



## USE LOW-IMPEDANCE BRIDGES ON 4-20mA CURRENT LOOPS

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If you need more transducer excitation current than is available on a standard 4-20mA 2-wire current loop, consider a 3-wire transmitter. A 2-wire 4-20mA transmitter uses the same two wires for signal and power. Part of the 4mA minimum loop current is used to power the transmitter circuitry. The remaining current can be used for transducer excitation. In some applications even the entire 4mA is not enough for transducer excitation.

Exciting a low-impedance bridge (such as a 350Ω bridge) often requires more current than is normally available from a 2-wire 4-20mA current loop. A 350Ω bridge excited with a 10V reference requires more than 28mA. An easy way to solve this problem is to use a 3-wire transmitter such as the XTR110.

The XTR110 3-wire transmitter is similar to a 2-wire transmitter, except that one of the two wires is connected to ground and a third (power supply) wire is added. With external power available at the transmitter, it is easy to interface to low-impedance bridges. The XTR110 contains an on-board precision 10.0V reference for sensor excitation. The reference has a sense connection so that its output can be easily boosted.

### THE COMPLETE BRIDGE TO CURRENT-LOOP CIRCUIT IS SHOWN IN FIGURE 1

A series-pass transistor,  $Q_1$ , boosts the XTR110's 10.0V reference output-current to drive the bridge. Using an external pass transistor allows high output-drive without overheating the XTR110. To improve reliability you may need to heat-sink  $Q_1$ , especially for high ambient temperatures.

An INA114 precision instrumentation amplifier is used to amplify the bridge output to drive the XTR110 low-impedance input. The INA114 is operated single-supply from the 10V reference to eliminate any error due to power-supply changes. The XTR110 is connected so a 1V to 5V input on pin 5 produces a 4-20mA output. A voltage divider buffered by an OPA177 drives the INA114 *reference* pin. With 3V on the *reference* pin, the INA114 output is 3V with the bridge in balance. This produces a 12mA (mid-scale) XTR110 output with the bridge in balance. If you want to use the bridge in a unipolar mode, the resistor divider can be set to put either 1V or 5V on the INA114 *reference* pin to produce either a 1V or 5V INA114 output at bridge balance. In any case, select the INA114 gain-set resistor for 4V INA114 output change with  $\pm$ full-scale bridge output.

A P-channel enhancement-mode MOSFET,  $Q_2$ , is used to drive the 4-20mA output current. Using an external FET to drive the output current improves precision by eliminating

thermal feedback. If an internal driver were used, the signal-dependent power change due to the 4-20mA current change would result in relatively large nonlinearity in the transfer function.

Burr-Brown offers a complete line of 2-wire and 3-wire current loop transmitters and receivers.

### XTR101

General purpose two-wire 4-20mA current-loop transmitter. This transmitter has an instrumentation amplifier input and two 1mA current sources for transducer excitation and offsetting.

### XTR103

Two-wire RTD 4-20mA current-loop transmitter with 9V compliance. Similar to XTR101, but with internal linearization circuitry for direct interface to RTD Resistance Temperature Detectors. The XTR103, along with an RTD, forms a precision temperature to 4-20mA current loop transmitter. Along with an RTD, the XTR103 can achieve better than 0.1% span linearity over a  $-200^{\circ}\text{C}$  to  $+850^{\circ}\text{C}$  temperature span.

### XTR104

Two-wire bridge 4-20mA current-loop transmitter with 9V compliance. Similar to XTR101, but with shunt regulator and linearization circuitry for direct interface to high-impedance strain-gauge and Wheatstone bridges. The XTR104 can provide better than 0.1% span linearity from bridges with uncorrected linearity in excess of 2%.

### XTR110

Three-wire 4-20mA current-loop transmitter. Essentially a precision, single-supply voltage-to-current converter with an internal 10.0V reference and input resistor network for span offsetting. Various input-output ranges are available by pin strapping so that 0 to 5V or 0 to 10V inputs can be used to get 0 to 20mA or 4 to 20mA outputs for example.

### RCV420

Self-contained 4-20mA receiver. Conditions and offsets 4-20mA input signals to give a precision 0-5V output. Contains precision voltage reference, 75Ω precision sense resistor and  $\pm 40\text{V}$  common-mode input range difference amplifier. The RCV420 has a total combined span and zero error of less than 0.1%—adjustable to zero.

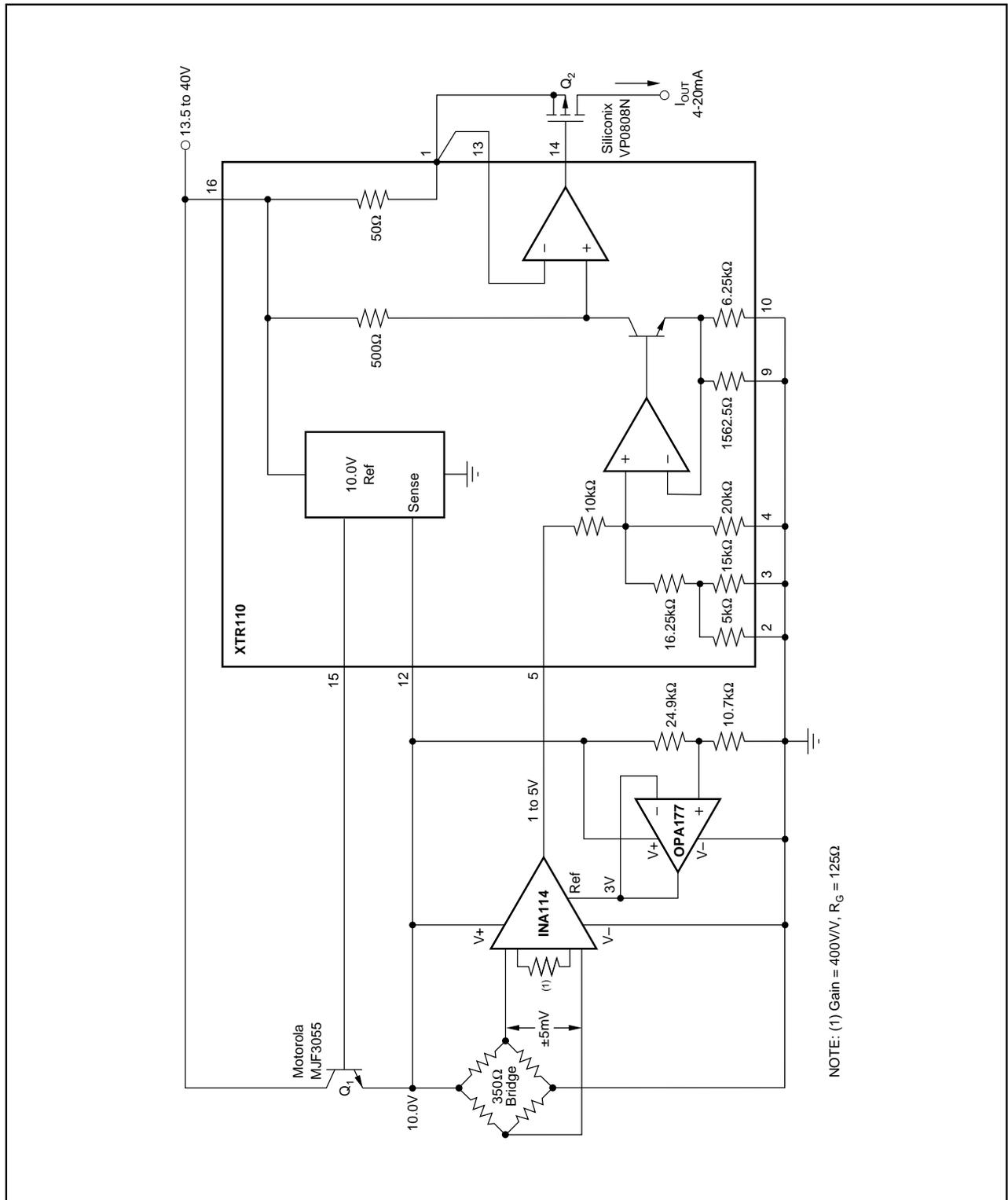


FIGURE 1. Complete 350Ω Bridge to 4-20mA Current-Loop Transmitter Uses XTR110 3-Wire Current Loop Transmitter and INA114 Precision Instrumentation Amplifier Operating in a Single-Supply Mode.

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