

DATASHEET



ONYX™ Sensing Unit Hardware Features and Technical Specification

Distributed Optical Sensing System

ONYX™ represents the next step in the evolution of Distributed



Optical Sensing. It measures acoustic/sound data over long optical fiber lengths using advanced optical sensing techniques with a high detection sensitivity and a low false alarm rate in a compact, low power unit.

ONYX™ has been designed to address three key aspects:

- Performance
- Usability
- Cost

A new approach to Distributed Fiber Optic Sensing

Building on over a decade's worth of experience, the team at Sintela are focused on providing Next Generation Distributed Sensing solutions. The first of these is ONYX™ which is a highly cost-effective, long-range fiber-optic Distributed Acoustic Sensing (DAS) system, with industry leading levels of performance.

The ONYX™ Sensing Unit (OSU) has been developed to represent the next phase in the advancement of distributed fiber-sensing technology, and addresses the limitations commonly found in other DAS systems, namely:

- **Integrated Design:** A single OSU integrates the optical sensing components and functions of processing hardware and engineering displays into a single 3U ONYX™ Sensing Unit. This considerably reduces the space, power and heat dispersion requirements. Furthermore, the OSU has been designed with an internal modular design, allowing for quick and easy maintenance for individual modules.
- **Upto 130 km range:** Each OSU contains two optical modules each simultaneously interrogating two sensing fibers - up to 65 km length. This represents 130 km range for one unit. This long-range capability results in significantly less equipment being required and lower cost per kilometer of monitoring. Longer ranges are also possible depending upon the application.
- **Quantitative Measurements:** ONYX™ is the only system to make coherent quantitative measurements of sound and vibration using optical IR methods over 130 km. This enables the implementation of sophisticated signal processing techniques - significantly improving the detection and classification of events, thereby improving the probability of detection whilst reducing the nuisance alarm rate. This also allows machine learning algorithms to be used reliably on the system. In comparison, conventional DAS systems typically have a qualitative response, which is unable to measure sound/vibration quantitatively.
- **Distributed Architecture:** The ONYX™ system has been designed to be fully distributed. A distributed architecture has no single point-of-failure, minimizing downtime and increasing system availability. Administration and control functions are distributed across OSU's, providing the system with a high degree of fault tolerance.
- **Class 1 Laser Safety:** Class 1 lasers are eye-safe under all operating conditions, which makes the ONYX™ system inherently safe for use, lowers the HSE burden for end clients, and increases the life span of the optical components. This also eliminates the need for costly interlock safety switches and physical keys to operate the equipment.
- **Automatic Setup with integrated OTDR:** The ONYX™ system has an integrated OTDR [Optical Time Domain Reflectometer] capability and automated installation process, simplifying the setup, commissioning and testing stages of system implementation. This results in lower manpower costs and simplifies maintenance and administrative tasks for support by local engineers; specialist engineers are not required as often for straightforward tasks. The integrated OTDR enables the fiber health to be monitored and is extremely useful in mitigating faults caused by engineering works carried out on the telecoms network.

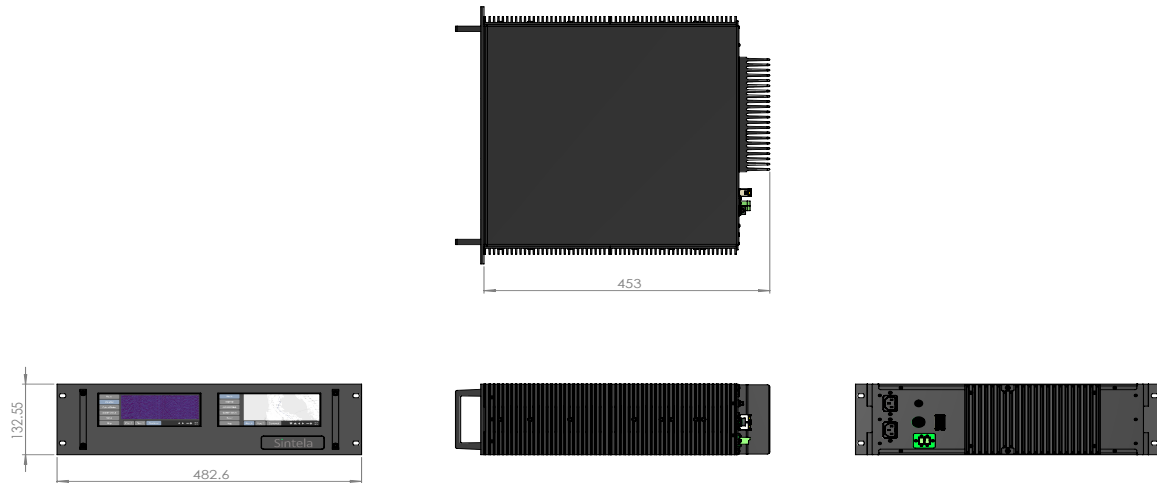
Specification

Functional specification ^[1]			
Measurement type	Quantitative ^[3] sound/vibration measurement		
Number of fibers	Two		
Standard operating wavelength ^[2]	1550.12 nm [193,400 GHz] [CH34]		
Sensing range @ 6.4m gauge length	Standard range up to 50 km per fiber (100 km in total) Greater ranges possible using longer gauge lengths		
GL - Gauge Length [Min Max]	3.2 m 23.9 m		
SI - Sample Interval [Min Max]	1.6 m 23.9 m		
SR - Sample Rate [Min Max]	1 kHz 40 kHz		
Acoustic Frequency Range	Min	< 1 mHz [Arbitrarily selectable]	
	Max	500 Hz -> 100 km fiber	20 kHz -> 2.5 km fiber
Minimum detectable signal (Noise Floor [NF])	5 km ^[4]	-80 dB Rad.Hz ^{-1/2} @ 10 Hz [Equivalent to an axial strain of ~1.5 pε.Hz ^{-1/2}]	
	50 km ^[5]	-60 dB Rad.Hz ^{-1/2} @ 10 Hz [Equivalent to an axial strain of ~15 pε.Hz ^{-1/2}]	
Dynamic range (front of 5 km fiber, using 20 kHz SR, 6.4 m GL) = largest linear signal / noise floor	155 dB @ 1 Hz	135 dB @ 10 Hz	115 dB @ 100 Hz
Linearity	Harmonic distortion typ. < -40 dB		
Crosstalk isolation	> 80 dB		

Sensing fiber requirement specification	
Standard fiber types	SMF-28e ITU-T G.652, G.654 or G.655
Fiber attenuation for given specs	0.2 dB.km ⁻¹ at 1550 nm
Maximum acceptable loss budget	18 dB per fiber
Maximum acceptable back reflection	< 2 %

Processing capability	
Built-in processing [For automated event detection, location and classification]	AI Performance: 32 Terra OPS GPU: 512 core Volta with Tensor Cores CPU: 8 core ARM v8.2 64 bit Memory: 32 GB 137 GB/s DL Accelerator: 2 x NVDLA Engines
Internal data storage	1x 256 GB MVMme SSD (Fixed) Standard: 2 x 2 TB SSD (Removable) Optional: 2 x 8 TB SSD (Removable)

Network requirements		
Minimum recommended bandwidth		2 Mbps (Megabits per second) ^[7]
Interfaces		
Optical connections		2 x E2000-PS APC [or user defined]
Data Interfacing	Electrical or Optical	SFP, 1000BASE-T, 100 m, Cat6 or 7 twisted pair
		SFP, 1000BASE-ZR, 100 km, single mode fiber
Data accessibility ^{[8], [9]}		Removeable SSD's USB-C TCP-IP over Ethernet
Real time data storage formats		Raw binary, HDF5, Frequency Band Extracted (FBE)
Timing synchronization	GNSS [Global Navigation Satellite System] ^[10] synchronization of internal reference clock. Providing approx. ±100 ns timing accuracy	
	NTP synchronization, Providing approx. ±10 ms timing accuracy	
External trigger		2x TTL inputs via LEMO connector ^[11]
Power		
Power supply	Option 1 – 100-240 VAC at 50-60 Hz Dual redundant power supplies	
	Option 2 – 24/48 VDC Dual redundant power supplies	
Power consumption		<100 W
Typical current rating		1.5 Amp @ 100-240 VAC; 5A @ 24-48 VDC
Size and Weight		
Size	Format	19-inch 3U Enclosure
	Height	132.5 mm 5.22 in
	Width	482.6 mm 19 in
	Depth	453 mm 17.8 in
Weight		17 kg 37 lbs
Mounting options		Option 1 – Slide rails for front and back support Option 2 – Wall mounting bracket for limited space environments



Environmental	
Heat management	Passive cooling (for high reliability)
Storage temperature range	-40 °C to +70 °C -40 °F to +158 °F
Operating temperature range	-5 °C to +50 °C 23 °F to +122 °F
Operating humidity (max)	85% non-condensing
Ingress Protection	IP50 [Protected against dust]
Safety	
Laser Safety Class	Class 1 (IEC 60825-1, 21CFR1040.10)
Reliability	
Mean Time Between Failures [MTBF]	>15 years [131,406 Hours]
Failures in Time (FIT) per 10 ⁹ hours	<7,610 FIT
Mean Time to Repair (MTTR)	20 minutes to bring back to working state, assuming repair by unit replacement, 1hr assuming module replacement
Declaration of Conformity	
Cybersecurity	CIS Benchmark compliant
Electromagnetic compatibility (EMC) Compliance	USA (FCC): 47 CFR Part 15 B Canada: ICES-003 2012 EU: CE compliant - 2014/30/EU
Electrical Safety Compliance	EU: CE Compliant - 2014/35/EU USA: UL 62368-1
RoHS (Restriction of Hazardous Substances) Compliance	2011/65/EU and Amending Directive, 2015/863
Laser Safety	Class 1 LASER PRODUCT Complies with IEC 60825: 2014, 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed 3, as described in Laser Notice No. 56, dated May 8, 2019
Management System	ISO 9001:2015 Certified

Export Conditions	
Export Control Classification Number (ECCN)	ONYX™ Sensing Unit: EAR99 ONYX™ contains components with the following EAR codes: 5A991.b, 5A992.c, 5A991, 3A991D, 7A994, 6A995.b.1.a, 5D992.c each is less than 4% of unit BOM cost
Harmonized Tariff Schedule (HTS)	90275000
Notes	
1	Measurements based upon recommended measurement procedures described in the SEAFOM MSP-02 'DAS Parameter Definitions and Tests' document, available upon request
2	Other wavelengths available upon request
3	Coherent in phase and amplitude across all channels
4	Measured at the front 5 km fiber using a 20 kHz sample rate and a 6.4 m gauge length
5	Measured at the front 50 km fiber using a 2 kHz sample rate and a 6.4 m gauge length
6	Calculated using Telcordia SR332 (Bellcore)
7	Full access and control can be achieved over a 4G mobile phone connection
8	Data can be written in real time to both internal and external disks
9	Facility available to hot swap external disks
10	Requires the connection of a GNSS antenna
11	Requires a separate external signal interface box customized to the user's requirements
Additional features	
Front panel touch screen	2x 6.8 in diagonal, 1280x480 resolution touch screens for standalone monitoring and control
Built-in OTDR	Offline feature for setup and for monitoring damage and long-term degradation to the sensing fibers
Auto optical setup	Optimization of optical signal-to-noise with auditable storage of the systems setting
Auto fault recovery	On detection of a fault the optical sensing unit can be remotely reset
Back reflection protection	ONYX™ can tolerate back reflections of 3% from connectors
Fiber cut tolerance	The system will continue to function on a fiber which has been cut. Performance on the fiber up to that cut will not be affected.
Status diagnostics	Remote, auto diagnostics
Vibration logging at runtime	Vibration logger included to detect excessive vibration events
Cloud storage of events	If either a single or network of ONYX™ Sensing Units is connected to the internet, alert data can be sent to cloud storage for remote access. In systems on a local intranet a similar approach can be taken using local Network Attached Storage (NAS).

Availability of capabilities and features

Unless otherwise expressly indicated in writing, Sintela products and data sheets relating thereto are subject to change without notice. Users should check for and obtain the latest relevant information and verify that such information is current and complete before placing orders for Sintela products.