Essential Guide to Setting Up the 3019 and 3020 Controller

There are many variables that must be considered when setting up a 4/20mA control loop. To keep this document to a manageable size and hopefully improve it's readability and usefulness it will be assumed that the controller is connected to a 10PSIG pressure transducer. We will than add a section regarding adding a PLC to the loop.

There are 3 distinct steps that are required to successfully make a controller operational. These steps are: 1) mount all the hardware and electronics; 2) run the wiring; and 3) configure the controller for the installation site.

Step 1) Mount the hardware and electronics

Usually a site schematic has all the details of how and where to mount that particulars of the site. It might be wise to change the electronics mounting site if they are being positioned in a spot where dirt and water might be falling on them, such as beneath the access hatch of a vault, or if their position hampers access to the device. A little forethought before installation helps the electronics maintain robust operation.

Step 2) run the wiring

Again, the site schematic should call out the details of the wiring. Here are some general rules.

If wiring is run through a conduit the conduit should never open pointing to the sky, it should always open pointing down. This is particularly important if the conduit is outside. Many site problems are due to water collecting in the conduit.

Wiring that is exposed to the elements should incorporate a drip loop as it goes through a bulkhead or wall or enters a conduit. Water will flow along a wire, being pulled by gravity. If water flows down a wire and hits a bulkhead, it will flow through the bulkhead. Even if ample gasket material is put around the wire, capillary action will still suck water through that joint. Hang a drip loop in the wire run. Gravity will pull the water away from the joint to the bottom of the loop where it will drip harmlessly away.

Motors and other controlled devices should be wired to the pole and normally open contact of the relay output. This ensures that if the controller fails the contact opens and powers down the controlled device.

Alarms and other problem indicating devices should be wired to the pole and normally closed contact of the relay output. This ensures that if the controller fails the contact closes and activates the problem indicating device.

Carefully run the 4/20mA signal wiring. Common site problems are due to improper 4/20mA signal wiring. Every device on the loop is wired so that the positive terminal runs towards the positive side of the loop supply, even if it has to pass though other devices to get there. The same applies for the negative terminal of the device. If there

are multiple devices on the loop, one might also have to consider the burden these devices put on the loop. The 3019 and 3020 manuals have crude "typical" wiring schematics to use as a guide.

Each device will have some listed power requirement or loop burden. For instance, a transducer might require a minimum of 14V, a loop powered display 5V, a signal isolator 7V, and the controller might have a 20 Ohm input. Using Ohm's law, that 20 Ohm input becomes 0.02A * 20 Ohms = 0.4V. Now total the requirements for all the devices in the loop, and 14 + 5 + 7 + 0.4 = 26.4V. A loop that requires 26.4V to operate but is powered by a 24V supply will not operate properly.

Programmable Logic Controllers (PLCs), auto dialers, and other devices are frequently added to loops to provide additional functionality. Adding these to the loop must be done with due consideration. Sometimes these devices provide a loop supply, and frequently they do not have isolated inputs. These devices should be added as a loop device, do not use the internal power supply. Also look carefully at the loop to ensure that there is only ONE point where the loop is electrically connected to earth ground. If there are more than one point connected to earth ground current from the loop can flow through that connection and make the loop malfunction. One possible solution is a signal isolator. Feel free to contact Devar, we have a variety of signal isolators that can solve your problem.

The Devar submersible pressure transducers have a red wire, a black wire, and a green / sheath wire. The red wire goes to the +24V supply, the black wire to the (+)mA IN, jumper the +24V return to the (–)mA IN, jumper the (+)VIN to the (+)mA IN, and the sheath wire should be earthed. The sheath is electrically isolated from the loop signal wires. If you are using a pressure transducer, look at the model number on the side of the transducer or the purchase order to find pressure range of the transducer. This will be come very important later. A common pressure range is 10 pounds.

Step 3) configure the controller for the installation site

Being able to configure the 3019 or 3020 depends on understanding the actions of the front panel buttons. These buttons are NEXT, ENTER, UP, and DOWN. The NEXT and ENTER buttons are used to navigate through the various settings, while all the buttons are used while editing a setting. A diagram of the settings is on the last page of this document.

While navigating, NEXT brings up the next option, and ENTER acts on the displayed setting. If you are looking at the flow chart for the configuration menu on the last page of this document, NEXT moves down while ENTER moves right or edits that setting.

While editing, NEXT will change which character is active (flashing), the UP and DOWN will change the value of the active (flashing) character, and ENTER will accept the value currently displayed as the entry.

The 3019 and 3020 have a few things that must be set for either of them to operate properly. The first task is to set the scaling, the second task is to set the control points, and the third task is to set the operational features. It doesn't matter which order the tasks are completed.

Set the Scaling

Setting the scaling means that you will set (program) the values that the 3019 or 3020 will use to indicate what the transducer is measuring. This is done utilizing the pushbuttons as described above. These are six settings and for the 10PSI pressure transducer set them as:

1) select input type	4/20mA
2) setup display-> set dP	012.345
3) setup display-> pick label	FT
4) setup display-> input-output curve	LINEAR INPUT
5) setup display-> define max range	023.1
6) setup display-> define min range	000.0
7) adjust offset	000.0

The adjust offset setting will have to be set to the particular value required for your installation. This setting is used to adjust the value on the display for where the transducer is relative to the bottom of the tank. Example: the transducer is in a cage that holds it 1 foot off the floor so the adjust offset value should be set to 001.0.

Set the control points

Each control channel will have its own entry in the menu. On a 3019 it will say ALARMx and on a 3020 it will say either ALARMx or PUMP x. The "x" is the channel number. The TRIP and RESET points are where that channel turns on and off. The LATCH should be set to DO NOT LATCH, the FAILSAFE should be set to FAIL RESET for a pump, or FAIL TRIPPED for an alarm. For the 3020 additionally set TRIP DELAY to 000, RESET DELAY to 000, ALTERNATE to DON'T TOGGLE, and ALARM or PUMP to either PUMP or ALARM, whatever that channel is doing.

What about Alternation?

Alternation is only available on the 3020. Activate alternation after you know that the system is operating. Pick the channels that you want to toggle. Change the ALTERNATION setting on these channels to TOGGLE. The TRIP points for these channels must be different. If you set the TRIP points to the same value, then these

pumps will activate simultaneously. Set the other pumps to slightly different values beyond the trip point so if any one pump fails, the other pump(s) will be called. For instance if the TRIP point has been reached and the pump being called isn't functioning, the level will continue to change until it reaches the next TRIP point and the next pump is called. The RESET points can be set to the same value or staggered, as desired.

Set the operational features

SENSOR FAILURE

The SENSOR FAILURE feature is either enabled or disabled. This uses a simple expectation to detect when a transducer fails, which is that when a transducer fails it usually outputs a high or a low current. The sensor failure is detected by setting two points, and should the signal go outside these points, the controller knows the sensor has failed. A good rule of thumb is to set the sensor failure limits 5% of the span outside the display points at 4mA and 20mA.

That isn't as hard to do as it sounds.

The span is 23.1 for a 10PSI transducer, 10% of that is 2.3, and half of that is about 1. With the offset set to 1.0 the controller will display 0.0 + 1.0 = 1.0ft at 4mA input and 23.1 + 1.0 = 24.1 at 20mA. Set limit 1 to 1.0 – 1.0 = 0.0 and limit 2 to 24.1 + 1.0 = 25.1.

When the input goes outside of the set limits the relays will be set to the states set in the SENSOR FAILURE menu. The user can pick whether the relay goes to the TRIPPED or RESET state. Typically a pump would be set to RESET, an alarm to TRIPPED.

Analog Retransmission

An optional retransmission is available for the 3019 and 3020. If a -420 is included in the model number, that unit has retransmission. The retransmission is not a blind echo of the input. The retransmission is controlled by two settings in the menu. The setting at ANALOG REXMIT -> dISPLAY @MIN OUTPUT sets the display value at which 4mA is generated, and the setting at ANALOG REXMIT -> dISPLAY @MAX OUTPUT sets the display value at which 20mA is generated. The unit uses these twoo settings and the value on the display to determine the output.

Adding a PLC to the loop

Devar does not build, sell, or support PLCs, so we only offer general advice for them. The problems with adding a PLC is that the connections need to be added to the proper terminals, in the proper polarity. One needs to determine if the PLC is grounding the loop and if that is causing a problem. Scale the PLC so that it agrees with the scaling of the loop applied to it, whether that loop is the transducer or the analog retransmission.

The PLC often has an internal power supply for the milliamp loop, it should have terminals for attaching a loop that is externally powered. Use the PLC externally powered loop terminals in this example. The mA input terminal on the PLC should go towards the + supply on the loop, the COM terminal should go towards the – supply on the loop. If you connect the loop to the PLC and power the loop up, measure the voltage on the terminals of the PLC, the + voltage should be on the mA IN terminal. Of course, please, please, please refer to the PLC documentation, or call the manufacturer of the PLC, to get their advice as to how to properly wire their device in a mA loop. If it is determined that an isolator is required, feel free to contact Devar as we sell a variety of high quality loop isolation products.

Adding a PLC to the analog retransmission

Wire OUT_A on the controller to mA IN on the PLC, wire OUT_B on the controller to COM on the PLC. Check the ANALOG REXMIT settings on the controller, set the PLC to these values.

Problems and troubleshooting

The most common problem phone support encounters is setting it up when first installed, or diagnosing problems after a lightening strike or some other type of damaging electrical event. Hopefully this guide, plus the 3020 guides can help set these controllers up rapidly.

Diagnosing the damage caused by an electrical event is a bit of a problem without extra equipment. When an electrical event occurs and the controller is observed operating in an unusual fashion one has to test the controller and the transducer to identify what parts are damaged. The first advice is to simply turn it off, wait a moment and turn it on.

A digital volt meter can be used to verify the operation of the transducer by measuring the voltage required to power it, and the milliamp signal it generates. One can verify the transducer by hauling the transducer out of the water, verifying 4mA on the loop, then putting the transducer back into the water and observing approximately 1mA increase for each 1.5’ lowered.

Troubleshooting the controller can be a bit more of a problem. The way to verify a controller is to observe its operation while a valid 4/20mA signal is being applied, a 4/20mA calibrator being very useful in this. One quick check is to disconnect the transducer. The display should read approximately -5.0. Another quick test would be to hook a DVM into the loop to measure the current. If the measured loop current is between 4mA and 20mA and steady, the controller should be indicating a number between the scaling points. If the controller is displaying some garbage or behaving erratically with a steady input at a valid level, the meter is damaged.

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A simple configuration menu diagram for the 3019 / 3020.
Entries that are marked with a "*" are only available on the 3020.