TCD Measurement of The New Phase Stable Optical Fiber

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The **Thermal Coefficient of Delay (TCD)** is an essential parameter of optical fiber which determines a fiber's phase transfer stability due to temperature variation. A measurement platform is designed to obtain the TCD of a **new phase stable single mode optical fiber (YPSOC)** from Yangtze Optical Fiber and Cable Company (YOFC). The measurement result shows that the TCD of YPSOC is **less than 10 ps/km/K** at room temperature. YPSOC and the measurement platform can be applied on signal transmission or measurement system that need to compensate the temperature drift.

Introduction

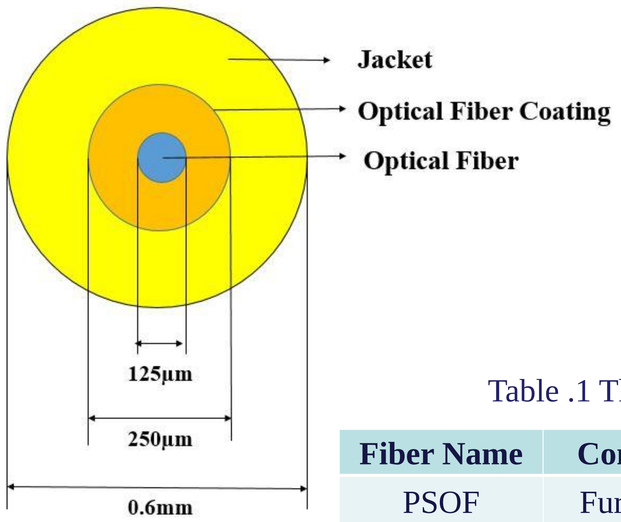


Fig .1 Cross sectional view of YPSOC

Table .1 The contrast of TCD

Fiber Name	Company	TCD
PSOF	Furukawa	< 5 ps/km/K
STFOC	Linden Photonics	< 7 ps/km/K
YPSOC	Yangtze Company	< 10 ps/km/K
Normal single mode fiber (SMFs)		33.4 ~ 42.7 ps/km/K

System Design

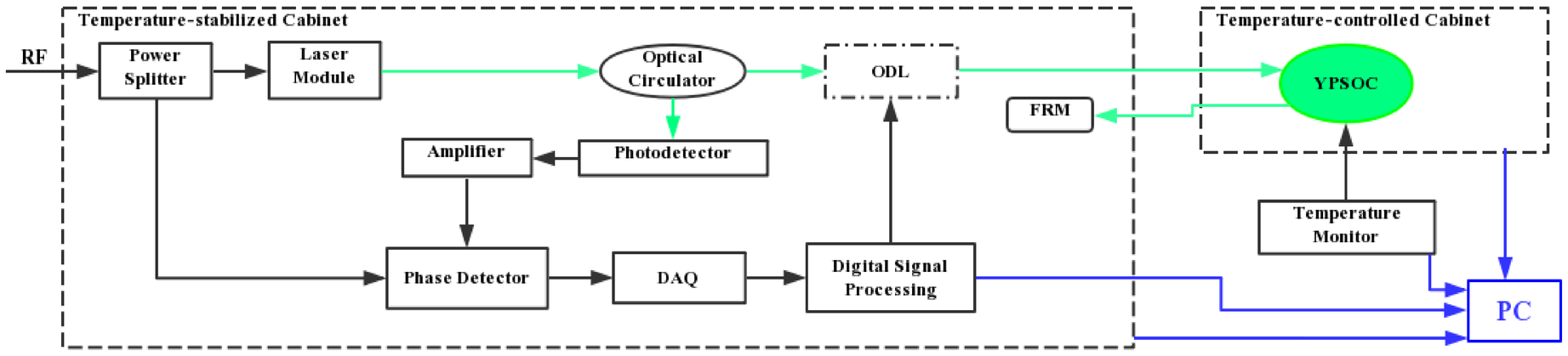
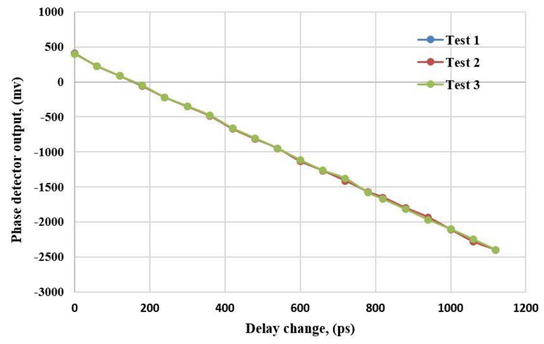


Fig .2: The layout of the fiber measurement system.

◆An electronic and optical system is designed to measure the TCD by changing theambient temperature of the fiber and detecting the time shift.
◆The TCD of a fiber can be calculated by the following formula.

$$TCD = \frac{\text{Delay shift}}{\text{Temperature change} * \text{Fiber Path}}$$

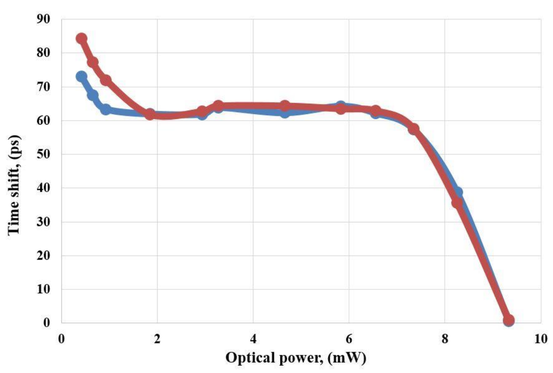
➢ PHOTODETECTOR TEST



◆The phase detector unit is based on the Analog Devices HMC439 IC;
◆A motorized optical fiber delay line (ODL) is used to change the delay of the system;
◆the phase resolution of this phase detector is 2.5 mV/ps.

Fig .3 The fitted curve of delay change and phase detector out-put.

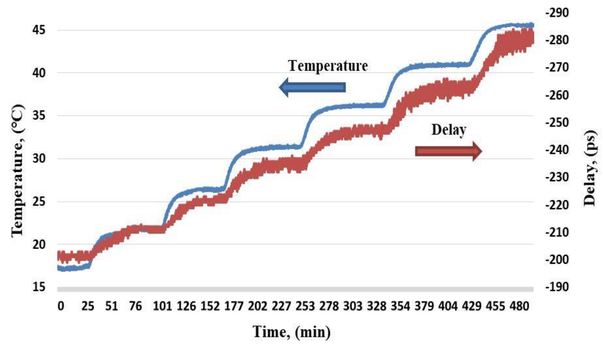
➢ PHOTODETECTOR TEST



◆An optical attenuator is used to change the input optical power of the photodetector;
◆time shift is stabilized when incident optical power of the photodetector is between 2 mW~7 mW.

Fig .4 Photodetected phase of 500 MHz RF vs. incident optical power, for an EOT's Photodetector.

Result



◆ After 8.5 hours of testing;
◆ Temperature changes from 17.2 ℃ to 45.6 ℃;
◆ The average TCD is 7.3 ps/km/K;
◆ The TCD ranges from 5 to 10.5 ps/km/K.

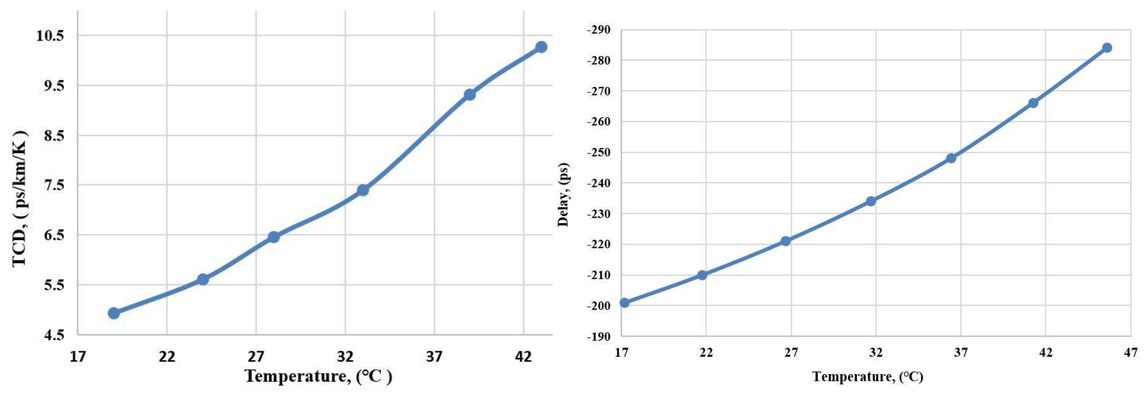


Fig .7 Ambient temperature of the fiber versus the phase delay.
Fig .8 Curve of phase delay vs. temperature change.
Fig .9 TCD of Yangtze's fiber curve with temperature.

➢ TEMPERATURE-CONTROLLED CABINET DESIGN

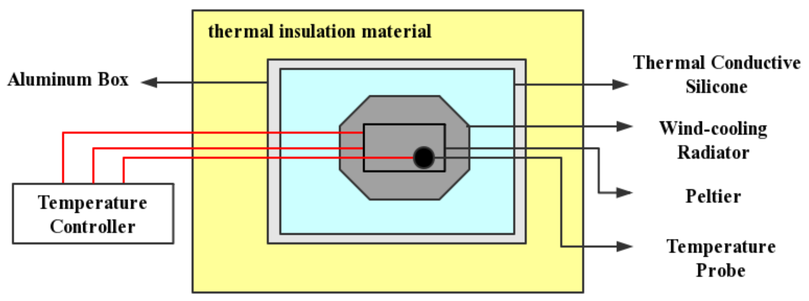
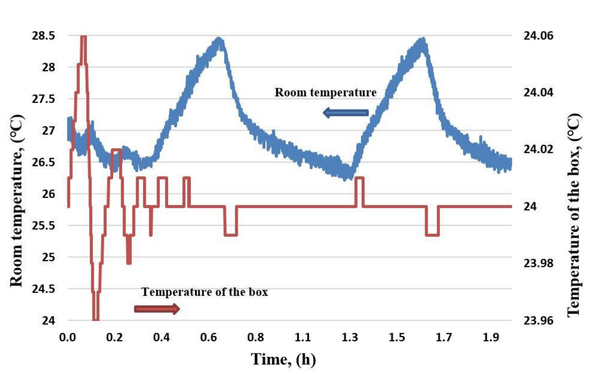


Fig .5 The layout of temperature-controlled cabinet.



◆The temperature of the temperature control box keeps the temperature about **±0.01 ℃** over 1.5 hours when the room temperature changes about ±1 ℃.
◆The system could keep the temperature stability less than ±0.02 ℃ for a long time measurement.

Fig .6 Temperature stability measurement of the temperature control box.

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