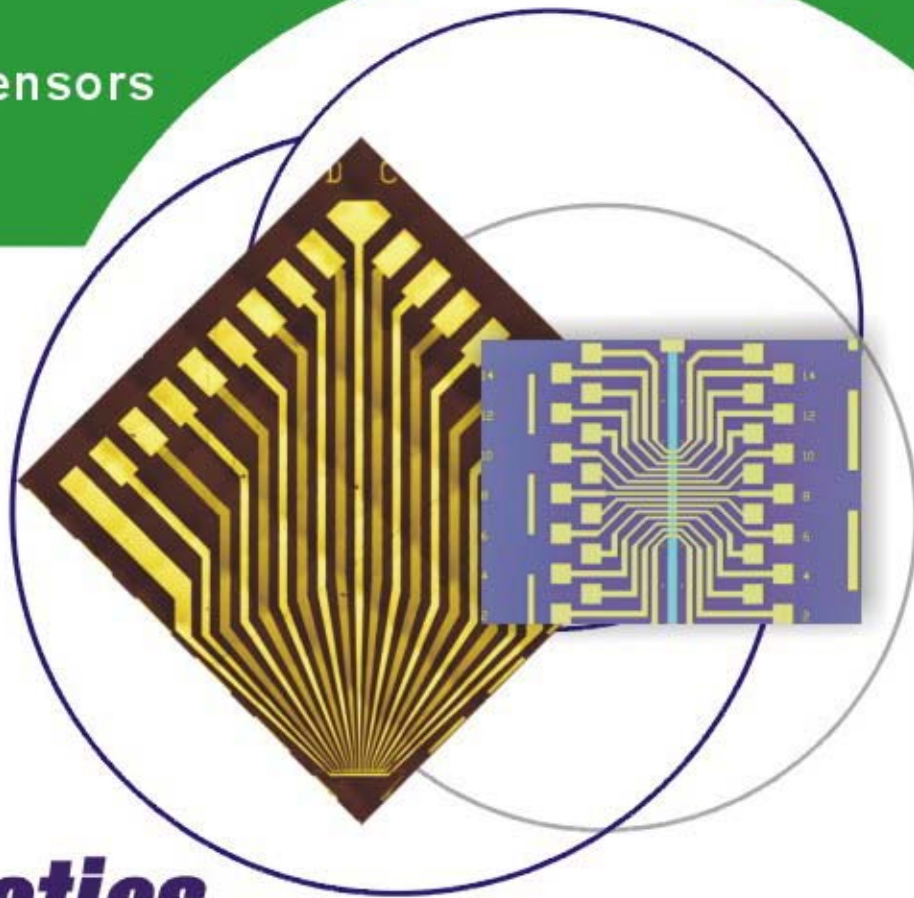


SpinTJ Series

Magnetic Field Microsensors



 **Micro Magnetics**
Sensible Solutions



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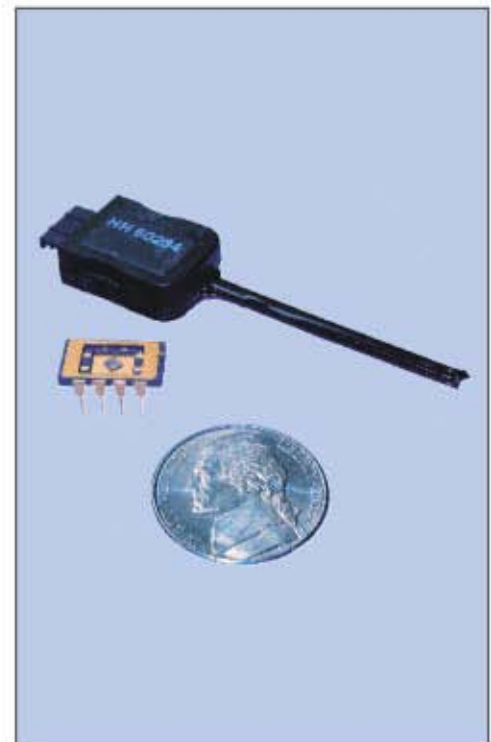
The SpinTJ magnetic sensor family builds upon Micro Magnetics' in-house expertise developing low-field magnetic tunnel junction sensor products. Based on our proprietary fabrication processes, we have developed patented recipes for fabricating macroscopic, micron-scale, and submicron field sensors. These sensors offer unmatched spatial resolution (active areas of less than $5\mu\text{m}^2$), superior field sensitivity (field noise on the order of 5 nanotesla), and the ability to withstand extreme environmental conditions. SpinTJ sensors have field sensitivity more than 50 times better than magnetoresistive read/write heads and over 100 times better than conventional Hall-effect sensors. In addition, their small active areas guarantee a spatial resolution far exceeding any other commercially available magnetic sensor technology.

SpinTJ Magnetic Field Microsensors : Key Parameters

Active Area Dimensions	2-15 μm^2
Active Area Thickness	3-12 nm
Field Noise Equivalent (100 Hz)	100 nT/Hz ^{1/2}
Field Noise Equivalent (> 20 kHz)	5 nT/Hz ^{1/2}
Total Magnetoresistance	80-200%
Hysteresis (1 G Sweep Range)	0.01 G
Non-linearity (1 G Sweep Range)	0.25%
Field Sensitivity	0.1-1.0 %/G (resistance change)
Sensor Impedance	Customizable from $10\text{-}10^6\Omega$

Our SpinTJ magnetic sensors are based on ultra-thin multi-layer magnetic films deposited on silicon substrates. These sensors are available in a number of packages and electrical configurations, including a socketed sensor probe and encapsulated or open 8-lead DIP packages. In addition, we offer custom packages and electrical configurations. Micro Magnetics also offers two dedicated preamplifier packages for use with SpinTJ microsensors.

Micro Magnetics' SpinTJ magnetic sensors are already in use in a number of cutting-edge industrial and research applications, including semiconductor fault isolation, detection of single micron-size bio-magnetic particles, and static and dynamic studies of micromagnetics and domain structure in small patterned magnetic films. See our Applications pages at www.micromagnetics.com for more information about some ways people have been using our magnetic sensor technologies.



SpinTJ Series

STJ-001: Magnetic Field Microsensor (Bare Die)

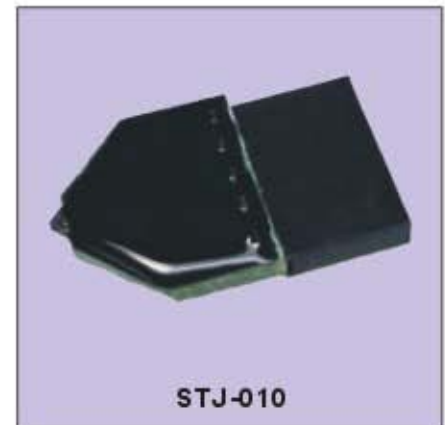
- The STJ-001 is Micro Magnetics' SpinTJ low-field magnetic microsensor in die form. The sensor die features an active (sensing) area of just a few microns (~0.0001") in size. The die is 1.9 mm square and 0.3 mm thick. It has four gold wirebonding pads which allow four-point measurement of the device resistance. The active area of the sensor is located at one corner of the die to allow the sensitive region to be brought very close to another object.
- The field sensitivity of a typical STJ-001 is 10 nT/Hz^{1/2} at 10 kHz. The high-frequency field noise equivalent is 5 nT/Hz^{1/2}, which is ten thousand times smaller than the magnetic field of the Earth.



STJ-010: Magnetic Field Microsensor (Probe)

STJ-020: Magnetic Field Microsensor (Probe)

- STJ-010 and STJ-020 are Micro Magnetics' SpinTJ low-field magnetic microsensors in probe form. They are designed for magnetic imaging and scanning applications. The sensor probe features a Micro Magnetics SpinTJ sensor with an active (sensing) area of just a few microns (~0.0001") in size. This allows them to detect field signatures from single magnetic particles or microscopic magnetic media. The field sensitivity of the STJ-010 and STJ-020 is 5 nT, which is ten thousand times smaller than the magnetic field of the Earth. The geometry of the sensor probe makes it perfect for magnetic imaging of currency, magnetic films, or media.
- The STJ-010 is available with a standard 0.1"-pitch female header. The mating connector can be supplied by Micro Magnetics or purchased from most electronics suppliers.
- The STJ-020 comes with a shielded multi-pin connector. This connector is designed to mate to our AL-05 signal conditioning board to create a full micron-resolution magnetic sensing solution. Micro Magnetics also supplies the mating connector for custom applications.



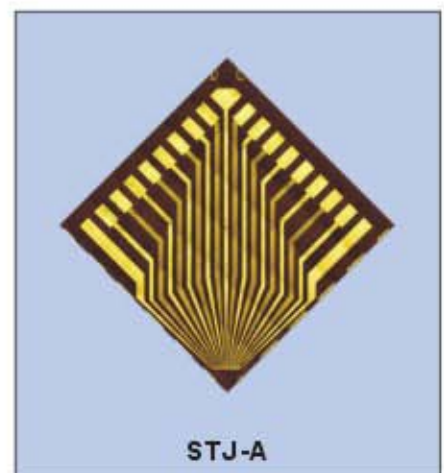
STJ-100: Magnetic Field Microsensor (DIP Package)

- The STJ-100 is a low-field magnetic field sensor with an active (sensing) area of just a few microns ($\sim 0.0001''$) in size. This allows the STJ-100 to detect field signatures from single magnetic particles or microscopic magnetic media. The field sensitivity is 5 nT, which is ten thousand times smaller than the magnetic field of the Earth.
- The STJ-100 uses an 8-pin dual in-line package which can be left open (as seen at left) or sealed with a ceramid lid. All STJ-100 devices feature on-board ESD and overvoltage protection.
- This sensor is designed for seamless interface with Micro Magnetics' D-801 signal conditioning board. The STJ-100 product is ideal for compassing, navigation, industrial, and bio-medical applications.



STJ-A: Magnetic Field Microsensor Arrays

- The STJ-A series of products consists of linear arrays of SpinTJ low-field magnetic sensors. These arrays feature up to 16 sensors, each of which has the nanotesla field sensitivity and micron-scale spatial resolution of our single-sensor product offerings. The STJ-A series of arrays features excellent ($< 3\%$) uniformity of sensor impedance and voltage sensitivity. These SpinTJ array products come mounted onto a single- or dual-row 0.1"-pitch female connector.
- Micro Magnetics also specializes in the creation of custom arrays. Custom arrays can consist of sensors with a wide range of active areas (~ 10 to $10^6 \mu\text{m}^2$) and device resistances (1 to $10^6 \Omega$). We also offer a wide range of packaging and connector options. Please contact us to discuss your application.



SpinTJ Series

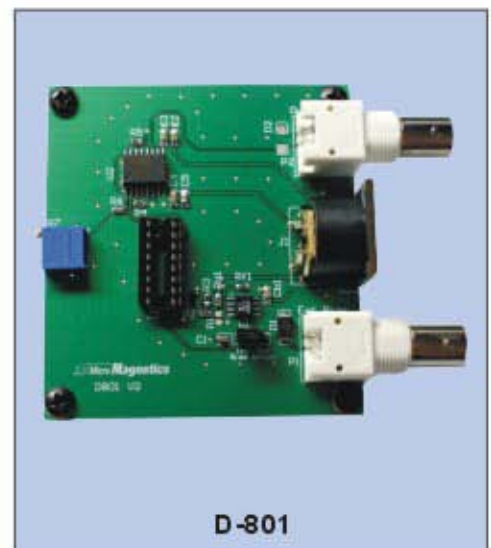
AL-05: STJ Signal Conditioning Electronics

- The AL-05 is a signal amplification board meant for use with Micro Magnetics' STJ-020 magnetic sensor probes.
- The AL-05 provides filtered power to the sensor, and amplifies and outputs the sensor response. The AL-05 outputs an analog voltage proportional to the magnetic field, through an external BNC connector. The proprietary design of the AL-05 allows power supply noise and other common-mode signals to be attenuated by over 100 dB. A switch on the AL-05 is used to select the powering of the sensor: the sensor can be biased either from an internal voltage supply or by an external voltage, which is introduced through a coaxial connector. The user can tune the DC offset voltage from -10 V to +10 V by turning an adjustment dial. Electrical protection circuitry on the board prevents the sensor from being subjected to voltage levels above its rated value.
- The gain of the AL-05 is adjustable from 1 to 2000. Each board's gain is customized to the user's specifications when assembled. Micro Magnetics' STJ-020 sensor probes are made to plug directly into a connector on the front of the AL-05, minimizing lead length and improving the noise characteristics of the sensor. If the application requires that the sensor not be located adjacent to the AL-05, Micro Magnetics also supplies adapters and cables of various lengths.



D-801: STJ Signal Conditioning Electronics

- The D-801 is a signal amplification board meant for use with Micro Magnetics' STJ-100 magnetic microsensors. The D-801 provides filtered power to the sensor, and amplifies and outputs the sensor response. The D-801 outputs an analog voltage proportional to the magnetic field, through an external BNC connector. The proprietary design of the D-801 allows power supply noise and other common-mode signals to be attenuated by over 100 dB.
 - A switch on the D-801 is used to select the powering of the sensor; the sensor can be biased either from an internal voltage supply or by an external voltage, which is introduced through a coaxial connector. The user can tune the DC offset voltage from -10 V to +10 V by turning an adjustment dial. Electrical protection circuitry on the board prevents the sensor from being subjected to voltage levels above its rated value.
 - The gain of the board is adjustable from 1 to 2000. Each board's gain is customized to the user's specifications when assembled.
- Micro Magnetics' STJ-100 DIP-packaged sensors are made to plug directly into the D-801 board, minimizing lead length and optimizing the noise performance of the sensor.



SpinTJ Series

STJ Series: Sensor Data

PHYSICAL	Min.	Typical	Max.	Unit
Die Size		1.9 x 1.9		mm
Die Thickness		0.3		mm
Active Area Length	3.0	4.0	6.0	µm
Active Area Width	1.0	2.0	3.0	µm
Active Area Thickness	2.5	4.0	10.0	Nm
Die Edge-to-Sensor Distance ¹	75	100	150	µm
ELECTRICAL				
Sensor Resistance ²	100	500	2000	Ω
Lead Resistance ³	50	90	500	Ω
Recommended Operating Voltage	0.01	0.2	0.4	V
Maximum Operating Frequency ⁴		500-1000		MHz
MAGNETIC				
Total 4-Point Magnetoresistance ⁵	40	80	200	%
Non-linearity ⁶ (+/- 1 G)		0.25	2.0	%
Hysteresis ⁷ (field range = +/- 1 G)		0.01	0.05	G
Non-linearity ⁶ (+/- 10 G)		0.50	5.0	%
Hysteresis ⁷ (field range = +/- 10 G)		0.5	2.0	G
Equivalent Field Noise (100 Hz)	50	90	250	nT/Hz ^{1/2}
Equivalent Field Noise (10 kHz)	5	10	25	nT/Hz ^{1/2}

Notes

1. Sensor lapping processes offered by Micro Magnetics can bring this value to 2-4 µm. Contact Micro Magnetics for details.
2. Sensor resistances can be customized over a wide range of values (10 Ω -1MΩ). Please contact Micro Magnetics to discuss your specific needs.
3. Micro Magnetics' STJ series sensors are fabricated for four-point resistance measurements, but generally are provided as two-terminal devices. The lead resistance is the additional resistance of electrical leads between the active area of the sensor and the sensor connector. The lead resistance will not have an adverse effect on sensor field noise, non-linearity, or hysteresis.
4. The STJ series of sensors have not been tested at frequencies above 100 MHz, but it is generally accepted that this sensor technology will respond to frequencies up to 1-2 GHz. The operating frequency range of the AL-05 and D-801 amplifiers is considerably lower (0-500 kHz, depending on the gain).
5. Four-point magnetoresistance is measured over a field sweep range of 100-150 G.
6. Sensor non-linearity is defined as the percentage difference between the measured experimental transfer (resistance versus applied field) curve and the best-fit line to the data. For example, a transfer curve with a linear correlation coefficient of 0.995 would have a non-linearity of 0.5%. Contact Micro Magnetics for more details on how this figure is calculated.
7. Sensor hysteresis is defined as the average (magnetic field) absolute separation between the increasing and decreasing transfer curve data, over the field range of interest. Contact Micro Magnetics for more details on how this figure is calculated.

STJ Series: Sample Microsensor Datasheet

Below is a sample sensor datasheet for an STJ-series magnetic microsensor. An individualized datasheet such as the one below is provided with every sensor.

