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WHY BUY
WHEN YOU CAN HIRE

KC series test leads

Wind turbine lightning protection test lead sets



- **Developed in conjunction with a leading manufacturer of wind turbines**
- **Allows easy and reliable measurement of lightning protection circuit resistance of wind turbines**
- **Available in three lengths, 30 m, 60 m and 100 m to suit both manufacturing and maintenance applications**
- **Long cable fitted on strong metal framed cable reel**
- **Cable reel fitted with friction brake to avoid tangles when paying out emfs**

DESCRIPTION

The KC series of test leads provide a complete and convenient solution to the problem of finding reliable test leads that are long enough for testing the continuity of lightning protection conductors in wind turbines.

KC-series wind turbine test leads are available in 100 m, 60 m and 30 m versions that are equally suitable for use on site or in the manufacturing plant. All lead set versions are 10 A rated.

The lead sets consist of two test leads. The first is a 5 m cable fitted with a duplex handspike for probing the lightning receptors on the tips of the turbine blades. The second cable is either, a 30 m, 60 m or 100 m cable, fitted with a large robust Kelvin clip, specially designed to offer ease of use while providing the consistently reliable connections needed to ensure accurate and repeatable test results.

The long cable is wound onto a high quality, robust cable reel fitted with a friction brake to avoid tangles whilst paying out.

ADDITIONAL FEATURES AND BENEFITS

- Hook terminations marked with C or P to assist in making the correct connections
- Duplex handspikes has a compress and rotate action to ensure good connection to lightning receptors
- Cable guide on cable reel to assist with neat re winding
- Light weight, even 100 m long KC100 lead set is less than 15 kg

APPLICATIONS

This lead set is intended to measure the resistance of the lightning protection circuit of a wind turbine, either in part in a production environment, or fully assembled during commissioning, maintenance, or following repair. This lead set is designed to be connected to any instruments in the Megger 10 A DLRO range or the Megger BT51. However, for outside use the DLRO10HD is recommended due to its robustness and high IP rating.

Lead resistance

KC30 250 mΩ

KC60 500 mΩ

KC100 900 mΩ

ORDERING INFORMATION	
Product	Order Code
KC100 Kelvin lead kit (1 x 100 m / 1 x 5 m)	1000-809
KC60 Kelvin lead kit (1 x 60 m / 1 x 5 m)	1001-248
KC30 Kelvin lead kit (1 x 30 m / 1 x 5 m)	1001-249

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CERTIFICATION ISO
 Registered to ISO 9001:2008 Cert. no. Q 09250
 Registered to ISO 14001:2004 Cert. no. EMS 61597

KC_TEST_LEADS_DS_EN_V03
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DLRO 10 & DLRO 10X

Digital Microhmmeter



- Auto current reversal cancels standing emfs
- Protected to 600 V
- Automatically detects continuity in potential and current connections
- Multiple operating modes including fully automatic
- Alpha-numeric keypad for entering test notes (DLRO 10X)
- User selectable high and low limits (DLRO 10X)
- Printer output and memory (DLRO 10X)

DESCRIPTION

DLRO 10 and DLRO 10X set the standards for low resistance measurement. DLRO 10 and DLRO 10X are fully automatic instruments, selecting the most suitable test current up to 10A d.c. to measure resistance from 0.1 $\mu\Omega$ to 2000 Ω , on one of seven ranges.

For users who desire more control over the measurement process, DLRO 10X uses a menu system controlled by a two-axis paddle to allow the user to manually select the maximum test current.

DLRO 10X also adds real time download of results and on board storage for later download to a PC.

Both instruments are built into a strong, lightweight case that is equally at home in the field or in the laboratory. Light enough to be worn around the neck, they are small enough to be taken into areas that were previously too small to access.

DLRO 10 uses a large, bright 4 1/2 -digit LED display while DLRO 10X has a large, backlit LCD display. Normally, measurements are made with forward and reverse currents to cancel the effects of any standing voltages across the test sample.

The average value is then displayed within 3 seconds, to a basic accuracy of 0.2%. DLRO 10X displays both forward and reverse measurements as well as the average of the two.

DLRO 10X allows the user to set high and low pass limits, thereby enabling simple go-no-go testing.

At the end of a test DLRO10X will store the test results, as well as any notes relevant to the test.

To assist operator safety and ease of use, both instruments are supplied complete with a pair of duplex handspikes with 1.2 m (4 ft) leads. One of the probes is fitted with LED's, which duplicate indicators on the instrument display indicating that all four contacts have been made, the presence of a high voltage across the load, and the presence of current flow while a load is discharging. A full range of test leads is available with probes, clamps and Kelvin clips.

Nickel Metal Hydride (NiMH) batteries power the instruments. The battery packs are interchangeable so that an exhausted battery may be recharged using the external charger supplied while testing continues using a spare pack. Although full charging will take 4 hours, a fast charge mode allows the battery to be 90% charged within 2 1/2 hours from a 12 volt battery or from a standard 120/230 V AC supply via the supplied charger. The battery pack contains its own battery state indicator, which allows the charge-state to be monitored, even without being connected to the instrument.

DLRO 10X is fitted with RS232 communications that will allow results to be downloaded in real time or stored for later retrieval.

Up to 700 sets of results may be stored within DLRO 10X complete with notes containing up to 200 characters which may be added using the on board keypad. These results can also be downloaded to a PC.

MEASUREMENT MODES:

A variety of measurement modes are available. Since the introduction of V2.0 firmware, Normal, Auto, Continuous and Inductive mode are available on both the DLRO 10 and the DLRO 10X.

DLRO 10 will display the average of the measurements achieved using forward and reverse current, while DLRO 10X displays both individual measurements and the average.

Normal mode initiates a test by pressing the Test button on the instrument front panel after connecting the test leads. Continuity of all four connections is checked, forward and reverse currents are applied.

Auto mode allows forward and reverse current measurements to be made and the average displayed simply by making contact with all four probes. This mode is ideal when working with the supplied handspikes. Each time the probes are removed and reconnected to the load another test will be performed without the need to press the test button on the instrument.

Continuous mode allows repeated measurements to be made on the same sample. Simply connect the test leads and press the test button. The measurement is updated every 3 seconds until the circuit is broken.

Inductive mode is intended for use when measuring inductive loads. When measuring inductive loads it is necessary to wait for the voltage to stabilise. This means that the measurement could take a few seconds or several minutes. The test leads are firmly connected to the item to be measured and the Test button is pressed. The instrument will pass a current through the sample and wait for the voltage to stabilise. If possible the current will be increased. This procedure will be repeated until the voltage detected falls into the range 15mV to 200 mV. The instrument will then continue to take readings, which will gradually decrease to the true value as the voltage stabilises further. The operator decides when the result is stable and presses the Test button to terminate the test. Measurement is made with forward current only.

Unidirectional mode, on DLRO 10X only, applies a current in one direction only. This does not enable any standing emfs to be negated but speeds up the measurement process. Test starts automatically when probes are connected.

APPLICATIONS

The needs for accurate low resistance measurement are well known and very diverse. They range through Goods Receiving inspection of components to ground bonding and welded joints. Typical applications include, but are not limited to, making d.c. resistance measurements of:

- Switch and contact breaker resistance
- Busbar and cable joints
- Aircraft frame bonds and static control circuits
- Integrity of welded joints
- Inter-cell connections on battery systems up to 600 V peak
- Quality control of resistive components
- Transformer and motor winding resistance
- Rail and pipe bonds
- Metal alloys, welds and fuse resistance
- Graphite electrodes and other composites
- Wire and cable resistance
- Transmitter aerial and lightning conductor bonding

FEATURES AND BENEFITS

- Small, lightweight and portable - can be used in tight places, reduces the need for extra long leads and two person operation.
- Four terminal resistance method shows the true resistance of the item under test.
- Bright LED (DLRO 10) and LCD (DLRO 10X) displays are easily visible under all lighting conditions and reduce human error.
- Automatically applies forward and reverse currents which cancel out any standing vltags across the sample under test.
- Checks for undue noise during measurement, reducing the possibility of recording the incorrect result.
- Automatically detects continuity in P and C circuits, preventing erroneously high reading to be taken due to high resistance contact.
- Battery module has a battery condition indicator allowing the user to check the state of spare batteries without connecting to the instrument.
- RS232 connector on the DLRO 10X allows downloading of results in real time or stored for later retrieval.



The DLROs are light enough to be worn around the neck. They are also small enough to be taken into areas which were previously too cramped for easy testing.

Full Scale	Resolution	Accuracy	Resistive	Full Scale Volts		Test Current
				Inductive	Resistive	Inductive
1.9999 mΩ	0.1 μΩ	±0.2% ±0.2μΩ	20 mV	n/a	10 A	n/a
19.999 mΩ	1 μΩ	±0.2% ±2 μΩ	20 mV	20 mV	1 A	1 A
199.99 mΩ	10 μΩ	±0.2% ±20 μΩ	20 mV	200 mV	100 mA	1 A
1.9999 Ω	100 μΩ	±0.2%±0.2 mΩ	20 mV	200 mV	10 mA	100 mA
19.999 Ω	1 mΩ	±0.2% ±2 mΩ	20 mV	200 mV	1 mA	10 mA
199.99 Ω	10 mΩ	±0.2% ±20 mΩ	20 mV	200 mV	100 μA	1 mA
1999.9 Ω	100 mΩ	±0.2% ±0.2 Ω	200 mV	200 mV	100 μA	100 μA

		DLRO 10	DLRO 10X
Measurement:	Mode:	Manual, Auto, Continuous, High Power	Manual, Auto, Continuous, High Power, Unidirectional
	Control:	Fully Automatic	Fully Automatic/Manual
	Speed:	<3s for forward & reverse current and to display average	
Display:	Measurement:	4 1/2 digit seven segment LED	
	Range and Safety:	LED indication	Large backlit LCD
Test Method:		Single cycle reversing d.c. ratiometric measurement -average result display.	
Test Current:	Accuracy:	±10%	
	Stability:	<10 ppm per second	
Maximum Lead Resistance:		100 mΩ total for 10A operation irrespective of battery condition.	
Voltmeter input impedance:		> 200kΩ	
Hum rejection:		Less than 1% ±20 digits additional error with 100 mV peak 50/60 Hz. on the potential leads. Warning will show if hum or noise exceeds this level.	
Data:	Transfer:		Real Time or from stoarge via RS232
	Storage:		700 tests
	Memo Field		Up to 256 characters per test via integral alphanumeric keypad
Battery:	Capacity:	7 Ah NiMH rechargeable	
	Life:	Typically 1000 x 10 A tests before recharge	
	Recharge:	Via External 90V - 260V 50/60 Hz charger or from 12 to 15V d.c. supply	
Charging Rate:	Standard:	2.5 hours to 90% capacity, 4 hrs for full charge	
Temperature:	Operation:	+5°C to +45°C (41°F to 113°F) at full specification	
	Storage:	-10°C to +50°C (14°F to 122°F) at reduced accuracy	
	Calibration:	-30°C to +70°C (-22°F to 158°F) 20°C (68°F)	
	Co-efficient:	<0.01% per °C over range 5°C to 40°C	
	Slow chargin:	<0.01% per oC from 5°C to 40°C (<0.006% per oF from 41°F to 104°F)	
	Fast charging:	0°C to +45°C (32°F to 113°F)	
Humidity (max):		+10°C to +45°C (50°F to 113°F)	
Altitude (max):		90% RH @ 40°C (104°F) non-condensing	
Safety:		2000m (6500 ft) to full safety specifications	
EMC:		In accordance with EN61010-1 600V Category III The instrument meets EN50081-1 and EN50082-1 (1992)	
Dimensions:		220 x 100 x 237 mm (8.6 x 4 x 9.5 in)	
Weight:		2.6 kg (5 3/4 lb.) including battery module.	



ORDERING INFORMATION			
Item (Qty)	Order No.	Item (Qty)	Order No.
DLRO 10 Digital Low Resistance Ohmmeter	6111-428	Straight Duplex Handspikes (2)	
DLRO10X Digital Low Resistance Ohmmeter	6111-429	Heavy Duty with fixed contacts.	2m/7 ft 242002- 5.5m/18ft 242002-18 9m/30 ft 242002-30
Complete with		Duplex Heavy Duty 5cm (2")	
7 Ah NiMH battery module.	6340-101	C-Clamps. (2)	2m/7 ft 242004-7 5.5m/18ft 242004-18 9m/30 ft 242004-30
DH4 Duplex handspikes (2), one with indicator lights. 1.2m / 4 ft	6111-503	Duplex handspikes with replaceable Needle Points	2m/7 ft 242003-7
Battery charger for operation from 115/230 V 50/60Hz supply.	6280-333	Duplex 1.27 cm (1/2 ")	
Cigar lighter adapter for battery charging.	6280-332	Kelvin Clips. (2) gold plated	2m/7 ft 241005-7
User guide.	6172-473	silver plated	2m/7 ft 242005-7
Warranty book.	6170-618	Duplex 3.8 cm (1 1/2")	
Optional Accessories at extra cost		Kelvin Clips. (2)	2m/7 ft 242006-7 5.5m/18ft 242006-18 9m/30 ft 242006-30
Carrying case for DLRO10/10X and all standard accessories.	6380-138	Single Leads	
Carrying case for optional lead sets.	18313	Single handspike (1) for potential measurement.	2m/7 ft 242021-7 5.5m/18ft 242021-18 9m/30 ft 242021-30
Calibration Shunt, 10 Ω, current rating 1 mA.	249000	Current clip (1) for current connections.	2m/7 ft 242041-7 5.5m/18ft 242041-18 9m/30 ft 242041-30
Calibration Shunt, 1 Ω, current rating 10 mA.	249001		
Calibration Shunt, 100 mΩ current rating 1A.	249002		
Calibration Shunt, 10 mΩ current rating 10 A.	249003		
Certificate of Calibration for Shunts, NIST	CERT-NIST		
Replacement tips for DH4, DH5 and DH6 handspikes.			
Needle point	25940-012		
Serrated end	25940-014		
Optional Test Leads at extra cost			
Duplex Leads			
DH5 straight duplex handspikes (2). One has indicator lights.	2.5m/8ft 6111-517		
DH6 Duplex handspikes (2) suitable for working on 600 V. systems.	2.5m/8ft 6111-518		
Duplex Handspikes (2) with spring loaded helical contacts.	2m/7 ft 242011-7 2.5m/8ft 6111-022 5.5m/18ft 242011-18 6m/20ft 6111-023 9m/30 ft 242011-30		



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ISO STATEMENT
Registered to ISO 9001:2001 Reg no. Q 09290
Registered to ISO 14001 Reg no. EMS 61597
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All equipment is thoroughly checked prior to dispatch to ensure you receive it in full, safe working order. Your shipment will be securely packed and include manufacturer's instructions, accessories or consumables and a valid calibration certificate where appropriate. In addition, Inlec offer a 24 hour replacement service if you decide the equipment is not suitable for your application*.

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*subject to availability and conditions

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