

Product is currently in the validation stage. Specifications represent typical development values. CE conformity planned.

Product Description

The standardized washer combines a force sensor with integrated digital signal processing and CAN communication (CANopen). The system enables precise measurement of axial forces in bolted connections, as well as additional measurement of temperature and motion data.

The analogue sensor signals are digitized directly on the washer, processed internally, and transmitted cyclically via the CAN bus. Parameter can be set and configured using simple CAN messages, without using the CANopen protocol.

Parameter settings and firmware updates are entirely software-based.

Key Features

- Axial force measurement in bolted connections using the capacitive DELTA-C® measuring principle (developed by Fraunhofer)
- Multi -Sensor-System:
 - Force in N
 - Temperature in C°
 - 6D motion detection (acceleration & angular velocity)
- 24-bit ADC – resolution application dependent (~ 10N)
- Internal signal processing via ARM-based controller architecture
- Parameter settings and firmware updates via CANopen
- Device identification via LEDs
- Software-based addressing via CANopen LSS (Node-ID: 1 - 127)
- Adjustable Bus speed via CANopen LSS
- Protection Class IP65
- Parameter settings and interpretation of CAN messages via EDS (CANopen) or BDC (CAN 2.0)

Operating Principle

The measurement is performed through elastic deformation of the washer under axial load within the bolted connection.

This deformation is detected by integrated sensor elements, digitally processed, and output as a force value.

Additionally, temperature and motion data are provided for conditioned monitoring of the connection.

CANopen Communication

The altosens.disc uses the standardized CANopen communication protocol for reliable integration into industrial CAN networks.

It is based on CAN-Bus and enables real-time communication and simple device integration.

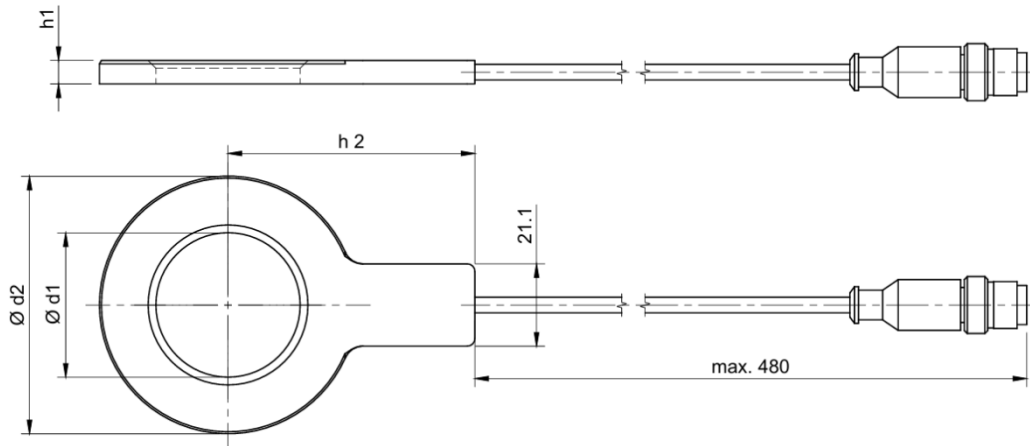
Device Profile & LEDs:

- Standardized objects for sensor values and status
- LEDs indicate operating state, errors, or communication

Advantages:

- Fast integration of multiple sensors
- Combination of PDO, SDO and SYNC for efficient data transmission
- EM, Heartbeat and LSS simplify diagnostics and management

Mechanical Data



Variant Overview

	<	M20	M24	M27	M30	M33	M36	M42	>
Ø d1	Available on request	21mm	25mm	28mm	31mm	34mm	37mm	43mm	Available on request
Ø d2		37mm	44mm	50mm	56mm	60mm	66mm	78mm	
H		5mm	5mm	5mm	5mm	5mm	6mm	8mm	
F_{nom}		200kN	300kN	400kN	500kN	600kN	700kN	950kN	

Technical Data

Parameter	Value
Sensor type	Force Sensor
Supply voltage	4,5 - 36 V DC
Resolution	24 bit
Protection Class	IP65
Temperature range	-40 to +80°C
Interface	CAN 2.0

Connector and Pin Assignment



Pin	Function
1	PE
2	+24 V
3	GND
4	CAN_H
5	CAN_L
Technical Data	
Connector	M12 connector, 5 pin, A-coded
Cable Ø	Ø 3,9 mm

Electrical Data

Parameter	Value
Supply voltage	4,5 - 36V DC
Connection	M12 x 1, 5-pin
Cable	0,5 m TPU
Conversion time	10 ms
Protection class *	IP 65 according to IEC 60529
<i>*The specified protection class only applies when connected with corresponding connectors of the same protection class</i>	

Signal Types

CANopen

Rea-Time Data (PDO)

CAN-ID/ Byte	0	1	2	3	4	5	6	7
PDO 1: 0x180 + Node ID	Force Z-Axis Value (0.0001 kN) (signed integer 32)				Force Raw Z-Axis Value (unsigned integer 32)			
PDO 2: 0x280 + Node ID	Acceleration X-Axis Value (0.001 g) (signed integer 16)	Acceleration Y-Axis Value (0.001 g) (signed integer 16)		Acceleration Z-Axis Value (0.001 g) (signed integer 16)		/		
PDO 3: 0x380 + Node ID	Angular Velocity X-Axis Value (0.1 dps) (signed integer 16)	Angular Velocity Y-Axis Value (0.1 dps) (signed integer 16)		Angular Velocity Z-Axis Value (0.1 dps) (signed integer 16)				
PDO 4: 0x480 + Node ID	Dummy	Dummy	Dummy	Dummy	Dummy	Dummy	Temperature Value (0.01 °C) (signed integer 16)	

Functions:

- **PDO:** real-time transmission of measured values and setpoints
- **SDO:** access to configuration, calibration and diagnostics
- **SYNC:** time-critical data transmission
- **EM (Emergency):** messages in case of errors or alarms
- **Heartbeat / Node Guarding:** device monitoring
- **LSS:** setting Node-ID and bitrate without physical access

LED Status Indicators

LED-Status	Beschreibung
LED on	LED permanently on
LED off	LED permanently off
LED blinking	ISO phase switching at approx. 2.5 (~200 ms on, ~200 ms off)
LED single flash	Short pulse (~200 ms) followed by long pause (~1000 ms)
LED triple flash	Three short pulses (~200 ms) separated by pauses (~200 ms). Pause after each sequence (~1000 ms).
* Detailed description: CiA 303 Chapter 5	
Red LED off	No error
Red LED single flash	CAN controller warning limit reached
Red LED on	Bus Off
Green LED on	Device state: OPERATIONAL
Green LED blinking	Device state: PRE-OPERATIONAL
Green LED single flash	Device state: STOPPED
Green LED triple flash	Software download in progress

Communication

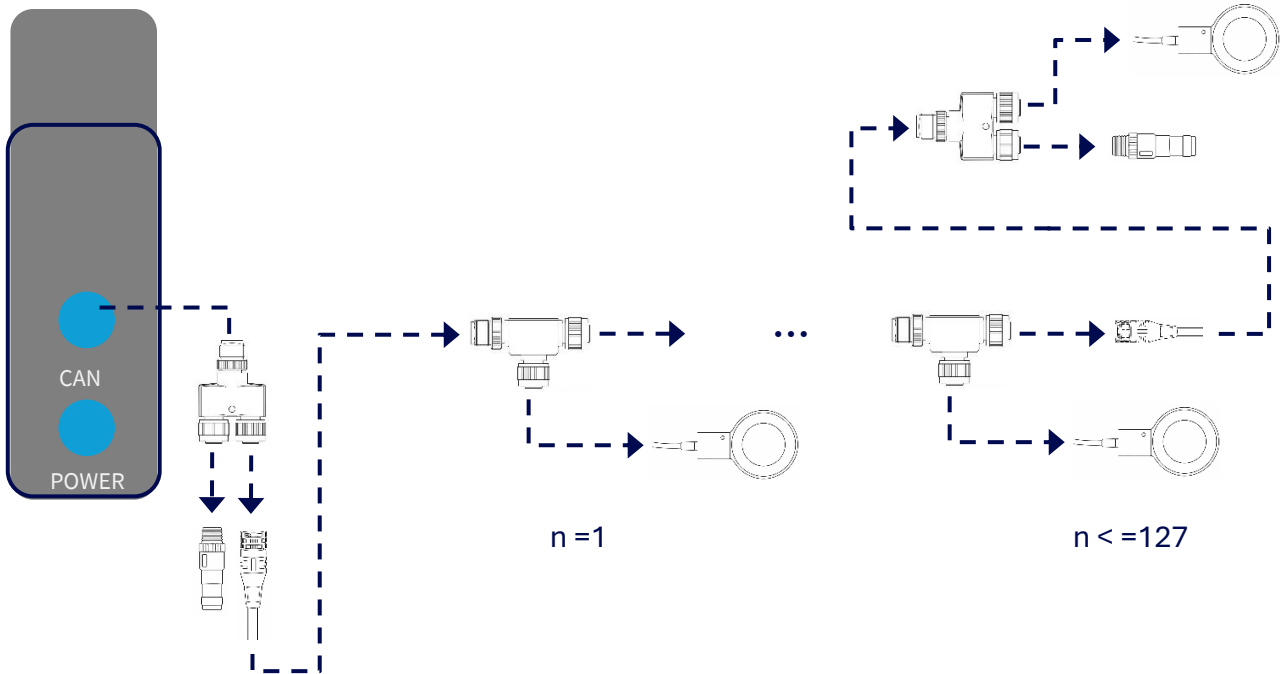
Output Signal		
Signal type		
CANopen	Application Layer & Communication Profile	CiA 301
	Indicator Specification	CiA 303
	Layer Setting Services and Protocol	CiA 305
Communication		
CANopen® Interface configuration	The altosens.disc can be ordered pre-configured	
Baud rate	0	1000 kbits/s
	1	800 kbits/s
	2	500 kbits/s
	3	250 kbits/s (standard)
	4	125 kbits/s
	5	-
	6	50 kbits/s
	7	20 kbits/s
	8	10 kbits/s
Node-ID	001... 127	002 (Standard)

Output Signal		
Signal type		
PDO Mapping	1	Objekt 0x6007.03 (Force Z-Axis, int32) und 0x6006.03 (Force Raw Z-Axis uint32)
	2	Objekt 0x6008.01 (Angular Velocity X-Axis, int16), 0x6008.02 (Angular Velocity Y-Axis, int16) und 0x6008.03 (Angular Velocity Z-Axis, int16)
	3	Objekt 0x6009.01 (Acceleration X-Axis, int16), 0x6009.02 (Acceleration Y-Axis, int16) und 0x6009.03 (Acceleration Z-Axis, int16)
	4	Objekt 0x0006.00 (Dummy, int16), 0x0006.00 (Dummy, int16), 0x0006.00 (Dummy, int16) und 0x600B.01 (Temperature, int16)
PDO Cycle	00001... 65535	Period in milliseconds
Transmission type	001... 240	Synchronous transmission PDO1: 015 (standard) PDO2: 001 (standard) PDO3: 001 (standard) PDO4: 240 (standard)
	254	Asynchronous cyclic transmission (event timer driven)
	255	Asynchronous transmission (event timer driven: not implemented)
Event timer	0	Automatic (standard)
	00001... 65535	Event timer in milliseconds
Auto-Start-Operational	0	Off via Objekt 0x2009.02 (standard)
	1	On via Objekt 0x2009.02
Heartbeat	1000	With (standard)
	00001... 65535	Heartbeat in milliseconds (Default: 1000)
Operating State: Operational	Normal operating state. The device sends and receives PDOs for real-time data and also supports SDO for configuration.	

NMT-Mode

Function	CAN-ID	Length	Data byte 0	Data byte 1
Start Node (Operational)	0x000	2	0x01	Node-ID
SYNC	0x080	0		
PDO	SYNC counter	Effective frequency	Transmission interval	
PDO1	240	Ca. 2.08 Hz	480 ms	
PDO2	15	Ca. 33.3 Hz	30 ms	
PDO3	1	500 Hz	2 ms	
PDO4	1	500 Hz	2 ms	

Example Application



Note: A CAN bus impedance of 120 Ω is mandatory to achieve maximum communication range and number of participants at all transmission rates.

To avoid potential differences, the shield must be connected across the entire bus with minimal impedance.

Accessories

Description	Qty.	Product number
altosens.edge with WLAN & LTE antennas	1	--
altosens.disc with Node ID-2 and ID-4	2	ADXXXG5XX001
Plug-in power supply with M12 connector	1	ACD1G1CB001
M12 connection cable	2	--
CAN Y-distributor	2	AYxxxG1CB001
CAN T-distributor	1	ATxxxG1CB001
Termination resistor	2	AR120G1CB001
Optional: Ethernet cable RJ45/m12	1	AGDING1EB001