Instruction Manual

4-20 mA
Vibration Sensor
Type

KSI84xx

v1.32.034

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15.11.2021	v1.32.030	new chapter: 4.8 Total Accuracy
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20.01.2022	v1.32.031	new sensor types with 5 m/s² range
		Increase of maximum dynamic range for types KSI84Ax with LP ≤ 1 kHz: see chapter 4.5.5
13.05.2022	v1.32.033	Order option: Current output limited to 20 mA
		Change of update rate for PEAK measurement: 0.5 s
		New sensor types KSI84D-3-300-xx for displacement measurement
13.06.2022	v1.32.034	Update rate at types KSI84AR-1k-10k-xxx: 62,5 ms
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Contents

1 Purpose

The vibration sensors of the KSI84xx family are used to measure vibration acceleration, velocity or displacement on machines and objects.

The sensors measure the vibration amplitude within a specified frequency range in axial sensor direction and outputs the measuring result as a 4-20 mA current loop signal. The sensor is supplied with power via the same signal line.

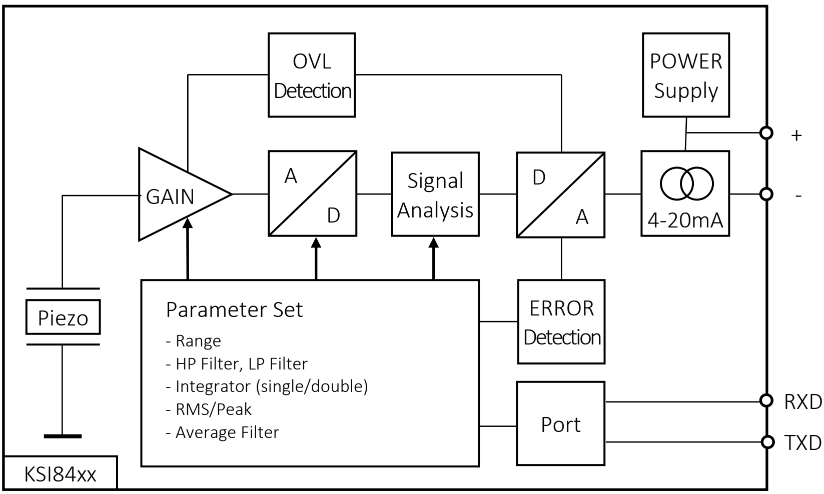
The sensor parameters are adjustable. There are different types for different applications in several measuring ranges. The sensors comply with the specifications for vibration measuring devices according to ISO 2954.

Possible applications are:

1. Measurement of the smooth running of rotating machines and reciprocating machines according to ISO 10816 / ISO 20816.
2. Measurement of bearing vibrations according to VDI 3832.
3. Measurement of vibrations in defined frequency ranges.

The sensors are suitable for use in harsh environmental conditions. The housing is double shielded, electrically isolated and complies with protection grade IP68.

2 Function



The sensors of the KSI84xx family are piezoelectric vibration sensors.

A piezoelectric accelerometer is used as the sensor element. Its electrical output signal is first amplified and digitized.

The signal analysis is digital. The signal is filtered (HP, LP), optionally integrated and the amplitude value is calculated, either as RMS or PEAK value. Finally, the amplitude value is converted into a 4-20 mA current loop signal with a 16 bit DAC.

Either the acceleration (without integrator), the velocity (integrator) or the displacement (double integrator) of the vibration can be measured.

In addition, proper sensor function and input signal are monitored. Defects or overloads are signaled by an error current value.

Before delivery, the sensor is parameterized according to the type code selected by the customer.

3 Type Selection

There are five different basic types, which differ in the measured quantity (Q) and the amplitude mode (M).

Sensor type		KSI84AR	KSI84AP	KSI84VR	KSI84VP	KSI84D
Quantity	Q	Acceleration		Velocity		Displacement
Mode	M	RMS	PEAK	RMS	PEAK	PEAK-PEAK

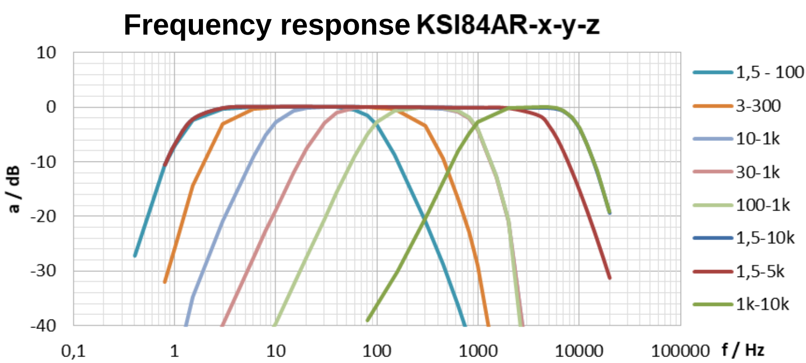
Furthermore, the types differ in the measured frequency range (HP, LP) and in their measuring range.

3.1 Frequency Range (HP, LP)

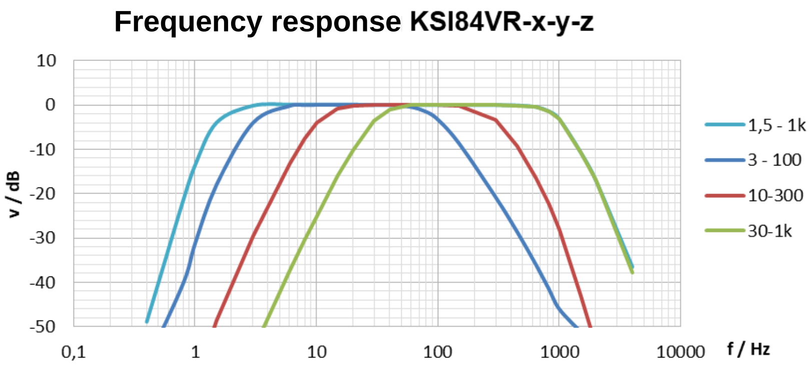
The used frequency range of a sensor type is described by the values HP and LP in the type table.

HP is the -3 dB cutoff frequency of the high pass filter and determines the lower cutoff frequency of the sensor.
LP is the -3 dB cutoff frequency of the low pass filter and determines the upper cutoff frequency of the sensor.
All frequencies between the lower and upper cutoff frequency have an impact to the measuring result.

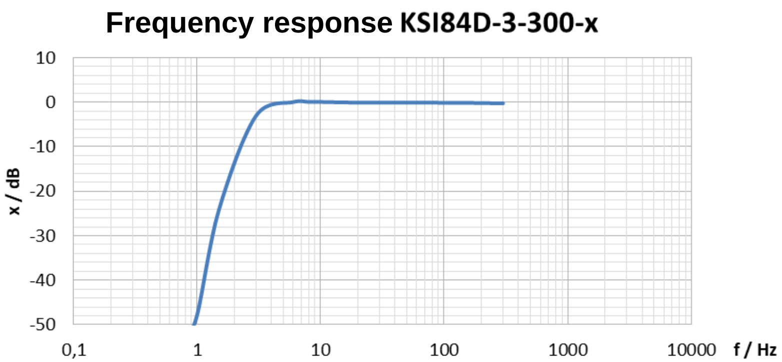
Sensors measuring **acceleration** have a 2nd order IIR high pass and low pass filter with a stopband attenuation of -40 dB/decade.



The HP filter of the **velocity** sensor types has a stopband attenuation of -50 dB/decade, the LP filter has a stopband attenuation of - 40 dB/decade.



The HP filter of the **displacement** sensor types has a stopband attenuation of -60 dB/decade. The upper cut-off frequency is 300 Hz. It results from the significant decrease of the dynamic range with increasing frequency. At 300 Hz the maximum current amplitude is only 1 % of the measuring range.



3.2 Measuring Range

The “Range” value specified in the type table corresponds to the value of the measured quantity at which the sensor current is 20 mA. At this value, the sensor output is set to 100 %.

The measurement result should always be within the linear measuring range of the sensor. It ranges from 4.16 mA (1 %) to 22 mA (112.5 %).

If 22 mA cannot be processed by the used measuring instrument, the output current can optionally be limited to 20 mA (specify when ordering if necessary).

3.3 Type Code

The type code is printed on the sensor housing. It is composed according to the following key. Note that only integer values without decimal places are printed in the type code.

KSI84**QM-HHH-LLL-RRR**

Range
in m/s² (1…3 places)
in mm/s (2 places)
in mm (2 places)

Low-Pass filter
-3dB cutoff frequency
(2…3 places)

High-Pass filter
-3dB cutoff frequency
(1…3 places)

Mode
R: RMS
P: Peak

Quantity
A: Acceleration
V: Velocity
D: Displacement

4 Sensor Operation

4.1 Sensor Mounting

The choice of an appropriate measuring point on the target is important for accurate vibration measurement. It can be helpful to consult a specialist in machine monitoring for this purpose.

In general, it is advisable to measure vibrations as near as possible to their source. This minimizes errors by transmitting mechanical components.
Suitable measuring points are rigid components, for instance the housing of bearings or gearboxes. Not recommended for vibration measurement are lightweight, flexible and soft components. The standard ISO 10816-1 gives some recommendations for suitable measuring points.

The KSI84xx is mounted via the M8 threaded hole in the sensor base. The sensor can either be mounted directly using the M8 mounting stud type 043 or with the help of the mounting pad type 229 with M8 stud by epoxy cementing on the object.

Alternatively, the senor can also be fixed by the magnetic base type 208 (M8) or type 008 (M5) in combination with the thread adapter type 044.

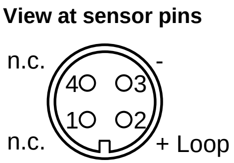
The sensor should be in touch with the target by its complete mounting surface. Rough, scratched or too small measuring points may cause errors. Cast or varnish surfaces are unsuited.

A thin layer of silicone grease between the mounting surfaces also improves vibration transmission.

4.2 Sensor Connection

4.2.1 Connection to the Loop Supply

The sensor is connected via PIN 2 (+) and PIN 3 (-) of the output connector to the loop supply voltage. PIN 1 and PIN 4 are not to be connected.



1: Do not connect
2: + current loop
3: - current loop
4: Do not connect

The loop supply voltage U_S should be within 10 to 30 V and free of noise.

It is recommended to select a lower voltage at ambient temperatures above 80 °C in order to reduce self-heating due to the power dissipation inside the sensor.

4.2.2 Sensor Cable

We recommend to use a two-core shielded cable for best EMI protection.

Alternatively, the sensor can also be connected with a four-core, shielded cable with a moulded plug. The unused wires must remain open.

Metra offers the following connection accessory:

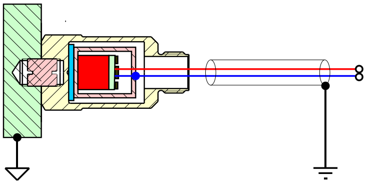
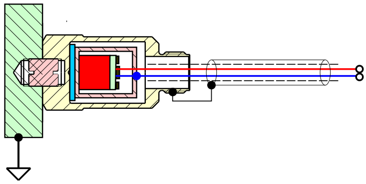
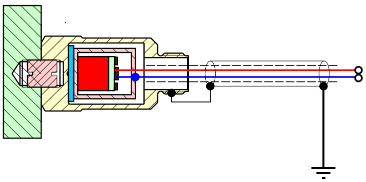
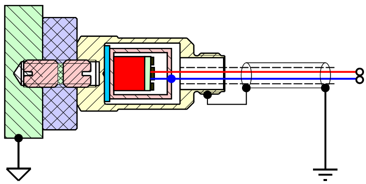
- Type 080G/W: Binder 713, female, straight (G) or angled (W) with screw terminals for connection an existing sensor cable; protection grade IP67
- Type 082-B713G-PIG-x or type 082-B713G-PIG-x:
  Shielded sensor cable, x m length with Binder 713, female, straight (G) or angled (W) and cable end sleeves; protection grade IP67

Make sure that the cable is not routed alongside AC power lines and in adequate distance to potential EMI sources. It should cross AC power lines at right angles.

4.2.3 Grounding Concept

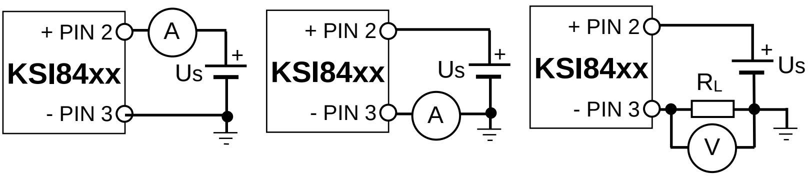
The sensor has an outer and an inner housing shield to protect the electronics against EMI. Both housings are electrically isolated from each other.

The inner housing is connected to the potential of the negative loop line via PIN3. The outer sensor housing is either connected directly to the device potential at the mounting location via the M8 thread (case 1) or obtains its reference potential via the cable shield (case 2).

Case 1: Sensor mounting on machine potential	
 Sensor connection with type 080G/W, type 082-B713G-PIG-x or type 082-B713W-PIG-x: Sensor connector electrically isolated → **connect shield to ground on device side**	 Sensor connection with metal plug or cable with moulded plug: Cable shield connected to threaded ring → **Leave shield open on device side**
Case 2: Potential free mounting	**Case 2: Isolated mounting**
 Sensor connection with metal plug or cable with moulded plug: → **connect shield to ground on device side**	 Sensor connection with metal plug or cable with moulded plug: → **connect shield to ground on device side**

4.3 Measuring the sensor current

The following figures show possibilities to measure the sensor current.



The sensor current can be measured either directly by a current meter connected in series or indirectly by measuring the voltage drop across the load resistance R_L between PIN 3 and the negative terminal.

Choose the connection shown in the first figure for best **EMI** protection.

The voltage drop u_L across R_L is calculated from the sensor current as follows:

$$u_L = R_L \cdot i_{Sensor}$$

The following table shows the voltage drop u_L as a function of the sensor current at different load resistors R_L.

		Voltage drop over R_L		
Excitation	i_{Sensor}	125 Ω	250 Ω	500 Ω
0 %	4 mA	0,5 V	1 V	2 V
10 %	5,6 mA	0,7 V	1,4 V	2,8 V
20 %	7,2 mA	0,9 V	1,8 V	3,6 V
50 %	12,0 mA	1,5 V	3 V	6 V
100 %	20,0 mA	2,5 V	5 V	10 V
112,5 %	22,0 mA	2,75 V	5,5 V	11 V

4.3.1 Maximum Load Resistance R_L

The maximum load resistance R_L depends on the loop supply voltage U_S. It results from the fact that the sensor requires at least 7 V at the highest possible loop current.

The calculation is as follows:

$$R_L \leq \frac{U_S - 7\,V}{24\,mA} \approx 40 \cdot (U_S - 7) * ohm$$

R_L : Load resistance of current loop
U_S: Loop supply voltage in V

It can be seen that the load resistance R_L must not exceed 680 Ω with a supply voltage U_S = 24 V.

4.4 Sensor Self-Test

The sensor starts with a self-test once it is connected to the loop supply voltage.

During self-test, the sensor outputs the maximum sensor current (22 mA[1)]) and the offset current of 4 mA for a duration of 2 seconds. These currents can be measured with an ampere meter to ensure proper function.

If there is no error, the normal measuring operation starts afterwards, in which the sensor current corresponds to the current measured value.

There is a LOOP error if the sensor is not able to drive 22 mA[1)]. In this case, the sensor repeats the self-test until the error is fixed.

4.5 Measuring Mode

4.5.1 Sensitivity B_i

In measuring mode, the sensor output current i_{Sensor} is proportional to the vibration amplitude of the measured quantity *x*. A constant offset current of 4 mA is overlaid on this current for the sensor supply.

$$i_{Sensor} = B_i \cdot a + 4\,mA$$

The proportionality factor B_i is called sensitivity. The sensitivity depends on the measuring range of the sensor. It results from the quotient of the current change at 100 % excitation and the measuring range.

[1)] 20 mA for order option with limited output current

$$B_i = \frac{(20\ mA - 4\ mA)}{Range} = \frac{16\ mA}{Range}$$

The following table shows the sensitivity of the acceleration and velocity types for different measuring ranges.

	Range in m/s²						
KSI84Ax	**5**	**10**	**20**	**50**	**100**	**200**	**500**
B_{ia} / mA/m/s²	3,2	1,6	0,8	0,32	0,16	0,08	0,032

	Range in mm/s					
KSI84Vx	**10**	**12.7**	**20**	**25.4**	**40**	**50.8**
B_{iv} / mA/mm/s	1.6	1.26	0.8	0.63	0.4	0.315

	Range in mm					
KSI84D	**10**	**12.7**	**20**	**25.4**	**40**	**50.8**
B_{id} / mA/mm	1.6	1.26	0.8	0.63	0.4	0.315

The sensitivity B_i changes only slightly over temperature due an electronic compensation. The remaining TC(B_i) can be found in the technical data.

4.5.2 Calculation of measured quantity

The amplitude of the measured quantity (a, v or d) is determined from the sensor current as follows:

$$a, v, d = \frac{1}{B_i} \cdot (i_{Sensor} - 4\ mA) = \frac{Range}{16\ mA} \cdot (i_{Sensor} - 4\ mA)$$

4.5.3 Offset Current and *Noise*

The offset current I_{off} of the sensor is **4 mA**. This is the **zero point** in measuring mode. The calibrated value is output while sensor elf-test for control.

A slightly larger current value is measured when no vibration excitation is present, the current in rest. This is the smallest output value in measuring mode. It consists of the offset current and the current of the sensor noise.

$$I(0) = 4\ mA + I_{\text{Noise}}$$

The ***Noise*** depends on the type and is specified in the type table in m/s² or mm/s. Multiplication by the sensitivity B_i gives:

$$I_{\text{Noise}} = Noise \cdot \frac{16\ mA}{Range}$$

The offset current I_{off} changes only slightly over temperature and time. For details see in technical data.

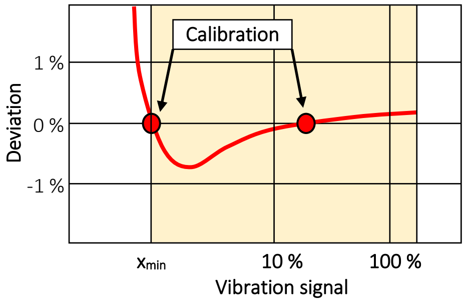
4.5.4 Linear Measuring Range $x_{min}...x_{max}$

The current loop sensor is calibrated at two vibration amplitudes to achieve optimum linearity of the sensor current over the entire measuring range.

The range for valid measurements extends from …

	x_{min}	x_{max}	Sensor types
(1)	1 % of range (4.16 mA)	112.5 % of range (22 mA) [1)]	All types except (2)
(2)	2 % of range (4.32 mA)		KSI84**AP**-xx-**10k**-xxx KSI84AR-xx-xx-**5**

Within this measuring range, the linearity of sensitivity (gain error) specified in the technical data is maintained.



If the vibration signal is **smaller** than the specified minimum x_{min}, the measurement error increases due to sensor noise and the limited resolution of the AD converter.

At vibration amplitudes **greater** than the maximum x_{max}, the sensor current no longer increases. It remains constant at **22 mA** [1)]. A sensor with a larger measuring range must be selected.

4.5.5 Dynamic Range

The dynamic range is the maximum peak amplitude value that can be processed without overdriving the signal processing. It is shown in the following table for the acceleration, velocity or displacement signal and the different measuring ranges.

		Range in m/s²						
KSI84Ax		**5**	**10**	**20**	**50**	**100**	**200**	**500**
a_pk / m/s²	LP ≤ 1 kHz	47	47	95	195	390	780	780
a_pk / m/s²	LP ≥ 5 kHz	-	47	47	95	195	390	780

		Range n mm/s					
KSI84Vx		**10**	**12,7**	**20**	**25,4**	**40**	**50,8**
v_pk / mm/s	@160 Hz	95	95	190	190	380	380
v_pk / mm/s	@640 Hz	24	24	48	48	95	95

		Range in mm					
KSI84D		**10**	**12,7**	**20**	**25,4**	**40**	**50,8**
x_pk-pk / mm	@16 Hz	40	40	80	80	160	160
x_pk-pk / mm	@32 Hz	10	10	20	20	40	40
x_pk-pk / mm	@160 Hz	0,4	0,4	0,8	0,8	1,6	1,6

[1)] *optional 20 mA (100 %) available*

For **accelerometers**, the dynamic range is independent of frequency. The sensor setting LP of the low-pass filter defines the corresponding range of values.

For all **velocity** sensors, the dynamic range depends on the frequency. It is halved when the frequency doubles.

The dynamic range of the **displacement** sensors depends strongly on the frequency. 100 % of measuring range can only be used at frequencies $f \leq 32$ Hz. At higher frequencies, the measuring range is limited. It decreases by a factor ¼ with each doubling of the frequency.

4.6 Overload Display

To signal an existing overload, the sensor outputs the maximum output current of 22 mA[1)]. The overload does not necessarily have to be in the linear frequency range of the sensor. It can also be within the stopband of the sensor type.

If there is an overload, the measurement result is incorrect and a sensor with a larger measuring range must be used.

4.7 Measurement Acquisition

The current output of the sensor is updated every 0.5 seconds. The only exceptions are the types KSI84AR-1k-10k-xx, where the update rate is 62.5 ms.

The RMS measurement is based on all samples within this time window.

The PEAK measurement uses the samples from two consecutive time windows. This results in a PEAK hold time of 1s.

4.7.1 Averages Filter - Settling Time

To reduce signal ripple by low frequencies and to improve the signal-to-noise ratio, the output signal is additionally filtered using a moving average filter. The number of averages *N* is adjustable.

By **default**, the sensor is delivered with the average filter setting ***N = auto***. In this mode the number of averages *N* depends on the amplitude mode (rms, peak) and on the high pass filter setting.

	average filter= auto	
HP-Filter	**RMS**	**PEAK**
1.5 Hz / 3 Hz / 10 Hz	N = 8	N = 8
30 Hz / 100 Hz	N = 4	
1 kHz	N = 1	

Optionally, the averaging filter can also be obtained with the settings **N = 1, 2, 4, 8**. The setting of the average filter can also be adjusted afterwards.

[1)] *20 mA for order option with limited output current*

The averaging filter causes a signal delay. If the vibration signal changes abruptly, the sensor signal only changes smoothly. The signal change is not completed until the settling time T has elapsed.

The table below shows the relationship between the number of averages *N* and the minimal settling time *T*.

N	PEAK	RMS, HP < 1 kHz	RMS, HP = 1 kHz
1	T = 0,5 s		T = 62,5 ms
2	T = 1 s		T = 125 ms
4	T = 2 s		T = 250 ms
8	T = 4 s		T = 0,5 s

We recommend to use a short settling time for the use of the sensor in a closed control loop. Please specify when ordering: N=1 or N=2.

4.8 Total Accuracy

All vibration sensors of the KSI84xx family are individually measured and calibrated before delivery. Calibration is performed both electrically and mechanically in our certified vibration measurement laboratory.

Systematic errors caused by temperature are largely corrected by signal processing.

The following overview contains the most important error quantities to estimate the total accuracy of the sensor.

Error quantities	Max		Importance
Basic accuracy of the nominal range	2	%	Accuracy of the sensor sine calibration (at a certain amplitude and frequency, at T = 23 °C)
Linearity	2	%	Additional error at any amplitude. The typical error function is shown in chapter 4.5.4. The error maximum is at the lower end of the linear measuring range.
Temperature	E_T	%	Additional error at any temperature within the operating temperature range. $E_T(T) = TC(B_i) \cdot (T - 23\,°C)$
Frequency response	1	%	Additional error due to deviation of sensor frequency response from ideal frequency response
Basic accuracy of offset current	1	µA	These errors influence the zero point of the sensor. They effect to the total error only at very low vibration levels.
Offset current drift	see 5.1		
Noise	see 5.5		

4.9 Error Messages

If the sensor current is between 4 mA and 22 mA[1)], the sensor is in normal operational mode.

Any current outside this range indicates a specific error. The following table shows the values used.

Current	Error	Cause	Remedy
3,75 mA	LOOP Error	The sensor cannot output the correct current value because the current loop proper setup	Restart the sensor. There is a LOOP-Error if the sensor remains in self-test after restart. **→ follow steps 4.9.1**
	SENSOR Error	Die Signalverarbeitung des Sensors arbeitet nicht normal.	Restart the sensor. There is a SENSOR-Error if the Sensor does not start with the self-test. The sensor constantly outputs 3,75 mA. **→ Replace sensor**
22mA[1)]	Overload (OVL)	Vibration signal too high	Use a sensor type with a higher measuring range. **→ Replace sensor**

4.9.1 Steps to Fix a LOOP Error

1. Check the value of the load resistance R_L and reduce it if possible
2. Check the value of the loop supply voltage and increase it if possible

[1)] *20 mA for order option with limited output current*

5 Technical Data

5.1 Technical Characteristics of the 4-20mA transducer			
Sensor system		Piezoelectric accelerometer	
Measured quantity	Q KSI84**A***x-x-x-x* KSI84**V***x-x-x-x* KSI84**D**-*x-x-x*	according to type code Acceleration Velocity Displacement	 m/s² mm/s mm $_{pk-pk}$
Mode	M KSI84x**R**-*x-x-x* KSI84x**P**-*x-x-x*	according to type code RMS PEAK	 ... pk
Linear frequency range High pass filter [1] -3dB Low pass filter [2] -3dB	 f_{HP} KSI84xx-**HP**-*x-x* f_{LP} KSI84xx-*x*-**LP**-*x*	according to type code 1.5 / 3 / 10 / 30 / 100 / 1k 100 / 300 / 1 k / 5k / 10k	 Hz Hz
Nominal range[1] ± accuracy	x_N @20 mA, @23°C KSI84Ax-*x-x*-**R** KSI84Vx-*x-x*-**R** KSI84D-*x-x*-**R**	according to type code 5/10/20/50/100/200/500± 2 % 10/12.7/20/25.4/40/50.8 ± 2 % 10/12.7/20/25.4/40/50.8 ± 5 %	 m/s² mm/s mm $_{pk-pk}$
Linear measuring range	x_{min} ... x_{max}	1...112.5 [3]; (2...112.5) [4]	% of x_N
Linearity of sensitivity (Gain error)	δB_{ix} @x_{min} ... x_{max} @23°C	± 2	%
Temperature coefficient of sensitivity	$TC(B_i)$	+ 0.015	%/K
Max. offset drift over temp.	ΔI_{off} @T_{min}...T_{max}	± 4	µA
Max. offset drift over time	ΔI_{off} @5.000 h	+ 1	µA
Resolution (noise)		see type table	
Transverse sensitivity	G_{90max}	< 5	%
5.2 Electrical Characteristics			
Current output	I_{OUT}	4...22 [3]	mA
Loop supply voltage	U_S	10...30	V
Settling time [5]	T @f_{HP}=1kHz; RMS @all types	< 0,125 < 5	s s
Load resistance	R_L	< 40 · (U_s - 7)	Ω
Ground insulation	R_{ISO} @250 VDC	> 4000	MΩ
Dielectric strength	U_{ISO}	350	VDC
5.3 Mechanical Characteristics			
Dimensions	Ø / h	SW22 / 43.1	mm
Weight	m	60 / 2.1	g / oz
Housing material		Stainless steel	
Mounting		M8 thread in base	
Sensor tightening torque		8	Nm
Connector		Binder 713, 4 pole, male	

[1] *Type code contains only integer values without decimal places*
[2] *The condition LP ≥ 10 HP must be met*
[3] *20 mA (100 %) for order option with limited output current*
[4] *Restricted linear measuring range for type code KSI84AP-x-10k-x and KSI84AR-x-x-5*
[5] *Settling time for average filter= auto, 1...5 (0,125...0,6) s optionally available*

5.4 Environmental Characteristics			
Operating temperature	T_{min} / T_{max}	-40 / 100	°C
Protection grade		IP68	
Destruction shock limit	a_{max}	5000	g
EMI		EN 61326-2-3:2013	

5.5 Type Tables

5.5.1 Acceleration, RMS

Q	M	HP Hz	LP Hz	Range m/s²	Type code	Noise m/s²
a	RMS	1,5	100 300 1k	5	KSI84AR-1-LP-5	0,005
				10	KSI84AR-1-LP-10	0,005
				20	KSI84AR-1-LP-20	0,005
				50	KSI84AR-1-LP-50	0,007
				100	KSI84AR-1-LP-100	0,007
				200	KSI84AR-1-LP-200	0,008
				500	KSI84AR-1-LP-500	0,016
			5k	10	KSI84AR-1-5k-10	0,020
				20	KSI84AR-1-5k-20	0,020
				50	KSI84AR-1-5k-50	0,030
				100	KSI84AR-1-5k-100	0,060
				200	KSI84AR-1-5k-200	0,080
				500	KSI84AR-1-5k-500	0,160
			10k	20	KSI84AR-1-10k-20	0,050
				50	KSI84AR-1-10k-50	0,090
				100	KSI84AR-1-10k-100	0,180
				200	KSI84AR-1-10k-200	0,200
				500	KSI84AR-1-10k-500	0,250
		3 10 30 100	100 [1)] 300 [1)] 1k	5	KSI84AR-HP-LP-5	0,005
				10	KSI84AR-HP-LP-10	0,005
				20	KSI84AR-HP-LP-20	0,005
				50	KSI84AR-HP-LP-50	0,007
				100	KSI84AR-HP-LP-100	0,007
				200	KSI84AR-HP-LP-200	0,008
				500	KSI84AR-HP-LP-500	0,016
		1k	10k	20	KSI84AR-1k-10k-20	0,050
				50	KSI84AR-1k-10k-50	0,090
				100	KSI84AR-1k-10k-100	0,180
				200	KSI84AR-1k-10k-200	0,200
				500	KSI84AR-1k-10k-500	0,250

[1)] *The condition LP ≥ 10 HP must be met*

5.5.2 Acceleration, PEAK

Q	M	HP Hz	LP Hz	Range m/s² pk	Type code	Noise m/s² pk
a	Peak	1.5	100 300 1k	10	KSI84AP-1-LP-10	0.005
				20	KSI84AP-1-LP-20	0.005
				50	KSI84AP-1-LP-50	0.007
				100	KSI84AP-1-LP-100	0.007
				200	KSI84AP-1-LP-200	0.008
				500	KSI84AP-1-LP-500	0.016
			5k	10	KSI84AP-1-5k-10	0.020
				20	KSI84AP-1-5k-20	0.020
				50	KSI84AP-1-5k-50	0.030
				100	KSI84AP-1-5k-100	0.060
				200	KSI84AP-1-5k-200	0.080
				500	KSI84AP-1-5k-500	0.160
			10k	50	KSI84AP-1-10k-50	0.090
				100	KSI84AP-1-10k-100	0.180
				200	KSI84AP-1-10k-200	0.200
				500	KSI84AP-1-10k-500	0.250
		3 10 30 100	100 [1)] 300 [1)] 1k	10	KSI84AP-HP-LP-10	0.005
				20	KSI84AP-HP-LP-20	0.005
				50	KSI84AP-HP-LP-50	0.007
				100	KSI84AP-HP-LP-100	0.007
				200	KSI84AP-HP-LP-200	0.008
				500	KSI84AP-HP-LP-500	0.016
		1k	10k	50	KSI84AP-1k-10k-50	0.090
				100	KSI84AP-1k-10k-100	0.180
				200	KSI84AP-1k-10k-200	0.200
				500	KSI84AP-1k-10k-500	0.250

[1)] *The condition LP ≥ 10 HP must be met*

5.5.3 Velocity, RMS

Q	M	HP Hz	LP Hz	Range mm/s	Type code	Noise mm/s
v	RMS	1,5	100 300, 1k	40	KSI84VR-1-LP-40	0,100
				50,8	KSI84VR-1-LP-50	
		3	100 300 1k	20	KSI84VR-3-LP-20	0,035
				25,4	KSI84VR-3-LP-25	
				40	KSI84VR-3-LP-40	
				50,8	KSI84VR-3-LP-50	

Velocity, RMS (continued)

Q	M	HP Hz	LP Hz	Range mm/s	Type code	Noise mm/s
		10 [1]	100 300 1k [1]	10	KSI84VR-10-LP-10	0,010
				12,7	KSI84VR-10-LP-12	
				20	KSI84VR-10-LP-20	
				25,4	KSI84VR-10-LP-25	
				40	KSI84VR-10-LP-40	
				50,8	KSI84VR-10-LP-50	
		30	300 1k	10	KSI84VR-30-LP-10	0,005
				12,7	KSI84VR-30-LP-12	
				20	KSI84VR-30-LP-20	
				25,4	KSI84VR-30-LP-25	
				40	KSI84VR-30-LP-40	
				50,8	KSI84VR-30-LP-50	

[1] *Complies with the requirements of ISO 2954*

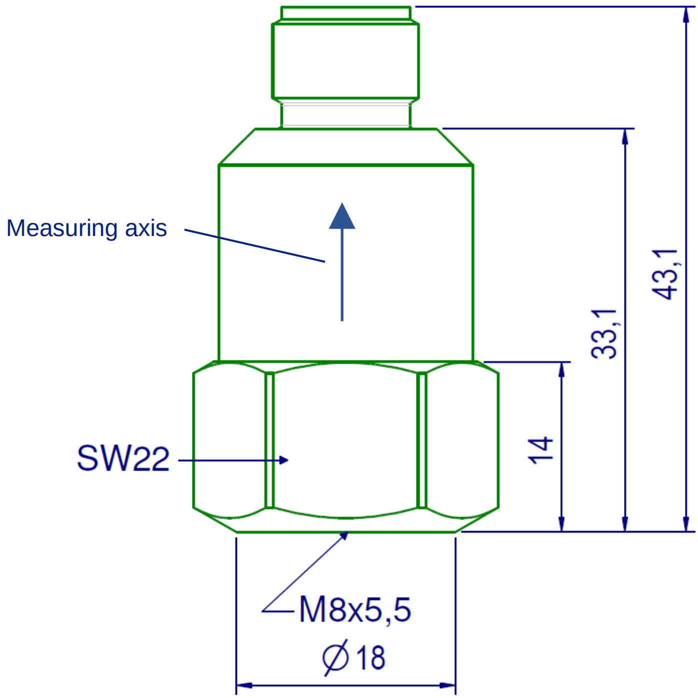
5.5.4 Velocity, PEAK

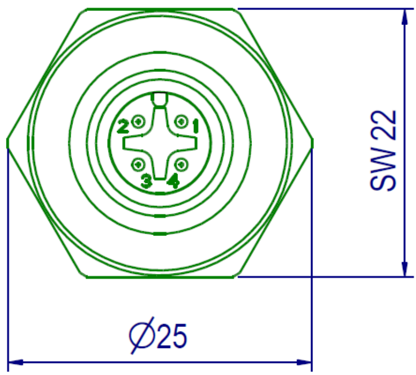
Q	M	HP Hz	LP Hz	Range mm/s pk	Type code	Noise mm/s pk
v	Peak	10	100 300 1k	20	KSI84VP-10-LP-20	0.010
				25.4	KSI84VP-10-LP-25	
				40	KSI84VP-10-LP-40	
				50.8	KSI84VP-10-LP-50	
		30	300 1k	10	KSI84VP-30-LP-10	0.005
				12.7	KSI84VP-30-LP-12	
				20	KSI84VP-30-LP-20	
				25.4	KSI84VP-30-LP-25	
				40	KSI84VP-30-LP-40	
				50.8	KSI84VP-30-LP-50	

5.5.5 Displacement

Q	M	HP Hz	LP Hz	Range mm pk-pk	Type code	Noise mm pk-pk
d	Peak-Peak	3	300	10	KSI84D-3-300-10	0,016
				12,7	KSI84D-3-300-12	0,020
				20	KSI84D-3-300-20	0,032
				25,4	KSI84D-3-300-25	0,040
				40	KSI84D-3-300-40	0,064
				50,8	KSI84D-3-300-50	0,080

5.6 Dimensions





Limited Warranty

Metra warrants for a period of

24 months

that its products will be free from defects in material or workmanship
and shall conform to the specifications current at the time of shipment.

The warranty period starts with the date of invoice.
The customer must provide the dated bill of sale as evidence.
The warranty period ends after 24 months.
Repairs do not extend the warranty period.

This limited warranty covers only defects which arise as a result
of normal use according to the instruction manual.

Metra's responsibility under this warranty does not apply to any
improper or inadequate maintenance or modification
and operation outside the product's specifications.
Shipment to Metra will be paid by the customer.

The repaired or replaced product will be sent back at Metra's expense.

Declaration of Conformity

According to EMC Directive 2014/30/EC

Product: Vibration Sensor
Type: KSI84xx

It is hereby certified that the above mentioned product complies
with the demands pursuant to the following standards:

EN 61326-2-3:2013
EN61000-6-4:2006 + A1:2011
EN61000-6-2:2005

The producer is responsible for this declaration
Metra Meß- und Frequenztechnik Radebeul GmbH & Co. KG
Meissner Str. 58a, D-01445 Radebeul
declared by:

Michael Weber, Radebeul, January 05, 2026