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Certificate of Calibration

UKAS CALIBRATION
0478

OPTICAL LENGTH

FOR:

DESCRIPTION: Single-Mode Distance Scale Calibration Artefact with ~2.2 km lead-in fibre and ~12.9 km loop fitted in a box with FC/UPC connectors

IDENTIFICATION:

DATE OF CALIBRATION:

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Reference:

Date of issue: **Signed:** **(Authorised Signatory)**

Checked by: **Name:** **on behalf of NPLML**

MEASUREMENTS

The OTDR distance scale calibration artefact is a recirculating loop as shown in Figure 1. The Lead-in time-of-flight τ_A, length L_A, is defined as the time-of-flight from the surface of connector 1 directly to the surface of internal connector 4. The Loop time-of-flight τ_B, length L_B, is defined as the time of flight for one trip around the loop from the coupler through 3 - 2 and back to the coupler.

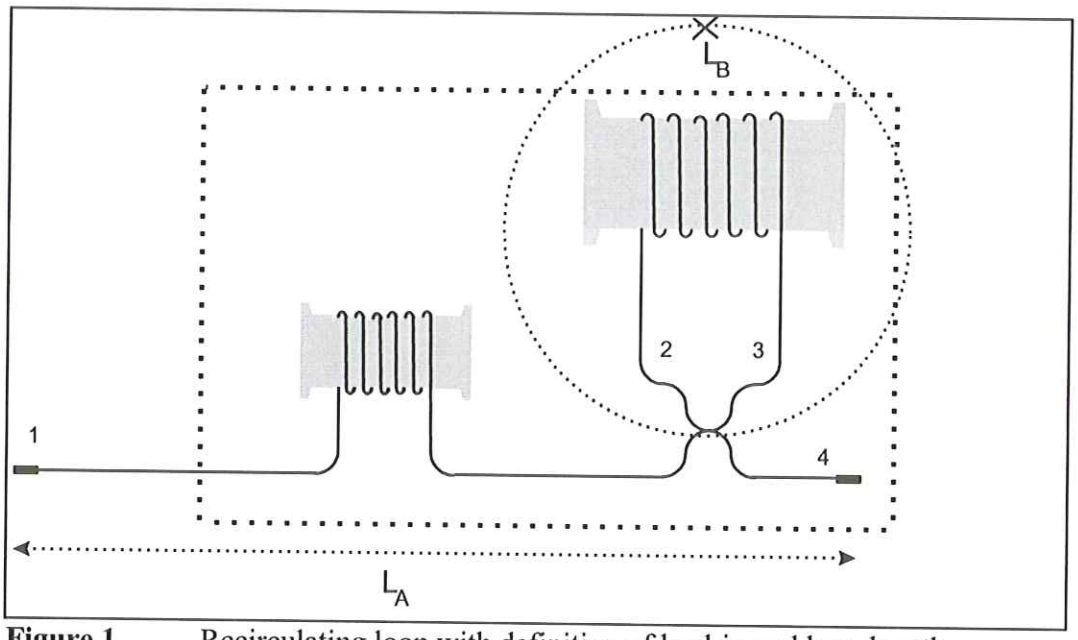


Figure 1 Recirculating loop with definition of lead-in and loop length.

The value for the optical time of flight was determined using the pulse technique described in Appendix A.

Measurements were made in a temperature-controlled laboratory at an air temperature of (23 ± 2) °C. The temperature of the artefact was measured independently to be (23.2 ± 0.5) °C. Measurements were made using laser diode sources whose centre wavelengths were close to 1310 nm and 1550 nm.

All wavelengths quoted on this certificate are vacuum wavelengths.

RESULTS

Five optical time-of-flight measurements were made at each wavelength and the mean calculated. Corrections were applied to the measured time-of-flight, using the chromatic dispersion characteristics of the fibre, to calculate the quoted time-of-flight values for 1310.0 nm and 1550.0 nm. These values are shown in the table below together with the calculated length of the fibre for an assumed group index of 1.46000.

Lead-in Length:

Wavelength (nm)	1310.0	1550.0
Optical Time of Flight (ns) τ_A	11073.12 ± 0.39	11077.74 ± 0.39
Length for N=1.46000 (m) L_A	2273.72 ± 0.08	2274.67 ± 0.08

Loop Length:

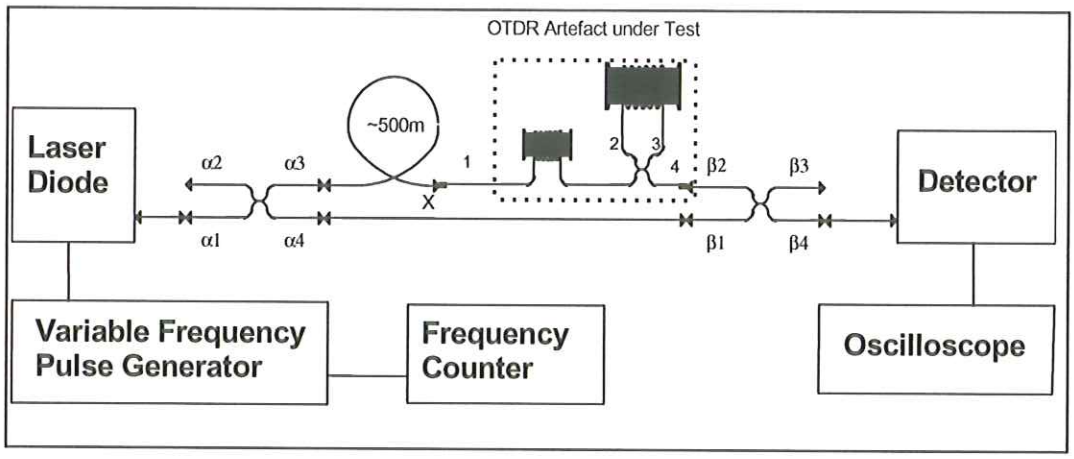
Wavelength (nm)	1310.0	1550.0
Optical Time of Flight (ns) τ_B	63176.07 ± 1.32	63202.45 ± 1.32
Length for N=1.46000 (m) L_B	12972.40 ± 0.27	12977.82 ± 0.27

The results and uncertainties refer to on the day values making no allowance for subsequent drift.

Reference:

Checked by:

APPENDIX A



The experimental arrangement is shown in the figure above.

The OTDR calibration artefact is connected between points X and β2 as shown. For each laser pulse the detector will receive a number of pulses. First the pulse which has gone directly α1 - α4 - β1 - β4 (the reference pulse), then the pulse which has gone α1 - α3 - X - 1 - 4 - β2 - β4 (the lead-in pulse) and then the pulse which has gone α1 - α3 - X - 1 - 3 - loop - 2 - 4 - β2 - β4 (the 1st loop pulse). Pulses which make multiple trips around the loop are not considered.

The repetition rate of the pulse generator is adjusted until the 1st loop pulse and the next reference pulse arrive simultaneously at the detector. The repetition frequency υ_{1a} is recorded.

The repetition rate of the pulse generator is adjusted until the lead-in pulse and the next reference pulse arrive simultaneously at the detector. The repetition frequency υ_{1b} is recorded.

The time-of-flight of the Loop, τ_B is given by $\tau_B = 1/\upsilon_{1a} - 1/\upsilon_{1b}$

The OTDR calibration artefact is disconnected and point X joined directly to point β2. For each laser pulse the detector will receive two pulses. First the pulse which has gone directly α1 - α4 - β1 - β4 (the reference pulse), and secondly the pulse which has gone α1 - α3 - X - β2 - β4 (the cut-back pulse).

The repetition rate of the pulse generator is adjusted until the cut-back pulse and the next reference pulse arrive simultaneously at the detector. The repetition frequency υ_2 is recorded.

The time of flight of the Lead-in, τ_A is given by $\tau_A = 1/\upsilon_{1b} - 1/\upsilon_2$