


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

|   |  |                                     |
|---|--|-------------------------------------|
|  <p><b>0072</b></p> <p>Accredited to<br/><b>ISO/IEC 17025:2005</b></p> | <b>Trescal CMS</b>   |                                     |
|   | <b>Issue No: 031</b>   | <b>Issue date: 07 February 2011</b> |
| <b>Unit 2</b><br>106 Hawley Lane<br>Farnborough<br>Hampshire<br>GU14 8EH  | <b>Contact: Mr Jeremy Struthers</b><br><b>Tel: +44 (0)1252 533 300</b><br><b>Fax: +44 (0)1252 533 333</b><br><b>E-Mail: ukcms@trescal.com</b><br><b>Website: www.trescal.com</b> |                                     |
| <b>Calibration performed by the Organisation at the locations specified below</b>   |  |                                     |

All Calibrations can be performed at customer premises

### Site Activities

| Location details   | Activity   | Location Code |
|--|--|---------------|
| <p><b>All activities performed at customers premises</b></p> <p>The customers' site or premises must be suitable for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer.</p> | Electrical DC & LF (including 17 <sup>th</sup> edition equipment) and RF<br>Humidity<br>Temperature<br>Pressure<br>Dimensional<br>Mass - weighing machines (non-automatic) | Sites         |



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DETAIL OF ACCREDITATION

| Measured Quantity<br>Instrument or Gauge | Range   | Calibration and<br>Measurement<br>Capability (CMC)<br>Expressed as an<br>Expanded<br>Uncertainty<br>( $k = 2$ )   | Remarks       | Location<br>Code |
|--|---|---|---------------|------------------|
| <b>ELECTRICAL</b>                        |   |   |               | Sites            |
| DC RESISTANCE                            | 1 $\Omega$ to 10 $\Omega$<br>10 $\Omega$ to 100 $\Omega$<br>100 $\Omega$ to 1 k $\Omega$<br>1 k $\Omega$ to 10 k $\Omega$<br>10 k $\Omega$ to 100 k $\Omega$<br>00 k $\Omega$ to 1 M $\Omega$<br>1 M $\Omega$ to 100 M $\Omega$ | 5.0 m $\Omega$<br>120 ppm + 5.0 m $\Omega$<br>120 ppm + 13 m $\Omega$<br>120 ppm + 163 $\Omega$<br>120 ppm + 1.63 $\Omega$<br>470 ppm + 120 $\Omega$<br>1.0 % + 12 k $\Omega$ |               |                  |
|  | 100 M $\Omega$ to 400 M $\Omega$  | 0.60 % + 40 k $\Omega$  | Source only   |                  |
| Specific Values; sourcing                | 30 M $\Omega$<br>100 M $\Omega$<br>190 M $\Omega$<br>300 M $\Omega$   | 0.10 %<br>0.62 %<br>0.61 %<br>0.61 %  |               |                  |
| DC VOLTAGE                               | 0 V to 100 mV<br>100 mV to 1 V<br>1 V to 10 V<br>10 V to 100 V<br>100 V to 1 kV<br>1 kV to 20 kV  | 69 ppm + 4.2 $\mu$ V<br>52 ppm + 8.2 $\mu$ V<br>47 ppm + 58 $\mu$ V<br>59 ppm + 700 $\mu$ V<br>59 ppm + 12 mV<br>2.5 %  |               |                  |
| AC VOLTAGE                               | 10 mV to 100 mV<br>45 Hz to 100 Hz  | 730 ppm + 46 $\mu$ V  |               |                  |
|  | 100 mV to 1 V<br>45 Hz to 20 kHz<br>20 kHz to 50 kHz  | 0.14 % + 59 $\mu$ V<br>0.69 % + 99 $\mu$ V  |               |                  |
|  | 1 V to 10 V<br>45 Hz to 20 kHz<br>20 kHz to 50 kHz  | 0.46 % + 680 $\mu$ V<br>730 ppm + 490 $\mu$ V   |               |                  |
|  | 10 V to 100 V<br>45 Hz to 20 kHz<br>20 kHz to 50 kHz  | 0.14 % + 3.5 mV<br>0.14 % + 3.6 mV  |               |                  |
|  | 100 V to 750 V<br>45 Hz to 1 kHz  | 0.46 % + 5.8 mV   |               |                  |
|  | 750 V to 1 kV<br>40 Hz to 10 kHz  | 0.12 % + 50 mV  | Generate only |                  |
|  | 1 kV to 20 kV @ 50 Hz<br>50 Hz  | 2.3%  |               |                  |



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|--|--|---|--|------------------|
| DC CURRENT                               | 0 A to 10 mA<br>10 mA to 100 mA<br>100 mA to 1 A<br>1 A to 3 A<br>3 A to 20 A<br>20 A to 100 A<br>100 A to 500 A | 600 ppm + 2.6 $\mu$ A<br>600 ppm + 26 $\mu$ A<br>600 ppm + 260 $\mu$ A<br>600 ppm + 1.2 mA<br>0.12 % + 12 mA<br>0.20 % + 10 mA<br>0.30 % + 700 mA |  | Sites            |
| AC CURRENT                               | 1 mA to 30 mA<br>45 Hz to 1 kHz  | 0.74 % + 130 $\mu$ A  |  |                  |
|  | 30 mA to 100 mA<br>4 Hz to 1 kHz   | 0.74 % + 130 $\mu$ A  |  |                  |
|  | 100 mA to 10 A<br>45 Hz to 1 kHz   | 1.5 % + 130 mA  |  |                  |
|  | 320 mA to 3.2 A<br>45 Hz to 1 kHz  | 0.20 % + 120 $\mu$ A  | Source only  |                  |
|  | 3.2 A to 20 A<br>45 Hz to 1 kHz  | 0.20 % + 1.2 mA   |  |                  |
| FREQUENCY                                | 10 Hz to 100 MHz   | 1.0 in $10^5$ + 1.0 Hz  | Measurement capability only  |                  |
| TIME INTERVAL                            | Up to 1 hour<br>1 hour to 1 Day  | 100 ms<br>100 ms + 1.0 ppm  | Mechanically triggered devices eg Stopwatches<br>20 °C $\pm$ 3 °C                        |                  |
|  | Up to 1 hour<br>1 hour to 1 Day  | 210 ms<br>210 ms + 20 ms/hr   | Mechanically triggered devices e.g. Stopwatches<br>0 °C to 40 °C                         |                  |
| BANDWIDTH                                | 1 MHz to 250 MHz<br>30 mV pp to 0.707 V pp<br>250 MHz to 1 GHz<br>30 mV pp to 2 V pp                             | 1.4 %<br>5.4 %  | Bandwidth uncertainty will be expressed in terms of frequency relative to the 3dB point. |                  |
| RIPPLE AND NOISE                         | 0 V to 100 mV<br>1 Hz to 1 MHz   | 0.20 % + 50 $\mu$ V   |  |                  |



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| ADDITIONAL MEASUREMENTS SPECIFIC TO 17 <sup>TH</sup> EDITION EQUIPMENT |  |   |         | Sites            |
| Continuity   | 0 $\Omega$ to 20 m $\Omega$<br>20 m $\Omega$ to 200 m $\Omega$<br>200 m $\Omega$ to 300 m $\Omega$<br>300 m $\Omega$ to 500 m $\Omega$<br>500 m $\Omega$ to 900 m $\Omega$<br>900 m $\Omega$ to 1 $\Omega$<br>1 $\Omega$ to 10 $\Omega$<br>10 $\Omega$ to 100 $\Omega$<br>100 $\Omega$ to 1 k $\Omega$ | 1.4 % + 12.5 m $\Omega$<br>0.45 % + 26 m $\Omega$<br>0.45 % + 27 m $\Omega$<br>0.45 % + 26 m $\Omega$<br>0.44 % + 26 m $\Omega$<br>0.44 % + 27 m $\Omega$<br>0.44 % + 26 m $\Omega$<br>0.44 % + 27 m $\Omega$<br>0.44 % + 27 m $\Omega$                                   |         |                  |
| Insulation   | 0 $\Omega$ to 1 M $\Omega$<br>1 M $\Omega$ to 10 M $\Omega$<br>10 M $\Omega$ to 100 M $\Omega$<br>100 M $\Omega$ to 1 G $\Omega$   | 0.70 % + 500 $\Omega$<br>1.7 % + 35 k $\Omega$<br>1.7 % + 260 k $\Omega$<br>2.0 % + 290 k $\Omega$  |         |                  |
| Loop Impedance (50 Hz)   | 50 m $\Omega$<br>100 m $\Omega$<br>220 m $\Omega$<br>340 m $\Omega$<br>500 m $\Omega$<br>1.0 $\Omega$<br>5.0 $\Omega$<br>10 $\Omega$<br>100 $\Omega$<br>1 k $\Omega$   | 0.66 % + 4.7 m $\Omega$<br>0.64 % + 4.7 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 5.2 m $\Omega$<br>0.64 % + 93 m $\Omega$<br>0.64 % + 120 m $\Omega$ |         |                  |
| RCDs   |  |   |         |                  |
| Timing   | 20 ms to 5 s   | 1.5 ms  |         |                  |
| Current (50 Hz)  | 10 mA @ 200 ms<br>30 mA @ 200 ms<br>100 mA @ 200 ms<br>300 mA @ 200 ms<br>1 A @ 200 ms   | 1.8 % + 70 $\mu$ A<br>1.8 % + 110 $\mu$ A<br>1.8 % + 170 $\mu$ A<br>1.8 % + 850 $\mu$ A<br>1.8 % + 700 $\mu$ A  |         |                  |



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|--|---|---|---|------------------|
| PAT TESTERS  |   |   |   | Sites            |
| Earth Bond Resistance  | 40 mΩ<br>100 Ω<br>290 mΩ<br>390 mΩ<br>1 Ω<br>5 Ω<br>10 Ω<br>100 Ω<br>1 kΩ | 0.58 % + 5.2 mΩ<br>0.58 % + 4.8 mΩ<br>0.58 % + 5.2 mΩ<br>0.58 % + 5.2 mΩ<br>0.58 % + 5.3 mΩ<br>0.57 % + 6.6 mΩ<br>0.58 % + 14 mΩ<br>0.58 % + 35 mΩ<br>0.52 % + 5.8 mΩ |   |                  |
| Earth Bond Current   | 100 mA<br>8 A<br>10 A<br>20 A   | 1.5 % + 1.0 mA<br>1.5 % + 10 mA<br>1.5 % + 11 mA<br>1.5 % + 15 mA   |   |                  |
| Load Test  | 0.13 kVA (nominal 440 Ω)  | 5.8 % + 3.1 Ω   |   |                  |
| Leakage Current  | 2 mA to 8 mA  | 1.7 % + 36 μA   |   |                  |
| Temperature simulators,<br>calibration by electrical<br>simulation |   |   |   |                  |
| Resistance thermometers<br>(Pt 100)                                | - 200 °C to + 800 °C  | 0.10 °C   |   |                  |
| Base metal thermocouples   | - 200 °C to -100 °C<br>- 100 °C to + 1372 °C                              | 1.7 °C<br>1.2 °C  | Including cold junction<br>compensation |                  |
| Noble metal thermocouples  | 0 °C to 100 °C<br>100 °C to 400 °C<br>400 °C to 1770 °C                   | 4.0 °C<br>2.7 °C<br>2.0 °C  | Including cold junction<br>compensation |                  |
| Temperature indicators,<br>calibration by electrical<br>simulation |   |   |   |                  |
| Resistance thermometers<br>(Pt 100)                                | - 200 °C to + 800 °C  | 0.15 °C   |   |                  |
| Base metal thermocouples   | - 200 °C to -100 °C<br>- 100 °C to + 1372 °C                              | 1.7 °C<br>1.2 °C  | Including cold junction<br>compensation |                  |
| Noble metal thermocouples  | 0 °C to 100 °C<br>100 °C to 400 °C<br>400 °C to 1770 °C                   | 4.0 °C<br>2.7 °C<br>2.0 °C  | Including cold junction<br>compensation |                  |



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| <b>HUMIDITY</b>  |  |   | The accreditation covers other humidity units directly related to dew point, eg vapour pressure, PPM volume, g/kg, etc.     | Sites            |
| Calibration of rh probes:  | 10 %rh to 90 %rh<br>15 °C to 25 °C   | 3.0 %rh   |   |                  |
| Calibration of chambers:<br>Dew-Point                                      | Over the temperature range<br>0 °C to 80 °C  | 0.20 °C to 0.30 °C  |   |                  |
| Relative Humidity  | Over the temperature range<br>0 °C to 80 °C<br>10 %rh up to 20 %rh<br>20 %rh to 98 %rh | 2.0 %rh<br>2.0 % of reading over<br>the range   | Dew Point and Relative Humidity Instruments may be calibrated in accordance with the schedule measured quantities and range |                  |
| <b>TEMPERATURE</b>   |  |   |   |                  |
| Temperature controlled chambers/ovens                                      | - 80 to 100 °C<br>Above 100 to 260 °C  | 0.20 °C<br>0.40 °C  |   |                  |
| Temperature controlled baths calibrated using PRTS                         |  |   |   |                  |
| Temperature controlled furnaces calibrated using type R T/CS               | 0 °C to 1100 °C<br>1100 to 1300 °C   | 3.0 °C<br>5.0 °C  |   |                  |
| Temperature controlled ovens/chambers calibrated with type T thermocouples | - 80 to + 260 °C<br>260 °C to 400 °C   | 1.0 °C<br>3.0 °C  |   |                  |
| Temperature controlled ovens/chambers calibrated with type K thermocouples | 400 °C to 700 °C   | 5.0 °C  |   |                  |
| Temperature controlled ovens/chambers calibrated with N type thermocouples | 0 °C to 1200 °C  | 5.0 °C  |   |                  |
| <b>TEMPERATURE INDICATORS</b>  | - 80 °C to - 25 °C<br>- 25 °C to + 140 °C<br>140 °C to 1100 °C<br>1100 °C to 1300 °C   | 0.20 °C<br>0.50 °C<br>3.0 °C<br>5.0 °C  |   |                  |



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| <b>PRESSURE</b>  |   |   |  | Sites            |
| <b>GAS PRESSURE GAUGE</b><br><br>Calibration of pressure<br>indicating instruments and<br>gauges           | - 95 kPa to - 2 kPa<br>- 2 kPa to - 200Pa<br>-200 Pa to + 200 Pa<br>200 Pa to 2 kPa<br>2 kPa to 2 MPa<br>2 MPa to 7 MPa | 2.0 kPa<br>7.0 Pa<br>2.0 Pa<br>7.0 Pa<br>2.0 kPa<br>0.10 %  | Calibration of pressure<br>devices with an electrical<br>output may be undertaken  |                  |
| <b>HYDRAULIC PRESSURE<br/>GAUGE</b><br><br>Calibration of pressure<br>indicating instruments and<br>gauges | 0 Pa to 70 MPa  | 100 kPa   | Calibration of pressure<br>devices with an electrical<br>output may be undertaken  |                  |
| <b>GAS PRESSURE ABSOLUTE</b><br><br>Calibration of pressure<br>indicating instruments and<br>gauges        | 5 kPa to 80 kPa<br>80 kPa to 115 kPa<br>115 kPa to 200 kPa  | 700 Pa<br>50 Pa<br>700 Pa   | Absolute pressure<br>calibrations may be<br>undertaken over the gauge<br>pressure ranges with the<br>addition of the barometric<br>pressure and uncertainty<br>of $\pm 50$ Pa                                      |                  |
| <b>DIMENSIONAL</b>   |   |   |  |                  |
|  | RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES<br>UNLESS OTHERWISE STATED  |   |  |                  |
| Electronic Height Gauges   | 0 m to 1000 mm  | 1.0 + (5.0 x L in m)  | 2  |                  |
| <b>FORM</b><br><br>Surface Plates  |   |   |  |                  |
| Granite<br>Cast iron   | As BS 817:1988  | 1.5 + (0.80 x diagonal<br>in m)   | The uncertainty quoted is<br>for the departure from<br>flatness, straightness or<br>squareness; ie the<br>distance separating the<br>two parallel planes which<br>just enclose the surface<br>under consideration. |                  |



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| <b>MEASURING INSTRUMENTS<br/>AND MACHINES</b>   |  |   |   | Sites            |
| Profile Projectors  | 0 to 100 x magnification<br>Linear<br>Angular  | 125 at the screen<br>4.0<br>4.0 minutes of arc  |   |                  |
| Horizontal measuring<br>machines  | 0 m to 1200 mm   | 0.30 + (4.0 X L in m)   |   |                  |
| <b>MASS</b><br>Weighing Machines (Non<br>Automatic)   | 50 g<br>100 g<br>200 g<br>500 g<br><br>1 kg<br>2 kg<br>5 kg<br>10 kg<br>20 kg<br>50 kg   | 0.13 mg<br>0.21 mg<br>0.42 mg<br>1.1 mg<br><br>2.1 mg<br>4.2 mg<br>10.5 mg<br>34 mg<br>71 mg<br>230 mg  | 1. Weights available in<br>OIML Class F1 from 1 mg<br>to 10 kg<br>Max grouped load 50 kg<br><br>2. Other loads within the<br>overall listed range may<br>also be used |                  |
| <b>CAMPAIGN ELECTRICAL:</b>   |  |   |   |                  |
| This is a site capability available to customers where the required environmental conditions can be suitably maintained. (20 °C ± 3 °C) |  |   |   |                  |
| <b>GENERATION</b>   |  |   |   |                  |
| <b>DC RESISTANCE</b><br>Generation  | 1 Ω<br>1.9 Ω<br>10 Ω<br>19 Ω<br>100 Ω<br>190 Ω<br>1 kΩ<br>1.9 kΩ<br>10 kΩ<br>19 kΩ<br>100 kΩ<br>190 kΩ<br>1 MΩ<br>1.9 MΩ<br>10 MΩ<br>19 MΩ<br>100 MΩ | 130 ppm<br>130 ppm<br>40 ppm<br>36 ppm<br>24 ppm<br>24 ppm<br>18 ppm<br>18 ppm<br>17 ppm<br>17 ppm<br>19 ppm<br>19 ppm<br>30 ppm<br>30 ppm<br>55 ppm<br>65 ppm<br>160 ppm |   |                  |



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| <b>DC VOLTAGE</b>                        |   |   |                      | Sites            |
| Generation                               | 0 V to 220 mV<br>220 mV to 2.2 V<br>2.2 V to 11 V   | 11 ppm + 1.0 $\mu$ V<br>10 ppm + 1.4 $\mu$ V<br>10 ppm + 5.0 $\mu$ V  |                      |                  |
|  | 11 V to 22 V<br>22 V to 220 V<br>220 V to 1100 V  | 10 ppm + 10 $\mu$ V<br>11 ppm + 120 $\mu$ V<br>13 ppm + 700 $\mu$ V   |                      |                  |
| <b>DC CURRENT</b>                        |   |   |                      |                  |
| Generation                               | 0 A to 220 $\mu$ A<br>220 $\mu$ A to 2.2 mA<br>2.2 mA to 22 mA<br>22 mA to 220 mA<br>220 mA to 2.2 A<br>2.2 A to 11 A   | 70 ppm + 12 nA<br>70 ppm + 12 nA<br>70 ppm + 120 nA<br>81 ppm + 1.2 $\mu$ A<br>110 ppm + 35 $\mu$ A<br>420 ppm + 560 $\mu$ A  |                      |                  |
| <b>DC CURRENT</b>                        |   |   |                      |                  |
| Simulation                               | 11 A to 550 A   | 0.30 % + 0.58 A   | Using a 50 turn coil |                  |
| <b>AC VOLTAGE</b>                        |   |   |                      |                  |
| Generation                               | 0.1 mV to 2.2 mV<br>10 Hz to 20 Hz<br>20 to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 500 kHz<br>500 kHz to 1 MHz   | 1000 ppm + 6.0 $\mu$ V<br>800 ppm + 6.0 $\mu$ V<br>750 ppm + 6.0 $\mu$ V<br>850 ppm + 6.0 $\mu$ V<br>0.14 % + 10 $\mu$ V<br>0.17 % + 20 $\mu$ V<br>0.23 % + 35 $\mu$ V<br>0.45 % + 35 $\mu$ V |                      |                  |
|  | 2.2 mV to 22 mV<br>10 Hz to 20 Hz<br>20 Hz to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 500 kHz<br>500 kHz to 1 MHz | 700 ppm + 7.0 $\mu$ V<br>300 ppm + 7.0 $\mu$ V<br>175 ppm + 7.0 $\mu$ V<br>500 ppm + 7.0 $\mu$ V<br>0.12 % + 10 $\mu$ V<br>0.16 % + 20 $\mu$ V<br>0.21 % + 35 $\mu$ V<br>0.43 % + 55 $\mu$ V  |                      |                  |



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| <b>AC VOLTAGE</b> (continued)<br>Generation | 22 mV to 220 mV<br>10 Hz to 20 Hz<br>20Hz to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 500 kHz<br>500 kHz to 1 MHz<br><br>220 mV to 2.2 V<br>10 Hz to 20 Hz<br>20Hz to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 500 kHz<br>500 kHz to 1 MHz<br><br>2.2 V to 22 V<br>10 Hz to 20 Hz<br>20Hz to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 500 kHz<br>500 kHz to 1 MHz<br><br>22 V to 220 V<br>10 Hz to 20 Hz<br>20Hz to 40 Hz<br>40 Hz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br><br>220 V to 1100 V<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 30 kHz<br><br>220 V to 750 V<br>30 kHz to 50 kHz<br>50 kHz to 100 kHz | 700 ppm + 18 $\mu$ V<br>280 ppm + 12 $\mu$ V<br>140 ppm + 12 $\mu$ V<br>410 ppm + 12 $\mu$ V<br>1000 ppm + 35 $\mu$ V<br>1300 ppm + 35 $\mu$ V<br>0.20 % + 50 $\mu$ V<br>0.42 % + 120 $\mu$ V<br><br>690 ppm + 120 $\mu$ V<br>210 ppm + 35 $\mu$ V<br>110 ppm + 8 $\mu$ V<br>170 ppm + 23 $\mu$ V<br>330 ppm + 92 $\mu$ V<br>560 ppm + 170 $\mu$ V<br>1400 ppm + 460 $\mu$ V<br>0.28 % + 1.2 mV<br><br>690 ppm + 1.2 mV<br>210 ppm 350 $\mu$ V<br>110 ppm + 80 $\mu$ V<br>170 ppm + 230 $\mu$ V<br>330 ppm + 450 $\mu$ V<br>700 ppm + 1.9 mV<br>0.16 % + 5.8 mV<br>0.35 % + 10 mV<br><br>700 ppm + 12 mV<br>210 ppm + 3.5 mV<br>110 ppm + 2.1 mV<br>290 ppm + 4.6 mV<br>700 ppm + 12 mV<br><br>110 ppm + 4.6 mV<br>200 ppm + 6.9 mV<br>700 ppm + 13 mV<br><br>690 ppm + 13 mV<br>0.27 % + 52 mV |         |                  | Sites |



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**Trescal CMS**  
**Issue No: 031 Issue date: 07 February 2011**

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|---|---|--|---------|------------------|
| <b>AC VOLTAGE</b><br>(WIDEBAND to 30 MHz)<br><br>Generation |   |  |         | Sites            |
|   | 10 $\mu$ V to 1.1 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz | 1.3 % + 2.3 $\mu$ V<br>1.0 % + 2.3 $\mu$ V<br>1.0 % + 2.3 $\mu$ V<br>1.2 % + 5.8 $\mu$ V<br>1.4 % + 5.8 $\mu$ V<br>2.7 % + 20 $\mu$ V      |         |                  |
|   | 1.1 mV to 3 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz       | 1.2 % + 3.5 $\mu$ V<br>0.93 % + 3.5 $\mu$ V<br>0.93 % + 6.9 $\mu$ V<br>1.2 % + 6.9 $\mu$ V<br>1.4 % + 6.9 $\mu$ V<br>2.5 % + 6.9 $\mu$ V   |         |                  |
|   | 3 mV to 11 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz        | 1.2 % + 9.2 $\mu$ V<br>0.92 % + 9.2 $\mu$ V<br>0.92 % + 13 $\mu$ V<br>1.2 % + 13 $\mu$ V<br>1.4 % + 13 $\mu$ V<br>2.5 % + 13 $\mu$ V       |         |                  |
|   | 11 mV to 33 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz       | 1.0 % + 46 $\mu$ V<br>0.81 % + 46 $\mu$ V<br>0.81 % + 50 $\mu$ V<br>0.92 % + 50 $\mu$ V<br>1.2 % + 50 $\mu$ V<br>1.9 % + 50 $\mu$ V        |         |                  |
|   | 33 mV to 110 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz      | 1.0 % + 19 $\mu$ V<br>0.81 % + 19 $\mu$ V<br>0.81 % + 22 $\mu$ V<br>0.93 % + 22 $\mu$ V<br>1.2 % + 22 $\mu$ V<br>1.9 % + 22 $\mu$ V        |         |                  |
|   | 110 mV to 330 mV<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz     | 0.92 % + 120 $\mu$ V<br>0.69 % + 120 $\mu$ V<br>0.69 % + 120 $\mu$ V<br>0.81 % + 120 $\mu$ V<br>1.0 % + 120 $\mu$ V<br>1.7 % + 120 $\mu$ V |         |                  |



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|---|--|---|----------------------|------------------|
| <b>AC VOLTAGE</b> (continued)<br>(WIDEBAND to 30 MHz) | 330 mV to 1.1 V<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz | 0.92 % + 460 $\mu$ V<br>0.69 % + 460 $\mu$ V<br>0.69 % + 470 $\mu$ V<br>0.81 % + 470 $\mu$ V<br>1.0 % + 470 $\mu$ V<br>1.7 % + 470 $\mu$ V  |                      | Sites            |
|   | 1.1 V to 3.5 V<br>10 Hz to 30 Hz<br>30 Hz to 120 Hz<br>120 Hz to 2 MHz<br>2 MHz to 10 MHz<br>10 MHz to 20 MHz<br>20 MHz to 30 MHz  | 0.81 % + 580 $\mu$ V<br>0.58 % + 580 $\mu$ V<br>0.58 % + 580 $\mu$ V<br>0.69 % + 580 $\mu$ V<br>0.92 % + 580 $\mu$ V<br>1.6 % + 580 $\mu$ V |                      |                  |
| <b>AC CURRENT</b>                                     |  |   |                      |                  |
| Generation  | 100 nA to 220 $\mu$ A<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 190 ppm + 23 nA<br>810 ppm + 58 nA<br>0.21 % + 115 nA   |                      |                  |
|   | 220 $\mu$ A to 2.2 mA<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 190 ppm + 46 nA<br>810 ppm + 580 nA<br>0.21 % + 1.2 $\mu$ A   |                      |                  |
|   | 2.2 mA to 22 mA<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 190 ppm + 460 nA<br>810 ppm + 5.8 $\mu$ A<br>0.21 % + 11.5 $\mu$ A  |                      |                  |
|   | 22 mA to 220 mA<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 210 ppm + 4.6 $\mu$ A<br>810 ppm + 58 $\mu$ A<br>0.21 % + 120 $\mu$ A   |                      |                  |
|   | 220 mA to 2.2 A<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 870 ppm + 46 $\mu$ A<br>980 ppm + 120 $\mu$ A<br>1.2 % + 230 $\mu$ A  |                      |                  |
| Generation  | 2.2 A to 11 A<br>40 Hz to 1 kHz<br>1 kHz to 5 kHz<br>5 kHz to 10 kHz   | 540 ppm + 200 $\mu$ A<br>0.11% + 440 $\mu$ A<br>0.42 % + 870 $\mu$ A  |                      |                  |
| Simulation  | 11 A to 550 A<br>45 Hz to 65 Hz  | 0.30 % + 580 mA   | Using a 50 turn coil |                  |



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|--|---|--|---------|------------------|
| <b>MEASUREMENT</b>                       |   |  |         |                  |
| <b>DC RESISTANCE</b>                     |   |  |         | Sites            |
| Measurement                              | 0 $\Omega$ to 12 $\Omega$<br>12 $\Omega$ to 120<br>120 $\Omega$ to 1.2 k $\Omega$<br>1.2 k $\Omega$ to 12 k $\Omega$<br>12 k $\Omega$ to 120 k $\Omega$<br>120 k $\Omega$ to 1.2 M $\Omega$<br>1.2 M $\Omega$ to 12 M $\Omega$<br>12 M $\Omega$ to 120 M $\Omega$<br>120 M $\Omega$ to 1.2 G $\Omega$ | 45 ppm + 0.10 m $\Omega$<br>30 ppm + 1.0 m $\Omega$<br>22 ppm + 1.0 m $\Omega$<br>21 ppm + 10 m $\Omega$<br>23 ppm + 100 m $\Omega$<br>35 ppm + 3.0 $\Omega$<br>80 ppm + 140 $\Omega$<br>600 ppm + 2.1 k $\Omega$<br>0.65 % + 160 k $\Omega$ |         |                  |
| <b>DC VOLTAGE</b>                        |   |  |         |                  |
| Measurement                              | 0 mV to 120 mV<br>120 mV to 1.2 V<br>1.2 V to 12 V<br>12 V to 120 V<br>120 V to 1050 V  | 13 ppm + 1.8 $\mu$ V<br>12 ppm + 2.0 $\mu$ V<br>12 ppm + 6.5 $\mu$ V<br>13 ppm + 130 $\mu$ V<br>19 ppm + 750 $\mu$ V   |         |                  |
| <b>DC CURRENT</b>                        |   |  |         |                  |
| Measurement                              | 0 $\mu$ A to 1.2 $\mu$ A<br>1.2 $\mu$ A to 12 $\mu$ A<br>12 $\mu$ A to 120 $\mu$ A<br>120 $\mu$ A to 1.2 mA<br>1.2 mA to 12 mA<br>12 mA to 120 mA<br>120 mA to 1.05 A   | 210 ppm + 85 pA<br>110 ppm + 210 pA<br>75 ppm + 1.7 nA<br>75 ppm + 11 nA<br>75 ppm + 75 nA<br>95 ppm + 1.1 $\mu$ A<br>170 ppm + 18 $\mu$ A   |         |                  |
| <b>AC VOLTAGE</b>                        |   |  |         |                  |
| Measurement                              | 10 $\mu$ V to 12 mV<br>10 Hz to 40 Hz<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz   | 800 ppm + 9.0 $\mu$ V<br>300 ppm + 8.0 $\mu$ V<br>400 ppm + 8.0 $\mu$ V<br>0.13 % + 8.0 $\mu$ V<br>0.6% + 11 $\mu$ V<br>4.7 % + 21 $\mu$ V   |         |                  |



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|--|---|--|---------|------------------|
| <b>AC VOLTAGE</b> (continued)<br>Measurement |   |  |         | Sites            |
|  | 12 mV to 120 mV<br>10 Hz to 40 Hz<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 1 MHz<br>1 MHz to 2 MHz | 800 ppm + 21 $\mu$ V<br>180 ppm + 13 $\mu$ V<br>230 ppm + 13 $\mu$ V<br>400 ppm + 13 $\mu$ V<br>0.15 % + 40 $\mu$ V<br>0.40 % + 40 $\mu$ V<br>1.3 % + 40 $\mu$ V<br>1.8 % + 40 $\mu$ V |         |                  |
|  | 120 mV to 1.2 V<br>10 Hz to 40 Hz<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 1 MHz<br>1 MHz to 2 MHz | 800 ppm + 140 $\mu$ V<br>140 ppm + 30 $\mu$ V<br>200 ppm + 30 $\mu$ V<br>400 ppm + 40 $\mu$ V<br>0.10 % + 110 $\mu$ V<br>0.36 % + 230 $\mu$ V<br>1.2 % + 1.1 mV<br>1.8 % + 1.2 mV      |         |                  |
|  | 1.2 V to 12 V<br>10 Hz to 40 Hz<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz<br>100 kHz to 300 kHz<br>300 kHz to 1 MHz<br>1 MHz to 2 MHz   | 750 ppm + 1.3 mV<br>140 ppm + 300 $\mu$ V<br>200 ppm + 300 $\mu$ V<br>400 ppm + 400 $\mu$ V<br>0.10 % + 600 $\mu$ V<br>0.36 % + 25 mV<br>1.3 % + 12 mV<br>1.8 % + 12 mV                |         |                  |
|  | 12 V to 120 V<br>10 Hz to 40 Hz<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 50 kHz<br>50 kHz to 100 kHz   | 750 ppm + 14 mV<br>280 ppm + 3.5 mV<br>280 ppm + 3.5 mV<br>510 ppm + 6 mV<br>0.16 % + 13 mV  |         |                  |
|  | 120 V to 700 V<br>40 Hz to 1 kHz<br>1 kHz to 20 kHz<br>20 kHz to 30 kHz   | 500 ppm + 20 mV<br>750 ppm + 20 mV<br>0.16 % + 25 mV   |         |                  |
|  | At 700 V<br>30 kHz to 50 kHz<br>50 kHz to 100 kHz   | 0.20 % + 25 mV<br>0.45 % + 25 mV   |         |                  |
|  | 220 V to 1.1 kV<br>40 Hz to 10 kHz<br>10 kHz to 30 kHz<br>30 kHz to 100 kHz   | 210 ppm + 25 mV<br>760 ppm + 60 mV<br>0.65 % + 250 mV  |         |                  |



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|--|---|---|----------------|------------------|
| <b>AC CURRENT</b>                        |   |   |                |                  |
| Measurement                              | 100 nA to 120 $\mu$ A<br>40 Hz to 45 Hz<br>45 Hz to 100 Hz<br>100 Hz to 5 kHz   | 0.18 % + 40 nA<br>0.080 % + 40 nA<br>0.11 % + 70 nA   |                |                  |
|  | 120 $\mu$ A to 1.2 mA<br>25 Hz to 45 Hz<br>45 Hz to 100 Hz<br>100 Hz to 5 kHz<br>5 kHz to 10 kHz                                      | 0.18 % + 300 nA<br>0.080 % + 300 nA<br>0.090 % + 700 nA<br>0.25 % + 1.3 $\mu$ A   |                |                  |
|  | 1.2 mA to 12 mA<br>25 Hz to 45 Hz<br>45 Hz to 100 Hz<br>100 Hz to 5 kHz<br>5 kHz to 10 kHz  | 0.18 % + 3.0 $\mu$ A<br>0.08 % + 3.0 $\mu$ A<br>0.09 % + 37 $\mu$ A<br>0.25 % + 13 $\mu$ A                                |                |                  |
|  | 12 mA to 120 mA<br>25 Hz to 45 Hz<br>45 Hz to 100 Hz<br>100 Hz to 5 kHz<br>5 kHz to 10 kHz  | 0.18 % + 30 $\mu$ A<br>0.080 % + 30 $\mu$ A<br>0.090 % + 70 $\mu$ A<br>0.25 % + 130 $\mu$ A                               |                |                  |
|  | 120 mA to 1.050 A<br>25 Hz to 45 Hz<br>45 Hz to 100 Hz<br>100 Hz to 5 kHz<br>5 kHz to 10 kHz  | 0.19 % + 250 $\mu$ A<br>0.11 % + 250 $\mu$ A<br>0.16 % + 550 $\mu$ A<br>1.3 % + 1 mA                                      |                |                  |
| Frequency                                | 5 Hz to 50 Hz<br>50 Hz to 1 kHz<br>1 kHz to 10 kHz<br>10 kHz to 100 kHz<br>100 kHz to 1 MHz<br>1 MHz to 300 MHz<br>300MHz to 26.5 GHz | 1.0 in $10^4$<br>1.0 in $10^5$<br>1.0 in $10^6$<br>1.0 in $10^7$<br>1.0 in $10^8$<br>1.0 in $10^{10}$<br>1.0 in $10^{10}$ | Gate time 10 s |                  |
| END                                      |   |   |                |                  |