4-20 mA Pressure Transducer

56410099

This equipment should be installed, maintained, and operated by technically qualified personnel. Any errors or omissions in data, or the interpretation of data, are not the responsibility of Durham Geo Slope Indicator. The information herein is subject to change without notification.

SLOPE INDICATOR
12123 Harbour Reach Drive
Mukilteo, Washington, USA, 98275
Tel: 425-493-6200 Fax: 425-493-6250
E-mail: solutions@slope.com
Website: www.slopeindicator.com

Contents

Introduction

Applications

The titanium pressure transducer is designed for compatibility with industrial data loggers. It is used to monitor water levels and water pressure. Typical applications include:

- Monitoring water levels and pressure in corrosive environments such as salt water and landfills.
- Monitoring dynamic changes at a rate of up to 20 measurements per second.
- Monitoring water levels in pumping tests.

Theory of Operation

The pressure transducer is typically sealed in a borehole or suspended in a well. Signal cable from the transducer is terminated at a readout station, where it can be connected to a data logger or readout device.

Water pressure acts on the diaphragm of the transducer. Semiconductor strain gauges bonded to the inside of the diaphragm sense the pressure and output a signal that is proportional to the pressure on the diaphragm.

The signal is transmitted to the data logger or readout device via a 4-20 mA loop circuit.

Installation

Installation Tips

Here are some installation tips.

Sensor Care

- Handle the pressure transducer with care.

Cable Care

- Handle cable carefully. Don't lay the cable across roads with traffic. Avoid dragging cable over rocks and sharp surfaces. Do not pull hard on the cable, since this may damage the con-ductors. Avoid making small radius bends in the cable for the same reason.
- Mark cables carefully for positive identification later.
- Protect the ends of signal cables so that water cannot enter the cable jacket. Cables should be terminated above ground level at a waterproof box or with waterproof connectors.

Installation in a Monitoring Well

4-20 mA pressure transducers can be installed in wells to monitor water levels and are immune to noise from operating pumps. Keep in mind that the pressure transducer is a sealed unit and is sensitive to any pressure on its diaphragm. Thus, when installed in a well that is open to atmosphere, the pressure transducer reading is affected by changes in atmospheric pressure as well as changes in water level.

For long-term accuracy better than ±150 mm (±6”) head of water is required, atmospheric pressure must be monitored and the reading must be adjusted for changes in atmospheric pressure.

Atmospheric pressure should be monitored by an on-site recording barometer or by a second pressure transducer that is dedicated to monitoring atmospheric pressure.

Installation

1. Lower the pressure transducer into the well and position it at the specified depth or just below the maximum expected drawdown. If turbulence is expected, use a centralizer to keep the pressure transducer stable.
2. Secure the signal cable above ground level.
3. If exact positioning is required, or if the transducer is removed from the well from time to time, it is suggested that the transducer be affixed to a small-diameter PVC pipe to ensure that the transducer is placed at the desired elevation.

Data Logging

Introduction

The 4-20mA pressure transducer is designed to be read with most data loggers. In this section we provide instructions for connecting and reading with a Campbell Scientific CR800, CR1000 or CR6.

Connecting to a CSI Data Logger

For best accuracy, differential measurements are advised for the 4-20 mA pressure transducers. With such, a maximum of two transducers with thermistors or three transducers without thermistors can be connected directly to the CR800. Five transducers with thermistors or eight without thermistors can be connected directly to the CR1000 or CR6. Up to 16 can be connected when using a 16/32 channel multiplexer.

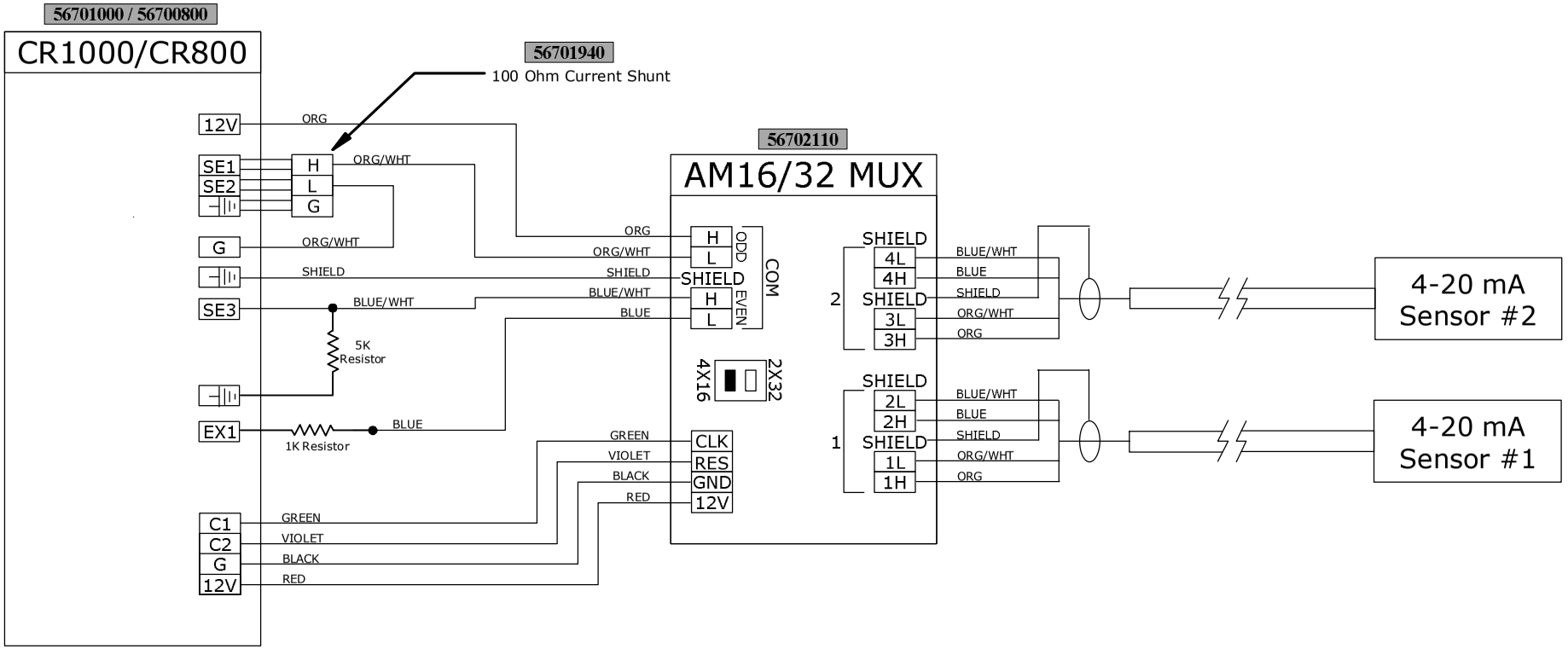
The Campbell Scientific data logger measures voltage, therefore, the current signal must be converted to a voltage before the data logger can measure the transducer.

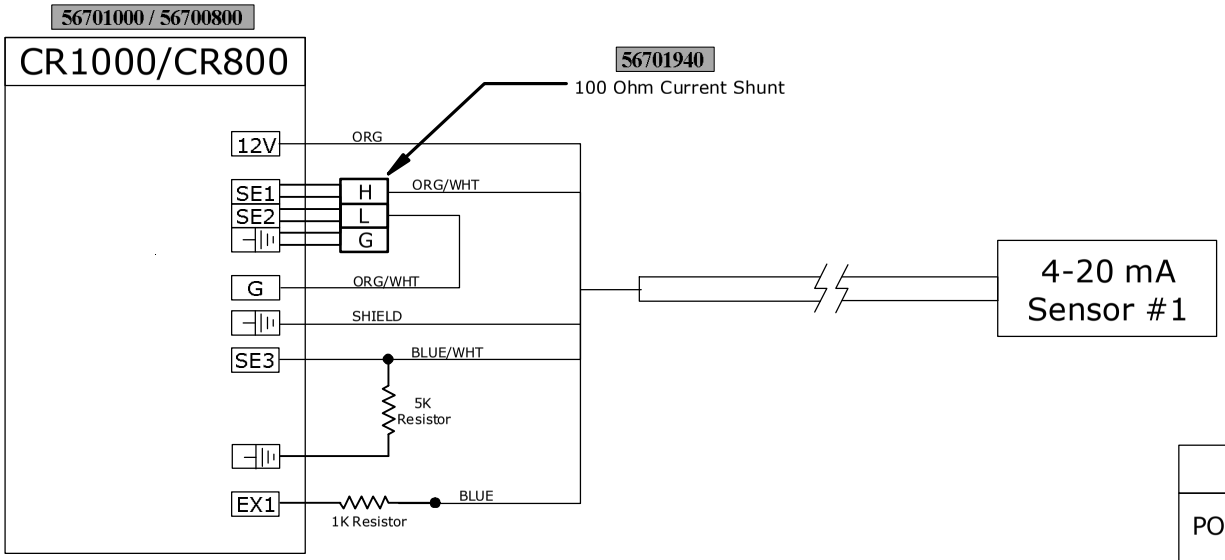
Ohm's Law states V = I x R, which allows the current signal (I) to be measured as a voltage (V), using a completion resistor (R).

When using the CSI loggers to measure a 4-20 mA sensor, Campbell Scientific recommends using the CURS100 Current Shunt Terminal Input Module (part no. 56701940).

Caution

When connecting wires from the pressure transducer into the data logger, the power on the logger must be turned off. One of the wires is connected directly to the 12V power supply. If that wire touches one of the analog channels without the current shunt, it will short out the data logger and void the warranty of the data logger.





WIRE COLORS		
POSITIVE VOLTAGE	RED	ORANGE
4-20mA OUTPUT	BLACK	ORANGE/WHITE
THERMISTOR	GREEN	BLUE
THERMISTOR	WHITE	BLUE/WHITE
SHIELD	SHIELD	SHIELD

Data Reduction

Overview

Readings from a 4-20 mA pressure transducer can be displayed in milliamps (mA) or % of full scale range (%FS). This section will tell you how to convert mA or %FS to psi.

Sensor Calibration Record

Each 4-20 mA pressure transducer has a unique calibration. Use the sensor serial number to match the sensor with its calibration record.

Actual Pressure: Applied pressure during calibration.

Equivalent %FS: Calculated on full scale range of 16mA.

Output Current: Actual output of transducer in mA.

Calculated Pressure: Pressure calculated from output current. Based on least squares fit linear regression analysis.

Linearity Error: %FS error of actual and calculated %FS reading.

Conversion Factors

The conversion factors, psi_per_milliamp and milliamp_offset, are unique to each pressure transducer. Use the sensor serial number to identify the correct calibration record to use.

Milliamps and %Full-Scale

Readings from a 4-20mA pressure transducer can be displayed in milliamps (mA) or as a percent of the full scale range (% FS). The relationship between mA and %FS is:

%FS = ((mA - 4) / 16) x 100
mA = ((%FS / 100) x 16) + 4

Converting mA Readings to Units of Pressure

1. Use the factors, milliamp_offset and psi_per_milliamp, on the sensor calibration record to convert milliamps to psi.

Pressure = (current reading - milliamp_offset) x psi_per_milliamps

Converting %FS Readings to Units of Pressure

1. Convert psi_per_milliamps, and milliamp_offset to equivalent %FS values.

%FS_offset = ((milliamp_offset-4.00)/16) x 100

psi_per_%FS = (psi_per_milliamp x 16) / 100

2. Apply the %FS_offset and psi_per_%FS to reading to convert to psi.

Pressure = (%FS - %FS_offset) x psi_per_%FS