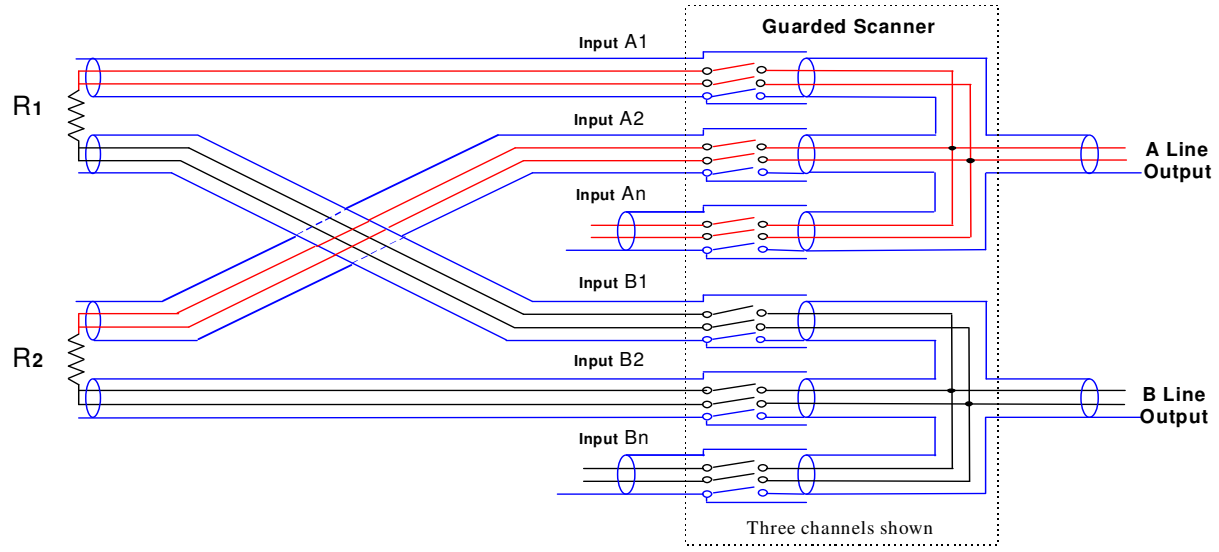
DATA PROOF

LOW THERMAL GUARDED SCANNER

Model: 160B Opt. 5



Data Proof's Low Thermal Guarded Scanners are designed to improve accuracy in high resistance measurements. Unguarded, the Data Proof scanners have leakages of about $1.5 \times 10^{12}\ \Omega$ which can cause errors of a few tenths of a ppm when measuring 1 MΩ. Guarding reduces the errors allowing excellent accuracy up to the 1 GΩ level.

The high guard surrounds the potential and current leads to the high end of each resistor, while a separate low guard surrounds the leads to the low end of the resistor. The guard shields are switched along with the current and potential lines. The guard is carried through shielded cables from the resistor, through the scanner and to the output cables.

The latching relays are modified so that the armatures are included in the guard circuit to prevent leakages through the relay coil circuitry. These are the same relays used to provide the low thermal performance that Data Proof is famous for.

The Option 5 Scanners are clearly a superior choice for automating precision resistance measurements. They offer advantages for making resistance measurements even if the guard system is not used. The high side and the low side of each resistor are switched by separate relays which reduces leakage current even when the guard is not used. Also 16 four-terminal devices can be connected to the 160B Opt. 5.

SPECIFICATIONS

Thermoelectric Potentials:
Less than 20 nanovolts typical
50 nanovolts maximum

Relay Contact Ratings:
Life: >10,000,000 cycles at low levels
Initial contact resistance: 0.05Ω maximum
Current: 2A maximum at 10 volts
Voltage switched: 100 volts max. at 20 mA
Voltage non-switched: 1,000 volts maximum

Leakage Resistance (not guarded): $1.5 \times 10^{12}\ \Omega$

REAR PANEL CONNECTIONS

Inputs:
160B Opt. 5: 16 pairs of six-foot guarded cables

Outputs: Two pairs of six-foot guarded cables
Cables: 2 Conductor Stranded Copper with Polyethylene (PE) Insulation, TC Braided Shield with PVC Wrap
Bus Inputs: 24 pin IEEE-488 connector
Size: 420mm (16.5in) length, 451mm (17.7in) width, 133mm (5.2in) height
Scanner Control:
Local - using front panel push buttons
Remote - via IEEE-488 bus (includes)

GUARDED HIGH-OHM RESISTANCE SYSTEM

By using a guarded scanner and two sources to form a guarded resistance bridge, measurements from 100KΩ to 10GΩ can be made with excellent accuracy. This system provides a simple yet effective way to activate both the high and low guard circuits. Adjusting the source outputs to set the high impedance side of the bridge circuit to zero volts reduces errors caused by meter circuit loading. The system described here is similar to the one used by NIST for measuring resistors in the GΩ ranges.

HIGH-OHM DESCRIPTION

This circuit is a wheatstone bridge where two legs of the bridge are voltage sources. A DVM measures the voltage across the bridge and a low thermal scanner is used to switch the resistors in the test.

The standard low thermal scanner has leakages of about $1.5 \times 10^{12}\Omega$. In a normal arrangement the leakage currents would cause errors of about 1.5 ppm at the 1 MΩ and 150 ppm at 100 MΩ. By using a fully guarded scanner, leakages can be significantly reduced.

Because the sources have low impedances, the high guards can be connected directly to the source outputs. The low guard can be connected directly to ground because the sources are always adjusted so that the DMV reads zero.

Keeping both sides of the bridge at zero volts reduces leakage errors. This is done by using two voltage sources for two arms of the bridge as shown in the diagram below. Voltage source #1 is adjusted so that the DVM always reads zero, which sets the center point of the two resistors being compared to zero volts. The tare standard is always in the circuit, and the low thermal scanner is used to switch the standard and test resistors into the circuit one at a time.

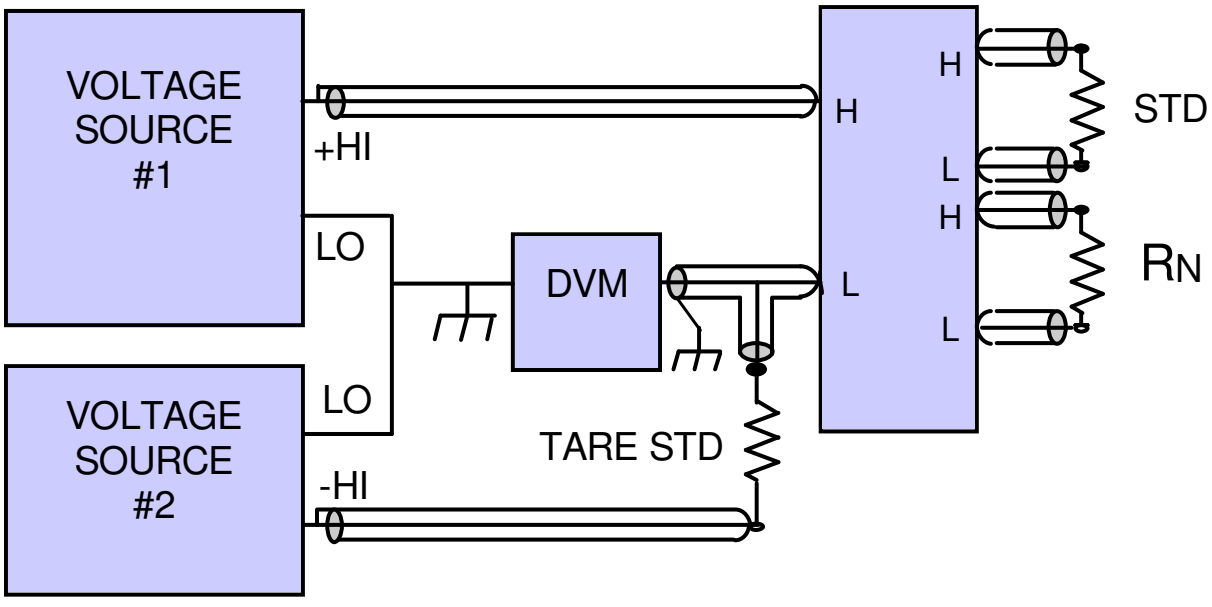
OhmRef SOFTWARE

The High-Ohm Resistance method is now included in the Data Proof OhmRef software. This provides a convenient means to set up an make high resistance measurements. OhmRef will allow up to 8 resistors to be compared at a time.

HIGH-OHM RESULTS

A non-guarded scanner can be used to compare resistors to 10MΩ with an uncertainty of about 1ppm. With a guarded scanner good results can be obtained comparing 1GΩ resistors with an uncertainty of about 10 ppm.

Different values of resistors can be compared over a wide range with the uncertainty primarily dependant upon the scaling accuracy of the voltage source being used



Guarded High-Ohm Resistance System