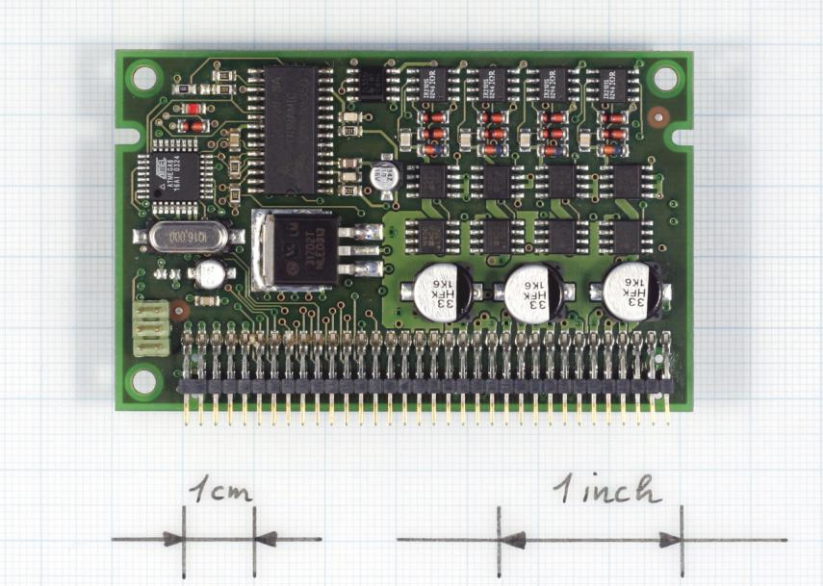
TMCM-035

Manual

1-Axis stepper driver module
3.5A RMS (5A peak) / 50V



TRINAMIC
MOTION CONTROL

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1 Features

The TMCM-035 is a compact motor driver module for highly dynamic or high torque axis. It can be combined with the driver-less modules TMCM-100, TMCM-301 or TMCM-302 or with any step / direction controller. Its small size and low power dissipation, together with the variety of three different control interfaces, make it an optimum solution for integration on any user board. The board can be connected to a baseboard or customized electronics with a pin connector. Applications are consumer and industrial controls, CNC power stages, lab automation, robotics, pick- and place machines
The TMCM-035 drives a two-phase bipolar stepping motor, with a maximum coil current of 5A and a maximum voltage of 50V. It is based on the TMC239 or TMC249 stepper motor driver chip. The interface between the control logic and the TMCM-035 module can be either Step / Direction, SPI or an analogue interface. The maximum motor current can be selected via external inputs. Since the new Version V2.0 of the board, the module has been extended from maximum 16 to 32 and 64 microsteps.

Applications
- Driver module for a highly dynamic or high torque axis
- Easy integration through three different control interfaces into any user board

Electrical Data
- Up to 3.5A RMS coil current (5A peak)
- 14V to 50V DC motor supply voltage
- 5V DC logic supply voltage

Supported motors
- two-phase bipolar motors with 0.3A to 3.5A coil current

Interface
- Step / Direction input (TTL/CMOS signal)
- SPI™ interface
- Classical analog interface

Highlights
- Up 64 times microstepping, since version 2.0 (prev. versions up to 16)
- Motor current settings via internal and / or external resistors
- Up to 245kHz microstep frequency
- TRINAMIC driver technology: No heat sink required
- StallGuard™ optional for SPI operation
- Standby reduction programmable
- "mixed-decay" mode for good microstep performance mode
- low EME design for ease of use

Other
- 68 pin connector carries all signals
- RoHS compliant
- Size: 80x50mm² (credit card)

Order code	Description
TMCM-035/SG (-option)	1-axis driver 3.5A / 50V with StallGuard
Related products	BB-035, BB-301
Option	
-H	horizontal pin connector (standard)
-V	vertical pin connector (on request)

Table 1.1: Order codes

Life support policy

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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 Electrical and Mechanical Interfacing

2.1 Dimensions

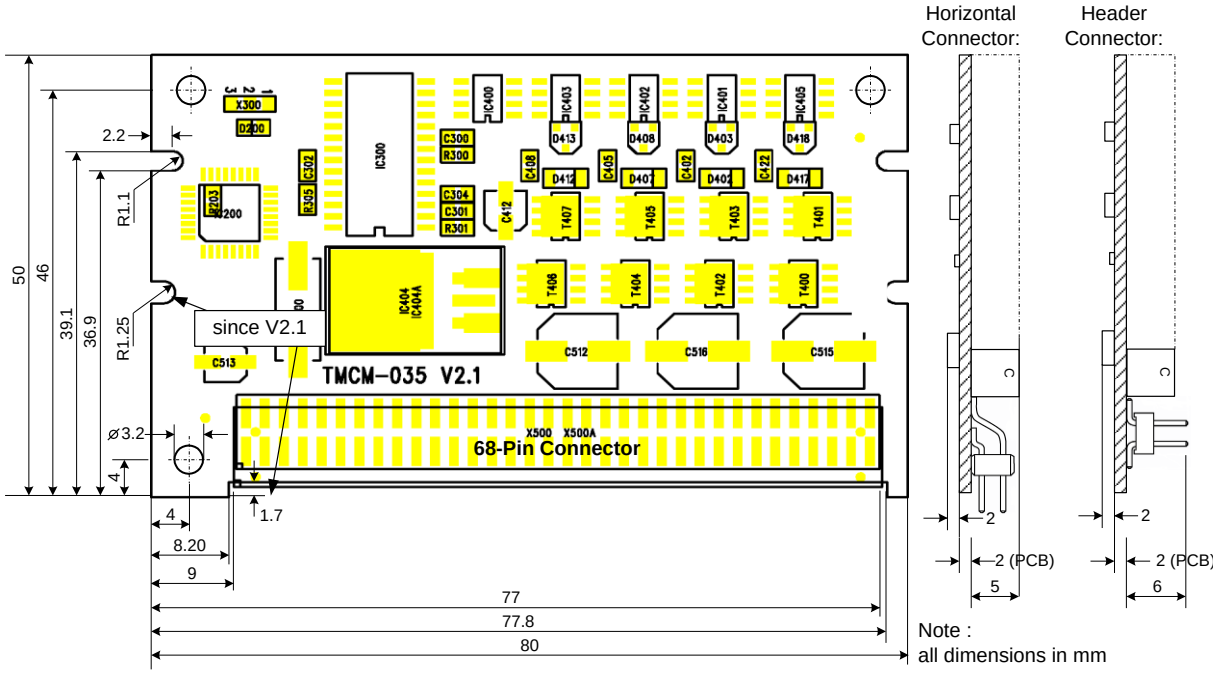


Figure 2.1: Dimensions

The size of the module (80x50mm) is the same as of the other Trinamic motion control modules. It also uses the same connector.
The 68 pin connector has a 2.0mm pitch.

Bord outline changes since TMCM-035 V2.1

- second notch (lower one) on each side for other type of plate holder
- clearance in the board close to the 64 pin connector to allow easier mounting. The pins of a horizontal connector are completely free and the opposite part wont abut against the board.

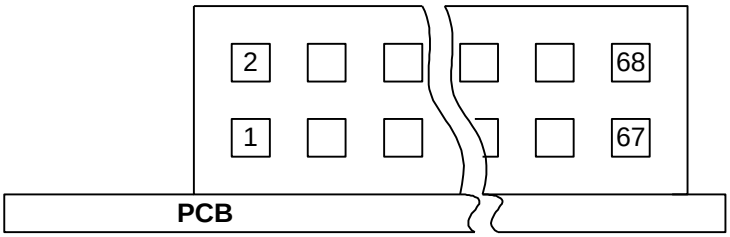


Figure 2.2: Pin order of the connector

2.2 Connecting the Module

The pin assignments of the connector are as follows:

Pin	Dir.	Description	Pin	Dir.	Description
1	In	+5VDC (+/- 5%) I_{max}=50mA	2	In	GND
3	In	+5VDC (+/- 5%)	4	In	GND
5	In	V_Motor (+14 to 50VDC)	6	In	GND
7	In	V_Motor (+14 to 50VDC)	8	In	GND
9	In	V_Motor (+14 to 50VDC)	10	In	GND
11	In	ENN (0 = enable driver)	12	In	Step/Dir mode: do not connect SPI mode: TMC239 CLK signal Analog mode:TMC239 MDBN signal
13	In	Step/Dir mode: do not connect SPI mode: TMC239 CSN signal Analog mode: TMC239 PHB signal	14	Out	Step/Dir mode: do not connect SPI mode: TMC239 SDO signal Analog mode: TMC239 ERR signal
15	-	n. c.	16	In	Step/Dir mode: do not connect SPI mode: TMC239 SDI signal Analog mode: TMC239 PHA signal
17	In	Reset (active low), leave open	18	In	Step In
19	In	SPE (0 = Analog mode, 1=SPI or Step/Dir mode)	20	In	Dir In
21	In	INA	22	In	SDEN: must be to 1 for Step/Dir mode or 0 for SPI or Analog mode
23	In	INB	24	In	STEP16: Step/Dir mode only: 1 = 16 resp. 64 microsteps 0 = 8 resp. 32 microsteps
25	In	SPI mode: ANN (INA and INB provide current reference if 0) Step/Dir mode: do not connect Analog Mode: TMC239 MDAN signal	26	In	USEMD: Set to 1 to use mixed decay in Step/Dir mode
27	In	/STEP64EN: Leave open or tie to +5V for 8 / 16 microsteps, tie to GND for 32 / 64 microstep resolution	28	In	OSC: leave open or supply external chopper clock
29	-	n. c.	30	-	n. c.
31	-	n. c.	32	-	n. c.
33	-	n. c.	34	-	n. c.
35	-	n. c.	36	-	n. c.
37	Out	OB2	38	Out	OB2
39	Out	OB2	40	Out	OB2
41	Out	OB1	42	Out	OB1
43	Out	OB1	44	Out	OB1
45	In	RSB2	46	In	RSB2
47	In	RSB1	48	In	RSB1
49	Out	OA2	50	Out	OA2
51	Out	OA2	52	Out	OA2
53	Out	OA1	54	Out	OA1
55	Out	OA1	56	Out	OA1
57	In	RSA2	58	In	RSA2
59	In	RSA1	60	In	RSA1
61	In	GND	62	In	GND
63	-	n. c.	64	-	n. c.
65	-	n. c.	66	-	n. c.
67	-	n. c.	68	-	n. c.

Table 2.1: Pinout 68-Pin Connector

3 Operational Ratings

The operational ratings show the intended / the characteristic 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	14		50	V
V_{+5V}	+5V DC input (max. 300mA)	4.75	5.0	5.25	V
I_{COIL}	Motor coil current for sine wave **peak** (chopper regulated, adjustable via RSA / RSB pins and software)	0	0.3 ... 5	5	A
f_{CHOP}	Motor chopper frequency		36.8		kHz
I_S	Power supply current (per motor)		<< I_{COIL}	1.4 * I_{COIL}	A
f_{STEP}	Step frequency			245	kHz
t_{SPulse}	Step pulse length	0.1			µs
t_{S2D}	Direction hold time	2			µs
t_{D2S}	Direction to step delay	0			µs
V_{ANA}	INx analog measurement range		0 ... 3		V
f_{SPI}	SPI clock frequency			2	MHz
T_{BOARD}	Recommended PCB temperature limit		+85	+105	°C
T_{ENV}	Environment temperature at rated current (3.5A RMS), module mounted vertically without forced cooling	-40		+40	°C
	Environment temperature for up to 2.5A RMS, module mounted vertically without forced cooling	-40		+60	°C

Table 3.1: Operational Ratings

4 Functional Description

In Figure 4.1 the main parts of the TMCM-035 module are shown.

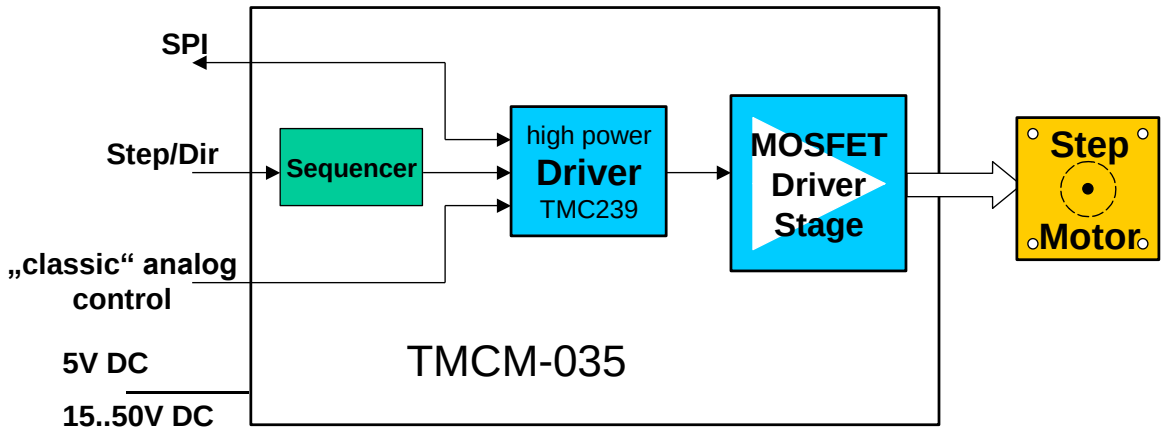


Figure 4.1: Main parts of the TMCM-035

4.1 Power Supply

The power supply for the TMCM-035 is 14V to 50V DC. The module is not protected against wrong polarity. Also a +5VDC supply for module functionality is needed. Please use all listed pins for the power supply inputs and ground parallel.

4.2 Motor Connection

Connect the motor to the OA and OB pins. Always use all the pins to connect the motor! Connect one coil of the motor to the OA1 (53, 54, 55, 56) and OA2 (49, 50, 51, 52) pins and the other coil to the OB1 (41, 42, 43, 44) and OB2 (37, 38, 39, 40) pins. **Never connect or disconnect the motor while the module is under power as this may damage the module.**

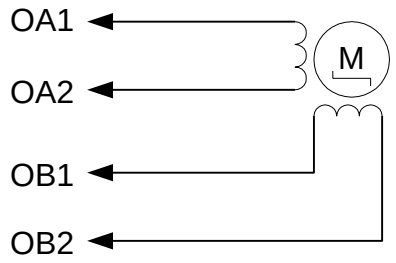


Figure 4.2: How to connect the motor

4.3 Interfaces

The TMCM-035 has three different interfaces to fit in all applications. There is a SPI interface, a analog interface and step / direction interface available. The classic analog interface provides very high microstep resolutions but has compared to the SPI interface a disadvantage of poor diagnostics. SPI on the other hand has all the diagnostics but is limited to 16x microstep resolution. Refer to 4.6.2 for the possibility to increase microstep resolution to up to 64x for SPI.

4.3.1 SPI

The SPI interface pins of the connector are directly connected to the SPI pins of the TMC239. So, the data that must be supplied via the SPI interface can be found in the TMC239 data sheet. The SPI data can either be generated directly by a microcontroller or by a TMC428. To use the SPI interface you will have to make the following connections:

Signal name	Pin number	Connection
SPE	19	High (can be left open, SPI enable)
SDEN	22	Connect to GND (to disable Step / Direction interface unit).
SDI	16	Connect to SPI bus
SDO	14	Connect to SPI bus
CSN	13	Connect to SPI bus
CLK	12	Connect to SPI bus
ANN	25	Set high (or leave open) for normal current settings or low to provide the current reference via the INA and INB inputs (please see section 4.4.1 for details).
/STEP64EN	27	Leave open or connect to +5V to operate in 16 microstep mode, directly using the 12 bits control shift register of the TMC239/249 (please refer to the respective manuals) Connect to GND for 64 microstep mode with 6 bit DAC. In this mode, the SPI word is extended by an 8 bit shift register (see SPI table in Figure 4.6).

Table 4.1: SPI interface connections

The SPI interface is mainly to be used to connect the TMCM-035 module to a TMCM-301 module. This way, up to three TMCM-035 modules can be connected to one TMCM-301 module. The connection for one module is shown in Table 4.2.

TMCM-035 pin number	TMCM-301 pin number	Signal name (TMCM-035)
1, 3	1, 3	+5V
2, 4, 6, 8, 10	2, 4, 6, 8, 10	GND
11	--	Enable, connect to GND
12	30	CLK
13	20	CSN
14	28	SDO
16	26	SDI

Table 4.2: Connecting a TMCM-035 to a TMCM-301

For operation with microstep resolution of 32 or 64 steps per fullstep refer to 4.6.2 Increasing Microstep resolution with SPI interface

In SPI mode the LED on the board does not have any function and can be ignored.

4.3.2 Analog

The analog interface is mainly to be used to connect the TMCM-035 to a TMC453 chip or to a TMCM-100 module (that contains a TMCM453 stepper motor controller chip).
The following pins are to be used in analogue mode:

Signal name	Pin number	Connection
SPE	19	Connect to GND (to enable analog interface unit)
SDEN	22	Connect to GND (to disable Step / Direction interface unit).
Enable	11	Connect to GND to enable or set high to disable the motor driver.
INA	21	Analog input which determines the current of phase A (0..3V).
INB	23	Analogue input which determines the current of phase B (0..3V).
PHA	16	Digital input which determines the polarity of phase A.
PHB	13	Digital input which determines the polarity of phase B.
MDAN	25	Set low to use mixed decay or high to use slow decay on phase A.
MDBN	12	Set low to use mixed decay or high to use slow decay on phase B.

Table 4.3: Analog interface connections

Please see Figure 4.3 for an explanation of the INA/INB/PHA/PHB signals.

Here is how to connect the TMCM-035 module to a TMCM-100 module:

TMCM-035 pin number	TMCM-100 pin number	Signal name (TMCM-035)
1, 3	1, 3	+5V
2, 4, 6, 8, 10	2, 4, 6, 8, 10	GND
19	--	SPE, connect to GND
11	--	Enable, connect to GND
22	--	SDEN, connect to GND
21	39	INA
23	41	INB
16	25	PHA
13	29	PHB
25, 12	--	MDAN/MDBN, connect to GND to use mixed decay or leave open for slow decay.

Table 4.4: Connecting a TMCM-035 to a TMCM-100 (analog)

Please see section 4.4 for selecting the peak motor current.

In analog mode the LED shows the status of the module:

- The LED is on when the motor is enabled and the supply voltage is high enough.
- The LED is off when the motor is disabled due to pin 11 (Enable) set high or supply voltage to low.
- The LED flashes when there is an error :
  - Temperature too high: motor stops until temperature is acceptable (normally a few seconds)
  - Current too high (short circuit): motor is switched off until short circuit is corrected
  - Power supply too low for motor: motor is switched off, until power supply is sufficient.
  - Open load: motor is NOT switched off (occurs when a motor coil circuit is open or sometimes at high velocities when the motors current limit is reached

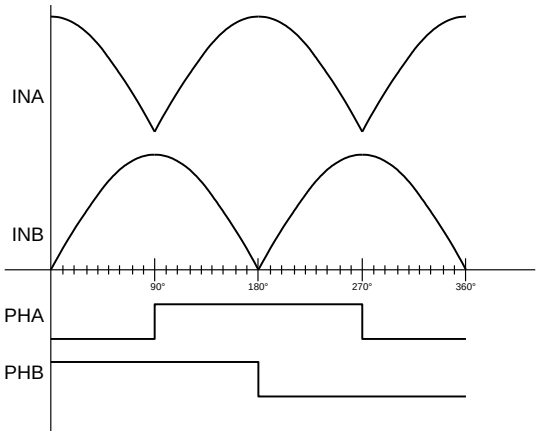


Figure 4.3: Analog control

4.3.3 Step / Direction

To use the Step / Direction interface connect the inputs as follows:

Signal name	Pin number	Connection
SPE	19	high (+5V, can be left open alternatively)
SDEN	22	high (+5V, can be left open alternatively) , step / direction enable
STEP16	24	high for 16, low for 8 microsteps (STEP64EN is high) high for 64, low for 32 microsteps (STEP64EN is low)
STEP64EN	27	high (can be left open) for 8/16 microsteps, low for 32/64 microsteps available since version 2.0
USEMD	26	Set high (or leave open) to use mixed decay (recommended for most applications), or low to use slow decay.
Step In	18	Connect your step signal here. The rising edge of the signal is a step pulse.
Direction In	20	Connect your direction signal here.
ANN	25	Do not connect!

Table 4.5: Step / Direction interface connections

Note: Pins 12, 13, 14, 16 and 25 must not be connected in this mode!

The Step / Direction interface can also be used to connect the TMCM-035 module to a TMCM-100 module (however it results in a higher microstep resolution, if the analogue interface is used with the TMCM-100). Here is how to do it:

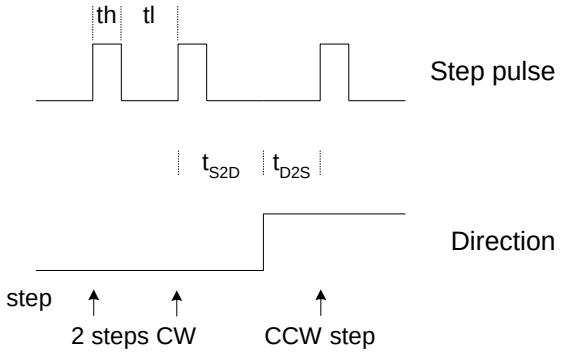
TMCM-035 pin number	TMCM-100 pin number	Signal name (TMCM-035)
1, 3	1, 3	+5V
2, 4, 6, 8, 10	2, 4, 6, 8, 10	GND
11	--	Enable, connect to GND
18	20	STEP
20	19	DIR

Table 4.6: Connecting a TMCM-035 to a TMCM-100 (step / direction)

In step / direction mode the LED shows the status of the module:

- The LED is on when the motor is enabled and the supply voltage is high enough.
- The LED is off when the motor is disabled due to pin 11 (Enable) set high or supply voltage to low.
- The LED flashes when there is an error (please refer to chapter 4.3.2 for more information).

Step-Direction signal timing:



	Min
T_{S2D}	2 µs
T_{D2S}	0 µs
th	0.1µs

Figure 4.4: Step / Direction signal timing

4.4 Current setting

The motor current setting can be selected by connecting the RSA and RSB pins to GND as shown in the following table.
Note: In step-/direction mode the motor is without current until the first step impulse is given. The same applies after a disable/enable cycle.

Caution: Never leave both, RSA/B1 and RSA/B2 pins, open!

peak coil current	RMS current (microstep operation)	RSA1, RSB1	RSA2, RSB2
1.5 A	1 A	GND	open
3.4 A	2.5 A	open	GND
5.0 A	3.5 A	GND	GND
variable	peak current / 1.41	(external resistor from RSA/RSB to GND)	

Table 4.7: Current setting

4.4.1 Fine current adjustment in SPI mode:

In SPI mode, the current values set via the sense resistors can be modified using the analog inputs INA and INB. In this case the ANN input (pin 25) must be pulled low. The INA and INB inputs supporting a voltage range of 0 to 3V can be used. Use a simple voltage divider on the 5V supply to accomplish this, e.g. a 10K Potentiometer. A value of 2V corresponds to the currents given in the table, i.e.

Current set value = (Value from Table 4.7) * (INA/INB-Voltage) / 2V

Please be careful with values of INA/INB > 2V since the maximum current of the module can be exceeded (150% at 3V).
In 64 microstep mode the current adjustment via the analog inputs is limited. The voltage on INA and INB should not exceed the range from 1.5 to 2.5 V in your application.

Following exemplary R/C filter gives an analog voltage range of about 0 to 2.1V.

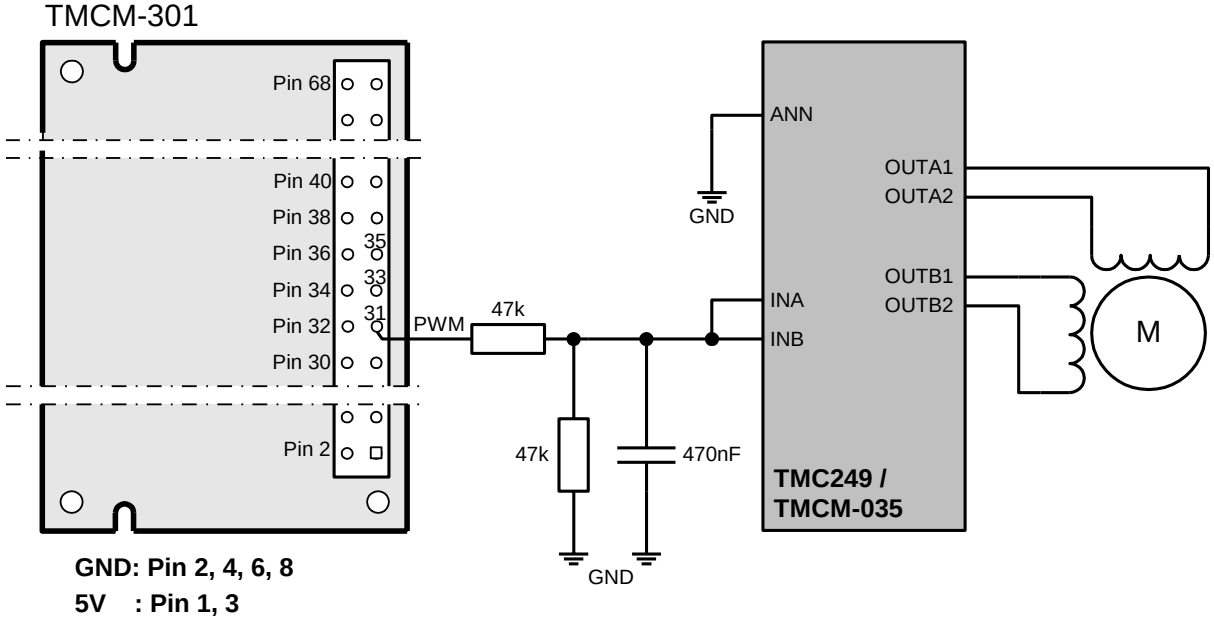


Figure 4.5: Application example for a TMCM-035 and TMCM-301 with analog current control

Another way of setting a different peak coil current is to connect the RSA pins to GND via an external resistor and the RSB pin via the same size of resistor. The two resistors should be in the range 100mOhms to 1 Ohm. This possibility can also be used when the module is connected via its analogue interface. However it is very important to use SMD resistors with low inductivity and very short traces to GND for a stable operation in this configuration.

peak coil current	RMS current (microstep operation)	RSA1, RSB1	RSA2, RSB2
1.0 A	0.7 A	open	each 0.22 R to GND
1.2 A	0.85 A	each 0.18R to GND	open
1.7 A	1.2 A	GND	each 1.5R to GND
2.1 A	1.5 A	GND	each 0.47R to GND
2.8 A	2.0 A	GND	each 0.15R to GND
4.2 A	3.0 A	each 0.27R to GND	GND

Table 4.8: Current fine adjustment with RSA and RSB

4.4.2 Standby current reduction for Step-/ Direction mode

In step / direction interface mode, the current control will switch to the INA and INB inputs when there has been no step pulse for at least four seconds. Current control will switch back to the normal value set via RSA/RSB pins when the next step pulse occurs. This way the standby current can be set using the INA and INB pins (by applying a voltage between 0 (0%) and 2V (100%). The maximum current while the motor is running must be set using the RSA/RSB pins.
The coil current should be reduced when the motor is standing still!

Power down current set value = Value from Table 4.7 * (INA/INB-Voltage) / 2V

4.4.3 Continuous Current restrictions / Thermal conditions

The module is designed as a microstepping module, with sine wave currents (sine and cosine) driving both coils. The current peak of the sine wave can be as high as 5A, when the RMS current is set to 3.5A. The mean motor current (RMS) is calculated by dividing the peak current by 1.41.

The compact design of the module does not allow to continuously drive the full current unless forced air cooling is used to keep the board temperature below 85°C, because of excessive heat generation. On a short term basis, the board is allowed to reach 105°C, but it will shorten life time, if this occurs in longer periods. However, since continuous maximum current operation also shortens the lifetime of the motor, this is in most cases no restriction. The driver transistors on the module (8 transistors labeled "4450" or similar) may heat up to 120°C at their surface - this is not critical!

The module provides a thermal protection, but this is only meant as a means against sudden destruction, i.e. when a cooling blower fails and the module slowly overheats. The protection is not meant to limit normal operation! It can not protect against all faults, since it is central in the TMC249 IC, and might react too slowly!

The following limits apply:

- Maximum environment temperature for up to 3.5A RMS (= **5A peak**) is **40°C**, module mounted vertically
- Maximum environment temperature for up to 2.5A RMS (= **3.5A peak**) is **60°C**, module mounted vertically
- If the module is mounted horizontally, use forced air flow for current above 2.0A RMS.
- The phase current should be reduced to a maximum of 70% of the above values while the motor is standing

- Maximum current for fullstep operation (both coils on) is 3.5A (peak value for fullstep is identical to RMS value!)
- For continuous operation above 2.5A RMS a forced cooling is mandatory. The module should not be mounted in a horizontal position for continuous operation with coil currents above 2.5A RMS.
- At a reduced supply voltage, heating will be less. The actual heat dissipation also depends on the motor!

If the module will be operated near to these limits for extended periods of time, a measurement of the board temperature in the final application / housing should be done in order to make sure, that life time is not reduced by module operation near to / above the temperature limits.

4.5 Mixed decay and slow decay

When using the step / direction interface it is possible to switch to mixed decay by setting the USEMD pin (pin 26) high or to switch to slow decay by pulling the USEMD pin low. When using the analogue mode use the MDAN and MDBN pins to select between mixed decay and slow decay (pull MDAN/MDBN low to use mixed decay). When using the SPI interface the mixed decay feature is controlled by bit 11 and bit 5 of the SPI telegram (please see [TMC239] datasheet for details about the structure of the SPI telegram).
The mixed decay setting especially at rotation velocities in the range of a few 10 steps per seconds to several 100 steps per second improves motor behavior (less resonance). However, the actual performance depends on the motor and mechanics. For supply voltages above 24V and for low inductivity motors, best microstep behavior is reached when mixed decay setting is continuously on.
Mixed decay should be switched off when StallGuard operational in order to get usable results.

4.6 Microstep resolution adjustments

Step / direction and analog interface support high microstep resolutions. SPI is restricted to 16x microstepping without external hardware additions described in [TMC236/239/246/249 FAQ] (Extending the microstep resolution). Since hardware version V2.0 a 64 microstep resolution is possible without additional hardware, refer to 4.6.2.

4.6.1 Microstep resolution with step / direction interface

When using the step / direction interface it is possible to select the microstep resolution of 8, 16, 32 or 64 microsteps per fullstep. The resolution is since hardware version 2.0 (some labeled TMCM-035 D) pre-selected with Pin 27 "STEP64EN". Pin 27 set high or left open selects low resolutions (8 or 16 microsteps), Pin 27 set low (to GND) selects high resolutions (32 or 64 microsteps). The final selection has to be done by pin 24 "STEP16", set high or left open the microstep resolution is either 16 or 64 depending on the setting of pin 27. Set low the microstep resolution is either 8 or 32. In former hardware versions pin 24 sets the TMCM-035 to 8 or 16 microsteps only, and pin 27 has no function.

4.6.2 Increasing Microstep resolution with SPI interface

Even the 16 microstep version of the TMCM-035 can realize more than 16 microsteps via TMC428 SPI control: Just program the TMC428 for 32 microstep mode. Due to the combination of two DACs driving the two coils, this results in a resolution somewhere between 20 and 30 microsteps.

4.6.3 64 Microstep resolution with SPI interface since TMCM-035 V2.0

To get full 64 microsteps using the TMC428 with a user built electronics, please refer to the schematic example in [TMC239] or [TMC249] and [TMC236/239/246/249 FAQ] (Extending the microstep resolution).

Please remark, that the **lower two bits are inverted**, and the **values from 0 to 3 give a zero current**. This effectively results in a 60 level current resolution. A suitable microstep table is printed below. The effect of this modified DAC behaviour is, that the TMC428 ramp-phase-dependent current scaling function does not lead to a good result and should not be used! This could be improved by inverting the additional DAC-Bits. Please be aware, that the module in 64 microstep mode can not be included in SPI busses with multiple /CS lines.

For best microstep performance run the motors with mixed decay switched on continuously and 36kHz chopper.

To program the TMCM-035 for 64 microstep mode the pins 24 and 27 are used (refer to 4.6.1). It is important to load the proper wave table as well as the proper SPI configuration. Both are available on the TRINAMIC technical library. The following table depicts the SPI bit ordering. The bits are to be shifted into the SPI chain from left (19) to right (0). The function of the bits is described in the TMC239 / TMC249 manual and FAQ document.

	TMC239 control word												Additional 8 bits in 64 microstep mode							
Bit	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Standard function	MXA	CA5 (MSB)	CA4	CA3	CA2	PHB	MXB	CB5 (MSB)	CB4	CB3	CB2	PHB	/CB1	/CB0	/CA1	/CA0	-	-	-	-

Figure 4.6: SPI word assignment in 64 microstep mode

Required TMC428 driver chain configuration for each TMCM-035 in 64 microstep mode:

```
0x11,0x05,0x04,0x03,0x02,0x06,0x11,0x0d,0x0c,0x0b,0x0a,0x0e,0x09,0x08,0x01,0x00,
0x10,0x10,0x10,0x30              // 4 unused bytes, last plus next motor bit
```

The suitable microstep table for 32 and 64 microstep with inverted LSBs (1/4 wave, like in TMC428):

```
0x00,0x07,0x05,0x04,0x0a,0x09,0x0f,0x0e,0x0c,0x13,0x11,0x10,0x17,0x15,0x14,0x1a,
0x19,0x18,0x1e,0x1d,0x1c,0x22,0x21,0x20,0x27,0x25,0x24,0x2b,0x2a,0x29,0x28,0x2f,
0x2e,0x2d,0x2c,0x33,0x32,0x31,0x30,0x37,0x36,0x35,0x35,0x34,0x3b,0x3a,0x3a,0x39,
0x39,0x38,0x38,0x3f,0x3f,0x3e,0x3e,0x3d,0x3d,0x3d,0x3d,0x3d,0x3c,0x3c,0x3c,0x3c
```

Since the wave table is modified (lower two bits, bit 0 and bit 1, are inverted), the current scaling function of the TMC428 (IS_AGTAT, IS_ALEAT, IS_V0) should be switched off, i.e. these registers should be set to zero (full current).

Hint for operation with TMC428 based controllers: The needs to read back the TMC249 bits for operation of the StallGuard or for driver diagnostics. While the TMC428 can control driver chains with up to 64 bits, it can read back a total of 48 bits only. Thus, when cascading three TMCM-035 in one TMC428 driver chain and all modules are set to 64 microstep mode, the first 12 bits sent back from the 60 bit long driver chain to the TMC428 can not be read back. These are all bits from the last TMC249 in the chain, including its StallGuard bits. Thus, you should attach only two TMCM-035 in 64 microstep mode to a TMC428 based module. This brings also an advantage for the reachable motor velocity. If you need all StallGuard bits in a three driver chain, switch at least two modules in the chain to 16 microstep mode.

Example: Up to three TMCM-035 with 64 microsteps in use with a TMCM-301

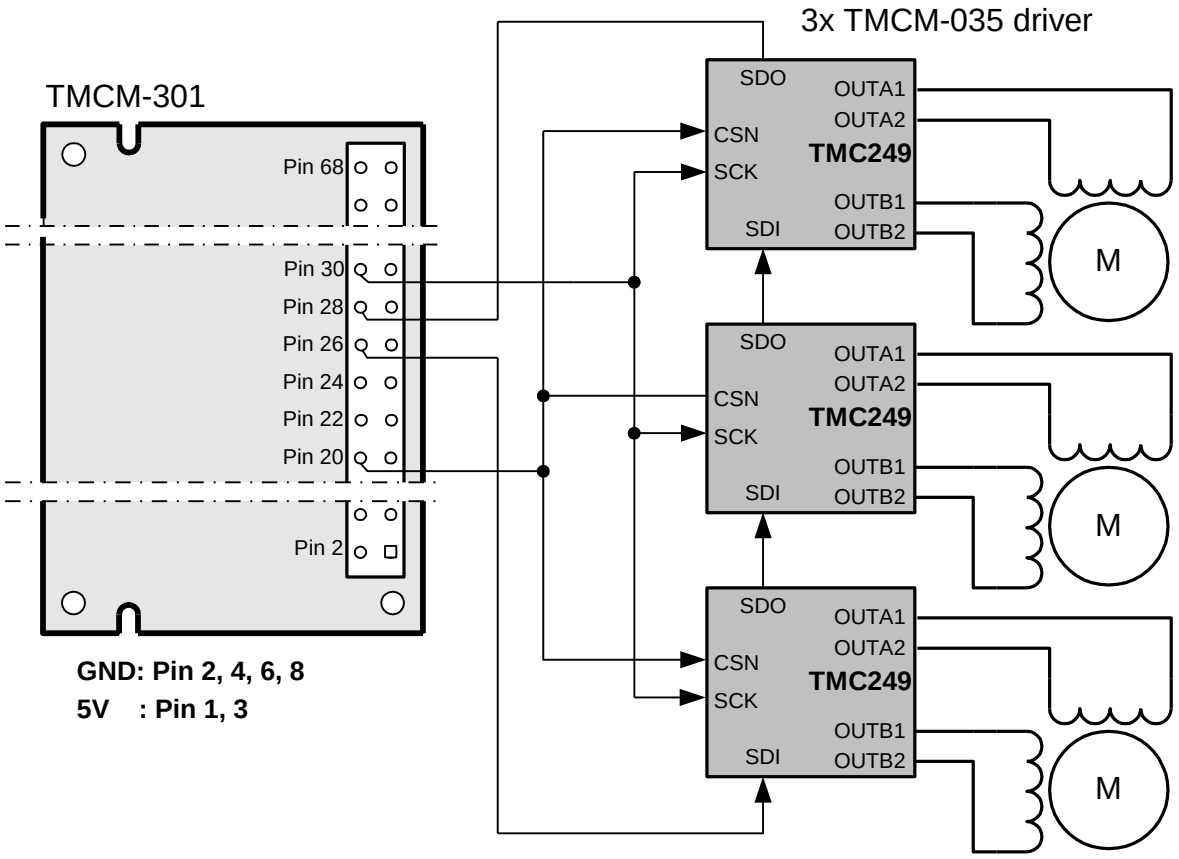


Figure 4.7: Application with 3 TMCM-035 controlled by a TMCM-301

The microstep configuration of the three TMCM-035 drivers (digital pins 24 and 27) can be controlled by the I/O ports of the TMCM-301, so that each driver is configured directly.
Fill in the Driver Chain and set global parameters according to Figure 4.8. CS_COMM_IND has to be deactivated for cascaded TMCM-035 modules. LSMD defines the number of motors used (2 for 3 motors). After loading or filling in the driver chain press "Set" to program the TMCM-301.

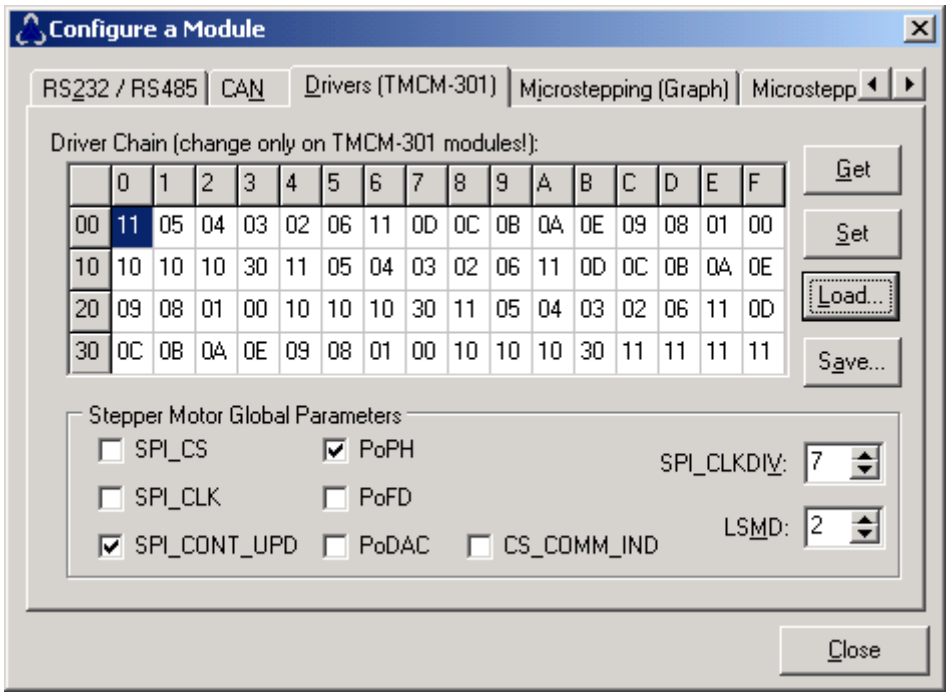


Figure 4.8: Driver chain configuration for up to 3 TMCM-035 in use with TMCM-301

Now it is time to program the TMCM-301 with the following microstep table (Figure 4.9) by pressing "Set". Please use the 64 microstep table to get the smoothest operation.

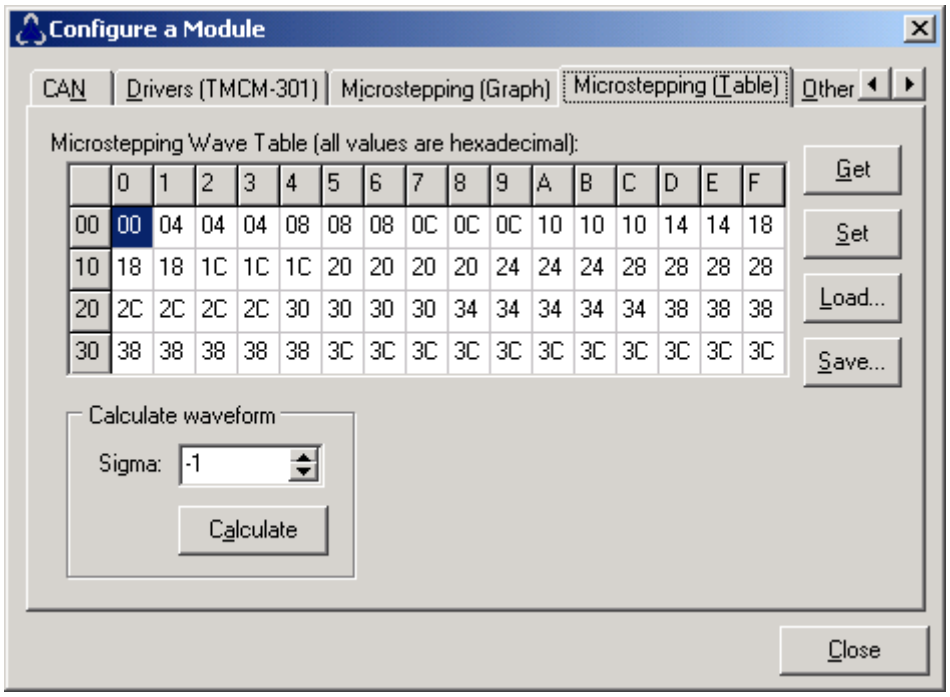


Figure 4.9: Microstep table for 64 microsteps in use with TMCM-301

Mixed decay has to be switched on constantly, SAP 203 has to be set to 2048 for all used motors. This values can be saved with STAP 203 to the EEPROM of the TMCM-301 for each motor.

5 Hardware Revision

Version	Since	Description
1.0	2003	Initial version
2.0	Mar.2006	Labelled TMCM-035-D V1.0. The module has been extended from maximum 16 to 32 and 64 microsteps New function of connector pin 27 (activates 64 microsteps)
2.1	Jan 2007	Bord outline changes (please refer to 2.1): • second notch on each side for other type of plate holder • clearance close to the 64 pin connector to allow easier mounting.

Table 5.1: Hardware revision

6 Documentation Revision

Version	Date	Author	Description
1.00	08-Jan-04	OK	Initial version
1.01	20-Apr-04	OK	Minor error corrections
1.02	01-Oct-04	OK	Address corrected
1.03	28-Oct-04	BD	Maximum step rate increased
1.04	13-Feb-04	OK	Ordering information added
2.00	20-Jun-06	BD	64 microstep version info added
2.01	14-Jul-06	HC	Major revision
2.02	21-Aug-06	HC	Additions to 64 microstep version info
2.03	29-Nov-06	BD	Comments on maximum component temperature
2.04	10-Jan-07	HC	Addition to 4.4; step-/Dir: motor currentless before first step
2.05	21-Feb-07	HC	Added 2.0mm pitch connector info
2.06	25-May-07	HC	Hardware revision and new dimensions for version 2.1 added
2.07	13-Jun-07	HC	Additions to 4.4.1 Fine current adjustment in SPI mode:
2.08	28-Nov-07	HC	Additions to errors indicated by LED in analog mode (4.3.2)
2.09	27-Feb-09	OK	Step/Dir connections (Table 4.5) corrected

Table 6.1: Documentation Revisions

7 References

[TMC239] TMC239 manual (see http://www.trinamic.com)
[TMC249] TMC249 manual (see http://www.trinamic.com)
[TMC236/239/246/249 FAQ] TMC239/249 FAQ (see http://www.trinamic.com)
[TMCM-301] TMCM-301 manual (see http://www.trinamic.com)
[TMCM-100] TMCM-100 manual (see http://www.trinamic.com)

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