

## **USB2705A – Axial 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
- 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**

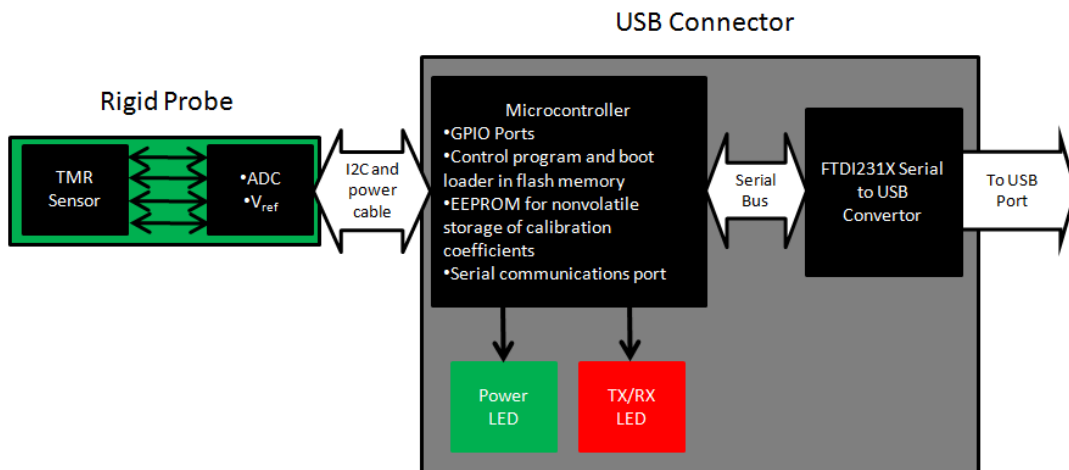
The MDT USB2705A is a single-axis digital magnetometer that is intended for the measurement of magnetic fields aligned along the axis of the probe at frequencies less than 100 Hz. The MDT USB2705A combines a MDT TMR2705 TMR full-bridge magnetic field sensor with plug-and-play USB data acquisition electronics and software to provide a single-axis digital magnetometer system in a simple low-cost 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 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 comprises a magnetic field sensor located on the end of a rigid probe. The rigid probe is connected to data acquisition and computer interfacing hardware by a 1 m long cable. The rigid probe has the following configuration.



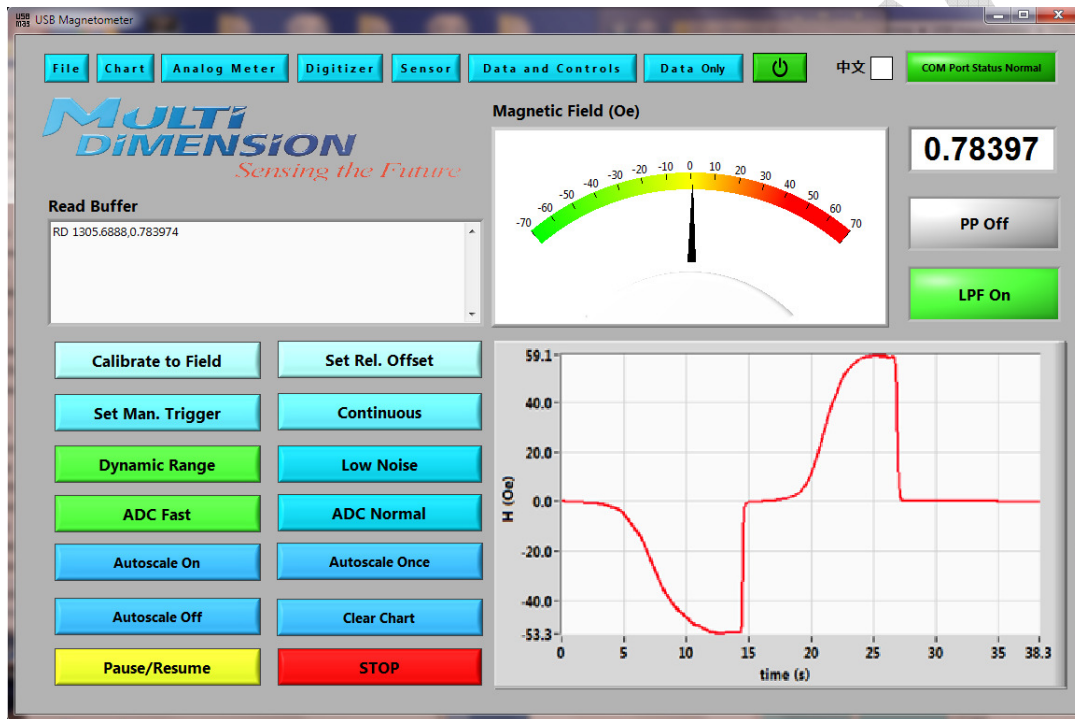
The USB magnetometer hardware is program compatible with the popular open source Arduino UNO board, and thus the Arduino programming environment or Atmel microcontroller development tools. The user may develop custom firmware at his/her own risk. The hardware includes a boot loader for uploading Arduino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



A TMR or other sensor is used to detect a magnetic field, and it converts the magnetic field to a voltage value. The TMR sensor is biased by a temperature compensated voltage reference. The TMR sensor output is connected to an ADC, which digitally samples the voltage and sends the digital signals via a 1 m long cable to the microcontroller over an I2C bus. The microcontroller converts the sampled sensor voltage to a magnetic field value using calibration coefficients stored within the non-volatile program Flash memory or the user reprogrammable EEPROM. When factory calibrated, the calibration coefficients are stored in the EEPROM. These EEPROM values may be overwritten by the user. The microcontroller then sends the computed magnetic field value 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 USB 2.0 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 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 a data viewing mode 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 programming non-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	$H_{\text{ext}}$	1000	Oe <sup>(1)</sup>
ESD Voltage	$V_{\text{ESD}}$	4000	V
Operating Temperature	$T_A$	-40 ~ 85	°C
Storage Temperature	$T_{\text{stg}}$	-50 ~ 150	°C

## Specifications

Parameter	Comments	Min	Typ	Max	Unit
Supply Voltage	From USB Bus		5		V
Sensing Direction	Axial				
Cable Length			1		m
Hardware Interface	USB 2.0				
GUI Supported Operating Systems	Windows XP, Vista, 7, 8, 10				
Custom Program Compatible Operating Systems <sup>(2)</sup>	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	%/°C
ADC Resolution <sup>(3)</sup>		12		16	bits
Sampling Frequency <sup>(4)</sup>	ADC Resolution Dependent			110	Hz

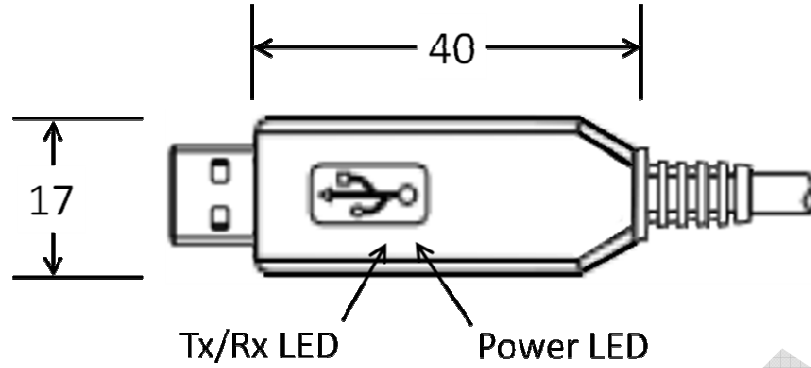
### Notes:

- (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
- (4) Limited by ADC hardware

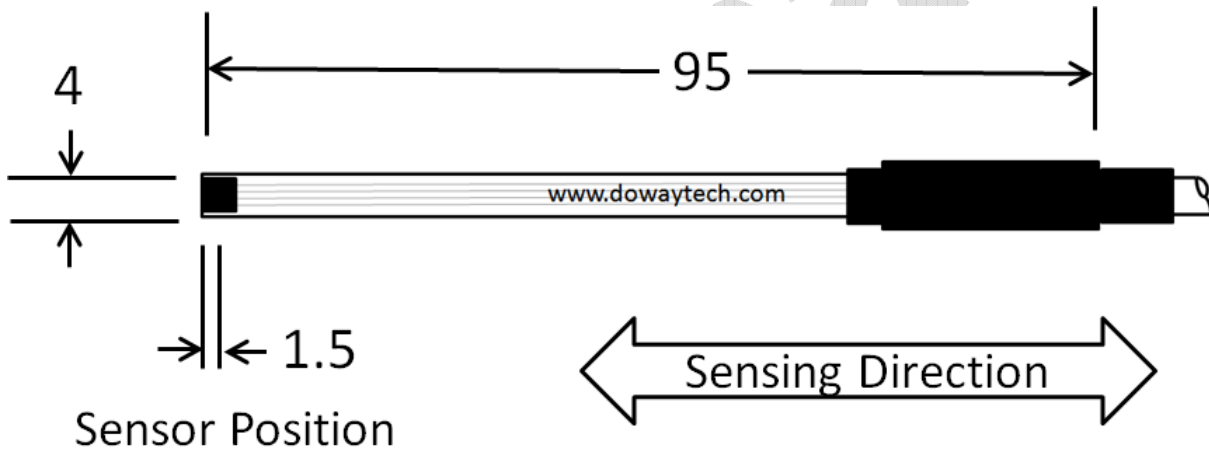
## Related Documents

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

## USB Connector Dimensions



## Rigid Probe Dimensions



USB Connector and Rigid Probe view units: mm



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