

BRIDGE SENSOR APPLICATION ADAPTOR FOR EMANT300, EMANT380

The Bridge Sensor Application Adaptor is used to connect bridge sensors like strain gauge, force sensor, pressure sensor, load cells in PC or Smartphone based Data Acquisition Systems. Used with the **EMANT300** USB Data Acquisition Module or the **EMANT380** Bluetooth Data Acquisition Module, they form a very low cost Bridge Sensor Data Logger or Instrument. It is ideal for use in hands-on teaching laboratories or projects involving bridge sensors.



FEATURES

- 3.3 V excitation source (max 250 mA)
- Up to 3 bridge sensor inputs
- Requires external quarter or half bridge completion network

FULL BRIDGE SENSORS

Force sensors, pressure sensors and load cells that have a full bridge configuration and are ratiometric can be connected directly to the bridge sensor application adaptor. You can connect up to 3 full bridge type sensors. For full bridges, no completion resistors are required.

Load Cell Example

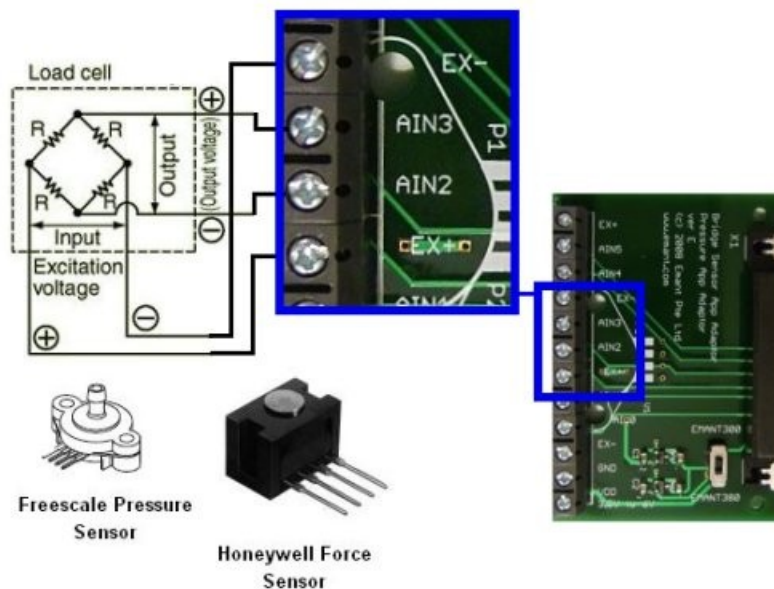


Figure 1: Load Cell connected to EX+, EX-, AIN3 and AIN2

If the load cell has the following specifications:

- Excitation: 10 Vdc (15V max)
- Output: 2 mV/V nominal
- Capacity: 10kg

Using an excitation of 3.3V, the full scale voltage output at 10kg is $3.3 * 2 = 6.6\text{mV}$. The conversion factor is:

$$\text{weight (kg)} = \frac{V_o * 10}{0.0066}$$

C# Program

Below is part of the C# program that reads the voltage output from the load cell and converts the voltage to weight. The variable **zero** is the offset voltage.

```
emant3001.ConfigAnalog(0.05, Emant.Emant300.POLARITY.Bipolar, 10);  
.  
.  
temp = emant3001.ReadAnalog(Emant.Emant300.AIN.AIN3, Emant.Emant300.AIN.AIN2);  
label1.Text = temp.ToString("0.000000 Volt");  
weight = (temp - zero) / 0.0066 * 10;  
label2.Text = weight.ToString("0.0 kg");
```

STRAIN GAUGE



A strain gauge can be used to measure the strain of an object. The most common type of strain gauge consists of a flexible backing which supports a metallic foil pattern etched onto the backing. As the object is deformed, the foil pattern is deformed, causing its electrical resistance to change. The gauge factor of a strain gauge relates strain to change in electrical resistance. The gauge factor G_F is defined by the formula

$$G_F = \frac{\Delta R / R_G}{\epsilon}$$

where R_G is the resistance of the undeformed gauge, ΔR is the change in resistance caused by strain, and ϵ is strain. ΔR is typically in the region of 0.1%. To measure such small resistance changes, a Wheatstone bridge is employed. 3 configurations are used - quarter bridge, half bridge or full bridge. External resistors are required to form the bridge in the quarter bridge and half bridge.

Quarter Bridge Strain Gauge Example

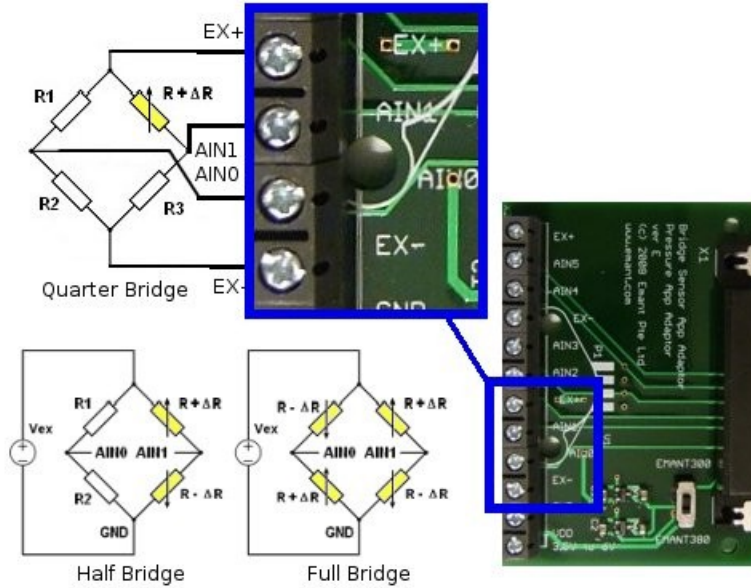


Fig 2: Connecting the strain gauge and external bridge completion resistors

We will use one strain gauge with $G_F=2$, $R_G = 120$ ohms and connected in a quarter bridge configuration. The bridge is excited at $V_{EXC}=3.3V$.

The voltage output of the wheatstone bridge V_o (seen at the differential input AIN0, AIN1) is given by

$$V_o = V_{EXC} \left[\frac{R_2}{R_G + R_2} - \frac{R_4}{R_3 + R_4} \right]$$

$$V_o = -V_{EXC} \left[\frac{R_G R_4 - R_2 R_3}{(R_G + R_2)(R_3 + R_4)} \right]$$

If the bridge is balanced $V_o = 0$ since all the resistances are equal. When a strain is applied, R_G becomes $R + \Delta R$ and substituting R to all the other resistances, the equation becomes

$$\Delta V_o = -V_{EXC} \left[\frac{\Delta R}{4R + 2\Delta R} \right]$$

If we assume $2 \Delta R \ll 4R$

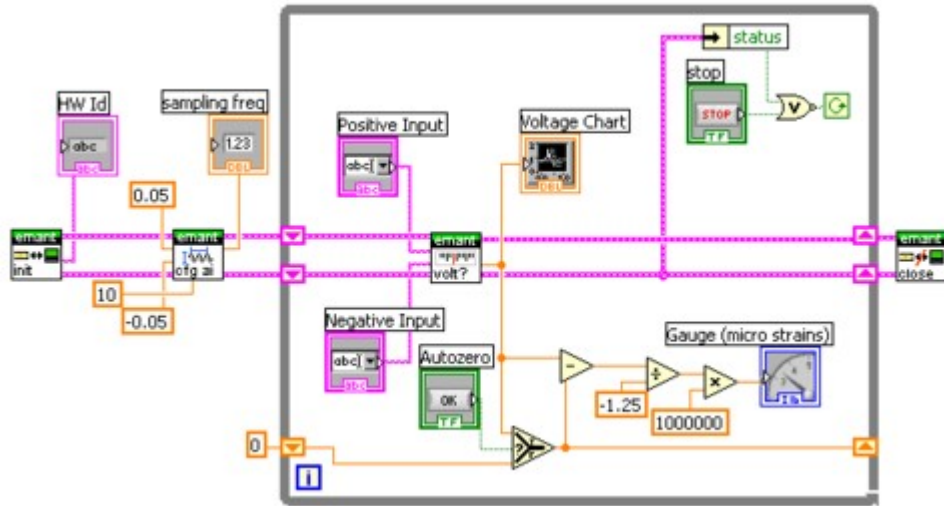
$$\Delta V_o = -V_{EXC} \left[\frac{\varepsilon G_F}{4} \right]$$

Finally substituting $V_{EXC}=3.3V$, $G_F=2$, we obtain

$$\varepsilon = \frac{-\Delta V_o}{1.66}$$

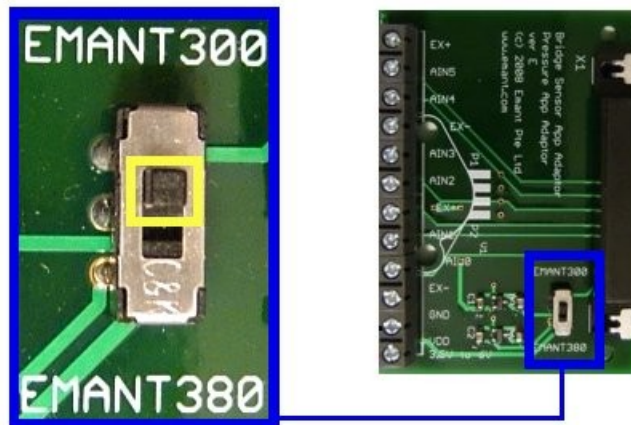
LabVIEW Block Diagram

The following LabVIEW VI that reads the voltage across the bridge and converts the voltage to μ strain. We use software zeroing of the offset.



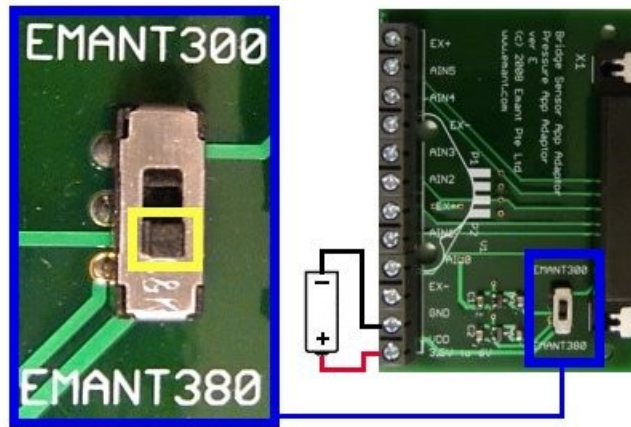
Switch setting

EMANT300 USB DAQ



1. Push switch towards the word **EMANT300**
2. Connect the adaptor to the EMANT300 USB DAQ module
3. Plug USB cable from USB DAQ to PC

EMANT380 Bluetooth DAQ



1. Push switch towards the word **EMANT380**
2. Connect the adaptor to the EMANT380 Bluetooth DAQ module
3. Connect power supply (3.5V to 6V Max)

Schematic

