RESISTANCE AND TEMPERATURE MEASUREMENT WHERE PRECISION MATTERS

UTECO

www.uteco.mk
www.festo-didactic.com.mk

A PRECISE MEASUREMENT IS A VALUABLE PIECE OF INFORMATION. AN IMPRECISE MEASUREMENT ISN'T.

We produce a wide range of high quality measuring instruments and standards and have done for over 50 years.

Our range of products covers all aspects of resistance and temperature measurement. Our resistance meters range from hand-held to high powered bench micro ohmmeters. We pride ourselves on accuracy and reliability of measurement with our entry level model having 1 micro ohm resolution.

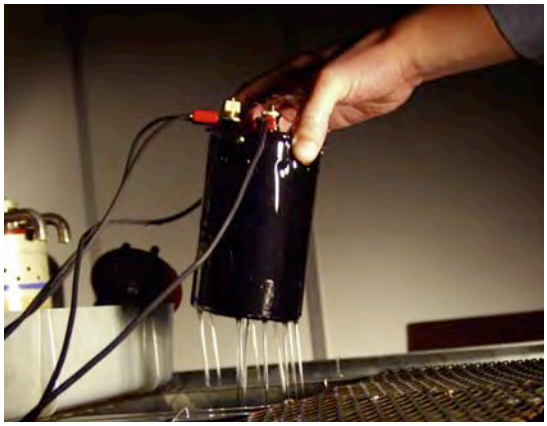
We offer a wide range of micro ohmmeters so we can provide the best instrument for your resistance measurement needs.

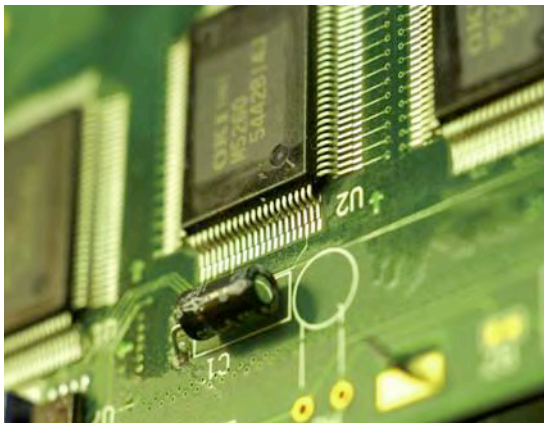
To compliment our range of units we also have all the accessories you could ever need, these range from cable clamps with built-in water baths to a calibration resistor.

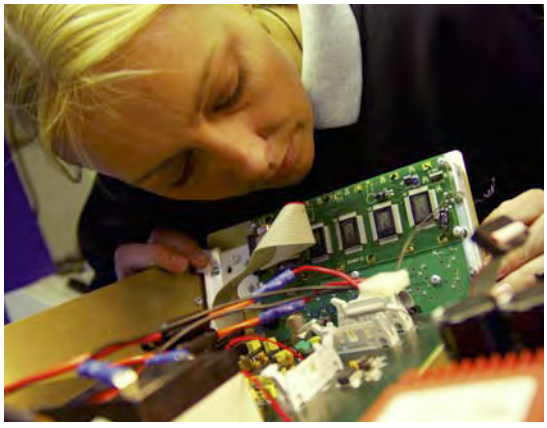
We also have an industry leading range of thermometers, these units are upgradeable to take up to 8 extra channels, giving 10 input channels, this makes our units ideal for use in medical autoclaves where 9 channels are required for measuring, with one channel for reference. Our thermometers offer accuracy of 0.01°C, with a resolution of 0.001°C. We also offer the ability to mix and match between Pt25, Pt100 and thermocouples, these features make this range of units unchallenged in the industry.

Cropico also have a range of Resistance Decade boxes and Resistance standards. We have Resistance Decade boxes covering ranges from 0.001 ohm to 1 Tera ohm. Some of the high accuracy decade boxes are suitable for Pt100 simulation. Our Resistance standards are among the most stable in the world, having typical stability of 0.001% over the year, this is achieved by using only the best and most carefully selected components.

We also believe that flexibility is key to customer satisfaction, therefore, if you want special jigs, fixtures or cables please let one of our dedicated staff know and we will be able to work out a solution.







RESISTANCE MEASUREMENT

Cropico specialise in low resistance measurement and offer a variety of ohmmeters to cover the various applications and customer circumstances. Typical applications are listed on the next page.

Some applications and testing standards require special leads and jigs for connecting to the sample under test. We offer a wide range of connecting leads, and have a number of standard jigs available. We will always be happy to supply special jigs if required, all we need is the drawing, a description of the application, or a sample of the item to be measured.

These application notes are intended to explain good measurement practice and highlight some of the more common sources of error.

Four Terminal Measurement

When measuring resistance below 100 ohm it is advisable to use a four wire measurement technique, this is often referred to as a Kelvin or Thomson configuration. By using this type of measurement configuration the connecting lead resistance is not included in the measurement, and the need for lead balancing and nulling is eliminated.

The measuring current is passed through the unknown resistance Rx using the current leads. The placing of these leads is not critical but should always be outside the voltage leads. The voltage across Rx is measured with the voltage probes and these should be placed at exactly the points where the resistance is to be measured. The measuring current is simultaneously passed through an internal reference resistor in the ohmmeter and the voltage across Rx is compared with the voltage across this internal standard. From the ratio of these two voltages the resistance value of Rx is calculated and displayed. Because the same current is passed through both the standard and the Rx and the ratio is calculated, the current does not need to be a precise value, all that is required is that the current is stable for the period during which each measurement is made, typically 0.5 seconds.

The most common cause of errors when making low resistance measurement is due to poor or inappropriate connection of the Rx. Connections should be clean, mechanically firm and free from oxides which can cause an insulating effect.

Measuring Current

It is a misconception by a lot of customers that they must have a high measuring current, the higher the better they believe. This was true of the older digital instruments and their predecessor, the Kelvin Bridge. High currents were needed to realise sufficient voltage across Rx measurement.

With today's measuring components and techniques we are able to reliably and consistently measure these low voltages and make reliable and accurate measurements at the low currents. The disadvantages of using high currents are; added cost, added weight to instrument, increased size of instrument and less measuring time when batteries are used. Test current heats up the Rx and changes its value, and possible introduction of thermal E.M.F's which will affect the reading accuracy.

There are however, some applications where Test Specifications demand higher measuring currents and there is an argument that says a higher test current also tests the mechanical integrity of joints, i.e. if only a strand of wire is making the connection a high test current would burn away this strand. We believe there are better and more reliable ways of testing a joint's mechanical integrity.

Possible Measurement Errors

Poor Connection:

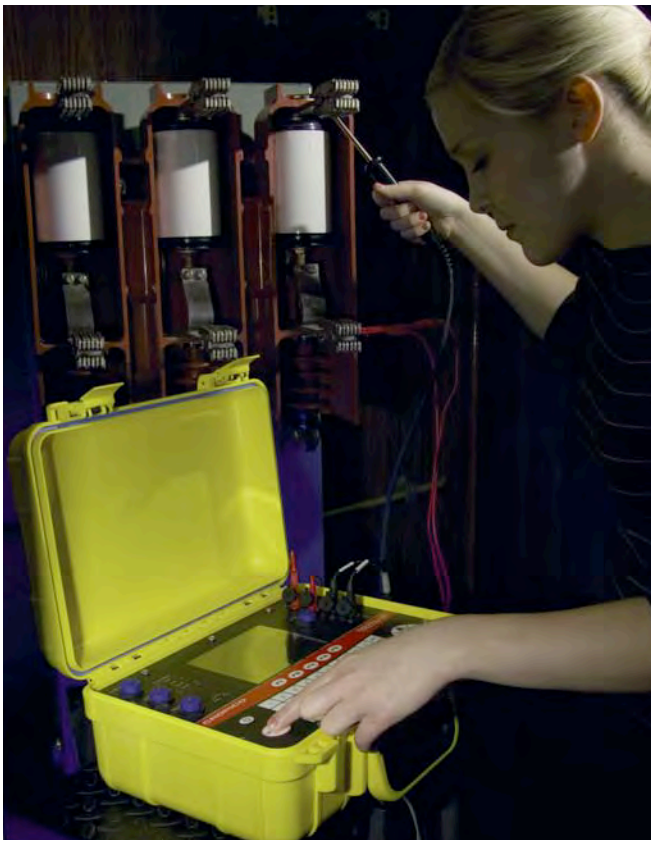
Most causes of measurement error can be traced back to poor or inconsistent connection to the object under test. In many cases it is desirable, if not essential, to make a jig to suit the particular component, this ensures that the voltage connections are always made at the same point on the sample. We offer a variety of jigs and test leads, detailed in the product accessory sections.

Thermal E.M.F:

Another source of error can be thermal E.M.F. When two dissimilar metals are joined together an E.M.F. can be generated (thermocouple effect). Most ohmmeters use a dc measuring system to ensure true DC resistance, and not AC impedance, is measured. If the Rx resistance is also generating an E.M.F. it is obvious that this will add or subtract to the E.M.F. measured at the voltage connections. This is overcome by making two measurements and reversing the current connections on the second measurement. The two readings are averaged to give the correct answer; Rx = (R1 + R2)/2.

Most of the Cropico ohmmeters have the ability to select forward or reverse measurement current and to automatically average the two readings thus displaying the correct value.

Simple precautions should also be taken when making connections. The material used should be carefully selected, for example Nickel Plated Brass connecting clips can cause very large thermal E.M.F.'s to be generated when connected to copper wires. For best results unplated copper or brass leads and fittings should be used.



Typical Applications

There are many reasons why resistance of material is measured, and here are a few:

■ Manufacturers of components such as resistors, inductors and chokes all have to verify that their product meets the specified resistance tolerance, end of production line and quality control testing.

■ Manufacturers of switches, relays and connectors all need to verify that the contact resistance is below pre specified limits, end of production line testing and quality control.

■ Cable manufacturers must measure the resistance of the copper wires they produce. Resistance too high means that the current carrying capability of the cable is reduced, resistance too low means that the manufacturer is being too generous on the cable diameter using more copper than he needs to, this can be very expensive.

■ Installation and maintenance of power cables, switchgear and voltage tap changers require the cable joints and switch contacts to be of the lowest possible resistance thus avoiding the joint or contact becoming excessively hot. A poor cable joint or switch contact will soon fail due to this heating effect. Routine preventative maintenance with regular resistance checks ensures the best possible life performances.

■ Electric Motor and Generator manufacturers need to determine the maximum temperature reached under full load. To determine this temperature, the temperature coefficient of the copper winding is used. The resistance is first measured with the motor / generator cold i.e. at ambient temperature, the unit is then run at full load for a specified period and then the resistance measured again from the change in resistance value, so the internal motor / generator temperature can be determined. Our ohmmeters are also used to measure the individual coils of a motor winding to ensure there are no short or open circuit turns and that each coil is balanced.

■ Those in the Automotive Industry need to measure the resistance of Robot Welding Cables to ensure that the weld quality does not deteriorate. Cropico products can also be used to measure battery lead crimp connectors, air bag detonator resistance, resistance of wiring harnesses and quality of crimp connectors on components.

■ Fuse manufacturers need to measure resistance for quality control.

■ Resistance bonding measurements on aircraft and military vehicles must be measured. It is necessary to ensure that all equipment installed in aircraft is electrically connected to the air frame, this includes galley equipment. Tanks and other military vehicles have the same requirements. Producers and users of large electrical currents all need to measure distribution joint resistance, bus bars and connectors to electrodes for electroplating.

■ Railway utilities including trams and underground railways (Metro) use the equipment for the measurement of power distribution cable joints. The resistance of rail track joints also needs measuring as the rails are often used for signalling information.

PRODUCT COMPARISON TABLE FOR RESISTANCE MEASUREMENT

	4000	4001	4002	DO4A	DO6	DO7e	DO7	DO7Plus	DO7010	DO5000	DO5001	DO5002
Ranges	40mΩ to 4kΩ	40mΩ to 4kΩ	4mΩ to 400Ω	40mΩ to 4kΩ	20mΩ to 200kΩ	6mΩ to 600Ω	600μΩ to 60Ω	6mΩ to 6KΩ	6mΩ to 6Ω	3mΩ to 30kΩ	3mΩ to 30kΩ	200mΩ to 30kΩ
Resolution	10μΩ	10μΩ	1μΩ	10μΩ	1μΩ	1μΩ	0.1μΩ	0.1μΩ	1μΩ	0.1μΩ	0.1μΩ	10μΩ
Accuracy	0.1%	0.1%	0.1%	0.1%	-	0.25%	0.25%	0.05%	0.2%	0.03%	0.03%	0.03%
Man/Auto Range	Yes	Yes	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Measuring Current	1mA to 100mA	1mA to 100mA	1mA to 1A	1mA to 100mA	9μA to 900mA	1mA to 10A	1mA to 10A	100mA to 10A	100mA to 10A	10μA to 10A programmable	10μA to 10A programmable	10μA to 100mA programmable
Auto Average	Yes	Yes	Yes	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mains/Battery	Battery Rechargeable Option	Battery Rechargeable Option	Battery Rechargeable Option	Mains/Batt	Mains	Mains/Batt	Mains/Batt	Mains/Batt	Rechargeable Battery	Mains	Mains/Bat	Mains
Input Protection	415V rms	415V rms	415V rms	415V rms	45V rms	415V rms	415V rms	EN61010-1: 2001 cat 3	45V rms	415V rms	415V rms	415V rms
Temp Compensation	-	Yes	-	-	Yes	-	-	Yes	-	Yes	Yes	Yes
Hi/Low Limits	-	-	-	-	Yes	-	-	Yes	Yes	Yes	Yes	Yes
Data Logging	-	-	-	-	-	-	-	Yes	Yes	Yes	Yes	Yes
Interfaces	-	-	-	-	RS232	-	RS232	RS232/ USB	RS232	RS232 / IEEE488 / PLC	RS232 / IEEE488 / PLC	RS232 / IEEE488 / PLC
Fast Measure Mode	-	-	-	-	-	-	-	-	-	50 meas. / s	50 meas. / s	50 meas. / s

INDUSTRY COMPARISON TABLE FOR RESISTANCE MEASUREMENT

Ohmmeter	Automotive	Aerospace	Cable	Calibration Labs	Drivers and electrical machines	Distribution catalogues	Military	Manufacturing	Utilities; electrical, water and gas
	Manufacturers of vehicles and components - motors, alternators, connectors, cable harnesses, switches	Bonding resistance (metallization) of aircraft frames and all equipment	Measurement of cable resistance	Calibration standards	Measurement of motor, generator and transformer resistance		Army, Navy, Air force, bonding resistance of vehicles and equipment. Calibration of equipment	Resistance measurement of components, switches, connectors, crimp joints, fuses etc	Measurement of power cable joints, underground and pylon. Measurement of earthing resistance and contactor resistance in substations
DO4000 Series	■	■				■	■	■	■
DO4A		■			■		■	■	■
DO5000 Series	■		■	■	■		■	■	
DO6	■		■					■	
DO7	■	■			■	■	■		■
DO7e	■	■				■	■		■
DO7Plus	■	■	■		■	■	■	■	■
DO7010	■	■					■	■	■

DO4A

RUGGED, PORTABLE DIGITAL OHMMETER WITH 415V PROTECTION, DIGITAL CALIBRATION & 4000 COUNT

The DO4A is a practical instrument for low resistance measurement, ideal for use in the workshop, field or test facilities. It is of rugged construction contained in an aluminium case with tilt handle. The DO4A has many advanced features, including protection up to 415 volts rms, digital calibration and long scale length (4000 count). The rechargeable sealed lead acid battery means real portability with more than 14 hours continuous operation, without the problems normally associated with other battery types. Full measurement capability is maintained while charging. For ease of operation the control functions have been kept to a minimum and are clearly marked. It is of course direct reading, warning LEDs illuminate when an open circuit lead condition is detected. Over range and low battery indication is also provided. The DO4A is supplied ready for immediate use with battery, mains cord and measuring leads, no extras are normally necessary. The 15mm LCD provides easy viewing and the instrument can be used in any position for many and varied applications. The test leads provided have a length of 1 metre with spade tags for connection to the ohmmeter terminals. They are terminated in combined current and potential probes that will accept conductor diameters up to 6mm.

KEY FEATURE	DO4A
True 4 wire measurement eliminates lead resistance errors	■
6 push button ranges 40 milli ohm… 4 kilo ohm with long scale length	■
10 micro ohm resolution on 40 milli ohm range	■
Input protection up to 415 Volts rms	■
Zero control thermal E.M.F. compensation	■
Digital calibration	■
Mains / rechargeable battery operation	■
Open circuit lead warning	■
Rugged industrial maintenance free design	■
Universal mains supply 100 / 200 / 220/ 240 Volts +10% - 13%	■

DO4A SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy @ 20°C ±5°C 1 year	Temperature Coefficient/°C
4kΩ	1Ω	100µA	±(0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
400Ω	100mΩ	1mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
40Ω	10mΩ	10mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
4Ω	1mΩ	10mA	± (0.05% Rdg +0.03% FS)	30ppm Rdg + 4ppm FS
400mΩ	100µΩ	10mA	± (0.05% Rdg +0.05% FS)	30ppm Rdg + 25ppm FS
40mΩ	10µΩ	100mA	± (0.05% Rdg +0.05% FS)	30ppm Rdg + 25ppm FS

Measurement

4 terminal Kelvin/Thomson principle eliminates errors due to lead resistance

Display

15mm LCD 4000 count with automatic decimal point and polarity indication

Ranges

6 push button selected with LED indication

Terminals

4mm binding posts accept spade tags and 4mm banana plugs

Working Temperature

0°C to +40°C re. humidity 80% max. non-condensing

Storage Temperature

-20°C to +50°C

Mains Supply

100/120/220/240V +10% to 13%
47Hz to 63Hz 20VA

Safety

EN 61010-1 EMC-EN 61236

Dimensions

15mm x 250mm x 88mm (W H D) approx
1/2 19" rack 2U high
467mm x 374mm x 216mm packed in carton

Mass

3.5kg approx. 4.5kg packed in carton

Auto Zero

Permits the automatic zero of amplifiers and external circuits, eliminating errors due to thermal E.M.F.

Protection

415 Vrms maximum at the measuring terminals will blow internal protection fuse

Calibration

Digital security key protected

Battery

6V 2.8Ah sealed lead acid battery with built-in charger. 14 hour typical operating time on lowest range, 28 hours typical on other ranges. Internal charger and automatic switch off

CODE	ITEM	DO4A OPTIONS
C02	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 0.1…100mm^2	
C02A	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 1…1000mm^2	
C03	1 metre cable clamp with water bath for the precise measurement of 1 metre cable samples 1…1000mm^2	
CB01	Carrying bag	
HS01	Duplex handspikes with 3 metre lead length	
HS02	Duplex handspikes with 3 and 15 metre lead length	
LS03	Lead set with 2 x 3 metre leads terminated in large Kelvin clips type KC3	
LS04	Lead set with 3 metre and 15 metre lead length terminated in large Kelvin clips type KC3	
LS05	Lead set with 4 x 1 metre leads terminated in banana plugs, 4 x crocodile clips, 4 x test probes and 2 x Kelvin clips type KC1	
LS06	Lead set with 1 metre leads terminated in miniature Kelvin clips type KC2	
MTS2	Calibration standard	
CHO1	Concentric handspikes	

DO4000 SERIES

HAND HELD, GENERAL PURPOSE, PORTABLE DIGITAL MICROHMMETERS COMBINING ALL THE FEATURES YOU MIGHT NEED

The series D04000 digital micro ohmmeters offer true portability without any sacrifice to accuracy or functionality. These ruggedly constructed instruments are housed in a stylish plastic case with easy to use keyboard. The measured values are displayed on a large LCD screen which allows for ease of viewing.

Automatic or manual range selection is available and many advanced features are included. The table below will help with your selection needs as there are 3 models in the range.

KEY FEATURE	DO4000	DO4001	DO4002
True 4 terminal measurement eliminates lead resistance errors	■	■	■
Measuring range from 40 milli ohm to 4 kilo ohm	■	■	
Measuring range from 4 milli ohm to 400 ohm			■
10 micro ohm resolution	■	■	
1 micro ohm resolution			■
True zero capabilities	■	■	■
Digital Calibration	■	■	■
Auto / Manual range selection	■	■	■
Automatic temperature compensation		■	
Temperature measuring range -50 to +800 °C		■	
Open circuit lead warning on display	■	■	■
100mA measuring current	■	■	
1A measuring current			■
Auto power off to maximise battery life	■	■	■
MEIGaN Compliant			■

DO4000/DO4001 SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy @ 20°C ±5°C 1 year	Temperature Coefficient/°C
4kΩ	1Ω	100µA	±(0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
400Ω	100mΩ	1mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
40Ω	10mΩ	10mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
4Ω	1mΩ	10mA	± (0.05% Rdg +0.03% FS)	30ppm Rdg + 4ppm FS
400mΩ	100µΩ	10mA	± (0.05% Rdg +0.05% FS)	30ppm Rdg + 25ppm FS
40mΩ	10µΩ	100mA	± (0.05% Rdg +0.1% FS)	30ppm Rdg + 25ppm FS

DO4002 SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy @ 20°C ±5°C 1 year	Temperature Coefficient/°C
400Ω	100mΩ	1mA	±(0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
40Ω	10mΩ	10mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
4Ω	1mΩ	100mA	± (0.05% Rdg +0.02% FS)	30ppm Rdg + 1ppm FS
400mΩ	100µΩ	1A	± (0.05% Rdg +0.03% FS)	30ppm Rdg + 4ppm FS
40mΩ	10µΩ	1A	± (0.05% Rdg +0.05% FS)	30ppm Rdg + 25ppm FS
4mΩ	1µΩ	1A	± (0.05% Rdg +0.1% FS)	30ppm Rdg + 25ppm FS

Measurement

4 terminal Kelvin/Thomson principle eliminates errors due to lead resistance

Display

15mm LCD 4000 count with automatic decimal point and polarity indication

Ranges

6 automatic or manual selection with LED indication

Terminals

4mm safety sockets

Working Temperature

0°C to +40°C rel. humidity 80% max. non-condensing

Storage Temperature

-20°C to +50°C

Safety

EN 61010-1 EMC-EN 61236

Dimensions

215mm x 130mm x 55mm (W H D) approx
467mm x 374mm x 216mm packed in carton

Mass

0.8kg approx

Zero & Ave

Buttons to null measurement offsets

Protection

415 Vrms maximum at the measuring terminals will blow internal protection fuse

Calibration

Digital security code protected

Battery

Removable pack with 5 1.5V non-rechargeable batteries. Separate rechargeable pack, charger and docking station as optional extras

CODE	ITEM	DO4000 SERIES OPTIONS
4000-01		Rechargeable battery pack includes battery cassette with rechargeable batteries. Docking station also acts as bench stand and charger
4000-02		Replaceable battery holder with non-rechargeable batteries
4000-03		Replaceable battery holder with rechargeable batteries
CB02		Carrying bag with shoulder strap and lead pouch that has a clear front panel to enable full operation
HS01-P		2 x Duplex handspike with 3 metre lead length
HS02-P		Duplex handspikes with 3 and 15 metre lead length
LS03-P		Lead set with 3 metre leads terminated in large Kelvin clips type KC3
LS04-P		Lead set with 3 metres and 15 metres lead length terminated in large Kelvin clips type KC3
LS05		Lead set with 4 x 1 metre leads terminated in banana plugs, 4 x crocodile clips, 4 x test probes and 2 x Kelvin clips type KC1
LS06-P		Lead set with 1 metre leads terminated in miniature Kelvin clips type KC2
MTS2		Calibration standard
CHO1		Concentric handspikes
RB		Rubber boots
PT01-4000		Rod type Pt100 probe with 2 metre lead
PT03-4000		Stubby Pt100 probe for ambient temperature measurement

DO5000 SERIES

A COMPREHENSIVE RANGE OF MAINS AND BATTERY POWERED DIGITAL MICROHMMETERS WITH TEMPERATURE COMPENSATION

The D05000 series of digital micro ohmmeters offer flexibility of measurement with high accuracy and exceptional functionality. The D0500 series encompass all the features required in an ohmmeter in one practical instrument.

This series of instruments have programmable measuring current in 100 steps, ensuring that we have a model in the range suitable for your application.

Automatic temperature compensation references the measurement to 20°C and Hi / Lo limits permits sorting of components with the minimum of fuss. The D05000 series all have the ability to take an external Pt100 sensor, this is easily plugged into the socket on the front of the unit.

All these functions are available as standard as well as a data logging function which stores up to 4000 date and time stamped readings. Statistical analysis of these values allows you to display the Max / Min / Average values as well as the peak to peak and standard deviation.

The range of D05000 instruments is ideally suited for laboratory testing of samples, production line testing, and with the addition of the IEEE-48 or PLC interfaces, the D05000 series may be remotely controlled and integrated into an automated testing system. RS-232 fitted as standard.

When the units are used in the fast measuring mode they can easily do 50 measurements per second.

These features are available on all of the models in the range. The D05001 only differs from the D05000 in that it can be mains and battery powered. The D05002 has a lower current capability than both of the other models.

KEY FEATURE	DO5000	DO5001	DO5002
True 4 terminal measurement eliminates lead resistance errors	■	■	■
Measuring range from 3 milli ohm to 30 kilo ohm	■	■	
Measuring range from 200 milli ohm to 30 kilo ohm			■
10 micro ohm resolution			■
100 nano ohm resolution	■	■	
True zero capabilities	■	■	■
Digital Calibration	■	■	■
Automatic temperature compensation with programmable coefficients	■	■	■
Open circuit lead warning LED	■	■	■
Current range from 10µA to 10A	■	■	
Current range from 10 µA to 10mA			■
Programmable measuring current 10% to 100% in 1% steps	■	■	■
High Accuracy 0.03%	■	■	■
Fast measuring capability of 50 measurements per second	■	■	■
Programmable High Low Limits with red / green lamps on front panel	■	■	■
Open Circuit voltage limit mode 20mV / 50mV maximum	■	■	■
Measuring current selection +I / -I and Auto average	■	■	■
Data logging with statistical analysis	■	■	■
Cable length calculations	■	■	■
Rechargeable batteries built in		■	
RS-232 Interface	■	■	■

DO5000/DO5001 SPECIFICATIONS

Range	Resolution	Minimum Current	Maximum Current	Accuracy at Full Rated Current
30kΩ	1Ω	10µA	100µA	±(0.03% Rdg +0.02% FS)
3kΩ	100mΩ	100µA	1mA	±(0.03% Rdg +0.01% FS)
300Ω	10mΩ	1mA	10mA	±(0.03% Rdg +0.01% FS)
30Ω	1mΩ	10mA	100mA	±(0.03% Rdg +0.01% FS)
3Ω	100µΩ	100mA	1A	±(0.03% Rdg +0.01% FS)
200mΩ	10µΩ	1A	10A	±(0.03% Rdg +0.01% FS)
30mΩ	1µΩ	1A	10A	±(0.03% Rdg +0.01% FS)
3mΩ	100nΩ	1A	10A	±(0.03% Rdg +0.02% FS)

DO5002 SPECIFICATIONS

Range	Resolution	Minimum Current	Maximum Current	Accuracy at Full Rated Current
30kΩ	1Ω	10µA	100µA	±(0.03% Rdg +0.02% FS)
3kΩ	100mΩ	100µA	1mA	±(0.03% Rdg +0.01% FS)
300Ω	10mΩ	1mA	10mA	±(0.03% Rdg +0.01% FS)
30Ω	1mΩ	10mA	100mA	±(0.03% Rdg +0.01% FS)
3Ω	100µΩ	10mA	100m A	±(0.03% Rdg +0.01% FS)
200mΩ	10µΩ	10mA	100m A	±(0.03% Rdg +0.01% FS)

Measurement
4 terminal Kelvin/Thomson principle eliminates errors due to lead resistance

Display
LCD graphics panel with backlit 30,000 count

Ranges
8 automatic or manual selection

Terminals
4mm safety sockets

Working Temperature
0°C to +45°C rel. humidity 80% max. non-condensing

Storage Temperature
-20°C to +60°C

Mains Supply
115/230V, +/-10%, 47Hz to 63Hz, 250VA

Safety
EN 61010-1 EMC-EN 61236

Dimensions
339mm x 324mm x 131mm (W H D) approx

Mass
DO5000 46x47x31 12kg
DO5001 46x47x31 15kg
DO5002 46x47x31 11kg

Auto Zero
Permits the zero of measurement values

Average
Automatic average and display of measurement with forward and reverse current

Auto Temperature Compensation
Automatically references measurement to temperature of 20°C or user defined temperature. User coefficients may be used. External Pt100 senses temperature manual value can be used

Hi / Lo Limits
Limit values can be set over entire measurement range

Calibration
Digital pass code protected

Protection
415 Vrms between any of the measuring terminals.

CODE	ITEM	DO5000 SERIES OPTIONS
C02	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 0.1…100mm²
C02A	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 1…1000mm²
C03-DO5000	1 metre cable clamp with water bath for the precise measurement of 1 metre cable samples 1…1000mm²
DO5000-CS	Calibration standard
HS01-P	Duplex handspikes with 3 metre lead length
HS02-P	Duplex handspikes with 3 and 15 metre lead length
IEEE-DO5	Interface IEEE-488
IEEE-L01	IEEE-488 cable 1 metre
LS03-P	Lead set with 3 metre leads terminated in large Kelvin clips type KC3
LS04-P	Lead set with 3 metre and 15 metre lead length terminated in large Kelvin clips type KC3
LS05	Lead set with 4 x 1 metre leads terminated in banana plugs, 4 x Crocodile clips, 4 x test probes and 2 x Kelvin clips type KC1
LS06-P	Lead set with 1 metre leads terminated in miniature Kelvin clips type KC2
PLC-DO5	PLC Interlace and Analogue output
PT02-DO5	Temperature probe with 2 metre lead length
CHO1	Concentric handspikes

DO7PLUS

RUGGED DIGITAL MICROHMMETER FOR LOW RESISTANCE MEASUREMENT, WITH BUILT IN TEMPERATURE COMPENSATION

The DO7Plus is a 10A Microhmmeter, suitable for applications within Aerospace, Utilities, Cable or Machine Manufacturers or where a cooling curve is required to plot peak resistance. Sealed in an IP67 case (when closed or IP53, lid open) it is ruggedly constructed to ensure durability.

The DO7Plus has a backlit LCD graphics panel, full QWERTY keyboard, temperature compensation via optional Pt100 probe, and built in coefficients for Copper and Aluminium as well as user defined. Full cooling curve facilities are built in, with real time graphical plotting on the LCD. Data log memory contents can be plotted and a curve fitted to calculate the peak resistance value when t=0.

The unit has a display length of 60000 counts and auto averaging of forward and reverse measurement removes thermal emf differences. Connectivity is improved with both USB and RS232 for data downloading. The internal memory holds up to 1000 date and time stamped readings and which can be viewed on the LCD or downloaded with the free software provided, as CSV file to a PC for further analysis.

The data log memory using the latest FRAM technology which offers unlimited read/write cycles and over 10 years of data retention, without relying on internal batteries.

The unit has built in rechargeable batteries which will provide up to 1 hour of continuous use at 10A, and up to 20 hours at all other ranges.

KEY FEATURE	DO7 +
On screen real time graphical plotting cooling curve facilities with peak resistance value calculator	■
It's fast, reading rate of 2 readings per second	■
Measuring ranges from 6 mohm to 6 kohm	■
Resolution 100 nohm on 6 mohm range	■
Backlit LCD graphic panel with programmable timer for battery conservation	■
Single pulse measurement for fast resistance tests	■
Continuous measurement current for inductive tests	■
Full test lead continuity testing and diagnostic display	■
Multi lingual - Display available in English, French, German, Spanish or Italian	■
RS-232 and USB interfaces	■

DO7 PLUS SPECIFICATIONS

Range	Current	Resolution	FSV	Uncertainty
6.0000 mΩ	10 A	100 nΩ	60 mV	0.05% Rdg +0.01%FS
60.000 mΩ	1 A	1 µΩ	60 mV	0.05% Rdg +0.01%FS
600.00 mΩ	100 mA	10 µΩ	60 mV	0.05% Rdg +0.01%FS
6.0000 Ω	10 mA	100 µΩ	60 mV	0.05% Rdg +0.01%FS
60.000 Ω	1 mA	1 mΩ	60 mV	0.05% Rdg +0.01%FS
600.00 Ω	100 µA	10 mΩ	60 mV	0.05% Rdg +0.01%FS
6.0000 kΩ	100 µA	100 mΩ	600 mV	0.05% Rdg +0.01%FS

Measurement

4 terminal Kelvin / Thompson principle eliminates errors due to lead resistance

Display

60,000 count + sign LCD graphics panel with backlight Select display value of °C or °F

Ranges

7 resistance ranges

Terminals

4mm safety sockets

Working Temperature

0 deg C to 40 deg C

Storage Temperature

-20 deg C to +50 deg C

Safety

Conforms to EN 61010-1:2001 50V Cat 3

Dimensions

358mm X 269mm X 155mm

Mass

6kg (instrument only)

Calibration

Digital Password protected, manual or via remote interface

Battery

Internal, fixed NiMh battery pack, Gas Gauge circuits to monitor battery capacity. Internal automatic FAST / TRICKLE battery Charger. DC input from 9V to 36V.

Mains Supply

External mains psu 90V – 253V, 47Hz to 63Hz with interchangeable plugs.

CODE	ITEM	DO7PLUS OPTIONS
LS05	Lead set with 4 x 1 metre leads terminated in banana plugs, 4 x Crocodile clips, 4 x test probes and 2 x Kelvin clips type KC1	
LS03-P	Lead set with 3 metre leads and terminated with large Kelvin clips type KC3	
LS04-P	Lead set with 3 metres and 15 metres lead length terminated in large Kelvin clips type KC3	
HS01-P	2 x Duplex handspike with 3 metre lead length	
HS02-P	Duplex handspikes with 3 and 15 metre lead length	
CH01	Concentric handspikes 3M lead length	
MTS 5	Calibration Standard Note: Lead sets can be supplied in different lengths to order	
C02	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 0.1…100mm2	
CO2A	1 metre cable clamp with metal base for the precise measurement of 1 metre cable samples 1…1000mm2	
C03-DO7 Plus	1 metre cable clamp with water bath for the precise measurement of 1 metre cable samples 1…1000mm2	
Pt02-DO7 Plus	Pt100 temperature probe with 1 metre lead	

DO7

RUGGED DIGITAL MICROHMMETER FOR LOW RESISTANCE MEASUREMENT

The DO7 is a practical instrument for low resistance measurement, ideal for use in the workshop, field or test facilities. It is of rugged construction in a sealed ABS plastic case with lid and carrying handle. The DO7 has many advanced features, including protection up to 415 volts rms at the measuring terminals, digital calibration and long scale length, 6000 count. Rechargeable batteries mean real portability with more than 1 hour of continuous operation on the lowest ranges, and 20 hours on all others. Battery charge indicators are provided. The internal charger will boost charge to 90% of full charge, switching automatically to a trickle maintenance charge. Warning LEDs illuminate when an open circuit lead condition is detected. A front panel socket provides a serial RS232 output for connection to an external printer or PC, and a socket is also provided for the connection of an external start switch, e.g. a foot switch. The DO7 is supplied ready for use with batteries, mains cord and test leads, no extras are normally necessary. For special lead sets we offer a variety of different styles which are listed on the accessories page, together with calibration standards.

KEY FEATURE	DO7
True 4 terminal measurement eliminates lead resistance errors	■
10 Amp measuring current	■
Rechargeable batteries with built-in charger	■
Measuring range 600 micro ohm...60 ohm	■
Resolution 0.1 micro ohm on 600 micro ohm range	■
0.8" LED display daylight viewable	■
Auto average of forward and reverse measurement	■
Remote start socket	■
All solid state design	■
Wide range of leads and accessories available	■
RS232 printer output	■

DO7 SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy at 20°C ±5°C, 1 Year	Temp Coefficient/°C
60Ω	10mΩ	1mA	±(0.15% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
6Ω	1mΩ	10mA	±(0.15% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
600mΩ	100µΩ	100mA	±(0.15% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
60mΩ	10µΩ	1A	±(0.15% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
6mΩ	1µΩ	10A	±(0.2% Rdg +0.01% FS)	40ppm Rdg + 30ppm FS
600µΩ	0.1µΩ	10A	±(0.2% Rdg +0.2% FS)	40ppm Rdg + 250ppm FS

Measurement

4 Terminal Kelvin / Thomson principle eliminates errors due to lead resistance. Open circuit measurement voltage = 2V dc

Display

0.8" LED 6000 count with automatic decimal point and polarity indication

Ranges

6 push button selected with LED indication

Terminals

6mm binding posts accept spade tags and 4 mm banana plugs

Working Temperature

0°C to 40°C rel. humidity 80% max. non-condensing

Storage Temperature

-20 to +50°C

Mains Supply

100 / 120 / 220 / 240 Volts
+10% - 13% 47Hz to 63Hz. max 80VA

Safety

EN 61010-1 Protective Class 1

Dimensions

343mm x 327mm x 152mm (W D H) approx

Mass

8kg approx

Protection

415 Vrms maximum at input terminals

Calibration

Digital, security key protected

Battery

Sealed lead acid, rechargeable cells giving a minimum of 1 hour of continuous measurement on the lowest 10 amp ranges and 20 hours on all other ranges. Internal charger with battery state indicator

Average

Automatic average and display of measurement with forward and reverse current

CODE	ITEM	DO7 OPTIONS
CB03	Lead bag attaches to lid of DO7, must be ordered with DO7	
DO7-RS	Remote start plug	
FS01	Remote start foot switch	
HS01	Duplex handspikes with 3 metre lead length	
HS01-RS	Duplex handspikes with 3 metre lead length with remote start button	
HS02	Duplex handspikes with 3 and 15 metre lead length	
HS02-RS	Duplex handspikes with 3 and 15 metre lead length with remote start button	
LS03	Lead set with 3 metre leads terminated in large Kelvin clips type KC3	
LS04	Lead set with 3 metre and 15 metre lead length terminated in large Kelvin clips type KC3	
LS05	Lead set with 4 x 1 metre leads terminated in banana plugs, 4 x Crocodile clips, 4 x test probes and 2 x Kelvin clips type KC1 in miniature Kelvin clips type KC2	
MTS2	Calibration standard	
RSL01	RS232 cable	
CHO1	Concentric handspikes	

DO7e

RUGGED DIGITAL MICROHMMETER FOR LOW RESISTANCE MEASUREMENT

The DO7e is a very rugged yet compact and portable digital micro ohmmeter for the measurement of low resistance. Using a rechargeable sealed lead acid battery with built-in charger, the DO7e is capable of measuring with a current of 10 Amps on the lowest range. The DO7e has been designed with the latest solid state and microprocessor techniques to ensure the very best in measurement, reliability and features. Automatic range selection, forward and reverse current measurements with auto average and a remote start socket are all included as well as an energy saving power down mode.

KEY FEATURE	DO7e
True 4 wire measurement eliminates lead resistance	■
6 push button ranges 6 milli ohm to 600 ohm	■
Resolution 1 micro ohm on 6 milli ohm range	■
Auto ranging	■
10 Amp measuring current on lowest range	■
0.8'' LED Display daylight viewable	■
Input protection up to 415 Volts rms	■
Forward and reverse current measurement	■
Auto average of forward and reverse measurement	■
Auto power off	■
Mains / rechargeable battery operation	■
Digital calibration pass code protected	■

DO7e SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy at 20°C ±5°C, 1 Year	Temp Coefficient/°C
600Ω	100mΩ	1mA	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
60Ω	10mΩ	10mA	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
6Ω	1mΩ	100mA	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
600mΩ	100µΩ	1A	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
60mΩ	10µΩ	1A	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 30ppm FS
6mΩ	1µΩ	10A	±(0.25% Rdg +0.05% FS)	40ppm Rdg + 250ppm FS

Measurement

4 Terminal Kelvin / Thomson principle eliminates errors due to lead resistance. Open circuit measurement voltage = 2V dc

Display

0.8" LED 6000 count with automatic decimal point and polarity indication

Ranges

6 push button selected with LED indication

Terminals

Binding posts accept 6mm bare wires and 4mm banana plugs (4mm safety sockets)

Working Temperature

0°C to 40°C rel. humidity 80% max. non-condensing

Storage Temperature

-20 to +50°C

Mains Supply

115/230 Volts +10%-10%
47 to 63Hz 20VA

Safety

EN 61010-1

Dimensions

343mm x 327mm x 152mm (W D H) approx

Mass

6kg approx

Protection

415 Vrms maximum at input terminals

Calibration

Digital Pass code protected

Battery

Sealed lead acid battery with built-in charger. Greater than 1000 measurements on lowest (10A range) and 20 hours on other ranges from a fully charged battery

Average

Automatic average and display of measurement with forward and reverse current

CODE	ITEM	DO7E OPTIONS
CB03	Lead bag attaches to lid of DO7e must be ordered with DO7e	
D07-RS	Remote start plug	
FS01	Remote start foot switch	
HS01	Duplex handspikes with 3 metre lead length	
HS01-RS	Duplex handspikes with 3 metre lead length with remote start button suitable for DO7 and DO7e	
HS02	Duplex handspikes with 3 and 15 metre lead length	
HS02-RS	Duplex handspikes with 3 and 15 metre lead length with remote start button	
LS03	Lead set with 3 metre leads terminated in large Kelvin clips type KC3	
LS04	Lead set with 3 metres and 15 metres lead length terminated in large Kelvin clips type KC3	
MTS2	Calibration standard	
CHO1	Concentric handspikes	

DO7010

RUGGED PORTABLE MICRO OHMMETER FOR LOW RESISTANCE MEASUREMENT

The DO7010 is a very rugged and very compact, portable digital ohmmeter for the measurement of low resistance. Using rechargeable and replaceable NiMh batteries with external charger the DO7010 is capable of measuring with a current of 1 and 10 Amps on all except the highest range. The DO7010 has been designed with the latest solid state and microprocessor techniques to ensure the very best in measurement reliability and features. The LCD graphic display panel gives full information regarding the measurement configuration, and a single measurement start button ensures that the operation is simple and easy to use. The measurement may be triggered when the measurement leads are applied to the device under test ensuring fast single person operation. A remote hand terminal is also available which will fully control the DO7010 at a distance of up to 15 metres. The data logging function also permits test sequences to be downloaded from an Excel spreadsheet and the measured results uploaded back to the spreadsheet.

KEY FEATURE	DO7010
True 4 wire measurement eliminates lead resistance errors	■
4 ranges 6 milli ohm to 6 ohm	■
Resolution 1 micro ohm on 6 milli ohm range	■
Graphics Display with backlight 3 languages	■
1 and 10 Amp measuring current even on the 600 milli ohm range	■
Forward and reverse current measurement	■
Auto average of forward and reverse measurement	■
True zero offset	■
Built in test resistor for confidence check	■
Data logging with up to 1000 readings stored with date and time stamp	■
Hi-Lo limits with audible and visual warning	■
Automatic measurement trigger when leads are connected to DUT	■
Small size and light weight <4Kg	■
RS232 interface with option remote terminal to enable operation up to 15 metres distance	■
Rechargeable NiMh batteries with charge indicator and easily replaceable battery pack	■

DO7010 SPECIFICATIONS

Range	Resolution	Typical Current	Accuracy at 20°C ±5°C, 1 Year	Temp Coefficient/°C
6Ω	1mΩ	100mA/1A	±(0.1% Rdg +0.1% FS)	40ppm Rdg + 30ppm FS
600mΩ	100µΩ	1A/10A	±(0.1% Rdg +0.1% FS)	40ppm Rdg + 30ppm FS
60mΩ	10µΩ	1A/10A	±(0.1% Rdg +0.1% FS)	40ppm Rdg + 30ppm FS
6mΩ	1µΩ	1A/10A	±(0.1% Rdg +0.1% FS)	40ppm Rdg + 30ppm FS

Measurement

4 Terminal Kelvin/Thomson principle eliminates error due to lead resistance. Open circuit measurement voltage =5Vdc

Display

240 x 64 dot graphics LCD with backlight

Ranges

4 ranges with auto range mode. Two selectable measuring currents for each range

Terminals

The measurement leads are connected via Jaeger connectors and a full range of lead configurations are available

Working Temperature

0°C to +50°C rel. humidity up to 80% non condensing

Storage Temperature

-20 to +50°C

Safety

Conforms to EN 61010-1, Main instrument Class III (SELV), Battery pack Class III (SELV), external mains charger Class II

Dimensions

390mm x 160mm x 270mm (W H D) approx

Mass

4kg approx

Battery

The DO7010 is supplied with battery fitted. The batteries are NiMh and the charger is external. The battery pack may be removed from the front panel when discharged and a replacement charged pack inserted. This ensures minimum down-time when making measurements

Remote Terminal

The remote terminal emulates the DO7010 front panel and all functions and readings are fully controllable up to 15 metres from the ohmmeter. Connection is made through the RS232 terminal

Lead Sets

We offer a wide variety of lead sets with 3 sizes of Kelvin clip or handspikes. Lead lengths may be up to 100 meters total loop

Data Logging

The DO7010 has data logging modes. The first will store each reading with record number date and time. The second is a sequence mode which will store values with operator ID, serial number etc

CODE	ITEM	DO7010 OPTIONS
DO7010-BP	Additional battery pack
DO7010-REM	Remote terminal emulates the DLRO710 front panel and permits the operation remotely up to 15 metres. Supplied complete with 15 metre RS232 cable
HS01-710	Duplex handspikes with 3 metre lead length
HS02-710	Duplex handspikes with 3 and 15 metre lead length
LS03-710	Lead set with 3 metre leads and terminated with large Kelvin clips type KC3
LS04-710	Lead set with 3 metres and 15 metres lead length terminated in large Kelvin clips type KC3
MTS3	Calibration Standard
REMTC015	Remote terminal cable 15 metres
RSL04	RS232 interface cable 1 metre
XL-710	Excel spread sheet software permits upload of measurment parameters and download of stored values

MTS

EASY TO USE MILLI OHMMETER 4 TERMINAL TEST STANDARD WITH + AND - FULL SCALE VALUES

This milli ohmmeter test standards are designed for the simple and easy calibration of low resistance ohmmeters and Kelvin / Thomson bridges. The four terminal resistance values are switch selected and provision is made + and - full scale values. A four terminal zero value may also be selected, thus making zero and full scale calibration of instruments simplicity itself. Two models are available , the MTS1A which has 11 values from 1 milli ohm to 100 kilo ohm and the MTS2 has 10 values from 400 micro ohm to 400 kilo ohm making it ideally suited for the calibration of digital instruments with a long scale length of 4000 or 6000 count. The test standards are housed in a rugged bench portable aluminium case with tilt handle. The internal standards are manufactured from premium quality resistance wire with low temperature and load coefficients. The units are supplied complete with a calibration certificate.

KEY FEATURE	MTS
True 4 terminal standards	■
Switch selectable values	■
Polarity reversal switch	■
Four terminal zero	■
Two models available: MTS1A: 1 milli ohm to 100 kilo ohm and MTS2: 400 micro ohm to 400 kilo ohm	■
Supplied complete with calibration certificate	■

MTS 1A SPECIFICATIONS

Resistance Value	Uncertainty of Adjustment @ 20°C	Power Max W	Current Max A	Typical Temp Coefficient
100kΩ	±0.01%	0.1	1mA	<10ppm / °C
10kΩ	±0.01%	0.1	3mA	<10ppm / °C
1kΩ	±0.01%	0.6	25mA	<10ppm / °C
100Ω	±0.01%	0.6	75mA	<10ppm / °C
19Ω	±0.01%	0.43	150mA	<10ppm / °C
10Ω	±0.01%	0.45	212mA	<10ppm / °C
1.9Ω	±0.01%	0.475	500mA	<10ppm / °C
1Ω	±0.01%	0.56	750mA	<10ppm / °C
100mΩ	±0.01%	0.625	2.5A	<10ppm / °C
10mΩ	±0.05%	0.25	5A	<10ppm / °C
1mΩ	±0.05%	0.1	10A	<10ppm / °C

MTS 2 SPECIFICATIONS

Resistance Value	Uncertainty of Adjustment @ 20°C	Power Max W	Current Max A	Typical Temp Coefficient
400kΩ	±0.01%	0.1	0.5mA	<10ppm / °C
40kΩ	±0.01%	0.1	1.5mA	<10ppm / °C
4kΩ	±0.01%	0.1	5mA	<10ppm / °C
400Ω	±0.01%	0.1	15mA	<10ppm / °C
40Ω	±0.01%	0.1	50mA	<10ppm / °C
4Ω	±0.01%	0.1	150mA	<10ppm / °C
400mΩ	±0.01%	0.1	500mA	<10ppm / °C
40mΩ	±0.01%	0.1	1.5A	<10ppm / °C
4mΩ	±0.1%	0.4	10A	<10ppm / °C
400μΩ	±0.1%	0.04	10A	<10ppm / °C

Working Temperature

+5 to +40°C

Storage Temperature

+5 to +50°C

Dimensions

215mm x 88mm x 250mm (W H D) approx

Mass

2.8kg approx

Terminal

4mm binding posts will accept spade tags and 4mm banana plugs. Low thermal E.M.F. types are used for the potential terminals

Switches

Combination switch with low thermal contacts for the potential selection and low resistance contacts for the current selection

D05000-CS

CALIBRATION STANDARD FOR D05000

The calibration Standard D05000-CS is designed to enable the full calibration of the Digital microhmmeter type D05000, The resistance ranges are adjusted to a nominal accuracy and the actual value is measured and recorded on the calibration certificate. The value on the calibration certificate is the value that should be used when calibrating the D05000.

KEY FEATURE	D05000-CS
True 4 terminal standards	■
Switch selectable values	■
Polarity Reversal switch	■
Four terminal zero	■
Pt100 calibration	■
Upto 10A calibration current	■

D05000-CS SPECIFICATIONS

CURRENT RANGES

Current	Normal Accuracy
100µA	±0.05%
1mA	±0.05%
10mA	±0.05%
100mA	±0.05%
1A	±0.05%
10A	±0.05%

RESISTANCE VALUES

Resistance Value	Nominal Accuracy	Certified Accuracy
30kΩ	±0.01%	±0.01%
3kΩ	±0.01%	±0.01%
300Ω	±0.01%	±0.01%
30Ω	±0.01%	±0.01%
3Ω	±0.05%	±0.01%
200mΩ	±0.05%	±0.01%
30mΩ	±0.05%	±0.01%
3mΩ	± 1%	±0.02%

TEMPERATURE VALUES

Temperature	Nominal Accuracy	Certified Accuracy
0°C	± 1%	±0.05%
+100°C	± 1%	±0.05%

Working Temperature

0 to +40°C

Storage Temperature

0 to +40°C

Dimensions

460mm x 420mm x 180mm

Weight

5Kg

Terminals

4mm safety sockets. Low thermal EMF types.

Switches

Combination switch with low thermal contacts for the potential selection and low resistance contacts for the current and range selections

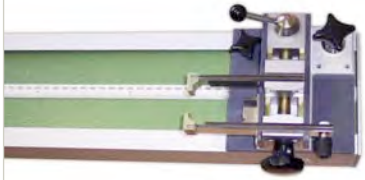
CO2/CO2-A/CO3

COST EFFECTIVE CABLE CLAMPING DEVICES FOR PRECISE MEASUREMENT

KEY FEATURE	CO2	CO2-A	CO3
1metre long reference measurement	■	■	■
Test unit cross sections 0.1mm² to 100mm²	■		
Test unit cross sections 1mm² to 1500m²		■	■
Integrated Water bath for temp stabilisation			■
Current connections up to 100A	■	■	■
Guide rail for support	■	■	■

During the manufacture of wires, rails, cables and conductors, the electrical conductivity (resistance) must be checked for compliance with specified values. In conjunction with one of our range of digital ohmmeters, the clamping devices are used in the cable industry for production monitoring and quality assurance.

CO2



Adjustable clamp support: measurement length of 50mm to 1000mm. Test unit cross-sections: ranging from 0.1mm² to 100mm² Current connections: designed for up to 100A. Potential tap: routed to 4mm standard terminals using material with low thermal E.M.F. Dimensions (height x width x depth): 1300mm x 120mm x 150 mm. Weight: Approximately 8.5kg

Optional guide rail available

CO2-A

Measurement length: 1000mm. Clamping device: designed for cross sections of 1mm² to 1500mm². Distance between voltage tap and current-feed: 420mm. Dimensions (height x width x depth): 170mm x 2100mm x 250 mm. Weight: Approximately 25kg.

Optional guide rail available

CO3

Measurement length: 1000mm in a temperature controlled water bath. Clamping device: designed for cross sections of 1mm² to 1500mm². Constant water temperature ensured by a two position controller and an integrated circulation pump. Precise temperature measurement with an integrated sensor. Operating range: 25 °C to 60 °C, tolerance +/- 0.5 °C. Current connections: designed for up to 100A. Output of the integrated heating filaments: 2kW Voltage supply: 230V, +6% - 10%. Mains frequency: 50/60 Hz. Power consumption: approximately 2.2kVA. Device protection: in accordance with EN 61010. Dimensions (height x width x depth): 300 x 2100 x 750 mm. Without wire holder: (height x width x depth): 300mm x 1330mm x 500 mm. Weight (without water): Approximately 80kg.

THE 3000 SERIES

PORTABLE HIGH ACCURACY TEMPERATURE INDICATOR WITH FULL INSTRUMENT CONTROLS, PT25, PT100 AND 13 THERMOCOUPLE TYPES

Cropico has produced a family of precision digital thermometers, the series 3000. Three units, all with 1 millikelvin resolution for RTDs, are offered with a range of standard features and a list of "mix-and-match" options which will provide a very high degree of flexibility.

The units can be used by Quality Assurance departments throughout the process industries for calibrating temperature probes, particularly in ISO-9000 applications, and they also have wide-ranging use where high accuracy temperature measurement is essential and where values have to be stored for data processing.

Two-channel input provides A, B or A-B measurement on an LCD display, and front panel keys are provided for the most commonly used functions. Pull-down menus provide further functions, such as the selection of thermocouples. Probe characteristics can be stored for optimum accuracy, and the measuring current can be reduced by half power to check the probe's self heating.

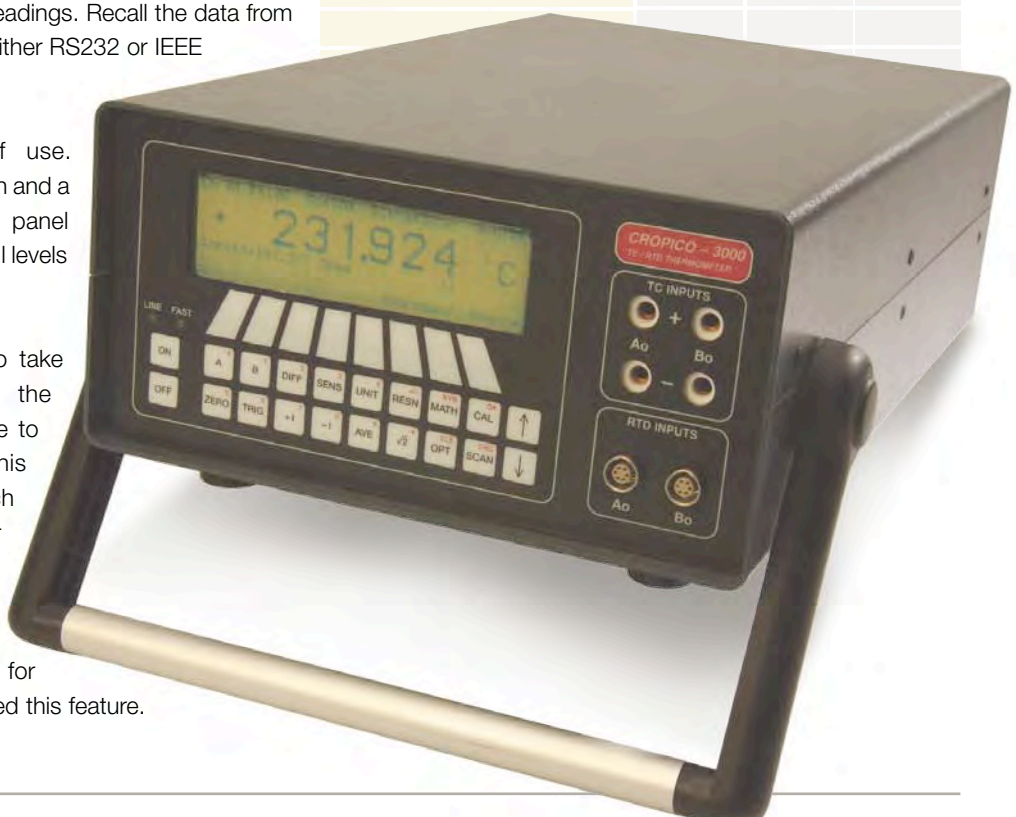
Other features include mains or rechargeable battery operation, with built-in charger, and two interface options - RS232 and IEEE-488 - by plug-in cards. An analogue output, via a BNC socket, is another option.

The 3000 series include an inbuilt data logger which can store upto 4000 date and time stamped readings. Recall the data from the front panel or send to a PC via either RS232 or IEEE both of which are options.

The 3000 series offer ease of use. Password protected digital calibration and a large clear backlit LCD graphics panel ensure the 3000 series are easy for all levels to use.

The 3000 series have the ability to take reverse measurements switching the polarity then computing the average to eliminate the error source. This reduces the thermal E.M.F. which most resistance thermometers suffer from. The thermal E.M.F error can be greater than the quoted accuracy of an instrument. If you need small measurement uncertainy for high temperature PRT work, you need this feature.

KEY FEATURE	3000	3001	3002
Accuracy of RTD measurement 0.01°C	■	■	■
Accuracy of T/C measurement 0.1°C	■	■	
1 milli kelvin resolution for RTD's	■	■	■
10 milli kelvin resolution for T/C	■	■	
2 Measuring inputs	■	■	■
14 thermocouples B,C,D,E,J,K,L,N,P,R,S,T,U, AuPt	■	■	
T/C reference junction internal or external	■	■	
Pt 25 sensor	■		
Pt 100 sensor	■	■	■
Input of RTD characteristics	■	■	■
Probe self-heat check	■	■	■
Automatic current reversal for RTD's	■	■	■
Suitable for 3 and 4 wire RTD's	■	■	■
Units °C, °F, K, mV or ohm	■	■	
Units °C, °F, K or ohm	■	■	■
Maths function max / min standard deviation	■	■	■
Data logging 4000 values	■	■	■
Digital calibration	■	■	■
Rechargeable sealed lead acid battery	■	■	■



3000 SPECIFICATIONS

Sensor	Range °C	Resistance Ω	Current	Resolution °C, °F, K	Accuracy Typically @ 20°C ±5°C
Pt25	-200 to -100	2.5 to 15	1mA	0.001	0.02°C
Pt25	-100 to +500	15 to 70	1mA	0.001	0.01°C
Pt25	+500 to +900	70 to 101.25	1mA	0.001	0.02°C
Pt100	-200 to -100	10 to 60	0.5mA	0.001	0.02°C
Pt100	-100 to +500	60 to 280	0.5mA	0.001	0.01°C
Pt100	+500 to +900	280 to 405	0.5mA	0.001	0.02°C

3001 SPECIFICATIONS

Sensor	Range °C	Resistance Ω	Current	Resolution °C, °F, K	Accuracy Typically @ 20°C ±5°C
Pt100	-200 to -100	10 to 60	0.5mA	0.001	0.02°C
Pt100	-100 to +500	60 to 280	0.5mA	0.001	0.01°C
Pt100	+500 to +900	280 to 405	0.5mA	0.001	0.02°C

3002 SPECIFICATIONS

Sensor	Range °C	Resistance Ω	Current	Resolution °C, °F, K	Accuracy Typically @ 20°C ±5°C
Pt100	-200 to -100	10 to 60	0.5mA	0.001	0.02°C
Pt100	-100 to +500	60 to 280	0.5mA	0.001	0.01°C
Pt100	+500 to +900	280 to 405	0.5mA	0.001	0.02°C

THERMOCOUPLE TYPE CHART FOR THE 3000 AND 3001

Sensor	Range °C	Common Name	Resolution °C, °F, K	Standard	Uncertainty @ 20°C ±5°C 1 Year	Uncertainty @ 20°C ±5°C 60 Days
B	+250 to +1820	Platinum / Rhodium	0.01	NIST 175	±(0.025%Rdg. + 0.006%FS)	±(0.02%Rdg. + 0.006%FS)
C	0 to +2315	Tungsten / Rhenium	0.01	ASTM E988	±(0.075%Rdg. + 0.005%FS)	±(0.05%Rdg. + 0.005%FS)
D	0 to +2315	Tungsten / Rhenium	0.01	ASTM E988	±(0.075%Rdg. + 0.005%FS)	±(0.05%Rdg. + 0.005%FS)
E	-200 to +1000	Chromel / Constantan	0.01	NIST 175	±(0.026%Rdg. + 0.004%FS)	±(0.01%Rdg. + 0.004%FS)
J	-210 to +1200	Iron / Constantan (SAMA)	0.01	NIST 175	±(0.03%Rdg. + 0.005%FS)	±(0.008%Rdg. + 0.005%FS)
K	-200 to +1372	Chromel / Alumel	0.01	NIST 175	±(0.035%Rdg. + 0.006%FS)	±(0.01%Rdg. + 0.006%FS)
L	-200 to +500	Iron / Constantan	0.01	DIN 43710	±(0.03%Rdg. + 0.005%FS)	±(0.008%Rdg. + 0.005%FS)
N	-200 to +1300	Nicrosil / Nisil	0.01	NIST 175	±(0.035%Rdg. + 0.005%FS)	±(0.01%Rdg. + 0.005%FS)
P	0 to +1395	Platinel	0.01	Englehard	±(0.035%Rdg. + 0.006%FS)	±(0.01%Rdg. + 0.006%FS)
R	-50 to +1768	Platinum / Rhodium	0.01	NIST 175	±(0.02%Rdg. + 0.015%FS)	±(0.005%Rdg. + 0.015%FS)
S	-50 to +1768	Platinum / Rhodium	0.01	NIST 175	±(0.02%Rdg. + 0.015%FS)	±(0.005%Rdg. + 0.015%FS)
T	-200 to +400	Copper / Constantan	0.01	NIST 175	±(0.025%Rdg. + 0.015%FS)	±(0.005%Rdg. + 0.015%FS)
U	-200 to +600	Copper / Constantan	0.01	DIN 43710	±(0.025%Rdg. + 0.015%FS)	±(0.005%Rdg. + 0.015%FS)
Au/Pt	0 to +1000	Gold / Platinum	0.01	NIST-Burns	±(0.02%Rdg. + 0.015%FS)	±(0.005%Rdg. + 0.015%FS)

3000 Series continued ▶▶

THE 3000 SERIES

Display

LCD Graphics panel with backlight

Terminals

4mm safety sockets and 6 pin Lemo socket

Working Temperature

0°C to +40°C re. humidity 80% max. non-condensing

Storage Temperature

-20°C to +50°C

Mains Supply

100/120/220/240 Volts +10% to 13%
47Hz to 63Hz 40VA

Safety

EN 61010-1 EMC-EN 61236

Dimensions

219mm x 315mm x 110mm (W H D) approx

1/2 19" Rack 2 1/2 U high

Mass

5.5kg approx

Calibration

Digital Pass code protected

Battery

Sealed Lead acid battery with internal intelligent charger.
14 hours approx operation from full charge, may be used whilst charging

Inputs

Thermocouples via 4mm sockets in copper block on 19mm pitch, adaptor plugs available for direct thermocouple wire connection. PRT via Lemo low thermal sockets. 3002 model has low thermal E.M.F sockets only

Average

Automatic average and display of PRT measurements with forward and reverse current

Auto Temperature Compensation for Thermocouples

Automatically compsensates for ambient temperature using internal sensor, or to remote junction using external sensor.

Interfaces

Interface cards are available as option, only one card may be fitted.
RS232: To specification ANSI/EIA/TIA/-232-E-1991
IEEE-488: Conforms to ANSI-IEEE Std 488, 1-1987 and performs the following functions: SH1, AH1,T5,TEO, L3, LEO, SR1, RL1, PPO, DT1, CO, E2. Interface may be set to 'talk only' mode to permit stand alone printer output
Scanner Option: 2 additional input cards may be fitted, each card has 4 measurement channels. Measurement and scan sequences may be configured from the front panel. Full accuracy is maintained

Thermocouples

The above readings apply to values with the reference junction switched off. Reference junction uncertainty when used in automatic mode is better than 0.1°C at 20 °C with a deviation of not more than 0.01 °C/°C over the range 0 to 100 °C. RTD types linearised to ITS-90 conforms to EN 60751. Thermocouples are not available on 3002 model

SCANNER OPTIONS

The 3000 series scanner option provides for multi inputs of either thermocouples or Pt100 sensors. Two cards may be fitted each with four input channels, which may be either thermocouples or Pt100. The flexibility of the system is such that scanner cards can be interchanged giving 10 channels for Pt100, 10 channels for thermocouples, or 4 channels thermocouples plus 4 channels Pt100 plus the two front panel inputs, which may be either Pt100 or thermocouples. No other instrument in this price range gives the versatility and accuracy of measurement to match the 3000.

CODE	ITEM	3000 SERIES OPTIONS	3000	3001	3002
3000-01	RS232 interface		■	■	■
3000-03	IEEE-488 interface		■	■	■
3000-04	Analogue output		■	■	■
3000-05	Scanner option, input cards to be ordered separately		■	■	■
3000-06	Scanner card for Pt100 4 channels. Scanner option 3000-05 must be installed		■	■	■
3000-07	Scanner card for thermocouple inputs 4 channels. Scanner option 3000-05 must be installed		■	■	■
3000-A-10	Calibration cable		■	■	■
3000-A-11	Calibration standards for Pt100 channels, consisting of 3 standard resistors 100, 250, and 400 ohm		■	■	■
3000-A-12	Adapter box 4mm copper terminals to Lemo plug		■	■	■
3000-A-13	RTD Lemo input plug		■	■	■
3000-A-20	Thermocouple plug with screw terminals materials type R S B J T E K available please specify when ordering		■	■	■
3000-A22	External thermocouple reference junction		■	■	■
RSL-02	RS232 Cable		■	■	■

DP6

THERMOCOUPLE SIMULATOR LINEARISED FOR 10 TYPES & CALIBRATED TO ITS90 & IPTS68

The portable thermocouple calibrator is a compact and easy to use instrument that is equally at home in the laboratory or service environment. The DP6 will both measure and simulate 10 of the most popular thermocouple types, and may be scaled in °C, °F, K or mV. Automatic reference junction compensation is provided with the option for manual value entry. For full portability the calibrator is powered by a rechargeable battery giving more than 15 hours continuous use. The DP6 is delivered in an ABS transport case which also houses the charger and a copper transition adapter for easy connection to miniature thermocouple plugs. A soft carrying bag with neck strap is available as an option.

KEY FEATURE	DP6
Linearised for 10 thermocouple types	■
Measures and simulates	■
Calibrated to ITS90 and IPTS68	■
Displays in °C, °F, K and mV	■
1 micro volt Resolution	■
Reference junction compensation	■
Rechargeable battery	■
Memory with 130 Stores	■
Digital calibration	■

DP6 SPECIFICATIONS

Code	Thermocouple Type °C	Range	Accuracy
B	PtRh30-PtRh6	+500 to +1820 +200 to +500 +60 to +200	±0.5°C ±1.5°C ±6.5°C
E	NiCr-CuNi	-200 to +1000 -250 to –200 -270 to –250	±0.2°C ±0.6°C ±6.0°C
J	Fe-CuNi	+800 to +1200 +200 to +800 0 to +200 -210 to 0	±0.3°C ±0.2°C ±0.1°C ±0.3°C
K	NiCr-NiAl	+1000 to +1370 +100 to +1000 -50 to +100 -150 to –50 -225 to -150 -270 to -225	±0.4°C ±0.3°C ±0.1°C ±0.2°C ±0.5°C ±3.0°C
L	Fe-CuNi	+300 to +900 -100 to + 300 -200 to -100	±0.2°C ±0.1°C ±0.15°C
N	NiCrSi-NiSi	+1100 to +1300 +400 to +1100 +150 to +400 0 to 150	±0.4°C ±0.3°C ±0.15°C ±0.1°C
R	PtRh13-Pt	+1200 to +1760 +100 to +1200 0 to +100 -50 to 0	±0.8°C ±0.4°C ±0.5°C ±0.8°C
S	PtRh10-Pt	+1400 to +1760 +1200 to +1400 +50 to +1200 -50 to +50	±0.95°C ±0.5°C ±0.4°C ±0.6°C
T	Cu-CuNi	-100 to +400 -230 to –100 -250 to –230 -270 to -250	±0.2°C ±0.5°C ±1.0°C ±2.5°C
U	Cu-CuNi	+300 to +400 0 to +300 -150 to 0 -200 to -150	±0.2°C ±0.1°C ±0.15°C ±0.2°C

Resolution on all types of thermocouple –0.1°C, 0.1°K, 0.1°F. Limits of error apply for 1 year at 20°C ±1°C

Range	Max Display	Uncertainty	Resolution
10mV	±15.000mV	±0.02% of reading ±0.015% FS	1µV
100mV	±150.00mV	±0.01% of reading ±0.015% FS	10µV
1V	±1.5000V	±0.01% of reading ±0.015% FS	100µV

Display

4.5 digit high contrast LCD 10.2mm. Display range 19999 digits, automatic decimal point, polarity and units. Two line alphanumeric LCD for programming and display of configuration

Ranges

The reference junction reference value may also be set via the keyboard over the range 0°C to +100°C

Terminals

2 4mm low thermal E.M.F. copper terminals

Working Temperature

0°C to +40°C

Storage Temperature

-20°C to +50°C

Mains Supply

External charger operating from mains supply

Dimensions

150mm x 130mm x 60mm (W H D) approx

Mass

1.4kg approx

Calibration

Digital pass code protected

Battery

6 Volt 1.2 Ah sealed lead acid, replaceable

005/6/8

VERY HIGH ACCURACY DECADE BOXES WITH VERSATILE WIDE OHM RANGE

A versatile range of resistance decade boxes available in 5, 6 & 8 decades. High Accuracy and wide range 0.001 ohm to 11 Mega ohm are combined in a compact lightweight metal case. The switches have gold plated contacts to ensure a low contact resistance and negligible thermal E.M.F. Some models employ the Waidner Wolf technique to eliminate the errors switch contact resistance and are particularly suited to Pt100 simulation with resolution as low as 0.001 ohm (» 0.0025°C).

KEY FEATURE	005/6/8
High accuracy 0.01% and high performance	■
Suitable for Pt100 and tranducer simulation	■
5, 6 and 8 Decades	■
Long term stability <20ppm/year	■
Low temperature co-efficient <3ppm/°C	■
Gold-plated switch contacts and solid copper input terminals	■
Negligible thermal E.M.F.'s	■
Light weight / small size	■
With certificate of conformity	■
In-house test figures optional	■

005/6/8 SPECIFICATIONS

008			006			005	Decade	Accuracy	Current Max mA
C	B	A	C	B	A	B			
		■			■		10 x 0.001Ω	±2%	2000
	■	■		■	■	■	10 x 0.01Ω	±1%	2000
■	■	■	■	■	■	■	10 x 0.1Ω	±0.5%	2000
■	■	■	■	■	■	■	10 x 1Ω	±0.2%	600
■	■	■	■	■	■	■	10 x 10Ω	±0.01%	200
■	■	■	■	■	■	■	10 x 100Ω	±0.01%	60
■	■	■	■	■			10 x 1kΩ	±0.01%	20
■	■	■	■				10 x 10kΩ	±0.01%	6
■	■						10 x 100kΩ	±0.01%	2
■							10 x 1MΩ	±0.01%	0.6

Model	No. Decades	Total Resistance	Resolution	Sutable for Pt100 Simulation	Resolution °C when Simulating Pt100	Residual Resistance
005-B	5	1,112.10Ω	0.01	■	0.025	1Ω
006-A	6	1,112.11Ω	0.001	■	0.0025	1Ω
006-B	6	11,112.10Ω	0.01	■	0.025	1Ω
006-C	6	111,111Ω	0.1	—	—	0.07Ω
008-A	8	111,112.11Ω	0.001	■	0.0025	1Ω
008-B	8	1,111,112.1Ω	0.01	■	0.025	1Ω
008-C	8	11,111,111Ω	0.1	—	—	0.08Ω

Calibration

Calibration certificates including UKAS traceable are available on request

Switches

Contact material gold plated brass

Contact resistance < 5 mohm

Insulation Resistance (all paths > 10Gohm)

Resistors

Temperature Co-efficient:

±3ppm / +20°C to + 85°C ±5ppm maximum over –55°C to +125°C 0.1, 0.01, & 0.001 dials 10ppm/°C

Full Load Stability:

±35ppm/10,000 hours

±50ppm/26,000 hours

No Load Stability:

±25ppm/10,000 hours

±35ppm/26,000 hours

Over full temperature range:

-50°C to +125°C

Power Rating:

0.33 watt (+85°C) 0.25 watt (+110°C)

Maximum Continuous Working Voltage:

70Vdc / 33vrms

Noise:

Essentially non-measurable

Thermal E.M.F:

<0.4µV / °C typical, <15µV / °C maximum

Windings:

Exclusive 'air cushioned' technique provides virtually stressless elements for improved performance. Non inductively wound. Direction of winding reversed at half turns point

Weight

005 - 0.5kg

006 - 0.6kg

008 - 0.8kg

0010 - 1kg

Size

350mm x 100mm x 80mm (W H D) approx

RBB

HIGH ACCURACY DECADE BOXES WITH VERSATILE WIDE OHM RANGE

A versatile range of resistance decade boxes, available in 5 & 6 decades. Both high accuracy and a wide range, 0.001 ohm to 11 mega ohm, are combined in a rugged case. The switches used are gold plated to ensure a low contact resistance and negligible thermal E.M.F. Some models employ the Waidner Wolf technique to eliminate the errors that may be caused by the variations in switch contact resistance. These models are particularly suited to applications such as Pt100 simulation where resolutions as low as 0.001 ohm (» 0.0025°C) are required.

KEY FEATURE	RBB
5 and 6 decades available	■
Total Range 11.111 Mega ohm	■
Smallest Steps 0.001 milli ohm	■
Special Waidner Wolff decade minimises switch contact resistance	■
Accuracy 0.05% for premium dials	■
Resistance coils wound in selected low TC wire	■
Special models for Pt100 simulation	■
Special model for insulation simulation	■

RBB SPECIFICATIONS

RBB5				RBB6					Decade	Accuracy	Current Max mA
B	C	D	E	B	C	D	E	F			
				■					10 x 0.001Ω	± 2%	2000
■				■	■				10 x 0.01Ω	± 1%	2000
■	■			■	■	■			10 x 0.1Ω	± 0.5%	2000
■	■	■		■	■	■	■		10 x 1Ω	± 0.2%	600
■	■	■	■	■	■	■	■	■	10 x 10Ω	± 0.05%	200
■	■	■	■	■	■	■	■	■	10 x 100Ω	± 0.05%	60
	■	■	■		■	■	■	■	10 x 1kΩ	± 0.05%	20
		■	■			■	■	■	10 x 10kΩ	± 0.05%	6
			■				■	■	10 x 100kΩ	± 0.1%	2
								■	10 x 1MΩ	± 0.1%	0.6

Model	No. Decades	Total Resistance	Resolution	Sutable for Pt100 Simulation	Resolution °C when Simulating Pt100	Residual Resistance
RBB5-B	5	1,112.1Ω	0.01	■	0.025	1Ω
RBB5-C	5	11,111Ω	0.1	—	—	0.012Ω
RBB5-D	5	111,110Ω	1	—	—	0.012Ω
RBB5-E	5	1.1111MΩ	10	—	—	0.012Ω
RBB5-F	5	11,111Ω	100	—	—	0.012Ω
RBB6-B	6	1,112.11Ω	0.001	■	0.0025	1Ω
RBB6-C	6	11,112.1Ω	0.01	■	0.025	1Ω
RBB6-D	6	111,111Ω	0.1	—	—	0.013Ω
RBB6-E	6	1.11111MΩ	1	—	—	0.013Ω
RBB6-F	6	11.1111MΩ	10	—	—	0.013Ω

Calibration

Calibration certificates including UKAS traceable are available on request

Switches

Contact material gold plated brass

Contact resistance < 5 mohm
Insulation Resistance (all paths >10Gohm)

Resistors

Temperature Co-efficient:

±3ppm / +20°C to +85°C ±5ppm maximum over –55°C to + 125°C 0.1, 0.01, and 0.001 dials 10ppm/°C

Full Load Stability:

±35ppm/10,000 hours
±50ppm/26,000 hours

No Load Stability:

±25ppm/10,000 hours
±35ppm/26,000 hours

Over full temperature range:
-50°C to +125°C

Power Rating:
0.33 watt (+85°C) 0.25 watt (+110°C)

Maximum Working Voltage:
70V dc / 33Vrms

Noise:
Essentially non-measurable

Thermal E.M.F:
<0.4µV / °C typical <1.5µV / °C maximum

Encapsulation:
Moulded epoxy

Windings:
Exclusive 'air cushioned' technique provides virtually stressless elements for improved performance. Non inductively wound. Direction of winding reversed at half turns point

Weight

RBB5 - 0.5kg

RBB6 - 0.6kg

Size

350mm x 100mm x 80mm (W H D) approx

RBC

HIGH ACCURACY HIGH CURRENT DECADE BOXES WITH VERSATILE WIDE OHM RANGE

The RBC Series is a robust range of high dissipation resistance decades available in 5 or 6 decade versions and suitable for applications where reasonably precise and stable adjustable loads are required. Constructed using the same high quality components as our other resistance decades and housed in a light alloy ventilated case, the RBC Series will withstand the most arduous use and give many years service. All parts are fully serviceable and can be repaired in our workshop should the more enthusiastic user damage the units with high overloads.

KEY FEATURE	RBC
5 and 6 Decades available	■
High dissipation	■
5 Watts per coil	■
Accuracy 5%	■
0.1 ohm to 111,111 ohm	■
Fully serviceable	■
Special model for insulation simulation	■

RBC SPECIFICATIONS

RBC5		RBC6	Decade	Accuracy	Current Max mA
A	B	A			
■		■	10 x 0.1Ω	5%	7000
■	■	■	10 x 1Ω	5%	2200
■	■	■	10 x 10Ω	5%	700
■	■	■	10 x 100Ω	5%	220
■	■	■	10 x 1kΩ	5%	70
	■	■	10 x 10kΩ	5%	22

Calibration

Calibration certificates including UKAS traceable are available on request

Switches

Contact material gold plated brass

Contact resistance < 5mohm
Insulation Resistance (all paths > 10Gohm)

Resistors

Temperature Co-efficient:
0.1Ω: <10ppm / °C
1Ω, 10Ω: <400ppm / °C
100Ω, 1KΩ, 10KΩ: <200ppm / °C

Full Load Stability:
<5%, 70°C, 1000 hours

No Load Stability:
<1%, 20°C, 1 year

Temperature range:
0°C to + 70°C

Power Rating:
5W per resistor

Maximum Working Voltage:
70vdc / 33 vrms

Weight

5 Dial Box - 3.0kg
6 Dial Box - 3.5kg

Size

5 Dial Box - 390mm x 105mm x 130mm (W H D) approx
6 Dial Box - 450mm x 105mm x 130mm (W H D) approx

RH9A SERIES

HIGH RESISTANCE, HIGH VOLTAGE DECADE RESISTANCE BOX WITH SP1 SWITCH

Designed using the Cropico high quality SP1 switch combined with specially selected resistors, this range of high ohm resistance decades is ideal for the calibration of insulation test sets having a voltage rating up to 5kV. Housed in a rugged carrying case and available in either 3, 6, or 9 decades the RH9A series covers the range 1 kilo ohm to 1 tera ohm and is equally at home in the laboratory workshop or field application. A single decade unit is also available with 10 switched values from 1 kilo ohm to 1 tera ohm. Supplied complete with high voltage test leads 1 metre in length and calibration certificate.

KEY FEATURE	RH9A
1, 3, 6 & 9 decades available	■
Range 1 kilo ohm to 1 tera ohm	■
Max Voltage 5kV	■
Accuracy ± 0.1%	■
Portable case	■

The RH9A Series of products vary in design

RH9A SPECIFICATIONS

RH9A-1	RH9A-2	RH9A-3	RH9A	Decade	Accuracy @ Certified Voltage 1Kv Max	Typical Voltage Coeff	Max V/Step	Power Rating	Temp Coeff
	■		■	10 x IkΩ	±0.1%	<1ppm/V	30V	1 watt	±50 ppm /°C
	■		■	10 x I0kΩ	±0.1%	<1ppm/V	100V	1 watt	±50 ppm /°C
	■		■	10 x I00kΩ	±0.1%	<1ppm/V	300V	1 watt	±50 ppm /°C
	■	■	■	10 x IMΩ	±0.1%	<1ppm/V	350V	1 watt	±50 ppm /°C
	■	■	■	10 x I0MΩ	±1%	1ppm/V	3,500V	1.5 watts	±100 ppm /°C
	■	■	■	10 x I00MΩ	±1%	1ppm/V	4,000V	1.5 watts	±100 ppm /°C
■		■	■	10 x IGΩ	±1%	1ppm/V	4,000V	3.5 watts	±100 ppm /°C
■		■	■	10 x I0GΩ	±1%	1ppm/V	5,000V	3.5 watts	±250 ppm /°C
■		■	■	10 x I00GΩ	±2%	25ppm/V	5,000V	1.3 watts	±2,000 ppm /°C

RH9A-5 SPECIFICATIONS

Value	Accuracy @ Certified Voltage 1Kv Max	Typical Voltage Coeff	Max V	Power Rating	Temp Coeff
1kΩ	±0.1%	<1ppm/V	30V	1 watt	±50 ppm /°C
10kΩ	±0.1%	<1ppm/V	100V	1 watt	±50 ppm /°C
100kΩ	±0.1%	<1ppm/V	300V	1 watt	±50 ppm /°C
1MΩ	±0.1%	<1ppm/V	350V	1 watt	±50 ppm /°C
10MΩ	±1%	1ppm/V	3,500V	1.5 watt	±100 ppm /°C
100MΩ	±1%	1ppm/V	4,000V	1.5 watt	±100 ppm /°C
1GΩ	±1%	1ppm/V	5,000V	3.5 watt	±100 ppm /°C
10GΩ	±1%	1ppm/V	5,000V	3.5 watt	±250 ppm /°C
100GΩ	±2%	25ppm/V	5,000V	1.3 watt	±2000 ppm /°C
1TΩ	±2%	25ppm/V	5,000V	1.3 watt	±2000 ppm /°C

Weight

RH9A 8.8kg

RH9A-1 7kg

RH9A-2 8kg

RH9A-3 8kg

RH9A-5 0.8kg

Size

RH9A 460mm x 380mm x 160mm (W H D) approx

RH9A-1 460mm x 380mm x 160mm (W H D) approx

RH9A-2 460mm x 380mm x 160mm (W H D) approx

RH9A-3 460mm x 380mm x 160mm (W H D) approx

RH9A-5 220mm x 110mm x 90mm (W H D) approx

RM6

WIDE RANGE, COMPACT & VERSATILE 6 DECADE RESISTANCE BOX WITH DOUBLE POLE SWITCHING

This small, cost effective decade box further enhances our comprehensive range, offering excellent value for money. This 6 decade model has a total resistance of 11.1111 Mega ohm with a resolution of 10 ohm. The accuracy of ±1% is achieved using metal film resistors which have a power rating of 0.4 Watt. Designed for durability the case is hardwood with an anaodised aluminium top panel which is clearly marked with the switch position numbers and the decade values. The size is only 287 x 65 x 65 mm. The RM6 is a valuable addition to any workshop or laboratory offering a wide range of values with minimum cost.

KEY FEATURE	RM6
6 decades	■
Range 10 ohm to 10 Mega ohm	■
Accuracy 1%	■
Low cost	■

RM6 SPECIFICATIONS

Decade	Accuracy	Maximum Current
10 x 10Ω	± 1%	200mA
10 x 100Ω	± 1%	60mA
10 x 1kΩ	± 1%	20mA
10 x 10kΩ	± 1%	6mA
10 x 100kΩ	± 1%	2mA
10 x 1MΩ	± 1%	0.6mA

Terminals

2 binding posts will accept 4mm banana plugs and spade tags.
1 terminal for connection to panel/earth

Dimensions

287mm x 65mm x 65mm (W H D) approx

Mass

0.48kg

Maximum Continuous Working Voltage

70Vdc, 33Vrms

Resistors

Metal film 0.4 W at 70°C

Temperature coefficient ±100 ppm / °C

Switches

Silver plated brass contact resistance <10 mOhm

positive click mechanism

Insulation Resistance >50,000Mohm

Residual Resistance

< 0.1 Ω

Case

Wood with anodised aluminium top panel

RM6N

SPACE SAVING, COMPACT & VERSATILE 6 DECADE RESISTANCE BOX WITH WIDE RANGE

KEY FEATURE	RM6N
6 decades	■
Range 10 ohm to 10 Mega ohm	■
Accuracy 1%	■
Low cost	■

The RM6-N is a space saving 6 decade resistance box, 3 models are available covering the range 1 ohm to 111,111 Mega ohm. An additional 1 kilo ohm resistor is available at the terminals enabling the user to make a simple divider. The RM6-N incorporates 0.4 watt resistors with a specified accuracy of ±1%. Designed for durability and ease of maintenance, the case is high impact polystyrene and the size is only 190 x 140 x 70 mm. The RM6-N's constitute an ideal tool for use in all electrical and electronic laboratories or workshop environments offering a wide range of values with minimum cost.

RM6N SPECIFICATIONS

Decade	Accuracy	Maximum Current	RM6-N	RM6-N2	RM6-N3
10 x 1Ω	± 1%	600mA		■	
10 x 10Ω	± 1%	200mA	■	■	
10 x 100Ω	± 1%	60mA	■	■	■
10 x 1kΩ	± 1%	20mA	■	■	■
10 x 10kΩ	± 1%	6mA	■	■	■
10 x 100kΩ	± 1%	2mA	■	■	■
10 x 1MΩ	± 1%	0.6mA	■		■
10 x 10MΩ	± 1%	0.2mA			■

Dimensions

190mm x 140mm x 70mm (W H D) approx

Mass

0.49kg

Maximum Continuous Working Voltage

70Vdc, 33Vrms

Resistors

Metal film 0.4W at 70 °C
Temperature coefficient ±100 ppm / °C
Except 1Ω: ±200 ppm / °C

Switches

Silver plated brass Contact resistance = 10 milli ohm, positive click mechanism. Insulation Resistance >50,000 Mega ohms

Residual Resistance

< 0.1 Ω

Case

High impact polystyrene

RM8

WIDE RANGE, COMPACT & VERSATILE 8 DECADE RESISTANCE BOX WITH DOUBLE POLE SWITCHING

The model RM8 decade resistance box is designed to compliment our range of resistance boxes, offering a very wide range 0.01 ohm to 1 Mega ohm in a compact and versatile unit. The low decade steps of 0.01 ohm enable very high resolution, when simulating resistance values and the power rating is 1.0 watt per coil. The RM8 uses double pole switching to minimize the effects of contact resistance. The lower value decades (0.01 and 0.1 ohm) are manufactured from Manganin resistance wire and the other decades from selected metal film resistors. This offers good stability combined with excellent load and temperature coefficients. Housed in a hardwood case with metal panel the size is only 254 x 145 x 80mm and the connections are with 4mm binding posts that will accept spade or banana plugs.

KEY FEATURE	RM8
8 decades	■
Wide range 0.01 ohm to 1 Mega ohm	■
Accuracy 0.1%	■
Exceptional value for money	■
Compact size	■
Power rating 1W / resistor	■

RM8 SPECIFICATIONS

Decade	Accuracy	Maximum Current
10 x 100kΩ	± 0.1%	3mA
10 x 10kΩ	± 0.1%	10mA
10 x 1kΩ	± 0.1%	30mA
10 x 100Ω	± 0.1%	100mA
10 x 10Ω	± 0.5%	300mA
10 x 1Ω	± 1%	1000mA
10 x 0.1Ω	± 5%	1000mA
10 x 0.01Ω	± 10%	1000mA

Terminals

2 binding posts will accept 4mm banana plugs and spade tags.
1 terminal for connection to panel/earth

Dimensions

254mm x 145mm x 80mm (W H D) approx

Mass

0.95 kg

Maximum Continuous Working Voltage

70Vdc, 33Vrms

Resistors

Power Rating: 1 watt per resistor
Lower decades (0.01 & 0.1 ohm) Manganin wire wound, other decades metal film

Temperature coefficient: <10ppm / °C

Switches

Rotary 2 poles in parallel, contacts silver plated brass with positive click mechanism. Insulation >50,000 Mega ohm

Residual Resistance

< 0.1 ohm

CM5-N

5 DECADE CAPACITANCE COMPENSATION BOX TO COMPLIMENT THE RM6-N

KEY FEATURE	CM5-N
5 decades	■
Range 100 pF to 11.111 uF	■
Accuracy 5%	■
Residual capacitance 30 pF at zero setting	■
Residual capacitance compensation	■

A five decade capacitance box to compliment the RM6-N range of resistance decades. Styled in the same ergonomic desk case, the CM5-N is a useful addition to any laboratory, as well as for industrial and educational use. The required capacitance is set by means of rotary switches with skirted knobs and stators giving a clear indication of the dial setting. The capacitors are a combination of polycarbonate and polystyrene, generously rated minimum 160 Vdc with a good dissipation factor and high insulation. A useful feature of this unit is the residual capacitance being compensated for on the 10 x 100pF and 10 x 1nF dials so that the actual value of the dial setting appears at the terminals.

CM5-N SPECIFICATIONS

Dimensions
190mm x 140mm x 100mm (W H D) approx

Mass
0.8kg

Case
High impact polystyrene anthracite grey RAL 7016

Switches
Contacts silver plated brass. Contact resistance < 10 mohm with positive click mechanism. Insulation Resistance > 50,000 Mohm

Capacitance Range
11.111µF in 100pF steps

Max Operating Voltage
70Vdc, 33Vrms

Residual Capacitance
Dials set at zero: 35pF Max

Connections
4mm terminals

Decade	Accuracy
10 x 100pF	± 5%
10 x 1nF	± 5%
10 x 10nF	± 5%
10 x 100nF	± 5%
10 x 1µF	± 5%

RS3

4 TERMINAL CONSTRUCTION, HIGH STABILITY RESISTANCE STANDARD WITH WIDE RANGE

The RS3 range of resistance standards are constructed using carefully selected low temperature coefficient Manganin or Zeranin wire, depending on the value, mounted on formers which have a high mechanical stability. The wires are wound in a strain free manner and heat treated to remove any stresses. They are also artificially aged under the strictest control. The result is a standard of high quality with long term stability and permanence of calibration combined with a low temperature coefficient. We offer the widest range of standard values available today. In addition we are able to manufacture for special applications (e.g. Pt100 simulation) special values to customer requirements. The RS3 range also offers a high current carrying capability which makes them ideal for applications where precise current needs to be measured.

KEY FEATURE	RS3
Wide range 0.0001 ohm to 1Mohm	■
Excellent load coefficient	■
Special values made to order	■
4 terminal construction	■
Can be used in air or oil bath	■
Each standard supplied complete with calibration certificate	■

RS3 SPECIFICATIONS

Model	Value	Uncertainty of Adjustment @20°C	Uncertainty of Certification	Temp Coeff Typical 15 to 20°C	Stability Over 1 Year	Dissipation Max in Air Watts	Dissipation Max in Oil Watts	Max. DC Current in Air	Max. DC Current in Oil
RS3/0001	0.0001Ω	0.02%	±200ppm	30ppm/°C	0.0025%	1	4	100A	200A
RS3/001	0.001Ω	0.01%	±50ppm	25ppm/°C	0.0025%	1	4	30A	60A
RS3/01	0.01Ω	0.01%	±25ppm	10ppm/°C	0.001%	1	4	10A	20A
RS3/02	0.02Ω	0.01%	±50ppm	10ppm/°C	0.001%	1	4	7A	14A
RS3/05	0.05Ω	0.01%	±50ppm	10ppm/°C	0.001%	1	4	4.5A	9A
RS3/0.1	0.1Ω	0.003%	±25ppm	10ppm/°C	0.001%	1	4	3A	6A
RS3/1	1Ω	0.003%	±25ppm	10ppm/°C	0.001%	2	10	1.4A	3A
RS3/10	10Ω	0.003%	±25ppm	10ppm/°C	0.001%	2	10	450mA	1A
RS3/25	25Ω	0.005%	±25ppm	10ppm/°C	0.001%	1	10	200mA	600mA
RS3/50	50Ω	0.005%	±25ppm	3ppm/°C	0.001%	1	10	140mA	450mA
RS3/100	100Ω	0.003%	±25ppm	3ppm/°C	0.001%	1	10	100mA	300mA
RS3/250	250Ω	0.005%	±25ppm	3ppm/°C	0.001%	1	10	60mA	200mA
RS3/1k	1kΩ	0.003%	±25ppm	3ppm/°C	0.001%	1	5	30mA	70mA
RS3/10k	10kΩ	0.003%	±25ppm	3ppm/°C	0.001%	0.5	0.5	7mA	7mA
RS3/100k	100kΩ	0.003%	±25ppm	3ppm/°C	0.001%	0.05	0.05	700µA	700µA
RS3/1M	MΩ	0.01%	±25ppm	3ppm/°C	0.002%	0.005	0.005	70µA	70µA

**Special values can be made to order.*

Value in ohms	Typical time constant
1Ω	+ 0.34µH/Ω
10Ω	+ 0.18µH/Ω
100Ω	+ 0.03µH/Ω
1kΩ	+ 0.04µH/Ω
10kΩ	+ 0.6µH/Ω

The resistance standards type RS3 were primarily designed as DC standards, however values above 0.1 ohm are non inductively wound and the adjacent AC characteristics are typical

Dimensions

160mm high x 90mm diameter approx

Mass

0.9kg approx

Maximum Operating Voltage

70Vdc, 33Vrms

Resistance Elements

Manganin or Zeranin depending on the value. 100 ohm, 1, 10 and 100 kilo ohm low inductance winding on brass formers with PTFE insulation. 0.1, 1 and 10 ohm bifilar winding on cylindrical brass formers with PTFE insulation. 0.01, 0.001, and 0.0001 ohm resistance material in the form of straight rods or loops supported on 12mm brass conductors

Terminals

Potential — Gold plated copper 4mm
Current — Nickel

Top Panel

Bakelite marked with the value, class designation and serial number

Case

Light alloy, black anodised to give maximum heat radiation
Thermometer Tube: Slotted extending the length of the resistance element

Label

Each standard is fitted with a label that describes its characteristic and operating parameters

CR

HIGH ACCURACY, COST EFFECTIVE 4 TERMINAL CALIBRATION RESISTOR

This range of low cost 4 terminal calibration resistors combine high accuracy, class 0.02, long term stability and permanence of calibration in a compact unit. Constructed using carefully selected low temperature coefficient Manganin or Zeranin wire, depending upon value and mounted to ensure mechanical stability, these resistors will provide a cost effective addition to any laboratory or workshop. Typical applications include calibration reference, accurate current measurement instrument calibration and accurate shunt resistors.

KEY FEATURE	CR
Low capacitance and low inductance design	■
High accuracy 0.02%	■
Suitable for DC of AC current	■
High stability <±0.01% over many years	■

Dimensions

38mm x 97mm x 41mm (61mm with terminals - approx)

Mass

250g approx

Maximum Operating Voltage

70Vdc, 33Vrms

CR SPECIFICATIONS

Model	Resistance Value	Tolerance ± %	Resistivity material	Max. current in air	Nominal voltage at voltage taps	Storage stability type/year
CR-0.0001	100 µΩ	0.1		60 A	6 mV	< 4 x 10^{-4}
CR-0.0002	200 µΩ	0.05		60 A	12 mV	< 4 x 10^{-4}
CR-0.0005	500 µΩ	0.05		60 A	30 mV	< 4 x 10^{-4}
CR-0.001	1 mΩ	0.05		30 A	30 mV	< 5 x 10^{-5}
CR-0.002	2 mΩ	0.05	Manganin® sheet	30 A	60 mV	< 5 x 10^{-5}
CR-0.005	5 mΩ	0.05	<10ppm / °C	20 A	100 mV	< 5 x 10^{-5}
CR-0.01	10 mΩ	0.03		14 A	140 mV	< 5 x 10^{-5}
CR-0.02	20 mΩ	0.03		10 A	200 mV	< 5 x 10^{-5}
CR-0.05	50 mΩ	0.03		6 A	300 mV	< 5 x 10^{-5}
CR-0.1	100 mΩ	0.02		5 A	500 mV	< 3 x 10^{-5}
CR-0.2	200 mΩ	0.02		3 A	600 mV	< 2 x 10^{-5}
CR-0.5	500 mΩ	0.02		2 A	1 V	< 2 x 10^{-5}
CR-1	1 Ω	0.02		1.5 A	1.5 V	< 1 x 10^{-5}
CR-2	2 Ω	0.02		1 A	2 V	< 2 x 10^{-5}
CR-5	5 Ω	0.02		0.7 A	3.5 V	< 2 x 10^{-5}
CR-10	10 Ω	0.02		0.5 A	5 V	< 1 x 10^{-5}
CR-20	20 Ω	0.02		0.35 A	7 V	< 2 x 10^{-5}
CR-50	50 Ω	0.02		0.2 A	10 V	< 2 x 10^{-5}
CR-100	100 Ω	0.02	Zeranin® wire	0.15 A	15 V	< 1 x 10^{-5}
CR-200	200 Ω	0.02	<2ppm / °C	0.1 A	20 V	< 2 x 10^{-5}
CR-500	500 Ω	0.02		70 mA	35 V	< 2 x 10^{-5}
CR-1 k	1 kΩ	0.02		45 mA	45 V	< 1 x 10^{-5}
CR-2 k	2 kΩ	0.02		20 mA	40 V	< 2 x 10^{-5}
CR-5 k	5 kΩ	0.02		14 mA	70 V	< 2 x 10^{-5}
CR-10 k	10 kΩ	0.02		10 mA	100 V	< 1 x 10^{-5}
CR-20 k	20 kΩ	0.02		7 mA	140 V	< 2 x 10^{-5}
CR-50 k	50 kΩ	0.02		4 mA	200 V	< 3 x 10^{-5}
CR-100 k	100 kΩ	0.02		3 mA	300 V	< 3 x 10^{-5}