User Manual MTi 1-series DK

Document MT0513P, Revision A, 8 Jul 2015

Features

- Easy to use Development Board
- Complete MT Software Suite
  - MT Manager logging and visualization GUI
  - SDK for Windows, Linux, embedded
  - Magnetic Field Mapper
- Full functionality
- Delivered with MTi-3-8A7G6 mounted
- API-compatible with all Xsens' Motion Trackers
  - Drivers and examples on ARM® mbed™
- USB, RS232, UART, SPI, I2C interfaces

Related Resources

- www.xsens.com/MTi-1-series
- MT Low Level Communication Protocol Documentation
- MTi 1-series Data sheet (MT0512P)
- MT Low Level Communication Protocol Documentation (MT0101P)
- MT Manager User Manual (MT0216P)
- MTi White Paper: Next generation Xsens Motion Trackers for Industrial applications

Description

The MTi 1-series Development Kit is an excellent tool to start working with the MTi 1-series. It has a pre-mounted MTi-3-8A7G6 AHRS and comes with the extensive MT Software Suite and USB-cabling. This software suite is uniform and suitable for all Xsens' products, including the high-performance MTi 100-series. This makes the MT Software Suite full-featured, with logging and visualization options, intuitive configuration windows and possibilities to export data for use in other programs. The Software Development Kit contains source code for communication and libraries for data processing.

The 24-pins header connects to all interfaces available on the MTi 1-series module. Connections with development platforms for Cortex-M processors of different brands can be made easy using the Xsens examples on the mbed.org website.

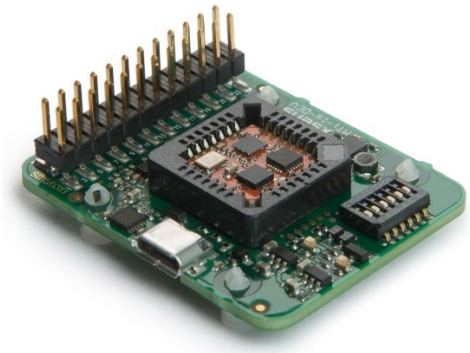


Figure 1: MTi 1-series Development Board with MTi-3-8A7G6 module

Table of Contents

1 General information

1.1 Ordering Information

Part Number	Output	Package	Packing Method
MTi-3-8A7G6-DK	Development kit for MTi 1-series, including MTi-3-8A7G6		Single unit

2 Getting started

The MTi 1-series Development Kit contains

- the Development Board with the MTi 1-series mounted;
- a micro-USB to USB-B cable;
- the MT Software Suite on a USB flash drive

The MTi Development Board has the following layout:

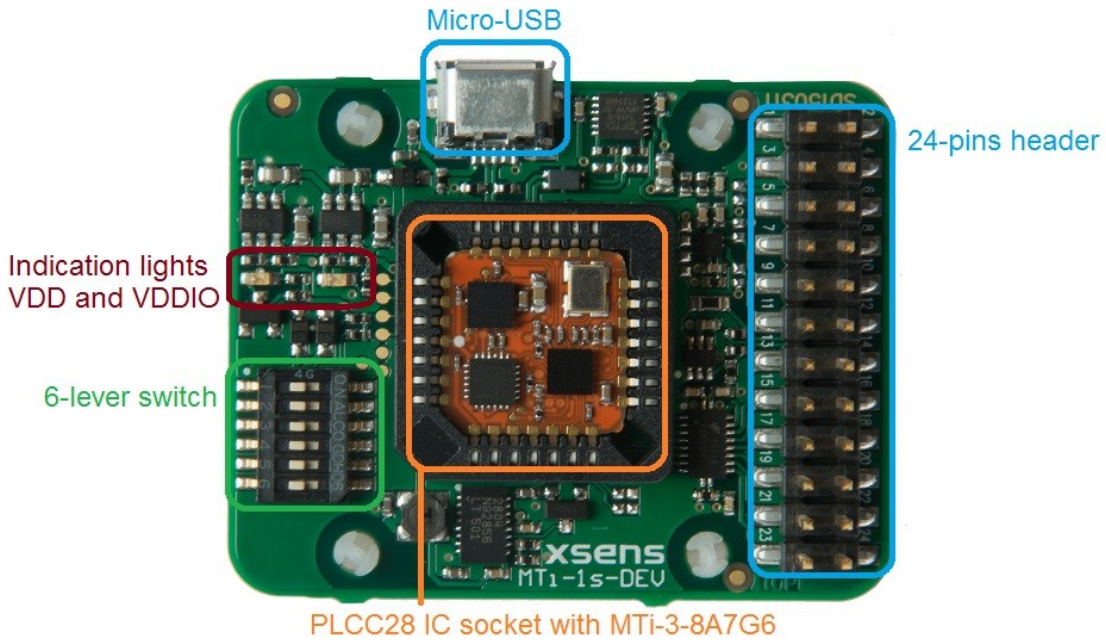


Figure 2: Top view of the MTi 1-series Development Board with the various components

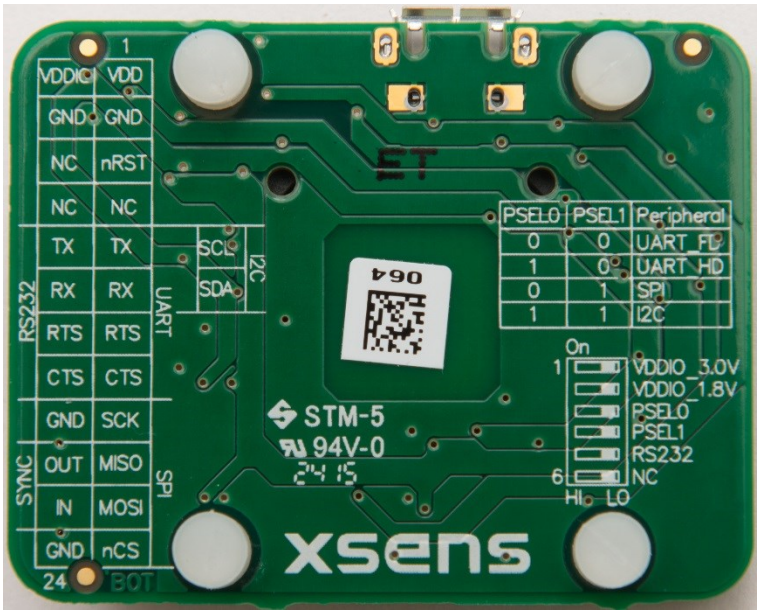


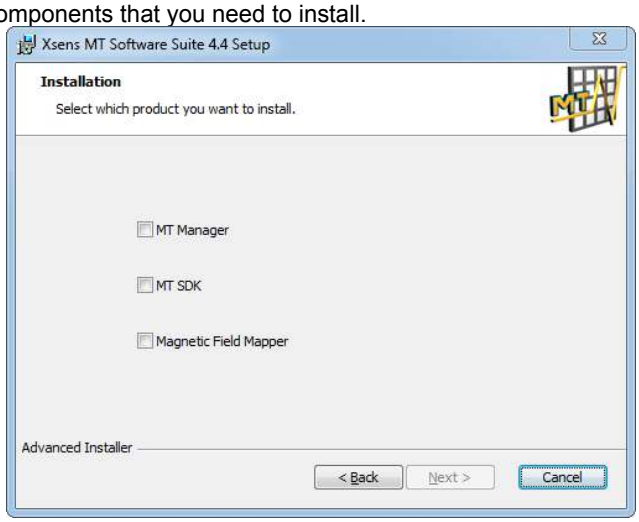
Figure 3: Bottom view of the MTi 1-series Development Board with the description of the header and switch. Text is displayed as see-through.

2.1.1 Installing MT Software Suite

The MT Software Suite is delivered on a USB flash drive in the Development Kit. The following will be installed:

The installation procedure consists of a set of several installers and starts with this screen:

It is possible to choose the components that you need to install.



When you cancel the installation of a particular component, the installer will continue with the next component. Make sure to accept the End-User License agreement and Software License Agreements

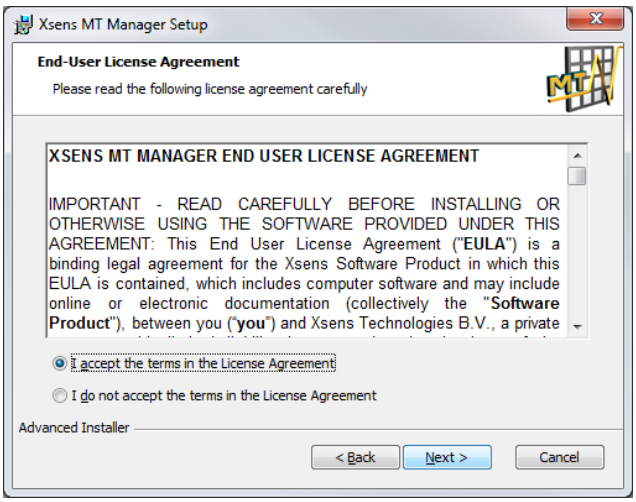


Figure 4: Xsens MT Manager EULA

2.1.2 Connecting your device to MT Manager

Connect the Development Board to your PC using the supplied USB cable. With the USB cable, the Development Board is automatically found.

Note: When you already have products from Xsens installed, there is a chance that the Development board will be incorrectly identified as a serial mouse or serial ballpoint. Navigate to the Device Manager, double-click “Motion Tracker Development Board Virtual COM” and click “Advanced” under “Port Settings”. Uncheck the box “Serial Enumerator”.

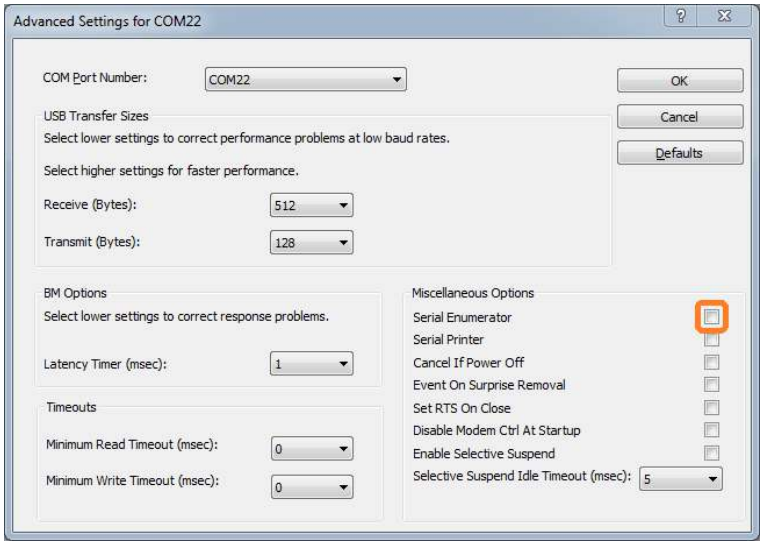
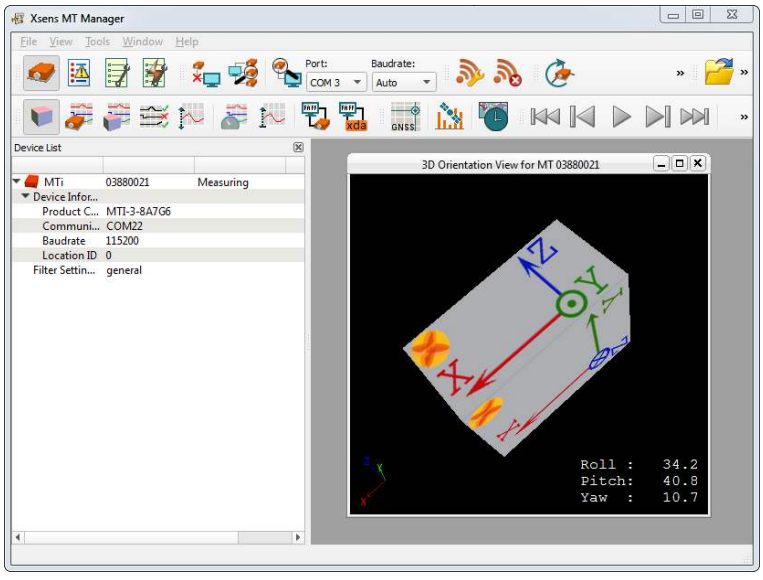
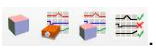


Figure 5: Serial Enumerator must be unticked for the MTi 1-series Development Board to prevent identification as a serial mouse or ballpoint

2.1.3 Displaying data in MT Manager

When the MTi Development Board is connected, click the 3D View icon:  . This will result in a 3D box representation of the MTi.



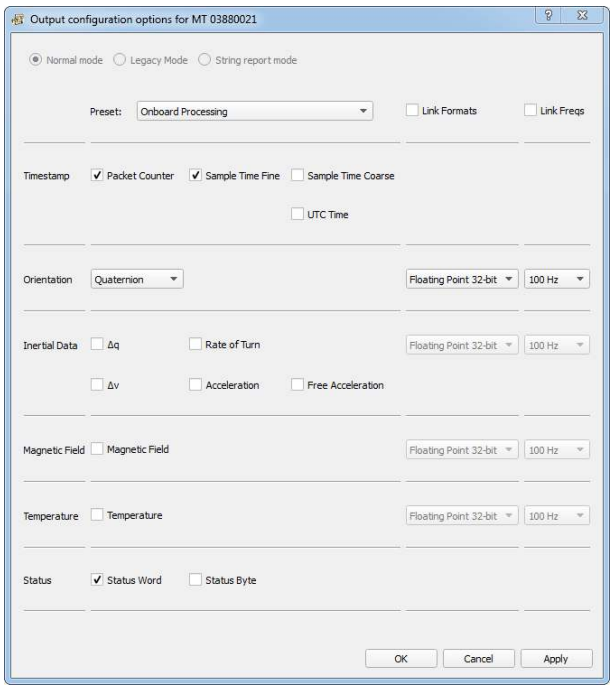
The other visualizations can be opened using the windows toolbar:  .

Refer to the MT Manager User Manual for more information on these graphs and their features. The MT Manager User Manual can be found via Help – Documentation.

2.1.4 Configuring the MTi 1-series

MT Manager is an excellent tool to configure the MTi 1-series. Click the Output Configuration button: 

The following screen appears:



By default, the output of the MTi 1-series is orientation only. Click “Inertial Data” (Δq/Δv or Rate of Turn/Acceleration) and “Magnetic Field” to be able to show this data in MT Manager.

2.1.5 Other functionality of MT Manager

With the MT Manager, it is possible to record data and export that data for use in other programs, configure synchronization options and to review the test and calibration report.

More information on the functions in MT Manager can be found in the MT Manager User Manual.

2.1.6 Embedded examples

The MTi 1-series is designed for easy integration in embedded systems. To aid in development example code is provided for the ARM mbed platform. An example implementation of the Xbus Low Level Communication Protocol is provided as generic C99 compliant source code[1], while an ARM mbed specific application demonstrates the use of the Xbus library to communicate with an MTi 1-series development kit using UART communications.

The example code has been tested with the following ARM mbed compatible boards:

- ST Nucleo F302R8 – Cortex M4
- FreeScale FRDM-KL46Z – Cortex M0+
- NXP EA LPC 4088 – Cortex M4

The example code is available at http://www.mbed.org/teams/Xsens. Documentation on how-to-use is provided on the description page and in the code. Note that these examples are provided as is and are not supported by the Xsens support team. The examples are licensed under the Apache Licence version 2.0.

Several basic commands were used, it is easy to extend the program with commands from the Xsens Low Level Communication Protocol (LLCP). This protocol is documented in detail in the MT Software Suite and in the Low Level Communication Protocol Documentation.

[1] Xbus example code is not specific to ARM processors and should be compatible with other embedded architectures.

2.1.7 Frames of reference used in MTi 1-series

The MTi 1-series uses a right-handed coordinate system as the basis of the sensor of frame.

The following data is outputted in corresponding reference coordinate systems:

Data	Symbol	Reference coordinate system
Acceleration	a_x, a_y, a_z	Sensor-fixed
Rate of turn	ω_x, ω_y, ω_z	Sensor-fixed
Magnetic field	m_x, m_y, m_z	Sensor-fixed
Free acceleration	a	Local Tangent Plane (LTP), default ENU
Velocity increment	Δv_x, Δv_y, Δv_z	Local Tangent Plane (LTP), default ENU
Orientation increment	Δq_0, Δq_1, Δq_2, Δq_3	Local Tangent Plane (LTP), default ENU
Orientation	Euler angles, quaternions or rotation matrix (DCM)	Local Tangent Plane (LTP), default ENU

Local Tangent Plane (LTP) is a local linearization of the Ellipsoidal Coordinates (Latitude, Longitude, Altitude) in the WGS-84 Ellipsoid.

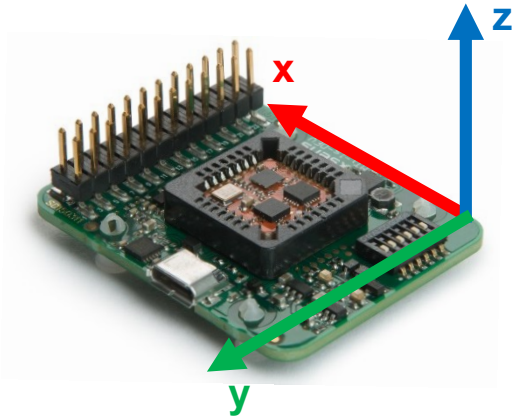


Figure 6: Default sensor fixed system for the MTi 1-series Development Board with MTi.

It is straightforward to apply a rotation matrix to the MTi, so that the velocity and orientation increments, free acceleration and the orientation output is using that coordinate frame. The default reference coordinate system is East-North-Up (ENU) and the MTi 1-series has predefined outputs for North-East-Down (NED) and North-West-Up (NWU). Any arbitrary alignment can be entered. These orientation resets have effect on all outputs that are by default outputted with an ENU reference coordinate system.

3 Package and handling

Note that this is a mechanical shock (g) sensitive device. Proper handling is required to prevent damage to the part.
Note that this is an ESD-sensitive device. Proper handling is required to prevent damage to the part.

3.1 Development Kit

The MTi 1-series is available with a development kit. An MTi-3 AHRS is mounted in a PLCC-28 socket and connects to USB, RS232, UART, I2C and SPI. The MTi-1 series DK comes with MT Manager, an intuitive GUI for Linux and Windows, example code and example applications.

The Development Board exposes the pins of the MTi-1 on an easy to use 24-pins header allowing easy connectivity during prototyping.

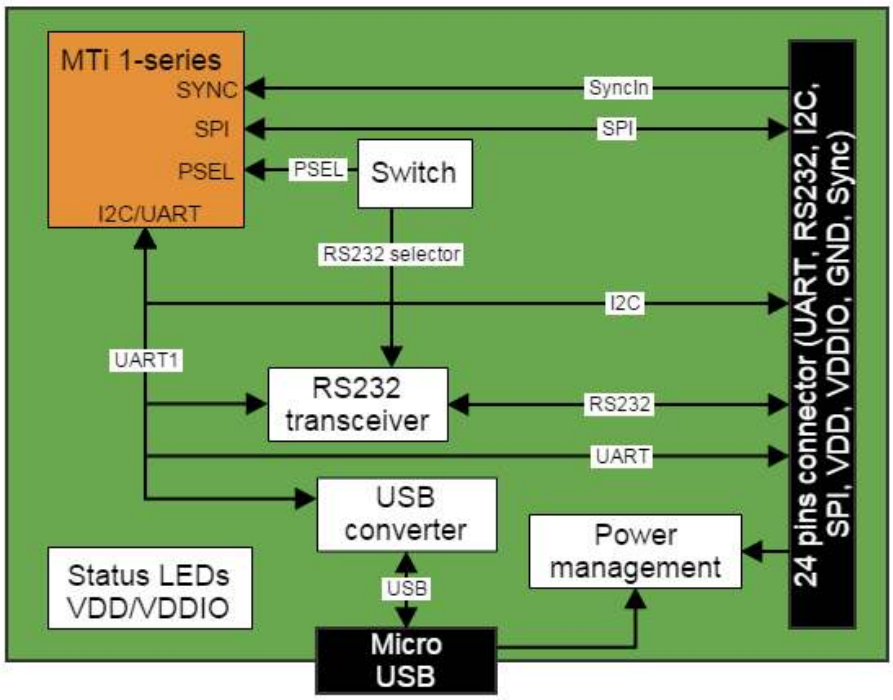


Figure 7: MTi 1-series Development Board

3.1.1 Connections and peripheral switch

The MTi Development Board has the following connections and switches:

- 24-pins dual row header with a pitch of 2.54 mm: The table below shows the connections: For information on the connections, refer to the pin description in section 3.2. Refer to Table 3 how to enable the various interfaces on the Development Board.

Table 1. Connections on 24-pins header

Pin nr			Pin nr	
1	VDD		2	VDDIO
3	GND		4	GND
5	nRST		6	NC
7	NC		8	NC
9	UART TX or I2C SCL		10	RS232-TX
11	UART RX or I2C SDA		12	RS232-RX
13	UART-RTS		14	RS232-RTS
15	UART-CTS or DRDY		16	RS232-CTS
17	SPI-SCK		18	GND
19	SPI-MISO		20	RESERVED
21	SPI-MOSI		22	SYNC_IN
23	SPI-nCS		24	GND

- Micro USB: the MTi-1 Development Board has a micro USB connection that can be used to connect directly to a USB port on a PC or laptop. To enable the communication via USB, make sure to have the peripheral selection set to UART (full duplex).
- Peripheral switch: This switch sets the interface configuration of the 12.1 x 12.1 mm module in the socket of the MTi-1 Development Board.

Table 2. Settings for switch

<table>
<tr><th>Lever nr</th><th>Description</th><th>Comments</th></tr>
<tr><td>1</td><td>VDDIO_3.0V</td><td>Sets the VDDIO of UART, SPI and I2C to 3.0V, if VDDIO is not supplied to pin nr 2 of the 24-pins connector. Setting a VDDIO, either external or with this lever, is required to properly define the voltage levels of SYNC_IN.</td></tr>
<tr><td>2</td><td>VDDIO_1.8V</td><td>Sets the VDDIO of UART, SPI and I2C to 1.8V, if VDDIO is not supplied to pin nr 2 of the 24-pins connector. When VDDIO_3.0V is selected as well, VDDIO will be 3.0V. Setting a VDDIO, either external or with this lever, is required to properly define the voltage levels of SYNC_IN.</td></tr>
<tr><td>3</td><td>PSEL0</td><td rowspan="2"><table><tr><th>PSEL0</th><th>PSEL1</th><th>Peripheral[2]</th></tr><tr><td>0</td><td>0</td><td>UART_FD</td></tr><tr><td>1</td><td>0</td><td>UART_HD</td></tr><tr><td>0</td><td>1</td><td>SPI</td></tr><tr><td>1</td><td>1</td><td>I2C</td></tr></table></td></tr>
<tr><td>4</td><td>PSEL1</td></tr>
<tr><td>5</td><td>RS232</td><td>Set this lever to 1 (high) to enable RS232 communication. Also, PSEL0 and PSEL1 must be set to UART. This lever must be set to 0 to enable I2C</td></tr>
<tr><td>6</td><td>NC</td><td>N/A</td></tr>
</table>

[2] Note that the values for the peripheral selection on the switch are inverted with respect to the values on the module

Table 3. Switch positions to enable interfaces on Development Board

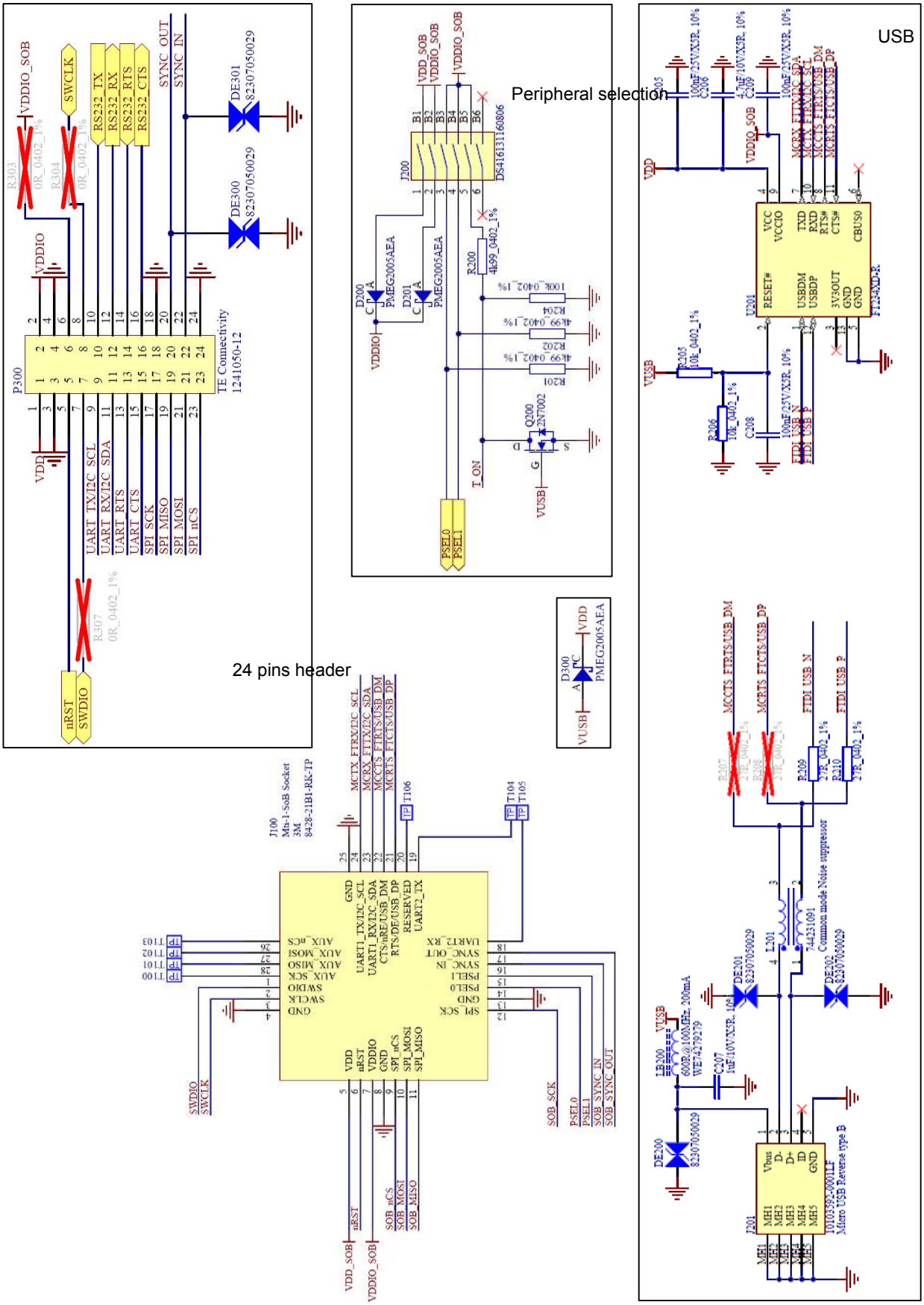
Interface	PSEL0	PSEL1	RS232	Comments
UART FD	0	0	0	When USB is detected, interface is USB
UART HD	1	0	0	
USB	0	0	0	When USB is detected, interface is USB
I2C	1	1	0	
SPI	0	1	0	
RS232	0	0	1	When USB is detected, interface is USB

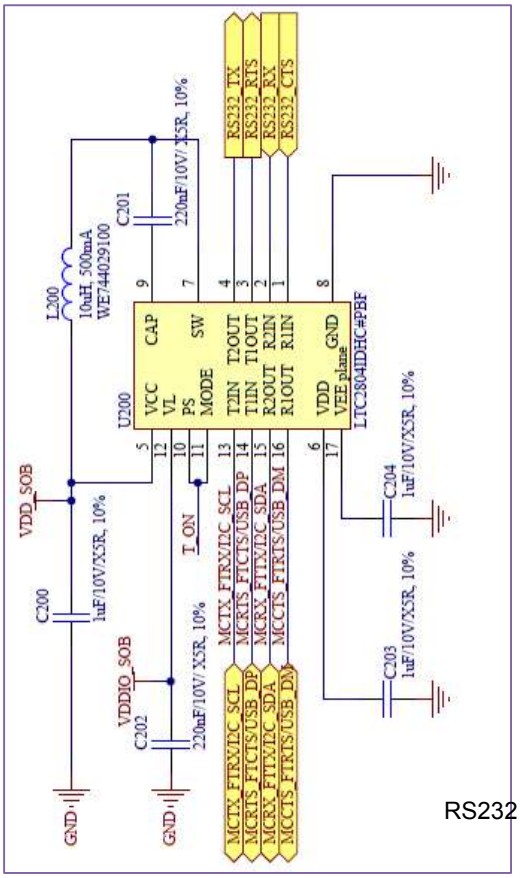
Figure 8: Switch to I²C interface and VDDIO of 3.0V

3.2 Pin Descriptions

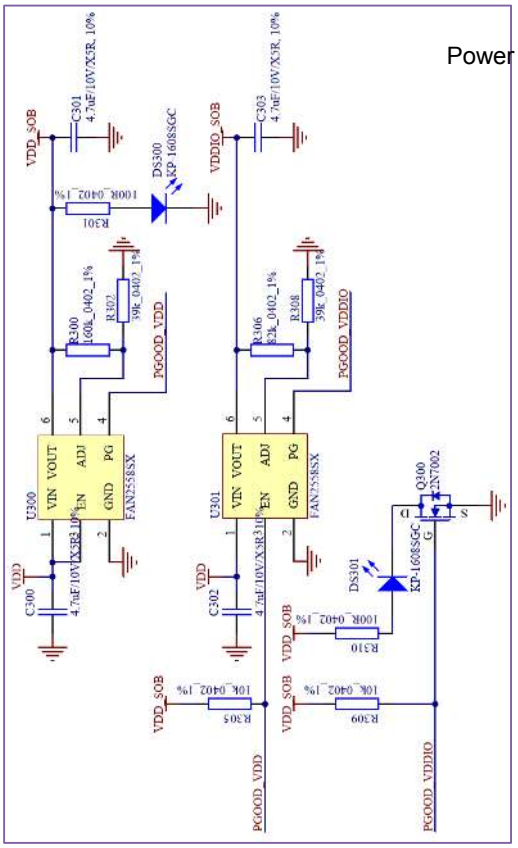
Name	Type	Description
Power Interface		
VDD	Power	Power supply voltage for sensing elements
VDDIO	Power	Digital I/O supply voltage
Controls		
PSEL0	Selection pins	These pins determine the signal interface. See table below. Note that when the PSEL0/PSEL1 is not connected, its value is 1. When PSEL0/PSEL1 is connected to GND, its value is 0
PSEL1		
nRST		Active low reset pin, connect to VDDIO if not used
Signal Interface		
I2C_SDA	I²C interface	I²C serial data
I2C_SCL		I²C serial clock
SPI_nCS	SPI interface	SPI chip select
SPI_MOSI		SPI serial data input (slave)
SPI_MISO		SPI serial data output (slave)
SPI_SCK		SPI serial clock
RTS	UART interface	Hardware flow control in UART full duplex mode (Ready-to-Send)
CTS		Hardware flow control in UART full duplex mode (Clear-to-Send)
nRE		Receiver control signal in UART half duplex mode
DE		Transmitter control signal in UART half duplex mode
UART-RX		Receiver data input
UART-TX		Transmitter data output
RS232-TX	RS232 interface	Receiver data input
RS232-RX		Transmitter data output
RS232-RTS		Hardware flow control in RS232 mode (Ready-to-Send)
RS232-CTS		Hardware flow control in RS232 mode (Clear-to-Send)
SYNC_IN	Sync interface	SYNC_IN accepts a trigger which has the following functionality, depending on the configuration set in the firmware - It sends out the latest available data message, or - It adjusts the bias of the clock onboard the MTi
DRDY	Data ready	Data ready pin indicates that data is available (SPI / I²C)

3.2.1 Schematics

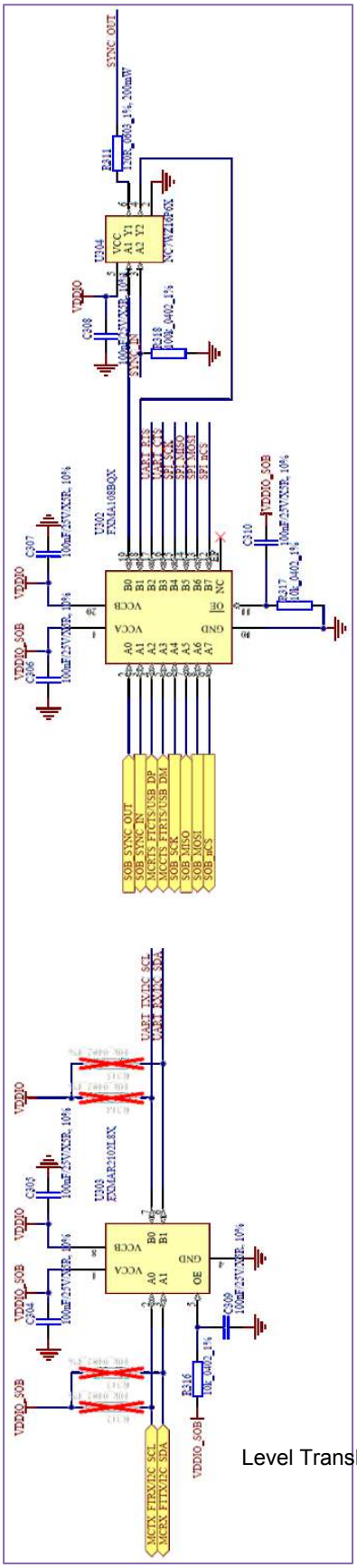




RS232



Power



Level Translators

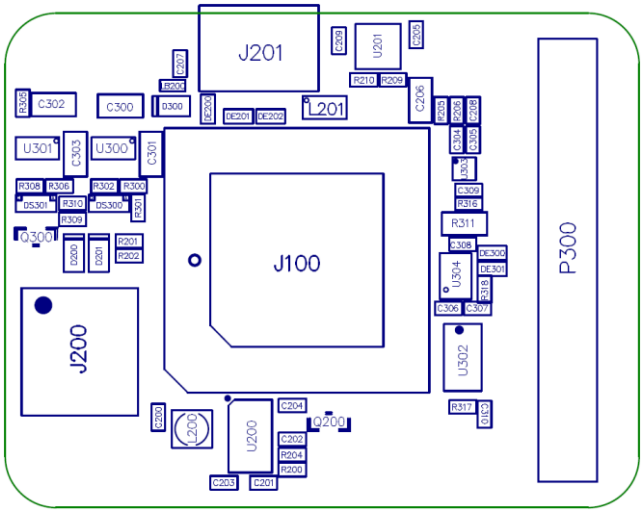


Figure 9: Physical location of components

3.2.2 Physical dimensions

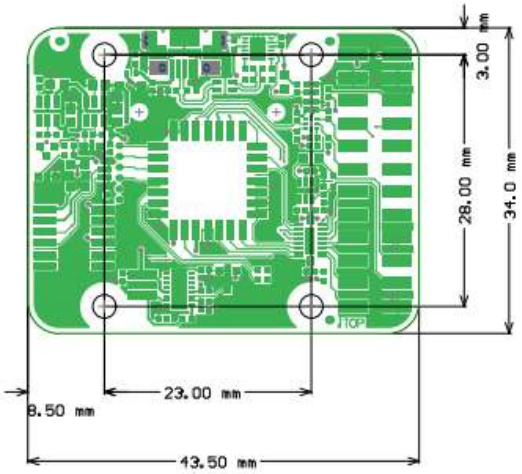


Figure 10: The outer dimensions of the MTi DEV Board. PCB spacers are placed

3.2.3 Electrical specifications

The Development Board has the same communication protocol as the MTi 1-series module. The table below shows the electrical specifications for the Development Board.

Table 4. System specifications Development Board

		Min	Typ	Max	Unit	Comments
VDD		3.3		5.5	V	
VDDIO		1.6		5.5	V	
SyncIn	V_{IH}	0.75 * VDDIO			V	
	V_{IL}			0.25 * VDDIO	V	

3.3 Absolute maximum ratings

	Min	Max	Unit	Comments
Storage temperature	-40	+125	ºC	
Operating temperature	-30	+85	ºC	
VDD	0.3	6.0	V	
VDDIO	0.3	VDD + 0.5	V	
V_{SYNC_IN}		7.0	V	
Acceleration [3]		10,000	g	Any axis, unpowered, for 0.2 ms
ESD protection[4]		±2000	V	Human body model

[3] This is a mechanical shock (g) sensitive device. Proper handling is required to prevent damage to the part.
[4] This is an ESD-sensitive device. Proper handling is required to prevent damage to the part.

4 Trademarks and revisions

4.1 Trademarks

4.2 Revisions

Revision	Date	By	Changes
A	8 July 2015	MHA	Initial release