



TR-10 System Module
Made in U.S.A.

The TR-10 System Module is the in-circuit test system complex impedance measurement module. This module is one part of a typical system module set.

The TR-10 features:

- **Stimulus and measurement circuitry**
- **Controlled by CheckSum test system software**
- **16-pin analog bus for switch module-to-module stimulus and measurement**
- **External sense capability for 4-wire and 6-wire measurements**
- **Up to six measurement guard circuits**
- **8-bits digital I/O**
- **Industry standard PC bus interface**
- **Test status and control signals for external devices**
- **Fixture control signals**
- **Test point locator connection**

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CheckSum TR-10 Module

TR-10 Specifications

Resistance Measurement

Resistors are measured with a choice of DC-constant-current, DC-constant-voltage, or AC-complex-impedance measurements. Low impedance measurements can be externally sensed.

Measurement using DC Current Stimulus

Range	F.S.	Current	Voltage at F.S.	Accuracy
19Ω		10mA	0.2 V	2% F.S.
190Ω *		10mA	2 V	1% F.S.
1.9KΩ *		1mA	2 V	1% F.S.
19KΩ *		0.1mA	2 V	1% F.S.
190KΩ *		10μA	2 V	1% F.S.
1.9MΩ *		1μA	2 V	2% F.S.
19MΩ		0.1μA	2 V	5% F.S.

*0.2V ranges are available. For 0.2V ranges, multiply typical accuracy by 3. For internally sensed measurements, add 2Ω to accuracy. Maximum voltage may exceed full-scale value during over-range.

Measurement using AC/DC Voltage Stimulus

Range	Source Voltage, Typical	Accuracy
0Ω to 10KΩ	3.8V DC or 2VAC RMS	1% Value+0.5Ω
10KΩ to 100KΩ	3.8V DC or 2VAC RMS	2% Value
100KΩ to 1MΩ	3.8V DC or 2VAC RMS	4% Value
1MΩ to 10MΩ	3.8V DC or 2VAC RMS	10% Value (20% @ 1KHz)

0.2V & .02V sources are also available. For 0.2V, multiply accuracy by 3. For .02V, multiply accuracy by 10 (not specified above 1MΩ). For internally sensed measurements, add 2Ω to accuracy. Available AC stimulus frequencies 100Hz and 1KHz. Technique is fully auto-ranging. Source current is less than 10mA.

Inductance Measurement

Inductors are measured with AC-complex-impedance measurements. Effective measurement range is 1μH - 1000H.

Range	Accuracy			
	100KHz	10KHz	1KHz	100Hz
1μH - 10μH	4%+0.5μH	4%+0.5μH	10%+2μH	–
10μH - 100μH	4%+2μH	4%+2μH	10%+4μH	–
100μH - 1mH	4%	4%	4%	10%
1mH - 10mH	10%	4%	4%	4%
10mH - 100mH	–	10%	4%	4%
100mH - 1H	–	–	10%	4%
1H - 10H	–	–	–	10%
10H - 100H	–	–	–	10%
100H - 1000H	–	–	–	20%

Specifications assume residual inductance is offset. Specifications apply to 2V source. 0.2 and 0.02V sources are also available. For 0.2V, multiply accuracy by 3. For 0.02V, multiply accuracy by 10. Technique is fully auto-ranging. Source current is less than 10mA. Measurements less than 100μH should be externally sensed for full accuracy.

Capacitance Measurement

Capacitors are measured with a choice of DC-constant-current or AC-complex-impedance measurements. Measurements can be effectively made from 2pF - 20,000μF³.

Range	Accuracy					
	100KHz	10KHz	1KHz	100Hz	1mA	10mA
1pF - 100pF	4% ¹	4% ¹	4% ¹	–	–	–
100pF - 1000pF	4% ²	4% ²	4% ²	10% ²	–	–
1000pF - 0.01μF	10%	4%	4%	4%	–	–
0.01μF - 0.1μF	–	4%	4%	4%	–	–
0.1μF - 1μF	–	10%	4%	4%	–	–
1μF - 10μF	–	–	4%	4%	–	–
10μF - 100μF	–	–	10%	4%	4%	–
100μF - 1000μF	–	–	–	10%	10%	4%
1000μF - 20000μF	–	–	–	10%	20%	10%

Notes:

- ± 5pF
- ± 10pF
- While small isolated capacitances (pF region) can effectively be tested by the system, often times in-circuit influences such as parallel impedances in IC's degrade measurements. Values less than 100pF can be difficult to measure in many circuits.

Specifications assume residual capacitance is offset and apply to 2V source. 0.2V and 0.02V sources are also available. For 0.2V, multiply accuracy by 3. For 0.02V, multiply accuracy by 10. Technique is fully auto-ranging. Source current is less than 10mA.

Guarding Capability

The test system provides guarding to minimize the effects of parallel impedances. Without special wiring, any test point can be used as a measurement point, a guard point, or an external sense point. All points can be guarded (with selected deletions), or up to six individual guard-points can be simultaneously used. Each measurement or guard point can be externally sensed.

Guarding uses a separate guard amplifier for each guard point to provide extremely precise guarding. Even without guarding, the system can often directly measure components of different types connected in parallel, such as a capacitor and a resistor, using complex-impedance measurements.

CheckSum TR-10 Module

Guarding

Maximum Current per Test Point	10mA
Max. Number of Simultaneous Guard Points	6 (or guard-all less selected points)
Maximum Total Guard Current (TR-10)	20mA

Typical Resistance Measurement Accuracy Degradation when using Guarding:

Guard Ratio	Multiply Accuracy
1:1	x 1
10:1	x 2
100:1	x 3

Any test point can be designated as a guard or external guard sense point without special wiring, except Power points.

Voltage Measurement

Diode and Zener Diode Measurement

Standard diodes, LEDs and zener diodes are tested by applying a constant current to the anode and cathode, then measuring the resultant voltage (forward voltage drop). Measurements of up to 50V can be performed using up to 100 mA of applied current.

Diode Test Type

Accuracy

Range	Source Current		
	10mA	1mA	0.1mA
2V	±40mV	±40mV	±40mV
10V*	±200mV	±200mV	±200mV

* Typical constant current to 7V compliance

Zener Test Type

Range	Source Current	Accuracy
20V	10mA	±300mV

DC Voltage Measurement

DC Voltage Measurement (VOLT test type)

Measurement Range	Accuracy
± 0.2V	4mV
± 2.0V	40mV
± 10 V	200mV

Ranges are bipolar. Stimulus may float ±8V from controller chassis ground.

Opens/Shorts Measurement

The system self-learns a known-good UUT, then tests against this map. The continuity map can be edited and no-care conditions can be specified for measurements where components exist, and either condition is acceptable.

Connection/Open Thresholds	Separately programmable from 2Ω - 50KΩ
Typical Test Time for 400 Test Points	1-2 seconds

(Test time depends on UUT circuit topology)

Low Threshold Continuity (rated speed)

Range	Threshold
1mA	2Ω to 50Ω

High Threshold Continuity (lower speed)

Range	Threshold
100μA	20Ω to 500Ω
10μA	200Ω to 5KΩ
1μA	2KΩ to 50KΩ

IC-Orientation/Presence Measurement

IC presence and orientation is verified by checking the semiconductor junctions of the protection diodes typically present between IC pins and the UUT power supplies. Using a proprietary algorithm, the system self-learns a mapping of these ICs and tests against this map. The map can be manually edited for specification of specific tests and no-cares.

Constant Current

Constant Current Ranges	Threshold
0.1mA/1mA	0 to 2V
1mA/10mA	0 to 2V

Opto-isolator Testing

Diode Drive	Measurement Stimulus	Measurement Threshold
0mA to 10mA	1mA	0 to 2V

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Transistor Testing

Three terminal devices can be measured between the power terminals (e.g., collector and emitter) while biasing the control terminal with another test point using voltage or current. This can effectively measure the operation, and in most cases the polarity of devices such as FETs, SCRs and transistors.

Third Terminal Drive	Measurement Stimulus	Measurement Threshold
0mA to +1mA	1mA	0 to +2V
-10V to +10V	1mA	0 to +2V
0mA to -1mA	-1mA	0 to -2V
+10V to -10V	-1mA	0 to -2V

Voltage Sourcing

Low Power Sourcing

DCV 5

Amplitude	-10V to +10V in 80mV steps
Accuracy	3% \pm 80mV
Test Point Source Resistance	< 1K Ω

Sourced from TR-10

Constant Current Sourcing

Low Power Sourcing

Range	Resolution	Accuracy
-1mA to 1mA	4 μ A	3% \pm 4 μ A
-10mA to 10mA	40 μ A	3% \pm 40 μ A

Sourced from TR-10

Operating Environment

The test system operating temperature range is 0°C to +35°C with 0 to 80% RH (without condensation). Rated accuracy at \pm 10°C from calibration temperature. Maximum altitude for operation is 3000m (9843 ft.).

Calibration and General Notes

The system calibration cycle is 6 months. To obtain stated accuracies, low impedance measurements (less than about 100 Ω) may require external sensing to compensate for typical 5 Ω to 10 Ω lead resistance beyond internal sense points. Self-test performs automatic offset characterization for this lead resistance.

All specifications shown are typical accuracies when measuring isolated components. Accuracies may degrade depending on surrounding circuitry. Specifications are typical for a system with externally sensed measurements when impedances are less than 100 Ω .

There are some limitations on the number of simultaneous sources available. Unless otherwise stated, all measurements and stimulus are from the TR-10 system electronics.