TSP10-PNE Feldbus Appendix

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Advanced Hybrid Stepper Systems

Table of changes:

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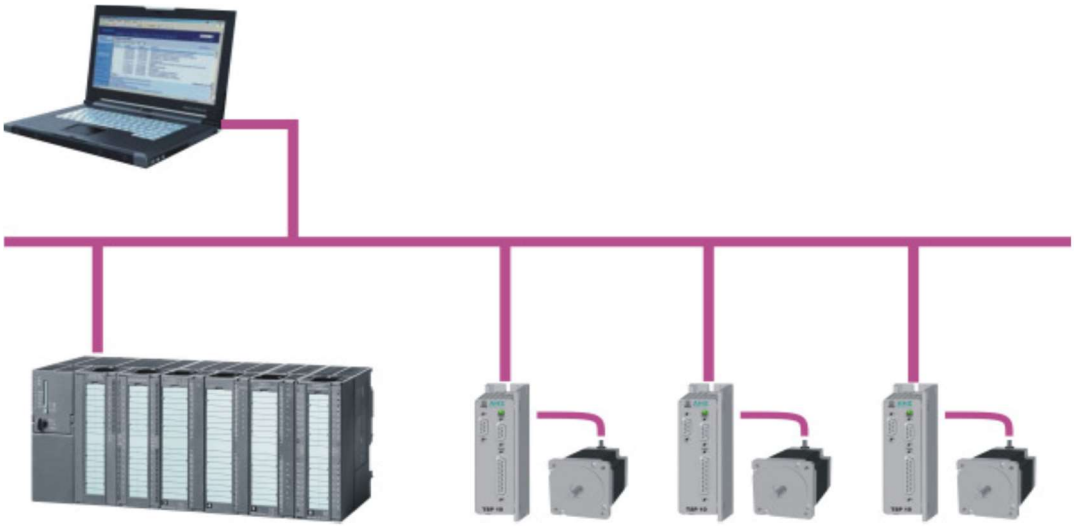
TSP10-PNE - Compact Stepper Motor Controllers with Encoder Feedback

1 Profinet-Control

The TSP10-PNE is a modular station with 2 modules. There is an output module and an input module. The stepper motor drive can be operated in speed or positioning mode. The Profinet controller can start actions of the drive by setting control bits in the command word.



The current status and position can be recorded by the control at any time by reading the input data.

The absolute target position that the stepper motor control is to reach with the next movement profile is entered in the output data. In this way, exact decentralised path positioning can be carried out without burdening the master. An example project can be requested by e-mail (info@ahs-antriebstechnik.de).

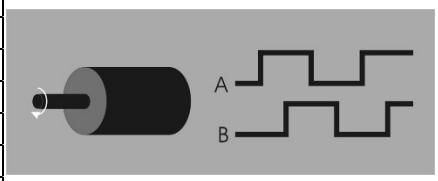
In this appendix you will find the additional functions of the TSP10-PNE and the differences to the basic unit TSP10-BA. The general functions of the unit are described in the TSP10-BA manual. (https://www.ahs-antriebstechnik.de/de/produkte/schrittmotoransteuerungen#tsp10-handbuecher)

1.1 Pin assignment

Two RJ45 sockets (connections X5A and X5B) are available for Profinet. The built-in switch allows the signals to be looped through.

The encoder is connected via the 9-pin sub-D socket X6 below the RJ45 sockets and has the following assignments:

Signal	TSP10 X6 Pin	AE30 Wire colour	M21 Wire colour	DFS Wire colour
+5V	1	Red	Red	Red
A	2	Purple	Green	White
B	3	Yellow	Orange	Pink
Index	4	Green	White	Purple
GND	6	Black	Black	Blue
/A	7	Brown	Red/Black	Brown
/B	8	Orange	White/Black	Black
/Index	9	Blue	Blue	Yellow



The inputs for end, reference and stop switches are set as follows for the TSP10-PNE:

GND-DE	Reference potential	X2 pin 1
DE2	lower limit switch	X2 pin 10
DE3	Upper limit switch	X2 pin 11
DE4	Reference switch	X2 pin 12
DE5	Stop switch	X2 pin 13

The inputs are optically separated and designed for both 24V and 5V (see type key). The inputs can be deactivated via the parameter data (see 1.2).

1.2 Parameter datea

The settings for limit switch, smoothing, standstill current reduction, motor direction of rotation, stop switch polarity, current reduction in %, motor current, step width (microstep factor) and homing are specified via the Profinet hardware configurations. Defaults are specified in the GSDML file.

Parameter	Wert	Datentyp	Erlaubte Werte	Beschreibung
Parameter PN				
Endschalter	Endschalter sind angeschlossen	Bit		Verwendung von Endschaltern
Smoothing	Ja	Bit		Sanfte Motorbewegung bei geringen Schrittauflösungen
Stromreduzierung	Nach 100 ms	BitArea		
Motordrehrichtung	Standard-Drehrichtung	Bit		
Stopp-Schalter Polarität	High Level	Bit		
Stromreduzierung in %	40	Unsigned8	0..100	%
Motorstrom	3000	Unsigned16	100..7000	mA
Mikroschrittfaktor	20	Unsigned8	1..128	n*200
Referenzfahrtmethode	Unterer Referenzschalter (Fahrtr. -)	Unsigned8		

1.2.1 Limit switch

If the limit switches (X2 pin 10 and 11) are not used, the parameter (byte offset 4 bit offset 0) must be set to zero so that the motor can move. The limit switches function as break contacts and prevent the motor from moving when open.

Parameter ID=Endschalter	
Help Text	Verwendung von Endschaltern
Value	**Content**
0	Keine Endschalter verwendet
1	Endschalter sind angeschlossen

1.2.2 Smoothing

A smoother run with a small microstep factor can be achieved by switching on the smoothing (byte offset 4 bit offset 1).

Parameter ID=Smoothing	
Help Text	Sanfte Motorbewegung bei geringen Schrittauflösungen
Value	**Content**
0	Nein
1	Ja

1.2.3 Standstill current reduction

The waiting time until the current is reduced can be parameterised in 8 steps (byte offset 4 bit offset 2). The motor current is specified as a percentage of the set value (byte 5) so that the heating of the motor is reduced.

Parameter ID=IdleCurrentAfter	
Value	**Content**
0	Nie
1	Nach 25 ms
2	Nach 50 ms
3	Nach 100 ms
4	Nach 250 ms
5	Nach 500 ms
6	Nach 1 s
7	Nach 2 s

1.2.4 Direction of motor rotation

In the standard setting, the motor rotates clockwise when looking at the shaft.
If "Reverse direction of rotation" is selected as the setting (byte offset 4 bit offset 6), the limit switch functions DE2 and DE3 are swapped.

Parameter ID=Polarity	
Value	**Content**
0	Standard-Drehrichtung
1	Umgekehrte Drehrichtung

1.2.5 Stop switch

The polarity of the stop input (byte offset 4 bit offset 7) can be configured.

Parameter ID=StopSwitch	
Value	**Content**
0	Low Level
1	High Level

1.2.6 Power reduction in percent

The reduced motor current (byte offset 5) can be specified from 0%...100% of the nominal value.

1.2.7 Motor current

The motor current can be set between 100 and 7000 mA (byte offset 6 and 7). The parameterised value must never - even briefly - be higher than the permissible motor current.

1.2.8 Microstep factor (step size)

The microstep factor (byte offset 8) can be selected between 1 and 128 (200 and 25600 steps per revolution). A higher resolution provides smoother operation at low speeds.

Microstep factor n * 200 steps per revolution

Example:
A drive turns a spindle that produces 4 mm of feed per revolution. The total travel is 700 mm - i.e. 175 revolutions. With a selected microstep factor of n = 20, a microstep resolution of 4000 steps per revolution is obtained. The position in µm (micrometres) can then be specified as the target position. The final position would thus be 700,000.

1.2.9 Homing

The homing method can be specified via byte offset 9.

Parameter ID=HomingMethod	
Value	**Content**
17	Endschalter unten
18	Endschalter oben
24	Unterer Referenzschalter (Fahrtr. +)
25	Oberer Referenzschalter (Fahrtr. +)
28	Oberer Referenzschalter (Fahrtr. -)
29	Unterer Referenzschalter (Fahrtr. -)
35	Istposition
250	Unterer mechanischer Anschlag
251	Oberer mechanischer Anschlag

1.2.10 Encoder

The resolution of the encoder can be set in the value range between 0...10000. If no encoder is used, the value 0 must be entered.

2 Control module (output data)

The table shows the individual output data for the control of the TSP10-PNE. Parts that are only used for positioning are marked in green. Values that are only used in speed mode are coloured orange.

Name	Data Type	Display as Bits
Kommandowort	Unsigned16	Bit 2: Beschleunigung mit Rampe Bit 3: Geschwindigkeitsmode Bit 4: Positionierung starten Bit 5: Richtung Bit 6: Freigabe Bit 7: Fehler lölschen Bit 11: Referenzfahrt starten
Zielposition	Integer32	No
Beschleunigungszeit [ms] (Geschwindigkeitsmode: pro 100 Upm)	Unsigned16	No
Geschwindigkeit [0..3000 Upm]	Unsigned16	No

2.1 Command word

Bit		Meaning	Description
0		reserved	
1		reserved	
2	A	Acceleration	0 = no ramp (jump) 1 = linear velocity change
3	V	Velocity Mode	0 = Positioning 1 = Speed mode
4	S	Motor start	0 = Stop motor 1 = Start positioning
5	D	Direction	0 = forward 1 = backwards
6	E	Enable	0 = Motor is de-energised 1 = Holding torque or torque active
7	F	Fault Reset	0 = no action 1 = Reset error, if possible
11	H	Homing	0 = Standard operation 1 = Reference drive

In positioning mode, a ramp is always used and the direction of rotation results from the target position and the actual position.
In the case of limit switch or alarm stops or also stops by reaching the target position, the next motor start only takes place when the motor start bit is reset and then set again.

2.2 Target position

In order to be able to work with a high resolution and absolute positioning over a long distance, the target position is specified as a 32-bit integer value.

The reference point is always used for orientation during absolute positioning.

The actual position of the stepper is shown in the input data. The counter is set to 0 after reaching the reference point during homing and the counter status is set to referenced in the status word. Since the position is undefined after the unit is switched on, the counter is also set to 0 in this state to give the user the option of moving in both directions without homing. By querying the current counter reading, the control system can determine the current position of the drive and utilise it within the user programme.

For positioning, it is not necessary for the control to query the current counter reading; the busy message can be used for this purpose in the status word. The module compares the actual position with the target position at each step and ends the travel job as soon as both match.

When the stepper has reached the target position, the user programme will preselect a new target position. Before the stepper starts running again, however, the motor start bit of the command byte, which may still be active due to the previous run, must first be set to inactive and then active again.

It should also be noted that the stepper sets the direction of travel itself in positioning mode. The corresponding command bit is therefore ineffective. The direction of travel selected by the stepper always results from the comparison of the actual and target positions.

The stop conditions (stop and limit switches) are constantly checked during travel. They have a higher priority, i.e. if the specified position value has not yet been reached and the corresponding switch is actuated, the motor is stopped immediately.

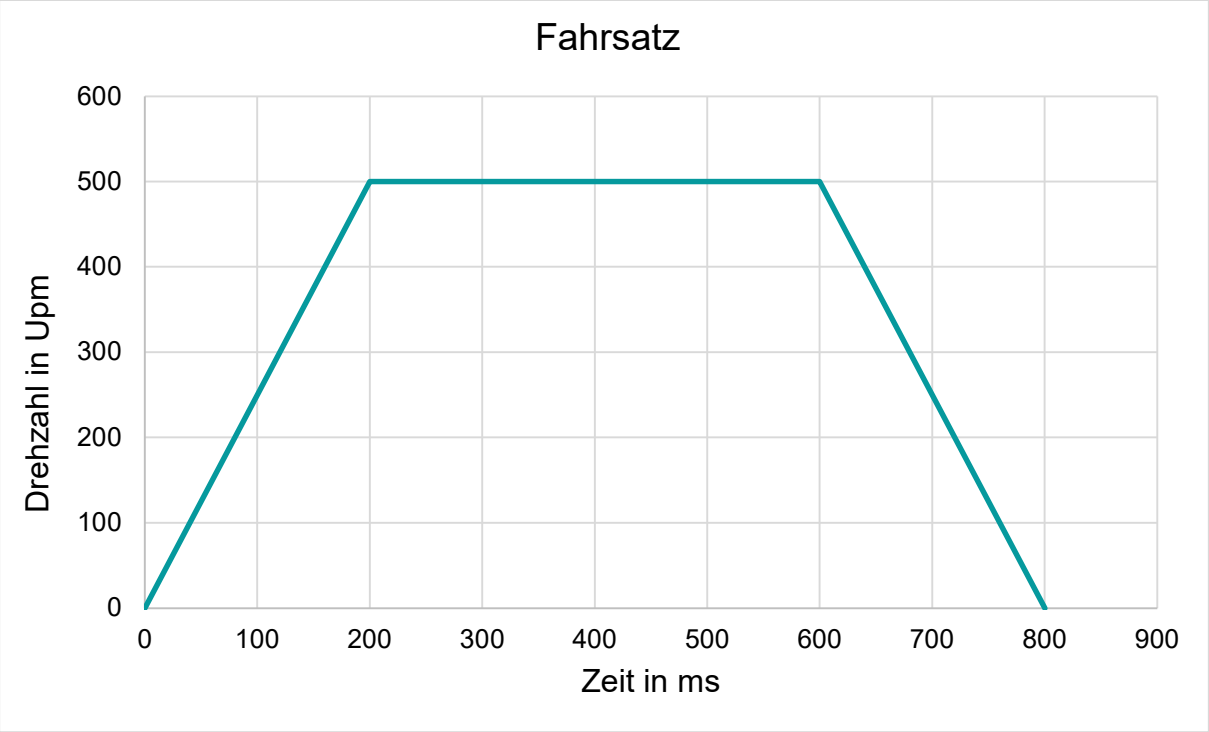
2.3 Acceleration

The acceleration time is set in milliseconds. The acceleration results from the set speed divided by the time for the acceleration. In velocity mode, 100 rpm is used as the velocity for calculating the acceleration. If the value is zero, the acceleration is set to 1 second.

2.4 Speed

In the last output word, the speed is entered in revolutions per minute. The maximum value for the speed is 3000 rpm. Values above this speed are ignored.

Example of the speed profile of a positioning:



Like the braking time, the acceleration time is 200 ms.
The final speed is 500 rpm.

2.5 Homing

The reference run is a special feature of the commands to the stepper motor. The reference run is always started by setting command bit 11.

There are various ways to carry out homing. The homing modes are listed in the parameter data. The acceleration and speed of the reference run are specified as described in chapters 2.3 and 2.4.

After a successful reference run, the drive is exactly at the reference point and the position counter is set to zero. The status word indicates that the data of the position counter are valid. Another reference run is not carried out.

Now the stepper motor drive is ready to accept absolute position commands. The reference run is interrupted by the stop switch and when the second limit switch is reached, since the reference switch was not found then. When the lower limit switch is reached, the alarm state is assumed; when the stop switch responds during the reference run, only the drive is stopped and thus the reference run is aborted. All states can be recognised by the control unit via the status data and appropriate steps can be initiated.

Example: **upper reference switch (travel direction pos.)**, slide between reference point and upper limit switch:
Assignment of output data:

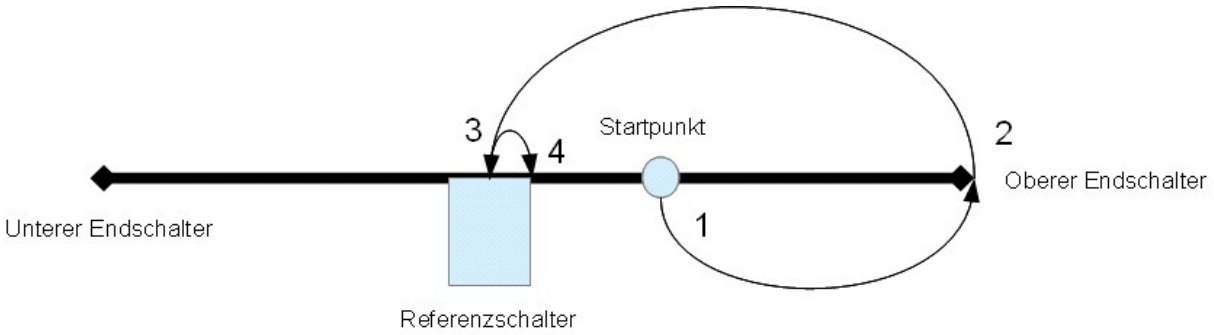
Velocity	100
Command word	0x0840
Target position	beliebig

After output of the command, the following assignment of the input data results:

Actual velocity	100
Status bytes	0x1000

Sequence of the homing procedure:

1	Start: Position counter incremented, speed as preselected.
2	Upper limit switch responds. Direction of travel changes, position counter decrements. Speed as preselected. Reference point is below the initial position.
3	Reference switch responds. Direction of travel changes. Position counter value increases.Reference switch hit from above, back until reference switch edge is reached.
4	Reference point is verified by leaving and re-triggering the reference switch. Set position counter to zero. Motor is at the reference point.



3 Modul state (input data)

Name	Data Type	Display as Bits
Istgeschwindigkeit	Integer16	No
Statuswort	Unsigned16	Bit 0: Stopp-Schalter Bit 1: Endschalter unten Bit 2: Referenzschalter Bit 3: Endschalter oben Bit 4: Richtung Bit 5: Geschwindigkeit erreicht Bit 7: Fahrauftrag aktiv Bit 12: Referenziert Bit 13: Zwischenkreisspannung ok Bit 14: Fehler erkannt
Istposition	Integer32	No

3.1 Status word

To be able to monitor the status of the stepper motor controller in the control unit, the status word (input byte 3+4) of the stepper motor drive is read. The table below shows which displays can be evaluated within the status word.

Bit		Meaning	Description
0	S	Stop switch	0 = Stop switch not active 1 = Stop switch triggered
1	↓	Limit switch bottom	0 = Limit switch bottom active
2	R	Reference switch	1 = Reference switch active
3	↑	Limit switch above	0 = Limit switch above active
4	D	Direction	0 = forward (increasing actual position) 1 = backward
5	V	Final velocity	0 = not achieved 1 = achieved
6		reserved	
7	B	Busy	0 = Driving task finished 1 = Driving task active
8		reserved	
9		reserved	
10		reserved	
11		reserved	
12	C	Counter status	1 = Counter status is referenced
13	M	Motor voltage	1 = DC link voltage ok
14	E	Error	1 = Error

3.2 Actual position and velocity

The values for the current position and speed have the same format as the default values in the output data.