APPLICATION NOTE 41B

INCREASED RESOLUTION FOR PERMANENT RECORDS
OF DC VOLTAGE WITH ℌ MODEL 405AR*

The ℌ 405AR Digital Voltmeter has an automatic range feature. When you connect an input voltage, the proper range and corresponding decimal point position are selected automatically.

However, in some applications it is desirable not to change ranges. For example, if the input voltage is varying by a small amount around a voltage of 10 volts, a range change will occur every time the voltage crosses 10 volts. When the range changes, it is necessary for the voltmeter's sampling circuits to wait for the new range, hence decreasing voltmeter sampling rate and corresponding amount of information collected.

You can eliminate range-changing by setting the range switch on the front panel to a "hold" position. In this position of the range switch, the voltmeter range will remain fixed regardless of the variations in input voltage. In addition to increasing sampling rate, this arrangement allows increased resolution of small voltage variations. For example, consider a voltage which is varying around 1 volt. When the voltage goes slightly above 1 volt for example, 1.023 volts, in normal operation the range will change and the indication on the digital voltmeter will be 1.02 (3 digit readout). However, if the range is held the 1 will go off scale and the reading would be .023. What we have done is to sacrifice the 1 which we knew anyway for an extra significant digit, the 3, which is the information we need in this application.

In many applications it is desirable to record these voltage variations for a permanent record. The Model 405A will operate the ℌ 560A and 561B Digital Recorders. In normal operation the Digital Recorder is a slave to the Digital Voltmeter and will print whatever the voltmeter reads.

When the range is held, the Digital Recorder will print voltmeter readings provided that they are less than full scale and as long as the voltage doesn't decrease below a reading of 099. For example on the 1000 Volt range, voltages from 999 volts down to 99 volts will be recorded. However, if the input voltage equals or exceeds the full scale value, it will not be recorded because, even though the range is held, the 405AR still thinks it should change ranges, and will not issue a print command.

Since these normal variations in input voltages typically go above full scale, a print command from the digital voltmeter would be extremely useful for high resolution permanent records of small voltage variations.

This requirement can be met very easily by the addition of a switch and one resistor to the print command circuitry in the Model 405AR. The print command circuitry itself is shown in Figure 1. The print command pulse is applied internally at point A. When a range change is made in normal operation or when the input voltage equals or exceeds full scale in the hold position, CR17 is reverse biased so that a print command cannot be passed. The reverse bias voltage comes from V14 and occurs when the plate, pin 1 is not conducting.

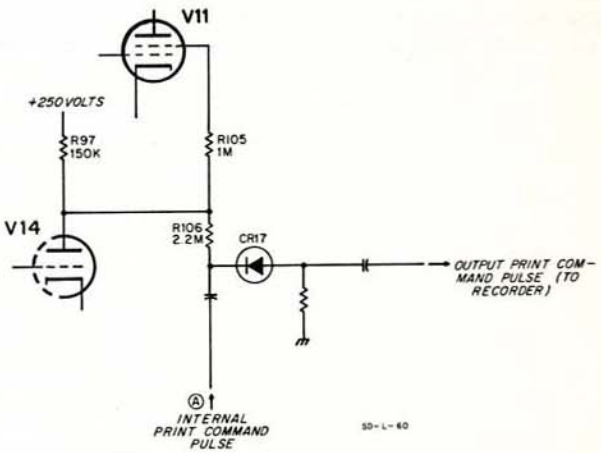

Figure 1. Simplified Model 405A Print Command Circuitry

The only modification of the print command circuit required is to move a wire from V14 to R106, add a switch between V14 and R106 and add one resistor. The procedure is:

1. Find the wire which runs from R105 to pin 1 of V14.

2. Disconnect the wire at pin 1 of V14.

* The newer ℌ Model 405CR contains the modification described in this Application Note.

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3. Connect it to R106.

4. Remove the wire which runs between pin 1 of V14 and R106.

5. Replace the wire with a single-pole single-throw switch. The switch can be mounted at the rear of the instrument. Dress the leads to keep wiring capacity to a minimum.

6. Place a 2.2 M 1/2 watt resistor in the unused tie point nearest R107 at the right rear of the chassis, as seen from the bottom of the 405AR with the front panel toward you.

7. Solder a 3" blue lead from the blue lead on R106 to one end of the new 2.2 M resistor.

8. Solder a 5-1/4" red lead from the red lead end of R97 to the other end of the new 2.2 M resistor.

As seen from the bottom of the 405AR with the front panel toward you, V14 is on the right hand side in front of the transformer; R106 is mounted on the vertical resistor board on the right hand side and R105 is mounted on the vertical resistor board on the left hand side of the 405AR. The components can be located quickly since they are labeled. A schematic diagram of the circuitry with the switch added is shown in Figure 2. When the switch is open it prevents the reverse bias from

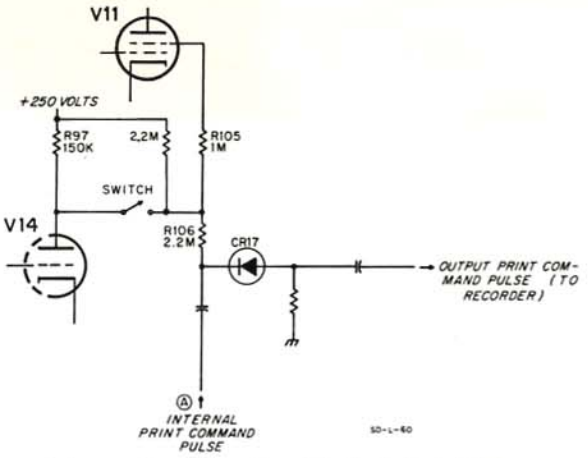

Figure 2. Circuit with Switch Added

pin 1 of V14 from reaching CR17 so a print command will be delivered through CR17. With the switch added, a print command will be issued at the end of every count cycle.

So if the range switch is changed from the hold position to "automatic" the switch should be closed. Otherwise print commands will be issued even during range changes.

The addition of the switch for print commands while the range is held should make the Model 405A more useful for measurement of varying dc voltages with greater resolution.

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