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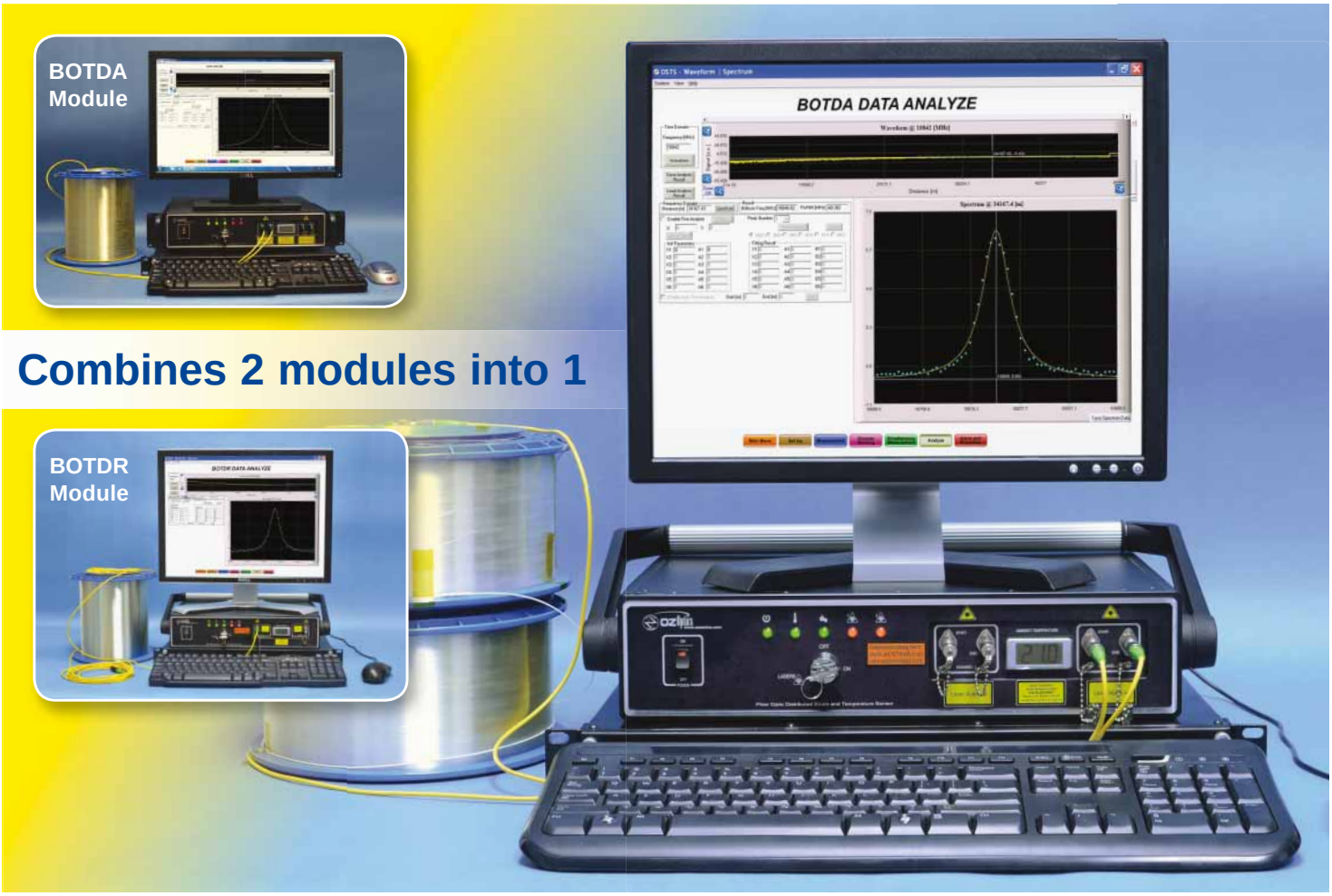
Fiber Optic Distributed Strain and Temperature Sensor (DSTS)

BOTDA+BOTDR Combo Module



Features

- Loop or single end measurements
- Uses low-cost telecom single mode fiber
- High spatial resolution and long range
- Multiple channel monitoring available

Performance at a glance

- 0.1 m (BOTDA) / 1 m (BOTDR) spatial resolution
- 160 km (BOTDA) / 70 km (BOTDR) maximum fiber length

Description

OZ Optics' ForeSight™ family of fiber optic Brillouin distributed strain and temperature sensors (DSTS) are sophisticated optical sensor systems employing Brillouin scattering. Distributed sensing provides a direct method of measuring the changes in strain and temperature along the entire length of an optical fiber. A new unit combining BOTDA (Brillouin Optical Time Domain Analyzer) and BOTDR (Brillouin Optical Time Domain Reflectometer) capabilities is now available. If there is a break somewhere along the fiber, this unit can switch from the BOTDA to the BOTDR to continue the measurement.

Specifications

	Model		BOTDA module	BOTDR module
Performance	Number of Channels[1]		2 to 25	
	Sensor Configuration		Loop fiber	Single end
	Maximum Fiber Length[2]		160 km	70 km
	Spatial Resolution		0.1 to 50 m	1 to 80 m
	Spatial Step		as low as 5 cm	
	Dynamic Range		30 dB	>15 dB
	Temperature Sensing Range (depending on cable material)		-270 °C to +1000 °C	-100 °C to +500 °C[3]
	Temperature Resolution		0.005 °C	
	Temperature Accuracy (2σ)		± 0.1 °C	± 0.8 °C[5]
	Strain Range (depending on cable material)		-3% to +4%	-1.4% to +1.6%[3]
	Strain Resolution		0.1με	
	Strain Accuracy (2σ)		± 2με	± 16με[5]
	Fault Point Detection	Acquisition Time	1 second per thousand scans	
		Sensing Range (round trip)	100 km	
	Simultaneous Measurement of Strain and Temperature (using patented cable design)	Temperature Resolution[4]	0.005 °C	
		Temperature Accuracy (2σ)	± 0.1 °C (whole sensing range for BOTDA)	
		Strain Resolution[4]	0.1 με	
		Strain Accuracy (2σ)	± 2 με (whole sensing range for BOTDA)	
		Sensing Range	50 km	
	Measured Variables		Strain, Temperature, Brillouin spectrum	
General	Communication & Connections		Ethernet port, USB	
	Output Signals		Software alarms via TCP/IP, SPST, SSR relays (optional)	
	Data Storage		Internal hard disc (128GB or more)	
	Data Format		Database, text files, MS Excel, bit map plot	
	Optical Connections		FC/APC	
	Operating Temperature		0 °C to 40 °C, <85% RH, Non-condensing	
	Power Supply		115 or 230 VAC; 50–60Hz; max 300W	
	Dimensions (L x W x H)		390 mm x 344 mm x 85 mm (not including computer)[6]	
	Weight		8 kg (not including computer)	
Features	Measurement Modes		Manual, remote or automatic unattended measurements	
	Data Analysis		Measurement analysis, Multiple trace comparison with respect to selectable baseline, Measurement trends, Graphical zoom	
	Alarms & Warnings		Automatic alarm triggering, configurable alarm settings (gradient, threshold, etc.)	
	Remote Operation		Remote control, configuration and maintenance via TCP/IP	
	Watch Dog		Long term operation 24/7 guaranteed by automatic recovery and continuous self diagnostics	

1 2 channels are provided within the sensor unit. Additional channels can be added by using an external optical switch.

2 For fiber lengths longer than 100 km, only the first 100 km has a valid Brillouin spectrum.

3 -270 °C to 1500 °C and -3% to +3% is optional.

4 This value is estimated/calculated from the uncertainty of laser beat frequency (5 kHz), and temperature and strain coefficients of fibers.

5 Measurement condition: 1km SM fibers with unstrained condition at pulse width of 10ns, average time of 60000, frequency sweep span of 300MHz with frequency step of 5 MHz, standard deviation (2σ) of 100 consecutive data on temperature/strain distribution waveform.

6 Dimensions do not include carrying handle or rackmount tabs. Air vents on sides of unit must not be obstructed.

The ForeSight™ Brillouin based DSTS design enables focus on the variable of most concern. For instance, concrete fracture detection may require tight spatial resolution and high precision.

The measurement time of the DSTS BOTDA module can vary from **1 second** to **10 minutes** based on the requirements dictated by the application. The sample table below reflects some common requirements: better than ± 0.5 °C and ± 10 με precision. All table measurements were completed in less than 1 minute and 40 seconds.

The table is not a restriction of what can be achieved. Variations in the four areas of concern can be accommodated. For instance, the measurement of temperature/strain for 50 km sensing fiber, 2 m spatial resolution, with a precision of 0.2 °C/4 με is attainable, but will increase measuring time to 3 minutes and 45 seconds. Another comparison of the interaction of fiber length, spatial resolution, accuracy of temperature/strain, and measurement time: 100 km sensing fiber, 6 m spatial resolution can be 0.4 °C/8 με when measuring time is 4 minutes and 38 seconds, however the same 100 km can have a precision of 0.1 °C/2 με when spatial resolution is increased to 50 m with a measuring time of 3 minutes and 48 seconds.

	10 cm	50 cm	1 m	2 m	3 m	4 m	5 m	10 m	20 m	50 m
<=1 km	0.3 °C/6 με	0.2 °C/4 με								
<=2 km	0.4 °C/8 με	0.3 °C/6 με	0.1 °C/2 με							
<=4 km		0.4 °C/8 με	0.3 °C/6 με							
<=10 km			0.3 °C/6 με							
<=20 km			0.4 °C/8 με	0.06 °C/1.2 με						
<=30 km				0.2 °C/4 με						
<=40 km				0.3 °C/6 με	0.1 °C/2 με	0.2 °C/4 με				
<=50 km					0.2 °C/4 με	0.3 °C/6 με	0.2 °C/4 με	0.1 °C/2 με		
<=60 km								0.2 °C/4 με		
<=70 km								0.3 °C/6 με		
<=80 km									0.2 °C/4 με	
<=90 km									0.4 °C/8 με	
<=100 km									0.4 °C/8 με	0.2 °C/4 με

Typical BOTDA module measurement precision table (acquisition time ≤ 100 seconds)

		Spatial Resolution						
		1 m	**2.5 m**	**4 m**	**10 m**	**25 m**	**35 m**	**40 m**
Fiber Length	**1 km**	± 0.8 °C / ± 16με						
	2 km	± 1.2 °C / ± 24με						
	5 km	± 1.5 °C / ± 30με						
	10 km		± 1.5 °C / ± 30με					
	20 km			± 1 °C / ± 20με				
	30 km				± 1.5 °C / ± 30με			
	40 km				± 1.5 °C / ± 30με			
	50 km					± 1.75 °C / ± 35με		
	60 km						± 1.25 °C / ± 25με	
	70 km							± 2 °C / ± 40με

Typical BOTDR module measurement precision table

Results listed above are based on 100 contunuous measurement using a single mode sensing fiber with zero strain.
Averaging a greater number of scans can provide better precision but it will require longer measurement time.

Optional Accessories

Bar Code	Part Number	Description
48298	DSTS-TRAVEL-CASE-1U/3U	Optional aluminum carrying case for DSTS. Includes wheels and handle. Designed for checking on airplane. Approximate dimensions: 23.75 (H) x 22.5 (W) x 15 (D). {60.3 cm x 57.2 cm x 38.1 cm}.
48979	CI-1100-A2	Handheld Video Microscope kit for Fiber Optic Connector Inspection. The kit includes a 3.5" TFT LCD display with video probe, an AC power adapter with battery charger, and a rechargeable battery pack. It also includes one SC/FC PC female connector, one LC/PC female connector, one Universal 2.5 mm FC/PC male connector and one Universal 1.25 mm FC/PC male connector.
48980	CI-1100-A2-PT2-FS/APC/F	Tip for SC and FC APC type female (in receptacle) connector for CI-1100-A2 handheld microscope.
36939	HUXCLEANER-2.5	Receptacle fiber cleaner for FC, SC and ST types.
5336	Fiber-Connector-Cleaner-SA	Disposable Cletop reel type A optical fiber connector cleaner.
8122	SMJ-3A3A-1300/1550-9/125-3-1	1 meter long, 3 mm OD jacketed, 1300/1550 nm 9/125 µm Corning SMF 28e fiber patchcord, terminated with angled FC/APC connectors on both ends.
11	PMPC-03	Flanged sleeve thru connector for polarization maintaining FC/PC connectors. Keyway width is 2.03/2.07 mm wide for 2.00 mm wide (Type R) key connectors.
19711	AA-200-11-9/125-3A3A	Universal connector with a male angle FC/APC connector at the input and a female angle FC/APC receptacle at the output end for SM 9/125 applications.

Related Products

Fiber Optic Sensor Probes, Components, Termination Kits, and Training

OZ Optics offers a full spectrum of fiber optic sensor probes, components, termination kits and training. OZ Optics' standard fiber optic products have been used worldwide in high performance sensor and telecommunications applications since 1985. OZ Optics also offers specialty fiber optic sensor probes and custom cabling for high temperature applications and other hostile and corrosive environments. System integrators with experience in structural and pipeline monitoring will find that OZ Optics offers a complete suite of enabling products and services for installing and maintaining fiber optic systems. If you are planning a pipeline or structural monitoring project, please contact OZ Optics to learn more about our fiber optic solutions.

For more information about our strain and temperature sensor system and related products, please visit www.ozoptics.com.

Ordering Information

Part Number Description: ***DSTS-C-0.1/50-1/100-H-BOTDA/R***

Questionnaire

1. What is your application? Please describe briefly.
2. Are you looking for a BOTDA module (requires both ends of fiber to be connected to DSTS) or a BOTDR module (requires only one end of fiber to be connected to DSTS) or a COMBO unit with both BOTDA and BOTDR functions?
3. What are your resolution and precision requirements for temperature measurements?
   Resolution
   Precision
4. What are the highest and lowest temperatures you expect?
5. What are your resolution and precision requirements for strain measurements?
   Resolution
   Precision
6. What is the maximum strain to be measured?
7. What is the desired sensing range or fiber length in this application?
8. What spatial resolution do you desire?
9. Do you want to measure temperature, strain or both?
10. What is the desired data acquisition time?
11. Do you need fiber calibration / system design / project engineering service?
12. Where will unit be housed?
13. Any additional information?