ONYX™ peta

Hardware Performance and Features

February 2025
Version No. 1.4

SINTELA

ONYX™

peta

Industry Leading Distributed Acoustic Sensing (DAS) System

ONYX *peta* is the flagship Distributed Fiber Sensing platform from Sintela. It provides quantitative distributed acoustic measurements over long fiber lengths with industry leading sensitivity and high spatial resolution in a compact, low power unit.

With inbuilt processing able to process over a petabyte of acquired data per day, and user definable processing workflows, it also provides a flexible DAS edge processing capability.

A new approach to Distributed Fiber Optic Sensing

Our mission is to provide the highest performing Distributed Fiber-Optic Sensing solutions and built on our ONYX platform, ONYX *peta* is our latest cost-effective, long-range fiber-optic Distributed Acoustic Sensing (DAS) system.

The ONYX *peta* Sensing Unit (OSU) has been developed to provide users with fully flexible acquisition setup enabling them to achieve the highest quality DAS data, and addresses the limitations commonly found in other DAS systems, namely:

Integrated Design: A single OSU combines the optical sensing components and functions of processing hardware and engineering displays into a single 3U rack mount or bench-top deployment. This considerably reduces the space, power, and heat dispersion requirements.

Dual fiber: As standard the OSU is configured for dual fiber operation with each fiber being independent and able to be configured with their own Gauge Length and Sample Interval. A single fiber option is also available.

Long range: Each OSU contains two optical modules, simultaneously interrogating separate sensing fibers – standard length is 50 km per fiber, but this can be pushed out beyond 65 km (130 km from a single OSU) by using longer gauge lengths. This long-range capability results in significantly less equipment being required and a lower cost per kilometer of monitoring.

Quantitative Measurements: ONYX *peta* makes phase based-quantitative measurements of sound and vibration. The resultant high fidelity and repeatable measurements enable 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.

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Distributed Architecture: Administration and control functions are distributed across OSU's when configured in a network. This provides a high degree of fault tolerance with no single point-of-failure, minimizing downtime and increasing system availability.

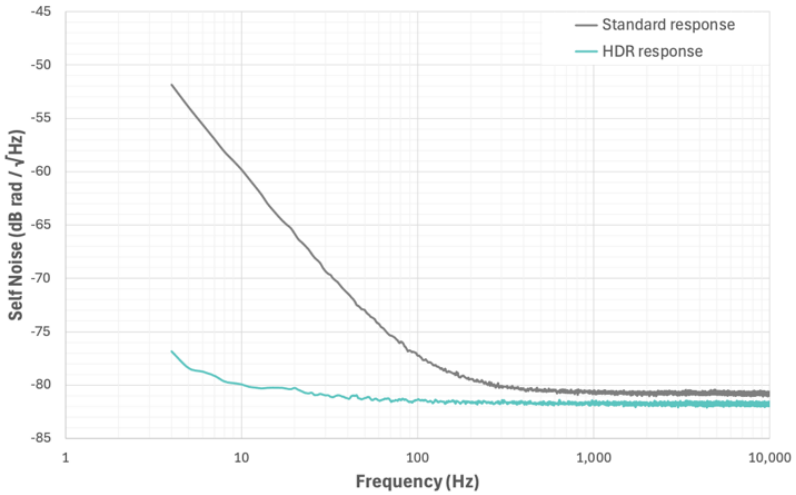
Class 1 Laser Safety: Class 1 lasers are eye-safe under all operating conditions, which makes ONYX *peta* Sensing Units inherently safe for use, lowers the HSE burden for end clients, and increases the life span of the optical components. This also eliminates the need for costly interlock safety switches and physical keys to operate the equipment.

Automatic Setup with integrated fiber characterization: ONYX *peta* Sensing Units have an integrated fiber characterization mode and automated installation process, simplifying the setup, commissioning, and testing stages of deployment. This results in lower manpower costs and simplifies maintenance and administrative tasks for support by local engineers; specialist engineers are required infrequently, if at all. The integrated fiber characterization enables the fiber health to be monitored and is extremely useful in mitigating faults caused by engineering works that might interfere with the fiber.

High Reliability: Passive cooling removes the need for fans and creates a sealed unit which has a high mean time between failure and requires minimal maintenance.

Sensing fiber requirement	
Standard fiber types	• Single Mode Fiber (SMF): ITU-T G.652, G.654 or G.65 • Multi-Mode Fiber (MMF): ITU-T G651.1 etc. (NB: Range limited to ~8 km for MMF) • Engineered fiber: Continuous scatter enhanced type [1]
Maximum fiber attenuation for given specs	0.2 dB.km^{-1} at 1550 nm
Maximum acceptable one-way loss budget	13 dB per fiber
Maximum acceptable back reflection	< 3 %

Performance [2]				
Measurement type		Quantitative [3] – Heterodyne optical phase measurement as a proxy for strain, vibration, and temperature		
Number of fibers		Two (Independent, 100% duty cycle [not multiplexed])		
Standard operating wavelength [4]		1550.12 nm | 193,400 GHz | ITU CH34 (L-Band option is also available)		
Sensing range @ 6.4 m Gauge Length [5]		Standard range up to 50 km (31 miles) per fiber. Greater ranges possible using large gauge lengths		
PW – Pulse Width | Length [Min | Max | Step]		7.0 ns | 0.70 m	192.7 ns | 19.70 m	0.43 ns | 0.044 m
GL – Gauge Width | Length [Min | Max | Step]		10.4 ns | 1.06 m	234.4 ns | 23.93 m	5.2 ns | 0.53 m
SP – Sample Interval | Pitch [6] [Min | Max | Step]		5.2 ns | 0.53 m	161.5 ns | 16.49 m	5.2 ns | 0.53 m
SR – Sample Rate [Min | Max]		250 Hz – 40 kHz [7] (Equivalent to: 408 km – 2.5 km)		
Acoustic Frequency Range	Min	< 1 mHz [Arbitrarily selectable]		
	Max	20 kHz <= 2,500 m	10 kHz @ 5 km	1 kHz @ 50 km
Dynamic range (front of 5 km fiber, using 20 kHz SR, 6.4 m GL) = largest linear signal / noise floor		115 dB @ 100 Hz	135 dB @ 10 Hz	155 dB @ 1 Hz
Noise Floor [NF] @ 100 Hz Measured at front end of fiber		5 km @ 20 kHz Using 3.2 m GL	50 km @ 2 kHz Using 6.4 m GL	65 km @ 1.6 kHz Using 9.6 m GL
		-81 dB Rad.Hz$^{-½}$	-60 dB Rad.Hz$^{-½}$	-57 dB Rad.Hz$^{-½}$
Linearity		Harmonic distortion typ. < -40 dB		
Crosstalk isolation		> 75 dB		

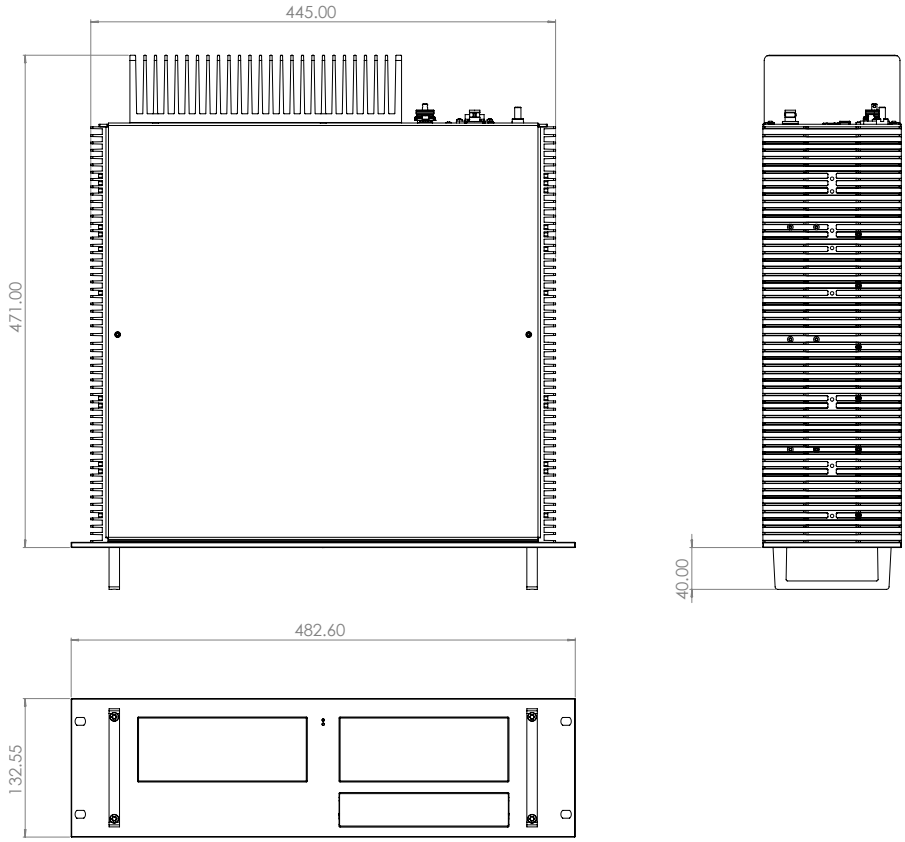


Measurements based on SEAFOM MSP-02
Sample Rate: 20 kHz, Gauge Length: 6.4 m

Processing capability	
Built-in processing [For acoustic signal processing and automated event detection, location, and classification]	AI Performance: 275 Terra OPS GPU: 2048 core Ampere with 64 Tensor Cores CPU: 12 core ARM v8.2 64 bit Memory: 64 GB 204.8 GB/s DL Accelerator: 2 x NVDLA Engines
Data storage	1x 256 GB NVMe SSD (Internal – fixed) Standard: 2 x 2 TB SSD (removable) Optional: 2 x 8 TB SSD (removable)

Network requirements	
Minimum recommended upload bandwidth	2 Mbps [8]

Interfaces			
Optical connections		2 x E2000-PS APC (or user defined)	
Data Interfacing	Electrical or Optical	QSFP28	
		2 x SFP+	1x 10GBASE and 1x 1GBASE copper supplied as standard
			10 MbE to 10 GbE available. Either copper or fiber
Data accessibility		Removable SSDs, 2x USB-C, TCP-IP over Ethernet	
Real time data storage formats		Raw Binary, SEG-Y, HDF5, PRODML	
Timing synchronization		GNSS (Global Navigation Satellite System) [9] synchronization of internal reference clock. Providing approx. ±100 ns timing accuracy	
		NTP and PTP synchronization, Providing approx. ±10 µs timing accuracy	
External Time Break input		TB input via BNC connector (Software selectable level)	



Size and Weight		
Size	Format	19-inch 3U Enclosure
	Height	132.5 mm | 5.22 in
	Width	482.6 mm | 19 in
	Depth	471 mm | 18.5 in
Weight		16.5 kg | 37 lbs
Mounting		Telescopic rackmount rails

Power		
Power supply	Option 1	110 / 230 VAC nominal (85 - 264 VAC) at 50 – 60 Hz Dual redundant power supplies and cables
	Option 2	24 / 48 VDC nominal (16.8 – 62.4 VDC) Dual redundant power supplies and cables
Power consumption		110 W [Standard but future advanced options may exceed this power]
Current rating		1.5 Amp @ 100-240 VAC; 6.3 A @ 24-48 VDC

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]	95% non-condensing
Ingress Protection	IP50 (Protected against dust)

Reliability [10]	
Mean Time Between Failures [MTBF]	>10 years (95,400 Hours)
Failures in Time (FIT) per 10^9 hours	<10,482 FIT
Mean Time to Repair (MTTR)	20 minutes (unit replacement), 1 hr (module replacement)

Declaration of Conformity	
Cybersecurity	CIS Benchmark compliant
Electromagnetic compatibility (EMC)	USA (FCC): 47 CFR Part 15 B Canada: ICES-003 2020 2013/30/EU: EN55032:2015+A11:2020, EN55035:2017+A11:2020, EN301 489-1 V2.2.3, EN301 489-19 V2.1.1 UK: SI 2016/1091 and amendments Test Specifications: CISPR 22/32, EN55022/32, EN/IEC61000-4-11, EN/IEC61000-4-2, EN/IEC61000-4-29, EN/IEC61000-4-4, EN/IEC61000-4-3, EN/IEC61000-4-6, EN/IEC61000-4-5
Electrical Safety Compliance	USA: UL 62368-1 2014/35/EU: EN 62368-1: 2018/COR1:2020 UK: SI 2016/1101 and amendements
RoHS (Restriction of Hazardous Substances)	2011/65/EU and Amending Directive, 2015/863
Laser Safety	CLASS 1 LASER PRODUCT (Also compliant with CLASS 1M) Complies with IEC 60825: 2014/ISH1:2017, Complies with 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 FDA Product Code: 95R - - HY, FDA Accession Number: 2432611-000
Management System	ISO 9001:2015 Certified

Export Conditions	
Export Control Classification Number (ECCN)	EAR99
Harmonized Tariff Schedule (HTS)	9027500000 (UK) 9027504060 (US) 90278990 (India)

Notes	
1	Contact Sintela for details of compatible 'Engineered' fiber
2	Measurements based upon recommended measurement procedures described in the 'SEAFOM MSP-02_V2 – DAS Parameter Definitions and Tests' document and are available upon request
3	Coherent in phase and amplitude across all channels
4	Other wavelengths available upon request
5	All lengths calculated assuming a single mode fiber with an effective refractive index of 1.4685
6	Raw data can be extracted at up to 1.74 ns / 0.18 m sample interval, but data rate would be 25 TB/Hr [Pending software implementation]
7	ONYX *peta* platform is capable of sampling up to 480 kHz
8	Full access and control can be achieved over a 4G mobile phone connection
9	Requires the connection of a GNSS antenna via SMA connector
10	Calculated using Telcordia SR332 (Bellcore)

Additional Hardware Features	
Front panel touch screen	2x 6.8 in diagonal, 1280x480 resolution color touch screens for display of key information such as instrument IP and status for fast setup as well as standalone monitoring and control.
Auto optical setup	With optimization checking and auditable storage of the system settings
Auto fault recovery	On detection of a fault the optical sensing unit can be remotely reset
Built-in fiber characterization	Like an OTDR, this offline feature is used for setup and for monitoring damage and long-term degradation to the sensing fibers
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.
Vibration logging at runtime	Vibration logger included to detect excessive vibration events
Cloud storage of events	If either a single or network of ONYX *peta* 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).

Software Features	
Remote configuration	Web interface for full remote configuration and operation, including software and firmware updates, over the internet.
Web User Interface	For real-time monitoring of the acquisition, recording and export of data. Light and Dark modes available.
Acoustic output	Acoustic output from any user selected real-time or recorded channel.
Data visualization	User selectable colourmap for the display of time versus distance waterfall plots.
Signal analysis	Analysis window provides real-time temporal and spectral analysis of acquired data.
Data Formatting	Data output configurable in continuous or triggered Raw Binary, SEG-Y, HDF5 and / or PRODML formats.
Recorders	Intuitive recorder manager to configure user selected data streams to internal or external recording media.
Processing	Flexible, user configurable signal processing set-up via an intuitive graphical based processing chain.
Status diagnostics	Full system logging with remote monitoring of all the key operational parameters including internal temperatures, currents, voltages, and data rates.
Cybersecurity	Cybersecurity compliance to CIS Benchmarks. SAML authentication.
Workflow management	Step-by step interface for simplified setup.
UI for linear asset monitoring	Map based GIS with full event management workflow covering multiple Onyx Sensing Units.
UI for well monitoring	Well monitoring software displaying well diagram next to waterfall of acquired data.
Detection algorithms	Toolbox of heuristic rule and machine learning based detection algorithms. Detection algorithms include, but are not limited to: o Fiber break and anomaly detection. o Movement detection and classification of people and vehicles, manual / mechanical digging, fence climbing / cutting, etc. o Pipeline leak detection and Pig tracking. o Real-time microseismic detection.
Zone management	Zone and schedule management of algorithms.
Interface support	MODBUS, OPC UA, Dry Contact, SMS via cloud, SMS via modem, Email interface.
Camera integration	Support for control and display of ONVIF compatible cameras.
Reporting	Activity and alert reporting for operational staff and management.
Application Programming Interface (API)	gRPC Protobuf – Secure authentication via mTLS REST commands via gRPC gateway – Swagger Definition
Offline data replay and reprocessing	Docker image of Onyx Software available for Cloud and on-prem date replay, analysis and experimentation. Command tools available for data reformatting and processing.

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