MODEL 827A
SINGLE CHANNEL
MASS FLOW
CONTROLLER/READOUT

Instructions

READ AND COMPLY WITH THESE INSTRUCTIONS BEFORE
INSTALLING, OPERATING, OR SERVICING

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I. SERVICE

General Service

A unit which is not functioning in a normal manner should be removed from service until such time that repairs or replacement can be made. Upon completion of repair, full testing should be performed to assure the user that the unit has been returned to its original operating parameters. MATHESON can repair or replace equipment. To arrange for repair or replacement service, call 1-800-828-4313 and ask for the Warranty Administrator. **No product will be received by MATHESON without indication of gas service and without proper return material authorization provided by the warranty administrator. (All repairs must be made by MATHESON or an assigned and approved facility to maintain any warranties or guarantees).**

If the unit is under an applicable warranty, return the unit to MATHESON for repair or replacement. To arrange for warranty service, call 1-800-828-4313 and ask for the Warranty Administrator. **No product will be received by MATHESON without indication of gas service and without proper return material authorization provided by the warranty administrator.**

If advised by the Warranty Administrator to return the product to MATHESON, prepare the product for shipment and write, in large lettering the RMA Number assigned by the Warranty Administrator on the outside of the box. Also, if required by the Warranty Administrator, supply the completed RMA form with the product. Make sure that the product is adequately packaged, in the original shipping container if possible, and shipped prepaid (MATHESON will not accept COD freight) with a description of the observed deficiency to the attention of the:

<div align="center">

Warranty Administrator
MATHESON
166 Keystone Drive
Montgomeryville, PA   18936

</div>

The user is expected to periodically inspect the product for leaks, loose or worn parts, broken or non-functioning components and to address those situations immediately. If the user would require verbal assistance in ascertaining the potential of a problem with any MATHESON product, contact the local MATHESON branch for assistance or your MATHESON Sales Representative.

II. LIMITED WARRANTY

This equipment is sold by MATHESON under the warranties set forth in the following paragraphs.   Such warranties are extended only with respect to the purchase of this equipment directly from MATHESON or MATHESON's Authorized Agent as new merchandise and are extended to the first Buyer thereof other for than the purpose of resale.

For a period of one year from date of original delivery (ninety days in corrosive service) to Buyer or to Buyer's order, this equipment, is warranted to be free from functional defects in materials and workmanship and to conform to the description of this equipment contained in this manual and any accompanying labels and/or inserts, provided that this equipment is properly operated under the conditions of normal use and that regular and periodic maintenance and service is performed or replacements are made in accordance with the instructions provided.   Expendable parts of this equipment are similarly warranted to be free from functional defects in materials and workmanship and to conform to the description of this equipment contained in this manual and any accompanying labels and/or inserts.   The foregoing warranties shall not apply if the equipment has been repaired other than by MATHESON or a service facility designated by MATHESON, or if this equipment has not been operated and maintained in accordance with written instructions provided by MATHESON, or has been altered by anyone other than MATHESON, or if the equipment has been subject to abuse, misuse, negligence or accident.

MATHESON's sole and exclusive obligation and the Buyer's sole and exclusive remedy under the above warranties is limited to repairing or replacing, free of charge, at MATHESON's sole discretion, the equipment or part which is telephonically reported to be a problem to the local MATHESON Branch Location, and which if so advised, is returned with a written statement of the observed deficiency, not later than seven days after the expiration of the applicable warranty, to the MATHESON Gas Equipment Technology Center during normal business hours, transportation charges prepaid, and which, upon examination, is found to comply with the above warranties.   The Buyer shall pay for return trip transportation charges for the equipment or part.

MATHESON shall not be otherwise liable for any damages including but not limited to incidental damages, consequential damages, or special damages, whether such damages result from negligence, breach of warranty or otherwise.

There are no express or implied warranties that extend beyond the warranties hereinabove set forth.   MATHESON makes no warranty of merchantability or fitness for a particular purpose with respect to the equipment or parts thereof.

Acceptance of the equipment by the final buyer indicates the final buyer's acceptance of all warranties and limitations set forth above.

III. USER RESPONSIBILITY

This equipment will perform in conformity with the description thereof contained in this manual and accompanying labels and/or inserts when installed, operated, maintained and repaired in accordance with the instructions provided.   This equipment must be checked periodically, with the frequency of such inspections depending upon the scope of use. Damaged, worn or contaminated equipment should not be used.   Parts that are broken, missing, plainly worn, distorted or contaminated should be replaced immediately. Should such repair or replacement become necessary, MATHESON recommends that a telephonic or written request for service advice be made to the MATHESON Equipment Engineering Group in Montgomeryville, Pennsylvania or to the nearest MATHESON branch location.

This equipment or any of its parts should not be altered without the prior written approval of MATHESON Equipment Engineering Group.   The user of this equipment shall have the sole responsibility for any malfunction, which results from improper use, faulty maintenance, damage, improper repair or alteration by anyone other than MATHESON or a service facility designated by MATHESON.   Further, the ultimate user of the equipment is responsible for the training and safe operation of the equipment by personnel in his/her employ.

IV. DESCRIPTION

The 827Ais a microprocessor-based digital indicator capable of interfacing directly to a mass flow meter or a mass flow meter controller. An integrated +/-5vdc @ 250ma power supply is available providing a well regulated, short circuit and thermal overload protected output. It is packaged in a small 1/8 DIN, 5.5" deep extruded aluminum housing which provides excellent EMI/RFI shielding and good heat dissipation characteristics.

The 827A is a state-of-the-art product and uses the latest surface mount components. The internal microprocessor provides the following capabilities:

- Pushbutton Zero and Full Scale Calibration
- Front Panel Setup of Flow meter Controller Control Voltage (0-5 vdc)
- Front Panel Setup of (2) High and (2) Low Digital Set points with open collector outputs.

V. SPECIFICATIONS

Signal Input:	0-5 vdc
Input Resistance:	> 1 Megohm
Input Bias Current:	< 1 na
Display Type:	0.4" high efficiency red LEDs
Max Display Range:	+/- 99,999 counts
A/D Resolution:	+/- 19,999 counts
Linearity:	+/- 0.01% FS +/- 1 count
FS Accuracy:	+/- 0.01% FS +/- 1 count
FS Step Response:	500ms (typ)
Over-range Display:	Flashing digits for input > 5.5 vdc
No Sensor Indication:	Flashing digits
Flow meter Set point Output:	0-5 vdc
Flow meter Power Supply:	+/- 15 vdc +/- 5% @ 250 ma (min)
Operating Range:	-10 to +50 degC
Input Power:	100, 110, 220 and 240 VAC
	(solder pad jumper selectable)
Pkg dimensions:	3.78W x 1.89H x 5.13D

VI. INSTALLATION

The 827A enclosure is designated for panel mounting in a 1/8 DIN cut out.   The cutout
dimensions are shown below.
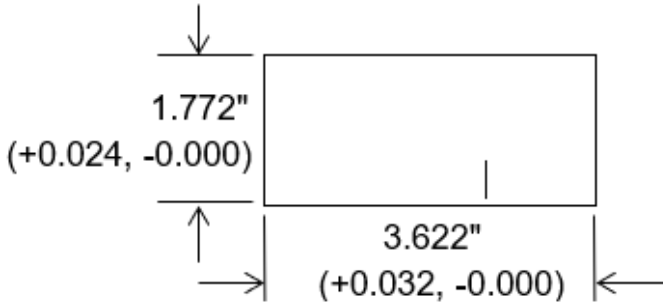
To panel mount the unit, perform the following steps.

1. Rotate the four pawl screws (outside screws in each corner several turns
    counterclockwise to retract the pawls.   Make sure the pawls retract enough to clear
    the back of the mounting panel.   The pawls may be retracted to accommodate panel
    thicknesses up to 0.25 inches (6.35mm).

2. Insert the instrument into the panel cutout.

3. Position the pawls so that their elongated dimension overlaps the panel cut out, then
    tighten the screws. Do not over-tighten.

4. Installation complete.

VII. WIRING

Reference Figures 3 and 4 for TRANSDUCER and INPUT/OUTPUT (I/O) wiring information. Power is applied with a 3-prong AC power cord. The instrument is protected by a 250V, 500ma, slo blo, 5mm fuse. The fuse holder is an integral part of the input power connector. A spare fuse is provided in the fuse holder. Internal solder jumpers are provided to allow 100, 110, 220 or 240VAC operation.
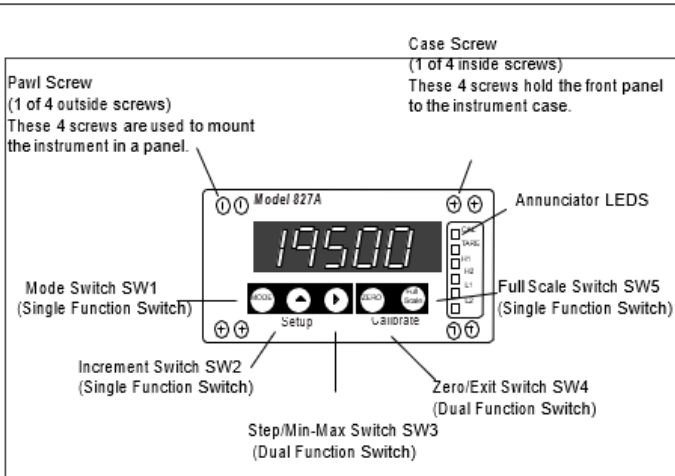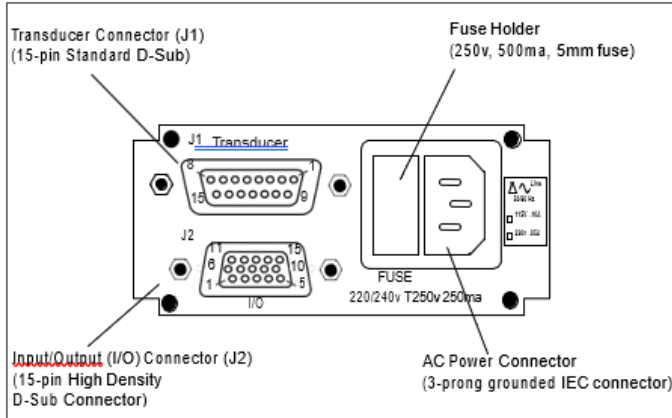

Figure 1. 827A Front Panel View
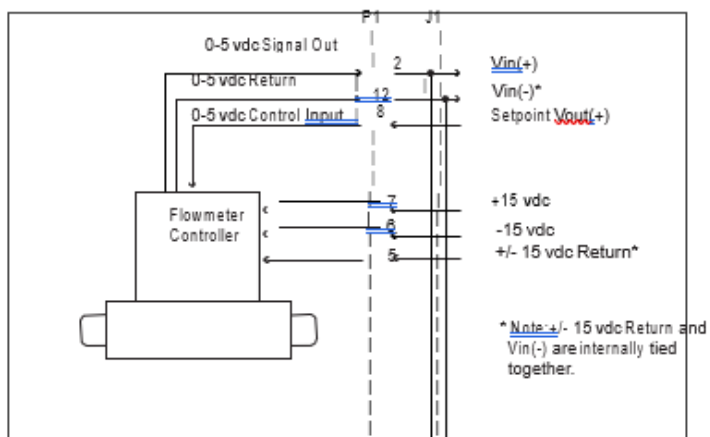
Figure 2. 827A Model Rear Panel View

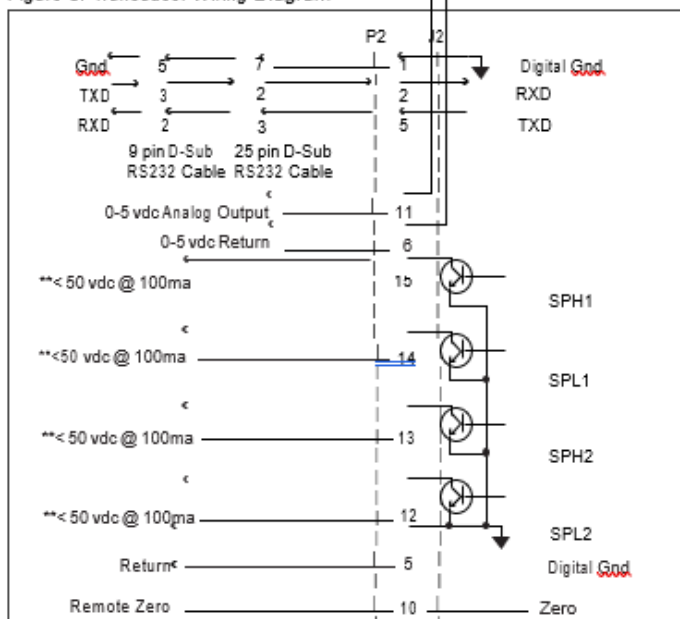0-5 vdc Signal Out

0-5 vdc Return

0-5 vdc Control Input

Flowmeter Controller

P1   J1

2 — Vin(+)

12 — Vin(-)*

8 — Setpoint Vout(+)

7 — +15 vdc

6 — -15 vdc

5 — +/- 15 vdc Return*

* Note: +/- 15 vdc Return and Vin(-) are internally tied together.

Figure 3. Transducer Wiring Diagram

P2   J2

Gnd	5	1	1	Digital Gnd
TXD	3	2	2	RXD
RXD	2	3	5	TXD

9 pin D-Sub   25 pin D-Sub
RS232 Cable   RS232 Cable

0-5 vdc Analog Output — 11

0-5 vdc Return — 6

**< 50 vdc @ 100ma — 15   SPH1

**<50 vdc @ 100ma — 14   SPL1

**< 50 vdc @ 100ma — 13   SPH2

**< 50 vdc @ 100ma — 12   SPL2

Return — 5   Digital Gnd

Remote Zero — 10 — Zero

** Maximum recommended load

Figure 4. I/O Wiring Diagram

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VIII. SWITCH DEFINITIONS

Mode Switch (S1)

The Mode switch (S1) is used to cycle through the various set points, hysteresis, calibration values and decimal point locations. The sequence is as follows. The designators, in parenthesis, identify text that will be displayed, momentarily, followed by the value.

Setpoint for Flow	StPt)
Set Point High 1	(SPH1)
Set Point Low 1	(SPL1)
Set Point High 2	(SPH2)
Set Point Low 2	(SPL2)
Hysteresis High	(HH)
Hysteresis Low	(HL)
Cal	(CAL)
Decimal Point	(dP)
Exit	

While in the Mode Selection sequence, the indicator is no longer monitoring the input signal. To exit at any time, simply depress S4. All new data entered prior to exiting, except StPt, will be stored in non-volatile memory and recalled at power on. The StPt value is retained in static RAM and valid only while power to the unit is maintained. At power turn on the value of StPt defaults to 0000 and the Setpoint output voltage will be approximately -0.5 vdc.

Increment Switch (S2)

This switch increments the flashing digit. When first used, no digits may be flashing. The most significant digit for StPt can be turned off using S2. While updating this digit the display will toggle through the following digits:1, 2, 3, 4, 5, 6, 7, 8, 9, Blank. Zero (0) cannot be selected.

Step and Min-Max Switch (S3)

This switch has a dual function. When in the MODE sequence, it steps the digit to be incremented, one position to the right. Using S3 in conjunction with S2 allows rapid updating of all parameter values.

When *not* in the MODE sequence, depressing S3 displays the HI (Max) and LO (Min) readings, momentarily. These values are stored in static RAMS and are reset when power is applied.

Zero and Exit Switch (S4)

This switch has a dual function. When *not* in the MODE sequence, this switch must be depressed and held for approximately 3 seconds before it zeroes the reading on the display. The ZERO annunciator on the front panel should be illuminated. ZEROing is accomplished by storing the reading just prior to ZEROing and subtracting this value from all subsequent readings. This value is retained in non-volatile memory and recalled when power is applied. It is also used to compensate the StPt control voltage output.

When in the MODE sequence, this switch is used to exit. All values entered prior to exiting, except for the StPt value, will be retained in non-volatile memory and recalled when power is applied.

Cal Switch (S5)

This switch must be depressed and held for approximately 3 seconds to auto-calibrate the readout. When initially held and depressed for 3 seconds the CAL annunciator will extinguish and the display will read the raw data generated by the analog-to-digital converter. When depressed and held again for 3 seconds the CAL annunciator will illuminate and the raw data will automatically be scaled to the CAL value entered previously. (Reference the PROGRAM INSTRUCTIONS page 10 and the CALIBRATION INSTRUCTIONS on page 14 for more information)

IX. FUNCTION DEFINITIONS

The Mode switch (S1) cycles through the following functions.

Setpoint (StPt)
The Setpoint (0-5 vdc) command signal used to control the flow through a flowmeter controller. The output voltage is 0-5 vdc. The setpoint output is defined as:

$$\text{Setpoint Output} = \text{StPt} / \text{CAL} \times 5.000 \text{ vdc} +/- \text{Voffset}$$
$$\text{where Voffset} = \text{Flowmeter Output Offset voltage}$$

Example: If the CAL value was programmed to be 7500 sccm and the desired flow rate is 5000 sccm, enter 5000 for the StPt value. Depress the ZERO switch to exit the MODE sequence and the Setpoint Output voltage will be 3.333 vdc. This is assuming the Flowmeter output had no offset voltage.

Note: If switch SWd (Reference drawing on page 15) is ON at power-up, the last StPt value will be recalled.   If Switch SWd is OFF, the StPt output will be zero at power-up. The StPt display will always default to 0000 at power-up and may not correspond to the actual StPt value if SWd is ON.

Set Point High 1 (SPH1)
SPH1 is a digital setpoint being constantly compared with the displayed reading. If the magnitude and sign of the reading *exceeds* the SPH1 value, the SPH1 open collector output will activate and pull its respective D-Sub connector pin to ground (Ref Figure 4 on page 7). The front panel LED (H1) will also illuminate. If SPH1 is exceeded, the reading must then drop below SPH1 less the Hysteresis High (HH) value before the open collector output opens and the H1 LED turns off.

Set Point Low 1 (SPL1)
SPL1 is another digital setpoint being constantly compared with the displayed reading. If the magnitude and sign of the displayed reading *is less* than the SPL1 value, the SPL1 open collector output will activate and LED (L1) will illuminate.   If the displayed reading drops below SPL1, it must then exceed SPL1 plus the Hysteresis Low (HL) value before the open collector output opens and the L1 LED turns off.

Set Point High 2 (SPH2)
SPH2 is independent and functions identically to SPH1. SPH2 has its own open collector outputs and front panel LED (H2).

Set Point Low 2 (SPL2)
SPL2 is independent and functions identically to SPL1. SPL2 has its own open collector outputs and front panel LED (L2).

Hysteresis High (HH)

HH is the hysteresis value for SPH1 and SPH2. The hysteresis value determines the number of counts the displayed reading must fall below SPH1 and SPH2 values before deactivating their respective open collector outputs and LEDs. The maximum value of hysteresis is 99 counts while the minimum is 00 counts.

Hysteresis Low (HL)

HL is the hysteresis value for SPL1 and SPL2. The hysteresis value determines the number of counts the displayed reading must exceed the SPL1 and SPL2 values before deactivating their respective open collector outputs and LEDs. The maximum value of hysteresis is 99 counts while the minimum is 00 counts.

FS Cal (CAL)

This input allows the user to calibrate the full scale readout to any desired engineering units. This input must be entered prior to performing the calibration. The FS Cal number may be any number from 1 to 99,999. Zero is an invalid FS Cal number. For best resolution and stability, choose a CAL number between 2000 and 19000 counts.

Example: If the Flowmeter is to be calibrated at a full scale flowrate of 500 sccm, the FS Cal value could be 500.00, 500.0 or 500. If the FS Cal value of 500.00 is used, the unit will automatically count by 3 when full scale calibration is completed since the analog-to-digital converter resolution is only 19,999 counts. Choosing a FS Cal value of 500.0 or 500 assures the best resolution and stability in this particular case.

Decimal Point (dP)

dP allows selection of decimal point locations for display. The locations selectable are x.xxxx, xx.xxx, xxx.xx, xxxx.x and xxxxx.

The STEP and MIN-MAX RECALL switch (S3) is used to momentarily display the MAX (HI) and the MIN(LO) values displayed. Switch S3 must be used without first depressing MODE (S1). If S1 is depressed first, S3 takes on the STEP function.

Min/Max Recall (HI/LO)

The HI and LO values are the maximum and minimum values, respectively, of the displayed readings. Sign and magnitude are constantly compared with the displayed readings at the instrument update rate of 2.5 times per second. The HI and LO values are retained in static RAM and are lost if power to the instrument is removed. When power is applied, the maximum value is initialized to -99,999 and the minimum value to 99.999.

X. OPERATING INSTRUCTIONS

TURN-ON INSTRUCTIONS

Reference Figures 3 and 4 for proper input and output signal wiring.

1. Apply power to the instrument.

2. Verify the instrument readout blanks momentarily, then displays

   the value of the input signal.

3. To clear the StPt register, depress the MODE(S1), then the

   ZERO (S4) switch prior to using the instrument.

XI. PROGRAM INSTRUCTIONS

Five front panel switches (S1, S2, S3, S4 and S5) allow the user to program Flowmeter Setpoint Output Voltage (StPt), Digital Set points (SPH1, SPL1, SPH2 and SPL2), Hysteresis (HH and HL), Calibration Number (CAL) and Decimal Points (dP) and monitor minimum, maximum or real time values.
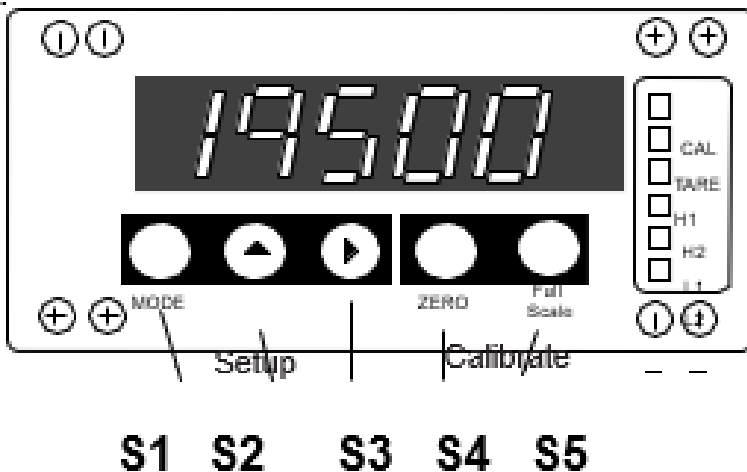
1. Depress MODE (S1) switch once.
The text ***StPt*** will be displayed momentarily followed by the current value for the Flowmeter Setpoint. Use switches S2 and S3 to set the StPt value. Proceed to Step 2 to set Set Point H1 (SPH1) or depress S4 to exit the MODE sequence. If S4 is depressed the latest StPt value is used to generate a new Flowmeter Setpoint output voltage.

2. Depress MODE (S1) switch once.
The text ***SPH1*** followed by the current value of Set Point High 1 (SPH1) will be displayed. Use S2 and S3 to set SetPoint High 1 to the desired value. Proceed to Step 3 to set Setpoint Low 1 (SPL1) or depress S4 to exit MODE sequence. If S4 is depressed, the new value for SPH1 will be saved in non-volatile NOVRAM memory.

3. Depress MODE (S1) switch once.
The text ***SPL1*** followed by the current value of Set Point Low 1 will be displayed. Repeat Step 2 to set SetPoint Low 1 to the desired value. Proceed to Step 4 or depress S4 to exit.

4. Depress MODE (S1) switch once.
The text ***SPH2*** followed by the current value of SetPoint High 2 will be displayed. Repeat Step 2 to set SetPoint High 2 to the desired value. Proceed to Step 5 or depress S4 to exit.

5. Depress MODE (S1) switch once.
The text ***SPL2*** followed by the current value of SetPoint Low 2 will be displayed. Repeat Step 2 to set SetPoint Low 2 to the desired value. Proceed to Step 6 or depress S4 to exit.

6. Depress MODE (S1) switch once.
The text ***HH*** followed by the current value of Hysteresis High will be displayed. Repeat Step 2 to set Hysteresis High to the desired value. The maximum value for HH is 99 counts. Proceed to Step 7 or depress S4 to exit.

7. Depress MODE (S1) switch once.
The text ***HL*** followed by the current value of Hysteresis Low will be displayed. Repeat Step 2 to set Hysteresis Low to the desired value. The maximum value for HL is 99 counts. Proceed to Step 8 or depress S4 to exit.

8. Depress MODE (S1) switch once.
The text ***CAL*** followed by the current CAL number will be displayed. Repeat Step 2 to set the CAL number. Proceed to Step 9 or depress S4 to exit.

9. Depress MODE (S1) switch once.
The text ***dP*** followed by the current decimal position will be shown flashing. Use S2 to set the decimal point to the desired location.

10. Depress MODE (S1) switch once.

   The instrument will exit the Mode Selection Sequence and enter the normal operating mode (i.e. monitoring the input signal).   This is the end of the PROGRAM INSTRUCTIONS.

XII. CALIBRATION INSTRUCTIONS

Prior to connecting the 827A to the Flowmeter Controller, verify that the Controller's +/-15 vdc requirement is no more than 250 ma. The 827A is capable of supplying up to 500 ma for short periods of time (in 1/2 or 1 hour increments). Consult the factory if the current requirement is > 250ma for prolonged periods of time.

Connect the 827A to the Flowmeter Controller or a precision voltage source with an accuracy of 0.01% or better per Figure 3. The voltage source should be connected between J1-2 and J1-12. Apply AC power to the 827A. Verify that the 827A lights up and the instrument is displaying a stable reading. If no display appears after 1 or 2 seconds has elapsed, remove the ac power and check the fuse contained in the AC Power Connector at the rear of the 827A (Reference Figure 2 on page 6).

If a stable display appears, allow 15-30 minutes for the 827A to stabilize, then perform the calibration procedure shown below.

1. The FS Cal (CAL) value must be entered prior to performing this calibration procedure. Reference page 9 to enter the FS Cal (CAL) value.

2. Apply zero flow to the Flowmeter, if calibration is done with a Flowmeter, or zero vdc to the 827A, if calibration is done with a precision voltage source.

3. Depress and hold CAL (S5) switch for approximately 3 seconds. Verify FS CAL annunciator is extinguished. The 827A is now uncalibrated.

4. Depress and hold the ZERO (S4) switch for approximately 3 seconds (Reference Figure 1 on page 6). Verify ZERO annunciator LED is illuminated and the display reads 0000 +/- 0001 counts. Ignore the decimal point. The 827A is now zeroed.

5. Apply full scale flow to the Flowmeter or 5.000 vdc +/- 0.0005 vdc to the 827A.

6.   Depress and hold CAL (S5) for approximately 3 seconds.   The FS CAL LED should illuminate and the readout should display the FS Cal value within +/- 1 digit.

7. The CALIBRATION sequence is now complete.

NOTE: Calibration information (zero and scale factor values) are stored in non-volatile memory and are updated every time calibration step 6 above is performed.   ZEROing the display changes and stores a new zero value but does not affect the scale factor value.

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XIII. RS232 SERIAL COMMUNICATIONS

The Parity (Even or None) and the Baud Rate (2400 or 9600) are selectable by setting DIP switches *SWa* and *SWb*, accessible from the right side of the instrument case. *SWc* is utilized for Pressure Controller applications only. *Swd* turns StPt memory ON or OFF (Reference StPt Function Definition on Page 10).
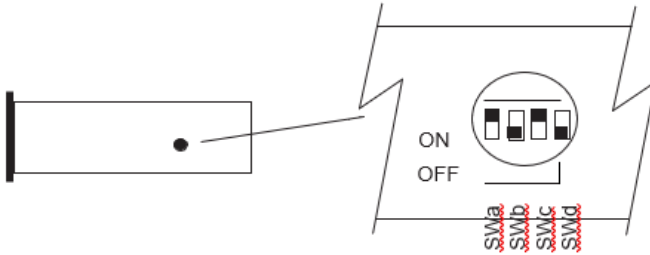
Parity (SWa)	Baud Rate (SWb)	Stpt Voltage (SWc)	Stpt Memory (SWd)
ON = Even	ON = 2400	On = 5 V	On= Memory On
OFF = None	OFF = 9600	Off = 10V	Off= Memory Off

Baud Rate: Programmable for 2400 or 9600 Baud
Parity: Programmable for Even or None
Data Bits: For Even Parity (7 data bits) For Odd Parity (8 data bits)
Stop Bits: One
Delimeter: CrLf (Carriage Return-Line Feed)

Command Syntax
Notes: In the following tables, each command or request element separated with square brackets [ ] is for clarity only.

Unless Otherwise Specified
[value] is indicated as % of full scale and takes the following form: signxxx.xx

When entering commands, unless a minus sign is included, value will be accepted as positive.

When responding to a request, value will contain a +/- sign followed by a number complete to two decimal places [counts] will represent an actual number within a defined range

COMMAND PROTOCOL	FUNCTION
[Z] [CR] [LF]	Zero the displayed reading
[F] [CR] [LF]	Calibrate Full Scale (Input signal is scaled to display Full Scale)
[S] [counts] [CR] [LF]	Set Full Scale display value. (counts range = 0 .... 99999)
[D] [value] [CR] [LF]	Set decimal position
	1 = x.xxxx
	2 = xx.xxx
	3 = xxx.xx
	4 = xxxx.x
	5 = xxxxx
[P1] [value] [CR] [LF]	Set level of Lo Alarm #1
[P2] [value] [CR] [LF]	Set level of Lo Alarm #2
[P3] [value] [CR] [LF]	Set level of Lo Alarm #3
[P4] [value] [CR] [LF]	Set level of Lo Alarm #4
[H1] [counts] [CR] [LF]	Set Lo Alarms #1&2 hysteresis
[H2] [counts] [CR] [LF]	Set Hi Alarms #1&2 hysteresis

REQUEST PROTOCOL FUNCTION	RETURN MESSAGE
[R5] [CR] [LF]	Pressure value [P] [value] [CR] [LF]
[R8] [CR] [LF]	Full Scale display [S] [counts] [CR] [LF]
[R9] [CR] [LF]	Decimal location [D] [value] [CR] [LF]
	1 = x.xxxx
	2 = xx.xxx
	3 = xxx.xx
	4 = xxxx.x
	5 = xxxxx
[R1] [CR] [LF]	Lo Alarm #1 level [P1] [value] [CR] [LF] Hi
[R2] [CR] [LF]	Alarm #1 level [P2] [value] [CR] [LF]
[R3] [CR] [LF]	Lo Alarm #2 level [P3] [value] [CR] [LF]
[R4] [CR] [LF]	Hi Alarm #2 level [P4] [value] [CR] [LF]
[R6] [CR] [LF]	Lo Alarm #1&2 hysteresis [H1] [counts] [CR] [LF]
[R7] [CR] [LF]	Hi Alarm #1&2 hysteresis [H2] [counts] [CR] [LF]
[RX] [CR] [LF]	Setpoint value [X] [counts] [CR] [LF]

Serial Lockout:
The 827A will respond to RS-232 commands and queries while it is in the normal display mode. When it is in the menu entry or calibration modes it will not respond to RS-232 commands or queries.

MATHESON
ask. . .The Gas Professionals™

166 Keystone Drive
Montgomeryville, PA 18936
800-828-4313
www.mathesongas.com
INT-0329 rev B

TERMS AND CONDITIONS OF SALE
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