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DIGITAL MULTIMETER APPLICATIONS (2)

OHMS GUARD
A UNIQUE DATRON FEATURE & A USER BENEFIT
(AVAILABLE ON AUTOCAL & SELFCAL DMM's)

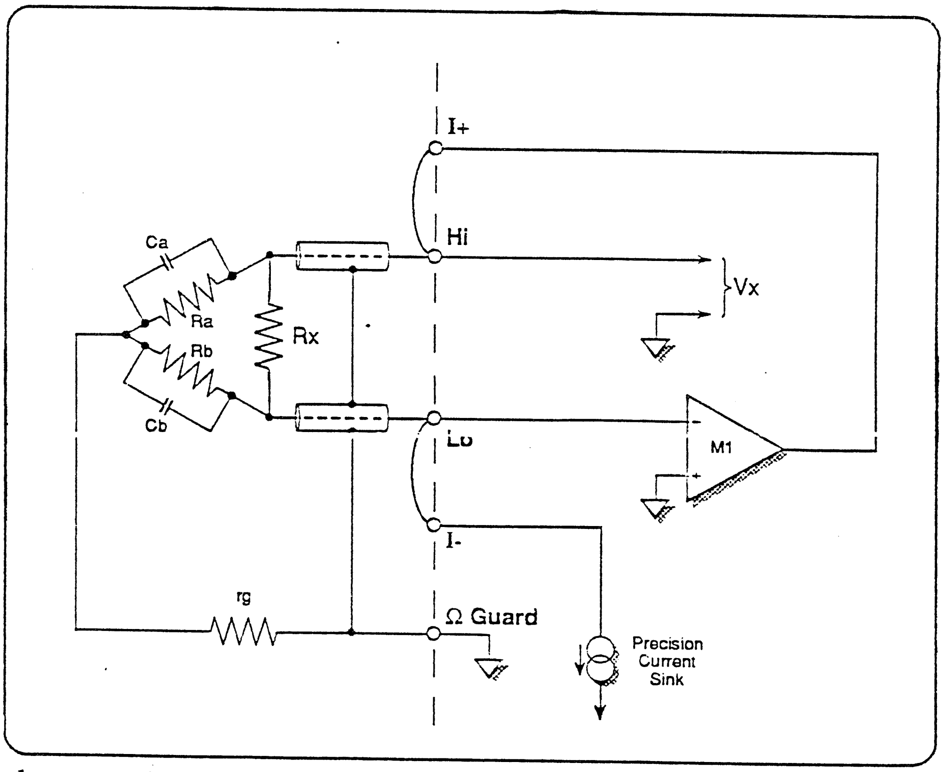
Ohms Guard is a very useful, but not well understood feature, which is available on all Datron DMM's, both Autocal and Selfcal. The Ohms Guard facility is unique to Datron, and has on occasion enabled a sales engineer to secure an order. Therefore what is Ohms Guard, and what are the benefits to the prospective customer, briefly:

1. The Ohms Guard connection can be used to eliminate the effects of parallel networks, either real components during in circuit measurements, or "strays" when measuring high resistance values.

2. Ohms Guard can also be used to negate the effects of real capacitance in parallel with a resistor measurement, stray capacitance associated with any cable, or the effects of leakage in long cable runs. In all these applications using Ohms Guard can significantly reduce settling times and noise.

FUNCTIONAL OPERATION

The Ohms Guard terminal is internally connected to the DMM's analogue common line, ie at the same potential as the none-inverting input of M1.



If connected to a suitable point, in this instance to the "star point", but generally this selection will need to be determined empirically, shunt resistances and capacitances can be "guarded out"

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As the Ohms Guard, I- and Lo terminals are all at the same potential, ideally no current will flow through Rb or Cb.

The precision current sink still draws its full current through the resistor to be measured Rx, and the developed voltage Vx is impressed across Ra and Ca, this additional current, provided by the output of M1, is sunk via the Ohms Guard terminal to analogue common.

This connection of the "star point" to analogue common (zero volts) ensures that no current flows through the two parallel arms, and therefore Ra/Ca and Rb/Cb do not effect the measurement.

PRACTICAL LIMITATIONS

There are practical limitations to the value of shunt resistors, relative to Rx, that can be accommodated by this technique. This limitation being determined by the maximum current available from M1.

Providing that Ra & Rb are not less than 250Ω (1.5 KΩ on the 1MΩ & 10MΩ ranges) and Rg does not exceed 5Ω on the 1271 and Autocals, and that Ra & Rb are at least 1KΩ and Rg not more than 1Ω on the 1281, then the real value of Rx can be calculated from the displayed value Rd by the following formula:

$$Rx = Rd \cdot (1+E).$$

The deviation fraction "E" can be determined to within 1% by the simplified formula:

$$E = \frac{Rd \cdot Rg}{Ra \cdot Rb}$$

Where the shunt resistors are of equal value and greater than 250Ω, then better accuracies are possible:

1271: EXAMPLES OF OHMS GUARD

Full Range	Equal Shunt Resistors 1kΩ	10kΩ	100kΩ	1MΩ
100Ω	100ppm	1ppm	0	0
1kΩ	0.1%	10ppm	0.1ppm	0
10kΩ	1%	100ppm	1ppm	0
100k	-	0.1%	10ppm	0.1ppm
1MΩ	-	1%	100ppm	1ppm

cont ......

Within the drive capability of M1, and where Rx and Ra are near equal in value, as is often the case in a passive network, then lower values of Rx can be accommodated using the more complex formula:

$$Vx = \frac{Ic(Rx.Ra.Rb) + Ve.Ra\,(Rx + Rb)}{(Ra.Rb) + (Rx.Rg)}$$

Where: Ic = Range Current
Rg = an internal constant (< 0.5Ω)
Ve = Small offset voltage (approx 1 μV) at the inverting input to M1

Generally for specific values of Rx, Ra, and Rb these additional errors can be quantified to a single offset, which can be compensated for by utilizing the A - B maths mode.

SUMMARY

As stated, even where parallel resistance paths do not exist, Ohms Guard can be used to drive the screens of connecting cables and fixtures to reduce the settling times. As little as 1nF in parallel with 10MΩ can require a settling time of 0.5s.

BENEFITS of OHMS GUARD.

a) **In circuit resistance measurements. Can be combined with a Matrix Switch for complex systems testing.**

b) **Passive Network component testing**

c) **To reduce settling time where the resistor under test is shunted by a capacitance.**

d) **To reduce settling time in a "System" where long lead lengths and screening increase shunt capacitance.**

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