PROCESS CURRENT
DIGITAL PANEL METER

OPERATION AND MAINTENANCE
MANUAL

P/N 1669100
P/N 1669101

Manual 301
Revision F
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Consilium

Consilium US, Inc.
59 Porter Road
Littleton, MA 01460-1431 USA
Tel: 978-486-9800
Fax: 978-486-0170

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1.0 INTRODUCTION

Consilium has selected two Red Lion Controls digital panel meters to support its standard tank level gauging applications. Red Lion manufactures a line of instruments in their Apollo series designated Intelligent Meter for Process Inputs (IMP). They accept standard 4 to 20 mA process current inputs, provide a flexible display and feature several important options. These meters are microprocessor based and therefore allow utmost programmability. In addition, an optional NEMA 4X enclosure is available that will allow wall mounting of either meter. The part numbers assigned to these items are as follows:

Red Lion Model IMP20160	P/N 1669100
Red Lion Model IMP20167	P/N 1669101
Enclosure	P/N 1712000

These meters are intended to be used with any of the standard Consilium liquid level sensors. Because the resistance tape sensor is entirely resistive, it must be first connected to signal conditioning electronics such as a transmitter that will convert the resistance to a 4-20 mA process current signal. Several typical applications are provided as guidance.

Both meters are 115/230 VAC powered digital panel meters that can provide tank readings in standard engineering units. Any values may be displayed between 999999 and -99999. The display is an LED type with six 0.56" high digits. Both meters feature an 18 volt DC excitation so that separate power supplies are not required for signal conditioning electronics. The 1669101 meter also features remote alarm set points (Two Form C relays), linearization and an independent analog output. The housing is rated NEMA 4 from the front and, when properly installed in a panel or enclosure, can maintain the NEMA 4 rating.

The Red Lion *Model IMP Istruction Manual* is included with the Digital Panel Meter. It has additional information regarding other setup parameters that may be useful. The Red Lion manual should be kept with this manual.

2.0 SPECIFICATIONS

2.1 Meter Specifications

Manufacturer:	
Name	Red Lion Controls, Inc.
Address	20 Willow Springs Circle York, PA 17402
Telephone	717-767-6511
Consilium US, Inc.	**Part Numbers:**
1669100	Process meter with transmitter excitation
1669101	Process meter with transmitter excitation, linearization, 2 alarms and auxiliary 4-20 mA output
Standard Features:	
Input type	Process current (4-20mA)
Input Impedance	10 _ (0.2 VDC @ 20 mA)
Current range	0 mA - 50.0 mA
Maximum current	200 mA (continuous)
Data entry	Microprocessor based - all digital setup and calibration
Display	6-digit, 0.56" [14mm] high red LED display
Line Voltage	115 VAC ± 10% or 230 VAC ± 10%
Power Consumption	14 watts
Enclosure:	
Package	Standard 1/8 DIN (48mm x 96mm) panel mount
Front panel	Die cast metal bezel; NEMA 4
Gasket	Meter to panel
Case	High impact plastic
Weight	1.2 lbs [0.5 kg]
Mounting	
Panel Cutout	1.77"[45mm] H x 3.63"[92mm] W
Depth	6.85"[174mm] + 0.25"[6mm] for wiring
Temperature:	
Operating	32°F to 122°F [0°C to 50°C]
Storage	-40°F to 176°F [-40°C to 80°C]
Transmitter Excitation	
Voltage	18 VDC @ 60 mA

Alarm Set points (P/N 1669101 only):

Relay output	
Type	Two Form C
Rating	5 A @ 120/240 VAC or 28 VDC
Solid state output	
Type	Opto-isolated open collector;
Current	100 mA maximum @ V_{SAT} = 1V
Voltage	30 VDC maximum
Indication	Flashing message (can be disabled)

Process Current Output (P/N 1669101 only):

Maximum load	500 _ @ 20 mA (10 VDC compliance voltage)
Accuracy	± 0.1%
Resolution	12 bit

Linearization (P/N 16691901 only):

Points	2 - 10
Segments	1 - 9

Performance

Accuracy	± .02% ± 1 digit
Temperature effects	
Zero	± .00063% of span / °C
Span	± .01% of span / °C (maximum) ± .004% of span / °C (typical)

Setup parameters

Decimal point	xxxxxx, xxxxx.x, xxxx.xx, xxx.xxx, xx.xxxx
Calibration	Two points - user must specify input high current / high display value and input low current / low dispaly value; current may be provided as a signal input or may be key entered
Alarm Display	Enable / Disable flashing message
Alarm 1	Set point, Action direction (HI or LO), Hysteresis
Alarm 2	Set point, Action direction (HI or LO), Hysteresis
Linearization	10 points (9 segments)
Analog output	Displayed value at 4.00 mA, Displayed value at 20.00 mA

2.2 ENCLOSURE SPECIFICATIONS

Consilium US Part Number	1712000
Outside Dimensions	7.40" H x 7.40" W x 7.50" D [188.0mm H x l88.0mm W x 190.50mm D]
Mounting Holes	Four (clearance for #10)
Type	NEMA 4X
Material	Polycarbonate

3.0 PREPARATION

WARNING:

These meters are not intrinsically safe or explosion proof. They must not be located in hazardous areas.

3.1 Panel Mounting

A sturdy mounting panel of at least 1/8" thickness must be available. Panel space approximately 3" [74mm] high by 5" [125mm] wide should be allotted for the meter. A cutout centered in that space of 1.77" [45mm] high by 3.63" [92mm] wide should be made to accommodate the meter. A minimum depth behind the panel of 6.85" [174mm] plus 0.25" [6mm] to accommodate rear wiring should be allowed. Figure 1 shows the outline and mounting requirements for the meter in a panel. Note that if a plastic panel is used, metal reinforcement is required as the meter's retaining screws are pointed and they will dig into the panel and break off edges. In addition if the NEMA 4 integrity is to be maintained, the panel thickness / reinforcement must be sufficient to prevent buckling under gasket compression.

3.2 Wall / Surface Mounting

Figure 2 shows the outline and mounting dimensions of the optional enclosure. Space must be provides for the enclosure and conduit/cable access. The box must be mounted on a flat surface. Four 0.20" [5mm] diameter holes are provided on the indicated centers.

4.0 INSTALLATION

4.1 Panel Mounting

If not already removed, remove two side mounting clips from meter. Remove and set aside the removable plug-in terminal blocks. Remove the adhesive backing from the meter gasket (supplied with the meter). Carefully apply gasket to panel. Do not apply adhesive side of gasket to meter bezel. Slide meter into gasketed panel opening from the front. On the rear side of the panel, snap in two retaining clips. Using a Philips screwdriver, tighten the two retaining clip screws just enough to retain the meter and to slightly compress the gasket. The meter should not be loose on the panel nor should the screws be tightened so much that the panel is distorted. Do not over tighten screws.

4.2 Enclosure mounting

The enclosure has a top cover and a bottom base. Separate the two halves and set aside the top cover. Determine wiring entrance location and drill holes for conduit or the fitting. File any burrs or sharp edges created.

CAUTION:

Care must be taken while drilling holes in enclosure to prevent cracking or chipping.

Mount the bottom base to the panel / wall space provided for in section 3.2. Care should be taken when tightening the four mounting screws as the box can be damaged. Bring conduit and cables to box.

CAUTION:

When using rigid conduit, ensure that alignment of the conduit does not stress enclosure. Tightening conduit entrance nuts may fracture box if misaligned.

Once the base is mounted the meter should be mounted into the cover per section 4.1 and set aside.

4.3 Wiring

Several typical applications are shown in Figures 3 though 5. Figure 3 shows an application when the Consilium resistance-tape sensor is in a non-hazardous location. Figures 4 and 5 show applications when the sensor is a hazardous location. In such cases, intrinsic safety barriers are required.

WARNING:

Proper wiring is required to maintain intrinsic safety ratings.

All wiring should be of stranded copper with a recommended minimum AWG #18 gauge. Intrinsically safe wiring should be in accordance with ANSI/ISA Standard RP12.6, "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Fire Protection Association, "National Electrical Code", Articles 500 through 504.

When making connections to the meter, use the supplied removable plug-in terminal blocks. After the unit has been mechanically mounted, it is ready to be wired. All wiring connections are made on removable plug-in terminal blocks. There is an 8-pin terminal block for the bottom board (TBA) and an optional (P/N 1669101 only) 11-pin terminal block for the top board (TBB). Ensure that sufficient service loop is provided so that connector can be easily pushed over meter connector(s). This is especially true when using the optional wall mount enclosure. Strip the wire, leaving 1/4" bare conductor exposed. Stranded wires should be tinned with solder. Insert each wire into its terminal and clamp tightly with terminal screw. Each terminal can accept up to one 14-gauge, two 18-gauge or four 20-gauge wires. After the terminal block is wired, install it into the proper location on the PC Board.

4.4 Power Wiring

The AC power to the unit must be selected for either 115VAC or 230VAC. The selector switch is located through an access slot on the side of the case. AC power is connected to terminal block TBA pins 1 and 2 (marked 50/60 HZ/4VA), located on left side of bottom block). The AC power should be relatively "clean" to reduce the chance of noise spikes, and within the specified ±10% variation limit. Heavily loaded circuits with loads that cycle on and off (contactors, relays, motors, machinery, etc.) should be avoided.

4.5 Signal Wiring

Connect the process current wiring per the appropriate wiring diagrams shown in Figures 3 through 5. In general when a floating transmitter is used, the meter's transmitter excitation must be used and the wiring will use pins 7 and 6 as the positive and negative inputs respectively as shown in Figure 3. If the process current source is an active output, the wiring should use pins 6 and 5 as the positive and negative inputs respectively as shown, for example, in Figure 5.

4.6 General Wiring Notes

To minimize coupling noise into signal wires, which might cause erratic and erroneous readings, certain guidelines are useful:

1) Never run signal wires in the same conduit or raceway with conditions feeding motors, solenoids, SCR controls, heaters, actuators, transformers, etc. Ideally signal wires should run in a separate conduit.

   WARNING:

   If the signal leads are connected to intrinsic safety barriers, they must not be routed near any cable or cable raceway with a voltages greater than 240 VAC even though this wiring is on the non-hazardous side of the barrier.

2) When shielded cable is used with a floating signal source such as a resistance tape sensor, the shield should be grounded at the sensor (or at the barrier in the case of intrinsically safe applications) and not connected to the indicator "COMM". Some trial and error in selecting grounding points may serve to reduce system noise problems.

3) Exceptionally long signal runs (several hundred feet) stand an increased chance for noise pick up.

4) Be sure all wires are clean and connections tight to provide good signal conductivity.

5) Signal leads within electrical enclosures should be routed as far as possible from contactors, motor starters, relays, transformers and similar components.

4.7 Outputs To User Equipment

The digital panel meter (P/N 1669101 only) provides several outputs that are available to user equipment:

TBB - 1	Alarm 1 Relay - Common
TBB - 2	Alarm 1 Relay - Normally Open
TBB - 3	Alarm 1 Relay - Normally Closed
TBB - 4	Alarm 2 Relay - Common
TBB - 5	Alarm 2 Relay - Normally Open
TBB - 6	Alarm 2 Relay - Normally Closed
TBB - 7	Alarm 1 Open Collector
TBB - 8	Open Collector Common
TBB - 9	Alarm 2 Open Collector
TBB - 10	Analog Output (-)
TBB - 11	Analog Output (+)

5.0 SETUP / CALIBRATION

The meter must be properly calibrated so that its displayed value accurately reflects the liquid level in the tank. As part of this process, the associated electronics (transmitter or other signal conditioning electronics) must be initially calibrated. It is intended that once the associated electronics is set up and calibrated, it will not have to be calibrated again unless replaced or repaired. All subsequent calibration should be done at the digital panel meter. Two examples showing a typical calibration sequence are shown in Appendix A.

5.1 SETUP

The general steps for a first time setup of a system are as follows:

1) Set up and calibrate the associated transmitter or associated signal conditioning electronics per the appropriate instructions of that equipment. It is the intent of this step to ensure that the 4-20 mA signal varies over the maximum usable range of the sensor. Typically the associated electronics is adjusted so that 4.00 mA is obtained at the sensor bottom helix (lowest measurable point) and 20.00 mA is obtained at the top helix (highest measurable point). Other systems may be set up so that 4.00 mA is at tank bottom and 20.00 mA is at tank top. In either case, note the levels calibrated at the 4.00 mA and 20.00 mA points as those levels will be used in the calibration of the Digital Panel Meter.

2) There are no user setable jumpers or DIP switches on the Digital Panel Meter.

5.2 GENERAL DIGITAL PANEL METER PROGRAMMING

To program any of the features of the Digital Panel Meter including calibration of the display, alarm thresholds, analog output, etc. the following general steps must be taken. There are three buttons on the front lower edge of the meter designated **P**, **Up** and **Dn**. The **Up** and **Dn** buttons are actually triangles with a point aiming up and down respectively. By pressing **P** once the programming mode can be entered and the display will now flash between a prompt and the current value or option of that prompt. In this case, after pressing **P** once, the display will flash between "Pro" and "0". In all of the following paragraphs the prompt and value or option is shown in parentheses. The prompt and the value/option displayed will be separated with a "/". As an example (Pro/0) would be the designation for a display flashing alternately between "Pro" and "0".

5.2.1 Programming Modes

The programming functions are divided into nine different programming modes. These modes are summarized below:

Mode	Description
0	Return to measurement mode.
1	Scaling by signal level method. Use current to calibrate the meter; most useful after installed in tank.
2	Scaling by key-in method Use keyed in current to calibrate the meter; most useful at initial calibration.
3	Program functions accessible with front panel lockout. Sets functions that can be changed when lockout jumper is installed on rear of panel.
4	Program digital filter and remote input. Sets filtering levels (none, normal, increased, maximum); controls function of remote digital inputs.
5	Program totalizer / integrator. Unit can be used to totalize or integrate the input; not useful with liquid level.
6	Program Alert / Set point Set alarm thresholds, direction of action and hysteresis.
7	Program serial communications Program the serial port (current loop); not normally appropriate for Consilium users.
8	Program retransmitted analog output Program buffered auxiliary 4-20 mA output.
9	Service operations Precision calibration of the instrument, current loop self test and programming reset.

5.2.2 Entering the Programming Mode

To enter programming the mode:

a) Press **P** (Pro/0)
b) Press **Up** or **Dn** to obtain the programming mode desired. Pressing **Up** once will cause the display to read Pro/1. Pressing **Up** again will cause the display to read Pro/2, etc.

5.2.3 Returning to the Measurement Mode

To return to normal measurement mode:

a) Press **Up** or **Dn** until Pro/0 is obtained
b) Press **P**. Measured data will be displayed.

5.3 Alarm Set Points (P/N 1669101 only)

The Digital Panel Meter (P/N 1669101 only) has two alarm set points that can be established. Each set point has a Form C relay. To program the set point option, the following data must be entered:

Level Threshold
Hysteresis
Direction of Action
HI - sets on rising level
LO - sets on falling level

Both set points are programmed separately. To enter or change the set points, Program Mode 6 is used:

a) Press **P** (Pro/0)
b) Press **Up** or **Dn** several times to obtain programming mode 6 (Pro/6)
c) Press **P** (trAc/option)
d) Press **Up** or **Dn** to obtain Yes or No; Yes indicates that when one alarm set point is changed the second will track it; normally a No answer is appropriate.
e) Press **P** (diSP/option)
f) Press **Up** or **Dn** to obtain Yes or No; Yes causes the alarm to alternately flash with the measured data on the display in addition to actuating the relay.
g) Press **P** (LAtC-1/OPTION)
h) Press **Up** or **Dn** to obtain Yes or No; Yes causes the alarm to set an internal latch that must be manually reset with a contact closure; No causes the alarm to reset only after the value has changed by the amount of the hysteresis. Unless an external acknowledge/reset switch is added, No will be the normal response.
h) Press **P** (ASn-1/option)
i) Press **Up** or **Dn** to obtain InPUt or totAL; only InPUt is normal for our functions
j) Press **P** (AL-1/value)
k) Press **Up** or **Dn** to obtain the desired alarm threshold for alarm #1
l) Press **P** (HYS-1/value)
m) Press **Up** or **Dn** to obtain the value of the hysteresis for alarm #1
n) Press **P** (Act-1/option)
o) Press **Up** or **Dn** to obtain the option of Hi or Lo for direction of alarm #1 action.
p) Press **P** (LAtC-2/OPTION)

q) Press **Up** or **Dn** to obtain Yes or No; Yes causes the alarm to set an internal latch that must be manually reset with a contact closure; No causes the alarm to reset only after the value has changed by the amount of the hysteresis.
r) Press **P** (ASn-2/option)
s) Press **Up** or **Dn** to obtain InPUt or totAL; only input is normal for our functions.
t) Press **P** (AL-2/value)
u) Press **Up** or **Dn** to obtain the desired value for alarm #2
v) Press **P** (HYS-2/value)
w) Press **Up** or **Dn** to obtain the value of the hysteresis for alarm #2.
x) Press **P** (Act-2/option)
y) Press **Up** or **Dn** to obtain the option of Hi or Lo for direction of alarm #2 action.
z) Press **P** (Pro/0)
aa) Press **P** (Measured value)

5.4 ANALOG OUTPUT (P/N 1669101 only)

The Digital Panel Meter (P/N 1669101 only) has an isolated 4-20 mA analog output. The 4.00 mA and 20.00 mA outputs can be set at any arbitrary value. To program the analog output option, the following data must be entered:

Displayed value at 4.00 mA
Displayed Value at 20.00 mA.

Both set points are programmed separately. To enter or change the set points, Program Mode 8 is used:

a) Press **P** (Pro/0)
b) Press **Up** or **Dn** several times to obtain programming mode 8 (Pro/8)
c) Press **P** (ASIN/option)
d) Press **Up** or **Dn** to obtain InPut or totAL. InPut indicates is used to derive the analog output from the input signal as it is displayed. totAL indicates that the analog output is derived from the totalized or integrated signal. In level gauging applications, the InPut option should be selected.
e) Press **P** (An-Lo/value)
f) Press **Up** or **Dn** to obtain the displayed value when the current is at 4.00 mA.
g) Press **P** (An-Hi/value)
h) Press **Up** or **Dn** to obtain the displayed value when the current is at 20.00 mA.
i) Press **P** (Pro/0)
j) Press **P** (Measured Value)

5.5 GENERAL CALIBRATION

Once the associated electronics has been calibrated, several means of calibrating the Digital Panel Meter are available. Four methods are summarized below. Read all four methods to determine which is the most appropriate. Methods #1 and #2 are most applicable for first time calibration or calibration after a transmitter or the associated electronics has been replaced and/or recalibrated. Methods #3 and #4 are most appropriate when the Digital Panel Meter has been previously calibrated or when there is a discrepancy in the displayed value and the actual measured value.

5.5.1 Method #1 - Use transmitter or associated electronics as current source; empty tank; active sensor length is known.

If the transmitter or associated electronics is calibrated for top and bottom contact, the electronics can be used as a "current calibrator" for the digital panel meter. This is most appropriate when a tank is initially empty because the sensor is resting at a resistance equal to the bottom contact. Applying a short across the sensor simulates the top contact. It is not necessary that the electronics output exactly 4.00 mA at the bottom contact and 20.00 mA at the top contact.

The procedure for calibrating the meter is as follows:

a) Determine the active helix length (AL). It is the value of the Sensor Resistance (RS), in ohms, recorded on the sensor tag divided by the sensor Resistance Gradient (RG), in ohms per meter, also recorded on the sensor tag. If necessary, convert that number to the desired engineering units to be displayed;

b) Use the following values to initially calibrate the meter:

    DSP1 = 0
    DSP2 = AL

c) If the distance from the bottom of the tank to the bottom of the sensor is known add that distance plus 6" (150mm) to the values of both DSP1 and DSP2.

d) Calibrate the meter using Signal Level Method in section 5.6. When requested for INP1 ensure that sensor is open (empty tank) so that transmitter or associated electronics is outputting current represented by the bottom helix. When requested for INP2, short out sensor (disconnect sensor connector and short input to transmitter or if electronics is centralized, short out sensor on hazardous side of barrier). At this point the display is calibrated for the proper Span but is not

calibrated for the proper offset (zero). If a correction was made in step c), the offset should be less than ± 3".

e) At a future time when tank is near half full, recalibrate per Offset Method in section 5.8.

5.5.2 Method #2 - Transmitter or associated electronics precisely calibrated at two known levels (may be the top and bottom of the tank)

If the transmitter or associated electronics has been calibrated for two known levels (not necessarily the top and bottom of the tank), the appropriate values can be keyed in; the following values must be known accurately:

1) Current at the lower known level - may be bottom of tank (should be near 4 mA but does not have to be exactly 4.00 mA)
2) Display reading at lower level
3) Current at the upper known level - may be top of tank (should be near 20 mA but does not have to be exactly 20.00 mA)
4) Display reading at upper level

The procedure for calibrating the meter is as follows:

a) Determine the values of INP1, DSP1, INP2 and DSP2 from the values known above

b) Calibrate the meter using key-in method in Section 5.7

5.5.3 Method #3 - Transmitter or associated electronics not precisely calibrated - may have been previously calibrated. Actual data must be collected.

The most accurate method for calibrating the Digital Panel Meter is to insert a precision current meter in the loop and to record and plot accurately the actual level (not the displayed level) and actual current at many different points. By determining the best straight line fit between all of these points, the new data to be entered can be derived.

The procedure for calibrating the meter is as follows:

a) Put a precision current meter in series with the +SIGNAL input (TBA pin 6) of the meter.

b) Record the current and the actual measured level (not the displayed level) at as many points as practical. At least one point should be near the bottom of the tank (liquid must be high enough to actuate the sensor) and at least one point should be near the top of the tank. Several points near the bottom and several points near the top are most desirable

c) Either graphically or analytically, determine the best straight line through all points. Determine the desired value to be displayed (DSP1) at 4.00 mA (INP1) and the value to be displayed (DSP2) at 20.00 mA (INP2). Other currents may be used but they should be reasonably far apart such as near the top and the bottom of the tank.

d) Calibrate the meter using key-in method in Section 5.7

5.5.4 Method #4 - The displayed level differs from the actual value by a constant value (offset); this is equivalent to the zero adjustment on a classic analog meters.

The procedure for calibrating the meter is as follows:

a) Determine the average offset (displayed value minus the measured value)

b) Use the offset method in Section 5.8

5.6 Calibration Using Signal Level Method

a) Press **P** (Pro/0)
b) Press **Up** to obtain programming mode 1 (Pro/1)
c) Press **P** (dECPnt/option)
d) Press **Up** or **Dn** until desired decimal point setting is obtained.
e) Press **P** (round/option)
f) Press **Up** or **Dn** until desired rounding or dummy zeros are obtained; options are 1, 2, 5, 10, 20, 50, 100
g) Press **P** (Scale/option)
h) You may exit programming and return to Pro/0 (return to measurement mode) or continue with scaling. Press **Up** or **Dn** until Yes or No is obtained; No exits programming (go to step s); Yes continues with scaling.
i) Press **P** (dSP1/value)
j) Press **Up** or **Dn** to obtain the value of dSP1 to be displayed at lower current (4 mA for example)
k) Press **P** (inP1/value)
l) Apply a signal current (from a transmitter for example) that corresponds with the value entered in j); current measured will be displayed.
m) Press **P** (dSP2/value)
n) Press **Up** or **Dn** to obtain the value of dSP2 to be displayed with upper current (20 mA for example).
o) Press **P** (inP2/value)
p) Apply a signal current that corresponds with the value entered in n); this current may be obtained by shorting out the sensor; the current measured will be displayed.
q) Press **P** (SEGt/value).

r) Press **Up** or **Dn** to obtain the number of segments to be entered for linearization; Normally enter a value of "1" which is one segment (two points) which have just been entered;
s) Press **P** (Pro/0)
t) Press **P** (measured value)

5.7 Calibration using Key-In method

a) Press **P** (Pro/0)
b) Press **Up** twice to obtain programming mode 2 (Pro/2)
c) Press **P** (dECPnt/option)
d) Press **Up** or **Dn** until desired decimal point setting is obtained.
e) Press **P** (round/option)
f) Press **Up** or **Dn** until desired rounding or dummy zeros are obtained; options are 1, 2, 5, 10, 20, 50, 100
g) Press **P** (SCALE/option)
h) You may exit programming and return to Pro/0 (return to measurement mode) or continue with scaling. Press **Up** or **Dn** until Yes or No is obtained; No exits programming (go to step r); Yes continues with scaling.
i) press **P** (dSP1/value)
j) Press **Up** or **Dn** to obtain the value (dSP1) to be displayed with lower current (4 mA for example).
k) Press **P** (inP1/value)
l) Press **Up** or **Dn** to change value of lower input current (inP1) that corresponds with the value entered in j);
m) Press **P** (dSP2/value)
n) Press **Up** or **Dn** to change the value (dSP2) to be displayed at upper current (20 mA for example).
o) Press **P** (inP2/value)
p) Press **Up** or **Dn** to change value of upper input current (inP2) that corresponds with the value entered in n);
q) Press **P** (SEGt/value).
r) Press **Up** or **Dn** to obtain the number of segments to be entered for linearization; normally enter a value of "1" which is one segment (two points) which have just been entered;
s) Press **P** (Pro/0)
t) Press **P** (Measured value)

5.8 Calibration using Offset method

a) Press **P** (Pro/0)
b) Press **Up** twice to obtain programming mode 2 (Pro/2)
c) Press **P** (dECPnt/option)
d) Do not hit **Up** or **Dn** to change decimal point setting
e) Press **P** (round/option)
f) Do not press **Up** or **Dn** to change rounding
g) Press **P** (SCALE/option)
h) Press **Up** or **Dn** until Yes is obtained;
i) Press **P** (dSP1/value)
j) Note present value of display

k) Add offset correction desired to present value to determine new value
l) Press **Up** or **Dn** to obtain the new value determine in step k).
m) Press **P** (inP1/value)
n) Do not press **Up** or **Dn** to change value
o) Press **P** (dSP2/value)
p) Note present value of display
q) Add offset correction used in step k) to present value to determine new value
r) Press **Up** or **Dn** to obtain the new value determine in step k).
s) Press **P** (inP2/value)
t) Do not press **Up** or **Dn** to change value
u) Press **P** (SEGt/value).
v) Press **Up** or **Dn** to obtain the number of segments to be entered for linearization; normally enter a value of "1" which is one segment (two points) which have just been entered;
w) Press **P** (Pro/0)
x) Press **P** (Measured value)

6.0 OPERATION

When power is applied to the meter, the display will momentarily show all eights (888888), thus illuminating all segments. After approximately two (2) seconds the meter will display the measured value. Other than changing calibration and other setup parameters, there is no interaction with the meter.

7.0 THEORY OF OPERATION

Both meters employ a microprocessor to control total operation, setup and calibration of the instrument. A non-volatile EPROM memory provides permanent data retention for operating, setup and calibration variables. The input current is fed through a 10_ current sampling resistor and to a voltage-to-frequency converter to perform the A/D conversion. The frequency derived is digitally scaled, filtered, and corrected for such drift as may be present and then directed to the 6-digit, solid-state LED display.

An internal power supply provides internal power for the meter electronics and external 18 VDC power suitable for driving a transmitter.

P/N 1580101 provides some additional options. The microprocessor continuously compares the displayed value to the alarm set points and if exceeded, actuates both an opto-isolated transistor and a Form C relay. The microprocessor also drives a 12-bit Digital-to-Analog converter to provide a digitally scaled 4 to 20 mA isolated current output for retransmission. A digital current loop interface
also allows serial communication with other equipment. An additional feature of this part is the ability to linearize the input signal which is controlled with internal software.

Unlike classic analog systems that generate a straight line with an offset (zero) and a slope (span), the microprocessor based display uses two points as shown in Figures 6 and 7. All of the calibration procedures in Section 5 use this concept.

8.0 TROUBLESHOOTING

The majority of problems with the digital panel meter can be traced to improper connections or faulty programming steps. The following table lists some of the possible problems that may occur and the solutions:

Problem	Probable Cause	Solution
Display is blank	No line power	Provide power
		Check wiring
	Faulty meter	Replace meter
Meter display shows 888888 when power is applied; display does change with signal or level	Improper wiring	Check wiring
	Transmitter or associated electronics not providing current	Check transmitter or associated electronics or sensor
	Faulty meter	Replace meter
Meter display shows 888888 when power is applied; display is not accurate	Improper wiring	Check wiring
	Improper calibration	Re-calibrate system

Problem	Probable Cause	Solution
Alarms relays do not operate	Wrong meter	Option only available with P/N 1699101 only
	Improper set points	Reset set points per Section 5.3
	Faulty meter	Replace meter
Alarm message displayed	Improper setup	Repeat alarm setup not per Section 5.3; select Yes in step f)
No analog output	Wrong meter	Option only available with P/N 1699101 only
	Incorrect wiring	Check wiring
	Faulty meter	Replace meter
Analog output does not vary with level	Improper setup	Recalibrate per Section 5.4
Unable to perform setup or calibration	Jumper not removed	Remove jumper from PGM.DIS. (TBA pin 3)
Display shows "PPPPPP"	Programming error	Check programming
Display shows "ULULUL"	Input underload; signal level too low (or negative)	Check input level
Display shows "OLOLOL"	Input overload; signal level too high	Check input level

There are no replaceable parts or subassemblies. Either the meter or the enclosure must be replace in its entirety.

9.0 MAINTENANCE

The following maintenance steps are recommended:

1) Every three (3) months the accuracy of the system should be checked. If the overall accuracy is improper, repeat the calibration of section 5

2) If NEMA 4 integrity is required, every three (3) months check enclosures for evidence of leakage.

3) Every two (2) years perform unit service operations as indicated in Red Lion manual. These instructions are located on page 19 of that manual under Programming Module #9 - Service Operations

4) Clean lens as required with clean cloth and mild detergent in water.

APPENDIX A

CALIBRATION AND SETUP EXAMPLES

EXAMPLE #1:

The Consilium level sensor and transmitter have been previously calibrated for the following:

a) When the liquid level is 1.50 ft, the transmitter output is 4.97 mA
b) When the liquid level is 15.35 ft, the transmitter output is 20.45 mA

The transmitter is connected to the digital panel meter (P/N 1669101) per Figure 3. The following parameters are desired.

c) High alarm at 13.00 ft. with 6" of hysteresis
d) Low alarm at 5.00 ft. with 6" of hysteresis
e) Alarm message should flash on display
f) Alarms should be non-latching
g) Analog output of 4.00 mA at a display of 0.00 ft
h) Analog output of 20.00 mA at a display of 16.00 ft.

To initially calibrate the level use Key-In Method #2 (Section 5.5.2). Note that the calibration information given above in a) through h) is shown in the following steps in braces { }:

a) Press **P** (Pro/0)
b) Press **Up** twice (Pro/2)
c) Press **P** (dECPnt/option)
d) Press **Up** or **Dn** until 0000.00 is obtained.
e) Press **P** (round/option)
f) Press **Up** or **Dn** until 1 is obtained
g) Press **P** (SCALE/option)
h) Press **Up** or **Dn** until Yes is obtained
i) Press **P** (dSP1/value)
j) Press **Up** or **Dn** to obtain the value of 1.50 {a}
k) Press **P** (inP1/value)
l) Press **Up** or **Dn** to obtain the value of 4.97 {a}
m) Press **P** (dSP2/value)
n) Press **Up** or **Dn** to obtain the value of 15.35 {b}
o) Press **P** (inP2/value)
p) Press **Up** or **Dn** to obtain the value of 20.45 {b}
q) Press **P** (SEGt/value).
r) Press **Up** or **Dn** to obtain the number 1
s) Press **P** (Pro/0)
t) Press **P** (Measured value)

If the sensor is in the tank with liquid at a measurable level, the display should be reading the proper liquid level.

To initially set the alarm set point parameters (Section 5.3):

a) Press **P** (Pro/0)
b) Press **Up** six times or **Dn** four times (Pro/6)
c) Press **P** (trAc/option)
d) Press **Up** to obtain No
e) Press **P** (diSP/option)
f) Press **Up** to obtain Yes {e}
g) Press **P** (LAtC-1/OPTION)
h) Press **Up** or **Dn** to obtain No {f}
h) Press **P** (ASn-1/option)
i) Press **Up** or **Dn** to obtain InPUt
j) Press **P** (AL-1/value)
k) Press **Up** or **Dn** to obtain the value of 13.00 {c}
l) Press **P** (HYS-1/value)
m) Press **Up** or **Dn** to obtain the value of 0.50 {c}
n) Press **P** (Act-1/option)
o) Press **Up** or **Dn** to obtain Hi {c}
p) Press **P** (LAtC-2/OPTION)
q) Press **Up** to obtain No {e}
r) Press **P** (ASn-2/option)
s) Press **Up** to obtain InPUt
t) Press **P** (AL-2/value)
u) Press **Up** or **Dn** to obtain value of 5.00 {d}
v) Press **P** (HYS-2/value)
w) Press **Up** or **Dn** to obtain the value of 0.50 {d}
x) Press **P** (Act-2/option)
y) Press **Up** to obtain Lo {d}
z) Press **P** (Pro/0)
aa) Press **P** (Measured value)

To initially set the analog output parameters (Section 5.4):

a) Press **P** (Pro/0)
b) Press **Dn** twice (Pro/8)
c) Press **P** (ASIN/option)
d) Press **Up** to obtain InPut
e) Press **P** (An-Lo/value)
f) Press **Up** or **Dn** to obtain the value of 0.00 {g}
g) Press **P** (An-Hi/value)
h) Press **Up** or **Dn** to obtain the value of 16.00 {h}
i) Press **P** (Pro/0)
j) Press **P** (Measured Value)

The meter is fully calibrated to the liquid level and the option parameters are set as desired.

EXAMPLE #2:

The Consilium level sensor and transmitter have been previously calibrated for the following:

a) When there is no liquid on the sensor (calibrated for bottom helix), the transmitter output is 3.97 mA
b) When the sensor is shorted (calibrated for top helix), the transmitter output is 20.45 mA
c) The sensor tag shows a sensor resistance (RS) of 4654 ohms and a resistance gradient of 305.2 ohms/foot.

The transmitter is connected to the digital panel meter (P/N 1669100) per Figure 3. Calculate the active length of the sensor to be 15.25 feet (4654 – 305.2)

To initially calibrate the digital panel meter use Signal Level Method #1 (Section 5.5.1). Note that the calibration information given above in a) through c) is shown in the following steps in braces { }:

a) Press **P** (Pro/0)
b) Press **Up** (Pro/1)
c) Press **P** (dECPnt/option)
d) Press **Up** or **Dn** until 0000.00 is obtained.
e) Press **P** (round/option)
f) Press **Up** or **Dn** until 1 is obtained
g) Press **P** (SCALE/option)
h) Press **Up** or **Dn** until Yes is obtained
i) Press **P** (dSP1/value)
j) Press **Up** or **Dn** to obtain the value of 0.00 {a}
k) Press **P** (inP1/value)
l) With the tank empty or the sensor out of the tank, the meter should be reading approximately 3.97 {a}
m) Press **P** (dSP2/value)
n) Press **Up** or **Dn** to obtain the value of 15.25 {c}
o) Press **P** (inP2/value)
p) Short out the sensor, the meter should be reading approximately 20.45 {b}
q) Press **P** (SEGt/value).
r) Press **Up** or **Dn** to obtain the number 1
s) Press **P** (Pro/0)
t) Press **P** (Measured value)

If the sensor is in the tank with liquid at a measurable level, the display will have a constant offset. With the tank approximately half full, carefully determine the actual level. The offset correction is the actual level minus the displayed level. If the measured level is 9.67 feet and the displayed level is 8.42 feet, the offset is 1.25 feet (9.67- 8.42).

To perform final calibration, use the Offset Method #4 (Section 5.5.4):

a) Press **P** (Pro/0)
b) Press **Up** twice (Pro/2)
c) Press **P** (dECPnt/option)
d) Press **P**
e) Press **P** (round/option)
f) Press **P**
g) Press **P** (SCALE/option)
h) Press **Up** to obtain Yes
i) Press **P** (dSP1/value)
j) Press **Up** or **Dn** to obtain the value of 1.25
k) Press **P** (inP1/value)
l) Press **P**
m) Press **P** (dSP2/value)
n) Press **Up** or **Dn** to obtain the value of 16.50 (15.25 + 1.25)
o) Press **P** (inP2/value)
p) Press **P**
q) Press **P** (SEGt/value).
r) Press **Up** or **Dn** to obtain the number 1
s) Press **P** (Pro/0)
t) Press **P** (Measured value)

The meter is fully calibrated to the liquid level and the option parameters are set as desired.

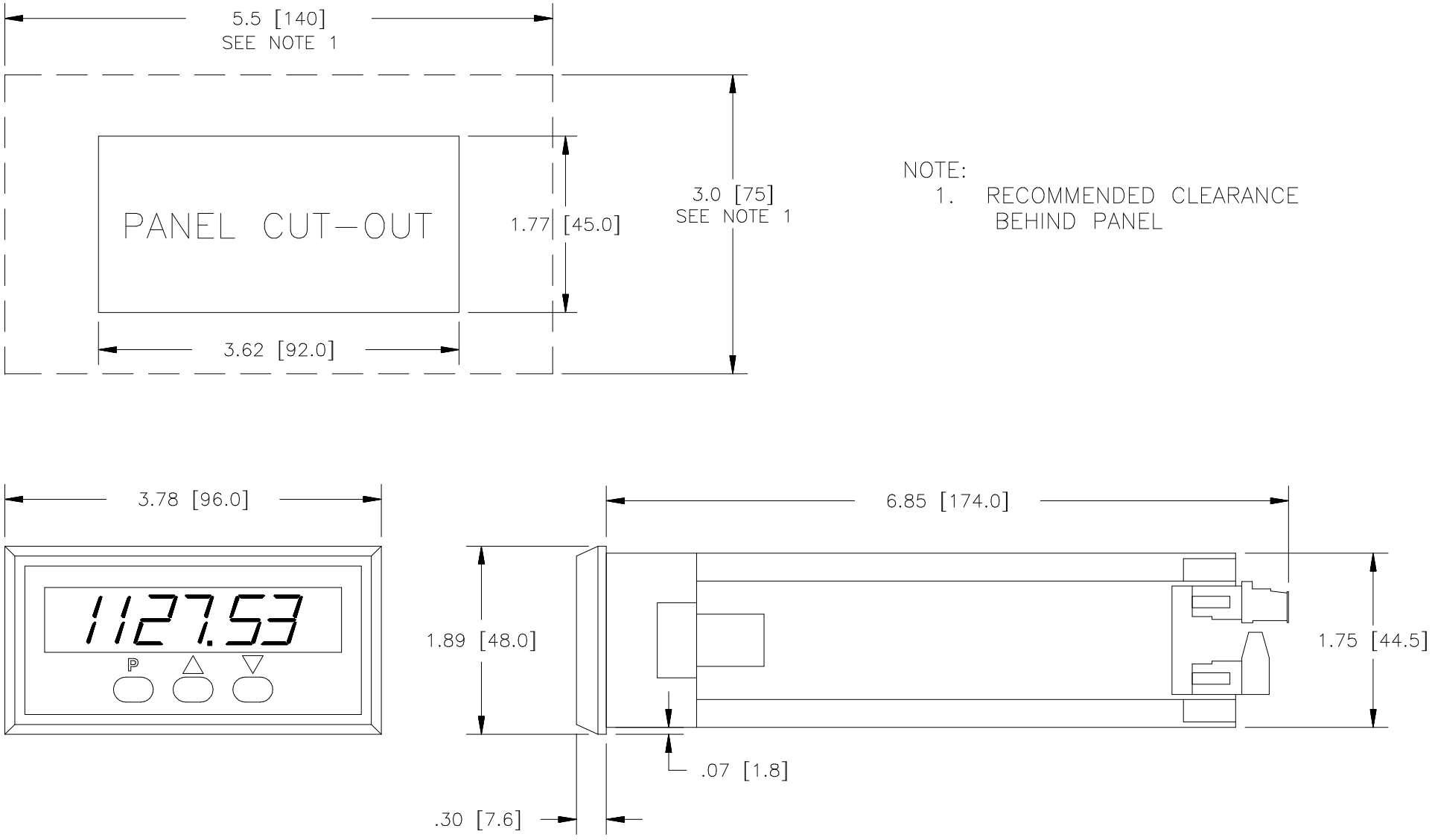
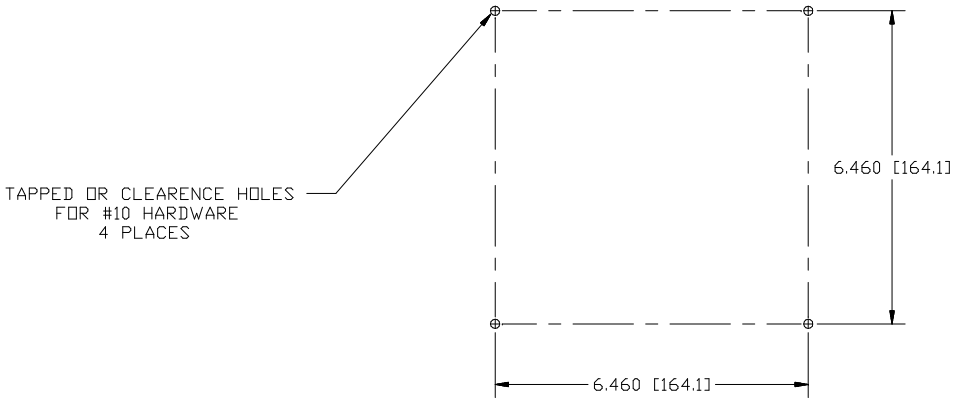
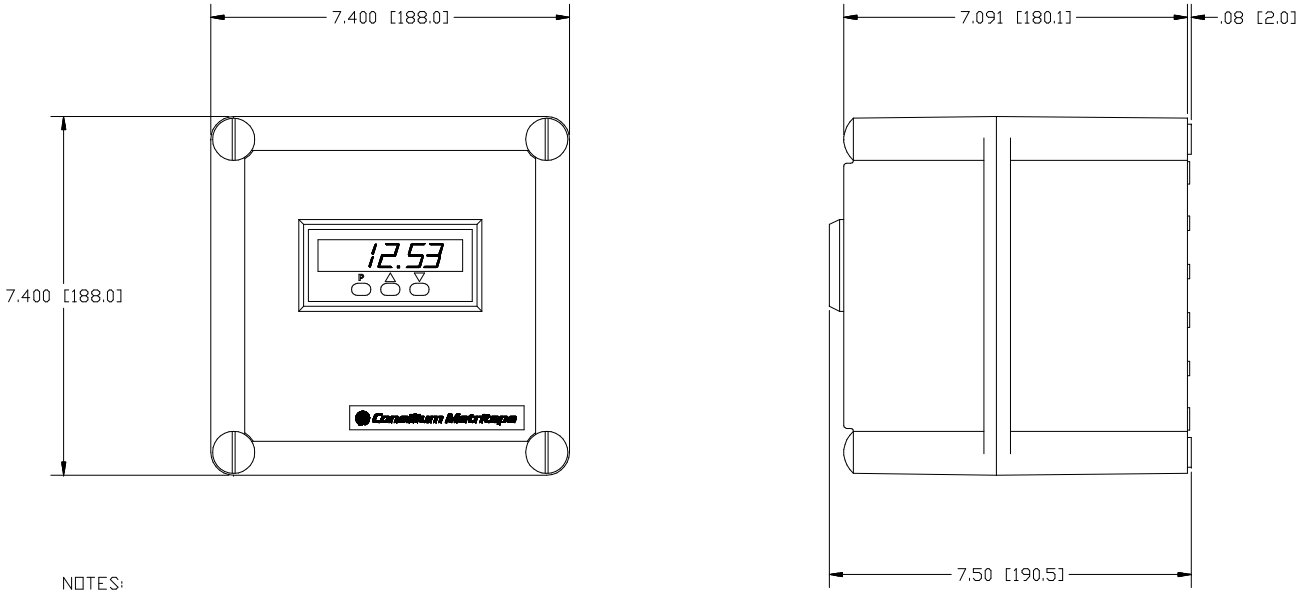


FIGURE 1

OUTLINE AND MOUNTING
DIGITAL PANEL METER



MOUNTING DETAIL



NOTES:
1. METER MUST BE PURCHASED SEPARATELY.
2. APPROXIMATE WEIGHT - 4 LB [2 KG].

FIGURE 2
OUTLINE & MOUNTING
DIGITAL PANEL METER
NEMA 4 ENCLOSURE

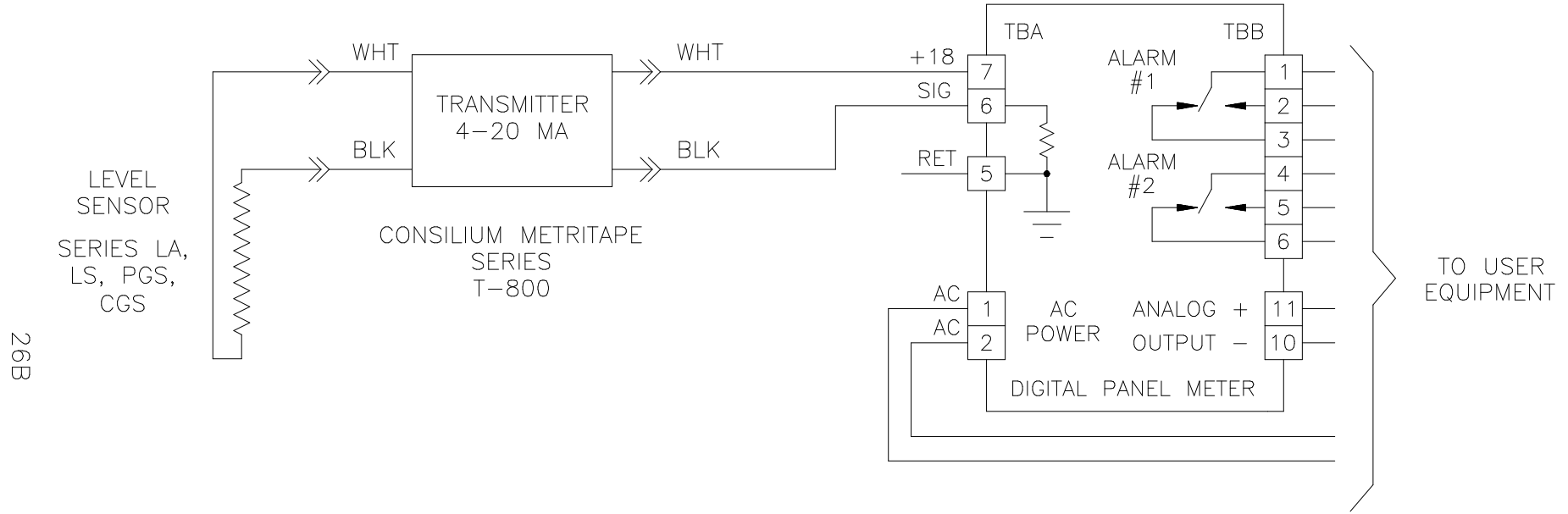


FIGURE 3

RESISTANCE–TAPE LEVEL SENSOR & TRANSMITTER
IN NON–HAZARDOUS LOCATION WITH DIGITAL PANEL METER.

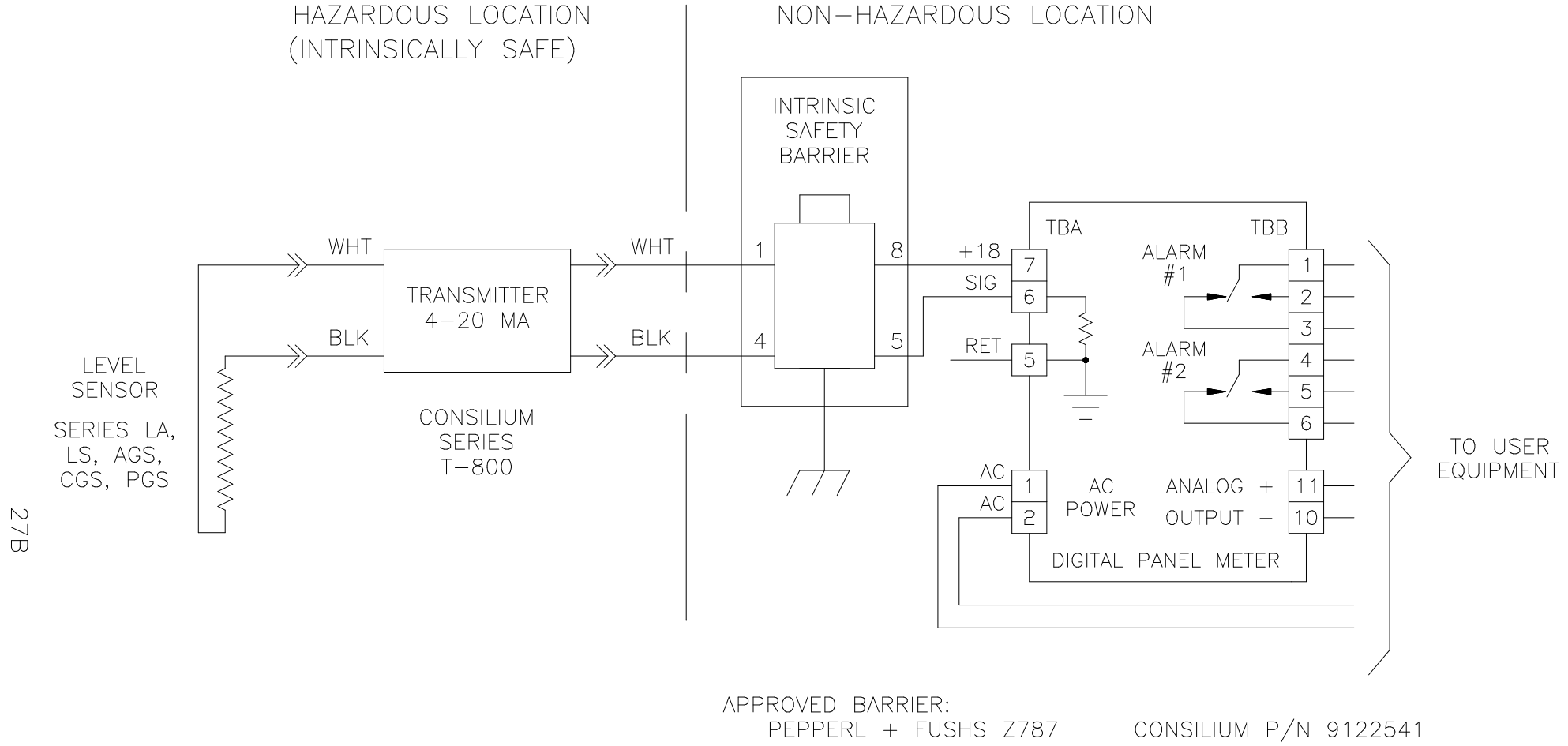


FIGURE 4

RESISTANCE–TAPE LEVEL SENSOR & TRANSMITTER
IN HAZARDOUS LOCATION WITH DIGITAL PANEL METER.

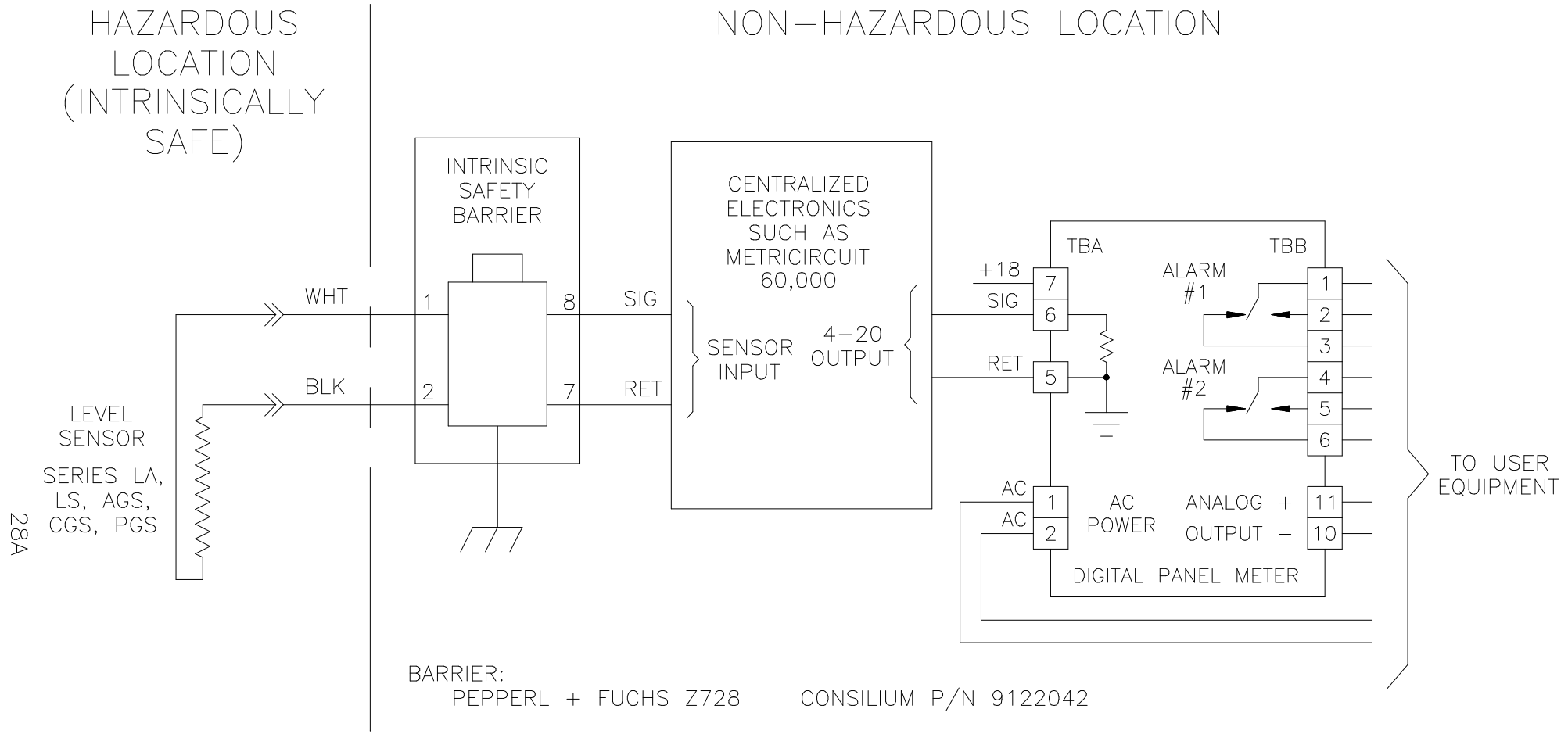


FIGURE 5

RESISTANCE–TAPE LEVEL SENSOR
IN HAZARDOUS LOCATION WITH DIGITAL
PANEL METER USING CENTRALIZED ELECTRONICS.

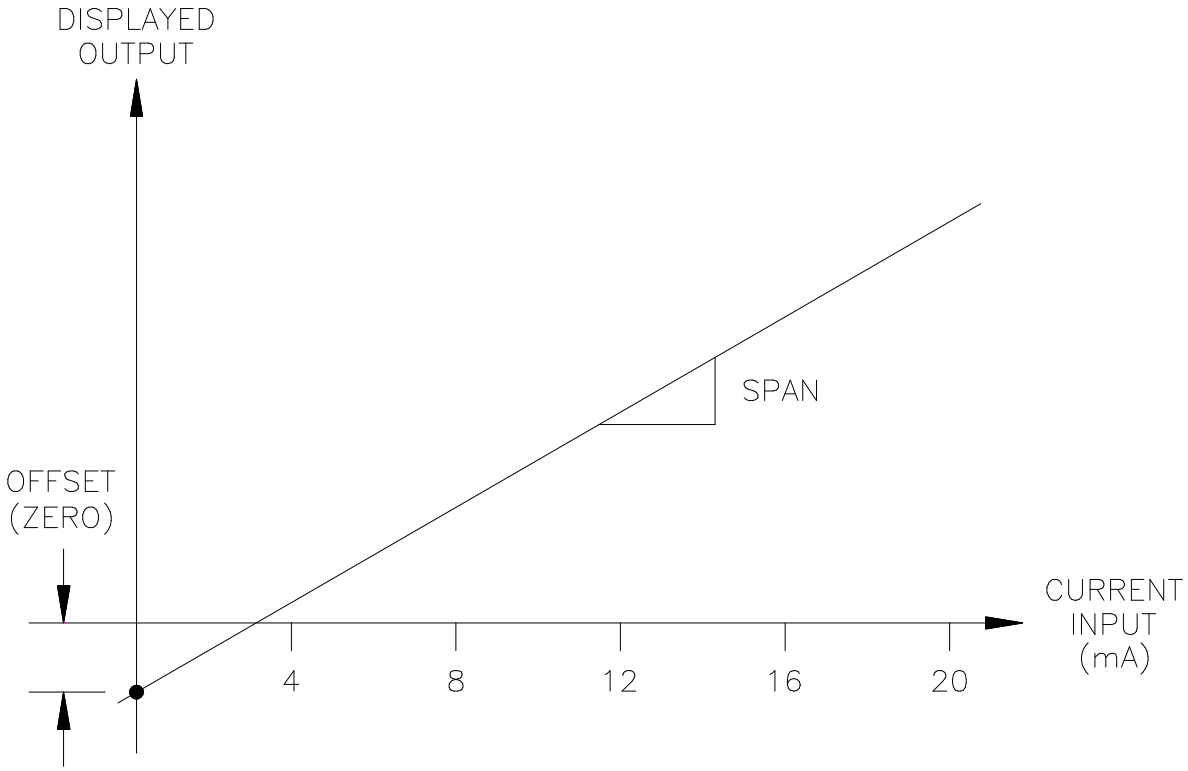


FIGURE 6 – CLASSIC ANALOG CALIBRATION
USING ZERO AND SPAN

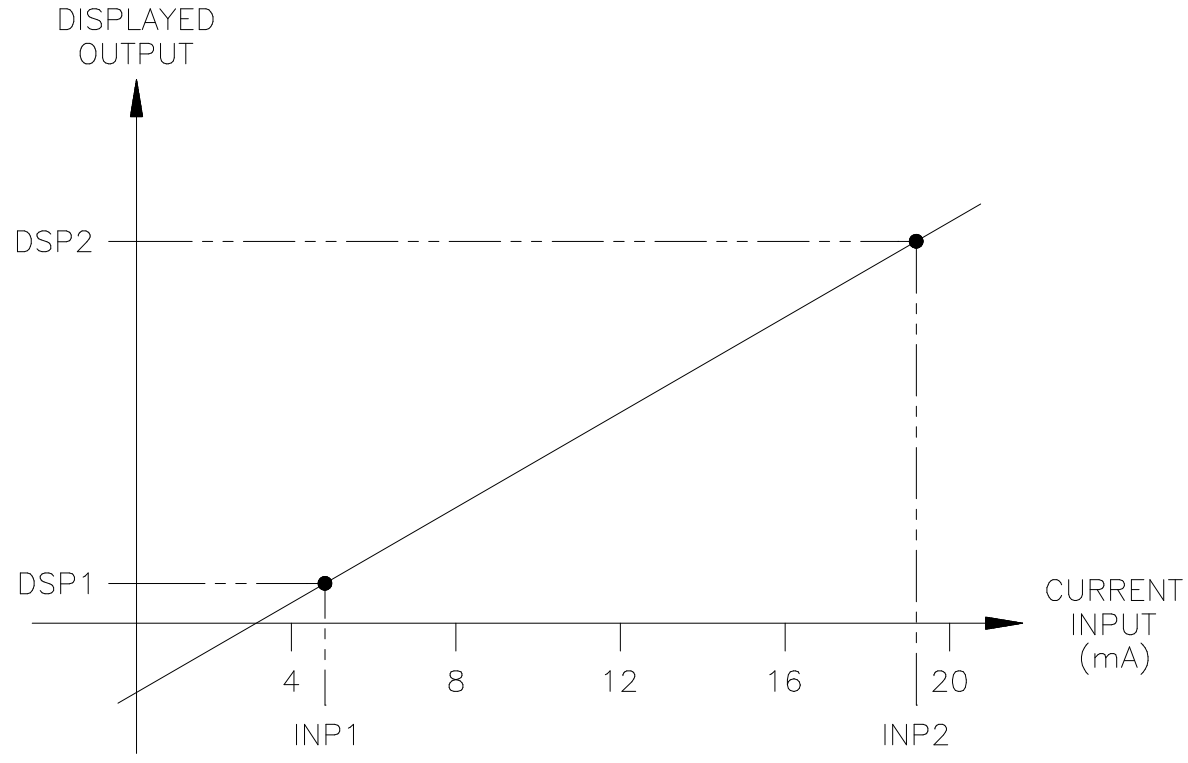


FIGURE 7 – DIGITAL CALIBRATION
USING TWO POINTS

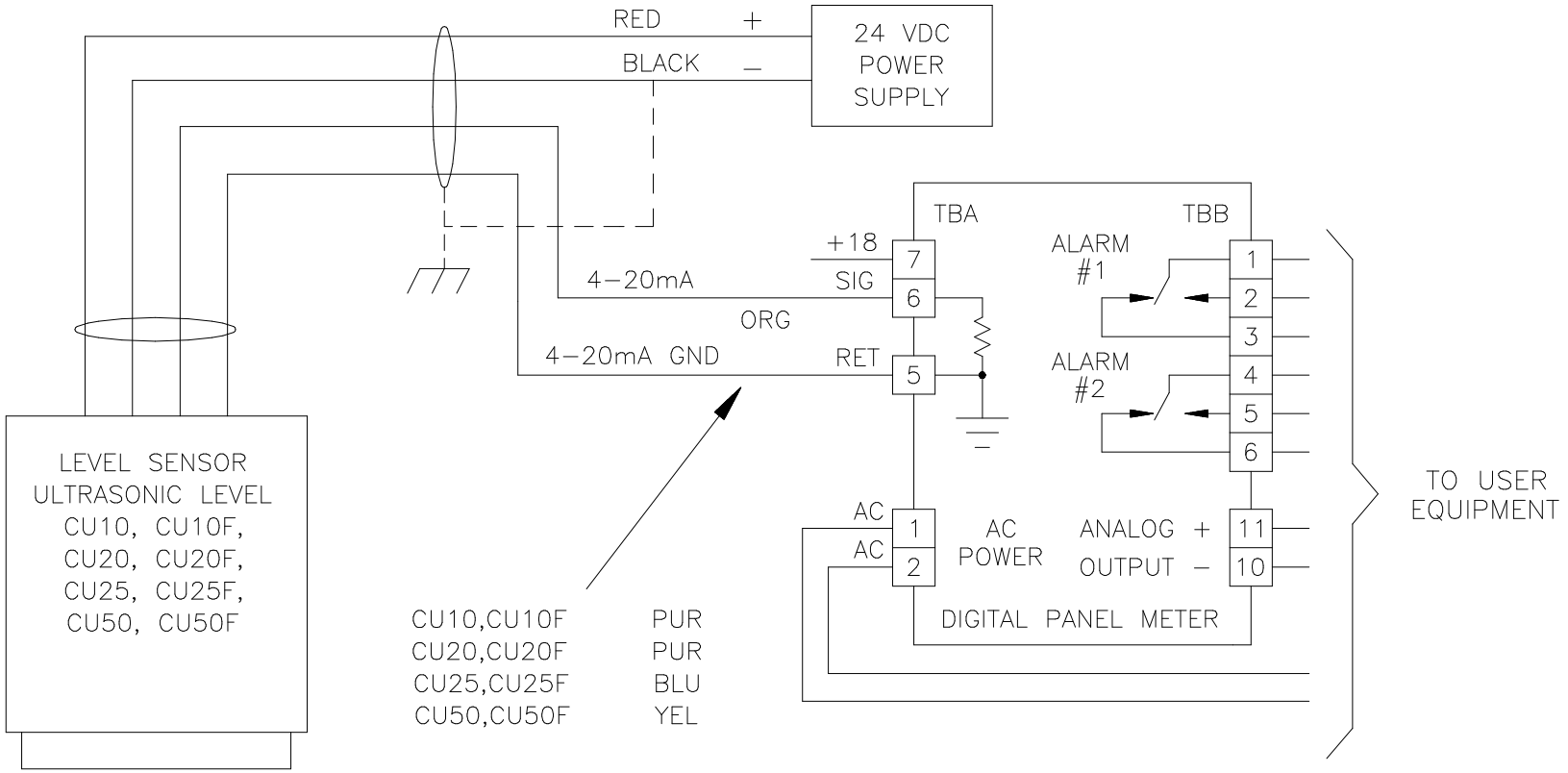


FIGURE 8

ULTRASONIC LEVEL SENSOR TO DIGITAL PANEL METER