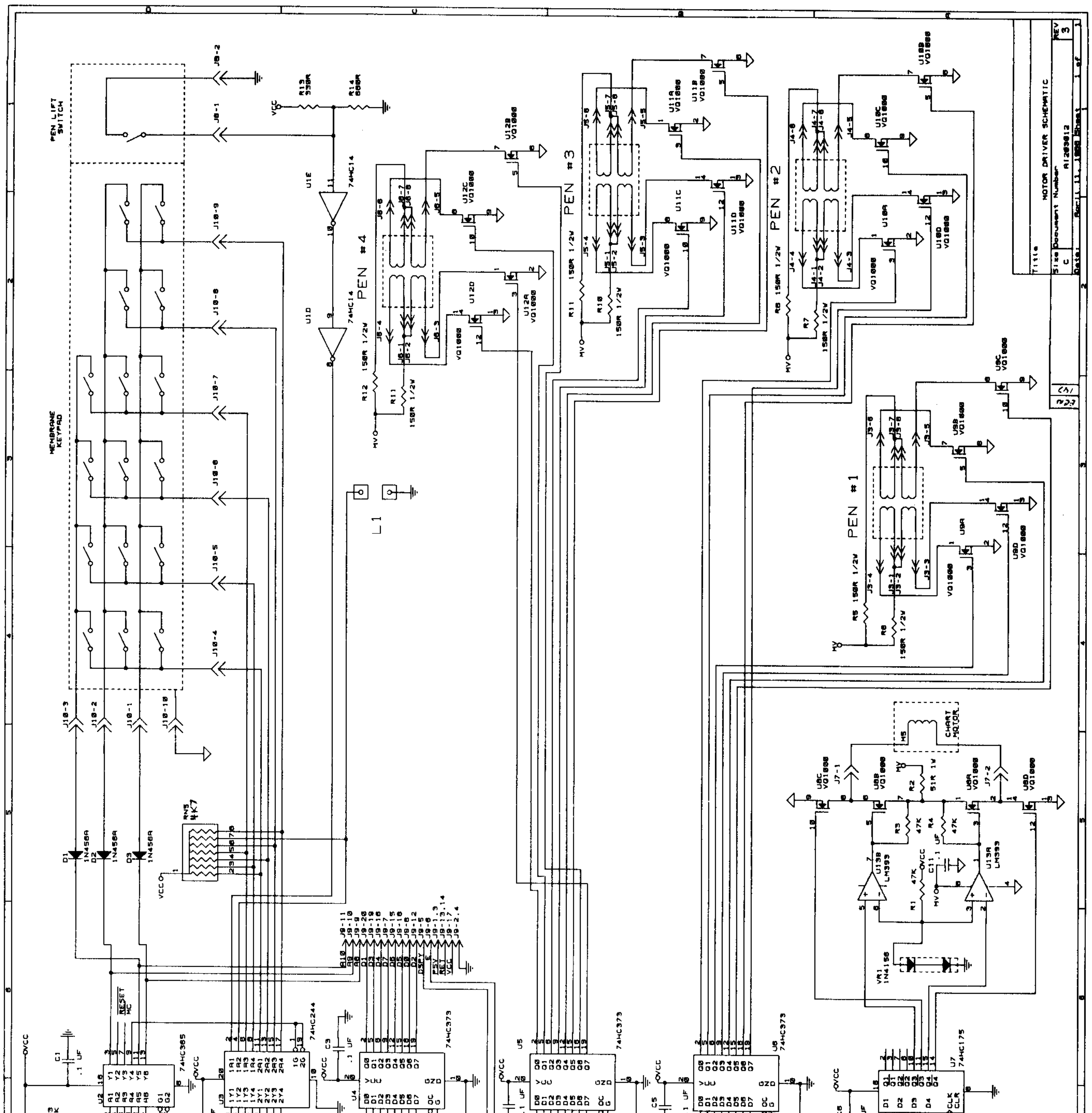


Figure 14. Motor Driver Circuit

8.2.2 Motor Driver Board Assembly

The motor driver interface board is mounted on the back of the display board on the platen assembly and contains the circuitry required to drive the pen and chart drive stepper motors. This assembly also contains the interface circuitry for the operator keyboard.

Refer to Figure 14.

The pen stepper motors are driven by the quad MOSFET drivers U9, U10, U11 and U12. The drivers are controlled by latches U5 and U6, which are connected to the buffered microprocessor data bus. The pen motor drive latches are memory mapped at hexidecimal addresses 1008 and 1010.

The chart drive motor is a synchronous motor that is driven with time spaced bursts of 50 Hertz frequency. The time between the bursts is proportional to the selected chart speed. The chart motor drive control latch is memory mapped at hexidecimal address 1000.

The 16 key membrane switch panel is configured in a matrix of 3 strobe lines and six data lines. The strobe lines are buffered by U2 and memory mapped into hexidecimal addresses 0B00, 0D00, and 0E00. The 6 data lines are buffered by U3 along with the pen lift detection switch and a spare data line. The keyboard is scanned at a rate of 2 times per second by the microprocessor for detection of a key press.

Tristate buffers U2, U3, and U4 buffer the microprocessor bus for connection to the display board via J9.

8.2.3 Display Board Assembly

The display board is mounted on the platen assembly and contains the vacuum fluorescent display, indicator lights, and the associated drive electronics. The display board is connected to the external microprocessor bus via the motor/driver board.

Refer to Figure 15.

Binary counter U1 divides the E clock frequency down to drive transformer T1. The regulated 6.5 volts from TR1 is chopped to provide a high voltage of 25 volts and a 5 volt P-P filament voltage required to drive the vacuum fluorescent display. The grid drivers U5, U6 provide the multiplexed selection of 1 of 16 characters. The anode drivers U7, U8 control the 16 character segments of row 1 and U9, U10 control the 16 character segments of row 2. The latched drivers are strobed by a two-write sequence. The first write selects 1 of 7 latch drivers hexidecimal addresses 1020, 1120, 1220, 1320, 1420, 1520, or 1620. second write to the enable address strobes the data into that latch regardless of which display address is used. The seventh latch U4 drives the 8 LED indicators. The eighth display address 1720 controls the display.

8.2.4 Pneumatic Input Board

The Pneumatic input option board enables the Recorder to connect to pneumatic control systems. The board mounts above the Main CPU board and is connected to the Main CPU board via a cable harness.

Refer to Figure 16.

The pneumatic input board has provisions to mount up to 4 pressure sensors. Any input not assigned as pneumatic input could be used as an analog input. The circuit provides the power supply and signal conditioning required to interface the piezoresistive pressure sensor to the instrument's analog input. The pressure sensors are temperature compensated to provide stable performance over the specified temperature ratings of the instrument.

The pressure sensors are connected to bulkhead fittings at the bottom of the case by flexible tubing. The user pressure connection provided by the bulkhead fitting is 1/8" female NPT.

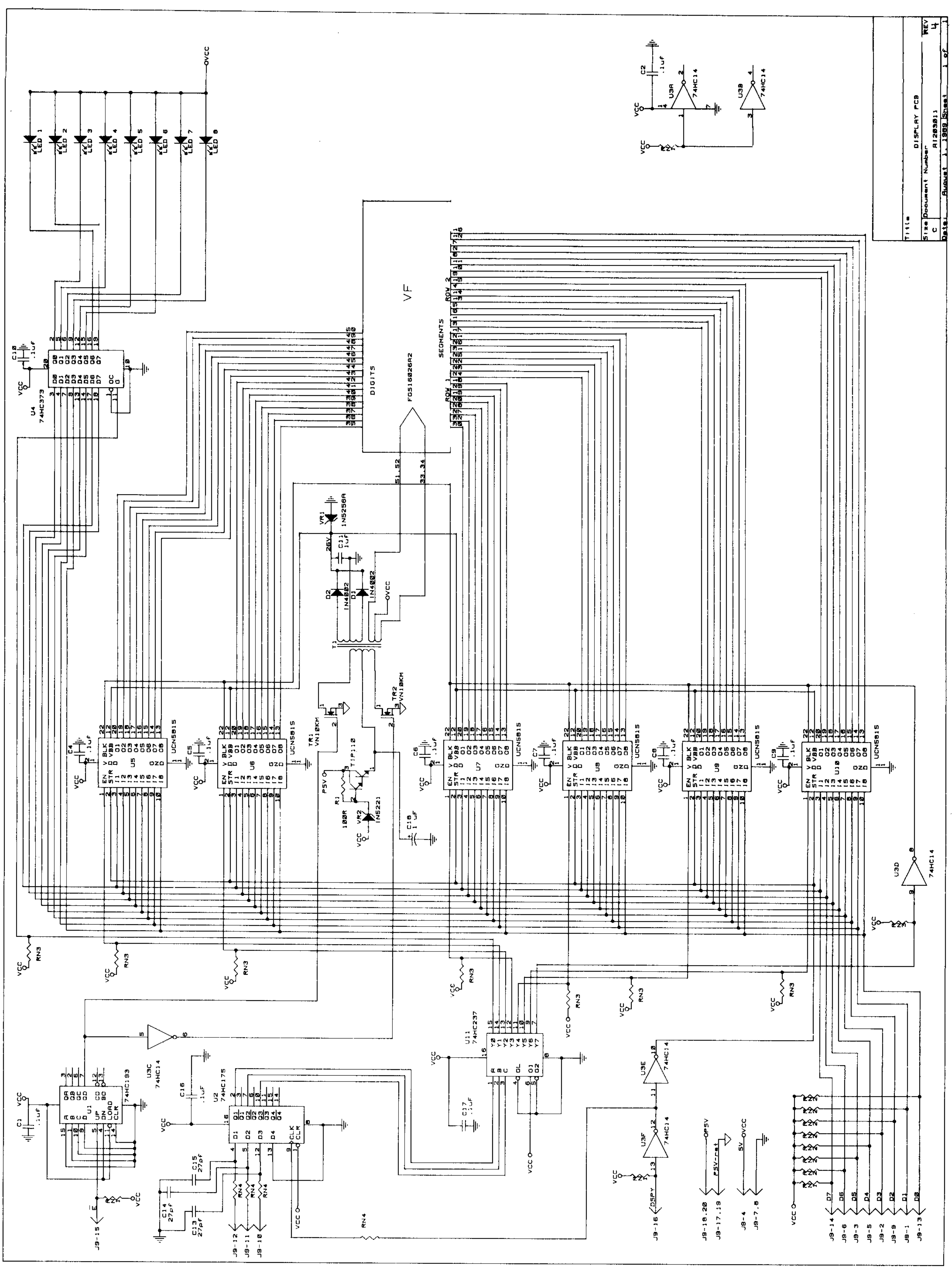


Figure 15. Display Circuit

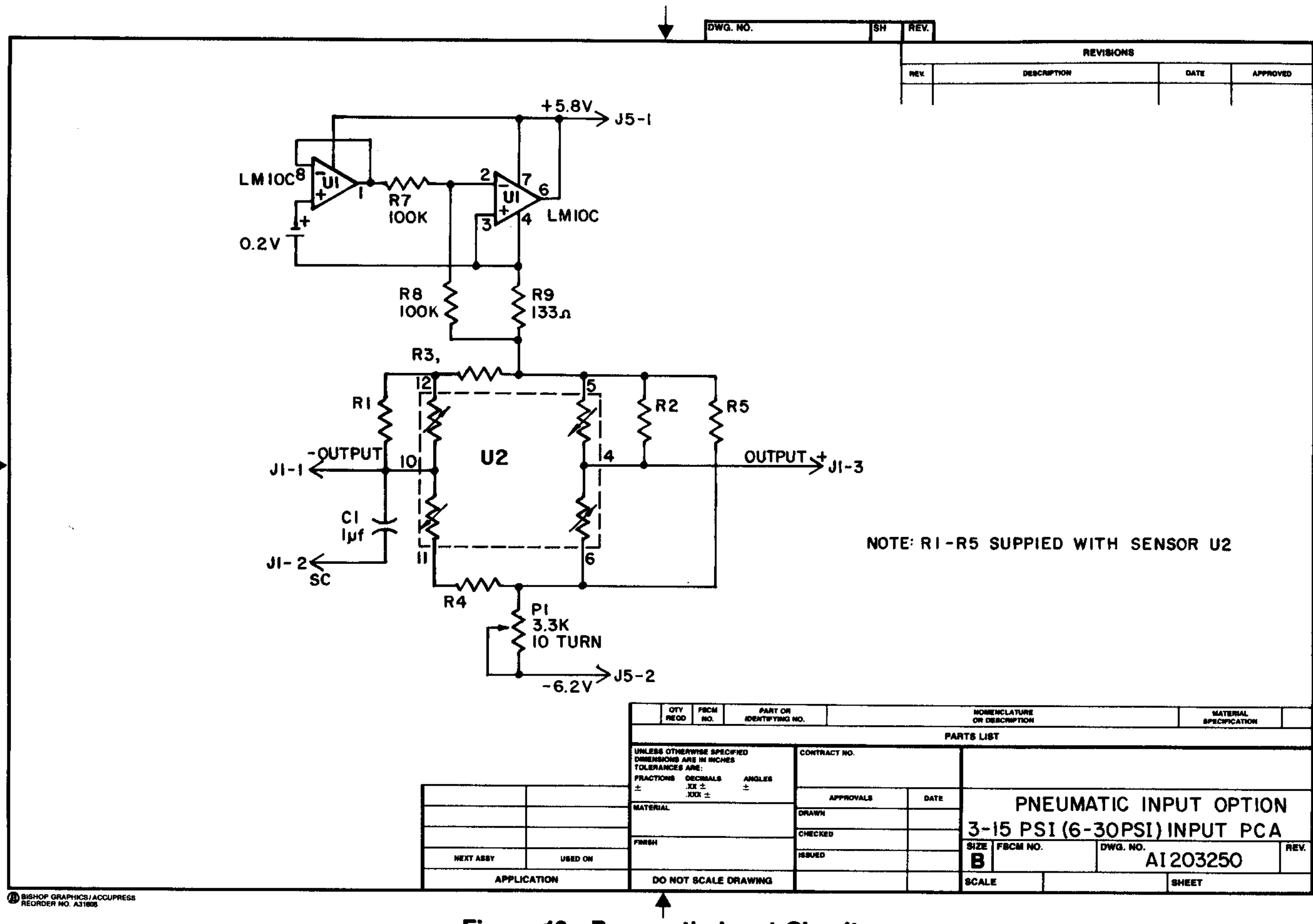


Figure 16. Pneumatic Input Circuit

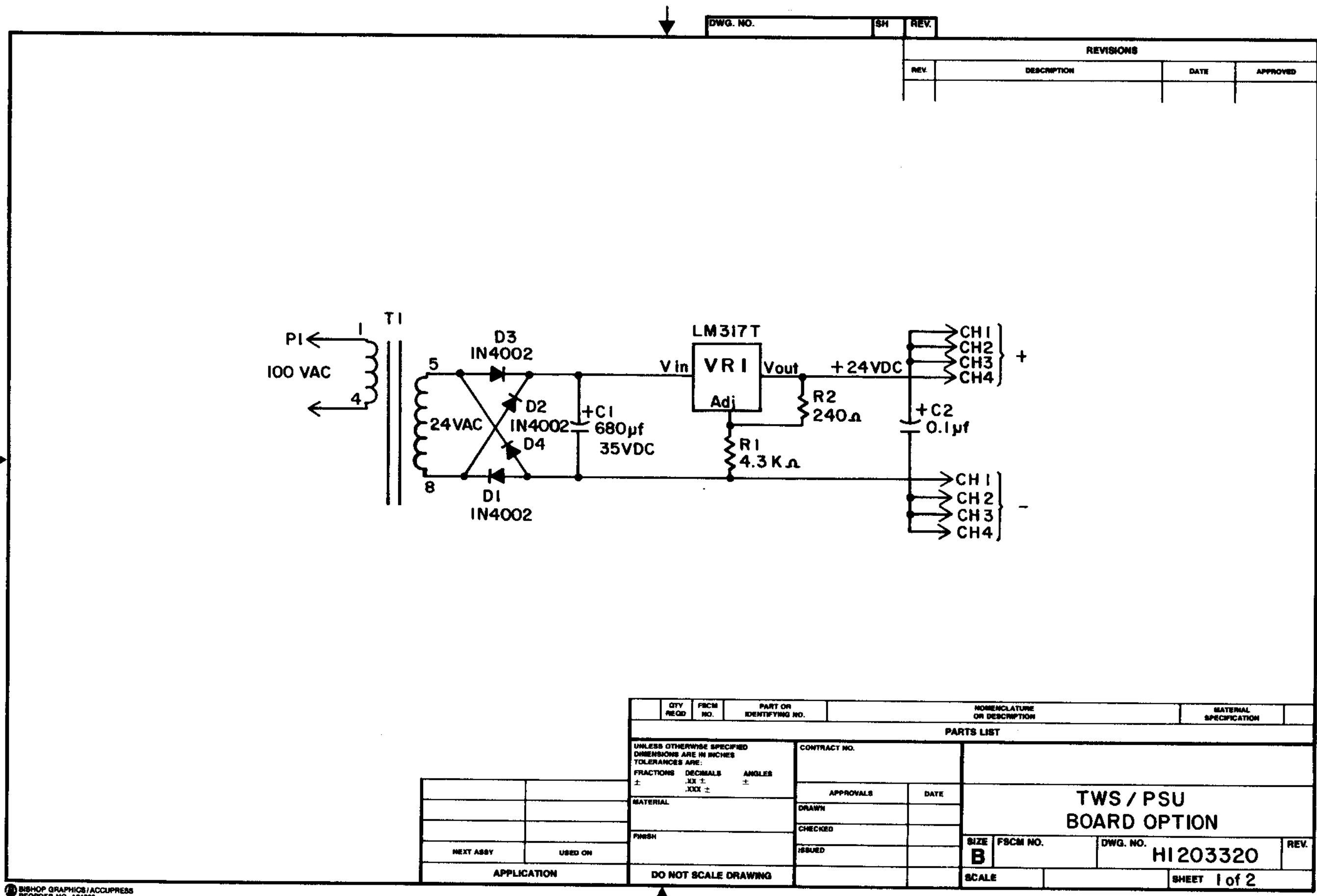


Figure 17. Transmitter Power Supply Circuit

8.3 MECHANICAL ASSEMBLIES

The instrument is comprised of three major mechanical parts, namely the case, door and platen. The case houses the main pcb, options pcbs, and platen. The platen assembly provides a mounting base for the Recorder mechanism. Access to the interior of the case is obtained by unscrewing the platen retaining screw. The platen assembly can be removed from the case by disconnecting the interconnection cables and unfastening the top and bottom hinge plates. The door, which is attached to the case by a continuous hinge, is secured via the Cam Latch handle assembly.

8.3.1 Door and Latch Assembly

The door is constructed of structural foam thermoplastic. It is connected to the case with a stainless steel continuous hinge (item 3) secured in place with screws (item 4).

Refer to Figure 18.

A stainless steel cam latch (with optional DIN type lock) secures the door to the case. The latch itself comprises the handle and shaft (items 3 & 2), eccentric collar (item 9), hook (item 11) and spring (item 8). They are all held in place with a screw (item 13).

The door has a raised tongue form on it, which compresses into a seal recessed in a groove on the lip of the case. The amount of compression can be adjusted by turning the latch bracket mounting screw. This adjusts the depth in the case that the hook reaches.

The door can be supplied with glass or optional acrylic windows.

8.3.2 Platen Assembly

The platen is constructed of structural foam thermoplastic. It supports the main functional parts of the instrument. The upper portion houses the display assembly (item 3) and the motor driver assembly (item 6). The membrane keypanel (item 1) is bonded into the recess on the front of the platen.

Refer to Figure 19.

One to four stepper motors, with attached gearboxes and associated linkages, are fitted to the back of the platen to provide one to four channels of recording. Motor one is always fitted and provides the common shaft about which the linkages for the additional channels can pivot. Associated with each channel is a plastic feedback element (item 17) together with a wiper arm (item 19) fitted with a contact plate with gold contacts (item 21). The platen has molded-in overtravel stops. The wiper arm assembly travel is limited to a few millimeters past the zero and span positions on the chart.

Fitted in the center of the platen is a synchronous motor-gearbox (driven in stepper motor fashion), which provides the chart drive power. A hub is fitted to the gearbox, over which the chart is fitted and a clamp nut held captive by the paper gate molding (item 12), secures the chart to the hub.

The pen lift feature is also built into the platen. Upward movement of the lever (item 39) on the front of the platen will cause the pen(s) to lift, full upward movement will cause the pen(s) to move to the side of the chart, by virtue of the pen lift arm (item 47) tripping a microswitch (item 66) which actuates a "pen park" routine. There is also a center position where the pen(s) are lifted but the microswitch is not tripped. This can be used to allow the pens to move to the measured position before lowering them onto a new chart.

The pen arm(s) (item 75) are attached by a clamp plate(s) (item 77) to the pen bracket(s). The pen arm is the same design for each pen position and are adjusted such that the #2 pen position coincides with the time mark on the platen, with pen #1 being approximately 4 millimeters ahead (in time), and #3 pen and #4 pen being approximately 4 and 8 millimeters behind respectively. On a one pen instrument the single pen can be adjusted to the time line position.

8.3.3 Case Assembly

The case is constructed of structural foam thermoplastic. It houses the main pcb and option(s) pcb(s). A peripheral groove contains a closed cell neoprene sponge gasket (item 2) upon which the matching raised form on the door seals. An adjustable latch bracket (item 19) for the door catch is located on the right side. Two clamp plates (item 6) hold the hinge pin of the platen in place. Three 22.2 millimeter (0.875 inch) diameter holes are provided at the bottom of the case for conduit entry.

Refer to Figure 20.

Threaded inserts are fitted on the outside of the case for attaching the brackets for panel or wall mounting. There are also threaded inserts for the optional pipe mounting kit. With the exception of the conduit entry holes all other holes in the case are blind, minimizing the possibility of moisture entry.

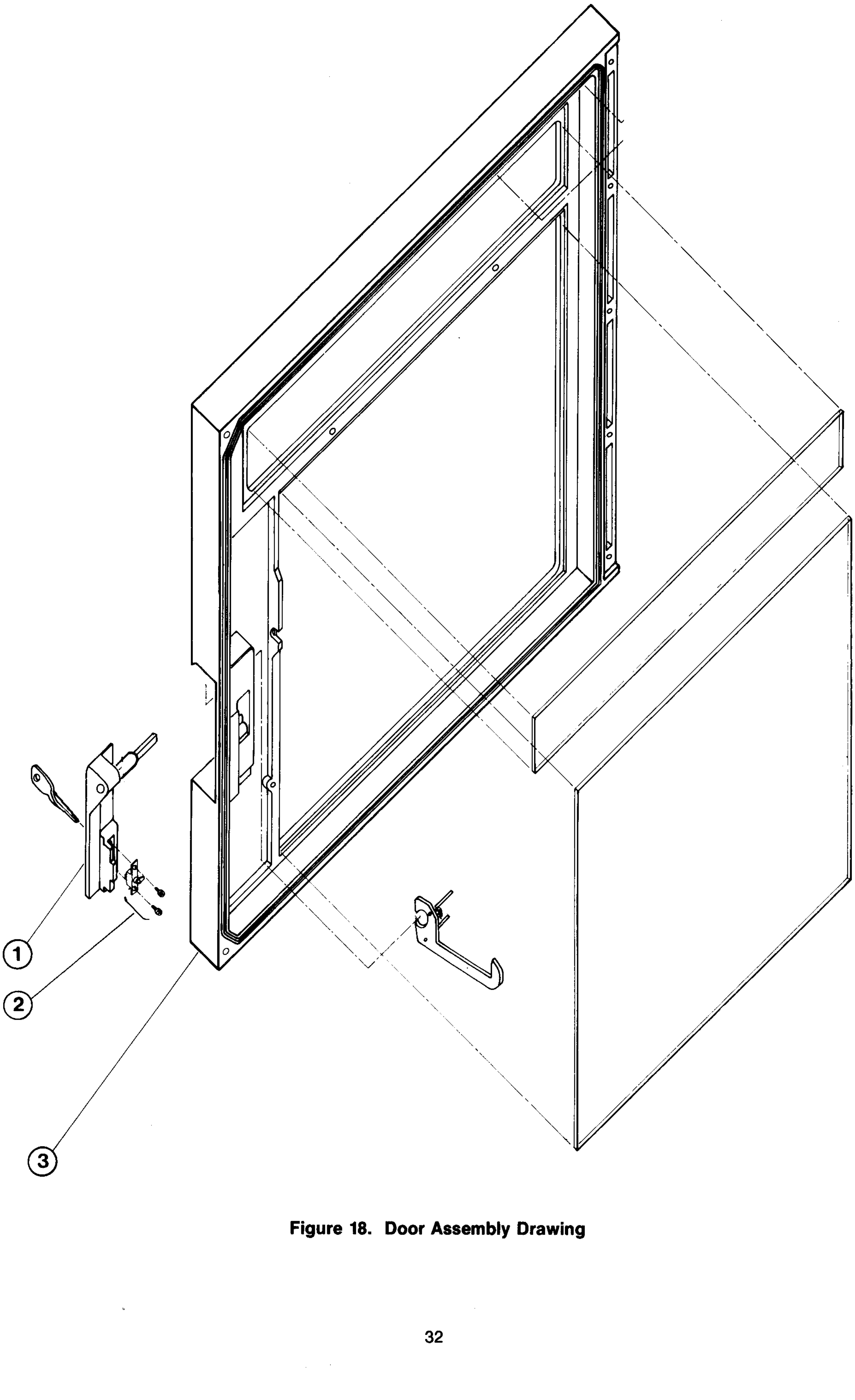


Figure 18. Door Assembly Drawing

PARTS LIST — DOOR ASSEMBLY LA203303		
ITEM #	**DESCRIPTION**	**PART #**
1)	HANDLE ASSEMBLY HANDLE ASSEMBLY WITH LOCK	LA203258 LA203258U100
2)	LOCK ASSEMBLY WITH TWO KEYS	LA203186
3)	DOOR (See price sheet for complete P/N)	LA203303U__ __ __

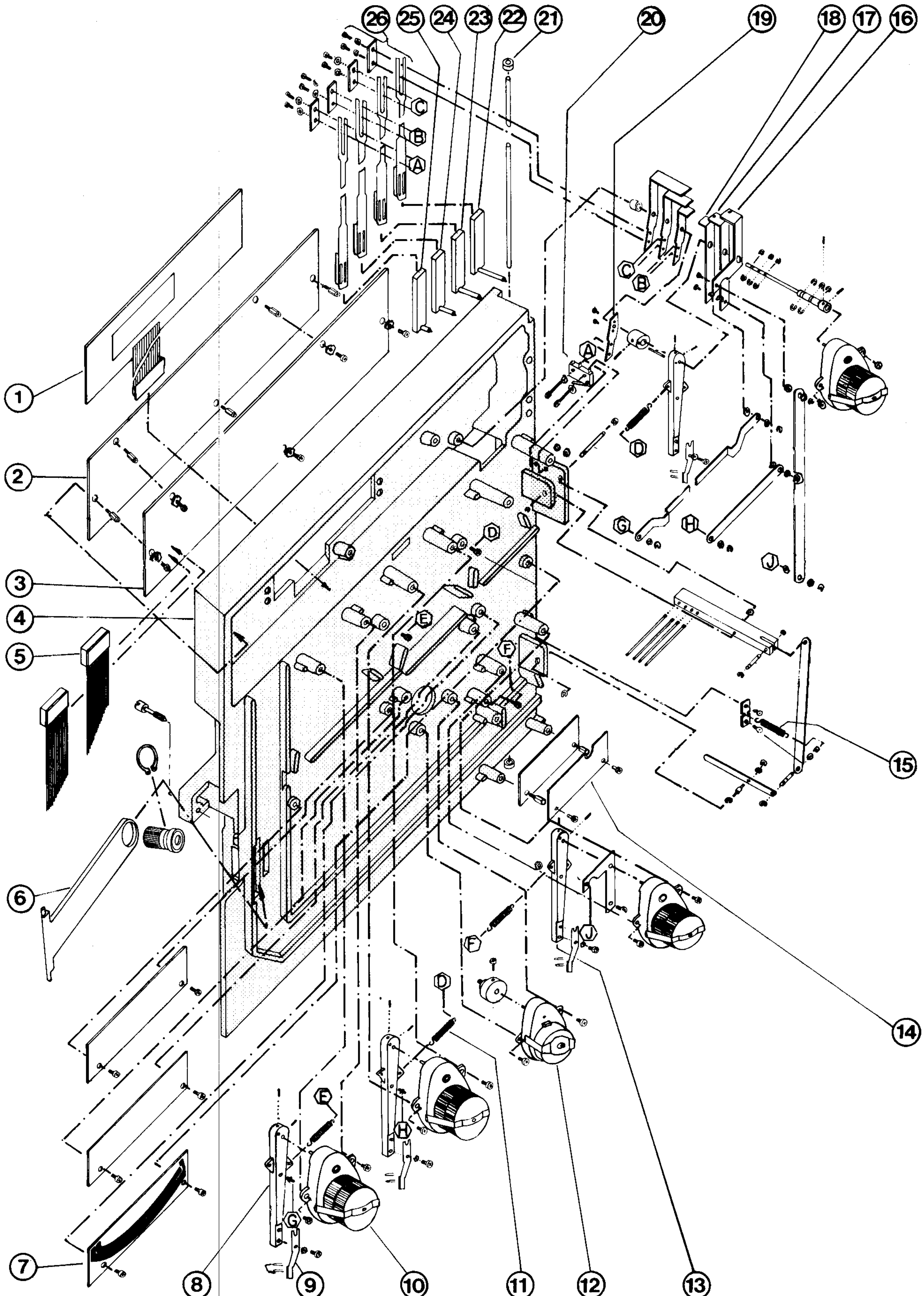


Figure 19. Platen Assembly Drawing

PARTS LIST — PLATEN ASSEMBLY LA203303		
ITEM #	**DESCRIPTION**	**PART #**
1)	MEMBRANE PANEL WITHOUT CONTROLLER MEMBRANE PANEL WITH CONTROLLER	DT203152 DT203153
2)	DISPLAY PC ASSEMBLY WITH MOUNTING HARDWARE	LA203537
3)	MOTOR DRIVER PC ASSEMBLY, WITH MOUNTING HARDWARE, 1 PEN MOTOR DRIVER PC ASSEMBLY, WITH MOUNTING HARDWARE, 4 PEN	AH203012U100 AH203012U400
4)	PLATEN (See price sheet for complete P/N)	LA 203301U_ _ _
5)	RIBBON CABLE SET WITHOUT CONTROLLER RIBBON CABLE SET WITH CONTROLLER	LA203404U001 LA203404U002
6)	PAPER GATE ASSEMBLY KIT	LA203546
7)	FEEDBACK ELEMENT FEEDBACK ELEMENT WITH MOUNTING HARDWARE, PEN 1 FEEDBACK ELEMENT WITH MOUNTING HARDWARE, PEN 2 FEEDBACK ELEMENT WITH MOUNTING HARDWARE, PEN 3 FEEDBACK ELEMENT WITH MOUNTING HARDWARE, PEN 4	BT203128 LA203128U011 LA203128U012 LA203128U013 LA203128U014
8)	FEEDBACK ARM ASSEMBLY WITH MOUNTING PEN 2 OR 3	LA203297
9)	FEEDBACK CONTACT ASSEMBLY WITH MOUNTING HARDWARE	LA203252U001
10)	PEN MOTOR WITH MOUNTING HARDWARE	LA203220U011
11)	PEN ARM SPRING	BH203188KITO
12)	CHART MOTOR WITH MOUNTING HARDWARE	LA203219U011
13)	FEEDBACK ARM ASSEMBLY WITH MOUNTING HARDWARE, PEN 1 OR 4	LA203296
14)	FEEDBACK ELEMENT COVER WITH MOUNTING HARDWARE	LA203185U001
15)	PEN LIFT SPRING	BH20318KITO
16)	PEN LINKAGE ASSEMBLY, 4 PENS	LA203256U004
17)	PEN LINKAGE ASSEMBLY, 3 PENS	LA203256U003
18)	PEN LINKAGE ASSEMBLY, 2 PENS	LA203256U002
19)	PEN LINKAGE ASSEMBLY, 1 PEN	LA203256U001
20)	PEN LIFT MICRO SWITCH ASSEMBLY	LA203263
21)	PLATEN MOUNTING HARDWARE KIT	LA203543
22)	MARKING MATERIAL, BLACK PEN	LA203194
23)	MARKING MATERIAL, GREEN PEN	LA203193
24)	MARKING MATERIAL, RED PEN	LA203192
25)	MARKING MATERIAL, BLUE PEN	LA203191
26)	PEN ARM ASSEMBLY WITH MOUNTING HARDWARE	LA203132U001

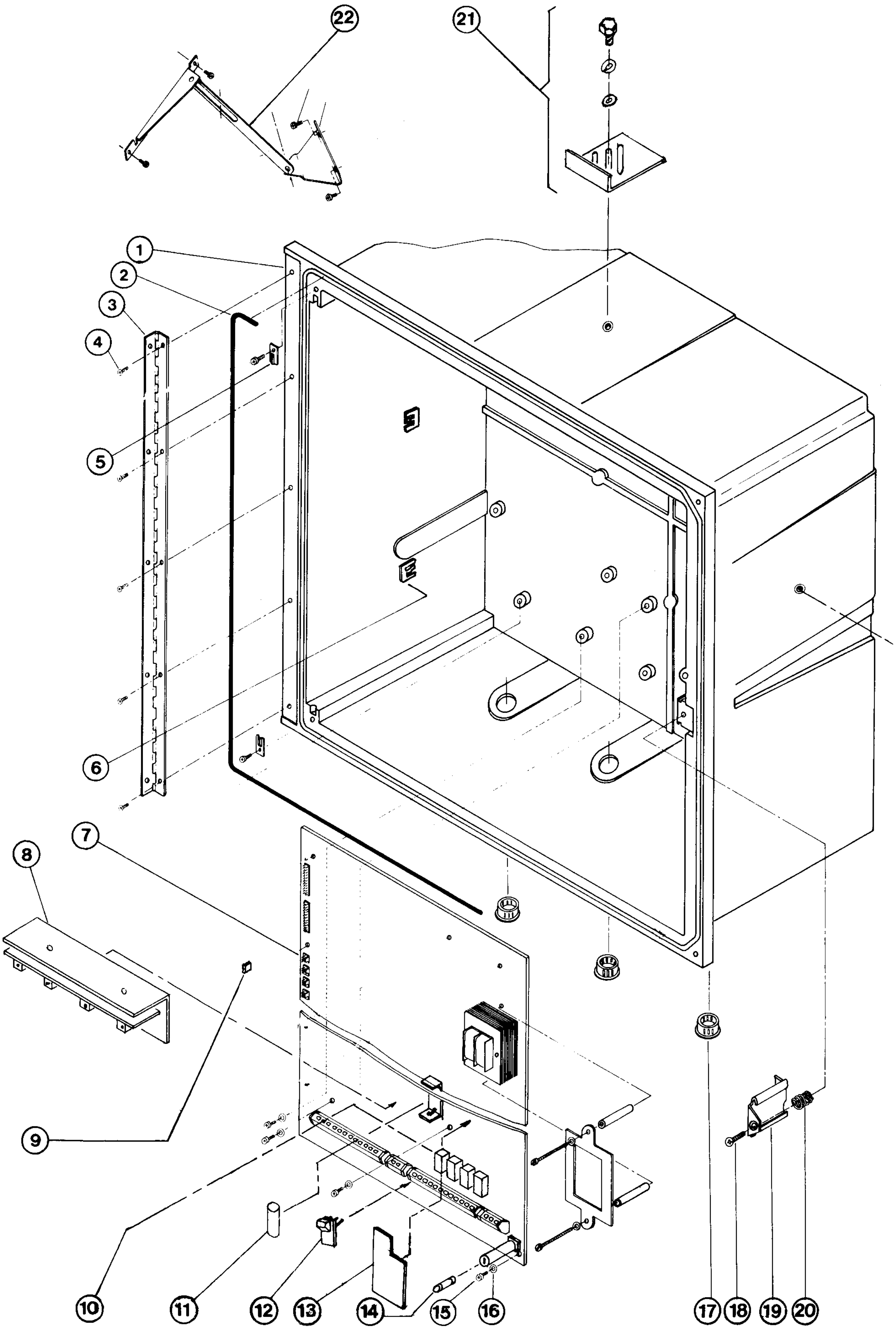


Figure 20. Case Asembly Drawing

PARTS LIST — CASE ASSEMBLY LA203302		
ITEM #	**DESCRIPTION**	**PART #**
1)	CASE WITH INSERTS ONLY	BD203000
2)	CASE SEAL — 5 FEET	BO203007
3)	HINGE (Attaches door to case)	BE203010
4)	SCREW M3×8 CSK, PHILLIPS	FB203014KITO
5)	HINGE PLATE	BA203114KITO
6)	RIBBON CABLE RETENTION CLIP	FE203205KITO
7)	MAIN PCB ASSEMBLY, 1 PEN/CHANNEL MAIN PCB ASSEMBLY, 2, 3, 4, PENS/CHANNELS	AH203009U100 AH203009U400
8)	PNEUMATIC PCB ASSEMBLY (See price sheet for complete P/N)	AH203440U__ __ __
9)	JUMPER, 0.2 INCH FOR PCB BOARD	CI203369KITO
10)	RELAY, 28 VDC, 2 AMP	DB203179
11)	BATTERY, 3.4V, 1/2 AA SIZE	LA234093U100
12)	ATTENUATOR (See price sheet for complete P/N)	AH203447U__ __ __
13)	TRANSMITTER POWER SUPPLY ASSEMLY (See price sheet for complete P/N)	AH203290U__ __ __
14)	FUSE, 250 mA, 5×20 mm, SLOW BLOW FUSE, 500 mA, 5×20 mm, SLOW BLOW	CH050250KITO CH050252KITO
15)	SCREW, M3×6, PHILLIPS	FE203181KITO
16)	WASHER, M3, CRINKLE	FC12307JKITO
17)	BLANKING, PLUG	BD203008KITO
18)	SCREW, M4×10, CSK, PHILLIPS	FB203015KITO
19)	LATCH BRACKET	BA203004
20)	DOOR LATCH PLATE SPRING	BH203189KITO
21)	CASE MOUNTING (See price sheet for complete P/N)	
22)	SLIDE BRACKET ASSEMBLY	LA203260

NOTES

MODEL 390 CIRCULAR CHART RECORDER
CONFIGURATION, OPERATION & MAINTENANCE MANUAL

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