

# Manual



W\*.02 and CON.USB.WT

**Manual-Version**

WT02\_WI02\_M\_DE\_170314\_E002

**SW-Version**

This manual is valid for

Main SW: V3.00 and higher

Display SW: V2.22 and higher

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# 1. General Information

## 1.1. Features

The converters type W\*.02 are passive 4 - 20 mA sensors with carrier-frequency (WT) or inductive (WI) input stage.

In addition to the analogue output the sensor provides a galvanically isolated open collector output, which can be used either as a switch or frequency output. The frequency output is freely scalable for a calibration to the volume flow independent of the type of flow meter.

The W\*.02 have an interface integrated in the M12 sensor plug. The W\*.02 can be programmed by using the interface adapter CON.USB.WT and the parameterization software KEM EasyControl.

The output frequency and current can be linearized with up to 20 points.

In most cases, the W\*.02 are supplied in combination with a displacement counter, to which they are adjusted in production.

## 1.2. Safety

### 1.2.1. General Safety

All statements regarding safety of operation and technical data in this manual will only apply when the unit is operated correctly in accordance with this manual.

The data for Ingress Protection (IP 65) will only apply when all connectors are capped properly with the corresponding counterpart with the same or better IP rating. Cable glands must be populated with cables with the specified diameter and closed properly.

During operation all openings of the housing must be closed unless otherwise noted in this manual.

All connections to the load and to the supply must be made with shielded cables unless otherwise noted in this manual. This unit must be grounded.

This unit must be supplied by a safety approved power supply with outputs which comply with Safety Extra Low Voltage (SELV).

As a protection against fire in the positive supply a fuse with a current rating not higher than the current carrying capacity of the cable used is required.

National and international standards regarding electrical installation have to be adhered to.

The devices described in this manual may only be connected and operated by authorized and qualified personnel.

### 1.2.2. Special requirements for Ex installations

When used in hazardous area a suitable separation amplifier or zener barriers must be used.

When using long cables make sure that the maximum inductances and capacitances for the respective voltage or gas group are not exceeded.

### 1.2.3. Warnings in this manual

#### NOTE:

Notes provide important information for the correct usage of the equipment. If the notes are not observed, a malfunction of the equipment is possible.

#### WARNING!

Warnings provide very important information for the correct usage of the equipment. Not observing the warnings may lead to danger for the equipment and to danger for health and life of the user.

## 1.3. Ordering Codes and Accessories

### 1.3.1. Ordering Code

	W	X	02	-	X	-	X
Carrier-Frequency		T					
Inductive		I					
Short version for ZHM 02 up to 04 and HM series					K		
Long version for ZHM 02 up to ZHM 07 and HM series					L		
Long version for ZHM 01, 01/1 up to 1/3, SRZ series and LFM					R		
Long version for ZHM 01, 01/1 up to 1/3, SRZ series and LFM					S		
ATEX Zone 1: II 2G Ex ia IIC T4							Ex
ATEX Zone 2: II 3G Ex nA IIC T4							Exn

### 1.3.2. Accessories

Ordering Code	Description
CON.USB.WT:	Interface converter KEM interface to USB. When communicating via CON.USB.WT, the W*.02 can be powered via the USB interface or via an external power supply.
EasyControl:	Remote software for WINDOWS® XP or VISTA. With WINDOWS® XP SP3 or N.NET framework is required.
Upon request	Connector M12; 5 pin, type 713
Upon request	Shielded cable

## 2. Getting started

### 2.1. Unpacking

Verify that you have received the following items:

When you ordered W\*02....:

- W\*02.....
- User's manual

When you ordered CON.USB.WT

- CON.USB.WT
- USB-cable A/B 1.5m
- CD (remote software EasyControl and USB drivers)
- User's manual

### 2.2. Operating Elements

#### 2.2.1. W\*02



Fig. 1: Operating elements W\*.02

1 = Electrical connector

2 = Lock nut

3 = Installation thread

4 = Pickup tip

## 2.2.2. CON.USB.WT

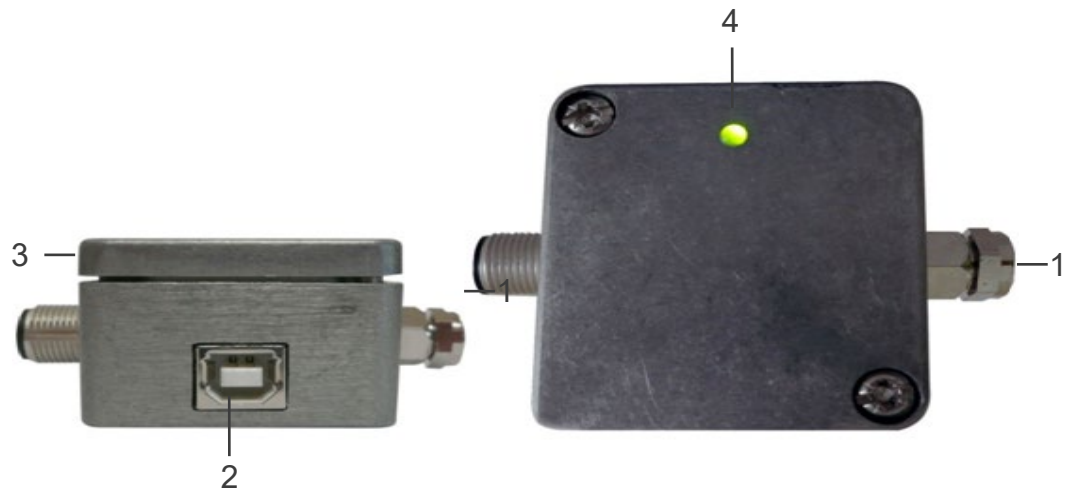


Fig. 2: Operating elements CON.USB.WT

1 = Cable connection to W\*02

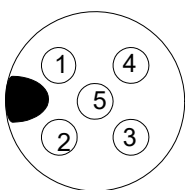
2 = USB connector

3 = Output connector

4 = Control LED

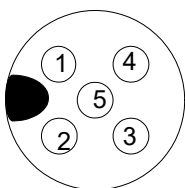
## 2.3. Pin Assignments

### 2.3.1. W\*02



- 1 +I
- 2 -I
- 3 D GND (digital ground)
- 4 D OUT (frequency output)
- 5 D IN (communication input)

### 2.3.2. CON.USB.WT



- 1 +I
- 2 -I
- 3 D GND (digital ground)
- 4 D OUT (frequency output)
- 5 WT supply/n.c. (see chapter 4.2.2)

## 3. Installation

### 3.1. Mechanical Installation

Screw the W\*02 with the sensor tip (see Fig. 1: Operating elements W\*02) by hand (without tools) into the M14x1.5 sensor thread of the meter until you reach the stop.

---

**WARNING!**

Too much force will damage the sensor tip!

Turn the W\*02 back by 90°

Fix the W\*02 with the fixing nut (see Fig. 1: Operating elements W\*02).

### 3.2. Electrical Installation

Make sure that the flow meter is grounded.

---

**NOTE**

For connecting the W\*02, shielded cables must be used. The W\*02 housing is connected to the cable shield. If in bigger systems the shield must not present a DC connection for avoiding high ground loop currents, make the ground connection of the shield via a capacitor of e. g. 100 nF.

---

**WARNING!**

Improper grounding and shielding may lead to bad EMC behavior or danger to your health!

Connect the W\*02 via a shielded cable to the control unit. The W\*02 requires a regulated DC power supply of 24 V nominal and works properly over a supply range of 15 V to 30 V.

---

**NOTE:**

Make sure that all cable and wires are connected and fixed properly before applying power to the W\*02.

For the electrical connections refer to the drawings in chapter 4.1.

### 3.3. Ex Installation

The W\*02-Ex is intrinsically safe when operated with zener barriers.

Mount the W\*02 as described in chapter 3.1.

Connect the W\*02 to suitable zener barriers.

---

**WARNING**

When used in hazardous areas the W\*02 must not be connected to any circuitry except suitable zener barriers.



## 4. Operation

### 4.1. Normal operation

The W\*02 is ready to use and does not require any special settings.

When you make changes to parameters such as KF (K-factor), operating mode from analog or digital output, activate the remote control mode from W\*.02 (see chapter 4.2).

#### 4.1.1. Operation as passive 4 - 20 mA sensor

For operating the W\*.02 as passive 4 - 20 mA sensor, only pin 1 and 2 are to be connected.

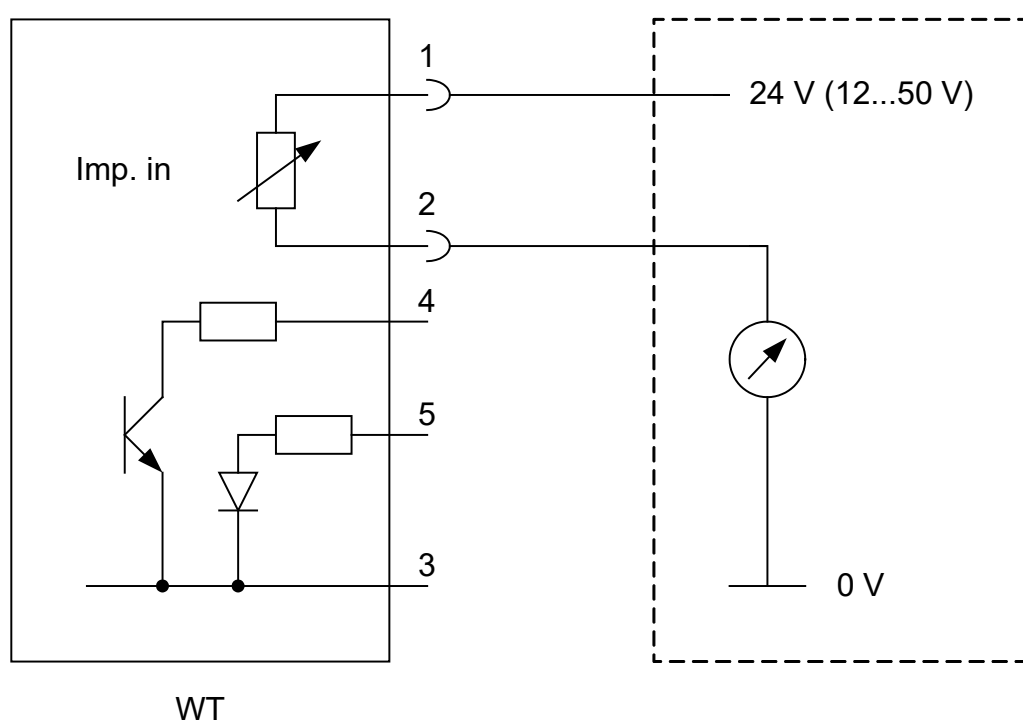


Fig. 3: Wiring diagram 2 wire operation passive

The following operating modes can be activated for the 4 - 20 mA interface:

**OFF or 4mA:**

In this operating mode, the W\*02 outputs constant 4 mA regardless of the flow rate.

**FLOW (default)**

The output current is proportional to the measured flow. The set minimum flow rate is 4 mA, the set maximum flow rate is 20 mA (see adjustment hints in chapter 4.2.3).

**BATCH**

The output current is proportional to the total flow :

$$I[mA] = 16 * \frac{V}{V_{set}} + 4$$

For. 1: Calculation of I in BATCH mode

$V_{set}$  is the set flow rate, which can be varied via the software KEM EasyControl.

**NOTE:**

If only the current output is used, it is recommended to deactivate the frequency output (operating mode: "OFF").

#### 4.1.2. Operation with current and frequency output

The W\*02 operates as a passive 4 - 20 mA sensor with galvanically isolated open collector output.

Connect the W\*02 according to the figure below.

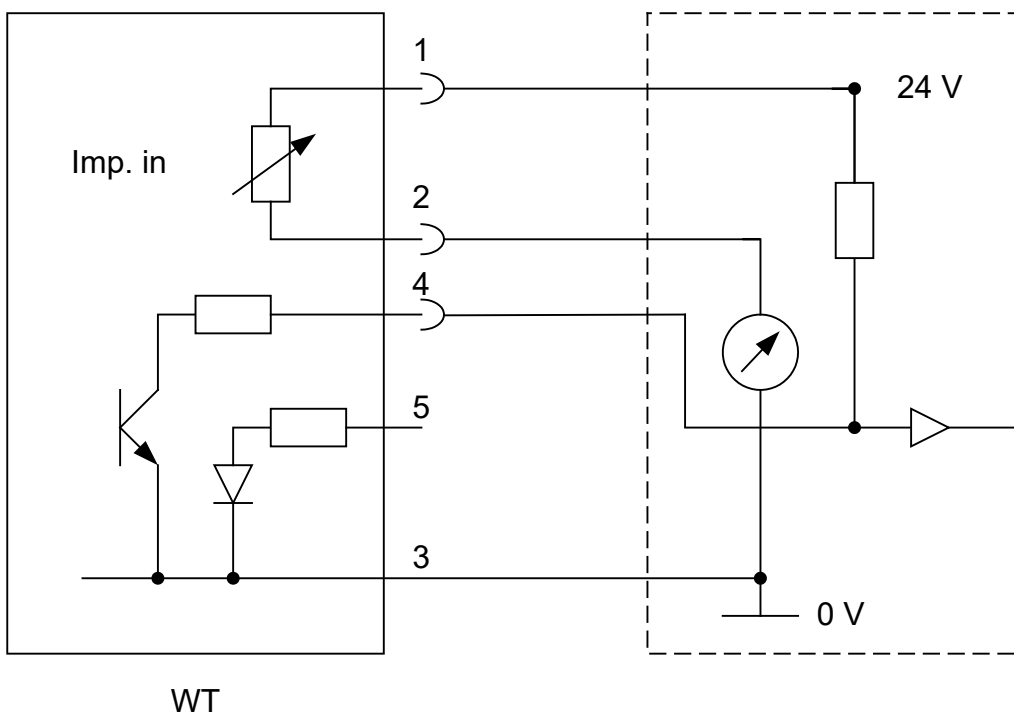


Fig. 4: Wiring diagram 2 wire operation passive with digital output

The operating modes for the 4 - 20 mA interface are listed in chapter 4.1.1.

The following operating modes can be activated for the digital output:

## OFF:

The digital output is disabled.

## Input Frequency (default)

The input signal of the flow sensor is output 1: 1 at the digital output.

---

## NOTE:

No linearization of the output signal is possible in this operating mode.

---

## Switch normally open

The output works like a normally open contact:

At low frequencies the output is HIGH or open. When the input frequency exceeds the value of  $f_{switch} + f_{hyst}$ , the transistor becomes conductive, the output goes to HIGH or closes the contact.

As soon as the input frequency falls below the value of  $f_{switch} - f_{hyst}$ , the output becomes non-conductive and goes to LOW or opens the contact again, presuming an external pull-up resistor is connected.

## Switch normally closed

The output works like a normally closed contact:

At low frequencies the output is LOW (conductive) or closed. When the input frequency exceeds the value of  $f_{switch} + f_{hyst}$ , the transistor becomes non-conductive, the output goes to HIGH or opens the contact, presuming an external pull-up resistor is connected.

As soon as the input frequency falls below the value of  $f_{switch} - f_{hyst}$ , the output becomes conductive and goes to LOW or closes the contact again.

## Corrected Frequency

The input signal  $f_{in}$  is used to calculate the flow rate (see Formula 3). The output frequency is calculated from the calculated flow rate:

$$F_{out} = Q * \frac{F_{max}}{Q_{max}}$$

*For. 2: Berechnung von  $F_{out}$  in der Betriebsart Corrected Frequency*

The parameters  $Q_{max}$  and  $F_{max}$  can be configured with the KEM EasyControl software. The frequency  $F_{out}$  is generated on the digital output (pin 4 in Fig. 4: Wiring diagram 2 wire operation passive with digital output).

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## NOTE:

The frequency range is 1.4 to 5,000 Hz. Calculated frequencies less than 1.4 Hz result in zero.

---

### 4.1.3. Operation with frequency output only

If only a digital output is required, connect the W\*02 according to the figure below.

For the description of the digital output modes refer to chapter 4.1.2.

**NOTE:**

For the best possible performance and lowest power input, deactivate the current output (operating mode: OFF or 4 mA) when using the digital output exclusively. The current output supplies 4 mA in this operating mode regardless of the flow rate.

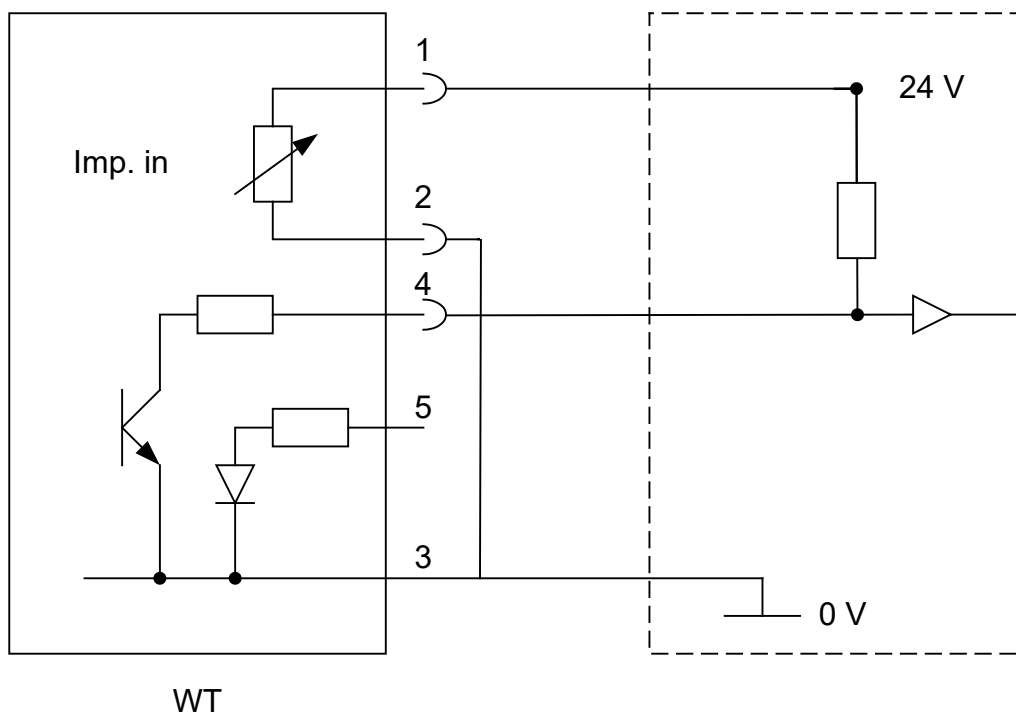


Fig. 5: Electrical connections digital output only

## 4.2. Remote Control

The W\*02 has a built in interface which uses the frequency output and pin 5 of the connector for communication.

Communication with a computer is easily implemented by using the USB converter CON.USB.WT and the remote SW KEM EasyControl. For detailed information on installing and using the software, refer to the KEM EasyControl Manual.

**WARNING!**

In remote mode the digital output is used for communication and does not provide the frequency output or switch functionality!

#### 4.2.1. Installation of Easy Control

For detailed information on installing and using the software, refer to the KEM EasyControl Manual.

#### 4.2.2. Connecting the W\*.02 to the PC

The communication adapter CON.USB.WT provides 3 modes of operation:

**POW int:**

The W\*.02 is powered from the USB interface. No connection at the 5-pin output connector of the CON.USB.WT is required. The frequency output cannot be used.

The LED lights up when the CON.USB.WT is connected to a PC and the USB drivers have been successfully installed.

This mode is used for setting up the W\*.02 or for simple measurements of the input frequency

**POW DAM:**

The W\*.02 is powered from the USB interface. Between Pin 2 and 5 of the output connector of the CON.USB.WT a current meter (DAM) must be connected. This DAM shows the loop current signal of the W\*.02.

The frequency output cannot be used.

The LED lights up when the CON.USB.WT is connected to a PC and the USB drivers have been successfully installed.

This mode is used for setting up the W\*.02, for calibrating the analogue output and for simple measurements of the input frequency

**POW off:**

The W\*.02 is not powered from the USB interface. An external power supply at the output connector of the CON.USB.WT is required.

The LED does not light up!

This mode is used for online monitoring of W\*.02.

To set the mode of CON.USB.WT proceed as follows:

- Open the CON.USB.WT by removing the 2 screws in the top cover
- Set the rotary switch with a small screwdriver to the desired position (see figure)
- Close the CON.USB.WT with the 2 screws



Fig. 6: Electrical connections digital output only

### 4.2.3. Changing the settings

K-factor and calculation of the flow rate

The flow rate  $Q$  is proportional to the input frequency  $f_{in}$  as shown in the formula below:

$$Q[l/min] = \frac{f_{in} [Hz] * 60}{KF[pulses/l]}$$

For. 3: Calculation of the flow rate

The K-factor **KF** is unique for each displacement meter. The value of the K-factor is determined by means of the mandatory flow rate calibration. Only authorized personnel are permitted to change the K-factor of a KEM displacement meter!

#### Cut-off frequency

Influence of the cut-off frequency on flow rate calculation:

If  $f_{in} \geq f_{cutOff}$  then  $Q$  is calculated according to formula For. 3.

If  $f_{in} < f_{cutOff}$  then  $Q = 0$ .

The default setting for the cut-off frequency is:  $f_{cutOff} = 0.5 * f_{min}$ .  $f_{min}$  is the input frequency generated by the displacement meter at the flow rate  $Q_{min}$ .

#### Linearization

When linearization is active, the measured flow rate is corrected with the linearization factors as shown in the simplified formula below:

$$Q_{lin} = Q * lin\_error$$

For. 4: Calculation of the linearized flow rate

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#### NOTE:

When linearization is active,  $Q_{lin}$  instead of  $Q$  is used in all calculations.

---

#### Current output

The calculation of the current output in the "FLOW" operating mode is shown in the formula below.

$$I[mA] = 16 * \frac{Q - Q_{min}}{Q_{max} - Q_{min}} + 4$$

For. 5: Calculation of the current rating

At  $Q = Q_{min}$  the W\*.02 outputs a current of  $I = 4 mA$  and at  $Q = Q_{max}$  a current of  $I = 20 mA$ . The parameters  $Q_{min}$  and  $Q_{max}$  correspond to the minimum and maximum flow range of the respective displacement meter.

The behavior of the current output at flow rates outside the specified range through  $Q_{min}$  and  $Q_{max}$  is shown below:

$Q < Q_{min}$

If  $I \geq 3.8 mA \pm hysteresis$  then  $I$  is calculated according to formula For. 5.

If  $I < 3.8 mA \pm hysteresis$  then  $I = 3.6 mA$  (leakage current)

$Q > Q_{max}$

If  $I \leq 20.5 mA \pm hysteresis$  then  $I$  is calculated according to formula For. 5.

If  $I > 20.5 mA \pm hysteresis$  then  $I = \text{etwa } 21.5 mA$  (leakage current)

## 5. Service and Maintenance

### 5.1. Maintenance

The W\*.02 does not require regular maintenance.

If for the specific application an obligatory calibration is required, refer to the corresponding national regulations for the necessary calibration intervals. For the best performance we recommend a calibration of current output in the interval of 5 years.

The calibration can be carried out by CON.USB.WT and the software KEM EasyControl directly from the customer or in our production.

### 5.2. Trouble shooting

In case the W\*.02 does not work properly, first check the following items:

#### **No output signal**

All cables properly connected (see chapter 4.1)?

→ Connect the missing cables.

W\*02 properly mounted (see chapter 3.1)?

→ Check mounting position and, if necessary, mount the W\*02 properly.

#### **Output frequency too low**

All cables properly connected (see chapter 4.1)?

→ Reconnect the loose cables.

Meter working properly?

→ Check and, if necessary, replace the meter.

#### **Output frequency too high or unstable**

Most probably EMC problems

Shield and ground properly connected?

→ Connect shield properly.

If necessary, try additional means of grounding and shielding

### 5.3. Service

The W\*02 does not contain any user serviceable parts.

In case of malfunction, please contact your nearest dealer or directly KEM.

For the addresses see the last page of this document.

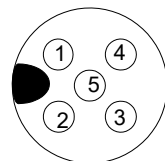
## 6. Listings

### 6.1. Warranty

For warranty refer to the general terms and conditions of KEM Küppers Elektromechanik GmbH, which can be found on the corresponding website ([www.kem-kueppers.com](http://www.kem-kueppers.com)).

### 6.2. Technical Data

Analog Output	
Type	4 - 20 mA, 2-wire (passive)
Resolution	5 $\mu$ A
Supply Voltage	12 - 30 V, regulated
Allowable Load	(UB - 12 V) / 20 mA, max. 800 $\Omega$
Operating Modes	ON (frequency proportional current) OFF (supply current 4 mA independent of frequency)
Digital Output	
Type	Open collector, potential free
Protective Resistor	1,600 $\Omega$
Frequency Range	1 – 5,000 Hz
Operating Modes	OFF (frequency output disabled) 1:1 (output frequency = input frequency) CORR (scalable output frequency) SW (switch output)
Further Specifications	
Measuring Frequency	WT: 1 - 3,000 Hz (type 0,5 up to 5,000 Hz) WI: 7 - 3,000 Hz (type 5 up to 5,000 Hz)
Response Time	250 ms (for input frequencies > 5 Hz)
Temperature Drift	< 100 ppm/K
Connector	M12; 5 pin 1 = +I 2 = -I 3 = emitter (digital ground) 4 = collector (frequency output) 5 = remote input
Ambient Temperature	-40 °F up to +158 °F [-40 °C up to +70 °C] Ex-version -40 °F up to +122 °F [-40 °C up to +50 °C]
Medium Temperature	-40 °F up to +248 °F [-40 °C up to +120 °C] WT.02, distance of 25 mm between flowmeter and amplifier housing -40 °F up to +302 °F [-40 °C up to +150 °C] WI.02, distance of 65 mm between flowmeter and amplifier housing Type K + R: -40 °F up to +248 °F [-40 °C up to 120 °C]
Dimensions	See drawing
Material	Stainless Steel
Protection Class	IP65
Ex-Protection	II 2G Ex ia IIC T4 II 3G Ex nA IIC T4





6.3. Dimensional Drawings

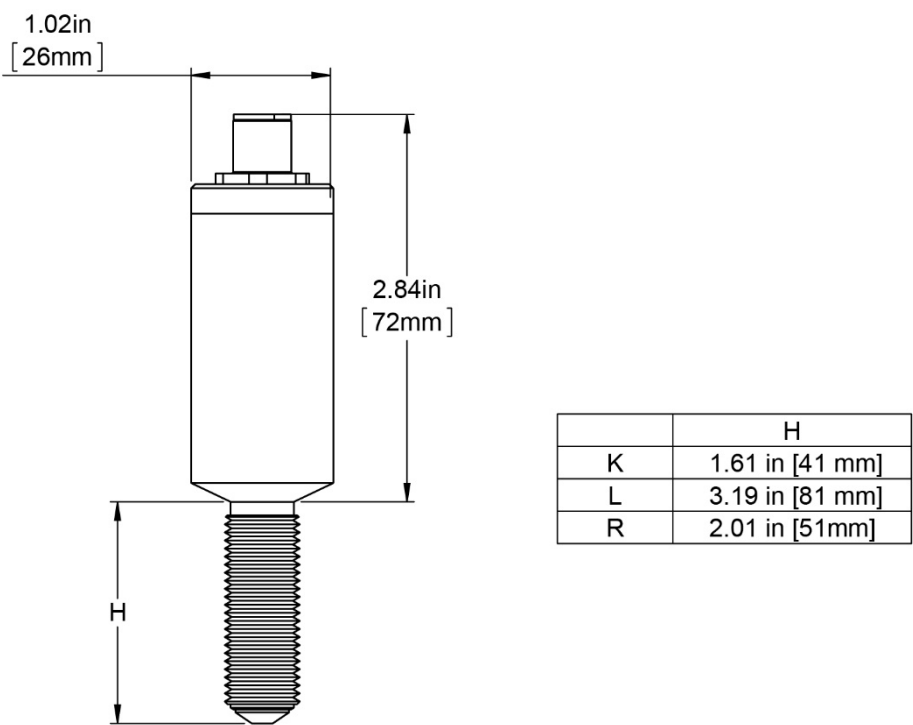


Fig. 7: Dimensional drawings W\*.02

6.4. WEEE and RoHS

The unit described herein is not subject to the WEEE directive and the corresponding national laws.

At the end of life forward the unit to a specialized recycling company and do not dispose it off as domestic waste.

The unit described herein fully complies with the RoHS directive.

6.5. List of figures

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Fig. 6: Electrical connections digital output only.....13

Fig. 7: Dimensional drawings W\*.02.....17

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