SCOPE OF MANUAL

This manual contains information concerning the installation, operation and maintenance of the Series 5000 Compu-Sonic ultrasonic flowmeter. To ensure proper performance of the meter, the instructions given in this manual should be thoroughly understood and followed.

Keep the manual in a readily accessible location for future reference.

Changes and additions to the original edition of this manual will be covered by a "CHANGE NOTICE" supplied with the manual. The change notice will explain any changes made to the product described in this manual.

MODEL 5000 TABLE OF CONTENTS

To avoid damage in transit, Eastech Badger products are shipped to the customer in special shipping containers. Upon receipt of the product, perform the following unpacking and inspection procedures:

NOTE: If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.

a. Carefully open the shipping container following any instructions that may be marked on the box. Remove all cushioning material surrounding the product and carefully lift the product from the container.

Retain the container and all packing material for possible use in reshipment or storage.

b. Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the customer.

GENERAL DESCRIPTION

The Series 5000 Compu-Sonic flowmeters are designed to measure flow in open channels or partially filled conduits. These flowmeters utilize ultrasonic measurement techniques to determine fluid velocity and fluid depth to calculate the volume of flow.

There are several installation configurations utilized in the Series 5000 flowmeters depending on the particular application. These installation configurations are divided into two models: the Model 5100 where the velocity and level sensors are mounted on existing open channels or pipes; and the Model 5200 where the velocity and level sensors are factory mounted on a fabricated spool that is installed into a section of the pipe line.

The Series 5000 flowmeters are calibrated at the factory to the application parameters provided by the customer. Minimal on-site calibration of the system is usually required. Factory start-up is provided with each flowmeter to ensure proper operation of the system and to train personnel that will be responsible for maintaining the flowmeter.

At the front of this manual are the data sheets and an installation drawing describing the parameters for which the flowmeter was calibrated and the installation configuration for the velocity and level sensors. The customer should view these for correctness and notify the factory should he discover any parameters that are not correct.

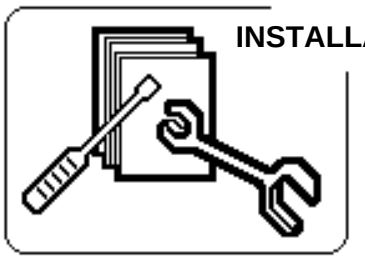
The following sections of this manual cover the installation and operation procedures for the Series 5000 flowmeters. **These procedures should be read before attempting installation or operation of the flowmeter.**

The Installation Section for the velocity and level sensors will cover the various installation configurations. Refer to the data sheet and installation drawing in the front of this manual for the proper installation procedure to be used.

Below are the General Specifications for the Series 5000 flowmeters.

GENERAL SPECIFICATIONS

OUTPUT SIGNALS	Isolated 4-20 mADC for flow, 800 ohms max. Isolated 4-20 mADC for level, 800 ohms max. Isolated 4-20 mADC for velocity, 800 ohms max. Pulse output to pace sampler, Triac max 230 VAC at 600 mA Pulse output for remote totalizer, open collector 40 VDC max. at 100 mA Four assignable relay outputs, SPDT, 1 amp at 120 volts.
DISPLAYS	Four 2 line, 24 character LCD, for flow, level, velocity and Doppler/pressure
POWER	117 VAC 20 watts (210 watts with heater and thermostat)
ENCLOSURE	NEMA 4X with viewing window
TEMPERATURE LIMITS	Sensors: -20° F to 160° F (-30° C to 70° C) Electronics: 32°F to 150°F (0°C to 65°C), -40°F to 150°F (-40°C to 65°C) with heater and thermostat



INSTALLATION

ELECTRONIC ENCLOSURE

The Series 5000 electronics is housed in a NEMA 4X plastic enclosure designed for wall mounting. The enclosure is normally provided with heater and thermostat, front door viewing window and lockable door latches. The front door can be provided without the viewing window at the option of the user.

ENCLOSURE MOUNTING

Figure 1 shows the dimensions of the enclosure. **If the enclosure is to be installed outdoors, care should be taken so it is not exposed to the direct sun light by selecting an area in the shade or providing a sun shield.**

The enclosure is provided with four mounting ears which are packed in a plastic bag and taped to the inside of the enclosure. This bag will also contain the screws for installing the ears to the enclosure and the keys for the lockable door latch.

The enclosure weights approximately 40 pounds, and care should be taken to securely mount the enclosure to the wall.

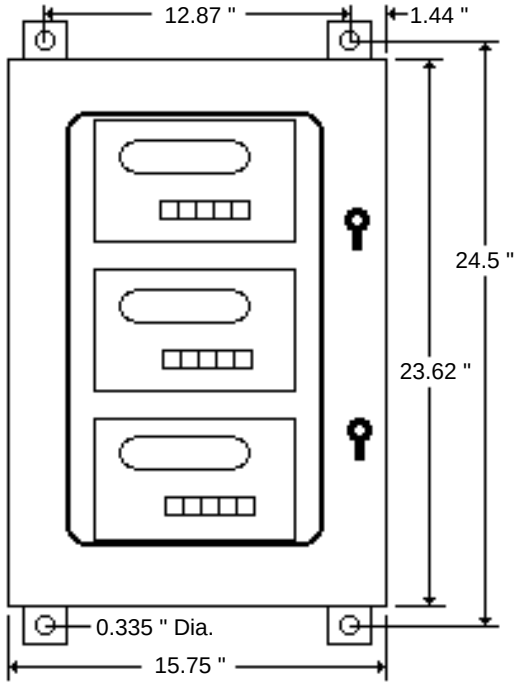


FIGURE 1

WIRING CONNECTIONS

The Series 5000 enclosure is provided with five (5) holes in the bottom of the housing for 1/2 inch conduit connections. These five (5) holes allow the entry of the Doppler/pressure cable, AC power wires, transit-time velocity sensor cables, ultrasonic level sensor cable, and 4-20 mADC signal output wires.

Terminal blocks for connecting the AC power wires, signal output wires, transit time velocity sensor cables and ultrasonic level sensor cable are mounted on the back panel inside the enclosure. The Doppler/pressure sensor cable connects to a terminal block on the Doppler/pressure circuit board on the back panel. To gain access to the wiring terminals, open the front door, lift the two (2) latches on the front panel and swing out the front panel. Refer to Figures 2 and 3.

Wiring connections should be made by a licensed electrician following the electrical wiring codes for your area.

AC POWER CONNECTIONS. The AC power wires are connected to terminal 1, 2, and 3 of the Panel Terminal Block. Terminal 1 is the high, or hot, (black wire) connection. Terminal 2 is the low or neutral (white wire) connection. Terminal 3 is the earth ground (green wire) connection.

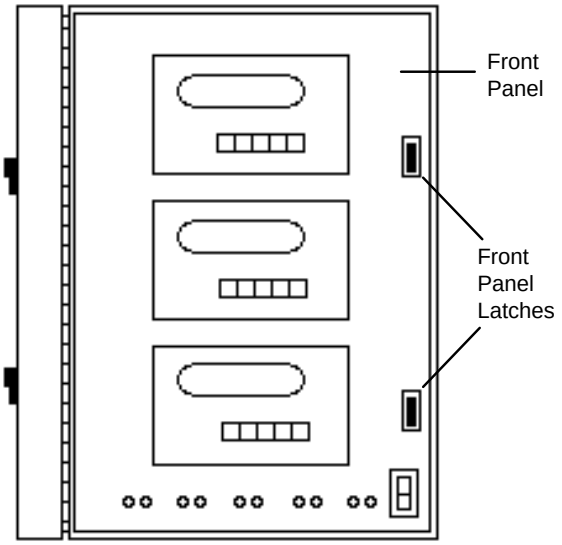


FIGURE 2
FRONT OF ENCLOSURE WITH DOOR OPEN

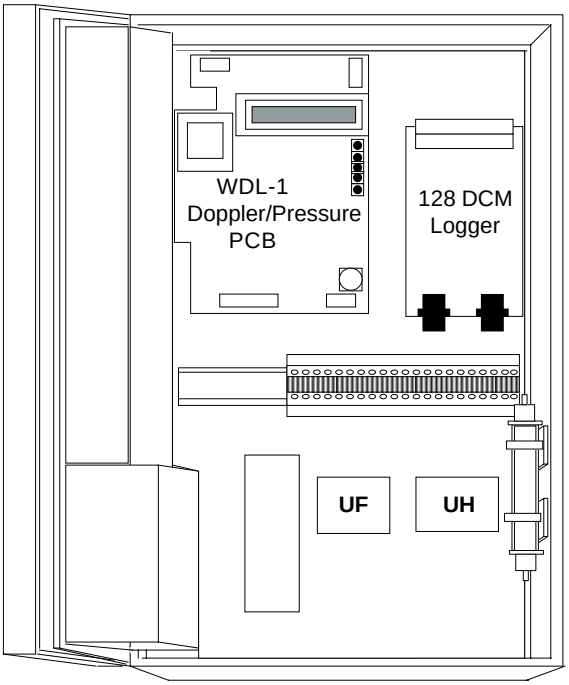
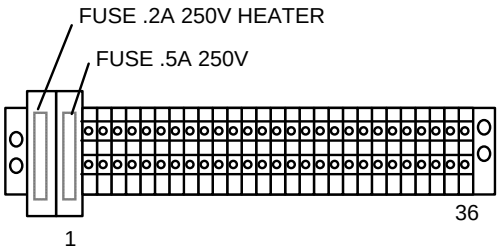


FIGURE 3
VIEW OF BACK PANEL

FIGURE 4
BACK PANEL TERMINAL
BLOCK WIRING CONNECTIONS

AC POWER-LINE (FUSED)			# 1
AC POWER-NEUTRAL			# 2
AC POWER-GROUND			# 3
OPEN			# 4
OPEN			# 5
LEVEL/RELAY 1	-NC		# 6
LEVEL/RELAY 1	-C		# 7
LEVEL/RELAY 1	-NO		# 8
LEVEL/RELAY 2	-NC		# 9
LEVEL/RELAY 2	-C		#10
LEVEL/RELAY 2	-NO		#11
SAMPLER	-LO		#12
SAMPLER	-HI		#13
REMOTE TOTALIZER		(-)	#14
REMOTE TOTALIZER		(+)	#15
NOT USED			#16
NOT USED			#17
HI SCALE FLOW	(4-20)	(-)	#18
HI SCALE FLOW	(4-20)	(+)	#19
LO SCALE FLOW	(4-20)	(-)	#20
LO SCALE FLOW	(4-20)	(+)	#21
VELOCITY	(4-20)	(-)	#22
VELOCITY	(4-20)	(+)	#23
LEVEL	(4-20)	(-)	#24
LEVEL	(4-20)	(+)	#25
VEL / RELAY 3	-NC		#26
VEL / RELAY 3	-C		#27
VEL / RELAY 3	-NO		#28
VEL / RELAY 4	-NC		#29
VEL / RELAY 4	-C		#30
VEL / RELAY 4	-NO		#31
LEVEL COMM	VTX		#32
LEVEL COMM	GND		#33
LEVEL COMM	RX		#34
LEVEL COMM	TX		#35
OPEN			#36



LOW LEVEL ALARM. Terminals 6, 7 and 8 are the connections for the low level alarm relay. The relay is a dry contact single pole double through (SPDT) with a 1 amp max contact rating. Terminal 6 is the normally closed side of the relay, Terminal 7 is common, and Terminal 8 is the normally open side. This alarm is adjusted by the Level Monitor control panel of the electronics. Refer to the Operating Instructions Section of this manual for the procedure.

HI LEVEL ALARM. Terminals 9, 10, and 11 are the connections for the high level alarm relay. The relay is a dry contact single pole double throw (SPDT) with a 1 amp max contact rating. Terminal 9 is the normally closed side of the relay, Terminal 10 is the common, and Terminal 11 is the normally open side. This alarm is adjusted by the Level Monitor control panel of the electronics. Refer to the Operating Instructions Section of this manual for the procedure.

SAMPLER OUTPUT. Terminals 12 and 13 are the connections for the sampler output. This output is a TRIAC switch with a rating of 230 VAC at 600 mA max. Terminal 12 is the LO or negative connection and Terminal 13 is the HI or positive connection. The setting of the sampler rate is made on the main 5000 control panel of the electronics. Refer to the Operating Instructions Section of this manual for the procedure.

REMOTE TOTALIZER. Terminals 14 and 15 are the connections for the remote totalizer output. This output is an open collector transistor output rated at 50 volts DC maximum at 100 mA.

HI SCALE FLOW OUTPUT. This output is only available when operating the meter in dual range. Terminals 18 and 19 are the connections for the High Scale Flow output. Terminal 18 is the negative (-) connection and Terminal 19 is the positive (+) connection. These are the connections for the dual range 4-20 mADC flow output signal (0 to 100% full scale). For adjustment of this signal, refer to the Operating Instructions Section of this manual. If your meter has been setup for a dual flow range (refer to the data sheet in the front of this manual), the Lo Scale output connections could be used.

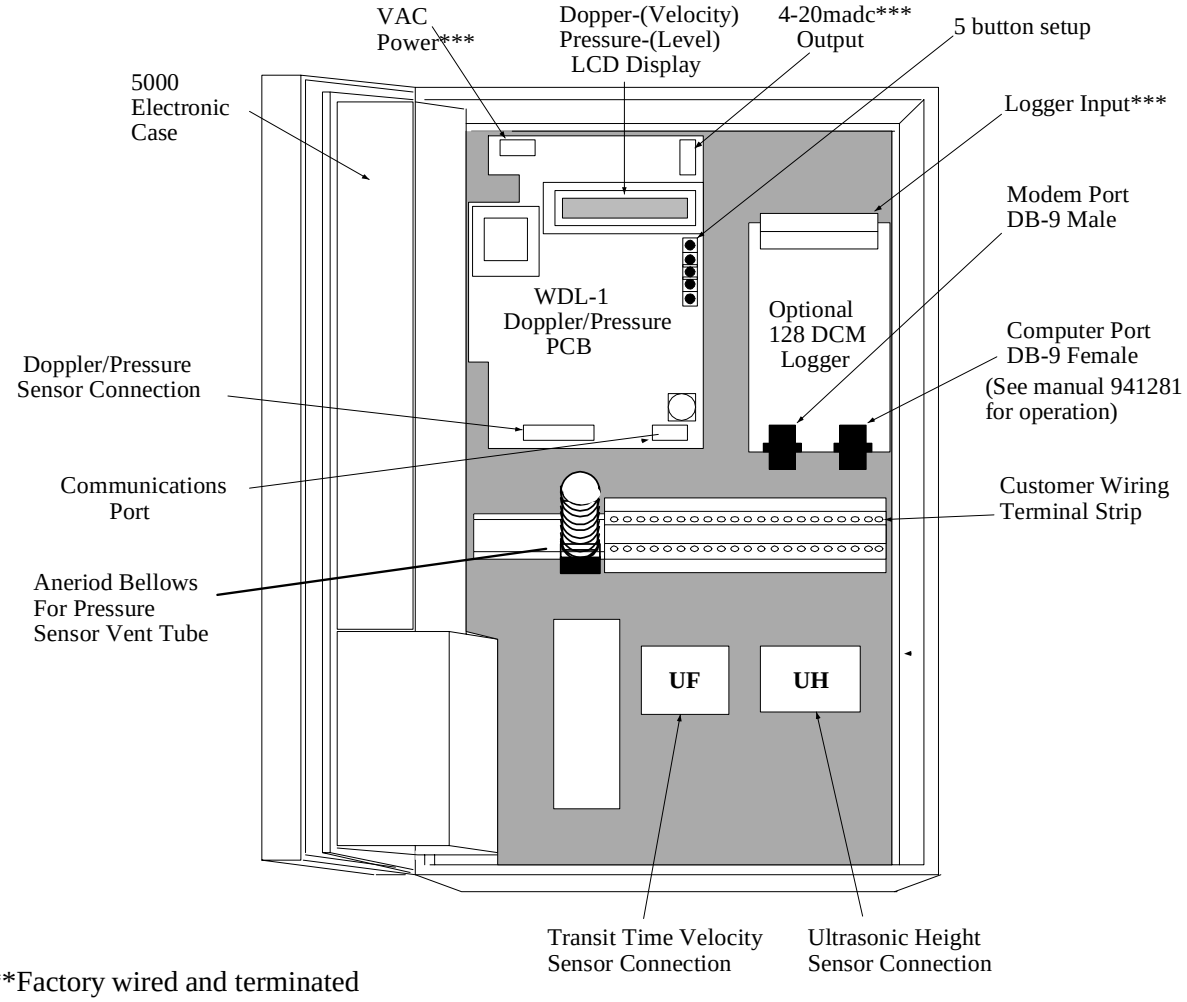
LO SCALE FLOW OUTPUT. Terminals 20 and 21 are the connections for the Lo Scale Flow output. Terminal 20 is the negative (-) connection and Terminal 21 is the positive (+) connection. **These are the normal connections for the single range 4-20 mADC flow output signal (0-100% full scale).** In the dual range they are the 4-20 mADC output (0 to crossover flow value). For example, if your meter was scaled for a maximum flow of 20 MGD and crossover flow is 2 MGD, the Lo Scale Flow 4-20 mADC signal will represent 0 to 2 MGD. For adjustment of this signal, refer to the Operating Instructions Section of this manual.

VELOCITY OUTPUT. Terminals 22 and 23 are the connections for the velocity output signal. Terminal 22 is the negative (-) connection and Terminal 23 is the positive (+) connection. This is a 4-20 mADC signal that represents 0 to 100% of the full scale velocity for which the meter has been setup. Refer to the data sheet at the front of this manual for the full scale velocity.

LEVEL OUTPUT. Terminals 24 and 25 are the connections for the level output signal. Terminal 24 is the negative (-) connection and Terminal 25 is the positive (+) connection. This is a 4-20 mADC signal that represents 0 to 100% of the maximum level for which the meter has been setup. Refer to the data sheet at the front of this manual for the maximum level.

SERIES 5000 DOPPLER/PRESSURE BOARD CUSTOMER WIRING/OPERATION

The Series 5000 Compound Ultrasonic flowmeter has been designed to be versatile as each customer application is unique and special. With the additional of the WDL-1 Doppler/pressure board and the 128 DCM Logger board, the Series 5000 becomes not only a velocity and level unit to achieve the equation Q = V x A, but has redundant backup of velocity and level measurements utilizing different techniques to assure continuous operation in almost all conditions.



***Factory wired and terminated

FIGURE 5

Figure 5 will give you an overall view of the back panel of the Series 5000 enclosure, please note the locations of the WDL-1 and the 128 DCM Logger board. These boards, if supplied as options will be completely wired for operation at the factory. The only terminations necessary will be the WDL-1 Doppler/pressure sensor, pressure vent tube, and the optional modem or computer interface cables if included.

WDL-1 Sensor Wiring Diagram

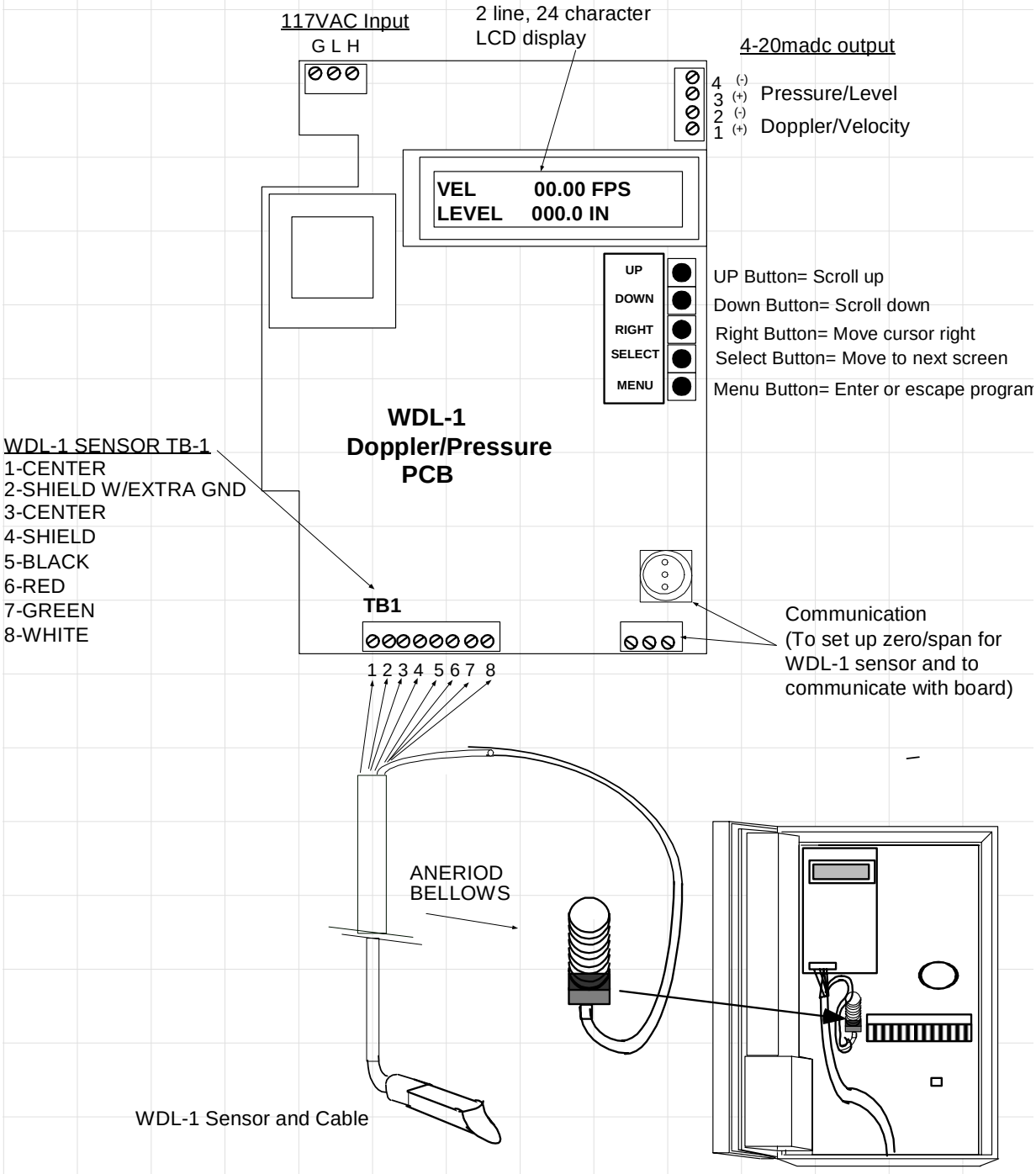
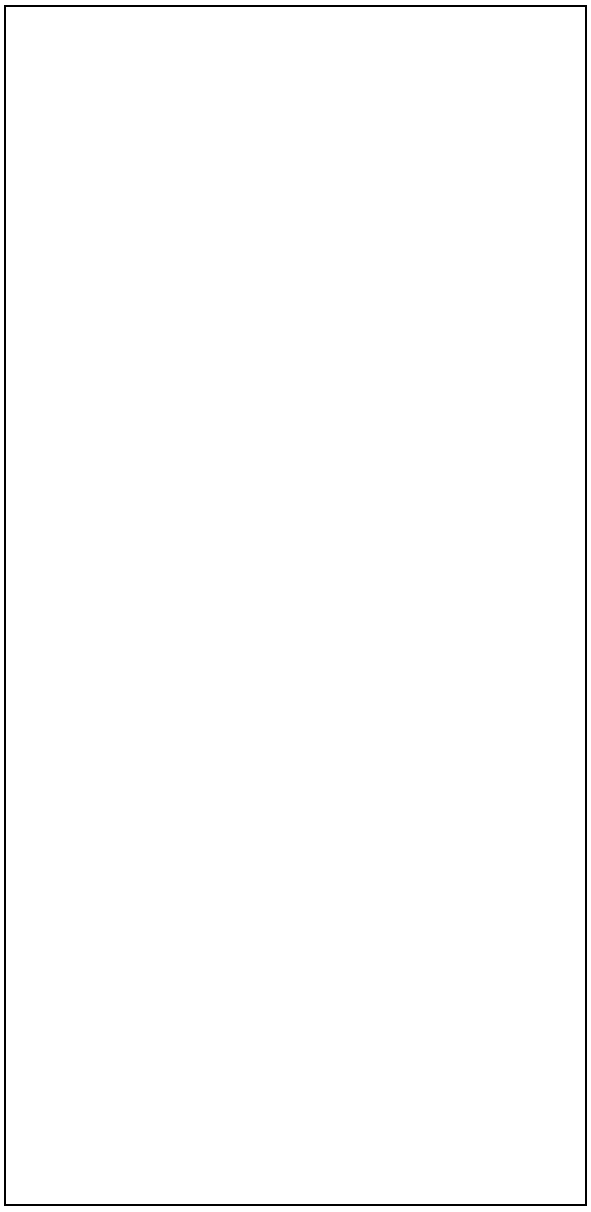


Figure 6

BACK PANEL DOPPLER/PRESSURE UNIT

A partial view of the back panel of the Model 5000 enclosure showing the Doppler/pressure circuit board.

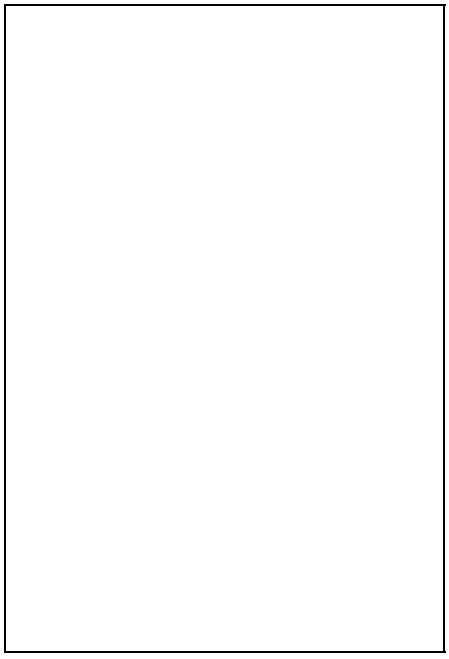


DOPPLER/PRESSURE SENSOR CONNECTION

The velocity/pressure sensor cable consists of two small black coaxial wires, 5 colored wires and a plastic vent tube. The sensor cable terminations are made on terminal block TB2 on the velocity/pressure circuit board. TB2 is located on the lower left corner of the circuit board.

Any excess length of sensor cable can be cut off, but be sure to leave enough for proper connections.

Remove five inches of the outside red jacket being careful not to cut into the wires inside. Carefully strip away one inch of the outside black insulation jacket from each of the two coaxial cables. Then strip 1/4" of the insulation from each of the two coaxial inner conductors. Strip 1/4" of insulation from each of the five colored wires.



Inspect the two coaxial cables. Each of them has an inner conductor and an outside shield wire. One of the cables also has a bare wire with the shield. Connect the inner conductor of the coaxial cable without the bare wire to terminal 1 of TB2. Connect the shield to terminal 2. Connect the inner conductor of the coaxial cable with the bare wire to terminal 3 of TB2. Connect the shield and bare wire to terminal 4. Connect the black wire to terminal 5, red wire to terminal 6, green wire to terminal 7, and the white wire to terminal 8. Connect the orange wire to the crimp connector connected to the grounding screw on the lower left corner of the circuit board.

Insert the vent tube connector from the aneroid bellows into the vent tube in the red sensor cable.

Use the plastic tie down strap on the back panel located under the sensor terminal strip to tie the sensor cable down.

VELOCITY AND LEVEL SENSOR CABLES. The velocity and level sensor cables are connected to terminal blocks separate from the main back panel terminal block. They are located below and to the left for the velocity and below and to the right for the level of the main terminal block on the back panel (See Figure 3).

Before pulling the sensor cables through the conduit, mark the ends of the cables to indicate which is the upstream and downstream sensor cable. Leave approximately 1 foot of cable extending from the conduit in the enclosure. Refer to Figure 7 and prepare the cable ends in the following manner.

1. Remove outer cable cover. Measure 1-7/8" from the end of the cable. With a cutting tool, carefully cut through the outer covering completely around the cable making sure not to cut into the outer shield. Make another cut from the first cut to the end of the cable and remove the outer cover.

2. Remove outer shield. Measure 1-3/8" from the end of the cable. With a pair of small side cutters, cut the shield around the cable at the measured point and remove the cut off shield.

3. Remove middle cover. Measure 1-1/8" from the end of the cable. With a cutting tool, carefully cut through the middle covering completely around the cable making sure not to cut into the middle shield. Make another cut from the first cut to the end of the cable and remove the middle cover.

4. Remove middle shield. Measure 3/4" from the end of the cable. With a pair of small side cutters, cut the shield around the cable at the measured point and remove the cut off shield.

5. Remove inner cover. Measure 1/2" from the end of the cable. With a cutting tool or pair of wire strippers, carefully cut the inner covering completely around the cable, making sure not to cut into the center conductor and remove the inner cover.

VELOCITY SENSOR CABLE CONNECTIONS

After the ends of the cables have been prepared, loosen the screws on the terminals and remove the two pairs of clamps on the velocity sensor cable terminal board.

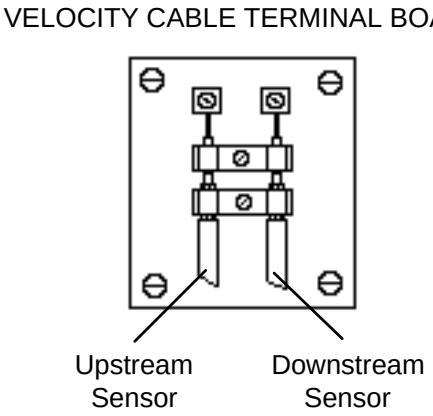


FIGURE 8

Take the upstream cable and insert the center conductor into the upstream terminal connection and tighten the screw. Slightly pull on the cable to insure the wire is secured to the terminal. Take the downstream cable and insert the center conductor into the downstream terminal connection and tighten the screw. Slightly pull on the cable to insure the wire is secured to the terminal.

Place the two pairs of clamps over the middle and outer shields and secure them into place. Verify that the clamps are making good contact with the shields and that no wires of the shields are extending beyond their own clamp down area.

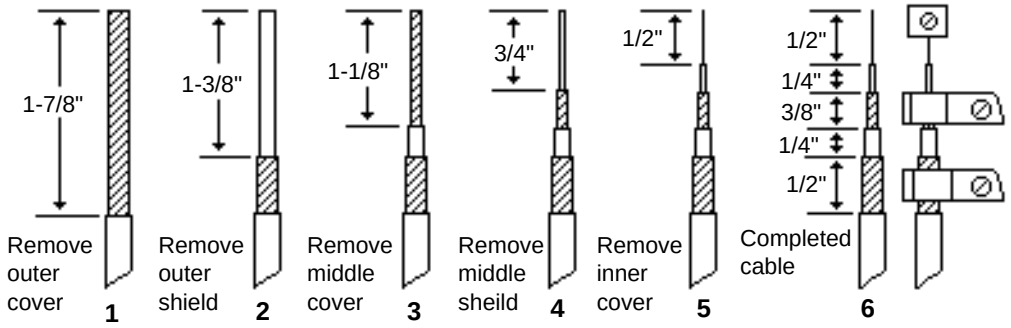


FIGURE 7
VELOCITY AND LEVEL SENSOR CABLE PREPARATION

LEVEL SENSOR CABLE CONNECTION

After the end of the cable has been prepared for the level sensor, loosen the screws on the terminals on the level sensor terminal at the lower middle in the enclosure and remove the two clamps.

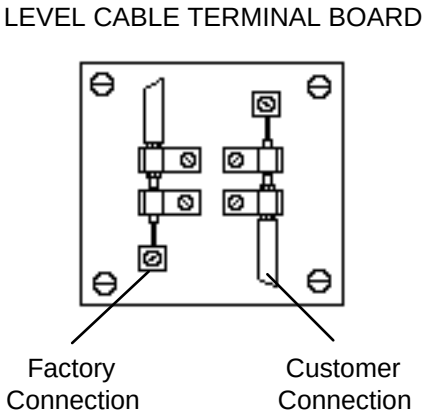


FIGURE 9

Take the level sensor cable and insert the center conductor into the sensor connection and tighten the screw. Slightly pull on the cable to insure the wire is secured to the terminal.

Place the clamps over the middle and outer shields and secure them into place. Verify that the clamps are making good contact with the shields and that no wires of the shields are extending beyond their own clamp down area.

This completes the wiring instructions for the Series 5000 flowmeter.

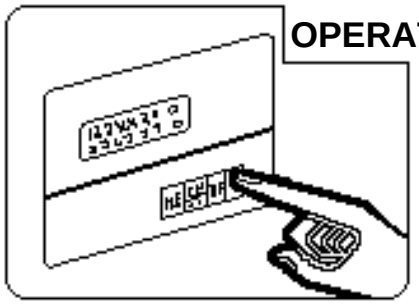
LEVEL AND VELOCITY SENSOR MOUNTING

There are several mounting configurations for the level and velocity sensors depending on the particular application. Drawings are provided in the front of this manual detailing the mounting instructions for your specific application. It is important the dimensions given on the drawings be held to within the tolerances to insure the accuracy of the flowmeter.

The Model 5200 is provided with a fabricated spool piece with the level and velocity sensors factory mounted. A drawing will be provided in the front of this manual detailing the proper positioning of the spool piece.

The level sensor cable, doppler/pressure sensor cables, and the velocity sensor cables should be run in separate metallic conduit.

This completes the mounting instructions for the level and velocity sensors.



OPERATION

PRINCIPLES OF OPERATION

The Series 5000 Compu-Sonic flowmeters utilize a compound measurement system to compute the flow through open channel or partially filled conduits.

Transit-time ultrasonic measurement is used to measure the velocity of the fluid in the flow stream and ultrasonic level measurement is used to measure the depth of the fluid. The volume of the fluid flow can be computed using the Continuity equation which states:

$$Q = \bar{v} \times A$$

where: Q = Flow in Cubic Fee/Second
$\bar{v}$ = Average Velocity in Feet/Second
A = Area in Square Feet

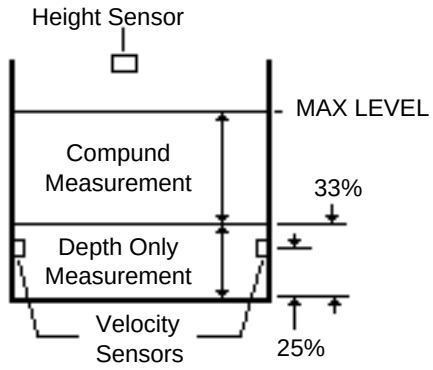


FIGURE 10

The two velocity sensors are normally installed at 25% of the maximum level from the bottom of the channel or conduit. At this location the velocity measurement will be within 2 to 4% of the true average velocity of the fluid at all levels of flow sources. Compound measurement is accomplished from flow levels of 33% to 100%. For flows where the fluid depth is less than 33% the level measurement is used to determine volume flow. In this mode of measurement a free flow equation, such as Manning's, is used or if greater accuracy is required, a flume may be used. An optional Doppler velocity sensor may be used as a back up for the transit time velocity sensors. Refer to the installation drawings for proper location.

The electronics of the Series 5000 flowmeters are made up of four sections: velocity measurement, ultrasonic level measurement, Doppler velocity/pressure level and integrator (H x V).

VELOCITY MEASUREMENT SECTION

The velocity section has its own microprocessor with EEPROM for non-volatile memory storage of the velocity meter constants. It has a 2 line, 24 character LCD display that shows the fluid velocity and operational status of the velocity electronics. There is a front panel keypad that allows the user to enter into a menu driven prompt mode for modifying various parameters and adjusting the 4-20 mA output. This will be described in more detail later in this section.

The transit time velocity measurement section transmits acoustic energy pulses between the two velocity sensors. The velocity sensors are mounted on opposite sides of the channel or pipe with a separation of approximately 20°. Each sensor functions as a transmitter and a receiver.

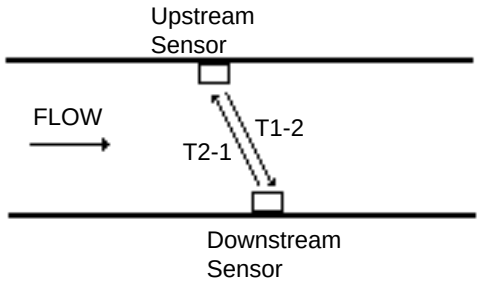


FIGURE 11

When there is no flow in the channel or pipe the time between transmission and reception from e upstream sensor to the downstream sensor (T1-2) will equal the transit time between the transmission and reception from the downstream sensor to the upstream sensor (T2-1). When there is flow T1-2 will decrease because the transmitted acoustic energy is aided by the flow and T2-1 will increase because the transmitted acoustic energy is opposed by the flow. This difference in transit time (T2-1 — T1-2) is directly proportional to the velocity of the fluid. A 4-20 mADC signal is developed which represents 0 to 100% of the full scale velocity. This signal is sent to the integrator section.

With the separate Doppler sensor, the Doppler signal is used when there is a loss of the transmit time signal. This is automatically switched by the transit time velocity unit. When the Doppler signal is used, the velocity display will show NS in the upper right corner.

The Doppler/pressure sensor is normally installed near, or on, the bottom of the channel or conduit. Fluid velocity

is measured by the Doppler technique. Operating with twin piezoelectric crystals, 1 mhz ultrasonic energy bursts are transmitted by the transmitting crystal into the flow stream at a 30 degree angle. The signals reflect off of solids, air bubbles, or flow disturbances moving in the flowstream. The reflected signals are received by the receiving crystal and sent to the electronics. The transmitted frequency is shifted or changes frequency when the signal bounces off of a particle moving in the flow. The frequency shift is measured to determine the velocity of the fluid.

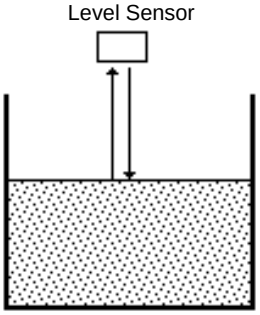
Transit Time-Doppler Velocity Switch

The 4-20 mA outputs from both the transit time velocity unit and the Doppler velocity unit are connected to the normally open and normally closed contacts of relays 1 & 2 in the transit time electronics. The common of the relays is routed to the integrator unit. The relays are assigned to "LOS" for loss of signal. With transit time operation, the 4-20 mA output of the transit time unit is sent to the integrator via the normally closed to common relay contacts. With a loss of transit time signal, the relays energize and the 4-20 mA output from the Doppler is coupled through the normally open contacts to the common and sent to the integrator unit.

When the transit time signal is restored, the relays are deactivated and the transit time 4-20 mA output is once again sent to the integrator unit.

LEVEL MEASUREMENT SECTION

The level section has its own microprocessor with EEPROM for non-volatile memory storage of the meter constants. It has a 2-line, 24-character LCD display that shows the fluid level and operational status of the electronics. There is a front panel keypad that allows the user to enter into a menu driven prompt mode for modifying various parameters and adjusting the 4-20 mA output. This will be described in more detail later in this section.



The level section transmits bursts of acoustic energy from the level sensor. The acoustic energy is directed towards the surface of the fluid. The energy is reflected off the surface of the water and received back at the level sensor.

The time from transmission to reception of the reflected energy is measured by the electronics. This time is divided by two and multiplied by the sonic velocity of the air to compute the distance from the face of the sensor to the surface of the fluid. The air temperature is measured to compensate for changes in the sonic velocity of the air. The depth of the fluid is then computed based on the parameter programmed in the electronics pertaining to the mounting of the level sensor. A 4-20 mADC signal is developed which represents 0 to 100% of the maximum depth of the fluid. This signal is sent to the integrator section.

The doppler/pressure sensor contains a pressure cell for measuring level by pressure. Level is measured by the direct immersion of the pressure cell (sensor). The pressure cell can measure level within 0.25% of full scale over a range from 0.5" to 100".

Ultrasonic Level-Pressure Level Switch

The 4-20 mA outputs from both the ultrasonic level unit and pressure velocity unit are connected to the normally open and normally closed contacts of relays 3 & 4 in the level unit electronics. The common of the relays is routed to the integrator unit. The relays are assigned to "LOS" for loss of signal. With ultrasonic level operation, the 4-20 mA output of the level unit is sent to the integrator via the normally closed to common relay contacts. With a loss of ultrasonic level signal, the relays energize and the 4-20 mA output from the pressure unit is coupled through the normally open contacts to the common and sent to the integrator unit.

When ultrasonic level signal is restored, the relays are deactivated and the ultrasonic 4-20 mA output is once again sent to the integrator unit.

INTEGRATOR SECTION

The integrator section has its own microprocessor with EEPROM for non-volatile memory storage of the meter constants. It has a 2-line, 24-character LCD display that indicates the flow rate, flow total and operational status of the electronics. A front panel keypad allows the user to enter into a menu driven prompt mode for modifying various parameters and adjusting the 4-20 mA output. This will be described in more detail later in this section.

The integrator receives the 4-20 mADC signals from the velocity (transit time or Doppler) and level (ultrasonic or pressure) sections. The flow is then computed based on the parameters programmed into the microprocessor.

The integrator determines the mode of operation, compound or level only, by comparing the level input signal to the crossover point programmed into the electronics. If the level is above the crossover point, the flow is calculated by converting the level information to area and multiplying by the velocity. If the level is below the crossover point, the flow is calculated by a head (level) versus flow (H/Q) curve based on a free flow equation such as Manning's, or an equation for a flume or weir.

The integrator provides three 4-20 mADC signal outputs: flow rate, velocity and level. The 4-20 mA output can be operated in a dual mode for greater resolution over a wide turndown. Other outputs provided

are a sampler pulse output and a remote totalizer pulse output.

OPERATIONAL INSTRUCTIONS

The Series 5000 flowmeter is programmed and calibrated at the factory to the application specifications provided by the customer. No programming will be required by the user except for the setting of alarm set points.

A trip by a factory service person is provided with the price of the flowmeter. He will start-up the flowmeter and verify that the system is operational and is programmed properly for the application. He will also provide training for the personnel who will be responsible for the flowmeter.

It is recommended that the user not attempt to make any changes to the parameters in the flowmeter before receiving training from the factory serviceman.

This section of the manual will be divided into two parts. The first part will address the normal operating procedures that will be used by the operator of the flowmeter on a periodic basis, such as setting the HI and LO level alarm set points, adjusting the 4-20 mADC outputs, setting sampler output, etc. The second part will address the calibration procedure for rescaling the full scale flow or making parameter changes due to changes of the application.

NORMAL OPERATING PROCEDURES

Figure 13 shows the front panel of the Series 5000 flowmeter which contains the displays and keypads for the integrator, level and velocity sections. Upon power up the displays will show the following:

INTEGRATOR (UPPER DISPLAY)

```
BADGER METER INC.
MODEL 5000      VER. X.XX
```

Identifies Eastech Badger as the manufacturer of the product, the model number and the software version number. After 10 seconds the normal operating screen will be displayed.

```
FLOW  =  0000  X1   GPM          L
TOTL  =  00000000   X100  GAL
```

In the normal operating mode of the 5000 flowmeter integrator section, the display will show flow rate and totalized flow. The flow rate has a maximum of four digits followed by the multiplier and the units of measure. The totalizer has a maximum of 8 digits followed by the multiplier and the units of measure. In the upper right corner a L or C will be displayed to indicate whether the meter is operating in the level only mode or compound mode.

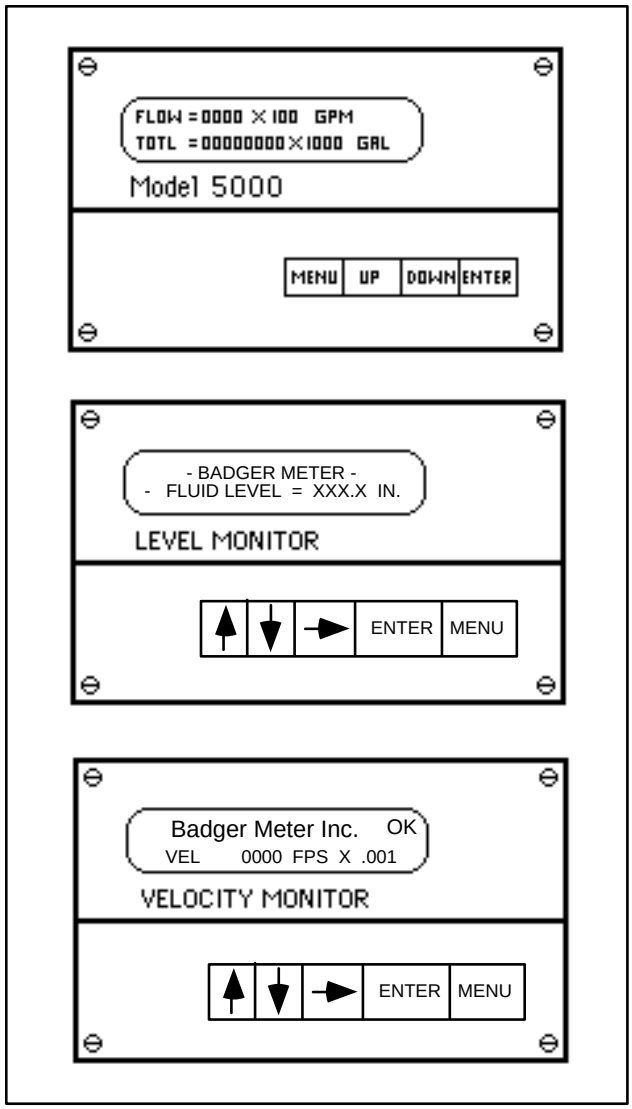


FIGURE 13
FRONT PANEL

LEVEL (MIDDLE DISPLAY)

```
- - - -BADGER METER INC.- - - -
MODEL 2000        V X.X  R  .XX
```

After 5 seconds then:

```
- - - -UNIT SERIAL NUMBER- - - -
00000000
```

After 5 seconds then normal display:

```
- BADGER METER -
-   FLUID LEVEL  =  XXX.X  IN.
```

In the normal operating mode of the level section, the level of the fluid is displayed in inches, feet, millimeters or centimeters. In the lower left hand corner of the display will be a flashing operating status symbol. The (-) indicates the level section is operating normally with no malfunctions or alarms tripped. The (*) indicates there is a malfunction or alarm tripped.

TRANSIT TIME VELOCITY (LOWER DISPLAY)

```
Badger Meter Inc.        OK
  VEL      0000  FPS  X  .01
```

In the normal operation mode of the velocity section, the display will show the velocity of the fluid. The velocity will be displayed with a maximum of four digits followed by the unit of measure and the multiplier. In the upper right hand corner of the display will be an operation status indication. There will be an OK displayed if there is no malfunction detected. If a malfunction is detected, a two letter code will be displayed.

Keypads are provided on the front of each display section for use to enter into the menu selections for each of the electronic sections. Each electronic section has security protection to prevent anyone not authorized from tampering with the constants programmed into each of the microprocessors. The following describes the menu functions that can be used with the security enabled with each electronic section.

INTEGRATOR SECTION - From the normal display screen, which shows the flow rate and flow total, the user may enter into the Status Mode. To do this press the MENU key and the following screen will appear:

```
> STATUS INFORMATION
  DATA ENTRY
```

This screen allows the selection to enter into the Status Information mode or the Data Entry mode. The arrow on the left side of the display indicates which mode will be entered if the ENTER key is pressed. The arrow can be moved up and down by pressing the UP and DOWN arrow keys. If the ENTER key is pressed with the arrow pointing to the STATUS INFORMATION line, the following screen will appear:

```
RTOT = 00000000  X100 GAL
NTOT = 00000000  X100 GAL
```

This screen displays the resettable and non-resettable totalizer values. The non-resettable totalizer value is the same value that is displayed on the normal operating screen.

The resettable totalizer value may be zeroed when in the calibration mode. No other information is displayed in this mode. To return to the normal operating screen, press the ENTER key.

If the arrow had been moved to the DATA ENTRY line, and the security was enabled, the following screen would appear:

```
SECURITY ENABLED
PRESS MENU TO CONTINUE
```

This screen informs the user that the security has been enabled and entry into DATA ENTRY is not permitted. Refer to the Calibration Section for instruction to disable the security. Press the MENU key to return to the normal operating screen.

ULTRASONIC LEVEL SECTION - From the normal operating screen, which shows the level, the user may enter into the status mode. To do this press the MENU key and the following screen will appear:

```
PRESS UP FOR CALIBRATION
PRESS DOWN FOR STATUS
```

This screen allows the entry into the Calibration Mode or the Status Mode. Press the DOWN arrow key and the following screen will appear:

```
ALARMS TRIPPED
 ECHO 4-20 PNT #1
```

This screen indicates any malfunction, alarms, or set points that are tripped. The following are the possible alarms:

ECHO: Loss of return echo of transmitted signal.
4-20: Open 4-20 mA loop circuit.
EEPRM: Failure of the EEPROM in the microprocessor
OVRR: Fluid level is above maximum set span of the level meter.
PNT#1: Set point #1
PNT#2: Set point #2
PNT#3: Set point #3
PNT#4: Set point #4

To leave the Status Mode, press the MENU key and the meter will return to the normal operating mode. Pressing the ENTER key will step through the Status Mode screens.

Press the ENTER key and the following screen will appear:

```
RELAYS TRIPPED
```

RLY#1 RLY#2 RLY#3 RLY#4

This screen indicates the relays that are tripped. These relays may be assigned to set points or error alarms. The assignment of these are covered in the Calibration Mode Section.

Press the ENTER key and the following screen will appear:

```
FLUID LEVEL  =  XXX.X  IN
DISTANCE  =  XXX.X  IN
```

This screen indicates the measured fluid level and the distance from the sensor face to me fluid level. If the indicated distance is not correct, refer to the Calibration Mode instructions for correction.

Press the ENTER key and the following screen will appear:

```
RX GAIN XX     TEMP.  + XX° C
SIG■A■: ■  ■
```

This screen indicates the received signal strength and the temperature at the sensor head in degrees Celsius. A receiver gain of 01 indicates maximum signal strength and 99 indicates minimum signal strength. The bottom line of the screen will indicate the signal strength with black squares. There should be at least 3 squares for good meter operation.

Press the ENTER key and the following screen will appear:

```
SELF TEST
PRESS UP TO ACTIVATE
```

This screen allows entry into the self test diagnostics routine. Press the UP arrow and the following screen will appear:

```
SELF TEST
EEPROM  =>  TESTING
```

This screen indicates that the EEPROM of the microprocessor is being tested. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED". The following screen will appear:

```
SELF TEST
SENSOR TX => TESTING
```

This screen indicates that the meter is testing the sensor head to determine if it is transmitting a signal. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED". The following screen will appear:

```
SELF TEST
SENSOR ECHO => TESTING
```

This screen indicates that the meter is testing for the presence of a return echo of the transmitted signal. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED".

The display will then return to the main self test screen. You may repeat the self test, return to me normal operating mode by pressing the MENU key, or continue with the Status Mode screens by pressing the ENTER key.

Press the ENTER key and the following screen will appear:

```
LEVEL SIMULATION
PRESS UP TO ACTIVATE
```

This screen allows entry into the level simulation mode. The level range the meter has been set up for can be simulated to check the 4-20 mA output, the set points, and relay controls.

Press the UP arrow key and the following screen will appear:

```
- BADGER METER -
S   FLUID LEVEL  = 000.0  IN
```

This screen allows the user to simulate the level or level volume measurement of the level section. On the bottom left corner of the display will be a flashing 'S'. This is to remind the user that the meter is in the simulation mode and not actually measuring level.

To simulate a level, use the UP or DOWN arrow keys to change the fluid level value that is displayed on the screen. The maximum level that can be simulated is the maximum level that has been programmed into the meter.

NOTE: If no signal is present, the pressure level (if used), will be active and the ultrasonic level simulation will only affect the ultrasonic level display, set points and relay controls, but not the 4-20 mA output to the integrator (flow calculation).

To leave the level simulation screen press the MENU key. This display will return to the normal operating screen.

This completes the Status Mode Section of the Level Section.

VELOCITY SECTION

TRANSIT TIME STATUS MODE

The Transit Time velocity unit Status Mode allows the user to determine the operational status of the velocity meter as well as perform a self diagnostic and a flow simulation. Normal meter operation will still be performed while in the Status Mode except when in the flow simulation function.

To enter into the Status Mode, press the MENU key and the following screen will appear:

```
PRESS UP FOR CALIBRATION
PRESS DOWN FOR STATUS
```

This screen allows entry into the Calibration Mode or the Status Mode. Press the DOWN arrow key and the following screen will appear:

```
Measurement Data
Press UP to Activate
```

This screen allows entry into the measurement data of the meter. This is normally used in troubleshooting to detect signal strength and error codes.

Press the UP arrow key and the following screen will appear:

```
ZOF = 0000        NOR = BE38
DEL = A9C2        T12 = 02C4
```

This screen of the measurement data gives the values of the captured zero offset (ZOF), the normalized flow rate (NOR), the phase shift (DEL) and the signal crossing time (T12).

Press the ENTER key and the following screen will appear:

```
ERR = 0000        AGC = 25024F
SIG ■ ■ ■ ■ ■ ■
```

This screen shows the error codes and the AGC (automatic gain control) value on the first line and the signal strength indication on the second line.

The first two hexadecimal digits of the AGC value indicate the relative strength of the received signal with a value of 9F for a minimum signal and 10 the maximum signal, of the upstream sensor, the second two digits for the downstream sensor.

You may switch between the two screens by pressing the UP arrow key.

Press the ENTER key and the following screen will appear:

```
Self Test
Press UP to Activate
```

This screen allows entry into the self test diagnostics routine. Press the UP arrow and the following screen will appear:

```
SELF TEST
TRANSMIT:   <<PASSED>>
```

The self diagnostic routine first tests the transmitter section of the electronics. A brief message will be displayed indicating that testing is in process and then a "PASSED" or "FAILED" message will appear. The self test automatically steps through each test segment.

The following screen will appear next:

```
SELF TEST
RECEIVER:   <<PASSED>>
```

Again a brief message will be displayed indicating that testing is in process and then a "PASSED" or "FAILED" message will appear. This test checks that the receiver section of the electronics is functioning properly. The self test then checks for the presence of a signal. If a received signal is present and within the timing limits, the self test will step to the EEPROM test. If there is no signal, this will be indicated on the display. If there is a signal arriving at a time shorter than expected, then 'T12 Short' will be displayed. If there is a signal arriving at a time longer than expected, then 'T12 Long' will be displayed.

The following screen will appear next:

```
SELF TEST
EEPROM:   <<PASSED>>
```

This screen indicates the EEPROM of the microprocessor is being bested. After a few seconds the "TESTING" message will change to either "PASSED" or "FAILED". The following screen will appear:

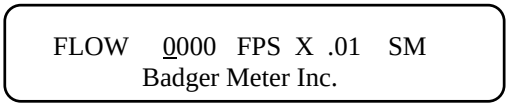
```
SELF TEST
* * * * * Completed * * * * *
```

This screen indicates that the self test function of the Status Mode is completed. The following screen will appear:

```
Flow Simulation
Press UP to Activate
```

This screen allows the entry into the flow simulation function. This function can be used to simulate the velocity from zero to full scale. It will drive the 4-20 mADC output and the relays, if assigned, to either of the velocity set points.

Press the UP arrow key and the following screen will appear:



This screen is the flow simulation screen. In the top, right corner of the display are the letters SM. These letters are to prevent confusion with the normal flow screen. **The meter will stay in this mode until the MENU key is pressed.**

To adjust the flow simulation to a specific flow rate, use the RIGHT arrow key to move the cursor under the digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to simulate a velocity of 5 FPS, move the cursor under the second digit from the left with the RIGHT arrow key and press the UP arrow key five times for a value of five (5). The display will now show 0500 which is 5 FPS with the X.01 multiplier.

NOTE: If there is a loss of transit time signal, the Doppler velocity will be active and the transit time simulation will affect the transit time velocity display, set points and relay controls, but not the 4-20 mA output to the integrator (flow calculation).

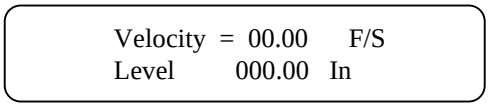
To exit from the flow simulation press the MENU key. The screen will return to the normal operating screen.

To exit from any screen and go directly back to the normal operating screen press the MENU key.

This completes the Status Mode Section of the Velocity Section.

DOPPLER/PRESURE UNIT

The back panel display shows Doppler velocity and Pressure level.



The unit is field programmable with push button access to the programming menu selections. It has security protection to prevent tampering with the critical application specific programming information.

The push buttons are: MENU, SELECT, UP, DOWN and RIGHT. The unit menu has two program modes: Status menus and Calibration menus. The Statue Menu Mode provides menu access to an alarm screen which indicates a loss of velocity signal if it were to occur.

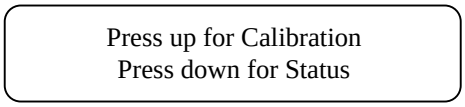
The status menus also provides access to a velocity and level simulation mode of operation whereby velocity and/or level can be simulated. The Calibration Menu Mode provides menu access to the site specific application programming information.

The MENU button provides access to the two menu modes. While in either of the menu modes, pressing the MENU button will exit the menu modes and return to the normal operating screen.

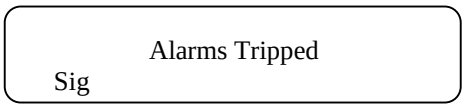
The SELECT button changes the display from one menu screen to the next.

Status Menus

To access the velocity/level menus, pres the MENU button and the display will change to the following:

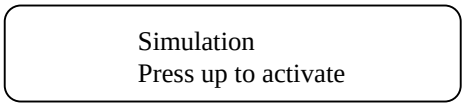


Press DOWN to access the status menu. The first status screen appears:



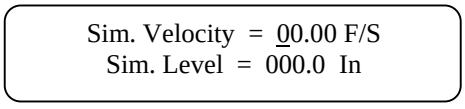
Sig represents a loss of Doppler Velocity signal. If Sig appears, then a loss of signal has occurred. Exiting the alarms screen will reset the alarm status.

Press SELECT and the simulation screen will appear.



Pressing UP will access the velocity and level simulation screen or pressing SELECT will bypass the simulation screen.

Press UP to access the simulation screen



Using the UP, DOWN, and/or RIGHT buttons will change the velocity value to a "simulated" value and output the appropriate 4-20 mA current to the Integrator unit. **NOTE:** when in the simulate mode, the velocity unit does not measure the actual real time velocity. Sim. indicates the unit is in simulate mode and not actually measuring velocity. **NOTE:** If the transit time velocity unit is operational with a signal, then the simulated velocity will not be routed to the integrator.

Press SELECT and the cursor will move to the Sim. Level display line.

Using the UP, DOWN, and/or RIGHT buttons will change the level value to a "simulated" value and output the appropriate 4-20 mA current to the Integrator unit. **NOTE:** when in the simulate mode, the level unit does not measure the actual real time level. Sim. indicates the unit is in simulate mode and not actually measuring level. **NOTE:** If the ultrasonic level unit is operational with a signal, then the simulated pressure level will not be routed to the integrator.

Press MENU to exit the simulation screen and advance to the A-D value screen.

Level Sensor A – D Value 0000FE00

An 8 digit hexadecimal value will appear. This value is used for pressure diagnostics and should be recorded if a problem with the pressure/level unit is suspected.

Press either SELECT or MENU to return to the normal operating screen.

This completes the status mode menu screens.

CALIBRATION PROCEDURE

This section of the operating instructions describes the calibration procedure for the level, velocity and integrator sections of the Series 5000 flowmeter. Each of these electronic sections has security protection to prevent unauthorized changes of the programmed parameter and adjustments of various meter functions and outputs.

The user must follow these procedures carefully to prevent inducing inaccuracies in the flowmeter's operation. Areas in the calibration procedure that are critical to maintain proper operation and accuracy will be pointed out.

The calibration procedure will begin with the Ultrasonic Level Section, then the Transit Time Velocity Section, Integrator Section, and Doppler/Pressure Section.

Some calibration procedures will require working in the Calibration Mode of all three electronic sections. Please completely read the whole calibration procedure before attempting to perform any of the calibrations.

LEVEL SECTION - To enter into the Calibration Mode, press the MENU key while the display is in the normal operating screen**. The Calibration Mode does not have to be stepped all the way through to make changes in the calibration.** Once the desired change(s) is(are) made, the MENU key can be pressed instead of the ENTER key and the microprocessor will store the new change(s) and return to the normal operating screen. The following screen will appear:

PRESS UP FOR CALIBRATION PRESS DOWN FOR STATUS

Press the UP arrow key and the following screen will appear:

SECURITY ID INPUT 4 DIGIT ID 0000

This screen is the security screen which requires the correct 4 digit number to allow entry into the Calibration Mode. To change the value of each digit, move the line under the digit to be changed with the RIGHT arrow key and then use the UP or DOWN arrow keys to change the value of the digit. When the 4 digit number is correct press the ENTER key. If the number is incorrect the meter will go back to the normal operating screen. If the number is correct the following screen will appear:

LEVEL UNIT UNIT SELECTION = XXX

This display allows the selection of the unit of measure to be used. The selections are:

FT. = Feet
IN. = Inches
M = Meters
cm = Centimeters
mm = Millimeters

To make the unit selection, use the UP or DOWN arrow keys until the correct unit is displayed and then press the ENTER key. The following screen will appear:

LEVEL ADJUSTMENT SPAN = XXX.X IN.

This sets the maximum level to be measured for a specific application. The maximum level the span can be set is 25 feet. The minimum span is 1 foot.

To adjust the span, use the RIGHT arrow key to move the line under the digit to be adjusted and then use the UP and DOWN arrow keys to change the value of the digit. After the desired span value has been set, press the ENTER key to store this new value. The following screen will appear:

LEVEL ADJUSTMENT
OFFSET = XXX.X IN.

This screen allows the adjustment of the offset region. The offset region is the distance from the maximum fluid level to the face of the sensor head. The minimum offset is 12 inches. The total of the offset and span values must not be greater than 26 feet and must equal the vertical mounting dimension of the sensor as measured from the bottom of the sensor to the bottom of the channel or conduit.

To change the value of the offset use the RIGHT arrow key to move the line under the digit to be changed and then use the UP and DOWN arrow keys to change the value of the digit. Once the correct value has been set press the ENTER key to store this value. The following screen will appear:

OUTPUT DAMPING
XXXX SECONDS

This screen allows the adjustment of the response time of the output signal to changes in fluid level. To change this value, use the UP or DOWN arrow keys to change to the desired value. The available values are 8, 16, 32, 64, 128, 256, 512 and 1024 seconds. Once the desired value is displayed press the ENTER key to store this new value. The following screen will appear:

LOST ECHO DEFAULT
XXXX SECONDS

This screen allows the setting of the time desired to hold the last level value after the loss of the return signal before defaulting to the selected no signal output value. The available time values are 8, 16, 32, 64, 128, 256, 512 and 1024 seconds. Use the UP or DOWN arrow keys to change to the desired value and press the ENTER key. The following screen will appear:

SETPOINT # 01
ON AT XX% OFF AT XX%

This screen allows the setting of the set points for low or high alarms and the dead band. These values are in percent of the maximum span value level (see 4-20 and set points tracking screen). To make the set point a low alarm, **the ON value must be lower than the OFF value.** For example, if the ON value was 30% and the OFF value was 35% then this set point alarm will be activated at the level of 30% of span and below and will be deactivated at the level of 35% of span and above.

To make the set point a high alarm**, the ON value must be higher than the OFF value.** For example, if the ON value was 60% and the OFF value was 50% then this set point alarm will be activated at the level of 60% of span and above and will be deactivated at the level of 50% of span and below.

To set the desired values, use the RIGHT arrow key to move the line under the ON or OFF values and use the UP or DOWN arrow keys to change the values. Press the ENTER key to store the new values. The screen will then advance to the next set point. There are four set points available. After the last set point has been entered the following screen will appear:

RELAY OVERRIDE
ACTIVATED -> NO

This screen allows the activation of the relay override feature. **This feature is not used with the Model 5000.** Use the UP or DOWN arrow keys to select NO. Press the ENTER key and the following screen will appear:

PUMP ALTERNATION
ACTIVATED -> NO

This screen allows the activation of the pump alternation feature**. For use with the Model 5000, NO should be selected.** Use the UP or DOWN arrow keys if necessary to change to NO. Press the ENTER key and the following screen will appear:

RELAY ASSIGNMENT
RELAY 01 +> ECHO

In this screen the four relays are assigned to the alarm for which they are to activate. The assignments available are:

ECHO = Lost return echo
EEPRM = Failure of the EEPROM
OVRR = Level above the set span
4-20 = 4-20 mA output loop circuit open
PNT#4 = Set point number 4
PNT#3 = Set point number 3
PNT#2 = Set point number 2
PNT#1 = Set point number 1

Once the desired alarm has been selected for relay #1, press the ENTER key to store this assignment. The screen will advance through the available relays. **NOTE: If the pressure**

level unit is included, relays #3 and #4 must be assigned to

ECHO in order for the ultrasonic level unit to switch to pressure if a loss of signal (echo) occurs. After the last relay assignment has been made the following screen will appear:

VOLUME LABEL
INITIALS = NONE

This screen allows the selection of the volume units. **NONE should be selected for the Model 5000.** Use the UP or DOWN arrow keys to select NONE if necessary. Press the ENTER key and the following screen will appear:

4-20 CURRENT CALIBRATION
PRESS UP TO CHANGE

This screen allows entry into the calibration screens for the 4-20 mA current output. **If adjustment is made, the zero/span analog height calibration in the integrator calibration menus should also be performed.** Press the UP arrow key and the following screen will appear:

4-20 M.A. CALIBRATION
ZERO WORD = 2345

This screen allows the adjustment of the zero level output value for 4 mA. The 4-20 mA output can be monitored on the level test jacks on the bottom of the front display housing. The 4-20 mA output must be connected to a load for the test points to work. Use the RIGHT arrow key to position the line under the digit to be adjusted. Fine adjustment is made on the most right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct value. The value of the Zero Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

4-20 M.A. CALIBRATION
SPAN WORD = C345

This screen allows the adjustment of the maximum span level output of 20 mA. The 4-20 mA output can be monitored on the level test jacks on the bottom of the front display housing. Use the RIGHT arrow key to position the line under the digit to be adjusted. Fine adjustment is made on the most right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct value. The value of the Span Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

4-20 M.A. CALIBRATION
DEFAULT WORD = 2345

This screen allows setting the 4-20 mA output signal when the meter goes into a default condition due to the loss of a return signal. This value is set depending on the user's desire for the value of the output to indicate a default condition. The 4-20 mA output can be adjusted from 3 to 23 mA and can be monitored on the level test jacks on the bottom of the front display housing. Use the RIGHT arrow key to position the line under the digit to be adjusted. Fine adjustment is made on the most right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct value. Press the ENTER key to store the value. **NOTE: If pressure/level backup is used, it will supply the level to the integrator and the ultrasonic loss of signal default will not be used.**

The following screen will appear:

DISTANCE CALIBRATION
PRESS UP TO CHANGE

This screen allows entry into the distance calibration screen which enables the calibration of the transmitter if necessary. This is set at the factory and only needs to be checked every three months. Do not set the distance calibration to an arbitrary number. The display shows the actual distance from the sensor to the surface at that measurement cycle. Checking will require measuring from the bottom of the sensor (face) to the water, then setting the distance calibration to this measurement. Press the UP arrow key and the following screen will appear:

DISTANCE CALIBRATION
NEAR DIST. => XX.XX IN

This screen calibrates the meter for the maximum flow level. If this adjustment is made, the fluid surface should be smooth to assure a steady reading. The near distance calibration should be made during high flow - surface of fluid at, or close to, the maximum (full scale) level**. Do not perform this calibration if the distance from the sensor to the surface is greater than 10% of span plus offset.** The display shows the distance from the surface of the fluid to the sensor.

Checking will require measuring from the bottom of the sensor (face) to the surface of the fluid and adjusting the distance calibration to this measurement. Use the UP or DOWN arrow keys to adjust to the correct value. Allow time for the meter to settle. Press the RIGHT arrow key. The following screen will appear:

DISTANCE CALIBRATION
FAR DIST. => XX.X IN.

This screen calibrates the meter for the zero flow level. If this adjustment is made, the fluid surface should be smooth to assure a steady reading. The far distance calibration should be

made during low flow - surface of fluid at, or close to, the minimum (zero) level**. Do not perform this calibration if the distance from the sensor to the surface is less than 70% of span plus offset.** The display shows the distance from the surface of the fluid to the sensor.

Checking will require measuring from the bottom of the sensor (face) to the surface of the fluid and adjusting the distance calibration to this measurement. Use the UP or DOWN arrow keys to adjust to the correct value. Allow time for the meter to settle. Press the ENTER key and the following screen will appear:

SECURITY ID
PRESS UP TO CHANGE

This screen allows the entry of the user's security identification number. When the meter is shipped from the factory, the security number is 0000. To prevent unauthorized entry into the Calibration Mode, the user should select a number then record this number and store it in a secure area. In the event the security number is lost, access can be made through a special procedure. Call (800) 226-3569 for instructions. Press the UP arrow key to enter into the Security ID screen. The following screen will appear:

SECURITY ID
INPUT 4 DIGIT ID XXXX

This screen allows the user to enter a new Security ID number. Use the RIGHT arrow key to move the line under the desired digit to change. Use the UP or DOWN arrow keys to change the digit to the desired value. The value can be numbers 0-9 and letters A-F. Press the ENTER key to store the new Security ID number. The following screen will appear:

- STORING PARAMETERS -
PARAMETERS-STORED

This screen indicates that the new parameters are being stored into the EEPROM of the microprocessor. The display will then return to the normal operating screen.

The Calibration Mode does not have to be stepped all the way through to make changes in the calibration. Once the desired change(s) is (are) made, the MENU key can be pressed instead of the ENTER key and the microprocessor will store the new changes and return to the normal operating screen.

This completes the Calibration Mode Section of the Level Section.

TRANSIT TIME VELOCITY SECTION

The Calibration Mode allows the user to calibrate and adjust various functions related to the operation of the velocity section.

To enter into the Calibration Mode, press the MENU key while the display is in the normal operating screen. The following screen will appear:

PRESS UP FOR CALIBRATION
PRESS DOWN FOR STATUS

Press the UP arrow key and the following screen will appear:

SECURITY ID
Input 4 Digit ID - - - -

This screen is the security screen which requires the correct 4 digit number to allow entry into the Calibration Mode of the velocity unit. To change the value of each digit, move the line under the digit to be changed with the RIGHT arrow key and then use the UP or DOWN arrow keys to change the value of the digit. When the 4 digit number is correct, press the ENTER key. If the number is incorrect the meter will go back to the normal operating screen. If the number is correct the following screen will appear:

4-20 mA Calibration
Press UP to Activate

This screen allows entry into the calibration screens for the 4-20 mA current output**. If adjustment is made, the zero/span calibration should also be performed at the same time, see Page 20.** Press the UP arrow key and the following screen will appear:

4-20 mA Calibration
ZERO WORD = 2300

This screen allows adjustment of the zero output to 4 mA. The 4-20 mA output can be monitored with a DVM or current meter on the test jacks on the bottom of the 5000 front panel marked velocity with the red jack positive, black jack negative. The 4-20 mA output must be connected to a load for the test points to work. If a load is not connected to back panel terminals 22 and 23, place a jumper wire between 22 and 23 to activate the test jacks. Use the RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct output. The display Zero Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

4-20 mA Calibration
SPAN WORD = AD00

This screen allows adjustment of span to 20 mA. The 4-20 mA output can be monitored on the test jacks on the bottom of the 5000 front panel marked velocity with the red jack positive, black jack negative. Use the RIGHT arrow key to position the cursor under the digit to be adjusted. Fine adjustment is made on the far right digit with the adjustment becoming more coarse with each digit to the left. Use the UP or DOWN arrow keys to adjust for the correct output. The display Span Word is for reference only. Press the ENTER key to store the value. The following screen will appear:

Meter Rescale
Press UP to Activate

This screen allows entry into the meter rescale screen which increases or decreases the full scale of the meter. Press the UP arrow key and the following screen will appear:

Meter Rescale
Full Scale 0900 x .01

The full scale value shown on this screen is the present full scale (20 mA output). To change the full scale of the meter, use the RIGHT arrow key to move the cursor under the digit to be adjusted and use the UP or DOWN arrow keys to adjust the digit to the desired value. For example, if you wanted to change the full scale from 9 to 10, move the cursor under the first digit from the left with the RIGHT arrow key and press the UP arrow key once for a value of one (1). Then move the cursor under the second digit from the left with the RIGHT arrow key and press the DOWN arrow key nine times for a value of zero (0). The display will now show 1000 which is 10 with the X .01 multiplier.

There is a maximum and minimum full scale limit. When the full scale value reaches either limit the digits will stop changing.

Remember: Changing the full scale of the meter will cause the 4-20 mADC output to change to reflect the new full scale value. The integrator section will have to be rescaled for correct meter operation.

Press the ENTER key to store the value. The following screen will appear:

Meter Factor
Press UP to Activate

This screen allows the user to calibrate the velocity section to reproduce actual flow conditions. The user can modify the meter factor for calibration of the meter to a known standard.

Press the UP arrow key and the following screen will appear:

Meter Factor
Meter Factor = 1.000

The user can modify the meter factor from a value of 0.800 to 1.200. The meter factor is the relation between the indicated velocity of the meter and the actual velocity as proven by calibration tanks or other means. If, for example, the meter was installed on a pipe and due to uncertainty in the pipe dimensions, the meter was determined to be indicating a velocity 5.6% higher than the velocity, the flowmeter is indicating 1.056 times the true value. The initial meter factor will be 1.000 as set at the factory.

To correct for the 5.6% high error, the meter factory must be changed to 0.947 (1/1.056). To change the meter factor, press the RIGHT arrow key to move the cursor under the first digit to the right of the decimal point and press the DOWN arrow key to change the value to 9. Press the RIGHT arrow key to move the cursor under the second digit to the right of the decimal point and press the UP arrow key to change the value to 4. Press the RIGHT arrow key to move the cursor under the third digit to the right of the decimal point and press the UP arrow key to change the value to 7. Pressing the MENU or ENTER key will store the new value.

After pressing the ENTER key the following screen will appear:

Zero Offset
Press UP to Activate

This screen allows the user to capture and correct for zero offsets that may be present in the metering system. It is intended to be used for periodic maintenance to correct for small zero drifts. **THE FLOW IN THE PIPE MUST BE ZERO TO USE THIS FUNCTION. IF FLOW EXISTS IN THE PIPE, USE OF THIS FUNCTION WILL CREATE LARGE ERRORS IN THE METER.** Therefore, the user must prepare for use of this function. Appropriate valving must be done to ensure that no flow exists; allow at least 10 minutes for the fluid motion to settle out. To start the Zero Offset function press the UP arrow key and the following screen will appear:

Zero Offset
STAT : Evaluating >

The zero offset function is now activated and the display will indicate that it is evaluating for any offsets in the system. After a period of approximately 20 seconds, the screen will display: 'ERROR: Failed' or 'CAPTURED: Press UP to Sav'.

If an error is indicated, it means that an offset was measured greater than is expected under normal conditions. The pipe needs to be rechecked to verify that

there

is no flow. Press the ENTER key to step out of the error screen. If you desire to try the zero offset function again, press the DOWN arrow key and the display will step back to the zero offset screen. Repeat the above procedure.

Response Time Press UP to Activate

This screen allows setting of the response time of the meter to changes in the flow rate. Press the UP arrow key and the following screen will appear:

Response Time Response Const: 007

This screen sets the response time of the meter. The selections are from 1 to 14. The response time for each of the selections is: 1 = 2 seconds; 2 = 4 seconds; 3 = 8 seconds; 4 = 16 seconds; 5 = 32 seconds; 6 = 64 seconds; 7 = 128 seconds, etc. Use the UP or DOWN arrow keys to change to the desired response time. Press the ENTER key to save. The following screen will appear:

Failure Mode Press UP to Activate

This screen allows setting of the default output of the meter in the event there is a loss of signal failure. There are three available selections: Zero, Full Scale or Hold Last Reading. The selection of zero will drive the velocity output to 4 mA. The selection of hold last will retain the last flow value before loss of signal.

Press the UP arrow key and the following screen will appear:

Failure Mode FAIL TO: ZERO _

This screen allows selection of the failure mode to zero, full scale, or hold last reading. Use the UP or DOWN arrow keys to make the desired selection. Press the ENTER key to store the selection. The following screen will appear:

Set Point Configuration Press UP to Activate

This screen allows entry into the configuration screens for the two set points. The set points can be set up for either high or low alarms with desired dead band. Press the UP arrow key and the following screen will appear:

SETPOINT = 01 ON AT 00.0% OFF AT 00.0%

This screen allows the adjustment of the number 1 set point as a high or low alarm as well as the dead band**. For a low alarm, the ON value must be a lower value than the OFF value. For a high alarm, the ON value must be a higher value than the OFF value.** For example, to make the set point a high alarm at 90% of full scale flow with a 10% dead band, press the UP arrow key to change the ON value to 90.0. The RIGHT arrow key is used to move the cursor under the digit to be changed. Press the ENTER key to move the cursor under the OFF digits. Press the UP arrow key to change the OFF value to 80.0. Press the ENTER key to store these settings. The following screen will appear:

SETPOINT = 02 ON AT 00.0% OFF AT 00.0%

This screen is for setting the number 2 set point. Use the same procedure as described for the number 1 set point. After pressing the ENTER key to store the settings, the following screen will appear:

RELAY CONFIGURATION Press UP to Activate

This screen allows entry into the relay configuration screens where the four relays are assigned to desired functions. Press the UP arrow key and the following screen will appear:

RELAY ASSIGNMENT RELAY 01 => NONE

This screen allows the selection of the desired assignment to the number 1 relay. The following functions are available:

- NONE - Relay not used
- DIR - Direction output for forward and reverse flow
- TX - Transmitter failure in the electronics
- LOS - Loss of signal
- EEPRM - EEPROM failure
- TOTL - Remote totalizer output
- CINT - Contact integrator output
- PNT#1 - Set point #1
- PNT#2 - Set point #2

Use the UP or DOWN arrow keys to make the desired selection. Press the ENTER key to store the selection. The next screens will be for relays 2, 3 and 4. The same procedure is used as for the number 1 relay. **Note: If the Doppler velocity unit is included, relays #1 and #2 must be assigned to LOS in order for the transit time velocity unit to switch to Doppler velocity if a loss of signal occurs.** After the selection is made for the number 4 relay, the following screen will appear:

SECURITY ID
Press UP to Activate

This screen allows entry into the security identification where the security code may be changed. Press the UP arrow key and the following screen will appear:

SECURITY ID
Input 4 Digit Id 0000

This screen will show the present security code in the meter. To change the security code move the cursor with the RIGHT arrow key under the digit to be changed. Use the UP or DOWN arrow keys to change the value. The value can be 1 through 9 and A through F. After the new code has been entered, press the ENTER key to store the new values. The display will then return to the normal operating screen.

NOTE: At any time after a change has been entered in the Calibration Mode, the MENU key can be pressed and the display will return to the normal operating screen. Also the DOWN arrow key can be used to step backwards through the main function screens of the Calibration Mode.

This completes the calibration procedure for the transit time velocity section.

INTEGRATOR SECTION (HxV) – Note: the integrator unit is also referred to as "H x V" unit or "H x V" board in this manual.

To enter into the calibration mode of the Integrator Section press the MENU key and the following screen will appear:

STATUS INFORMATION
>DATA ENTRY

Use the DOWN arrow key to position the arrow next to the DATA ENTRY line and press the ENTER key. If the screen does not advance to the data entry screens, then the security protection is enabled and must be disabled to continue.

To disable the security protection, you must change the position of a security jumper located on the electronic circuit board.

To gain access to the security jumper, remove power from the electronics by turning off the power switch in the lower right corner of the front panel. Lift up the two latches on the front panel and swing the panel open. On the back of the front panel are the covers for the electronic packages. The top cover holds the integrator and level electronics and the lower cover holds the velocity electronics.

Remove the two finger nuts on the left side of the top cover. Swing open the top cover. Remove the four screws holding the front display cover of the integrator section (top unit). **Caution: There are two ribbon cables attached to the front display cover that are connected to the electronic board mounted in the back of the cover.** Carefully swing the front display cover from left to right. Disconnect the two ribbon cable connectors from the electronic board.

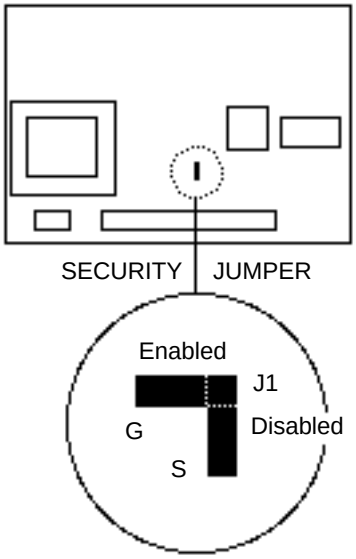


FIGURE 14

The security enable/disable jumper is located in the middle of the board approximately 1/3 up from the bottom of the board and is identified as J1. With the jumper in the horizontal position (J1 to G) the security is enabled. To disable the security remove the jumper and position it in the vertical position (J1 to S).

Reconnect the ribbon cable connectors from the front display cover to the circuit board and attach the front display cover back with the four screws. Close the electronic housing cover and reinstall the two finger screws. Close the front panel and turn on the power with the power switch.

Now that the security has been disabled, the DATA ENTRY MODE can be entered. With the display screen in the normal operating mode (showing flow rate and flow total), press the MENU key and the following screen will appear:

STATUS INFORMATION
>DATA ENTRY

Use the DOWN arrow key to position the arrow next to the DATA ENTRY line and press the ENTER key.

Caution: Changes to the next three screens from the original data will cause errors in the information displayed by the flowmeter. Refer to the data sheet in the front of this manual for the correct data. If changes are necessary consult the factory before making any changes.

After pressing the ENTER key the following screen will appear:

DATA ENTRY MODE
UNITS = XXX

This screen allows the selection of the flow units to be displayed for the flow rate indication. The XXX's represent the abbreviation for the unit of flow. The following units are available:

GPM = Gallons per minute
GPD = Gallon per day
MGD = Million gallons per day
CFS = Cubic feet per second
L/H = Liters per hour
L/S = Liters per second
M3H = Cubic meters per hour
M3D = Cubic meters per day

To select the desired flow units, press the DOWN arrow key to scroll through the selections and stop at the desired unit. Press the ENTER key to store the unit. The following screen will appear:

DATA ENTRY MODE
FLOW MULT = XXXX

This screen allows the selection of the proper flow rate multiplier. The following multipliers are available:

X1	X10
X100	X1000
X.001	X.01
X.1	

To select the desired flow multiplier, press the DOWN arrow key to scroll through the selections and stop at the desired multiplier (keep in mind the 4 digit resolution). Press the ENTER key to store the value. The following screen will appear:

DATA ENTRY MODE
TOTL MULT = XXXX

This screen allows the selection of the proper totalizer multiplier. The following multipliers are available:

X.01	X.1	X1	X10
X100	X1K	X10K	

To select the desired flow multiplier, press the DOWN arrow key to scroll through the selections and stop at the desired multiplier. If the multiplier is changed the totalizer word must also be changed. Refer to Page 29 for instructions. Press the ENTER key to store the value. The following screen will appear:

DATA ENTRY MODE
DAMPING FACTOR = XXXX

This screen allows the selection of the damping of the 4-20 mADC output signal. This is not a critical adjustment to the calibration of the flowmeter and can be adjusted to the desired value by the user. The damping can be adjusted in the following steps: .25, .5, 1, 2 and 4 seconds.

To select the desired damping value, press the DOWN arrow key to scroll through the selections and stop at the desired multiplier. Press the ENTER key to store the value. The following screen will appear:

DATA ENTRY MODE
LO FLOW CURVE = XXXXXXXXXX

Caution: Changes to this screen and the next three screens from the original data will cause errors in the flowmeter. Refer to the Data Sheet in the front of this manual for the correct selections. If changes are necessary, consult the factory before making any changes.

The LO FLO CURV screen selects the flow curve to be used below the crossover point. The selections are: RECT MANNGS, Manning's flow curve for a rectangular channel; CIRC MANNGS, Manning's flow curve for a circular pipe; and SPECIAL, which allows a sixteen point curve to be entered into the program. If a special curve is incorporated in your system, the data points will be provided in the front of this manual.

To select the proper low flow curve, press the DOWN arrow key to scroll through the selections and stop at the desired curve. Press the ENTER key to store the value.

If SPECIAL is selected, the next screen will show POINT 0 with a 4 digit hexadecimal value. Refer to the data sheet in the front of this manual for the correct values to enter. Press the MENU key to move the cursor under the first digit and use the UP/DOWN keys to select the correct character value. Press the ENTER key to advance the cursor to the next digit and repeat the procedure. When all four digits are correct, pressing the ENTER key will advance the screen to the next data point in the sixteen point curve. After all the points have been entered, press the ENTER key and the following screen will appear:

DATA ENTRY MODE
HI FLO CURVE = XXXXXXXXXX

This screen selects the area curve to be used above the switch over point. The selections are: RECTANGULAR; CIRCULAR; AND SPECIAL, which allows a sixteen point curve to be entered into the program. If a special curve is incorporated in your system, the data points will be provided in the front of this manual. If special is selected, follow the same procedure as explained in the previous paragraph.

To select the proper high area curve, press the DOWN arrow key to scroll through the selections and stop at the desired curve. Press the ENTER key to store the value. The following screen will appear:

METER MAX CAPACITY
FLOW = XXXX X100 GPM

This screen allows the setting of the maximum flow of the system. **This is factory set and should not be adjusted without consulting the factory first.** The display will show the flow units and multiplier previously selected. To change the maximum flow value, press and hold either the UP or DOWN arrow key to the new value. The rate of change will increase the longer you hold the keys down. To enter the new value, press the ENTER key. The following screen will appear:

CROSSOVER FLOW
FLOW = XXXX X100 GPM

This screen sets the flow rate at crossover. The display will show in the flow units and multiplier previously selected. To change the crossover flow value, press and hold either the UP or DOWN arrow key to the new value. The rate of change will increase the longer you hold the keys down. To enter the new value, press the ENTER key. The following screen will appear:

FULL SCALE FLOW
20 MA = XXXX X100 GPM

This screen sets the full scale flow value for the 20 mA output signal. This can be adjusted down or up to the METER MAX CAPACITY value. Should the flow go above the value set, the meter will continue to output 20 mA but the display will continue to read flow and totalize up to the meter maximum value capacity. To change the full scale flow value, press and hold either the UP or DOWN arrow key to the new value. The rate of change will increase the longer you hold the keys down. To enter the new value, press the ENTER key. The following screen will appear:

FLOW PROPORTIONAL SAMPLE
VOLUME = XXXX X100 GAL

This screen plus the next two screens are not critical adjustments that will affect the accuracy of the flowmeter. The user may set these values to meet his requirements.

The FLOW PROPORTIONAL SAMPLE screen allows the user to set the volume of flow between pulse outputs to pace a sampler. The adjustable value is in increments of the totalizer multiplier. To change the sample value, press and hold either the UP or DOWN arrow key to the new value. The rate of change will increase the longer you hold the keys down. To enter the new value, press the ENTER key. The following screen will appear:

REMOTE TOTAL PULS WDTH
PULSE WIDTH = XXXX

This screen allows the adjustment of the pulse width for the remote totalizer output. The increments of adjustment are in multiples of 30 milliseconds. For example, if the pulse width value was 4 then the pulse width would be 120 milliseconds. Use the UP or DOWN arrow keys to change the value. To enter the new value, press the ENTER key. The following screen will appear:

SAMPLER PULSE WIDTH
PULSE WIDTH = XXXX

This screen allows the adjustment of the pulse width for the sampler output. The increments of adjustment are in multiples of 30 milliseconds. For example, if the pulse width value was 4, then the pulse width would be 120 milliseconds. Use the UP or DOWN arrow keys to change the value. To enter the new value, press the ENTER key. The following screen will appear:

>SINGLE ANALOG OUTPUT
DUAL ANALOG OUTPUT

Caution: Changes to remaining screens from the original data will cause errors in the flowmeter. Refer to the Data Sheet in the front of this manual for the correct selections. If changes are necessary, consult the factory before making any changes.

The above screen allows the user to select either single or dual analog outputs. Single analog output will give 0-100% (4-20 mA) of maximum flow on the LO SCALE OUTPUT terminals. Dual range switches between the outputs, giving 0-100% of crossover flow on the LO SCALE outputs and switching to 0-100% of maximum flow on the HI SCALE flow. The factory default is Single Analog Output using the Lo Scale Output terminals.

Use the UP or DOWN arrow keys to select the proper output mode of operation and press the ENTER key. The following screen will appear:

CAL. ANAL. H PRESS MENU

STOP: Do not press MENU if you are not prepared to calibrate the level section to the H x V board.

This screen allows entry into the calibration of the level analog input signals. If you do not desire to enter this menu press the ENTER key and you will bypass this section and go to the CAL. ANAL. V screen. To enter the analog calibration press the MENU key and the following screen will appear:

INPUT H ZERO/SET OUTPUT
ZERO WORD = XXXX

The XXXX's will be some combination of the letters A-F, and the numbers 0-9. They represent, to the processor in the H x V section, how hard to drive the 4-20 mA retransmitter output for the desired current.

Place the level transmitter in hard zero(4-20 current calibration Zero Word-4.00 mA output). Note: If there is a loss of ultrasonic signal, then place the pressure unit in hard zero (4-20 current calibration Zero Word).

Measure the current going into the H x V section by using the test jacks marked 'LEVEL'. There should be 4.00 mA when the level transmitter has settled. Move the current meter over to the "LEVEL RETRANSMIT' jacks. Measure the current. If current is not 4.00 mA, adjust the H x V section using the UP/DOWN keys to adjust to 4.00 mA. **NOTE:** In order for the retransmit jacks to be active, there has to be a load connected to terminals 24 and 25 or a jumper connected between them.

When the current measured on both the 'LEVEL' and the 'LEVEL RETRANSMIT' is 4.00 mA, press ENTER on the H x V section. Then press ENTER on the Level unit.

After pressing the ENTER key the following screen will appear:

INPUT H SPAN/SET OUTPUT
SPAN WORD = XXXX

The Ultrasonic level transmitter should be in hard span, (4-20 current calibration Span Word – 20.00 mA output). Note: If there is a loss of ultrasonic signal, then place the pressure unit in hard span (4-20 current calibration Span Word).

Measure the current going into the H x V section by using the test jacks marked 'LEVEL'. There should be 20.00 mA when the level transmitter has settled. Move the current meter over to the 'LEVEL RETRANSMIT' jacks. Measure the current. If current is not 20.00 mA, adjust the H x V section using the UP/DOWN keys to adjust to 20.00 mA. **NOTE:** In order for the retransmit jacks to be active, there has to be a load connected to terminals 24 and 25 or a jumper connected between them.

When the current measured on both the 'LEVEL' and the 'LEVEL RETRANSMIT' is 20.00 mA, press ENTER on the H x V section. Then place the ultrasonic level unit and/or pressure unit in normal operation.

After pressing the ENTER key the following screen will appear:

CAL. ANAL. V PRESS MENU

STOP: Do not press MENU if you are not prepared to calibrate the velocity section to the H x V board.

This screen allows entry into the calibration of the velocity input signals. If you do not desire to enter this menu press the ENTER key and you will bypass this section and go to the CAL. ANAL. FL screen. To enter the analog calibration press the MENU key and the following screen will appear:

INPUT V ZERO/SET OUTPUT
ZERO WORD = XXXX

Place the transit time velocity transmitter in hard zero (4-20 current calibration Zero Word - 4.00 mA output). Note: If there is a loss of transit time signal, then place the Doppler unit in hard zero (4-20 current calibration Zero Word).

Measure the current going into the H x V section by using the test jacks marked 'VELOCITY'. There should be 4.00 mA when the level transmitter has settled. Move the current meter over to the 'VELOCITY RETRANSMIT' jacks. Measure the current. If current is not 4.00 mA, adjust the H x V section using the UP/DOWN keys to adjust to 4.00 mA. **NOTE:** In order for the retransmit jacks to be active, there has to be a load connected terminals 22 and 23 or a jumper connected between them.

When the current measured on both the 'VELOCITY' and the 'VELOCITY RETRANSMIT' is 4.00 mA, press ENTER on the H x V section. Then press ENTER on the velocity unit.

After the ENTER is pressed the following screen will appear:

INPUT V SPAN/SET OUTPUT
SPAN WORD = XXXX

The velocity transmitter should be in hard span, (4-20 current calibration Span Word – 20.00 mA output). Note: If there is a loss of transit time signal, then place the Doppler unit in hard span (4-20 current calibration Span Word).

Measure the current going into the H x V section by using the test jacks marked 'VELOCITY'. There should be 20.00 mA when the velocity transmitter has settled. Move the current meter over to the 'VELOCITY RETRANSMIT' jacks. Measure the current. If current is not 20.00 mA, adjust the H x V section using the UP/DOWN keys to adjust to 20.00 mA. **NOTE:** In order for the retransmit jacks to be active, there has to be a load connected terminals 22 and 23 or a jumper connected between them.

When the current measured on both the 'VELOCITY' and the 'VELOCITY RETRANSMIT' is 20.00 mA, press ENTER on the H x V section. Then press ENTER on the velocity unit. Return the velocity unit to normal operation.

After pressing the ENTER key on the H x V section, the following screen will appear:

```
CAL. ANAL. FL PRESS MENU
```

This screen allows the adjustment of the zero and span 4-20 mA flow output current. If this adjustment is not desired, press the ENTER key and you will bypass this section and go to the MAX LEVEL screen. To enter the analog flow calibration, press the MENU key and the following screen will appear:

```
FLOW OUTPUT CALIBRATION
ZERO WORD = XXXX
```

Measure the flow output current by using the test jacks marked 'Flow' on the bottom of the front display panel. There should be 4.00 mA. The LO SCALE FLOW output terminals 20 and 21 must be connected to a load or jumpered together in order for the test jacks to be active. Use the UP/DOWN keys on the H x V section to adjust the current output to 4.00 mA and then press the ENTER key. The following screen will appear:

```
FLOW OUTPUT CALIBRATION
SPAN WORD = XXXX
```

The flow output (span) is calibrated by monitoring the 'FLOW' test points on the bottom of the front display panel. The LO SCALE FLOW output terminals 20 and 21 must be connected to a load or jumpered together in order for the test jacks to be active. Use the UP/DOWN keys to adjust the current output to 20.00 mA and then press the ENTER key. The following screen will appear:

```
DATA ENTRY MODE
MAX LEVEL =      000.00 IN
```

This screen is used to set the maximum level of the system and the display is presented in the units previously selected by the user. Refer to the Calibration Data Sheets in the front of this manual for the maximum level value. To adjust this value, use the UP and DOWN arrow keys to scroll the display to the correct maximum level value and then press the ENTER key. The following screen will appear:

```
DATA ENTRY MODE
BOTTOM OFFSET =    000.00 IN
```

This screen is used to set the bottom offset, if a primary device is used, to correct for an offset at zero flow. Refer to the Calibration Data Sheets in the front of this manual to determine the correct value. Use the UP and DOWN arrow keys to adjust the bottom offset to the correct value and then press the ENTER key. The following screen will appear:

```
DATA ENTRY MODE
CROSSOVER      000.00 IN
```

This screen is used to set the crossover level where the flowmeter switches from compound operation to level only operation. Refer to the Calibration Data Sheets in the front of this manual to determine the correct value. Use the UP and DOWN arrow keys to adjust the crossover level to the correct value and then press the ENTER key. The following screen will appear:

```
TOTALIZER WORD
0000  02C5  03A9
```

This screen is used to enter the totalizer word to calibrate the totalization of the flow. The totalizer word is a Hexadecimal value that is calculated from the meter maximum capacity, the desired totalizer volume, and the program time base. Refer to the Calibration Data Sheets for the correct value.

To change the totalizer rate the following equation applies:

Totalizer Word = HEX
(total multiplier/flow per sec. X 2,000,000)

For example: Totalizer Multiplier is .001 and maximum flow is 50 million gallons per day or .000578704 million gallons per second, then:

Totalizer Word = .001/.000578704 X 2,000,000
= Hex (3,544,998)
= 0000 0034 BBFE

To enter the calculated totalizer word into the system, press MENU and the underline cursor will move to the left most digit of the display. Press the UP and DOWN arrow keys to scroll the digit to the desired value then press the ENTER key. The cursor will move to the next digit. Repeat

this procedure until the correct totalizer word has been entered. After the last digit has been entered, the microprocessor will store all of the values entered while in the Data Entry Mode. The display will then return to the normal operating screen which shows the flow rate and flow total.

This completes the calibration procedure for the Integrator Section (H x V) Section of the Series 5000 flowmeter.

NOTE: If the user is in the Integrator (H x V) Calibration Mode for more than 35 minutes, the system will default and return to the normal operating mode, ignoring any changes made, and use the previously programmed parameters.

DOPPLER/PRESSURE CALIBRATION MENUS

This section of the operating instructions covers the application programming menus for the Doppler velocity and pressure level unit. The unit has security protection to prevent unauthorized changes of the programmed parameters and adjustments of various meter functions and outputs.

Note: The unit has been programmed at the factory for the specific application. No further programming is required.

The programming procedure is presented her for information and reference only. Refer to the data sheet in the front of this manual for the site specific programming parameters.

The user must follow these procedures carefully to prevent inducing inaccuracies in the flowmeter's operation. Areas in the calibration procedure that are critical to maintain proper operation and accuracy will be pointed out.

To enter into the calibration menus, from the normal operating screen, press the MENU button and the screen will change to:

Press up for Calibration
Press down for Status

Press UP to go into the calibration menus. The security ID screen will appear.

Security ID
Input 4 Digit ID 0 0 0 0

A customer selectable security code must be entered in order to gain access to the calibration - application programming menus. This 4 digit code uses the letters A-F and numbers 0-9. The factory default is 0000. The first time into the security screen, the security screen will show 0000 as the code. Pres SELECT to gain access to the calibration screens. The last screen in the calibration menus allows a different security code to be set.

If a security code is needed to gain access to the calibration menus, enter the correct 4 digit security ID code using the UP, DOWN, and RIGHT buttons. When the screen is first activated, a line (cursor) will appear under the first (most significant digit). Press the UP or DOWN buttons to select the correct character for the code. Press the RIGHT button and the line (cursor) will move to the next character. Use the UP or DOWN buttons to change this character to the correct value. Press the RIGHT button to move the cursor and repeat the process. When the correct four digit security code is present on the screen, press the SELECT button and the first calibration screen will appear:

Lost Signal Default
64 Seconds

This screen sets a "time out" in case of a loss of velocity signal. The "time out" is selectable in seconds. The selected value is the amount of time that the display will hold the last velocity measurement in case of a loss of velocity signal. If a loss of signal occurs, the display will hold the last velocity measurement for the length of time selected as the default. If signal is restored during this default period, the actual velocity measurement will resume. If signal is not restored during the default period of time, the velocity unit will go to zero velocity and output 4 mA (zero) to the integrator unit, until the velocity signal is restored. The selectable default time units are: 0, 8, 16, 32, 64, 128, 256 and 512 seconds.

Press SELECT and the output damping screen will appear:

Output Damping
Setting = 4

The output damping is the response time of the unit to a change in velocity or level. It sets the response time of the display and the velocity/level 4-20 mA outputs to the integrator. The selectable units are: 1-8, with 1 being the fastest response time and 8 being the slowest. Use the UP of DOWN buttons to select the damping.

Press SELECT and the pressure calibration screen will appear:

Pressure Calibration
Press up to activate

Press UP and the level units screen will appear:

Level Measurement
Units Used = In

Use the UP or DOWN buttons to select Inches (in) or Millimeters (mm).

Press SELECT and the sensor type screen appears:

Type of Level Sensor
Used – 100 Inch

Use the UP or DOWN buttons to select 100 inch or 360 inch depending on which sensor is used.

Press SELECT and the level zero capture screen appears:

Level Zero Capture
Press up to activate

STOP – If you are not prepared to calibrate the pressure sensor at this time, do not activate the zero capture screen. The calibration requires the sensor to be out of the fluid, and then placed under a known level of fluid. This procedure is covered in the calibration section of this manual.

Press SELECT to bypass the level zero capture screen or press UP to activate it.

When activated, the screen shows:

Level Zero Capture
* Wait *

The level unit measures the pressure at the sensor and sets that value as representing zero pressure (level).

The screen automatically advances to the level span capture screen.

Level Span Capture
Press up to activate

STOP – If you are not prepared to calibrate the pressure sensor at this time, do not activate the span capture screen. The calibration requires the sensor to be out of the fluid, and then placed under a known level of fluid. This procedure is covered in the calibration section of this manual.

Press SELECT to bypass the level span capture screen or press UP to activate it.

When activated, the screen shows:

Level Span Capture
000.0 In

The level span capture shows the level of fluid being measured at the present time. Use the UP, DOWN, and RIGHT buttons to set the display screen level value to the actual level of fluid as measured from the bottom of the pipe or channel to the surface of the fluid.

Press SELECT and the level zero/span view screen appears:

Level Zero/Span View
Pres up to activate

Press the UP button and view screen appears:

Level Adjustment
Zero=000054E2

The hexadecimal value shown on the display represents the hexadecimal value captured for zero. This value may be changed using the UP, DOWN, RIGHT and SELECT buttons. However, do not change the value unless instructed to do so. The UP, DOWN and RIGHT buttons will allows changes to be made to the first 4 digits. Pressing the SELECT button advances the cursor to the last 4 digits and allows for changes to them using the UP, DOWN and RIGHT buttons.

Press SELECT to advance to the span view screen.

Level Adjustment
Span=00011100

The hexadecimal value shown on the display represents the hexadecimal value captured for span. This value may be changed using the UP, DOWN, RIGHT and SELECT buttons. However, do not change the value unless instructed to do so. The UP, DOWN and RIGHT buttons will allow changes to be made to the first 4 digits. Pressing the SELECT button advances the cursor to the last 4 digits and allows for changes to them using the UP, DOWN and RIGHT buttons.

Press SELECT once or twice to advance to the bottom offset screen.

Sensor bottom
Offset=000.2 In

The bottom offset is to set the difference between the invert of the pipe or channel and the pressure sensor. The pressure cell is located .2 inches (5.1 mm) above the bottom of the Doppler/pressure sensor housing. If the sensor is mounted on the invert of the pipe or the bottom

of the

channel, then set the bottom offset to .2 inches (5.1 mm). If the sensor is mounted higher up in the pipe or channel, then determine the distance from the invert or bottom of the pipe or channel, to the bottom of the sensor and add .2 inches (5.1 mm). This value will be the bottom offset. Use the UP, DOWN and RIGHT buttons to set the offset.

Press SELECT and the velocity calibration screen will appear:

Velocity Calibration Press up to activate

Press UP to advance the calibration screen.

Velocity Measurement Units Used = F/S

This screen sets the units of measure for the velocity section. The selections are: F/S (feet per Second) and M/S (Meters per Second). Use the UP or DOWN buttons to select the velocity units.

Press SELECT to advance to the meter factor screen.

Velocity Calibration Meter Factor – 0.000

The velocity meter factor is the relation between the indicated velocity and the actual velocity as proven by on-site calibration tests. The default meter factor is 1.000. The meter factor can be modified from a value of 0.800 to 1.200. If the velocity unit is reading low compared to the calibration test, then raise the meter factor by a value equal to the percent of increase required. For example, if it is determined by independent means that the velocity unit is reading 2% low, change the meter factor to 1.02 (1.000 + 2%). If it is determined by independent means that the velocity unit is reading high, lower the meter factor by a value equal to the percent of decrease required. For example, if the velocity unit is reading 2% high, then change the meter factor to 0.980 (1.000 – 2%).

NOTE: Changing the velocity meter factor without independent means of velocity verification, will affect the accuracy of the 5000.

Press SELECT and the 4-20 ma current screen will appear:

4-20 Current Press up to activate

NOTE: The 4-20 mA velocity and level outputs are adjusted at the factory and should not need to be field calibrated. Calibrating the 4-20 mA outputs requires a digital volt meter or current meter and a small blade screwdriver. The calibration procedure will be covered in the calibration section of this manual. You can bypass the current screens by pressing the SELECT button. you can press the UP button to activate the screens. If you do not change any of the values in the screens, it will not affect the current calibration.

Press UP to access the 4-20 current screen or SELECT to bypass the 4-20 current screens.

Pressure 4-20 Zero = 24E0

This screen allows adjustment of the level zero or 4 mA output reference. refer to the Calibration Section of this manual.

Press SELECT and the 4-20 current pressure span screen will appear:

Pressure 4-20 Span = ACB0

This screen allows adjustment of the level span or 20 mA output reference. Refer to the calibration section of this manual.

Press SELECT and the velocity 4-20 mA calibration screen will appear:

Velocity 4-20 Zero = 24F0

This screen allows adjustment of the velocity zero or 20 mA output reference. Refer to the Calibration Section of this manual.

Press SELECT and the 4-20 current velocity span screen will appear:

Velocity 4-20 Span = ACB0

This screen allows adjustment of the velocity span or 20 mA output reference. Refer to the Calibration Section of this manual.

Press SELECT and the full scale level screen will appear:

Level at 20 milliamps Output = 100.0 In

This screen sets the full scale level of the application. Full scale level is calculated based on the specific application and programmed at the factory. The full scale level is listed on the application data sheet in the front of this manual. Use the UP, DOWN, and/or RIGHT buttons to change the full scale level.

NOTE: The 5000 is an Area x Velocity meter. The full scale velocity and the maximum wetted area of the pipe or channel (level), determines the maximum flow range of the 5000. Changing the full scale level changes the maximum area value and affects the full scale flow value. This change will require calculating new values for the Integrator unit. These new values must be programmed into the Integrator or the accuracy of the 5000 will be affected.

Press SELECT and the full scale velocity screen appears:

Velocity at 20 milliamps Output = 00.00 F/S

This screen sets the full scale velocity of the application. Full scale velocity is calculated based on the specific application and programmed at the factory. The full scale velocity is listed on the application data sheet in the front of this manual. Use the UP, DOWN, and/or RIGHT buttons to change the full scale velocity.

NOTE: The 5000 is an Area x Velocity meter. The full scale velocity and the maximum wetted area of the pipe or channel (level), determines the maximum flow range of the 5000. Changing the full scale velocity value affects the full scale flow value and requires calculating new values for the Integrator unit. These new values must be programmed into the Integrator unit. These new values must be programmed into the Integrator or the accuracy of the flowmeter will be affected.

Press SELECT and the security ID screen will appear:

Security ID Press up to activate

Press UP to access the security ID screen.

Security ID Input 4 Digit ID 0 0 0 0

This screen shows the security ID code in use at the present time and is used to change the security code if desired. Use the UP, DOWN, and/or RIGHT buttons to change the security code to a new one or press SELECT to retain the existing code. The security code screen is the last screen in the calibration menus.

Pressing the SELECT button loops to the beginning of the calibration menus.

To return to the normal operating screen, press the MENU button.

This completes the Doppler/pressure calibration menus.

CALIBRATION SECTION

Calibration procedures covered in this section are: Calibrate Doppler velocity 4-20 mA output to the Integrator unit, calibrate pressure level 4-20 mA output to the Integrator unit, calibrate Integrator analog height input, calibrate Integrator analog velocity input, calibrate Integrator flow output, site calibrate Doppler velocity unit and site calibrate pressure level unit.

NOTE: The 4-20 mA and Integrator input calibrations are performed at the factory prior to shipping the flowmeter.

Pressure Level 4-20 mA Output Adjust

NOTE: Read through this section before attempting this procedure. This procedure must be followed carefully to prevent inducing inaccuracies in the flowmeter's operation.

Equipment Needed: Small blade screwdriver and Digital Volt Meter (DVM) or DC Milliampere current meter.

1. Turn off AC power to flowmeter.

2. Remove the violet wire connected to TB3, terminal 3 on the velocity/pressure unit.

3. Set DVM to measure DC current (milliampere range).

4. Connect DVM leads to the disconnected violet wire and TB3, terminal 3.

5. Turn on AC power to flowmeter.

6. Press the MENU button on the velocity/level board until the display screen shows:

Press up for Calibration Press down for Status

7. Press the UP button to go into the calibration mode.

8. Press the SELECT button 5 times or unit the display shows:

4-20 Current Press up to activate

9. Press the UP button to enter the level 4-20 calibration screen.

Pressure 4-20 Zero = 24E0

Read the mA current on the DVM and adjust the 4 digit hexadecimal zero value for 4.00 mA current output by using the UP/DOWN buttons to change the value and the RIGHT button to move to the next digit. The 4 digit zero value displayed is for reference only and does not hold any true mA value. The left digit (most significant digit) when changed, will make a large change in the current output (about 2 mA). The next digit when changed, makes a smaller change in the output. The last digit (least significant digit) makes a very small change in the mA output. By using the last two digits, and specifically, the right hand digit, the output can be adjusted to 4.00 mA.

10. When the output is adjusted to 4.00 mA, press the SELECT button and the display screen will change to the span value screen.

Pressure
4-20 Span = ACB0

Read the mA current on the DVM and adjust the 4 digit hexadecimal span value for 20.00 mA current output by using the UP/DOWN buttons to change the value and the RIGHT button to move to the next digit. The 4 digit span value displayed is for reference only and does not hold any true mA value. The left digit (most significant digit) when changed, will make a large change in the current output (about 2 mA). The next digit when changed, makes a smaller change in the output. The last digit (least significant digit) makes a very small change in the mA output. By using the last two digits, and specifically, the right hand digit, the output can be adjusted to 20.00 mA.

11. When the output is adjusted to 20.00 mA, press the SELECT button to exit the pressure/level span calibrate screen. The next screen is for calibrating the 4-20 mA output of the velocity section. Press the MENU button to return to the normal operating screen.

12. Turn off AC power to flowmeter.

13. Remove the DVM leads and reconnect the violet wire to TB3, terminal 3.

14. Turn on AC power to flowmeter.

This completes the level 4-20 mA adjustment.

Doppler Velocity 4-20 mA output Adjust

NOTE: Read through this section before attempting this procedure. The procedure must be followed carefully to prevent inducing inaccuracies in the flowmeter's operation.

Equipment Needed: Small blade screwdriver and Digital Volt Meter (DVM) or DC Milliampere current meter.

1. Turn off AC power to flowmeter.

2. Remove the blue wire connected to TB3, terminal 1 on the velocity/pressure unit.

3. Set DVM to measure DC current (milliampere range).

4. Connect DVM leads to the disconnected blue wire and TB3, terminal 1.

5. Turn on AC power to flowmeter.

6. Press and hold the MENU button on the velocity/level board until the display screen shows:

Press up for Calibration
Press down for Status

7. Press the UP button to go into the calibration mode.

8. Press the SELECT button 5 times until the display shows:

4-20 Current
Press up to activate

9. Press the UP button to enter the calibration screen. Press the SELECT button 2 times until the screen displays:

Velocity
4-20 Zero = 24E0

Read the ma current on the DVM and adjust the 4 digit hexadecimal zero value for 4.00 mA current output by using the UP/DOWN buttons to change the value and the RIGHT button to move to the next digit. The 4 digit zero value is for reference only and does not hold any true mA value. The left digit (most significant digit) when changed, will make a large change in the current output (about 2 mA). The next digit when changed, makes a smaller change in the output. The last digit (least significant digit) makes a very small change in the mA output. By using the last two digits, and specifically, the right hand digit, the output can be adjusted to 4.00 mA.

10. When the output is adjusted to 4.00 mA, press the SELECT button and the display screen will change to the span value screen.

Velocity
4-20 span = ACB0

Read the mA current on the DVM and adjust the 4 digit hexadecimal span value for 20.00 mA current output by using the UP/DOWN buttons to change the value and the RIGHT button to move to the next digit. The 4 digit span value is for reference only and does not hold any true mA value. The left digit (most significant digit) when changed, will make a large change in the current output (about 2 mA). The next digit when changed, makes a smaller change in the output. The last digit (least significant digit) makes a very small change in the mA output. By using the last two digits, and specifically, the right hand digit, the output can be adjusted to 20.00 mA.

11. When the output is adjusted to 20.00 mA, press the SELECT button to exit the span value screen and then press the MENU button to return to the normal operating screen.

12. Turn off AC power to flowmeter.

13. Remove the DVM leads and reconnect the blue wire to TB3, terminal 1.

14. Turn on AC power to flowmeter.

This completes the velocity

Pressure/Level Calibration Procedures

NOTE: Read through this section before attempting this procedure. The procedure must be followed carefully to prevent inducing inaccuracies in the flowmeter's operation.

Pressure Calibrations

The pressure portion of the velocity/pressure circuit board and sensor must be calibrated. The pressure sensor has to be calibrated to the specific circuit board it will be used with.

With a new flowmeter, the pressure sensor is calibrated to the circuit board at the factory and further calibration may not be necessary unless the sensor cable length has been significantly changed in the field.

Each pressure sensor has a specific millivolt range that sets the pressure parameters. This range varies from sensor to sensor. Therefore, calibration of each sensor is required. The zero and span range that is set for each sensor is stored in the velocity/pressure circuit board microprocessor. Therefore, each sensor and circuit board has to be calibrated as a pair.

When either the velocity/pressure circuit board or the sensor is changed or replaced, then the sensor must be calibrated to the board.

There are 3 situations which would require sensor calibration. They are:

1. Calibrating a new installation in the field, if the sensor cable length has been significantly changed in the field.

2. Replacing the velocity/pressure circuit board in the field requires calibrating the new circuit board to the existing sensor.

3. Replacing the existing sensor with a new one requires calibrating the new sensor to the existing circuit board.

There are two different calibration procedures depending on whether the sensor to be used is already installed in the application.

The easiest calibration procedure is performed when the sensor has not been installed in the flow stream.

Calibrating a new sensor prior to installation or calibrating a sensor that has been removed from the flow stream

This procedure requires exposing the sensor to the outside air and then submerging the sensor in a known amount of water.

Materials Needed: A container large enough to hold the sensor and at least 12" of water.

1. Turn off AC power to the flowmeter.

2. Connect the sensor to the circuit board.

3. Apply power to the flowmeter.

4. With the sensor removed from the flow stream, set it on the ground or on tope of a container with the sensor exposed to the outside air.

5. On the velocity/pressure unit, press the MENU button and the screen should change to:

Press up for Calibration
Press down for Status

Press UP and the security ID screen should appear. Enter the correct security ID and press SELECT. Press SELECT 3 times or until the pressure calibration screen appears.

Pressure Calibration
Press up to activate

Press UP to activate.

Press SELECT 2 times or until the zero capture screen appears.

Level Zero Capture
Press up to activate

NOTE: Before proceeding, make sure the sensor is exposed to the air and not submerged with fluid.

Press UP to activate the zero capture. The screen will indicate "Wait".

Level Zero Capture
* Wait *

After a few seconds, the screen will change to:

Level Zero Capture
* Captured *

After the zero level has been captured, the screen will automatically change to the span capture screen.

Level Span Capture
Press up to activate

Place the sensor flat on the bottom of a container full of water. There must be at least 12" of fluid covering the sensor.

Press UP to activate the span capture.

Level Span Capture
0000 In

The screen will indicate the fluid level measured by the sensor.

Physically measure the level of water in the container and compare with the span capture reading on the display screen. If there is a difference, use the UP, DOWN and RIGHT buttons to adjust the screen span value to the actual measured level of fluid.

Press SELECT to exit the span capture screen.

Press MENU to return to the normal operating screen.

Check level indicated on the normal operating screen for the correct level of fluid. If incorrect, repeat the zero/span procedure.

The sensor is ready to install in the application.

This completes the calibration procedure.

Calibrating a sensor installed in the flow stream or under a flow condition

If the sensor is already installed in the channel or conduit, there must be fluid covering the sensor in order to perform the calibration procedure.

Material needed: Laptop computer, Millivolt source, two pieces of small gauge wire, small screwdriver, Eastech Badger Velocity/4500 interface cable, Eastech Badger software "MVPRESS" and "AP45".

Note: This calibration procedure should be performed with a laptop computer on battery power only.

1. Locate the zero and span tag voltages for the sensor. These are located on a label affixed to the open end of the sensor cable or on the back panel of the enclosure. Record these values.

2. Connect the sensor to the circuit board.

3. Apply power to the velocity/level circuit board.

4. On the velocity/level circuit board, press the MENU button until the display changes to:

Press up for Calibration
Press down for Status

Press the UP button to enter the calibration mode.

Enter the correct security ID code and press SELECT.

Press SELECT again and the output damping screen will appear:

Output Damping
Setting = 4

Record the output damping setting. Use the UP or DOWN buttons to change the setting to 1. Press the SELECT button to exit the output damping screen. Press the MENU button to return to the normal operating screen.

5. Turn off the power to the circuit board.

6. On the velocity/pressure board, remove the white wire from TB2, terminal 8, and connect the millivolt source to TB2, terminal 8 (positive) and TB2, terminal 7 (negative). Do not remove the wire from terminal 7.

7. Connect the interface cable from the laptop to the velocity/pressure circuit board at the round connector on the bottom right corner of the circuit board.

8. Turn on power to the velocity/pressure circuit board.

9. Start-up the laptop computer. Remember to use battery power only for the laptop. From the DOS mode of operation, start-up the software program "MVPRESS" by typing MVPRESS. Follow the on-screen instructions.

Read the on-screen information and then press the ENTER key.

10. Enter the tag voltage for zero. Use the minus sign for negative numbers. Press the ENTER key.

11. Enter the tag voltage for span. Use the minus sign for negative numbers.

The program calculates both a zero and span millivolt source value. Record both of these values and select "N" for no. This exits the program.

12. At the DOS prompt, start AP45 by typing AP45 –t (AP45 space minus sign and small letter t). When the intro window appears, press ENTER to begin. The bottom right hand corner of the computer screen should indicate "ON LINE". If not, use the arrow keys to highlight "Meter" and press ENTER. Arrow down to highlight Comm Parameters and press ENTER. Setup the defaults as follows: Baud Rate 9600 and Com Port 1 or 2, whichever port the interface cable is connected to on the laptop.

13. Using the arrow keys, highlight "METER" and press ENTER. Down arrow to highlight Meter Terminal and press ENTER. When the terminal screen appears, press the ENTER key. The message "Illegal Parameter/Commands" should appear followed by a second line of text "Pressure/Velocity>". If this does not appear, try pressing the ENTER key several times.

14. At the pressure/velocity prompt, type ILC and press the ENTER key. A 4 digit hexadecimal value will be returned. Record this value. The factory default value is 07FF. Type ILC 01FF using a space between ILC and 01FF, then press the ENTER key. Watch for the "spade" character indicating the circuit board accepted the command.

15. Type RST and press the ENTER key. Watch for the "spade" character indicating the circuit board accepted the command.

16. Turn on the millivolt source and set its output to the calculated millivolt source zero value.

17. Type PRESSURE and press the ENTER key. The display will indicate hexadecimal values starting with Average, Raw, Zero, and Span.

Continue to enter the command PRESSURE and compare the average and raw hexadecimal values until the average and raw values are within 1 or 2 counts of each other. Record the average hexadecimal value. This will be the new Zero Value.

18. Set the Millivolt source output to the calculated millivolt source span value.

19. Type PRESSURE and press the ENTER key. The display will indicate 4 hexadecimal values starting with Average, Raw, Zero, and Span.

Continue to enter the command PRESSURE and compare the average and raw hexadecimal values until the average and raw values are within 1 or 2 counts of each other. Record the average hexadecimal value. This will be the new span Value.

20. Type PZERO XXXXXX where XXXXXX is replaced by the new zero hexadecimal value. Be sure to enter 6 digits. Use leading zeros if necessary and include a space after PZERO. Watch for the "Spade" character indicating the circuit board has accepted this value.

21. Type PSPAN XXXXXX where XXXXXX is replaced by the new span hexadecimal value. Be sure to enter 6 digits. Use leading zeros if necessary and include a space after PSPAN. Watch for the "Spade" character indicating the circuit board has accepted this value.

22. Type ILC XXXX where XXXX is replaced by the original ILC constant (probably 07FF). Use a space after "ILC". Press the ENTER key and watch for the "spade" character indicating the circuit board accepted the command.

23. Remove power from the velocity/pressure circuit board.

24. Remove the Millivolt source and reconnect white wire to TB2-8.

25. Turn off the laptop computer and remove the interface cable.

26. Turn on the power to the velocity/pressure circuit board.

27. On the velocity/pressure circuit board, press the MENU button until the display changes to "Press Up for calibration –

Down for status". Press the UP button to enter the calibration mode. Press the SELECT key three times until the display shows:

Output Damping
Setting = 4

Use the UP/DOWN buttons to change this value back to the original setting. Press the SELECT button to exit the output damping screen. Press the MENU button to return to the normal operating screen.

This completes the calibration procedure.

Calibrating a new circuit board to an existing sensor

This procedure only works if the circuit board to be replaced has a working microprocessor and display. Otherwise refer to the calibration procedures regarding new sensors.

This procedure reads the current pressure zero and span values in the existing circuit board and via laptop computer, transfers those values to the new circuit board.

Material needed: Laptop computer, Eastech Badger Velocity/4500 interface cable and Eastech Badger software "AP45".

1. Make sure the old Doppler/pressure circuit board is installed and the sensor is connected.

2. Connect the interface cable from the laptop computer to the circular connector at the bottom right of the circuit board.

3. At the DOS prompt, start AP45 by typing AP45 –t (AP45, space, minus sign and small letter t). When the intro window appears, press ENTER to begin. The bottom right hand corner of the computer screen should indicate "ON LINE". If not, use the arrow keys to highlight "Meter" and press ENTER. Arrow down to highlight Comm Parameters and press ENTER. Setup the defaults as follows: Baud Rate 9600 and Com Port 1 or 2, whichever port the interface cable is connected to on the laptop.

4. Using the arrow keys, highlight "Meter" and then press ENTER. Down arrow to highlight Meter Terminal and press ENTER. When the terminal screen appears, press the ENTER key. The message "illegal Parameter/Commands" should appear followed by a second line of text "Pressure/Velocity>". If this does not appear, try pressing the ENTER key several times.

5. Type PRESSURE and press the ENTER key. The display will indicate 4 hexadecimal values starting with Average, Raw, Zero and Span.

6. Record the Zero and Span hexadecimal values.

7. Press the ESC key and arrow over to FILE. Arrow down to EXIT and press ENTER. This exits the AP45 program.

8. Disconnect the interface cable from the circuit board.

9. Turn off power to the circuit board.

10. Remove the existing circuit board and install the new circuit board.

11. Apply power to the circuit board.

12. Connect the interface cable from the laptop computer to the circular connector at the bottom right of he circuit board.

13. At the DOS prompt, start AP45 by typing AP45 –t (AP45, space, minus sign and small letter t). When the intro window appears, press ENTER to begin. The bottom right hand corner of the computer screen should indicate "ON LINE". If not, use the arrow keys to highlight "Meter" and press ENTER. Arrow down to highlight Comm Parameters and press ENTER. Setup the defaults as follows: Baud Rate 9600 and Com Port 1 or 2, whichever port the interface cable is connected to on the laptop.

14. Using the arrow keys, highlight "Meter" and then press ENTER. Down arrow to highlight Meter Terminal and press ENTER. When the terminal screen appears, press the ENTER key. The message "Illegal Parameter/Commands" should appear followed by a second line of text "Pressure/Velocity>". If this does not appear, try pressing the ENTER key several times.

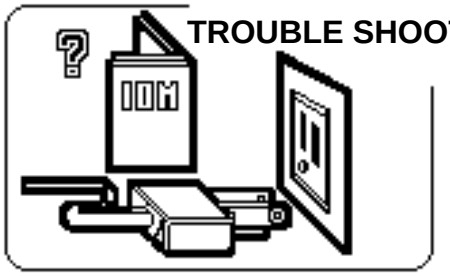
15. Type PZERO XXXXXX where XXXXXX is replaced by the new zero hexadecimal value. Be sure to enter 6 digits. Use leading zeros if necessary and include a space after PZERO. Watch for the "Spade" character indicating the circuit board has accepted this value.

16. Type PSPAN XXXXXX where XXXXXX is replaced by the new span hexadecimal value. Be sure to enter 6 digits. Use leading zeros if necessary and include a space after PSPAN. Watch for the "Spade" character indicating the circuit board has accepted this value.

17. Press ESC and then arrow over to EXIT and arrow down to EXIT.

18. Disconnect the interface cable.

This completes the calibration procedure.



Principles of Troubleshooting

When troubleshooting the flowmeter, certain guidelines should be followed in order to achieve a satisfactory conclusion in a minimal amount of time. It is important to remember that troubleshooting is a sequence of orderly events, checks, and verifications to achieve the objective. In some cases, it may involve a simple process of elimination - verifying what is operations, in order to determine what is not operational.

Troubleshooting involves identifying the symptom, the problem, and the source of the problem. Only then, can corrective action take place. It is important to separate and analyze each one. For example, suppose the amount of flow the flowmeter is indicating is fluctuating and very erratic. This is the symptom, not the problem. While some may consider this the problem, it is only the result of the problem. The actual problem is something causing the erratic flow indication. It could be a malfunction in one of the flowmeter circuits; external interference such as radio frequency interference (RFI), or a hydraulic phenomenon such as fluid swirl or fluctuations in the conduit. Any of these three could be the source of the problem. Once the source is narrowed down to one of these, then and only then, can proper corrective action be taken.

Guidelines for Troubleshooting

- Do not assume anything! Verify the information yourself.
- Look at the symptom and verify that it is a problem and not a normal characteristic of the system.
- Determine if the problem is external to the system or internal within the system.
- Look at the system as a whole and then break it down into smaller sections and check each section.
- Determine which sections are operating properly in order to eliminate them as the source of the problem.

System Troubleshooting

Should symptoms indicate a problem, try to determine if it is temporary. It is possible for a temporary hydraulic condition, AC power fluctuation or other external, non-repetitive event to cause a temporary situation that needs no further investigation.

If the symptoms indicate a possible malfunction, but the flowmeter appears to be operational, use the Data Sheets in the front of the IOM Manual to verify that the application parameters are programmed into the system correctly. If the programming is correct, perform the level, transit time, and integrator 4-20 mADC calibration procedures in order for the integrator to "recapture" the level and velocity 4-20 mA current values.

If the flowmeter still does not appear to be operating properly, check each unit - level, transit time velocity, Doppler velocity and integrator separately to determine which is operating properly and which is not operating properly. Then refer to the individual troubleshooting guides for that unit of the system.

Troubleshooting the System

It is important to remember that the 5000 flowmeter is actually 4 individual units.

Four of the units have their own power supplies and fuses: Level Unit, Transit Time Velocity Unit, Doppler Velocity Unit and the Integrator Unit.

All of the units have their own LCD displays: Level Unit, Transit Time Velocity Unit and the Integrator Unit.

Three of the units have their own sensors: Level Unit, Transit Time Velocity Unit and the Doppler Velocity Unit.

Troubleshoot the system as a whole, but when necessary, troubleshoot each unit separately.

System symptoms are broken down into three groups. Determine which group the symptom belongs to and follow the suggested procedures.

NOTE:
For clarity, the terms "flowmeter and system" refer to the Model 5000 flowmeter as a complete system including the level, transit time velocity, Doppler velocity, integrator, associated power supplies and sensors.

The term unit refers to the individual level, transit time, Doppler, or integrator portion of the flowmeter and the hardware associated with that unit - sensors, display, etc.

SYMPTOMS GROUP 1

The flowmeter is:
Off, displays blank, or inoperative

SYMPTOMS GROUP 2

The flowmeter is:
Showing flow at no flow, not showing flow, or reading incorrectly.

SYMPTOMS GROUP 3

The flowmeter is:
Erratic/drifting or spiking.

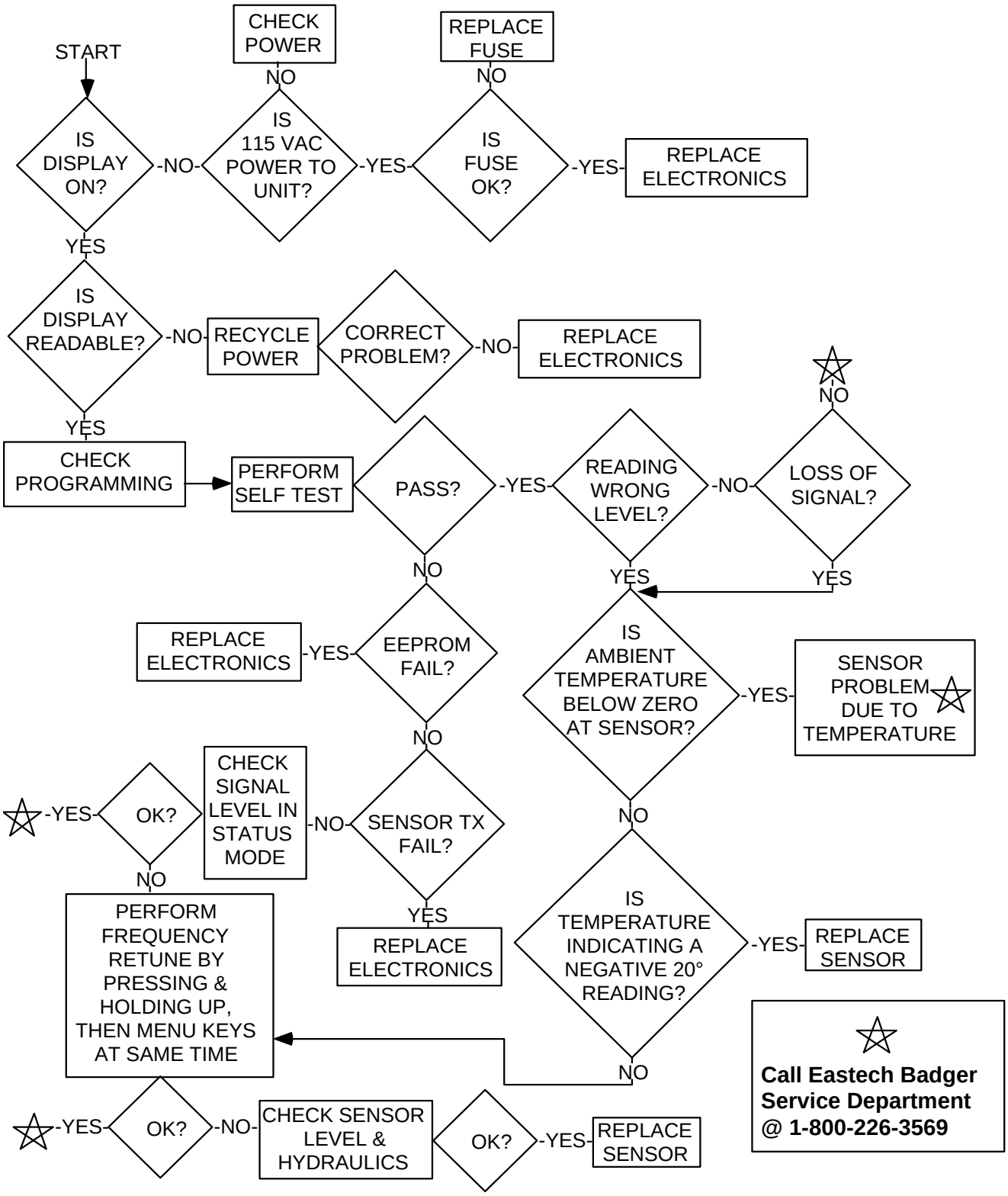
TROUBLESHOOTING GROUP 1

Symptom	**Check**
All displays blank	Check for AC power at terminal block. Check internal fuse 5 x 20 mm at 500 mA. Check power switch set to 'ON'. Check power switch push-on connectors.
One display blank	Check unit 4-20 mA loop. Loop reads OK - Check display ribbon cable. Loop not reading OK - Check unit power supply. Check unit internal fuse.

TROUBLESHOOTING GROUP 2

Symptom	**Check**
Flow at no flow	Verify no flow condition (including no standing water or debris under level sensor - if operating in low flow regime). Verify level display reading is correct. Verify level system zero current. Verify zero = 4.00 mA zero current is OK, recapture zero & span points in integrator unit. Check integrator flow output & verify zero span. Set 4.00/ Is there a H/Q curve in the system or is it using Manning's below crossover? If Manning's, check cross-over flow rate in integrator module. It may be the automatic correction based on the flow rate at the last crossover switch. If H/Q curve, check curve pro-gramming in the integrator.
Shows no flow	Verify flow condition is occurring. Verify flow 4-20 mA current loop terminated properly. Verify flow 4-20 mA current loop is accurate. Verify level display reading is correct. Verify level unit 4-20 mA loop is correct. Verify velocity display reading is correct (above crossover). Verify velocity 4-20 mA current loop is correct (above cross-over). Is there a H/Q curve in the system? If yes, check curve programming in the integrator.

LEVEL TROUBLESHOOTING CHART



The Transit Time Velocity unit is equipped with self test features which allow the user to identify the operation status of the unit to determine proper action to be taken.

The normal operating screen indicates velocity. In the upper right hand side of the display appears an operational code which indicates the operating condition of the meter. When the meter is first powered up, the flow rate will display XXXX and there will not be an operation code. The microprocessor is initializing the meter constants and performing a self test to ensure that all areas of the electronics are operating properly. This may take several seconds.

After initialization, the X's in the display will change to 0's. The operation code will display an OK which indicates the meter is operating properly. The meter may recycle a few times before locking onto a good signal. Should an OK not be displayed, refer to the troubleshooting chart for appropriate action.

The following is a list of the operation codes and their meanings.

OK - Nominal Operation
NS - Switches to Doppler
XM - Transmit Confirm Failure
TL - Signal Transit Time Out of Bounds (too long)
TS - Signal Transit Time Out of Bounds (too short)
TM - FIFO Error (missing or misaligned timing mark)
OF - Amplitude Overflow
UF - Amplitude Underflow
GE - Gain Error
CM - Communications Mode Enabled

The Measurement Data screen of the Status Mode displays several measurement parameters that can be used to determine the operational status of the flowmeter. These screens are intended to help facilitate troubleshooting should a problem exist, especially when communicating with the factory service department. The following is an explanation of the data:

ZOF - Value of the capture zero offset.
NOR - Hexadecimal flow rate in percent of full scale.
DEL - Hexadecimal measured phase in percent of full scale.
T12 - Hexadecimal measured average transit-time of the signals in microseconds.
ERR - Error codes.
AGC - First two hexadecimals digits represent relative signal strength with 9F being minimum signal strength and 10 being maximum signal strength.

TROUBLESHOOTING CHART

On the following two pages is the troubleshooting chart for the transit time velocity unit. This chart will help you in isolating possible causes for problems you may encounter and give suggested corrective actions.

In the troubleshooting chart, there will be areas that require certain tests to be performed. The following describes these tests.

Sensor cable connection continuity test. This test will require the use of an ohmmeter. Connect the test leads of the ohmmeter to Points 1 and 3 of the sensor cable connections on the sensor terminal block. The ohmmeter should read 5000 ohms +/- 5%. Repeat this test at Points 2 and 3.

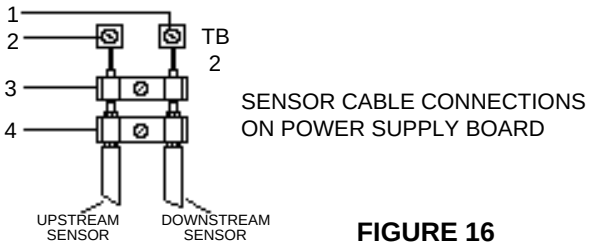


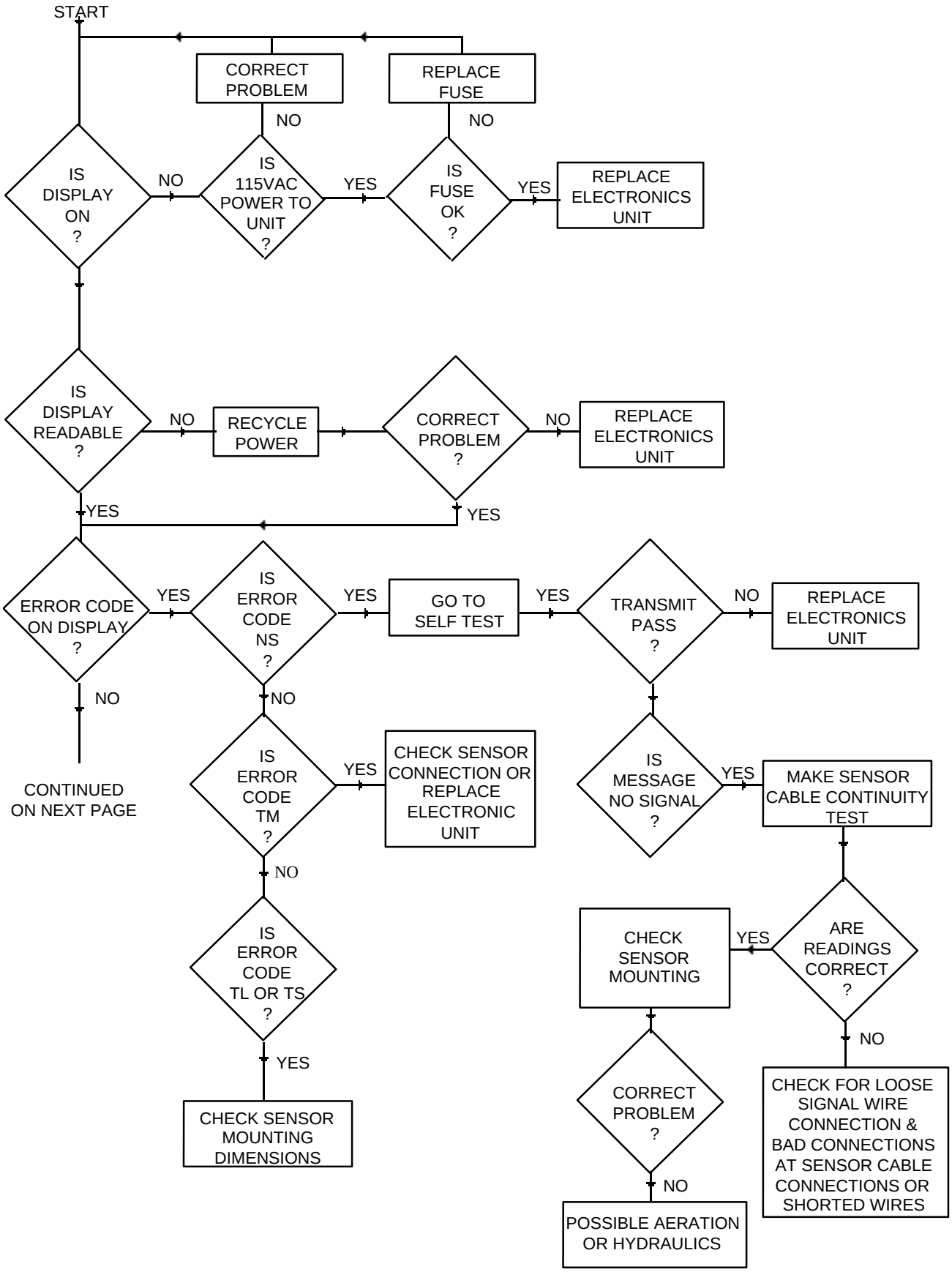
FIGURE 16

NOTE: The reading should be 500 ohms for windowed spool type sensors.

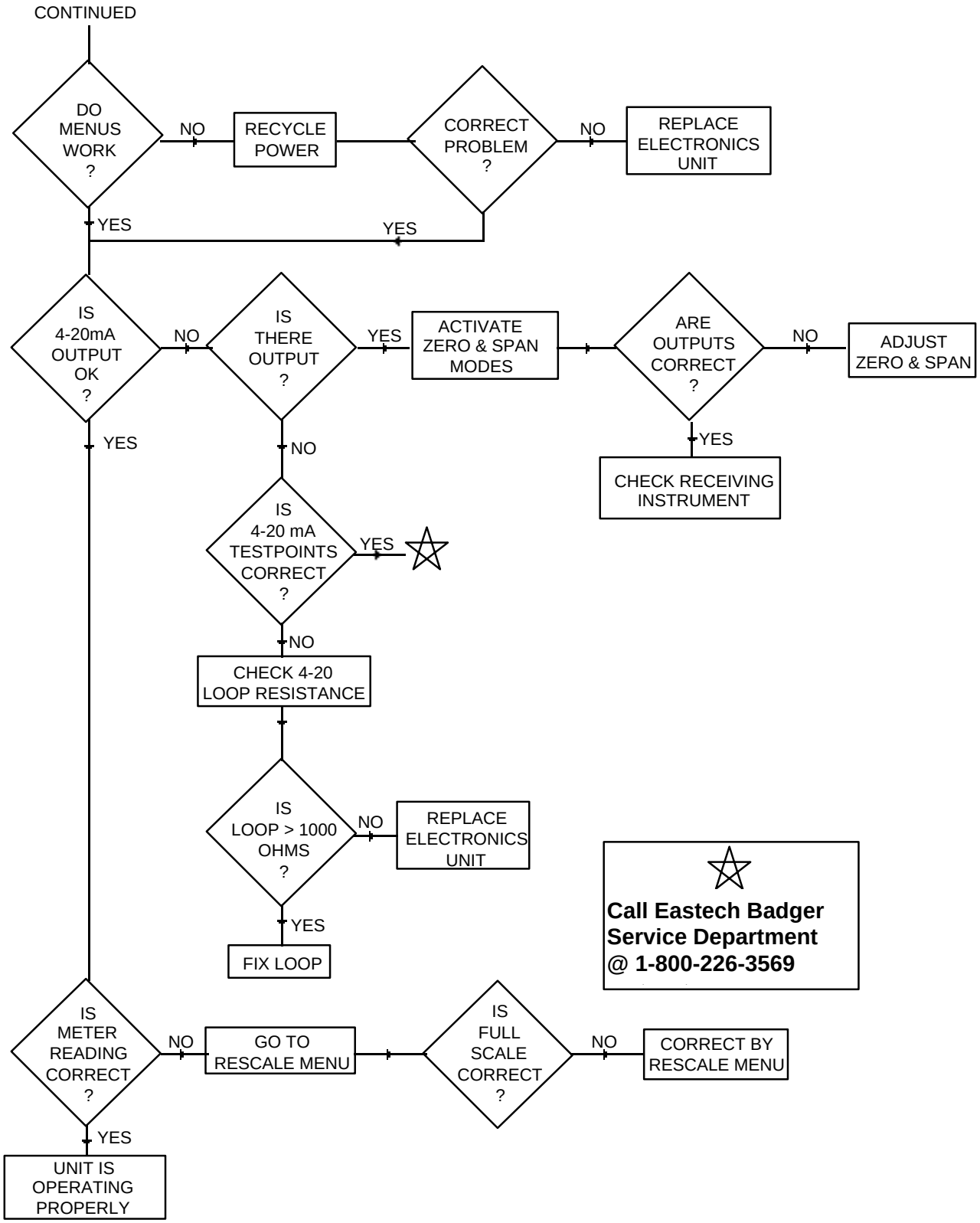
Connect the test leads to Points 3 and 4. The reading should indicate infinity (or an open).

Connect the test leads to Points 1 and 4, then 2 and 4. The reading should indicate infinity (or an open).

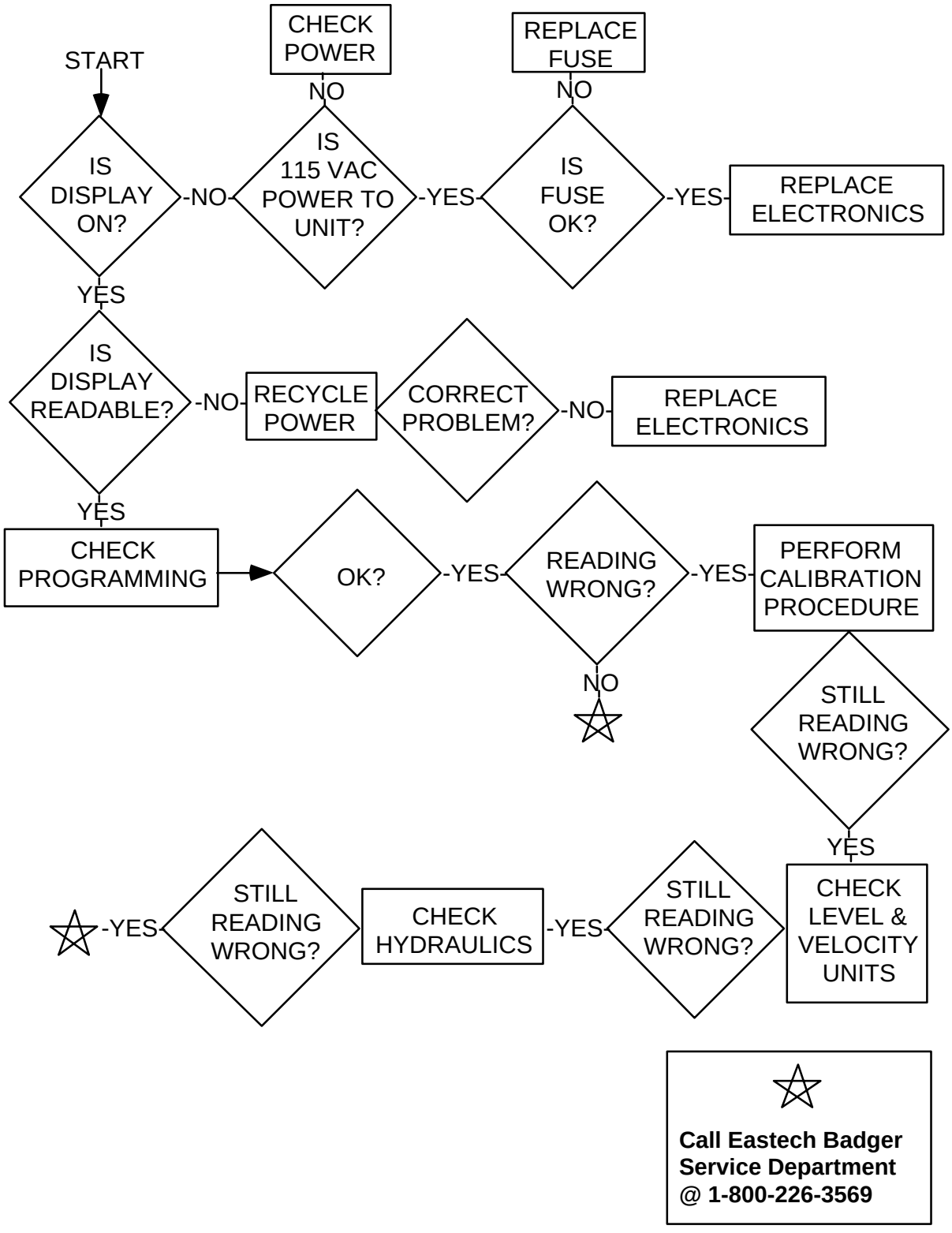
VELOCITY TROUBLESHOOTING CHART



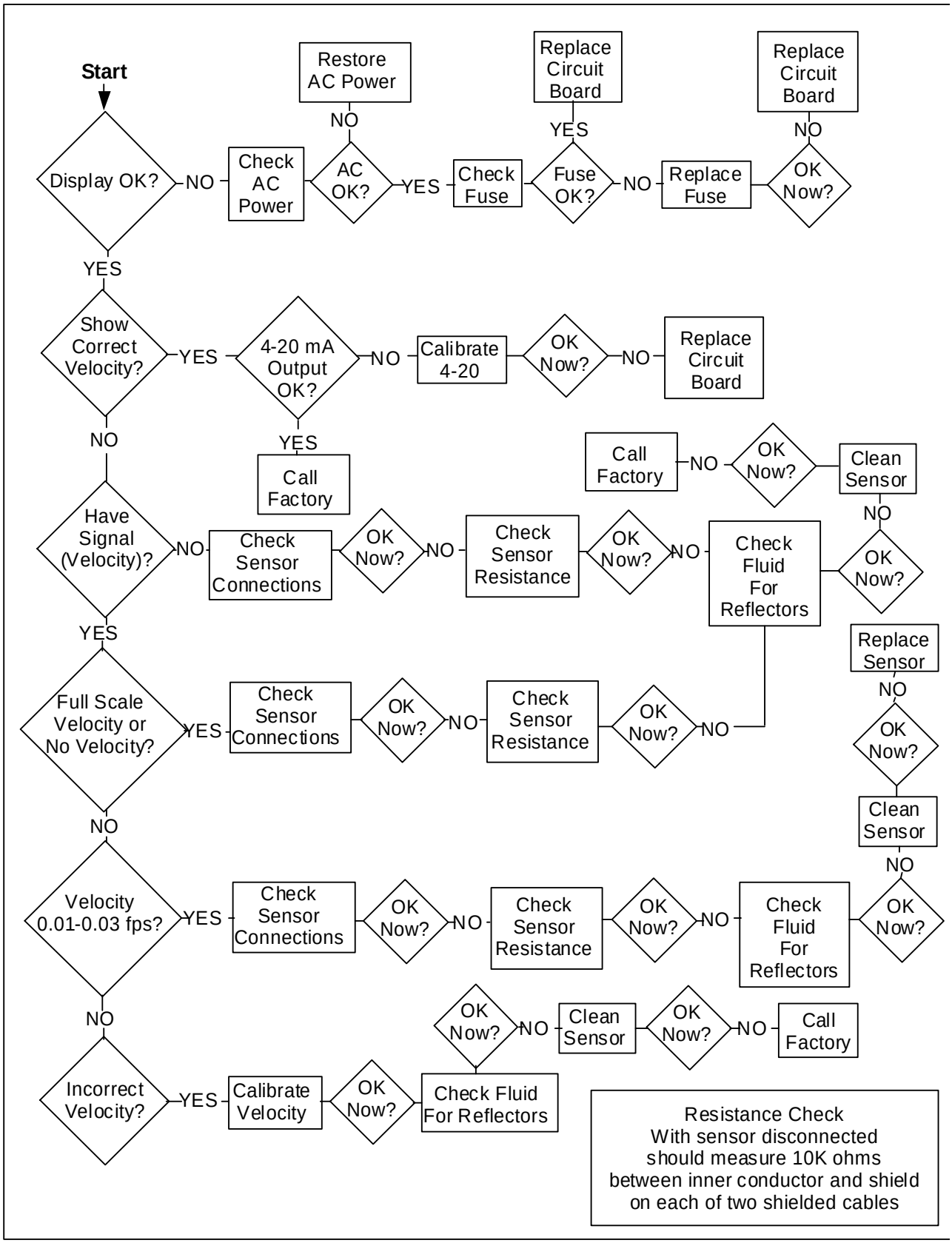
VELOCITY TROUBLESHOOTING CHART CONTINUED



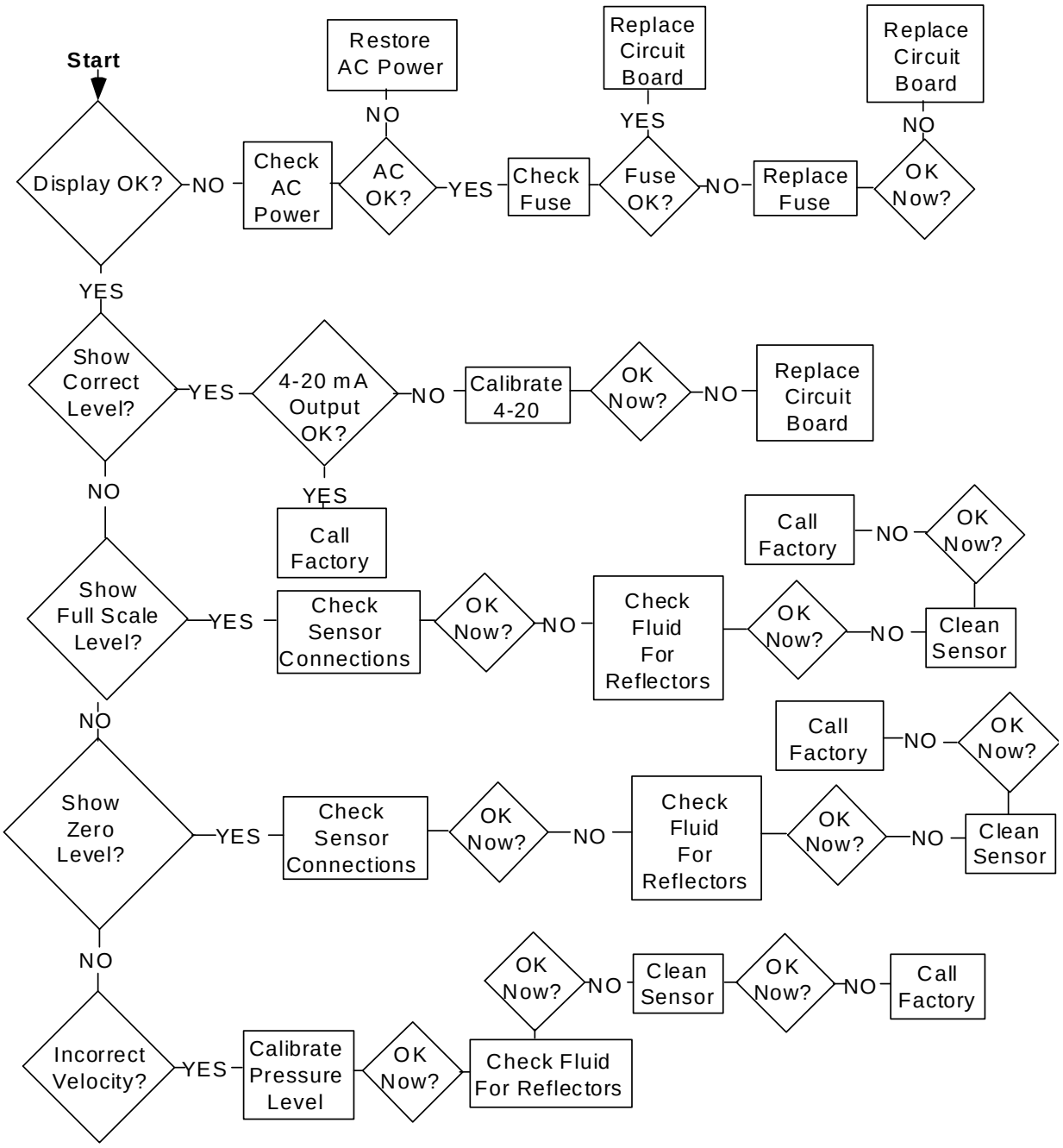
INTEGRATOR TROUBLESHOOTING CHART



DOPPLER VELOCITY TROUBLESHOOTING CHART



PRESSURE LEVEL TROUBLESHOOTING CHART



5000 ELECTRONICS ENCLOSURE ASSEMBLY P/N 543845-9999

ITEM	PART NUMBER	DESCRIPTION	UM	QTY
001	543709-0001	ENCLOSURE H x V & LEVEL-M 117 VAC	EA	1.0
002	543707-0001	ENCLOSURE VEL-MONITOR 1280 KHZ	EA	1.0
003	151945-0001	PCB ASSY POWER 117 VAC 4500 DS	EA	1.0
016	512817-0001	DECAL 5000 WIRING CUST CONNECT	EA	1.0
017	500901-0001	TAPE FOAM DBL SIDED ADHE 3/4" W	FT	1.25
	151964-0001	AC DOPPLER BOARD	EA	1.0
	543837-0001	LOGGER MODULE	EA	1.0

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