

SRC-Tnetwork

Resistance Standard

User and Service Manual



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SRC-100T-Tnetwork im/August 2022

◆ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ◆



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WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Safety Symbols

General definitions of safety symbols used on the instrument or in manuals are listed below.



Caution symbol: the product is marked with this symbol when it is necessary for the user to refer to the instruction manual.



Hazardous voltage symbol: the product is marked with this symbol when high voltage maybe present on the product and an electrical shock hazard can exist.



Indicates the grounding protect terminal, which is used to prevent electric shock from the leakage on chassis. The ground terminal must connect to earth before using the product



Direct current.



Alternating current.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.



On supply.



Off supply.



Hot surface. Avoid contact. Surfaces are hot and may cause personal injury if touched.



Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This product complies with the WEEE Directive (2002/96/EC) marking requirements.

The affixed label indicates that you must not discard this electrical/ electronic product in domestic household waste.

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.



Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities.

Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being.

When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal.

Proposition 65 Warning for California Residents



WARNING: Cancer and Reproductive Harm - www.P65Warnings.ca.gov.

This product may contain chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm

SAFETY PRECAUTIONS

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. Such noncompliance would also violate safety standards of design, manufacture, and intended use of the instrument.

IET Labs assumes no liability for the customer's failure to comply with these precautions.

This is an indoor use product.

DANGEROUS PROCEDURE WARNINGS

Comply with all WARNINGS - Procedures throughout in this manual and instructions on the instrument prevent you from potential hazard. These instructions contained in the warnings must be followed.

BEFORE APPLYING POWER

Verify that all safety precautions are taken. Make all connections to the instrument before applying power. Note the instrument's external markings described under "Safety Symbols".

- DO NOT Operate in an Explosive Atmosphere
- Do not operate the instrument in the presence of inflammable gasses or fumes
- Operation of any electrical instrument in such an environment clearly constitutes a safety hazard
 - Use Caution around live circuits and whenever hazardous voltages > 45 V are present
 - Operators must not remove instrument covers
 - Component replacement and internal adjustments must be made by qualified maintenance personnel only
 - DO NOT substitute parts or modify the instrument
 - When working with high voltages; post warning signs, train personnel and keep unauthorized personnel away.

To avoid the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument.

Return the instrument to an IET Labs for service and repair to ensure that safety features are maintained in operational condition.



WARNING



OBSERVE ALL SAFETY RULES
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

**Dangerous voltages may be present inside this instrument. Do not open the case
Refer servicing to qualified personnel**

HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO
AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE
CONDUCTORS WHEN USING THIS INSTRUMENT.

Use extreme caution when working with bare conductors or bus bars.

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND
KEEP UNREQUIRED PERSONNEL SAFELY AWAY.



CAUTION



DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS
INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON
THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

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Chapter 1

INTRODUCTION

1.1 Introduction

The SRC-Tnetwork is a standard resistor designed for calibration of various electrometers and megohmmeters.

The SRC-Tnetwork is a high resistance standard that uses 3 lower value resistors configured in a T network to create a higher resistance.

1.2 T-Networks

For high resistance measurements a T-network is often used with instruments such as electrometers and megohmmeters equipped with a guard terminal.

A T-network uses low value resistors to achieve what electronically looks like a high value resistor.

The basic operation of a T-network is three resistors are placed in a T configuration and connected to the positive, negative and guard terminals of the megohmmeter.

The ratio of the resistors then determines the effective resistance value that will actually be displayed by the megohmmeter.

The advantages of the T network is that low value resistors are used that can be easily and accurately measured as compared with trying to calibrate a single high value resistor.

This technique is used quite often in calibration where it is difficult to accurately calibrate a resistor.

A T-network is illustrated in Figures 1.1 and 1.2 along with the formula to calculate the effective resistance.

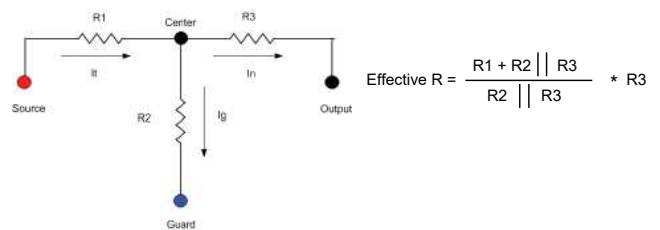


Figure 1.1: T-Network Model

Figure 1.2 illustrates an example T-network comprised of two 1 GΩ resistors and a single 10 kΩ resistor to create a T-network that has an effective resistance of 100 TΩ.

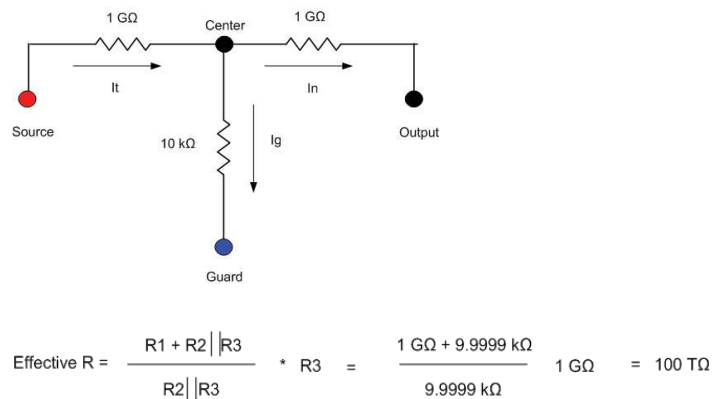


Figure 1.2: T-Network Example

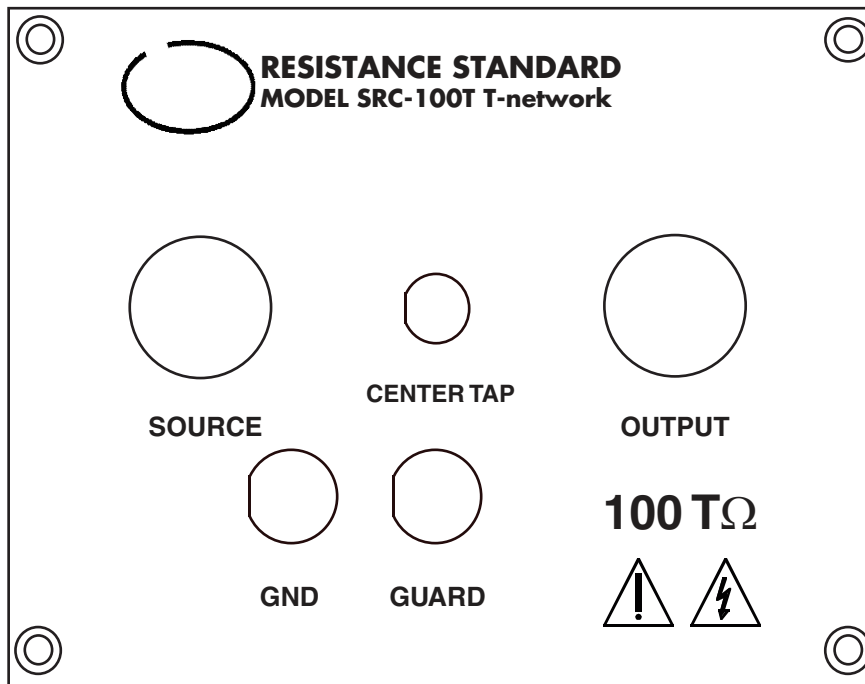


Figure 1-1: SRC-Tnetwork Standard Resistor

Chapter 2

SPECIFICATIONS

For convenience to the user, the pertinent specifications are given in an **OPERATION GUIDE**,

Calibration conditions:

At 23°C, low power, accredited calibration traceable to SI
Using T-network calculation based upon calibration of the 3 internal resistors at a maximum of 200 V.

Operating temperature range: - 55 to 70°C < 80% RH

Altitude: <2000 m

Enclosure: Cast Aluminum housing to minimize noise

Terminals:

3 gold plated, low thermal-emf binding posts for Source, Output and Guard, 1 binding post for Ground and one bnc for Center Tap.

Dimensions: 9 cm W x 11.5 cm L x 5 cm H
(3.5" x 4.5" x 2")

Weight: 0.45 kg (1 lbs)

Model SRC-	Nominal (Ω)	Initial Adjustment to Nominal (ppm)	Calibration Uncertainty (Typical) (ppm)	Stability 1 year (ppm)	Tempco (ppm/°C)	Voltage Coef. (ppm/V)	Resistor type	Max. Voltage (V)
10T-Tnetwork	10 T	±1%	750	±500	±25	1	precision thick film resistors in a T-Network	5000
20T-Tnetwork	20 T							
50T-Tnetwork	50 T							
100T-Tnetwork	100 T							

SRC-Tnetwork RESISTANCE STANDARD

CONSULT INSTRUCTION MANUAL FOR PROPER INSTRUMENT OPERATION

Initial adjustment to nominal: $\pm 1\%$

Stability: ± 500 ppm/yr

Temp coef: ± 25 ppm/ $^{\circ}\text{C}$

Voltage coef: 1 ppm/V

Maximum Voltage: 5000 V

Observe all safety rules when working with high voltages or line voltages. Connect the (G) terminal to earth ground in order to maintain the case at a safe voltage. Whenever hazardous voltages (>45 V) are used, take all measures to avoid accidental contact with any live components: a) Use maximum insulation and minimize the use of bare conductors. b) Remove power when adjusting switches. c) Post warning signs and keep personnel safely away.

SRC-100T-Tnetwork

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SCR-5156-IET - August 2022

Figure 1-1: Typical Operating Guide affixed to the SRC-100T-Tnetwork

Chapter 3

OPERATION

3.1 Initial Inspection and Setup

This instrument was carefully inspected before shipment. It should be in proper electrical and mechanical order upon receipt.

3.2 Connections

The SRC-Network is designed to be connected to an electrometer or megohmmeter such as the IET 1865 Plus.

1865 Plus Connections

When connecting to the IET 1865 Plus remove the shorting link between the GND and Guard Terminal and connect the SRC-100T as shown in Figure 3-1.

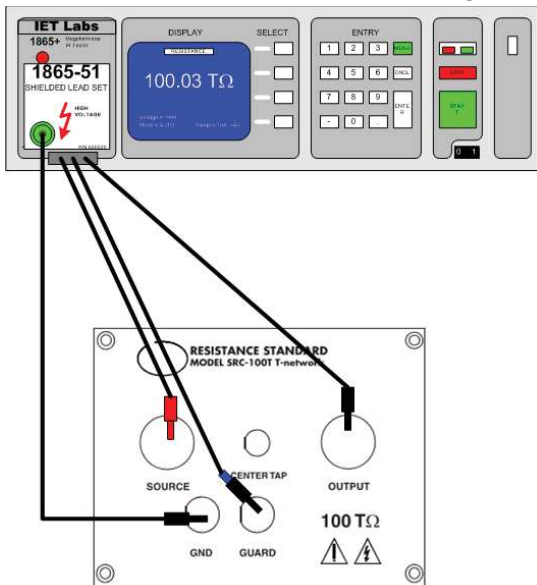


Figure 3-1 1865 Plus Megohmmeter Connection

Keithley 6517A/B Connections

When connecting to the 6517A/B make sure the shorting link is between the GND and Guard Terminal and connect the SRC-100T as shown in Figure 3-2.

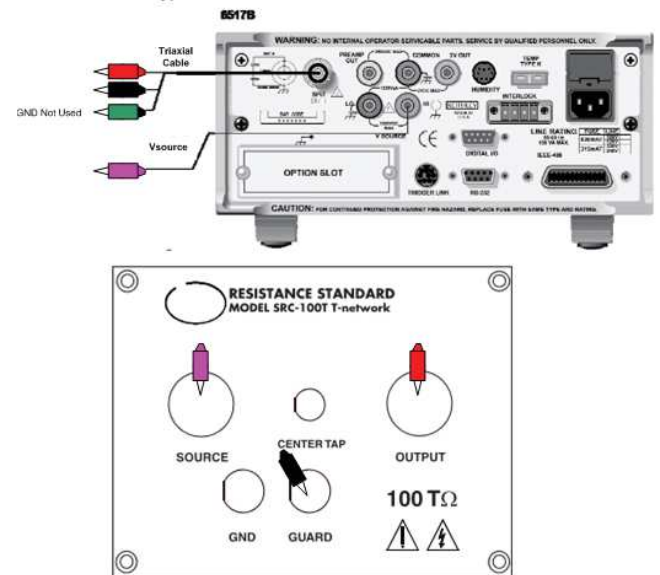


Figure 3-2 Keithley 6517A/B Connection

3.3 Environmental Conditions

3.3.1 Operating Temperature

For optimal accuracy, SRC-Tnetwork should be used in an environment of 23°C. They should be allowed to stabilize at those temperatures after any significant temperature variation.

3.3.2 Storage Temperature

The SRC-Tnetwork should be maintained within the storage temperature range of 0°C to 40°C to retain its accuracy within the specified limits.

3.4 Shipping and Handling

The SRC-Tnetwork should not be exposed to any excessive shock or temperature extremes. The option SRC-100, a lightweight transit case capable of storing two SRC-Tnetworks, is recommended for shipping or transporting the models.

Chapter 4

MAINTENANCE

4.1 Maintainability and Reliability

It is possible to maintain SRC-Tnetwork indefinitely. They are reliable due to their closed, rugged design and resistors. The units are resistant to electromagnetic interference (EMI) because of their metal enclosure.

4.2 Preventive Maintenance

Keep the SRC-Tnetwork in a clean environment. This will help prevent possible contamination.

The front panel may be cleaned to eliminate any leakage paths from near or around the binding posts. To clean the front panel:

Wipe the front panel clean using alcohol and a lint-free cloth.

4.3 Calibration

The SRC-Tnetwork may be employed as stand-alone instruments or as an integral components of a system. If used as part of a system, they should be calibrated as part of the overall system to provide an optimum system calibration.

If an SRC-Tnetwork is employed as a stand-alone device, the following should be observed:

- Calibration Interval
- General Considerations
- Required Equipment
- Calibration Procedure

4.3.1 Calibration Interval

The recommended SRC-Tnetwork calibration interval is twelve (12) months.

If the instrument is used to transfer resistance values only, recalibration is not required, assuming that there has been no drastic change of value.

4.3.2 General Considerations

Before starting the calibration procedure, you need to consider the following:

- Calibration environment should be 23°C and less than 50% relative humidity.
- Test instruments should be sufficiently more accurate than the SRC-Tnetwork, and/or the uncertainty of the measurement instrumentation has to be considered in the calibration Test Uncertainty Ratio (TUR).
- The testing equipment and the SRC-Tnetwork unit should stabilize at laboratory conditions for at least 24 hours.
- Steps should be taken to minimize thermal emf effects, such as using a meter with “True Ohm” capacity.
- Accepted metrology practices should be followed.

4.3.3 Required Equipment

Many combinations of standards, transfer standards, meters, and bridges may be used to calibrate this instrument. The following are some possible choices:

- A dual source guarded bridge
- A high-precision, high-stability digital multimeter (e.g. Fluke 8508A, Fluke 8588A or Keysight 3458A) or other DMM with an accuracy of 20 ppm or better for direct measurements.

4.3.4 Calibration Procedure

To calibrate an SRC-Tnetwork proceed as follows:

1. Set up the calibration equipment in the resistance measurement mode.
2. Measure R1, R2 and R3. The bnc center tap connection is there to assist in measuring these resistances without opening the standard. Just measure between the center conductor of the bnc and the Source, Guard and Output terminals.
3. Calculate the Effective R using the formula in Figure 4.1
4. Confirm that the resistance is consistent with historical measurements to verify stability.

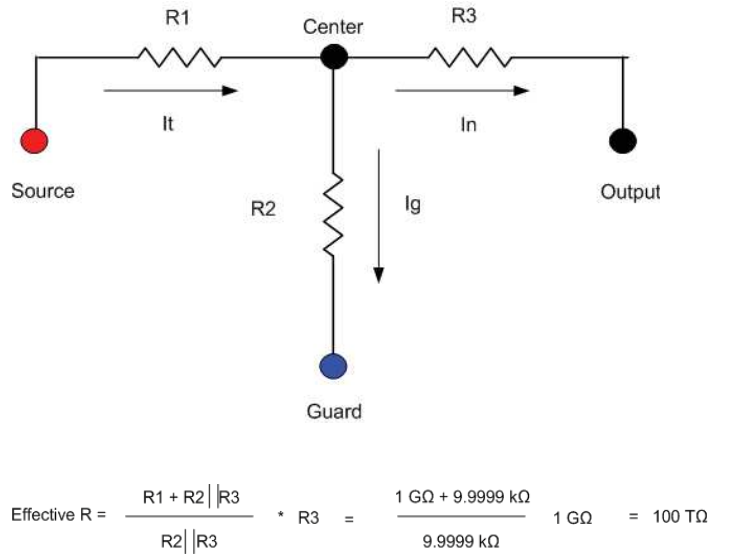


Figure 4-1 Schematic and formulas

