Application note

MLX90392 EVB

Contents

1. Scope

This document shows the schematic of the EVB and how it can be used easily to get started. Note that any of the code is provided as is, and is not guaranteed to be error free. It is only to be used as a demo.

1.1. Different EVB Versions

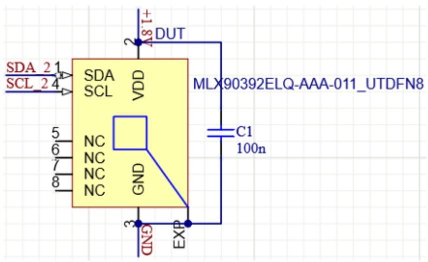
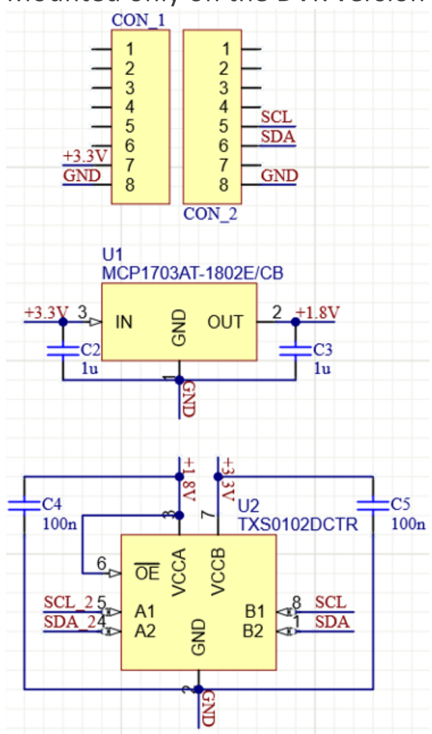
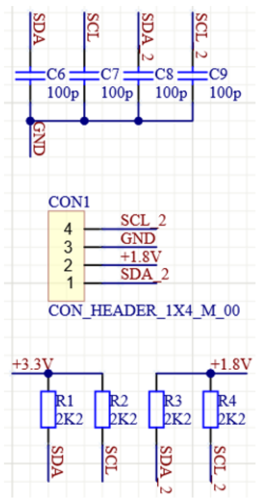
Important: the MLX90392 operates at 1.8V, which means that when connecting it to a microcontroller one needs to either use a 1.8V microcontroller or use a level shifter in between. The EVB for both the 50mT and the 5mT version are offered in two flavors for exactly this reason. The PCB itself is the same, but some components are not mounted on the breakout version:

- **Breakout** version: The IC is mounted, together with a 100nF decoupling capacitor. The four pins of the IC are directly routed to the 4-pin header.

- **DVK Magnetic** version: The IC is mounted, together with a 100nF decoupling capacitor. Also a level shifter and 1.8V regulator is added to the PCB to translate the 3.3V supply and signal levels from the main DVK to the 1.8V levels needed by the IC. This version can be used also with other microcontrollers not operating at 1.8V, using the parallel connectors. Note that the drill holes of these are smaller than the standard headers, this due to the DVK having precision header sockets.

1.2. Schematic

The schematic is for each version (Breakout and DVK) the same, and shown below for the -011 version of the IC. Some components are never populated but can be placed by the user in case needed.

Mounted on both versions	Mounted only on the DVK version	Never mounted, optional
		

1.3. Microcontroller and GUI Setup

Firmware is written for two different microcontrollers. These microcontrollers do not operate at 1.8V, so the "DVK Magnetic" version is required.

- Compatible Arm® Mbed™ LPC1768 microcontroller: https://os.mbed.com/platforms/mbed-LPC1768/
    - A firmware (.bin) is provided that can be uploaded to the device. The source code itself is not provided.
    - To interface to the device, a driver needs to be installed to have it appear in the device manager as a COM port. Follow the instructions on https://os.mbed.com/docs/mbed-os/v6.7/program-setup/windows-serial-driver.html. Uploading firmware is done by drag-and-drop the file into the device which is shown as a USB drive.
- Compatible Arduino®: https://www.arduino.cc/
    - An example code (.ino) is made implementing all the functions, executing them based on serial commands and returning the replies to the PC.[1]
    - Install the software from the website to have also the drivers and to be able to upload the code to the board.

As GUI, an executable is available which implements the commands from section 3 of this document and visualizes the reply from the IC. As the GUI is written in LabVIEW™ software, make sure to install the runtime engine (2019, 32-bit) in order to run it, which can be downloaded free of charge.

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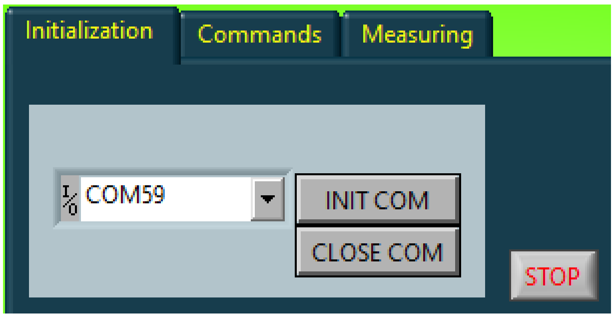
[1] *Due to the implementation of the I^2C library, the "Read Direct" function does not detect Nacks. As from Rev2.0 of the demo code this has been fixed.*

2. GUI

In the demo, three tabs are present. All of them are shown in the following chapters.

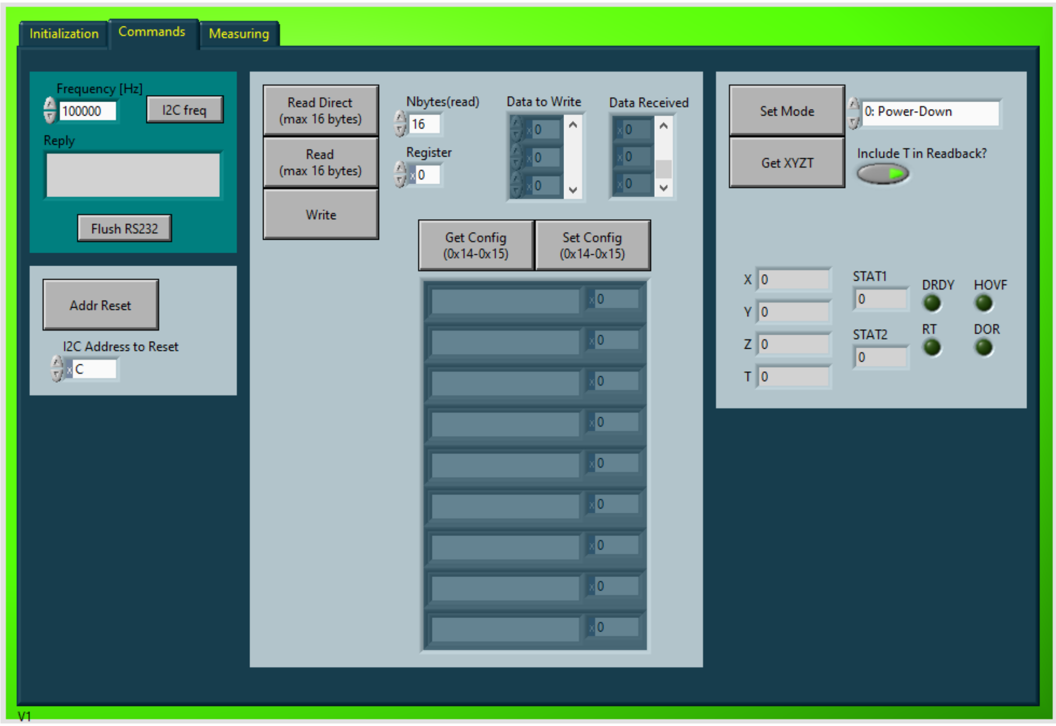
2.1. Initialization



Button	Action/Usage
INIT COM	Select the COM port in the drop down list and click this button to connect to the device.
CLOSE COM	To close to COM port, click this button.
STOP	This button stops the UI, there is no need to use this normally.

2.2. Commands

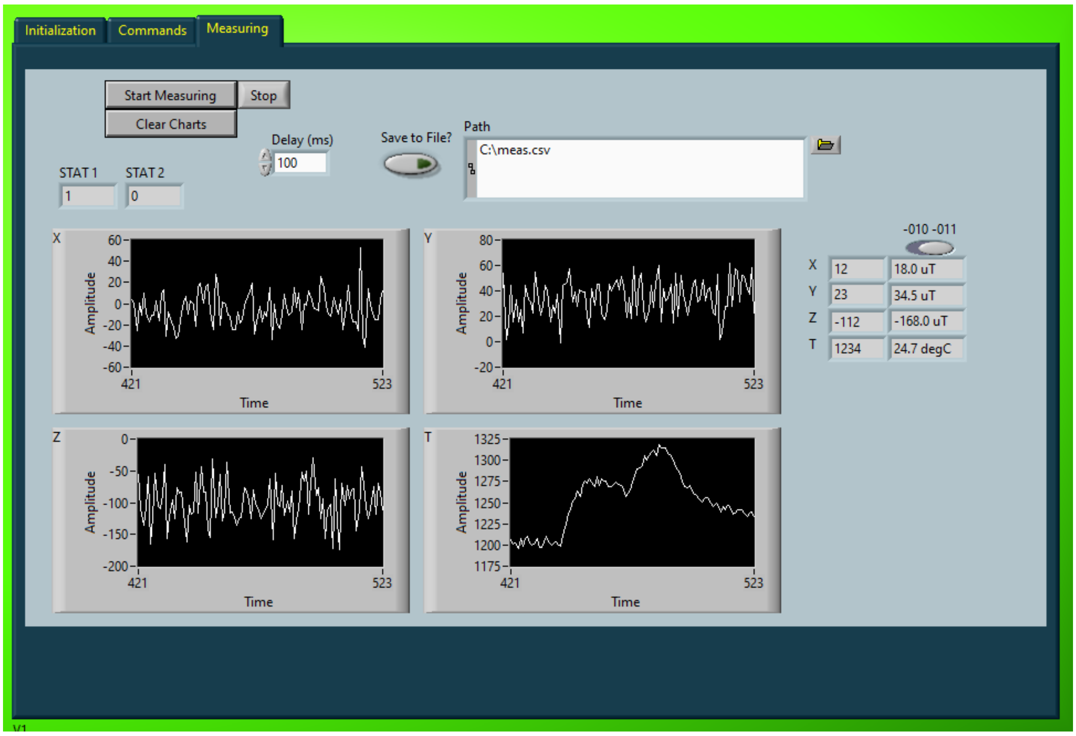
If a Nack is detected, the green border will turn red.(1)



Button	Action/Usage
I2C freq	Change the I^2C frequency. By default, the I^2C frequency is set to 100kHz.
Flush RS232	Flush the RS232 buffers, click a couple of times in case of corrupted data.
Addr Reset	Send a reset command to the device with I^2C address as in the “I2C Address to Reset” input box.
Read Direct	Read a number of registers (specified by input box “Nbytes(read)”, starting from register 0x00. Answer shown in the “Data Received” output box.
Read	Read a number of registers (specified by input box “Nbytes(read)”, starting from the register specified by the input box “Register”. Answer shown in the “Data Received” output box.
Write	Write the content in the input box “Data to Write” to the IC, starting from the register specified by the input box “Register”.
Get Config	Reads registers 0x14 and 0x15 and decodes them in the section below.
Set Config	Writes registers 0x14 and 0x15 with the content of the section below.
Set Mode	Select a mode in the enumeration list next to it and click to set the IC in that mode.
Get XYZT	Get the magnetic measurement and status (and decoded status) from the IC, and show the result in the below output boxes. Temperature can also be read out if “Include T in Readback?” is set.

2.3. Measuring

If a Nack is detected, the green border will turn red. A conversion to µT and degC using typical sensitivity can be done. Selection of the correct version is needed.



Button	Action/Usage
Start Measuring	Starts sending in a loop single measurement commands to the IC, and asks after a delay specified by “Delay (ms)” the measurement results from the IC. The data is displayed in the graphs below. Enabling the option “Save to File?” allows for the data to be stored in a csv format. Specify the path first.
Stop	Stop the measurement loop, it allows for the last loop to be completed.
Clear Charts	Clears the graphs below.
-010 -011	Set to the correct version to use the correct sensitivity for the conversion LSB to µT.

3. Serial Commands

The commands are send on the serial bus with following settings:

Setting	Value
Baud rate	9600
# Data bits	8
# Stop bits	1
Parity	None
Flow control	No
End character (PC->microcontroller)	None needed (if ending is sent, execution starts before ending is received and ending is discarded)
End character (microcontroller->PC)	0x0A ("\n" or "Line Feed")

If more than one information is returned, each data section is ended by a ";" to allow for splitting, this includes the last section. In case of a single information, the data is not ended by a ";".

3.1. Read N Bytes

To read N bytes starting from a specified register, send to the microcontroller the following sequence. Note that setting Nbytes to 0 will equal 16 bytes to be read out.

Char #	Message to send	Example: Read 2 bytes, starting from register 0x14
1	**A** as character	A
2	**R[7:4]** as hex character	1
3	**R[3:0]** as hex character	4
4	**Nbytes** as hex character	2

Data #	Data received	Example: Read 2 bytes, starting from register 0x14
1	**Nack;** >0 if I^2C NACK are observed	0;
2	**R_1[7:0];** in decimal value	225;
3	**R_2[7:0];** in decimal value	
…	**…**	
N+1	**R_N[7:0];** in decimal value	181;
N+2	**"\n"**	\n

3.2. Read Direct N Bytes

To read N bytes starting from register 0x00, send to the microcontroller the following sequence. Note that setting Nbytes to 0 will equal 16 bytes to be read out.(1)

Char #	Message to send	Example: Read Direct 16 bytes
1	**B** as character	B
2	**Nbytes** as hex character	0

Data #	Data received	Example: Read Direct 16 bytes
1	**Nack;** >0 if I^2C NACK are observed	0;
2	**R_1[7:0];** in decimal value	0;
3	**R_2[7:0];** in decimal value	0;
…	**…**	0;0;0;0;0;0;0;0;152;186;0;0;0;
17	**R_N[7:0];** in decimal value	0;
18	**"\n"**	\n

3.3. Addressed Reset

To send an addressed reset on the bus, send to the microcontroller the following sequence.

Char #	Message to send	Example: Addressed Reset, 7-bit I^2C address 0x0C
1	**D** as character	D
2	**I2CAddr[6:4]** as hex char, pad MSB "0"	0
3	**I2CAddr[3:0]** as hex character	C

Data #	Data received	Example: Addressed Reset, 7-bit I^2C address 0x0C
1	**Nack** >0 if I^2C NACK are observed	0
2	**"\n"**	\n

3.4. Write N Bytes

To write N bytes starting from a specified register, send to the microcontroller the following sequence.

Char #	Message to send	Example: Write 0xE1 0xB5, starting from register 0x14
1	**E**, as character	E
2	**R[7:4]** as hex character	1
3	**R[3:0]** as hex character	4
4	**D1[7:4]** as hex character	E
5	**D1[3:0]** as hex character	1
6	**D2[7:4]** as hex character	B
7	**D2[3:0]** as hex character	5
…	**…**	-
2*N+3	**DN[7:4]** as hex character	-
2*N+4	**DN[3:0]** as hex character	-
2*N+5	**T** as character (terminate transmission)	T

Data #	Data received	Example: Write 0xE1 0xB5, starting from register 0x14
1	**Nack** >0 if I^2C NACK are observed	0
2	**"\n"**	\n

3.5. Change I²C Frequency

To change the I²C frequency, this command has to be sent. The length of the frequency value (in Hz) is fixed to 7 decimals, so padding with "0" is required for frequencies smaller than 1MHz. The default I²C frequency is 100kHz.

Char #	Message to send	Example: Set I²C frequency to 100kHz
1	**W**, as character	W
2	**F6** as hex character	0
3	**F5** as hex character	1
4	**F4** as hex character	0
5	**F3** as hex character	0
6	**F2** as hex character	0
7	**F1** as hex character	0
8	**F0** as hex character	0

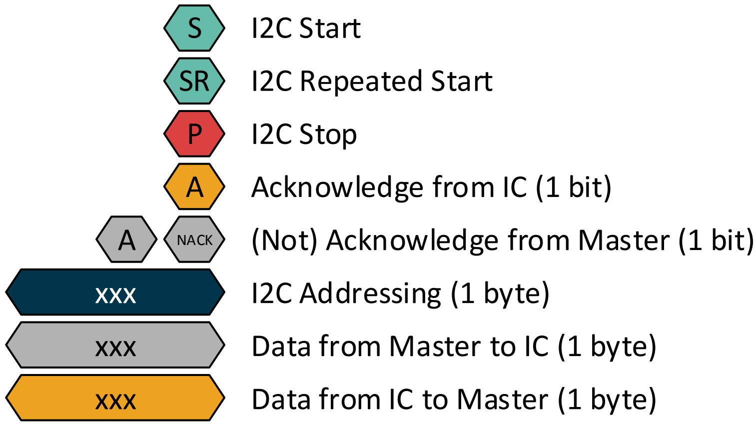
Data #	Data received	Example: Set I²C frequency to 100kHz
1	**"I2C freq now: xxxxx Hz\n"**	I2C freq now: 100000 Hz\n

Application note

MLX90392 EVB

4. Examples

In the examples, the I^{2}C communication is shown using the legend below:



4.1. Changing Filter Settings

7-bit I^{2}C address is 0x0C, this gives for reading 0x19 and for writing 0x18 as byte to send on the I^{2}C bus. The digital filters (one for XY and one for Z) for the magnetic measurements will be both set to zero.

A first step is to read the registers where the filters are stored, in order to know what the content is of the other bits in the registers. The filters are stored at register 0x14 (XY) and at register 0x15 (Z). Both will be read out with an addressed memory read command:

Setting 0x14[5:3] and 0x15[2:0] to 0 gives 0xC1 and 0xB0 as new content for registers 0x14 and 0x15 respectively:

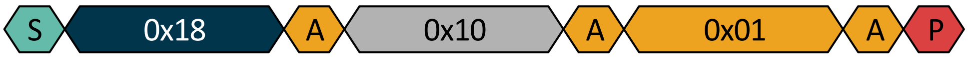
An addressed memory read is performed again to verify that the content is written:

Note that it is not written in non-volatile memory! Issuing a reset command will set the content back to the factory defaults:

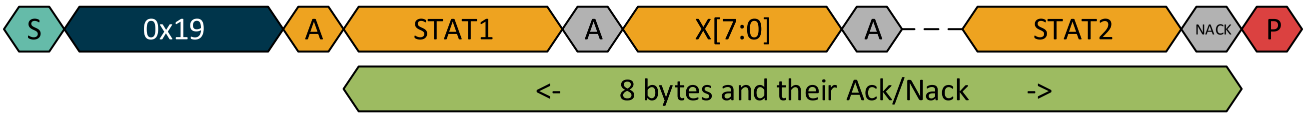
4.2. Performing a Single Measurement (XYZ)

7-bit I^{2}C address is 0x0C, this gives for reading 0x19 and for writing 0x18 as byte to send on the I^{2}C bus.

First the mode ‘1’ needs to be written into register 0x10:



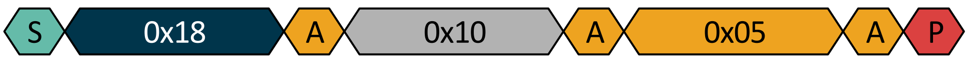
From register 0x00, the measurement data and status bytes can be read out after the measurement came to completion. A Read Direct is used here:



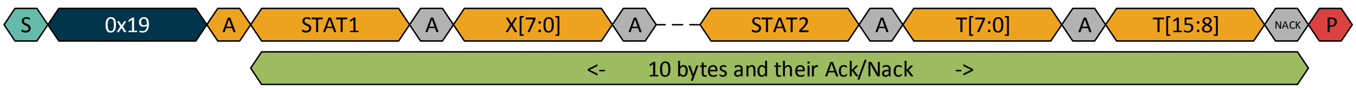
4.3. Performing a Continuous Measurement (XYZT, 100Hz), and Returning to Idle Mode

7-bit I^{2}C address is 0x0C, this gives for reading 0x19 and for writing 0x18 as byte to send on the I^{2}C bus.

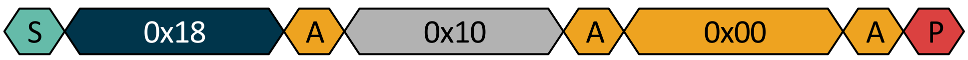
First the mode ‘5’ needs to be written into register 0x10:



From register 0x00, the measurement data and status bytes can be read out after the measurement came to completion. A Read Direct is used here. This can be done repeatedly to get new data.



To go back to idle, set the mode back to ‘0’:



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6. Revision History

Revision	Changes
001, April 2021	Creation
002, July 2021	Footnote 1: Rev2.0 of the demo code has a detection of missing bytes

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