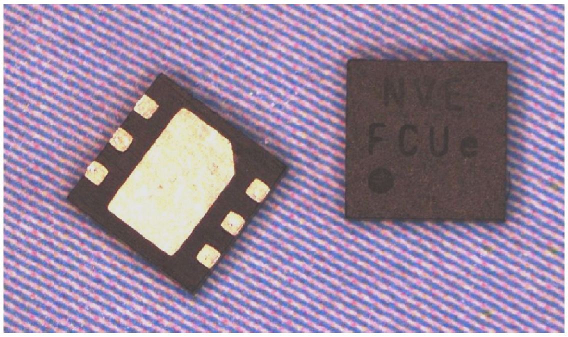
# SM324-10E TMR Smart Magnetometer



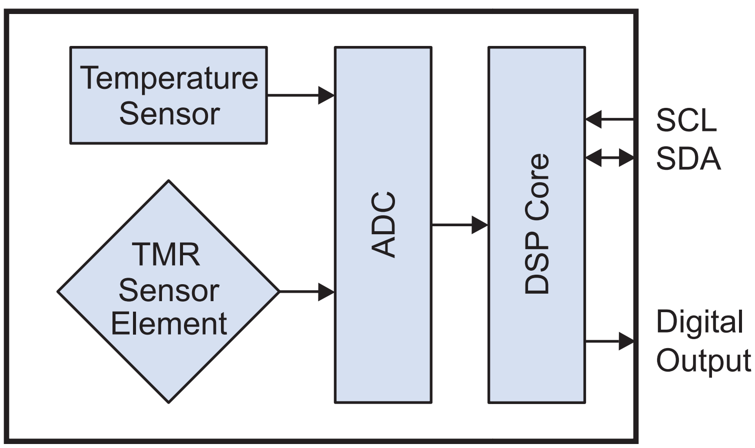

## Features

- Can detect magnets more than 50 mm away
- In-plane sensitivity—more usable than Hall sensors
- Internal temperature compensation
- I²C field measurement plus on/off digital output
- Ultraminiature 2.5 x 2.5 x 0.8 mm TDFN6 package

## Key Specifications

- 0 to ±20 Oe magnetic field operating range
- Ultra accurate— ±0.3% of full scale at 25°C
- 1.5 mA typical supply current
- 300 samples/second
- –40°C to +125°C operating range

## Block Diagram




## Applications

- Proximity sensors
- Noncontact current sensing
- Automotive applications
- Robotics
- Internet of Things (IoT) end nodes

## Description

The SM324 Smart Magnetometer provides ultraprecise magnetic field measurements.

The sensor combines a precise Tunneling Magnetoresistance (TMR) sensor element with sophisticated digital signal processing. The digital signal processing improves accuracy and allows application-specific calibration. Calibration coefficients are stored in an internal nonvolatile memory.

Unlike awkward, old-fashioned Hall-effect sensors, TMR is sensitive in-plane for optimal current sensing and easy mechanical interfaces. TMR also provides more sensitivity, higher precision, and lower noise than Hall.

An I²C interface provides data as well as a programming interface. A digital output provides precise, programmable magnetic thresholds.

Designed for harsh industrial or automotive environments, the SM324 has robust ESD protection and full –40°C to +125°C operating temperature range.



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## Absolute Maximum Ratings

| Parameter | Min. | Max. | Units |
|---|---|---|---|
| Supply voltage | –0.4 | 3.63 | Volts |
| Input/ Output voltages (SCL, SDA, Digital Out) | –0.5 | $V_{DD}$+0.5 | Volts |
| Storage temperature | –50 | 130 | °C |
| ESD (Human Body Model) | 4000 | | Volts |
| Applied magnetic field | | Unlimited | Oe |


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## Operating Specifications

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Condition |
|---|---|---|---|---|---|---|
| Operating temperature | $T_{MIN}$; $T_{MAX}$ | –40 | | 125 | °C | |
| Supply voltage | $V_{DD}$ | 1.68 | | 3.6 | V | |
| Supply current ($V_{DD}$ = 3.3 V) | $I_{DD}$ | | 1.5<br>20<br>50 | 2.5<br>250<br>750 | mA<br>nA<br>nA | Active; $T_{MIN}$ to $T_{MAX}$<br>Idle Mode; ≤ 85°C<br>Idle Mode; ≤ 125°C |
| **Power-Up and Power-down** | | | | | | |
| Power-on reset low voltage | $V_{BOR}$ | 0 | | 0.2 | V | |
| Power down time (duration below $V_{BOR}$) | $t_{BOR}$ | 3 | | | µs | |
| Power-on reset rising slope | $SR_{VDD}$ | 10 | | | V/ms | |
| Start-up time | $t_{ST1}$ | | | 1 | ms | $V_{DD}$ ramp time to active communication |
| | $t_{ST2}$ | | | 2.5 | ms | $V_{DD}$ ramp time to active operation |
| Wake-up time | $t_{WU1}$ | | | 0.5 | ms | Idle to active communication |
| | $t_{WU2}$ | | | 2 | ms | Idle to active operation |
| **Internal Temperature Sensor** | | | | | | |
| Temperature resolution | $T_{RES}$ | | 0.003 | | °K/LSB | $T_{MIN}$ to $T_{MAX}$ |
| **Magnetic Measurements** | | | | | | |
| Operating magnetic field strength | H | | | 20 | Oe | |
| Conversion rate | $f_{CON}$ | 270 | 300 | | S/s | |
| Accuracy | | | | ±0.3 | %FS | 25°C |
| | | | | ±1 | | $T_{MIN}$ to $T_{MAX}$ |
| Hysteresis | | | | 0.1 | %FS | $T_{MIN}$ to $T_{MAX}$ |
| Output resolution | | | | 24 | bits | |
| **Digital Output** | | | | | | |
| Update rate | $f_{UPDATE}$ | | 300 | | S/s | During repeated 0xAA commands |
| Sink current | $I_{SOURCE}$ | | 10 | | mA | $V_{DD}$ = 3.3V |
| Source current | $I_{SINK}$ | | 10 | | mA | $V_{OL}$< 0.5V; $V_{OH}$> 2.8V |
| Low-level analog output voltage | $V_{OL}$ | 0 | | 50 | mV | $I_L$ = –50 µA |
| High-level analog output voltage | $V_{OH}$ | $V_{DD}$–0.05 | | $V_{DD}$ | V | $I_L$ = 50 µA |
| **Nonvolatile Memory** | | | | | | |
| Write time | | | 5 | 16 | msec | |
| Endurance | | 1000 | 10000 | | cycles | |
| **Thermal Characteristics** | | | | | | |
| Junction-to-ambient thermal resistance | $\theta_{JA}$ | | 320 | | °C/W | |
| Package power dissipation | | | 500 | | mW | |
| **I²C Interface** | | | | | | |
| Data transfer rate | DR | | | 400 k | Baud | Standard mode |
| | | | | 3.4 M | | I²C fast mode |
| Bus voltage | $V_{BUS}$ | 3 | | $V_{DD}$ + 0.5 | V | |
| Low level input threshold voltage | $V_{IL}$ | 0.8 | | | V | |
| High level input threshold voltage | $V_{IH}$ | | | 2.2 | V | |
| Low level output current | $I_{OL}$ | 3 | | mA | | $V_{OL}$=0.4V |
| Capacitive load | $C_B$ | | | 400 | pF | |
| I/O capacitance | $C_{I/O}$ | | | 10 | pF | |



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**SM324 Overview**

The SM324 is a non-contact magnetometer designed for proximity or current sensing.

The heart of the SM324 is a tunneling magnetoresistive (TMR) sensor. With a tiny 2.5 x 2.5 mm TDFN package and typical 1.5 mA active supply current and 50 nA idle current, the SM324 is the smallest, lowest-power magnetometer in its class.

Factory calibration for gain and offset, plus temperature correction and digital linearization provide extraordinary accuracy of ±0.3% of full scale. Combined with a high-sensitivity TMR element, absolute accuracy is 0.12 Oe at 25°C, or 0.4 Oe from −40°C to 125°C.

The unique TMR element also yield negligible hysteresis of less than 0.1%, or 0.04 Oe from −40°C to 125°C.

**SM324 Operation**

A block diagram is shown below:

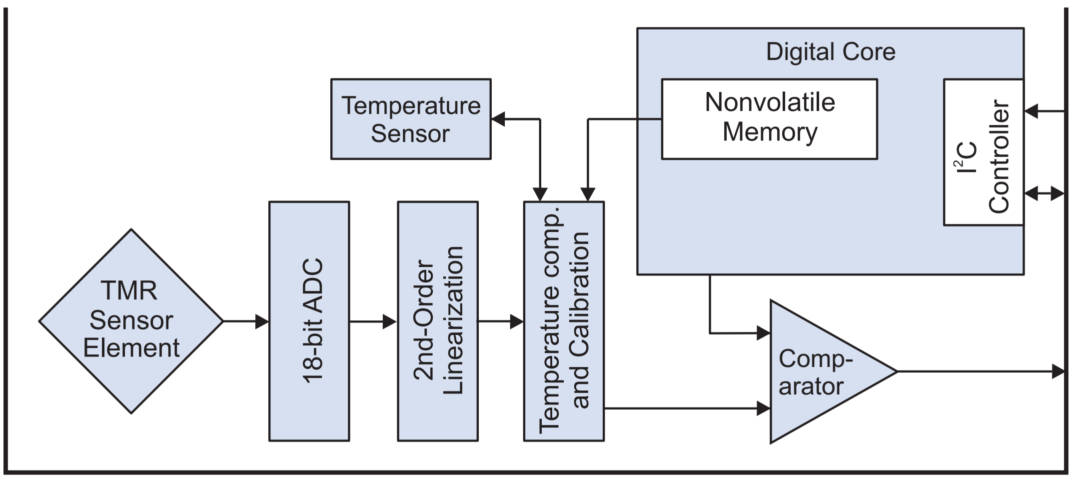


**Figure 1. Detailed block diagram.**

A robust 18-bit ADC, second-order linearization, and temperature compensation provide ultra-precise magnetic field measurements.

The digital core provides three bytes (24 bits) of mathematical precision.

Two outputs are available: an industry-standard I²C output for interfacing directly to microcontrollers and FPGAs, and a simple digital output for threshold detection of proximity, fault, overcurrent, and saturating magnetic fields.

Several other parameters can be programmed into the SM324 through the I²C interface.

*User Defined Memory*
Twenty-six 16-bit blocks of nonvolatile memory are available for part identification or general purpose use. This number can be overwritten if needed. Note that the nonvolatile memory is subject to endurance limitations and should only be used for occasionally updated data.

*Sensor Offset*
The sensor core of the SM324 is factory calibrated for highest accuracy, and a programmable three-byte parameter, OFFS, is available for user adjustments to environments with non-zero magnetic fields. OFFS has a signed sign/magnitude form value with where the most-significant bit is the sign (1 = negative), and the range is ±50% of the ±20 Oe full-scale range.

*Internal Temperature Sensor*
The SM324 utilizes an internal temperature sensor to allow for compensation of temperature effects. The thermometer is factory calibrated and a user-programmable three-byte variable, TEMP, is available for additional temperature offset calibration. Similar to the OFFS parameter, TEMP has a sign/magnitude form where the most-significant bit is the sign (1 = negative), and the range is ±50% of the 165°C full-scale range.

## Digital Output for Threshold Detection

The SM324 has a programmable digital output that can be configured for threshold detection. The output is programmable usind two 24-bit threshold parameters (THRSH1 and THRSH2). THRSH1 and THRSH2 are unsigned integers, each representing 0 to 100% of full scale, where 50% is zero field, 0 is the low end of the range ( –20 Oe), and 0xFFFFFF is the high end of the range (+20 Oe).

***Digital Threshold Updating***
DOUT updates automatically with each sample in the Cyclic Mode, although the refresh rate is limited to eight samples per second in that mode. In normal mode, DOUT updates with each data request, so the sensor must be connected to a I²C Master actively requesting data for the output to work.

***Digital Threshold Modes***
The digital output can be programmed as a high-field, low field, or window comparator function. The configuration of the output can also be reversed with a two-bit parameter, so either a high-field or low-field output can be generated. The figures below show the outputs for the three comparator modes, which are set by the CONFIG parameter.

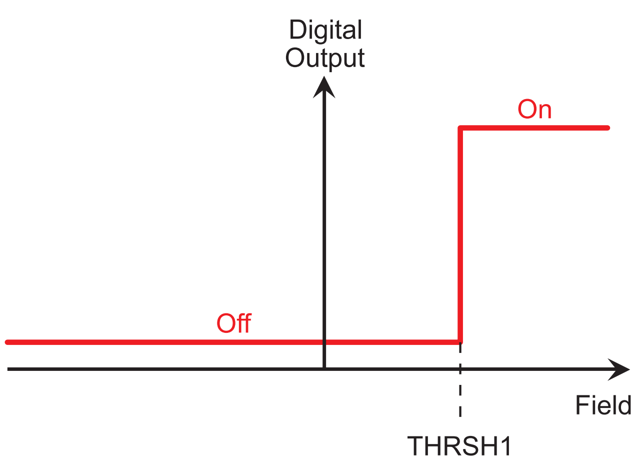


**Fig. 2a. Normal mode (CONFIG = 01 bin).**

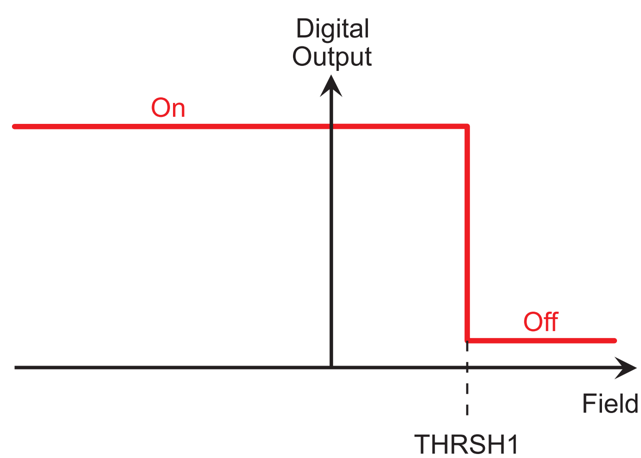


**Fig. 2b. Inverted mode (CONFIG = 10 bin).**



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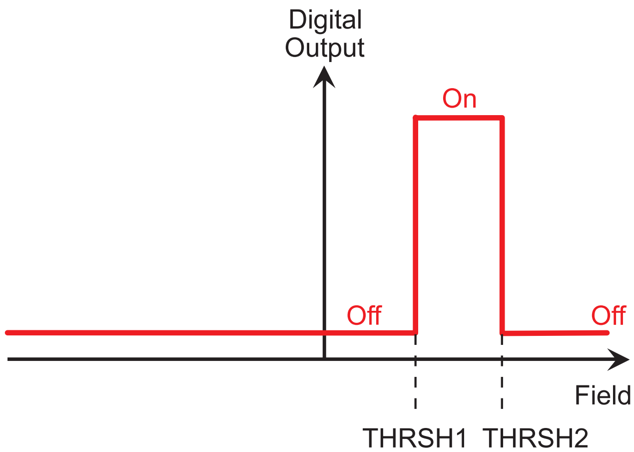



**Fig. 2c. Window mode (CONFIG = 11 bin; THRSH2>THRSH1).**

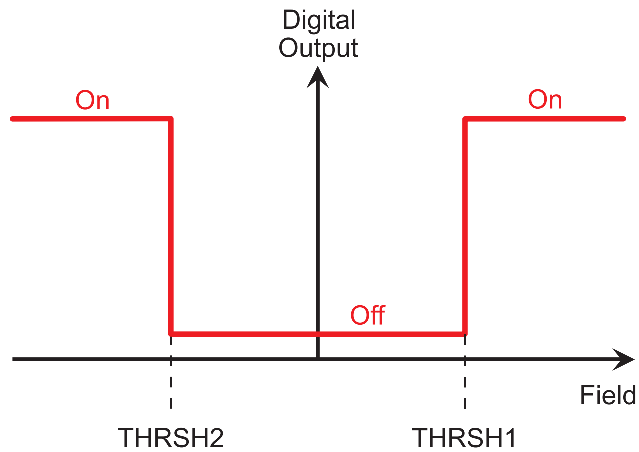



**Fig. 2d. Inverted Window mode (CONFIG= 11; THRSH1>THRSH2).**

These graphs are with respect to magnetic field, with zero field at the y-axis intercept in the center of the x-axis. The I²C output is unsigned, with zero field corresponding to 50%.

The Digital Threshold Modes are summarized in the following table:

| **CONFIG** (Bin) | **DOUT** |
|---|---|
| 01 | 0: Measurement < THRSH1<br>1: Measurement > THRSH1 |
| 10 | 0: Measurement > THRSH1<br>1: Measurement < THRSH1 |
| 11 | Output determined by threshold settings.<br>If THRSH1 > THRSH2<br>1: Measurement > THRSH1 OR Measurement < THRSH2<br>0: THRSH1 > Measurement > THRSH2<br>If THRSH2 > THRSH1<br>1: THRSH1 < Measurement < THRSH2<br>0: Measurement > THRSH2 OR Measurement < THRSH1 |

**Table 1. Digital Output (DOUT) Threshold Configuration**

The Window mode (CONFIG = 11) can be used to provide a response independent of polarity. For example, the default settings of CONFIG = 11, THRSH1 = 75% (0xC00000), and THRSH2 = 25% (0x400000) cause DOUT to be high if the field magnitude is more than 10 Oe (i.e., greater than +10 Oe or less than −10 Oe) as shown in the following diagram:

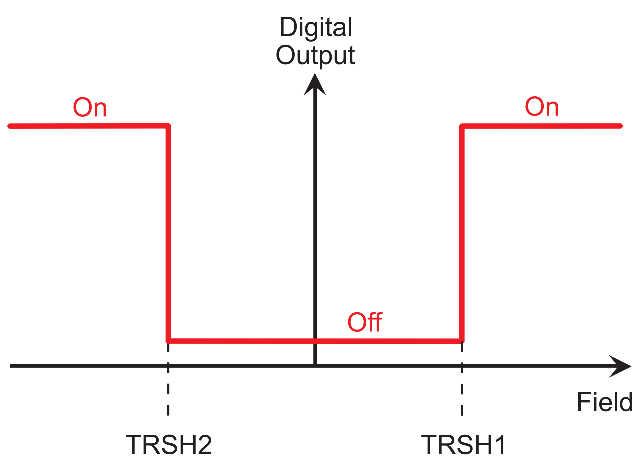



**Fig. 2e. Default DOUT configuration (CONFIG = 11; THRSH1 = 75%; THRSH2 = 25%; for ominpolar DOUT).**

***Directions of Sensitivity***

Unlike Hall effect or other sensors, TMR sensors are sensitivitive to fields in the plane of the package, which is more convenient. The axis of sensitivity is in the pin 2 to pin 5 sensor axis, which is ideal for position sensing or current sensing so a current-sensing trace can be run under the sensor without crossing the pins.

***Position Sensing***

A typical proximity sensor using an SM324-10E sensor and magnet is shown below. With a 4 Oe operate point, the sensor actuates with a rare-earth magnet at more than 50 mm (two inches) from the sensor:

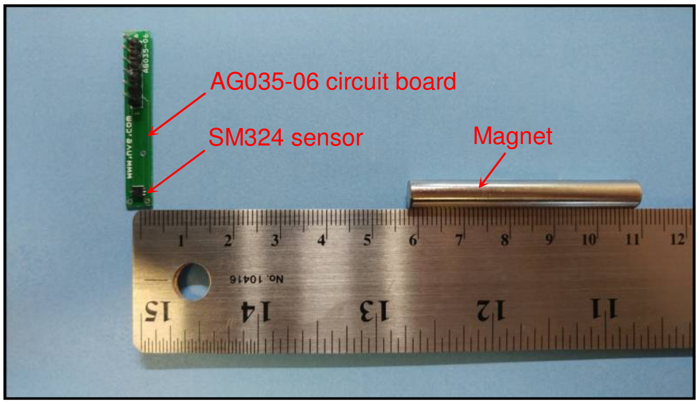



**Figure 3. The SM324-10E sensor can be activated by a magnet more than 50 mm away.**

Thresholds even lower than 4 Oe can be programmed for the SM324-10E, although care must be taken to account for the earth's magnetic field, which is approximately 0.5 Oe.

Typical magnetic operate distances are illustrated below for an inexpensive ceramic disk magnet:

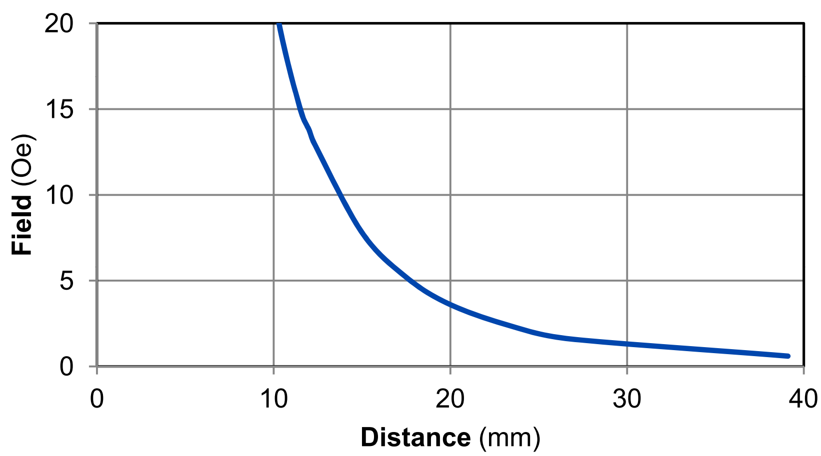



**Figure 4. Field vs. distance from the center of the sensor**
**(NVE part number 12216; ferrite magnet; d=6 mm; t=4 mm; C1/Y10T; $M_s$=$B_r$=2175 G).**

Larger and stronger magnets allow farther operate and release distances. For more calculations, use our axial disc magnetic field versus distance Web application at:

*www.nve.com/spec/calculators.php#tabs-Axial-Disc-Magnet-Field.*

***Current Sensing***

In a typical current sensor configuration, a magnetic field provided by an off-chip current strap produces a magnetic field in the plane of the sensor. The digital output can be used for current threshold detection or overcurrent protection.

Typical current sensing configurations are shown below:

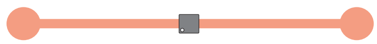


**Figure 5a. 0.05" (1.3 mm) trace (0 – 5 A typ.).**

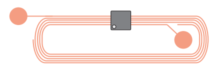


**Figure 5b. Five turns of 0.0055" (0.14 mm) trace (0 – 1 A typ.).**

For the geometry shown below and narrow traces, the magnetic field generate can be approximated by Ampere's law:

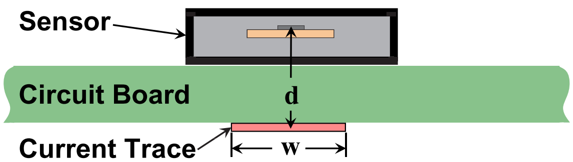



**Figure 6. The geometry of current-sensing over a circuit board trace.**

$$H = \frac{2I}{d}$$ ["H" in oersteds, "I" in amps, and "d" in millimeters]

For traces on the top side of the board, "d" is simply the distance of the sensor element from the bottom of the package, which is 0.5 millimeters.

Traces on the top side of the board are typically used for currents of five amps or less. Large traces on the bottom side of the PCB can be used for currents of more than five amps.

More precise calculations can be made by breaking the trace into a finite element array of thin traces, and calculating the field from each array element. We have a free, Web-based application with a finite-element model to estimate magnetic fields and sensor outputs in this application:

*www.nve.com/spec/calculators.php#tabs-Current-Sensing*

## Power-Saving Modes

Two operational modes are available with the SM324. A normal mode allows the user to retrieve a single sensor reading via I²C and return the part to an ultra-low power idle state when communication is complete. A cyclic mode automatically updates the sensor read buffer at programmed interval. The SM324 returns to an idle state between readings. The mode of the sensor is set via an I²C command (see Table 2 below), and the cyclic interval is programmed using the CINT parameter.

A read can be performed at any time in cyclic mode, and the latest full 24-bit sensor and temperature measurement will be returned. In fact, a read from any memory address in cyclic mode will return the sensor/temp measurement. Reading or writing to memory requires a 0xBF to stop cyclic mode.

The sensor's digital threshold output is updated by single and oversample measure commands in normal mode or on the timed cadence of the cyclic measurements in cyclic mode.

| Parameter Value (Binary) | Cyclic Mode Interval |
|---|---|
| 000 | Not assigned |
| 001 | 125 msec |
| 010 | 250 msec |
| 011 | 500 msec |
| 100 | 1000 msec |
| 101 | 2000 msec |
| 110 | 4000 msec |
| 111 | Not assigned |

**Table 2. CINT parameter values.**

| Command | Command Value (hex) | Notes |
|---|---|---|
| Read User Memory | 0x20-0x38 | 16-bit user defined data |
| Write User Memory | 0x60-0x78 | 16-bit user defined data |
| Checksum | 0x90 | Perform memory update to CHECKSUM parameter. |
| Single Measurement | 0xAA | 24-bit field plus 24-bit temperature measurement |
| Cyclic Measurement | 0xAB | Cyclic 24-bit field plus 24-bit temperature measurement |
| 2x Oversample Measure | 0xAC | Complete 2x full continuous measurements and compute average values |
| 4x Oversample Measure | 0xAD | Complete 4x full continuous measurements and compute average values |
| 8x Oversample Measure | 0xAE | Complete 8x full continuous measurements and compute average values |
| 16x Oversample Measure | 0xAF | Complete 16x full continuous measurements and compute average values |
| Cyclic Measure Stop | 0xBF | Stops cyclic measurements |

**Table 3. SM324 command options.**

## Sensor Measurements and Offsets

### *Field and Temperature Measurements*

The sensor provides field and temperature measurements with each reading.

The measurements are 24-bit unsign integers. 0x000000 represents the minimum value which is −20 Oe for field and −40°C for temperature. 0xFFFFFF represents full scale, which is +20 Oe for field and +125°C for temperature.

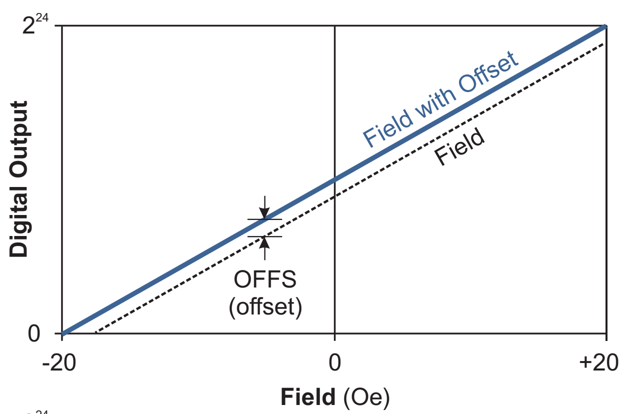
### *Saturation and Overflow*

All measurements responses start with a status byte followed by the data. Bit 0 of the status byte indicates when the field is too high for an accurate measurement, i.e., the sensor is saturated. In this case, Bit 0 of the status byte will be set and the field will remain at or near 0xFFFFFF.

### *Offsets*

Temperature and field offsets are factory calibrated, but can be reprogrammed if necessary. Offsets are in 24-bit Sign/Magnitude format, where the most significant bit (bit 23) is the sign (0 = positive; 1 = negative), and bits 22:0 are the magnitude. The offset range is ±50% of full-scale, where field full-scale is ±20 Oe;
and temperature full-scale is 165°C.

Measurements and offsets are illustrated below:



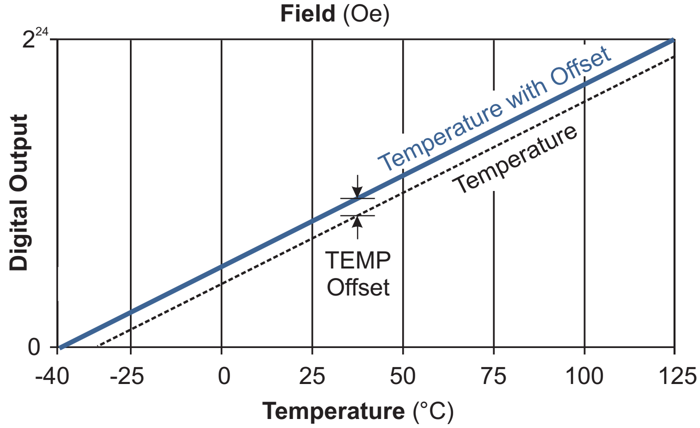




**Fig. 7a. Sensor output versus field.**

**Fig. 7b. Sensor output versus temperature.**

## I²C Interface

The I²C interface is an industry standard full-duplex 400 kHz connection with the sensor as the slave to an external master such as a microcontroller.

Consistent with industry practice, SDA and SCL are open-drain, and pull up resistors to $V_{DD}$ are normally needed. The SDA / SCL pins should not be left floating for proper power-up/operation.

A schematic of a typical microcontroller interface is show in the Applications section.

*I²C Address*
The SM324 has a seven-bit address, which can be defined in the nonvolatile memory with the $I^2C_{ADD}$ parameter. Allowable I²C addresses are 8 to 127. Addresses 4 to 7 are reserved for I²C High Speed Mode. The factory default I²C Slave Address is 16 (0x10 hex). A power cycle is required for a device to respond to an $I^2C_{ADD}$ change.

*Data Format*
Each command follows the sequence shown below. All I²C read responses start with a status byte followed by the data. The data depends on the previous commands. Only the number of bytes that are needed for the command must be sent. An exception is the I²C High Speed Mode where three bytes must always be sent. After the execution of a command, the expected data can be read or if no data is returned by the command, the next command can be sent. You can read the same data more than once if the read request is repeated.

***Command or I²C Memory Write Sequence***

| | | | | | | |
|---|---|---|---|---|---|---|
| S | Addr | W | A | Command | A | P |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S | Addr | W | A | Command | A | Data [15:8] | A | Data [7:0] | A | P |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S | Addr | W | A | Memory Address | A | Data [15:8] | A | Data [7:0] | A | P |

***Read Sequence Following $AA_{HEX}$ Command***

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | Addr | R | A | Status | A | Field [23:16] | A | Field [15:8] | A | Field [7:0] | A | Temp [23:16] | A | Temp [15:8] | A | Temp [7:0] | N | P |

***Read Sequence Following 2-byte Memory Write Command***

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S | Addr | R | A | Status | A | Data [15:8] | A | Data [7:0] | N | P |

***Key***:
S/P: Start/Stop
A/N: Acknowledge / Not Acknowledge
R/W: Read (0) / Write (1)

*Status Byte*

A read status can be executed at any time with the following command sequence:

| | | | | | | |
|---|---|---|---|---|---|---|
| S | Addr | R | A | Status | N | P |

The status byte contains the following bits:

| Bit | 7 | 6 | 5 | 4, 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **Meaning** | 0 | Powered? | Busy? | 00 | Memory Error? | 0 | Saturation? |

Power indication (bit 6): This bit is 1 if the sensor element is powered and 0 if not powered.

Busy indication (bit 5): This bit is 1 if the device is busy, which indicates that the data for the last command is not available yet. No new commands are processed if the device is busy. Note that the device is always busy if the cyclic measurement operation has been started.

Memory integrity/error flag (bit 2): This bit indicates whether the checksum-based integrity test passed or failed. The bit is 0 if the integrity test passed and 1 if it failed. The memory error status bit is calculated only during the power-up sequence, so a newly written CHECKSUM will only be used for memory verification and status update after a subsequent power-on reset (POR).

Saturation (bit 0): This bit is 0 for any non-measurement command or if the last command was a measurement request and the computation is valid. This bit is 1 if the last command was a measurement request and the computation caused an internal saturation or is invalid.



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## Memory Register

The SM324 uses an internal nonvolatile memory to enable user programmable parameters such as $I^2C$ address, temperature and field offsets, digital output thresholds and configuration parameter, and cyclic mode interval. Each register is 16 bits and is written using the scheme described in the $I^2C$ interface section.

The memory address and number of bits for each parameter are also provided. Memory address bit 6 is a write bit, so writing to nonvolatile memory uses an address 0x40 higher than the address for reading.

Table 4 summarizesprogrammable parameters:

| Parameter | Symbol | Read Address (hex) | Write Address (hex) | Bits | Default Hex | Default Value | Notes |
|---|---|---|---|---|---|---|---|
| **Device Identifiers** | | | | | | | |
| User Memory | | 00-01; 20-38 | 40-41; 60-78 | [15:0] | -- | -- | |
| $I^2C$ Address | $I^2C_{ADD}$ | 0x02 | 0x42 | [6:0] | 0x10 | 16 dec | Address changes require power cycle. |
| **Offsets** | | | | | | | |
| Temperature Offset (lower 16 bits) | TEMP | 0x18 | 0x58 | [15:0] | Factory Calibrated | | Sign/Magnitude format; most significant bit is sign (1=negative); bits 22:0 are magnitude (±50% of full scale); full scale field = ±20 Oe; full scale temp. = 165°C. |
| Temperature Offset (sign bit + upper 7 bits) | | 0x19 | 0x59 | [15:8] | | | |
| Field Offset (lower 16 bits) | OFFS | 0x17 | 0x57 | [15:0] | | | |
| Field Offset (sign bit + upper 7 bits) | | 0x19 | 0x59 | [7:0] | | | |
| **Mode Parameters** | | | | | | | |
| Cyclic Interval | CINT | 0x02 | 0x42 | [14:12] | $000_{BIN}$ | 0 | |
| **Digital Output Configuration** | | | | | | | |
| Threshold 1 (LSB) | THRSH1 | 0x13 | 0x53 | [15:0] | 0x0000 | 10 Oe | Unsigned (0–100% of full scale) |
| Threshold 1 (MSB) | | 0x15 | 0x55 | [7:0] | 0xC0 | | |
| Threshold 2 (LSB) | THRSH2 | 0x14 | 0x54 | [15:0] | 0x0000 | −10 Oe | |
| Threshold 2 (MSB) | | 0x15 | 0x55 | [15:8] | 0x40 | | |
| Threshold Configuration | CONFIG | 0x02 | 0x42 | [8:7] | $11_{BIN}$ | 3 | |

**Table 4. SM324 programmable parameters.**

## Supply Decoupling

$V_{DD}$ should be bypassed with a 1 nF (0.001 µF) capacitor placed as close as possible to the supply pin. Note that a larger capacitor is not required, and could interfere with power-up timing.

## Typical Circuit

A typical microcontroller interface is shown below:

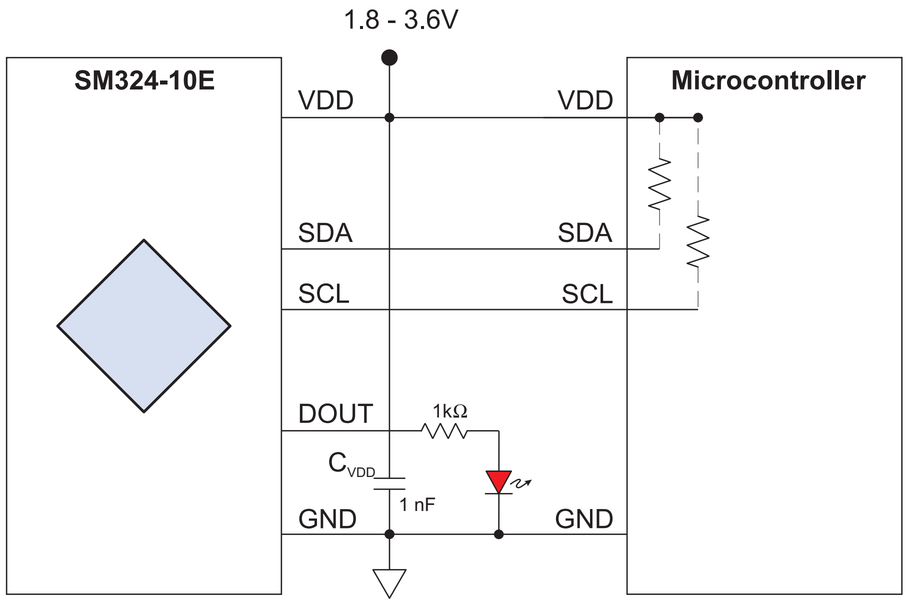


**Figure 8. Typical microcontroller interface.**

The SM324 is configured as a Slave and the microcontroller should be configured as the Master. The SM324 I²C interface is compatible with 1.8 to five-volt nominal microcontrollers.

The SM324 SDA and SCL lines are open-drain, so the microcontroller's internal pull-up resistor should be activated in software. If an external pull-up is used with different power supplies, it should be connected to the lower supply voltage, which is usually the sensor (Slave) supply.

$V_{DD}$ should be bypassed with a 1 nF (0.001 µF) capacitor placed as close as possible to the $V_{DD}$ and GND pins.

A LED can be used to indicate the digital output. The appropriate series resistor depends on the supply voltage and LED type, and of course the LED cannot be operated at the low end of the sensor supply voltage range, such as 1.8 volts.


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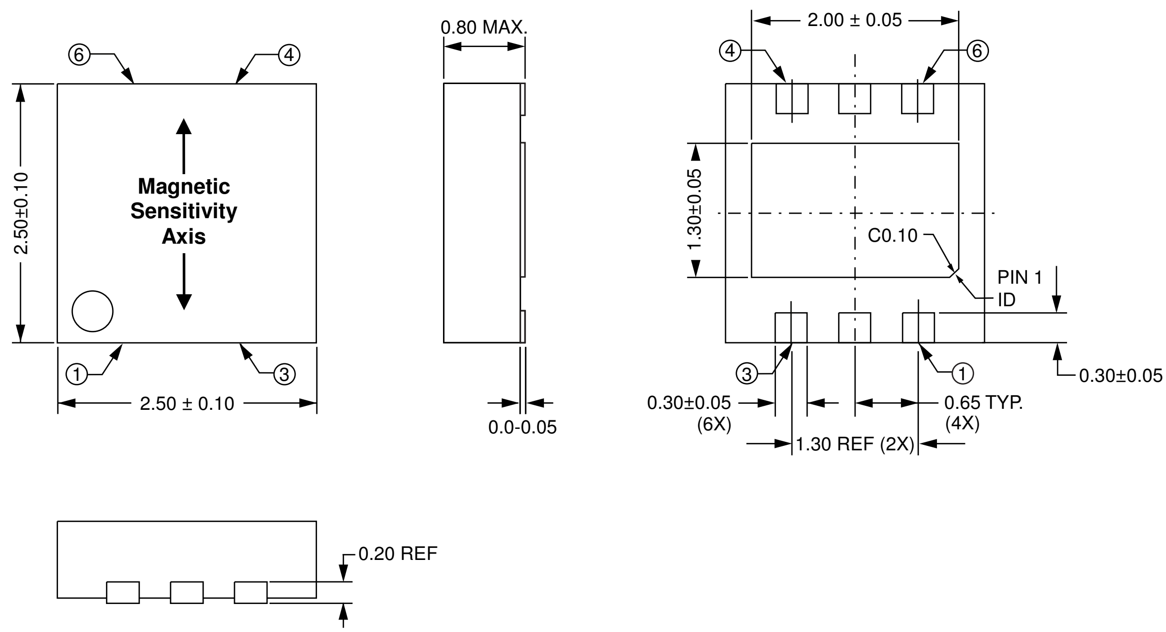
**2.5 x 2.5 mm TDFN6 Package** (approx. 15x actual size)




| Pin | Symbol | Description |
|---|---|---|
| 1 | VDD | Power Supply (bypass with a 1 nF capacitor) |
| 2 | GND | Ground / $V_{SS}$ |
| 3 | DOUT | Digital Output |
| 4 | SCL | I²C Clock (input) |
| 5 | SDA | I²C Data (bidirectional/open drain) |
| 6 | NC | Not internally connected |

RoHS
COMPLIANT

**Notes:**
- Dimensions in millimeters.
- Soldering profile per JEDEC J-STD-020C, MSL 1.



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## Ordering Information

# SM324 - 10E TR13

**Product Family**
SM = Smart Magnetometer

**Precision**
3 = 3-Byte resolution; TMR Sensor Element

**Magnetic Orientation**
2 = Cross-axis (sensitive to a field vector in the pin 2 to pin 5 direction)

**Field Range**
4 = 20 Oe Magnetic Field Range

**Part Package**
10E = RoHS-Compliant 2.5 x 2.5 mm TDFN6 Package

**Bulk Packaging**
TR13 = 13" Tape and Reel Bulk Packaging



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## Revision History

**SB-00-077 Rev. B**
February 2019

**Change**
- Added charts showing field and temperature outputs (p. 10).
- More detailed descriptions of bit/byte concatenation (p. 11).
- Clearer Table 4 memory map; merged Table 5 into Table 4 (p. 13).
- Clarified direction of sensitivity (p. 15).
- Corrected minor specification inconsistencies.

**SB-00-077 Rev. A**
September 2018

**Change**
- Dropped "Preliminary" designation.
- Misc. style changes.
- Dropped fax number.

**SB-00-077-PRELIM2**
August 2018

**Change**
- Dropped "Product Preview" designation.
- Added 25°C accuracy specification.
- Added hysteresis specification.
- Misc. minor changes.

**SB-00-077-PRELIM**
July 2018

**Change**
- Initial release.



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