

Safety manual in accordance with series of standards EN 61508

Level sensor type TORRIX ... and type VISY-Stick ...

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I Range of application

The level sensors are suitable for areas in which a safety-related subsystem according to EN 61508 with SIL 2 is mandatory.

II Standards

The level sensors are designed in accordance with the following standards

EN 61508:2010, all parts Functional safety of electrical/electronic/programmable electronic safety-related systems

III Instructions for safe ...

III.a ... use

This safety manual applies to all level sensors from hardware version 4 and from firmware version 4.9 upwards. The version numbers can be read with differences:

TORRIX ... HART ...: The version numbers can be read out using the configuration program FAFNIR HART-Setup.

TORRIX ... RS485 ...: The firmware version can be read out using the MODBUS ASCII protocol.

TORRIX ... SC ... and VISY-Stick ...: The version numbers can be read out using the configuration program VISY-Setup or the FAFNIR protocol Universal Device Protocol (UDP). The respective technical documentation is to be consulted for the use of the named options.

TORRIX ... TAG ...: The firmware version is issued at regular intervals in the identification message. The field name is "Firmware Version" and has a length of two bytes.

In principle, the level sensor indicates the correct fill level (plausibility check) and / or, in the case of a detected error, an error value (safe state), which corresponds to a mode of operation with a continuous requirement. The safe state is reached within ten seconds. The safety function is ensured differently depending on the level sensor.

It must be ensured that there are no strong magnetic fields in the area of the probe tube. In addition, the safe use with adhering liquids is not guaranteed.

Type	Approval	Electrical design	Structure	Measuring accuracy	Mechanical design	Temperature range
						HHT Maximum temperature -40 °C ... +450 °C HT High temperature (HT) -40 °C ... +250 °C LLT Minimum temperature -200 °C ... +80 °C LT Low temperature -65 °C ... +125 °C NT Normal temperature -40 °C ... (+85) +125 °C
					<i>n</i> Rigid sensor tube with 12 mm diameter <i>n</i> = sensor tube Ø, e.g. 6 (mm) <i>nB</i> <i>n</i> = sensor tube Ø; Sensor tube not centered on the sensor head 90B Sensor tube bent 90° in front of the sensor head and Bypass B Sensor tube not centered on the sensor head (Bypass) Flex ... Flexible sensor tube (... Ø _{sensor tube} : F = 13 mm; T = 12 mm) PL Plastic coating against very aggressive media SP Sampling tube, e.g. for sampling	
					Standard -5T With five temperature sensors -A5T Increased measurement accuracy and five temperature sensors -A Increased measurement accuracy (Advanced)	
					Standard construction VT Internal structure vibration resistant for portable tanks	
					4 ... 20 mA interface with internal setting button C 4 ... 20 mA interface without internal setting button HART 4 ... 20 mA interface with HART protocol internal setting button HART C 4 ... 20 mA interface with HART protocol and without internal setting button RS485 RS-485 interface SC Serial communication (for connection to isolating amplifier VP-... or VPI) TAG TAG interface; signal transmission based on EN 14116	
					Without Ex approval Ex With Ex approval	

TORRIX Magnetostrictive level sensor (from version 5) with terminals or connection plug

Type code III.a1: Level sensor TORRIX ...

System	Type	Accuracy	Sensor tube	Usage	Interface
					For connection to isolating amplifier VP-... or VPI RS485 For connection to an RS-485 interface TLS For connection to a TLS (Veeder-Root)
					Standard level sensor Biodiesel Level sensor; Biodiesel E15 Level sensor; Ethanol admixture up to 15 % Ethanol Level sensor; Ethanol Interstitial Device for monitoring intermediate chambers in double-walled tanks LPG Level sensor; LPG N Level sensor; AdBlue Sump Environmental sensor for monitoring the dispenser sump with liquid distinction (product / water) Dispenser Sump Environmental sensor for monitoring the manhole with liquid distinction (product / water) Manhole Temp Temperature measuring chain with up to 32 temperature sensors
					Rigid sensor tube Flex Flexible sensor tube
					Standard Advanced Increased accuracy
					Stick Magnetostrictive level and environmental sensor with up to five temperature sensors in the sensor tube

VISY- Volume Information System

Type code III.a2: Level sensor VISY-Stick ...

III.b ... assembling and dismantling

For level sensors with connection board, only the cover of the connection housing may be removed for electrical installation and - by means of push buttons - for adjusting the level sensor. After installation, the connection housing must be closed again.

Also, the floats may be removed from the probe tube. When mounting the floats, pay attention to the correct orientation.

III.c ... installation

To integrate the devices in the equipotential bonding, a PA terminal is provided on the sensor head. For functional safety, it is relevant that the probes are integrated in the equipotential bonding. For the level sensors with screw terminals, the terminal designation is "+" and "-". For level sensors with M12 male connectors, the pin assignments are as follows:

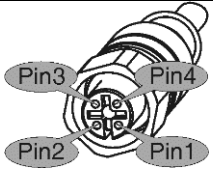
Pin	TORRIX ... SC ... VISY-Stick ...	TORRIX ... C ... TORRIX ... TAG ... VISY-Stick ... TLS	TORRIX ... RS485 ... VISY-Stick ... RS485	M12 Cable (Female)
1	+	+	+	
2	A		A (+)	
3	-	-	-	
4	B		B (-)	

Table III.c: Terminal assignment of the sensors

III.d ... adjustment

No SIL-relevant adjustments are required for operation of the sensors.

III.e ... putting into service

Before putting into service, all devices must be checked of right installation and connection. The electrical supply, as well of connected devices, must be checked.

III.f ... maintenance (servicing and emergency repair)

Generally, the level sensor is maintenance-free. In the event of a defect, it must be sent back to the manufacturer or one of its representations.

If an error occurs, e.g. no float on the probe tube, the corresponding diagnostic error is issued. If the error is corrected during active operation, the sensor leaves the error mode.

Level sensors with 4 ... 20 mA interface

In the event of a fault, the residual current flows (3.6 mA or 21.5 mA, whichever is set). If the fault current of 21.5 mA can not flow, e.g. if there is a low supply, the fault current of 3.6 mA is automatically set.

Level sensors with HART protocol

The second data byte of the level sensor response contains the device status. The flag "Device malfunction" (0x80, bit 7) signals a device error. If the "More Status Available" flag (0x10, bit 4) is also set, then device-specific status bits (byte 0) can be queried:

Bit	Fault	Description
0	HART parameters	HART parameters have been changed illegally
1	Sensor parameters	Sensor parameters have been changed illegally
2	Measurement	No measurement possible
3	Error counter	Too many errors during the measurement
4	Undervoltage	Supply voltage is too low

Table III.f1: Device-specific status bits in the HART protocol

Level sensors with DDA protocol:

In the event of an error, the error code "E102" is output in the fill level data field.

Level sensors with H, Modbus, UC and UDP protocol:

In the event of an error, the status code 1 is output.

Level sensors with LC protocol:

In the event of an error, the status bit (bit 7) in the status byte is set to 1.

Level sensors with TAG protocol

In the event of an error, the status bit (bit 23) is set to 1 and the fill level indicates the cause of the error:

Fill level (only bits 22 ... 0)	Status information
0x000000	General problem with the sensor
0x000001	RAM error
0x000002	Parameter error
0x000003	The float is too close to the end
0x000005	The float is upside down
0x000007	Switched ON (power up) or reset (Reset)
0x7FFFFFF	Level overflow

Table III.f2: Device-specific status bits in the TAG protocol

Level sensors with TLS interface:

For each measurement, the probes are switched on for approximately 500 ms. If the probe is unable to perform regular measurements, the measurement is marked as invalid by falsification of the parity bit.

IV Safety related codes

Parameter	Value			
Safety Integrity Level	SIL 2			
Hardware fault tolerance	HFT = 0			
Security related subsystem	Type B			
Failure rate [h ⁻¹]	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
TORRIX ...	8.53E-09	3.46E-07	8.34E-07	1.38E-07
TORRIX ... C... / TORRIX ... TAG...	4.11E-08	3.13E-07	8.13E-07	1.20E-07
TORRIX ... HART C...	3.95E-08	3.59E-07	8.10E-07	1.16E-07
VISY-Stick ... RS485 / TORRIX ... RS485...	3.95E-08	2.65E-07	7.73E-07	1.10E-07
VISY-Stick ... / TORRIX ... SC...	3.95E-08	1.87E-07	7.25E-07	9.82E-08
VISY-Stick ... TLS	3.95E-08	2.33E-07	8.19E-07	1.15E-07
Mean frequency of dangerous failure per hour, PFH [h ⁻¹]	See failure rate λ_{DU}			
Mean Time to Recovery	MTTR = 8 h			
Interval of the retest	$T_1 = 1$ year			
Architecture	1001			

Table IV: Safety related codes

V Additional requirements for software elements

There are no requirements for software elements.