

# **FIBRODRIVE *plus***

**Operation manuel ProfiNet for  
CNC-control with STO**

**FIBRODYN DM, FIBROTOR**





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## 1. General

This user guide covers the PROFINET IO interface of esiMot, esiMotXL, SC2 and SC10. For simplicity reasons all of these devices are called “esiMot” throughout this user guide.

esiMot works as a device in a PROFINET IO network.

Communication between a PROFINET IO controller (e.g. Simatic S7 CPU) and esiMot runs via cyclic exchanged data fields.

The IP address of the device is adjusted during commissioning via the PROFINET IO controller.

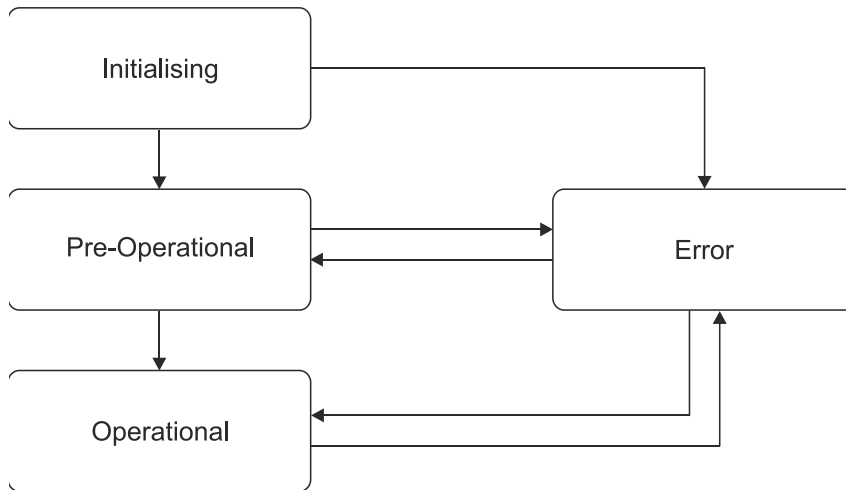
### 1.1 Bus-LED

Immediate after power-on the unit is looking for the Profinet connection. The status is displayed with the bus LED H3.

Following signals apply

LED	Meaning
Green flashing	Looking for the bus connection. The flash rate is reduced after some time.
Green on	Bus is okay
Orange	esiMotXL + SC10: No network could be found and the reaction to bus-fault was set to “no reaction”.

Status after power-on of the unit:



- During initialising the controller checks the hardware for functionality. Motor parameters are read and the regulator adjustments made.
- In status Pre-Operational the unit is programmable through serial RS232 Interface. Drive commands are not valid and cause an error. The controller remains in this status until it finds the PROFINET IO network.
- After the controller has found the Profinet is in status Operational. All commands including drive commands are valid. From now on, the Profinet connection needs to be active all time. If the controller loses Profinet connection it displays error „Bus-Off“.

## 2. Integration in the PROFINET IO system

esiMot is integrated into the PROFINET system via the included GSDML-file. The name and IP address of the esiMot are projected here and stored inside the esiMot.

### 2.1 Communication via function blocks

There is a library of function blocks (FBs) provided for consistent control of the esiMot and integration to the Windows-Programming software „Step 7“.

#### 2.1.1 Installation of the library

The provided library is installed the following way:

- Put the CD in your drive
- Start the "SIMATIC Manager"
- Dearchive the library „esimot.zip“ from the CD with „Dearchive“ in the menu „File“

The library „esiMotKonsistent“ is now integrated in Step 7.

#### 2.1.2 Integration of functions blocks and user data types into a project

Function block	Meaning
FB0 fbEsiMot	Function block for consistent control of the esiMot

The following steps are required to use the function block and the data structure in a STEP 7 project:

- Open the target project
  - Open the library "esiMotKonsistent" with „open“ in the menu „file“
  - Copy the function block from the library „esiMotKonsistent“ into the target project
- Copy for each esiMot the entity-DB of the function block FB0 (fbEsiMot) to the project.

#### 2.1.3 How to work with the function block fbEsiMot

##### 2.1.3.1 Parameter definition

The following table shows the parameters of the function block fbEsiMot:

Name	Type	Data type	Meaning
iiAddress	IN	INT	Base address esiMot (peripheral area)
iiCommand	IN	INT	Command to be processed
iiCommError	OUT	BOOL	DP communication error flag

**This function block needs to be called cyclic.**

**2.1.3.2 Static variables**

The following table shows the static variables of an entity data block of the function block fbEsiMot. The structures are each constructed as the data fields described in section "4.3 Description of the parameter data fields".

Name	Type	Data type	Meaning
stEsiMotTX	stat	STRUCT	Send buffer to the esiMot (used internal)
stEsiMotTXPos	stat	STRUCT	Structure for send data field commands 3/4/12/13 "Start positioning to absolute position [Increments]"/" Start relative positioning [Increments]"/" Absolute positioning rotary axis + [Increments]"/"Absolute positioning rotary axis - [Increments]" (see chapters 4.3.3, 4.3.4, 4.3.10, 4.3.11)
stEsiMotTXRef	stat	STRUCT	Structure for send data field command 5 "Start referencing" (see chapter 4.3.5)
stEsiMotTXStop	stat	STRUCT	Structure for send data field commands 7/279 "Stop with ramp( command 7)" (see chapter 4.3.7) and "Stop positioning (with brake ramp) with error message (Command 279)" (see chapter 4.3.25)
stEsiMotTXHand	stat	STRUCT	Structure for send data field commands 10/11 "Jog mode positive direction" and "Jog mode negative direction" (See chapters 4.3.8, 4.3.9)
stEsiMotTXRegType	stat	STRUCT	Structure for send data field command 256 "Set regulator type" (see chapter 4.3.16)
stEsiMotTXSollPreset	stat	STRUCT	Structure for send data field command 258 "Position controller set position = preset position [Increments]" (see chapter 4.3.17)
stEsiMotTXSoll	stat	STRUCT	Structure for send data field commands "Set value speed controller [rpm]" and "Set value current controller [1/10 Ampere]" (see chapters 4.3.18 and 4.3.20)
stEsiMotTXSollProz	stat	STRUCT	Structure for send data field commands "Set value speed controller [%]" and "Set value current controller [%]" (see chapters 4.3.19 and 4.3.21)
stEsiMotTXSollDZLim	stat	STRUCT	Structure for send data field command 371 "Set value current regulator [1/10Amps], continuous setpoint acceptance, speed limited" (see chapter 4.3.45)
stEsiMotTXSollDZLimProz	stat	STRUCT	Structure for send data field command 372 "Set value current regulator [%], continuous setpoint acceptance, speed limited" (see chapter 4.3.46)
stEsiMotTXPar	stat	STRUCT	Structure for send data field command 275 "Write Parameter " (see chapter 4.3.23)
stEsiMotTXRiSinn	stat	STRUCT	Structure for send data field command 283 "Adjust rotational direction" (see chapter 4.3.27)
stEsiMotTXPosRec1	stat	STRUCT	Structure for send data field command 284 "Write record 1" (see chapter 4.3.28)
stEsiMotTXPosRec2	stat	STRUCT	Structure for send data field command 285 "Write record 2" (see chapter 4.3.29)
stEsiMotTXProgCtrl	stat	STRUCT	Structure for send data field command 286 "Program control" (see chapter 4.3.30)
stEsiMotTXOutputs	stat	STRUCT	Structure for send data field command 288 "Set digital output free usage" (see chapter 4.3.32)
stEsiMotTXCfgStat	stat	STRUCT	Structure for the send data field command 292/293 "Configure status field iStat" / "Configure status field lStat" (see chapter 4.3.36)
stEsiMotTXDiag	stat	STRUCT	Structure for send data field command 400 "Extended Status" (see chapter 4.3.36)
stEsiMotRX	stat	STRUCT	Receive buffer of the esiMot
stEsiMotRXDefault	stat	STRUCT	Structure for the default input data field (see chapter 4.5.1)

<b>Name</b>	<b>Type</b>	<b>Data type</b>	<b>Meaning</b>
stEsiMotRXPar	stat	STRUCT	Structure for the input data field command 274 "Read Parameter" (see chapter 4.3.22)
stEsiMotRXVersion	stat	STRUCT	Structure for the input data field command 282 "Read software version" (see chapter 4.3.26)
stEsiMotRXDiag	stat	STRUCT	Structure for input data field command 400 "Extended Status"
stEsiMotRXPosRec1	stat	STRUCT	Structure for the input data field command 290 "Read record 1" (see chapter 4.3.34)
stEsiMotRXPosRec2	stat	STRUCT	Structure for the input data field command 291 "Read record 2" (see chapter 4.3.35)
iDPRDWRRet	stat	INT	Return value of the internal used system functions DPRD_DAT/DPWR_DAT
iBLKMOVRet	stat	INT	Return value of the internal used system functions BLKMOV



### 2.1.3.3 Calling a function block in IL/SCL

The following variables and data blocks have been defined in the symbol table:

Name	Data type	Remarks
iEsiMotCommand1	INT	Flag word
iCommError1	BOOL	Flag
dbEsiMot	fbEsiMot/FB0	Entity block

#### Call in IL - view:

```
CALL fbEsiMot, dbEsiMot(
iiAddress := 256, // esiMot at P-Address 256
iiCommand := iEsiMotCommand1,
iioCommError := iCommError1)
```

#### Call in SCL - view:

```
fbEsiMot.dbEsiMot(
iiAddress := 256, // esiMot at P-Address 256
iiCommand := iEsiMotCommand1,
iioCommError :=iCommError1);
```

If this call is executed cyclic, the function block fbEsiMot process the data transfer at a change of the variable „iEsiMotCommand1“ and the data is accessible for the user in dbEsiMot in the respective structures. After execution of a command „iEsiMotCommand1“ should be set to command 0 (no command) to update the status of the esiMot continuously.

The variable iioCommError delivers the return value for system functions DPRD\_DAT() and DPWR\_DAT().

If more than one esiMot is to be controlled with a Profinet master, each esiMot needs an entity block of the type fbEsiMot and fbEsiMot needs to be called cyclic with each of these entity blocks.

### 2.1.3.4 Memory requirements

Type	Size	Meaning
Code memory	ca.3.138 bytes	Function block fbEsiMot
Local data	30 Bytes	Function block fbEsiMot
Global data	x Data blocks 420 Bytes	Entity block of fbEsiMot; Memory requirement per used esiMot !

All data from and to the esiMot are stored in entity block. Therefor no additional user specific buffers are necessary.

### 2.1.3.5 Examples

There is an example program „esiMotBspKonsistent“ provided in the package.

Install the example program as followed:

- Insert the CD into the drive
- Start the „SIMATIC Manager“
- Dearchive the file „esimotbs.zip“ from the CD with „Dearchive“ in the menu „File“

The example program is now available in STEP 7.

In the example program, the variable table "vatEsiMot" can be found where all the data structures of the entity data block dbEsiMot1 as well as all other necessary variables required to control the function module (command, command echo, etc.) are defined. All esiMot function can easily be tested using these variable table and the functions "Controlling / monitoring".

### 3. Command interface

#### 3.1 Overview to commands

The following commands provide control to the esiMot

Number [Dec]	Number [Hex]	Meaning
0	0x0000	no command
1	0x0001	Login
2	0x0002	Logout
3	0x0003	Start positioning to absolute position [Increments]
4	0x0004	Start relative positioning [Increments]
5	0x0005	Start referencing
6	0x0006	Fast Stop
7	0x0007	Stop with ramp
10	0x000A	Jog mode positive direction
11	0x000B	Jog mode negative direction
12	0x000C	Absolute positioning rotary axis + [Increments]
13	0x000D	Absolute positioning rotary axis - [Increments]
20	0x0014	Deactivate regulator
21	0x0015	Activate regulator
22	0x0016	Error acknowledge
23	0x0017	Save parameters
256	0x0100	Set regulator type
258	0x0102	Position controller set position = preset position [Increments]
264	0x0108	Activate electric shaft
265	0x0109	Deactivate electric shaft
266	0x010A	Set value speed controller [rpm]
267	0x010B	Set value speed controller [%]
268	0x010C	Set value current controller [1/10 Ampere]
269	0x010D	Set value current controller [%]
274	0x0112	Read Parameter
275	0x0113	Write Parameter
278	0x0116	Fast stop positioning (without brake ramp) with error message
279	0x0117	Stop positioning (with brake ramp) with error message
282	0x011A	Read software version
283	0x011B	Adjust rotational direction
284	0x011C	Write record 1
285	0x011D	Write record 2
286	0x011E	Program control
287	0x011F	Start Program
288	0x0120	Set digital output free usage
289	0x0121	Clear digital output free usage
290	0x0122	Read record 1
291	0x0123	Read record 2

Number [Dec]	Number [Hex]	Meaning
292	0x0124	Configure status field IStat
293	0x0125	Configure status field iStat
294	0x0126	Error acknowledge without enabling regulator at falling edge
295	0x0127	Guided ramp stop torque- and speed controller
303	0x012F	Start positioning to absolute position [Increments], continuously following set-point
366	0x016E	Set value speed controller [rpm], continuously following set-point
367	0x016F	Set value speed controller [%], continuously following set-point
368	0x0170	Set value current controller [1/10 Ampere], continuously following set-point
369	0x0171	Set value current controller [%], continuously following set-point
371	0x0173	Set value current controller [1/10 Ampere], continuously following set-point, speed limited
372	0x0174	Set value current controller [%], continuously following set-point, speed limited
400	0x0190	Extended Status
512	0x0200	Reset

### 3.2 Send data field to esiMot

The send data field to esiMot is arranged the following way:

Byte-No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Function	Command		Parameter for "Command"													

### 3.3 Description of the parameter data fields

#### 3.3.1 Login (Command 1)

<no parameters>

This command is required to change parameters. The user must log in prior to a parameter write command (275).

#### 3.3.2 Logout (Command 2)

<no parameters>

#### 3.3.3 Start positioning to absolute position [Increments] (Command 3)

Byte-No.	2-5	6-7	8-9	10-11	12-15
Function	Target position	Positioning speed	Acceleration time	Deceleration time	Reserved
Range	-2 140 000 000 – +2 140 000 000 <i>Hex:</i> <i>80723100</i> ... <i>7F8DCF00</i>	1-10000  <i>Hex:</i> <i>0x01...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	-
Unit	Increments	Rpm (Motor)	ms	ms	-

### 3.3.4 Start relative positioning [Increments] (Command 4)

Byte-No.	2-5	6-7	8-9	10-11	12-15
Function	Distance	Positioning speed	Acceleration time	Deceleration time	Reserved
Range	-2 140 000 000 – +2 140 000 000 <i>Hex: 80723100</i> ... <i>7F8DCF00</i>	1-10000  <i>Hex: 0x01...2710</i>	10-10000  <i>Hex: 0x0A...2710</i>	10-10000  <i>Hex: 0x0A...2710</i>	-
Unit	Increments	Rpm (Motor)	ms	ms	-

### 3.3.5 Start referencing (Command 5)

Byte-No.	2-13	14-15
Function	Reserved	Referencing mode
Range	-	-2 ... 30 <i>Hex: FFFE ... 0x1E</i> see List on page 37
Unit	-	-

### 3.3.6 Fast Stop (Command 6)

< No parameters >

A new drive command is permissible direct after a fast stop command. Sending a 0-command is not required.

### 3.3.7 Stop with ramp (command 7)

Byte-No.	2-9	10-11	12-15
Function	Reserved	Deceleration time (optional)	Reserved
Range	-	10 – 10 000 <i>Hex: 0x0A...2710</i>	-
Unit	-	ms	-

A new drive command is permissible direct after a ramp stop command. Sending a 0-command is not required

### 3.3.8 Jog mode positive direction (Command 10)

Byte-No.	2-5	6-7	8-15
Function	Reserved	0: Creep speed 1: Rapid traverse	Reserved
Range	-	-	-
Unit	-	-	-

The esiMot switches to continuous movement if the jog mode command is applied for more than 100ms.

 If the tip increments are set to 0, there is no delay for continuous movement.

To switch from jog mode positive direction to jog mode negative direction a falling edge at the end of the command is required.

### 3.3.9 Jog mode negative direction (Command 11)

Byte-No.	2-5	6-7	8-15
Function	Reserved	0: Creep speed 1: Rapid traverse	Reserved
Range	-	-	-
Unit	-	-	-

The esiMot switches to continuous movement if the jog mode command is applied for more than 100ms.

 If the tip increments are set to 0, there is no delay for continuous movement.

To switch from jog mode negative direction to jog mode positive direction a falling edge at the end of the command is required.

### 3.3.10 Absolute positioning rotary axis + [Increments] [Increments] (command 12)

Byte-No.	2-5	6-7	8-9	10-11	12-15
Function	Target position	Positioning speed	Acceleration time	Deceleration time	Reserved
Range	-2 140 000 000 – +2 140 000 000 <i>Hex:</i> <i>80723100</i> ... <i>7F8DCF00</i>	1-10000  <i>Hex:</i> <i>0x01...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	-
Unit	Increments	Rpm (Motor)	ms	ms	-

### 3.3.11 Absolute positioning rotary axis - [Increments] [Increments] (Command 13)

Byte-No.	2-5	6-7	8-9	10-11	12-15
Function	Target position	Positioning speed	Acceleration time	Deceleration time	Reserved
Range	-2 140 000 000 – +2 140 000 000 <i>Hex:</i> <i>80723100</i> ... <i>7F8DCF00</i>	1-10000  <i>Hex:</i> <i>0x01...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	10-10000  <i>Hex:</i> <i>0x0A...2710</i>	-
Unit	Increments	Rpm (Motor)	ms	ms	-

### 3.3.12 Deactivate regulator (Command 20)

<no parameters>


### 3.3.13 Activate regulator (Command 21)

<no parameters>

### 3.3.14 Error acknowledge (Command 22)

<no parameters>

The acknowledgement of an error is done with rising and falling edge. That means the signal must toggle.

 A pulse is required!

### 3.3.15 Save parameters (Command 23)

<no parameters>

All parameters and set data are stored. A previous "Login" command (1) is required to store parameters.

### 3.3.16 Set regulator type (Command 256)

Byte-No.	2-3	4-15
Function	Regulator type	Reserved
Range	2: torque regulator 3: speed regulator 4: positioning	-
Unit	-	-

Values are decimal coded.

### 3.3.17 Position controller set position = preset position [Increments] (Command 258)

Byte-No.	2-5	6-15
Function	Preset position	Reserved
Range	-2 140 000 000 – +2 140 000 000 <i>Hex: 80723100</i> ... <i>7F8DCF00</i>	-
Unit	Increments	-

### 3.3.18 Activate electric shaft (Command 264)

<no parameters>

### 3.3.19 Deactivate electric shaft (Command 265)

<no parameters>

### 3.3.20 Set value speed controller [rpm] (Command 266)

Byte-No.	2-5	6-13	14-15
Function	Set value speed controller	Reserved	Current limit
Range	-10000 ... 10000 <i>Hex: D8F0...2710</i>  (respectively max. motor speed)	-	-32 768 ... Motor pulse current > 0: value is set = 0: no function < 0: reset current limit to parameter value
Unit	Rpm	-	1/10 Ampere

### 3.3.21 Set value speed controller [%] (Command 267)

Byte-No.	2-3	4-13	14-15
Function	Set value speed controller	Reserved	Current limit
Range	-100 ... +100 <i>Hex: FF9C...0x64</i>	-	-32 768 ... Motor pulse current > 0: value is set = 0: no function < 0: reset current limit to parameter value
Unit	%	-	1/10 Ampere

### 3.3.22 Set value current controller [1/10 Ampere] (Command 268)

Byte-No.	2-5	6-15
Function	Set value current controller	Reserved
Range	-14.0 ... +14.0 <i>Hex: FF74 ... 0x8C</i> (respectively max. motor current)	-
Unit	1/10 Ampere	-

### 3.3.23 Set value current controller [%] (Command 269)

Byte-No.	2-3	4-15
Function	Set value current controller	Reserved
Range	-100 ...+100 <i>Hex: FF9C...0x64</i>	-
Unit	%	-



### 3.3.24 Read Parameter (Command 274)

Byte-No.	2-5	6-15
Function	Parameter number	Reserved

The value of the parameter is fed back to the appropriate input data field.

### 3.3.25 Write Parameter (Command 275)

Byte-No.	2-5	6-9	10-15
Function	Parameter number	Parameter value	Reserved

	<b>A previous "Login" (1) command is required to write parameters.</b>
	<b>To activate parameters permanently, they need to be saved (Command 23: Save parameters)</b>

Parameter numbers and accompanying values are described in chapter 5

### 3.3.26 Fast stop positioning (without brake ramp) with error message (Command 278)

<no parameters>

### 3.3.27 Stop positioning (with brake ramp) with error message (Command 279)

The parameterised ramp time on errors (parameter 94) is used if no deceleration time is transmitted.

Byte-No.	2-9	10-11	12-15
Function	Reserved	Deceleration time (optional)	Reserved
Range	-	10 - 10000 <i>Hex: 000A...2710</i>	-
Unit	-	ms	-

### 3.3.28 Read software version (Command 282)

<no parameters>

### 3.3.29 Adjust rotational direction (Command 283)

Byte-No.	2-3	4-15
Function	Rotational direction 0 = normal, 1 = inverted	Reserved
Range	0-1	-
Unit	-	-



### 3.3.30 Write record 1 (Command 284)

A record consists of several parameters. Two commands are necessary to write all parameters of a record.

A description of the types of records is in the user guide "esiMot".

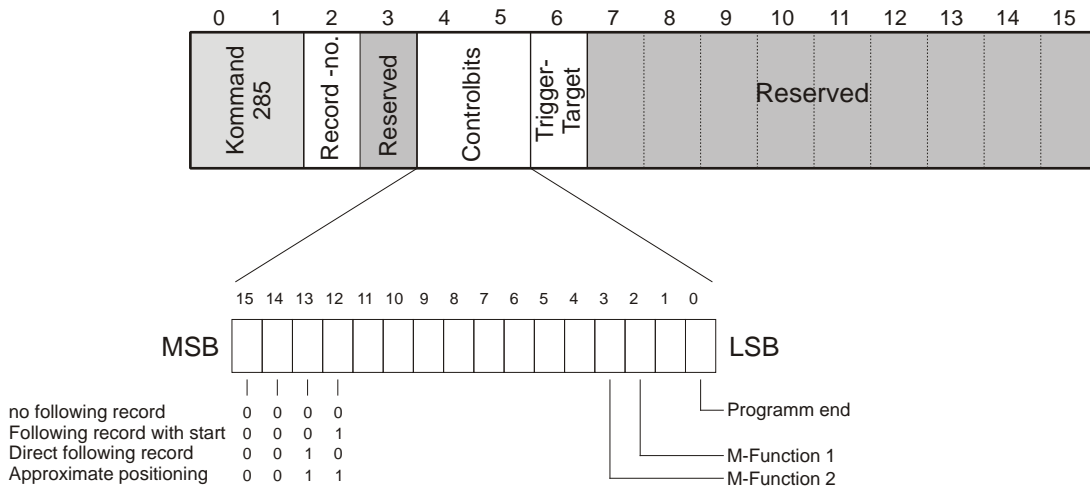
Byte-No.	2	3	4-5	6-7	8-9	10-11	12-15	
Function	Record number	Type of record	Record value 1	Acceleration time	Deceleration time	Delay time	Position resp. Increments	
Range	1-15	0: Absolute positioning	1-10.000 <i>Hex: 0x01 ... 2710</i> [rpm]	10-10.000 <i>Hex: 0x0A ... 2710</i>	10-10.000 <i>Hex: 0x0A ... 2710</i>	0-10.000 <i>Hex: 0x00 ... 2710</i>	-2.140 Mio. ... +2.140 Mio.  <i>HEX: 80723100</i> ... <i>7F8DCF00</i>	
		1: Relative positioning (Distance)	1-10.000 <i>Hex: 0x01 ... 2710</i> [rpm]					
		2: Set speed value in rpm	-10.000 -10.000 <i>Hex D8F0...2710</i> [rpm]	-	-			
		3: Set speed value in %	-100 - +100 <i>Hex: FF9C...0x64</i> [%]					
		4: Set current value in $\frac{1}{10}$ Ampere	-140 - 140 <i>Hex FF74 ... 0x8C</i> [A/10]					
		5: Set current value in %	-100 - 100 <i>Hex: FF9C...0x64</i> [%]					
		6: Absolute positioning rotary axis +	1-10.000 <i>Hex: 0x01 ... 2710</i> [Rpm]	10-10.000 <i>Hex: 0x0A ... 2710</i>	10-10.000 <i>Hex: 0x0A ... 2710</i>			max. rotary resolution see parameter: 85
		7: Absolute positioning rotary axis -	1-10.000 <i>Hex: 0x01 ... 2710</i> [Rpm]					
		127: Referencing	Referencing mode (List on page 37)		-			-
255: Empty record								
Unit	-		-	ms	ms	ms	Increments	

☞ „Empty record“ is used to delete a record.

### 3.3.31 Write record 2 (Command 285)

Byte-No.	2	3	4-5	6	7-15
Function	Record number	Reserve d	Control bits	Trigger A Target Record No.	Reserved
Range	1 - 15		LSB: Bit 0 – Program end Bit 3 – M Function 1 Bit 4 – M Function 2  Bit 12-15: 0: no following record 1: following record with start 2: direct following record (without start) 3: Approximate positioning	0-15 <i>0x00 ... 0x0F</i> 0 means no trigger ☞ In a record started by trigger function a trigger address may not be set again	-
Unit	-	-	-	-	-

Write record 2nd command

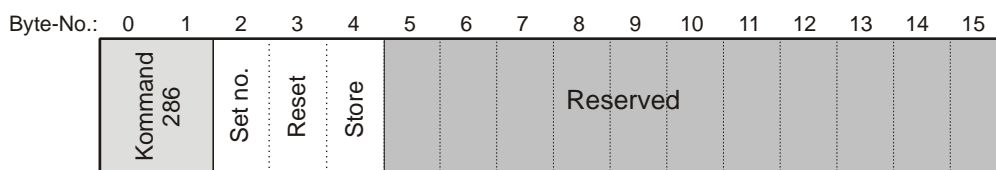


### 3.3.32 Program control (Command 286)

This command is effective only if no input function is assigned to record selection.

Byte-No.	2	3	4	5-15
Function	Record pointer number	Reset	Store	Reserved
Range	1-15			-
Unit	-			-
Remarks	This record number determines the record which is taken for the next regular read-in of records.	If byte 3 is different to 0, the record pointer is set to 1, if the esiMot is stopped, e.g. with stop input or missing "Enable".  Byte 3 has higher priority than byte 2.	If byte 3 is different to 0, the record data in the RAM are stored safe to power outage.  Byte 4 has higher priority than byte 3.	

Programm control



**3.3.33 Start Program (Command 287)**

<no parameters>

This command is effective only if not input function is assigned to START.

**3.3.34 Set digital output free usage (Command 288)**

Activate output 1, 2, 3 or 4. Note: Depending on the hardware not all 4 outputs might be present.

Byte-No.	2	3-15
Function	Output number	Reserved
Range	1, 2, 3 or 4 (depending on hardware)	-
Unit	-	-

**3.3.35 Clear digital output free usage (Command 289)**

Clear output 1, 2, 3 or 4. Note: Depending on the hardware not all 4 outputs might be present.

Byte-No.	2	3-15
Function	Output number	Reserved
Range	1, 2, 3 or 4 (depending on hardware)	-
Unit	-	-

**3.3.36 Read record 1 (command 290)**

Byte-No.	2	3-15
Function	Record number	Reserved
Range	1-15	-
Unit	-	-

The parameters of the record are sent back into the default data field. Compare to command 284.

**3.3.37 Read record 2 (command 291)**

Byte-No.	2	3-15
Function	Record number	Reserved
Range	1-15	-
Unit	-	-

The parameters of the record are sent back into the default data field. Compare to command 285.

**3.3.38 Configure status field IStat (command 292)**

Byte-No.	2	3-15
Function	Configuration default status field IStat	Reserved
Range	0...3	-
Unit	-	-

Configuration IStat	Meaning
0	Actual position [Increments] (default setting)
1	Actual speed [rpm]
2	Actual current [1/10A]
3	Value analogue input [-32768 ... 32767]

**3.3.39 Configure status field iStat (command 293)**

Byte-No.	2	3-15
Function	Configuration default status field iStat	Reserved
Range	1...3	-
Unit	-	-

Configuration iStat	Meaning
1	Actual speed [rpm] (default setting)
2	Actual current [1/10A]
3	Value analogue input [-32768 ... 32767]

**3.3.40 Error acknowledge without enabling regulator at falling edge (command 294)**

<no parameters>

A rising edge acknowledges errors.

**3.3.41 Guided ramp stop torque- and speed controller (Command 295)**

<no parameters>

In torque mode a guided stop is performed with the parameter 49: Ramp time to Vmax (only speed regulator).

In speed mode a guided stop is performed with the parameter 94: Brake ramp on errors

**3.3.42 Start positioning to absolute position [Increments], continuously following set-point (command 303)**

Byte-No.	2 – 5	6-7	8-9	10-11	12-15
Function	Target position	Positioning speed	Acceleration time	Deceleration time	Reserved
Range	-2.140 Mio. ... +2.140 Mio.  <i>HEX:</i> <i>80723100</i> ... <i>7F8DCF00</i>	0-10.000  <i>Hex:</i> <i>0x00 ... 2710</i>	10-10.000  <i>Hex:</i> <i>0x0A ... 2710</i>	10-10.000  <i>Hex:</i> <i>0x0A ... 2710</i>	-
Unit	Increments	rpm (motor)	msec	msec	-

**3.3.43 Set value speed controller [rpm], continuously following set-point (command 366)**

Byte-No.	2-5	6-7	8-9	10-11	12-13	14-15
Function	Set-point speed controller	Acceleration time	Speed reg. P-portion	Speed reg. I-portion	Speed reg. I-Limit	Reserved
Range	-10 000 ... 10 000 <i>Hex: D8F0 ... 2710</i> (respectively maximum motor speed)	10-10.000  <i>Hex:</i> <i>0x0A ... 2710</i>	>0: value will be set =0: no function -1: restore parameter value	>0: value will be set =0: no function -1: restore parameter value	>0: value will be set =0: no function -1: restore parameter value	-
Unit	rpm	msec	-	-	-	-

**3.3.44 Set value speed controller [%], continuously following set-point (command 367)**

Byte-No.	2-3	4-5	6-15
Function	Set-point speed controller	Acceleration time	Reserved
Range	-100 ... 100 <i>Hex: FF9C ... 0x64</i>	10-10.000  <i>Hex:</i> <i>0x0A ... 2710</i>	-
Unit	%	msec	-

**3.3.45 Set value current controller [1/10 Ampere], continuously following set-point (command 368)**

Byte-No.	2-5	6-15
Function	Set-point current controller	Reserved
Range	-140 ... 140 <i>Hex: FF74 ... 0x8C</i> (respectively maximum motor current)	-
Unit	1/10 Ampere	-

### 3.3.46 Set value current controller [%], continuously following set-point (command 369)

Byte-No.	2-5	4-15
Function	Set-point current controller	Reserved
Range	-100 ... 100 Hex: FF9C ... 0x64	-
Unit	%	-

### 3.3.47 Set value current controller [1/10 Ampere], continuously following set-point, speed limited (command 371)

Byte-No.	2-5	6-7	8-15
Function	set-point current regulator	speed limitation	reserved
Range	-140 ... +140 Hex: FF74 ... 0x8C respectively max. motor current	0-65535	-
Unit	1/10 Ampere	rpm	-

### 3.3.48 Set value current controller [%], continuously following set-point, speed limited (command 372)

Byte-No.	2-3	4-5	6-15
Function	set-point current regulator	speed limitation	reserved
Range	-100 ... +100 Hex: FF9C ... 0x64	0-65535	-
Unit	%	rpm	-

### 3.3.49 Extended Status (command 400)

After selection further status information is transmitted.

Byte-No.	2-4	5	6-15
Function	reserved	diagnosis parameter	reserved
Range		0-3	-
Unit		-	-

Diagnosis parameter:

0 = motor temperature

1 = output stage temperature

2 = motor load

3 = ballast load

## 3.4 Input data field of esiMot

The input data field of the esiMot is assigned like follows:

Byte-No.	0-1	2-15
Function	Echo Command	Status to "Command"

The echo of the command can be read back through the variables „dbEsiMot.stEsiMotRX.iCommand.

### 3.5 Description of the status fields

#### 3.5.1 Default data field

Byte-No.	2-5	6-7	8	9	10	11
Function	IStat	iStat	Status of Inputs	Status of Outputs	Error status	Actual current
Unit	see below	see below	-	-	-	-

Byte-No.	12	13	14	15
Function	Status 1	Status 2	Status 3	Status 4
Unit	-	-	-	-

##### 3.5.1.1 IStat (Bytes 2-5)

IStat transmits the data defined with command 292 "Configure status field IStat". Default value is the actual position as signed long value (+/- 31 Bit)

The current configuration is reported back in byte 15 "status 4".

##### 3.5.1.2 iStat (Bytes 6-7)

iStat transmits the data defined with command 293 "Configure status field iStat" Default value is the actual speed as signed integer value (+/- 15 Bit)

The current configuration is reported back in byte 15 "status 4".

##### 3.5.1.3 Status of inputs (Byte 8)

Bit-No.	0	1	2	3	4	5	6	7
Function	Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Input 8

##### 3.5.1.4 Status of outputs (Byte 9)

Bit-No.	0	1	2	3	4	5	6	7
Function	Output 1	Output 2	Output 3	Output 4	Speed window reached	Reserved	Reserved	Reserved

##### 3.5.1.5 Error status (Byte 10)

For meaning of error numbers see table.

Bit-No.	0	1	2	3	4	5	6	7
Function	Error number 0-255							

##### 3.5.1.6 Actual current (Byte 11)

Bit-No.	0	1	2	3	4	5	6	7
Function	Actual current in 1/10 A							

### 3.5.1.7 Status 1 (Byte 12)

Bit-No.	0	1	2	3	4	5	6	7
Function	Ready	Homed	Regulator active	Position reached	Axle in motion	Ramp	Brake	Error (all)

#### Description of signals

Bit-No:	Signal name	Signal state and description	
0	Ready	1	Ready
		0	Not ready
1	Homed	1	Valid referencing performed
		0	No valid reference point present
2	Regulator active	1	The regulator is active
		0	The regulator is not active
3	Position reached	1	The target window has been reached and the regulator is still active.
		0	The axle is outside the target window.
4	Axle in motion	1	The axle moves with a speed <ul style="list-style-type: none"> <li>Greater 4 increments per 20ms (3rpm with 4096 incr./rev encoder; 6rpm with 2048 incr./rev encoder.)</li> <li>Greater 1 increment per 100ms with hall sensors.</li> </ul>
		0	The axle is motionless or moves with a speed <ul style="list-style-type: none"> <li>Less than 4 increments per 20ms (3rpm with 4096 incr./rev encoder; 6rpm with 2048 incr./rev encoder.)</li> <li>Less than 1 increment per 100ms with hall sensors.</li> </ul>
5	Ramp	1	A positioning is running.
		0	No positioning is running. However, the axle could be moving in speed or torque mode.
6	Brake	1	The (optional) parking brake is closed.
		0	The (optional) parking brake is open.
7	Error (all)	1	An error exists. See error state (Byte10) and error list in chapter 8.3 on page41
		0	No error exists.



### 3.5.1.8 Status 2 (Byte 13)

Bit-No.	0	1	2	3	4	5	6	7
Function	Reserved	Enable	Stop	Limit switch +	Limit switch -	Software limit of travel +	Software limit of travel -	Error (acknowledge required)

#### Description of signals

Bit-No:	Signal name	Signal state and description	
0	STO active (only drives with STO option)	1	STO active
		0	STO not active
1	Enable	1	The regulator is enabled
		0	The regulator is blocked
2	Stop	1	An input signal "stop" is present. i.e. the appropriate input is 0V.
		0	No input signal "stop" is present. i.e. the appropriate input is 24V.
3	Limit switch +	1	An input signal "limit switch +" is present. i.e. the appropriate input is 0V.
		0	No input signal "limit switch +" is present. i.e. the appropriate input is 24V.
4	Limit switch -	1	An input signal "limit switch -" is present. i.e. the appropriate input is 0V.
		0	No input signal "limit switch -" is present. i.e. the appropriate input is 24V.
5	Software limit of travel +	1	The maximal travel range in positive direction is reached.
		0	The position is inside the parametrized limits of travel.
6	Software limit of travel -	1	The maximal travel range in negative direction is reached.
		0	The position is inside the parametrized limits of travel.
7	Error (acknowledge required)	1	An error which requires an error acknowledge exists. See error state (Byte10) and error list in chapter 8.3 on page41 See also respective unit manual
		0	No error exists.

### 3.5.1.9 Status 3 (Byte 14)

Bit-No.	0	1	2	3	4	5	6	7
Function	2: Torque regulation 3: Speed regulation 4: Positioning							

### 3.5.1.10 Status 4 (Byte 15)

Bit-No.	0	1	2	3	4	5	6	7
Function	Record pointer (0-15)				Configuration iStat		Configuration IStat	



The default data field is used for the esiMot answer-back, if not one of the following commands is sent.

### 3.5.2 Data field command 274 "Read Parameter"

Byte-No.	2-5	6-9	10-15
Function	Echo Parameter number	Value of parameter „Parameter number“	Reserved

### 3.5.3 Data field command 275 "Write Parameter "

Byte-No.	2-5	6-9	10-15
Function	Echo Parameter number	Echo parameter value	Reserved

-  A previous "Login" (1) command is required to write parameters.
-  To finalise the procedure written parameters need to be stored (Command 23: Save parameters)

### 3.5.4 Data field command 282 "Read software version"

Byte-No.	2-11	12-15
Function	ASCII-String Software version "xxx.xxx.xx"	Reserved

### 3.5.5 Data field command 400 „extended status information“

Byte-No.	2-5	6-9	10-15
Function	Echo diagnosis parameter	Diagnosis parameter	Reserved

Diagnosis parameter	Diagnosis value
0 = motor temperature	Digital value represents motor PTC value
1 = output stage temperature	Digital value represents electronic NTC value.
2 = motor load	%
3 = ballast load	%

#### Motor temperature:

The used PTC has a very steep and nonlinear curve. A precise motor temperature reading is not possible. Following limits apply:

Diagnosis value	Meaning
< 31343	Motor is in normal operating temperature
31343 ... 43277	WARNING: The motor has reached a critical temperature but is still working
> 43278	ERROR: The motor exceeded the maximum tolerable temperature

#### Output stage temperature:

The used NTC has a nonlinear curve. The following calculation is an approximation. It's about 5°C exact.

Regulator size	Relevant value range	Conversion
esiMot	240 ... 770	Temperature $\cong 126 - (\text{diagnosis value} / 6,82)$
esiMot XL + SC10	200 ... 800	Temperature $\cong 115 - (\text{diagnosis value} / 7,75)$

The exact temperature can be read from the table in the annex.

## 4. Parameter list

The following parameters can be read and written with the commands „Read Parameter“ and „Write Parameter“:

### 4.1 User parameter

Number	Hex	Description	value range	unit
103	0x67	Motor supply voltage	24-230	Volt
54	0x36	Bus fault reaction	0-3	0: Immediate response to errors 1: Response to error after 3 sec 2: Response to error after 10 sec 255: No response
33	0x21	Maximum speed at 100%	1...10000 <i>0x01...2710</i>	rpm
75	0x4B	Maximum current in % of peak current	0-100 <i>0x00 ... 0x64</i>	%
50	0x32	Working mode after power-on	0-8:	0: regulator off 1: speed regulation 2: current regulation 4: positioning 5: switch-over speed – torque regulation 6: switch-over position – torque regulation 7: switch-over position – speed regulation 8: positioning with reference run after power-on
58	0x3A	Referencing required		0: No 1: Yes 2: Yes, with auto-ref on release.
90	0x5A	Reference run acceleration ramp	10-10.000 <i>0x0A...2710</i>	msec
91	0x5B	Referencing brake ramp	10-10.000 <i>0x0A...2710</i>	msec
73	0x49	Referencing search speed	1-10.000 <i>0x01...2710</i>	rpm
74	0x4A	Referencing positioning speed	1-10.000 <i>0x01...2710</i>	rpm
89	0x59	Reference offset	- 2 139 999 999 - + 2 139 999 999 <i>807230FF ... 7F8DCEFF</i>	Increments
77	0x4D	Reference Preset	- 2 139 999 999 - + 2 139 999 999 <i>807230FF ... 7F8DCEFF</i>	Increments
64	0x40	Absolute encoder travel range offset	0 – 100 <i>0x00 ... 0x64</i>	%
76	0x4C	Torque limit for referencing to block	0-100 <i>0x00...0x64</i>	%

7	0x07	Axle type + short circuit detection (Safe Torque Off, STO)		<ul style="list-style-type: none"> <li>• Bit 0: axle type 0: Linear axle 1: Rotary axle</li> <li>• Bit 2: short circuit detection 0: Deactivated 1: Activated</li> </ul>
86	0x56	Reference run mode	-3 – 30 <i>FFFE ... 0x1E</i>	see table 8.1 on page 37
85	0x55	Rotary axle resolution	512 – 2140000000 00 <i>0x200- 7F8DCF00</i>	Incr/360°
55	0x37	Response to errors + Brake management		<ul style="list-style-type: none"> <li>• Bit 0: Response to errors 0: Fast stop 1: Ramp stop</li> <li>• Bit 3: Brake management 0: Deactivated 1: Activated</li> </ul>
94	0x5E	Brake ramp on errors	10-10.000 <i>0x0A ... 2710</i>	msec
99	0x63	Electronic axis type		0 = Clock + direction 1 = Channel A + Channel B
100	0x64	Electronic axis sense of rotation		0 = Normal 1 = Inverted
101	0x65	Electronic axis edge detection		0 = Positive edge 1 = Negative edge 2 = Both edges
102	0x66	Electronic axis ratio	0,001 ... 9999,999	Number of increments to move on each motion impulse.
83	0x53	Limit of travel range +	-2 140 000 000 – +2 140 000 000  <i>80723100 ... 7F8DCF00</i>	Increments
84	0x54	Limit of travel range -	-2 140 000 000 – +2 140 000 000  <i>80723100 ... 7F8DCF00</i>	Increments
69	0x45	Brake management		1 = Activated 0 = Deactivated
10	0x0A	Network axle number	0-255	-

## 4.2 Inputs and outputs

Number	Hex	Meaning	Range	Unit
12	0x0C	Function Input 1	0-127	Input function, see 5.2.1
13	0x0D	Function Input 2	0-127	Input function, see 5.2.1
14	0x0E	Function Input 3	0-127	Input function, see 5.2.1
15	0x0F	Function Input 4	0-127	Input function, see 5.2.1
16	0x10	Function Input 5 (special version)	0-127	Input function, see 5.2.1
17	0x11	Function Input 6 (special version)	0-127	Input function, see 5.2.1
24	0x18	Function input 7 (special version)	0-127	Input function, see 5.2.1
25	0x19	Function input 8 (special version)	0-127	Input function, see 5.2.1
26	0x1A	Function Output 1	0-32	Output function, see 5.2.2
27	0x1B	Function Output 2	0-32	Output function, see 5.2.2
28	0x1C	Function Output 3 (special version)	0-32	Output function, see 5.2.2
29	0x1D	Function Output 4 (special version)	0-32	Output function, see 5.2.2

#### 4.2.1 Input functions

The following definitions apply to inputs:

Number	Hex	Function
0	0x00	no function
2	0x02	Direction (only in amplifier version )
3	0x03	Switch-over operating mode
4	0x04	Fast stop with error
5	0x05	Fast stop without error
6	0x06	Ramp stop with error
7	0x07	Ramp stop without error
8	0x08	Reference switch
9	0x09	Limit switch +
10	0x0A	Limit switch -
11	0x0B	Error acknowledge
12	0x0C	Enable
13	0x0D	Jog +
14	0x0E	Jog -
15	0x0F	Rapid traverse
16	0x10	Referencing
17	0x11	Start
18	0x12	-
19	0x13	-
20	0x14	Record selection S1
21	0x15	Record selection S2
22	0x16	Record selection S4
23	0x17	Record selection S8
24	0x18	Digital input free usage
25	0x19	Channel A / clock (only for input 3 available)
26	0x1A	Channel B / direction (only for input 4 available)
27	0x1B	Teach – In
28	0x1C	Trigger (only for input 2 available)
29	0x1D	Electronic axle x10
30	0x1E	Start with monitoring
31	0x1F	Fast stop with succeeding reference run
32	0x20	Ramp stop with succeeding reference run
33	0x21	Enable with succeeding reference run
34	0x22	Delayed start
35	0x23	Electronic shaft on/off

### 4.2.2 Output functions

The following definitions apply to outputs:

Number	Hex	Function
0	0x00	no function
1	0x01	Ready
2	0x02	Regulator active
3	0x03	Error
4	0x04	Warning
5	0x05	Position reached
6	0x06	Axle in motion
7	0x07	Ballast active
8	0x08	M-Function 1
9	0x09	M-Function 2
10	0x0A	Digital output free usage
12	0x0C	Target window reached
13	0x0D	Axle motionless
14	0x0E	Limit of travel reached

### 4.3 Regulator

Number	Hex	Meaning	Range of values Dec. / Hex	Unit
40	0x28	Current regulator loop gain P-portion	0-1000 0x00...03E8	
41	0x29	Current regulator loop gain I-portion	0-1000 0x00...03E8	1/s
42	0x2A	Current regulator I-portion limitation	0-100 0x00...0x64	%
43	0x2B	Speed regulator loop gain P-portion	0-1000 0x00...03E8	
44	0x2C	Speed regulator loop gain I-portion	0-1000 0x00...03E8	1/s
45	0x2D	Speed regulator I-portion limitation	0-100 0x00...0x64	%
48	0x30	Speed regulator speed window	0-65 535 0x00...FFFF	rpm
49	0x31	Ramp time to Vmax (only speed regulator)	0-10 000 0x00...2710	ms
111	0x6F	Speed regulator loop gain K-portion (velocity pre-control)	0-100 0x00 ... 0x64	%
80	0x50	Positioning loop gain P-portion	0-1.000 0x00...03E8	Normalized value
110	0x70	Positioning loop gain K-portion (position pre-control)	0-100 0x00 ... 0x64	%
81	0x51	Target window	0-65.535 0x00...FFFF	Increments
82	0x52	Max. lag error	0-65.535 0x00...FFFF	Increments
98	0x62	Store position safe against power-outage		0: No 1: Yes



**4.4 Jog**

Number	Hex	Meaning	Range of values	Unit
92	0x5C	Jog acceleration	10-10.000 0x0A...2710	msec
93	0x5D	Jog deceleration	10-10.000 0x0A...2710	msec
72	0x48	Creep speed	1-10.000 0x01...2710	rpm
71	0x47	Rapid traverse	1-10.000 0x01...2710	rpm
88	0x58	Tip increments	0-65.535 0x00...FFFF	Increments

## 5. Control through PROFINET IO

### 5.1 Protocol

The execution of a command is triggered by a change of the data field „command“ in bytes 0 – 1. At this change, the parameter data in byte 2 – 15 are transferred. After interpretation of the command through esiMot, the command is answered-back to the input data field of esiMot and the respective data are provided in the status field.

**When using working mode 1 (inconsistent data transfer), take care the parameter data are already written at the time of the command change. Furthermore the master must write the command with a word access in the data field.**

### 5.2 Control with Simatic S7

#### 5.2.1 Working mode 1 (inconsistent data transfer)

The output data fields to esiMot may be written with the commands „PAx“ in peripheral output area. The input data fields can be read with the commands „PEx“ in peripheral input area. The address must be set to those addresses which are assigned to esiMot data fields in the hardware configuration. A precise application is in example project „esiMotBsp“ implemented.

#### 5.2.2 Working mode 2 (consistent data transfer)

The output data fields to esiMot may be written with the SFC 15 „DPWR\_DAT“. The input data fields may be read from esiMot with the SFC 14 „DPRD\_DAT“. The data fields are completely consistent written respectively read with this SFCs . A precise application is in example project „esiMotBsp“ implemented.

### 5.3 Examples

#### 5.3.1 Execution of the command "Start absolute positioning"

An absolute positioning to position 1000 [Increments] with speed 100 [rpm], an acceleration ramp of 200 [ms] and a deceleration ramp of 300 [ms] shall be executed. In the output data field to esiMot is „no command“ (0) active.

The following data field needs to be transferred:

Byte-No.	0-1	2-5	6-7
Value	Command = 3	Target position = 1000	Positioning speed = 100

Byte-No.	8-9	10-11	12-15
Value	Acceleration ramp = 200	Deceleration ramp = 300	Reserved

After error free execution of the command, esiMot sends the following data field (default data field):

Byte-No.	0-1	2-5	6-7	8	9
Function	Echo Command = 3	Actual position	Actual speed	Status of inputs	Status of outputs

Byte-No.	10	11	12	13	14	15
Function	Error status 1	Actual current	Status 1	Status 2	Status 3	Status 4

### 5.3.2 Execution of the command "Write parameter"

The value „500“ shall be written to parameter number 100. In the output data field to esiMot is „no command“ (0) active.

**A previous "Login" (1) command is required to write parameters.**

The following data field needs to be transferred:

Byte-No.	0-1	2-5	6-9	10-15
Value	Command = 275	Parameter number = 100	Parameter value = 500	Reserved

After error free execution of the command, esiMot sends the following data field (default data field):

Byte-No.	0-1	2-5	6-9	10-15
Function	Echo Command = 275	Parameter number = 100	Parameter value = 500	Reserved

To get back the default status field „no command“ (0) needs to be transferred.

Byte-No.	0-1	2-15
Value	Command = 0	Reserved

As answer-back esiMot sends the following data field (default data field):

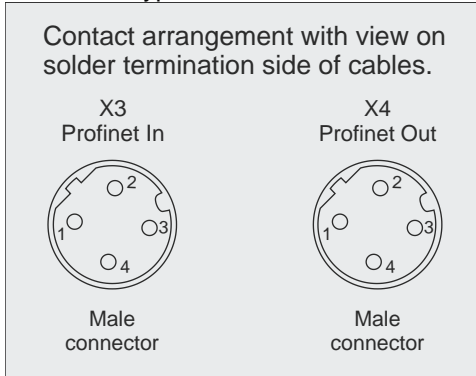
Byte-No.	0-1	2-5	6-7	8	9
Function	Echo Command = 0	Actual position	Actual speed	Status of inputs	Status of outputs

Byte-No.	10	11	12	13	14	15
Function	Error status 1	Actual current	Status 1	Status 2	Status 3	Status 4

## 6. Technical data

### 6.1 PROFINET IO – Interface esiMot + esiMotXL

Connector type: M12, D-coded



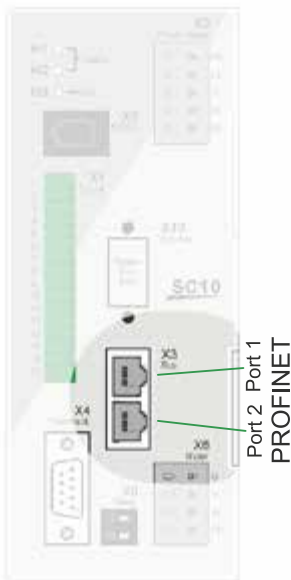
072569\_2

X3/X4 Pin-No.	Function	Remarks
1	Tx+	PROFINET Standard
2	Rx+	
3	Tx-	
4	Rx-	

There is no termination resistor required.

### 6.2 PROFINET IO – Interface SC10

Connector type RJ45



### 6.3 Interface status LED H3

There's a multicolour LED for interface status. The table shows the meanings.

LED colour	State	Description
Green	On	PROFINET – connection available
Green	Flashing	Searching for PROFINET
Orange	On	No PROFINET connection found and the parameter "reaction to bus error" is set to "no reaction".

## 7. Lists

### 7.1 Referencing modes

Referencing mode	HEX	Reference switch type	Search direction	Index pulse	Positioning direction
-3	<i>FFFD</i>	to block / negative search direction			
-2	<i>FFFE</i>	to block / positive search direction			
-1	<i>FFFF</i>	simple zero setting			
0	<i>0x00</i>				
1	<i>0x01</i>	Break contact (Limit switch -)	-	yes	+
2	<i>0x02</i>	Break contact (Limit switch +)	+	yes	-
7	<i>0x07</i>	Make contact	+	yes	-
8	<i>0x08</i>	Make contact	+	yes	+
9	<i>0x09</i>	Break contact	+	yes	-
10	<i>0x0A</i>	Break contact	+	yes	+
11	<i>0x0B</i>	Break contact	-	yes	+
12	<i>0x0C</i>	Break contact	-	yes	-
13	<i>0x0D</i>	Make contact	-	yes	+
14	<i>0x0E</i>	Make contact	-	yes	-
23	<i>0x17</i>	Make contact	+	/	+
24	<i>0x18</i>	Make contact	+	/	-
25	<i>0x19</i>	Break contact	+	/	+
26	<i>0x1A</i>	Break contact	+	/	-
27	<i>0x1B</i>	Break contact	-	/	+
28	<i>0x1C</i>	Break contact	-	/	-
29	<i>0x1D</i>	Make contact	-	/	+
30	<i>0x1E</i>	Make contact	-	/	-
33	<i>0x21</i>	/	-	Yes	-
34	<i>0x22</i>	/	+	yes	+

 With absolute encoder referencing modes without index pulse are permitted only.

## 7.2 Parameter Numbers





Parameter Number	Hex	Meaning
5	0x05	Reserved
6	0x06	Reserved
7	0x07	Axle type + short circuit detection
8	0x08	Reserved
10	0x0A	Network axle number
11	0x0B	Reserved
12	0x0C	Function Input 1
13	0x0D	Function Input 2
14	0x0E	Function Input 3
15	0x0F	Function Input 4
16	0x10	Function Input 5
17	0x11	Function Input 6
18	0x12	Reserved
19	0x13	Reserved
20	0x14	Reserved
21	0x15	Reserved
22	0x16	Reserved
23	0x17	Reserved
24	0x18	Function input 7
25	0x19	Function input 8
26	0x1A	Function Output 1
27	0x1B	Function Output 2
28	0x1C	Function Output 3
29	0x1D	Function Output 4
30	0x1E	Reserved
31	0x1F	Reserved
32	0x20	Reserved
33	0x21	Maximum speed at 100%
34	0x22	Reserved
35	0x23	Reserved
36	0x24	Reserved
37	0x25	Reserved
38	0x26	Reserved
39	0x27	Reserved
40	0x28	Current regulator loop gain P-portion
41	0x29	Current regulator loop gain I-portion

<b>Parameter Number</b>	<b>Hex</b>	<b>Meaning</b>
42	0x2A	Current regulator I-portion limitation
43	0x2B	Speed regulator loop gain P-portion
44	0x2C	Speed regulator loop gain I-portion
45	0x2D	Speed regulator I-portion limitation
46	0x2E	Reserved
48	0x30	Speed regulator speed window
49	0x31	Ramp time to Vmax (only speed regulator)
50	0x32	Working mode after power-on
51	0x033	Reserved
52	0x034	Reserved
53	x0x35	Reserved
54	0x36	Bus fault reaction
55	0x37	Response to errors + Brake
57	0x38	Reserved
58	0x3A	Referencing required
59	0x3B	Reserved
63	0x3F	Status Referenced
64	0x40	Absolute encoder travel range offset
65	0x41	Reserved
66	0x42	Reserved
67	0x43	Reserved
68	0x44	Reserved
69	0x45	Brake management
70	0x46	Reserved
71	0x47	Rapid traverse
72	0x48	Creep speed
73	0x49	Referencing search speed
74	0x4A	Referencing positioning speed
75	0x4B	Maximum current in % of peak current
76	0x4C	Torque limit for referencing to block
77	0x4D	Reference Preset
78	0x4E	Reserved
79	0x4F	Reserved
80	0x50	Positioning loop gain P-portion
81	0x51	Target window
82	0x52	Max. lag error
83	0x53	Limit of travel range +

<b>Parameter Number</b>	<b>Hex</b>	<b>Meaning</b>
84	0x54	Limit of travel range -
85	0x55	Rotary axle resolution
86	0x56	Reference run mode
87	0x57	Reserved
88	0x58	Tip increments
89	0x59	Reference offset
90	0x5A	Reference run acceleration ramp
91	0x5B	Referencing brake ramp
92	0x5C	Jog acceleration
93	0x5D	Jog deceleration
94	0x5E	Brake ramp on errors
95	0x5F	Reserved
96	0x60	Reserved
97	0x61	Speed limitation in torque mode
98	0x62	Store position safe against power-outage
99	0x63	Electronic axis type
100	0x64	Electronic axis sense of rotation
101	0x65	Electronic axis edge detection
102	0x66	Electronic axis ratio
103	0x67	Motor supply voltage
104	0x68	Reserved
105	0x69	Reserved
106	0x6A	Reserved
107	0x6B	Reserved
108	0x6C	Reserved
109	0x6D	Reserved
111	0x6F	Speed regulator loop gain K-portion
112	0x70	Positioning loop gain K-portion




### 7.3 Error and status messages

Error	Hex	Error message / Status	Error cause / remedy
0	0x00	No error	-
3	0x03	Tracking error	The drive is unable to follow the set value. The drive may be sluggish or even blocked. The parameter for the allowable tracking error is set too small. The acceleration is too high. Encoder signals erroneous. Incorrect direction of control. Loop gain insufficient or excessive (drive is oscillating).
4	0x04	Timeout drive	Desired position was not reached within the given time. Tune regulator, increase position window.
5	0x05	Axle moving	It was attempt to send a new drive or positioning command while the drive was in motion.
6	0x06	Erroneous ramp parameter	The drive can't comply with the given data. The acceleration time is too long
7	0x07	Travel for ramp to far	It's not possible to calculate the ramp for the given data.
8	0x08	Limit switch +	The drive has reached the limit switch in positive direction
9	0x09	Limit switch -	The drive has reached the limit switch in negative direction
10	0x0A	Limit of travel range +	The machine has reached the admissible limit of the travel of 2.140 Mio increments in "+".  Reference point is lost. After error acknowledge the position value is set to 0.
11	0x0B	Limit of travel range -	The machine has reached the admissible limit of the travel of 2.140 Mio increments in "-".  Reference point is lost. After error acknowledge the position value is set to 0.
12	0x0C	Motor temperature too high (PTC sensor)	Possible cause for excessive temperature: Drive blocked or difficult to operate, Requirements too highly, to high acceleration values, high engine load with high ambient temperature...  The temperature error can be acknowledged when the temperature of the motor went down again.
13	0x0D	Controller temperature too high.	Possible cause for excessive temperature: Drive blocked or difficult to operate, Requirements too highly, to high acceleration values, high engine load with high ambient temperature...  The temperature error can be acknowledged when the temperature of the controller went down again.
14	0x0E	Over-voltage Motor	When the Motor source exceeds one of the limits defined in the settings this error is given. This can happen due to spikes in the supply voltages. In most cases, the over-voltage can also occur if the motor needs to slow down a heavy load. Check machine and state. An external ballast resistor can help.

<b>Error</b>	<b>Hex</b>	<b>Error message / Status</b>	<b>Error cause / remedy</b>
15	0x0F	Under-voltage Motor	<p>The motor supply falls below the limits set in the parameters. It can be that on the supply voltage peaks (spikes) arise. Undervoltage in most cases develops, if the engine must accelerate a large load. A stronger power pack can help.</p> <p>☞ If the enable input is switched off, the motor supply voltage is not monitored. There is no error message if before the start the voltage is switched on.</p>
16	0x10	Over-voltage Logic	The logic supply voltage exceeds 30V. It can be that on the supply voltage peaks (spikes) arise.
17	0x11	Under-voltage Logic	The logic supply voltage falls under 18V. Possibly voltage drops arise. Insufficient smoothing of supply voltage. A stronger power pack can help.
18	0x12	EEPROM checksum error	<p>Unit was switched off, during parameter input. Check parameters.</p> <p>☞ If a firmware update was accomplished, there is a chance of new parameters which haven't been used before. Use the „ServoLink“ software to load all parameters into the PC, check them and load them back into the controller.</p>
19	0x13	Stop applied – Status Information –	<p>“Stop without error message” present There was a falling edge on the stop input. This can be caused by user or by a power loss on the stop input. No acknowledgement is required.</p>
20	0x14	Stop applied - Error message -	<p>“Stop with error message” present There was a falling edge on the stop input. This can be caused by user or by a power loss on the stop input. Check machine and state. If no error or dangerous situation can be discovered try to acknowledge the “Stop” Error with a raising edge on the enable input. Be aware that acknowledgement can only be successful when the error which caused this state no longer exists.</p>
21	0x15	Overload Motor	Drive blocked or difficult to operate, Requirements too highly, to high acceleration values, high engine load with high ambient temperature...
22	0x16	Login missing	Parameter setting is allowed only after login. Attempt to write parameters without prior login causes this error-message.
23	0x17	Error at initialisation	Internal initialisation error. No access to EEPROM. Please consult your dealer.
24	0x18	Waiting for enable	The motor control is able to operate and waits for a raising edge on the enable input.
25	0x19	Working mode wrong	A function was selected which is in the current working mode not possible. For example a position value was given to the speed regulator.
26	0x1A	Bus off-line	The connection to the fieldbus has failed
27	0x1B	Timeout RS232/RS485	e RS232/RS485 interface link was disconnected, while the axle was moving.
28	0x1C	Axle not referenced	A drive command was given whilst no reference run was done.
29	0x1D	Wrong value – Status Information –	A value was transmitted which is not allowed. E.g. speed > n <sub>max</sub>
30	0x1E	Reference voltage to low	The internal reference voltage is too low. Please check the logic supply.

<b>Error</b>	<b>Hex</b>	<b>Error message / Status</b>	<b>Error cause / remedy</b>
31	0x1F	Range of travel exceeded.	The maximum permitted number of countable increments was exceeded.
32	0x20	Reference lost	The motor moved after the voltage was switched off. The procedure for position storage safe against power outage was not accomplished
33	0x21	Wrong set value mode	Clock/Direction inputs were defined and it was tried to start a record or another set value was given.
34	0x22	Regulator state wrong	The response time of the brake was not taken care for and a new drive command given.
35	0x23	CANopen Error	Reserved error
36	0x24	Encoder error	A not existing encoder was selected in the parameters.
37	0x25	Reference type not supported –Status information-	A referencing mode was selected which is not supported.
38	0x26	Resolver error	Resolver fault or signal processing defective. Signals interfered or cable broken.
39	0x27	Resolver error	
40	0x28	Resolver error	
41	0x29	Output stage excessive current	Drive blocked or difficult to operate, Requirements too highly, to high acceleration values, high motor load with high ambient temperature...
42	0x2A	Temperature sensor	The measured temperature is not plausible. The sensor is faulty.
43	0x2B	Limit switch + direction deviant	The positive limit switch was activated during movement in negative direction.
44	0x2C	Limit switch - direction deviant	The negative limit switch was activated during movement in positive direction.
45	0x2D	Missing second shutdown circuit	Possible cross fault (short circuit) between signals on input 9 + 10 (Safe Torque Off, STO)
46	0x2E	STO internal	There is an internal fault (STO)
47	0x2F	STO – status information -	The drive is in the state “STO”. (No error message, status information only) No error acknowledgement is required to leave this state.
48	0x30	Short circuit – STO	The switch time difference between both inputs for safe torque off is too short. (Cross fault)
49	0x31	Temperature sensor motor	The temperature sensor of the motor reads values outside the valid range.

 All error messages must be acknowledged by a rising edge on the enable input respectively on the acknowledge input (if assigned) or via appropriate command through fieldbus.

### 7.4 Output stage temperature esiMot (24-60V DC – supply)

Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature
0 125	1 125	2 125	3 125	4 125	5 125	6 125	7 125	8 125	9 125	10 125	11 125	12 125	13 125	14 125	15 125				
16 125	17 125	18 125	19 125	20 125	21 125	22 125	23 125	24 125	25 125	26 125	27 125	28 125	29 125	30 125	31 125				
32 125	33 125	34 125	35 125	36 125	37 125	38 125	39 125	40 125	41 125	42 125	43 125	44 125	45 125	46 125	47 125				
48 125	49 125	50 125	51 125	52 125	53 125	54 125	55 125	56 125	57 125	58 125	59 125	60 125	61 125	62 125	3 125				
64 125	65 125	66 125	67 125	68 125	69 125	70 125	71 125	72 125	73 125	74 125	75 125	76 125	77 125	78 125	79 125				
80 125	81 125	82 125	83 125	84 125	85 125	86 125	87 125	88 125	89 125	90 125	91 125	92 125	93 125	94 125	95 125				
96 125	97 125	98 125	99 125	100 125	101 125	102 125	103 125	104 125	105 125	106 125	107 125	108 125	109 124	110 124	111 123				
112 123	113 123	114 122	115 122	116 121	117 121	118 121	119 120	120 120	121 120	122 119	123 119	124 119	125 118	126 118	127 118				
128 117	129 117	130 117	131 116	132 116	133 116	134 115	135 115	136 115	137 114	138 114	139 114	140 113	141 113	142 113	143 113				
144 112	145 112	146 112	147 111	148 111	149 111	150 111	151 110	152 110	153 110	154 109	155 109	156 109	157 108	158 108	159 108				
160 108	161 107	162 107	163 107	164 107	165 106	166 106	167 106	168 106	169 105	170 105	171 105	172 105	173 104	174 104	175 104				
176 104	177 103	178 103	179 103	180 103	181 102	182 102	183 102	184 102	185 102	186 101	187 101	188 101	189 101	190 100	191 100				
192 100	193 100	194 99	195 99	196 99	197 99	198 99	199 98	200 98	201 98	202 98	203 97	204 97	205 97	206 97	207 97				
208 96	209 96	210 96	211 96	212 96	213 95	214 95	215 95	216 95	217 95	218 94	219 94	220 94	221 94	222 94	223 93				
224 93	225 93	226 93	227 93	228 92	229 92	230 92	231 92	232 92	233 91	234 91	235 91	236 91	237 91	238 90	239 90				
240 90	241 90	242 90	243 90	244 89	245 89	246 89	247 89	248 89	249 88	250 88	251 88	252 88	253 88	254 88	255 87				
256 87	257 87	258 87	259 87	260 87	261 86	262 86	263 86	264 86	265 86	266 85	267 85	268 85	269 85	270 85	271 85				
272 84	273 84	274 84	275 84	276 84	277 84	278 84	279 83	280 83	281 83	282 83	283 83	284 83	285 82	286 82	287 82				
288 82	289 82	290 82	291 81	292 81	293 81	294 81	295 81	296 81	297 80	298 80	299 80	300 80	301 80	302 80	303 79				
304 79	305 79	306 79	307 79	308 79	309 79	310 78	311 78	312 78	313 78	314 78	315 78	316 77	317 77	318 77	319 77				
320 77	321 77	322 77	323 76	324 76	325 76	326 76	327 76	328 76	329 75	330 75	331 75	332 75	333 75	334 75	335 75				
336 74	337 74	338 74	339 74	340 74	341 74	342 74	343 73	344 73	345 73	346 73	347 73	348 73	349 73	350 72	351 72				
352 72	353 72	354 72	355 72	356 72	357 71	358 71	359 71	360 71	361 71	362 71	363 71	364 70	365 70	366 70	367 70				
368 70	369 70	370 70	371 69	372 69	373 69	374 69	375 69	376 69	377 69	378 68	379 68	380 68	381 68	382 68	383 68				
384 68	385 68	386 67	387 67	388 67	389 67	390 67	391 67	392 67	393 66	394 66	395 66	396 66	397 66	398 66	399 66				
400 65	401 65	402 65	403 65	404 65	405 65	406 65	407 65	408 64	409 64	410 64	411 64	412 64	413 64	414 64	415 63				
416 63	417 63	418 63	419 63	420 63	421 63	422 63	423 62	424 62	425 62	426 62	427 62	428 62	429 62	430 61	431 61				
432 61	433 61	434 61	435 61	436 61	437 61	438 60	439 60	440 60	441 60	442 60	443 60	444 60	445 59	446 59	447 59				
448 59	449 59	450 59	451 59	452 59	453 58	454 58	455 58	456 58	457 58	458 58	459 58	460 58	461 57	462 57	463 57				
464 57	465 57	466 57	467 57	468 56	469 56	470 56	471 56	472 56	473 56	474 56	475 56	476 55	477 55	478 55	479 55				
480 55	481 55	482 55	483 54	484 54	485 54	486 54	487 54	488 54	489 54	490 54	491 53	492 53	493 53	494 53	495 53				
496 53	497 53	498 53	499 52	500 52	501 52	502 52	503 52	504 52	505 52	506 51	507 51	508 51	509 51	510 51	511 51				
512 51	513 51	514 50	515 50	516 50	517 50	518 50	519 50	520 50	521 49	522 49	523 49	524 49	525 49	526 49	527 49				
528 49	529 48	530 48	531 48	532 48	533 48	534 48	535 48	536 47	537 47	538 47	539 47	540 47	541 47	542 47	543 47				

Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature
544 46	545 46	546 46	547 46	548 46	549 46	550 46	551 45	552 45	553 45	554 45	555 45	556 45	557 45	558 44	559 44			
560 44	561 44	562 44	563 44	564 44	565 44	566 43	567 43	568 43	569 43	570 43	571 43	572 43	573 42	574 42	575 42			
576 42	577 42	578 42	579 42	580 41	581 41	582 41	583 41	584 41	585 41	586 41	587 40	588 40	589 40	590 40	591 40			
592 40	593 40	594 39	595 39	596 39	597 39	598 39	599 39	600 39	601 38	602 38	603 38	604 38	605 38	606 38	607 38			
608 37	609 37	610 37	611 37	612 37	613 37	614 36	615 36	616 36	617 36	618 36	619 36	620 36	621 35	622 35	623 35			
624 35	625 35	626 35	627 34	628 34	629 34	630 34	631 34	632 34	633 33	634 33	635 33	636 33	637 33	638 33	639 33			
640 32	641 32	642 32	643 32	644 32	645 32	646 31	647 31	648 31	649 31	650 31	651 31	652 30	653 30	654 30	655 30			
656 30	657 30	658 29	659 29	660 29	661 29	662 29	663 29	664 28	665 28	666 28	667 28	668 28	669 27	670 27	671 27			
672 27	673 27	674 27	675 26	676 26	677 26	678 26	679 26	680 25	681 25	682 25	683 25	684 25	685 25	686 24	687 24			
688 24	689 24	690 24	691 23	692 23	693 23	694 23	695 23	696 22	697 22	698 22	699 22	700 22	701 21	702 21	703 21			
704 21	705 21	706 20	707 20	708 20	709 20	710 19	711 19	712 19	713 19	714 19	715 18	716 18	717 18	718 18	719 17			
720 17	721 17	722 17	723 16	724 16	725 16	726 16	727 16	728 15	729 15	730 15	731 15	732 14	733 14	734 14	735 14			
736 13	737 13	738 13	739 13	740 12	741 12	742 12	743 11	744 11	745 11	746 11	747 10	748 10	749 10	750 9	751 9			
752 9	753 8	754 8	755 8	756 8	757 7	758 7	759 7	760 6	761 6	762 6	763 5	764 5	765 5	766 4	767 4			
768 4	769 3	770 3	771 2	772 2	773 2	774 1	775 1	776 0	777 0	778 0	779 -1	780 -2	781 -3	782 -4	783 -5			
784 -6	785 -7	786 -8	787 -10	788 -11	789 -12	790 -13	791 -14	792 -15	793 -15	794 -16	795 -17	796 -18	797 -19	798 -20	799 -20			
800 -21	801 -22	802 -24	803 -25	804 -27	805 -28	806 -30	807 -31	808 -33	809 -34	810 -36	811 -37	812 -39	813 -40	814 -42	815 -43			
816 -44	817 -46	818 -47	819 -49	820 -50	821 -52	822 -53	823 -54	824 -55	825 -55	826 -55	827 -55	828 -55	829 -55	830 -55	831 -55			
832 -55	833 -55	834 -55	835 -55	836 -55	837 -55	838 -55	839 -55	840 -55	841 -55	842 -55	843 -55	844 -55	845 -55	846 -55	847 -55			
848 -55	849 -55	850 -55	851 -55	852 -55	853 -55	854 -55	855 -55	856 -55	857 -55	858 -55	859 -55	860 -55	861 -55	862 -55	863 -55			
864 -55	865 -55	866 -55	867 -55	868 -55	869 -55	870 -55	871 -55	872 -55	873 -55	874 -55	875 -55	876 -55	877 -55	878 -55	879 -55			
880 -55	881 -55	882 -55	883 -55	884 -55	885 -55	886 -55	887 -55	888 -55	889 -55	890 -55	891 -55	892 -55	893 -55	894 -55	895 -55			
896 -55	897 -55	898 -55	899 -55	900 -55	901 -55	902 -55	903 -55	904 -55	905 -55	906 -55	907 -55	908 -55	909 -55	910 -55	911 -55			
912 -55	913 -55	914 -55	915 -55	916 -55	917 -55	918 -55	919 -55	920 -55	921 -55	922 -55	923 -55	924 -55	925 -55	926 -55	927 -55			
928 -55	929 -55	930 -55	931 -55	932 -55	933 -55	934 -55	935 -55	936 -55	937 -55	938 -55	939 -55	940 -55	941 -55	942 -55	943 -55			
944 -55	945 -55	946 -55	947 -55	948 -55	949 -55	950 -55	951 -55	952 -55	953 -55	954 -55	955 -55	956 -55	957 -55	958 -55	959 -55			
960 -55	961 -55	962 -55	963 -55	964 -55	965 -55	966 -55	967 -55	968 -55	969 -55	970 -55	971 -55	972 -55	973 -55	974 -55	975 -55			
976 -55	977 -55	978 -55	979 -55	980 -55	981 -55	982 -55	983 -55	984 -55	985 -55	986 -55	987 -55	988 -55	989 -55	990 -55	991 -55			
992 -55	993 -55	994 -55	995 -55	996 -55	997 -55	998 -55	999 -55	1000 -55	1001 -55	1002 -55	1003 -55	1004 -55	1005 -55	1006 -55	1007 -55			
1008 -55	1009 -55	1010 -55	1011 -55	1012 -55	1013 -55	1014 -55	1015 -55	1016 -55	1017 -55	1018 -55	1019 -55	1020 -55	1021 -55	1022 -55	1023 -55			

### 7.5 Output stage temperature esiMotXL + SC10 (230V AC-supply)

Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature
0 126	1 126	2 126	3 126	4 126	5 126	6 126	7 126	8 126	9 126	10 126	11 126	12 126	13 126	14 126	15 126			
16 126	17 126	18 126	19 126	20 126	21 126	22 126	23 126	24 126	25 126	26 126	27 126	28 126	29 126	30 126	31 126			
32 126	33 126	34 126	35 126	36 126	37 126	38 126	39 126	40 126	41 126	42 126	43 126	44 126	45 126	46 126	47 126			
48 126	49 126	50 126	51 126	52 126	53 126	54 126	55 126	56 126	57 126	58 126	59 126	60 126	61 126	62 126	63 126			
64 126	65 126	66 126	67 126	68 126	69 126	70 126	71 126	72 126	73 126	74 126	75 126	76 126	77 126	78 126	79 126			
80 126	81 126	82 126	83 125	84 125	85 125	86 125	87 125	88 125	89 125	90 125	91 125	92 125	93 125	94 125	95 125			
96 124	97 124	98 123	99 123	100 123	101 122	102 122	103 121	104 121	105 120	106 120	107 120	108 119	109 119	110 118	111 118			
112 118	113 117	114 117	115 117	116 116	117 116	118 115	119 115	120 115	121 114	122 114	123 114	124 113	125 113	126 113	127 112			
128 112	129 112	130 111	131 111	132 111	133 110	134 110	135 110	136 109	137 109	138 109	139 109	140 108	141 108	142 108	143 107			
144 107	145 107	146 106	147 106	148 106	149 106	150 105	151 105	152 105	153 104	154 104	155 104	156 104	157 103	158 103	159 103			
160 103	161 102	162 102	163 102	164 102	165 101	166 101	167 101	168 101	169 100	170 100	171 100	172 99	173 99	174 99	175 99			
176 99	177 98	178 98	179 98	180 98	181 97	182 97	183 97	184 97	185 96	186 96	187 96	188 96	189 96	190 95	191 95			
192 95	193 95	194 94	195 94	196 94	197 94	198 94	199 93	200 93	201 93	202 93	203 93	204 92	205 92	206 92	207 92			
208 91	209 91	210 91	211 91	212 91	213 90	214 90	215 90	216 90	217 90	218 89	219 89	220 89	221 89	222 89	223 88			
224 88	225 88	226 88	227 88	228 88	229 87	230 87	231 87	232 87	233 87	234 86	235 86	236 86	237 86	238 86	239 85			
240 85	241 85	242 85	243 85	244 85	245 84	246 84	247 84	248 84	249 84	250 84	251 83	252 83	253 83	254 83	255 83			
256 83	257 82	258 82	259 82	260 82	261 82	262 82	263 81	264 81	265 81	266 81	267 81	268 80	269 80	270 80	271 80			
272 80	273 80	274 79	275 79	276 79	277 79	278 79	279 79	280 79	281 78	282 78	283 78	284 78	285 78	286 78	287 77			
288 77	289 77	290 77	291 77	292 77	293 77	294 76	295 76	296 76	297 76	298 76	299 76	300 75	301 75	302 75	303 75			
304 75	305 75	306 75	307 74	308 74	309 74	310 74	311 74	312 74	313 73	314 73	315 73	316 73	317 73	318 73	319 72			
320 72	321 72	322 72	323 72	324 72	325 72	326 71	327 71	328 71	329 71	330 71	331 71	332 70	333 70	334 70	335 70			
336 70	337 70	338 69	339 69	340 69	341 69	342 69	343 69	344 69	345 69	346 69	347 68	348 68	349 68	350 68	351 68			
352 68	353 68	354 68	355 67	356 67	357 67	358 67	359 67	360 67	361 67	362 67	363 66	364 66	365 66	366 66	367 66			
368 66	369 66	370 66	371 65	372 65	373 65	374 65	375 65	376 65	377 65	378 65	379 64	380 64	381 64	382 64	383 64			
384 64	385 64	386 64	387 63	388 63	389 63	390 63	391 63	392 63	393 63	394 63	395 62	396 62	397 62	398 62	399 62			
400 62	401 62	402 62	403 61	404 61	405 61	406 61	407 61	408 61	409 61	410 61	411 60	412 60	413 60	414 60	415 60			
416 60	417 60	418 60	419 59	420 59	421 59	422 59	423 59	424 59	425 59	426 59	427 59	428 58	429 58	430 58	431 58			
432 58	433 58	434 58	435 58	436 57	437 57	438 57	439 57	440 57	441 57	442 57	443 57	444 56	445 56	446 56	447 56			
448 56	449 56	450 56	451 56	452 55	453 55	454 55	455 55	456 55	457 55	458 55	459 55	460 55	461 54	462 54	463 54			
464 54	465 54	466 54	467 54	468 54	469 53	470 53	471 53	472 53	473 53	474 53	475 53	476 53	477 53	478 52	479 52			
480 52	481 52	482 52	483 52	484 52	485 52	486 51	487 51	488 51	489 51	490 51	491 51	492 51	493 51	494 51	495 50			
496 50	497 50	498 50	499 50	500 50	501 50	502 50	503 49	504 49	505 49	506 49	507 49	508 49	509 49	510 49	511 49			
512 48	513 48	514 48	515 48	516 48	517 48	518 48	519 48	520 48	521 47	522 47	523 47	524 47	525 47	526 47	527 47			
528 47	529 46	530 46	531 46	532 46	533 46	534 46	535 46	536 46	537 45	538 45	539 45	540 45	541 45	542 45	543 45			

Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature	Value Temperature
544 45	545 45	546 44	547 44	548 44	549 44	550 44	551 44	552 44	553 44	554 44	555 43	556 43	557 43	558 43	559 43			
560 43	561 43	562 43	563 42	564 42	565 42	566 42	567 42	568 42	569 42	570 42	571 42	572 41	573 41	574 41	575 41			
576 41	577 41	578 41	579 41	580 40	581 40	582 40	583 40	584 40	585 40	586 40	587 40	588 40	589 39	590 39	591 39			
592 39	593 39	594 39	595 39	596 39	597 38	598 38	599 38	600 38	601 38	602 38	603 38	604 38	605 37	606 37	607 37			
608 37	609 37	610 37	611 37	612 37	613 37	614 36	615 36	616 36	617 36	618 36	619 36	620 36	621 36	622 35	623 35			
624 35	625 35	626 35	627 35	628 35	629 35	630 34	631 34	632 34	633 34	634 34	635 34	636 34	637 34	638 33	639 33			
640 33	641 33	642 33	643 33	644 33	645 33	646 32	647 32	648 32	649 32	650 32	651 32	652 32	653 32	654 31	655 31			
656 31	657 31	658 31	659 31	660 31	661 31	662 30	663 30	664 30	665 30	666 30	667 30	668 30	669 29	670 29	671 29			
672 29	673 29	674 29	675 29	676 29	677 28	678 28	679 28	680 28	681 28	682 28	683 28	684 27	685 27	686 27	687 27			
688 27	689 27	690 27	691 26	692 26	693 26	694 26	695 26	696 26	697 26	698 26	699 25	700 25	701 25	702 25	703 25			
704 25	705 25	706 24	707 24	708 24	709 24	710 24	711 24	712 24	713 23	714 23	715 23	716 23	717 23	718 23	719 23			
720 22	721 22	722 22	723 22	724 22	725 22	726 21	727 21	728 21	729 21	730 21	731 21	732 21	733 20	734 20	735 20			
736 20	737 20	738 20	739 20	740 19	741 19	742 19	743 19	744 19	745 19	746 18	747 18	748 18	749 18	750 18	751 18			
752 17	753 17	754 17	755 17	756 17	757 17	758 16	759 16	760 16	761 16	762 16	763 16	764 15	765 15	766 15	767 15			
768 15	769 15	770 14	771 14	772 14	773 14	774 14	775 13	776 13	777 13	778 13	779 13	780 12	781 12	782 12	783 12			
784 12	785 11	786 11	787 11	788 11	789 11	790 11	791 10	792 10	793 10	794 10	795 10	796 10	797 9	798 9	799 9			
800 9	801 8	802 8	803 8	804 8	805 7	806 7	807 7	808 7	809 7	810 6	811 6	812 6	813 6	814 5	815 5			
816 5	817 5	818 5	819 4	820 4	821 4	822 4	823 3	824 3	825 3	826 2	827 2	828 2	829 2	830 1	831 1			
832 1	833 1	834 0	835 0	836 0	837 0	838 -1	839 -1	840 -1	841 -2	842 -2	843 -2	844 -2	845 -3	846 -3	847 -3			
848 -4	849 -4	850 -4	851 -5	852 -5	853 -5	854 -6	855 -6	856 -6	857 -7	858 -7	859 -8	860 -8	861 -8	862 -9	863 -9			
864 -9	865 -10	866 -10	867 -11	868 -11	869 -11	870 -12	871 -12	872 -13	873 -13	874 -14	875 -14	876 -15	877 -15	878 -16	879 -16			
880 -17	881 -17	882 -18	883 -19	884 -19	885 -20	886 -20	887 -21	888 -22	889 -23	890 -23	891 -24	892 -25	893 -25	894 -25	895 -25			
896 -25	897 -25	898 -25	899 -25	900 -25	901 -46	902 -46	903 -46	904 -46	905 -46	906 -46	907 -46	908 -46	909 -46	910 -46	911 -46			
912 -46	913 -46	914 -46	915 -46	916 -46	917 -46	918 -46	919 -46	920 -46	921 -46	922 -46	923 -46	924 -46	925 -46	926 -46	927 -46			
928 -46	929 -46	930 -46	931 -46	932 -46	933 -46	934 -46	935 -46	936 -46	937 -46	938 -46	939 -46	940 -46	941 -46	942 -46	943 -46			
944 -46	945 -46	946 -46	947 -46	948 -46	949 -46	950 -46	951 -46	952 -46	953 -46	954 -46	955 -46	956 -46	957 -46	958 -46	959 -46			
960 -46	961 -46	962 -46	963 -46	964 -46	965 -46	966 -46	967 -46	968 -46	969 -46	970 -46	971 -46	972 -46	973 -46	974 -46	975 -46			
976 -46	977 -46	978 -46	979 -46	980 -46	981 -46	982 -46	983 -46	984 -46	985 -46	986 -46	987 -46	988 -46	989 -46	990 -46	991 -46			
992 -46	993 -46	994 -46	995 -46	996 -46	997 -46	998 -46	999 -46	1000 -46	1001 -46	1002 -46	1003 -46	1004 -46	1005 -46	1006 -46	1007 -46			
1008 -46	1009 -46	1010 -46	1011 -46	1012 -46	1013 -46	1014 -46	1015 -46	1016 -46	1017 -46	1018 -46	1019 -46	1020 -46	1021 -46	1022 -46	1023 -46			