

# PRECISION THERMAL RESISTANCE ANALYZERS

(A.C./D.C./PULSE)

**Introduction:**

Precision pulse thermal resistance/conductivity analyzers in 8 different regular models apart from tailor models (two/three point/four points) solutions virtually covering all industrial and research applications meeting all electrical, thermal, mechanical, and environmental specifications. These analyzers has in-built variable frequency excitation thermal power source to measure ultra high/low resistivity of sample elimination thermal polarization effect . These analyzers are first choice for online measurement of thermal conductivity/resistivity . These finds applications in generation, transmission/distribution, defense, electrical/mechanical m/c testing instrument, industrial electronics, railway, and avionics, textiles , concrete and solid state physical application like dielectrics characterization, switch gears, MEMS and many research and development activities. These precision instruments are compatible to any standard external heat flux/voltage sensor and power source of specification as specified under.

**Operating Principle:** Such test ring consist of 1.High thermal conductivity electrode with negligible thermo-electric voltage  
2. Connection between the sample conductors and the sample electrode. To measure this conductivity for variety of thermal application. Following technique is used...



MTCA-0009991 (Three point measurement)



MTCA- 0099991(four-point measurement profile)



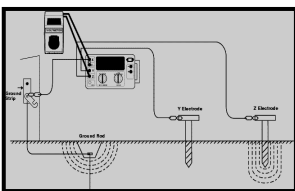
MTCA-9999992 (four -point measurement)

**Four point thermal potential measurement system:**

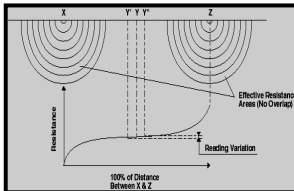
The 4-point method requires the insertion of four equally spaced and in-line electrodes into the test area. A known heat flux passes from a constant heat source between the outer electrodes. The differential thermal drop (a function of the thermal resistivity) is then measured across the two inner electrodes.

$R = (n \times p) / (4 \times \text{pie} \times a)$ , when  $b \gg a$  where...  $a = \text{distance between holes}$ ,  $b = \text{depth of hole}$ :  $n = b/a$ ,  $p = \text{sample resistivity}$   
 $R = (n \times p) / (2 \times \text{pie} \times a)$ , when  $b \ll a$  where...  $a = \text{distance between holes}$ ,  $b = \text{depth of hole}$ :  $n = b/a$

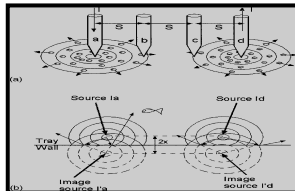
$D1=0.63D2/D2=5 \times D3$



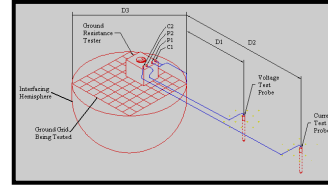
Three point measurement



three point thermal resistance profile



four-point earth measurement profile



electrode arrangement in three point potential method

**2.Three-point thermal potential measurement system/ fall of thermal Potential Method:** A measured constant heat flux is passed between the electrode under test 'X', and the remote Heat flux electrode 'C'. The differential thermal drop between 'X', and the remote thermal electrode 'P' is measured. The thermal resistance of the electrode under test is then the voltage between 'X' and 'P', divided by the heat flux flowing between 'X' and 'C', provided there is no overlap of the thermal resistance areas of the electrodes. The thermal resistance area is where the incremental thermal drop is still significant, owing to localized heat flux flows. Further this test is measure the ability of measure pulse dissipation of thermal energy in sample from source. To measure the energy dissipation capacity of sample electrode, known heat flux is generated by the model MTCASS-025032 between the heat flux electrode and the sample , while the drop in thermal potential drop is measured between the two point of sample. To obtain a reliable measurement. In general, reliable results may be expected if the distance between the heat source and the sample under test is at least ten times the maximum dimension of the electrode system, e.g. 30 m for a 3 m electrode system. The optimum position is the point on the curve where reading variation is minimal. Provided there is reasonable homogeneity of the sample, the distance apart is adequate, and the straight line of the electrodes is maintained, the Theoretical value of sample thermal resistance is

$R_{\text{meas}} = p/2 \times \text{pie} [1/r - 1/C - 1/P + 1/C - P]$

$p = \text{sample thermal resistivity}$ ,  $\text{pie} = 3.14(\text{nepier constant})$   
 $r = \text{radius of hemispherical}$   $C = \text{distance between sample electrode and source electrode}$ ,  
 $P = \text{distance between sample electrode and sensing electrode}$

**3.Isothermally Isolated thermal resistance meter:**

These isothermally isolated thermal resistance has two high frequency thermal source namely energizing coil which inject controlled heat flux in sample through thermal conductor and sensing electrode is the proportional to differential temperature. Its main advantage is to measure thermal conductivity/resistivity in highly non-conductive materials It gives a fairly correct reading of these parameters. model no. MTCA-9999992002/ MTCA- 9999992003 corresponds to this.

**Benefits:**

- High input impedance/Low input biased heat flux /higher accuracy.
- 5-1/2 & 6-1/2 digit display /consistent performance over large temperature/humidity range (300°C and 80 % RH)
- Scaled directly in ohm to micro-watt/mili.K. in step down range to 1:100000 with repeatable accuracy.
- Auto/manual zero offset without drift. /Auto drift tracking
- RS-32 interface/high sample rate – 10,000 sample/second. / Feed back heat flux measurement technique.
- Inbuilt climatically temperature/pressure compensated.

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**PRECISION THERMAL RESISTANCE ANALYZERS**

(A.C./D.C./PULSE)

**Micro-Kelvin Thermal Conductivity analyzers static/dynamic.**

Range &lt; 999999 micro/mili Kelvin

Model	Range °C	Thermal resistivity mili .K/kilowatt	Pulse/D.C./Pulse Frequency Range	Thermal Burdon	Accuracy Restricted to Resolution level	Resolution Quantified/ optional	Thermal source /optional As demanded	interface
MPTCA-9999990101	05.0/02.0 -999999 mili°C 0009999-0999999 °C	05.0 – 999999x10 <sup>-3</sup>	0.0-20 cycle	< 100 mili °C	99.99999%	2/5/10 mili °C	05.0/02.0 -999999 mili°C 0009999-0999999 °C	RS-232USB
MPTCA-9999990401	05.0/01.0 -999999 mili°C	05.0 – 999999x10 <sup>-3</sup>	0.0-20 cycle	< 100 mili °C	99.99999%	2/5 /10mili °C	05.0/02.0 -999999 mili°C 099.999-0999999 °C	RS-232/USB
MPTCA-9999990102	10.0/05.0 -999999mu°C	05.0 – 999999x10 <sup>-6</sup>	0.0-20 cycle	< 100 micro °C	99.99999%	2/5/10 micro °C	05.0/02.0 -999999 mili°C 099.999-0999999 °C	RS-232/USB
MPTCA-9999990402	10.0/01.0 -999999mu °C	05.0 – 999999 x 10 <sup>-4</sup>	0.0-20 cycle	< 100 micro °C	99.99999%	2/5/10 micro °C	05.0/02.0 -999999 mili°C 099.9999-0999999 °C	RS-232/USB

**Isothermal power source specification:**

Operating voltage: 220 volt A.C. (50-20,000 Hz)/ 12 volts D.C.  
 Measurement range (full scale): as above in different model.  
 Resistivity range: as above.  
 Temperature range: as above  
 Input capacitance: 10 nF  
 Response time: 1000 sample/sec  
 Burden: less than 100 micro volt/full scales current or better  
 Accuracy: 0.5/1.0/2.0 % reading  
 Repeatability: 100 of reading  
 Thermal Resolution: 1/5 micro/mili.kelvin  
 Linearity adjustment: upto 100 least count  
 Input imedence: ultra low(<1000 count burdon),  
 Filtering: low pass( adjustable)  
 Offset: variable upto 10,000 least count (manual/auto)  
 CMMR: >80 db at 50-60 Hz  
 Isolation: > 100 giga ohm  
 Connector: BNC-9 pinx2 and BNC-25 pinx2  
 Size: 5X8X8 inches/rack mounted or portable  
 Interface: RS-232

Option : **ADDITIONAL SOFTWARE to plot V/I OR ANY DESIRED INFERENCEAL PARAMETER. THESE SPECIFICATIONS OR PART THERE OF MAY BE MODIFIED TO MEET ANY TAILOR MADE SOLUTIONS.**

**Specifications of Isothermal Power Source**

Differential Temperature: 600degree cel

Model	Temperature	Watts	Vmax	Imax	Repetition rate in case of Pulse/sec x10	Resolution % Of FSM	Ripple	Accuracy %-Reading	Step down Range	Cooling
MITPS-012002	024.0	024.0	12.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-025005	050.0	050.0	25.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-025002	025.0	025.0	25.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-025005	050.0	050.0	25.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-050005	005.0	005.0	50.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-050005	050.0	050.0	50.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-100001	010.0	010.0	100.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-100020	100.0	100.0	100.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-200002	020.0	020.0	200.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-200002	200.0	200.0	200.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air
MITPS-200004	040.0	040.0	400.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1:1000000	Air

**Constant Isothermal Power Source Dimension:**

MITPS-006050	08X06X06	MITPS-050150	14X12X12
MITPS-012050	10X06X06	MITPS-050200	16X14X14
MITPS-012100	12X08X08	MITPS-100025	18X16X16
MITPS-025025	12X10X10	MITPS-100050	20X18X18
MITPS-025050	12X10X10	MITPS-100100	20X18X18
MITPS-025100	12X10X10	MITPS-100150	20X18X18
MITPS-0025200	08X06X06	MITPS-100200	14X12X12
MITPS-050050	10X06X06	MITPS-100400	16X14X14
MITPS-200050	18X16X14	MITPS-200100	18X16X16

Three numerals x 100 after MHCLS indicates voltage of power supply and last three-digit Indicates current. All dimensions are in inches.

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# PRECISION THERMAL RESISTANCE ANALYZERS

(A.C./D.C./PULSE)

## Isothermal power source specification:

Operating voltage 220 volts, 1phase, 40-60 Hz

Output current/voltage :as in data sheet(linear/pulse)

Voltage/current control accuracy: 99.9999% of set point or better for CT

Ripple: 0.00001% of set point for voltage/0.00001% for CT or optional/amended

**Resolution:** 1/5 nV & 1/5 nano amps or 1/5 nV & 1/5 pico-amp or optional and may be altered based on time behavior of signal

Range (V/I): Voltage: 10-09-10-04 volt/10-4-10+1 volt least count- 5.0 nano volt

Current: 10-12-10-07 amp/10-7-10-2 amp least count- 5.0 pico ampere or optional

Accuracy: 0.000001% of set volts for (CV mode/0.000001% of set current (CC mode)

Interface Signal 0.0-12.0 volts D.C. (proportional to Voltage/current control range)

Step down ratio 0-1000000 or option

Temperature coefficient of variation: &lt; 10-912ppm

Control options 1. Slide mode with soft start

Display 5 1/2 &amp; 6 1/2 digit LED display

OTHER OPTION: DC/AC/PULSE (100-10000 PULSE/SEC)

Protection over voltage/short ckt

Option: These power supplies may offer in pulse mode.

Interface:

RS-232/U.S.B.



MHCLS-024100



MHCLS-024100



MHCLS-100100

### Specifications OF CONSTANT VOLTAGE POWER SOURCE

Power range &lt; 400 watts

Model	Watts	Vmax	I <sub>max</sub>	Repetition rate in case of pulse/sec x10	Resolution Quantified/ optional	Ripple	Accuracy %-reading	Zout 10-6	Step down range	Cooling
MHCLS1-012002	024.0	12.0	002.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-012004	048.0	12.0	004.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-012008	096.0	12.0	008.0	100-10000	5 nV/5pA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-025005	050.0	25.0	002.0	100-10000	5 nV/5pA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-025010	0100.0	25.0	004.0	100-10000	5 nV/5pA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-025020	0200.0	25.0	008.0	100-10000	5 nV/5pA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-025032	0325.0	25.0	015.0	100-10000	5 nV/5fA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-050020	0200.0	50.0	004.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-050004	0400.0	50.0	008.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-100010	0100.0	100.0	001.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-100020	0200.0	100.0	002.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-200004	0400.0	200.0	002.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-200008	0800.0	200.0	004.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-400020	2000.0	400.0	005.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air
MHCLS1-999002	2000.0	1000.0	002.0	100-10000	5 nV/5nA	0.00001%	99.99999%	< 10	1:1000000	Air

Company offer voltage source in high voltage ranges upto 100 kilo volts/10 mill amps. These are not part of our Regular model.

### Specifications OF CONSTANT CURRENT POWER SOURCE

Power range &lt; 200 watts

Model	Watts	Vmax	I <sub>max</sub>	Repetition rate in case of pulse/sec x10	Resolution % of FSM	Ripple	Accuracy %-reading	Zout	step down Range	cooling
MHCLS1-012002	024.0	12.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-025005	050.0	25.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-025002	025.0	25.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-025005	050.0	25.0	002.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-050005	005.0	50.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-050005	050.0	50.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-100001	010.0	100.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-100020	100.0	100.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-200002	020.0	200.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-200002	200.0	200.0	001.0	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air
MHCLS1-200004	040.0	400.0	000.1	100-10000	0.0000001%	0.000001%	99.999999%	1018	1:1000000	Air

Three numerals x 100 after MHCLS indicates voltage of power supply and last three digit Indicates current. All dimensions are in inches.

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# PRECISION CONSTANT VOLTAGE/CURRENT POWER SUPPLIES

Programmable/Non-programmable

MHCLS-Series

## Constant voltage/ current power source specification:

Operating voltage 220 volts, 1phase, 40-60 Hz

Output current/voltage :as in data sheet(Linear/pulse)

Voltage/current control accuracy: 99.9999% of set point or better for CC/CV

Ripple: 0.000001% of set point for voltage/0.000001% for CC or optional/amended

**Resolution:** 1/5 nV & 1/5 nano amps or 1/5 nV & 1/5 pico-amp or optional and may be altered based on time behavior of signal

Range (V/I): Voltage: 10-09-10-04 volt/10-4-10+1 volt least count- 5.0 nano volt

Current: 10-12-10-07 amp/10-7-10-2 amp least count- 5.0 pico ampere or optional

Accuracy: 0.0000001% of set volts for (CV mode/0.0000001% of set current (CC mode)

Interface Signal 0.0-12.0 volts D.C. (proportional to Voltage/current control range)

Step down ratio 0-1000000 or option

Temperature coefficient of variation: < 10-912ppm

Control options 1.cascade feedback control with soft start

2. Constant voltage mode with external adjustment.

Display 5<sup>1/2</sup> & 6<sup>1/2</sup> digit LED display

OTHER OPTION: DC/AC/PULSE (100-10000 PULSE/SEC)

Protection over voltage/short ckt

Option: These power supplies may offer in pulse mode.

Interface: RS-232/U.S.B.

## Constant voltage/current power source dimension:

MHCLS-006050	08X06X06	MHCLS-050150	14X12X12
MHCLS-012050	10X06X06	MHCLS-050200	16X14X14
MHCLS-012100	12X08X08	MHCLS-100025	18X16X16
MHCLS-025025	12X10X10	MHCLS-100050	20X18X18
MHCLS-025050	12X10X10	MHCLS-100100	20X18X18
MHCLS-025100	12X10X10	MHCLS-100150	20X18X18
MHCLS-0025200	08X06X06	MHCLS-100200	14X12X12
MHCLS-050050	10X06X06	MHCLS-100400	16X14X14
MHCLS-200050	18X16X14	MHCLS-200100	18X16X16

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