

## TECHNICAL INFORMATION

**Vibracon**

**LVL-B1, LVL-B2**

**Vibration Limit Switch**

**Limit Switch for Bulk Solids**



With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

## Application

The device is a robust level limit switch for silos with fine-grained or coarse-grained, non-fluidized bulk solids.

The various designs means the device has a wide range of applications. Certificates are also available for use in dust incentive hazard areas.

LVL-B1: compact design (250 mm) as vibrating rod for installation in any direction

LVL-B2: vibrating rod with extension pipe (500 mm/1000 mm/1500 mm/20 inch/40 inch/60 inch) for installation in any direction

Typical applications: cereals, coffee beans, sugar, animal feed, rice, detergents, dye powder, chalk, gypsum, cement, sand, plastic granules

## Your benefits

- No calibration: easy commissioning (plug and play)
- Insensitive to build-up: maintenance-free operation
- No mechanically moving parts: no wear, long operating life
- Sensor material 316L: hardly any abrasion even with building materials
- F16 plastic housing with cover with sight glass: switch status visible from outside
- F18 aluminium housing also available
- Insensitive to external vibration and flow noises
- Also available with explosion protection ATEX II 1/3 D, FM or CSA approval



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# 1 Function and System Design

## 1.1 Measuring Principle

A piezoelectric drive excites the vibrating rod of the device to its resonance frequency. If medium covers the vibrating rod, the rod's vibrating amplitude changes (the vibration is damped). Device's electronics compare the actual amplitude with a target value and indicates whether the vibrating rod is vibrating freely or whether it is covered by medium.

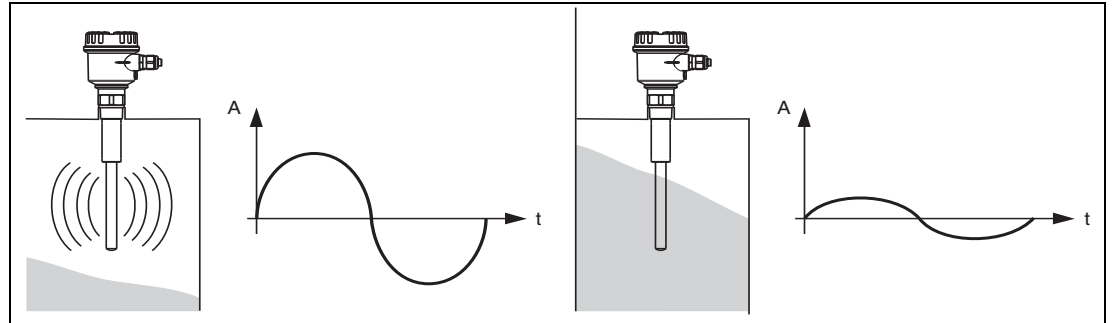


Figure 1.1

**A** Amplitude

## 1.2 Measuring System

The device is a compact electronic switch.

Thus, the entire measuring system only consists of:

- Device LVL-B1 or LVL-B2 with FEM22 (E5) or FEM24 (WA) electronic insert
- a supply point and
- the connected control systems, switching units, signalling systems (e. g. lamps, horns, PCS, PLC, etc.)

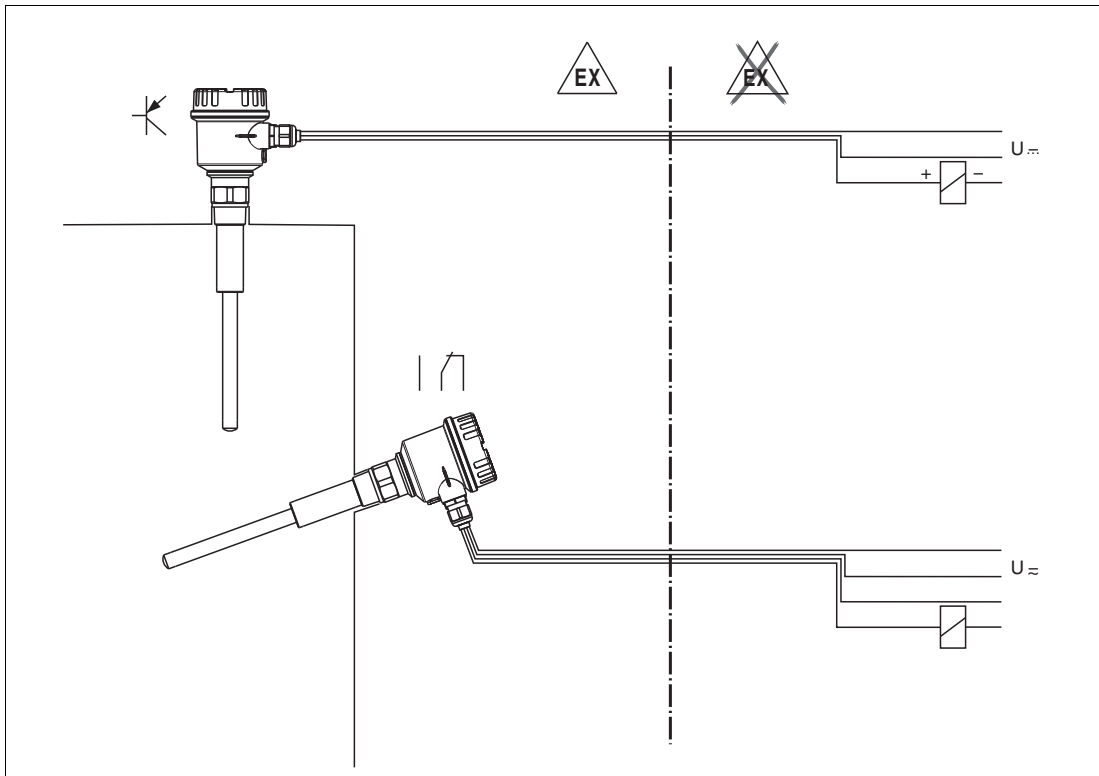


Figure 1.2



## 2 **Cable Specifications**

Use a shielded cable in the event of strong electromagnetic radiation.

### **Immunity to temperature change of connecting cable**

The connecting cables must withstand the ambient temperature +15 K.

### 2.1 **Cable Entries**

M20x1.5 (cable gland), NPT1/2, G1/2



### **3 Input**

#### **3.1 Measured Variable**

Level (according to the mounting location and the overall length)

#### **3.2 Measuring Range**

The measuring range depends on the mounting location of the device and the length of the pipe extension selected. The pipe extension is available in the following lengths: 500 mm, 1000 mm, 1500 mm, 20 inch, 40 inch, 60 inch.

#### **3.3 Input Signal**

- Probes covered => small amplitude
- Probe not covered => large amplitude

#### **3.4 Measuring Frequency**

700 to 800 Hz



## 4 Output

### 4.1 Galvanic Isolation

- FEM22 (E5): between sensor and power supply
- FEM24 (WA): between sensor, power supply and load

### 4.2 Switch Behavior

Binary

### 4.3 Power-on Behavior

When switching on the power supply the output is set to "signal on alarm". After a maximum of 3 s it switches to the correct output signal.

### 4.4 Fail-Safe Mode

Minimum/maximum quiescent current safety can be switched at electronic insert

- Max. = maximum safety:  
When the vibrating rod is covered, the output switches in the direction of the signal on alarm  
Used for overfill protection for example
- Min. = minimum safety:  
When the vibrating rod becomes exposed, the output switches in the direction of the signal on alarm  
Used for empty running protection for example

### 4.5 Switching Delay

- 0.5 s when the sensor is covered
- 1 s when the sensor is exposed

### 4.6 Ex Specifications

FEM22 (E5), FEM24 (WA): Explosion protection for explosive dust-air mixtures: Dust-Ex, DIP

## 5 Connection

### 5.1 FEM22 (E5) Electronic Insert, DC PNP

#### 5.1.1 Power Supply

- DC voltage 10 V to 45 V
- Ripple max. 5 V, 0 to 400 Hz
- Current consumption max. 18 mA
- Power consumption max. 0.81 W
- Reverse polarity protection
- Separation voltage: 2.2 kV
- Overvoltage protection: overvoltage category III

#### 5.1.2 Electrical Connection

##### Three-wire direct current connection

Preferred in conjunction with programmable logic controllers (PLC), DI modules as per EN 61131-2.

Positive signal at electronics switch output (PNP);  
Output blocked at level limit.

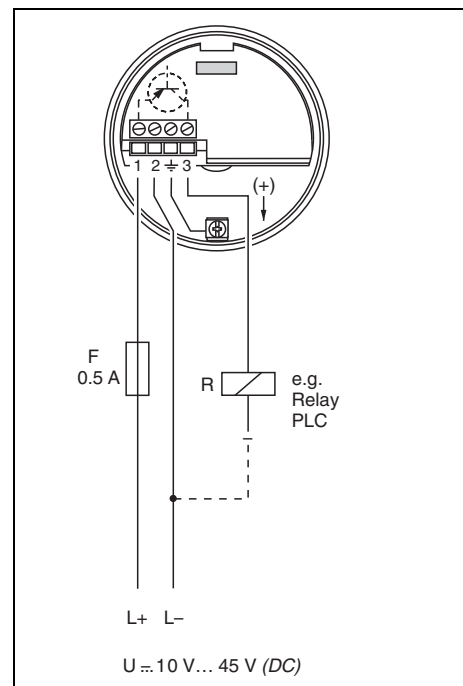


Figure 5.1

### 5.1.3 Output Signal

$I_L$  = Load current  
(switched through)

$< 100 \mu A$  = Residual current  
(blocked)



= Lit



= Not lit

Safety connection	Level	Output signal	LEDs green yellow
Max.		$L+ \xrightarrow{I_L} +$ $1 \xrightarrow{\quad} 3$	
		$L+ \xrightarrow{< 100 \mu A} +$ $1 \xrightarrow{\quad} 3$	
Min.		$L+ \xrightarrow{I_L} +$ $1 \xrightarrow{\quad} 3$	
		$L+ \xrightarrow{< 100 \mu A} +$ $1 \xrightarrow{\quad} 3$	

Table 5.1

### 5.1.4 Signal on Alarm

Output signal on power failure or in the event of device failure:  $< 100 \mu A$

### 5.1.5 Connectable Load

- Load switched via transistor and separate PNP connection
- Load current: max. 45 V (cyclical overload and short-circuit protection),  
continuous max. 350 mA
- Residual current:  $< 100 \mu A$  (for blocked transistor)
- Capacitive load: max. 0.5  $\mu F$  for 45 V, max. 1.0  $\mu F$  for 24 V
- Residual voltage:  $< 3 V$  (for transistor switched through)

## 5.2 FEM24 (WA) Electronic Insert, AC/DC with Relay Output

### 5.2.1 Power Supply

- Alternating voltage 19 V to 253 V, 50/60 Hz or DC voltage 19 V to 55 V
- Power consumption max. 1.3 W
- Reverse polarity protection
- Separation voltage: 2.2 kV
- Overvoltage protection: overvoltage category III

### 5.2.2 Electrical Connection

#### Universal current connection with relay output

##### Power supply:

Please note the different voltage ranges for AC and DC.

##### Output:

When connecting a device with high inductance, provide a spark arrester to protect the relay contact. A fine-wire fuse (depending on the load connected) protects the relay contact in the event of a short-circuit.

Both relay contacts switch simultaneously. DPDT (double pole double throw)

\* When jumpered, the relay output works with NPN logic.

\*\* See below "Connectable load"

##### Note!

Please note the different voltage ranges for direct and alternating current.

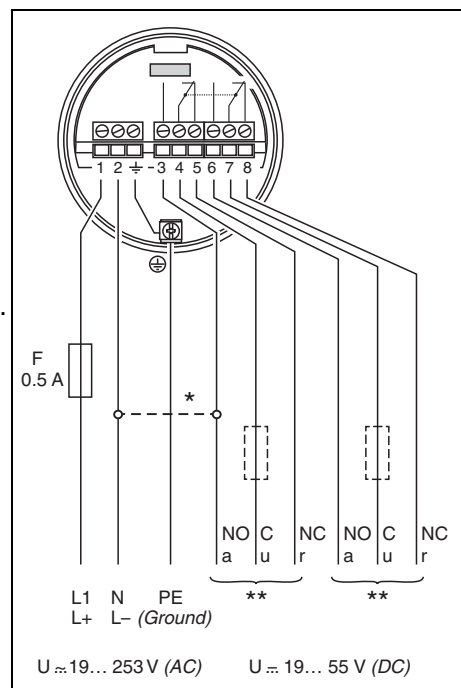






Figure 5.2

### 5.2.3 Output Signal

-  = Relay energized
-  = Relay de-energized
-  = Lit
-  = Not lit

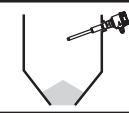
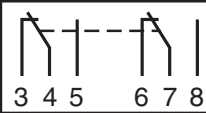


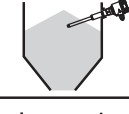
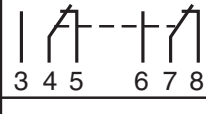


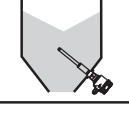
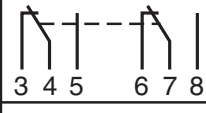


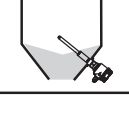
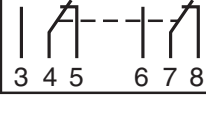


Safety connection	Level	Output signal	LEDs green yellow	
Max.		 3 4 5 6 7 8		
		 3 4 5 6 7 8		
Min.		 3 4 5 6 7 8		
		 3 4 5 6 7 8		

Table 5.2

### 5.2.4 Signal on Alarm

Output signal in event of power failure: relay de-energized

### 5.2.5 Connectable Load

- Loads switched via 2 floating change-over contacts.
- I~ max. 6 A, U~ max. 253 V; P~ max. 1500 VA,  $\cos \varphi = 1$ , P~ max. 750 VA,  $\cos \varphi > 0.7$ ;
- I- max. 6 A to 30 V, I- max. 0.2 A to 125 V.
- The following applies when connecting a functional extra-low voltage circuit with double insulation as per IEC 1010: Sum of voltages of relay output and power supply max. 300 V

## 6 Operating Conditions

### 6.1 Installation Instructions

#### Mounting location

e. g. storage or buffer container

#### Orientation

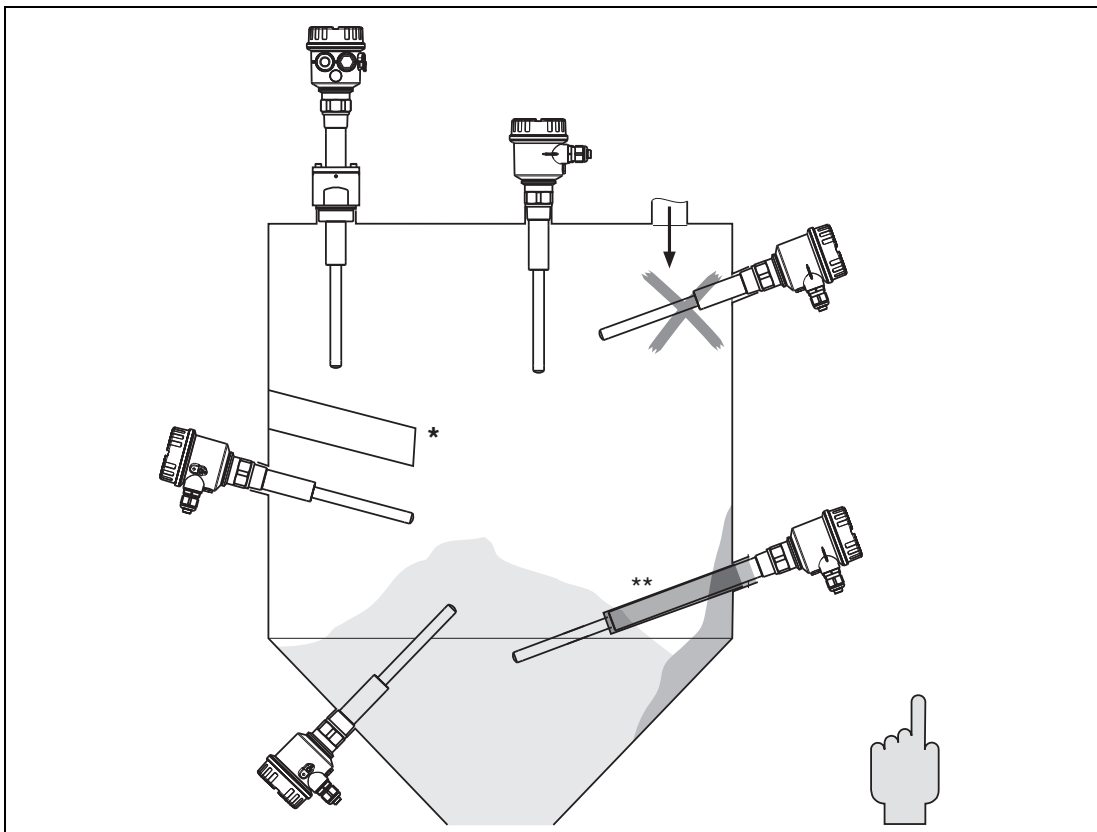


Figure 6.1 Horizontal installation/vertical installation

\* With protective cover (to be provided by customer)

\*\* With protecting tube (to be provided by customer)

## **7 Environment**

### **7.1 Ambient Temperature Range**

-40 to 70 °C

### **7.2 Storage Temperature**

-40 to 85 °C

### **7.3 Climate Class**

Climatic protection as per DIN IEC 68 Part 2-38, Fig. 2a

### **7.4 Degree of Protection**

IP66/IP67, NEMA 4X

### **7.5 Vibration Resistance**

DIN 60068-2-27/IEC 68-2-27: shock 30 g; vibration 0.01 g<sup>2</sup>/Hz

### **7.6 Electrical Safety**

IEC 61010, CSA 1010.1-92, FM3600

### **7.7 Electromagnetic Compatibility**

- Interference emission to EN 61326, Electrical Equipment Class B
- Interference immunity to EN 61326, Annex A (Industrial)

## 8 Process

### 8.1 Ambient Temperature

Permitted ambient temperature  $T_{amb}$  at housing depending on the medium temperature  $T_p$  in the container:

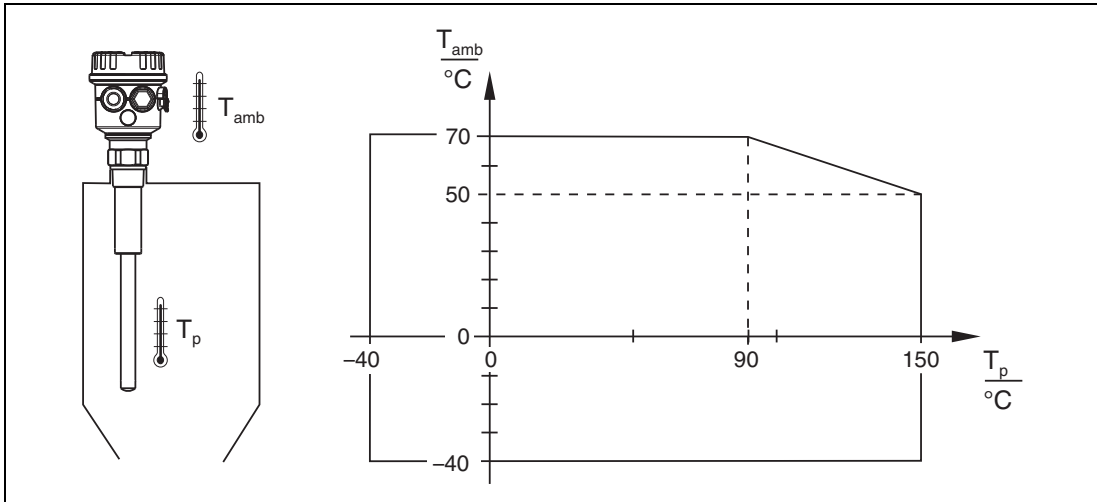


Figure 8.1

$$x \text{ } ^\circ\text{C} = (1.8 x + 32) \text{ } ^\circ\text{F}$$

### 8.2 Thermal Shock Resistance

Maximum 120 K

### 8.3 Limiting Medium Pressure Range

-1 to 25 bar

#### Maximum Working Pressure (MWP)

25 bar

#### Burst Pressure

100 bar

### 8.4 State of Aggregation

Solids

### 8.5 Grain Size

$\leq 25 \text{ mm}$

### 8.6 Bulk Density

$\geq 200 \text{ g/l}$ , not fluidized





## 8.7 Lateral Load

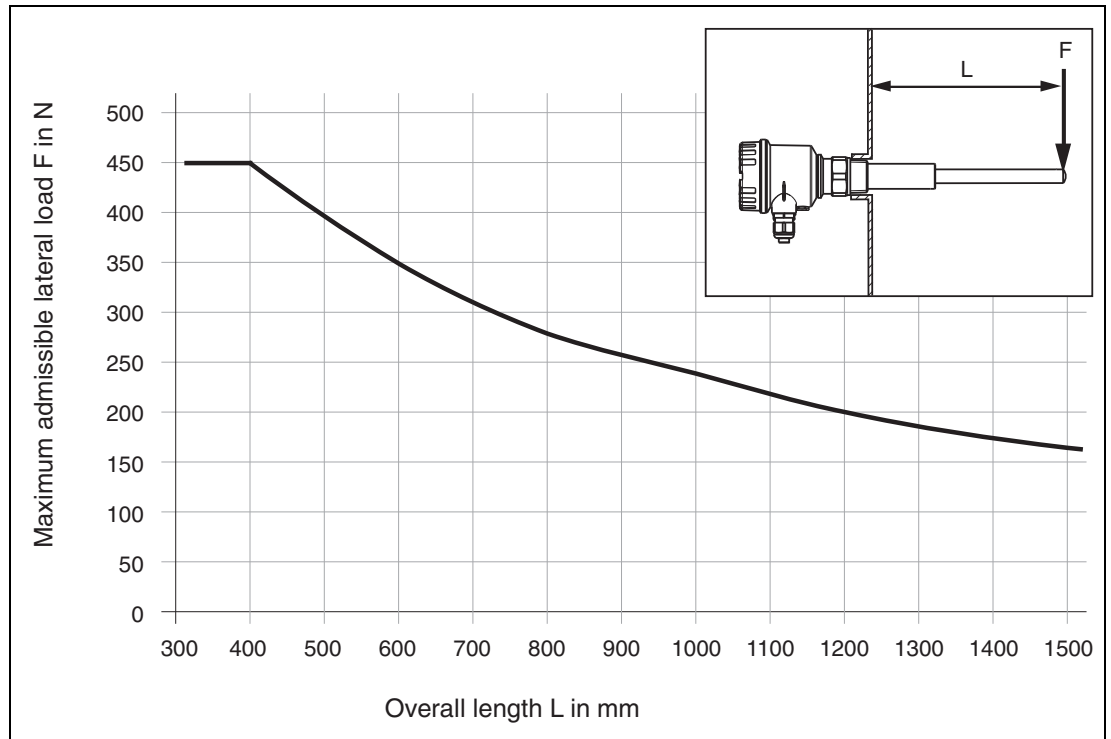


Figure 8.2

100 mm = 3.94 inch

## 9 Mechanical Construction



**Note!**

All dimensions in mm! (100 mm = 3.94 inch)

### 9.1 Design, Dimensions

#### Compact Device LVL-B1

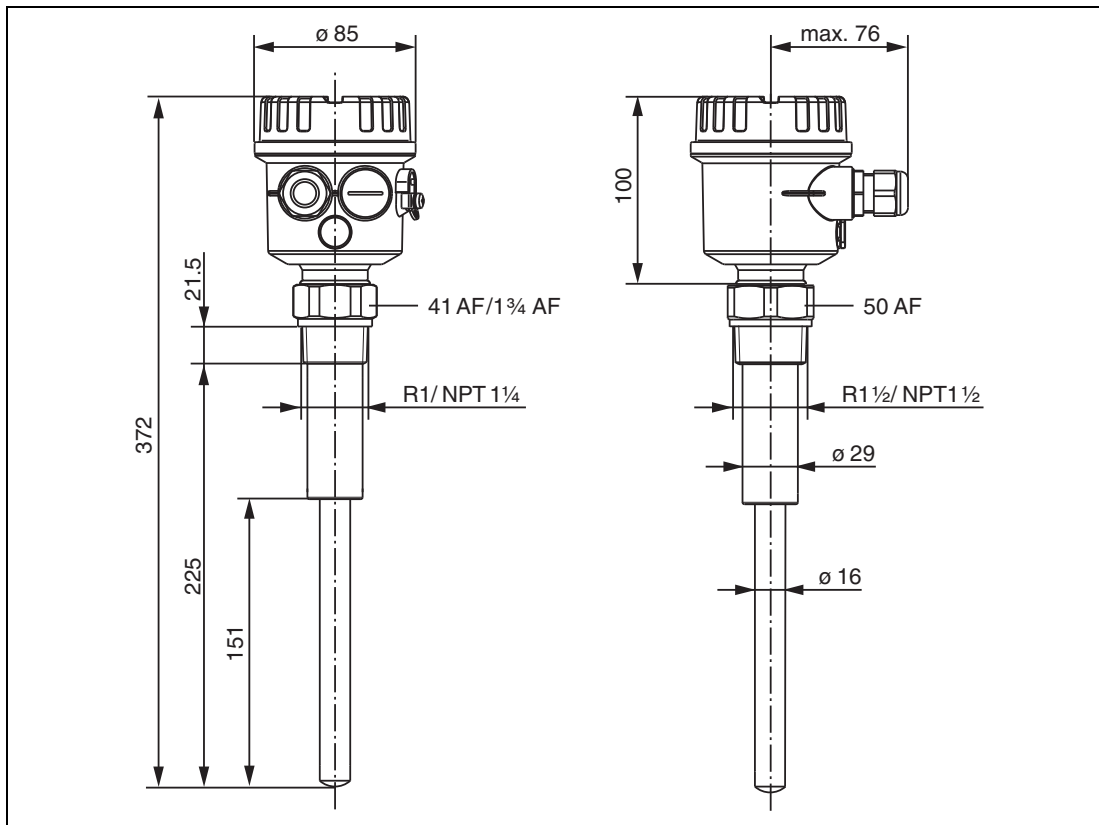


Figure 9.1

### Device with Pipe Extension LVL-B2

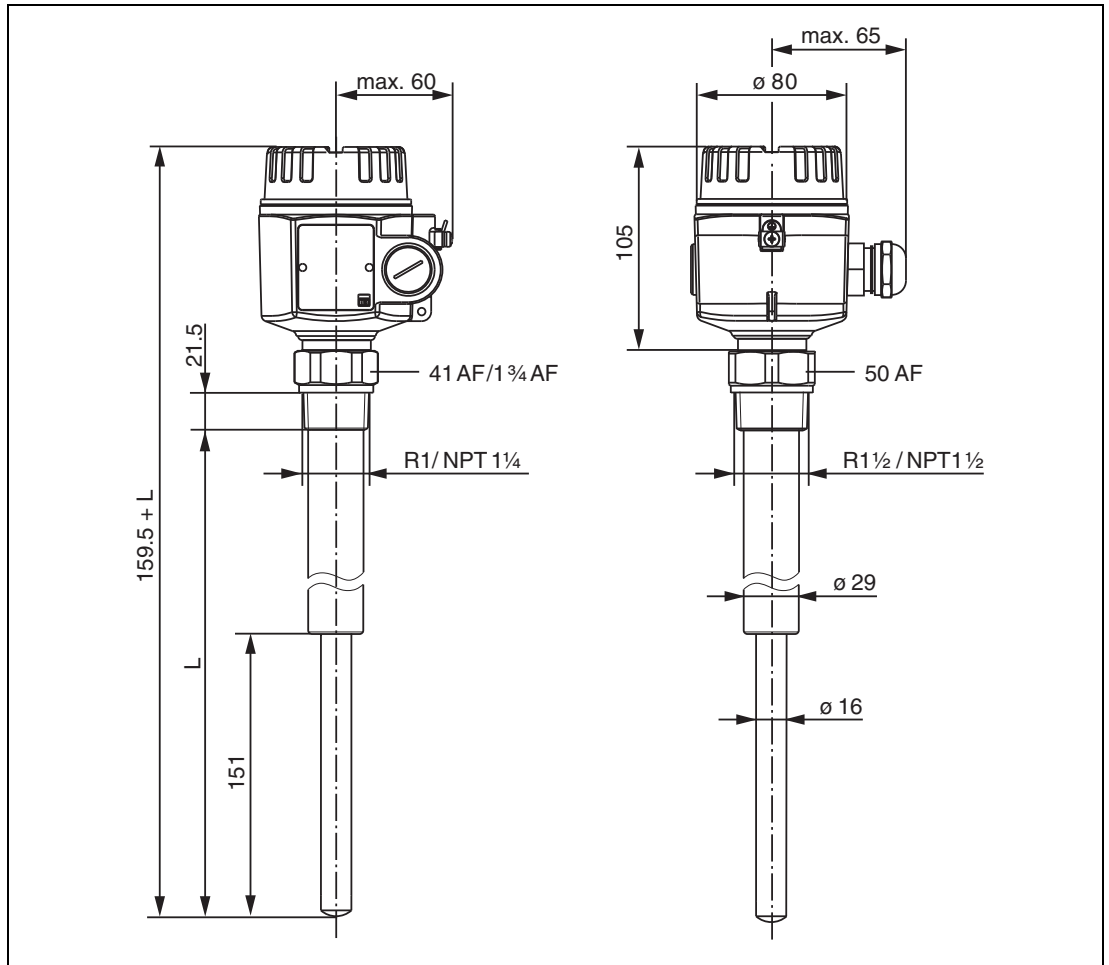


Figure 9.2

L = 500 mm, 1000 mm, 1500 mm, 20 inch, 40 inch, 60 inch

## 9.2

### Weight

LVL-B1/LVL-B2 with F16 housing (A6, A7, A8), FEM24 (WA) and R1 thread (R3):

Sensor type	Weight
compact	= approx. 1.0 kg
500 mm	= approx. 1.3 kg
1000 mm	= approx. 2.0 kg
1500 mm	= approx. 2.6 kg

Table 9.1



## 9.3

### Material

#### **F16 Housing (A6, A7, A8)**

PTB-FR, cover with sight glass made of PA12, EPDM cover seal

#### **F18 Housing (C2, Q3, P4)**

Aluminium EN-AC-AISi10Mg, plastic-coated

EPDM cover seal

#### **Process Connections**

R1, R1-1/2 (316L, DIN 2999)

NPT1-1/4 - 11-1/2, NPT 1-1/2 - 11-1/2 (316L, ANSI B 1.20.1)

#### **Sensor**

316L

## 10 Human Interface

### 10.1 Display Elements



**Note!**

The switch settings in the following graphics are in the as-delivered state.

**FEM22 (E5)**

One green LED: operation

One yellow LED: electronic switch closed

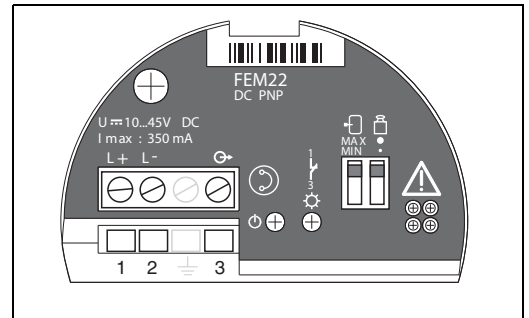


Figure 10.1

**FEM24 (WA)**

One green LED: operation

One yellow LED: contact closed (relay energized or fed with current)

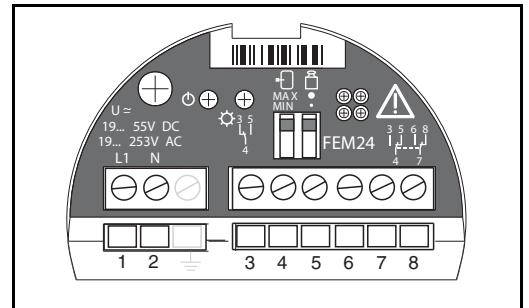


Figure 10.2

### 10.2 Operating Elements of Electronic Inserts



(factory setting)



One switch for safety mode  
MAX – Overfill protection  
MIN – Dry running protection



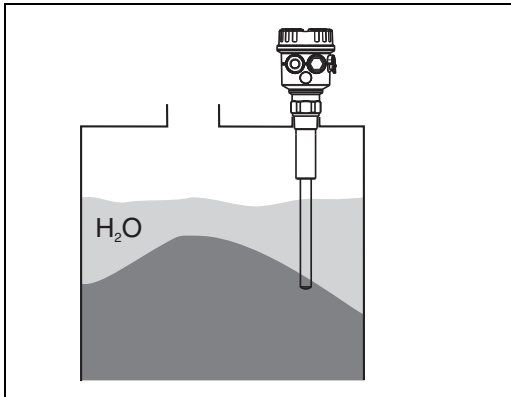
One switch for bulk density/density setting

- 400 g/l (high bulk density)
- 200 g/l (low bulk density)



## 10.3 Sediment Detection

### Detection of solids under water



The system does not detect coverage by liquids similar to water.

Figure 10.3

## 11 Certificates and Approvals



### **Note!**

The following documents are also available in the download area of the Pepperl+Fuchs web site: [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com)

### 11.1 CE Mark, Declaration of Conformity

The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate.

The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EG directives.

Pepperl+Fuchs confirms successful testing of the device by affixing to it the CE mark.

### 11.2 Ex Approval

Your Pepperl+Fuchs sales centre can provide you with information on the Ex versions which can currently be delivered.

All explosion protection data are given in a separate documentation (see "Documentation") which is available upon request.

### 11.3 Type of Protection

See "Ordering information" as of page 24 and "Documentation" on page 28.

### 11.4 Standards and Guidelines

Other standards and guidelines that were taken into consideration in designing and developing Vibracon LVL-B1, LVL-B2:

- Low Voltage Directive (2006/95/EC): EN 61010-1:2010 (electronic insert FEM24 (WA))
- Electromagnetic compatibility (2004/108/EC): EN 61326-1:2006, EN 61326-2-3:2006
- ATEX Directive (94/9/EC): EN 60079-0:2012, EN 60079-31:2009
- Degree of protection: IEC 60529:2001
- Vibration resistance: EN 60068-2-27
- Climate class: EN 60068, part 2-38, fig. 2a

## 12 Ordering Information

### 12.1 Product Structure LVL-B1



**Note!**

This overview does not mark options which are mutually exclusive.  
Option with \* = on request/in preparation

Device	
LVL	Vibration limit switch

Design	
B1	Compact device

Process connection	
N3	Thread NPT1-1/4, ANSI, 1.4435/316L
N5	Thread NPT1-1/2, ANSI, 1.4435/316L
R3	Thread R1, DIN 2999, 1.4435/316L
R5	Thread R1-1/2, DIN 2999, 1.4435/316L
XX	Special version

Housing, cable entrance	
A6	Aluminium housing F18, IP66/IP67, NEMA 4X, cable gland M20
A7	Aluminium housing F18, IP66/IP67, NEMA 4X, thread NPT3/4
A8	Aluminium housing F18, IP66/IP67, NEMA 4X, thread G1/2
C2	Polyester housing F16, IP66/IP67, NEMA 4X, cable gland M20
Q3	Polyester housing F16, IP66/IP67, NEMA 4X, thread NPT1/2
P4	Polyester housing F16, IP66/IP67, NEMA 4X, thread G1/2A

Electrical output	
E5	FEM22, 3-wire, PNP, 10 V DC ... 45 V DC
WA	FEM24, relay, DPDT, 19 V AC ... 253 V AC, 19 V DC ... 55 V DC

Additional equipment	
A	Basic version

Approval	
NA	Version for non-hazardous area
CU	CSA General Purpose, CSA C US
EX	ATEX II 1/3D Ex ta/tc IIIC T170°C Da/Dc
IK	IECEx Ex ta/tc IIIC T170°C Da/Dc



## 12.2 Product Structure LVL-B2



### Note!

This overview does not mark options which are mutually exclusive.  
Option with \* = on request/in preparation

Device	
LVL	Vibration limit switch

Design	
B2	Device with pipe extension

Process connection	
N3	Thread NPT1-1/4, ANSI, 1.4435/316L
N5	Thread NPT1-1/2, ANSI, 1.4435/316L
R3	Thread R1, DIN 2999, 1.4435/316L
R5	Thread R1-1/2, DIN 2999, 1.4435/316L
XX	Special version

Sensor length	
2	500 mm
3	1000 mm
4	1500 mm
6	20 inch
7	40 inch
8	60 inch

Housing, cable entrance	
A6	Aluminium housing F18, IP66/IP67, NEMA 4X, cable gland M20
A7	Aluminium housing F18, IP66/IP67, NEMA 4X, thread NPT3/4
A8	Aluminium housing F18, IP66/IP67, NEMA 4X, thread G1/2
C2	Polyester housing F16, IP66/IP67, NEMA 4X, cable gland M20
Q3	Polyester housing F16, IP66/IP67, NEMA 4X, thread NPT1/2
P4	Polyester housing F16, IP66/IP67, NEMA 4X, thread G1/2A

Electrical output	
E5	FEM22, 3-wire, PNP, 10 V DC ... 45 V DC
WA	FEM24, relay, DPDT, 19 V AC ... 253 V AC, 19 V DC ... 55 V DC

Additional equipment	
A	Basic version



Approval	
NA	Version for non-hazardous area
CU	CSA General Purpose, CSA C US
EX	ATEX II 1/3D Ex ta/tc IIIC T170°C Da/Dc
IK	IECEx Ex ta/tc IIIC T170°C Da/Dc

## 13 Accessories

### 13.1 Sliding Sleeves for Vibracon LVL-B2

#### Sliding sleeve for pressurized container

- R1-1/2, DIN 2999  
Order designation: LVL-Z200
- NPT1-1/2 - 11-1/2, ANSI B 1.20.1  
Order designation: LVL-Z201

**Note!**

Suitable for multiple switch-point configurations!

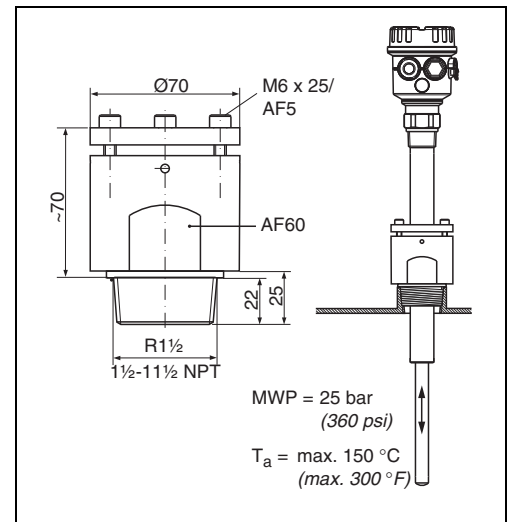


Figure 13.1

#### Sliding sleeve for unpressurized container

- Degree of protection IP65
- R1-1/2, DIN 2999  
Order designation: LVL-Z202
- NPT1-1/2 - 11-1/2, ANSI B 1.20.1  
Order designation: LVL-Z203

**Note!**

Only suitable for one-time switch-point configuration!

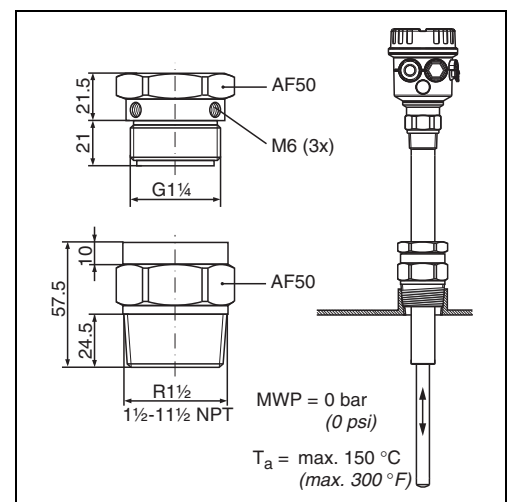


Figure 13.2

### 13.2 Spare Parts

- FEM22 (E5) electronic insert
- FEM24 (WA) electronic insert
- Cover for polyester housing (F16), transparent plastic with seal
- Cover for aluminium housing (F18), aluminium with seal
- Cover for aluminium housing (F18), aluminium with glass insert and seal (not for Ex d)



## 14 Documentation



**Note!**

The following document types are available in the download area of the Pepperl+Fuchs web site: [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

Document type	Document code
Technical information	TI00389O/98/EN
Brief instructions	KA00227O/98/A6
Instruction manuals	SI00300O/98/A3 (ATEX II 1/3D Ex ta/tc IIIC T170°C Da/Dc)
	SI00424O/98/EN (Ex ta/tc IIIC T170°C Da/Dc)

Table 14.1







# PROCESS AUTOMATION – PROTECTING YOUR PROCESS



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