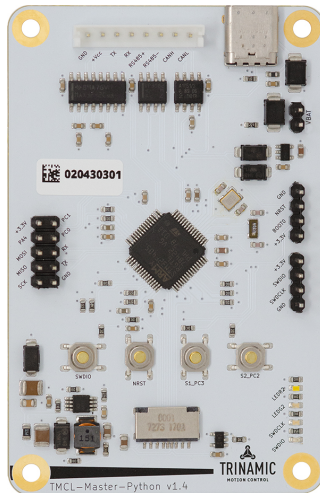


## TMCM-0960-MotionPy

Document Revision V1.00 • 2020-10-23

The **TMCM-0960-MotionPy board** is a single board computer running MicroPython. It comes with several communication interface options like CAN, RS485, UART, and separate GPIO headers. With a wide supply voltage range of +6...+50V and industrial Fieldbus interfaces it is the engineers' swiss-army-knife for small automation applications.



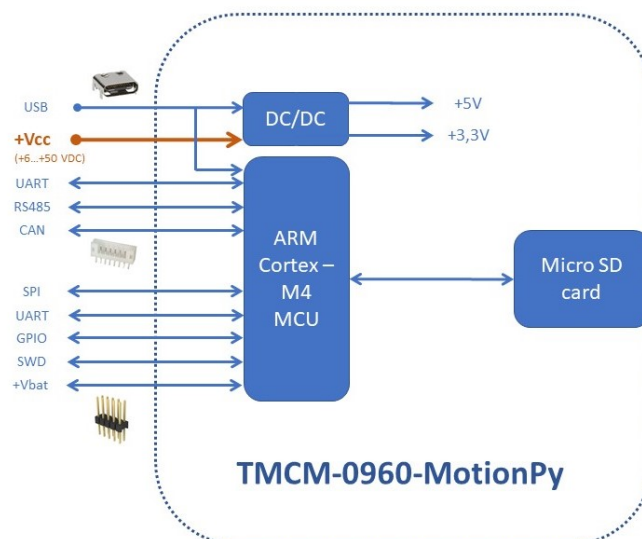
### Features

- Board supply voltage: +6V to +50V
- Screw terminals and standard connectors
- CAN, RS485, UART Interfaces
- Connectors and headers for GPIOs
- CAD design files available for download on [www.trinamic.com](http://www.trinamic.com)
- Software projects available on Github: [www.github.com](http://www.github.com)

### Applications

- Laboratory Automation
- Semiconductor Handling
- Factory Automation
- Drives
- Robotics

### Simplified Block Diagram



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# 1 Getting Started

## You need

- TMCM-0960-MotionPy
- Regulated Power Supply for nominal +24 VDC
- Latest [TMCL-IDE](#)
- For TMCL and CAN firmware versions: USB-2-RS485 adapter or CAN adapters

## Precautions

- Do not mix up signals or short-circuit pins.
- Do not exceed the maximum rated supply supply voltage!
- **Start with power supply off!**

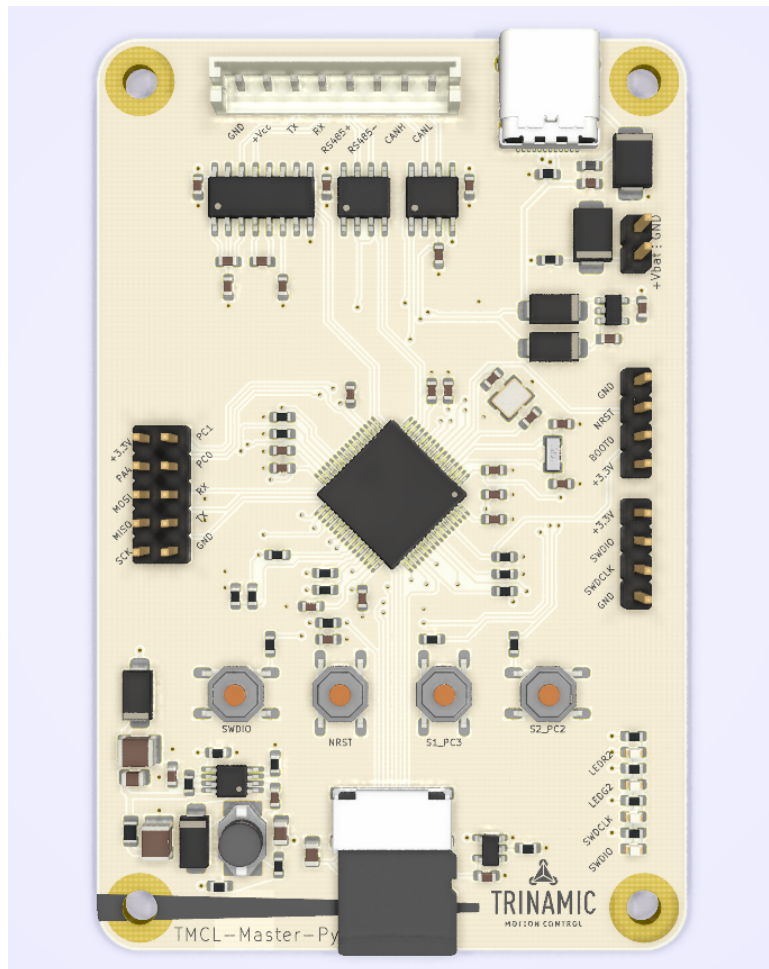


Figure 1: TMCM-0960-MotionPy Evaluation board

### NOTICE

Both supplies (motor supply and logic supply) must be connected. They can be driven by the same source.



## 2 Connectors and LEDs

Figure 5 top view of the TMCM-0960-MotionPy shows the main connector JST-PH with Power input (+Vcc) and UART, RS485, CAN communication interfaces (marked light blue), GPIO signal pin headers (marked green, red, pink) and Realtime Clock power source (+Vbat) 2pin header (marked gray).

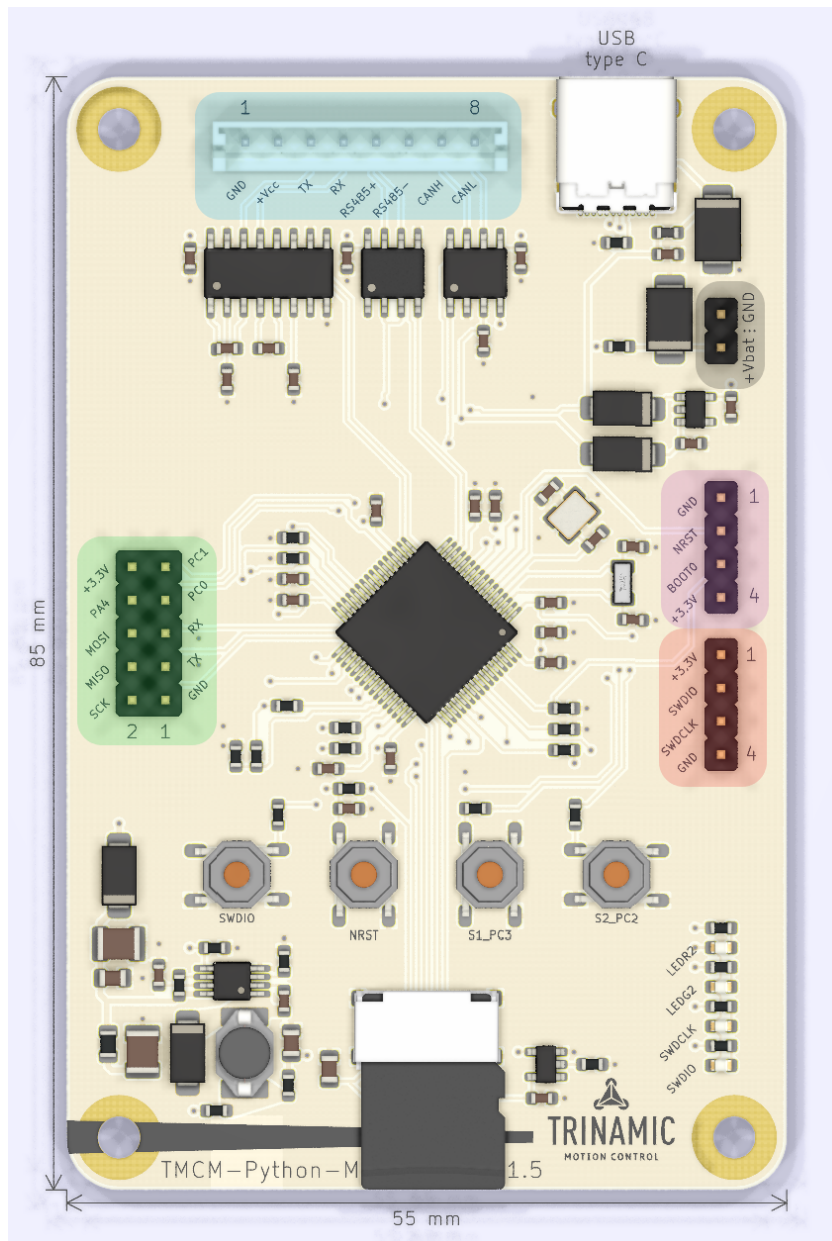


Figure 2: Top view of TMCM-0960-MotionPy

Each connector has a small individual signal name marked in the silkscreen of the board , right next to the respective connectors' pin.



## 2.1 Power supply and Communication Interface Connector

Connector Types and Mating Connectors		
Connector	Connector type on-board	Mating connector type
Power/Comms	JST B8B-PH-K-S (JST PH series, 8pins, 2mm pitch)	Connector housing: JST PHR-8 Contacts: JST SPH-002T-P0.5S Wire: 0.22mm <sup>2</sup> , AWG 24
USB-C	USB-C female connector	USB-C male connector

Table 1: Connector Types and Mating Connectors of the TMCM-0960-MotionPy

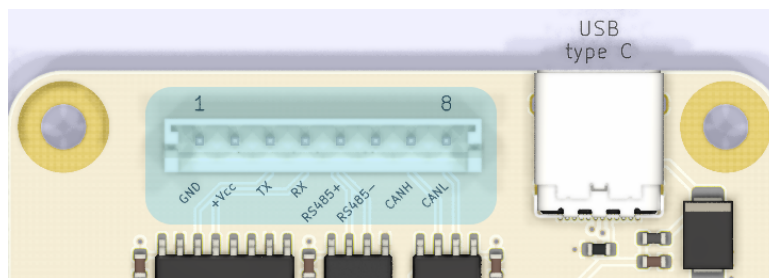


Figure 3: Power/Communication and USB-C connectors of TMCM-0960-MotionPy

Power/Communication Connector Pin Assignment			
Pin no.	Pin name	Level	Description
1	GND	Power (GND)	Supply and signal ground connection
2	+Vcc	Supply	Supply voltage input (+6V to +50 VDC)
3	UART TX	+3.3 VDC	Serial comm. transmitting signal
4	UART RX	+3.3 VDC	Serial comm. receiving signal
5	RS485+	+3.3 VDC	Bidirectional diff. RS485 bus signal (non-inverting)
6	RS485-	+3.3 VDC	Bidirectional diff. RS485 bus signal (inverting)
7	CAN_H	+3.3 VDC	Bidirectional diff. CAN bus signal (non-inverting)
8	CAN_L	+3.3 VDC	Bidirectional diff. CAN bus signal (inverting)

Table 2: TMCM-0960-MotionPy Power supply and Communication Interface connector pin assignment

### NOTICE

**Always keep the power supply voltage below the upper limit of 50V!** Otherwise the driver electronics will be seriously damaged. Especially, when the selected operating voltage is near the upper limit a regulated power supply is highly recommended.



## 2.2 GPIO Connectors

The TMCM-0960-MotionPy offers three separated input/output headers, directly connected to the MCU (STM32F405RGT6). On the left side of the board, from 2x5pin header (green) - direct SPI and serial interfaces, plus three GPIO options. On the right side of the board, from two 1x4pin headers (pink / red) - MCU direct reset and boot, plus software-set digital input/output and clock signals. In addition, from the 1x2pin header - Supply for the MCU Real-Time Clock.

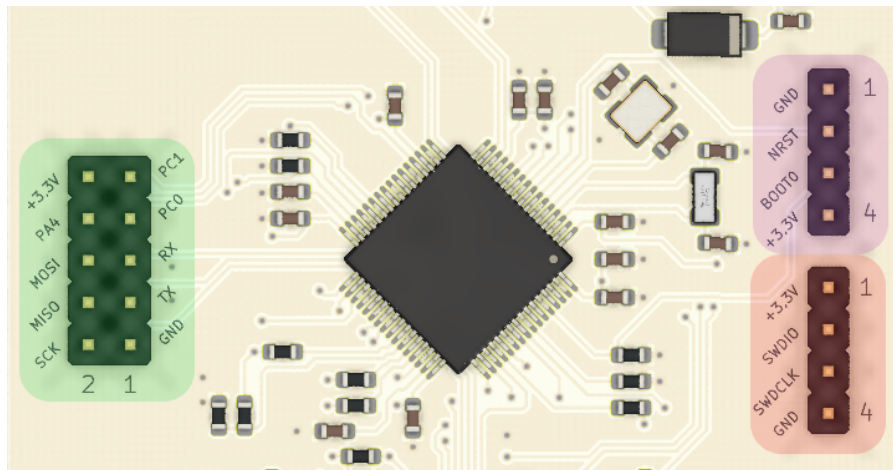


Figure 4: GPIO connectors of TMCM-0960-MotionPy

Please check the online available design files and schematic data for additional information on the connectors' signal connections and pinning.

2x5pin GPIO Header (Green) Pin Assignment			
Pin no.	Pin name	Level	Description
1	GND	Power (GND)	Common system supply and signal ground
2	SPI SCK	+3.3 VDC	SPI Interface Serial Clock
3	UART TX	+3.3 VDC	UART General Serial Output
4	SPI MISO	+3.3 VDC	SPI Interface Master In Slave Out
5	UART RX	+3.3 VDC	UART General Serial Input (Pull-down)
6	SPI MOSI	+3.3 VDC	SPI Interface Master Out Slave In
7	GPIO (PC0)	+3.3 VDC	MCU GPIO PC0 pin
8	GPIO (PA4)	+3.3 VDC	MCU GPIO PA4 pin
9	GPIO (PC1)	+3.3 VDC	MCU GPIO PC1 pin
10	+3.3V	+3.3 VDC	Common on-board +3.3V supply level

Table 3: 2x5pin GPIO Header (Green) Pin Assignment



1x4pin Header (Pink) Pin Assignment			
Pin no.	Pin name	Level	Description
1	GND	Power (GND)	Common system supply and signal ground
2	NRST	+3.3 VDC	MCU NRST pin7 - MCU Reset signal (Activated through button SW101)
3	BOOT0	+3.3 VDC	MCU BOOT0 pin60 - MCU Boot signal (Pull-down)
4	+3.3V	+3.3 VDC	Common on-board +3.3V supply level

*Table 4: 1x4pin Header (Pink) Pin Assignment*

1x4pin Header (Red) Pin Assignment			
Pin no.	Pin name	Level	Description
1	+3.3V	+3.3 VDC	Common on-board +3.3V supply level
2	SWDIO	+3.3 VDC	Software programmable GPIO (Green LED)
3	SWDCLK	+3.3 VDC	Software programmable CLK (Red LED)
4	GND	Power (GND)	Common system supply and signal ground

*Table 5: 1x4pin Header (Red) Pin Assignment*

1x2pin RTC Header (Gray) Pin Assignment			
Pin no.	Pin name	Level	Description
1	GND	Power (GND)	Common system supply and signal ground
2	+Vbat	+1.65...+3.3 VDC	MCU VBAT pin1 Supply for Real-Time Clock (RTC)

*Table 6: 1x2pin RTC Header (Gray) Pin Assignment*



### 2.3 Evaluation Board LEDs and Switches

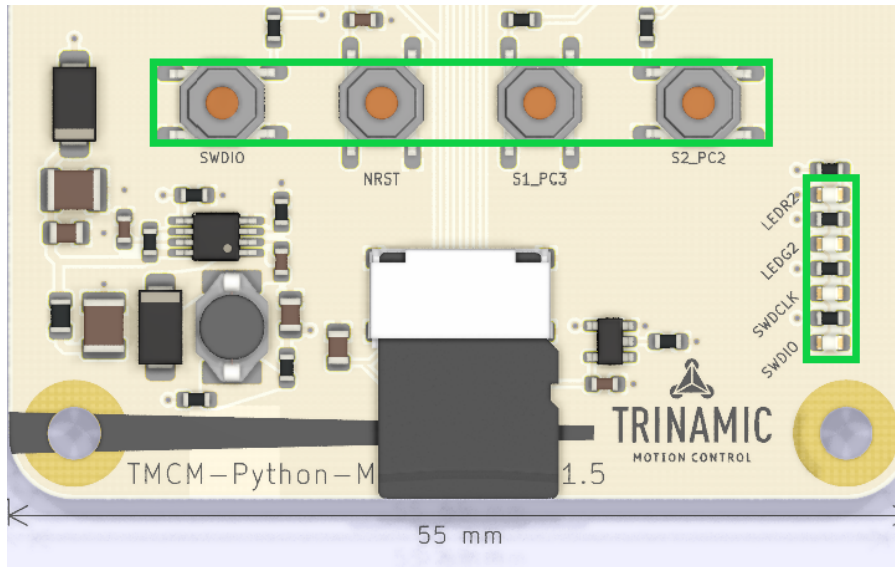


Figure 5: Switches and LEDs of TMCM-0960-MotionPy

Switches	
Switch	Description
SWDIO	Software defined; special function - USR Switch (chapter 2.4)
NRST	Board reset
S1PC3	Software defined; connected to MCU
S2PC2	Software defined; connected to MCU

Table 7: TMCM-0960-MotionPy Switches

LED	Description
LEDR2	White LED - Software defined; connected to MCU
LEDG2	Blue LED - Software defined; connected to MCU
SWDCLK	Green LED - Software defined; connected to 1x4pin Header (Red) pin 3 and MCU
SWDIO	Red LED - Software defined; connected to 1x4pin Header (Red) pin 2 and MCU

Table 8: TMCM-0960-MotionPy LEDs





## 2.4 Safe Mode

To enter safe mode, do the following steps:

1. Connect the board with USB, so it powers up.
2. Hold down the USR switch (SWDIO switch).
3. While still holding down USR, press and release the NRST switch.
4. The LEDs will then cycle red to blue to red+blue and back again.
5. Keep holding down USR until only the red LED is lit, and then let go of the USR switch.
6. The red LED should flash quickly 4 times, and then turn off.
7. You are now in safe mode.

In safe mode, the `boot.py` and `main.py` files are not executed, and so the MotionPy board boots up with default settings. This means you now have access to the filesystem (the USB drive should appear), and you can edit `boot.py` and `main.py` to fix any problems. Entering safe mode is temporary, and does not make any changes to the files on the pyboard.

## 2.5 Reset to Factory Default

The SWD connector can also be used to reset the Evaluation board to factory default settings. This is useful for example when the RS485 and/or CAN bit rate and ID settings of the board are not known. Do the following things to perform a reset to factory default settings:

1. Switch off the supply power.
2. Link together the pins CLK and DIO of the 1x4pin Header (Red) (using a jumper).
3. Switch on the supply power.
4. Wait until the MCU status and error LED flash alternating.
5. Switch off the supply power.
6. Remove the link between the CLK and the DIO pin.
7. Switch on again. The module now runs with factory default settings.



### 3 Evaluation Board Design Files

All design files for the base board are available for free. We offer the original ECAD files, Gerber data, the BOM, and PDF copies.

- For the TMCM-0960-MotionPy the ECAD files are in KiCAD format.

The files are available on Trinamic's website at <https://www.trinamic.com/>.

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**Note** If files are missing on the website or something is wrong please send us a note.

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### 4 Software and Firmware Information

Example firmware projects are available on Github: <https://github.com/trinamic/PyTrinamicMicro>.



## 5 Revision History

### 5.1 Document Revision

Version	Date	Author	Description
1.00	2020-10-29	HH, LK, SK	Initial release version.

*Table 9: Document Revision*



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