Comparators replace mechanical set-point meter

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A standard ammeter and a simple comparator circuit can replace the expensive and bulky mechanical dual-set-point meters used for most process control applications. This electronic circuit provides higher efficiency at low cost and can be built on a printed-circuit card. With a slight modification to the basic circuit, a double high set point and a double low set point may be established—a feature that is not available from the mechanical meter.

The mechanical meter used for industrial purposes contains internal relays and a 115-volt power supply to drive them, as well as a meter that triggers when its pointer or indicating device comes into contact with the high or low set points on the meter dial.

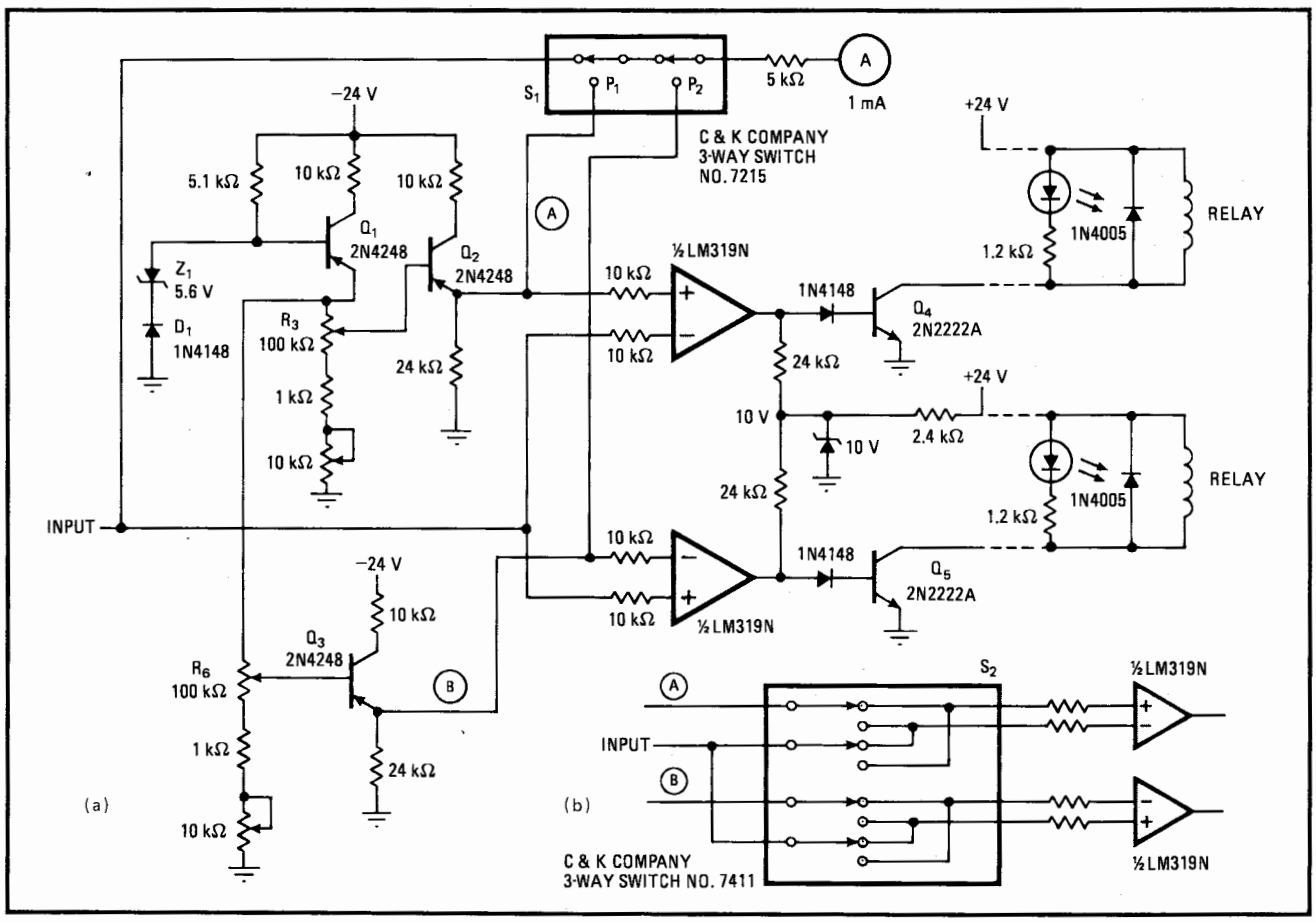
In the electronic circuit shown in the figure, the mechanical set control is replaced by two potentiometers, transistors Q_1 through Q_5, and the LM319 operational amplifier. A 1-milliampere meter indicates conditions at the output of the monitored circuit. The meter is no longer part of the relay triggering circuit, and the relays no longer need a power supply. If the circuit is to control heavy loads, relays must be employed, but they draw only little power from output transistors Q_4 and Q_5 and can be placed far from the metering circuit.

In normal operation, an input signal is applied to each of the two op amps in the LM319, which compares it to a previously set (high- and low-point) reference. In the circuit, the reference voltages are adjustable from 0 to −5.6 v. This is made possible by the biasing arrangement at Q_1, in which diodes Z_1 and D_1 are configured to supply a constant −5.6 v at its emitter. The voltage across potentiometers R_3 and R_6 thus may vary between two references, one at −5.6 v and the other at −0.6 v, so that the input to the comparator can vary between −5 v and ground.

When the input voltage, as set by the meter, exceeds the high or low reference, the appropriate output of the LM319 fires and switches either transistor Q_4 or Q_5, which closes the proper relay.

The high and low reference points may be set by using the meter. Switching switch S_1 to P_1 removes the metering circuit from the input signal, and the meter then displays the high-point reference voltage, which can be adjusted by R_3. With S_1 moved to position P_2, the desired low-level voltage may be adjusted with potentiometer R_6.

The voltage drop across zener diode Z_1 and the



Mechanical to electrical conversion. Implementation of dual-set-point meter using standard meter and comparator circuits (a) is low-cost and reliable. When a three-way switch is added to circuit (b), double high and low set points can be set.

number of standard diodes (D_1) determines the range of reference voltages possible. Reversing diode polarities and changing Q_1, Q_2, and Q_3 to npn devices produces positive reference voltages.

To establish double high set and low set points, a four-pole, three-way toggle switch is placed in the path of transistors Q_2 and Q_3 and the input of the op amp, as the lower part of the figure shows. □