

Aquarius Technical Bulletin - No. 22

Effect of Ground Loops on DDC Interfacing.

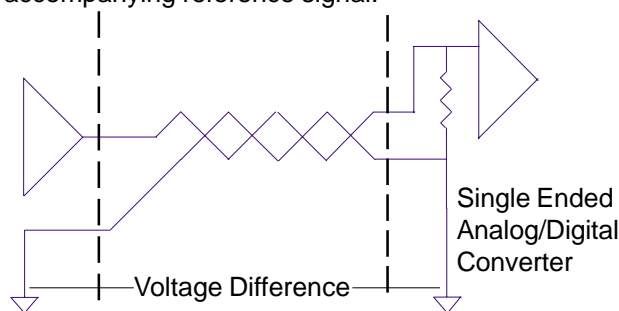
The ability to continuously monitor Water Treatment systems via DDC data acquisition is becoming more and more prevalent both on a legal standpoint and as a means of maximizing the water treatment performance. To the unwary, this can create a great deal of heartache to all concerned in the installation and servicing of the equipment.

Aquarius **Technical Bulletin No. 21** discussed the requirement to provide input isolation for various Water Treatment sensors and output isolation of the monitored signals going to the Data Acquisition systems in order to negate the effects of any possible Ground Loops in the sensing and control circuitry. Unfortunately, if Ground Loops are present, they can also have a dramatic effect on the input section of the Data Acquisition system at the DDC.

This Technical Bulletin looks at recent experiences encountered with Ground Loops on Data Acquisition systems and details the requirements, which should provide trouble free installation and operation.

At the heart of a Data Acquisition system lies an analog to digital converter which is fed by a multiplexer of some description which directs the various number of different input channels.

Depending on the type of system, the input channels can be either single ended; that is, the input signal is compared to the ground of the instrument, or have differential inputs where the each input is compared with its' accompanying reference signal.



4 - 20 mA.
Driver

Figure 1

Single Ended Inputs.

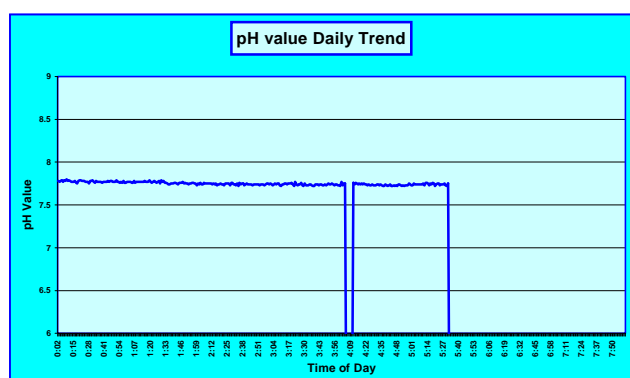
Figure 1 shows a typical interconnection using a single ended input. Particularly, note the problems that can arise if the two ends of the interconnection are at different potential. Also note that in most situations, the operation of the driving equipment will not be known by the manufacturer of the Data Acquisition equipment. Conversely, the operation of the Data Acquisition equipment will not be known by the manufacturer of the driving equipment.

To make matters worse, it is highly probable that the person responsible for installation will not have access to the technical specifications of either equipment. Thus, it becomes a matter of 'hope and pray' when interfacing the systems.

Figure 2 graphically illustrates the dilemma faced with such a configuration. This data was derived from a recent real life scenario and shows three key concerns. Firstly, the Data Acquisition results start off being as expected and so it could be assumed that the interface is functioning correctly. This in fact could have been the case for many days and indeed weeks.

The second concern is the small glitch which momentarily appeared and, for whatever reason, recovered by itself. The final and most alarming concern is the continual erroneous readings which soon appear.

Figure 2



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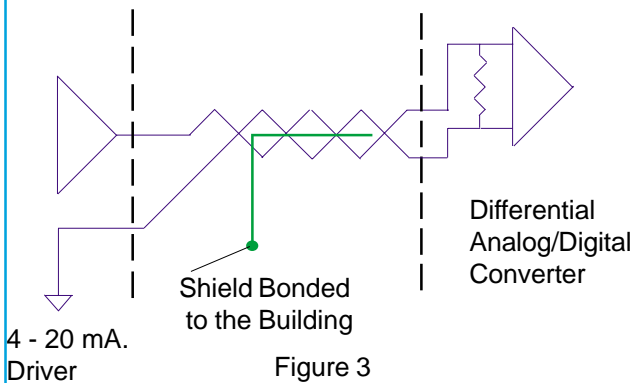
Differential Inputs.

What caused both the momentary glitch and then the fatal loss of usable data? Most probably it was caused by some electromagnetic interference (EMI) or Radio Frequency Interference (RFI).

Variable Speed drives on condenser pumps are notorious for producing such interference, but are not the only culprits.

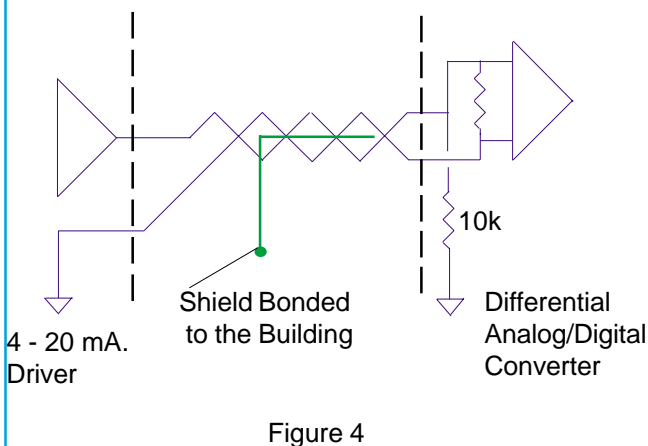
All of these potential problems can be overcome by utilizing differential inputs as shown in Figure 3. This provides the Signal Low signal to float above or below Ground potential; however, this independence is limited to the Common Mode Range of the input stage which is generally related to the power supply voltage of the input stage.

To overcome the possibility of floating the input above the Common Mode Range, a 10,000 ohm resistor between Signal Low and Analog Ground can be fitted. This provides a reference for the Analog to Digital converter without affecting the input stage.



There are many many instances where simple single ended inputs will work. However, it has to be argued that it is better to configure all installations in such a way as not to be affected by some invisible and yet powerful interference problem, which can greatly extend the installation time, and create hours of unnecessary communications between the parties involved.

This is illustrated in Figure 4 which is the configuration recommended by Aquarius Technologies Pty Ltd. The proof that this configuration works in all situations can be clearly provided by extending the graphs from Figure 2. to include that data obtained when the system was configured to a differential input.



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