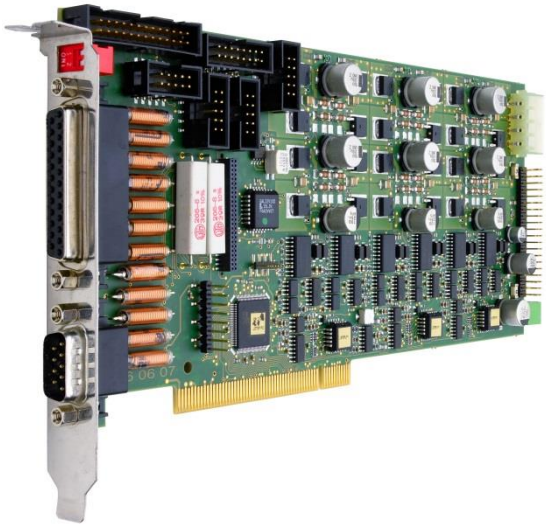
Precision Positioning Systems

LSTEP / ECO-STEP

LSTEP / PCI



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Dear Customer!

Thank you for choosing one of our controllers!

With this unit, you have chosen a positioning controller which automates complex positioning tasks yet takes up a minimum of space. The high precision of the controller opens up vast application possibilities. The resolution of up to 50,000 (100,000) steps per motor revolution for a two-hundred step motor and 2000 microsteps per full step for linear stepping motors offers resolutions in the sub-µm range. In addition, „closed loop„ operation in connection with high-resolution transducer interpretation with optical and magnetic measuring systems provide a very high positioning accuracy. The many additional functions, such as e.g. snapshot, triggerout, clock pulse and direction of rotation inputs make this controller the ideal partner for many applications.

Before putting your controller into operation, please take the time to read this manual through carefully.

Pay particular attention to the safety instructions!

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Contents

1 Safety Instructions

1.1 General Instructions

- Maintenance and repair work must only be done by duly qualified and trained experts who have sufficient knowledge of the controller!

- Pull out the mains plug before opening the unit!

- The power consumption of LSTEP-2x/2 may rise up to 200 VA for brief periods, when all three axes are being operated at 2.5 A and at maximum speed. This high power consumption is not however permissible for continuous operation, as LSTEP-2x/2 works without additional cooling (fan). An average power consumption of 100 VA should not be exceeded!

- For the controller model LSTEP 22/2 (3,75), the standing power consumption must be reduced to at least 75%!

- Only devices specified by us may be connected.
  Failure to heed this instruction could cause irreparable damage to the controller or to the device connected to it!

- The main power plug for the controller or the socket into which the controller is plugged must be accessible at all times, so that the controller can be disconnected in all poles from the power supply at any time!

- Do not plug in or disconnect any cables whilst the equipment is switched on!

1.2 Initial Start-Up Information

- LSTEP Interface Assignment.
  The Commander (terminal for LSTEP and MCL) is supplied with a controlled d.c. voltage of +5V or +12V via the interface port. For the LSTEP, the voltage is connected to PIN 1 of ST2 via the jumper J1 (behind ST2), provided that a terminal is supplied with the controller.
  Please therefore always use the original interface cable provided by Messrs. LANG.
  Note for ECO-STEP: A wire strap is used instead of a jumper.

- Setting The Mains Voltage.
  The LSTEP can be operated at 100V - 120V or at 200V - 240V . The required voltage is set on a pluggable voltage selector with fuse carrier at the power input. Make sure that the unit is always operated at the voltage which has been set. If the voltage selector has been set for 100V - 120V but the LSTEP is connected to 200V - 240V , the **control electronics could be irreparably damaged**. The power input fuse will most certainly blow!
  Note for ECO-STEP: The ECO-STEP is supplied by an external power pack with a 100-240V wide range input.

- Ventilation slots in the housing.
  Ventilation slots are provided in the housing to cool the power electronics of the controller by ventilation. You must make sure that no chips, liquids or other electrically conductive substances get inside the housing. This applies to the LSTEP-3x/2 (phase current up to 5A) only.

- Protection Of The Connected Mechanical Components
  After the controller has been switched on, the range of travel should always be checked with the commands "Calibrate" and "Measure Table Stroke". The controller is then able to detect and prevent any movement which would exceed the maximum range of travel (see Chapter 5.1, Chapter 5.2).
  Once the travel limits have been set, the axis will only travel to the preset limits. This is necessary when you only have one limit switch available per axis.

2 Functional Description

The LSTEP stepping motor controller is used to operate coordinate tables, e.g. for microscopes or production cycles with resolutions up to 0.0001 mm. The controller excels due to extremely smooth and quiet running of the motors. Despite a high resolution of 50,000 (100,000) microsteps per motor revolution, the dynamic microstep drive principle allows high speeds of up to 40 r/sec. (7,5 r/sec) to be achieved with a 200 step motor. For linear stepping motors, individual motor tables with 2000 microsteps per full step, i.e. 8000 microsteps per tooth pitch are used.
The controller works with linear interpolation (all axes reach the target position simultaneously) and automatic, individually programmable ramp generation (Limitation of the acceleration when starting and stopping). The LSTEP can be operated as a stand-alone unit or can be controlled from a PC. A position indicator (optional) at the front panel and a “Joystick” round off the unit. A new instruction set has been developed for the LSTEP, which offers considerably more functionality. The instruction register set which has been used successfully for years on the “MCL” controller remains available.

To ensure smooth running and accurate positioning, motors with a step angle error of < ± 3% should be used. To reach the maximum speed, low impendance motors with a low inductance should preferably be used.
To avoid unnecessary heating of the motors, LSTEP reduces the motor current to the preset zero signal current every time there is a pause in operation (even for joystick operation) (see Chapter 6.7).

2.1 RS232 Interface

An RS232 serial interface with the following standard settings is used as the standard interface to the higher-ranking PC:
- 9600 baud, 11 bit frame, 1 start-, 8 data-, no parity-, 2 stop bits
For trouble-free operation, LSTEP needs an RS 232 port at the PC with the following signals:

RxD:	LSTEP receive line	(computer transmit line)
TxD:	LSTEP transmit line	(computer receive line)
RTS:	LSTEP ready to send	
CTS:	PC clear to send	
GND:	Signal ground	

Operation without the RTS line is possible with certain restrictions.

2.1.1 Operation without Control Computer

Simple movements can be made with the LSTEP, without a control computer. The “Joystick” switch is set to “manual” for this purpose. Any position can now be approached using the joystick. On controllers with an LC-display, the momentary absolute position is continuously displayed. In addition, the axes can be set to zero individually with help of the “CLEAR” switch.

2.2 Controls

The display (only on units which are equipped with a display) and all controls, except the main power switch, are located on the front panel.

Control	Function
CLEAR X/Y/Z (optional)	Switch for resetting the display (separate for X- Y-and Z- position). The position register is also deleted.
SPEED 1..10 (optional)	Potentiometer for changing the motor speed when running with external clock pulse. The speed set in the software can be regulated from 0 to 100%. The parameter value set before a vector is started is valid for travelling the whole vector and cannot be changed whilst travel is in progress. If the joystick is active, the speed of travel can be changed on the potentiometer. Note: Especially interesting for joystick manual mode.
JOYSTICK MAN / AUTO	Joystick selector switch MAN = Manual mode (no "move" commands can be executed) AUTO = Automatic mode with the appropriate commands
RESET (optional)	When the reset switch is switched up, the controller is returned to starting status (just as if you had switched it off and on).
ON	Shows LSTEP is on and ready for operation
LCD Display (optional)	LCD display with 4*16 characters for displaying the mode of operation and the absolute position. Positions in a value range of $-99.999.999,9 \leq P \leq +99.999.999,9$ are displayed .

Table 1:Controls At The Front Panel Of The LSTEP

Joystick Switch Set At "AUTO"		
	READY TO RECEIVE	LSTEP waits for commands via the RS232 interface
	GO TO POSITION	LSTEP moves to a position
	RELATIVE STRAIGHT LINE	LSTEP travels a relative straight line
	CALIBRATION	LSTEP moves to zero position
	TABLE LENGTH	LSTEP moves to the end limit position
	JOYSTICK AUTO	LSTEP moves with joystick operation
Joystick Switch Set At H		
	JOYSTICK MAN	LSTEP moves with joystick operation

Table 2: LSTEP Modes of Operation

3 Initial Start-Up

CAUTION:	The ventilation grate at the back of the unit and on the bottom plate (LSTEP-3x/2) must not be covered!

3.1 Connections

- Connect the motors using the cable supplied.
- Connect the incremental measuring systems (if any).
- Connect the joystick and lock it into place with the slides.
- Connect the computer or Commander with the interface cable.
- Connect the power supply.

3.2 Input/Output Port Data *(not for ECO-STEP)*

The following power ratings must be maintained for the inputs/outputs

- Digital inputs (e.g. clock forward/back, moment trigger)

Signal level:	TTL; max. input current ±5mA
Existing input wiring	RC-low pass with 470 Ω /220pF, 4.7 Ω Pull-Up at +5V

- Digital outputs (Trigger-Out) — TTL-level with ±1.6 mA

3.3 Connection Of Incremental Measuring Systems *(not for ECO-STEP)*

Incremental rotary or linear encoder systems for detection or avoidance of a step offset can be connected. This allows closed loop operation. The uses are not restricted to optical measuring systems. Inductive or magnetorestrictive systems can also be interpreted, provided that their output signals keep to the specified limits. The optional encoder interface allows encoder systems with sinusoidal output signals to be connected.

The following two alternatives are available:

1. sinusoidal voltage signals $1V_{SS.}$
2. magnetic linear transducer.

Due to the limited data capacity of micro controllers, not all combinations of spindle pitch values and encoder graduation periods give correct position calculation results. Some of the possible spindle pitch and period graduation combinations for linear measuring systems are given in the table below. An (X) means that the combination can be used without restriction.

	Encoder Graduation in mm						
Spindle Pitch in mm	1.00 mm	0.50 mm	0.10 mm	0.020 mm	0.0080 mm	0.0040 mm	0.0001 mm
0.40 mm	X	X	X	X	X	X	X
0.50 mm	X	X	X	X	X	X	X
1.00 mm	X	X	X	X	X	X	X
2.00 mm	X	X	X	X	X	X	X
3.00 mm							
4.00 mm	X	X	X	X	X	X	X
5.00 mm	X	X	X	X	X	X	X
8.00 mm	X	X	X	X	X	X	X
10.00 mm	X	X	X	X	X	X	X
15.00 mm							
20.00 mm	X	X	X	X	X	X	
25.00 mm	X	X	X	X	X	X	
30.00 mm							
35.00 mm							
50.00 mm	X	X	X	X	X	X	
100.00 mm	X	X	X	X	X	X	

Table: Permitted encoder graduations (X) depending on the selected spindle pitch

The following equation can be used for instances not given in the table.

$$\text{encoder factor} = \frac{4 \cdot 10^{5} \cdot t_p}{h}$$

h : spindle pitch *in mm*

t_p : encoder graduation *in mm*

If the selected spindle pitch and the period graduation of the measuring system results in a whole number without decimal for the *encoder factor*, the selected combination can be used without restriction.
In all other cases, please contact the manufacturer of the controller.

3.4 Function Test

- Switch on the unit
  After it has been switched on, LSTEP performs an automatic calibration of the connected joystick. This takes about 5s. To ensure correct calibration, the joystick must not be deflected during this time.
- Set the "Joystick" switch to "MAN"
- Move the joystick in all directions: The motors run according to how you move the joystick. If however there is no reaction, check the motor and joystick connections. If the connections are ok., inspect the unit for possible, hidden transport damage.
- Set the "Joystick" switch to "AUTO"
- Call the functions (see instruction set)

3.5 Problems when Setting up the RS 232 connection and their solutions

- LSTEP is not responding via RS 232:
  - Check the pin assignments and the connecting cable to the control computer
  - Check the interface conditions (OPEN-command) at the control computer

- Individual bytes from LSTEP messages are being lost:
  - There is no CTS line available at the control computer (RTS -line of the LSTEP is not checked): When the LSTEP is working and cannot receive data, the interface is blocked via RTS. Synchronization of the computer and the LSTEP also takes place without a check of the RTS line, when the computer is waiting for the LSTEP status signals, as described in the examples in this manual. Problems may however arise in the functions "Set resolution and spindle pitch", if a safe protocol was not established with the "Autostatus" instruction (see instruction set). In this case, the computer must be delayed, e.g. with the help of loops, so that the data or commands are not lost. The typical delay is approx. 20 msec.

3.6 Firmware Update

The controller can be updated easily with program updates. Depending on the controller used, please follow the procedure described below:

- Connect one of the serial interfaces (COM) of your PC to the serial interface at the back of the controller (LSTEP + ECO-STEP).
- Close all programs which access the same interface.
- Copy the self-unpacking program „LFlash.exe„onto your PC and unpack it.
- Copy the new control program „*.ihx„ onto your PC
- Start „Flash.exe„ in Windows
- Select the interface of the PC which you have connected with the controller,
- Select the type of unit.(LSTEP; ECO-STEP)
- Set the dip switch "1" at the back of the unit to ON and then switch on the controller. Using the PCI-card make a reset after switching on the dip switch 1 with the dip switch 2 (switching ON/OFF)
- Click on the **Update** box and confirm with "**Yes**". The old program is deleted from the controller (depending on the program version only the banks 0-2 have to be deleted).
- Select the file type (IntelHexFile).
- Load the new control program.

➔ The firmware is now transmitted to the controller.

- When programming is complete, return dip switch "1" to its original position.

To subsequently operate the controller with the new firmware, you must either press the reset button, or switch the controller off and on again.

3.6.1 Firmware update with new Flashtool starting version 3.0.0.0

How to perform an Update:

1. Select the serial interface.

2. Set the DIP-switch 1 of the control to ON:

3. Now switch on the control and actuate the reset button while the control is still switched on.

4. Start the Update. Therefore click the button with the inscription „Update“. The program automatically establishes a connection to the control and deletes the Flash. Afterwards you are requested to select the new control software. After selecting the file it will be saved in the Flash..

5. After a successful Update set the DIP-.switch 1 back to ‚OFF‘.

6. Actuate the reset-button or switch the control OFF and ON. This way you start the control with the new software.

4 The LSTEP Controller Instruction Set

For better clarity, all instruction and parameters, which are sent to the controller and all acknowledgements/feedback's from the controller, are transmitted as ASCII characters. The advantage of this is that on the one hand, the commands can be input manually at a normal terminal. On the other hand, these plain language commands make troubleshooting easier, when a customised program sets the commands.

Commands or parameters which are transmitted to the controller begin with an exclamation mark "!". Inquiries are denoted with a question mark "?" .For example, the following mean:

!cal	*Calibrate*
?status	*Read out status*

Note:	For write-only or read-only instructions, the characters "!" or "?" may be omitted.

Some instructions, e.g. specification of travels, require the transmission of parameters. These are then transmitted after the instruction itself. A space must be inserted and transmitted between the command text and the parameters and between the various individual parameters to separate them.

moa 45 13 20	*Move x, y and z to the positions 45, 13 and 20*

Each instruction must be concluded with a carriage return (CR). This character is shown in the ASCII character set as follows:

Symb. Name	Dec. Value	Hex. value	Bin. value
CR	13	0xD	00001101

4.1 Short description of the LStep Instruction set

Instruction	Example	Note	Chap.4 Page
Interface			
baud	(?) !baud 9600	set baud rate to 9600	13
cts	(?) !cts 0	the CTS-interpretation is deactivated	13
intcom	(?) !intcom 1	Communication interrupt-controlled through DPRAM	13

Controller-informations			
ver	?ver	read version number	9
iver	?iver	addition to the current version number	9
det	?det	read out detailed version number	10
readsn	?readsn	read out serial number of the controller	11

Instruction	Example	Note	Chap.4 Page
Settings			
ipreter	(?) !ipreter 0; 1; or 2	switching the command set	14
xycomp	(?) !xycomp (1-6)	for drives which influence themselves	40
dim	(?) !dim 1	setting the unit in µm	23
pitch	(?) !pitch 1 1 1 (y 4)	setting the spindle lead X Y Z or only Y	24
gear	(?) !gear	gear factor	24
accel	(?) !accel 1 1 1 (x 1)	setting the acceleration X Y Z or only X	25
vel	(?) !vel 10 10 10 (x 20)	setting the speed X Y Z or only X	25
velfac	(?) !velfac (1-100)	reduction of the set speed	26
pot	(?) !pot 1(0)	switch Speedpoti ON/OFF	42
cur	(?) !cur 1 2 2.5	motor current setting: X=1A Y=2A Z=2,5A	27
maxcur	?maxcur	all max. currents are indicated (=configuration)	26
reduction	(?) !reduction 0.5 0.5 0.5	current reduction to 50% in all axis'	27
curdelay	(?) !curdelay 1000	deceleration of the current reduction (0 - 10000 ms)	28
opfl	(?) !opfl 20 20 20 20	starting 20 rpm. the maximum current will be driven	21
axis	(?) !axis1 0 1 (y 1)	switch axis ON/OFF	28
axisdir	(?) !axisdir 0 1 0	motor turning direction turned of Y-axis	29
caliboffset	(?) !caliboffset 1 1 1 1	The zero position will be shifted 1mm with Dim 2	35
rmoffset	(?) !rmoffset 1 1 1 1	The end position will be shifted 1mm with Dim 2	35
caldir	(?) !caldir z 1	the Z-axis will be calibrated in positive direction	36
calbspeed	!calbspeed 10	when "cal"+"rm" the speed is 0,1U/s while driving out of the limit switch (5...100)	37
calrefspeed	!calrefspeed 0-100	Speed during calibrating when searching the reference mark	37
save	save	the current parameters are burned into the Flash	15
savejoyonoff	(?) !savejoyonoff 1 (0)	after a subsequent Save and Reset, the joystick is active with the LSETP-PC after switching on the PC.	49
saveipreter	(?) !saveipreter 0	after a subsequent Save and Reset, the LSTEP is set permanent to the register instruction set	15
hardreset	!hardreset	The hard- and software gets resetted	12
reset	reset	The software gets resetted	12
pa	pa 1	power amplifier 1 (power stage switch on) 0 = switched off	12
vlevel	(?) !vlevel 1 0.8 !vlevel 2 1.2	Fade out of speeds, with which resonances arise.	21
mtpatch	(?) !mtpatch 1	the correction table as activated	22
joyfilter	(?) !joyfilter 1	Filtration and Hysteresis activated in joystick operation	22
stoppol	(?) !stoppol 0 oder 1	The stop input (MFP) is low or high active	33
stopaccel	(?)!stopaccel 2	The stop acceleration is 2m/ s^2 when the stop input is active	33

Instruction	Example	Note	Chap.4 Page
Status inquiry			
autostatus	(?) !autostatus 0 (0-4)	setting the acknowledgement of the controller	16
status	?status	shows the current condition of the controller	16
stopstatus	?statusaxis	current condition of the stop input	16
statusaxis	?statusaxis	current condition of each axis (@,M,J,C,S,A,D,-,)	17
err	?err	shows the current error number	17
statuslimit	?statuslimit	A= calibrated; D= measured table stroke; L=Software end position;-=basic setting.	30
securitystatus	(!)?	see descriction	19
securityerror	(!)?	see descriction	20

Moving Command and position administration			
cal	!cal	calibrate	34
rm	!rm	measure table stroke	34
delay	(?) !delay 1000	delaysthe vector start by a second	43
moa	!moa 10 10 10 (x 10)	drive to absolut position X Y Z (only X)	39
mor	!mor 4 4 4 (y 4)	relative-positioning X Y Z (only Y)	39
m	!m	start of a move (track with mor or.distance)	40
itm		For vector start through ext. signal	41
distance	(?) !distance	set the track for X Y Z (start with "m")	41
a	!a	Cancel (Stop)	44
moc	!moc od. moc	all axis are centered (centerpoint of the software limits)	43
pos	(?) !pos 0 0 0 (z 0)	set or read position	42
clearpos	!clearpos	all postion values are set to zero (for endles turning axis)	43
calpos	?calpos	sends back the position (depending on the period of the measuring system), where the proximity switch was left.	36
refdir	(?) !refdir x 1	X-axis movesafter the instruction "ref" in positive direction	38
ref	!ref	X-axis calibrates on the reference switch (only possible with LSTEP)	38

Joystick and Hand wheel			
speed	(?) !speed 5 5 5 (y 10)	digital Joystick, all axis are turning with 5U/S od.Y with 10	45
joydir	(?) !joydir 1 1 -1	set motor turning direction for the Joystick	46
joy	(?) !joy 0 (1) (2) (3) (4) ?joy	switch Joystick ON/OFF with or with position counter acknowledgement "M" (Joystick manual active)	47
joywindow	(?) !joywindow 10	set range where the axis move (0-100)	48
joychangeaxis	(?) !joychangeaxis 1	Changes the allocation of the AD-Joystick channels Changes of allocation of X and Y axes	48
hw	(?) !hw 1 (0-4)	activation of the hand wheel	50
hwvel	(?) !hwvel 1.00001.0000	The max. speed in hand wheel operation = 1U/s	50
hwaccel	(?) !hwaccel 0.50.5	The acceleration in hand wheel operation =0,5 m/s^2	51

Instruction	Example	Note	Chap.4 Page
Control panal with Trackball and Joyspeed-keys or Trackball with function keys			
joyspeed	(?) !joyspeed (1-3) 25	parameter 1;2 or 3 with speed 25	47
bpz	(?) !bpz (1-4)	control panal / Trackball 0=Aus 1= On, Joyspeed keys 2= On, with trackball-factor, with Joyspeedkeys 3= On, without trackball-factor, with Function keys 4= On,with trackball-factor, with funktion keys	51
bpztf	(?) !bpztf 10	trackball-factor = 10 (value range = 0,01 to 100)	52
bpzbl	(?) !bpzbl 0.01 0.01	Trackball-Back-Lash (set reversal backlash; 1/10µ bis 15µ)	52
Limit switch (Hardware a. Software)			
lim	(?) !lim 0 10 0 10 0 10	moving range for all axis 0+10mm	29
limctr	(?) !limctr x 1	monitoring of range for all axis X is active	30
nosetlimit	(?) !nosetlimit 1 1 1 1	no value range is set for all axis	31
limmode	!?limmode	Inspection of software limits	31
swpol	(?) !swpol 1 0 1 (z 1 0 1)	assign polarity of the limit switch for all axis or only for Z.	31
swact	(?) !swact 1 0 1 (z 1 0 1)	switch ON/OFF limit switch for all axis or. only Z	32
readsw	?readsw	read the staus all limit switches	32
Digital and analog Input and Output			
digin	?digin od. ?digin 8	read all inputs or input 8	53
digout	!digout 5 1/?digout	output 5 is set to 1 / read status of all outputs	53
digfkt	!digfkt 7 0 / ?digfkt 9	-no infulence to E-7/A-7 / -read function of E 9/A-9	54
edigin	nur bei LSTEP-44	(like digin)	55
edigout	nur bei LSTEP-44	(like digout)	55
edigfkt	nur bei LSTEP-44	(for thoseI/O´s only the polarity can be set)	56
anain	?anain c 2	read current status of the analog channel 2	57
anaout	(?) !anaout c 1 0	set analog cjannel 1 to 0	57
Pulse-For/Back Inputs			
tvr	(?) !tvr 1 1	aktiviert Takt-F/B for X + Y	73
tvrf	(?) !Tvrf 1	factor pulse For/Backw 1= 1pulse is 1 motor increment	74
Pulse-For/Back through Interface			
px, nx	px	1 pulse in positive diection in X	74

Instruction	Example	Note	Chap.4 Page
Pulse-For/Back Outputs for external and integrated auxiliary Axis			
tvrout	(?) !tvrout 1 1	for X + Y pulse-V/R output is active	75
tvrores	(?) !tvrores y 1000	for Y a resolution of 1000 impulses/rotation is set	75
tvropitch	(?) !tvropitch 1	a 1 mm spindle is used for the X-axis is used	76
tvroa	(?) !tvroa 1	the acceleration of the X-axis is 1m/s²	76
tvrov	(?) !tvrov z 10	Z speed is 10 r.p/sec.	76
tvropos	(!) ?tvropos	all current position values are shown	77
tvromoa	!tvromoa 10 10	X + Y are driven absolute to 10 10	77
tvromor	!tvromor 10 10	X + Y are driven relative 10 10 from the current position.	77
tvroautostatus	!tvroautostatus 1	Switch Autostaus for pulse-for/back outputs on	78
tvrostatus	?tvrostatus	gives the current status: "-"=OFF "M"=Motion "@"=Stop	78

Pulse-For/Back Outputs for integrated auxiliary Axis (ECO-STEP)			
tvrocur	(?) !tvrocur 1.2 0.75	Set current of auxiliary axis in X to 1.2A and in Y to 0.75A	79
tvroswpol	(?) !tvroswpol 1 0 1 (?) !tvroswpol z 1 0 1	Assign polarity of the limit switch for all axis. Assign polarity of the limit switch for Z-axis.	79
tvroswact	(?) !tvroswact 1 0 1 (?) !tvroswact x 1 0 1	Switch ON/OFF limit switch for all axis. switch ON/OFF limit switch for X-axis or.	80
tvroreadsw	(?)tvroreadsw	read the staus of all limit switches	80
tvrocaldir	(?) !tvrocaldir z 1	The Z-axis will be calibrated in positive direction.	81
tvrocaliboffset	(?) !tvrocaliboffset 2 1 4.5	Set calibration-offset to 2 in X-axis, 1 in Y-axis and 4,5 in Z-axis according to user-dimension	81
tvrocal	!tvrocal	Calibrate all enabled auxiliary axis	82

Encoder-Setting			
twi	(?) !twi 10 10 10	The target window for all axis=10µ (for dimmension=1)	65
encmask	(?) !encmask 1 0 1	Encoder: X+Z active; Y deactivated	59
enc	(?) enc	Answer: 1 0=Encoder-X = aktive Encoder-Y = deaktived	59
encperiod	(?) !encperiod 0.1	division period of the X-encoder = 0,1mm	60
encres	(?) !encres	Shows the amount of encoder signal periods per motor revolution.	60
encref	(?) !encref 0	no reference signal evaluation	61
encpos	(?) !encpos 1	the encoder values are indicated by the inquery of the positions	61
encerr	(?) !encerr 0	clear encoder error messages X; (acknowledgement= 0 or. e)	62
ctr	(?) !ctr 2 2 2	the controller for all axes stays on	65
ctrc	(?) !ctrc 10	controller call every 10 ms	66
ctrs	(?) !ctrs 9 9 9	sets the controller steps to 9 MI/ms for all axes	66
ctrf	(?) !ctrf 2 2 2	sets the controller steps to 2	67
ctrd	(?) !ctrd 5 5 5	sets the delay for all axes to 5ms	67
ctrt	(?) !ctrt 1-10000	controller monitoring (Timeout)	66
ctrfm	(?) !ctrfm 1	if controller difference is larger than catching area than new vector	68
ctrfmc	(?) !ctrfm 0	clear Fast Move Counter / (?ctrfm = Abfrage Counter	68

Instruction	Example	Note	Chap.4 Page
MR-specific			
mro	(!) ?mro	sends back the determined offset values of the controller	69
mrp	(!) ?mrp	sends back the maximum value off all measuring systems	69
mrt	(!) ?mrt x	sends back the current signal value of X	70
mra	(!) ?mra y	sends back the aplification factor of Y	70
mrs	(!) ?mrsa x 0	sends the signal form sinus-X	71
LSTEP-PCI – Ecnounder position			
hwcount	?hwcount	read all encoder positions	62
clearhwcount	!clearhwcount	set all encoder counter to zero	62
Trigger-Output			
trig	(?) !trig	switches the trigger on	83
triga	(?) !triga	selects the axis, that should be triggered (i.e. X)	83
trigm	(?) !trigm 1	sets the trigger-mode to 1	84
trigs	(?) !trigs 4	sets the trigger-signal-length to 4µs	85
trigd	(?) !trigd 1	sets the trigger-distance to 1mm (for Dim 2)	85
trigoffsetone trigoffsettwo	(!) ?trigoffsetone ; (!) ?trigoffsettwo	-delivers the current Trigger offset for Trigger 1 -delivers the current Trigger offset for Trigger 2	86
trigcount trigcounttwo	(!)?!trigcount; (!)?trigcounttwo	-reads counter setting Trigger 1 -reads counter setting Trigger 2	86
Snapshot-Input			
sns	(?) !sns 1	snapshot "ON"	87
snsl	(?) !snsl 1	snapshot ist high-aktive	87
snsm	(?) !snsm 1	Auto-snapshot	88
snsc	?snsc	delivers the amount of the released snapshots	88
snsp	(!) ?snsp	delivers the saved position	88
snsa	?snsa 11	Inquiry of the snapshot-position 11	89
snsf	(?)!snsf 10	serves as input filter for all rebound switches (value 0-100)	87
snso	(?)!snso	Snapshot Offset	89

Explanations	
!	write only ("!" can also be left out)
(?) !	write and read
?	read only ("?" can also be left out)

Possibilities for input	
Command Value Value Value Value	alle Achsen werden gesetzt oder gelesen
Command Value Value	nur X + Y werden gesetzt oder gelesen
Command Axis Value	nur die ausgewälte Achse wird gesetzt oder gelesen

Error messages	
0	no error
1	no valid axes notation
2	no executeable function
3	to many characters in the command-string
4	no valid command
5	outside valid number area
6	incorrect amount of the parameters
7	No ! Or ?
8	no TVR possible, because axis is active
9	no switching On/Off of the axes, bacause TVR is active
10	function is not configured
11	no Move-command possible, because joystick-hand
12	limit switch activated
13	function cannot be carried out because Encoder was recognized
14	Fault during calibration (Limit switch was not set free correctly)
15	This function is interrupted activated while releasing the encoder during calibrating or table stroke measuring if the opposite encoder is activated.
20	driver relay defective (safty circle K3/K4)
21	only single vectors may be driven (setup mode)
22	no calibrating, measuring table stroke or joystick operation can be carried out (door open or setup mode)
23	SECURITY Error X-axis
24	SECURITY Error Y- axis
25	SECURITY Error Z- axis
26	SECURITY Error A- axis
27	Emergency-STOP
28	Fault in the door switch safty circle (only with LS44/Solero)
29	Power stages are not switched on (only with LS44/ECO-STEP)
30	GAL safty fault (only with LS44)
31	While activating the joy-stick, if Move is still active.

4.2 Firmware and Hardware Information

The Firmware version can be inquired with the “ver” instructions. Which options are released in the Firmware can be inquired with the “det“instruction. Each LStep has its own individual internal serial number. This serial number can be read out with the instruction “readsn“.

Read Out Version Number	
Instruction:	?ver or ver
Parameters:	none
Description:	gives the current Firmware version number
Feedback:	LS44.xx.xxx
Error code:	--
Example:	?ver

Read out Internal Version number	
Instruction:	?iver or iver
Parameters:	none
Description:	gives detailled information of the version number
Feedback:	weekday_calendar week_year-consecutive number
Error code:	--
Example:	?iver Rückmeldung z. B.: T04_35-02-0004

Read Out Version Number In Detail		
Instruction:		?det or det
Parameters:		none
Description:		gives the detailed Firmware version number-
Feedback:		A decimal value is given which has to be converted to a hexadecimal value:
		0x0 - - - 1 ➔ 1Vss encoder configured
		0x0 - - - 2 ➔ MR encoder configured
		0x0 - - - 4 ➔ TTL encoder configured
		0x0 - - 3 - ➔ The second number specifies the number of axes (here 3)
		0x0 - 1 - - ➔ Display configured
		0x0 - 2 - - ➔ Speed poti configured
		0x0 - 4 - - ➔ Handwheel (man. encoder) configured
		0x0 - 8 - - ➔ Snapshot configured
		0x01 - - - ➔ TVR configuredt
		0x02 - - - ➔ Triggerout configured
		0x1 - - - - ➔ 16 digital I/O configured
		0x2 - - - - ➔ 32 digital I/O configured
		0x4 - - - - ➔ Trackball
		The appropriate combination of the information gives the present configuration.
Error code:		--
Example:		?det = 81697 ➔ 13F21H
Description 13F21	**1**	16 digitale I/O configured
	3	TVR and Triggerout configured
	F	display; speedpoti; handwheel and snapshot configured
	2	2 axis
	1	1Vss encoder configured

Read Serial Number	
Instruction:	?readsn
Parameters:	none
Description:	Read out serial number of the controller.
Feedback:	9-characters
Error code:	--
Example:	?readsn

4.3 Reset

There are five ways to reset the control program:

- The hardware reset at the main power switch (for controllers without a display).
- The hardware reset with the Reset button (for controllers with display only).
- The hardware reset with the Dip-switch 1 for the PCI-card
- The hardware reset by instruction
- The software reset

Hardware - Reset	
Instruction:	hardreset
Parameters:	None
Description:	The hard- and software of the ontroller is reset to starting status
Feedback:	None
Error code:	--
Example:	Reset

Software – Reset	
Instruction:	reset
Parameters:	None
Description:	The software of the controller is reset to starting status
Feedback:	None
Error code:	--
Example:	reset

Poweramplifier	
Instruction:	!poweramplifier oder !pa
Parameters:	0 or 1
Description:	This instruction applies only to the LS44-controller. !poweramplifier or !pa switches the power stages of the LS44 On (1) or Off (0).
Feedback:	--
Error code:	--
Example:	!pa 1 => Switches on all power stages of the LS44.

4.4 Interface Configuration

Baud - Rate	
Instruction:	!baud or ?baud
Parameters:	9600, 19200, 38400, 57600 or 115200
Description:	!baud 19200 ➔ The transmission rate of the interface is set at 19200.
	?baud ➔ gives the present transmission rate
Feedback:	Present transmission rate
Error code:	--
Example:	?baud

CTS Interpretation Of The RS232-Interface	
Instruction:	?cts or !cts
Parameters:	0 or 1
Description:	!cts 1 => activates the CTS interpretation of the RS232 interface !cts 0 => deactivates the CTS interpretation of the RS232 interface ?cts => Display of the present CTS Interpretation status
Feedback:	0 or 1
Error code:	--
Example:	?cts (Display of the curren CTS interpretation status)

Interrupt-controlled Communication (relevant only for LStepPCI)	
Instruction:	!intcom or ?intcom
Parameters:	0, 1
Description:	!intcom 0 ➔ Communication with DPRAM by Polling
	!intcom 1 ➔ Communication interrupt-controlled with DPRAM
Feedback:	0 or 1
Error code:	--
Example:	!intcom 1 (Change-over to Communication by interrupt) ?intcom

4.5 Instruction Set Used and save Functions

The controller supports three different instruction sets.

- The instruction set introduced for the new controller generation “June 2000“, described here.
- The register instruction set used on the previous controller model until June 2000.
- The multi-control instruction set (Venus).

Use the instruction described below to select the required instruction set.

Interpreter		
Instruction:	!ipreter oder ?ipreter	
Parameters:	0, 1 und 2	
Description:	!ipreter 0	➔ Register oriented instruction set
	!ipreter 1	➔ New instruction set
	!ipreter 2	➔ instruction set ITK
	?ipreter	➔ Which instruction set? (can only read 1)
Addition:	The commands of the register instruction set.	
	U7ma	➔ Register
	U7mb	➔ New instruction set?
	U7mc	➔ Venus instruction set?
Feedback:	0, 1 oder 2	
Error code:	--	
Example:	!ipreter 0 (Switch to old instruction set) ?ipreter	

The instruction set is preset in the factory, i.e. if for reasons of compatability, the old register instruction set has been set, the following command can be used to switch to the newer instruction set.

Instruction: U7mb ↵

Configuration of the command set	
Instruction:	!?saveipreter
Parameter:	0 (Register), 1 (Interpreter) oder 2 (ITK)
Comment:	This command exists only for the 168‘ controller and needs the „save“-function, with subsequent RESET/NEW START, to be effective.
Description:	?saveipreter => reading of the current condition !saveipreter 0 => register set is configured
Feedback:	0, 1 oder 2
Error code:	--
Example:	!saveipreter 0 (Register-command set) !save (setting is burned in the Flash) !reset (NEW START)

Parameter Save Funktion	
Instruction:	save
Parameter:	--
Comment:	This command exists only for controllers with ST10F168 controller! Save means: The current parameters (spindl pitch, aso.) are programmed in the Flash and are available immediately for a new start
Description:	save => The current parameters are programmed in the Flash.
Feedback:	in the Display with ?err the success can be controlled. i.e.: Acknowledgement = 0 => Save OK Acknowledgement unequal 0 => Save not OK (see controller-manual)
Error code:	--
Example:	--

4.6 Status and Fault / Error Messages

AutoStatus	
Instruction:	!autostatus or ?autostatus
Parameters:	-1, 0, 1, 2, 3 or 4
Description:	-1 ➔ The controller is transmitting no status.
	0 ➔ The controller is only transmitting an active stop input, no further status signals are transferred.
	1 ➔ “Position reached” signals are transmitted automatically by the controller.
	2 ➔ “Position reached” and status signals are transmitted automatically by the controller.
	3 ➔ For “Position reached“, only a carriage return is returned.
	4 ➔ The controller returns all transmitted commands with parameters.
Feedback:	
Error code:	--
Example:	!autostatus 1 ?autostatus

Status	
Instruction:	?status or status
Parameters:	--
Description:	gives the present status of the controller
Feedback:	OK... or ERR and error message
Error code:	--
Example:	?status

Current condition of the stop signal	
Instruction:	?stopstatus
Parameters:	--
Description:	Returns the the present state of the stop signal in consideration of the chosen stop polarity (see command "stoppol")
Feedback:	0 = stop is inactive 1 = stop is active
Error code:	--
Example:	?stopstatus

StatusAxis	
Instruction:	?statusaxis or statusaxis
Parameters:	--
Description:	gives the present status of the individual axes.
Feedback:	e.g.: @ - M –
	@ ➔ Axis stands and is ready
	M ➔ Axis is moving (Motion)
	J ➔ Joystick mode
	C ➔ in control
	S ➔ limit switch activated
	A ➔ Acknowledgement after calibrating
	E ➔ Acknowledgement after calibrating if a fault occurs. (Limit switch was not set free correctly).
	D ➔ Acknowledgement after table stroke measuring
	U ➔ setup mode (Setting **U**p)
	T ➔ Timeout
	F ➔ Active at Emergency stop, if during calibration both limit switchs are active, if during calibration at moving out the final position switch will be positioned
	- ➔ Axis is not enabled
Error code:	--
Example:	?statusaxis

Error	
Instruction:	?err or err
Parameters:	--
Description:	Error gives the present error number (see error description)
Feedback:	Decimal value
Error code	--
Example:	?err

Error_Nr	Description of the error messages
0	no error
1	no valid axes notation
2	no executeable function
3	to many characters in the command-string
4	no valid command
5	outside valid number area
6	incorrect amount of the parameters
7	No ! Or ?
8	no TVR possible, because axis is active
9	no switching On/Off of the axes, bacause TVR is active
10	function is not configured
11	no Move-command possible, because joystick-hand
12	limit switch activated
13	function cannot be carried out because Encoder was recognized
14	Fault during calibration (Limit switch was not set free correctly)
15	This function is interrupted activated while releasing the encoder during calibrating or table stroke measuring if the opposite encoder is activated.
20	driver relay defective (safty circle K3/K4)
21	only single vectors may be driven (setup mode)
22	no calibrating, measuring table stroke or joystick operation can be carried out (door open or setup mode)
23	SECURITY Error X-axis
24	SECURITY Error Y- axis
25	SECURITY Error Z- axis
26	SECURITY Error A- axis
27	Emergency-STOP
28	Fault in the door switch safty circle (only with LS44/Solero)
29	Power stages are not switched on (only with LS44/ECO-STEP)
30	GAL security error (only with LS44)
31	While activating the joy-stick, if Move is still active.
32	When a Move is without the software limits and Limmode=1

SECURITY STATUS	
Instruction:	!?securitystatus
Parameters:	--
Note:	This instruction only exists for LS44-controller
Description:	?securitystaus => reading the current status of the security monitoring !securitystatus 0 => Clear reminder for testing
Feedback:	Bit 0 0000000000000000 Bit15 Bit 0-3 internal reminder Bit 4 X-axis standstill monitoring tested Bit 5 Y- axis standstill monitoring tested Bit 6 Z- axis standstill monitoring tested Bit 7 A- axis standstill monitoring tested Bit 8 X- axis speed monitoring tested Bit 9 Y- axis speed monitoring tested Bit 10 Z- axis speed monitoring tested Bit 11 A- axis speed monitoring tested Bit 12 Bit 13 Bit 14 condition setup mode (setup mode = 1) Bit 15 condition door (door „Open“ = 1)
Error code:	--
Example:	--

SECURITY ERROR	
Instruction:	?securityerror
Parameters:	--
Note:	This instruction only exists for LS44-controller
Description:	?securityerror => reading the current status and results of the GAL-security monitoring
Feedback:	Bit 0 0000000000000000 Bit15 Bit 0 : axis X axis standstill monitoring result (OK [1] / nicht OK [0]) Bit 1 : axis Y axis standstill monitoring result Bit 2 : axis Z axis standstill monitoring result Bit 3 : axis A axis standstill monitoring result Bit 4 : axis X axis standstill monitoring test (getestet [1] / nicht getestet [0] Bit 5 : axis Y axis standstill monitoring test Bit 6 : axis Z axis standstill monitoring test Bit 7 : axis A axis standstill monitoring test Bit 8 : axis X speed monitoring result (OK [1] / not OK [0] Bit 9 : axis Y speed monitoring result Bit 10 : axis Z speed monitoring result Bit 11 : axis A speed monitoring result Bit 12 : axis X speed monitoring test (tested [1] / not tested [0] Bit 13 : axis Y speed monitoring test Bit 14 : axis Z speed monitoring test Bit 15 : axis A speed monitoring test
Error code:	--
Example:	--

Output Function Level	
Instruction:	!?opfl
Parameters:	x, y, z, and a 2,5-65 revolutions/second and also greater!
Note:	If the set speed is exeeded the current will be switched from pramametric to maximum current.
Description:	!opfl x 25 => at the x-axis the current switch is done at 25 Rev/s. ?opfl => reading all speed limits.
Feedback:	speed in Rev/s
Error code:	--
Example:	?opfl y (read the speed limit of ther y-axis)

Switch Level for Velocity	
Instruction:	!?vlevel
Parameters:	1-7 and 0 – max. speed
Note:	With this command it is possible exclude speed areas in which the system tends to resonance. Ther are 3 speed areasand one limit that can be set with this command: Vlevel 1 = Lower limit of the first/lower area Vlevel 2 = Upper limit of the first/lower area Vlevel 3 = Lower limit of the second/third area Vlevel 4 = Upper limit of the second/third area Vlevel 5 = Lower limit of the third/upper area Vlevel 6 = Upper limit of the third/upper area Vlevel 7 = Up to this speed limit, the correction table is used These 3 speed areas are deactivated if the corretion table is active. Applies to all axes!
Description:	!vlevel 1 0.8 = Lower limit of the first/lower area !vlevel 2 1.2 = Upper limit of the first/lower area. ?vlevel 3 = Reading the speed limit of the second/lower area
Feedback:	Set speed
Error code:	--
Example:	!vlevel 7 10 (The correction table is valid up to a speed of 10 revolution/s)

Motor – Table Patch	
Instruction:	!?mtpatch
Parameters:	0 or 1
Note:	With this command, the correction table is activated. The correction table was determined for Vextra Motore by measurement.
Description:	!mtpatch 1 = Activating the correction table ?mtpatch = Reading the current condition
Feedback:	0 or 1
Error code:	--
Example:	!mtpatch 0 (The correction table is not used.)

Joystick Filter	
Instruction:	!?joyfilter
Parameters:	0 or 1
Note:	With this command, the filtration and Hysteresis in the Joystick-operation is activated.
Description:	!joyfilter 1 = Activating of the filtration ?joyfilter = Reading the current condition
Feedback:	0 or 1
Error code:	--
Example:	!joyfilter 0 (The filtration and Hysteresis is not used.)

4.7 Settings

The controller can be adapted to the mechanical components which are being used and to the desired requirements with the instructions described below.

Dimension		
Instruction:	!dim or ?dim	
Parameters:	x, y, z and a 0, 1, 2, 3 or 4 The units for specification of lengths for input and output are:	
	0	➔ Microsteps
	1	➔ µm
	2	➔ mm
	3	➔ 360°
	4	➔ Number of revolutions
Description:		
	!dim 4 1	➔ The dimensions for the X- and Y-axes are “Number of revolutions“ and “µm“.
	!dim z 2	➔ The dimension for the Z-axis is “mm“.
	?dim	➔ All dimensions are displayed.
	?dim a	➔ The dimension of the A-axis is displayed.
Feedback:	Present setting	
Error code:	--	
Example:	!dim 1 1 1 1 (all values in µm) ?dim	

Note:	The Spindle pitch schould be set at 1 mm for dimensions 3 (degrees) and 4 (revolutions).

Spindle Pitch		
Instruction:	!pitch or ?pitch	
Parameters:	x, y, z and a 0.001 – 68	
Description:	!pitch 4.0 1.0	➔ Spindle pitches X = 4mm and Y = 1mm are programmed.
	!pitch z 1.0	➔ Spindle pitch Z = 1mm is programmed.
	?pitch	➔ All spindle pitches are displayed.
	?pitch a	➔ The spindle pitch of the A-axis is displayed.
Feedback:	Present spindle pitch	
Error code:	--	
Example:	!pitch 10 (spindle pitch X = 10mm) ?pitch	

Gear		
Instruction:	!gear or ?gear	
Parameters:	x, y, z and a 0.01 – 0.99 and 1-1000	
Description:	!gear 4.0 1.0	➔ Gear transmissions ¼ for X and 1/1 for Y are programmed.
	!gear z 10.0	➔ Gear transmissions 1/10 for Z is programmed.
	?gear	➔ All gear transmissions are displayed.
	?gear a	➔ The gear transmissions for the A-axis are displayed.
Feedback:	Present gear transmissions	
Error code:	--	
Example:	!gear 10 (gear transmission 1/10 for X) ?gear	

Acceleration		
Instruction:	!accel or ?accel	
Parameters:	x, y, z and a 0.01 – 20.00 [m/s^2]	
Description:	!accel 1.00 1.50	➔ The accelerations (X-1.00, Y = 1.50 [m/s²] are set for the X- and Y- axes, the other axes remain unchanged.
	!accel x 1	➔ The acceleration for the X-axis is set to 1.00 [m/s^2] .
	?accel	➔ All preset accelerations are displayed.
	?accel z	➔ The preset acceleration of the Z-axis is displayed.
Feedback:	Preset acceleration	
Error code:	--	
Example:	!accel 1.00 (set accelerations for X-axis to 1 m/s^2) ?accel	

Speed (Velocity)		
Instruction:	!vel or ?vel	
Parameters:	x, y, z and a 0 – maximum speed	
Description:	!vel 1.0 15	➔ The speeds are described for axes X and Y (X=1.0, Y=15 [r/s]), the other axes remain unchanged.
	!vel z 0.1	➔ The speed for the Z-axis is set to 0.1 [r/s] .
	?vel	➔ All preset speeds are displayed.
	?vel x	➔ Display of the preset speed of axis x.
Feedback:	Preset speed	
Error code:	--	
Example:	!vel 10 (The X-axis is run at max. 10 r/s) ?vel	

The speed of rotation of the motors can be set in steps (St) of 0.01 r/sec. to 40 r/sec, or for the ECO-STEP, up to 15 r/sec. The top speed ranges can be reached only if the motors and the mechanical components are optimally synchronized on the LSTEP.

Value	Speed [r/sec]	Value	Speed [r/sec]	Value	Speed [r/sec]
0	0.01	2.0	2.0	12.0	12
0.1	0.1	3.0	3.0	13.0	13
0.2	0.2	9.0	9.0	15.0	15
0.9	0.9	10.0	10	20.0	20
1.0	1.0	11.0	11	40.0	40

Speed Reduction	
Instruction:	!velfac ?velfac
Parameters:	x, y, z and a 0.01 to 1.00
Description:	!velfac x 0.1 => reduces the speed of the X-axis to 1/10 of the preset speed. ?velfac => gives the settings for all axes
Feedback:	A decimal value is returned (0.01 to 1.00)
Error code:	--
Example:	?velfac z (gives the setting for the Z-axis)

MaxCurrent (max. possible motor current)	
Instruction:	?maxcur
Parameters:	x, y, z and a
Description:	?maxcur y =>gives the maximum possible motor current for the Y-axis ?maxcur => gives the maximum possible motor current for all axes
Feedback:	Motor current in amps
Error code:	--
Example:	?maxcur

Output Current		
Instruction:	!cur or ?cur	
Parameters:	x, y, z and a 0 – maximum current	
Description:	!cur 1.0 2	➔ The output currents for the X- and Y-axes are set to X = 1A and Y = 2A, the other axes remain unchanged:
	!cur z 0.1	➔ The output current for the Z-axis is set at 0.1A.
	?cur	➔ All preset output currents are displayed.
	?cur x	➔ Display the preset output current for the X-axis.
Feedback:	Preset output current	
Error code:	--	
Example:	!cur 1.0 (The X-axis is run at maximum 1A) ?cur	

Current Reduction		
Instruction:	!reduction or ?reduction	
Parameters:	x, y, z and a 0 – 1.0	
Description:	In quiescent state, the rated motor current is reduced to the parameterized ratio.	
	!reduction 0.1 .7	➔ X-axis = 0.1*rated current and Y-axis = 0.7*rated current
	!reduction z 0.5	➔ Z-axis = 0.5*rated current
	?reduction	➔ Display of the preset current reductions of all axes
	?reduction x	➔ Display of the preset current reduction for the X-axis.
Feedback:	Preset current reduction	
Error code:	--	
Example:	!reduction 0.3 0.5 (X-and Y-axes are reduced) ?reduction	

Delay Current Reduction	
Instruction:	!curdelay or ?curdelay
Parameters:	x, y, z and a 0 – 10000 (ms)
Description	After moving a vector the motor current is maintained for the time thaat is setr in curdelay. Afterwards it is reduced to the specifiedvalue of the current reduction. !curdelay 100 300 = x-axis = 100 ms delay and y-axis = 300 ms delay !curdelay z 450 = z-axis = 450 ms delay ?curdelay = indication of the set current reduction of all axes ?curdelay x = indication of the set current reduction of the x-axes
Feedback:	set delay of the current reduction
Error code:	--
Example	!curdelay 100 300 (x- and y-axis are delayed) ?curdelay

Axis Enable		
Instruction:	!axis or ?axis	
Parameters:	x, y, z and a 0 and 1	
Description:	!axis 1 0 1 0	➔ The X- and Z-axes are enabled, the Y- and A- axes are not enabled.
	!axis y 1	➔ Y-axis enabled
	?axis	➔ Show status of all axes
	?axis a	➔ Show status of axis A
Feedback:	Present operating status	
Error code:	--	
Example:	!axis 1 1 1 1 (enable all axes) ?axis x (read status of X-axis)	

Axis direction	
Instruction:	!?axisdir
Parameter:	x, y, z and a 0 or 1
Note:	With axisdir the motor – turning direction can be turned, the corresponding limit switches are turned also.
Description:	!axis 0 1 0 1 => the turning direction of the axis y and a are turned. ?axisdir x = indication, if the turning direction of the x-axis is activated.
Feedback::	0 = no change turning direction 1 =
Error code::	--
Example::	!axisdir 0 0 0 0 (Cancel all changes of turning direction)

Limit		
Instruction:	!lim or ?lim	
Parameter:	x, y, z and a +- maximale Verfahrbereich	
Note:	The values must be given in pairs. The in- and output values are dependet on the dimension.	
Description:	!lim -1000 1000 -2000 2000	➔ Moving range limits are assigned to x- and y-axis
	!lim z –500 1700	➔ Moving range limits are assigned to z-axis.
	?lim	➔ Read moving range limits of all axis.
	?lim a	➔ represent moving range limits a-axis
Feedback:	Current moving range	
Error code:	--	
Example:	!lim 10 (program only Lower limitx-axis) ?lim	

Limit Control	
Instruction:	!limctr or ?limctr
Parameters:	x, y, z and a 0 or 1
Description:	!limctr 1 1 1 ➔ Limit control active for the X-, Y- and Z-axes.
	!limctr z 1 ➔ Limit control active for the Z-axis.
	?limctr a ➔ Limit control active for the A-axis?
	?limctr Display of the status of the individual limit controls.
Feedback:	0 = Limit control not active 1 = Limit control active
Error code:	--
Example:	! limctr y 0 (Deactivate Y-axis limit control ? limctr

Statuslimit	
Instruction:	?statuslimit or statuslimit
Parameters:	--
Description:	Statuslimit delivers the current condition of the software-limits of each single axis.
Feedback:	A = Axis was calibratet
	D = table stroke was measured
	L = Software – Limit was set
	- = Software – Limit was not changed
	The sequence of the acknowledgement is for example: AA-A--DD-LL-L--L
	X,y and a = calibratet
	Z and a = measure table stroke Y and z = min. software limit set
	X and a = max. software limit set
Error code:	--
Example:	?statuslimit

NoSetLimit	
Instruction:	!?nosetlimit
Parameters:	x, y, z and a 0 or 1
Note:	When calibrating and measuring table stroke normaly the internal software – limits are set, this can be avoided herewith
Description:	nosetlimit 1 1 1 => No moving range limits are set for the axis x, y and z. !nosetlimit y 1 => No moving range limit is set for the y-axis. ?nosetlimit = Read settings of all axis ?nosetlimit a = Read settings of axis a
Feedback:	0 = Software – Limits will be set (calib/rm)
Error code:	--
Example:	?nosetlimit

Monitoring of the software limits	
Command:	!?limmode
Parameter:	0+1
Description:	0 = Software limits are monitored as with the older versions 1 = Moves are not executed when they are outside of the positioning capacity, ERR 32 return.
Feedback:	Adjusted mode

Limit Switch Polarity		
Instruction:	!swpol or ?swpol	
Parameters:	x, y, z and a **0**  or **1** 	
Description:	!swpol 1 0 1	➔ Assign polarity of the limit switches for all axes. (Order: E0 REF EE).
	!swpol z 1 0 1	➔ Assign polarity of the limit switch for the Z-axis. (Order: E0 REF EE)
	?swpol a	➔ Show polarity of the limit switch for axis A.
Feedback:	Polarity of the limit switches	
Error code:	--	
Example:	!swpol y 1 1 1 (All Y-axis switches react to the positive edge) ?swpol x	

Limit Switch On/Off	
Instruction:	!swact or ?swact
Parameters:	x, y, z and a 0 or 1
Description:	!swact 1 0 1 ➔ Limit switches for all axes : E0=On REF=Off EE=On
	!swact z 1 0 1 ➔ Z-axis limit switch: E0=On REF=Off EE=On
	?swact a ➔ Show status of the A-axis limit switches.
Feedback:	Status of the limit switches
Error code:	--
Example:	!swact y 1 1 1 (All Y-axis switches active) ?swact x

Read Limit Switches													
Instruction:	?readsw												
Parameters:													
Description:	?readsw ➔ Read status of all limit switches.												
Feedback:	Status of the limit switches.												
	Axis:	**x**	**y**	**z**	**a**	**x**	**y**	**z**	**a**	**x**	**y**	**z**	**a**
	Switch:	**E0**	**E0**	**E0**	**E0**	**Ref**	**Ref**	**Ref**	**Ref**	**EE**	**EE**	**EE**	**EE**
	E0 = Zero limit switch					Ref = Reference limit switch				EE = End limit switch			
Error code:	--												
Example:	?readsw (Read all limit switches)												

Stop input set polarity	
Instruction:	!stoppol or ?stoppol
Parameters:	0 = low active 1 = high active
Description:	Due to the pullup resistor of the stop input (connected to +5 V), low active has to be set for a make contact and high active for a break contact.
Feedback:	--
Error code:	--
Example:	!stoppol 1 (the stop input is high active)

Stop accelerationfor the emergency stop	
Instruction:	!stopaccel or ?stopaccel
Parameters:	0,01 bis 20 m/s²
Description:	During activating of the stop inputs the acceleration speed which is set with "accel" will be used for stopping, if "stopaccel" is not set. When "stopaccel" is set, this acceleration is valid unless the value in "accel" is higher. This value will not be saved with Save. The Position is not lost (if the acceleration was selected correctly) After the release of the Stop input, calibration is not necessary .
Feedback:	--
Error code:	--
Example:	!stopaccel 2 (it will be stopped with 2m/s²)
Attention! **Note:**	stopaccel is only valid for vector operating **not for:** Joystick, calibrating and stroke measuring

4.8 Determination Of The Mechanical Work Range

After initializing the controller, the instructions calibrate “cal“ and measure stroke “rm“should be performed. This will determine the maximum mechanical work range. This ensures that the axes cannot be moved into the limit switches.
The work stroke can only be measured when all axes have a zero and and end limit switch.
So that the limit switches respond when the zero or the end position is reached if the mechanical components overshoot them, the work range can be limited with the instructions “caliboffset“ and “rmoffset“.

Calibrate	
Instruction:	!cal or cal
Parameters:	x, y, z and a
Description:	cal ➔ Moves all enabled axes towards lower positional values.Travel is stopped as soon as the limit switches have been tripped and is then resumed slowly in the opposite direction until the switch is no longer active. The positional value is set to 0. The position is taken over as a software limit, as described in the instruction “Limit“.
	cal y ➔ As above, only for the Y-axis.
Feedback:	An ‘A’ for each calibrated axis or ‘E’ if fault occurs
Error code:	--
Example:	!cal

Measure Table Stroke	
Instruction:	!rm or rm
Parameters:	x, y, z and a
Description:	rm ➔ Moves all enabled axes towards greater positional values. The travel is stopped as soon as the limit switch has been tripped and is then resumed slowly in the opposite direction until the switch is no longer active. The positional value is saved and is taken over as the software limt, as described in the instruction “Limit“.
	rm z ➔ As above, however for the Z-axis only
Feedback:	A ,D‘for every axis
Error code:	--
Example:	!rm

RM Offset		
Instruction:	!rmoffset or ?rmoffset	
Parameters:	x, y, z and a 0 – 32*50000 (32*spindle pitch)	
Description:	!rmoffset 1 1 1	➔ The X-, Y-, and Z-axes are each moved 1mm (for Dim. 2 2 2) away from the limit switch towards the center of the table when the table stroke is measured and the software limit is then set.
	?rmoffset y	➔ Read present offset of the Y-axis.
Feedback:	Distance	
Error code:	--	
Example:	?rmoffset	

Calibration Offset		
Instruction:	!caliboffset or ?caliboffset	
Parameters:	x, y, z and a 0 – 32*50000 (32*spindle pitch)	
Description:	!caliboffset 1 1 1	➔ The X-, Y-, and Z-axes are each moved 1 mm (for Dim 2 2 2) away from the zero limit switch towards the center of the table when calibration is done and the zero position is then set (software limit).
	?caliboffset y	➔ Read present offset of the Y-axis
Feedback:	Distance	
Error code:	--	
Example:	?caliboffset	

Calibration Direction	
Instruction:	!?caldir
Parameters:	x, y, z and a 0 or 1
Note:	When calibrating in positive direction, the positive software limit is set.
Description:	!caldir 0 0 1 => The axes X, Y are calibratet in negative direction and the Z-axis in positive direction. ?caldir => read current direction for calibrating.
Feedback:	0 = negative direction 1 = positive direction
Error code:	--
Example:	!caldir y 1 (The Y-axis will be calibratet in positive direction)
Attention!	This command works only with controls without measuring systems

Calibration Position	
Instruction:	!?calpos (only in connection with a measuring system)
Parameters:	x, y, z and a position value
Note:	The position where the limit switch was left, is saved for each axis when calibrating.
Description:	!calpos 0 0 0 => Set the positionen for X-, Y- and Z-axis to 0.?calpos => read current position
Feedback:	In range of the encoder
Error code:	--
Example:	?calpos y (The position of the Y-axis)

Calibration Backspeed	
Instruction:	!?calbspeed
Parameters:	value range 5 bis 100
Note:	The speed equals the entered value *0.01 U/s.
Description:	calbspeed sets resp. reads the revolution speed, the axes drive after reaching the limit switch. The entered value must be 0.01 U/s multiplied.
Feedback:	--
Error code:	--
Example:	!calbspeed 10 => After reaching the limit switches when calibrating they are left with 0.1 R/s. ?calbspeed => Read current setting (given value *0.01 U/s).

Calibration Refspeed	
Instruction:	!?calrefspeed
Parameters:	Value range 0 - 100
Note:	The basic setting = 32 This value will not be saved with Save.
Description:	This setting changes the speed for finding the reference mark
Feedback:	--
Error code:	--
Example:	!calrefspeed 5

Direction for Reference	
Instruction:	!?refdir (applies only to LSTEP)
Parameters:	x, y, z and a 0 or 1
Note:	In the basic condition the reference direction is negative if no switch was activated this can be changed with „!refdir“.
Description:	!refdir 0 0 1 => The axes X, Y will be referenced in negative direction and the Z-axis in positive direction. ?refdir => Read current position for referencing
Feedback:	0 = negative direction 1 = positive direction
Error code:	--
Example:	!refdir Y (The Y-axis will be referenced in positive direction)

Reference	
Instruction:	!ref or ref (applies only to LSTEP)
Parameters:	x, y, z and a
Note:	In the basic condition the reference direction is negative if no switch was activated this can be changed with „!refdir“.
Description:	ref = Moves all released axes in the direction indicted via “refdir” The movement will be interruppted as soon as a reference switch is reached. The position value is not set. ref y = Like above but y-axis.
Feedback:	For each referenced axis a ‚R‘
Error code:	--
Example:	!ref

4.9 Travel Instructions And Their Control Functions

Linear interpolation takes place for all positioning instructions, i.e. all axes reach the specified position at the same time. The axis where the motor must traverse the most revolutions is deemed the lead axis and thus travels at the preset speed and acceleration.
The x-axis is the lead axis, if all axes haves to travel the same stretch. In this case all axes exceed the preset speed and acceleration.
If the axes have totally different dynamic behavior, they should be startet individually. Also an assynchrones movement is possible. Herewith is to be noted that in the setting auto status 1 the acknowledgement first comes, if all axes came to standstill. If you want to start another axis while one is already moving the auto status = 0 and pollt with ?statusaxis.

Position absolut	
Instruction:	!moa or moa
Parameters:	x, y, z and a +- Range of travel
Note:	The input depends on the dimension.
Description:	moa 10 0 20 ➔ The X-, Y- and Z-axes are positioned at the positional values which were input.
	moa y 333 ➔ As above, however Y-axis only.
Feedback:	A ‚@‘ for every positioned axis
Error code:	--
Example:	moa x 10 (The X-axis is positioned at the position which was input)

Relative Position	
Instruction:	!mor or mor
Parameters:	x, y, z and a +- Range of travel
Note:	The input depends on the dimension.
Description:	mor 100 0 39 ➔ The X- and Z-axes are travelled the distances which were input.
	mor a 298 ➔ The A-axis is travelled the distance which was input.
Feedback:	A,@‘ for every axis which is travelled
Error code:	--
Example:	!mor 0 0 0 100 (Only the A-axis is travelled)

X Y Compensation	
Instruction:	!?xycomp
Parameters:	0 bis 6
Note:	0 = No compensation 1 = „X = X+Y“ 2 = „Y = X+Y“ 3 = „X = X-Y and Y = X+Y“ 4 = „X = X+Y and Y = X-Y“ 5 = „X = X-Y“ 6 = „Y = X-Y“
Description:	xycomp 1 => The axes X, Y are manipulated after above-mentioned formula. ?xycomp => Read current condition
Feedback:	Type of the compensation
Error code:	--
Example:	?xycomp (Would read current condition of the compensation)

Position relative (short command)	
Instruction:	!m or m
Parameters:	
Note:	This instruction is used when the same distance is to be travelled again and again at short intervals. The distance to be travelled must first be set with !distance or more instructions. The position is not updated, until after the next Move-command.
Description:	m ➔ Start travel of all enabled axes.
Feedback:	Depends on the autostatus setting.
Error code:	--
Example:	!mor 0 0 0 100 (Only the A-axis is travelled) m (A-axis is travelled by 100 again)

External vector start	
Command:	!?itm
Parameter:	0-4
Remark:	The value which is in « distance » will be operated. At „autostaus = 1“, follows after the Move the @@@, and itm will set to 0. At Auto status 0 no feedback follows and you can proceed any vectors.
Description:	0 = Function not active 1 = Positioning absolute at positive edge 2 =Positioning absolute at negative edge 3 = Positioning relative at positive edge 4 = Positioning relative at negative edge
Feedback:	Adjusted mode

Distance		
Instruction:	!distance or ?distance	
Parameters:	x, y, z and a Min-/max- travel range	
Note:	Input and output depend on the dimension.	
Description:	!distance 1 2 3	➔ The distances for the X-, Y-, and Z-axes are set.
	!distance y 20	➔ The Y-axis distance is set.
	?distance	➔ Inquire present distances for all axes.
	?distance z	➔ Inquire present distance for Z-axis.
Feedback:	Distances	
Error code:	--	
Example:	!distance 10 20 (Set X- and Y-axis distances) ?distance (Inquire distances of all axes)	

SpeedPoti	
Instruction:	!pot or ?pot
Parameters:	0 or 1
Note:	
Description:	0 ➔ Travelling is done at the preset speed (vel).
	1 ➔ Travelling is done at a percentage of the preset speed (vel), depending on the setting of the potentiometer.
Feedback:	--
Error code:	--
Example:	!pot 1 ?pot

Position		
Instruction:	!pos or ?pos	
Parameters:	x, y, z and a Min-/max range of travel	
Note:	Input and output depend on the dimension.	
Description:	!pos 1000 2000 3000	➔ The positional values for the X-, Y-. and Z-axes are set.
	!pos y 2000	➔ The position of the Y-axis is set.
	?pos	➔ Inquire present position of all axes.
	?pos z	➔ Inquire present position of Z-axis.
Feedback:	Positional values	
Error code:	--	
Example:	!pos100 200 (Set positions of X- and Y-axes) ?pos (Inquire positions of all axes)	

Clear Position	
Instruction:	clearpos
Parameters:	x, y, z and a
Note:	This command sets the position to Ø, also the internal counter (is not the same function as setting position with !pos x Ø). This function is needed for endless axes, because the control can process only ± 1000 motor revolutions of the value range. In recognized encoders, the function is not carried out for the respective axis.
Description:	clearpos => All position values become are set to zero
	clearpos y => Position of the y-axis is set to zero.
Feedback:	No
Error code:	--
Example:	clearpos x (Position der x-Axis wird genullt)

Central Positioning	
Instruction:	!moc or moc
Parameters:	x, y, z and a
Note:	All axes are centered. It makes sence to calibrate and measure the table stroke previously!
Description:	moc a => The A-axis is centered.
Feedback:	For each positioned axis a ‚@‘
Error code:	--
Example:	moc (All axes are centered)

Delay	
Instruction:	?delay or !delay
Parameters:	0 – 10000 (ms)
Description:	The delay instruction can be used to delay the vector start.
Feedback:	Decimal value
Error code:	--
Example:	!delay 1000 (1s delay) ?delay

Abbort	
Instruction:	!a or a
Parameters:	None
Description:	All travels are stopped.
Feedback:	A @ for every axis
Error code:	--
Example:	!a

4.10 Joystick- Handwheel- and Trackball Instructions

Note:	If the joystick switch on the controller is set at “manual“, all axes can be moved right up to the end limit positions using the joystick. The position is thereby also counted. Instructions for setting the controller are possible in this mode of operation, “Move“ instructions however are not. If an inquiry is made with the instruction “Statusaxis“, the controller gives the reply “J J J“. In an inquiry with the instruction „?joy“ the controller gives the reply „M“.

Digital Joystick (Speed)		
Instruction:	!speed or ?speed	
Parameters:	x, y, z and a +- Maximum speed (vel)	
Description:	The individual axes can be travelled at a constant speed with this instruction.	
	!speed 0	➔ All axes at speed 0 and joystick mode “OFF“
	speed 10	➔ All axes at speed 10.0 [r/s] and joystick mode “ON“.
	!speed 10 10 0 10	➔ X-, Y-, and A-axes at speed 10.0 [r/s], Z-axis speed 0 and joystick mode “ON“.
	!speed y 25	➔ Y-axis speed 25 and joystick mode “ON“.
	!speed y -25	➔ Axis y speed 25 in negative direction joystick-operation „ON„.
	?speed	➔ Read the preset speeds.
	?speed y	➔ Read the preset speed of the Y-axis.
Feedback:	Present speeds	
Error code:	--	
Example:	!speed 33 11 (X-axis speed 33.0 [r/s], Y-axis speed 11.0 [r/s] and joystick mode “ON“) ?speed	
Note:	In order to position absolute or relative after carrying out the speed command, the didital joystick must be switched off with !speed 0 and the speed needs to be set new.	

Joystick Direction + disable joystick			
Instruction:	!joydir or ?joydir		
Parameters:	x, y, z and a 0, ±1, ±2		
Description:	When joydir is input, the direction of rotation of the motors is changed when the joystick is moved and the axes are disabled or enabled.		
	!joydir –1 –1 1 1	=	Negative direction of rotation for the X-and Y-axes, positive direction of rotation for the A-axis
	!joydir –2 –2 2 2	=	Like in above-mentioned example, but if the axes have not moved longer than 1s,they will be switched to the current reduced mode.
	!joydir z 0	=	Z-axis is disabled.
	Peculiarity: Because only a 3-axes joystick is planned,the third joystick-axis controlls the z- and a-axis.		
Feedback:	Preset directions or status.		
Error code:	--		
Example:	!joydir-1 (negative preceding sign for X-axis) ?joydir		

Joystick	
Instruction:	!joy or ?joy
Parameters:	0, 1, 2, 3, 4 and 5
Note:	The joystick switch must be set at Automatic
Description:	!joy 0 ➔ Joystick "OFF"
	!joy 1 ➔ Joystick "ON" without position count (tracking)
	!joy 2 ➔ Joystick "ON" with position count
	!joy 3 ➔ Joystick "ON" with position count and periodic position feedback.
	!joy 4 ➔ Joystick "ON" with position count (encoder values, if any)
	!joy 5 ➔ Joystick "ON" with position count and periodic position feedback (encoder values, if any).
	?joy ➔ Present status
Feedback:	Present position or present status of joystick operation. If the joy-stick is switched off for each axis comes as a return message @ if Autostatus =1
Error code:	--
Example:	!joy 2 (Joystick "ON" with position count) ?joy (Inquire present status)

Joystick Speed	
Instruction:	!joyspeed or ?joyspeed
Parameters:	x, y, z and a 0, 1 or 2 +- Maximum speed (vel)
Note:	For additional control panel
Description:	!joyspeed 0 25 ➔ Parameter 0 described at speed 25 .
	?joyspeed 1 ➔ Read preset speed of parameter 1.
Feedback:	Currently preset speeds
Error code:	--
Example:	!joyspeed 2 11 (Parameter 2 described at speed 11 .) ?joyspeed 2

Joystick Window (joywindow)	
Instruction:	!?joywindow
Parameters:	0 – 100
Description:	With joywindow the analog range is determined in which the axes move. Applies to all axes.
	joywindow 10 the axes move only, if the excursion of the joystick is greater than 10 (points).
	?joywindow => Read out the joystick – window .
	Example: zero position joystick = 512 (analog value) Joywindow = 10 i.e., that the axes move withhin the values < 502 and > 522.
Feedback:	Preset window
Error code:	--
Example:	?joywindow (reading window size)

Joystick-allocation of axes	
Instruction:	!joychangeaxis or ?joychangeaxis
Parameters:	0, 1
Description:	!joychangeaxis 0 ➔ Changes the allocation of the AD-Joystick channels (conventional evaluation of Joystick)
	!joychangeaxis 1 ➔ Changes the allocation of the AD-Joystick channels (Changes of allocation of X and Y axes)
Feedback:	0 or 1
Error code:	--
Example:	! joychangeaxis 1 (Exchange of allocation of X and Y axes) ? joychangeaxis

Configuration Joystick On/Off	
Instruction:	!?savejoyonoff
Parameters:	0 = Joystick is switched OFF after switching ON the PCs 1 = Joystick is switched ON after switching ON the PCs
Note:	This command only exists for the LSTEP-PCI
Description:	?savejoyonoff => reading the current state !savejoyonoff 1 => the joystick is active after a subsequent save commend and reset. of the control or (new start)
Feedback:	0 or 1
Error code:	--
Example:	!savejoyonoff 1 !save (Setting is burned into the flash) !reset (re start)

Handwheel reporting:

The movements of the table reacts dynamic to the turns of the handwheel.Slow turns are operated in micro steps, and fast turns with a speed profile. The the max. speed and tje accelaration for the handwheel operation can be set with the commands hwvel und hwaccel.

Handwheel	
Instruction:	!hw or ?hw
Parameters:	0, 1, 2, 3, 4 and 5
Note:	Alternative to joystick a handwheel can be connected.
Description:	!hw 0 ➔ Handwheel „OFF„
	!hw 1 ➔ Handwheel „ON„ without position count
	!hw 2 ➔ Handwheel „ON „ with position count
	!hw 3 ➔ Handwheel „ON „with position count and periodic position acknowledgement.
	!hw 4 ➔ Handwheel „ON „with position count (encoder value, if exists).
	!hw 5 ➔ Handwheel „ON „with position count and periodic position acknowledgement (encoder value, if exists).
	?hw ➔ current condition
Feedback:	Current position or current status of the hand wheel operation.
Error code:	--
Example:	!hw 2 (Handwheel „ON„ with position count) ?hw (Inquiry of the current condition)

Handwheel Speed	
Instruction:	!hwvel or ?hwvel
Parameters:	X and Y 0.0001 to 40.0000 U/s
Note:	This command only exists in connection with a handwheel.
Description:	!hwvel 1 1 The max. reachable speed for X + Y is 1U/s
Feedback:	Value of set speed.
Error code:	--
Example:	!hwvel 0.5 0.5 The axis X and Y drive with max. 0,5 U/s ?hwvel

Handwheel accelaration	
Instruction:	!hwaccel or ?hwaccel
Parameters:	x and y 0 – max. speed
Note:	This command only exists in connection with a handwheel.
Description:	!hwaccel 0.5 0.5 Accelaration for X + Y is 0.5m/s²
Feedback:	Value of the set acceleration.
Error code:	--
Example:	!hwaccel 1 1 The acceleration for X + Y is 1m/s² ?hwaccel

Control panel	
Instruction:	!bpz or ?bpz
Parameters:	0,1 or 2
Note:	For an additionl control panel with trackball
Description:	!bpz 0 => Control panel „OFF“
	!bpz 1 => activate control panel and operate trackball with 0,1µ step resolution, Joyspeed active.
	!bpz 2 => operate activate control panel and trackball with factor, Joyspeed active.
	!bpz 3 => activate control panal and operate track ball with 0,1µ step resolution, function keys active
	!bpz 4 => activate control panal and operate track ball with factor, function keys
	?bpz => read preset status
Feedback:	current status
Error code:	--
Example:	!bpz 1 (activate control panel and operate trackball with 0,1µ step resolution)

Control panel Trackball Factor	
Instruction:	!bpztf or ?bpztf
Parameters:	0,01 to 10,00
Note:	For an additionl control panel
Description:	!bpztf 1 => Trackball – Factor = 1, i.e. A trackball-impuls =motor-increment.
	?bpztf => Reading the preset factors
Feedback:	current factor
Error code:	--
Example:	?bpztf => Reading the preset factors

Control panel Trackball Back Lash	
Instruction:	!bpzbl or ?bpzbl
Parameters:	0,0001 to 0,015 mm
Note:	Reading the preset factors
Description:	!bpzbl 0.01 0.005 => Backlash of x-axis = 10µm and y-axis = 5µm.
	!bpzbl z 0.001 => Backlash of z-axis = 1µm.
	?bpzbl => Readout set reverse backlash
Feedback:	Current reverse backlash
Error code:	--
Example:	?bpzbl => Readout Auslesen des eingestellten Lose

4.11 In/Outputs *(not with ECO-STEP)*

The LSTEP may be eqipped with an additional module which makes 16 digital inputs and outputs and two analog outputs available. An additional card for the LSTEP-PCI has only 16 switch In/Outputs. To use these inputs and outputs, you must order the appropriate LSTEP model. At the multifunction-port (chapter 5.1) analog In/Outputs are also available.

Digital Input	
Instruction:	?digin
Parameters:	0 through 15
Description:	?digin ➔ Read all input pins
	?digin 8 ➔ Read input pin 8
Feedback:	Status of the input pins
Error code:	--
Example:	?digin (Read all input pins)

Digital Output	
Instruction:	!digout or ?digout
Parameters:	0 through 15
Description:	!digout 11110000 ➔ Output pins 0,1,2,3 are set to “1“ and output pins 4,5,6,7 are set to“0“.
	!digout 5 1 ➔ Output pin 5 is set to “1“.
	?digout ➔ Read the current status of all output pins.
	?digout 8 ➔ Read the current status of output pin 8
Feedback:	Status of the output pins
Error code:	--
Example:	!digout 7 0 (Set output pin 7 to “0“) ?digout (Read all output pins)

Function Of The Digital Inputs/Outputs		
Instruction:	!digfkt or ?digfkt	
Parameters:	0 through 15 (input/output), 16 (all 16 port pins) 0 through 4 (function) 0 through 100 mm (distance) or polarity of the inputs X, Y, Z and A (axes)	
Description:	**Functions:**	
	0 ➔ switch off function	
	1 ➔ Allocation of the emergency stop pins.	
	2 ➔ Activation of an output depending on the distance set before reaching the target position.	
	3 ➔ Activation of an output depending on the distance set after the starting position.	
	4 ➔ 2&3	
	Instructions:	
	!digfkt 7 2 78.9 z	➔ Output 7 is activated 78.9mm before the target position is reached.
	!digfkt 14 1	➔ Input 14 is used as the emergency stop.
	!digfkt 16 0	➔ All functions are set to 0.
	!digfkt 16 0 0	➔ All inputs high aktiv
	!digfkt 16 0 1	➔ All inputs low aktiv
	!digfkt 5 0 0	➔ Input 5 high aktiv
	?digfkt 16 or ?digfkt	➔ The current function statuses of all inputs and outputs are displayed.
	?digfkt 6	The current function statuses of input 6 and output 6 are displayed.
	?digfkt 7 4	The relevant distance and axis allocation are displayed.
Feedback:	All settings	
Error code:	--	
Example:	!digfkt 7 0 (Set the function of input and output 7 to “0“) ?digfkt 9 (Read the function of input and output 9)	

EXTENDED DIGITAL INPUT	
Instruction:	?edigin
Parameters:	0 to 15
Note:	This instruction only applies to the LS44-controller.
Description:	?edigin = Read the current statusof all additional input pins ?edigin 8 = Read the current statusof all additional input pin 8
Feedback:	Status of the additional input pin
Error code:	--
Example:	?edigin (Read all additional inputs pins)

EXTENDED DIGITAL OUTPUT	
Instruction:	!edigout oder ?edigout
Parameters:	0 bis 15
Note:	This instruction only applies to the LS44-controller
Description:	!edigout 11110000 = All additional output pins 0,1,2,3 auf „1“ and 4,5,6,7 are set to „0“ . !edigout 5 1 = An additional output pin 5 is set to „1“. ?edigout = Read the current status of all additional output pins ?edigout 8 = Read the current status of all additional output pin 8
Feedback:	Status of the additional output pin
Error code:	--
Example:	!edigout 7 0 (Set the additional output pin 7 to „0“) ?edigout (Read all additional output pins)

FUNCTION of the additional In and Outputs	
Instruction:	!edigfkt or ?edigfkt
Parameters:	0 to 15 (Input/Output), 16 (all 16 portpins) 0 (Function)
Note:	This instruction only applies to the LS44-controller
Description:	Function: 0 = no influence of the In-/Outputs and setting of the polarity (0 = High-, 1 = Low-Active) !edigfkt 16 0 = All functionsare set to 0. ?edigfkt 16 oder ?edigfkt = The current function status of all additional In- and Outputs are displayed ?edigfkt 6 = The current function status of the additional In- and Output 6 is displayed
Feedback:	All settings
Error code:	--
Example:	!edigfkt 7 0 (Set the function of the additional In- and Output 7 to „0“) ?digfkt 9 (Read the function of the additional In- and Output 9)

There are also two analog outputs on the module. The outputs are standardly designed for 0...5V . Other output voltage ranges (e.g. +/- 5V, +/- 10V, 0...10V,...) are possible on request. The outputs can be loaded with +/- 5mA . The internal resistance is approx. 100 Ohm.

Analog Output		
Instruction:	!anaout or ?anaout	
Parameters:	0 through 100 % 0, 1 and 2 (analog channels) c (c = channel)	
Note:	Channels 0 and 1 are on the additional board (D/A-converter) Channel 2 is on the LS2000 board.	
Description:	!anaout 100 50	➔ The first analog channel is set to 100% (full power.) and the second to 50% (half power).
	!anaout c 1 25	➔ Analog channel 1 is set to 25%.
	?anaout	➔ Read the current status of all analog channels.
	?anaout c 2	➔ Rea the current status of analog channel 2.
Feedback:	Status of the modulation in percent of the analog channels.	
Error code:	--	
Example:	!anaout c 1 0 (Set analog channel 1 to “0“) ?anaout (Read all analog channels)	

ANALOG INPUT	
Instruction:	?anain
Parameters:	0 bis 9 (analog channel) c (c = channel)
Description:	?anain c 2 => Read the current status of analog channel 2
Feedback:	Status depending on the analog channel
Error code:	--
Example:	?anain c 2 (Read the current status of analog channel 2)

Channel						
0	MFP	Pin 24	Joystick X			
1	MFP	Pin 12	Joystick Y			
2	MFP	Pin 25	Joystick Z			
3	MFP	Pin 26	ST11 (not on 25pol DSub)			
4	Speedpoti for LSTEP with display					
5	Motor current for the LSTEP-PCI					
6	MFP	Pin 8	or	LSTEP-PCI	St10	Pin 1
7	MFP	Pin 20	or	LSTEP-PCI	St10	Pin 2
8	MFP	Pin 7	or	LSTEP-PCI	St10	Pin 3
9	MFP	Pin 19	or	LSTEP-PCI	St10	Pin 4
10	MFP	Pin 6	or	LSTEP-PCI	St10	Pin 6/7

4.12 Interpretation Of Incremental Measuring Systems *(not for ECO-STEP)*

Axes with and without encoders can be operated simultaneously on the controller. During the calibration operation, the controller checks whether encoders are connected, provided that they have been enabled via *encmask*. To instruction *?enc* can be used to see the results of these checks. The controller does not however distinguish between incorrectly connected encoders and missing encoders.
Also while calibration to reference mark, the axis drives in negative direction into the zero-proximity switch, does a inversion of direction and drives with the speed which was set via calrefspeed to the reference mark. If a system does not have a proximity switch (i.e. a turn axis) it moves directly to the reference mark, if all proximity switches were deactivated prior.
Staring firmware version„T03.19.06-2001“ only the Sin.- Cos.- Signals need to be connected in there count direction towards motor count direction. An alignment towards the encoder reference mark is no necessary anymore.

Encoder Mask For Encoders		
Instruction:	!encmask or ?encmask	
Parameters:	x, y, z and a 0, 1 (On, Off)	
Note:	Enabling of the individual encoders.	
Description:	!encmask 1 0 1	➔ X- and Z-encoders are active, Y-encoder deactivated.
	?encmask	➔ The encoder mask for all encoders is displayed.
	?encmask x	➔ Display the encoder mask for the X-axis.
Feedback:	Encoder mask	
Error code:	--	
Example:	!encmask 1 0 (X-axis encoder enabled, Y-axis encoder not enabled) ?encmask	

Encoder Mask For Detected Encoders		
Instruction:	?enc	
Parameters:	x, y, z and a 0, 1 (On, Off)	
Note:	If encoders are activated which are not available, malfunctions may occur.	
Description:	!enc 1 0 1	➔ X- and Z-encoder active, Y-encoder deactivated.
	?enc	➔ All encoder statuses are displayed.
	?enc x	➔ Display of the encoder mask for the X-axis.
Feedback:	Encoder status	
Error code:	--	
Example:	!enc 1 0 (X-axis encoder active, Y-axis encoder deactivated) ?enc	

Signal Periods / Linear Encoder		
Instruction:	!encperiod or ?encperiod	
Parameters:	x, y, z and a 0.0001 – Spindle pitch * 0.8 (mm)	
Description:	!encperiod 0.5 0.020	➔ Length of the the encoder signal period is 500µm for the X-axis and 20µm for the Y-axis.
	?encperiod	➔ All encoder period lengths are displayed.
	?encperiod x	➔ Display of the length of the encoder period length the X-axis.
Feedback:	Length of encoder period in mm	
Error code:	--	
Example:	!encperiod 0.1 (Length of encoder period for the X-axis is 0.1mm) ?encperiod	

Encoder Resolution/ Rotary Encoder	
Command: Instruction	!?encres
Parameter: Parameters	1 to 40000
Note:	Shows the amount of encoder signal periods per motor revolution. The ratio of the periods to the unit factor should result to a whole number (integer), if the encoder is mounted behind a gear.
Description:	?encres !encres 250 500 1000
Feedback:	-
Error code:	--
Example:	!encres 500 500 500 For the axes X,Y,Z, 500 signal periods per motor revolution are send to the control.

Encoder Reference Signal		
Instruction:	!encref or ?encref	
Parameters:	x, y, z and a 0 or 1	
Description:	!encref 1 1 0	➔ The reference signal of the X-and Y-axis encoders is interpreted when calibration is done.
	!encref z 1	➔ The reference signal of the Z-axis encoder is interpreted when calibration is done.
	?encref	➔ The present setting is displayed.
	?encref y	➔ The present setting for the Y-axis is displayed.
Feedback:	0 or 1	
Error code:	--	
Example:	!encref 0 (No reference signal interpretation for the X-axis) ?encref	

Encoder Position		
Instruction:	!encpos or ?encpos	
Parameters:		
Description:	!encpos 1	➔ When the position is inquired, the encoder positions of the detected encoders are displayed.
	?encpos	➔ The present setting is displayed.
Feedback:	0 or 1	
Error code:	--	
Example:	!encpos 0 (Encoder position display “OFF“) ?encpos	

Encoder Error		
Instruction:	!encerr or ?encerr	
Parameters:	x, y, z and a 0	
Description:	!encerr 0 0 0	➔ Clear encoder error messages from X-, Y-and Z-axes.
	!encerr a 0	➔ Clear encoder error message from A-axis.
	?encerr	➔ The present encoder error messages for all axes are displayed.
	?encerr z	➔ The present encoder error message for the Z-axis is displayed.
Feedback:	0 or e	
Error code:	--	
Example:	!encerr 0 (Clear encoder error message from A-axis) ?encerr	

Geber – Position PCI (EncoderReadPositionPCI)	
Instruction:	?hwcount
Parameters:	x, y, z and a
Description:	?hwcount => Read all encounder positions ?hwcount a => Read encounder position of a-axis
Feedback:	Counter value 4-times interpolate
Error code:	--
Example:	?hwcount x (Read encounder position of a-axis)

Encoder – Position PCI (EncoderClear-PositionPCI)	
Instruction:	!clearhwcount
Parameters:	x, y, z and a
Description:	!clearhwcount => Clear all encoder – counter. !clearhwcount a => Clear encoder – counter of the A-axis
Feedback:	--
Error code:	--
Example:	!clearhwcount x (Clear encoder – counter of the A-axis)

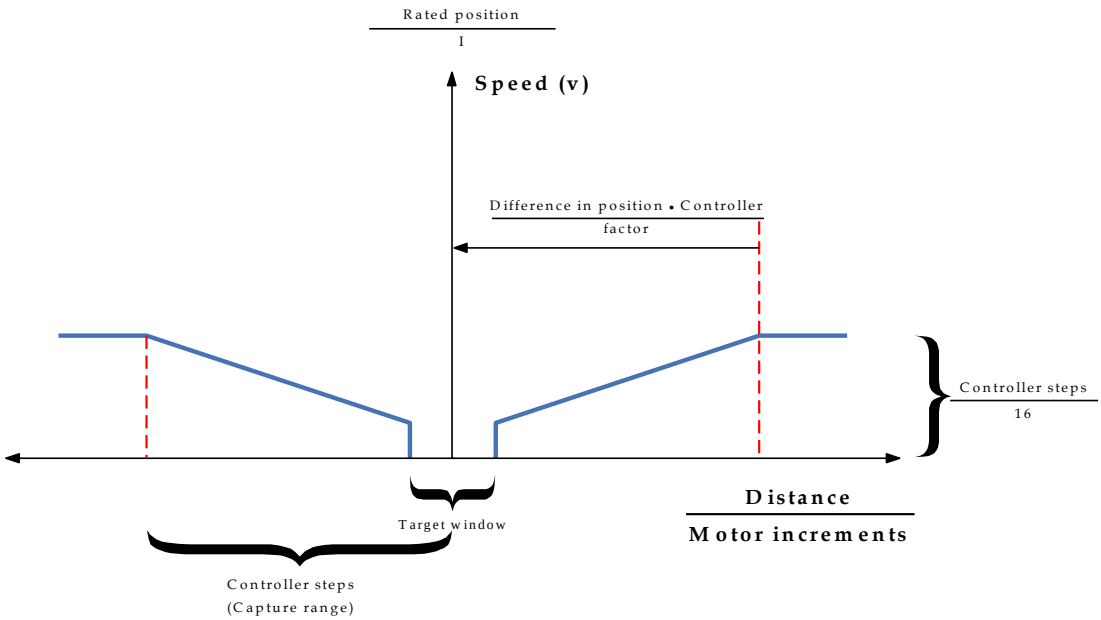
4.13 Controller Settings For LSTEP *(not for ECO-STEP)*

The control behaviour in closed loop operation can be influenced with the help of various parameters.

These parameters are:

1. Ctrc (Controller call)
2. Ctrs (Controller steps / capture range)
3. Ctrf (Controller factor)
4. Ctrd (Controller delay)
5. Ctrt (Controller monitoring / Timeout)

The values for **Ctrc, Ctrd** and **Ctrt** apply for all axes simultaneously. The values for **Ctrs** and **Ctrf** can be set individually for each axis.



The difference in position is the deviation of the present actual position from the preset target position. If the actual position is outside of the preset capture range, the controller moves at constant speed (if is set "ctrm 0"). This is set with **Ctrs** Within the capture area, the speed of travel is adapted to the difference in position. This adaption can be influenced with the parameter **Ctrf**.

The parameters have the following meanings:

- Ctrc The value in *Ctrc* specifies the sampling time with which the controller is called.. Generally speaking, attenuation is increased as the sampling time increases.
- Ctrs The contents of *Ctrs* corresponds to a distance depending on the dimension, which specifies the capture range for the axis in question.

  Example: Ctrs = 500, Dimension = 1 ➔ 500 • 1µm = 500µm)

  If the difference in position is greater than *Ctrs*, the target position is approached at a constant speed.
- Ctrf Within the capture range, the difference in position is manipulated individually for each axis by a mathematical function. The control factor determines to what degree the respective difference in position acts on the speed at which the target position is approached.
- Ctrd *Ctrd* specifies how long the specified axes are not allowed to leave the target window, in order for the "position reached" signal to be transmitted.
- Ctrt The controller timeout limits the time available to the controller to balance out any difference in position.

Example (ctrs):

$$\frac{\text{1mm spindle pitch}}{\text{50000 Controller steps / Capture range}} = \text{0,02 µm (= one Motor increment)}$$

$$\frac{\text{Capture range = 0,1 mm (=100 µm)}}{\text{0,02 µm (Motor increment)}} = \text{5000 Motor increments}$$

$$\frac{\text{5000 Motor increments}}{16} = \text{312,5 Motor increments}$$

$$\frac{\text{312,5 Motor increments}}{\text{ctrc (Controller call)}} = V_{constant}$$

Target Window	
Instruction:	!twi or ?twi
Parameters:	x, y, z and a 1 to 25000 (motor increments) 0.1 to spindle pitch/2 (µm) 0.0001 to spindle pitch/2 (mm)
Note:	The input and output values depend on the dimension.
Description:	!twi 1.0 0.002 ➔ The target window is 1 mm for the X-axis and 2µm for the Y-axis(when Dim = 2). The other axes remain unchanged.
	!twi z 0.1 ➔ The target window is set to 0.1µm for the Z-axis (when Dim = 1).
	?twi ➔ All preset target windows are displayed.
	?twi x ➔ The preset target window for the X-axis is displayed.
Feedback:	Target window which has actually been set (rounding errors are displayed)
Error code:	--
Example:	!twi 10 (The X-axis has a target window of 10 motor increments (when Dim = 0)). ?twi

Controller	
Instruction:	!ctr or ?ctr
Parameters:	x, y, z and a
	0 ➔ Controller “OFF“
	1 ➔ Controller “OFF after reaching target position“
	2 ➔ Controller “Always ON“
	3 ➔ Controller “OFF after reaching target position“ at reduced current.
	4 ➔ Controller “Always ON“ with reduced current.
Description:	!ctr y 2 ➔ Y-axis controller “Always ON”.
	?ctr ➔ All controller statuses are displayed
	?ctr x ➔ Display of the X-axis controller status
Feedback:	Controller statuses
Error code:	--
Example:	!ctr 0 0 0 0 (All controllers “OFF“) ?ctr

Controller Timeout	
Instruction:	!ctrt or ?ctrt
Parameters:	0 – 10000 (ms)
Description:	!ctrt 2 ➔ Controller timeout 2ms.
	?ctrt ➔ Display of the control timeout
Feedback:	Controller timeout
Error code:	--
Example:	!ctrt 0 (Controller timeout “OFF“) ?ctrt

Controller Call	
Instruction:	!ctrc or ?ctrc
Parameters:	1 – 100 (ms)
Description:	!ctrc 2 ➔ Controller call every 2ms.
	?ctrc ➔ Controller call time is displayed.
Feedback:	Controller call time
Error code:	--
Example:	!ctrc 10 (Controller call every 10ms) ?ctrc

Controller Steps	
Instruction:	!ctrs or ?ctrs
Parameters:	x, y, z and a 1 to spindle pitch
Note:	Input and output values depend on the dimension
Description:	!ctrs y 2 ➔ 2mm controller steps for the Y-axis (when DIM = 2).
	?ctrs ➔ All controller steps are displayed.
	?ctrs x ➔ Display the controller steps for the X-axis.
Feedback:	Controller steps
Error code:	--
Example:	!ctrs 4 5 7 9 (Controller steps for all axes, dependent on the dimension) ?ctrs

Control Factor	
Instruction:	!ctrf or ?ctrf
Parameters:	x, y, z and a 1 – 64
Description:	!ctrf y 2 ➔ Control factor for the Y-axis is 2.
	?ctrf ➔ All control factors are displayed.
	?ctrf x ➔ Display of the control factor for the X-axis.
Feedback:	Control factors
Error code:	--
Example:	!ctrf 1 2 3 4 (Set all control factors) ?ctrf

Controller Delay	
Instruction:	!ctrd or ?ctrd
Parameters:	0 – 100 (ms)
Description:	!ctrd y 2 ➔ Controller delay for Y-axis is 2ms.
	?ctrd ➔ All controller delays are displayed.
	?ctrd x ➔ Display of the controller delay for the X-axis.
Feedback:	Controller delay
Error code:	--
Example:	!ctrd 0 0 0 0 (All controller delays “OFF”) ?ctrd

Controller (Fast Move)	
Instruction:	!?ctrfm
Parameters:	0 or 1
Note:	Meaning of Fast Move function: A new vector is startet if the controller differnce is greater than the capture range.
Description:	!ctrfm 1 => Activates the Fast Move funktion ?ctrfm => Display the status of the Fast Move function
Feedback:	0 = Fast Move function not active 1 = Fast Move function active
Error code:	--
Example:	!ctrfm 0 (Fast Move function „OFF“)

Controller (Fast Move Counter)	
Instruction:	!?ctrfmc
Parameters:	0 to 255
Note:	Meaning of Fast Move function: A new vector is startet if the controller differnce is greater than the capture range.and the corresponding counter raised by one.
Description:	!ctrfmc 0 => Clear Fast Move Counter ?ctrfmc => Display the amount of performed Move functions.
Feedback:	0 to 255
Error code:	--
Example:	!ctrfmc 0 (Clear Counter)

4.14 Special Instructions for the MR-System

MR Offset		
Instruction:	!mro or ?mro	
Parameters:	x, y, z and a +- 2048	
Description:	!mro 20 –3 56	➔ Offset sinx = 20, Offset cosx = -3 and Offset siny = 56 points.
	!mro y 2 9	➔ Offset siny = 2 and Offset cosy = 9 points.
	?mro	➔ All offset values are displayed
	?mro x	➔ Display of the offset values for the X-axis
Feedback:	Always sin cos for each axis	
Error code:	--	
Example:	!mro 0 0 0 0 (Set the offset values for the X-and Y-axes to 0) ?mro	

Maximum Signal Values (Peaks)		
Instruction:	!mrp oder ?mrp	
Parameters:	x, y, z and a +- 2048	
Description:	!mrp	➔ Error 2 (There were up to 16 values).
	!mrp y 1000 –1000 1000	➔ Pos.peak siny = 1000, neg. peak siny = -1000 and Pos. Peak cosy = 1000 points.
	?mrp	➔ All peaks are displayed.
	?mrp x	➔ Display of the peaks for the X-axis.
Feedback:	Always pos. sin, neg. sin and pos. cos, neg. cos for each axis.	
Error code:	--	
Example:	!mrp 0 0 0 0 (Set peaks for the X-axis to 0) ?mrp	

Actual Signal Values	
Instruction:	!mrt or ?mrt
Parameters:	x, y, z and a
Description:	!mrt ➔ Error 2
	!mrt z ➔ Error 2
	?mrt ➔ Error 2
	?mrt x ➔ Display of the actual signal values for the X-axis
Feedback:	Always 10 * (sin, cos for the respective axis)
Error code:	--
Example:	?mrt a (Display of the actual signal values for the A-axis)

Amplification (Gain) Factor	
Instruction:	!mra or ?mra
Parameters:	x, y, z and a 0.01 – 2.00
Note:	The amplification or gain factor always refers to the cosine signal
Description:	!mra 1 1.01 0.98 ➔ Amplification factors for cosx = 1, cosy = 1.01 and cosz = 0.98
	!mra z 1.23 ➔ Amplification factor cosz = 1.23
	?mra ➔ Display of the amplification factors for all axes.
	?mra x ➔ Display of the present amplification factor for the X-axis.
Feedback:	Amplification (gain) factor
Error code:	--
Example:	!mra 1.11 (Amplification factor for the X-axis is = 1.11) ?mra a (Display of the present amplification factor for the A-axis)

Signal Shape		
Instruction:	!mrs or ?mrs	
Parameters:	x, y, z and a 0 or 1	
Note:	0 = Sine and 1 = Cosine	
Description:	!mrs	➔ Error 2
	!mrs z 1	➔ Selection of the cosine signal for the Z-axis.
	?mrs	➔ Display of the axis identification and the sigan values.
	?mrs x	➔ Error 2
Feedback:	Signal identification (y 0: values ->)	
Error code:	--	
Example:	!mrs x 0 (Selection of the sine signal for the X-axis) ?mrs (Display of the signal values for the preset axis and the signal identification)	

4.15 Clock Pulse- And Direction-Inputs *(not for ECO-STEP)*

Instead of using vector instructions or the joystick, the axes can be moved back and forth with clock pulse signals dependent on the direction of rotation signals, at option. This mode is also possible asynchronously to travel operations which have been initiated by means of travel instrucitons. The multi-funciton port MFP is available for this purpose.

Note:	As described in Clock Pulse Forward/Back (internal control) , the same function can be transmitted via the serial interface.

4.15.1 Range Of Travel Monitoring

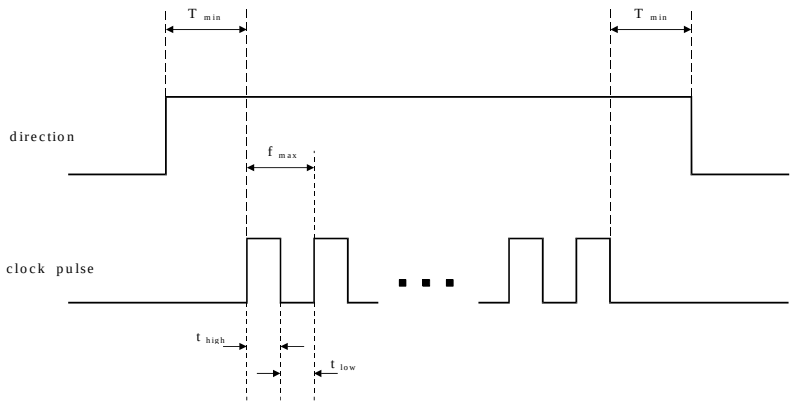
In TVR mode, it is also checked that the permissible travel limits are not exceeded. The travel limits may thereby have been determined using the combination ‚*Calibrate*‘ and ‚*Measure Stroke*‘. Another way is to set the travel limits with a command (instruction).
If the controller determines that the accumulated metering pulses would cause a travel limit to be exceeded, all further movement of the axis in that direction is inhibited. Travelling is however still possible in the opposite direction. No notification is given to the PC.

Note:	The applications (user-written) program is responsible for ensuring that the maximum Start /Stop frequencies of the drive are not exceeded and that the respective axis is not overloaded acceleration-wise.

4.15.2 Temporal Marginal Conditions For the Signals

The temporal sequence of the flanks of the clock pulse and direction of rotation signals of an axis is subject to the following marginal conditions

- The next clock pulse may be applied T_{min} after every change in polarity of the direction of rotation signal at the earliest.
- The clock pluses must have been completed T_{min} prior to every change in polarity of the direction signal at the latest
- T_{min} is presently 50µs.
- The maximum clock pulse frequency must not exceed f_{max} = 833 kHz , whereby the minimum times T_{low} = 600ns and T_{high} = 600ns must be maintained.
- To protect the control inputs, input filters of 470Ω and 220pF are used. You must therefore ensure that the clock pulse source has an adequate driver power.



Clock Pulse Forward / Back	
Instruction:	!tvr or ?tvr
Parameters:	x, y, z and a 0, 1, 2, 3, 4
Description:	**Functions:**
	0 ➔ Clock pulse Forward / Back "OFF".
	1 ➔ Normal clock pulse Forward / Back processing.
	2 ➔ Clock pulse Forward/Back process with a factor.
	3 ➔ Clock pulse Forward/Backward processing must be enabled externally with Start/Stop inputs.
	4 ➔ Combination of 2 & 3.
	Instructions:
	!tvr 1 1 ➔ Activate clock pulse forward/back for the X-and Y-axes.
	!tvr a 1 ➔ Activate clock pulse Forward/Back for the A-axis.
	?tvr ➔ All preset status are displayed.
	?tvr z ➔ The present status of the Z-axis is displayed.
Feedback:	Status depending on the analog channel
Error code:	--
Example:	!tvr 1 (Activate clock pulse Forward/Back for the X-axis) ?tvr

Factor Clock pulse Forward/Back		
Instruction:	!tvrf or ?tvrf	
Parameters:	x, y, z and a 0.01 – 100.00	
Description:	!tvrf 1.00 1.00	➔ Clock pulse Forward/Back is to use a factor 1 for the X- and Y-axes (i.e. one clock pulse = one motor increment).
	!tvrf a 1	➔ Clock pulse Forward /Back is to use a factor 1 for the A-axis
	?tvrf	➔ All preset factors are displayed
	?tvrf z	➔ The present factor for the Z-axis is displayed
Feedback:	Factor values	
Error code:	--	
Example:	!tvrf 10.00 (Factor = 10.00 for the X-axis) (One clock pulse = ten motor increments) ?tvrf	

Clock Pulse Forward/Back (Internal Control)	
Instruction:	px, nx, py, ny, pz, nz, pa, na
Parameters:	None
Description:	All instructions have the same effect as an external clock pulse with directional information. The first letter determines whether a positive (p) or a negative (n) movement is to be performed. The second letter denotes the axis which is to be moved.
Feedback:	None
Error code:	--
Example:	py (1clock pulse forwards for the Y-axis)

4.16 Clock-pulse- and Rotating-direction-Outputs for additional axes

By means of clock-pulse and rotating-direction-outputs it is possible to drive up to three external motordrivers with the LSTEP- and LSTEP PCI-Controller. Optionally, three auxiliary axes can be integrated to ECO-STEP controllers from PCB-version 06 16 13. They are internally connected to the outputs of the inside the controller used microcontroller. These axis stand by directly for the user, limit-switch-utilization and calibration are functionally integrated.

4.16.1 Instructions for Clock-pulse and Rotating-direction for external and integrated additional axes

Below the in all above described controllers embedded instructions are listed.

TVR Output	
Instruction:	!?tvrout
Parameters:	x, y and z 0 or 1
Note:	x, y and z are additional axes, besides the main axes x, y, z and a
Description:	!tvrout 1 1 = For axis x and y the clock pulse For/Back should be activated !tvrout a 1 = For all axis the clock pulse For/Back should be activated ?tvrout = Display all preset status ?tvrout z = Display the current status of the z-axis
Feedback:	0 => Clock pulse For/Back „OFF“ 1 => Clock pulse For/Back „ON“
Error code:	--
Example:	!tvrout 1 (Aktivate clock pulse For/Back for the x-axis) ?tvrout

TVR Out resolution	
Instruction:	!?tvrores
Parameters:	x, y and z 0 to 51200 For ECO-STEP with integrated auxiliary axis only the following resolutions are possible: 200, 400, 800, 1600, 3200, 6400, 12800, 25600, 51200
Note:	Here the resolution of the power stage to be controlled is entered
Description:	!tvrores 1000 1000 = For axis x and y the resolution is set to 1000 impulses per revolution ?tvrores = Display all set resolutions
Feedback:	0 to 51200 for each axis
Error code:	--
Example:	!tvrores z 2500 (resolution of the z-axis is 2500 I/R)

TVR Out Pitch	
Instruction:	!?tvropitch
Parameters:	x, y and z 0.001 – 100
Note:	This parameter is necessary to perform correct movements
Description:	!tvropitch 1 1 = For axis x and y a spindle with a spindle pitch of 1mm is used. ?tvropitch = All spindle pitch's are displayed
Feedback:	0.001 to 100
Error code:	--
Example:	!tvropitch y 4 (The spindle pitch for the y-axis is 4mm)

TVR Out acceleration	
Instruction:	!?tvroa
Parameters:	x, y and z 0.01 – 1500
Description:	tvroa 100 100 = The x- and y-axis are accelerated with 100 r/s^2 ?tvroa = All preset accelerations are displayed
Feedback:	0.01 to 1500
Error code:	--
Example:	!tvroa z 50 (The z-axis accelerates with 50 r/s^2)

TVR Out velocity	
Instruction:	!?tvrov
Parameters:	x, y and z 0 to 40.0
Description:	!tvrov a 10 => a-Axis should be operated with max speed of 10 r/s ?tvrov = All preset accelerations are displayed
Feedback:	0 to 40.0 for each axis
Error code:	--
Example:	!tvrov 1 (x-Axis should be operated with max speed 1 r/s)

TVR Out position	
Instruction:	!?tvropos
Parameters:	x, y and z Min. range limits to max. raange limits
Note:	See !?pos
Description:	tvropos 45 88 => Set position of x- and y-axis ?tvropos = Dsiplay all current position
Feedback:	Position value (in dependence of the dimension)
Error code:	--
Example:	!tvropos 1 (Set position of x- axis)

TVR Out move absolute	
Instruction:	!tvromoa
Parameters:	x, y and z +- Moving range
Note:	See !moa! The entry dependens on the dimension
Description:	tvromoa 1 1 = The axis x and y are driven to position 1
Feedback:	--
Error code:	--
Example:	!tvromoa z 3.5 (Position the z-axis to the position 3.5)

TVR Out move relative	
Instruction:	!tvromor
Parameters:	x, y and z +- Moving range
Note:	See mor ! The entry dependens on the dimension.
Description:	tvromor 1 1 = The axis x and y are moved 1mm (Dim = 2)
Feedback:	--
Error code:	--
Example:	!tvromor z 3.5 (move the z-axis 3.5mm (Dim = 2))

TVR Out autostatus	
Instruction:	!tvroautostatus or ?tvroautostatus
Parameters:	0 or 1
Description:	0 ➔ The controller is transmitting no status.
	1 ➔ "Position reached" signals are transmitted automatically by the controller.
Feedback:	
Error code:	--
Example:	!tvroautostatus 1 ?tvroautostatus

TVR Out status	
Instruction:	tvrostatus
Parameters:	--
Note:	--
Description:	tvrostatus => Gives the current status of the axes
Feedback:	„-“ = Axis „OFF“ „M“ = Axis in „Motion“ „@“ = Axis „Stopped“
Error code:	--
Example:	tvrostatus

4.16.2 Instructions for Clock-pulse and Rotating-direction for integrated additional axes

Following instructions can be used with ECO-STEP from PCB-version 06 16 13 to operate the integrated auxiliary axis.

Output Current		
Instruction:	!tvrocur or ?tvrocur	
Parameters:	x, y and z 0 – maximum current	
Description:	!tvrocur 1.0 2	➔ The output currents for the X- and Y-axes are set to X = 1A and Y = 2A, the other axes remain unchanged:
	!tvrocur z 0.1	➔ The output current for the Z-axis is set at 0.1A.
	?tvrocur	➔ All preset output currents are displayed.
	?tvrocur x	➔ Display the preset output current for the X-axis.
Feedback:	Preset output current	
Error code:	--	
Example:	!tvrocur 1.0 (The X-axis is run at maximum 1A) ?tvrocur	

Limit Switch Polarity		
Instruction:	!tvroswpol or ?tvroswpol	
Parameters:	x, y and z **0**  or **1** 	
Description:	!tvroswpol 1 0 1	➔ Assign polarity of the limit switches for all axes. (Order: E0 REF EE).
	!tvroswpol z 1 0 1	➔ Assign polarity of the limit switch for the Z-axis. (Order: E0 REF EE)
	?tvroswpol a	➔ Show polarity of the limit switch for axis A.
Feedback:	Polarity of the limit switches	
Error code:	--	
Example:	!tvroswpol y 1 1 1 (All Y-axis switches react to the positive edge) ?tvroswpol x	

Limit Switch On/Off	
Instruction:	!tvroswact or ?tvroswact
Parameters:	x, y and z 0 or 1
Description:	!tvroswact 1 0 1 ➔ Limit switches for all axes : E0=On REF=Off EE=On
	!tvroswact z 1 0 1 ➔ Z-axis limit switch: E0=On REF=Off EE=On
	?tvroswact a ➔ Show status of the A-axis limit switches.
Feedback:	Status of the limit switches
Error code:	--
Example:	!tvroswact y 1 1 1 (All Y-axis switches active) ?tvroswact x

Read Limit Switches													
Instruction:	?tvroreadsw												
Parameters:	--												
Description:	?tvroreadsw ➔ Read status of all limit switches.												
Feedback:	Status of the limit switches.												
	Axis:	**x**	**y**	**z**	**a**	**x**	**y**	**z**	**a**	**x**	**y**	**z**	**a**
	Switch:	**E0**	**E0**	**E0**	**E0**	**Ref**	**Ref**	**Ref**	**Ref**	**EE**	**EE**	**EE**	**EE**
	E0 = Zero limit switch					Ref = Reference limit switch				EE = End limit switch			
Error code:	--												
Example:	?tvroreadsw (Read all limit switches)												

Calibration Direction		
Instruction:	!tvrocaldir or ?tvrocaldir	
Parameters:	x, y and z 0 or 1	
Description:	!tvrocaldir 0 0 1 ➔	The axes X, Y are calibratet in negative direction and the Z-axis in positive direction
	?tvrocaldir ➔	Read current direction for calibrating.
Feedback:	0 = negative direction 1 = positive direction	
Error code:	--	
Example:	!tvrocaldir y 1 (The Y-axis will be calibratet in positive direction)	

Calibration Offset		
Instruction:	!tvrocaliboffset or ?tvrocaliboffset	
Parameters:	x, y and z	
Description:	!tvrocaliboffset 1 1 1 ➔	The X-, Y-, and Z-axes are each moved 1 mm (for Dim 2 2 2) away from the zero limit switch towards the center of the table when calibration is done and the zero position is then set (software limit).
	?tvrocaliboffset y ➔	Read present offset of the Y-axis
Feedback:	Distance	
Error code:	--	
Example:	?tvrocaliboffset	

Calibrate		
Instruction:	!tvrocal or tvrocal	
Parameters:	x, y and z	
Description:	tvrocal	➔ Moves all enabled axes towards lower positional values.Travel is stopped as soon as the limit switches have been tripped and is then resumed slowly in the opposite direction until the switch is no longer active. The positional value is set to 0. The position is taken over as a software limit, as described in the instruction “Limit“.
	tvrocal y	➔ As above, only for the Y-axis.
Feedback:	An ‘A’ for each calibrated axis or ‘E’ if fault occurs	
Error code:	--	
Example:	!tvrocal	

4.17 Configuration of the Trigger- Output signal

These Commands synchronizes an external unit i.e. video camera or laser. The signals are send via a multi function port, which is available. Important!

Trigger	
Instruction:	?trig or !trig
Parameter:	0 or 1 (OFF / ON)
Comment:	!trig 1 ➔ Trigger „ON“
	?trig ➔ Shows the current status of the trigger processing
Important!	Switch on the trigger, only **after** all settings are transferred.. (exception with Triggermode 99)
Feedback:	ON or OFF
Error code:	--
Example:	!trig 0 (Triggerbearbeitung „OFF“) ?trig

Trigger Achse	
Instruction:	?triga or !triga
Parameter:	x, y, z and a
Comment:	!triga y ➔ Trigger in reference to the x-axis
	?triga ➔ Shows the current reference axis
Feedback:	x, y, z and a
Error code:	--
Example:	!triga x (Trigger referring to the x-Axis) ?triga

Trigger Modus		
Instruction:	?trigm or !trigm	
Parameter:	0 – 17 or 99	
Comment:	!trigm 0 ➔	high active
	!trigm 1 ➔	high active
	!trigm 2 ➔	high active
	!trigm 3 ➔	low active
	!trigm 4 ➔	low active
	!trigm 5 ➔	low active
	!trigm 6 ➔	high active
	!trigm 7 ➔	high active
	!trigm 8 ➔	high active
	!trigm 9 ➔	low active
	!trigm 10 ➔	low active
	!trigm 11 ➔	low active
	!trigm 12 ➔	high active
	!trigm 13 ➔	high active
	!trigm 14 ➔	high active
	!trigm 15 ➔	low active
	!trigm 16 ➔	low active
	!trigm 17 ➔	low active
	!trigm 18 ➔	high active
	!trigm 19 ➔	high active
	!trigm 20 ➔	high active
	!trigm 21 ➔	low active
	!trigm 22 ➔	low active
	!trigm 23 ➔	low active

!trigm 99 With the trigger mode 99, at the beginning and at the end of the uniform motion, a trigger impulse is generated . A certain sequence has to be observed during the execution of the function. The command !trigm 99 needs to be send as the last command after the common settings, because it would be deleted with another mode setting.	
Feedback:	0 – 23! (Mode)
Error code:	--
Example:	!trigm 3 (Trigger Mode 3) ?trigm

Legend				
▸	⋮ ⋮ ⋮			
Start point	Trigger point	Path	External Trigger signal	low active

Trigger Signal	
Instruction:	?trigs or !trigs
Parameter:	0 – 5 (µs) 0 = ninmum Trigger (a few 100ns)
Comment:	!trigs 4 ➔ Trigger-Signal length 4 µs
	?trigs ➔ Shows the current status of the set Trigger-Signal length.
Feedback:	0 – 5 (µs)
Error code:	--
Example:	!trigs 3 (Trigger-Signallänge = 3µs) ?trigs

Trigger Distance	
Instruction:	?trigd or !trigd
Parameter:	1 – 5000000 Motor increments (Abhängig von der Dim)
Comment:	!trigd 1 ➔ Trigger-Distance 1mm (bei Dim 2)
	?trigd ➔ Shows the current Trigger distance..
Feedback:	Distance
Error code:	--
Example:	!trigd 3 (3mm Trigger distance for Dim 2) ?trigd

Trigger Offset 1 ; Trigger Offset 2	
Instruction:	?trigoffsetone ; ?trigoffsettwo !trigoffsetone ; !trigoffsettwo
Parameter:	0 – 5000000 Motor increments (depending on Dim)
Comment:	!trigoffsetone 20000 ➔ Trigger-Distance 1mm (bei Dim 2)
	?trigoffsettwo ➔ Shows the current Trigger distance.
Feedback:	Offset (distance, degree, or Revolution)
Error code:	--
Example:	!trigoffsettow 180 (180 Grad bei Dim 3) ?trigoffsettow

Trigger Counter; Trigger Counter 2	
Instruction:	?!trigcount; ?trigcounttwo
Parameter:	0 bis 2147483647
Comment:	Es werden alle OFFgegebenen Trigger gezählt
	!trigcount 0 => Clear Counter 1 Ttrigcounttwo 0 => Clear Counter 2 ?trigcount => Lese Zählerstand Counter 1 ?trigcounttwo => Lese Zählerstand Counter 2
Feedback:	Anzahl der OFFgeführten Trigger
Error code:	--
Example:	?trigcount ; ?trigcounttwo (Lese Zählerstand)

4.18 Configuration Of The Snapshot Input

The current positions can be saved in the controller whilst travelling is in progress with these instructions. These values can then subsequently be read out or the positions approached. This signal is set via the multi-function port, which is available as an option.

Snapshot	
Instruction:	?sns or !sns
Parameters:	0 or 1
Description:	!sns 1 ➔ Snapshot "ON"
	?sns ➔ Gives the present snapshot status.
Feedback:	Snapshot status
Error code:	--
Example:	!sns 0 (Snapshot "OFF") ?sns

Snapshot-Level (Polarity)	
Instruction:	?snsl or !snsl
Parameters:	0 or 1
Description:	!snsl 1 ➔ Snapshot is high-active. 
	?snsl ➔ Gives the current polarity
Feedback:	Current polarity
Error code:	--
Example:	!snsl 0 (Snapshot is low-active)  ?snsl

Snapshot Filter	
Instruction:	?snsf or !snsf
Parameters:	0 – 100 ms
Note:	Serves as input filter for rebounding switches
Description:	!snsf 10 => 10 ms Eingangsfilter ?snsf => Gives the current status
Feedback:	Current filter time
Error code:	--
Example:	!snsf 0 (no input filter) ?snsf

Snapshot-Mode	
Instruction:	?snsm or !snsm
Parameters:	0 or 1
Description:	!snsm 1 ➔ Snapshot "Automatic" The position is approached automatically after the first pulse has been given.
	?snsm ➔ Gives the present mode
Feedback:	Snapshot mode
Error code:	--
Example:	!snsm 0 (Normal snapshot) ?snsm

Snapshot Counter	
Instruction:	?snsc
Parameters:	–
Description:	Contents are deleted after every "read".
	?snsc ➔ Gives the number of initiated snapshots.
Feedback:	Number of initiated snapshots
Error code:	--
Example:	?snsc

Snapshot Position	
Instruction:	!snsp or ?snsp
Parameters:	x, y, z and a Min./max. range of travel
Note:	Input and output depend on the dimension.
Description:	!snsp 1000 2000 3000 ➔ Positional values are set for the X-, Y-, and Z-axes.
	!snsp y 2000 ➔ Position of the Y-axis is set.
	?snsp ➔ Inquire present snapshot position of all axes.
	?snsp z ➔ Inquire present snapshot position of Z-axis.
Feedback:	Positional values
Error code:	--
Example:	!snsp 100 200 (Set the X-and Z-axis positions) ?snsp (Inquire the snapshot positions of all axes)

Snapshot Position Array	
Instruction:	?snsa
Parameters:	x, y, z and a 1 – 200 (Positions)
Note:	Input and output depend on the dimension
Description:	?snsa 33 ➔ Inquire the snapshot position 33 of all axes
	?snsa z 99 ➔ Inquire the snapshot position 99 of z-axis.
Feedback:	Position values
Error code:	--
Example:	?snsa 1 (Inquire the snapshot position 1 of all axes)

Snapshot Offset	
Instruction:	!?snso
Parameters:	x, y, z and a
Note:	only for automatic operation
Description:	?snso!snso 2 0 0
Feedback:	set value
Error code:	--
Example:	!snso –2 0 1 (the X-Axis will be moved 2mm back and the Z-axis moves1mm forward, like the saved position.

5 Appendix General

5.1 Multi-Function Port Pin Assignment *(not for ECO-STEP)*

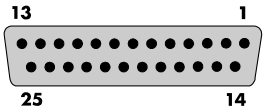


Fig.: The Multi-Function Port (25 Pole Sub-D Socket)

Due to the variety of functions, some of the pins of the multi-function port *(MFP)* have more than one assignment. Depending on how the controller is equipped, this means that only one singnal output or input is present on a pin of the MFP.
The desired functionality has to be clarified with the order.
Standard is: Trigger, Snapshot, and Stop input.

Pin	Signal		Remarks
1	Clock input X	Standard:	TTL level
	Clock output X	Special function:	TTL level
	Encoder input X Track A	Special function:	+5V U-low ≤ 0.8V / U-High ≥ 3.6V
2	X Forward /Back input	Standard:	TTL level
	X Forward/Back output	Special function:	TTL level
	Encoder input X Track B	Special function:	+5V U-low ≤ 0.8V / U-High ≥ 3.6V
3	Clock input Y	Standard:	TTL level
	Clock output Y	Special function:	TTL level
	Encoder input Y Track A	Special function:	+5V U-low ≤ 0.8V / U-High ≥ 3.6V
4	Y Foward/Back input	Standard:	TTL level
	Y Forward / Back output	Special function:	TTL level
	Encoder input Y Track B	Special function:	+5V U-low ≤ 0,8V / U-High ≥ 3,6V
5	Clock input Z	Standard:	TTL level
	Clock output Z	Special function:	TTL level
	Encoder input Z Track A	Special function:	+5V U-low ≤ 0.8V / U-High ≥ 3.6V
	Tigger out 2	Standard:	TTL-level / Imax = 1,6 mA
6	Analog input Ain 10 Channel 10	Special function:	Measuring range 0...0.5V/ Ri = 1.1 kΩ

Pin	Signal		Remarks
7	Start / Stop Z	Standard:	TTL level Start Stop Enable for clock pulse Forward/Back
	Ain 8 / Channel 8	Special function:	0...5V
8	Start / Stop X	Standard:	TTL level Start Stop Enable for clock pulse Forward / Back
	Ain 6 / Channel 6	Special function:	0...5V
9	- 12V		I_{max} = 20mA
10	Joystick on	Standard:	External switch „MAN/AUTO„
11	VAGND	Standard:	Ground of the +5V reference voltage
12	Joystick Y Ain 1 / Channel 1	Standard:	lies parallel to ST1 pin 4
13	VAREF	Standard:	+5V reference voltage
14	Z Forward/Back input	Standard:	TTL level
	Z Forward/Back Output	Special function:	TTL level
	Encoder input Z Track B	Special function:	+5V U-low ≤ 0.8V / U-High ≥ 3.6V
15	Tigger out	Standard:	TTL level / I_{max} = 1.6 mA
16	GND		
17	+5V		I_{max} = 300 mA
18	Analog output Channel 2	Standard:	Analog output 0...10V or +/-10V depending on component placement, Ri_{min} = 1kOhm / I_{max} =10mA
	Digital output	Special function:	TTL level
19	Ain 9 / Channel 9	Special function:	Measuring range 0...0.5V/ Ri = 1.1 kΩ
20	Start / Stop Y	Standard:	TTL level Start Stop Enable for clock pulse Forward/Back
	Analog input	Special function:	0...5V
21	+12V		I_{max} = 500 mA
22	SnapShot input	Standard:	TTL, Pull Up = 4.7 kOhm, RC-Filter 470 Ohm/100nF
23	Stop input	Standard:	TTL, Pull Up = 4.7 kOhm, RC-Filter 470 Ohm/100nF
24	Joystick X Ain 0 / Channel 0		lies parallel to ST1 pin 3
25	Joystick Z Ain 2 / Channel 2		lies parallel to ST1 pin 5

5.2 RS232 Interface Pin Assignment

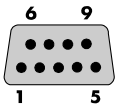


Fig.: The RS232 Interface (9 Pole, Sub-D Socket)

Pin	Signal	Remarks
1	n.c.	
2	RxD	LSTEP receive line
3	TxD	LSTEP transmit line
4	GND	
5	GND	Signal ground
6	+5V	
7	RTS	Request to send, from LSTEP
8	CTS	Clear to send, from PC
9	either n.c. +5V or +12V DC	

5.3 The Interface Cable

LSTEP		PC		
9 Pole, Sub-D Plug	Assignment	9 Pole, Sub-D	25 pole, Sub-D	Assignment
1	n.c.	-	-	-
2	RxD	3	2	TxD
3	TxD	2	3	RxD
4	n.c.	-	-	-
5	GND	5	7	GND
6	n.c.	-	-	-
7	RTS	8	5	CTS
8	CTS	7	4	RTS
9	n.c.	-	-	-

5.4 Joystick Connection Pin Assignment

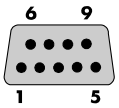


Fig..: The Joystick Connection (9 Pole, Sub-D Socket)

Pin	Signal	Remarks
1	GND	
2	Joystick On	
3	X-axis	Sliding contact of the joystick
4	Y-axis	Sliding contact of the joystick
5	Z-axis	Sliding contact of the joystick
6	Snapshot	
7	Stop	
8	VAref (+5V)	5V analog reference voltage
9	VAref (+5V)	5V analog reference voltage

5.5 The CAN Interface *(not for ECO-STEP)*

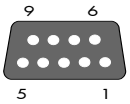


Fig.: The CAN Interface (9 Pole, Sub-D Socket)

The CAN interface is used in order to be able to operate more than one controller of the type LSTEP-xx/2 on a single PC. This is a high-speed serial connection with data rates of up to **5MBd**. In order to equip the PC with this kind of interface, an additional plug-in module is normally needed.
In theory, up to **254** different LSTEP-xx/2 controllers or other devices with a CAN port can be networked.
Physically, this interface is a twisted, two-wire cable as per RS 485 .
Attention! At the moment the CAN-Protocol is not supported.

Pin-No.	Assignment	Pin-No.	Assignment
1	n.c.	6	CAN GND
2	CAN L	7	CAN H
3	CAN GND	8	n.c.
4	n.c.	9	CAN V+ (J2 plugged: +12V)
5	CAN screen (GND)	10	n.c.

5.6 The Handwheel Connection (Coax Connector)

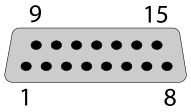


Fig.: The Handwheel Connection (15 Pole, Sub-D Socket)

Pin	Assignment	Pin	Assignment
1	Analog VCC (+5V)	9	Analog GND
2	+5V	10	Analog GND
3	A+, X-axis	11	C+, Y-axis
4	A-, X-axis	12	C-, Y-axis
5	B+, X-axis	13	D+, Y-axis
6	B-, X-axis	14	D-, Y-axis
7	TTL input resolution	15	n.c.
8	TTL input snapshot	Housing	Screen

5.7 Interpreter For MULTICONTROL Commands

The LSTEP-xx/2 can also process multicontrol commands at option.
Switching to this instruction set can be done either by switching dipswitch switch no. 2 „ON„ or by means of a command
(see Chapter 4 „Interpreter„).
To switch to the instruction set per dip switch, the power supply to the controller must first be switched off. The dip switch of both controllers is located in the back panel.

Fig.: Dip Switch Of The LSTEP-xx/2

Fig.: Dip Switch Of The ECO-STEP

5.7.1 Input Of Parameters

Parameters can be input as integers or as floating decimals. The scientific format **cannot** be used.

23.45676	Input is supported
34.e01	Input is not supported
0.67E-1	Input is not supported

5.7.2 Supported Multicontrol Commands

The following Venus commands are presently supported:

setdim	setlimit	setaccel	calibrate	setsw
getdim	getlimit	getaccel	rmeasure	getsw
geterror	setpitch	setaxis	move	setcalvel
setvel	getpitch	getaxis	rmove	getcalvel
getvel	setpos	version	pos	setrmvel
joyspeed	setjoysticktype	identify	devpos	getrmvel
joystick	getjoysticktype	status	getpos	

If a Venus command is transmitted which the controller cannot interpret, the error code is set to 9999. Further actions are not performed.

The following commands are not supported at present:

align	getunit	setunit	Ico	scale
getec	setcloop	getcloop	Setclfactor	getclfactor
echo	And all commands which use the stack and chain.			

Deviations And Differences

Some of LSTEP Venus interpreter' s instructions work a little differently to those of a multicontrol. This applies in particular to commands which display the internal status or which feed back the version number of the controller or the firmware. The known deviations are documented below:

Venus-Command	MultiControl Meaning	LSTEP-xx/2 Meaning
version	Returns the version number of the Venus interpreter	Returns the version and revision number of the ITK interpreter.
identify	Returns the identification of the controller, the switch setting at the back whilst the unit is being switched on, the internal configuration switch settings, the hardware and the software revision number	Returns the version and the revision number of the ITK interpreter. The first 4 characters of the string which is transmitted back contains the coded version number of the ITK interpreter. The next two digits specify the revision number of the version. Example.: *1.00-12 99 99 3d* means Vers. 1.00, Rev. 12
setdim	Sets the dimension of the position for the instructions with the parameters in []	Same as for MultiControl.In an incorrect number of parameter is transmitted with any of the instructions, the instructions in question are not executed
status	Returns the present satus of the MultiControl	Always returns 0 . *Note:* the status register of the LSTEP can be read out instead
mode	Set the interactive mode of the Venus interpreter 1 = Terminal mode 0 = Host mode	The LSTEP-xx works exclusively in host mode . Therefore, the command *1 mode* will result in the error code 1003
save	Saves all parameters with the identification nv in the non-volatile memory	Saving of the preset parameters in the non-volatile memory is not supported at present. If this instruction is called, error code 1200 *'Write error in flash memoryr'* is set
restore	Overwrites all parameters with the identification nv with the values stored in the non-volative memory	A readout of the preset parameters in the non-volatile memory is not supported at present. If this instruction is called, error code 1202 *'Read error in flash memoryr'* is sett
setunit	Sets the unit of an axis in physical terms	0 = motor increments 1 = µm 2 = mm

Venus-Command	MultiControl Meaning	LSTEP-xx/2 Meaning
setpitch	r, i, setpitch: Sets the spindle pitch of the axis i to r	r, i, setpitch: Sets the spindle pitch of the axis i to r. The speed axis (i=0) is not supported.
move	Absolute positioning. If the permitted range of travel is exceeded, error code 1004 is set.	Absolute positioning. Overshooting of the range of travel is monitored and may be limited to the maximum permitted range of travel. The LSTEP does not set the error code to 1004.
selftest	Gives the result after the self-test for an axis for the controller	Always returns 0
setjoysticktype	Defines the type of joystick which is connected	The type of joystick always depends on the number of axes of the connected controller. A 2-axis controller always assumes a two-axis joystick, a 3-axis controller always assumes a 3-axis joystick. For reasons of compatability with application programs for controllers of the type MultiControl, this instruction is permitted here. The LSTEP executes this instruction without giving any error message It does not however have any effect, other than that the value set here can be read back with *getjoysticktype*.
getjoysticktype	Returns the present joystick type	Returns the last value which was set with *setjoysticktype*
setjoyspeed **joyspeed**	Sets the speed for the joystick	Has the same effect as the instruction *joyspeed*. The maximum joystick speed is specified in motor revolutions / sec. Example: 13 setjoyspeed sets the maximum speed to 13 revolutions /sec.
getjoyspeed	Returns the present joystick speed	Gives the maximum speed when the joystick is fully deflected. This is the same speed which was set with the instructions *joyspeed* or *setjoyspeed*.

Venus-Command	MultiControl Meaning	LSTEP-xx/2 Meaning
setmotortype **getmotortype**	Allocates certain motor types to the axes For service purposes only	The LSteps have been preset in the factory so that they can be used for all common motor types without adaption. The instuctions *setmotortype* and *getmotortype* are thus not needed her and are therefore not supported.
setcurrent, getcurrent	For service purposes only	Sets or reads the output current of the axes.
v t setcalvel	Defines the calibration speed (velocity) „v“ in revolutions / sec. when approaching the limit switch position (t=1) and moving away from the limit switch position (t=2)	Defines the calibration speed „v“ in revolutions / sec when approaching the limit switch position (t=1). The speed for retracting from, i.e. moving away from the limit switch position (t=2) is preset in the LSteps. The instruction with the parameter t=2 is therefore not supported. The fault number 9999 is set.
[r] setpos	Sets the present position to [r]	Sets the present position to [r]. This corresponds to an offset of the coordinate system which is being used.
getpos	Returns the zero offset in microsteps	Returns the offset of the coordinate system defined by the user with *setpos* referred to the zero point after calibration in microstep
pos	Returns the present position in the current coordinate system	Returns the position with the current coordinate system (which has been offset with *setpos*) in mm .
devpos	Returns the present position from the zero position in microsteps	Returns the position in microsteps within the user coordinate system which has been offset with *setpos* .
m n l setsw	m = 0 Defines the limit switch n as normally open contact m = 1 Defines the limit switch n as normally closed contact n = 0 means the calibration limit switch n = 1 means the end limit switch l = 1,2,3 means the axis number	With the LSTEP, all limit switch inputs are wired so that depending on the type of limit switch used, the following allocation applies: Normally closed: When a limit switch is overrun a flank from 0 to 1 appears. Normally open: When the limit is overrun, a flank of 1 to 0 appears. The same allocation as that for the MultiControl applies for m, n and l

5.8 Motor Connection

The LSTEP-xx/2 is mainly designed for use with light coordinate tables, driven by 2-phase stepping motors up to 5 A. The high-resolution activation and acceleration by means of ramps in all modes of operation (including joystick), guarantees gentle running. For safe operation, you should however also heed the following points:

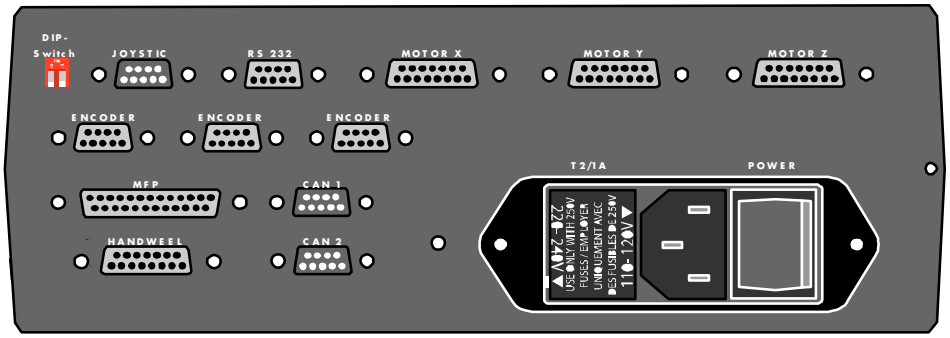
- Select low-resistance (low-impedance) motors with low inductances.
- Switch 8-conductor motors to low resistance.
- To avoid unnecssary heat errors, the motor current should however only be set as high as absolutely necessary.
- Motor currents which are at rated current lead to saturation of the magnetic magerial and step angle errors increase.

5.9 Troubleshooting

Description Of The Fault	Location / Rectification Of The Fault
1 Total failure	Check the mains power connection and fuse in the Euro-socket at the back of the unit
2 Motor overheating	Check the wiring of the motor (see Motor Connection)
3 Motor won't run at high speed	Motor is too high resistive (see Motor Connection)
4 Individual motor humming and has stopped even though a low speed has been set	Interchange the motor cables at the table, if the fault remains in the same axis: - check the cabling and motor; if the fault is now in the other axis: - there is a fault in the LSTEP
5 Individual axis not running, no humming noises	a) Check limit switches b) Check as described in 4
6 No data connection via the RS 232	a) Check the voltages at the LSTEP with the interface cable disconnected b) Check the computer and interface cable
7 LSTEP feedbacks are distorted. The correct message only appears after reading several times	LSTEP message was not read out of the receive buffer, check the application program, after a Start or Read instruction, LSTEP's response was ignored

6 Appendix LSTEP

6.1 Back Panel Of The LSTEP



6.2 Motor Connection X/Y/Z

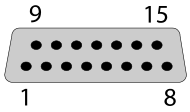


Fig.: Motor Connection (15 Pole, Sub-D Socket)

15 pole, D-SUB at LSTEP, Pin No.	Colour	12-pole Flanged Socket, Motor	Pin Connections:
1 + 9	blue	K	Phase 1R
2 + 10	orange	J	Phase 1T
3 + 11	white	B	Phase 2T
4 + 12	brown	C	Phase 2R
5	yellow	G	Limit switch end position
6	grey	H	Limit switch zero position
7	red	A	+5V
8	black	F	GND
13	green	E	Reference switch
14 **(for the X- and Y-axis!)**	violet	D	Temperature
14 **(for the Z-axis!)**	violet	D	Optional voltage for a motor brake.
15			+12V

6.3 Encoder Connection X/Y/Z *(not for ECO-STEP)*

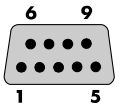


Fig..: Encoder Connection (9 Pole, Sub-D Socket)

PIN	Signal	PIN	Signal
1	U_{1-}	6	U_{1+}
2	0V	7	5V
3	U_{2-}	8	U_{2+}
4	+12V (Optional)	9	U_{0+}
5	U_{0-}	Housing	Outer screen

6.4 The Power Supply Module

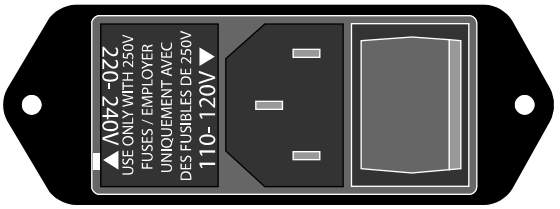


Fig..: The power supply module

The power supply consists of the device plug, the main power switch and the voltage selector with integrated power input fuses.
The controller can be operated either at 220V-240V or 110V-120V . You must set the voltage selector accordingly. The arrow for the required voltage must point to the white mark.
To change a fuse, pull the voltage selector out of the power supply module. For a voltage of 220V-240V , use a 1 amp. time-lag fuse. For a voltage of 110V-120V , use a 2 amp. time-lag fuse . (This applies for the LSTEP-1x/2 + 2x/2) The side of the arrow of the relevant voltage applies in both cases.

6.5 DIP Switch Settings

Fig.: The LSTEP DIP Switches

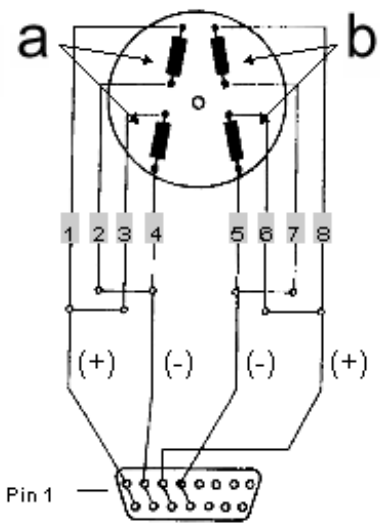
Switch 1	ON	➔	Firmware update switched on
	OFF	➔	Firmware update switched off
Switch 2	ON	➔	Multicontrol instruction set
	OFF	➔	Standard instruction set

6.6 Technical Data

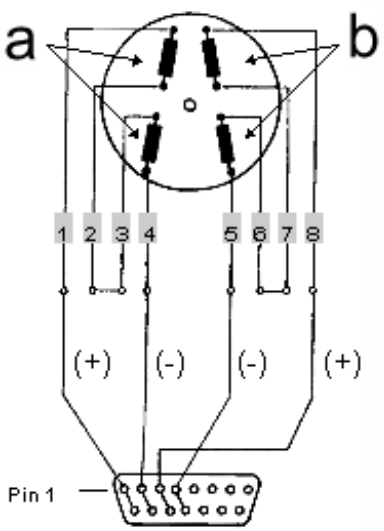
Power supply:	110V - 120V / 200V - 240V +/-10% 50/60Hz, 100VA
Fuses:	
- primary (in Euro socket):	• 2 A time-lag / 1 A time-lag LSTEP-1 and LSTEP-2 • 5 A time-lag / 2.5 A time-lag LSTEP-3
- secondary (on the circuit board)	Fuse1 LSTEP-1 and 2 ➔ 5 A time-lag / LSTEP-3 ➔10A time-lag
Max. power failure duration:	< 50ms if a power failure occurs (<0.77 * U_N), the LSTEO switches to Reset
Max. motor speed:	40 r/sec. for a 200-step motor
Max. motor current:	1.25A per motor phase for LSTEP-1 2.5A per motor phase for LSTEP-2 5.0A per motorphase for LSTEP-3
Max. motor voltage:	40V
Step resolution	• max. 50,000 (100,000) steps/revolution for a 200 step motor. • 2000 microsteps/full step for linear stepping motors
Baud rate:	9600, 19200, 38400, 57600 or 115200
MTTF (parts count method):	519260 h
Ambient conditions:	
Air temperature when in operation:	15 ... 40 degrees C
Air temperature when not in operation:	0 ... 43 degrees C
Relative humidity when in operation	8 ... 80 % at 31° / Max. 50% at 40°
Relative humidity when not in operation	0 ... 80 %
Dimensions W * D * H (without handle):	
	250 mm • 230 mm • 100 mm for LSTEP-1x
	250 mm • 230 mm • 100 mm for LSTEP-2x
	475 mm (19,,) • 266 mm • 90 mm (2HE) for LSTEP-3x
Weight:	4.5 kg / LSTEP-1 and LSTEP-2
	9 kg / LSTEP-3

6.7 Wiring Of The Motor

2-phase, low resistance motor



2-phase, high-resistive motor



15 pole plug or flanged plug

6.8 Testing and Calibration Instructions

The following instructions tell you how to test and adjust the LSTEP xx/2. These jobs must only be done by duly qualified experts.

CAUTION: **Pull out the mains plug before you open the unit!**

Jumper 5:	Reference voltage (+5V +/-5%)
Solder bridge 11	controlled logic voltage (+4.8V...5.25V)
Solder bridge 10	controlled logic voltage (-12V +/-5%)
Solder bridge 8	controlled logic voltage (+12V +/-5%)
Meas. point 15	Motor voltage 40 Volts

Checking The Motor Current With The Oscilloscope (X/Y-Presentation):

- X-motor current:
  Connect the oscilloscope to measuring point 5 and measuring point 6.
- Y- motor current:
  Connect the oscilloscope to measuring point 9 and measuring point 10.
- Z- motor current:
  Connect the oscilloscope to measuring point 12 and measuring point 13.

Note: The motor current is the measured current rs (circle radius) and **not** rss (circle diameter)

LSTEP-1x /2	6V/A, max. 1.25A
LSTEP-2x /2	3V/A, max. 2.5A
LSTEP-3x /2	1.5V/A, max. 5.0A

Joystick Calibration
The joystick is calibrated automatically by the controller.

Note: When switching on the controller, the joystick must not be displaced, as the controller calibrates to the zero position.

6.9 View Of The Circuit Boards

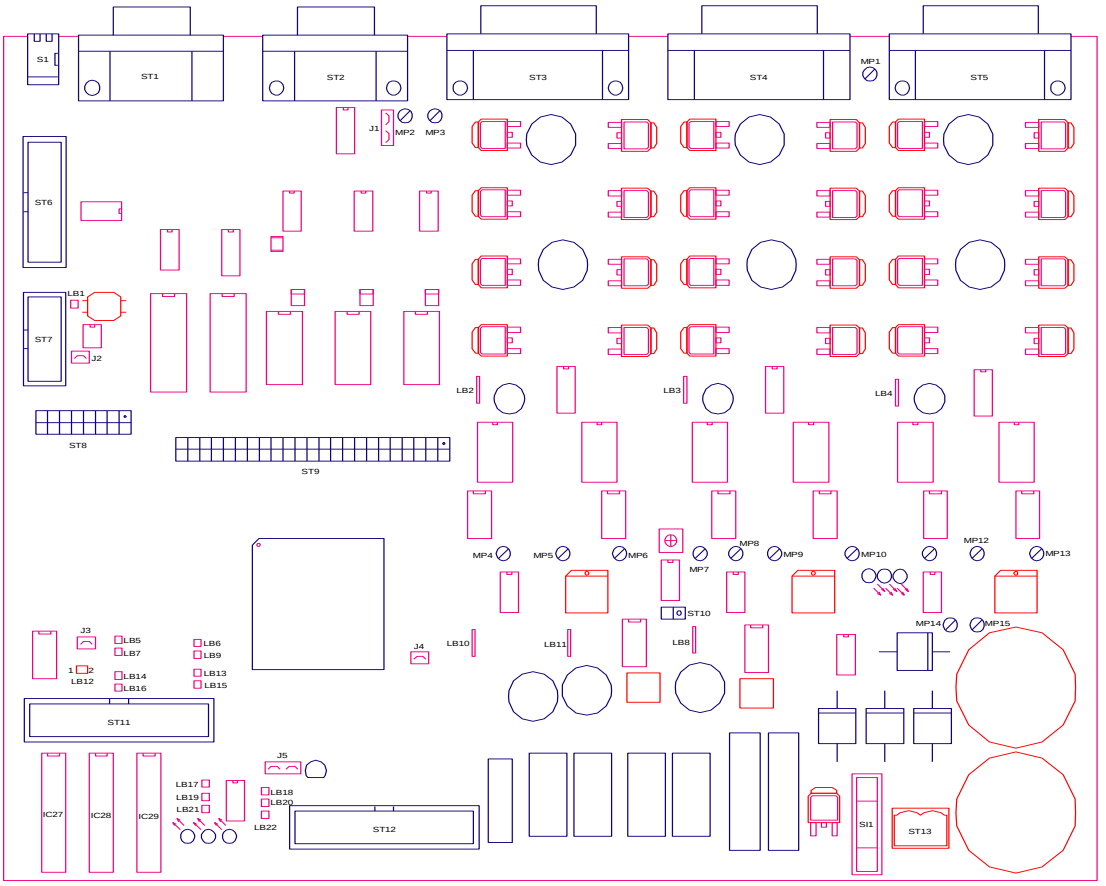


Fig..: The main circuit board

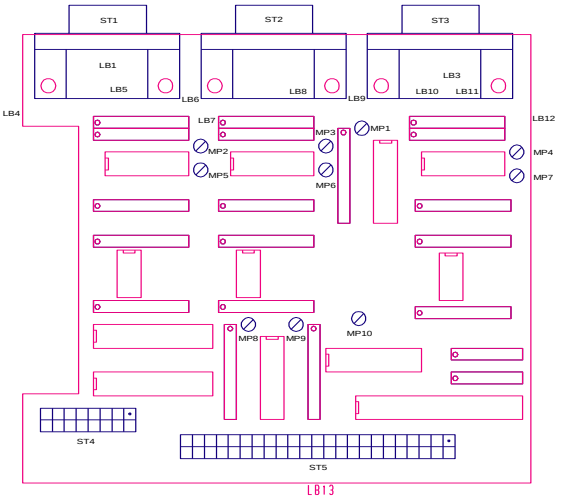
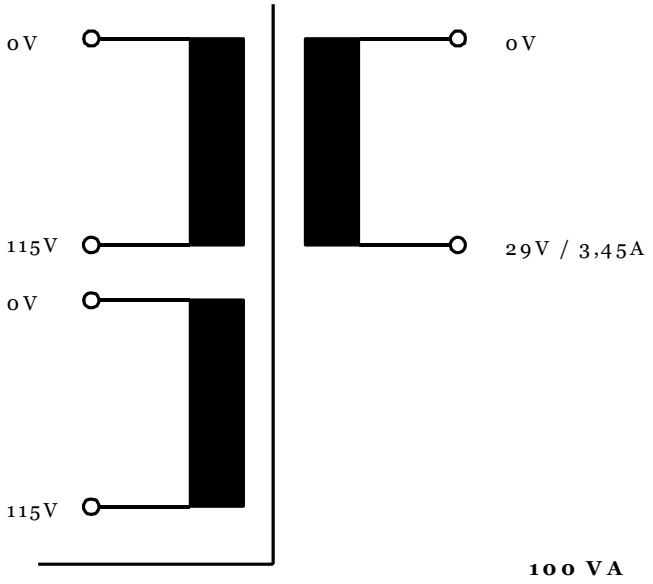


Fig..: The encoder board (optional)

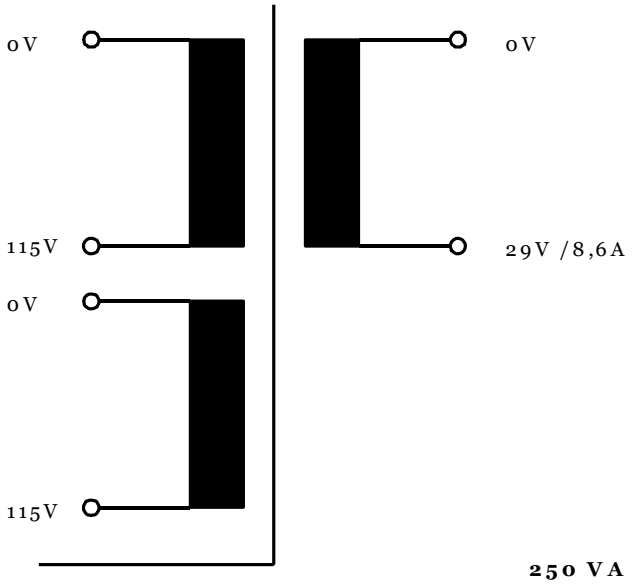
Note:	The solder bridges of the encoder board are located on the soldered side of the circuit board.

6.10 Transformer Wiring

LSTEP-1x/2 ; LSTEP-2x/2



LSTEP-3x/2



6.11 I /O - Card for LSTEP Controller

Description of 16 In-, 16 Outputs and 2 analog Outputs for LSTEP 46-pin Bus adapter:
The 16 in- and 16 output extensive card is suited for the LANG 46-pin female connector- bus adapter.
The connection of ST2 varies from the connection of the I/O plug from the LSTEP-PC-card.
Reason: With a flat band cable, each lead of the cable can only be connected with 1A. The supply voltage of the LSTEP-PC is supplied from outside. I.e. the +11,4...32V-line carries the total current, while the GND-line stays almost non-loaded. The +11,4...32V-line is therefore 4-folded. In the existing card, the current is fed in on the card (ST4). Therefore the +11,4...32-V-cable is almost non-loaded while the GND-line as a back line carries almost the total current. That is why it is 4-folded. The external power supply the 11,4...332V-power supply must be fed in through ST4. A feeding in over ST2 is inadmissible.

ST1: Connections of the 46-pin-bus adapters:

Pin No.	Function
1-9	D0 - D8
18 - 20	A1 - A3
23 - 34	A6 - A17
35	/RD
36	/WR
37	- 12V
38	+ 12V
39	+ 5V
40	GND
42	/RSTOUT

ST3: 10-pol Female connector with D-Sub-Socket-Connection: 2 Analogue Outputs

The outputs are designed for +/- 10V as a standard. Other output voltage ranges (i.e. +/- 5V, 0...5V, 0...10V,...) are poosible if requested. The power handling capacity of the outputs is +/- 5mA. The internal resistance is ca. 100 Ohm.

Pin No.	Function
1,2	GND
3	Output 1
4	Output 2

Assembling of the circuit card with different voltage ranges at the analogue outputs

Output voltage	R1/R2	R4/R5	R6/R7
0...5V	10kOhm		10kOhm
0...10V	10kOhm		20kOhm
-5V...+5V	10kOhm	20kOhm	20kOhm
-10V...+10V	10kOhm	20kOhm	39 (40)kOhm

ST4: 2-pol Power plug for the supply of the In- and Outputs

The power supply of the circuit card is protected by a microfuse. The release current can not exceed 4A quick fasting fuse.

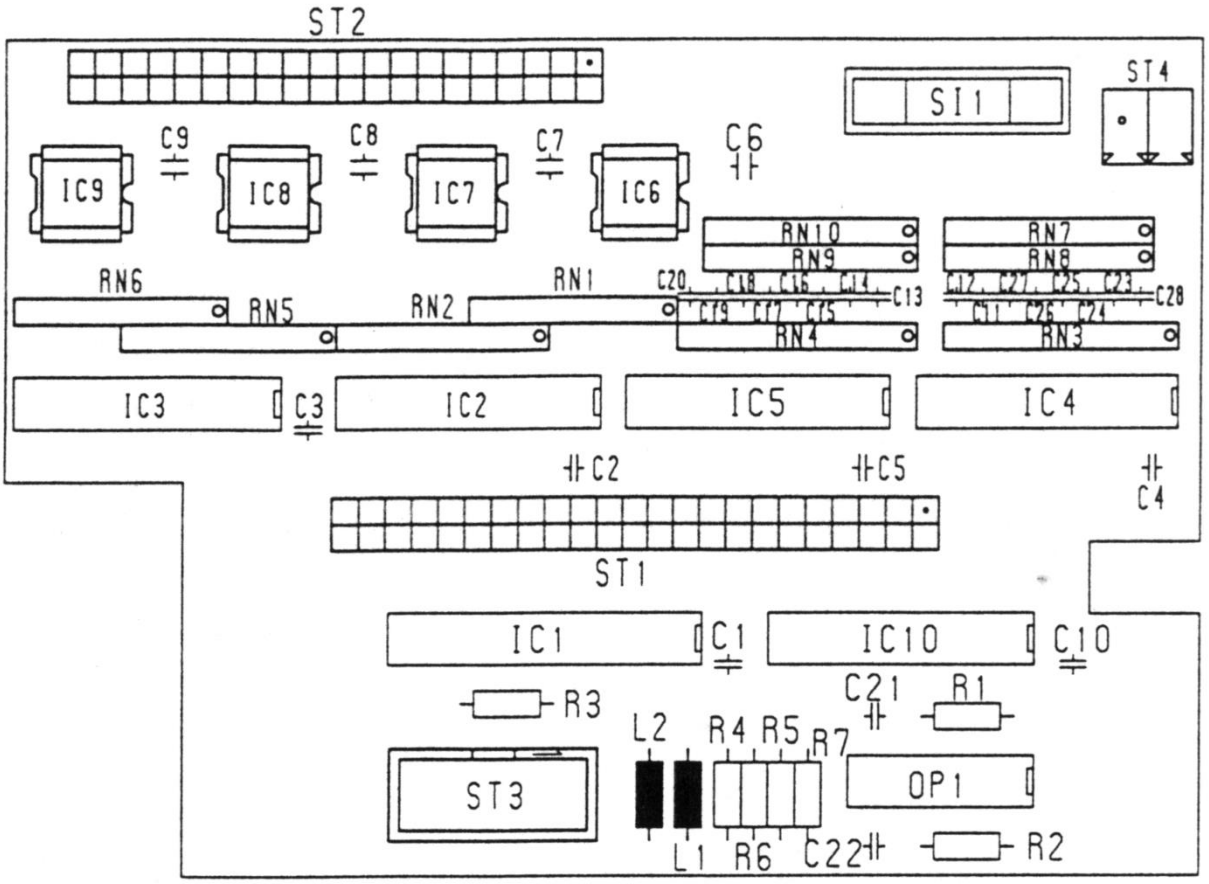
Pin No.	Function
1	+11,4...32V
2	0V

ST2: 40-pol Multipin plug with 37-pin D-Sub-socket-connection: 16 Inputs, 16 Outputs

Inputs: 0...3V = „L“, 10...32V = „H“, Ri = ca. 3,3kOhm
Outputs: Switches to +Ub=11,4...32V, Imax = 0,5A, short circuit protected

Pin No.	Connections
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5
6	Output 6
7	Output 7
8	Output 8
9	Output 9
10	Output10
11	Output11
12	Output12
13	Output13
14	Output14
15	Output15
16	Output16
17-19	GND
20	Input 1
21	Input 2
22	Input 3
23	Input 4
24	Input 5
25	Input 6
26	Input 7
27	Input 8
28	Input 9
29	Input 10
30	Input 11
31	Input 12
32	Input 13
33	Input 14
34	Input 15
35	Input 16
36	GND
37-40	+11,4...32V

Assembly
Circuit card number 06 14 98



6.12 Documentation: Trackball for LSTEP

The trackball of the LSTEP-xx/2 was developed, to perform very fine manual movements. The trackball can be activated by switching on the joystick. The joystick is used for bigger movements, the trackball for smaller movements. It is suggested to use a LSTEP with a display., because the key functions are shown in the display.

Functions:

The trackball comes with three additional functions.

1. With the left and middle button the trackball factor can be changed.
2. With the right button the axes X and Y can be locked individually for the trackball.

to 1. The Trackball-Factor specifies how many motor increments are issued with a trackball-impulse. , The basic setting is 1, i.e.. 1 Impulse = 1 Motor increment. With the left button, the setting can be reduced to a factor = 0,05, with the left button increased to a factor =9.9. Pressing the left and middle button simultaneous the basic setting factor = 1 applies. The set factor is always shown for a short time in the display.

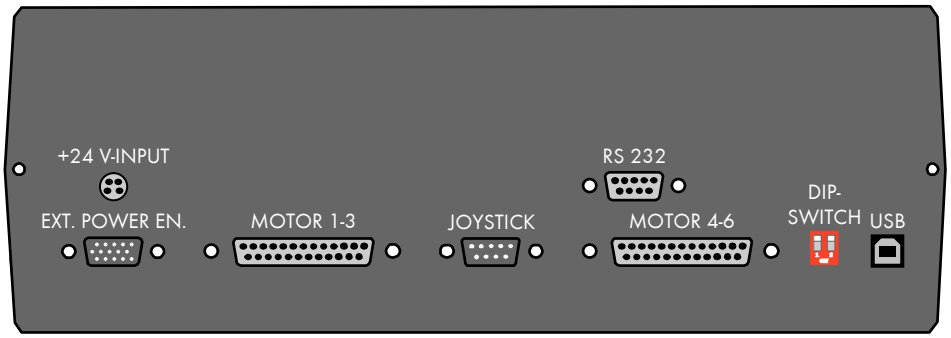
to 2. Because it is very difficult to move only one axis, it is possible to lock and release the axes alternately with the right button. This is also displayed shortly after pressing the button.

Note:

Via the command " Trackball Back Lash " the reverse back lash can be set for each axis , so that the mechanic exactly follows each change of direction with. every trackball movement. Further information to this you find in this documentation chapter 4 / command set LSTEP or in chapter 9 / Appendix LSTEP_API.

7 Appendix ECO-STEP 3 Axes / ECO-STEP 6 Axes

7.1 Back Panel Of The ECO-STEP



7.2 Plug Configuration

7.2.1 Motor Connection

ST5, Motor Connection (MOTOR 1-3)
ST4, Motor Connection (MOTOR 4-6)

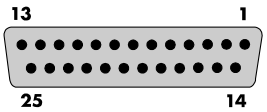


Fig.: Motor connection (25-Pole Sub-D Socket)

Pin-No.	Configuration	Pin-No.	Configuration
1	Motor X, Phase 1 +	14	Motor Z, Phase 1 +
2	Motor X, Phase 1 -	15	Motor Z, Phase 1 -
3	Motor X, Phase 2 +	16	Motor Z, Phase 2 +
4	Motor X, Phase 2 -	17	Motor Z, Phase 2 -
5	Motor Y, Phase 1 +	18	Limit switch Y zero position
6	Motor Y, Phase 1 -	19	Limit switch Y end position
7	Motor Y, Phase 2 +	20	Limit switch Z zero position
8	Motor Y, Phase 2 -	21	Limit switch Z end position
9	Limit switch X zero position	22	+5V
10	Limit switch X end position	23	+12V
11	Not connected	24	GND
12	Not connected	25	GND
13	Not connected	Housing	GND

7.2.2 Voltage Connection / External Power Enable

ST2 (EXT. POWER EN.)

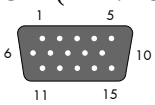
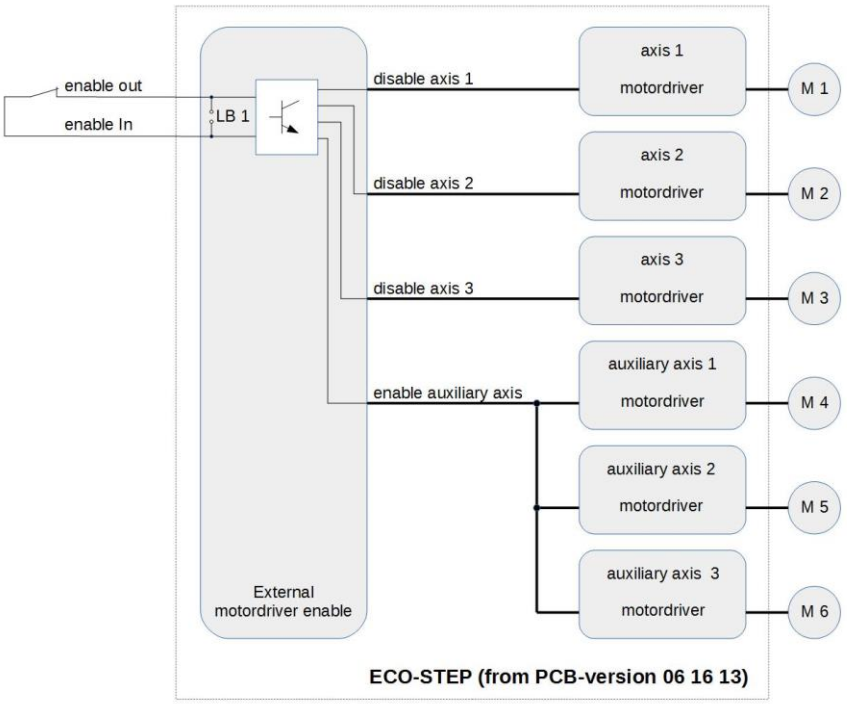


Fig.: The voltage connection (15-Pole Sub-HD Plug)

Pin-No.	Configuration	Pin-No.	Configuration
1, 2, 6, 7, 8, 11,12	GND	5, 10, 14, 15	+24 V DC controlled
3	External power enable out	13	External power enable in
4, 9	Not connected	Housing	GND

The power amplifiers of ECO-STEPS-model from PCB-version 06 16 13 can be disabled by opening an external connection between signal "External power enable out" (Pin 3) and "External power enable in" (PIN 13). Therefore the solder bridge LB 1 must be opened. After disabling the amplifiers it is only possible to enable them again by using the instruction "!hardreset" (see chapter 4). The following picture shows a simplified illustration of the circuit-parts for enabling / disabling of the amplifiers.



7.2.3 Voltage Connection

Mini-DIN Plug (+24 V-INPUT)

Fig.: The voltage connection (4-Pole Mini-DIN Plug)

Pin-No.	Configuration	Pin-No.	Configuration
1, 2	+24 V DC controlled	3, 4	GND

(Note: At ECO-STEP in housing, the Mini-DIN plug is connected to ST13. The use of ST2 for power supply is not available.)

7.2.4 ST13: Voltage Connection

Pin-No.	Configuration	Pin-No.	Configuration
1	+24 V DC controlled	2	GND

7.2.5 Joy-Stick, Stop and Snap-Shot

ST3, 9-Pole D-Sub-Socket (JOYSTICK)

Pin-No.	Configuration	Comment
1	VAGND	Analogue GND
2	/Joy-Stick on	TTL, Pull Up = 4,7 kOhm
3	Joy-Stick X	
4	Joy-Stick Y	
5	Joy-Stick Z	
6	Snap-Shot	
7	/Stop	TTL, Pull Up = 4,7 kOhm
8	VAREF	+5 V analogue reference voltage
9	VAREF	+5 V analogue reference voltage
Housing	GND	

7.2.6 RS 232-Interface

ST7, 10-Pole Connecting Plug, D-Sub-Configuration (RS 232):

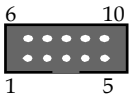


Fig.: RS 232-Interface (10-Pole Connecting Plug, D-Sub-Configuration)

Pin-No.	Configuration	Comment
1	Not connected	
2	RXD	
3	TXD	
4	GND	
5	GND	
6	+5 V	
7	RTS	
8	CTS	
9	NC / RS 232 RI(+5 V / +12 V)	Depending on LB2, (default: NC)
10	Not connected	

(Note: The configuration of the 9-pole D-Sub-Plug is available at appendix general.)

7.2.7 CAN-Bus-Connection

ST6, 10-Pole Connecting Plug, D-Sub-Configuration

Pin-No.	Configuration	Comment
1	Not connected	
2	CAN L	
3	CAN GND	
4	Not connected	
5	CAN shielding (GND)	
6	CAN GND	
7	CAN H	
8	Not connected	
9	NC / CAN V+ (+12 V)	Depending on LB4, (default: NC)
10	Not connected	

7.2.8 Connection For The Control Panel Connector

ST11, 26-Pole Connecting Plug

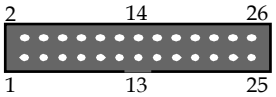


Fig.: Connection for the control panel connector (26-Pole Connecting Plug)

Pin-No.	Configuration	Comment
1,2	GND	
3	RS	TTL, Pull Up = 22 kOhm
4	R, /WR	
5	/E	TTL, Pull Up = 22 kOhm
6	DB 0	
7	DB 1	
8	DB 2	
9	DB 3	
10	DB 4	
11	DB 5	
12	DB 6	
13	DB 7	
14	/STOP	
15	/Joy-Stick on	
16	/Clear X	TTL, Pull Up = 22 kOhm
17	/Clear Y	TTL, Pull Up = 22 kOhm
18	/Res in	
19	VAGND	
20	Speed	
21	/CLR Z	TTL, Pull Up = 22 kOhm
22	+12 V	
23	-12 V	
24	VAREF	+5 V analogue reference voltage
25,26	+5 V	

7.3 Solder Bridge Configuration

Identification	Function
LB1	Open: External shutdown of power amplifiers
LB2.1	Close: RS 232 RI = +5 V (LB2.2 open)
LB2.2	Close: RS 232 RI = +12 V (LB2.1 open)
LB3	Close: CAN L/ CAN H terminated with 120 Ohm
LB4	Close: CAN V+ = +12 V

7.4 DIP Switch Settings

Fig..: DIP Switches of the ECO-STEP

Switch 1	ON	➔	Firmware-Update switched on
	OFF	➔	Firmware-Update switched off
Switch 2	ON	➔	Reset on
	OFF	➔	Reset off

7.5 Technical Data

7.5.1 Common

Max. motor speed:	40 r/sec. (depending on motor type)
Max. motor current:	1.25A per motor phase (2.5 A optional)
Max. motor voltage:	24 V
Step resolution:	max. 50,000 steps/revolution for a 200 step motor (50 pole-pairs)
Baud rate:	57.6 kBd

7.5.2 ECO-STEP - profile housing

Power supply:	Table-top power pack /	AC INPUT:	90 V – 264 V 2.8 A 47-63 Hz
		DC OUTPUT:	+24 V ---- 8.3 A
Max. power failure duration:	< 20 ms if the power fails (<0.77 * UN) the ECO-STEP switches to Reset		
Ambient conditions when in operation:	15° … 40° C		
Dimensions W • D • H:	without display 245 mm • 185 mm • 91 mm		
	with display 245 mm • 220 mm • 91 mm		
Weight:	3.5 kg		

7.5.3 ECO-STEP - printed circuit board

Power supply:	+24 V DC
Ambient conditions when in operation:	15° … 48° C[1]
Dimensions W • D • H:	233,6 mm • 158,5 mm • 17 mm
Weight:	0.3 kg

7.5.4 Notes

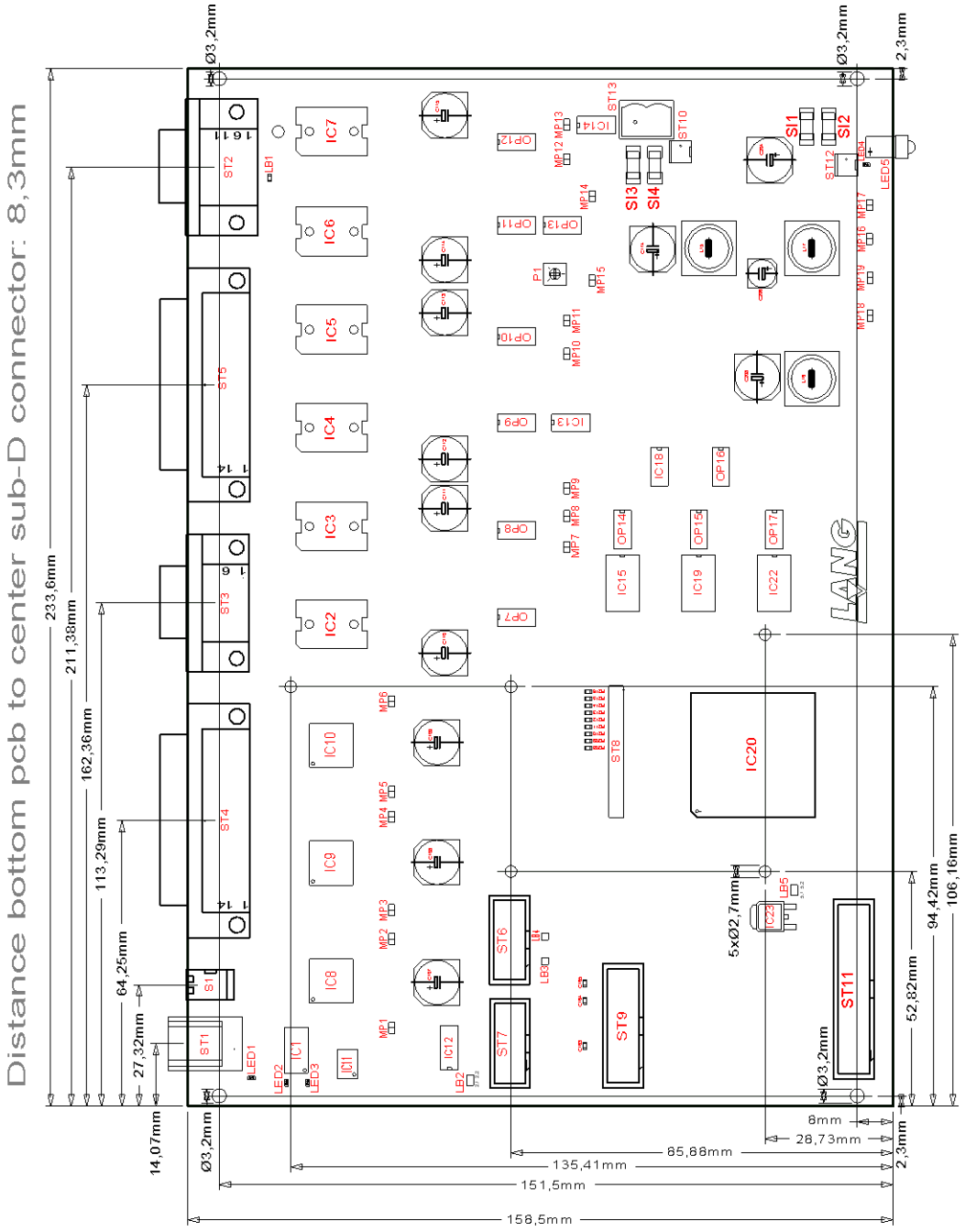
ECO-STEP 3 Axes
With the ECO-STEP 3 Axes you can only drive the three main axes (motor 1-3). The beside axes (motor 4-6) are not available.

ECO-STEP (printed circuit board) - ambient conditions

The ECO-STEP controller is available as a board without housing. In this case, the customer needs to ensure the limiting temperature specifications. First, the ambient temperature of the board ≤ 48° C. Second, prevention of temperature rise of the components needs to be checked. Components IC2 to IC10 must not exceed 90° C.
This needs to be particularly respected with controllers working with 2.5A motor current per axis. To increase heat flow, a cooling plate can be mounted below the stages. Suitable drawings and proposals are provided on request.

[1] See ECO-STEP (printed circuit board) - ambient conditions

7.6 View Circuit Board with dimensions



7.7 The Power Pack

The controller is supplied complete with an external power pack.

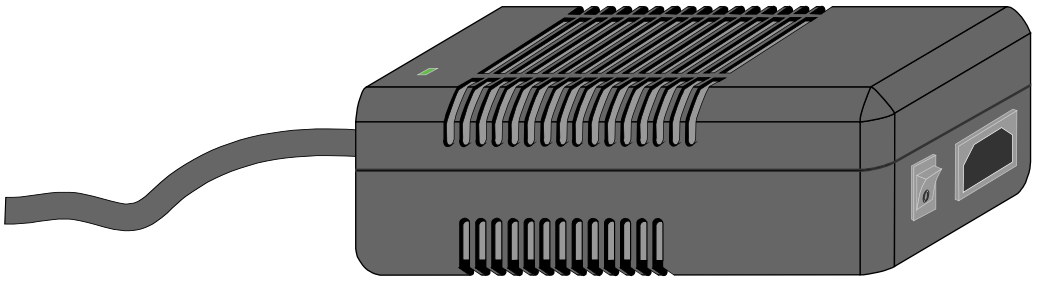


Fig.: The external power pack

7.7.1 Technical data for the power pack

Power supply:	Wide range input 90 V to 264 V~ / 2.8 A, 47-63 Hz
Output:	+24 V ⎓ 8.3 A

8 Hardware Documentation of the LSTEP-PCI

8.1 Jumper / PCI

Notation	Function if jumper is plugged
J1.1	RS 232 - interfaceSt2, Pin9 = +5V
J1.2	RS 232 – interface St2, Pin9 = +12V
J2	CAN-BUS-plug St7, Pin9 = +12V
J3	If St11, Pin18 and St10, Pin5 supposed to be digital-I/O, the OP1 must be removed and J3 plugged.
J4	VPP-input controller is set to +12V (for flash-programming)
J5.1	PCI-component is booted by the content of the EEPROMS (IC21) .
J5.2	PCI- component uses its standard Vendor- and ID-number (booted internal)

0-Ohm Resistors **LSTEP-PCIcompact**	
Natation / (R …)	**Function if resistor is equipped**
0E*1 / 12; 13; 14; 15; 16; 65	NPN – Encoder (preferred equipment)
0E*2 / 32; 34; 36; 37; 38; 97	PNP – Encoder
/ 165	22V connection to the encoder OP´s

8.2 Switch / PCI and PCIcompact

Notation	Function if switch is ON
S1	After reset the control goes into the bootstrapmode
S2	Reset active

8.3 Solder bridges / PCI

Solder bridge (LB)	Function closed/ Comment
1	Termination resistor CAN-Bus (120 Ohm) on St7,Pin 2 and 7
2	Power supply powerstage X (used for setup)
3	Power supply powerstage Y (used for setup)
4	Power supply powerstage Z (used for setup)
5	For separating the PT-100-Sensor amplifier of St11,Pin6. It can also be used as analogue-or digital input.
6.1	EEPROM IC21 is supplied with +5V
6.2	EEPROM IC21 is supplied with +3,3V.
12.1	Output voltage at St11,Pin18 and St10,Pin5 (Aout) = +/- 10V
12.2	Output voltage at St11,Pin18 and St10,Pin5 (Aout) = 0...10V

Solder bridges / PCIcompact

Solder bridge (LB)	Function closed / Comment
5	Termination resistor CAN-Bus (120 Ohm) on St7,Pin 2 and 7
4.1	RS 232 - Interface St2,Pin9 = +5V
4.2	RS 232 - Interface St2,Pin9 = +12V
2	CAN-BUS-Plug St7,Pin9 = +12V
3	For separating the PT-100-Sensor amplifier of St11,Pin6. It can also be used as analog or digital input.
1	If St11, Pin18 and St10,Pin5 supposed to be Digital-I/O, than OP2 must be removed and LB1 closed.
6.1	Output voltage at St11,Pin18 and St10,Pin5 (Aout) = +/- 10V
6.2	Output voltage at St11,Pin18 and St10,Pin5 (Aout) = 0...10V

8.4 LED´s / PCI

Notation	Function
LED1	Powerstage X active
LED2	Powerstage Y active
LED3	Powerstage Z active

LED´s / PCIcompact

Notation	Function
LED 3	Powerstage X aktiv
LED 1	Powerstage Y aktiv
LED 2	Powerstage Z aktiv

8.5 Plugs

8.5.1 Joy-Stick, Stop, Snap-Shot (PCI and PCIcompact)

ST1, 9-pol D-Sub-plug

Pin No	connections	Comment
1	VAGND	Analogue GND
2	/Joy-Stick on	TTL, Pull Up = 4,7 kOhm, RC-filter 470 Ohm/100nF
3	Joy-Stick X	RC-filter 10kOhm/10nF
4	Joy-Stick Y	RC-filter 10kOhm/10nF
5	Joy-Stick Z	RC-filter 10kOhm/10nF
6	Snap-Shot	TTL, Pull Up = 4,7 kOhm, RC-filter 470 Ohm/100nF
7	/Stop	TTL, Pull Up = 4,7 kOhm, RC-filter 470 Ohm/100nF
8	VAREF	5V Analogue reference voltage
9	VAREF	5V Analogue reference voltage
Housing	GND	

Note: The connections 3-5: Joystick X,Y,Z are identical with ST 11, Pin`s 24,12 and 25.

8.5.2 RS 232-Interface (PCI and PCIcompact)

ST2, 10-pol Female connector with D-Sub-connection

Pin No.	Connections
1	nc.
2	RXD
3	TXD
4	GND
5	GND
6	+5V
7	RTS
8	CTS
9	J1.1 plugged: +5V; J1.2 plugged: +12V

8.5.3 CAN-Bus / PCI and PCIcompact

St7, 10-pol. Female connector, D-Sub-connection

Pin No.	Connections
1	NC
2	CAN L
3	CAN GND
4	NC
5	CAN Screen(GND)
6	CAN GND
7	CAN H
8	NC
9	CAN V+ (J2 plugged: +12V)
10	NC

8.5.4 Measuring point 1-8 (PCI and PCIcompact)

St5, 8-pol Female connector

Pin No	Notation	Function
1	MP1	Measuring point: Port 8.0 of the control (also used internal)
2	MP2	Measuring point: Port 8.1 of the control (also used internal)
3	MP3	Measuring point: Port 8.2 of the control (also used internal)
4	MP4	Measuring point: Port 8.3 of the control (also used internal)
5	MP5	Measuring point: Port 8.4 of the control
6	MP6	Measuring point: Port 8.5 of the control
7	MP7	Measuring point: Port 8.6 of the control
8	MP8	Measuring point: Port 8.7 of the control

8.5.5 Motor- and prox. switch connection (PCI and PCIcompact)

ST3, 25-pol D-Sub-socket

Pin No.	Connection
1	Motor X, phase 1 +
2	Motor X, phase 1 -
3	Motor X, phase 2 +
4	Motor X, phase 2 -
5	Motor Y, phase 1 +
6	Motor Y, phase 1 -
7	Motor Y, phase 2 +
8	Motor Y, phase 2 -
9	Proximity switch X zero point
10	Proximity switch X stop position
11	+ Power supply power stage
12	+ Power supply power stage
13	+ Power supply power stage
14	Motor Z, phase 1 +
15	Motor Z, phase 1 -
16	Motor Z, phase 2 +
17	Motor Z, phase 2 -
18	Proximity switch Y zero point
19	Proximity switch Y stop position
20	Proximity switch Z zero point
21	Proximity switch Z stop position
22	+5V
23	+12V
24	GND
25	GND
Housing	GND

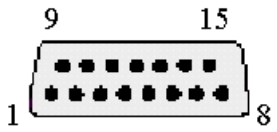
If the operating voltage is fed in at ST3, it has to be insured that there is a sufficient current load capacity of the plugs and cables (especially with flat cable).

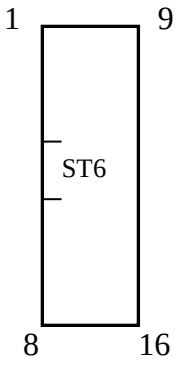
8.5.6 TTL-encoder input (PCI and PCIcompact)

All inputs have a TTL-level and pull-up-resistors 4,7kOhm against +5V.
St6 and St8 can only be used alternatively. The maximum count frequence is 2,5 Mflank = 625 KHz.

St6, 16-pol Female connector (D-Sub-counter)

Pin No	Notation	Function
1	Ph1A	Incremental encoder1, Track A
2	Ph1B	Incremental encoder1, Track B
3	Ph1Z	Incremental encoder1, Track Z (Reference signal)
4	Ph2A	Incremental encoder2, Track A
5	Ph2B	Incremental encoder2, Track B
6	Ph2Z	Incremental encoder2, Track Z (reference signal)
7	GND	
8	GND	
9	Ph3A	Incremental encoder3, Track A
10	Ph3B	Incremental encoder3, Track B
11	Ph3Z	Incremental encoder3, Track Z (reference signal)
12	+5V	
13	+5V	
14	+12V	
15	+12V	
16	nc	





8.5.7 Encoder-Plugin card (PCI)

St8, 16-pol-Female connector (normal counter)

Pin No	Notation	Function /Comment
1	Ph1A	Incremental encoder1, Track A
2	Ph1B	Incremental encoder1, Track B
3	Ph1Z	Incremental encoder1, Track Z (Reference signal)
4	Ph2A	Incremental encoder2, Track A
5	Ph2B	Incremental encoder2, Track B
6	Ph2Z	Incremental encoder2, Track Z (reference signal)
7	ClkIn	TTL-Clock signal of T6, IC7/Pin66
8	Ph1A	Incremental encoder3, Track A
9	Ph1B	Incremental encoder3, Track B
10	Ph1Z	Incremental encoder3, Track Z (reference signal)
11	/ERRX	TTL-input error signal X (active L)
12	/ERRY	TTL-input error signal Y (active L)
13	/ERRZ	TTL-input error signal Z (active L)
14	CSAD	CS-Signal 4, IC7,Pin3: For AD-converter (active L)
15, 16	nc	

8.5.8 Multi functioning port (PCI and PCIcompact)

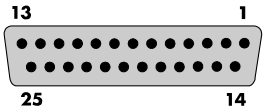


Fig.: The Multi-Function Port (25 Pole Sub-D Socket)

Due to the variety of functions, some of the pins of the multi-function port *(MFP)* have more than one assignment. Depending on how the controller is equipped, this means that only one singnal output or input is present on a pin of the MFP.
The desired functionality has to be clarified with the order.
Standard is: Trigger, Snapshot, and Stop input

St11, 26-pol Female connector, D-Sub counter

Pin No	Notation	Comment
1	Pulse X	Pulse in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
2	V/R X	V/R in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
3	Takt Y	Pulse in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
	Tigger out 2	Standard: TTL- level / I_{max} = 1,6 mA
4	V/R Y	V/R in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
5	Pulse Z	Pulse in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
6	Ain 10	Only useable if J5 is disconnected (St10,Pin6 and 7 is than inactive): Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF, Option: Analogue input0...5V
7	Ain 8	Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF Option: Analogue input0...5V (=St10,Pin3)
8	Ain 6	Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF Option: Analogue input0...5V (=St10,Pin1)
9	- 12V	
10	/Joystick on	Corresponds with St1,Pin2: TTL, Pull Up = 4,7 kOhm, RC-Filter 470 Ohm/100nF
11	VAGND	
12	AN1/Joystick Y	RC-Filter 10kOhm/100nF **Joystick Y**
13	VAREF	+5V Reference voltage
14	V/R Z	V/R in- or output, 10kOhm against +5V, RC-component 470Ohm/220pF
15	Tigger out	HCMOS-output: I,max = 1,6 mA
16	GND	
17	+5V	
18	Analogue Out	Standard: Analogue output 0...10V reps. +/-10V depending on LB12, Ri, min = 1kOhm, Option: Digital I/O (see Jumper 3) (=St10,Pin5)
19	Ain 9	Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF Option: Analogue input0...5V (=St10,Pin4)
20	Ain 7	Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF Option: Analogue input0...5V (=St10,Pin2)
21	+12V	

22	SnapShot	Input: TTL, Pull Up = 4,7 kOhm, RC-Filter 470 Ohm/100nF
23	/Stop	Input: TTL, Pull Up = 4,7 kOhm, RC-Filter 470 Ohm/100nF
24	AN0/Joystick X	RC-Filter 10kOhm/100nF **Joystick X**
25	AN2/Joystick Z	RC-Filter 10kOhm/100nF **Joystick Z**
26	Ain 3	Standard: TTL-input, 4,7kOhm pull-up, RC-Filter 10kOhm/100nF Option: Analogue input0...5V

8.5.9 Analogue I/O (PCI and PCIcompact)

St10, 10-pol Female connector with D-Sub-connection

Pin No	Connection	Comment
1	Analogue In 1	Analogue: 0...5V, 4,7kOhm against +5V, RC-Filter 10KOhm/100nF (=St11,Pin8)
2	Analogue In 2	Analogue: 0...5V, 4,7kOhm against +5V, RC-Filter 10KOhm/100nF (=St11,Pin20)
3	Analogue In 3	Analogue: 0...5V, 4,7kOhm against +5V, RC-Filter 10KOhm/100nF (=St11, Pin7)
4	Analogue In 4	Analogue: 0...5V, 4,7kOhm against +5V, RC-Filter 10KOhm/100nF (=St11,Pin19)
5	Analogue Out	0...10V or +/-10V, R, Load >=1kOhm Ri= ca. 100 Ohm (=St11,Pin18)
6, 7	PT 100 Temperature sensor connection	Measuring current = 10 mA, LB 5 must be closed, St11, Pin6 is not useable)
8	GND	
9	VAREF = +5V / 1A	Output
10	NC	

8.5.10 Motor power supply (PCI and PCIcompact)

ST4, 4-pol PC-supply unit plug

Pin No	Connection	Comment
1	+Um	Motor power supply: When using the PC-supply unit = 12V, for external supply unit = 11,4....48V (48V=max. use only regulated supply unit)
2,3	GND	
4	NC	

8.5.11 System bus for extension module (PCI)

St 9, 46-pol Female connector

Pin No.	Connection
1	D0
2	D1
3	D2
4	D3
5	D4
6	D5
7	D6
8	D7
9	D8
10	D9
11	D10
12	D11
13	D12
14	D13
15	D14
16	D15
17	A0
18	A1
19	A2
20	A3
21	A4
22	A5
23	A6
24	A7
25	A8
26	A9
27	A10
28	A11
29	A12
30	A13
31	A14
32	A15
33	A16
34	/CS0
35	/RD
36	/WR
37	-12V
38	+12V
39	+5V
40	GND
41	Digital I/O 1, Interrupt capable
42	Reset Out
43	Analogue/ Digital Input1
44	Analogue/ Digital Input2
45	Analogue/ Digital Input3
46	Digital I/O 2 (Presently used internal: VPP Flash on)

8.5.12 For Sin.- Cos.- Encoder evaluation (PCIcompact)

St 8 / 50-pol Female connector

Pin Nr.	Connection
1	D0
2	D1
3	D2
4	D3
5	D4
6	D5
7	D6
8	D7
9	D8
10	D9
11	D10
12	D11
13	GND
14	A1
15	A2
16	A3
17	A6
18	A7
19	A8
20	A9
21	A10
22	A11
23	A12
24	A13
25	A14
26	A15
27	A16
28	CSO
29	/RD
30	/WR
31	-12V
32	+12V
33	+5V
34	GND
35	P7.4
36	/RST
37	Takt X
38	U/D X
39	Takt Y
40	U/D Y
41	Takt Z
42	U/D Z
43	CIKin
44	/Ref X
45	/Ref Y
46	/Ref Z
47	/Err X
48	/Err Y
49	/Err Z
50	CSAD

8.5.13 PCI-Bus (PCI and PCIcompact)

St12, only used pins are listed

Notation	Pin No.
AD0	A58
AD1	B58
AD2	A57
AD3	B56
AD4	A55
AD5	B55
AD6	A54
AD7	B53
AD8	B52
AD9	A49
AD10	B48
AD11	A47
AD12	B47
AD13	A46
AD14	B45
AD15	A44
AD16	A32
AD17	B32
AD18	A31
AD19	B30
AD20	A29
AD21	B29
AD22	A28
AD23	B27
AD24	A25
AD25	B24
AD26	A23
AD27	B23
AD28	A22
AD29	B21
AD30	A20
AD31	B20
C/BE0	A52
C/BE1	B44
C/BE2	B33
C/BE3	B26
/INTA	A6
PAR	A43
/SERR	B42
/PERR	B40
/STOP	A38
/DEVSEL	B37
/TRDY	B35
/IRDY	B35
/FRAME	A34
IDSEL	A26
/REQ	B18
/GNT	A17
CLK	B16

/RESET	A15
/PRSNT1	B9
/PRSNT2	B11
PCI-VIO	B19,B59,A10,A16,A59
-12V	B1
+12V	A1
+5V	A5,A8,A61,A62,B5,B6,B61,B62
GND	A:18,24,30,35,37,42,48,56 B:3,15,17,22,28,34,38,46,49,57

8.5.14 Encoder (PCI and PCIcompact)

St14 / 10-pol male connector with D-Sub-assignment

Pin No.	Connection	Notation : Assembly variation
1	Encoder 0-Position X	NPN = R15 equipped / PNP = R37 equipped
2	Encoder End-Position X	NPN = R65 equipped / PNP = R97 equipped
3	Encoder 0-Position Y	NPN = R16 equipped / PNP = R38 equipped
4	Encoder End-Position Y	NPN = R14 equipped / PNP = R36 equipped
5	Encoder 0-Position Z	NPN = R12 equipped / PNP = R32 equipped
6	Encoder End-Position Z	NPN = R13 equipped / PNP = R34 equipped
7	+5V	
8	+12V	
9	GND	
10	nc	

- Only one resistor can be equipped per encoder input.
- The basic equipment is only designed for the NPN Encoder.

8.5.15 16 digital I/O´s (PCIcompact)

St 9 / 40-pol Male connector with D-Sub assignment

Pin No.	Connection
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5
6	Output 6
7	Output 7
8	Output 8
9	Output 9
10	Output 10
11	Output 11
12	Output 12
13	Output 13
14	Output 14
15	Output 15
16	Output 16
17	GND
18	GND
19	GND
20	Input 1
21	Input 2
22	Input 3
23	Input 4
24	Input 5
25	Input 6
26	Input 7
27	Input 8
28	Input 9
29	Input 10
30	Input 11
31	Input 12
32	Input 13
33	Input 14
34	Input 15
35	Input 16
36	GND
37	+24V
38	+24V
39	+24V
40	+24V

8.5.16 24V power supply for digital I/O´s (PCIcompact)

ST15 / 2-pol Plug

Pin No.	Connection
1	+24V
2	GND

8.6 Measuring point (PCI and PCIcompact)

Measuring point	Notation	Function
MP1	GND	
MP2	MCOSX	Measuring point motor current X-axis, phase 2 (cos)
MP3	MCOSY	Measuring point motor current Y-axis, phase 2 (cos)
MP4	MCOSZ	Measuring point motor current Z-axis, phase 2 (cos)
MP5	MSINX	Measuring point motor current X-axis, phase 1 (sin)
MP6	MSINY	Measuring point motor current Y-axis, phase 1 (sin)
MP7	MSINZ	Measuring point motor current Z-axis, phase 1 (sin)
MP8	GND	
MP9	+3,3V	+3,3V power supply
MP10	Sz.gen. 20kHz	Signal triangular generator
MP11	GND	

Measuring point/ PCIcompakt Nr.	Notation	Function
MP10	GND	
MP3	MCOSX	Measuring point motor current X-axis, phase 2 (cos)
MP1	MCOSY	Measuring point motor current Y-axis, phase 2 (cos)
MP6	MCOSZ	Measuring point motor current Z-axis, phase 2 (cos)
MP4	MSINX	Measuring point motor current X-axis, phase 1 (sin)
MP2	MSINY	Measuring point motor current Y-axis, phase 1 (sin)
MP5	MSINZ	Measuring point motor current Z-axis, phase 1 (sin)
MP7	GND	
MP8	+3,3V	+3,3V power supply
MP11	Sz.gen. 20kHz	Signal triangular generator

8.7 Fuses (PCI and PCIcompact)

No.	Bemerkung
SI 1 PCI and PCIcompact	SI1: protrects St4,Pin1 and St3,Pin11-13 (power supply power stage). Value: max. F 5A. When protecting, watch the current load capacity of the used cables (especially if ST3 is supplied with a flat cable)
SI 2 PCIcompact	Protects the 24V input voltage fort the digital outputs.

8.8 Encoder adapter card with analog outputs (PCI)

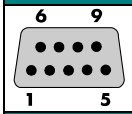
With the encoder adapter card 06 09 04 3 encoders and 2 analogue outputs with 0...10V or +/-10V can be controlled. The encoder interface is provided with difference inputs for sinus, cosine and the reference signal. Depending on the equipment of the card 1 Vss (i. e. with optical encoders), 5Vss (i. e. with MR-sensors) can be adapted.

The analogue outputs consisting of a 2-time-8-bit-converter which is amplified via OP9. Is J1.1 resp. J2.1 plugged, the output range is +/- 10V. Is J1.2 resp. 2.2 plugged, than the output voltage range is 0...10V. L1 and L2 supposed to avoid oscillation with capacity loads.

The outputs are with +/- 5mA. The inside resistor has about 100 Ohm.

Solder briges	Function (closed)
LB1	+12V on St1,Pin 4
LB2	+12V on St2,Pin 4
LB3	+12V on St3,Pin 4
LB4	120 Ohm connecting resistor St1,Pin 6 und 1 (sin)
LB5	120 Ohm connecting resistor St1, Pin 3 und 8 (cos)
LB6	120 Ohm connecting resistor St1, Pin 5 und 9 (ref)
LB7	120 Ohm connecting resistor St2,Pin 6 und 1 (sin)
LB8	120 Ohm connecting resistor St2, Pin 3 und 8 (cos)
LB9	120 Ohm connecting resistor St2, Pin 5 und 9 (ref)
LB10	120 Ohm connecting resistor St3,Pin 6 und 1 (sin)
LB11	120 Ohm connecting resistor St3, Pin 3 und 8 (cos)
LB12	120 Ohm connecting resistor St3, Pin 5 und 9 (ref)
LB 13	5,1kOhm Pull Up resistor on St5,Pin 41 (Interrrupt AD-converter)

Jumper	Function
1.1	Voltage range on ANOut1 = +/- 10V
1.2	Voltage range on ANOut1 = 0...10V
2.1	Voltage range on ANOut2 = +/- 10V
2.2	Voltage range on ANOut2 = 0...10V

PLug	ST1,2,3, Plug 1(X), 2(Y), 3(Z) Encoder plug
	*Fig.: The encoder connection (9 Pol socket)*
Pin No.	**Function**
1	- Sin
2	GND
3	-Cos
4	when LB 1,2 or 3 are plugged, than ST 1,2,3 = +12V
5	- Ref
6	+Sin
7	+5V
8	+Cos
9	+Ref
Voltage: Encoder interface: 0,6...1,2Vss; MR-Interface max. 5Vss	

Pin No.	ST4, 16-pol Female connector PCI	
	Description	Function / Comment
1	Takt X	Clock signal of the encoder X
2	U/D X	Direction signal of the encoder X
3	Takt Y	Clock signal of the encoder Y
4	U/D Y	Direction signal of the encoder Y
5	Takt Z	Clock signal of the encoder Z
6	U/D Z	Direction signal of the encoder Z
7	Clk	TTL-Clock signal of T6
8	/Ref X	Reference signal encoder X
9	/Ref Y	Reference signal encoder Y
10	/Ref Z	Reference signal encoder Z
11	/ERRX	TTL-Error signal X (active L)
12	/ERRY	TTL-Error signal Y (active L)
13	/ERRZ	TTL-Error signal Z (active L)
14	/CSAD	CS-Signal 4: Frr AD-converter (active L)
15,16	nc	

ST5: PCIcompact ST6: PCI 10-pol Female connector (D-Sub-connection): Analog Out	
Pin No.	Function
Pin No.	Function
1,2	GND
3	Output 1
4	Output 2
7	+5V
8	+12V
9	-12V

8.9 Description I / O - card for the LSTEP-PCI

Note: in the PCIcompact the I/O´s are on board

The 16 in- and 16 output extensive card is suited for the LANG 46-pin female connector- bus adapter. The form factor fits on the LSTEP-PCI (right-angled arrangement of 46-pin-plug and I/O-cable outlet; No further slot is blocked.) /CS, /RD and /WR-signal of 65ns length are sufficiently, while the bus 25ns after the/RD floated. For a C168 no waitstates, early read/ write, or ALE-extender are required, but a float extender is the least requirement.
The connection of ST2 varies from the connection of the I/O plug from the LSTEP-PC-card.
Reason: With a flat band cable, each lead of the cable can only be connected with 1A. The supply voltage of the LSTEP-PC is supplied from outside. I.e. the +11,4...32V-line carries the total current, while the GND-line stays almost non-loaded. The +11,4...32V-line is therefore 4-folded. In the existing card, the current is fed in on the card (ST4). Therefore the +11,4...32-V-cable is almost non-loaded while the GND-line as a back line carries almost the total current. That is why it is 4-folded. The external power supply the 11,4...332V-power supply must be fed in through ST4. A feeding in over ST2 is inadmissible.

8.9.1 ST1: Connections of the 46-pin-bus adapter (PCI)

Pin No.	Function
1-16	D0 – D15
18	A1
21 - 33	A4 - A16
34	/CS
35	/RD
36	/WR
39	+ 5V
40	GND
41	Interrupt: Low, if outputs are overloaded. (Diag. =L); LB1 closed: Pull up 10kOhm against +5V
42	/RSTOUT

8.9.2 Supply of the In- and Output (PCI)

The power supply is protected by a „Pigtail fuse“ F4A (Manufacturer: Wickmann) on the circuit card. Because the outputs are short circuit proof, a short circuit does not release the fuse at the output. LED1 (green) shows, that voltage is present behind the fuse.

ST4, 2-pol Power plug / Used with a Phönix Mini-Combicon basic housing 2-polig.

Pin No.	Function
1	+11,4...32V
2	0V

8.9.3 16 inputs, 16 outputs (PCI)

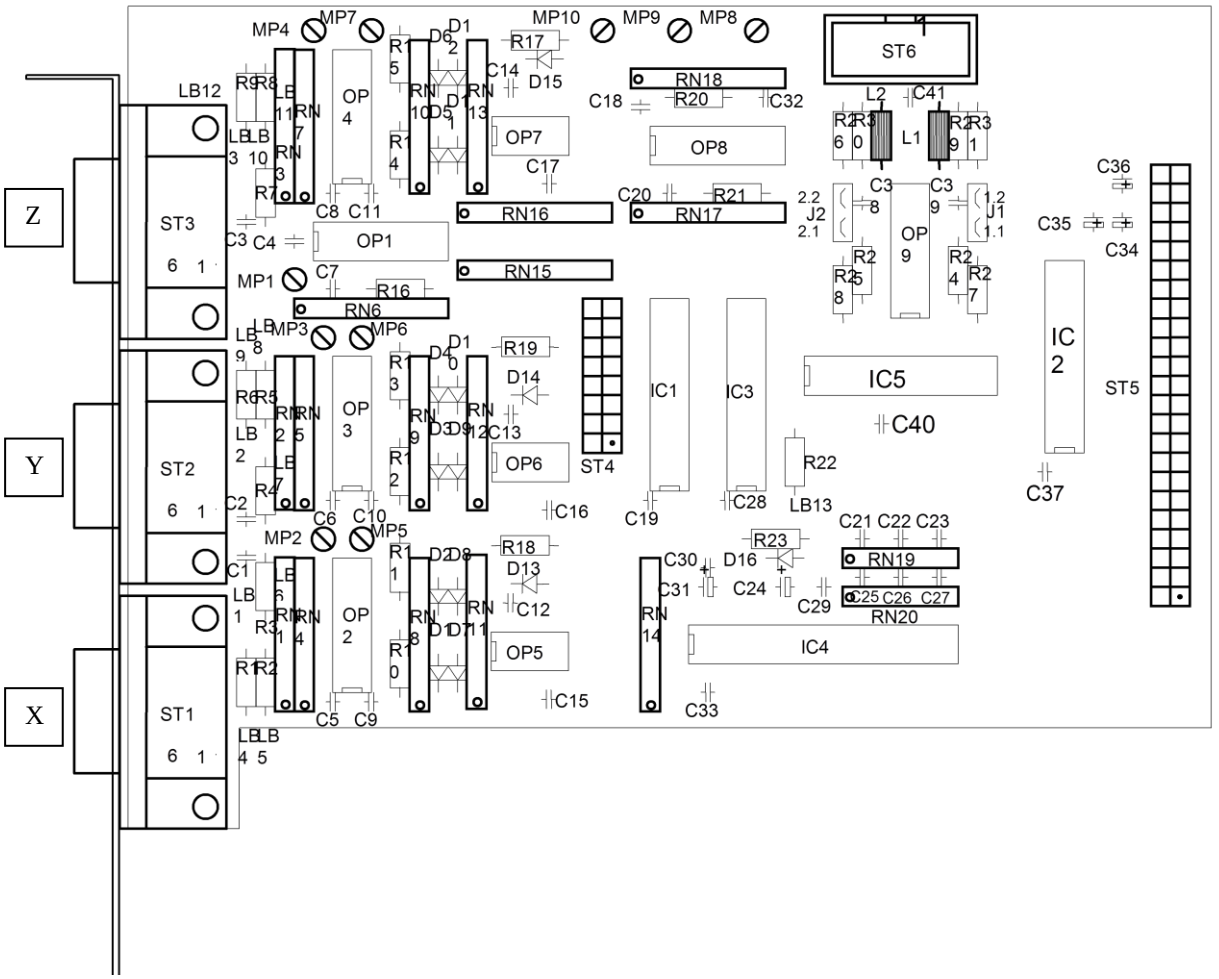
Inputs: 0...2,7V = „L“, 7,5...32V = „H“, Ri = ca. 10kOhm
Outputs: Switches to +Ub=11,4...32V, Imax = 0,5A, short circuit proof

ST2, 40-pol Female connector with 37-pol D-Sub-plug-connection

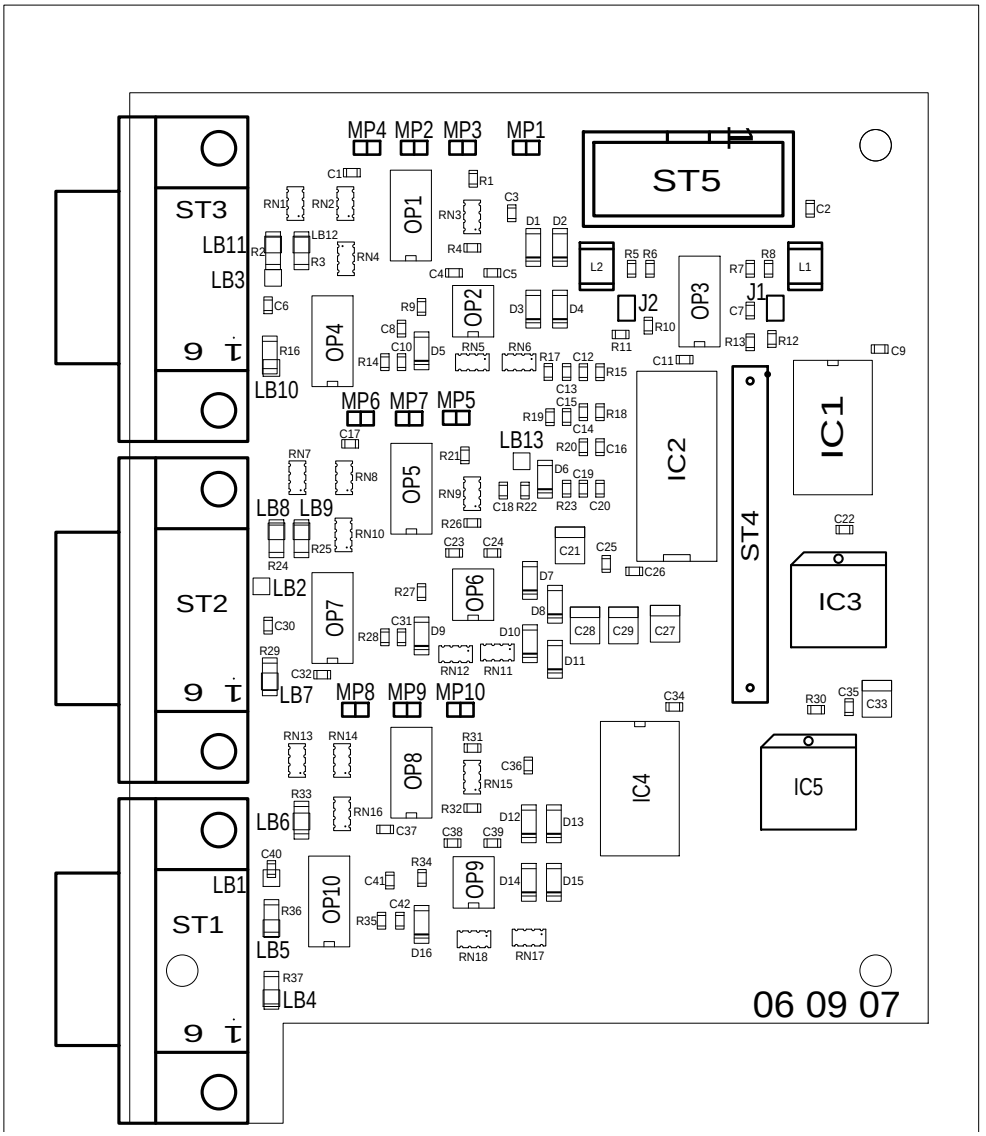
Pin No.	Connection
1	Output 1
2	Output 2
3	Output 3
4	Output 4
5	Output 5
6	Output 6
7	Output 7
8	Output 8
9	Output 9
10	Output10
11	Output11
12	Output12
13	Output13
14	Output14
15	Output15
16	Output16
17-19	GND
20	Input1
21	Input2
22	Input3
23	Input4
24	Input5
25	Input6
26	Input7
27	Input8
28	Input9
29	Input10
30	Input11
31	Input12
323	Input13
33	Input14
34	Input15
35	Input16
36	GND
37-40	+11,4...32V

8.10 Assembly scheme

LSTEP PCI- Encoder adapter card

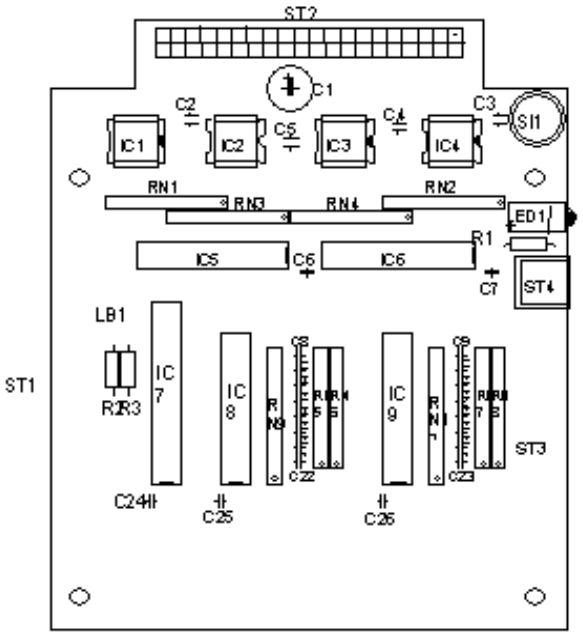


Encoder adapter card LSTEP PCIcompact 06 09 07



Die Lotbrücken (LB1-12) befinden sich auf der Lötseite der Platine./
Solder bridge (LB1-12) is located on the solder side of the circuit card

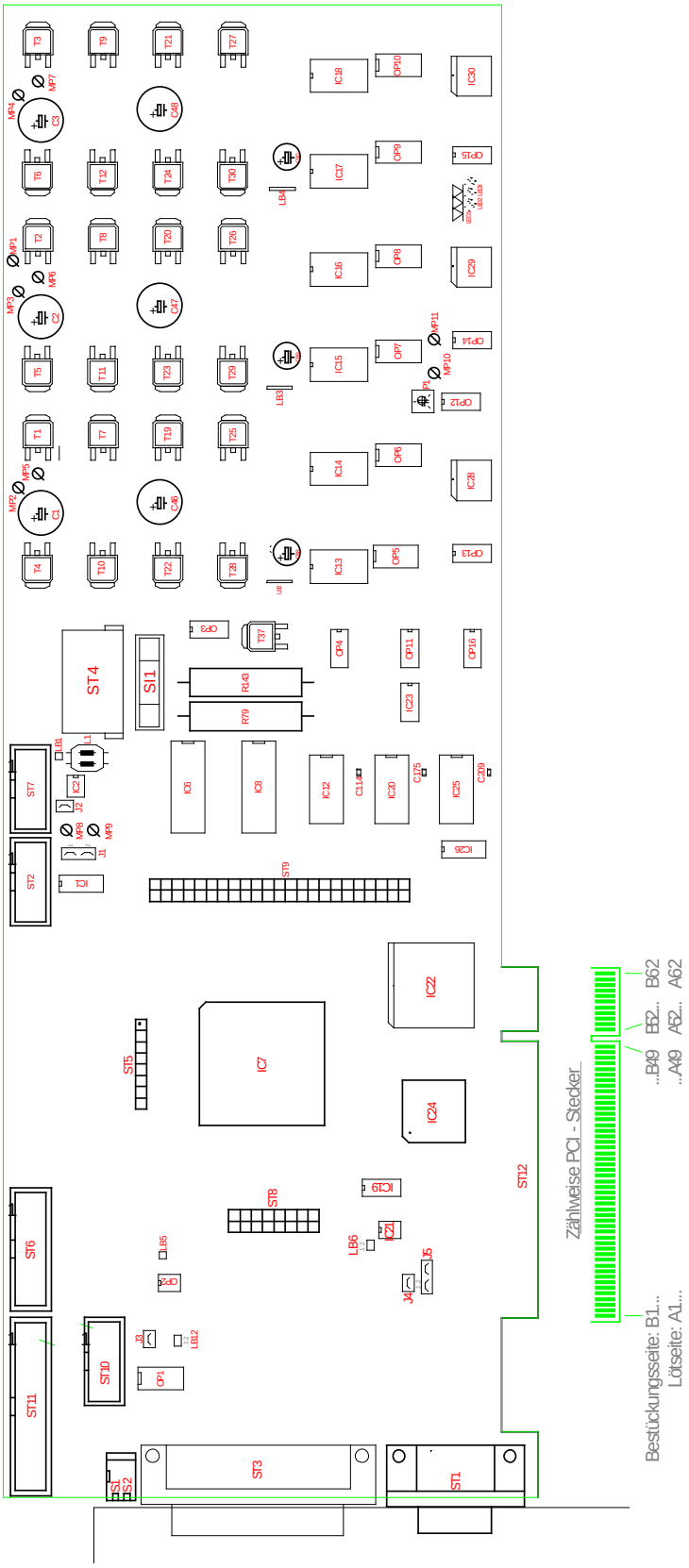
I / O – Adapter card for LSTEP PCI 06 07 00



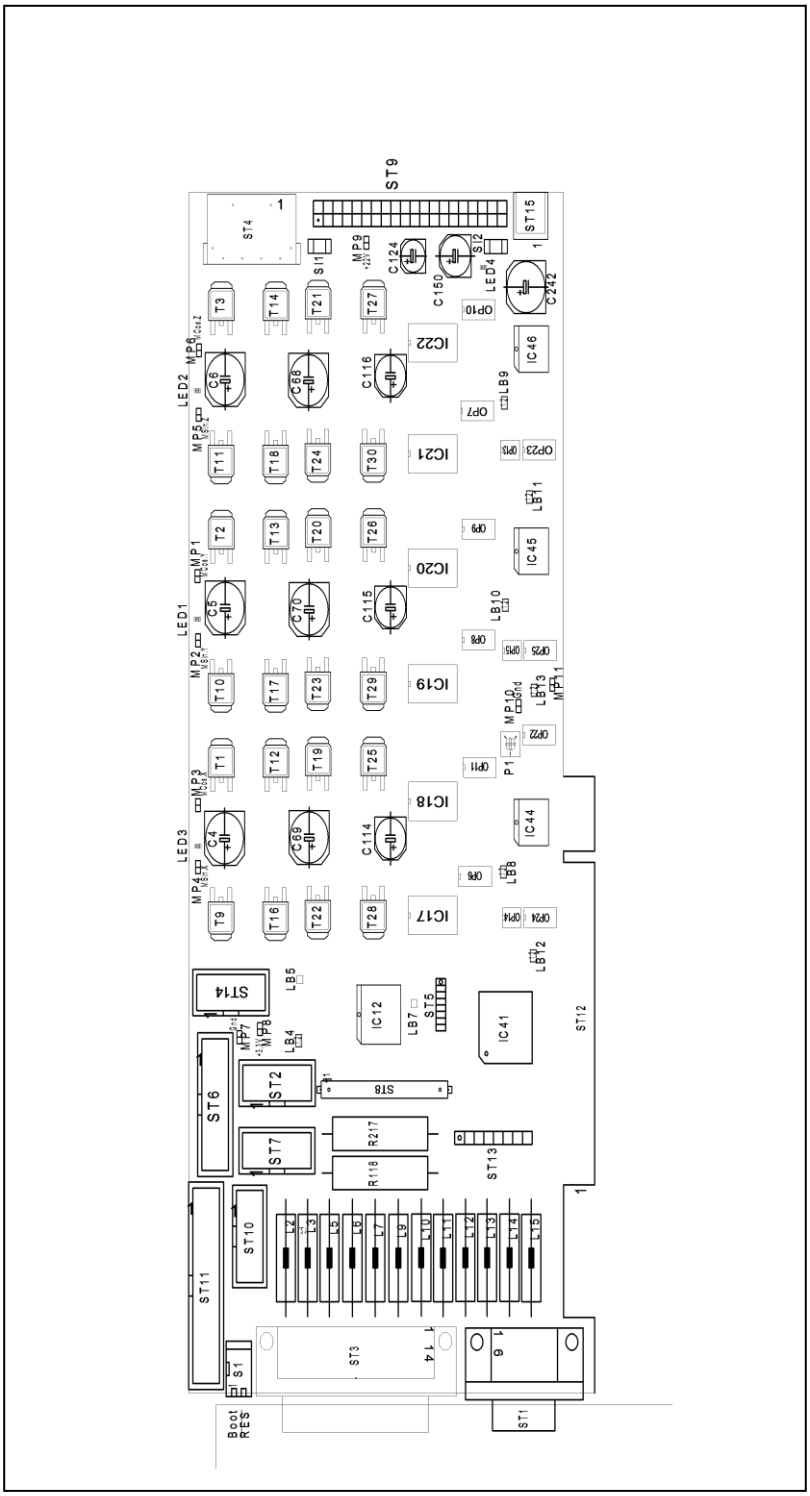
Lötbrücke LB1 befindet sich auf der Platinenlötseite.

Solder bridge LB1 is located on the solder side of the circuit card

LSTEP PCI Assembly scheme 06 06 00



LSTEP PCI/compact 06 06 07



8.11 Appendix LSTEP-PCI /PCIcompact Technical Data

Power supply:	Logic voltage through PCI-Slot of PC Motor voltage: 12V from the PC-power supply unit 11,4-48V through ext. power supply unit		
Max. motor revolution:	40 U/sec. for 200-step motor		
Max. motor current:	1,25A	per motor phase	LSTEP-PCI / 1
	2,5A	per motor phase	LSTEP-PCI / 2
	3,75A	per motor phase	LSTEP-PCI / 3
Max. motor voltage:	48V		
Step resolution:	Max. 50.000 steps/revolution for 200step motor		
Baud rate:	57,6 Kbd		
Measurements L x H x B (1 Slot) PCI PCIcompact	 341mm x 120mm x 20mm (1 Slot) 236mm x 107mm x 15mm (1 Slot)		
max. count frequence for TTL-Encoder inputs	2,5 Mflank= 625 KHz -Flank interpretation		