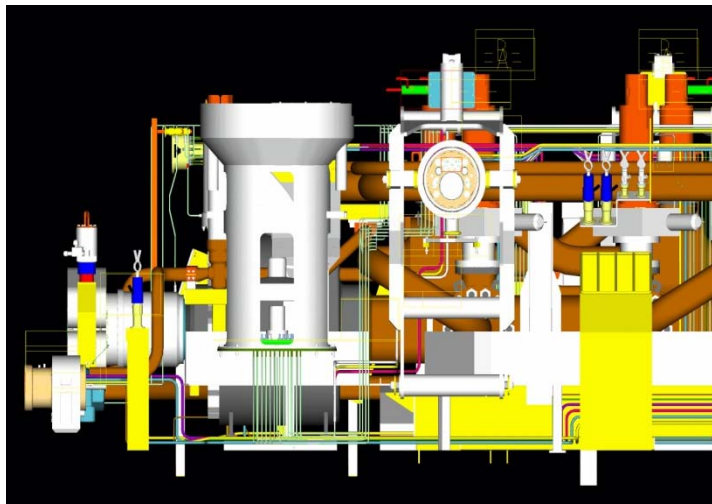


Vibrations always start at very high frequencies and change to lower frequencies as the conditions develop. The ClampOn DSP Vibration Monitor is an ideal instrument to monitor three directional vibrations on structures and pipelines with either high frequency shear waves or low frequencies. The system is designed with a broadband frequency response from 0 Hz to 262 144 Hz, suitable for early detection of vibrations in objects such as:

- Flow lines, jumpers
- Pumps, rotary machinery
- Subsea structures

The vibrations are monitored by utilizing two different measurement principles in combination.

1. Shear waves propagating from metal friction are picked up by an *ultrasonic element*. These measurements will give an early indication of potential fault conditions as all these are typically high frequency waves.
2. 3D Vibrations from 0 Hz to 1 000Hz will be quantified by an *accelerometer*.



To optimize both metering schemes, the Vibration Monitor 3D needs both mechanical and acoustic coupling to the structure.

The ClampOn DSP Vibration Monitor 3D can also function in parallel as a regular Particle Monitor in REAL TIME.

Frequency range accelerometer:	0,125 Hz – 1 000 Hz, 0 g – 5 g
Frequency range ultrasonic element:	1 024 Hz – 262 144 Hz
Output format:	X,Y & Z in average and max data, each variable is u16 data type.
Vibration resolution:	10 mg; 10 mg = 1, 1 g = 100
Measurement update time:	1 sec (updating sequence)

The system is set up to provide measurements as an FFT where the amplitude represents acceleration. Each frequency bin will contain the maximum and average from all axes - X, Y and Z. Measurements done by the ultrasonic element will have max and average values, and have been calibrated in order to provide the correct frequency and acceleration response.

# DSP Compact Vibration Monitor 3D

## Instrument Datasheet



### INSTRUMENT DATA

### INSTRUMENT LAYOUT

#### GENERAL

1.0	Manufacturer	ClampOn AS	
1.1	Model description	DSP Vibration Monitor 3D	
1.2	Part number	921-2x1x0-xxx	1

#### NOTE

#### CLIENT DATA

2.0	Customer
2.1	Project title
2.2	Field / installation
2.3	P.O. number
2.4	Part number
2.5	Tag number
2.6	Document number / rev.
2.7	Pipe OD
2.8	Jumper length
2.9	Connector

#### PHYSICAL

3.0	Dimensions (ø x h)	89 mm x 489 mm [3.5 in x 19.3 in]	
3.1	Material	Titanium grade 2	2
3.2	Weight (approximate)	In air: 5 kg [11 lb] In water: 4 kg [8.8 lb]	
3.3	Protective coating	None	3
3.4	Cathodic protection	None	
3.5	Operating temperature	-40 °C to 150 °C [-40 °F to 302 °F]	4, 5
3.6	Ambient temperature	-40 °C to 60 °C [-40 °F to 140 °F]	
3.7	Max design pressure	330 bar [4 786 psi]	
3.8	Max water depth	3 000 m [9 842 ft]	
3.9	Mounting	Clamp on to surface	6
3.10	Sealing	Welded 1 atmospheric chamber	7
3.11	Jumper interface	See note	8
3.12	Filling / ventilation port	See note	8

#### HARDWARE

4.0	Supply voltage	12 VDC to 28 VDC	9
4.1	Power consumption	40 mA @ 24 VDC (typical)	9
4.2	Electronic	Single or independent redundant	
4.3	Signal output	RS-485	10
4.4	Protocol	See note	10,11
4.5	Baud rate	See note	10,11
4.6	Microprocessor	1 200 MIPS	
4.7	Battery	Real time clock (RTC), 10 years	
4.8	Memory	64 MB onboard flash	
4.9	Vibration	3-axis (X, Y, & Z direction)	11
4.10	Diagnostic features	Self-testing	12
4.11	Insulation resistance	>10 GΩ @ 50 VDC	
4.12	Penetrator	Glass to titanium seal, 8 pin	13
4.13	Max wire cross-section	1,5 mm <sup>2</sup> [AWG 16]	

#### OPERATION

5.0	Manner of operation	Real-time measurement	
5.1	Technology	Accelerometer & ultrasonic	
5.2	Frequency range	0 Hz to 262 144 Hz	11
5.3	Calibration	Factory calibrated	14
5.4	Sensitivity	0,004 g or 38 mV / 9,81 m/s <sup>2</sup>	14
5.5	Max sensitivity drift	±0,5 %	15
5.6	Repeatability	Better than 1 %	
5.7	Operating limits	See note	15
5.8	MTBF	>30 years	

#### INSTALLATION

6.0	Installation method	By ROV, diver or fixed	
6.1	ROV handle	See note	16
6.2	Locking	Spring-loaded in J-slot	17
6.3	Installation torque	Typical / max: 30 N m / 100 N m [22 ft lb <sub>r</sub> / 74 ft lb <sub>r</sub> ]	
6.4	Retrieval torque	Typical / max: 50 N m / 100 N m [37 ft lb <sub>r</sub> / 74 ft lb <sub>r</sub> ]	



### NOTES

- 1 X notation subject to change according to type of jumper interface, signal output, protocol, baud rate and handle.
- 2 All major parts exposed to seawater are made of titanium grade 2. Material certificates according to EN 10204 3.1.
- 3 ROV handle coating according to NORSOK M-501, system 7 RAL 2004 (orange) if specified.
- 4 Maximum pipe surface temperature 200 °C [392 °F].
- 5 Operating temperature stated for 15 °C [59 °F] ambient temperature.
- 6 Funnel / fixture have to be made to fit actual installation and installed manually at surface.
- 7 Electronics encapsulated in nitrogen gas-filled (N<sub>2</sub>) 1 atmospheric chamber, welded by electronic beam welding and helium leak tested.
- 8 Bennex Omnitech Mk II Anguila M25 system or Ocean Design Inc. ¾" SAE Boss interface
- 9 Inrush current sequence worst case @ 24 VDC: <2,1 A for <2 ms, <30 mA for 12 s, thereafter 40 mA.
- 10 Proprietary DSP protocol (1 200 bps to 57 600 bps) Modbus RTU (9 600 bps to 38 400 bps)
- 11 Vibration:
  - 0 g to 5 g, 0 Hz to 1 000 Hz (X, Y, & Z direction)
  - Acoustic energy 1 024 Hz to 262 144 Hz (46 bins)
 Vibration output as Modbus RTU at speeds 9 600 bps to 38 400 bps or proprietary DSP protocol at speeds 1 200 bps to 57 600 bps. Ask supplier for more details.
- 12 Internal self-testing of analogue filters, amplifiers and flash memory.
- 13 See sensor GA drawing for details.
- 14 All sensors are calibrated on vibration jig. Option: Particle measurements are calibrated to a master sensor at factory, enabling use of standard algorithm. See particle monitor datasheet for more details regarding particle specification.
- 15 Depends on installation:
  - Minimum detectable vibration is 0,01 g
  - Calibrated range is 0 g to 5 g
  - Output resolution set to 0,01 g
  - Shock: 30 g (qualified), component rated for 200 g
 Sensitivity drift related to temperature is from -55 °C to 125 °C [-67 °F to 257 °F].
- 16 ROV handle, paddle handle according to ISO 13628-8. Other types of handle available on request:
  - T-bar, Extended T-bar, Fishtail, or hex-nut.
 Ask supplier for details.
- 17 See funnel GA drawing for details. Ask supplier for alternative designs.

### SYSTEM DESIGN

ClampOn Compact DSP Vibration Monitor 3D is designed to measure small vibration on structures/pipes, and can also be combined with a particle monitor to provide real-time data. The sensor is non-intrusive and installed in a funnel clamped to the pipe surface; hence no parts are in contact with the flow. ClampOn subsea sensors have two-way communication via RS-485 and can be upgraded / customized by software download.