USB27053 – Three-Axis Low-Field USB Magnetometer

Features and Benefits

- High Sensitivity Tunneling Magnetoresistance (TMR) Technology
- Measurement Range of -50 Oe to 50 Oe
- High Resolution
- Plug and Play USB Interface
- Powered from USB Bus
- Graphical User Interface
- Command Line User Interface
- Manual Range Selection
- Adjustable Filtering and Averaging
- Simple Zeroing and Calibration
- Customizable Linearization and Orthogonalization
- Documented Programming Interface
- Reconfigurable Hardware
- Manual and Automatic Triggering

Applications

- High Resolution Laboratory Measurements
- Automated Data Acquisition and Control
- Materials Research
- Non Destructive Testing
- Magnetic Object Tracking
- Sensor Algorithm Development
- STEM Education
- Hobby and DIY

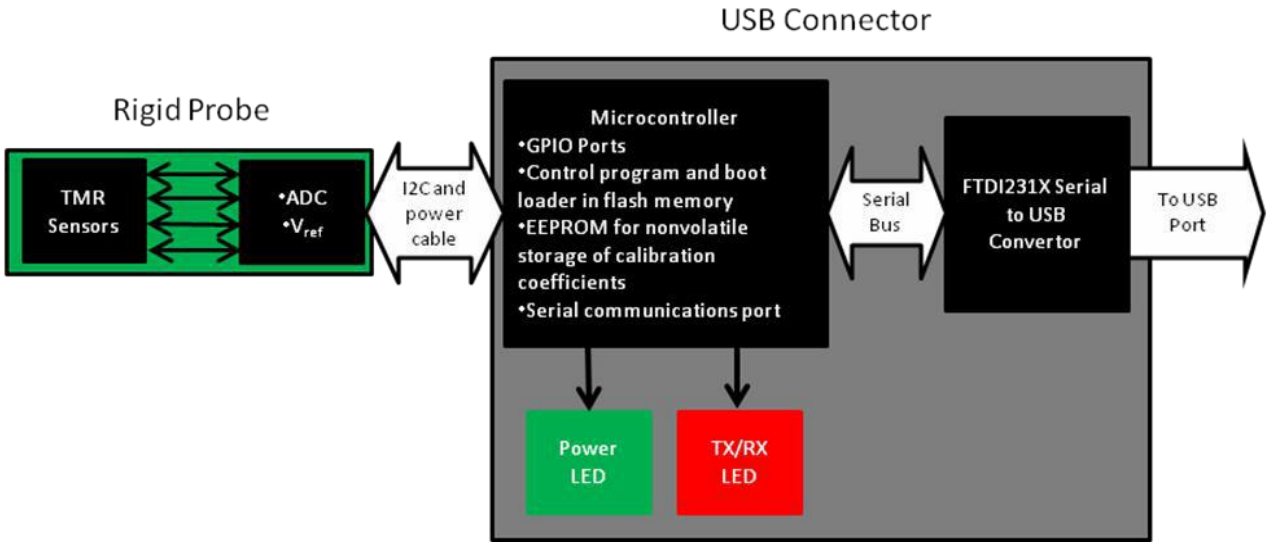
General Description

The MDT USB27053 is a three-axis digital magnetometer that is intended for the measurement of magnetic fields near the probe tip at frequencies less than 200 Hz. The MDT USB27053 combines three orthogonal MDT TMR2705 TMR full-bridge magnetic field sensors with plug-and-play USB data acquisition electronics and software to provide a three-axis digital magnetometer system in a simple form factor. It is designed such that the user may use it directly combined with the proprietary MDT graphical user interface (GUI), controlled with a terminal emulator program, or integrated into the user's custom written program. The GUI can be run on a desktop computer, a notebook, or a Windows tablet. Additionally, the probe electronics may be reprogrammed by the user using freely available open source Arduino development tools. The MDT USB Magnetometer is thus a complete development tool that allows a user a simple means for experimenting with MDT TMR sensors, sensor applications, and developing sensor algorithms.

Hardware Description

The USB magnetometer includes three orthogonal magnetic field sensors located within 3 mm from the probe tip and covered with an aluminum tube. The probe is connected to USB data acquisition hardware by a 1 m long cable. The probe has the following configuration.

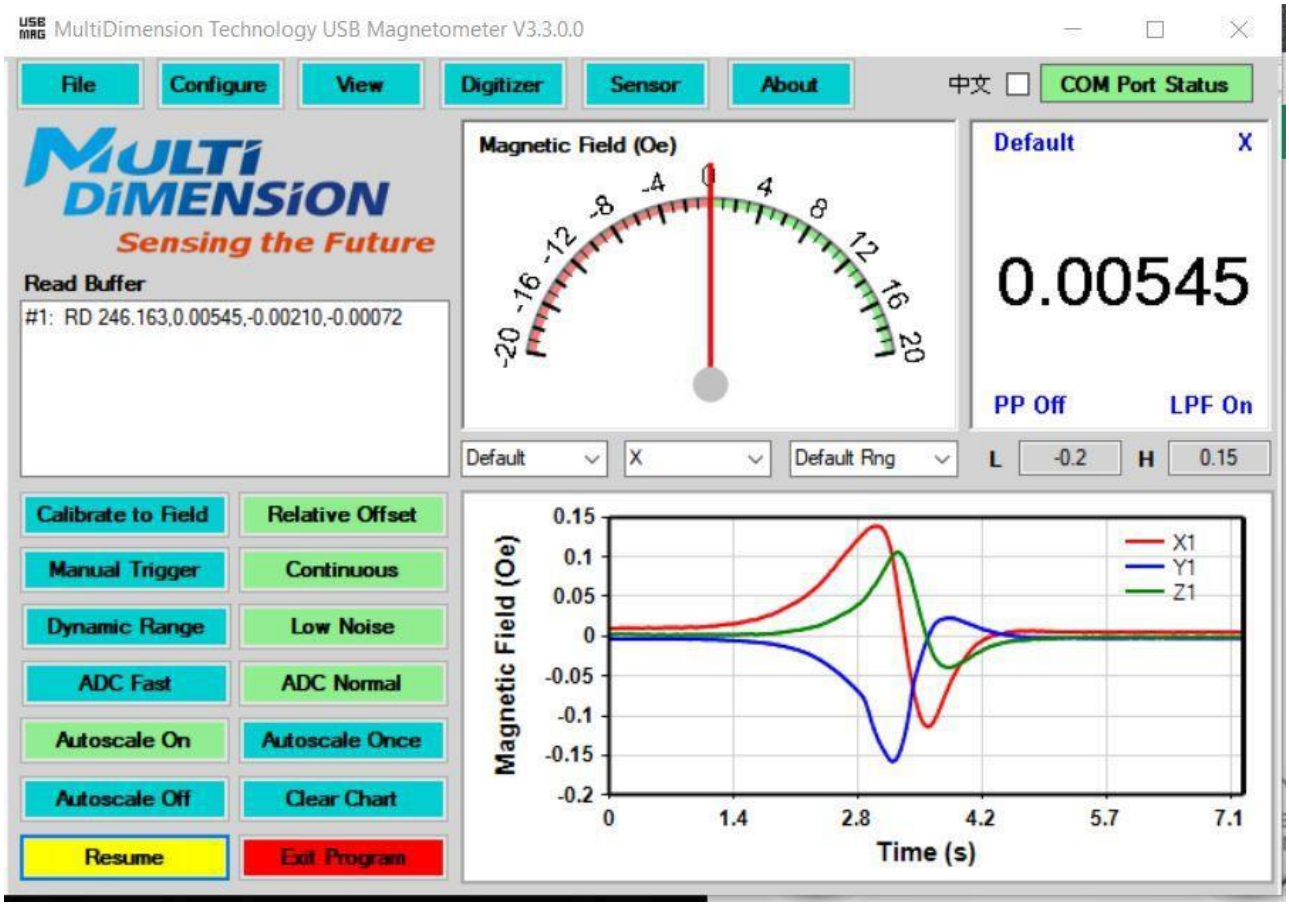
The USB magnetometer hardware is compatible with the popular open source Arduino UNO board, and thus with the Arduino programming environment or Atmel microcontroller development tools. The user may develop custom firmware at his/her own risk. The hardware includes a boot loader for uploading Arduino code. The USB magnetometer hardware model is defined as follows:



The TMR sensors are used to detect a magnetic field, which they convert to a proportional voltage value. The TMR sensors are biased by a temperature compensated voltage reference. The TMR sensor outputs are connected to ADCs which digitally sample the voltages and sends the digital signals via a 1 m long cable to a microcontroller over an I2C bus. The microcontroller converts the sampled sensor voltages to a magnetic field values using calibration coefficients stored within an EEPROM. These EEPROM values may be overwritten by the user. The microcontroller then sends the computed magnetic field values to a serial bus, which is connected to a FTDI231X Serial-to-USB convertor. The I/O of the FTDI231X Serial-to-USB convertor is a standard USB2.0 port. A driver on the computer or other computing device is used to create a virtual COM port, which is then accessed by the MDT USB magnetometer GUI, a terminal emulator program, or other custom written program.

Software Description

The USB Magnetometer includes a GUI for data logging the field readings from the sensor in units of Oersted and displaying those readings in analog, digital, and graphical formats. The data in the graphical display can be logged or output to a csv file, which is compatible with most spreadsheet programs and easy to import into analysis software. The display can be configured in several data viewing modes or in a mode to control operation of the acquisition electronics. The software allows a user to set the resolution, sample rate, filtering, averaging, trigger mode, linearization, and to perform sensor calibration. The GUI also contains a built in terminal emulator for sending and receiving low-level commands to and from the probe, which is useful for programmingnon-standard configurations and also for debugging commands to be used in custom software applications.



The USB Magnetometer was designed to enable users to interface it with their own custom programs by sending and receiving text commands using a COM port. This is useful for writing data acquisition and data acquisition system control programs, such that the user can input data directly to a program without needing to export it from the USB Magnetometer GUI to a csv file. The COM port commands are fully documented in the user manual, and they may be tested using any terminal emulator program or the built in terminal emulator.

Absolute Maximum Ratings

Parameter	Symbol	Limit	Unit
External Magnetic Field	H_{ext}	1000	Oe (1)
ESD Voltage	V_{ESD}	4000	V
Operating Temperature	T_A	-40 ~ 85	℃
Storage Temperature	T_{stg}	-50 ~ 150	℃

Specifications

Parameter	Comments	Min	Typ	Max	Unit
Supply Voltage	From USB Bus		5		V
Sensing Direction	X/Y/Z				
Cable Length	Custom Length Possible		1		m
Hardware Interface	USB 2.0				
GUI Supported Operating Systems	Windows XP, Vista, 7, 8, 10				
Custom Program Compatible Operating Systems (2)	Windows, Macintosh, Linux, Android, iOS				
Sensor Linear Range		-10		10	Oe
Corrected Linear Range		-50		50	Oe
Hysteresis	Fit @ ±15 Oe			0.3	Oe
Uncorrected Nonlinearity	Fit @ ±15 Oe		3		%FS
RMS Noise	No Averaging, Low Noise, 16 bits		0.35		mOe
Temperature Coefficient of Sensitivity		-0.3		0.3	%/℃
ADC Resolution (3)		16			bits
Sampling Frequency (4)	ADC Resolution Dependent		40	250	Hz
Orthogonality	Software Corrected		1		degree

Notes:

(1) 1 Oe (Oersted) = 1 Gauss in air = 0.1 millitesla = 79.8 A/m.

(2) Limited by FTDI USB driver availability and computing device USB port hardware

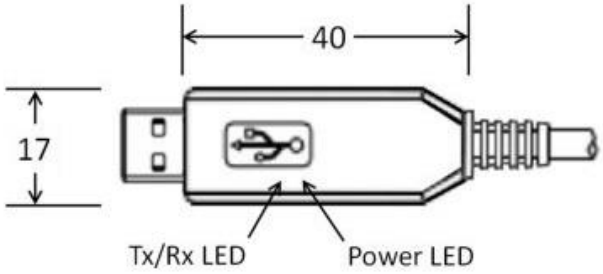
(3) Resolution can be increased by software averaging, minimum is 16 bits

(4) Limited by ADC hardware

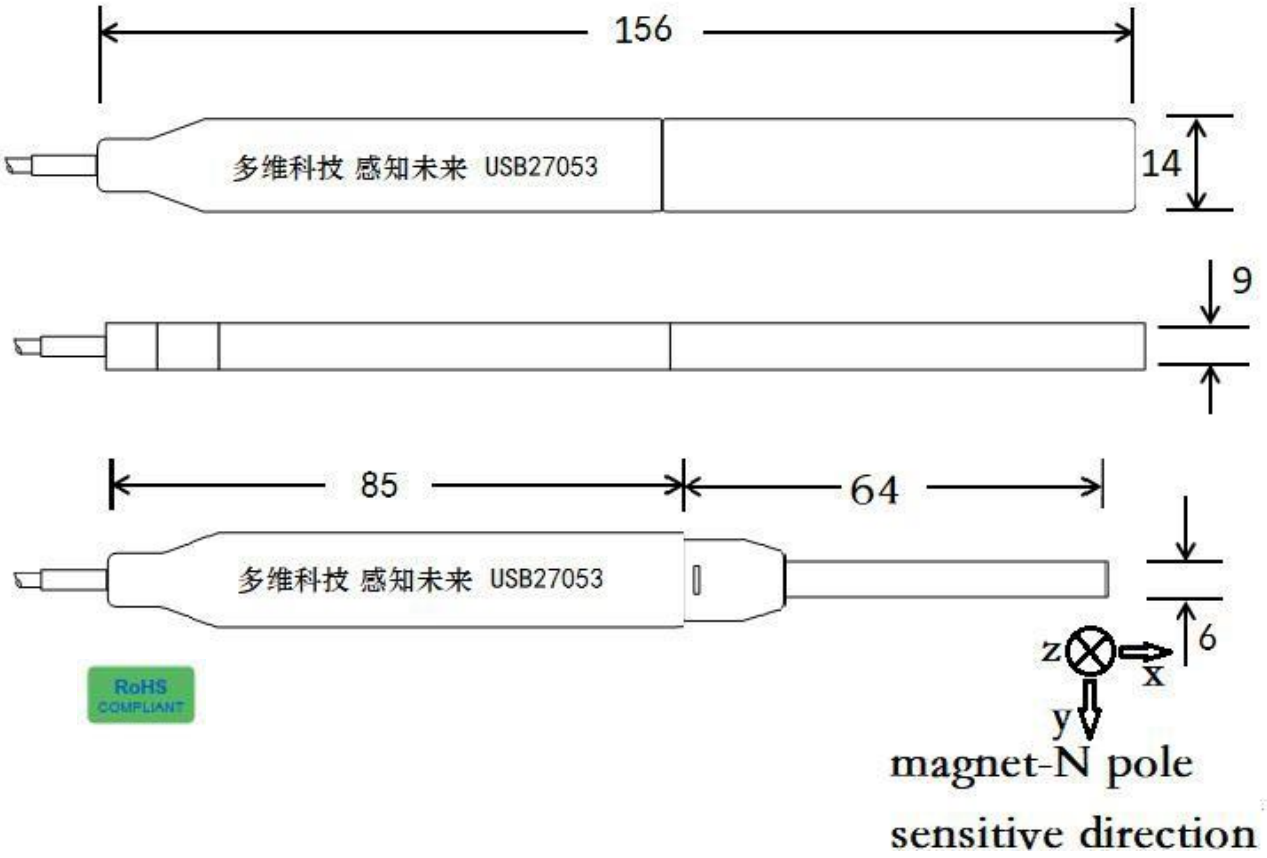
Related Documents

- MDT USB Magnetometer User Manual
- MDT TMR2705 Linear Sensor Datasheet

USB Connector Dimensions



Rigid Probe Dimensions



USB Connector and Probe view units: mm

Notes: If there is any improvement in product functionality, will be reflected in the new product data sheet; If there is any change in the appearance of the product, please refer to the actual, without prior notice.