



# ECT-4 DATASHEET

## CONTINUITY TESTER FOR METALLIC & REMOTELY BONDED STRUCTURES

Excellent mobility

Single handed operation

Extended operating time

Three discrete current injection levels

Continuous & pulsed current direction modes



# REDPHASE INSTRUMENTS

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## **KEY FEATURES:**

The ECT-4, (Earth Continuity Tester V4) is a low resistance micro-ohmmeter used to test the electrical integrity of metal structures, electrical connections and grid bonded utility assets in small or large electrical systems such a single transformer sub to larger extended grids such as a transmission station or industrial complex. Such structures include the bonded electrical equipment itself and / or peripheral elements such as a station's fencing and equipment barriers.

The ECT-4 comes with the following:

- One base unit or main current source housed in a tough ABS case
- One ABS moulded pistol grip probe which includes a control & display panel, two retractable spring loaded stainless steel pins and a connecting fly lead
- One lithium battery pack & connecting cable
- Lithium battery pack charger
- One reference resistor block for field calibration check
- One 10 metre / 33 foot two-way main earth cable
- One 100 metre / 330 foot two-way main earth cable on a canvas or cloth reel
- One custom carry pack or back pack

The carry pack contains cable guides, hook loops, and compartments for the base unit, a battery pack and the test probe.

The carry pack allows the base unit to connect to the battery pack, the main earth cable and the test probe via a compartment gap at the base of the carry pack.

This gives the operator total portability without being encumbered by a mains extension cable or to have to carry the base unit with the other hand.

The carry pack also allows the operator freedom of movement around an electrical network while performing electrical continuity tests.

With three different current range settings to choose from, field testing with the ECT-4 can last for over five (5) hours on one battery pack.

The test probe's LCD display and control panel allow the operator to perform all of the tests with one hand freeing up the other hand for note taking or performing other tasks.

The test probe provides the following test information and physical features:

- Resistance reading
- Applied current reading
- Battery status indicator
- Three push buttons to set the different test modes and current injection level
- Has a type A USB input for future software updates if so required
- Spring loaded stainless steel pins which compress and rotate when pressed onto a metallic asset, making for easier connection to structures through corroded and painted surfaces.

## **1.0. APPLICATIONS**

### **1.1. Where it is used**

The Model ECT-4 is a lightweight field portable instrument designed to test the integrity of buried conductors and remotely connected structures in and around a grid connected or grounded Electrical or Industrial complex.

Types of structures which may be tested:

- Transformers
- Poles / Towers
- Fencing
- Equipment barriers

It's ideally used to map the continuity of these grid bonded structures prior to performing an earth or ground system current injection test.

*please refer to our [Earth Testing products at www.redphase.com.au](http://www.redphase.com.au) for more information*

## **2.0. COMPONENTS**

The ECT-4 kit of components:

### **2.1. Base Unit**

Housed in a rugged ABS case, it contains the main current source, a fan, the source switch, probe connector, main earth connector, battery pack connector and a USB interface for firmware upgrades when required.

### **2.2. Main Earth / Ground Lead**

A twin core 1 mm<sup>2</sup> cable is provided in 2 lengths. This cable carries one half of the 4 wire Kelvin connection from the Base Unit to the earthed grid. One end has a 4 way Amphenol connector for connection to the base unit and the other end has two crocodile clips for earth bar or grid connection.

A 10 metre or 33 ft main earth cable is provided for smaller grounded or grid system while a 100 metre or 330 ft reel is provided for larger extended earth or bonded grid systems.

To maintain proper regulation of drive current up to a maximum of 3 Amps, the connecting lead between the Base Unit and the grid connection must be limited to a loop resistance of 8 Ω or less.

### **2.3. Test Probe**

This pistol grip probe has two retractable stainless steel contact pins which rotate when compressed. The probe has a custom moulded body made from rugged ABS plastic and comes with a 1.5m lead which connects directly to the base unit.

The probe has a 102 x 64 FSTN graphic display and back light which displays test point data and settings such as current, resistance, battery level, current direction setting and manual or automatic current settings.

Also, three tactile buttons located beneath the display allows the operator to adjust the ECT-4's test settings and parameters.

## **3.0. HARDWARE & PERFORMANCE**

### **3.1. Power Source**

One 14.4V / 3200mAH lithium battery pack is provided with the ECT-4 kit.

The battery comes in a customized enclosure and includes both over-charge and over-discharge protection circuitry.

A customized battery tamper protection circuit has also been added to mitigate effects of potential misuse such as a short circuit, battery overload and heat stress.

When fully charged the battery pack voltage can often start off as high as 16.6 V<sub>dc</sub> however once connected to the ECT-4 base unit the voltage will reduce within 10 minutes to an average of 13.3 V<sub>dc</sub> where it shall remain stable for over 90% of the ECT-4's field operation.

The consumption figures given below are based on this average battery level.

The battery pack is considered to be fully discharged when the battery level falls to 10.5 V<sub>dc</sub>. At this voltage the in-built protection circuit will electrically disconnect the battery from the ECT-4 to spare the battery from being over-discharged.

***Important note: this battery pack is non-serviceable***

### **3.2. Power consumption - Standby**

The current source and the measurement circuit is comprised of the Base unit and the Probe. The probe's LCD backlight and base unit fan remained on at all times during the consumption tests below.

Standby	V <sub>dc</sub>	I <sub>dc</sub>	Power
<b>Base Unit</b>	13.3 V	340 mA	4.52 W
<b>Probe</b>	13.3 V	60 mA	0.8 W
<b>Total</b>	13.3 V	400 mA	5.32 W

Based on these figures it is estimated that the battery pack is capable of maintaining the ECT-4 in standby mode for at least 24 hours before a new battery pack or re-charge is required.

### **3.3. Power consumption - Under Load**

The consumption figures shown below indicate the ECT-4 system's total consumption at applied current across a 1Ω resistive load.

V <sub>dc</sub>	I <sub>dc</sub>	Load	Power
13.3 V	1 A	1 Ω	18.6 W
13.3 V	2 A	1 Ω	32 W
13.3 V	3 A	1 Ω	45 W

***Consumption test above performed with 100m main earth cable***

### 3.4. Accuracy

Accuracy:  $\pm 0.05\%$  with respect to full scale

Output current accuracy:  $\pm 2\%$

Measured current stability under load:  $< 10\text{ppm/s}$

**Please note that to achieve the typical accuracy figures listed above the probe must be applied to the bonded structure for at least 3 seconds.**

Range	Display	Resolution
0 to 200 m $\Omega$	0.00 - 200.00 m $\Omega$	10 $\mu\Omega$
200 m $\Omega$ to 4 $\Omega$	0.2001 - 4.0000 $\Omega$	100 $\mu\Omega$

### 3.5. Noise and frequency rejection

ECT-4 has a very precise filter at both 50Hz and 60Hz achieving a signal attenuation of 100dB.

Also, the analogue to digital conversion of the measured voltages are set well above the noise floor to maintain higher signal to noise (S/N) ratio.

To maintain a consistently high S/N ratio it is recommend that the Automatic current range setting be used only.

If the operator chooses to use the Manual current setting the table below must be used as a guide to set the optimal current injection level for the ohmic values shown here.

Range	Current Setting
0 to 200 m $\Omega$	2A or 3A
200 m $\Omega$ to 1.2 $\Omega$	1A, 2A or 3A
1.2 $\Omega$ to 2 $\Omega$	1A or 2A
2 $\Omega$ to 4 $\Omega$	1A

**Note:** current range entry can only be made when the ECT-4 is set to Manual mode.

In both manual and automatic modes the ECT-4 will attempt to inject the maximum level of current up to the chosen level or to the most suitable level of test current that is not limited by the external load, the supply and heat dissipation factors.

### 3.6. AC<sub>rms</sub> Voltage rejection during DC test

Table below shows the maximum tolerable 50Hz induced AC voltage across a 1  $\Omega$  load which the ECT-4 can accurately measure before a drift in the order of 1 m $\Omega$  or more begins to occur.

ECT-4 I <sub>DC</sub>	Injected I <sub>AC</sub> r.m.s.	Load	Induced V <sub>AC</sub> r.m.s.
1 A	4.0 A <sub>ac</sub>	1 $\Omega$	4 V <sub>ac</sub>
2 A	4.9 A <sub>ac</sub>	1 $\Omega$	4.9 V <sub>ac</sub>
3 A	5.2 A <sub>ac</sub>	1 $\Omega$	5.2 V <sub>ac</sub>

#### Please Note:

Maximum tolerable non-destructive induced 50Hz / 60Hz AC Voltage: V<sub>AC</sub> r.m.s.  $< 10\text{V}$

### 3.7. Current direction mode

To further mitigate noise, signal coupling and d.c. bias, the operator may change or cycle the direction of the current source as shown below.

Two current injection modes are available for the operator to choose from on the ECT-4 Probe.

#### i. Continuous mode

Forward D.C.: Continuous current applied in the forward direction displayed as:



-or-

Reverse D.C.: Continuous current applied in the reverse direction displayed as:



#### ii. Pulse mode

Forward Pulse Current: Off + Off +

Current is supplied for a set **ON** period in the forward direction and a set **OFF** period.

Displayed as:



-or-

Reverse Pulse Current: - Off - Off

Current is supplied for a set **ON** period in the reverse direction and a set **OFF** period.

Displayed as:



-or-

Bipolar: - + - +

Current applied in both forward and reverse directions in bipolar mode with preset ON intervals for each direction. Displayed as:



#### Note:

In Pulse mode the pulse **ON** times are set to a minimum of two seconds to achieve a stable reading, however the forward and reverse **ON & OFF** times may also be adjusted independently in 1 second increments up to 999 seconds to achieve asymmetric readings if required.

### 3.8. Current Levels and Load limit reading

The table in section 3.5 shows the measurable load limits for each current range.

When using the manual current setting the operator must be aware that the choice of current range and the maximum measurable load may be limited by the main earth cable's lengthwise resistance.

The ECT-4 kit is supplied with two 1mm<sup>2</sup> two way cable lengths for the main earth connection.

- A 10 metre or 33 foot main earth cable with an average loop resistance of: 0.172  $\Omega$ .
- A 100 metre or 330 foot main earth cable with an average loop resistance of: 1.72  $\Omega$

### 3.9. Reference Check

The ECT-4 is supplied with a factory certified 1  $\Omega$  resistive reference block which the operator can use to check the ECT-4's performance before a field test commences.

### 3.10. Battery Discharge Time

Table i below shows the time taken for the ECT-4 to fully discharge the 14.4V, 3200mAh battery pack when a continuous forward d.c. current is applied across a 1.0Ω resistive load.

Table i


Continuous Current 	Discharge Time
1 A	2 hours
2 A	1 hours
3 A	0.5 hour

Table ii. below shows the time taken to fully discharge the battery pack when continuously applying a three second pulsed forward **ON** current and a three second **OFF** pulse across a 1.0Ω resistive load.

Table ii



Pulsed Current 	Discharge Time
1 A	3 hours

Table iii. below shows the time taken to fully discharge the battery pack when continuously applying a three second Bipolar **forward ON** current and a three second **reverse ON** current across a 1.0 Ω resistive load.

Table iii

Bipolar <b>ON</b> 	Discharge Time
1 A	3 hours

**Field tests do not require the ECT-4 to be under constant resistive load such as the discharge tests undertaken here, thus the operator can expect the average field test using the 1 Amp current level setting to last well over 5 hours per battery pack.**

In operation the battery level can be monitored on the test probe's FSTN LCD display.

To prolong battery life an automatic shutdown feature will disconnect the battery pack when its capacity runs low.

### 3.11. Battery Charge Time

The ECT-4 is supplied with a dedicated lithium battery charger for exclusive use with the battery pack provided.

An average of four (4) hours is required to fully charge the 14.4 V / 3200 mAh battery pack. The dedicated battery charger's LED indicator will display a Red colour when the battery pack is charging and a Green colour when fully charged.

**Warning, do not use a Lithium charger other than the one supplied with the ECT-4 kit as it may result in damaging the battery pack.**

### 3.12. Battery Pack Protection Specifications

The 14.4 V, 3200 mAh lithium pack supplied has an in-built protection circuit to prevent the over charging and over discharging of the battery pack.

Red Phase Instruments have also designed extra protection circuitry to mitigate the effects of the extreme or accidental misuse of the battery pack.

Results of tests performed with the inclusion of the extra protection circuitry is shown here:

#### Short Circuit Test

Cut-off and disconnect in 7.5 ms at 31 A

#### Overload Test

Cut-off and disconnect in 1.5 s at 18 A

#### Thermal Test

Cut-off and disconnect at Temp > 70°C or 158°F

### 3.13. Temperature Specification - Base Unit

Extensive tests have shown that the critical drive system which is the hottest part of the ECT-4's circuitry never exceeds 10°C or 50°F above ambient even when run at a full 3.0 Amps into a load.

Operating Temperature range: -10°C to 55°C  
or  
14°F to 131°F

Storage Temperature range: -30°C to 70°C  
or  
-22°F to 158°F

Relative Humidity is 95% for between:  
-10°C to 55°C or 14°F to 131°F is

**Please note: for equipment safety, the thermal cut-off temperature for the ECT-4 base unit's operation has been set to 55°C or 131°F Ambient.**

### 3.14. Thermal Drift

**Thermal drift test performed across the following temperature range: 20°C to -10°C or 68°F to 14°F**

#### Resistance drift reading

Over 30°C / 86°F change: 60ppm / °C

#### Current drift reading

Over 30°C / 86°F change: 25ppm / °C

### 3.15. Fan Operation

The latest ECT-4 design saves battery power even further by activating the convection fan only during prolonged high current activity and / or high ambient temperatures.

When the base unit's internal current source circuit has cooled sufficiently the convection fan will turn off.



#### **4.0. INCLUDED ACCESSORIES**

The ECT-4 kit comes with the following included accessories

##### **Main Earth Cables**

10m / 33 ft twin core cable with 1mm<sup>2</sup> conductors.

**Part No. ECT-4 10M**

100m / 330 ft twin core cable with 1mm<sup>2</sup> conductors.

**Part No. ECT-4 100M**

##### **Battery Pack and Charger**

A 14.4 V / 3200 mAh Lithium battery pack + cable

**Part No. ECT-4 Batt**

Dedicated Lithium Charger

**Part No. ECT-4 Charger**

##### **Carry Pack**

Carry Pack or Back Pack to house base unit.

**Part No. ECT-4 Pack**

##### **Test Probe**

Kelvin probe with LCD display, control panel and re-tractable stainless steel pins.

**Part No. ECT-4 Probe**

##### **Reference Test Block**

A 1  $\Omega$  Kelvin test block used as a field verification tool. **Part No. ECT-4 Ref**

Accessories listed above may also be purchased separately if required.

#### **5.0. ENCLOSURE**

##### **5.1. Cases**

The ECT-4 Base Unit is housed in a plastic ABS case.

A customised carry pack is also provided to house the Base Unit and other accessories.

The carry back has the following features:

- Base Unit pouch with mesh ventilation
- Two Battery Pack pouches
- Cable guides
- Strain relief ring for the main earth cable
- Padded shoulder straps
- Waist and chest strap / fastener

##### **5.2. Case Sizes (L x W x H)**

ECT-4 Base Unit: 24 cm x 16 cm x 12 cm  
9.4 in x 96.3 in x 4.7 in

Test Probe: 17 cm x 4.7 cm x 15 cm  
6.7 in x 1.9 in x 5.9 in

Battery Pack: 10 cm x 3 cm x 10.5 cm  
3.9 in x 1.2 in x 4.1 in

Probe Pins extended: 2.2 cm or 0.87 in  
Probe Pins retracted: 0.9 cm or 0.35 in

Carry Back Pack: 50 cm x 15 cm x 30 cm  
19.7 in x 5.9 in x 10.8 in

##### **5.3. Weight**

ECT-4 Base Unit:	2.0 kg or 4.4 lb
ECT-4 Pack:	0.5 kg or 1.1 lb
ECT-4 Probe:	0.5 kg or 1.1 lb
ECT-4 Batt:	0.35 kg or 0.77 lb
ECT-4 Charger:	0.15 kg or 0.33 lb
ECT-4 10M:	0.5 kg or 1.1 lb
ECT-4 100M:	7.0 kg or 14.4 lb
ECT-4 Ref:	0.20 kg or 0.44 lb
ECT-4 Holster	0.20 kg or 0.44 lb

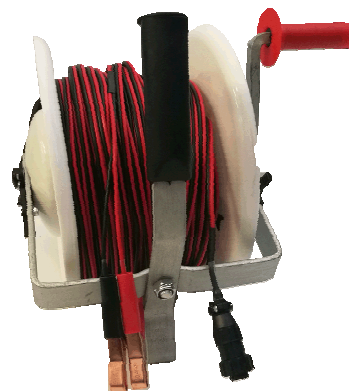
#### **6.0. WARRANTY**

This product and its accessories is covered by a twelve month limited warranty.

##### **Carry pack with 10 m / 33 ft main earth**



##### **100 m / 330 ft main earth cable on a drum reel**



Every care has been taken to ensure that the above data is correct at the time of printing. Always refer to the latest data sheet when purchasing. RED PHASE INSTRUMENTS reserves the right to alter specifications without notice.