TM StepDrive 1x24..48V/5A

Stepper Motor Module for the SIMATIC®ET 200®SP

Manual 1303-A004 EN

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TM StepDrive 1x24..48V/5A

for SIMATIC®ET 200®SP

Module Description and Commissioning

TRANSLATION OF THE GERMAN ORIGINAL MANUAL

Version	Content
1	new
2	derating
3	EMC filters, supplements warnings
4	product photo, figures, power supply (p.33)

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In this manual you will find the feature descriptions and specifications of the ET 200®SP module for positioning of a stepper motor: TM StepDrive 1x24..48V/5A (phytron 10020273).

This manual is supplementary to the *SIMATIC ET 200SP Distributed I/O system.*

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.

Further manuals

All current manuals for SIMATIC products are available for free download on the Internet: (https://support.industry.siemens.com/cs/start?lc=en-DE)

Helpful documentation for commissioning the TM StepDrive 1x24..48V/5A technology module in which you will find detailed information on hardware configuration, configuration, wiring, commissioning, diagnostics and the technical data of the ET 200®SP decentralized peripheral system:

– SIMATIC ET 200SP Distributed I/O system (https://support.industry.siemens.com/cs/mdm/58649293?c=104269682827&t=1&s=BaseUnit&lc=en-DE)

– Device Manuals Interface module (https://support.industry.siemens.com/cs/products?dtp=Manual&mfn=ps&pnid=14034&lc=en-DE)

– Operating Manual for ET 200®SP BaseUnit 6ES7-193-6BP20-0BB1 compatible with TM StepDrive 1x24..48V/5A ET 200SP BaseUnits (https://support.industry.siemens.com/cs/mdm/59753521?c=104409187595&t=1&s=ET%20200SP%20BaseUnit&lc=en-DE)

– Function manual SIMATIC PROFINET with STEP 7 (https://support.industry.siemens.com/cs/mdm/49948856?c=106491543819&t=1&s=PROFINET%20with%20STEP%207%20V13%20SP1&lc=en-DE)

Content

1 TM StepDrive 1x24..48V/5A

1.1 Short Overview

Fig. 1: The TM StepDrive technology module

The TM StepDrive 1x24..48V/5A technology module is a stepper motor controller with integrated power stage. It is specially developed for application in the decentralised SIMATIC®ET 200®SP peripheral system.

2 phase stepper motors in the 200 W power range up to 5 A_{PEAK} with a supply voltage from 24 to 48 V_{DC} can be controlled by this technology module.

Modes of operation

It can be operated in two different operating modes, as an autonomous system which receives motion commands from the CPU and then executes them (**positioning mode, PM mode**), or as a frequency controller which is controlled by a technology object (**frequency mode, TO mode**).

In PM mode, three parameterisable digital inputs are available as limit or reference switches; in TO mode, one input can be used as reference switch.

Connection types

The function of the TM StepDrive module can be defined differently by the two connection types:

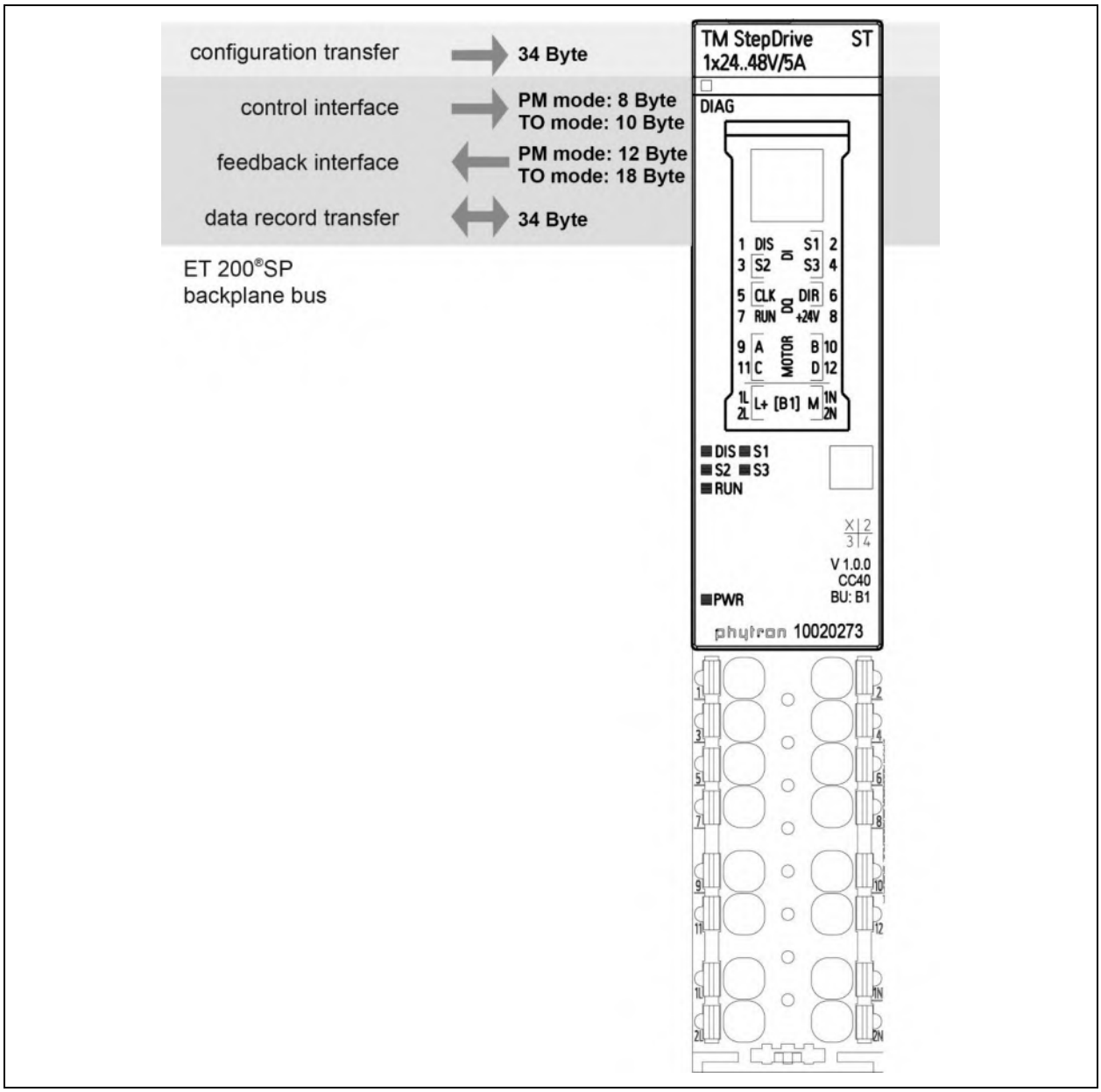
“Power stage" connection type: The TM module uses the integrated output stage to supply a stepper motor.

“**Indexer**” connection type: The TM module provides the control signals control pulses and direction for a separate external power stage.

1.2 Overview of the most important features of the StepDrive technology module:

- 2-phase stepper motor controller with integrated power stage for SIMATIC®ET 200®SP
- 200 W power range up to 5 A_{PEAK} at 24 to 48 V_{DC}
- up to 1/256 micro step
- maximum run frequency 250 kHz
- operating modes:
    - positioning mode (PM mode) for linear- and circular axes:
        - Moving to absolute position
        - Moving by relative distance
        - reference point run
        - free run with variable velocity
        - set position
        - motor stop
        - emergency stop
    - frequency mode (TO mode)
- connection types:
    - power stage
    - indexer
- Function and active levels of the three digital inputs S1, S2 and S3 can be parameterised
- Feedback values adjustable in the feedback interface (position and distance-to-go or position and frequency)
- Setting of the power stage parameters at system start and during operation: e.g. run, stop, boost current, step resolution, run current delay time, etc.
- Online power stage diagnosis
- Parameterisation with STEP®7 TIA Portal® from V15 or via GSD file for PROFIBUS or PROFINET

1.3 Overview of the Data Interfaces



Configuration transfer: Configuration of the module with STEP®7: all parameters of the TM StepDrive technology module can be set by mouse click and transmitted.
See chap. 6.5

Control / Feedback interface: So-called control values can be transmitted and statuses can be read clock synchronously with the clock of the control and feedback interface
See chap. 7

Data record transfer: A user program can read or write the complete parameter set of the module (e.g. run current, stop current or run frequency). Reading the data record and status query is possible independently of the traversing job. New parameters can also be written while a traversing job is running.
See chap. 7.3

1.4 Directives and Standards

CE Mark	With the declaration of conformity and the CE Mark on the product the manufacturer certifies that the product complies with the requirements of the relevant EC directives. The unit, described here, can be used anywhere in the world.
EC Machinery Directive	The drive system, described here, is not a machine in the sense of the EC Machinery Directive (2006/42/EC), but a component of a machine for installation. They have no functional moving parts, but they can be part of a machine or equipment. The conformity of the complete system in accordance with the machine guideline is to be certified by the manufacturer with the CE marking.
EC EMC Directive	The EC Directives on electromagnetic compatibility (2014/30/EU) applies to products that can cause electromagnetic interference or whose operation can be impaired by such interference. The power stage's compliance with the EMC Directive cannot be assessed until it has been installed into a machine or installation. The instructions provided in "Installation" (chap. 5) must be complied with to guarantee that the TM is EMC compliant when fitted in the machine or installation and before use of the device is permitted.
Standards for safe operation	EN 60204-1: 2007-6: Electrical equipment of machines, degree of pollution 2 must be observed EN 60529: 2014-09: IP Degree of protection
Standards for observing the EMC limit values	EN 61000-3-2: EMC EN 61000-6-1,3,4: Interference immunity and emission EN 61000-6-2:2005: Immunity for industrial environments
Standards for measuring methods of observing EMC limit values	EN 55011 class B: Noise field and voltage measuring EN 61000-4-2...6,11 Emission standard test

1.5 Declaration of Conformity

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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 and 2014/35/EU relating to electrical equipment.

Product denomination
10020273 TM-StepDrive 24-48V/5A

valid from serial number 1810xxxxx

Applied harmonized standards (EMC directive)

EN 61000-6-2: 2005	Electromagnetic compatibility (EMC) - Immunity for industrial environments
EN 61000-6-3: 2007 + A1:2011	Electromagnetic compatibility (EMC) - Emission standard for residential, commercial and light-industrial environments

Gröbenzell, October 29, 2018

ppa Adams

Rainer Adams
Technical Director

AP QM-0671-10
CE 7066 Rev. 1

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2 To Consider Before Installation

Read this manual very carefully before installing and operating the TM StepDrive. Observe the safety instructions in the following chapter!

2.1 Qualified Personnel

Design, installation and operation of systems using the TM StepDrive 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 planned.

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

WARNING

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

2.2 Safety Instructions

The TM StepDrive is designed for operating in a SIMATIC®ET 200®SP System. An installation is allowed only if the requirement of the EC Machine Directive and EMC are conformed with. See chap.1.4.

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 complete system (e.g. machine concept).

In any application the reliability of operation of the software products can be impaired by adverse factors, e.g. differences in electrical power supply or, computer hardware malfunctions.
To avoid damage by system failures the user must take appropriate safety measures, including back-up or shutdown mechanism.

Malfunctions are possible while programming the instruction codes – e.g. sudden running of a connected motor, braking etc.
Please test the program flow step by step!

Each end user system is customised and differs from the testing platform.
Therefore the user or application designer is responsible for verifying and validating the suitability of the application.

WARNING

Injury or damage by overvoltage!

Operate the module only in accordance with the protective measures in chap.3.

ATTENTION

Risk of damage by incorrect motor current setting!

The TM StepDrive s set to a default current on delivery!
The motor current must be set to the designated value before installation (see data of the motor).

DANGER

Danger of electrical arcing!

Always switch off the supply voltage before connecting or disconnecting any wires or connectors at the power stage.

DANGER

Danger of electrical arcing!

Do not unplug the connector while powered!

Load voltage must be powered off by external switches or by a removable fuse link!

DANGER

Danger of electric shock!

Up to 3 minutes after turning off the supply voltage, dangerous voltages may still exist at the connectors or on the board.

Energising the input DIS or in the case of a CPU STOP (see 6.5.1.4) the power stage is not safe in the case of an emergency stop.
The voltage supply has to be interrupted for safe isolation of the drive.

The DIS input is not a safety operating mode according to IEC61800-5-2 such as "Safe Torque Off" (ST0) by pulse pattern inhibition.

2.3 Ambient Conditions

Operating temperature	0 °C to +60 °C
Storage and transport temperatures	- 40 °C to +70 °C
Relative humidity	95 % max. no dew
Degree of pollution	level 2
Protection class	IP 20
EMC tests	acc. to EN 55011 acc. to EN 61000-2,3,4,5,6
Approval	CE

3 Safety Concept

3.1 Safety Measures

The following measures are vital to the safety of the system. Carry out the safety measures with particular care and adapt them to meet the requirements of the system.

WARNING

Safety operating modes such as SafeTorqueOff (STO) from IEC61508-2 cannot be implemented directly!

WARNING

To prevent personal injury and damage to equipment please observe the following points:

- Install an emergency stop system in keeping with current technical standards (for example, European norms EN 60204, EN 418, etc.).
- Make sure that no one has access to areas of the system with moving parts.
- Install, for example, hardware limit switches for the end positions of the axes that switch off the power control system directly.
- Install devices and take steps to protect motors and power electronics.

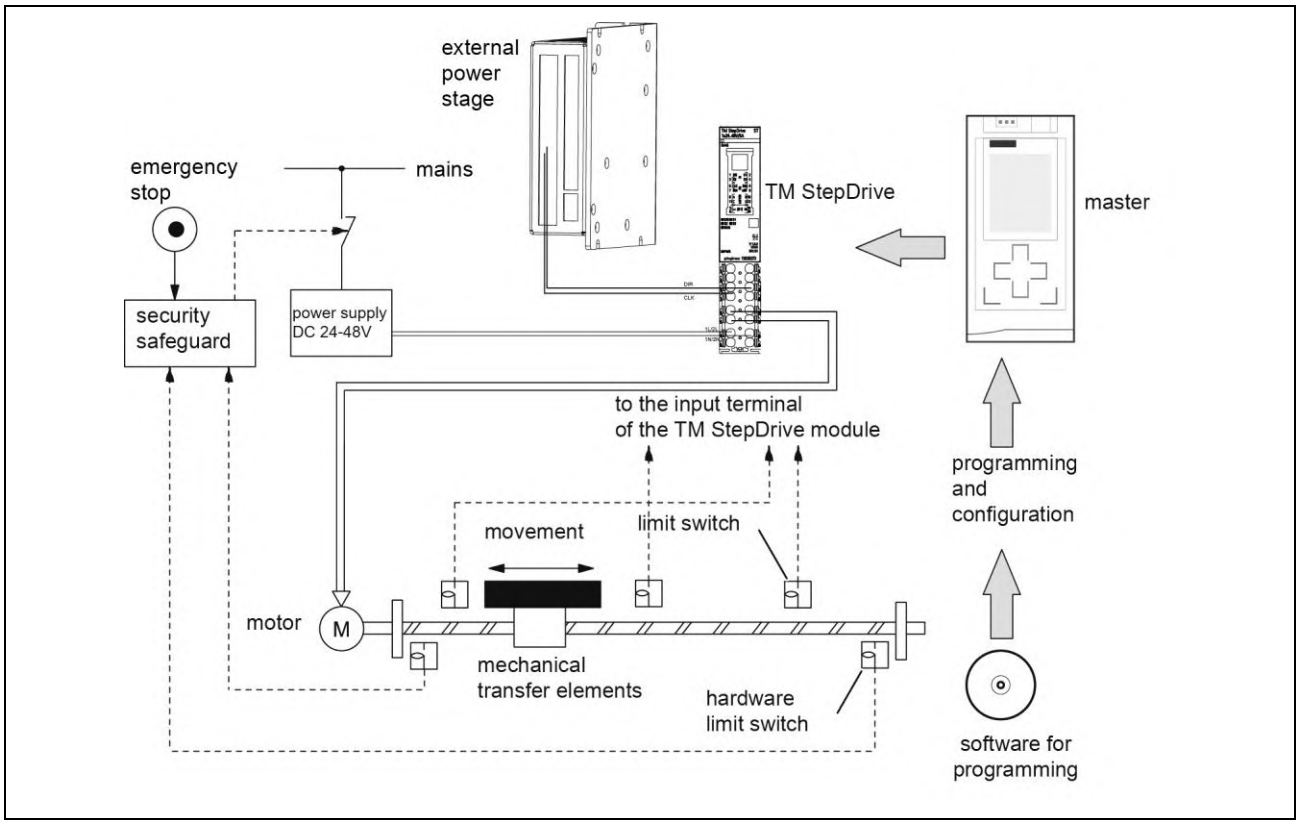


Fig. 2: Design of a positioning system with a stepper motor

3.2 EMC Measures

Preset for EMC: Motor cable

The motor cable is a source of interference and must be positioned carefully.

Use the cables recommended by Phytron. They are tested for EMC safety and are suitable for movement.

The shield of the motor cable must be connected to the BaseUnit and to the motor with low impedance or flat.

- Connect the motor cables without interruption (do not use switches) from the motor to the device. If a cable must be interrupted, use shielded connections and metal housings to avoid interferences.
- Lay the motor cable at a distance of at least 20 cm from the signal cables. If they are laid closer together, motor cable and signal wiring must be shielded and grounded.
- Use potential equalization cables with suitable cross section when the cables are long.

Potential equalisation cables

Connect the shielding on all sides for protection from interference.

The difference of potential can cause incorrect currents on the shielding and must be avoided by potential equalization cables.

The TM StepDrive must be operated with protective measure PELV/SELV.

3.3 Shielding

To avoid interference affecting the wires and instruments installed close to the drive system, we recommend the use of shielded cables.

The shield must be connected on both sides. Use a shield strip of the switch cabinet to connect the shield.

The shield contact element of Siemens (order no. 6ES7193-6SC00-1AM0) does not contact the base unit B1.

If there is no DC/DC power supply unit in the direct vicinity of the ET 200®SP unit, the use of the filter developed by Phytron Filters (order ID: 10022069) may be necessary.

4 Technical Data

4.1 Mechanical Data

Type	SIMATIC®ET 200®SP plastic housing
Dimensions	20 x 73 x 58 mm (W x H x D)
Weight	about 62 g
Mounting	Pluggable in SIMATIC®ET 200®SP system with connections according to ET 200®SP specification (BaseUnit BU20-P12+A0+4B)
Mounting position	optional (power loss see chap. 5.2)

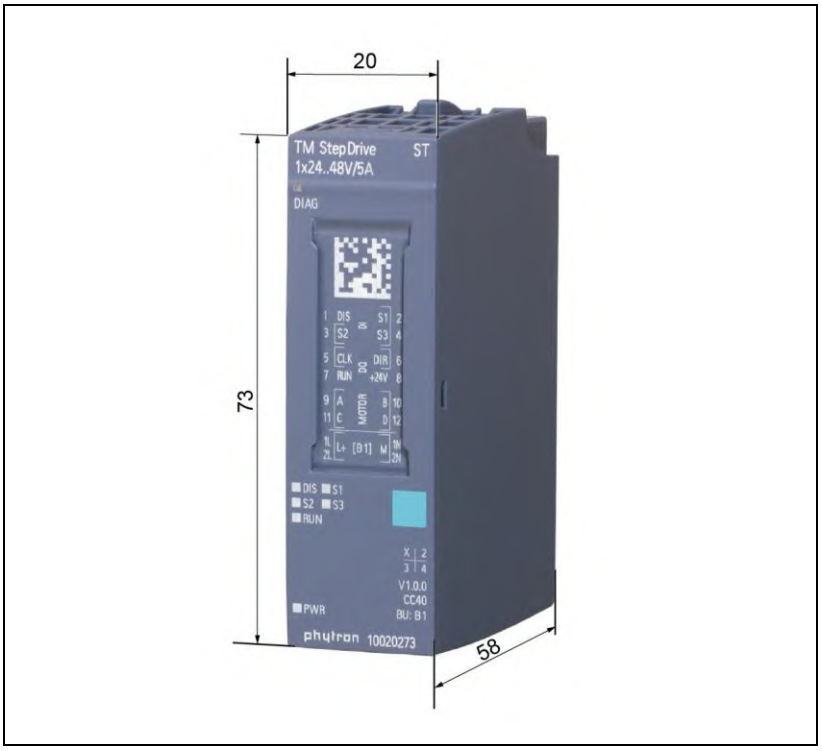


Fig. 3: Dimensions

The dimension drawing of the BaseUnit B1 (BU20-P12+A0+4B) peripheral module can be found in the SIEMENS device manual *SIMATIC ET 200SP BaseUnits*.

4.2 Features

Features	
Stepper motors	Suitable for bipolar control of 2 phase stepper motors with 4, (6) or 8 lead wiring
Superior main station	SIMATIC®ET 200®SP
Power supply	24 to 48 V_{DC} Nominal voltage: 48 V_{DC}
Phase current	5 A_{PEAK}
Motor current adjustment	100 mA increments
Step resolutions	Full step, half step, 1/4, 1/8, 1/16, 1/32,1/64,1/128,1/256 micro step
Maximum step frequency	250.000 steps/sec Remark: the frequency generation is digital, only values can be generated which result from dividing the processor frequency by an integer divider.
Physical resolution	Approx. 51.200 positions per revolution (0.007°/step). An encoder with a counter should be considered for very fine positioning.
Current consumption (max.)	3 A_{DC} at 5 A_{PEAK}
Mechanical output power	Up to the 200 W range
Nominal power of the motor voltage supply	168 W
Cable length - motor	Shielded: 50 m max.
Cable length - digital inputs	3 m max.

Diagnostic LEDs	• DIAG • DIS (power stage disabled) • S1 (switch 1 is active) • S2 ((switch 2 is active) • S3 ((switch 3 is active) • RUN (motor is running) • PWR (load voltage is present)
Motion commands in PM mode	• moving to absolute position • moving by relative distance • reference point run • free run with variable velocity • set position • motor stop • emergency stop
Safety modes	Safety modes, such as e.g. Safe Torque Off (STO) from IEC 61508-2 can only be realised with this controller with external components.
Mechanism of the communication via backplane bus	Synchronous: control interface, feedback interface Asynchronous – PLC in STOP mode: Base parameterising Asynchronous – PLC in RUN mode: Parameterising with DS128
Hardware error detection	Over temperature at the power stage T>105 °C
Refresh rate	1 ms

Interfaces	
Analogue outputs	A, B, C, D for a 2-phase stepper motor
Digital inputs for PM mode S1, S2, S3: for TO mode S1, S2, S3:	3 configurable digital inputs S1, S2 and S3: 0 signal: 0 ... 1 V with max. 2 mA 1 signal: 2.3 V ... 30 V with typ. 5 mA Input delay: 2 ms each of the inputs can be configured as limit switches in forward / reverse direction or as reference switches. One of the inputs can be configured as reference switch All switches can be parameterised as normally open/ normally closed.
DC input	24 V_{DC} supply voltage for the digital outputs
Backplane bus	Backplane bus of the ET 200®SP
Module supply	Module supply via ET 200®SP backplane bus (logic) 24 to 48V via BaseUnit (power)
Communication and Programming	
Programming	via Profibus Master or via STEP®7 (TIA Portal®) from V15 or PROFINET controller

<table>
<tr><td rowspan="2">Control interface</td><td>Specifications in positioning mode:
Target position with absolute positioning
Number of steps for relative positioning
Frequency at free run
Offset during reference run
Use of the reference sensor during reference travel
Traversing job
moving to absolute position
moving by relative distance
reference point run
free run with variable velocity
set position
motor stop
emergency stop</td></tr>
<tr><td>Required parameters for operation with technology object:
control word
velocity reference value
counted pulses as actual position
In operation with a technology object, the technology object operates the control interface.

 
Further manual
There is a further manual on this topic:
SIMATIC S7-1500 Motion Control Function manual
https://support.industry.siemens.com/cs/ww/en/view/109739589</td></tr>
</table>

Feedback interface	Configurable in positioning mode:
	• residual distance
	• velocity
	Also included in the feedback:
	• absolute position
	• status bits
	  ○ motor is running
	  ○ ready for new run command
	  ○ parameterisation error
	  ○ power stage error
	  ○ limit switch causes a stop

	Feedback when operating with technology object: • status word • actual velocity value
Data record transfer to the TM StepDrive **(asynchronous while CPU RUN)**	Parameterising the power stage: • step resolution (1/1, 1/2, …1/256) • run current (100 mA increments) • stop current (100 mA increments) • boost current (100 mA increments) • current delay time 1…1000 ms • reaction to CPU STOP
Data record transfer to the TM StepDrive **(asynchronous)**	Diagnostics Feedback of the following driver parameters(asynchronous) to the main station: • read back the power stage parameters • error (overtemperature, parameterisation error, DIS input)

5 Installation

Following modules/components are necessary for the connection of the TM StepDrive:

- ET 200®SP station with a controller with PN- or DP master
- 24 to 48 V_{DC} supply
- BaseUnit type B1 BU20-P12+A0+4B (Siemens article number 6ES7-193-6BP20-0BB1)
- TM StepDrive 1x24..48V/5A (Phytron order number 10020273)
- 2-phase stepper motor up to 5 A_{PEAK}
- the necessary wiring material

5.1 Sizing of the Power Supply

The voltage of the supply unit (24 V_{DC} or 48 V_{DC}) depends on the motor speed during operation. For low velocity (about < 300 rev/min) but high torque or if only low torque is necessary at higher velocity (> 300 rev/min), a 24 V_{DC} supply voltage is often sufficient. Refer to the technical data of the stepper motor manufacturer for information about the required performance with 24 V. These usually indicate torque characteristics dependent on the supply voltage.

If higher numbers of revolutions must be achieved, we recommend supplying the TM StepDrive module with 48 V_{DC}.

Generally, the necessary power of the supply voltage is calculated by rules of thumb:

$P_{SUPPLY} = 2 \times P_{MECHANICAL}$ (for speed < 300 rev/min)

$P_{SUPPLY} = 3 \times P_{MECHANICAL}$ (for speed > 300 rev/min)

5.2 Mechanical Installation

See chap. 3 of the *SIMATIC ET 200SP BaseUnits* technical manual.

You can mount the ET 200SP decentralised peripheral system in any mounting position. The preferred installation position is horizontal mounting on a vertical wall. Restrictions of the ambient temperature are possible in certain installation positions.

Further information can be found in chap. 5 of the *SIMATIC ET 200SP Distributed I/O system* system manual (mechanical and climatic ambient conditions).

The following figure shows the minimum distances that you must observe when mounting or dismounting the ET 200®SP decentralised peripheral system.

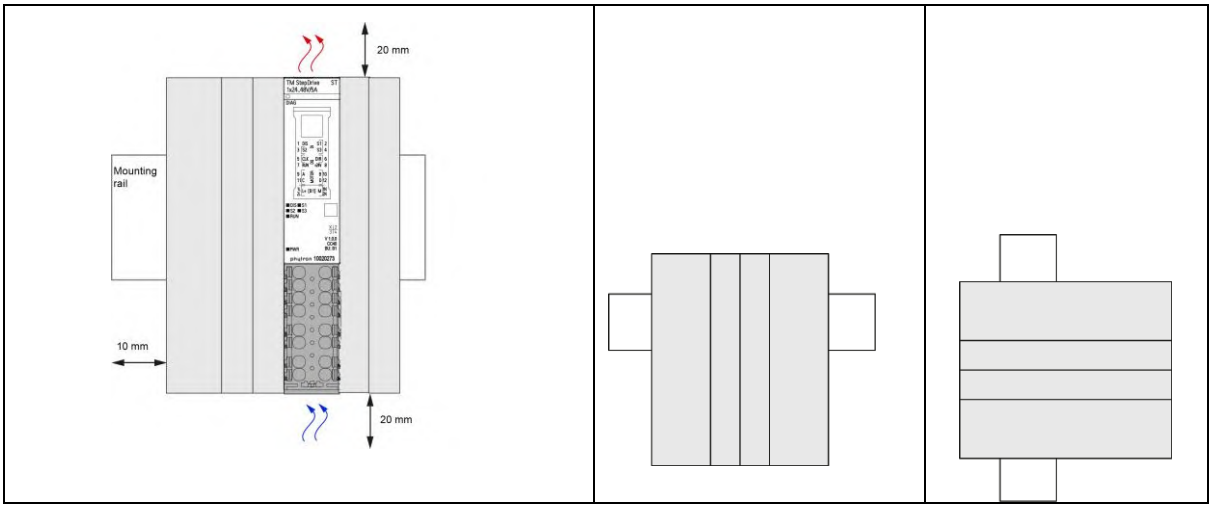


Fig. 4: Mounting position horizontal or vertical

5.3 Temperature Behaviour of the TM StepDrive under Typical Operating Conditions

The adjusting module temperature depends on the motor type, the motor cable length, phase current, supply voltage and the tolerance of the components.
In practice it can differ from the diagrams below.

Measuring conditions or procedure:

- TM StepDrive Module vertical arranged
- 48 V_{DC} supply voltage
- Motor type: ZSH 87.200.6,5
- Temperatures are normalised, i.e. relatively to the ambient temperature

The power stage temperature (measured on the power stage) should not exceed 105 °C to prevent the destruction of the hardware. The power stage has an internal emergency shutdown

Normalised power stage temperature, max. current (3.5 $A_{r.m.s}$), 25, 50, 75, 100 % duty cycle (ED)

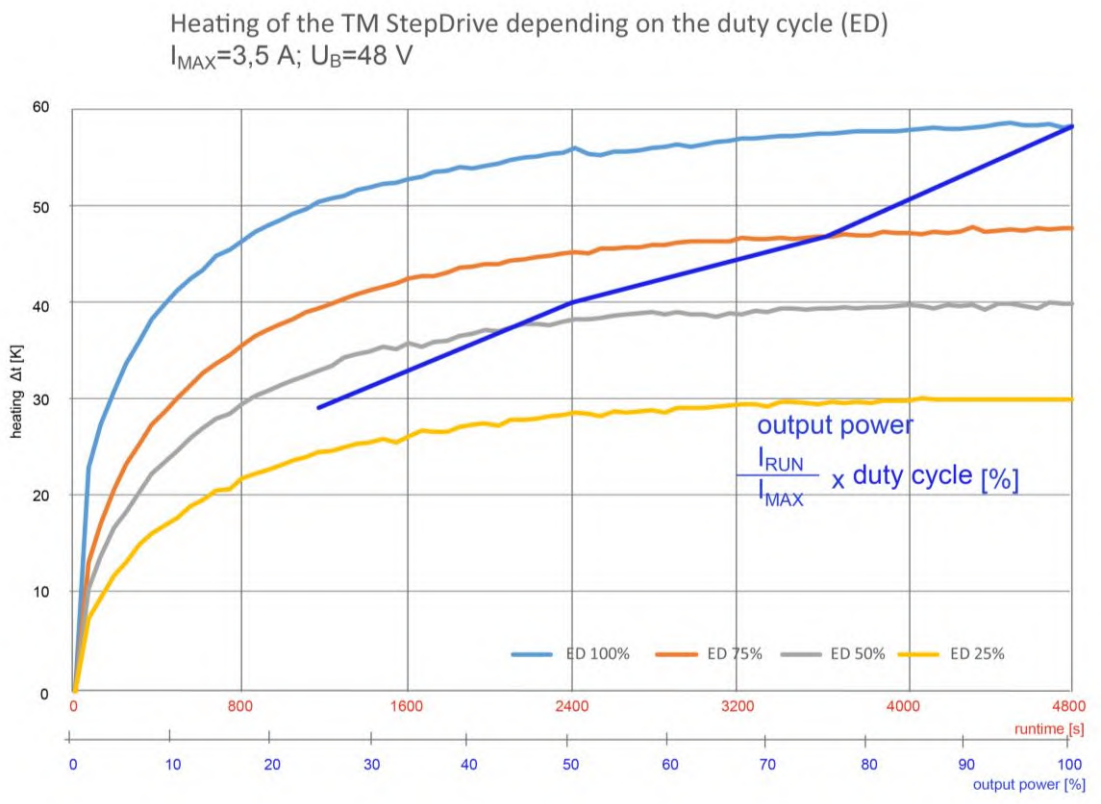


Fig. 5: Heating curve of the TM Step Drive and output power

5.4 Electrical Installation

The function of the TM StepDrive module is defined by two different connection types:

5.4.1 Connection Type “Power stage“

- Connect the motor voltage (24 to 48 V_{DC}) to terminals L+ and M
- Connect the stepper motor to the terminals A, B, C, D

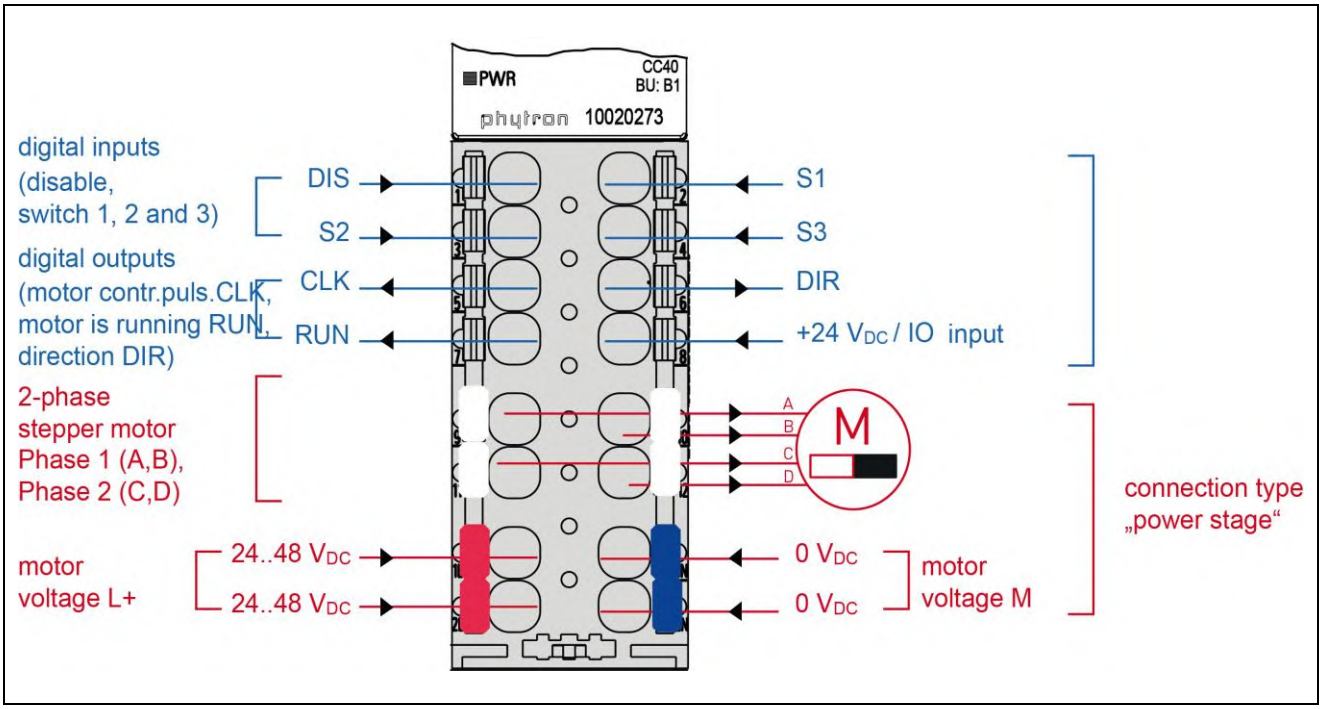


Fig. 6: Pin assignment for the connection type “power stage”

The following applies for connecting the motor voltage at terminals L+ and M:
An internal protection circuit protects the technology module from damage due to reverse polarity of the supply voltage.

If the +24 V_{DC} input is additionally supplied with voltage in this connection type, the CLK, DIR and RUN outputs are also active. In this way, an external power stage can be controlled by the indexer in addition to the integrated power stage.

The limit switches are optional.

5.4.2 Connection Type “Indexer“

IMPORTANT

Malfunction due to missing I/O input voltage !

If the motor voltage is applied to L+ and M terminals, the indexer is in operation. However, the indexer only outputs signals when the 24 V_{DC} input voltage is applied to the I/O input.

- If the module is to be operated in the connection type “Indexer”, the 24 V voltage **must** be connected (+24 V and M terminals).
- The power supply at L+ terminal is **not necessary**!
- If voltage is applied to L+ terminal, a failure of the I/O voltage will not be detected.

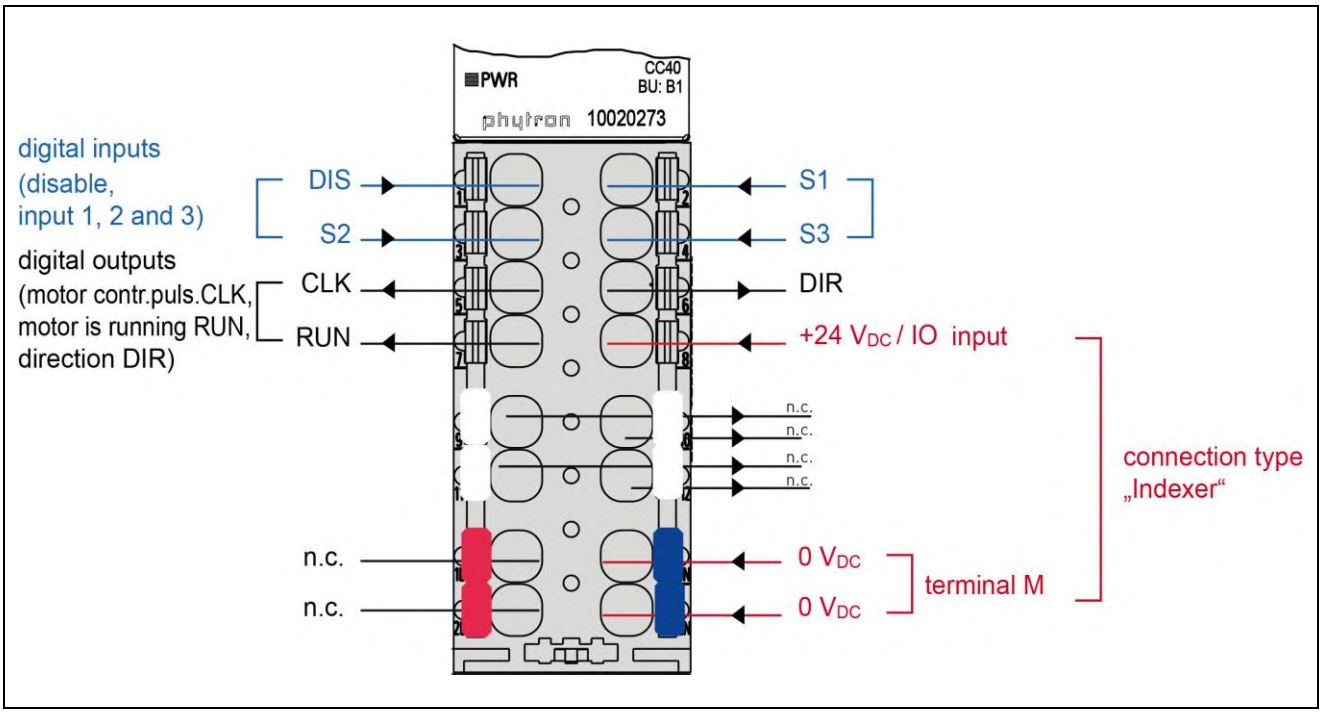


Fig. 7: Pin assignment for the connection type “Indexer”

The following applies to controlling an external power stage during connection type “Indexer”:

- The CLK output is actively high, i.e. the idle level of the clock signal is 0 V.
- The DIR output is at 0 V when the motor rotates in the positive direction the position value is incremented). If the motor rotates in negative direction (the position value is decremented), the output is +24 V.
- The RUN output is actively high when the motor is running.

The logic is supplied for both connection types.

The limit switches and external output stage are optional.

Further manual

For connecting the TM StepDrive to the BaseUnit, refer to the instructions in the following manual:

SIMATIC ET 200SP Distributed I/O system, A5E03576849-AH

https://support.industry.siemens.com/cs/document/58649293/simatic-et-200sp-distributed-i-o-system?dti=0&lc=en-DE

Chap. 5 Mounting

DANGER

Danger of electrical arcing!

Do not unplug the connector while powered!

A connected motor must not be energised, either set motor current to zero or switch off load voltage!

5.4.3 Motor Connection

The following chapter describes how to wire different types of two phase stepper motors.

TM StepDrive stepper motor power stages may be connected to stepper motors with 0.1 to 5 A_{PEAK} phase current.

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 energised according to wiring scheme (5).

Damage of the power stage!

5-lead stepper motors must **not** be connected to the TM StepDrive module.

Motor time constant τ:

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

The total inductance L_{total} is equal to the winding inductance in a parallel circuit, because of shared inductances.
L_{total}= 4 x 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 x R**	$\frac{R}{2}$
Inductance L_{total}	**4 x L**	**L**
Motor time constant τ	$\tau_{series} = \frac{4 \times L}{2 \times R} = \frac{2 \times L}{R}$	$\tau_{parallel} = \frac{L}{R/2} = \frac{2 \times L}{R}$

The values for L and R can be found in the technical data sheet of the connected stepper motor.

5.5 Wiring Schemes

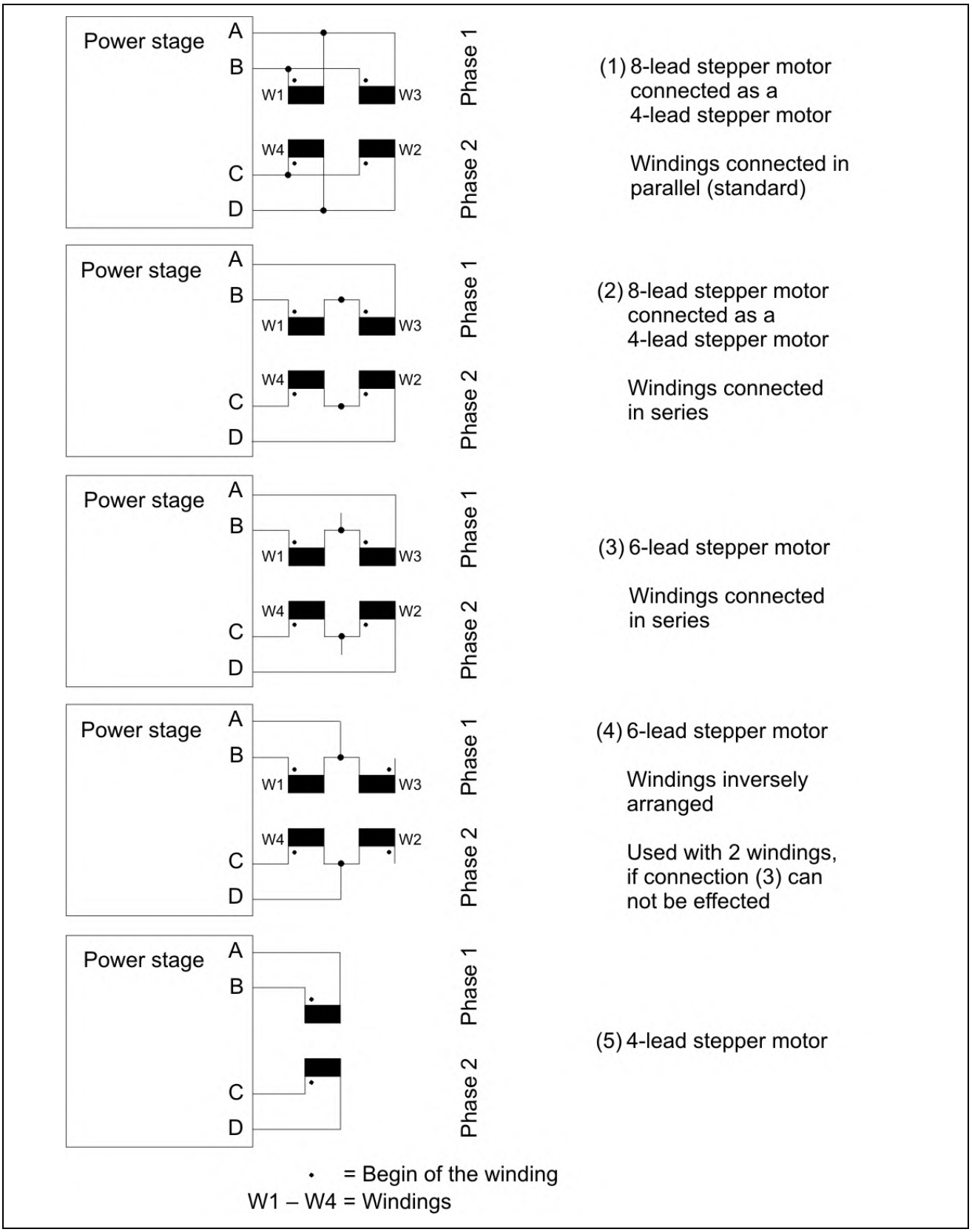
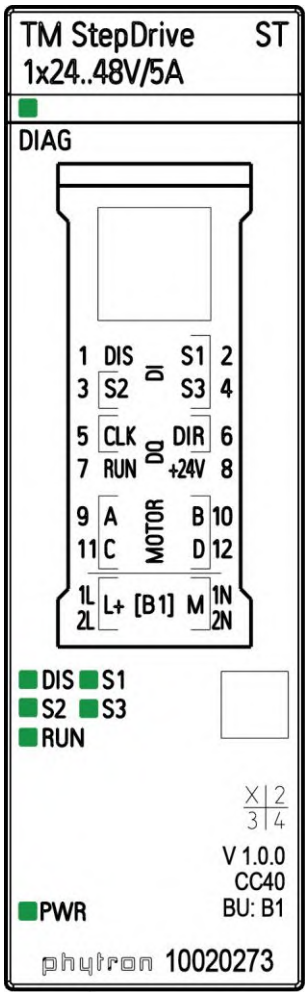


Fig. 8: Connection diagrams for 4-, (6-) and 8- wire stepper motors

5.6 Diagnostics by the LEDs

The LEDs indicate the status and error of the power stage of the TM StepDrive module by colour:



LED	Colour	Meaning
DIAG	off	The backplane bus supply of the ET 200®SP is not OK.
	blinks red	The technology module is parameterised and a module diagnosis is signaled (at least one module error is pending).
	blinks green	The technology module is not configured.
	shines green	The technology module is configured and there is no module error..
DIS	green	The DISABLE input is activated.
S1	green	Digital input S1 is activated.
S2	green	Digital input S2 is activated.
S3	green	Digital input S3 is activated.
RUN	green	Motor is running
PWR	off	The supply voltage of the module is missing. Neither the load voltage nor the +24 V voltage are present.
	green	The supply of the module is OK. Either the external load voltage or the +24 V supply the module.

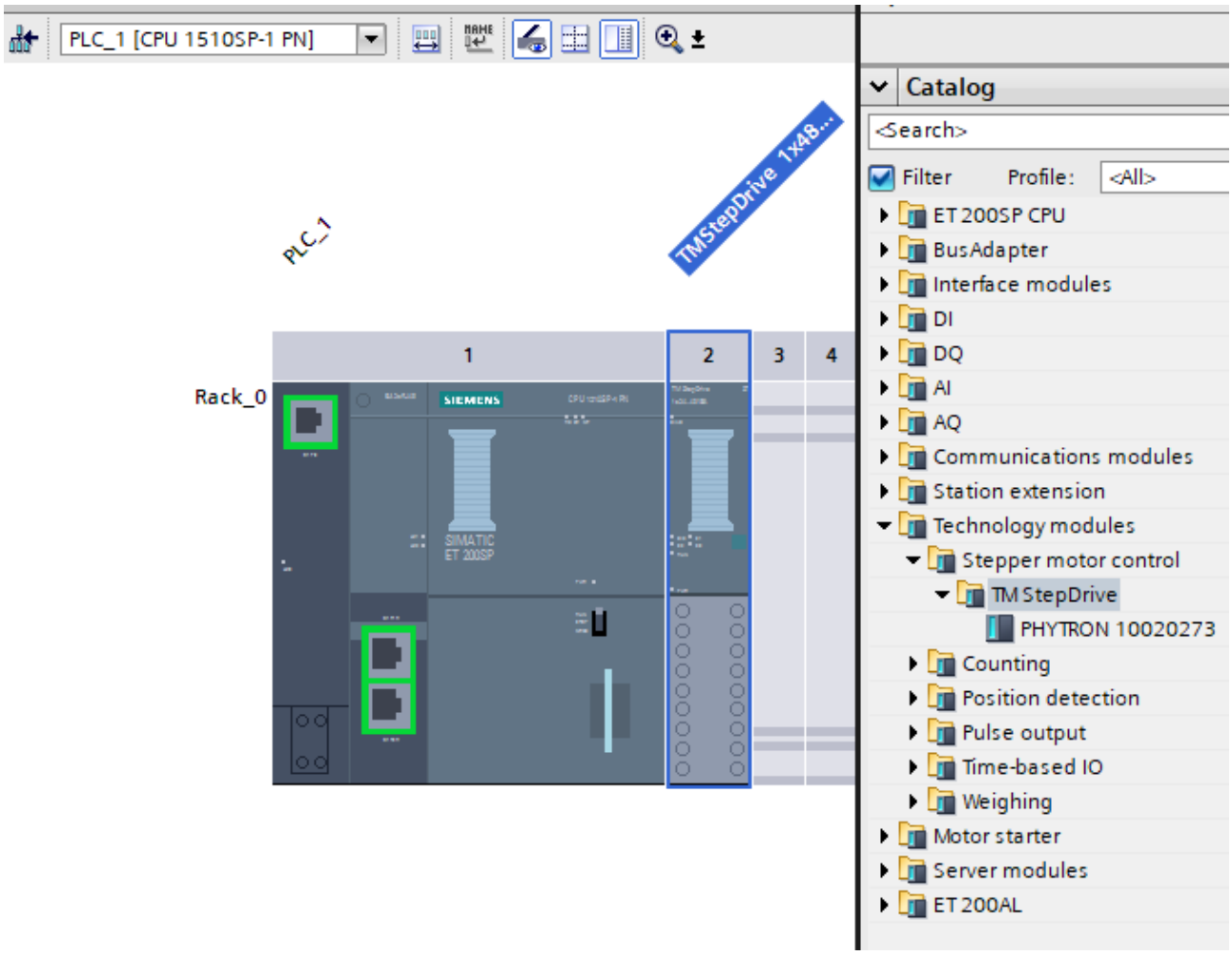
6 Commissioning

You begin by adapting the hardware configuration to your existing ET 200®SP-Station.

This is possible with PROFIBUS Master or with STEP®7 (TIA Portal®) from V15 or via GSD file for PROFIBUS or GSDML file for PROFINET. The TIA Portal® is described here.

6.1 Configuration of the Module via TIA Portal®

Drag and drop the TM StepDrive from the hardware catalogue into a rack image. In the following example rack, the TM StepDrive is used in a decentralised peripheral system. When you click on the image of the TM StepDrive in a rack, the module is highlighted by a blue line and you can set parameters that appear in the properties tab.



6.2 Configuration of the Module Using the GSD Description File

The resolution of the current settings is reduced, because in the GSD format only a small amount of data is available on the PROFIBUS.

The resulting current is shown in the following table:

Bit value	Current [A]
0x00	0.0
0x01	0.1
0x02	0.2
0x03	0.3
0x04	0.4
0x05	0.5
0x06	0.6
0x07	0.7
0x08	0.8
0x09	0.9
0x0A	1.0
0x0B	1.1
0x0C	1.2
0x0D	1.3
0x0E	1.4
0x0F	1.5

Bit value	Current [A]
0x10	1.6
0x11	1.7
0x12	1.8
0x13	1.9
0x14	2.0
0x15	2.1
0x16	2.2
0x17	2.3
0x18	2.4
0x19	2.5
0x1A	2.6
0x1B	2.8
0x1C	3.0
0x1D	3.2
0x1E	3.3
0x1F	3.5

If the full resolution is required, the DS128 can be set in 100 mA increments.

6.3 Operating Modes of the StepDrive Technology Module

The task of the TM StepDrive is the positioning of a stepper motor to certain specified targets (positioning mode (PM mode)) and endless travel at defined frequencies (frequency mode (TO mode)). In addition, numerous technology parameters of the TM StepDrive can be adapted in such a way that the best can be get out of the stepper motor module and the customer's drive system. These topics will be explained in the following chapters.

6.4 Potential Group

The TM StepDrive is electrically isolated from the other potential groups of the BaseUnit to the right and left of the TM StepDrive and requires its own power supply at terminal L+ for the connection type "power stage".

In order to avoid repercussions on adjacent modules, it is strongly recommended to use a separate power supply for the motor voltage.

ATTENTION – Possible fault operation or error message!

When a TM StepDrive module is plugged in, the capacitors in the module are charged. Depending on the capacity of the power supply unit, this can result in voltage dips at the modules that are already plugged in. These can generate error messages by means of undervoltage detection.

- Plug the TM StepDrive module only when the supply voltage is disconnected from the mains.

DANGER

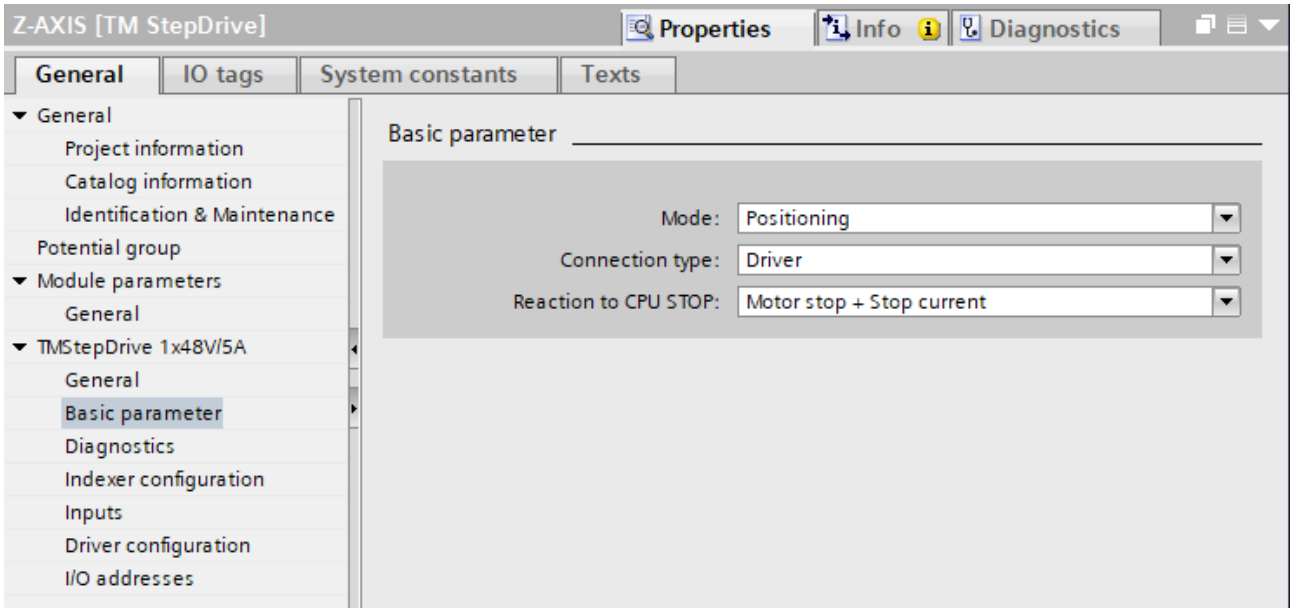
Danger of electric arc!

The contacts can be destroyed by disconnecting the module when it is live.

- Never disconnect the TM StepDrive when it is live!

6.5 Configuration of the Module

6.5.1 Basic Parameters



6.5.1.1 Operating Mode

Selecting an operating mode:

- Positioning or positioning mode (**PM mode**)
- Control via technology object (**TO mode**)

6.5.1.2 Connection Type

Selecting a connection type:

- "**Power stage**": The TM-StepDrive uses the integrated power stage to supply a stepper motor.
- "**Indexer**": The TM-StepDrive provides the control signals clock and direction for a separate external power stage.

6.5.1.3 Start

Description of the function

The parameter activates or deactivates the internal power stage (the motor is energised or de-energised).

Movement of a motor connected to the power stage is only possible **with activation**!

.

An external power stage connected to the outputs CLK / DIR is supplied with clock and direction signals.

6.5.1.4 Reaction to CPU STOP

This parameter defines the behaviour of the module in the event of a CPU STOP during a motor run.

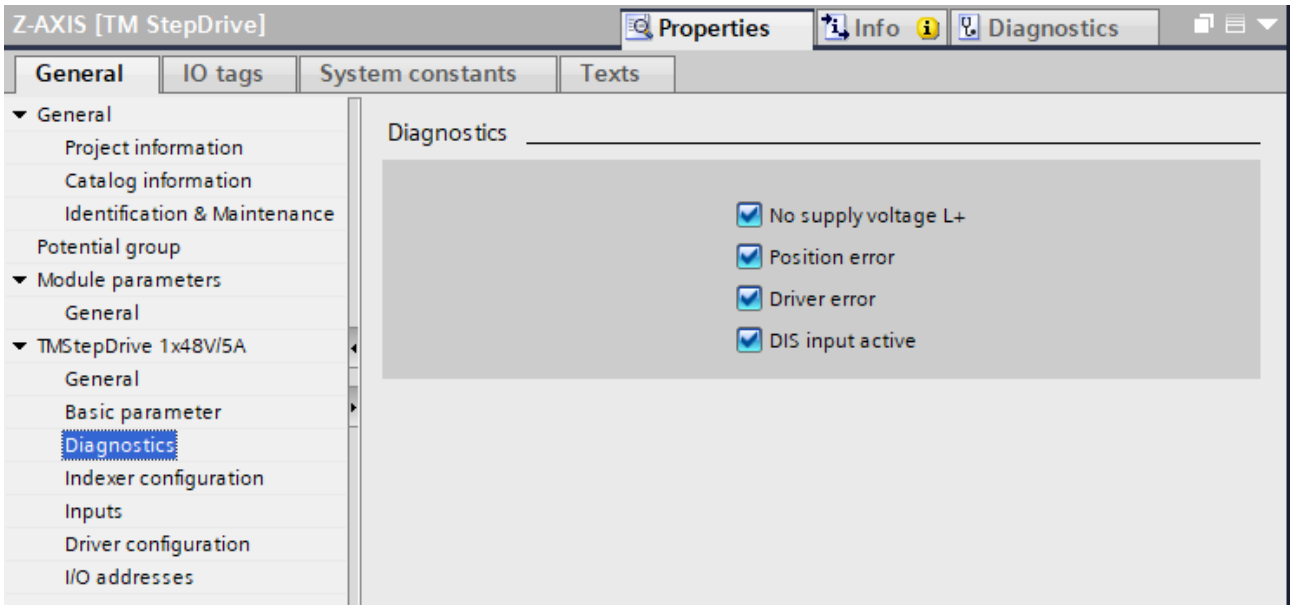
Motor stop + deactivation:
the motor is stopped and the power stage is deactivated (de-energised).

Motor stop + stop current:
the motor is stopped and the power stage remains in the stop current.

Complete positioning + deactivation:
a running positioning is completed, free run is stopped immediately. After motor stop the power stage is deactivated (de-energised).

Complete positioning + stop current:
a running positioning is completed, free run is stopped immediately After motor stop the power stage remains in the stop current.

6.5.2 Diagnosis



The module monitoring is always active. A detected error only triggers a diagnostic alarm if the diagnostic type is activated in the diagnostic check boxes.

Diagnosis type	**TM StepDrive module error**	**Standard option**	**Diagnosis message**
missing supply voltage L+	missing motor voltage	deactivated	17
positioning error	faulty positioning of the module (e.g. during positioning, the travel range was exceeded).	deactivated	740
Power stage error	Error in the power stage (e.g. power stage driver is not accessible due to a defect).	deactivated	741
DIS input active	A running traversing job was cancelled because the DIS input of the module was activated.	deactivated	743

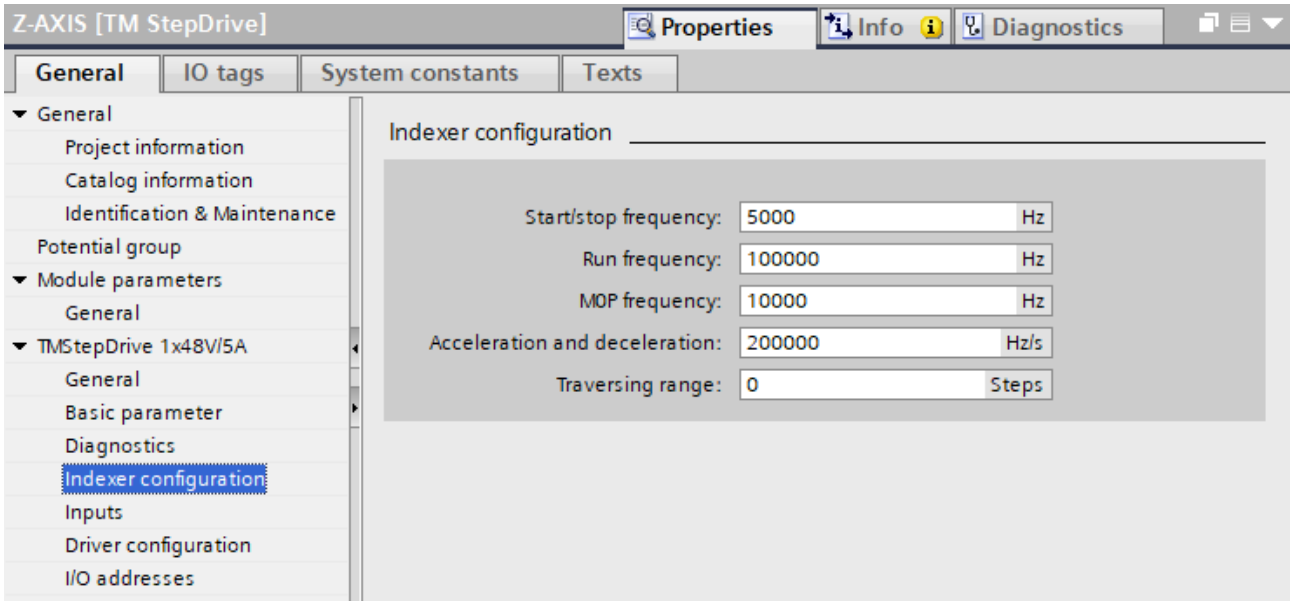
When a diagnostic alarm is triggered by a TM StepDrive error event, the following happens:

- The DIAG light flashes red when a diagnostic alarm is present. The light is switched off after error correction.
- The diagnosis is displayed as plain text in the online and diagnostic view of STEP 7 (TIA Portal®).
- options for the reaction of a CPU executing your control program

  - The CPU changes to STOP and interrupts the program processing. The diagnostic alarm OB (e.g. OB 82) is activated. The action that triggered the alarm is written to the start information of the diagnostic alarm OB.
  - The CPU remains in RUN even if there is no diagnostic alarm OB in the CPU. As far as possible, the technology module continues operation while the error is pending.
- Details of the error event are available when you execute the RALRM program instruction (alarm readout information).

See also chap.14.2 (Diagnosis Notifications).

6.5.3 Indexer Configuration



6.5.3.1 Start-Stop Frequency (only for PM Mode)

The start/stop frequency is the maximum frequency at which the stepper motor can start or stop without a ramp, without loss of steps. The start-stop frequency depends on various variables such as motor type, load and mechanics, power stage.

This value determines whether the frequency profile of the motor is trapezoidal or rectangular. Run frequencies below this value are spontaneously added to the motor, i.e. without ramp. For run frequencies above this value, a ramp is used, i.e. the motor is accelerated to the final frequency with constant acceleration.

This frequency is also used to retract a limit switch.

Value can be set from 1 Hz to 250 kHz.

6.5.3.2 Run Frequency (only for PM Mode)

This frequency is used for positioning and for free run.

Value can be set from 1 Hz to 250 kHz

6.5.3.3 Reference Frequency (only for TO Mode)

In TO mode, the run frequency is set relative to the reference frequency. Permitted value range is -200% to +200% of the reference frequency.

Value can be set from 1 Hz to 125 kHz.

Please note that the TM Step Module can only process integer values, for example, a frequency setting of 0.2 Hz causes a motor stop.

In TO mode, the module is controlled by the technology object. The speed of rotation of the stepper motor must be specified there. The relationship between motor speed n and reference frequency of the stepper motor module is as follows:

f_{REF} = (n * s * m) / (60 sec/min) or

n = f_{REF} * (60 sec/min) / (s * m)

f_{REF} = reference frequency in Hz
n = velocity in rpm
s = physical full step resolution of the stepper motor (typical: 200 steps/rev). For further information refer to the technical data for the stepper motor.
m = the fine step resolution in microstep per step

6.5.3.4 M0P Frequency (only for PM mode)

This frequency is used to search for the limit switches or the reference sensor. M0P means "Mechanical zero point" or reference point.

The M0P frequency defines the clock frequency for the reference run.

Value can be set from 1 Hz to 250 kHz.

6.5.3.5 Acceleration and Deceleration

Here the frequency change in Hz/s is set during acceleration and deceleration phase of the stepper motor.

Value can be set from 100 Hz/s to 100MHz/s.

6.5.3.6 Traversing Range (in PM mode only)

The value determines whether it is a rotating axis or a linear axis. For a rotating axis, a zero is set here, i.e. the movement of the axis is not restricted. (0--> rotation axis)

With a linear axis, the maximum traverse range can be set here, which activates a limitation of the axis by software. In addition to the limit switches, the movement of the axis can be limited in order to generate an error message if the axis is out of step, for example. The setting value is interpreted as distance in positive and negative direction, e.g. setting value 500,000 leads to a permitted travel range of ± 500,000 steps.
Range from 1 to (2^{16}-1) step

6.5.4 Inputs

The function of the inputs differs depending on the operating mode:

6.5.4.1 Operating Mode Positioning (PM mode)

The three parameters "Function input S1/2/3" each link one input to its logic function. Each input can be used as left limit switch, right limit switch, reference switch or remain unused. Each logic function may only be assigned to one input.

Value adjustable: NO

Limit switch +

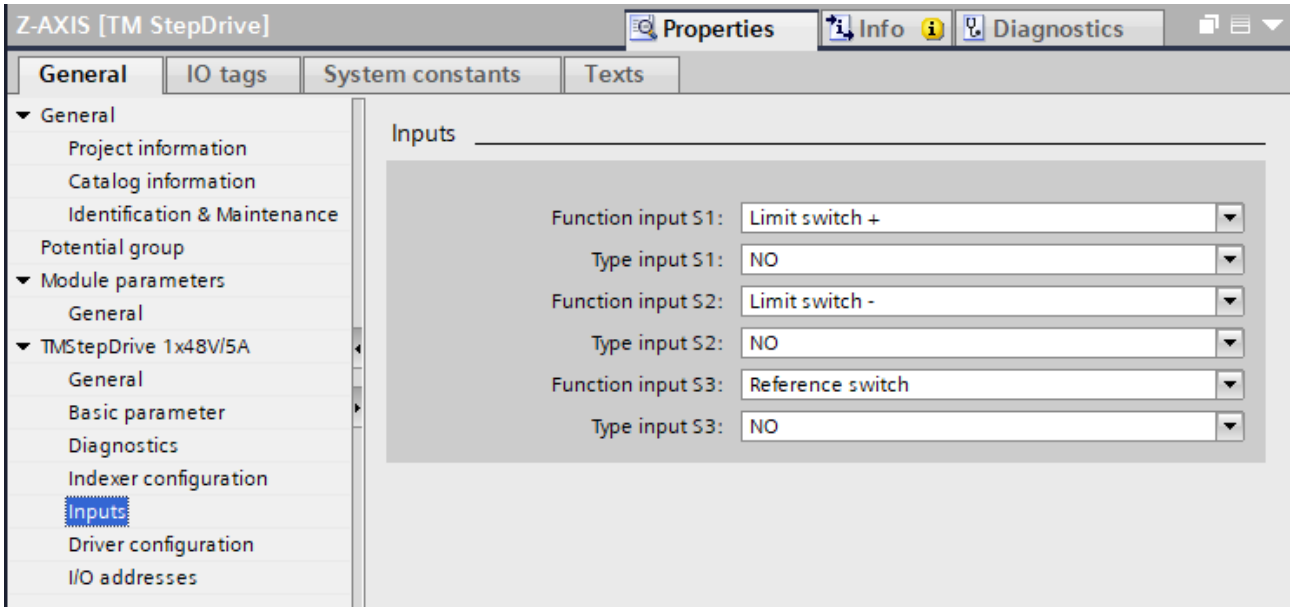
Limit switch –

Reference switch

The "Type of input S1/2/3" parameter determines whether you want to wire normally closed (NC) or normally open (NO) for the limit switches.

NC: the limit switches are activated by a 0 signal.

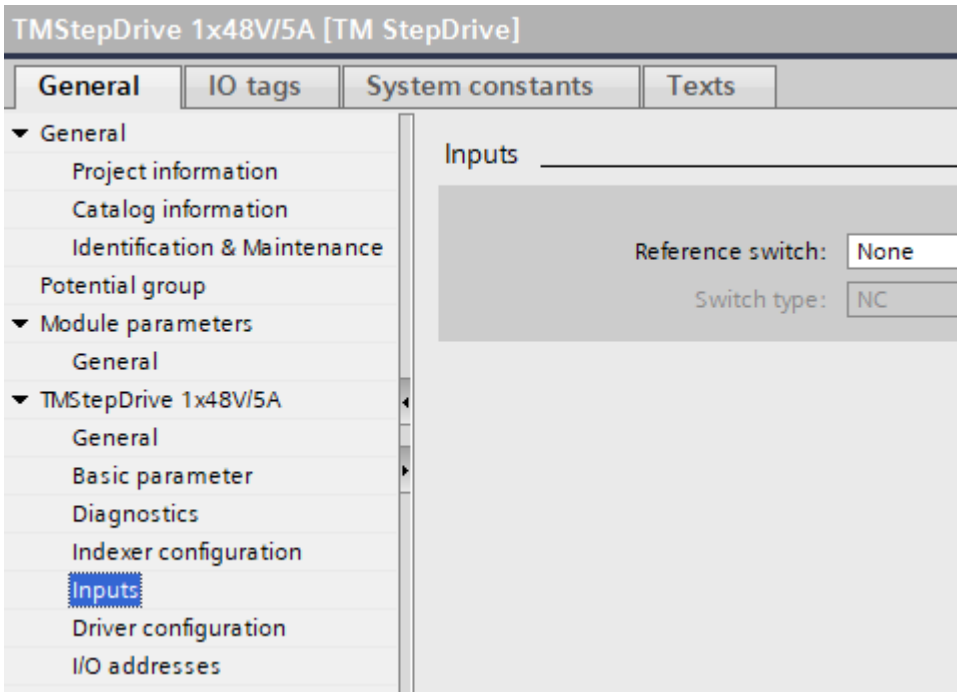
NO: the limit switches are activated by a 1 signal



6.5.4.2 Operating Mode Technology Object (TO mode)

In this operating mode there is only one input, as reference switch. You can select with this parameter which input functions as reference switch as normally closed or normally open contact.

The other two inputs remain unused.



6.5.4.3 Normally Closed (NC) or Normally Open Contact (NO)

Input S1/2/3 can be used for opening and closing switches. If the input is used, its status will be indicated by LED S1/2/3. The LED shines, when the input is active, i.e. depending on the switch type, the LED shines, when a normally closed contact has opened or when a normally open contact has closed.

Parameterisation of the limit switches

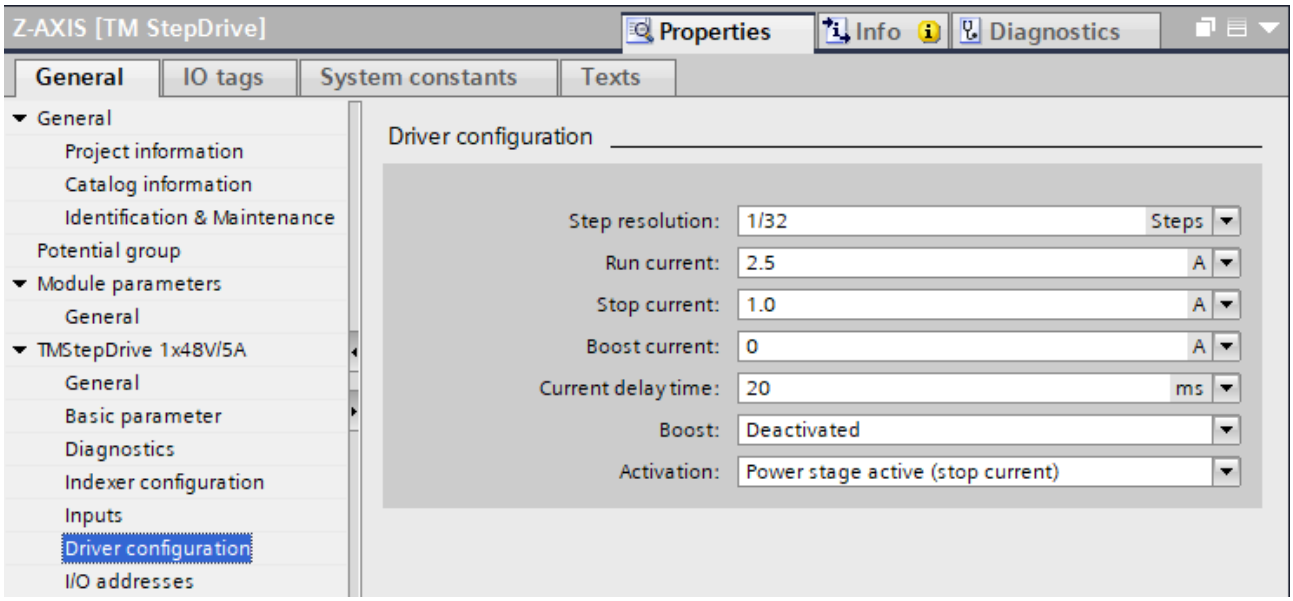
By means of parameterisation you determine whether you wire normally closed (NC) or normally open (NO) for the limit switches.

NC means: the limit switches are activated by a 0 signal. When the limit switches are reached, the corresponding control bit is deleted.

N/O contact means: the limit switches are activated by a 1 signal. When the limit switches are reached, the corresponding control bit is set.

Value adjustable: 0 = NC contact; 1 = NO contact

6.5.5 Power Stage Configuration



6.5.5.1 Step Resolution

With a 2 phase stepper motor operating in the full step mode, the exact physical resolution of the motor is reached. For a 200 step motor that means an obtainable resolution of 200 steps per revolution at the motor shaft.

With specially designed electronic drivers, the physical, that means the full step resolution, can be enhanced. When the resolution is doubled it is known as half step mode. The 200 step motor can now resolve 400 steps at the motor shaft. Additional to the advantage of a larger number of steps per revolution, this operation mode stimulates smoother motor running and reduced resonance behaviour, which is often found in the full step mode.
If you increase the step resolution further, you speak of quarter step, eighth step ...

Value can be set:

0 = 1/1
1 = 1/2
2 = 1/4
3 = 1/8
4 = 1/16
5 = 1/32
6 = 1/64
7 = 1/128
8 = 1/256 of a full step

6.5.5.2 Run Current

Here, the motor current during run is defined.

Value adjustable (in 100 mA increments):

0 = not allowed
1 = 0.1 $A_{r.m.s.}$

35 = 3.5 $A_{r.m.s.}$

6.5.5.3 Stop Current

Here, the motor current is defined, to which is switched after the lapse of the current delay time as soon as the motor is stopped.

Value adjustable (in 100 mA increments):

0 = allowed
1 = 0.1 $A_{r.m.s}$
35 = 3.5 $A_{r.m.s}$

6.5.5.4 Boost Current (in PM mode only)

This parameter defines the motor current during acceleration and braking processes if boost is activated.

Value adjustable (in 100 mA increments):
0 = allowed
1 = 0.1 $A_{r.m.s}$
35 = 3.5 $A_{r.m.s.}$

6.5.5.5 Current Delay Time

This parameter defines the time until switching from run current to stop current after motor stop. The parameter should be adjusted to the minimum run velocity.

Value adjustable:

0: 1 ms
1: 2 ms
2: 4 ms
3: 6 ms
4: 8 ms
5: 10 ms
6: 12 ms
7: 14 ms
8: 16 ms
9: 20 ms

10: 40 ms
11: 60 ms
12: 100 ms
13: 200 ms
14: 500 ms
15: 1000 ms

6.5.5.6 Boost at Acceleration (in PM Mode Only)

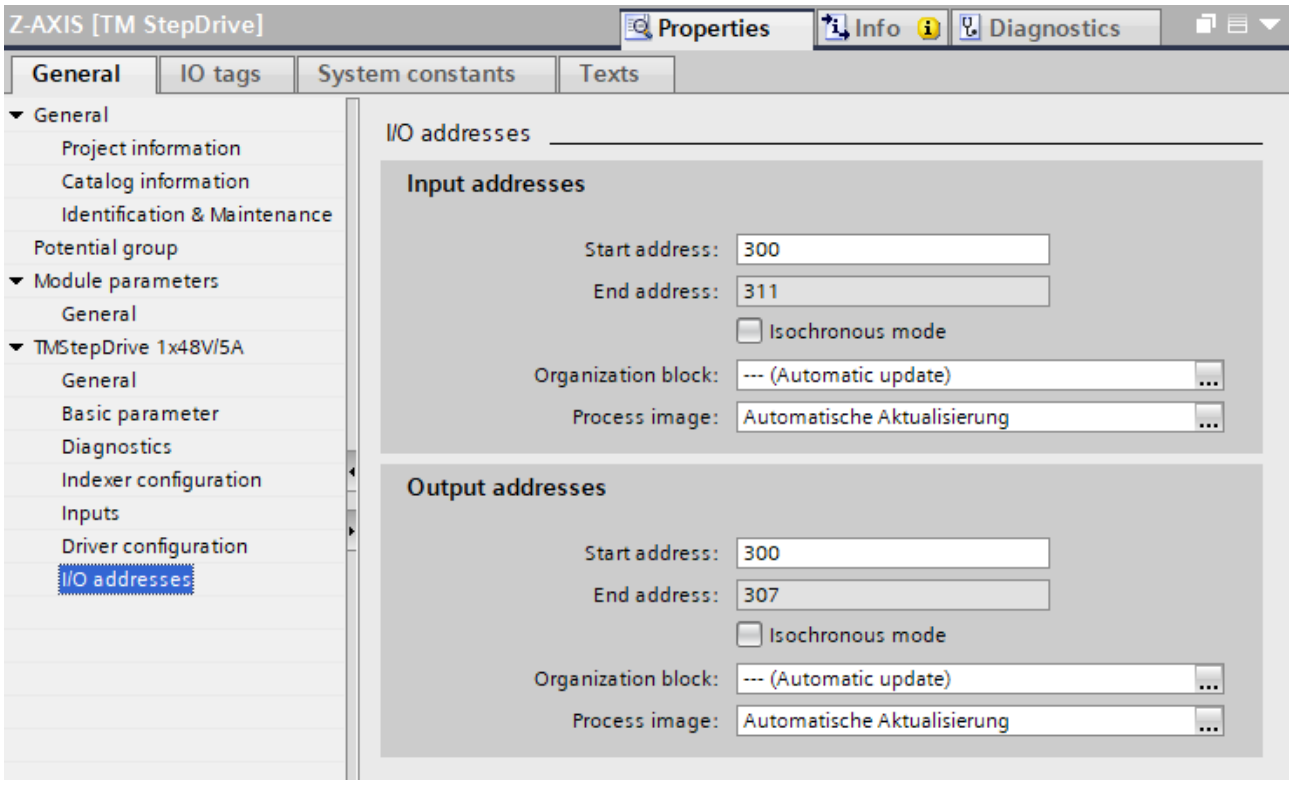
If the parameter is set to one, a different current is used during acceleration and braking than for movement with constant frequency.
This is set with the parameter Boost current.

6.5.5.7 Steps per Revolution (in TO Mode Only)

This parameter is used to inform the CPU which number of steps corresponds to one motor revolution. The parameter depends on the set increment and the connected motor, i.e.

- 1/8-step, 200-step motor: 200 * 8 = 1600
- 1/16-step, 500-step motor: 500 * 16 = 8000

6.5.6 I/O Addresses



You can assign the base addresses for the control and feedback interfaces. Your program logic uses the values stored in these addresses to control the TM StepDrive output and to read the feedback signals from the module.

Operating mode	Input addresses (I-addresses)	Output addresses (Q-addresses)
Positioning	12-byte	8-byte
Technology object	18-byte	10-byte

Output Addresses

Start address: Assign of a start address up to 8 (or 10) bytes (Q addresses) for the control interface of a channel.

End address: The end address of the control interface is a calculated read-only field

Input Addresses

Start address: Assign of a start address up to 12 (or 18) bytes (I addresses) for the feedback interface of a channel.

End address: The end address of the feedback interface is a calculated read-only field.

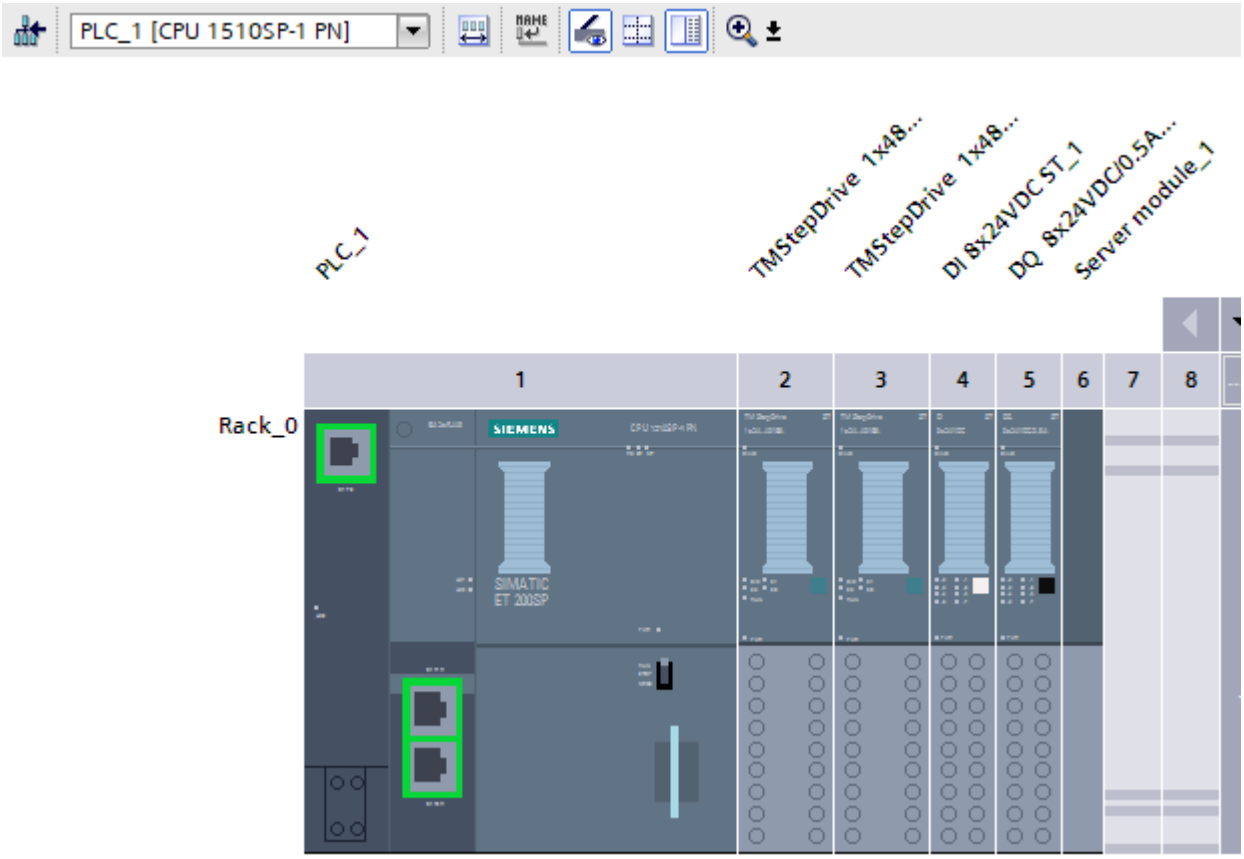
Clock synchronous operation

The checkbox for clock-synchronous operation is only displayed, if the system hardware supports clock-synchronous operation.

6.6 Configuration of the Module via TIA Portal®

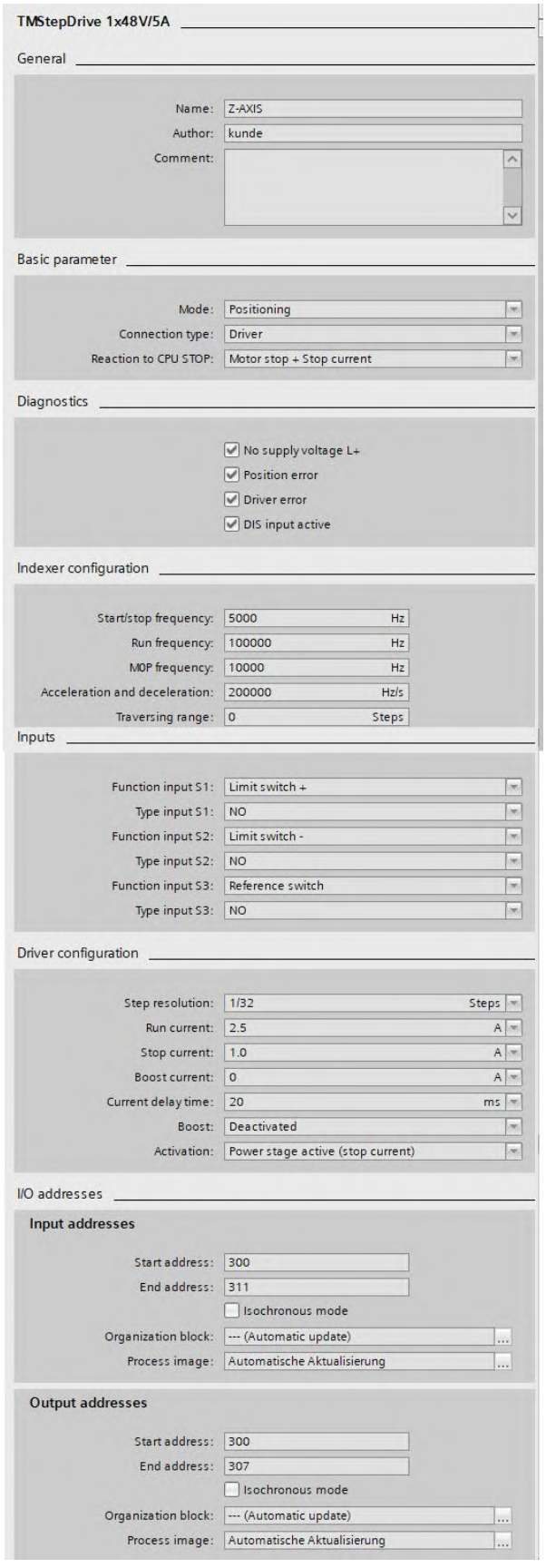
You begin by adapting the hardware configuration to your existing ET 200®SP station. Here is an example of a step-by-step configuration for a project with the TM StepDrive module. Steps 5 to 7 only have to be executed once.

1. Start the Step 7 (TIA-Portal®).
2. Select "Create new project" in the portal view. Assign a new project name.
3. Select "Configure a device" → "Add new device“.
4. Add the Siemens station you are using.
5. Click on "Add from file system" in the dialog "Detailed information, installation of Support Packages by „Extras → Support Packages“.
6. Select the HW description file "HSP0191 ET200SP TM STEP DRIVE" from the CD (HSP TIA) and click on "Open“.
7. After the file was copied, mark it in the selection list and click on "Install".
8. If the file has been successfully installed, the TM StepDrive can now be selected in the hardware catalogue.
9. Select all entries of the connected hardware modules from the hardware catalogue by drag and drop: e.g. ET 200SP (IM155-6 PN HF), DI, DQ, TM StepDrive, server module etc.
10. Double-click on the module to open the "Properties TM StepDrive" mask.
11. In the I/O Addresses tab you will find the addresses of the slot to which you have dragged the TM StepDrive. Note these addresses for later programming.
12. On the TMStepDrive tab page you can adapt the default settings for the TM Step-Drive to your required configuration. If you do not connect limit switches to the TM StepDrive, set the inputs S1, S2 and S3 to "None" and all inputs to "NO". Save and translate your configuration with  and transfer the configuration in the STOP state of the CPU with  „Online > Load into device".


PLC_1 [CPU 1510SP-1 PN]
PLC_1
TMStepDrive 1x48...
TMStepDrive 1x48...
DI 8x24VDC ST_1
DQ 8x24VDC/0.5A...
Server module_1
Rack_0
1
2
3
4
5
6
7
8
SIEMENS
SIMATIC
ET 200SP

6.7 Parameterising of the Module via TIA Portal®

The next step sets the parameters for the TM StepDrive with TIA Portal®.



6.7.1 Parameter (DS128)

Introductory remarks

When the system is switched on, the configured parameters are transferred from the CPU to the module via DS128. The parameters can be changed during operation by the user program (see chap. 12).

The parameters are explained in chapter 6.5.

6.7.2 Causes of Parameter Setting Errors

- Invalid combination of the functions of the digital inputs (two limit switches are assigned the same function)
- Traversing range out of range of values
- Invalid step resolution
- Invalid current specification
- Invalid frequency setting

See chap. 14.

6.7.3 Demo Project

A demo project with program blocks (valid from TIA Portal V15) is available for download from the Phytron website.

7 Program Control and Feedback Interface

Data is written from the CPU to the module and data from the module is read out by the CPU (optionally synchronous) via the control and feedback interface.

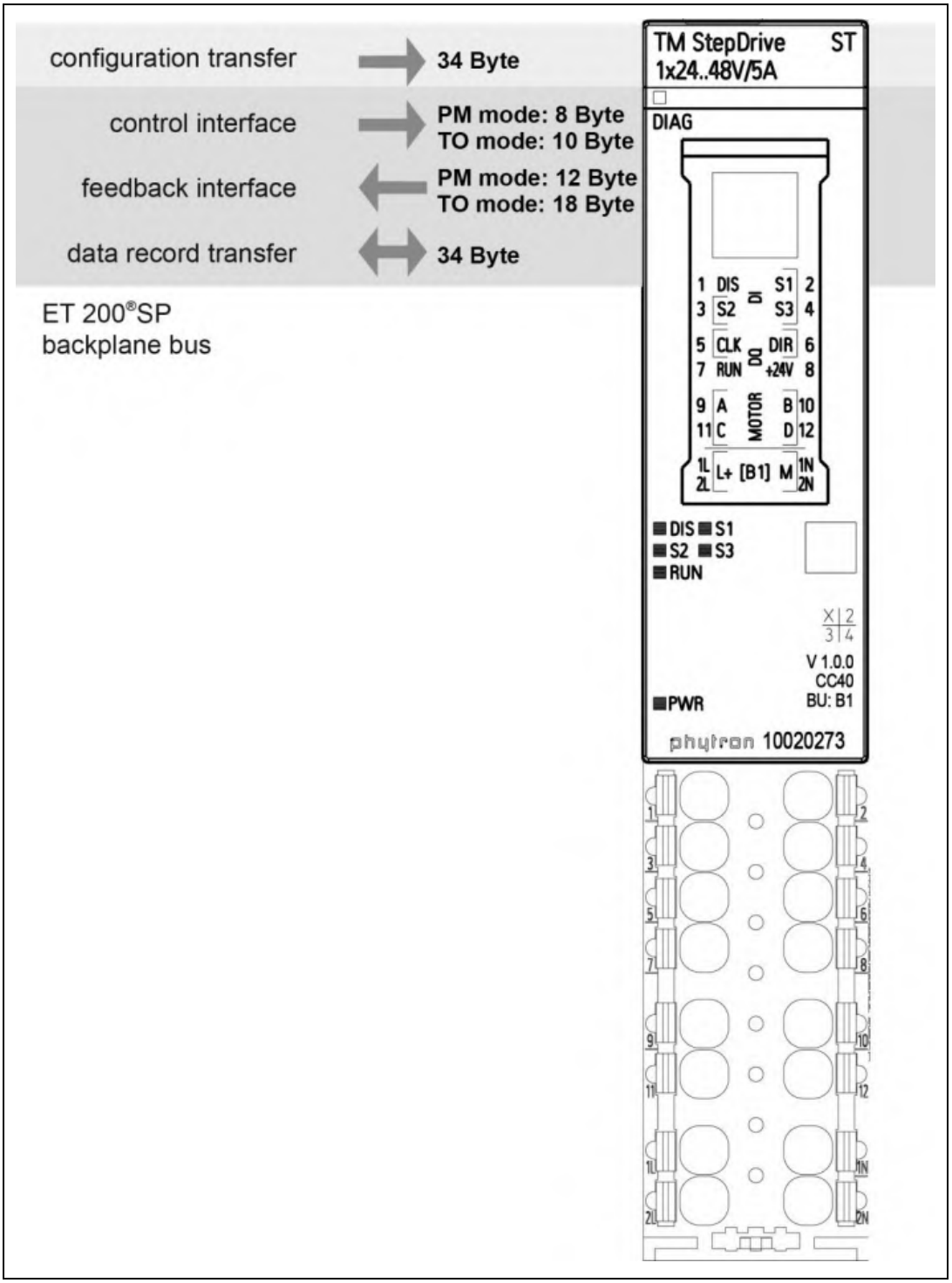


Fig. 9: Data interfaces

7.1 Control Interface in the PM mode

The control interface is shown in a table in chapter 13. The address data in the example refer to a configuration in which the module has been assigned input addresses from 0 to 11.

7.1.1 Control Value

Depending on the operating command, the control value is interpreted as the absolute target position for positioning or the distance to be moved relative to the target position, for free travel as a frequency specification and as an offset for reference travel. (data type 32 Bit, DEZ+/-, address QD0)

7.1.2 Operating Command

A new command is transmitted to the module with this value (data type 8 Bit, DEZ, address QB4). These are the permissible operating modes:

0. no function
1. move to absolute position (control value). The direction of positioning results from the set point (control value) and actual value (current motor position).
2. drive a relative distance (control value). The direction of positioning is determined by the sign of the control value.
3. reference search: The sign of the control value defines the direction in which the search is started. The control bits "Referencing with offset" and "Referencing to reference sensor" also have an influence on the search sequence. See chapter 8.2.3.
4. free run with constant frequency (control value). The sign of the control value defines the direction of the free movement.
5. set position counter to control value
6. motor stop
7. emergency stop

Modified frequency or ramp values are only processed after the motor stop. We recommend changing driving parameters when the drive is at a standstill (exception: the run current can be changed during a movement).

7.1.3 Feedback Mode Setting

This determines ((data type 8 Bit, DEZ, address QB5) which value is transmitted as a feedback value in the feedback interface:

0. no response value
1. distance remaining (only for positioning)
2. current frequency

7.1.4 Error Reset

The parameter (data type single bit, BOOL, address Q6.6) causes the module to delete pending error messages:

0. No action
1. delete error messages

7.1.5 Offset for Reference Search

If this bit is set (data type single bit, BOOL, address Q6.1), the control value is interpreted as an offset. After successful search of the reference point, this offset is approached away from the switch. The position counter remains unchanged.

7.1.6 Consider Reference Switch for Reference Search

If this bit is set (data type single bit, BOOL, address Q6.0), an extended reference run is executed. After the successful search for a limit switch, the reference switch is evaluated. Then an offset is optionally run.

7.2 Feedback Interface in PM Mode

The feedback interface is shown in a table in chapter 13. The address data in the example refer to a configuration in which the module has been assigned output addresses from 0 to 7.

7.2.1 Position

The value transmitted here corresponds to the current stepper motor position (data type 32 Bit, DEZ+/-, address ID0).

7.2.2 Feedback Value

Depending on the setting in byte 5 of the control interface, either nothing is displayed here or the remaining distance to be travelled or the current frequency is displayed when positioning (data type 32 Bit, DEZ+/-, address ID4).

7.2.3 Set Feedback Value

Here, the setting of byte 5 of the control interface is displayed (data type 8 Bit, DEZ, address IB8).

7.2.4 Feedback Bits in Byte 9 ...11

Bit	Name	Meaning
I9.0	Input 3	is active, when input 3 is in the active status.
I9.1	Input 2	is active, when input 2 is in the active status.
I9.2	Input 1	is active, when input 1 is in the active status.
I9.3	Reference search successfully completed	is set, if the zero point of the axis was found during a reference run.
I9.4	Reference search is executed	is set while the axis is executing a reference run
I9.5	deactivated	is set, when the power stage does not supply the motor with current.
I9.6	Ramp	is set, when the motor accelerates or brakes.
I9.7	Motor is running	is set, when the motor is running and is reset, when the motor is stopped.
I10.0	Rotation	is set, if the motor rotates in negative direction.
I10.2	Hardware limit switch active	is set, when an input parameterised as a limit switch becomes active for a traversing job.

Bit	Name	Meaning
I10.3	Software limit switch active	is set, when, for a traversing job, the distance is exceeded via the parameterised value of the distance limitation.
I10.4	limit switch error	is set if the parameterisation of the limit switches is incorrect, e.g. if two switches have been assigned the identical function.
I10.5	Internal error	is set, when the module is malfunctioning or defective.
I10.6	Power stage error	is set, when one of the following errors occurs, which switched off the power stage for self-protection: undervoltage detected, exceed temperature of 105 °C.
I10.7	Positioning error	is set, - if a software or hardware limit switch is crossed during positioning, or - if a switch was not found within the distance limit during referencing, or - if the wrong limit switch was activated during referencing. If the error occurs during referencing, the *"Error limit switch"* bit is also set.
I11.0	Warning temperature	is activated when the board temperature is higher than 85 °C and is deleted when the temperature is lower.
I11.1	Shutdown temperature	is set when the board temperature has reached over 105 °C and must be deleted by the user program (control bit error reset).
I11.2	No load voltage	is set when the load voltage is missing and is deleted again when it is applied again.
I11.3	DIS input active	Is set, when the "DIS" input is activated.
I11.4	Invalid control value	is set if an invalid control value is set in the control data, e.g. too high a frequency for free run.

Bit	Name	Meaning
I11.5	Invalid OP mode (operating command)	is set if an invalid value for the motion command is set in the control data.
I11.6	Invalid feed-back operat-ing mode	is set if an invalid value for the feedback operating mode is set in the control data.
I11.7	READY	is set when the module is ready to accept a new operating command.

7.3 Data Record Transfer

All parameters of the data record 128 (DS128) are preset by the configuration.

The complete data record of the power stage can also be transferred in the run-time to the TM StepDrive technology module.

The parameters are changed by the mechanism "Read / write data record“. In TIA Portal® the system functions WRREC (write data record) and RDREC (read data record) are available.

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i If the "run frequency" or "acceleration and deceleration" parameters are written while a " Move to absolute position" or " Move a relative distance" motion command is running, the parameters are not accepted until the positioning is completed. Reading back from the module is possible at any time.

Data records 128 and 245 are described in table form in chapter 12.

i The data record can be read **without** restriction..

8 Operation of the TM StepDrive as a positioning controller (PM mode)

One of the TM StepDrive tasks is the positioning of a stepper motor to certain specified targets. Driving in positioning mode (PM mode) is explained in more detail in the following chapters.

8.1 Traversing Curve

Revolution frequency of the stepper motor

The revolution frequency of a stepper motor is usually indicated in rpm. From the view of the stepper motor module a frequency is displayed at the output terminal (run frequency f_{RUN}). The relationship between the speed of the stepper motor (velocity n) and the output frequency (f_{RUN}) of the stepper motor module is as follows:

$f_{RUN} = (n * s * m) / (60 \text{ sec/min})$ or

$n = f_{RUN} * (60 \text{ sec/min}) / (s * m)$

f_{RUN} = run frequency in Hz
n = speed in rpm
s = physical full step resolution of the stepper motor (typical: 200 steps/rev). For further information, refer to the technical data for the stepper motor.

m = the fine step resolution in microstep per step

General traversing curve of the TM StepDrive

A trapezoidal traverse curve is normally always used for positioning.

1) The stepper motor accelerates via a parameterisable ramp to the required run frequency f_{RUN}.
2) Travel at constant velocity. The system frequency f_{MAX} limits the maximum possible velocity of the drive system.
3) The stepper motor is decelerated by a ramp.

The key parameters of the traverse curve result from the parameters you have selected, run frequency f_{RUN} and acceleration a_{RAMP}.

If the set traverse frequency is below the start/stop frequency, the system moves without acceleration and deceleration ramp (rectangular traverse curve).

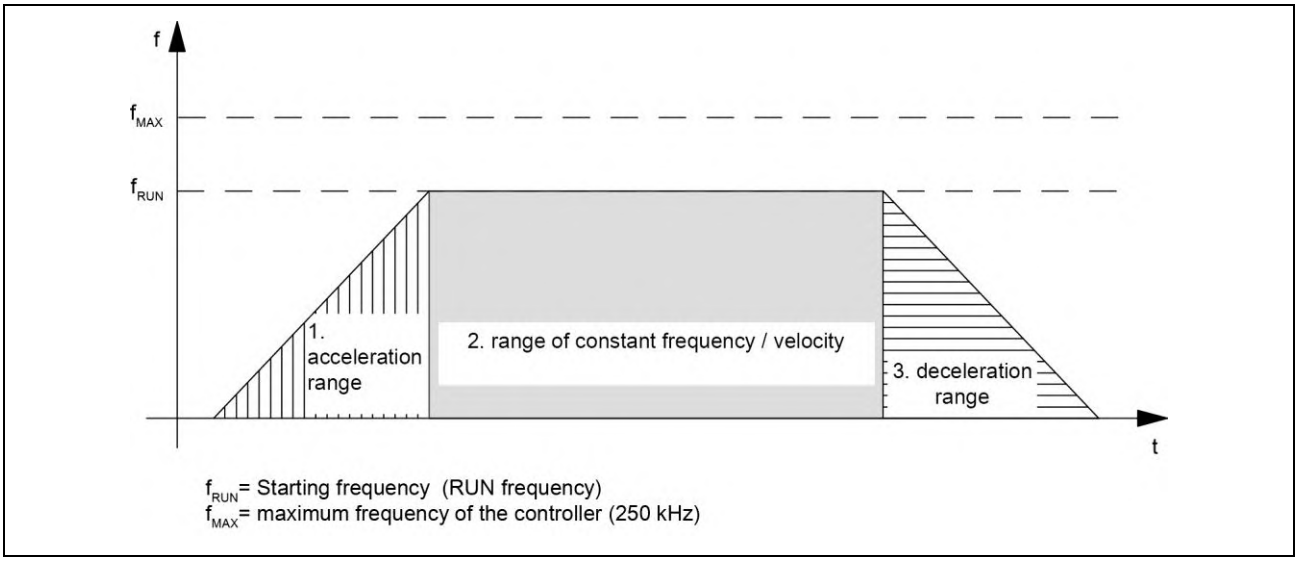


Fig. 10: Traversing curve of the TM StepDrive for positioning

f_{RUN} = run frequency
f_{max} = systemic, maximum stepper motor frequency

Run frequency / velocity f_{RUN}

The run frequency can be set differently for each drive (DS128).

If the selected running frequency is lower than the set start-stop frequency f_{ss} the set frequency is approached without ramp (rectangular traverse profile).

Make sure that the step resolution also has an influence on the speed of the motor, but is not transmitted with a run command.

Start-Stop Frequency f_{ss}

The f_{ss} start-stop frequency is the frequency to which the motor can be accelerated under load from a standstill without losing the synchronisation of the electrical field and also without losing steps.

The maximum f_{ss} start-stop frequency mainly depends on the moment of inertia of the load, as well as from the friction of the system.

Maximum Frequency / Velocity of the Axis $f_{permissible}$

When choosing a stepper motor, remember the following:

The maximum frequency/velocity is determined by the application. At this frequency, the motor must reach a torque high enough to move its load.

The maximum Frequency $f_{permissible}$ can be estimated from the corresponding characteristic curve.

Please note that a sufficiently large safety margin must be applied.

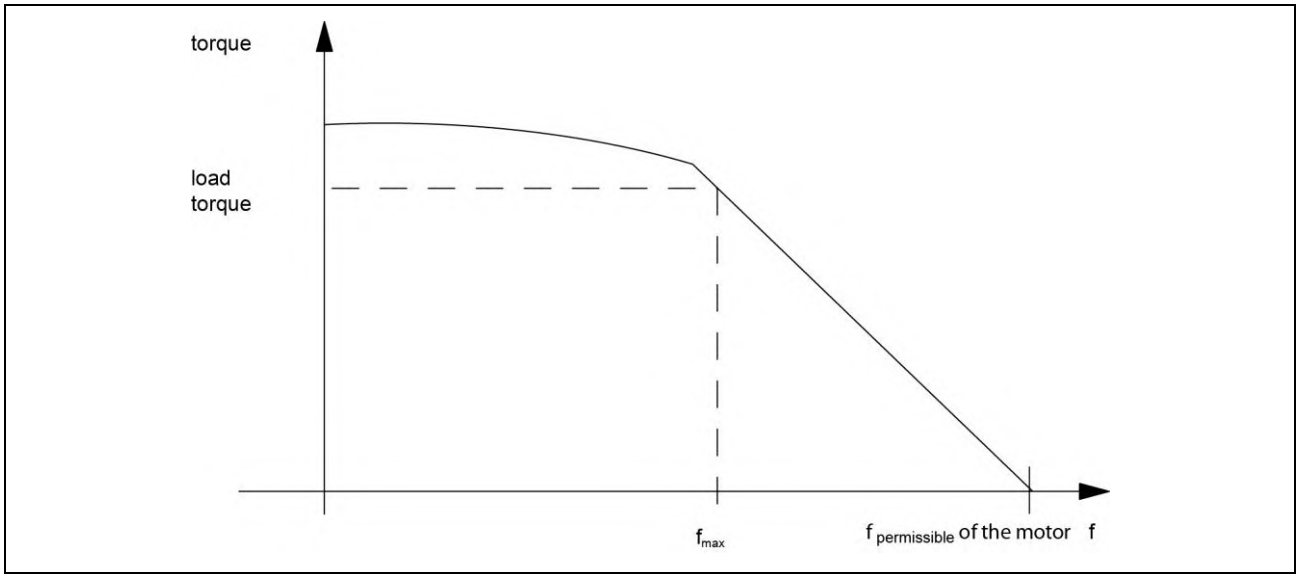


Fig. 11: Torque Characteristic Curve of a Stepper Motor

Acceleration / deceleration a

The maximum permitted acceleration / deceleration depends on the load to be moved. The motor must reach a torque high enough to accelerate or deceleration the load without loss of step.

Further criteria for determining acceleration or deceleration, such as smooth starting and deceleration, must also be observed, depending on the application.

If the stepper motor has to pass through a resonance range during the acceleration phase, either the ramp should be steeply parameterised in order to pass through the resonance range quickly or the mechanical system should be damped by means of dampers.

8.2 Run Commands

This chapter explains the permitted modes of operation during positioning:

8.2.1 Moving to Absolute Position

Description of the function

The absolute mode is used to move the stepper motor to a defined position and thus approach a specified position.

You define the position at start. The TM StepDrive automatically determines the direction and distance of the drive based on the starting position (actual position value).

Traversing job for absolute positioning

The traversing job contains the following information:

- Control value = target position
- Run command = 1
- Acceleration and run frequency via DS128

The axis must be referenced, otherwise the command is not accepted. Referencing can be done either by a reference point search or by setting the position.

If the "Travel range" parameter has a value other than zero, the TM StepDrive checks the specified travel distance for the parameterised limit values ("Travel range" parameter). The distance to the limit switch is not checked by the TM StepDrive. The travel is stopped at the latest when the limit switch is reached. The emergency stop ramp is used (10 times steepness of the set acceleration).

Feedback

At the beginning of positioning, the "READY" feedback bit is reset.
As long as the positioning is running, this is indicated by the "Motor running" feedback bit set.
After positioning has run correctly, the position is indicated by the "READY" feedback bit set.
If positioning is cancelled due to an error, this can be seen from the error bits (e.g. limit switch error).

8.2.2 Moving a Relative Distance

Description of the function

With relative positioning, you can move the stepper motor a defined distance and thus move to a specific position. You determine the direction of the trip and the route to be driven at the start.

Traversing job for relative positioning

The traversing job contains the following information:

- Control value = distance (number of pulses o be executed)
- Run command = 2

i If the "Travel range" parameter has a value other than zero, the TM StepDrive checks the specified travel distance for the parameterised limit values ("Travel range" parameter). The distance to the limit switch is not checked by the TM StepDrive. The travel is stopped at the latest when the limit switch is reached.

Feedback

The "READY" feedback bit is reset at the beginning of incremental mode.

While the positioning is active, it is indicated by the set "Motor is running" feedback bit.

After the positioning has been correctly executed, the set "READY" feedback bit indicates that the position has been reached.

If the positioning is interrupted this can be recognised from the error bits (e.g. limit switch error).

8.2.3 Search for Reference

Description of the function

The home position marks the point of reference of the drive system (reference cam) for the following traversing jobs. You can determine the home position in different ways.

- Using a limit switch as a reference
- Using e.g. a reference sensor

The TM StepDrive technology module has three inputs S1, S2 and S3.

Each of the inputs can be assigned the functions limit switch +, limit switch - and reference switch during configuration.

The highest reproducibility of the reference point is achieved by always approaching it from the same direction and always with the same frequency and step resolution.

The direction is determined by the control data.

Traversing job for search for reference

- The sign of the control value defines the direction
- Motion command number 3 starts the search for reference

- The "Referencing with Offset" bit causes the absolute control value to be approached as an offset at the end of the reference search.
- The "Referencing to reference sensor" bit causes the reference sensor input to be evaluated.

Various Sequences

Depending on the position Ⓟ at the start of the reference point approach there are different sequence patterns of the movement around the REF C reference point ⊕ a optionally to reach the offset ⊙. REF indicates the reference switch in the graphic illustration, LIMIT+ und LIMIT– the limit switches. The illustration applies to the forward starting direction (positive control values).

"Referencing with Offset" = 0 and "Referencing to reference sensor" = 0

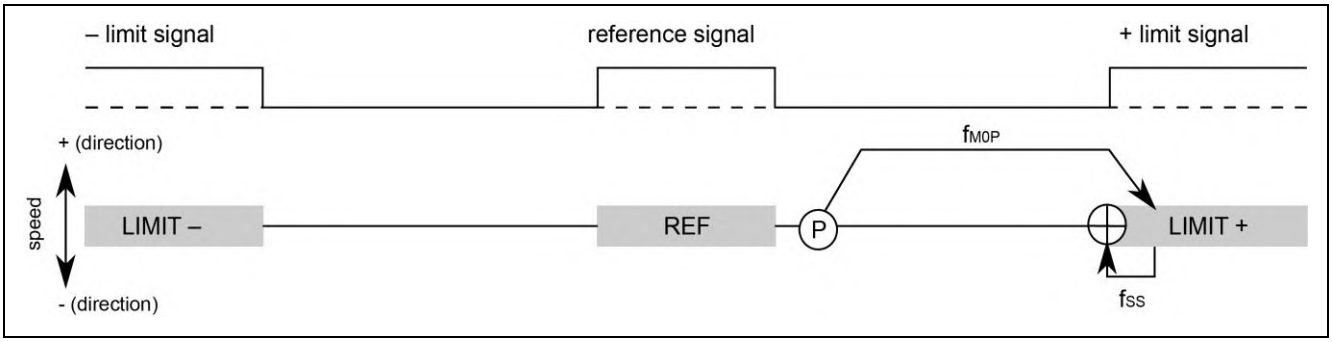


Fig. 12: Reference point approach, M0P → limit switch

"Referencing with Offset" = 1 and "Referencing to reference sensor" = 0

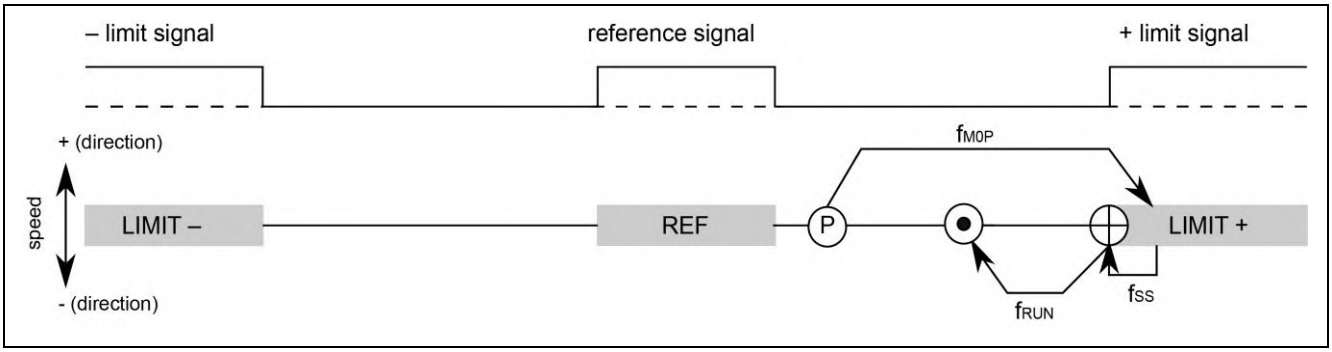


Fig. 13: Reference point approach, M0P → limit switch + offset

"Referencing with Offset" = 0 and "Referencing to reference sensor" = 1

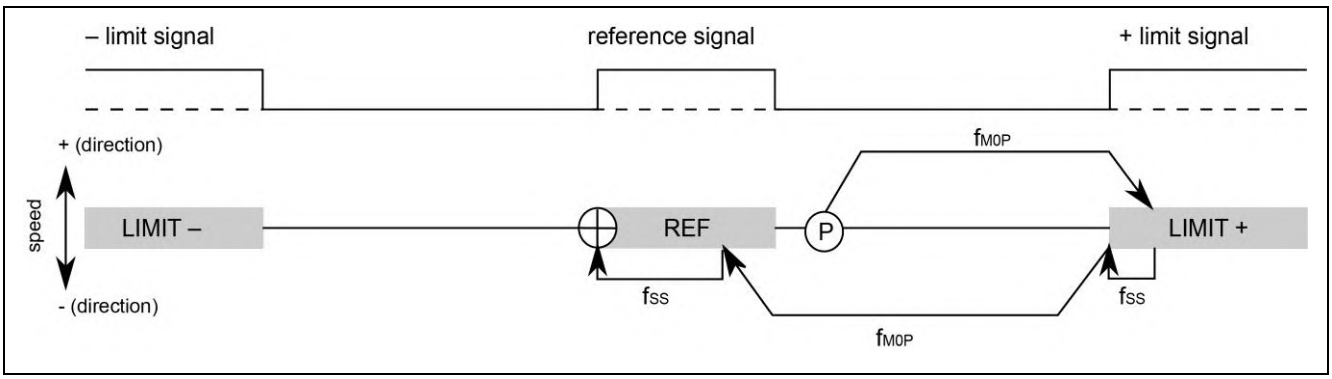


Fig. 14: Reference point approach, M0P → reference sensor

"Referencing with Offset" = 1 and "Referencing to reference sensor" = 1 in pos. direction, start position is to the right of the reference signal

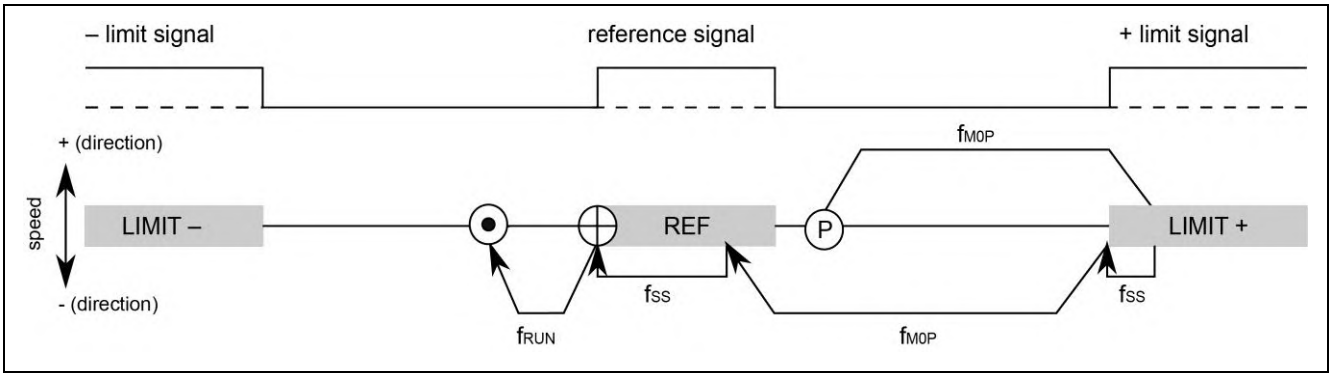


Fig. 15: Reference point approach, M0P → reference sensor + offset in positive direction

"Referencing with Offset" = 1 and "Referencing to reference sensor" = 1 in pos. direction, start position is to the left of the reference signal

If the reference sensor is detected before the limit switch, it is immediately moved freely:

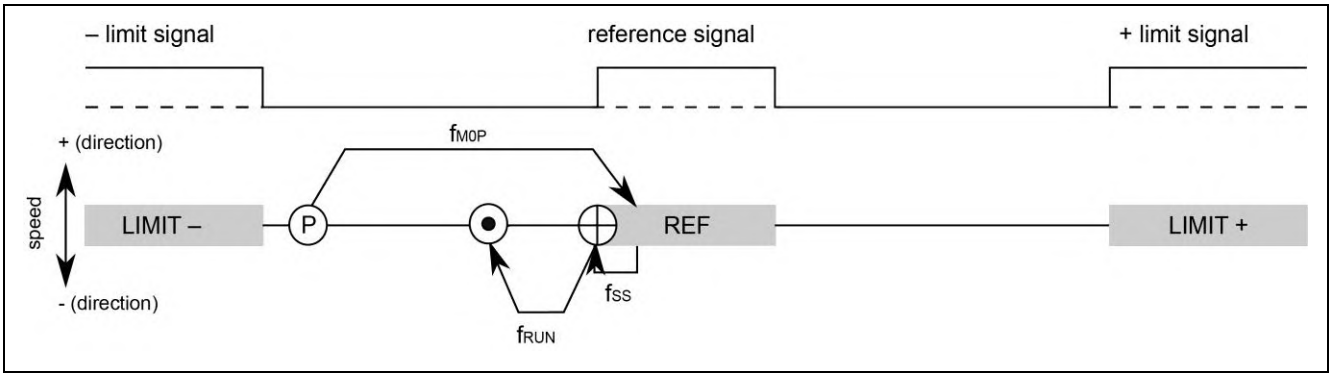


Fig. 16: Reference point approach, M0P → reference sensor + offset in positive direction

If a traverse range is parameterised and a switch is not found within this range, the reference point search is aborted with "Positioning error".

8.2.4 Free Run with Variable Velocity

Description of the function

In this mode of operation, the frequency is specified at which the pulses (steps) are to be output. If the frequency is changed, the pulses are output with the new frequency after an acceleration or deceleration phase. The output is continuous until the traversing job is stopped or the travel range of a linear axis is exceeded.

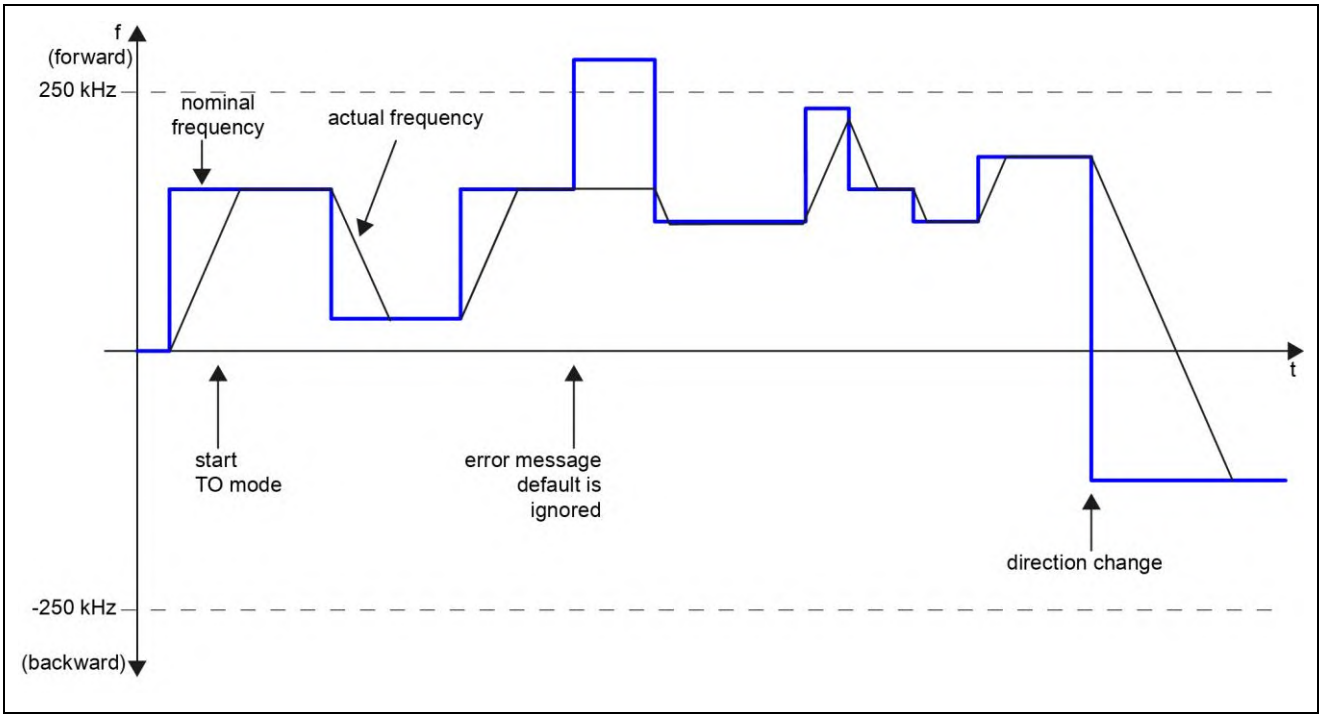


Fig. 17: Frequency mode

Traversing job for frequency mode

The traversing job contains the following information:

- Nominal frequency
- Direction setting by the sign of the nominal frequency (positive: forward)
- Mode of operation = 4 for frequency mode

The TM StepDrive checks the preset frequency for limit values (minimum -250.0 kHz and maximum +250.0 kHz).

The specified frequency is approached with the parameterised acceleration and deceleration. The lowest adjustable frequency is 1 Hz.

The endless output of the frequency is terminated at the following events:

- the limits of the parameterised travel range are reached (if a linear axis is parameterised)
- Other cancel conditions for traversing jobs (see chapter 8.3).

Feedback

As long as the traversing job is running, this is indicated by the "Motor running" feedback bit set. In addition, the "READY" bit is not set during the traversing job.

If a new frequency is set during the acceleration or deceleration phase, the "Ramp" feedback bit is set; "Ramp" is cleared again when the new frequency is reached.

The current frequency is displayed in the feedback interface as a "feedback value" if the feedback mode of operation is set to "Frequency" (see Chapter 7 "Control and feedback interface").

8.2.5 Set Position

Description of the function

The value transferred as "control value" is transferred to the position counter of the TM StepDrive.

After a reference point search, the command is suitable for setting the reference point of the drive system to a new value to which following positioning and the position value in the feedback interface refer (e.g. zero).

Traversing job for set position

The traversing job contains the following information:

- New position
- Mode of operation = 5 for set position

Feedback

After the order has been correctly executed, the set value is displayed as "Position" in the feedback interface.

8.2.6 Motor Stop

Description of the function

The command terminates running run commands. Absolute, relative positioning and free running are aborted with deceleration ramp. The position counter is also valid after the stop.

Traversing job for motor stop

The traversing job contains the following information:

- Mode of operation = 5 for motor stop

Feedback
In the feedback interface, the "READY" bit is set after the stop, the "Motor running" bit is removed.

8.2.7 Emergency Stop

Description of the function

The command terminates running motion commands, absolute and relative positioning is cancelled, and free run is terminated. In contrast to the "Motor stop" run command, the acceleration set by the "acceleration or deceleration" parameter is not used, but a ramp with 10 times the slope. The position counter has only limited validity after the stop, because the steep ramp can lead to step loss.

Traversing job for emergency stop

The traversing job contains the following information:

- Mode of operation = 6 for emergency stop

Feedback

In the feedback interface, the "READY" bit is set after the stop, the "Motor running" bit is removed.

8.3 Stop Conditions

8.3.1 Directed Hold Traversing Job

The Hold traversing job is specifically

– caused by	– indicated by feedback bit
STOP by run command 6 or 7	"READY" after stop "Motor running" is removed
STOPP by digital input DIS	" DIS input active "
Limit switch position reached	"Hardware limit switch reached "
"Travel range" exceeded	"Software limit switch reached"

8.3.2 Hold Traversing job in Exceptional Cases

In the following cases, the traversing job is stopped with loss of synchronisation:

- Incorrect operation of the control interface during a traversing job
- Voltage loss of the IM
- CPU loss
- Station stop

Impacts

If one of the reasons for stopping the current positioning occurs, it is terminated by a deceleration ramp.

The feedback value is also updated when the transport order is stopped in exceptional cases. This allows you to move a remaining distance after stopping through a new traversing job in the "relative positioning" operating mode.

i When stopping during the acceleration phase, the TM StepDrive emits pulses for a maximum of 50 ms at the frequency already reached before initiating the deceleration process. This avoids abrupt frequency changes that could lead to step losses.

8.4 Functions of the Integrated Power Stage

It is possible to parameterise both the positioning orders and also the technology parameters of the integrated power stage. These parameterizations are defined once and not with each traversing job. The parameters of the power unit are transferred in the asynchronous interface of the data record transfer.

Thus, the technology parameters cannot be changed synchronously with the control and feedback interface, but always while CPU RUN, if no traversing job is available on the TM StepDrive.

This guarantees that the power stage can be adjusted perfectly for its task before each traversing job, if it is required by the drive system. For example, you increase the stop current when the motor must hold a load and you reduce the current once the system is stationary without a load in order to minimise power consumption and motor heating. These parameters are available at any time to get the best out of the TM StepDrive and therefore of the drive system.

8.4.1 Phase Currents (Run, Stop, Boost Current)

Three different phase currents can be indicated for the TM StepDrive module: run current, stop current and boost current.

The run current is the one that is produced at a constant velocity (f_{RUN}) during the run mode. After the motor is brought to a stop we recommend switching to a reduced stop current after a parameterised Run Current Delay Time (t_{DELAY}). This reduces the thermal losses of the motor at standstill and saves power consumption.

While a stepper motor is accelerated or decelerated, it needs more torque and thus more power compared to a pure run with a constant velocity (f_{RUN}). The torque can then be increased in the phases of acceleration and deceleration.

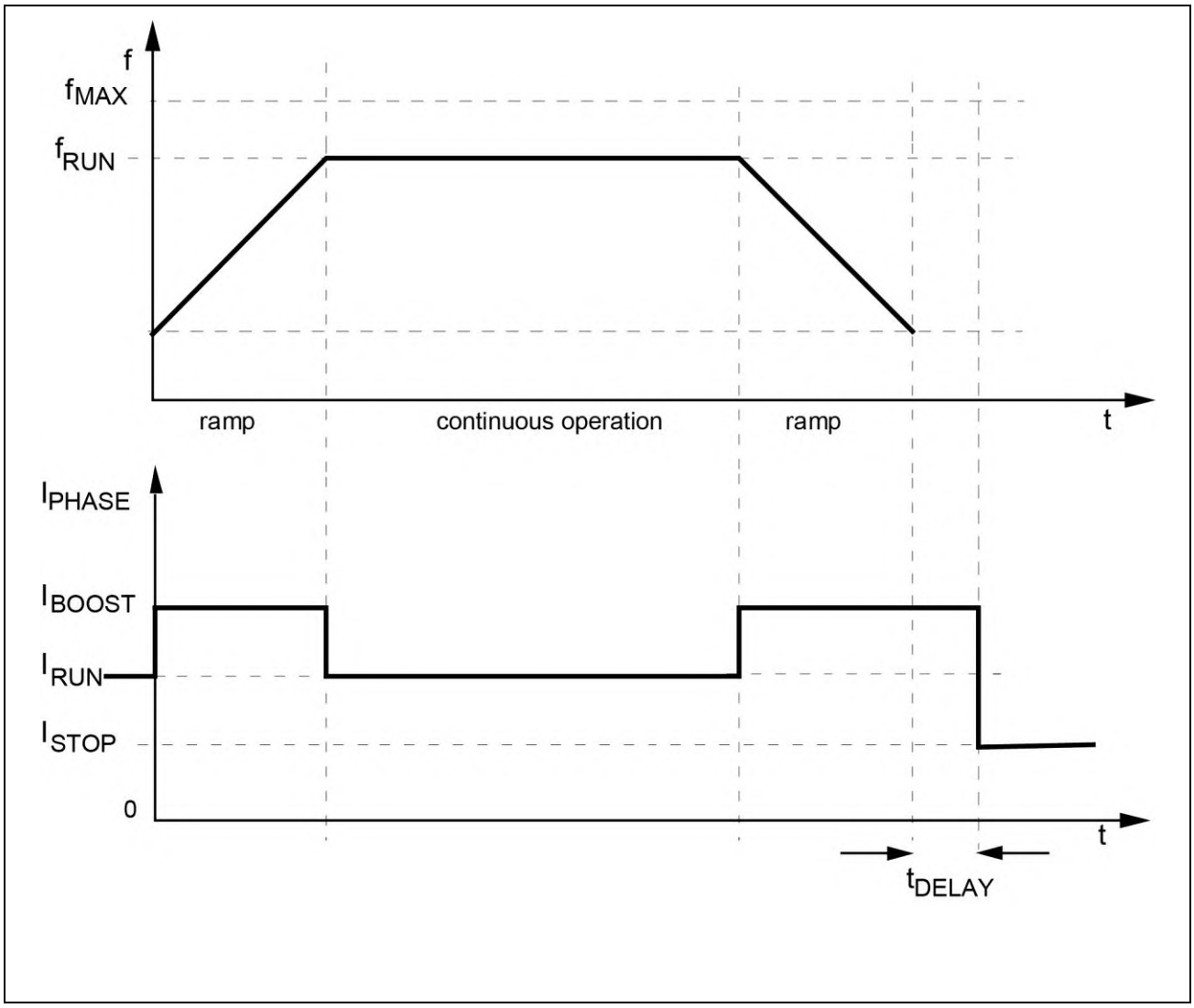


Fig. 18: Traversal curve versus current adjustment at the power stage

During the acceleration/deceleration phases it is automatically switched to the Boost Current I_{BOOST}. According to a time set in the parameter “Run Current Delay Time” t_{DELAY} it will be switched to Stop Current I_{STOP} after the run is finished.

8.4.2 Reaction to CPU STOP

The reaction to CPU STOP of the TM StepDrive can be predefined, depending on what is more convenient for the system.

Set the reaction to “disable power stage”, if the drive should be without current and therefore without torque.

Set “stop current of the power stage”, if the drive should be holding with stop current.

In addition, you can define whether a running positioning job is to be completed or cancelled prematurely.

i The reaction to CPU STOP “disable power stage“ or “stop current of the power stage“ is not a safe mode according to IEC61800-5-2 such as “Safe Torque Off” (ST0) or similar. They are only aids to increase confidence in the system´s performance.

8.4.3 Step Resolution

Full step

The “full step“ mode is the operating mode in which a 200-step motor, for example, drives 200 steps per revolution. The physical resolution of the motor is achieved in the full step mode. Any further increase of the step resolution (e. g. half step, quarter step, etc.) is done electronically. In the full step mode, both stepper motor phases are permanently energised.

.

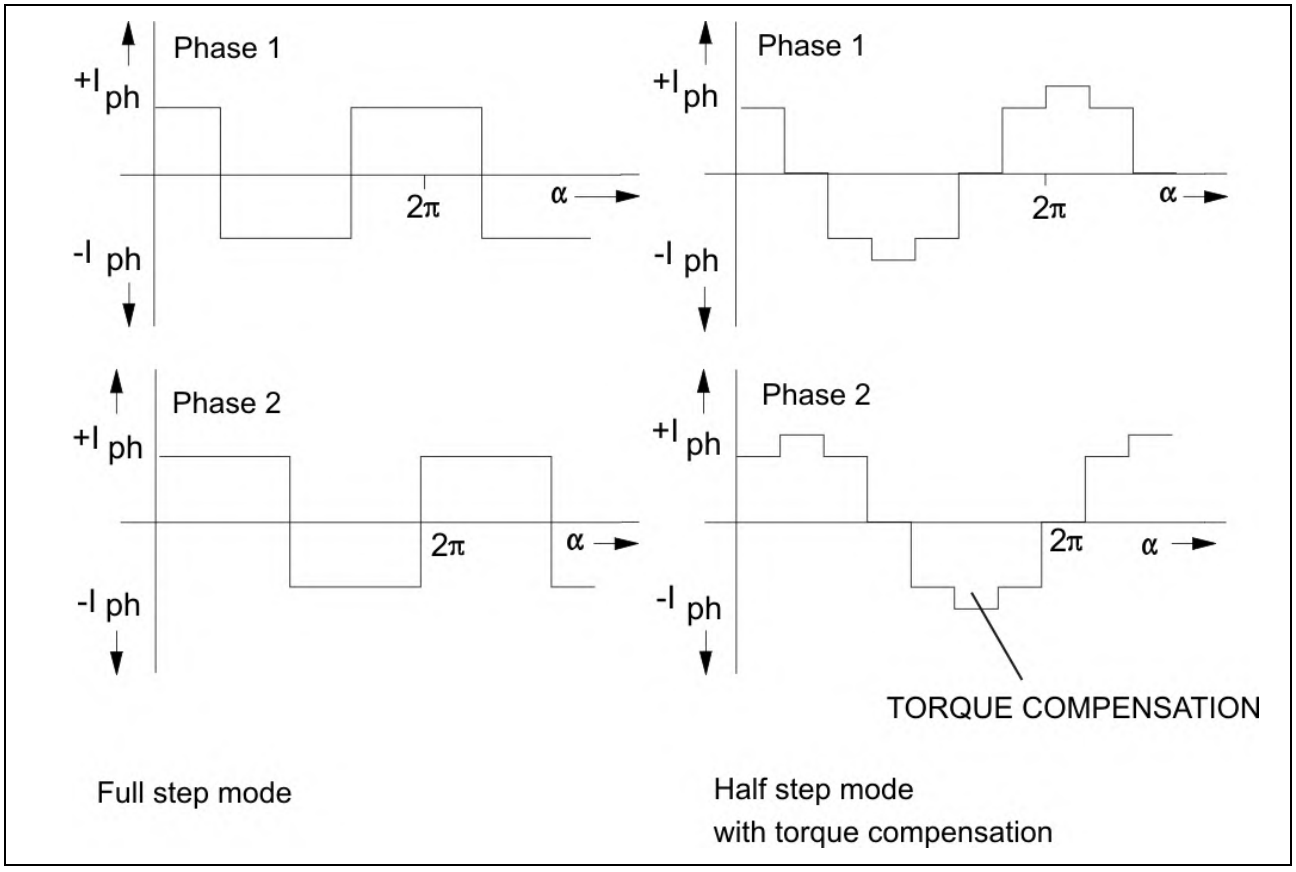


Fig. 19: Phase current curves

Half Step

The motor step resolution can be electronically multiplied by 2 by alternately energizing the stepper motor's phases 1, 1+2, 2 etc. This is the "half step" mode. The torque, however, is reduced in the half step mode, compared to the full step mode.

To compensate for this lack of torque, the operating mode "half step mode with torque compensation" was developed: the current is increased by $\sqrt{2}$ in the energised phase. Compared to the full step mode, the torque delivered is almost the same and most of the resonance is suppressed.

The following diagram shows the magnitude and direction of the holding torques of a 4 step motor during one revolution without and with torque compensation. In the full step position two phases are energised, in the half step position only one phase is energised. The total torque is the result of the vector sum for any phases that are energised.

The Torque Full Step, M_{FS}, as compared to the torque in the half-step mode is: $|M_{FS}| = |M_{HS}| \times \sqrt{2}$

This means, when a single phase is energised, the current must be increased by a $\sqrt{2}$ factor to obtain an identical torque.

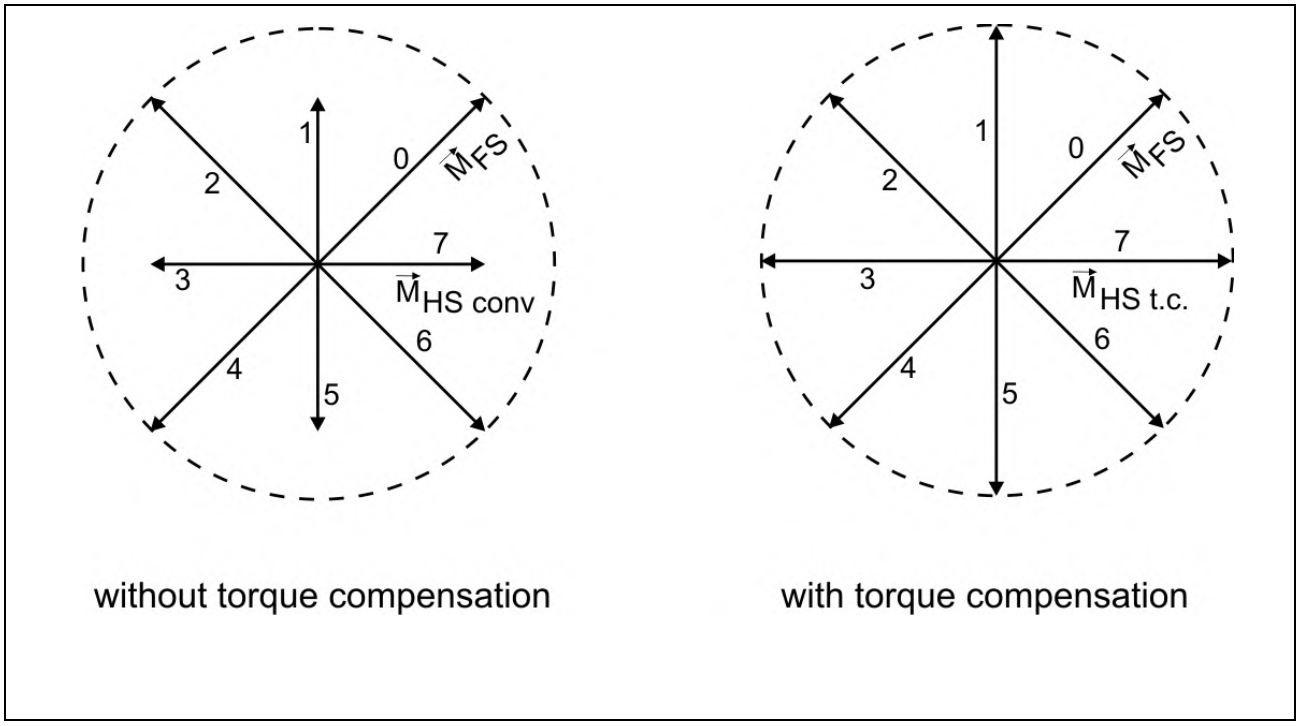


Fig. 20: Holding torques without/with torque compensation

Micro Step

The step resolution of the TM StepDrive can be increased electronically to 1/256 of a full step. A 200 step motor can, in theory, be commanded to one of 51,200 positions (equal to 0.007° per move pulse) per revolution.

Various advantages are obtained with the micro step mode:

- The torque undulation drops when the number of micro steps is increased.
- The achievable torque can increase up to 1/8 step, also a further increase of the resolution does not increase torque.
- Resonance and overshoot phenomena are greatly reduced; the motor operation is almost resonance-free.
- The motor noise also drops when the number of micro steps is increased.

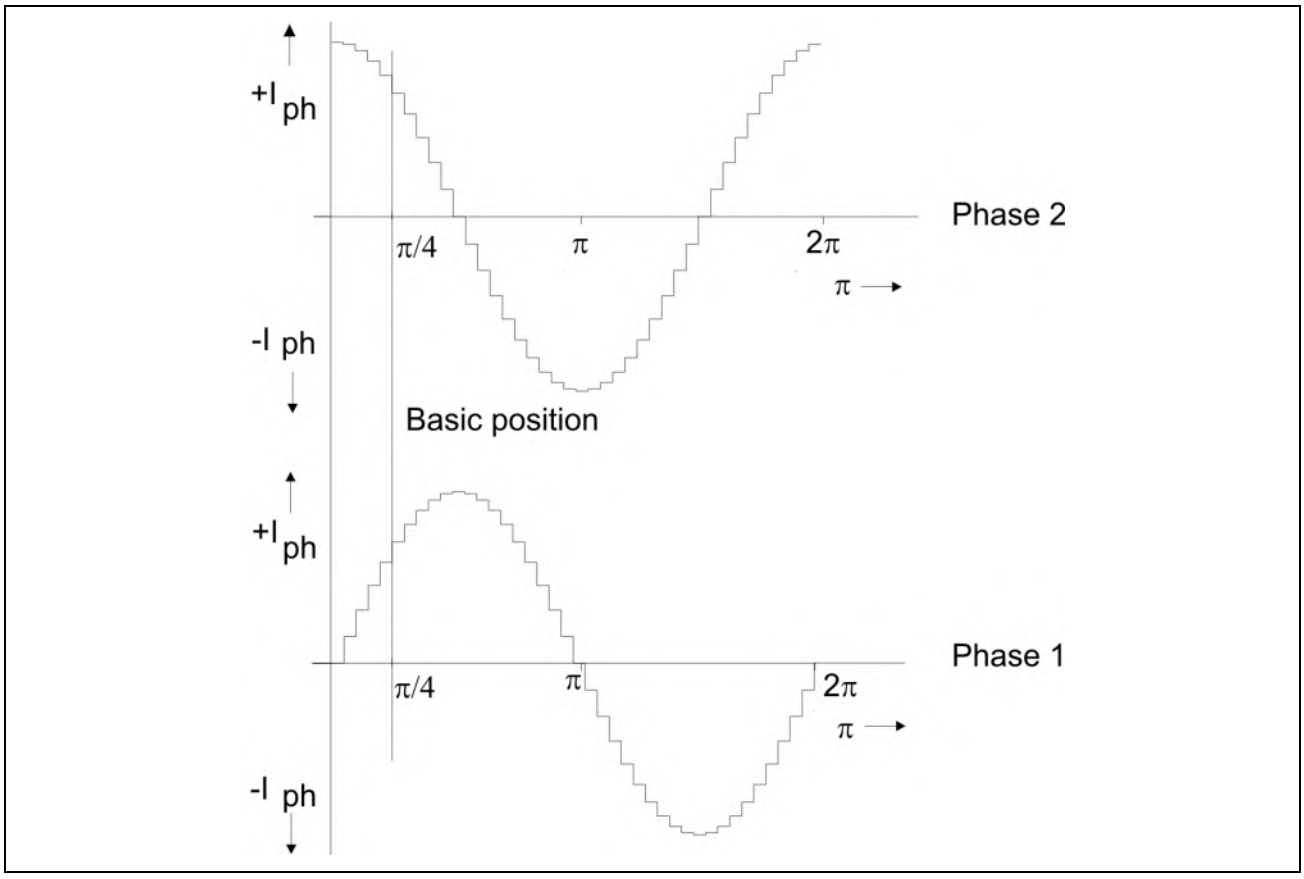
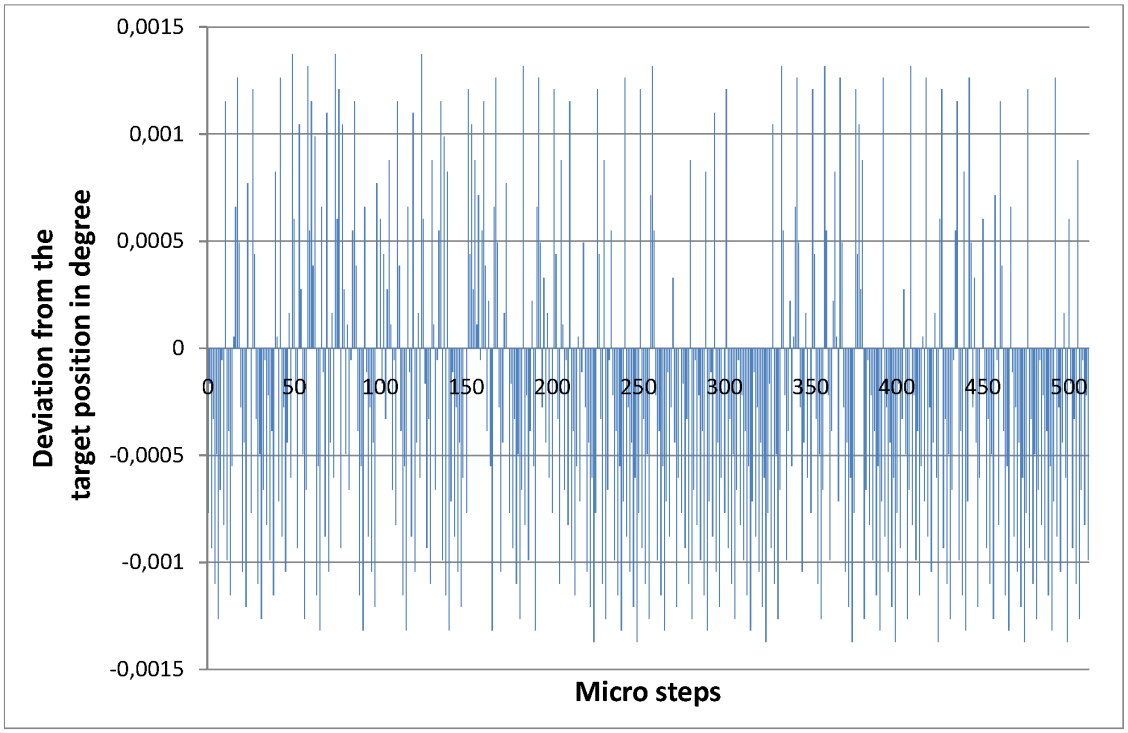


Fig. 21: Schematic profile of the phase currents with 1/10 micro step (of a full step)

i If using the highest micro step settings to perform accurate and absolute precision positioning, then use also a counter module with an attached encoder in order to achieve this. Than you can ensure the achievement of the target position or readjust if necessary. Even the slightest mechanical failure in the stepper motor can cause an incorrect micro step. The accuracy of the current setting of the TM StepDrive is high enough to dissolve even 1/256 step electrically safe.


0,0015
0,001
0,0005
0
-0,0005
-0,001
-0,0015
0
50
100
150
200
250
300
350
400
450
500
Deviation from the target position in degree
Micro steps

8.4.4 Current Delay Time

After the last control pulse, the stop current is activated after a set time to minimise power consumption and motor heating. The time after the last control pulse until changing to the stop current is called Current Delay Time t_{DELAY}.

Phytron recommends specifying t_{DELAY} so that the motor's oscillations are decaying after the last motor step and positioning is more accurate. The higher current reduces in this case the decay and incorrect positioning is avoided.

A value of 1 to 1000 ms can be adjusted in 15 stages (see chap.**Fehler! Verweisquelle konnte nicht gefunden werden.**).

Automatic change from run to stop current:

After the stop current is applied, the ratio between both phase currents remains the same in the respective current feed pattern. Changing from run to stop current is achieved synchronously.
In the following figure the next motor step follows after every **rising** control pulse edge:

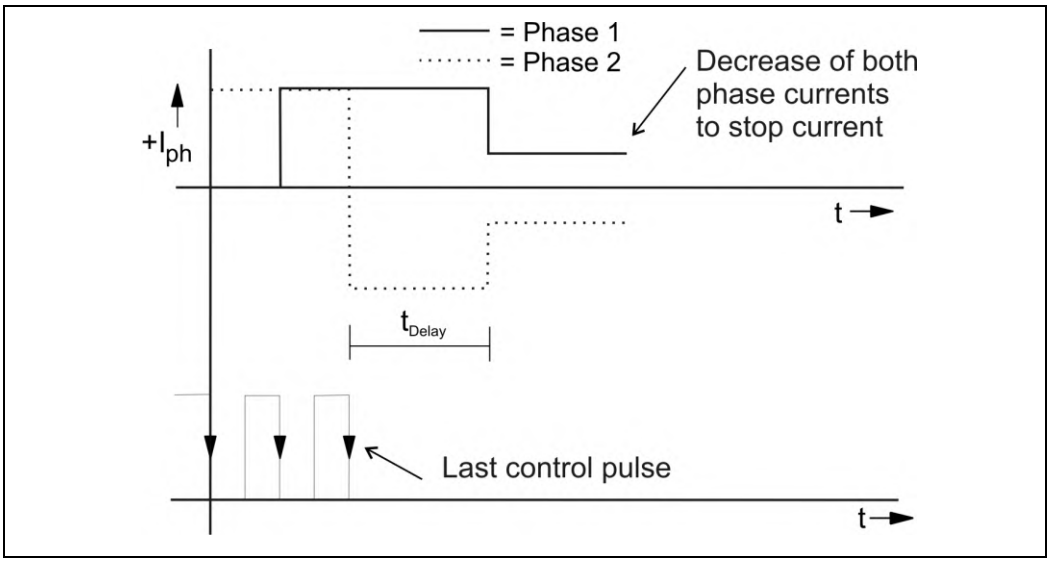


Fig. 22: Decrease to stop current after the last control pulse (full step)

Decreasing to stop current has the following advantages:

- Motor and power stage heating and power consumption is reduced.
- EMC is further improved due to smaller current values at a standstill.

The Current Delay Time t_{DELAY} after the last step of a traversing job has the following advantages:

- The release time of the stepper motor at its target position will be accelerated. So the next traversing job can be started quicker.
- Step loss, therefore incorrect positioning, by decaying effects on reaching a position is minimised.

9 ESD Protective Measures

Each product is tested before delivery and submitted to an endurance test run. To eliminate failures due to electrostatic discharge (ESD), a great many protective measures have been implemented throughout the entire manufacturing process - from incoming material to outgoing products.

When handling components, ESD protection measures (e. g. EN 61340-5-1) must be applied!

Our warranty does not cover failures due to incorrect handling.

10 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.

11 Warranty and Trade Marks

The TM StepDrive 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, unauthorised modifications, incorrect handling or wiring.

SIMATIC®, ET 200®SP, TIA Portal® and STEP®7 are trademarks of SIEMENS AG.

12 Appendix: Parameters and Data Record

12.1 Data Record 128 (DS128): Read and Write Parameters

The data record can be read **without** restriction.

Bit → / Byte ↓	7	6	5	4	3	2	1	0
HEADER								
0	reserved = 0		MajorVersion = 1		MinorVersion = 0			
1	Length of the following channel parameter block (byte 2 ... 35)→34 Byte							
DIAGNOSIS								
2	Position Error	Driver Error	reserved	DIS input active	reserved			Missing supply voltage L+
DRIVER CONFIGURATION								
3…6	Start-stop frequency							
7…10	Acceleration							

Bit → / Byte ↓	7	6	5	4	3	2	1	0
11…14	PM mode: Run frequency TO mode: Reference frequency							
15…18	M0P frequency							
19…22	PM mode: Traversing range TO mode: reserved							
23	Step resolution							
24	Current delay time							
25	Run current							
26	Stop current							
27	PM mode: Boost current TO mode: reserved							
BASIC PARAMETERS								
28	Reaction to CPU STOP		**PM mode** Power stage **TO mode** reserved	**PM mode** Boost with accelera-tion **TO mode** reserved	Connec-tion type	reserved		Mode
VERHALTEN DI								
29	**PM mode** Function S1 Input **TO- Mode** Reference switch		Type Input S1	reserved				
30	**PM mode** Function S2 Input		Type Input S1	reserved				
	TO- Mode reserved		–					
31	**PM mode** Function S3 Input		Type Input S1	reserved				
	TO- Mode		reserved					
32…35	**PM mode** reserved							
	TO- Mode Steps per revolution							

12.2 Data Record 245: Module Parameters PROFIBUS

12.2.1 Positioning Mode (PM mode)

Byte\Bit	7	6	5	4	3	2	1	0
HEADER								
0	reserved = 0		MajorVersion = 1		MinorVersion = 0			
1	Length of the following channel parameter block: byte 2 ... 9 →8 byte							
DRIVER CONFIGURATION / BEHAVIOR DI								
2 … 5	Traversing range							
6	Mode = 0	Power stage	Accelera-tion with Boost	Reserved	Step resolution			
7	Function S1 Input		Type input S1	Run current level				
8	Function S2 Input		Type input S1	Stop current level				
9	Function S3 Input		Type input S1	Boost current level				

12.2.2 Technology Object Mode (TO mode)

Bit → / Byte ↓	7	6	5	4	3	2	1	0
HEADER								
0	reserved = 0		MajorVersion = 1		MinorVersion = 0			
1	Length of the following channel parameter block:(byte 2 … 8)→7 byte							
DRIVER CONFIGURATION / BEHAVIOR DI								
2 … 5	Steps per revolution							
6	Mode=1	reserved			Step resolution			
7	Reference switch		Switch type	Run current step				
8	reserved			Stop current step				

13 Appendix: Assignment of the Control and Feedback Interface

13.1 Assignment of the Control Interface (PM mode)

Bit → / Byte ↓	7	6	5	4	3	2	1	0
0 … 3	Control value							
4	Drive command							
5	Feedback operating mode							
6	reserved	Error Reset	reserved				Referen-cing with Offset	Referen-cing to ref. sensor
7	reserved (internal)							

13.2 Assignment of the Feedback Interface (PM mode)

Bit → / Byte ↓	7	6	5	4	3	2	1	0
0…3	Position							
4…7	Feedback value							
8	Feedback mode							
9	Motor is running	Ramp	deactivat-ed	Referenc-ing active	Referenc-ing suc-cessfully	Input S1	Input S2	Input S3
10	Positioning Error	Driver Error	Module Error	Reference Switches Error	Software Limit Switch acted	Hardware Limit Switch acted	Reserved	Direction
11	READY	Invalid FB mode	Invalid OP mode	Invalid control value	DIS Input active	Missing supply voltage L+	Shutdown tempera-ture	Warning tempera-ture

14 Appendix: Error Message and Diagnostic Alarm

14.1 Error Messages when Writing Data Records

If parameterisation errors occur while writing the DS128, an error message is generated:

Error No.	Hex	Parameter	Permissible Setting range	PM mode	TO mode
32	0x20	Acceleration	100 - 100000000	X	X
33	0x21	Start stop frequency	1 - 250000	X	-
34	0x22	Run frequency	1 - 250000	X	-
35	0x23	M0P frequency	1 - 250000	X	-
36	0x24	Stop current	0 - 35	X	X
37	0x25	Run current	1 - 35	X	X
38	0x26	Boost current	0 - 35	X	-
39	0x27	Step resolution	0 - 8	X	X
40	0x28	Current delay time	0 - 15	X	X
41	0x29	Function of inputs	0 - 3, each function may only be assigned to one input	X	-
			0 - 3, Reference is assigned to an input	-	X
42	0x2A	Steps per revolution	4 - 128000	-	X
43	0x2B	Traversing range	0 - 2147483647 steps	X	-
44	0x2C	Reference frequency	1 - 125000	-	X

14.2 Diagnosis Notifications

Diagnosis Notification	Number	Meaning
Missing power supply L+	17	Missing motor voltage, the module is not supplied via the L+ terminal.
positioning error	740	An error occurred during positioning. Possible cause can be: • a limit switch became active during positioning. • the travel range was exceeded during positioning. • a traversing job in positive direction has been started and the positive limit switch is active. • a traversing job in negative direction has been started and the negative limit switch is active.
Power stage error	741	The power stage has reported an error. Possible cause can be: • The switch-off temperature has been reached. • The power stage driver is not responsive due to a defect. • It was designed for power stage operation, but it is only supplied via the supply pins for indexer operation. • The supply voltage was too low. The power stage has been deactivated for self-protection.
DIS input active	743	A running traversing job was cancelled because the DIS input of the module was activated. In any case, even when the motor is at a standstill, the power stage is deactivated and the diagnosis is triggered. Further traversing jobs are only accepted again when the DIS input is passive again and the error bit with the status has been deleted.

15 Glossary

Term	Meaning
BaseUnit	The BaseUnit carries the StepDrive technology module and represents the contacting for wiring.
Boost current	Higher motor torque is required for acceleration and deceleration of a stepper motor compared to the torque at average and slew velocity (f_{MAX}). With a phase current setting adjusted for rapid acceleration and deceleration (steep ramps), the current is higher than needed while at constant velocity. The motor will heat up faster than with the rated current applied. With a lower phase current, it is only possible to accelerate or decelerate with correspondingly longer ramp times. Therefore, it is recommended to select different current settings for acceleration/deceleration and slewing: – Continuous/slewing: Run current – Acceleration/deceleration: Boost current
Data record	List of parameters Various presetting such as frequencies, acceleration ramps or waiting times are required, which are referred to as parameters to operate the controller. Basic parameters are stored at delivery with which the controller can be operated in many applications.
DIS input	Input DISABLE: It disables operation with external signal present.
Direction	This signal determines the direction of rotation of the motor: If the bit is set, the motor rotates in negative direction. If the bit is not set, the motor rotates in positive direction. The signal may only be changed if the stepper motor is at a standstill or driven at a velocity within the start/stop range. The signal must not change 1 µs before the clock signal until 4 µs after that. Switching the direction of rotation at higher speed leads to step failure or standstill of the motor.
ET 200SP-Station	Distributed, multi-modular and micro modular I/O system with different interface modules (also with CPU functionality) for connection to PROFIBUS or PROFINET. Power supplies, digital, analogue and other technology modules, such as I/O-mastering and motor starters can be connected.

Term	Meaning
GSD file	The device database (GSD) describes the characteristics of a device type clearly and completely in an accurate and specific format. The GSD is produced by the equipment manufacturer for each type of device and is available to the user. The file describes a PROFIBUS slave: address space size, number of inputs and outputs, length of contiguous blocks of data and configurable properties.
Hardware configuration	Configuration and parameterization of hardware for an automation project.
HSP file	Hardware support package defines the system environment of an ET 200SP station and is used for the integration of modules (e.g. TM StepDrive) in the SIMATIC CPU.
HW Config	Software tool for configuration of the hardware. It offers a slave-select dialog to insert the hardware modules according to the S7 project.
HW module (hardware module)	Electronic module e.g. TM StepDrive, which is plugged onto a terminal module.
Current delay time	The current delay time is an important feature of the stepper motor power stage technology. Power stages, also called amplifiers, are usually controlled by a pulse and a direction signal. The current delay time is the waiting time between the last arriving control pulse and change over from run current to a reduced stop current.
PROFINET-Controller	Process Field Network (Industrial networking for data exchange in automation; device with so-called master functionality)
Distance-to-go	Acquisition of actual values (remaining distance) normalised to length units (steps)
Feedback interface	8-byte data for control status: content: residual distance, absolute position, velocity
Feedback value	For flexibility, the current velocity, the current position or the distance yet to be travelled are available as a feedback value.

Term	Meaning
Backplane bus	The backplane bus is a serial data bus over which the TM StepDrive communicates and provides them with the necessary voltage. The connection between the modules is via the BaseUnits.
S7 station	Superior PLC controller in the SIMATIC family
Step resolution	Stepper motor power stages using electronic measures to raise the physical resolution of the stepper motor are called micro step, mini step or fine step power stages. TM StepDrive can resolve up to 1/256 of a full step, the selectable step resolution is enhanced by factors from 2 to 256. Converted into steps per revolution, a resolution of 1/256 for a 200 step motor results in 51,200 micro steps per motor revolution or 0.007° on the shaft.
SIMATIC	SIMATIC is a product name of Siemens used for products in the automation, process control and manufacturing level. The SIMATIC automation products are electronic programmable logic controllers (PLC). The control functions are stored as firmware in a part of the CPU module. The SIMATIC is programmed by using the SIMATIC programming software STEP®7. The automation components are modular and can be mounted next to the CPU with a variety of digital and analogue I/O modules and pre-processing, intelligent modules.
SIMATIC Manager	The SIMATIC Manager looks after all data that belongs to an automation project. The tools required to process the selected data are started automatically by the SIMATIC Manager.
STEP®7	Software for configuration and programming of SIMATIC Automation systems (part of the SIMATIC industrial software)
Control interface	8 byte data for position and direction information
Isochronous	The synchronous coupling of a SIMATIC automation solution to the equidistant PROFIBUS is called isochronous.
TIA Portal®	Totally Integrated Automation Portal With SIMATIC STEP®7 (TIA Portal®) users configure, program, test and diagnose basic, advanced and distributed controllers of all generations, whether PLC- or PC-based, including software controllers.

Term	Meaning
Behaviour at CPU STOP	This can be used to configure how the module behaves in the event of CPU failure, cable breakage, etc.: Cancel or continue current positioning, deactivate output stage or set to stop current.

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