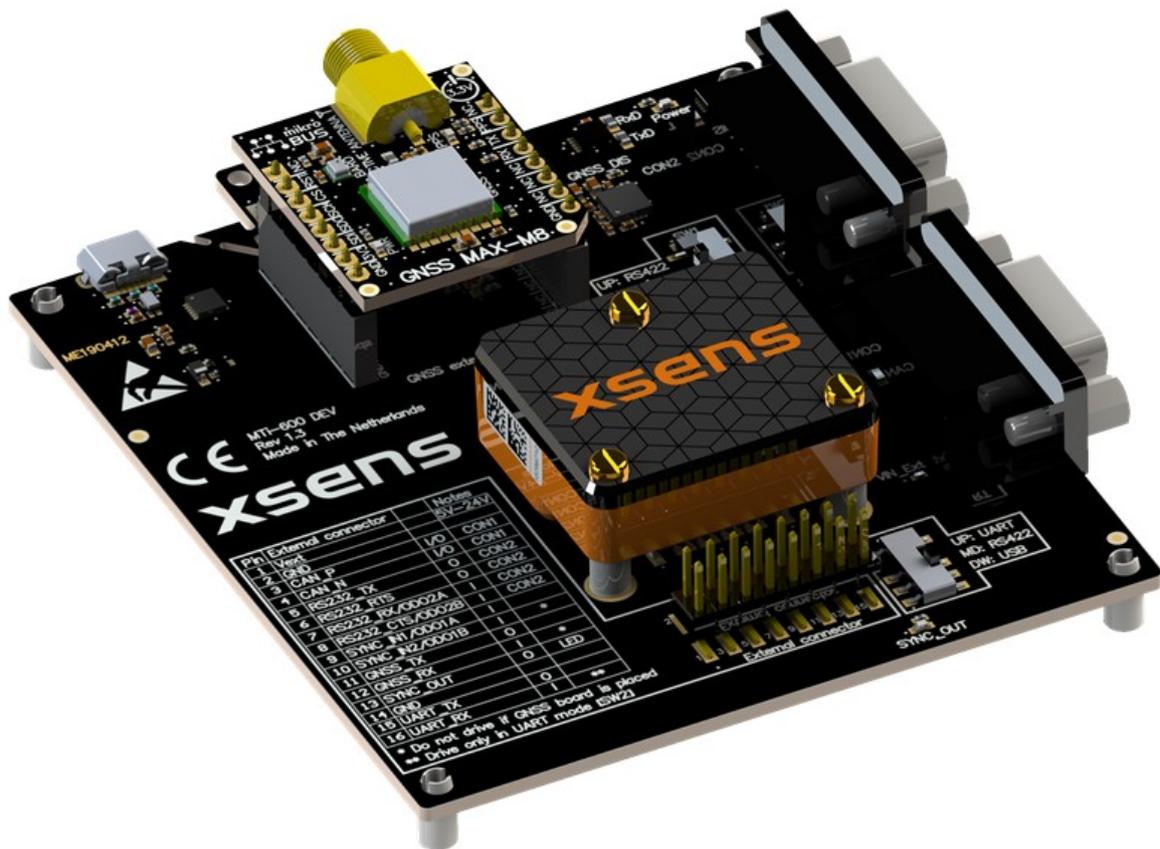# MTi 600-series Development Kit

MTi-630-DK and Mti-670-DK
User Manual

Document MT1602P, Revision A, 27 aug 2019

Revisions

Revision	Date	By	Changes
A	8 July 2019	APD	Initial release
…	…	…	…

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1 General information

This document provides information on the contents and usage of the MTi 600-series Development Kit. The MTi 600-series module (MTi-600) is a fully functional, self-contained module that is easy to design-in. The MTi-600 can be connected to a host through a CAN, RS232 or UART interface. The MTi 600-series Development Kit (MTi-600-DEV) enables users to evaluate features of the MTi-600. In addition to the MTi-600 interfaces, this Development Kit includes a USB and RS422 interface.

The *MTi 600-series Datasheet[1]* provides information on the usage and technical details of the MTi 600-series modules. The MTi 600-series module (MTi-600) is a fully functional, self-contained module that is easy to design-in. The MTi-600 module can be connected to a host through RS232, CAN or UART interfaces, or through USB using the UART to USB converter (included in the MTi 600-series Development Kit).

The *MTi Family Reference Manual[1]* supplements this document. It reports generic information on the MTi 1-series and MTi 600-series, such as output definitions, algorithm details and installation tips.

The *MTi 600-series Hardware Integration Manual[1]* supplements this document. In this document, notes on typical application scenarios, printed circuit board (PCB) layout, origin of measurement reference system, stress related considerations, reference designs and handling information can be found.

The *MT Low Level Communication Protocol[1]* document provides a complete reference for the protocols used to communicate with Xsens Motion Trackers on low-level basis. The MT Low Level Communication Protocol document also describes the synchronization messages and settings in detail.

Table 1 summarizes all available official documents for the Xsens MTi product line.

Table 1: MTi product documentation overview

MTi 1-series	MTi 600-series	MTi 10/100-series
MTi Family Reference Manual		
MTi 1-series Datasheet	MTi 600-series Datasheet	MTi User Manual
MTi 1-series DK User Manual	MTi 600-series DK User Manual	
MTi 1-series HW Integration Manual	MTi 600-series HW Integration Manual	
	MT CAN Protocol Docomentation	
MT Manager Manual		
Magnetic Calibration Manual		
MT Low Level Communication Protocol Documentation		
Firmware Updater User Manual		

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[1] Links to the latest available documentation can be found via the following link: Xsens MTi Documentation

1.1 Package information

Table 2: Package contents for MTi 600-series Development Kit

Component	Name
	MTi-600 Development Board including USB to UART converter
	MTi 600-series module
	3x M2 x 12 mm brass screws

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	GNSS daughter card[2]
	GNSS antenna[2]
	Micro USB cable
	Ribbon cable

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[2] Only with MTi-670-DK

1.2 Ordering information

Table 3: Ordering information for MTi 600-series Development Kit

Kit	Description	Package contents	Packing Method
MTi-630-DK	Development Kit for MTi-630 AHRS	- MTi-600-series Development Board (incl. USB to UART converter) - MTi-630 AHRS module - 3x M2 x 12 mm brass screws - USB cable	Single unit
MTi-670-DK	Development Kit for MTi-670 (GNSS/INS)	- MTi-600 series Development Board (incl. USB to UART converter) - MTi-670 GNSS/INS module - 3x M2 x 12 mm brass screws - GNSS daughter card - GNSS antenna - USB cable	Single unit

Note: Development Kits for the MTi-610-IMU and MTi-620-VRU are not available. Instead, the MTi-630-DK can be used for testing purposes as it covers all functionality of the MTi-610 IMU and MTi-620 VRU.

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2 Introduction

2.1 Development Board contents and features
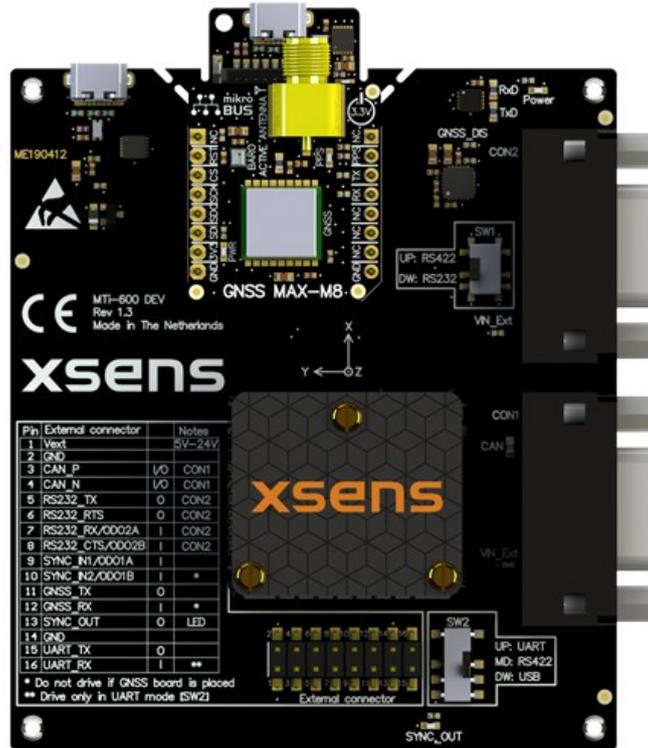
Figure 1: Top view of an assembled MTi-670-DK

Figure 1 shows an assembled MTi-670-DEV with the MTi-670 and the GNSS daughter card. The hardware features of the Development Board include:

- Main connector for the MTi-600
- External connector, providing access to the individual pins of the MTi-670 main connector
- Two DSUB9 connectors for CAN and RS232/RS422 respectively
- Micro USB connector
- Peripheral interface switches (SW1 and SW2)
- Power indicator LED
- SYNC_OUT indicator LED
- Separable USB to UART converter board

See Section 4 for more details regarding the interfaces and their electrical specifications.

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2.2 Software and documentation

The MTi-600 series Development Kit is supported by the MT Software Suite, which includes the following software components:

- MT Manager
- Magnetic Field Mapper
- MT SDK including programming examples and documentation

Additionally, the latest firmware for the MTi-600 can be downloaded and updated using the Firmware Updater which is separately available.

All software components can be downloaded from the Xsens website – www.xsens.com.

Along with the SDK documentation that is part of the MT Software Suite installer package, the MTi-600 series Development Kit is supported by the following additional documents[3], see also Table 1

- MTi Family Reference Manual
- MTi 600-series Hardware Integration Manual
- MTi 600-series Datasheet
- MT Low Level Communication Protocol Documentation
- MT Manager User Manual
- MT Magnetic Calibration Manual

2.2.1 Programming examples

Inside the MT SDK folder of the MT Software Suite, programming examples can be found for various programming languages, including C++, C#, Python and Matlab. A ROS node is also available. These examples are based on the (open source) Xsens Device API (XDA). For more information and a complete overview, refer to the following article:
https://base.xsens.com/hc/en-us/articles/360032347394

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[3] The latest available documentation can be found via the following link: *https://xsens.com/xsens-mti-documentation*

3 Getting started

3.1 Setting up the Development Kit

Before testing the MTi-600 Development Kit, the MTi-600 needs to be installed onto the MTi-600 DEV. Place the MTi-600 onto the socket between the spacers. Secure the MTi-600 by screwing the three M2 brass screws in the spacers.

For the MTi-670-DK the GNSS daughter card is already installed on the MTi-600 DEV. To use the GNSS receiver, the included GNSS antenna needs to be connected to the SMA connector of the GNSS daughter card.

For using the UART to USB breakout board, refer to section 5.

3.2 Installing MT Software Suite

The MT Software Suite is available from the Xsens website (www.xsens.com/mt-software-suite).

The installation procedure consists of a set of several installers and starts with the GUI as shown in Figure 2.

Figure 2: Start up screen for the MT Software Suite installer

It is possible to choose the components that you need to install (Figure 3).

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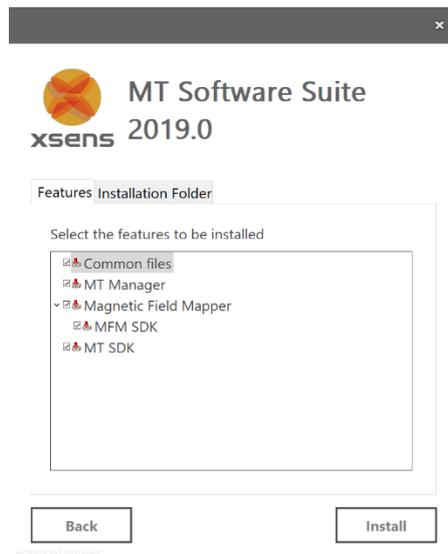
Figure 3: Software components installation

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, and then wait for the successful installation screen to appear as shown in Figure 4.

Figure 4: Successful installation screen

3.3   Displaying data in MT Manager

When the MTi 600-series Development Board is connected in MT Manager, the device description is shown in the "Device List" on the left side of the screen (Figure 5). To see a real time 3D visualization of the orientation of the MTi, click the 3D View icon . The inertial data , orientation data in Euler angles and the status data can be visualized by clicking their respective icons. In order to open these windows, the corresponding data outputs of the MTi need to be configured. Otherwise, the window icons will be grey.
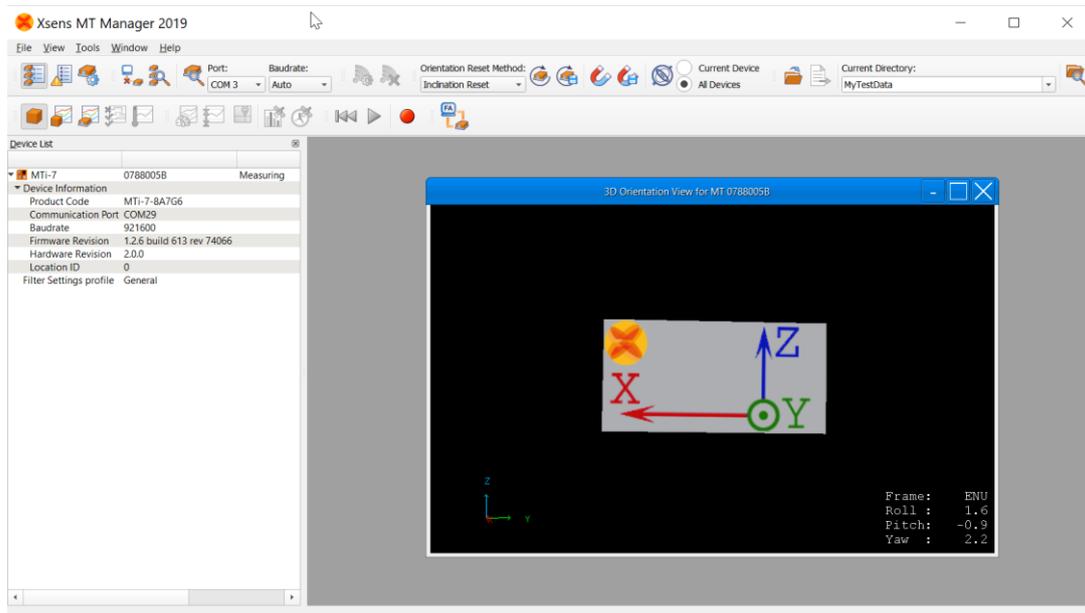
Figure 5: MT Manager overview

3.4 Configuring the MTi 600-series

The MTi 600-series can be directly configured by means of MT Manager. Click the Device Settings button ![icon] to open the Output Configuration dialog (Figure 6).

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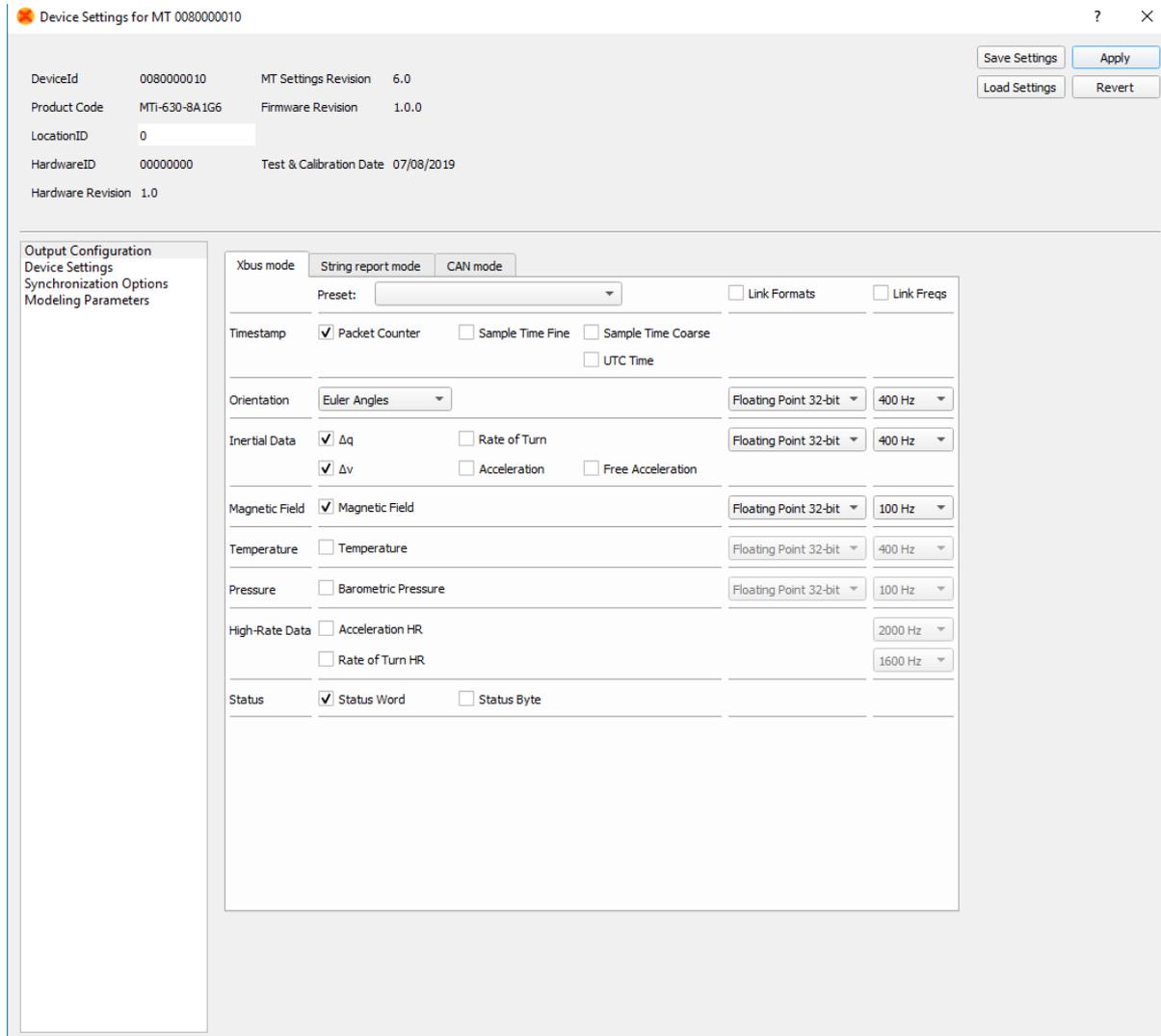
Figure 6: Output configuration dialog in MT Manager using an MTi-600-DK

By default, the output of the MTi-600 is set to the 'Onboard Processing' preset, Click "Inertial Data" (Δq/Δv or Rate of Turn/Acceleration) and "Magnetic Field" to be able to show this data in MT Manager.

With MT Manager, it is possible to record data and export that data for use in other programs, set alignment matrices, configure synchronization options and to review the test and calibration report. More information on the functions and features can be found in the MT Manager User Manual. The MT Manager User Manual can be found via Help –> Documentation.

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4 Development board

The MTi 600-series Development Board (MTi-600 DEV) exposes the pins of the MTi-600 on the *External connector,* a 2.54 mm pitch header, making it easier for the user to test all the features and the peripherals offered by the MTi-600. Next to that, the MTi-600 DEV has a micro USB connector and two *DSUB9* connectors for testing different communication protocols. It also includes a mikroBUS™ compatible *GNSS extension socket* to connect a GNSS module for the MTi-670-DK. This chapter discusses in more detail the connections and peripherals available on the MTi-600 DEV.

4.1 Overview

The MTi-600 DEV has the following connections as shown in Figure 7:
- *External connector*.
- Main connector for the MTi-600.
- *DSUB9* female connector 1 for CAN interface.
- *DSUB9* female connector 2 for RS232 or RS422 interface.
- *Micro USB connector*.
- Peripheral selection switches (*SW1* & *SW2*).
- *GNSS extension socket* (*P100* and *P200* female sockets).
- Zero-Ohm resistor positions for disabling the GNSS UART and enabling VIN_Ext.
- 120-Ohm termination resistors for CAN and RS422.
- UART to USB breakout board.
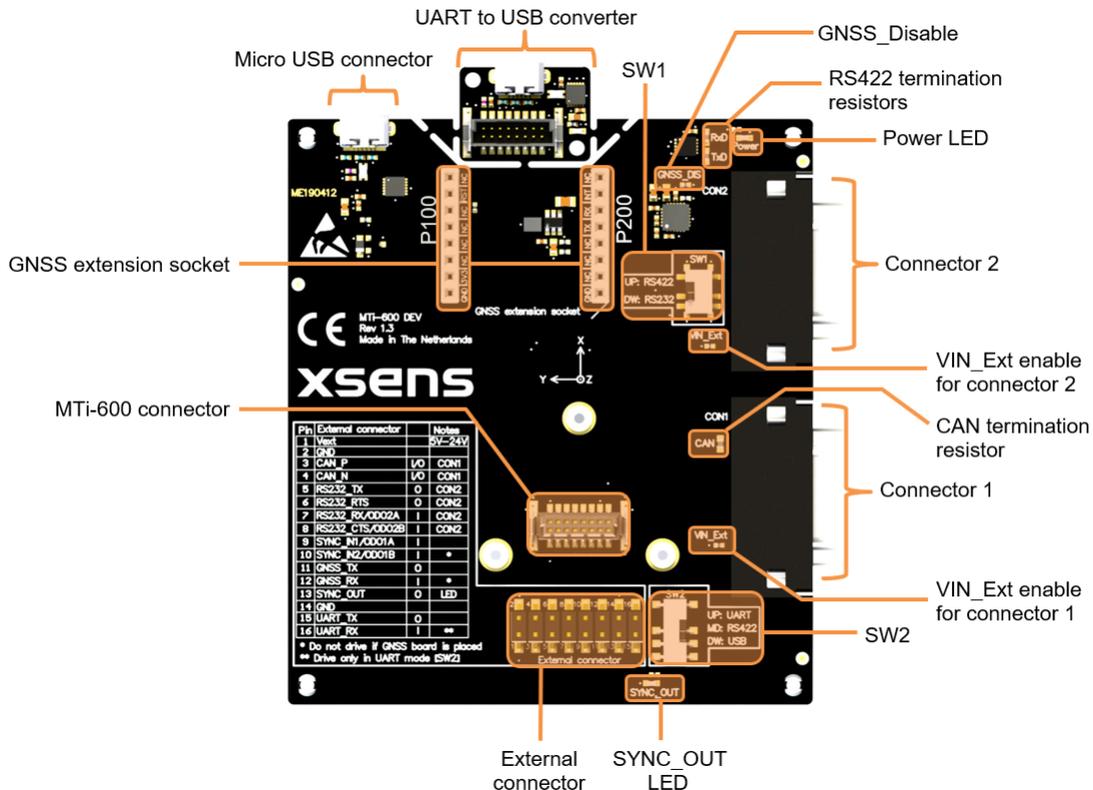
Figure 7: MTi 600-series Development Board overview with connector designators

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4.2 External Connector

The External Connector makes all of the MTi-600 pins available on a 2.54 mm pitch header. The pin numbering is an exact copy of the MTi-600 pinning itself. All pins have a direct connection to the MTi-600 except for pin 1 (Vext). Pin 1 is connected though a diode and can only be used to power the MTi-600 (not for monitoring). The pinning can be seen in Table 4.

Table 4: Pin descriptions of External Connector

Pin	Name	I/O	Description
1	Vext	PWR	Power input
2	GND	PWR	Ground
3	CAN_H	I/O	CAN bus differential low side
4	CAN_L	I/O	CAN bus differential high side
5	RS232_TxD	O	RS232 transmitter output to host
6	RS232_RTS	O	RS232 Ready To Send output to host
7	RS232_RxD	I	RS232 receiver input from host
8	RS232_CTS	I	RS232 Clear To Send input from host
9	SYNC_IN1	I	Multifunctional synchronization input
10	SYNC_IN2	I	Multifunctional synchronization input
11	GNSS_TxD	O	RS232 transmitter output to GNSS module
12	GNSS_RxD	I	RS232 receiver input from GNSS module
13	SYNC_OUT	O	Configurable synchronization output
14	GND	PWR	Ground
15	UART_TxD	O	UART transmitter output
16	UART_RxD	I	UART receiver input

4.3 Power

The MTi-600-DK can be supplied by USB or through the External Connector. In case the External Connector is used to power the board, the USB power will be disconnected from the MTi-600. Additionally, pin 9 of both DSUB9 connectors can be connected directly to pin 1 (Vext) of the External connector by placing the corresponding zero-Ohm resistor.

⚠️ **The DSUB9 VIN_Ext pins are directly connected to pin 1 of the External connector when the zero-Ohms resistors are placed. Do not supply power to more than one of these pins at the same time!**

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4.4 Host connections

4.4.1 USB

The micro USB port on the main board can be used to connect the MTi-600 to a host though the included micro USB cable. The USB device requires the drivers that are automatically included when downloading the MT Software Suite. Table 5 shows the required switch configuration for this connection.

Table 5: Switch configuration USB

Switch	Position
SW1	-
SW2	Down (default)

4.4.2 CAN

Connector 1 can be used to connect a CAN bus to the MTi-600 with a DSUB9 connector. Table 6 shows the pinning of this connector. The DSUB9 connector connects directly to the MTi-600 without relying on any switch. The CAN bus interface includes a 120 Ohm termination resistor on the MTi-600 DEV.
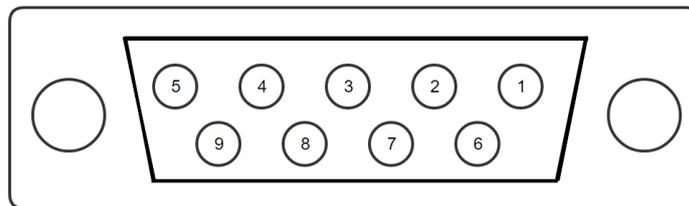
Figure 8: Pin out of DSUB9 connector CAN

Table 6: DSUB9 connector 1 pinning for CAN

Pin	Name	Description
2	CAN_L	CAN bus differential low side
3	GND	Ground
5	GND	Ground
7	CAN_H	CAN bus differential high side
9	VIN_Ext	Supply input (requires zero-Ohm resistor)

4.4.3 RS232

Switch SW1 needs to be set in the downward position to enable the RS232 connections on DSUB9 connector 2. Table 7 shows the pinning of DSUB9 connector 2 if the RS232 interface is enabled.
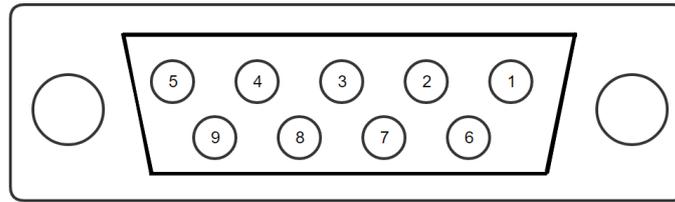
Figure 9: Pin out of DSUB9 connector RS232

Table 7: DSUB9 connector 2 pinning for RS232

Pin	Name	Description
2	RS232_TxD	RS232 transmitter output to host
3	RS232_RxD	RS232 receiver input from host
5	GND	Ground
7	RS232_CTS	RS232 Clear To Send input from host
8	RS232_RTS	RS232 Ready To Send output to host
9	VIN_Ext	Supply input (requires zero-Ohm resistor)

Table 8: Switch configuration for enabling RS232

Switch	Position
SW1	Down (default)
SW2	-

4.4.4 RS422

To activate the RS422 interface, switch SW1 should be in the upward position and switch SW2 in the middle position. Table 9 shows the pinning of DSUB9 connector 2 if the RS422 connections are enabled. The RS422 interface includes a 120 Ohm termination resistor on both the RxD and TxD lines.

Table 9: Connector 2 pinning for RS422

Pin	Name	Description
1	RS422_RxD-	RS422 negative receiver input from host
2	RS422_RxD+	RS422 positive receiver input from host
3	RS422_TxD+	RS422 positive transmitter output to host
4	RS422_TxD-	RS422 negative transmitter output to host
5	GND	Ground
9	VIN_Ext	Supply input (requires zero-Ohm resistor)

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Table 10: Switch configuration for enabling USB

Switch	Position
SW1	Up
SW2	Mid

4.4.5 UART

To be able to use the UART pins on the External Connector, switch SW2 needs to be set in the upward position. This will ensure that the UART_RxD is not controlled by any of the transceivers of the MTi-600 DEV. The UART_TxD will still transmit over USB and RS422 (when enabled), allowingto monitor the MTi-600 output. The UART pinning on the External Connector can be seen in Table 4.

Table 11: Switch configuration for enabling UART

Switch	Position
SW1	-
SW2	Up

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4.5 External GNSS extension socket and daughter card (MTi-670 DK only)

The MTi-670-DK comes with the GNSS daughter card installed in the *GNSS extension socket*. As shown in Figure 10**Error! Reference source not found.**, the GNSS daughter card consists of a GNSS receiver and a barometer sensor component. The barometer is not used/connected for the MTi-670-DK, since the MTi-600 has an internal barometer. The LEDs (Power and PPS) give indication of proper functioning of the GNSS daughter card. The supplied GNSS antenna can be connected to the SMA connector.

The MTi-600 DEV board translates the RS232 signal levels from the MTi-600 to the 3V3 UART levels used on the extension board. This transceiver can be disabled by placing a zero-Ohm resistor on the *GNSS_Disable* resistor position (see Figure 7). In this case the GNSS pins on the *External connector* can be used to connect a RS232 level enabled GNSS receiver.
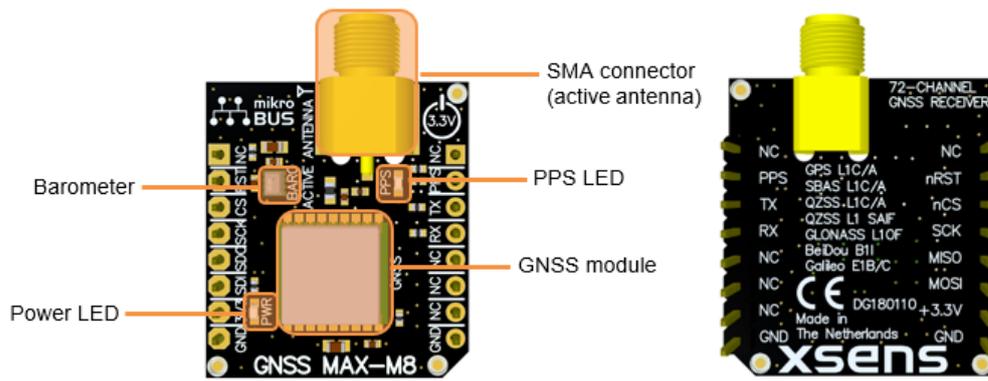

Figure 10: Top view (left) and the bottom view (right) of the GNSS daughter card

The *GNSS extension socket* has mikroBUS™ compatible pinning. This enables the user to connect alternate GNSS daughter card modules with mikroBUS™ pinning to the MTi-600-DEV. The pinning connections for the *GNSS extension socket* are listed in Table 12. This extension only uses the 3.3V supply pin, which is connected to the 3V3 that is generated on the MTi-600 DEV.

Table 12: Connections on UART communication GNSS extension sockets.

Pin	Mikro BUS	MTi-670	Pin	Mikro BUS	MTi-670
P100-1	AN	NC	P200-1	PWM	NC
P100-2	RST	Pull-up	P200-2	INT	CLK_SYNC
P100-3	CS	NC	P200-3	TX	RxD
P100-4	SCK	NC	P200-4	RX	TxD
P100-5	MISO	NC	P200-5	SCL	NC
P100-6	MOSI	NC	P200-6	SDA	NC
P100-7	3.3V	3V3	P200-7	5V	NC
P100-8	GND	GND	P200-8	GND	GND

4.6 Electrical specifications

Table 13: MTi-600 DEV power supply specifications

	Min	Typ	Max	Unit
V_{USB}	4.5	5	5.5	V
V_{ext}	4.5	-	24	V

4.7 Absolute maximum ratings

Table 14: Absolute maximum ratings MTi-600 DEV

Parameter	Min	Max	Unit	Comments
Operating temperature	-40	+85	ºC	
V_{ext}	-0.3	30	V	Power input on *External connector* or *DSUB9* connectors
V_{USB}	-0.3	6.0	V	USB power input
V_{UART}	-0.3	3.6	V	
$V_{RS232/SYNC}$	-25	25	V	
V_{RS422}	-15	15	V	
V_{CAN_DC}	-58	58	V	Common mode voltage of CAN_H and CAN_L with respect to ground
V_{CAN_DIFF}	-17	17	V	Differential voltage between CAN_H and CAN_L
Acceleration[4]		10,000	g	Any axis, unpowered, for 0.2 ms
ESD protection[5]		±2000	V	Human body model

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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

5 Standalone Configuration

The MTi-600 DEV includes a UART to USB breakout board that can be used for a minimalistic connection to a host through the supplied ribbon cable. This board can be separated from the main MTi-600 DEV board by breaking it off gently. With this board the MTi-600 can be mounted up-side-down, with the connector facing up, onto any surface by using the mounting holes of the MTi-600. The location of the MTi-600 mounting holes can be found in the *MTi 600-series Datasheet*[6] or *MTi 600-series Hardware Integration Manual*[6].

The UART to USB breakout board uses the 5V power supply of the USB to power the MTi-600 and the UART pins of the MTi-600 for communication.

5.1 UART to USB board drawing

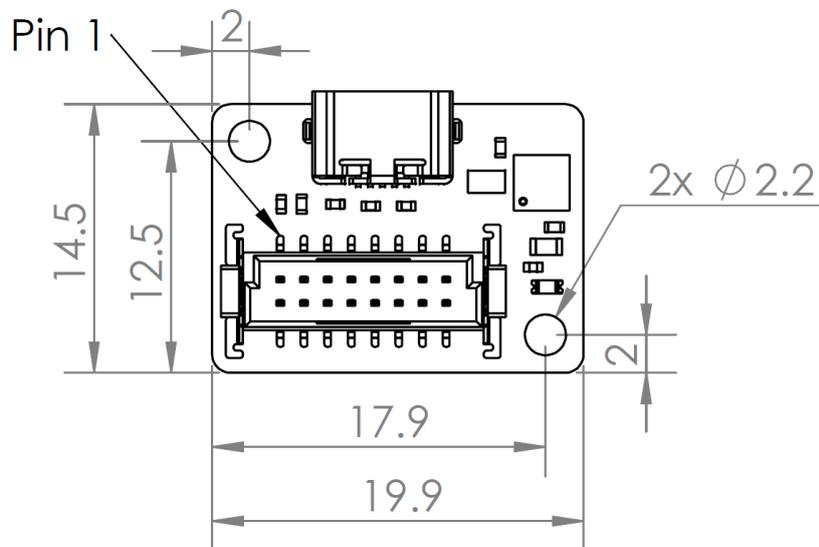Figure 11 shows the dimensions of the UART to USB breakout board together with its mounting holes.

Figure 11: UART to USB converter.

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