

Better ways to troubleshoot automation and process control loops

Application Note

Troubleshooting and the need for speed

Instrument and automation technicians are constantly challenged to keep instrumentation loops and I/O working at peak efficiency while using the least possible time to do it.

When Fluke first released the 771 mA Clamp Meter in

2007, technicians found that measuring loop current without breaking the circuit saved a great deal of time. Now, the new 772 and 773 models can save even more time.

By incorporating the functions of a loop calibrator, these more advanced tools allow technicians to troubleshoot on the spot.

Tracing control loop problems

Often the first indication of a control loop problem comes from the operator: "I think we have a bad valve" or "this loop isn't responding the way it used to." In either case, it's the technician's signal to begin troubleshooting.



The first step is to measure the 4-20 mA signal, either by breaking the loop connecting in series with a DMM, or by using a mA clamp meter like the Fluke 771 and verifying the loop current value. If the loop current measured is not as expected, there are three likely causes: broken/disconnected/shorted wires, a bad loop power supply, or faulty instrumentation.

If no problem is found in the wires, use a DMM (or the 773 clamp meter) to check the loop power supply. If the power supply shows no output, use the 24 V loop power function of the meter to substitute for it; if the loop then works properly the source of the problem is obvious.

If the wiring and the power supply both check out, it's time to check the transmitter. If you have a loop calibrator, process calibrator or multi-function clamp-on meter, use its mA simulate mode to substitute for the transmitter. If the loop performs as requested, the problem lies with the transmitter, if not, it is elsewhere.

If a final control element (valve positioner, etc.) is suspected, use the mA source/simulate mode on the Fluke 772/3 to feed a signal into it while watching the local indicator for a response.

Loop malfunctions

If the problem is not a dead loop but an inaccurate one, likely possibilities include a bad I/O card on the PLC or DCS, or a bad final control element (I/P on a valve positioner, etc.). It's usually best to start by doing a field check of the transmitter, local or remote indicator or final control element.

For a final control element, use a clamp-on meter to measure loop current and compare the value to the local position indicator on the valve or other final control element. Relay that information to the operator to verify findings.

In the case of a measurement loop, use the clamp meter to measure loop current, then check with the operator to see how well the value indicated on the control panel agrees with the actual loop current. This will give a quick check on the PLC or DCS I/O card that handles that particular loop. It's also possible to use the meter's mA source/simulate mode to send a known signal to the control room; as before, compare the value as read by the operator to the actual current in the loop.

Some loops show random fluctuations or intermittent faults that tend not to happen while a technician is watching. The solution here is to use a clamp meter with a scaled mA output. In this mode the meter measures the current in the loop without breaking the circuit, and produces an identical and isolated mA output. Feed that output to a DMM with a logging function; by allowing the DMM to record over time, any disturbance will be recorded.

Field checks and plant commissioning

Start by using a clamp-on loop current meter like the Fluke 771 to check each loop for current in a matter of seconds, without disconnecting anything. If a loop is not working, a multifunction clamp meter can also make quick work of diagnostics. If current is not present on some loops go on to classic troubleshooting: check the wiring, the power supply, and the control system's I/O cards (by using the meter to inject a signal into the I/O, then contacting the operator to ask what he sees. If the operator agrees with what is being sent, then there may be something amiss with the transmitter—either the transmitter itself or, if this is a new installation, perhaps miswiring, the sensor's input to the transmitter.

Checking DCS and PLC I/O cards

The mA process clamp meter can be used as an accurate signal source to check the operation of input/output cards on programmable logic controllers (PLCs) and distributed process control systems (DCSs). For 4-20 mA input cards, disconnect the process loop and use the meter's mA source mode to feed in a known signal value (4.0 mA for zero, 12 mA for 50 %—using the meter's 25 % step function, and 20.0 mA for 100 %) and compare it to the value shown on the operator's readout.

Voltage input cards (1 V to 5 V or 0 V to 10 V) are checked in a similar way, using the meter's voltage source function.

Checking a valve positioner

Milliamp clamp meters can be used for periodic in-field checks of electronic valve positioners as part of preventive maintenance programs. Accounting for manufacturer-specific instructions, perform quick operational checks using the Fluke 772/3 as a signal source while observing the valve stem position, mechanical position indicators, or flow indicators as input changes are made.

Mitch Stewart, Field Service Manager, L2 Systems, tells of using the 4-20 sourcing output of a mA process clamp meter to drive a control valve open and closed when the process output from the PLC wasn't working. "We disconnected the PLC's output at the control valve and connected the [meter] up to the control valve and ran it open and closed to verify that the I/P on the valve worked correctly," he explains.

The general method is to set the meter to the 4-20 mA source/simulate mode and connect it to the input terminals of the valve positioner. Set the meter to output 4 mA and wait for the positioner to settle; then vary the current in small

increments between 4.0 mA and ~3.9 mA, while feeling the valve stem with your free hand to check for any sign of movement. Adjust for zero movement between these two current settings by using the zero adjustment on the positioner.

Next increase and decrease current from 4 mA to ~4.1 mA. Insure that the valve stem just begins movement above the ~4.1 mA setting and fully closed at 4 mA.

Span can be checked similarly, by setting the meter at 20 mA, ~19.9 mA and ~20.1 mA, and linearity can be checked by using the meter's 25 % step function.

Checking loop isolators

To check a loop isolator, apply a mA input signal to the device and measure its 4-20 mA output using the clamp-on current measuring function. This two channel simultaneous source/measure function in the 773 can also be used for valves that report their position using 4-20 mA.

Checking VFDs

Variable frequency drives (VFDs) are used to power motors, blowers and fans in process applications as well as conveyor systems and machine tools. Control inputs are generally voltage (1 V to 5 V or 0 V to 10 V) or current (4 mA to 20 mA). A mA process clamp meter can feed in a signal to simulate a normal input while the technician observes the result.

Quick calibration

While not classified as loop calibrators, today's mA process clamp meters boast accuracies of 0.2 %, and can be used for quick calibration checks, while cutting down on the number of instruments needed. For example, checking a process transmitter on the bench normally requires (aside from a pump and separate pressure standard) a loop power supply and an instrument for reading the transmitter's 4-20 mA output. But with today's mA process clamp meters it's possible to

both power the transmitter and read the output. "This tiny little thing," says Paul Jusak, Maintenance Engineer, Puget Sound Energy, "allows you to do that function without having to drag out a separate power supply."

Summary

Today's mA process clamp meters can save instrumentation and automation technicians a great deal of time in trouble shooting, because they can replace a number of separate instruments. The technician no longer has to spend 15 minutes going back to the shop to get an instrument, because the one instrument he takes with him will do all the necessary functions. And, adds Jusak, "instead of having two tools in your pouch you now have one tool in your pouch for doing all 4-20 mA loop calibrations and troubleshooting. That to me is pretty doggone convenient."

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