STRAIN APPLICATION ADAPTOR FOR EMANT300

The Strain Application Adaptor is used for the teaching or demonstrating of PC Based Data Acquisition. Used with the **EMANT300** Low Cost USB Data Acquisition Module, they form a very low cost PC based Strain Data Logger. It is ideal for use in hands-on teaching laboratories and projects involving strain measurements.

FEATURES

- 2.5 V excitation source.
- Up to 6 inputs
- Accepts quarter, half or full bridge configurations

When an object is stretched due to an external force and the length of the object increases from L to L+ΔL, the ratio ΔL/L is called strain.

$$\varepsilon = \Delta L/L$$

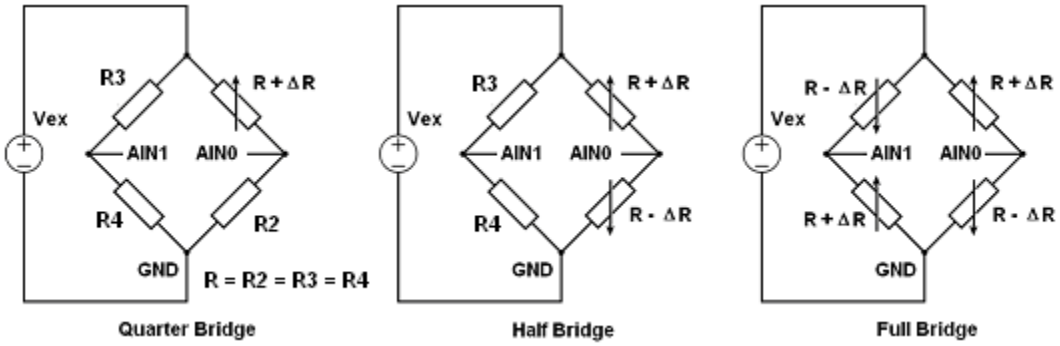
As the ratio of deformation is often very small, it is often represented in a units of 10^{-6} or μstrain

A strain gauge can be used to measure the strain of this 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. This resistance change, usually measured using a Wheatstone bridge circuit, can be used to calculate the exact amount of deformation.

The gauge factor of a strain gauge relates strain to change in electrical resistance. The gauge factor G_F is defined by the formula

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

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. There are 3 configurations are used - quarter bridge, half bridge or full bridge. The strain adaptor allows for all these three configurations by plugging in the respective bridge completion resistors and then wiring up the strain gauges via the screw terminals. Excitation voltage of 2.5V is provided. Up to six input channels are available.



Typical Application: Quarter Bridge Strain Measurement

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}=2.5V.

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 + ΔR and substituting R to all the other resistances, the equation becomes

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

If we assume 2 ΔR << 4R

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

Finally substituting V_{EXC}=2.5V, G_F=2, we obtain

$$\varepsilon = \frac{-\Delta V_O}{1.25}$$

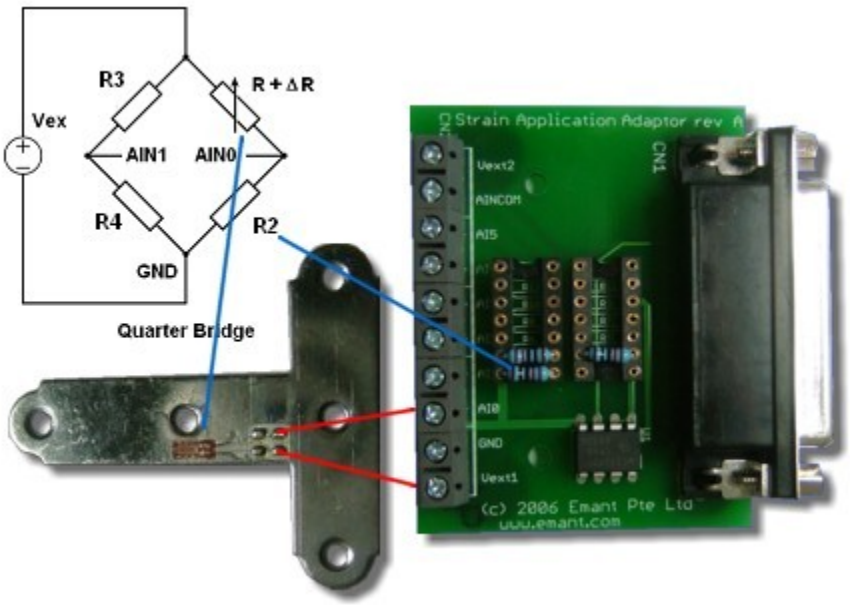
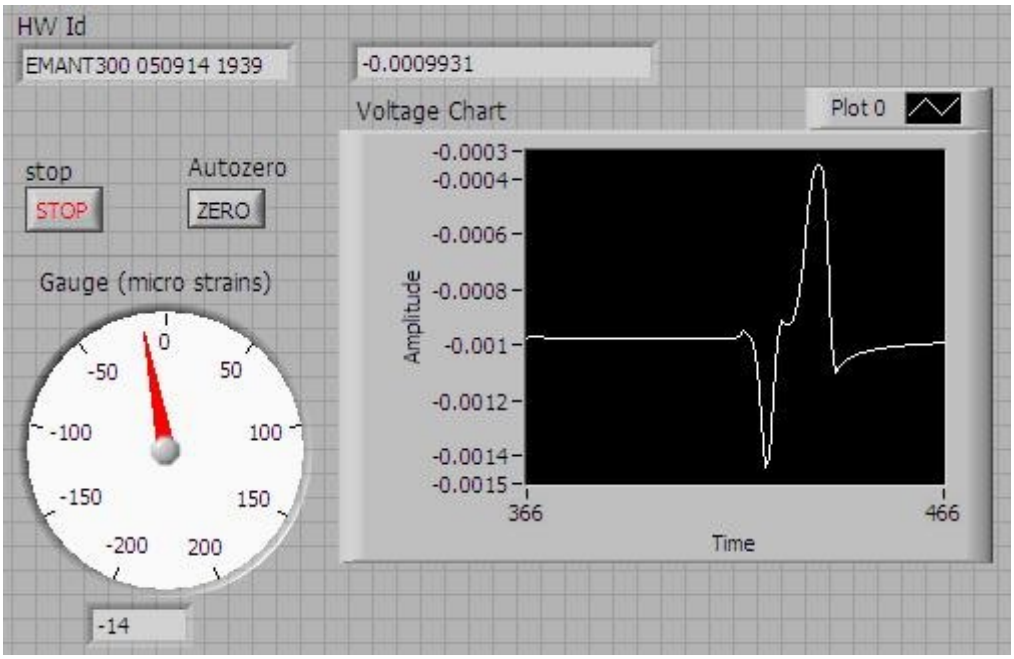


Fig 3: Connecting the strain gauge and bridge completion resistors

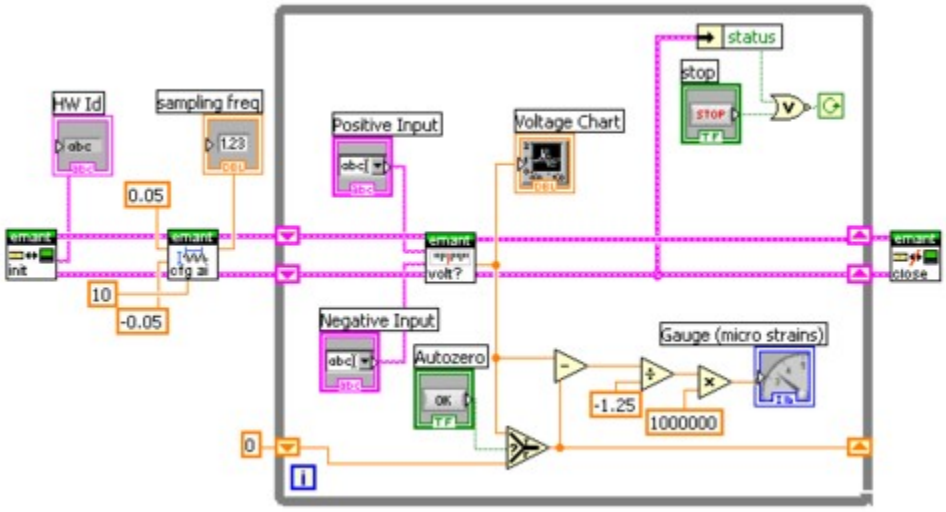
LabVIEW Program

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

Front Panel



Block Diagram



LabVIEW is a trademark of National Instruments

C# Program

Below is part of the C# program that reads the voltage across the bridge and converts the voltage to μstrain. We use software zeroing of the offset.

```
emant3001.ConfigAnalog(0.05,Emant.Emant300.POLARITY.Bipolar, 10);

temp = emant3001.ReadAnalog(Emant.Emant300.AIN.AIN0,Emant.Emant300.AIN.AIN1);
label1.Text = temp.ToString("0.000000 Volt");
analogMeter1.Value = (temp - zero) /-1.25 * 1000000;
label2.Text = analogMeter1.Value.ToString("0 ustrain");
```

Optional Accessories

1) Gaged Bracket

Together with the strain application adaptor and EMANT300 it forms a strain training kit. A 120 ohm strain gage is mounted on the bracket.

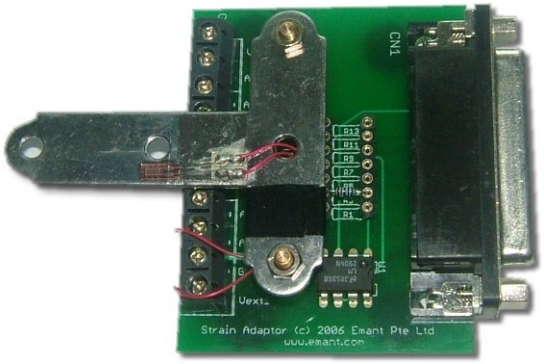
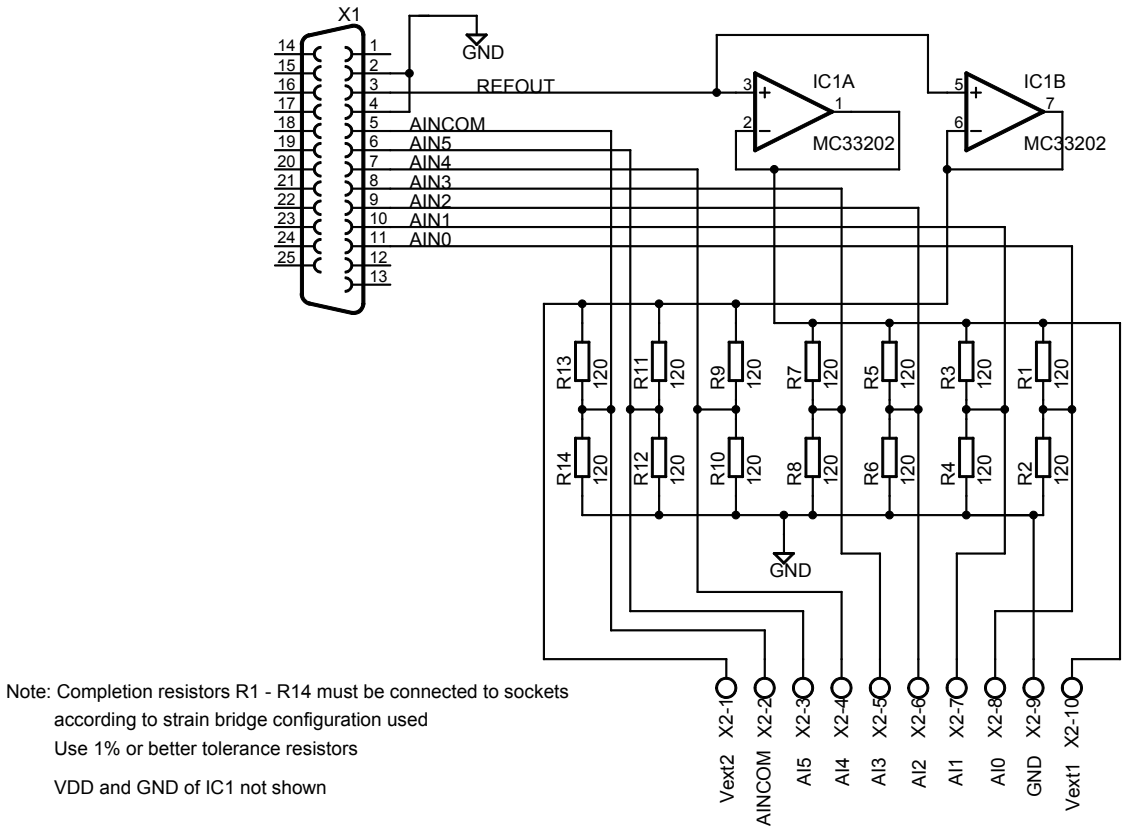


Fig 4: Optional gaged bracket with strain application adaptor

2) Strain Gage

Manufacturer **Kyowa**
Type **KFG-2-120-C1-11**
Temperature compensated for **Steel**
Gage length **2mm**
Gage resistance (24ºC, 50%RH) **119.8 +/- 0.2 ohms**
Gage Factor (24ºC, 50%RH) **2.11 +/- 1.0%**



Note: Completion resistors R1 - R14 must be connected to sockets according to strain bridge configuration used

Use 1% or better tolerance resistors

VDD and GND of IC1 not shown

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