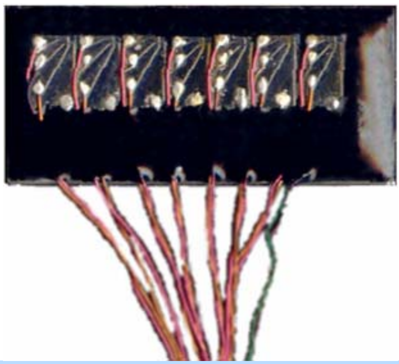
AREPOC s.r.o.

High Linearity Hall Probes for Room and Cryogenic Temperatures



CONTENTS

HALL PROBES FOR CRYOGENIC & ROOM TEMPERATURES

SPECIFICATIONS

About AREPOC

AREPOC s.r.o. established in 1991, is a small sized European company that supplies high quality products to customers in both basic and applied research laboratories, universities, government nuclear research institutions and cryogenic industry. Since 1992, Arepoc has entered into the mutually beneficial relationship with the Institute of Electrical Engineering the Slovak Academy of Sciences. Arepoc has positioned itself to commercialize new developed Hall probes produced by this non-profit state organization. Over the past several years, Arepoc has distinguished itself as the leading supplier of cryogenic high linearity Hall probes. The complete line of sensors includes special Hall probes suitable for precision magnetic field measurements up to 30 Tesla, 3-axis and linear multi-probe arrays for line mapping of HTc superconductors. Arepoc works with clients that need assistance in designing custom Hall probe suitable for their specific measurements.

An extended area of concentration includes custom AC and DC electromagnets and coils designed for cryogenic applications. A recent addition to the product line is programmable 20 to 24 bits data acquisition PC board AD25PCI, which is capable to supply and monitor different types of Hall probes and temperature sensors with high resolution. Additional capabilities include design and construction of tooling equipments using parametric 3D solid modeling software.

Since 1995, Arepoc has participated in three-year joint research project, signed with the Commission of the European Communities, to develop manufacturing techniques for HTc superconducting magnets. In 1996, the company has invented method for longitudinal deformation of high temperature superconductors. An Eccentric roll machine utilizing the new method was patented in 1997. In 1998 - 2004, the Arepoc was a corporate sustaining member of the Cryogenic Society of America. In March 2000, Arepoc has signed a membership agreement with the Consejo Superior de Investigaciones Cientificas, established in Spain to realize specific RTD program entitled “Metal oxide multilayers obtained by cost-effective new CVD technologies for magnetoelectronic microsystems and nanotechnologies” founded by European Community.

We believe that by means of this catalogue you are receiving a real aid, which will help you to be easily orientated in selection of the product you need in your scientific work.

Hall probes have accomplished a rapidly growing demand in the past years, although, the Hall effect was discovered by Edwin F. Hall in 1879. Basically, the Hall probe is a small piece of semiconductor layer. Four leads are connected to the midpoints of opposite sides. When control current $\mathbf{I_c}$ is flowing trough the semiconductor and magnetic field **B** is applied, the resultant Hall voltage $\mathbf{U_H}$ can be measured on the sides of the layer [Figure 1].

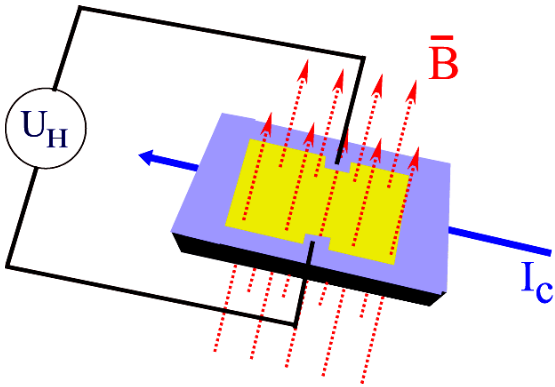


Figure 1

If constant control current supplies the Hall probe a Hall voltage is directly proportional to the magnetic flux density. Voltage output varies with the angle between the vector of the magnetic flux lines and the plane of the sensing area. Maximum value is reaching when the magnetic flux lines are perpendicular to the sensing area. Linear Hall probe is ratiometric - its output voltage is proportional to the control current.

Cryogenic Hall probes described in this catalogue are intended for the precise measurement of magnetic fields in the temperature interval from 350 K down to liquid nitrogen or liquid helium temperatures. High linearity of the Hall voltage versus magnetic field and small temperature dependence of sensitivity represents an advantage for physical and technical experiments.

Great attention is paid to the low value of the offset voltage $\mathbf{U_0}$ as well as to the stability of Hall probe parameters during thermal cycling from room to cryogenic temperatures. Laboratory specimens have withstood 100 cycles from 300 K to 77 K without a considerable change in parameters. Low change in sensitivity after this cycling offers stable operation in long-term application.

Special Hall probes for operation in AC magnetic fields with suppressed induced voltage can be prepared. The minimum value of the equivalent loop area is less then 0.1 mm^2.

Hall probes are available in a variety of shapes and active area dimensions. The three basic constructions represent transverse, axial and 3-axis packages.

The transverse types are designed for the measurement of perpendicular component of the magnetic field. Typically, the active area position of transverse types is near the middle of the side margins of the probe [Figure 2]. Transverse probes where the position of the active area is shifted to a corner [Figure 3] or to the front margin [Figure 4] as well as linear multi-probe arrays [Figure 5] are available.

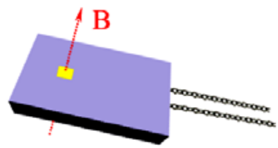


Figure 2

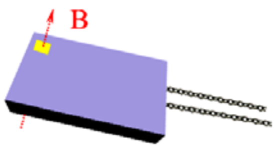


Figure 3

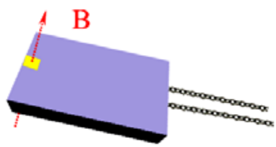


Figure 4

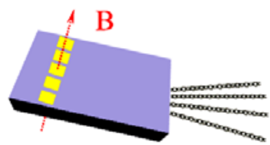


Figure 5

The axial types are designed for the parallel component of the magnetic field measurement. Typically, the active area position of axial types is situated in the axis of the probe [Figure 6]. Also linear multi-Hall probes arrays in axial mounting construction [Figure 7] are available.

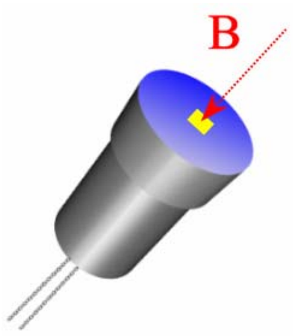


Figure 6

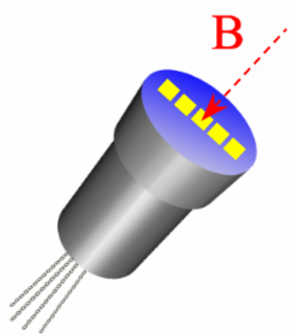


Figure 7

The 3-axis Hall probe [Figure 8] is ideal for simultaneous measurement of all three orthogonal components (**B_x, B_y, B_z)** of the magnetic field.

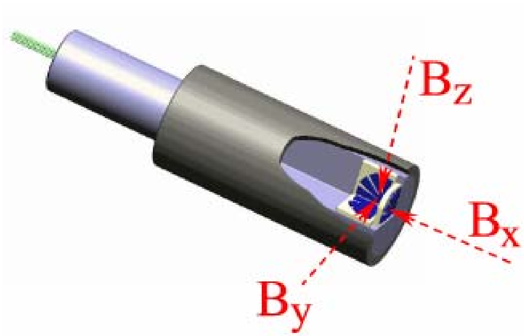


Figure 8

One of the significant advantages of our cryogenic Hall probes is their small size. This allows new concepts in sensing in space-limited applications. The electrical system of axial and transverse types is available in several packaging configurations. Packaged transverse and axial Hall probes have 350 μm distance between the active area and the probe surface [Figure 9]. The active area center is marked with accuracy better than ± 0.1 mm.

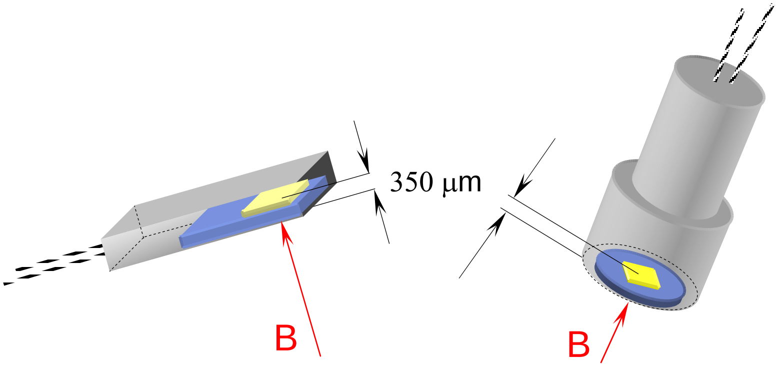


Figure 9

Transverse and axial Hall probes with un-covered active area [Figure 10] can be used in order to decrease the gap between the sensor and the measured surface. The electrical system is

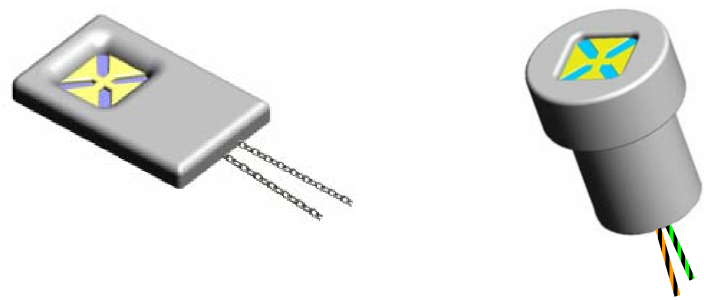


Figure 10

supported by a ceramic plate and only partially protected by a resin enclosure against an accidental contact with a measured sample.

This construction allows decreasing the distance between the surface of the active area and the probe's surface to 150 μm, in comparison with the 350 μm of the packaged one.

Transverse and axial probes with un-packaged the whole electrical system are available too. Thickness of the transverse un-packaged Hall probe (Figure 11) is 0.75 mm, and the distance between the active area and measured sample surface is limited by the wiring connections only. Axial un-packaged Hall probes are available in two basic modifications, varied by arrangement of wiring connections and design of the probe casing. The wiring connections of the first one (Figure 12) are made of thin tapes. It allows reducing the distance of the sensing area from a sample surface to < 40 μm. The wiring method of the second one is made of thin wires. On the upper side of the casing is situated short shoulder, which allows mounting a distance ring for the precise distance adjustment (Figure 13). A special water resistant varnish coats un-packaged Hall probes.

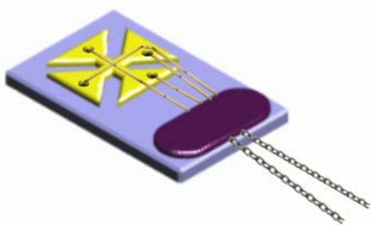


Figure 11

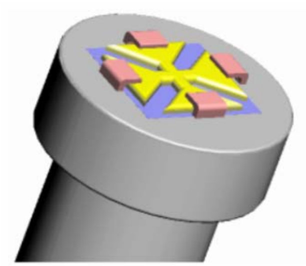


Figure 12

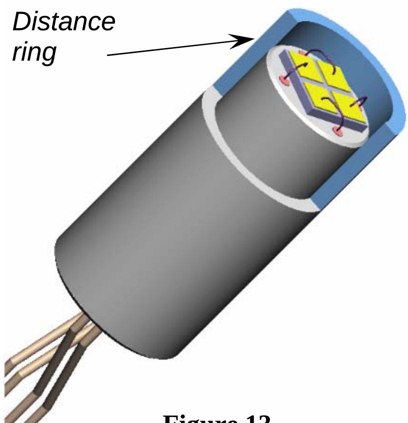


Figure 13

Cryogenic high linearity Hall probes are used primarily to measure strength, direction and relatively small changes in magnetic flux density.

The accurate measurement of the very high magnetic field in the superconducting, hybrid or copper pulse magnets could be met using our **LHP-N...** or **LHP-M...** models [1]. These models feature superior linearity and repeatability to other cryogenic models.

Analysis of the magnetic field above a superconducting tape using Hall probe is relatively simple non-destructive method. Several methods exist for the magnetic field mapping. Models **HHP-V...** allow to measure the perpendicular component of the magnetic field above a tape using movable XY positioner [2]. Alike, the **AXIS-3** Hall probe is suitable for the homogeneity studies of all three components of magnetic field produced by the superconductor [3, 11]. **MULTI-7...**, **MULTI-15...**, **M7-TH5** or **MULTI-THV** Hall probes are adequate for monitoring the magnetic field profile near the surface of the multifilamentary tape [4, 5]. For study on 2D self-field distribution in Ag-sheathed monofilamentary tape using a scanning magnetometry are suitable **HHP-VP**, **VF, VA, SA** or **SF** models [6]. The homogeneity of the critical current of long superconducting tapes can be measured by contactless inductive method [7]. The **MULTI-15A** or **MULTI-7A** Hall probe can be used for recording magnetic field produced by screening currents in a long multifilamentary tape.

Possible approach for evaluating the behavior of grain boundaries in YBCO pellets is to measure the trapped flux by **HHP-MA** or **HHP-MP** Hall probe. Such measurement techniques are increasingly popular since they are non-destructive and may be applied to large samples [8]. The **HHP-VA** or **HHP-SF** models are recommended for higher spatial resolution measurements.

Influence of current re-distribution on minimum quench energy of superconducting cable against local disturbance can be studied using **HHP-MT** or **HHP-VC** Hall probes [9].

Detection of small cracks in steel constructions coated by nonmagnetic paint is rapidly developing non-destructive technique. Scanning Hall-sensor Microscope using **HHP-VP** or **HHP-VA** Hall probe is suitable to measure spontaneous magnetic field distribution in steels caused by a fatigue process [10].

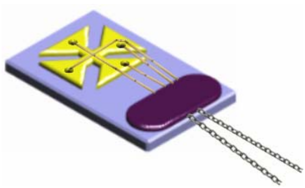
As a standard, the Hall probes are supplied with the following measured parameters:

- sensitivity at 300 K and 0.2 Tesla
- off-set voltage at 300 K and 77 K
- change in sensitivity due to reversing of magnetic field
- input and output resistances at 300 K and 77 K in a zero magnetic field

On a request the calibration of all types of the Hall probes up to **7 T** at **4.2 K**, or up to **0.4 T** at **77 K**, or up to **0.7 T** at **300 K** can be carried out. The special calibrations at **77 K** up to **5 T** or at temperature below **4.2 K** are also available.

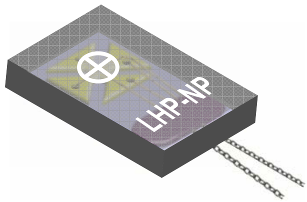
LHP-NU

The model **LHP-NU** is appropriate for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 30 Tesla. This basic type of our Hall probes is suitable for magnetic field measurements of superconducting magnets cooled by liquid helium. Its small overall dimensions make it ideally suited for space-limited applications. The dimensions of the active area are **1250 x 500 μm** and the overall dimensions are 5 x 4 x 0.7 mm. The model LHP-NU is a probe with a specially passivated uncovered electric system.



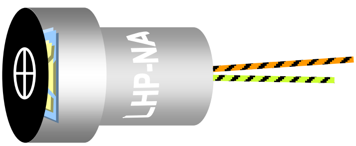
LHP-NP

The model **LHP-NP** features transverse package construction with the same electrical specifications as the type LHP-NU. A cross, located with accuracy better than ± 0.1 mm properly marks the active area center of this packaged sensor. The LHP-NP model is a probe covered by special synthetic resin in transverse modification with overall dimensions 7 x 5 x 1 mm. The electrical system is located parallel to the undersurface with high accuracy.



LHP-NA

The model **LHP-NA** features axial mounting construction with the same electrical specifications as the model LHP-NU. The active area center of this packaged sensor is properly marked by a cross located with accuracy better than ± 0.1 mm. The overall dimensions are ∅ 7 x 8 mm. The LHP-NA model is a probe covered by cryogenic synthetic resin in axial modification and the electrical system is parallel to the front wall of the cover with high precision.



Features

- *Active area 0.625 mm^2*
- *High linearity*
- *Low input and output resistance*
- *Wide magnetic field range ± 30 T*
- *Temperature range 1.5 - 350 K*
- *Low offset voltage*

LHP-NU
LHP-NP
LHP-NA

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 30
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	100
Maximum control current	[mA]	150
Sensitivity at I_n	[mV/T]	> 10
Linearity error at 300K, B = 0 - 1 T	[%]	< 0.2
Linearity error at 77K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2K, B = 0 - 5 T	[%]	< 1
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	2.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	3.10^{-5}
Residual voltage	[μV]	< 100
Temperature coefficient of residual voltage	[μV/K]	< 0.02
Input resistance at 4,2 K (in zero field, including leads)	[Ω]	0.9
Input resistance at 77 K (in zero field, including leads)	[Ω]	1.1
Input resistance at 300 K (in zero field, including leads)	[Ω]	1.5
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	1.3
Output resistance at 77 K (in zero field, including leads)	[Ω]	1.8
Output resistance at 300 K (in zero field, including leads)	[Ω]	3
Quantum oscillations beginning at 4.2 K	[T]	> 2
Amplitude of quantum oscillations at 4.2K, B = 0 - 5 T	[%]	< 0.1
Active area	[mm^2]	0.625
Control current leads (green, black)	[mm]	∅ 0.1
Hall voltage leads (orange, red)	[mm]	∅ 0.08

Contact us for more information on non-standard modifications. The LHP-NU overall dimensions can be reduced to 3 x 2.5 x 0.7 mm.

LHP-MU

The model **LHP-MU** is derived from the basic type LHP-NU to meet the requirements of customers to reduce the active area size to smaller dimensions. This probe can operate at a temperature range of 1.5 - 350 K in magnetic fields up to 33 T, and feature higher linearity of the Hall voltage versus the magnetic field. Its small overall dimensions make it ideally suited for space limited applications. The dimensions of the active area are **100 x 100 μm**, and the overall dimensions are 5 x 4 x 0.7 mm. The model LHP-MU is a probe with a specially passivated uncovered electric system.

LHP-MPO New!

The **LHP-MPO** model is similar to the LHP-MU model. This probe is partially protected by a resin enclosure, but the electrical system remains uncovered. Overall dimensions are 5 x 4 x 0.9 mm.

LHP-MP

The model **LHP-MP** features transverse package construction with the same electrical specifications as the LHP-MU type. The active area center of this packaged sensor is properly marked by a cross located with accuracy better than ± 0.1 mm. The overall dimensions are 7 x 5 x 1 mm. Model LHP-MP is a probe covered by special synthetic resin in transverse modification, and the electrical system is parallel to the undersurface with high accuracy.

LHP-MA

The model **LHP-MA** features axial mounting construction with the same electrical specifications as the LHP-MU model. A cross, located with accuracy better than ± 0.1 mm properly marks the active area center of this packaged sensor. The overall dimensions are ∅ 7 x 8 mm. The LHP-MA model is a probe covered by cryogenic synthetic resin in axial modification, and the electrical system is parallel to the front wall of the cover with high precision.

SPECIFICATIONS

Features

- *Small active area 0.01 mm^2*
- *Wide magnetic field range ± 33 T*
- *Temperature range 1.5 - 350 K*
- *High linearity*
- *High stability*
- *Low offset voltage*

LHP-MU
LHP-MPO
LHP-MP
LHP-MA

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 33
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	20
Maximum control current	[mA]	50
Sensitivity at I_n	[mV/T]	> 5
Linearity error at 300 K, B = 0 - 1 T	[%]	< 0.2
Linearity error at 77 K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2 K, B = 0 - 5 T	[%]	< 1
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	2.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	3.10^{-5}
Residual voltage	[μV]	< 100
Temperature coefficient of residual voltage	[μV/K]	< 0.02
Input resistance at 4,2 K (in zero field, including leads)	[Ω]	1.8
Input resistance at 77 K (in zero field, including leads)	[Ω]	2.2
Input resistance at 300 K (in zero field, including leads)	[Ω]	4
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	1.9
Output resistance at 77 K (in zero field, including leads)	[Ω]	2.6
Output resistance at 300 K (in zero field, including leads)	[Ω]	6
Quantum oscillations beginning at 4.2 K	[T]	> 2
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.1
Active area	[mm^2]	0.01
Control current leads (green, black)	[mm]	∅ 0.1
Hall voltage leads (orange, red)	[mm]	∅ 0.08

Contact us for more information on non-standard modifications. The LHP-MU overall dimensions can be reduced to 3 x 2.5 x 0.7 mm.

HHP-NU

The model **HHP-NU** is designed to operate at any temperature between 1.5 K and 350 K in a magnetic field range up to 5 T. This type of the probe, prepared from specially doped semiconductor, features high sensitivity at least 70 mV/T at the standard active area size. Its small overall dimensions make it ideally suited for space-limited applications. The dimensions of the active area are **1250 x 500 μm**, and the overall dimensions are 5 x 4 x 0.9 mm. The probe is partially protected by a resin enclosure, but the electrical system remains uncovered. This construction allows decreasing the distance between the surface of the active area and the probe's surface to 150 μm.

HHP-NP

The model **HHP-NP** features transverse mounting construction with the same electrical specifications as the HHP-NU type. The active area center of this packaged sensor is properly marked by a cross located with accuracy better than ± 0.1 mm. The overall dimensions are 7 x 5 x 1 mm. The model HHP-NP is a probe covered by special synthetic resin in transverse modification, and the electrical system is parallel to the undersurface with high accuracy.

HHP-NA

The model **HHP-NA** features axial mounting construction with the same electrical specifications as the model HHP-NU. A cross, located with accuracy better than ± 0.1 mm, properly marks the active area center of this packaged sensor. The overall dimensions are ∅ 7 x 8 mm. The model HHP-NA is a probe covered by cryogenic synthetic resin in axial modification and its electrical system is parallel to the front wall of the cover with high precision.

Features

- *High sensitivity*
- *Active area 0.625 mm^2*
- *High linearity*
- *Magnetic field range ± 5 T*
- *Temperature range 1.5 - 350 K*

HHP-NU
HHP-NP
HHP-NA

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	20
Maximum control current	[mA]	50
Sensitivity at I_n	[mV/T]	> 70
Linearity error at 300K, B = 0 - 1 T	[%]	< 0.2
Linearity error at 77K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2K, B = 0 - 5 T	[%]	< 1.5
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	5.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	2.10^{-4}
Residual voltage	[μV]	< 300
Temperature coefficient of residual voltage	[μV/K]	< 0.3
Input resistance at 4.2 K (in zero field, including leads)	[Ω]	< 10
Input resistance at 77 K (in zero field, including leads)	[Ω]	< 10
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 10
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	< 30
Output resistance at 77 K (in zero field, including leads)	[Ω]	< 30
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 30
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K up to 5 T	[%]	< 0.15
Active area	[mm^2]	0.625
Control current leads (green, black)	[mm]	∅ 0.1
Hall voltage leads (orange, red)	[mm]	∅ 0.08

Contact us for more information on non-standard modifications. Minimum overall dimensions of HHP-NU model can be reduced down to 3 x 2.5 x 0.7 mm.

HHP-MU

The model **HHP-MU** is derived from the type HHP-NU where the active area size is minimized to **100 x 100 μm**. This probe covers a magnetic field range up to 5 Tesla with a temperature range of 1.5 - 350 K. It has high sensitivity and the miniature active area size. The enhanced accuracy makes the probe applicable in sample homogeneity characterization and microstructure - related magnetic field studies. Its small overall dimensions make it ideally suited for space-limited applications. This probe is partially protected by a resin enclosure, but the electrical system remains uncovered. The distance between the surface of the active area and the probe's surface is 150 μm. Overall dimensions are 5 x 4 x 0.9 mm.

HHP-MP

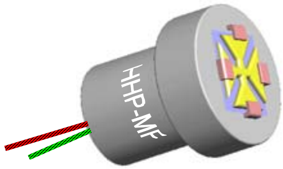
The model **HHP-MP** features transverse mounting construction with the same electrical specifications as the type HHP-MU. The active area center of this packaged sensor is properly marked by a cross, located with accuracy better than ± 0.05 mm. Overall dimensions are 7 x 5 x 1 mm. The model HHP-MP is a probe covered by special synthetic resin in the transverse modification and electrical system is parallel to the undersurface with higher accuracy.

HHP-MA

The model **HHP-MA** characterizes axial mounting construction with same electrical specifications as the model HHP-MU. A cross, located with accuracy better than ± 0.05 mm, properly marks the active area center of the packaged sensor. The overall dimensions are ∅ 7 x 8 mm. The model HHP-MA is a probe covered by cryogenic synthetic resin in axial modification and its electrical system is parallel to the front wall of the cover with highest precision.

HHP-MF

The model **HHP-MF** is appropriate for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 Tesla. This type of the probe provides high sensitivity and miniature active area. In axial position, the probe is designed for measurement of perpendicular magnetic field components to the sample surface at very small distance (< 40 μm) from it. The dimensions of the active area are 100 x 100 μm and the overall dimensions are ∅ 7 x 8 mm. There is no package on the semiconductor surface; it is passivated by synthetic varnish only.



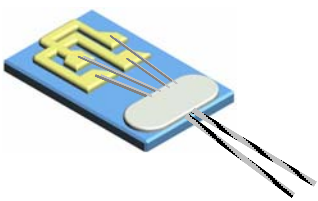
New!

HHP-MFO

The **HHP-MFO** model is similar to the HHP-MF model. This Hall probe is partially protected by a resin enclosure, but the electrical system remains uncovered. Overall dimensions are ∅ 7 x 8 mm. This construction allows decreasing the distance between the surface of the active area and the probe's surface to 150 μm.

HHP-MT

The **HHP-MT** model is developed for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 T. The dimensions of the active area are 100 x 100 μm, the distance between its center and the frontal margin of the plate is 250 μm. This type of the probe is intended for the measurement of magnetic field components tangential to the sample surface. The overall dimensions are 5 x 4 x 0.7 mm. The probe is not packaged due to better adjustment of its center position.



Features

- *Small active area 0.01 mm²*
- *High sensitivity*
- *High linearity*
- *Magnetic field range ± 5 T*
- *Temperature range 1.5 - 350 K*
- *Wide variety of shapes*

HHP-MU
HHP-MP
HHP-MA
HHP-MT
HHP-MF
HHP-MFO

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	20
Maximum control current	[mA]	30
Sensitivity at I_n	[mV/T]	> 20
Linearity error at 300K, B = 0 - 1 T	[%]	< 0.5
Linearity error at 77K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2K, B = 0 - 5 T	[%]	< 1.5
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	$[K^{-1}]$	5.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	$[K^{-1}]$	2.10^{-4}
Residual voltage	[μV]	< 200
Temperature coefficient of residual voltage	[μV/K]	< 0.3
Input resistance at 4,2 K (in zero field, including leads)	[Ω]	< 30
Input resistance at 77 K (in zero field, including leads)	[Ω]	< 30
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 30
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	< 30
Output resistance at 77 K (in zero field, including leads)	[Ω]	< 30
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 30
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.15
Active area	$[mm^2]$	0.01
Control current leads (green, black)	[mm]	∅ 0.1
Hall voltage leads (orange, red)	[mm]	∅ 0.08

Please contact us for more information on non-standard modifications. Non-standard overall dimensions of HHP-MU can be reduced to 3 x 2.5 x 0.7 mm.

HHP-VU

The **HHP-VU** model is appropriate for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 T. This type of probe features micro size active area and therefore, the device can be used as a scanning Hall probe for superconductor field mapping with enhanced accuracy. Its small overall dimensions make it ideally suited for space-limited applications. The dimensions of the active area are **50 x 50 μm** and the overall dimensions are 5 x 4 x 0.9 mm. Probe is partially protected by a resin enclosure but the electrical system remains uncovered. Its construction allows decreasing the distance between the surface of the active area and the probe's surface to 150 μm.

HHP-VP

The **HHP-VP** model characterizes transverse mounting construction with the same electrical specifications as the type HHP-VU. The active area center of this packaged sensor is properly marked by a cross, located with accuracy better then ± 0.05 mm. The overall dimensions are 7 x 5 x 1 mm. The model HHP-VP is a probe covered by special synthetic resin in transverse modification and its electrical system is parallel to the undersurface with high accuracy.

HHP-VA

The **HHP-VA** model features axial mounting construction with same electrical specifications as the model HHP-VU. A cross, located with accuracy better than ± 0.05 mm, properly marks the active area center of the packaged sensor. The overall dimensions are ∅ 7 x 8 mm. The HHP-VA model is a probe covered by cryogenic synthetic resin in axial modification and its electrical system is parallel to the front wall of the cover with highest precision.

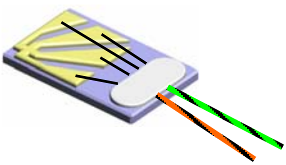
HHP-VF

The model **HHP-VF** is designed to operate at a temperature range of 1.5 - 350 K in magnetic fields up to 5 Tesla. This type of the probe provides high sensitivity and micro size active area. In axial position, the probe is designed for high-resolution measurements of perpendicular magnetic field components to the sample surface at 120 μm distance.

The dimensions of the active area are **50 x 50 µm** and the overall dimensions are ∅ 7 x 8 mm. This Hall probe is partially protected by a resin enclosure, but the electrical system remains uncovered.

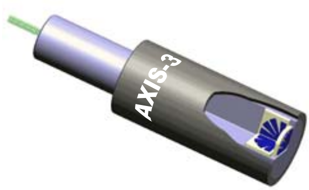
HHP-VC

The model **HHP-VC** is developed for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 T. Position of active area is shifted to the left (right) corner with the distance 250 µm from the corner edges. The probe is designed for high resolution mapping of the magnetic field using an XY microstage-positioning device. The dimensions of the active area are **50 x 50 µm** and the overall dimensions are 5 x 4 x 0.8 mm. The HHP-VC model is a probe with specially passivated uncovered semiconductor surface.



AXIS-3

The model **AXIS-3** is developed for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 T. The Hall probe is designed for the measurement of all three perpendicular components of the magnetic field within a **250 x 250 x 250 µm** cube. This type is appropriate for the measurement of fringing fields from magnets, coils, and for other homogeneity characterizations. Active area of each elementary sensor is **50 x 50 µm**. The probe sensitivity is higher than 70 mV/T at the nominal control current of 10 mA. The overall dimensions are ∅ 10 x 20 mm.



AXIS-3H

The **AXIS-3H** Hall probe consists of AXIS-3 Hall probe connected to a stainless steel tube holder with flexible twisted-pairs cable. The mechanical robustness of the holder enables the probe to be used directly in a XYZ positioning device. Overall dimensions of the stainless steel holder are ∅ 10 x 300 mm. The cable length is 2 meters without connector. It is possible to adjust the tube and/or the cable length according to your demands.

SPECIFICATIONS

Features

- *Very small active area 0.0025 mm^2*
- *High sensitivity*
- *High linearity*
- *Magnetic field range ± 5 T*
- *Temperature range 1.5 - 350 K*
- *Wide variety of shapes and applications*

HHP-VU
HHP-VP
HHP-VA
HHP-VC
HHP-VF
AXIS-3H
AXIS-3

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	10
Maximum control current	[mA]	15
Sensitivity at I_n	[mV/T]	> 50
Linearity error at 300K, B = 0 - 1 T	[%]	< 0.5
Linearity error at 77K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2K, B = 0 - 5 T	[%]	< 1.5
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	5.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	2.10^{-4}
Residual voltage	[μV]	< 200
Temperature coefficient of residual voltage	[μV/K]	< 0.3
Input resistance at 4,2 K (in zero field, including leads)	[Ω]	< 60
Input resistance at 77 K (in zero field, including leads)	[Ω]	< 60
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 60
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	< 70
Output resistance at 77 K (in zero field, including leads)	[Ω]	< 70
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 70
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.15
Active area	[mm^2]	0.0025
Control current leads (green, black)	[mm]	∅ 0.1
Hall voltage leads (orange, red)	[mm]	∅ 0.08

Please contact us for more information on non-standard modifications. Non-standard overall dimensions of HHP-VU model can be reduced to 3 x 2.5 x 0.7 mm.

HHP-SU

The **HHP-SU** model is suitable for operation at a temperature range of 1.5 - 350 K in magnetic fields up to 5 Tesla. This improved type of probe features reduced active area size than HHP-VU model. Therefore, the device can be used as a scanning Hall probe for the superconductor magnetic field mapping with high resolution. Its small overall dimensions make it ideally suited for space-limited applications. The dimensions of the active area are **20 x 20 μm** and the overall dimensions of the probe are 5 x 4 x 0.9 mm. This probe is partially protected by a resin enclosure, but the electrical system remains uncovered.

HHP-SA

The **HHP-SA** model characterizes axial mounting construction with same electrical specifications as the model HHP-SU. A cross, located with accuracy better than ± 0.05 mm, properly marks the active area center of the packaged sensor. The overall dimensions are ∅ 7 x 8 mm. The HHP-SA model is a probe covered by cryogenic synthetic resin in axial modification and its electrical system is parallel to the front wall of the cover with highest precision.

HHP-SF

The model **HHP-SF** is designed to operate at a temperature range of 1.5 - 350 K in magnetic fields up to 5 Tesla. This improved type of probe features reduced size active area than HHP-VF model and, therefore, the device can be used as a scanning Hall probe for superconductor field mapping with high accuracy at 120 μm distance from the sample surface. The dimensions of the active area are **20 x 20 μm** and the overall dimensions are ∅ 7 x 8 mm. This Hall probe is partially protected by a resin enclosure, but the electrical system remains uncovered.

SPECIFICATIONS

Features

- *Mini active area 0.0004 mm^2*
- *High sensitivity*
- *High linearity*
- *Magnetic field range ± 5 T*
- *Temperature range 1.5 - 350 K*

HHP-SU
HHP-SA
HHP-SF

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	5
Maximum control current	[mA]	7
Sensitivity at I_n	[mV/T]	> 30
Linearity error at 300K, B = 0 - 1 T	[%]	< 0.5
Linearity error at 77K, B = 0 - 0.2 T	[%]	< 0.1
Linearity error at 4.2K, B = 0 - 5 T	[%]	< 1.5
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	5.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	2.10^{-4}
Residual voltage	[μV]	< 200
Temperature coefficient of residual voltage	[μV/K]	< 0.3
Input resistance at 4,2 K (in zero field, including leads)	[Ω]	< 150
Input resistance at 77 K (in zero field, including leads)	[Ω]	< 180
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 200
Output resistance at 4,2 K (in zero field, including leads)	[Ω]	< 150
Output resistance at 77 K (in zero field, including leads)	[Ω]	< 180
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 200
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.15
Active area	[mm^2]	0.0004
Control current leads (green, black)	[mm]	∅ 0.10
Hall voltage leads (orange, red)	[mm]	∅ 0.08

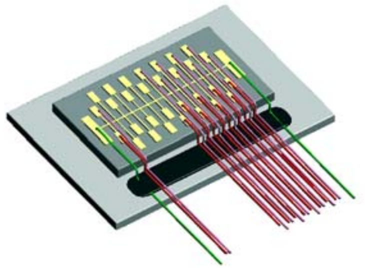
MULTI-7U

The **MULTI-7U** model serves for operation at 1.5 - 350 K temperature range in magnetic fields up to 5 T. This type of probe is appropriate for high sensitivity studies of magnetic materials, and its construction allows a line mapping of superconducting tapes. The probe consists of 7 elementary independent Hall sensors, which lie in a single line 600 μm apart. The active area of each elementary sensor is **100 x 100 μm**. Overall dimensions of the unpackaged unit are 6 x 4 x 1.2 mm.

MULTI-7A

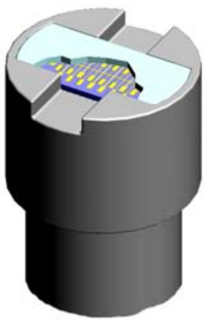
The **MULTI-7A** model features axial mounting construction with same electrical specification as the MULTI-7U model. The overall dimensions of the probe are ∅ 10 x 18 mm. There is no package on the semiconductor surface; it is passivated by synthetic varnish only. The electrical system of the array is turned inside the package to decrease the possibility to damage the probe. The distance of the electrical system from the front wall of the axial cover is 300 μm.

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	20
Maximum control current	[mA]	30
Sensitivity at I_n	[mV/T]	> 50
Linearity error at 77 K, B = 0 - 0.2 T	[%]	< 0.1
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	5.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	2.10^{-4}
Residual voltage	[μV]	< 400
Temperature coefficient of residual voltage	[μV/K]	< 0.3
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 350
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 150
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.15
Active area of each sensor	[mm^2]	0.01
Control current leads (green, black)	[mm]	∅ 0.08
Hall voltage leads (orange, red)	[mm]	∅ 0.06



MULTI-15U

The **MULTI-15U** model can be used at 1.5 - 350 K temperature range in magnetic fields up to 5 T. This type of probe is developed to study the distribution of magnetic field and its relaxation near the surface of high temperature superconductors and other materials. The Hall probe consists of 15 elementary independent Hall sensors, which lie in a single line 200 μm apart. The active area of each elementary sensor is **50 x 50 μm**. The overall dimensions of the unpackaged unit are 7 x 5 x 1.8 mm.



MULTI-15A

The **MULTI-15A** model characterizes axial mounting construction with the same electrical specification as the MULTI-15U model. The overall dimensions of the probe are ∅ 10 x 25 mm. To decrease the possibility to damage the probe a ceramic, 250 micrometers thin plate, covers the electrical system of the array. The distance of the electrical system from the front wall of the axial cover is 300 μm.

MULTI-15AH

The **MULTI-15AH** Hall probe consists of MULTI-15A Hall probe connected to a stainless steel tube holder with a flexible twisted-pairs cable. The mechanical robustness of the holder enables the probe to be used directly in a positioning device. Overall dimensions of the stainless steel holder are ∅ 10 x 300 mm. The cable length is 2 meters without connector. It is possible to adjust the tube and/or the cable length according to a demand.

Features

- *Small active area 0.0025 mm^2*
- *High sensitivity*
- *High linearity*
- *Magnetic field range ± 5 T*
- *Temperature range 1.5 - 350 K*
- *Small overall dimensions*
- *Nominal control current 10 mA*

MULTI-15U
MULTI-15A
MULTI-15AH

PARAMETER	UNIT	VALUE
Magnetic field range	[T]	0 - 5
Temperature range	[K]	1.5 - 350
Nominal control current I_n	[mA]	10
Maximum control current	[mA]	15
Sensitivity at I_n	[mV/T]	> 50
Linearity error at 77 K, B = 0 - 0.2 T	[%]	< 0.1
Mean temp. coefficient of sensitivity at temperature range 4.2 - 77 K	[K^{-1}]	3.10^{-5}
Mean temp. coefficient of sensitivity at temperature range 77 - 300 K	[K^{-1}]	1.10^{-4}
Residual voltage	[µV]	< 500
Temperature coefficient of residual voltage	[µV/K]	< 0.3
Input resistance at 300 K (in zero field, including leads)	[Ω]	< 600
Output resistance at 300 K (in zero field, including leads)	[Ω]	< 400
Quantum oscillations beginning at 4.2 K	[T]	> 1.5
Amplitude of quantum oscillations at 4.2 K, B = 0 - 5 T	[%]	< 0.15
Active area of each sensor	[mm^2]	0.0025
Control current leads (green, black)	[mm]	∅ 0.08
Hall voltage leads (orange, red)	[mm]	∅ 0.06
Twisted-pair cable length (MULTI-15AH only)	[m]	2

Although, cryogenic Hall probes have been constructed to be as rugged and strain-free as possible for maximum reliability after repeated temperature cycling, they are precision semiconductor devices and must be treated accordingly. Do not touch the electrical system of the un-packaged Hall probe.

It is very important to understand that environmental stress from incompliant thermal expansions or mechanical sources can affect the output of the Hall probe and significantly modify the calibration curve.

When gluing the packaged Hall probe to a holder, match the thermal expansion coefficient of the glue as closely as possible to the expansion rate of 2.5 to 6.5×10^{-5} K^{-1}. Highly filled non-conductive epoxies fit well into this category. Do not use cyanoacrylate adhesives because of high rate of shrinkage and biodegradable inclination. For gluing the un-packaged Hall probe choose a material with thermal expansion coefficient in the range of 0.5 to 1.5×10^{-5} K^{-1} (ceramic, steel, glass). Use very tiny dot sizes to glue the sensor to the surface. In situations where the Hall probe must be glued on a material with higher coefficient of thermal expansion a buffer aluminum oxide substrate is recommended. The electrical system of the un-packaged types cannot be covered with adhesives or with vacuum grease or with other varnishes.

Mounting of the Hall probe's leads is necessary part of the probe gluing. Leads should not be formed closer to the package than 3 mm. Avoid reciprocal bending or tension on the leads. There is no allowable force trying to pull leads from the package during the thermal dilatation.

A lot of magnetic field measurements are made as close as possible to a sample surface. After the Hall probe mounting must be carefully examined the position and thermal elongation of all system elements to avoid unexpected clash with the sensing area.

IMPORTANT NOTICE

Do not remove the Hall probe from its original package until you are ready to install it. Ground yourself to discharge any static electric charge that may build up in your body while working on installation or handling the probe. Handle the probe by its edges or by the leads to avoid touching the uncovered electrical system of the probe. Do not touch a measured sample by an uncovered type of the Hall probe.

To avoid damaging the probe by frozen water, the surface must be carefully dried by fine airflow before insertion to a cryostat. Cool down the probe slowly in dry atmosphere. Dry up the probe using a stream of dry air after the measurement.

Maximum ratings are absolute ratings. Exceeding any one of these values may cause irreversible damage to the Hall probe. Before connecting the Hall probe to a current source check the output for a current peak when it is turned on/off. The bias current must be switched off during rapid temperature changes (cooling and heating) of the sensor. Do not switch on maximal bias current unless the sensor is at a constant temperature.

The offset voltage of the Hall probe can be changed if some component of your cryogenic system has a remanent magnetic field. In this case, it is recommended to carefully examine the equipment for magnetic materials or parts, which tend to remain magnetized.

Our Hall probes are not intended for use in life support equipment and systems. Use of the sensor in such applications requires the advance written approval of the AREPOC s.r.o. Certain applications using this probe may involve potential risks of personal injury, property damage, or loss of life. In order to minimize these risks, the customer to minimize inherent or procedural hazards should provide adequate design and operating safeguards. Inclusion the probe in such applications is understood to be fully at the risk of the customer.

ORDERING INFORMATION

➢ PRICING

All prices are stated in the enclosed prices list and are mentioned on an EXW Bratislava basis. Fright costs, insurance and any special packaging charges will be added to the invoice. The price of non-standard models will be adjusted by a surcharge relating to the finish. We reserve the right to change prices without prior notice. The current price and delivery date will be confirmed with you at the time you place a demand or purchase order. Written price quotations are valid for 30 days.

➢ SHIPPING

All orders are shipped via FedEx Express. Other shipping methods are available on request. AREPOC s.r.o. shall not be liable for damages to the purchaser for delayed delivery. Orders are subject to the terms and conditions stated on the standard AREPOC s.r.o. invoices in effect at the time of shipment.

➢ WARRANTY

The warranty period is 12 months from the date of shipment. In case of misfunction of the probe, or if probes do not meet the specifications, they can be returned within 30 days of shipment. In this case, either the full purchase price will be refunded or the units will be replaced, as preferred, unless the unit has been damaged by rough handling or improper mounting. We will not accept return shipments unless we have given prior permission and shipping instruction.

If you are interested in further information, please contact:

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