BAUR
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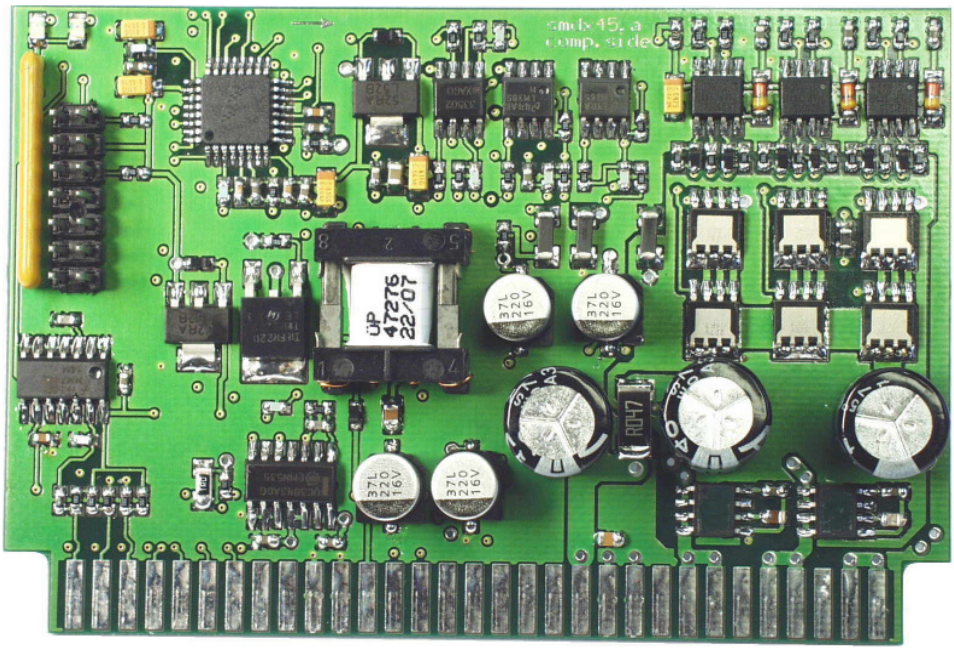
Operator Manual

2-Phase Stepper Drive smd255

3-Phase Stepper Drive smd355



Revision: 14/2010 subject to change without prior notice

Product Features

- For all common 2-(3) Phase-Hybrid-Stepper Motors

- OEM-Module, for integration into your application

- Complete, all functions on-board

- Only one supply voltage from 24 to 50 Volt required

- Motor phase current from 1.0 to 5.0 Amps

- Settable step resolutions per revolution
200, 400, 500, 1000, 2000, 2500, 5000 and 10000

- Automatic motor set up at power on

- Automatic operating parameter setup
o High dynamic in the upper speed range
o High torque during acceleration
o Quiet at stand still due to StandBy Mode

- Inputs: (CMOS 3,3V to 5V)
PULSE, DIRECTION, IN1[OFF, RESET, GATE]
4 Bit Current Setting
3 Bit Steps/Revolution
1 Bit Current Reduction (on/off)

- Outputs: (CMOS 3,3V, Ri=750ohm)
READY, BALLAST, Auxiliary

- Brake-out of all connections

- Smooth and low resonance running performance

- High and constant torque from step to step

- Protected against over-current, over-temperature, over-voltage and low voltage

- Extensive device status information with LEDs

- Automatic current reduction at stand still

- Variable boost-function at acceleration

- Active ballast circuit protects from over-voltage

- Dimensions: L:W:H 90x60x12(mm) w/o connector

Options:

- Slot connector, pin row

This power drive sets new standards for the digital control of stepping motors. Utilizing a state-of-the-art digital signal processor (DSP) made it possible to develop new procedures and control technologies. The result is a low cost power drive especially suitable for OEM markets. The target group are end users or OEMs with application oriented controls such as for (hose) pumps , pin(needle) stampers, lab devices, measurement equipment etc. The power drive is simply integrated as a complete module into the user circuit.

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. Specific power drive know how is therefore not required.

Boost and Current Reduction

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. The current reduction reduces the motor current at stand still to 60% of the set current value.

Dynamic Operating Parameter Adjustment

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.

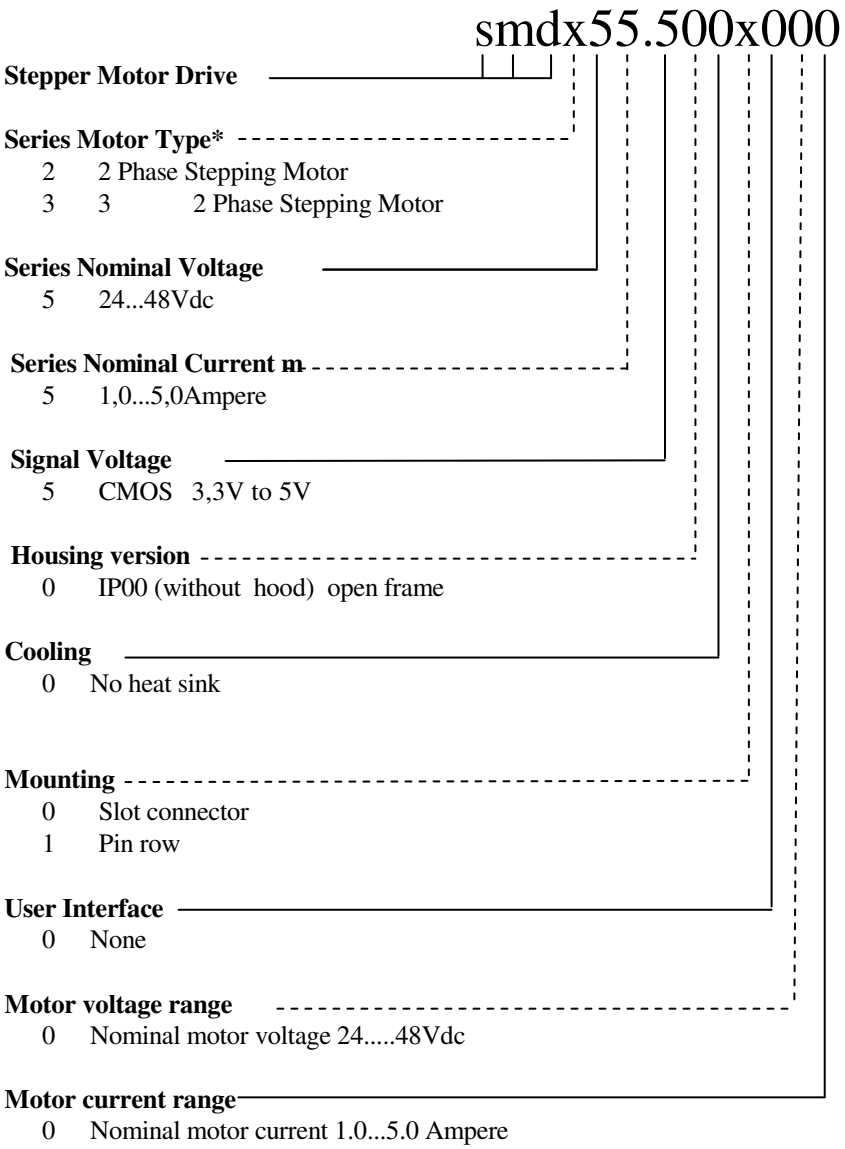
StandBy Mode

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.

Digital Phase Current Controller

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 module is fully equipped and contains all necessary hardware components so that no additional peripheral circuitry is needed.. All required supply voltages are generated on board with an internal power supply. Furthermore auxiliary voltages are available to supply the user application as well. Preferably the drive is integrated and connected with a slot connector or optionally with a pin row connector.

Ordering Number Key

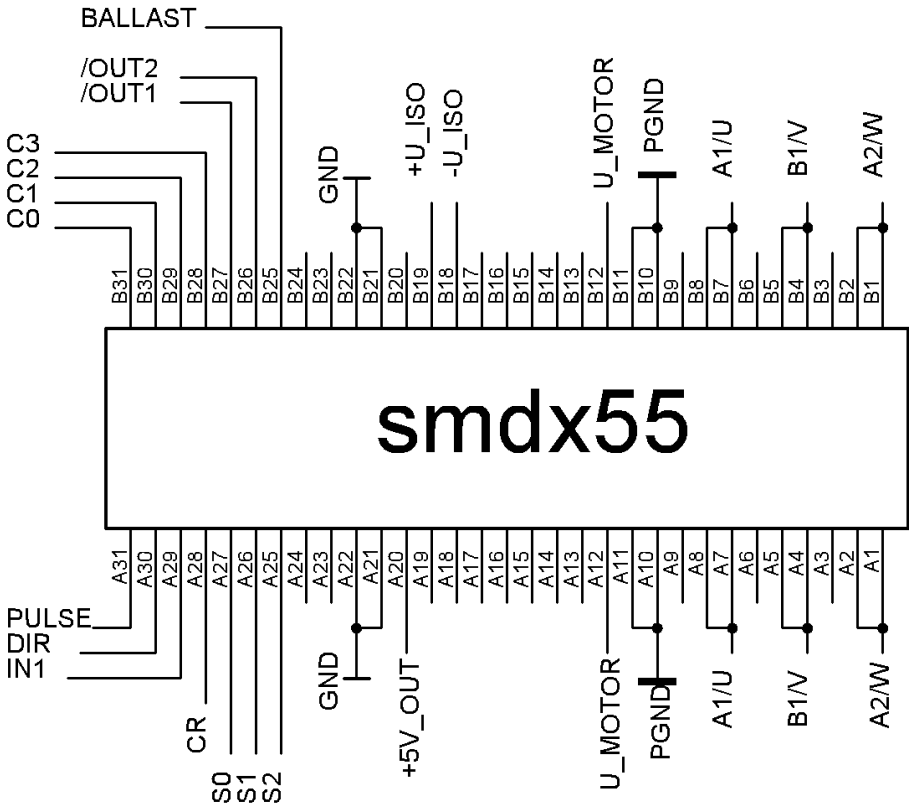


Accessories (separate order items)

STS.07	Slot connector
STS.08	Pin row
KM*m*	Motor cable 2x2 0.75mm^2 twisted pairs with overall shielding *m* = Length in Meter 01, 02, 05, 10 (e.g.: 2 Meter motor cable = KM02)
DOKU	DIN-A5 paper manual

* Stepper motors upon request. Please contact us for assistance concerning motor selection and drive calculation

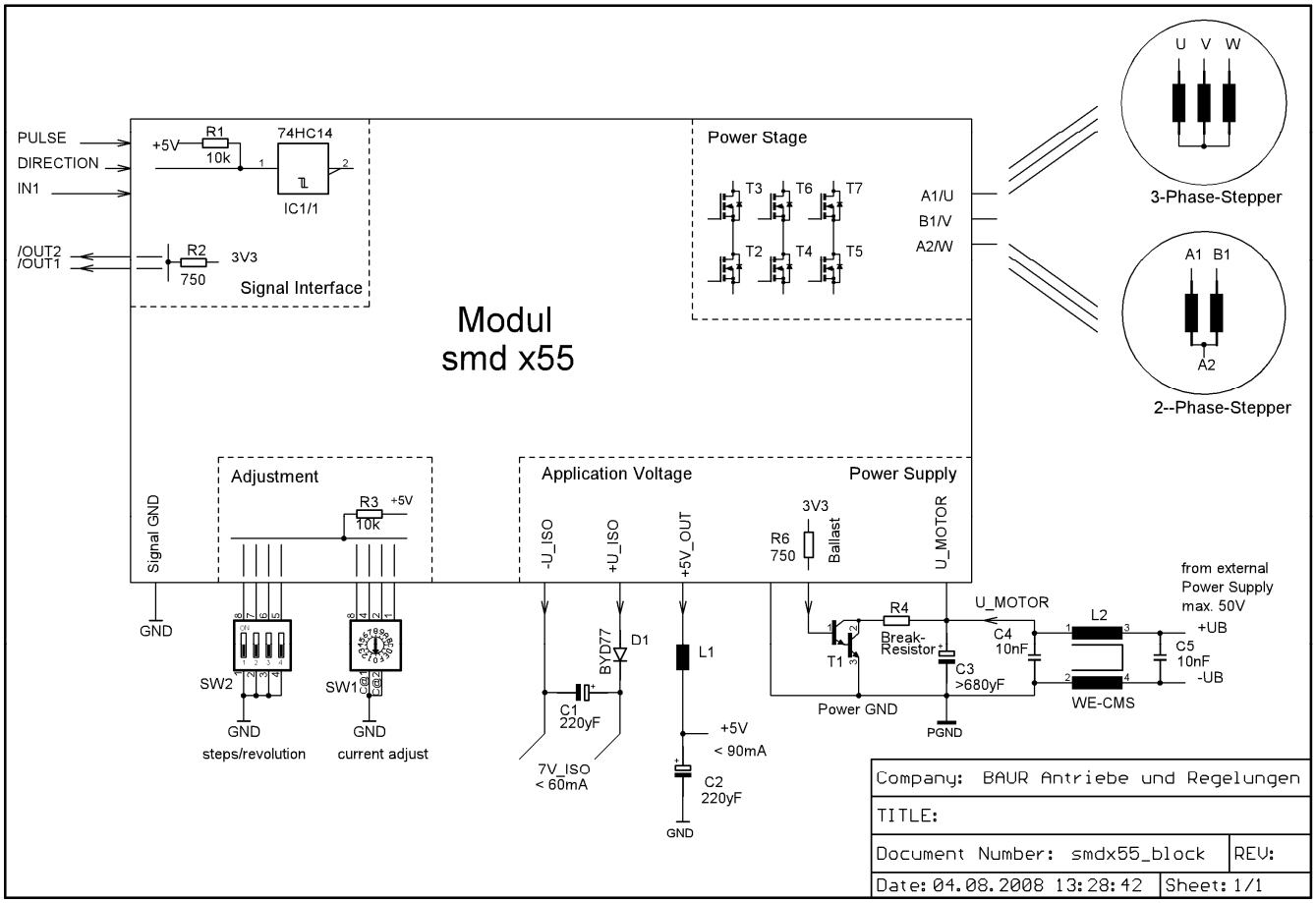
Pin Assignment: (Looking down on the PCB component side A31 is to the left)



Pin Description:

Slot-Pin	Name	Description
A31	PULSE	Input: CMOS 10k Pull-Up 5V Schmitt-Trigger active high Control-Interface: Pulse, Direction, Off (motor powerless)
A30	DIR	
A29	IN1	
		Input: CMOS 10k Pull-Up 3V3 active low - Current reduction - Motor current
A28	CR	
A27…A25	S0…S2	
B31…B28	C0…C3	
		Output: CMOS Ri= 750 Ohm 3V3 active low
B27,B26	/OUT1, /OUT2	/OUT1: Ready, /OUT2: Status
		Output: CMOS Ri= 750 Ohm 3V3 active low
B25	BALLAST	- Signal for ballast resistor control
A22...A21 B22...B21	GND	Logic-Ground (internal connected with PGND) Common potential for logic signals
A20	+5V_OUT	5V output voltage to supply peripheral user circuit
B19,B18	+U_ISO, -U_ISO	Can be used to create an electrically isolated auxiliary 7V voltage
A12,B12	U_MOTOR	Supply voltage
A11…A10 B11..B10	PGND	Power-Ground (internal connected with GND) Common potential for power drive
A8,A7,B8,B7	A1/U	Motor connection
A5,A4,B5,B4	B1/V	
A2,A1,B2,B1	A2/W	

Block Diagram



Function Description

The inputs **PULSE, DIR** and **IN1** are control inputs.

PULSE: **(Pulse)**
A step is executed with each positive signal edge. The power drive exclusively reacts on signal edges. In case of an active current reduction (switch „current reduction“ on) and pulse pauses greater than approx. 1s, 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 smd255
Phase U and Phase V at smd355.

IN1: **(OFF** standard)
Input IN1 is an auxiliary input that can be defined for different tasks. Per default the function of the input is “OFF“. The motor is switched off by activating the input “OFF“. The current chopper is switched off. This feature is occasionally used in measuring equipment to be able to measure even the smallest signal amplitudes without interference. This condition allows to move the motor mechanically.

/OUT_1: **READY**
This output is switched low active when the drive is functional. In an error state the level is high (3,3V). The condition is indicated with LED L1 (left upper 1.LED).

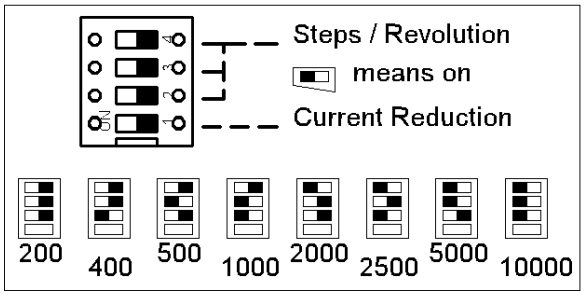
/OUT_2: **parallel to L2** (left upper 2. LED)

Status display with L1 and L2

Ready:	L1 on
	L2 on in Zero-Position
Error:	L1 off, L2 flashes (see below):
	2x Low-voltage occurred
	3x Over-temperature
	4x Over-current detected

The error state can be reset with input IN1.

Step resolution S0...S2: (steps per revolution)
Using a standard hybrid stepper motor with 50 magnetic poles result in following steps/revolution (assumed that S0..S2 are connected to DIP switches 2, 3 and 4).



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. 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%

Motor current setting: C0...C3
The motor current is set precisely with the HEX switch.
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 mA:

Imotor[mA]

0	1000	4	2000	8	3000	C	4000
1	1250	5	2250	9	3250	D	4250
2	1500	6	2500	A	3500	E	4500
3	1750	7	2750	B	3750	F	5000

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.

Current reduction CR: (current reduction)
"Current Reduction" (e.g. activated with DIP switch 1 to position "ON") 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. 1s.
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

POWER SUPPLY: (U_Motor)
The drive can be operated in the range of 24 to max. 50
It must be guaranteed that the power supply voltage at no load and +10% mains over-voltage does not exceed 50 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

BALLAST CIRCUIT:
The motor voltage is continuously monitored . Should this voltage become excessively high (e.g. when braking the motor) the output "BALLAST" is switched on fort he duration of the over-voltage. An external transistor and break resistor can be used to dissipate the over-voltage.

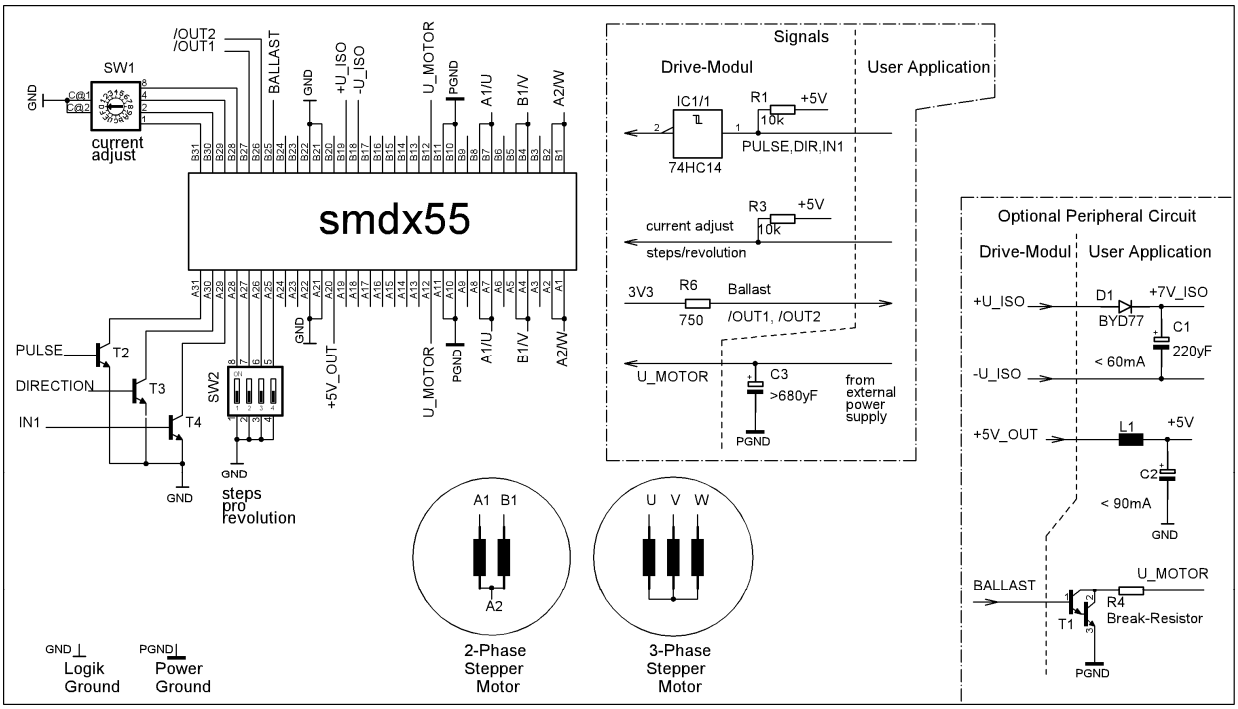
APPLICATION VOLTAGE:
The internal power supply provides +5V_OUT that in an ideal case it is possible to supply the external user circuit. A "choke" inductance should be switched between user circuit and power drive.
Furthermore two electrically isolated voltages are available U_ISO. With a diode (super fast) and electrolytic capacitor a DC voltage of approximately 7V can be created. (to

MOTOR CONNECTION smd255:
By swapping a phase, e.g. phase A1 and A2 the motor sense of rotation can be inverted to the logic assignment of the direction signal „DIR".

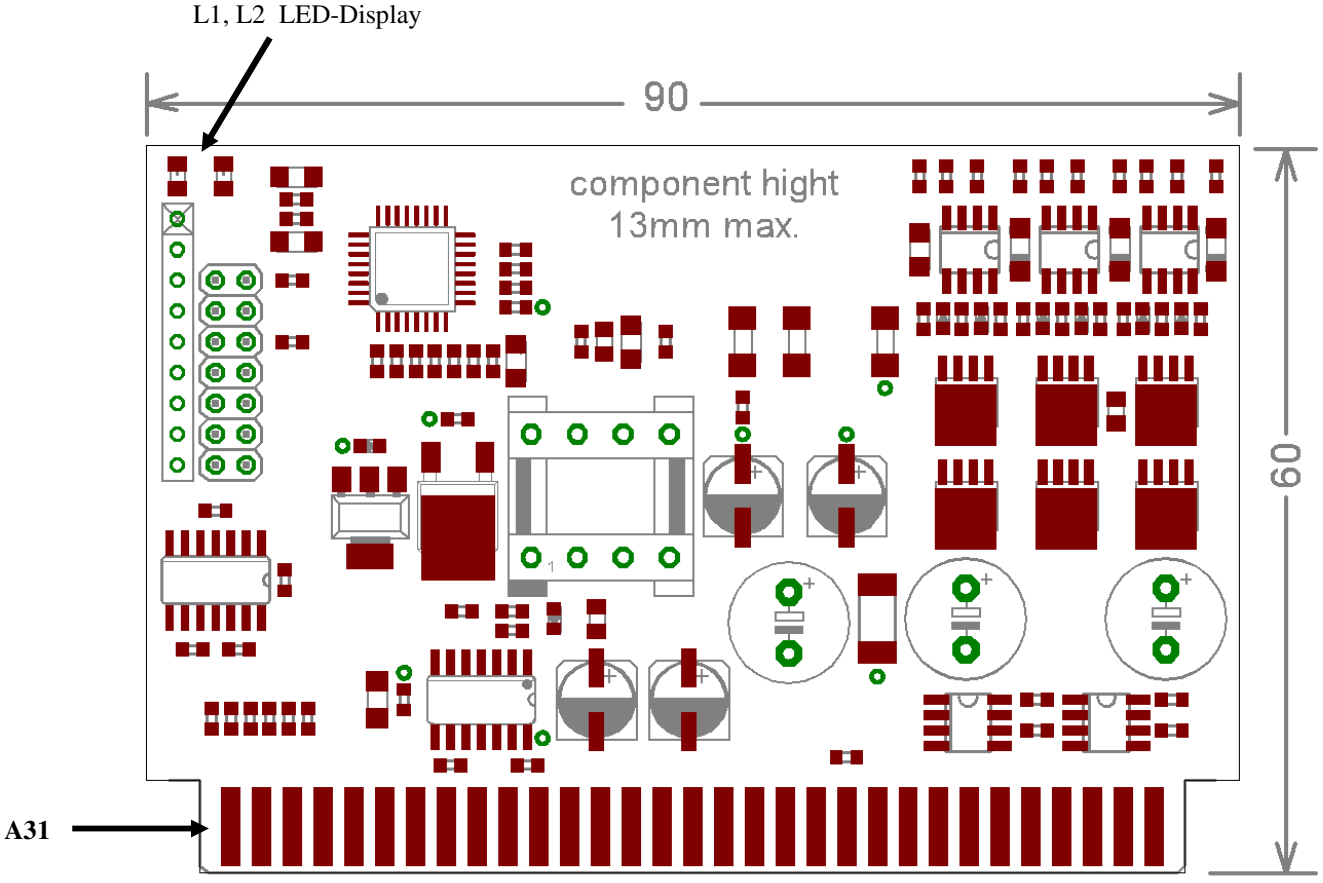
MOTOR CONNECTION smd355:
By swapping a phase, e.g. phase U and V the motor sense of rotation can be inverted to the logic assignment of the direction signal „DIR".

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.

Wiring Diagram



Dimensions



SPECIFICATIONS:

Power drive supply:

Absolute max. voltage:	50Vmax.
Minimum voltage:	21V
Recommended voltage	24..48 V
Voltage ripple:	< 2.0V peak
Input peak current at power on:	< 2.0A peak
Fusing:	3,0 A medium
Power supply charge capacitor:	>6800µF
Power supply cable cross section:	0,75mm²
Distance to power supply capacitor:	< 1m

Motor connection:

Cable cross section:	>0,75mm²
Cable length:	max. 1m

Inputs:

Pulse, Dir, IN1:	CMOS, 5V, Schmitt-Trigger	
Input voltage	low/high	<0,8V / >3,5V
	maximum	<5V
Pull-up-Resistor		10k to 5V

CR, Sx, Cx:		CMOS, 3V3
Input voltage:	low/high	<0,8V / >2,5V
	maximum	<5V
Pull-up-Resistor		10k to 3V3

Outputs:

OUT1, OUT2:	CMOS, 3V3
Internal resistor:	750 ohm
Load:	non reactive

Signal Timing

Pulse width/pause:	>2,0ys
Pulse slope:	<500ns
Direction before pulse:	> 1,0ys
Direction after pulse:	> 1,0ys
Pulse after OFF:	> 1ms
Current reduction after pulse pause:	approximately 1s
Nominal current after pulse:	< 500ys
Nominal current after OFF:	< 1ms
Ready /OUT1 after power on:	< 1s

Motor current setting:

Hex-Switch, 16 steps	1...5A

Ambient conditions:

(for Ub=50V, 1000steps/rev, 1kHz, free standing)

I_{Motor} 1,0A	59°C	
I_{Motor} 2,0A	54°C	
I_{Motor} 3,0A	48°C	
I_{Motor} 4,0A	40°C	
I_{Motor} 5,0A	31°C	!Forced Air Cooling
Switch off-temperature:	80°C	

UL94V-1 all components
IP00

TROUBLE SHOOTING:

Motor has no holding torque but supply voltage is connected
-The motor voltage is below the minimum value
-Signal input "Off" is active
- Internal fuse defective

Motor has holding torque, but doesn't execute steps
- Faulty pulse signal wiring
- The pulse signal level is too low

Sudden "crackling" noises in the motor
- Motor is operated at the minimum voltage limit
- The motor connection is bad
- Noise vial pulse/direction input

The motor doesn't reach the set speed but starts
- The motor voltage is too low for the required speed
- The motor inductance is too high
- The motor current was set too low
- The acceleration ramp was set too high
- Motor wires are too long or too small cross section
- Power supply is not powerful enough

The motor "loses" steps and drifts
- The amplitudes of the control signals are too low
- Signal cable noise is too high (shielded cables?)
-The wiring concept is not optimal (all ground signals must be connected one common potential)
- The mechanical shaft coupling has play
- The motor stalls and can't follow

Motor vibrates at pulse frequency and doesn't start
- The motor current is set too low
- Start/Stop-frequency too high
- Motor windings are connected wrong or broken cable
- The automatic current reduction remains active (pulse duration too low at low pulse frequencies)

The automatic current reduction doesn't work
- The pulse input remains active after the last
- The current reduction switch or input is not on or enabled

The motor is hot
Up to 85 ° Celsius should be no problem

GENERAL INSTALLATION REQUIREMENTS

The device housing[1] must be grounded separately. In most cases a wing nut on the front panel or another grounding connection is available. Each component must be grounded wit a separate grounding wire at a central ”grounding point“. This is usually the machine bed or a grounding rail inside the electrical cabinet.

Before installation and setup make sure that the required drive power is sufficient for your application and that the maximum values are not exceeded.

Mounting orientation is vertical, make sure air intake[1] and cooling slots are not blocked.

Only shielded motor cable must be installed. For identical potential between motor flange and power drive)short distance) the shield is grounded on both ends. Otherwise it is recommended to ground only the device end and that the shield on the motor end is ground connected electrically isolated via a capacitor.

In general the ground potential difference must be in the range of only a couple mV.

For symmetrical motor cables such as with 2 phase steppers twisted pair wires are recommended per circuit.

Signal cables must also be shielded. Twisted pair wires are recommended per circuit.

The ground potential common point should be located directly at the housing or the mounting point of the power drive.

Signal cable and motor cable must be separated. Long parallel cable installation must be avoided. Cable crossings (if necessary) should be installed vertically.

Check all device settings for validity.

[1] if available

SAFETY AND PROTECTION REQUIREMENTS

The installation of the device must only be conducted by an educated, trained and experienced expert (electro). The local guidelines for safety, installation of electrical and mechanical systems and EMI must be observed.

Unintended operation and faulty installation of the device can lead to personal injury (incl. the possibility of death) and the device as well as other external components can be damaged or an excessive pollution of the environment can occur.

Operation is only permitted with the mounted housing[2]. Because of eventually present high voltage the device must not be opened (also not after a long period of idle time). Make sure children have no direct access to the device.

No technical modifications of the device are permitted.

The device housing[3] must be grounded separately. In most cases a wing nut on the front panel or another grounding connection is available. The device must be grounded prior to the installation.

Under no circumstances live of functional connectors must be removed or connected. All installations must be conducted in the powerless de-energized state.

Device operation in damp, humid environment or with present spray water is not permitted

[2] not with open frame (only PCBs)
[3] if available