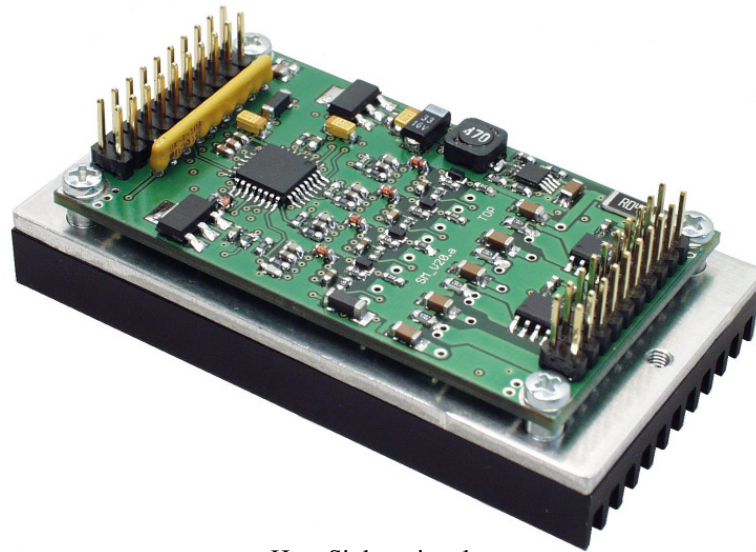


Data Sheet

StepperModule SMMx76

OEM Power Drive for 2(3)-Phase Stepper Motors



Heat Sink optional

Draft

Revision: 46/2010 subject to change without prior notice

Product Features

- OEM module for 2(3)-phase steppers
- Automatic motor setup at power on
- Automatic setting of the operating parameters
- 24..80V motor voltage 1..8Amps(peak) phase current
- 200 to 10000 steps/revolution for all common lead screw pitches
- High step accuracy and high and constant torque
- Control Interface (3,3V, TTL, CMOS compatible)
 - o Pulse and Direction up to 500kHz
 - o optional: ASI(RS232, RS485), SPI, I²C
- Outputs (3,3V, TTL)
 - o Ready , Diagnostics
- Comprehensive protection functions
 - o Over current, temperature + cooling fan control,
 - o Low voltage, phase interruption, current reduction
- Comprehensive diagnostics indicator LED
- Innovative Mechatronics
 - o Heat conducting mounting bracket
 - o Optional heat sink
- All signals on pin row
 - o Module for plug in or to solder in
- Super compact, only 75x40x10 mm³

Variants / Order Code:

SMM276-xx 2-Phase Power Module
SMM376-xx 3-Phase Power Module

-00 Puls + Direction
-01 reserved
-02 SPI Comand Interface (beta version)
-03 ASI-Comand Interface (motion control)

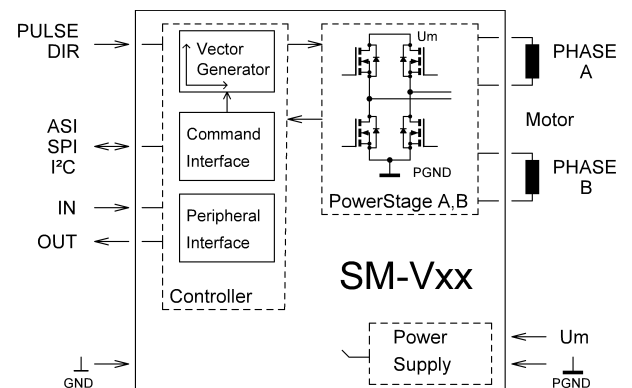
-10+ customized variants

Stepper power for limited space requirements

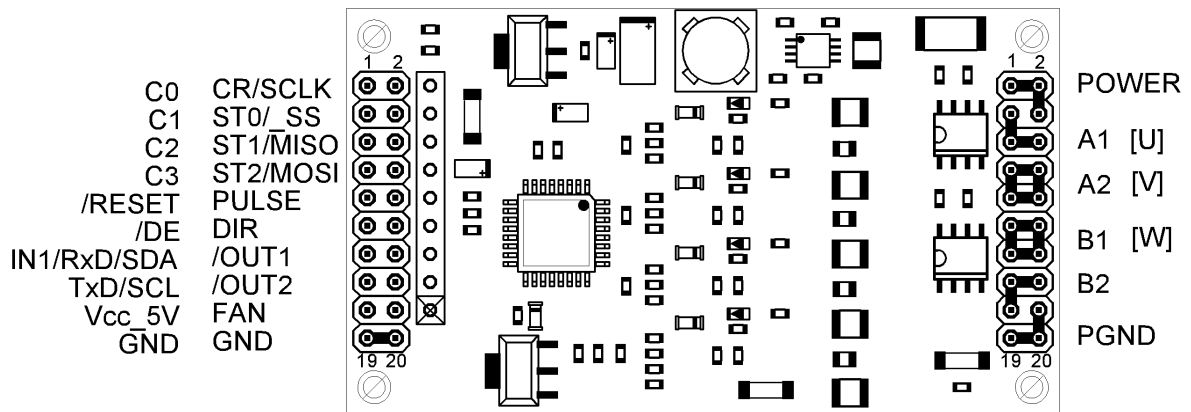
The SM-Vxx stepper module is intended for all users who want to integrate a high power density drive into their application. The module is complete, meaning all “critical“ components are already integrated. Therefore special power drive know is not essential. Integration into a user circuit is simple and easy. All signals are connected via pin rows. The module can also be plugged in since the high current power signals share multiple pins.

The power drive sets new standards for digital control of stepper drives. Utilizing state-of-the-art DSP-technology made it possible to realize new control procedures and circuit technologies. These are especially the **Automatic Controller Setup** (used for optimal stepper performance) when switching on the drive power, the continuous **Setting of the Operating Parameters** during operation, a **variable Boost-Function** and current reduction as well as a special **StandBy Mode** when the drive is idle. The power drive design is fully digital and the phase current is measured directly in the motor windings. The strict focus was here to achieve optimal operating performance such as low resonance run, high step angle accuracy and high and constant torque from step to step. The power specs are 24...80V, 1...8Apeak, up to 10000 steps/revolution with a super compact design foot print of only 75x40x10mm³. In addition to pulse and direction signal there are optional interfaces such as ASI(RS232, RS485), SPI and I²C possible that allow set drive operating parameters remotely.

Block Diagram (shown for 2-Phase Stepper)



Pin Assignment:



StepperModule SM-Vxx

Pin Description:

/Name= low active, first line is default, otherwise optional, oC= open Collector

Left connector

Pin	Name	Type	Description
1,3,5,7	C0...3 IO_0...3	Pull Up	Input: Phase current setting with 16 steps I/O: Digital IO for customer specific use
9	/RESET	Pull Up	reserved: Not used, do not connect PIN
11	/DE	Pull Up	reserved: Not used, do not connect PIN
13	IN1/RxD/SDA	Pull Up	Input: IN1 OFF(no motor current), Reset in fault condition I/O: RxD Receive-Data for asynchronous serial Interface I/O: SDA Data for I ² C-Interface I/O: Digital IO for customer specific use
15	TxD/SCL	Pull Up	Output: TxD Transmit-Data for asynchronous serial interface I/O: SCL Clock for I ² C-Interface I/O: Digital IO for customer specific use
17	Vcc_5V		Power Supply: Only for external optical isolator supply (20mA max.)
19, 20	GND		Digital Ground: Common potential for logic signals (only w. galvanic isolation)
2	CR/SCLK		Input: CR Current reduction on/off I/O: SCLK Clock signal for SPI-interface I/O: Digital IO for customer specific use
4	ST0/_SS		Input: ST0 Setting of the step resolution I/O: _SS Slave select for SPI-Interface I/O: Digital IO for customer specific use
6	ST1/MISO		Input: ST1 Setting of the step resolution Output: MISO Slave output signal for SPI-Interface I/O: Digital IO for customer specific use
8	ST2/MOSI		Input: ST2 Setting of the step resolution I/O: MOSI Slave input signal for SPI-Interface I/O: Digital IO for customer specific use
10	PULSE		Input: Clock for stepping motor
12	DIR		Input: Direction for stepping motor
14	/OUT1	oC	Output: Module ready, ok
16	/OUT2	oC	Output: Diagnostics
18	FAN		Output: Cooling fan control at over temperature

Right connector

Pin	Name	Description
1,2, 4	POWER	Module power supply (motor voltage)
3,5,6	A1	Motor connection Phase A1
7,8,9,10	A2	Motor connection Phase A2
11,12,13,14	B1	Motor connection Phase B1
15,16,17	B2	Motor connection Phase B2
18,19,20	PGND	Common potential for module supply

PIN function description

C0..3: Motor current setting

The motor current is set in 16 steps. In general only as much current should be set as actually is required for the application even though the nominal motor current is not reached. The table below lists the possible current settings in milliamps for C3..0.

1111	1000	1011	2500	0111	4500	0011	6500
1110	1250	1010	3000	0110	5000	0010	7000
1101	1500	1001	3500	0101	5500	0001	7500
1100	2000	1000	4000	0100	6000	0000	8000

The set motor current value represents the peak current I_{PEAK} of one phase. The calculate RMS current per phase is $I_{RMS} = I_{PEAK}/\sqrt{2}$. The effective motor phase current I_m generating the motor torque results from the geometrically added phase currents I_a and I_b : $I_m = \sqrt{I_a^2 + I_b^2}$. Because of the motor inductance the set motor current value can not be reached a higher step frequency rates. Consequently the motor torque drops at higher speeds (see torque/speed characteristic diagrams of the motor manufacturer) We recommend a high current motor version with low inductance or a higher motor voltage (! don't exceed max. voltage).

Automatic current reduction is recommended.

ST0..2 Step resolution

The step resolutions are for standard hybrid stepper motors with 50 magnetic. The table below lists possible setttable step resolutions per motor revolution for ST2..0.

000	10000	010	2500	100	1000	110	400
001	5000	011	2000	101	500	111	200

Running performance:

☺ less than 400 ☹ 400 ☺ more than 400

The step performance improves with higher motor current (set nominal motor current)

Behavior of resonance

The motor resonance can be reduced by increasing the steps/revolution.

The following table will show the effect under the condition that the resonance at full step will be 100%

steps/rev.:	behavior of resonance
200	100%
400	29%
800	8%

PULSE: Clock signal for steps

A step is executed with each positive signal edge. The power drive exclusively reacts on signal edges. In case of an active current reduction (Pin CR „current reduction“ low) and pulse pauses greater than approx. 2s, the motor current is reduced to approx. 60% of the set value.

DIR: Direction

The direction signal defines the sense of motor rotation. The logic assignment can be inverted by swapping the wires of one motor phase.

e.g. Phase A1 and A2 at 2 phase steppers
Phase U and Phase V at 2 phase steppers

/OUT_1: READY

This output is switched low active when the drive is functional. In an error state the level is high (3,3V).

/OUT_2: DIAGNOSTICS

This output is used to signal a fault:

Ready: /OUT2 is continuously low active

Fault: /OUT2 pulses as described below:
100ms active, 300ms non active
2x Low voltage occurred
3x Over temperature
4x Over current detected
5x Problem in motor wiring
Repetition after 1,3s pulse brake

The fault state can be reset with input IN1.

FAN: Cooling fan control

The output switches active (level 3,3V) at power drive temperatures exceeding 65°C. This signal can be used to control a cooling fan. Should the temperature still rise, the power drive is switched off at approx. 72°C.

POWER: Supply

The drive can be operated in the range of 24 to max. 80 Volt. In close proximity to the pins "POWER" and "PGND" an electrolytic capacitor with low ESR and at least 47µF must be placed (see wiring guideline). Furthermore it must be guaranteed that the power supply voltage at no load and +10% mains over-voltage does not exceed 80 Volt and that there is a sufficient charge capacitor of at least 6800µF.

Never connect live supply voltage wires to the terminals, because the sudden charge current of the internal electrolytic capacitors can destroy the internal fuses

!CHECK FOR CORRECT POLARITY

PGND: Power Ground

Common potential for the module supply voltage. The module must generally be supplied via the pins "POWER" and "PGND".

GND: Logic Ground

Common potential for the logic signals (see wiring guideline).

A1, A2 und B1, B2: Motor connection

The power drive can operate both 2-phase and 3-phase motors.

By swapping a phase, e.g. phase A1 and A2 of the 2 phase motor the motor sense of rotation can be inverted to the logic assignment of the direction signal „DIR“.

By swapping a phase, e.g. phase U and V the 3 phase motor sense of rotation can be inverted to the logic assignment of the direction signal „DIR“.

Under no circumstances motor wires must be disconnected during operation. Induction voltages can destroy the power drive. For this reason assure proper contact of the motor wires at the screw terminal.

/RESET: Module-Reset

Is usually not used because the module has its own internal PowerUp-Reset.

/DE reserved

For internal use only. ! Do not connect.

Vcc_5V: Optical isolator supply

Supply voltage for possible external optical isolators. No other loads must be connectors. ! Load < 20mA

Options:

Some applications may require that the module parameters must be remotely set by an external controller, because it is not possible to access the module. For this reason multiple serial interfaces were implemented:

RxD, TxD: ASI Interface

Asynchronous Serial Interface. With the corresponding drivers a RS232 or RS485 interface can be realized

SDA, SCL: I²C Interface

Inter Integrated Circuit. The module generally operates in slave mode.

SCLK, SS, MISO, MOSI: SPI Interface

Serial Peripheral Interface. The module generally operates in slave mode.

Function description**Current reduction CR:**

Switching CR to 0V level activates the automatic current reduction. The motor current is reduced to approximately 60% of the set motor current. The losses in the motor as well as in the drive can therefore be significantly reduced.

! Current reduction reduces holding torque. Assure the resulting holding torque is acceptable for your application.

The current reduction is activated, if the pulse input is inactive for more than approx. 2s.

At pulse frequencies less than 1 Hz it can happen that the current reduction is briefly switched on. To avoid this effect the start/stop-frequency should be set significantly higher than 1 Hz. Immediately after detecting an active pulse input nominal current is restored.

It is recommended to generally activate the current reduction. Practical experience values show that the temperature can be reduced more than 10°C

Automatic controller setup:

At power on, the drive electronically analyzes the motor. Next the operating parameters are automatically tuned to achieve optimal dynamic and smooth run drive performance. Consequently the power drive adjusts itself to the respective motor.

Variable boost function:

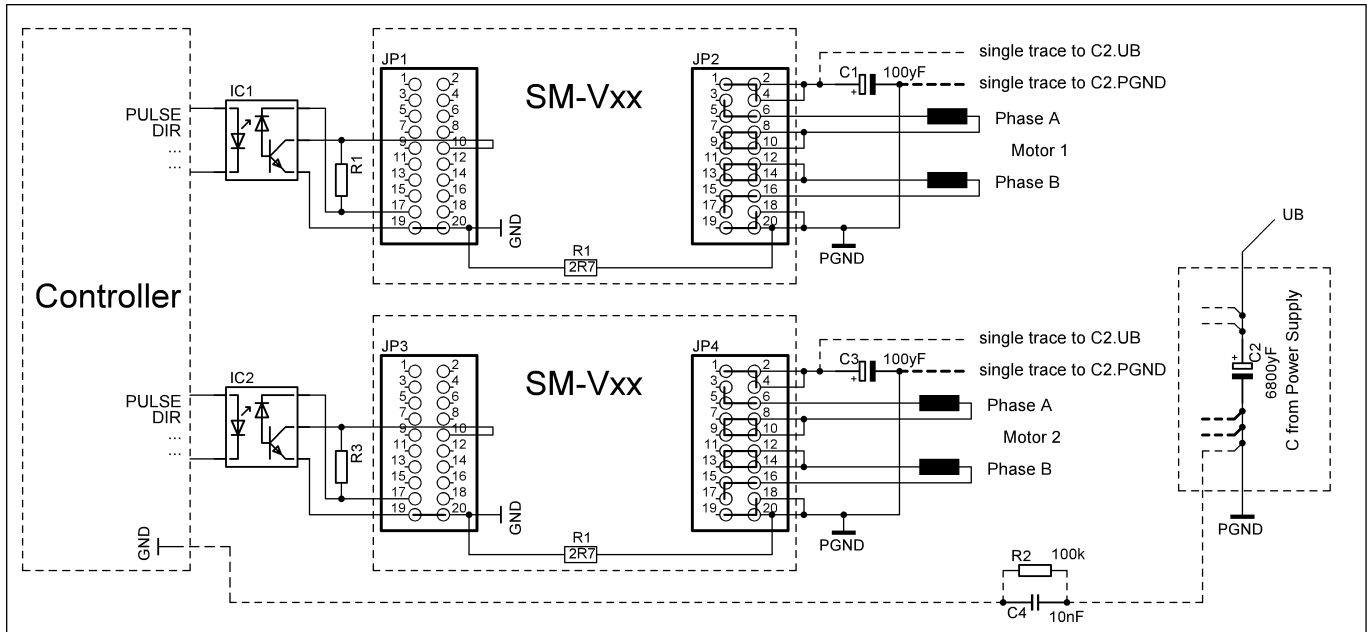
A variable boost function is enabled depending on the actual acceleration rate, i.e. an additional current offset is added to the set current value. With this, higher acceleration rates are possible.

Automatic operating parameter setting:

Several conditions are continuously monitored during operation and the operating parameters are automatically adjusted. As a result the constant motor torque range stretches and dynamic positioning moves are also possible in the higher speed range.

StandBy Mode:

With lower speeds down to stand still the power drive gradually switches to the stand by mode. The motor is absolutely quiet and this with full torque. A big advantage for office and lab environments.

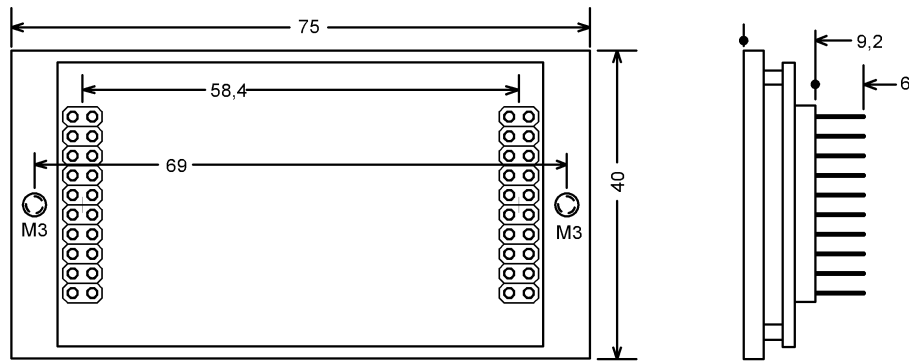
Wiring guideline: with galvanic isolation**(preferred)****Design-Requirements:**

- C1 must be placed as close as possible to the power module
- C1 of at least 47µF and with low ESR
- Each must be connected with a separate trace to the power supply capacitor C2, the ground trace must be solid
- PGND of the power supply capacitor C2 is the common potential point for all modules and controllers
- The motor power supply must only be connected via PowerGround PGND and UB.

With galvanic isolation:

- R2 and C4 are used for potential equalization
- The common potential for the optical isolators is GND of stepper module SM_Vxx
- Optical isolators with digital output must be used

Dimensions



Technical Specifications:

Item	Symbol	Notes	Min	Type	Max	Unit
Motor Supply Voltage	POWER	5	21	24..72	80	V
Supply Current @ 48V (Motor off)	I_{SC}			40		mA
Voltage ripple	U_{rip}				2	V
Inrush current @ 48V, $I_{Motor} = 4A$	I_{up}				2	A
Fusing	F			3		Amtr
5V auxiliary Output					20	mA
Current settings 16 values peak current	C0...C3		1		8	A
Steps per rotation 8 steps	ST0...ST2		200		10000	steps
Input Voltage High (digital)	V_{IH}		2,0		5,5	V
Input Voltage Low (digital)	V_{IL}				0,8	V
Input Current High (digital)	I_{IH}		-2,5		2,5	μA
Input Current Low (digital)	I_{IL}	PinGroup 1		-60		μA
Input Current Low (digital)	$I_{ILPullUp}$	PinGroup 2		-400		μA
Output Voltage High @ 4mA	V_{OH}	PinGroup 3	2,4			V
Output Voltage Low @ 4mA	V_{OL}	PinGroup 4			0,4	V
Output Voltage High max	V_{OHm}	PinGroup 4			5,5	V
PWM-Frequency	PWM_{FREO}			16		kHz
Temperature FAN on	T_{FANon}			65		$^{\circ}C$
Temperature Device off	T_{Doff}			72		$^{\circ}C$
Time: PowerUp to READY @48V	$T_{puready}$				2	s
Time: PULSE before DIR	T_{pd}		100			ns
Time: DIR after PULSE	T_{dp}		100			ns
Baud Rate ASI (Rx,D,TxD)	BR_{ASI}			9600		
Clock SPI (SCLK, MISO, MOSI)	CLK_{SPI}			500		kHz
Data Setup Time SPI	T_{SPIDSU}		20			ns
Data Hold Time SPI	T_{SPIDH}		2			ns
Clock I ² C (SCL)	SCL_{PC}			100		kHz
Data Setup Time I ² C	T_{PCDSU}		4			μs
Data Hold Time I ² C	T_{PCDH}		300			ns

Notes:

- 1: PinGroup 1: CR/SCLK, ST0/_SS, ST1/MISO, ST2/MOSI, PULSE, DIR
- 2: PinGroup 2: C0..3, /RESET, /DE, IN1/RxD/SDA, TxD/SCL, with PullUp 10k
- 3: PinGroup 3: FAN
- 4: PinGroup 4: /OUT1, /OUT2 open collector type
- 5: Reference= PGND