


# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

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

 <p><b>UKAS</b> CALIBRATION</p> <p><b>0013</b></p> <p>Accredited to <b>ISO/IEC 17025:2005</b></p>	<h3>Trescal CMS</h3> <p><b>Issue No: 058    Issue date: 05 March 2012</b></p>	
	<p><b>Trescal CMS</b> Unit 2 Hawley Lane Farnborough Hampshire GU14 8EH</p>	<p><b>Contact: Mr John Adams</b> Tel: +44 (0)1252 533 300 Fax: +44 (0)1252 533 333 E-Mail: ukcms@trescal.com Website: www.trescal.com</p>
<p><b>Calibration performed by the Organisation at the locations specified below</b></p>		

### Locations covered by the organisation and their relevant activities

#### Laboratory locations:

Location details		Activity	Location code
<p><b>Address</b></p> <p>Trescal CMS Unit 2 Hawley Lane Farnborough Hampshire GU14 8EH</p>	<p><b>Local contact</b></p> <p>Mr James Luff</p> <p>Tel: +44 (0)1252 533 300 Fax: +44 (0)1252 533 333 Email: jim.luff@trescal.com</p>	<p><u>Electrical dc &amp; lf</u> <u>17<sup>th</sup> Edition equipment</u> <u>Electrical rf</u> <u>Photometric</u></p>	Farnboro'
	<p>Mr Jeremy Struthers</p> <p>Tel: +44 (0)1252 533 300 Fax: +44 (0)1252 533 333 Email: jeremy.struthers@trescal.com</p>	<p><u>Pressure</u> <u>Flow</u> <u>Vacuum</u> <u>Temperature</u> <u>Humidity</u> <u>Air velocity</u></p>	
<p>Trescal CMS Greenfold Way Leigh Commerce Park Leigh Greater Manchester WN7 3XJ</p>	<p>Mr Paul Charman</p> <p>Tel: +44 (0)1252 533 300 Fax: +44 (0)1942 261 083 Email: paul.charman@trescal.com</p>	<p><u>Electrical dc &amp; lf</u> <u>17<sup>th</sup> Edition equipment</u> <u>High Voltage</u> <u>Accelerometry</u> <u>Acoustics</u> <u>Dimensional</u> <u>Mass</u> <u>Volume</u> <u>Force</u> <u>Torque</u></p>	Leigh
			Farnboro' and Leigh



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DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k=2$ )	Remarks	Location Code												
DIMENSIONAL MEASUREMENTS: RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETERS UNLESS OTHERWISE STATED																
Gauge blocks		Class (See Footnotes)	NOTES	Leigh												
Inch (Steel and tungsten carbide)	BS 4311:Parts 1 and 3:1993 0 to 0.4 in 0.4 to 1 in 2 in 3 in 4 in	<table border="0"> <tr> <td><u>A</u></td> <td><u>C</u></td> </tr> <tr> <td>1.0</td> <td>3.0 <math>\mu</math>m</td> </tr> <tr> <td>1.5</td> <td>4.0 <math>\mu</math>m</td> </tr> <tr> <td>2.5</td> <td>5.0 <math>\mu</math>m</td> </tr> <tr> <td>3.0</td> <td>6.0 <math>\mu</math>m</td> </tr> <tr> <td>3.5</td> <td>7.0 <math>\mu</math>m</td> </tr> </table>	<u>A</u>		<u>C</u>	1.0	3.0 $\mu$ m	1.5	4.0 $\mu$ m	2.5	5.0 $\mu$ m	3.0	6.0 $\mu$ m	3.5	7.0 $\mu$ m	<p>1. In addition to the items listed above, other similar items, including parts of measuring instruments and machines, may be calibrated to the uncertainties stated. Where the item or part calibrated is of lower quality due to wear, errors in geometry (next paragraph should be attached to this paragraph), or form, or poor surface texture, or where any other factor adversely affects the measurement capability, greater uncertainties must be quoted.</p> <p>2. The uncertainty quoted if for the departure from flatness, straightness, or squareness, ie the distance separating the two parallel planes which just enclose the surface under consideration.</p> <p>3. Single start, symmetrical thread forms only.</p>
<u>A</u>	<u>C</u>															
1.0	3.0 $\mu$ m															
1.5	4.0 $\mu$ m															
2.5	5.0 $\mu$ m															
3.0	6.0 $\mu$ m															
3.5	7.0 $\mu$ m															
Millimetre (Steel and tungsten carbide)	BS 4311:Parts 1 and 3:1993 0 to 10 10 to 25 30, 40, 50 60, 70, 75 80, 90, 100	<table border="0"> <tr> <td><u>A</u></td> <td><u>C</u></td> </tr> <tr> <td>0.030</td> <td>0.080</td> </tr> <tr> <td>0.040</td> <td>0.10</td> </tr> <tr> <td>0.060</td> <td>0.12</td> </tr> <tr> <td>0.070</td> <td>0.15</td> </tr> <tr> <td>0.090</td> <td>0.18</td> </tr> </table>	<u>A</u>		<u>C</u>	0.030	0.080	0.040	0.10	0.060	0.12	0.070	0.15	0.090	0.18	
<u>A</u>	<u>C</u>															
0.030	0.080															
0.040	0.10															
0.060	0.12															
0.070	0.15															
0.090	0.18															
Long Series gauge blocks	BS EN ISO 3650:1999 100 to 1000	0.15+(1.5 x length in m)														
<p><b>Class A</b> uncertainties apply to the measurement of length by interferometry of grade K standards of length to BS 4311:2007 and BS EN ISO 3650:1999 when they are measured twice, wrung to a platen by each of the two measuring faces in turn, and the mean of these two measurements stated.</p> <p><b>Class C</b> uncertainties apply to the measurement of length of steel and tungsten carbide gauges by comparison with grade K standards of length of a similar material. Class C uncertainties apply to new and used grade 0, 1 and 2 gauges to BS 4311:2007 and BS EN ISO 3650:1999.</p>																
Gauge block accessories	BS 4311:Part 2:2009 0.1 to 12.5	0.30														
Length bars Inspection, workshop and Grades 1 and 2	As BS 1790:1961 and BS 5317:1976 10 to 2000	0.15 + (1.5 x length in m)														
Precision scales (linear)	0 to 400	1.5 + (3 x length in m)														
Stage Micrometers	0 to 10	0.60														



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**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k=2$ )	Remarks	Location Code
DIMENSIONAL MEASUREMENTS: RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETERS UNLESS OTHERWISE STATED				
Thread measuring cylinders	BS 3777, BS 5590 and specials 0.1 to 5	0.50		Leigh
Screw plug gauges (parallel) including check and setting plugs See Note 3	1 to 100 diameter	3.0		
	100 to 150	4.0 on pitch diameter		
Screw ring gauges (parallel) See Note 3	6 to 100 diameter	5.0		
	100 to 150	6.0		
Screw pitch Screw flank angle	0.2 to 8 0° to 52°	1.5 5.0 minutes of arc		
Length gauges, flat and spherical ended	0 to 2000	1.0 + (8 x length in m)		
Receiver, position and profile gauges, jigs, fixtures.	Maximum dimensions Up to 750 x 750 x 750	Dependant on size and 3.0 + (10 x length in m)		
Vee blocks	BS 3731:1987 20 to 200	2.5 to 5.0		
Plain plug gauges (parallel) and cylindrical setting standards	Diameter : 1 to 50 50 to 100 100 to 150 150 to 200 200 to 300	0.80		
		1.0		
		1.2	on diameter	
		2.0		
		3.0		



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<b>DIMENSIONAL MEASUREMENTS: RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETERS UNLESS OTHERWISE STATED</b>				
Plain ring gauges (parallel)	Diameter: 1.5 to 50 50 to 100 100 to 150 150 to 30	1.0 1.6 2.0 3.0	on diameter	Leigh
Plain gap gauges (parallel)	2 to 25 25 to 100 100 to 150	3.0 5.0 8.0		
Steel balls	1 to 30	1.0 on diameter		
Parallels	As BS 906:Parts 1&2:1992 5 to 50 x 100 x 400	1.5 up to 5.0		
<b>ANGLE</b>				
Angle gauges NPL type	0° to 90°	4.0 seconds of arc		
Squares Blade type	BS 939:2007 0 to 300 300 to 600	3.0 5.0		
Cylindrical	BS 939:2007 0 to 600	2.0	On Squareness See Note 2	
Block	BS 939:2007 0 to 300 300 to 600	3.0 5.0		
Angle plates and box angle plates	BS 5535:1978 50 to 600	Squareness: 3.0 + (1.0 per 100 mm) Parallelism: 1.0 + (1.0 per 100 mm) See Note 2		



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<b>ANGLE</b> (Cont'd)				Leigh
Sine bars and tables	BS 3064:1978 0 to 500 length	Linear dimensions: $1.0 + (10 \times \text{length in m})$ Overall performance: 5.0 seconds of arc		Leigh
<b>FORM</b>				Leigh
Surface plates				Leigh
Granite and cast iron	BS 817:2008 160 x 100 to 1600 x 1000	$1.5 + (0.80 \times \text{diagonal in m})$		Leigh
Roundness	BS 3730			Leigh
External	0 to 350 diameter	0.050 on radius		Leigh
Internal	3 up to 350 diameter	0.050 on radius		Leigh
Surface texture	BS 1134	7.0 % of measured value	In support of other measurements	Leigh
Straightedges				Leigh
Cast Iron, Steel and Granite	BS 5204:Part 1:1975 and BS 5204:Part 2:1977 0 to 2000	$1.0 + (2.0 \times \text{length in m})$ See Note 2		Leigh
<b><u>MEASURING INSTRUMENTS AND MACHINES</u></b>				
Horizontal Measuring machines	0 to 1200	$0.30 + (4.0 \times \text{length in m})$		Leigh
Micrometers				Leigh
External	BS 870:2008 0 to 600	Heads: 2.0		Leigh
Internal	BS 959:2008 0 to 900	Setting and extension rods		Leigh
Depth	BS 6468:2008 0 to 300	$1.0 + (8.0 \times \text{length in m})$		Leigh
3 point Bore	6 to 300 mm	5.0		Leigh
Micrometer heads	BS 1734:1951 0 to 50	1.0		Leigh
Bench micrometer	0 to 100	Overall performance 2.0		Leigh



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<b>MEASURING INSTRUMENTS AND MACHINES (Cont'd)</b>				Leigh
Height setting micrometer	0 to 300	Heads: 1.5 between any two points stepped column 2.5 Overall performance: 3.0		
Riser blocks for above	150 300	2.5 5.0		
Feeler gauges And shims	BS 957:2008 0.025 to 1	1.5		
Electronic Height Gauges	0 to 1000mm	1.0 + (5.0 x Lin m)		
Vernier gauges Calliper Height Depth	BS 887:2008 0 to 1000 BS 1643:2008 0 to 1000 BS 6365:2008 0 to 600	Overall performance: 10 + (30 x length in m)		
Dial gauges and dial test indicators	BS 907:2008 and BS 2795:1981 0 to 50	2.0		
Bench Centres	0 to 600 between centres	Linear dimensions 1.0 + (10 x length in m)		
Profile projectors	10 to 100 magnification Linearity Angle	125 at the screen 4.0 2 minutes of arc		
Steel rules	0 to 1000	15 + (20 x length in m)		
Spirit levels	BS 958:1968 5 seconds of arc to 60 minutes of arc nominal sensitivity	Mean sensitivity: 10% of nominal Minimum 0.50 seconds of arc		
<u>Electronic indicating levels</u>	0 to 20 minutes of arc	1.0 % of range (min 0.30 seconds of arc)		
Clinometers	0 to 360 degrees	10 seconds of arc or greater dependent on sensitivity		
Bevel protractors	BS 1685:2008 0° to 360°	6.0 minutes of arc		
Displacement transducers	0 to 300	1.0 + (2.0 % length in mm)		



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<b>MEASURING INSTRUMENTS AND MACHINES (Cont'd)</b>				Leigh
Inclinable tables	0 to 450 length	Linear dimensions: 1.0 + (10 x length in m) Overall performance: 15 seconds of arc		
<b>FORCE</b>				
Push pull force measuring devices in tension and compression	0.10 N to 2500 N	0.10 %		
Gram Gauges	10 grams force to 5000 grams force	1.0 %		
Load cells (excluding proving devices)	0.2 kN to 100 kN	0.41 %		
<b>TORQUE</b>				
Hand torque tools	As BS EN ISO 6789 :2003  0.1 N.m up to 1350 N.m	1.0 %		
Torque measuring devices	As BS EN 7882:2008  0.05 N.m to 2.5N.m 0.5 N.m to 1500 N.m	0.050 % 0.035 %		



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<b>MASS</b>	(g)	(mg)	Intermediate values can be calibrated with an uncertainty interpolated from the next higher and lower values in the table above.			
Nominal values	20 000 10 000 5 000 2 000 1 000 500 200 100 50 20 10 5 2 1 0.5 0.2 0.1 0.05 0.02 0.01 0.005 0.002 0.001	20 10 5.0 2.0 1.0 0.50 0.10 0.050 0.033 0.027 0.020 0.016 0.013 0.010 0.0080 0.0060 0.0050 0.0040 0.0030 0.0026 0.0020 0.0020 0.0020				
<b>VOLUME</b>						
Liquid Pipettes	2 µL to 10 µL 10 to 20 µL 20 to 100 µL 100 to 200 µL 200 to 500 µL 0.5 to 1 mL 1 to 2 mL 2 to 5 mL 5 to 10 mL 10 to 20 mL	0.12 µL 0.50 µL 0.50 µL 0.50 µL 1.5 µL 4.0 µL 15 µL 20 µL 40 µL 55 µL				
<b>TEMPERATURE</b>						Farnboro'
Temperature in air	- 40 °C to 180 °C	0.20 °C				
Liquid-in-glass thermometers	- 40 °C to - 80 °C 0 °C to - 40 °C 0 °C 0 °C to 100 °C 100 °C to 260 °C 260 °C to 450 °C	0.10 °C 0.050 °C 0.010 °C 0.050 °C 0.10 °C 0.20 °C				
Platinum thermocouples	0 °C to 1100 °C 1100 °C to 1500 °C	1.0 °C 3.0 °C				



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<b>TEMPERATURE</b> Continued				
Other thermocouples	- 80 °C to 260 °C  - 80 °C to 260 °C  260 °C to 500°C 500 °C to 1500°C	0.15 °C (Wires up to 0.30 mm diameter) 0.25 °C (Wires over 0.30 mm diameter)  1.0 °C 3.0 °C		
Resistance thermometers	- 80 °C to 260 °C 260 °C up to 450 °C 450 °C to 600°C  Triple point of water (0.01 °C) Freezing point of Zinc (419.527 °C)	0.010 °C 0.040 °C 0.10 °C  0.0030 °C 0.020 °C		
Electronic thermometers with sensors Analogue Digital	Range as for sensor	As for sensor - plus: Resolution of instrument One least significant digit		
Block calibrators	- 40 °C to 260 °C 260 °C to 1100 °C 1100 °C to 1300 °C	0.10 °C 1.0 °C 3.0 °C		
<b>ELECTRICAL</b>				
Temperature indicators and simulators: Calibration by electrical simulation			Including cold junction compensation	Farnboro' and Leigh
Type K	- 200 °C to - 100 °C - 100 °C to - 25 °C - 25 °C to 120 °C 120 °C to 1000 °C 1000 °C to 1372 °C	0.41 °C 0.25 °C 0.21 °C 0.32 °C 0.50 °C		
Type J	- 210 °C to - 100 °C - 100 °C to - 30 °C - 30 °C to 150 °C 150 °C to 760 °C 760 °C to 1200 °C	0.33 °C 0.21 °C 0.19 °C 0.22 °C 0.28 °C		
Type T	- 250 °C to - 150 °C - 150 °C to 0 °C 0 °C to 120 °C 120 °C to 400 °C	0.73 °C 0.30 °C 0.21 °C 0.19 °C		



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<b>ELECTRICAL</b> Temperature indicators and simulators: Calibration by electrical simulation Continued			Including cold junction compensation	
Type R	0 °C to 250 °C 250 °C to 400 °C 400 °C to 1000 °C 1000 °C to 1767 °C	0.70 °C 0.42 °C 0.40 °C 0.54 °C		
Type N	- 200 °C to - 100 °C - 100 °C to - 25 °C - 25 °C to 120 °C 120 °C to 410 °C 1000 °C to 1300 °C	0.47 °C 0.27 °C 0.24 °C 0.23 °C 0.33 °C		
Type E	- 250 °C to - 100 °C - 100 °C to 25 °C - 25 °C to 350 °C 350 °C to 650 °C 659 °C to 1000 °C	0.59 °C 0.21 °C 0.19 °C 0.21 °C 0.26 °C		
<b><u>ELECTRICAL</u></b>				Farnboro' and Leigh
Type B	600 °C to 800 °C 800 °C to 1000 °C 1000 °C to 1550 °C 1550 °C to 1820 °C	0.52 °C 0.41 °C 0.36 °C 0.40 °C		
Type C	0 °C to 150 °C 150 °C to 650 °C 650 °C to 1000 °C 1000 °C to 1800 °C 1800 °C to 2316 °C	0.36 °C 0.32 °C 0.59 °C 0.59 °C 1.0 °C		
PRT	- 200 °C to - 80 °C - 80 °C to 0 °C 0 °C to 100 °C 100 °C to 300 °C 300 °C to 400 °C 400 °C to 630 °C 630 °C to 800 °C	0.06 °C 0.06 °C 0.11 °C 0.11 °C 0.12 °C 0.14 °C 0.27 °C		
<b>HUMIDITY</b>				Farnboro'
DEW-POINT	- 20°C to 40°C 40°C to 82°C	0.10 °C 0.15 °C		
Relative humidity Temperature range	5 %rh to 98 % rh 15 °C to 90 °C	1.0 % rh 0.20 °C		



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<p><b>SALT CAPSULES</b> Nominal Values Within the temperature range of 15 °C to 40 °C</p> <p><b>FLOW</b>  Flow-rate - gas and Quantity passed - gas</p>	<p>5 % rh to 80 % rh  80 % rh to 98 % rh</p> <p>0.083 ml/s to 0.42 l/s 0.42 l/s to 16.7 l/s 16.7 l/s to 46.7 l/s</p>	<p>1.5 % rh 0.2 °C 1.6 % rh 0.20 °C</p> <p>0.20 % 0.35 % 0.90 %</p>	<p>Dry air normally used. Any non-corrosive gas may be used.</p>	
<p><b>PRESSURE</b>  Gas Pressure (absolute)  Calibration of pressure indicating instruments and gauges  Gas Pressure (gauge)  Calibration of pressure indicating instruments and gauges  Hydraulic Pressure (gauge)  Calibration of pressure indicating instruments and gauges</p>	<p>3.6 kPa to 5 MPa</p> <p>- 95 kPa to - 15 kPa - 15 kPa to - 3.6 kPa - 3.6 kPa to - 2.5 kPa - 2.5 kPa to - 490 Pa - 490 Pa to 490 Pa 490 Pa to 2.5 kPa 2.5 kPa to 3.6 kPa 3.6 kPa to 126 kPa 126 kPa to 5 MPa 5 MPa to 7 MPa</p> <p>0 Pa to 20 MPa 20 MPa to 70 MPa</p> <p>550 kPa to 7 MPa 7 MPa to 140 MPa</p>	<p>0.0075 % + 8.0 Pa</p> <p>0.0070 % + 64 Pa 2.0 Pa 1.5 Pa 0.80 Pa 0.40 Pa 0.80 Pa 1.5 Pa 0.0070 % 0.0075 % 0.010 %</p> <p>1.9 kPa 4.8 kPa</p> <p>0.013 % + 100 Pa 0.013 % + 100 Pa</p>	<p>Calibration of instruments with an electrical output may be undertaken</p>	<p>Farnboro'</p>



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<b>VACUUM</b>	1.3 x 10 <sup>-4</sup> Pa to 1.3 x 10 <sup>-3</sup> Pa 1.3 x 10 <sup>-3</sup> Pa to 0.13 Pa 0.13 Pa to 1.3 Pa 1.3 Pa to 130 Pa 130 Pa to 1.3 kPa 1.3 kPa to 6.6 kPa 6.6 kPa to 120 kPa	15 % 12 % 4.0 % 3.5 % 2.5 % 1.5 % 0.40 %	Uncertainty achieved will vary according to pressure dependent effects during calibration	Farnboro'
<b>AIR VELOCITY</b>  <u>Calibration of vane anemometers</u>	1 m/s to 5 m/s 5 m/s to 30 m/s	0.70 % + 0.088 m/s 1.7 % + 0.088 m/s	Anemometers up to 100 mm diameter can be calibrated.	Farnboro'
<b><u>ACCELEROMETRY</u></b>  <b>ACCELERATION TRANSDUCERS</b>  Working or non-precision grades Piezoelectric type  Nominal peak acceleration 1 g to 5 g <sub>n</sub> (10 m/s <sup>2</sup> to 50 m/s <sup>2</sup> )  Nominal peak acceleration 0.3 g <sub>n</sub> to 2 g <sub>n</sub>  Integral Electronics type  Nominal peak acceleration 1g up to 5 g <sub>n</sub> (10 to 50 m/s <sup>2</sup> )	High frequency test 20 Hz to 5 kHz  System sensitivity > 2 mV/m/s <sup>2</sup> (tx) > 20 mV/Cg <sub>n</sub> (tx)  Low frequency test 2 Hz to 20 Hz  System sensitivity > 3.0 mV/m/s <sup>2</sup> (tx) > 30 mV/Cg <sub>n</sub> (tx)  High frequency test 20 Hz to 5 kHz  System sensitivity > 0.1 mV/m/s <sup>2</sup> > 10 mV/Cg <sub>n</sub>	2.0 %  2.7 %  2.0 %	Calibration of charge sensitivity by comparison with a reference (precision grade) transducer System calibration comprising transducer (tx), signal conditioner and power can be undertaken within the quoted uncertainties	Leigh



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

**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k=2$ )	Remarks	Location Code
<b>ACCELERATION TRANSDUCERS</b> Continued  Nominal peak acceleration up to $0.3 g_n$ to $2 g_n$  Nominal peak acceleration up to $0.3 g_n$ to $2 g_n$	Low frequency test <i>2 Hz to 20 Hz</i>  System sensitivity > $3.0 \text{ mV/m/s}^2$ > $30 \text{ mV/Cg}_n$	2.7 %		Leigh
	20 Hz to 630 Hz	3.0 %	Transducer any Temperature from - 50 °C to 190 °C	
<b>CHARGE AMPLIFIERS</b> Calibration of voltage output per picocoulomb or millivolt input. Minimum input 1 pC or 10mV	1 Hz to 10Hz 10 Hz to 30 kHz 30 kHz to 100 kHz 100 kHz to 500kHz	0.80 % 0.29 % 0.32 % 1.5 %		
<u><b>ACCOUSTICS</b></u>  <b>SOUND PRESSURE LEVEL</b>  Pistonphones Sound calibrators	34 dB to 125 dB (ref : 20 $\mu\text{Pa}$ )			
	250 Hz	0.10 dB	<b>Note</b> Calibration of pistonphones and sound calibrators is restricted to configurations accepting B&K $\frac{1}{4}$ , $\frac{1}{2}$ , and 1 inch microphones, as described above. B&K types 4220 and 4228, with B&K microphone types 4144, 4134, 4136. Rion type NC72, with B&K microphone types 4144, 4134.	
	1000 Hz	0.10 dB	CEL type 184, B&K type 4230, Rion type NC73 and Cirrus type 511D; each with B&K microphone types 4160, 4180. CEL types 177 and 182, with B&K microphone types 4144, 4134.	
	1000 Hz	0.10 dB	B&K type 4231, with B&K microphone types 4160. 4180. (20 dB level step)	



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<b>PHOTOMETRIC.</b>  Illuminance	0.5 lux to 20000 lux	1.5 %		Farnboro'
<b>EMC SUPPORT</b>				
<b>Electrostatic discharge characteristics</b>  Current Pulse	1 A to 35 A (Pulse width <2ns) 1 A to 35 A (Pulse width >2ns)	3.8 % 4.4 %	For application to ESD generators as specified in IEC61000-4-2, using a calibration technique referred to in this specification	Farnboro'
Rise Time	0.5 ns to 10 ns	2.2 %		
Time interval	2 ns to 100 ns	2.0 %		
DC Voltage	10 V to 30 kV	0.65 %		
Spot value	8 kV	0.52 %		
<b>Surge discharge characteristics</b>  Open circuit voltage	10 V to 16 kV	3.3 %		
Rise time	0.5 $\mu$ s to 10 $\mu$ s (OCV) 0.5 $\mu$ s to 10 $\mu$ s (SCI)	3.0 % 2.6 %		
Time interval				
Short circuit current pulse	10 A to 5 kA	4.2 %		
Phase angle (Surge on AC line)	0 ° to 360 °	15 °		
<b>Electrical fast transient characteristics</b>  Peak voltage into 50 $\Omega$	100 V to 8 kV	4.2 %	For application to EFT generators.	
Peak voltage into 1 k $\Omega$	100 V to 8 kV	6.3 %		



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<b>EMC SUPPORT</b>				
(Continued) Rise time	2 ns to 10 ns	40 ps	For application to variation simulators as specified in IEC61000-4-11	
Time interval				
Burst	50 $\mu$ s to 100 ms	0.40 %		
Repetition rate	50 $\mu$ s to 100 ms	0.40 %		
Duration	5 ns to 100 ns	0.40 %		
Surge impedance	40 $\Omega$ to 60 $\Omega$	7.6 %		
<b>Voltage variation characteristics</b>				
AC Voltage	10 V to 16 kV @ 50 Hz to 400 Hz	0.30 %		
Rise/Fall time	0.5 s to 10 $\mu$ s	0.50 %		
Phase accuracy	0 ° to 360 °	1.8 °		
Time interval	0 s to 1 s	4 ms		
<b>ELECTRICAL STANDARDS DC &amp; LF</b>				
<b><u>DC RESISTANCE</u></b>			The stated uncertainties refer to negligible power dissipation; resistors having significant power dissipation can be measured at voltages (up to 1000kV) and currents (up to 1000 A) with uncertainties in the range 10 ppm to 500 ppm  Specific values are those, which fall within $\pm 0.1\%$ of the stated values at or below 100 T $\Omega$ .  Resistors of modest dimensions suitable for oil immersion can be measured at temperatures in the range 15°C to 25°C. Resistors which are not oil immersible can be measured over the temperature range 20°C to 30°C	
Specific Values	100 $\mu\Omega$ 1 m $\Omega$ 10 m $\Omega$	2.5 ppm 0.90 ppm 0.90 ppm		
	100 m $\Omega$ 1 $\Omega$ 10 $\Omega$	0.20 ppm 0.090 ppm 0.080 ppm		
	100 $\Omega$ 1 k $\Omega$ 10 k $\Omega$	0.070 ppm 0.070 ppm 0.090 ppm		
	100 k $\Omega$ 1 M $\Omega$ 10 M $\Omega$	0.28 ppm 0.38 ppm 0.46 ppm		
	100 M $\Omega$ Nom 10 V	0.53 ppm		



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<b>ELECTRICAL STANDARDS DC &amp; LF</b>				
Continued				
Other Values	0 $\Omega$ to 1 m $\Omega$ 1 m $\Omega$ to 10 m $\Omega$ 10 m $\Omega$ to 100 m $\Omega$	3.4 n $\Omega$ 6.0 ppm 3.5 ppm		
	100 m $\Omega$ to 1 $\Omega$ 1 $\Omega$ to 10 $\Omega$ 10 $\Omega$ to 100 $\Omega$	0.24 ppm 0.20 ppm 0.20 ppm		
	100 $\Omega$ to 1 k $\Omega$ 1 k $\Omega$ to 10 k $\Omega$ 10 k $\Omega$ to 100 k $\Omega$	0.20 ppm 0.30 ppm 0.50 ppm		
	100 k $\Omega$ to 1 M $\Omega$ 1 M $\Omega$ to 10 M $\Omega$ 10 M $\Omega$ to 100 M $\Omega$	1.0 ppm 2.0 ppm 5.0 ppm	Uncertainties at high values also depend on applied voltage	
High Resistance system	100 M $\Omega$ to 1 G $\Omega$ 1 G $\Omega$ to 10 G $\Omega$ 10 G $\Omega$ to 100 G $\Omega$	30 ppm 30 ppm 30 ppm	The applied voltages are 100 V for values from 100 M $\Omega$ to 100 G $\Omega$ and 500 V for higher values.	
	100 G $\Omega$ to 1 T $\Omega$ 1 T $\Omega$ to 10 T $\Omega$ 10 T $\Omega$ to 100 T $\Omega$	100 ppm 250 ppm 250 ppm		
<b>AC RESISTANCE</b>				
Spot Values Generate	1 $\Omega$ 70 Hz 1 kHz 1592 Hz 2 kHz 5 kHz	4.0 ppm 4.0 ppm 4.0 ppm 4.0 ppm 15 ppm		
	10 $\Omega$ ; 25 $\Omega$ ; 100 $\Omega$ ; 1 k $\Omega$ & 10k $\Omega$ 70 Hz 1 kHz 1592 Hz 2 kHz 5 kHz 10 kHz 20 kHz	4.0 ppm 4.0 ppm 4.0 ppm 4.0 ppm 10 ppm 15 ppm 30 ppm		
	Nominal 10 Hz 100 m $\Omega$ to 10 k $\Omega$	0.20 %		
Measured	100 m $\Omega$ , 1 $\Omega$ , 10 $\Omega$ , 100 $\Omega$ , 1 k $\Omega$ & 10 k $\Omega$ 10 Hz	0.15 %		



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<b>AC RESISTANCE</b> <u>Measured - continued</u>	1 $\Omega$ ; 10 $\Omega$ ; 25 $\Omega$ ; 100 $\Omega$ ; 1 k $\Omega$ 75 Hz	5.0 ppm		Farnboro'
	1 $\Omega$ 1 kHz & 1.592 kHz 2 kHz & 5 kHz	25 ppm 45 ppm		
	10 $\Omega$ 1 kHz & 1.592 kHz 2 kHz, 5 kHz, 10 kHz & 20 kHz	25 ppm 30 ppm		
	25 $\Omega$ ; 100 $\Omega$ 1 k $\Omega$ 1 kHz & 1.592 kHz 2 kHz, 5 kHz, 10 kHz & 20 kHz	15 ppm 30 ppm		
<b>DC VOLTAGE</b>			Stated uncertainties can be realised with cells only if they are suitable for oil-immersion at 20°C or have their own temperature-controlled enclosure of appropriate thermal stability Standard Cells and DC Voltage Standards of a moderate size can be measured over a temperature range 15°C to 25°C and on a fully automated system	
Standard cell value	1.018 V nominal	0.15 ppm		
Zener References	1.0V 10 V	0.15 ppm 0.12 ppm		
Other values	0 V to 1 mV 1.0 mV to 10 mV 10 mV to 100 mV 100 mV to 999 mV 1 V to 10 V 10 V to 1000 V	50 nV 60 nV 100 nV 1.2 ppm 0.30 ppm 0.70 ppm		
	1 kV to 1.99 kV 2 kV to 10 kV	0.25 % + 1.0 V 0.25 % + 3.5 V		
<b>DC VOLTAGE RATIO</b>	10 <sup>-1</sup> to unity	10 <sup>-7</sup> of input	Uncertainty depends on input voltage: upper limit 1 kV	
<b>DC CURRENT</b>	0 A to 2 pA 20 pA to 20 pA 20 pA to 200 pA 200 pA to 2 nA	0.50 % + 10 fA 0.45 % + 10 fA 0.30 % + 30 fA 0.090 % + 100 fA		
	2 nA to 20 nA 20 nA to 200 nA 200 nA to 100 $\mu$ A	0.085 % + 1.0 pA 0.050 % + 10 pA 5.0 ppm		



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<b>DC CURRENT</b> (cont'd)	100 $\mu$ A to 100 mA 100 mA to 1 A 1 A to 15 A 15 A to 100 A 100 A to 600 A	4.0 ppm 10 ppm 20 ppm 50 ppm 0.010 %		Farnboro'									
<b>DC POWER</b>	1 W to 20 kW	The arithmetic sum of the individual uncertainties of the corresponding voltages and current measurements											
<b>AC/DC TRANSFER VOLTAGE</b>													
Appropriate to the calibration of AC/DC transfer instruments													
Specific Values	AC/DC Transfer, at Specific Values, expressed as an expanded uncertainty $k=2$ are all in ppm.												
Voltage	Frequency												
(V)	10	20	40	60	1 k	10 k	20 k	50 k	100 k	300 k	500 k	700 k	1M
1 mV	280	230	240	220	220	230	230	230	250	280	350	530	880
2 mV	330	330	250	240	240	250	230	230	250	290	310	370	450
10 mV	130	120	110	110	110	110	110	110	120	120	130	150	130
20 mV	110	87	77	77	88	77	77	77	87	87	120	170	110
100 mV	30	30	30	30	21	21	21	22	24	34	37	45	30
200 mV	37	38	38	38	27	30	30	33	36	50	62	77	37
300 mV	29	27	28	27	20	26	23	25	28	31	34	46	29
500 mV	26	23	24	23	19	19	19	21	23	26	30	45	26
1 V	20	19	20	19	18	18	18	19	24	25	37	43	20
2 V	22	19	19	19	18	18	18	18	22	24	37	43	22
3 V	22	21	20	20	18	18	18	18	22	23	25	37	22
5 V	22	20	19	19	18	18	18	18	22	22	25	37	22
10 V	21	20	20	19	18	19	19	19	23	24	26	37	21
20 V	25	21	22	22	19	19	19	21	28	33	47	57	25
30 V	35	26	26	25	22	22	22	22	26	-	-	-	-
50 V	30	27	26	25	21	22	22	25	29	-	-	-	-
100 V	35	31	31	30	21	24	23	26	33	-	-	-	-
200 V	40	31	31	30	22	22	22	31	38	-	-	-	-
300 V	22	22	21	20	21	22	21	24	48	-	-	-	-
500 V	25	22	21	21	21	22	23	34	76	-	-	-	-
1 kV	25	22	21	21	21	22	30	39	81	-	-	-	-



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<b>AC/DC TRANSFER VOLTAGE</b>														
Other Values														
For intermediate points the uncertainty will be the greater of the adjacent points														
AC/DC Transfer at intermediate values expressed as an expanded uncertainty $k=2$ are all in ppm.														
Voltage	Frequency (Hz)													
↓	10	20	40	60	1 k	10 k	20 k	50 k	100 k	300 k	500 k	700 k	1 M	Farnboro'
(V)														
1 mV	280	230	240	230	230	230	230	230	260	280	350	530	880	
2 mV	330	330	250	240	240	250	240	240	260	290	310	370	450	
10 mV	140	120	110	110	120	110	110	110	120	120	140	160	180	
20 mV	110	92	82	82	93	82	82	82	91	91	120	170	240	
100 mV	42	42	42	42	36	36	36	36	36	43	46	52	70	
200 mV	47	47	48	48	39	42	41	44	45	57	67	81	132	
300 mV	41	40	40	39	35	39	37	39	39	41	43	53	56	
500 mV	39	37	38	37	35	35	35	36	35	37	40	52	59	
1 V	35	35	35	35	34	34	34	34	36	37	46	51	51	
2 V	36	35	35	35	34	34	34	34	35	36	46	51	51	
3 V	36	36	35	35	34	34	34	34	35	35	37	45	51	
5 V	36	35	35	35	34	34	34	34	34	35	37	45	51	
10 V	36	35	35	35	34	35	35	34	35	36	38	46	57	
20 V	38	36	36	36	35	35	35	36	39	42	54	63	65	
30 V	45	39	39	39	36	36	36	36	37					
50 V	42	39	39	38	36	36	36	38	39					
100 V	46	43	43	42	36	38	37	39	43					
200 V	50	42	42	42	36	37	36	43	47					
300 V	37	36	36	35	36	36	36	38	55					
500 V	39	37	36	36	36	36	37	45	80					
1 kV	38	36	36	36	36	36	42	49	86					
<b>TOTAL AC VOLTAGE</b>														
At Specific Values														
Expressed as an expanded uncertainty ( $k=2$ ) ( $\pm$ ppm)														
Voltage	Frequency (Hz)													
(V)	10	20	40	60	1 k	10 k	20 k	50 k	100 k	300 k	500 k	700 k	1 M	Farnboro'
1 mV	640	630	630	620	620	620	620	620	640	640	680	780	1100	
2 mV	440	440	390	380	380	390	370	370	390	410	420	470	540	
10 mV	150	130	130	120	130	120	120	120	130	130	150	160	190	
20 mV	110	92	83	83	94	83	83	83	93	92	120	170	240	
100 mV	31	31	31	31	23	23	23	23	26	35	38	46	66	



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200 mV	37	38	39	27	31	30	34	36	50	62	77	130					
300 mV	30	28	29	28	22	27	25	26	29	32	35	47	50				
500 mV	27	24	25	24	20	20	22	23	27	31	45	52					
1 V	21	20	21	20	19	19	19	24	26	37	44	44					
2 V	22	20	20	20	18	18	19	23	25	37	44	44					
3 V	22	21	21	20	19	19	19	22	23	25	37	44					
5 V	22	21	20	20	18	18	18	22	23	25	37	44					
10 V	21	20	20	19	19	19	19	23	24	27	38	50					
20 V	25	21	22	22	19	20	19	21	29	33	47	57	60				
30 V	35	27	27	26	23	23	23	27	-	-	-	-					
50 V	30	27	27	26	22	22	22	26	29	-	-	-	-				
100 V	35	31	32	31	22	24	23	26	33	-	-	-	-				
200 V	41	31	31	30	22	23	22	31	39	-	-	-	-				
300 V	23	23	22	21	22	23	22	25	49	-	-	-	-				
500 V	26	23	21	21	21	23	24	34	76	-	-	-	-				
1 kV	25	22	22	22	22	22	30	40	82	-	-	-	-				
<b>Total AC Voltage,</b>																	
At intermediate Values, expressed as an expanded uncertainty (k=2) (± ppm)																	
Other values	For intermediate points the uncertainty will be the greater of the adjacent points																
Voltage	Frequency (Hz)																
(V)	10	20	40	60	1 k	10 k	20 k	50 k	100 k	300 k	500 k	700 k	1 M				
1 mV	640	630	630	620	620	620	620	620	640	640	680	780	1100				
2 mV	440	440	390	380	380	380	380	380	390	410	420	470	540				
10 mV	150	140	130	130	130	130	130	130	140	130	150	170	190				
20 mV	110	97	88	88	98	88	88	88	96	96	120	170	240				
100 mV	42	43	43	43	37	37	37	37	37	44	47	53	71				
200 mV	47	48	48	48	40	42	42	44	45	57	67	82	130				
300 mV	41	40	41	40	36	40	38	39	39	42	44	54	57				
500 mV	40	38	38	38	35	35	35	36	35	38	41	52	59				
1 V	36	35	36	35	34	35	35	35	36	37	46	51	51				
2 V	36	35	35	35	34	34	34	35	35	36	46	51	51				
3 V	36	36	36	35	34	34	34	34	35	35	37	45	51				
5 V	36	36	35	35	34	34	34	34	35	35	37	45	51				
10 V	36	35	35	35	34	35	35	35	35	36	38	46	57				
20 V	38	36	36	36	35	35	35	36	39	43	54	63	65				
30 V	46	39	40	39	37	37	37	37	38	-	-	-	-				
50 V	42	40	39	39	36	37	37	39	39	-	-	-	-				
100 V	46	43	43	42	36	38	37	39	43	-	-	-	-				
200 V	50	42	42	42	37	37	36	43	47	-	-	-	-				
300 V	37	37	37	36	36	37	36	38	56	-	-	-	-				
500 V	39	37	36	36	36	37	37	45	81	-	-	-	-				
1 kV	38	36	36	36	36	37	42	49	86	-	-	-	-				
<b>AC VOLTAGE</b>	1 kV to 2 kV 50 Hz to 20 kHz							0.75% + 7.0 V							Measurement only	Farnboro'	
	2 kV to 10 kV 50 Hz to 20 kHz							0.75% + 30 V									



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<b>AC VOLTAGE RATIO</b>	0.000 000 01 to unity <i>70 Hz to 1kHz</i> <i>1 kHz to 10 kHz</i>	$5.0 \times 10^{-8}$ of input $1.5 \times 10^{-6}$ of input		Farnboro'				
Synchro Resolver Standards	0 ° to 360 °	1.0 second of arc						
Synchro Resolver Bridges	0 ° to 360 °	1.0 second of arc						
Synchro Resolver simulators	0 ° to 360 °	2.0 seconds of arc						
Synchro Resolver indicators	0 ° to 360 °	2.0 seconds of arc						
<b>AC CURRENT</b>								
<b>AC/DC TRANSFER UNCERTAINTY AT SPECIFIC VALUES.</b> Uncertainties in ppm								
	<i>40 Hz</i>	<i>60 Hz</i>	<i>1 kHz</i>		<i>10 kHz</i>	<i>20 kHz</i>	<i>50 kHz</i>	<i>100 kHz</i>
10 mA	25	27	25		25	28	53	56
20 mA	22	23	21		23	25	52	55
30 mA	45	45	45		45	46	65	67
50 mA	31	32	31		34	33	57	81
100 mA	25	28	24		25	28	56	90
200 mA	25	25	26		27	28	58	97
300 mA	46	46	47		46	54	78	120
500 mA	34	36	34	34	44	73	146	
1 A	34	30	31	29	52	85	201	
2 A	29	30	30	28	66	96	239	
3 A	53	49	50	48	89	130	285	
5 A	39	38	38	37	83	130	311	
10 A	35	33	38	34	96	160	362	
15 A	36	35	38	36	110	170	402	
20 A	37	35	37	35	110	170	--	
<b>TOTAL AC CURRENT MEASUREMENTS AT SPECIFIC VALUES</b> Uncertainties In PPM								
	<i>40 Hz</i>	<i>60 Hz</i>	<i>1 kHz</i>	<i>10 kHz</i>	<i>20 kHz</i>	<i>50 kHz</i>	<i>100 kHz</i>	
10 mA	25	27	25	25	28	53	56	
20 mA	22	23	22	23	25	52	55	
30 mA	45	45	45	45	47	66	67	
50 mA	31	33	32	34	34	57	82	
100 mA	25	28	24	26	28	56	90	
200 mA	25	26	26	28	28	58	97	
300 mA	46	46	47	46	54	78	119	
500 mA	34	36	35	34	44	73	146	
1 A	34	30	31	29	52	85	201	
2 A	31	31	31	29	66	96	239	
3 A	53	49	51	49	90	131	286	
5 A	40	39	40	38	84	129	311	
10 A	36	35	39	36	96	156	362	
15 A	38	36	39	37	110	170	400	
20 A	42	41	43	41	110	170	--	



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<b>AC/DC TRANSFER UNCERTAINTY AT INTERMEDEATE VALUES.</b>								
Other Values								
Uncertainties in ppm								
For intermediate points the uncertainty will be the greater of the adjacent points								
	40 Hz	60 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	
10 mA	42	44	43	43	64	127	240	
20 mA	41	42	41	41	63	127	240	
30 mA	57	57	57	57	74	133	240	
50 mA	47	47	47	48	67	129	250	
100 mA	43	45	42	43	64	128	250	
200 mA	43	43	43	44	64	129	250	
300 mA	57	58	58	58	79	139	260	
500 mA	48	50	49	49	72	137	270	
1 A	49	46	46	45	78	143	310	
2 A	45	46	46	44	87	150	330	
3 A	63	60	61	59	106	175	370	
5 A	52	51	52	51	101	173	390	
10 A	68	67	69	67	150	279	500	
15 A	68	68	69	68	160	288	530	
20 A	68	68	69	68	160	288	--	
<b>TOTAL AC CURRENT MEASUREMENTS AT INTERMEDEATE VALUES.</b>								
Uncertainties in ppm								
For intermediate points the uncertainty will be the greater of the adjacent points								
	40 Hz	60 Hz	1 kHz	10 kHz	20 kHz	50 kHz	100 kHz	
10 mA	43	44	43	43	64	130	238	
20 mA	41	42	41	42	63	130	237	
30 mA	57	57	57	57	74	130	241	
50 mA	47	48	47	48	67	130	245	
100 mA	43	45	42	43	64	130	248	
200 mA	43	43	43	44	64	130	250	
300 mA	57	58	58	58	79	140	260	
500 mA	48	50	49	49	73	140	273	
1 A	49	46	46	45	78	140	306	
2 A	46	47	47	45	88	150	332	
3 A	64	60	61	60	110	180	367	
5 A	53	52	53	51	100	170	388	
10 A	68	67	70	68	150	280	501	
15 A	69	68	70	69	160	290	530	
20 A	72	71	72	71	160	290	--	



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**Trescal CMS**

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<b>AC CURRENT</b>  Other values	10 $\mu$ A to 100 $\mu$ A 40 Hz to 10 kHz 100 $\mu$ A to 1 mA 40 Hz to 10 kHz 1 mA to 10 mA 40 Hz to 2 kHz 10 mA to 100 mA 40 Hz to 2 kHz 100 mA to 1 A 40 Hz to 2 kHz  20 A to 100 A 40 Hz to 400 Hz  100 A to 500 A 40 Hz to 400 Hz	70 ppm to 45 ppm  70 ppm to 45 ppm  70 ppm to 45 ppm  70 ppm to 45 ppm  70 ppm to 45 ppm  0.060 %  0.080 %		Farnboro'			
<b>AC POWER</b> Sinusoidal Power, W & VA at Unity Power Factor, 16 Hz to 450 Hz  Sinusoidal Power, Power Factor setting 1.0 – 0.75, 16 Hz to 69 Hz		Uncertainties in tables are calculated in ppm		Farnboro'			
V Range →	16	33	78	168	336	1008	
I Range ↓	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 – 168)	(134 – 336)	(330 – 1008)	
0.1 – 2	350	330	280	280	280	330	
2.1 – 5	350	330	280	280	280	330	
5.1 -10	375	330	300	300	300	350	
10.1 – 21	400	380	330	330	330	380	
20.1 - 80	475	475	425	425	425	475	
Sinusoidal Power, Power Factor setting 0.5 – 0.25, 16 Hz to 69 Hz							
V Range	16	33	78	168	336	1008	
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 – 168)	(134 – 336)	(330 – 1008)	
0.1 – 2	380	350	300	300	300	350	
2.1 – 5	350	330	280	280	280	350	
5.1 -10	400	380	330	330	330	380	
10.1 – 21	430	400	350	350	350	400	
20.1 - 80	500	500	450	450	450	500	
Sinusoidal Power, Power Factor setting 0.5 – 0.25, 16 Hz to 69 Hz							
V Range	16	33	78	168	336	1008	
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 – 168)	(134 – 336)	(330 – 1008)	
0.1 – 2	430	400	380	380	380	430	
2.1 – 5	430	400	380	380	380	400	
5.1 -10	500	480	450	450	450	480	
10.1 – 21	500	500	450	480	480	500	
20.1 - 80	580	580	550	550	550	580	



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<b>AC POWER</b> Sinusoidal Power, Power Factor setting 1.0 – 0.75, 69 Hz to 180 Hz						Farnboro'	
V Range	16	33	78	168	336		1008
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 - 168)	(134 – 336)		(330 - 1008)
0.1 – 2	375	350	300	300	300		350
2.1 – 5	350	330	280	280	280		330
5.1 -10	400	380	330	330	330		380
10.1 – 21	425	400	350	350	350		400
20.1 - 80	500	500	450	450	450		500
Sinusoidal Power, Power Factor setting 0.75 – 0.5, 69 Hz to 180 Hz							
V Range	16	33	78	168	336		1008
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 - 168)	(134 – 336)		(330 - 1008)
0.1 – 2	400	400	350	350	350		380
2.1 – 5	400	380	330	330	330		380
5.1 -10	450	430	400	400	400		430
10.1 – 21	480	450	430	430	430		450
20.1 - 80	580	550	530	530	530		550
Sinusoidal Power, Power Factor setting 0.5 – 0.25, 69 Hz to 180 Hz							
V Range	16	33	78	168	336		1008
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 - 168)	(134 – 336)		(330 - 1008)
0.1 – 2	580	550	550	550	550		580
2.1 – 5	580	550	530	530	530		580
5.1 -10	700	700	630	680	680		700
10.1 – 21	730	700	680	680	680		700
20.1 - 80	830	830	800	800	800		830
Sinusoidal Power, Power Factor setting 1.0 – 0.75, 180 Hz to 450 Hz							
V Range	16	33	78	168	336		1008
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 - 168)	(134 – 336)		(330 - 1008)
0.1 – 2	450	430	400	400	400		430
2.1 – 5	450	430	400	400	400	430	
5.1 -10	530	500	480	480	480	500	
10.1 – 21	550	530	500	500	500	530	
20.1 - 80	680	650	630	630	630	650	
Sinusoidal Power, Power Factor setting 0.75 – 0.5, 180 Hz to 450 Hz							
V Range	16	33	78	168	336	1008	
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)	(67 - 168)	(134 – 336)	(330 - 1008)	
0.1 – 2	650	650	630	630	630	650	
2.1 – 5	650	650	630	630	630	650	
5.1 -10	830	800	800	800	800	800	
10.1 – 21	830	830	800	800	800	830	
20.1 - 80	1000	1000	1000	1000	1000	1000	



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<b>AC POWER</b> Sinusoidal Power, Power Factor setting 0.5 – 0.25, 180 Hz to 450 Hz				Farnboro'			
V Range	16	33	78		168	336	1008
I Range	(6.4 – 16)	(13.2 – 33)	(31 – 78)		(67 - 168)	(134 – 336)	(330 - 1008)
0.1 – 2	1300	1300	1300		1300	1300	1300
2.1 – 5	1300	1300	1300		1300	1300	1300
5.1 -10	1700	1700	1700		1700	1700	1700
10.1 – 21	1700	1700	1700		1700	1700	1700
20.1 - 80	2100	2100	2100		2100	2100	2100
DC Voltage and AC Voltage harmonics.							
	DCV 0.7 mV to 8 V		160 ppm + 7.0 mV				
	ACV 1.5 mV to 4.8 V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		160 ppm + 1.5 mV  220 ppm + 1.5 mV 630 ppm + 1.5 mV				
	DCV 8 V to 16.5 V		160 ppm + 13 mV				
	ACV 4.8 V to 9.9 V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		160 ppm 2.5 mV  220 ppm+ 2.5 mV 630 ppm + 2.5 mV				
	DCV 16.5 V to 39 V		160 ppm + 30 mV				
	ACV 9.9 V to 23V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		160 ppm 2.5 mV 220 ppm+ 2.5 mV 630 ppm + 2.5 mV				
	DCV 39 V to 84 V		160 ppm + 60 mV				
	ACV 23 V to 50 V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		160 ppm 5.5 mV 220 ppm+ 5.5 mV 625 ppm + 5.5 mV				
	DCV 84 V to 168 V		160 ppm + 125 mV				
	ACV 50 V to 100 V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		160 ppm 15 mV 220 ppm+ 15 mV 68025 ppm + 15 mV				
	DCV 168 V to 504 V		230 ppm + 400 mV				
	ACV 100 V to 302 V 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz		230 ppm 40 mV 270 ppm+ 40 mV 680 ppm + 40 mV				



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DC Current and AC Current harmonics	DCI 0 A to 125 mA	180 ppm + 90 $\mu$ A		
	ACI 8 $\mu$ A to 75 mA 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	180 ppm + 8.0 $\mu$ A 240 ppm + 8.0 $\mu$ A 630 ppm + 8.0 $\mu$ A		
	DCI 125 mA to 250 mA	180 ppm + 180 $\mu$ A		
	ACI 75 mA to 150 mA 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	180 ppm + 15 $\mu$ A 240 ppm + 15 $\mu$ A 630 ppm + 15 $\mu$ A		
	DCI 250 mA to 500 mA	180 ppm + 350 $\mu$ A		
	ACI 150 mA to 300 mA 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	180 ppm + 30 $\mu$ A 240 ppm + 30 $\mu$ A 630 ppm + 30 $\mu$ A		
	DCI 500 mA to 1.0 A	180 ppm + 700 $\mu$ A		
	ACI 300 mA to 600 mA 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	180 ppm + 60 $\mu$ A 240 ppm + 60 $\mu$ A 630 ppm + 60 $\mu$ A		
	DCI 1 A to 2.5 A	180 ppm + 1.8 mA		
	ACI 600 mA to 1.5 A 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	180 ppm + 150 $\mu$ A 240 ppm + 150 $\mu$ A 625 ppm + 150 $\mu$ A		
	DCI 2.5 A to 5.0 A	2500 ppm + 3.5 mA		
	ACI 1.5 A to 3.0 A 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	240 ppm + 300 $\mu$ A 330 ppm + 300 $\mu$ A 650 ppm + 300 $\mu$ A		
	DCI 5 A to 10 A	280 ppm + 7.0 mA		
	ACI 3 A to 6.0 A 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	280 ppm + 900 $\mu$ A 350 ppm + 900 $\mu$ A 800 ppm + 900 $\mu$ A		
	ACI 6 A to 24 A 16 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 6 kHz	350 ppm + 3.5 mA 400 ppm + 3.5 mA 850 ppm + 3.5 mA		



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Phase				Farnboro'
250 mA to 5 A 16 V to 1008 V	0 ° to 360 °  16 Hz to 69 Hz 70 Hz to 180 Hz 181 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 3 kHz < 3 kHz to 6 kHz	0.0040 ° 0.0070 ° 0.020 ° 0.040 ° 0.20 ° 0.35 °		
5 A to 21 A 16 V to 1008 V	16 Hz to 69 Hz 70 Hz to 180 Hz 181 Hz to 450 Hz 451 Hz to 850 Hz 851 Hz to 3 kHz 3 kHz to 6 kHz	0.0050 ° 0.0090 ° 0.025 ° 0.050 ° 0.25 ° 0.50 °		
Harmonic values for non sinusoidal waveforms				
50 Hz fundamental; Harmonics up to 3 kHz	RMS Values 1 A to 10 A	850 ppm		
Flicker (Pst)	Modulated 230 V 50 Hz sine wave	0.42 %		
At unity power factor	37.5 W to 6 kW 50 Hz to 60 Hz	0.050 %	Maximum voltage 300 V Maximum current 20 A	
	75 mW to 50 kW 50 Hz to 400 Hz	0.10 %	Maximum voltage 1 k V Maximum current 50 A	
<b>INDUCTANCE</b>				
Specific Values	At 1 kHz 1 μH 10 μH 100 μH 500 μH 1 mH 5 mH 10 mH 50 mH 100 mH 1 H 5 H 10 H	0.0050 μH 0.0050 μH 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 % 0.012 %		
	At nominal 50 Hz 1 H 5 H 10 H	0.020 % 0.020 % 0.025 %		



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<b>INDUCTANCE</b> cont	<i>At 200 Hz</i> 10 H	0.025 %		Farnboro'
	<i>At 400 Hz</i> 1 H 10 H	0.020 % 0.025 %		
Specific Values	<i>At 10 kHz</i> 1 mH 10 mH 100 mH 1 H	0.022 % 0.022 % 0.022 % 0.10 %		
Other Values	<i>At 1 kHz</i> 5 nH to 100 $\mu$ H 100 $\mu$ H to 100 mH 100 mH to 1 H 1.0 H to 10 H	0.20 % + 5 nH 0.050 % 0.030 % 0.030 %		
<b>MUTUAL INDUCTANCE</b>	1 $\mu$ H to 500 mH 1 kHz	The arithmetic sum of the individual uncertainties of the two inductances	By 'sum and difference' method	
<b>CAPACITANCE</b> Specific Values	<i>At 1 kHz:</i> 0.001 pF 0.01 pF 0.1 pF  1 pF 10 pF 100 pF  1000 pF 10 nF 100 nF 1 $\mu$ F	0.000 0050 pF 0.000 0050 pF 0.000 0050 pF  5.0 ppm 1.5 ppm 1.5 ppm  5.0 ppm 30 ppm 40 ppm 50 ppm	This facility is mainly appropriate to the measurement of 2-Terminal, 3-Terminal or 4-Terminal capacitance standards.  2-terminal capacitance standards usually incur larger uncertainties than the 3- terminal or 4-terminal capacitors.	
Other Values	<i>At 1 kHz:</i> 0.01 fF to 0.01 pF 0.01 pF to 0.1 pF 0.1 pF to 1 pF  1 pF to 10 pF 10 pF to 100 pF 100 pF to 1000 pF  1 nF to 10 nF 10 nF to 100 nF 100 nF to 1000 nF 1 $\mu$ F to 10 $\mu$ F	0.000 010 pF 0.000 010 pF 0.000 010 pF  10 ppm 10 ppm 10 ppm  50 ppm 50 ppm 100 ppm 0.10 %	A number of known reference capacitors are also available, mainly decade values from 0.001 pF to 1 $\mu$ F, for calibration of bridges and capacitance meters.	



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<b>CAPACITANCE</b> (cont'd) Other Values (cont'd)	<i>From 10 Hz to 10 kHz:</i> 1 pF to 1 nF 1 nF to 1 $\mu$ F  <i>At 100 Hz:</i> 1 nF to 1 $\mu$ F 1 $\mu$ F to 100 $\mu$ F 100 $\mu$ F to 10 mF	22 ppm 100 ppm  0.020 % 0.35 % 0.40 %		
<b>CAPACITANCE LOSS</b> (Dissipation factor)	$10^{-4}$ to 1 50 Hz to 10 kHz	$0.50 \times 10^{-4}$ to $10 \times 10^{-4}$	Uncertainty range stated is for capacitance values $\leq$ 100nF at 1kHz	Farnboro'
<b>ATTENUATION</b>	<i>At dc:</i> 0.0 to 10 dB 10 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 80 dB 80 dB to 90 dB 90 dB to 100 dB  <i>From 70 Hz to 1 kHz:</i> 0 dB to 10 dB 10 dB to 30 dB 30 dB to 50 dB 50 dB to 70 dB 70 dB to 90 dB 90 dB to 100 dB  <i>From 1 kHz to 10 kHz:</i> Up to 10 dB 10 dB to 30 dB  <i>From 10 kHz to 20 kHz:</i> 0 dB to 10 dB	0.0020 dB 0.0050 dB 0.010 dB 0.020 dB 0.050 dB 0.10 dB 0.20 dB  0.0050 dB 0.010 dB 0.010 dB 0.050 dB 0.10 dB 0.020 dB  0.0050 dB 0.050 dB  0.10 dB	For 50 $\Omega$ , 75 $\Omega$ and 600 $\Omega$ systems. Thee effective range is limited to 60dB for 50 $\Omega$ and 75 $\Omega$ systems.	Farnboro'
<b>PHASE ANGLE</b> Generation	$0^\circ$ to $360^\circ$ <i>10 Hz to 1 kHz</i> <i>kHz to 6.25 kHz</i>  <i>6.26 kHz to 50 kHz</i> <i>50 kHz to 100 kHz</i>	$(0.010 + 0.000050 R)^\circ$ $(0.010 + 0.00010R)^\circ$  $(0.025 + 0.00025 R)^\circ$ $(0.050 + 0.00050 R)^\circ$ (R is the ratio between the output voltages and may have any value between 1 and 100)		Farnboro'



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<b>PHASE ANGLE</b> (cont'd)  Measurement	0° to 360° 10 Hz to 50 kHz 50 kHz to 100 kHz  30 Hz to 6 kHz 6 kHz to 30 kHz	0.050° 0.15°  0.025° 0.040°		
<b>DC/LF AUTOMATED SYSTEMS FOR GENERATION</b> Farnborough and Leigh				
DC RESISTANCE Generation	1 Ω 1.9 Ω 10 Ω  19 Ω 100 Ω 190 Ω  1 kΩ 1.9 kΩ 10 kΩ  19 kΩ 100 kΩ 190 kΩ  1 MΩ 1.9 MΩ 10 MΩ  19 MΩ 100 MΩ	86 ppm 86 ppm 26 ppm  24 ppm 16 ppm 16 ppm  12 ppm 12 ppm 11 ppm  11 ppm 13 ppm 13 ppm  18 ppm 20 ppm 37 ppm  45 ppm 105 ppm		Farnboro' & Leigh
DC VOLTAGE Generation	0 V to 220 mV 220 mV to 2.2 V 2.2 V to 11 V  11 V to 22 V 22 V to 220 V 220 V to 1100 V	7.5 ppm + 0.65 μV 6.5 ppm + 1.0 μV 6.5 ppm + 3.5 μV  6.5 ppm + 6.5 μV 7.0 ppm + 80 μV 8.5 ppm + 470 μV		Farnboro' & Leigh



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<b>DC CURRENT</b> Generation	0 A to 220 $\mu$ A 220 $\mu$ A to 2.2 mA 2.2 mA to 22 mA 22 mA to 220 mA 220 mA to 2.2 A 2.2 A to 11 A	47 ppm + 8.0 nA 47 ppm + 8.0 nA 47 ppm + 80 nA 55 ppm + 800 nA 75 ppm + 24 $\mu$ A 280 ppm + 380 $\mu$ A		Farnboro' & Leigh
<b>DC CURRENT</b> Simulation	11 A to 550 A	0.30 % + 600 mA	Using a 50 turn coil	
<b>AC VOLTAGE</b> Generation	0.1 mV to 2.2 mV 10 Hz to 20 Hz 20 to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	850 ppm + 4.0 $\mu$ V 750 ppm + 4.0 $\mu$ V 720 ppm + 4.0 $\mu$ V 800 ppm + 4.0 $\mu$ V 0.10 % + 6.5 $\mu$ V 0.12 % + 12 $\mu$ V 0.17 % + 25 $\mu$ V 0.33 % + 25 $\mu$ V		
	2.2 mV to 22 mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	480 ppm + 5.0 $\mu$ V 220 ppm + 5.0 $\mu$ V 140 ppm + 5.0 $\mu$ V 340 ppm + 5.0 $\mu$ V 750 ppm + 6.5 $\mu$ V 0.11 % + 12 $\mu$ V 0.15 % + 25 $\mu$ V 0.30 % + 25 $\mu$ V		
	22 mV to 220 mV 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	470 ppm + 13 $\mu$ V 190 ppm + 8.0 $\mu$ V 105 ppm + 8.0 $\mu$ V 290 ppm + 8.0 $\mu$ V 700 ppm + 25 $\mu$ V 860 ppm + 25 $\mu$ V 0.14 % + 32 $\mu$ V 0.28 % + 80 $\mu$ V		
	220 mV to 2.2 V 10 Hz to 20 Hz 20 Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	470 ppm + 80 $\mu$ V 150 ppm + 25 $\mu$ V 75 ppm + 6.0 $\mu$ V 115 ppm + 16 $\mu$ V 220 ppm + 65 $\mu$ V 380 ppm + 115 $\mu$ V 950 ppm + 320 $\mu$ V 0.19 % + 800 $\mu$ V		



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<b>AC VOLTAGE</b> (cont'd) Generation	2.2 V to 22 V 10 Hz to 20 Hz 20Hz to 40 Hz 40 Hz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 500 kHz 500 kHz to 1 MHz	470 ppm + 800 $\mu$ V 150 ppm 240 $\mu$ V 75 ppm + 55 $\mu$ V 120 ppm + 160 $\mu$ V 220 ppm + 320 $\mu$ V 470 ppm + 1.3 mV 0.11 % + 4.0 mV 0.24 % + 7.0mV		Farnboro' & Leigh
<b>AC VOLTAGE</b> Generation	22 V to 220 V 10 Hz to 20 Hz 20Hz to 40 Hz 40 Hz to 20 kHz 300 kHz to 50 kHz 50 kHz to 100 kHz	470 ppm + 8.0 mV 150 ppm + 2.5 mV 80 ppm + 800 $\mu$ V 200 ppm + 3.1 mV 470 ppm + 8.0 mV		
	220 V to 1100 V 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 30 kHz	80 ppm + 3.1 mV 140 ppm + 5.0 mV 470 ppm + 8.5 mV		
<b>AC VOLTAGE</b> (WIDEBAND to 30 MHz) Generation	220 V to 750 V 30 kHz to 50 kHz 50 kHz to 100 kHz	470 ppm + 8.5 mV 0.18 % + 35 mV		Farnboro' ONLY
	10 $\mu$ V to 1.1 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.85 % + 1.6 $\mu$ V 0.70 % + 1.6 $\mu$ V 0.80 % + 4.0 $\mu$ V 0.95 % + 4.0 $\mu$ V 1.1 % + 4.0 $\mu$ V 1.8 % + 14 $\mu$ V		
	1.1 mV to 3 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.80 % + 2.5 $\mu$ V 0.65% + 2.4 $\mu$ V 0.65 % + 5.2 $\mu$ V 0.80 % + 5.0 $\mu$ V 0.95 % + 5.0 $\mu$ V 1.7 % + 5.0 $\mu$ V		
	3 mV to 11 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.80 % + 6.5 $\mu$ V 0.65 % + 6.5 $\mu$ V 0.65 % + 8.5 $\mu$ V 0.80 % + 8.5 $\mu$ V 0.95 % + 8.5 $\mu$ V 1.7 % + 8.5 $\mu$ V		



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**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

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<b>AC VOLTAGE</b> (WIDEBAND to 30 MHz) (cont.)				Farnboro' ONLY
Generation	11 mV to 33 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.7 % + 12.5 $\mu$ V 0.55 % + 12.5 $\mu$ V 0.55 % + 15 $\mu$ V 0.65 % + 15 $\mu$ V 0.80 % + 15 $\mu$ V 1.3 % + 15 $\mu$ V		
	33 mV to 110 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.70 % + 31 $\mu$ V 0.55 % + 31 $\mu$ V 0.55 % + 35 $\mu$ V 0.65 % + 35 $\mu$ V 0.80 % + 35 $\mu$ V 1.3 % + 35 $\mu$ V		
	110 mV to 330 mV 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.62 % + 80 $\mu$ V 0.50 % + 80 $\mu$ V 0.50 % + 80 $\mu$ V 0.55 % + 80 $\mu$ V 0.70 % + 80 $\mu$ V 1.20 % + 80 $\mu$ V		
	330 mV to 1.1 V 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.65 % + 310 $\mu$ V 0.50 % + 310 $\mu$ V 0.50 % + 310 $\mu$ V 0.55 % + 310 $\mu$ V 0.70 % + 310 $\mu$ V 1.20 % + 310 $\mu$ V		
	1.1 V to 3.5 V 10 Hz to 30 Hz 30 Hz to 120 Hz 120 Hz to 2 MHz 2 MHz to 10 MHz 10 MHz to 20 MHz 20 MHz to 30 MHz	0.55 % + 400 $\mu$ V 0.40 % + 400 $\mu$ V 0.40 % + 400 $\mu$ V 0.50 % + 400 $\mu$ V 0.65 % + 400 $\mu$ V 1.1 % + 400 $\mu$ V		
<b>AC CURRENT</b>				Farnboro' & Leigh
Generation	100 nA to 220 $\mu$ A 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	130 ppm + 16 nA 550 ppm + 40 nA 0.14 % + 870 nA		
	220 $\mu$ A to 2.2 mA 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	130 ppm + 31 nA 550 ppm + 400 nA 0.14 % + 800 nA		



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<b>AC CURRENT</b> Generation (cont.)	2.2 mA to 22 mA 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	140 ppm + 410 nA 550 ppm + 4.0 $\mu$ A 0.14 % + 8.0 $\mu$ A		Farnboro' & Leigh
	22 mA to 220 mA 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	150 ppm + 3.1 $\mu$ A 550 ppm + 40 $\mu$ A 0.14 % + 80 $\mu$ A		
	220 mA to 2.2 A 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	590 ppm + 31 $\mu$ A 670 ppm + 80 $\mu$ A 0.80 % + 120 $\mu$ A		
	2.2 A to 11 A 40 Hz to 1 kHz 1 kHz to 5 kHz 5 kHz to 10 kHz	370 ppm + 140 $\mu$ A 750 ppm + 300 $\mu$ A 0.28 % + 600 $\mu$ A		
<b>AC CURRENT</b> Simulation	11 A to 550 A 45 Hz to 65 Hz	0.30 % + 600 mA	Using a 50 turn coil	
<b>DC/LF AUTOMATED SYSTEMS FOR MEASUREMENT</b> Farnborough and Leigh				
<b>DC RESISTANCE</b> Measurement	0 $\Omega$ to 12 $\Omega$ 12 $\Omega$ to 120 120 $\Omega$ to 1.2 k $\Omega$ 1.2 k $\Omega$ to 12 k $\Omega$ 12 k $\Omega$ to 120 k $\Omega$ 120 k $\Omega$ to 1.2 M $\Omega$ 1.2 M $\Omega$ to 12 M $\Omega$ 12 M $\Omega$ to 120 M $\Omega$ 120 M $\Omega$ to 1.2 G $\Omega$	45 ppm + 0.10 m $\Omega$ 30 ppm + 1.0 m $\Omega$ 22 ppm + 1.0 m $\Omega$ 21 ppm + 10 m $\Omega$ 23 ppm + 100 m $\Omega$ 35 ppm + 3.0 $\Omega$ 80 ppm + 140 $\Omega$ 600 ppm + 2.1 k $\Omega$ 0.65 % + 160 k $\Omega$		Farnboro' & Leigh
<b>DC VOLTAGE</b> Measurement	0 V to 120 mV 120 mV to 1.2 V 1.2 V to 12 V 12 V to 120 V 120 V to 1050 V	12.5 ppm + 1.8 $\mu$ V 11.5 ppm + 2 $\mu$ V 11.5 ppm + 6.5 $\mu$ V 13 ppm + 130 $\mu$ V 19 ppm + 750 $\mu$ V		



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<b>DC CURRENT</b> Measurement (cont.)	0 A to 1.2 $\mu$ A 1.2 $\mu$ A to 12 $\mu$ A 12 $\mu$ A to 120 $\mu$ A 120 $\mu$ A to 1.2 mA  1.2 mA to 12 mA 12 mA to 120 mA 120 mA to 1.05 A	210 ppm + 85 pA 110 ppm + 210 pA 75 ppm + 1.7 nA 75 ppm + 11 nA  75 ppm + 75 nA 95 ppm + 1.1 $\mu$ A 170 ppm + 18 $\mu$ A		Farnboro' & Leigh
<b>AC VOLTAGE</b> Measurement	10 $\mu$ V to 12 mV 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz	800 ppm + 9.0 $\mu$ V 300 ppm + 8.0 $\mu$ V 400 ppm + 8.0 $\mu$ V 0.13 % + 8.0 $\mu$ V 0.60 % + 11 $\mu$ V 4.7 % + 21 $\mu$ V		
	12 mV to 120 mV 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 MHz	800 ppm + 21 $\mu$ V 175 ppm + 13 $\mu$ V 225 ppm + 13 $\mu$ V 400 ppm + 13 $\mu$ V 0.15 % + 40 $\mu$ V 0.40 % + 40 $\mu$ V 1.3 % + 40 $\mu$ V 1.8 % + 40 $\mu$ V		
	120 mV to 1.2 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 MHz	800 ppm + 140 $\mu$ V 140 ppm + 30 $\mu$ V 200 ppm + 30 $\mu$ V 400 ppm + 40 $\mu$ V 0.10 % + 110 $\mu$ V 0.36 % + 225 $\mu$ V 1.2 % + 1.1 mV 1.8 % + 1.2 mV		
	1.2 V to 12 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 MHz	750 ppm + 1.3 mV 140 ppm + 300 $\mu$ V 200 ppm + 300 $\mu$ V 400 ppm + 400 $\mu$ V 0.10 % + 600 $\mu$ V 0.36 % + 25 mV 1.25 % + 12 mV 1.8 % + 12 mV		



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AC VOLTAGE Measurement (cont.)	12 V to 120 V 10 Hz to 40 Hz 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 50 kHz 50 kHz to 100 kHz	750 ppm + 14 mV 275 ppm + 3.5 mV 275 ppm + 3.5 mV 510 ppm + 6 mV 0.16 % + 13 mV		Farnboro' & Leigh
	120 V to 700 V 40 Hz to 1 kHz 1 kHz to 20 kHz 20 kHz to 30 kHz	500 ppm + 20 mV 750 ppm + 20 mV 0.16 % + 25 mV		
AC CURRENT Measurement	At 700 V 30 kHz to 50 kHz 50 kHz to 100 kHz	0.20 % + 25 mV 0.45 % + 25 mV		
	220 V to 1.1 kV 40 Hz to 10 kHz 10 kHz to 30 kHz 30 kHz to 100 kHz	210 ppm + 25 mV 760 ppm + 60 mV 0.65 % + 250 mV		
	100 nA to 120 µA 40 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz	0.18 % + 40 nA 0.08 % + 40 nA 0.11 % + 70 nA		
	120 µA to 1.2 mA 25 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz 5 kHz to 10 kHz	0.18 % + 300 nA 0.08 % + 300 nA 0.09 % + 700 nA 0.25 % + 1.25 µA		
	1.2 mA to 12 mA 25 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz 5 kHz to 10 kHz	0.18 % + 3.0 µA 0.08 % + 3.0 µA 0.090 % + 37 µA 0.25 % + 13 µA		
	12 mA to 120 mA 25 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz 5 kHz to 10 kHz	0.18 % + 30 µA 0.080 % + 30 µA 0.090 % + 70 µA 0.25 % + 130 µA		
	120 mA to 1.050 A 25 Hz to 45 Hz 45 Hz to 100 Hz 100 Hz to 5 kHz 5 kHz to 10 kHz	0.19 % + 250 µA 0.11 % + 250 µA 0.16 % + 550 µA 1.3 % + 1.0 mA		



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**Trescal CMS**

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<b>Other Electrical capabilities outside automated systems or held at specific sites:</b>				
<b>DC RESISTANCE</b>	1 mΩ to 10 mΩ 10 mΩ to 100 mΩ 100 mΩ to 500 mΩ 500 mΩ to 1 Ω  100 μΩ to 1 mΩ  1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 kΩ  1 kΩ to 10 kΩ 10 kΩ to 100 kΩ 100 kΩ to 1 MΩ  1 MΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ  1 GΩ to 10 GΩ 10 GΩ to 100 GΩ 100 GΩ to 1 TΩ	45 ppm 35 ppm 15 ppm 12 ppm  0.030 μΩ  6.0 ppm 5.0 ppm 4.0 ppm  6.0 ppm 15 ppm 30 ppm  80 pm 0.15 % 0.40 %  0.80 % 1.2 % 1.5 %	Resistors of modest dimensions suitable for oil immersion can be measured over the range 10°C to 40°C  Maximum current available 200 A          Uncertainties also dependent on rated voltage	Leigh
<b>AC RESISTANCE</b> All at 50 Hz	0.05 Ω 0.1 Ω 0.22 Ω 0.34 Ω 0.5 Ω 1.0 Ω 5.0 Ω 10 Ω 100 Ω 1000 Ω	0.60 % + 4.7 mΩ 0.63 % + 4.0 mΩ 0.87 % + 4.0 mΩ 0.78 % + 4.0 mΩ 0.55 % + 4.0 mΩ 0.58 % + 4.0 mΩ 0.52 % + 4.0 mΩ 0.54 % + 4.0 mΩ 0.52 % + 4.0 mΩ 0.57 % + 5.8 mΩ		Leigh
<b>DC HIGH VOLTAGE</b> Measurement and Generation	1 kV to 25 kV 25 kV to 50 kV 50 kV to 100 kV 100 kV to 150 kV	40 ppm 50 ppm 150 ppm 180 ppm		Leigh
<b>DC POWER</b>	10 V to 300 V 10 mA to 200 A	0.10 % 0.10 %	Due to correlated terms the uncertainty will be the sum of the A and V contributions.	Leigh



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<b>AC VOLTAGE</b>	220 V to 1.1 kV 40 Hz to 10 kHz 10 kHz to 30 kHz 30 kHz to 100 kHz	210 ppm + 25 mV 760 ppm + 60 mV 0.65 % + 250 mV		Leigh
<b>HIGH VOLTAGE</b>	1 kV to 50 kV 50 Hz	500 ppm		
<b>AC CURRENT</b>	100 A to 1000 A 50 Hz	0.25 %		
<b>AC POWER</b> @ 50 Hz, Maximum Voltage 1 kV	1 W to 25 kW 25 kW to 100 kW 100 kW to 1 MW	0.12 % 0.15 % 0.20 %	Limiting current 25A Limiting current 100 A Limiting current 1 kA	
<b>INDUCTANCE</b>	At 1 kHz 1 $\mu$ H to 3 $\mu$ H 3 $\mu$ H to 5 $\mu$ H 5 $\mu$ H to 10 $\mu$ H 10 $\mu$ H to 100 $\mu$ H 100 $\mu$ H to 1m H 1 mH to 10m H 10mH to 100m H 100 mH to 1H 1H to 10H	7.0 % 2.2 % 1.2 % 0.15 % +50 nH 0.040 % + 60 nH 0.030 % + 1 $\mu$ H 0.030 % + 10 $\mu$ H 0.03 0% + 100 $\mu$ H 0.030 % + 1.0 mH	Unity power factor	
<b>CAPACITANCE</b>	At 1 kHz 0.1pF, 1 pF, 10 pF, 100 pF, 1 nF 25 pF, 10nF, 100nF 1 $\mu$ F, 10 $\mu$ F, 100 uF, 1 mF	60 ppm 20 ppm 0.020 % +0.010 pF 40 ppm 60 ppm 0.020 %		
	At 1 kHz 1 pF to 10 pF	0.35 % to 0.080 %		
	At 1 kHz 10 pF to 100 pF	0.12 %		
	100 Hz to 5 kHz 100 pF to 100 nF	0.060 %		
	100 nF to 10 $\mu$ F 100 Hz to 5 kHz	0.030 %		



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<b>FREQUENCY</b> Measurement	1 $\mu$ Hz to 100 Hz 100 Hz to 1.3 GHz	1.0 $\mu$ Hz 1.0 in $10^{10}$		Leigh
Generation	1 MHz to 100 MHz	1.0 in $10^{10}$		
Rise Time	500 $\mu$ V to 20 V	4.4 ns		
<b>RF AND MICROWAVE ELECTRICAL MEASUREMENTS</b>				
<b>FREQUENCY</b>				Farnboro'
Specific Values	100 kHz, 1 MHz, 5 MHz and 10 MHz	1.0 in $10^{12}$	10 second gate time	
Other Values	5 Hz to 50 Hz 50 Hz to 500 Hz 500 Hz to 5 kHz  5 kHz to 50 kHz 50 kHz to 500 kHz 500 kHz to 99 GHz 99 GHz to 110 GHz	2.0 in $10^8$ 2.0 in $10^9$ 2.1 in $10^{10}$  1.9 in $10^{11}$ 1.0 in $10^{11}$ 4.0 in $10^{12}$ 4.0 in $10^{11}$	For the calibration of signal sources and frequency meters/ counters  Measure only above 40 GHz	
<b>RF AND MICROWAVE MEASUREMENTS: Standards</b>				
<b>FREQUENCY (cont'd)</b> Other Values (cont'd)	500 MHz to 1.5 GHz 1.5 GHz to 40 GHz  1 GHz to 18 GHz	1.5 in $10^{11}$ to 8.3 in $10^{12}$ 1.1 in $10^{10}$  1 in $10^{12}$	For frequency generation	Farnboro'
<b>RF ADMITTANCE</b>	1 mS to 50 mS 30 MHz to 500 MHz 500 MHz to 1 GHz	0.060 mS 0.11 mS		
<b>RF CAPACITANCE</b>	At 1 kHz 0.002 pF to 1000 pF 1 nF to 1 $\mu$ F  From 1 kHz to 1 MHz: 0.002 pF to 1000 pF  From 100 kHz to 1 MHz: 1 nF to 10 nF 10 nF to 100 nF	0.0020 % + 0.0020 pF 0.020 %  0.0030 %  0.10 % + 1.0 pF 0.10 % + 10 pF	14mm GPC  Capacitance as the major term of an admittance.	



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<b>RF CAPACITANCE</b> (cont.)	<i>From 20 MHz to 30 MHz:</i> 1 pF to 50 pF 50 pF to 200 pF 200 pF to 500 pF 500 pF to 1000 pF	0.015 % 0.040 % 0.15 % 0.30 %		Farnboro'
	<i>From 30 MHz to 40 MHz</i> 1 pF to 100 pF 100 pF to 200 pF 200 pF to 500 pF 500 pF to 1000 pF	0.025 % 0.080 % 0.25 % 0.70 %		
	1 pF to 230 pF <i>40 MHz to 100 MHz</i>	2.0 % + 1.0 pF		
	1 pF to 75 pF <i>100 MHz to 250 MHz</i>	0.65 pF		
<b>BRIDGE CALIBRATION</b>	1 pF to 20 pF <i>1 MHz to 250 MHz</i>	0.20 % + 0.0020 pF	The capability shown for bridge calibration is for instruments fitted with 14mm GPC connectors. Other connector systems may invoke slightly larger uncertainties.	
	50 pF <i>1 kHz to 1 MHz</i> <i>1 MHz to 40 MHz</i> <i>40 MHz to 60 MHz</i> <i>60 MHz to 80 MHz</i> <i>80 MHz to 100 MHz</i> <i>100 MHz to 120 MHz</i>	0.0030 % 0.040 % 0.08 % 0.10 % 0.20 % 0.30 %		
	100 pF <i>1 kHz to 1 MHz</i> <i>1 MHz to 40 MHz</i> <i>40 MHz to 60 MHz</i> <i>60 MHz to 80 MHz</i> <i>80 MHz to 100 MHz</i> <i>100 MHz to 120 MHz</i>	0.010 % 0.050 % 0.10 % 0.20 % 0.30 % 0.50 %		
	200 pF <i>1 kHz to 1 MHz</i> <i>1 MHz to 40 MHz</i> <i>40 MHz to 60 MHz</i> <i>60 MHz to 80 MHz</i>	0.010 % 0.080 % 0.20 % 0.50 %		
	500 pF <i>1 kHz to 1 MHz</i> <i>1 MHz to 20 MHz</i> <i>20 MHz to 30 MHz</i> <i>30 MHz to 40 MHz</i>	0.010 % 0.050 % 0.15 % 0.25 %		
	1000 pF <i>1 kHz to 1 MHz</i> <i>1 MHz to 10 MHz</i> <i>10 MHz to 20 MHz</i> <i>20 MHz to 30 MHz</i>	0.0030 % 0.020 % 0.10 % 0.30 %		



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<b>RF CONDUCTANCE</b>				Farnboro'	
	<i>From 1 kHz to 1 MHz:</i> 10 $\mu$ S to 10 mS 10 mS to 100 mS 100 mS to 1 S	0.10 % + 1.0 $\mu$ S 0.10 % + 10 $\mu$ S 0.10 % + 100 $\mu$ S	The RF Conductance capability is for instruments fitted with 14mm GPC connectors. Other connector systems may invoke larger uncertainties.		
	1 mS to 50 mS 300 kHz to 1 GHz	0.20 %			
	50 mS to 100 mS 300 kHz to 1 GHz	0.50 %			
Bridge Calibrations	1 mS (1 k $\Omega$ ) 1 kHz to 200 MHz	0.10 % to 1.0 %			
	10 mS (100 $\Omega$ ) 1 kHz to 1 GHz	0.10 % to 0.25 %			
	100 mS (10 $\Omega$ ) 1 kHz to 200 MHz	0.10 % to 0.40 %			
	1 S (1 $\Omega$ ) 1 kHz to 200 MHz	0.10 % to 2.0 %			
<b>VSWR</b>	1.0 to 2.0 1 MHz to 20 MHz	0.0030 to 0.0050			14mm GPC
	1.0 to 1.33 20 MHz to 100 MHz	0.0050 to 0.015			14mm GPC
	1.0 to 1.33 100 kHz to 2 GHz 2 GHz to 3 GHz	0.020 0.030			75 $\Omega$ (14mm & 7mm)
	1.0 to 1.05 250 MHz to 8.25 GHz in 250 MHz steps	0.0030 to 0.0060			14mm GPC. Other connectors invoke slightly larger uncertainties
	1.0 to 1.5 500 MHz to 8.25 GHz	0.0060 to 0.0090			14mm GPC. Other connectors invoke slightly larger uncertainties
	1.5 to 10 500 MHz to 8.25 GHz	0.0090 to 0.20			14mm GPC. Other connectors invoke slightly larger uncertainties
	1.0 to 1.5 1.8 GHz to 18 GHz	0.020 to 0.030		APC-7 connector	
	1.5 to 10 1.8 GHz to 18 GHz	0.030 to 0.060	APC-7 connectors		



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<b>VSWR</b> (cont.)	1.0 to 1.2 2 GHz to 18 GHz	(0.0080 + 0.00080 $f_{GHz}$ )	APC 7 connectors	
	2 GHz to 18 GHz	(0.0080 + 0.0010 $f_{GHz}$ )	Precision Type N	
Directivity (of VSWR bridges)	2 GHz to 26.5 GHz	(0.016 + 0.0015 $f_{GHz}$ )	APC 3.5 (uncertainty may increase for other 3.5 versions)	
	20 dB to 56 dB 2 GHz to 18 GHz	(0.0040 + 0.00040 $f_{GHz}$ )	APC 7 connectors	
<b>VSWR</b> (waveguide)	2 GHz to 18 GHz	(0.0040 + 0.0035 $f_{GHz}$ )	Precision Type N	
	2 GHz to 26.5 GHz	(0.0080 + 0.00080 $f_{GHz}$ )	APC 3.5 (uncertainty may increase for other 3.5 mm versions)	
<b>VSWR</b> (waveguide)	1.0 to 1.05 2.6 GHz, 2.8 GHz, 3.0 GHz, 3.2 GHz, 3.4 GHz, 3.6 GHz, 3.8 GHz and 3.95 GHz	0.0030		
	1.0 to 1.5 2.6 GHz to 3.95 GHz	0.0060 to 0.0090	Waveguide No 10 WR 284, RG 48/U)	
	1.5 to 10 2.6 GHz to 3.95 GHz	0.0090 to 0.20		
	1.0 to 1.5 3.95 GHz to 5.85 GHz	0.0040 to 0.0060	Waveguide No 12 (WR 187, RG 49/U) fitted with circular clamped flanges	
	1.5 to 10 3.95 GHz to 5.85 GHz	0.0060 to 0.10		
	1.0 to 1.05 6.2 GHz, 6.8 GHz, 7.5 GHz and 8.0 GHz	0.0030		
	1.0 to 1.5 5.85 GHz to 8.2 GHz	0.0060 to 0.0090	Waveguide No 14 (WR 137, RG 50/U)	
	1.5 to 10 5.85 GHz to 8.2 GHz	0.0090 to 0.20		
	1.0 to 1.05 7.5GHz, 8.5GHz, & 9.5GHz.	0.0030	Waveguide No 15 (WR 112, RG 51/U, R 84)	
	1.0 to 1.05 8.25 GHz, 8.50 GHz, 9.30 GHz, 10.0 GHz, 10.5 GHz, 11.0 GHz, 11.5 GHz, 12.0 GHz and 12.4 GHz	0.0030	Waveguide No 16 (WR 90, RG 52/U) fitted with circular clamped flanges.	



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VSWR (waveguide) (cont.)	1.0 to 1.05 8.2 GHz, 8.5 GHz, 9.0 GHz, 9.5 GHz, 10.0 GHz, 10.5 GHz, 11.5 GHz, 12.0 GHz and 12.5 GHz	0.0030	Waveguide No 16 (WR 90 RG 52/U) fitted with square bolted flanges.	Farnboro'
	1.0 to 1.5 8.2 GHz to 12.5 GHz	0.011 to 0.017	Waveguide No 16 (WR 90, RG 52/U)	
	1.5 to 10 8.2 GHz to 12.5 GHz	0.017 to 0.30		
	1.0 to 1.05 16.5 GHz	0.0050	Waveguide No 18 (WR 62, RG 91/U) fitted with square bolted flanges.	
	1.0 to 1.05 12.5 GHz, 14.5 GHz, 15.5 GHz, 16.5 GHz and 17.5 GHz	0.0050		
	1.0 to 1.5 11.9 GHz to 18 GHz	0.0060 to 0.018	Waveguide No 18 (WR 62, RG 91/U) Fitted with circular Clamped flanges.	
	1.5 to 10 11.9 GHz to 18 GHz	0.018 to 0.40		
	1.0 to 1.2 18 GHz, 20 GHz, 22 GHz, 22.5 GHz, 23 GHz and 25 GHz	0.0060		
	1.0 to 1.5 18 GHz to 26.5 GHz	0.012 to 0.029	Waveguide No 20 (WR 42, RG 53/U, R 220)	
	1.5 to 10 18 GHz to 26.5 GHz	0.029 to 0.40		
	1.0 to 1.2 27.5 GHz, 30 GHz, 33.5 GHz, 35 GHz, 37 GHz and 40 GHz	0.0070		
	1.0 to 2.0 26.5 GHz to 40 GHz	0.016 to 0.040	Waveguide No 22 (WR 28, RG 96/U, R 320)	
	2.0 to 10.0 26.9 GHz to 40 GHz	0.040 to 0.10		
VSWR (of precision airlines)	1.0 to 1.05 2 GHz to 18 GHz*	(0.0060 + 0.00030 $f_{GHz}$ )	APC 7 connectors	
	2 GHz to 18 GHz*	(0.0060 + 0.00030 $f_{GHz}$ )	Precision Type N	
	2 GHz to 26 GHz*	(0.0080 + 0.00080 $f_{GHz}$ )	APC 3.5 (Uncertainty may increase for other 3.5 versions).	
	*in steps of 1 GHz			



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**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

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Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k=2$ )	Remarks	Location Code
<b>VOLTAGE REFLECTION COEFFICIENT</b> Complex VRC	0 to 0.2 300 kHz to 2 GHz 2 GHz to 3 GHz	0.0010 0.0015	14mm 50Ω GPC	Farnboro'
	0.2 to 0.9 300 kHz to 2 GHz 2 GHz to 3 GHz	0.0020 0.0040	14mm 50Ω GPC	
	0 to 1.0 100 kHz to 4 GHz	0.0043 (magnitude), 0.0030 (complex)	7 mm 75Ω Type N	
Modulus	0.82 to 0.997 500 MHz to 8.25 GHz	0.0030	14mm 50Ω GPC	
Modulus Continued	0.82 to 0.99 1.8 GHz to 18 GHz	0.010	7mm coaxial line	
	0.82 to 0.997 2.6 GHz to 3.95 GHz	0.0025	Waveguide No 10 (WR 284, RG 48/U)	
	0.82 to 0.998 3.95 GHz to 5.85 GHz	0.0015	Waveguide No 12 (WR 187, RG 49/U)	
	0.82 to 0.998 5.38 GHz to 8.2 GHz	0.0015	Waveguide No 14 (WR 137, RG 50/U)	
	0.82 to 0.995 8.2 GHz to 12.4 GHz	0.0050	Waveguide No 16 (WR 90, RG 52/U)	
	0.82 to 0.998 12.4 GHz to 18 GHz	0.0015 to 0.0060	Waveguide No 18 (WR 62, RG 91/U)	
<b>VOLTAGE REFLECTION COEFFICIENT</b>				
Modulus	0.82 to 0.998 26.5 GHz to 40 GHz	0.0050	Waveguide No 22 (WR 28, RG 96/U)	
Magnitude	0 to 1.0 50 GHz to 75 GHz 75 GHz to 110 GHz	0.018 0.024	Waveguide No 25 Waveguide No 27	
Phase	-180° to +180° 50 GHz to 75 GHz	$180 \left( \frac{Unc}{\pi  \Gamma } \right)^0$	Waveguide No 25	
	75 GHz to 110 GHz	$180 \left( \frac{Unc}{\pi  \Gamma } \right)^0$	Waveguide No 27	



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<b>RF ATTENUATION</b>	<i>From 100 kHz to 40 GHz</i> 0 dB to 50 dB 50 dB to 70 dB 70 dB to 100 dB	0.001 dB to 0.005 dB 0.005 dB to 0.010 dB 0.010 dB to 0.020 dB	The uncertainties are for incremental attenuation	Farnboro'
<b>RF VOLTAGE</b>	<i>From 100 kHz to 1 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V  <i>From 1 MHz to 10 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V  <i>From 10 MHz to 50 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V  <i>From 50 MHz to 100 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V  <i>From 100 MHz to 200 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V  <i>From 200 MHz to 1000 MHz:</i> 50 $\mu$ V to 200 mV 200 mV to 3 V 3 V to 100 V	0.65 % 0.060 % 0.070 %  0.65 % 0.070 % 0.10 %  0.65 % 0.15 % 0.16 %  0.65 % 0.15 % 0.16 %  0.65 % 0.20 % 0.35 %  0.70 % 0.25 % 0.60 %		
<b>RF POWER</b> (coaxial line)	10 $\mu$ W to 100 $\mu$ W 100 kHz to 8 GHz 8 GHz to 18 GHz  100 $\mu$ W to 10 mW 100 kHz to 500 MHz 500 MHz to 2 GHz 2 GHz to 5 GHz 5 GHz to 7 GHz 7 GHz to 8 GHz  1 mW to 10 mW 8.2 GHz to 12.4 GHz 12.4 GHz to 18 GHz 18.0 GHz to 26.5 GHz 26.5 GHz to 40 GHz  10 mW to 10 W 10MHz to 18GHz	1.0 % 3.0 %  0.30 % 0.35 % 0.45 % 0.50 % 0.65 %  0.65 % 0.80 % 1.5 % 2.1 %  1.0 %	For the calibration of signal Sources and power sensors	







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<b>NOISE TEMPERATURE</b> (Coaxial Line) (cont.)  <b>NOISE TEMPERATURE</b> (Waveguide)  Excess Noise Ratio (ENR) in dB of a noise source over that of a source at 290K.  <b>ENR values in the range 15 to 16dB</b>	20.0 GHz	0.16 dB		Farnboro'
	20.5 GHz	0.19 dB		
	21.0 GHz	0.19 dB		
	21.5 GHz	0.17 dB		
	22.0 GHz	0.15 dB		
	22.5 GHz	0.16 dB		
	23.0 GHz	0.14 dB		
	23.5 GHz	0.23 dB		
	24.0 GHz	0.23 dB		
	24.5 GHz	0.23 dB		
	25.0 GHz	0.23 dB		
	25.5 GHz	0.25 dB		
	26.0 GHz	0.25 dB		
	26.5 GHz	0.28 dB		
	2.6, 2.8, 3.0, 3.2 & 3.4 GHz	0.040 dB	Waveguide No 10 (WR284, RG48/U, R32)	
	2.75, 3.5, 3.6 & 3.8 GHz	0.035 dB		
	4.0 GHz	0.045 dB		
	2.6 to 4.0	0.045 dB		
	5.4, 6.0, 6.5, 7.0, 7.5 & 8.2 GHz	0.047 dB	Waveguide No 14 (WR137, RG50/U, R70)	
5.5 & 8.0 GHz	0.051 dB			
7.3 GHz	0.043 dB			
5.4 to 8.2 GHz	0.055 dB			
8.2, 8.5, 9.5, 12.0, & 12.4 GHz	0.040 dB	Waveguide No 16 (WR90, RG 52/U, R100)		
9.0, 10.5, 11.2, 11.5,	0.035 dB			
8.2 to 12.4 GHz	0.04 dB			
12.4, 13.0, 13.5, 14.0, 16.0, 16.5 & 18.0 GHz	0.045 dB	Waveguide No 18 (WR62, RG 91/U, R140)		
12.5, 15.0, 15.5 & 17.0 GHz	0.040 dB			
17.5 GHz	0.051 dB			
12.4 to 18 GHz	0.055 dB	ENR values larger or smaller can be accommodated but with increased uncertainty.  The uncertainty applies to the measurement of a noise source with a source VRC not greater than 0.02, the uncertainty may be increased for noise sources with higher VRC.		





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<b>AMPLITUDE MODULATION</b> (cont.)	Modulation index 0.001 to 0.1 0.1 to 0.15 0.15 to 0.3 0.3 to 0.5 0.5 to 0.995	3.5 % 3.5 % 1.5 % 1.0 % 0.50 %		Farnboro'
<b>RF POWER</b>	3.16 $\mu$ W to 100 mW 100 kHz to 300 kHz 300 kHz to 1 MHz 1 MHz to 2 GHz 2 GHz to 18 GHz	0.27 dB 0.17 dB 0.13 dB 0.27 dB	For 50 $\Omega$ Type N connectors. If other types are used the uncertainty may be increased	
<b>RF VOLTAGE</b>	3 mV to 10 V 100 kHz to 200 MHz	1.6 %	Applicable to 50 ohm BNC connectors Applicable to 50 ohm N-type connectors	
<b>FREQUENCY</b>	0.01 Hz to 10 Hz 10 Hz to 10 MHz 10 MHz to 100 MHz 100 MHz to 1 GHz 1 GHz to 26.5 GHz	1.0 in 10 <sup>8</sup> + 10 $\mu$ Hz 1.0 Hz 1.0 in 10 <sup>9</sup> + 15 $\mu$ Hz 10 mHz 100 mHz 1.0 Hz	Frequency measurement and generation capability	
<b>RF ATTENUATION</b>	100 kHz to 1 MHz 1 MHz to 10 MHz 10 MHz	5.0 in 10 <sup>9</sup> 5.0 in 10 <sup>10</sup> 5.0 in 10 <sup>11</sup>	Frequency measurement capability only	
	2.5 MHz to 1.3 GHz: 6 dBm to $\geq$ -34 dBm 6 dBm to (< -34 dBm, $\geq$ -54 dBm) 6 dBm to (< -54 dBm, $\geq$ -104 dBm) 6 dBm to (< -104 dBm, $\geq$ -120 dBm)	0.060 dB 0.080 dB 0.12 dB 0.15 dB		
<b>AMPLITUDE MODULATION</b> Modulation index	0.001 to 0.95 $f_c$ 1 MHz to 1 GHz; $f_m$ 50 Hz to 20 kHz	5.0 %		



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**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

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<b>FREQUENCY MODULATION</b> Frequency deviation	10 Hz to 400 kHz $f_c$ 1 MHz to 1 GHz; $f_m$ 50 Hz to 20 kHz	2.0 %		Farnboro' & Leigh
<b>AC VOLTAGE</b>	0.1 V to 30 V 50 Hz to 20 kHz	0.20 %		
<b>SINAD</b> (Signal to Noise/Distortion)	Fundamentals in the range of 100 Hz to 100 kHz up to 7 VRMS	2.24 % Or 0.19 dB		Farnboro'
<b>DISTORTION</b> Distortion Factor	20 Hz to 100 kHz			
	0.1% to 0.25% 0.2 V to 0.5 V	0.083 % absolute		
	0.5 V to 2 V 2 V to 300 V	0.043 % absolute 0.023 % absolute		
	0.25% to 0.4% 0.2 V to 0.5 V 0.5 V to 2 V 2 V to 300 V	0.068 % absolute 0.068 % absolute 0.032 % absolute		
	0.4% to 1.0% 0.2 V to 0.5 V 0.5 V to 2 V 2 V to 300 V	0.17 % absolute 0.090 % absolute 0.080 % absolute		
<b>HARMONIC CONTENT</b>	CW Frequency 1 MHz to 1.2 GHz Harmonic Frequency 2 MHz to 2.4 GHz	1.5 dB	Maximum CW amplitude +15 dBm; minimum harmonic level -80 dBc	Farnboro'
<b>SPURIOUS RESPONSES</b>	CW/spurious Response Frequency 1 MHz to 2.4 GHz	1.5 dB	Maximum CW amplitude +30 dBm; minimum spurious response level -90 dBc	Farnboro'



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<b><u>AUTOMATIC NETWORK ANALYSER</u></b> (1) Up to 3 GHz				Farnboro'
<b>RF ATTENUATION</b>	0 dB to 20 dB 300 kHz to 1 GHz 1 GHz to 2 GHz 2 GHz to 3 GHz	0.040 dB 0.040 dB 0.050 dB	For coaxial 50 Ω systems fitted with APC-7 or N-Type connectors, with a VSWR of < 1.5:1.	
	<i>From 300 kHz to 3 GHz:</i> 20 dB to 30 dB 30 dB to 60 dB 60 dB to 70 dB 70 dB to 80 dB 80 dB to 90 dB 90 dB to 100 dB	0.060 dB 0.10 dB 0.080 dB 0.18 dB 0.68 dB 2.25 dB		
<b>VOLTAGE REFLECTION COEFFICIENT</b>	0 to 0.1 300 kHz to 1 GHz 1 GHz to 3 GHz	0.0090 0.013	For coaxial 50Ω systems fitted with APC-7 or N-Type connectors. Results may also be quoted in terms of VSWR with uncertainties equivalent to those given for VRC.	
	0.1 to 0.33 300 kHz to 1 GHz 1 GHz to 3 GHz	0.010 0.014		
	0.33 to 1.0 300 kHz to 1 GHz 1 GHz to 3 GHz	0.018 0.021		
<b>TRANSMISSION PHASE</b>	0° to 360° 300 kHz to 1 GHz 1 GHz to 3 GHz	0.80 ° 1.2 °	For measurements made on airlines of length 30 cm or less fitted with APC-7 or N-Type connectors and with a nominal transmission loss of 0 dB	
<b><u>AUTOMATIC NETWORK ANALYSER</u></b> (2) to 18 GHz				
<b>RF ATTENUATION</b>	<i>From 45 MHz to 6 GHz:</i> 0 dB to 40 dB 40 dB to 60 dB 60 dB to 70 dB	0.040 dB 0.10 dB 0.18 dB	For coaxial 50Ω systems fitted with APC-7 or N-Type connectors, with a VSWR of < 1.5:1.	
	<i>From 6 GHz to 12 GHz:</i> 0 dB to 40 dB 40 dB to 60 dB 60 dB to 70 dB	0.080 dB 0.10 dB 0.19 dB		



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<b>RF ATTENUATION</b> (cont.)	<i>From 12 GHz to 18 GHz:</i> 0 dB to 50 dB 50 dB to 60 dB 60 dB to 70 dB	0.120 dB 0.20 dB 0.50 dB		Farnboro'
	<i>From 45 MHz to 12 GHz:</i> 70 dB to 80 dB 80 dB to 90 dB	0.50 dB 2.0 dB		
	<i>From 12 GHz to 18 GHz:</i> 70 dB to 80 dB	2.0 dB		
<b>VOLTAGE REFLECTION COEFFICIENT (VRC)</b>	0 to 0.1 <i>45 MHz to 6 GHz</i> <i>6 GHz to 18 GHz</i>	0.015 0.030	For coaxial 50Ω systems fitted with APC-7 or N-Type connectors. Results may also be quoted in terms of VSWR with uncertainties equivalent to those given for VRC.	
	0.1 to 0.33 <i>45 MHz to 6 GHz</i> <i>6 GHz to 18 GHz</i>	0.012 0.030		
	0.33 to 1.0 <i>45 MHz to 6 GHz</i> <i>6 GHz to 18 GHz</i>	0.022 0.036		
<b>TRANSMISSION PHASE</b>	0° to 360° <i>45 MHz to 6 GHz</i> <i>6 GHz to 18 GHz</i>	0.80 ° (0.20 + 0.10 $f_{GHz}$ )°	For measurements made on airlines of length 30 cm or less fitted with APC-7 or N-Type connectors and with a nominal transmission loss of 0 dB	
<b>VOLTAGE REFLECTION COEFFICIENT (VRC)</b>	<i>10 MHz to 1 GHz</i> 0 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.6 0.6 to 0.7	0.015 0.015 0.025 0.040 0.050	For devices fitted with 50Ω Type N connectors	
	<i>1 GHz to 3 GHz</i> 0 to 0.1 0.1 to 0.2 0.2 to 0.3 0.3 to 0.6 0.6 to 0.7	0.020 0.020 0.020 to 0.025 0.025 to 0.040 0.040 to 0.050		



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<b>VOLTAGE REFLECTION COEFFICIENT (VRC)</b> (cont.)	<b>3 GHz to 5 GHz</b>			
	0 to 0.1	0.020		
	0.1 to 0.2	0.020		
	0.2 to 0.3	0.020 to 0.030		
	0.3 to 0.6	0.030 to 0.050		
	0.6 to 0.7	0.050 to 0.060		
	<b>5 GHz to 7 GHz</b>			
	0 to 0.1	0.020		
	0.1 to 0.2	0.020		
	0.2 to 0.3	0.025 to 0.030		
	0.3 to 0.6	0.030 to 0.050		
	0.6 to 0.7	0.050 to 0.070		
	<b>7 GHz to 9 GHz</b>			
	0 to 0.1	0.025		
	0.1 to 0.2	0.025		
	0.2 to 0.3	0.025 to 0.040		
	0.3 to 0.6	0.040 to 0.050		
	0.6 to 0.7	0.050 to 0.070		
	<b>9 GHz to 11 GHz</b>			
	0 to 0.1	0.025		
	0.1 to 0.2	0.025 to 0.03		
	0.2 to 0.3	0.030 to 0.040		
	0.3 to 0.6	0.040 to 0.050		
	0.6 to 0.7	0.050 to 0.060		
	<b>11 GHz to 13 GHz</b>			
	0 to 0.1	0.030		
	0.1 to 0.2	0.030		
	0.2 to 0.3	0.030 to 0.040		
0.3 to 0.6	0.040 to 0.070			
0.6 to 0.7	0.070 to 0.090			
<b>13 GHz to 15 GHz</b>				
0 to 0.1	0.030			
0.1 to 0.2	0.030			
0.2 to 0.3	0.030 to 0.040			
0.3 to 0.6	0.040 to 0.070			
0.6 to 0.7	0.070 to 0.090			
<b>15 GHz to 17 GHz</b>				
0 to 0.1	0.030			
0.1 to 0.2	0.030 to 0.040			
0.2 to 0.3	0.040 to 0.050			
0.3 to 0.6	0.050 to 0.070			
0.6 to 0.7	0.070 to 0.090			
<b>17 GHz to 18 GHz</b>				
0 to 0.1	0.030 to 0.035			
0.1 to 0.2	0.035 to 0.040			
0.2 to 0.3	0.040 to 0.050			
0.3 to 0.6	0.050 to 0.090			
0.6 to 0.7	0.090 to 0.11			



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<b>ATTENUATION</b>	10 MHz to 8 GHz 0 dB to 20 dB 20 dB to 25 dB 25 dB to 40 dB 40 dB to 50 dB 50 dB to 60 dB 60 dB to 65 dB	0.070 dB 0.090 dB 0.16 dB 0.30 dB 0.40 dB 0.70 dB	The uncertainties are for two port coaxial devices fitted with Type N 50 Ω connectors in good condition  The uncertainties will be increased for devices where connector repeatability exceeds ±0.02 dB and/or input/output VSWR exceeds 1.1:1	Farnboro'
	8 GHz to 16 GHz 0 dB to 20 dB 20 dB to 25 dB 25 dB to 40 dB 40 dB to 50 dB 50 dB to 60 dB 60 dB to 65 dB	0.090 dB 0.10 dB 0.20 dB 0.30 dB 0.45 dB 0.70 dB		
<b>RF POWER</b> (Campaign)	16 GHz to 18 GHz 0 dB to 20 dB 20 dB to 25 dB 25 dB to 40 dB 40 dB to 50 dB 50 dB to 60 dB 60 dB to 65 dB	0.10 dB 0.12 dB 0.30 dB 0.35 dB 0.45 dB 0.70 dB	The uncertainties apply to the measurement of the output power of sources fitted with Type N female connectors and with output VSWR not exceeding 1.1:1. The uncertainties will be increased for sources with higher VSWR and/or with other connector types.	Farnboro'
	100 mW to 2 W 10 MHz to 40 MHz 40 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 9 GHz 9 GHz to 13 GHz 13 GHz to 16 GHz 16 GHz to 17 GHz 17 GHz to 18 GHz	2.1 % 2.0 % 2.5 % 3.2 % 3.7 % 4.3 % 5.1 % 5.9 %		
	30 mW to 100 mW 100 kHz to 400 kHz 400 kHz to 10 MHz 10 MHz to 40 MHz 40 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 9 GHz 9 GHz to 13 GHz 13 GHz to 16 GHz 16 GHz to 17 GHz 17 GHz to 18 GHz	3.7 % 3.1 % 2.2 % 2.0 % 2.2 % 2.6 % 2.8 % 3.2 % 3.6 % 4.1 %		



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RF POWER (Campaign) (cont.)	100 mW to 2 W	2.1 %	The uncertainties apply to the measurement of the output power of sources fitted with Type N female connectors and with output VSWR not exceeding 1.1:1. The uncertainties will be increased for sources with higher VSWR and/or with other connector types.	Farnboro'
	10 MHz to 40 MHz	2.0 %		
	40 MHz to 1 GHz	2.5 %		
1 GHz to 5 GHz	3.2 %			
5 GHz to 9 GHz	3.7 %			
9 GHz to 13 GHz	4.3 %			
13 GHz to 16 GHz	5.1 %			
16 GHz to 17 GHz	5.9 %			
17 GHz to 18 GHz				
30 mW to 100 mW	3.7 %			
100 kHz to 400 kHz	3.1 %			
400 kHz to 10 MHz	2.2 %			
10 MHz to 40 MHz	2.0 %			
40 MHz to 1 GHz	2.2 %			
1 GHz to 5 GHz	2.6 %			
5 GHz to 9 GHz	2.8 %			
9 GHz to 13 GHz	3.2 %			
13 GHz to 16 GHz	3.6 %			
16 GHz to 17 GHz	4.1 %			
17 GHz to 18 GHz				
1 nW to 10 $\mu$ W	2.2 % + 0.020 nW			
10 MHz to 30 MHz	1.8 % + 0.020 nW			
30 MHz to 50 MHz	1.7 % + 0.020 nW			
50 MHz to 90 MHz	1.8 % + 0.020 nW			
90 MHz to 1 GHz	1.9 % + 0.020 nW			
1 GHz to 3 GHz	2.0 % + 0.020 nW			
3 GHz to 5 GHz	2.4 % + 0.020 nW			
5 GHz to 7 GHz	2.6 % + 0.020 nW			
7 GHz to 10 GHz	2.7 % + 0.020 nW			
10 GHz to 12 GHz	3.0 % + 0.020 nW			
12 GHz to 15 GHz	3.0 % + 0.020 nW			
15 GHz to 16 GHz	3.3 % + 0.020 nW			
16 GHz to 17 GHz	3.7 % + 0.020 nW			
17 GHz to 18 GHz				
RF POWER (Generation)	-50 dBm to -20 dBm		These uncertainties are for devices fitted with type N connectors with a VSWR not exceeding 1.02. The uncertainty will be increased if the device under test has a higher VSWR or is fitted with a different connector type.	Farnboro'
	10 MHz to 50 MHz	1.1 %		
	50 MHz to 1 GHz	1.0 %		
	1 GHz to 5 GHz	1.5 %		
	5 GHz to 10 GHz	1.8 %		
	10 GHz to 15 GHz	2.1 %		
	15 GHz to 18 GHz	2.2 %		



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<b>RF POWER</b> (Generation) (cont.)  <b>CALIBRATION FACTOR</b>  Nominal power level 0 dBm  Nominal power level -30 dBm	-20 dBm to +16 dBm			Farnboro'
	10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	1.1 % 1.0 % 1.4 % 1.6 % 1.7 % 1.8 %		
<b>AMPLITUDE MODULATION</b>  (Modulation Factor)  <b>Frequency Modulation</b>  (Carrier Deviation)	10 MHz to 50 MHz 50 MHz to 1 GHz 1 GHz to 5 GHz 5 GHz to 10 GHz 10 GHz to 15 GHz 15 GHz to 18 GHz	0.70 % 0.60 % 1.2 % 1.4 % 1.5 % 1.6 %		Farnboro'
	0.05 to 0.50 Carrier 10.7 MHz Modulation 1 kHz  0.50 to 0.95 Carrier 10.7 MHz Modulation 1 kHz 5 kHz to 40 kHz Carrier 10.7 MHz, 21.4 MHz and 42.8 MHz Modulation 1 kHz  40 kHz to 500 kHz Carrier 10.7 MHz, 21.4 MHz and 42.8 MHz Modulation 1 kHz	0.80 % 0.60 % 1.3 % 1.6 % 2.0 % 2.2 %  0.0070  0.013  0.70 %  2.5 %		



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**Trescal CMS**

Issue No: 058 Issue date: 05 March 2012

Calibration performed by the Organisation at the locations specified

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k=2$ )	Remarks	Location Code	
<b>Spectrum analyser calibration.</b>					
Frequency response	500 Hz to 3 GHz 3 GHz to 6 GHz 6 GHz to 11 GHz 11 GHz to 26.5 GHz 26.5 GHz to 40 GHz	0.14 dB 0.31 dB 0.40 dB 0.50 dB 0.86 dB		Farnboro'	
Scale linearity	500 Hz to 40 GHz	0.15 dB			
Input level IF Gain and Attenuator accuracy	500 Hz to 40 GHz Fundamental 0 dBm to - 30 dBm - 30 dBm to - 80 dBm - 80 dBm to - 100 dBm - 100 dBm to - 110 dBm - 110 dBm to - 120 dBm	0.060 dB 0.10 dB 0.15 dB 0.25 dB 0.60 dB			
Resolution Bandwidth	50 MHz to 300 MHz	0.59 %			
Reference output	-20 dBm 50 MHz to 300 MHz	0.05 dB			
<b>OSCILLOSCOPE CALIBRATION SYSTEM</b>					
Vertical Deflection Accuracy chopped DC (At 1 kHz)	6 mV to 60 mV 60 mV to 200 V	1.0 % 0.50 %	Calibration of vertical deflection coefficients using 1kHz chopped DC		
DC Levels	60 mV to 30 mV 30 mV to 200 V	1.0 % 0.50 %	Calibration of vertical deflection coefficients using DC levels.		
Cursor Accuracies chopped DC (At 1 kHz)	6 mV to <60 mV 60 mV to < 600 mV 600 mV to <12 V 12 V to 200 V	1.0 % 0.5 % 0.15 % 0.10 %	Calibration of vertical deflection coefficients using 1kHz chopped DC based on a 12 bit resolution.		
DC Levels	6 mV to <12 mV 12 mV to < 30 mV 30 mV to <60 mV 60 mV to <120 mV 120 mV to 200 V	1.0 % 0.50 % 0.20 % 0.15 % 0.10 %	Calibration of vertical deflection coefficients using DC levels based on a 12 bit resolution.		
DC Resistance Measurement	10 Ω to 100 Ω 100 Ω to 150 Ω 50 kΩ to 800 kΩ 800 kΩ to 1.2 MΩ 1.2 MΩ to 12 MΩ	0.050 % 0.60 % 0.60 % 0.20 % 0.60 %	Input terminal resistance measurement		



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RF Voltage	0.3 V to 3 V peak to peak 100 MHz to 100 MHz 100 MHz to 550 MHz 500 MHz to 1.1 GHz	3.5 % 4.5 % 5.5 %	Uncertainties are for RF voltage developed across a perfectly matched 50 Ω coaxial line system relative to a reference voltage level at 50 kHz in the same system. Uncertainties include those associated with the visual display of voltage levels	Farnboro'
Bandwidth	100 MHz to 100 MHz 100 MHz to 550 MHz 500 MHz to 1.1 GHz	level: 3.5 % level: 4.5 % level: 5.5 %	The uncertainty quoted on a calibration certificate will be in terms of frequency and will be based on the relationship between level and frequency, at the - 3 dB point for the system under calibration	
Risetime Measurement	31 ps to 50 ps 50 ps to 150 ps 150 ps to 300 ps 300 ps to 600 ps >600 ps	+9.0 ps, -10 ps +7.0 ps, -7 ps +15 ps, -12 ps 7.5 % 2.0 %	Measurement of fast risetime square waves	
Risetime Generation	21 ps to 35 ps 35 ps to 150 ps 150 ps to 300 ps 300 ps to 600 ps >600 ps	+7 ps, -11 ps +7 ps, -7 ps +14 ps, -14 ps 7.5 % 2.0 %	Generation of fast risetime square waves for calibration of amplifiers or mainframes	
Timebase Sweep Rate	0.4 ns to 1 ns 1 ns to 50 s	0.50 % 0.25 %	Calibration of timebase sweep rates	
DC Voltage Measurement	1 mV 2 mV 5 mV 10 mV 20 mV 50 mV 100 mV to 200 V	2.5 % 1.5 % 0.50 % 0.30 % 0.15 % 0.070 % 0.050 %	Calibration of DC voltage reference  Includes uncertainty of measurement for stability and reset ability checks	



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Period Measurement	1 ns to 50 ms 0.1 s to 5 s	0.10 ppm + 0.10 ps 0.010 %	Calibration of time mark generators  The following additional characteristics can be measured:  Delay between channels (s) Comparator voltage (V) Horizontal amplifier sensitivity (V/Div) Delay time multiplier (Ratio: 1) Trigger sensitivity Internal (Div) External (V) Common mode rejection (Ratio:1)	Farnboro'
END				