

# Schedule of Accreditation

issued by

## United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

 <p><b>0286</b></p> <p>Accredited to <b>ISO/IEC 17025:2005</b></p>	<h3>Optical Test &amp; Calibration Limited</h3> <p>Issue No: 037    Issue date: 20 June 2016</p>	
	<p>21-23 Campus Road Listerhills Science Park Bradford BD7 1HR</p>	<p>Contact: Mr K G Dove Tel: +44 (0)1274 393857 Fax: +44 (0)1274 393336 E-Mail: sales@otc.co.uk Website: www.otc.co.uk</p>
<p><b>Calibration performed at the above address only</b></p>		

### DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty ( $k = 2$ )	Remarks
<p><b>FIBRE OPTIC CALIBRATION</b></p> <p>OPTICAL POWER METERS</p> <p>Absolute responsivity of fibre optic power meters with FC/PC connectors</p>	<p>Wavelength and Power levels:</p> <p><i>850 nm</i> - 10 dBm and - 20 dBm - 23 dBm</p> <p><i>1310 nm</i> - 10 dBm - 20 dBm and - 23 dBm</p> <p><i>1550 nm</i> - 10 dBm - 20 dBm and - 23 dBm</p>	<p>0.08 dB (1.7 %) 0.08 dB (1.7 %)</p> <p>0.080 dB (1.7 %) 0.080 dB (1.7 %)</p> <p>0.080 dB (1.7 %) 0.080 dB (1.7 %)</p>	<p>Wavelengths quoted are <math>\pm 1</math> nm</p> <p>850 nm, multimode fibre</p> <p>1310 nm, 1550 nm single mode fibre</p>
<p>Linearity of response of fibre optic power meters with FC/PC connectors</p>	<p><i>850 nm</i> - 10 dBm to - 40 dBm - 40 dBm to 65 dBm -65 dBm to -70 dBm</p> <p><i>1310 nm</i> - 5 dBm to - 50 dBm - 50 dBm to - 70 dBm</p> <p><i>1550 nm</i> + 5 dBm to - 65 dBm - 65 dBm to - 70 dBm</p>	<p>0.06 dB (1.2 %) 0.070 dB (1.5 %) 0.100 dB (2.3 %)</p> <p>0.050 dB (1.0 %) 0.060 dB (1.2 %)</p> <p>0.050 dB (1.0 %) 0.060 dB (1.2 %)</p>	<p>850 nm, multimode fibre</p> <p>1310 nm 1550 nm single mode fibre</p>
<p>OPTICAL ATTENUATORS</p> <p>Insertion loss</p>	<p><i>850 nm</i> <i>1310 nm</i> <i>1550 nm</i></p>	<p>0.070 dB (1.5 %) 0.060 dB (1.4 %) 0.060 dB (1.4 %)</p>	<p>Fitted with FC/PC connectors</p>
<p>Attenuation setting</p>	<p><i>850 nm:</i> 0 dB to - 35 dB - 35 dB to - 60 dB</p> <p><i>1310 nm:</i> 0 dB to - 65 dB</p>	<p>0.060 dB (1.2 %) 0.060 dB (1.2 %)</p> <p>0.060 dB (1.2 %)</p>	<p>Excluding insertion loss</p>



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<b>FIBRE OPTIC CALIBRATION</b> (cont'd)			
<b>OPTICAL ATTENUATORS</b> (cont'd)			
Attenuation setting (cont'd)	1550 nm: 0 dB to - 70 dB	0.060 dB (1.2 %)	
Repeatability of attenuation setting	850 nm, 1310 nm and 1550 nm 0 dB to - 65 dB	0.040 dB (1.0 %)	
<b>OPTICAL TIME DOMAIN REFLECTOMETERS (OTDRs)</b> (Single mode fibre)			
Loss scale deviation	1310 nm (nominal) 1550 nm (nominal) 1625 nm (nominal)	0.025 dB/dB 0.050 dB/dB 0.050 dB/dB	Results reported with standard adjacent to and remote from the UUT (typically at 7 km and 20 km respectively)
Length scale:			Measured by comparison to single mode fibre physical standards.
Zero location offset		0.30 m	Wavelengths: 1310 nm, 1550 nm and 1625 nm.
Distance scale factor	6.5 km	0.80 m	
Distance scale deviation	6.5 km	0.12 m/km	
Locational readout error		0.12 m	Pulse duration 3 ns to 20 $\mu$ s Maximum nominal power 25 mW, minimum nominal power 1 mW
Centre wavelength	1200 nm to 1700 nm	1.0 nm	Pulsed source with RMS spectral width of less than 25 nm
Spectral width	< 0.1 nm 0.1 nm to 9.9 nm 10 nm to 50 nm	0.20 nm 0.50 nm 0.90 nm	
<b>CW FIBRE OPTIC LIGHT SOURCES</b>			
Output power	600 nm to 1700 nm: - 5 dBm to - 55 dBm except where the following wavelength conditions are met: 850 nm $\pm$ 1 nm: - 5 dBm to - 55 dBm 1310 nm $\pm$ 1 nm - 5 dBm to - 55 dBm 1550 nm $\pm$ 1 nm + 5 dBm to - 55 dBm	0.30dB(7.0%)  0.08dB(1.7%) 0.08dB(1.7%) 0.08dB(1.7%)	CW source with RMS spectral width of less than 25 nm



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<b>FIBRE OPTIC CALIBRATION</b> (cont'd)			
<b>CW FIBRE OPTIC LIGHT SOURCES</b> (cont'd)			
Output power stability of fibre optic light sources	- 5 dBm to - 55 dBm	0.0040 dB (0.10 %)	Wavelength range 600 nm to 1700 nm
Wavelength	600 nm to 1700 nm	0.50 nm	CW source with RMS spectral width of less than 25 nm
Spectral width	< 0.1 nm	0.20 nm	Minimum optical output power level - 30 dBm
	0.1 nm to 5.9 nm 6 nm to 24.9 nm	0.60 nm 1.00 nm	
<b>PULSED FIBRE OPTIC LIGHT SOURCES</b>			
Centre wavelength	1200 nm to 1700 nm	1.0 nm	Pulse duration 3 ns to 20 µs Maximum nominal power 25 mW, minimum nominal power 1 mW
Spectral width	< 0.1 nm 0.1 nm to 9.9 nm 10 nm to 50 nm	0.20 nm 0.50 nm 0.90 nm	Pulsed source with RMS spectral width of less than 25 nm
<b>OPTICAL FIBRES</b>			
Length (single mode fibre)	0.25 m to 1 m	0.0020 m	Intercomparison with physical standard
	1 m to 16 km	(0.07 + (3*10 <sup>-5</sup> *L)) m Where L is the length of the Fibre Under Test in metres.	Time of flight technique Wavelengths: 1310 nm, 1550 nm and 1625 nm
<b>ILLUMINANCE</b>			
for a source colour temperature of 2856 K	1 lux to 10 lux 10 lux to 20 lux 20 lux to 200 lux 200 lux to 1000 lux 1000 lux to 2000 lux 2000 lux to 10 000 lux 10 000 lux to 20 000 lux	2.9% 2.8 % 2.1 % 1.7 % 2.3 % 2.9 % 3.1 %	
Colour temperature	2856 K	0.8 %	
<b>LUMINANCE</b> (luminance meters)			
for a source colour temperature of 2856 K	1 cdm <sup>-2</sup> to 20 cdm <sup>-2</sup> 20 cdm <sup>-2</sup> to 20000 cdm <sup>-2</sup>	5.4 % 5.1 %	



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<b>ELECTRICAL CALIBRATION</b>			
<b>DC VOLTAGE</b>			
Generation	0 V to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 330 V to 1 kV	14 ppm + 2.2 $\mu$ V 8.0 ppm + 6.9 $\mu$ V 8.0 ppm + 26 $\mu$ V 10 ppm + 200 $\mu$ V 13 ppm + 2.0 mV	
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 1 kV	6.0 ppm + 1.4 $\mu$ V 4.0 ppm + 1.5 $\mu$ V 4.0 ppm + 2.0 $\mu$ V 4.0 ppm + 60 $\mu$ V 7.0 ppm + 130 $\mu$ V	
<b>DC CURRENT</b>			
Generation	0 $\mu$ A to 330 $\mu$ A 0.33 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 3 A 3 A to 11 A 11 A to 20 A	100 ppm + 24 nA 39 ppm + 60 nA 41 ppm + 0.40 $\mu$ A 61 ppm + 4.0 $\mu$ A 200 ppm + 70 $\mu$ A 290 ppm + 0.60 mA 670 ppm + 3.0 mA	
Measurement	0 $\mu$ 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 A	10 ppm + 1.7 nA 11 ppm + 7.0 nA 15 ppm + 70 nA 46 ppm + 700 nA 57 ppm + 15 $\mu$ A	
<b>DC RESISTANCE</b>			
Generation			
Specific Values	1 m $\Omega$ 10 m $\Omega$ 100 m $\Omega$ 1 $\Omega$	55 ppm 35 ppm 85 ppm 25 ppm	
Other values	0 $\Omega$ to 11 $\Omega$ 11 $\Omega$ to 110 $\Omega$ 110 $\Omega$ to 1.1 k $\Omega$ 1.1 k $\Omega$ to 11 k $\Omega$ 11 k $\Omega$ to 110 k $\Omega$ 110 k $\Omega$ to 1.1 M $\Omega$ 1.1 M $\Omega$ to 11 M $\Omega$ 11 M $\Omega$ to 100 M $\Omega$	72 ppm + 1.2 m $\Omega$ 93 ppm + 1.8 m $\Omega$ 21ppm + 2.4 m $\Omega$ 14 ppm + 23 m $\Omega$ 12 ppm + 230 m $\Omega$ 20 ppm + 2.4 $\Omega$ 66 ppm + 59 $\Omega$ 300 ppm + 3.6 k $\Omega$	



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<b>ELECTRICAL CALIBRATION</b> (cont'd)			
DC RESISTANCE (cont'd)			
Measurement	0 mΩ to 1 mΩ 1 mΩ to 10 mΩ 10 mΩ to 100 mΩ 100 mΩ to 1 Ω 1 Ω to 12 Ω 12 Ω to 120 Ω 120 Ω to 1.2 kΩ 1.2 kΩ to 12 kΩ 12 kΩ to 120 kΩ 120 kΩ to 1.2 MΩ 1.2 MΩ to 12 MΩ 12 MΩ to 120 MΩ 120 MΩ to 1 G Ω	210 ppm + 1.6 μΩ 210 ppm + 1.8 μΩ 230 ppm + 10 μΩ 70 ppm + 50 μΩ 9.0 ppm + 60 μΩ 4.0 ppm + 600 μΩ 8.0 ppm + 1.2 mΩ 3.0 ppm + 12 mΩ 4.0 ppm + 120 mΩ 11 ppm + 3.3 Ω 26 ppm + 120 Ω 120 ppm + 1.2 kΩ 600 ppm + 12 kΩ	
AC VOLTAGE			
Generation	45 Hz to 20 kHz 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V  20 kHz to 100 kHz 33 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V  45 Hz to 10 kHz 330 V to 1000 V  500 kHz 300 mV 3 V	0.0080 % + 10 μV 0.0060 % + 70 μV 0.010 % + 0.70 mV 0.025 % + 7.0 mV  0.020 % + 40 μV 0.039 % + 150 μV 0.042 % + 2.0 mV  0.015 % + 12 mV  0.10 % 0.19 %	
Measurement	45 Hz to 20 kHz 12 mV to 120 mV  20 Hz to 20 kHz 120 mV to 1.2 V  20 kHz to 100 kHz 12 mV to 120 mV 120 mV to 1.2 V  20 Hz to 100 kHz 1.2 V to 12 V 12 V to 120 V  50 Hz to 20 kHz 120 V to 750 V	0.011 % + 3.0 μV  0.010 % + 50 μV  0.011 % + 2.0 μV 0.011 % + 40 μV  0.044 % + 500 μV 0.044 % + 5.0 mV  0.045 % + 23 mV	



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<b>ELECTRICAL CALIBRATION</b> (cont'd)			
AC CURRENT			
Generation	<p><i>33 <math>\mu</math>A to 330 <math>\mu</math>A</i> 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>330 <math>\mu</math>A to 3.3 mA</i> 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>3.3 mA to 33 mA</i> 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>33 mA to 330 mA</i> 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>330 mA to 3 A</i> 20 Hz to 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>3 A to 11 A</i> 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p> <p><i>11 A to 20 A</i> 45 Hz 45 Hz to 1 kHz 1 kHz to 5 kHz</p>	<p>0.090 % + 0.12 <math>\mu</math>A 0.060 % + 0.12 <math>\mu</math>A 0.12 % + 0.18 <math>\mu</math>A</p> <p>0.030 % + 0.18 <math>\mu</math>A 0.028 % + 0.18 <math>\mu</math>A 0.050 % + 0.24 <math>\mu</math>A</p> <p>0.030 % + 2.4 <math>\mu</math>A 0.017 % + 2.4 <math>\mu</math>A 0.025 % + 2.4 <math>\mu</math>A</p> <p>0.030 % + 24 <math>\mu</math>A 0.017 % + 24 <math>\mu</math>A 0.028 % + 60 <math>\mu</math>A</p> <p>0.050 % + 0.12 mA 0.030 % + 0.10 mA 0.17 % + 1.2 mA</p> <p>0.069 % + 2.4 mA 0.090 % + 2.4 mA 0.73 % + 2.4 mA</p> <p>0.070 % + 6.0 mA 0.10 % + 6.0 mA 0.78 % + 6.0 mA</p>	
Measurement	<p><i>20Hz to 1 kHz</i> 10 <math>\mu</math>A to 120 <math>\mu</math>A</p> <p><i>20 Hz to 5 kHz</i> 120 <math>\mu</math>A to 1.2 mA 1.2 mA to 12 mA 12 mA to 120 mA 120 mA to 1 A</p>	<p>0.022 % + 35 nA</p> <p>0.032 % + 0.23 <math>\mu</math>A 0.041 % + 2.3 <math>\mu</math>A 0.044 % + 23 <math>\mu</math>A 0.17 % + 230 <math>\mu</math>A</p>	



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<b>ELECTRICAL CALIBRATION</b> (cont'd)			
<b>CAPACITANCE</b>			
Generation	0.2 nF to 0.4 nF 0.4 nF to 1 nF 1 nF to 10 nF 10 nF to 100 nF 100 nF to 1 $\mu$ F 1 $\mu$ F to 10 $\mu$ F 10 to 100 $\mu$ F 100 $\mu$ F to 1 mF	1.1 % + 12 pF 0.30 % + 12 pF 0.20 % + 12 pF 0.11 % + 120 pF 0.10 % + 1.2 nF 0.11 % + 12 nF 0.19 % + 120 nF 0.160 % + 1.2 $\mu$ F	
<b>FREQUENCY</b>			
Generation	0.5 Hz to 10 Hz 10 Hz to 100 Hz 100 Hz to 1 kHz 1 kHz to 100 kHz 100 kHz to 2 MHz	18 ppm + 6 $\mu$ Hz 3.0 ppm + 6 $\mu$ Hz 5.0 ppm + 6 $\mu$ Hz 2.0 ppm + + 6 $\mu$ Hz 1.0 ppm + + 6 $\mu$ Hz	May also be expressed as 1/ f for periodic time of repetitive events
Measurement	1 Hz to 40 Hz 40 Hz to 10 MHz	16 ppm 6 ppm	
<b>RADIOMETRY</b>			
Responsivity of UV detectors at power levels 0.3 to 5 mWcm <sup>-2</sup>	365 nm		
Detectors up to 25 mm		10 %	
Responsivity of uv detectors at power levels 0.3 to 2 mWcm <sup>-2</sup>			
Detectors 25 mm to 40 mm		10 %	
END			