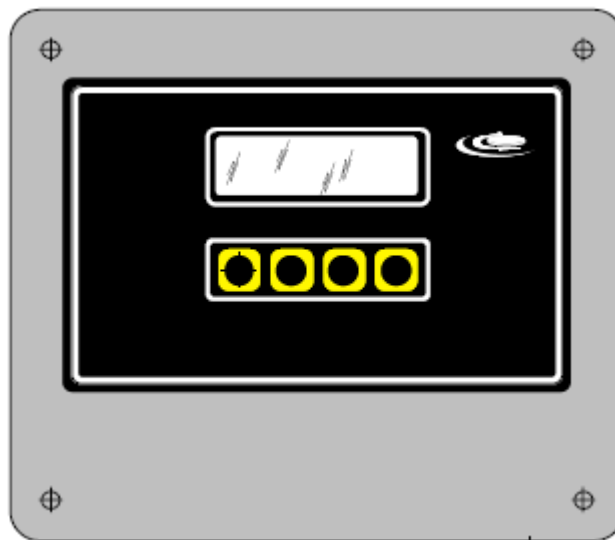# Premier Series Monitor

USL1000
ULTRASONIC LEVEL DETECTOR

TECHNICAL REFERENCE
MANUAL

EAGLE MICROSYSTEMS, INC.
366 Circle of Progress

Pottstown, PA 19464

The USL1000 is an ultrasonic transducer meter that furnishes up to four set points and an isolated 4-20mA output. A flow-meter application is supported.

ULTRASONIC MAIN SCREENS

The ultrasonic run screen displays the ultrasonic input (PV2) or US-2000 in user selectable units and a 4-20mA-output bar graph.
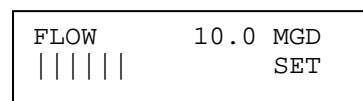
LEVEL METER SCREEN

- Press SET to enter ultrasonic setup.
- Press the leftmost pushbutton to switch to unit 2. Press again to switch back to unit 1 (level application). The flow meter displays one unit.

```
        10.0 ft
||||||          SET
```
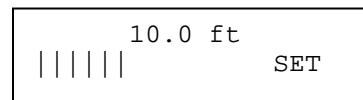
FLOW METER SCREEN (flow meter application only)

- Press SET to enter ultrasonic/flow-meter setup.
- Press the left pushbutton to view the level.

```
FLOW      10.0 MGD
||||||          SET
```

TOTALIZER SCREEN (flow meter application only)

- Press SET to enter ultrasonic/flow-meter setup.
- The flow meter totalizer (if enabled) is displayed/ on the bottom line and can be cleared by pressing the SET pushbutton, entering the correct password and pressing ENT, and pressing ESC. The CLEAR TOTALIZER prompt will then be displayed. Press YES to clear the totalizer or NO to not clear the totalizer.

```
        33423 GAL
TOTAL x100      SET
```
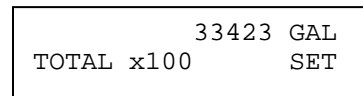
ULTRASONIC TEMPERATURE SCREEN (US-2000 option)

- From any of the above screens, press the second to the left pushbutton to view the ultrasonic transducer temperature in degrees Fahrenheit for two-seconds. If the thermistor is open or shorted, the appropriate message is displayed in lieu of the temperature.

```
   SENSOR TEMP
    77.0 F
```
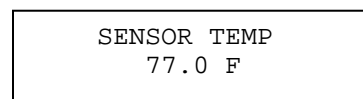
TooCls = Too close
NoEcho = No echo

ULTRASONIC SETUP

From the main operating screen, press the SET pushbutton and enter the password (default 000). Press ENT to, if a valid password was entered, enter the main ultrasonic setup menu.

CAL	Calibrate the ultrasonic input (IN) & PO1 4-20mA output. The user is prompted to change the password upon exiting this menu.
ALM	Set K1, K2, K3 & K6 (if enabled) set points. Note: Set point values are set using the primary units. Set point values are accessed from the LEVELMETER/FLOWMETER SETUP->ALM menu (US SETPOINT).
PARM	Set the **zero** (tank zero) & **span** (4-20mA range) values.
ESC	Return to main operating screen.

PARAMETER LIST PARM MENU

To access these parameters from the main operating screen, press SET and enter the password, now the ultrasonic setup menu will be displayed. Press the PARM push button to view and possibly change the parameters listed below.

Parameter: **ZERO**
Sets the tank zero point in UNIT 1; see the LEVEL APPLICATION section.
When the flow meter application is enabled, set to the crest threshold (in feet).
When adjusting the zero point, one can press the RD pushbutton to sample the ultrasonic input, which is copied into the zero value.

Parameter: **PO1** (**SPAN)/FM SPAN**
Sets the PO1, 4 to 20mA output range in UNIT 1; see the LEVEL APPLICATION section.
When the flow meter application is enabled, set to the flow rate in FLOW UNITS that should represent a 20mA output.

PARAMETER LIST IN RNG MENU

To access these parameters from the main operating screen, press SET and enter the password, now the ultrasonic setup menu will be displayed. Press CAL, IN, and RNG push buttons. One can now view and, possibly, change the parameters listed below.

Parameter: **APP (application)**
LEVEL METER or FLOW METER

LEVEL METER PARAMETERS

Parameter: **UNIT 1**
Sets the ultrasonic units. Choices are ft, in, m, cm, mm, GAL, & L.

Parameter: **UNIT 1 DP**
Sets the decimal point to 0, 0.0, 0.00, or 0.000 for unit 1

Parameter: **UNIT 2**
Sets the secondary ultrasonic units. Choices are ft, in, m, cm, mm, GAL, & L.

Parameter: **UNIT 2 DP**
Sets the decimal point to 0, 0.0, 0.00, or 0.000 for unit 1

Parameter: **kFACTOR**
Converts unit 1 to unit 2. $U_2/U_1 = $ **kFACTOR**

FLOW METER PARAMETERS

Parameter: **FLOW DP (DECIMAL POINT)**
0, 0.0, 0.00, 0.000

Parameter: **DSP (display) NEGATIVE**
YES or NO – If this parameter is set to YES, the level display (not flow) will display negative numbers to aid in determining the zero-level during installations. Normally, this parameter should be set to NO.

Parameter: **TYPE**

 Selects the weir type…

TYPE	DESCRIPTION
W-CONTR	Rectangular weir with end contractions
W-SUPR	Rectangular weir without end contractions (suppressed)
V-NOTCH	V-notch
PARSHALL	Parshall Flume
PAL-BWLS	Palmer-Bowlus Flume

Parameter: **CREST**
Crest in feet (0.00)
Available if needed (Weir).

Parameter: **ALPHA**
22.5, 30, 45, 60, 90, 120 degrees
Available if needed (V-notch).

Parameter: **THROAT W**
Throat width in inches.
Available if needed (Parshall Flume)

Parameter: **UNITS**
Sets the flow units – selections are:
CFS (cubic-ft/sec), MGD (million-gallons/day), or GPM (gallons/minute)

Parameter: **FM TOTALIZER**
ON/OFF – A twelve or eleven (w/ decimal point) totalizer can be selected via the left-most pushbutton
while viewing the main flow/level screen.

Parameter: **FM MULT**
This parameter allows one to multiply the flow-meter output by a whole number. This is useful if the
application contains two or more weir, flume, etc. and only one site contains an ultrasonic device.

Parameter: **TTL MULT** (x1, x10, x100, x1000)
This selection allows the MGD totalizer to display a slower changing output for MGD.

Parameter: **TTL RELAY**
Turns the totalizer relay output (PS-1000 K4 or PS-1000S K6) on or off. One relay pulse is sent for each
"tick" of the totalizer. Note: The relay is enabled for 25ms and disabled for 25ms or higher (20
pulses/sec). It is important that the totalizer will not increment more than 20 times/second when this
output is enabled or missed pulses will result.

ULTRASONIC DEVICE PARAMETERS
*Common to both the level and flow meter applications… If the US-2000 board is installed, these
parameters are not available.*

Parameter: **PV2 @ 4mA**
Set the length (volume) that a 4mA signal from the ultrasonic represents. This value could be a minimum
or maximum distance. This parameter is available for the 4-20mA ultrasonic sensors (US-2000 is OFF). *

Parameter: **PV2 @ 20mA**
Set the length (volume) that a 20mA signal from the ultrasonic represents. This value could be a minimum
or maximum distance. This parameter is available for the 4-20mA ultrasonic sensors (US-2000 is OFF). *

*The ultrasonic sensor provider furnishes the engineering unit (i.e., ft) and minimum and maximum
distance points.*

Parameter: **INVERT US**
Inverts the output of the ultrasonic sensor… This is available for 4-20mA and US-2000 devices.
The typical settings are as follows:
US-2000 = OFF
4-20mA sensors = ON (may change)

US-2000 SPECIFIC PARAMETERS
These parameters are available when a US-2000 board is installed.

Parameter: **Rx GAIN**
Receive gain: 1 through 12

Parameter: **FILTER**
Filter – 0% through 99%

Parameter: **Tx PULSES**
Number of pulses that are transmitted: 1 through 32

Parameter: **DEAD TIME**
Ultrasonic dead-time: 1 to 20ms

<u>MESSAGES</u>

NoEcho
No echo was received by the transducer.

TooCls
The target is too close to the sensor. There is a typical dead-band of 12", which is dependent on the DEAD TIME parameter. If the TooCls message is displayed at all times, increase the dead time parameter my 0.05ms until the message is no longer shown.

CALIBRATE PO1

To calibrate the process output (PO1), one must connect either a DMM (mA input) or other device that can read the PO1 current output. The device should have, at least, 0.01mA precision.

1. From the CALIBRATE menu (entered by pressing CAL from the ultrasonic setup menu), press the PO1 pushbutton to enter the SET ANALOG OUT screen.
2. Press the 4mA pushbutton and the mA meter should read around 4.00mA.
3. Use the UP & DOWN pushbuttons to set the output to exactly 4.00mA and press set when done. This is the zero point.
4. Press the 20mA pushbutton; the mA meter should read around 20.00mA.
5. Use the UP & DOWN pushbuttons to set the output to exactly 20.00mA and press set when done. This is the span point.
6. The two points are not interactive so one should not need to readjust each point again. Press the EXIT pushbutton to go back to the CALIBRATE menu.

US-2000 CALIBRATION

If the US-2000 board is installed, the calibration procedure is accomplished as follows:

1. Enter the calibration screen from the main screen by pressing SET, entering the correct password, pressing ENT, pressing CAL, pressing IN, and then pressing SNS. The screen to the right should be displayed.

```
CAL          23.4 in
P1  P2   RESET  ESC
```

2. Position the sensor to a distance 12" or greater. Press P1 and adjust the distance in inches to the correct value and then press SET.
3. Position the sensor to a distance greater than P1. Press P2 and adjust the distance in inches to the correct value and then press SET.

RESET: Press the reset pushbutton to reset the calibration to the default value.

CALIBRATION OF PV2 4-20mA INPUT

To increase the accuracy of the PV2 4-20mA input, one must use a 4-20mA generator connected to the PV2 input. The ultrasonic must be disconnected to complete this procedure. If possible, the best results will be achieved if the user can generate the 4mA and 20mA signals from the ultrasonic sensor.

- Power down the USL1000 instrument.
- Disconnect the ultrasonic input PV2.

```
 SET PV2    4.00mA
4mA 20mA       ESC
```

- Connect the mA (current) generator to the PV2 input.
- Power the USL1000 instrument.
- Go to SETUP->CAL->IN->mA (password must be entered).
- Set the mA generator to 4.00mA and press the pushbutton under the 4mA label to set the zero mA point. The display should read 4.00mA.
- Set the mA generator to 20.00mA and press the pushbutton under the 20mA label to set the span mA point. The display should read 20.00mA.
- Repeat to verify calibration. However, the zero and span points are not interactive so one can skip this step.
- Press the ESC pushbutton to exit to the calibration menu until the main operating display is shown.
- Power down the USL1000 instrument.
- Disconnect the mA (current) generator.
- Reconnect the ultrasonic sensor to input PV2.
- Power the USL1000 instrument.

END OF CALIBRATION

ENGINEERING SETUP

To select the instrument as a ultra sonic meter (USL1000), do as follows: From the current main operating screen, press SET and enter the password "1?1" and press the ENT pushbutton. Alternatively, if one is in the setup menu, press the right most pushbutton until the password screen is displayed, enter the password "1?1" and press the ENT pushbutton.

Parameter: **MODE**
Selects the instrument-operating mode. Press the ADJ pushbutton to set the choice to ULTRASONIC (USL1000).

Parameter: **US-2000 EXP**
If a US-2000 board is installed, set this parameter to YES. Otherwise, this parameter should be set to NO. If the US-2000 board is not installed or detected, this parameter cannot be set to YES.

Parameter: **SERIAL PORT**
This parameter turns the continuous transmission to an SI420-16 ON or OFF.

Parameter: **SERIAL BAUD**
This parameter selects the transmission baud rate (default 1200). The choices are 1200, 2400, and 4800.

Parameters: **K1, K2, K3 & K6**
Sets the operating mode of the selected relay.

K1, K2, K3	ENERGIZED	DE-ENERGIZED
OFF	NEVER	ALWAYS
LOW	INPUT <= SP	INPUT > SP
LOW /w ACK	INPUT <= SP	INPUT > SP *OR* Acknowledged by USER
HIGH	INPUT >= SP	INPUT < SP
HIGH /w ACK	INPUT >= SP	INPUT < SP *OR* Acknowledged by USER

After one is finished, press the ESC pushbutton to return to the main operating screen.

Parameters: **K1 POLARITY, K2 POLARITY, K3 POLARITY, K4/K6 POLARITY**
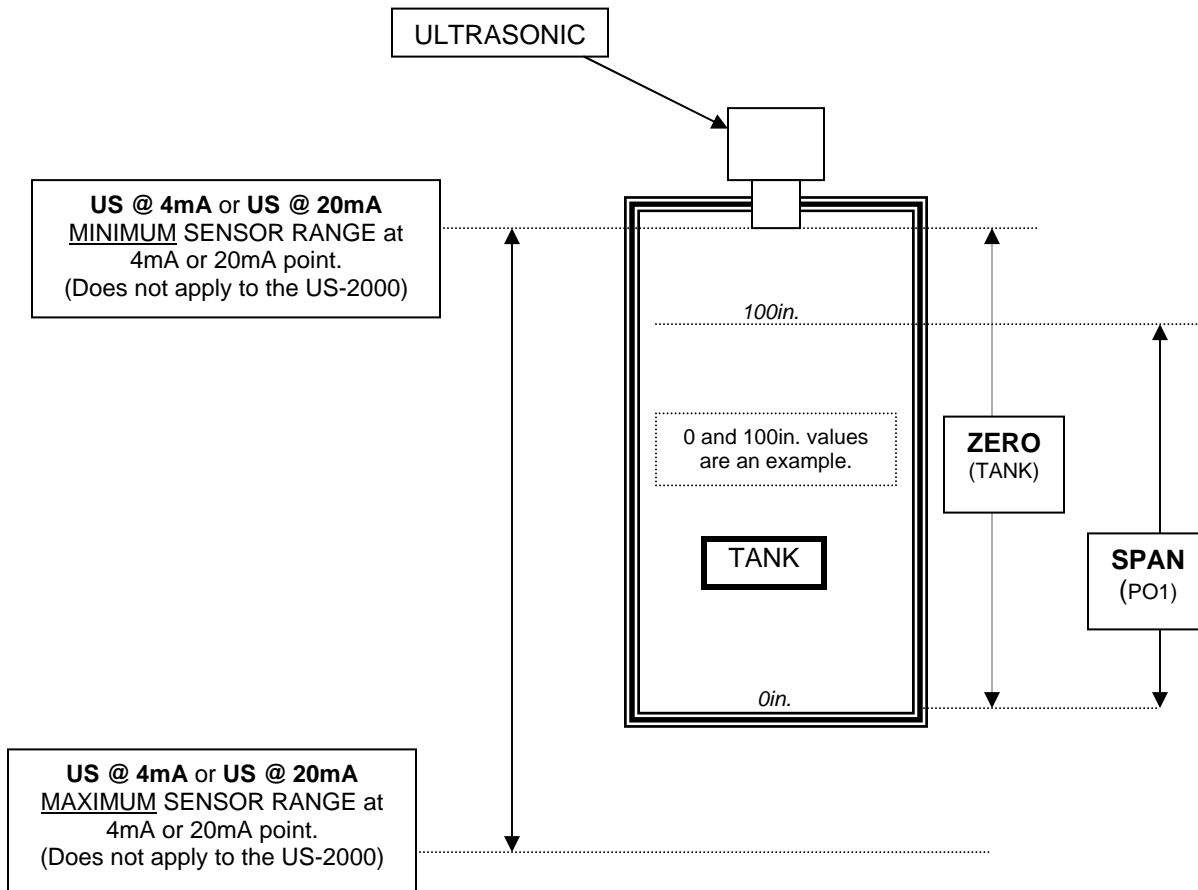These parameters set the relay polarity.

N/O:	Normally open
N/C	Normally closed

Note: Set point values are set using the primary units. Set point values are accessed from the LEVELMETER/FLOWMETER SETUP->ALM menu (US SETPOINT).

PASSWORD

After one exits the CALIBRATION menu, one is first prompted to change the stored password. If one does not want to change the password, press the NO pushbutton. If the YES pushbutton is pressed, the SET new password screen is entered and now one can set the new password.

LEVEL APPLICATION

ULTRASONIC

US @ 4mA or **US @ 20mA**
MINIMUM SENSOR RANGE at
4mA or 20mA point.
(Does not apply to the US-2000)

100in.

0 and 100in. values
are an example.

ZERO
(TANK)

TANK

SPAN
(PO1)

0in.

US @ 4mA or **US @ 20mA**
MAXIMUM SENSOR RANGE at
4mA or 20mA point.
(Does not apply to the US-2000)

- Go to SETUP->CAL->IN->RNG: Enter the ultrasonic 4mA & 20mA points (US @4mA and US @ 20mA) provided by the ultrasonic sensor provider. If other units are needed (i.e. meters), one may have to convert the points by multiplying a constant, see table 1. *NOTE: Before entering these two points, set the UNITS and DP settings.*
- To increase the accuracy of the system, one may calibrate the 4mA and 20mA points by using a current source calibration device, see OPTIONAL: CALIBRATION OF PV2 4-20mA INPUT.
- SETUP->PARM->ZERO sets the tank zero.
- SETUP->PARM->SPAN sets the PO1, 4-20mA analog output range.

Convert	Multiply by		
feet to inches	12		
feet to yards	0.33333		
feet to meters	0.3048		
feet to centimeters	30.48		
feet to millimeters	304.8		

TABLE 1

END OF DOCUMENT

US-2000 INSTALLATION

If the board is installed in an enclosure, it must be removed before the US-2000 board can be installed. Also, the display cable that connects to P3 must be disconnected.
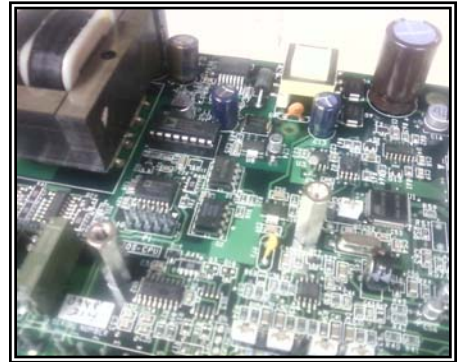
Mounting hardware:
2 – ¾", 6-32 STANDOFF
2 – 6-32 KEP SCREW
2 – 6-32 NUT w/ STAR WASHER

Install the ¾" standoffs on the PS-1000S-CPU board with the 6-32 nut on the reverse side (solder-side) of the board. Do not fully tighten the hex nuts at this time.

Install the US-2000 board. There are two connectors, P1 and P3A that must connect properly to the PS-1000S-CPU board (P1 and P3).

P1 CONNECTOR   P3/P3A CONNECTOR
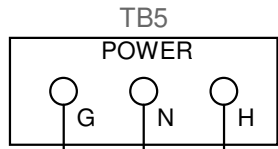

Install the 6-32 screws.

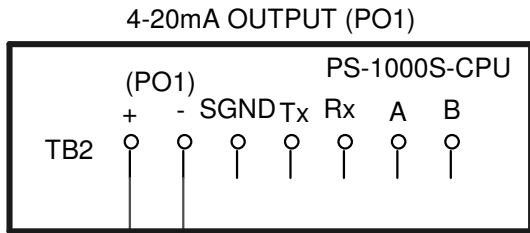The hex-nuts on the other side of the board should be tightened at this time.

Install the board in the enclosure.

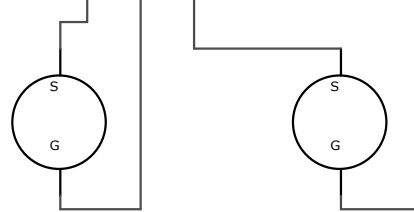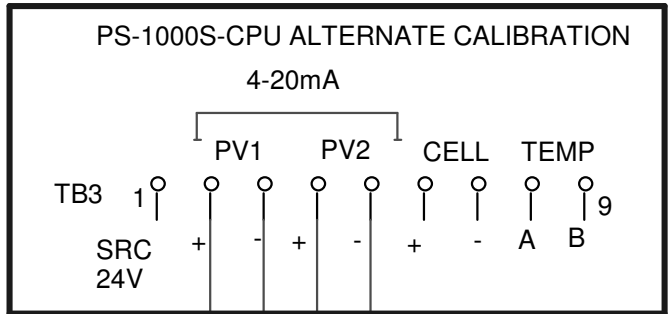Connect the display connector to P3B located on the US-2000 board.

A | B | C | D

TB5
POWER
G N H

E.G.
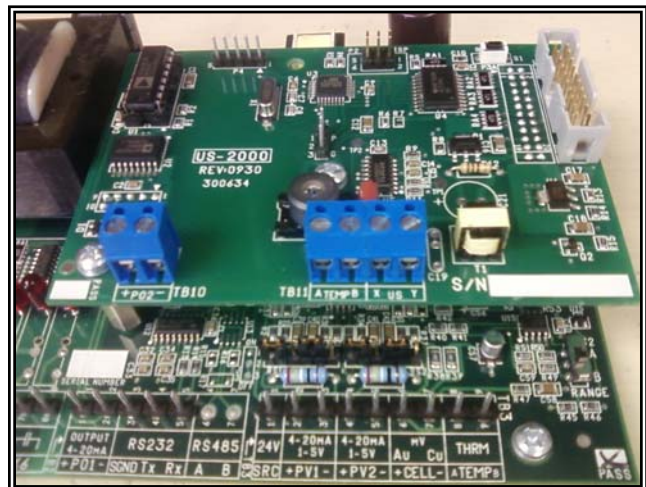
A.C. POWER SOURCE

S1 (V.SELECT)
SELECTS 115V OR 230V A.C. POWER

4-20mA OUTPUT (PO1)
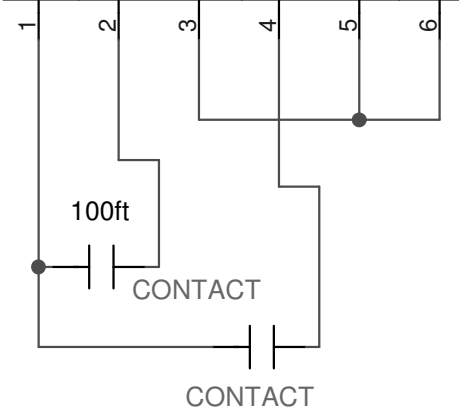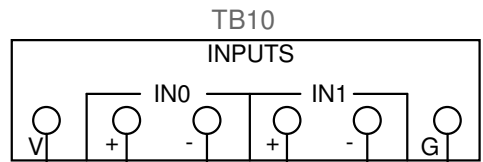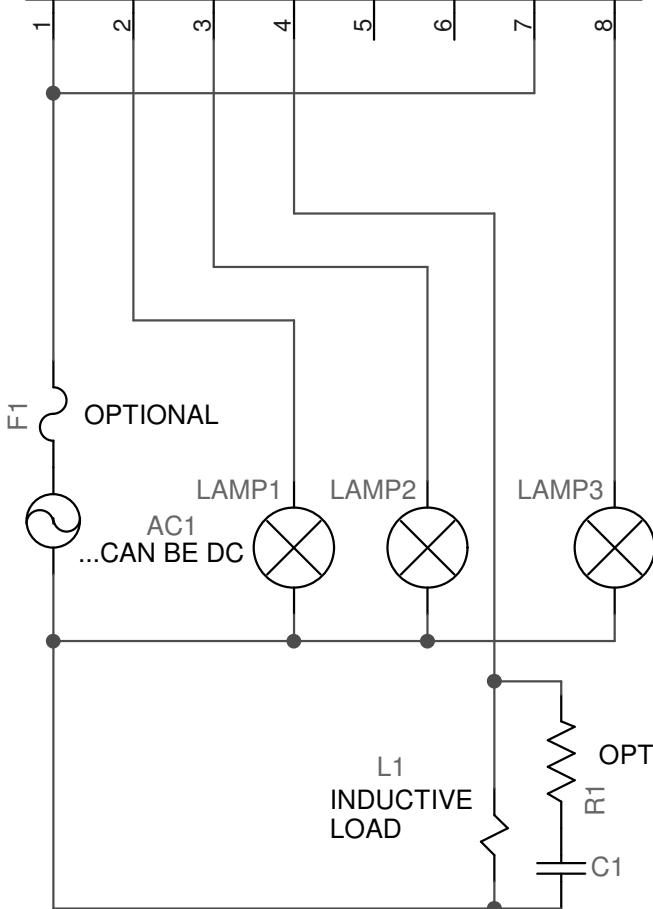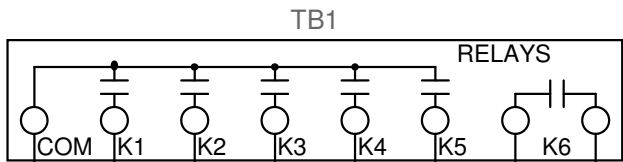
(PO1)
PS-1000S-CPU
+ - SGND Tx Rx A B
TB2

CONTROLLER 4-20mA LOAD (VALVE, PUMP, ETC.)
SCADA SYSTEM, CHART RECORDER, ETC.

4-20mA SELF POWERED SOURCES
& 4-20 CALIBRATOR WIRING

NOTE: PV1 & PV2 share common negative (TB3-3 & 5)
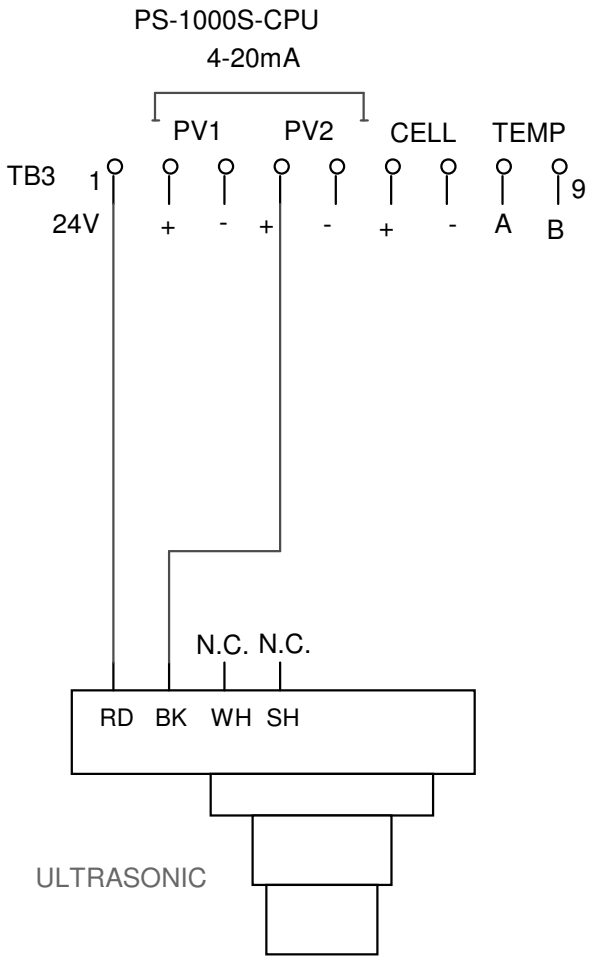if J1 and J2 both have G selected.

PS-1000S-CPU ALTERNATE CALIBRATION

4-20mA

PV1   PV2   CELL   TEMP
TB3 1   9
SRC   +   -   +   -   +   -   A   B
24V

S G   S G

CHANNEL ONE 4-20mA SOURCE   CHANNEL TWO 4-20mA SOURCE

TB1
RELAYS
COM K1 K2 K3 K4 K5 K6
1   2   3   4   5   6   7   8

TB10
INPUTS
IN0   IN1
V   +   -   +   -   G
1   2   3   4   5   6

100ft

CONTACT

CONTACT

WARNING
THE CONTACT CANNOT
SUPPLY ANY POTENTIAL

F1 OPTIONAL

AC1
...CAN BE DC

LAMP1 LAMP2 LAMP3

L1
INDUCTIVE
LOAD

R1 OPTIONAL SNUBBER

C1

BOARD REVISION (REV):
0644 AND ABOVE

EAGLE MICROSYSTEMS, INC

PS-1000S-CPU

FLOWLINE SENSOR WIRING

PS-1000S-CPU
4-20mA

PV1   PV2   CELL   TEMP

TB3 1
24V   + - + - + - A B   9

N.C. N.C.

RD BK WH SH

ULTRASONIC

1: RED - 24V Power

2: BLACK - Signal

3: WHITE - N.C.

APG SENSOR WIRING

PS-1000S-CPU
4-20mA

PV1   PV2   CELL   TEMP

TB3 1
24V   + - + - + - A B   9

1
2
3
6
5
4

SHIELD (OPTIONAL)

ULTRASONIC WIRING

ULTRASONIC
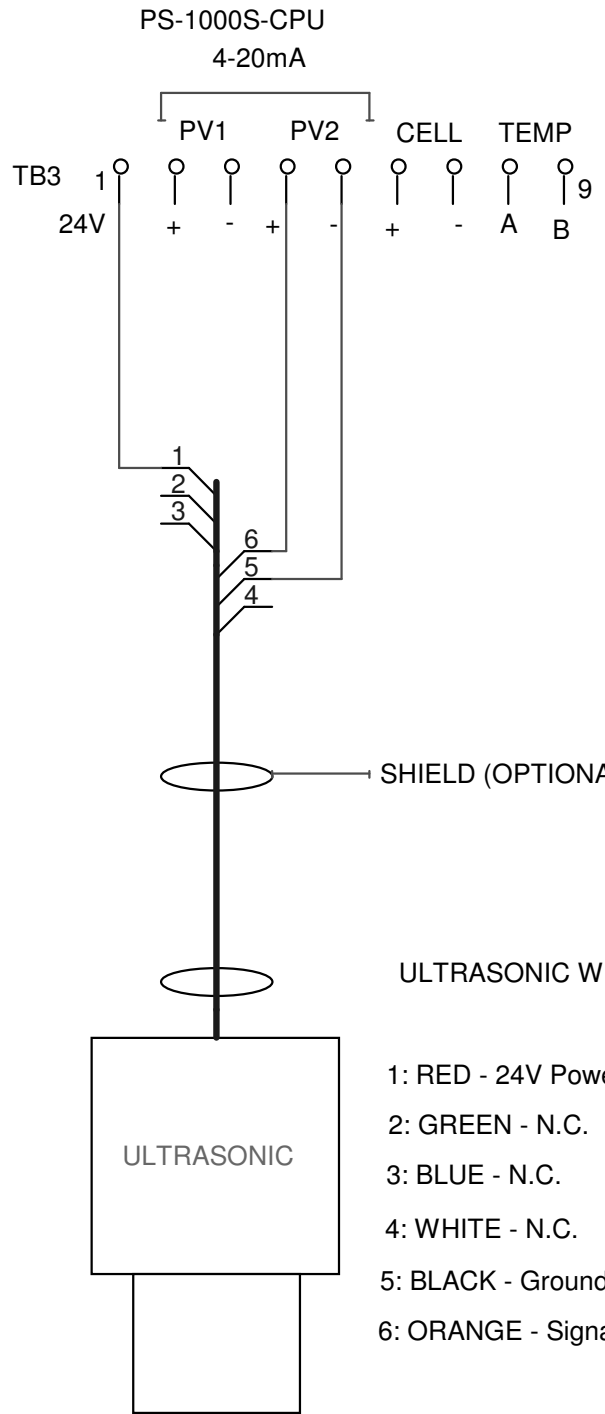
1: RED - 24V Power

2: GREEN - N.C.

3: BLUE - N.C.

4: WHITE - N.C.

5: BLACK - Ground

6: ORANGE - Signal

EAGLE MICROSYSTEMS, INC

USL1000

ULTRASONIC WIRING

REV: 04/22/08

TB2

4-20mA OUTPUT
PO1
+ -

TB3   PS-1000S-CPU

24V	PV1 1-5V 4-20mA		PV2 1-5V 4-20mA		CELL		THRM	
SRC	+	-	+	-	Au	Cu	TEMP A	B
						mV		
1	2	3	4	5	6	7	8	9

P3

P2

1x5
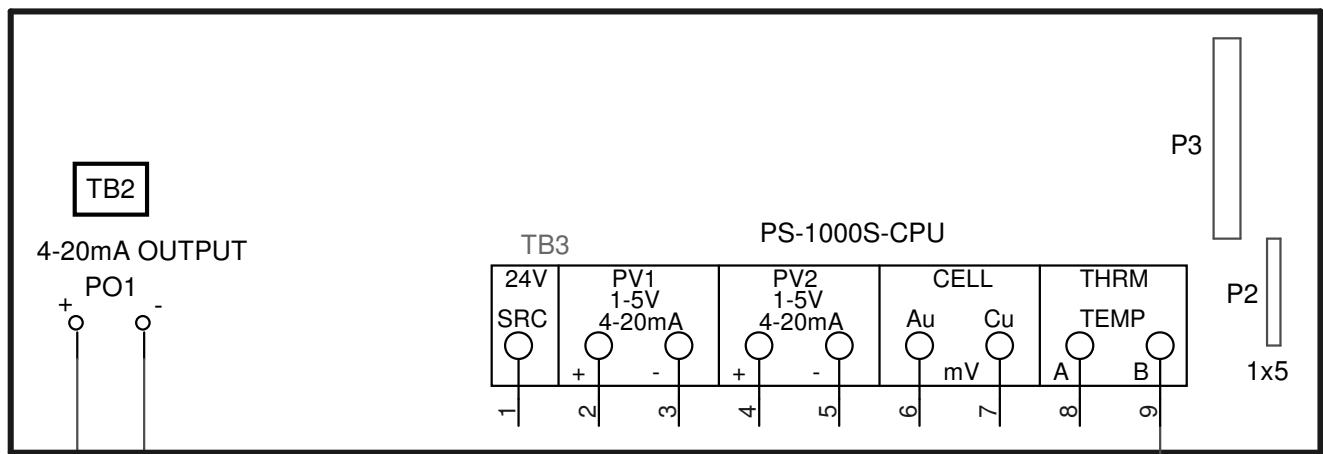
4-20mA LOAD (<=600ohms)
TRACKS FLOWMETER/LEVEL

TO DISPLAY
PS-1000S-DSP

P3

THE US-2000 MOUNTS ON
THE PS-1000S-CPU.

P1

4-20mA OUTPUT
1 +   2 -
TB10   TB11

TEMP   US
A   B   X   Y
1   2   3   4
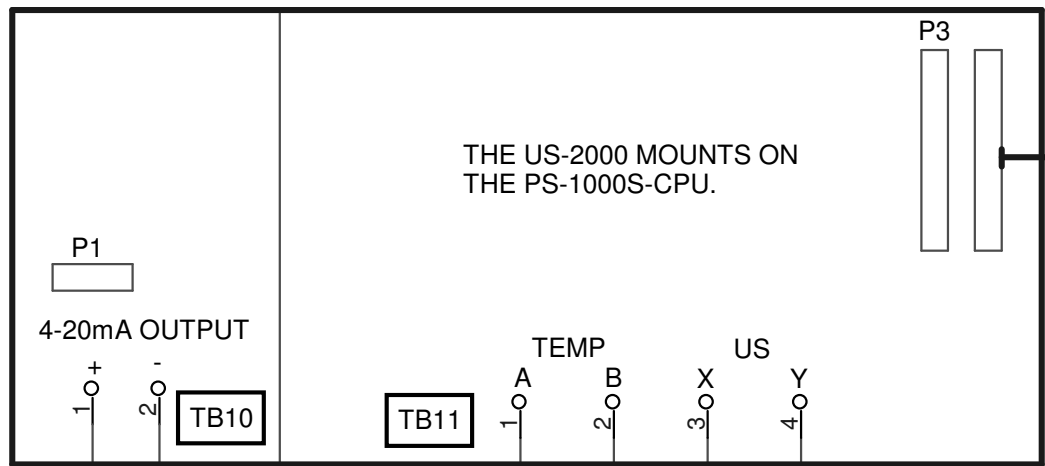
GN   WH   RD   BK
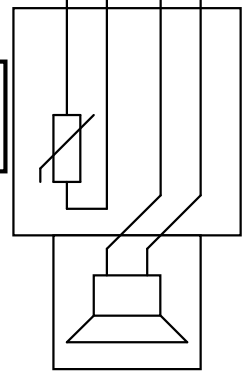
4-20mA LOAD (<=600ohms)
NOT USED AT THIS TIME

GN   WH   RD   BK

THE SHIELD IS
CONNECTED TO
TB1-9

YL

50kHz ULTRASONIC
FLOW/LEVEL METER
TRANSDUCER

THE DEAD TIME SHOULD BE SET TO
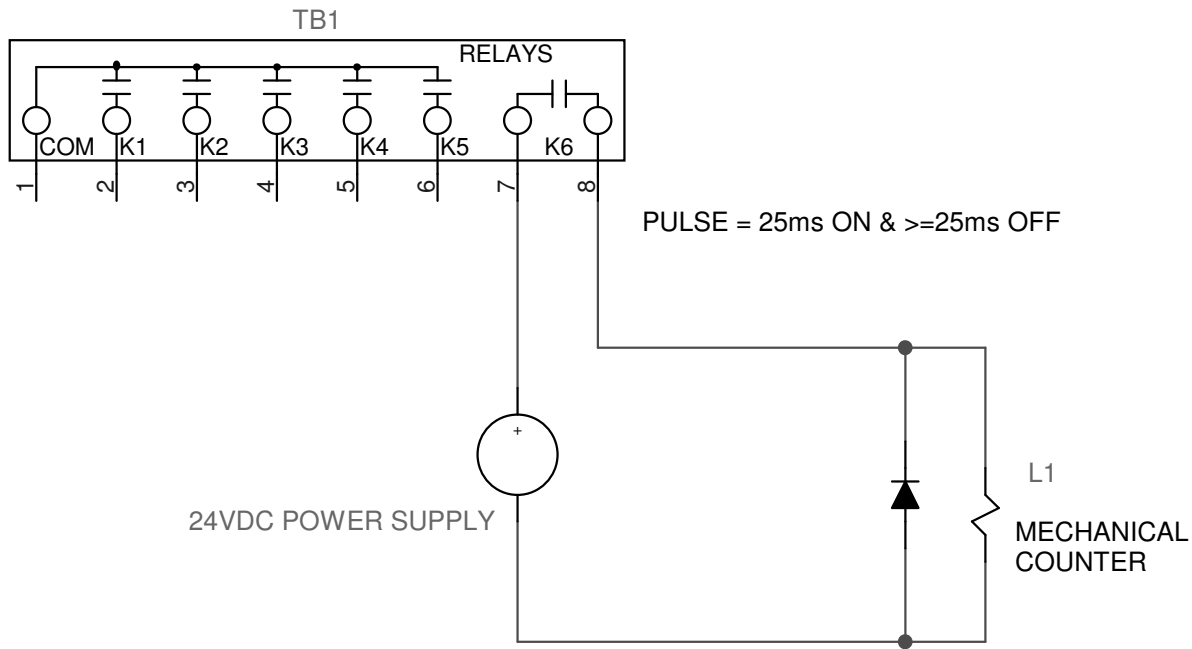THE RANGE OF 150ms to 155ms.

PS-1000S w/ US-2000

TB1

RELAYS

COM K1 K2 K3 K4 K5 K6

1 2 3 4 5 6 7 8

PULSE = 25ms ON & >=25ms OFF

24VDC POWER SUPPLY

+

L1

MECHANICAL
COUNTER

PS-1000S-CPU
TOTALIZER RELAY OUTPUT

BOARD REVISION (REV):
0644 AND ABOVE

Notes:

USL1000 ROUTING TICKET (ULTRASONIC)

SO#: _____   DATE: _____

PROGRAM: _____   SERIAL #: _____

VERSION: _____   PCB REV: ☐ 0644 ☐

US P/N: _____   US S/N: _____

ENGINEERING		PROGRAMMING	
MODE:	ULTRASONIC	APP:	
US-2000 EXP:		UNIT 1:	
SERIAL PORT:		UNIT 1 DP:	
SERIAL BAUD:		UNIT 2:	
K1:		UNIT 2 DP:	
K1 POLARITY:		K FACTOR:	
K2:		DP or FLOW DP:	
K2 POLARITY:		TYPE:	
K3:		ALPHA:	
K3 POLARITY:		CREST:	
K4:		THROAT W:	
K4/K6 POLARITY:		UNITS:	
		FM TOTALIZER:	
		FM MULT:	
PASSWORD:	0 0 0	TTL MULT:	
		TTL RELAY:	
ZERO:		PV2 @ 4mA:	
PO1 SPAN:		PV2 @ 20mA:	
		INVERT US:	
US SP 1:		AUTO GAIN:	
US SP 2:		Rx GAIN:	
US SP 3:		FILTER:	
US SP 4:		Tx PULSES:	
		DEAD TIME:	
		TEMP COMP:	

HARDWARE INSTALLED OPTIONS

K1, K2, K3 [X]   K4 [ ]   K5 [ ]   K6 [ ]

RS232/20mATx [ ]   (PO1) 4-20mA [X]   US-2000-EXP [ ]   PS-1000-AOUT [ ]

S1 =115V [ ]   **S1 = 230V** [ ]