DEWESoft®

DEWESoft IOLITEi 3xMEMS-ACC

A data acquisition device with embedded triaxial MEMS accelerometer, analog-to-digital conversion and EtherCAT interface based on the Dewesoft IOLITEd EtherCAT platform (www.dewesoft.com).

Key features:

- 25 µg√Hz noise density
- EtherCAT bus, daisy-chaining with single cable up to 50 m device-device
- DEWESoftX software support

Typical applications:

- Bridge structural monitoring
- Seismic measurements
- Mobile network antenna structural monitoring

IOLITEi 3xMEMS-ACC is an integrated sensing device. Acceleration is measured by a triaxial MEMS accelerometer inside the device that is tightly attached to the mechanical chassis. Analog to digital conversion is done inside the device, eliminating any noise pick up in analog cabling. Microprocessor inside the device transmits the acceleration samples over EtherCAT protocol into DEWESoft software running on a Windows PC, or alternatively to any controller running EtherCAT master on any platform. Scaling is automatic in DEWESoft software, therefore the data in g or m/s^2 is readily available to the user. MEMS sensor internal temperature is also available as a data channel in DEWESoft software under System monitor channels.

Specifications of the MEMS accelerometer:

	Min.	Typ.	Max.	Unit
Measurement ranges	+-2		+-8*	g
-3 dB bandwidth		1000		Hz
Sample rate			4	kHz
Dynamic range		96		dB
Noise density (+-2 g)		25		µg/√Hz
Residual noise (+-2 g @50 Hz bandwidth)		100		µg RMS
Residual noise (+-2 g @125 Hz bandwidth)		150		µg RMS
Calibrated offset error (0 Hz)		+-4		mg
Calibrated gain error (0 Hz)		+-0.2		%
Offset temp. drift (-20...60 degC)	-0.15	+-0.02	0.15	mg/degC
Sensitivity temp. drift (-20...60 degC)		+-0.01		%/degC
Linearity error -1g ... +1g range		0.1		% FS
Crossaxis sensitivity	-1		+1	%

*a version with +-10 ... +-40 g range is also available, contact your local sales representative for more info
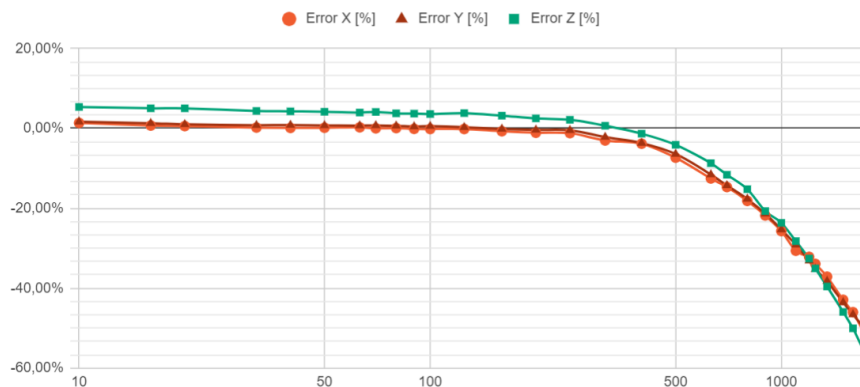
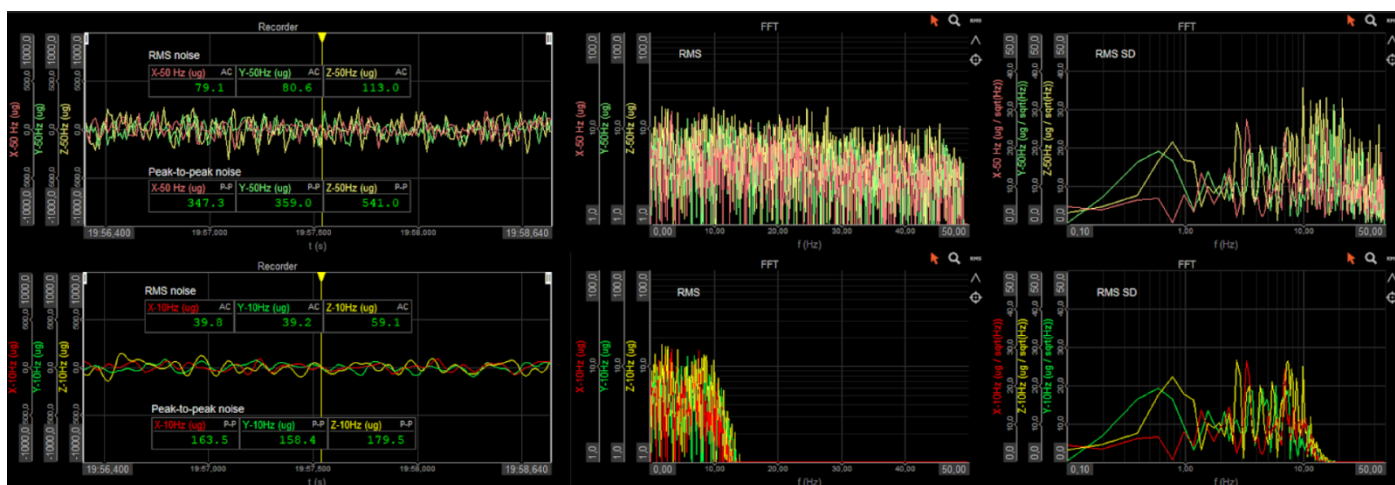Figure 1 - IOLITEi 3xMEMS-ACC frequency response (Range: 2g, SR: 4 kS/s)

Figure 2 - a typical noise spectrum of all three axes of the DEWESOFT 3xMEMS-ACC. From left to right the plots show: time recorder, FFT (RMS value), FFT (RMS spectral density value). The top section shows noise floor at 50 Hz bandwidth and the bottom section shows the reduced noise when a 12 Hz low pass filter is applied.

Velocity noise specification

DewesoftX software includes functions for integrating the acceleration measurements from the 3xMEMS-ACC sensor into velocity and displacement. The integration high-pass frequency is freely adjustable in software.

	RMS noise	Peak-Peak noise
1-100 Hz, axes X and Y	0.04 mm/s	0.15 mm/s
1-100 Hz, axis Z	0.05 mm/s	0.20 mm/s

Internal temperature sensor: there is an internal temperature sensor mounted inside the device that measures the temperature of the MEMS accelerometer. The readings from the temperature sensor are diplayed in Dewesoft software as a System Monitor channel. The values are updated once per second.

Synchronization: EtherCAT communication between devices ensures 1 us synchronization between the samples taken from different devices in the chain. The distance between devices does not influence the precision of the synchronization.

Long term stability: Based on actual ageing and artificial ageing tests (vibration exposure, temperature cycling) it is expected that the 0 g offset drift over 1 year is within +-50 ug.
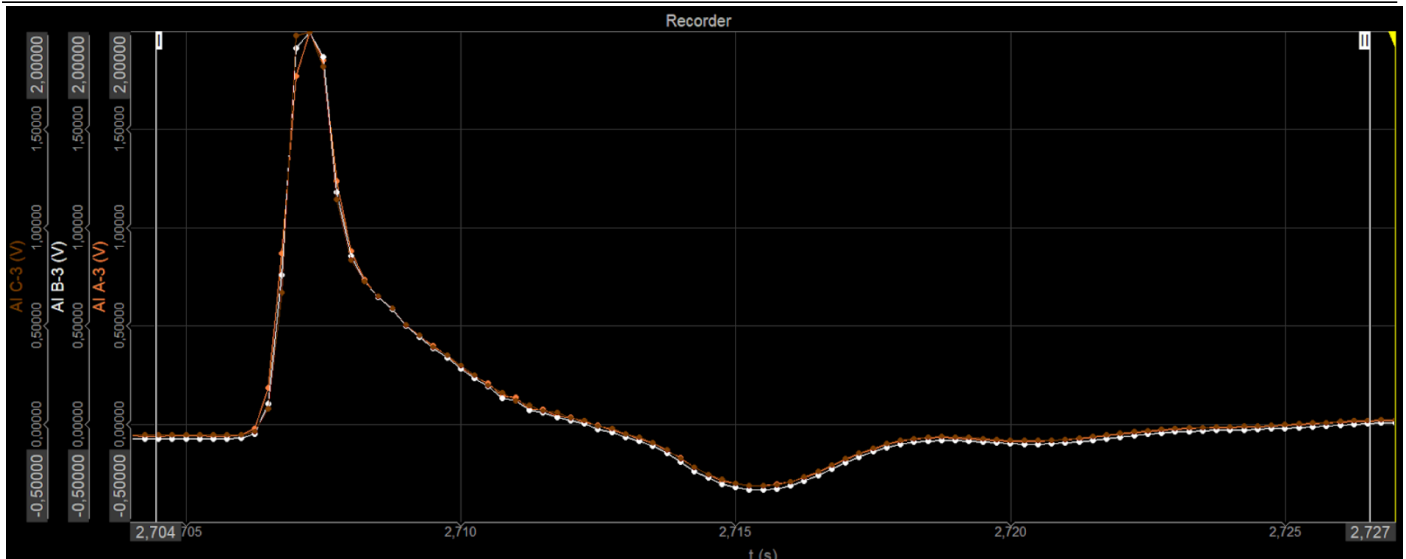
Figure 3 – acceleration data from three 3xMEMS-ACC devices that had 50 m of cable between each of them. Devices were screwed together and excited by a drop test. The data is totally synchronized.

General specifications of the IOLITEi 3xMEMS-ACC device:

Digital interface	EtherCAT
Interface connectors	RJ45
Power consumption	1300 mW
Supply voltage	12-48 V
Operating temperature	-20 ... 65 degC
IP rating	IP20
Weight	105 g
Housing material	Aluminium
Tariff number (HTS)	8471.90.0000
Tested according to	IEC-61010, IEC-61326 (EMC compatibility - measurement & control) IEC-62236-4 (EMC compatibility - railway)

Option: IOLITEi 3xMEMS-ACC-INC (static inclinometer / tiltmeter)

IOLITEi 3xMEMS-ACC can be used as a two-axial static inclinometer. The requirement needs to be specified at the time of order (-INC option) since additional calibration procedure is required to guarantee the calibrated accuracy of the device. 3xMEMS-ACC can be used to measure the roll and pitch angles (about its X and Y axes) with the Z axis positioned vertically. The inclination (tilt) angles appear as two additional channels (roll and pitch) in DewesoftX software (from software version 2023.5 and device firmware version 2.6.7 onwards).

Inclinometer specifications	
Measurement range	+-15 deg
Resolution	0.001 deg
Relative accuracy (23 degC)	0.01 deg
Bandwidth	<0.1 Hz
Update rate of inclination channels	1 Hz

Option: IOLITEiw 3xMEMS-ACC (outdoor version)

IOLITEi 3xMEMS-ACC can be supplied in a wateproof aluminium enclosure with cable glands. The enclosure is designed to be mounted outdoor. Cables are to be inserted through the cable glands at the installation location and crimped to the male RJ45 connectors. Female RJ45 connector of the 3xMEMS-ACC are located inside the waterproof enclosure. The top lid is to be fixed to the enclosure using an O-ring seal and four bolts after the connectors are mated.
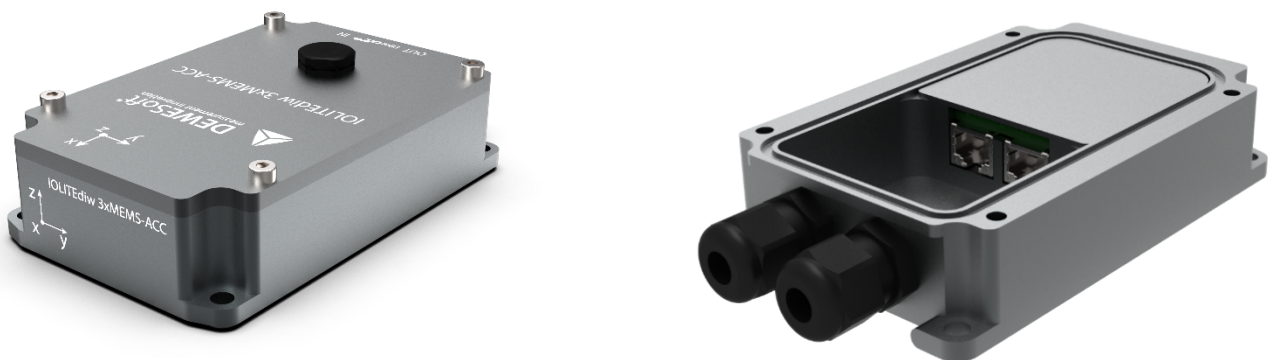

Figure 4 - IOLITEi 3xMEMS-ACC-w option - outdoor enclosure

The outdoor enclosure automatically vents air to equalize pressure inside the enclosure to the outside air pressure while it does not allow water to pass into the enclosure. This prolongs the life span of the seal and increases durability of the enclosure.

Option: IOLITEi 3xMEMS-ACC-T (external temperature sensor)

A version of the device with an input channel for an external temperature sensor. M8 connector is added to the front panel of the device to which a digital external temperature sensor is connected. The temperature sensor DS-TEMP-1WIRE-M8 must be ordered separately, cable lengths up to 10 m are available. Both IOLITEi and IOLITEiw versions are available.

Figure 5 - IOLITEi 3xMEMS-ACC-T option and DS-TEMP-1WIRE-M8 external temperature sensor

External temperature sensor specifications	
Measurement range	-55 degC … 125 degC
Accuracy	+-0.5 deg C (-10 degC to 85 degC)
Accuracy with additional factory calibration*	+-0.3 deg C (-20 degC to 80 degC)
Resolution	0.063 deg C

*on request only

Software support

1. DewesoftX – the IOLITEi 3xMEMS-ACC is automatically recognized by the DewesoftX software. Device settings such as measurement range and sample rate are easily configured with the user interface. DewesoftX offers limitless posibilities of synchronized data acquisition, display, recording, mathematics, post-analysis and data export.

2. Any standard EtherCAT master – the IOLITEi 3xMEMS-ACC is a standard EtherCAT slave and can therefore be connected to any EtherCAT master controller (Beckhoff TwinCAT, NI Labview, Simulink RT, Acontis etc.).

Hardware Installation

Devices are daisy chained with a standard network cable. It is recommended that the cable is shielded (SFTP, CAT5e) and has a minimum 24 AWG wire thickness. The cable must have 4 wire pairs. The maximum distance node-to-node is 50 m.

Power supply: Passive PoE power injector is neccessary for merging the EtherCAT signal and power into a single cable.
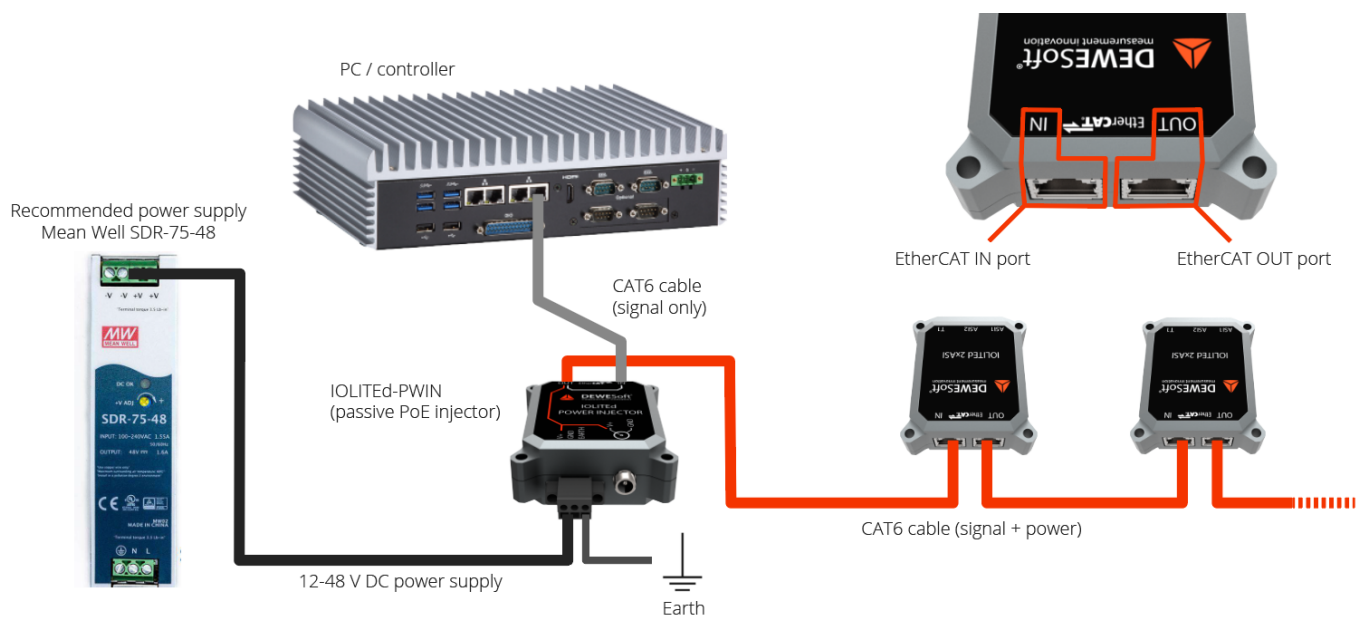

Power supply voltage	Cable length device-to-device	Cable size	Max. number of devices from a single power supply
24 V	1 m	AWG 24	8
24 V	50 m	AWG 24	4
48 V	1 m	AWG 24	12
48 V	50 m	AWG 24	10

Ordering information

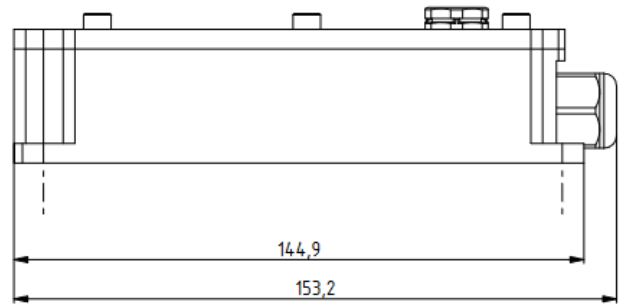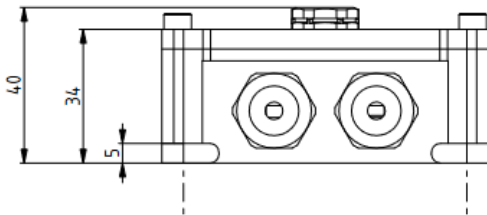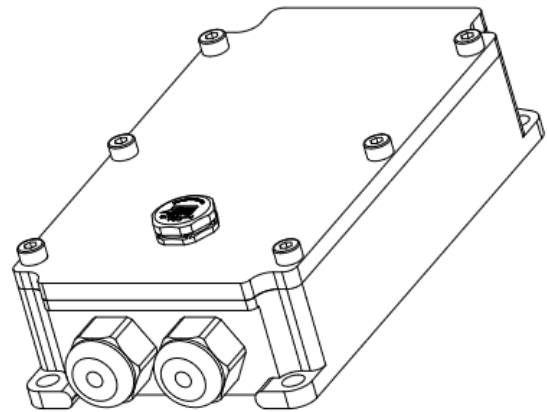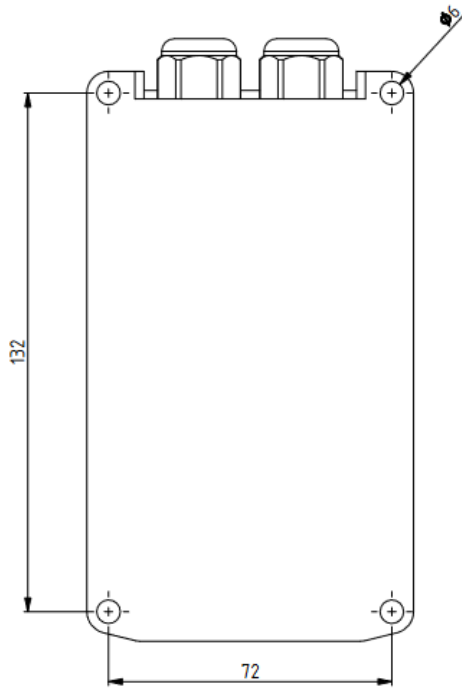| Order code	Description
IOLITEi-3xMEMS-ACC-8g	2g, 4g, 8g ranges, IP20
IOLITEi-3xMEMS-ACC-40g	10g, 20g, 40g ranges, IP20
IOLITEiw-3xMEMS-ACC-8g	2g, 4g, 8g ranges, IP67
IOLITEiw-3xMEMS-ACC-8g	10g, 20g, 40g ranges, IP67
IOLITEi-3xMEMS-ACC-INC	2g, 4g, 8g ranges, IP20, temperature offset drift compensation (2 ug/degC typ.)
IOLITEiw-3xMEMS-ACC-INC	2g, 4g, 8g ranges, IP67, temperature offset drift compensation (2 ug/degC typ.)
IOLITEi-3xMEMS-ACC-8g-T	2g, 4g, 8g ranges, IP20, external temperature sensor channel
IOLITEiw-3xMEMS-ACC-8g-T	2g, 4g, 8g ranges, IP67, external temperature sensor channel
DS-TEMP-1WIRE-M8-2m	External temperature sensor, 2 m cable length
DS-TEMP-1WIRE-M8-5m	External temperature sensor, 5 m cable length
DS-TEMP-1WIRE-M8-10m	External temperature sensor, 10 m cable length

Mechanical drawing - IOLITEi 3xMEMS-ACC
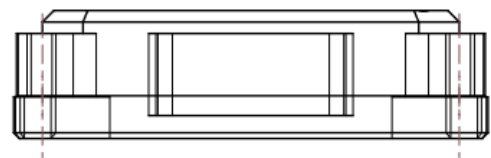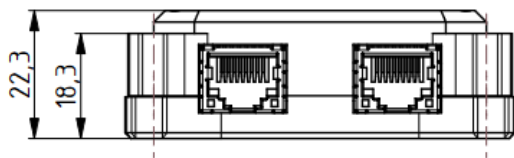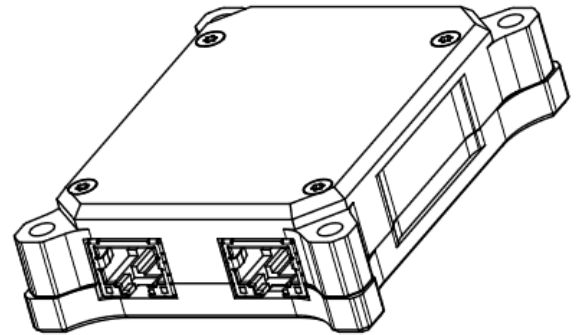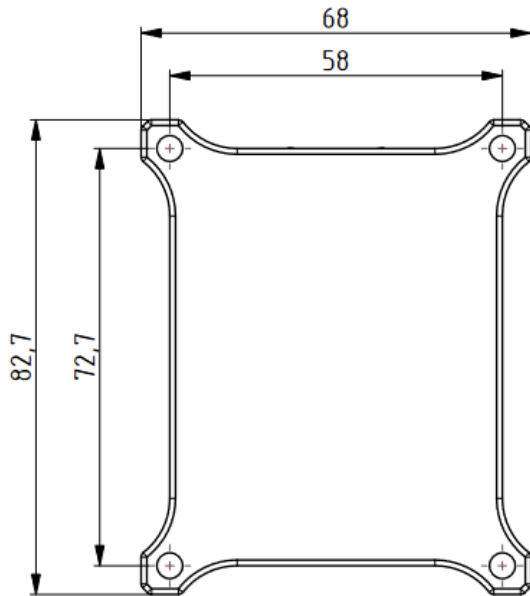
(Not to scale)

Preferred mounting: M4 screws in each of the four Φ4.5 mm corner holes.

Mechanical drawing - IOLITEiw 3xMEMS-ACC

(Not to scale)