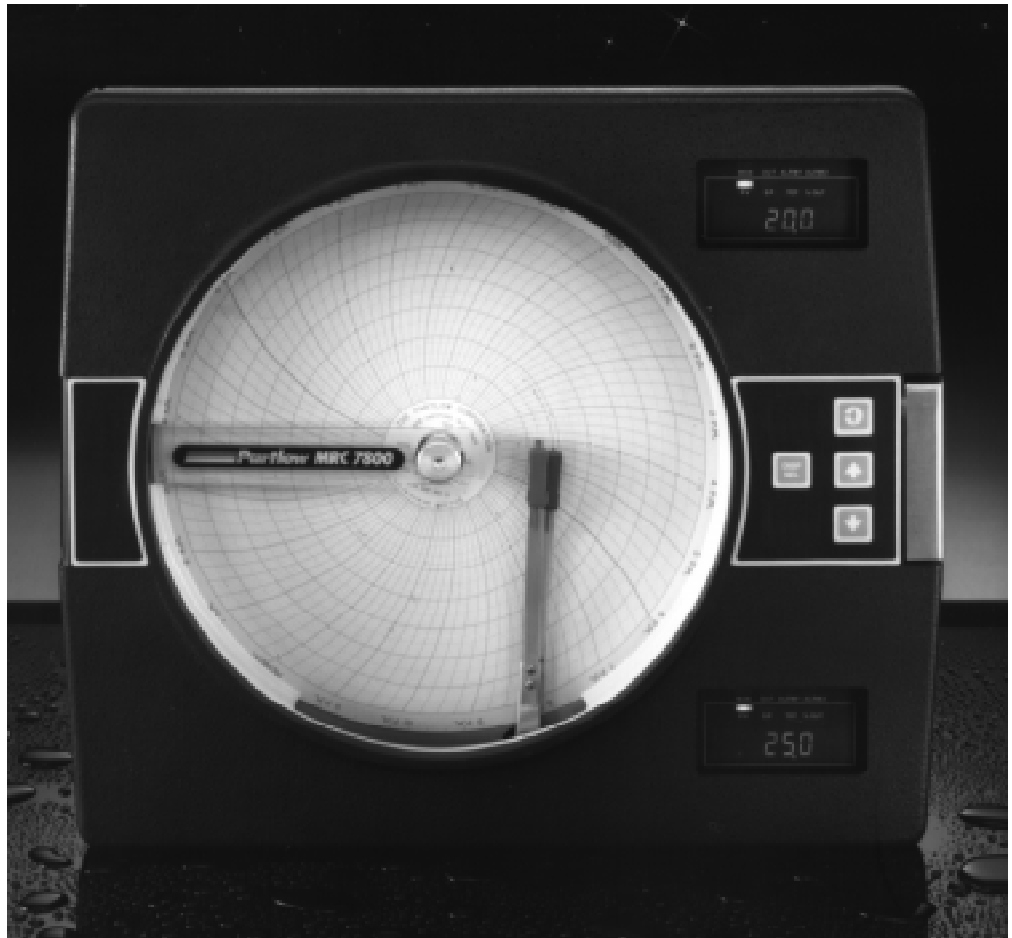


ONE AND TWO PEN CIRCLE CHART FLOW RECORDER

MRC 7800

Installation, Wiring, Operation Manual



The Partlow-West Company • Two Campion Road • New Hartford NY 13413 • 315.797.2222 • Fax: 315.797.0403
QUALITY INSTRUMENTATION DESIGNED & MANUFACTURED IN THE U.S.A.

Information in this installation, wiring, and operation manual is subject to change without notice. One manual is provided with each instrument at the time of shipment. Extra copies are available at the price published on the front cover.

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This is the Seventh Edition of the MRC 7800 Flow Recorder manual. It was written and produced entirely on a desktop-publishing system. Disk versions are available by written request to the Partlow Advertising and Publications Department.

We are glad you decided to open this manual. It is written so that you can take full advantage of the features of your new MRC 7800 Flow Recorder.

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Product Description 1.1

1.1.1 GENERAL

The instrument is a microprocessor based circular chart recorder capable of measuring, displaying, recording, and datalogging flow process variables. Three square root extraction algorithms are available for use with a variety of transmitters and transducers, and four algorithms are available for use with a variety of weirs and flumes.

Recording functions, alarm settings, and other parameters are easily entered via the front keypad. All user data can be protected from unauthorized changes by the Enable mode security system, and is protected against loss from AC power failure by battery back-up.

The process input for each pen is user configurable to directly connect to either mVDC, VDC, or mADC inputs. Changes in input type are easily accomplished in the field. The unit's process input is isolated from the rest of the unit. An isolated 24VDC regulated transmitter power supply can be provided for use with two-wire mADC inputs.

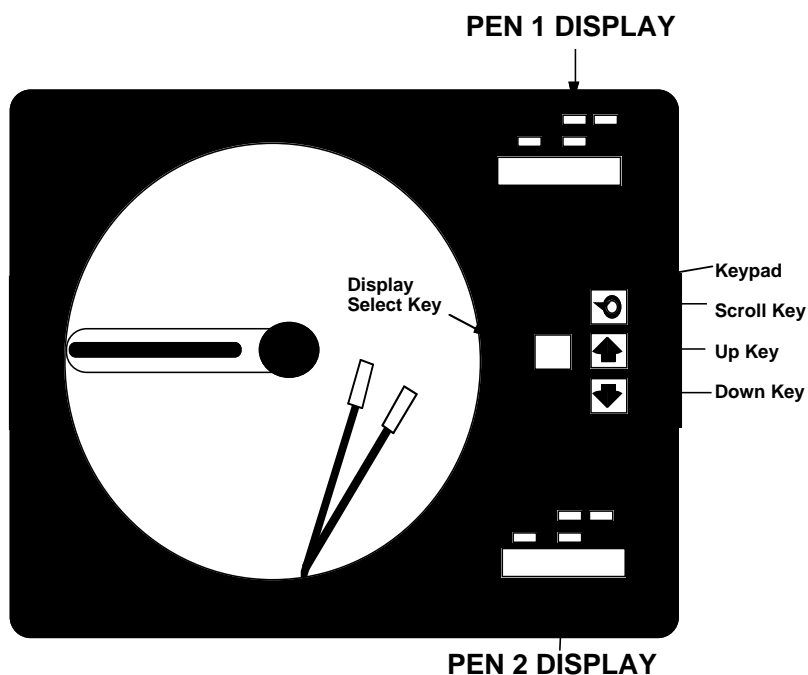
The unit can be ordered for either 115VAC or 230VAC power at 50/60Hz. The 230VAC option includes a switch for changing back and forth between 230VAC and 115VAC. The unit is housed in a plastic enclosure suitable for panel or surface mounting.

1.1.2 RECORDING

The unit incorporates a 10 inch circular chart. One box of standard charts is provided with each unit. Charts are available in a wide selection of ranges. Chart rotation speed is programmable from 0.1 to 999.9 hours per revolution in 0.1 hour increments. The instrument can be provided with one or two pens. Pen 1 is red and Pen 2 is green. Pens are of the disposable fiber-tip type. Changes in pens, as well as charts, are quickly and easily accomplished.

A programmable chart/display filter is provided. This filter provides adjustable dampening of the value displayed and recorded. The filter need not be used. (Configured in program mode as "dFF," Display Filter Factor.)

FIGURE 1-1



1.1.3 DISPLAYS

Each unit is provided with an eight character digital display and status indicators for each pen provided. The display provided in the upper right corner is for Pen 1, and the display in the lower right corner is for Pen 2. Status indication is provided for Alarm 1 and Alarm 2. The display is programmable for none, one, two or three decimal places for process value and total, with additional scaling ability for the total. The second display is also optional on one pen units with totalization for simultaneous display of the process value and total.

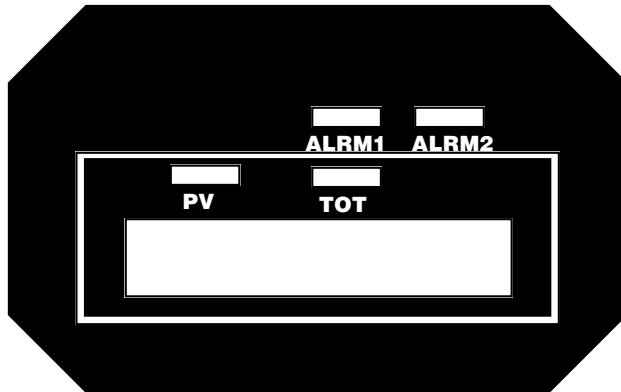
1.1.4 ALARMS

Alarm indication is standard on all units. Alarm settings are fully programmable. Alarm type may be set as Process high or low. Indication is via status LED's provided for each pen. Alarm outputs can be provided by assigning any specified relays (SPST, SPDT or SSR driver) to the respective alarm.

1.1.5 PROCESS VALUE OUTPUT

If a unit is specified with 4 to 20 mADC outputs, these outputs may be programmed to operate as a Process Value Output. As such, the output is scaleable.

FIGURE 1-2



Installation & Wiring 2.1

CAUTION: The Instrument AC power input is as specified in the model number; 115VAC or 230VAC. Verify the AC power input provided with the instrument prior to proceeding with installation.

Read these instructions carefully before proceeding with installation and operation. Electrical code requirements and safety standards should be observed. Installation should be performed by qualified personnel.

Unpacking 2.2

Remove the unit from the carton and inspect it for any damage due to shipment. If any damage is noticed due to transit, report and file a claim with the carrier. Write the model number and serial number of the unit on the inside of the front cover of this Operation Manual for future reference when corresponding with the factory.

Location 2.3

Locate the instrument away from excessive moisture, oil, dust, and vibration. Do not subject the instrument to operating temperatures outside of 0 to 55° C.

Mounting 2.4

Figure 2-1 (page 8) shows installation view and physical dimensions for a panel mounted unit.

The panel that the unit will be mounted in must provide rigid support for the approximately 20 pound unit. Adjacent units may be mounted within a minimum of 2 inches horizontally and 3 inches vertically, providing that proper panel support is supplied.

PANEL MOUNTING HARDWARE REQUIRED: (not provided with instrument)

- (4) 9/32" x 2" bolts w/nuts
- (4) appropriate lockwashers

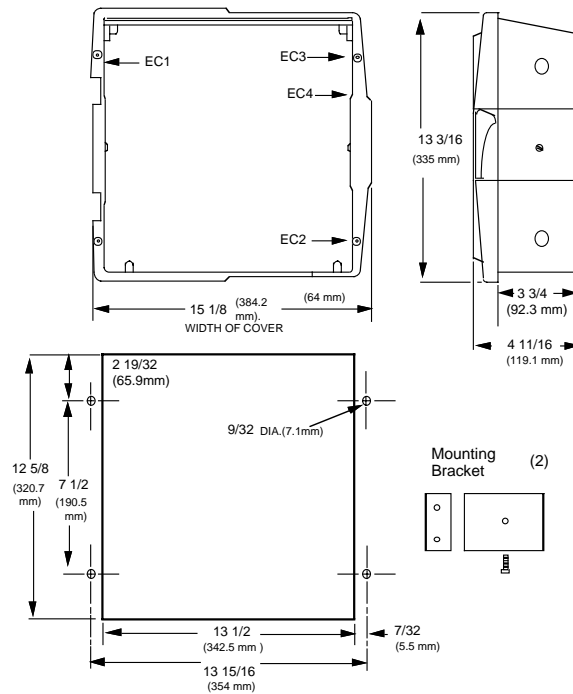
PANEL MOUNTING:

- 1) Cut panel hole to dimensions shown in Figure 2-1 (page 8).
- 2) If the rear of the panel is accessible for wiring after mounting, place the unit in the panel cutout and fasten it to the panel through mounting holes supplied in the case flange.
- 3) If the rear of the panel is not accessible for wiring, proceed with wiring preparation and wiring, then mount the unit.

SURFACE MOUNTING:

- 1) If surface mounting is required, use Kit # 64402001 (ordered separately) Install mounting brackets on sides of case and mount on the mounting surface.

FIGURE 2-1



Preparation for Wiring 2.5

2.5.1 WIRING GUIDELINES

Electrical noise is a phenomenon of the typical industrial environment. The following are guidelines that must be followed to minimize the effect of noise upon any instrumentation.

2.5.1.1 INSTALLATION

Listed below are some of the common sources of electrical noise in the industrial environment:

- * Ignition Transformers
- * Arc Welders
- * Mechanical contact relays
- * Solenoids
- * Motors

Before using any instrument with devices listed previously, the instructions below should be followed:

1. If the unit is to be mounted in the same panel as any of the listed devices, separate them by the largest distance possible. For maximum electrical noise reduction, the noise generating devices should be mounted in a separate enclosure.
2. If possible, eliminate mechanical contact relays and replace them with solid state relays. If a mechanical relay being powered by the unit's output device cannot be replaced, you may wish to use a solid state relay to isolate the instrument from this source of noise.
3. A separate isolation transformer which feeds only instrumentation should be considered. If available, it can isolate many noise sources from the AC power input of the unit.
4. If the unit is being installed in an existing installation, a review of the wiring in the existing area should be done.

2.5.1.2 AC POWER WIRING

Earth Ground

Each unit includes noise suppression components attached to the chassis that require an earth ground connection. To verify that it is earth ground being attached, make a resistance check from instrument chassis to the nearest metal water pipe or proven earth ground. This reading should not exceed 100 ohms.

Neutral (For 115 VAC)

It is good practice to assure that the AC neutral is at or near ground potential. To verify this, a voltmeter check between neutral and ground should be done. On the AC range, the reading should not be more than 50 millivolts. If it is greater than this amount, the secondary of this AC transformer supplying the instrument should be checked by an electrician. A proper neutral will help ensure maximum performance from the instrument.

2.5.1.3 WIRE ISOLATION

The instrument is designed to promote proper separation of the wiring groups that connect to the instrument. The AC power wire terminals are located near the top of the instrument boards. The analog signal terminals are located near the bottom of the instrument boards. Maintain this separation of the wires to insure the best protection from electrical noise. If the wires need to be run parallel with any of the other lines, maintain a minimum 6 inch space between the wires. If wires must cross each other, do so at 90 degrees. This will minimize the contact with each other and reduces "cross talk". "Cross talk" is due to the EMF (Electro Magnetic Flux) emitted by a wire as current passes through it. This EMF can be picked up by other wires running in the same bundle or conduit.

2.5.1.4 USE OF SHIELDED CABLE

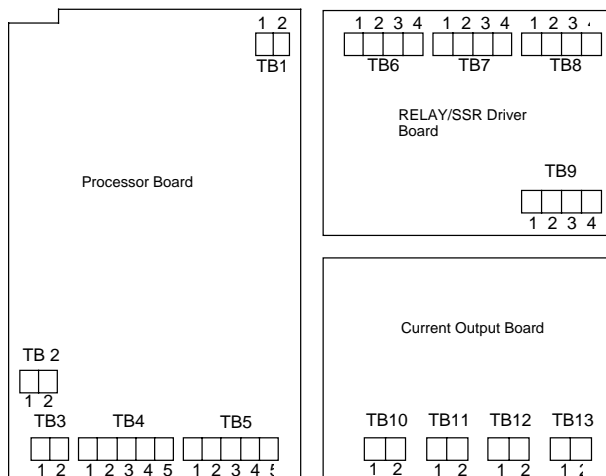
Shielded cable helps eliminate pickup of noise the wires may be exposed to. Shielded cable is a single or multi-pair of insulated wires with each wire or pair of wires surrounded by a wire mesh or conductive foil and then covered with plastic insulation.

It is recommended that all analog signals be run with shielded cable. Connection lead length should be kept as short as possible, thus keeping wires protected by the shielding. The shield should be grounded at one end only, at the transmitter or transducer and the shield should be stripped back before going inside the unit case .

Wiring Connections 2.6

All wiring connections are typically made to the unit with it installed. Connections should be made at the terminal blocks, two 12 gauge wires maximum, using copper conductors only. Terminal blocks are designated TB1 thru TB13. See Figure 2-2 for the terminal block locations.

FIGURE 2-2



2.6.1 ELECTRICAL CONDUIT OPENINGS

The instrument case will have 3 or 4 conduit openings, depending upon the number of outputs specified. To help minimize electrical noise that may adversely affect the operation of the instrument, the wires indicated below should be routed through the conduit opening specified. See Figure 2-1 (page 8) for conduit opening locations.

- EC1 - AC power
- EC2 - Analog input and mAdc outputs
- EC3 - SPST, SPDT relay or SSR driver outputs
- EC4 - SPST, SPDT relay or SSR driver outputs
(provided when > 4 relays & SSR's are specified)

Unused conduit openings should be sealed if exposed to the environment.

2.6.2 AC POWER WIRING CONNECTIONS

WARNING: To avoid electrical shock AC power wiring must not be connected at the source distribution panel until all wiring connections are completed.

FIGURE 2-3

AC Instrument Power Input

Connect the 115 VAC hot and neutral to terminals 1 and 2 respectively of TB1. See Figure 2-2 (page 9) for Terminal Board locations on the instrument. Connect the 230 VAC one leg to each terminal, be sure to check the position of the Voltage Selector switch provided with 230 VAC instruments. The switch position must match the voltage input to the instrument.

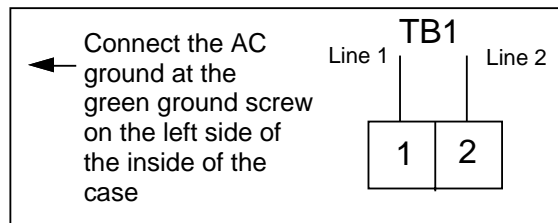


FIGURE 2-4

Volt, Millivolt and milliamp Input

Make the volt, millivolt or milliamp connections as shown below. Use TB4 for Pen 1 and TB5 for Pen 2. Terminal 1 is positive and terminal 2 is negative. Be sure that input conditioning jumpers are in the correct positions for the input being connected. See Appendix A-1 (page 46).

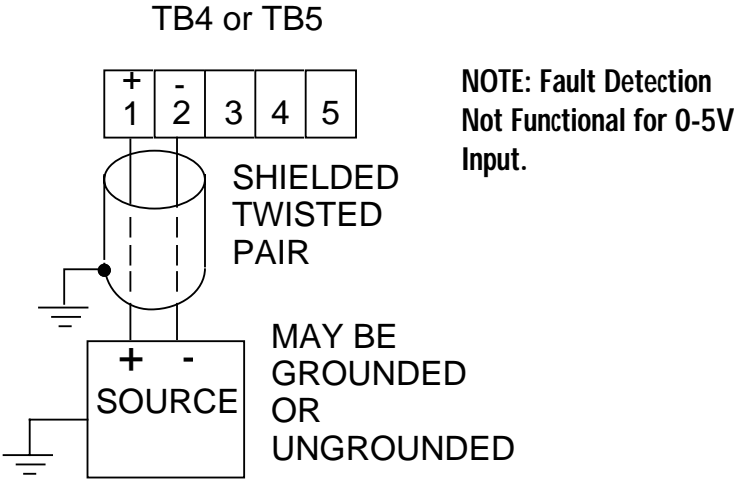


FIGURE 2-5

Transmitter Power Supply

If the isolated 24 VDC regulated transmitter power supply has been specified, the connections should be made as shown. Connections are made using TB3, terminal 1 is positive and terminal 2 is negative. The power supply is capable of providing the power needed by up to 2 transmitters.

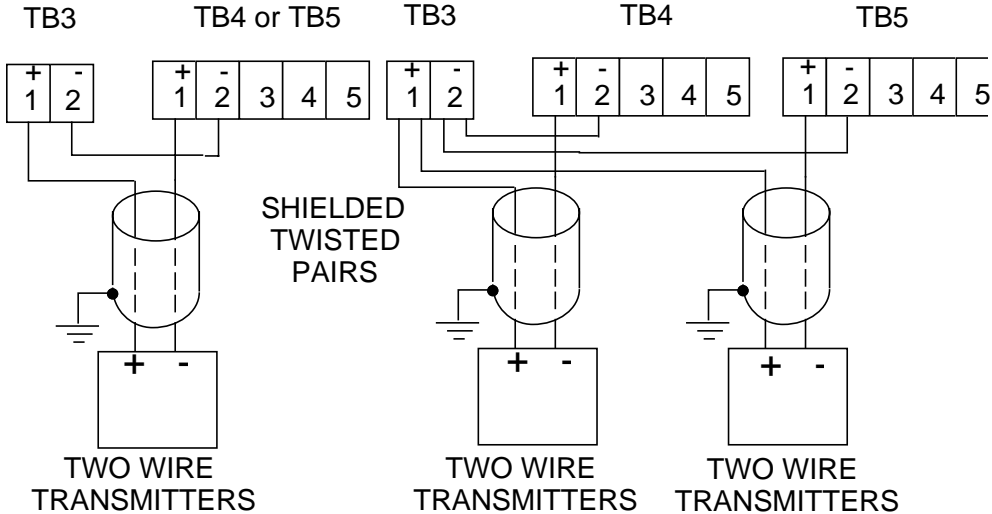
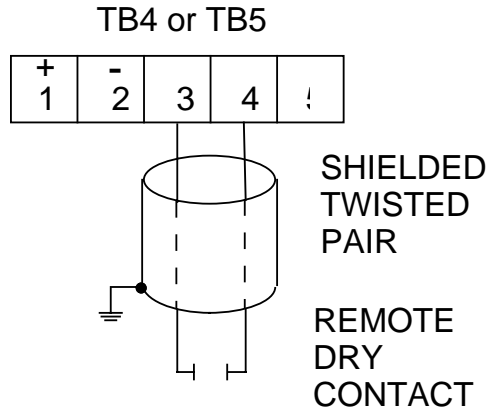


FIGURE 2-6

Remote Reset Input

Make connections as shown. Use TB4 for Pen 1 and TB5 for Pen 2. Terminal 3 is ground and terminal 4 is the input.



2.6.3 OUTPUT CONNECTIONS

Relay outputs, if provided in the instrument, may be assigned to alarm, preset, or pulsed output functions for Pen 1 and/or Pen 2 (if present). Current outputs may be assigned to process value retransmission output for Pen 1 and/or Pen 2 (if present). The assignment of the output function is accomplished in the Program mode, see Section 4.5.3 (page 22). SPST relay and/or SSR driver output(s) is/are designated as Relay A through Relay H. SPST relays begin with Relay A designation, then B, C, etc. SSR drivers begin with Relay H designation, then G, F, etc.

FIGURE 2-7A

Relay Output (SPST)

Connections are made to relays A through F as shown. Terminal connections are made using TB6 (Relay/SSR Driver A, B), TB7 (Relay/SSR Driver C,D), and TB8 (Relay/SSR Driver E, F).

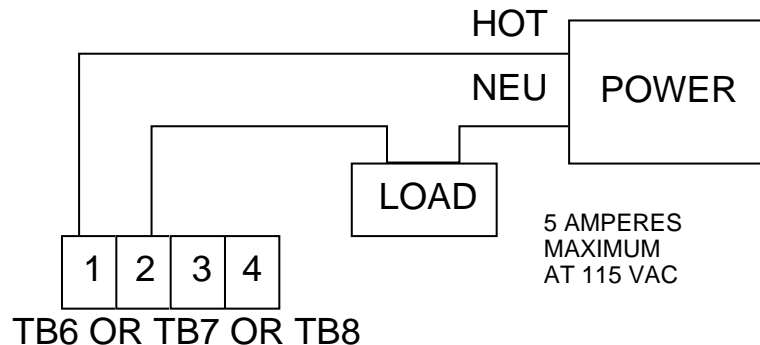


FIGURE 2-7B
Relay Output (SPDT)

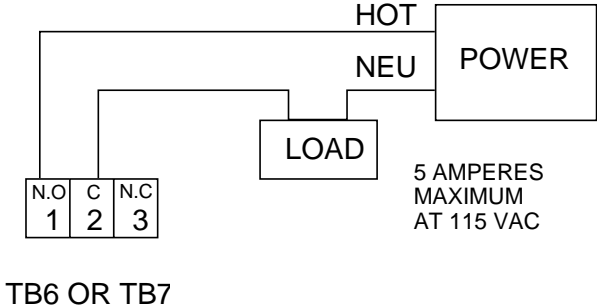


FIGURE 2-8
SSR Driver Output
Connections are made to relays H through A as shown. Terminal connections are made using TB9, TB8, etc. depending on the number of SSR Driver outputs specified.

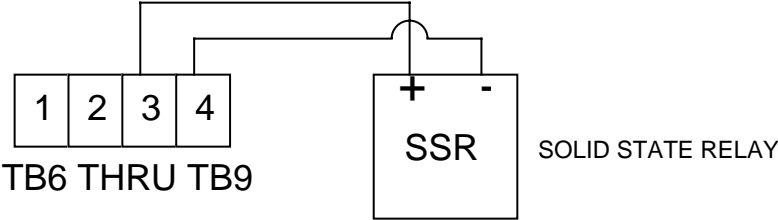
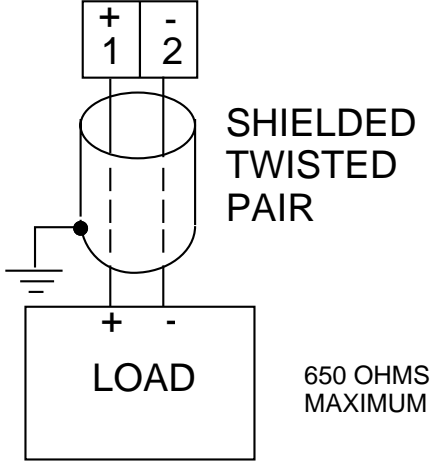


FIGURE 2-9
Current Output
Connections are made to standard current outputs A through D as shown. Each current output is programmable as either 4 to 20mADC or 0 to 20mADC. Each output must be assigned to the desired function (refer to Table 4-2, page 26, for details). Terminal connections are made using TB10 through TB13 for current output A through D respectively. Connect positive lead (+) to terminal 1 and the negative lead (-) to terminal 2. Current outputs will operate up to 650 ohms maximum load.



How The Instrument Operates 3.1

3.1.1 OFF MODE

In the Off mode, the instrument alarm and preset function(s) is/are turned off, pulsed output(s) are inactive and process retransmission signal(s) remain(s) active. The chart rotation can be selected in the Program mode to stop or continue to rotate when the instrument is in the Off mode. The pen remains active. The totalization function is inactive, but datalogging functions continue.

The Off mode is entered by pressing and releasing the SCROLL key until the display reads **oFF**, then pressing the DOWN key. If the instrument was displaying process value, the display will read **oFF**, then the current process variable at two second intervals. If the instrument was displaying total, the display will read **oFF**, then the total at two second intervals. Entering the Off mode of a dual pen instrument will cause both pens to enter the Off mode. The second pen display will be blank as the upper display reads **oFF** and displays the value for the second pen at the same time as the upper display.

To exit the Off mode, depress the SCROLL key to proceed to any other mode, pressing the DOWN key to enter that mode.

3.1.2 OPERATE MODE

In the Operate mode, the instrument alarm function(s), the preset function(s), the pulsed output(s) and the process retransmission signal(s) are actively responding to the process variable as selected in the Program, Alarm Set and Preset modes and the chart will be rotating at the rate selected. The totalization function is active, as is the datalogging function.

3.1.2.1 TOTALIZATION

Totalization can be implemented on instruments provided with the totalization feature. Totalization can be programmed on or off for each pen.

To initiate totalization, depress the SCROLL key until **oPEr** is displayed, then depress the DOWN key.

To view the total, depress the DISPLAY SELECT key once with the PV value displayed. The TOT light should be lit and the total for Pen 1 in the upper display and the total for Pen 2 in the lower display.

Instruments with Totalization and second display will have the total displayed in the lower display whenever the upper display is set to PV.

On two pen units only, a Combined Total is available. When activated in the Program mode an additional step is added to the display choice sequence provided by the Display Select Key.

If the totals are displayed and the DISPLAY SELECT key is depressed, the Combined Flow Rate will appear in the top display with a **C** in the leftmost digit and the Combined Total will appear in the bottom display. The PV and TOT indicators will be lit, respectively.

Note: When Combined Total is being used, it is required that the decimal position, dPoS, and totalizer decimal position, tdP, in the Program mode, for both pens are the same. When the totalizer for Pen 1 is reset, the combined total is also reset.

Upon sensor break, the Combined Total will increment at a indeterminate rate.

3.1.2.2 PULSED OUTPUTS

Pulsed output(s), one for each pen, can be implemented on instruments provided with the totalization feature and a relay that is not assigned to any other function.

Pulsed output is selected in the Program mode. With a pulsed output select (PoS) equal to 1, each time the Totalizer Display is incremented, the relay that is assigned, in the Program mode, as a pulsed output will close for a duration of 50 milliseconds or 60 milliseconds based on a 60 Hz or 50 Hz line frequency, respectively.

On two pen instruments, a Combined Pulse Output is available. This feature provides a pulsed output as the Combined Total increases.

Note: Upon sensor break, the Combined Pulse Output will increment at a indeterminate rate.

3.1.2.3 PROCESS VALUE RETRANSMISSION

Process value retransmission can be implemented on instruments provided with at least one 4 to 20mA output.

Process value retransmission is selected in the Program mode. When selected, a current output must be assigned and the process output must be scaled.

On two pen instruments, a Combined Flow Rate is available. When selected in the Program mode, this feature provides a process value retransmission value equal to the combined flow rate. The value is scaled using Pen 1 process output upper and lower parameters.

3.1.2.4 DATA LOGGING

Data logging can be implemented on instruments provided with the data logging feature, and it will store data for up to 28 days.

Each day, at the time specified by **ttLd** (time to log data), the following data will be logged: date, minimum rate, its time, maximum rate, its time, daily total, and average rate. The daily total is derived by subtracting "yesterday's total" from the current total. The average rate is derived from the daily total, taking into account the flow time base. After the data is logged, "yesterday's total" will be set to the current total, and the minimum and maximum rates and times are set to the current rate and time.

Logged data is accessed via a day number, with 1 through 7 corresponding to the current week. At the beginning of each week (00:01 on day 1 - each Monday) the data is shifted down one week, with the oldest weeks worth of data being discarded. All data for the current week is zeroed, including the date for each day.

3.1.2.5 ENGINEERING UNITS PROCESSING ALGORITHM

In the Program mode, the parameter **EuPA**, Engineering Units Processing Algorithm specifies how the engineering unit inputs are handled. This allows selection of the various algorithms to convert the raw input in to the desired process value.

LINEAR CONVERSION - **EuPA** = 0

For those sensors/transmitters that provide an output directly proportional to flow, or other applications where the instrument may be used with a linear input to output transformation.

SQUARE ROOT EXTRACTION - **EuPA** = 1

The square root extraction function applies to rate of flow measurements using differential pressure sensors. Differential pressure transmitters typically generate a 4-20mADC signal that represents differential pressure, not flow. The flow is a function of the square root of the differential pressure.

2 STAGE SQUARE ROOT EXTRACTION - **EuPA** = 2

This approach is used to minimize the process value below a 4% input, since it is less meaningful due to inaccuracy and repeatability problems. Below 4% a linear function is applied.

(Continued on next page)

3 STAGE SQUARE ROOT EXTRACTION - EuPA = 3

This approach is used to further minimize the process value below a 1% input, since it is even less meaningful. Below 1% a low gain linear function is applied. Between 1% and 2.5% a higher gain linear function is applied. Above 2.5% the square root function applies, as the sensor begins to provide a reasonably accurate and repeatable output. Refer to the glossary (page 53).

VARIABLE EXPONENT - EuPA = 4

Open channel flow is used in wastewater and other applications. For rectangular weirs, the flow is proportional to the height/head to the 3/2 power. For triangular (or V notch) weirs, the flow is proportional to the height/head to the 5/2 power. For Parshall flumes, the flow is proportional to the height/head to approximately the 3/2 power. See Table 3-1. When variable exponent is selected in the Program mode, Engineering Units Exponent, **EuE**, must be set for the correct exponent value.

TABLE 3-1

The exponent for a number of common Parshall flumes are as follows:

- 1 - inch = 1.55
- 2 - inch = 1.55
- 3 - inch = 1.547
- 6 - inch = 1.58
- 9 - inch = 1.53
- 1 to 8 ft = 1.522w raised to the .023 power
- 10 to 50 ft = 1.6

w = throat width in feet

PIECEWISE LINEAR - EuPA = 5

For some applications, the relationship between the input and process value cannot be specified by one of the available algorithms. For these instances, the relationship can be approximated by a straight line relationship over portions of the span. Provided enough pieces, this method will provide the required accuracy. When piecewise linear is selected, the second set of Engineering Units parameters, **EuU2** and **EuL2** must be used to specify the span of the input, and then **Iu1, Iu2....Iu20** and **Pu1, Pu2.....Pu20** are the input and process values for the respective points, in engineering units.

VARIABLE EXPONENT WITH CORRECTION - EuPA = 6

For some applications, the relationship between the input and process value can be basically characterized as exponential, but not to within the accuracy desired. Use of the Piecewise Linear algorithm may require a large number of points to provide the desired accuracy. By using the piecewise linear method to provide a correction to the simple exponential, a high degree of accuracy can be achieved. This is especially applicable to open channel flow using Palmer-Bowlus flumes or H flumes. Consult factory for assistance, if needed, when using variable exponent with correction.

SATURATED STEAM FLOW WITH PRESSURE CORRECTION - EuPA = 7

Only available with a 2 Pen unit. For saturated steam flow, accurate flow measurement is dependent on pressure correction. By using the second pen to input and record pressure, the pressure data is available to correct the flow value. The input is typically gauge pressure, which is converted to absolute pressure by the instrument. Since the pressure may be in the 60 PSIG range, barometric pressure or elevation can induce an error. Therefore, the barometric pressure, **bAro**, needs to be set in the Alarm Set mode. If the input is absolute pressure, **bAro** must be set to zero.

3.1.2.6. TOTALIZER FACTOR

Scaling of the displayed total is possible, with the use of totalizer factor, **tFAC**. When used, the displayed value is multiplied by a factor to obtain the actual total. See Table 3-2.

TABLE 3-2

tFAC = 0	Actual Total = Displayed Total Times 1
tFAC = -1	Actual Total = Displayed Total Times 10
tFAC = -2	Actual Total = Displayed Total Times 100
tFAC = -3	Actual Total = Displayed Total Times 1000
tFAC = -4	Actual Total = Displayed Total Times 10000
tFAC = 1	Actual Total = Displayed Total Times 0.1
tFAC = 2	Actual Total = Displayed Total Times 0.01
tFAC = 3	Actual Total = Displayed Total Times 0.001

Example

An application is measuring flow at a maximum rate of 6000 gallons per minute (6000 gpm). The steady flow rate is 2000 gallons per minute (2000 pgm). Table 3-3 shows how, with various settings in the Program mode, the process variable displayed and the total displayed can be configured.

TABLE 3-3

6000 gpm, flow rate 2000 gpm

dPoS	Euu	EuL	PV	tdP	tFAC	Ftb	Total displayed at t = 1 min
0	6000	0	2000	0	0	2	XXXX2000
0	6000	0	2000	0	-1	2	XXXXX200
0	6000	0	2000	0	-3	2	XXXXXXXX2

6000 gpm, flow rate 2000 pgm, PV in gps

dPoS	Euu	EuL	PV	tdP	tFAC	Ftb	Total displayed at t = 1 min
0	100	0	33	0	0	1	XXXX1980
0	100	0	33	0	-1	1	XXXXX198
0	100	0	33	0	-3	1	XXXXXXXX1

6000 gpm, flow rate 2000 gpm, PV in gpm

dPoS	Euu	EuL	PV	tdP	tFAC	Ftb	Total displayed at t = 1 min
0	6000	0	2000	1	0	2	XXX2000.0
0	6000	0	2000	1	-3	2	XXXXXX2.0

6000 gpm, flow rate 2000 pgm, PV in gps

dPoS	Euu	EuL	PV	tdP	tFAC	Ftb	Total displayed at t = 1 min
0	100	0	33	1	1	1	XXX1980.0
0	100	0	33	1	-3	1	XXXXXX1.9

6000 gpm, flow rate 2000 gpm, PV in mgd

dPoS	Euu	EuL	PV	tdP	tFAC	Ftb	Total displayed at t = 1 min
3	8.640	0.000	0.002	0	0	4	XXXXXXXX0
3	8.640	0.000	0.002	0	3	4	XXXXXXXX2
3	8.640	0.000	0.002	2	3	4	XXXXX2.00

Configuration Introduction 4.1

After completing installation of the unit, the configuration procedures contained within this section must be performed to prepare the unit for operation on the intended application. The procedures include selecting specific parameters, entering data and possible jumper positioning.

Parameter selections and data entry are made via the front keypad. To ease configuration and operation, user entered data has been divided up into several modes. Each mode contains a different type of data or may be used for specific operating functions. For two pen instruments, each mode is common to both pens. These modes are as follows:

Mode	Display Code	Function	Description
Off	oFF	Operation	Alarm Outputs off, Totalization off
Operation	oPEr	Operation	Operation
Program	Prog	Configuration	Configure operating parameters
Alarm Set	ASet	Configuration	Set alarm settings
Data logger Setup	dLS	Configuration	Adjust/set real time and log time
Data logger Display	dLd	Operation	View logged data
Preset Adjust	PSA	Operation	Adjusts, sets preset values
Test	tESt	Service	Perform unit tests
Calibration	CAL	Service	Perform unit calibration
Enable	Enab	Configuration	Lockout or enable access to any mode

Associated with each mode is a series of unique displays which are accessed via the front keypad.

Prior to first time operation of the unit, the configuration procedures for the Program, Preset Adjust, Data logger Setup, and Alarm Set modes must be performed as applicable.

Calibration and Test modes are not used as part of the unit configuration or operation. These are used for service and maintenance functions and are discussed in detail in Section 5.6 of this manual (page 40).

Shipped Configuration/Jumper

Positioning 4.2

Each instrument is factory shipped ready to accept a 4-20 mA process input on each specified pen. All configuration parameters in each mode are set to default values. These defaults are shown in tabular form under the description for each mode. Instrument AC power input is as specified in the instrument model number and as shown on the ratings label. The 230VAC option includes a switch for changing between 230VAC and 115VAC. If this feature is provided, verify AC input and switch position before applying power to the instrument.

4.2.1 JUMPER POSITIONING

Jumpers are used in all units to provide a security lockout feature and to condition the process input for each pen. All jumpers are typically of the three pin type and have two functions. All jumpers are located on the instrument's Processor board. A board layout and jumper locations are shown in Appendix A-1 (page 46). Check the actual jumper position in the unit to be configured and verify the proper position for the intended application. If the current position is not correct, make changes.

The process input jumpers JU4 and JU5 condition the hardware at a basic level. Detailed input type selection is made in the Program mode configuration (page 26).

Operation Summary 4.3

The configuration and operating modes, the method of moving from one mode to another, and the basic parameter functions are described in each individual section. Data and parameter entry is made by stepping through each mode and making an appropriate response or entry to each step.

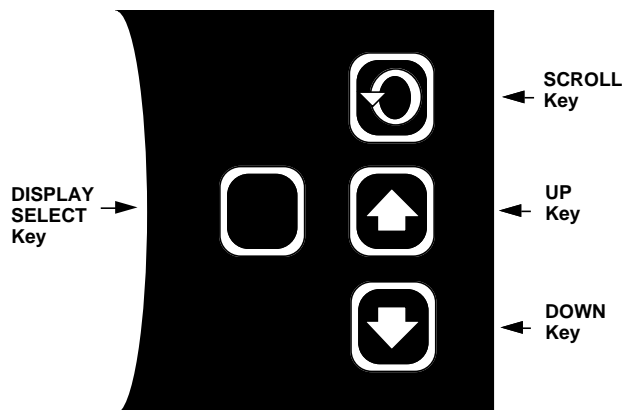
4.3.1 KEYPAD OPERATION

Refer to Figure 4-1 for the Keypad features. Use the SCROLL, UP and DOWN keys as indicated to program and operate the instrument.

4.3.1.1 UP/DOWN CHANGE RATE

The Up and Down keys are used to adjust numerical values up or down respectively. The rate at which a given value will change is dependent upon the length of time the key is kept depressed, initially slow then increasingly faster.

FIGURE 4-1



4.3.2 CONFIGURATION DISPLAYS

Each pen specified is provided with its own 4 digit LED display (8 digits for totalization option). These are used during configuration to display the parameter codes and values. The display located in the upper right hand corner of the instrument is used to show the codes for Pen 1 and those that are common between Pens 1 and 2. The display in the lower right hand corner is used to show the configuration codes for Pen 2 (if provided).

During normal operation, the display(s) are used to indicate process value(s) as selected in the Program mode.

4.3.3 MODE SELECTION

If the instrument is either in the Off mode or the Operation mode, repeated pressing and releasing of the SCROLL key will cause the instrument to display the code corresponding to each mode that is enabled. To enter a mode, while the code is displayed, press the DOWN key.

Entry into any mode, except the Operation and Enable modes, will cause the alarm(s) to turn off and any process re-transmission value output(s) to be 0%.

Start Up Procedure 4.4

All configuration parameters are listed in Tables 4-1 through 4-3 (pages 25-30)

For a single pen instrument, parameters for each mode are displayed in the upper right display. If the instrument being configured is a two pen, a sequence of applicable parameters will be displayed in the Pen 2 display after Pen 1 parameters have been reviewed and configured. After the Pen 2 parameters have been completed, parameters common to both pens will be configured and displayed in the Pen 1 display.

The instrument is provided with a time out feature. If the instrument is in any mode and no keypad activity takes place for 30 seconds, the instrument will time out and exit the mode automatically. The display will be the code for the respective mode. If a mode code is displayed for 5 seconds with no keypad activity, then the time out will cause the instrument to proceed to either the Operation or Off mode, depending upon which operational state was in use before entrance into the mode.

4.4.1 POWER UP PROCEDURE

Step 1

Verify that all electrical connections have been properly made before applying power to the unit.

Step 2A - For instruments with software revision R2.99 and below

Upon power up, **7XXX** will be displayed (X representing digits), then **XXXX**, then **XXXX**, identifying the twelve digit model number as defined in the order matrix. Next, the EPROM part number will be indicated **P-XX**. After the EPROM part number, the software revision level will be displayed in the format **rX.XX** then **tSt1**, **tSt2**, and **tSt3** will be displayed while Test 1 through 3 are executed automatically. Upon successful completion of these test, **oPEr** or **oFF** will be displayed for about 3 seconds. The mode displayed will be the mode the instrument was in when the power was turned off. During this time, the operator may select another mode (Alarm Set, Enable) or non-operational mode (Test, Program, Cal).

Step 2B - For instruments with software revision r3.00 and above

Upon power up, a brief flash on all displays (upper and, if equipped, lower) will occur to show the instrument is "alive". Then **7XXX** will be displayed (X representing digits) then **XXXX**, then **XXXX**, identifying the twelve digit model number as defined in the order matrix. Next, the EPROM part number will be indicated **P-XX**. After the EPROM part number, the software revision level will be displayed in the format **rX.XX** followed by **P.dn** (if **Pen Action on Power Up**, **PAPU**, in Program Mode is set to **0**, pens go to "home" position at power up). During this display, the decimal point after the "P" will blink to show the mode is active. Upon successful completion of this routine, **oPEr** or **oFF** will be displayed for about 3 seconds. The mode displayed will be mode that the instrument was in when the power was turned off. During this time the operator may select another mode (Alarm Set, Enable) or non-operational mode (Test, Program, Cal).

Step 3

If any error messages are displayed, refer to Section 5.6 (page 40) for a definition of these error messages and the required action.

Configuration 4.5

4.5.1 DIGITAL DISPLAY AND STATUS LED'S

The digital display provided for each pen has 4 digits (8 digits for totalization option) and a decimal point. Each digit has seven segments and is capable of producing numeric characters from 0-9 and certain alpha characters. The digital display is used to provide indication of process variable as well as displaying codes used for configuration and operation of the instrument. The following status indicators are also provided:

ALRM1	Red	Lights when Alarm 1 is on
ALRM2	Red	Lights when Alarm 2 is on
PV	Red	Lights to indicate that the Process Value is being displayed
TOT	Red	Lights to indicate that the Total is being displayed

Refer to Figure 1-2 (page 6) for the display features.

4.5.2 KEYPAD CONTROLS

The keys provided on the keypad and their functions include:

SCROLL: Used to:	<ol style="list-style-type: none"> 1. Advance the display through the enabled modes. 2. While in a mode, used to sequence the parameter codes and values 3. Exit some Test and Calibration functions. 4. Work in conjunction with other keys.
UP: Used to:	<ol style="list-style-type: none"> 1. Exit a mode. 2. Turn a mode On in the Enable mode. 3. Increase a numerical value. 4. Work in conjunction with other keys.
DOWN: Used to:	<ol style="list-style-type: none"> 1. Enter a mode. 2. Turn a mode Off in the Enable mode. 3. Decrease a numerical value. 4. Work in conjunction with other keys.

- DISPLAY SELECT: Used to:
1. For units specified with totalization, to change the value displayed between Process Value (PV) Total (TOT), Combined Flow/Total, and Alternate Process Value.
 2. For units not specified with totalization, this key has no function.
 3. DISP/SEL and UP will reset 1st pen total. DISP/SEL and DOWN will reset 2nd pen total. They must be kept depressed for 5 seconds.

Lamp test

All display and status LED's can be illuminated simultaneously by depressing the UP and DOWN keys at the same time. Any defective LED's will not light.

***CHANGE CHART (also see Changing Charts, Section 5.2)**

If the UP and DOWN keys are held depressed for more than 2 seconds but less than 4 seconds, the display will show **Cchg** momentarily. The pen(s) will move to and remain at a point above the top graduation on the chart and the chart will stop rotation to allow the chart to be changed. The pens will remain fully upscale with the chart OFF; otherwise, the unit will continue to operate normally in the current mode. To restore pen(s) position and chart rotation, press the UP and DOWN keys for more than 2 seconds but less than 4 seconds.

PEN RESYNCHRONIZATION

To resynchronize the pen(s), depress the UP and DOWN keys for 4 seconds, the display will show **P dn** momentarily, the pen(s) are driven to the "Pen Home" position below the bottom graduation on the chart while the unit resynchronizes their position. After about 14 seconds, the pen(s) will return to their correct position. All other functions of the unit's present mode continue to operate normally.

4.5.2.1 ENTERING THE ENABLE MODE

The Enable mode is entered by pressing and holding the UP and DOWN keys simultaneously while in the Operate or Off modes. Holding the two keys depressed for 10 seconds will cause the display to show the **EnAb** prompt which is the entry point into the Enable mode.

A hardware jumper located on the Processor Board (Appendix A-1, page 46) can be used to lock/unlock the Enable mode. When the jumper is moved to the locked position, entry into the Enable mode is not possible until the jumper is moved to the unlock position.

4.5.3 PROGRAM MODE CONFIGURATION PROCEDURE

The Program mode provides a means to configure or reconfigure the unit operation within the limits of the hardware specified and provided. Only those parameters that are applicable, as determined by the hardware provided, will appear.

Review the entry procedure in 4.4.1 and the configuration procedures in Table 4-2 (page 26). Use the "Your Setting" column in the table to record your programming.

4.5.3.1 ENTERING THE PROGRAM MODE

From the Operate or Off mode, or with any other mode code displayed, depress the SCROLL key until **Prog** is displayed. This is the mode code for the Program mode. With **Prog** in the top display depress the DOWN key to enter the Program mode. If the **Prog** code does not appear, then the mode has been disabled. Refer to Table 4-1 (page 25) for Enable mode instructions.

Upon entering the Program mode, **PEn1** will be displayed. The Program mode is broken into three parts. The parameters that are associated solely with Pen 1 will be displayed in the upper display. The parameters associated with Pen 2, will be displayed in the lower display. The parameters that are common to both pens, such as chart rotation speed, will be displayed in the upper display. Access to the Pen 1, Pen 2, or Unit (common) parameters may be quickly obtained by depressing the SCROLL key, if necessary, until the desired code, **PEn1**, **PEn2**, or **unit** is displayed and then depressing the DOWN key. Once into the parameters, the three parts automatically follow one another.

4.5.3.2 MOVEMENT IN THE PROGRAM MODE

Each time the DOWN key is depressed while a parameter code is being displayed, such as **inPS**, another parameter code will be displayed.

Depressing the SCROLL key while a parameter code is displayed will cause the parameter value to appear. Depressing the SCROLL key with a parameter value displayed will cause the next parameter code to appear.

Depressing the UP key while a parameter code is being displayed will exit the Program mode and **Prog** will appear in the display. Use the DOWN key to re-enter the mode, or the SCROLL key to proceed to another mode.

4.5.3.3 ONE PEN INSTRUMENTS

For instruments specified and provided with only one pen, all configuration and operating parameters and values will appear in the upper display, which is dedicated to Pen 1 and Unit parameters. This is the only display provided. **Pen2** will not appear.

4.5.3.4 TWO PEN INSTRUMENTS

Instruments specified and provided with two pens require configuration of each pen.

4.5.3.5 PROGRAM MODE CONFIGURATION

Refer to Table 4-2 (page 26) for configuration procedures for the Program mode. All possible parameters are shown for illustration purposes. Only those parameters applicable to each respective pen and the unit will actually be shown.

4.5.4 ALARM SET MODE CONFIGURATION PROCEDURE

The Alarm Set mode allows the entry, review or altering of any of the alarm settings. Parameters to be configured will be only those that are applicable as determined by the hardware provided or as assigned in the Program mode.

Review the entry procedure and the configuration procedures in Table 4-3 (page 30). Use the "Your Setting" column in the table to record your programming.

4.5.4.1 ENTERING THE ALARM SET MODE

From the Operation or any other mode code, depress the SCROLL key until **ASeT** is displayed. With **ASeT** in the top display depress the DOWN key to enter the mode. If **ASeT** does not appear, then the mode has been disabled. Refer to Table 4-1 (page 25) for Enable mode instructions.

4.5.4.2 MOVEMENT IN THE ALARM SET MODE

Each time the DOWN key is depressed while a parameter code is being displayed another parameter code will be displayed.

Depressing the SCROLL key while a parameter code is displayed will cause the parameter value to appear. Depressing the SCROLL key with a parameter value displayed will cause the next parameter code to come up in the display.

Depressing the UP key while a parameter code is being displayed will exit the Alarm Set mode and **ASeT** will appear in the display. Using the SCROLL key at this point will allow you to proceed to any other mode.

4.5.4.3 ALARM SET MODE CONFIGURATION

Refer to Table 4-3 (page 30) for configuration procedures for the Alarm Set mode. All possible parameters are shown for illustration purposes. Only those parameters applicable to each respective pen will actually be shown.

4.5.5 DATA LOGGER SETUP MODE CONFIGURATION PROCEDURE

The Data logger setup mode allows the entry, review, or altering of the datalog settings.

4.5.5.1 ENTERING THE DATA LOGGER SETUP MODE

From the Operation or any other mode code, depress the SCROLL key until **dLS** is displayed. With **dLS** in the top display, depress the DOWN key to enter the mode. If **dLS** does not appear, then the mode has been disabled. Refer to Table 4-1 (page 25) for Enable mode instructions.

4.5.5.2 MOVEMENT IN THE DATA LOGGER SETUP MODE

Each time the DOWN key is depressed while a parameter code is being displayed, another parameter code will be displayed.

Depressing the SCROLL key while a parameter code is displayed will cause the parameter value to appear. Depressing the SCROLL key with a parameter value displayed will cause the next parameter code to come up in the display.

Depressing the UP key while a parameter code is being displayed will exit the Data logger Setup mode and **dLS** will appear in the display. Using the SCROLL key at this point will allow you to proceed to any other mode.

4.5.5.3 DATA LOGGER SETUP MODE CONFIGURATION

Refer to Table 4-4 (page 30) for configuration procedures for the Datalog Setup mode.

4.5.6 PRESET ADJUST MODE CONFIGURATION PROCEDURE

(TOTALIZATION OPTION ONLY)

The Preset mode allows the entry, review, and altering of the preset parameters. These parameters are used to trigger relays at selected totalization totals.

4.5.6.1 ENTERING THE PRESET ADJUST MODE

From the Operate or any other mode code, depress the SCROLL key until **PSA** is displayed. This is the mode code for the Preset Adjust mode. With **PSA** in the top display, depress the DOWN key to enter the mode. If the **PSA** code does not appear, then the mode has been disabled. Refer to Table 4-1 (page 25) for Enable mode instructions.

4.5.6.2 MOVEMENT IN THE PRESET ADJUST MODE

The preset values will be changeable in the Preset Adjust mode as follows: With the **PSA** mode code displayed, depress the DOWN key. **PS1H** (preset high value) will be displayed in the upper display, assuming that the Preset has been selected in the Program mode. When the SCROLL key is depressed, the value will be displayed. The UP or DOWN keys can now be used to increment or decrement the value by a factor of ten thousand (10,000) units per depression. When the SCROLL key is depressed again, **PS1L** (preset low value) will be displayed. The UP or DOWN keys can now be used to increment or decrement the values by single units (ignoring the decimal position). When the SCROLL key is depressed again, the next preset code will be displayed in the appropriate display. Refer to Table 4-5 (page 31).

4.5.6.3 PRESET ADJUST MODE CONFIGURATION

Refer to Table 4-5 (page 31) for configuration procedures for the Preset Adjust mode. All possible parameters are shown for illustration purposes. Only those parameters applicable to each respective pen will actually be shown. Access to either Pen 1 or Pen 2 parameters may be quickly obtained by depressing the DOWN key at either the **PEn1** or **PEn2** code.

4.5.7 TOTALIZATION CONFIGURATION

Selection of the totalization function, how to reset the totalizer, the decimal position, the low flow cutoff point, the time base and the functions of the presets are all covered in the Program mode. Preset values are adjusted in the Preset Adjust mode.

4.5.8 RESETTING THE TOTALIZER

Resetting the Totalizer (to 0) can be accomplished from the keypad or from a remote contact closure.

Resetting the totalizer from the keypad for Pen 1 is accomplished by selecting the totalizer display and by depressing the UP key and then also depressing the DISPLAY SELECT key for 5 seconds. Resetting Pen 2 is accomplished by selecting the totalizer display and by depressing the DOWN key and then also depressing the DISPLAY SELECT key for 5 seconds.

When the totalizer for Pen 1 is reset, the combined total is also reset.

Note: Remote Resetting of the totalizer will not operate if the unit is in the Off mode.

TABLE 4-1 ENABLE MODE

Press the UP and DOWN keys while in **oPEr** or **oFF** modes. All display lamps will light. After 10 seconds, the lamps will go out and **EnAb** will be displayed. Release the keys and the display will change to **EtSt**. Press and release the DOWN key and each mode to be enabled/disabled will be displayed. With the Enable mode prompt for the desired mode displayed, press the SCROLL key to verify that the displayed mode is either **on** (enabled) or **oFF** (disabled). Press the DOWN key to turn off the mode, press the UP key to turn on the mode or press the SCROLL key to advance the display to the next Enable mode prompt. Use the "Your Setting" column in the table to record your programming. The Test and Calibration modes are factory set to **oFF** (disabled).

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING	YOUR SETTING
1	Enable Test Mode	EtSt	on or oFF	oFF	
2	Enable Calibration Mode	ECAL	on or oFF	oFF	
3	Enable Program Mode	EPro	on or oFF	on	
4	Enable Alarm Set Mode	EASt	on or oFF	on	
5	Enable Data Logger Setup	EdLS	on or oFF	on	
6	Enable Data Logger Display	EdLd	on or oFF	on	
7	Enable Preset Adjust Mode	EPSA	on or oFF	on	

TABLE 4-2 PROGRAM MODE CONFIGURATION PROCEDURE

Press the SCROLL key until **Prog** is displayed. Press the DOWN key to enter the Program mode. **PEn1** will be displayed in the upper display. To enter the Pen 1 parameter, press the DOWN key. To enter the Pen 2 parameter, if provided, press the SCROLL key, then the DOWN key. To enter the unit parameter, press the SCROLL key with either **PEn1** or **PEn2** displayed until **unit** is displayed, then press the DOWN key. Press the SCROLL key to advance the display through the parameter codes and their values. Use the UP and DOWN keys to adjust the values. After adjusting a parameter, press the SCROLL key to proceed to the next parameter. After all selections have been made, press the UP key with a parameter in the display (not a setting) to exit the mode. For two pen instruments, the parameters and values which are applicable to Pen 1 will appear in the upper display, then the parameters and values which are applicable to Pen 2 will appear in the lower display, then the unit parameters and values will appear in the upper display.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING	YOUR SETTING
1	Input Select	inPS	0=4-20mA with the shunt resistor in place 0=1-5V with resistor removed 1-100=variable mV span with JU4 (pen 1), JU5 (pen 2) in mV position and resistor removed (i.e., 50=0-50mV input) 100=0-5V with jumper JU4 (pen 1), JU5 (pen 2) in the volt/mA position and the resistor removed	0	
NOTE: Fault Detection Not Functional for 0-5V Input.					
2	Input Correction	iCor	-1000 to 1000 units	0.0	
3	Alarm 1	AL1	0=None 1=Process Alarm-Direct 2=Process Alarm-Reverse	0	
4	Alarm 2	AL2	Same selections as Alarm1	0	
5	Decimal Position	dPoS	0 to 3	1	
6	Engineering Units Processing Algorithm 0 to 7 for Pen 1 of 2 pen units; 0 to 6 otherwise	EuPA	0=Linear 1=Square Root 2=Two Stage Square Root 3=Three Stage Square Root 4 = Variable Exponent 5 = Piecewise Linear Conversion 6 = Variable Exponent plus Piecewise Linear Correction 7 = Saturated Steam Flow with Pressure correction	0	
7	Engineering Units Upper Value	Euu	0 to 9999	100.0	
8	Engineering Units Lower Value (parameter applies only if EuPA =0)	EuL	0 to 9999	0.0	
9	Engineering Units Exponent (parameter applies only if EuPA =4 or 6)	EuE	0.400 to 4.000	1.500	
10	Low Flow Cutoff	LFC	-25.0 to 25.0% (of Euu value)	-10.0	
Note: Parameters dP2 through Pu20 only appear if EuPA = 5 or 6.					
11	Decimal Position for Engineering Units Value 2	dP2	0 to 3	1	
12	Engineering Units Upper Value 2	Euu2	0 to 9999	100	

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING	YOUR SETTING
13	Engineering Units Lower Value 2	EuL2	0 to 9999	0	
14	Number of piecewise linear points	nPtS	2 to 20	2	
	Input Units-Point 1	iu 1		0.0	
	Input Units-Point 2	iu 2		100.0	
	Input Units-Point 3	iu 3		0.0	
	•				
	•				
	•				
	Input Units-Point 20	iu20		0.0	
	Process Units-Point 1	Pu 1		0.0	
	Process Units-Point 2	Pu 2		100.0	
	Process Units-Point 3	Pu 3		0.0	
	•				
	•				
	•				
	Process Units-Point 20	Pu20		0.0	
15	Hysteresis for Alarm Outputs	HyAo	0 to 1000 units	10.0	
16	Process Rounding	Prnd	1 to 1000 units 0=No rounding	0.0	
17	Display Filter Factor	dFF	1 to 20 units (number of values averaged)	1	
			1=no filtering		
18	Process Filter Factor	PFF	1 to 20 units (number of values averaged)	1	
			1=no filtering		
19	Process Output	Pout	0=Not selected 1=Selected	0	
20	Process Output Upper Value	Pou	0 to 9999 units	100.0	
21	Process Output Lower Value	PoL	0 to 9999 units	0.0	
<p>The output will be 0% when $PV \leq PoL$ and 100% when $PV \geq Pou$ and will increase linearly from 0 to 100% as the Process Value goes from PoL to Pou.</p>					
22	Chart Range Upper Value	Cru	0 to 9999 units	100.0	
23	Chart Range Lower Value	CrL	0 to 9999 units	0.0	
24	Pen Action on Error Condition	PAEC	0=Pen goes to 0% span 1=Pen goes to 100% span	1	
25	Totalizer Select 0 to 3 only for Pen 1 of 2 pen units; 0 to 1 otherwise	tSEL	0=Off 1=On 2=Combined total activated (Pen 1 plus Pen 2) 3=Combined total activated (Pen 1 minus Pen 2)	0	
26	Totalizer Reset	trES	0=Off (Non-Resettable) 1=Resettable from keypad 2=Resettable by remote contact closure 3=Resettable from either	1	
27	Totalizer Decimal Position	tdP	0 to 3	0	
28	Totalizer Factor (if tSEL >0)	tFAC	-4 to 3	0	
29	Totalizer Low Flow Cutoff	tLFC	0.0 to 25.0% (of Euu value)	1.0	
30	Flow Time Base	Ftb	1=units/second 2=units/minute 3=units/hour 4=units/day	1	

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY	YOUR SETTING	SETTING
31	Preset Select 1	PSS1	0=Off 1=On when Total>Preset Value 2=On when Total<Preset Value 3=On when Combined Total > Preset Value 4=On when Combined Total < Preset Value		1	
32	Preset Select 2	PSS2	Same selection as PSS1		1	
33	Preset Select 3	PSS3	Same selection as PSS1		1	
34	Pulsed Output Select (if tSEL >0)	PoS	0=Off 1 to 9999 (decimal point per tdP)		0	
35	Scan Rate	SCnr	3 scans/second on 2 Pen units 5 scans/second on 1 Pen units		3 5	
36	Relay Assignment	rLyA	0=Not assigned 1=Assigned to Alarm 1-Pen 1 2=Assigned to Alarm 2-Pen 1 3=Assigned to Alarm 1-Pen 2 4=Assigned to Alarm 2-Pen 2 9=Assigned to Preset 1-Pen 1 10=Assigned to Preset 2-Pen 1 11=Assigned to Preset 3-Pen 1 12=Assigned to Preset 1-Pen 2 13=Assigned to Preset 2-Pen 2 14=Assigned to Preset 3-Pen 2 15=Assigned to Pulsed Output-Pen 1 16=Assigned to Pulsed Output-Pen 2 17=Assigned to Pulsed Output-Combined		0	
37	Relay B Assignment	rLyb	Same selection as rLyA		0	
38	Relay C Assignment	rLyC	Same selection as rLyA		0	
39	Relay D Assignment	rLyd	Same selection as rLyA		0	
40	Relay E Assignment	rLyE	Same selection as rLyA		0	
41	Relay F Assignment	rLyF	Same selection as rLyA		0	
42	Relay G Assignment	rLyg	Same selection as rLyA		0	
43	Relay H Assignment	rLyH	Same selection as rLyA		0	
44	Current OutputA Assignment	CurA	0=Not Assigned 1=Assigned to Process Value Output-Pen1 2=Assigned to Process Value Output-Pen2 3=Assigned to Process Value Output-Combined		0	

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY	YOUR SETTING	SETTING
45	Current OutputB Assignment	Curb	Same selection as CurA		0	
46	Current Output C Assignment	CurC	Same selection as CurA		0	
47	Current Output D Assignment	Curd	Same selection as CurA		0	
48	Current OutputA Range	CoAr	0=0-20mA 1=4-20mA		1	
49	Current Output B Range	Cobr	Same selection as CoAr		1	
50	Current Output C Range	CoCr	Same selection as CoAr		1	
51	Current Output D Range	Codr	Same selection as CoAr		1	
52	Chart Rotation Time	Crt	0.1 to 999.9 hours per rotation		24.0	
53	Pen Action on Power Up	PAPu	0=Pen(s) go to the "home" position (towards chart center) when powered up 1=Pen(s) remain in last position prior to power down		0	
54	Chart Operation in Off mode	Coo	0=Chart continues rotating while in the Off mode 1=Chart stops rotating while in the Off mode		1	

TABLE 4-3 ALARM SET MODE CONFIGURATION PROCEDURE

Press and release the SCROLL key until **ASet** is displayed, then press the DOWN key. Press the SCROLL key to advance the display through the parameters

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY	YOUR SETTING	SETTING
1	Process Alarm1	PAL1	0 to 9999 units		0.0	
2	Process Alarm 2	PAL2	0 to 9999 units		0.0	
3	Barometric Pressure (EuPA = 7 only)	bAro	0.0 to 35.9		29.9	

TABLE 4-4 DATA LOGGER SETUP MODE CONFIGURATION

Depress the SCROLL key until **dLS** is displayed. Use the DOWN key to enter the Data logger setup mode. Depress the SCROLL key to scroll through the parameters and their values. Use the UP and DOWN keys to adjust the values. After adjusting a parameter, depress the SCROLL key to proceed to the next parameter. After all selections have been made, depress the UP key with a parameter code in the display (not a setting) to exit the mode.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY	YOUR SETTING	SETTING
1	Day of the week	dAy	1 to 7 1=Monday through 7=Sunday		1	
2	Time of Day in HH.MM format	tod	00.00 to 23.59		00.00	
3	Time to Log Data	ttLd	00.01 to 23.59		23.59	
4	Date in MM.DD month and day format	dAtE	1.01 to 12.31		01.01	
5	Year	yEAr	1990 to 2089		1997	

Note: Before using the Data Logger Display mode, it is suggested that a CAL8 be performed to initialize the data table.

TABLE 4-5 PRESET ADJUST MODE CONFIGURATION

Depress the SCROLL key until **PSA** is displayed. With **PSA** displayed, press the DOWN key to enter the Preset Adjust mode. **PS1H** will be displayed in the upper display, assuming it has been selected in the Program mode. When the SCROLL key is depressed, the value will be displayed. The UP and DOWN keys can now be used to increment or decrement the displayed value by a factor of ten thousand (10,000) per depression (ignoring the decimal point). When the SCROLL key is depressed again, **PS1L** will be displayed. When the SCROLL key is depressed again, the value will be displayed again. The UP or DOWN keys can now be used to increment or decrement the value by one (ignoring the decimal point). After adjusting a parameter, depress the SCROLL key to proceed to the next parameter. After all selections have been made, depress the UP key with a parameter in the display (not a setting) to exit the mode

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS	FACTORY SETTING	YOUR SETTING
1	Preset 1 High Value Increment/Decrement value by 10000	PS1H	0 to 99999999 units		5000
	Preset 1 Low Value Increment/Decrement value by 1	PS1L	0 to 99999999 units		
2	Preset 2 High Value Increment/Decrement value by 10000	PS2H	0 to 99999999 units		10000
	Preset 2 Low Value Increment/Decrement value by 1	PS2L	0 to 99999999 units		
3	Preset 3 High Value Increment/Decrement value by 10000	PS3H	0 to 99999999 units		15000
	Preset 3 Low Value Increment/Decrement value by 1	PS3L	0 to 99999999 units		

Note: Upon a sensor error condition (**SnSr**), the preset outputs will remain in the state they were in upon entering the error condition.

Data Logger Display Mode 4.6

4.6.1 DATA LOGGER DISPLAY MODE OPERATION

The Data Logger Display mode allows the user to view the parameters and values that are stored during data logging. In the Data Logger Display mode, the instrument operational functions are all active, as in the Operate mode. This provides a means of viewing the logged data, on-line, while the unit continues normal operation.

4.6.1.1 ENTERING THE DATA LOGGER DISPLAY MODE

From the Operation or any other mode code, depress the SCROLL key until **dLd** is displayed. With **dLd** in the top display depress the DOWN key to enter the mode. If **dLd** does not appear, then the mode has been disabled. Refer to Table 4-1 (page 25) for Enable mode instructions.

4.6.1.2 MOVEMENT IN THE DATA LOGGER DISPLAY MODE

Each time the DOWN key is depressed while a parameter code is being displayed, another parameter code will be displayed.

Depressing the SCROLL key while a parameter code is displayed will cause the parameter value to appear. Depressing the SCROLL key with a parameter value displayed will cause the next parameter code to come up in the display.

Depressing the UP key while a parameter code is being displayed will exit the Data Logger Display mode and **dLd** will appear in the display. Using the SCROLL key at this point will allow you to proceed to any other mode.

TABLE 4-6 DATA LOGGER DISPLAY MODE

Depress the SCROLL key until **dLd** is displayed. Use the DOWN key to enter the Data Logger Display mode. With **dAy** displayed, press the SCROLL key. Use the UP or DOWN key to set the value equal to the day that is to be viewed. Press the SCROLL key to scroll through the parameters and their values. After all parameters have been reviewed, depress the UP key with a parameter code in the display (not a setting) to exit the mode.

STEP	DESCRIPTION	DISPLAY CODE	AVAILABLE SETTINGS
1	Day of the Week	dAy	1 to 28 1= Monday through 7= Sunday of this week 8=Monday through 14=Sunday of previous week etc.
2	Corresponding Date in MM.DD format	dAtE	
3	Low or Minimum Flow Rate for the 24 hour period	LFLo	
4	Time of Day of minimum rate in HH.MM format	Ltod	
5	High or Maximum Flow Rate for the 24 hour period	HFLo	
6	Time of Day of maximum rate in HH.MM format	Htod	
7	Average Flow Rate for the 24 hour period	AFLo	
8	Total Flow for the 24 hour period	dtot	

Default parameters don't apply as this mode only displays data.

Service 5.1

This section contains information regarding calibration and test procedures that can be performed in the field as well as items concerning the normal maintenance of the instrument.

Changing Charts 5.2

Chart changes may be done while in the normal operating mode.

CAUTION: The chart flange assembly pin is sharp to perforate the chart. Use caution while installing the chart to avoid coming into contact with the pin.

1. Depress and hold the UP and DOWN keys for between 2 and 3 seconds. Immediately after depressing the keys, the unit will do a Lamp Test with all LED segments and indicators lighted on the upper (and lower) display.
2. After 2-3 seconds, the display will show **Cchg**, the pen(s) will move to and remain at a point above the top graduation on the chart and the chart will stop rotating. All other functions remain active (Operate, Display, etc).
3. Open the instrument door, snap up the chart hold down lever on the chart flange assembly, gently lift the pen(s) and remove old chart.
4. With the pen(s) held up, install new chart. Be sure to line up the chart time line so that the current time is aligned with the time setting mark on the chart platen.
5. Snap down chart hold down lever and close the instrument door.
6. Depress and hold the UP and DOWN keys for between 2 and 3 seconds. Immediately after depressing the keys, the unit will do a Lamp Test with all LED segments and indicators lighted on the upper (and lower) display.
7. After 2-3 seconds, the display will show **Cchg** momentarily, then the pen(s) position and chart rotation will be restored.

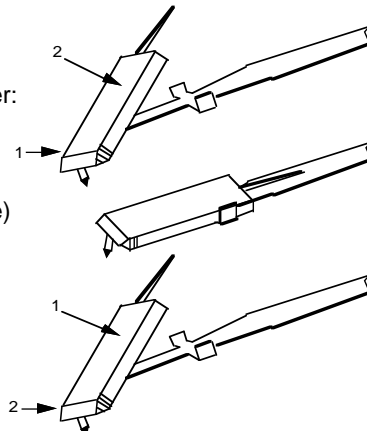
Changing Pens 5.3

Open the instrument door. Refer to Figure 5-1 for pen changing procedure. This procedure is also provided on a label on the instrument chart platen. Be sure to replace the pen cartridge with the same type (color) that was removed. Be careful not to bend the pen arm while changing the pen.

FIGURE 5-1

For replacement pens, order:
Green #60500401
Red #60500402

(Pens are sold in lots of five)



To install pen, slide pen into holder (1) and push down (2) as shown by arrows

To remove pen, pull up at back end (1) and push out

Calibration 5.4

CAUTION: Do not attempt any calibrations without the proper test equipment that meets or exceeds the specifications listed.

To enter the calibration mode it must first be turned on in the Enable mode (page 25). Once enabled, press and release the SCROLL key until **CAL** appears on the display, then press the DOWN key to enter the mode. The display will change to **CAL1**. Press the SCROLL key to advance the display to the other calibration modes available. Table 5-1 provides a listing of field calibration routines. All instruments are calibrated prior to shipment from factory.

TABLE 5-1 CALIBRATION PROCEDURES

Calibration Procedure	Description
CAL1	Reinitialization of program and tuning values.
CAL2	Main calibration necessary for all input types.
CAL6 & 7	Factory use only.
CAL8	Data Logger Re-initialization.
CAL9	Pen position calibration used to calibrate pens to chart.

5.4.1 CAL 1 PARAMETER RE-INITIALIZATION

This routine is used to clear all information in the Program, Alarm Set, and Preset modes. All parameters will be reset to default values. Before performing this procedure, make sure that the Program, Alarm, and Preset values are written down so that they can be re-entered after Calibration 1 is completed. No test equipment required.

With **CAL1** displayed, press and hold the DOWN key, then press the SCROLL key. The display will momentarily blank; release the keys. Upon completion of the routine, **CAL1** will re-appear on the display.

5.4.2 CAL 2 MAIN CALIBRATION

This routine determines and saves calibration values which correct for component variations relating to the basic measuring function of the unit. A 100.00 mVDC \pm .01 mVDC source is required for testing. **Make sure that the Processor board jumpers JU4 and JU5 are in the non-volt positions. See Appendix A-1 (page 46) for proper positioning. After completing CAL2, be sure to re-position these jumpers to the appropriate position for your input.**

With **CAL2** displayed, press and hold the DOWN key, then press the SCROLL key. Release the keys when the instrument displays **hLd1**. Short the input terminals or apply 0.00 \pm .01 mVDC to TB4 terminals 1 and 2. Press the DOWN key and **dELy** will appear for 10 seconds, then **SCAn** will appear for 10 seconds. A calibration reference number will then appear, this should be 0 \pm 50. If this number falls outside these limits, press the SCROLL key and **CAL2** will be displayed. Perform the calibration again. Repeat the calibration until the number falls within the tolerance limits. If the number remains outside the limits, check the connections and try the calibration again. If the number does not approach the tolerance limits, contact the nearest representative or factory for assistance. With an acceptable reference number on the display, remove the short and connect a 100.00, \pm .01 mVDC source to the TB 4 terminals 1 and 2. Be sure to observe the proper polarity when connecting the source. Terminal 1 is positive and terminal 2 is negative. (Continued on next page)

(Continued from page 35)

Press the DOWN key, **deLy** will be displayed for 10 seconds and then **SCAn** for 10 seconds. When the calibration is complete **CAL2** will reappear.

CAL2 QUICK CALIBRATION

This routine will allow the operator to execute a rough calibration on their unit via the keypad with no other equipment or disturbance to established wiring. It is intended to provide a partial recovery from a calibration corruption where the necessary equipment indicated may not be available. It should be noted that this is not intended as a substitution to the main calibration procedure described earlier and may deter considerably from the accuracy of the instrument.

With **CAL2** displayed, press and hold the DOWN ARROW key, then press the SCROLL key. Release both keys and the instrument will display **hLd1**. Press and hold the UP ARROW key, then press the SCROLL key. The display will momentarily blank and then **CAL1** will be displayed. Release both keys and depress the UP ARROW key. **CAL** will be displayed.

Error recovery:

See section 5.6 (page 40) for details. Insure that the millivolt source is connected correctly and functioning properly.

The calibration can be exited when **hLd1** or the calibration reference number is displayed by pressing the SCROLL key.

5.4.3 CAL8 DATA TABLE INITIALIZATION

This routine initializes the logged data on the recorder.

With **CAL8** displayed, while pressing the DOWN ARROW key, press the SCROLL key. The display will momentarily blank while the initialization is in progress. Upon completion of the routine, **CAL8** will be displayed. The routine can be executed again or another routine selected.

5.4.4 CAL 9 PEN CALIBRATION

This procedure is used to calibrate the pen(s). No special test equipment required.

Valid inputs must be connected to TB 4 and TB 5 before performing this calibration. With **CAL 9** displayed, push and hold the DOWN key, then press the SCROLL key. Release both keys and the display will indicate **PEn1**. For 2 Pen instruments, press the DOWN key to toggle the display between pen 1 and pen 2. With desired pen displayed, press the SCROLL key.

FOR INSTRUMENTS WITH SOFTWARE REVISION R2.99 AND BELOW:

dELY will be displayed as the pen selected moves toward the center chart hub. **PEnL** will be displayed; use the UP and/or DOWN keys to adjust the pen to the low end or 0% of the chart. When adjusted, press the SCROLL key, **SCAn** will appear for 10 seconds and the pen location value will be saved in memory. Next **dELY** will appear as the pen moves to the outer edge or, 100% mark on the chart. **PEnh** will appear, use the UP and/or DOWN keys to adjust the pen position to the proper 100% of chart position. Press the SCROLL key and **SCAn** will be displayed as the pen position value is saved. Then **dELY** will be displayed as the pen moves to about mid-scale. **CAL9** will be displayed showing that the calibration is complete. When the calibration is complete, with **CAL9** displayed, press the UP key twice to properly exit the calibration mode. **CAL9** can now be repeated on the other pen of a 2 pen instrument or another routine can be selected.

FOR INSTRUMENT WITH SOFTWARE REVISION R3.00 AND ABOVE:

P.dn will be displayed while the selected pen is moved to its "HOME" position (toward the chart hub) with the decimal point flashing to indicate this mode. Once "Pen Home" is found, the pen will move to the inner ring and **PEnL** will be displayed. At this point, one of two adjustments may be made; Pen Arc or Zero and Span.

Pen Arc - To adjust the pen arc, the UP and DOWN keys are pressed simultaneously to draw an arc for visual reference. The display will show **P uP** while the selected pen moved upscale to the top stop position. The pen then moves back downscale to nominally place the pen at the outer ring (100%) of the chart. The display will now display **ArC**.

The pen arm may be loosened and the length adjusted to a position and angle to place the pen tip near the outer ring then re-tighten the pen arm. Press any key and the pen will drive to "HOME", then back to the inner ring (0%) and **PEnL** will be displayed.

Zero and Span - To begin a pen zero, with **PEnL** in the display, the UP or DOWN key may be pressed to move the pen to the low end of the chart span (0%). When adjusted, press the SCROLL key and **P uP** is displayed while the pen is moved to the outer edge (100%) of the chart, then **PEnh** is displayed. To adjust pen span, use the UP and DOWN keys to adjust the pen for the high end (100%) of the chart. When adjusted, press the SCROLL key and **P dn** will be displayed for about 5 seconds while the pen is moved to the 50% point on the chart, then **PEn1** is displayed. Calibration may now be performed again to verify the accuracy, or press the UP key twice to exit back to the CAL mode.

Test Mode 5.5

To enter the Test mode, press and release the SCROLL key until **tEst** appears on the display then press the DOWN key. **tSt1** will be displayed, press and release the SCROLL key to advance the display to the desired test. Tests 1, 2 and 3 are performed as a unit so the display will advance directly to **tSt4** from **tSt1**. Listed below in Table 5-2 are the test procedures available. Test 1, 2 and 3 are performed on start up, periodically during operation, and on entry into the Test mode. Test 4 is executed on entry into and periodically during the Operation mode. These tests can be used as a trouble shooting aid.

TABLE 5-2 TEST PROCEDURES AND DESCRIPTION

<u>Test</u>	<u>Description</u>
Test 1	Microprocessor internal RAM test. Used to check the processor RAM to make sure it is functioning correctly.
Test 2	External RAM test, used to test the RAM chip for proper function.
Test 3	EPROM checksum test, used to check that the EPROM program is correct.
Test 4	External RAM checksum test; instrument test and identifies how many times Errors 16 and 17 have occurred.
Test 5	Verifies that all keys are functional and all LEDs are working.
Test 6	Used to verify that all relays and solid state relay driver outputs are working correctly.
Test 7	This procedure will allow operator to adjust the current output value to check the output and to test the operation of the external device.
Test 8	Pen and chart motor operational check.
Test 9	Auxiliary input test, used to test remote reset.

5.5.1 TEST 1 INTERNAL RAM TEST

Tests the Random Access Memory internal to the microprocessor. No special test equipment is required.

With **tSt1** displayed, press and hold the DOWN key, then press the SCROLL key. **tSt1** will be displayed momentarily while the test is in progress. Upon successful completion, the instrument will proceed to Test 2.

5.5.2 TEST 2 EXTERNAL RAM TEST

Tests the battery backed up RAM external to the microcomputer. No special test equipment is required.

After completion of Test 1, **tSt2** will be displayed momentarily while the test is in progress. Upon successful completion, the instrument will proceed to Test 3.

5.5.3 TEST 3 PROGRAM EPROM TEST

This is a checksum test to verify data integrity of the stored program. No special test equipment is required.

After completion of Test 2, **tSt3** will be displayed momentarily while the test is in progress. Upon successful completion of Test 3, **tSt1** will be displayed.

5.5.4 TEST 4 EXTERNAL RAM CHECKSUM TEST

This is a checksum test to verify the integrity of data stored in RAM and indicate the number of times the instrument has had an Error 16 or 17. The unit may have automatically recovered from these errors. No special test equipment is required.

5.5.5 TEST 5 KEYPAD/DISPLAY TEST

This test allows the operator to verify that the keys work and that all display elements can be lighted. No special test equipment is required.

With **tSt5** displayed, press and hold the DOWN key, then press the SCROLL key and then release both keys. The display will go blank. The following code will be displayed while the corresponding key is pressed:

<u>Key</u>	<u>Display</u>
SCROLL	SCrL
UP	uAro
DOWN	dAro
UP and DOWN	(All Led's and segments lit)
DISPLAY SELECT	diSp
SCROLL and UP	(exit)

To exit, press the SCROLL and UP keys simultaneously, **tSt5** will be displayed.

5.5.6 TEST 6 RELAY/SOLID STATE RELAY DRIVER OUTPUT TEST

Allows the operator to verify that the Relay and/or the Solid State Relay Driver output(s) are working. A volt/ohm meter will be required to test the output.

With **tSt6** displayed, press and hold the DOWN key, then press the SCROLL key. **oFF** will be displayed. For SPST or SPDT Relay outputs, connect the meter across the relay output in the ohm scale. For SPDT Relay outputs, connect the meter across the N.O. and COM output in the ohm scale. The meter should read continuity with the relay on and infinity when the relay is off. For SSR Driver outputs, connect the meter across the output in the Volt DC scale.

The meter should read 5 VDC when the SSR driver is on and 0 VDC when the driver is off. Press and release the DOWN key to advance through the following sequence:

Display	Relay ON SPST	RELAY ON SPDT
rLYA	A	A
rLYb	B	B
rLYC	C	C
rLYd	D	D
rLYE	E	None
rLYF	F	None
rLYg	G	G
rLYH	H	H
oFF	None	None

To exit, press the SCROLL key and **tSt6** will be displayed. The existence of Relay and Solid State Relay Driver output(s) is dependent upon the hardware configuration.

5.5.7 TEST 7 CURRENT OUTPUT TEST

This test allows the operator to verify that the current output(s) are functioning properly or will allow the selection of an output value for testing of associated equipment. A milliamp meter is required for testing.

With **tSt7** displayed, press and hold the DOWN key, then press the SCROLL key. The display will indicate **CurA**, for the first current output. By pressing the DOWN key, the instrument will advance through the selection sequence of **Curb**, **CurC**, **Curd**, and then back to **CurA**. Choose the desired output to be tested and connect the milliamp meter across the output terminals being tested. Be sure to observe the proper polarity when connecting the meter. Terminal 1 is positive and terminal 2 is negative. Press the SCROLL key and the display will indicate 4 milliamps.

Use the UP and/or DOWN key to increase or decrease the current output in 1 mADC steps from 0 to 20mADC. The current output reading should be ± 0.5 mADC at any output value. A $\pm 5\%$ of span adjustment for the current output(s) is provided by using the potentiometer adjacent to the current output on the Current Output board. See Appendix A-3 (page 51). To exit the test, press the SCROLL key and **tSt7** will be displayed. The existence of a mADC current output is dependent upon the hardware configuration.

5.5.8 TEST 8 PEN/CHART MOTOR TEST

This test allows the operator to verify that pen and chart motors are functioning properly. No special test equipment is required.

With **tSt8** displayed, press and hold the DOWN key, then press the SCROLL key. The display will show **ALL** while the test is in progress. This test functions automatically. The chart speed will be at maximum, 72 seconds per revolution. Starting at the current pen position, pen 1 will move (sweep) upscale for about 5 seconds, then downscale for about 5 seconds. Pen 2 (if provided) will sweep in the opposite direction. The pens will continue to cycle until the test is exited. To exit, press the SCROLL key. The display will show **tSt8**.

5.5.9 TEST 9 AUXILIARY INPUT TEST

This test allows the operator to verify that the auxiliary input(s) are functioning properly. With **tSt9** displayed, press and hold the DOWN key, then press the SCROLL key. The display will show **Ai1**, Auxiliary Input 1. By pressing the DOWN key the instrument will alternate between **Ai1** and **Ai2**. With the desired input selected, press the SCROLL key. The corresponding value will be displayed. To terminate a particular test, press the SCROLL key. The display will show **tSt9**.

Trouble-shooting and Diagnostics 5.6

This section consists of two columns. The first column is a list of some possible instrument conditions. The second column is a list of steps that should improve the condition. The steps should be performed in order until the condition improves or all the steps have been completed. If the instrument condition has not improved, contact the nearest representative or the factory for assistance.

Trouble-shooting should be performed by qualified personnel using the proper equipment and following all safety precautions. Whenever possible, the trouble-shooting should be accomplished with the electrical power disconnected. The instrument contains static sensitive components so care should be taken to observe anti-static procedures.

Condition	Correction Steps
Display(s) is/are blank	<ol style="list-style-type: none"> <li data-bbox="844 682 1487 913">1. Verify that the correct instrument power, as indicated on the wiring label on the platen, is supplied to TB1 terminals 1 & 2. Check the position of the power select switch, on 230 VAC models, correctly indicates the power that is connected to the instrument. If the switch does not indicate the correct voltage, reposition as necessary. If the voltage is not correct, check the power source. <li data-bbox="844 934 1487 997">2. Turn off the instrument power. Wait about 5 seconds then turn the power on again . <li data-bbox="844 1018 1487 1659">3. Turn off the instrument power, open the cover, loosen the platen hold down screw, and swing the platen out of the way. Inspect the instrument for poor connections. <ol style="list-style-type: none"> <li data-bbox="941 1134 1487 1260">a. The white ribbon cables that connect the Processor board (Appendix A-1, page 46) to the platen must be properly aligned and seated in the sockets. <li data-bbox="941 1281 1487 1407">b. The display board(s) white ribbon cable(s) pins should be properly aligned and seated in the sockets on the platen potentiometer segment board. <li data-bbox="941 1428 1487 1554">c. Inspect the EPROM (U3), RAM (U8) and microprocessor chips (U5) to see that the legs are properly seated in their sockets on the Processor Board (page 46). <li data-bbox="941 1575 1487 1659">d. Close the platen and tighten the hold down screw. Close the cover and turn on the power to see if the display(s) will now light. <li data-bbox="844 1680 1487 1856">4. Turn off the instrument power. Press and hold the UP and DOWN keys. Turn on the power. Hold the keys pressed for about 10 seconds. If the display(s) light(s) the model number, Program and Alarm Set mode parameters will need to be re-entered (pages 26 & 30 or Software Ref. Sheet, page 55, if already filled out).

Model Number Displayed during power up is incorrect

1. Turn off the instrument power, wait 5 seconds then re-apply the power. Verify that the number displayed during the power up sequence is the same as indicated on the label affixed to the platen. If the number displayed is incorrect, perform the following steps:
 - a. Turn off the power to the instrument. Press and hold the UP and DOWN keys. Turn on the power and keep the keys pressed until the model number displayed resets to **78X0-0000-0021**. Release the keys and turn off the power.
 - b. To enter the correct model number, press and hold the SCROLL and DOWN keys and turn on the instrument power. **78X0** should be displayed. Wait about 5 seconds and release the keys. The display should stay **78X0**. Use the UP/DOWN keys as necessary to change the displayed number to match the first 4 digits of the model number as indicated on the label on the platen. After adjusting the first 4 digits to the proper values, press the SCROLL key and the display will change to **0000**. Use the UP/DOWN keys to set the next 4 digits of the model number to the correct values. Press the SCROLL key and the display will be 0000. Use the UP/DOWN keys to set the last 4 digits of the model number. Press the SCROLL key and the power sequence will complete. The Program, Alarm Set, Preset and Datalog mode parameters will need to be re-entered (pages 26 & 30 or Software Ref. Sheet, page 55, if already filled out).

Relay/SSR Driver Malfunction

1. Verify that the Program, Alarm Set and Preset mode parameters are correctly set (pages 26 & 30 or Software Ref. Sheet, page 55, if already filled out).
2. Turn off the power to the instrument. Wait about 5 seconds and turn the power on again. Confirm that the model number displayed during the power up sequence indicates that the output(s) is/are present in the instrument. See Appendix C (page 52) for the model number explanation/decoding. This number should match the number on the label affixed to the platen.
3. Turn off the power to the instrument. Open the cover. Loosen the platen hold down screw and swing the platen open. Inspect the instrument Relay/SSR Driver board (See Figure 2-2, page 9) for the presence of the output device(s). A relay output will appear to be a cube. The SSR Driver will appear as a resistor and a jumper wire. The output will not work if the hardware is not present. Inspect that the output terminal connections are present and firmly attached.

(Continued on next page)

(Continued from page 43)

4. Check the output(s) operation by performing Test 6 as described in the Test section (page 38). If the output(s) function(s) in the Test mode, re-examine the Program, Alarm Set and Preset mode parameter settings (pages 26 & 30 or Software Ref. Sheet, page 55, if already filled out).
5. If the output appears not to turn off, remove the power to the instrument. Open the cover and loosen the platen hold down screw. Swing the platen open. Clip the resistor located on the Relay Board adjacent to the output(s) that seem to stay on (See Appendix A-2A or A-2B, page 47 or 48). A .01 microfarad, 1 KV capacitor should be connected from the terminal listed below, for the output where the resistor indicated was removed, to the AC ground.

SPST

Relay A	R1	TB6	Terminal 1
Relay B	R2	TB6	Terminal 3
Relay C	R3	TB7	Terminal 1
Relay D	R4	TB7	Terminal 3
Relay E	R5	TB8	Terminal 1
Relay F	R6	TB8	Terminal 3

SPDT

Relay A	R1	TB6	Terminal 1
Relay A	R2	TB6	Terminal 3
Relay B	R3	TB7	Terminal 1
Relay B	R4	TB7	Terminal 3
Relay C	R5	TB8	Terminal 1
Relay D	R6	TB8	Terminal 3

Close the platen and tighten the hold down screw. Close the cover and turn the power on to the instrument. Check the operation of the output(s).

**mADC Output(s)
Malfunction**

1. Verify that the Program mode parameters are correctly set (page 26).
2. Turn off the power to the instrument. Wait about 5 seconds and turn the power on again. Confirm that the model number displayed during the power up sequence indicates that the output(s) is/are present in the instrument. See Appendix C (page 52) for the model number explanation/decoding. This number should match the number on the label affixed to the platen.
3. Turn off the power to the instrument. Open the cover. Loosen the platen hold down screw and swing the platen open. Inspect the instrument Current Output board (See Figure 2-2, page 9) for the presence of the output device(s). The output will not work if the hardware is not present. Inspect that the output terminal connections are present and firmly attached. Close the platen and tighten the hold down screw. Close the cover and turn on the power.

4. Refer to the Test section and carry out the procedure for the Current Output(s) Test 7 (page 39). If the current output operates properly in the Test mode, re-check the Program mode parameters (page 26 or Software Ref. Sheet, page 55) if already filled out).

Pen(s) do not operate

1. Verify that the Program mode parameters are properly set (page 26 or Software Ref. Sheet, page 55, if already filled out).
2. If the process value in the display exceeds the chart upper or chart lower values selected in the Program mode, the pen will appear stuck at the chart upper or lower edge respectively. Re-configure values as needed by the application (may require a new chart).
3. Perform Test 8 as described in the Test section of the manual (page 39). If the pen(s) operate(s) in Test 8, perform the pen calibration, Cal 9, as described in the Calibration section of the manual (page 36). Return the instrument to the **oPEr** and check the operation of the pen(s).
4. For software revision R2.99 and below, perform Test 9 as described in the Test Section of the manual (page 39). If the pen feedback voltage does not vary, check the pen Potentiometer Segment board for proper ribbon cable connection to the Processor board (Appendix A-1, page 46) and that the pen position fingers are making contact with Potentiometer Segment board.
5. For software revision R2.99 and below, inspect to see that the Potentiometer Segment of the pen feed back is clean. Use a non-residue type cleaner that does not affect the plastic to clean the segment if necessary.
6. Verify the instrument is not in Change Chart function.

Error Code Displayed

SnSr - Sensor Break or Over Range

1. Inspect the sensor for proper operation and connection to the instrument. Acceptable sensor ranges for the instrument are listed in the Specifications section of Appendix D (page 53).
2. Verify that the Program mode input selection matches the sensor input connected (page 26 or Software Ref. Sheet, page 55, if already filled out).
3. Check that the input conditioning jumpers on the processor board (Appendix A-1, page 46) are in the proper position for the sensor input. Check that the jumpers are in the proper position for the Terminal Board where the sensor is connected.
4. Perform the calibration procedure(s), as described in the Calibration section (page 35), for the sensor input type.

Hi - Input more than 10% Over Span	1. Perform the steps listed for the SnSr Error Condition (above).
Lo - Input more than 10% Under Span	1. Perform the steps listed for the SnSr Error Condition (above).
o - display overranged (the "broken 6" appears on the left segment of the display)	<ol style="list-style-type: none"> 1. If this error code is displayed as a Program, Alarm Set, or Preset mode parameter, perform the CAL1 procedure as described in the Calibration section of the manual (page 35). 2. If this error code appears as part of the model number during the power up sequence, follow the steps listed for the "Model Number is not correct" condition (page 41). 3. If this error appears, check the Program mode parameter dPos, if set to 1, change to 0 and see if the error clears.
Er1 - Microprocessor RAM Failure	<ol style="list-style-type: none"> 1. Turn off the power to the instrument. Wait 5 seconds, and turn the power on. 2. Turn off the power to the instrument. Open the cover, and loosen the platen hold down screw. Swing open the platen and inspect that the microprocessor chip (U5) is properly seated in the socket located on the Processor board (Appendix A-1, page 46). Close the platen and tighten the screw. Close the cover and turn on the power.
Er2 - External RAM Failure	1. Turn off the power to the instrument. Wait 5 seconds, and turn the power on.
Er3 - EPROM Checksum Failure	1. Perform the steps listed for Er1 except that the EPROM (U7) on the Processor board should be inspected.
Er5 - No Zero Crossings Detected	<ol style="list-style-type: none"> 1. Turn off the power to the instrument. Wait 5 seconds, and turn the power on. 2. Connect the instrument to another AC power source.
Er6 - AC line below 45 HZ	<ol style="list-style-type: none"> 1. Turn off the power to the instrument. Wait 5 seconds, and turn the power on. 2. Connect the instrument to another AC power source.
Er7 - AC line over 65 HZ	<ol style="list-style-type: none"> 1. Turn off the power to the instrument. Wait 5 seconds, and turn the power on. 2. Connect the instrument to another AC power source.

Er8 - Cal2 Volt Input Error

1. Check that 100mVDC is properly connected to the instrument and is within the tolerance limits as indicated in the CAL2 procedure of the Calibration section (page 35).
 2. Turn off the power to the instrument and open the cover. Loosen the platen hold down screw and swing the platen open. Inspect the Processor board (Appendix A-1, page 46) to insure that the input conditioning jumper JU4 is in the non-volt position. The jumper must be in the non-volt position to perform the **CAL2** procedure properly. Close the platen and tighten the hold down screw. Close the cover and turn on the power to the instrument.
 3. Perform the **CAL2** procedure as described in the Calibration section (page 35).
-

Er9 - ADC Reference Number Error

1. Perform the **CAL2** procedure as described in the Calibration section (page 35).
-

Er10 - ADC Reference Voltage Error

1. Perform the **CAL2** procedure as described in the Calibration section (page 35).
-

Er12 - CAL2 Voltage Error

1. Check that 100 mVDC is properly connected to the instrument and is within the tolerance limits as indicated in the **CAL2** procedure of the Calibration section (page 35)
 2. Turn off the power to the instrument and open the cover. Loosen the platen hold down screw and swing the platen open . Inspect the Processor board (Appendix A-1, page 46) to insure that the input conditioning jumper JU4 is in the non-volt position.
 3. Perform the **CAL2** procedure as described in the Calibration section (page 35).
-
-
-
-

Appendix A Board Layout

FIGURE A-1 - Processor Board

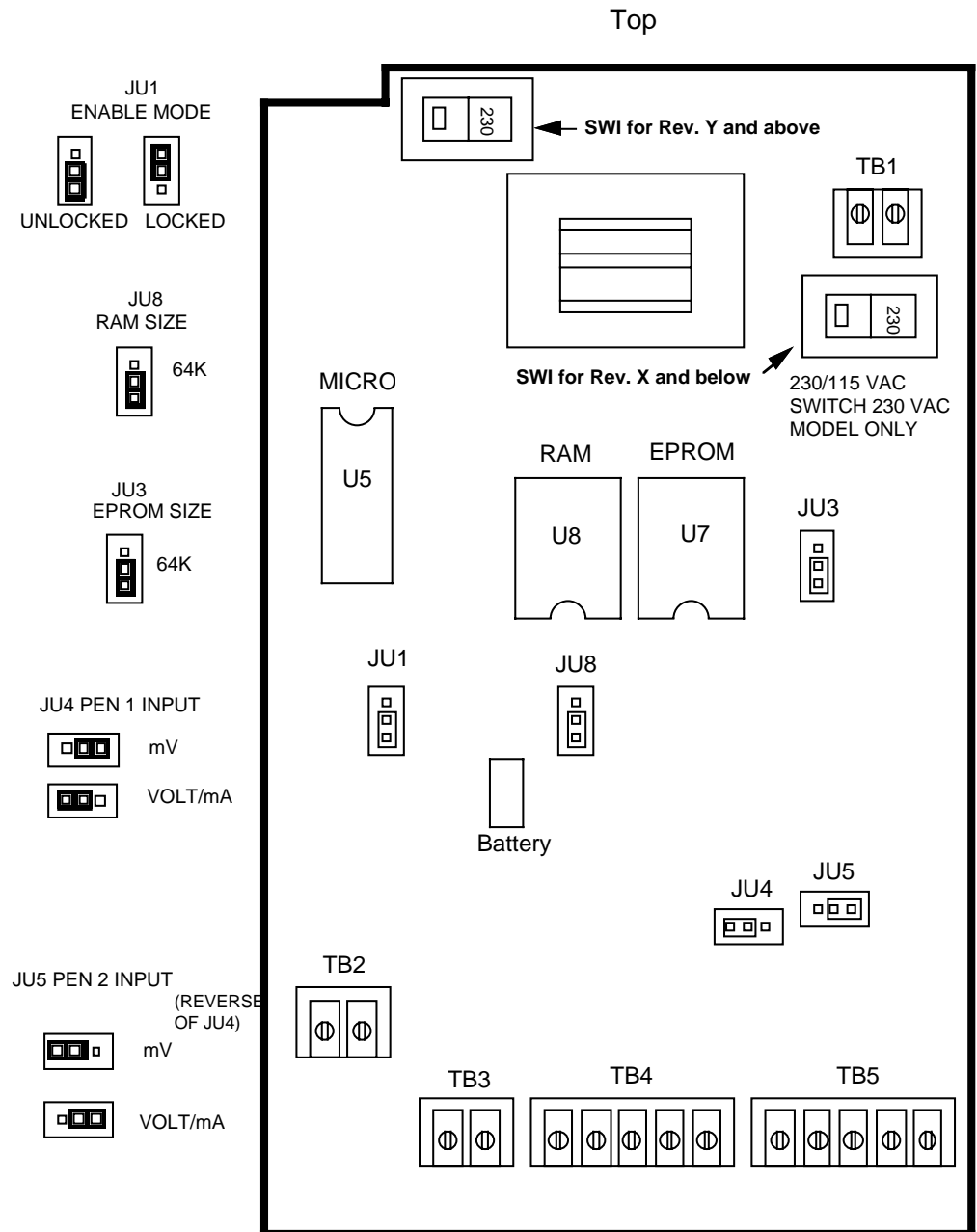
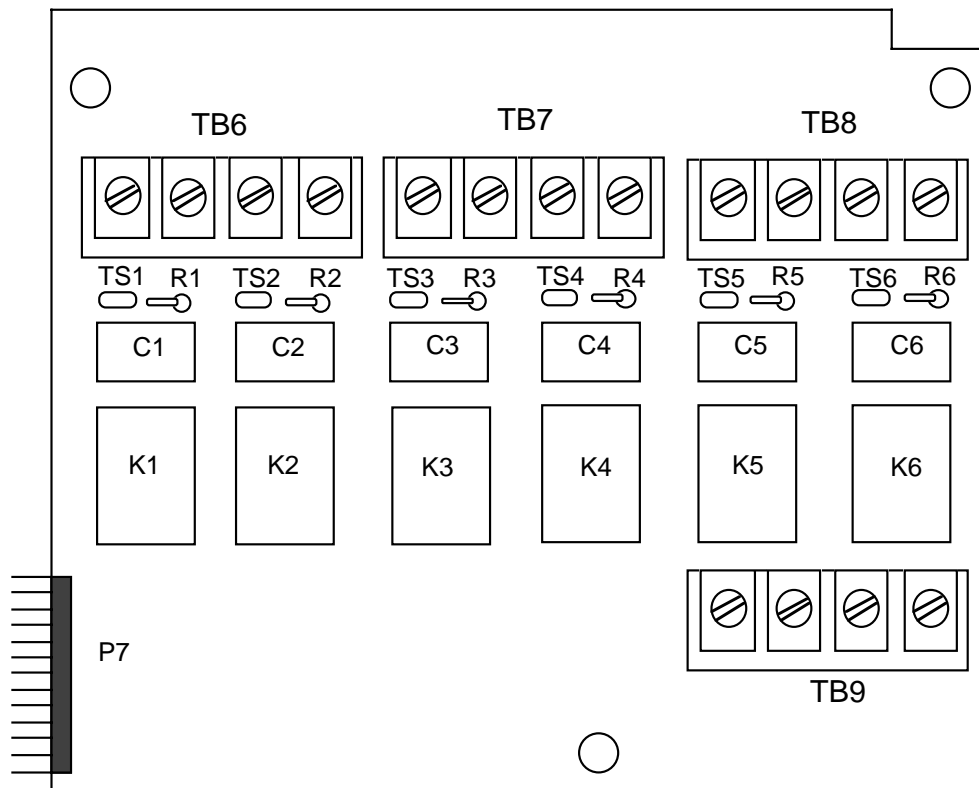


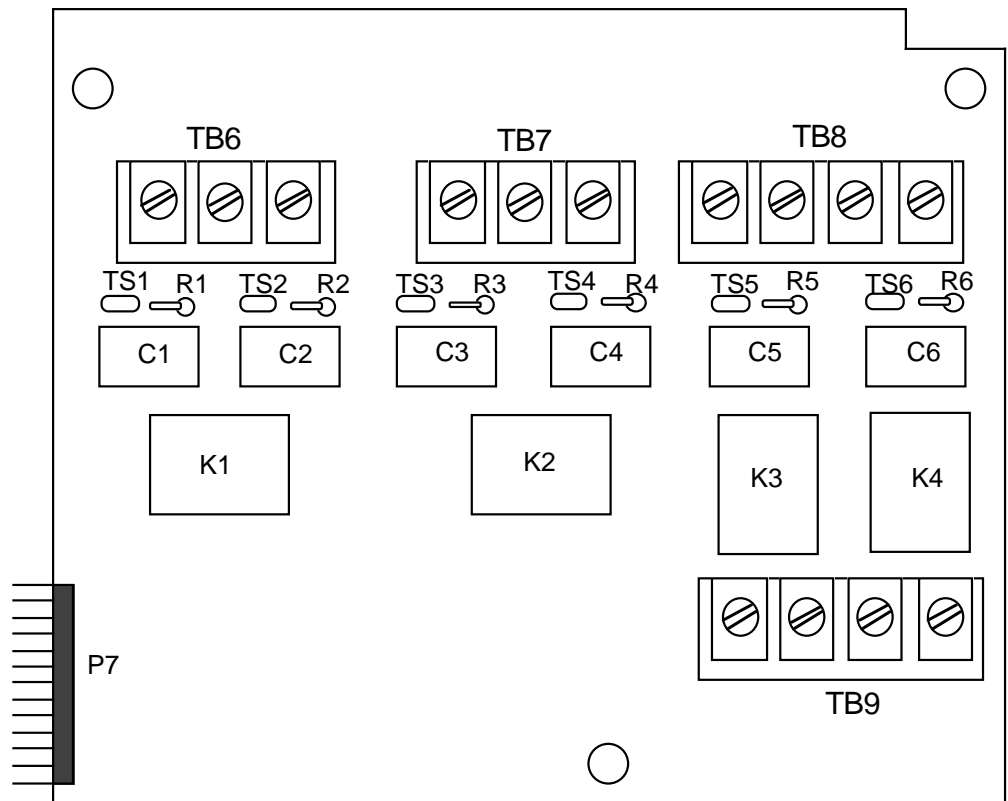
FIGURE A-2A - Relay/SSR (SPST) Driver Output Board



If the relay is connected to a high impedance AC device, the snubber network used to protect the relay contact may cause the output to appear to be activated when the relay is off. To cure the problem, cut the snubber resistor for the output that is being affected.

<u>Resistor</u>	<u>Relay</u>
R1	Relay A
R2	Relay B
R3	Relay C
R4	Relay D
R5	Relay E
R6	Relay F

FIGURE A-2B - Relay (SPDT) Output Board



If the relay is connected to a high impedance AC device, the snubber network used to protect the relay contact may cause the output to appear to be activated when the relay is off. To cure the problem, cut the snubber resistor for the output that is being affected.

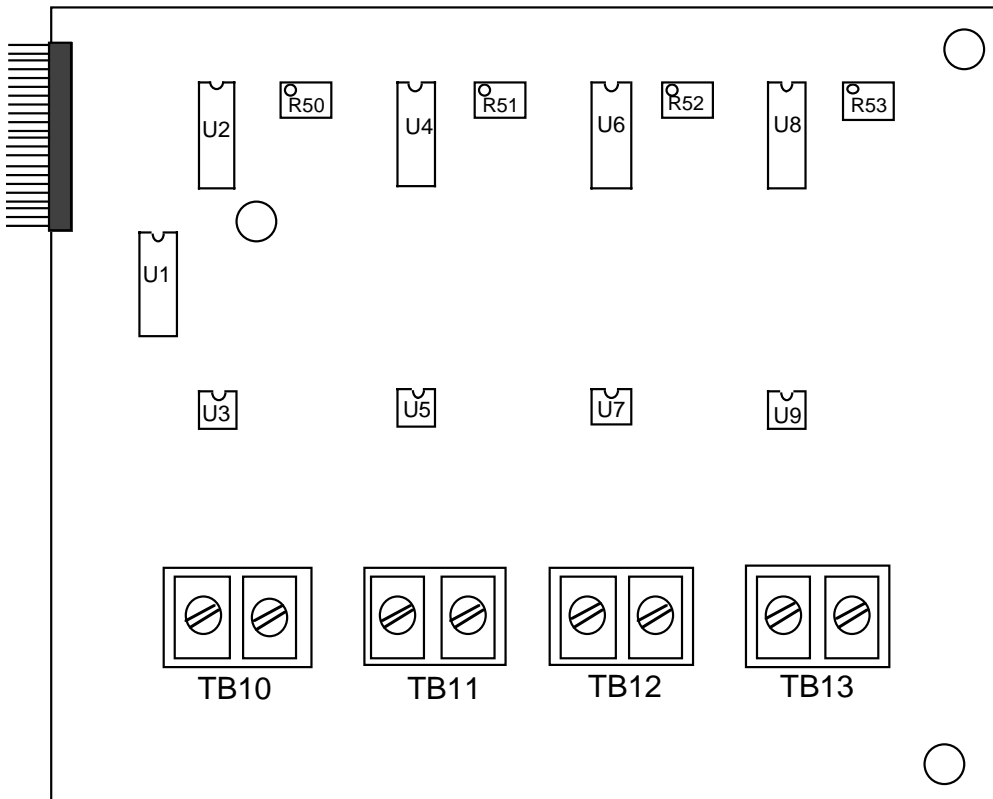
Resistor

- R1
- R2
- R3
- R4
- R5
- R6

Relay

- Relay A N.O
- Relay A N.C.
- Relay B N.O.
- Relay B N.C.
- Relay C
- Relay D

FIGURE A-3 - Current Output Board



If this option board was ordered, you will find it located in the lower right hand corner of the instrument.

Appendix B

Glossary

Display Filter Factor

This parameter is adjustable from 1 to 20 which represents the number of scans of the process variable that are averaged together before updating the displayed and recorded value, and process value for retransmission. The factory default is 1=no filtering. Display code **dFF**.

Flow Time Base

Specifies whether the displayed process value is in units/second, units/minute, units/hour or units/day, such that the flow rate can be converted to flow for totalization. Factory default = 1, units/second. Display code **Ftb**.

Hysteresis

The parameter is adjustable from 0 to 1000 units representing the width of the band (half above and half below alarm setting). Factory default =10. Display code **HyAo**.

Input Correction

This parameter is adjustable from -1000 to 1000 units and is used as a method to compensate for a linear sensor error. Factory default is 0=no correction. Display code **iCor**.

Platen

The flat surface in the instrument upon which the chart rotates.

Process Filter Factor

This parameter is adjustable from 1 to 20 which represents the number of scans per second of the process variable that are averaged together before updating the process value used for alarm, presets. The factory default value is 1=no filtering. Display code **PFF**.

Process Output

Allows retransmission of the process variable. Factory default is 0=not selected. Display code **Pout**. If selected, a current output must be assigned to it and scaled using Process Output upper and lower values.

Process Output Upper and Lower Values (used in conjunction with process output)

These parameters specify the process value range over which the assigned current output will decrease linearly from 100% to 0%. If the process value is greater than **Pou** the output will be 100%. If the process value is less than **PoL** the output will be 0%. Factory default values are 100.0 for the upper value and 0 for the lower value. Display codes **Pou** (upper) and **PoL** (lower).

Process Rounding

This parameter is adjustable from 0 to 1000 units and is used to round the process value to the nearest value specified. Intended for use where the engineering units span is large, to reduce fluctuation. Factory default is 0=no rounding. Display code **Prnd** (e.g. Prnd=3, Process Value=-6, -3, 0, 3, 6, 9 ...).

Square Root Extraction Algorithms (Engineering Units Processing Algorithm)

This parameter chooses the equation for processing the input from a transmitter or transducer.

EuPA = 0 - Linear is for inputs that are directly proportional to flow (no square root extraction needed).

EuPA = 1 - Square Root, takes the square root of the input (pressure or differential pressure) over the whole range of the input.

EuPA = 2 - Two Stage Square Root, takes the square root of the input when the input is greater than 4% of input (20% of flow) and uses a linear relationship below 4% with a slope of 5.

EuPA = 3 - Three Stage Square Root, uses a linear relationship when input is less than 1% with a slope of 1, a linear relationship between 1 and 2.5% with a slope of 10 and a square root above 2.5%.

EuPA = 4 - Variable Exponent, when properly set, provides a means of accurately accommodating weirs and flumes.

EuPA = 5 - Piecewise Linear, provides the user with a means of inputting data from a non-linear sensor.

EuPA = 6 - Variable Exponent with correction, provides a means to use Palmer-Bowlus or H flumes.

EuPA = 7 - Saturated Steam Flow with Pressure Correction.

Display code **EuPA**.

Totalizer Decimal Position

Specifies how the total, preset, and pulsed output values will be displayed. The factory default=0, no decimal. Display code **tdP**.

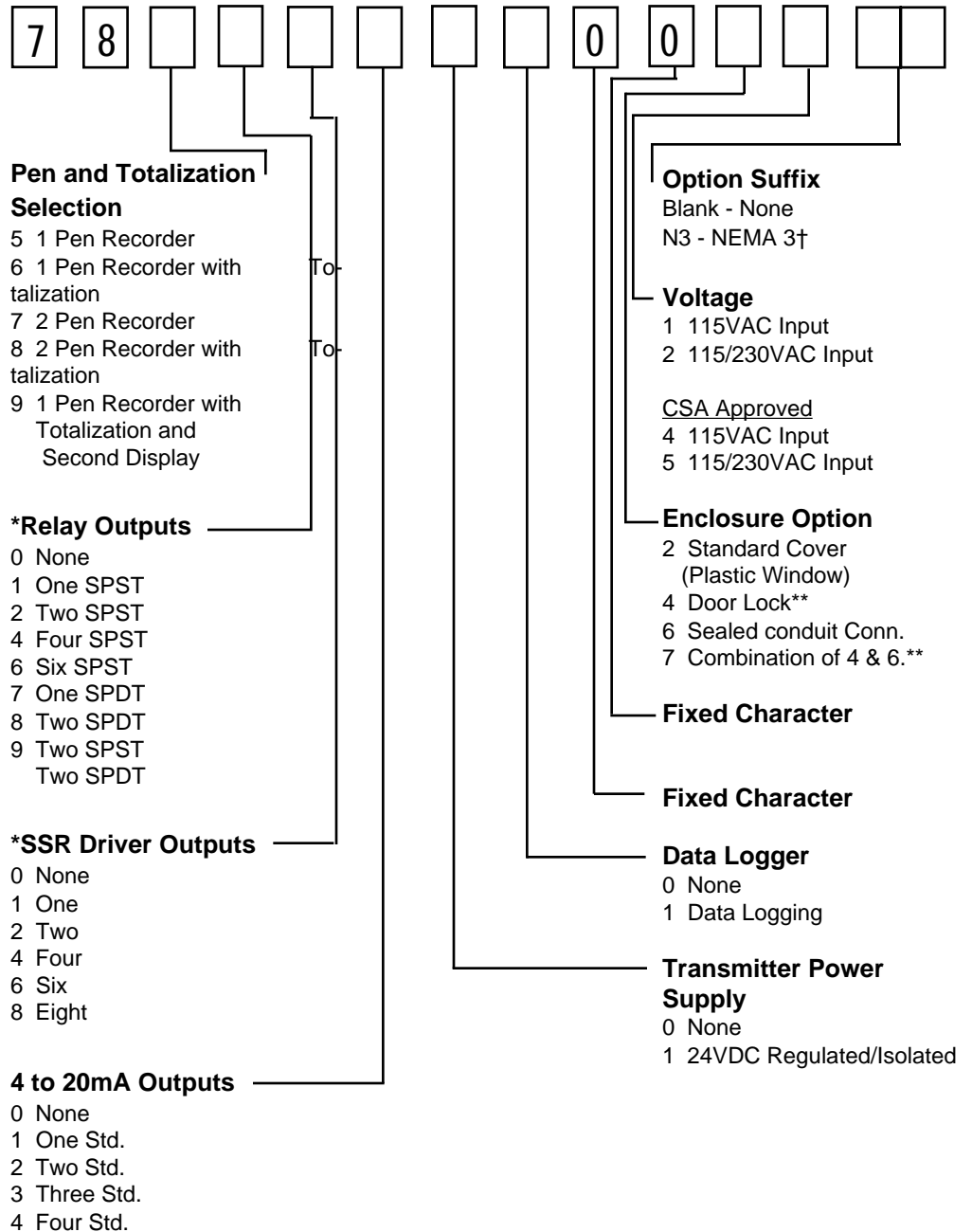
Totalizer Factor

Specifies how the total will be scaled, and as a result, the corresponding scaling of the preset and pulsed output values. For totalizer factor = -4, -3, -2, -1, 0, 1, 2, or 3, the total will be multiplied by .0001, .001, .01, .1, 1, 10, 100, or 1000 respectively. The factory default=0. Display code **tFAC**.

Totalizer Low Flow Cutoff

Below the specified percent of full scale Process Value, the flow will not be added to the total. The factory default = 1.0. Display code **tLFC**.

Appendix C Order Matrix



*Total quantity of Relays and SSR Drivers must be less than or equal to (8) eight.

** This option comes with structural foam cover.

† N3-NEMA3 Equivalent Spray Resistant Enclosure.

Appendix D Specifications

Measurement Error Limit	mA, mV, and VDC +/- 0.25% of scaled span plus 1 Least Significant Digit @ 25 degrees C
Ambient Temperature Error	0.01% of span per degree C deviation from 25 degrees C
Scan Rate	1 to 5 scans/second (One pen units) 1 to 3 scans/second (Two pen units)
Display Decimal Positions	None, One, two or three decimal places
Noise Rejection	Normal mode, 85dB minimum at 60Hz or greater Common mode, 90dB minimum, 115VAC maximum
Line Voltage	115/230VAC +/- 10% 50/60 Hz
Power Consumption	25VA maximum
Operating Temperature	0 to 55° C (ambient) 32 to 131° F
Storage Temperature	-40 to 65° C -40 to 149° F
Humidity	0 to 90% RH, noncondensing
Dimensions	13.19" H x 15.13" W x 3.63" Deep
Weight	20 pounds maximum
Transmitter Fault Detection	Displays SnSr for sensor or transmitter break. Alarm Outputs go off. Presets remain as they were, Pulsed outputs stop. Fault detection is not functional for 0-5V or 0-20mA inputs.
Agency Approvals	UL and CSA
Transmitter Power Supply	Provides up to 42mA of current at 24VDC
Warranty	3 years, see back page for details.

INPUTS	
Milliamps 4-20mADC	Millivolts 0 to 100mV (Can be scaled to any portion of this range)
Volts 0 to 5VDC* 1 to 5VDC*	
*Volt inputs are accomodated by removal of a shunt resistor	

ALARM ADJUSTMENTS	
Process Alarm	0 to 9999
Hysteresis	0 to 1000

PROCESS VALUE OUTPUT	
Current	0 to 20 or 4 to 20 mADC

ALARM, PRESET, AND PULSED OUTPUTS	
Relay	SPST/SPDT 115VAC: 5.0A Resistive, 1/8HP or 250VA 230VAC: 2.5A Resistive, 1/8HP or 250VA
SSR Driver	Open collector output Short circuit protected @ 100mA maximum Provides 4VDC at 20mA or 3VDC at 40mA

DISPLAY	
Digital Display	Two possible; one per installed pen. Red LEDs 0.36" high
Status Indicators	LED indicators for Alarm 1 and Alarm 2, Process Value Displayed (PV) and Total displayed (TOT)

RECORD	
Chart	10 inch circular chart; 100 charts furnished with each instrument if standard range
Chart Range	0 to 9999 units
Chart Drive	DC stepper motor
Chart Rotation	User configurable from 0.1 to 999.9 hours per revolution
Pen Type	Disposable fiber tip
Pen Color	Pen 1 - Red Pen 2 - Green
Pen Response Time	< 9 Seconds over chart span
Accuracy	±1% of chart span max. error from displayed value
Chart Rotation Accuracy	±.5% of chart rotation

Appendix E
Software Record/Reference Sheet

PROGRAM MODE						
	Pen 1	Pen 2	Pen 1	Pen 2		unit
inPS			Pu4			SCnr
iCor			Pu5			rLyA
AL1			Pu6			rLyb
AL2			Pu7			rLyC
dPos			Pu8			rLyd
EuPA			Pu9			rLyE
Euu			Pu10			rLyF
EuL			Pi11			rLyg
EuE			Pu12			rLyH
LFC			Pu13			CurA
dP2			Pu14			Curb
Euu2			Pu15			CurC
EuL2			Pu16			Curd
nPtS			Pu17			CoAr
iu1			Pu18			Cobr
iu2			Pu19			CoCr
iu3			Pu20			Codr
iu4			HyAo			Crt
iu5			Prnd			Coo
iu6			dFF			PAPu
iu7			PFF			
iu8			Pout			
iu9			Pou			
iu10			PoL			
iu11			Cru			
iu12			CrL			
iu13			PAEC			
iu14			tSEL			
iu15			trES			
iu16			tdP			
iu17			tFAC			
iu18			tLFC			
iu19			Ftb			
iu20			PSS1			
Pu1			PSS2			
Pu2			PSS3			
Pu3			PoS			

ENABLE MODE	
EtSt	
ECAL	
EPro	
EASSt	
EdLS	
EdLd	
EPSA	

DATA LOGGER SETUP MODE	
dAy	
tod	
ttLd	
dAtE	
YEAr	

ALARM SET Pen 1 Pen 2		
PAL1		
PAL2		
bAro		

PRESET ADJUST Pen 1 Pen 2		
PS1H		
PS1L		
PS2H		
PS2L		
PS3H		
PS3L		

