Instrumentation Northwest, Inc.

Protecting our water resources since 1982

PS-9805 Submersible Pressure/Temp. Transducer

INSTRUCTION MANUAL

Table of Contents

Introduction - PS9805 Pressure Transducer

The PS9805 Pressure Transducer represents the latest state-of-the-art technology and has been designed to provide trouble-free submersible operation in liquid environments, when properly installed and operated. Please take the time to read through this manual if you are not familiar with this product.

Initial Inspection and Handling

Upon receipt of your transducer, inspect the shipping package for damage. If any damage is apparent, note the signs of damage on the appropriate shipping form. After opening the carton, look for concealed damage such as a cut cable. If concealed damage is found, immediately file a claim with the carrier.

Check the etched label on the transducer to be sure that the proper range and type were provided. Also check the label attached to the cable at the connector end for the proper cable length.

Do's and Don'ts

Do handle the device with care.
Do store the device in a dry, inside area when not in use.
Do install a desiccant tube if you are doing long-term outdoor monitoring.

Don't install the device so that the connector end is submerged.
Don't support the device with the connector or with the connectors of an extension cable. Use a strain relief device to take the tension off the connectors.
Don't allow the device to free-fall down a well at high velocities as impact damage can occur.
Don't bang or drop the device on hard objects.
Don't disassemble the device. (The warranty is void if transducer is disassembled.)

General Information

The following paragraphs outline the basics of how pressure is measured using submersible pressure transducers:

Liquids and gasses do not retain a fixed shape. Both have the ability to flow and are often referred to as fluids. One fundamental law for a fluid is that the fluid exerts an equal pressure in all directions at a given level. Further, this pressure increases with an increasing depth of "submergence". If the density of a fluid remains constant (noncompressible...a generally good assumption for water at "normal" pressures and temperatures), this pressure increases linearly with the depth of "submergence".

We are all "submerged" in the atmosphere. As we increase our elevation, the pressure exerted on our bodies decreases as there is less of this fluid above us. It should be noted that atmospheric pressure at a given level does vary with changes in the weather. One standard atmosphere (pressure at sea level on a "normal" day) is defined to be 14.7 PSI (pounds per square inch).

There are several methods to reference a pressure measurement (see Figure 1). Absolute pressure is measured with respect to an ideal vacuum (no pressure). Gauge pressure is the most common way we express pressure in every day life and is the pressure exerted over and above atmospheric pressure. With this in mind, gauge pressure (Pg) can be expressed as the difference between the absolute pressure (Pa) and atmospheric pressure (Patm):

$$Pg = Pa - Patm$$

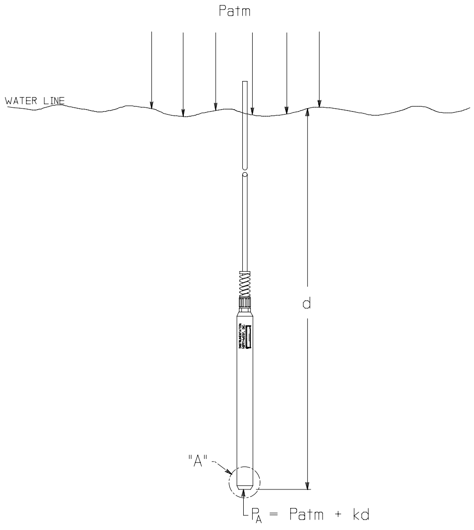

Figure 1: Pressure Diagram

To measure gauge pressure, atmospheric pressure is subjected to one side of the system and the pressure to be measured is subjected to the other. The result is that the differential (gauge pressure) is measured. A tire pressure gauge is a common example of this type of device.

Recall that as the level of submergence increases (in an incompressible fluid), the pressure increases linearly. Also, recall that changes in weather cause the absolute atmospheric pressure to change. In water, the absolute pressure Pa at some level of depth (d) is given as follows (see Figure 2):

$$Pa = Patm + kd$$

where k is simply a constant (i.e.: 2.307 ft of water = 1 PSI)

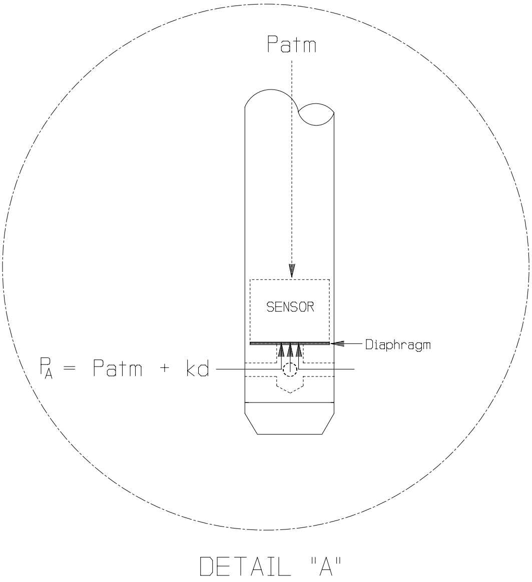

Figure 2: Pressure Diagram, Detail "A"

INW's standard gauge submersible pressure devices utilize a vent tube in the cable to allow the device to reference atmospheric pressure. The resulting gauge pressure measurement reflects only the depth of submergence. That is, the net pressure on the diaphragm (Figure 2) is due entirely to the depth of submergence.

Installation & Operation

The PS9805 measures pressure. The most common application is measuring liquid levels in wells and tanks. In order to do this, the transducer must be installed below the water level at a fixed depth. The installation depth depends on the range of the transducer. One (1) PSI is equal to approximately 2.31 feet of water. If you have a 5 PSI transducer, the range is 11.55 feet of water and the transducer should not be installed at a depth below 11.55 feet. If the transducer is installed below its maximum range, damage may result to the transducer and the output reading will not be correct.

Connecting to a Campbell Scientific Datalogger

The PS9805 submersible pressure/temperature transducer represents the latest in state-of-the-art level measurement technology. This sensor was designed for use with Campbell Scientific dataloggers and provides a pressure and temperature output.

Connect the PS9805 per the wiring diagram below.

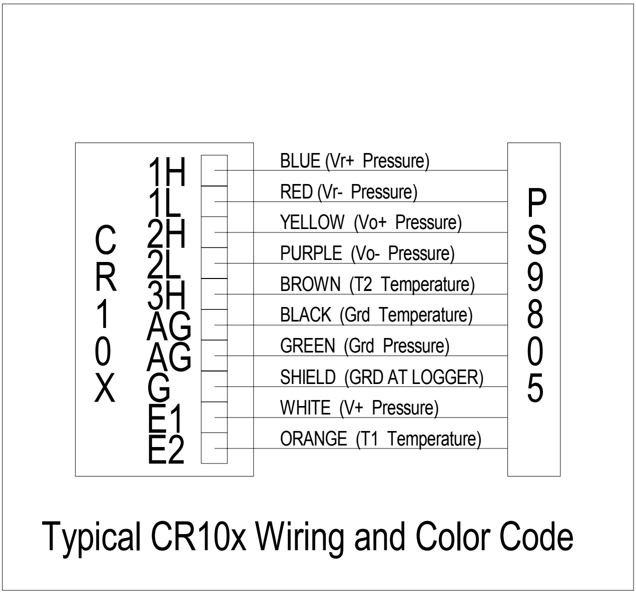

Figure 3: CR10X wiring

To program for pressure measurement, a standard Campbell Scientific P8 instruction is used to power the sensor, and measure two output voltages. The results of this measurement are then mathematically converted to pressure units. This technique automatically compensates for voltage drops in the cable and minimizes AC noise.

For programming the temperature measurement, a thermistor circuit is used that is directly compatible with a Campbell Scientific P11 instruction.

If desired INW can provide an enhanced calibration that takes the pressure and temperature measurements and mathematically corrects the pressure measurement for thermal errors. This calibration method typically reduces temperature errors by a factor of 10.

We have provided typical sample programs near the end of this manual for your reference.

Once you have connected the sensor to the dataloggers, the PS9805 is ready to install in its application.

Well Installation

Lower the transducer to the desired depth. Fasten the cable to the well head using tie wraps or a weather proof strain-relief system. When securing the cable, make sure not to pinch the cable too tightly or the vent tube inside the cable jacket may be sealed off. Take a measurement to insure the transducer is not installed below its maximum range. It is recommended that several readings be taken to insure proper operation after installation.

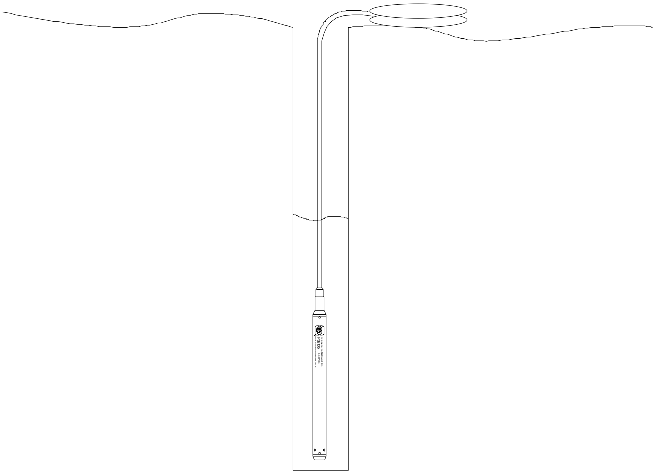

Figure 4: Installation

Notes:

- If the transducer is to be left in the well for a long-term monitoring application and the connector end is not in a dry, thermally-stable environment, a desiccant tube must be installed in line with the cable to prevent condensation in the cable vent tube. (See figure 5.) Water in the vent tube will cause inaccurate readings and, in time, will work its way into the transducer and damage it.

- **Proper grounding is very important!** INW recommends the following: (1) the sensor cable shield (the wrapped shield inside the cable) be attached to the power ground (G terminal) on the CR10X and (2) the grounding lug be connected via a 12 AWG or larger wire, to a grounding rod driven into the earth. It is also recommended that if you are using an external power supply to power the CR10X that it be tied to the same earth ground. (See also: Grounding Issues in the Trouble Shooting section of this manual.)

Other Installations

The transducer can be installed in any position; however, when it leaves the factory it is tested in the vertical position. Strapping the transducer body with tie wraps or tape will not hurt it. INW can provide an optional 1/4” NPT input adapter that is interchangeable with the standard end cone for those applications where it is necessary to directly attach the transducer to a pipe, tank or other pipe port. If the transducer is being installed in a fluid environment other than water, be sure to check the compatibility of the fluid with the wetted parts of the transducer. INW can provide a variety of seal materials if you are planning to install the transducer in an environment other than water.

Maintenance

INW recommends that the transducer be returned for factory recalibration and checkup every six months or if problems develop with sensor stability or accuracy. If the transducers have been exposed to hazardous materials, do not return them without notification and authorization. INW will ask that if the transducer assembly has been exposed to hazardous or toxic chemicals, you send back only the transducer and end connector, discarding the cable.

Transducer - all models: There are no user-serviceable parts.

Cable: Cable can be damaged by abrasion, sharp objects, twisting, crimping or crushing and pulling. Take care during installation and use to avoid cable damage. If a section of cable is damaged, it is recommended that you send your sensor back to replace the cable harness assembly.

End Connections: The contact areas (pins & sockets) of Mil-spec connectors will wear out with extensive use. If your application requires repeated connections (in excess of 5000 connections) other types of connectors can be provided. The connectors used by INW not submersible, but are designed to be splash-resistant.

Desiccant Tubes: Inspect the Desiccant Tube at least once every two months. The desiccant is a bright blue color when active and dry, as moisture is absorbed the color will begin to fade until becoming white indicating full saturation and time to replace. Replacement desiccant can be purchased from INW, please contact an INW sales engineer at 1-800-776-9355 for more information.

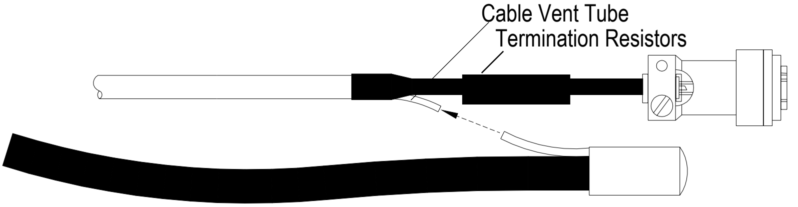

Figure 5: Desiccant Tube

Trouble Shooting

Erratic Readings

Erratic readings can be caused by a damaged transducer, damaged cable, poor connections or improper operation of readout equipment. In most cases, erratic readings are due to moisture getting into the system. Assuming that the readout equipment is working correctly, the first thing to check is the connection. Look for moisture between contacts or a loose or broken wire. If the connection appears OK, pull the transducer up a known distance while monitoring its output. If the transducer responds approximately as it should, but the reading is still erratic, most likely the cable is damaged. If the transducer does not respond approximately as it should, it is most likely that the sensor is damaged. In either case, consult the factory.

Erratic and erroneous readings can also occur due to improper grounding. See Grounding Issues, next page.

Oscillating Readings Over Time

If, after time, your transducer is functioning normally but your data is showing a cyclic effect in the absence of water level changes, you are probably seeing barometric changes. The amount is usually .5 to 1.5 feet of water. This can be caused by a plugged vent tube in the cable or actual water level changes in the aquifer itself in response to barometric pressure changes. This effect can occur in tight formations where the transducer will immediately pick up barometric changes but the aquifer will not. If you think you are having this type of problem you will have to record the barometric pressure as well as the water level pressure and compensate the data. If it appears that the vent tube is plugged, consult the factory.

If a desiccant tube is not installed in line with the cable, water may have condensed in your vent tube causing it to plug. After you are finished installing the desiccant tube you can test the vent tube by applying a small amount of pressure to the end of the desiccant tube and seeing if this affects the transducer reading.

Zero Readings When Pressurized

Continuous zero readings are caused by an open circuit which usually indicates broken cable, a bad connection, or possibly a damaged transducer. Check the connector to see if a wire has become loose, or if the cable has been cut. If neither of these appears to cause the problem, the transducer needs factory repair.

Grounding Issues

It is commonly known that when using electronic equipment, both personnel and equipment need to be protected from high power spikes that may be caused by lightning, power line surges, or faulty equipment. Without a proper grounding system, a power spike will find the path of least resistance to earth ground – whether that path is through sensitive electronic equipment or the person operating the equipment. In order to ensure safety and prevent equipment damage, a grounding system must be used to provide a low resistance path to ground.

When using several pieces of interconnected equipment, each of which may have its own ground, problems with noise, signal interference, and erroneous readings may be noted. This is caused by a condition known as a *Ground Loop*. Because of natural resistance in the earth between the grounding points, current can flow between the points, creating an unexpected voltage difference and resulting erroneous readings.

The single most important step in minimizing a ground loop is to tie all equipment (sensors, dataloggers, external power sources and any other associated equipment) to a **single common grounding point.** INW recommends the following: (1) the sensor cable shield (the wrapped shield inside the cable) be attached to the power ground (G terminal) on the CR10X and (2) the grounding lug be connected via a 12 AWG or larger wire, to a grounding rod driven into the earth. It is also recommended that if you are using an external power supply to power the CR10X that it be tied to the same earth ground.

Technical Specifications

Transducer Components

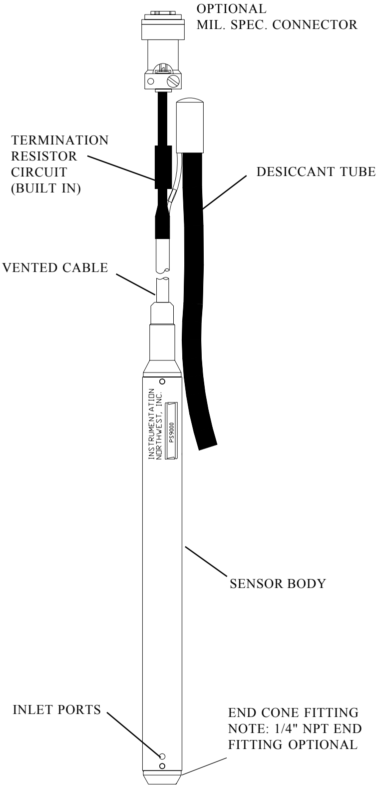

Figure 6: Transducer Components

Wiring Information

Cable type: 9-conductor, vented

Pressure Sensor Connections:

White = V(+) excitation (800 mV)
Green = Analog Ground
Blue = Vr (+)
Red = Vr (-)
Yellow = Vo (+)
Purple = Vo (-)
Shield = Ground at logger

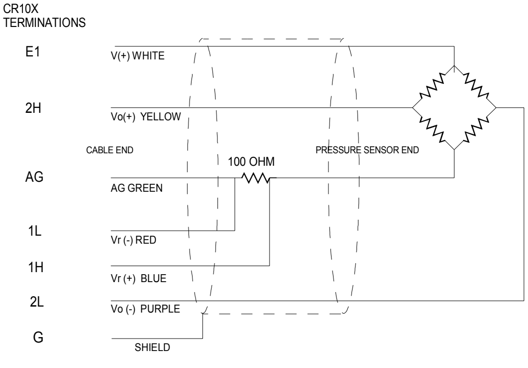

Figure 7: Pressure Sensor Connections

Temperature Sensor Connections:

Orange = (T1) temp. excitation
Brown = (T2) temp. out
Black = Temp. analog ground

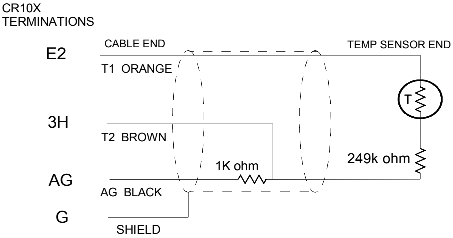

Figure 8: Temperature Sensor Connections

Operating Pressure Specifications

Static Accuracy	±0.1% FSO (typ.)	B.F.S.L. 25° C
Output Span	15 mV/V (typ.)	
Std. Thermal Error (0-50° C, reference 25° C)	±2.0% FSO (max.)	±0.8% FSO (typ.)
Typ. Enhanced Temp. Error	0-40° C (requires enhanced calibration) ±0.1% FSO	
Over Range Protection	2x (except 300 PSIA)	
Operating Temp. Range	-5° C to 70° C	
Temperature (thermister)		
Accuracy	±0.75° C (max.)	±0.3° C (typ.)
Operating Temp. Range	-24° C to 48° C (using P11 instruction)	

If you did not purchase a connector with your transducer, please see Component and Wiring information above.

Mechanical Specifications

Transducer:	
Length:	9.125"
O.D.:	0.840"
Body Material:	316 stainless steel
Wire Seal Material:	Viton /Buna-N
Diaphragm:	316 stainless steel
Desiccant Tube:	Included
Terminating Connector:	Available Option (10 pin required)
Cable:	
O.D.:	max. 0.28"
Cable Jacket:	Polyurethane, Polyethylene, or Teflon
Conductor Type:	9-conductor, vented

Vent Tube:	Nylon
Break Strength:	138 lbs.
Maximum Length:	2000 ft.

Adaptors

The following adaptor is available. Contact your INW representative for details and ordering information.

1/4” male NPT pipe fitting

Sample Programs

Standard Measurement Program Example

```
1:  Ex-Del-Diff (P8)
        1: 2      Reps
        2: 3      25 mV Slow Range
        3: 1      DIFF Channel
        4: 1      Excite all reps w/Exchan 1
        5: 1      Delay (units 0.01 sec)
        6: 800    mV Excitation
        7: 1      Loc [ Vr      ]
        8: 1.0    Mult
        9: 0.0    Offset

; Calculate L factor

L=100*(Vo/Vr)

; Measure Temperature

2:  Temp (107) (P11)
        1: 1      Reps
        2: 5      SE Channel
        3: 2      Excite all reps w/E2
        4: 4      Loc [ T       ]
        5: 1.0    Mult
        6: 0.0     Offset

; L can be translated to a pressure measurement using the following formula,
; where m and b (in psi) are determined from device calibration sheet.
```

```
P=(m)*L + (b)

; Now data can be further processed or written to data storage memory.
```

In the above example

Vr = differential voltage at diff channel 1

Vo = differential voltage at diff channel 2

L = pressure measurement in nominal units

P = pressure measurement in psi units using provided calibration values m and b from calibration data sheet for the specific sensor being used

T = temperature measurement in degrees C

Enhanced Measurement Program Example

```
1:  Ex-Del-Diff (P8)
        1: 2       Reps
        2: 3       25 mV Slow Range
        3: 1       DIFF Channel
        4: 1       Excite all reps w/Exchan 1
        5: 1       Delay (units 0.01 sec)
        6: 800     mV Excitation
        7: 1       Loc [ Vr        ]
        8: 1.0     Mult
        9: 0.0     Offset

; Calculate L factor

L=100*(Vo/Vr)

; Measure Temperature

2:  Temp (107) (P11)
        1: 1       Reps
        2: 5       SE Channel
        3: 2       Excite all reps w/E2
        4: 4       Loc [ T         ]
        5: 1.0     Mult
        6: 0.0      Offset

; L can be translated to a pressure measurement using the following formula.
; Coefficients for m and b are developed from thermal characterization and provided
with the enhanced calibration sheet.
```

P=(m)*L + (b)
;where m = $(m_2)*T^2 + (m_1)*T + (m_0)$ and
;where b = $(b_2)*T^2 + (b_1)*T + (b_0)$

; Now data can be further processed or written to data storage memory.

In the above example
Vr = differential voltage at diff channel 1
Vo = differential voltage at diff channel 2
L = pressure measurement in nominal units
m = calculated slope value from provided calibration values m_2, m_1, and m_0 from enhanced process calibration
b = calculated offset value from provided calibration values b_2, b_1, and b_0 from enhanced process calibration
P = pressure measurement in psi units using enhanced calibration values from calibration data sheet for the specific sensor being used
T = temperature measurement in degrees C

High Precision Measurement Program Example - for 5 PSI Sensors

The Standard and Enhanced Measurement Programming Examples (see previous pages) result in a resolution of ±0.2 inches. These methods use the 25 mV Slow Range of the CR10X. This level of resolution is acceptable for many measurement needs. However, in the 0 – 5 PSI range, greater resolution is often needed.

Using the High Precision Measurement Programming Example (below) will result in a resolution of ±0.03 inches. This uses the 7.5 mV Slow Range of the CR10X.

```
1:  Ex-Del-Diff (P8)
      1: 1       Reps
      2: 3       25 mV Slow Range
      3: 1       DIFF Channel
      4: 1       Excite all reps w/Exchan 1
      5: 1       Delay (units 0.01 sec)
      6: 800     mV Excitation
      7: 1       Loc [ Vr       ]
      8: 1.0     Mult
      9: 0.0     Offset

1:  Ex-Del-Diff (P8)
      1: 1       Reps
      2: 2       7.5 mV Slow Range
      3: 2       DIFF Channel
      4: 1       Excite all reps w/Exchan 1
      5: 1       Delay (units 0.01 sec)
```

```
        6: 800    mV Excitation
        7: 2      Loc [ Vo       ]
        8: 1.0    Mult
        9: 0.0    Offset

; Calculate L factor

L=100*(Vo/Vr)

; Measure Temperature

3:  Temp (107) (P11)
        1: 1      Reps
        2: 5      SE Channel
        3: 2      Excite all reps w/E2
        4: 4      Loc [ T        ]
        5: 1.0    Mult
        6: 0.0     Offset

; L can be translated to a pressure measurement using the following formula,
; where m and b (in psi) are determined from device calibration sheet.

P=(m)*L + (b)

; Now data can be further processed or written to data storage memory.
```

In the above example
Vr = differential voltage at diff channel 1
Vo = differential voltage at diff channel 2
L = pressure measurement in nominal units
P = pressure measurement in psi units using provided calibration values m and b from calibration data sheet for the specific sensor being used
T = temperature measurement in degrees C

Appendix A: Using PS-9805s With a Campbell Scientific CR1000

This appendix presents details necessary for using a PS-9805 with a Campbell CR1000.

Using a CR1000 to Read Pressure

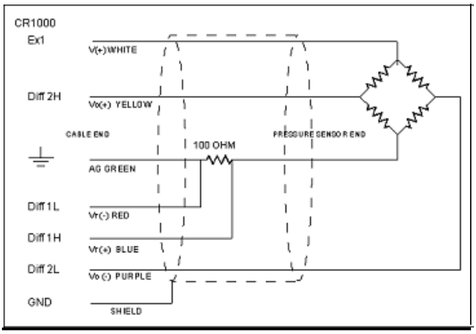

Figure 9: Typical Pressure Element Wiring on a CR1000

Basic Pressure Measurement Theory

- Apply 800 mV excitation across V+ (white) and AG (green).
- After a 25 milli-second delay, measure the reference voltage (Vr) across the 100 ohm resistor by measuring across Vr+ (blue) and Vr- (red). *
- Measure the output voltage (Vo) across Vo- (purple) and Vo+ (yellow).
- Compute the normalized ratiometric output (L) as: L = (Vo/Vr) * 100.
- Apply calibration/scaling values (from INW calibration sheet) to convert to psi:
- multiplier * L + offset.

Reading the Pressure

Apply 800 mV excitation voltage as follows:

```
ExciteV(Vx1,800,0)
```

Wait 10 milli-seconds, as follows:

```
Delay(0,25,msec)
```

Use the VoltDiff( ) function to read Vr and Vo, as follows:

```
VoltDiff(Vr,1,mV25,1,false,0,_60Hz,1.0,0)
VoltDiff(Vo,1,mV25,2,true,0,_60Hz,1.0,0)
```

Note that the fifth parameter (RevDiff) is false when measuring Vr and true when measuring Vo. When RevDiff is true a second measurement is made with the inputs reversed, in order to help compensate for offsets in the circuitry, thus giving a more accurate reading. On a 9805, the Vr (excitation) cannot be reversed, however, the Vo (output) can and should be to give the best readings.

Compute the L factor (normalized ratiometric output) as follows:

L = 100 * (Vo/Vr)

Apply calibration values and convert to pressure in psi as follows:

P = m * L + b

Where m and b are obtained from the calibration sheet supplied by INW.

For even more accurate readings, advanced calibration values can be applied. (See Sample Program Two.)

Using a CR1000 to Read Temperature

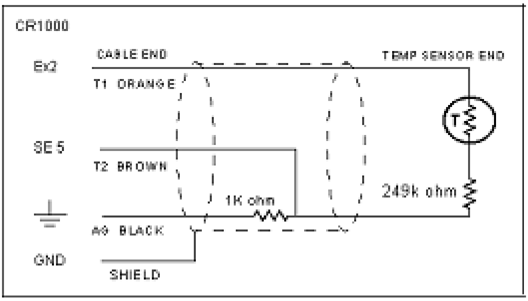

Figure 10: Typical Temperature Element Wiring on a CR1000

Basic Temperature Measurement Theory

- Apply excitation voltage across T1 (orange) and AG (black).
- Measure voltage output across T2 (brown) and AG (black).
- Apply math to process and linearize the measurement, resulting in degrees centigrade.

Reading the Temperature

When using a CR1000, use the Therm107 function to read the temperature, as follows:

```
Therm107 (Temp,1,5,Vx3,0,_60hz,1.0,0)
```

This function is designed for the thermistor used in the PS9805. It automatically selects the excitation voltage and processes the result using the Steinhart-Hart calculation to get an output in degrees centigrade.

CR1000 CONNECTIONS

Wiring Two 9805's for Use with Sample Programs

Single Ended Channel Number	**Differential Channel Number**	**Sensor 1**	**Sensor 2**
1	1H	Vr+ (Blue)	
2	1L	Vr- (Red)	
	⏚	AG (Green)	
3	2H	Vo+ (Yellow)	
4	2L	Vo- (Purple)	
	⏚	Temperature AG (Black)	
5	3H	Temperature Out (Brown)	
6	3L		Temperature Out (Brown)
	⏚		
7	4H		Vr+ (Blue)
8	4L		Vr- (Red)
	⏚		AG (Green)
	Ex1	Excite (White)	Excite (White)
9	5H		Vo+ (Yellow)
10	5L		Vo- (Purple)
	⏚		Temperature AG (Black)
	Ex2	Temperature Excite (Orange)	Temperature Excite (Orange)
Ground Lug		Shield	Shield

SAMPLE PROGRAM ONE – STANDARD CALIBRATION

```
'Program = Sample Program for two 9805s
'Sensor 1 is 5 psig, Sensor 2 is 15 psig

'Declare Variables and Units
Public Mult(2)      'calibration multiplier, one per sensor
Public Offset(2)    'calibration offset, one per sensor
                    'multipliers and offsets provided on INW
                     calibration sheet

Public V(4)         'reference voltage, then output voltage for
                     each sensor
                    'For example:  V(1)=Vr for 1st sensor,
                    '              V(2)=Vo for 1st sensor,
                    '              V(3)=Vr for 2nd sensor,
                    '              V(4)=Vo for 2nd sensor

Public Temp(2)      'temperature, one per sensor
Public L(2)         'L factor (Vo/Vr * 100), one per sensor
Public P(2)         'Standard calibrated pressure in psi, one per
                     sensor

Public Batt_volt
Units Batt_Volt=Volts

'Define Data Tables
DataTable(Table1,True,-1)
     DataInterval(0,500,msec,10)
     Sample(1,Batt_Volt, IEEE4)  'battery voltage
     Sample(4,V(),IEEE4)         'excitation voltage, then output
                                  voltage,
                                 'for each sensor

         'For example:  V(1)=Vr for 1st sensor,
         '              V(2)=Vo for 1st sensor,
         '              V(3)=Vr for 2nd sensor,
         '              V(4)=Vo for 2nd sensor

     Sample (2,Temp(),Ieee4)     'temperature, one per sensor
     Sample (2,L(),Ieee4)        'L factor (Vo/Vr * 100), one per
                                  sensor
     Sample (2,P(),IEEE4)        'Standard pressure in psi, one
                                  per sensor
EndTable
```

```
'Main Program

BeginProg

'Set mulitpliers and offsets - from calibration sheet
   Mult(1) = 0.078165              'typical 5 psig sensor
   Mult(2) = 0.1922972             'typical 15 psig sensor
   Offset(1) = 0.022447            'typical 5 psig sensor
   Offset(2) = 0.176678            'typical 15 psig sensor

Scan(500,mSec,1,0)                 'scan once every 500 msec
   ExciteV (Vx1,800,0)             'excite voltage of 800 mV
   Delay (0,25,mSec)
   VoltDiff (V(1),1,mV25,1,false,0,_60Hz,1.0,0) 'Vr 1st sensor,
                                                diff ch 1
   VoltDiff (V(2),1,mV25,2,true,0,_60Hz,1.0,0)  'Vo 1st sensor,
                                                diff ch 2
   VoltDiff (V(3),1,mV25,4,false,0,_60Hz,1.0,0) 'Vr 2nd sensor,
                                                diff ch 4
   VoltDiff (V(4),1,mV25,5,true,0,_60Hz,1.0,0)  'Vo 2nd sensor,
                                                diff ch 5

   Therm107 (Temp(1),1,5,Vx3,0,_60hz,1.0,0)     'Temp Out 1st
                                                sensor, degC
                                                'se ch 5
   Therm107 (Temp(2),1,6,Vx3,0,_60hz,1.0,0)     'Temp Out 2nd
                                                sensor, degC
                                                'se ch 6

   L(1)=100*(V(2)/V(1))                  'L factor for 1st sensor
   L(2)=100*(V(4)/V(3))                  'L factor for 2nd sensor

   ' Apply calibration values, results in psi
   P(1) = Mult(1)*L(1) + Offset(1)
   P(2) = Mult(2)*L(2) + Offset(2)

   CallTable Table1

NextScan
EndProg
```

SAMPLE PROGRAM TWO – ENHANCED CALIBRATION

```
'Program = Sample Enhanced Program for two 9805s
'Sensor 1 is 5 psig, Sensor 2 is 15 psig

'Declare Variables and Units
Public m2(2)     'first calibration multiplier, one per sensor
Public m1(2)     'second calibration multiplier, one per sensor
Public m0(2)     'third calibration multiplier, one per sensor

Public b2(2)     'first calibration offset, one per sensor
Public b1(2)     'second calibration offset, one per sensor
Public b0(2)     'third calibration offset, one per sensor


Public V(4)      'reference voltage, then output voltage for each
                  sensor
                 'For example: V(1)=Vr 1st sensor,
                 '             V(2)=Vo 1st sensor,
                 '             V(3)=Vr 2nd sensor,
                 '             V(4)=Vo 2nd sensor

Public Temp(2)   'temperature, one per sensor
Public L(2)      'L factor (Vo/Vr * 100), one per sensor
Public P(2)      'Enhanced calibrated pressure in psi, one per
                  sensor

Public Batt_volt
Units Batt_Volt=Volts

Dim me
Dim be

'Define Data Tables
DataTable(Table1,True,-1)
       DataInterval(0,500,msec,10)
       Sample(1,Batt_Volt, IEEE4) 'battery voltage
       Sample(4,V(),IEEE4)'excitation voltage, then output voltage,
       each sensor

                 'For example: V(1)=Vr for 1st sensor,
                 '             V(2)=Vo for 1st sensor,
                 '             V(3)=Vr for 2nd sensor,
                 '             V(4)=Vo for 2nd sensor

       Sample (2,Temp(),Ieee4)  'temperature, one per sensor
       Sample (2,L(),Ieee4)     'L factor (Vo/Vr * 100), one per
                                 sensor
       Sample (2,P(),IEEE4)     'Standard pressure in psi, one
                                 per sensor
EndTable
```

```
'Main Program

BeginProg

'Set mulitpliers and offsets - from calibration sheet
'Sensor 1 (typical 5 psig sensor)
       m2(1) = -0.00000042199
       m1(1) = 0.00002049701
       m0(1) = 0.07816585737
       b2(1) = 0.00001242100
       b1(1) = 0.00099866224
       b0(1) = 0.02247116187

'Sensor 2 (typical 15 psig sensor)
       m2(2) = 0.000000133861
       m1(2) = 0.000001790422
       m0(2) = 0.192297242812
       b2(2) = 0.000040080304
       b1(2) = -0.001486634952
       b0(2) = 0.176678958007

Scan(500,mSec,1,0)      'scan once every 500 msec

    ExciteV (Vx1,800,0) 'excite voltage of 800 mV
    Delay (0,25,mSec)
    VoltDiff (V(1),1,mV25,1,false,0,_60Hz,1.0,0)    'Vr 1st sensor,
                                                     diff ch 1
    VoltDiff (V(2),1,mV25,2,true,0,_60Hz,1.0,0)     'Vo 1st sensor,
                                                     diff ch 2
    VoltDiff (V(3),1,mV25,4,false,0,_60Hz,1.0,0)    'Vr 2nd sensor,
                                                     diff ch 4
    VoltDiff (V(4),1,mV25,5,true,0,_60Hz,1.0,0)     'Vo 2nd sensor,
                                                     diff ch 5

    Therm107 (Temp(1),1,5,Vx3,0,_60hz,1.0,0)        'Temp Out 1st
                                                     sensor, degC
                                                    'se ch 5,
    Therm107 (Temp(2),1,6,Vx3,0,_60hz,1.0,0)        'Temp Out 2nd
                                                     sensor, degC
                                                    'se ch 6

    L(1)=100*(V(2)/V(1))                            'L factor for
                                                     1st sensor
    L(2)=100*(V(4)/V(3))                            'L factor for
                                                     2nd sensor
```

```
    ' Apply enhanced calibration values, results in psi
    ' Sensor 1
            me = (m2(1) * Temp(1)^2) + (m1(1) * Temp(1)) + m0(1)
            be = (b2(1) * Temp(1)^2) + (b1(1) * Temp(1)) + b0(1)
            P(1) = me * L(1) + be                'pressure in psi
    ' Sensor 2
            me = (m2(2) * Temp(2)^2) + (m1(2) * Temp(2)) + m0(2)
            be = (b2(2) * Temp(2)^2) + (b1(2) * Temp(2)) + b0(2)
            P(2) = me * L(2) + be                'pressure in psi


    CallTable Table1

NextScan
EndProg
```

Reordering Information

For sales & service offices, please contact:

Instrumentation Northwest, Inc.
www.inwusa.com
800-776-9355

Accessories

PS9805:
Specifically designed to be used with Campbell Scientific measurement and control equipment.
Accessories:

- 6E459 Desiccant Tube Replacement
- 6E517 Strain Relief Kit
- 6E400 M6 Connector
- 6E413 Lightening Protection Module Kit

Also see:
PS9800 - Perfect for all Groundwater Monitoring Applications
PS98i - Perfect for Inline Pipe and RediFlo3 Applications
AquiStar® SDI-12 - Perfect for pressure/temperature applications using SDI-12 protocol

LIMITED WARRANTY/DISCLAIMER - PS9805 SUBMERSIBLE PRESSURE TRANSDUCER

A. Seller warrants that products manufactured by Seller when properly installed, used and maintained **with a properly installed desiccant tube**, shall be free from defects in material and workmanship. Seller's obligation under this warranty shall be limited to replacing or repairing the part or parts or, at Seller's option, the products which prove defective in material or workmanship within ONE (1) year from the date of delivery, provided that Buyer gives Seller prompt notice of any defect or failure and satisfactory proof thereof. Any defective part or parts must be returned to Seller's factory or to an authorized service center for inspection. Buyer will prepay all freight charges to return any products to Seller's factory, or any other repair facility designated by Seller. Seller will deliver replacements for defective products to Buyer (ground freight prepaid) to the destination provided in the original order. Products returned to Seller for which Seller provides replacement under this warranty shall become the property of Seller.

This limited warranty does not apply to lack of performance caused by abrasive materials, corrosion due to aggressive fluids, mishandling or misapplication. Seller's obligations under this warranty shall not apply to any product which (a) is normally consumed in operation, or (b) has a normal life inherently shorter than the warranty period stated herein.

In the event that equipment is altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void. Equipment and accessories not manufactured by the Seller are warranted only to the extent of and by the original manufacturer's warranty.

THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. SELLER'S WARRANTY OBLIGATIONS AND BUYER'S REMEDIES THEREUNDER (EXCEPT AS TO TITLE) ARE SOLELY AND EXCLUSIVELY AS STATED HEREIN. IN NO CASE WILL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES, LABOR PERFORMED IN CONNECTION WITH REMOVAL AND REPLACEMENT OF THE SENSOR SYSTEM, LOSS OF PRODUCTION OR ANY OTHER LOSS INCURRED BECAUSE OF INTERRUPTION OF SERVICE. A NEW WARRANTY PERIOD SHALL NOT BE ESTABLISHED FOR REPAIRED OR REPLACED MATERIAL, PRODUCTS OR SUPPLIES. SUCH ITEMS SHALL REMAIN UNDER WARRANTY ONLY FOR THE REMAINDER OF THE WARRANTY PERIOD ON THE ORIGINAL MATERIALS, PRODUCTS OR SUPPLIES.

B. With respect to products purchased by consumers in the United States for personal use, the implied warranties including but not limited to the warranties of merchantability and fitness for a particular purpose, are limited to twelve (12) months from the date of delivery.

Some states do not allow limitations on the duration of an implied warranty, so the above limitation may not apply to you. Similarly, some states do not allow the exclusion or limitation of consequential damages, so the above limitation or exclusion may not apply to you. This limited warranty gives you specific legal rights; however, you may also have other rights which may vary from state to state.

www.inwusa.com

Please visit INW's Web site to learn more about our products and services.

Printed on recycled paper.

Doc# 9B0004r5 08/2008 P/N 3A342

Instrumentation Northwest, Inc.
8902 122nd Avenue NE
Kirkland, WA 98033
(425) 822-4434 • (425) 822-8384 (fax)
(800) 776-9355 • www.inwusa.com