

*phy***MOTION**[™]

Interface Module for an External Power Stage

EXAM01.1

TRANSLATION OF THE GERMAN ORIGINAL MANUAL

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In this manual you will find the descriptions of the features and specifications of the **phyMOTION™** module: Interface Module for an External Power Stage EXAM01 (<http://www.phytron.de/phyMOTION>).

This manual is supplementary to the “**phyMOTION™** 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!	<i>Indicates a high risk of serious injury or death!</i>
	DANGER – Serious injury from electric shock!	<i>Indicates a high risk of serious injury or death from electric shock!</i>
	WARNING – Serious injury possible!	<i>Indicates a possible risk of serious injury or death!</i>
	WARNING – Serious injury from electric shock!	<i>Indicates a possible risk of serious injury or death from electric shock!</i>
	CAUTION – Possible injury!	<i>Indicates a possible risk of personal injury.</i>
	CAUTION – Possible damage!	<i>Indicates a possible risk of damage to equipment.</i>
	CAUTION – Possible damage due to ESD!	<i>Refers to a possible risk of equipment damage from electrostatic discharge.</i>
	“Any heading”	<i>Refers to an important paragraph in the manual.</i>

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 addition to the following main manual:

“phyMOTION™ Modular Multi-axis Controller for Stepper Motors”

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

Intended use:



The phyMOTION™ 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 phyMOTION™ 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 isolation 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 phyMOTION™ 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.

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3 EXAM01 Module Overview

EXAM01 stands for external Power Stage module. This module is used as an interface between indexer and external power stage. The module needs an Indexer (e.g. I4XM01) in front and sends Control pulses/Direction/Boost and Enable to an external power stage. Two limit switches and a third switch, which can be wired as limit switch evaluation are included as standard.

In addition, sub modules can be optionally selected for encoder evaluation (ECAS01, ECES01, ECMS01, ECBS01) as well as motor temperature evaluation (PTS01 and KTS01).

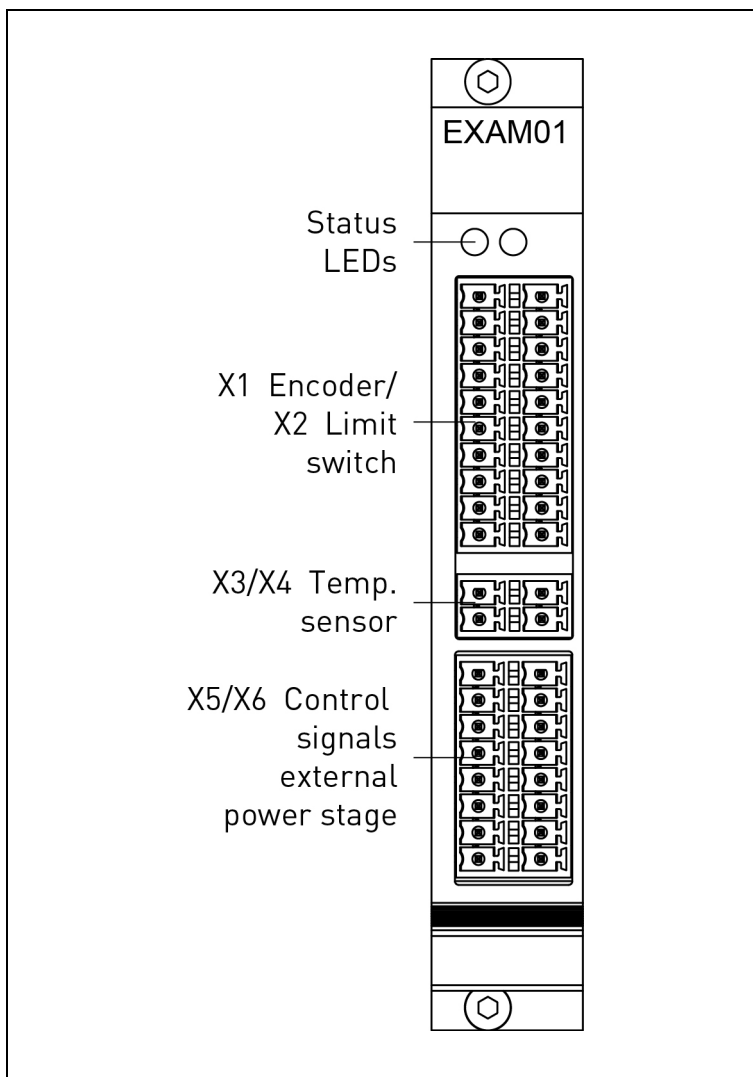


Fig. 1: EXAM01 View of the front panel

Ordering code of the EXAM01 modules:

Ordering code (example): **EXAM01-ECES01-PTS01**
Stepper motor power stage module with integrated
encoder and Pt sensor

Ordering Code		
Type	Encoder evaluation	Temperature evaluation
EXAM01	- ECES01	- PTS01
Options		
Encoder evaluation	ECES01 ECAS01 ECBS01 ECMS01	ENDAT encoder SSI/QUADR. encoder BiSS Resolver no encoder module
Temperature evaluation	PTS01 KTS01	Pt sensor K type no temperature module
Mating connectors are included in delivery.		

4 Technical Data

4.1 Declaration of Conformity



Declaration of Conformity according to EC directive 2014/30/EU (EMC-Directive)

Name and address of the manufacturer:

Phytron GmbH,
Industriestr. 12
82194 Gröbenzell

We declare that the following product is in conformity with the EC Directives 2014/30/EU relating to EMC.

Product denomination

Part-No.	Title	
10015050	EXAM01.1	Indexer Interface Module

From serial number 1604xxxxx

Applied harmonized standards

- EN 61000-6-1: 2007-01 Electromagnetic Compatibility (EMC) - Immunity for residential, commercial and light-industrial environmental
- EN 61000-6-2: 2005-08 Electromagnetic compatibility (EMC) - Immunity for industrial environments
- EN 61000-6-2: Corrigendum 1:2011
- EN 61000-6-3: 2007-01 Electromagnetic compatibility (EMC) - Emission standard for residential, commercial and light-industrial environments
- EN 61000-6-3: A1:2011
- EN 61000-6-3: AC:2012
- EN 61000-6-4: 2007-01 Electromagnetic compatibility (EMC) - Emission standard for industrial environments
- EN 61000-6-4: A1:2011

Comment:

This declaration of conformity is valid only if the device is built in a suitable casing e.g. phyMOTION-6SL-MR-s.

Gröbenzell, 2016-04-20

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(Österreich) Oberbank: IBAN: AT80 1500 0006 1111 1766 - BIC: OBKLAT2LXXX

4.2 Mechanical Data

Dimensions	100 x 100 mm (without front panel)
Weight	55 g / 75 g (without / with front panel)
Mounting	Plug-in module into the modular stepper motor controller <i>phy</i> MOTION TM
Mounting position	Vertical

4.3 Features

Performance Characteristics	
Stepper motor	Suitable for power stages with Control pulses/Direction input
Superior controller	Modular controller <i>phyMOTION</i> TM
Supply voltage	I/O voltage 24 V _{DC}
Current consumption maximum	250 mA (5 V) 10 mA (24 V) 30 mA (EnDat encoder 5 V) 20 mA + encoder (24 V) 30 mA (temperature module)
Cable length – digital inputs / outputs	30 m; if longer (100 m max.) use shielded cable and contact shield close to the controller.
Diagnostics	2 Status LEDs on the front panel for monitoring
Support of linear and rotary axes	yes
Refresh rate	2 ms

Interfaces	
Digital outputs	Control pulses/Direction/Boost and Enable for an external power stage
Analogue inputs	Option: Motor temperature evaluation <ul style="list-style-type: none"> - K thermal element (needs sub module: KTS01) - Pt100 sensor (needs sub module: PTS01)
Digital inputs	Limit switches: PNP- NOC/NCC Option: Encoder evaluation <ul style="list-style-type: none"> - with ECAS01 sub module: incremental or SSI - with ECES01 sub module: EnDat, incremental or SSI - with ECBS01 sub module: incremental, SSI or BiSS - with ECMS01 sub module: Resolver, LVDT or RVDT
Communication via backplane bus	Proprietary phytron bus
Communication and Programming	
Programming	Via phytron's programming environment <i>phyLOGIC</i> TM ToolBox
Communication	Master-slave communication. The EXAM01 is slave and communicates with the MCM01 main controller module.

4.4 Functions

Interface between stepper motor indexer and external power stage

- Requires an upstream installed indexer (i.e. I4XM01)
- Outputs Control pulses/Direction/Boost and Enable to an external power stage
- External stepper motor power stage with ServiceBus can be diagnosed and parameterised online via the interface on the indexer module (i.e. I4XM01).

3 Limit/reference switches

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

Option: Encoder evaluation

- The evaluation of the following encoders depends on the selected sub module:
 - with ECAS01 sub module: incremental or SSI
 - with ECES01 sub module: EnDat, incremental or SSI
 - with ECBS01 sub module: BiSS, incremental or SSI
 - with ECMS01 sub module: Resolver, LVDT or RVDT

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 **phyMOTION™** 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:

*“**phyMOTION™** Modular Multi-axis Controller for Stepper Motors”*

5.1 Mechanical Installation

In case you receive an individually packed EXAM01 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 **phyMOTION™** 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.

Before integrating or switching modules always make sure that the **phyMOTION™** 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 **phyMOTION™** 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 EXAM01 module referring to your order and documentation – the EXAM01 needs at least a preceding Indexer module (i.e. I4XM01), a POWM01 or POWM02 and the MCM01 main controller module.

The EXAM01 module is always built as a sandwich with its subsequent indexer module (i.e. I4XM01). 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.

Connect the EXAM01 module to the connector (2x13 pole, ribbon cable) with the appropriate indexer modules from the rear side.

Push the sandwich module carefully into the guide rail until the rear contacts the housing frame of the **phyMOTION™**.

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.

5.2 Electrical Installation

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

We recommend labelling 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
Encoder X1	1x10	MCDN1,5/10-G1-3,5P26	FMC1,5/10-ST-3,5	10013217
Limit switches X2	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
Control signals X5/X6	2x8	MCDN1,5/8-G1-3,5P26	FMC1,5/8-ST-3,5	10005881

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



CAUTION – Possible damage!

Damage of the module by wrong connection.

- Do not exchange the 10 pin limit switch connector with the 10 pin connector for the encoder evaluation.

5.2.2 Pin Assignment

In the following the pin assignment:

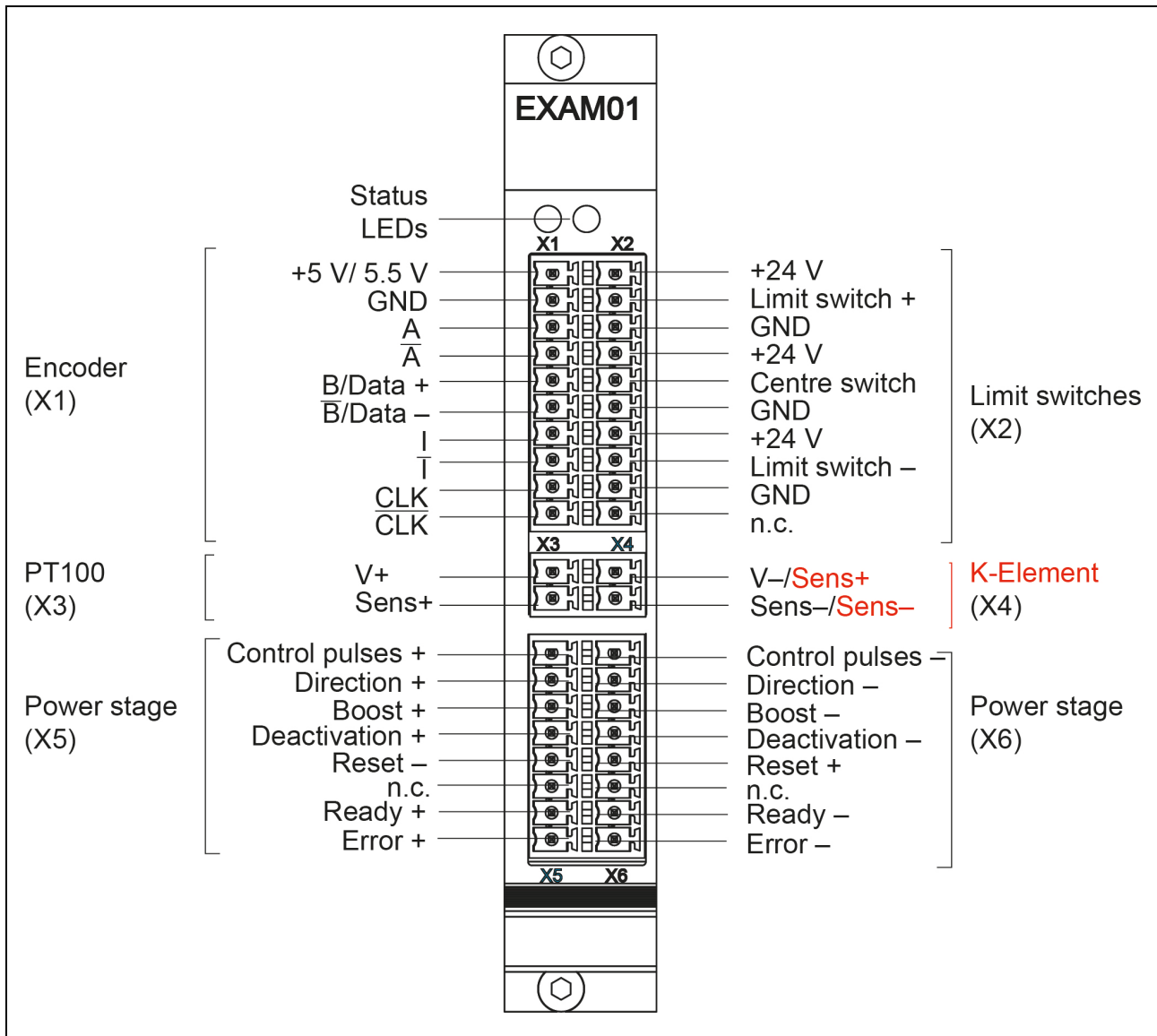


Fig. 2: Pin assignment

Use the specified mating connectors for wiring.

5.2.3 Connection Control signals X5/X6

This connector is used for the external power stage connection.

Signal level: 5 V

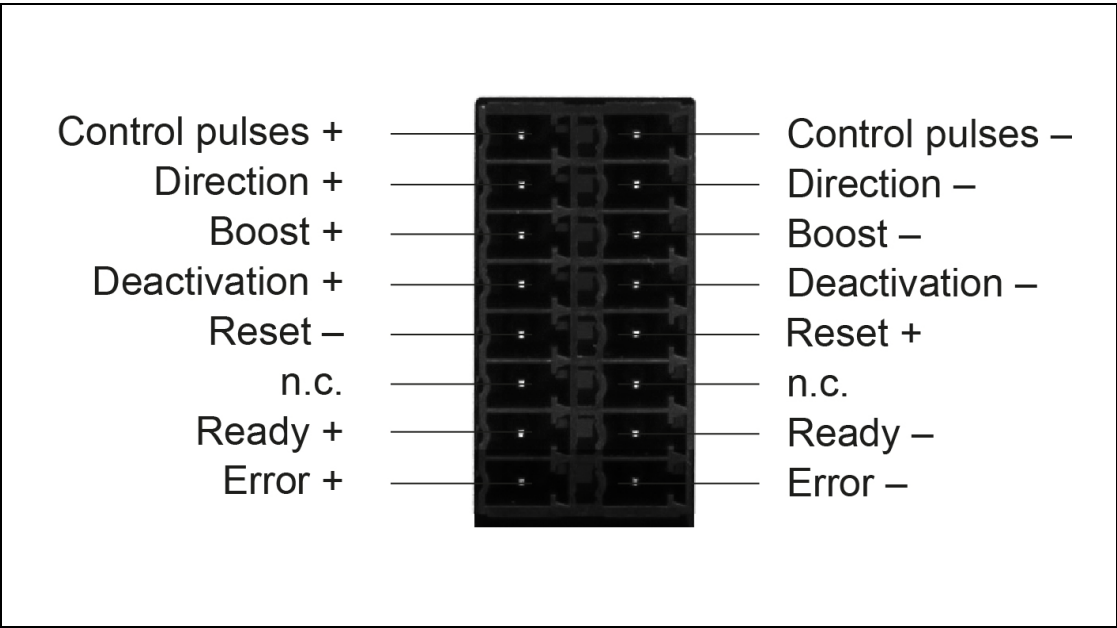


Fig. 3: Digital outputs

Connection example: EXAM01 with MCD+ power stage

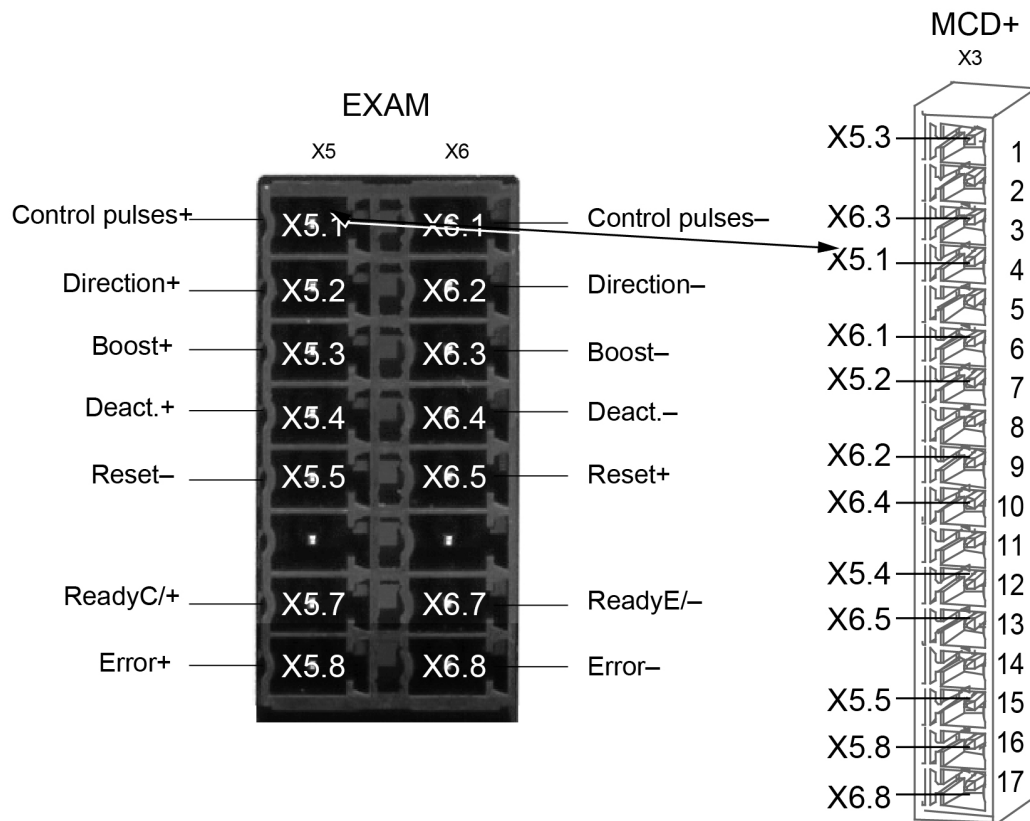


Fig. 4: Signal connection of the MCD+ with EXAM01

Optional Accessories:

Adaptor cable for EXAM01 connection with MSD power stage

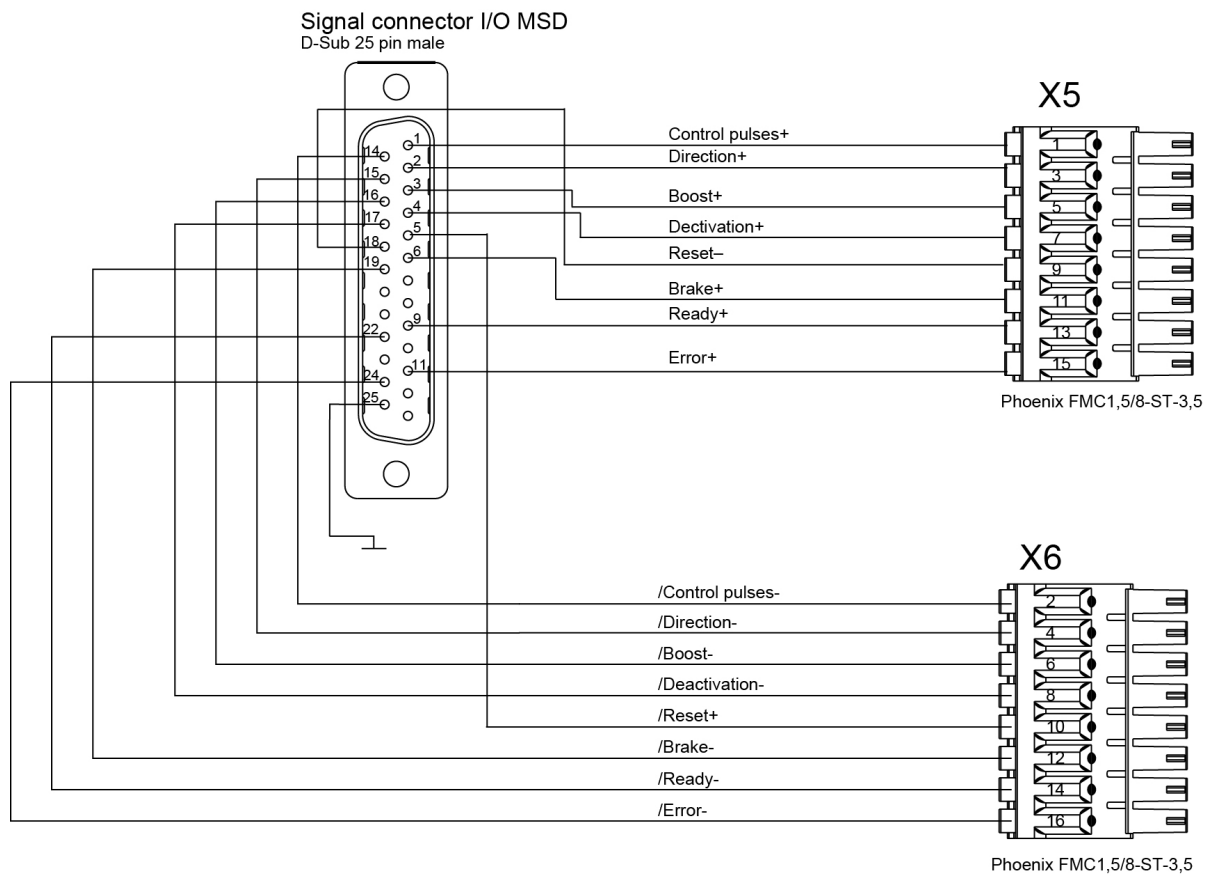


Fig. 5: Adaptor cable : cable length 0.5 m (ID no. 10015012), 2.0 m (ID no. 10014906)

5.2.4 Limit switch connection X2

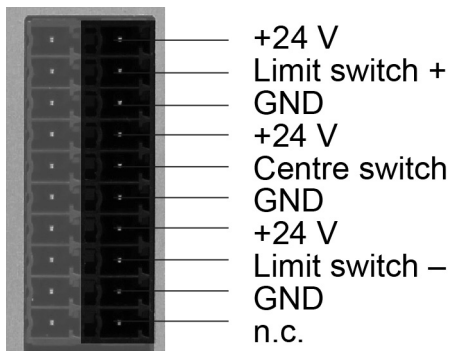


Fig. 6: Pin assignment limit switches

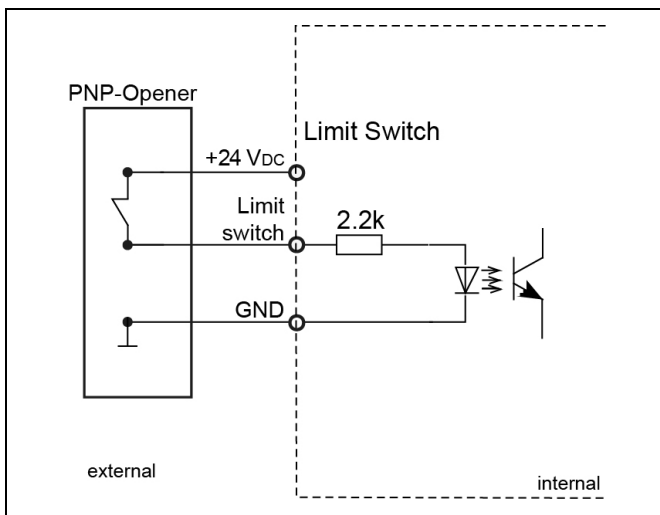


Fig. 7: Input wiring

The controller is designed for connection of up to three limit switches type PNP NOC or NCC. A limit switch is used for monitoring the movement in the + direction (limit switch +), the second for the direction (limit switch –) is determined. The third switch (center switch) can for example be used as a reference switch. Cable breaks can be detected by the PNP NOC .

Mechanical limit switches (NOC) can be used, too.



CAUTION – Possible damage!

Damage of the module by wrong connection.

- Do not exchange the 10 pin limit switch connector with the 10 pin connector for the encoder evaluation.

5.2.5 Option: Encoder connection X1

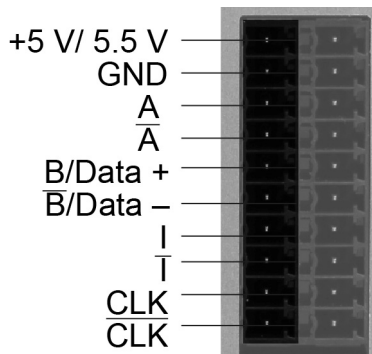


Fig. 8: Pin assignment of the encoder

- Suitable encoder types depend on the selected evaluation module:
 - with **ECAS01** sub module: **differential incremental encoder** with quadrature signals or absolute encoder according to the **SSI** standard
 - with **ECES01** sub module: **EnDat**, **differential incremental encoder** with quadrature signals or absolute encoder according to the **SSI** standard
 - with **ECBS01** sub module: **differential incremental encoder** with quadrature signals or absolute encoder according to the **SSI** standard or **BiSS** standard
 - with **ECMS01** sub module: **Resolver**, **LVDT** or **RVDT**
- The incremental encoder supply voltage 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 pages.

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.
- Please observe the supply voltage of the encoder: 5 V or 15 V
- 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

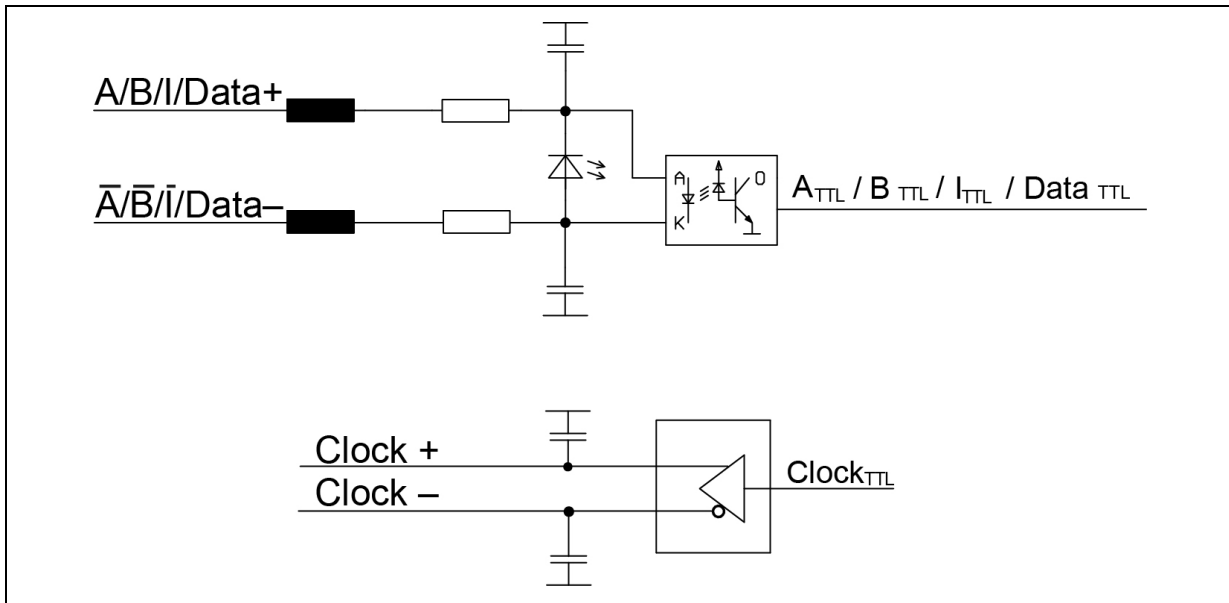


Fig. 9: Wiring: SSI/Quadrature

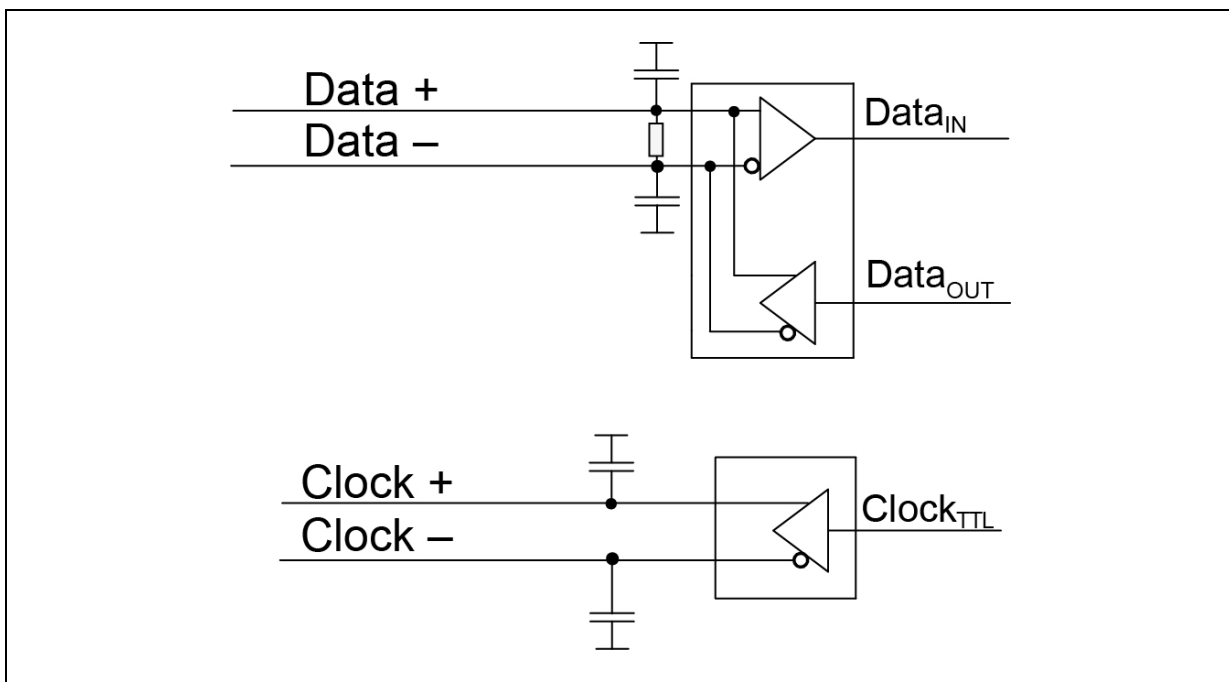


Fig. 10: Wiring: EnDat/BiSS encoder

Resolver wiring refer to chap. 5.2.6

Optional accessories: adaptor cable for EnDat encoder

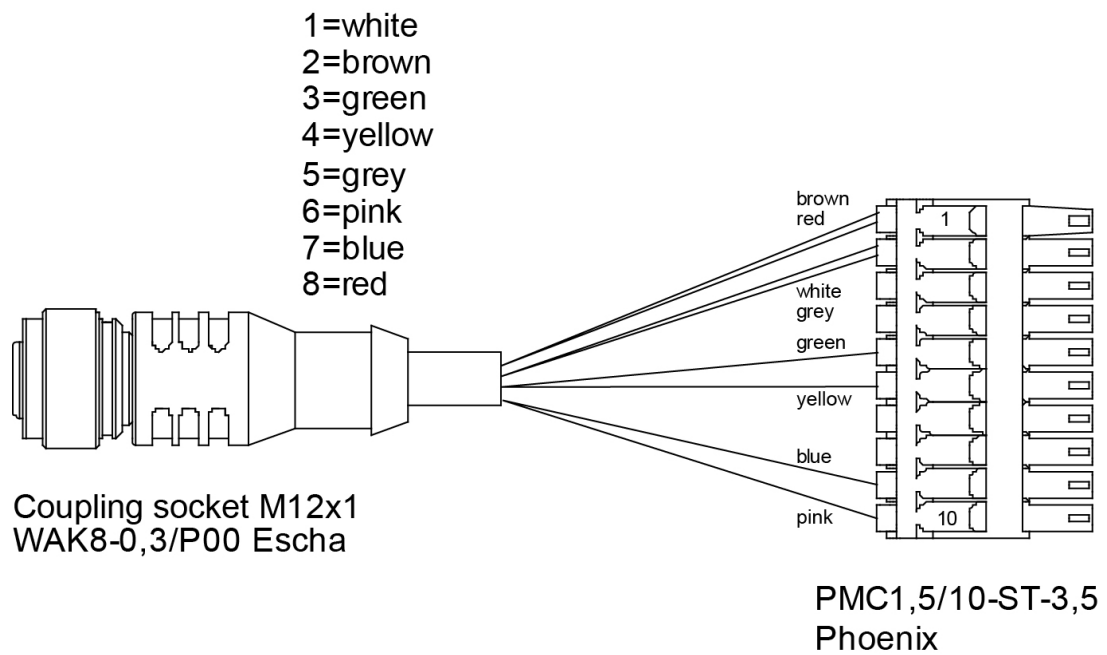


Fig. 11: Adaptor cable (ID no 10014905)

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.)

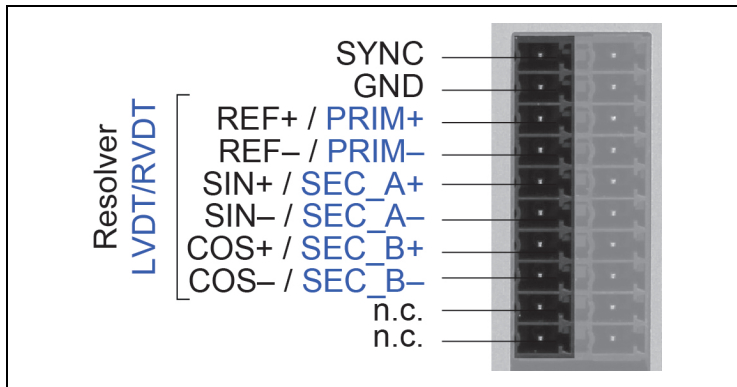


Fig. 12: Pin assignment of the encoder connector

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.



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

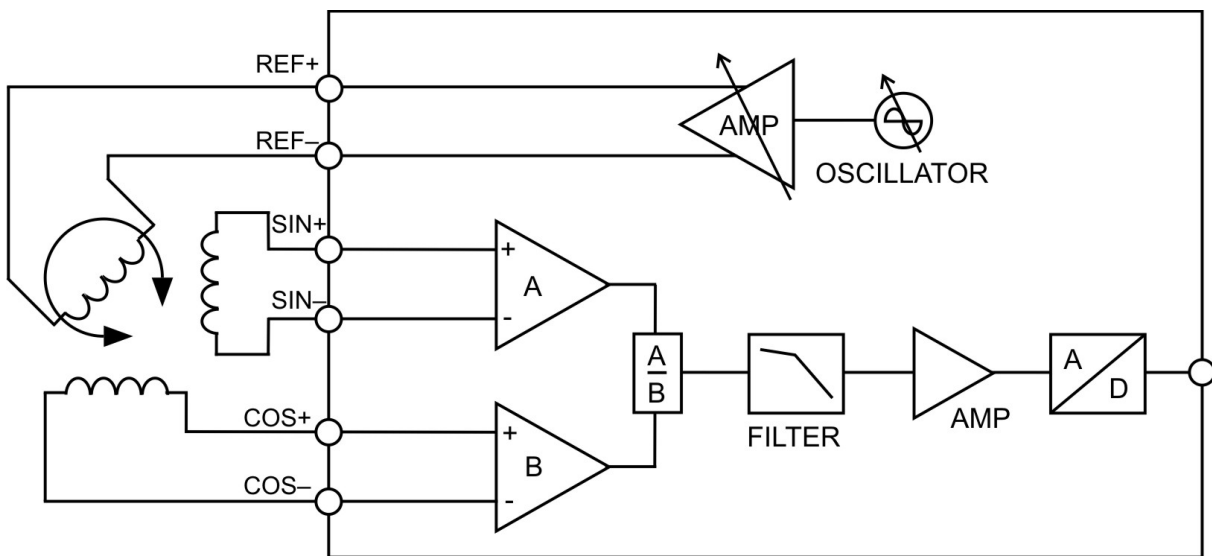


Fig. 13: Resolver wiring

4-wire-LVDT

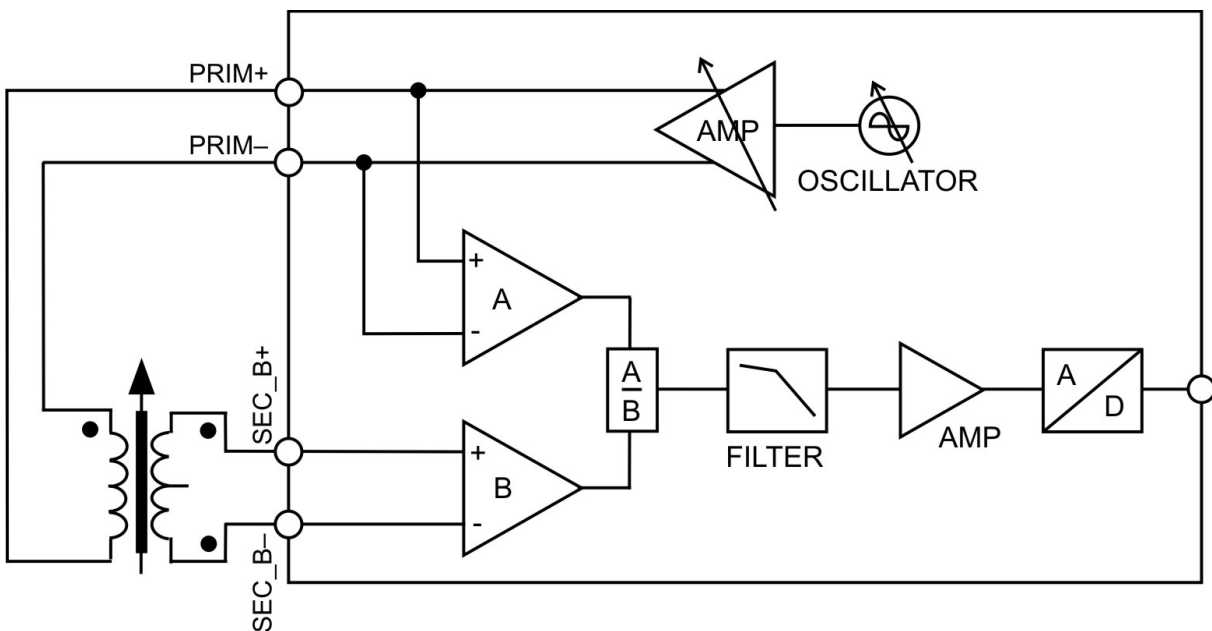


Fig. 14: 4-wire-LVDT/RVDT wiring (full bridge)

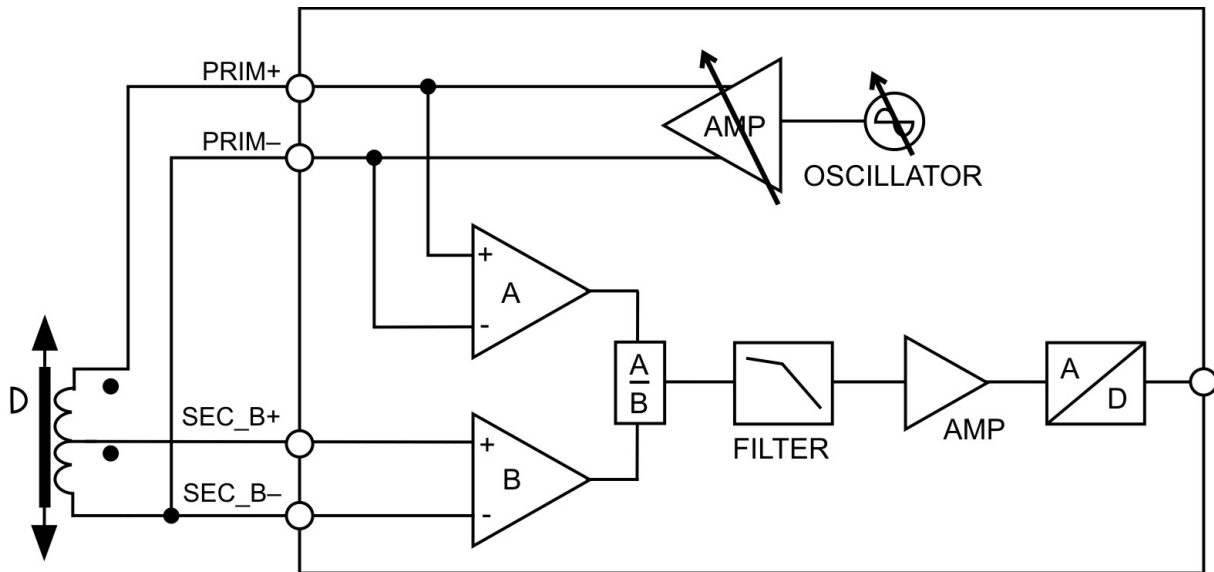


Fig. 15: 4-wire-LVDT/RVDT-wiring (half bridge)

5/6-wire-LVDT

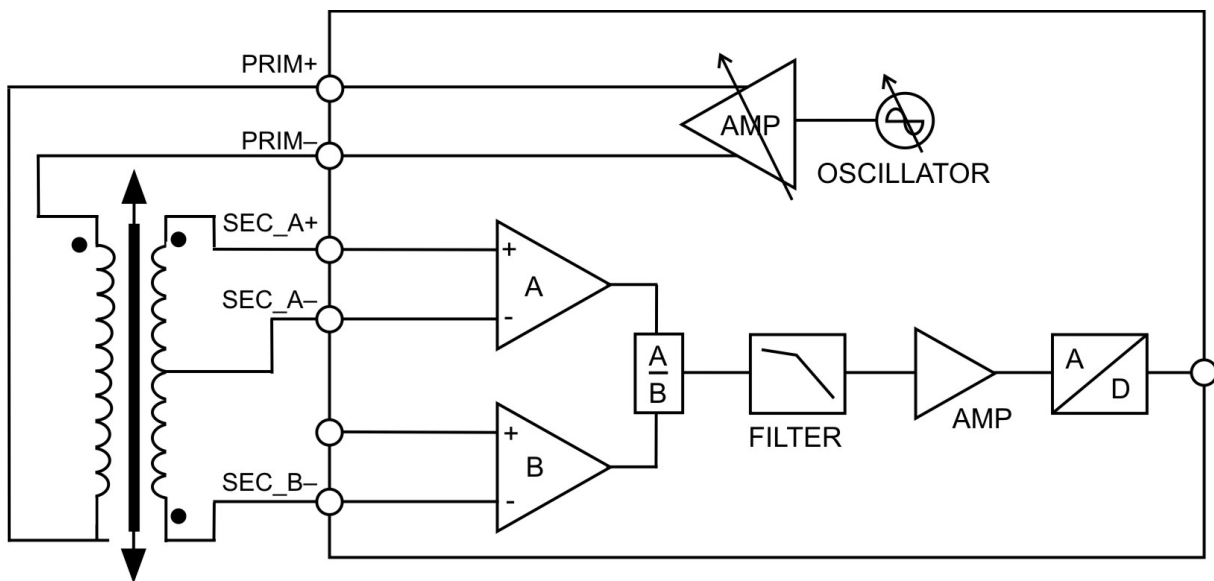


Fig. 16: 5-wire-LVDT/RVDT-wiring

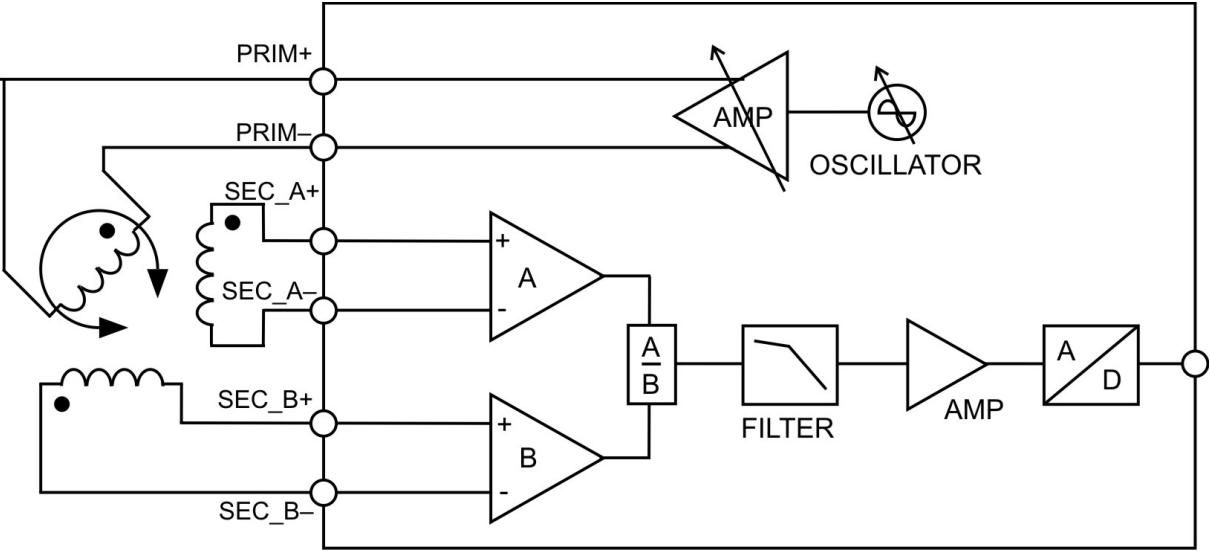


Fig. 17: 6-wire-LVDT/RVDT-wiring

Synchronisation

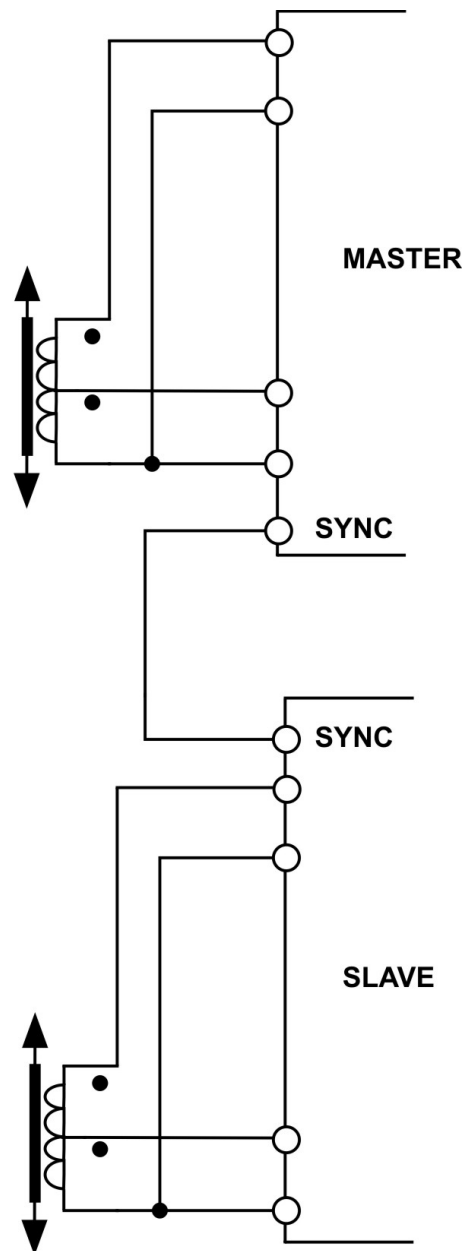


Fig. 18: Synchronisation wiring

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).

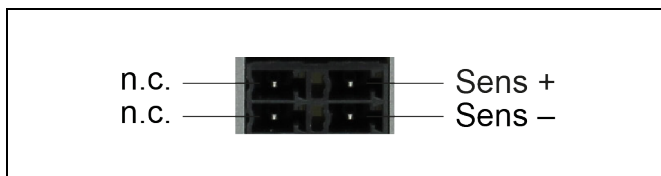


Fig. 19: K element connection

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

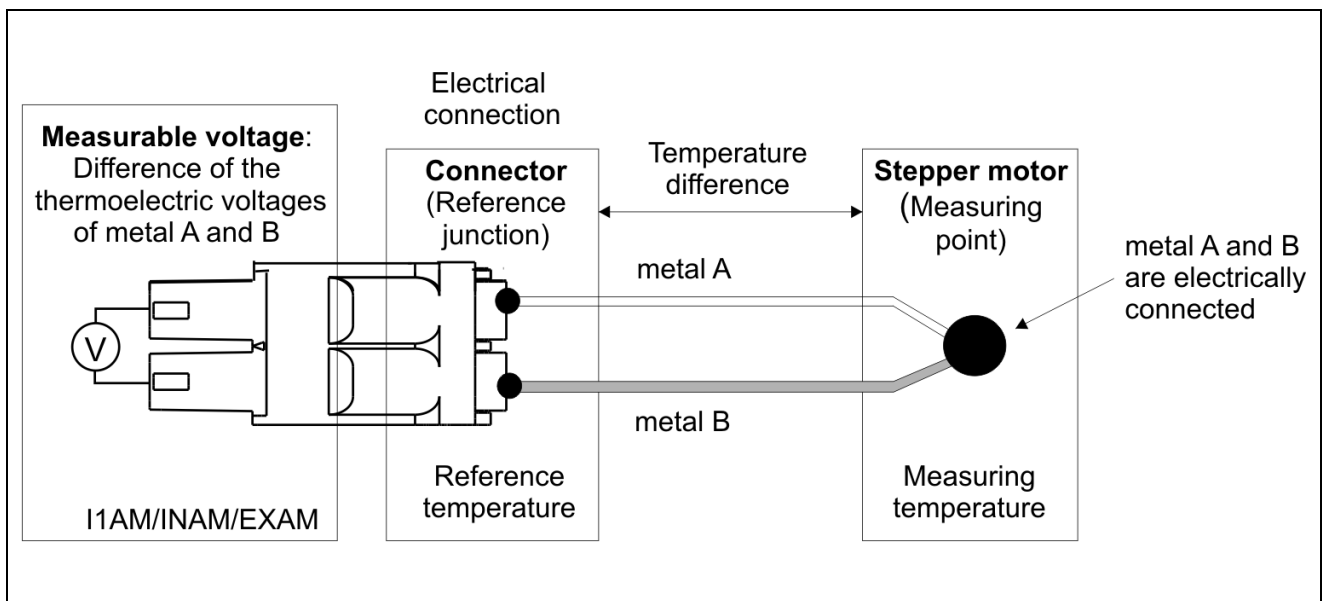


Fig. 20: Sample form

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.



CAUTION – Possible damage!

Damage of the module by wrong connection or wire break.

- Check the integrity of the element type K and the correct **phyMOTION™** 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.

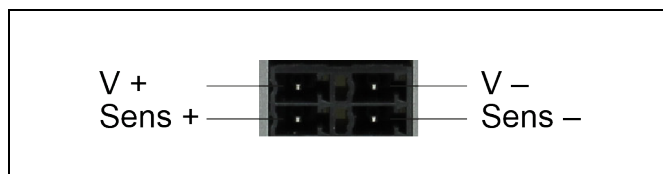


Fig. 21: Pt100 connection

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 I1AM01/I1AM0a module:



Further manual

Detailed information on this subject is in a supporting manual:

“**phyMOTION**TM Modular Multi-axis Controller for Stepper Motors”

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



Further manual

Detailed information on this subject is in a supporting manual:

“**phyLOGIC**TM ToolBox – Communication Software for the **phyMOTION**TM Stepper Motor Controller”

For programming the sequential program please read:



Further manual

Detailed information on this subject is in a supporting manual:

“**phyLOGIC**TM Command Reference for the **phyMOTION**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”



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 EXAM01 module:

LEDs	left	right
off	No power supply available	
green	Logic power OK	24 V power OK

6.2 Parameterising the Module

When using encoders, the corresponding *phyLOGIC*TM parameters **P34** to **P39** should be checked and set.

For the external power stage setting, please note as follows:

External power stage (i.e. MCD+, MSX+,ZMX+,..)	Parameter	
without ServiceBus connection	P40 to P45 have no function	the settings (current, step resolution) should be made with the rotary or DIP switches.
is connected via I4XM01 module to the ServiceBus	P40 to P44 settings acc. to the parameter list P45 is invalid	P45: Distribution of step resolution (0 to 15) according to the power stage table (see power stage manual)

For a general overview of the parameters:



Further manual

Detailed information on this subject is in a supporting manual:

“*phyLOGIC*TM Command Reference for the *phyMOTION*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:

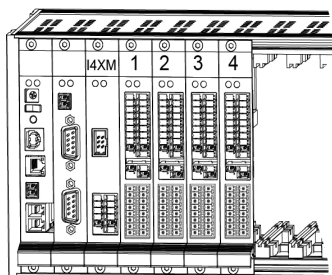
“Principles of Positioning of the Stepper Motor Controllers”

8 Service

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 module:

- Switch off the *phyMOTION*TM's supply voltage
- Disconnect the supply voltage
- POWM01 or POWM02 and the MCM01 main controller module.
- 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 EXAM 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 EXAM).
- Then pull the I4XM module carefully out of the housing by the handle – proceed with the four EXAM modules as well.
- Exchange the EXAM01 module.
- 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.
- If you want to use the *phyMOTION*TM after removing a module, the gap has to be sealed with a blanking plate before power supply is reconnected and switched on.
- To send a module to phytron use ESD packaging only.

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 *phyMOTION*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:

- *phyMOTION*TM is a trademark of Phytron GmbH.
- *phyLOGIC*TM is a trademark of Phytron GmbH.
- Microsoft is a registered trade mark and WINDOWS[®] is a trade mark of the Microsoft Corporation in the USA and other countries.
- DuPontTM is a registered trade mark and Kapton[®] is a trade mark of E. I. du Pont de Nemours and Company or its affiliates.

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