NC-Step

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Technical Information

Stepper Motor Card >HP-Step.pro<

Rev. 2.0 (last updated 1.3.2006)

Functional Description

HP-Step.pro is a 1 channel stepping motor driver board that can drive step motors with a rating of up to 3.5/5 amperes (effective/peak current) in full, half, 1/4th, 1/8th, 1/2.5th, 1/5th and 1/10th step modes. The board is designed as an euro size board to fit in common 19" rack systems. Therefor it is equipped with a DIN41612 type D connector.
To realise the microstep functions, an AVR microcontroller is used, which generates the set values for the current regulator via an external D/A converter. After power up the controller waits 2 seconds, to allow the power supply to reach a stable level, before the power amplifiers are switched on. At this point, the motor is driven by only 25% of the nominal current. After an additional 2 seconds the full current is switched on, so that the power supply is not overloaded when multiple outputs are switched on ("soft start"). To protect the amplifiers, a self resetting short circuit guard is integrated that also displays any faults with LEDs.

Exclusion of Liability, EMC (electromagnetic compatibility)

All parts of the circuit were carefully checked and tested. I still can't garantie that everything will work. I especially take no responsibility for any damages caused by reproduction, reverse engineering or initial operation of the here described circuit.
The stepping motor power amplifier "HP-Step.pro" is an OEM product made for use in industry, electronic trade and other EMC experienced sectors. According to EMVG §5, section 5 this product does not require CE qualification.
Cabling, used amplifiers, power supply, housing and the surrounding environment are factors that influence the EMC properties of a device. A device using one or more step motor power amplifiers must of course be evaluated according to corresponding directives, when CE conformity must be documented. During development all possible means were used to conform to EMC regulations.

Installation of the board

The board can be used in 19" systems with a compatible interface without any preparation. A compatible backplane for a 19" rack is available as an option. Additionally, a drilled and ready to mount front panel (3U/8HP) is available. Alternatively the board can be used in other housings. Power suplly and motor connections are then made with screw type terminals. The logic signals are connected with a 10 pin flat cable in this case. To connect the board to a printer port without using the backplane, the interface-relay board available for HP-Step and Tiny-Step can be used. In operation, depending on the environment, it may be necessary to use an additional fan for cooling. If the casing is already well ventilated, it may not be necessary to use an additional fan, if the board is mounted in the air-stream.

Initial Operation

Before first use, set the jumpers to the desired step divider (refere to the table below). Start with only the power supply - without connectiong the motors or connecting the board to the PC. If a backplane is used, the connections to the motors and the PC have to be seperated from the backplane.
Set the reference voltage for the motor current with the P1 trimmer. The voltage can be measured at the test point TP1 or at pin 7 of the service connector CN5. The measured voltage V(ref) depends on the motor current in the following way:
V(ref) = 0.85 * I(Motor) * 0.22 ohms
equals the set value for the line current. E.g. to achieve 3A effective current set Vref to 0.56 volts. The motor current given by the manufacturer is always the effective current.
Now the board can be tested with a motor. To do this, connect the board (or the backplane respectively) to the controller (PC with software or a microcontroller board). Always start up the PC first and then activate the power supply for the board! During boot up the logic levels of some signal can change, that can cause undesired reactions. For tests a free demo (for example PCNC) is recommended.

Settings for step divider

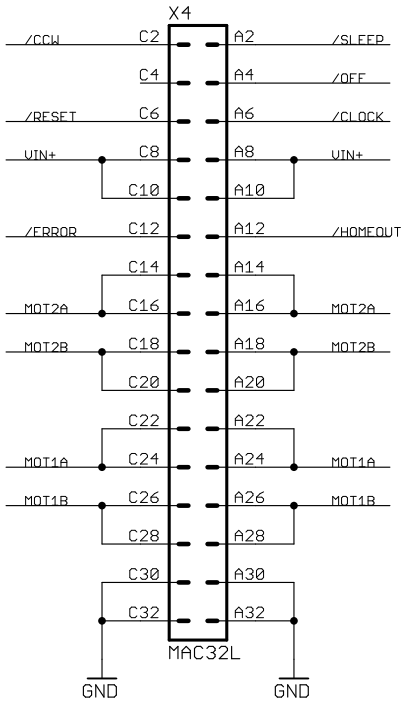
Jumper		JP2	JP1	JP0
Full steps		open	open	open
Half steps	open	open	closed	
1/4 steps		open	closed	open
1/8 steps		open	closed	closed
reserved		closed	open	open
1/2.5 steps	closed	open	closed	
1/5 steps		closed	closed	open
1/10 steps		closed	closed	closed

Note: After applying changes the microcontroller must to be reset.

External Connections

• The motor is connected via the backplane or to the screw connectors CN2 (1st coil) and CN3 (2nd coil). The rotational direction of the motor can be changed by reversing the polarity of one coil. Center pins of unipolar motors (with 5 or 6 pins) are not connected. The pins must be insulated and may not be connected to the positive supply or ground in any case! Bipolar motors with 8 pins provide the possibility to connect two coil pairs in series or in parallel. Connection in series will always work, parallel connection will give higher revolutional speed. ATTENTION: If the coils are connected in series, the resulting max. current is 0.7 times lower than the given value for unipolar mode, in parallel the current is 1.4 times higher.
• The PROG connector (CN7 or CN5) is used to reprogram the firmware of the microcontroller. The free tool "Ponyprog" is available at http://www.LancOS.com and is compatible to the AVR - ISP Programming Board.
• For easy setup of a 19" rack system, a backplane is available that also offers connectors for the parallel port and Endpoint- and Emergency-Off-Switches. Alternatively the connections can be made with the interface relay board, that also offers seperate connectors for Endpoint- and Emergency-Off-Switches.

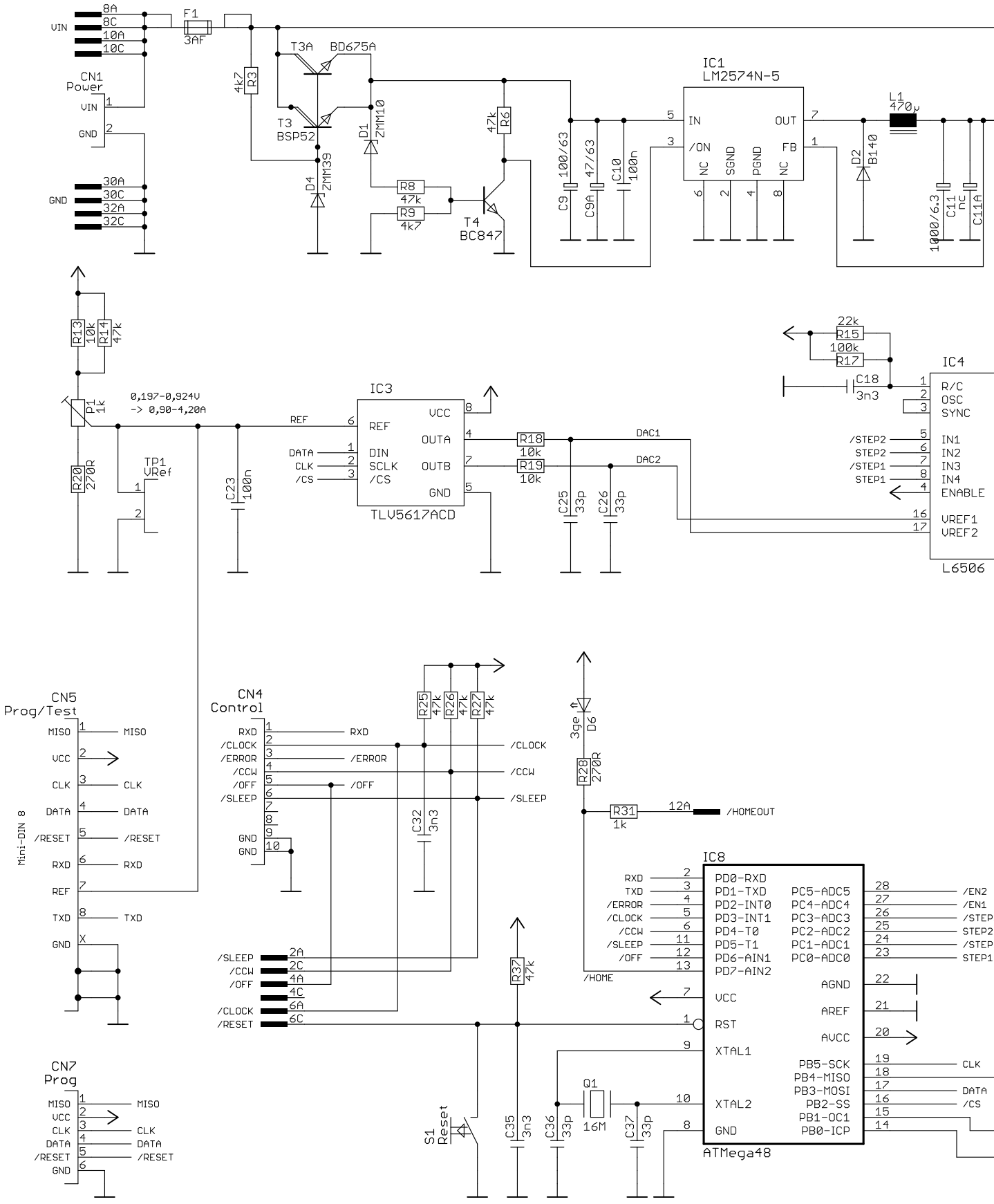
Pinout of CN6 – system

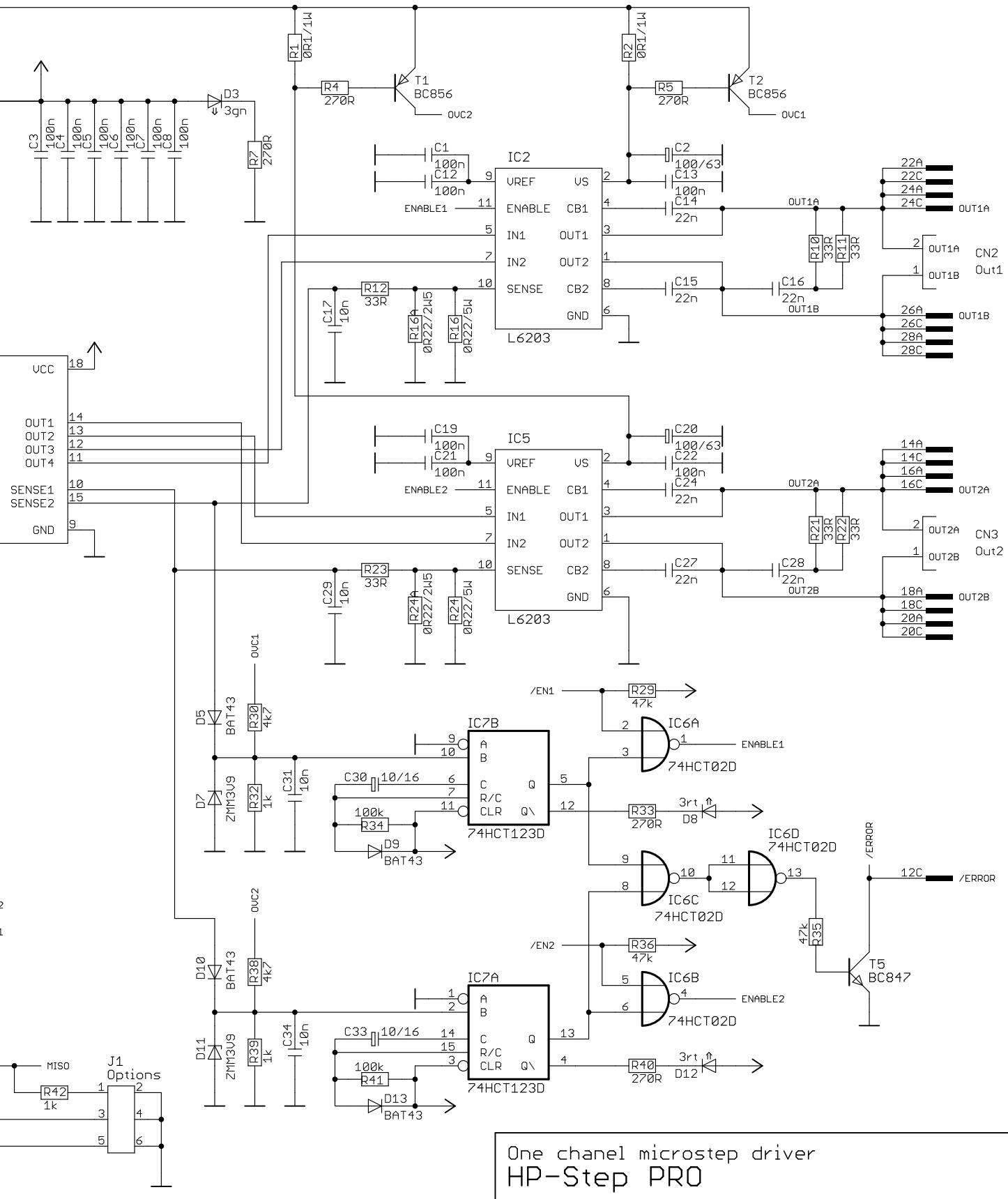


/CCW direction of movement, counterclockwise at low level
/SLEEP current reduction to 25% of set value at low level
/OFF disable the power stage at low level
/RESET resets the microcontroller at low level. The motor is set back to it's home position.
/CLOCK clock signal. Each rising flank causes one step of the motor.
VIN+ positive supply voltage
/ERROR output: pulled low if one of these errors occurs: short circuit output, clock frequency is to high. Must be cleared with a controller reset. 5mA max.
/HOMEOUT output: pulled low at each 4th fullstep position. 5mA max.
MOT2A connection for motor coil 2
MOT2B connection for motor coil 2
MOT1A connection for motor coil 1
MOT1B connection for motor coil 1
GND ground, negative supply voltage

Pinout of CN4 - control

1 RXD
2 /Clock (Clock signal, rising edge generates a step)
3 /Error (pulled low if an error occurred, reset is needed for new startup)
4 /CCW (rotational direction, counterclockwise at low-level)
5 /OFF (disable power stage at low-level)
6 /Sleep (current reduction to 25% of the nominal current at low-level)
7,8 not connected (n.c.)
9,10 Ground


CN1
Power
VIN
GND
F1
3AF
T3A BD675A
T3 BSP52
D1 ZM10
D4 ZM39
R3 4k7
R6 47k
R8 47k
R9 4k7
T4 BC847
IC1
LM2574N-5
IN
/ON
OUT
FB
NC
SGND
PGND
NC
L1 470µ
D2 B140
C9 100/63
C9A 47/63
C10 100n
C11 nc
C11A 1000/6.3
R13 10k
R14 47k
R1 1k
0,197-0,924V
-> 0,90-4,20A
R20 270R
TP1 VRef
C23 100n
IC3
TLV5617ACD
REF
DATA
CLK
/CS
VCC
OUTA
OUTB
GND
R18 10k
R19 10k
DAC1
DAC2
C25 33p
C26 33p
R15 22k
R17 100k
C18 3n3
IC4
L6506
R/C
OSC
SYNC
/STEP2
STEP2
/STEP1
STEP1
IN1
IN2
IN3
IN4
ENABLE
VREF1
VREF2
CN5
Prog/Test
Mini-DIN 8
MISO
VCC
CLK
DATA
/RESET
RXD
REF
TXD
GND
CN4
Control
/CLOCK
/ERROR
/CCW
/OFF
/SLEEP
R25 47k
R26 47k
R27 47k
C32 3n3
3ge D6
R28 270R
R31 1k
12A
/HOMEOUT
/HOME
IC8
ATMega48
PD0-RXD
PD1-TXD
PD2-INT0
PD3-INT1
PD4-T0
PD5-T1
PD6-AIN1
PD7-AIN2
VCC
RST
XTAL1
XTAL2
GND
AGND
AREF
AVCC
PC5-ADC5
PC4-ADC4
PC3-ADC3
PC2-ADC2
PC1-ADC1
PC0-ADC0
PB5-SCK
PB4-MISO
PB3-MOSI
PB2-SS
PB1-OC1
PB0-ICP
/EN2
/EN1
/STEP
STEP2
/STEP
STEP1
CLK
DATA
/CS
R37 47k
Q1 16M
C35 3n3
C36 33p
C37 33p
S1 Reset
CN7
Prog



One chanel microstep driver

HP-Step PRO

TITLE: HP-Step-Pro-V20

Document Number:

Created by: T. Ostermann

REV: 2.0

Date: 28.02.2006 20:25:07

Sheet: 1/1

Pinout of CN5 – prog/test

1	MISO
2	VCC
3	CLK
4	Data
5	/Reset
6	RXD
7	Vref
8	TXD
shield	Ground

Meaning of Buttons and LEDs

POWER: Turns on as soon as the supply voltage reaches 18 Volts.
SIGNAL: Is on during the softstart phase and in use, at every 4th full step position (home position).
SHORT1&2: Lights up at a short circuit at the corresponding driver.
RESET: Restarts the controller.

Current Reduction (Sleepmode)

There are 3 different power reduction modes.
- No current reduction: Leave /Sleep pin open or connected to VCC.
- Automatic current reduction: /Sleep is connected to ground. (not recommended for multiple axis configurations) 1-2 seconds after the last clock signal, the current is reduced to 25%. At the next clock signal the circuit switches back to the nominal current.
- Current reduction by software: /Sleep input is set by software. /Sleep is pulled to ground by the PC software when all axis are idling (in multiple axis use). The current reduction is activated after a maximum of 1 sec. (or 2 seconds after the last clock signal). When using PCNC, set current reduction to "inverted".

Hints for Troubleshooting

- If any part of the circuit does not work after first assembly, or when a failure occurs, find and fix the error, before connecting or running a motor with the circuit!
These additional hints may be of help:
- Is the processor running? If it is, the SIGNAL-LED should light up, 2 seconds after power up, or reset. If the processor is not running, check the Power Supply (5 Volt at pin 7 of the controller IC8) and make sure the quarz is resonating. If this is the case: Is the processor correctly programed?
- Check pins 16 and 17 of the L6506 for the correct reference voltage. (Both should be between 0 and 1 Volts, they should never both be 0 Volts.) Otherwise either the DAC is broken, or is not being correctly initialised (for example because the processor is not working correctly).

If these hints and the additional help in the forum at www.NC-Step.de don't answer all your questions, contact me for further help by email. Please provide a detailed description of the problem and your configuration (power supply, used software a.s.o.) -> E-Mail: Ostermann@NC-Step.de

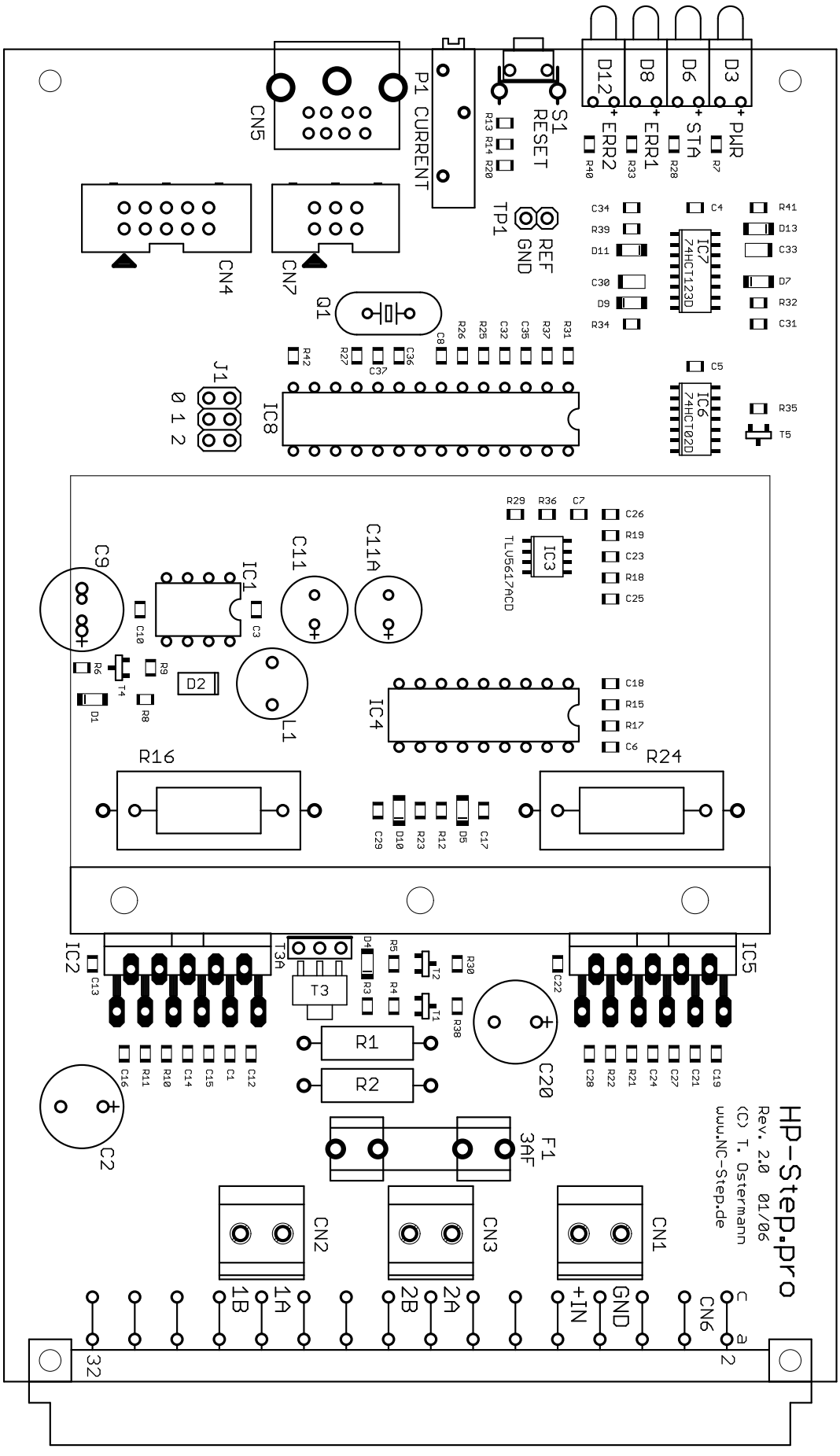
Additional Notes

- A well stabilized motor voltage saves time and work, when searching for errors and reduces noise levels. (Rule of thumb: 10.000µF for 3 motors)

Technical Data

Power Supply (logic):	5 Volts, on board regulator
Power Supply (power stage):	18-45 Volts, with undervoltage shutdown
Power Drain (Power Element):	dependent on power supply voltage, motor current and used motor. Maximum continuous current: 3 Amperes.
Fuse:	3A fast blow
Control:	Clock- and Direction signals, CMOS-compatible.
Step Resolution:	Full-, Half-, 1/4th, 1/8th, 1/2.5th, 1/5th and 1/10th-steps
Outputs:	1 stepping motor channel up to 3.5/5A (effectiv/peak) per coil, short circuit protected
Dimensions:	100*160mm (euro size)

Notices


HP-Step.pro
Rev. 2.0 01/06
(C) T. Ostermann
www.NC-Step.de
CN1
CN2
CN3
CN4
CN5
CN6
CN7
GND
+IN
1A
1B
2A
2B
32
2
D12
D8
D6
D3
ERR2
ERR1
STA
PWR
S1
RESET
P1 CURRENT
TP1
REF
GND
Q1
J1
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
L1
D2
F1
3AF
R1
R2
R16
R24
C2
C9
C11
C11A
C20
TLV5617ACD
74HCT123D
74HCT02D