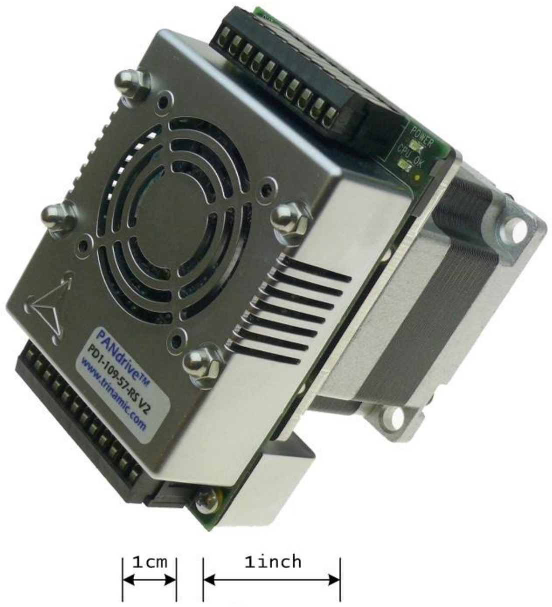
PDx-109-57 V2



Hardware Manual

Version: 1.13
2010-SEP-25

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Contents

List of Figures

List of Tables

1 Life support policy

TRINAMIC Motion Control GmbH & Co. KG does not authorize or warrant any of its products for use in life support systems, without the specific written consent of TRINAMIC Motion Control GmbH & Co. KG.

Life support systems are equipment intended to support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided, can be reasonably expected to result in personal injury or death.

2 Features

The PANdrive PDx-109-57 V2 features a full mechatronic solution including a 57mm flange motor. It is based on the TMCM-109-57 electronics and offers RS232 and RS485 interfaces. The power supply, the interface and the multipurpose I/Os can be connected via two pluggable screw terminal connectors. With the stallGuard™ feature it is possible to detect motor overload or motor stall.

The TMCM-109-57 comes with the PC based software development environment TMCL-IDE for the Trinamic Motion Control Language (TMCL™). Using predefined TMCL™ high level commands like *move to position* or *constant rotation* a rapid and fast development of motion control applications is guaranteed. Communication traffic is kept very low since all time critical operations, e.g. ramp calculation are performed onboard. The TMCL™ program can be stored in the on-board EEPROM for stand-alone operation. The firmware of the module can be updated via the serial interface.

Applications

- decentralized mechatronic drive with integrated intelligence
- high-precision drives with high dynamics and torque

Electrical data

- 18V to 55V motor supply voltage for highest motor dynamics
- up to 2.8A RMS nominal motor current

Motor data

- all PANdrive Motors optimized for 2.8A RMS motor current
- flange max. 56.5mm x 56.5mm
- D-cut of 15mm length and 0.5mm depth
- more specifications:

Specifications	Parameter	Units	QSH5718			
			-41-28-055	-51-28-101	56-28-126	-76-28-189
Number of Leads		N°	4	4	4	4
Step Angle		°	1.8	1.8	1.8	1.8
Step Angle Accuracy		%	5	5	5	5
Rated Voltage	V_{RATED}	V	2	2.3	2.5	3.2
Rated Phase Current	$I_{RMS\ RATED}$	A	2.8	2.8	2.8	2.8
Phase Resistance at 20°C	R_{COIL}	Ω	0.7	0.83	0.9	1.13
Phase Inductance (typ.)		mH	1.4	2.2	2.5	3.6
Holding Torque		Nm	0.55	1.01	1.26	1.89
Detent Torque		Nm	0.020	0.035	0.039	0.066
Rotor Inertia		g cm^2	120	275	300	480
Insulation Class			B	B	B	B
Max. applicable voltage		V	75	75	75	75
Max. radial force (20mm from front flange)		N	75	75	75	75
Max. axial force		N	15	15	15	15
Weight		kg	0.45	0.65	0.7	1
Length		mm	41	51	56	76
Temp. Rise (rated current, 2 phase on)		°C	+80 max	+80 max	+80 max	+80 max
Ambient Temperature		°C	-20 +50	-20 +50	-20 +50	-20 +50

Table 2.1: Specifications of the PANdrive motors

Interface

- RS232, RS485
- 2 inputs for reference and stop switches
- 3 general purpose inputs and 1 general purpose output

Features

- up to 16 times microstepping
- memory for 2048 TMCL commands
- automatic ramp generation in hardware
- on the fly alteration of motion parameters (e.g. position, velocity, acceleration)
- stallGuard™ for sensorless motor stall detection
- optically isolated inputs for two general purpose inputs and the disable input
- dynamic current control

Software

- stand-alone operation using TMCL™ or remote controlled operation
- PC-based application development software TMCL-IDE included

Other

- Pluggable screw terminal connectors for all external signals
- RoHS compliant latest from July 1st, 2006
- Protection class IP20 according to DIN EN 60529 (IEC 529/VDE 047 T1)

3 Order codes

Order code	Description	Dimensions
PD1-109-57-RS	PANdrive 0.55Nm with motor QSH5718-41-28-055 (new series), RS232 and RS485 interfaces	74.6 x 57.2 x 86
PD2-109-57-RS	PANdrive 1.01Nm with motor QSH5718-51-28-101 (new series), RS232 and RS485 interfaces	84.6.6 x 57.2 x 86
PD3-109-57-RS	PANdrive 1.26Nm with motor QSH5718-56-28-126 (new series), RS232 and RS485 interfaces	89.6 x 57.2 x 86
PD4-109-57-RS	PANdrive 1.89Nm with motor QSH5718-76-28-189 (new series), RS232 and RS485 interfaces	109.6 x 57.2 x 86

Table 3.1: Order codes

4 Electrical and mechanical interfacing

4.1 Dimensions

4.1.1 Dimensions of PCB

- Height: 22mm *(additional: minimum 3mm distance to the motor; 4-5mm are recommended)*
- The PCB has four M3 mounting holes for the QMOT motor configuration.

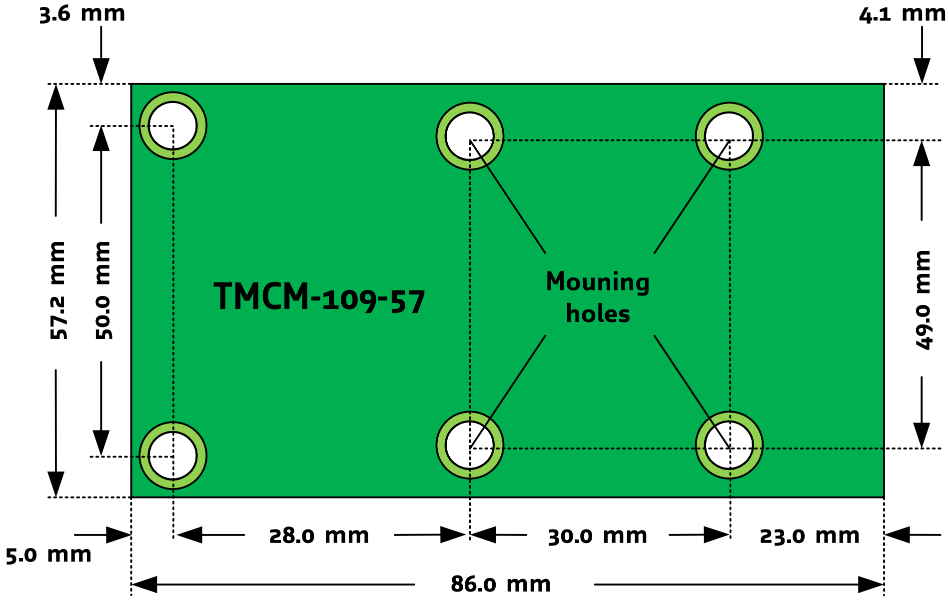
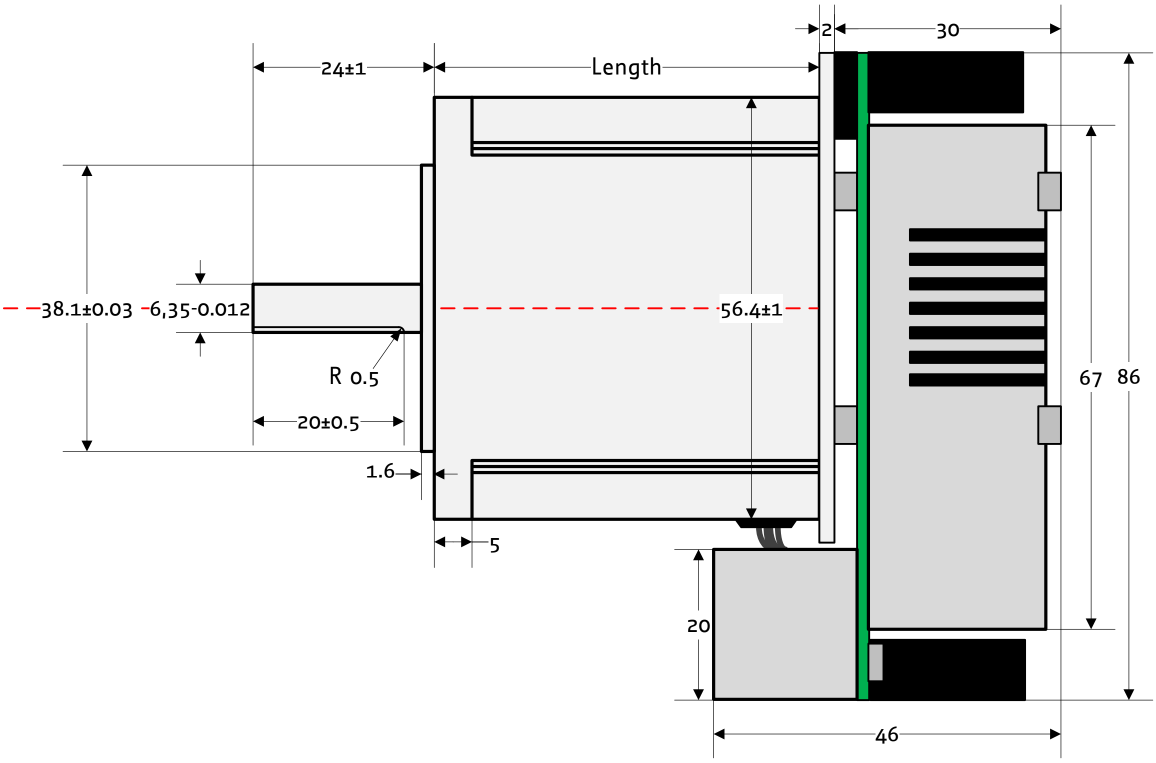


Figure 4.1: Dimensions of base PCB

4.1.2 Dimensions of PDx-109-57 V2



Motor	Length (mm)
QSH5718-41-28-055	41
QSH5718-51-28-101	51
QSH5718-56-28-126	56
QSH5718-76-28-189	76

Figure 4.2: Side view of PDx-109-57 V2

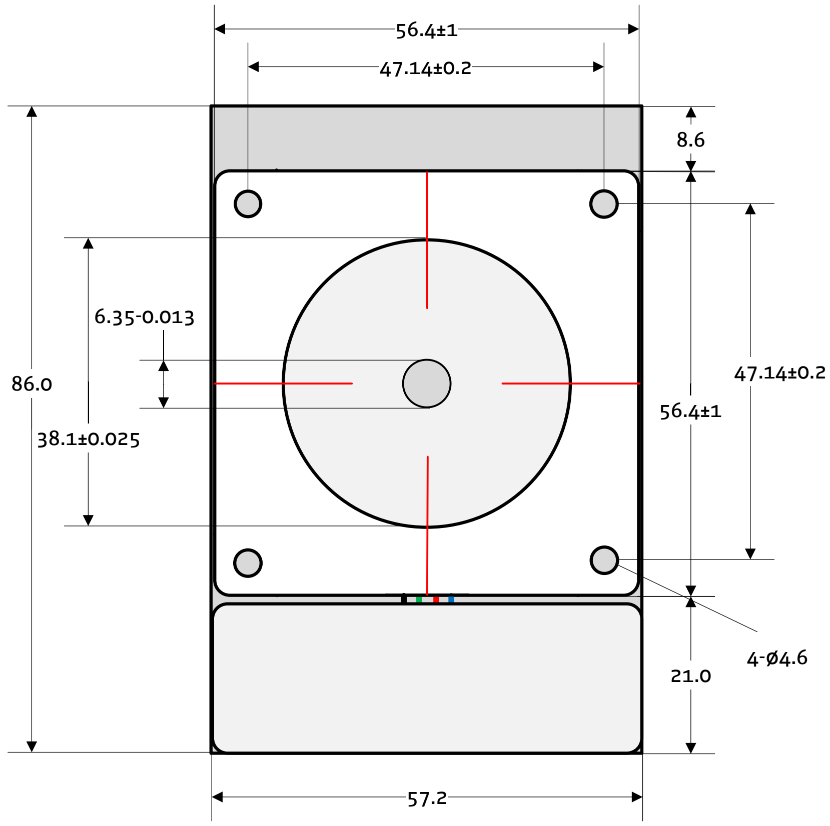


Figure 4.3: Front view of PDx-109-57 V2

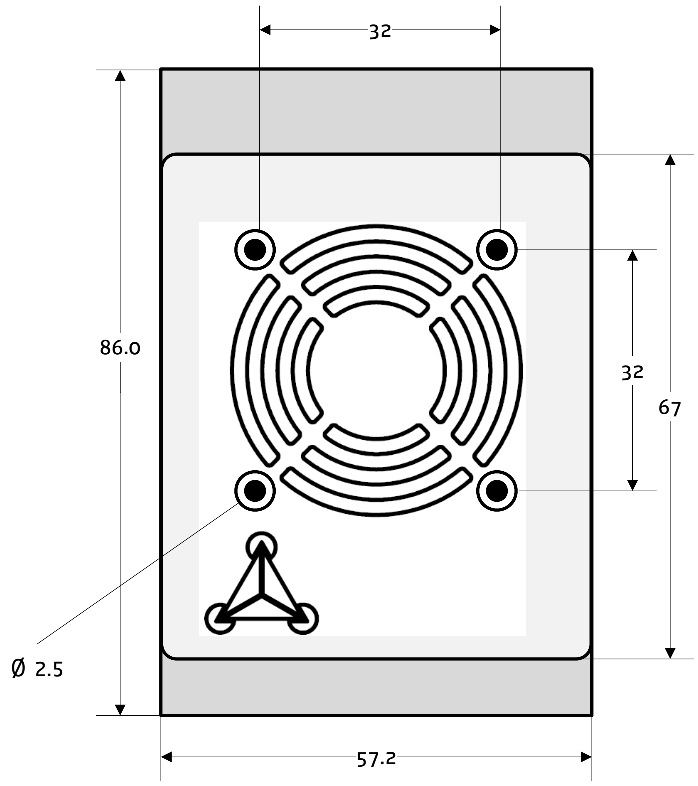


Figure 4.4: Rear view of PDx-109-57 V2

4.2 Connectors

The TMCM-109 consists of two PCBs: the CPU board and the base board. All the connectors can be found on the base board. They are shown in Figure 4.5.

The connectors onboard of the module are a 10 and a 12 pin female connector from RIACON,
Type 183, RM 3.5mm. Fitting male connectors with screw terminals are RIACON Type 169, RM 3.5mm.

Please refer to www.riaconnect.com for more detailed information.

Attention: Never plug in the board in reverse direction!

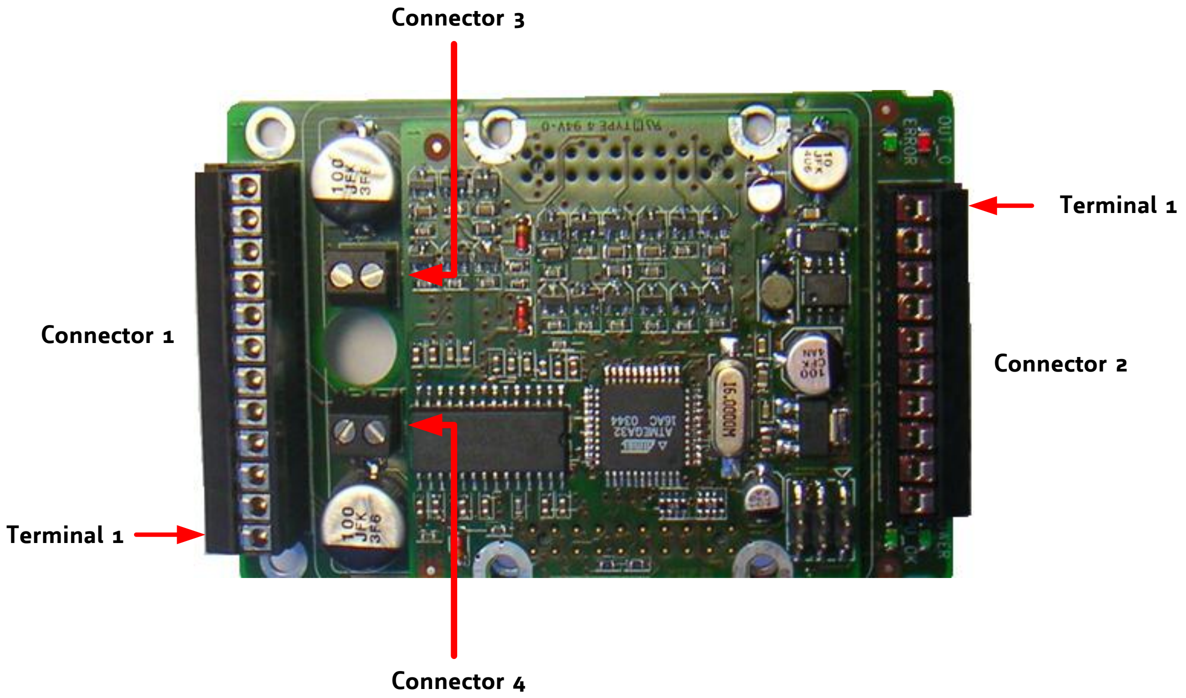


Figure 4.5: The TMCM-109 module and its connectors

4.2.1 Connector 1: Power supply, RS485, and GPI1/2

Use this connector to connect the module to the power supply. The connector also provides pins for the RS485 and the general purpose input 1 and 2 signals. To use the RS485 interface, it has to be enabled via the interface selection input (please see connector 2 pinning). The polarity of the shutdown input can be configured using TMCL™. Please note that the shutdown input and general purpose inputs 1 and 2 are connected to photo couplers. The ground line of all three photo couplers is connected to terminal 5.

Terminal	Name	Function
1	GPO0	General purpose output 0 (same as connector 2, terminal 5) (open collector, max. 250mA, max. 40V, 1K pull up to 5V integrated)
2	Shutdown	Shutdown input (positive optocoupler input, polarity set via SW, SGP 80)
3	GPI1	General purpose input 1 (positive optocoupler input)
4	GPI2	General purpose input 2 (positive optocoupler input)
5	OC_GND	Optocoupler ground
6	RS485-	RS485-
7	RS485+	RS485+
8	RS485-	RS485- (same as terminal 6)
9	RS485+	RS485+ (same as terminal 7)
10	GND	Ground
11	GND	Ground
12	+VM	+18..55V DC power supply

Table 4.1: Connector 1

4.2.2 Connector 2: RS232 and additional I/O

The RS232 interface and all other inputs and outputs of the module can be connected here. These are the limit switches, a general purpose input and a general purpose output. The limit switch inputs are equipped with internal pull-up resistors, so they have to be connected to GND via normally closed switches, if enabled via software. The general purpose input can either be used as a digital TTL input or as an analogue input with a voltage range of either 0… 5V or 0… 10V. This voltage range is selectable by software. The general purpose output is an open collector output for a maximum current of 250mA. Freewheeling diodes connected to the supply voltage are also included so that e.g. a 24V relay or a coil can be connected directly. The pin assignment of this connector is as follows:

Terminal	Name	Function
1	GND	Ground
2	IF select	Interface selection: Leave open to use RS232, connect to ground to use RS485.
3	TXD	RS232 TxD (output)
4	RXD	RS232 RxD (input)
5	GPO0	General purpose output 0 (same as connector 1, terminal 1) (open collector, max. 250mA, max. 40V, 1K pull-up to 5V integrated)
6	GPI0	General purpose input 0 (max. 5V)
7	StopR	Right limit switch input (integrated 10K pull-up to 5V)
8	StopL	Left limit switch input (integrated 10K pull-up to 5V)
9	+5V	+5V output (max. 150mA) Can be used to supply 5V fan or optical switches.
10	GND	Ground

Table 4.2: Connector 2

4.2.3 Connectors 3 and 4: Motor

Normally, the TMCM-109 module comes mounted on a suitable stepper motor. Should you have a module without a motor you can connect a two phase bipolar stepper motor yourself. To connect the motor there are two screw terminals adjacent to a cable feed through hole on the board. Connect one coil of the motor to one of the connectors and the other coil to the other connector. Please always make sure that the module is disconnected from the power supply before connecting or disconnecting a motor. Connecting or disconnecting a motor while the module is powered can damage the module!
Connect one motor coil to connector 3 and the other motor coil to connector 4. The direction of the motor shaft can be reversed by changing the polarity of one coil.

Do not connect or disconnect the motor while power on. Damage to the module may occur.

5 Operational ratings

The operational ratings show the intended range for the values and should be used as design values. In no case shall the maximum values be exceeded.

Symbol	Parameter	Min	Typ.	Max	Unit
V_S	Power supply voltage for operation	18	24... 48 [1)]	55 [1)]	V
I_{COIL}	Motor coil current for sine wave peak (chopper regulated, adjustable via software)	0	2.1 ... 5.0	5.0	A
I_{MC}	Continuous motor current (RMS) recommended for supply voltages up to 36 V	0	1.5... 3.5	3.5	A
	Continuous motor current (RMS), recommended for supply voltages exceeding 36 V	0	1.5... 3.0	3.5 [2)]	A
f_{CHOP}	Motor chopper frequency		36.8		kHz
I_S	Power supply current		<< I_{COIL}	1.4 * I_{COIL}	A
U_{+5V}	+5V output (max. 150mA load)	4.8	5.0	5.2	V
V_{ISO}	Isolation voltage of optocoupler		± 42	±100	V
V_{OPTON}	Signal active voltage at enable, step and direction input (optocoupler on)	4	5... 24	27	V
I_{OPTON}	Signal current for optocoupler (internally limited) (meas. at 24V)	11	15	18	mA
V_{OPTOFF}	Signal inactive voltage on enable, GPI1 and GPI2 input (optocoupler off)	-1	0	1.5	V
V_{INPROT}	Input voltage for StopL, StopR, GPI0 (internal protection, DC)	-24		24	V
V_{ANA}	GPI0 analog measurement range (20k voltage divider in high range)		0... 5 0... 10		V
V_{STOPLO}	StopL, StopR low level input		0	0.9	V
V_{STOPHI}	StopL, StopR high level input (integrated 10k pull-up to +5V)	1.9	5		V
T_{ENV}	Environment temperature at rated current (no cooling)	-40		+40	°C
	Environment temperature at 80 % of rated current or 50% duty cycle (no cooling)	-40		+60	°C

Table 5.1: Operational ratings

1) *Attention:* First samples (until Oct. 05) are limited to a maximum of 38V supply voltage
2) Forced cooling might be required

5.1 GPI1, GPI2, and disable inputs

The GPI1 input, the GPI2 input, and the disable input are optically isolated inputs. Their functional voltages V_{OPTON} and V_{OPTOFF} are directly depending on the input voltages (V_{GPI1}, V_{GPI2} and $V_{DISABLE}$). For off-state the input voltage has to be less than 1.5V (V_{OPTOFF}) and for on-state it has to exceed 4.0V (V_{OPTON}).

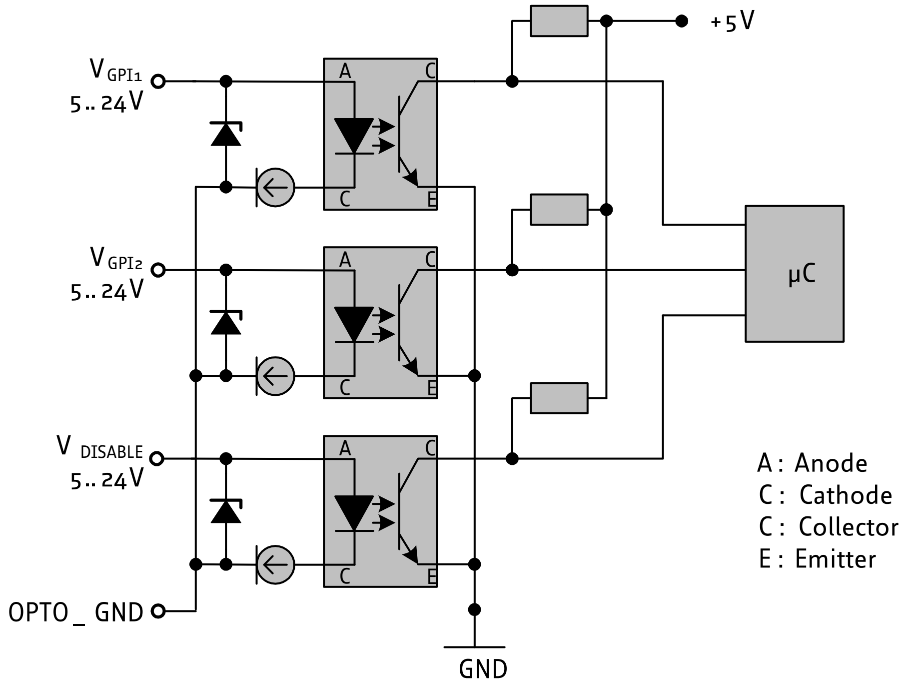


Figure 5.1: GPI1, GPI2, and disable inputs

Logic level:

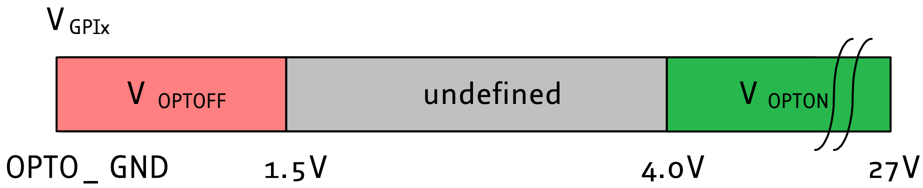


Figure 5.2: Example for GPI1, GPI2, and disable inputs

6 Functional description

In figure 6.1 the main parts of the PDx-109-57-RS V2 are shown. The module mainly consists of the µC, a TMC428 motion controller, a TMC249 stepper motor driver, the TMCL™ program memory (EEPROM) and the host interfaces RS232 and RS485.

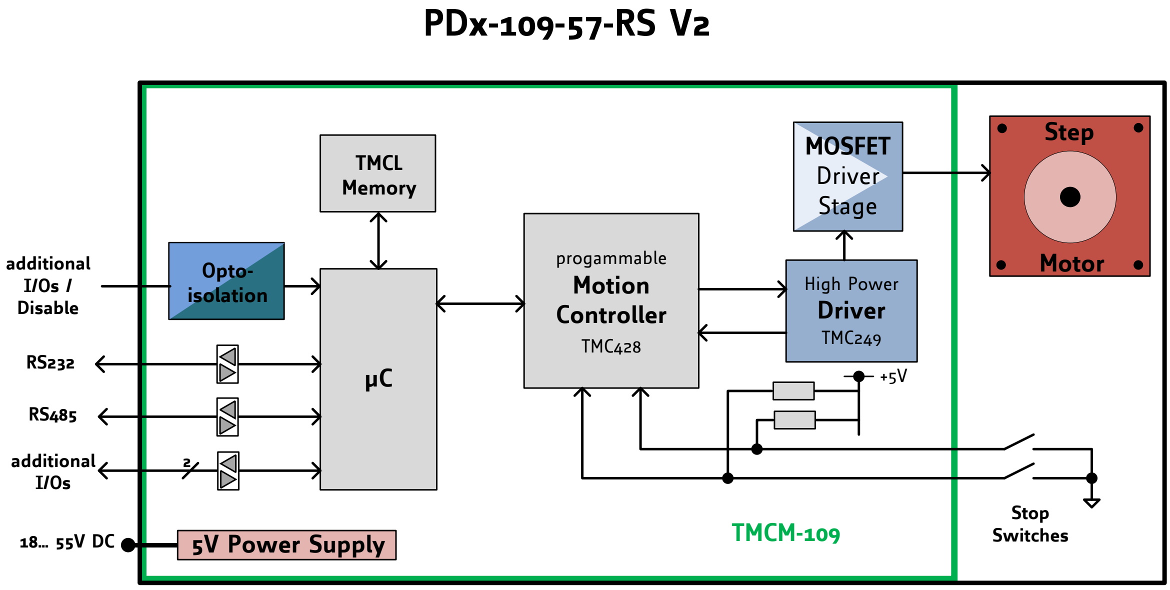


Figure 6.1: Main parts of the PDx-109-57 V2

6.1 System architecture

The TMCM-109 integrates a microcontroller with the TMCL™ (Trinamic Motion Control Language) operating system. The motion control real-time tasks are realized by the TMC428.

6.1.1 Microcontroller (µC)

The flash ROM of the microcontroller holds the TMCL™ operating system and the EEPROM memory of the microcontroller is used to permanently store configuration data, while an additional EEPROM memory holds the user TMCL™ programs.

The TMCL™ operating system can be updated only via the host interfaces. Please use the latest version of the TMCL-IDE to do this.

6.1.2 TMCL™ EEPROM

To store TMCL™ programs for standalone operation the TMCM-109 module is equipped with a 16kByte EEPROM attached to the microcontroller. The EEPROM can store TMCL™ programs consisting of up to 2047 TMCL™ commands.

6.1.3 TMC428 motion controller

The TMC428 is a high-performance stepper motor control IC and can control up to three 2-phase-stepper-motors (on this module, only one motor can be used). Motion parameters like speed or acceleration are sent to the TMC428 via SPI by the microcontroller. Calculation of ramps and speed profiles are done internally by hardware based on the target motion parameters.

6.1.4 TMC249 motor driver

The stepper motor driver used on the TMCM-109 module is the TMC249 chip. This driver is very dependable, because it provides a variety of protection and diagnostic features, which even can be read out by the user software. It's 16 times microstepping gives a quiet and precise motor operation. A maximum coil current of 5.0A is supported by this driver IC together with the high performance MOSFETs the module is equipped with.

6.2 Power supply requirements

The TMCM-109 is equipped with a switching voltage regulator that generates the 5V supply voltage for the digital components of the module from the motor power supply. Because of that only one supply voltage is needed for the module. The power supply voltage can be 18… 55V DC. Please note that there is no protection against reverse polarity or too high voltage. The power supply typically should be within a range of 24 to 48V to achieve highest motor performance. When using supply voltages near the upper limit, a regulated power supply becomes a must. Please ensure, that enough power filtering capacitors are provided in the system (2200µF or more recommended), in order to absorb mechanical energy fed back by the motor in stall conditions. In larger systems a zener diode circuitry might be required, when motors are operated at high velocities.

The power supply should be designed in a way, that it supplies the nominal motor voltage at the desired maximum motor power. In no case shall the supply value exceed the upper/lower voltage limit. To ensure reliable operation of the unit, the power supply has to have a sufficient output capacitor and the supply cables should have a low resistance, so that the chopper operation does not lead to an increased power supply ripple directly at the unit. Power supply ripple due to the chopper operation should be kept at a maximum of a few 100mV.

Therefore we recommend to

- keep power supply cables as short as possible
- use large diameter for power supply cables
- use a robust 2200µF or larger additional filtering capacitor located near to the motor driver unit, if the distance to the power supply is large (i.e. more than 2-3m)

6.3 Disable

The disable input works as an emergency shutdown. The polarity can be configured using TMCL™.
It is in the user's responsibility to stop the step impulses or set the velocity to zero before enabling the motor again, because it would start abruptly or otherwise loose track.

V_{OPTON}	open wire	V_{OPTOFF}
polarity 1	polarity 2	

6.4 Communication interfaces RS232 and RS485

The communication between the host and the module takes place via its host interface. This can be either RS232 or RS485. The module is equipped with both interfaces, but only one interface can be used at a time. All interfaces integrated on the module are ready-to-use, so there are no external drivers or level shifters necessary. To select RS232, leave open the interface selection pin, for RS485 pull it to ground. Please see chapter 4.2 for the pin assignments of the interfaces.

Interface selection pin (connector 2, terminal 2)	Selected communication interface
open wire	RS232
pulled to ground	RS485

The communication with the TMCM-109 module is done using TMCL™ commands.

When using the RS485 interface, the devices can be daisy-chained. Bus termination resistors in the range of 100 Ohms are typically required at each of the two ends of the cables.

6.5 Motor current setting

The motor current can be set in a range of 0 to 255, using the TMCL™ software instruction 5:

SAP, type 6: max. current (255 correspond to the module's maximum I_{COIL} setting.)

You can find the appropriate value in Table 6.1: Motor current examples

Setting	$I_{COIL,PP}$	$I_{COIL,RMS}$
255	5.0A	3.54A
216	4.2A	3.0A
180	3.5A	2.5A
144	2.8A	2.0A
108	2.1A	1.5A
72	1.4A	1.0A
0	0A	0A

Table 6.1: Motor current examples

6.6 Microstep resolution

The microstep resolution can be set using TMCL™ software. The default setting is 64 microsteps which is the highest resolution.

To set the microstep resolution with a TMCL™ command use instruction 5:

SAP, type 140: microstep resolution

<u>You can find the appropriate value in Table 6.2:</u>

Value	Microsteps
0	Do not use: for fullstep please see ***fullstep threshold***
1	Halfstep (not recommended)
2	4
3	8
4	16
5	32
6	64

Table 6.2: Microstep resolution setting

Despite the possibility to set it up to 64 microsteps, the motor physically will be positioned to a maximum of about 24 microsteps, when it is operated in the 32 or 64 microstep setting.

6.7 Reference switches

Two digital reference/stop switch inputs are provided (StopL= stop left and StopR = stop right). They are used as an absolute position reference for homing and to set a hardware limit for the motion range. The inputs have internal pull-up resistors. Either opto-switches or mechanical switches with normally closed contact can be used. The 5V output can be used as a supply for opto-switches.

6.8 stallGuard™ - sensorless motor stall detection

The integrated stallGuard™ feature gives a simple means to detect mechanical blocking of the motor. This can be used for precise absolute referencing, when no reference switch is available. The load value can be read using a TMCL™ command or the module can be programmed so that the motor will be stopped automatically when it has been obstructed or the load has been too high. Just activate stallGuard™ and then let the traveler run against a mechanical obstacle that is placed at the end of the operation area. When the motor has stopped it is definitely at the end of its way, and this point can be used as the reference position.

Please refer to the TMCL™ Firmware Manual on how to activate the stallGuard™ feature. The TMCL-IDE also has some tools which let you try out and adjust the stallGuard™ function in an easy way.

Mixed decay should be switched off when stallGuard™ is operational in order to get usable results.

6.9 Environment temperature considerations

As the power dissipation of the MOSFETs is very low, no heat sink or cooling fan is needed, unless the environment temperature is raised and the module continuously is operated at a high current.
When the output bridge temperature reaches a critical value, the output current is reduced by 20%. If the temperature still rises higher, the outputs become switched off. The coils are automatically switched on again when the temperature is within the limits again. An optional cooling fan can be mounted to cope with higher environment temperatures, when problems are perceived. The 5V power supply output can be used to operate a small fan.

6.10 State indication LEDs

The TMCM-109 module is equipped with four LEDs that show the actual state of the module:

LED	Function
POWER	Shows that the module is powered
CPU_OK	Flashes during normal operation. After resetting the configuration EEPROM it may take some seconds before the LED starts flashing again. When the operating system is being downloaded to the module the LED lights steadily.
ERROR	On when the temperature of the MOSFETs is getting too high. The LED is off during normal operation
OUT_0	Shows the state of the general purpose output

Table 6.3: State indication LEDs

6.11 Firmware update

Use the ***Install OS*** function of the TMCL-IDE. It is located in the ***Setup*** menu.

6.12 Resetting the module

The reset to factory default values can be done using the TMCL-IDE. Select ***Setup***, ***Configure module***, the ***Other*** tab and then ***Restore Factory Default***.

<u>If there are communication problems, the reset procedure of the PDx-109-57 is as follows:</u>

1. Turn OFF the power.
2. Link pins 1 and 3 of the programming connector (as shown in the picture below) by hardwire.
3. Turn the power ON and wait until the LED on the module flashes fast (faster than normally).
4. Turn the power OFF.
5. Remove the link between the pins.
6. Turn the power ON again and wait until the LED flashes normally (this can take some seconds).
7. All settings are restored to the factory default now.

Figure 6.2: Pins for resetting the module

7 Putting the PDx-109-57 into operation

On the basis of a small example it is shown step by step how the PDx-109-57 is set into operation. Users who are already familiar with TMCL™ and other TRINAMIC modules may skip this chapter.

Example:
The following application is to be implemented on the TMCM-109 module using the TMCL-IDE Software development environment.

The simple application is:

- Move the Motor to position 150000
- Wait 2 seconds
- Move the Motor back to position 0
- Wait 1 second
- Start again with the first step

Before implementing this application on the PDx-109 it is necessary to do the following:

Step 1: Connect the host interface to the PC

Step 2: Connect the power supply voltage to the module

Step 3: Switch ON the power supply. The activity LED should start to flash. This indicates the correct configuration of the microcontroller.

Step 4: Start the TMCL-IDE software development environment. Enter the program shown below.

```
//A simple example for using TMCL and the TMCL-IDE

        SAP 4, 0, 100              //Set the maximum speed

Loop:   MVP ABS, 0, 150000        //Move to position 150000
        WAIT POS, 0, 0
        WAIT TICKS, 0, 200
        MVP ABS, 0, 0             //Move back to position 0
        WAIT POS, 0, 0
        WAIT TICKS, 0, 100

        JA Loop                    //Infinite Loop
```

Step 5: Click the ***Assemble*** icon to convert the TMCL™ program into byte code. Then download the program to the TMCM-109 module by clicking the ***Download*** icon.

Step 7: Click the ***Run*** icon. The downloaded program will now be executed.

A detailed documentation about the TMCL™ operations and the TMCL-IDE can be found in the TMCL™ Firmware Manual.

8 TMCM-109 operational description

8.1 Calculation: Velocity and acceleration vs. microstep- and fullstep frequency

The values of the parameters sent to the TMC428 do not have typical motor values, like rotations per second as velocity. But these values can be calculated from the TMC428 parameters, as shown in the table below. It is also possible to use the calculator of the TMCL-IDE.

TMC428 velocity parameters:

Parameter	Description	Range
f_{CLK}	Clock frequency	16 MHz
velocity		0… 2047
a_max	Maximum acceleration	0… 2047
pulse_div	Velocity pre-divider. The higher the value is the less is the maximum velocity. Default value = 3 Can be changed in TMCL™ using SAP 154.	0… 13
ramp_div	Acceleration pre-divider. The higher the value is the less is the maximum acceleration default value = 7 Can be change in TMCL™ using SAP 153.	0… 13
Usrs	Microstep resolution (microsteps per fullstep = 2^{usrs}). Can be changed in TMCL™ using SAP 140.	0… 6

Table 8.1: TMC428 velocity parameters

The **microstep-frequency** of the stepper motor is calculated with:

$$usf[Hz] = \frac{f_{CLK}[Hz] \cdot velocity}{2^{pulse\_div} \cdot 2048 \cdot 32}$$ with *usf*: microstep-frequency

To calculate the **fullstep-frequency** from the microstep-frequency, the microstep-frequency must be divided by the number of microsteps per fullstep:

$$fsf[Hz] = \frac{usf[Hz]}{2^{usrs}}$$ with *fsf*: fullstep-frequency

The change in the pulse rate per time unit (microstep frequency change per second - the **acceleration a**) is given by:

$$a = \frac{f_{CLK}^{\ 2} \cdot a_{max}}{2^{pulse\_div + ramp\_div + 29}}$$

This results in acceleration in fullsteps of:

$$af = \frac{a}{2^{usrs}}$$ *with af: acceleration in fullsteps*

Example:

CLK	16MHz on the TMCM-109 module
velocity	1000
a_max	1000
pulse_div	1
ramp_div	1
usrs	6

$$msf = \frac{16\,MHz \cdot 1000}{2^1 \cdot 2048 \cdot 32} = \underline{\underline{122070.3125\,Hz}}$$

$$fsf[Hz] = \frac{122070.3125}{2^6} = \underline{\underline{1907.35\,Hz}}$$

$$a = \frac{(16Mhz)^2 \cdot 1000}{2^{1+1+29}} = \underline{\underline{119.208\frac{MHz}{s}}}$$

$$af = \frac{119.208\frac{MHz}{s}}{2^6} = \underline{\underline{1{,}863\frac{MHz}{s}}}$$

If the stepper motor has e.g. 72 fullsteps per rotation, the number of rotations of the motor is:

$$RPS = \frac{fsf}{fullsteps\ per\ rotation} = \frac{1907.35}{72} = 26.49$$

$$RPM = \frac{fsf \cdot 60}{fullsteps\ per\ rotation} = \frac{1907.35 \cdot 60}{72} = 1589.458$$

9 Software

TMCL™, the Trinamic Motion Control Language is used to send commands from the host to the TMCM-109 module and to write programs that can be stored in the EEPROM of the module so that the module can execute the TMCL™ commands in a stand-alone mode.

TMCL™ is described in the PDx-109-57 V2 Firmware Manual. This document also describes the TMCL™ Integrated Development Environment (TMCL-IDE), a program running on Windows which allows easy development of TMCL™ applications.

All manuals are provided on the TMC TechLib CD and on the web site of TRINAMIC Motion Control GmbH & Co. KG www.trinamic.com. Also the latest versions of the firmware (TMCL™ operating system) and PC software (TMCL-IDE) can be found there.

10 Revision history

10.1 Document revision

Version	Comment	Author	Description
1.00	Initial Release	OK	
1.01	2005-JUN-29	BD	Added technical specs
1.03	2005-DEC-09	BD, HC	Added PANdrive documentation
1.04	2005-DEC-15	BD	Added ordering info
1.06	2006-MAR-12	BD	Added mechanical dimensions for PANdrive
1.07	2006-JUL-13	BD	Corrected mechanical dimensions
1.08	2006-OCT-18	HC	Added resetting information
1.09	2007-JUN-06	HC	Microstep resolution (chapter 0) and operational description (chapter 8) added
1.10	2007-OCT-17	HC	Step/direction firmware information (chapter 5.1)
1.11	2008-DEC-08	OK	Step/direction inputs and all sections related to this removed
1.12	2010-JAN-15	SD	Motor specifications and dimensions updated, order codes renewed, minor other changes
1.13	2010-SEP-25	SD	Order codes corrected, dimensions corrected

Table 10.1: Document revision

10.2 Firmware revision

Version	Comment	Description
3.35	Actual revision	Please refer to TMCL™ manual

Table 10.2: Firmware revision

11 References

[PDx-109] PDx-109-57 Vs TMCL™ Firmware Manual
[TMCL-IDE] TMCL-IDE User Manual
[QSH5718] QSH5718 Manual

Please see http://www.trinamic.com.