phytron

*phy*MOTION[TM]

Power Stage Carrier Module INAM01.1 and

1-Axis Module INAM02.1

TRANSLATION OF THE GERMAN ORIGINAL MANUAL

In this manual you will find the descriptions of the features and specifications of the *phy*MOTION™ module: Carrier Module for APS Power Stage INAM01 and INAM02 (http://www.phytron.de/*phy*MOTION).

This manual is supplementary to the "*phy*MOTION™ *Modular Multi-axis Controller for Stepper Motors"* manual.

Every possible care has been taken to ensure the accuracy of this technical manual. All information contained in this manual is correct to the best of our knowledge and belief but cannot be guaranteed. Furthermore we reserve the right to make improvements and enhancements to the manual and / or the devices described herein without prior notification.

We appreciate suggestions and criticisms for further improvement.

Email address: doku@phytron.de

Questions about the use of the product described in the manual that you cannot find answered here, please contact your representative of Phytron (http://www.phytron.de/) in your local agencies.

1 Information

This manual:

Read this manual very carefully before mounting, installing and operating the device and if necessary further manuals related to this product.

- Please pay special attention to instructions that are marked as follows:

	DANGER – **Serious injury!**	*Indicates a high risk of serious injury or death!*
	DANGER – **Serious injury from** **electric shock!**	*Indicates a high risk of serious injury or death from electric shock!*
	WARNING – **Serious injury** **possible!**	*Indicates a possible risk of serious injury or death!*
	WARNING – **Serious injury from** **electric shock!**	*Indicates a possible risk of serious injury or death from electric shock!*
	CAUTION – Possible **injury!**	*Indicates a possible risk of personal injury.*
	CAUTION – Possible **damage!**	*Indicates a possible risk of damage to equipment.*
	CAUTION – Possible **damage due to ESD!**	*Refers to a possible risk of equipment damage from electrostatic discharge.*
	"Any heading"	*Refers to an important paragraph in the manual.*

Observe the following safety instructions!

Qualified personnel

WARNING – Serious injury possible!

Serious personal injury or serious damage to the machine and drives could be caused by insufficiently trained personnel!

Without proper training and qualifications damage to devices and injury might result!

- Design, installation and operation of systems may only be performed by qualified and trained personnel.

- These persons should be able to recognize and handle risks emerging from electrical, mechanical or electronic system parts.

- The qualified personnel must know the content of this manual and be able to understand all documents belonging to the product. Safety instructions are to be provided.

- The trained personnel must know all valid standards, regulations and rules for the prevention of accidents, which are necessary for working with the product.

Safety Instructions

Further Manual

This manual is in addition to the following main manual:

*"phy**MOTION**^{TM} Modular Multi-axis Controller for Stepper Motors"*

- First, read the main manual and then continue with this manual.

Intended use:

The phyMOTION^{TM} is designed for operating in a drive system.

- An installation is allowed only if the requirements of the EC Machinery and EMC Directives are conformed with.

Part of a machine:

This product is used as a part of a complete system, therefore risk evaluations concerning the specific application must be made before using the product.

- Safety measures have to be taken according to the results and be verified.

- Personnel safety must be ensured by the concept of this overall system (e.g. machine concept).

WARNING – Serious injury from electric shock!

*If the phy**MOTION**^TM is not operated with SELV/PELV voltages, the risk of dangerous voltages may be on the device. Touching these components carrying high voltages can cause serious injury or death from electric shock:*

- Always observe the safety concept SELV / PELV to ensure safe insulation and separation of low voltage supplies from the mains.

WARNING – Serious injury from electric shock!

During electrical installation cables, connectors, etc. can be live.

- Before starting wiring, make sure that none of the power supplies are connected to the primary side of the mains supply. Isolate the power supplies from the mains or remove the appropriate fuses.

- All modules must be inserted and screwed into the *phy**MOTION**^TM housing before powering up. If necessary, unoccupied module slots must be covered with the supplied blank front plates.
  Never operate the equipment when open.

- Do not plug or unplug the modules while powered.

- Do not plug or unplug the connectors while powered.

- If the equipment was energised, wait 3 minutes after power off to allow the capacitors to discharge and ensure that there are no residual charges on cables, connectors and boards.

2   Contents

3 INAM Module Overview

INAM stands for internal Amplifier (Power Stage) module. INAM01 is a carrier board for stepper motor power stages (up to 5 A_{PEAK} max.) or the APS01 power stage (as a sub module). INAM02 is a 1-axis module for the integrated MSX power stage (up to 15 A_{PEAK} max.). The INAM02 is only available in *phy***MOTION**^{TM} configurations with integrated power supply **INT**

Both INAM modules need an Indexer (e.g. I4XM01) in front.
Two limit switches and a third switch, which can be wired as a reference switch evaluation, are included as standard.

In addition, sub modules can be optionally selected for encoder evaluation (ECAS01, ECES01, ECMS01 as well as motor temperature evaluation (PTS01 and KTS01).
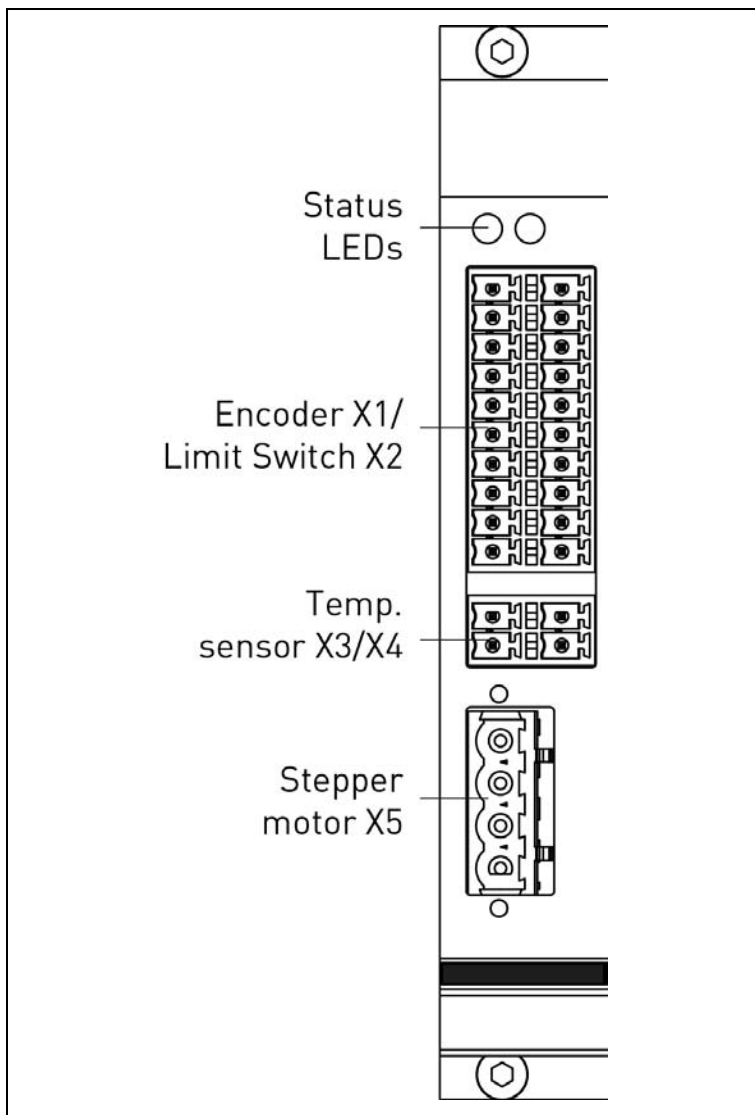
Fig. 1:   INAM01 / INAM02 View of the front panel

Ordering code of the 1 axis stepper motor drive module (INAM01):

Ordering code (example):   **INAM01-ECES01-PTS01:**
1 axis stepper motor drive module with integrated encoder and Pt sensor

Ordering code of the 1 axis stepper motor drive module (INAM02):

Ordering code (example):   **INAM02-MSX-ECAS01-PTS01:**
Module with connected MSX power stage, integrated encoder and Pt sensor

4 Technical Data

4.1 Declaration of Conformity: Modules gen. & External Supply EXT

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Declaration of Incorporation
according to EC directive 2006/42/EC on machinery (Annex II B)
for partly completed machinery

Name and address of the manufacturer:
Phytron GmbH,
Industriestr. 12
82194 Gröbenzell

Representative in EU, authorized to compile the relevant technical documentation:
Rainer Gareis
Phytron GmbH,
Industriestr. 12
82194 Gröbenzell

Description of the partly completed machinery:

_phy_MOTION™, assembled with several of the following modules

Part-Name	Description
AIM01.1	Analog Input-Module
AIOM01.1	Analog I/O Module
AOM01.1	Analog Output-Module
APS01.1	High-End Stepper Motor Power Stage
CANS01.1	CAN Communication Sub Module
DIOM01.1	Digital I/O Module
DIOM0a.1	Digital I/O Module (customer-specific version)
ECAS01.1	SSI/ Quadratic Encoder Sensing Sub Module
ECES01.1	EnDat Encoder Sensing Sub Module
ECMS01.1	Resolver Evaluation Submodule
EXAM01.1	Indexer Interface Module
I1AM01.1	1-Axis Stepper Motor Drive
I1AM0a.1	1-Axis Stepper Motor Drive (customer-specific version)
I1AM0b.1	Indexer & Power Stage Carrier (cust)
I4XM01.1	4 Axes HighEnd Indexer
INAM01.1	Carrier Module for APS Power Stage
MCM01.1	Main Controller Module
MCM02.1	Main Controller & ext. Power Input
PBS01.1	Profibus Communication Sub Module
PNS01.1	ProfiNet Communication Sub Module
POWM01.1	Main Power Input Module
POWM02.1	Intermediate Power Input Module
RSS01.1	RS485/RS232 Communication Sub Module

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From serial number 1506xxxxx

We declare that the product complies with the following essential requirements of the Machinery Directive2006/42/EC:
1.1.2.; 1.1.5.; 1.3.1.; 1.3.4.; 1.5.1.; 1.5.2.; 1.5.4.; 1.5.5.; 1.5.6.; 1.5.16.; 1.6.3.; 1.6.4; 1.7.2.; 1.7.3.; 1.7.4.

In addition the partly completed machinery is in conformity with the following EC Directives:
EC Directives 2004/108/EC relating to electromagnetic compatibility.

We declare that the relevant technical documentation is compiled in accordance with part B of Annex VII.

We commit to transmit, in response to a reasoned request by the market surveillance authorities, relevant documents on the partly completed machinery.

Important note! The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Directive 2006/42/EC on Machinery, where appropriate, and until the EC Declaration of Conformity according to Annex II A is issued.

Gröbenzell, 2015-06-25

Birgit Hartmann
Managing Director

4.2 Declaration of Conformity: Modules with Internal Supply **INT**

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Declaration of Incorporation
according to EC directive 2006/42/EC on machinery (Annex II B)
for partly completed machinery

Name and address of the manufacturer:
Phytron GmbH,
Industriestr. 12
82194 Gröbenzell

Representative in EU, authorized to compile the relevant technical documentation:
Rainer Gareis
Phytron GmbH,
Industriestr. 12
82194 Gröbenzell

Description of the partly completed machinery:

*phy*MOTION™, with internal power supply assembled with several of the following modules

Part-Name	Description
NETM01.1	Power Supply Input 230V
PEM01.1	Protective Earth Module
MSXS01.1	Power Stage; 15A
INAM02.1	High Performance Power Stage Carrier
POWM03.1	Main Power Input; int. Supply
MCM03.1	Main Controller & internal Supply
POWM04.1	Secondary Power Input; int. Supply

From serial number 1506xxxxx

We declare that the product complies with the following essential requirements of the Machinery Directive 2006/42/EC:
1.1.2.; 1.1.5.; 1.3.1.; 1.3.4.; 1.5.1.; 1.5.2.; 1.5.4.; 1.5.5.; 1.5.6.; 1.5.16.; 1.6.3.; 1.6.4; 1.7.2.; 1.7.3.; 1.7.4.

In addition the partly completed machinery is in conformity with the following EC Directives:
EC Directives 2006/95/EC relating to electrical equipment
EC Directives 2004/108/EC relating to electromagnetic compatibility.

We declare that the relevant technical documentation is compiled in accordance with part B of Annex VII.

phytron
— Extreme. Precision. Positioning.

We commit to transmit, in response to a reasoned request by the market surveillance authorities, relevant documents on the partly completed machinery.

Important note! The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Directive 2006/42/EC on Machinery, where appropriate, and until the EC Declaration of Conformity according to Annex II A is issued.

This Declaration of Incorporation is only valid in combination with the Declaration of Incorporation 7029, *phy*MOTION® with external power supply.

Gröbenzell, 2015-06-25

Birgit Hartmann
Managing Director

4.3 Mechanical Data

Dimensions	100 x 100 mm (without front panel)
Weight	INAM01: 94 g / 71 g (without / with font panel) INAM02: 75 g / 52 g (without / with font panel)
Mounting	Plug-in module into the modular stepper motor controller *phy***MOTION**™
Mounting position	Vertical

4.4 Features

Performance Characteristics		
Stepper motor	Suitable for bipolar control of 2 phase stepper motors with 4, (6) or 8 lead wiring	
Superior controller	Modular *phy***MOTION**^{TM} controller	
Supply voltage	with APS	24…70 V_{DC} Nominal voltage: 70 V_{DC}
	with MSX	70…120 V_{DC} Nominal voltage: 120 V_{DC}
Phase current	with APS	0.1 to 5 A_{PEAK}, (short-circuit-proof, overload-proof)
	with MSX	0.8 to 15.4 A_{PEAK}
Current adjustment	with APS	10 mA steps
	with MSX	10 / 20 / 30 mA steps (dep. on the MSX type)
Step resolutions	with APS	Full step, half step 1/2,5, 1/4, 1/5, 1/8, 1/10, 1/16, 1/20, 1/32,1/64,1/128,1/256,1/512
	with MSX	Full step, half step,1/4, 1/5, 1/10, 1/20
Maximum step frequency	with APS	500,000 steps/sec.
	with MSX	500,000 steps/sec
Physical resolution	with APS	Approx. 102,400 positions per revolution (0.00035° / step). The optional encoder modules should be considered for very fine positioning.
	with MSX	about 4000 (0.09° / step)
Current consumption (max.)	with APS	3 A_{DC} at 5 A_{PEAK}
	with MSX	3 / 6 / 10 A_{DC} at 15 A_{PEAK} (dep. on the MSX type)
Mechanical output power	with APS	Up to the 250 W range
	with MSX	about 300 / 600 / 1200 W (dep. on the MSX type)
Nominal power of the motor voltage supply	with APS	100 W
	with MSX	500 W
Cable length – motor	Shielded: 50 m max.	

Cable length – digital inputs	30 m; if longer (100 m max.) use shielded cable and contact shield close to the controller.
Diagnostics	Possibility for connection via 2 signal cables with 3.3 V logic level: LED1: power stage ready LED2: error

Features	
Support of linear and rotary axes	Yes

Hardware error detection	with APS Over current, short circuit > 10 A
	
	               Over temperature T>85 °C
	with MSX Over current, short circuit > 8.4 / 16.8 / 25.2 A (dep. on the MSX type)
	
	               Over temperature T>85 °C

Refresh rate	2 ms

Interfaces	
Analogue outputs	A, B, C, D for a 2 phase stepper motor
Analogue inputs	Option: Motor temperature evaluation - K thermal element (needs sub module: KTS01) - Pt100 sensor (needs sub module: PTS01)
Digital inputs	3 Limit switches: PNP- NOC/NCC Option: Encoder evaluation - SSI/Quadrature (needs sub module: ECAS01) - EnDat (needs sub module: ECES01) - Resolver or LVDT/RVDT (needs ECMS01)

4.5 Functions

INAM01: Integrated APS power stage with encoder and temperature module as option

INAM02: Connected MSX power stage with encoder and temperature module as option

- Relative and absolute positioning

- Reference movements/ speed mode

- Step frequency up to 500,000 steps/sec. with APS or MSX

Integrated 5 A_{PEAK} power stage APS01

- Integrated 5 A_{PEAK} / 24 to 70 V_{DC} stepper motor power stage

- Selectable step resolution up to 1/512 micro step

- Online power stage parameterisation and diagnostics

INAM02 [NT]: Verbundene 15,4 A_{PEAK} Endstufe MSX

- 15.4 A_{PEAK} / 70 or 120 V_{DC} stepper motor power stage

- Selectable step resolution up to 1/512 micro step

- Online power stage parameterisation and diagnostics

3 Limit/reference switches

- Evaluation of up to three limit/reference switches (PNP NCC/NOC)

Option: Encoder evaluation

- The evaluation of a SSI / quadrature encoder (with ECAS01 sub module) or EnDat (with ECES01 sub module) or resolvers/LVDT/RVDT (with ECMS01 sub module) is possible depending on the selected sub module.

Option: Motor temperature evaluation

- The evaluation of Pt100 temperature sensors (with PTS01 sub module) or K types (with KTS01 sub module) is possible depending on the selected sub module.

5   Installation

Phytron always delivers the *phy***MOTION**™ completely assembled in order to make sure you can start with the installation and the wiring right away.

Further manual

Detailed information on this subject is in a supporting manual:

"*phy***MOTION**™ Modular Multi-axis Controller for Stepper Motors"

5.1   Mechanical Installation

5.1.1   INAM01

In case you receive an individually packed INAM01 as an expansion module or after repair or service unpack the module in ESD protected area only.

CAUTION – Possible damage by ESD!

*The modules of the phy***MOTION**™ *consist of sensitive electronic components that can be destroyed by electrostatic discharge voltages.*

-   Always store and transport single modules in ESD protective packaging.
-   Always handle the components in compliance with the ESD protection measures.
-   No liability is accepted for any consequences resulting from improper handling or non-ESD-friendly packaging.

CAUTION – Possible damage!

The INAM01 module is designed for a maximum supply voltage of 48 V_{DC}. If it is supplied with >48 V_{DC} the card might be damaged.

-   Make sure that a power module (POWM01, POWM02) is supplied on the left with less than 48 V_{DC} to avoid damage.

Before integrating or switching modules always make sure that the *phy***MOTION**™ is shut down and the power supplies are disconnected.

⚠ **WARNING – Serious injury from electric shock!**

During electrical installation cables, connectors, etc. can be live.

- Before starting wiring, make sure that none of the power supplies are connected to the primary side of the mains supply. Isolate the power supplies from the mains or remove the appropriate fuses.

- All modules must be inserted and screwed into the *phy***MOTION**^{TM} housing before powering up. If necessary, unoccupied module slots must be covered with the supplied blank front plates.
  Never operate the equipment when open.

- Do not plug or unplug the modules while powered.

- Do not plug or unplug the connectors while powered.

- If the equipment was energised, wait 3 minutes after power off to allow the capacitors to discharge and ensure that there are no residual charges on cables, connectors and boards.

Make sure not to leave free slots in between modules so the module addressing sequence can work correctly.

Identify the correct slot position for your INAM01 referring to your order and documentation. The INAM01 needs at least a preceding power module (POWM01, POWM02), the main controller module (MCM01) and an additional indexer (EXAM01).

Push the module carefully into the guide rail until the rear contacts the housing frame of the *phy***MOTION**^{TM}.

In the last few millimetres the module's plug has to match with the backplane's socket. You should be able to push in the module with light pressure. In case you experience problems move the module's front plate slightly to the left and to the right while pushing in the module, so that the plug's pins can slide into the backplane's socket.

As soon as the module's front plate contacts the housing's frame the module is integrated properly and can be fixed with two electro-conductive bolts.

Now you can start with the electrical installation.

5.1.2 INAM02

The INAM02 module is only installed in phytron's plant.

5.2 Electrical Installation

Ensure sufficient bending radius of the cables during installation. Do not lay the cables in tension or bend them.

We recommend labeling the mating connectors to prevent interchanging the connectors.

If all the connections are made, the last step is to plug in the power supply to the mains.

5.2.1 Connectors - Overview

Connector	Number of pins	Connector on the module (Phoenix)	Mating connector (Phoenix)	Mating connector ID number
INAM01: Motor (X5)	1x4	IC 2,5/4-G-5,08	IC 2,5/4-ST-5,08	10005390
INAM02: Motor (X5)	1x4	IC 2,5 HC/ 4-G-5,08	FKIC 2,5 HC/4-ST-5,08	10015856
Limit switches (X2)	1x10	MCDN1,5/10-G1-3,5P26	FMC1,5/10-ST-3,5	10013217
Encoder (X1)	1x10	MCDN1,5/10-G1-3,5P26	FMC1,5/10-ST-3,5	10013217
Temperature evaluation (X3/X4)	2x2	MCDN1,5/2-G1-3,5P26	FMC1,5/2-ST-3,5	10007077

The mating connector is included in delivery of the module and is usually plugged into the module at the factory.

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CAUTION – Possible damage!

Damage of the module by wrong connection.

- Do not exchange the 10-pin connector for limit switches with the 10-pin connector for the encoder evaluation. Module and encoder can be damaged.

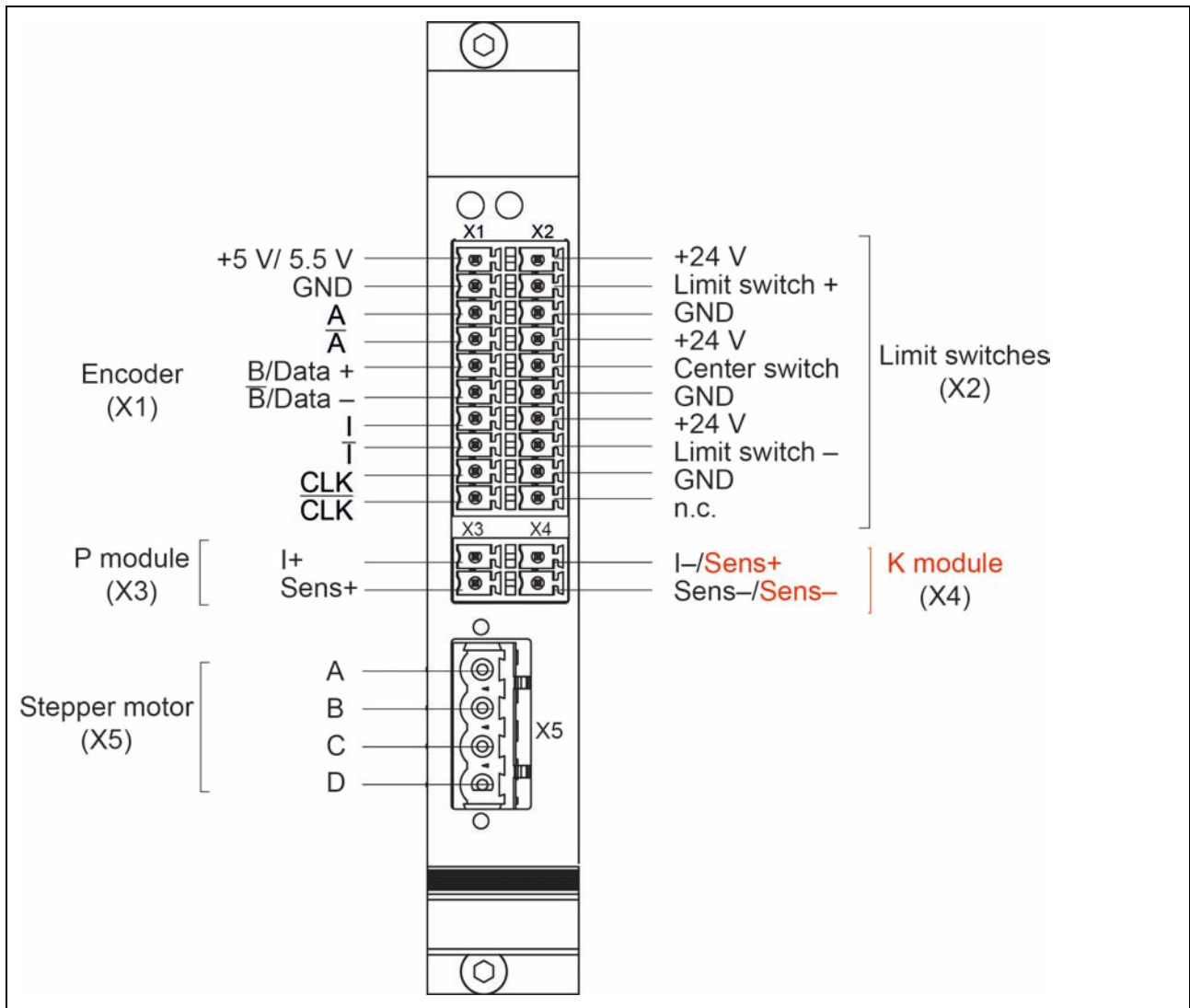## 5.2.2 Pin Assignment

In the following the pin assignment:

Fig. 2:   Pin assignment INAM01 / INAM02

Use the specified mating connectors for wiring.

CAUTION – Possible damage!

Damage of the module by wrong connection.

- Do not exchange the 10-pin connector for limit switches with the
  10-pin connector for the encoder evaluation. Module and encoder can be
  damaged.

5.2.3 Stepper Motor Connection X5

Stepper motors with the INAM01 module can be driven with 0.1 to 5 A_{PEAK} phase current at max. 70 V_{DC}, with the INAM02 module motors up to 15.4 A_{PEAK} phase current at max. 120 V_{DC}.

In the next chapter the connection of a 2 phase stepper motor with 4, (6), or 8 lead wiring is described.
Stepper motors with 0.1 to 5 A_{PEAK} can be controlled at maximum 70 V_{DC} by the INAM01.
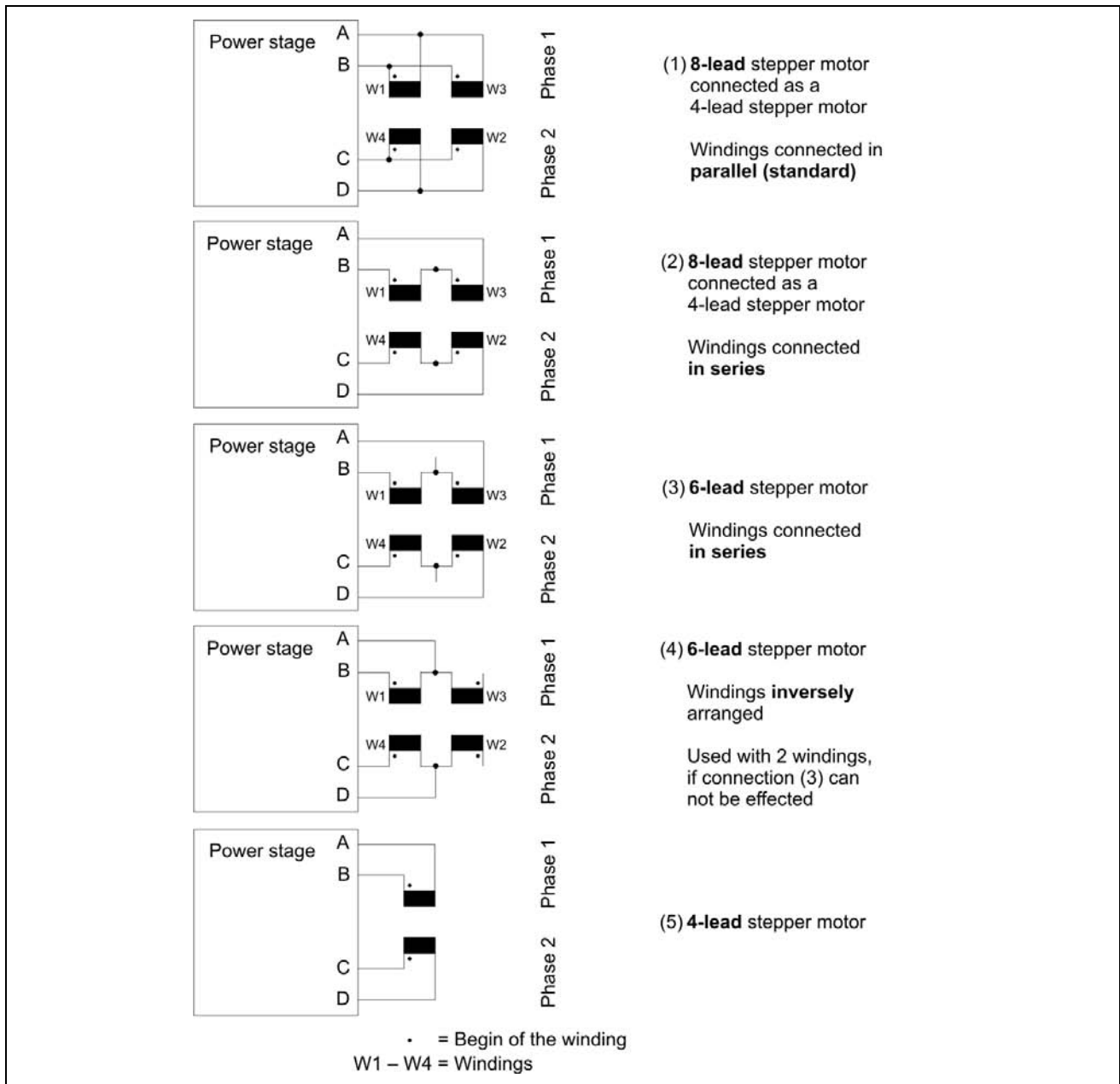
Wiring schemes

Fig. 3: Connection diagrams for 4,(6) and 8 lead stepper motors

Stepper motors with 8 leads can be connected with the windings wired in parallel (1) or series (2).

For 6 lead stepper motors, wiring scheme (3) with series windings is recommended.

If wiring scheme (3) cannot be used because of the motor construction, the motor may be operated with only two of the four windings energized according to wiring scheme (4).

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CAUTION – Possible damage!

Destruction of the power stage by connecting a 5 phase stepper motor.

- Do not connect any 5 phase stepper motors to avoid damage.

Motor time constant τ:

$\tau = \dfrac{L}{R}$ applies to the electrical motor time constant τ.

The total inductance L_{total} is equal to the winding inductance in a parallel circuit, because of interlinked inductances.
$L_{total}= 4 \times L$ applies to a series circuit.

The result is an equal motor time constant τ for a serial and a parallel circuit:

Circuit	series	parallel
Resistance R_{total}	$2 \times R$	$\dfrac{R}{2}$
Inductance L_{total}	$4 \times L$	L
Motor time constant τ	$\tau_{series} = \dfrac{4 \times L}{2 \times R} = \dfrac{2 \times L}{R}$	$\tau_{parallel} = \dfrac{L}{R/2} = \dfrac{2 \times L}{R}$

If motor voltage >70 V: all equipment must be grounded!

WARNING – Serious injury from electric shock!

If the phyMOTIONTM is not operated with SELV/PELV voltages, the risk of dangerous voltages may be on the device. Touching these components carrying high voltages can cause serious injury or death from electric shock:

- Always observe the safety concept SELV / PELV to ensure safe insulation and separation of low voltage supplies from the mains.

WARNING – Serious injury from electric shock!

Bei der elektrischen Installation können Kabel, Stecker o.ä. stromführend sein.

- Before starting wiring, make sure that none of the power supplies are connected to the primary side of the mains supply. Isolate the power supplies from the mains or remove the appropriate fuses.

- All modules must be inserted and screwed into the phyMOTIONTM housing before powering up. If necessary, unoccupied module slots must be covered with the supplied blank front plates. Never operate the equipment when open.

- Do not plug or unplug the modules while powered.

- Do not plug or unplug the connectors while powered.

- If the equipment was energised, wait 3 minutes after power off to allow the capacitors to discharge and ensure that there are no residual charges on cables, connectors and boards.

CAUTION – Possible damage!

To avoid damage please consider the following items in your safety concept:

- When protection by automatic disconnection (EN 61140, VDE 0100, part 410) is used for power stages with definite voltage > 50 V_{AC} or +U_B > 70 V_{DC}:

- Only use motors, which are checked according to EN 60034-1 (500 V_{AC} + twice determined voltage).

- The motors must have a protective conductor clamp (EN 60034).

For stepper motor grounding the PE wire is connected to the PE clamp of the PEM01 module or the NETM01 module.
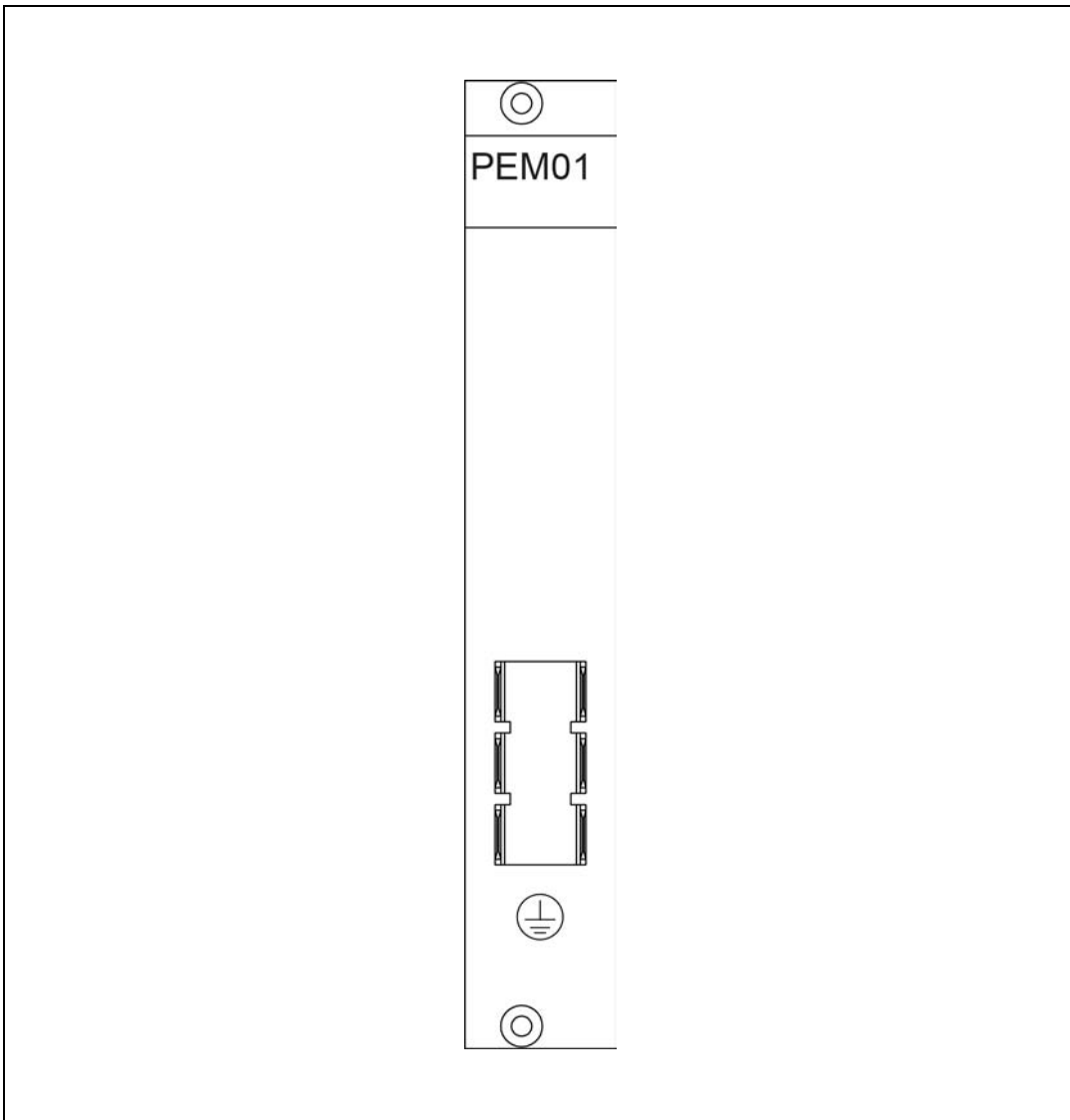

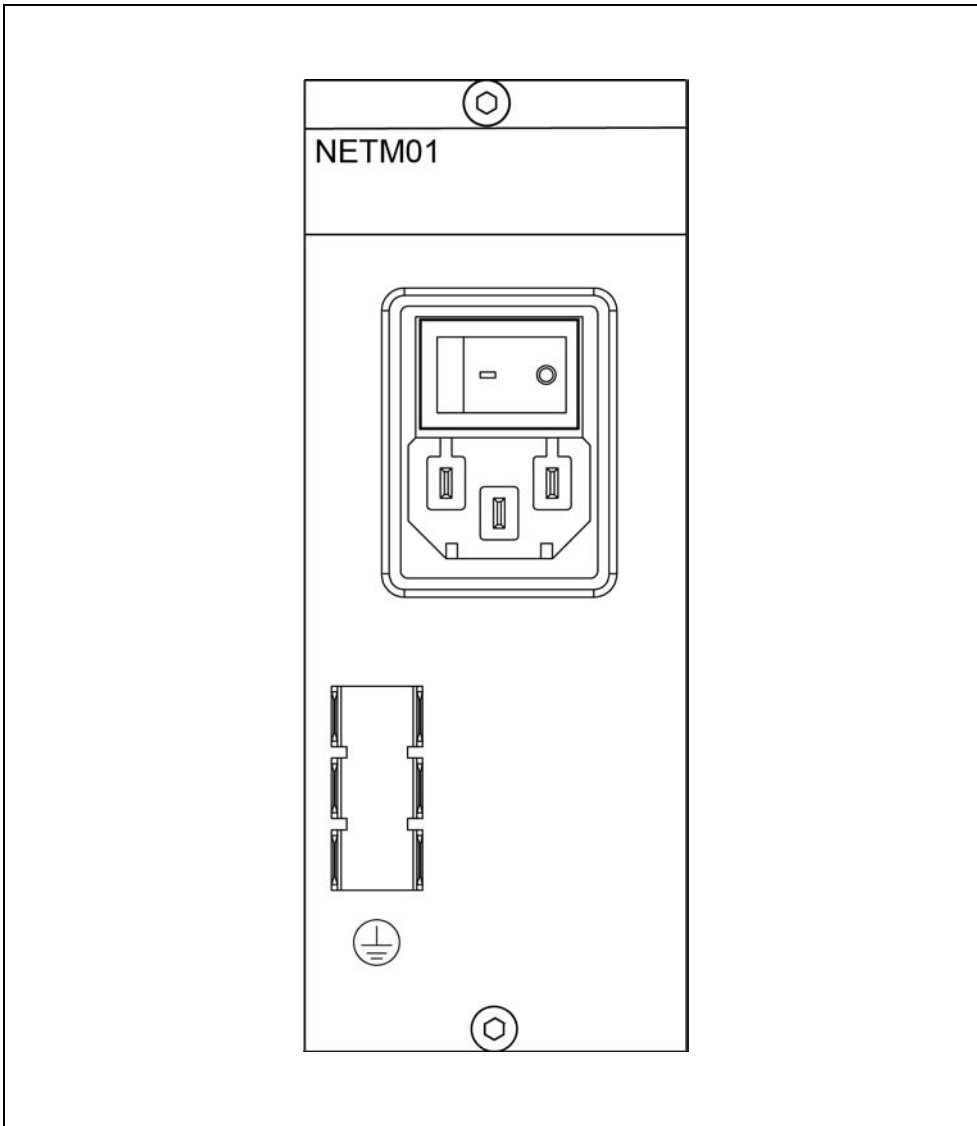Fig. 4:   PE connection for 5-wire motor cable by the PEM01 module

Fig. 5:   PE connection for 5-wire motor cable by the NETM01 module
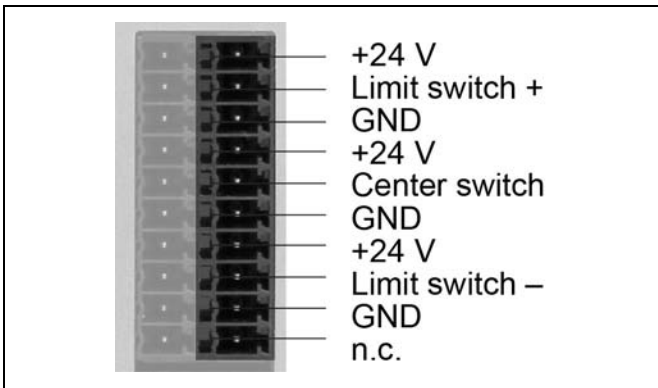
5.2.4 Limit Switch Connection X2
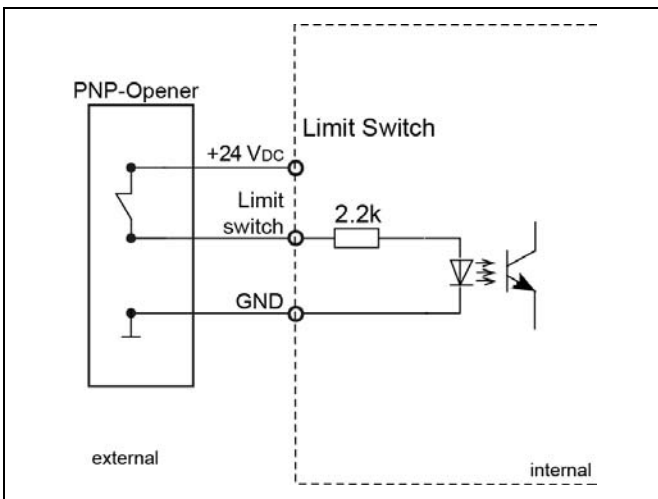

Fig. 6: Pin assignment of the limit switches

Fig. 7: Input wiring

The module is designed for connection of up to three limit switches type PNP-NOC/NCC.
A limit switch is determined for monitoring the movement in the + direction (limit switch +), the second in the – direction (limit switch –). The third switch (centre switch) for example can be used as a reference switch. The switch type PNP NCC has the advantage that cable breaks can be detected.
Mechanical limit switches (NCC) can also be used.

CAUTION – Possible damage!

Damage of the module by wrong connection.

-   Do not exchange the 10 pin connector for limit switches with the 10 pin connector for the encoder evaluation. Module and encoder can be damaged.
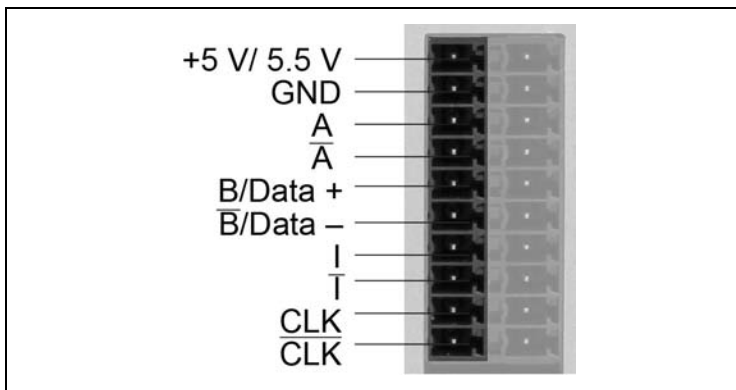
5.2.5 Option: Encoder Connection X1

Fig. 8:   Pin assignment of the encoder

- Suitable encoder types depend on the selected evaluation module (ECES01/ECAS01):
  - differential incremental encoder with quadrature signals (ECAS01/ECES01)
  - Absolute encoder according to the SSI standard (ECAS01/ECES01)
  - EnDat encoder (ECES01)

- The incremental encoder supply voltage (5 or 5.5 V_{DC} / 200 mA max.) is generated by the controller.

- Use shielded cables, twisted pair, for encoder connection. The transmission mode includes no protection against faulty transmission values.

- Wiring diagrams for the encoder types: see next page.

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CAUTION – Possible damage!

Damage of the module by wrong connection..

- Do not exchange the 10 pin connector for limit switches with the 10 pin connector for the encoder evaluation. Module and encoder can be damaged.

- Also ensure that the encoder is configured correctly in its programming. The connection of an incremental encoder and parameterising for SSI can cause damage.
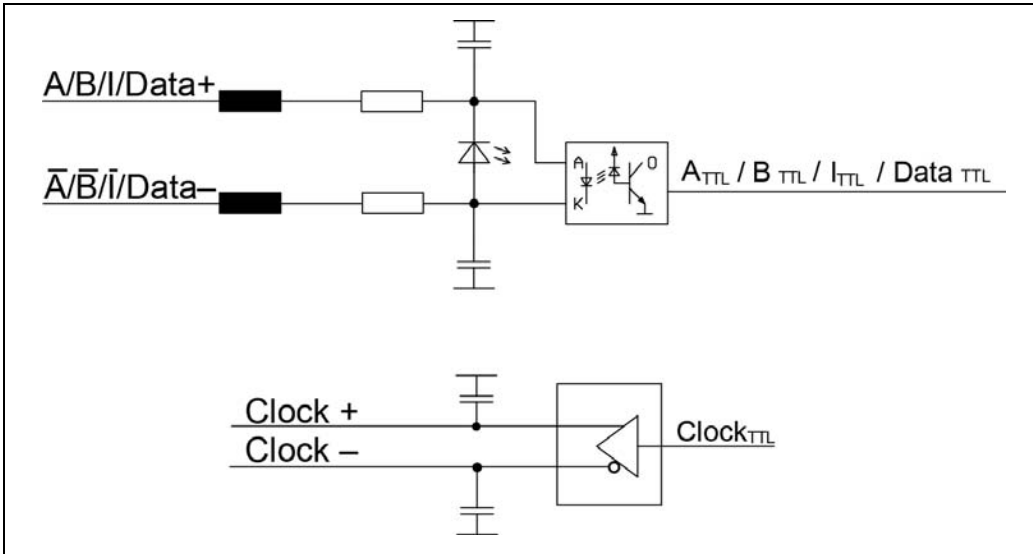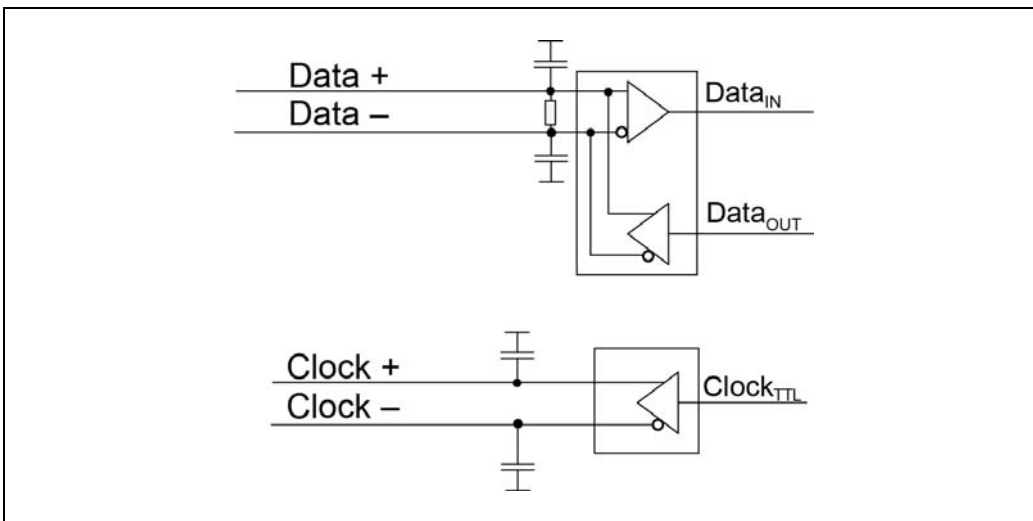
Wiring of the encoder

Fig. 9:   Wiring: SSI/Quadrature

Fig. 10: Wiring: EnDat encoder
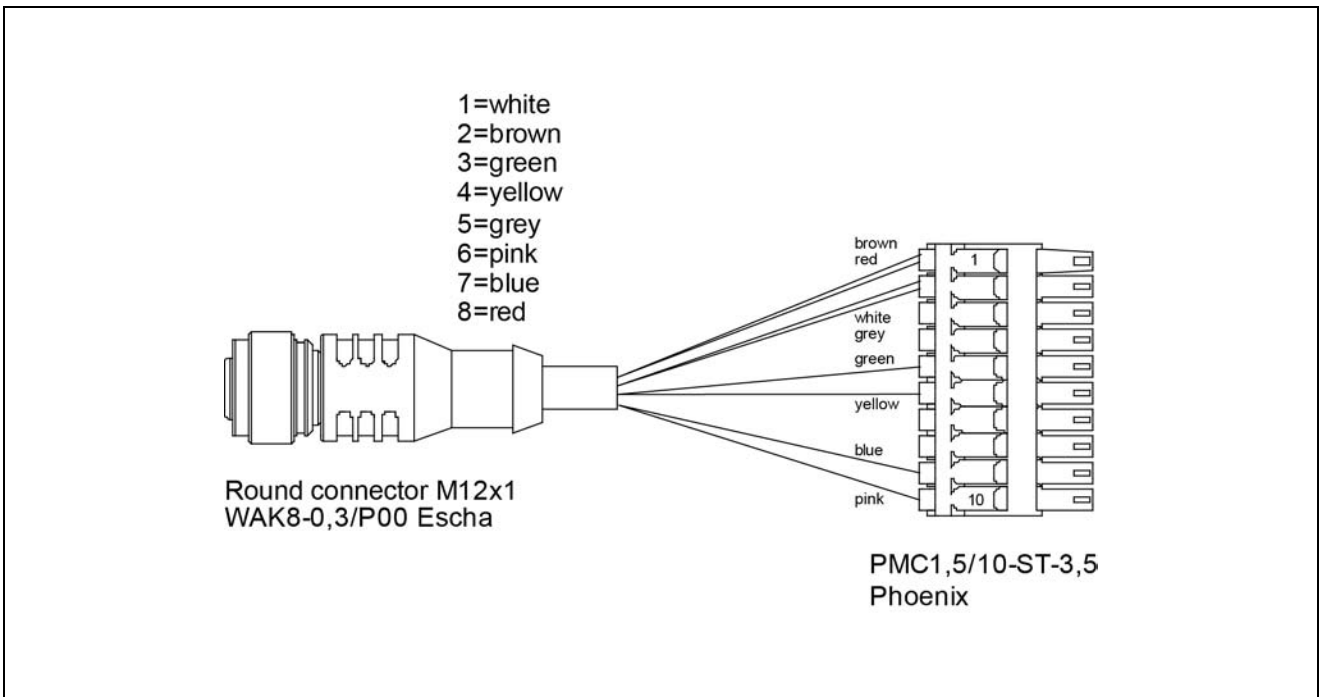
Optional accessories: adapter cable for EnDat encoder

Fig. 11: Adapter cable (ID no 10014905)

5.2.6 Option: Resolver, LVDT or RVDT Connection X1

Characteristics

- Excitation amplitude: 5 to 10 $V_{r.m.s}$

- Excitation frequency: 10 kHz

- Excitation current: up to 150 mA
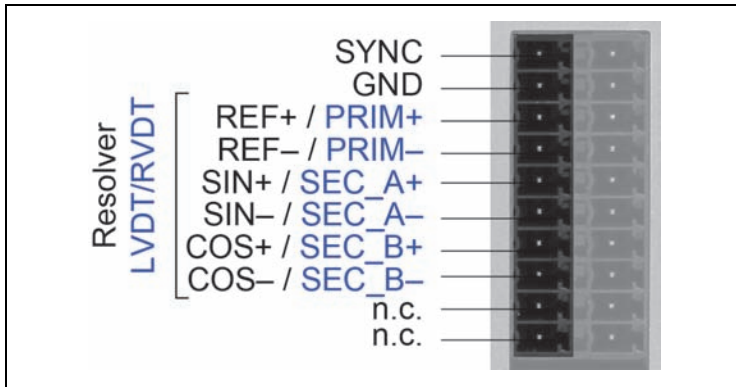
- Resolution: up to 8 arcmin (8/4096 increments/rev.)

Fig. 1: Pin assignment of the encoder connector

Setable parameters

- Primary sinusoidal voltage from 5 to 10 $V_{r.m.s.}$ in 1 V steps.

- Ratio from 1/8 to 2 (1/8, 1/4, 1/2, 1 and 2) only in the resolver or 5/6-wire-LVDT mode

- Operating modes: Resolver, 4-wire-LVDT and 5/6-wire-LVDT

The supply voltage for the ECSM module is provided by the controller.

i	Use shielded cables, twisted pair, for encoder connection. The transmission mode includes no protection against faulty transmission values

Default values

Operating mode: Resolver

Excitation amplitude: 5 V$_{r.m.s}$

Ratio: 1/2

SYNC-Slave: deactivated

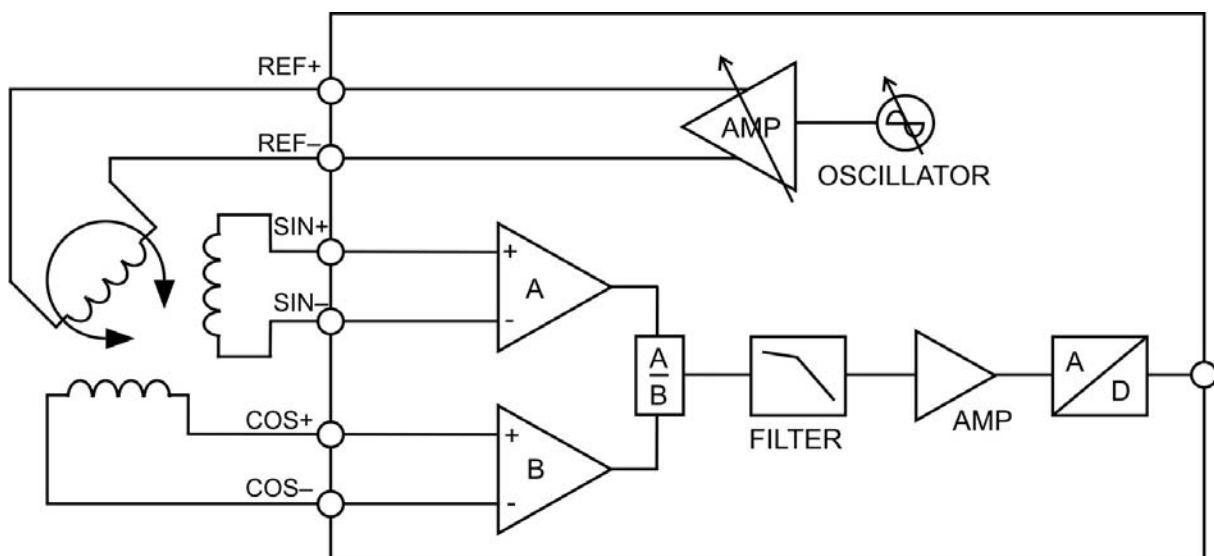# Operating modes of the encoders

Resolver
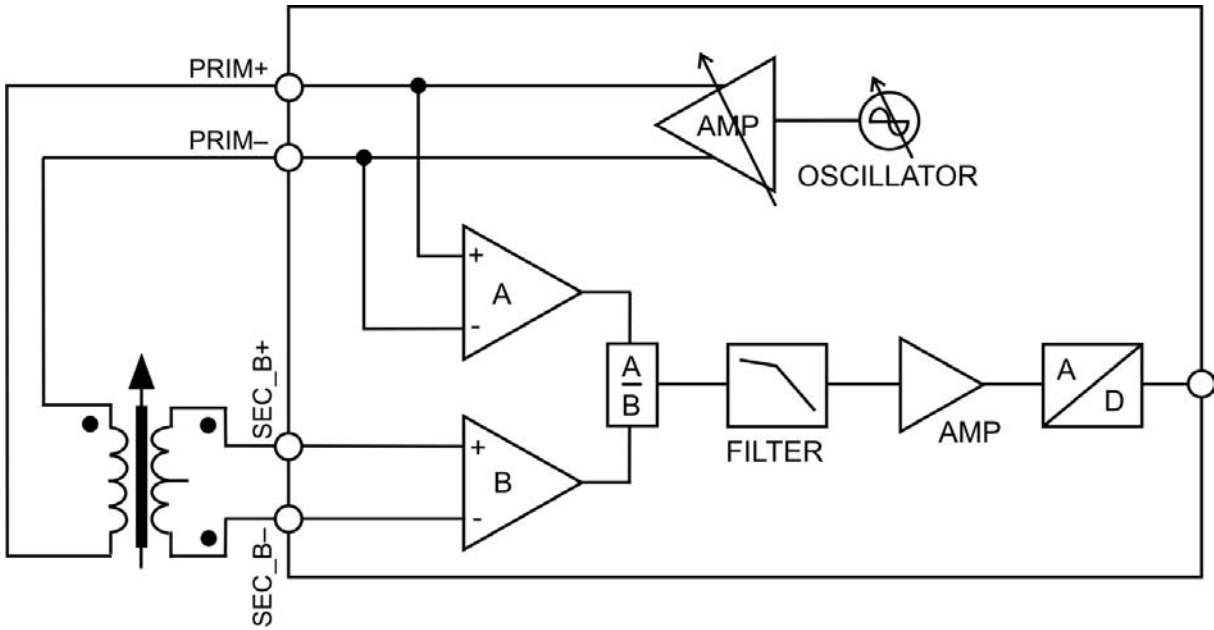

Fig. 2: Resolver wiring

4-wire-LVDT

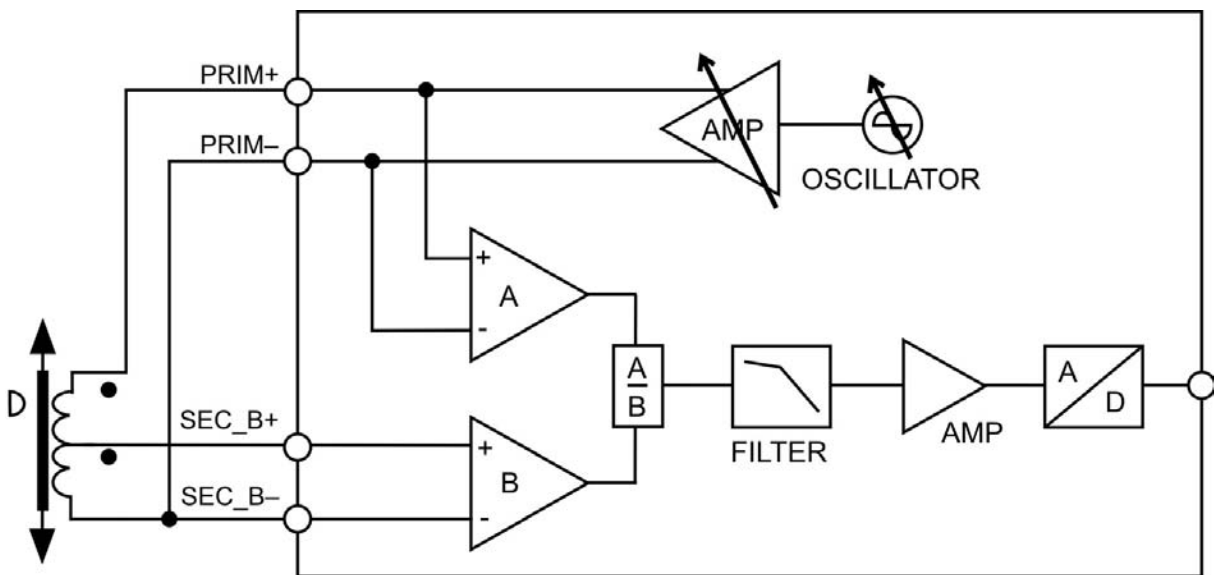Fig. 3: 4-wire-LVDT/RVDT wiring (full bridge)

Fig. 4: 4-wire-LVDT/RVDT-wiring (half bridge)
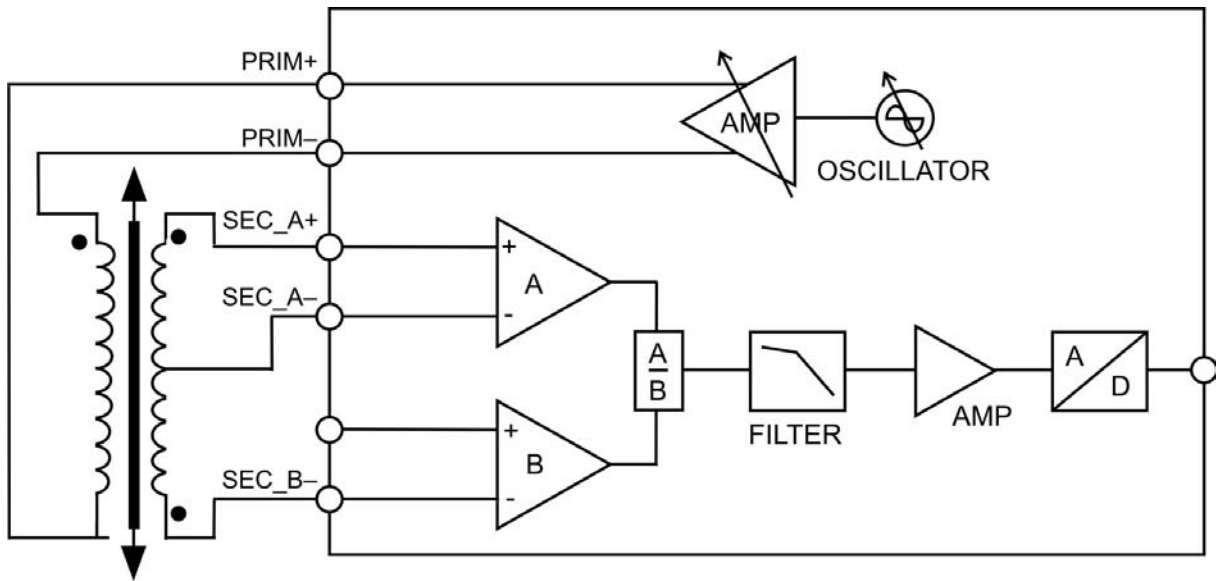
5/6-wire-LVDT
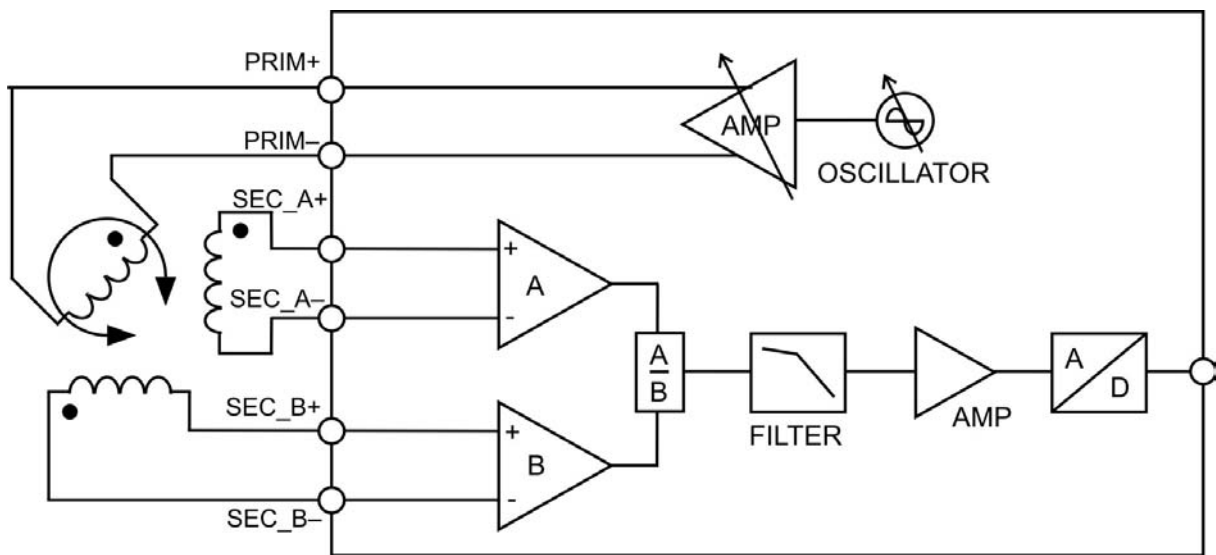

Fig. 5: 5-wire-LVDT/RVDT-wiring

Fig. 6: 6-wire-LVDT/RVDT-wiring
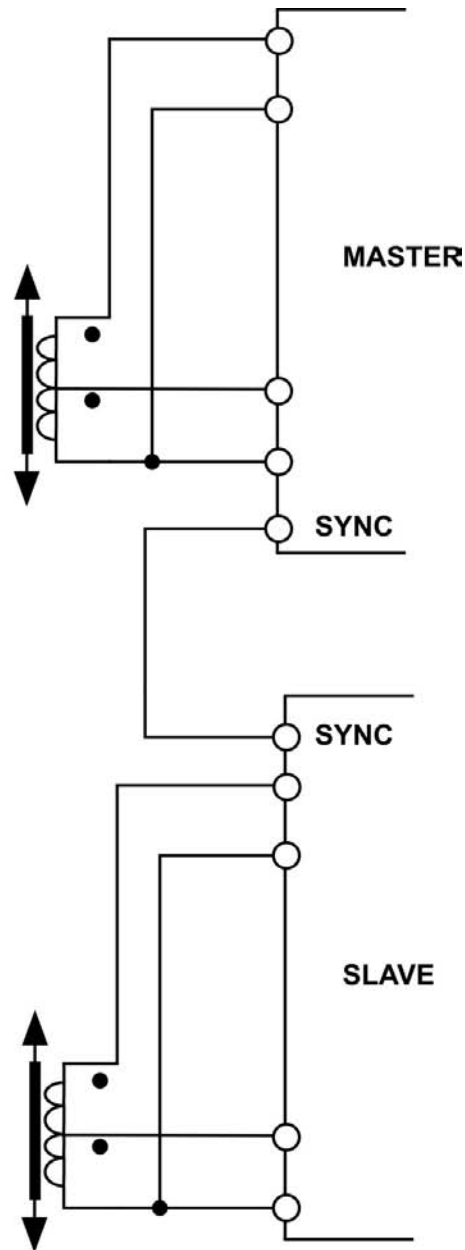
Synchronisation

Fig. 7: Synchronisation wiring

5.2.7 Option: Motor Temperature Sensor Connection X3/X4

The temperature evaluation module is used for monitoring the stepper motor temperature.

Depending on the selected evaluation module (KTS01 or PTS01) thermal elements type K or platinum sensors PT100 can be used.

The insulated temperature sensor in phytron motors is integrated in the motor windings. The response time is very short, compared to temperature sensors mounted outside the motor housing. The temperature is measured all the time, even if only one motor phase is powered at any one time.

Thermal element type K

With the Type K (NiCr-Ni) in-vacuum and cryo stepper motors, thermal elements in the temperature range from –270 to +1370 °C, accuracy class 1, are used.

The Type K is a metal thermal element with nickel-based alloy conductors. Temperature ranges, accuracy and characteristics of thermal elements for industrial use are defined in the IEC 584 standard (temperature measuring with thermal elements).
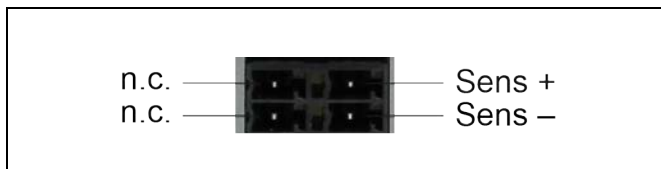

Fig. 8: K element connection

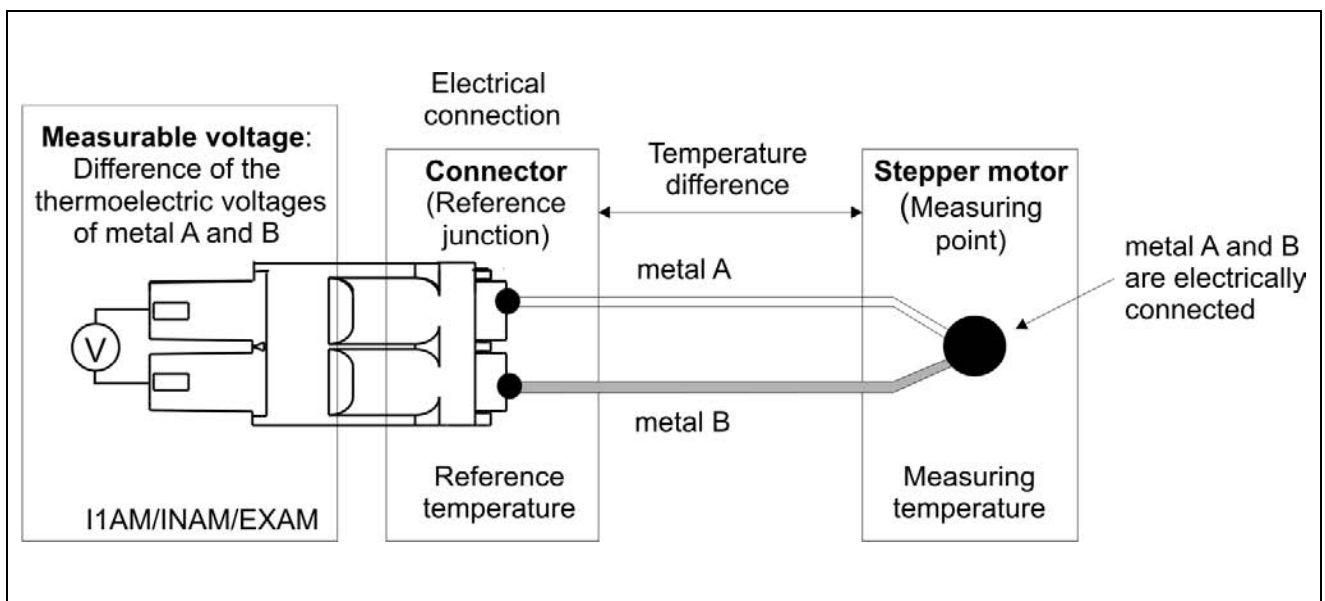**Principle of the stepper motor temperature measurement by element type K:**

Fig. 9: Sample form

An accurate temperature can only be measured when the temperature at the reference junction (connector) is exactly known. This is not possible by the connection construction and und can cause indeterminate deviations of the temperature values.

Software evaluation of the measuring values from -180 °C to +260 °C.

> **i**
>
> **CAUTION – Possible damage!**
>
> *Damage of the module by wrong connection or wire break.*
>
> - Check the integrity of the element type K and the correct *phy***MOTION**™ connection before motor temperature measurement. An improperly connected or broken wire can result a wrong temperature evaluation and thus a damage of the motor or other system components by overheating.

Pt100 Resistor Sensor

Pt100 resistor sensors are used with in-vacuum and cryo stepper motors in the temperature range −200 to +300 °C.

These precise sensors are used in extreme industrial and laboratory conditions. They consist of a wound resistance wire that is mounted and unsupported inside a cylindrical ceramic case.
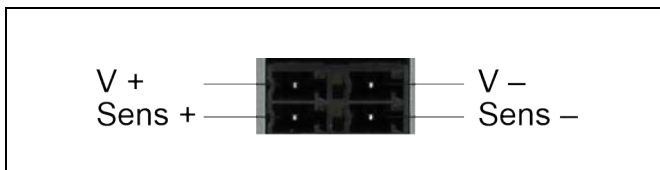


```
V +  ─────■■■■■■■─────  V −
Sens + ───■■■■■■■───── Sens −
```

Fig. 10: Pt100 connection

Principle of the stepper motor temperature measurement by Pt100 resistor sensors:

The PTS generates a constant current between I+ and I-. This current generates a voltage drop at the Pt100 which is measured at Sens+ and Sens-. The Pt100 sensors are connected with 4 leads in order to enable measuring independent of the wire resistance.

Software evaluation of the measuring values from -220 °C to +390 °C.

6 Commissioning

Please read the manual for basic commissioning information of the INAM01 module:

Further manual

Detailed information on this subject is in a supporting manual:

"*phy***MOTION**TM Modular Multi-axis Controller for Stepper Motors"

The programming environment *phy***LOGIC**TM ToolBox is explained in the following manual:

Further manual

Detailed information on this subject is in a supporting manual:

"*phy***LOGIC**TM ToolBox – Communication Software for the *phy***MOTION**TM Stepper Motor Controller"

For programming the sequential program please read:

Further manual

Detailed information on this subject is in a supporting manual:

"*phy***LOGIC**TM Command Reference for the *phy***MOTION**TM Controller"

Information about positioning you'll find in:

Further manual

Detailed information on this subject is in a supporting manual:

"Principles of Positioning of the Stepper Motor Controllers"

i

CAUTION – Possible damage!

Some modules are set to a default value on delivery. So e.g., the motor current must be set to the corresponding value (see the motor data from the motor manufacturer). Connected components like motors can be damaged by incorrectly set values.

- Please check if the parameters are correct before starting.

6.1 Diagnostics by the LEDs

The LEDs indicate the status and error of the INAM01 module by colours and blinking:

LEDs	left	right
Off	no logic power available	Power stage not ready
green	logic power ready	Power stage ready
orange	-	–
red	–	Error power stage

6.2 Parameterising the Module

When using encoders, the corresponding *phy***LOGIC**^{TM} parameters **P34** to **P39** should be checked and set.

For the power stage settings use the parameters **P43** to **P45**.

For a general overview of the parameters:

Further manual

Detailed information on this subject is in a supporting manual:

"*phy***LOGIC**^{TM} Command Reference for the *phy***MOTION**^{TM} Controller"

Information about positioning you'll find in:

Further manual

Detailed information on this subject is in a supporting manual:

"Principles of Positioning of the Stepper Motor Controllers"

7 Principles of Positioning

Further manual

Detailed information on this subject is in a supporting manual:

"Principles of Positioning of the Stepper Motor Controllers"

8 Service

In the case of a service order, please proceed as follows:

First try to identify the technical problem. Feel free to ask our support team for help. We are pleased to assist you.

Removal of a INAM01 module or exchange of the APS power stage sub module:

- Switch off the *phy*MOTION™'s supply voltage

- Disconnect the supply voltage

- Cut the red seal tape and the black label tape carefully on the left and right edge of the module/front panel which you want to remove. Don't slide the blade between the front panels by no means. When backfitting by our service the red seal tape is renewed.

- Please note the following before the removal, because up to four INAM modules are connected with the I4XM indexer module by a ribbon cable on the rear of the module:
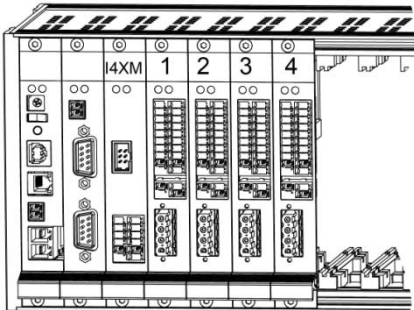
- First, loosen the front screws of all five modules (I4XM and INAM).

- Then pull the I4XM module carefully out of the housing by the handle – proceed with the four INAM modules as well.

- Replace the corresponding APS assembly of the INAM module by loosening/removal.

- Then, starting with the I4XM module slide the five modules carefully back into the guide rail. If you have problems to push the module for the last half centimeter, move the module to the front panel slightly to the left and to the right during sliding, so that the connector pins contact the backplane socket.

- To send a module to phytron use ESD packaging only.

The INAM02 module can only be replaced in the phytron's plant. For this, the entire *phy*MOTION™ device must be sent.

9 Warranty, Disclaimer and Registered Trademarks

9.1 Disclaimer

Phytron GmbH has verified the contents of the manual to match with the hardware and software. However, errors and omissions are exempt and Phytron GmbH assumes no responsibility for complete compliance. The information contained in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

9.2 Warranty

The *phy*MOTION^{TM} modules are subject to **legal warranty**. Phytron will repair or exchange devices which show a failure due to defects in material or caused by the production process. This warranty does not include damage caused by the customer, for example, not intended use, unauthorized modifications, incorrect handling or wiring.

9.3 Registered Trademarks

In this manual several trademarks are used which are no longer explicitly marked as trademarks within the text. The lack of these signs may not be used to draw the conclusion that these products are free from third parties' rights. For example, some product names used herein are:

- *phy*MOTION^{TM} is a trademark of Phytron GmbH.

- *phy*LOGIC^{TM} is a trademark of Phytron GmbH.

- Microsoft is a registered trade mark and WINDOWS^{TM} is a trade mark of the Microsoft Corporation in the USA and other countries.

- DuPont^{TM} is a registered trade mark and Kapton^{TM} is a trade mark of E. I. du Pont de Nemours and Company or its affiliates.

10 Index