

# Keysight Technologies

## Process Control Calibration Made Easy with U1401A

Application Note



# Introduction

This application note explains how the Keysight Technologies U1401A with simultaneous source and measure functions eases technicians' calibration tasks in industrial process control applications.

In today's world, the 4–20 mA current loop is a common method of transmitting sensor information to a remote location in industrial process-monitoring applications. Physical parameters such as temperature, pressure, speed, and liquid flow rates in the manufacturing processes are converted into signal current 4–20 mA with a signal conditioner. The 4 mA current normally represents the sensor's zero-level output, while the 20 mA represents the sensor's full-scale output. However, transmitting a signal current over a long distance to another system with a different ground loop may cause serious signal disruption. Loop powered isolators will eliminate the ground loop in the control systems.

Figure 1 shows a chemical water treatment plant block diagram. The system is specifically designed to control introduction of chemicals based on calibrated flow rather than just pump speed. In this system, the flow meter frequency signal conditioner, loop power isolator, and pump signal conditioner need periodic calibration to the signal conditioner in order to provide precise and repeatable chemical addition automatically with the PLC (programmable logic controller). Square pulse, current, and voltage source are required during the system calibrations.

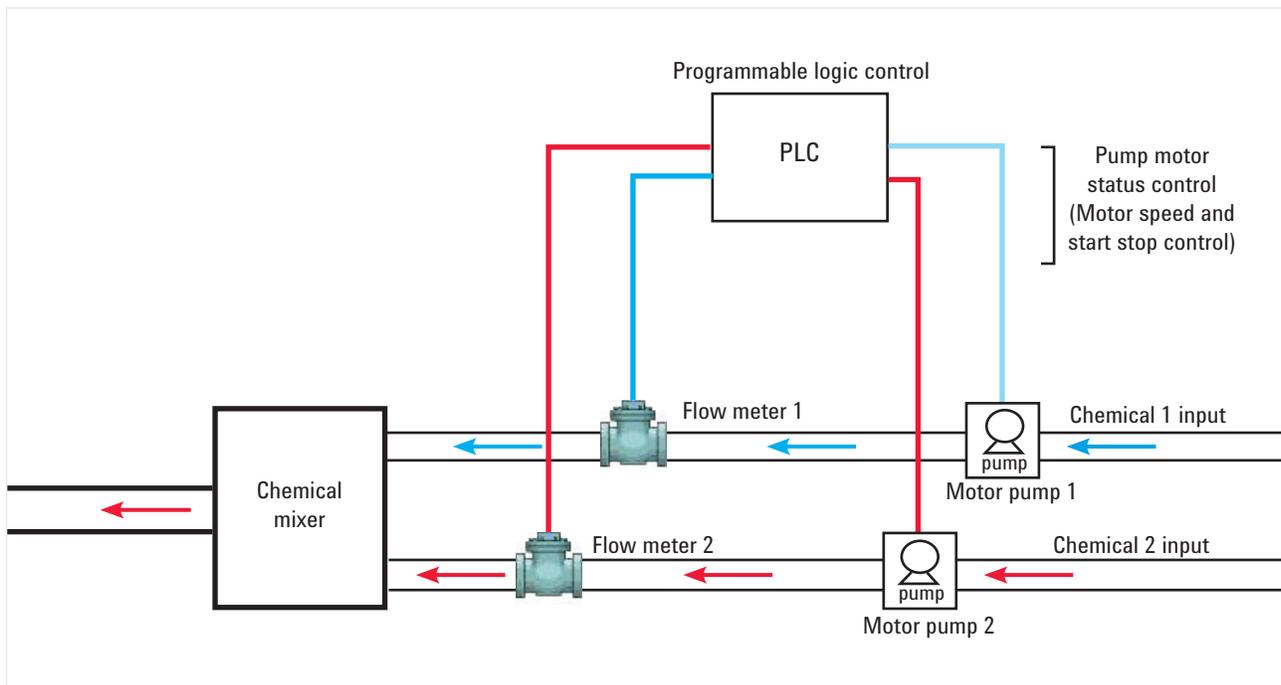


Figure1. Chemical water treatment plant block diagram

## Frequency input signal conditioner calibration (square pulse source)

A turbine flow meter is used to measure the chemical and water flow rate. As fluid flows through the meter, the turbine causes it to rotate at an angular velocity proportional to the flow rate. The pick-up coil senses the spinning motion of the rotor inside the pipe and converts it into a pulsating electrical signal. Thus, a precise square pulse is needed to calibrate the frequency signal conditioner. Thanks to the build-in square pulse generation functionality, no extra tool is required to generate a square wave source.

### Procedures to calibrate the transmitter

1. Disconnect the signal conditioner from the magnetic pickup.
2. Turn the U1401A rotary switch to square wave output mode and mA measure mode. See Figure 2.
3. Connect the signal conditioner's output in series with a DC power supply (according to manufacturer specification) and monitor the U1401A output current.
4. Connect the input of the signal conditioner to a U1401A source terminal for precision square pulse output.
5. The U1401A is now outputting a square pulse, and you can adjust the square wave frequency and amplitude of the square wave according to the manufacturer specification.
6. Set the input frequency to the low end of your range and adjust the zero control for the low-end output current to 4 mA.
7. Increase the input frequency to full scale and adjust the span control for full-scale output (usually 20 mA).

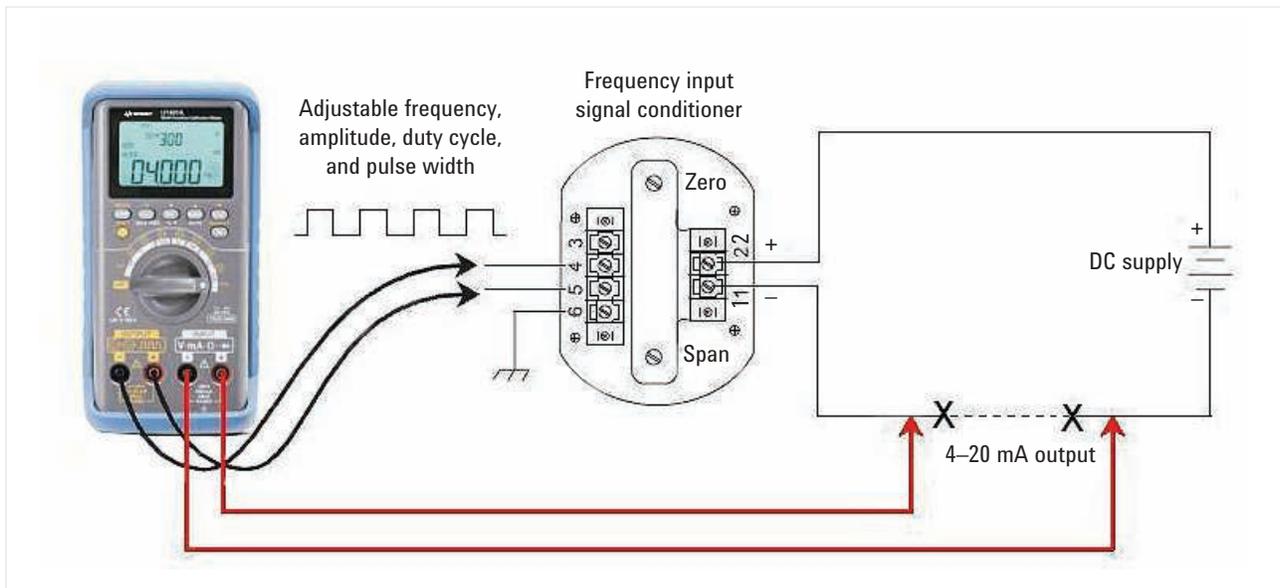


Figure 2. Calibrating turbine flow meter signal conditioner

## Loop powered isolator calibration (current source)

The U1401A's simulation mode allows precise control of current output between 0 mA to 20 mA with an external power supply. This connection can be used for any loop voltage from 12 V to 30 V. This feature is ideal for loop powered isolator calibration.

Note: Always use the yellow test lead for mA simulation mode.

### Procedures to calibrate the transmitter

1. Disconnect the loop powered isolator, and connect the mA output simulation terminal to a DC power supply of 24 V (according to signal conditioner manufacturer specification).
2. Turn the rotary switch to mA output and measure current positions.
3. Connect the special yellow test lead from the positive output terminal of the U1401A to the positive terminal of the measurement device on the current loop.
4. Connect the negative terminal of the loop powered isolator to the computer output microfilm (COM) terminal of the loop source.
5. Connect the positive output terminal of the instrument to the positive terminal of the current loop source. Make sure the polarity is correct.
6. Set the current level of the calibrator to 4 mA and test the output current.
7. Connect the loop powered isolated output to the current measurement terminal of the U1401A. See Figure 3.
8. Adjust the zero control on the isolator for a reading of 4 mA on the output meter.
9. Step the input current to 20 mA, and then adjust the span control on the isolator to read 20 mA on the output meter connected to the isolator.
10. Repeat step 8 and check the linearity of the loop isolator according to the table below.

Simulation Current	Output Current	Percentage of 4-20mA
4 mA	4 mA	0 %
8 mA	8 mA	25 %
12 mA	12 mA	50 %
16 mA	16 mA	75 %
20 mA	20 mA	100 %

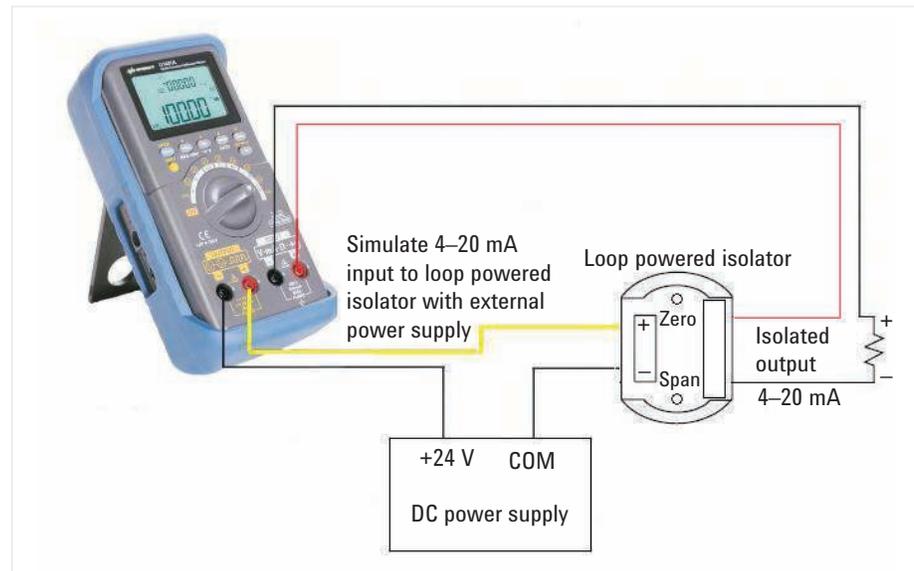


Figure 3. Calibrating turbine flow meter signal conditioner



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