Hardware Manual

Indel motion boards

Made in Switzerland

Tabel of contents

1   Description

MAX boards offer extremely flexible possibilities for motor control. There are various versions with 2 ...
10 motor output stages, PWM outputs, encoder, resolver, SinCos inputs, etc. available.

The units feature various analogue and digital inputs and outputs alongside the motor output stages.
The MAX boards are capable of controlling entire machines.
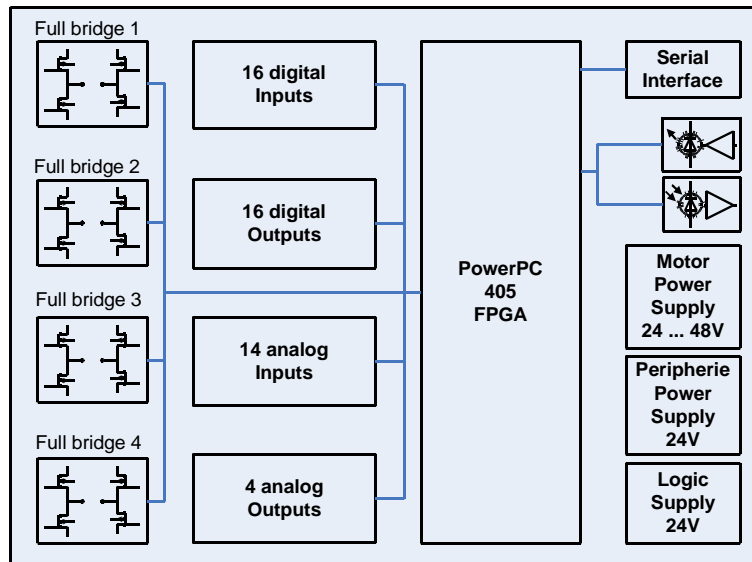
Figure 1.1: Block wiring diagram, MAX4 motion board

1.1   Position controller

PID controller
The user has access to 3 different PID2 parameter sets (forwards, backwards,
stand-by). This allows changes in load to be dealt with
in the best possible way.

Filter
Up to 4 bi-quad filters can be configured per axis.

Computational power
The PowerPC 405-300MHz assumes the following tasks in a 8 ... 32kHz cycle:
- PID position controller, speed regulation, active current regulation
- 2. Target value: torque regulation
- Measuring wheel correction (inc encoder)
- Limitation for: I_{MAX}, I_{2t} , controller, motor temperatures
- Logger for 64 freely selectable parameters
- Customer-specific application
- Filter calculation

Position detection
- Resolver: single or multi-pole, 16-bit resolution per resolver revolution
- SinCos encoder: 4096 periods per revolution, 16-bit resolution
- Incremental encoder: up to 20,000 increments (incl. 4Q resolution)
- SSI, Endat, Hiperface interface

Operational safety

A number of variables are continually monitored within the motion boards: short-circuit monitors switch off the controller in the case of motor or ground short-circuit.

Rapid overcurrent cut-outs protect the motor and output stage within the individual phases. These intervene when the drive is stuck or is stopped suddenly.

The motor and output stage are monitored for overheating.

1.2   Assembly groups

Order no.	Type	Description
611041900	GIN-AX4	4/2 Axis Board with C96-PPC-Card4, 16 Input, 16 Output
610838600	GIN-MAX10	Multiaxis DC-Motor Module, 6x2.5A, 4x1.25A, 16 Out 24V 2A, 16 Inp 24V, 4 Analogue Input
610636340-4x2.5A	GIN-MAX4	Multi-Axes Board, 4 x 3-Phase 48V/2.5A, 16x24V/2A IO, 14 x Analog Input +-10V, 4 x Analog Out +-10V
610636341-2x5A	GIN-MAX4	Multi-Axis Board, 2 x 3-Phase 48V/5A, 16x24V/2A IO, 14 x Analog Input +-10V, 4 x Analog Out +-10V
610636300-4x2.5A	INFO-MAX4	Multi-Axes Board, 4 x 3-Phase 48V/2.5A, 16x24V/2A IO, 14 x Analog Input +-10V, 4 x Analog Out +-10V
610636301-2x5A	INFO-MAX4	Multi-Axis Board, 2 x 3-Phase 48V/5A, 16x24V/2A IO, 14 x Analog Input +-10V, 4 x Analog Out +-10V
610535700	MAX2-DBIT	Distribution Board for MAX-2
610636400	MAX4-DBIT	Distribution Board for MAX-4
610636501	MAX-DBMT	Distribution Board for MAX Boards with 2 Resolvers Inputs and 2 PWM 48V/3A outputs resistant to short-circuiting

2   Safety notes

Questions
These safety notes do not claim to be exhaustive. Please call us if you have any questions or problems. (Tel. +41 44 956 20 00)

2.1   General safety notes

Documentation
Please read this documentation fully before installation and commissioning. Incorrect handling of the modules can lead to personal injury or property damage. Ensure that the technical details and information on connection conditions are complied with.

Qualified personnel
Only qualified specialist personnel may carry out work such as transport, assembly, installation, commissioning, servicing and maintenance.

National accident prevention regulations must be observed.

ESD protection
The modules contain components that are sensitive to static charge, and that can be damaged through improper handling. Discharge the static from your body before touching the modules. Avoid contact with highly insulating materials (artificial fibres, plastic film, etc.). Place the modules on a conductive surface in a voltage-free state.

Do not touch the plug connector contacts on the drive and the connected cables, or contact pins on conductors.

2.2　Safety requirements

2.2.1　Risk analysis

The machine manufacturer must compile a risk analysis for the machine and take suitable measures to ensure that unforeseen movements do not cause damage to persons or property.

Notes on possible risks are also provided in other places throughout this document. All notes on risks, warnings, precautions and information must be observed.

Run-on

If application-dependent risks arise due to run-on, additional protective measures (e.g. moveable covers with locking) must be taken to cover the danger zone until such a time that the risk to persons or property no longer exists.

It must be noted that run-on of the drive is possible without a mechanical brake or defective brake. The securing brake is not safely controlled by the Indel servo drives. (Active output)

Braking resistance

The braking resistor is not safely controlled by the Indel servo drives. A defective or incorrectly connected braking resistor will result in the motor not stopping within the expected time span. In unfortunate cases, this can lead to personal injury or property damage.

Protection from dangerous movements

Incorrect control of motors can trigger unwanted and dangerous movements.

Such behaviour may be caused by, for example:
- Faulty installation
- Faulty configuration
- Faulty or incomplete wiring
- Defective devices or cables
- Faulty control by the software

Essentially, movement of the motor should be expected as soon as the motion board is switched on. Protection of persons and the machine can only be guaranteed by means of overarching safety measures.

Suitable measures must be taken to ensure that the movement zone of machines are protected against unintentional access by persons.

Removing, bypassing or circumventing the safety mechanisms is strictly prohibited.

Plenty of easily accessible emergency stop switches must be available in and around the machine.

Suspended loads

In the case of suspended loads, additional measures must be taken to ensure that the axis stays in place. The Indel servo drives do not offer outputs that allow you to safely control securing brakes. Holding brakes do not offer any protection when slowing down the motor.

Further notes

The emergency stop function may not necessarily lead to the energy supply being switched off. Drives may remain in operation. Protection against touching live parts is therefore not necessarily guaranteed.

Position switches and actuating controls must be secured against shifting in accordance with EN1088.

The reaction in the event of a power cut must be considered.

2.2.2   24V DC power supply

The motor may spin out in the event of loss of the 24V power supply to the motion board. If this is not permissible, external measures must be taken to prevent the axis from spinning out.

2.2.3   48V DC power supply (motor supply)

The motor may spin out in the event of loss of the 48V DC power supply to the motors. If the intermediate circuit voltage U_{CC} falls below the configured limit $U_{CC\ MIN}$, the motor control will go into error mode and the motor will be switched off.

2.2.4   EMV

For EMC-compliant wiring, see the Indel wiring guidelines, as well as the wiring instructions in this document.

The manufacturer of machines or systems must take additional EMC safety measures if the product standard applicable to their machine stipulates lower limit values. Additional EMC safety measures may be required for machines that contain a large number of Indel servo drives. In such cases, the installation of a central mains filter is usually sufficient.

When using Indel motion boards in residential areas or when connecting Indel motion boards to a low-voltage network that will supply buildings in residential areas without intermediate transformers, additional measures must be implemented in order to filter out interference.

2.2.5   Commissioning

Before switching on a motion board, it must be ensured that the unit is correctly connected to the earth potential. The earth connections must always be put in place, even if the motion board is only being operated for testing purposes.

The commissioning must be documented and proof of the safety functions must be kept.

2.2.6   Intended use

The Indel motion boards must only be used within the framework specified in this document and other documents to which it refers.

Intended use is prohibited until it has been established that the machine complies with the provisions of EC Directive 2006/42/EC (Machinery Directive) and Directive 2004/108/EEC (EMC Directive), or the relevant current version of said directives. Otherwise, the Indel motion board cannot be marketed.

Additional measures must be taken for use in areas at risk of explosion, such as flame-proof enclosure in accordance with EN 50014 and EN 50018.

2.2.7 Plug-in connections

Plug-in connections must never be plugged in or unplugged when the unit is switched on.

2.2.8 Responsibility

The motion boards are not completely safe from failure, particularly the safety functions. In the event of failure, the operator is responsible for ensuring that the machine/system is put into a safe condition.

> **All diagnosis and monitoring functions can only interrupt the control of the motor. This means that the motor becomes currentless and can no longer be controlled or slowed down!**
>
> **Depending on the application, additional measures are required to slow down or stop the motor.**
>
> **The operator is responsible for safety.**

3   Technical details

3.1   Technical details for motion boards

Ambient conditions		Motion boards
Switch-on interval	s	> 10
Ambient temperature: Storage	°C	-20 … 80
Ambient temperature: Operation [1]	°C	0 … 45
Heat sink temperature max.	°C	80
Relative humidity, no condensation	°C	80%
Protection class		IP-20
Degree of contamination		2 (EN 50178)
Installation position MAX-Boards(sufficient cooling required, possibly with fan)		any
Installation position GIN-AX4(sufficient cooling required, possibly with fan)		vertical, upright
Vibration as per IEC 68-2-6 Amplitude, frequency response	mm Hz	0.35 10 … 120
Shock	g	1
Interference emission, industrial zone		EN 61000-6-4
Interference resistance, with mains filter, industrial zone		EN 61000-6-2

1) To keep the ambient temperature below 40℃ you m ay need to install additional cooling measures

24V logic supply

Logic supply		INFO-MAX4 2x5A	INFO-MAX4 4x2.5A	GIN-MAX4 2x5A	GIN-MAX4 4x2.5A	GIN-MAX10	GIN-AX4
Operating voltage	VDC	24V -5% +15%					
Galvanic isolation		no					
External fusing, fast	A	8					
Max. potential between earth and 0V	VDC	50					
Power consumption at 24V	mA	250	250	300	300	300	300

On-board supplies

Supplies		MAX-2,4,10	AX4
Voltage	V	± 15 / ± 15%	
Power (± 15V supply)	mA	50	
Voltage	V	± 5 / ± 5%	
Power (± 5V supply)	mA	100	
Supply for encoders; voltage	V	5 / ± 5%	5 / ± 5%
Power (5V supply)	mA	600	600
Supply for logic; voltage	V	3.3 / ± 5%	
Power (3.3V supply)	mA	50	

Motors

Motor		Motion boards
Minimum inductance	mH	1
Minimum resistance	Ohm	0.2
Max. Cable length in the case of cable lengths > 20m use choke 0.5 … 1mH	m	20
Min. Cable length in parallel operation of GIN-AX4 Minimum length of the parallel strands of the motor connections.	m	0.12
Motor temperature monitoring Bi-metal sensor must be in motor cable Motor temperature monitoring only for AX4		Bi-metal KTX-84 100 / 110 PTC 10k GT2
Accuracy of analogue temperature sensors	°C	± 2
Motor cable		shielded
Motor types: - Synchronous servo motors and brushless asynchronous motors - DC motors, linear motors, stepper motors (two coils) The motors must be designed for operation using digital servo drives		

MAX boards output stages

Nominal values		MAX4 4x2.5A	MAX4 2x5A	MAX10	AX4 4x5A	AX4 2x10A
Number of output stages (MAX-10 only DC motors)		4	2	10	4	2
Motor supply voltage	VDC	15 … 48			0 … 48	
Overvoltage cut-off	VDC	54				
Overheating cut-off	°C	80				
Max. Output per motor	W	100	200	4 x 50 6 x 100	200	400
I_{rated} at 8kHz sampling rate	Arms	2.5	5.0	1.25 / 2.5	5.0	10.0
I_{MAX} at 8kHz sampling rate	Arms	2.5	5.0	1.25 / 2.5	5.0	10.0
I_{rated} at 12kHz sampling rate	Arms	2.5	5.0	1.25 / 2.5	5.0	10.0
I_{MAX} at 12kHz sampling rate	Arms	2.5	5.0	1.25 / 2.5	5.0	10.0
I_{rated} at 16kHz sampling rate	Arms		5.0		5.0	10.0
I_{MAX} at 16kHz sampling rate	Arms		5.0		5.0	10.0
I_{MAX} brake FET	ADC	5	5	–	10	10
Minimum external braking resistance (48V supply)	Ohm	10	10		10	10
External fusing, triggering characteristic: Slow, C	A	10	10	10	20	20
Power dissipation	W	25	25	25	35	25
Weight	Kg					

PWM oversampling for motor drive: Sampling rate x2, x3, x4
Iron-less motors run better with PWM oversampling.

Feedback systems

MAX-2/4
total of 4 encoder inputs: 2 incremental encoder inputs, as well as 2 inputs that can be configured as either an incremental encoder input or a SinCos input.

MAX-10
10 x incremental encoder inputs

AX4 (SinCos)
4 encoder inputs: each encoder input can be configured as an incremental encoder or SinCos encoder.
Plus 2 digital interfaces for Hiperface, Endat, SSI (motor 1, 3)

Absolute feedback systems

Digital absolute feedback systems		AX4
Number of dig. feedback systems (motor 1, 3)		2
Endat 2.1		☑
Endat 2.2		a.A.
Synchronous serial interface, max. Telegram length	Bit	32
Hiperface		☑
Biss		a.A.

An incremental encoder can also be connected to the absolute feedback inputs.
See section 3.3.5 Pin assignment for AX4 encoder systems

Resolver

Resolver inputs		MAX-Boards with DBMT connector board
Resolution	Bit	16
Reference, bridge circuit	Vrms	2
Sine/cosine input	Vrms	1
Multi-pole resolvers		☑
Resolver cable		Pair-twisted, double shielded
Number of channels per board		2

Incremental encoder

Incremental encoder inputs		MAX2,4	AX4	MAX-10
Level		RS422 [6]		
Max. Counting frequency of incremental enco-der track [1]	MHz	2.5	2.5	2.5
Max. Counting frequency for incremental enco-der at SinCos input [2]	kHz	250		–
Max. Counting frequency for incremental enco-der at absolute feedback system inputs [3]	MHz	–	2.5	–
Voltage supply for encoders	V	5		
Power, total for all encoders	mA	200	800	200
Encoder cable		shielded		
Number of channels per board		4 [4]	4 [5]	10

1) Example: Incremental encoder with 0.1µm resolution (with 4-quadrant resolution) can be moved at 10m/s. A safety factor of 2 has already been included.

2) Example: Incremental encoder with 1µm resolution (with 4-quadrant resolution) can be moved at 10m/s. A safety factor of 2 has already been included.

3) On the AX board, rapid digital encoders can be connected to the absolute feedback system inputs. Also see section 3.3.5 Pin assignment for AX4 encoder systems.
In the case of AX4 boards, this function is available from HW Rev. B.

4) The MAX2, MAX4 boards are each equipped with two pure digital encoder inputs and two combined digital encoder / SinCos inputs.

5) The AX4 board is equipped with four combined digital encoder / SinCos inputs. Also see section 3.3.5 Pin assignment for AX4 encoder systems

6) In accordance with the RS422 standard, each input is equipped with 120 Ohm resistance. The encoder must be able to handle this load

SinCos encoder

Sin/Cos inputs		GIN-MAX2,4 INFO-MAX2,4	AX4
Level: Sine, cosine, reference	Vrms	1	1
Differential input resistance	Ohm	120	120
Max. Periods / s [1], [2]	kHz	200	200
Voltage supply for encoders		5V + 10% / 200mA	5V + 10% / 200mA
Voltage supply for encoders		10V + 10% / 100mA	10V + 10% / 100mA
Encoder cable		pair-twisted double shielded	pair-twisted double shielded
Number of channels per board [3]		2	4

1) Analogue inputs: The maximum sampling rate for analogue inputs is 450kHz, or 250kHz with a multiplexer.

2) For incremental encoder to Sin/Cos input see "Incremental encoder" table.

3) The MAX2, MAX4 boards are each equipped with two pure digital encoder inputs and two combined digital encoder / SinCos inputs. Also see section 3.3.5 Pin assignment for AX4 encoder systems

Digital inputs and outputs

Digital inputs and outputs		MAX-2,4	MAX-10	AX4
Number of digital outputs		16		
24V outputs (resistant to short-circuiting)	V_{OUT}	18 … 32		
Constant current of 24V outputs	A	1		
Switching delay of outputs	ms	0.5		
Number of digital inputs		16		
Digital inputs U_{IN}	V	18 … 32		
Digitale Eingänge I_{ON} @ 24V	mA	1		
Input filter	us	250		
Level for logic 1	V_{ON}	13.2		
Level for logic 0	V_{OFF}	5.4		
Input impedance	Ohm	26.7k		
Galvanic isolation of inputs and outputs		☐		
Number of trigger inputs		–	4	–
Trigger inputs U_{MAX}	V	–	5	–

Pulsators (optional)

TTL outputs		AX4		
TTL outputs (74ABT245)	$V_{OUT\ MAX}$	5V/3.3V		
Constant current of TTL outputs I_{MAX}	mA	10		
PWM frequency	kHz	20		
Shortest Δt	ns	20		
Number of TTL outputs		8		

PWM outputs

PWM outputs		MAX2,4	MAX-10	AX4
PWM outputs, resistant to short-circuiting, open drain	$V_{OUT\ MAX}$	0 … 36	0 … 36	0 … 48
Constant current of PWM outputs I_{MAX}	A	2.5	2.5	5
PWM frequency	kHz	20	20	20
Shortest Δt	ns	20	20	20
Number of PWM outputs, incl. brake		3	6	1

Analogue inputs and outputs

Analogue inputs and outputs		MAX2,4	MAX-10	AX4
Number of analogue inputs		14	4	-
Ranges	V	± 10 ± 1 ± 0.1	± 5	
Converter time / channel	Khz	4	8 … 12	
Resolution	Bit	16	16	
Average filter		1 … 256	1 … 256	
Number of analogue outputs		4	-	-
Range	V	± 10		
Power per channel I_{MAX}	mA	5		
Resolution	Bit	16		
Accuracy		1 ‰		

Once switched on, the output of the analogue outputs is -12V over 300ms.

Accuracy of analogue inputs

Accuracy of analogue inputs Measuring range		Relative accuracy of individual measurement	Relative accuracy averaged for 100 values	Absolute accuracy
± 10 V	Bit	14	15	14
± 1 V	Bit	13	14	13
± 0.1 V	Bit	12	14	12

Optimum stability of measurement values is achieved once the unit has been switched on for 15min.

The accuracy specifications apply at the operating temperature.

Interfaces

Interfaces		INFO-MAX2,4	GIN-MAX2,4	GIN-MAX10	GIN-AX4
Serial interface	RS232	1	1	1	1
Baud rate	RS232	115'200	115'200	115'200	115'200
Protocols: Modbus		☑	☑	☑	☑
INFO-link interface	11MBit	☑	☐	☐	☐
Ethernet interfaces 2 x GinLink or 1 x Ethernet, 1x GinLink	1GBit	-	2	2	2
IMP interface		☐	☐	☐	☑
Number of participants		-	-	-	1
5V supply (IMP bus)	mA	-	-	-	800

3.2   *Technical details for connector boards*

3.2.1   MAX-DBIT

Analogue inputs

Analogue inputs		Channel no.	Pin	MAX-DBIT
Vacuum sensor 1)		0	On Board	
Analogue inputs		1 … 3	X19, X20	
Potentiometer input		3	X38	
Potentiometer voltage	V			10
PT-100 inputs		4 … 7	X20, X21, X22	
Measuring current for PT-100 re-sistance	mA			3.333
Thermocouple inputs		8 … 12	X11 … X15	
PT-100 balancing point		13	On Board	
PT-100 references		14 … 15	On Board	

1) For specifications for the analogue inputs see section 3.1 Technical details for motion boards

3.2.2 MAX-DBMT

Analogue inputs

Analogue inputs		Channel no.	Pin	MAX-DBMT
Analogue inputs 1)		0 … 11	X16, 17, 18	
PT-100 inputs		12 … 13	X13	
PT-100 references		14 … 15		
Measuring current for PT-100 re-sistance	mA			3.333

Analogue outputs

Analogue outputs		Channel no.	Pin	
Analogue outputs 1)		0 … 1	X14	
Resolver reference 2)		2 … 3	X13	

1) For specifications for the analogue inputs and outputs see section 3.1 Technical details for motion boards

2) For resolver specifications see section 3.1 Technical details for motion boards Resolver

PWM outputs

PWM outputs		MAX-DBMT	
Number of PWM outputs, open collector Pins X27, X28: PDOUT-0, PDOUT-1		2	
Maximum PWM frequency	kHz	4	
Maximum voltage	VDC	50	
Maximum power	A	5A	
$R_{DS\ ON}$	mOhm	0.1	

3.3   *Dimensions, pin assignment*
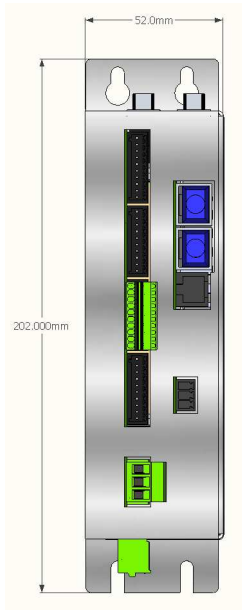
3.3.1   Dimensions of AX4
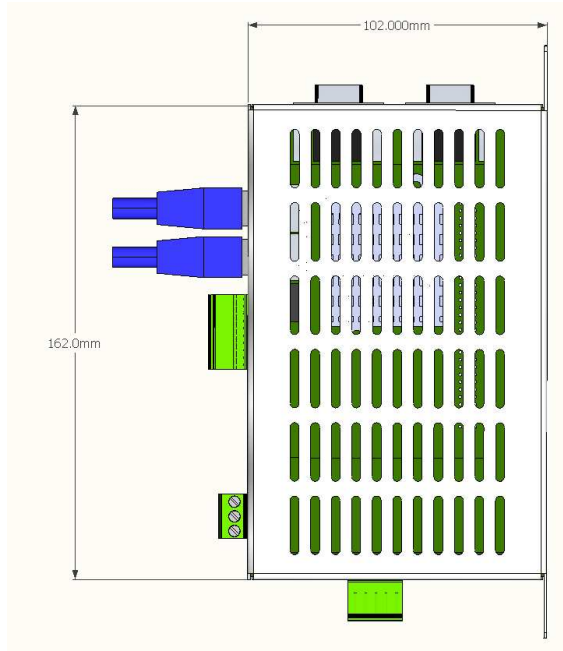

Fig. 2: AX4 front   *Fig. 1: AX4 side*

A minimum distance of 50mm must be maintained between the individual motion boards.
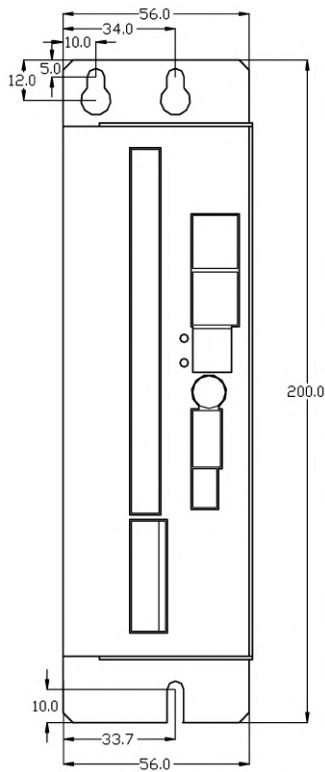
Fig. 3: Drill plan, AX4

3.3.2   Pin arrangement for AX4 board
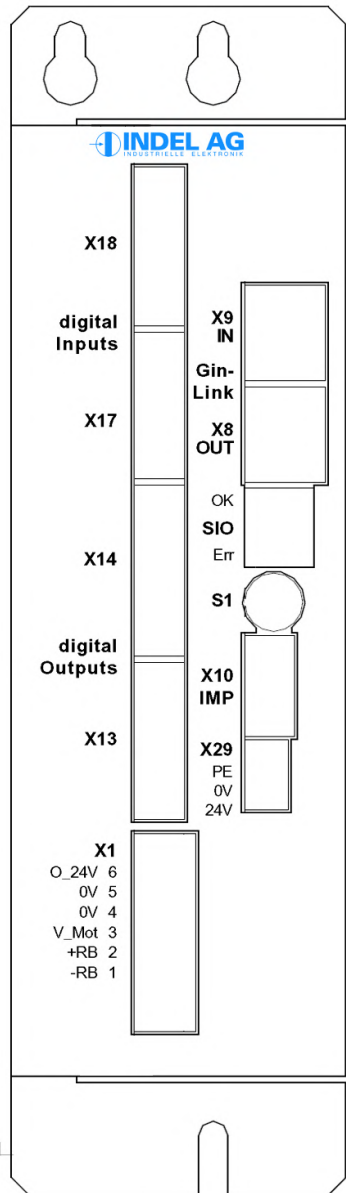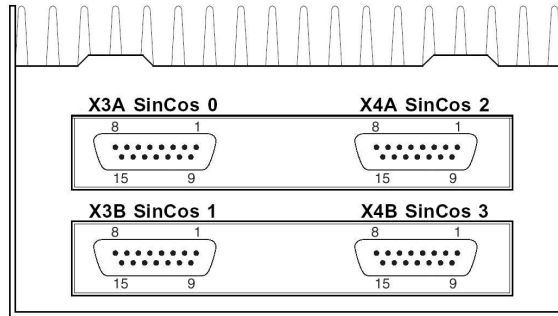
Fig. 5: Encoder pins
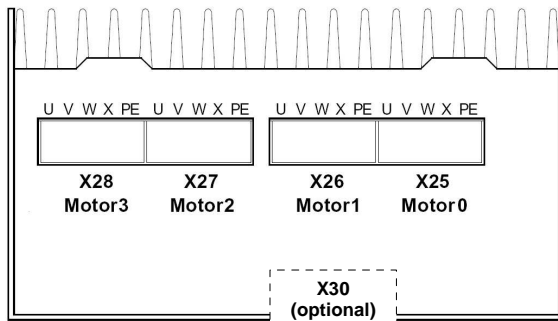
Fig. 6: Motor pins

Fig. 4: Front pins

Absolute feedback systems can be connected to pins X3B, X4B; SinCos 1, 3.

3.3.3   Pin assignment for digital inputs and outputs in AX4

X13	1	O	0V	Ground for 24V outputs
Digital outputs	2	O	OUT 0	Output 0
	3	O	OUT 1	Output 1
	4	O	OUT 2	Output 2
	5	O	OUT 3	Output 3
	6	O	OUT 4	Output 4
	7	O	OUT 5	Output 5
	8	O	OUT 6	Output 6
	9	O	OUT 7	Output 7
	10	O	0V	Ground for 24V outputs

X14	11	O	0V	Ground for 24V outputs
Digital outputs	12	O	OUT 8	Output 8
	13	O	OUT 9	Output 9
	14	O	OUT 10	Output 10
	15	O	OUT 11	Output 11
	16	O	OUT 12	Output 12
	17	O	OUT 13	Output 13
	18	O	OUT 14	Output 14
	19	O	OUT 15	Output 15
	20	O	0V	Ground for 24V outputs

X17	1	O	0V	24V Ground
Digital inputs	2	I	IN 0	Input 0
	3	I	IN 1	Input 1
	4	I	IN 2	Input 2
	5	I	IN 3	Input 3
	6	I	IN 4	Input 4
	7	I	IN 5	Input 5
	8	I	IN 6	Input 6
	9	I	IN 7	Input 7
	10	O	24V	24V supply for sensors

X18	11	O	0V	24V Ground
Digital inputs	12	I	IN 8	Input 8
	13	I	IN 9	Input 9
	14	I	IN 10	Input 10
	15	I	IN 11	Input 11
	16	I	IN 12	Input 12
	17	I	IN 13	Input 13
	18	I	IN 14	Input 14
	19	I	IN 15	External enabler for all axes
	20	O	24V	24V supply for sensors

3.3.4 Pin assignment for supplies and interfaces in AX4

X1		1	I	- Brake	Braking resistor
Supply		2	I	+ Brake	Braking resistance (V_Mot)
Output		3	I	V_Mot	Supply for motors
		4	I	0V	24V Ground
		5	I	0V	24V Ground
		6	I	24V Out	Supply for digital outputs

X10		1	I	SOut	Serial data out, from IMP modules
IMP interface		2	O	SIn	Serial data in, to IMP modules
		3	O	SEL	Select
		4	O	Clk	Clock
		5	O	+5V	Logic supply
		6	O	Gnd	Ground

X29		1	I	24V	Supply for logic and inputs
Supply		2	I	0V	24V Ground
Logic		3	I	Earth	Earth

X30		1	O	Out 0	TTL output 0
Pulsators		2	O	Out 1	TTL output 1
(optional)		3	O	Out 2	TTL output 2
		4	O	Out 3	TTL output 3
		5	O	0V	0V
		6	O	Out 4	TTL output 4
		7	O	Out 5	TTL output 5
		8	O	Out 6	TTL output 6
		9	O	Out 7	TTL output 7
		10	O	0V	0V

GinLink / Ethernet

AX4 board as GinLink slave
X9   GinLink In
X8   GinLink Out

AX4 board as stand-alone controller
X9   GinLink In
X8   Ethernet

For stand-alone operation, rotary switch S1 must be set to 0x4.

3.3.5   Pin assignment for AX4 encoder systems

Pin	Encoder type 1		Encoder type 2	Encoder type 3
X3A	SinCos 0	Enc 0		
X3B	SinCos 1	Enc 1	Absolute feedback system 1	
X4A	SinCos 2	Enc 2		
X4B	SinCos 3	Enc 3	Absolute feedback system 3	

X3A, X4A

SinCos Interface
Incremental encoder
interface

D-sub, 15-pole

Female

ENC_A–	8
ENC_A+	15
MTmp+	7
Ref–	14
Ref+	6
ENC_B–	13
ENC_B+	5
+5V	12
+12V	4
Cos–	11
Cos+	3
Gnd	10
Gnd	2
Sin–	9
Sin+	1
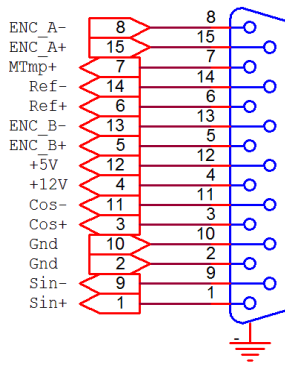
Pin 4 = +12V DC
Pin 12 = +5V DC

X3B, X4B

SinCos Interface
Incremental encoder
interface
SSI-Interface

D-sub, 15-pole

Female

Clk–	8
Clk+	15
MTmp+	7
Ref–	14
Ref+	6
Data–	13
Data+	5
+5V	12
+12V	4
Cos–	11
Cos+	3
Gnd	10
Gnd	2
Sin–	9
Sin+	1
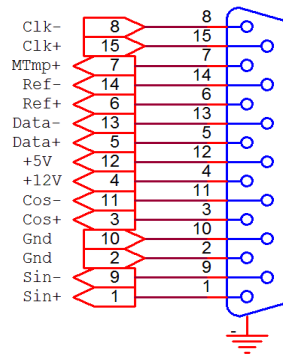
Pin 4 = +12V DC
Pin 12 = +5V DC

Incremental encoder to absolute feedback inputs (pins X3B, X4B)

Incremental encoders can also
be connected to the inputs for the
absolute feedback system.

+IncA = Clk+

-IncA = Clk-

+IncB = Data+

-IncB = Data-

+Ref = Ref+

-Ref = Ref-

This type of connection allows you to achieve considerably higher signal frequencies for the encoder signals; see section 3.1 Technical details for motion boards, sub-section: Incremental encoder

In the case of AX boards, this function is available from HW Rev. B.

Interruptions in the encoder and motor cables – when leading them into a cabinet or similar – should be designed with metal plug connections, not clamp connections.

Single-ended incremental encoders

Additional level adjustment is required if single-ended incremental encoders are being used. A connection must be made to the encoder interface at jacks X3A and X4A and to the absolute feedback interface at jacks X3B and X4B. Fig. 7 und Fig. 8 give an example for the absolute feedback interface. **However, we generally recommend that you use incremental encoders with a RS422 interface as per the current industry standard.**
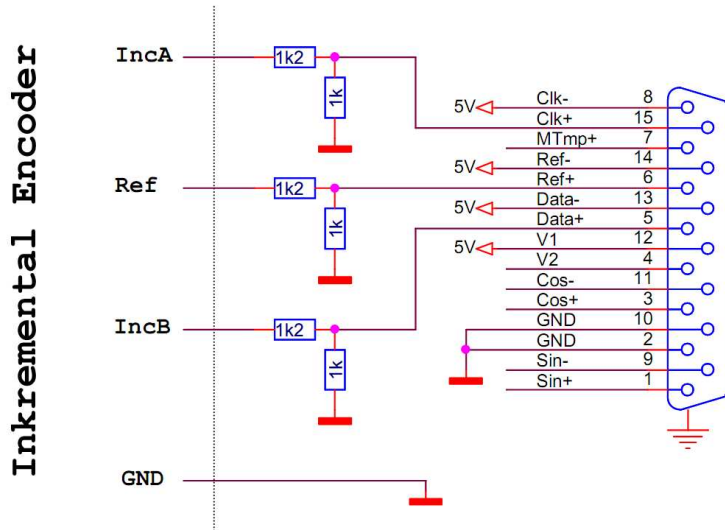
Fig. 7: Connection example for 24V single-ended incremental encoder
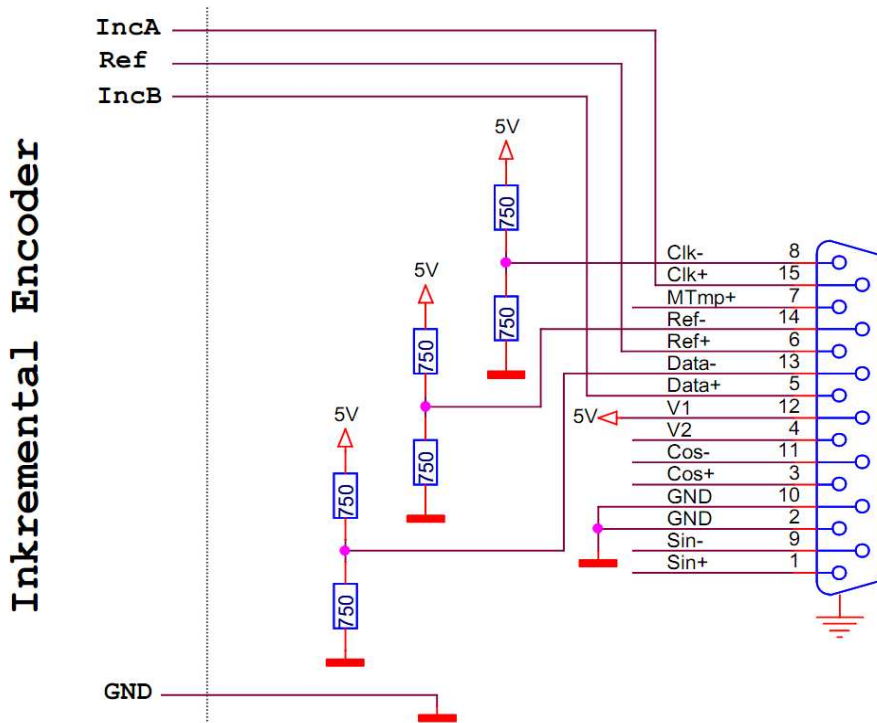
Fig. 8: Connection example for 5V single-ended incremental encoder

3.3.6   Pin assignment for motors in AX4

X25, X26, X27, X28				3-phase motors	Stepper motors
	5	O	Earth	Shield	Shield
	4	O	X	-	Stepper motor L2-
	3	O	W	Phase W	Stepper motor L1-
	2	O	V	Phase V	Stepper motor L2+
	1	O	U	Phase U	Stepper motor L1+

In order to operate 2 motors on the AX4 board, motors 0,1 and motors 2,3 must be switched in parallel: (direct view of motor pins)

3-phase motors in parallel operation

> **In the case of parallel operation, the Y cables (from the motor pin to the junction of the parallel cables) must be at least 25 cm long. Otherwise, the output stages may be damaged.**
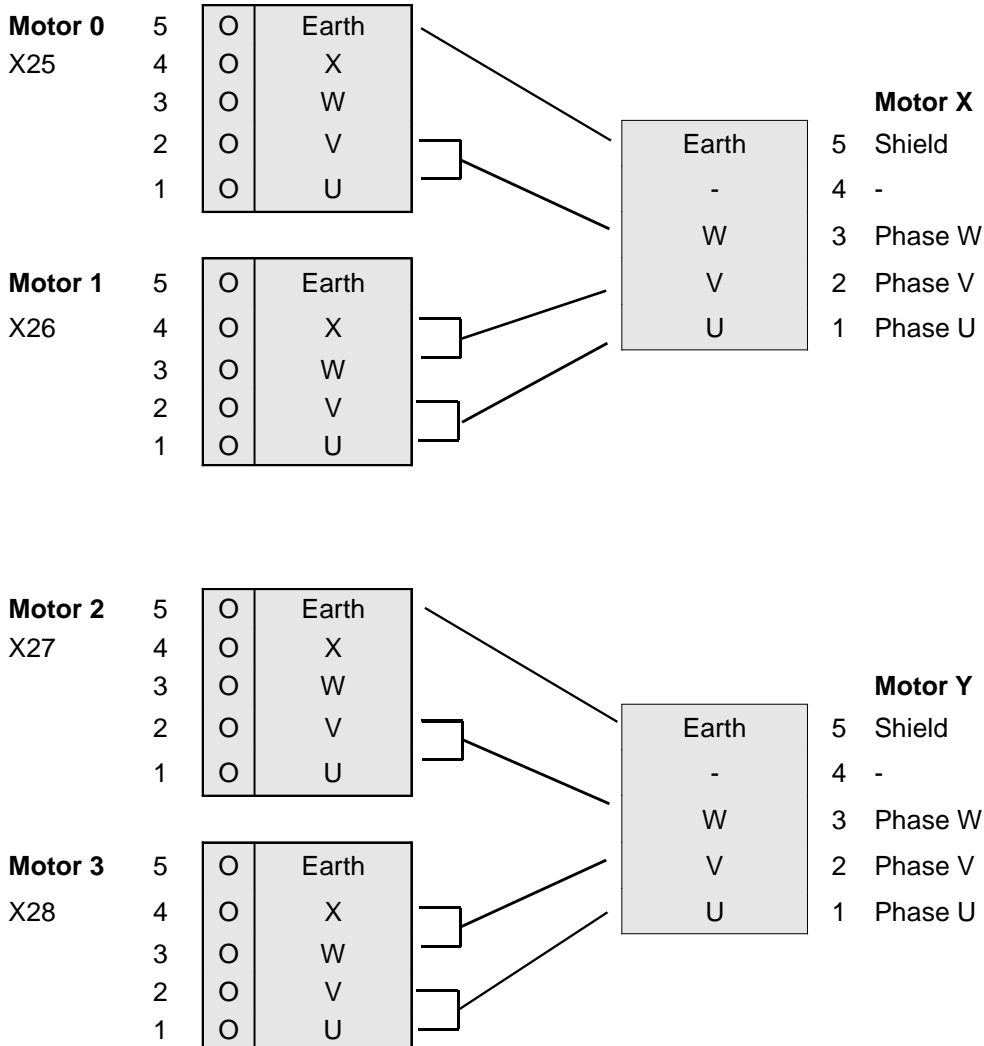
Stepper motors in parallel operation

Motor 0	5	O	Earth				
X25	4	O	X				
	3	O	W		**Motor X**		
	2	O	V	Earth	5	Shield	
	1	O	U	L2-	4	Stepper motor L2-	
				L2+	3	Stepper motor L2+	
Motor 1	5	O	Earth	L1-	2	Stepper motor L1-	
X26	4	O	X	L1+	1	Stepper motor L1+	
	3	O	W				
	2	O	V				
	1	O	U				

Motor 2	5	O	Earth				
X27	4	O	X				
	3	O	W		**Motor Y**		
	2	O	V	Earth	5	Shield	
	1	O	U	L2-	4	Stepper motor L2-	
				L2+	3	Stepper motor L2+	
Motor 3	5	O	Earth	L1-	2	Stepper motor L1-	
X28	4	O	X	L1+	1	Stepper motor L1+	
	3	O	W				
	2	O	V				
	1	O	U				
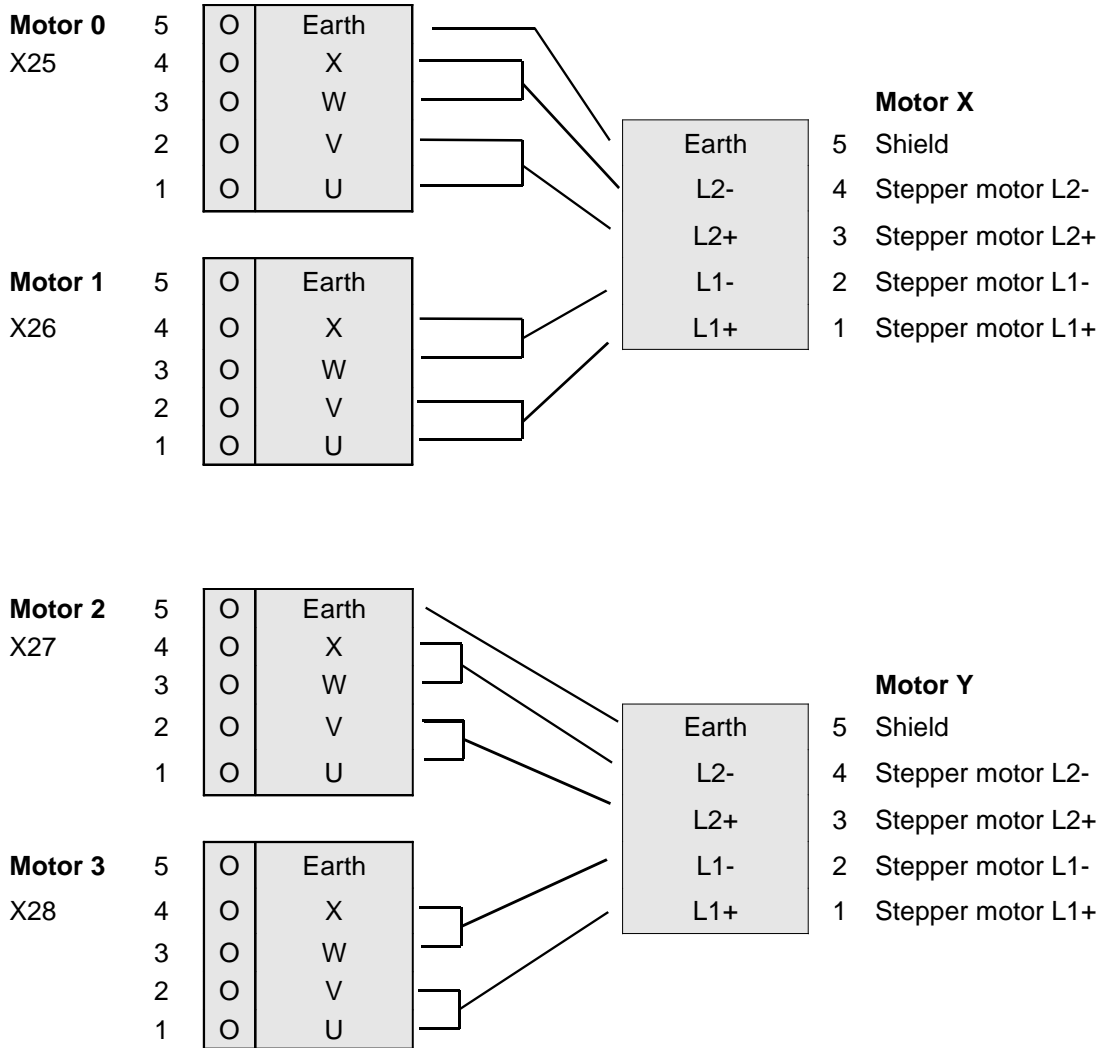
3.3.7   Dimensions of MAX boards

3.3.7.1 MAX-Boards
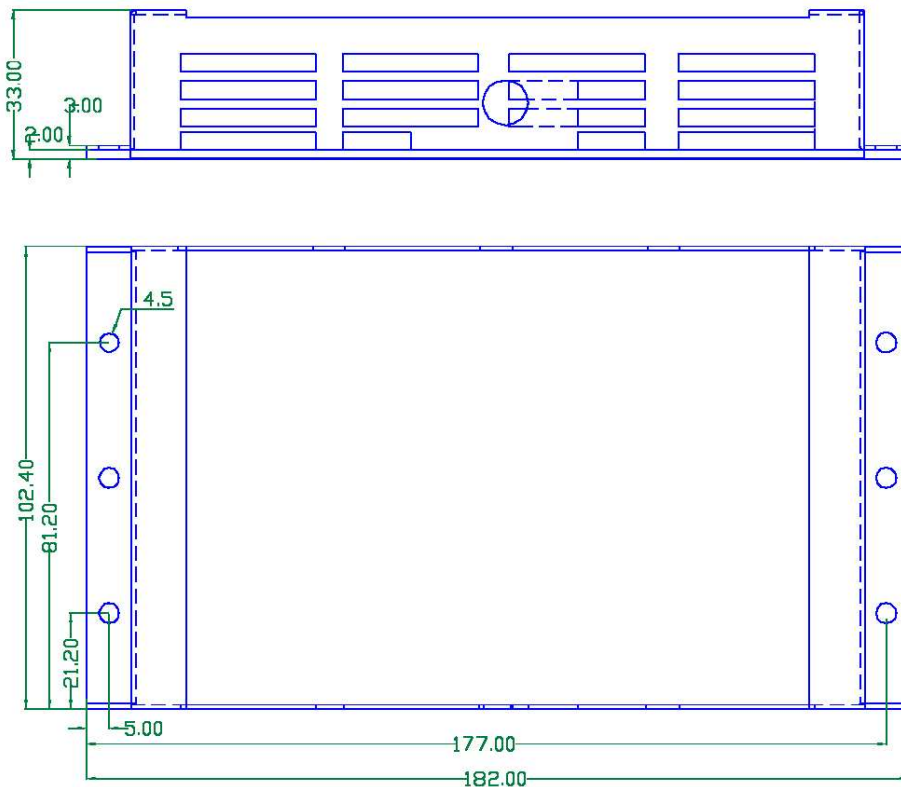
Fig. 9: MAX housing

Total height with pins, without cabling: 50mm

Pins at INFO-MAX2/4/10

Pins X1, X3
Pins with press-fit technology
Harting: 0973 196 6904 male

3.3.7.2 Connector board MAX2-DBIT

Dimensions of MAX2-DBIT
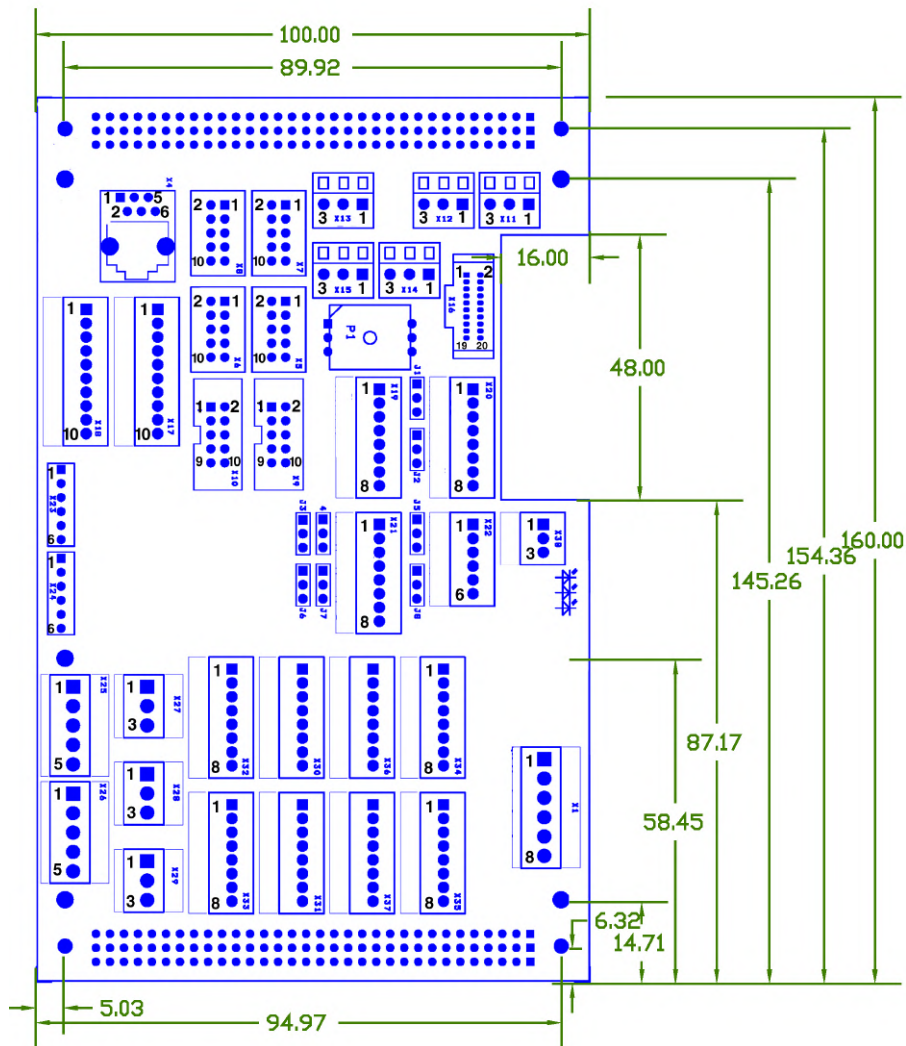
Fig. 10: MAX2-DBIT measurements

Vacuum sensor
- Honeywell SDX15A2
- Measuring range: 0 ... 15 psi
- Full Scale: 90mV

PT-100 inputs
4 PT-100 inputs at pins: X20, X21, X22
The measuring current for PT100 resistance is 3.3333mA.

Motor enabler input
Input 15 (DI15, pin 30) at pin X37 is reserved for the motor enabler. All output stages are released by input 15.

Thermocouple inputs
Thermocouple elements can be connected directly to pins X11 ... X15. There is a PT-100 balancing element on the connector board.

- Relative accuracy   256 averages   15 bit
- Absolute accuracy   45uV
- Type T,U   CU-constantan
- Type J,L   Fe-constantan
- Type E,K   Chromel-alumel
- Type B,E,R   Platinum-rhodium

Connection diagram
Pin assignment can be found in the file:
Anschluss-Schema-MAX-DBIT.pdf

Power consumption with connector board
INFO-MAX2 with MAX2-DBIT   280 mA
without load at analogue and digital outputs, without encoder

Pins on connector board MAX2-DBIT

|			
Pins X2, X3	Harting:	0903 296 6850	female
Pins with press-fit technology on connector board			
Companion piece on INFO-MAX2	Harting:	0973 196 6904	male
Pin X4, serial interface RS232	Compona	319 566	RJ12, 6p.
Pins on connector board			
Companion piece on serial cable	Compona	327 266	RJ 12, 6p.
Pins X5 ... X8	Molex microFit	90130-1210	Header, 10 p.
Encoder 1 ... 4, jack on connector board	Arrow	245270	
Companion piece on housing	Molex microFit	90142-0010	10 p. female
Crimp contacts	Molex microFit	90119-2110	gold, AWG 22-24
Crimp contacts	Molex microFit	90119-2120	gold, AWG 26-28
Crimp-Tool	Digikey	0638118700	
Removal tool series CGRID Molex	Digikey	69008-0003	
Pins X9 ... X10	Tyco	609-1027	
Encoder 1 ... 2, jack on connector board	Arrow	341380	

All information on pins is subject to correction.

Connection diagram
Pin assignment can be found in the file: Anschluss-Schema-MAX-DBIT.pdf

3.3.7.3 Connector board MAX4-DBIT

Dimensions of MAX4-DBIT
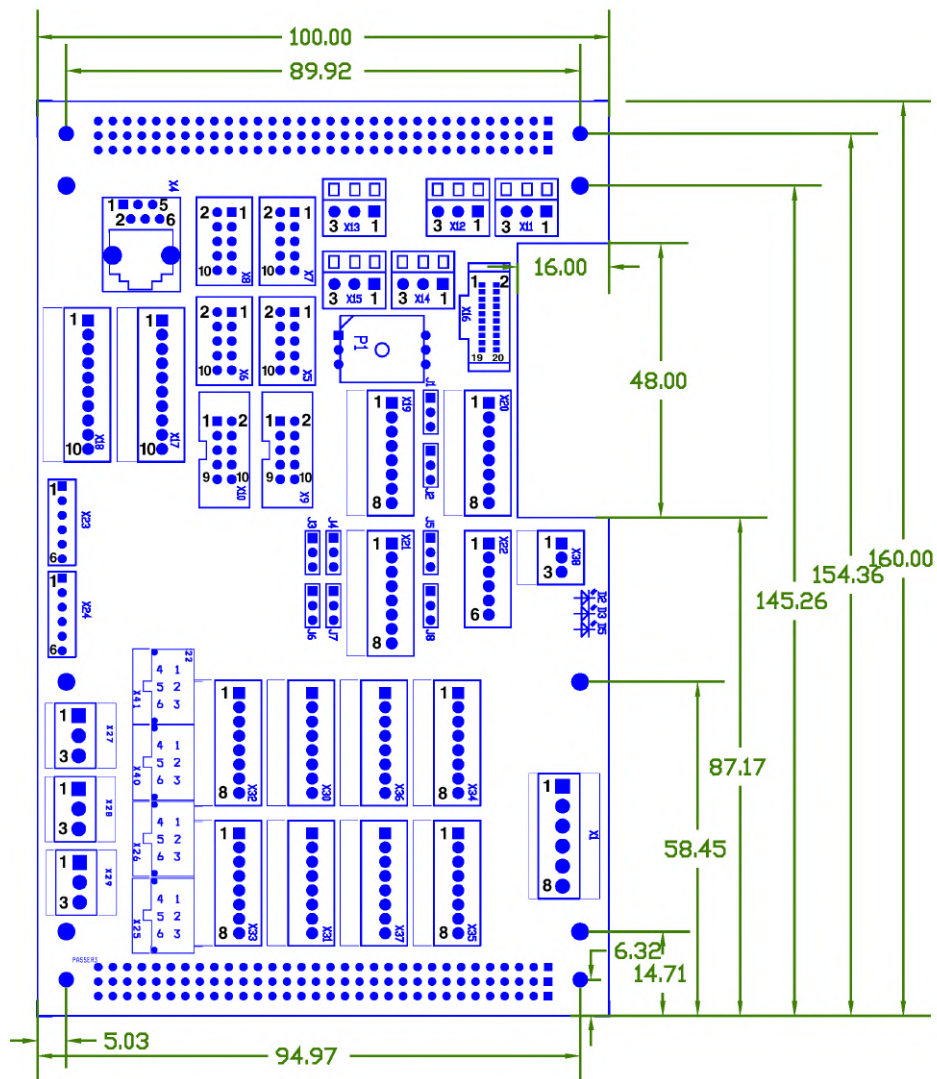
Fig. 11: MAX4-DBIT measurements

All pins as in MAX2-DBIT

Pins X25, X26, X40, X41 on connector board MAX4-DBIT

Motor pins	Molex	43045 series 250V/5A
	Arrow	43045-0612
Companion piece on cable		
Pin housing	Digikey	43025-0600
Crimp contacts	Molex microFit	43030-0007 tin-plated
Extraction tool Micro-Fit, Pico-Blade	Digikey	11-03-0043
Crimp-Tool	Digikey	63819-0000

All information on pins is subject to correction.

3.3.7.4 Connector board MAX-DBMT
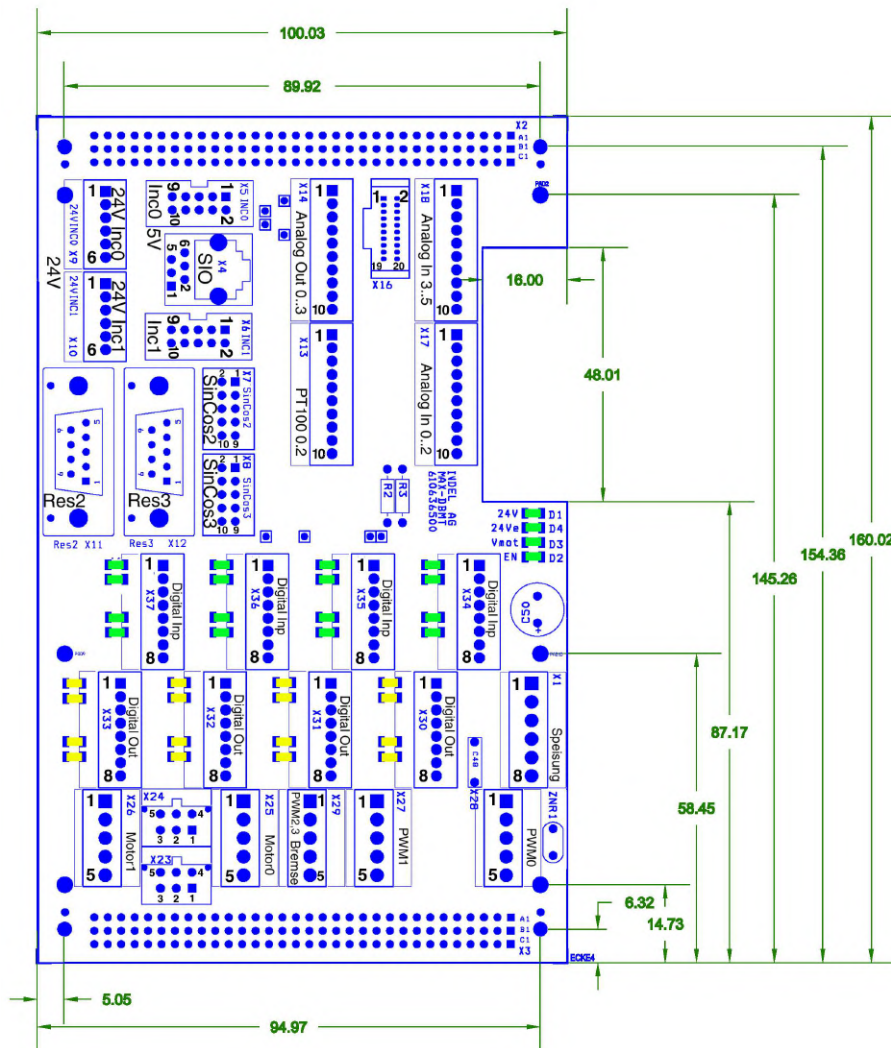
Dimensions of MAX-DBMT

Fig. 12: MAX-DBMT measurements

Digital I/Os
Status display for all I/Os

PT-100 inputs
2 PT-100 inputs at pin X13
The measuring current for PT100 resistance is 3.3333mA.

Motor enabler input
Input 15 (DI15, pin 30) at pin X37 is reserved for the motor enabler. All output stages are released by input 15.

24V encoder
24V encoders can be connected to pins X9, X10. With the 24V encoder version, only TTL encoders – not RS422 encoders – can be connected to pins X5, X6!

SinCos encoders and RS422 encoders can be connected to the SinCos inputs.

Thermocouple inputs
Thermocouple elements can be connected to pins X17 ... X18.
- Relative accuracy: 256 averages   15 bit
- Absolute accuracy   45uV
- Type T,U   CU-constantan
- Type J,L   Fe-constantan
- Type E,K   Chromel-alumel
- Type B,E,R   Platinum-rhodium

Resolver
Resolvers can be connected to pins X11, X12.

Analogue outputs
Analogue outputs 0 and 1 are free, analogue outputs 2 and 3 are reserved for the resolver reference and cannot be used.

PWM outputs
Loads such as heating elements can be connected to pins X27, X27.
- PWM voltage   48V
- PWM power   duration 3 ... 6A
- PWM power   max. 10A, resistant to short-circuiting

Power consumption with connector board
INFO-MAX2 with MAX-DBMT   450 mA
without load at analogue and digital outputs, 16 LEDs on, without encoder

Pins on connector board MAX-DBMT

Pins X2, X3 Pins with press-fit technology on connector board	Harting	0903 296 6850	female
Companion piece on INFO-MAX2	Harting	0973 196 6904	male
Pin X4, serial interface RS232 Pins on connector board	Compona	319 566	RJ12, 6p.
Companion piece on serial cable	Compona	327 266	RJ 12, 6p.
Pins X5 ... X6, encoders 0 ... 1 Jack on connector board	Tyco Arrow	609-1027 341380	
Pins X7 ... X8, SinCos 2, 3 Jack on connector board	Molex microFit Spoerle	90130-1210 245270	Header, 10-pole
Pins X9 ... X10, 24V incremental feedback encoder 0, 1 Jack on connector board, 6-pole	Phoenix	19 63 573	MCV 0.5/6-G-2.5 THT
Companion piece on encoder cable	Phoenix	18 81 367	FK-MCP 1.5/6-ST-2.5
Pins X11 ... X12, resolvers 2, 3 Jack on connector board	Harting	0966 151 6512 D-SUB standing female 9-pole	

For companion pieces see MAX-DBIT

Connection diagram
Pin assignment can be found in the file: Anschluss-Schema-MAX-DBMT.pdf

All information is subject to correction.

3.3.7.5 GinLink, ethernet connections

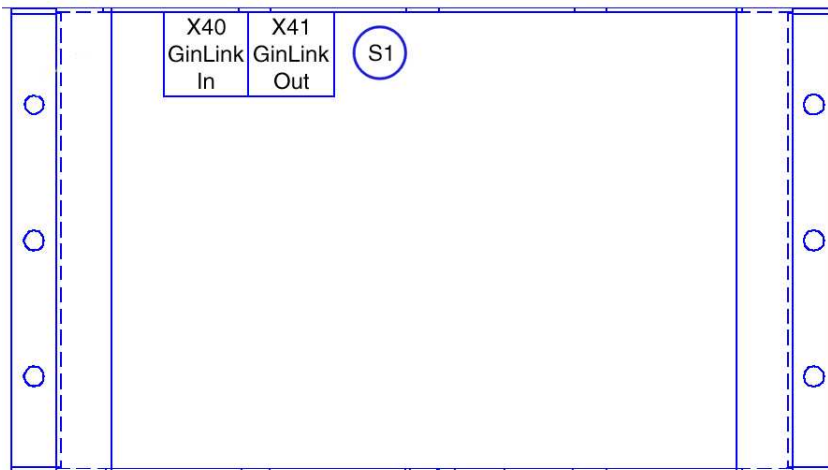*Fig. 13: GinLink, ethernet pins*

MAX4 board as GinLink slave

X40   GinLink In
X41   GinLink Out

MAX4 board as stand-alone controller

X40   GinLink In
X41   Ethernet

For stand-alone operation, rotary switch S1 must be set to 0x4.

3.3.8   Pin assignment for MAX-2,4

Pin X3 - MAX2/MAX4

	a			b			c	
1	I	+V0	IN	I	-V0	IN	I	+V1	IN
2	I	-V1	IN	I	+V2	IN	I	-V2	IN
3	I	+V3	IN	I	-V3	IN	I	+V4	IN
4	I	-V4	IN	I	+V5	IN	I	-V5	IN
5	I	+V6	IN	I	-V6	IN	I	+V7	IN
6	I	-V7	IN	I	+V8	IN	I	-V8	IN
7	I	+V9	IN	I	-V9	IN	I	+VA	IN
8	I	-VA	IN	I	+VB	IN	I	-VB	IN
9	I	+VC	IN	I	-VC	IN	I	+VD	IN
10	I	-VD	IN	I	PT R100		O	AGnd	
11	I	PT R270		O	+V1	Out	O	AGnd	
12	O	+V2	Out	O	+V0	Out	O	AGnd	
13	O	+V3	Out	O	Gnd		I	Enc_2_Sin+	
14	I	Enc_2_Sin-		O	+ENC_5V		I	Enc_2_Cos+	
15	I	Enc_2_Cos-		O	Gnd		I	Enc_2_Ref+	
16	I	Enc_2_Ref-		O	+ENC_5V		I	Enc_3_Sin+	
17	I	Enc_3_Sin-		O	Gnd		I	Enc_3_Cos+	
18	I	Enc_3_Cos-		O	+ENC_5V		I	Enc_3_Ref+	
19	I	Enc_3_Ref-		O	Gnd		I	Enc_0_A+	
20	I	Enc_0_A-		O	+ENC_5V		I	Enc_0_B+	
21	I	Enc_0_B-		O	Gnd		I	Enc_0_Ref+	
22	I	Enc_0_Ref-		O	+ENC_5V		I	Enc_1_A+	
23	I	Enc_1_A-		O	Gnd		I	Enc_1_B+	
24	I	Enc_1_B-		O	+ENC_5V		I	Enc_1_Ref+	
25	I	Enc_1_Ref-		O	Gnd		O	Erde	
26	O	C_DTR		O	C_TxD		I	C_RxD	
27	I	C_DSR		O	Gnd		I	Ext_Board	
28	O	SCLA		B	SDA		O	+3.3V	
29	I	EEWC		O	SER_CLK		O	SER_Load	
30	O	SER_OEN		O	SER_DMD		I	SER_DDM	
31	O	+15V		O	-15V		O	AGnd	
32	O	-5V		O	+5V		O	AGnd	

Fig. 14: MAX2/4 pin assignment, X3

Pin-Out	
+V0 / -V0 … +VD / -VD	Analoge Eingänge differenziell
PT R 100 / PT R 270	Referenzwiderstände für PT-100 Messung
+V0 Out … +V3 Out	Analoge Ausgänge
AGnd	Analoges Ground
ENC_5V / Gnd	Speisung für SinCos-, Inkremental-Geber 5V DC
ENC_Sin / ENC_Cos	Sinus-Cosinus, Nullimpuls von SinCos-Geber bzw.
ENC_Ref	A-, B-, NP von Inkrementalgeber
ENC_A / ENC_B	A-, B-, NP von Inkrementalgeber
C_TxD / C_RxD	Sende-, Empfangs-Leitung von RS232 Schnittstelle
C_DTR / C_DSR	Steuer-Signale von RS232 Schnittstelle
Ext_Board	Erkennung Anschlussboard
SCLA / SDA / EEWC	I2C Bus für EEPROM
SER_CLK	Schieberegister-Clock
SER_Load	Schieberegister-Load
SER_OEN	Schieberegister-Enable
SER_DMD	Daten von MAX2 -> Anschlussboard
SER_DDM	Daten von Anschlussboard -> MAX2
+15V / -15V / +5V / AGnd	Spannungen für analoge Peripherie

Fig. 15: MAX2/4 pin description, X3

3.3.9   Pin assignment for MAX-2

Pin X1 - MAX2

		a		b		c
1	I	+24V	I	+24V	I	+24V
2	I	Gnd	I	Gnd	I	Gnd
3	I	Gnd	I	Gnd	I	Gnd
4	I	Gnd	I	Gnd	I	Gnd
5	I	Gnd	I	Gnd	I	Gnd
6	I	DIN 0	I	DIN 1	I	DIN 2
7	I	DIN 3	I	DIN 4	I	DIN 5
8	I	DIN 6	I	DIN 7	I	DIN 8
9	I	DIN 9	I	DIN 10	I	DIN 11
10	I	DIN 12	I	DIN 13	I	DIN 14
11	I	DIN 15	O	Gnd	O	DOUT 0
12	O	DOUT 1	O	Gnd	O	DOUT 2
13	O	DOUT 3	O	Gnd	O	DOUT 4
14	O	DOUT 5	O	Gnd	O	DOUT 6
15	O	DOUT 7	O	Gnd	O	DOUT 8
16	O	DOUT 9	O	Gnd	O	ERDE
17	O	DOUT 10	O	DOUT 11	O	Gnd
18	O	DOUT 12	O	DOUT 13	O	Gnd
19	O	DOUT 14	O	DOUT 15	I	24VDO 2
20	I	24VDO 1	I	24VDO 1	I	24VDO 2
21	O	PWM 0	O	PWM 0	O	PWM 0
22	O	PWM 1	O	PWM 1	O	PWM 1
23	O	BRAKE	O	BRAKE	O	BRAKE
24	O	MOT_0U	O	MOT_0U	O	MOT_0U
25	O	MOT_0W	O	MOT_0W	O	MOT_0W
26	I	V_MOT	I	V_MOT	I	V_MOT
27	O	MOT_0V	O	MOT_0V	O	MOT_0V
28	O	MOT_1V	O	MOT_1V	O	MOT_1V
29	I	V_MOT	I	V_MOT	I	V_MOT
30	O	MOT_1U	O	MOT_1U	O	MOT_1U
31	O	MOT_1W	O	MOT_1W	O	MOT_1W
32	I	V_MOT	I	V_MOT	I	V_MOT

Fig. 16: MAX 2 pin assignment, X3

Pin-Beschreibung	
+24V / Gnd	24V Kartenspeisung, gemeinsames Ground für Kartenspeisung und Endstufen (Motoren)
DIN 0 ... DIN15	Digitale 24V Eingänge
DOUT 0 ... DOUT 15	Digitale 24V Ausägne, kurzschlussfest
24V DO 1	Speisung für DOUT 0 ... 7
24V DO 2	Speisung für DOUT 7 ... 15
PWM 0 / PWM 1	PWM Ausägne 0 ... 1
BRAKE	Bremse für Zwischenkreis Begrenzung
MOT_0U / MOT_0W	Vollbrücke 1
MOT_1U / MOT_1W	Vollbrücke 2
MOT_0V / MOT_1V	Vollbrücke 3
V_MOT	Speisung für Endstufen: PWM-Ausgänge und Vollbrücken

Fig. 17: MAX2 pin description, X

3.3.10 Pin assignment for MAX-4

Pin X1 - MAX4

		a		b		c
1	I	+24V	I	+24V	I	+24V
2	I	Gnd	I	Gnd	I	Gnd
3	I	Gnd	I	Gnd	I	Gnd
4	I	Gnd	I	Gnd	I	Gnd
5	I	Gnd	I	Gnd	I	Gnd
6	I	DIN 0	I	DIN 1	I	DIN 2
7	I	DIN 3	I	DIN 4	I	DIN 5
8	I	DIN 6	I	DIN 7	I	DIN 8
9	I	DIN 9	I	DIN 10	I	DIN 11
10	I	DIN 12	I	DIN 13	I	DIN 14
11	I	DIN 15	O	Gnd	O	DOUT 0
12	O	DOUT 1	O	Gnd	O	DOUT 2
13	O	DOUT 3	O	Gnd	O	DOUT 4
14	O	DOUT 5	O	Gnd	O	DOUT 6
15	O	DOUT 7	O	Gnd	O	DOUT 8
16	O	DOUT 9	O	Gnd	O	ERDE
17	O	DOUT 10	O	DOUT 11	O	Gnd
18	O	DOUT 12	O	DOUT 13	O	Gnd
19	O	DOUT 14	O	DOUT 15	I	24VDO 2
20	I	24VDO 1	I	24VDO 1	I	24VDO 2
21	O	PWM 0	O	PWM 0	O	PWM 0
22	O	PWM 1	O	PWM 1	O	PWM 1
23	O	BRAKE	O	BRAKE	O	BRAKE
24	O	MOT_0U	O	MOT_0U	O	MOT_2U
25	O	MOT_0W	O	MOT_0W	O	MOT_2W
26	I	V_MOT	I	V_MOT	I	V_MOT
27	O	MOT_0V	O	MOT_0V	O	MOT_2V
28	O	MOT_1V	O	MOT_1V	O	MOT_3V
29	I	V_MOT	I	V_MOT	I	V_MOT
30	O	MOT_1U	O	MOT_1U	O	MOT_3U
31	O	MOT_1W	O	MOT_1W	O	MOT_3W
32	I	V_MOT	I	V_MOT	I	V_MOT

Fig. 18: MAX4 pin assignment, X3

Pin-Beschreibung	
+24V / Gnd	24V Kartenspeisung, gemeinsames Ground für Kartenspeisung und Endstufen (Motoren)
DIN 0 ... DIN15	Digitale 24V Eingänge
DOUT 0 ... DOUT 15	Digitale 24V Ausägne, kurzschlussfest
24V DO 1	Speisung für DOUT 0 ... 7
24V DO 2	Speisung für DOUT 7 ... 15
PWM 0 / PWM 1	PWM Ausägne 0 ... 1
BRAKE	Bremse für Zwischenkreis Begrenzung
MOT_0W / MOT_0U	Vollbrücke 1
MOT_2W / MOT_2U	Vollbrücke 2
MOT_1W / MOT_1U	Vollbrücke 3
MOT_3W / MOT_3U	Vollbrücke 4
MOT_0V / MOT_2V	Vollbrücke 5
MOT_1V / MOT_3V	Vollbrücke 6
V_MOT	Speisung für Endstufen: PWM-Ausgänge und Vollbrücken

Fig. 19: MAX4 pin description, X

3.3.11 Supplies to MAX boards

Supply	Pin	Supply for
+24V_IN	X1: A1, B1, C1	Digital inputs Analogue inputs Logic supply Encoders: Incremental, SinCos
+24V DOut 1	X1: A20, B20	Digital outputs 0 ... 7
+24V DOut 2	X1: C19, C20	Digital outputs 8 ... 15
0V	X1: A2, B2, C2 X1: A3, B3, C3 X1: A4, B4, C4 X1: A5, B5, C5	Ground
+V Mot	X1: A26, B26, C26 X1: A29, B29, C29 X1: A32, B32, C32	Motor supply 24 ... 48V
0V	X1: B11, B12, B13, X1: B14, B15, B16	Ground
Earth	X1: C15	Earth

Important
Motor "0V " and logic "0V" are galvanically connected!

4   Serial interface

RS232 Norm	Connector board AX4-Board			Cable		PC (9-pole pin)	
Pin 1	-				nc	Pin 1
Pin 2	Pin 1	Tx	Output	⟶	Rx	Pin 2
Pin 3	Pin 2	Rx	Input	⟵	Tx	Pin 3
Pin 4	Pin 3	DTR	Output		DTR	Pin 4
Pin 5	Pin 4	DSR	Input	⤬	DSR	Pin 6
Pin 6	Pin 5	Gnd		⟷	Gnd	Pin 5
Pin 7	Pin 6	nc			nc	Pin 7
Pin 8	-				nc	Pin 8
					nc	Pin 9
					Shield	Housing
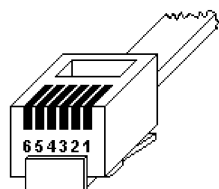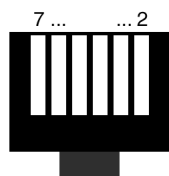
Fig. 20: RJ pin   Fig. 21: RJ-12(6P6C)

5   Connection examples

5.1   Motors on MAX2 board

AC-Servo Motor 1

INFO-MAX2 Board   Distribution Board   Cable

Fig. 22: Connection example for AC servo motor 1

DC-Servo Motor 1

INFO-MAX2 Board   Distribution Board   Cable
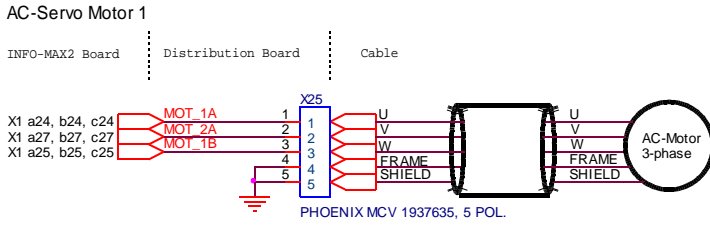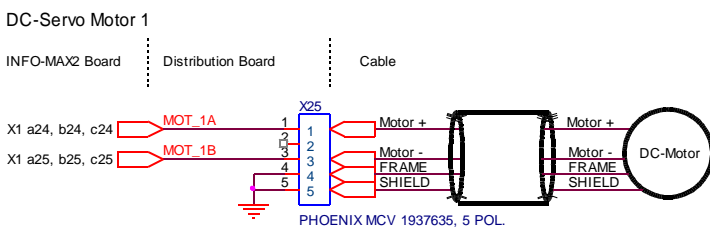
Fig. 23: Connection example for DC motor 1

AC-Servo Motor 2

INFO-MAX2 Board   Distribution Board   Cable
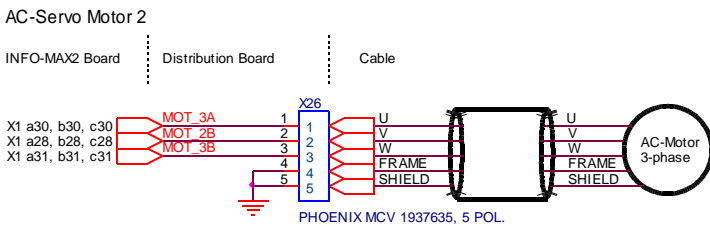
Fig. 24: Connection example for AC servo motor 2

DC-Servo Motor 2

INFO-MAX2 Board   Distribution Board   Cable
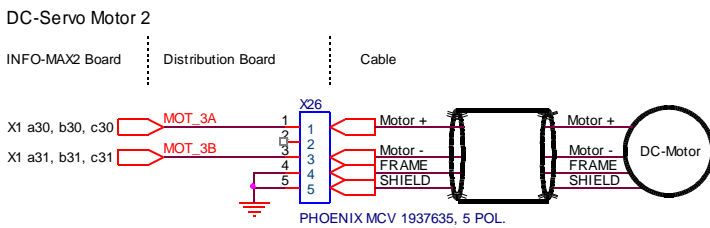
Fig. 25: Connection example for DC motor 2
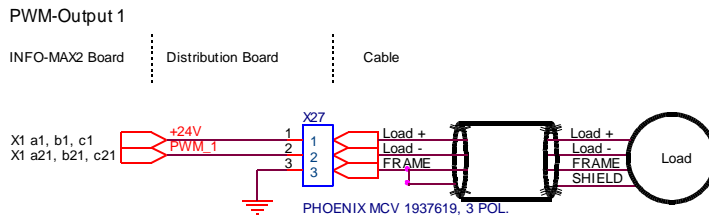
Fig. 26: Connection example for PWM output 1
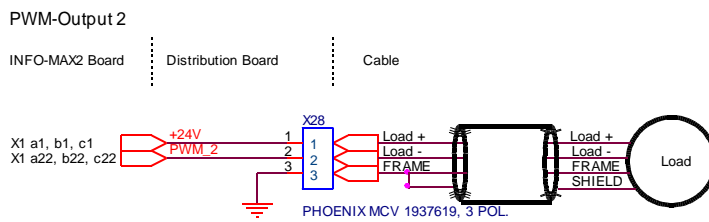
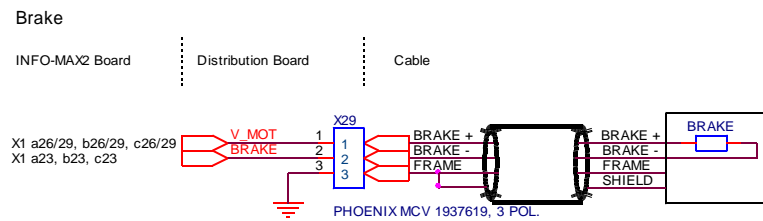*Fig. 27: Connection example for PWM output 2*
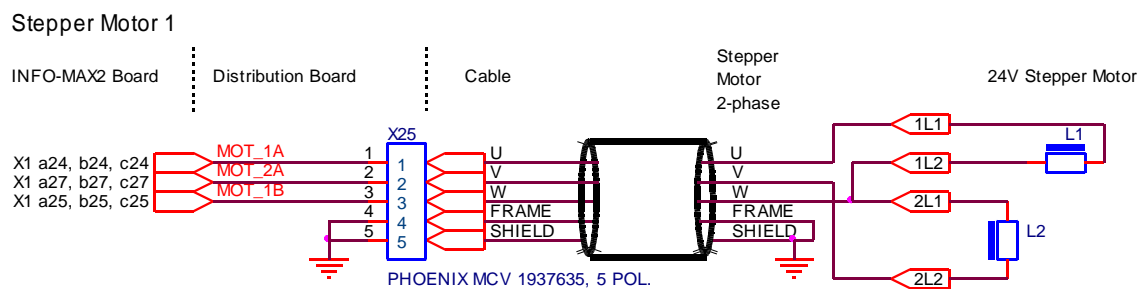

Fig. 28: Connection example for brake

Fig. 29: Connection example for stepper motor 1

2-phase stepper motors with Ucc/2: As there are 3 outputs available per motor, one end of both coils must be connected to a shared output in the case of a 2-phase stepper motor.

This shared connection is raised to 24V by the motor control. The two other ends of the coils are each wired to a free output. This allows a 48V motor to be operated at max. 24V.

5.2   Wiring of digital inputs and outputs

The wiring of the digital inputs and outputs is identical on all MAX boards and AX4 boards:
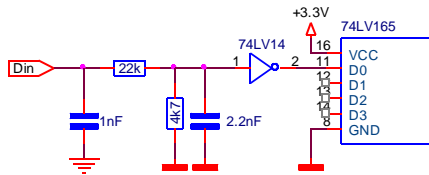
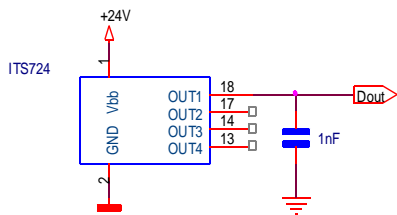

Fig. 30: Wiring of digital inputs

Fig. 31: Wiring of digital outputs

6   Installation

Assembly
Assembly must be carried out according to the documentation and using suitable tools. The devices must only be assembled when switched off. When carrying out wiring work on the drive, the control cabinet must be secured against reactivation. National accident prevention regulations must be complied with. Electrical installation must be carried out in accordance with national provisions (wire colours, cross-sections, fuses, protective earth connection, etc.).

Card supply
A regulated 24V supply with sufficient reserve capacity is recommended for the power supply to the card. The 24V supply must be equipped with a mains filter.

Shielded cables
The resolver and SinCos interface signals are extremely susceptible to interference, meaning that these lines are equipped with a pair-twisted and double shielded cable.
The INC encoder and serial interface, as well as the motor cable, must be shielded cables!

The motor cables must be placed on an uncoated metallic base plate with a bracket with all-round contact in front of the motion board.

Also see "Indel-Verdrahtungsrichtlinie.pdf"

Potential equalisation
Apply all shielding on both sides. You may need to use a potential compensator in order to avoid unwanted leakage currents over the shielding, particularly in the case of larger distances or different supplies. See "Indel wiring guidelines".

Shield rail
The control cabinet must include a shield rail, to which all shielded cables can be attached. Metallic pins with all-round contact with the shielding are also suitable for cable insertion.

The motor boards must be assembled on the assembly plate with good conductivity. All shielded cables must be shielded on both sides.

Plug-in connections
Interruptions in the resolver and motor cables – when leading them into a cabinet or similar – should be designed with metal plug connections, not clamp connections. This ensures that the cable shielding is not interrupted unnecessarily.

Inputs and outputs
The additional digital inputs and outputs can only be wired within the control cabinet. If the cabling is longer than 1m, these inputs and outputs must also be equipped with shielding.

Motor temperature
The motor temperature can be measured using either a bi-metal switch (T-switch) in the motor or an NTC (MTemp). The bi-metal switch can only be wired with the motor cables. The NTC can only be wired in the resolver cables. (Insulation class!)

Cabling

The motor cable must be laid separately from the signal and network cables. Motor cables must not lead over clamps; if necessary, use metallic plug connectors. The shielding must be attached with all-round contact in the pin.

Also see Indel wiring guidelines and INDEL setup guidelines.

Protective earth connection (PE)

The protective earth must be designed in accordance with EN 61800-5-1:

Cross-section of the outer conductor [mm²]	Minimum cross-section of the corresponding protective earth conductor S_p [mm²]
S ≤ 16	S
16 < S ≤ 16	16
35 < S	S/2

Table 6.1

Protective earth conductors that are not part of a cable must have a minimum cross-section of 4mm2.

Mains filter

The power supply must be equipped with a filter. The optimum filter and placement may need to be defined by means of an emission measurement as the emitted interference is dependent upon the motor cable length, among other things. Without correctly dimensioned filters, the product may cause very frequent interference.

6.1 *Cooling and ventilation*

Sufficient measures must be taken to ensure that the temperature in the control cabinet does not exceed the specified maximum. Fans or air conditioning units must therefore be placed in suitable locations inside the control cabinet.

If air conditioning units are being used, it must be ensured that excessively low temperatures do not cause condensation.

> **Cold air exiting the air conditioning unit must be prevented from blowing directly onto the housing of a servo drive. In unfortunate cases, particularly where humidity is high, this can lead to condensation on the inside of the device.**

6.1.1   Notes on UL directive

Motor overload protection
External motor overload protection must be provided by the user.

Additional overload protection is provided for motors by means of temperature sensors in the field winding. The user is responsible for applying this overload protection.

Only use UL-certified copper wires for 75℃.

UL fuses and cable cross-sections
The controller requires a fuse in the supply line. Only use UL-certified fuses and holders. Triggering characteristic "K".

Safety fuse A	Cable cross-section mm^2	AWG
5	1	17
10	1	17
25	6	9
25	6	9

Manufacturers of UL-certified safety fuses:

- FS Ferraz Shawmut
- Limitron KTK from Bussmann

6.1.2   Braking resistance
There is no braking resistor on the MAX2 board. The external braking resistor must be secured against thermal overload.

Supply: 48V
Ballast 0%   Ucc = 50V
Ballast 100%   Ucc = 52V

Supply: 24V
Ballast 0%   Ucc = 25V
Ballast 100%   Ucc = 27V

For resistance values for the braking resistor see technical details.

7   Operation

7.1   Braking resistor

It is highly recommended that a braking resistor be used on all motion boards.
e.g. 150 Ohm 2W for minimum braking energy destruction.

The braking resistance must be dimensioned in accordance with the application.

7.2   Motion boards with an ethernet interface

The following conditions must be met in order to be able to speak to the MAX-2,4,10 motion boards or the AX4 board via the ethernet interface:

- Ethernet communication must run at 1GHz. In addition, a 1GBit-enabled switch can also be used in order to use PCs or laptops with a 100MBit interface
- The address switch on the motion board must be set to 0x4
- The GinLink pin Gin-Out is used for the ethernet connection

8   Fieldbus systems

8.1   *GinLink*
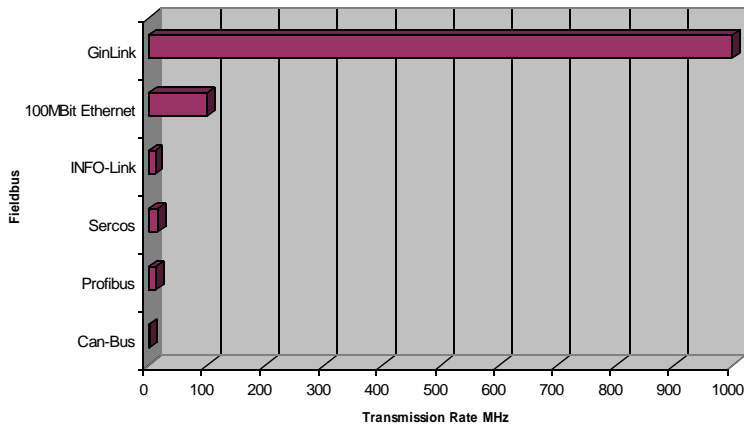
- GHz fieldbus, max. 32kHz cycle time
- Ethernet, up to 100m segment length
- GinLink frames packed into ethernet frames
- Standard ethernet frames: PowerLink, EtherCat cameras
- Deterministic transmission
- Jitter <70ns
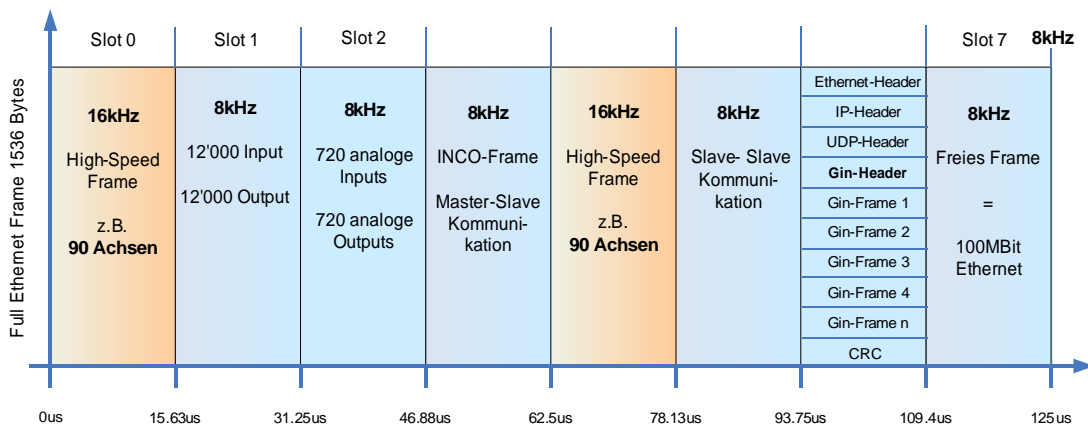
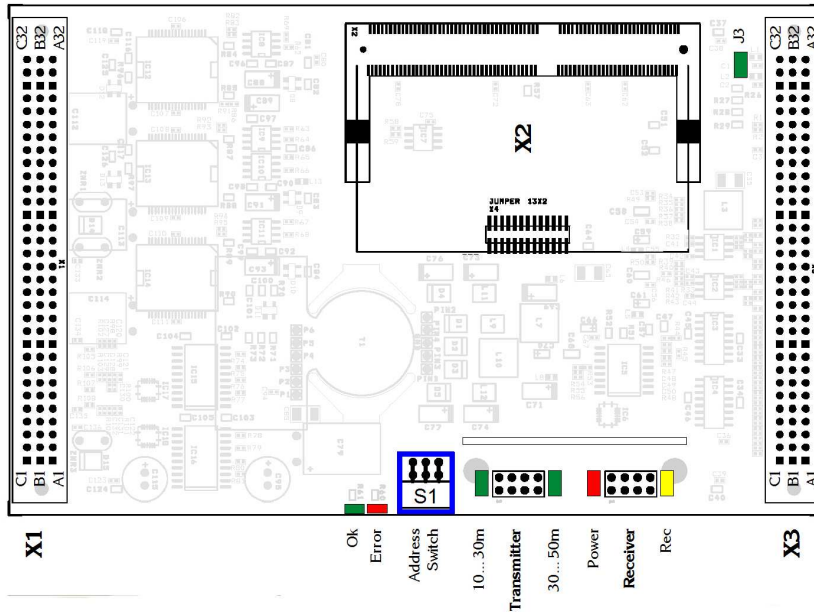|	Number	Sampling-Rate	Data
Axes	90	16kHz	4 x 32 Bit
Digital Inputs	12000	8kHz	1 Bit
Digital Outputs	12000	8kHz	1 Bit
Analog Inputs	720	8kHz	16 Bit
Analogue outputs	720	8kHz	16 Bit
Communication			
Slave to Master	1	8kHz	11.5 MByte/s
Slave to Slave	1	8kHz	11.5 MByte/s
Standard Ethernet frames	2	8kHz	23.0 MByte/s

8.2   INFO-Link

Fig. 32: MAX equipment

Addressing (blue)

S1 Low	0x00	0x01	0x02	0x03	0x04
Axis 0	00	10	20	30	40
Encoder 1	01	11	21	31	41
Axis 2	02	12	22	32	42
Encoder 3	03	13	23	33	43
PWM 0					
PWM 1					
Digital Output	0...15	16..31			
Digital input	0 ... 15	16..31			
Analogue input	0 ... 13	14..25			
Analogue output	0 ... 3	4 ... 7			

LEDs on the receiver module

Power	=	+5V supply
Rec	=	INFO-link receiver-signal OK

Transmitting power jumper (green)

The jumpers influence the brightness of the transmitting LEDs, and therefore the segment length of the fibre cable to the next card.

Segment length	Jumper position
0 ... 10m	no jumper
8 ... 30m	10 ... 30 m
20 ... 50m	30 ... 50 m

8.3   *Error messages*

Stop, deactivated	0x0000'0001
Ucc below Ucc min	0x0000'0002
Ucc above Ucc max	0x0000'0004
I2t exceeded > 120%	0x0000'0008
Output stage overheated	0x0000'0010
Motor temp exceeded	0x0000'0020
Motor short-circuit / IGBT protection	0x0000'0040
Resolver SinCos error	0x0000'0080
Maximum rotational speed exceeded	0x0000'0100
Safety relay not switched on	0x0000'0200
Auto-commutation error	0x0000'0400
Power end stop reached	0x0000'0800
Phase error	0x0000'1000
PWM watchdog: Interrupt overrun	0x0000'2000
missing Exteral Enable	0x0000'4000
missing (Motor) configuration	0x0000'8000
Feldbus Watchdog	0x0001'0000

8.4   *Warnings*

Ucc below Ucc ok	0x0000'0001
Ucc is set up and OK	0x0000'0002
Warning Iq_max reached	0x0000'0004
Warning output phase hot	0x0000'0010
Warning I2t exceeded	0x0000'0020
Motor temp exceeded	0x0000'0040
100% modulation exceeded	0x0000'0080
Warning unloading time exceeded	0x0000'0100

9 Sales and service

9.1 *Manufacturer*

Indel AG
Tüfiwis 26
CH-8332 Russikon
Switzerland

info@indel.ch
www.indel.ch

Tel.   +41 / 44 956 20 00
Fax   +41 / 44 956 20 09

9.2 *Maintenance, cleaning, repair*

The Indel servo drives are maintenance-free. Any warranty shall expire if the housing is opened.

Do not submerge or spray the housing. In the event of contamination inside the unit: have it cleaned by the manufacturer.

Repairs can only be carried out by authorised specialist personnel. Any warranty on the part of Indel shall expire in the event of unauthorised intervention.

9.3 *Transport and storage*

When storing, please consider the effect of the ambient conditions: avoid impermissible stresses such as mechanical load, temperature, moisture, aggressive atmospheres.

9.4 *Disposal*

The Indel servo drives are made of various materials:
steel housing, aluminium heat sinks, electronic board

The individual components must be disposed of properly. All Indo servo drives can be returned to Indel AG for proper disposal. The sender shall bear the costs of transport.

9.5   Declaration of conformity

<div style="border:1px">

CE

DECLARATION OF CONFORMITY

We,   INDEL AG
       Tüfiwis 26
       Postfach
       CH-8332 Russikon

hereby declare that the product families listed below:

GinLink, INFO-LINK, IMP-Controlling System, IPS-32/16 and EXT-Fieldbus

to which this declatation relates, are in conformity with the essential requirements of the Directive and the following Standards and other Normative Documents:

Directives
Machine Directive 2006/42/EG
Low Voltage Directive 2006/95/EG
EMC-Directive 2004/108/EG

Authorised Person
Person authorised to compile technical file in accordance with Annex VII A of Directive 2006/42/EC:

       Arthur Jericke
       Indel AG
       Tüfiwis 26
       CH-8332 Russikon
       Switzerland

Savety of Machinery

Savety of Machinery - Electrical equipment of machines	EN 60204-1: 2006
Adjustable speed electrical power drive systems	EN 61800-5-1: 2007
Adjustable speed electrical power drive systems	EN 61800-5-2: 2007

Emission standard for industrial environment	**EN 61000-6-4 (2007)**
Electromagnetic disturbance characteristics (radiated)	EN 55011 (2007)
Electromagnetic disturbance characteristics (conducted)	EN 55011 (2007)

Immunity for industrial environment	**EN 61000-6-2 (2001)**
Electrostatic discharge immunity test	EN 61000-4-2 (2001)
Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3 (2001)
Immunity to conducted disturbances, radio frequencies fields	EN 61000-4-6 (2007)
Electrical fast transient/burst immunity test	EN 61000-4-4 (2004)
Surge immunity test	EN 61000-4-5 (2001)
Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11 (2004)

Russikon, 28.06.2010   CEO

                                             Arthur Jericke   INDEL AG

Rev 1006	Tel. +41 44/956 20 00 Fax +41 44/956 20 09	**1**	CH-8332 Russikon Tüfiwis 26

INDEL AG
INDUSTRIELLE ELEKTRONIK

</div>

CE

The products below are in conformity with the requirements of the CE-Directives:

GinLink

610736800	GIN-SAM3
610736801	GIN-SAM3
610736804	GIN-SAM3
610736940	GIN-SAC3x3
610941700	GIN-SAC3x3
610838600	GIN-MAX10
610636340	GIN-MAX4
610636341	GIN-MAX4
610838842	GIN-SAC3
610838844	GIN-SAC3
610838845	GIN-SAC3
610838846	GIN-SAC3
610838848	GIN-SAC3
611041900	GIN-AX42

IMP-Controlling System

609826800	IMP-6PLR
609826900	IMP-8PIN
609827110	IMP-5VPS
609928500	IMP-8POT
609929200	IMP-IOPC
609929500	IMP-PT100
609929800	IMP-CNT
609929801	IMP-INC
609929802	IMP-SSI
609929900	IMP-FADC
609929901	IMP-FADC
610031001	IMP-DAC
610031200	IMP-SMI
610132200	IMP-SMC
610132300	IMP-SSR
610132400	IMP-SIO
610132500	IMP-DCM
610233200	IMP-4RE
610334000	IMP-SSI-L
610334200	IMP-4DC
610334400	IMP-MAS2
610334401	IMP-MAS2
610334402	IMP-MAS2
610334500	IMP-I8OUT
610334600	IMP-I8IN
610334601	IMP-I8IN
610434800	IMP-MASp
610535300	IMP-TRIAC
610636600	IMP-MAS3
610839100	IMP-16PIN
610839000	IMP-16POT
610940610	IMP-GIN-MAS
610940600	IMP-GIN-MAS

INFO-Link

609314700	KLM-48
609314900	ZK-IGEN
609314901	ZK-IGEN
609314902	ZK-IGEN
609314903	ZK-IGEN
609314904	ZK-IGEN
609315000	INFO-DFM
609315001	INFO-USM
609416000	INFO-16P
609416100	INFO-4KP
609416102	INFO-SPM
609416300	INFO-ADC
609416400	INFO-DAC
609416601	INFO-PCM

609416602	INFO-PCM
609416700	INFO-PT100
609417200	INFO-FAD
609417300	INFO-DEI
609520000	INFO-SSI
609520200	INFO-DEX
609520201	INFO-LEX
609520202	INFO-LEX
609520500	INFO-4KPr
609520700	EMV-TEST
609520800	INFO-16Pr
609622000	INFO-SIO
609622100	INFO-I16r
609622200	INFO-TSP
609622321	INFO-PPC
609622400	INFO-ADAr
609622401	INFO-ADCr
609622402	INFO-DACr
609622600	INFO-32Ir
609622700	INFO-32Or
609622800	BT-16r
609623000	FCP-PCTA
609623001	FCP-PCTA
609623200	INFO-ADA
609724200	INFO-TTL
609724201	INFO-TTL
609724330	INFO-SAM
609724332	INFO-SAM
609724500	INFO-MUM
609724800	INFO-PT100r
609725100	ZK-MESS
609725200	INFO-SIOr
609725300	INFO-DIF
609725310	INFO-DIF
609725400	INFO-LCD
609725500	ZK-ZUSP
609725501	ZK-ZUSP
609725700	INFO-ZLK
609725800	INFO-MESS
609826000	BALZ-ADC
609826100	BALZ-DAC
609826200	BALZ-16P
609826700	INFO-FSH
609827300	INFO-BVO
609827400	INFO-AC1r
609827401	INFO-AC3r
609928800	INFO-CPV
609929000	INFO-HCPr
609929300	INFO-16Ps
609929700	INFO-MASi
609930200	INFO-HCSx
609930300	INFO-HCPx
610132000	INFO-MMI
610132600	INFO-SAM2
610132601	INFO-SAM2
610132603	INFO-SAM2
610132604	INFO-SAM2r
610132606	INFO-SAM2
610132607	INFO-SAM2
610333700	INFO-PCI2
610333701	INFO-PCI2
610333720	INFO-PCI2
610334301	INFO-PVC
610434900	INFO-SAC2
610434901	INFO-SAC2
610434902	INFO-SAC2
610434903	INFO-SAC2

610434904	INFO-SAC2
610434905	INFO-SAC2
610434906	INFO-SAC2
610434907	INFO-SAC2
610434908	INFO-SAC2
610434909	INFO-SAC
610535100	INFO-HCS2r
610535101	INFO-HCS2r
610535102	INFO-HCS2r
610535103	INFO-HCS2r
610535104	INFO-HCS2r
610535105	INFO-HCS2r
610535200	INFO-SAC2x
610535500	INFO-MAX2
610535800	INFO-SBB
610535801	INFO-SBB
610536000	IT-MAS2
610536100	INFO-PCIe
610940700	INFO-HVA
610636101	INFO-HVA2
610636300	INFO-MAX4
610636400	MAX4-DBIT
610636500	MAX-DBMT
610736920	INFO-SAC3x3
610736800	INFO-SAM3
610737300	INFO-iADC
610838301	HEAT-I
610838401	HEAT-E2
610838700	PPC-Card4
610838800	INFO-SAC3
610838802	INFO-SAC3
610838804	INFO-SAC3
610838805	INFO-SAC3
610838806	INFO-SAC3
610838808	INFO-SAC3
610838822	INFO-SAC3
610838824	INFO-SAC3
610838825	INFO-SAC3
610838826	INFO-SAC3
610838828	INFO-SAC3

Copper Fieldbus

608806800	EXT-16P
608806802	EXT-16PC
609010400	EXT-ADC
609010600	EXT-PT
609010700	EXT-4KP
609112100	EXT-DAC
609112303	PCMAS-32
609213000	Ventil-I/O
609314701	KLM-48

IPS16/32

607830500	ADC 64-12
607830501	ADC 64-12
608101500	INP-32
608101501	INP-32
608101600	OUT-32
608201500	ADC 32D-12
608201700	INT-16
608202400	CPU 32016
608202401	CPU 32016
608303502	EPROM 64K
608303800	2K-POS
608303801	2K-POS
608350000	RACK 19"
608402500	DBUS-27

608404500	SIO-32
608404700	MODEM-UTI
608503100	FDC-4
608503200	OUT-P16
608503600	I/O-BUS
608504000	F-Video
608605300	I/O MASTER
608605801	DEBUG
608706400	FV-Driver
608706500	FV-Receiver
608706700	LASER-ABT
608706900	ISI-32
608807000	ISO-32
608807200	MGPU-10
608807201	MGPU-10
600301000	ASK12
600302000	ASL14
608013100	DAC-8
608202100	ADC 32D-16
608303500	CRAM 64K
608303501	CRAM 64K
608404200	PT100-16
608503900	ADC 16-12
608605000	Z-15
608605600	CENTRONICS
608605800	DEBUG
608706100	F-ADC 16-12
608706600	2K-SIO
608807400	BT-8/10
608807500	DAC-16/20
608807600	FGV
608807800	FCV
608909200	INP-32NP
608909300	OUT-32P
608909400	INT-16P
608909500	4K-POS
608909501	4K-POS
608909600	OUT-32N
608909700	BUS-EXP
608909800	FDC-2
608909801	UHR
608910000	RACK 19"
608910001	RACK 19"
608910002	IBUS-27
608910027	IBUS-27
609010100	GCPU-15
609010101	GCPU-15
609010102	GCPU-15
609010103	GCPU-15
609010300	EPA-1MB
609010500	MASTER-32
609010501	MASTER-32
609112100	D-END
609112101	D-END
609112200	D-NETZ
609112201	D-NETZ
609314200	Fx_CPU-25
609314201	Gx_CPU-15
609314202	Fx_CPU-25
609314300	Fx_EPR
609314400	Fx_DEB
609314500	TTL-IO64
609416200	FCV-DRV
609417100	INFO-MAS
609417101	INFO-MAS
609623000	FCV-PCTA
609623001	FCV-PCTA

INDEL AG
INDUSTRIELLE ELEKTRONIK

Tel. +41 44/956 20 00
Fax +41 44/956 20 09

2

CH-8332 Russikon
Tüfiwis 26

Rev 1006

10   List of figures

11   Document status

Disclaimer
No guarantee is made for the correctness or completeness of the information provided. Subject to technical changes.

File-History

1.15	29.04.2011	Disclaimer
	.	AX4: X10 and GinLink pin described; MAX boards: GinLink pin described
1.16	13.05.2011	AX-4: parallel switching of output stages
1.17	17.05.2011	AX-4: Encoder-Stecker für SinCos, Encoder, SSI
1.18	23.05.2011	Missing links to images, address switch Gin-MAX2,4
1.19	07.06.2011	Technical details for connector boards
1.22	30.09.2011	Disclaimer added
1.23	21.11.2011	Correction of +/-5V in Fig. 14: +5V to 32b -5V to 32a
		Inc correction to absolute feedback inputs: IncA to Clk, IncB to Data
1.24	31.01.2012	AX4 with resolver option removed, pin assignment for AX4 phase U and V corrected
1.25	21.02.2012	Connection example for 5V/24V single-ended inc encoder
1.26	27.04.2012	Correction: in stand-alone operation of MAX4 and AX4, GinLink Out becomes the ethernet interface
1.27	27.04.2012	Document status section added
1.28	21.12.2012	Note on RS422 with 120 Ohm completed. The encoder must be able to deal with this load Ax4 5V supply for encoders from 200mA to 800mA (all encoders together)
1.29	25.06.2013	Expansion of section 3.3.6 Pin assignment for motors in AX4. Connection of stepper motors and 3-phase motors in parallel operation (GIN-Ax4 2x10A)
1.30	26.09.2013	Expansion of section 3.3.6 Pin assignment for motors in AX4 Minimum length for Y cables in parallel operation
1.31	04.11.2013	Chapter 3.1 add tip for additional cooling measures to keep the ambient temperature below 40℃. Increase the minimum distance between servo drives to 50mm