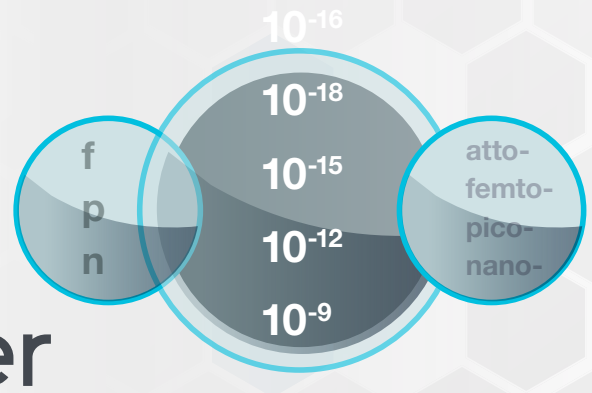
Tektronix®

4 Step Error Checker



KEITHLEY
A Tektronix Company

HOW TO AVOID COMMON MEASUREMENT ERRORS

1 Measurement Type and Typical Applications	2 Error Symptoms	3 Likely Causes	4 How to Avoid
Low Voltage • Standard cell intercomparison • Microcalorimetry • Hall voltage • Thermometry • Relay/connector contact • Low voltage sensors	Noisy readings	Thermoelectric EMFs	Construct circuits using same type of conductive materials. Minimize temperature gradients. Allow test equipment to warm up.
		Line cycle interference	Identify and remove offending source, if possible. Use noise shields. Use integer value of line cycle integration (e.g., 1, 2, etc.).
		RFI/EMI	Keep sensitive test circuitry away from interference source. Use noise shields.
		Johnson noise	Lower temperature of source resistance. Increase instrument filtering. Increase integration time.
		Magnetic fields	Reduce loop area of test leads. Minimize vibration of test circuit.
		Ground loops	Ground all equipment at a single point.
	DC voltage offsets	Internal voltmeter offsets	Use proper zeroing techniques. Make sure voltmeter is in calibration.
		Thermoelectric EMFs	Construct circuits using same type of conductive materials. Minimize temperature gradients. Allow test equipment to warm up.
		RFI/EMI	Keep sensitive test circuitry away from interference source. Use noise shields.
	One or two digits of resolution	Range selected is too high or instrument not sensitive enough	Select a lower voltage range, or use autoranging. Use a more sensitive voltmeter. Check instrument specifications.
Low Current • Diode reverse leakage current • MOSFET gate leakage current • MOSFET sub-threshold current • Single electron devices • Ion/electron currents • IC quiescent currents • MOS charge pumping current • Photodetector current	Noisy readings	Electrostatic coupling	Use shielding and avoid nearby movements. Use low noise cabling.
		Source resistance too low	Use shunt ammeter.
		Source capacitance too high	Add series resistance or series diode.
		Temperature variations of test circuit Offset current drift	Operate measurement system in a thermally stable environment. Allow system to warm up to achieve thermal stability.
		Noisy input signal Johnson noise	Use filtering. Reduce temperature of DUT, if possible.
		50 Hz or 60 Hz interference	Identify and remove offending source, if possible. Use shielding. Increase PLC setting of ammeter.
	Offset current	Input bias current of meter	Use instrument with low input bias current such as an electrometer. Zero or REL the offset. Check instrument calibration.
		Cable, connectors, or test fixtures	First measure the input bias current of the ammeter. Then, verify the open circuit offset current of the entire system by adding one piece of cabling and/or connector at a time and repeating the open circuit current measurements. Use cabling appropriate for high impedance applications.
		Offset current drift due to temperature changes in the test circuit	Stabilize the temperature of the entire test circuit including the ammeter.
		Excessive humidity	Keep humidity to moderate levels, <50% relative humidity, the lower the better.
	Gain error at low voltage	Voltage burden too high	Use feedback ammeter. Use higher range.
	Readings too high	Insufficient settling time	Allow a longer time delay before taking a reading.
	One or two digits of resolution	Range selected is too high or instrument not sensitive enough	Select a lower current range or use autoranging. Use a more sensitive ammeter. Check instrument specifications.
Low Resistance • Superconductor resistance • Resistivity of conductors • Relay/connector contact • Continuity of cables/ connectors • Conductive inks	Readings too high	Lead resistance	Use four-wire method.
		Ohmic contacts	Use appropriate contact material. Use four-wire method.
		Thermoelectric EMFs	Use an offset compensation method.
		Self heating effects	Reduce test current. Use pulsed current.
	Readings toohigh or too low	Thermoelectric EMFs	Use an offset compensation method.
		Non-ohmic contacts	Use appropriate contact material. Use four-wire method.
High Resistance • Insulation resistance • Insulator resistivity • Polymer conductivity	Readings too low	Fixture in parallel with DUT	Use fixture and cables with higher insulation resistance. Guarding will effectively increase shunt resistance.
		Low voltmeter input resistance (Force I, Measure V method)	Use force voltage, measure current method.
		Offset current	Suppress or REL the current offset with test voltage off. Use alternating voltage method.
		Insufficient settling time	Increase measurement time to ensure a settled reading.
		Contamination and humidity	Select insulators that resist water absorption, keep humidity to moderate levels, keep all insulators clean and free of contamination.
	Noisy readings	Electrostatic coupling	Shield test circuit and avoid movement and fluctuating voltages nearby.
		50 Hz or 60 Hz interference	Identify and remove offending source, if possible. Shield. Increase PLC setting of ammeter.
	Negative readings, or readings that are much higher or lower than expected	Background currents due to dielectric absorption, triboelectric charge or piezoelectric effects	Use offset correction technique such as the alternating polarity method or the alternating voltage method.
		Current measure range too high	Use more sensitive current range or use auto ranging.
Voltage from a High Resistance Source • pH or ion selective electrode • Dielectric absorption • Hall effect voltage • Electrochemistry applications	Readings too low (loading error)	Shunt resistance loading	Use fixtures and cables with higher insulation resistance. Guarding will effectively increase shunt resistance.
		Offset current loading	Input bias current of meter is too high. Use electrometer.
	Noisy readings	Electrostatic coupling	Use shielding. Avoid movement and fluctuating voltages nearby.
		Noisy input signal, Johnson noise	Use filtering. Reduce temperature of DUT, if possible.

View/download the Keithley Low Level Measurements Handbook: **tek.com/LLM-Handbook**

102721 SBG 1KW-73830-1