Tower Oscillation Monitor
GEL 3010
with EtherCAT or
CANopen interface

Technical information

Version 02.13

General

- 2-axis tower oscillation monitor in compact design
- Integrated safety relay switches on reaching the adjustable limits
- Maintenance and wear-free operation due to MEMS acceleration sensors
- Measuring system is not subject to ageing, is insensitive to temperature fluctuations, dirt or condensation
- Redundant system possible due to usage of 2 tower oscillation monitors

Features

- Measuring direction X and Y
- Resolution 0.01 m/s^2
- Extended temperature range -40 °C to +85 °C
- Interfaces:
  - EtherCAT,
  - CANopen
  - Adjustable safety relay output
- Protection class IP 67
- Installation altitude 4000 m

Advantages

- Suitable for all standard applications and also for real heavy-duty applications
- Temperature behaviour stable over the long-term
- Full function in case of condensation: dew-point resistant!

Field of application

- Wind power

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Description

Construction and design

The tower oscillation monitor GEL 3010 is designed for monitoring oscillations and vibration on machines and installations “in accordance with DIN ISO 10816”.
MEMS acceleration sensors, safety relay and EtherCAT or CANopen interface are integrated into a compact housing made of anodised aluminium. The state of the vibration monitor can be checked on-site using 6 diagnostics LEDs.
The tower oscillation monitor contains a positively driven switched output that can be integrated into an existing safety chain. A redundant system can be realised by using two tower oscillation monitors.
The GEL 3010 is suitable for standard and heavy-duty applications, it also withstands aggressive media and impresses with a long, maintenance-free service life. It can be used in an expanded temperature range from -40 °C to +85 °C.

Interfaces

The tower oscillation monitor is available with an EtherCAT interface or a CANopen interface.
The switched output is a positively driven, floating safety relay with one normally closed contact and one normally open contact. In the de-energised state and in case of an error, the relay is open. The switching points (trigger limits) and the trigger delay are adjustable.

Sensing principle

The tower oscillation monitor GEL 3010 measures the accelerations in the X and Y direction using so-called MEMS acceleration sensors, micro-electro-mechanical systems that operate like spring-mass systems.
In principle a freely moving mass is suspended in the MEMS module; this mass is held in the middle position between two reference electrodes by springs. The mass forms the moving electrode of two capacitors.
The moving mass is accelerated by oscillations and vibration. It moves and the distance between the middle electrode and the reference electrodes changes, as a consequence the electrical capacitance of the capacitors also changes. The electronics measure this change in the capacitance and compare the values measured with the limits set. If the acceleration reduces, the springs return the moving mass to its original position. If the acceleration is zero, the installation has reached the required speed or it is not in operation, as a result the spring-mass system is at rest.
The GEL 3010 contains two acceleration sensors that measure the movement in both the X and Y direction. This configuration makes it possible to test the sensors internally during the self-test.

Safety function

Self-test

After power up the GEL 3010 checks the internal acceleration sensors and the relay during the self-test. Once the device is ready for operation, the status is sent to the installation control system via the bus interface.
The continuous self-test function in the GEL 3010 ensures both acceleration sensors are tested during operation. A defective sensor is reliably detected and the device signals the failure of the sensor via the field bus.
During operation a self-test can be triggered by the installation control system using the field bus protocol. For this purpose the relay is switched once, as a result the safety circuit is opened.
To ensure an interruption-free safety circuit even during the self-test, two tower oscillation monitors should be connected in parallel. In this case the self-test triggered via the field bus must not be initiated on both devices simultaneously.

Safety chain

The GEL 3010 can be permanently wired in series with other monitoring devices in the safety chain. If a monitoring device triggers, the safety chain is interrupted and, if necessary, emergency braking initiated.
On reaching the limit set, the safety relay in the tower oscillation monitor can be switched and the safety chain opened. In parallel the critical state is signalled to the installation control system via the field bus. In this way dangerous, superimposed resonances are reliably detected and the installation shut down.
By using several tower oscillation monitors in the safety chain, different safety concepts can be realised:

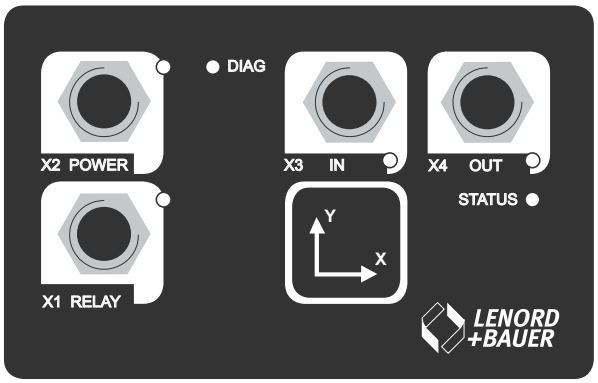
Onshore	Usage of two devices provides redundancy by means of cross-comparison
Offshore	Usage of three devices ensures safe operation even in case of the failure of a device

General	
Measuring axes	2 (X, Y direction)
Measuring range	± 20 m/s^2 (2g)
Resolution	± 0.01 m/s^2
Accuracy	± 0.05 m/s^2 typical
Zero point offset(1)	± 0.5 10^{-3} m/s^2K
Cross-sensitivity	≤ 2 %
Electrical data	
Operating voltage	15 to 36 V DC
Power consumption • CANopen • EtherCAT	 < 2.4 W < 3.5 W
Scanning rate	5 ms
Digital interfaces	CANopen, EtherCAT
Switched output	
Relay	1 × NC, 1 × NO, positively driven, floating, Position in the de-energised state: open Position in case of error: open
Relay nominal values	24 V DC / 0,5 A
Relay minimum current	≥ 5 mA at 24 V DC
Trigger limit X direction	± 2 m/s^2 (0.2g)
Trigger limit Y direction	± 2 m/s^2 (0.2g)
Trigger delay	0.05 s
Inhibit time after relay triggering	30 s
Cut-off frequency low-pass filter	10 Hz
Mechanical data	
Housing material	Anodised aluminium
Weight	625 g
Dimensions (W×D×H)	156 × 76 × 46 mm
Environmental conditions	
Assured operating temperature range	-40 °C to + 85 °C
Storage temperature range	-50 °C to + 85 °C
Installation altitude	4000 m
Protection class in accordance with DIN 60529	IP 67
Vibration resistance (DIN EN 60068-2-6)	200 m/s^2, 10 ... 2000 Hz
Shock resistance (DIN EN 60068-2-27)	1000 m/s^2, 11 ms
EMC	EN 61000-6-1 to 4
Insulation strength	Ri > 1 MΩ, at a test voltage of 500 V AC
Max. relative humidity of air	99 %
Condensation permitted	yes

(1) at 25 °C

Overview of connections and status monitoring, Switching variants

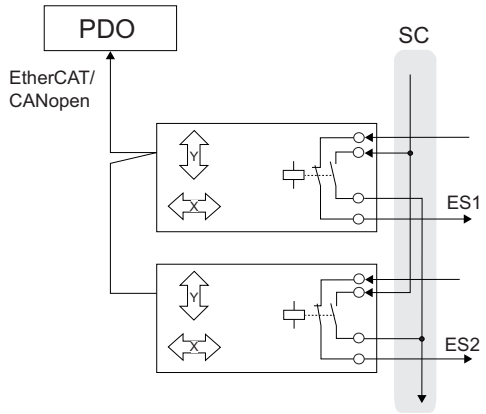
Overview of connections and status monitoring



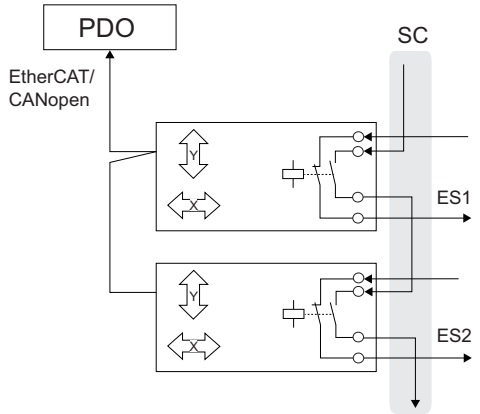
Identifier	Function	LED status indication	
X1 RELAY	Relay	off	Triggered (SC open)
		green	Ready (SC closed)
		flashing red	Error
X2 POWER	Power supply	red	24 V power supply in order
		orange	Internal device power supply in order
DIAG	Device status	green brighter/dimmer	Ready (SC closed)
		green flashing	Bus communication interference (SC opened)
		flashing red	Error
		red/green flashing	Relay has triggered, switching back on not yet allowed (SC opened)
X3 IN	Bus input	green/red	Function dependent on the interface
X4 OUT	Bus output	green/red	Function dependent on the interface
STATUS	Bus status	green/red	Function dependent on the interface

Switching variants within the safety chain

2 × GEL 3010 connected in parallel



2 × GEL 3010 connected in series



SC Safety chain
ES Error signal
PDO Process data transmission to the installation control system

Pin layout,
Technical data – interfaces

Pin layout

Relay
M12 plug, 4-pin, D-coded

Pin assignment

Pin	X1 RELAY
1	Normally closed contact
2	Normally closed contact
3	Normally open contact
4	Normally open contact

1 × NC, 1 × NO,
positively driven, floating,
Position in the de-energised state: open
Position in case of error: open

Power supply
M12 plug, 4-pin, A-coded

Pin assignment

Pin	X2 POWER
1	$+V_S$
2	–
3	GND
4	–

Pin layout – interfaces

EtherCAT

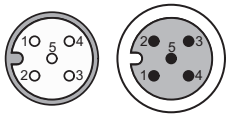
M12 sockets, 4-pin, D-coded

Pin assignment

Pin	X3 IN	X4 OUT
1	Transmission Data+	Transmission Data+
2	Receive Data+	Receive Data+
3	Transmission Data-	Transmission Data-
4	Receive Data-	Receive Data-

CANopen

M12 plug/socket, 5-pin, A-coded



IN OUT

Pin assignment

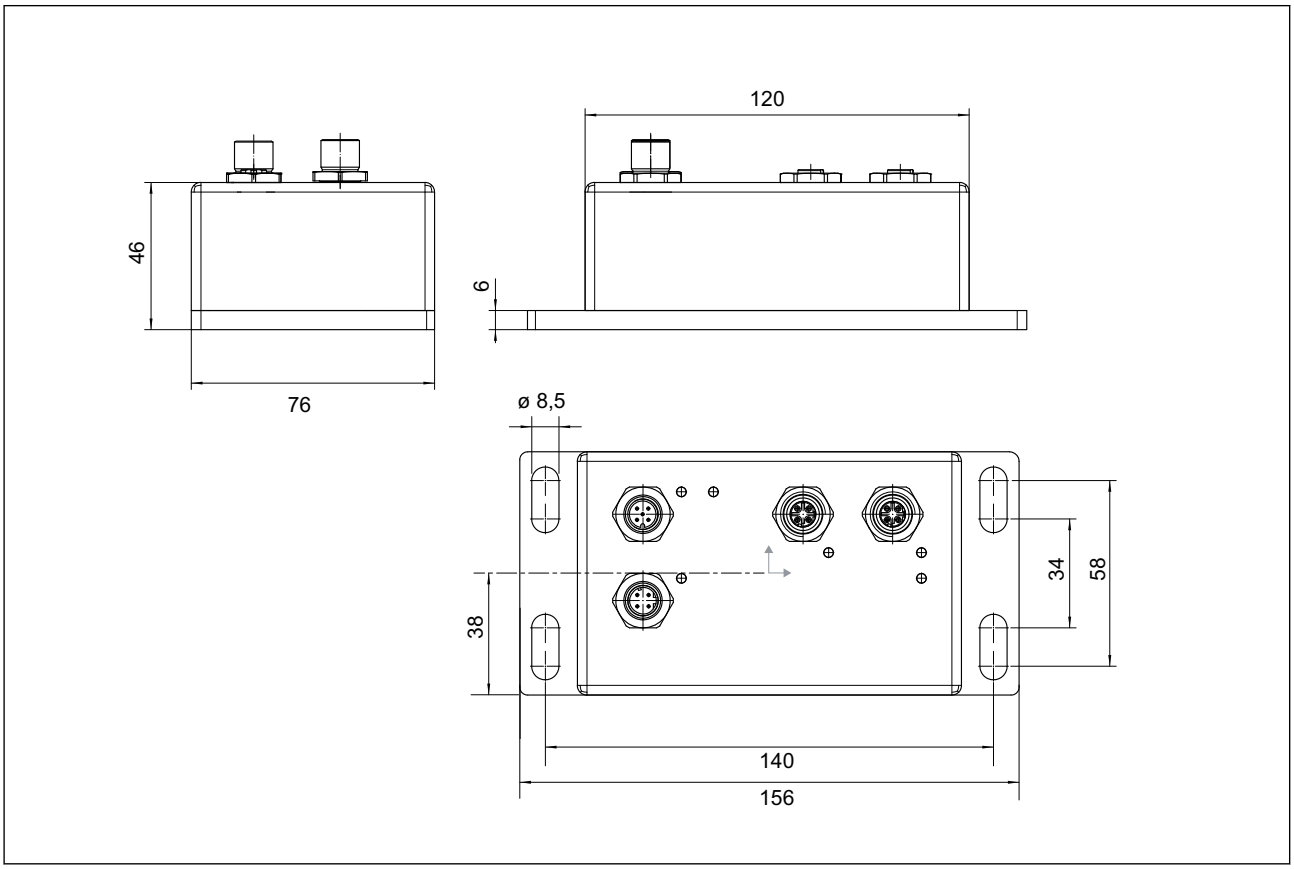
Pin	X3 IN	X4 OUT
1	Screen	Screen
2	V_S IN	V_S OUT
3	GND	GND
4	CAN_H	CAN_H
5	CAN_L	CAN_L

Technical data — interfaces

Interface	EtherCAT	CANopen
Device profile	CoE (CANopen over EtherCAT) DS 401	CANopen DS 401
Connection	D-coded M12 connection and diagnostics LEDs	A-coded M12 connection and diagnostics LEDs
Parameter	Limits in X and Y direction, trigger delay, relay inhibit time, cut-off frequency (low-pass filter)	Limits in X and Y direction, trigger delay, relay inhibit time, cut-off frequency (low-pass filter)
Sensor ID	Automatic address assignment	LSS in accordance with DS 302
Operating temperature	-40 … +85 °C	-40 … +85 °C

Dimensional drawing

Dimensional drawing GEL 3010



Type code, Accessories

Type code GEL 3010

	Interface						
	EC EtherCAT						
	CO CANopen						
		Measuring axes					
		2 2–axis					
			Measuring range				
			A ± 2 g				
				Status output			
				0 Without status output			
				1 Relay, 1x positively driven			
					Type of mounting		
					G Floor mounting		
						Housing material	
						A Anodised aluminium	
							Device pre-setting
							00 Default setting
GEL 3010	_ _	_	_	_	_	_	_ _

Customer-specific designs

Customer-specific modifications to mechanical and electrical features are in principle possible.

Accessories

Description	Item number
CANopen connection cable 10 m, 5-pin plug / flying lead with ferrules	BK 2100
CANopen connection cable 2 m, 5-pin plug / flying lead with ferrules	BK 2101
CANopen connection cable 10 m, 5-pin socket / flying lead with ferrules	BK 2102
CANopen connection cable 2 m, 5-pin socket / flying lead with ferrules	BK 2103
CANopen connecting cable 10 m, 5-pin socket/plug	BK 2104
CANopen connecting cable 2 m, 5-pin socket/plug	BK 2105
CANopen, mating connector 5-pin socket, A-coded	FS 3020
CANopen, mating connector 5-pin plug, A-coded	FS 3021
CANopen terminating resistor M12	FS 3040
Power supply connection cable 10 m, 4-pin A-coded socket/ flying lead with ferrules	FS 3019
Power supply connection cable 2 m, 4-pin A-coded socket / flying lead with ferrules	FS 3018
EtherCAT, mating connector, M12, 4-pin plug, D-coded	FS 3039
Relay output connection cable 10 m, 4-pin socket D-coded / flying lead with ferrules	FS 3075
Relay output connection cable 2 m, 4-pin socket D-coded / flying lead with ferrules	FS 3074
Relay output mating connector, M12, 4-pin socket, D-coded	Upon request

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LENORD +BAUER
... automates motion.

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