TMCM-0010-OPC Hardware/Firmware Manual

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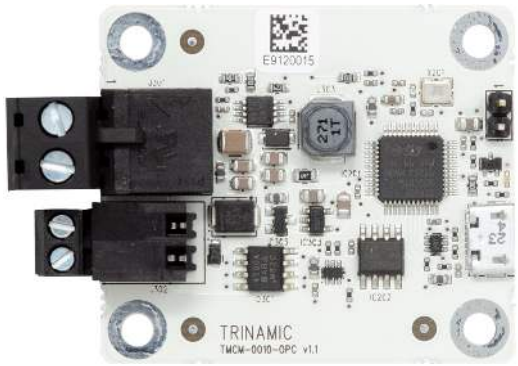
TMCM-0010-OPC is a simple over-voltage protection module that helps to limit a voltage rail at a configurable maximum level. The voltage is limited by switching a resistive load (brake resistor) connected to the module. The module can be configured via USB using Trinamic's TMCL-IDE.



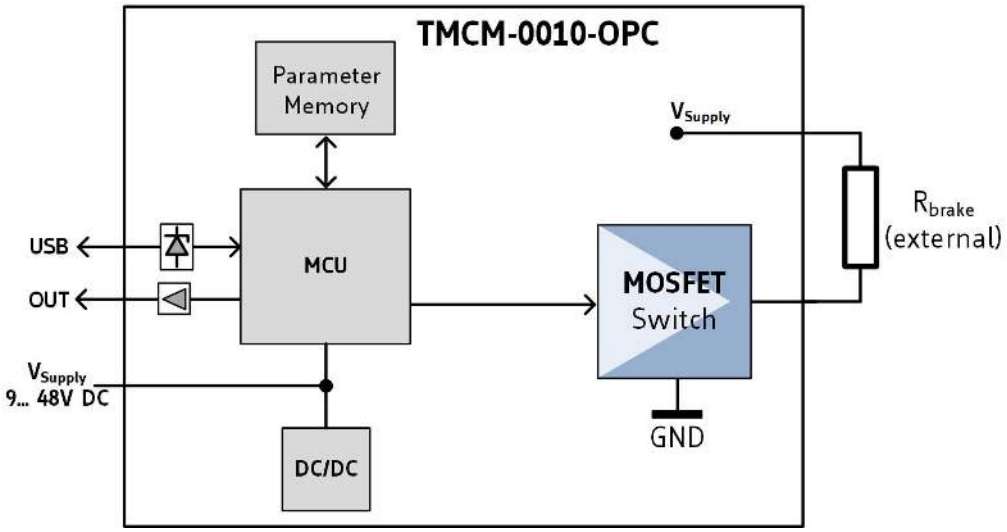
Features

- Supply Voltage 9V..48V
- Configurable overvoltage protection
- USB configuration interface
- On-board configuration EEPROM to save default settings
- Heat-sink mountable

Applications

- Lab testing
- Test setups
- Voltage Limitation
- Drive circuit protection

Simplified Block Diagram



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Contents

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1 Features

TMCM-0010-OPC is a simple over-voltage protection module that helps to limit a voltage rail at a configurable maximum level. The voltage is limited by switching a resistive load (brake resistor) connected to the module. The module can be configured via USB using Trinamic's TMCL-IDE.

- Supply Voltage +9V to +48V DC
- Supply rail monitoring with external brake resistor
- Active limitation of supply rail to a configured maximum value
- Trigger output as feedback to control system
- USB interface for configuration and firmware updates via bootloader
- TMCL-based protocol for online configuration and permanent parameter settings

2 Order Codes

Order Code	Description	Size (LxWxH)
TMCM-0010-OPC	Over-voltage protection module, supply input, external brake resistor connector, USB configuration interface	45x39x9 (mm)

Table 1: Order codes

3 Mechanical Information

The size of TMCM-0010-OPC is approximately 45mm x 39mm. There are 4 mounting holes for M3 screws for mounting the TMCM-0010-OPC to a carrier board or heat sink (highlighted in green). The maximum component height is 9mm.

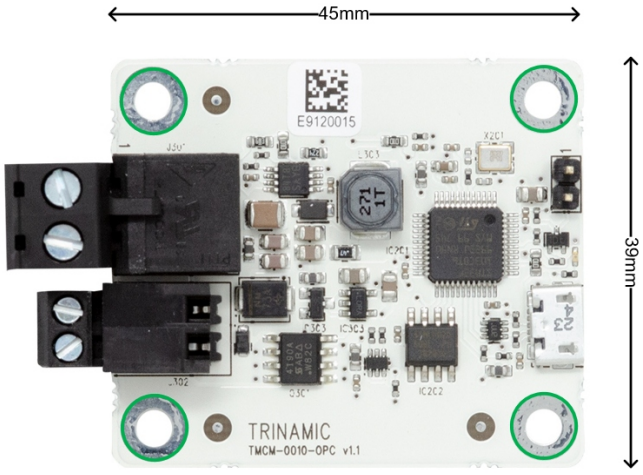

Figure 1: TMCM-0010-OPC top view mechanical dimensions

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4 Connectors and LEDs

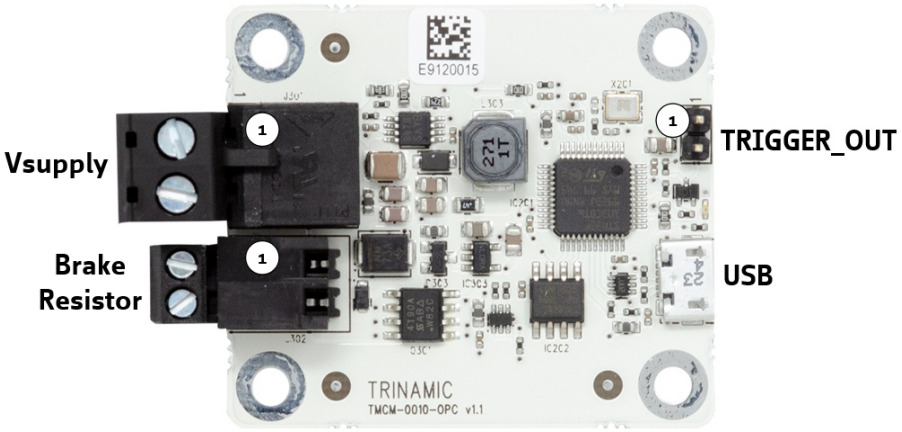

Figure 2: TMCM-0010-OPC connectors

4.1 Power and Supply Connector

The supply connector is of type Metz Connect 31349102 in 5mm pitch.
The mating female connector is Metz Connect 31330102.

Pin no.	Pin name	Description
1	GND	Supply ground
2	$+V_{Supply}$	Supply voltage +9V to +48V DC

Table 2: Power and supply connector

4.2 Brake Resistor Connector

The supply connector is of type Metz Connect 31182102 in 3,5mm pitch.
The mating female connector is Metz Connect 31169102.

Pin no.	Pin name	Description
1	$+V_{Supply}$	Supply voltage output to first (upper) terminal of brake resistor
2	BRAKE	Connection to second (lower) terminal of brake resistor

Table 3: Brake resistor connector

4.3 Trigger Output Header

The trigger output is a simple 2-pin header in standard 0.1" pitch.

Pin no.	Pin name	Description
1	GND	Supply ground

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Pin no.	Pin name	Description
2	OUT	Trigger output, +3.3V, open collector

Table 4: Trigger output header

4.4 USB Connection

The USB interface requires a USB Micro connector. Interface standard is USB 2.0. TMCM-0010-OPC is handled as a virtual COM device / CDC device.

4.5 Status LEDs

The TMCM-0010-OPC has one green status LED.

- A blinking LED (1s) indicates normal operation of the module.
- A fast blinking LED (0.1s) indicates bootloader mode.

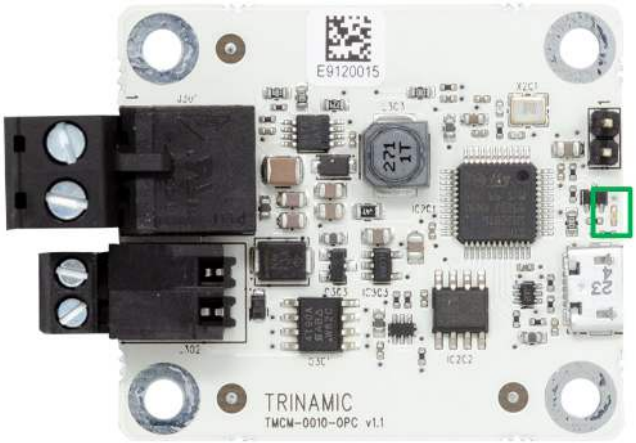

Figure 3: TMCM-0010-OPC LED

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5 Functional Description

5.1 Software Functions and Parameters

The TMCM-0010-OPC measures the actual supply voltage. If the brake chopper is enabled and the actual supply voltage is higher than the brake chopper voltage limit, the brake chopper output will be switched on. If the actual supply voltage is lower than the (voltage limit - hysteresis), the brake chopper output will be switched off.

The software runs on a microprocessor and consists of two parts. The boot loader is installed by TRINAMIC during production. It remains untouched throughout its entire product lifetime. The firmware can be updated by the user. New versions can be downloaded free of charge from the product's web page at www.trinamic.com.

The TMCM-0010-OPC supports TMCL direct mode (binary commands). In direct mode the TMCL communication over USB follows a strict master/slave relationship. That is, a host computer (e.g. PC/PLC) acting as the interface bus master will send a command to the TMCM-0010-OPC. The TMCL interpreter on the module will then interpret this command, read inputs and write outputs or whatever is necessary according to the specified command. As soon as this step has been done, the module will send a reply back over the interface to the bus master. Only then the master should transfer the next command.

Normally, the module will just switch to transmission and occupy the bus for a reply, otherwise it will stay in receive mode. It will not send any data over the interface without receiving a command first.

The Trinamic Motion Control Language (TMCL) provides a set of structured control commands. Every command has a binary representation and a mnemonic. The binary format is used to send commands from the host to a module in direct mode, whereas the mnemonic format is used for easy usage of the commands when developing standalone TMCL applications using the TMCL-IDE. There is also a set of configuration variables which allow individual configuration of the module.

5.2 Binary Command Format

Every command has a mnemonic and a binary representation. When commands are sent from a host to a module, the binary format has to be used. Every command consists of a one-byte command field, a one-byte type field, a one-byte motor/bank field and a four-byte value field. So the binary representation of a command always has seven bytes. When a command is to be sent via RS-232, RS-485, RS-422 or USB interface, it has to be enclosed by an address byte at the beginning and a checksum byte at the end. In these cases it consists of nine bytes.

The binary command format with RS-232, RS-485, RS-422 and USB is as follows:

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TMCL Command Format	
Bytes	Meaning
1	Module address
1	Command number
1	Type number
1	Motor or Bank number
4	Value (MSB first!)
1	Checksum

Table 5: TMCL Command Format

5.2.1 Checksum Calculation

The checksum is calculated by adding up all bytes (including the module address byte) using 8-bit addition as shown in this C code example:

```
unsigned char i, Checksum;
unsigned char Command[9];

//Set the Command array to the desired command
Checksum = Command[0];
for(i=1; i<8; i++)
      Checksum+=Command[i];

   Command[8]=Checksum; //insert checksum as last byte of the command
//Now, send it to the module
```

5.3 Reply Format

Every time a command has been sent to a module, the module sends a reply. The reply format with RS-232, RS-485, RS-422 and USB is as follows:

TMCL Reply Format	
Bytes	Meaning
1	Reply address
1	Module address
1	Status (e.g. 100 means no error)
1	Command number
4	Value (MSB first!)
1	Checksum

Table 6: TMCL Reply Format

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5.3.1 Status Codes

The reply contains a status code. The status code can have one of the following values:

TMCL Status Codes	
Code	Meaning
100	Successfully executed, no error
1	Wrong checksum
2	Invalid command
3	Wrong type
4	Invalid value
5	Configuration EEPROM locked
6	Command not available

Table 7: TMCL Status Codes

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5.4 TMCL Command Overview

This sections gives a short overview of the available TMCL commands.

Overview of all TMCL Commands			
Command	Number	Parameter	Description
SAP	5	<parameter>, <motor number>, <value>	Set axis parameter
GAP	6	<parameter>, <motor number>	Get axis parameter
STAP	7	<parameter>, <motor number>, <value>	Store axis parameter
RSAP	8	<parameter>, <motor number>	Restore axis parameter

Table 8: Overview of all TMCL Commands

5.5 Detailed TMCL Command Descriptions

The module specific commands are explained in more detail on the following pages. They are listed according to their command number.

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5.5.1 SAP (Set Axis Parameter)

With this command most of the parameters of the module can be specified. The settings will be stored in SRAM and therefore are volatile. Thus, information will be lost after power off. For a table with parameters and values which can be used together with this command please refer to section 5.6.

Internal function: The specified value is written to the axis parameter specified by the parameter number. **Related commands:** GAP
Mnemonic: SAP <parameter number>, <axis>, <value>

Binary representation:

Binary Representation			
Instruction	Type	Motor/Bank	Value
5	see chapter 5.6	0	<value>

Example Set brake chopper voltage limit to 50.0V. (*Mnemonic:* SAP 2, 0, 500)

Binary Form of SAP 2, 0, 500	
Field	Value
Target address	01_h
Instruction number	05_h
Type	02_h
Motor/Bank	00_h
Value (Byte 3)	00_h
Value (Byte 2)	00_h
Value (Byte 1)	01_h
Value (Byte 0)	$F4_h$
Checksum	FD_h

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5.5.2 GAP (Get Axis Parameter)

Most parameters of the TMCM-0010-OPC can be adjusted using e.g. the SAP command. With the GAP parameter they can be read out. For a table with parameters and values that can be used together with this command please refer to section 5.6.

Internal function: The specified value gets copied to the accumulator.
Related commands: SAP
Mnemonic: GAP <parameter number>, <axis>

Binary representation:

Binary Representation			
Instruction	Type	Motor/Bank	Value
6	see chapter 5.6	0	<value>

Example Get the actual brake chopper voltage limit. (*Mnemonic:* GAP 2, 0)

Binary Form of GAP 2, 0	
Field	Value
Target address	01_h
Instruction number	06_h
Type	02_h
Motor/Bank	00_h
Value (Byte 3)	00_h
Value (Byte 2)	00_h
Value (Byte 1)	00_h
Value (Byte 0)	00_h
Checksum	09_h

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5.5.3 STAP (Store Axis Parameter)

This command is used to store TMCL axis parameters permanently in the EEPROM of the module. This command is mainly needed to store the default configuration of the module. For a table with parameters and values which can be used together with this command please refer to dection 5.6.

Internal function: The axis parameter specified by the type and bank number will be stored in the EEPROM.

Related commands: SAP, GAP, RSAP.
Mnemonic: STAP <parameter number>, <bank>

Binary representation:

Binary Representation			
Instruction	Type	Motor/Bank	Value
7	see chapter 5.6	0	0 (don't care)

Example Store axis parameter 2. (*Mnemonic:* STAP 2, 0)

Binary Form of STAP 2, 0	
Field	Value
Target address	01_h
Instruction number	07_h
Type	02_h
Motor/Bank	00_h
Value (Byte 3)	00_h
Value (Byte 2)	00_h
Value (Byte 1)	00_h
Value (Byte 0)	00_h
Checksum	$0A_h$

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5.5.4 RSAP (Restore Axis Parameter)

With this command the contents of an axis parameter can be restored from the EEPROM. By default, all axis parameters are automatically restored after power up. An axis parameter that has been changed before can be reset to the stored value by this instruction. For a table with parameters and values which can be used together with this command please refer to section 5.6.

Internal function: The axis parameter specified by the type and bank number will be restored from the EEPROM.

Related commands: SAP, GAP
Mnemonic: RSAP <parameter number>, <bank>

Binary representation:

Binary Representation			
Instruction	Type	Motor/Bank	Value
8	see chapter 5.6	0	0 (don't care)

Example Restore axis parameter 2. (*Mnemonic:* RSAP 2, 0)

Binary Form of RSAP 2, 0	
Field	Value
Target address	01_h
Instruction number	08_h
Type	02_h
Motor/Bank	00_h
Value (Byte 3)	00_h
Value (Byte 2)	00_h
Value (Byte 1)	00_h
Value (Byte 0)	00_h
Checksum	$0B_h$

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5.6 Axis Parameters

The TMCM-0010-OPC supports the parameter shown in the following table.

Axis parameters of the TMCM-0010-OPC module					
Number	Axis parameter	Description	Range [Units]	Default	Access
0	supply voltage	The actual supply voltage.	0 ... 600 [0.1V]	240	R
1	enable brake chopper	Enable brake chopper functionality. 0 - Deactivate brake chopper. 1 - Activate brake chopper.	0 ... 1	0	RWE
2	brake chopper voltage limit	If the brake chopper is enabled and supply voltage exceeds this value, the brake chopper output will be activated.	50 ... 600 [0.1V]	260	RWE
3	brake chopper hysteresis	An activated brake chopper will be disabled if the actual supply voltage is lower than (limit voltage-hysteresis).	0 ... 50 [0.1V]	5	RWE
4	brake chopper lower voltage limit	Shows the lower voltage limit which results from brake chopper (voltage limit - hysteresis).	0 ... 600 [0.1V]	255	R
5	brake chopper active	A value unequal to zero indicates an active brake chopper.	0 ... 600	255	R

Table 9: All TMCM-0010-OPC Axis parameters

The access abbreviations means R for readonly, and RWE for read/write/storeable in EEPROM for directly use after next reboot.

5.7 Typical Application Wiring

The following diagram shows the typical application scenario.

- Connect the power supply to the TMCM-0010-OPC supply connector in parallel to your application.
- Connect the brake resistor terminals to the brake connector.
- If not yet done use the USB connection for configuration and monitoring.
- In case you want to monitor when the TMCM-0010-OPC detects an over-voltage condition and actively switches the supply rail to the brake resistor you need to connect the trigger output to an application input or to your higher-level assembly.

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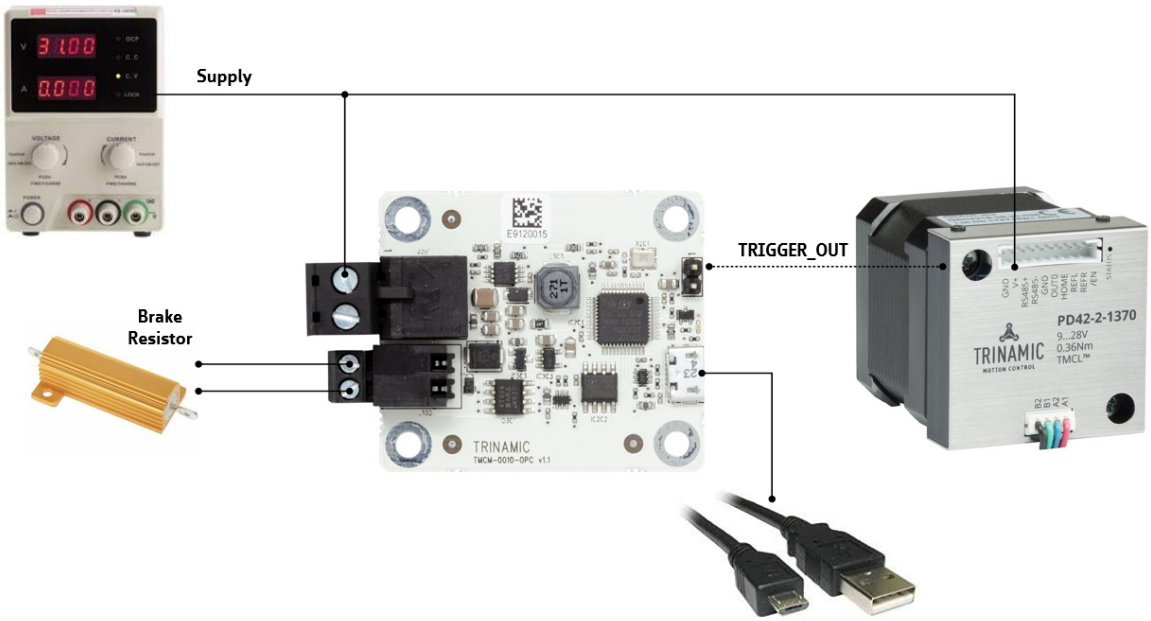

Figure 4: Typical application scenario

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6 Operational Ratings and Characteristics

6.1 Absolute Maximum Ratings

Parameter	Min	Max	Unit
Supply voltage	+9	+60	V
Max. ADC measurement range		+60	V
Working temperature	-30	+40	° C

NOTICE

Never Exceed the absolute maximum ratings! Stresses above those listed under "'Absolute Maximum Ratings"' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

6.2 Electrical Characteristics (Ambient Temperature 25° C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	VDD	+9		+48	V
Power consumption	P	37		38	mW
Supply current draw at 24V	I_VDD	1.54		1.56	mA

Table 11: Electrical Characteristics

6.3 Other Requirements

Specifications	Description or Value
Cooling	Free air or heat sink mounted
Working environment	Avoid dust, water, oil mist and corrosive gases, no condensation, no frosting
Working temperature	-30° C to +40° C

Table 12: Other Requirements and Characteristics

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7 Figures Index

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8 Tables Index

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9 Supplemental Directives

9.1 Producer Information

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10 Revision History

10.1 Hardware Revision

Version	Date	Author	Description
1.10	03.04.2019	SK	First Version.

Table 13: Hardware Revision

10.2 Firmware Revision

Version	Date	Author	Description
1.00	05.04.2019	ED	First release.

Table 14: Firmware Revision

10.3 Document Revision

Version	Date	Author	Description
1.00	10.04.2019	SK/ED	Initial release.

Table 15: Document Revision

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