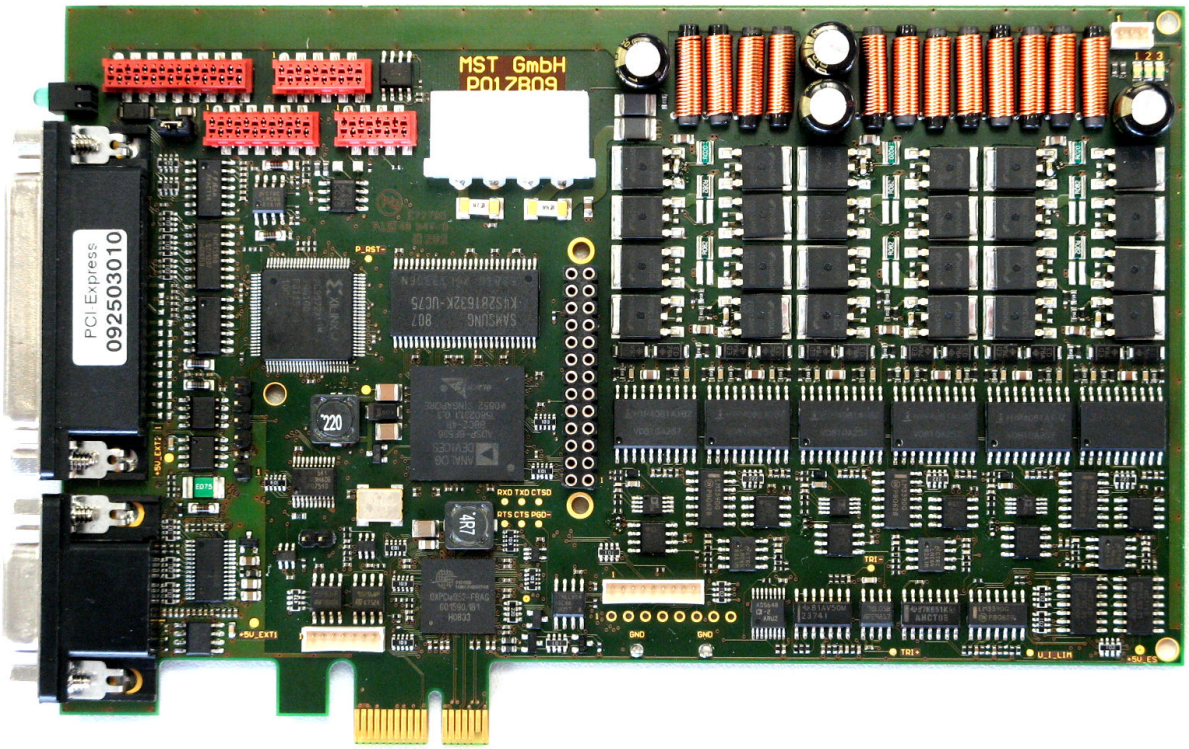
Operating Manual Tango PCIe



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1. Product Description

The PCI express slot card Tango PCIe, hereafter named "Controller", is a device for driving 2/4 phase stepper motors. In the operation mode "automatic operation" the card can be operated by using the PCIe slot of a PC or optionally with an adapter board via RS232 or USB interface. A CAN interface is also provided. In the operation mode "manual operation" the card can be operated by means of a joystick, track ball or with a hand wheel. 2 limit switch inputs are available per axis, meant for limitation of travel range and for calibrating. Optionally, other digital and analogous I/O are available, which have partly been equipped with special functions and are placed in the plug connector list under AUX-I/O. Furthermore, a interface module is available for connecting various types of incremental encoders, and a module with a 4. stepper motor axis can be provided.

2. Safety Instructions

- Repair works may only be carried out by qualified specialist staff, which is familiar with the Controller and only with written permission from Märzhäuser Wetzlar. It is forbidden for any other persons to carry out repair works.
- The Controller has a PCIe x1 connector. It is suited for mounting in a PC with PCIe bus of any width. It is not suitable for other Controllers, other PC buses, specially not for the PCI bus.
- Only devices, which have been released for this purpose by Märzhäuser Wetzlar, may be connected. Non-compliance can cause damage to the Controller or to the connected device. Accessories such as joystick, hand wheel, track ball, wiring sets in the PC, connecting leads exterior of the PC, etc. are available at Märzhäuser Wetzlar. Märzhäuser Wetzlar cannot be held responsible for any results from connections made with accessories, which have not been approved of.
- The Controller has parts which react sensitively to electrostatic discharge (ESD sensitive). Ground all parts that are in contact with the Controller, this includes yourself.
- During and before mounting the card in to the PC as well as with the mounting of the accessories ensure that all parts are free of voltage. Check that mounting of all components is correct before switching the PC on.
- Make sure that your PC's electricity supply, and if attached also external motor voltage power supply are sufficient for the operation of the card. (See also: „Technical Data ".)
- Install the card in such a manner that prevents splinters, liquids or other objects getting in contact with the card.
- Install the card in such a way that no heat accumulations originate. The max. allowed ambient temperatures are listed in the Technical Data.
- While the PC is switched on, do not plug in or remove connecting plugs.
- Ensure that the Controller, in combination with its application, corresponds to applicable safety regulations and statutory regulations. This Controller is correspondent to EN61010-1:2002 "Safety requirements for electrical equipment for measurement, control and laboratory use". Please take into consideration that the actual motor voltage may be as high as the DC voltage at the plug motor voltage.
- Endangering movement: The normal status is that the HDI (joystick, track ball, hand wheel) is active once the device has been switched on. Ensure that danger-bringing movements can neither in this nor in any other operation mode originate. Note: The Controller can also be configured in such a way that the joystick remains inactive after switching on the device.

- Parts of the Controller can become very hot during operation. Prevent touching the card during and shortly after the operation. A cool down time of 2min at ambient temperature should be kept. Prevent any objects from contacting the surface of the Controller.

3. Manufacturer's Declaration

Herewith we declare that the positioning controller Tango PCIe is not a ready-for-use or ready-for-connection device as mentioned in the " Directive: General Product Safety", the "EMI Directive" or in the "EC-Machine Guideline", but a component.

The finally intended mode of operation can only be achieved by integration into the user's construction.
The conformity of the user's construction with existing safety regulations and/or statutory regulations lies in the user's area of responsibility.

Regulations and recommendations for installation and designated operation are included in the manual.

The initial operation of the Controller is prohibited until it has been ascertained, that all legal protection and safety requirements have been complied with.

3.1 Underlying EU Directives:

EMI-Directive:	2004/106/EG	dated 15.12.2004
Low-Voltage Directive:	2006/96/EG	dated 12.12.2006

3.2 Applied Harmonised Standards:

The Controller has been developed and was manufactured on the basis of following standards.
EN61326-1: 2006
EN61010-1: 2002

4. Installation and Initial Operation

- Before beginning with the installation and initial operation first of all please read chapter 2 *"Safety Instructions"* completely.

- Detach the PC's power plug from its socket. This is for your own security and prevents damages to Motherboard and/or Tango Controller in case of any possible standby voltages in your PC.

- If necessary mount the expansion modules to the controller Tango PCIe.

- Mount the card (with expansion modules if existent) in your PC.

- Connect the Controller's connector "motor voltage" to
  a) the power supply unit of your PC (+5V and +12 V from hard disk plug, Controller has Y cable enclosed) or
  b) to an optionally available external power supply by using the corresponding cable set. Note, that the connection to the hard disk plug is also needed for providing the +5V supply.

- In case of the options
  a) Connection motor 4 or
  b) AUX-I/O connector
  mount the corresponding bracket together with the premounted accompanying wiring sets.
  Connect the wiring sets according to "Image 2: Position of components".

- In case of AUX-I/O Connector option: Check that wiring is correct. The motors are without current if AUX I/O, Pin PSE isn't connected to +12V. A start-up adapter *(see chapter 8.3.4)* is provided.

- Connect the Controller to the motors by using provided motor cables.

- If necessary, connect the joystick, track ball or hand-wheel to the connector HDI.

- In case of encoder interface option: Connect the encoders to appropriate sockets of the Controller.

- **Caution when switching on the Controller:** Once the Controller has been switched on components will be searched for in the HDI. If the joystick is used then the zero point will now be calibrated. The process is finished

when the status LED lights up. Make sure that during this period of time the joystick doesn't get shifted. The result would be that the zero point would also be shifted and axes would move when letting go of the joystick!

- Connect PC with socket and switch on, if necessary together with the external power supply unit. The external power supply should be switched on at the same time or before the PC is switched on. Otherwise the controller will go to error status, because the motor voltage was not present at the time of switching it on.

- The PC will now search for a driver for the card. Insert the provided CD. Follow the installation instructions for loading the driver.

- If necessary, check that used limit switches (polarity, normally open / normally closed, pull up - / pull down - resistance) correspond with the settings of the Controller.

- Once the status LED lights up you can carefully proceed operating joystick, hand-wheel or track ball axes.

- Now check the connection between computer and Controller. This is achieved by setting up the right connection parameters (standard: 57600 Bauds, 11 bits of frame, 1 start bit, 8 data bits, 2 stop bits). The Controller uses a "Virtual Com Port". The COM port with the highest number is usually the correct one. The driver will automatically raise the inner baud rate to the highest value that is allowed (e.g., 4Mbaud), even if other parameters are still shown at the interface, e.g., 57600 Bauds.

- Send (e.g., via the hyper terminal) the command “ver”. The response you receive in return is the version number of the Controller.

- Further commands can be found in the Tango Instruction Set description, provided on the CD.

5. Position of Connections and LEDs

The connection’s configurations as well as their technical data are described in the chapter named *Connectors, Measure Points, Pads, LEDs, Fuses.*

The following connections are optional (see connector description):
- AUX I/O (X403)
- UART ZBV + CAN (X406)
- I²C (X400)

Expansion modules (e.g., encoder interface or Axis 4) can be connected to the extension module plug.

The Status LED at the slot bracket has following functions:
a) LED off: Controller not ready
b) LED on: Controller ready
c) LED blinks approx. 1x / sec.: Boot loader active
d) LED blinks approx. 3x / sec.: Output stages are switched off via PSE signal or an error
e) LED blinks approx. 6x / sec.: Status not OK, e.g., false command

Ref. c): A software update can be loaded by using the boot loader in the Controller. During this period of time the Controller must remain switched on!

Ref. d): The output stages may be switched off for one of the following reasons:
- The over current shut down of the output stage has responded (=error)
- An operating voltage is beyond its specification (=error)
- With the PSE input in connector AUX I/O with X408 (PSE) open the output stages have been deactivated.
- The ambient temperature is to high

The 3 LEDs "Powerstage 1,2,3 ON" indicate whether the accompanying output stage is switched on or not.

By connecting both pins of X102 (Reset) only the Controller will be reseted but not, however, the PCIe Bus.

The fuses F601 and F602 has only to be replaced by Märzhäuser Wetzlar. In case of a defect the controller has to be sent to the service address (see chapter 9.2).

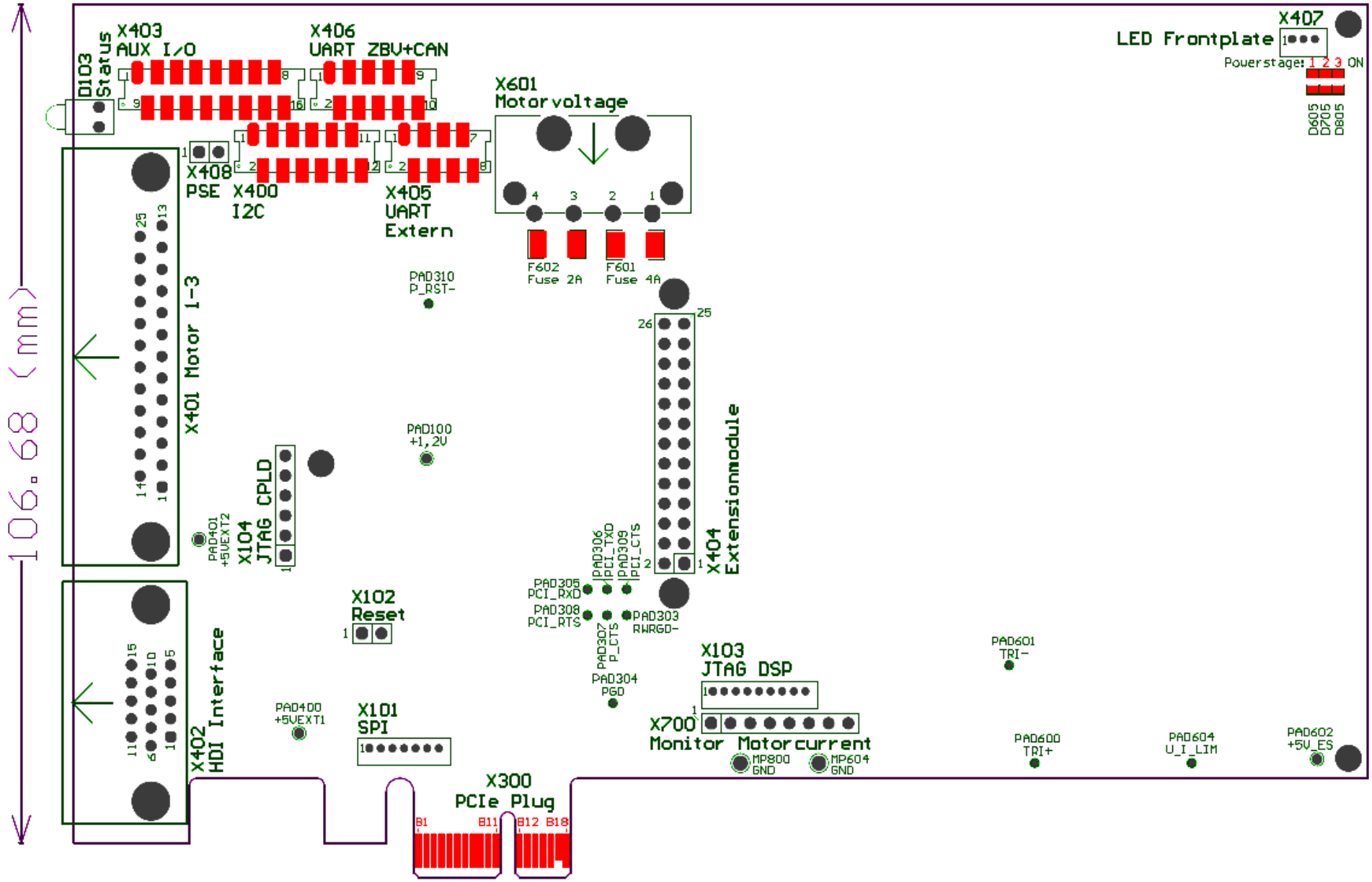


Image 2: Position of components

6. TANGO PCIe: Connectors, Measure Points, Pads, LEDs, Fuse

6.1 25-Pin D-Sub Socket: Motor 1-3 (X401)

Pin	Label	Function
1	MOT1PH1+	Motor 1, Phase 1+
2	MOT1PH1-	Motor 1, Phase 1-
3	MOT1PH2+	Motor 1, Phase 2+
4	MOT1PH2-	Motor 1, Phase 2-
5	MOT2PH1+	Motor 2, Phase 1+
6	MOT2PH1-	Motor 2, Phase 1-
7	MOT2PH2+	Motor 2, Phase 2+
8	MOT2PH2-	Motor 2, Phase 2-
9	END10	Endswitch axis 1, zeropoint)*
10	END1END	Endswitch axis 1, endpoint)*
11	ETS A	Electronic Identification Plate A
12	ETS B	Electronic Identification Plate B
13	N.C.	Not connected
14	MOT3PH1+	Motor 3, Phase 1+
15	MOT3PH1-	Motor 3, Phase 1-
16	MOT3PH2+	Motor 3, Phase 2+
17	MOT3PH2-	Motor 3, Phase 2-
18	END20	Endswitch axis 2, zeropoint)*
19	END2END	Endswitch axis 2, endpoint)*
20	END30	Endswitch axis 3, zeropoint)*
21	END3END	Endswitch axis 3, endpoint)*
22	+5VEXT2	+5V)**
23	N.C.	Not connected
24	GND	GND
25	GND	GND
Housing		GND

)* TTL-Input, 1kOhm Pull up/down, software selectable, Low Pass-Filter 1kOhm, 100nF
)** +5VEXT2: Max. current is 500mA.

6.2 4-Pin PC-Harddisk Drive Plug: Motor Voltage (X601)

Pin	Label	Description
1	+VMOT	11.4…50.4V, fuse on board (F601): 4A
2	GND	
3	GND	
4	+VCC5	+5V)*

)* For current consumption refer to chapter 7: technical data.

6.3 15-Pin HD-Sub Socket: HDI Interface (X402)

HDI = Human Device Interface (Joystick, Trackball, Coaxial Drive)

Pin	Label	Description)*	Function Joystick	Function Trackball	Function Coaxial Drive
1	IN1A	AN, FI 1k,10n	Axis 1	/	Axis 1, A+
2	IN2A	AN, FI 1k,10n	Axis 2	/	Axis 1, B+
3	IN3A	AN, FI 1k,10n	Axis 3	/	Axis 2, A+
4	IN4A	AN, FI 1k,10n	Key F1	Middle Key: Resolution up	Axis 2, B+
5	SPEED	AN, FI 1k,100n	Key F3	Left Key: Resolution down	/
6	IN1B	AN, FI 1k,10n	/	Axis 1, Quadrature 1	Axis 1, A-
7	IN2B	AN, FI 1k,10n	/	Axis 1, Quadrature 2	Axis 1, B-
8	IN3B	AN, FI 1k,10n	/	Axis 2, Quadrature 1	Axis 2, A-
9	IN4B	AN, FI 1k,10n	/	Axis 2, Quadrature 2	Axis 2, B-
10	HDI_ID	AN, PU, FI 1k,100n	Autom. Identification	Autom. Identification	Autom. Identification
11	SNAP_SHOT1	TTL, PU, FI 1k,10n, HDI_TXD	Key F2	Snap-Shot	Snap-Shot
12	AX_SEL	TTL, PU, FI 1k,10n, HDI_RXD	Key F4	Right Key	Axis Select
13	HDI_ON	5V OUT, max. 500mA	LED Device aktive	/	/
14	+5VEXT1	5V, 50mA,max.	+5Vref	+5V	+5V
15	GND	GND	AGND	GND	GND
Housing		GND	Shield (GND)	Shield (GND)	Shield (GND)

)* AN = Analogue Input 0...5V, TTL = TTL-Input, PU = Pull-Up 4.7kOhm → +5V, FI = Low Pass-Filter

6.4 8-Pin Micro Match Socket (Normal Pin Count): UART Extern (X405)

Pin	Label	Description
1	GND	
2	EXT_TXT	Output, 3,3V CMOS level
3	EXT_RXD	)1
4	EXT_RTS	Output, 3,3V CMOS level
5	EXT_CTS	)1, „Low“ = interface active / available
6	VCC5	+5V
7	VCC3	+3,3V
8	GND	

)* Input, TTL / 3,3V CMOS level, 5V-tolerant, Pull-up 4,7kOhm → +3,3V

6.5 16-Pin Micro Match Socket (D-Sub Pin Count): AUX I/O (X403)

Pin	Label	Description)*	Function
1	TAKT_IN	TTL, PU, FI 1k,1n	Pulse input for Pulse/Direction Mode of one axis
2	V/R_IN	TTL, PU, FI 1k,1n	Direction input for Pulse/Direction Mode of one axis
3	STOP-	TTL, PU, FI 1k,10n	TTL low = All axes stop
4	SNAP_SHOT2-	TTL, PU, FI 1k,10n	Position capture
5	TAKT_OUT	HCMOS - Output 5V	Pulse output for Pulse/Direction Mode of one external axis.
6	V/R_OUT	HCMOS - Output 5V	Direction output for Pulse/Direction Mode of one external axis.
7	SHUTTER_OUT	HCMOS - Output 5V	For driving an external shutter control.
8	TRIGGER_OUT	HCMOS - Output 5V	Position synchronized trigger output
9	ANIN0	AN, FI 1k,100n	0...5V Analogue input
10	ANOUT0	Analogue Out	Ua = 0…10V, RI= 100 Ohm, Resolution: 14 bit
11	ANOUT1	Analogue Out	Ua = 0…10V, RI= 100 Ohm, Resolution: 14 bit
12	PSE	Power Stage Enable	Power Stage Enable. When connected to +12V: Power stages are enabled. When open or connected to GND: Power stages are off. Switching power: 12V, 3.5A (<30µs) after 60µs max. 200mA.
13	+12V	+12V	Max. current is 500mA + 200mA for Pin 12 (PSE)
14	+5VEXT2	5V)**	
15	GND	GND	
16	GND	GND	

)* AN = Analogue Input 0...5V, TTL = TTL-Input, PU = Pull-Up 4.7kOhm → +5V, FI = Low Pass-Filter
)** +5VEXT2: Max. current is 500mA.

6.6 26-Pin Header Female (Normal Pin Count): Extension Module (X404)

Pin	Label	Description / Function
1	DR0B	SPORT: Data Receive 0 Channel B, 10k → GND
2	GND	GND
3	DR0A	SPORT: Data Receive 0 Channel A, 10k → GND
4	GND	GND
5	RFS0	SPORT: Receive Frame Sync 0, 10k → GND
6	GND	GND
7	RSCLK0	SPORT: Receive Shift Clock 0, 10k → GND
8	GND	GND
9	DT0B	SPORT: Data Transmit 0, Channel B
10	X_ZBV2	I/O, 3.3V CMOS level, 5V tolerant, 10k → GND
11	RESET-	Reset low active, Open Drain, level: 3,3V
12	X_ZBV1	I/O, 3.3V CMOS level, 5V tolerant, 10k → GND
13	SPI MOSI	SPI-Interface: Master Out, Slave In, 3.3V CMOS- level
14	X_ZBV0	I/O, 3.3V CMOS level, 5V tolerant, 10k → GND
15	SPI MISO	SPI-Interface: Master In, Slave Out, 3.3V CMOS level
16	X_ID1	Identifier Input 1: Analogue Input 0…5V, 4.7K→GND,10nF→GND
17	SPI SCK	SPI-Interface: Shift Clock, 3.3V CMOS level
18	X_ID0	Identifier Input 0: Analogue input 0…5V, 4.7K→GND,10nF→GND
19	SPI_CSMOD-	SPI-Interface: Chip Select, 3.3V CMOS level
20	VCC3	+3.3V
21	IRQ_MOD-	Interrupt Input, 3.3V CMOS-level, 10k → +3.3V
22	N. C.	No connection
23	VCC5	+5V
24	X_ZBV3	I/O, 3.3V CMOS level, 5V tolerant, 10k → GND
25	+VMOT_I	Motor voltage, fused by F601 (normal +11.4...50V)
26	V+12V	+12V

6.7 JST B7B-ZR Male (option): SPI (X101)

Only for manufacturer's information.

Pin Nr.	Label
1	SPI_CLK
2	SPI_MISO
3	SPI_MOSI
4	SPI_CSBOOT-
5	GND
6	GND
7	RESET-

6.8 2-Pin Header Male: Reset (X102)

Pin	Label
1	RESET-
2	GND

6.9 JST B9B-ZR Male: JTAG DSP (X103)

Only for manufacturers information.

Pin Nr.	Label / Function	Circuit
1	VCC3	+3,3V
2	Pull Up	10k→+3,3V
3	EMU_AD-	
4	TMS_AD	10k→+3,3V
5	TCK_AD	10k→+3,3V
6	TRST_AD-	4,7k→GND
7	TDI_AD	10k→+3,3V
8	TDO_AD	
9	GND	

6.10 6-Pin Header Male: JTAG CPLD (X104)

Only for manufacturer's information.

Pin	Label
1	+3.3V
2	GND
3	TCK_XI
4	TDO_XI
5	TDI_XI
6	TMS_XI

6.11 PCI-Plug (X300)

Unused pins are signed with " --". Low active pins have a – extension.

Pin (Bottom Side)	Label	Pin (Top Side)	Label
A1	PRSNT1-	B1	+12V
A2	+12V	B2	+12V
A3	+12V	B3	+12V
A4	GND	B4	GND
A5	--	B5	--
A6	TDI	B6	--
A7	TDO	B7	GND
A8	--	B8	+3,3V
A9	+3,3V	B9	--
A10	+3,3V	B10	--
A11	PERST-	B11	WAKE-
A12	GND	B12	--
A13	REFCLK+	B13	GND
A14	REFCLK-	B14	PETP0
A15	GND	B15	PETN0
A16	PERp0	B16	GND
A17	PERn0	B17	PRSENT2-
A18	GND	B17	GND

6.12 8-Pin Header Female: Monitor Motorcurrent (X700)

Pin	Label	Description
1	GND	
2	I1,PH1,IST	Motor Current Axis 1, Phase 1)*
3	I1,PH2,IST	Motor Current Axis 1, Phase 2)*
4	I2,PH1,IST	Motor Current Axis 2, Phase 1)*
5	I2,PH2,IST	Motor Current Axis 2, Phase 2)*
6	I3,PH1,IST	Motor Current Axis 3, Phase 1)*
7	I3,PH2,IST	Motor Current Axis 3, Phase 2)*
8	GND	

)* U = VCC5/2 +/-1,64V/A on I,max = 1,25A; U = VCC5/2 +/-820mV/A on I,max = 2,5A, Ri = 1 kOhm

6.13 JST B3B-ZR Male: LED Frontplate (X407)

Nr.	Label	Description
1	LED +	Level: 5V, Ri = 220 Ohm
2	GND	GND
3	LED F2	Level: 5V, Ri = 220 Ohm

6.14 10-pin Micro Match Socket: UART ZBV – CAN (X406)

Pin Nr.	Label	Description
1	GND	
2	ZBV_TXT	Output, 3,3V CMOS level
3	ZBV_RXD	)1
4	ZBV_RTS	Output, 3,3V CMOS level
5	ZBV_CTS	)1, „Low“ = interface active / available
6	VCC5	+5V
7	VCC3	+3,3V
8	GND	
9	CANL	Terminator R439 (120E) can optional be mounted by manufacturer
10	CANH	Terminator R439 (120E) can optional be mounted by manufacturer

)* Input, TTL / 3,3V CMOS level, 5V-tolerant, Pull-up 4,7kOhm → +3,3V

6.15 12-pin Micro Match Socket: I2C (X400)

Pin Nr.	Label	Description
1	ZBV1	I/O, 3,3V CMOS level, 5V tolerant
2	ZBV2	I/O, 3,3V CMOS level, 5V tolerant
3	ZBV3	I/O, 3,3V CMOS level, 5V tolerant
4	ZBV4	I/O, 3,3V CMOS level, 5V tolerant
5	ZBV5	I/O, 3,3V CMOS level, 5V tolerant
6	ZBV6	I/O, 3,3V CMOS level, 5V tolerant
7	+12V	
8	VCC5	+5V
9	SDA	I²C Data Pin (I/O): 300 Ohm series resistor, 4,7kOhm Pull Up →VCC5
10	VCC3	+3,3V
11	SCL	I²C Clock Pin (I/O): 300 Ohm series resistor, 4,7kOhm Pull Up →VCC5
12	GND	

6.16 2-pin Male: PSE (X408)

Pin Nr.	Label	Description
1	PSE	Power Stage Enable: When a Jumper is located at Pin 1+2, the power stages can be enabled. When the Jumper is removed, the power stages can be enabled by connecting X403, Pin 12 and 13 together. (see chapter 6.5)
2	+12V	

6.17 Measurement Pins

6.17.1 Measurement Pins

No.	Label	Function
1	MP604	GND
2	MP800	GND

6.17.2 Multi-layer PADs

No.	Label	Measured variable	Measurement value	Description
1	PAD100	1.2V	0.8...1.32V (programmable) 1.2V type.	VDDINT: Voltage is choppered from the DSP for internal use
2	PAD303	PWRGD-	3,3V	Power Good inverted for PCIe circuit
3	PAD304	PWRGD	3,3V	Power Good for PCIe circuit
4	PAD305	PCI_RXD	3,3V	PCIe circuit RXD in
5	PAD306	PCI_TXD	3,3V	PCIe circuit TXD out
6	PAD307	P_CTS	3,3V	PCIe circuit CTS in)*
7	PAD308	PCI_RTS	3,3V	PCIe circuit RTS out
8	PAD309	PCI_CTS	3,3V	CTS Signal for PCI circuit)*
9	PAD310	P_RST-	3,3V	PCIe circuit Reset in
10	PAD400	+5VEXT1	5V +/- 5%	Supply for X402, HDI
11	PAD401	+5VEXT2	5V +/-5%	Supply for X401, X403 (Motor 1-3, Auxiliary I/O)
12	PAD600	TRI+	Ca. 0,5...4,5V	Triangle voltage
13	PAD601	TRI-	Ca. 0,5...4,5V	Triangle voltage
14	PAD602	+5V_ES	5V +/- 5%	5V-Supply for the overcurrent-protection of the power stages.
15	PAD603	U_I_LIM	1,48…1,52V	Trigger level for overcurrent-protection

)* The signal PCI_CTS is isolated by use of a logic gate and is then named P_CTS.

6.17.3 Bottom Side PADs

No.	Label	Measured variable	Measurement value	Description
1	PAD103	Reset-	3.3V Reset signal, low-active	Open Drain, 10k Pull-up --> 3,3V
2	PAD300	1,2V_P1	1,08...1,32V	Switching regulator of the PCIe circuit
3	PAD301	1,2V_P2	1,08...1,32V	VP of the PCIe circuit
4	PAD302	VCC3_PIO	3,13...3,46V	VCCIO of the PCI circuit
5	PAD402	X_ZBV2	3,3V	I/O DSP, 10kOhm →GND
6	PAD403	X_ZBV1	3,3V	I/O DSP, 10kOhm →GND
7	PAD404	X_ZBV0	3,3V	I/O DSP, 10kOhm →GND
8	PAD405	X_ID1	0…5V	Analog input, 4,7kOhm → +5Vext1, 10nF → GND
9	PAD406	X_ID0	0…5V	Analog input, 4,7kOhm → +5Vext1, 10nF → GND
10	PAD407	X_ZBV3	3,3V	I/O DSP, 10kOhm →GND
11	PAD408	IRQ_MOD-	3,3V	Input, 10k→VCC3
12	PAD603	+VMOTI	0…50V	Motor voltage after F601 and Filter
13	PAD605	DIS_END1	5V HCMOS-Level,	H = powerstage 1 off
14	PAD700	DIS_END2	5V HCMOS-Level,	H = powerstage 2 off
15	PAD701	GND	0V	GND Pin
16	PAD800	DIS_END3	5V HCMOS-Level,	H = powerstage 3 off
17	PAD801	GND	0V	GND Pin

6.18 LEDs

No.	Label	Label PCB	Description
1	D103	-	Placement: Slot. (For function refer to chapter 5.)
2	D605	1	ON when Power Stage 1 is active
3	D705	2	ON when Power Stage 2 is active
4	D805	3	ON when Power Stage 3 is active

6.19 Fuses

Label	Value	Description
F601	4A fast	Protection of the Motor Voltage. This fuse has only to be replaced by Märzhäuser Wetzlar.
F602	2A fast	Protection of the +5V supply. This fuse has only to be replaced by Märzhäuser Wetzlar.

7. Tango PCIe Specification

Performance Motor Controller	
Number of Axes	Up to 4
Type of Motor	Stepper motor 2/4 phases, e.g. 100, 200 or 400 full steps/revolution
Microstep Resolution	819200 steps/revolution (@ motor with 200 steps/revolution)
Power Stage	Automatic adaptation to a wide rage of stepper motors
Max. Phase Current	1.25A / 2.5A, depends on order
Motor Current	Selectable per software from 0.1A to max. phase current
Current Reduction after Movement	0% to 100% of selected motor current
Current Reduction Delay	Selectable from 0…65000 ms
Motor Voltage	48V,eff AC max.; 48V DC max. depends on power supply
Mode of Movement	Simultaneous vector drive of 1 to 3 axes or/and single axis movement is even possible at the same time
Max. Amount of Vectors/s with PC	250 vectors per second (depends on used PC and software)
Speed Range	0.000001…70 revolutions/s
Acceleration / Deceleration	0.0001…20 m/s² programmable with one parameter per axis
Position Range	Max. ± 2.6 m
Command Set	LSTEP or Venus-1 (others on demand)

Processing System	
Processor	ADSP BF536: 32bit, 400 MIPS DSP
Processor Clock Speed	396 MHz
Processor MMACS	Up to 792 MMACS
Flash Memory	8 Mbit for programme storage
EEPROM	256 kBit for configuration data
SDRAM	16Mbyte for extended system processing
Fast DSP RAM	100kByte for fast data / instruction processing
Reset	Via hardware or software command

Safety Functions	
Voltage Monitor Logic	Supervises 3.3V and 5V supply, takes reset on low voltage
Voltage Monitor Power Stage	Switches power stage off in case of PSE (+12V, AUX I/O Socket) or the motor voltage is out of range, motor voltage is readable via software
Short Circuit Protection Motor	Phase to phase and phase to ground, power stage switches off within typical 1µs, resetable via software
Overcurrent Protection for External Devices	Protection for +12V, +5Vext1, +5Vext2 and HDI ON, is self resetting after removing overload
Hardware Limit Switch Input	2 per axis, TTL-level, NO or NC, switching either to 0V or +5V, software selectable pull-up or pull-down resistors for each input
Software Limits for Movement	User-definable within range of ± 2.6 m
Software Stop	Stops the movement
Power Stage Enable [)1]	When connected to +12V: Power stages can be enabled. When open or connected to GND: Power stages are off.
Stop Input [)1]	Stops the movement of all axes

[)1]= Only with option AUX I/O

I/O: Human Device Interface	
Human Device Interface (HDI)	For connecting joystick, hand wheel or trackball, all with automatic device identification (Plug & Play)

I/O: Special Functions (only with option AUX I/O)	
Pulse, V/R Out	Pulse and direction signal for driving e.g. an external axis controller
Takt, V/R In	Pulse and direction signal from e.g. an external auto focus unit for driving e.g. the z-axis
Trigger Out	Position synchronized trigger output for e.g. video camera
Shutter Out	Signal for driving e.g. a shutter unit
Snapshot	Position capture: Stores the actual position value. Value can be read afterwards.
Stop	Stops the movement.
PSE	Power Stage Enable. When connected to +12V: Power stages can be enabled. When open or connected to GND: Power stages are off.
Analogue Out	2 independent outputs 0...10V. E.g. for controlling microscope illumination. Resolution: 14 bit Precision depends on the +5V supply (= reference)
Analogue In	Input 0...5V, e.g. for temperature measurement
TTL In	Up to 3 TTL user readable inputs
TTL Out	Up to 3 TTL user writeable outputs

Optional Modules	
Encoder Interface	Up to 3 encoders: 1Vpp, MR, TTL, RS422, depends on order. Analogue resolution is 14 bit. RS422 up to 30 MHz.
Axis 4	Additional stepper motor axis, max. current is 1A

Power Requirements (without additional cards)	
Motor Voltage	11.4…50V DC [)2]
+12V (+/- 5%)	200 mA (via PCI Plug) [)3]
+5V (+/- 5%)	550 mA (via X601: Motor voltage) [)1]
+3,3V (+/-5%)	700 mA (via PCI Plug)

Supply currents apply only to the controller card without auxiliary modules.

[)1] The card itself takes at maximum 200mA. The mentioned rating includes typical peripherals.

[)2] Current depends on type of motor, motor current, DC voltage, number of motors, rotations per second, etc. An estimation is: I,max. = ca. 1/3 x sum of all motor currents. Individual measurements are needed.

[)3] If the PSE function is used, the current can reach 3.5A for 30µs.

Environment	
Form factor	LxW = 167.64x106.68mm without connectors and bracket
Operating temperature	+5…70°C ambient
Cooling	Normal convection. Refer to Safety Instructions.
Humidity	RH = 85% max., non condensing
Weight without cables	Approx. 200g

8. Accessories

8.1 Joystick

Image 3: Joystick 3-Axis

Image 4: Joystick 2-Axis

Image 5: Joystick 2-Axis with hand wheel

The joysticks shown in the illustration above may only be used with the Tango Controller. Please read the chapter *Safety Instructions* carefully before using the joystick with the Tango PCIe Controller.
The joysticks are delivered with relaxed joystick mechanics. Slide both pushers, which are situated underneath and to the right of the joystick, towards the middle (see image above). The joystick is now in the medial position.
Joysticks are used for operating axes manually. They have the operational controls *Joystick Mechanics* and *Function Keys*.

Joystick Mechanics:
The following assignment of joystick mechanics to moved axis is pre-set:

- X Direction: Axis 1
- Y-Direction: Axis 2
- Turn the knob on the stick (only joystick with 3 axes): Axis 3
- Turn hand wheel Axis 3

The following can be achieved by software command:

1. Turning the knob on the top of the stick (axis 3) can alternatively be associated to Axis 4.
2. The assignment of the motor turning direction to joystick positioning can be inverted per axis.
3. Each axis can be locked individually.
4. The joystick positioning can be queried.
5. The maximum speed per axis can be pre-set.

Function Keys:
The function keys F1... F4 can be interrogated by the user via interface or can be evaluated by the Controller (special function assignment on request).

8.2 Trackball

Image 6: Trackball

Image 7: Trackball 2

The trackballs shown in the illustration above may only be used with the Tango Controller. The trackballs are used to operate the Controller's axes manually. They have the operational controls *Ball* and the *Keys* LEFT, RIGHT, CENTRE.

Ball:
The following assignment of turning direction to moved axis is pre-set:

- X-Direction: Axis 1
- Y-Direction: Axis 2

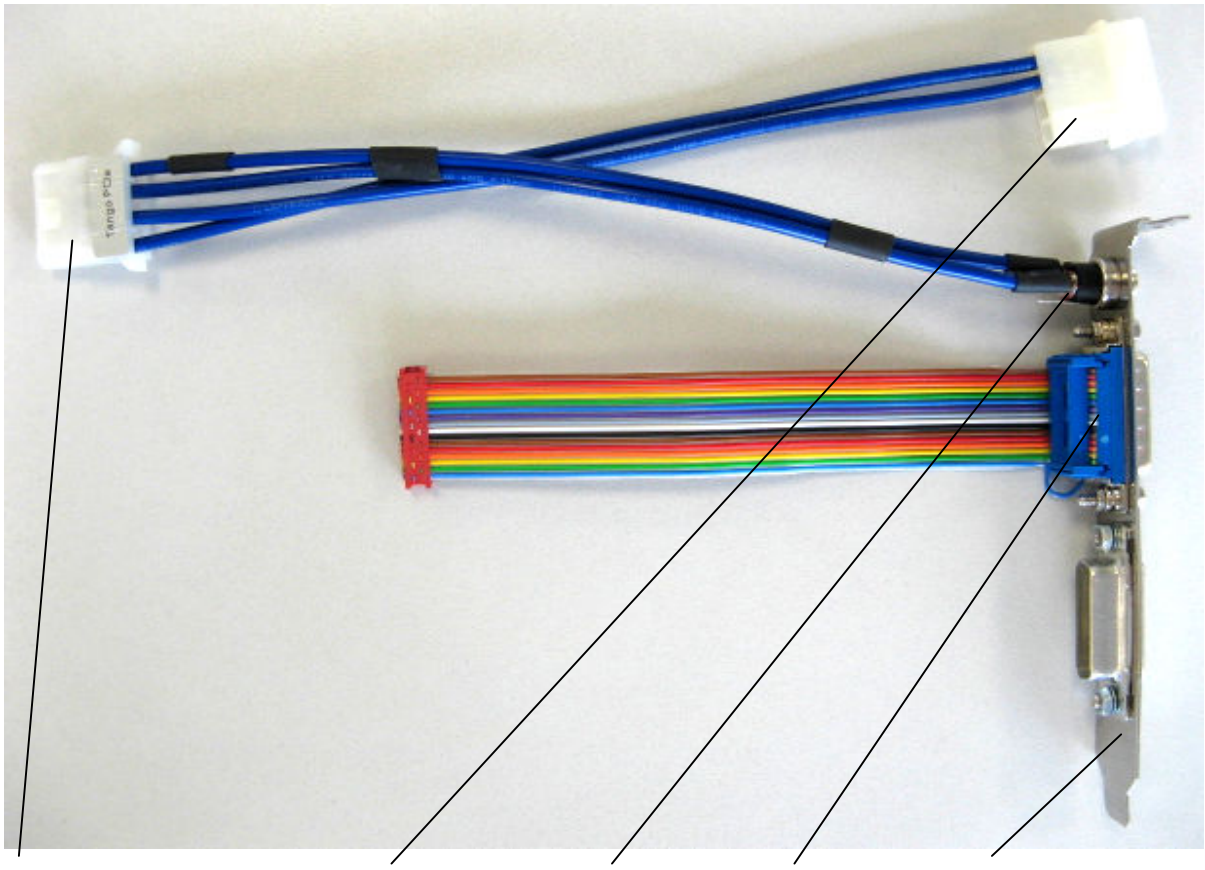
The following can be achieved by software command:

1. The assignment of the motor turning direction to ball direction can be inverted per axis.
2. Each axis can be locked individually.
3. The maximum speed per axis can be pre-set.

Keys:

- Key LEFT: The resolution becomes finer. The travelling range per ball turn decreases.
- Key CENTRE: The resolution becomes coarser. The travelling range per ball turn increases.
- Key RIGHT: Can be interrogated by the user via interface or can be evaluated by the Controller (special function assignment on request).

8.3 Cable Set Internal Wiring



Power Tango PCIe To the power supply PC Motor voltage AUX I/O Bracket
Image 8: Tango PCIe Cable Set Internal Wiring

The cable set Internal Wiring is used to lead out the optional connections for motor voltage (if an external power supply is used), module axis 4 and AUX I/O. Depending on the order, there may be 1 or 2 cables installed on the bracket.

8.3.1 15-Pin D-Sub Plug: Auxiliary I/O (X403)

Allocation: See chapter 6.5. The Pins 1-15 are equal to the allocation of the D-Sub plug on the bracket. When using this cable please note that the Pin PSE should be connected to +12V for activating the power stages.

8.3.2 2-Pin DC-Plug with 2.1mm Pin: Motor Voltage

Table 1: Allocation of pins DC-plug motor voltage

DC-Plug with center Pin	Function
Center (Pin)	+48V (11.4...50V)
Outside	GND

8.3.4 Start-up Adapter AUX-I/O

This adapter will be provided in case of the option AUX-I/O. It connects Pin 12 (PSE) with Pin 13 (+12V) on the AUX-I/O socket.
If plugged, the power stages may be activated.
If Pin 12 is unconnected or connected to ground, the power stages are off.

Image 9: Start-up adapter AUX-I/O

8.4 Power Supply 48V/120W Extern

MEAN WELL

120W AC-DC Single Output Desktop **AS-120P series**

■ Features :

- 3 pole AC inlet IEC320-C14
- Built-in active PFC function, PF>0.95
- Protections: Short circuit/ Over load/ Over voltage/Over temperature
- High power density 5w/in³
- Fully enclosed plastic case
- Approvals: UL/ CUL/ TUV/ CB/ CE
- No load power consumption<0.75W@240VAC
- ZCS/ZVS technology to reduce power dissipation
- 2 years warranty

SPECIFICATION

MODEL		AS-120P-12	AS-120P-15	AS-120P-20	AS-120P-24	AS-120P-48
OUTPUT	ORDER NO.	AS120P12R7B	AS120P15R7B	AS120P20P1M	AS120P24P1M	AS120P48P1M
	DC VOLTAGE Note.2	12V	15V	20V	24V	48V
	RATED CURRENT	8.4A	6.7A	6A	5A	2.5A
	CURRENT RANGE	0~ 8.4A	0 ~ 6.7A	0 ~ 6A	0 ~ 5A	0 ~ 2.5A
	RATED POWER	100W	100W	120W	120W	120W
	RIPPLE & NOISE (max.) Note.3	100mVp-p	100mVp-p	200mVp-p	200mVp-p	240mVp-p
	VOLTAGE ADJ. RANGE	11 ~ 13.5V	13.5 ~ 16.5V	18 ~ 22V	21.6 ~ 26.4V	43.2 ~ 52.8V
		Fixed output by customer choose				
	VOLTAGE TOLERANCE Note.4	±4.0%	±4.0%	±3.0%	±2.0%	±2.0%
	LINE REGULATION Note.5	±1.0%	±1.0%	±1.0%	±1.0%	±1.0%
	LOAD REGULATION Note.6	±3.5%	±3.0%	±2.5%	±2.0%	±2.0%
	SETUP, RISE TIME	3000ms, 80ms at full load				
	HOLD TIME (Typ.)	50ms/230VAC 16ms/115VAC at full load				
INPUT	VOLTAGE RANGE	90 ~ 264VAC 127 ~ 370VDC				
	FREQUENCY RANGE	47 ~ 63Hz				
	POWER FACTOR (Typ.)	PF ≥ 0.95/230VAC PF ≥ 0.98/115VAC at full load				
	EFFICIENCY (Typ.)	85.5%	87.5%	89.5%	90%	89%
	AC CURRENT (Typ.)	1.4A/115VAC 0.7A/230VAC				
	INRUSH CURRENT (Typ.)	120A/230VAC				
	LEAKAGE CURRENT (max.)	<1mA / 240VAC				
PROTECTION	OVER LOAD	105 ~ 135% rated output power				
		Protection type : Hiccup mode, recovers automatically after fault condition is removed				
	OVER VOLTAGE	14 ~ 16.8V	17 ~ 21V	22.5 ~ 28V	27 ~ 33.6V	53.3 ~ 67.2V
		Protection type : Shut down o/p voltage, re-power on to recover				
	OVER TEMPERATURE	90℃ ±15℃ (RTH2) Detect on heatsink of power transistor				
		Protection type : Shut down o/p voltage, re-power on to recover				
ENVIRONMENT	WORKING TEMP.	0 ~ + 50℃ (Refer to output load derating curve)				
	WORKING HUMIDITY	20% ~ 90% RH non-condensing				
	STORAGE TEMP., HUMIDITY	-20 ~ +85℃, 10 ~ 95% RH				
	TEMP. COEFFICIENT	±0.03% / ℃ (0 ~ 50℃)				
	VIBRATION	10 ~ 500Hz, 2G 3AXES 10min./1cycle, period for 60min. each along X, Y, Z axes				
SAFETY & EMC (Note. 7)	SAFETY STANDARDS	UL60950-1, TUV EN60950-1 Approved				
	WITHSTAND VOLTAGE	I/P-O/P:4.25KVDC				
	ISOLATION RESISTANCE	I/P-O/P:100M Ohms				
	EMI CONDUCTION & RADIATION	Compliance to EN55022(CISPR22) class B, FCC part 15J class B				
	HARMONIC CURRENT	Compliance to EN61000-3-2,3				
	EMS IMMUNITY	Compliance to EN61000-4-2,3,4,5,6,8,11, Light industry level, criteria A				
OTHERS	LIFE	Average life expectancy of 6 years (12 hours / day, 70% load, 115VAC)				
	MTBF	308.9K hrs min. MIL-HDBK-217F (25℃)				
	DIMENSION	167*67*35mm (L*W*H)				
	PACKING	0.52Kg; 30pcs/16.6Kg/1.1CUFT				
CONNECTOR	PLUG	Standard type R7B,P2M: 2.5φ * 5.5φ * 11mm, center positive for stock ; Other type available by customer requested				
	CABLE	Standard type 120cm of SPT-1, 16Awg*2c for stock ; Other type available by customer requested				

NOTE

1. All parameters are specified at 230VAC input, rated load, 25℃ 70% RH. Ambient.
2. DC voltage: The output voltage set at point measure by plug terminal & 50% load.
3. Ripple & noise are measured at 20MHz by using a 12" twisted pair terminated with a 0.1uf & 47uf capacitor.
4. Tolerance: includes set up tolerance, line regulation, load regulation.
5. Line regulation is measured from low line to high line at rated load.
6. Load regulation is measured from 0% to 100% rated load.
7. The power supply is considered a component which will be installed into a final equipment. The final equipment must be re-confirmed that it still meets EMC directives.

8.5 Encoder Interface PCIe

Generally:
Termination Resistors 120 Ohm for axis:

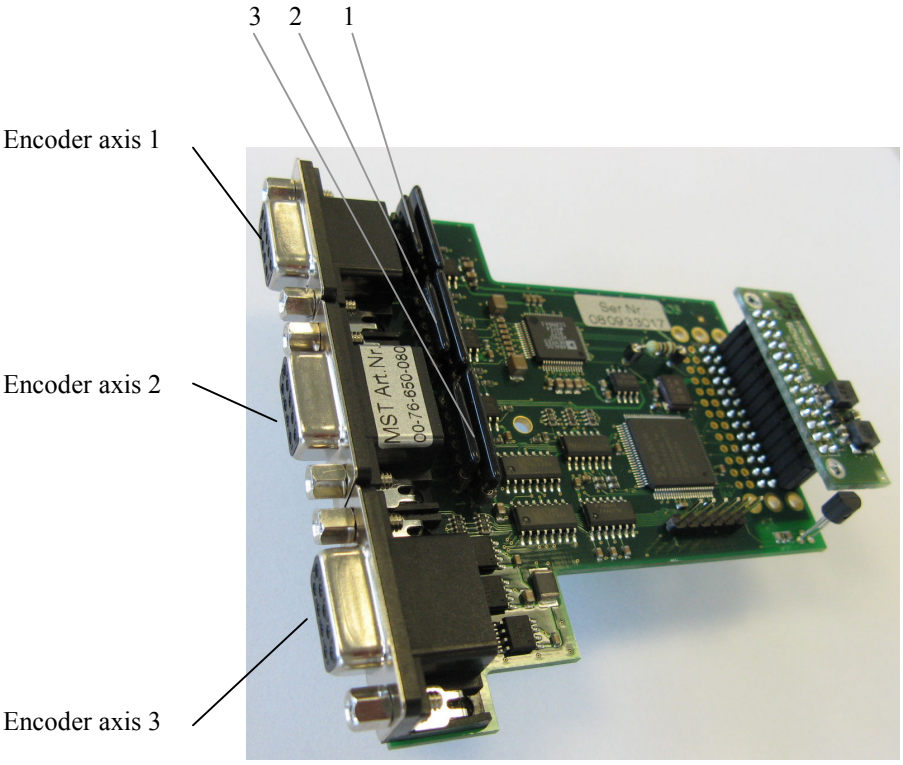


Image 10: Encoder interface PCIe

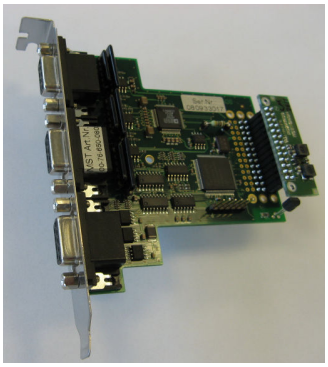


Image 11: Board with bracket

The encoder interface PCIe may be used exclusively with the Tango PCIe Controller. The mechanical design varies depending upon installation situation. The interface will be delivered installed on a Tango controller. For the PC versions of the Tango, a bracket is mounted on the board (refer to image 11).
The encoder interface is useable for the following incremental encoder types:

- RS422 quadrature interface
- 1Vpp interface
- MR interface.
- TTL interface: Please contact vendor!

The type of the interface depends on the order.

8.5.1 9 Pin D Sub sockets: Encoder 1-3:

Pin No.	Label	Function
1	-U1	Phase 1 (sine), negative input
2	GND	GND
3	-U2	Phase 2 (cosine), negative input
4	NAS)*	Error signal
5	-U0	Reference signal, negative input
6	+U1	Phase 1 (sine), positive input
7	+5V	Supply voltage
8	+U2	Phase 2 (Cosine), positive input
9	+U0	Reference signal, positive input
Housing		GND, for connecting the shield

)* Input is inactive on delivery

8.5.2 Technical Data

Nr.	Parameter	1Vss	MR	RS422	Comment
1	Input Voltage of Position Signal	0,6…1,2Vpp	1,5...5Vpp	> +/-0,2V	Differential voltage should be in the DC voltage range 0...5V
2	Reference Voltage	> +/- 50mV	> +/- 50mV	> +/- 50mV	Common mode voltage range 0...5V
3	NAS-Signal)*	TTL	TTL	TTL	„H“ = measure system ok „L“ = error, 1kOhm→GND low pass filter 1kOhm/1nF
4	Bandwidth Position Signal	Ca. 250kHz	Ca. 250kHz	32ns edge distance	At very high frequency, the MR and 1Vpp signals will be counted like the RS422 signals.
5	Max. Frequency for the Position Signal during Reference Move	6 kHz	6kHz	> 40µs edge distance	The reference signal will be synchronized with the positioning signal.
6	Max. reachable Interpolation Factor	51400-fold	51400-fold	4-fold	Per signal period
6	Interpolation Factor at max. Voltage of Position Signal	29100- fold	32700- fold	4- fold	Per signal period, based on worst case of signal angle.
7	Interpolation Factor at min. Voltage of Position Signal	14500- fold	9800- fold	4- fold	Per signal period, based on worst case of signal angle.
8	Input Resistance	120 Ohm	120 Ohm	120 Ohm	Input resistance may be changed on request. Please contact vendor.
9	Supply Current +5V				Max. 0.5A per encoder. Amount of all currents is 1A max..

)* Input is inactive on delivery

8.6 Tango Achse 4 (Axis 4)

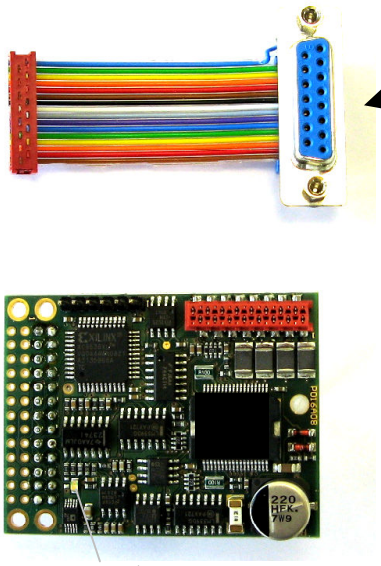


Image 12: Tango Axis 4

Pinning motor connector:

15-pol D-Sub Socket Pin	Function	Comment
1,9	MOT1PH1+	Motor, Phase 1-
2,10	MOT1PH1-	Motor, Phase 1+
3,11	MOT1PH2+	Motor, Phase 2+
4,12	MOT1PH2-	Motor, Phase 2-
5	ENDEND	Endswitch endpoint)*
6	END0	Endswitch zeropoint)*
7	+5VEXT	+5V, max. 500mA
8	GND	GND
13,14,15	n.c.	Not connected

)* TTL-Input, 1kOhm Pull up/down, software selectable, Low Pass-Filter 1kOhm, 100nF

LED1: Is on when powerstage is active.

The module Tango Axis 4 is designed to drive a 2 or 4-phase stepper motor. 2 endswitches may be connected to the module. The module must be used exclusively for the Tango PCI-S, Tango PCIe and Tango DT controller. The mechanical design varies depending upon installation situation. The interface will be delivered installed on a Tango controller. For the PCI and PCIe versions of the Tango, a bracket is mounted on the motor connector.
Note: The PSE Pin at the AUX-IO connector of the Tango (to switch off the power stage) switches off the power stage of the Tango Achse 4 via software. There is no switching off via Hardware like it is at the Tango PCI-S, Tango PCIe or Tango DT.

Technical Data:

Performance Motor Controller	
Number of Axes	Up to 3
Type of Motor	Stepper motor 2/4 phases, e.g. 100, 200 or 400 full steps/revolution
Microstep Resolution	819200 steps/revolution (@ motor with 200 steps/revolution)
Power Stage	Automatic adaptation to a wide rage of stepper motors
Max. Phase Current	1.0A
Motor Current	Selectable per software 0.1A to max. phase current
Current Reduction after Movement	0% to 100% of selected motor current
Current Reduction Delay	Selectable from 0…65000 ms
Motor Voltage	48V,eff AC max.; 48V DC max. depends on power supply

Power Requirements (without additional cards)	
Motor Voltage	11.4…50V DC)1
+12V (+/- 5%)	About 10 mA
+5V (+/- 5%)	About 15 mA
+3,3V (+/-5%)	About 30 mA

)1 Current depends on type of motor, motor current, DC voltage, rotations per second, etc. An estimation is: I,max. = ca. 1/3 x motor current. Individual measurements are needed.

Environment	
Form factor	LxW = 57 x 44mm without cable
Operating temperature	+5…70°C ambient
Cooling	Normal convection
Humidity	RH = 85% max., non condensing

Safety Functions	
Voltage Monitor Power Stage	Switches power stage off at low voltage
Short Circuit Protection Motor	Phase to phase and phase to ground, power stage switches off within typical 5µs, resetable via software
Overcurrent Protection for External Devices	+5VEXT is self resetting after removing overload
Hardware Limit Switch Input	2 per axis, TTL-level, NO or NC, switching either to 0V or +5V, software selectable pull-up or pull-down resistors for each input

9. Inspection and Service

9.1 Maintenance

The positioning Controller is free of maintenance. Clean the cover with a soft, slightly moist, cloth. Avoid direct contact with liquids or solvents.

9.2 Service Address

Should any problem or malfunction appear during operation, please check all external connections first (voltage supply, cabling, etc.). If the malfunction or problem can't be solved, please return the controller to the manufacturer together with a brief description of the error:

Märzhäuser Wetzlar GmbH & Co. KG
- Service -
In der Murch 15
D-35579 Wetzlar
Email: service@marzhauser.com
Tel.: +49/6441/9116-0

9.3 Disposal

The positioning Controller Tango PCIe should be returned to the manufacturer free of charge for purpose of disposal. Please send the Controller to the address mentioned in chapter 9.2. Don't dispose electronic equipment to the normal waste.
The positioning Controller is registered with the registration number DE 25271278.

10. Warranty

Märzhäuser Wetzlar GmbH & Co. KG grants a warranty of 24 months for the positioning controller Tango PCIe.

Within this warranty, Märzhäuser Wetzlar GmbH & Co. KG will repair or replace your instrument, if in any way it is defective in material or workmanship.

Other claims of guarantee or claims of damage in result of defectives, are excluded from this warranty.

This warranty doesn't cover any defectives, which result from abnormal use or incorrect handling. Changes or interventions without our approval, void this warranty.

Revision history:

Number	Version	Date	Changes	Reason
4	C	26.8.2009	First english version	Number 1-3 = Version A + B = german versions
5	D	18.1.2010	Chapter 5 d): …via PSE signal or an error	Software change
6	D	18.1.2010	Chapter 7: Number of axis: Up to 4	