USC701 Measurements with Load-Cell/Strain-Gauge

Introduction

As the USC701 is truly a universal signal conditioner problems with setting up some sensors may occur due to assumptions made by the engineer at the time of user calibration.

This article is intended to show the potential problems and the methods to overcome them.

Basic Information to Consider

What is a Tare Adjustment

Tare adjustment is the cancelling out of the load effect of the material holding container or vessel. An example would be the common metal tray used in grocery shopping, its influence (weight) is removed before the weight of the groceries is taken.

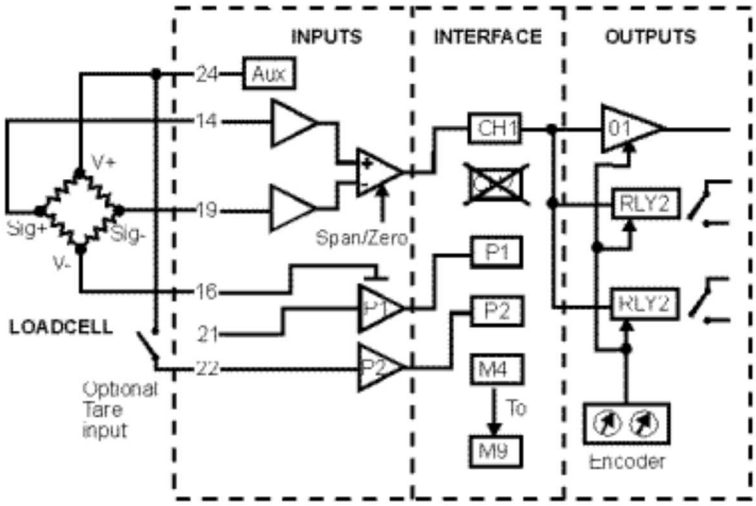

Figure 1 Block Diagram of a USC configured as a Load-Cell transmitter with Alarm

Determining Output from A Load Cell

Range = $\frac{Actual\_Load}{Capacity}$ x Sensitivity x Excitation

Load cell of 1000-kg capacity, with 2mV/V sensitivity. Set up using 8Vdc excitation.
Then if the "actual load" is 500 kg max.

Then Range = $\frac{500.kg}{1000.kg}$ x 2mV/V x 8V = 8mV.

If 1000 kg load cell has a 200 kg tare (tare = empty tank for example), with a 800 kg live load, then tare off the 200 kg and Range = $\frac{800.kg}{1000.kg}$ x 2mV/V x 8 = 12.8mV.

Common Mode Input Range of a USC

When measuring a strain gauge the difference in voltage is measured across the input terminals (Sig+ Sig-), and the common voltage (measured between GND and Sig+) is rejected. As the maximum common mode voltage is 4.5Vdc the maximum excitation for the load cell on a USC is 8Vdc.

Maximum Output Current from a USC Axillary Supply (pin 24)

The excitation voltage can support a 50mA load. Therefore;

- With one or two 350 ohm load cells in parallel the excitation voltage can be up to 8Vdc.
- With three 350 ohm load cells in parallel, the excitation voltage must be less than or equal to 5Vdc.

Accuracy in setting the USC Axillary Supply Voltage (pin 24)

While the axillary supply voltage is stable and will not drift the voltage will not be exactly what you have programmed. If setting it to 8Vdc the actual level could be 7.99 or 8.1 Dc. This is because an 8 bit DAC sets the level. This variation in output will affect the mV out of the load-cell bridge. In most cases this will not be a problem as the overall system is calibrated with test weights. One method of compensating for this problem is to measure the voltage coming out of the auxiliary after it is programmed and use the measured value in your calculations.

The USC Encoder Offset and Span Controls

The zero and span of the analogue out O1 and the trip points of the relays RLY1, RLY2 are set independently using the encoder controls on the top of the USC. If the USC is programmed as a strain gauge transmitter without using RLY1, RLY2 or the field bus the adjusting the zero and span on the analogue output will provide suitable final calibration and tare removal.

Operation/Calibration Methods

USC, Load-Cell with a Tare Input Example

1. After switch on the weighing system will settle to the no load condition. The output of the load-cell will represent the weight of the measuring system.
2. The operator or some part of the automatic system will set the tare input. The USC will remember the tare weight and set the output of CH1 to 0 Kg.
3. The load is applied to the measuring system. The USC will output the weight of the load with the tare value removed on CH1 in Kg's.

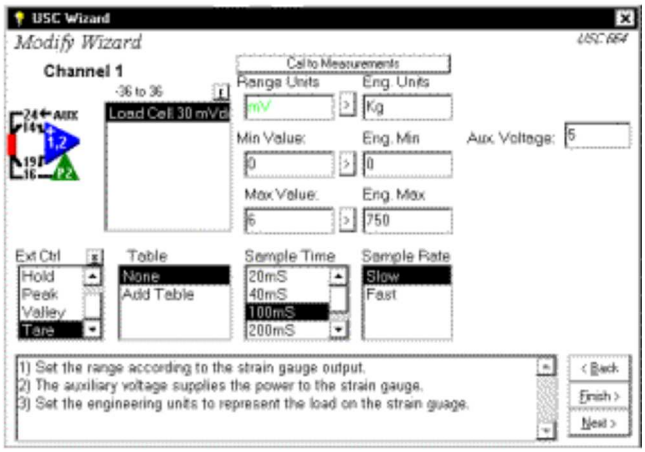

Figure 2 USC Wizard, Load-Call with Tare Input

USC, Load-Cell without Using a Tare Input

The measurement system will work in a similar way as above except that the tare value is subtracted during system calibration.

Typical Calibration Procedure

1. The range parameters of the load-call are determined from the mV/V and maximum loading of the load-cell, see "Determining Output from A Load Cell".
   In figure 2 initial values were entered that I determined for a 1.375mV/V, 750Kg load cell (5 x 2.2mV = 11mV).
2. Program the USC with the initial range settings (I will use 6mV instead of 11 to demonstrate calibration program).
3. Switch on the weighing system with no load or a known low load value "Input Eng.Min" (normally 0). After the output settles record the reading displayed from the USC "Disp.Min".
4. Apply a known load to the measuring system "Input Eng.Max". After the output settles record the reading displayed from the USC "Disp.Max"

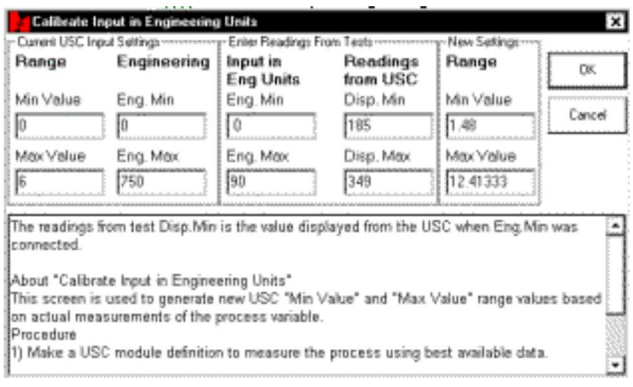

Figure 3 USC Modify Wizard with "Calibrate Input in Engineering Units"

5. Renter the modify wizard for the input to be updated.

6. Press the "Cal to Measurements" command and enter the "Input Eng.Min", "Disp.Min", "Input Eng.Max", and "Disp.Max" values that were recorded from steps 3 and 4.
7. The new range settings for "Min Value" and "Max Value" will be calculated and displayed on the right side of the screen. Press "Ok" to accept the values.
8. Reprogram the USC and redo steps 3 and 4 to verify correct operation.

USC Programs

File	Comment
Help	If unexpected results occur when loading the .usc file press back and click on help for instructions.
UAP00161.usc	Convert to USC config 105 standard.

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