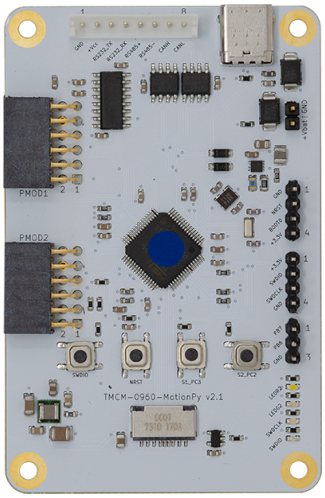
TMCM-0960-MotionPy V21

Hardware Version V2.1 | Document Revision V3.00 • 2021-07-01

The TMCM-0960-MotionPy V21 board is a single board computer running MicroPython. It comes with several communication interface options like CAN, RS485, UART, and SPI. It offers two standard PMOD connectors and separate GPIO headers. With a wide supply voltage range of +6...+36V and industrial field bus interfaces it is the engineers' swiss-army-knife for small automation applications.



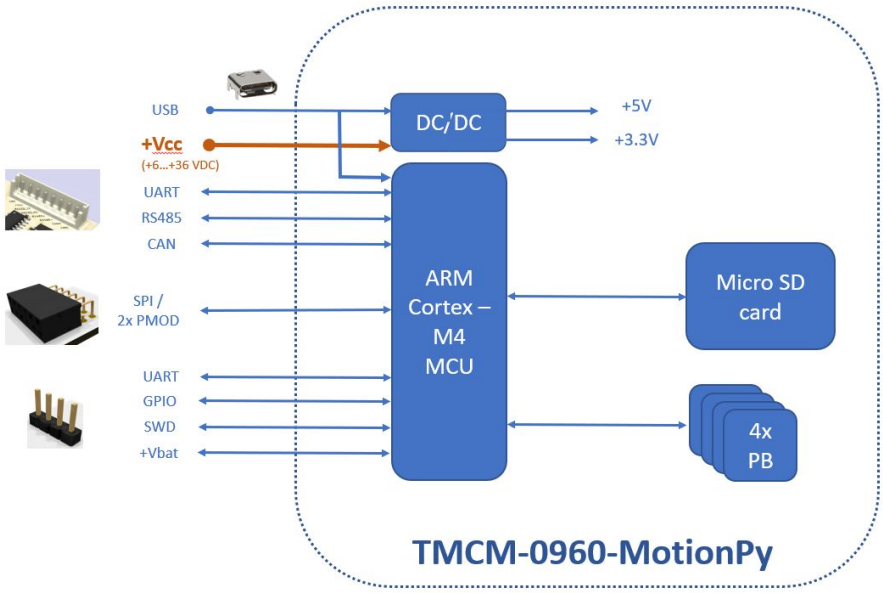
Features

- Board supply voltage: +6V to +36V
- CAN, RS485, UART
- 2x standard SPI/PMOD interfaces and connectors
- GPIO connectors and headers
- CAD design files available for download on www.trinamic.com
- Software projects available on Github: www.github.com

Applications

- Test Setups
- Prototype Testing
- Tabletop bring-up
- Drives
- Robotics
- Automation

Simplified Block Diagram



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1 Order Codes

Order Code	Description	Size
TMCM-0960-MotionPy V21	MicroPython controller board, +6V to +36V supply, USB, CAN, RS485, UART, GPIO, SPI, 2x PMOD, SD-Card, incl. 8-pin JST-EH cable	85mm x 55mm

Table 1: TMCM-0960-MotionPy V21 Order Codes

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2 Getting Started

You need

- TMCM-0960-MotionPy V21 board
- Regulated Power Supply for nominal +24 VDC to connect to +VCC input
- USB-C cable
- SD-Card (optional)
- Useful links:
  - Getting started video Trinamic's Swiss Army Knife for Engineers Running MicroPython
  - Getting started application notes
  - Software projects on Github

Precautions

- Do not mix up signals or short-circuit pins.
- Do not exceed the maximum rated supply supply voltage!
- **Start with power supply off!** Connect cables first. Then switch on your supply.

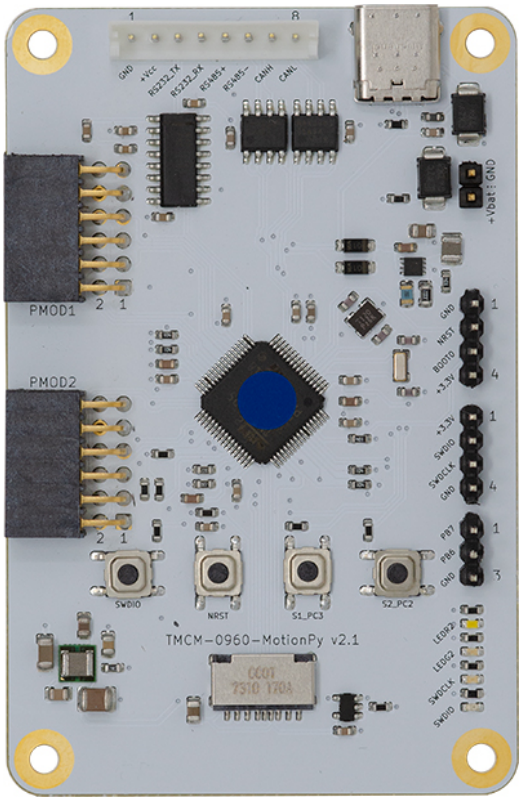


Figure 1: TMCM-0960-MotionPy V21 top view

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3 Connectors

The top view of the TMCM-0960-MotionPy V21 shows the main connector in red with power input (+VCC) and the three communication interfaces UART, RS485, and CAN. USB connector in yellow. The GPIO signal pin headers are marked pink and green. The SWD pin header is marked light blue). The PMOD connectors are marked dark blue. The real time clock power source (+Vbat) 2-pin header is marked dark green.

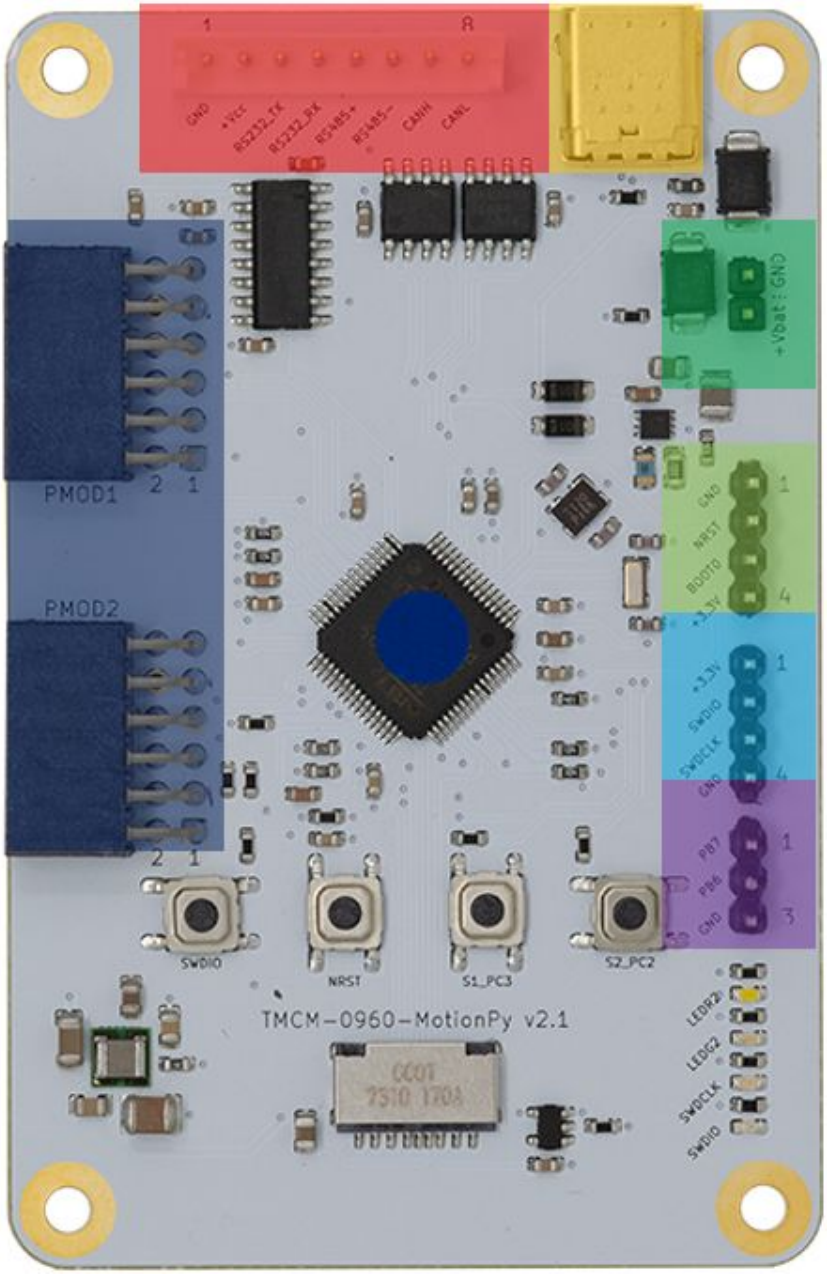


Figure 2: Connectors of TMCM-0960-MotionPy V21

Each connector has the signal names marked in the silkscreen of the board next to the respective connector pins. The pin numbers (pin 1) are also labeled.

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3.1 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^2, AWG 24
USB-C	USB-C female connector	USB-C male connector

Table 2: Connector Types and Mating Connectors of the TMCM-0960-MotionPy V21



Figure 3: Power / communication connector of TMCM-0960-MotionPy V21

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 +36V DC**)
3	RS232_TX	RS232 level	Serial comm. transmitting signal
4	RS232_RX	RS232 level	Serial comm. receiving signal
5	RS485+	RS485 level	Bidirectional diff. RS485 bus signal (non-inverting)
6	RS485-	RS485 level	Bidirectional diff. RS485 bus signal (inverting)
7	CAN_H	CAN level	Bidirectional diff. CAN bus signal (non-inverting)
8	CAN_L	CAN level	Bidirectional diff. CAN bus signal (inverting)

Table 3: TMCM-0960-MotionPy V21 Power supply and Communication Interface connector pin assignment

NOTICE

Always keep the power supply voltage below the upper limit of +36V! 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.

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3.2 PMOD Connectors

The TMCM-0960-MotionPy V21 offers two separate PMOD interfaces with two independent SPI channels. For exact PMOD pinout, please refer to the documentation of your specific PMOD board. General internal signals are as follows.

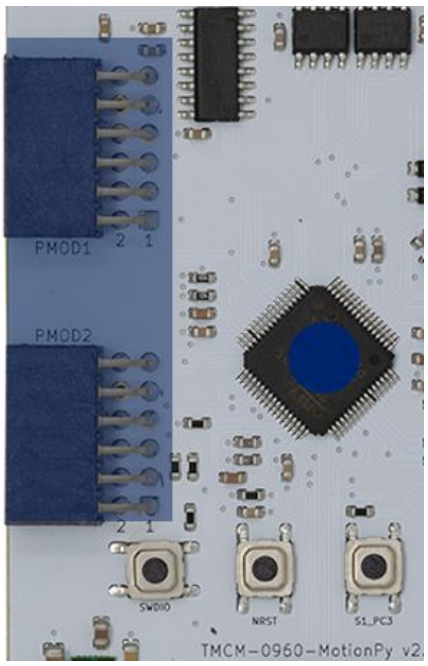


Figure 4: PMOD connectors of TMCM-0960-MotionPy V21

PMOD Header 1 (dark blue) Pin Assignment			
Pin no.	Pin name	Level	Description
1	CS01	+3.3 VDC	Chip select SPI bus 0 channel 1 (PA4)
2	CS02	+3.3 VDC	Chip select SPI bus 0 channel 2 (PC6)
3	SPI1_MOSI	+3.3 VDC	Chip select SPI bus 0 MOSI
4	GP01	+3.3 VDC	GPIO chip 0 pin 1 (PB0)
5	SPI1_MISO	+3.3 VDC	Chip select SPI bus 0 MISO
6	GP02	+3.3 VDC	GPIO chip 0 pin 2 (PC13)
7	SPI1_SCK	+3.3 VDC	Chip select SPI bus 0 SCK
8	GP03	+3.3 VDC	GPIO chip 0 pin 3 (PC5)
9	GND	Ground	Common system supply and signal ground
10	GND	Ground	Common system supply and signal ground
11	+3.3V	+3.3 VDC	System supply
12	+3.3V	+3.3 VDC	System supply

Table 4: PMOD Header 1 (dark blue) Pin Assignment

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PMOD Header 2 (dark blue) Pin Assignment			
Pin no.	Pin name	Level	Description
1	CS11	+3.3 VDC	Chip select SPI bus 1 channel 1 (PB12)
2	CS12	+3.3 VDC	Chip select SPI bus 1 channel 2 (PC2)
3	SPI1_MOSI	+3.3 VDC	Chip select SPI bus 1 MOSI
4	GP11	+3.3 VDC	GPIO chip 1 pin 1 (PC4)
5	SPI1_MISO	+3.3 VDC	Chip select SPI bus 1 MISO
6	GP12	+3.3 VDC	GPIO chip 1 pin 2 (PC7)
7	SPI1_SCK	+3.3 VDC	Chip select SPI bus 1 SCK
8	GP13	+3.3 VDC	GPIO chip 1 pin 3 (PC3)
9	GND	Ground	Common system supply and signal ground
10	GND	Ground	Common system supply and signal ground
11	+3.3V	+3.3 VDC	System supply
12	+3.3V	+3.3 VDC	System supply

Table 5: PMOD Header 2 (dark blue) Pin Assignment

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3.3 GPIO Connectors

The TMCM-0960-MotionPy V21 offers three separated input/output headers, directly connected to the MCU (STM32F405RGT6). They are located on the right side of the board.

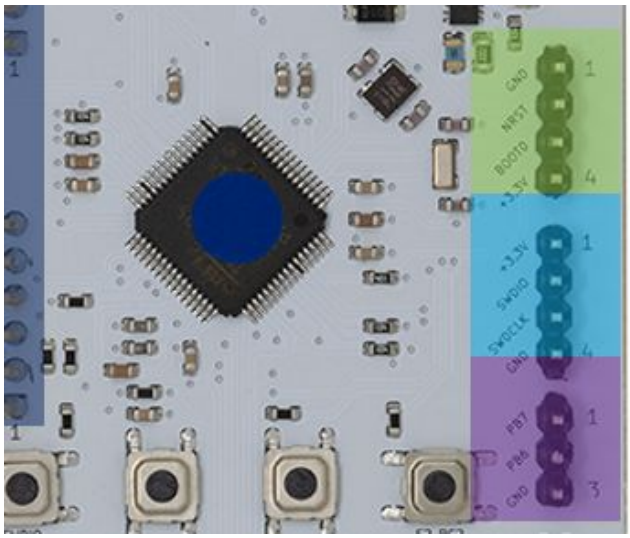


Figure 5: GPIO connectors of TMCM-0960-MotionPy V21

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

3-Pin GPIO Header (pink) Pin Assignment			
Pin no.	Pin name	Level	Description
1	PB7	+3.3 VDC	GPIO Port B Pin 8
2	PB6	+3.3 VDC	GPIO Port B Pin 9
3	GND	Ground	Common system supply and signal ground

Table 6: 3-Pin GPIO Header (pink) Pin Assignment

SWDIO-Pin Header (light blue) 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 7: SWDIO-Pin Header (light blue) Pin Assignment

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IO-Pin Header (green) 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 8: IO-Pin Header (green) Pin Assignment

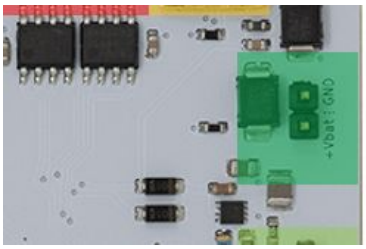


Figure 6: VBAT connector of TMCM-0960-MotionPy V21

RTC Vbat Header (dark green) 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 9: RTC Vbat Header (dark green) Pin Assignment

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3.4 Evaluation Board LEDs and Switches

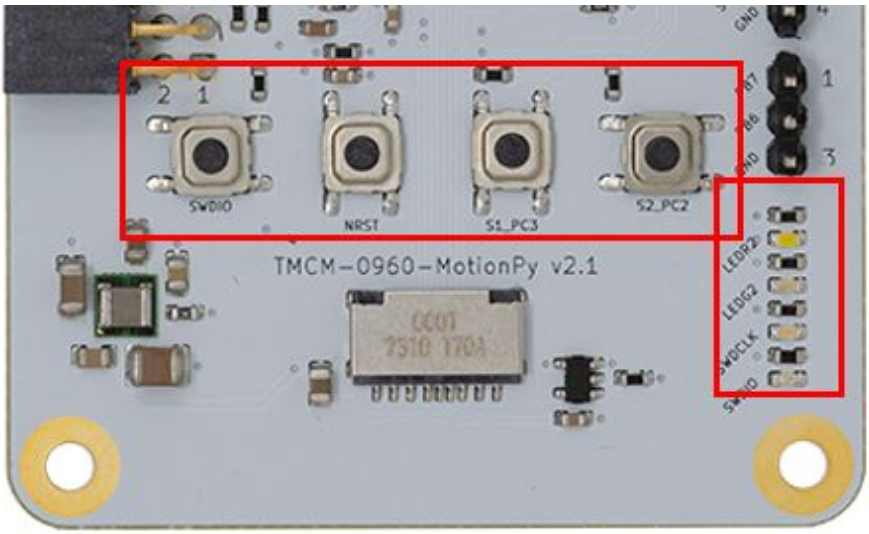


Figure 7: Switches and LEDs of TMCM-0960-MotionPy V21

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 10: TMCM-0960-MotionPy V21 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 SWD Header (light blue) pin 3 and MCU
SWDIO	Red LED - Software defined; connected to SWD Header (light blue) pin 2 and MCU

Table 11: TMCM-0960-MotionPy V21 LEDs

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3.5 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 file system (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 board.

3.6 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.

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4 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 V21 the ECAD files are in KiCAD format.

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

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

5 Software and Firmware Information

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

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6 Revision History

6.1 Document Revision

Version	Date	Author	Description
1.00	2020-10-29	HH, LK, SK	Initial release version.
2.00	2021-05-18	LK	Updated for board version 2.0
2.10	2021-05-25	SK	initial bugfix of some values and typos
3.00	2021-07-01	SK	Updated for board version 2.1. Maximum supply voltage at +VCC changed to +36V.

Table 12: Document Revision

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