

**Data-sheet:**

## 3-axis Hall probe type KS, KM and KL for the SENIS F3A analog magnetic field transducers and 3MH3A digital teslameters

Thin (0.75 mm) fully integrated 3-axis Hall Probe with high spatial resolution

### DESCRIPTION:

The new developed Hall probe type **KX** for SENIS F3A analog magnetic field transducers and 3MH3A digital teslameters has a thin probe tip (0.5 mm) with a naked Si-chip glued on a ceramic substrate. The thickness of the probe body is 0.75 mm.

The probe provides simultaneous analogue voltage outputs for all three components ( $B_x$ ,  $B_y$  and  $B_z$ ) of a measured magnetic flux density and for the probe temperature.

The **KX** probes are available in 3 (three) different lengths (see Figure 1):

1. **KL** (long): 71 mm,
2. **KM** (medium): 47 mm,
3. **KS** (small): 8 mm.



Figure 1: Photos of the 3-axis Hall probes type KS, KM and KL.

The probe contains a CMOS integrated circuit, which incorporates a group of 3 (three) mutually orthogonal Hall elements, biasing circuits, amplifiers and a temperature sensor.

The integrated Hall elements occupy very small area ( $0.15 \times 0.15 \text{ mm}^2$ ), which provides very high spatial resolution of the probe, see Figure 2:

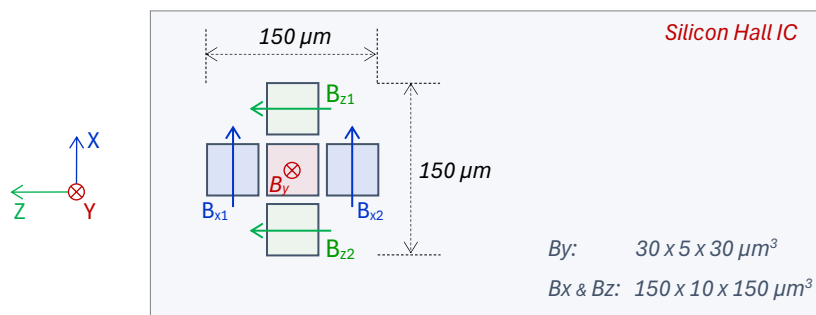


Figure 2: Magnetic field sensitive volume (FSV) of the applied fully integrated 3D Hall sensor

The CMOS IC technology enables very high precision in the fabrication of the vertical and horizontal Hall elements, which gives high angular accuracy between the three measurement axes of the probe (mutual orthogonality error is  $< 1^\circ$ , measured with accuracy of better than  $0.1^\circ$  by the utilization of an improved calibration method).

The on-chip application of the spinning-current technique in the biasing of the Hall elements suppresses the planar Hall effect.

The signal pre-processing on the chip enables a very high frequency bandwidth of the probe (DC - 25 kHz (-3 dB)), and on-chip signal amplification provides high output signals of the Hall probe.

The sensor chip is embedded in the probe package made of alumina-ceramics ( $\text{Al}_2\text{O}_3$ ) and it is connected to the flexible shielded cable.

The outputs of the KS, KM and KL Hall probes are:

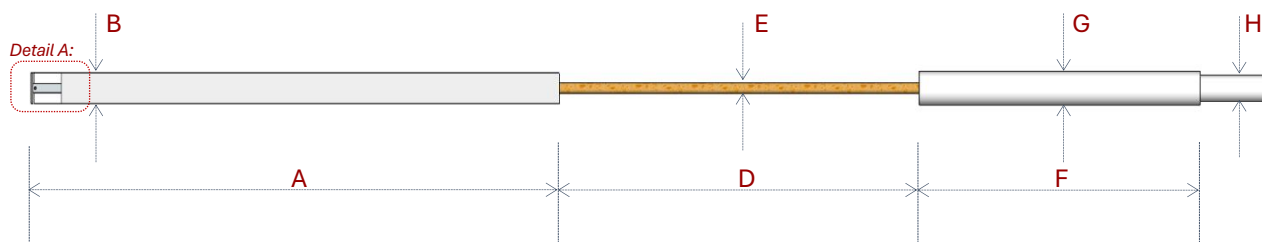
- high-level voltages proportional to the measured magnetic field components  $B_x$ ,  $B_y$  and  $B_z$ , and
- a voltage proportional to the actual local temperature of the Hall chip.

#### Key features of the Hall probe type Kx:

- Hall probe type Kx for SENIS F3A analog magnetic field transducers and 3MH3A digital teslameters has a thin probe tip (0.5 mm) with a naked Si-chip glued on a ceramic substrate.  
The probe is available in 3 (three) different lengths (x): 71 mm (KL - long), 47 mm (KM - medium), and 8 mm (KS - small probe), and the thickness of the probe body is 0.75 mm.
- Probe package is made fully of  $\text{Al}_2\text{O}_3$  ceramics, with the chip and cable connecting pads directly printed on the ceramic substrate.
- Fully integrated CMOS 3-axis ( $B_x$ ,  $B_y$ ,  $B_z$ ) Hall Probe, of which one, two, or three channels are used.
- Very high spatial resolution:  $B_y$ :  $30 \times 5 \times 30 \mu\text{m}^3$ ;  $B_x$  &  $B_z$ :  $150 \times 10 \times 150 \mu\text{m}^3$ .
- High angular accuracy of the measurement axes: mutual orthogonality between the three measurement axes of the probe is  $< \pm 1^\circ$ , determined with accuracy better than  $0.1^\circ$  by the application of an improved method.
- High frequency bandwidth: DC - 25 kHz (-3 dB point of sensitivity attenuation).
- Virtually no planar Hall Effect.
- Negligible inductive loops on the Probe.
- Integrated temperature sensor on the probe for temperature compensation, etc.

## Hall probe and Cable - Mechanical specifications:

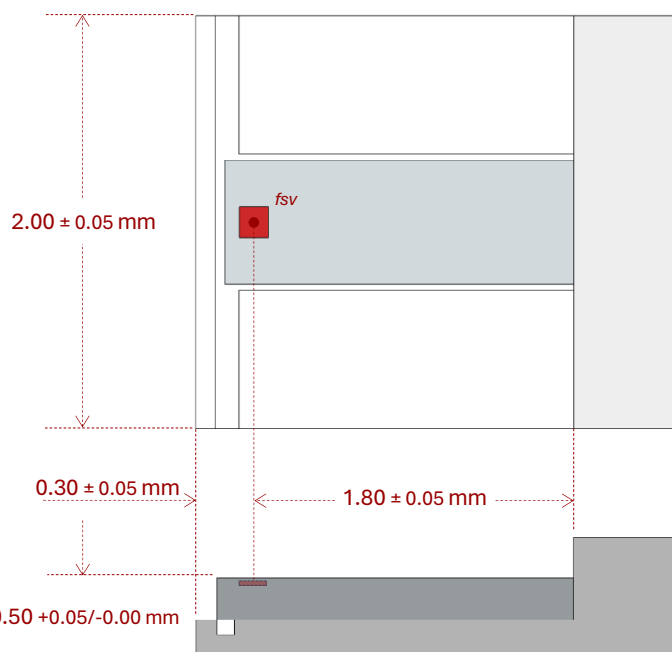
TOP side view:



LEFT side view:



Detail A:



Probe-to-Teslameter Adapter,  
(D-SUB25F connector)

Probe Cable CaH

Transient  
cable section

Flexible  
cable section

Hall probe



Part	Dimension (mm)	Part	Dimension (mm)
<i>KS</i>	$8.0 \pm 0.2$	<i>F</i>	$25 \pm 2$
<i>A</i> <i>KM</i>	$47.0 \pm 0.5$	<i>G</i>	$\varnothing 2.2 \pm 0.1$
<i>KL</i>	$71.0 +0.5/-0.0$	<i>H</i>	$\varnothing 1.7 \pm 0.1$
<i>B</i>	$2.00 \pm 0.05$	<i>I</i>	Standard cable lengths: $2'000 \pm 1 \%$ $5'000 \pm 1 \%$ $10'000 \pm 1 \%$
<i>C</i>	$0.75 +0.05/-0.00$		
<i>D</i>	$50 \pm 1$		
<i>E</i>	$\varnothing 0.7 \pm 0.1$		

Figure 3: Dimensions and tolerances of the H-module type F3A-03K*x*0IC (here “*x*” denotes probe type: L, M or S, and “*I*” denotes the length of the probe cable).

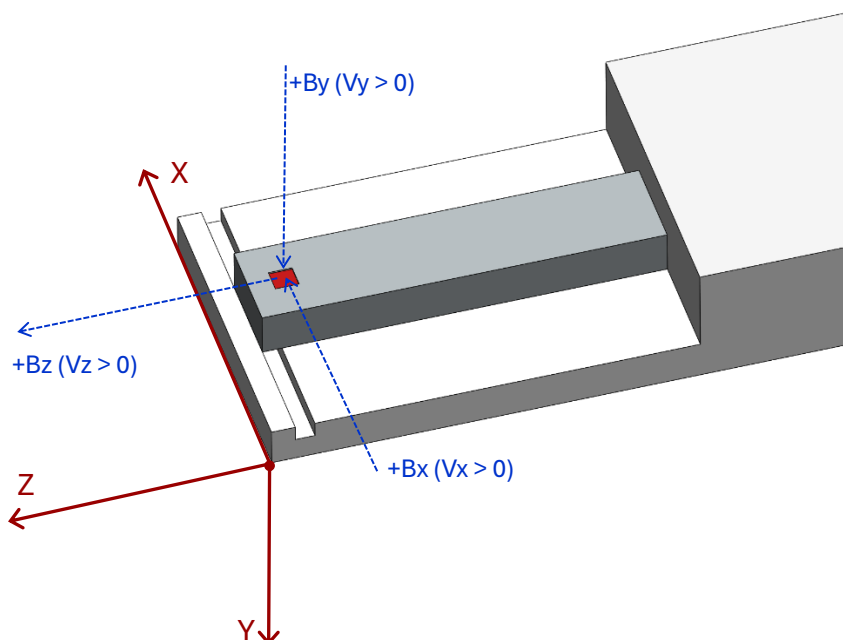


Figure 4: Reference Cartesian coordinate system (X, Y, Z) of the 3-axis Hall probes type KL, KM and KS.

Parameter				
Dimensions		X (mm)	Y (mm)	Z (mm)
Magnetic field sensitive volume (FSV)		0.15	0.01	0.15
Position of the FSV centre (Fig. 3 and 4)		1.00 ± 0.05	-0.25 -0.05/+0.00	-0.30 ± 0.05
External dimensions of the probe	KS	2.00 ± 0.05	Probe body:	8.00 ± 0.2
	KM		0.75 +0.05/-0.00	47.0 ± 0.5
	KL		Sensitive probe tip:	71.0 +0.5/-0.0
Positioning accuracy				
Angular accuracy of the measurement axes		▪ < ±1° with respect to the reference surface		
		▪ Mutual orthogonality between the meas. axes: < ±1° (determined with an accuracy of better than 0.1° by the application of a well-improved measurement method)		
Cable properties				
Conductor:		Silver plated soft copper core, 7 x 44 AWG		
Insulation:		PFA (Perfluoro Alkoxy), diameter 0.30 mm		
Minimum bending radius:		10 x OD	in static applications	
		15 x OD	in dynamic applications	
Shield:		Silver plated soft copper braid		
Jacket:		PFA (Perfluoroalkoxy)		
Service temperature:		-196 / +200 °C		
Linear resistance:		1.4 Ω/m		
Rated voltage:		150 Vac		
RoHS compliance:		Yes		
Cable length:		Standard: 2 m	Notation: F3A-03Kx02C	
		Optional: X m	Notation: F3A-03Kx0XC	
NOTE: Various cable lengths are available upon request.				

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## Installation Manual for the Kx probes:



**NOTE:** The Kx probes are fragile! Please handle it with a special care.

The Hall probe type Kx is made as a “sandwich” of the two thin ceramic plates with a silicon Hall sensor glued on a very thin probe tip and can be easily broken (as a probe is longer, as mechanically more sensitive is).

Therefore, avoid any mechanical contact of the probe tip with other objects! Moreover, avoid the immersion of the probe in any liquid, as well as its exposure to moisture and aggressive gasses.

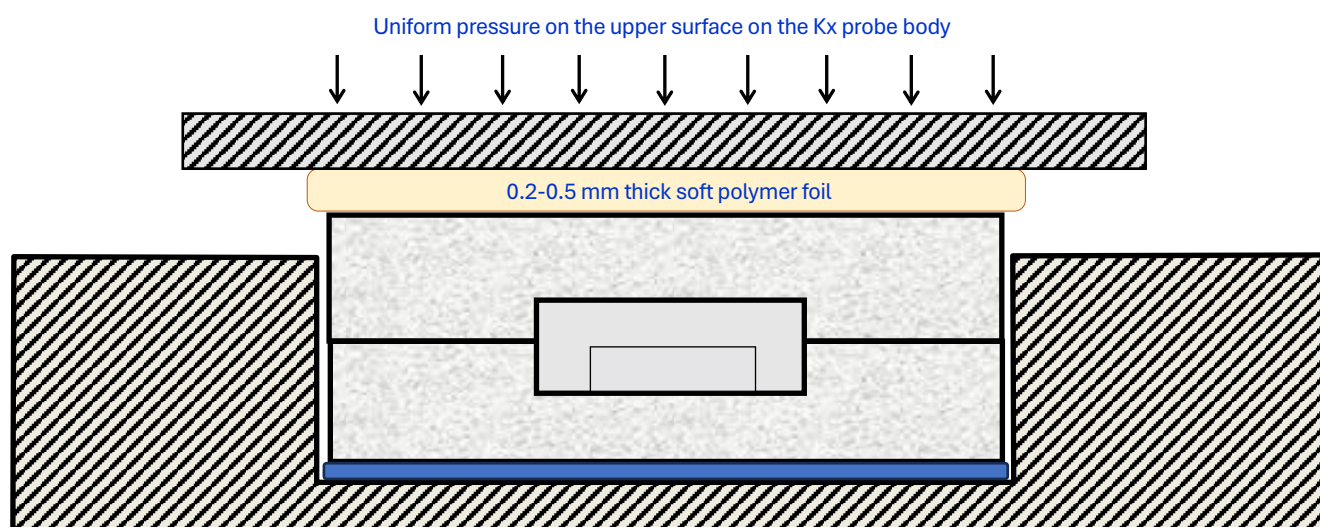
Considering that we deal with a high-precision device of very small dimensions, following precautions should help to avoid damage to the probe during installation and handling, and ensure that the accurate calibration of the device remains preserved:

- Always disconnect powering of the instrument before plugging/unplugging the Hall probe!



- Applied CMOS Hall sensor can be damaged by ESD. We strongly recommend that the probe be handled with appropriate ESD preventive precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.
- Mounting of the Probe should be carried out by application of very low pressure to its head and the thin red cable.
- Do not apply more force than required to hold the probe in its place. Damage to either the ceramics package of the Hall sensor or thin wiring could destroy the Probe.
- If the probe head is clamped, the user needs to make sure that the environment surface in contact with the reference plane of the probe is flat and covers as much of the probe reference surface as possible.
- Do not apply more force than required to hold the probe in its mounting. Also, do not press the probe just in a single spot. Pressure on the probe should be uniformly distributed over its upper surface.

To relax a stress while mounting or gluing the probe in a groove, it is recommended to press the probe by application of a flat 0.2-0.5 mm thick soft polymer or a rubber foil over the upper surface of the probe:



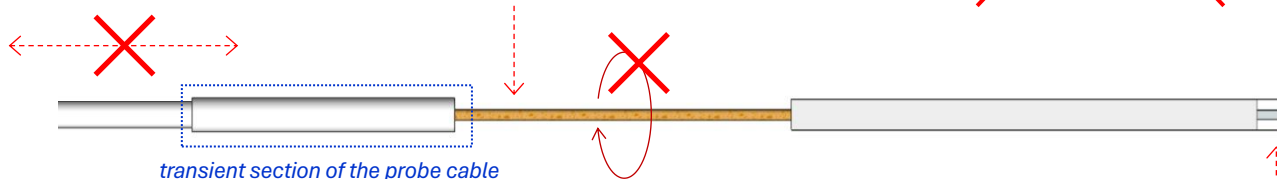
- In order to prevent rupture of the thin probe wiring, the user should fix and secure the probe cable in the proximity of the head. The thin red wire from the probe can be folded only with a special care. Strongly avoid loops or twisting of this section.



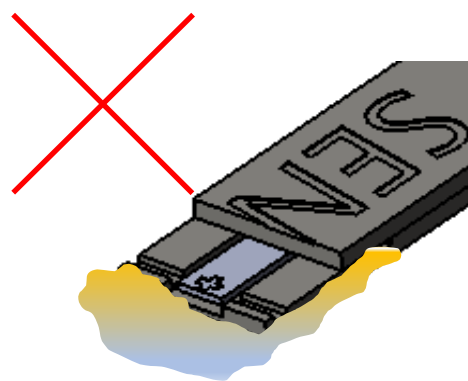
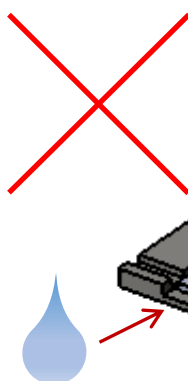
Do not push / pull the probe cable if the probe head is fixed !

The following actions must be strictly avoided:

- pressing the thin red cable;
- contacts to any sharp edges;
- loops or twisting of the thin red part !



Do not expose the front side of the probe to any liquid or gas !



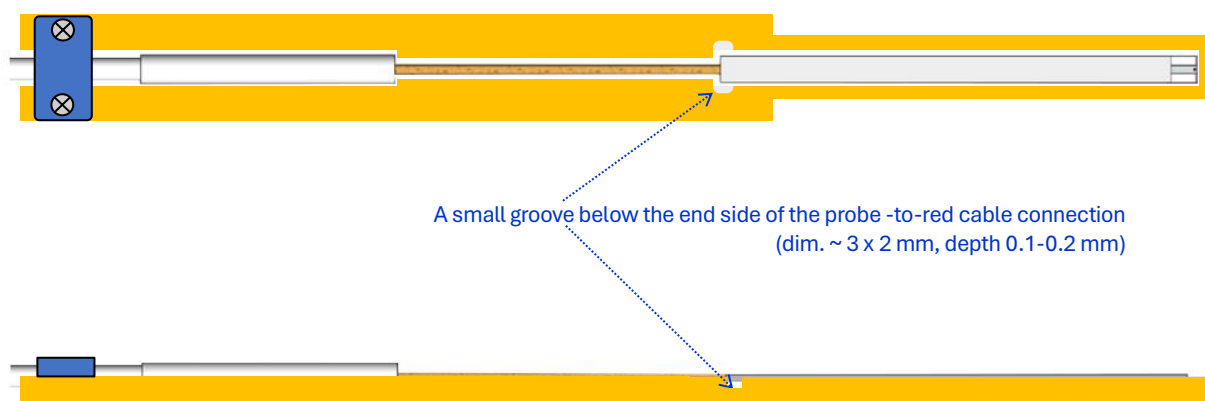
Strongly avoid contact of the FRONT side of the probe (especially CMOS Hall sensor) with any liquid or a grain mass (such as a glue). Due to capillary effect, such matter could enter through the cavity into the interior of the probe and destroy or deteriorate the characteristics of the Hall sensor !

- Do not expose the thin red cable to the external sharp edges.
- Do not expose the probe to moisture and aggressive gasses.
- Avoid immersion of the probe in any liquid.
- Strongly avoid any high pressure, tightening and/or bending of the rigid (non-flexible) transient section between the thin (red) and thick (white) probe cables.

- Safe area for bending the thick (white) probe cable is illustrated on the following drawing:



- A severed cable cannot be re-joined without altering the probe performance, and requires factory repair and full re-calibration of the device.
- Example / proposal for a safe fixation of the Kx probe on a probe holder:



- Keep the cable out of the way of foot traffic. Do not pinch the cable, or drop sharp or heavy objects on it.
- Firstly, ensure that the instrument is not powered. If so, carefully plug the probe connector (female SUB-D/25-pins connector) to the corresponding male SUB-D/25-pins connector on the electronic box. Ensuring that its pins engage correctly, tighten the metal screws of the probe connector. Do not leave these loose since they are the component part of the shielding system of the teslameter.