EDSPM-TXXX
13321201

System Manual

I/O-System IP20

EPM-T1XX, EPM-T2XX, EPM-T3XX, EPM-T4XX, EPM-T9XX

Modular system
Compact system

Lenze

Contents

1 Preface

Contents

1.1 The I/O system IP20

The system

Automation is playing an ever more important part in the operation of machines and systems. The increasing number of peripherals has increased the amount of wiring required. This is where distributed I/O systems bring order to the chaos. Lenze has developed two new product concepts with IP20 protection which are suitable for both basic digital applications and more complex automation tasks.

The modular system

Lenze can now provide you with a modular system for complex automation applications, consisting of three components: a gateway, electronic modules and a backplane bus. The key element is the gateway which processes all process data traffic via the system bus (CAN) / CANopen or PROFIBUS-DP. An internal backplane bus is also used for the in-station communication between process and parameter data, as well as diagnostics data.

The compact system

This system comprises a range of compact products with a fixed number of digital inputs and outputs. The integrated gateway serves as a communication interface which processes the complete process data traffic via system bus (CAN) / CANopen.

The I/O system IP20 is supported by

Application	As of version	Note
Global Drive Control	4.4	Device data only are available after a software update.
	4.5	Device data are available, except for the following modules of the modular system: • ”16×digital input”, ”16×digital output”, ”4×analog input/output”, ”SSI interface”, ”1×counter/16×digital input” After a software update, device data are available for all modules.
Drive Developer Studio	1.4	Libraries only are available after a software update.
	2.1	Libraries are available, except for the following modules of the modular system: • ”16×digital input”, ”16×digital output”, ”4×analog input/output”, ”SSI interface”, ”1×counter/16×digital input” After a software update, libraries are available for all modules.

1.2 How to use this System Manual

1.2.1 Information provided by the System Manual

Target group

This System Manual is intended for all persons who design, install, set up, and adjust the I/O system IP20.

Together with the catalog it provides the basis of project planning for the manufacturers of plants and machinery.

Contents

The System Manual complements the Mounting Instructions included in the scope of supply:

- The features and functions are described in detail.
- It provides detailed information on further possible fields of application.
- The parameter setting for typical applications is explained by means of examples.

How to find information

Each main chapter is a unit in itself and covers all information on the corresponding subject:

- Therefore, you only need to read the chapter that is relevant to you.
- The contents and table of keywords allow you to easily find information about specific topics.
- Descriptions and data of other Lenze products (drive PLC, Lenze operator terminals, ...) are included in the corresponding catalogs, Operating Instructions, and Manuals. The required documentation can be ordered at your Lenze sales partner or downloaded as PDF file from the internet.

Paper or PDF

The System Manual is designed as a loose-leaf collection so that we are able to inform you quickly and specifically about news and changes. Each page is marked by publication date and version.

We also make the System Manual available as PDF file in the internet.

Note!

Current documentation and software updates for Lenze products are available on the Internet in the "Services & Downloads" area under

http://www.Lenze.com

1.2.2 Products to which the System Manual applies

This documentation is valid for the I/O system IP20 as of the nameplate data:

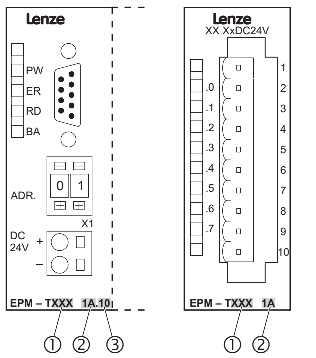
	①	②	⑤	Nameplate
EPM-T	**XXX**	**1A**	**13**	

Type

110	CAN gateway
111	CAN GatewayECO
120	PROFIBUS Gateway
121	PROFIBUS GatewayECO
210	8×digital input
211	16×digital input
220	8×digital output 1A
221	8×digital output 2A
222	4×relay
223	16×digital output 1A
224	8×digital output 0.5A
225	16×digital output 0.5A
230	8×digital input / output
310	4×analog input
311	4×analog input ±10V
312	4×analog input ±20mA
320	4×analog output
321	4×analog output ±10V
322	4×analog output 0...20mA
330	4×analog input / output
410	2/4×counter
411	SSI interface
430	1×counter/16×digital input
830	8×dig. I/O compact
831	16×dig. I/O compact (single-wire conductor)
832	32×dig. I/O compact
833	16×dig. I/O compact (three-wire conductor)
940	Terminal module

Hardware version

Software version
Types EPM-T1XX, EPM-T3XX, EPM-T4XX and EPM-T8XX only



epm-t008

1.2.3 Document history

What is new / what has changed?

Material number	Version			Description
13321201	9.0	11/2009	TD23	Error correction
13301241	8.0	07/2009	TD23	New edition due to reorganisation of the company, error correction
13266570	7.0	08/2008	TD14	Revised for software version 1.3, extended by the indices $I2004_h$, $I3401_h$, $I6423_h$, error correction
13237966	6.0	02/2008	TD31	Revision of the signal functions in the chapters ”Parameterising analog modules”
13187750	5.0	08/2006	TD31	Extended by PROFIBUS-DP, new electronic modules
13052114	4.0	05/2005	TD14	Supplements for software version 1.2
00488905	3.0	04/2004	TD23	New electronic modules, error correction
00460836	2.0	10/2002	TD23	First edition

1.3 Legal regulations

Labelling

All components of the I/O system IP20 are unequivocally identified through the contents of the nameplate.

Manufacturer

Lenze Digitec Controls GmbH, Grünstraße 36, D-40667 Meerbusch

CE conformity

Conforms with the EC Directives on electromagnetic compatibility (89/336/EEC) and low voltage (73/23/EEC).

Application as directed

Components of I/O system IP20

- must only be operated under the conditions prescribed in this System Manual,
- are not approved for use in potentially explosive environments,
- are electric units for the installation into control cabinets or similar enclosed operating housing,
- conform with the EC Directives on electromagnetic compatibility (89/336/EEC) and low voltage (73/23/EEC),
- are not machines for the purpose of the EC Directive "Machinery",
- are not to be used as domestic appliances, but for industrial purposes only.

The user is responsible for the compliance of his application with the EC directives.

Any other use shall be deemed inappropriate!

Liability

The information, data, and notes in this System Manual met the state of the art at the time of printing. Claims on modifications referring to components of the I/O system IP20 which have already been supplied cannot be derived from the information, illustrations, and descriptions given in this Manual.

The specifications, processes, and circuitry described in this System Manual are for guidance only and must be adapted to your own specific application. Lenze Digitec Controls does not take responsibility for the suitability of the process and circuit proposals.

The specifications in this System Manual describe the product features without guaranteeing them.

Lenze does not accept any liability for damage and operating interference caused by:

- Non-compliance with the System Manual
- Unauthorised modifications to components of the I/O systemIP20
- Operating errors
- Improper working on and with the I/O system IP20

Warranty

See terms of sales and delivery of Lenze Digitec Controls GmbH.

Warranty claims must be made to Lenze Digitec Controls immediately after detecting the deficiency or fault.

The warranty is void in all cases where liability claims cannot be made.

2 Safety instructions

Contents

2.1 Definition of notes used

All safety notes given in these instructions have the same structure:

Pictograph (indicates the type of danger)

Signal word! (indicates the severity of danger)

Note (describes the danger and informs the reader how to avoid danger)

Pictograph	Signal word		Consequences if the safety instructions are disregarded
	Signal word	**Meaning**	
	Stop!	**Possible damage to material**	Damage to the I/O system IP20 or its environment
	Note!	**Useful note or tip** which, if observed, will simplify handling of the I/O system IP20.	

3 Technical data

Contents

3.1 General data/operating conditions

Note!

- The technical data of the modules of the modular system is included in the chapter "The modular system" in the corresponding module description.
- The technical data of the modules of the compact system is included in the chapter "The compact system" in the corresponding module description.

General data

Conformity and approval		
Conformity		
CE	73/23/EEC	Low-Voltage Directive
Approval		
UL	UL 508	Power Conversion Equipment

Protection of persons and device protection		
Type of protection		IP20
Electrical isolation		
Modular system, compact modules		
To the fieldbus		Via optocouplers
To the process level		Via optocouplers
Insulation resistance	IEC 61131-2	
Insulation voltage to reference earth		
Inputs / outputs		AC/DC 50 V, test voltage AC 500 V
Protective measures		Against short circuit

EMC		
Noise emission	EN 61000-6-4	
Noise immunity	EN 61000-4-2	ESD
	EN 61000-4-3	HF interference (enclosure)
	EN 61000-4-4	Burst

Operating conditions

Ambient conditions		
Climatic		
Storage	IEC/EN 60068-2-14	-25 ... +70 °C
Operation		
Horizontal installation	EN 61131-2	0 ... +60 °C
Vertical installation		0 ... +40 °C
Air humidity	60068-2-30	RH1 (without condensation, relative humidity 10 ... 95 %)
Pollution	EN EN 61131-2	Degree of pollution 2
Mechanical		
Vibration resistance	IEC 60068-2-6	1 g
	IEC 60068-2-27	15 g

Mounting conditions		
Mounting place		In the control cabinet
Mounting position		Horizontal and vertical
Station design		
Modular system		1 gateway module with up to 32 electronic modules attached to it without any free space

4 The modular system

Contents

4.1 CAN gateway

Description

The CAN gateway is the interface between the process level and the master bus system. The control signals at the process level are transmitted by the electronic modules. These modules are connected with the CAN gateway via the backplane bus (EPM-T9XX). CAN gateway and the connected electronic modules communicate via the backplane bus. A configuration is not required.

Features

- Up to 32 modules can be connected to a CAN gateway
- Integrated power supply unit for the internal voltage supply and the voltage supply of the connected electronic modules
  – Power supply unit is fed via an external DC voltage source
- Connection to the system bus (CAN) / CANopen via a 9-pole Sub-D plug
- Address and baud rate setting via coding switch
- The baud rate is stored permanently in an EEPROM in the module
- LED for status display

Overview

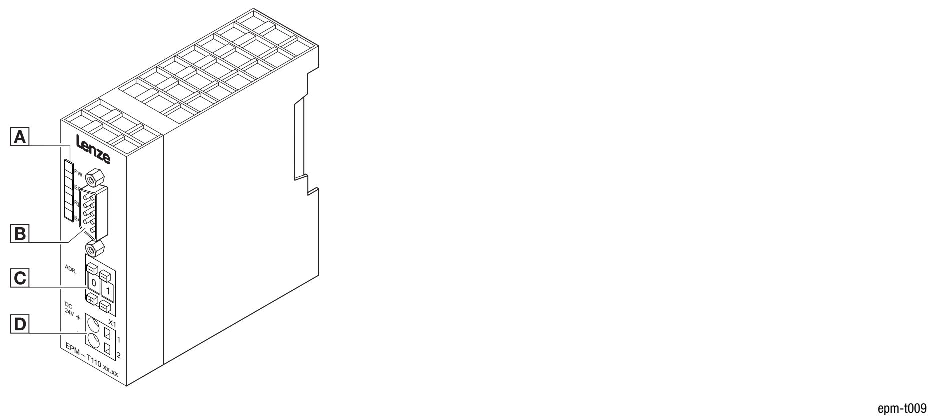
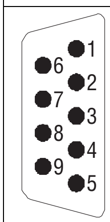


Fig. 4.1-1 Overview of CAN gateway

A LED for status display
B 9-pole Sub-D plug for connection to the system bus (CAN)
C Coding switch to set address and baud rate
D External voltage supply connection

Connecting system bus (CAN)/CANopen

View	Pin	Assignment	Explanation
 epm-t023	1	Not assigned	-
	2	CAN-LOW	Data line
	3	CAN-GND	Data ground
	4	Not assigned	-
	5	Not assigned	-
	6	Not assigned	-
	7	CAN-HIGH	Data line
	8	Not assigned	-
	9	Not assigned	-

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

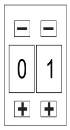


Fig. 4.1-2 Coding switch at CAN gateway

[−] Decrease numerical value
[+] Increase numerical value

Baud rate setting

System bus (CAN)	**CANopen**	**Baud rate**
Coding switch value	Coding switch value	[kbit/s]
90	80	1000
91	81	**500**
92	82	250
93	83	125
94	84	100
95	85	50
96	86	20
97	87	10
98	88	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   - Select ”9x” when using the ”system bus (CAN)” protocol (x = value for the required baud rate)
   - Select ”8x” when using the ”CANopen” protocol (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   - The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the modular system needs approx. 10 s for initialisation. During this time, the modules cannot be parameterised.

Status displays

LED	Status	Meaning
PW (yellow)	on	Module supply voltage on
ER (red)	on	Incorrect data transmission on the backplane bus.
RD (green)	on	Signals error-free data transmission on the backplane bus.
		See table below
BA (yellow)		See table below

PW (yellow)	**ER** (red)	**RD** (green)	**BA** (yellow)	**Meaning**
on	off	blinking (1 Hz)	off	Self test and initialisation in progress
on	off	on	on	System bus (CAN)/CANopen in the "Operational"state
on	off	on	blinking (1 Hz)	System bus (CAN)/CANopen in the "Pre-Operational"state
on	off	on	blinking (10 Hz)	System bus (CAN)/CANopen in the "Stopped"state
on	blinking (10 Hz)	on	on blinking (1 Hz) blinking (10 Hz)	System bus (CAN)/CANopen "Offline"state
on	blinking (1 Hz)	on		System bus (CAN)/CANopen "Warning"state
on	on	on	on	Error during RAM or EEPROM initialisation
on	blinking (1 Hz)	blinking (1 Hz)	blinking (1 Hz)	Baud rate setting mode active
on	blinking (10 Hz)	blinking (10 Hz)	blinking (10 Hz)	Error during baud rate setting
on	off	blinking (1 Hz)	off	Address setting mode active

Note!

NMT telegrams for changing to the different states can be found in the chapter "Networking via system bus (CAN)" or "Networking via CANopen".

Technical data

<table>
<tr><td colspan="3">Type</td><td colspan="9">CAN gateway</td></tr>
<tr><td colspan="12">Voltage supply</td></tr>
<tr><td></td><td colspan="2">Voltage</td><td colspan="9">DC 24 V (DC 20.4 ... 28.8 V)</td></tr>
<tr><td></td><td colspan="2">Max. current consumption CAN Gateway</td><td colspan="9">0.7 A</td></tr>
<tr><td></td><td colspan="2">Max. current consumption of electronic modules</td><td colspan="9">3,5 A</td></tr>
<tr><td colspan="3">Connectable cable cross-section</td><td colspan="9">≤ 2.5 mm² (≥ AWG 14)</td></tr>
<tr><td colspan="12">Communication</td></tr>
<tr><td></td><td colspan="2">Communication protocol</td><td colspan="9">• System bus (CAN)
• CANopen (CAL-based communication profile DS301/DS401)</td></tr>
<tr><td></td><td colspan="2">Communication medium</td><td colspan="9">DIN ISO 11898</td></tr>
<tr><td></td><td colspan="2">Network topology</td><td colspan="9">Line (terminated at both ends)</td></tr>
<tr><td></td><td colspan="2">Max. cable length</td><td colspan="9"></td></tr>
<tr><td></td><td></td><td>Baud rate [kbit/s]</td><td>10</td><td>20</td><td>50</td><td>100</td><td>125</td><td>250</td><td>500</td><td>800</td><td>1000</td></tr>
<tr><td></td><td></td><td>Cable length [m]</td><td>5000</td><td>2500</td><td>1000</td><td>600</td><td>500</td><td>250</td><td>80</td><td>50</td><td>25</td></tr>
<tr><td></td><td colspan="2">Max. number of nodes</td><td colspan="9">63</td></tr>
<tr><td></td><td colspan="2">Electrical isolation from system bus</td><td colspan="9">Yes, via optocouplers</td></tr>
<tr><td colspan="12">Connectable electronic modules</td></tr>
<tr><td></td><td colspan="2">Max. number of elements</td><td colspan="9">32</td></tr>
<tr><td></td><td colspan="2">Max. number of digital input/output modules</td><td colspan="9">32</td></tr>
<tr><td></td><td colspan="2">Max. number of analog input/output modules</td><td colspan="9">9</td></tr>
<tr><td></td><td colspan="2">Max. number 2/4×counters</td><td colspan="9">4</td></tr>
<tr><td></td><td colspan="2">Max. number SSI interface</td><td colspan="9">9</td></tr>
<tr><td></td><td colspan="2">Max. number of 1×counter/16×digital input</td><td colspan="9">9</td></tr>
<tr><td></td><td colspan="2">Max. digital input data</td><td colspan="9">72 bytes</td></tr>
<tr><td></td><td colspan="2">Max. digital output data</td><td colspan="9">72 bytes</td></tr>
<tr><td></td><td colspan="2">Max. analog input data</td><td colspan="9">72 bytes</td></tr>
<tr><td></td><td colspan="2">Max. analog output data</td><td colspan="9">72 bytes</td></tr>
<tr><td colspan="12">Dimensions</td></tr>
<tr><td></td><td colspan="2">Width</td><td colspan="9">25.4 mm</td></tr>
<tr><td></td><td colspan="2">Height</td><td colspan="9">76.0 mm</td></tr>
<tr><td></td><td colspan="2">Depth</td><td colspan="9">76.0 mm</td></tr>
<tr><td colspan="3">Weight</td><td colspan="9">80 g</td></tr>
</table>

Order designation	**EPM-T110**

4.2 CAN GatewayECO

Description

The CAN GatewayECO is the interface between the process level and the master bus system. The control signals at the process level are transmitted by the electronic modules. These modules are connected with the CAN Gateway via the backplane bus (EPM-T9XX). CAN Gateway and the connected electronic modules communicate via the backplane bus. A configuration is not required.

Features

- Up to 8 modules can be connected to a CAN Gateway
- Integrated power supply unit for the internal voltage supply and the voltage supply of the connected electronic modules
  – Power supply unit is fed via an external DC voltage source
- Only supports the electronic module types EPM-T2xx and EPM-T3xx
- Connection to the system bus (CAN) / CANopen via a 9-pole Sub-D plug
- Address and baud rate setting via DIP switch
- The baud rate is stored permanently in an EEPROM in the module
- LED for status display

Overview

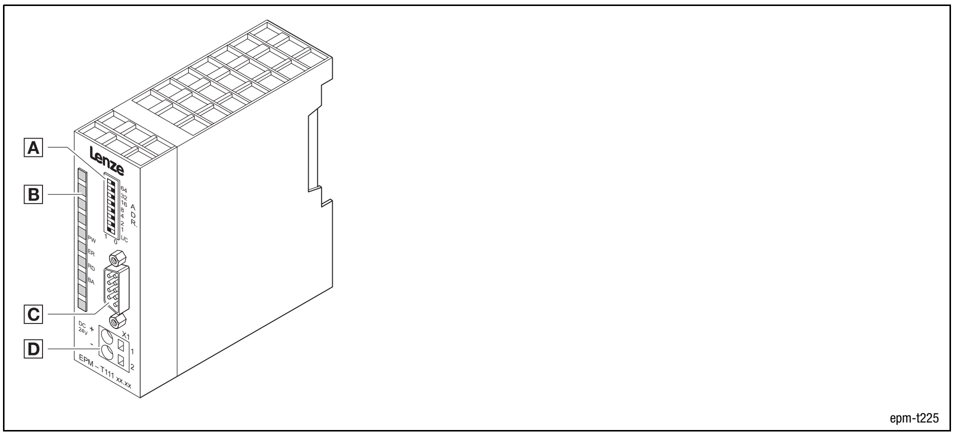
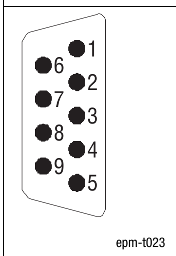


Fig. 4.2-1 Overview of Can GatewayECO

A Coding switch to set address and baud rate
B LED for status display
C 9-pin Sub-D plug for the connection to the fieldbus
D External voltage supply connection

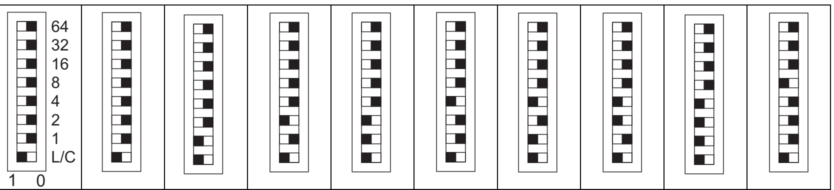
Connecting system bus (CAN)/CANopen

View	Pin	Assignment	Explanation
	1	Not assigned	-
	2	CAN-LOW	Data line
	3	CAN-GND	Data ground
	4	Not assigned	-
	5	Not assigned	-
	6	Not assigned	-
	7	CAN-HIGH	Data line
	8	Not assigned	-
	9	Not assigned	-

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

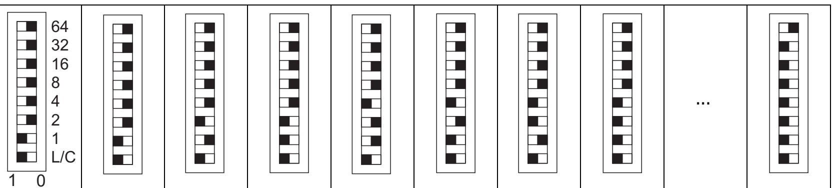
Setting the baud rate

Coding switch									
									
Value	0	1	2	3	4	5	6	7	8
Baud rate [kBit/s]	1000	**500**	250	125	100	50	20	10	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Set all switches to ”0” (not switch ”L/C”) on the coding switch.
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA blink with a frequency of 1 Hz.
4. Set the desired baud rate with the coding switch. You have 10 seconds time.
   – LEDs ER and BA go off after 10 seconds, and the set baud rate is stored.
5. You have a further 10 seconds time to set the node address.

Node address setting

Coding switch									
								...	
Node address	1	2	3	4	5	6	7	...	63

6. Set the node address for the module with the coding switch.
   – Allowed device addresses are 1 ... 63.
   – Each node address must be assigned only once.
   – If the entered address is valid, the LED RD is extinguished and the Gateway module changes to the pre-operational mode. The set address is saved.
   – If the entered address is invalid, the LEDs ER, RD and BA blink with a frequency of 10 Hz.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the modular system needs approx. 10 s for initialisation. During this time, the modules cannot be parameterised.

Setting the communication protocol

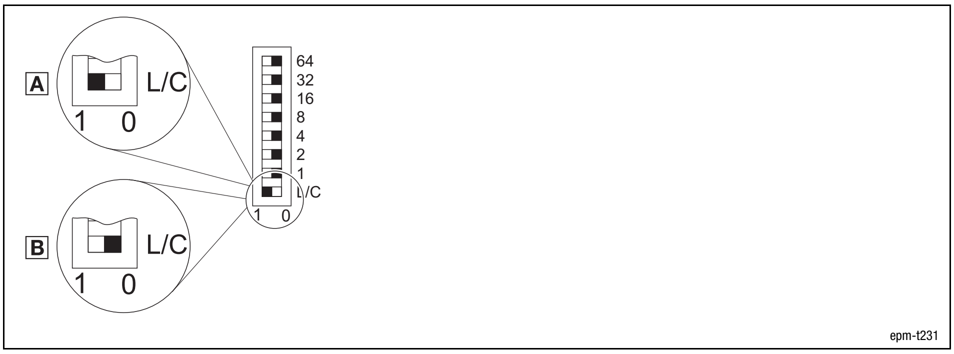


Fig. 4.2-2 Set the communication protocol for the CAN GatewayECO

A System bus (CAN)
B CANopen

Note!
Changes to the communication protocol are only adopted when the supply voltage is switched on again.

Status displays

LED	Status	Meaning
PW (yellow)	on	Module supply voltage on
ER (red)	on	Incorrect data transmission on the backplane bus.
RD (green)	on	Signals error-free data transmission on the backplane bus.
		See table below
BA (yellow)		See table below

PW (yellow)	**ER** (red)	**RD** (green)	**BA** (yellow)	Meaning
on	off	blinking (1 Hz)	off	Self test and initialisation in progress
on	off	on	on	System bus (CAN)/CANopen in the ”Operational”state
on	off	on	blinking (1 Hz)	System bus (CAN)/CANopen in the ”Pre-Operational”state
on	off	on	blinking (10 Hz)	System bus (CAN)/CANopen in the ”Stopped”state
on	blinking (10 Hz)	on	on blinking (1 Hz) blinking (10 Hz)	System bus (CAN)/CANopen ”Offline”state
on	blinking (1 Hz)	on		System bus (CAN)/CANopen ”Warning”state
on	on	on	on	Error during RAM or EEPROM initialisation
on	blinking (1 Hz)	blinking (1 Hz)	blinking (1 Hz)	Baud rate setting mode active
on	blinking (10 Hz)	blinking (10 Hz)	blinking (10 Hz)	Error during baud rate setting
on	off	blinking (1 Hz)	off	Address setting mode active

Note!
NMT telegrams for changing to the different states can be found in the chapter ”Networking via system bus (CAN)” or ”Networking via CANopen”.

Technical data

Type	CAN GatewayECO								
Voltage supply									
Voltage	DC 24 V (DC 20.4 ... 28.8 V)								
Max. current consumption CAN GatewayECO	0.3A								
Max. current consumption of electronic modules	0.8A								
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)								
Communication									
Communication protocol	• System bus (CAN) • CANopen (CAL-based communication profile DS301/DS401)								
Communication medium	DIN ISO 11898								
Network topology	Line (terminated at both ends)								
Max. cable length									
Baud rate [kbit/s]	10	20	50	100	125	250	500	800	1000
Cable length [m]	5000	2500	1000	600	500	250	80	50	25
Max. number of nodes	63								
Electrical isolation from system bus	Yes, via optocouplers								
Connectable electronic modules									
Max. number of electronic modules	8	The number is limited by the maximum current consumption of electronic modules.							
Max. number of digital input/output modules	8								
Max. number of analog input/output modules	8								
Max. digital input data	8 bytes								
Max. digital output data	8 bytes								
Max. analog input data	64 bytes								
Max. analog output data	64 bytes								
Dimensions									
Width	25.4 mm								
Height	76.0 mm								
Depth	76.0 mm								
Weight	80 g								

Order designation	**EPM-T111**

4.3 PROFIBUS Gateway

Description

The PROFIBUS Gateway is the interface between the process level and the master bus system. The control signals at the process level are transmitted by the electronic modules. These modules are connected with the PROFIBUS Gateway via the backplane bus (EPM-T9XX). PROFIBUS Gateway and the connected electronic modules communicate via the backplane bus. A configuration is not required.

Features

- PROFIBUS-DP slave for up to 32 electronic modules
- Supports PROFIBUS-DP-V1
- Integrated power supply unit for the internal voltage supply and the voltage supply of the connected electronic modules
  – Power supply unit is fed via an external DC voltage source
- Internal diagnostic protocol with time stamp
- Connection to the PROFIBUS via 9-pin Sub-D socket
- LED for status display

Overview

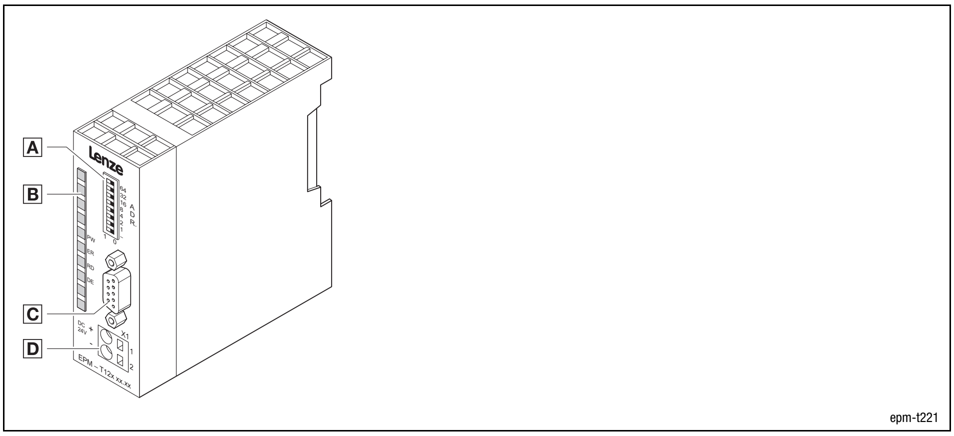
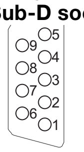


Fig. 4.3-1 Overview of PROFIBUS Gateway

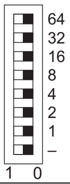
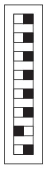
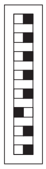
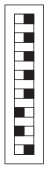
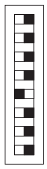
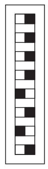
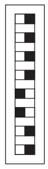
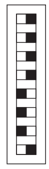
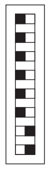
A Coding switch to set the address
B LED for status display
C 9-pin Sub-D socket for the connection to the PROFIBUS
D Connection of the external DC voltage source

Assignment of the Sub-D socket



	Assignment	Explanation
	Not assigned	-
2	Not assigned	-
3	RxD/TxD-P	Data line B (received / transmitted data plus)
4	RTS	Request To Send (received / transmitted data, no differential signal)
5	M5V2	Data ground (mass to 5 V)
6	P5V2	DC 5 V / 30 mA (bus termination)
7	Not assigned	-
8	RxD/TxD-N	Data line A (received / transmitted data minus)
9	Not assigned	-

Setting the device address

Coding switch									
								...	
Device address	1	2	3	4	5	6	7	...	125

- Set the device address for the module with the coding switch.
  - Allowed device addresses are 1 ... 125.
  - Every device address must only be assigned once on the bus.
  - Changes to the device address are only adopted when the supply voltage is switched on again.

Status displays

LED	Status	Meaning
PW (green)	on	Module supply voltage on
ER (red)	on	• Incorrect data transmission on the backplane bus. • Internal fault • Lights up for approx. 1 second when the module is restarted
RD (green)		See table below
DE (green)	on	Error-free communication with PROFIBUS-DP

PW (green)	**ER** (red)	**RD** (green)	**DE** (green)	**Meaning**
on	on	off	off	Self-test and initialisation in progress
on	off	blinking	off	Self-test and initialisation was successful
on	blinking	off	off	Initialisation error
on	blinking	blinking	off	• ”ER” and ”RD” blink asynchronously: – Configuration faulty • ”ER” and ”RD” blink synchronously: – Parameter settings faulty
on	off	on	on	The backplane bus cycle is quicker than the PROFIBUS cycle
on	off	off	on	The backplane bus cycle is slower than the PROFIBUS cycle

Technical data

Type	PROFIBUS Gateway	
Voltage supply		
Voltage	DC 24 V (DC 20.4 ... 28.8 V)	
Max. current consumption PROFIBUS Gateway	1 A	
Max. current consumption of electronic modules	3.5A	
Connectable cable cross-section	$\leq$ 2.5 mm^2 ($\geq$ AWG 14)	
Communication		
Communication profile (DIN 19245 Part 1 and Part 3)	PROFIBUS-DP	
Communication media	RS485	
Network topology	Without repeater: line With repeater: line or tree	
PROFIBUS-DP nodes	Slave	
Baud rate for line type A (EN 50170)	9.6 kBit/s ... 12 MBit/s (automatic recognition)	
Max. number of nodes		
Standard	32	1 bus segment
With repeater	126	
Max. line length per bus segment	1200 m	Depending on the baud rate and the used line type
Electrical isolation from field bus	Yes, via optocouplers	
Diagnostic function	Stores the last 100 diagnoses with time stamp in the flash ROM	
Connectable electronic modules		
Max. number of electronic modules	32	The number can be limited by the maximum current consumption of electronic modules.
Max. number of digital input/output modules	32	
Max. number of analog input/output modules	9	
Process data for PROFIBUS-DP-V0		
Max. input data	244 bytes	
Max. output data	244 bytes	
Process data for PROFIBUS-DP-V1		
Max. input data	240 bytes	
Max. output data	240 bytes	
Dimensions		
Width	25.4 mm	
Height	76.0 mm	
Depth	76.0 mm	
Weight	80 g	

Order designation	**EPM-T120**

4.4 PROFIBUS GatewayECO

Description

The PROFIBUS GatewayECO is the interface between the process level and the master bus system. The control signals at the process level are transmitted by the electronic modules. These modules are connected with the PROFIBUS GatewayECO via the backplane bus (EPM-T9XX). PROFIBUS Gateway and the connected electronic modules communicate via the backplane bus. A configuration is not required.

Features

- PROFIBUS-DP slave for up to 8 electronic modules
- Integrated power supply unit for the internal voltage supply and the voltage supply of the connected electronic modules
  - Power supply unit is fed via an external DC voltage source
- Only supports the electronic modules EPM-T2xx and EPM-T3xx
- Internal diagnostic protocol with time stamp
- Supports the acyclic data exchange (DP-V1)
- Connection to the PROFIBUS via 9-pin Sub-D socket
- LED for status display

Overview

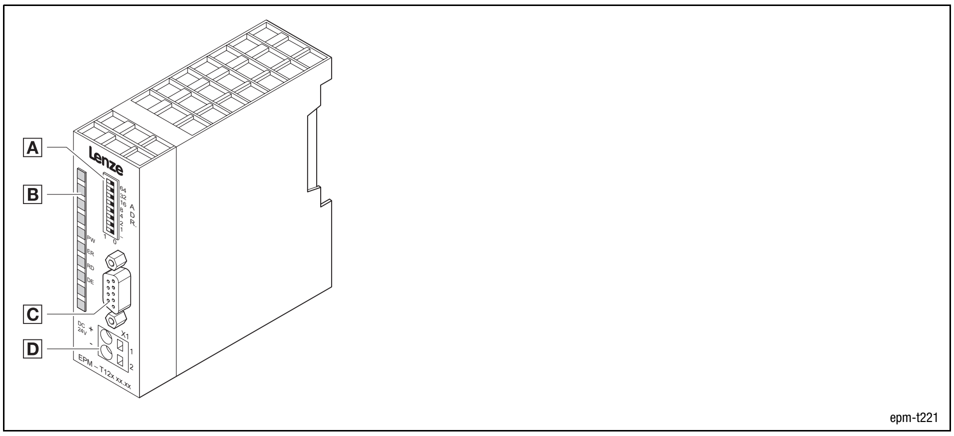
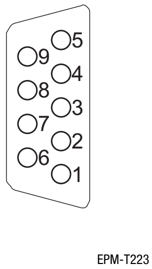


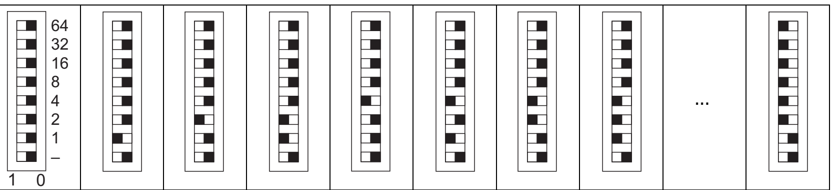
Fig. 4.4-1 Overview of PROFIBUS GatewayECO

A Coding switch to set the address
B LED for status display
C 9-pin Sub-D socket for the connection to the PROFIBUS
D Connection of the external DC voltage source

Assignment of the Sub-D socket

View	Pin	Assignment	Explanation
	1	Not assigned	-
	2	Not assigned	-
	3	RxD/TxD-P	Data line B (received / transmitted data plus)
	4	RTS	Request To Send (received / transmitted data, no differential signal)
	5	M5V2	Data ground (ground at 5 V)
	6	P5V2	DC 5 V / 30 mA (bus termination)
	7	Not assigned	-
	8	RxD/TxD-N	Data line A (received / transmitted data minus)
	9	Not assigned	-

Setting the device address

Coding switch									
									
Device address	1	2	3	4	5	6	7	...	125

- Set the device address for the module with the coding switch.
  – Allowed device addresses are 1 ... 125.
  – Every device address must only be assigned once on the bus.
  – Changes to the device address are only adopted when the supply voltage is switched on again.

Status displays

LED	Status	Meaning
PW (green)	on	Module supply voltage on
ER (red)	on	• Incorrect data transmission on the backplane bus. • Internal fault • Lights up for approx. 1 second when the module is restarted
RD (green)		See table below
DE (green)	on	Error-free communication with PROFIBUS-DP

PW (green)	**ER** (red)	**RD** (green)	**DE** (green)	**Meaning**
on	on	off	off	Self-test and initialisation in progress
on	off	blinking	off	Self-test and initialisation was successful
on	blinking	off	off	Initialisation error
on	blinking	blinking	off	• ”ER” and ”RD” blink asynchronously: – Configuration faulty • ”ER” and ”RD” blink synchronously: – Parameter settings faulty
on	off	on	on	The backplane bus cycle is quicker than the PROFIBUS cycle
on	off	off	on	The backplane bus cycle is slower than the PROFIBUS cycle

Technical data

Type		PROFIBUS GatewayECO	
Voltage supply			
	Voltage	DC 24 V (DC 20.4 ... 28.8 V)	
	Max. current consumption PROFIBUS GatewayECO	0.3A	
	Max. current consumption of electronic modules	0.8 mA	
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)	
Communication			
	Communication profile (DIN 19245 Part 1 and Part 3)	PROFIBUS-DP	
	Communication media	RS485	
	Network topology	Without repeater: line With repeater: line or tree	
	PROFIBUS-DP nodes	Slave	
	Baud rate for line type A (EN 50170)	9.6 kBit/s ... 12 MBit/s (automatic recognition)	
	Max. number of nodes		
	Standard	32	1 bus segment
	With repeater	126	
	Max. line length per bus segment	1200 m	Depending on the baud rate and the used line type
	Electrical isolation from field bus	Yes, via optocouplers	
Diagnostics function		Stores the last 100 diagnoses with time stamp in the flash ROM	
Connectable electronic modules			
	Max. number of electronic modules	8	The number can be limited by the maximum current consumption of electronic modules.
	Max. number of digital and analog input/output modules	8	
	Process data for PROFIBUS-DP-V0		
	Max. input data	244 bytes	
	Max. output data	244 bytes	
	Process data for PROFIBUS-DP-V1		
	Max. input data	240 bytes	
	Max. output data	240 bytes	
Dimensions			
	Width	25.4 mm	
	Height	76.0 mm	
	Depth	76.0 mm	
Weight		80 g	

Order designation	**EPM-T121**

4.5 8×digital input

Description

The module 8×digital input detects the binary control signals of the process level and transfers them to the master bus system.

Features

- 8 digital inputs
- Suitable for switches and proximity switches
- LED displays the states of the digital inputs

Overview

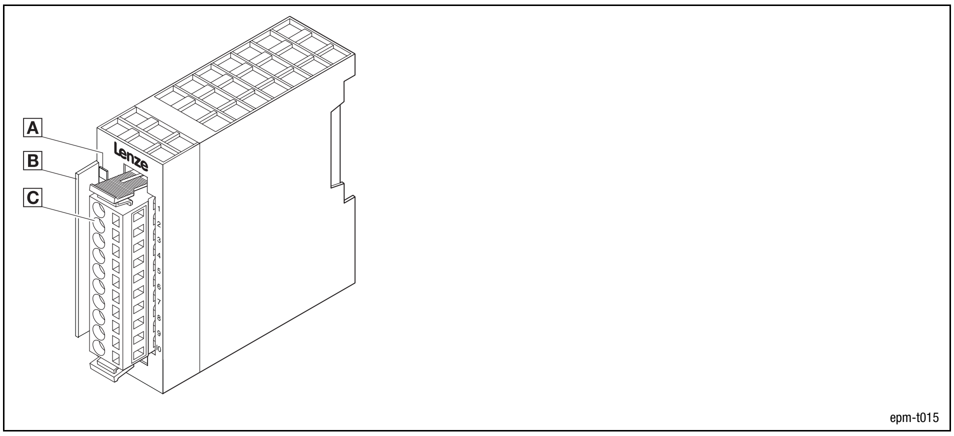


Fig. 4.5-1 Overview of 8×digital input

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

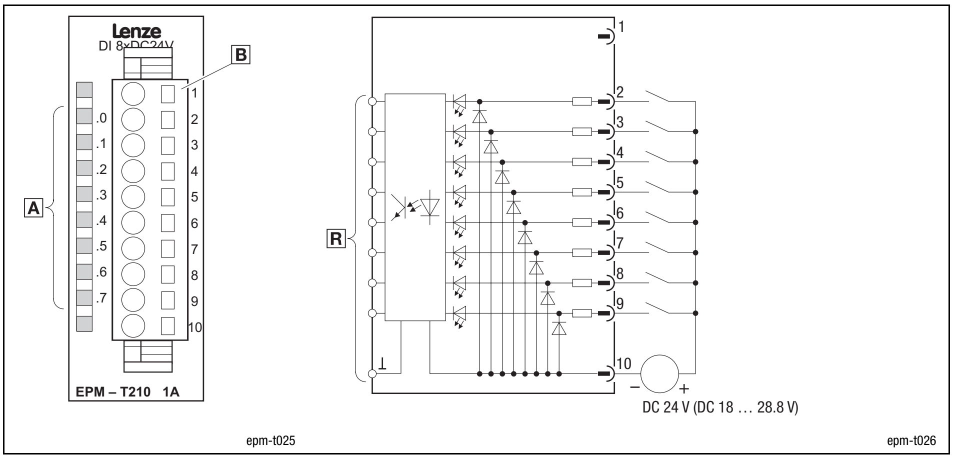


Fig. 4.5-2 Front view and connection of 8×digital input

A Status display .0 ... .7; LED (green) is lit when a HIGH level is recognised

B Terminal strip assignment details
1 Not assigned
2 Digital input E.0
3 Digital input E.1
4 Digital input E.2
5 Digital input E.3
6 Digital input E.4
7 Digital input E.5
8 Digital input E.6
9 Digital input E.7
10 GND (reference potential)
R Connection to backplane bus

Technical data

Type		8×digital input
Voltage supply		DC 5 V / 20 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Digital inputs		
	Rated input voltage	DC 24 V (DC 18 ... 28.8 V)
	Number of inputs	8
	Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V
	Input resistance	3.3 kΩ
	Delay time	3 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Input data	1 byte
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T210**

4.6 16×digital input

Description

The module 16×digital input detects the binary control signals of the process level and transfers them to the master bus system.

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 16 digital inputs
- Suitable for switches and proximity switches
- LED displays the states of the digital inputs

Overview

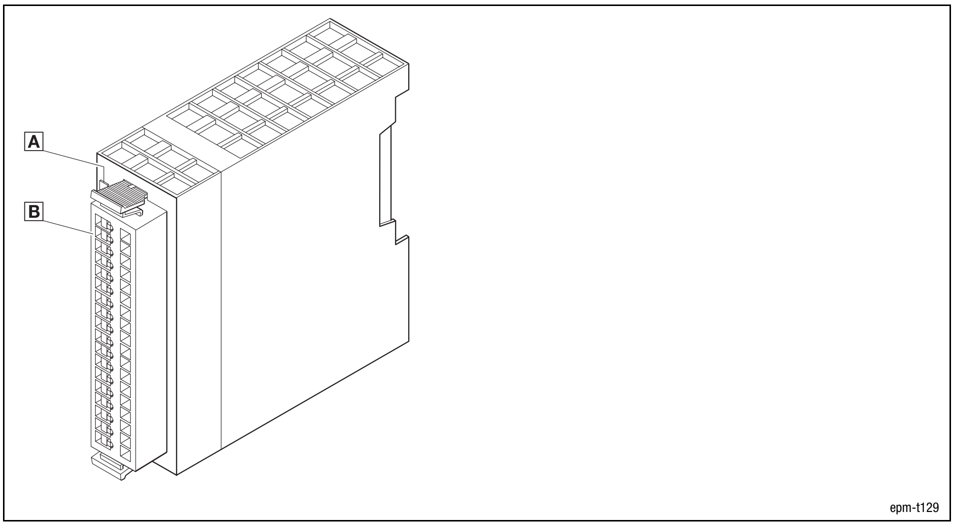


Fig. 4.6-1 Overview of 16×digital input

A LED for status display
B Plug-in terminal strip

Status display and terminal assignment

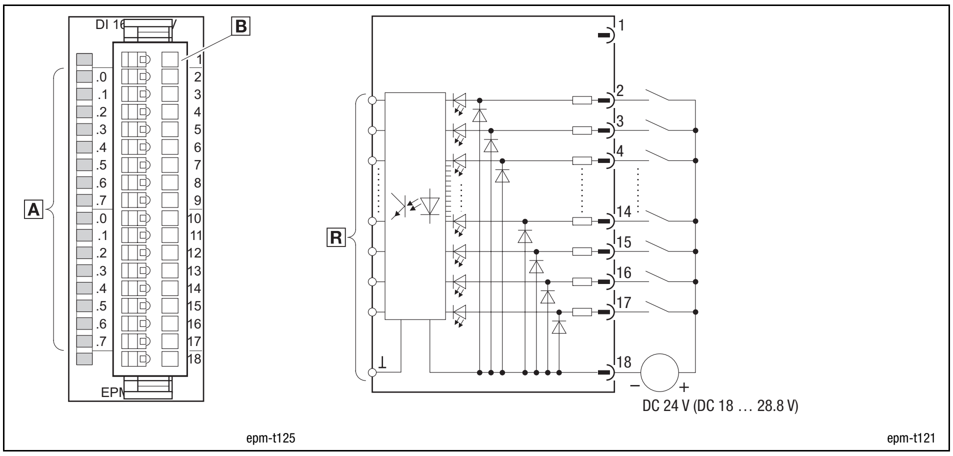


Fig. 4.6-2 Front view and connection of 16×digital input

- A 2 × status display .0 ... .7; LED (green) is lit when a HIGH level is recognised

B	Terminal strip assignment details
1	Not assigned
2	Digital input E.0
3	Digital input E.1
4	Digital input E.2
...	...
14	Digital input E.12
15	Digital input E.13
16	Digital input E.14
17	Digital input E.15
18	GND (reference potential)
R	Connection to backplane bus

Technical data

Type		16×digital input
Voltage supply		DC 5 V / 30 mA (via backplane bus)
Connectable cable cross-section		≤ 1.5 mm^2 (≥ AWG 16)
Digital inputs		
	Rated input voltage	DC 24 V (DC 18 ... 28.8 V)
	Number of inputs	16
	Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V
	Input resistance	3.3 kΩ
	Delay time	3 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Input data	2 bytes
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T211**

4.7 8×digital output 0.5A

Description

The module 8×digital output 0.5A detects the binary control signals from the master bus system and transports them to the process level via the outputs. The digital outputs are supplied via an external voltage source (DC 24 V).

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 8 digital outputs
- DC 24 V supply voltage
- Each digital output has a load capacity of up to 0.5 A
- Suitable for solenoid valves and DC contactors
- LED displays the states of the digital outputs

Overview

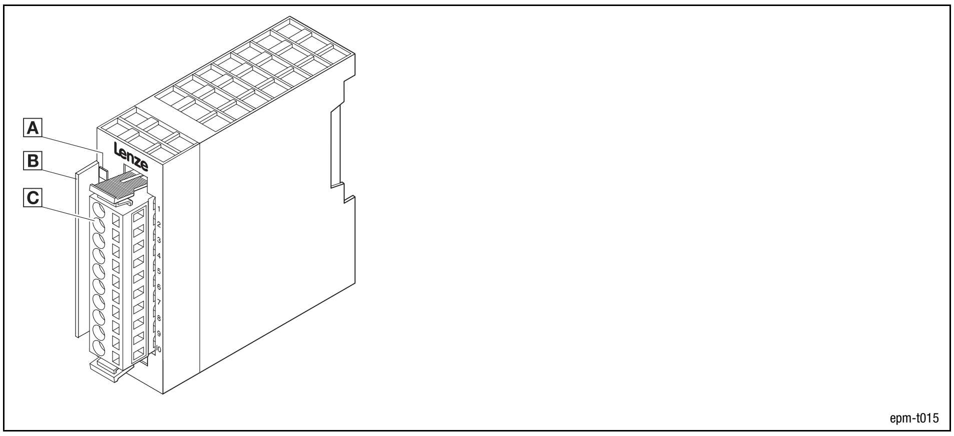


Fig. 4.7-1 Overview of 8×digital output 0.5A

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

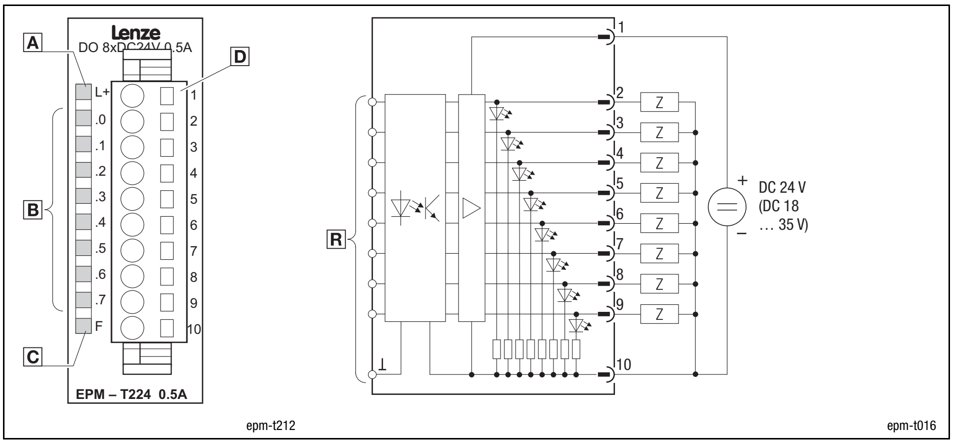


Fig. 4.7-2 Front view and connection of 8×digital output 0.5A

- A Status display L+; LED (yellow) is lit when a supply voltage is applied
- B Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered
- C Status display F; LED (red) is lit in case of overload, overheating or short circuit

D	Terminal strip assignment details
1	DC 24 V supply voltage
2	Digital output A.0
3	Digital output A.1
4	Digital output A.2
5	Digital output A.3
6	Digital output A.4
7	Digital output A.5
8	Digital output A.6
9	Digital output A.7
10	GND (reference potential)
R	Connection to backplane bus
Z	Load

Technical data

Type		8×digital output 0.5A
Voltage supply		DC 5 V / 50 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Digital output data		
	Rated load voltage	DC 24 V (DC 18 ... 35 V)
	Number of outputs	8
	Max. output current per output	0.5 A (sustained short-circuit-proof)
	Delay time	< 1 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Output data	1 byte
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T224**

4.8 16×digital output 0.5A

Description

The module 16×digital output 0.5A detects the binary control signals from the master bus system and transports them to the process level via the outputs. The digital outputs are supplied via an external voltage source (DC 24 V).

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 16 digital outputs
- DC 24 V supply voltage
- Each digital output has a load capacity of up to 0.5 A
- Suitable for solenoid valves and DC contactors
- LED displays the states of the digital outputs

Overview

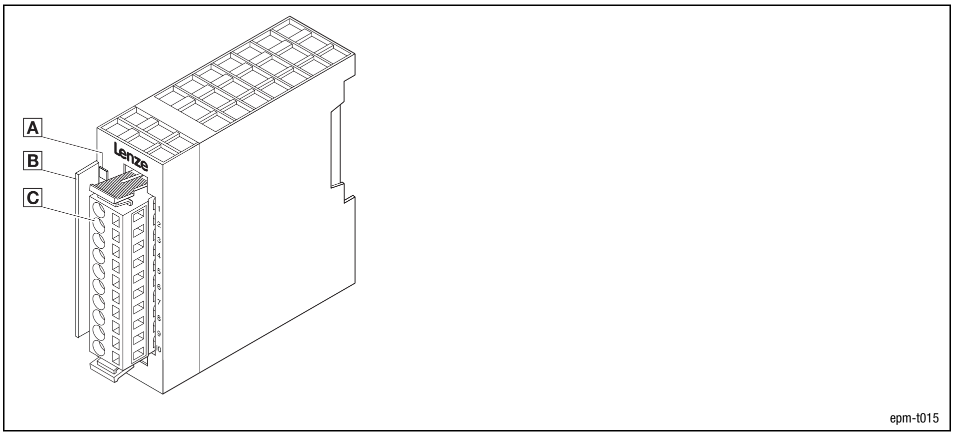


Fig. 4.8-1 Overview of 16×digital output 0.5A

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

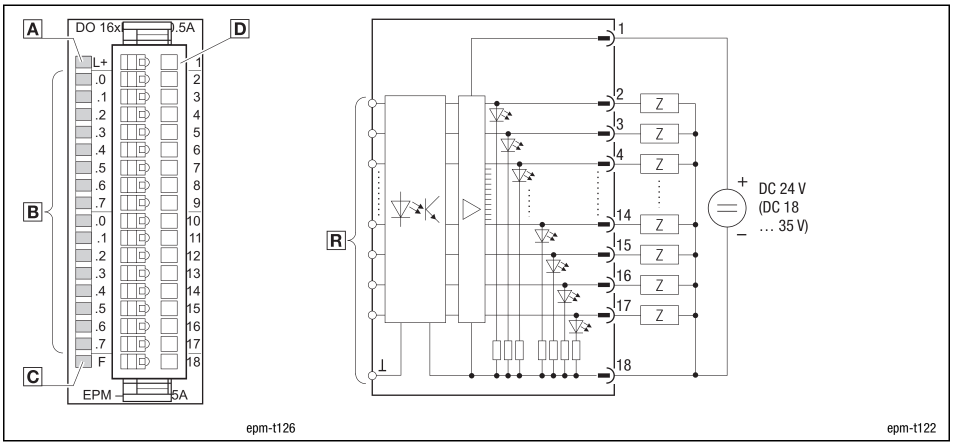


Fig. 4.8-2 Front view and connection of 16×digital output 0.5A

A	Status display L+; LED (yellow) is lit when a supply voltage is applied	D	Terminal strip assignment details
		1	DC 24 V supply voltage
		2	Digital output A.0
B	2 ×Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered	3	Digital output A.1
		4	Digital output A.2
		5	Digital output A.3
C	Status display F; LED (red) is lit in case of overload, overheating or short circuit	...	...
		15	Digital output A.13
		16	Digital output A.14
		17	Digital output A.15
		18	GND (reference potential)
		R	Connection to backplane bus
		Z	Load

Technical data

Type		16×digital output 0.5A
Voltage supply		DC 5 V / 80 mA (via backplane bus)
Connectable cable cross-section		≤ 1.5 mm^2 (≥ AWG 16)
Digital output data		
	Rated load voltage	DC 24 V (DC 18 ... 35 V)
	Number of outputs	16
	Max. output current per output	0.5 A (sustained short-circuit-proof)
	Max. output summation current	5A
	Delay time	< 1 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Output data	2 bytes
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T225**

4.9 8×digital output 1A

Description

The module 8×digital output 1A detects the binary control signals from the master bus system and transports them to the process level via the outputs. The digital outputs are supplied via an external voltage supply (DC 24 V).

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 8 digital outputs
- DC 24 V supply voltage
- Each digital output has a capacity of up to 1 A
- Suitable for solenoid valves and DC contactors
- LED displays the states of the digital outputs

Overview

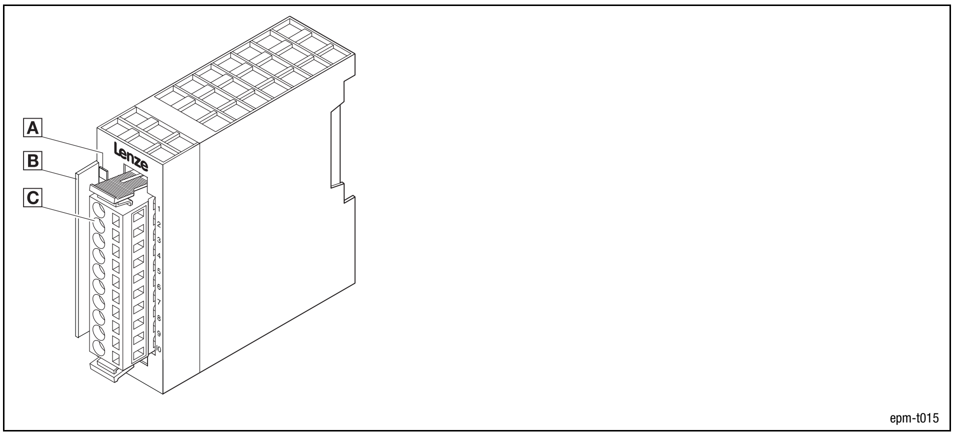


Fig. 4.9-1 Overview of 8×Digital output 1A

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

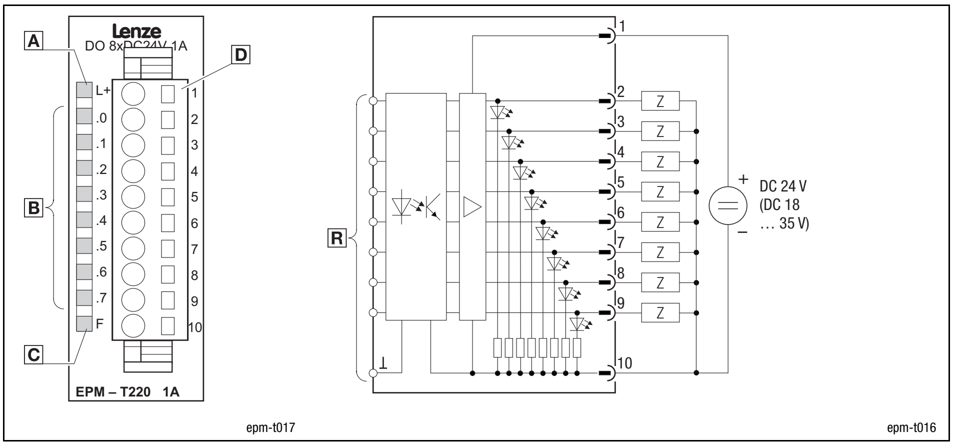


Fig. 4.9-2 Front view and connection of 8×digital output 1A

- A Status display L+; LED (yellow) is lit when a supply voltage is applied
- B Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered
- C Status display F; LED (red) is lit in case of overload, overheating or short circuit

D	Terminal strip assignment details
1	DC 24 V supply voltage
2	Digital output A.0
3	Digital output A.1
4	Digital output A.2
5	Digital output A.3
6	Digital output A.4
7	Digital output A.5
8	Digital output A.6
9	Digital output A.7
10	GND (reference potential)
R	Connection to backplane bus
Z	Load

Technical data

Type		8×digital output 1A
Voltage supply		DC 5 V / 50 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Digital output data		
	Rated load voltage	DC 24 V (DC 18 ... 35 V)
	Number of outputs	8
	Max. output current per output	1 A (sustained short-circuit-proof)
	Delay time	< 1 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Output data	1 byte
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T220**

4.10 16×digital output 1A

Description

The module 16×digital output 1A detects the binary control signals from the master bus system and transports them to the process level via the outputs. The digital outputs are supplied via an external voltage source (DC 24 V).

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 16 digital outputs
- DC 24 V supply voltage
- Each digital output has a capacity of up to 1 A
- Suitable for solenoid valves and DC contactors
- LED displays the states of the digital outputs

Overview

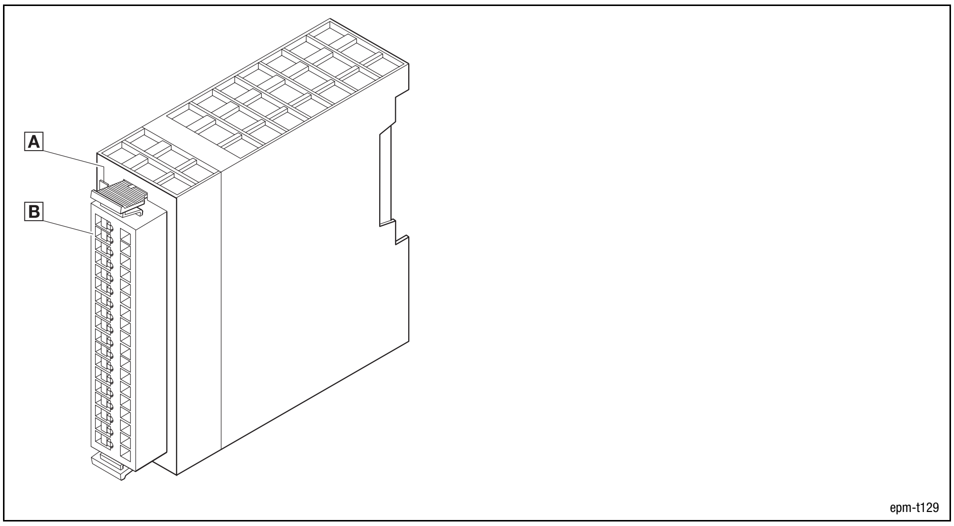


Fig. 4.10-1 Overview of 16×digital output 1A

A LED for status display
B Plug-in terminal strip

Status display and terminal assignment

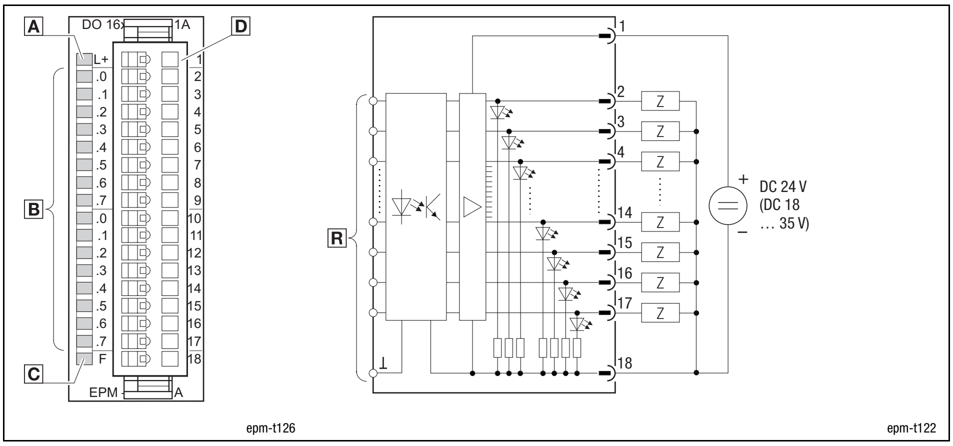


Fig. 4.10-2 Front view and connection of 16×digital output 1A

- A Status display L+; LED (yellow) is lit when a supply voltage is applied
- B 2 ×Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered
- C Status display F; LED (red) is lit in case of overload, overheating or short circuit

D	Terminal strip assignment details
1	DC 24 V supply voltage
2	Digital output A.0
3	Digital output A.1
4	Digital output A.2
5	Digital output A.3
...	...
15	Digital output A.13
16	Digital output A.14
17	Digital output A.15
18	GND (reference potential)
R	Connection to backplane bus
Z	Load

Technical data

Type	16×digital output 1A
Voltage supply	DC 5 V / 80 mA (via backplane bus)
Connectable cable cross-section	≤ 1.5 mm² (≥ AWG 16)
Digital output data	
Rated load voltage	DC 24 V (DC 18 ... 35 V)
Number of outputs	16
Max. output current per output	1 A (sustained short-circuit-proof)
Max. output summation current	10A
Delay time	< 1 ms
Electrical isolation from backplane bus	Yes, via optocouplers
Communication	
Output data	2 bytes
Dimensions	
Width	25.4 mm
Height	76.0 mm
Depth	76.0 mm
Weight	50 g

Order designation	EPM-T223

4.11 8×digital output 2A

Description

The module 8×digital output 2A detects the binary control signals from the master bus system and transports them to the process level via the outputs. The digital outputs are supplied via an external voltage source (DC 24 V).

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 8 digital outputs
- DC 24 V supply voltage
- Each digital output has a capacity of up to 2 A
- Suitable for solenoid valves and DC contactors
- LED displays the states of the digital outputs

Overview

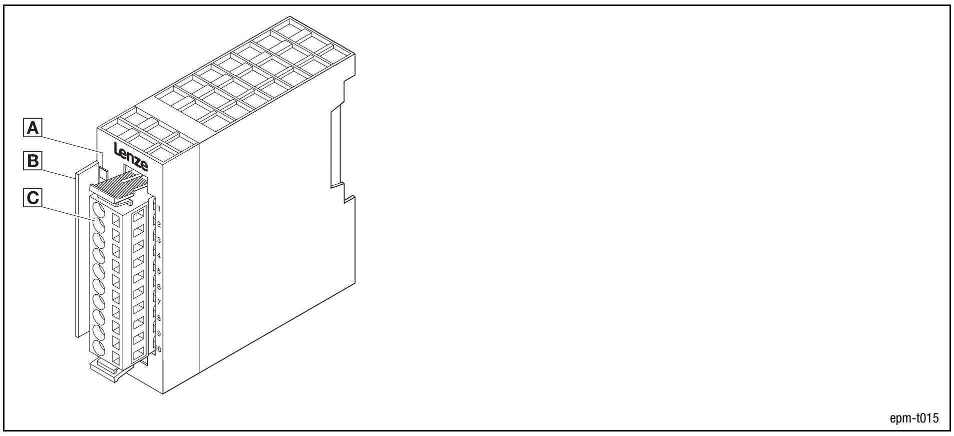


Fig. 4.11-1 Overview of 8×digital output 2A

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

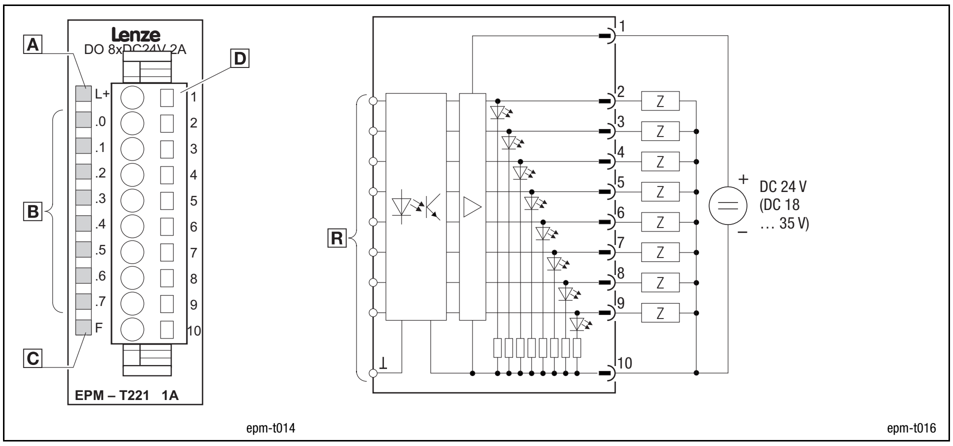


Fig. 4.11-2 Front view and connection of 8×digital output 2A

A	Status display L+; LED (yellow) is lit when a supply voltage is applied
B	Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered
C	Status display F; LED (red) is lit in case of overload, overheating or short circuit

D	Terminal strip assignment details
1	DC 24 V supply voltage
2	Digital output A.0
3	Digital output A.1
4	Digital output A.2
5	Digital output A.3
6	Digital output A.4
7	Digital output A.5
8	Digital output A.6
9	Digital output A.7
10	GND (reference potential)
R	Connection to backplane bus
Z	Load

Technical data

Type		8×digital output 2A
Voltage supply		DC 5 V / 50 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Digital output data		
	Rated load voltage	DC 24 V (DC 18 ... 35 V)
	Number of outputs	8
	Max. output current per output	2 A (sustained short-circuit-proof)
	Max. output summation current	10A
	Delay time	< 1 ms
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Output data	1 byte
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T221**

4.12 4×relay

Description

The module 4×relay detects the binary control signals from the master bus system and transports them to the process level via the outputs. The module has four relays with a switch each (NO contact).

> **Note!**
> The chapter "Parameter setting" describes how to parameterise the module.

Features

- Four isolated relay outputs
- Up to 230 V AC or up to 30 V DC contact voltage
- Max. 5 A contact current
- Suitable for motors, lamps, solenoid valves and DC contactors
- LED displays the switching states

Overview

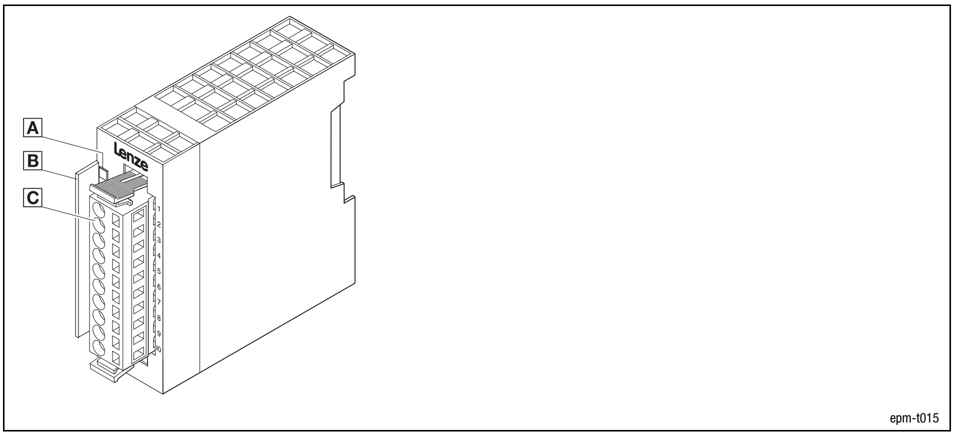


Fig. 4.12-1 Overview of 4×relay

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

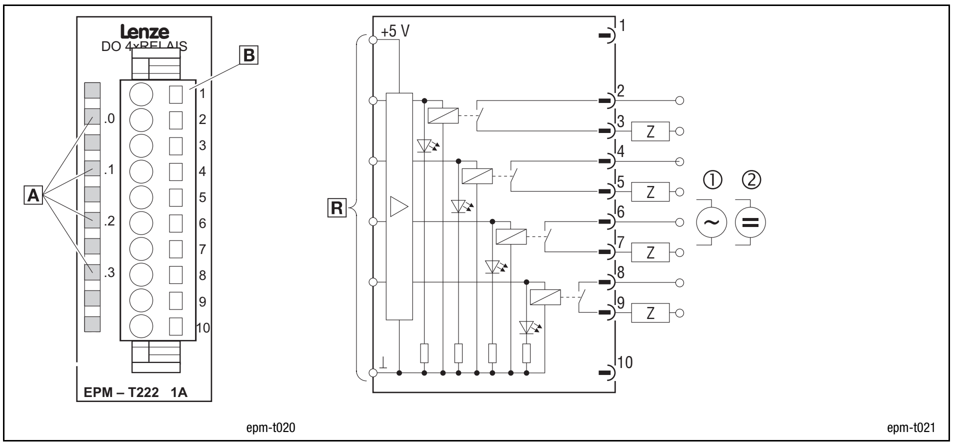


Fig. 4.12-2 Front view and connection of 4×relay

A Status display; LED (green) is lit when a relay output is triggered

.0	Relay output A.0
.1	Relay output A.1
.2	Relay output A.2
.3	Relay output A.3

B Terminal strip assignment details

1	Not assigned
2/3	Relay output A.0
4/5	Relay output A.1
6/7	Relay output A.2
8/9	Relay output A.3
10	Not assigned
R	Connection to backplane bus
①	External AC voltage source AC 0 ... 230 V
②	External DC voltage source DC 0 ... +30 V
-[Z]-	Load

Technical data

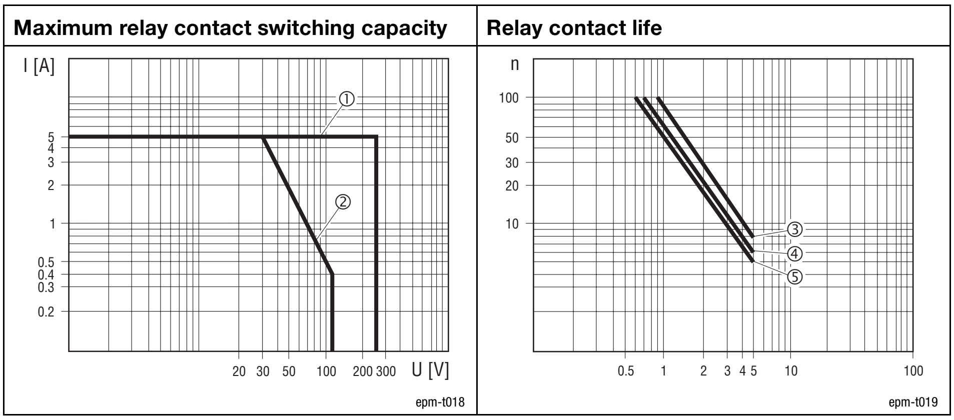


Fig. 4.12-3 Diagrams for the module 4×relay

I Contact current
U Contact voltage
① Switching capacity at AC voltage
② Switching capacity at DC voltage
n Number of switching cycles × 10^4
③ Service life at AC 125 V
④ Service life at DC 30 V
⑤ Service life at AC 230 V

Type		4×relay
Voltage supply		DC 5 V / 150 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm² (≥ AWG 14)
Relay outputs		
	Number	4
	Max. contact voltage	AC 230 V DC 30 V
	Max. contact current	5A
	Max. relay switching frequency	100 Hz
Communication		
	Output data	1 byte (bit 0 ... bit 3)
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		80 g

Order designation	**EPM-T222**

4.13 8×digital input / output

Description

The channels of the module 8×digital input / output can be used either as digital inputs or outputs. The digital inputs or outputs are supplied via an external voltage source.

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 8 digital inputs or outputs, depending on the circuit configuration
- DC 24 V supply voltage
- Each digital output has a capacity of up to 1 A
- LED shows the status

Overview

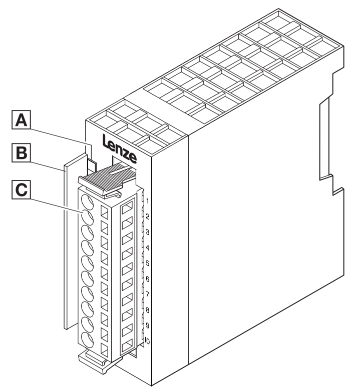


Fig. 4.13-1 Overview of 8×digital input / output

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

Stop!

If the voltage supply (DC 5 V via the backplane bus) fails, the module will malfunction:

- Switched outputs carry voltage if one input is assigned with a HIGH level,
- The module can be destroyed since the outputs are no longer resistant to short circuits.

The emergency-off switch ensures that when being operated, the outputs do not carry any voltage and the inputs are not assigned with a HIGH level.

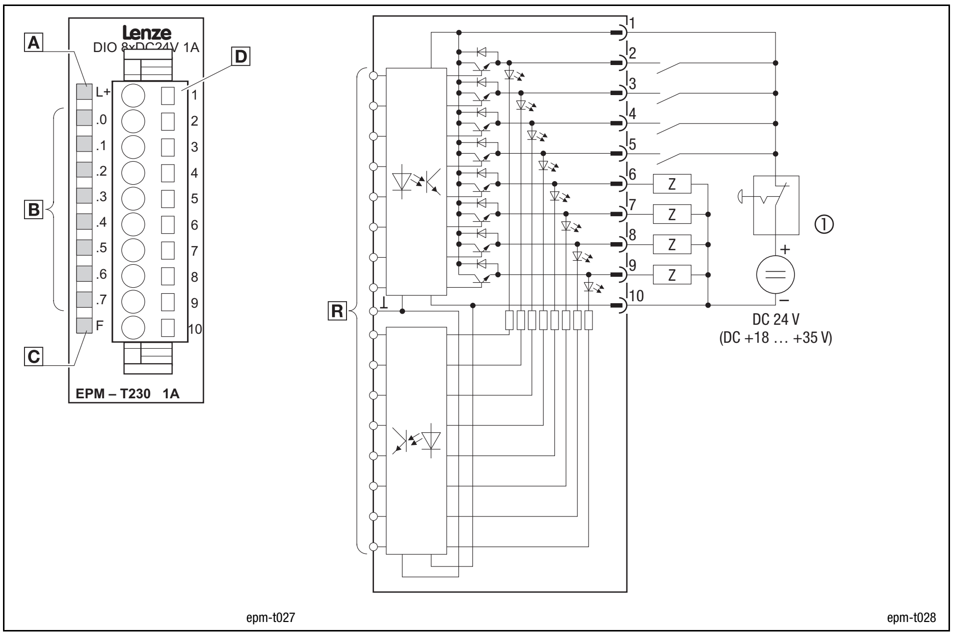


Fig. 4.13-2 Front view and connection of 8×digital input / output

A	Status display L+; LED (yellow) is lit when a supply voltage is applied	D	Terminal strip assignment details
		1	DC 24 V supply voltage
		2	Digital input / output E/A.0
B	Status display .0 ... .7; LED (green) is lit when the corresponding output is triggered	3	Digital input / output E/A.1
		4	Digital input / output E/A.2
		5	Digital input / output E/A.3
C	Status display F; LED (red) is lit in case of overload, overheating or short circuit	6	Digital input / output E/A.4
		7	Digital input / output E/A.5
		8	Digital input / output E/A.6
		9	Digital input / output E/A.7
		10	GND (reference potential)
		R	Connection to backplane bus
		①	Emergency-off switch
		Z	Load

Technical data

Type			8×digital input / output
Voltage supply			DC 5 V / 50 mA (via backplane bus)
Connectable cable cross-section			≤ 2.5 mm^2 (≥ AWG 14)
Digital inputs / outputs			
	Number		8, can be optionally parameterised as inputs or outputs
	Electrical isolation from backplane bus		Yes, via optocouplers
	Digital inputs		
		Inputs	8
		Rated input voltage	DC 24 V (DC 18 ... 35 V)
		Level	LOW: DC 0 V ... 5 V HIGH: DC 15 V ... 30 V
		Input resistance	3.3 kΩ
		Delay time	3 ms
	Digital outputs		
		Outputs	8
		Rated load voltage	DC 24 V (DC 18 ... 35 V)
		Max. output current per output	1 A (resistant to short circuits)
		Delay time	< 1 ms
Communication			
	Input data		1 byte
	Output data		1 byte
Dimensions			
	Width		25.4 mm
	Height		76.0 mm
	Depth		76.0 mm
Weight			50 g

Order designation	**EPM-T230**

4.14 4×analog input

Description

The module 4×analog input has four analog inputs which can be parameterised individually. The module assigns a total of eight bytes of input data in the process image (two bytes per input). The analog inputs are isolated with regard to the backplane bus.

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 4 analog inputs
- The inputs can be parameterised individually
- Any unused inputs can be deactivated
- The reference potentials (GND) of the analog inputs are electrically separated from each other
- The reference potentials may vary from each other by a voltage differential of up to 5 V
- Input ranges: Voltage, current, temperature, resistance
- LED diagnostics display a wire breakage or overcurrent in the current measuring range

Overview

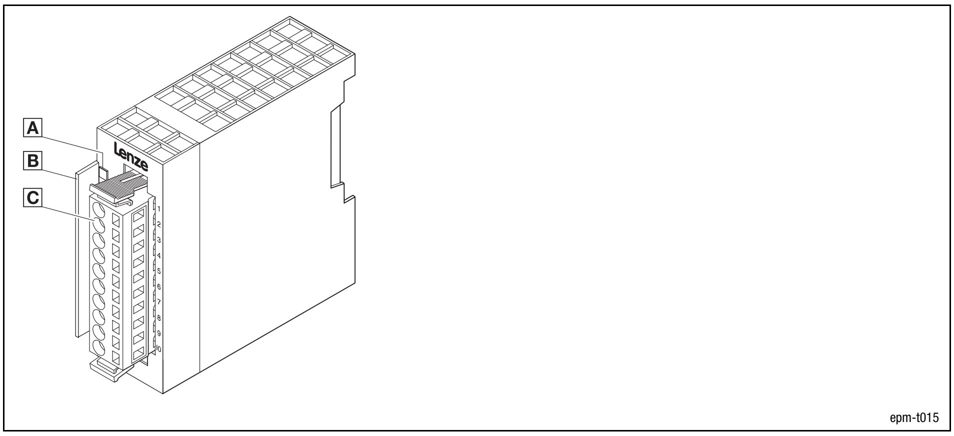


Fig. 4.14-1 Overview of 4×analog input

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

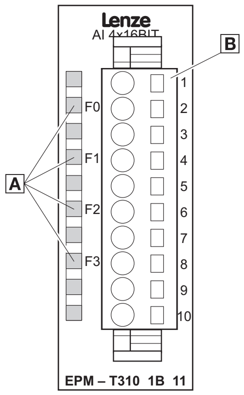


Fig. 4.14-2 Front view 4×analog input

A Status display
LED (red) is lit in case of a wire breakage in the measuring range of 4 ... 20 mA
LED (red) is blinking at an input current of >40 mA

F0	Analog input E.0
F1	Analog input E.1
F2	Analog input E.2
F3	Analog input E.3

B Terminal strip
Assignment:

	Two-wire connection	Four-wire connection
1	Not assigned	-V / analog input E.0
2	+ / analog input E.0	-I / analog input E.0
3	- / analog input E.0	Not assigned
4	+ / analog input E.1	+V / analog input E.0
5	- / analog input E.1	-I / analog input E.0
6	+ / analog input E.2	-I / analog input E.2
7	- / analog input E.2	Not assigned
8	+ / analog input E.3	+V / analog input E.2
9	- / analog input E.3	-I / analog input E.2
10	Not assigned	-V / analog input E.2

Connection

> **Stop!**
>
> The module will be destroyed if the connected signals or encoders do not match the set measuring range:
>
> - Max. 15 V input voltage in the voltage measuring range.
> - No input voltage in the resistance measuring range.
> - When the measuring range is changed, only assign the inputs after the first gateway initialisation has been completed:
>   – During initialisation, the previous settings are still active. Unsuitable input circuits may destroy the modules. Changes will only become effective and permanently saved after initialisation.

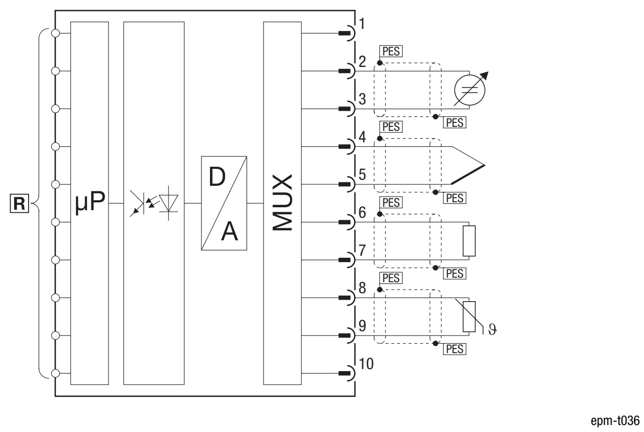
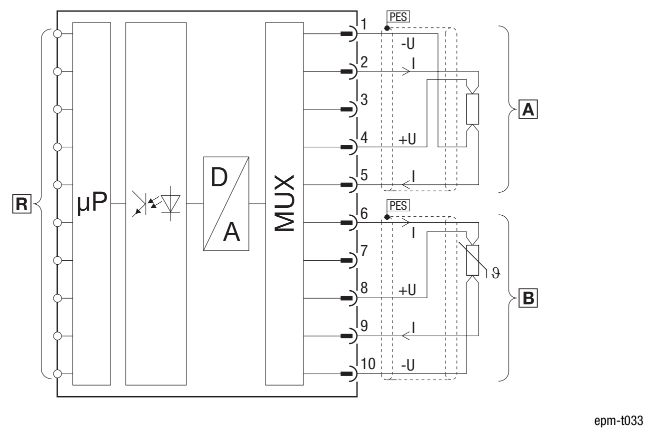
Two-wire connection	Four-wire connection
	

Fig. 4.14-3 Sensor connection

A Analog input E.0
B Analog input E.2
R Connection to backplane bus
PES HF shield termination through large-surface connection to PE
Sensor:
 Voltage or current source
 Thermal element
 Resistor
 Resistor, temperature-dependent

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by setting parameters.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type	4×analog input	
Voltage supply	DC 5 V / 280 mA (via backplane bus)	
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)	
Analog inputs		
Number	4	
Input area		
Voltage	-10 ... +10 V -4 ... +4 V -400 ... +400 mV 0 ... +50 mV	Information on tolerances can be found in the chapter ”Parameter setting”
Current	-20 ... +20 mA +4 ... +20 mA	
Resistance	60 Ω, 600 Ω, 3 kΩ,6 kΩ	
Resistor, temperature-dependent	PT100, PT1000, Ni100, NI1000	
Thermal element	J, K, N, R, S, T	
Input resistance		
Voltage range	2 MΩ	
Current range	50 Ω	
Delay times	Conversion time/resolution	

Delay times									
Conversion rate	[Hz]	3.7	7.5	15	30	60	123	168	202
Processing time per channel	[ms]	290	150	84	54	36	28	26	26
Resolution	[bit]	16	16	16	16	15	14	12	10

Electrical isolation from backplane bus	Yes, via optocouplers
Communication	
Input data	8 bytes (2 bytes per analog input)
Parameter data	10 bytes
Diagnostic data	4 bytes
Dimensions	
Width	25.4 mm
Height	76.0 mm
Depth	76.0 mm
Weight	100 g

Order number	**EPM-T310**

4.15 4×analog input ±10V

Description

The module 4×analog input ±10V has 4 analog inputs. The module assigns a total of eight bytes of input data in the process image (2 bytes per input). The analog inputs are isolated with regard to the backplane bus.

> **Note!**
>
> The chapter "Parameter setting" describes how to parameterise the module.

Features

- 4 analog inputs
- Voltage measuring range ± 10 V
- Signal function and data format can be parameterised
- The reference potentials may vary from each other by a voltage differential of up to 2 V
- Status LED indicates whether the input voltage is outside of the permitted measuring range

Overview

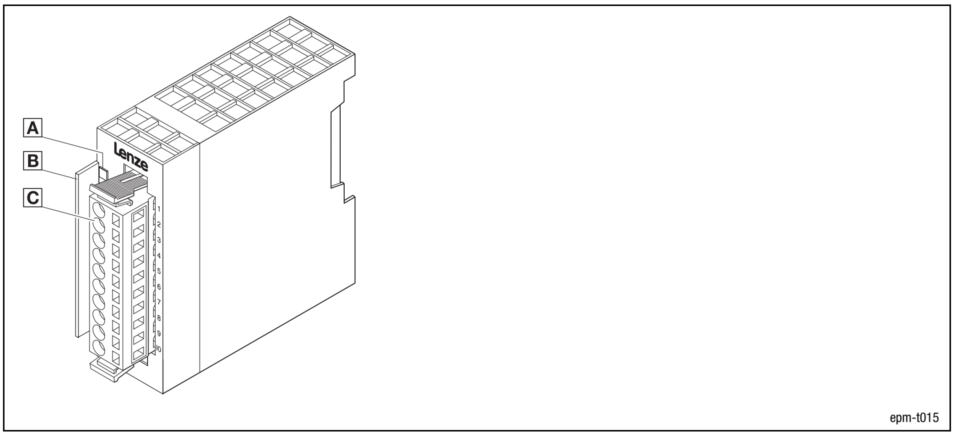


Fig. 4.15-1 Overview of 4×analog input ±10V

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

> **Stop!**
>
> The module will be destroyed if the connected signals or encoders do not match the set measuring range:

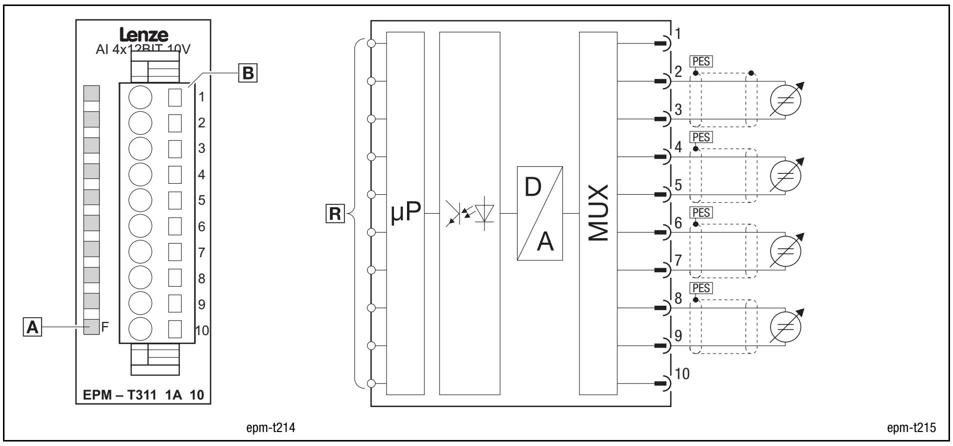


Fig. 4.15-2 Front view of 4×analog input ±10V

A Status display F; LED (red)
Lights if the input voltage is outside of the permitted measuring range

B Terminal strip assignment details

1	Not assigned
2	+ / analog input E.0
3	- / analog input E.0
3	+ / analog input E.1
5	- / analog input E.1
6	+ / analog input E.2
7	- / analog input E.2
8	+ / analog input E.3
9	- / analog input E.3
10	Not assigned

R Connection to backplane bus

Voltage source

PES HF shield termination through large-surface connection to PE

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by setting parameters.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type		4×analog input ±10V
Voltage supply		DC 5 V / 120 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Analog inputs		
	Number	4
	Input range	-10 ... +10 V
	Tolerance	± 0.3 %
	Input resistance	100 kΩ
	Max. input voltage	30 V
	Delay times	Conversion time/resolution
	Processing time per channel	2 ms
	Resolution	12 Bit
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Input data	8 bytes (2 bytes per analog input)
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		80 g

Order number	**EPM-T311**

4.16 4×analog input ±20mA

Description

The module 4×analog input ±20mA has 4 analog inputs. The module assigns a total of eight bytes of input data in the process image (2 bytes per input). The analog inputs are isolated with regard to the backplane bus.

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 4 analog inputs
- Current measuring range ± 20 mA
- Signal function and data format can be parameterised
- The reference potentials may vary from each other by a voltage differential of up to 2 V
- Status LED indicates if the input current is outside of the permitted measuring range

Overview

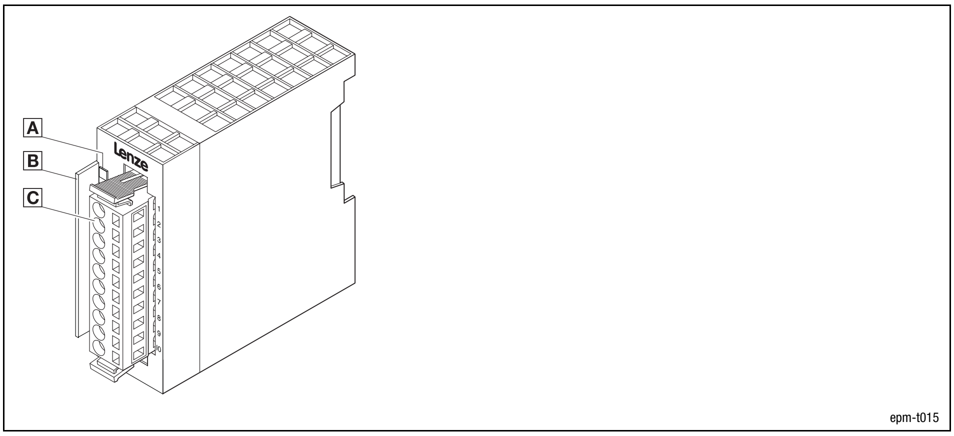


Fig. 4.16-1 Overview of 4×analog input ±20mA

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

Stop!

The module will be destroyed if the connected signals or encoders do not match the set measuring range:

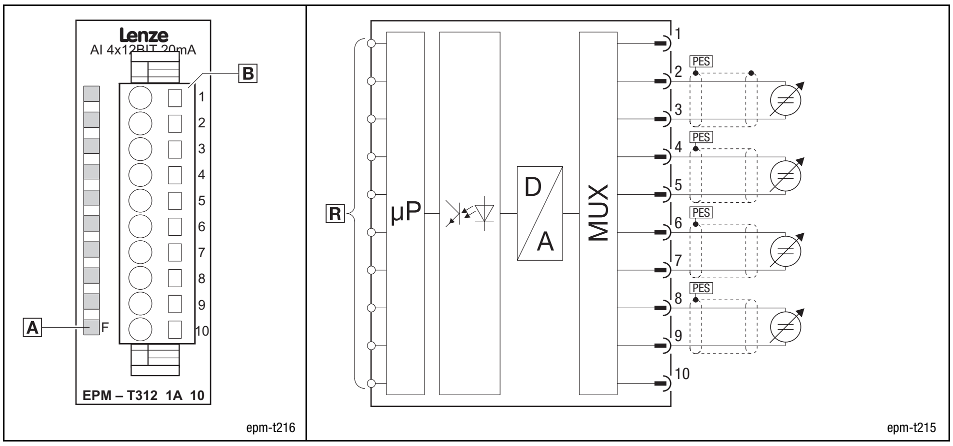


Fig. 4.16-2 Front view of 4×analog input ±20mA

A Status display F; LED (red)
Is lit if the input voltage is outside of the permitted measuring range

B Terminal strip assignment details

1	Not assigned
2	+ / analog input E.0
3	- / analog input E.0
3	+ / analog input E.1
5	- / analog input E.1
6	+ / analog input E.2
7	- / analog input E.2
8	+ / analog input E.3
9	- / analog input E.3
10	Not assigned

R Connection to backplane bus

 Current source

PES HF shield termination through large-surface connection to PE

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by setting parameters.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type		4×analog input ±20mA
Voltage supply		DC 5 V / 120 mA (via backplane bus)
Connectable cable cross-section		≤ 2.5 mm^2 (≥ AWG 14)
Analog inputs		
	Number	4
	Input range	- 20 ... + 20 mA
	Tolerance	± 0.3 %
	Input resistance	60 Ω
	Max. input current	40 mA
	Delay times	Conversion time/resolution
	Processing time per channel	2 ms
	Resolution	12 Bit
	Electrical isolation from backplane bus	Yes, via optocouplers
Communication		
	Input data	8 bytes (2 bytes per analog input)
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		80 g

Order number	**EPM-T312**

4.17 4×analog output

Description

The module 4×analog output has four analog outputs which can be parameterised individually. The analog outputs are isolated with regard to the backplane bus.

Note!

The chapter "Parameter setting" describes how to parameterise the module.

Features

- 4 analog outputs
- DC 24 V supply voltage
- The outputs can be parameterised individually
- One reference potential (GND) for all outputs
- Output ranges: Voltage, current
- LED diagnostics displays a wire breakage at current output and a short circuit at voltage output

Overview

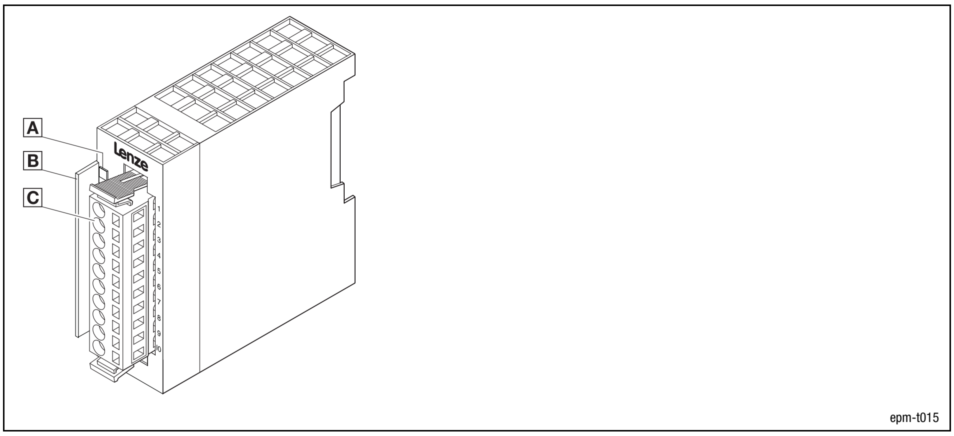


Fig. 4.17-1 Overview of 4×analog output

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

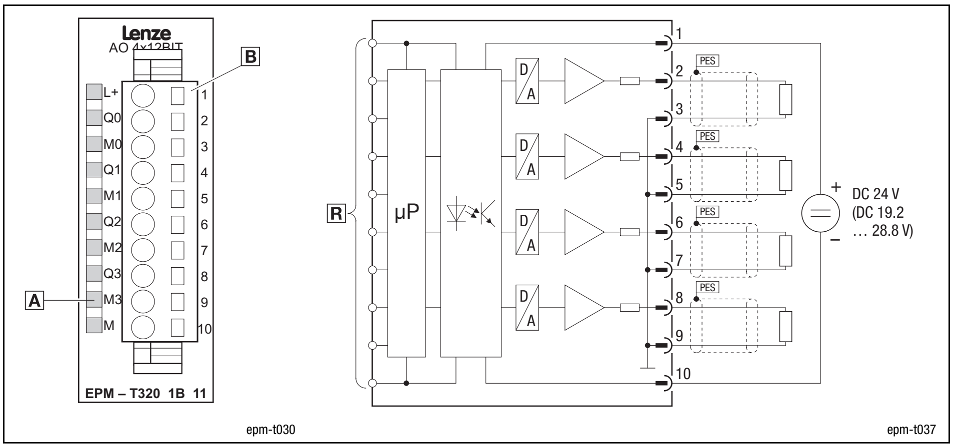


Fig. 4.17-2 Front view and connection of 4×analog output

A Status display M3; LED (red) is lit in case of the following faults:
- Short-circuit on voltage output
- Open circuit in the case of current output
- Gateway is not supplied with voltage

B Terminal strip assignment details

1	DC 24 V supply voltage
2	Analog output A.0
4	Analog output A.1
6	Analog output A.2
8	Analog output A.3
3, 5, 7, 9	GND1 (reference potential for analog signals)
10	GND (reference potential for supply voltage)

R Connection to backplane bus

▭ Input resistance of actuator

PES HF shield termination through large-surface connection to PE

- Ensure correct polarity when connecting the actuators.
- Unused outputs remain unassigned.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type	4×analog output	
Voltage supply	DC 5 V / 30 mA (via backplane bus)	
External voltage supply	DC 24 V / 200 mA (DC 19.2 ... 28.8 V)	
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)	
Analog outputs		
Number	4 outputs	
Analog-to-digital converter	12 bits	
Output ranges		
Voltage	-10 ... +10 V +1 ... +5 V 0 ... +10 V	Information on tolerances can be found in the chapter "Parameter setting"
Current	-20 ... +20 mA +4 ... +20 mA 0 ... +20 mA	
Actuator - input resistance		
Voltage range	min. 1 kΩ (output current max. 10 mA)	
Current range	min. 500 Ω (output current max. 20 mA)	
Delay time	10 ms	
Electrical isolation from backplane bus	Yes, via optocouplers	
Communication		
Output data	8 bytes (2 bytes per analog output)	
Parameter data	6 bytes	
Diagnostic data	4 bytes	
Dimensions		
Width	25.4 mm	
Height	76.0 mm	
Depth	76.0 mm	
Weight	100 g	

Order number	**EPM-T320**

4.18 4×analog output ±10V

Description

The module 4×analog output ±10V has 4 analog outputs. The module assigns a total of eight bytes of output data in the process image (2 bytes per output). The analog outputs are isolated with regard to the backplane bus.

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 4 analog outputs
- Output range: ± 10 V, 0 ... 10 V
- Signal function and data format can be parameterised
- DC 24 V supply voltage
- One reference potential (GND) for all outputs

Overview

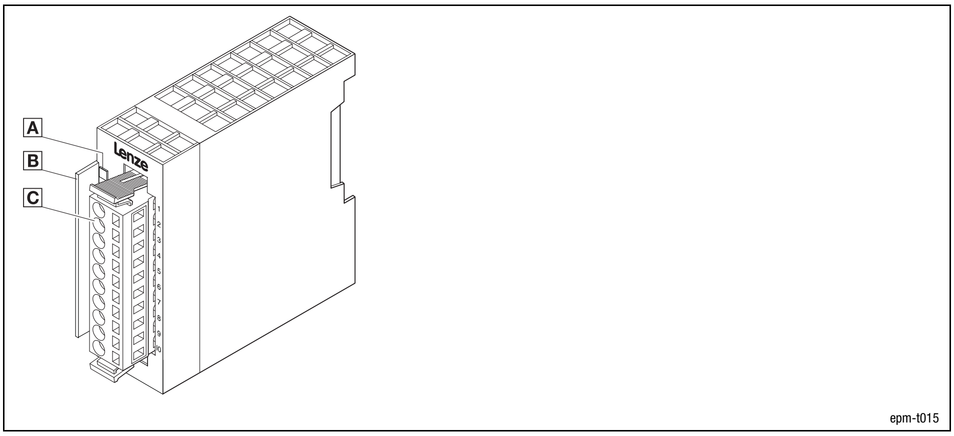


Fig. 4.18-1 Overview of 4×analog output ±10V

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

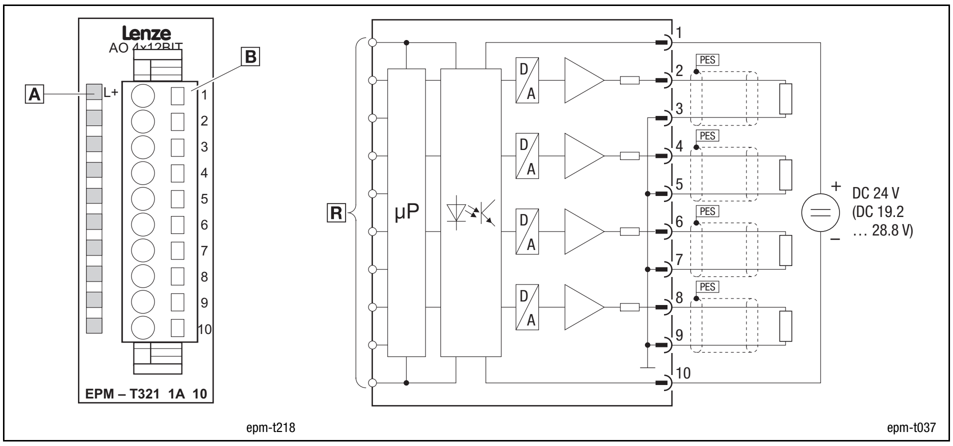


Fig. 4.18-2 Front view and connection of 4×analog output ±10V

A	Status display L+; LED (yellow) is lit when a supply voltage is applied	B	Terminal strip assignment details
		1	DC 24 V supply voltage
		2	Analog output A.0
		4	Analog output A.1
		6	Analog output A.2
		8	Analog output A.3
		3, 5, 7, 9	GND1 (reference potential for analog signals)
		10	GND (reference potential for supply voltage)
		R	Connection to backplane bus
		▭	Input resistance of actuator
		PES	HF shield termination through large-surface connection to PE

- Ensure correct polarity when connecting the actuators.
- Unused outputs remain unassigned.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type	4×analog output ±10V	
Voltage supply	DC 5 V / 60 mA (via backplane bus)	
External voltage supply	DC 24 V / 100 mA (DC 19.2 ... 28.8 V)	
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)	
Analog outputs		
Number	4 outputs	
Analog-to-digital converter	12 Bit	
Output range		
Voltage	-10 ... +10 V	Information on tolerances can be found in the chapter "Parameter setting"
Actuator - input resistance	> 5 kΩ	
Output current	< 6 mA	
Delay time per channel	450 µs	
Electrical isolation from backplane bus	Yes, via optocouplers	
Communication		
Output data	8 bytes (2 bytes per analog output)	
Dimensions		
Width	25.4 mm	
Height	76.0 mm	
Depth	76.0 mm	
Weight	100 g	

Order number	**EPM-T321**

4.19 4×analog output 0...20mA

Description

The module 4×analog output 0...20mA has 4 analog outputs. The module assigns a total of eight bytes of output data in the process image (2 bytes per output). The analog outputs are isolated with regard to the backplane bus.

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 4 analog outputs
- Output ranges: 0 ... 20 mA, 4 ... 20 mA
- Signal function and data format can be parameterised
- DC 24 V supply voltage
- One reference potential (GND) for all outputs

Overview

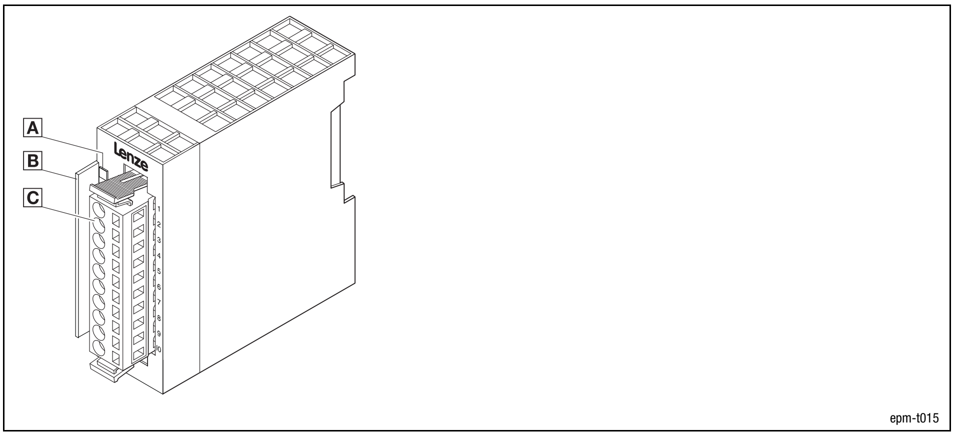


Fig. 4.19-1 Overview of 4×analog output 0...20mA

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

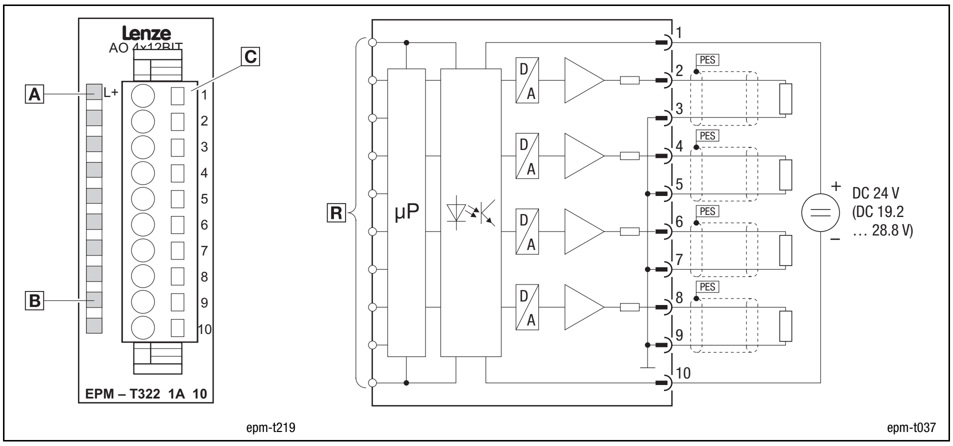


Fig. 4.19-2 Front view and connection of 4×analog output 0...20mA

A Status display L+; LED (yellow) is lit when a supply voltage is applied

B Status display M3; LED (red)
Open circuit on current output
Gateway is not supplied with voltage

C Terminal strip assignment details

1	DC 24 V supply voltage
2	Analog output A.0
4	Analog output A.1
6	Analog output A.2
8	Analog output A.3
3, 5, 7, 9	GND1 (reference potential for analog signals)
10	GND (reference potential for supply voltage)

R Connection to backplane bus

▭ Input resistance of actuator

PES HF shield termination through large-surface connection to PE

- Ensure correct polarity when connecting the actuators.
- Unused outputs remain unassigned.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type	4×analog output 0...20mA	
Voltage supply	DC 5 V / 60 mA (via backplane bus)	
External voltage supply	DC 24 V / 50 mA (DC 19.2 ... 28.8 V)	
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)	
Analog outputs		
Number	4 outputs	
Analog-to-digital converter	12 Bit	
Output range		
Current	0 ... 20 mA 4 ... 20 mA	Information on tolerances can be found in the chapter "Parameter setting"
Actuator - input resistance	> 350 Ω	
Delay time per channel	450 µs	
Electrical isolation from backplane bus	Yes, via optocouplers	
Communication		
Output data	8 bytes (2 bytes per analog output)	
Dimensions		
Width	25.4 mm	
Height	76.0 mm	
Depth	76.0 mm	
Weight	100 g	

Order number	**EPM-T322**

4.20 4×analog input / output

Description

The module 4×analog input / output has two analog inputs and two analog outputs which can be parameterised individually. The analog inputs and outputs are isolated from the backplane bus and the voltage supply.

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 2 analog inputs
- 2 analog outputs
- DC 24 V supply voltage
- The inputs and outputs can be parameterised individually
- Input ranges: Voltage, current
- Output ranges: Voltage, current
- LED diagnostics displays a wire breakage in the current measuring range

Overview

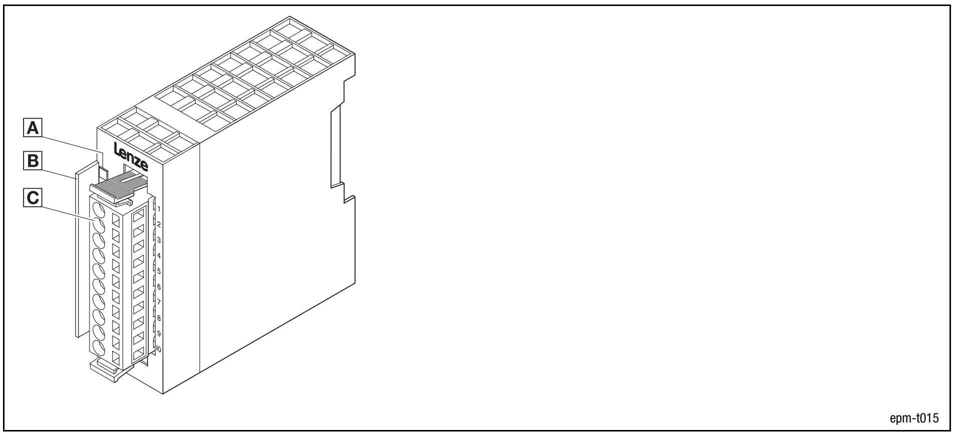


Fig. 4.20-1 Overview of 4×analog input / output

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

Stop!

The module will be destroyed if the connected signals or encoders do not match the set measuring range:

- Max. 15 V input voltage in the voltage measuring range.
- No input voltage in the resistance measuring range.
- When the measuring range is changed, only assign the inputs after the first gateway initialisation has been completed:
  - During initialisation, the previous settings are still active. Unsuitable input circuits may destroy the modules. Changes will only become effective and permanently saved after initialisation.

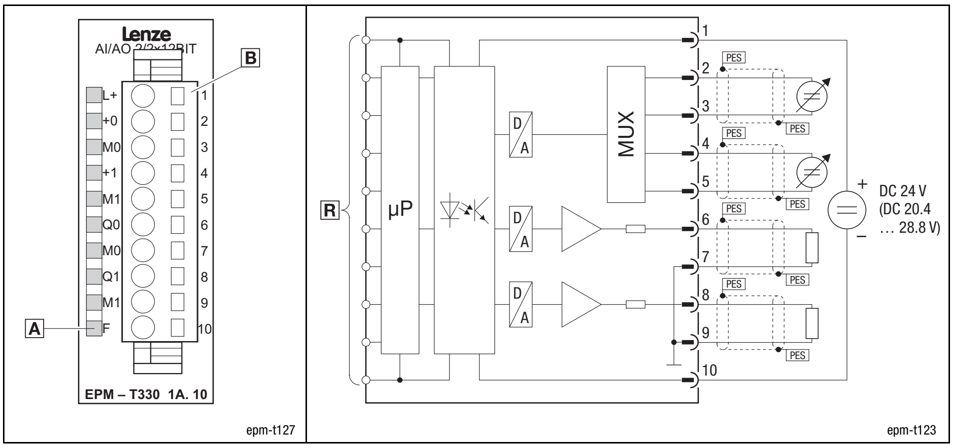


Fig. 4.20-2 Front view and connection of 4×analog input / output

A Status display F; LED (red) is lit in case of the following faults:
- No external supply voltage
- Wire breakage in the current measuring range

Input resistance of actuator

Sensor (voltage or current source)

PES HF shield termination through large-surface connection to PE

B Terminal strip assignment details

1	DC 24 V supply voltage
2	+ analog input E.0
3	- analog input E.0
4	+ analog input E.1
5	- analog input E.1
6	Analog output A.0
8	Analog output A.1
7, 9	GND (reference potential for analog signals)
10	GND (reference potential for supply voltage)

R Connection to backplane bus

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by setting parameters.
- Ensure correct polarity when connecting the actuators.
- Unused outputs remain unassigned.
- The module does not provide any auxiliary supply for sensors / actuators. For information on how to connect an auxiliary supply, please see the documentation for the sensors / actuators.

Technical data

Type	4×analog input / output
Voltage supply	DC 5 V / 100 mA (via backplane bus)
External voltage supply	DC 24 V / 110 mA (DC 20.4 ... 28.8 V)
Short-circuit current	30 mA
Connectable cable cross-section	≤ 2.5 mm² (≥ AWG 14)
Analog inputs	
Number	2
Input area	
Voltage	0 ... +10 V -10 ... +10 V +1 ... +5 V Information on tolerances can be found in the chapter ”Parameter setting”
Current	0 ... +20 mA -20 ... +20 mA +4 ... +20 mA

Conversion rate	[Hz]	3.7	7.5	15	30	60	123	168	202
Processing time per channel	[ms]	290	150	84	54	36	28	26	26
Resolution	[bit]	16	16	16	16	15	14	12	10

Electrical isolation from backplane bus	Yes, via optocouplers
Analog outputs	
Number	2
Analog-to-digital converter	12 bits
Output ranges (Tolerances refer to the upper limit of effective range)	
Voltage	0 ... +10 mA (±0.4 %) -10 ... +10 mA (±0.2 %) +1 ... +5 mA (±0.6 %)
Current	0 ... +20 mA (±0.6 %) -20 ... +20 mA (±0.3 %) +4 ... +20 mA (±0.8 %)
Actuator - input resistance	
Voltage range	min. 1 kΩ (output current max. 10 mA)
Current range	min. 500 Ω (output current max. 20 mA)
Delay time	10 ms
Electrical isolation from backplane bus	Yes, via optocouplers
Communication	
Input data	4 bytes (one word per channel)
Output data	4 bytes
Parameter data	12 bytes
Diagnostic data	12 bytes
Dimensions	
Width	25.4 mm
Height	76.0 mm
Depth	76.0 mm
Weight	100 g

Order number	**EPM-T330**

4.21 2/4×counter

Description

The module 2/4×counter detects the pulses of the connected encoders and processes these pulses according to the mode selected. The module has two 32-bit counters or four 16-bit counters. Each 32-bit counter has a digital output which can be triggered depending on the mode.

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- Two 32-bit counters or four 16-bit counters
- One freely configurable digital output per 32-bit counter with an output current of 0.5 A
- Counter and compare registers loaded via control byte
- Up / down counter, optionally with a channel width of 32 or 16 bits
- Compare and Auto Reload functionality
- Various modes for encoder pulses
- Period and frequency measuring
- LED displays status of the inputs and outputs

Overview

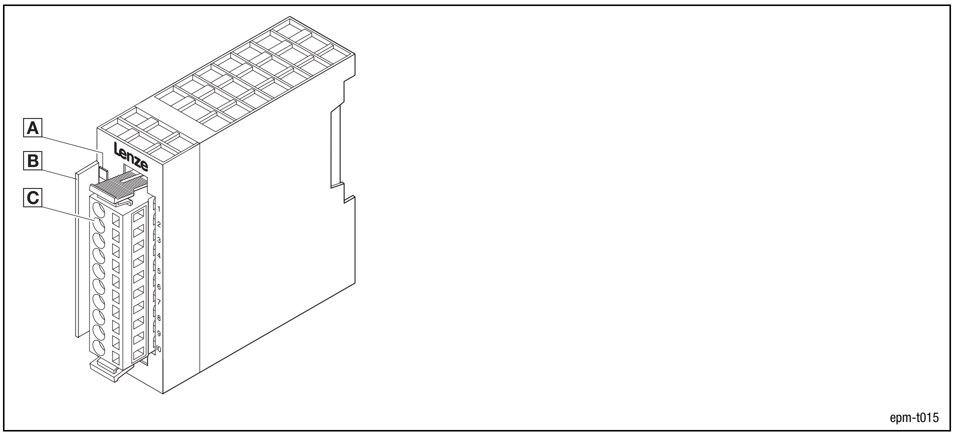


Fig. 4.21-1 Overview of 2/4×counter

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

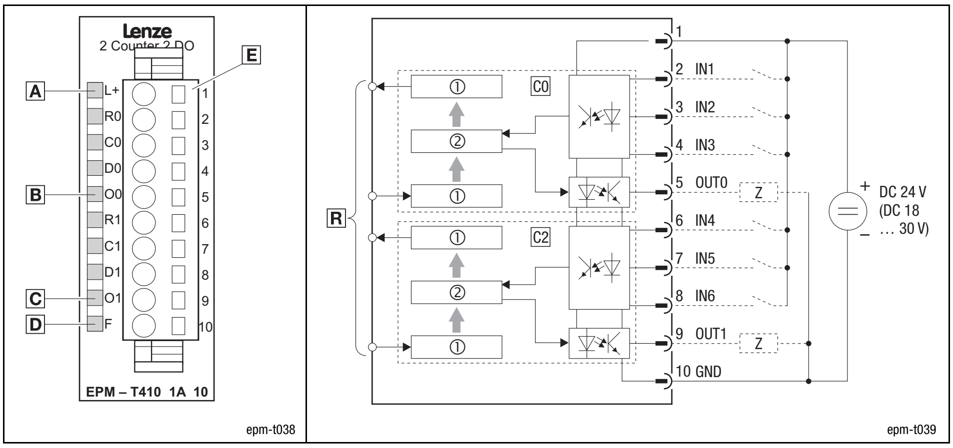


Fig. 4.21-2 Front view and connection of 2/4×counter

- A Status display L+; LED (yellow) is lit when a supply voltage is applied
- B Status display 00; LED (green) is lit when the digital output OUT0 is triggered by counter 0
- C Status display 01; LED (green) is lit when the digital output OUT1 is triggered by counter 1
- D Status display F; LED (red) is lit in case of overload, overheating, and short circuit
- E Terminal strip assignment details
  1. DC 24 V supply voltage
  2. IN1: Input 1 of counter 0
  3. IN2: Input 2 of counter 0
  4. IN3: Input 3 of counter 0
  5. OUT0: Counter 0 output
  6. IN4: Input 1 of counter 1
  7. IN5: Input 2 of counter 1
  8. IN6: Input 3 of counter 1
  9. OUT1: Counter 1 output
  10. GND (reference potential for supply voltage)
- R Connection to backplane bus
- C0 32-bit counter 0
- C1 32-bit counter 1
- ① Buffer
- ② Counter register
- Z Load

Counter mode overview

Mode of		Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
[h]	[dec]											
		2 counters		**0**			**1**					
00_h	0	32-bit counter	RES	CLK	DIR	RES	CLK	DIR	•	•	–	–
01_h	1	Encoder 1 edge	RES	A	B	RES	A	B	•	•	–	–
03_h	3	Encoder 2 edges	RES	A	B	RES	A	B	•	•	–	–
05_h	5	Encoder 4 edges	RES	A	B	RES	A	B	•	•	–	–
		4 counters		**0.1**	**0.2**		**1.1**	**1.2**				
08_h	8	2 × 16-bit counters (counting direction up/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
09_h	9	2 × 16-bit counters (counting direction down/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0A_h$	10	2 × 16-bit counters (counting direction up/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0B_h$	11	2 × 16-bit counters (counting direction down/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
		2 counters		**0**			**1**					

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
$0C_h$	12	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0D_h$	13	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0E_h$	14	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
$0F_h$	15	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
		1 counter	**0/1**									
10_h	16	Frequency measuring	RES	CLK	START	STOP	–	–	•	•	–	✓
11_h	17	Measuring the period	RES	CLK	START	STOP	–	–	•	•	–	✓
12_h	18	Frequency measuring (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓
13_h	19	Measuring the period (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓
		2 counters	**0**			**1**						
06_h	6	Measuring the pulse width (f_{ref} 50 kHz, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
14_h	20	Measuring the pulse width (f_{ref} programmable, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
15_h	21	Measuring the pulse width (f_{ref} programmable, counting direction: Upwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
16_h	22	Measuring the pulse width (f_{ref} programmable, counting direction: Downwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
		2 counters	**0**			**1**						
17_h	23	2 × 32-bit counters (counting direction up, "Set" function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
18_h	24	2 × 32-bit counters (counting direction down, "Set" function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
19_h	25	2 × 32-bit counters (counting direction up, "Reset" function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
$1A_h$	26	2 × 32-bit counters (counting direction down, "Reset" function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓

Mode of		Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
[h]	[dec]											
		2 counters		0			1					
$1B_h$	27	32-bit counter	G/RES⌋	CLK	DIR	G/RES⌋	CLK	DIR	•	•	–	–
$1C_h$	28	Encoder 1 edge	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1D_h$	29	Encoder 2 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1E_h$	30	Encoder 4 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
		2 counters		0			1					
$1F_h$	31	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
20_h	32	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
21_h	33	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
22_h	34	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
		2 counters		0			1					
23_h	35	32-bit counter	GATE	CLK	DIR	GATE	CLK	DIR	•	•	–	–
24_h	36	Encoder 1 edge	GATE	A	B	GATE	A	B	•	•	–	–
25_h	37	Encoder 2 edges	GATE	A	B	GATE	A	B	•	•	–	–
26_h	38	Encoder 4 edges	GATE	A	B	GATE	A	B	•	•	–	–

•	Digital output can signal an event
✓	Function available.
–	No function / function not available
A	Encoder signal A
Auto Reload	”Auto Reload” causes the counter to accept a preset value as soon as the counter content matches the Compare register content.
B	Encoder signal B
Compare Load	You may use ”Compare Load” to specify a counter limit value to trigger an output when reached or to restart the counters via Auto Reload.
CLK	Clock signal of a connected encoder HIGH level starts and / or stops the counting process
DIR	Indicates counting direction depending on signal level LOW: Upcounter HIGH: Downcounter
GATE	Gate signal is level-triggered HIGH: Pulses are measured
G/RES⌋	Gate signal is level-triggered and reset signal is edge-triggered HIGH: Pulses are measured LOW-HIGH edge: Deletes one or both counters
PULSE	The pulse width of the supplied signal is measured with an internal time base
RES	Reset signal is level-triggered HIGH: Deletes one or both counters
RES⌋	Reset signal is edge-triggered LOW-HIGH edge: Deletes one or both counters
START	Start signal is edge-triggered
STOP	Stop signal is edge-triggered

Technical data

Type			2/4×counter
Voltage supply			DC 5 V / 80 mA (via backplane bus)
Connectable cable cross-section			≤ 2.5 mm^2 (≥ AWG 14)
Counters			
	Number		2 × 32-bit counter or 4 × 16-bit counter
	Operating modes		38 modes
	Counting frequency		1 MHz
	Inputs / outputs		
		External voltage supply	DC 24 V (DC 18 ... 28.8 V)
		Input signal level	LOW: DC -30 ... +5 V HIGH: DC +13 ... +36 V
		Max. output current per output	0.5A
Communication			
	Input data		10 bytes
	Output data		10 bytes
	Parameter data		2 bytes
Dimensions			
	Width		25.4 mm
	Height		76.0 mm
	Depth		76.0 mm
Weight			100 g

Order number	**EPM-T410**

4.22 SSI interface

Description

An SSI interface (**S**ynchronous **S**erial **I**nterface) is a synchronously pulsed, serial interface.

The SSI interface module permits the connection of absolutely coded sensors with SSI interfaces. The module converts the serial information of the sensor into parallel information and makes it available to the control.

Note!

- Use sensors with a binary data format. The module only evaluates binary data.
- The chapter "Parameter setting" describes how to parameterise the module.

Features

- 1 SSI channel
- Data transmission in the Gray code or binary code (safe data collection by using the Gray code)
- Adjustable baud rate of 100 ... 600 kbits/s
- Maximum data integrity by using symmetrical clock and data signals
- Isolation from receiver and encoder by optocoupler
- Two parameterisable digital outputs, one of which parameterisable as hold input to "freeze" the current SSI encoder value
- Integrated power supply unit of the interface electronics and the connected sensor
- LED shows the status

Overview

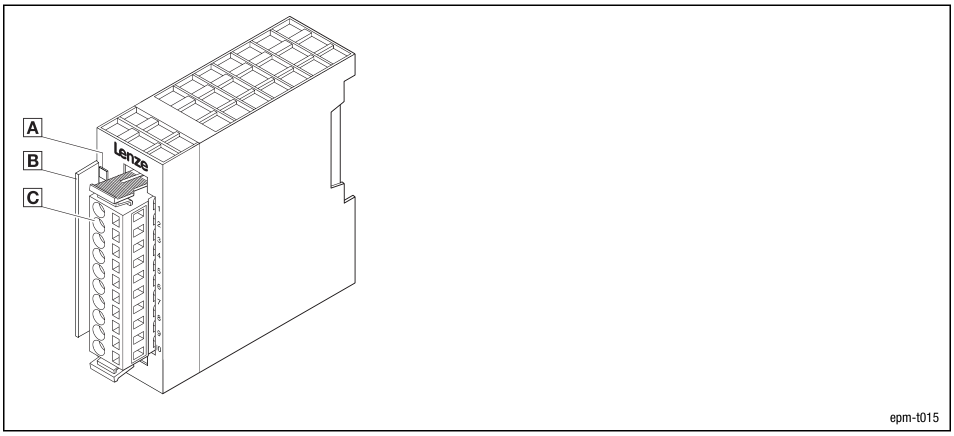


Fig. 4.22-1 Overview of SSI interface

A LED for status display
B Bit address label card
C Plug-in terminal strip

Status display and terminal assignment

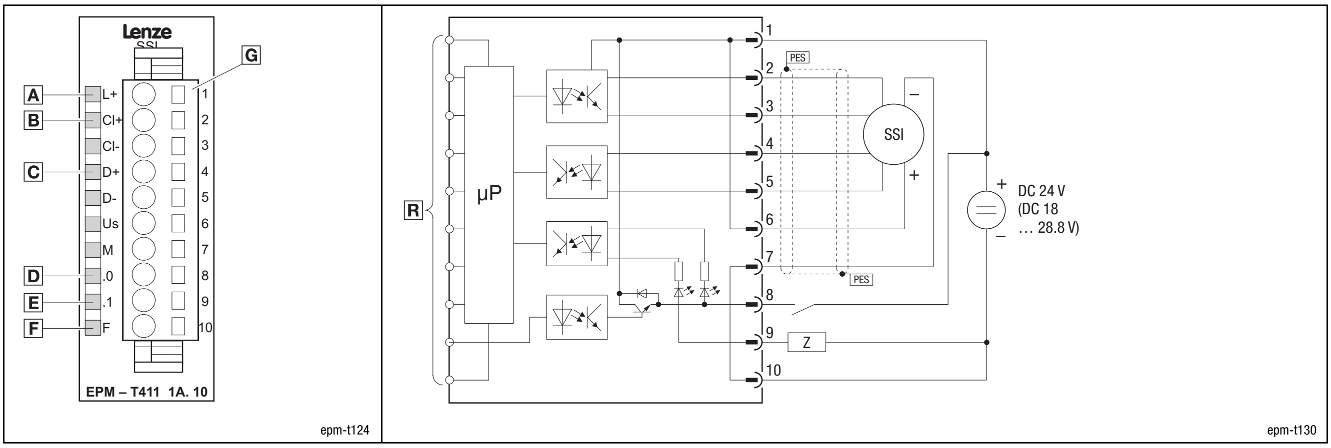


Fig. 4.22-2 Front view and connection of SSI interface

- A Status display L+; LED (yellow) is lit when a supply voltage is applied
- B Status display Cl+; LED (yellow) is lit with an output clock signal
- C Status display D+; LED (yellow) is lit when the SSI sensor is receiving data
- D Status display .0; LED (green) is lit when a HIGH level is applied to or output at input/output .0
- E Status display .1; LED (green) is lit when a HIGH level is applied to or output at input/output .1
- F Status display F; LED (red) is lit when the inputs / outputs .0 or .1 are short-circuited or overloaded
- G Terminal strip assignment details
  - 1 DC 24 V supply voltage
  - 2 Clock pulse
  - 3 Clock pulse converted
  - 4 Data
  - 5 Data converted
  - 6 DC 24 V supply voltage for SSI sensor
  - 7 GND (reference potential of supply voltage for SSI sensor)
  - 8 Input/output .0
  - 9 Input/output .1
  - 10 GND (reference potential for supply voltage)
- R Connection to backplane bus
- SSI SSI sensor
- Z Load

Technical data

Type	SSI interface		
Voltage supply	DC 5 V / 200 mA (via backplane bus)		
External voltage supply	DC 24 V / 50 mA mA (DC 18 ... 28.8 V)		
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)		
SSI interface			
External voltage supply	DC 24 V (DC 18 ... 28.8 V)		
Number of channels	1		
Data format of SSI sensor	binary		
Data line	RS422, isolated		
Clockline	RS422, isolated		
Cable specification	Shielded cable with cores twisted in pairs		
Cable length			
Baud rate [kbit/s]	100	300	600
Max. bus length [m]	400	100	50
Inputs / outputs			
Number	2, optional parameter setting		
Input signal level	LOW: DC -5 ... +7 V HIGH: DC +13 ... +36 V		
Max. output current per output	0.5A		
Communication			
Input data	4 bytes		
Output data	4 bytes, further 8 bytes in the module serving as buffer		
Parameter data	4 bytes		
Dimensions			
Width	25.4 mm		
Height	76.0 mm		
Depth	76.0 mm		
Weight	100 g		

Order designation	**EPM-T411**

4.23 1×counter/16×digital input

Description

The module 1×counter/16×digital input detects the binary control signals of the process level and transfers them to the master bus system. In addition, a counter can be triggered via the first two inputs.

Note!

The chapter ”Parameter setting” describes how to parameterise the module.

Features

- 16 digital inputs
- Adjustable counter function (pulse, frequency) for the first two inputs
- Suitable for switches and proximity switches
- LED displays the states of the digital inputs

Overview

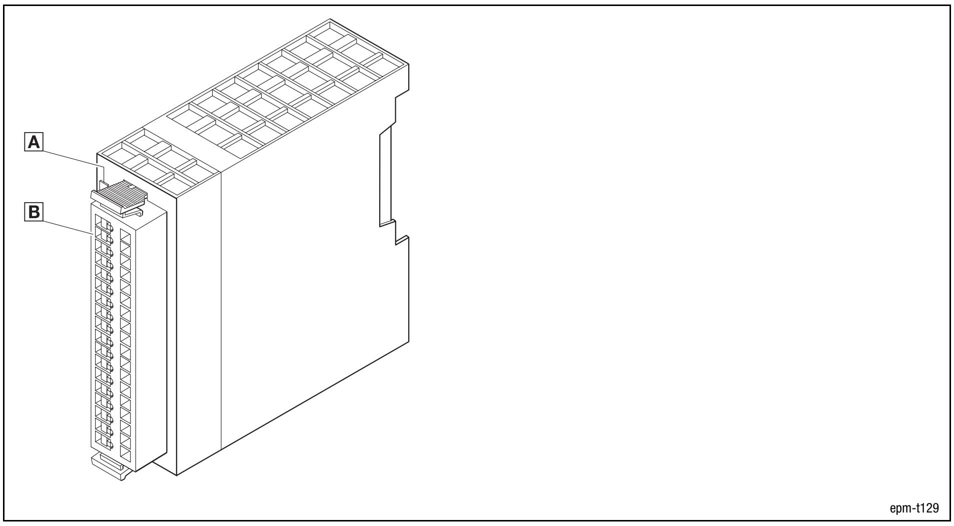


Fig. 4.23-1 Overview of 1×counter/16×digital input

A LED for status display
B Plug-in terminal strip

Status display and terminal assignment

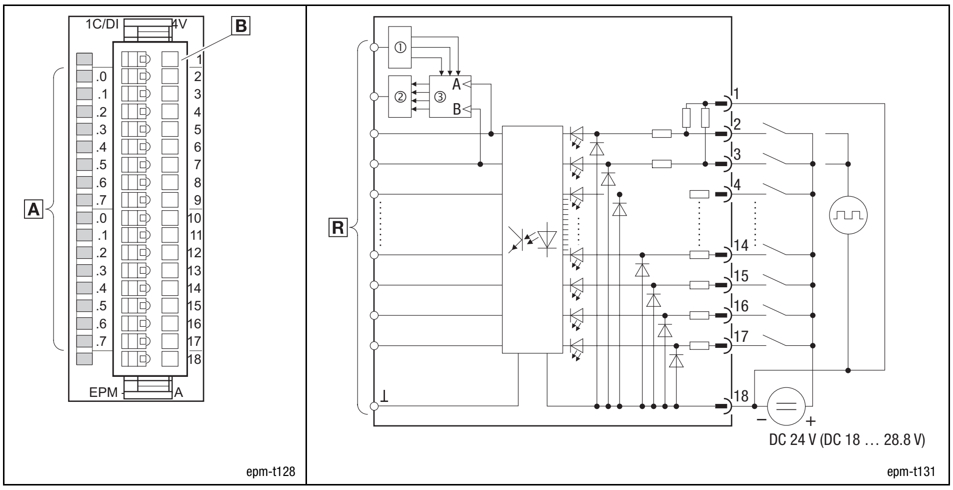


Fig. 4.23-2 Front view and connection 1×counter/16×digital input

A 2 × status display .0 ... .7; LED (green) is lit when a HIGH level is recognised

B Terminal strip assignment details

1	GND (reference potential)
2	Digital input E.0 or counter input A
3	Digital input E.1 or counter input B
4	Digital input E.2
...	...
16	Digital input E.14
17	Digital input E.15
18	GND (reference potential)

R Connection to backplane bus

① Pre-assign the counter with a count value

② Output the current count value

③ 32-bit counter with channel A and channel B

Counter mode overview

Mode	Function	E.0	E.1
0	4-fold pulse evaluation	CLK	CLK
1	Pulse and direction evaluation	CLK	DIR
2	Clock up/clock down evaluation	CLK-UP	CLK-DOWN
3	Frequency measurement	CLK	–
4	Period measurement	CLK	–

–	No function
CLK	Clock signal of a connected encoder HIGH level starts and / or stops the counting process
CLK-UP	Clock signal of a connected encoder With each LOW-HIGH edge the counter counts up by 1
CLK-DOWN	Clock signal of a connected encoder With each LOW-HIGH edge the counter counts down by 1
DIR	Indicates counting direction depending on signal level LOW: Upcounter HIGH: Downcounter

Technical data

Type			1×counter/16×digital input
Voltage supply			DC 5 V / 100 mA (via backplane bus)
Connectable cable cross-section			≤ 1.5 mm^2 (≥ AWG 16)
Digital inputs			
	Rated input voltage		DC 24 V (DC 18 ... 28.8 V)
	Number of inputs		16
	Level		LOW: DC 0 ... 5 V HIGH: DC 15 ... 28.8 V
	Input current		7 mA
	Input resistance		3.3 kΩ
	Delay time		3 ms
	Delay - pulse input		100 μs
	Counter		
		Number	1
		Inputs	2
		Max. frequency	100 kHz
	Electrical isolation from the backplane bus		Yes, via optocouplers
Communication			
	Input data		6 bytes
	Output data		6 bytes
	Parameter data		1 byte
Dimensions			
	Width		25.4 mm
	Height		76.0 mm
	Depth		76.0 mm
Weight			50 g

Order designation	**EPM-T430**

4.24 Terminal module

Description

The terminal module offers two terminal strips with 11 terminals each. All terminals of a terminal strip are connected with each other. The terminal strips are potential-free.

Sensors which must be supplied with external voltage, for instance, can be wired with the help of the terminal module with a minimum of effort.

Note!

Designing the modular system requires the consideration of the terminal module.

Since the backplane bus is also guided via the terminal module, it must be considered when calculating the project stage (max. 32 modules).

Features

- 2 terminal strips with 11 terminals each
- All terminals of a terminal strip are interconnected with each other.
- The terminal strips are potential-free

Overview

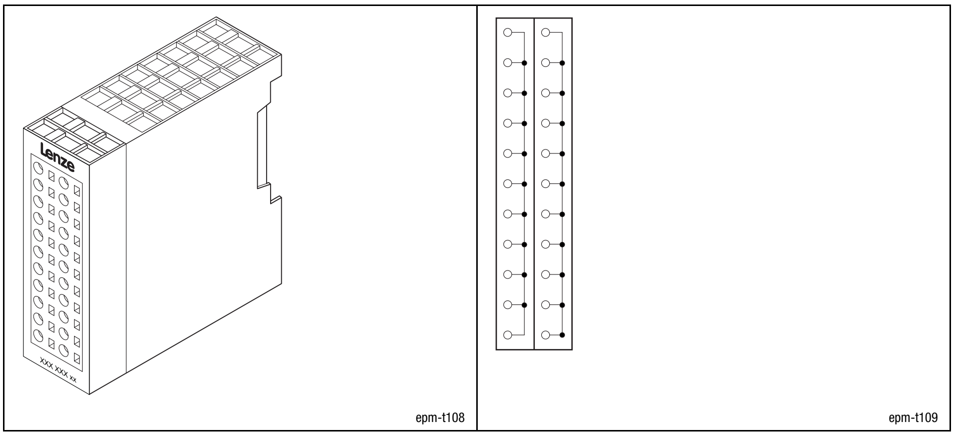


Fig. 4.24-1 Overview and internal wiring of the terminal module

Technical data

Type		Terminal module
Terminals		
	Terminal strips	2 spring-mounted clamps, not plug-in
	Terminals per strip	11
	Max. current capacity per terminal strip	10A
	Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)
Dimensions		
	Width	25.4 mm
	Height	76.0 mm
	Depth	76.0 mm
Weight		50 g

Order designation	**EPM-T940**

5 The compact system

Contents

5.1 8×dig. I/O compact

Description

The 8×dig. I/O compact module consists of a CAN gateway which serves as an interface to the master bus system as well as 8 digital inputs/outputs and 2 terminal strips.

The channels can be optionally used as digital inputs or outputs. Each output can be loaded with up to 1 A. The status of the channels is displayed by LEDs.

Features

- 8 digital inputs or outputs, depending on the circuit configuration
- Voltage supply via an external 24 V DC voltage source
- Connection to the system bus (CAN) via a 9-pole Sub-D plug
- Address and baud rate setting via coding switch
- The baud rate is stored permanently in an EEPROM in the module
- LEDs display the status

Overview

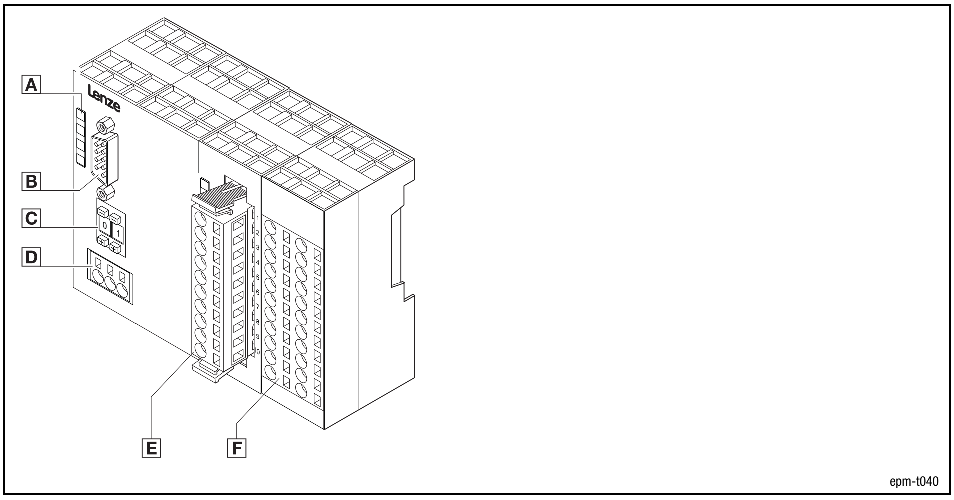


Fig. 5.1-1 8×dig. I/O compact

A LEDs for status display
B 9-pole Sub-D plug for connection to the system bus (CAN)
C Coding switch to set address and baud rate◘
D External voltage supply connection
E Terminal strip for digital input/output signals
F Terminal strips, additional terminals for wiring

Connecting system bus (CAN)/CANopen

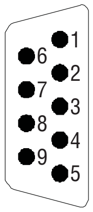


Fig. 5.1-2 Connection to the system bus (CAN)/CANopen with 9-pole Sub-D plug

Pin	Assignment
1	Not assigned
2	CAN-LOW
3	CAN-GND
4	Not assigned
5	Not assigned
6	Not assigned
7	CAN-HIGH
8	Not assigned
9	Not assigned

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

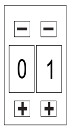


Fig. 5.1-3 Coding switch at CAN gateway

⊟ Decrease numerical value
⊞ Increase numerical value

Baud rate setting

System bus (CAN)	CANopen	Baud rate
Coding switch value	Coding switch value	[kbit/s]
90	80	1000
91	81	**500**
92	82	250
93	83	125
94	84	100
95	85	50
96	86	20
97	87	10
98	88	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ”9x” when using the ”system bus (CAN)” protocol (x = value for the required baud rate)
   – Select ”8x” when using the ”CANopen” protocol (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the compact system needs approx. 1 ms for initialisation. During this time, no parameters can be set.

Status displays

LED	Status	Meaning
PW (yellow)	on	Supply voltage is applied
ER (red)	on	Incorrect data transmission between microcontroller and digital inputs/outputs
RD (green)	on	Error-free data transmission between microcontroller and digital inputs/outputs
		See table below
BA (yellow)		See table below

PW (yellow)	**ER** (red)	**RD** (green)	**BA** (yellow)	**Meaning**
on	off	blinking (1 Hz)	off	Self test and initialisation in progress
on	off	on	on	System bus (CAN)/CANopen in the "Operational"state
on	off	on	blinking (1 Hz)	System bus (CAN)/CANopen in the "Pre-Operational"state
on	off	on	blinking (10 Hz)	System bus (CAN)/CANopen in the "Stopped"state
on	blinking (10 Hz)	on	on blinking (1 Hz) blinking (10 Hz)	System bus (CAN)/CANopen "Offline"state
on	blinking (1 Hz)	on		System bus (CAN)/CANopen "Warning"state
on	on	on	on	Error during RAM or EEPROM initialisation
on	blinking (1 Hz)	blinking (1 Hz)	blinking (1 Hz)	Baud rate setting mode active
on	blinking (10 Hz)	blinking (10 Hz)	blinking (10 Hz)	Error during baud rate setting
on	off	blinking (1 Hz)	off	Address setting mode active

Note!

NMT telegrams for changing to the different states can be found in the chapter "Networking via system bus (CAN)" or "Networking via CANopen".

Status display and terminal assignment

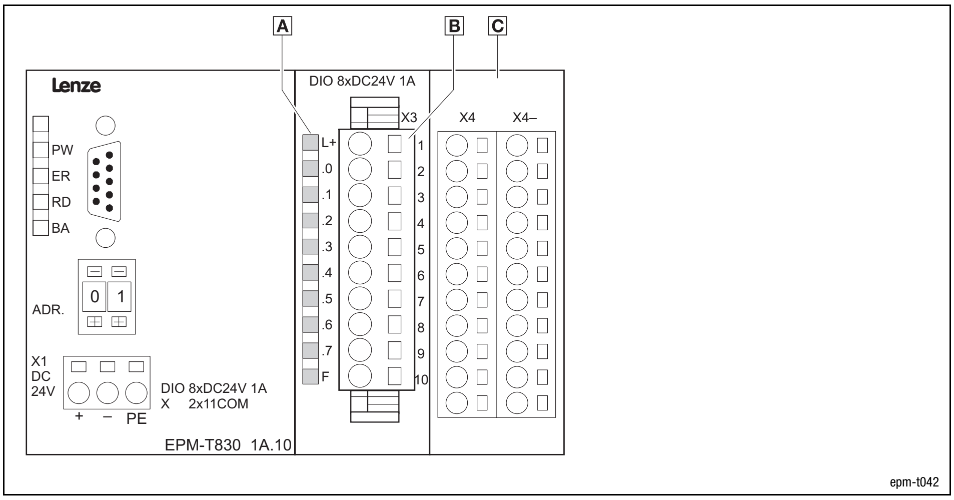


Fig. 5.1-4 Front view of 8×dig. I/O compact

A Status display for digital inputs/outputs at terminal strip X3

L+	LED (yellow) is lit when supply voltage is applied.
.0 7	LED (green) is lit when the output is triggered and / or a HIGH level is detected at the input, respectively.
F	LED (red) is lit in case of overload, overheating, short-circuit errors.

B Terminal strip X3 assignment

X3/1	+24 V DC (supply voltage)
X3/2 ... X3/9	Digital inputs/outputs E/A.0 ... E/A.7
X3/10	GND (reference potential)

C Terminal strips (2 × 11 terminals)

X4	Electrically isolated terminal strip
X4–	Terminal strip GND

Connection

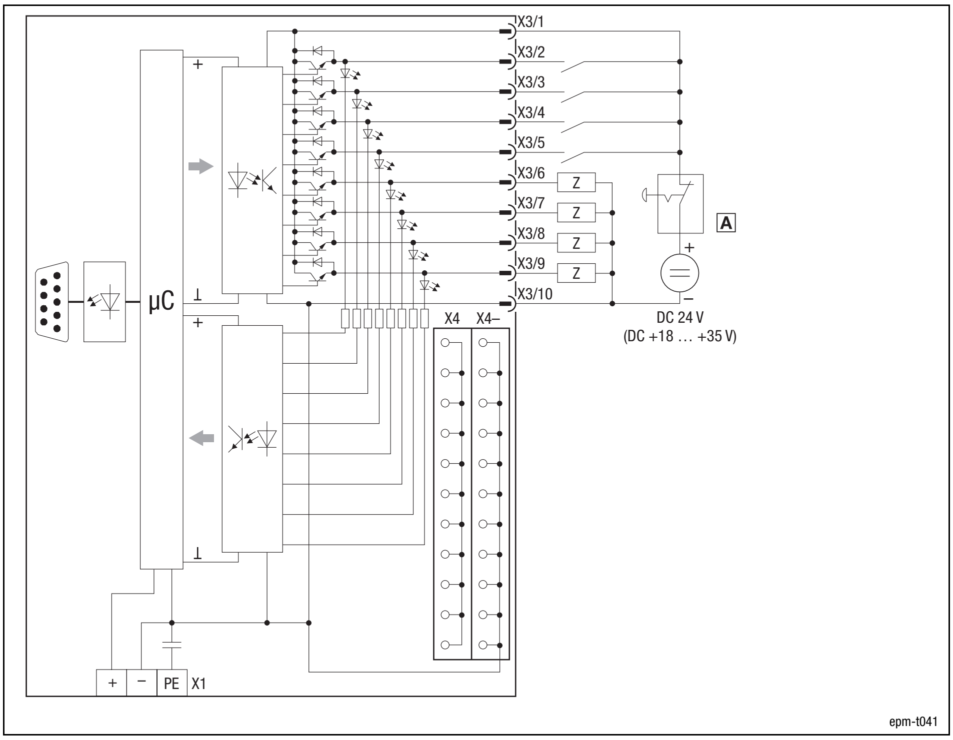


Fig. 5.1-5 Wiring diagram of 8×dig. I/O compact

A	Emergency-off switch
X4, X4–	Terminal strips
Z	Load

Stop!

If the voltage supply (DC 24 V) fails, the module will malfunction:

- Switched outputs carry voltage if one input is assigned with a HIGH level,
- The module can be destroyed since the outputs are not resistant to short circuits anymore.

The emergency-off switch ensures that when being operated the outputs do not carry any voltage and the inputs are not assigned with a HIGH level.

Technical data

Type	8×dig. I/O compact								
Voltage supply	DC 24 V / 55 mA (DC 20.4 ... 28.8 V)								
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)								
Communication									
Communication protocol	• System bus (CAN) • CANopen (CAL-based communication profile DS301/DS401)								
Communication medium	DIN ISO 11898								
Network topology	Line (terminated at both ends)								
Baud rate [kbit/s]	10	20	50	100	125	250	500	800	1000
Max. bus length [m]	5000	2500	1000	600	500	250	80	50	25
Max. number of nodes	63								
Digital inputs/outputs									
Number	8 optionally configurable digital inputs/outputs								
Electrical isolation from system bus	Yes, via optocouplers								
Digital inputs									
Input resistance	3.3 kΩ								
Delay time	3 ms								
Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V								
Digital outputs									
Rated load voltage	DC 24 V (DC 18 ... 35 V)								
Max. output current per output	1 A (resistant to short circuits)								
Delay time	< 1 ms								
Communication									
Input data	1 byte								
Output data	1 byte								
Diagnostic data	2 bits								
Dimensions									
Width	101 mm								
Height	76 mm								
Depth	48 mm								
Weight	200 g								

Order designation	**EPM-T830**

5.2 16×dig. I/O compact (single-wire conductor)

Description

The 16×dig. I/O compact (single-wire conductor) module consists of 1 CAN gateway which serves as an interface to the master bus system as well as 8 digital inputs, 4 digital outputs and 4 digital inputs/outputs.

Each output can be loaded with up to 1 A. The status of the channels is displayed by LEDs.

Features

- 8 digital inputs
- 4 digital inputs/outputs, depending on the circuit configuration
- 4 digital outputs
- Voltage supply via an external 24 V DC voltage source
- Connection to the system bus (CAN) via a 9-pole Sub-D plug
- Address and baud rate setting via coding switch
- The baud rate is stored permanently in an EEPROM in the module
- LEDs display the status

Overview

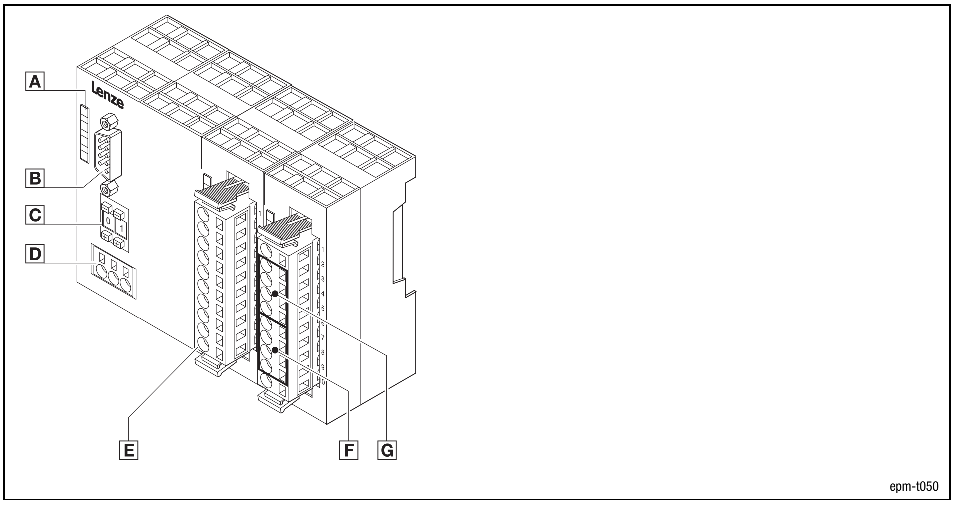


Fig. 5.2-1 16×dig. I/O compact (single-wire conductor)

A LEDs for status display
B 9-pole Sub-D plug for connection to the system bus (CAN)
C Coding switch to set address and baud rate
D External voltage supply connection
E Terminal strip for digital input signals
F Terminal strip for digital output signals
G Terminal strip for digital input / output signals (optionally configurable)

Connecting system bus (CAN)/CANopen

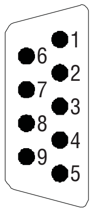


Fig. 5.2-2 Connection to the system bus (CAN)/CANopen with 9-pole Sub-D plug

Pin	Assignment
1	Not assigned
2	CAN-LOW
3	CAN-GND
4	Not assigned
5	Not assigned
6	Not assigned
7	CAN-HIGH
8	Not assigned
9	Not assigned

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

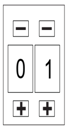


Fig. 5.2-3 Coding switch at CAN gateway

⊟	Decrease numerical value
⊞	Increase numerical value

Baud rate setting

System bus (CAN)	CANopen	Baud rate
Coding switch value	Coding switch value	[kbit/s]
90	80	1000
91	81	**500**
92	82	250
93	83	125
94	84	100
95	85	50
96	86	20
97	87	10
98	88	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ”9x” when using the ”system bus (CAN)” protocol (x = value for the required baud rate)
   – Select ”8x” when using the ”CANopen” protocol (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the compact system needs approx. 1 ms for initialisation. During this time, no parameters can be set.

Status displays

LED	Status	Meaning
PW (yellow)	on	Supply voltage is applied
ER (red)	on	Incorrect data transmission between microcontroller and digital inputs/outputs
RD (green)	on	Error-free data transmission between microcontroller and digital inputs/outputs
		See table below
BA (yellow)		See table below

PW (yellow)	**ER** (red)	**RD** (green)	**BA** (yellow)	**Meaning**
on	off	blinking (1 Hz)	off	Self test and initialisation in progress
on	off	on	on	System bus (CAN)/CANopen in the ”Operational”state
on	off	on	blinking (1 Hz)	System bus (CAN)/CANopen in the ”Pre-Operational”state
on	off	on	blinking (10 Hz)	System bus (CAN)/CANopen in the ”Stopped”state
on	blinking (10 Hz)	on	on blinking (1 Hz) blinking (10 Hz)	System bus (CAN)/CANopen ”Offline”state
on	blinking (1 Hz)	on		System bus (CAN)/CANopen ”Warning”state
on	on	on	on	Error during RAM or EEPROM initialisation
on	blinking (1 Hz)	blinking (1 Hz)	blinking (1 Hz)	Baud rate setting mode active
on	blinking (10 Hz)	blinking (10 Hz)	blinking (10 Hz)	Error during baud rate setting
on	off	blinking (1 Hz)	off	Address setting mode active

Note!

NMT telegrams for changing to the different states can be found in the chapter ”Networking via system bus (CAN)” or ”Networking via CANopen”.

Status display and terminal assignment

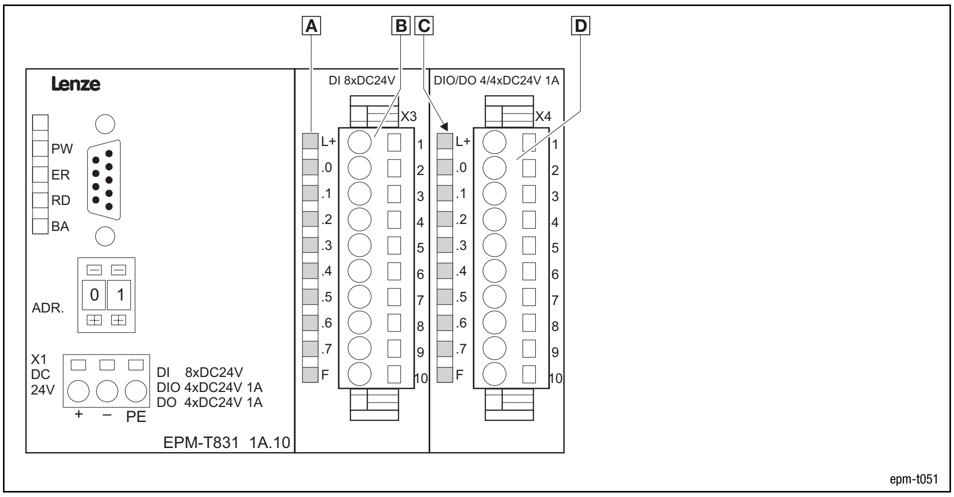


Fig. 5.2-4 Front view of 16×dig. I/O compact (single-wire conductor)

A C Status display for digital inputs / outputs at the terminal strips X3 and X4

L+	LED (yellow) is lit when the supply voltage is applied.
.0 7	LED (green) is lit when the output is triggered and/or a HIGH level is detected at the input
F	LED (red) is lit in case of overload, overheating, short-circuit errors.

B Terminal strip X3 assignment

X3/1	Not assigned
X3/2 ... X3/9	Digital inputs E.0 ... E.7
X3/10	GND (reference potential)

D Terminal strip X4 assignment

X4/1	DC 24 V supply voltage
X4/2 ... X4/5	Digital inputs/outputs E/A.0 ... E/A.3
X4/6 ... X4/9	Digital outputs A.4 ... A.7
X4/10	GND (reference potential)

Connection

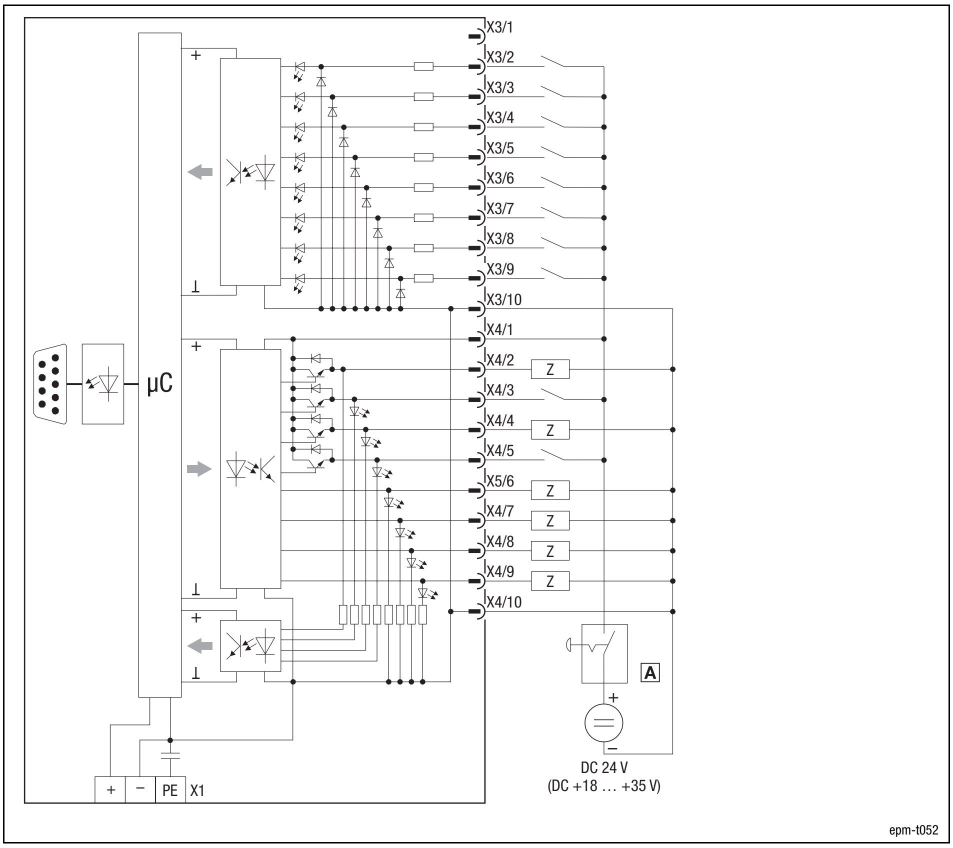


Fig. 5.2-5 Wiring diagram of 16×dig. I/O compact (single-wire conductor)

A Emergency-off switch

Z Load

Stop!

If the voltage supply (DC 24 V) fails, the module will malfunction:

- Switched outputs carry voltage if one input is assigned with a HIGH level,
- The module can be destroyed since the outputs are not resistant to short circuits anymore.

The emergency-off switch ensures that when being operated the outputs do not carry any voltage and the inputs are not assigned with a HIGH level.

Technical data

Type	16×dig. I/O compact (single-wire conductor)								
Voltage supply	DC 24 V / 55 mA (DC 20.4 ... 28.8 V)								
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)								
Communication									
Communication protocol	• System bus (CAN) • CANopen (CAL-based communication profile DS301/DS401)								
Communication medium	DIN ISO 11898								
Network topology	Line (terminated at both ends)								
Baud rate [kbit/s]	10	20	50	100	125	250	500	800	1000
Max. bus length [m]	5000	2500	1000	600	500	250	80	50	25
Max. number of nodes	63								
Digital inputs/outputs									
Number	8 digital inputs 8 optionally configurable digital inputs/outputs 4 digital outputs								
Electrical isolation from system bus	Yes, via optocouplers								
Digital inputs									
Input resistance	3.3 kΩ								
Delay time	3 ms								
Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V								
Digital outputs									
Rated load voltage	DC 24 V (DC 18 ... 35 V)								
Max. output current per output	1 A (resistant to short circuits)								
Current consumption if all outputs = LOW	50 mA								
Delay time	< 1 ms								
Communication									
Input data	2 bytes								
Output data	1 byte								
Diagnostic data	2 bits								
Dimensions									
Width	101 mm								
Height	76 mm								
Depth	48 mm								
Weight	200 g								

Order designation	**EPM-T831**

5.3 16×dig. I/O compact (three-wire conductor)

Description

The 16×dig. I/O compact (three-wire conductor) module consists of 1 CAN gateway which serves as an interface to the master bus system as well as 8 digital inputs, 4 digital outputs and 4 digital inputs/outputs.

Each output can be loaded with up to 1 A. The status of the channels is displayed by LEDs.

Features

- 8 digital inputs
- 4 digital inputs/outputs, depending on the circuit configuration
- 4 digital outputs
- Voltage supply via an external 24 V DC voltage source
- Connection to the system bus (CAN) via a 9-pole Sub-D plug
- Address and baud rate setting via coding switch
- The baud rate is stored permanently in an EEPROM in the module
- LEDs display the status

Overview

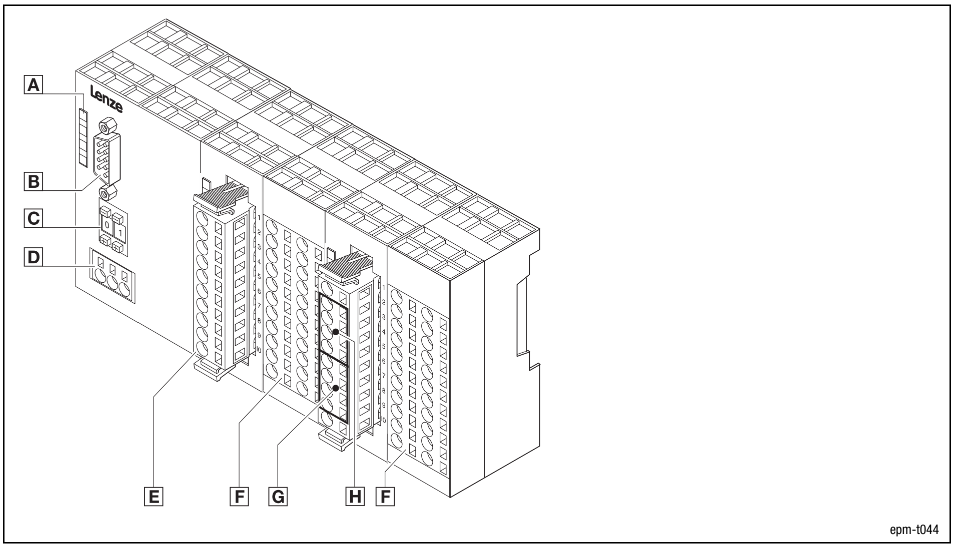


Fig. 5.3-1 16×dig. I/O compact (three-wire conductor)

A LEDs for status display
B 9-pole Sub-D plug for connection to the system bus (CAN)
C Coding switch to set address and baud rate
D External voltage supply connection
E Terminal strip for digital input signals
F Terminal strips, additional terminals for wiring
G Terminal strip for digital output signals
H Terminal strip for digital input / output signals (optionally configurable)

Connecting system bus (CAN)/CANopen

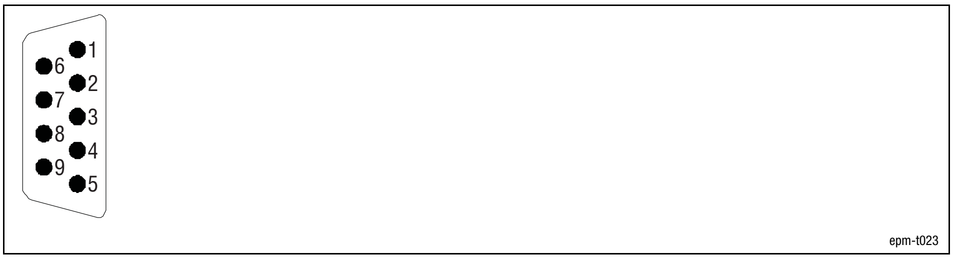


Fig. 5.3-2 Connection to the system bus (CAN)/CANopen with 9-pole Sub-D plug

Pin	Assignment
1	Not assigned
2	CAN-LOW
3	CAN-GND
4	Not assigned
5	Not assigned
6	Not assigned
7	CAN-HIGH
8	Not assigned
9	Not assigned

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

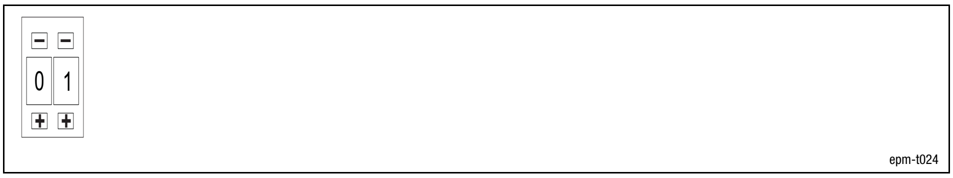


Fig. 5.3-3 Coding switch at CAN gateway

⊟ Decrease numerical value
⊞ Increase numerical value

Baud rate setting

System bus (CAN)	CANopen	Baud rate
Coding switch value	Coding switch value	[kbit/s]
90	80	1000
91	81	**500**
92	82	250
93	83	125
94	84	100
95	85	50
96	86	20
97	87	10
98	88	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ”9x” when using the ”system bus (CAN)” protocol (x = value for the required baud rate)
   – Select ”8x” when using the ”CANopen” protocol (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the compact system needs approx. 1 ms for initialisation. During this time, no parameters can be set.

Status displays

LED	Status	Meaning
PW (yellow)	on	Supply voltage is applied
ER (red)	on	Incorrect data transmission between microcontroller and digital inputs/outputs
RD (green)	on	Error-free data transmission between microcontroller and digital inputs/outputs
		See table below
BA (yellow)		See table below

<table>
<tr><th>PW (yellow)</th><th>ER (red)</th><th>RD (green)</th><th>BA (yellow)</th><th>Meaning</th></tr>
<tr><td>on</td><td>off</td><td>blinking (1 Hz)</td><td>off</td><td>Self test and initialisation in progress</td></tr>
<tr><td>on</td><td>off</td><td>on</td><td>on</td><td>System bus (CAN)/CANopen in the ”Operational”state</td></tr>
<tr><td>on</td><td>off</td><td>on</td><td>blinking (1 Hz)</td><td>System bus (CAN)/CANopen in the ”Pre-Operational”state</td></tr>
<tr><td>on</td><td>off</td><td>on</td><td>blinking (10 Hz)</td><td>System bus (CAN)/CANopen in the ”Stopped”state</td></tr>
<tr><td>on</td><td>blinking (10 Hz)</td><td>on</td><td rowspan="2">on
blinking (1 Hz)
blinking (10 Hz)</td><td>System bus (CAN)/CANopen ”Offline”state</td></tr>
<tr><td>on</td><td>blinking (1 Hz)</td><td>on</td><td>System bus (CAN)/CANopen ”Warning”state</td></tr>
<tr><td>on</td><td>on</td><td>on</td><td>on</td><td>Error during RAM or EEPROM initialisation</td></tr>
<tr><td>on</td><td>blinking (1 Hz)</td><td>blinking (1 Hz)</td><td>blinking (1 Hz)</td><td>Baud rate setting mode active</td></tr>
<tr><td>on</td><td>blinking (10 Hz)</td><td>blinking (10 Hz)</td><td>blinking (10 Hz)</td><td>Error during baud rate setting</td></tr>
<tr><td>on</td><td>off</td><td>blinking (1 Hz)</td><td>off</td><td>Address setting mode active</td></tr>
</table>

Note!

NMT telegrams for changing to the different states can be found in the chapter ”Networking via system bus (CAN)” or ”Networking via CANopen”.

Status display and terminal assignment

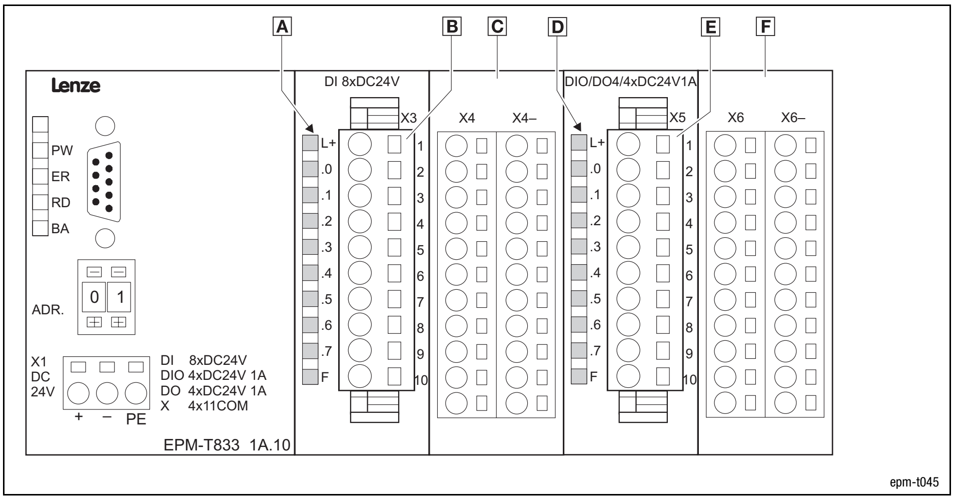


Fig. 5.3-4 Front view of 16×dig. I/O compact (three-wire conductor)

A D Status display for digital inputs / outputs at the terminal strips X3 and X5

L+	LED (yellow) is lit when the supply voltage is applied.
.0 7	LED (green) is lit when the output is triggered and/or a HIGH level is detected at the input
F	LED (red) is lit in case of overload, overheating, short-circuit errors.

B Terminal strip X3 assignment

X3/1	Not assigned
X3/2 ... X3/9	Digital inputs E.0 ... E.7
X3/10	GND (reference potential)

C Terminal strips (2 × 11 terminals)

X4	Electrically isolated terminal strip
X4–	Terminal strip GND

E Terminal strip X5 assignment

X5/1	DC 24 V supply voltage
X5/2 ... X5/5	Digital inputs/outputs E/A.0 ... E/A.3
X5/6 ... X5/9	Digital outputs A.4 ... A.7
X5/10	GND (reference potential)

F Terminal strips (2 × 11 terminals)

X6	Electrically isolated terminal strip
X6–	Terminal strip GND

Connection

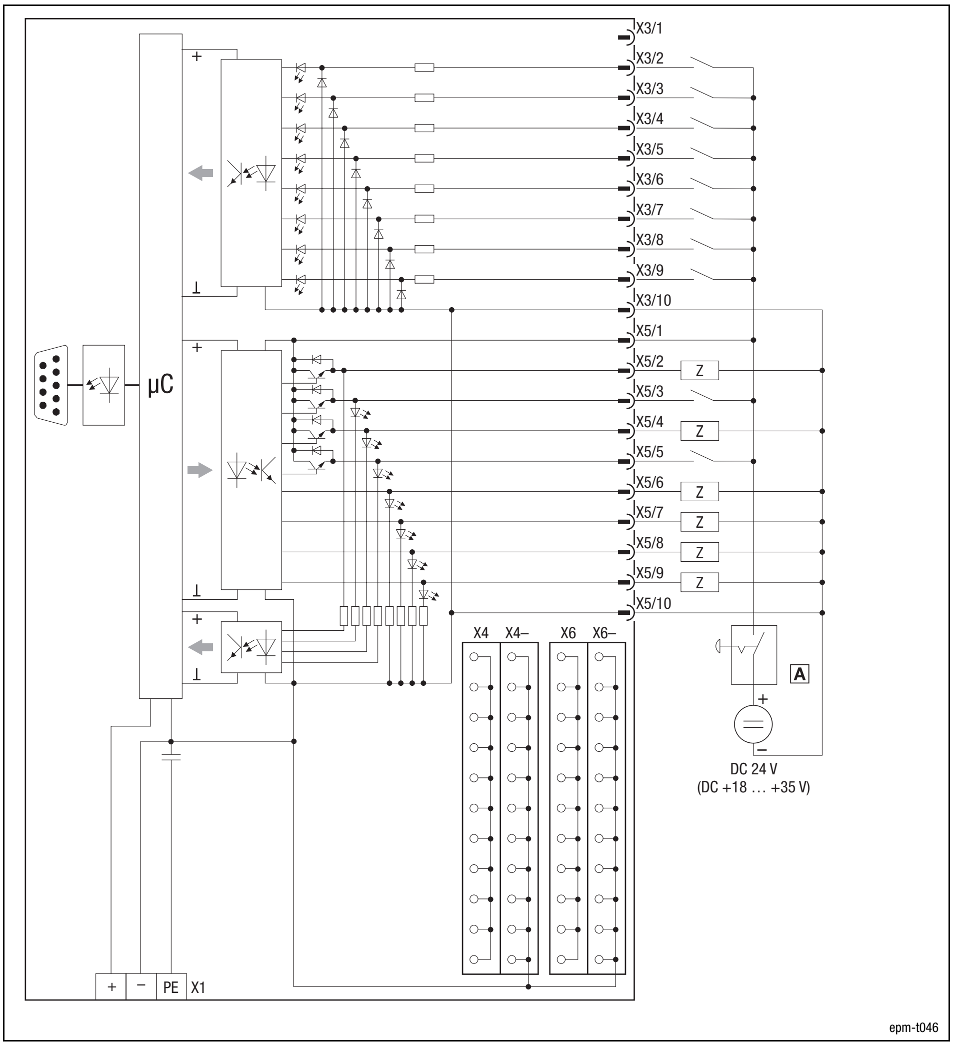


Fig. 5.3-5 Wiring diagram of 16×dig. I/O compact (three-wire conductor)

A	Emergency-off switch
X4, X4–	Terminal strips
X6, X6	Terminal strips
Z	Load

Stop!

If the voltage supply (DC 24 V) fails, the module will malfunction:

- Switched outputs carry voltage if one input is assigned with a HIGH level,
- The module can be destroyed since the outputs are not resistant to short circuits anymore.

The emergency-off switch ensures that when being operated the outputs do not carry any voltage and the inputs are not assigned with a HIGH level.

Technical data

Type	16×dig. I/O compact (three-wire conductor)								
Voltage supply	DC 24 V / 55 mA (DC 20.4 ... 28.8 V)								
Connectable cable cross-section	≤ 2.5 mm² (≥ AWG 14)								
Communication									
Communication protocol	• System bus (CAN) • CANopen (CAL-based communication profile DS301/DS401)								
Communication medium	DIN ISO 11898								
Network topology	Line (terminated at both ends)								
Baud rate [kbit/s]	10	20	50	100	125	250	500	800	1000
Max. bus length [m]	5000	2500	1000	600	500	250	80	50	25
Max. number of nodes	63								
Digital inputs/outputs									
Number	8 digital inputs 8 optionally configurable digital inputs/outputs 4 digital outputs								
Electrical isolation from system bus	Yes, via optocouplers								
Digital inputs									
Input resistance	3.3 kΩ								
Delay time	3 ms								
Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V								
Digital outputs									
Rated load voltage	DC 24 V (DC 18 ... 35 V)								
Max. output current per output	1 A (resistant to short circuits)								
Current consumption if all outputs = LOW	50 mA								
Delay time	< 1 ms								
Communication									
Input data	2 bytes								
Output data	1 byte								
Diagnostic data	2 bits								
Dimensions									
Width	152 mm								
Height	76 mm								
Depth	48 mm								
Weight	300 g								

Order designation	**EPM-T833**

5.4 32×dig. I/O compact

Description

The 32×dig. I/O compact module consists of 1 CAN gateway which serves as the interface to the master bus system as well as 24 digital inputs and 8 digital outputs.

Each output can be loaded with up to 1 A. The status of the channels is displayed by LEDs.

Features

- 24 digital inputs
- 8 digital outputs
- Voltage supply via an external 24 V DC voltage source
- Connection to the system bus (CAN) via a 9-pole Sub-D plug
- Address and baud rate setting via coding switch
- The baud rate is stored permanently in an EEPROM in the module
- LEDs display the status

Overview

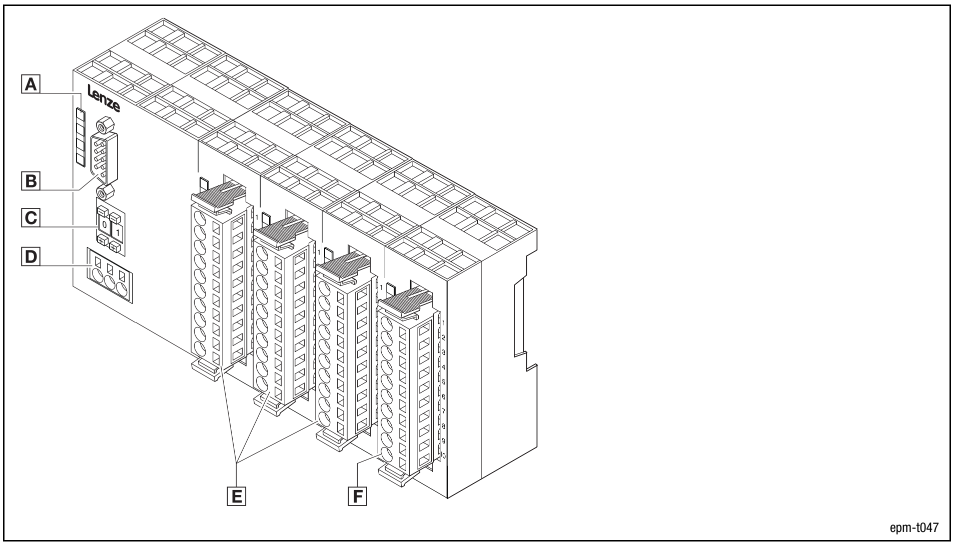


Fig. 5.4-1 32×dig. I/O compact

A LEDs for status display
B 9-pole Sub-D plug for connection to the system bus (CAN)
C Coding switch to set address and baud rate
D External voltage supply connection
E Terminal strips for digital input signals
F Terminal strip for digital output signals

Connecting system bus (CAN)/CANopen

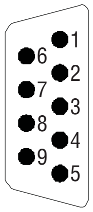


Fig. 5.4-2 Connection to the system bus (CAN)/CANopen with 9-pole Sub-D plug

Pin	Assignment
1	Not assigned
2	CAN-LOW
3	CAN-GND
4	Not assigned
5	Not assigned
6	Not assigned
7	CAN-HIGH
8	Not assigned
9	Not assigned

Baud rate and node address

- Use the coding switch to set the baud rate.
- The node address must be set via the coding switch.

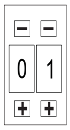


Fig. 5.4-3 Coding switch at CAN gateway

[−] Decrease numerical value
[+] Increase numerical value

Baud rate setting

System bus (CAN)	**CANopen**	**Baud rate**
Coding switch value	Coding switch value	[kbit/s]
90	80	1000
91	81	**500**
92	82	250
93	83	125
94	84	100
95	85	50
96	86	20
97	87	10
98	88	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ”9x” when using the ”system bus (CAN)” protocol (x = value for the required baud rate)
   – Select ”8x” when using the ”CANopen” protocol (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

- The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.
- After switching on the supply voltage, the compact system needs approx. 1 ms for initialisation. During this time, no parameters can be set.

Status displays

LED	Status	Meaning
PW (yellow)	on	Supply voltage is applied
ER (red)	on	Incorrect data transmission between microcontroller and digital inputs/outputs
RD (green)	on	Error-free data transmission between microcontroller and digital inputs/outputs
		See table below
BA (yellow)		See table below

PW (yellow)	**ER** (red)	**RD** (green)	**BA** (yellow)	**Meaning**
on	off	blinking (1 Hz)	off	Self test and initialisation in progress
on	off	on	on	System bus (CAN)/CANopen in the "Operational"state
on	off	on	blinking (1 Hz)	System bus (CAN)/CANopen in the "Pre-Operational"state
on	off	on	blinking (10 Hz)	System bus (CAN)/CANopen in the "Stopped"state
on	blinking (10 Hz)	on	on blinking (1 Hz) blinking (10 Hz)	System bus (CAN)/CANopen "Offline"state
on	blinking (1 Hz)	on		System bus (CAN)/CANopen "Warning"state
on	on	on	on	Error during RAM or EEPROM initialisation
on	blinking (1 Hz)	blinking (1 Hz)	blinking (1 Hz)	Baud rate setting mode active
on	blinking (10 Hz)	blinking (10 Hz)	blinking (10 Hz)	Error during baud rate setting
on	off	blinking (1 Hz)	off	Address setting mode active

Note!

NMT telegrams for changing to the different states can be found in the chapter "Networking via system bus (CAN)" or "Networking via CANopen".

Status display and terminal assignment

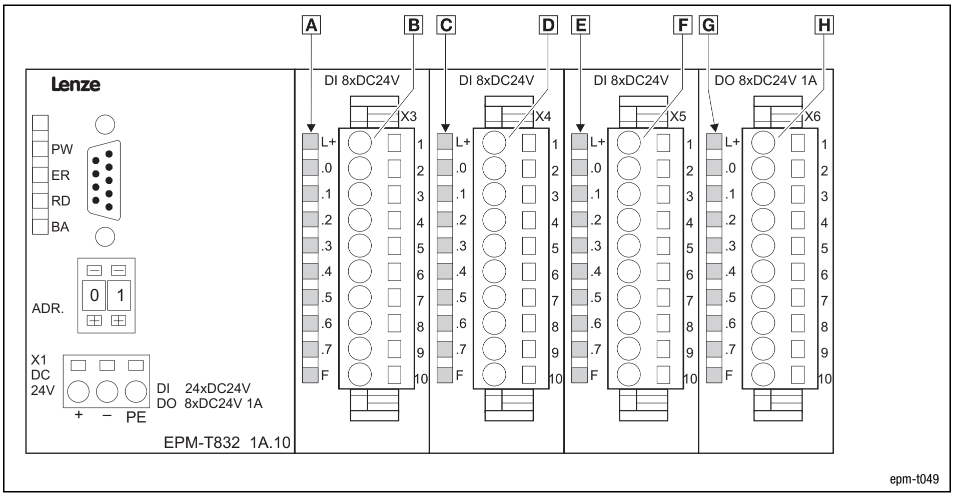


Fig. 5.4-4 Front view of 32×dig. I/O compact

A C E G Status display for digital inputs/outputs at terminal strips X3, X4, X5, and X6

L+	LED (yellow) is lit when the supply voltage is applied.
.0 7	LED (green) is lit when the output is triggered and/or a HIGH level is detected at the input
F	LED (red) is lit in case of overload, overheating, short-circuit errors.

B Terminal strip X3 assignment

X3/1	Not assigned
X3/2 ... X3/9	Digital inputs E.0 ... E.7
X3/10	GND (reference potential)

D Terminal strip X4 assignment

X4/1	Not assigned
X4/2 ... X4/9	Digital inputs E.0 ... E.7
X4/10	GND (reference potential)

F Terminal strip X5 assignment

X5/1	Not assigned
X5/2 ... X5/9	Digital inputs E.0 ... E.7
X5/10	GND (reference potential)

H Terminal strip X6 assignment

X6/1	DC 24 V supply voltage
X6/2 ... X6/9	Digital outputs A.0 ... A.7
X6/10	GND (reference potential)

Connection

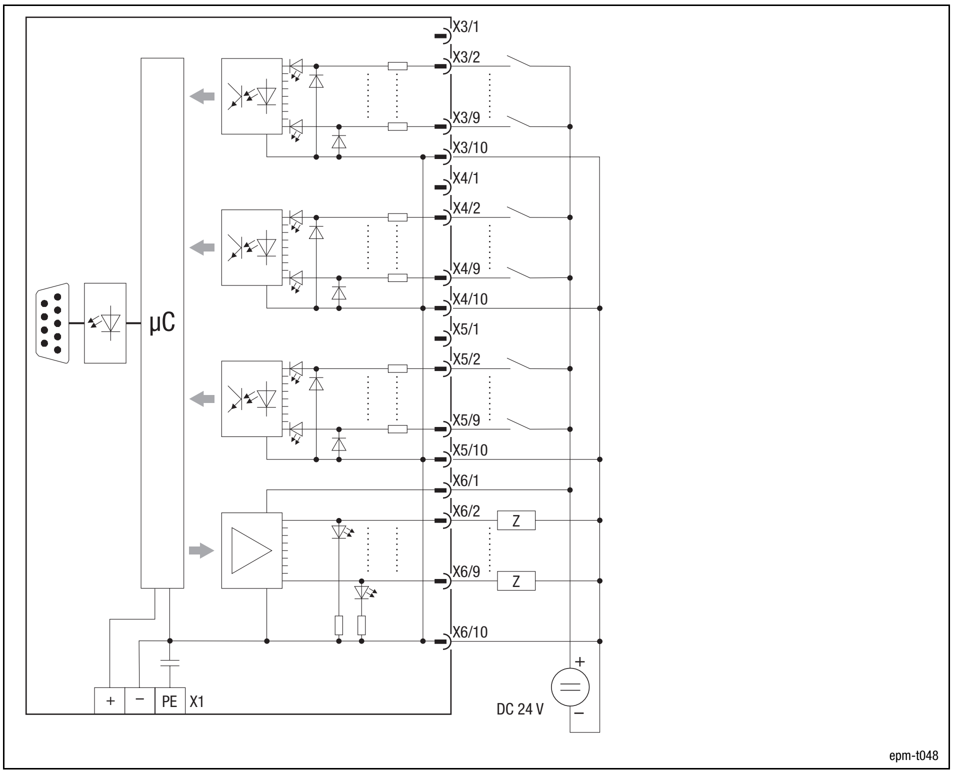


Fig. 5.4-5 Wiring diagram of 32×dig. I/O compact

-[Z]- Load

Technical data

Type	32×dig. I/O compact								
Voltage supply	DC 24 V / 55 mA (DC 20.4 ... 28.8 V)								
Connectable cable cross-section	≤ 2.5 mm^2 (≥ AWG 14)								
Communication									
Communication protocol	• System bus (CAN) • CANopen (CAL-based communication profile DS301/DS401)								
Communication medium	DIN ISO 11898								
Network topology	Line (terminated at both ends)								
Baud rate [kbit/s]	10	20	50	100	125	250	500	800	1000
Max. bus length [m]	5000	2500	1000	600	500	250	80	50	25
Max. number of nodes	63								
Digital inputs/outputs									
Number	24 digital inputs 8 digital outputs								
Electrical isolation from system bus	Yes, via optocouplers								
Digital inputs									
Input resistance	3.3 kΩ								
Delay time	3 ms								
Level	LOW: DC 0 ... 5 V HIGH: DC 15 ... 30 V								
Digital outputs									
Rated load voltage	DC 24 V (DC 18 ... 35 V)								
Max. output current per output	1 A (resistant to short circuits)								
Current consumption if all outputs = LOW	50 mA								
Delay time	< 1 ms								
Communication									
Input data	3 bytes								
Output data	1 byte								
Diagnostic data	2 bits								
Dimensions									
Width	152 mm								
Height	76 mm								
Depth	48 mm								
Weight	300 g								

Order designation	**EPM-T832**

6 Mechanical installation

Contents

6.1 The modular system

Mounting dimensions and other dimensions

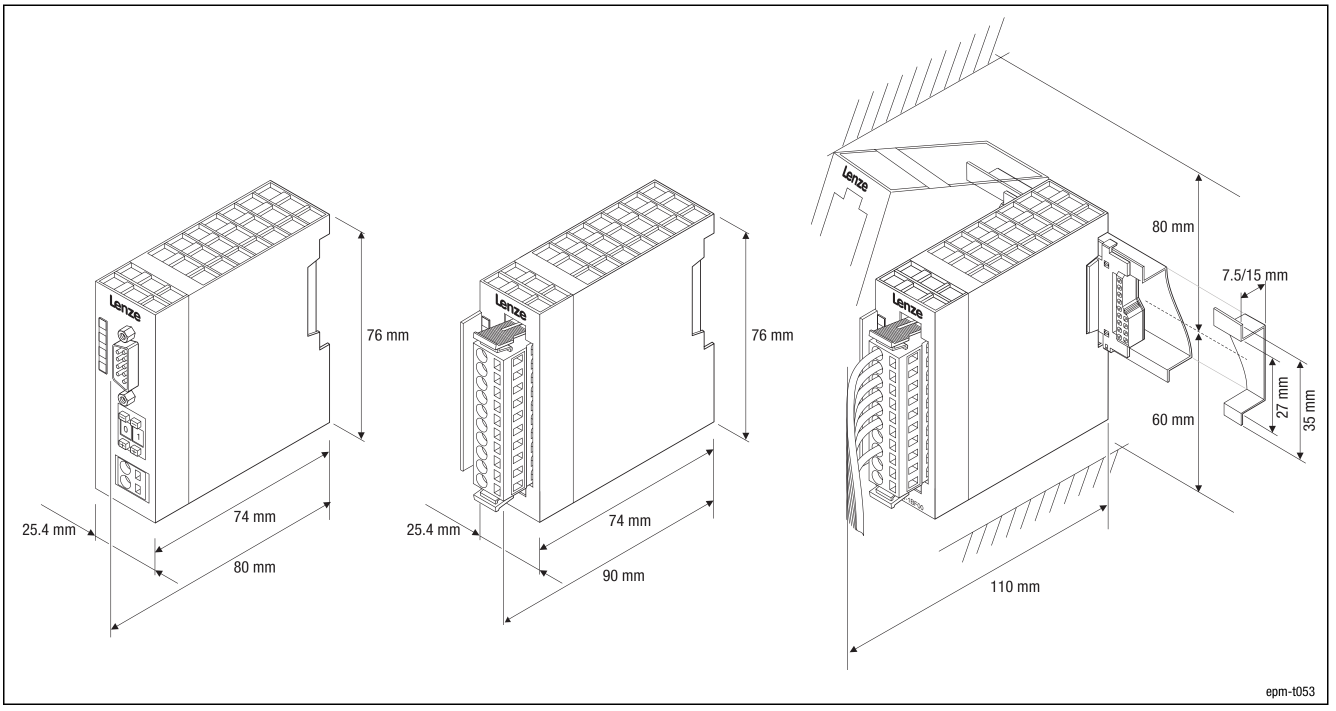


Fig. 6.1-1 Module dimensions of the modular system

Mounting

Stop!

Incorrect handling destroys the modules!

Modules may be destroyed if live during installation.

Protective measures:

- Make sure the supply voltage is disconnected before you insert modules into the backplane bus.

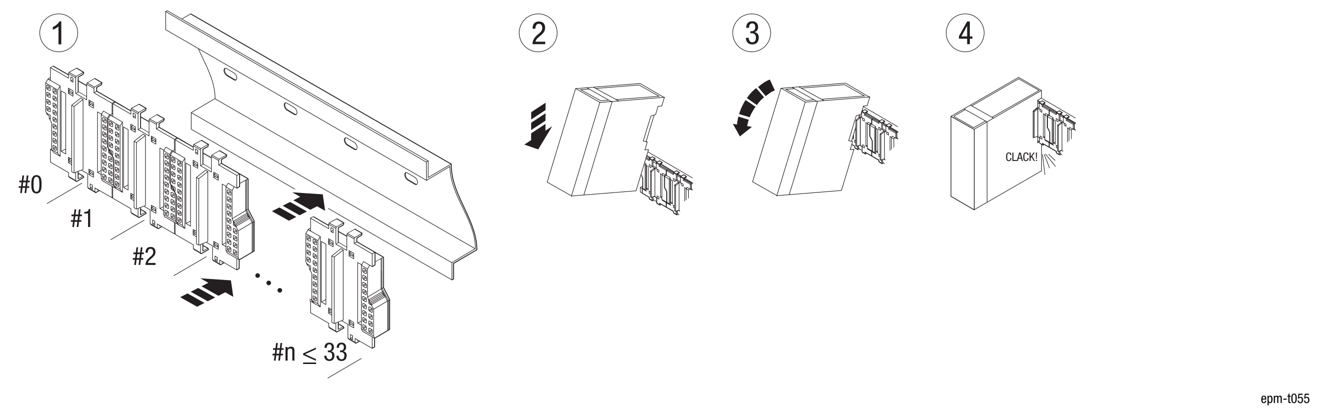


Fig. 6.1-2 Mounting the module on the DIN rail

① Mount the DIN rail. Provide enough mounting clearance for the modules (Fig. 6.1-1):
  At the top: Min. 80 from the middle of the DIN rail
  At the bottom: Min. 60 mm from the middle of the DIN rail

  Press the backplane bus onto the DIN rail until it safely engages

② Lower the module on to the DIN rail at an angle of approx. 45 °

③ Turn the module downward

④ Connection to the backplane bus is established once the module has audibly engaged with the DIN rail.

Note!

- The backplane bus is available in single (EPM-T910), double (EPM-T911), quadruple (EPM-T912) and octuple (EPM-T913) versions.
  – In order to determine the number of slots, add a 1 to the backplane bus versions you want to use, e. g.: single $_{\text{(EPM-T910)}}$ + octuple $_{\text{(EPM-T913)}}$ + 1 = 10 slots.
- The modules are always arranged from left to right and must always start with the CAN gateway module.
- Modules must always be plugged directly next to each other. Free slots are not permissible since this would interrupt the backplane bus.
- A module is electrically connected only once it has audibly engaged.
- Slots to the right of the last module may remain unassigned.
- The number of modules is limited to max. 32.

Dismounting

Stop!

Incorrect handling destroys the modules!

Modules may be destroyed if live when disassembled or removed without a suitable tool.

Protective measures:

- Only remove modules from the backplane bus when the supply voltage is disconnected.
- It is essential to use a screw driver to dismount the modules.

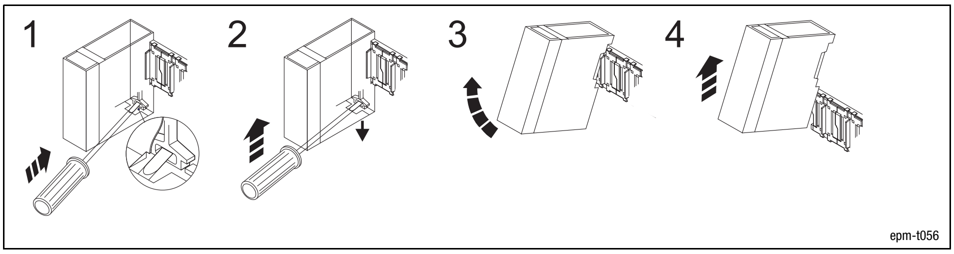


Fig. 6.1-3 Removing the module from the backplane bus

How to remove modules from the backplane bus:

1. Insert the screw driver into the slot of the unlocking pin.
2. Press the screw driver upwards to pull the unlocking pin downwards.
3. Turn the module upwards to disconnect from the backplane bus.
4. Remove the module from the DIN rail by pulling it upwards.

Note!

Unplugging a module leaves the backplane bus interrupted at that particular location.

6.2 The compact system

Mounting dimensions and other dimensions

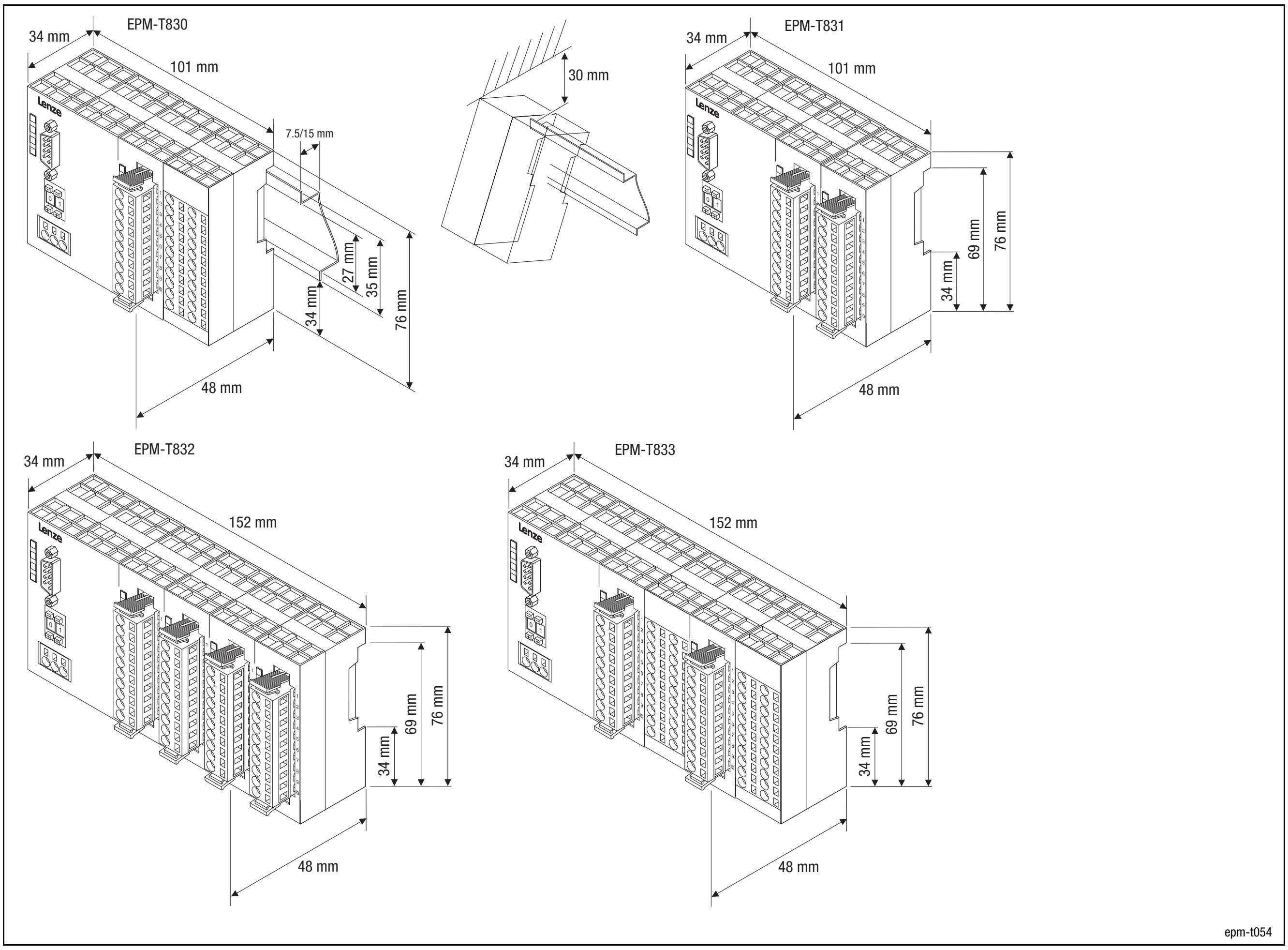


Fig. 6.2-1 Module dimensions of the compact system

Mounting

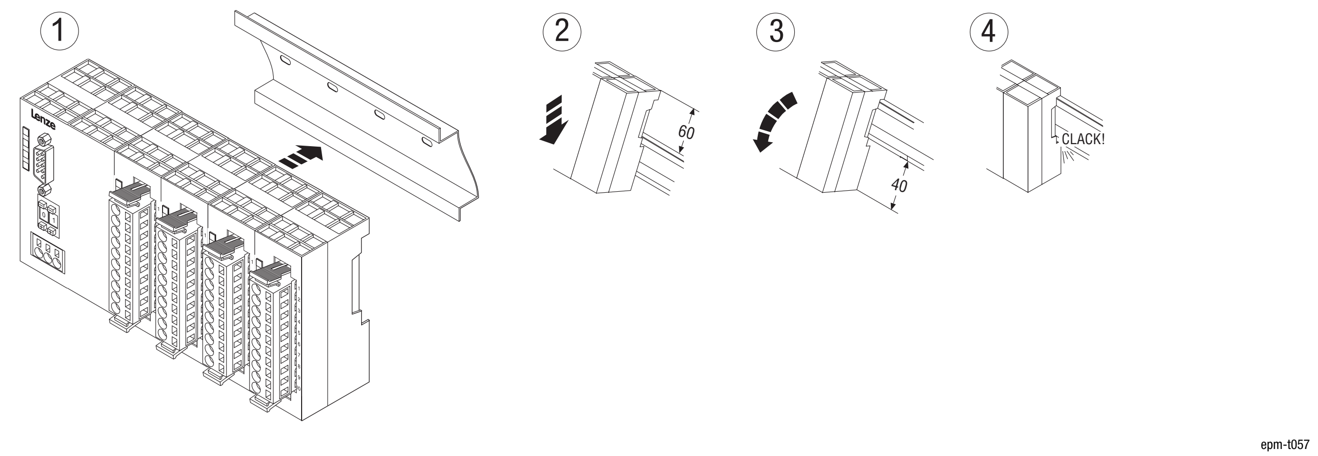


Fig. 6.2-2 Mounting the module on the DIN rail

① Mount the DIN rail to allow the module an installation clearance of min. 60 mm at the top and min. 40 mm at the bottom.
② Lower the module on to the DIN rail at an angle of approx. 45 °
③ Turn the module downward
④ Allow the module to audibly engage with the DIN rail

Dismounting

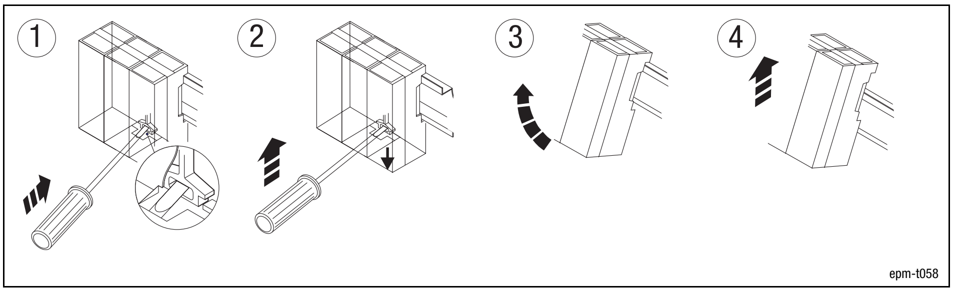


Fig. 6.2-3 Remove the module from the DIN rails

① Insert the screw driver into the withdrawal slot
② Press the screw driver upward to disengage the module
③ Pull the module towards the front by its bottom edge.
④ Remove the module from the DIN rail by pulling it upwards.

7 Electrical installation

Contents

7.1 Wiring according to EMC

General notes	• The electromagnetic compatibility of the I/O system IP20 depends on the type and accuracy of the installation. Special attention should be paid to: – Assembly – Shielding – Earthing • Any other installation set-ups require the system to be checked for compliance with the EMC limit values for assessment of conformity with the EMC Directive. This for instance applies to the following: – Use of unshielded cables • **Responsibility for compliance with the EMC Directive is with the user.** – It can be assumed, if the following measures are observed, that no EMC problems will arise during operation and that the EMC Directive and / or the EMC Act, respectively, is complied with. – Operating devices near the system that do not meet the CE standard in terms of disturbance immunity EN 61000-4-2, may cause electromagnetic interference to these devices by the decentralised I/O system IP20.
Assembly	• Connect DIN rail to earthed mounting plate: – Mounting plates with conductive surfaces (zinc-coated or stainless steel) allow permanent contact. – Painted plates are not suitable for installation in accordance with the EMC. • If you use several mounting plates: – Connect the mounting plates electrically with a surface as large as possible (e.g. with copper bands). • When laying the cables, ensure spatial separation from signalling and mains cables. • Route the cables as close as possible to the reference potential. Freely suspended cables act like aerials.
Shielding	• If possible, use only cables with braids. • The shield coverage should be in excess of 80%. • Data lines for serial coupling always require metallic or metallised plugs. Connect the shield of the data line to the plug housing. • Use metal cable clamps to attach the braids. • Connect shield to shield rail inside the switchgear cabinet. • Connect the shields of analog control cables at one end (either to the sensor or as closely as possible to the analog module input).
Earthing	• Earth all metallically conductive components with suitable cables from a central earthing point (PE bar). • Comply with the minimum cross-sections defined in the safety instructions: – It is not the cable cross-section that is decisive for EMC, but instead the cable surface and large-surface contact.

7.2 Wiring of terminal strips

Stop!

Insert the screw driver only into the rectangular opening of the terminal strip !

Using force to insert the screw driver into the round opening for the cable will destroy the spring-mounted terminal !

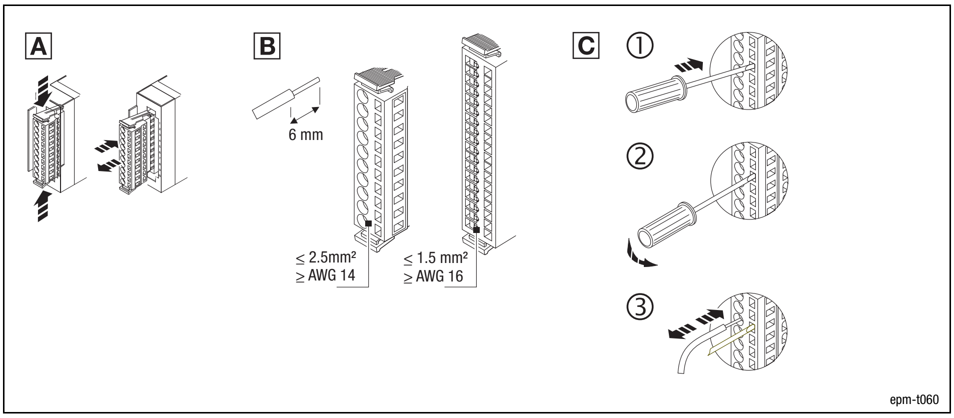


Fig. 7.2-1 Wiring of the terminal strips

- A Plugging and unplugging the terminal strip
- B Stripping length and max. permitted cable cross-section
- C Wiring of the terminal strip
  - ① Insert a suitable screw driver into the rectangular opening
  - ② To open the contact spring, press the screw driver in the shown direction and hold in position
  - ③ Insert the stripped core into the round opening. By removing the screw driver, the wire is securely connected to the terminal strip via a spring contact

7.3 Supply voltage connection

Modular system

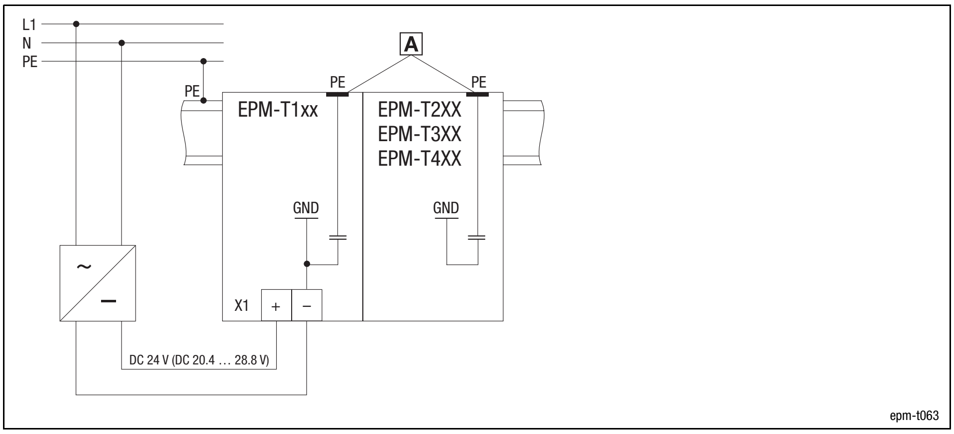


Fig. 7.3-1 Connecting the supply voltage

A PE connection of the modules is effected by means of the DIN rail and is established via a contact on the backplane of the module

Compact system

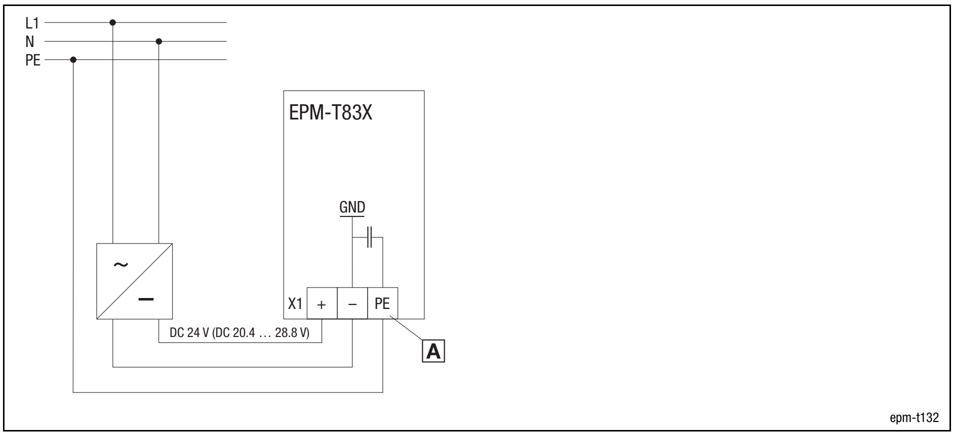


Fig. 7.3-2 Connecting the supply voltage

A The PE connection of the modules is made via terminal X1/PE

Note!

Specific connection data is included in the corresponding module description:

- Modular system (4.1 ff)
- Compact system (5.1 ff)

7.4 System bus (CAN) / CANopen

7.4.1 Wiring

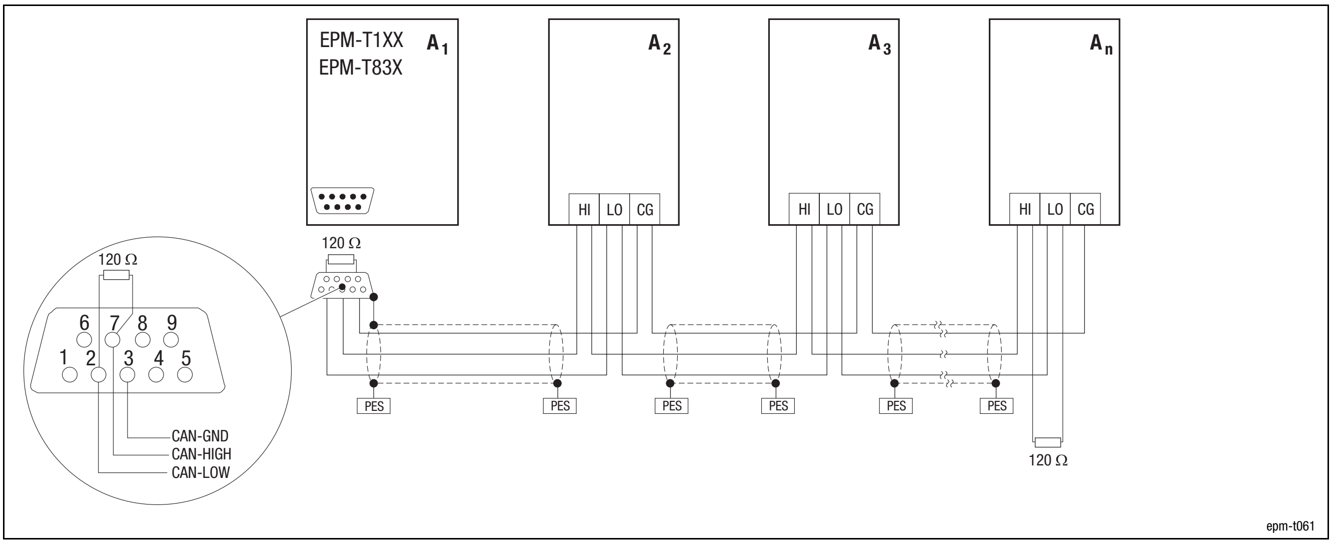


Fig. 7.4-1 Basic wiring of the system bus (CAN) / CANopen

A1 Nodes 1 EPM-T110 or EPM-T8XX
A2 Node 2
A3 Node 3
A_n Node n (e.g. PLC), n = max. 63

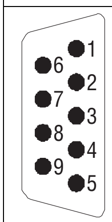
Specification of the transmission cable

We recommend the use of CAN cables according to ISO 11898-2:

CAN cable according to ISO 11898-2		
Cable type		Twisted pair with shielding
Impedance		120 Ω (95 ... 140 Ω)
Cable resistance	Cable length ≤ 300 m	≤ 70 mΩ/m
	Cable length ≤ 1000 m	≤ 40 mΩ/m
Signal propagation delay		≤ 5 ns/m

7.4.2 Communication connection

Assignment of Sub-D plug

View	Pin	Assignment	Explanation
	1	Not assigned	-
	2	CAN-LOW	Data line
	3	CAN-GND	Data ground
	4	Not assigned	-
	5	Not assigned	-
	6	Not assigned	-
	7	CAN-HIGH	Data line
	8	Not assigned	-
epm-t023	9	Not assigned	-

7.5 PROFIBUS-DP

7.5.1 Wiring

Basic wiring of PROFIBUS

The design of the bus system PROFIBUS-DP is shown in the general drawing.

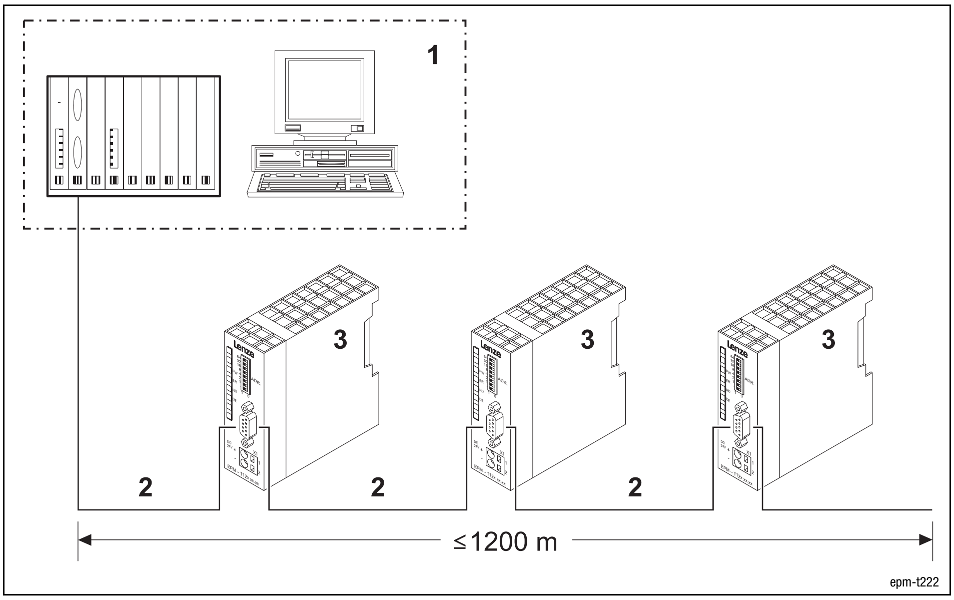


Fig. 7.5-1 PROFIBUS-DP with RS485 cabling (without repeater)

Element		Note
1	Master	Master computer, e.g. PC or PLC with PROFIBUS-DP master interface module
2	Bus cable	Adjust the baud rate to the length of the bus cable
3	Slave	PROFIBUS Gateway or PROFIBUS GatewayECO

Note!

When using a repeater, max. 125 devices can communicate via the PROFIBUS.

Number of bus stations

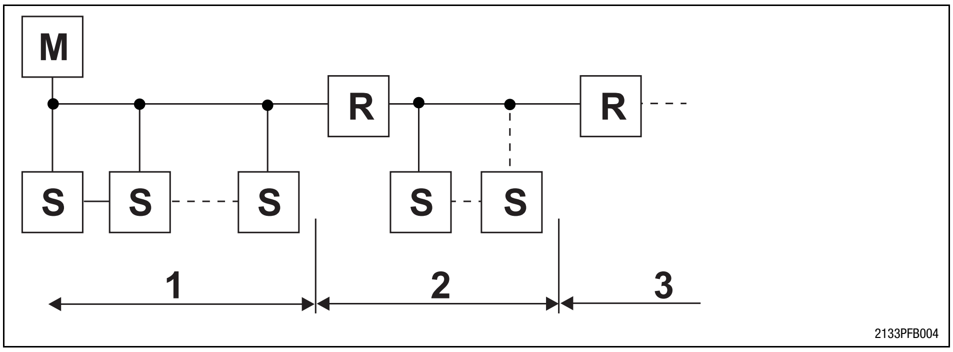


Fig. 7.5-2 Number of nodes in the bus system PROFIBUS-DP

Segment	Master (M)	Slave (S)	Repeater (R)
1	1 2	31 30	- -
2	-	31	1
3	-	30	2

Note!

Repeaters do not have a device address, but they are also included in the calculation of the maximum slave number of nodes.

Repeaters can be used to create line and tree topologies. The maximum total extension of the bus system depends on

- the used baud rate,
- the number of repeaters.

Baud rate / length of bus cable

Baud rate [kBit/s]	Length [m]
9.6 - 93.75	1200
187.5	1000
500	400
1500	200
3000 - 12000	100

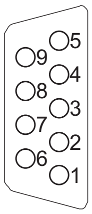
Specification of the transmission cable

Please follow our recommendations for signal cables.

Specification bus cable	
Cable resistance	135 - 165 Ω/km, (f = 3 - 20 MHz)
Capacitance per unit length	≤ 30 nF/km
Loop resistance	< 110 Ω/km
Core diameter	> 0.64 mm
Core cross-section	> 0.34 mm^2
Cores	Double twisted, insulated and shielded

7.5.2 Communication connection

Assignment of Sub-D socket

View	Pin	Assignment	Explanation
 EPM-T223	1	Not assigned	-
	2	Not assigned	-
	3	RxD/TxD-P	Data line B (received / transmitted data plus)
	4	RTS	Request To Send (received / transmitted data, no differential signal)
	5	M5V2	Data ground (ground at 5 V)
	6	P5V2	DC 5 V / 30 mA (bus termination)
	7	Not assigned	-
	8	RxD/TxD-N	Data line A (received / transmitted data minus)
	9	Not assigned	-

8 Networking via system bus (CAN)

Contents

8.1 Via system bus (CAN)

The I/O system IP20 supports the Lenze system bus (CAN).

Lenze has developed the system bus on the basis of CAN. As a result, functions of the communication profile CANopen have been integrated to DS301 which came into being under the umbrella organisation of CiA (CAN in Automation) in conformance with the CAL (CAN Application Layer).

Note!

- The communication profile system bus (CAN) can be selected with the setting of the node address (Node ID).
  - Information on how to proceed with the modular system is included in the description of the module CAN Gateway in the chapter ”The modular system”.
  - Information on how to proceed with the compact system is included in the description of the corresponding module in the chapter ”The compact system”.
  - Lenze setting: System bus (CAN)
- Additional information on the system bus (CAN) can be found in the Lenze CAN Communication Manual.

8.1.1 Structure of the CAN data telegram

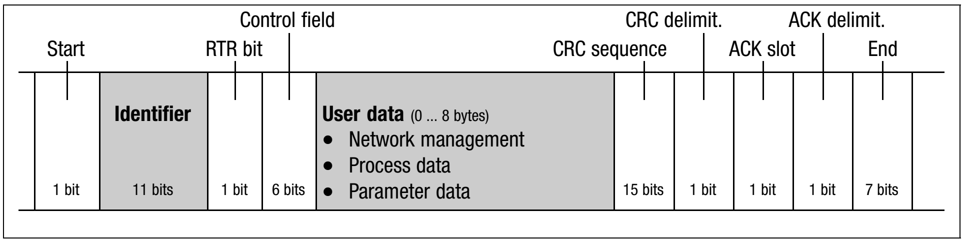


Fig. 8.1-1 Basic structure of the CAN telegram

Note!

Only the identifier and the user data are relevant to the user. All other data of the CAN telegram are automatically processed by the system.

8.1.2 Identifier

The principle of CAN communication is based on a message-oriented data exchange between a transmitter and many receivers. Therefore, all nodes can transmit and receive more or less at the same time.

The so-called *identifier* in the CAN telegram, also called *COB-ID* (*Communication Object Identifier*), controls which node is to receive a transmitted message. In addition to the addressing, the identifier contains information on the priority of the message and the type of user data.

The identifier consists of a 'basic identifier' and the node address of the device to be approached:

Identifier = Basic identifier + node address

- This node address is set with the coding switch at the module:
  - Modular system: At CAN gateway
  - Compact system: At each module
- Network management and sync telegram only require the basic identifier.
- The identifiers can also be set individually. (📖 8.3-3)

8.1.3 Saving changes

Note!

- Changes of the baud rate, node address, identifiers for PDOs, and the transmission mode for PDOs must be saved with $I2003_h$ = 1, for being maintained even after switching off the supply voltage.
- Any changes will become effective only after a Reset Node:
  - Switch the supply voltage on again
  - Execute NMT command "81_h" (see chapter "Network management (NMT)")
  - Set $I2358_h$ = 1

8.2 Network management (NMT)

Via the network management, the master can change a communication status for the whole CAN network.

Communication phases

Status	Explanation
"Initialisation"	Initialisation starts when the I/O system is switched on. In this phase, the I/O system does not take part in the bus data transfer. Furthermore it is in each NMT status possible to restart the entire initialisation or parts of it by transferring different telegrams (see "Status transitions"). All parameters already set are overwritten with their standard values. After initialisation has been completed, the I/O system is automatically set to the status "Pre-operational".
"Pre-Operational"	The I/O system can receive parameter data. Process data are ignored.
"Operational"	The I/O system can receive parameter and process data.
"Stopped"	Parameter and process data cannot be received. Network management telegrams can be received. The module outputs switch to the configured status (see chapter "Monitoring").

Telegram structure

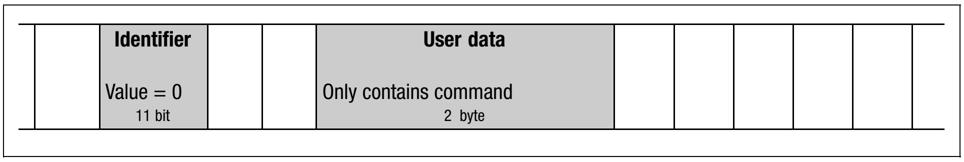


Fig. 8.2-1 Telegram for changing the communication phase

The telegram used for network management contains an identifier and the command which is part of the user data and consists of command byte and node address.

Telegrams with the identifier 0 and two bytes user data are used to change between the communication phases.

Only the network master (e.g. controller) can change a communication status for the whole network.

Note!

Communication via process data only is possible with a state change to "operational"!

Example:
For changing the state of all nodes on the bus from "pre-operational" to "operational" via the CAN master, the following identifier and user data must be set in the telegram:

- Identifier: 00 (broadcast telegram)
- User data: 0100 (hex)

State transitions

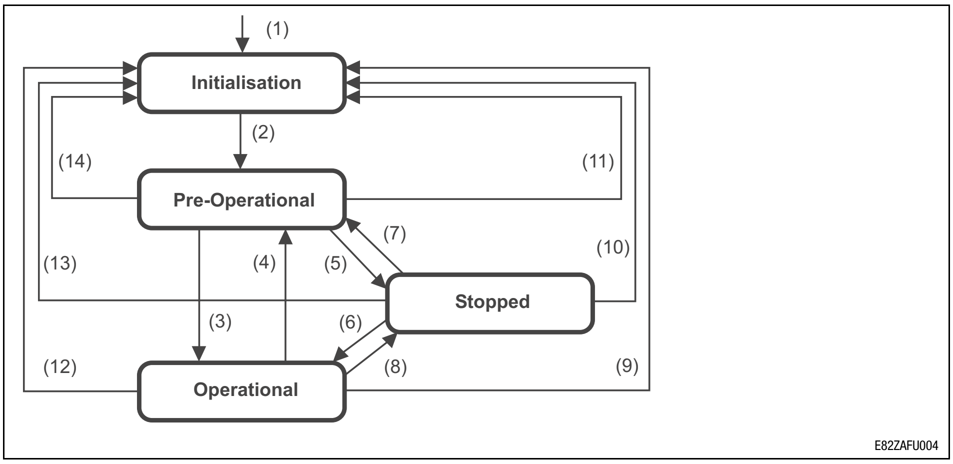


Fig. 8.2-2 Network management status transitions

Status transition	Command (hex)	Network status after change	Effects on process and parameter data
(1)	-	Initialisation	Initialisation starts automatically when the mains is switched on. During initialisation, the I/O system does not take part in the data transfer. After initialisation has been completed, the device sends a boot-up message with an identifier to the master. The device is automatically set to the status ”Pre-operational”.
(2)	-	Pre-Operational	In this phase, the master determines the I/O system communication.
From that moment on, the master changes a status for the whole network. A target address, which is part of the command, selects the slave(s).			
(3), (6)	01 xx	Operational	Network management telegrams, sync, emergency, process data (PDOs) and parameter data (SDOs) are active. Optional: When the status is changed, event and time-controlled process data (PDOs) will be sent once.
(4), (7)	80 xx	Pre-Operational	Network management telegrams, sync, emergency and parameter data (SDOs) are active (like “Enter pre-operational state“)
(5), (8)	02 xx	Stopped	Parameter and process data cannot be received. Network management telegrams can be received.
(9)	81 xx	Initialisation	No effects. The device is automatically set to the status ”Pre-operational”.
(10)			
(11)			
(12)	82 xx		No effects. The device is automatically set to the status ”Pre-operational”.
(13)			
(14)			

xx = 00_h With this assignment, all controllers connected are addressed by the telegram. All controllers can change their status at the same time.
xx = node ID If a node address is indicated, the status will only be changed for the controller addressed.

8.3 Transmitting process data

Process data are used for control-specific purposes, such as setpoint and actual values, for example.

- Process data or the input / output data of the I/O system IP20 are transmitted as so-called PDOs (*Process Data Objects*).

8.3.1 Process data telegram

Structure of the process data telegram:

11 bits	8 bytes of user data							
Identifier	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8

Identifier

Information on the identifier can be found in chapter ”Structure of the CAN data telegram”.

User data

The eight bytes of user data transmit the input signals (sent user data) and the output signals (received user data) of the modules.

8.3.2 Identifier of the process data objects (PDO)

The identifiers of process data objects PDO1 ... PDO10 consist of the so-called basic identifiers and the set node address:

Identifier = Basic identifier + node address

Basic identifiers of the process data objects

			Basic identifier		Available for	
			dec	hex	CAN gateway	8×dig. I/O compact 16×dig. I/O compact 32×dig. I/O compact
PDOs	Process data object 1					
		PD01-Rx	768	300	✓	✓
		PD01-Tx	767	2FF		
	Process data object 2					
		PD02-Rx	640	280	✓	–
		PD02-Tx	639	27F		
	Process data object 3					
		PD03-Rx	512	200	✓	–
		PD03-Tx	384	180		
	Process data object 4					
		PD04-Rx	832	340	✓	–
		PD04-Tx	896	380		
	Process data object 5					
		PD05-Rx	1024	400	✓	–
		PD05-Tx	448	1C0		
	Process data object 6					
		PD06-Rx	1088	440	✓	–
		PD06-Tx	704	2C0		
	Process data object 7					
		PD07-Rx	1152	480	✓	–
		PD07-Tx	960	3C0		
	Process data object 8					
		PD08-Rx	1280	500	✓	–
		PD08-Tx	1216	4C0		
	Process data object 9					
		PD09-Rx	1344	540	✓	–
		PD09-Tx	1728	6C0		
	Process data object 10					
		PD010-Rx	1664	680	✓	–
		PD010-Tx	1984	7C0		

8.3.3 Assigning individual parameters

For larger networks with many nodes, it may be useful to set individual identifiers for process data objects PDO1 ... PDO10 that are independent of the set node address.

Process data objects for input data

Individual identifiers for input data can be set via the indices $I1400_h$, subindex 1 ... $I1409_h$, subindex 1.

Process data objects for output data

Individual identifier for output data can be set via the indices $I1800_h$, subindex 1 ... $I1809_h$, subindex 1.

Note!

- Set the value which makes the required identifier (x = corresponding process data object) in index $I140x_h$, subindex 1 or $I180x_h$, subindex 1.
- Make a reset node so that the changes are accepted.

8.3.4 Process data transmission mode

Process data transmission mode

The transmission mode is configured via the index $I1400_h$, subindex 2 (PDO1-Rx) ... $I1409_h$, subindex 2 (PDO10-Rx):

- Sync-controlled reception
- N-sync-controlled reception
  - First, a certain number (n) of sync telegrams must be transmitted ($I140x_h$, subindex 2 = 1 ... 240). Then the PDO telegram must be received from the master. Finally, the process input data are accepted.
- Event-controlled reception (Lenze setting)

Process output data transmission method

The transmission mode is configured via the index $I1800_h$, subindex 2 (PDO1-Tx) ... $I1809_h$, subindex 2 (PDO10-Tx):

- Sync-controlled transmission
- n-sync-controlled transmission
  - First, a certain number (n) of sync telegrams must be transmitted ($I180x_h$, subindex 2 = 2 ... 240). Then, the PDO telegram is transmitted to the master.
- Event-controlled transmission (Lenze setting)

Note!

After changing to the CAN state "Operational", the current process image is transmitted from the I/O system IP20.

Sync telegram for cyclic process data

A special telegram, the sync telegram, is required for synchronisation when cyclic process data are transmitted.

The sync telegram must be generated by **another** node. It initiates the transmission for the cyclic process data of the I/O system I/P20 and at the same time triggers data acceptance of cyclic process data received in the I/O system IP20.

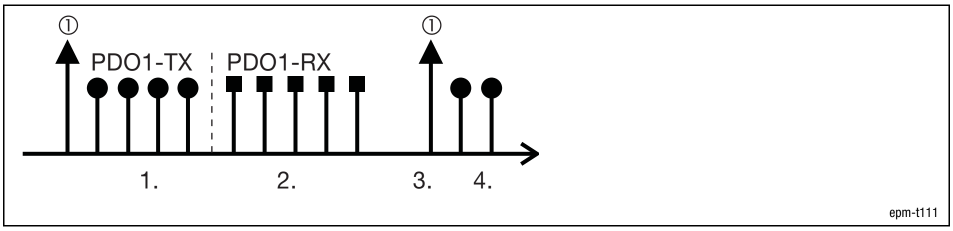


Fig. 8.3-1 Synchronisation of cyclical process data with the help of a sync telegram (asynchronous data not considered)

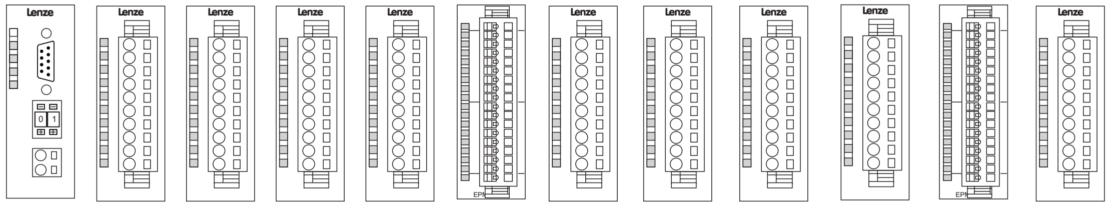
① Sync telegram

Transmission sequence

1. After receiving a sync telegram, the I/O system IP20 transmits the cyclic process output data (PDO1-Tx) if ”sync-controlled transmission” is active.
2. Once the transmission is completed, the I/O system IP20 receives the cyclic process input data (PDO1-Rx).
3. The data is accepted by the I/O system IP20 with the next sync telegram if ”sync-controlled reception” is active.
4. All other telegrams (e.g. for parameter or event-controlled process data) are accepted asynchronously by the I/O system IP20 after transmission.

8.3.5 Process image of the modular system

The process image of the modular system is explained on the basis of the following example. In addition to the CAN gateway, maximally 32 modules can be connected.

Module														
	CAN Gateway	8×DI	8×DI	8×DI	8×DI	16×DI	8×DO	4×AI	2/4× Counter	SSI interface	1×counter / 16×DI	4×AI/AO	–	–
Process data	–	1 byte TX	1 byte TX	1 byte TX	1 byte TX	2 bytes TX	1 byte RX	8 bytes TX	10 bytes TX 10 bytes RX	4 bytes TX 4 bytes RX	6 bytes TX 6 bytes RX	4 bytes TX 4 bytes RX		
Module No.	M0	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**...**	**M32**

Process image			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
PDO1	Fixed for the first DIO	PDO1-RX	**M6**	–	–	–	–	–	–	–
		PDO1-TX	**M1**	**M2**	**M3**	**M4**	**M5**	**M5**	–	–
PDO2	Fixed for the first AIO	PDO2-RX	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**
		PDO2-TX	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**
PDO3	DIO or AIO [1]	PDO3-RX	**M8**	**M8**	**M11**	**M11**	**M11**	**M11**	–	–
		PDO3-TX	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**
PDO4	DIO or AIO [1]	PDO4-RX	–	–	–	–	–	–	–	–
		PDO4-TX	**M8**	**M8**	**M11**	**M11**	**M11**	**M11**	–	–
PDO5	DIO or AIO [1]	PDO5-Rx	**M10**	**M10**	**M10**	**M10**	**M10**	**M10**	–	–
		PDO5-Tx	**M10**	**M10**	**M10**	**M10**	**M10**	**M10**	–	–
PDO6	DIO or AIO [1]	PDO6-Rx	**M9**	**M9**	**M9**	**M9**	–	–	–	–
		PDO6-Tx	**M9**	**M9**	**M9**	**M9**	–	–	–	–
...	...	...	...	...	...	...	...	...	...	...
PDO10	DIO or AIO [1]	PDO10-RX	–	–	–	–	–	–	–	–
		PDO10-TX	–	–	–	–	–	–	–	–

[1] A PDO can be either assigned to AIO or DIO. The modules are assigned according to the slot sequence, with the DIO being assigned first.

AI	Analog input data
AO	Analog output data
DI	Digital input data
DO	Digital output data
AIO	Analog input and output data
DIO	Digital input and output data

Special features of the modules 1×counter/16×digital input and SSI interface:

- The module 1×counter/16×digital input always assigns the next to last and the SSI interface module always the last of the PDOs used.
- The modules cannot be assigned to PDO1 and PDO2. Thus, only eight of these modules can be used in a system.
- The modules assign a whole PDO (8 bytes) each.

Transmission times

The transmission times of the input / output signals within the I/O system IP20 can be calculated with a formula.

$$t_t = t_c + (N_{PDOTX} \cdot 8\ \mu s) + (N_{PDORX} \cdot 2\ \mu s) + t_d + 742\ \mu s$$

t_t	Transmission time of input / output signals of a module between fieldbus connection and input / output terminals.
t_c	Time required for copying into the CAN object directory
N_{PDOTX}	Transmitting the PDO number (PDO1-Tx ... PDO10-Tx)
N_{PDORX}	Receiving the PDO number (PDO1-Rx ... PDO10-Rx)
t_d	Module delay time
742 µs	Fixed internal processing time

Time required for copying into the CAN object directory:

DO modules	DI modules	AO modules	AI modules
t_c = 50 µs + n × 14 µs	**t_c = 50 µs + n × 25 µs**	**t_c = 50 µs + n × 210 µs**	**t_c = 50 µs + n × 250 µs**

n Number of bytes assigned by the module in the PDOs

Example

In the I/O system shown in the example, the transmission time of the input signals at the module M3 (8×digital input) to the master is to be detected. The baud rate amounts to 500 kbits/s.

Solution:

- For transmitting the input signals, the module assigns one byte (byte 3) of the process data channel PDO1-Tx.
- The delay time t_d within the module amounts to 3 ms.

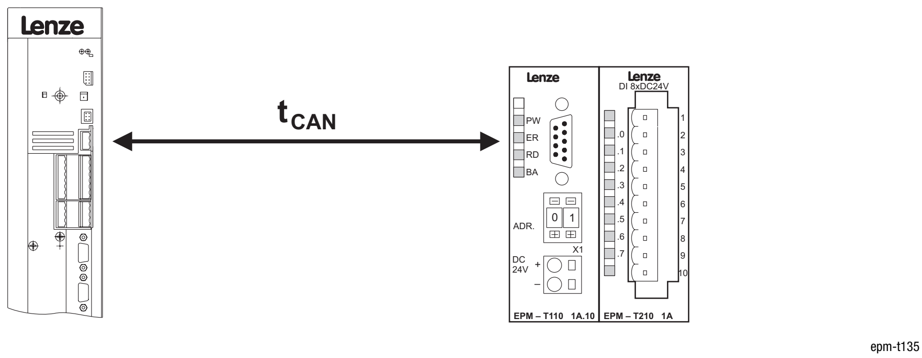
1. Calculating the time required for copying t_c into the CAN object directory:

$$t_c = 50\ \mu s + 1 \cdot 25\ \mu s = 75\ \mu s$$

2. Calculating the transmission time t_t of the input signals to the fieldbus:

$$t_t = 75\ \mu s + (1 \cdot 8\ \mu s) + (0 \cdot 2\ \mu s) + 3000\ \mu s + 742\ \mu s = 3825\ \mu s$$

3. Calculating the transmission time t_{CAN} via the fieldbus:



$$t_{CAN} = \frac{\text{CAN telegram length}}{\text{Baud rate}} = \frac{111\ \text{bits}}{\frac{500\ \text{kbits}}{\text{s}}} = 222\ \mu s$$

4. Calculating the total transmission time t:

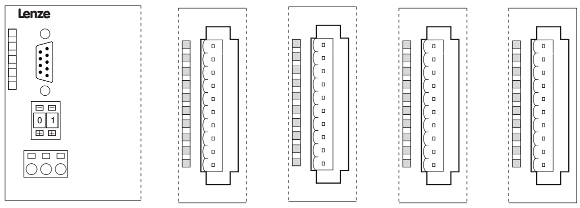
$$t = t_t + t_{CAN} = 3825\ \mu s + 222\ \mu s = 4047\ \mu s = 4.047\ \text{ms}$$

Note!

The internal processing times of the controller must also be considered.

8.3.6 Process image of the compact system

The process image of the compact system is explained on the basis of the module 32×dig. I/O compact.

Module					
	CAN gateway		8×DI	8×DI	8×DO
Process data	–	1 byte	1 byte DI	1 byte DI	1 byte DO
Slot	M0	**M1**	**M2**	**M3**	**M4**

Process image		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
PDO1	PDO1-RX	**M4**	–	–	–	–	–	–	–
	PDO1-TX	**M1**	**M2**	**M3**	–	–	–	–	–

DI Digital input data
DO Digital output data

8.3.7 Compatibility with Lenze drive and automation components

The tables below will assist you in finding out at which stage a modular system or which compact module, respectively, can be operated in combination with a Lenze drive and automation component.

Compatibility is dependent on the available process data objects (PDO).

Process data objects (PDO) of the I/O system IP20 (slave)		
Module type	**Module requires**	
	PDO-Rx	**PDO-Tx**
Modular system		
8×digital input	–	1/8
16×digital input	–	2/8
8×digital output 1A	1/8	–
8×digital output 2A	1/8	–
16×digital output 1A	2/8	–
8×digital input / output	1/8	1/8
4×relay	1/8	–
4×analog input	–	8/8
4×analog output	8/8	–
4×analog input / output	8/8	8/8
2/4×counter	8/8 + 2/8	8/8 + 1/8
SSI interface	8/8	8/8
1×counter/16×digital input	8/8	8/8
Compact system		
8×dig. I/O compact	8/8	8/8
16×dig. I/O compact	8/8	8/8
16×dig. I/O compact (single-wire conductor)	8/8	8/8
16×dig. I/O compact (three-wire conductor)	8/8	8/8

Process data objects (PDO) of the Lenze drive and automation components (master)		
Components	**PDO-Rx [x_{PDO-Rx}]**	**PDO-Tx [x_{PDO-Tx}]**
9300 Servo PLC	>10	>10
Drive PLC		
9300 inverter (all standard types)	2	2
8200 vector frequency inverter		
8200 motec frequency inverter		
Communication module EMF2175		

Note!

- A modular system allows the connection of max. 32 modules in addition to the CAN gateway.
- A modular system offers max. 20 PDOs (10 PDO-Rx and 10 PDO-Tx) for process data exchange.
- Since 9300 Servo PLC and Drive PLC are able to manage more than 20 process data objects, several modular systems can be operated on a Servo PLC or Drive PLC. For this each CAN gateway must be assigned to a unique node address.

Example

A control task requires the connection of 4 digital outputs, 10 digital inputs and 3 analog outputs to an 8200 vector frequency inverter.

Solution

The planned solution is a modular system with the following modules:

I/O system IP20 Modular system	Number modules	Required PDOs	
		PDO-Rx	PDO-Tx
8×digital input / output	1	1/8	1/8
8×digital input	1	–	1/8
4×analog input	1	1	–
Sum	**3**	**9/8**	**2/8**

For exchanging the process data, the 8200 vector makes enough PDOs available:

Frequency inverter	Available PDOs	
	PDO-Rx	PDO-Tx
8200 vector	2	2

8.3.8 Data transmission between I/O system IP20 and controller

- The basic identifiers of PDO1-Rx and PDO1-Tx are pre-assigned in such a way that they can exchange data with the process data objects of CAN-IN3/OUT3 of a controller.
- The basic identifiers of PDO2-Rx and PDO2-Tx are pre-assigned in such a way that they can exchange data with the process data objects of CAN-IN2/OUT2 of a controller.

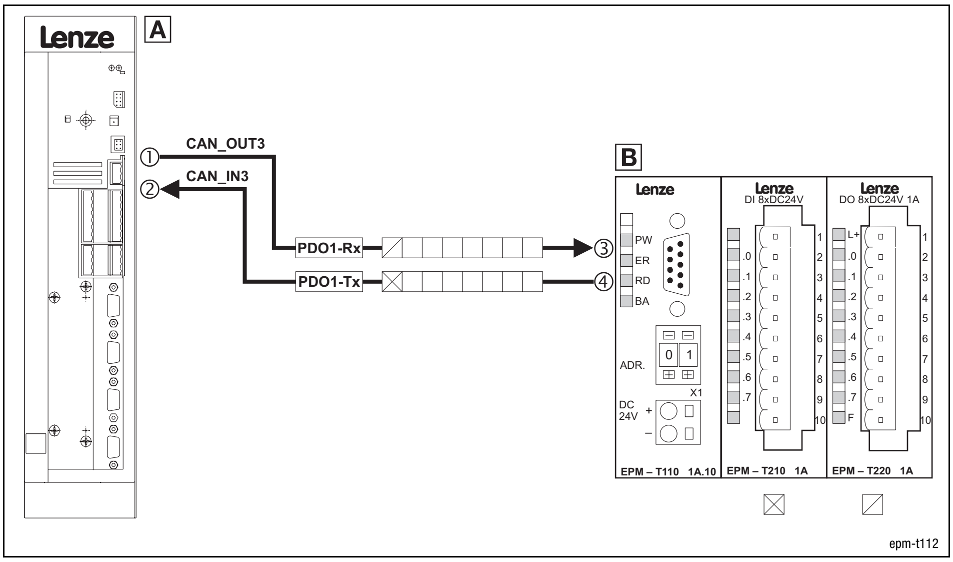


Fig. 8.3-2 Data transmission between I/O system IP20 and controller

PDO-Rx The I/O system IP20 receives the status information from the controller
PDO-Tx The I/O system IP20 transmits the status information to the controller

A Controller with node address 1 (C0350 = 1)

① 769_d (basic identifier) + 1 (node address) = 770_d (identifier)
② 768_d (basic identifier) + 1 (node address) = 769_d (identifier)

B CAN gateway of the modular system (or a module of the compact system) with node address 2

③ 768_d (basic identifier) + 2 (node address) = 770_d (identifier)
④ 767_d (basic identifier) + 2 (node address) = 769_d (identifier)

8.3.9 Indices for setting the process data transmission

Process data objects for input data

Index		Name	Possible settings				Important	
			Lenze	Selection				
I1400h ↵							Index is available in the modular and compact system	8.3-3
	1	COB-ID used by RxPDO 1	768	385	{1}	2047	Defining the individual identifiers for process data object 1	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	
	...	...						
I1409h ↵							Index is only available in the modular system	8.3-3
	1	COB-ID used by RxPDO 10	1665	385	{1}	2047	Defining the individual identifiers for process data object 10	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	

Process data objects for output data

Index	Name	Possible settings				Important	
		Lenze	Selection				
I1800h ↵							📖 8.3-3
1	COB-ID used by TxPDO 1	767	385	{1}	2047	Defining the individual identifiers for process data object 1	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time		0	{1 ms}	65535	Cycle time	
...	...						
I1809h ↵						Index is only available in the modular system	📖 8.3-3
1	COB-ID used by TxPDO 10	1984	385	{1}	2047	Defining the individual identifiers for process data object 10	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	

8.4 Transmitting parameter data

Parameter data are the so-called indices.

Parameters are usually set only once during commissioning.

Parameter data are transmitted as so-called SDOs (*Service Data Objects*) via the system bus and acknowledged by the receiver, i.e. the transmitter gets a feedback if the transmission was successful.

8.4.1 Telegram structure

Structure of the telegram for parameter data:

11 bits	8 bytes of user data							
Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4

- The subchapters below explain the individual telegram components in detail.
- Chapter 8.4.2 contains an example of how to write a parameter. (📖 8.4-4)
- Chapter 8.4.3 contains an example of how to read a parameter. (📖 8.4-5)

Identifier

Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4

Two parameter channels are available for parameter data transmission. They are addressed via the identifier.

		Identifier =	Basic identifier dec	Basic identifier hex	+ node address of the device
SDOs	Parameter channel 1				
		Output (transmit)	1408	580	+ value set with coding switch
		Input (receive)	1536	600	
	Parameter channel 2				
		Output (transmit)	1472	5C0	+ value set with coding switch
		Input (receive)	1600	640	

Note!

There is an offset of 64 between the identifiers for parameter channels 1 and 2:
- Output of parameter channel 1 = 1536
- Output of parameter channel 2 = 1536 + 64 = 1600

Instruction code

Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4

The instruction code contains the command to be executed and information about the parameter data length. It is structured as follows:

	bits 7 (MSB)	bits 6	bits 5	bits 4	bits 3	bits 2	bit 1	bit 0
Command	**Command Specifier (cs)**				**Length**		**E**	**s**
Write Request	0	0	1	0	00 = 4 bytes 01 = 3 bytes 10 = 2 bytes 11 = 1 byte		1	1
Write Response	0	1	1	0			0	0
Read Request	0	1	0	0			0	0
Read Response	0	1	0	0			1	1
Error Response	1	0	0	0	0	0	0	0

Instruction code for parameters with 4 bytes of data length:

	4 bytes of data (32 bits)		
Command	**hex**	**dec**	**Information**
Write Request	23	35	Transmitting parameters to a node
Write Response	60	96	Node response to the Write Request (acknowledgement)
Read Request	40	64	Request to read a parameter from a node
Read Response	43	67	Response to the read request with the actual value
Error Response	80	128	Node reports a communication error

Instruction “Error Response”

If an error occurs, the addressed node generates an “Error Response”.

In Data 4, this telegram always contains the value “6”, in Data 3 it contains an error code:

Command code Error Response	Data 3	Data 4	Error message
80_h	3	6	Access denied
	5		Wrong subindex
	6		Wrong index

Parameter addressing (Index/subindex)

Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4

The index of the telegram is used to address the index to be read or written:

- The index value must be entered in left-justified Intel format and divided into Low byte and High byte (see example).
- For subindices, the number of the associated subindex must be entered into the telegram's subindex.
- For indices without subindex, the subindex always has a value "0'.

Example

The subindex 1 of index I2400$_h$ (monitoring time for PDO1) is to be addressed:

11 bits	8 bytes of user data							
Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
		00$_h$	24$_h$	1				

Parameter data (data 1 ... data 4)

Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4

Up to 4 bytes (Data 1 ... Data 4) are available for parameter data.

Data are entered in left-justified Intel format with Data 1 as LSB and Data 4 as MSB (see example).

Example

The value "1 s" is to be transmitted for the index 2400$_h$ (monitoring time).

$Data_{1...4} = 1 \times 1000 = 1000 = 00\ 00\ 03\ E8_h$

11 bits	8 bytes of user data							
Identifier	Instruction code	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
					E8$_h$	03$_h$	00$_h$	00$_h$
					(LSB)			(MSB)

8.4.2 Writing a parameter (example)

Task

An I/O system IP20 has the node address 2. For the first analog module (4×analog output), the function of the output A.0 (voltage signal 0 ... +10 V, 12 bits) is to be shown.

Telegram to the I/O system IP20

	Formula	Information
Identifier	= Basic identifier + node address = 1536 + 2 =1538 = **602_h**	• Basic identifier for parameter channel 1 (output) = 1536 • Node address of the I/O system IP20 = 2
Instruction code:	= **23_h**	• Command “Write Request” (transmitting parameters to the I/O system IP20)
Index	= **$I3001_h$**	• Index first analog module
Subindex	= **1**	• Subindex = 1 (function for output A.1 among others)
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 05_h = $3B_h$ = **00 00 05 $3B_h$**	• Diagnostics (Lenze setting) • Reserved • Output A.0 (voltage signal 0 ... +10 V, 12 bits) • Output A.1 (Lenze setting)

11 Bit	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
602_h	23_h	01_h	30_h	1	00_h	00_h	05_h	3Bh
					(LSB)			(MSB)

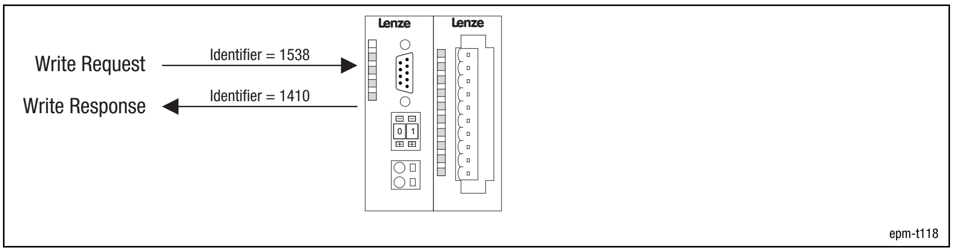


Fig. 8.4-1 Writing a parameter

Telegram from the I/O system IP20 (acknowledgement when being executed faultlessly)

	Formula	Information
Identifier	= Basic identifier + node address = 1408 + 2 = **1410**	• Basic identifier for parameter channel 1 (input) = 1408 • Node address of the I/O system IP20 = 2
Instruction code:	= **60_h**	• Command “Write Response” (acknowledgement from the I/O system IP20)
Index	= Index of the read request	
Subindex	= Subindex of the read request	
Data 1 ... 4	= **0**	• Acknowledgement only

11 Bit	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
1410	60_h	01_h	30_h	0	0	0	0	3

8.4.3 Reading a parameter (example)

Task

An I/O system IP20 has the node address 2. For the first module (4×analog output) the function of the A.0 output is to be read.

Telegram to the I/O system IP20

	Formula	Information
Identifier	= Basic identifier + node address = 1536 + 2 =1538 = **602_h**	• Basic identifier for parameter channel 1 (output) = 1536 • Node address of the I/O system IP20 = 2
Instruction code:	= **40_h**	• Command “Read Request” (request for reading a parameter of the I/O system IP20)
Index	= **$I3001_h$**	• Index first analog module
Subindex	= **1**	• Subindex = 1 (function for output A.0 among others)
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 00_h = 00_h = **$00\ 00\ 00\ 00_h$**	• Read request only

11 bits	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
602_h	40_h	01_h	30_h	1	00_h	00_h	00_h	00_h

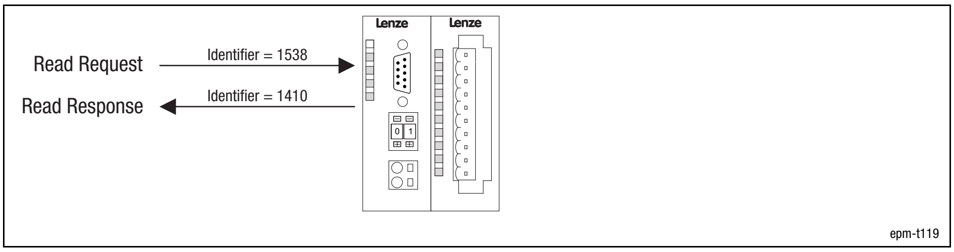


Fig. 8.4-2 Reading a parameter

Telegram from the I/O system IP20 (value of the requested parameter):

	Formula	Information
Identifier	= Basic identifier + node address = 1408 + 2 = **1410**	• Basic identifier for parameter channel 1 (input) = 1408 • Node address of the I/O system IP20 = 2
Instruction code:	= **43_h**	• Command “Read Response” (response to the read request with the current value)
Index	= Index of the read request	
Subindex	= Subindex of the read request	
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 05_h = $3B_h$ = **$00\ 00\ 05\ 3B_h$**	• Assumption: Analog output A.0 outputs a voltage signal 0 ... +10 V at a 12 bit resolution.

11 bits	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
1410	43_h	01_h	30_h	0	00_h	00_h	05_h	$3B_h$
					(LSB)			(MSB)

8.5 Setting of baud rate and node address (node ID)

Baud rate

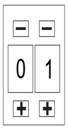
For establishing communication, all devices must use the same baud rate for the data transfer.

- The baud rate can be set via the coding switch at the module.

Node address

Each node of the network must be assigned to a node address, also called *Node ID* within a range of 1 ... 63 for clear identification.

- A node address in a network may be used only once.
- The node address must be set with the coding switch at the module.



epm-t024

Fig. 8.5-1 Coding switch at CAN gateway

[−] Decrease numerical value

[+] Increase numerical value

Baud rate setting

System bus (CAN)	Baud rate
Coding switch value	[kbit/s]
90	1000
91	**500**
92	250
93	125
94	100
95	50
96	20
97	10
98	800

Bold print = Lenze setting

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ”9x” (x = value for the required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.

Indices for setting

Index	Name	Possible settings					Important	
		Lenze	Selection					
$I100B_h$	Node ID	0	0		{1}	63	Display only System bus node address	
$I2001_h$	CAN baud rate	1	0		{1}	255	Display only System bus baud rate	
			0 1 2 3 4 5 6 7 8	1000 kbits/s 500 kbits/s 250 kbits/s 125 kbits/s 100 kbits/s 50 kbits/s 20 kbits/s 10 kbits/s 800 kbits/s				

8.6 Node Guarding

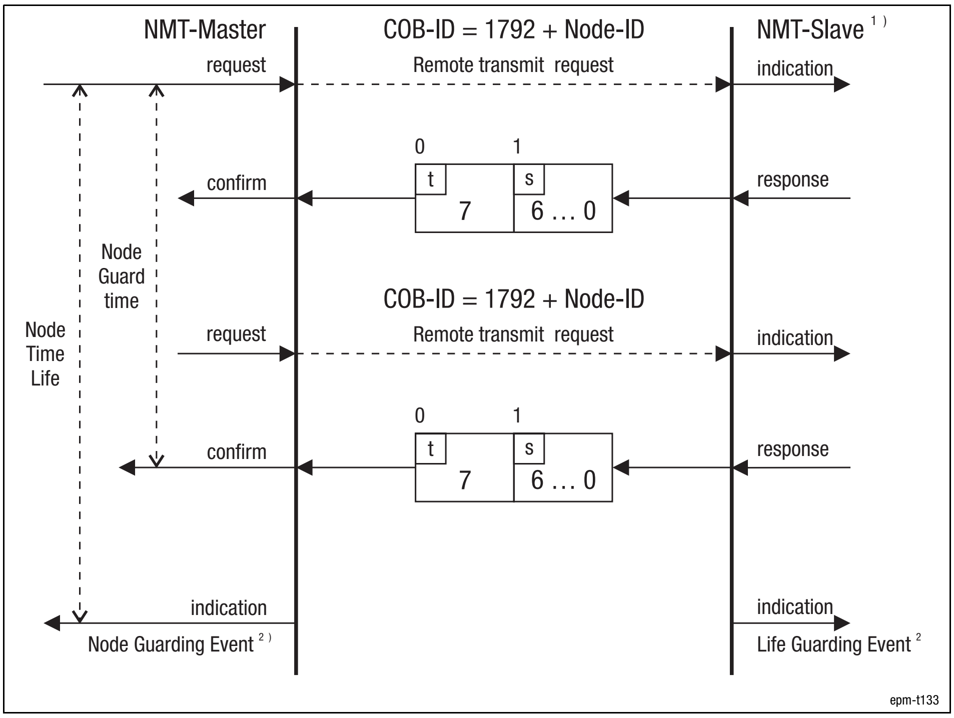


Fig. 8.6-1 Node Guarding Protocol

1) I/O system IP20
s Status of the I/O system IP20
T Toggle bit

Description

The Node Guarding Protocol monitors the connection between master and slave.

Via the index $I100C_h$ "Guard time", a time [ms] can be set and in the index $I100D_h$ "Life time factor" a factor can be set. If both indices are multiplied by each other, you get a monitoring time in which the master must send a Node Guarding telegram to the slave. If one of both indices is set to zero, the monitoring time is also zero and hence deactivated. The slave sends a telegram with its current status to the master.

With event-controlled process data transmission, Node Guarding ensures cyclical node monitoring.

- The master starts the Node Guarding by sending the Node Guarding telegram.
- If the slave (I/O system IP20) does not receive a telegram within the monitoring time, the Node Guarding Event is activated. The I/O system IP20 switches to the state set in $I1029_h$. The outputs switch to a defined state (also see the chapter Configuration → Diagnostics).
- A change to the Operational status triggers a reset.

Status telegram

11 bits	1 byte of user data	
Identifier	**Device status (bits 0 ... 6)**	**Toggle bit**
1792_d (700_h)		

Identifier:

	Formula	Information
Identifier	= Basic identifier + node address = 1792_d + xx	The basic identifier for Node Guarding is firmly adjusted to 1792_d (700_h) xx = Node address of the I/O system

Device status (bit 0 ... 6) of the slave (I/O system IP20):

Command (hex)	Device status
04	Stopped
05	Operational
7F	Pre-Operational

Indices for setting

Index	Name	Possible settings		Important	
		Lenze	Selection		
$I100C_h$ *	Guard time	0	0 {1 ms} 65535	Node Guarding Monitoring time 0 = monitoring not active	8.6-1
$I100D_h$ *	Life time factor	0	0 {1} 255	Node Guarding Response time computation factor 0 = monitoring not active The response time is computed as: monitoring period x factor	8.6-1
$I100E_h$	Node Guarding identifier			Display only Identifier = Basic identifier + node address (basic identifier cannot be modified)	8.6-1

Note!

The Lenze PLC’s 9300 servo PLC and Drive PLC in connection with the function library LenzeCanDSxDrv.lib support the ”Node Guarding” function.

8.7 Heartbeat

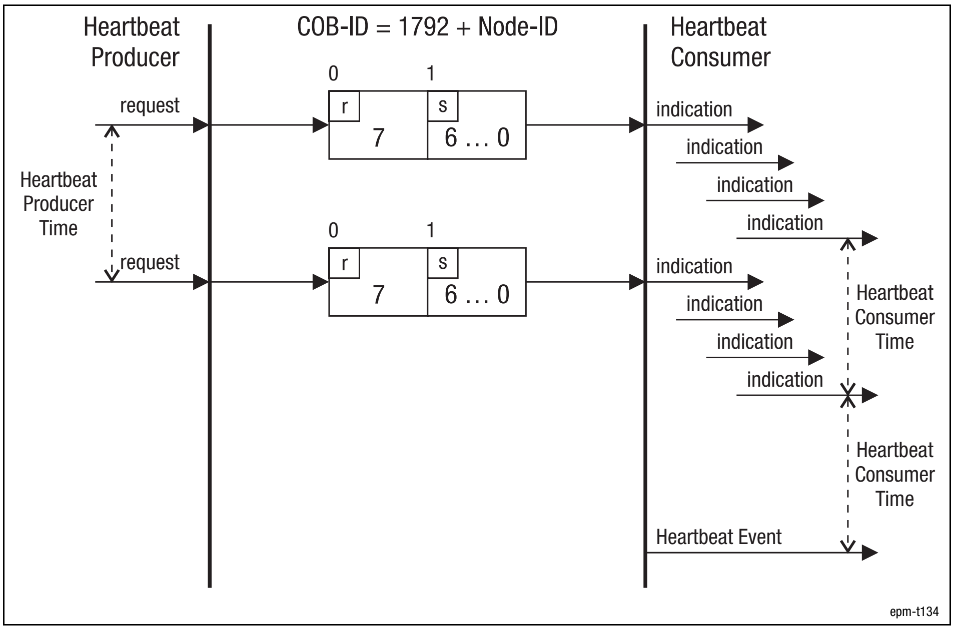


Fig. 8.7-1 Heartbeat Protocol

r Reserved
s State of the Heartbeat Producer

Heartbeat Consumer

The I/O system IP20 can monitor up to five nodes. The status telegrams of the nodes to be monitored must arrive cyclically within a certain time at the I/O system IP20. If a status telegram is not received within this time, the I/O system IP20 switches to the status set in $I1029_h$. The outputs switch to a defined status (also see the chapter Configuration → Diagnostics).

Settings are made in the index $I1016_h$.

Heartbeat Producer

The I/O system IP20 assigns a status telegram to the fieldbus and can thus be monitored by other nodes.

Settings are made in index $I1017_h$.

- Producer heartbeat is automatically started if a time > 0 is entered into the index 1017_h and the I/O system IP20 changes to the status ”Operational”.
- After the cycle time has been completed, the status telegram is transmitted to the fieldbus by the I/O system IP20.
- A change to the Operational status triggers a reset.

Status telegram

11 bits	1 byte of user data	
Identifier	**Device status (bits 0 ... 6)**	**bits 7**
1792_d (700_h)		reserved

Identifier:

	Formula	**Information**
Identifier	= Basic identifier + node address = 1792_d + xx	The basic identifiers for heartbeat is firmly adjusted to 1792_d (700_h) xx = node address of the I/O system IP20

Device status (bit 1 ... 6) of the heartbeat producer:

Command (hex)	**Status**
00	Boot-up
05	Operational
04	Stopped
7F	Pre-Operational

Indices for setting

Index	Name	Possible settings: Lenze	Possible settings: Selection	Important	
$I1016_h$ ↵	Heartbeat consumer time		Data contents: Heartbeat time: Byte 0 = 00_h, Byte 1 = 00_h; Node ID: Byte 2 = 00_h; Reserved: Byte 3 = 00_h	I/O system IP20 can monitor up to five nodes (subindex 1 ... 5). If the monitored node does not respond, I/O system IP20 changes to the status ”Pre-Operational”. The outputs switch to a defined state.	🕮 8.7-1
1	Heartbeat time	0	0 {1 ms} 65535	• In the compact system, only subindex 1 is available • Heartbeat time: – The monitored node must respond within the time set. The time is set in byte 0 and 1. – If the monitored node does not respond within the set time, I/O system IP20 switches to the communication status set under $I1029_h$ – The communication status is reset when a new heartbeat telegram is received • Node ID: – Node address of the node to be monitored. The address is set in byte 2.	
	Node ID	0	0 {1} 255		
2	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
3	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
4	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
5	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
$I1017_h$ ↵	Heartbeat producer time	0	0 {1 ms} 65535 0 Function is not active	I/O system IP20 can be monitored by other nodes. Within this time the device status of I/O system IP20 is transmitted to the fieldbus. Not available for system bus (CAN) communication protocol	🕮 8.7-1

Note!

The Lenze 9300 servo PLC and Drive PLC in connection with the function library LenzeCanDSxDrv.lib support the ”heartbeat” function.

8.8 Reset node

Changes of transmission modes and identifiers will be accepted after "reset node" only.

- Switch the supply voltage on again
- Execute NMT command "81_h" (see chapter "Network management (NMT)")
- Set $I2358_h = 1$

Index	Name	Possible settings			Important	
		Lenze	Selection			
$I2358_h$ *	CAN reset node	0	0	No function	Reset node	8.8-1
			1	CAN reset node		

8.9 Monitoring

8.9.1 Time monitoring for PDO1-Rx ... PDO10-Rx

A time monitoring can be configured for the inputs of the process data objects PDO1-Rx ... PDO10-Rx via the index $I2400_h$.

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I2400_h$ ↵	Timer value		0	{1 ms}	65535	Monitoring time for process data input objects For the compact system, only index $I2400_h$, subindex 1 is available	🕮 8.9-1
1	PD01	0					
2	PD02	0					
3	PD03	0					
4	PD04	0					
5	PD05	0					
6	PD06	0					
7	PD07	0					
8	PD08	0					
9	PD09	0					
10	PD10	0					

8.9.2 Digital output monitoring

Via the index I6206$_h$ you can configure the reactions of the digital outputs which are to take place when no telegrams, "node guarding events" or "heartbeat" have been received in the adjusted monitoring time.

Index	Name	Possible settings				Important	
		Lenze	Selection				
I6206$_h$ ↵	Error mode digital output		0	{1}	255	Configures digital output monitoring For the compact system, only index I6206$_h$, subindex 1 is available	🕮 8.9-2
			0	All digital outputs retain the last status output.			
			255	Response from I6207$_h$		In I6207$_h$, the response can be configured individually for each digital output	
1	Module 1	0					
2	Module 2	0					
...	...	...					
64	Module 64	0					

Individual response setting

Via index I6207$_h$ the response can be configured individually for each digital output.

Index	Name	Possible settings				Important	
		Lenze	Selection				
I6207$_h$ ↵	Error value digital output	0	0	{1}	255	Configures the individual digital output responses For the compact system, only index I620$_{7h}$, subindex 1 is available	🕮 8.9-2
			8 bits of information				
			Bit value 0	Output switches to LOW			
			Bit value 1	Output retains last status output			
1	Module 1	0					
2	Module 2	0					
...	...	...					
64	Module 64	0					

8.9.3 Monitoring of the analog outputs

Via the index I6443$_h$ you can configure the reactions of the analog outputs which are to take place when no telegrams, ”node guarding events” or ”heartbeat” have been received in the adjusted monitoring time.

- Monitoring is started on receipt of the next PDO telegram after the settings.
- If a telegram is not transmitted within the adjusted time, the module switches to the ”Pre-Operational” state. No further process data are transmitted.
- A change into the ”Operational” state triggers a reset.

Index		Name	Possible settings				Important	
			Lenze	Selection				
I6443$_h$ ↵		Error mode analog output		0	{1}	255	Configures analog output monitoring Index is only available in the modular system	📖 8.9-3
				0	All analog outputs retain the last value output			
				255	Response from I6444$_h$		In I6444$_h$ the response can be configured individually for each analog output	
	1	Channel 1	0					
	2	Channel 2	0					
	...	...	...					
	36	Channel 36	0					

Individual response setting

Via index I6444$_h$ the response can be configured individually for each analog output.

Index		Name	Possible settings				Important	
			Lenze	Selection				
I6444$_h$ ↵		Error value analog output		-32768	{1}	32767	Configures the individual analog output responses The analog outputs provide the set value Index is only available in the modular system	📖 8.9-3
	1	Channel 1	0					
	2	Channel 2	0					
	...	...	...					
	36	Channel 36	0					

8.10 Diagnostics

The following indices can be used for the diagnostics. They display operating states. Settings are not possible.

Index	Information displayed	Description
I1014$_h$	Emergency telegram	🕮 8.10-2
I2359$_h$	Operating status of the system bus	🕮 8.10-3
I1027$_h$	Module ID read	🕮 8.10-3
I6000$_h$	Digital input status	🕮 8.10-3
I6200$_h$	Digital output status	🕮 8.10-4
I6401$_h$	Analog input status	🕮 8.10-5
I6411$_h$	Analog output status	🕮 8.10-5
I1003$_h$	Current errors	

8.10.1 Emergency telegram

By means of the emergency telegram, the I/O system IP20 communicates internal device errors to other system bus nodes with high priority. 8 bytes of user data are available.

Index	Name	Possible settings		Important	
		Lenze	Selection		
$I1014_h$	COB ID emergency			Emergency telegram Identifier 80h + node address is displayed after boot-up.	🕮 8.10-2

Emergency telegram structure

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
LOW byte	HIGH byte	Error register	Error information				
Error code	Error code	$I1001_h$	1	2	3	4	5

Contents of the emergency telegram

Error cause	Byte 0	Byte 1	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Emergency telegram reset	0000_h		00_h	00_h	00_h	00_h	00_h
Error on initialisation of modules linked to backplane bus	1000_h		01_h	00_h	00_h	00_h	00_h
Error on module configuration check			02_h	Slot number	00_h	00_h	00_h
Error on module read/write			03_h	Slot number	00_h	00_h	00_h
Module configuration was changed			05_h	00_h	00_h	00_h	00_h
Configuration of the modules has been changed. The module is in the Pre-Operational state.			06_h	00_h	00_h	00_h	00_h
Incorrect module parameterisation			30_h	Slot number	00_h	00_h	00_h
Diagnostic alarm - analog module			40_h + Slot number	Diagnostic byte 0	Diagnostic byte 1	Diagnostic byte 2	Diagnostic byte 3
Process alarm - analog module			80_h + Slot number	Diagnostic byte 0	Diagnostic byte 1	Diagnostic byte 2	Diagnostic byte 3
PDO control (monitoring time in $I2400_h$ has been exceeded).			FF_h	10_h	PDO number	Monitoring time (LOW byte)	Monitoring time (HIGH byte)
SDO/PDO mapping error	6300_h		Map index (LOW byte)	Map index (HIGH byte)	Number of entries	00_h	00_h
Heartbeat error (monitoring time exceeded).	8130_h		Subindex	Node address	Monitoring time (LOW byte)	Monitoring time (HIGH byte)	00_h
Node guarding error (monitoring time exceeded).	8130_h		Guard time (LOW byte)	Guard time (HIGH byte)	Life time	00_h	00_h

8.10.2 Operating state of system bus (CAN)

Index I2359$_h$ displays the operating status of the system bus.

I2359$_h$	Operating status	Description
0	Operational	The system bus is fully functional. The I/O system can transmit and receive parameter and process data.
1	Pre-Operational	The I/O system can transmit and receive parameter data while process data are ignored. The status can be changed from *Pre-Operational* to *Operational* by: • The CAN master • An NMT telegram ’00 01 00’
2	Warning	The I/O system has received incorrect telegrams and becomes passive in the overall system bus environment, i. e., the I/O system can no longer transmit data. Possible causes: • A missing bus termination • Insufficient shielding • Potential differences in the earth connections for the control electronics • The bus load is too high
3	Bus off	The I/O system has disconnected itself from the system bus after receiving too many incorrect telegrams.

Index	Name	Possible settings				Important	
		Lenze	Selection				
I2359$_h$	CAN state		0	{1}	3	Display only System bus status	🕮 8.10-3
			0 1 2 3	Operational Pre-Operational Warning Bus off			

8.10.3 Reading out the module identifiers

When using the modular system, the number of the modules connected to the backplane bus as well as the module types used can be read out via index I1027$_h$. Each module type can be clearly identified via a hexadecimal value.

Index	Subindex	Reading...	Module type	Module identifier
I1027$_h$	0	... the number of plugged modules (0 ... 32)	–	0$_h$ ... 20$_h$
	1 ... 32	... the module type in slots 1 ... 32	No module	0$_h$
			8×digital input	9FC1$_h$
			16×digital input	9FC2h
			1×counter/16×digital input	08C0h
			8×digital output 1A 16×digital output 1A 8×digital output 2A 4×relay	AFC8$_h$
			8×digital input / output	BFC9$_h$
			4×analog input	15C4h
			4×analog output	A5E0$_h$
			4×analog input / output	45DB$_h$
			2/4×counter	B5F4$_h$
			SSI interface	B5DB$_h$

8.10.4 Status of the digital inputs

Via the index I6000$_h$ the status of the digital inputs can be displayed.

Index		Name	Possible settings				Important	
			Lenze	Selection				
$I6000_h$		Digital input		0	{1}	255	Display only Digital input status	8.10-3
	1	Module 1						
	2	Module 2						
	...	...						
	64	Module 64						

8.10.5 Status of the digital outputs

Via the index $I6200_h$ the status of the digital outputs can be displayed:

Index		Name	Possible settings				Important	
			Lenze	Selection				
$I6200_h$ *		Digital output		0	{1}	255	• Digital output status • The outputs can be set manually (forcing): – Depends on CAN status and $I2360_h$	8.10-4
	1	Module 1						
	2	Module 2						
	...	...						
	64	Module 64						

8.10.6 Status of the analog inputs

Via the index $I6401_h$ the status of the analog inputs can be displayed.

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I6401_h$	Analog input		-32768	{1}	32767	Display only Analog input status Index is only available in the modular system	8.10-5
1	Channel 1						
2	Channel 2						
...	...						
36	Channel 36						

8.10.7 Status of the analog outputs

Via the index $I6411_h$ the status of the analog outputs can be displayed:

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I6411_h$ *	Analog output		-32768	{1}	32767	• Analog output status • The outputs can be set manually (forcing): – Depends on CAN status and $I2360_h$ • Index is only available in the modular system	8.10-5
1	Channel 1						
2	Channel 2						
...	...						
36	Channel 36						

9 Networking via CANopen

Contents

9.1 About CANopen

The I/O system IP20 supports the CANopen communication module.

The CANopen protocol is a standardised layer-7 protocol for the CAN bus. This layer is based on the CAN Application Layer (CAL) which was developed as a universal protocol.

However, as the practice shows, applications with CAL were too complex for the users. CANopen provides a uniform and simple structure for connecting the CAN devices of the various manufacturers.

Note!

- The communication profile CANopen can be selected with setting the node address (Node-ID).
  - Information on how to proceed with the modular system is included in the description of the CAN Gateway module in the chapter "The modular system".
  - Information on how to proceed with the compact system is included in the description of the corresponding module in the chapter "The compact system".
  - Lenze setting: System bus (CAN)
- Additional information on CANopen can be found in the Lenze CAN Communication Manual.

9.1.1 Structure of the CAN data telegram

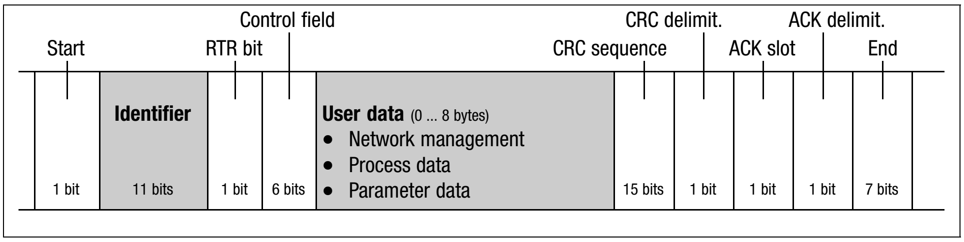


Fig. 9.1-1 Basic structure of the CAN telegram

Note!

Only the identifier and the user data are relevant to the user. All other data of the CAN telegram are automatically processed by the system.

9.1.2 Identifier

The principle of CAN communication is based on a message-oriented data exchange between a transmitter and many receivers. Therefore, all nodes can transmit and receive more or less at the same time.

The so-called *identifier* in the CAN telegram, also called *COB-ID* (*Communication Object Identifier*), controls which node is to receive a transmitted message. In addition to the addressing, the identifier contains information on the priority of the message and the type of user data.

The identifier consists of a 'basic identifier' and the node address of the device to be approached:

Identifier = Basic identifier + node address

- This node address is set with the coding switch at the module:
  - Modular system: At CAN gateway
  - Compact system: At each module
- Network management and sync telegram only require the basic identifier.
- The identifiers can also be set individually. (📖 9.3-3)

9.1.3 Saving changes

Note!

- Changes of the baud rate, node address, identifiers for PDOs, and the transmission mode for PDOs must be saved with $I2003_h$ = 1, for being maintained even after switching off the supply voltage.
- Any changes will become effective only after a Reset Node:
  - Switch the supply voltage on again
  - Execute NMT command "81_h" (see chapter "Network management (NMT)")
  - Set $I2358_h$ = 1

9.2 Network management (NMT)

Via the network management, the master can change a communication status for the whole CAN network.

Communication phases

Status	Explanation
"Initialisation"	Initialisation starts when the I/O system is switched on. In this phase, the I/O system does not take part in the bus data transfer. Furthermore it is in each NMT status possible to restart the entire initialisation or parts of it by transferring different telegrams (see "Status transitions"). All parameters already set are overwritten with their standard values. After initialisation has been completed, the I/O system is automatically set to the status "Pre-operational".
"Pre-Operational"	The I/O system can receive parameter data. Process data are ignored.
"Operational"	The I/O system can receive parameter and process data.
"Stopped"	Parameter and process data cannot be received. Network management telegrams can be received. The module outputs switch to the configured status (see chapter "Monitoring").

Telegram structure

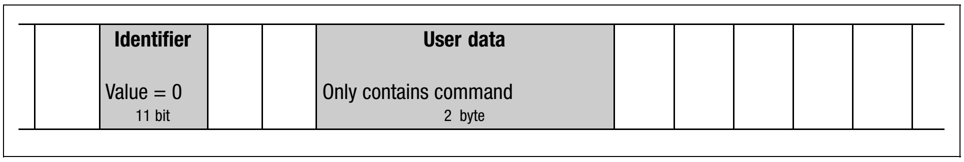


Fig. 9.2-1 Telegram for changing the communication phase

The telegram used for network management contains an identifier and the command which is part of the user data and consists of command byte and node address.

Telegrams with the identifier 0 and two bytes user data are used to change between the communication phases.

Only the network master (e.g. controller) can change a communication status for the whole network.

Note!

Communication via process data only is possible with a state change to "operational"!

Example:
For changing the state of all nodes on the bus from "pre-operational" to "operational" via the CAN master, the following identifier and user data must be set in the telegram:

- Identifier: 00 (broadcast telegram)
- User data: 0100 (hex)

State transitions

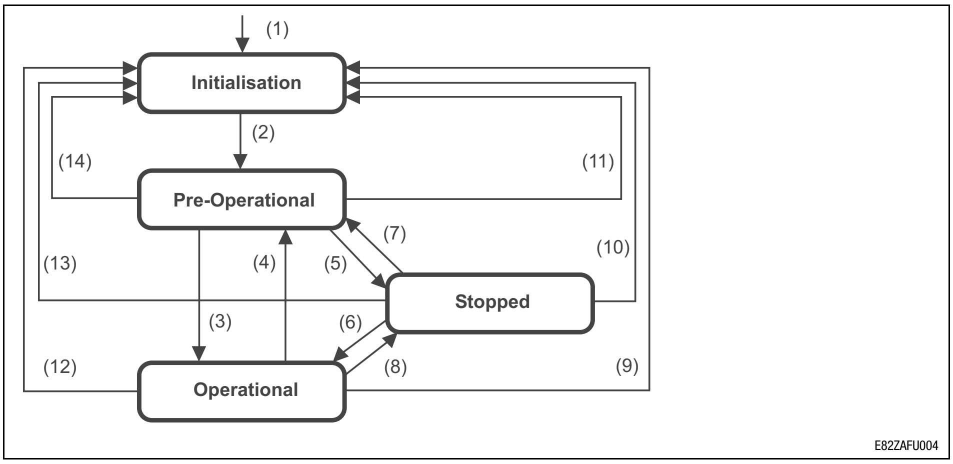


Fig. 9.2-2 Network management status transitions

Status transition	Command (hex)	Network status after change	Effects on process and parameter data
(1)	-	Initialisation	Initialisation starts automatically when the mains is switched on. During initialisation, the I/O system does not take part in the data transfer. After initialisation has been completed, the device sends a boot-up message with an identifier to the master. The device is automatically set to the status "Pre-operational".
(2)	-	Pre-Operational	In this phase, the master determines the I/O system communication.
From that moment on, the master changes a status for the whole network. A target address, which is part of the command, selects the slave(s).			
(3), (6)	01 xx	Operational	Network management telegrams, sync, emergency, process data (PDOs) and parameter data (SDOs) are active. Optional: When the status is changed, event and time-controlled process data (PDOs) will be sent once.
(4), (7)	80 xx	Pre-Operational	Network management telegrams, sync, emergency and parameter data (SDOs) are active (like "Enter pre-operational state")
(5), (8)	02 xx	Stopped	Parameter and process data cannot be received. Network management telegrams can be received.
(9)	81 xx	Initialisation	Initialises all indices with the Lenze setting.
(10)			
(11)			
(12)	82 xx		Initialises all communication parameters (index 0-1FFF$_h$) with the Lenze setting.
(13)			
(14)			

xx = 00$_h$ With this assignment, all controllers connected are addressed by the telegram. All controllers can change their status at the same time.
xx = node ID If a node address is indicated, the status will only be changed for the controller addressed.

9.3 Transmitting process data

Process data are used for control-specific purposes, such as setpoint and actual values, for example.

- Process data or the input / output data of the I/O system IP20 are transmitted as so-called PDOs (*Process Data Objects*).

9.3.1 Process data telegram

Structure of the process data telegram:

11 bits	8 bytes of user data							
Identifier	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8

Identifier

Information on the identifier can be found in chapter ”Structure of the CAN data telegram”.

User data

The eight bytes of user data transmit the input signals (sent user data) and the output signals (received user data) of the modules.

9.3.2 Identifier of the process data objects (PDO)

The identifiers of process data objects PDO1 ... PDO10 consist of the so-called basic identifiers and the set node address:

Identifier = Basic identifier + node address

Basic identifiers of the process data objects

			Basic identifier		Available for	
			dec	hex	CAN gateway	8×dig. I/O compact 16×dig. I/O compact 32×dig. I/O compact
PDOs	Process data object 1				✓	✓
		PD01-Rx	512	200		
		PD01-Tx	384	180		
	Process data object 2				✓	–
		PD02-RX	768	300		
		PD02-TX	640	280		
	Process data object 3				✓	–
		PD03-Rx	1024	400		
		PD03-Tx	896	380		
	Process data object 4				✓	–
		PD04-Rx	1280	500		
		PD04-Tx	1152	480		
	Process data object 5				✓	–
		PD05-Rx	1920	780		
		PD05-Tx	1664	680		
	Process data object 6				✓	–
		PD06-Rx	576	240		
		PD06-Tx	448	1C0		
	Process data object 7				✓	–
		PD07-Rx	832	340		
		PD07-Tx	704	2C0		
	Process data object 8				✓	–
		PD08-Rx	1088	440		
		PD08-Tx	960	3C0		
	Process data object 9				✓	–
		PD09-Rx	1344	540		
		PD09-Tx	1216	4C0		
	Process data object 10				✓	–
		PD010-Rx	1984	7C0		
		PD010-Tx	1728	6C0		

9.3.3 Assigning individual parameters

For larger networks with many nodes, it may be useful to set individual identifiers for process data objects PDO1 ... PDO10 that are independent of the set node address.

Process data objects for input data

Individual identifiers for input data can be set via the indices $I1400_h$, subindex 1 ... $I1409_h$, subindex 1.

Process data objects for output data

Individual identifier for output data can be set via the indices $I1800_h$, subindex 1 ... $I1809_h$, subindex 1.

Note!

- Set the value which makes the required identifier (x = corresponding process data object) in index $I140x_h$, subindex 1 or $I180x_h$, subindex 1.
- Make a reset node so that the changes are accepted.

9.3.4 Process data transmission mode

Process data transmission mode

The transmission mode is configured via the index $I1400_h$, subindex 2 (PDO1-Rx) ... $I1409_h$, subindex 2 (PDO10-Rx):

- Sync-controlled reception
- N-sync-controlled reception
  - First, a certain number (n) of sync telegrams must be transmitted ($I140x_h$, subindex 2 = 1 ... 240). Then the PDO telegram must be received from the master. Finally, the process input data are accepted.
- Event-controlled reception (Lenze setting)

Process output data transmission method

The transmission mode is configured via the index $I1800_h$, subindex 2 (PDO1-Tx) ... $I1809_h$, subindex 2 (PDO10-Tx):

- Sync-controlled transmission
- n-sync-controlled transmission
  - First, a certain number (n) of sync telegrams must be transmitted ($I180x_h$, subindex 2 = 2 ... 240). Then, the PDO telegram is transmitted to the master.
- Event-controlled transmission (Lenze setting)

Note!

After changing to the CAN state ”Operational”, the current process image is transmitted from the I/O system IP20.

Sync telegram for cyclic process data

A special telegram, the sync telegram, is required for synchronisation when cyclic process data are transmitted.

The sync telegram must be generated by **another** node. It initiates the transmission for the cyclic process data of the I/O system I/P20 and at the same time triggers data acceptance of cyclic process data received in the I/O system IP20.

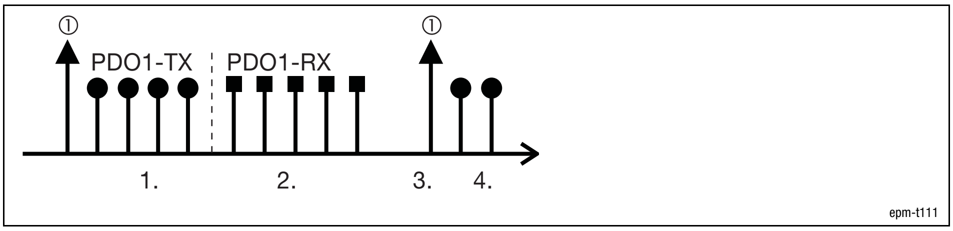


Fig. 9.3-1 Synchronisation of cyclical process data with the help of a sync telegram (asynchronous data not considered)

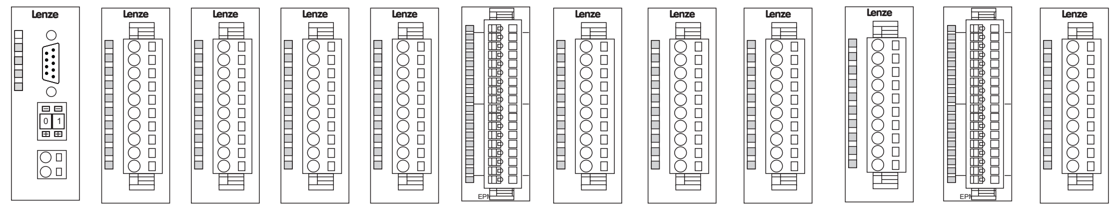
① Sync telegram

Transmission sequence

1. After receiving a sync telegram, the I/O system IP20 transmits the cyclic process output data (PDO1-Tx) if ”sync-controlled transmission” is active.
2. Once the transmission is completed, the I/O system IP20 receives the cyclic process input data (PDO1-Rx).
3. The data is accepted by the I/O system IP20 with the next sync telegram if ”sync-controlled reception” is active.
4. All other telegrams (e.g. for parameter or event-controlled process data) are accepted asynchronously by the I/O system IP20 after transmission.

9.3.5 Process image of the modular system

The process image of the modular system is explained on the basis of the following example. In addition to the CAN gateway, maximally 32 modules can be connected.

Module														
	CAN Gateway	8×DI	8×DI	8×DI	8×DI	16×DI	8×DO	4×AI	2/4× Counter	SSI interface	1×counter / 16×DI	4×AI/AO	–	–
Process data	–	1 byte TX	1 byte TX	1 byte TX	1 byte TX	2 bytes TX	1 byte RX	8 bytes TX	10 bytes TX 10 bytes RX	4 bytes TX 4 bytes RX	6 bytes TX 6 bytes RX	4 bytes TX 4 bytes RX		
Module No.	M0	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**	**...**	**M32**

Process image			Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
PDO1	Fixed for the first DIO	PDO1-RX	**M6**	–	–	–	–	–	–	–
		PDO1-TX	**M1**	**M2**	**M3**	**M4**	**M5**	**M5**	–	–
PDO2	Fixed for the first AIO	PDO2-RX	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**
		PDO2-TX	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**	**M7**
PDO3	DIO or AIO [1]	PDO3-RX	**M8**	**M8**	**M11**	**M11**	**M11**	**M11**	–	–
		PDO3-TX	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**	**M8**
PDO4	DIO or AIO [1]	PDO4-RX	–	–	–	–	–	–	–	–
		PDO4-TX	**M8**	**M8**	**M11**	**M11**	**M11**	**M11**	–	–
PDO5	DIO or AIO [1]	PDO5-Rx	**M10**	**M10**	**M10**	**M10**	**M10**	**M10**	–	–
		PDO5-Tx	**M10**	**M10**	**M10**	**M10**	**M10**	**M10**	–	–
PDO6	DIO or AIO [1]	PDO6-Rx	**M9**	**M9**	**M9**	**M9**	–	–	–	–
		PDO6-Tx	**M9**	**M9**	**M9**	**M9**	–	–	–	–
...	...	...	...	...	...	...	...	...	...	...
PDO10	DIO or AIO [1]	PDO10-RX	–	–	–	–	–	–	–	–
		PDO10-TX	–	–	–	–	–	–	–	–

[1] A PDO can be either assigned to AIO or DIO. The modules are assigned according to the slot sequence, with the DIO being assigned first.

AI	Analog input data
AO	Analog output data
DI	Digital input data
DO	Digital output data
AIO	Analog input and output data
DIO	Digital input and output data

Special features of the modules 1×counter/16×digital input and SSI interface:

- The module 1×counter/16×digital input always assigns the next to last and the SSI interface module always the last of the PDOs used.
- The modules cannot be assigned to PDO1 and PDO2. Thus, only eight of these modules can be used in a system.
- The modules assign a whole PDO (8 bytes) each.

Transmission times

The transmission times of the input / output signals within the I/O system IP20 can be calculated with a formula.

$$t_t = t_c + (N_{PDOTX} \cdot 8\ \mu s) + (N_{PDORX} \cdot 2\ \mu s) + t_d + 742\ \mu s$$

t_t	Transmission time of input / output signals of a module between fieldbus connection and input / output terminals.
t_c	Time required for copying into the CAN object directory
N_{PDOTX}	Transmitting the PDO number (PDO1-Tx ... PDO10-Tx)
N_{PDORX}	Receiving the PDO number (PDO1-Rx ... PDO10-Rx)
t_d	Module delay time
742 µs	Fixed internal processing time

Time required for copying into the CAN object directory:

DO modules	DI modules	AO modules	AI modules
$t_c = 50\ \mu s + n \times 14\ \mu s$	$t_c = 50\ \mu s + n \times 25\ \mu s$	$t_c = 50\ \mu s + n \times 210\ \mu s$	$t_c = 50\ \mu s + n \times 250\ \mu s$

n Number of bytes assigned by the module in the PDOs

Example

In the I/O system shown in the example, the transmission time of the input signals at the module M3 (8×digital input) to the master is to be detected. The baud rate amounts to 500 kbits/s.

Solution:

- For transmitting the input signals, the module assigns one byte (byte 3) of the process data channel PDO1-Tx.
- The delay time t_d within the module amounts to 3 ms.

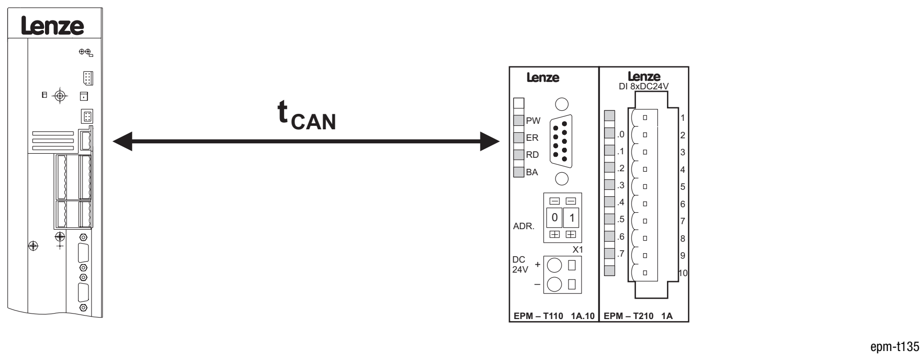
1. Calculating the time required for copying t_c into the CAN object directory:

$$t_c = 50\ \mu s + 1 \cdot 25\ \mu s = 75\ \mu s$$

2. Calculating the transmission time t_t of the input signals to the fieldbus:

$$t_t = 75\ \mu s + (1 \cdot 8\ \mu s) + (0 \cdot 2\ \mu s) + 3000\ \mu s + 742\ \mu s = 3825\ \mu s$$

3. Calculating the transmission time t_{CAN} via the fieldbus:



$$t_{CAN} = \frac{\text{CAN telegram length}}{\text{Baud rate}} = \frac{111\ \text{bits}}{\frac{500\ \text{kbits}}{s}} = 222\ \mu s$$

4. Calculating the total transmission time t:

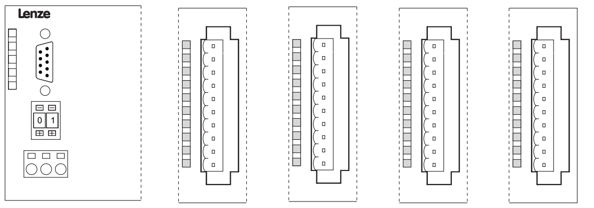
$$t = t_t + t_{CAN} = 3825\ \mu s + 222\ \mu s = 4047\ \mu s = 4.047\ ms$$

Note!

The internal processing times of the controller must also be considered.

9.3.6 Process image of the compact system

The process image of the compact system is explained on the basis of the module 32×dig. I/O compact.

Module					
	CAN gateway		8×DI	8×DI	8×DO
Process data	–	1 byte	1 byte DI	1 byte DI	1 byte DO
Slot	M0	**M1**	**M2**	**M3**	**M4**

Process image		Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
PDO1	PDO1-RX	**M4**	–	–	–	–	–	–	–
	PDO1-TX	**M1**	**M2**	**M3**	–	–	–	–	–

DI Digital input data
DO Digital output data

9.3.7 Compatibility with Lenze drive and automation components

The tables below will assist you in finding out at which stage a modular system or which compact module, respectively, can be operated in combination with a Lenze drive and automation component.

Compatibility is dependent on the available process data objects (PDO).

Process data objects (PDO) of the I/O system IP20 (slave)		
Module type	**Module requires**	
	PDO-Rx	**PDO-Tx**
Modular system		
8×digital input	–	1/8
16×digital input	–	2/8
8×digital output 1A	1/8	–
8×digital output 2A	1/8	–
16×digital output 1A	2/8	–
8×digital input / output	1/8	1/8
4×relay	1/8	–
4×analog input	–	8/8
4×analog output	8/8	–
4×analog input / output	8/8	8/8
2/4×counter	8/8 + 2/8	8/8 + 1/8
SSI interface	8/8	8/8
1×counter/16×digital input	8/8	8/8
Compact system		
8×dig. I/O compact	8/8	8/8
16×dig. I/O compact	8/8	8/8
16×dig. I/O compact (single-wire conductor)	8/8	8/8
16×dig. I/O compact (three-wire conductor)	8/8	8/8

Process data objects (PDO) of the Lenze drive and automation components (master)		
Components	**PDO-Rx [x_{PDO-Rx}]**	**PDO-Tx [x_{PDO-Tx}]**
9300 Servo PLC	>10	>10
Drive PLC		
9300 inverter (all standard types)	2	2
8200 vector frequency inverter		
8200 motec frequency inverter		
Communication module EMF2175		

Note!

- A modular system allows the connection of max. 32 modules in addition to the CAN gateway.
- A modular system offers max. 20 PDOs (10 PDO-Rx and 10 PDO-Tx) for process data exchange.
- Since 9300 Servo PLC and Drive PLC are able to manage more than 20 process data objects, several modular systems can be operated on a Servo PLC or Drive PLC. For this each CAN gateway must be assigned to a unique node address.

Example

A control task requires the connection of 4 digital outputs, 10 digital inputs and 3 analog outputs to an 8200 vector frequency inverter.

Solution

The planned solution is a modular system with the following modules:

I/O system IP20 Modular system	Number modules	Required PDOs	
		PDO-Rx	PDO-Tx
8×digital input / output	1	1/8	1/8
8×digital input	1	–	1/8
4×analog input	1	1	–
Sum	**3**	**9/8**	**2/8**

For exchanging the process data, the 8200 vector makes enough PDOs available:

Frequency inverter	Available PDOs	
	PDO-Rx	PDO-Tx
8200 vector	2	2

9.3.8 Data transmission between I/O system IP20 and controller

In the Lenze setting of the I/O system IP20, the basic identifiers of the PDOs are set for the communication protocol "system bus (CAN)".

For communicating with Lenze controllers the basic identifiers for the process data object 1 must be adapted.

1. Set PDO1-Rx via index 1400_h, subindex 1 to 770.
2. Set PDO1-Tx via index 1800_h, subindex 1 to 769.
3. Make a reset node by setting the index I2358h = 1. The settings are accepted.

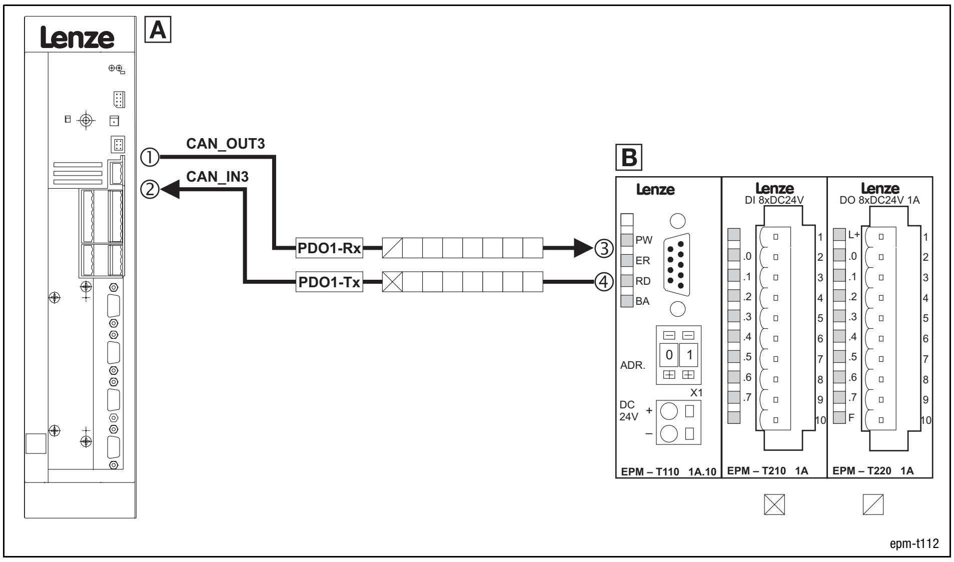


Fig. 9.3-2 Data transmission between I/O system IP20 and controller

PDO-Rx The I/O system IP20 receives the status information of the controller
PDO-Tx The I/O system IP20 transmits the status information to the controller

A Controller with node address 1 (C0350 = 1)
- ① 768_d (Basic identifier) + 1 (node address) = 769_d (identifier)
- ② 769_d (Basic identifier) + 1 (node address) = 770_d (identifier)

B CAN gateway of the modular system (or a module of the compact system) with node address 2
- ③ 767_d (Basic identifier) + 2 (node address) = 769_d (identifier)
- ④ 768_d (Basic identifier) + 2 (node address) = 770_d (identifier)

9.3.9 Indices for setting the process data transmission

Process data objects for input data

Index	Name	Possible settings				Important	
		Lenze	Selection				
I1400h ↵						Index is available in the modular and compact system	9.3-3
1	COB-ID used by RxPDO 1	768	385	{1}	2047	Defining the individual identifiers for process data object 1	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
			241 ... 254	Reserved			
			255	Process data update on occurrence of an event		Every received value is accepted	
...	...						
I1409h ↵						Index is only available in the modular system	9.3-3
1	COB-ID used by RxPDO 10	1665	385	{1}	2047	Defining the individual identifiers for process data object 10	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
			241 ... 254	Reserved			
			255	Process data update on occurrence of an event		Every received value is accepted	

Process data objects for output data

Index	Name	Possible settings			Important	
		Lenze	Selection			
I1800h ↵						📖 9.3-3
1	COB-ID used by TxPDO 1	767	385 {1} 2047		Defining the individual identifiers for process data object 1	
2	Transmisson type	255	0 {1} 255		Defining the transmission mode	
			0	Function deactivated	The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240	The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer	Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer		
			255	Event-controlled process data transfer with cyclic overlay	Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0 {1 ms} 65535		Inhibit time	
5	Event time		0 {1 ms} 65535		Cycle time	
...	...					
I1809h ↵					Index is only available in the modular system	📖 9.3-3
1	COB-ID used by TxPDO 10	1984	385 {1} 2047		Defining the individual identifiers for process data object 10	
2	Transmisson type	255	0 {1} 255		Defining the transmission mode	
			0	Function deactivated	The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240	The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer	Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer		
			255	Event-controlled process data transfer with cyclic overlay	Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0 {1 ms} 65535		Inhibit time	
5	Event time	0	0 {1 ms} 65535		Cycle time	

9.4 Transmitting parameter data

Parameter data are the so-called indices.

Parameters are usually set only once during commissioning.

Parameter data are transmitted as so-called SDOs (*Service Data Objects*) via the system bus and acknowledged by the receiver, i.e. the transmitter gets a feedback if the transmission was successful.

9.4.1 Telegram structure

Structure of the telegram for parameter data:

11 bit	8 bytes of user data							
Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4

- The subchapters below explain the individual telegram components in detail.
- The chapter 9.4.2 contains an example of how to write a parameter. (🕮 9.4-4)
- The chapter 9.4.3 contains an example of how to read a parameter. (🕮 9.4-5)

Identifier

Identifier	Instruction code	Index		Subindex	Data 1	Data 2	Data 3	Data 4
		Low byte	High byte					

One parameter channel is available for parameter data transmission, which is addressed via the identifier.

Identifier =			Basic identifier dec	Basic identifier hex	+ node address of the device
SDO	Parameter channel 1				
		Output (transmit)	1408	580	+ value set with coding switch
		Input (receive)	1536	600	

Instruction code

Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4

The instruction code contains the command to be executed and information about the parameter data length. It is structured as follows:

	Bit 7 (MSB)	Bit 6	Bit 5	Bit4	Bit 3	Bit 2	Bit 1	Bit 0
Command	**Command Specifier (cs)**				**Length**		**E**	**s**
Write Request	0	0	1	0	00 = 4 bytes 01 = 3 bytes 10 = 2 bytes 11 = 1 byte		1	1
Write Response	0	1	1	0			0	0
Read Request	0	1	0	0			0	0
Read Response	0	1	0	0			1	1
Error Response	1	0	0	0	0	0	0	0

Instruction code for parameters with 4 bytes of data length:

Command	4 bytes of data (32 bits) hex	dec	Information
Write Request	23	35	Transmitting parameters to a node
Write Response	60	96	Node response to the Write Request (acknowledgement)
Read Request	40	64	Request to read a parameter from a node
Read Response	43	67	Response to the read request with the actual value
Error Response	80	128	Node reports a communication error

Instruction "Error Response"

If an error occurs, the addressed node generates an "Error Response".

In data 4, this telegram always contains the value "6", in data 3 it contains an error code:

Command code Error Response	Data 3	Data 4	Error message
80_h	3	6	Access denied
	5		Wrong subindex
	6		Wrong index

Parameter addressing (Index/subindex)

Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4

The index of the telegram is used to address the index to be read or written:

- The index value must be entered in flush-left Intel format and divided into Low byte and High byte (see example).
- For subindices, the number of the associated subindex must be entered into the telegram's subindex.
- For indices without subindex, the subindex always has the value "0'.

Example

The subindex 1 of index I2400$_h$ (monitoring time for PDO1) is to be addressed:

11 bit	8 bytes of user data							
Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4
		00_h	24_h	1				

Parameter data (data 1 ... data 4)

Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4

Up to 4 bytes (data 1 ... data 4) are available for parameter data.

Data are entered in left-justified Intel format with data 1 as LSB and data 4 as MSB (see example).

Example

The value "1 s" is to be transmitted for the index 2400$_h$ (monitoring time).

$Data_{1...4} = 1 \times 1000 = 1000 = 00\ 00\ 03\ E8_h$

11 bit	8 bytes of user data							
Identifier	Instruction code	Index Low byte	Index High byte	Subindex	Data 1	Data 2	Data 3	Data 4
					$E8_h$	03_h	00_h	00_h
					(LSB)			(MSB)

9.4.2 Writing a parameter (example)

Task

An I/O system IP20 has the node address 2. For the first analog module (4×analog output), the function of the output A.0 (voltage signal 0 ... +10 V, 12 bits) is to be shown.

Telegram to the I/O system IP20

	Formula	Information
Identifier	= Basic identifier + node address = 1536 + 2 =1538 = **602_h**	• Basic identifier for parameter channel 1 (output) = 1536 • Node address of the I/O system IP20 = 2
Instruction code:	= **23_h**	• Command "Write Request" (transmitting parameters to the I/O system IP20)
Index	= **$I3001_h$**	• Index first analog module
Subindex	= **1**	• Subindex = 1 (function for output A.1 among others)
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 05_h = $3B_h$ = **$00\ 00\ 05\ 3B_h$**	• Diagnostics (Lenze setting) • Reserved • Output A.0 (voltage signal 0 ... +10 V, 12 bits) • Output A.1 (Lenze setting)

11 Bit	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
602_h	23_h	01_h	30_h	1	00_h	00_h	05_h	3Bh
					(LSB)			(MSB)

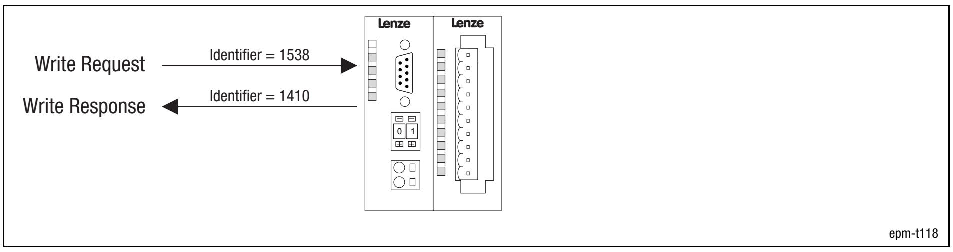


Fig. 9.4-1 Writing a parameter

Telegram from the I/O system IP20 (acknowledgement when being executed faultlessly)

	Formula	Information
Identifier	= Basic identifier + node address = 1408 + 2 = **1410**	• Basic identifier for parameter channel 1 (input) = 1408 • Node address of the I/O system IP20 = 2
Instruction code:	= **60_h**	• Command "Write Response" (acknowledgement from the I/O system IP20)
Index	= Index of the read request	
Subindex	= Subindex of the read request	
Data 1 ... 4	= **0**	• Acknowledgement only

11 Bit	8 bytes of user data							
Identifier	Instruction code:	Index LOW byte	Index HIGH byte	Subindex	Data 1	Data 2	Data 3	Data 4
1410	60_h	01_h	30_h	0	0	0	0	3

9.4.3 Reading a parameter (example)

Task

An I/O system IP20 has the node address 2. For the first module (4×analog output) the function of the A.0 output is to be read.

Telegram to the I/O system IP20

	Formula	Information
Identifier	= Basic identifier + node address = 1536 + 2 =1538 = **602_h**	• Basic identifier for parameter channel 1 (output) = 1536 • Node address of the I/O system IP20 = 2
Instruction code:	= **40_h**	• Command "Read Request" (request for reading a parameter of the I/O system IP20)
Index	= **$I3001_h$**	• Index first analog module
Subindex	= **1**	• Subindex = 1 (function for output A.0 among others)
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 00_h = 00_h = **$00\ 00\ 00\ 00_h$**	• Read request only

11 bits	8 bytes of user data							
Identifier	Instruction code:	Index		Subindex	Data 1	Data 2	Data 3	Data 4
		LOW byte	HIGH byte					
602_h	40_h	01_h	30_h	1	00_h	00_h	00_h	00_h

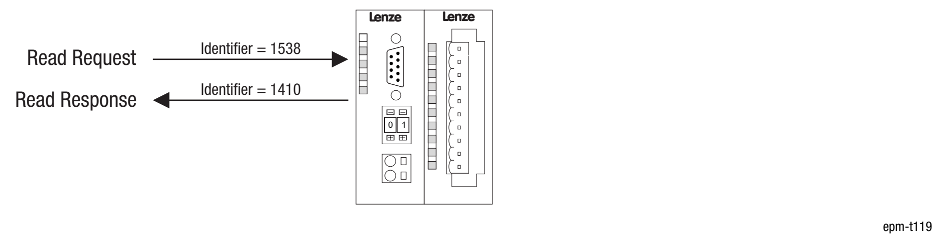


Fig. 9.4-2 Reading a parameter

Telegram from the I/O system IP20 (value of the requested parameter):

	Formula	Information
Identifier	= Basic identifier + node address = 1408 + 2 = **1410**	• Basic identifier for parameter channel 1 (input) = 1408 • Node address of the I/O system IP20 = 2
Instruction code:	= **43_h**	• Command "Read Response" (response to the read request with the current value)
Index	= Index of the read request	
Subindex	= Subindex of the read request	
Data 1 **Data 2** **Data 3** **Data 4** **Data 1 ... 4**	= 00_h = 00_h = 05_h = $3B_h$ = **$00\ 00\ 05\ 3B_h$**	• Assumption: Analog output A.0 outputs a voltage signal 0 ... +10 V at a 12 bit resolution.

11 bits	8 bytes of user data							
Identifier	Instruction code:	Index		Subindex	Data 1	Data 2	Data 3	Data 4
		LOW byte	HIGH byte					
1410	43_h	01_h	30_h	0	00_h	00_h	05_h	$3B_h$
					(LSB)			(MSB)

9.5 Setting of baud rate and node address (node ID)

Baud rate

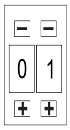
For establishing communication, all devices must use the same baud rate for the data transfer.

- The baud rate can be set via the coding switch at the module.

Node address

Each node of the network must be assigned to a node address, also called *Node ID* within a range of 1 ... 63 for clear identification.

- A node address in a network may be used only once.
- The node address must be set with the coding switch at the module.



epm-t024

Fig. 9.5-1 Coding switch at CAN gateway

− Decrease numerical value

+ Increase numerical value

Baud rate setting

CANopen	Baud rate
Coding switch value	[kbit/s]
80	1000
81	500
82	250
83	125
84	100
85	50
86	20
87	10
88	800

1. Switch off the voltage supply of the module.
2. Use the coding switch to set the required baud rate.
   – Select ’8x’ (x = value of required baud rate)
3. Switch on the voltage supply of the module.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.

Setting the node address

5. Now set the node address with the coding switch for the module. You have five seconds for this.
   – Each node address must be assigned only once.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The module changes to the pre-operational mode.

Note!

The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.

Indices for setting

Index	Name	Possible settings		Important	
		Lenze	Selection		
$I100B_h$	Node ID	0	0 {1} 63	Display only System bus node address	
$I2001_h$	CAN baud rate	1	0 {1} 255 0 1000 kbits/s 1 500 kbits/s 2 250 kbits/s 3 125 kbits/s 4 100 kbits/s 5 50 kbits/s 6 20 kbits/s 7 10 kbits/s 8 800 kbits/s	Display only System bus baud rate	

9.6 Node Guarding

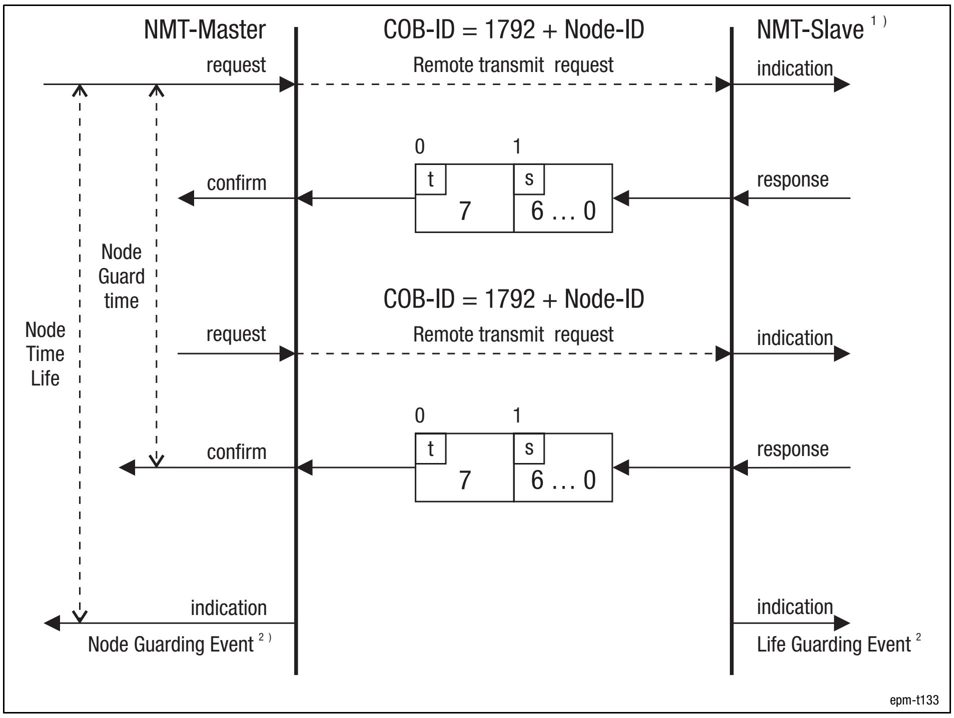


Fig. 9.6-1 Node Guarding Protocol

1) I/O system IP20
s Status of the I/O system IP20
T Toggle bit

Description

The Node Guarding Protocol monitors the connection between master and slave.

Via the index $I100C_h$ "Guard time", a time [ms] can be set and in the index $I100D_h$ "Life time factor" a factor can be set. If both indices are multiplied by each other, you get a monitoring time in which the master must send a Node Guarding telegram to the slave. If one of both indices is set to zero, the monitoring time is also zero and hence deactivated. The slave sends a telegram with its current status to the master.

With event-controlled process data transmission, Node Guarding ensures cyclical node monitoring.

- The master starts the Node Guarding by sending the Node Guarding telegram.
- If the slave (I/O system IP20) does not receive a telegram within the monitoring time, the Node Guarding Event is activated. The I/O system IP20 switches to the state set in $I1029_h$. The outputs switch to a defined state (also see the chapter Configuration → Diagnostics).
- A change to the Operational status triggers a reset.

Status telegram

11 bits	1 byte of user data	
Identifier	**Device status (bits 0 ... 6)**	**Toggle bit**
1792_d (700_h)		

Identifier:

	Formula	**Information**
Identifier	= Basic identifier + node address = 1792_d + xx	The basic identifier for Node Guarding is firmly adjusted to 1792_d (700_h) xx = Node address of the I/O system

Device status (bit 0 ... 6) of the slave (I/O system IP20):

Command (hex)	Device status
04	Stopped
05	Operational
7F	Pre-Operational

Indices for setting

Index	Name	Possible settings					Important	
		Lenze	Selection					
$I100C_h$ *	Guard time	0	0	{1 ms}	65535		Node Guarding Monitoring time 0 = monitoring not active	🕮 9.6-1
$I100D_h$ *	Life time factor	0	0	{1}	255		Node Guarding Response time computation factor 0 = monitoring not active The response time is computed as: monitoring period x factor	🕮 9.6-1
$I100E_h$	Node Guarding identifier						Display only Identifier = Basic identifier + node address (basic identifier cannot be modified)	🕮 9.6-1

Note!

The Lenze PLC’s 9300 servo PLC and Drive PLC in connection with the function library LenzeCanDSxDrv.lib support the ”Node Guarding” function.

9.7 Heartbeat

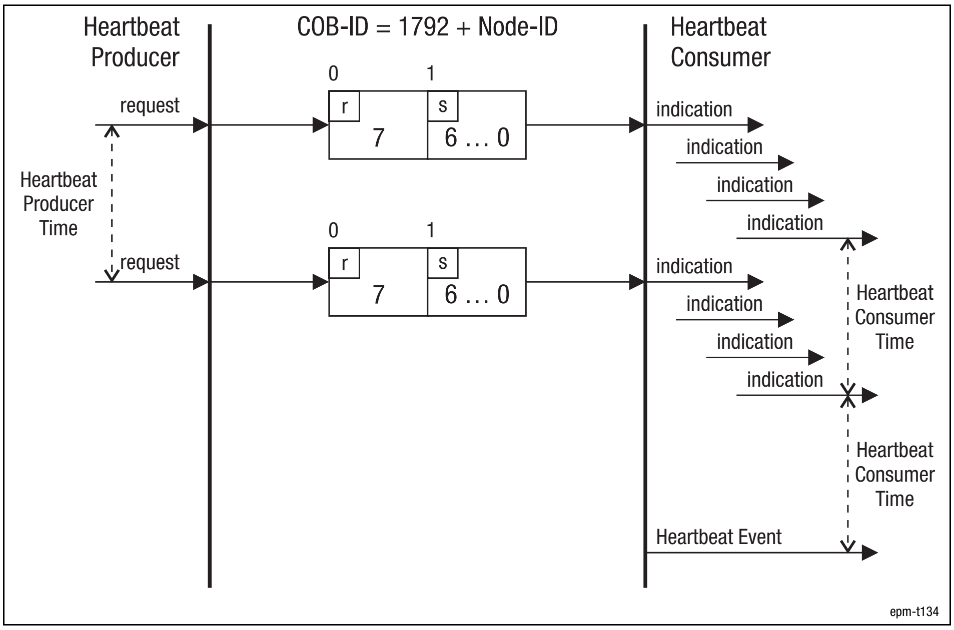


Fig. 9.7-1 Heartbeat Protocol

r Reserved
s State of the Heartbeat Producer

Heartbeat Consumer

The I/O system IP20 can monitor up to five nodes. The status telegrams of the nodes to be monitored must arrive cyclically within a certain time at the I/O system IP20. If a status telegram is not received within this time, the I/O system IP20 switches to the status set in $I1029_h$. The outputs switch to a defined status (also see the chapter Configuration → Diagnostics).

Settings are made in the index $I1016_h$.

Heartbeat Producer

The I/O system IP20 assigns a status telegram to the fieldbus and can thus be monitored by other nodes.

Settings are made in index $I1017_h$.

- Producer heartbeat is automatically started if a time > 0 is entered into the index 1017_h and the I/O system IP20 changes to the status ”Operational”.
- After the cycle time has been completed, the status telegram is transmitted to the fieldbus by the I/O system IP20.
- A change to the Operational status triggers a reset.

Status telegram

11 bits	1 byte of user data	
Identifier	**Device status (bits 0 ... 6)**	**bits 7**
1792_d (700_h)		reserved

Identifier:

	Formula	**Information**
Identifier	= Basic identifier + node address = 1792_d + xx	The basic identifiers for heartbeat is firmly adjusted to 1792_d (700_h) xx = node address of the I/O system IP20

Device status (bit 1 ... 6) of the heartbeat producer:

Command (hex)	**Status**
00	Boot-up
05	Operational
04	Stopped
7F	Pre-Operational

Indices for setting

Index	**Name**	**Possible settings**		**Important**	
		Lenze	**Selection**		
$I1016_h$ ↵	Heartbeat consumer time		Data contents Heartbeat time: Byte 0 = 00_h, Byte 1 = 00_h; Node ID: Byte 2 = 00_h; Reserved: Byte 3 = 00_h	I/O system IP20 can monitor up to five nodes (subindex 1 ... 5). If the monitored node does not respond, I/O system IP20 changes to the status "Pre-Operational". The outputs switch to a defined state.	📖 9.7-1
1	Heartbeat time	0	0 {1 ms} 65535	• In the compact system, only subindex 1 is available • Heartbeat time: – The monitored node must respond within the time set. The time is set in byte 0 and 1. – If the monitored node does not respond within the set time, I/O system IP20 switches to the communication status set under $I1029_h$ – The communication status is reset when a new heartbeat telegram is received • Node ID: – Node address of the node to be monitored. The address is set in byte 2.	
	Node ID	0	0 {1} 255		
2	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
3	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
4	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
5	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
$I1017_h$ ↵	Heartbeat producer time	0	0 {1 ms} 65535 0 Function is not active	I/O system IP20 can be monitored by other nodes. Within this time the device status of I/O system IP20 is transmitted to the fieldbus. Not available for system bus (CAN) communication protocol	📖 9.7-1

Note!

The Lenze 9300 servo PLC and Drive PLC in connection with the function library LenzeCanDSxDrv.lib support the "heartbeat" function.

9.8 Reset node

Changes of transmission modes and identifiers will be accepted after ”reset node” only.

- Switch the supply voltage on again
- Execute NMT command ”81_h” (see chapter ”Network management (NMT)”)
- Set $I2358_h$ = 1

Index	Name	Possible settings			Important	
		Lenze	Selection			
$I2358_h$ *	CAN reset node	0	0	No function	Reset node	9.8-1
			1	CAN reset node		

9.9 Monitoring

9.9.1 Time monitoring for PDO1-Rx ... PDO10-Rx

A time monitoring can be configured for the inputs of the process data objects PDO1-Rx ... PDO10-Rx via the index $I2400_h$.

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I2400_h$ ↵	Timer value		0	{1 ms}	65535	Monitoring time for process data input objects For the compact system, only index $I2400_h$, subindex 1 is available	🕮 9.9-1
1	PD01	0					
2	PD02	0					
3	PD03	0					
4	PD04	0					
5	PD05	0					
6	PD06	0					
7	PD07	0					
8	PD08	0					
9	PD09	0					
10	PD10	0					

9.9.2 Digital output monitoring

Via the index I6206$_h$ you can configure the reactions of the digital outputs which are to take place when no telegrams, "node guarding events" or "heartbeat" have been received in the adjusted monitoring time.

Index	Name	Possible settings			Important	
		Lenze	Selection			
I6206$_h$ ↵	Error mode digital output		0 {1} 255		Configures digital output monitoring For the compact system, only index I6206$_h$, subindex 1 is available	📖 9.9-2
			0	All digital outputs retain the last status output.		
			255	Response from I6207$_h$	In I6207$_h$, the response can be configured individually for each digital output	
1	Module 1	0				
2	Module 2	0				
...	...	...				
64	Module 64	0				

Individual response setting

Via index I6207$_h$ the response can be configured individually for each digital output.

Index	Name	Possible settings			Important	
		Lenze	Selection			
I6207$_h$ ↵	Error value digital output	0	0 {1} 255		Configures the individual digital output responses For the compact system, only index I620$_{7h}$, subindex 1 is available	📖 9.9-2
			8 bits of information			
			Bit value 0	Output switches to LOW		
			Bit value 1	Output retains last status output		
1	Module 1	0				
2	Module 2	0				
...	...	...				
64	Module 64	0				

9.9.3 Monitoring of the analog outputs

Via the index I6443$_h$ you can configure the reactions of the analog outputs which are to take place when no telegrams, "node guarding events" or "heartbeat" have been received in the adjusted monitoring time.

- Monitoring is started on receipt of the next PDO telegram after the settings.
- If a telegram is not transmitted within the adjusted time, the module switches to the "Pre-Operational" state. No further process data are transmitted.
- A change into the "Operational" state triggers a reset.

Index		Name	Possible settings			Important	
			Lenze	Selection			
I6443$_h$ ↵		Error mode analog output		0 {1} 255		Configures analog output monitoring Index is only available in the modular system	🕮 9.9-3
				0	All analog outputs retain the last value output		
				255	Response from I6444$_h$	In I6444$_h$ the response can be configured individually for each analog output	
	1	Channel 1	0				
	2	Channel 2	0				
	...	...	...				
	36	Channel 36	0				

Individual response setting

Via index I6444$_h$ the response can be configured individually for each analog output.

Index		Name	Possible settings		Important	
			Lenze	Selection		
I6444$_h$ ↵		Error value analog output		-32768 {1} 32767	Configures the individual analog output responses The analog outputs provide the set value Index is only available in the modular system	🕮 9.9-3
	1	Channel 1	0			
	2	Channel 2	0			
	...	...	...			
	36	Channel 36	0			

9.10 Diagnostics

The following indices can be used for the diagnostics. They display operating states. Settings are not possible.

Index	Information displayed	Description
I1014$_h$	Emergency telegram	🕮 9.10-2
I2359$_h$	Operating status of the system bus	🕮 9.10-3
I1027$_h$	Module ID read	🕮 9.10-3
I6000$_h$	Digital input status	🕮 9.10-3
I6200$_h$	Digital output status	🕮 9.10-4
I6401$_h$	Analog input status	🕮 9.10-5
I6411$_h$	Analog output status	🕮 9.10-5
I1003$_h$	Current errors	

9.10.1 Emergency telegram

By means of the emergency telegram, the I/O system IP20 communicates internal device errors to other system bus nodes with high priority. 8 bytes of user data are available.

Index	Name	Possible settings		Important	
		Lenze	Selection		
$I1014_h$	COB ID emergency			Emergency telegram Identifier 80h + node address is displayed after boot-up.	🕮 9.10-2

Emergency telegram structure

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
LOW byte	HIGH byte	Error register	Error information				
Error code	Error code	$I1001_h$	1	2	3	4	5

Contents of the emergency telegram

Error cause	Byte 0	Byte 1	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Emergency telegram reset	0000_h		00_h	00_h	00_h	00_h	00_h
Error on initialisation of modules linked to backplane bus	1000_h		01_h	00_h	00_h	00_h	00_h
Error on module configuration check			02_h	Slot number	00_h	00_h	00_h
Error on module read/write			03_h	Slot number	00_h	00_h	00_h
Module configuration was changed			05_h	00_h	00_h	00_h	00_h
Configuration of the modules has been changed. The module is in the Pre-Operational state.			06_h	00_h	00_h	00_h	00_h
Incorrect module parameterisation			30_h	Slot number	00_h	00_h	00_h
Diagnostic alarm - analog module			40_h + Slot number	Diagnostic byte 0	Diagnostic byte 1	Diagnostic byte 2	Diagnostic byte 3
Process alarm - analog module			80_h + Slot number	Diagnostic byte 0	Diagnostic byte 1	Diagnostic byte 2	Diagnostic byte 3
PDO control (monitoring time in $I2400_h$ has been exceeded).			FF_h	10_h	PDO number	Monitoring time (LOW byte)	Monitoring time (HIGH byte)
SDO/PDO mapping error	6300_h		Map index (LOW byte)	Map index (HIGH byte)	Number of entries	00_h	00_h
Heartbeat error (monitoring time exceeded).	8130_h		Subindex	Node address	Monitoring time (LOW byte)	Monitoring time (HIGH byte)	00_h
Node guarding error (monitoring time exceeded).	8130_h		Guard time (LOW byte)	Guard time (HIGH byte)	Life time	00_h	00_h

9.10.2 Operating state of system bus (CAN)

Index I2359$_h$ displays the operating status of the system bus.

I2359$_h$	Operating status	Description
0	Operational	The system bus is fully functional. The I/O system can transmit and receive parameter and process data.
1	Pre-Operational	The I/O system can transmit and receive parameter data while process data are ignored. The status can be changed from *Pre-Operational* to *Operational* by: • The CAN master • An NMT telegram ’00 01 00’
2	Warning	The I/O system has received incorrect telegrams and becomes passive in the overall system bus environment, i. e., the I/O system can no longer transmit data. Possible causes: • A missing bus termination • Insufficient shielding • Potential differences in the earth connections for the control electronics • The bus load is too high
3	Bus off	The I/O system has disconnected itself from the system bus after receiving too many incorrect telegrams.

Index	Name	Possible settings		Important	
		Lenze	Selection		
I2359$_h$	CAN state		0 {1} 3 0 Operational 1 Pre-Operational 2 Warning 3 Bus off	Display only System bus status	🕮 9.10-3

9.10.3 Reading out the module identifiers

When using the modular system, the number of the modules connected to the backplane bus as well as the module types used can be read out via index I1027$_h$. Each module type can be clearly identified via a hexadecimal value.

Index	Subindex	Reading...	Module type	Module identifier
I1027$_h$	0	... the number of plugged modules (0 ... 32)	–	0$_h$ ... 20$_h$
	1 ... 32	... the module type in slots 1 ... 32	No module	0$_h$
			8×digital input	9FC1$_h$
			16×digital input	9FC2h
			1×counter/16×digital input	08C0h
			8×digital output 1A 16×digital output 1A 8×digital output 2A 4×relay	AFC8$_h$
			8×digital input / output	BFC9$_h$
			4×analog input	15C4h
			4×analog output	A5E0$_h$
			4×analog input / output	45DB$_h$
			2/4×counter	B5F4$_h$
			SSI interface	B5DB$_h$

9.10.4 Status of the digital inputs

Via the index I6000$_h$ the status of the digital inputs can be displayed.

Index	Name	Possible settings				Important	
		Lenze	Selection				
I6000$_h$	Digital input		0	{1}	255	Display only Digital input status	📖 9.10-3
1	Module 1						
2	Module 2						
...	...						
64	Module 64						

9.10.5 Status of the digital outputs

Via the index I6200$_h$ the status of the digital outputs can be displayed:

Index	Name	Possible settings				Important	
		Lenze	Selection				
I6200$_h$ *	Digital output		0	{1}	255	• Digital output status • The outputs can be set manually (forcing): – Depends on CAN status and I2360$_h$	📖 9.10-4
1	Module 1						
2	Module 2						
...	...						
64	Module 64						

9.10.6 Status of the analog inputs

Via the index $I6401_h$ the status of the analog inputs can be displayed.

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I6401_h$	Analog input		-32768	{1}	32767	Display only Analog input status Index is only available in the modular system	📖 9.10-5
1	Channel 1						
2	Channel 2						
...	...						
36	Channel 36						

9.10.7 Status of the analog outputs

Via the index $I6411_h$ the status of the analog outputs can be displayed:

Index	Name	Possible settings				Important	
		Lenze	Selection				
$I6411_h$ *	Analog output		-32768	{1}	32767	• Analog output status • The outputs can be set manually (forcing): – Depends on CAN status and $I2360_h$ • Index is only available in the modular system	📖 9.10-5
1	Channel 1						
2	Channel 2						
...	...						
36	Channel 36						

10 Networking via PROFIBUS-DP

Contents

10.1 Via Profibus-DP

Power section DP-V0

Profibus-DP-V0 (Decentralised Peripherals) provides the basic functions of DP. This includes the cyclic data exchange as well as diagnostic functions.

- Diagnostic functions for fast error localisation:
  - Code-related diagnostics
  - Module status
  - Channel-related diagnostics

Power section DP-V1

Power section DP-V1 includes enhanced functions of DP-V0 with regard to process automation:

- Alarms for enhanced diagnostics
  - Status alarm, update alarm, manufacturer-specific alarm
- Simultaneously to the cyclic process data transfer, an acyclic data circuit to the slaves is created in order to
  - parameterise the slaves,
  - evaluate alarms.

Note!

Power section DP-V1 can only be used if it is supported by the master and the slaves.

Introduction

PROFIBUS is an integrated, open, digital communication system with a wide application range mainly in manufacturing and process automation. PROFIBUS is suitable for fast, time-critical and complex communication tasks.

PROFIBUS-DP can be used for manufacturing automation. It provides for an easy, fast, cyclic and deterministic process data exchange between a master and the assigned slaves. Power section DP-V0 is provided with these basic functions. Power section DP-V1 was enhanced by an acyclic data exchange between master and slave.

10.2 System configuration

10.2.1 Types

PROFIBUS differentiates between active nodes (master) and passive nodes (slave).

Class 1 master (DPM 1)

A class 1 master (DPM 1) is a central control which exchanges data with the slaves in a fixed cycle. Typical DPM 1 are, for example, PLC or PC. Via an active bus access, measured data is read cyclically from the input modules of the slaves and setpoints are written to the output modules of the slaves.

Class 2 master (DPM 2)

Class 2 masters (DPM 2) are used for engineering, configuration or operation. During commissioning, maintenance and diagnostics, for example, DPM 2 can be used to configure the connected slaves, evaluate measured values and parameters and query the status of the slaves. The data is transmitted acyclically. DPM 2 do not have to be permanently connected to the bus. DPM 2 are provided with active bus access.

Slave

Slaves are peripherals (PROFIBUS Gateway, PROFIBUS GatewayECO) making process information (input data and output data) available. Slaves only respond to direct requests by the master.

10.2.2 Mono-master system

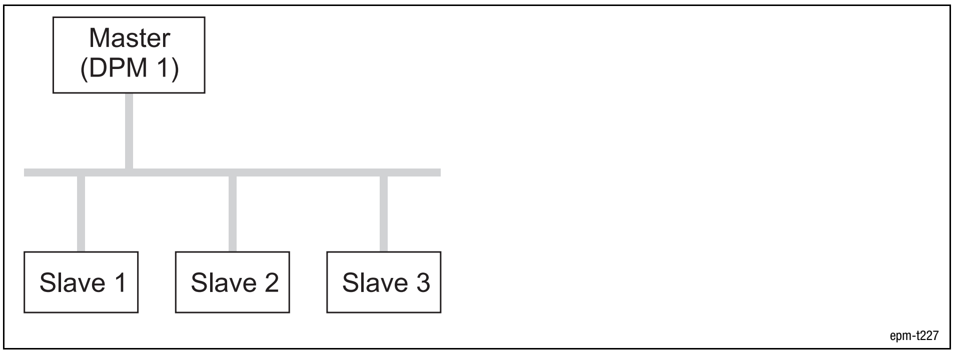


Fig. 10.2-1 PROFIBUS-DP mono-master system

In the case of mono-master systems, only one master on the bus is active during operation. The slaves are coupled to the master via the transmission medium in a decentralised manner. This system configuration achieves the shortest bus cycle time.

10.2.3 Multi-master system

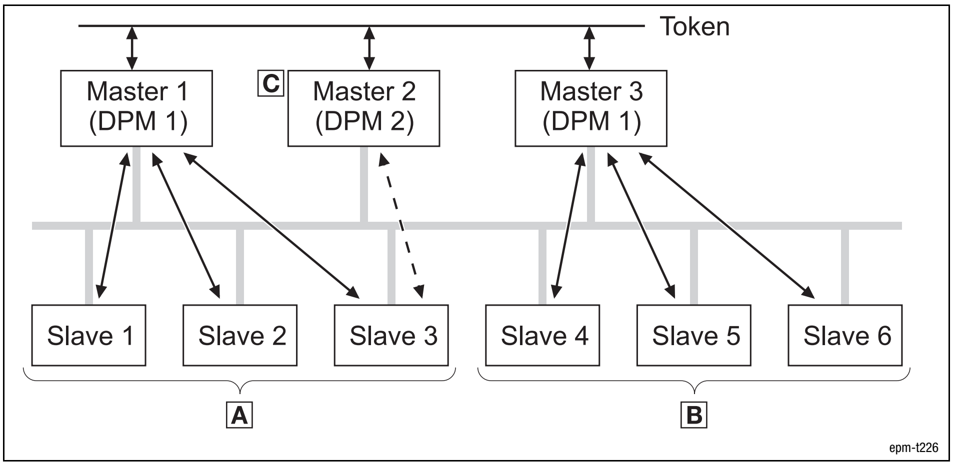


Fig. 10.2-2 PROFIBUS-DP multi-master system

A Subsystem consisting of master 1 and slaves 1 ... 3 with cyclic data transfer.
B Subsystem consisting of master 3 and slaves 4 ... 6 with cyclic data transfer.
C For configuration and diagnostics, master 2 can communicate with slave 1 ... 6. The data transfer is acyclic.

In multi-master operation, several masters are connected to one bus. They either form independent subsystems consisting of one class 1 master (DPM 1) each and the corresponding slaves, or additional class 2 masters (DPM 2) for configuration and diagnostics. The input and output images of the slaves can be read by all masters. Only the respective class 1 master (DPM 1) can write the outputs.

10.3 Communication

10.3.1 Bus access

The transmission protocol offers two bus access procedures.

Master ↔ Master

The master communication is also referred to as token passing procedure. The token passing procedure makes sure that the bus access authorisation is assigned. The bus access authorisation is given by means of a ”token”. The token is a special telegram transmitted via the bus.

If a master has a token, it can communicate with all of the other bus nodes. The token hold time is defined during system configuration. Once the token hold time has elapsed, the token is passed on to the next master which is then in possession of the bus access authorisation and can communicate with all of the other nodes.

The data transfer between the master and the slaves assigned to it is automatically controlled by the master and takes place in a fixed and recurring sequence. The slaves are assigned to a master during configuration. In addition, it can be defined which slaves participate in the cyclic process data transfer.

Master ↔ Slave

Before master and slave can communicate, the configuration and the parameter setting are checked for errors after startup.

The following are checked: type, format information, length information and the number of inputs and outputs.

If the parameters are valid, the slave changes over to the DataExchange (DE) state. The master can now transmit output data to the slave and receive the current input data from the slave.

While the process data transfer is in progress, the master can transmit new parameter data to the slave.

10.3.2 Cyclic data transfer

The data communication with PROFIBUS-DP-V0 includes cyclic diagnostics as well as cyclic process data and parameter data transfer.

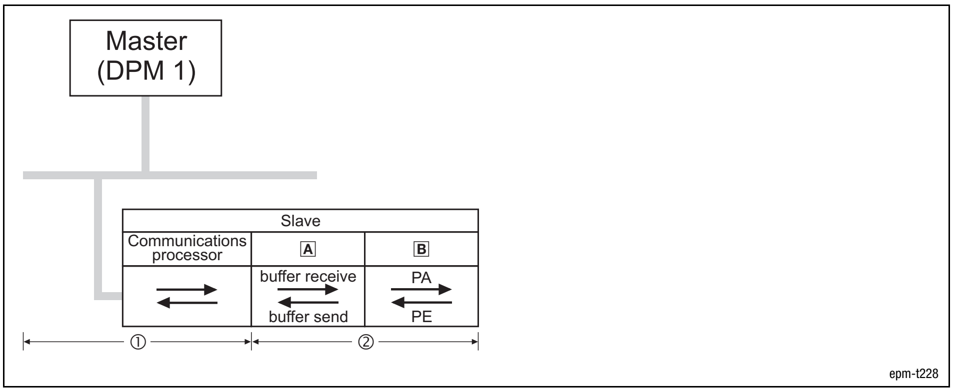


Fig. 10.3-1 DP cycle and cycle of backplane bus

A Backplane bus with transmit and receive buffer
B Input / output modules
PO: process image of outputs
PI: process image of inputs
① PROFIBUS cycle
② Backplane bus cycle

Backplane bus cycle

During a backplane bus cycle

- the input data (PI) on the inputs is collected and transmitted to the transmit buffer (buffer send),
- the output data (PO) of the receive buffer (buffer receive) is written to the outputs.

PROFIBUS cycle

During a PROFIBUS cycle, the master successively addresses all its assigned slaves with a DataExchange. During a DataExchange, the memory areas assigned to the PROFIBUS are transmitted.

- The data of the PROFIBUS input area is transmitted to the receive buffer (buffer receive).
- The data of the transmit buffer (buffer send) is transmitted to the PROFIBUS output area.

10.3.3 Acyclic data transfer

The PROFIBUS-DP-V1 service can be used as an optional extension to enable an acyclic parameter data transfer. PROFIBUS-DP-V0 and PROFIBUS-DP-V1 may be operated simultaneously in one network.

The integration of the acyclic service in a fixed bus cycle depends on the correct configuration of DPM 1:

- If configured, a time slot is reserved.
- If not configured, the acyclic service is added when a DP-V1 slave is accessed acyclically with a DPM 2.
- The acyclic service always has lower priority.

Parameter data transfer between DPM 1 and slaves

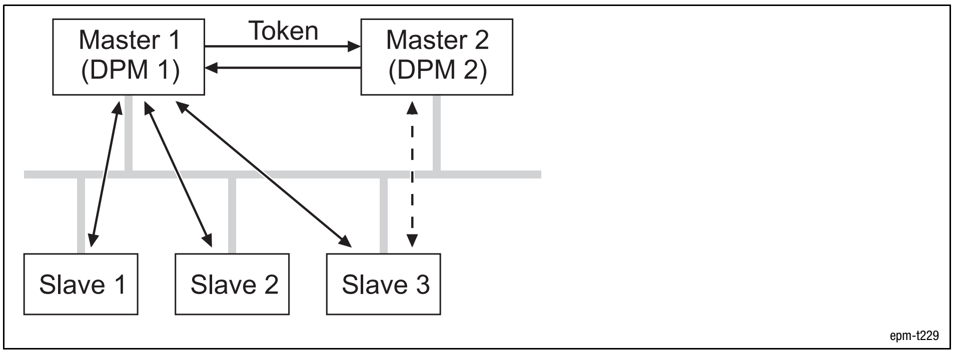


Fig. 10.3-2 Acyclic data transfer

⟷ Cyclic process data transfer between DPM 1 and slave 1 ... 3
◄ – –► Acyclic parameter data transfer between DPM 1 and slave 3

1. DPM 1 has the send authorisation (token) and communicates in a fixed sequence with slave 1, then with slave 2 etc. up to the last slave of the current list via the MS0 channel by means of request and response.
2. DPM 1 transfers the token to DPM 2.
3. During the remaining cycle time (time slot), DPM 2 establishes an acyclical connection to one of the slaves in order to transmit parameter data via the MS2 channel.
4. At the end of the running cycle time, DPM 2 returns the token to DPM 1.
   – Depending on the remaining cycle time, several time slots may be required for the acyclical data record transfer.
5. Once all of the data records have been transferred, DPM 2 establishes the connection within one time slot.

Note!

DPM 1 can perform the acyclical parameter data exchange via the MS1 channel.

Services for the acyclic parameter data transfer

Data transfer between DPM 1 and slaves

The connection is established by DPM 1 via the MS1 channel. The connection to the slave can only be established by the master that has parameterised and configured the slave.

Service	Description
Read	The master reads a data block from the slave.
Write	The master writes a data block to the slave.
Alarm	The slave transmits an alarm message to the master. The master acknowledges receipt. To prevent alarm messages from being overwritten, the slave can only transmit a new alarm message if it has received the acknowledgement.
Alarm_Acknowledge	The master transmits an acknowledgement to the slave, confirming that it has received an alarm message.
Status	The slave transmits a status message to the master. The master does not acknowledge receipt.

Data transfer between DPM 2 and slaves

The connection is established by DPM 2 via the MS1 channel using the "Initiate" service. One slave can maintain several active connections at the same time. The number of connections is limited depending on the resources available in the slave.

Service	Description
Initiate / Abort	Establishing or terminating a connection for the acyclic data transfer between DPM 2 and a slave.
Read	The master reads a data block from the slave.
Write	The master writes a data block to the slave.
Data_Transport	The master writes user-specific data (defined in profiles) to the slave and, if required, it reads data from the slave in the same cycle.

Note!

For further information on the services and communication with DP-V0 and DP-V1, refer to standard IEC 61158.

10.3.4 Communication medium

- The communication medium is an RS485 interface.
- The bus can be configured as line or tree topology.
- The bus structure under RS485 enables the reactionless connection and disconnection of stations as well as the gradual commissioning of the system. Subsequent enhancements do not affect the stations already in operation. It is automatically detected whether a node has failed or just been connected to the mains.
- PROFIBUS Gateway and PROFIBUS GatewayECO are provided with a 9-pin Sub-D socket to ensure that they can be connected to the bus.

10.4 Project planning

10.4.1 Important notes

The I/O system IP20 is configured via the master. The following work steps must be carried out:

- Install the GSE file (device description) on the master
- Address nodes
- Set the baud rate
- Parameterise slaves

10.4.2 GSE file for PROFIBUS connection

Before the I/O system IP20 can be configured, the device description (GSE file) has to be installed on the master.

Note that the GSE file has to match the PROFIBUS Gateway (slave) and the communication protocol used.

Slave	Communication protocol	GSE file
PROFIBUS Gateway	PROFIBUS-DP-V0	LE000A68.gse
	PROFIBUS-DP-V1	LENZ0A68.gse
PROFIBUS GatewayECO	PROFIBUS-DP-V0	LE000A69.gse
	PROFIBUS-DP-V1	LENZ0A69.gse

Installing the GSE file

1. Download the correct GSE file from the Internet.
   – You can find the GSE files on the Internet under the section ”Services & Downloads” at **http://www.Lenze.com**.
2. Install the GSE file on the master.
   – For notes on the installation, refer to the documentation on the master and the documentation on the configuration tool.

10.4.3 Setting of the station address

Every node at the PROFIBUS is identified by an address.

- Each address may only be assigned once in a bus system
- Addresses between 1 ... 125 can be assigned.
- At the PROFIBUS Gateway (slave), the address with the front DIP switch is set.
- At the master, the address is set during the configuration.

10.4.4 Setting of the baud rate

The baud rate is set in the configuration tool.

- The baud rate must correspond to the length of the bus cable.

10.5 Transmitting parameter data

10.5.1 PROFIBUS-DP-V0

Structure of the PROFIBUS telegram

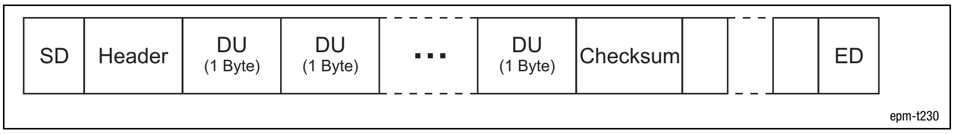


Fig. 10.5-1 Cycle of a PROFIBUS telegram

DU Data Unit (user data)
Value range: 1 ... 244 bytes
SD Start Delimiter (start of the telegram)
ED End Delimiter (end of the telegram)

Parameter data

For the communication protocol PROFIBUS-DP-V0, the following parameter data are available:

Byte	Assignment			Lenze setting
0	Bit 7 ... 0		Reserved	00_h
1	Bit 7 ... 0		Reserved	00_h
2	Bit 7 ... 0		Reserved	08_h
3	Bit 7 ... 0		Reserved	$0A_h$
4	Bit 7 ... 0		Reserved	81_h
5	Bit 7 ... 0		Reserved	00_h
6	Bit 7 ... 0		Reserved	00_h
7	Bit 0	0	Code-related diagnostics activated	70_h
		1	Code-related diagnostics deactivated	
	Bit 1	0	Module status enabled	
		1	Module status inhibited	
	Bit 2	0	Channel-related diagnostics activated	
		1	Channel-related diagnostics deactivated	
	Bit 3		Reserved	
	Bit4	0	Manufacturer-specific alarm deactivated	
		1	Manufacturer-specific alarm activated	
	Bit 5	0	Diagnostic alarm deactivated	
		1	Diagnostic alarm activated	
	Bit 6	0	Process alarm deactivated	
		1	Process alarm activated	
	Bit7		Reserved	
8	Bit 7 ... 0		Reserved	00_h
9	Bit 7 ... 0		Reserved	00_h
10	Bit 7 ... 0		Reserved	00_h
11	Bit 7 ... 0		Reserved	00_h
12	Bit 7 ... 0		Reserved	00_h

10.5.2 PROFIBUS-DP-V1

Structure of the PROFIBUS telegram

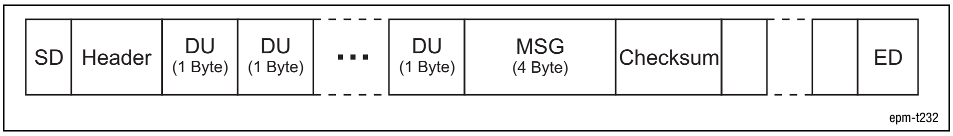


Fig. 10.5-2 Cycle of a PROFIBUS telegram

DU Data Unit (user data)
Value range: 1 ... 240 bytes
MSG Parameter data
SD Start Delimiter (start of the telegram)
ED End Delimiter (end of the telegram)

Parameter data

For the communication protocol PROFIBUS-DP-V1, the following parameter data are available:

Byte	Assignment			Lenze setting
0	Bit 7 ... 0		Reserved	$C4_h$
1	Bit 3 ... 0		Reserved	70_h
	Bit4	0	Manufacturer-specific alarm deactivated	
		1	Manufacturer-specific alarm activated	
	Bit 5	0	Diagnostic alarm deactivated	
		1	Diagnostic alarm activated	
	Bit 6	0	Process alarm deactivated	
		1	Process alarm activated	
	Bit7		Reserved	
2	Bit 7 ... 0		Reserved	08_h
3	Bit 7 ... 0		Reserved	$0A_h$
4	Bit 7 ... 0		Reserved	81_h
5	Bit 7 ... 0		Reserved	00_h
6	Bit 7 ... 0		Reserved	00_h
7	Bit 0	0	Code-related diagnostics activated	00_h
		1	Code-related diagnostics deactivated	
	Bit 1	0	Module status activated	
		1	Module status deactivated	
	Bit 2	0	Channel-related diagnostics activated	
		1	Channel-related diagnostics deactivated	
	Bit 7 ... 3		Reserved	
8	Bit 7 ... 0		Reserved	00_h
9	Bit 7 ... 0		Reserved	00_h
10	Bit 7 ... 0		Reserved	00_h
11	Bit 7 ... 0		Reserved	00_h
12	Bit 7 ... 0		Reserved	00_h

10.5.3 Addressing with slot and index

Description

> **Note!**
> Prerequisite for addressing data via slot and index:
> - Master and slave have to support the communication protocol PROFIBUS-DP-V1.
>   – The connection can be established via a class 1 master (DPM 1) or class 2 masters (DPM 2).
> - The function blocks SFB 52 (read) and SFB 53 (write) must be integrated in the slaves PROFIBUS Gateway and PROFIBUS GatewayECO.
>   – For further information, refer to the documentation on SFB 52 and SFB 53 (Siemens).

PROFIBUS interprets a slave as a logic entity with a physical modular structure.

Module	**PROFIBUS Gateway**	**8×digital output 1A**	**16×digital output 1A**	**8×digital input**	**4×analog input**	**...**
Slot number	0	1	2	3	4	**...**
Index	0 ... 255	0 ... 255	0 ... 255	0 ... 255	0 ... 255	**...**

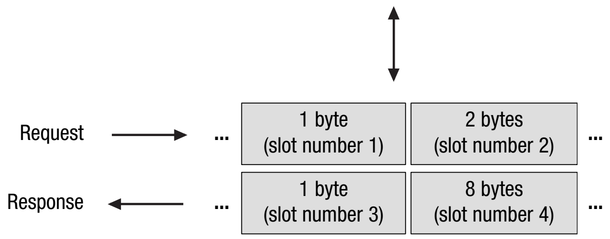


Fig. 10.5-3 Example of slave configuration

Data addressing is based on identifications defining the module type as input, output or a combination of the two. The identifications as a whole define the configuration of the slave. When the slave is initialised, the configuration is checked by DPM 1.

The data blocks enabled for read or write access are assigned to modules and can be addressed by means of slot number and index.

- The slot number addresses the module:
  - Slot number = 0 addresses data of PROFIBUS Gateway or PROFIBUS GatewayECO.
  - Slot number > 0 addresses data of the electronic modules.
- The index addresses the data blocks of the module:
  - One data block may have a size of up to 244 bytes (4 bytes header, 240 bytes user data).
  - The length specification in the read or write command also allows for reading or writing parts of a data block.

Data of PROFIBUS Gateway

The following PROFIBUS Gateway elements can be accessed via slot number 0:

Slot number	Index	Access	Description
0	$A0_h$	R	Read out device name (PROFIBUS Gateway or PROFIBUS GatewayECO)
	$A1_h$	R	Read out hardware version
	$A2_h$	R	Read out software version
	$A3_h$	R	Read out serial number (e.g. 000347 = 30_h, 30_h, 30_h, 33_h, 34_h, 37_h)
	$A4_h$	R	Read out device configuration (see table "Device configuration")
	$D0_h$	R	Read out number of saved diagnostics
		W	Delete diagnostic input
	$D1_h$	R	Read out stored diagnostic input (see table "Structure of a saved diagnostic input")
		W	Save diagnostic input in FLASH-ROM

R = read

W = write

Device configuration

The electronic modules belonging to PROFIBUS Gateway can be output via index $A4_h$:

Electronic module	Identification	Input data [Byte]	Output data [Byte]
8×digital input	9FC1h	1	-
16×digital input	9FC2h	2	-
8×digital output 1A	AFC8h	-	1
16×digital output 1A	$AFD0_h$	-	2
8×digital output 2A	AFC8h	-	1
4×relay	AFC8h	-	1
8×digital input / output	BFC9h	1	1
4×analog input	15C4h	8	-
4×analog input ±10V	15C4h	8	-
4×analog input ±20mA	15C4h	8	-
4×analog output	$25E0_h$	-	8
4×analog output ±10V	$25E0_h$	-	8
4×analog output 0...20mA	$25E0_h$	-	8
4×analog input / output	45DBh	4	4
2/4×counter	B5F4h	10	10
SSI interface	B5DBh	4	4
1×counter/16×digital input	08C0h	6	6

Structure of saved diagnostic entry

Every time index $D1_h$ is accessed, a saved diagnostic entry is read out. When it is accessed for the first time, the last entry is read out, when it is accessed the second time, the penultimate entry is read out, etc.

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	...	Byte 26
Length of diagnostic data		Internal time stamp				Diagnostic data (maximum 20 bytes)			

Data of electronic modules

- In the case of PROFIBUS Gateway, the 32 electronic modules can be accessed via slot numbers 1 ... 32.
- In the case of GatewayECO, the 8 electronic modules can be accessed via slot numbers 1 ... 8.

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

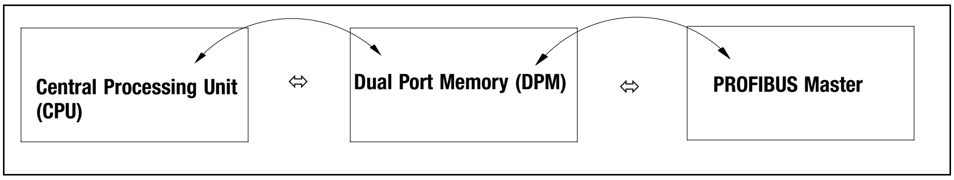
W = write

10.5.4 Consistent parameter data

In the PROFIBUS communication system, a permanent data exchange takes place between the master computer (CPU + PROFIBUS master) and the slave.

The PROFIBUS master and the CPU (central processing unit) of the master computer access a common storage medium for this purpose - the dual port memory (DPM).

The DPM enables a data exchange into both directions (read/write):



Without any further data organisation, a slower write action of the PROFIBUS master might be overtaken by a faster read action of the CPU within a cycle.

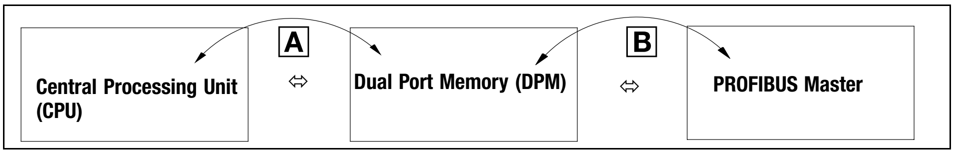
To prevent this from happening, the parameter data to be transferred must be marked as ”consistent”.

Data communication with existing consistency

With consistency either ”read” or ”write” is possible in the data memory if master and CPU have access at the same time:

- The PROFIBUS master only transfers the data as a complete data record.
- The CPU can only access completely updated data records.
- The PROFIBUS master cannot read or write data as long as the CPU accesses consistent data.

The result is shown in the following example:



A CPU wants to read!

B PROFIBUS master wants to write at the same time!

1. Due to the fact that the PROFIBUS master can only write if the CPU does not read, the PROFIBUS master has to wait until the CPU has read all of the data.
2. The PROFIBUS master only writes complete data records into the DPM.

Configuration of consistent data

Consistency is achieved by configuring the PROFIBUS master accordingly. Use the corresponding instructions of your configuration software for this purpose.

10.6 Diagnostics

10.6.1 Description

10.6.2 Diagnostic data

Comprehensive diagnostic functions in PROFIBUS-DP ensure that errors can be quickly located. The diagnostic data is transmitted to the master where it can be evaluated.

The diagnostics in power section DP-V1 can also trigger alarms. An alarm consists of an alarm message and a status message.

Internal diagnostic messages

Diagnostic messages such as the ”READY” and the ”DataExchange” states are stored internally in the slave. They are not transmitted to the master.

Every time the state changes from ”READY” to ”DataExchange” and vice versa, the slave stores the diagnostic data in RAM in a Flash-ROM and writes the content back into the RAM during every restart.

Diagnostic message in the event of voltage failure

If the voltage falls below a specific limit value or in the event of voltage failure, a time stamp is stored in EEPROM immediately.

- If the voltage is sufficient, a diagnostic message with time stamp is transmitted to the master.
- In the event of voltage failure, a diagnostic message with time stamp is generated from the EEPROM during the next restart and stored in the RAM of the slave.

Structure of the diagnostic data

Depending on the parameter setting, the diagnostics from the slave can be up to 58 bytes.

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	...		... Byte 58
6 bytes						2 bytes		6 bytes	3 bytes/channel	20 bytes
Standard diagnostic data						Code-related diagnostic data		Module status	Channel-related diagnostic data	Alarm data
Fixed range						Variable range				
The data is always transmitted to the master.						The diagnostic ranges to be transmitted are set via the parameter setting.				

During transmission to the master, the standard diagnostic data has a higher priority than the diagnostic data.

Byte	Assignment		
0	Bit 0	0	Reserved
	Bit 1	1	Slave not ready for data exchange
	Bit 2	1	Configuration data does not match
	Bit 3	1	Slave has external diagnostic data
	Bit4	1	Slave does not support requested function
	Bit 5	0	Reserved
	Bit 6	1	Incorrect parameter setting
	Bit7	0	Reserved
1	Bit 0	1	Slave has to be reparameterised
	Bit 1	1	Statistic diagnostics
	Bit 2	1	Reserved
	Bit 3	1	Response monitoring active
	Bit4	1	Freeze command received
	Bit 5	1	Sync command received
	Bit 6		Reserved
	Bit7	0	Reserved
2	Bit 6 ... 0		Reserved
	Bit7	1	Overflow diagnostic data
3	Bit 7 ... 0	11111111	Slave not parameterised
4	Bit 7 ... 0		ID number HIGH byte
5	Bit 7 ... 0		ID number LOW byte

Code-related diagnostic data

The code-related diagnostic data contains information about the slot on which an error has occurred.

- The code-related diagnostics are activated via the parameter setting.

Byte	Assignment		
Byte 1	Bit 5 ... 0	000010	Length of code-related diagnostic data
	Bit 7, 6	01	Code for code-related diagnostics
Byte 2	Bit 7 ... 0	The corresponding bit is set to "1" if the following occurs on a slot • the module is disconnected, • a non-configured module is connected, • the module cannot be accessed, • the module reports a diagnostic alarm.	
		00000001	Module slot 1
		00000010	Module slot 2
		00000100	Module slot 3
		00001000	Module slot 4
		00010000	Module slot 5
		00100000	Module slot 6
		01000000	Module slot 7
		10000000	Module slot 8
Byte 3	Bit 7 ... 0	00000001	Module slot 9
		00000010	Module slot 10
		...	...
		10000000	Module slot 16
Byte 4	Bit 7 ... 0	00000001	Module slot 17
		00000010	Module slot 18
		...	...
		10000000	Module slot 24
Byte 5	Bit 7 ... 0	00000001	Module slot 25
		00000010	Module slot 26
		...	...
		10000000	Module slot 32

Module status

The module status contains more detailed information on the error in a module.

Byte	Assignment		
Byte 1	Bit 5 ... 0	000110	Fix, length of the module status
	Bit 7, 6	00	Fix, code for module status
Byte 2	Bit 7 ... 0	10000010	Fix, status type of module status
Byte 3	Bit 7 ... 0	11111111	Reserved
Byte 4	Bit 7 ... 0	11111111	Reserved
	In byte 5 and byte 6, two bit each are used to report the errors of a module		
		00	Module without error
		01	Module defective
		10	Incorrect module
		11	No module connected
Byte 5	Bit 1, 0		Module on slot 1
	Bit 3, 2		Module on slot 2
	Bit 5, 4		Module on slot 3
	Bit 7, 6		Module on slot 4
Byte 6	Bit 1, 0		Module on slot 5
	Bit 3, 2		Module on slot 6
	Bit 5, 4		Module on slot 7
	Bit 7, 6		Module on slot 8
Byte 7	Bit 1, 0		Module on slot 9
	...		...
	Bit 7, 6		Module on slot 12
Byte 8	Bit 1, 0		Module on slot 13
	...		...
	Bit 7, 6		Module on slot 16
Byte 9	Bit 1, 0		Module on slot 17
	...		...
	Bit 7, 6		Module on slot 20
Byte 10	Bit 1, 0		Module on slot 21
	...		...
	Bit 7, 6		Module on slot 24
Byte 11	Bit 1, 0		Module on slot 25
	...		...
	Bit 7, 6		Module on slot 28
Byte 12	Bit 1, 0		Module on slot 29
	...		...
	Bit 7, 6		Module on slot 32

- The module status is activated via the parameter setting.

Channel-related diagnostic data

The channel-related diagnostic data contains detailed information on channel errors of a module. 3 bytes are assigned per channel.

- The channel-related diagnostics are activated via the parameter setting. Every module has to be activated via the configuration tool.

Note!

The channel-related diagnostic data is limited by the 58 bytes required for the complete diagnostics.

If required, other diagnostic ranges must be deactivated for more channel-related diagnostic data.

Byte	Assignment		
Byte 1	Bit 5 ... 0	Module from which the diagnostic data is transmitted.	
		000000	Module on slot 1
		000001	Module on slot 2
		...	...
		000111	Module on slot 8
	Bit 7, 6	10	Fix, code for channel-related diagnostics
Byte 2	Bit 5 ... 0	Channel of localised module	
		000000	Channel 1
		000001	Channel 2
		...	...
		111111	Channel 63
Byte 2	Bit 7, 6	Type of localised module	
		00	Input module
		01	Output module
		11	Input/output module
Byte 3	Bit 4 ... 0	Error according to PROFIBUS standard	
		00001	Short circuit
		00010	Supply voltage too low
		00011	Supply voltage too high
		00100	Module output overloaded
		00101	Overtemperature at the output module
		00110	Cable break of the connected sensor or actuator
		00111	Maximum limit value exceeded
		01000	Minimum limit value exceeded
		01001	Incorrect load voltage at the output – Encoder supply – Hardware error of the module
		Manufacturer-specific error	
		10000	Parameter setting error
		10001	No encoder or load voltage
		10010	Defective fuse
		10100	Mass error
		10101	Reference channel error
		10110	Process alarm lost
		11001	Safety-oriented disconnection
		11010	External error
		11010	Error cannot be specified
	Bit 7 ... 5	Channel type	
		001	1 Bit
		010	2 bits
		011	4 Bit
		100	8 bits (1 byte)
		101	16 bits (1 word)
		110	32 bits (1 double word)

10.6.3 Alarm messages

Description

> **Note!**
> Alarm messages are only available in power section DP-V1.

Alarm messages supply information on the type and the cause of the alarm. An alarm message has a maximum length of 20 bytes. Diagnostic messages can each be transmitted with one alarm message.

There are two types of alarm messages:

- Diagnostic alarm
- Process alarm

Process alarm

In the case of a process alarm (e.g. open circuit), the additional alarm information is 4 bytes long. The data is module-specific. For further information, refer to the corresponding module description.

Diagnostic alarm

> **Note!**
> In the case of a diagnostic event for channel/channel group 0 of a module, either the channel or the module is defective.
> - This event is transmitted even if the diagnostics are not activated for channel/channel group 0 of the module.

The alarm status is contained in bytes 1 to 5:

Byte	Assignment		
Byte 1	Bit 5 ... 0	010100	Number of assigned bytes
	Bit 7, 6		Code for device-specific diagnostics
Byte 2	Bit 6 ... 0	Alarm type	
		0000001	Diagnostic alarm
		0000010	Process alarm
	Bit7		Alarm code
Byte 3	Bit 7 ... 0	Module which triggered alarm	
		00000001	Module on slot 1
		00000010	Module on slot 2
		00000011	Module on slot 3
		...	...
		00001000	Module on slot 8
Byte 4	Bit 1, 0	00	Process alarm
		01	Incoming diagnostic alarm
		10	Outgoing diagnostic alarm
		11	Reserved
	Bit 2	0	Fix
	Bit 7 ... 3	00000000	Alarm sequence 1
		00000001	Alarm sequence 2
		00000010	Alarm sequence 3
		...	...
		00000111	Alarm sequence 8

Note!

Starting from byte 5, 16 bytes of additional alarm information are added.

Bytes 5 to 8 correspond to the CPU diagnostic data record 0:

Byte	Assignment		
Byte 5	Bit 0	1	Module error, an error was detected
	Bit 1	1	Internal error in module
	Bit 2	1	External error, module cannot be addressed
	Bit 3	1	Channel error in the module
	Bit4	1	No load voltage supply
	Bit 5	1	No front connector
	Bit 6	1	Module is not parameterised
	Bit7	1	Parameter setting error
Byte 6	Bit 3 ... 0	Module class	
		1111	Digital module
		0101	Analog module
		1000	Counter module
	Bit4	1	Channel information available
	Bit 5	1	User information available
	Bit 6	0	Reserved
	Bit7	0	Reserved
Byte 7	Bit 7 ... 0		Reserved
Byte 8	Bit 7 ... 0		Reserved

Bytes 9 to 20 correspond to the CPU diagnostic data record 1:

Byte	Assignment		
Byte 9	Bit 7 ... 0	01110000	Digital module with inputs
		01110001	Analog module with inputs
		01110010	Digital module with outputs
		01110011	Analog module with outputs
		01110100	Analog module with inputs and outputs
		01110101	Counter module
Byte 10	Bit 7 ... 0		Length of the channel-specific diagnostics
Byte 11	Bit 7 ... 0		Number of channels per module
Byte 12	Bit 7 ... 0		Position (channel) of the diagnostic event
Byte 13	Bit 7 ... 0		Diagnostic event for channel/channel group 0 (see module description)
...	...		...
Byte 19	Bit 7 ... 0		Diagnostic event for channel/channel group 7 (see module description)

11 Commissioning

Contents

11.1 System bus (CAN) / CANopen

11.1.1 Before switching on

Prior to supply voltage connection, check

- the wiring for completeness, short circuits and earth faults
- the wiring of the fieldbus
  – A bus terminating resistor has to be connected to the first and the last node.
- spatial cable separation from signalling and mains cables.

Note!

After switching on the supply voltage, the modules of the I/O system IP20 are initialised. During the initialisation, the modules cannot be parameterised.

- Initialisation time - modular system: approx. 10 s
- Initialisation time - compact system: approx. 1 s

11.1.2 Commissioning examples

I/O system IP20 at the 93xx controller

An I/O system IP20 with six digital inputs and two digital outputs is to be operated on a controller of the 9300 series.

- The node address at the controller is 1. Hence, the node address at the I/O system IP20 must be 2.
- The baud rate is to be 500 kbits/s.

Stop!

When transmitting the status information of the I/O system IP20, the complete byte is read into the controller, including the status information of the digital outputs.

- In the example, the input states are read via CAN-IN3.B0 ... CAN-IN3.B5 and the output states via CAN-IN3.B6 and CAN-IN3.B7.
- Check the internal connection of the input signals CAN-IN3.B6 and CAN-IN3.B7 at the controller. Otherwise, outputs set (HIGH level) at the I/O system may trigger uncontrolled actions of the controller.

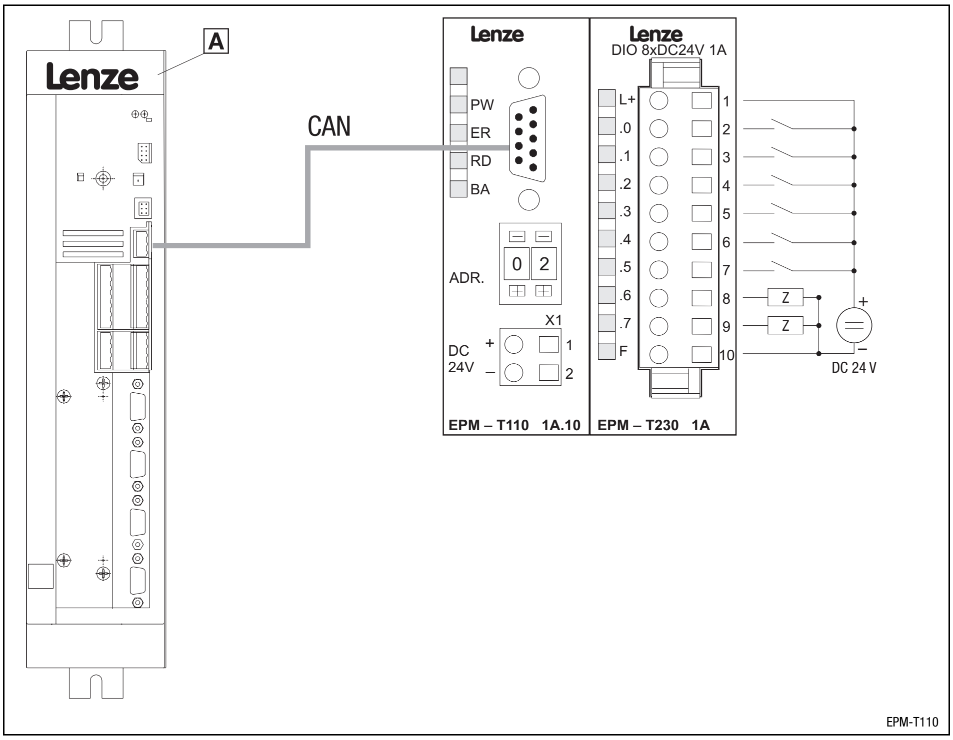


Fig. 11.1-1 9300 drive controller and I/O system IP20 with 6 digital inputs and 2 digital outputs

A Drive controller 93XX

Settings at the controller

Please also note relevant information on the controller in the System Manual!

Setting sequence:

1. Set CAN bus node address to value 1 (C0350 = 1).
2. Address for CAN3-IN and CAN3-OUT to be defined by C0350 (C0353/3 = 0).
3. Set CAN bus baud rate to 500 kbits/s (C0351 = 0).
4. Set CAN bus master operation (C0352 = 1).
5. Set cycle time for cyclical process data transfers (C0356/3 > 0).
6. Switch process output words in CAN3-OUT to digital output signals (C0864/3 = 1).
7. Save set parameters (C0003 = 1).
8. Trigger CAN Reset Node (C0358 = 1).

Note!

When using an 8200 vector frequency inverter, make sure to set the process data channel CAN-I/O from sync-controlled to event-controlled transmission (C0360 = 0) .

The modified settings will be accepted after a ”Reset Node” (C0358 = 1).

Settings at the I/O system IP20

If you use the communication profile system bus (CAN)

Setting of the baud rate and node address:

System bus (CAN)	**Baud rate**
Coding switch value	[kbit/s]
90	1000
91	**500**
92	250
93	125
94	100
95	50
96	20
97	10
98	800

Bold print = Lenze setting

1. Switch the CAN gateway module voltage supply off.
2. Use the coding switch to set the required baud rate.
   – Select value 91.
3. Switch the CAN gateway module voltage supply on.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.
5. Now set the node address 2 with the coding switch.
6. The set node address will be accepted after 5 seconds.
   – The LED RD goes off.
   – The CAN gateway module changes to Pre-Operational status.

Note!

The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.

When using the communication profile CANopen

1. Adapt the basic identifiers for the process data object 1.
   – Set PDO1-Rx via index 1400_h, and subindex 1 to 770.
   – Set PDO1-Tx via index 1800_h, and subindex 1 to 769.
2. Make a "reset node" by setting the index $I2358_h$ = 1. The settings are accepted.

Setting of the baud rate and node address:

CANopen	Baud rate
Coding switch value	[kbit/s]
80	1000
81	**500**
82	250
83	125
84	100
85	50
86	20
87	10
88	800

Bold print = Lenze setting

1. Switch the CAN gateway module voltage supply off.
2. Use the coding switch to set the required baud rate.
   – Select value 91.
3. Switch the CAN gateway module voltage supply on.
   – The LEDs ER, RD and BA are blinking with a frequency of 1 Hz.
4. LEDs ER and BA go off after 5 seconds, and the set baud rate is stored.
5. Now set the node address 2 with the coding switch.
6. The set node address will be accepted after 5 seconds.
   – LED RD goes off.
   – The CAN gateway module changes to Pre-Operational status.

Note!

The node address can be changed any time with the coding switch. The setting is accepted after switching on the supply voltage.

11.2 PROFIBUS-DP

11.2.1 Before switching on

Prior to supply voltage connection, check

- the wiring for completeness, short circuits and earth faults
- the wiring of the fieldbus
  - A bus terminating resistor has to be connected to the first and the last node.
- spatial cable separation from signalling and mains cables.

Note!

After connecting the supply voltage, the modules of the I/O system IP20 are initialised. During the initialisation, the modules cannot be parameterised.

- Initialisation time: approx. 10 s

11.2.2 Initialisation

After the supply voltage has been connected, the initialisation of PROFIBUS Gateway or PROFIBUS GatewayECO starts:

- The internal functions of the module and the communication via the backplane bus are checked.
- If communication faults occur on the backplane bus, the module changes into the "STOP" state. After approx. 2 seconds, the initialisation is started again.

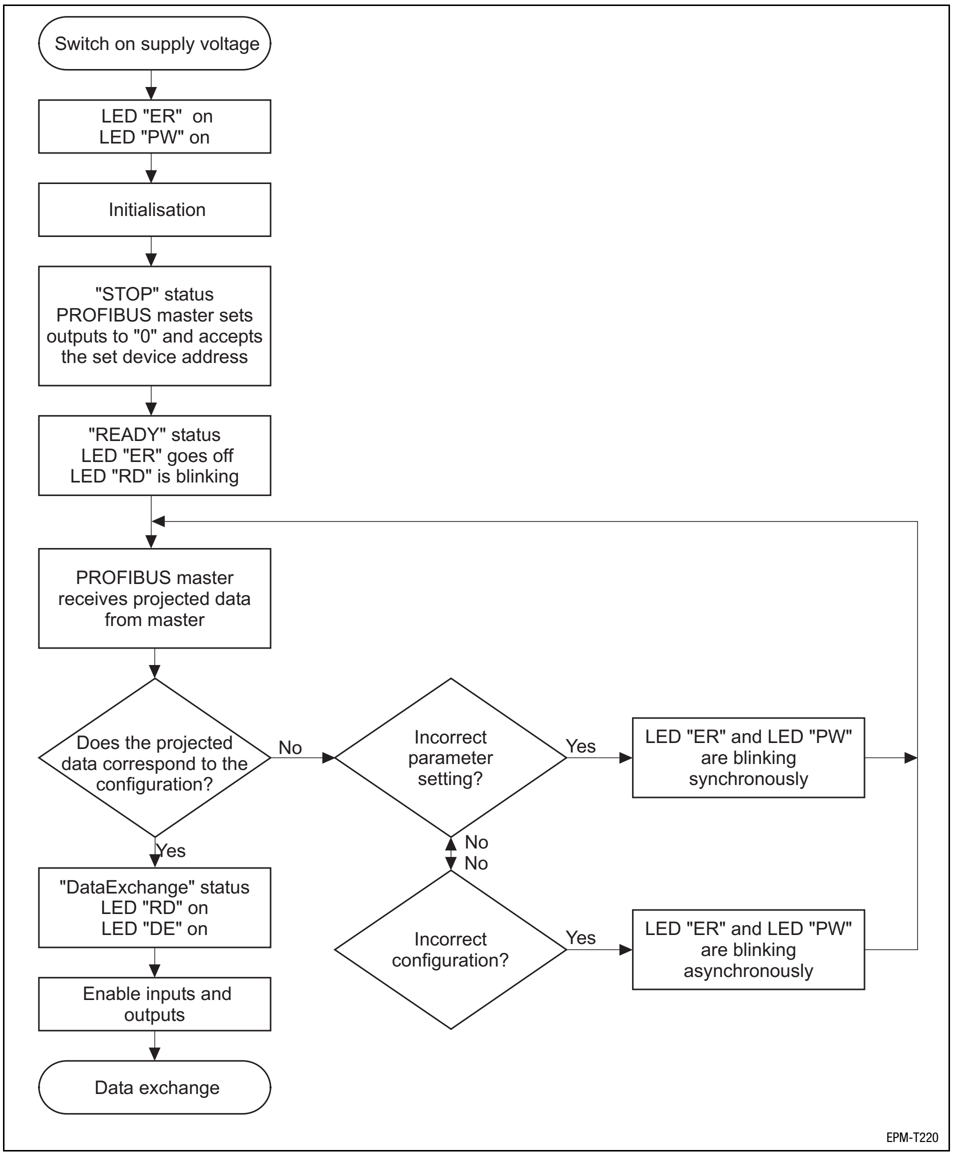


Fig. 11.2-1 Initialisation process

12 Parameter setting via system bus (CAN) / CANopen

Contents

Contents

12.1 Important notes

If you use the I/O system IP20 in connection with a CoDeSys-PLC, you must set the CANopen mode. This pre-assigns the identifiers according to the CANopen communication profile DS301.

12.2 Parameterising digital modules

12.2.1 Parameter data

8xdigital input module
8xdigital output module
8xdigital input/output module
16xdigital input module
16xdigital output module

Via the parameter data of the digital modules it can be defined how the control signals are to be transmitted: with original polarity or inverse polarity.

1 byte (8x module) or 2 bytes (16x modules) are available for parameter data, which are assigned via SDOs.

- Digital inputs are parameterised via the index I6002$_h$.
- Digital outputs are parameterised via the index I6202$_h$.

The subindex depends on the plug-in station (max. 32 digital modules).

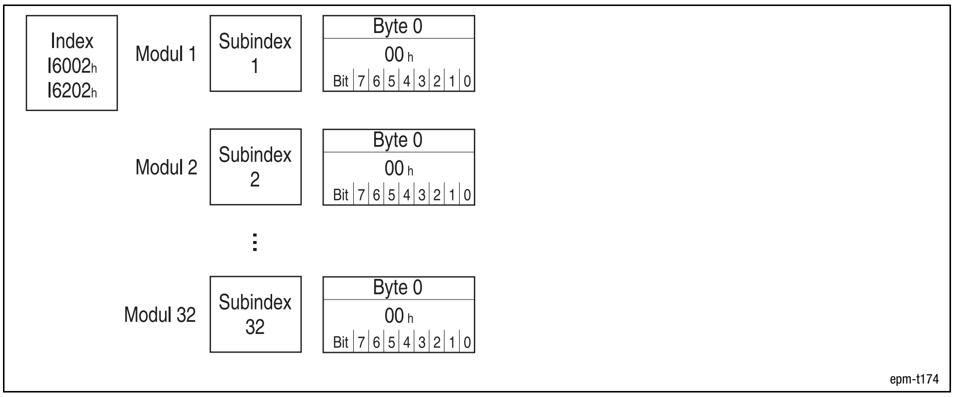


Fig. 12.2-1 Display of the parameter data "digital module"

Byte	Assignment				Lenze setting
0	Polarity of the transmitted signals	Bit 0	0	Signal is transmitted in original form	00$_h$
			1	Signal is transmitted in inverse form	
		Bits 1 ... 7		Reserve	

Note!

Store changed parameters in the EEPROM via index I2003$_h$. The settings are maintained after switching off the supply voltage.

12.3 Parameterising analog modules

12.3.1 Parameter data

Stop!

The modules are **not** protected against wrong parameter settings by the hardware. They will be destroyed if the signals or encoders connected do not match the measuring range set:

- Max. 15 V input voltage in the voltage measuring range.
- No input voltage in the resistance measuring range.
- When the measuring range is changed, only assign the inputs after the first gateway initialisation has been completed:
  - During initialisation, the previous settings are still active. Unsuitable input circuits may destroy the modules. Changes will only become effective and are permanently saved after initialisation.

4xanalog input module

For the 4xanalog input, 10 bytes of parameter data are available which are assigned via SDOs. The following can be defined via the parameter data:

- The signal function for each input (current measurement, voltage measurement, temperature measurement etc.),
- The module error behaviour,
- The conversion speed.

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the module is activated via the indices $I3001_h$ ... $I3010_h$ (max. 16 analog modules). The parameter data are assigned in the subindex 1 ... 3.

Parameter setting via CoDeSys:

The max. 16 analog modules are addressed via index $I3401_h$. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The module 4xanalog input assigns 3 subindices.

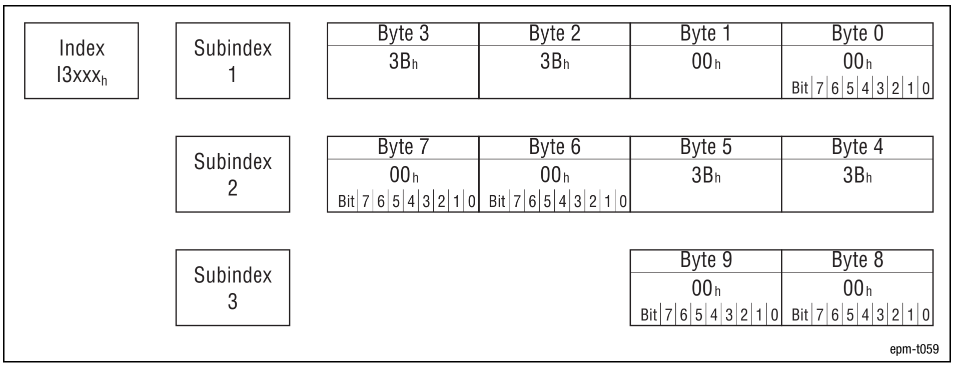


Fig. 12.3-1 Display of the parameter data 4xanalog input

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment		Lenze setting
0	Enable / inhibit diagnostic alarm [1) 3)]	Bits 0 ... 5 Reserved Bit 6 0 Alarm inhibited / 1 Alarm enabled (12.3-6) Bit 7 Reserved	00_h
1	Reserved		
2	Select signal function for input E.0	Selecting the signal function for analog inputs: 12.3-8	3Bh
3	Select signal function for input E.1		3Bh
4	Select signal function for input E.2		3Bh
5	Select signal function for input E.3		3Bh
6	Select options for input E.0 [3)]	Bits 0 ... 3 Conversion speed [2)] / Resolution 0000 15 conversions/s 16 bits 0001 30 conversions/s 16 bits 0010 60 conversions/s 15 bits 0011 123 conversions/s 14 bits 0100 168 conversions/s 12 bits 0101 202 conversions/s 10 bits 0110 3.7 conversions/s 16 bits 0111 7.5 conversions/s 16 bits Bits 4 ... 5 Data selection 00 Deactivated 01 Use 2 of 3 values 10 Use 4 of 6 values Bits 6 ... 7 Hysteresis 00 Deactivated 01 Hysteresis ±8 10 Hysteresis ±16	00_h
7	Select options for input E.1 [3)]		00_h
8	Select options for input E.2 [3)]		00_h
9	Select options for input E.3 [3)]		00_h

1) If the diagnostic alarm is enabled in byte 0, diagnostic data are transmitted to the master via the emergency telegram in the event of an error.

2) The conversion speeds given are valid for the operation of an analog input. When operating several inputs, the corresponding convervion speed must be divided by the number of active inputs to detect the conversion speed per input.
Please note that the resolution is reduced with higher conversion speeds due to shorter integration times. The data transfer format remains the same. Only the lower bits (LSBs) are not relevant anymore for the analog value.

3) The function is not available for the modules 4xanalog input ±10V and 4xanalog input ±20mA.

4xanalog output modules

For the 4xanalog output, 6 bytes of parameter data are available which are assigned via SDOs. The following can be defined via the parameter data:

- The signal function for each output (current signal output, voltage signal output),
- The module error behaviour.

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the module is activated via the indices $I3001_h$ ... $I3010_h$ (max. 16 analog modules). The parameter data are assigned in the subindex 1 ... 2.

Parameter setting via CoDeSys:

The max. 16 analog modules are addressed via index $I3401_h$. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The module 4xAnalog output assigns 2 subindices.

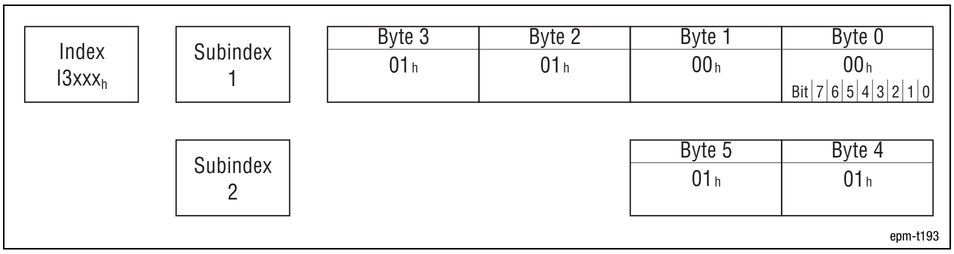


Fig. 12.3-2 Display of the parameter data 4xanalog output

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment		Lenze setting
0	Enabling / inhibiting diagnostic alarm [1) 2)]	Bits 0 ... 5: Reserved Bit 6: 0 Alarm inhibited; 1 Alarm enabled (📖 12.3-6) Bit 7: Reserved	00_h
1	reserved		
2	Select signal function for output E.0	Selecting the signal function for analog outputs: 📖 12.3-13	01_h
3	Select signal function for output E.1		01_h
4	Select signal function for output E.2		01_h
5	Select signal function for output E.3		01_h

1) If the diagnostic alarm is enabled, diagnostic data are transmitted to the master via the emergency telegram in the event of an error.

2) The function is not available for the modules 4xanalog output ±10V and 4xanalog output 0...20mA.

4xanalog input/output module

For the 4xanalog input/output, up to 8 bytes of parameter data are available which are assigned via SDOs. The following can be defined via the parameter data:

- The signal function for each input or output (current measurement, voltage measurement, temperature measurement, or current signal output, voltage signal output),
- The module error behaviour,
- The conversion speed.

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the module is activated via the indices $I3001_h$ ... $I3010_h$ (max. 16 analog modules). The parameter data are assigned in the subindex 1 ... 3.

Parameter setting via CoDeSys:

The max. 16 analog modules are addressed via index $I3401_h$. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The module 4xanalog input/output assigns 3 subindices.

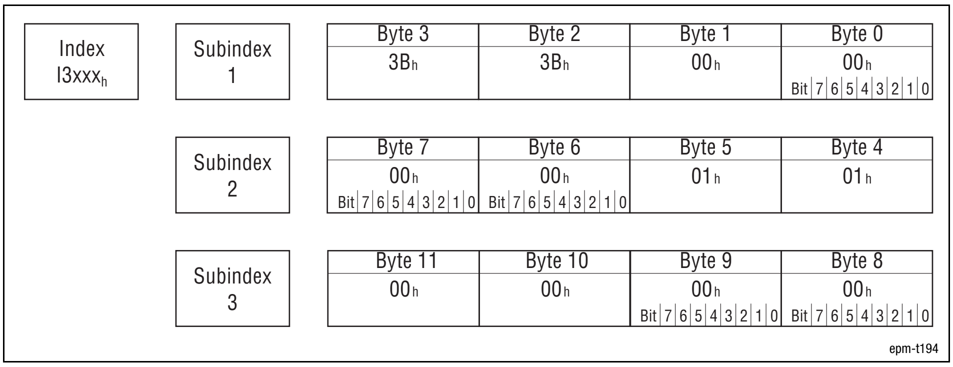


Fig. 12.3-3 Display of the parameter data 4xanalog input /output

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment	Bits	Value	Meaning		Lenze setting
0	Activate / deactivate wire breakage detection and enabling/inhibiting diagnostic alarm [1] [2]	Bit 0	Wire breakage detection for input E.0			00_h
			0	Deactivated	🕮 12.3-6	
			1	activated		
		Bit 1	Wire breakage detection for input E.1			
			0	Deactivated	🕮 12.3-6	
			1	activated		
		Bits 2 ... 5	Reserved			
		Bit 6	0	Diagnostic alarm inhibited	🕮 12.3-6	
			1	Diagnostic alarm enabled		
1	reserved	Bits 0 ... 7	Reserved			
2	Select signal function for input E.0	Selection of signal function 🕮 12.3-18				3Bh
3	Select signal function for input E.1					
4	Select signal function for output E.0					01_h
5	Select signal function for output E.1					
6	Select options for input E.0	Bits 0 ... 3	Conversion speed [3]		Resolution	00_h
7	Select options for input E.1		0000	15 conversions/s	16 Bit	00_h
			0001	30 conversions/s	16 Bit	
			0010	60 conversions/s	15 Bit	
			0011	123 conversions/s	14 Bit	
			0100	168 conversions/s	12 Bit	
			0101	202 conversions/s	10 Bit	
			0110	3.7 conversions/s	16 Bit	
			0111	7.5 conversions/s	16 Bit	
		Bits 4 ... 7	Reserved			
8...11	Reserved					

1) The wire breakage detection is used in the measuring range 4 ... 20 mA. If the wire breakage detection is activated in byte 0 and the diagnostic alarm is enabled, a current reduction to below 0.8 mA is indicated.

2) If the diagnostic alarm is enabled in byte 0, diagnostic data are transmitted to the master via the emergency telegram in the event of an error.

3) The conversion speeds given are valid for the operation of an analog input. When operating several inputs, divide the corresponding conversation speed by the number of active inputs to detect the conversion speed per input. Please note that the resolution is reduced with higher conversion speeds due to shorter integration times. The data transfer format remains the same. Only the lower bits (LSBs) are not relevant anymore for the analog value.

12.3.2 Diagnostic data

If the diagnostic alarm is activated in byte 0 of the parameter data, the diagnostic data in the emergency telegram are transmitted to the master (see chapter ”Diagnostics”, section ”Emergency telegram”).

4xanalog input module
4xanalog output module

The following bytes are available for diagnostic data:

Byte	Assignment			
0	Bit 0	Module monitoring		
		0	No fault	
		1	Module fault	
	Bit 1	Consistently at 0		
	Bit 2	External error		
		0	No error	
		1	External error	
	Bit 3	Error at inputs and / or outputs, respectively		
		0	No error	
		1	Error at at least one input and / or output, respectively	
	Bits 4 ... 7	Reserved		
1	Bits 0 ... 3	Module type		
		0101	Analog module	
	Bit 4	Information on inputs and / or outputs, respectively		
		0	No information available	
		1	Information available	
2	Reserved			
3	Reserved			

4xanalog input/output module

The following bytes with fixed assignment are available for diagnostic data:

Byte	Assignment			
0	Bit 0	Module monitoring		
		0	No fault	
		1	Module fault	
	Bit 1	Reserved		
	Bit 2	External error		
		0	No error	
		1	External error	
	Bit 3	Error at inputs and / or outputs, respectively		
		0	No error	
		1	Error at at least one input and / or output, respectively	
	Bit 4	Supply error		
		0	No error	
		1	No external supply voltage	
	Bits 5 ... 6	Reserved		
	Bit 7	Wrong parameters		
		0	No error	
		1	Wrong parameters in the module	
1	Bits 0 ... 3	Module type		
		0101	Analog module	
	Bit 4	Information on inputs and / or outputs, respectively		
		0	No information available	
		1	Information available	
2	Reserved			
3	Reserved			

12.3.3 Input data / output data

Two bytes (LOW byte, HIGH byte) are available for input and output data, which are assigned and read via PDOs.

Byte	S7 format	S5 format
LOW byte	Bits 0 ... 7 Binary signal value	Bit 0 Overflow bit 0 Value within signal range 1 Signal range exceeded Bit 1 Error bit 0 No error 1 Internal fault Bit 2 Activity bit (always 0) Bits 3 ... 7 Binary signal value
HIGH byte	Bits 0 ... 6 Binary signal value Bit 7 Polarity bit 0 Positive polarity 1 Negative polarity	Bits 0 ... 6 Binary signal value Bit 7 Polarity bit 0 Positive polarity 1 Negative polarity

12.3.4 Converting measured values for voltage and current

Signal range	Signal [U] / [I]	S7 format			S5 format		
		Decimal value [dec]	Hexadecimal value [h]	Formulae for calculation	Decimal value [dec]	Hexadecimal value [h]	Formulae for calculation
±10 V	-10 V	-27648	9400	$dec = 27648 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{27648}$	-16384	C000	$dec = 16348 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16348}$
	-5 V	-13824	CA00		-8192	E000	
	0 V	0	0000		0	0000	
	+5 V	+13824	3600		+8192	2000	
	+10 V	+27648	6C00		+16384	4000	
0 ... 10 V	0 V	0	0000	$dec = 16384 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16384}$	0	0000	$dec = 16384 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16384}$
	+5 V	+8192	2000		+8192	2000	
	+10 V	+16384	4000		+16384	4000	
1 ... 5 V	+1 V	—	—		0	0000	$dec = 27648 \cdot \frac{U-1}{4}$ $U = dec \cdot \frac{4}{16384} + 1$
	+3 V				+8192	2000	
	+5 V				+16384	4000	
±4 V	-4 V	-27648	9400	$dec = 27648 \cdot \frac{U}{4}$ $U = dec \cdot \frac{4}{27648}$	—	—	
	0 V	0	0000				
	+4 V	+27648	6C00				
±400 mV	-400 mV	-27648	9400	$dec = 27648 \cdot \frac{U}{400}$ $U = dec \cdot \frac{400}{27648}$	—	—	
	0 V	0	0000				
	+400 mV	+27648	6C00				
4 ... 20 mA	+4 mA	0	0000	$dec = 27648 \cdot \frac{I-4}{16}$ $U = dec \cdot \frac{16}{27648} + 1$	0	0000	$dec = 16384 \cdot \frac{I-4}{16}$ $U = dec \cdot \frac{16}{16384} + 1$
	+12 mA	+13824	3600		+8192	2000	
	+20 mA	+27648	6C00		+16384	4000	
±20 mA	-20 mA	-27648	9400	$dec = 27648 \cdot \frac{I}{20}$ $U = dec \cdot \frac{20}{27648}$	-16384	C000	$dec = 16384 \cdot \frac{I}{20}$ $U = dec \cdot \frac{20}{16384}$
	-10 mA	-13824	CA00		-8192	E000	
	0 mA	0	0000		0	0000	
	+10 mA	+13824	3600		+8192	2000	
	+20 mA	+27648	6C00		+16384	4000	

12.3.5 Signal functions of 4xanalog input

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:

Measuring task: Temperature measurement with signal function 01_h. Measured value = 80.5 °C.

1. I/O system IP20 converts the measured value into an integer:
   80.5 [°C] × 10 = 805
2. Reconvert the measured value to output it with decimal positions:
   $\frac{805\,[°C]}{10} = 80.5\,°C$

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance [2]
00_h	Parameter data in module are not overwritten						
01_h	Temperature measurement with two-wire connection	PT100	-200.0	{0.1 °C}	+850.0	S7 Two's complement	±1 °C [3]
02_h		PT1000	-200.0	{0.1 °C}	+500.0		
03_h		NI100	-50.0	{0.1 °C}	+250.0		
04_h		NI1000	-50.0	{0.1 °C}	+250.0		
05_h	Resistance measurement with two-wire connection	60 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+60.00 32767	S7	±0.2 % of the final value [3]
06_h		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 32767		
07_h		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 32767		
08_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 32767		
09_h	Temperature measurement with four-wire connection	PT100	-200.0	{0.1 °C}	+850.0	S7 Two's complement	±0.5 °C
$0A_h$		PT1000	-200.0	{0.1 °C}	+500.0		
$0B_h$		NI100	-50.0	{0.1 °C}	+250.0		
$0C_h$		NI1000	-50.0	{0.1 °C}	+250.0		
$0D_h$	Resistance measurement with four-wire connection	60 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+60.00 32767_{dec}	S7	±0.1 % of the final value
$0E_h$		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 32767_{dec}	S7	±0.05 % of the final value
$0F_h$		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 32767_{dec}	S7	±0.05 % of the final value
10_h	Temperature measurement with thermoelement and external compensation[4]	Type J	-210.0	{0.1 °C}	+850.0	S7 Two's complement	±1 °C
11_h		Type K	-270.0	{0.1 °C}	+1200.0		±1.5 °C
12_h		Type N	-200.0	{0.1 °C}	+1300.0		±1.5 °C
13_h		Type R	-50.0	{0.1 °C}	+1760.0		±4 °C
14_h		Type T	-270.0	{0.1 °C}	+400.0		±1.5 °C
15_h		Type S	-50.0	{0.1 °C}	+1760.0		±5 °C

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance [2]
18_h	Temperature measurement with thermoelement and internal compensation [5]	Type J	-210.0	{0.1 °C}	+850.0	S7 Two's complement	±1.5 °C
19_h		Type K	-270.0	{0.1 °C}	+1200.0		±2 °C
$1A_h$		Type N	-200.0	{0.1 °C}	+1300.0		±2 °C
1Bh		Type R	-50.0	{0.1 °C}	+1760.0		±5 °C
$1C_h$		Type T	-270.0	{0.1 °C}	+400.0		±2 °C
$1D_h$		Type S	-50.0	{0.1 °C}	+1760.0		±5 °C
27_h	Voltage measurement	0 ... 50 mV	0.00 0 Min. 0.00 0	{0.01 mV} {1_{dec}} Limit values	+50.00 27648 Max. +59.25 mV 32767 $_{dec}$	S7 Two's complement	±0.1 % of the final value
28_h	Voltage measurement	±10 V	-10.00 -27648 Min. -11.85 V -32767 $_{dec}$	{0.01V} {1_{dec}} Limit values	+10.00 27648 Max. +11.85 V 32767 $_{dec}$	S7 Two's complement	±0.05 % of the final value
29_h	Voltage measurement	±4 V	-4.00 -27648 Min. -4.74 V -32767 $_{dec}$	{0.01V} {1_{dec}} Limit values	+4.00 V 27648_{dec} Max. +4.74 V 32767 $_{dec}$	S7 Two's complement	±0.05 % of the final value
$2A_h$	Voltage measurement	±400 mV	-400 -27648 Min. -474 mV -32767 $_{dec}$	{1 mV} {1_{dec}} Limit values	+400 27648 Max. +474 mV 32767 $_{dec}$	S7 Two's complement	±0.1 % of the final value
$2C_h$	Current measurement	±20 mA	-20.00 -27648 Min. -23.70 mA -32767 $_{dec}$	{0.01 mA} {1_{dec}} Limit values	+20.00 27648 Max. +23.70 mA $+32767_{dec}$	S7 Two's complement	±0.05 % of the final value
$2D_h$	Current measurement	4 ... 20 mA	4.00 0 Min. 0 mA -5530_{dec}	{0.01 mA} {1_{dec}} Limit values	20.00 27648 Max. +22.96 mA $+32767_{dec}$	S7 Two's complement	±0.05 % of the final value
32_h	Resistance measurement with four-wire connection	6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 32767 $_{dec}$	S7	±0.05 % of the final value
33_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 6000 $_{dec}$		±0.05 % of the final value
35_h		60 Ω	0.00 0	{0.01 Ω}	+60.00 6000 $_{dec}$		±0.2 % of the final value [3]
36_h		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 6000 $_{dec}$		±0.1 % of the final value [3]
37_h		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 30000 $_{dec}$		±0.1 % of the final value [3]
38_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 6000 $_{dec}$		±0.1 % of the final value [3]

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance [2]
3A$_h$	Current measurement	±20 mA	-20.00 -16384 Min. -23.70 mA -19456$_{dec}$	{0.01 mA} {1$_{dec}$} Limit values	+20.00 16384 Max. +23.70 mA +19456$_{dec}$	S5 Two's complement	±0.05 % of the final value
3Bh	Voltage measurement	±10 V	-10.00 -16384 Min. -12.50 V -20480$_{dec}$	{0.01V} {1$_{dec}$} Limit values	+10.00 16384 Max. +12.50 V 20480$_{dec}$	S5 Two's complement	±0.2 % of the final value
3D$_h$	Resistance measurement with four-wire connection	60 Ω	0.00 0	{0.01 Ω} {1$_{dec}$}	+60.00 6000 $_{dec}$	S7	±0.1 % of the final value
3E$_h$		600 Ω	0.00 0	{0.01 Ω} {1$_{dec}$}	+600.00 6000 $_{dec}$		±0.05 % of the final value
3F$_h$		3000 Ω	0.00 0	{0.01 Ω} {1$_{dec}$}	+3000.00 30000 $_{dec}$		±0.05 % of the final value
57$_h$	Voltage measurement	0 ... 50 mV	0.00 0 Min. 0.00 0	{0.01 mV} {1$_{dec}$} Limit values	+50.00 5000 Max. +59.25 V 5925$_{dec}$	S7 Two's complement	±0.1 % of the final value
58$_h$	Voltage measurement	±10 V	-10.00 -10000 Min. -11.85 V -11850$_{dec}$	{0.01V} {1$_{dec}$} Limit values	+10.00 10000 Max. +11.85 V 11850$_{dec}$	S7 Two's complement	±0.05 % of the final value
59$_h$	Voltage measurement	±4 V	-4.00 -4000 Min. -4.74 V -4740$_{dec}$	{0.01V} {1$_{dec}$} Limit values	+4.00 4000 Max. +4.74 V 4740$_{dec}$	S7 Two's complement	±0.05 % of the final value
5A$_h$	Voltage measurement	±400 mV	-400 -4000 Min. -474 mV -4740$_{dec}$	{1 mV} {1$_{dec}$} Limit values	+400 4000 Max. +474 mV 4740$_{dec}$	S7 Two's complement	±0.1 % of the final value
5C$_h$	Current measurement	±20 mA	-20.00 -20000 Min. -23.70 mA -23700$_{dec}$	{0.01 mA} {1$_{dec}$} Limit values	+20.00 20000 Max. +23.70 mA +23700$_{dec}$	S7 Two's complement	±0.05 % of the final value

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1)]	Tolerance [2)]
$5D_h$	Current measurement	4 ... 20 mA	4.00 0	{0.01 mA} $\{1_{dec}\}$	20.00 16000	S7 Two's complement	±0.05 % of the final value
			Min.	Limit values	Max.		
			0 mA -4000_{dec}		+22.96 mA $+18960_{dec}$		
FF_h	Analog input deactivated						

1) Format of the input data (📖 12.3-7).

2) Tolerance of the input range at an ambient temperature of 25 °C and 15 conversions/s. Sensor inaccuracies were not considered.

3) Transition resistances on contacts and cable resistances were not taken into consideration.

4) Cold spot compensation must be effected externally.

5) The cold spot must be compensated internally. The temperature of the terminal is taken into consideration. Connect the conductors of the thermoelements directly to the terminal; if necessary, operate with thermoelement extension cables.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: $3B_h$

12.3.6 Signal functions of 4xanalog input ±10

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:
Measuring task: Voltage measurement with signal function 28_h. Measured value = 8.5 V.

1. I/O system IP20 converts the measured value into an integer:
   $8.5\ [V] \times 10 = 85$

2. Reconvert the measured value to output it with decimal positions:
   $$\frac{85\ [V]}{10} = 8.5\ V$$

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1)]	Tolerance
00_h	Parameter data in module are not overwritten						
28_h	Voltage measurement	±10 V	-10.00 -27648	{0.01V} $\{1_{dec}\}$	+10.00 27648	S7 Two's complement	±0.1 % [2)] ±0.2 % [3)]
			Min.	Limit values	Max.		
			-11.76 V -32512_{dec}		+11.76 V 32511_{dec}		

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1)]	Tolerance
3Bh	Voltage measurement	±10 V	-10.00 {0.01V} +10.00 -16384 $\{1_{dec}\}$ 16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} 20480_{dec}	S5 Two's complement	±0.1 % [2)] ±0.2 % [3)]
FF_h	Analog input deactivated				

1) Format of the input data (📖 12.3-7).

2) Tolerance of the input range at an ambient temperature of 25 °C.

3) Tolerance of the input range across the entire admissible temperature range.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: $3B_h$

12.3.7 Signal functions 4xanalog input ±20mA

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:

Measuring task: Current measurement with signal function $2C_h$. Measured value = 15.5 mA.

1. I/O system IP20 converts the measured value into an integer:
   15.5 [V] × 10 = 155
2. Reconvert the measured value to output it with decimal positions:
   $\frac{155\,[\text{mA}]}{10} = 15.5\text{ mA}$

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1)]	Tolerance
00_h	Parameter data in module are not overwritten				
$2C_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -27648 $\{1_{dec}\}$ 27648 Min. Limit values Max. -23.52 mA +23.52 mA -32512_{dec} $+32511_{dec}$	S7 Two's complement	±0.1 % [2)] ±0.2 % [3)]
$2D_h$	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 $\{1_{dec}\}$ 27648 Min. Limit values Max. 1.185 mA +22.81 mA -4864_{dec} $+32511_{dec}$	S7 Two's complement	±0.2 % [2)] ±0.5 % [3)]

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1]	Tolerance
39_h	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 $\{1_{dec}\}$ 16384 Min. Limit values Max. 0.8 mA +24.00 mA -3277_{dec} $+20480_{dec}$	S5 Two's complement	±0.2 % [2] ±0.5 % [3]
$3A_h$ 3Bh	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -16384 $\{1_{dec}\}$ 16384 Min. Limit values Max. -25.00 mA +25.00 mA -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.1 % [2] ±0.2 % [3]
FF_h	Analog input deactivated				

[1] Format of the input data (📖 12.3-7).

[2] Tolerance of the input range at an ambient temperature of 25 °C.

[3] Tolerance of the input range across the entire admissible temperature range.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: $3A_h$

12.3.8 Signal functions of 4xanalog output

Note!

In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1]	Tolerance
00_h	No signal emitted at output				
01_h	Voltage signal output	±10 V	-10.00 {0.01V} +10.00 -16384 $\{1_{dec}\}$ 16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} 20480_{dec}	S5 Two's complement	±0.2 % [2] [3]
02_h	Voltage signal output	+1 ... +5 V	1.0 {0.1V} +5.0 0 $\{1_{dec}\}$ 16384 Min. Limit values Max. 0.0 +6.0 V -4096_{dec} 20480_{dec}	S5 Two's complement	±0.4 % [2] [3]
05_h	Voltage signal output	0... +10 V	0.0 {0.1V} +10.0 0 $\{1_{dec}\}$ 16384 Min. Limit values Max. 0.0 +12.5 V 0 20480_{dec}	S5 Two's complement	±0.3 % [2] [3]

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
09_h	Voltage signal output	±10 V	-10.00 -27648 Min. -11.76 V -32512_{dec}	{0.01V} {1_{dec}} Limit values	+10.00 V 27648_{dec} Max. +11.76 V 32511_{dec}	S7 Two's complement	±0.2 % [2) 3)]
$0A_h$	Voltage signal output	+1 ... +5 V	1.00 0 Min. 0 V -6912_{dec}	{0.01V} {1_{dec}} Limit values	+5.00 27648 Max. +5.704 V 32511_{dec}	S7 Two's complement	±0.4 % [2) 3)]
$0D_h$	Voltage signal output	0... +10 V	0.00 0 Min. 0.00 0	{0.01V} {1_{dec}} Limit values	+10.00 27648 Max. +11.76 V 32511_{dec}	S7 Two's complement	±0.3 % [2) 3)]
03_h	Current signal output	±20 mA	-20.00 -16384 Min. -25.00 mA -20480_{dec}	{0.01 mA} {1_{dec}} Limit values	+20.00 16384 Max. +25.00 mA $+20480_{dec}$	S5 Two's complement	±0.2 % [2) 4)]
04_h	Current signal output	4 ... 20 mA	4.00 0 Min. 0.00 -4096_{dec}	{0.01 mA} {1_{dec}} Limit values	20.00 16384 Max. +24.00 mA $+20480_{dec}$	S5 Two's complement	±0.5 % [2) 4)]
06_h	Current signal output	0 ... 20 mA	0.00 0 Min. 0.00 0	{0.01 mA} {1_{dec}} Limit values	+20.00 16384 Max. +25.00 mA $+20480_{dec}$	S5 Two's complement	±0.4 % [2) 4)]
0Bh	Current signal output	±20 mA	-20.00 -27648 Min. -23.52 mA -32512_{dec}	{0.01 mA} {1_{dec}} Limit values	+20.00 27648 Max. +23.52 mA $+32511_{dec}$	S7 Two's complement	±0.2 % [2) 4)]
$0C_h$	Current signal output	4 ... 20 mA	4.00 0 Min. 0.00 -6912_{dec}	{0.01 mA} {1_{dec}} Limit values	20.00 27648 Max. +22.81 mA $+32511_{dec}$	S7 Two's complement	±0.5 % [2) 4)]

Parameter bytes 2/3/4/5	Signal function		Signal range			Format 1)	Tolerance
$0E_h$	Current signal output	0 ... 20 mA	0.00 0	{0.01 mA} $\{1_{dec}\}$	20.00 27648	S7 Two's complement	±0.4 % 2) 4)
$0E_h$	Current signal output	0 ... 20 mA	Min. 0.00 0	Limit values	Max. +23.52 mA $+32511_{dec}$	S7 Two's complement	±0.4 % 2) 4)
FF_h	Analog output is switched off						

1) Format of the output data (🕮 12.3-7).

2) Tolerance of the output range at an ambient temperature of 25 °C.

3) The value was determined with a load R = 1 GΩ. The output resistance is 30 Ω.

4) The value was determined with a load R = 10 Ω.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: 01_h

12.3.9 Signal functions of 4xanalog output ±10

Note!

In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
00_h	No signal emitted at output						
01_h	Voltage signal output	±10 V	-10.00 -16384	{0.01V} {1_{dec}}	+10.00 16384	S5 Two's complement	±0.1 % [2] ±0.2 % [3]
			Min.	Limit values	Max.		
			-12.50 V -20480_{dec}		+12.50 V 20480_{dec}		
05_h	Voltage signal output	0 ... +10 V	0.0 0	{0.1V} {1_{dec}}	+10.0 16384	S5 Two's complement	±0.2 % [2] ±0.4 % [3]
			Min.	Limit values	Max.		
			0.0 0		+12.5 V 20480_{dec}		
09_h	Voltage signal output	±10 V	-10.00 -27648	{0.01V} {1_{dec}}	+10.00 V 27648_{dec}	S7 Two's complement	±0.1 % [2] ±0.2 % [3]
			Min.	Limit values	Max.		
			-11.76 V -32512_{dec}		+11.76 V 32511_{dec}		
$0D_h$	Voltage signal output	0 ... +10 V	0.0 0	{0.1V} {1_{dec}}	+10.0 27648	S7 Two's complement	±0.2 % [2] ±0.4 % [3]
			Min.	Limit values	Max.		
			0.0 0		+11.76 V 32511_{dec}		
FF_h	Analog output is switched off						

1) Format of the output data (📖 12.3-7).

2) Tolerance of the output range at an ambient temperature of 25 °C.

3) Tolerance of the output range across the entire admissible temperature range.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: 01_h

12.3.10 Signal functions 4xanalog output 0...20mA

Note!

In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1]	Tolerance
00_h	No signal emitted at output				
01_h 06_h	Current signal output	0 ... 20 mA	0.00 {0.01 mA} +20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0.00 +25.00 mA 0 $+20480_{dec}$	S5 Two's complement	±0.2 % [2] ±0.4 % [3]
04_h	Current signal output	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0.00 +24.00 mA -4096_{dec} $+20480_{dec}$	S5 Two's complement	±0.3 % [2] ±0.5 % [3]
$0C_h$	Current signal output	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 0.00 +22.81 mA -6912_{dec} $+32511_{dec}$	S7 Two's complement	±0.3 % [2] ±0.5 % [3]
$0E_h$	Current signal output	0 ... 20 mA	0.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 0.00 +23.52 mA 0 $+32511_{dec}$	S7 Two's complement	±0.2 % [2] ±0.4 % [3]
FF_h	Analog output is switched off				

1) Format of the output data (📖 12.3-7).

2) Tolerance of the output range at an ambient temperature of 25 °C.

3) Tolerance of the output range across the entire admissible temperature range.

Lenze setting of the signal function in parameter bytes 2 and 3 or 4 and 5: 06_h

12.3.11 Signal functions of 4xanalog input /output

Note!
- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:

Measuring task: Temperature measurement with signal function 01_h. Measured value = 80.5 °C.

1. I/O system IP20 converts the measured value into an integer:
   80.5 [°C] × 10 = 805
2. Reconvert the measured value to output it with decimal positions:
   $\frac{805\ [°C]}{10} = 80.5\ °C$

Input functions

Parameter bytes 2/3	Signal function		Signal range			Format 1)	Tolerance 2)
00_h	Parameter data in module are not overwritten						
3Bh	Voltage measurement	±10 V	-10.00 -16384	{0.01V} $\{1_{dec}\}$	+10.00 +16384	S5 Two's complement	±0.2 %
			Min.	Limit values	Max.		
			-12.50 V -20480_{dec}		+12.50 V $+20480_{dec}$		
75_h	Voltage measurement	0 ... 10 V	0.00 0	{0.01V} $\{1_{dec}\}$	+10.00 +16384	S5 Two's complement	±0.4 %
			Min.	Limit values	Max.		
			0.00 0		+12.50 V $+20480_{dec}$		
28_h	Voltage measurement	±10 V	-10.00 -27648	{0.01V} $\{1_{dec}\}$	+10.00 +27648	S7 Two's complement	±0.2 %
			Min.	Limit values	Max.		
			-11.76 V -32512_{dec}		+11.76 V $+32511_{dec}$		
$7A_h$	Voltage measurement	1 ... 5 V	+1.00 0	{0.01V} $\{1_{dec}\}$	+5.00 +27648	S7 Two's complement	±0.6 %
			Min.	Limit values	Max.		
			0.00 -6912_{dec}		+5.704 V $+32511_{dec}$		

Parameter bytes 2/3	Signal function		Signal range	Format [1]	Tolerance [2]
$7D_h$	Voltage measurement	0 ... 10 V	0.00 {0.01V} +10.00 0 $\{1_{dec}\}$ +27648 Min. / Limit values / Max. 0.00 +11.76 V 0 $+32511_{dec}$	S7 Two's complement	±0.4 %
$3A_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -16384 $\{1_{dec}\}$ +16384 Min. / Limit values / Max. -25.00 mA +25.00 mA -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.3 %
76_h	Current measurement	0 ... 20 mA	0.00 {0.01 mA} +20.00 0 $\{1_{dec}\}$ +16384 Min. / Limit values / Max. 0.00 +25.00 mA 0 $+20480_{dec}$	S5 Two's complement	±0.6 %
$2C_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -27648 $\{1_{dec}\}$ +27648 Min. / Limit values / Max. -23.51 mA +23.51 mA -32512_{dec} $+32511_{dec}$	S7 Two's complement	±0.3 %
$2D_h$	Current measurement	4 ... 20 mA	+4.00 {0.01 mA} +20.00 0 $\{1_{dec}\}$ +27648 Min. / Limit values / Max. +1.18 mA +22.81 mA -4864_{dec} $+32511_{dec}$	S7 Two's complement	±0.8 %
$7E_h$	Current measurement	0 ... 20 mA	0.00 {0.01 mA} +20.00 0 $\{1_{dec}\}$ +27648 Min. / Limit values / Max. 0.00 +23.52 mA 0 $+32511_{dec}$	S7 Two's complement	±0.6 %
FF_h	Analog input deactivated				

1) Format of the input data (📖 12.3-7).

2) Tolerance of the input range at an ambient temperature of 25 °C. Sensor inaccuracies were not considered.

Lenze setting of the signal function in parameter bytes 2 and 3: $3B_h$

Output functions

Parameter bytes 4/5	Signal function		Signal range	Format [1)]	Tolerance [2)]
00_h	Parameter data in module are not overwritten				
01_h	Voltage signal output	±10 V	-10.00 {0.01V} +10.00 -16384 $\{1_{dec}\}$ +16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.2 %
02_h	Voltage signal output	1 ... 5 V	+1.00 {0.01V} +5.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. 0.00 +6.00 V -4096_{dec} $+20480_{dec}$	S5 Two's complement	±0.6 %
05_h	Voltage signal output	0 ... 10 V	0.00 {0.01V} +10.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. 0.00 +12.50 V 0 $+20480_{dec}$	S5 Two's complement	±0.4 %
09_h	Voltage signal output	±10 V	-10.00 {0.01V} +10.00 -27648 $\{1_{dec}\}$ +27648 Min. Limit values Max. -11.76 V +11.76 V -32512_{dec} $+32511_{dec}$	S7 Two's complement	±0.2 %
$0A_h$	Voltage signal output	1 ... 5 V	+1.00 {0.01V} +5.00 0 $\{1_{dec}\}$ +27648 Min. Limit values Max. 0.00 +5.704 V -6912_{dec} $+32511_{dec}$	S7 Two's complement	±0.6 %
$0D_h$	Voltage signal output	0 ... 10 V	0.00 {0.01V} +10.00 0 $\{1_{dec}\}$ +27648 Min. Limit values Max. 0.00 +11.76 V 0 $+32511_{dec}$	S7 Two's complement	±0.4 %
03_h	Current signal output	±20 mA	-20.00 {0.01 mA} +20.00 -16384 $\{1_{dec}\}$ +16384 Min. Limit values Max. -25.00 mA +25.00 mA -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.3 %
04_h	Current signal output	4 ... 20 mA	+4.00 {0.01 mA} +20.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. +0.00 +24.00 mA -4096_{dec} $+20480_{dec}$	S5 Two's complement	±0.8 %

Parameter bytes 4/5	Signal function		Signal range			Format [1]	Tolerance [2]
06_h	Current signal output	0 ... 20 mA	0.00 0	{0.01 mA} {1_{dec}}	+20.00 +16384	S5 Two's complement	±0.6 %
			Min. 0.00 0	Limit values	Max. +25.00 mA $+20480_{dec}$		
0Bh	Current signal output	±20 mA	-20.00 -27648	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.3 %
			Min. -23.52 mA -32512_{dec}	Limit values	Max. +23.52 mA $+32511_{dec}$		
$0C_h$	Current signal output	4 ... 20 mA	+4.00 0	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.8 %
			Min. 0.00 -6912_{dec}	Limit values	Max. +22.81 mA $+32511_{dec}$		
$0E_h$	Current signal output	0 ... 20 mA	0.00 0	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.6 %
			Min. 0.00 0	Limit values	Max. +23.52 mA $+32511_{dec}$		
FF_h	Analog output is switched off						

1) Format of the output data (12.3-7).

2) Tolerance of the output range at an ambient temperature of 25 °C.

Lenze setting of the signal function in parameter bytes 4 and 5: 01_h

12.4 Parameterising 2/4xcounter module

12.4.1 Parameter data

The operating mode of the 2/4xcounter (e.g. 2 x 32-bit counter or 4 x 16-bit counter) can be determined by assigning each channel (counter 0 and counter 1) a mode via the parameter data.

Stop!

Depending on the mode setting, the terminal assignment of the counter module changes!

For the 2/4xcounter two bytes of parameter data are available which are assigned via SDOs.

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the counter module is parameterised via the indices 3001_h ... 3010_h (max. 4 counter modules). The parameter data are stored in the subindex 1.

Parameter setting via CoDeSys:

The max. 4 counter modules are addressed via index $I3401_h$. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The counter module assigns 1 subindex.

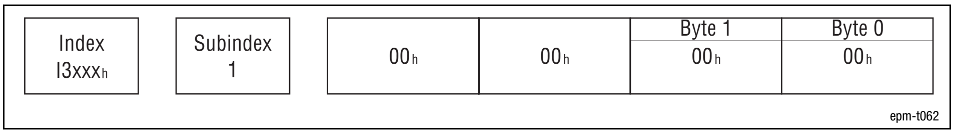


Fig. 12.4-1 Display of the parameter data of 2/4xcounter

The parameter data follow the assignment below:

Byte	Assignment		Lenze setting
0	Mode, counter 0	Selecting the modes	00_h
1	Mode, counter 1		00_h

Note!

Store changed parameters in the EEPROM via index $I2003_h$. The settings are maintained after switching off the supply voltage.

Counter mode overview

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
		2 counters		**0**			**1**					
00_h	0	32-bit counter	RES	CLK	DIR	RES	CLK	DIR	•	•	–	–
01_h	1	Encoder 1 edge	RES	A	B	RES	A	B	•	•	–	–
03_h	3	Encoder 2 edges	RES	A	B	RES	A	B	•	•	–	–
05_h	5	Encoder 4 edges	RES	A	B	RES	A	B	•	•	–	–

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
		4 counters		**0.1**	**0.2**		**1.1**	**1.2**				
08_h	8	2 × 16-bit counters (counting direction up/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
09_h	9	2 × 16-bit counters (counting direction down/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0A_h$	10	2 × 16-bit counters (counting direction up/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0B_h$	11	2 × 16-bit counters (counting direction down/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
		2 counters		**0**			**1**					
$0C_h$	12	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0D_h$	13	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0E_h$	14	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
$0F_h$	15	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
		1 counter				**0/1**						
10_h	16	Frequency measuring	RES	CLK	START	STOP	–	–	•	•	–	✓
11_h	17	Measuring the period	RES	CLK	START	STOP	–	–	•	•	–	✓
12_h	18	Frequency measuring (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓
13_h	19	Measuring the period (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓
		2 counters		**0**			**1**					
06_h	6	Measuring the pulse width (f_{ref} 50 kHz, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
14_h	20	Measuring the pulse width (f_{ref} programmable, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
15_h	21	Measuring the pulse width (f_{ref} programmable, counting direction: Upwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
16_h	22	Measuring the pulse width (f_{ref} programmable, counting direction: Downwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
		2 counters		**0**			**1**					
17_h	23	2 × 32-bit counters (counting direction up, ”Set” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
18_h	24	2 × 32-bit counters (counting direction down, ”Set” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
19_h	25	2 × 32-bit counters (counting direction up, ”Reset” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
$1A_h$	26	2 × 32-bit counters (counting direction down, ”Reset” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓

Parameterising 2/4xcounter module 12.4

Parameter data 12.4.1

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
		2 counters		0			1					
$1B_h$	27	32-bit counter	G/RES⌋	CLK	DIR	G/RES⌋	CLK	DIR	•	•	–	–
$1C_h$	28	Encoder 1 edge	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1D_h$	29	Encoder 2 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1E_h$	30	Encoder 4 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
		2 counters		0			1					
$1F_h$	31	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
20_h	32	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
21_h	33	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
22_h	34	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
		2 counters		0			1					
23_h	35	32-bit counter	GATE	CLK	DIR	GATE	CLK	DIR	•	•	–	–
24_h	36	Encoder 1 edge	GATE	A	B	GATE	A	B	•	•	–	–
25_h	37	Encoder 2 edges	GATE	A	B	GATE	A	B	•	•	–	–
26_h	38	Encoder 4 edges	GATE	A	B	GATE	A	B	•	•	–	–

•	Digital output can signal an event
✓	Function available.
–	No function / function not available
A	Encoder signal A
Auto Reload	”Auto Reload” causes the counter to accept a preset value as soon as the counter content matches the Compare register content.
B	Encoder signal B
Compare Load	You may use ”Compare Load” to specify a counter limit value to trigger an output when reached or to restart the counters via Auto Reload.
CLK	Clock signal of a connected encoder HIGH level starts and / or stops the counting process
DIR	Indicates counting direction depending on signal level LOW: Upcounter HIGH: Downcounter
GATE	Gate signal is level-triggered HIGH: Pulses are measured
G/RES⌋	Gate signal is level-triggered and reset signal is edge-triggered HIGH: Pulses are measured LOW-HIGH edge: Deletes one or both counters
PULSE	The pulse width of the supplied signal is measured with an internal time base
RES	Reset signal is level-triggered HIGH: Deletes one or both counters
RES⌋	Reset signal is edge-triggered LOW-HIGH edge: Deletes one or both counters
START	Start signal is edge-triggered
STOP	Stop signal is edge-triggered

12.4.2 Input data / output data

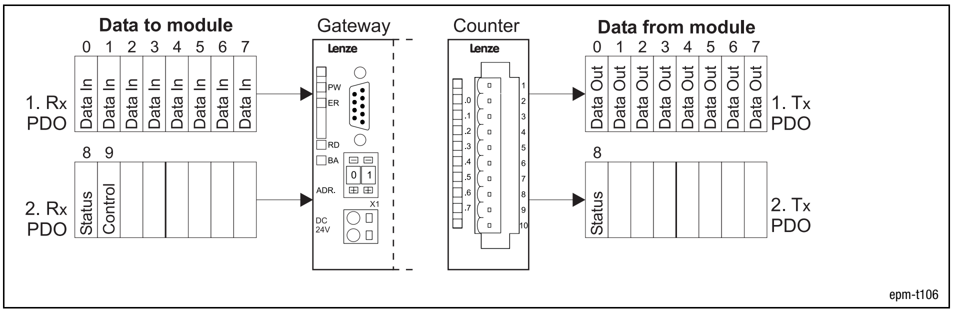


Fig. 12.4-2 Data input / output of 2/4xcounter

For data input / output, 10 bytes are available which are transmitted via two PDOs to the counter (Rx PDO) or output by the counter (Tx PDO).

Input data

Counter starting values or comparison values are included in the 1. Rx PDO in the bytes 0 to 7 (Data In).

Control byte

Due to a level change in byte 9 (Control), the values are written into a counter register. Each bit in byte 9 is assigned to a specific counter register word.

Output data

The current count values are included in the 1. Tx PDO in the bytes 0 to 7 (Data Out) and can be read out there.

Status byte

The behaviour of the counter when the master module restarts (e.g. after changing the parameter setting) can be controlled via byte 8 (status). The following combinations are possible:

Bit 0	Bit 1	
1	0	Counter reading remanent on restart
0	1	Counter reading cleared on restart (Lenze setting)
1	1	

A read access to byte 9 of the output data allows setting checks at any time.

Note!

Count values get lost when the mains supply is switched off/on; they are not stored!

Example

The counter 0 is to be set with the figure 26959382. To make the representation simpler, the figure is given in a hexadecimal format.

Selection	
Node address	2
Baud rate	500 kbaud
COB-ID Rx PDO 2 (I1401/1) COB-ID Rx PDO 3 (I1402/1) COB-ID Tx PDO 2 (I1801/1) COB-ID Tx PDO 3 (I1802/1)	282_h 202_h 281_h 182_h
Event time (I1801/1)	64_h
Mode (I3001/1)	00_h

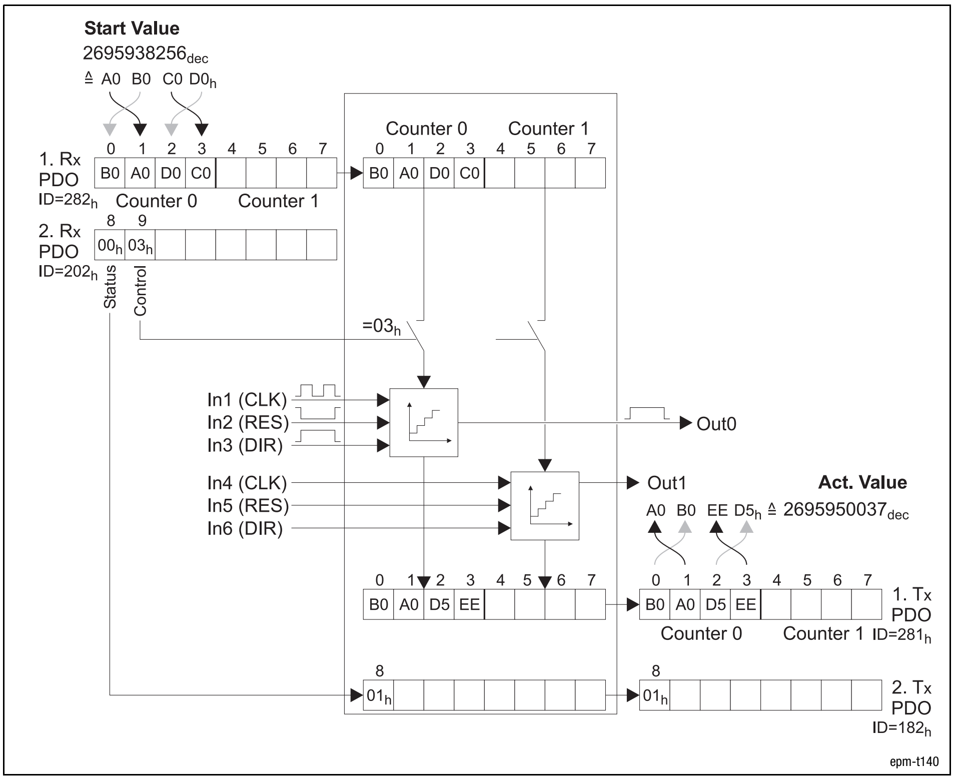


Fig. 12.4-3 Setting the counter content for the 2/4xcounter

1. Transmit the 1. Rx PDO with the counter setting value.
2. For accepting the counter setting value transmit the 2. Rx PDO: Control byte = 30_h.
3. The current count value is output via the 1. Tx PDO.

12.4.3 2 x 32 bit counter (mode 0)

Terminal assignment

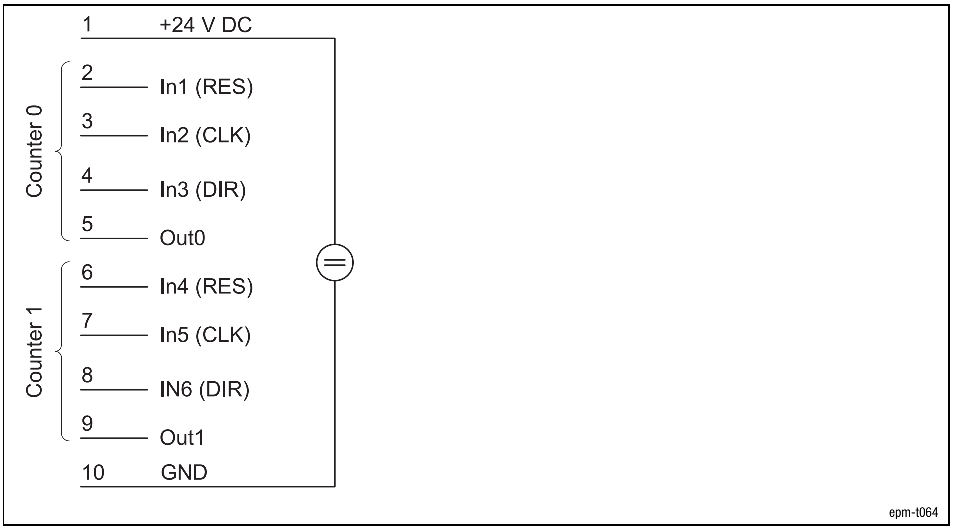


Fig. 12.4-4 Terminal assignment of the 2/4xcounter in the mode 0

The mode 0 offers two 32-bit counters which can be assigned with a starting value.

CLK signal

Each LOW-HIGH edge at input IN2 / IN5 (CLK) increments and/or decrements the counter by 1, respectively.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

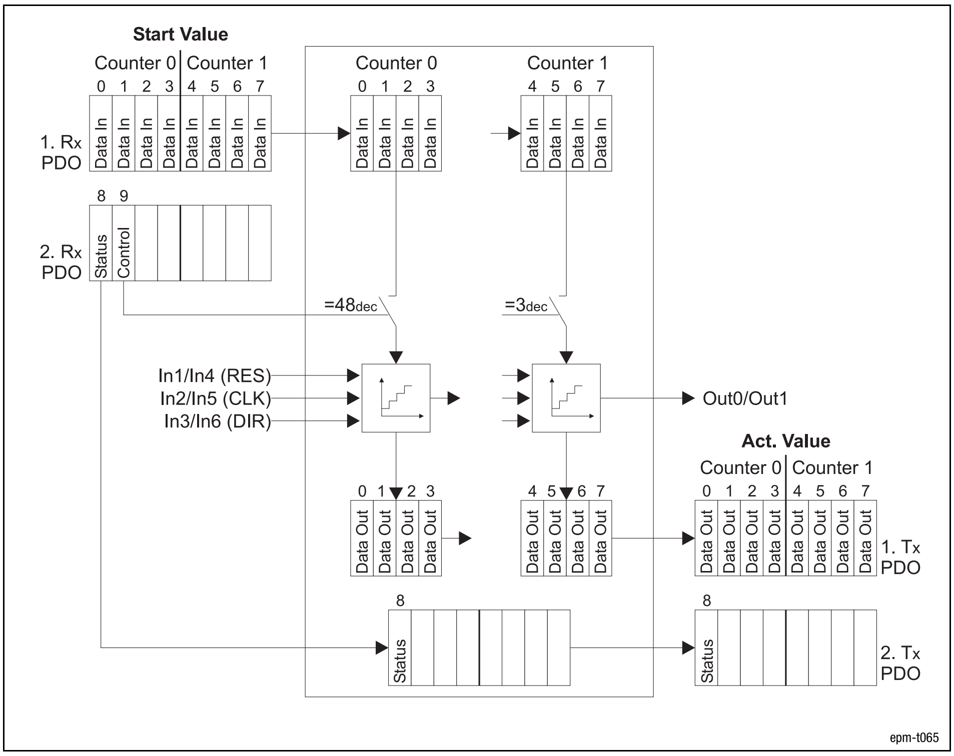


Fig. 12.4-5 Counter access of the 2/4xcounter in the mode 0

Signal characteristic

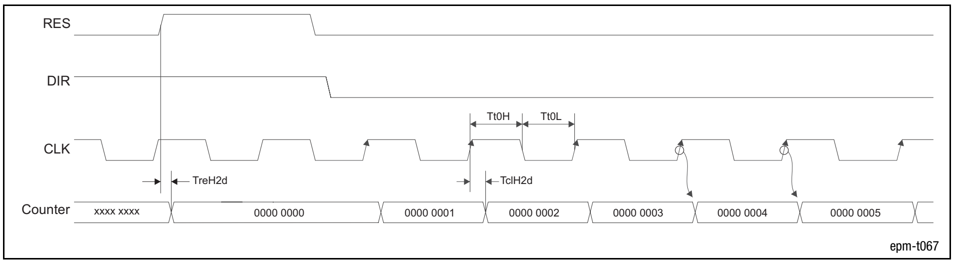


Fig. 12.4-6 Signal characteristic of 2/4xcounter in the mode 0 (upcounter)

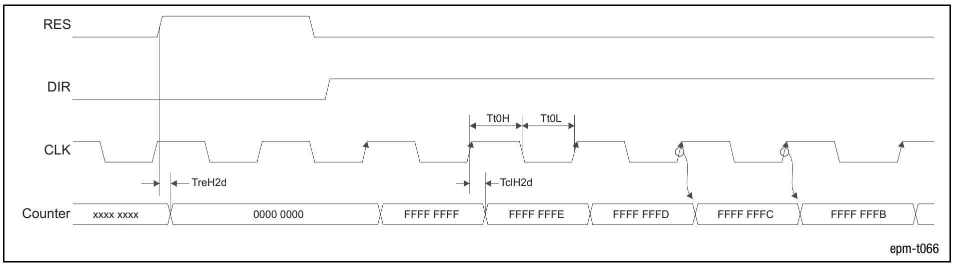


Fig. 12.4-7 Signal characteristic of 2/4xcounter in the mode 0 (downcounter)

12.4.4 Encoder (modes 1, 3, and 5)

Terminal assignment

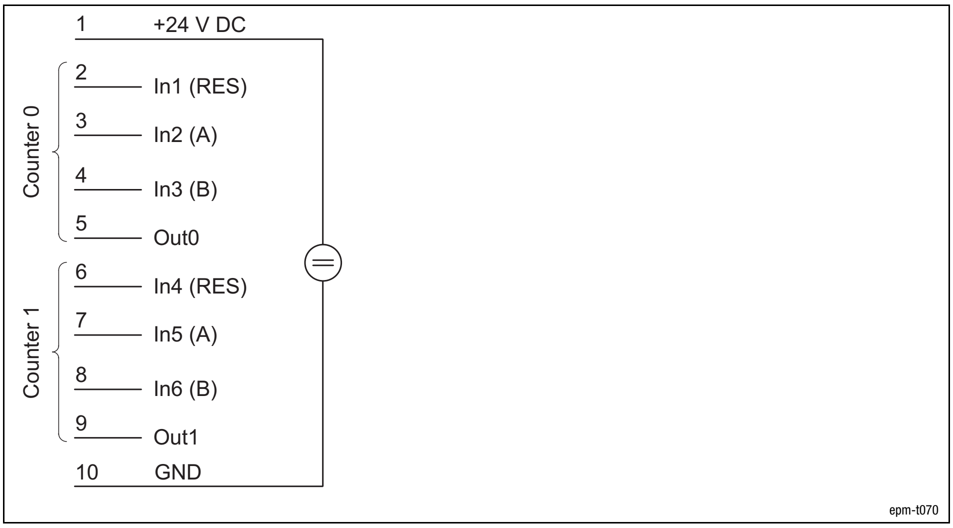


Fig. 12.4-8 Terminal assignment of the 2/4xcounter in the modes 1, 3 and 5

The modes 1, 3, and 5 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 1: 1 edge
Mode 3: 2 edges
Mode 5: 4 edges

A/B signal

See signal characteristics.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

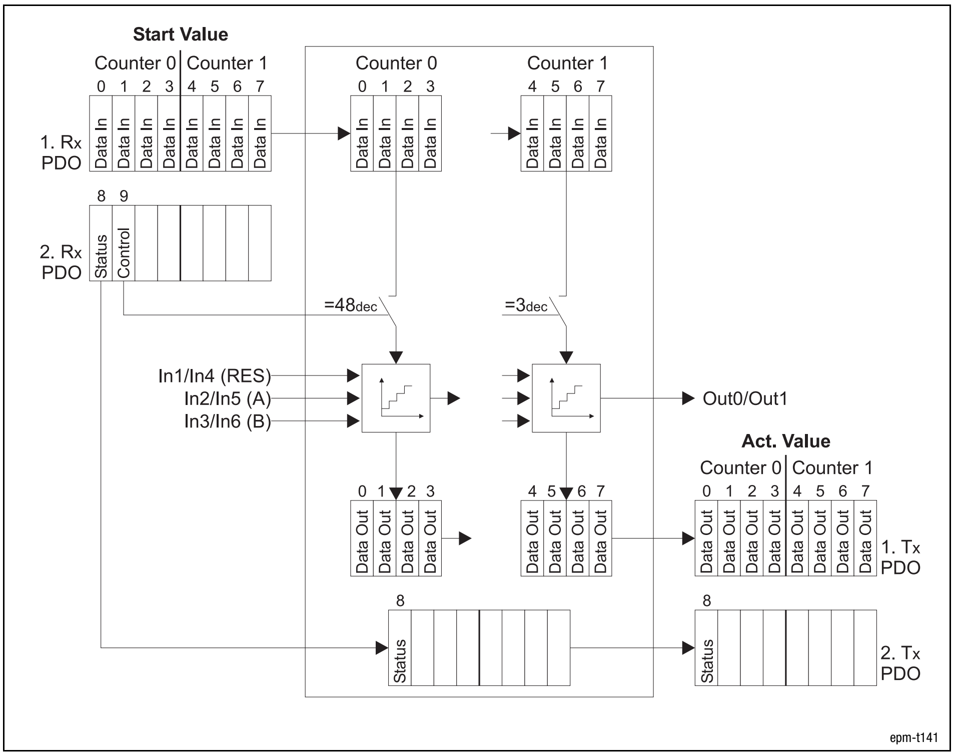


Fig. 12.4-9 Counter access of the 2/4xcounter in the modes 1, 3 and 5

Signal characteristic in mode 1

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

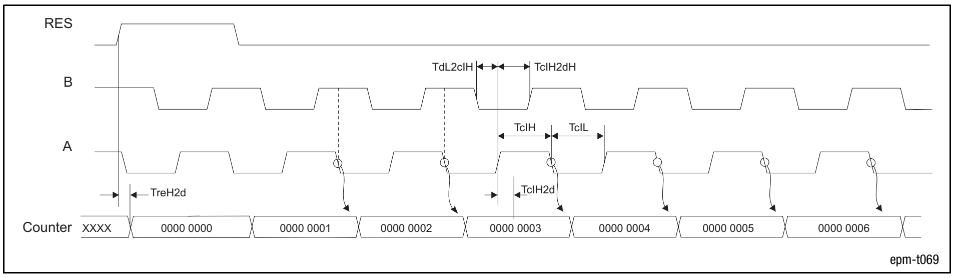


Fig. 12.4-10 Signal characteristic of 2/4xcounter in the mode 1 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

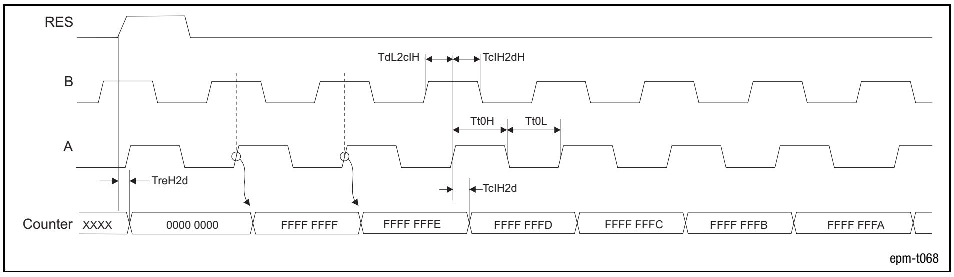


Fig. 12.4-11 Signal characteristic of 2/4xcounter in the mode 1 (downcounter)

Signal characteristic in mode 3

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

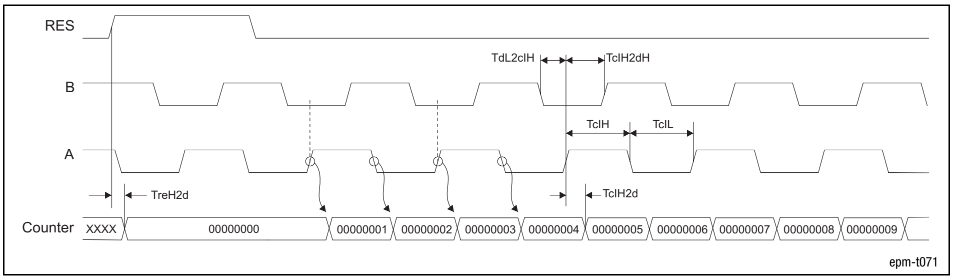


Fig. 12.4-12 Signal characteristic of 2/4xcounter in the mode 3 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

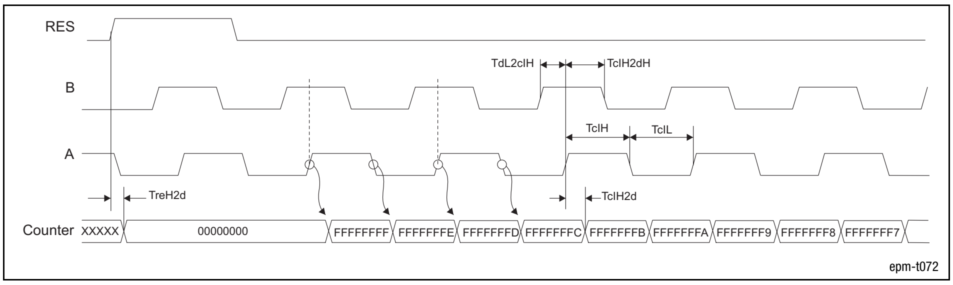


Fig. 12.4-13 Signal characteristic of 2/4xcounter in the mode 3 (downcounter)

Signal characteristic in mode 5

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

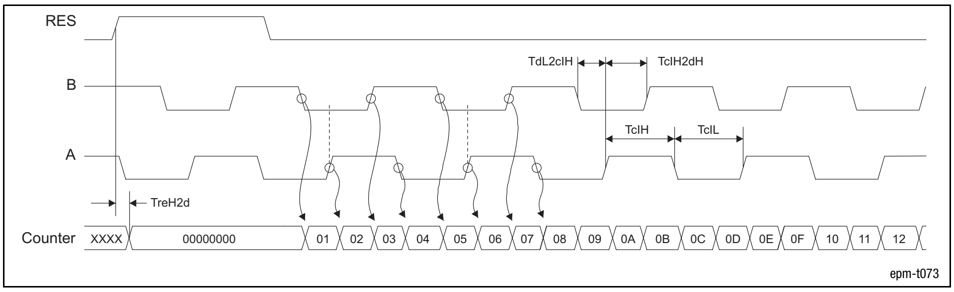


Fig. 12.4-14 Signal characteristic of 2/4xcounter in the mode 5 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

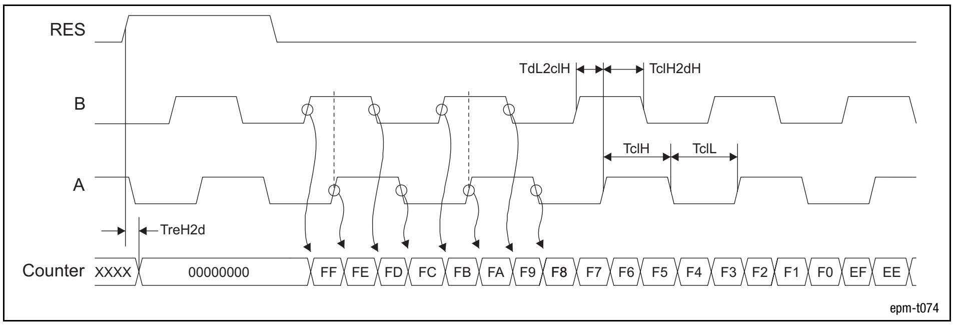


Fig. 12.4-15 Signal characteristic of 2/4xcounter in the mode 5 (downcounter)

12.4.5 Measuring the pulse width, f_{ref} 50 kHz (mode 6)

Terminal assignment

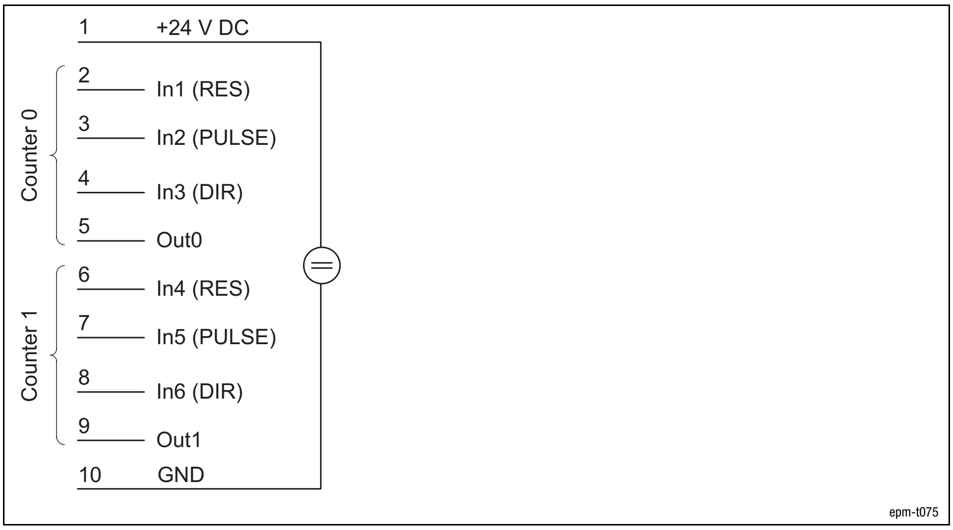


Fig. 12.4-16 Terminal assignment of the 2/4xcounter in the mode 6

The pulse widths of the signals at input IN2 / IN5 (PULSE) are measured with an internal time base.

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit 20 ms (corresponds to a clock frequency of f_{ref} = 50 kHz; the clock frequency cannot be changed). This result is available in the data output range and can be read out until the next new result.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Counter access

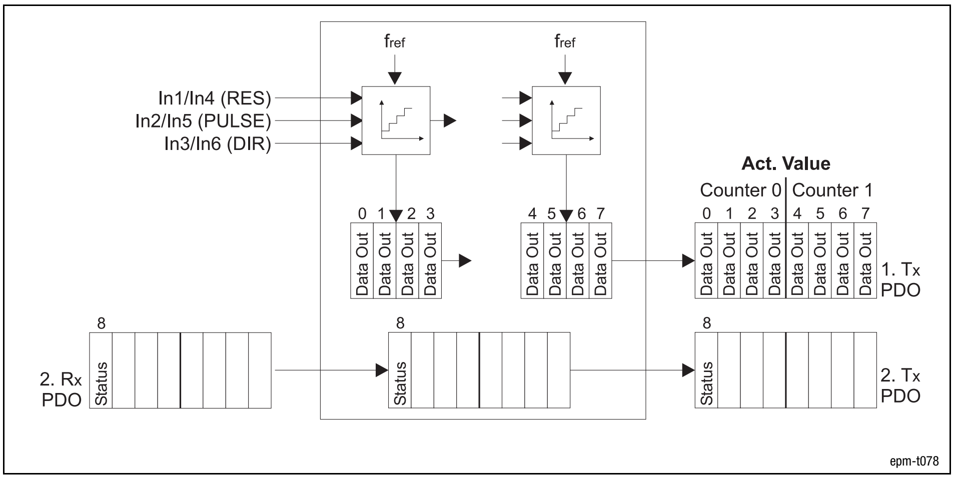


Fig. 12.4-17 Counter access of the 2/4xcounter in the mode 6

Signal characteristic

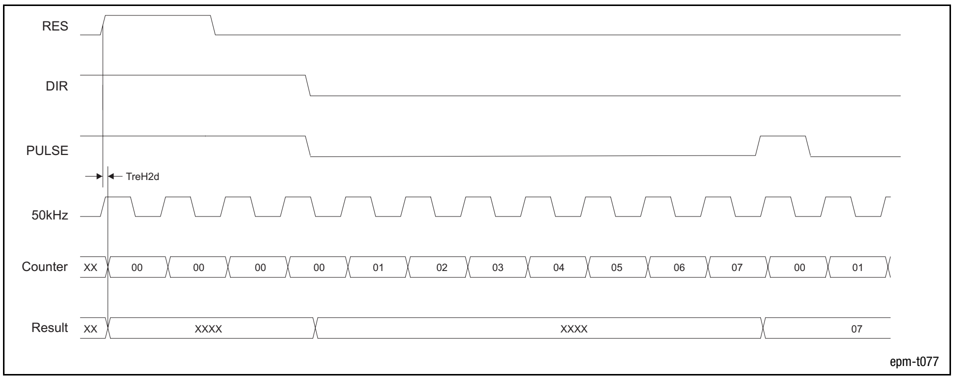


Fig. 12.4-18 Signal characteristic of 2/4xcounter in the mode 6 (upcounter)

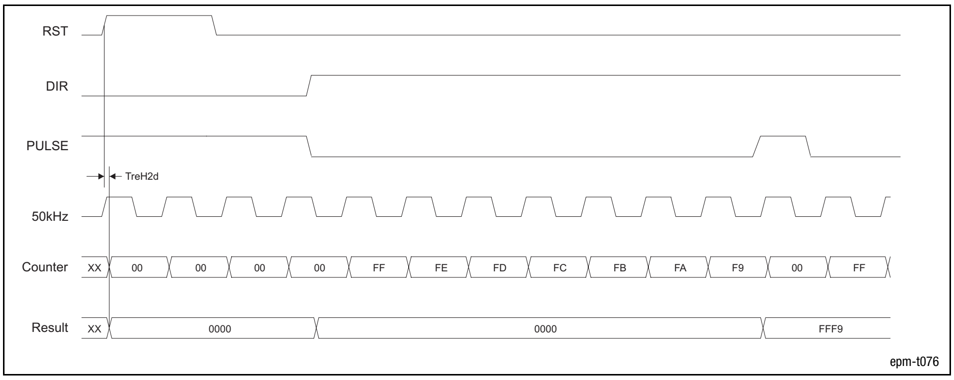


Fig. 12.4-19 Signal characteristic of 2/4xcounter in the mode 6 (downcounter)

12.4.6 4 × 16 bit counter (modes 8 ... 11)

Terminal assignment

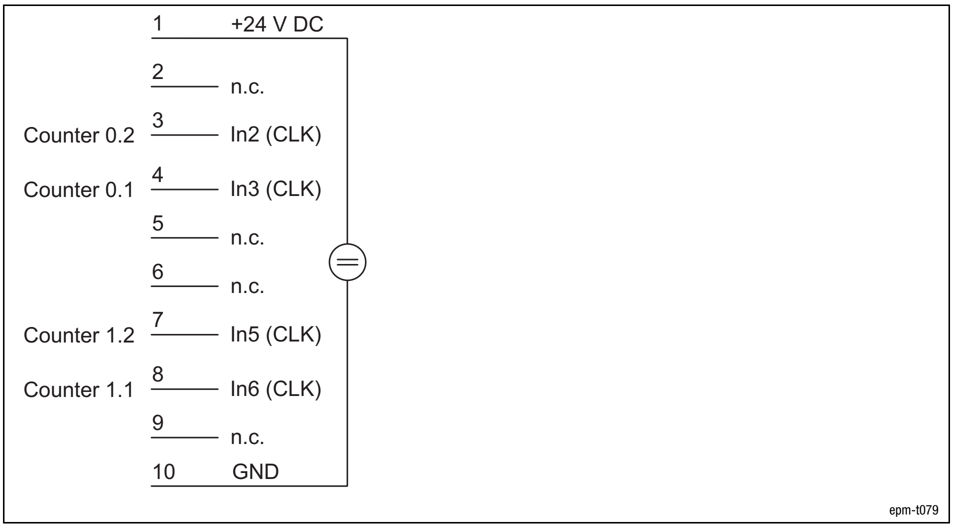


Fig. 12.4-20 Terminal assignment of the 2/4xcounter in the modes 8 ... 11

The modes 8 ... 11 offers four 16-bit counters which can be pre-assigned with a starting value.

The modules differ in having different counting directions:

Mode 8:

- Counters 0.2 and 1.2 count up
- Counters 0.1 and 1.1 count up

Mode 9:

- Counters 0.2 and 1.2 count down
- Counters 0.1 and 1.1 count up

Mode 10:

- Counters 0.2 and 1.2 count up
- Counters 0.1 and 1.1 count down

Mode 11:

- Counters 0.2 and 1.2 count down
- Counters 0.1 and 1.1 count down

CLK signal

Each LOW-HIGH edge at input IN2 / IN3 / IN5 / IN6 (CLK) causes the associated counter to count up and / or down, respectively.

Counter access

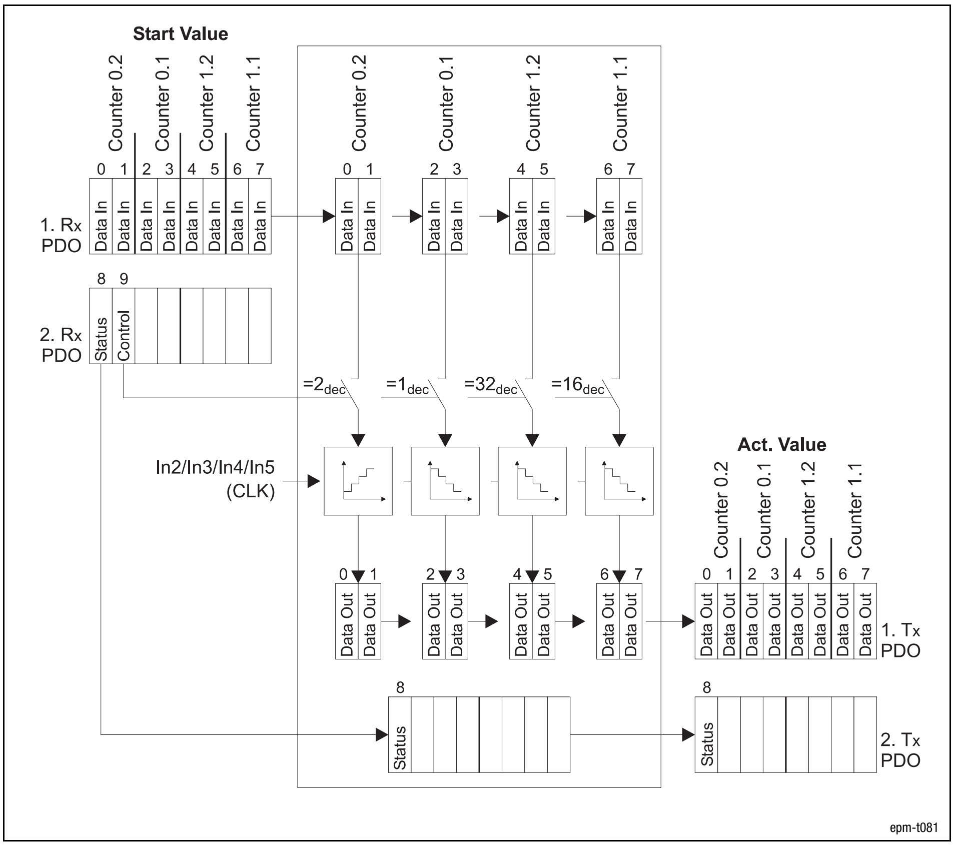


Fig. 12.4-21 Counter access of the 2/4xcounter in the modes 8 ... 11

Signal characteristic

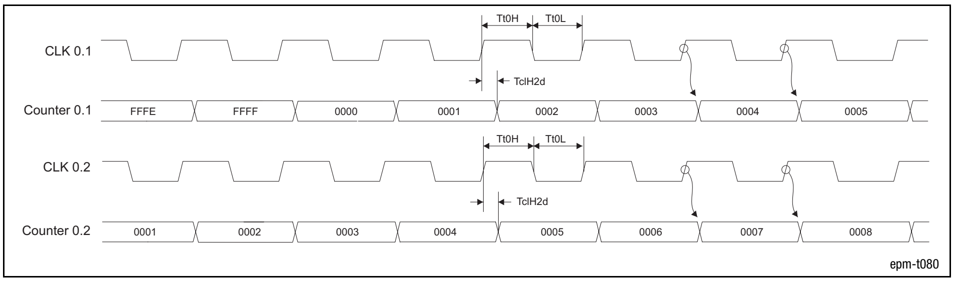


Fig. 12.4-22 Signal characteristic of 2/4xcounter in mode 8 considering as example the counters 0.1 and 0.2

12.4.7 2 × 32 bit counter with GATE and RES level-triggered (modes 12 and 13)

Terminal assignment

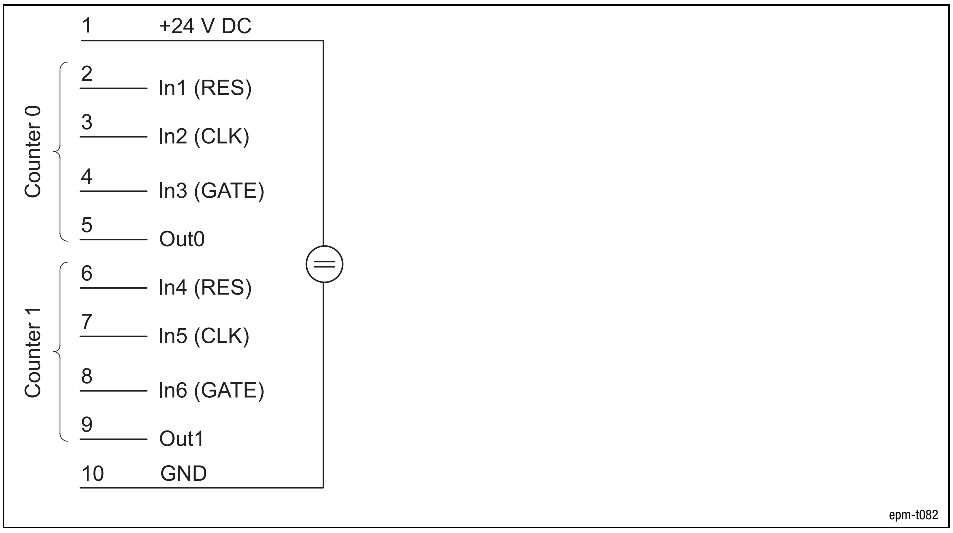


Fig. 12.4-23 Terminal assignment of the 2/4xcounter in the modes 12 and 13

In the modes 12 and 13, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modules differ in having different counting directions:

Mode 12: Upcounter.
Mode 13: Downcounter

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Once the counter reaches the value loaded in the ”Compare” register, output OUT0 / OUT1 is set to HIGH level for at least 100 ms, with the counter continuing its task.

Counter access

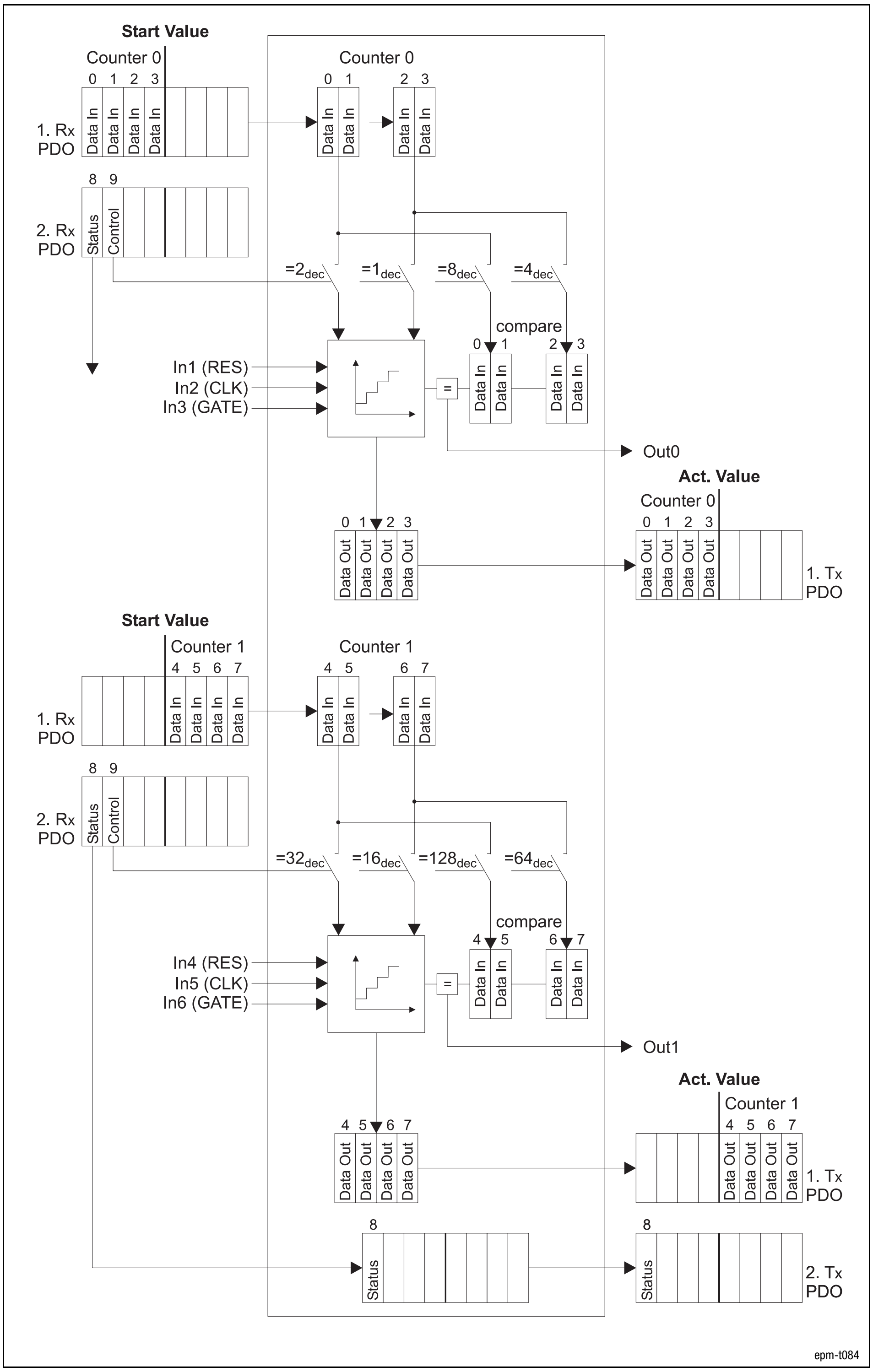


Fig. 12.4-24 Counter access of the 2/4xcounter in the modes 12 and 13

Signal characteristic

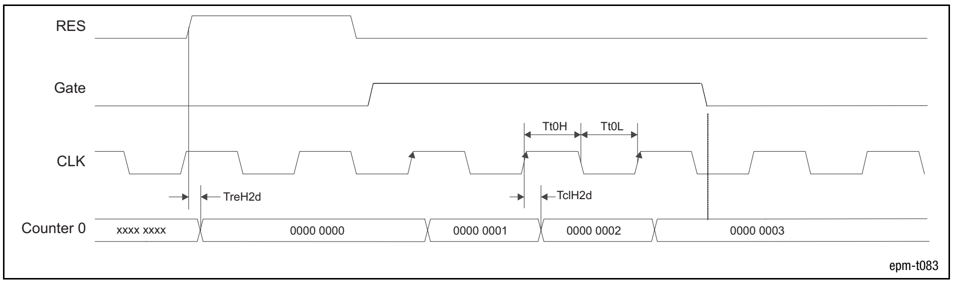


Fig. 12.4-25 Signal characteristic of 2/4xcounter in the mode 12

12.4.8 2 × 32 bit counter with GATE, RES level-triggered and auto reload (modes 14 and 15)

Terminal assignment

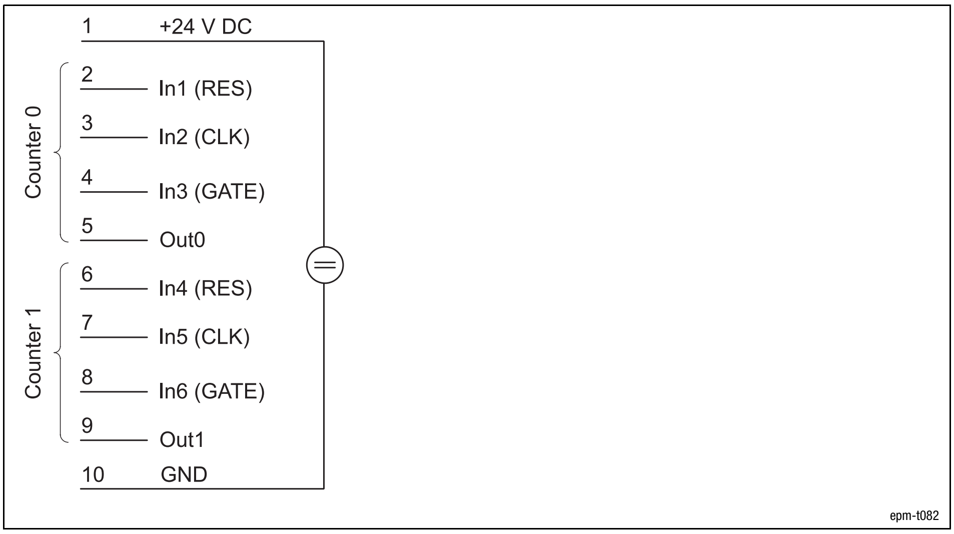


Fig. 12.4-26 Terminal assignment of the 2/4xcounter in the modes 14 and 15

In the modes 14 and 15, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

These modes offer the function "Auto Reload". This means, that the Load Register can be assigned with a value which is automatically loaded into the counter as soon as it reaches the comparison value set.

The modules differ in having different counting directions:

Mode 14: Upcounter.
Mode 15: Downcounter

RES signal

A HIGH level at input IN1 / IN4 (RES) sets the counter to zero.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

The counter counts up to the value set in the compare register. With this last LOW-HIGH edge the counter content is overwritten with the value set in the load register. This is repeated until the input IN3 / IN6 (GATE) receives a LOW signal.

OUT signal

If an "Auto Reload" occurs, the signal level at the output OUT0 / OUT1 changes. (A LOW-HIGH edge at the input IN1 / IN4 (RES) does not reset the output OUT0 / OUT1.)

Counter access

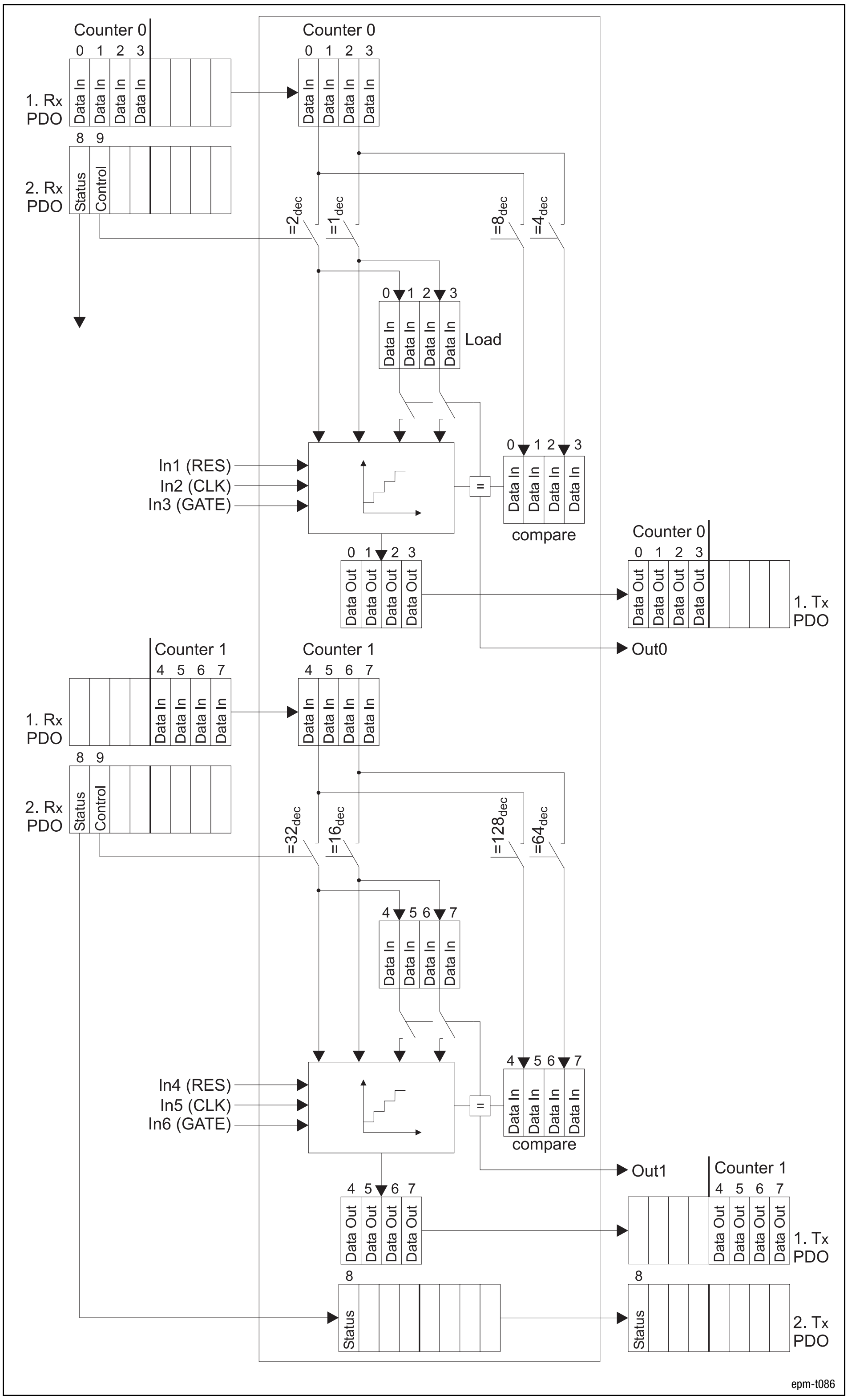


Fig. 12.4-27 Counter access of the 2/4xcounter in the modes 14 and 15

Signal characteristic

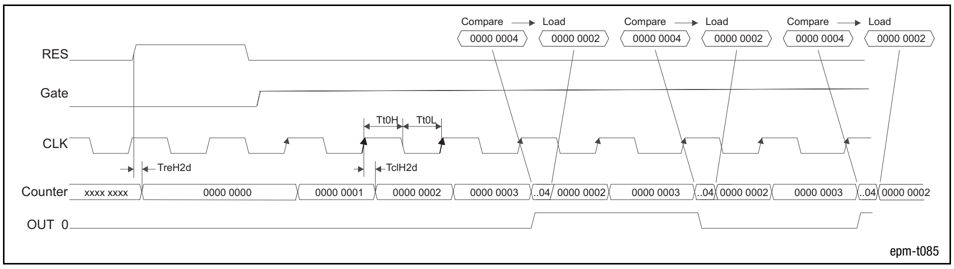


Fig. 12.4-28 Signal characteristic of 2/4xcounter in the mode 14 (upcounter)

12.4.9 Measuring the frequency (modes 16 and 18)

Terminal assignment

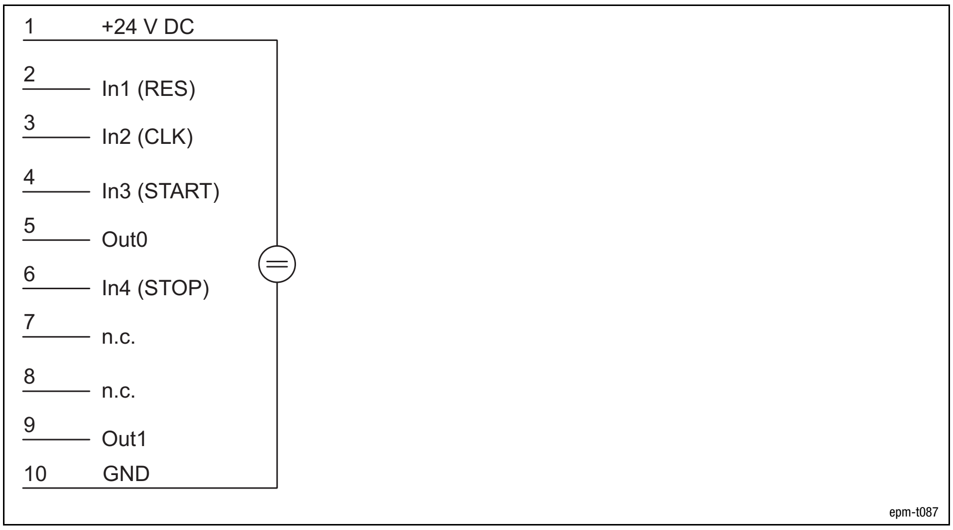


Fig. 12.4-29 Terminal assignment of the 2/4xcounter in the modes 16 and 18

Modes 16 and 18 allow determination of the frequency of a signal at input IN2 (CLK).

The modes differ in triggering the output Out0 / Out1 in different ways.

Note!

For measuring the frequency, counters 0 and 1 are required. For this, both counters must be parameterised to mode 16 or 18. Different modes cannot be set.

With the PDO byte 7 (Data In) a reference frequency (f_{ref}) is transmitted to counter 0 (see figure ”counter access”). The number ”n” of the reference frequency pulses determines the gate time (period of time the counter 1 is to be released). ”n” can be between 1 and 2^{32}-1 and is loaded into the compare register.

RES signal

A LOW-HIGH edge at input IN1 (RES) sets the counter to zero.

START signal

A LOW-HIGH edge at input IN3 (START) starts the measuring process.

CLK signal

During the measuring process the counter 0 counts with the first LOW-HIGH edge at the input IN2 (CLK) the pulses ”n” of the reference frequency. Simultaneously the counter 1 counts every LOW-HIGH edge at the input IN2 (CLK).

STOP signal

Both counters are stopped when

- the counter 0 reading reaches the Compare value, or
- input IN4 (STOP) receives a HIGH signal.

OUT signal

Mode 16:

The output OUT 0 is set to HIGH level when the *measuring process* starts, and is set to LOW level, when the *measuring process* is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Mode 18:

The output OUT 0 is set to HIGH level when the *counting process* starts, and is set to LOW level, when the *counting process* is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Computing the frequency

$f = \frac{f_{ref} \cdot m}{n}$	f	Frequency to be computed
	f_{ref}	Reference frequency (see figure "counter access")
	m	Content, counter 1 (number of CLK pulses)
	n	Number of reference frequency pulses in counter 0 (corresponds to Compare unless prematurely terminated by a HIGH signal at input IN4 (STOP)

Note!

If the reference frequency [f_{ref}] and the number of reference frequency pulses [n] are selected so that the wanted frequency [f] is exactly 1 Hz, the counter 1 directly displays this frequency.
Example: m = 1,000,000; f_{ref} = 1 MHz.

Counter access

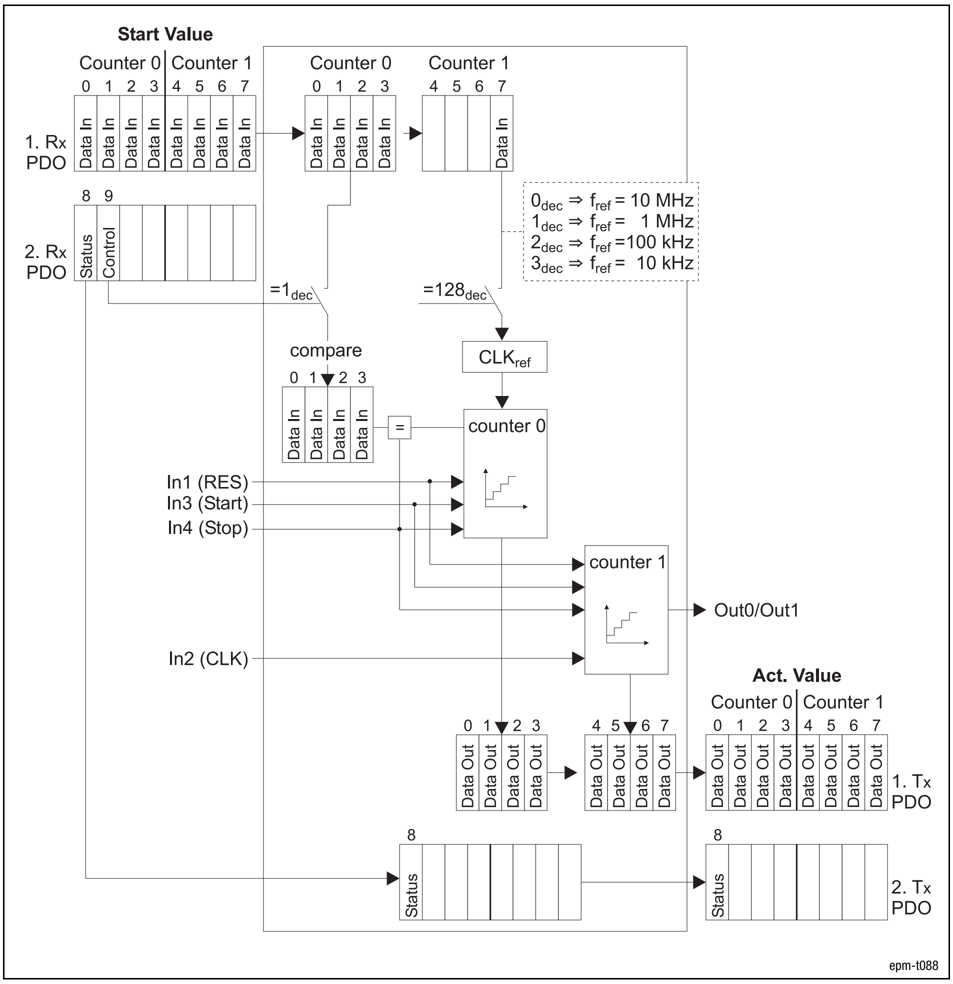


Fig. 12.4-30 Counter access of the 2/4xcounter in the modes 16 and 18

Signal characteristic in mode 16

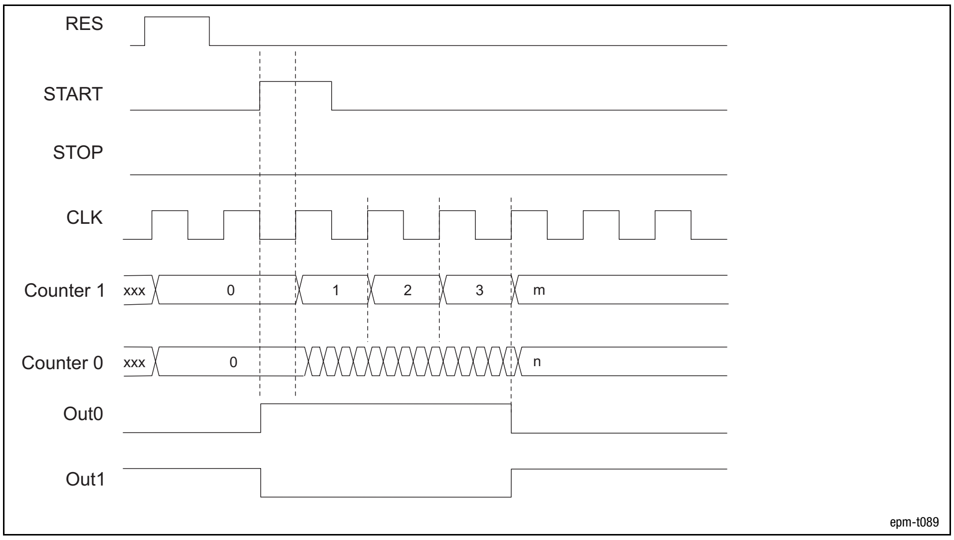


Fig. 12.4-31 Signal characteristic of 2/4xcounter in the mode 16

OUT0 = HIGH Measuring process in progress

Signal characteristic in mode 18

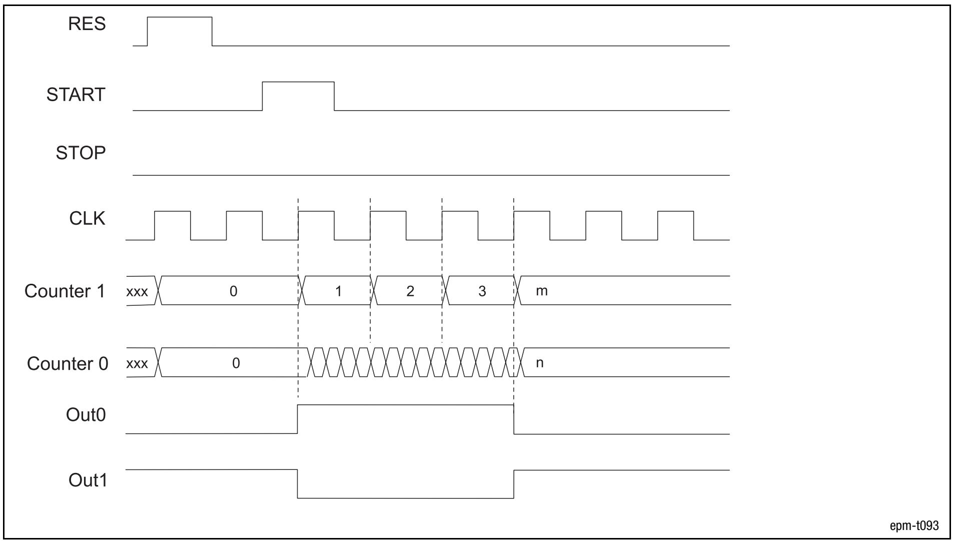


Fig. 12.4-32 Signal characteristic of 2/4xcounter in the mode 18

OUT0 = HIGH Gate open

12.4.10 Measuring the period (modes 17 and 19)

Terminal assignment

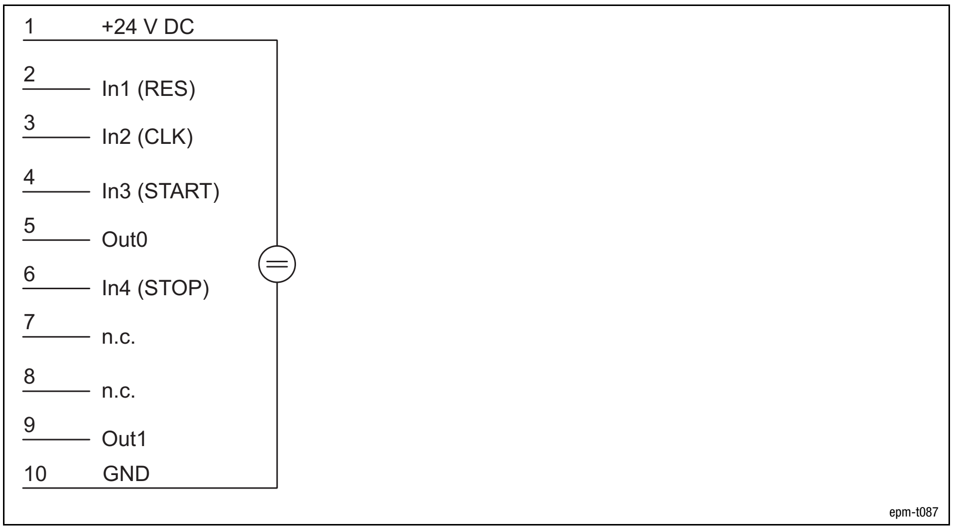


Fig. 12.4-33 Terminal assignment of the 2/4xcounter in the modes 17 and 19

Modes 17 and 19 allow the determination of the average period of ”n” measured period of signal at input IN2 (CLK).

The modes differ in triggering the output Out0 / Out 1 differently.

Note!

For measuring the frequency of the period, the counters 0 and 1 are required. For this, both counters must be parameterised to mode 17 or 19. Different modes cannot be set.

With the PDO byte 7 (Data In) a reference frequency (f_{ref}) is transmitted to counter 1 (see figure ”counter access”). The number ”m” of the reference frequency pulses determines the gate time (period of time the counter 1 is to be released). ”m” can be between 1 and 2^{32}-1 and is loaded into the compare register.

RES signal

A LOW-HIGH edge at input IN1 (RES) sets the counter to zero.

START signal

A LOW-HIGH edge at input IN3 (START) starts the measuring process.

CLK signal

During the measuring process the counter 1 counts with the first LOW-HIGH edge at the input IN2 (CLK) the pulses ”m” of the reference frequency. Simultaneously the counter 0 counts every LOW-HIGH edge at the input IN2 (CLK).

STOP signal

Both counters are stopped when

- the counter 0 reaches the Compare value, or
- input IN4 (STOP) receives a HIGH signal.

OUT signal

Mode 17:

The output OUT 0 is set to HIGH level when the *measuring process* starts, and is set to LOW level, when the measuring process is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Mode 19:

The output OUT 0 is set to HIGH level when the *counting process* starts, and is set to LOW level, when the counting process is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Computing the period

$T = \frac{n}{f_{ref} \cdot m}$	T Average period f_{ref} Reference frequency (see figure "counter access") m Content, counter 1 (number of reference frequency pulses) n Number of CLK pulses in counter 0 (corresponds to Compare unless prematurely terminated by a HIGH signal at input IN4 (STOP)

Counter access

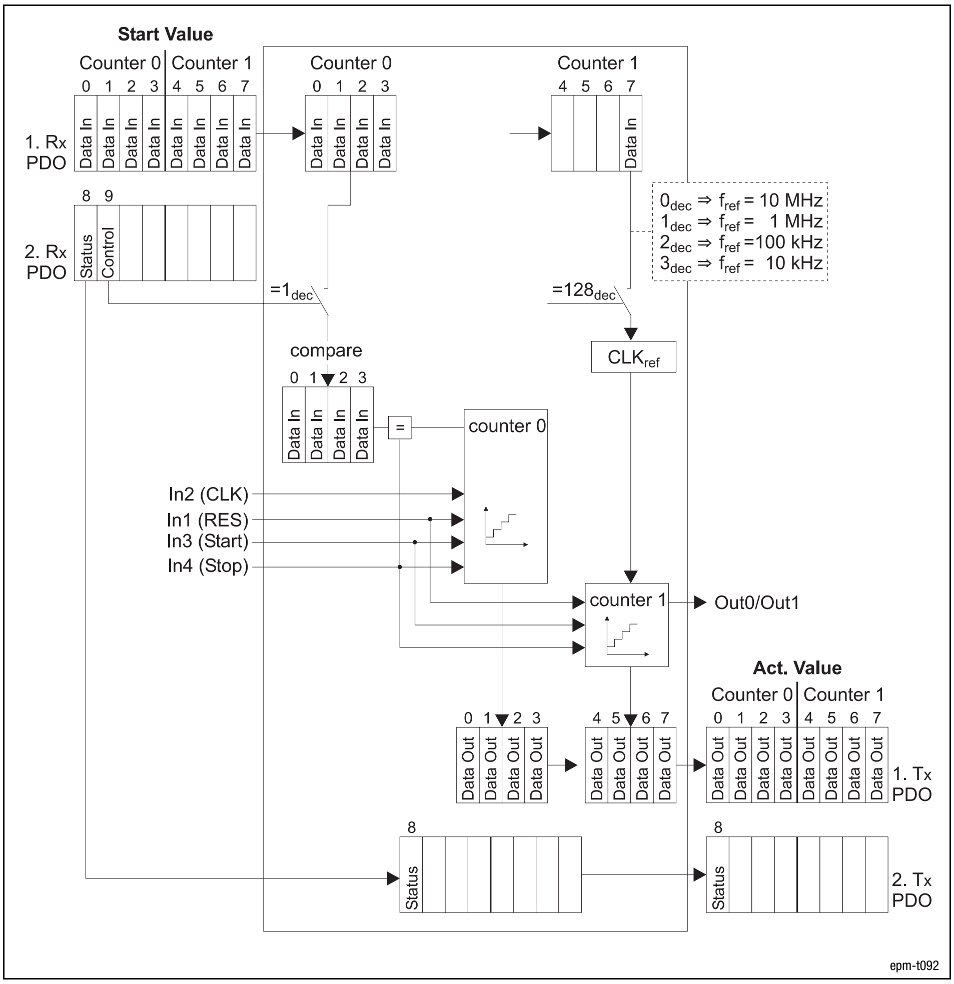


Fig. 12.4-34 Counter access of the 2/4xcounter in the modes 17 and 19

Signal characteristic in mode 17

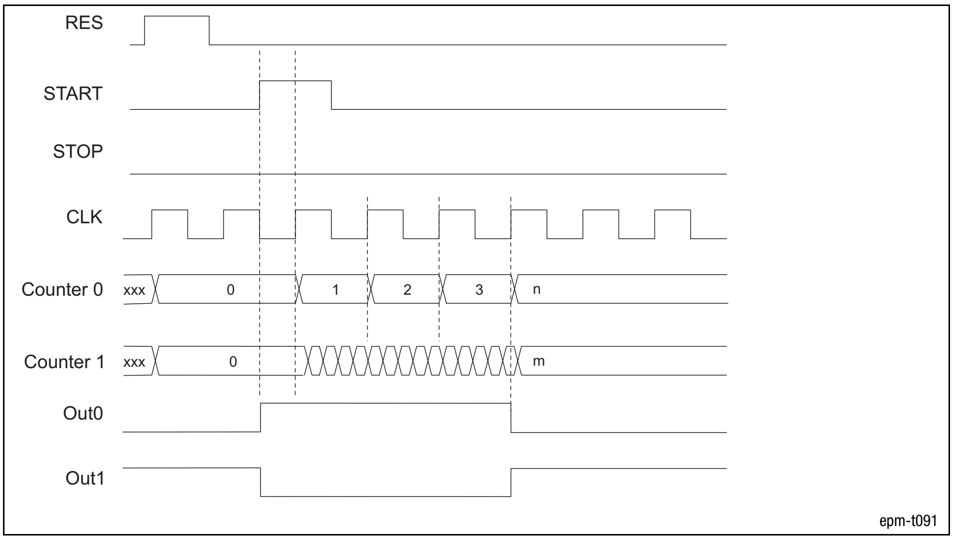


Fig. 12.4-35 Signal characteristic of 2/4xcounter in the mode 17

OUT0 = HIGH Measuring process in progress

Signal characteristic in mode 19

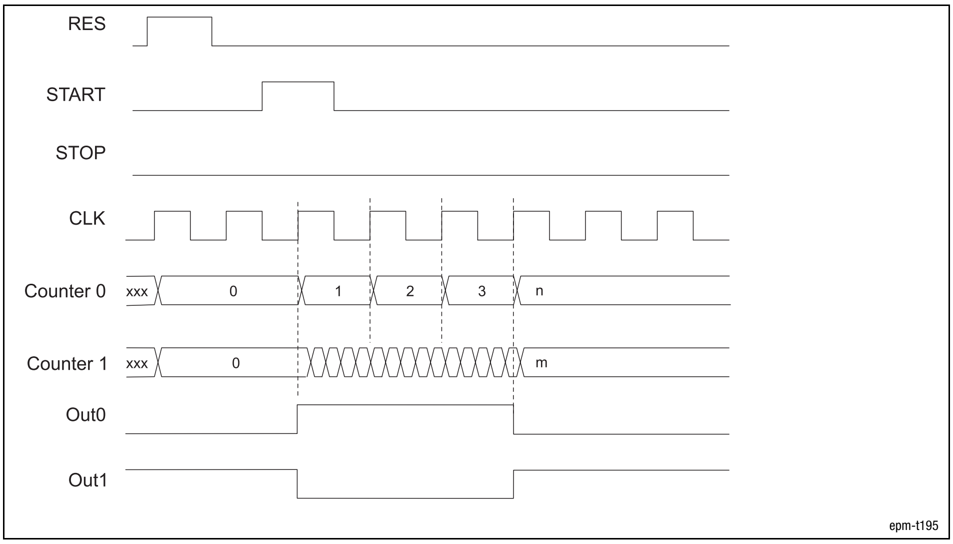


Fig. 12.4-36 Signal characteristic of 2/4xcounter in the mode 19

OUT0 = HIGH Gate open

12.4.11 Measuring the pulse width, f_{ref} programmable (mode 20)

Terminal assignment

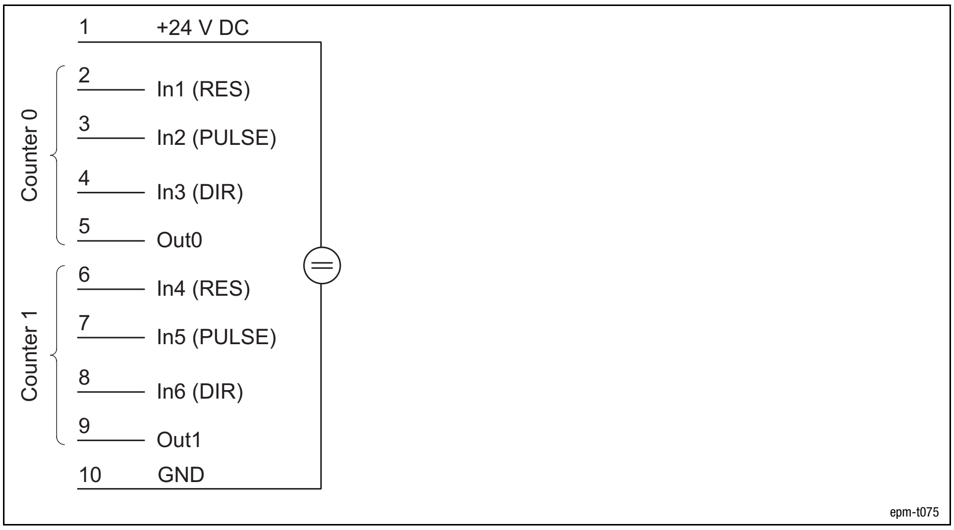


Fig. 12.4-37 Terminal assignment of the 2/4xcounter in the mode 20

The pulse widths of the signal at the input IN2 / IN5 (PULSE) are measured with a programmable time base (f_{ref}, see figure "Counter access").

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit $1/f_{ref}$. This result can be found and read out in the data output range until the next result appears.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR).

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Counter access

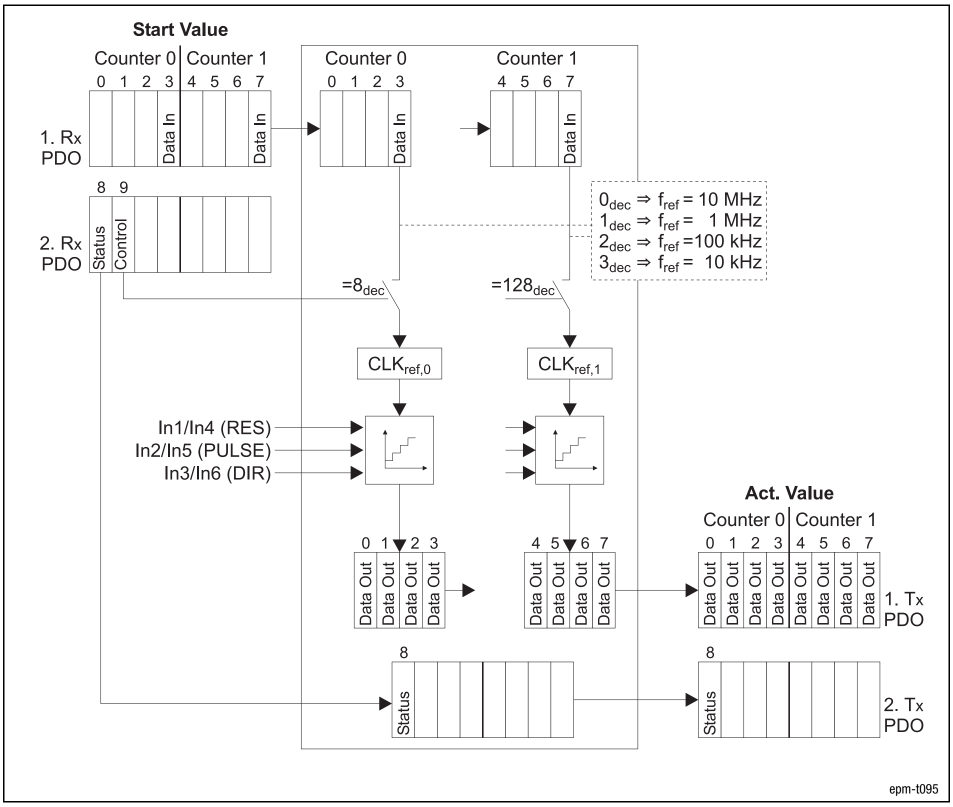


Fig. 12.4-38 Counter access of the 2/4xcounter in the mode 20

Signal characteristic

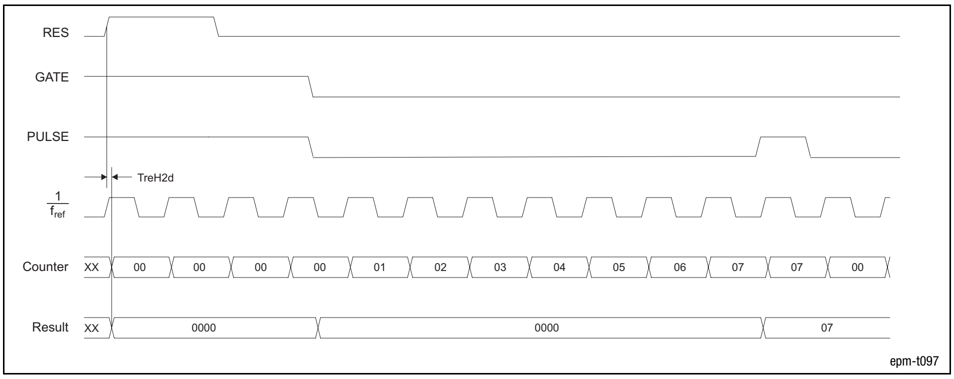


Fig. 12.4-39 Signal characteristic of 2/4xcounter in the mode 20 (upcounter)

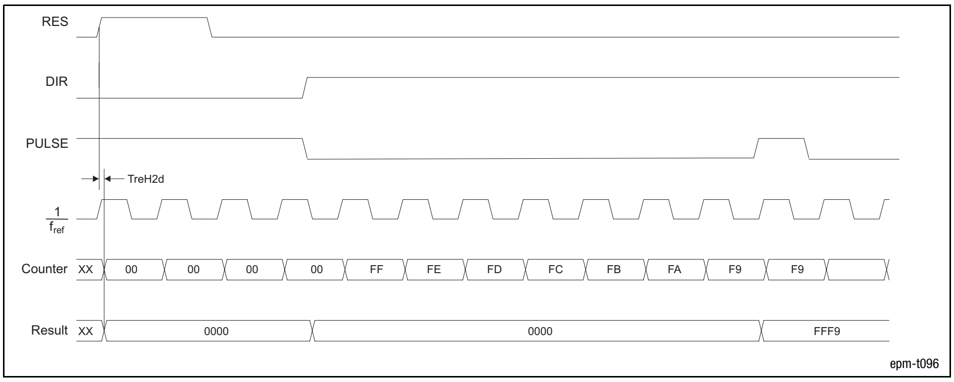


Fig. 12.4-40 Signal characteristic of 2/4xcounter in the mode 20 (downcounter)

12.4.12 Measuring the pulse width with GATE, f_{ref} programmable (modes 21 and 22)

Terminal assignment

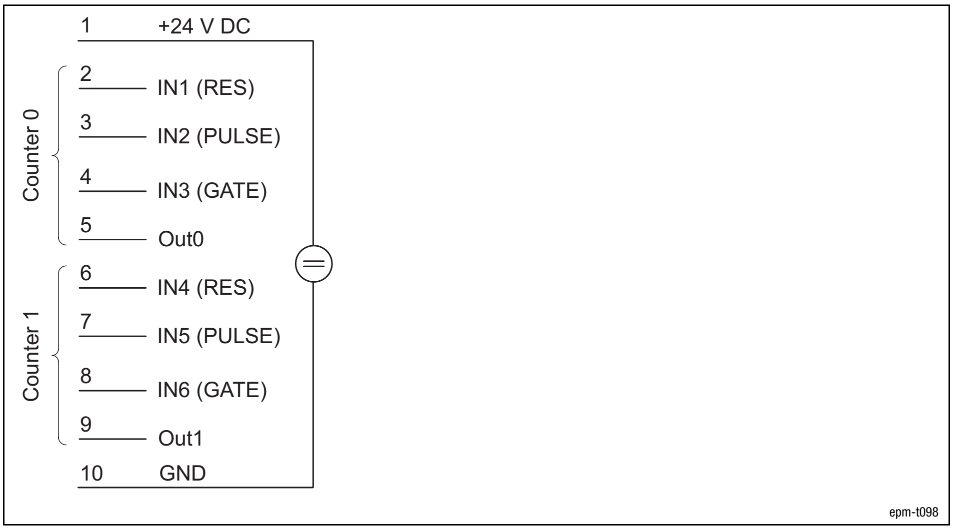


Fig. 12.4-41 Terminal assignment of the 2/4xcounter in the modes 21 and 22

The pulse widths of the signal at the input IN2 / IN5 (PULSE) are measured with a programmable time base (f_{ref}, see figure "Counter access").

The modules differ in having different counting directions:

Mode 21: Upcounter.
Mode 22: Downcounter

GATE/CLK signal

The measuring process is enabled with a HIGH level at input IN3 / IN6 (GATE).

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit $1/f_{ref}$. This result can be found and read out in the data output range until the next result appears.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Note!

The measuring process is terminated only if a HIGH level is applied at input IN3 / IN6 (GATE) for the complete duration of the measuring process.

Counter access

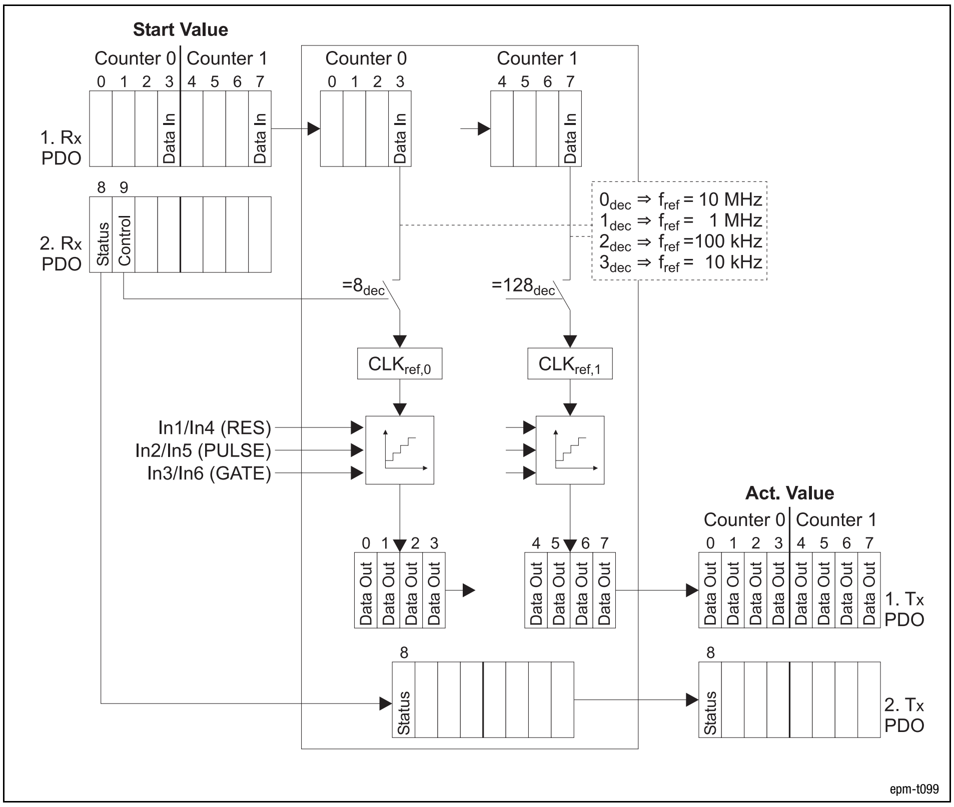


Fig. 12.4-42   Counter access of the 2/4xcounter in the modes 21 and 22

Signal characteristic in mode 21

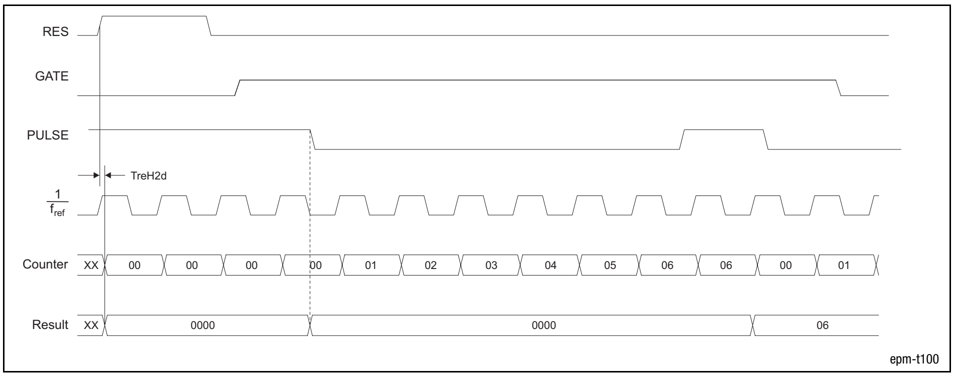


Fig. 12.4-43   Signal characteristic of 2/4xcounter in the mode 21 (upcounter)

Signal characteristic in mode 22

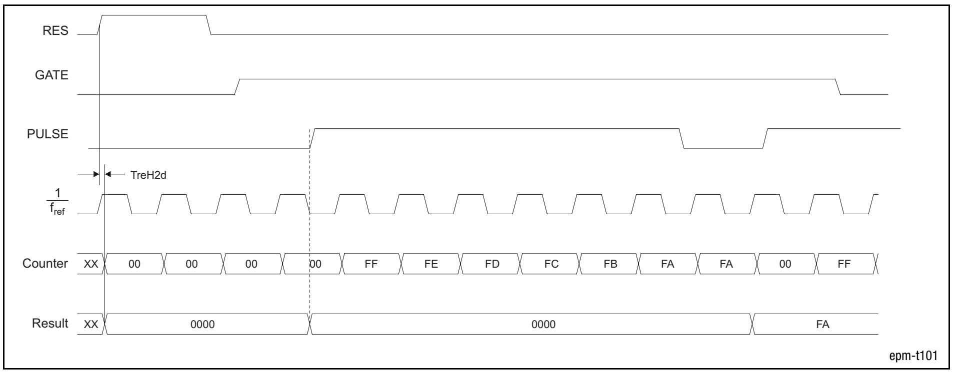


Fig. 12.4-44 Signal characteristic of 2/4xcounter in the mode 22 (downcounter)

12.4.13 2 × 32 bit counter with GATE and set/reset (modes 23 ... 26)

Terminal assignment

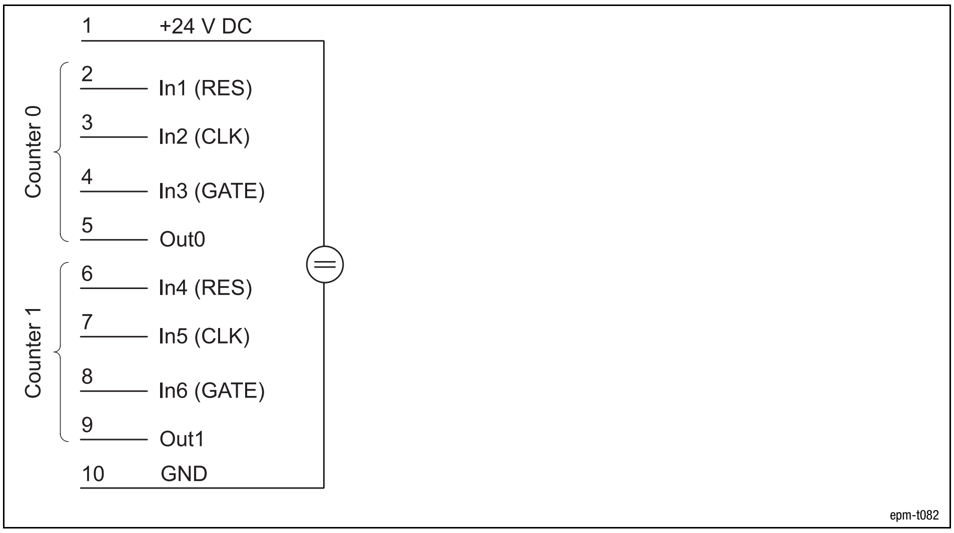


Fig. 12.4-45 Terminal assignment of the 2/4xcounter in the modes 23 ... 26

In the modes 23 to 26, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modes differ in triggering the outputs Out0 / Out 1 differently (set or reset function) and the counting direction:

Modes 23 and 25: Upcounter.
Modes 24 and 26: Downcounter

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Modes 23 and 24 (set function):

- The signal at output OUT0 / OUT1 is set to HIGH level on counter loading.
- When reaching the value loaded in Compare, the output signal is set to LOW level. The counter continues to run.

Modes 25 and 26 (reset function):

- The signal at output OUT0 / OUT1 is set to LOW level on counter loading.
- When reaching the value loaded in Compare, the output signal is set to HIGH level (modes 25 and 26). The counter continues to run.

Counter access

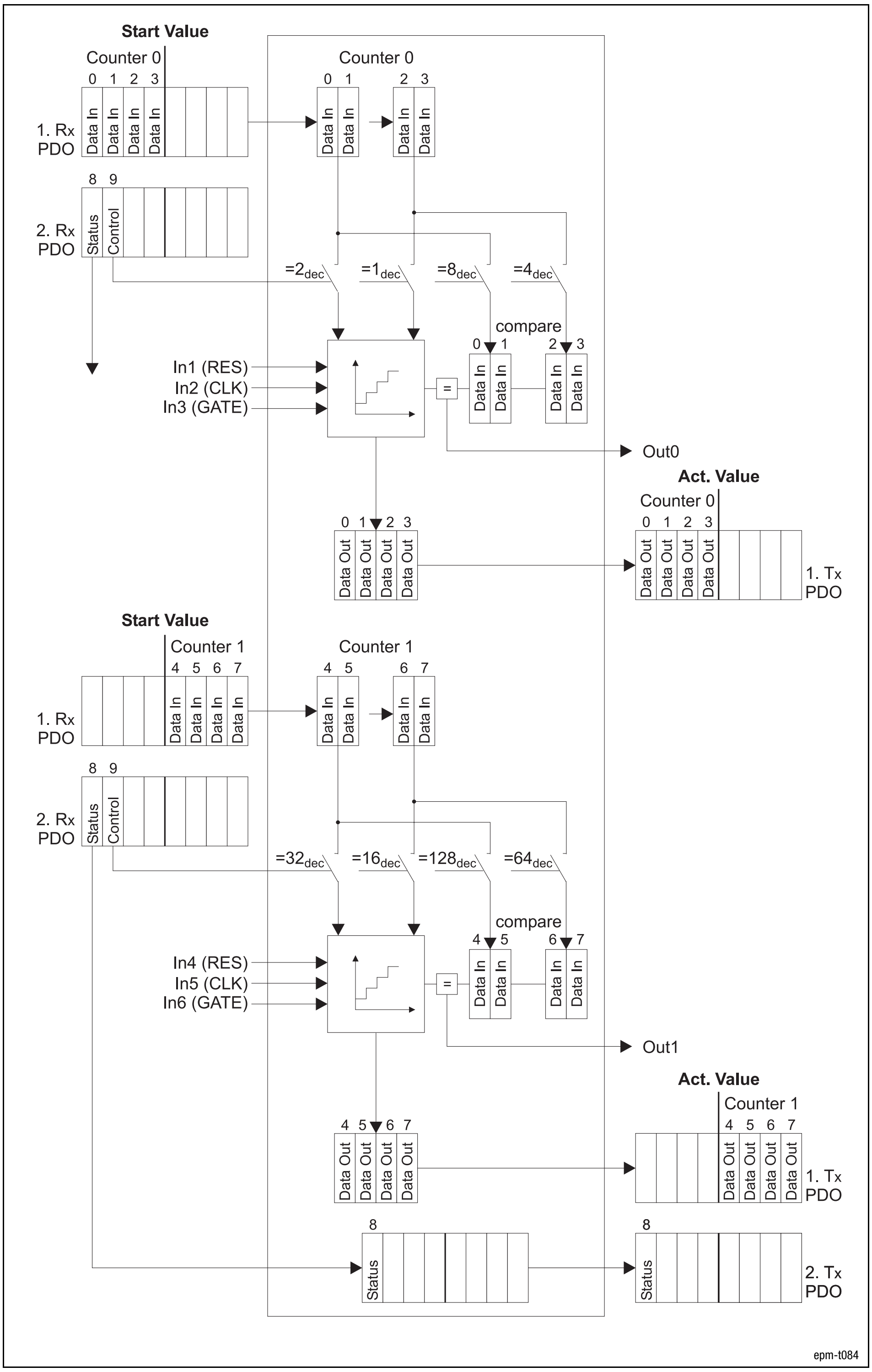


Fig. 12.4-46 Counter access of the 2/4xcounter in the modes 23 ... 26

Signal characteristic in mode 23

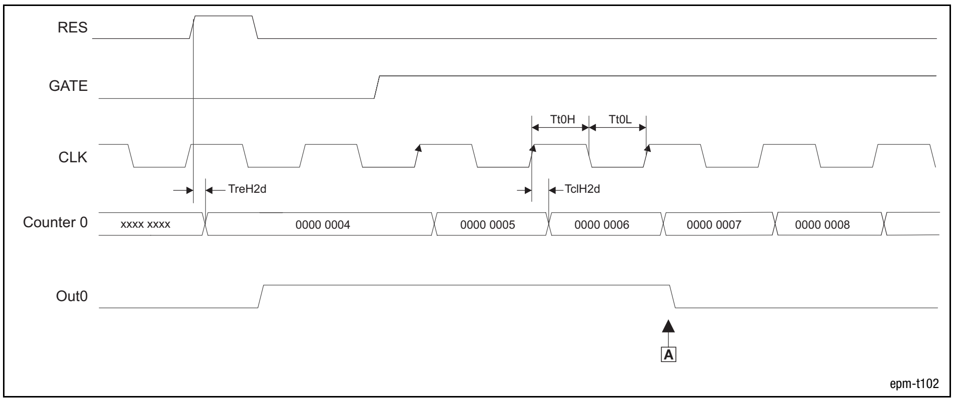


Fig. 12.4-47 Signal characteristic of 2/4xcounter in the mode 23 (upcounter, set function)

A Compare reached

Signal characteristic in mode 24

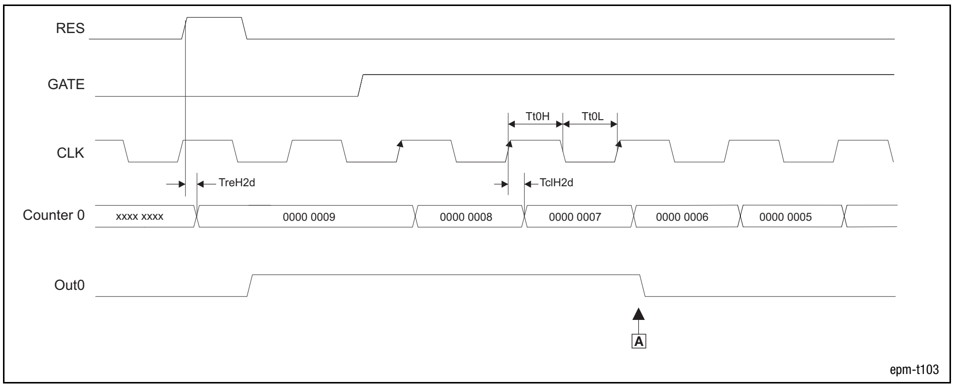


Fig. 12.4-48 Signal characteristic of 2/4xcounter in the mode 24 (downcounter, set function)

A Compare reached

Signal characteristic in mode 25

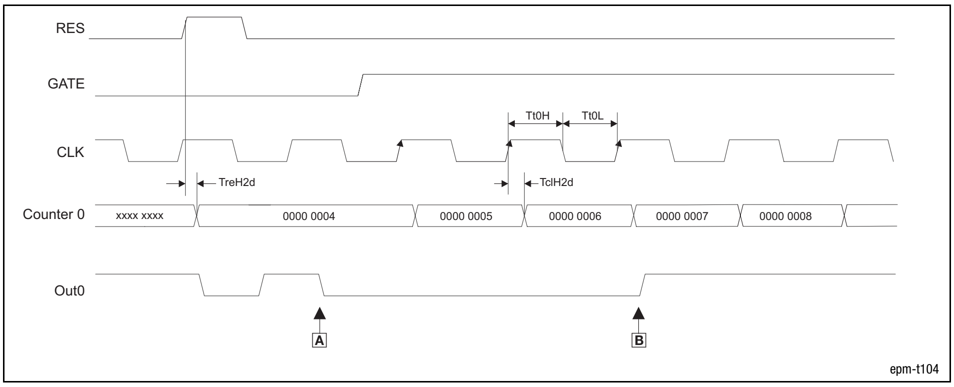


Fig. 12.4-49 Signal characteristic of 2/4xcounter in the mode 25 (upcounter, reset function)

OUT0 LOW active
A Load counter
B Compare reached

Signal characteristic in mode 26

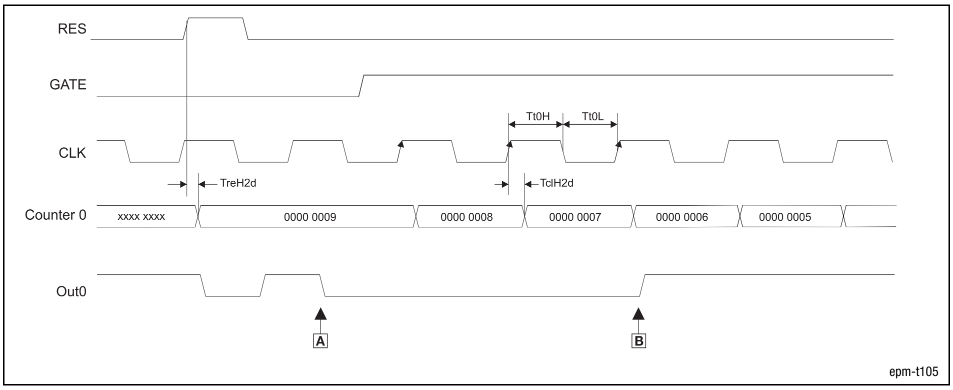


Fig. 12.4-50 Signal characteristic of 2/4xcounter in the mode 26 (downcounter, reset function)

OUT0 LOW active
A Load counter
B Compare reached

12.4.14 2 x 32 bit counter with G/RES (mode 27)

Terminal assignment

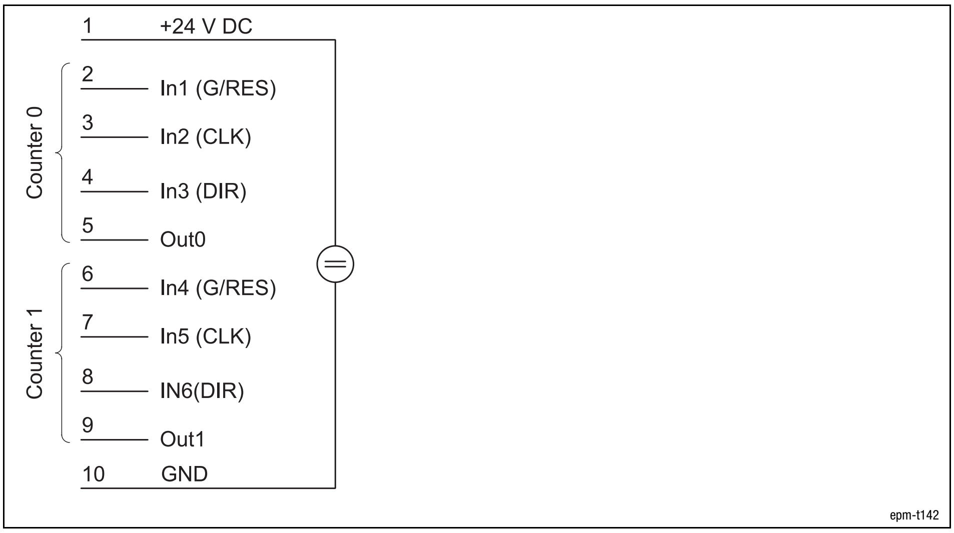


Fig. 12.4-51 Terminal assignment of the 2/4xcounter in the mode 27

The mode 27 offers two 32-bit counters which can be assigned with a starting value.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

CLK signal

If a HIGH level is applied to input IN3 / IN6 (G/RES), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

G/RES signal

During the counting process a HIGH level must be applied to input IN1 / IN4 (G/RES). With a LOW level the counter content is frozen. With a rising edge at the input IN1 / IN4 (G/RES) the counter is deleted.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

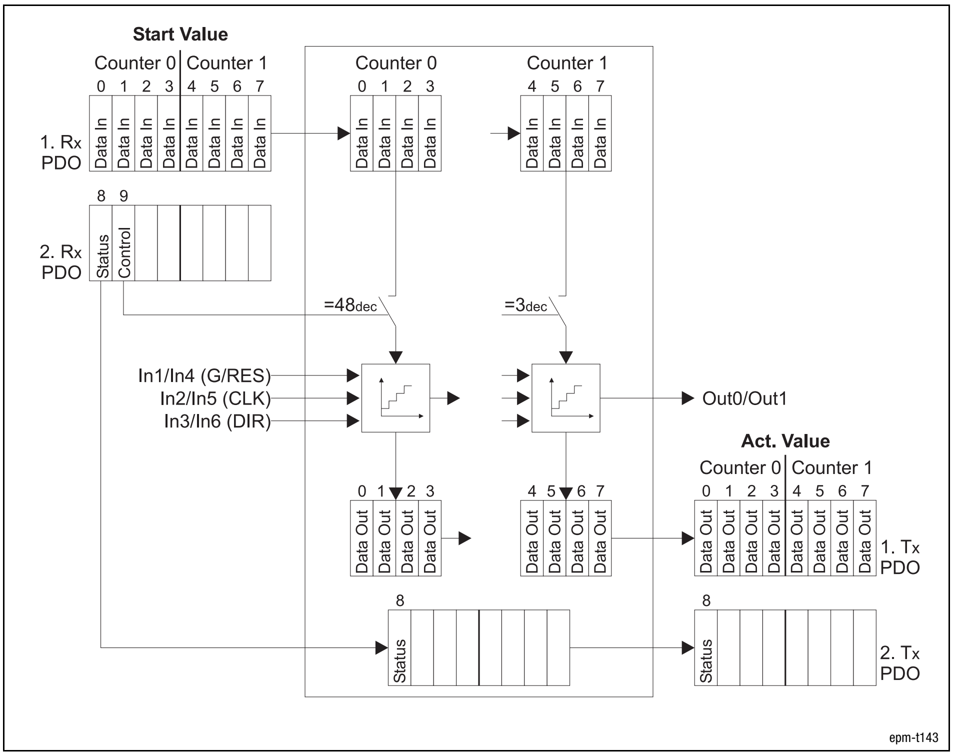


Fig. 12.4-52 Counter access of the 2/4xcounter in the mode 27

Signal characteristic

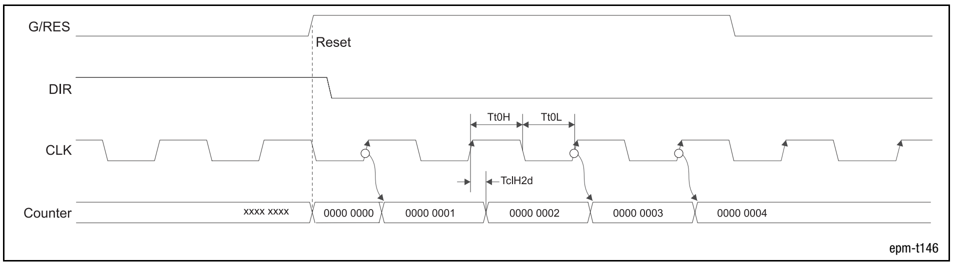


Fig. 12.4-53 Signal characteristic of 2/4xcounter in the mode 27 (upcounter)

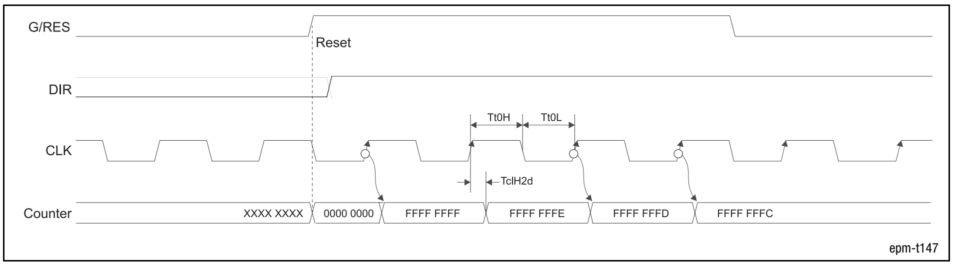


Fig. 12.4-54 Signal characteristic of 2/4xcounter in the mode 27 (downcounter)

12.4.15 Encoder with G/RES (modes 28 ... 30)

Terminal assignment

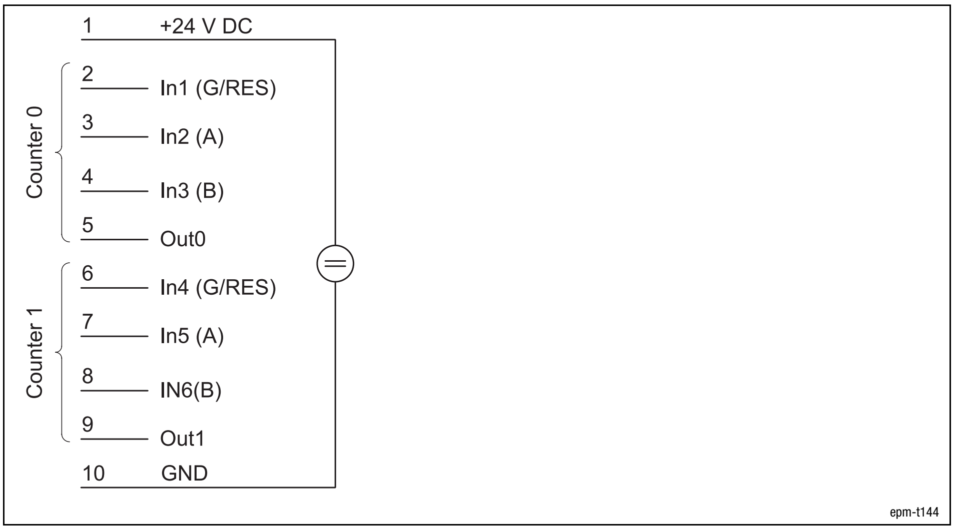


Fig. 12.4-55 Terminal assignment of the 2/4xcounter in the modes 28 ...30

The modes 28 to 30 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 28: 1 edge
Mode 29: 2 edges
Mode 30: 4 edges

A/B signal

See signal characteristics.

G/RES signal

During the counting process a HIGH level must be applied to input IN1 / IN4 (G/RES). With a LOW level the counter content is frozen. With a rising edge at the input IN1 / IN4 (G/RES) the counter is deleted.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

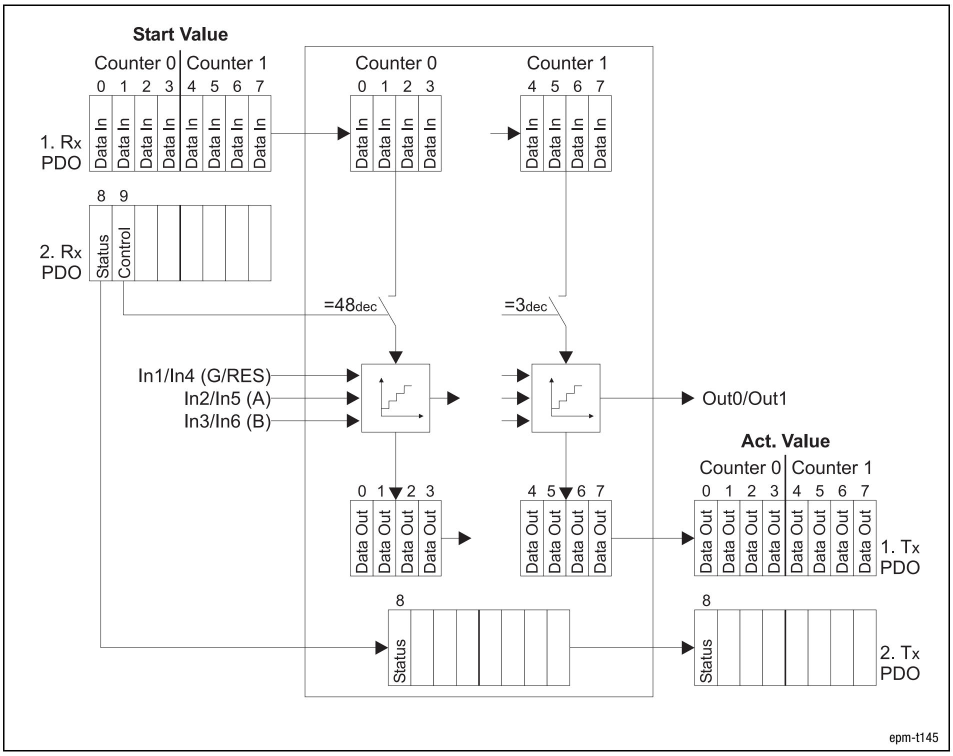


Fig. 12.4-56 Counter access of the 2/4xcounter in the modes 28 ... 30

Signal characteristic in mode 28

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

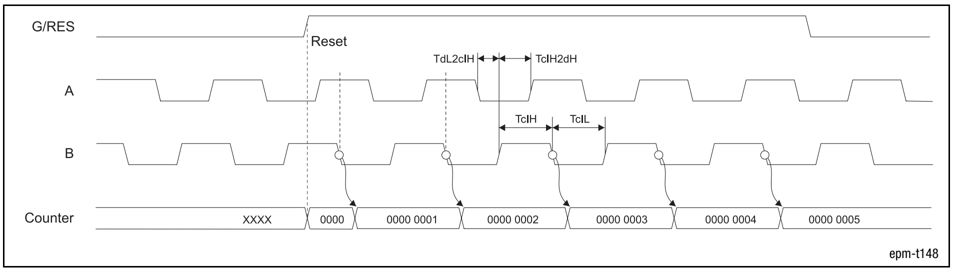


Fig. 12.4-57 Signal characteristic of the 2/4xcounter in the mode 28 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

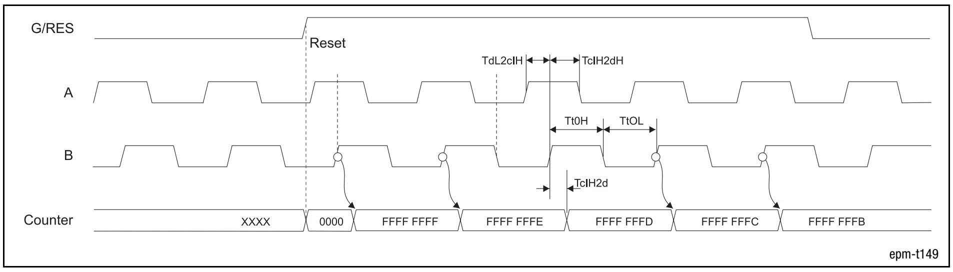


Fig. 12.4-58 Signal characteristic of 2/4xcounter in the mode 28 (downcounter)

Signal characteristic in mode 29

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

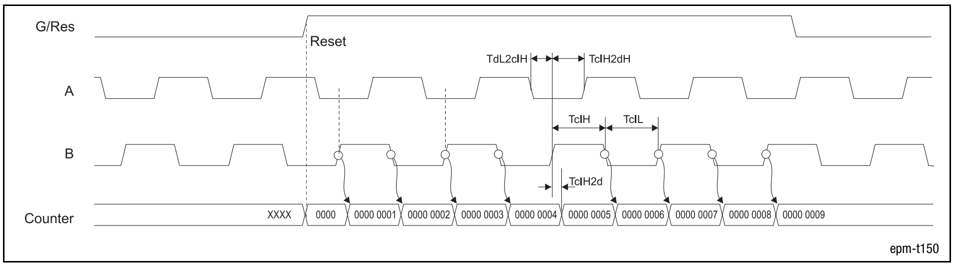


Fig. 12.4-59 Signal characteristic of 2/4xcounter in the mode 29 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

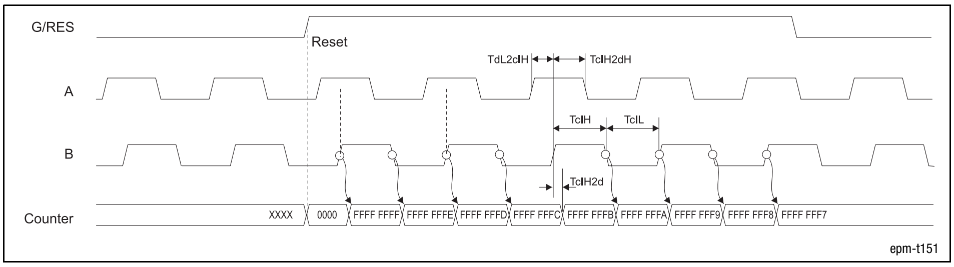


Fig. 12.4-60 Signal characteristic of 2/4xcounter in the mode 29 (downcounter)

Signal characteristic in mode 30

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

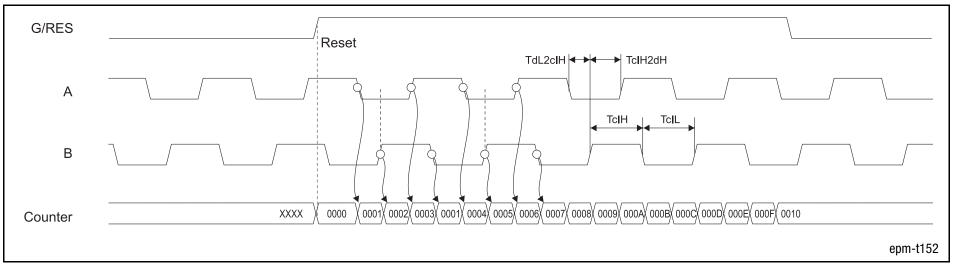


Fig. 12.4-61 Signal characteristic of 2/4xcounter in the mode 30 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

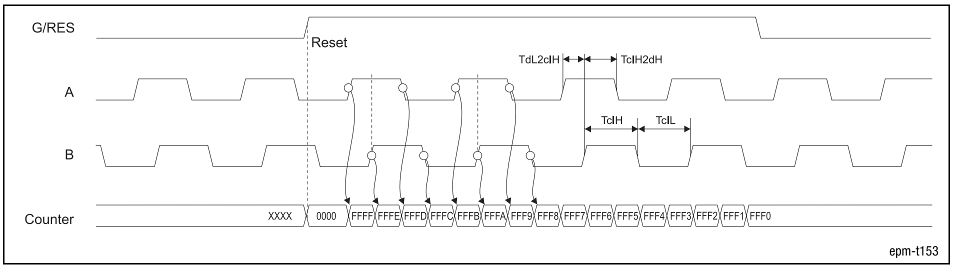


Fig. 12.4-62 Signal characteristic of 2/4xcounter in the mode 30 (downcounter)

12.4.16 2 × 32 bit counter with GATE and RES edge-triggered (modes 31 and 32)

Terminal assignment

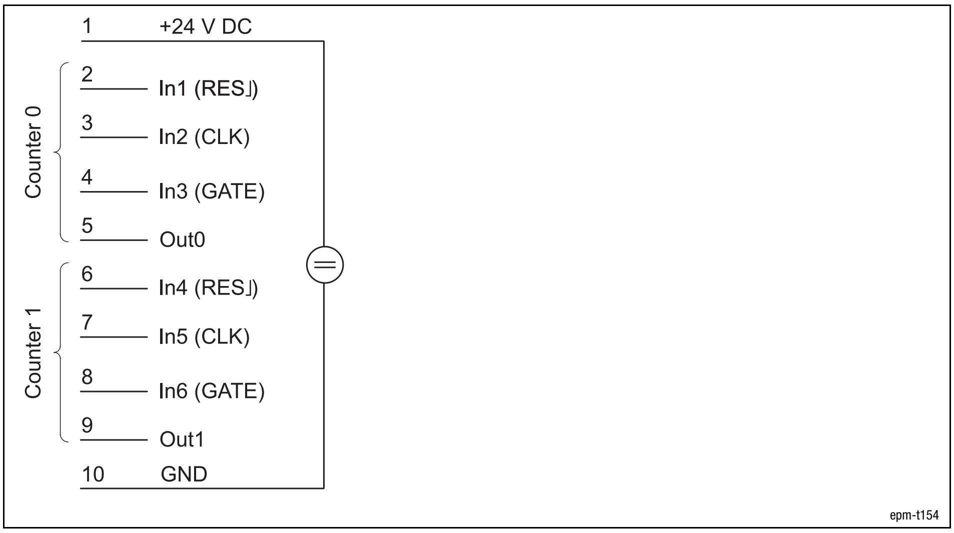


Fig. 12.4-63 Terminal assignment of the 2/4xcounter in the modes 31 and 32

In the modes 31 to 32, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modules differ in having different counting directions:

Mode 31: Upcounter.
Mode 32: Downcounter

RES⌋ signal

A LOW/HIGH edge at input IN1 / IN04 (RES⌋) clears the counter.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

OUT signal

Once the counter reaches the value loaded in the "Compare" register, output OUT0 / OUT1 is set to HIGH level for at least 100 ms, with the counter continuing its task.

Counter access

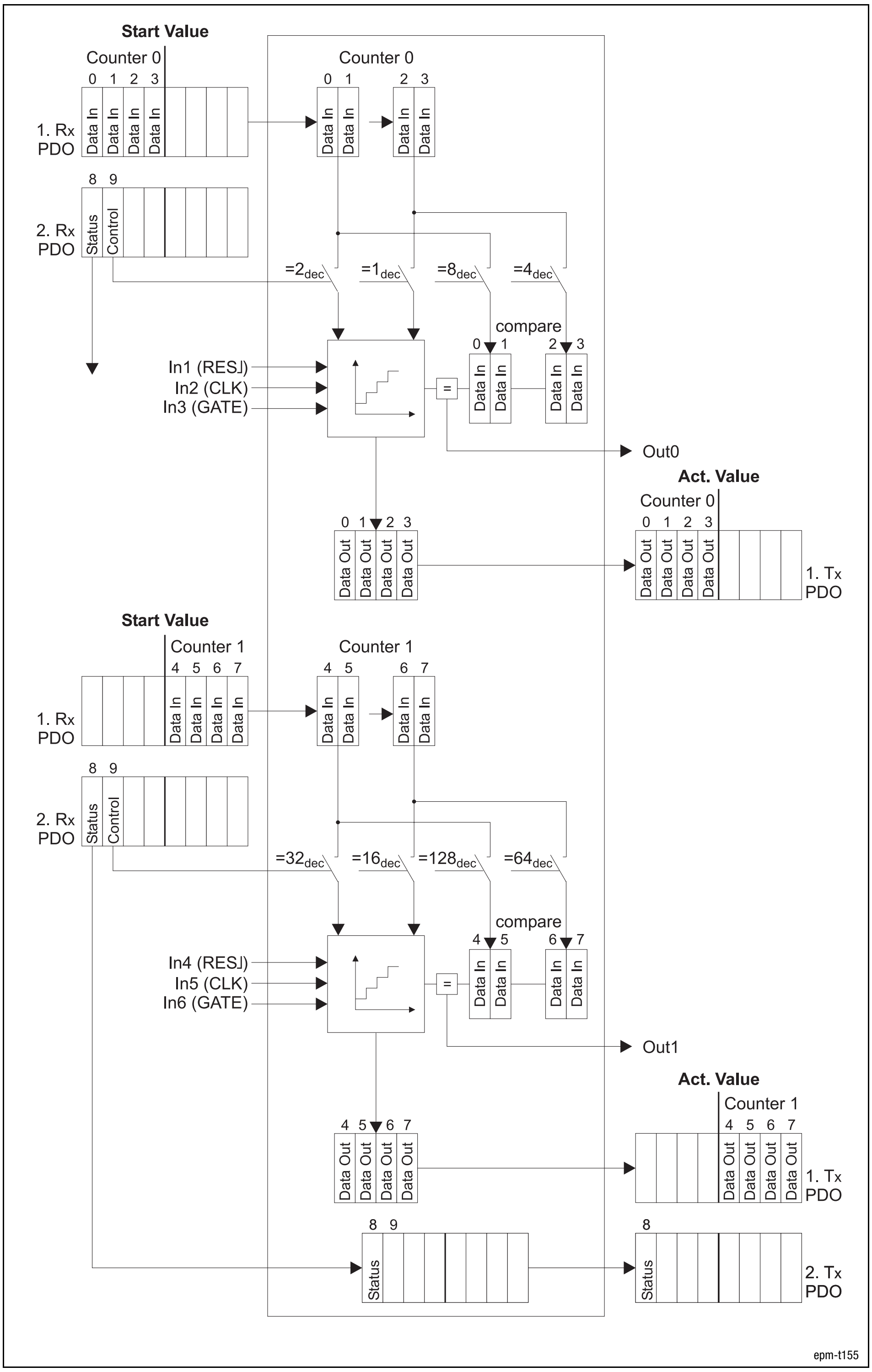


Fig. 12.4-64 Counter access of the 2/4xcounter in the modes 31 and 32

Signal characteristic

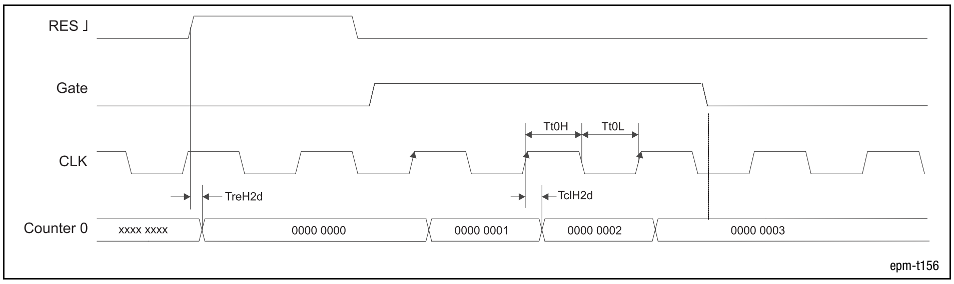


Fig. 12.4-65 Signal characteristic of 2/4xcounter in the mode 31

12.4.17 2 × 32 bit counter with GATE, RES edge-triggered and auto reload (modes 33 and 34)

Terminal assignment

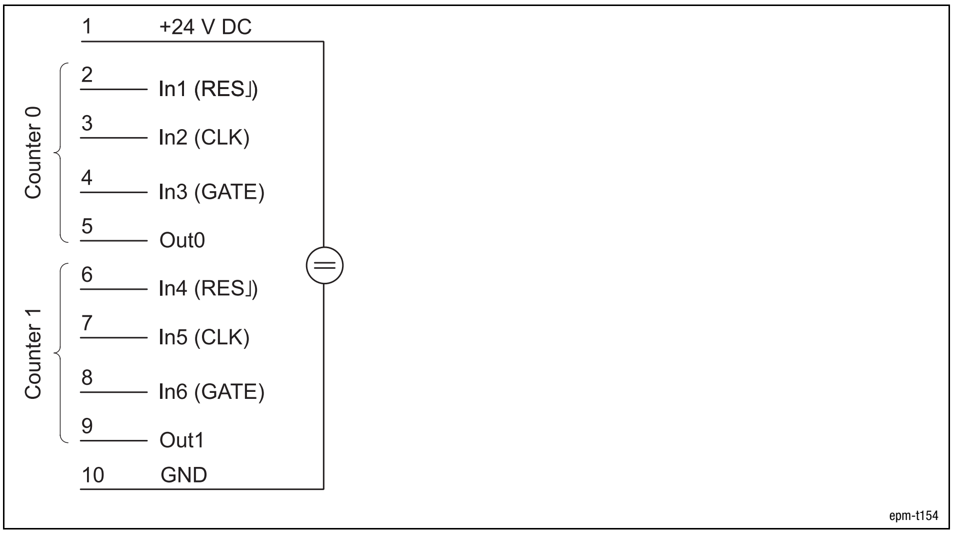


Fig. 12.4-66 Terminal assignment of the 2/4xcounter in the modes 33 and 34

In the modes 33 and 34, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

These modes offer the function ”Auto Reload”. This means, that the Load Register can be assigned with a value which is automatically loaded into the counter as soon as it reaches the comparison value set.

The modules differ in having different counting directions:

Mode 33: Upcounter
Mode 34: Downcounter

RES⌋ signal

A LOW/HIGH edge at input IN1 / IN04 (RES⌋) clears the counter.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

The counter counts up to the value set in the compare register. With this last LOW-HIGH edge the counter content is overwritten with the value set in the load register. This is repeated until the input IN3 / IN6 (GATE) receives a LOW signal.

OUT signal

If an ”Auto Reload” occurs, the signal level at the output OUT0 / OUT1 changes. (A LOW-HIGH-edge at the output IN1 / IN4 (RES⌋) does **not** reset the output OUT0 / OUT1.)

Counter access

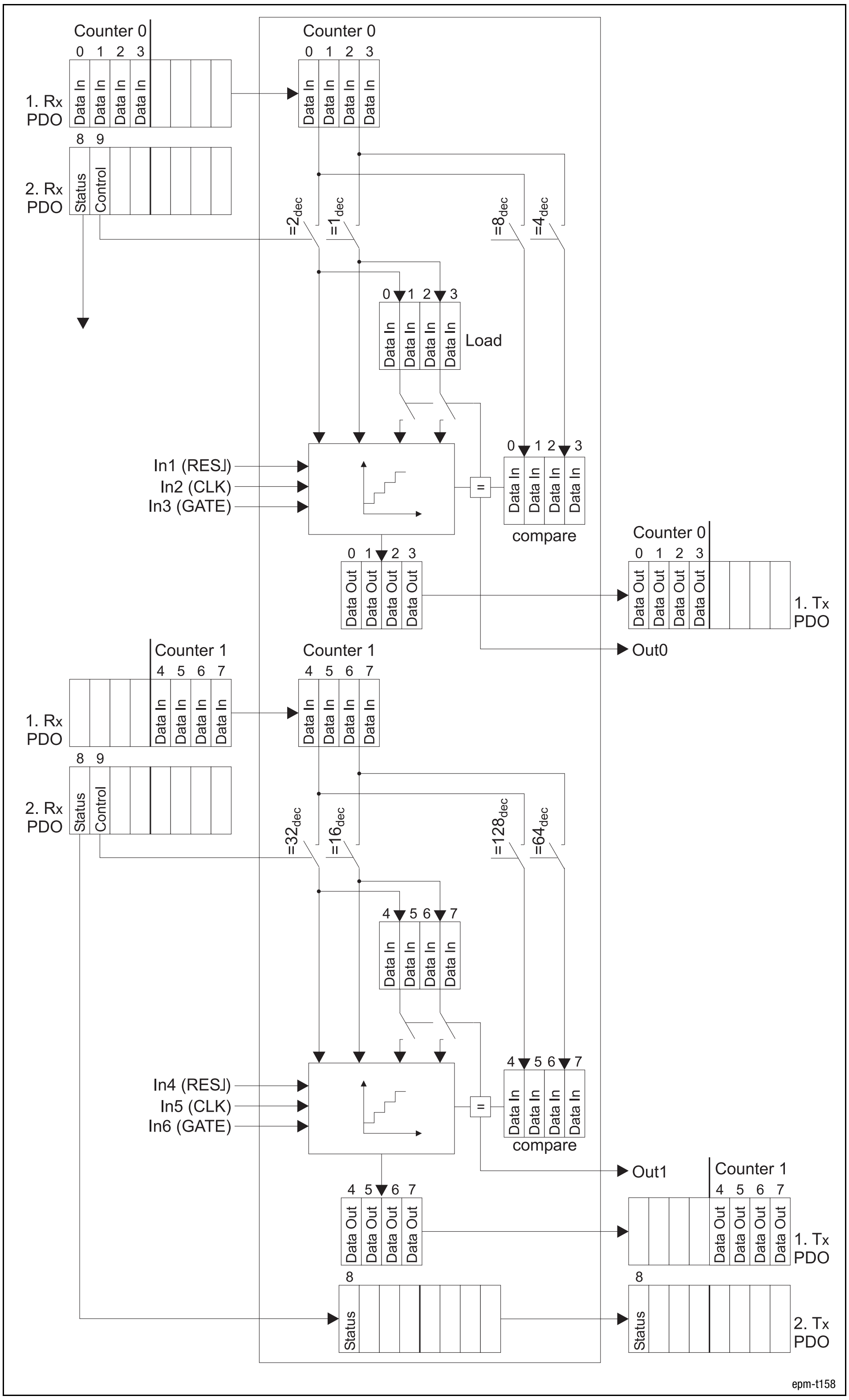


Fig. 12.4-67 Counter access of the 2/4xcounter in the modes 33 and 34

Signal characteristic

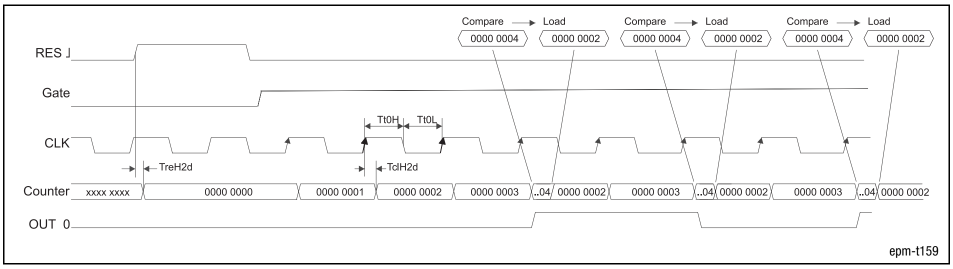


Fig. 12.4-68 Signal characteristic of 2/4xcounter in the mode 33 (upcounter)

12.4.18 2 x 32 bit counter with GATE (mode 35)

Terminal assignment

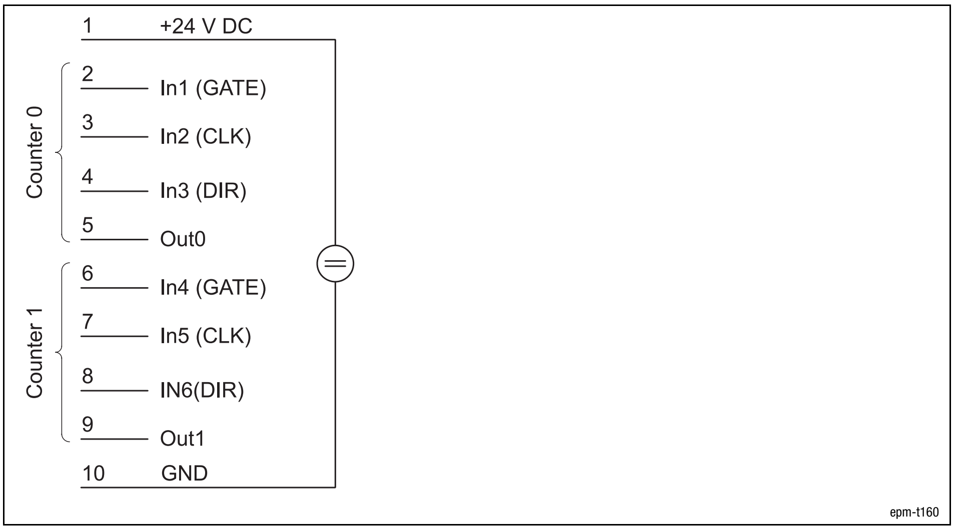


Fig. 12.4-69 Terminal assignment of the 2/4xcounter in the mode 35

The mode 35 offers two 32-bit counters which can be assigned with a starting value.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

CLK signal

Each LOW-HIGH edge at input IN2 / IN5 (CLK) increments and/or decrements the counter by 1, respectively.

GATE signal

During the counting process, a HIGH level must be applied to input IN1 / IN4 (GATE). With a LOW level the counter content is frozen.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

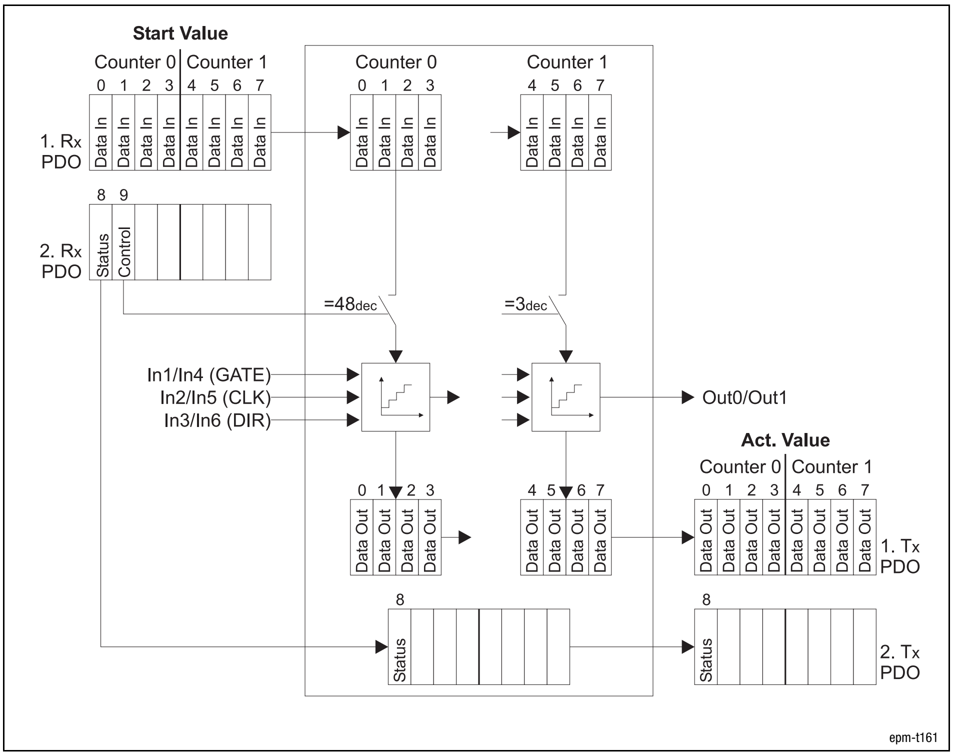


Fig. 12.4-70 Counter access of the 2/4xcounter in the mode 35

Signal characteristic

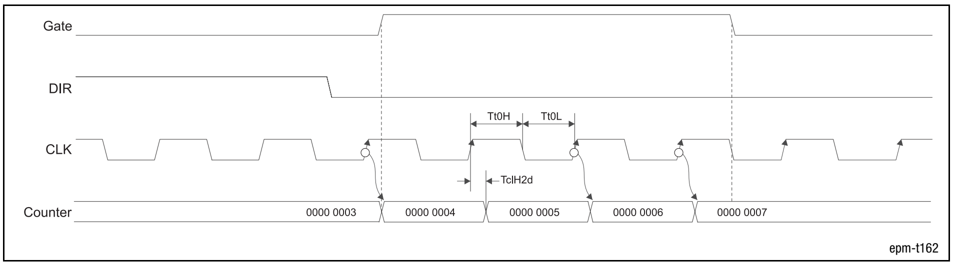


Fig. 12.4-71 Signal characteristic of 2/4xcounter in the mode 35 (upcounter)

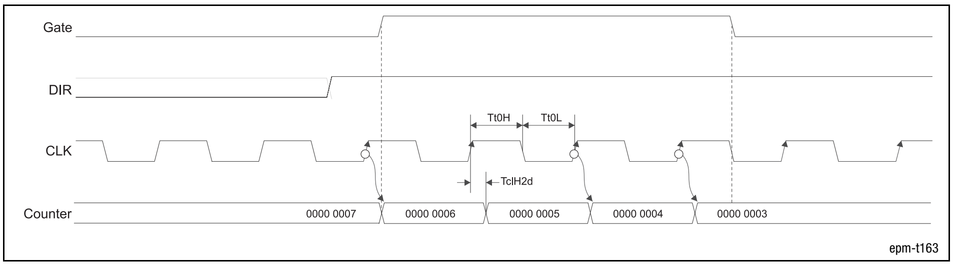


Fig. 12.4-72 Signal characteristic of 2/4xcounter in the mode 35 (downcounter)

12.4.19 Encoder with GATE (modes 36 ... 38)

Terminal assignment

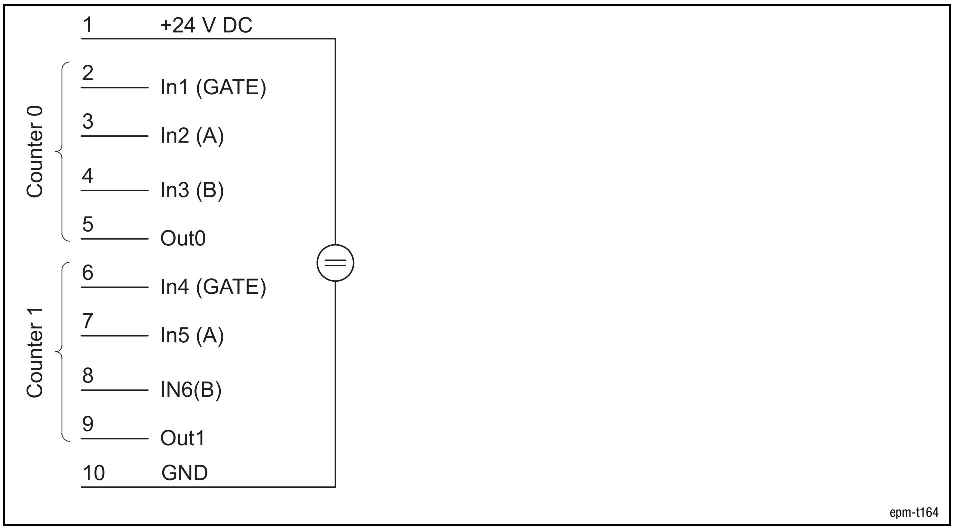


Fig. 12.4-73 Terminal assignment of the 2/4xcounter in the modes 36 ... 38

The modes 36 to 38 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 36: 1 edge
Mode 37: 2 edges
Mode 38: 4 edges

A/B signal

See signal characteristics.

GATE signal

During the counting process, a HIGH level must be applied to input IN1 / IN4 (GATE). With a LOW level the counter content is frozen.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

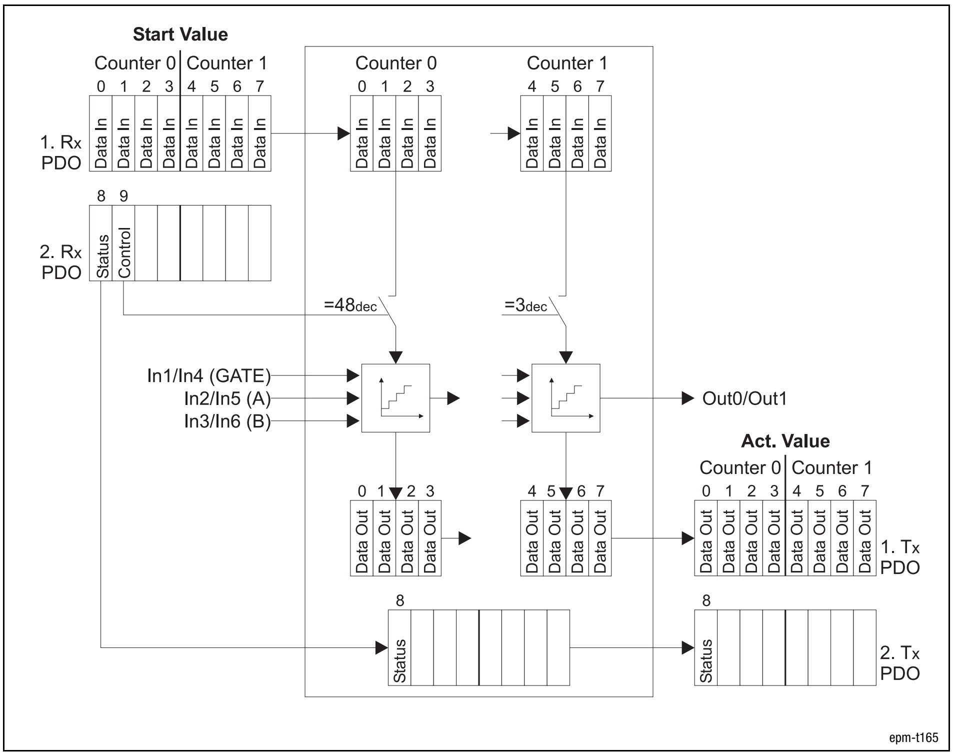


Fig. 12.4-74 Counter access of the 2/4xcounter in the modes 36, 37 and 38

Signal characteristic in mode 36

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

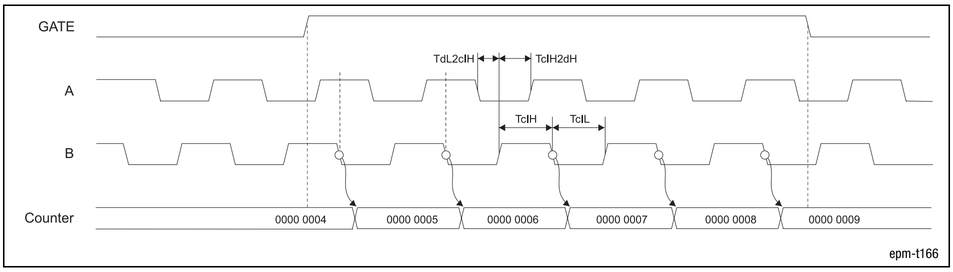


Fig. 12.4-75 Signal characteristic of 2/4xcounter in the mode 36 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

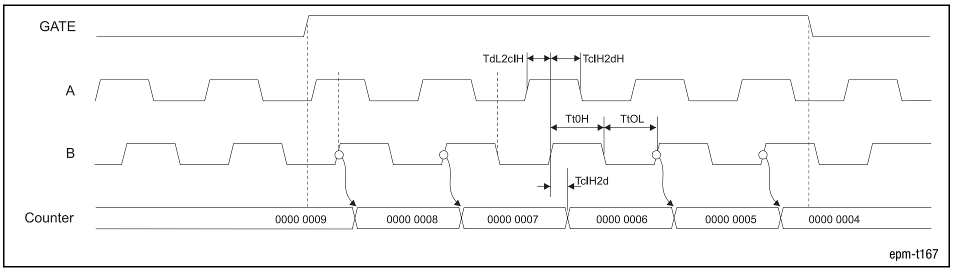


Fig. 12.4-76 Signal characteristic of 2/4xcounter in the mode 36 (downcounter)

Signal characteristic in mode 37

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

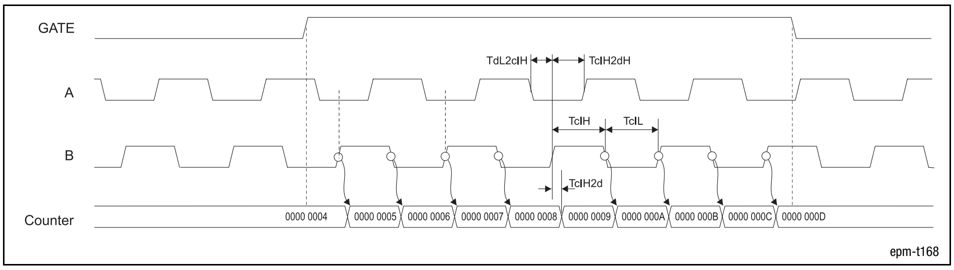


Fig. 12.4-77 Signal characteristic of 2/4xcounter in the mode 37 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

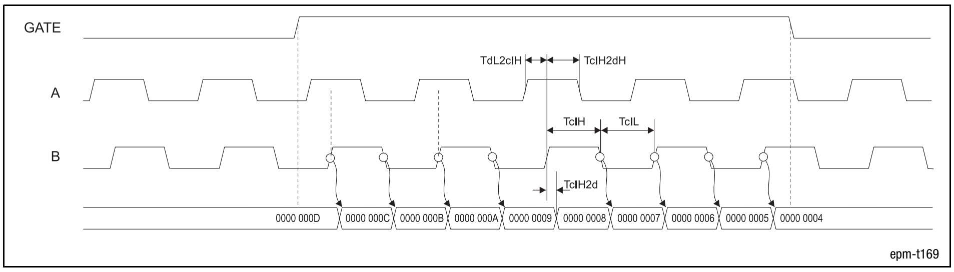


Fig. 12.4-78 Signal characteristic of 2/4xcounter in the mode 37 (downcounter)

Signal characteristic in mode 38

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

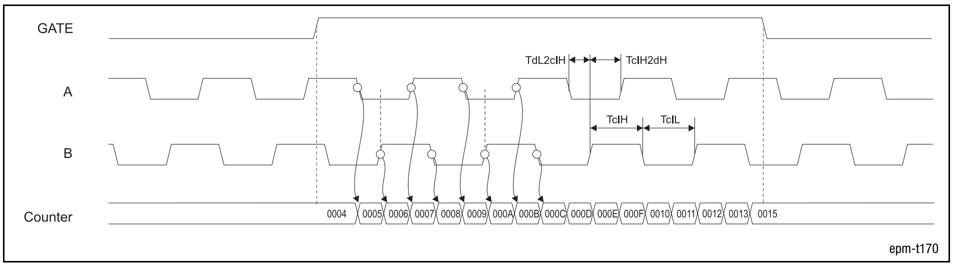


Fig. 12.4-79 Signal characteristic of 2/4xcounter in the mode 38 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

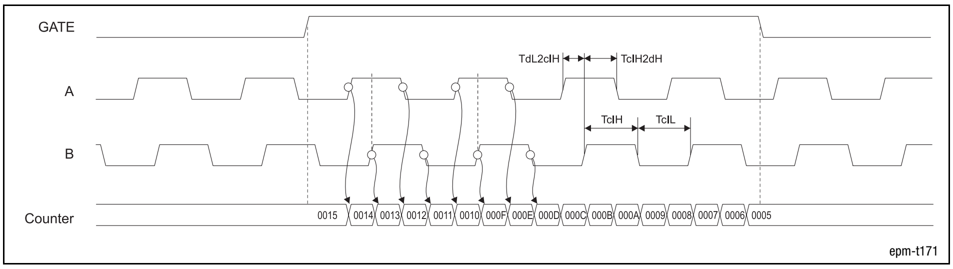


Fig. 12.4-80 Signal characteristic of 2/4xcounter in the mode 38 (downcounter)

12.5 Parameterising SSI interface

12.5.1 Parameter data

Mapping setting

Use index I4104h to define the process data mapping (PDO mapping) for the input/output bytes and the control byte of the SSI interface:

- I4104h = 0: SSI mapping PLC
  - PDO mapping is required for data evaluation with PLC units using the function blocks "L_IOSSIDataToIO" and "L_IOSSIDataFromIO".
- I4104h = 1: SSI mapping standard 1 and
  I4104h = 2: SSI mapping standard 2
  - PDO mapping is required for data evaluation with 9300 controllers using the function blocks "CAN-IN" and "CAN-OUT".

Note!

"SSI mapping standard 1" and "SSI mapping standard 2" differ in the arrangement of the input/output bytes and the control byte.

- Please read the documentation for the controller, in particular for the CAN-IN function block, to see which mapping is to be used for communication.

Baud rate, code and hold function setting

For the SSI interface, 4 bytes of parameter data are available, which are assigned via SDOs. The following can be defined via the parameter data:

- Baud rate
- Coding type
- Evaluation of the combined I/O.0

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the SSI interface is parameterised via the indices I3001h ... I3010h (max. 8 SSI interface modules). The parameter data are stored in subindex 1.

Parameter setting via CoDeSys:

The max. 8 SSI interface modules are addressed via index I3401h. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The SSI interface module assigns 1 subindex.

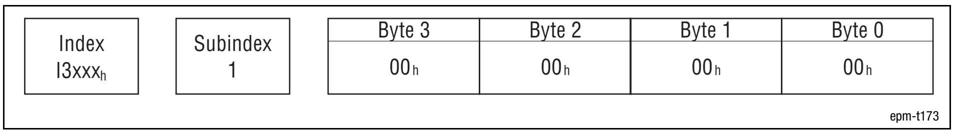


Fig. 12.5-1 Display of the parameter data of the SSI interface

The parameter data are assigned as follows:

Byte	Assignment		Lenze setting
0	Reserved		
1	Reserved		
2	Baud rate [1]	00_h = 300 kBaud 01_h = 100 kBaud 02_h = 300 kBaud 03_h = 600 kBaud 04_h ... FF_h = 300 kBaud	00_h
3	Coding [2]	Bit 0 0 Binary code 1 Gray Code Bit 1 Reserved	00_h
	Hold function [3]	Bit 2 0 Deactivate 1 Activate Bits 3 ... 7 Reserved	

[1] The encoder connected to the SSI interface transmits serial data. Therefore the encoder receives a clock pulse from the SSI interface. The clock pulse is determined by you.

[2] If the encoder transmits the data in Gray code to the SSI interface, activate the Gray code to ensure that the data will be transferred in binary code from the gateway.

[3] If the hold function is activated, the current encoder value will be frozen as soon as +24 V are applied to the input I/O.0 +24 V. For this, the switching function must be parameterised for the input I/O.0 ($I4101_h$ or $I4103_h$).

Note!

The baud rate depends on the cable length and the SSI encoder. The cables must be twisted and shielded in pairs. The following data serve as a guideline:

Cable length	Baud rate
< 400 m	100 kBaud
< 100 m	300 kBaud
< 50 m	600 kBaud

12.5.2 Input data assignment via index

The input data of the SSI interface can be parameterised via indices. The indices required depend on the mapping ($I4104_h$).

Note!

Settings under indices $I4101_h$ and $I4103_h$ can only be reset by disconnecting the supply voltage.

$I4104_h$ = 0 (SSI mapping PLC)

- The input data of the modules (subindex 1 ... 8) are set under index $I4101_h$:

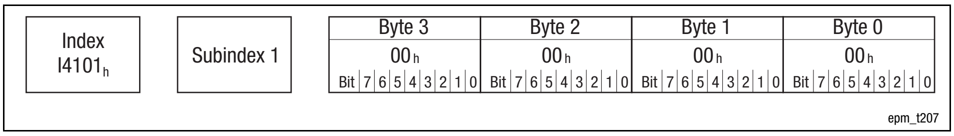


Fig. 12.5-2 Mapping of the input data under $I4101_h$, subindex 1 (module 1)

Byte	Assignment		
0	Control	Bits 0 ... 1	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value > setpoint 1: If SSI encoder value < setpoint
		Bits 4 ... 7	Reserved
1	Comparison value (LOW byte)	Bits 0 ... 7	Selection of comparison value
2	Comparison value (MID byte)	Bits 0 ... 7	
3	Comparison value (HIGH byte)	Bits 0 ... 7	

- The output data of the modules (subindex 1 ... 8) are indicated under index $I4100_h$:

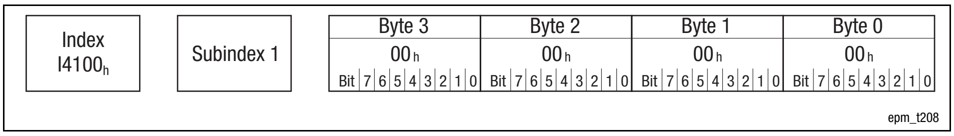


Fig. 12.5-3 Mapping of the output data under $I4100_h$, subindex 1 (module 1)

Byte	Assignment		
0	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7	Reserved
1	SSI encoder value (LOW byte)	Bits 0 ... 7	Output of SSI encoder value
2	SSI encoder value (MID byte)	Bits 0 ... 7	
3	SSI encoder value (HIGH byte)	Bits 0 ... 7	

SSI mapping standard 1 and SSI mapping standard 2

- Use the modes "SSI mapping standard 1" ($I4104_h$ = 1) and "SSI mapping standard 2" ($I4104_h$ = 2) to parameterise the input data of the modules (subindex 1 ... 8) under index $I4101_h$:

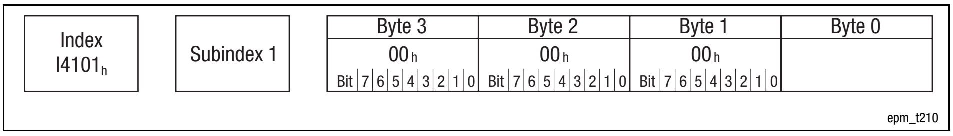


Fig. 12.5-4 Mapping of the input data under $I4101_h$, subindex 1 (module 1)

Byte	Assignment		
0	Reserved		
1	Comparison value (LOW byte)	Bits 0 ... 7	Selection of comparison value
2	Comparison value (MID byte)	Bits 0 ... 7	
3	Comparison value (HIGH byte)	Bits 0 ... 7	

- The switching conditions for module I/O.0 and I/O.1 are defined under index $I4103_h$ (subindex 1 ... 9):

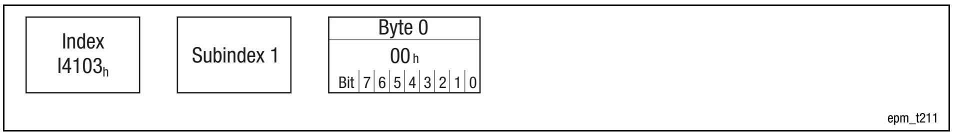


Fig. 12.5-5 Mapping of the control byte under $I4103_h$, subindex 1 (module 1)

Byte	Assignment		
0	Control	Bits 0 ... 1	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value is higher than setpoint 1: If SSI encoder value is lower than setpoint
		Bits 4 ... 7	Reserved

- The output data of the modules (subindex 1 ... 9) are indicated under index $I4100_h$:

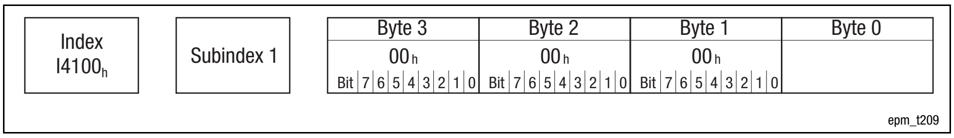


Fig. 12.5-6 Mapping of the output data under $I4100_h$, subindex 1 (module 1)

Byte	Assignment		
0	Reserved		
1	SSI encoder value (LOW byte)	Bits 0 ... 7	Output of SSI encoder value
2	SSI encoder value (MID byte)	Bits 0 ... 7	
3	SSI encoder value (HIGH byte)	Bits 0 ... 7	

- The status of the switching conditions for module I/O.0 and I/O.1 is indicated under index $I4102_h$ (subindex 1 ... 9):

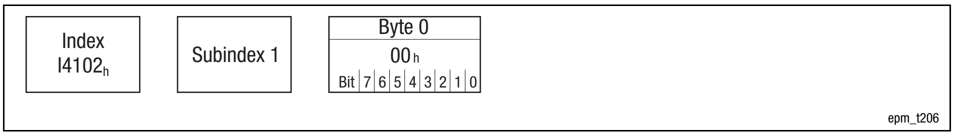


Fig. 12.5-7 Mapping of the status byte under $I4102_h$, subindex 1 (module 1)

Byte	Assignment		
0	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7	Reserved

12.5.3 Process data assignment for ”SSI mapping PLC” (I4104 = 0)

This mapping is required for encoder value evaluation with Lenze PLC units and function blocks of the ”IO_System.lib”.

Setting index $I4104_h$ = 0 (Lenze setting) adapts the input/output byte assignment for communication with Lenze PLC units.

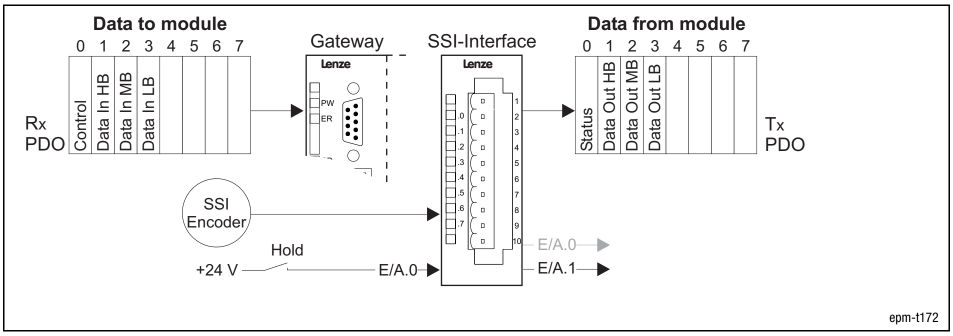


Fig. 12.5-8 Data input /output of SSI interface

For data input / output, four bytes are available which are transmitted (Rx PDO) or output (Tx PDO) by PDOs.

Note!

Input and output data get lost when the mains supply is switched off/on; they are not stored!

Input data

The Rx PDO contains the input data used to control the outputs (I/O.0 and I/O.1) depending on the encoder value.

Byte	Assignment		
0	Control	Bits 0 ... 1	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value is higher than setpoint 1: If SSI encoder value is lower than setpoint
		Bits 4 ... 7	Reserved
1	Comparison value (HIGH byte)	Bits 0 ... 7	Selection of comparison value
2	Comparison value (MID byte)	Bits 0 ... 7	
3	Comparison value (LOW byte)	Bits 0 ... 7	

Output data

The Tx PDO contains the output data supplied by the encoder.

Byte	Assignment		
0	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7	Reserved
1	SSI encoder value (HIGH byte)	Bits 0 ... 7	Output of SSI encoder value
2	SSI encoder value (MID byte)	Bits 0 ... 7	
3	SSI encoder value (LOW byte)	Bits 0 ... 7	

Counter access

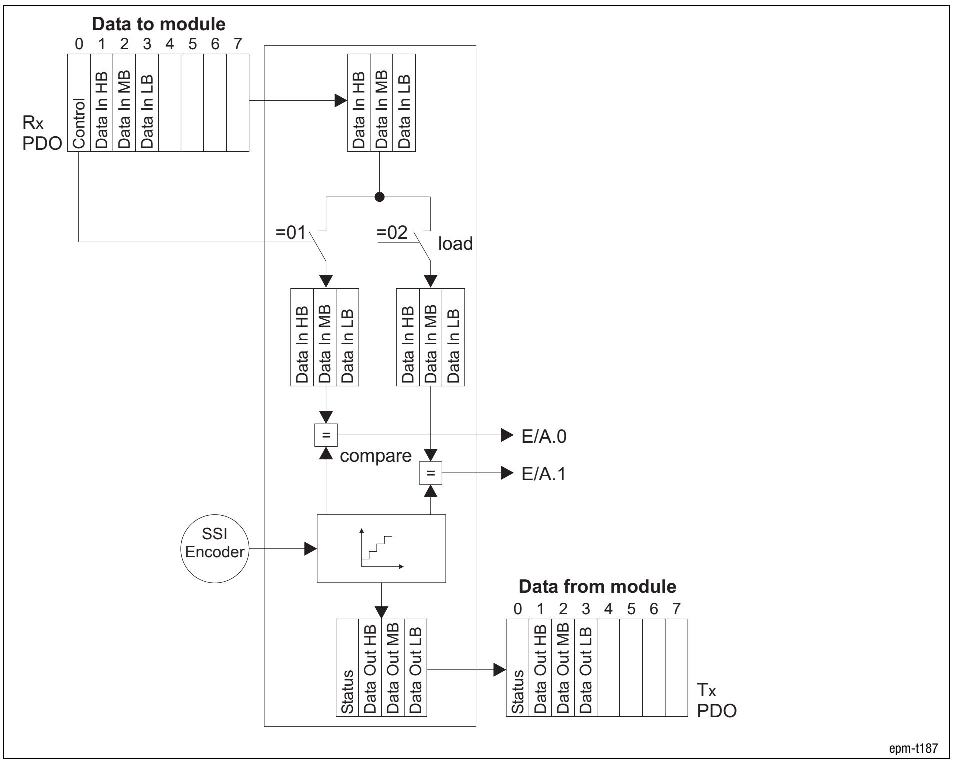


Fig. 12.5-9 Counter access SSI interface, Hold function deactivated

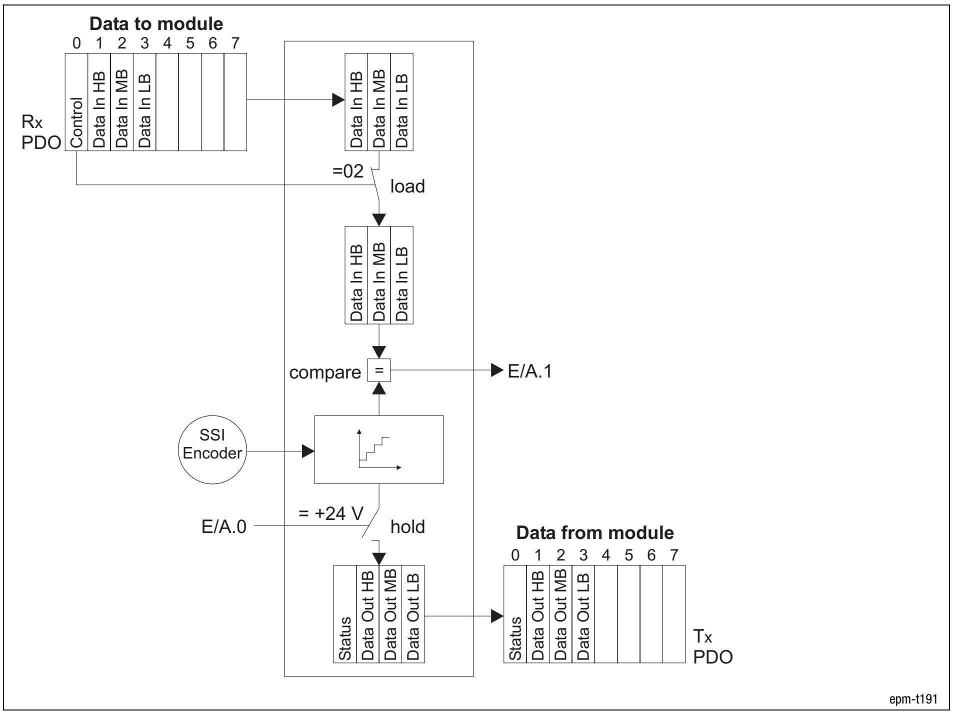


Fig. 12.5-10 Counter access SSI interface, Hold function activated

12.5.4 Process data assignment for ”SSI mapping standard 1” (I4104 = 1)

Note!

”SSI mapping standard 1” and ”SSI mapping standard 2” differ in the arrangement of the input/output bytes and the control byte.

- Please read the documentation for the controller, in particular for the CAN-IN function block, to see which mapping is to be used for communication.

This mapping is required for encoder value evaluation using standard 9300 controllers. The encoder value is provided as DWORD.

Setting index $I4104_h$ = 1 adapts the input/output byte assignment for communication with Lenze 9300 controllers.

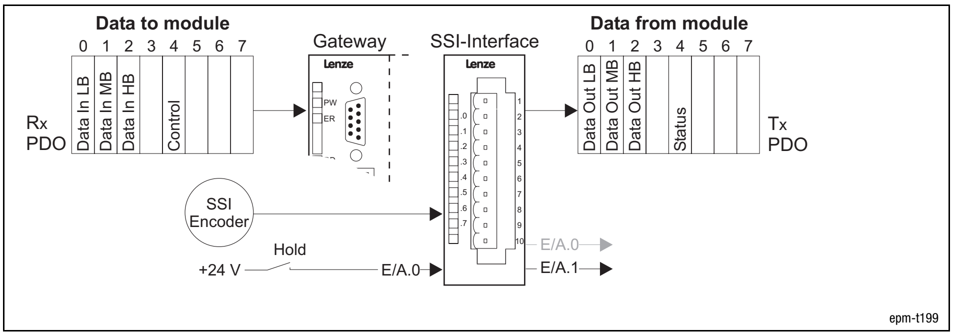


Fig. 12.5-11 Data input /output of SSI interface

For data input / output, four bytes are available which are transmitted (Rx PDO) or output (Tx PDO) by PDOs.

Note!

Input and output data get lost when the mains supply is switched off/on; they are not stored!

Input data

The Rx PDO contains the input data used to control the outputs (I/O.0 and I/O.1) depending on the encoder value.

Byte	Assignment		
0	Comparison value (LOW byte)	Bits 0 ... 7	Selection of comparison value
1	Comparison value (MID byte)	Bits 0 ... 7	
2	Comparison value (HIGH byte)	Bits 0 ... 7	
3	Reserved		
4	Control	Bits 0 ... 1	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value is higher than setpoint 1: If SSI encoder value is lower than setpoint
		Bits 4 ... 7	Reserved

Output data

The Tx PDO contains the output data supplied by the encoder.

Byte	Assignment		
0	SSI encoder value (LOW byte)	Bits 0 ... 7	Output of SSI encoder value
1	SSI encoder value (MID byte)	Bits 0 ... 7	
2	SSI encoder value (HIGH byte)	Bits 0 ... 7	
3	Reserved		
4	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7	Reserved

Counter access

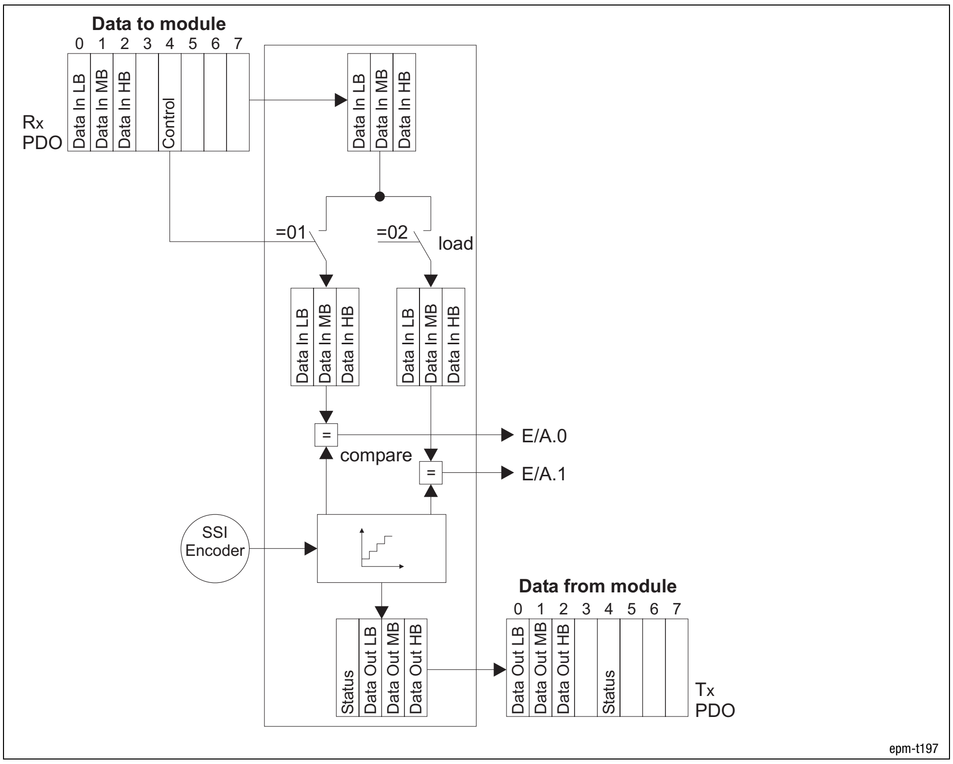


Fig. 12.5-12 Counter access SSI interface, Hold function deactivated

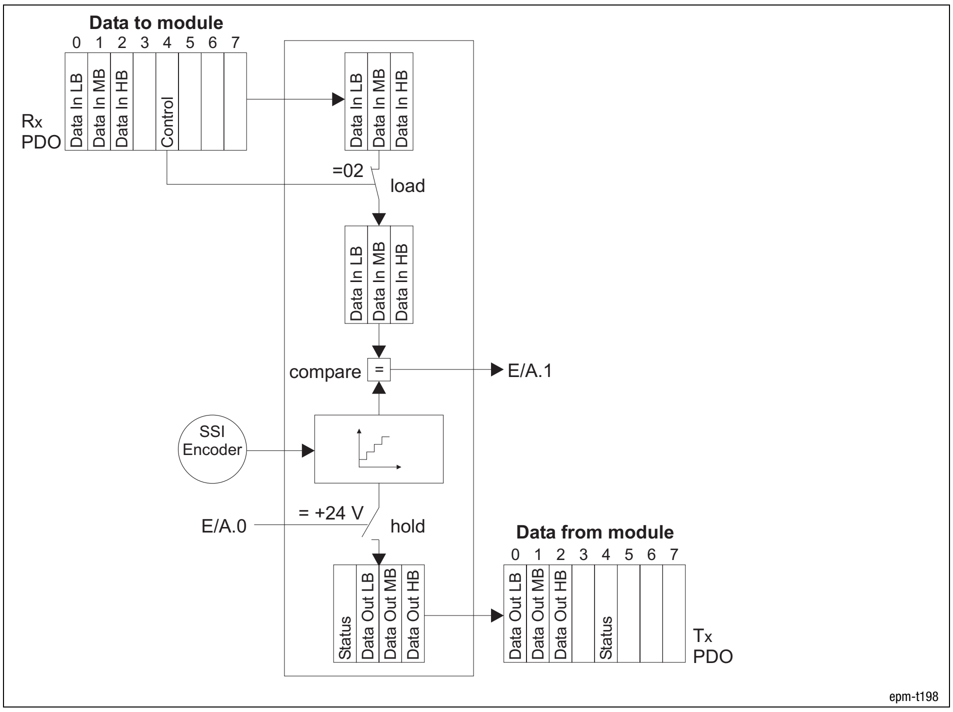


Fig. 12.5-13 Counter access SSI interface, Hold function activated

12.5.5 Process data assignment for ”SSI mapping standard 2” (I4104 = 2)

Note!

”SSI mapping standard 1” and ”SSI mapping standard 2” differ in the arrangement of the input/output bytes and the control byte.

- Please read the documentation for the controller, in particular for the CAN-IN function block, to see which mapping is to be used for communication.

This mapping is required for encoder value evaluation using standard 9300 controllers. The encoder value is provided as DWORD.

Setting index $I4104_h$ = 2 adapts the input/output byte assignment for communication with Lenze 9300 controllers.

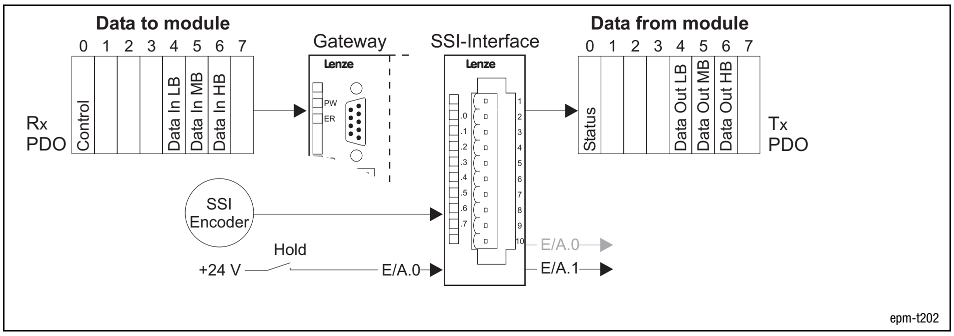


Fig. 12.5-14 Data input /output of SSI interface

For data input / output, four bytes are available which are transmitted (Rx PDO) or output (Tx PDO) by PDOs.

Note!

Input and output data get lost when the mains supply is switched off/on; they are not stored!

Input data

The Rx PDO contains the input data used to control the outputs (I/O.0 and I/O.1) depending on the encoder value.

Byte	Assignment		
0	Control	Bits 0 ... 1	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value is higher than setpoint 1: If SSI encoder value is lower than setpoint
		Bits 4 ... 7	Reserved
1	Reserved		
2	Reserved		
3	Reserved		
4	Comparison value (LOW byte)	Bits 0 ... 7	Selection of comparison value
5	Comparison value (MID byte)	Bits 0 ... 7	
6	Comparison value (HIGH byte)	Bits 0 ... 7	

Output data

The Tx PDO contains the output data supplied by the encoder.

Byte	Assignment		
0	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7	Reserved
1	Reserved		
2	Reserved		
3	Reserved		
4	SSI encoder value (LOW byte)	Bits 0 ... 7	Output of SSI encoder value
5	SSI encoder value (MID byte)	Bits 0 ... 7	
6	SSI encoder value (HIGH byte)	Bits 0 ... 7	

Counter access

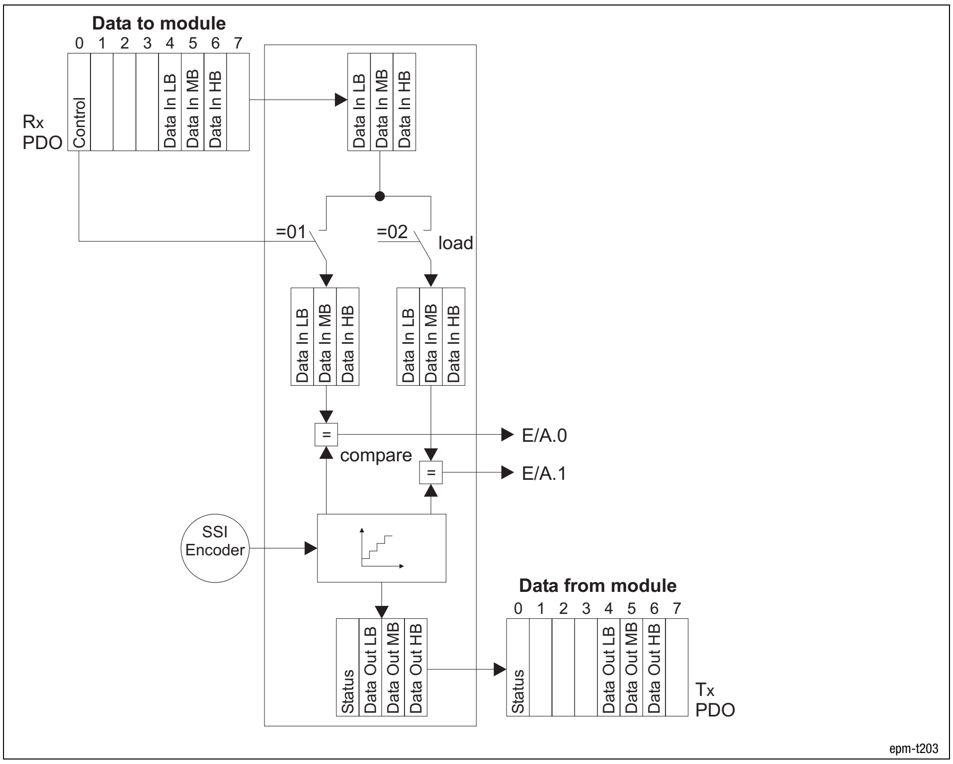


Fig. 12.5-15 Counter access SSI interface, Hold function deactivated

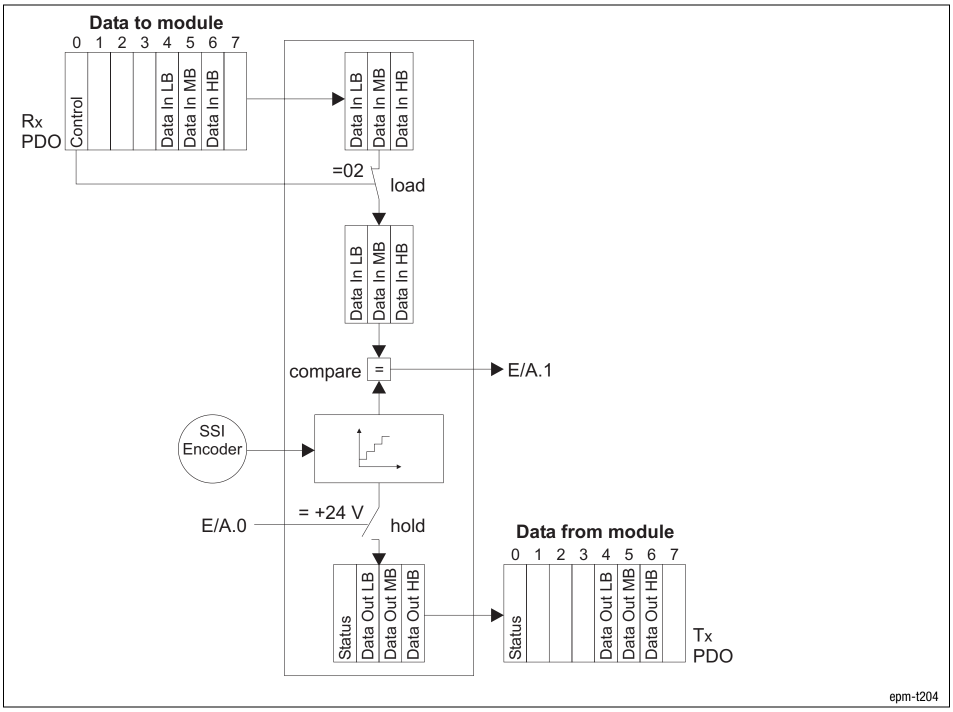


Fig. 12.5-16 Counter access SSI interface, Hold function activated

12.5.6 Example of parameter setting via process data

Example

The station consists of a CAN gateway and an SSI interface. An encoder with a 24-bit resolution and Gray code is used.

Output I/O.0 is to switch with a counter value of > 1000, output I/O.1 with a counter value of > 2000. For a simpler representation, the figures are provided in a hexadecimal format.

Selection	
Mapping	SSI mapping PLC (I4104$_h$ = 0)
Node address	2
Coding (I3001/1)	Gray code
Hold function (I3001/1)	Deactivated

1. Assigning parameter data

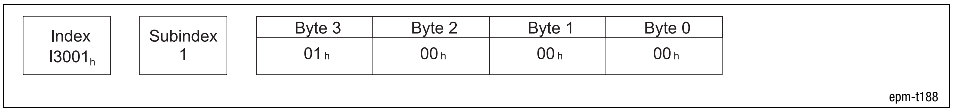


Fig. 12.5-17 Example - How to assign parameter data when using SSI interface

2. Assigning comparison value for channel 0

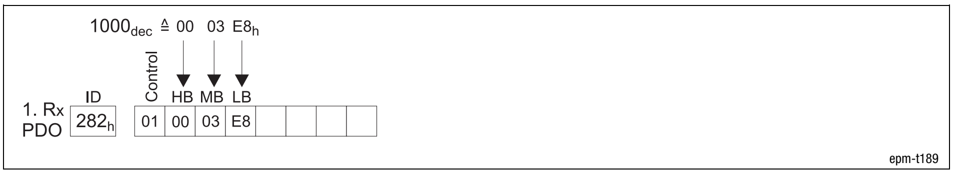


Fig. 12.5-18 Example - How to assign a comparison value to channel 0 when using SSI interface

3. Assigning comparison value for channel 1

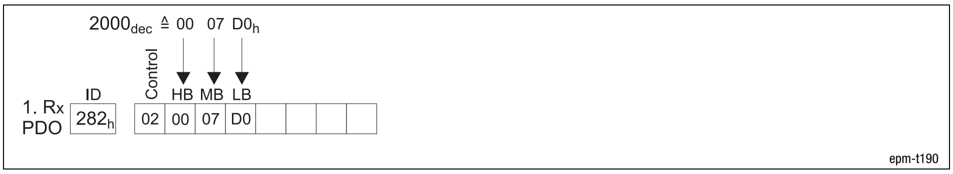


Fig. 12.5-19 Example - How to assign a comparison value to channel 1 when using SSI interface

12.6 Parameterising 1xcounter/16xdigital input module

12.6.1 Parameter data

The parameter data can be used to assign a mode to the internal counter and to configure the digital input filter.

For the 1xcounter/16xdigital input, three bytes of parameter data are available, which are assigned via SDOs.

Parameter setting via Global Drive Control (GDC):

Depending on the plug-in station, the module is parameterised via the indices 3001_h ... $3010x_h$ (maximum 8 counter modules). The parameter data is stored in the subindex 1.

Parameter setting via CoDeSys:

The max. 8 counter modules are addressed via index $I3401_h$. The parameter data are assigned in the subindices 1 ... 64 (4 bytes per subindex). The counter module assigns 1 subindex.

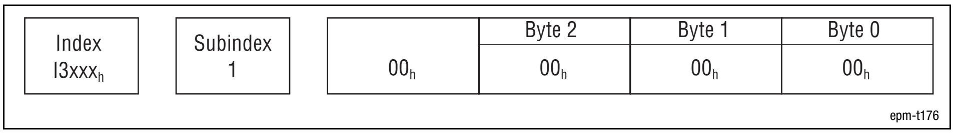


Fig. 12.6-1 Display of the parameter data of 1xcounter/16xdigital input

The parameter data follows the assignment below:

Byte	Assignment			Lenze setting
0	Counter mode	00_h	Encoder with 4 edges	00_h
		01_h	32-bit counter	
		02_h	Clock up/clock down evaluation	
		03_h	Measuring the frequency	
		04_h	Measuring the period	
		05_h ... FF_h	Reserved	
1	Filter factor A	0 ... 255	Configuration of the digital input filters for counter inputs E.0 and E.1	00_h
2	Filter factor B	0 ... 255		00_h

Note!

Store changed parameters in the EEPROM via index $I2003_h$. The settings are maintained after switching off the supply voltage.

12.6.2 Input data / output data

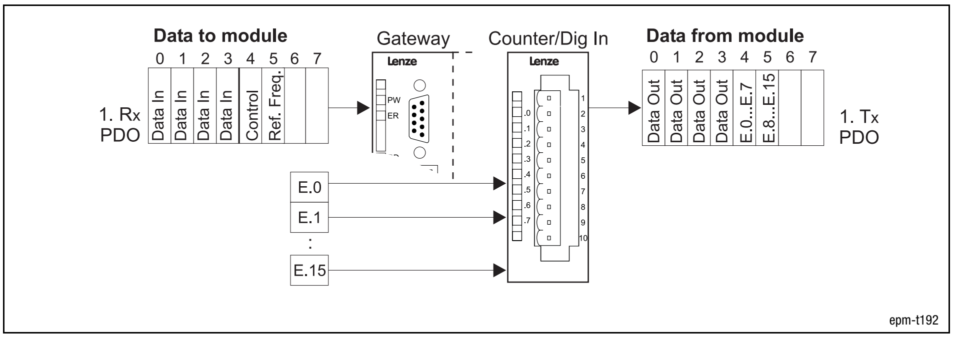


Fig. 12.6-2 Data input / data output 1xcounter/16xdigital input

For data input / output, six bytes are available which are transmitted via a PDO to the counter (Rx PDO) or output by the counter (Tx PDO).

Note!

Input and output data get lost when the mains supply is switched off/on; they are not stored!

Input data

The inputs E.0 and E.1 are used as counter inputs and digital inputs.

The counter starting value is located in the first Rx PDO in the bytes 0 to 3 (Data In). If a starting value is loaded, the counter counts upwards or downwards, starting with this value.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting upwards) has been reached, the count value jumps to the lower count limit. The moment the lower count limit (when counting downwards) has been reached, the count value jumps to the upper count limit.

The counter is controlled via byte 4 (control). It is assigned as follows:

Byte	Assignment		
4	Control byte	Bit 0	1 = Start counter (software gate is open) 1)
		Bit 1	1 = Stop counter (software gate is closed) 1)
		Bit 2	1 = Counter is loaded with starting value / comparison value
		Bit 3	1 = Count value is deleted
		Bits 4 ... 7	reserved

1) If start bit and stop bit = HIGH, "stop" is active. If both bits are LOW, the state of the bit that has been set last, is active.

Via byte 5 the reference frequency for the modes 3 (frequency measurement) and 4 (period measurement) can be set. It is assigned as follows:

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		08_h...FF_h	not permissible

Output data

The current count value is located in the first Tx PDO in the bytes 0 to 3 (Data Out) and can be read out there. Bytes 4 and 5 contain the control signals (E.0 ... E.15).

Counter access

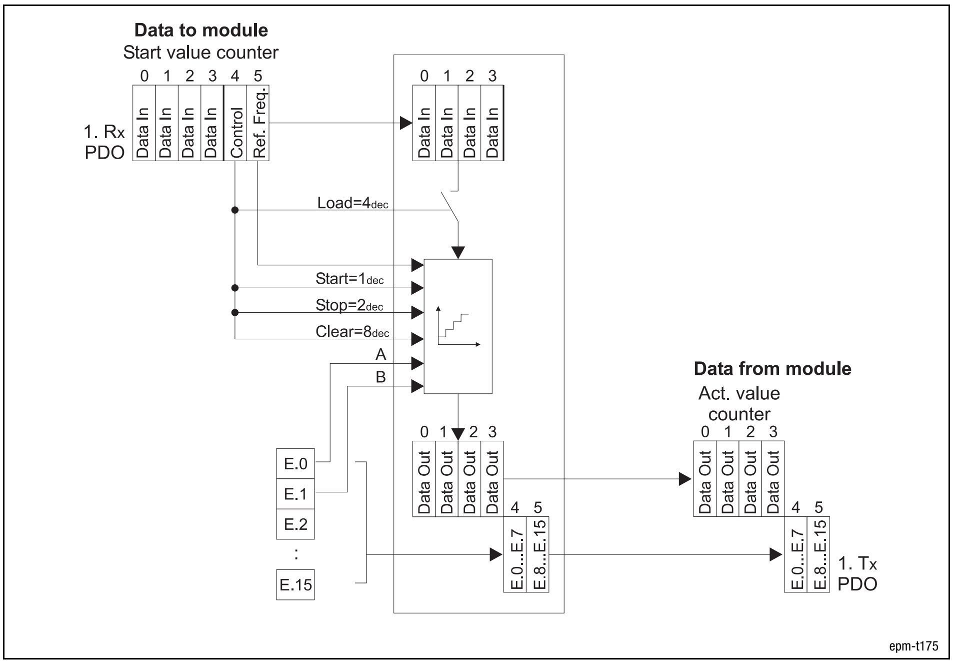


Fig. 12.6-3 Counter access - 1xcounter/16xdigital input

12.6.3 Encoder (mode 0)

In the mode 0, the rising and falling edges of signal A and B are evaluated. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting upwards) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting downwards) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process, is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: Every rising or falling edge of signal A (E.0) and B (E.1) increments or decrements the count value. The counting direction depends on which signal is leading.

Counter access

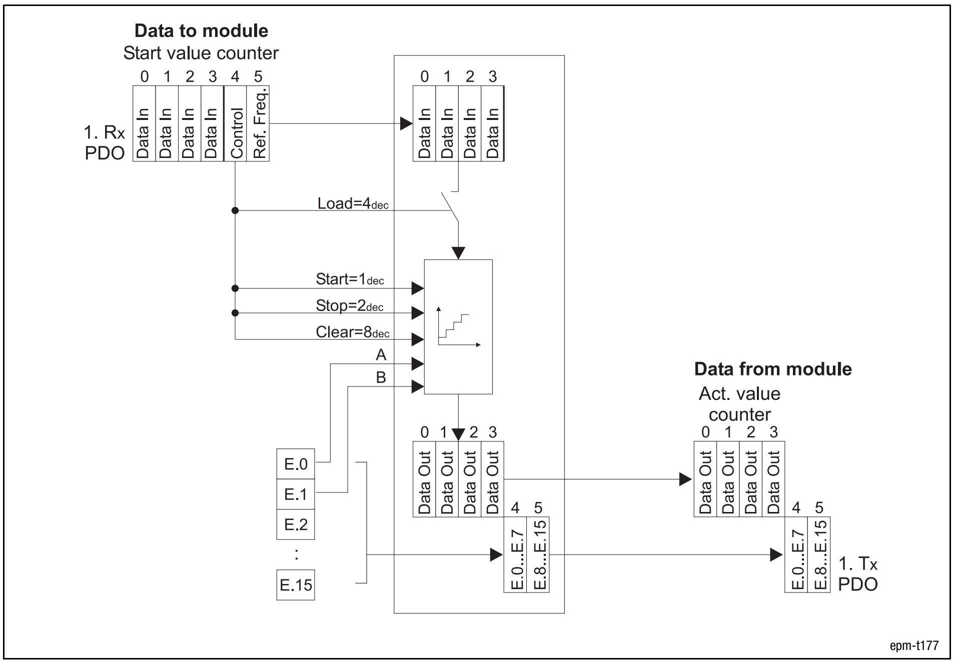


Fig. 12.6-4 Counter access of 1xcounter/16xdigital input in the mode 0

Signal characteristic

The counter is incremented by 1 on

- a LOW-HIGH edge of signal A and a LOW level of signal B.
- a HIGH-LOW edge of signal A and a HIGH level of signal B.
- a LOW-HIGH edge of signal B and a HIGH level of signal A.
- a HIGH-LOW edge of signal B and a LOW level of signal A.

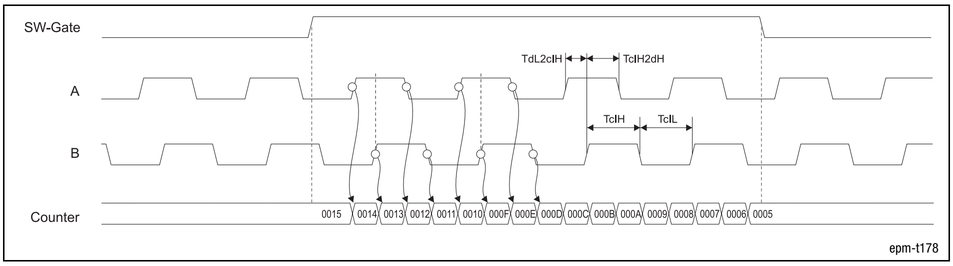


Fig. 12.6-5 Signal characteristic of 1xcounter/16xdigital input in the mode 0 (upcounter)

The counter is decremented by 1 with

- a LOW-HIGH edge of signal A and a HIGH level of signal B.
- a HIGH-LOW edge of signal A and a LOW level of signal B.
- a LOW-HIGH edge of signal B and a LOW level of signal A.
- a HIGH-LOW edge of signal B and a HIGH level of signal A.

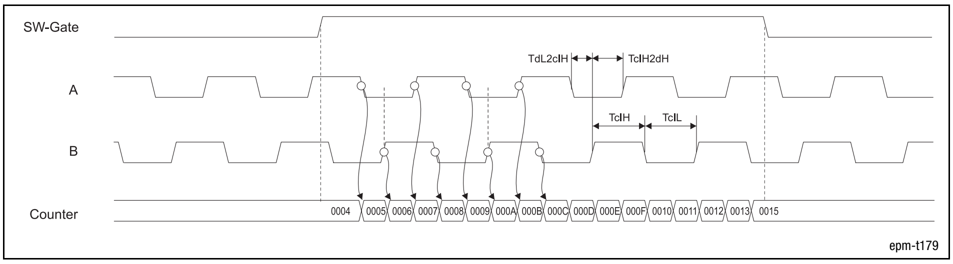


Fig. 12.6-6 Signal characteristic of 1xcounter/16xdigital input in the mode 0 (downcounter)

12.6.4 32 bit counter (mode 1)

In the mode 1 the counter operates as a 32-bit counter. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting upwards) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting downwards) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process, is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: With every rising edge of signal A (E.0) the counter is either incremented or decremented by 1.

The counting direction is determined via the level of signal B (E.1):

Upcounter: LOW level
Downcounter: HIGH level

Counter access

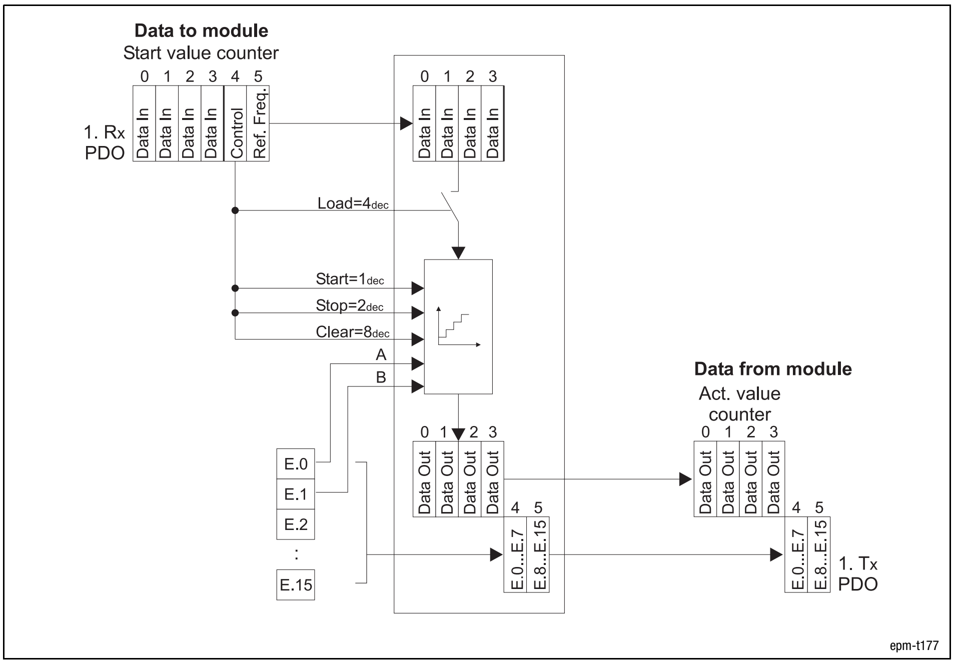


Fig. 12.6-7 Counter access of 1xcounter/16xdigital input in the mode 1

Signal characteristic

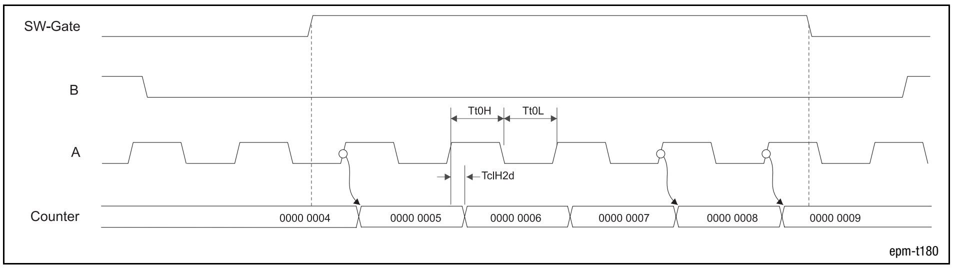


Fig. 12.6-8 Signal characteristic of 1xcounter/16xdigital input in the mode 1 (upcounter)

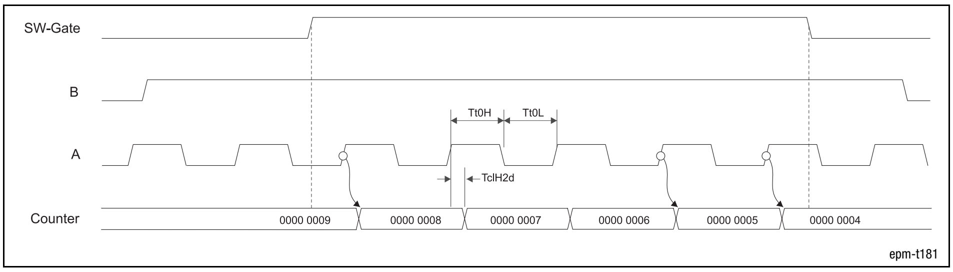


Fig. 12.6-9 Signal characteristic of 1xcounter/16xdigital input in the mode 1 (downcounter)

12.6.5 32 bit counter with clock up/down evaluation (mode 2)

In the mode 2 the counter operates as a clock-up/clock-down counter. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting up) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting down) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process is opened when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: With every rising edge of the signal A (E.0) the counter is incremented by 1. With every rising edge of the signal B (E.1) the counter is decremented by 1.

Counter access

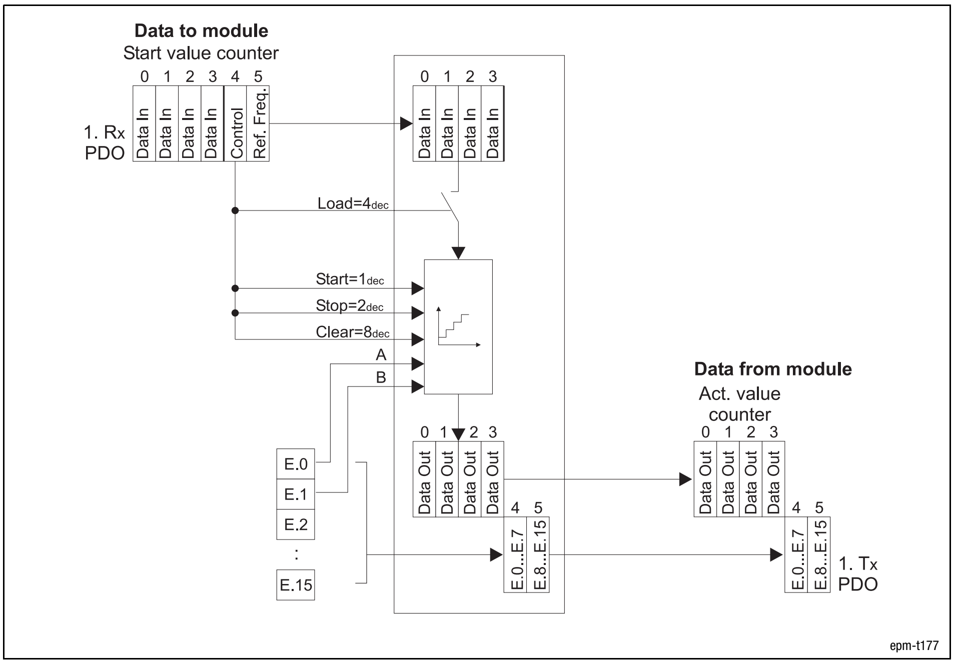


Fig. 12.6-10 Counter access of 1xcounter/16xdigital input in the mode 2

Signal characteristic

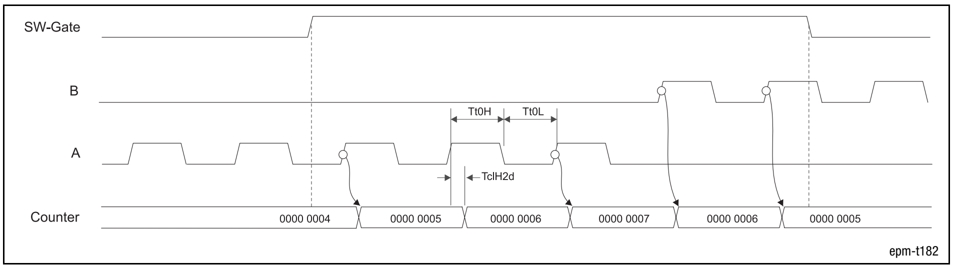


Fig. 12.6-11 Signal characteristic of 1xcounter/16xdigital input in the mode 2

12.6.6 Measuring the frequency (mode 3)

In mode 3, the counter operates as a frequency meter. For this purpose the counter counts the number of rising edges of signal A of a specified time slot.

The time slot can be determined by selecting a starting value (Data In) and a reference frequency (Ref. Freq.) in the Rx PDO.

Reference frequency

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		08_h ... FF_h	not permissible

Time slot calculation

$T_W = \frac{1}{f_{ref}} \cdot n$	T_W	Time slot
	f_{ref}	Reference frequency (is transmitted in byte 5)
	n	Starting value (is transmitted in bytes 0 ... 3)

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A signal

When the software gate is open:

- The reference counter is started by the first rising edge of signal A (E.0) and then incremented with every rising edge of the reference clock.
- When the reference counter reaches the starting value (time T_W has elapsed), the current count value is shifted into the Tx PDO in byte 0 ... 3 (Data Out).
- Then, the counter and reference counter are automatically reset and the next frequency measurement starts with the next rising edge of signal A.
- If two rising edges do not occur in the signal A within the time slot T_W, the count value for this measurement is interpreted with zero.

Clear signal

The counter can be cleared at any time via a HIGH level in byte 4 (Control), bit 3 (Clear). The loaded value remains valid until a new value is loaded.

Frequency calculation

$f = f_{ref} \cdot \frac{m}{n}$	f	Frequency of signal A
	f_{ref}	Reference frequency
	m	Count value
	n	Starting value

Example: Reference frequency f_{ref} = 1 MHz, starting value n = 1,000,000, count value m = 10,000

$$f = 1\ \text{MHz} \cdot \frac{10000}{1000000} = 10\ \text{kHz}$$

Counter access

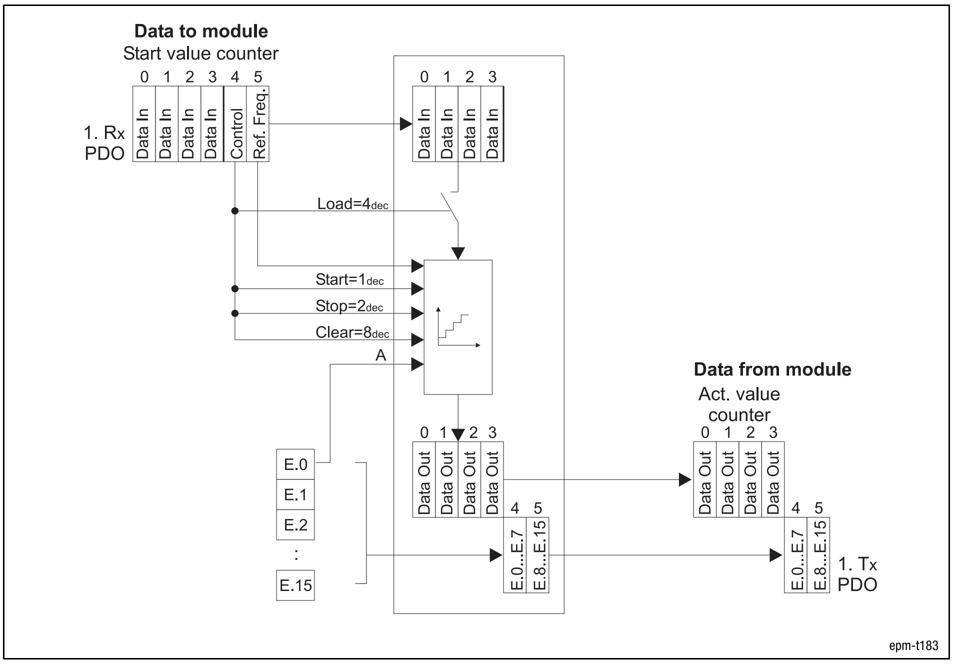


Fig. 12.6-12 Counter access of 1xcounter/16xdigital input in the mode 3

Signal characteristic

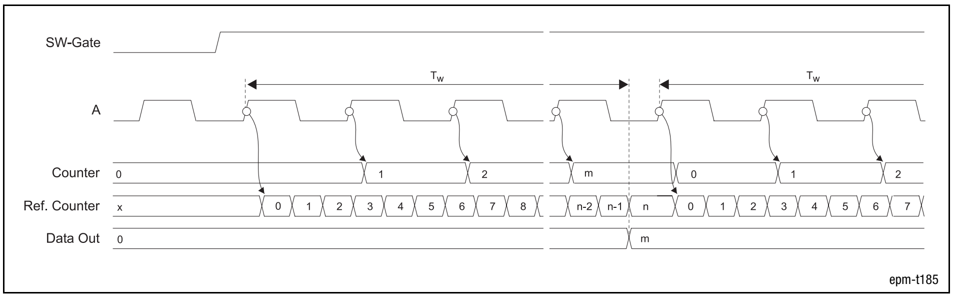


Fig. 12.6-13 Signal characteristic of 1xcounter/16xdigital input in the mode 3

12.6.7 Measuring the period (mode 4)

In mode 4 the counter operates as a permanent period meter. The counter counts the number of rising edges of a reference counter between two rising edges of signal A (E.0).

The frequency of a reference counter can be preset in the Rx PDO in byte 5 (Ref. Freq.).

Reference frequency

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		$08_h ... FF_h$	not permissible

Start/stop signal

The software gate which releases the counting process is opened when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A signal

When the software gate is open:

- The reference counter is started by the first rising edge of signal A and then incremented with every rising edge of the reference clock.
- The next rising edge of signal A stops the reference counter.

Clear signal

The counter can be cleared at any time via a HIGH level in byte 4 (Control), bit 3 (Clear). Then the measuring process is restarted with the next rising edge of signal A.

Period calculation

$T = \frac{1}{f_{ref}} \cdot n$	T	Period
	f_{ref}	Reference frequency
	n	Count value

Example: Reference frequency f_{ref} = 1 MHz, count value n = 10,000

$$T = \frac{1}{1\ \text{MHz}} \cdot 10000 = 10\ \text{ms}$$

Note!

The count value remains valid until the next measurement is completed or the counter is reset via the clear signal; this means that you do not receive the current count value, but the one from the previous measurement if a measurement has not been completed, e.g. because no second rising edge of signal A has occurred.

Counter access

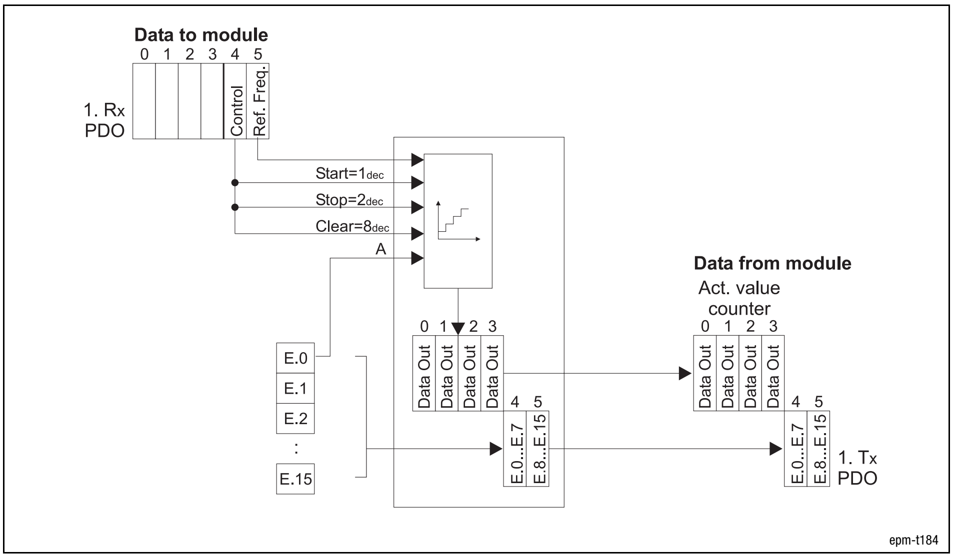


Fig. 12.6-14 Counter access of 1xcounter/16xdigital input in the mode 4

Signal characteristic

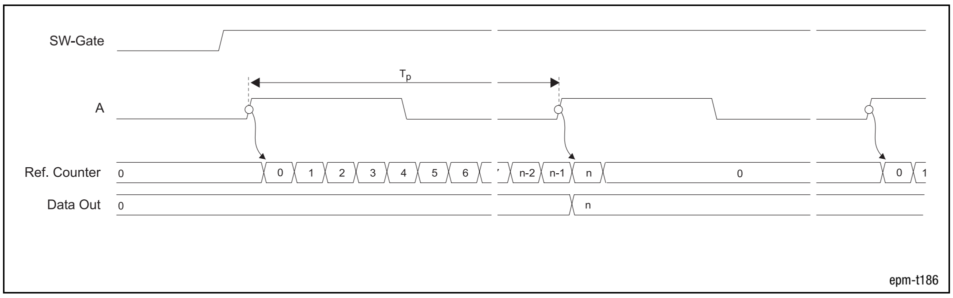


Fig. 12.6-15 Signal characteristic of 1xcounter/16xdigital input in the mode 4

12.6.8 Parameterising digital input filters

Counting pulses at the inputs E.0 and E.1 must have a specific minimum length to be evaluated. The pulse length T_{Pulse} is set via digital input filters.

- Lenze setting: $T_{Pulse} = 2.5\ \mu s$
- Filter factor A is defined via byte 1 of the parameter data:
  – Permissible values: 0 ... 255 (Lenze setting: 0)
- Filter factor B is defined via byte 2 of the parameter data:
  – Permissible values: 0 ... 255 (Lenze setting: 0)

Formula for calculation

$T_{Pulse} \geq (\textit{Filter factor A} + 1) \times (\textit{Filter factor B} + 1) \times 2.5\ \mu s$

Example

Filter factor settings:

- Filter factor A = 3
- Filter factor B = 0

Counting pulses with the following minimum length are evaluated:

$T_{Pulse} \geq (3 + 1) \times (0 + 1) \times 2.5\ \mu s$

$T_{Pulse} \geq 10\ \mu s$

12.7 Transmitting parameter data

If you change parameters (e. g. monitoring times in the index $I2400_h$), the new settings must be saved non-volatilely via index $I2003_h$. The settings continue to exist after disconnecting the supply voltage.

Step	Action	Note
1. Save changes	Set index $I2003_h$ = 1	

12.8 Loading default setting

Via index I2100$_{hex}$ all parameter changes are reset to the default setting. Changes made by you are deleted from the EEPROM of the distributed I/O system.

Step	Action	Note
1. Loading factory setting	Set index I2100$_h$ = 1	
2. Reset Node	Set index I2358$_h$ = 1	The changes are accepted.
3. Save changes	Set index I2003$_h$ = 1	

13 Parameter setting via PROFIBUS-DP

Contents

Contents

13.1 Parameterising analog modules

13.1.1 Parameter data

Stop!

The modules are **not** protected against wrong parameter settings by the hardware. They will be destroyed if the signals or encoders connected do not match the measuring range set:

- Max. 15 V input voltage in the voltage measuring range.
- No input voltage in the resistance measuring range.
- When the measuring range is changed, only assign the inputs after the first gateway initialisation has been completed:
  - During initialisation, the previous settings are still active. Unsuitable input circuits may destroy the modules. Changes will only become effective and are permanently saved after initialisation.

4xanalog input module

- For a 4×analog input module, 10 bytes of parameter data are available. The following are defined via the parameter data
  - The signal function for each input (current measurement, voltage measurement, temperature measurement etc.),
  - The module error behavior,
  - The conversion speed.
- The module can be parameterised with the configuration tool or via slot and index.
  - To set the parameters via slot and index, the function blocks SFB 52 (read) and SFB 53 (write) are required. (📖 10.5-3)

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

W = write

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment	Bits	Setting	Lenze setting
0	Enabling/inhibiting diagnostic alarm [1]	Bits 0 ... 5 % Bit 6 Bit7	Reserved 0 Alarm inhibited 1 Alarm enabled (see 12.3-6) Reserved	00_h
1	Reserved			
2	Selecting signal function for input E.0	Selection of signal function (see 13.1-7)		
3	Selecting signal function for input E.1			
4	Selecting signal function for input E.2			
5	Selecting signal function for input E.3			
6	Select options for input E.0 [1]	Bits 0 ... 3 Bits 4 ... 5 % Bits 6 ... 7	Conversion speed [2] / Resolution 0000 15 conversions/s — 16 Bit 0001 30 conversions/s — 16 Bit 0010 60 conversions/s — 15 Bit 0011 123 conversions/s — 14 Bit 0100 168 conversions/s — 12 Bit 0101 202 conversions/s — 10 Bit 0110 3.7 conversions/s — 16 Bit 0111 7.5 conversions/s — 16 Bit Data selection 00 Deactivated 01 Use 2 of 3 values 10 Use 4 of 6 values Hysteresis 00 Deactivated 01 Hysteresis ±8 10 Hysteresis ±16	00_h
7	Select options for input E.1 [1]			00_h
8	Select options for input E.2 [1]			00_h
9	Select options for input E.3 [1]			00_h

1) The function is not available for the modules 4×analog input ±10V and 4×analog input ±20mA.

2) The conversion speeds given are valid for the operation of an analog input. When operating several inputs, the corresponding conversion speed must be divided by the number of active inputs to detect the conversion speed per input.
Please note that due to shorter integration times the resolution is reduced at higher conversion speeds. The data transfer format remains the same. Only the lower bits (LSBs) no longer are relevant for the analog value.

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Parameter data 13.1.1

4xanalog output modules

- For a 4×analog output module, 6 bytes of parameter data are available. The following are defined via the parameter data
  - The signal function for each output (current signal output, voltage signal output),
  - The module error behaviour.
- The module can be parameterised with the configuration tool or via slot and index.
  - To set the parameters via slot and index, the function blocks SFB 52 (read) and SFB 53 (write) are required.

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

W = write

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment		Lenze setting
0	Enabling/inhibiting diagnostic alarm [1)]	Bits 0 ... 5 %: Reserved Bit 6: 0 Alarm inhibited; 1 Alarm enabled (📖 12.3-6) Bit7: Reserved	00_h
1	Reserved		
2	Selecting signal function for output E.0	Selection of the signal function: 📖 13.1-14	
3	Selecting signal function for output E.1		
4	Selecting signal function for output E.2		
5	Selecting signal function for output E.3		

1) The function is not available for the modules 4×analog output ±10V and 4×analog output 0...20mA.

4xanalog input/output module

- For the 4xanalog input/output module, up to 8 bytes of parameter data are available. The following are defined via the parameter data
  - The signal function for each input or output (current measurement, voltage measurement, temperature measurement, or current signal output, voltage signal output),
  - The module error behavior,
  - The conversion speed.
- The module can be parameterised with the configuration tool or via slot and index.
  - To set the parameters via slot and index, the function blocks SFB 52 (read) and SFB 53 (write) are required.

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

W = write

The following bytes with fixed assignment are available for parameter data:

Byte	Assignment					Lenze setting
0	Activating/deactivating wire breakage detection and enabling/inhibiting diagnostic alarm [1]	Bit 0	Wire breakage detection for input E.0			00_h
			0	Deactivated	📖 12.3-6	
			1	Activated		
		Bit 1	Wire breakage detection for input E.1			
			0	Deactivated	📖 12.3-6	
			1	Activated		
		Bits 2 ... 5	Reserved			
		Bit 6	0	Diagnostic alarm inhibited	📖 12.3-6	
			1	Diagnostic alarm enabled		
1	Reserved	Bits 0 ... 7	Reserved			
2	Selecting signal function for input E.0	Selection of signal function 📖 13.1-18				
3	Selecting signal function for input E.1					
4	Selecting signal function for output E.0					
5	Selecting signal function for output E.1					
6	Select options for input E.0	Bits 0 ... 3	Conversion speed [2]		Resolution	00_h
7	Select options for input E.1		0000	15 conversions/s	16 Bit	00_h
			0001	30 conversions/s	16 Bit	
			0010	60 conversions/s	15 Bit	
			0011	123 conversions/s	14 Bit	
			0100	168 conversions/s	12 Bit	
			0101	202 conversions/s	10 bits	
			0110	3.7 conversions/s	16 Bit	
			0111	7.5 conversions/s	16 Bit	
		Bits 4 ... 7	Reserved			
8 ... 11	Reserved					

1) The wire breakage detection is used in the measuring range 4 ... 20 mA. If the wire breakage detection is activated in byte 0 and the diagnostic alarm is enabled, a current reduction to below 0.8 mA is indicated.

2) The conversion speeds given are valid for the operation of an analog input. When operating several inputs, the corresponding conversion speed must be divided by the number of active inputs to detect the conversion speed per input.
Please note that due to shorter integration times the resolution is reduced at higher conversion speeds. The data transfer format remains the same. Only the lower bits (LSBs) no longer are relevant for the analog value.

13.1.2 Input data / output data

Two bytes (LOW byte, HIGH byte) are available for input and output data.

Byte	S7 format	S5 format
LOW byte	Bits 0 ... 7 Binary signal value	Bit 0 Overflow bit 0 Value within signal range 1 Signal range exceeded Bit 1 Error bit 0 No error 1 Internal fault Bit 2 Activity bit (always 0) Bits 3 ... 7 Binary signal value
HIGH byte	Bits 0 ... 6 Binary signal value Bit 7 Polarity bit 0 Positive polarity 1 Negative polarity	Bits 0 ... 6 Binary signal value Bit 7 Polarity bit 0 Positive polarity 1 Negative polarity

13.1.3 Converting measured values for voltage and current

Signal range	Signal [U] / [I]	S7 format			S5 format		
		Decimal value [dec]	Hexadecimal value [h]	Formulae for calculation	Decimal value [dec]	Hexadecimal value [h]	Formulae for calculation
±10 V	-10 V	-27648	9400	$dec = 27648 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{27648}$	-16384	C000	$dec = 16348 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16348}$
	-5 V	-13824	CA00		-8192	E000	
	0 V	0	0000		0	0000	
	+5 V	+13824	3600		+8192	2000	
	+10 V	+27648	6C00		+16384	4000	
0 ... 10 V	0 V	0	0000	$dec = 16384 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16384}$	0	0000	$dec = 16384 \cdot \frac{U}{10}$ $U = dec \cdot \frac{10}{16384}$
	+5 V	+8192	2000		+8192	2000	
	+10 V	+16384	4000		+16384	4000	
1 ... 5 V	+1 V	—	—		0	0000	$dec = 27648 \cdot \frac{U-1}{4}$ $U = dec \cdot \frac{4}{16384} + 1$
	+3 V				+8192	2000	
	+5 V				+16384	4000	
±4 V	-4 V	-27648	9400	$dec = 27648 \cdot \frac{U}{4}$ $U = dec \cdot \frac{4}{27648}$	—	—	
	0 V	0	0000				
	+4 V	+27648	6C00				
±400 mV	-400 mV	-27648	9400	$dec = 27648 \cdot \frac{U}{400}$ $U = dec \cdot \frac{400}{27648}$	—	—	
	0 V	0	0000				
	+400 mV	+27648	6C00				
4 ... 20 mA	+4 mA	0	0000	$dec = 27648 \cdot \frac{I-4}{16}$ $U = dec \cdot \frac{16}{27648} + 1$	0	0000	$dec = 16384 \cdot \frac{I-4}{16}$ $U = dec \cdot \frac{16}{16384} + 1$
	+12 mA	+13824	3600		+8192	2000	
	+20 mA	+27648	6C00		+16384	4000	
±20 mA	-20 mA	-27648	9400	$dec = 27648 \cdot \frac{I}{20}$ $U = dec \cdot \frac{20}{27648}$	-16384	C000	$dec = 16384 \cdot \frac{I}{20}$ $U = dec \cdot \frac{20}{16384}$
	-10 mA	-13824	CA00		-8192	E000	
	0 mA	0	0000		0	0000	
	+10 mA	+13824	3600		+8192	2000	
	+20 mA	+27648	6C00		+16384	4000	

13.1.4 Signal functions of 4xanalog input

Note!
- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:
Measuring task: Temperature measurement with signal function 01_h. Measured value = 80.5 °C.

1. I/O system IP20 converts the measured value into an integer:
   80.5 [°C] × 10 = 805
2. Reconvert the measured value to output it with decimal positions:
   $\frac{805\ [°C]}{10} = 80.5\ °C$

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance [2]
00_h	Parameter data in module are not overwritten						
01_h	Temperature measurement with two-wire connection	PT100	-200.0	{0.1 °C}	+850.0	S7 Two's complement	±1 °C [3]
02_h		PT1000	-200.0	{0.1 °C}	+500.0		
03_h		NI100	-50.0	{0.1 °C}	+250.0		
04_h		NI1000	-50.0	{0.1 °C}	+250.0		
05_h	Resistance measurement with two-wire connection	60 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+60.00 32767	S7	±0.2 % of the final value [3]
06_h		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 32767		
07_h		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 32767		
08_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 32767		
09_h	Temperature measurement with four-wire connection	PT100	-200.0	{0.1 °C}	+850.0	S7 Two's complement	±0.5 °C
$0A_h$		PT1000	-200.0	{0.1 °C}	+500.0		
0Bh		NI100	-50.0	{0.1 °C}	+250.0		
$0C_h$		NI1000	-50.0	{0.1 °C}	+250.0		
$0D_h$	Resistance measurement with two-wire connection	60 Ω	0.00	{0.01 Ω}	+60.00	S7	±0.1 % of the final value
$0E_h$		600 Ω	0.00	{0.01 Ω}	+600.00		±0.05 % of the final value
$0F_h$		3000 Ω	0.00	{0.01 Ω}	+3000.00		±0.05 % of the final value
10_h	Temperature measurement with thermoelement and external compensation[4]	Type J	-210.0	{0.1 °C}	+850.0	S7 Two's complement	±1 °C
11_h		Type K	-270.0	{0.1 °C}	+1200.0		±1.5 °C
12_h		Type N	-200.0	{0.1 °C}	+1300.0		±1.5 °C
13_h		Type R	-50.0	{0.1 °C}	+1760.0		±4 °C
14_h		Type T	-270.0	{0.1 °C}	+400.0		±1.5 °C
15_h		Type S	-50.0	{0.1 °C}	+1760.0		±5 °C

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1]	Tolerance [2]
18_h	Temperature measurement with thermoelement and internal compensation 5)	Type J	-210.0 {0.1 °C} +850.0	S7 Two's complement	±1.5 °C
19_h		Type K	-270.0 {0.1 °C} +1200.0		±2 °C
$1A_h$		Type N	-200.0 {0.1 °C} +1300.0		±2 °C
1Bh		Type R	-50.0 {0.1 °C} +1760.0		±5 °C
$1C_h$		Type T	-270.0 {0.1 °C} +400.0		±2 °C
$1D_h$		Type S	-50.0 {0.1 °C} +1760.0		±5 °C
27_h	Voltage measurement	0 ... 50 mV	0.00 {0.01 mV} +50.00 0 {1_{dec}} 27648 Min. Limit values Max. 0.00 +59.25 mV 0 32767 $_{dec}$	S7 Two's complement	±0.1 % of the final value
28_h	Voltage measurement	±10 V	-10.00 {0.01V} +10.00 -27648 {1_{dec}} 27648 Min. Limit values Max. -11.85 V +11.85 V -32767 $_{dec}$ 32767 $_{dec}$	S7 Two's complement	±0.05 % of the final value
29_h	Voltage measurement	±4 V	-4.00 {0.01V} +4.00 V -27648 {1_{dec}} 27648_{dec} Min. Limit values Max. -4.74 V +4.74 V -32767 $_{dec}$ 32767 $_{dec}$	S7 Two's complement	±0.05 % of the final value
$2A_h$	Voltage measurement	±400 mV	-400 {1 mV} +400 -27648 {1_{dec}} 27648 Min. Limit values Max. -474 mV +474 mV -32767 $_{dec}$ 32767 $_{dec}$	S7 Two's complement	±0.1 % of the final value
2Bh	Voltage measurement	±10 V	-10.00 {0.01V} +10.00 -16384 {1_{dec}} 16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} 20480_{dec}	S5 Sum and sign	±0.2 % of the final value
$2C_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -27648 {1_{dec}} 27648 Min. Limit values Max. -23.70 mA +23.70 mA -32767 $_{dec}$ $+32767_{dec}$	S7 Two's complement	±0.05 % of the final value
$2D_h$	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 0 mA +22.96 mA -5530_{dec} $+32767_{dec}$	S7 Two's complement	±0.05 % of the final value
$2E_h$	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0 mA +22.96 mA -4096_{dec} +20480 $_{dec}$	S5 Sum and sign	±0.2 % of the final value

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance [2]
$2F_h$	Current measurement	±20 mA	-20.00 -16384	{0.01 mA} {1_{dec}}	+20.00 16384	S5 Sum and sign	±0.05 % of the final value
			Min. -23.70 mA -19456_{dec}	Limit values	Max. +23.70 mA $+19456_{dec}$		
32_h	Resistance measurement with four-wire connection	6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 32767 $_{dec}$	S7	±0.05 % of the final value
33_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 6000 $_{dec}$		±0.05 % of the final value
35_h		60 Ω	0.00 0	{0.01 Ω}	+60.00 6000 $_{dec}$		±0.2 % of the final value [3]
36_h		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 6000 $_{dec}$		±0.1 % of the final value [3]
37_h		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 30000 $_{dec}$		±0.1 % of the final value [3]
38_h		6000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+6000.00 6000 $_{dec}$		±0.1 % of the final value [3]
$3A_h$	Current measurement	±20 mA	-20.00 -16384	{0.01 mA} {1_{dec}}	+20.00 16384	S5 Two's complement	±0.05 % of the final value
			Min. -23.70 mA -19456_{dec}	Limit values	Max. +23.70 mA $+19456_{dec}$		
3Bh	Voltage measurement	±10 V	-10.00 -16384	{0.01V} {1_{dec}}	+10.00 16384	S5 Two's complement	±0.2 % of the final value
			Min. -12.50 V -20480_{dec}	Limit values	Max. +12.50 V 20480_{dec}		
$3D_h$	Resistance measurement with four-wire connection	60 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+60.00 6000 $_{dec}$	S7	±0.1 % of the final value
$3E_h$		600 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+600.00 6000 $_{dec}$		±0.05 % of the final value
$3F_h$		3000 Ω	0.00 0	{0.01 Ω} {1_{dec}}	+3000.00 30000 $_{dec}$		±0.05 % of the final value
57_h	Voltage measurement	0 ... 50 mV	0.00 0	{0.01 mV} {1_{dec}}	+50.00 5000	S7 Two's complement	±0.1 % of the final value
			Min. 0.00 0	Limit values	Max. +59.25 V 5925_{dec}		
58_h	Voltage measurement	±10 V	-10.00 -10000	{0.01V} {1_{dec}}	+10.00 10000	S7 Two's complement	±0.05 % of the final value
			Min. -11.85 V -11850_{dec}	Limit values	Max. +11.85 V 11850_{dec}		
59_h	Voltage measurement	±4 V	-4.00 -4000	{0.01V} {1_{dec}}	+4.00 4000	S7 Two's complement	±0.05 % of the final value
			Min. -4.74 V -4740_{dec}	Limit values	Max. +4.74 V 4740_{dec}		

Parameter bytes 2/3/4/5	Signal function		Signal range			Format 1)	Tolerance 2)
$5A_h$	Voltage measurement	±400 mV	-400 -4000	{1 mV} {1_{dec}}	+400 4000	S7 Two's complement	±0.1 % of the final value
			Min.	Limit values	Max.		
			-474 mV -4740_{dec}		+474 mV 4740_{dec}		
$5C_h$	Current measurement	±20 mA	-20.00 -20000	{0.01 mA} {1_{dec}}	+20.00 20000	S7 Two's complement	±0.05 % of the final value
			Min.	Limit values	Max.		
			-23.70 mA -23700_{dec}		+23.70 mA $+23700_{dec}$		
$5D_h$	Current measurement	4 ... 20 mA	4.00 0	{0.01 mA} {1_{dec}}	20.00 16000	S7 Two's complement	±0.05 % of the final value
			Min.	Limit values	Max.		
			0 mA -4000_{dec}		+22.96 mA $+18960_{dec}$		
FF_h	Analog input deactivated						

1) Format of the input data (🕮 13.1-6).

2) Tolerance of the input range at an ambient temperature of 25 °C and 15 conversions/s. Sensor inaccuracies were not considered.

3) Transition resistances on contacts and cable resistances were not taken into consideration.

4) Cold spot compensation must be effected externally.

5) The cold spot must be compensated internally. The temperature of the terminal is taken into consideration. Connect the conductors of the thermoelements directly to the terminal; if necessary, operate with thermoelement extension cables.

13.1.5 Signal functions of 4xanalog input ±10

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:
Measuring task: Voltage measurement with signal function 28_h. Measured value = 8.5 V.

1. I/O system IP20 converts the measured value into an integer:
   $8.5\ [V] \times 10 = 85$
2. Reconvert the measured value to output it with decimal positions:
   $\frac{85\ [V]}{10} = 8.5\ V$

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
00_h	Parameter data in module are not overwritten						
28_h	Voltage measurement	±10 V	-10.00	{0.01V}	+10.00	S7 Two's complement	±0.1 % [2]
			-27648	$\{1_{dec}\}$	27648		±0.2 % [3]
			Min.	Limit values	Max.		
			-11.76 V		+11.76 V		
			-32512_{dec}		32511_{dec}		
$2B_h$	Voltage measurement	±10 V	-10.00	{0.01V}	+10.00	S5 Sum and sign	±0.1 % [2]
			-16384	$\{1_{dec}\}$	16384		±0.2 % [3]
			Min.	Limit values	Max.		
			-12.50 V		+12.50 V		
			-20480_{dec}		20480_{dec}		
3Bh	Voltage measurement	±10 V	-10.00	{0.01V}	+10.00	S5 Two's complement	±0.1 % [2]
			-16384	$\{1_{dec}\}$	16384		±0.2 % [3]
			Min.	Limit values	Max.		
			-12.50 V		+12.50 V		
			-20480_{dec}		20480_{dec}		
FF_h	Analog input deactivated						

[1] Format of the input data (13.1-6).
[2] Tolerance of the input range at an ambient temperature of 25 °C.
[3] Tolerance of the input range across the entire admissible temperature range.

13.1.6 Signal functions 4xanalog input ±20mA

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:

Measuring task: Current measurement with signal function $2C_h$. Measured value = 15.5 mA.

1. I/O system IP20 converts the measured value into an integer:
   15.5 [V] × 10 = 155

2. Reconvert the measured value to output it with decimal positions:
   $$\frac{155\ [\text{mA}]}{10} = 15.5\ \text{mA}$$

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1)]	Tolerance
00_h	Parameter data in module are not overwritten				
$2C_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -27648 {1_{dec}} 27648 Min. Limit values Max. -23.52 mA +23.52 mA -32512_{dec} $+32511_{dec}$	S7 Two's complement	±0.1 % [2)] ±0.2 % [3)]
$2D_h$	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 1.185 mA +22.81 mA -4864_{dec} $+32511_{dec}$	S7 Two's complement	±0.2 % [2)] ±0.5 % [3)]
$2E_h$	Current measurement	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0.8 mA +24.00 mA -3277_{dec} $+20480_{dec}$	S5 Sum and sign	±0.2 % [2)] ±0.5 % [3)]
$2F_h$	Current measurement	±20 mA	-20.00 {0.01 mA} +20.00 -16384 {1_{dec}} 16384 Min. Limit values Max. -25.00 mA +25.00 mA -20480_{dec} $+20480_{dec}$	S5 Sum and sign	±0.1 % [2)] ±0.2 % [3)]

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Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
39_h	Current measurement	4 ... 20 mA	4.00 0	{0.01 mA} {1_{dec}}	20.00 16384	S5 Two's complement	±0.2 % [2] ±0.5 % [3]
			Min. 0.8 mA -3277_{dec}	Limit values	Max. +24.00 mA $+20480_{dec}$		
$3A_h$	Current measurement	±20 mA	-20.00 -16384	{0.01 mA} {1_{dec}}	+20.00 16384	S5 Two's complement	±0.1 % [2] ±0.2 % [3]
			Min. -25.00 mA -20480_{dec}	Limit values	Max. +25.00 mA $+20480_{dec}$		
FF_h	Analog input deactivated						

1) Format of the input data (13.1-6).
2) Tolerance of the input range at an ambient temperature of 25 °C.
3) Tolerance of the input range across the entire admissible temperature range.

13.1.7 Signal functions of 4xanalog output

> **Note!**
> In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
00_h	No signal emitted at output						
01_h	Voltage signal output	±10 V	-10.00 -16384 Min. -12.50 V -20480_{dec}	{0.01V} {1_{dec}} Limit values	+10.00 16384 Max. +12.50 V 20480_{dec}	S5 Two's complement	±0.2 % [2) 3)]
02_h	Voltage signal output	+1 ... +5 V	1.0 0 Min. 0.0 -4096_{dec}	{0.1V} {1_{dec}} Limit values	+5.0 16384 Max. +6.0 V 20480_{dec}	S5 Two's complement	±0.4 % [2) 3)]
05_h	Voltage signal output	0... +10 V	0.0 0 Min. 0.0 0	{0.1V} {1_{dec}} Limit values	+10.0 16384 Max. +12.5 V 20480_{dec}	S5 Two's complement	±0.3 % [2) 3)]
09_h	Voltage signal output	±10 V	-10.00 -27648 Min. -11.76 V -32512_{dec}	{0.01V} {1_{dec}} Limit values	+10.00 V 27648_{dec} Max. +11.76 V 32511_{dec}	S7 Two's complement	±0.2 % [2) 3)]
$0A_h$	Voltage signal output	+1 ... +5 V	1.00 0 Min. 0 V -6912_{dec}	{0.01V} {1_{dec}} Limit values	+5.00 27648 Max. +5.704 V 32511_{dec}	S7 Two's complement	±0.4 % [2) 3)]
$0D_h$	Voltage signal output	0... +10 V	0.00 0 Min. 0.00 0	{0.01V} {1_{dec}} Limit values	+10.00 27648 Max. +11.76 V 32511_{dec}	S7 Two's complement	±0.3 % [2) 3)]
03_h	Current signal output	±20 mA	-20.00 -16384 Min. -25.00 mA -20480_{dec}	{0.01 mA} {1_{dec}} Limit values	+20.00 16384 Max. +25.00 mA $+20480_{dec}$	S5 Two's complement	±0.2 % [2) 4)]

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1]	Tolerance
04_h	Current signal output	4 ... 20 mA	4.00	{0.01 mA}	20.00	S5 Two's complement	±0.5 % [2] [4]
			0	$\{1_{dec}\}$	16384		
			Min.	Limit values	Max.		
			0.00		+24.00 mA		
			-4096_{dec}		$+20480_{dec}$		
06_h	Current signal output	0 ... 20 mA	0.00	{0.01 mA}	+20.00	S5 Two's complement	±0.4 % [2] [4]
			0	$\{1_{dec}\}$	16384		
			Min.	Limit values	Max.		
			0.00		+25.00 mA		
			0		$+20480_{dec}$		
0Bh	Current signal output	±20 mA	-20.00	{0.01 mA}	+20.00	S7 Two's complement	±0.2 % [2] [4]
			-27648	$\{1_{dec}\}$	27648		
			Min.	Limit values	Max.		
			-23.52 mA		+23.52 mA		
			-32512_{dec}		$+32511_{dec}$		
$0C_h$	Current signal output	4 ... 20 mA	4.00	{0.01 mA}	20.00	S7 Two's complement	±0.5 % [2] [4]
			0	$\{1_{dec}\}$	27648		
			Min.	Limit values	Max.		
			0.00		+22.81 mA		
			-6912_{dec}		$+32511_{dec}$		
$0E_h$	Current signal output	0 ... 20 mA	0.00	{0.01 mA}	20.00	S7 Two's complement	±0.4 % [2] [4]
			0	$\{1_{dec}\}$	27648		
$0E_h$	Current signal output	0 ... 20 mA	Min.	Limit values	Max.	S7 Two's complement	±0.4 % [2] [4]
			0.00		+23.52 mA		
			0		$+32511_{dec}$		
FF_h	Analog output is switched off						

1) Format of the output data (📖 13.1-6).

2) Tolerance of the output range at an ambient temperature of 25 °C.

3) The value was determined with a load R = 1 GΩ. The output resistance is 30 Ω.

4) The value was determined with a load R = 10 Ω.

13.1.8 Signal functions of 4xanalog output ±10

Note!

In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range			Format [1)]	Tolerance
00_h	No signal emitted at output						
01_h	Voltage signal output	±10 V	-10.00 -16384	{0.01V} {1_{dec}}	+10.00 16384	S5 Two's complement	±0.1 % [2)] ±0.2 % [3)]
			Min. -12.50 V -20480_{dec}	Limit values	Max. +12.50 V 20480_{dec}		
05_h	Voltage signal output	0 ... +10 V	0.0 0	{0.1V} {1_{dec}}	+10.0 16384	S5 Two's complement	±0.2 % [2)] ±0.4 % [3)]
			Min. 0.0 0	Limit values	Max. +12.5 V 20480_{dec}		
09_h	Voltage signal output	±10 V	-10.00 -27648	{0.01V} {1_{dec}}	+10.00 V 27648_{dec}	S7 Two's complement	±0.1 % [2)] ±0.2 % [3)]
			Min. -11.76 V -32512_{dec}	Limit values	Max. +11.76 V 32511_{dec}		
$0D_h$	Voltage signal output	0 ... +10 V	0.0 0	{0.1V} {1_{dec}}	+10.0 27648	S7 Two's complement	±0.2 % [2)] ±0.4 % [3)]
			Min. 0.0 0	Limit values	Max. +11.76 V 32511_{dec}		
FF_h	Analog output is switched off						

1) Format of the output data (13.1-6).
2) Tolerance of the output range at an ambient temperature of 25 °C.
3) Tolerance of the output range across the entire admissible temperature range.

13.1.9 Signal functions 4xanalog output 0...20mA

Note!
In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

Parameter bytes 2/3/4/5	Signal function		Signal range	Format [1)]	Tolerance
00_h	No signal emitted at output				
01_h 06_h	Current signal output	0 ... 20 mA	0.00 {0.01 mA} +20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0.00 +25.00 mA 0 +20480 dec	S5 Two's complement	±0.2 % [2)] ±0.4 % [3)]
04_h	Current signal output	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 16384 Min. Limit values Max. 0.00 +24.00 mA -4096 dec +20480 dec	S5 Two's complement	±0.3 % [2)] ±0.5 % [3)]
$0C_h$	Current signal output	4 ... 20 mA	4.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 0.00 +22.81 mA -6912 dec +32511dec	S7 Two's complement	±0.3 % [2)] ±0.5 % [3)]
$0E_h$	Current signal output	0 ... 20 mA	0.00 {0.01 mA} 20.00 0 {1_{dec}} 27648 Min. Limit values Max. 0.00 +23.52 mA 0 +32511dec	S7 Two's complement	±0.2 % [2)] ±0.4 % [3)]
FF_h	Analog output is switched off				

1) Format of the output data (13.1-6).
2) Tolerance of the output range at an ambient temperature of 25 °C.
3) Tolerance of the output range across the entire admissible temperature range.

13.1.10 Signal functions of 4xanalog input /output

Note!

- Short-circuit unused inputs (connect positive and negative terminals) or deactivate them by assigning the function number FF_h.
- In the event of an overflow or underflow, wrong values are output. Strong signal jumps with sign reversal may occur.

I/O system IP20 multiplies measured values with decimal positions and without normalisation by a factor and transfers them as integers to the bus. To output the decimal positions, divide the measured values by the same factor.

Example:

Measuring task: Temperature measurement with signal function 01_h. Measured value = 80.5 °C.

1. I/O system IP20 converts the measured value into an integer:
   80.5 [°C] × 10 = 805

2. Reconvert the measured value to output it with decimal positions:

$$\frac{805\ [°C]}{10} = 80.5\ °C$$

Input functions

Parameter bytes 2/3	Signal function		Signal range	Format 1)	Tolerance 2)
00_h	Parameter data in module are not overwritten				
3Bh	Voltage measurement	±10 V	-10.00 {0.01V} +10.00 -16384 {1_{dec}} +16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} $+20480_{dec}$	S5 Two’s complement	±0.2 %
2Bh	Voltage measurement	±10 V	-10.00 {0.01V} +10.00 -16384 {1_{dec}} +16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} $+20480_{dec}$	S5 Sum and sign	±0.2 %
72_h	Voltage measurement	1 ... 5 V	+1.00 {0.01V} +5.00 0 {1_{dec}} +16384 Min. Limit values Max. 0.00 +6.00 V -4096_{dec} $+20480_{dec}$	S5 Sum and sign	±0.6 %
75_h	Voltage measurement	0 ... 10 V	0.00 {0.01V} +10.00 0 {1_{dec}} +16384 Min. Limit values Max. 0.00 +12.50 V 0 $+20480_{dec}$	S5 Two’s complement	±0.4 %

Parameter bytes 2/3	Signal function		Signal range			Format 1)	Tolerance 2)
28_h	Voltage measurement	±10 V	-10.00	{0.01V}	+10.00	S7 Two's complement	±0.2 %
			-27648	$\{1_{dec}\}$	+27648		
			Min.	Limit values	Max.		
			-11.76 V		+11.76 V		
			-32512_{dec}		$+32511_{dec}$		
$7A_h$	Voltage measurement	1 ... 5 V	+1.00	{0.01V}	+5.00	S7 Two's complement	±0.6 %
			0	$\{1_{dec}\}$	+27648		
			Min.	Limit values	Max.		
			0.00		+5.704 V		
			-6912_{dec}		$+32511_{dec}$		
$7D_h$	Voltage measurement	0 ... 10 V	0.00	{0.01V}	+10.00	S7 Two's complement	±0.4 %
			0	$\{1_{dec}\}$	+27648		
			Min.	Limit values	Max.		
			0.00		+11.76 V		
			0		$+32511_{dec}$		
$3A_h$	Current measurement	±20 mA	-20.00	{0.01 mA}	+20.00	S5 Two's complement	±0.3 %
			-16384	$\{1_{dec}\}$	+16384		
			Min.	Limit values	Max.		
			-25.00 mA		+25.00 mA		
			-20480_{dec}		$+20480_{dec}$		
$2F_h$	Current measurement	±20 mA	-20.00	{0.01 mA}	+20.00	S5 Sum and sign	±0.3 %
			-16384	$\{1_{dec}\}$	+16384		
			Min.	Limit values	Max.		
			-25.00 mA		+25.00 mA		
			-20480_{dec}		$+20480_{dec}$		
$2E_h$	Current measurement	4 ... 20 mA	+4.00	{0.01 mA}	+20.00	S5 Sum and sign	±0.8 %
			0	$\{1_{dec}\}$	+16384		
			Min.	Limit values	Max.		
			+0.8 mA		+24.00 mA		
			-3277_{dec}		$+20480_{dec}$		
76_h	Current measurement	0 ... 20 mA	0.00	{0.01 mA}	+20.00	S5 Two's complement	±0.6 %
			0	$\{1_{dec}\}$	+16384		
			Min.	Limit values	Max.		
			0.00		+25.00 mA		
			0		$+20480_{dec}$		
$2C_h$	Current measurement	±20 mA	-20.00	{0.01 mA}	+20.00	S7 Two's complement	±0.3 %
			-27648	$\{1_{dec}\}$	+27648		
			Min.	Limit values	Max.		
			-23.51 mA		+23.51 mA		
			-32512_{dec}		$+32511_{dec}$		
$2D_h$	Current measurement	4 ... 20 mA	+4.00	{0.01 mA}	+20.00	S7 Two's complement	±0.8 %
			0	$\{1_{dec}\}$	+27648		
			Min.	Limit values	Max.		
			+1.18 mA		+22.81 mA		
			-4864_{dec}		$+32511_{dec}$		

<table>
<tr><th>Parameter bytes 2/3</th><th colspan="2">Signal function</th><th colspan="3">Signal range</th><th>Format 1)</th><th>Tolerance 2)</th></tr>
<tr><td rowspan="2">$7E_h$</td><td rowspan="2">Current measurement</td><td rowspan="2">0 ... 20 mA</td><td>0.00
0</td><td>{0.01 mA}
{1_{dec}}</td><td>+20.00
+27648</td><td rowspan="2">S7
Two’s complement</td><td rowspan="2">±0.6 %</td></tr>
<tr><td>Min.

0.00
0</td><td>Limit values</td><td>Max.

+23.52 mA
$+32511_{dec}$</td></tr>
<tr><td>FF_h</td><td colspan="5">Analog input deactivated</td><td></td><td></td></tr>
</table>

1) Format of the input data (📖 13.1-6).

2) Tolerance of the input range at an ambient temperature of 25 °C. Sensor inaccuracies were not considered.

Output functions

Parameter bytes 4/5	**Signal function**		**Signal range**	**Format** [1)]	**Tolerance** [2)]
00_h	Parameter data in module are not overwritten				
01_h	Voltage signal output	±10 V	-10.00 {0.01V} +10.00 -16384 $\{1_{dec}\}$ +16384 Min. Limit values Max. -12.50 V +12.50 V -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.2 %
02_h	Voltage signal output	1 ... 5 V	+1.00 {0.01V} +5.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. 0.00 +6.00 V -4096_{dec} $+20480_{dec}$	S5 Two's complement	±0.6 %
05_h	Voltage signal output	0 ... 10 V	0.00 {0.01V} +10.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. 0.00 +12.50 V 0 $+20480_{dec}$	S5 Two's complement	±0.4 %
09_h	Voltage signal output	±10 V	-10.00 {0.01V} +10.00 -27648 $\{1_{dec}\}$ +27648 Min. Limit values Max. -11.76 V +11.76 V -32512_{dec} $+32511_{dec}$	S7 Two's complement	±0.2 %
$0A_h$	Voltage signal output	1 ... 5 V	+1.00 {0.01V} +5.00 0 $\{1_{dec}\}$ +27648 Min. Limit values Max. 0.00 +5.704 V -6912_{dec} $+32511_{dec}$	S7 Two's complement	±0.6 %
$0D_h$	Voltage signal output	0 ... 10 V	0.00 {0.01V} +10.00 0 $\{1_{dec}\}$ +27648 Min. Limit values Max. 0.00 +11.76 V 0 $+32511_{dec}$	S7 Two's complement	±0.4 %
03_h	Current signal output	±20 mA	-20.00 {0.01 mA} +20.00 -16384 $\{1_{dec}\}$ +16384 Min. Limit values Max. -25.00 mA +25.00 mA -20480_{dec} $+20480_{dec}$	S5 Two's complement	±0.3 %
04_h	Current signal output	4 ... 20 mA	+4.00 {0.01 mA} +20.00 0 $\{1_{dec}\}$ +16384 Min. Limit values Max. +0.00 +24.00 mA -4096_{dec} $+20480_{dec}$	S5 Two's complement	±0.8 %

Parameter bytes 4/5	Signal function		Signal range			Format [1)]	Tolerance [2)]
06_h	Current signal output	0 ... 20 mA	0.00 0	{0.01 mA} {1_{dec}}	+20.00 +16384	S5 Two's complement	±0.6 %
			Min.	Limit values	Max.		
			0.00 0		+25.00 mA +20480 dec		
0Bh	Current signal output	±20 mA	-20.00 -27648	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.3 %
			Min.	Limit values	Max.		
			-23.52 mA -32512_{dec}		+23.52 mA $+32511_{dec}$		
$0C_h$	Current signal output	4 ... 20 mA	+4.00 0	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.8 %
			Min.	Limit values	Max.		
			0.00 -6912_{dec}		+22.81 mA $+32511_{dec}$		
$0E_h$	Current signal output	0 ... 20 mA	0.00 0	{0.01 mA} {1_{dec}}	+20.00 +27648	S7 Two's complement	±0.6 %
			Min.	Limit values	Max.		
			0.00 0		+23.52 mA $+32511_{dec}$		
FF_h	Analog output is switched off						

1) Format of the output data (📖 13.1-6).

2) Tolerance of the output range at an ambient temperature of 25 °C.

13.2 Parameterising 2/4xcounter module

13.2.1 Parameter data

The operating mode of the 2/4xcounter (e.g. 2 x 32-bit counter or 4 x 16-bit counter) can be determined by assigning each channel (counter 0 and counter 1) a mode via the parameter data.

Stop!

Depending on the mode setting, the terminal assignment of the counter module changes!

For the 2/4xcounter, 2 bytes of parameter data are available.

The parameter data follow the assignment below:

Byte	Assignment		Lenze setting
0	Mode, counter 0	Selecting the modes	00_h
1	Mode, counter 1		00_h

Counter mode overview

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
		2 counters		**0**			**1**					
00_h	0	32-bit counter	RES	CLK	DIR	RES	CLK	DIR	•	•	–	–
01_h	1	Encoder 1 edge	RES	A	B	RES	A	B	•	•	–	–
03_h	3	Encoder 2 edges	RES	A	B	RES	A	B	•	•	–	–
05_h	5	Encoder 4 edges	RES	A	B	RES	A	B	•	•	–	–
		4 counters		**0.1**	**0.2**		**1.1**	**1.2**				
08_h	8	2 × 16-bit counters (counting direction up/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
09_h	9	2 × 16-bit counters (counting direction down/up)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0A_h$	10	2 × 16-bit counters (counting direction up/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
$0B_h$	11	2 × 16-bit counters (counting direction down/down)	–	CLK	CLK	–	CLK	CLK	–	–	–	–
		2 counters		**0**			**1**					
$0C_h$	12	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0D_h$	13	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	–	✓
$0E_h$	14	2 × 32-bit counters (counting direction up)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
$0F_h$	15	2 × 32-bit counters (counting direction down)	RES	CLK	GATE	RES	CLK	GATE	•	•	✓	✓
		1 counter			**0/1**							
10_h	16	Frequency measuring	RES	CLK	START	STOP	–	–	•	•	–	✓
11_h	17	Measuring the period	RES	CLK	START	STOP	–	–	•	•	–	✓
12_h	18	Frequency measuring (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
13_h	19	Measuring the period (Counter output on/off)	RES	CLK	START	STOP	–	–	•	•	–	✓
		2 counters		**0**			**1**					
06_h	6	Measuring the pulse width (f_{ref} 50 kHz, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
14_h	20	Measuring the pulse width (f_{ref} programmable, counting direction is selectable)	RES	PULSE	DIR	RES	PULSE	DIR	–	–	–	–
15_h	21	Measuring the pulse width (f_{ref} programmable, counting direction: Upwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
16_h	22	Measuring the pulse width (f_{ref} programmable, counting direction: Downwards)	RES	PULSE	GATE	RES	PULSE	GATE	–	–	–	–
		2 counters		**0**			**1**					
17_h	23	2 × 32-bit counters (counting direction up, ”Set” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
18_h	24	2 × 32-bit counters (counting direction down, ”Set” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
19_h	25	2 × 32-bit counters (counting direction up, ”Reset” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓
$1A_h$	26	2 × 32-bit counters (counting direction down, ”Reset” function)	RES	CLK	GATE	RES	CLK	GATE	–	–	–	✓

Parameterising 2/4xcounter module 13.2

Parameter data 13.2.1

Mode of [h]	Mode of [dec]	Function	IN1	IN2	IN3	IN4	IN5	IN6	OUT0	OUT1	Auto Reload	Compare Load
		2 counters		**0**			**1**					
$1B_h$	27	32-bit counter	G/RES⌋	CLK	DIR	G/RES⌋	CLK	DIR	•	•	–	–
$1C_h$	28	Encoder 1 edge	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1D_h$	29	Encoder 2 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
$1E_h$	30	Encoder 4 edges	G/RES⌋	A	B	G/RES⌋	A	B	•	•	–	–
		2 counters		**0**			**1**					
$1F_h$	31	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
20_h	32	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	–	✓
21_h	33	2 × 32-bit counters (counting direction up)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
22_h	34	2 × 32-bit counters (counting direction down)	RES⌋	CLK	GATE	RES⌋	CLK	GATE	•	•	✓	✓
		2 counters		**0**			**1**					
23_h	35	32-bit counter	GATE	CLK	DIR	GATE	CLK	DIR	•	•	–	–
24_h	36	Encoder 1 edge	GATE	A	B	GATE	A	B	•	•	–	–
25_h	37	Encoder 2 edges	GATE	A	B	GATE	A	B	•	•	–	–
26_h	38	Encoder 4 edges	GATE	A	B	GATE	A	B	•	•	–	–

•	Digital output can signal an event
✓	Function available.
–	No function / function not available
A	Encoder signal A
Auto Reload	”Auto Reload” causes the counter to accept a preset value as soon as the counter content matches the Compare register content.
B	Encoder signal B
Compare Load	You may use ”Compare Load” to specify a counter limit value to trigger an output when reached or to restart the counters via Auto Reload.
CLK	Clock signal of a connected encoder HIGH level starts and / or stops the counting process
DIR	Indicates counting direction depending on signal level LOW: Upcounter HIGH: Downcounter
GATE	Gate signal is level-triggered HIGH: Pulses are measured
G/RES⌋	Gate signal is level-triggered and reset signal is edge-triggered HIGH: Pulses are measured LOW-HIGH edge: Deletes one or both counters
PULSE	The pulse width of the supplied signal is measured with an internal time base
RES	Reset signal is level-triggered HIGH: Deletes one or both counters
RES⌋	Reset signal is edge-triggered LOW-HIGH edge: Deletes one or both counters
START	Start signal is edge-triggered
STOP	Stop signal is edge-triggered

13.2.2 Input data / output data

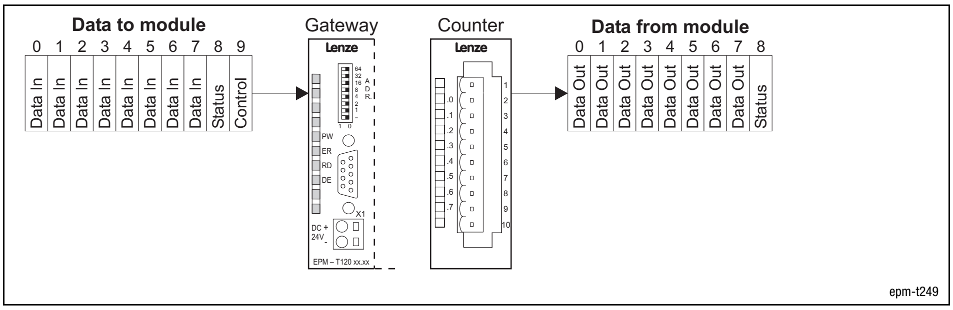

Fig. 13.2-1 Data input / output of 2/4xcounter

For the data input / data output, 10 bytes are available which are transmitted to the counter or output by the counter.

Input data

8 bytes (byte 0 ... 7) of input data (Data In) for the specification of counter starting values or comparison values.

Control byte

Due to a level change in byte 9 (Control), the values are written into a counter register. Each bit in byte 9 is assigned to a specific counter register word.

Output data

8 bytes (byte 0 ... 7) of output data (Data Out) for reading out the current count values.

Status byte

The behaviour of the counter, when the master module restarts (e.g. after changing the parameter setting), can be controlled via byte 8 (status). The following combinations are possible:

Bit 0	Bit 1	Description
1	0	Counter reading remanent on restart
0	1	Counter reading cleared on restart (Lenze setting)
1	1	

A read access to byte 9 of the output data allows setting checks at any time.

Note!

Count values get lost when the mains supply is switched off/on; they are not stored!

13.2.3 2 x 32 bit counter (mode 0)

Terminal assignment

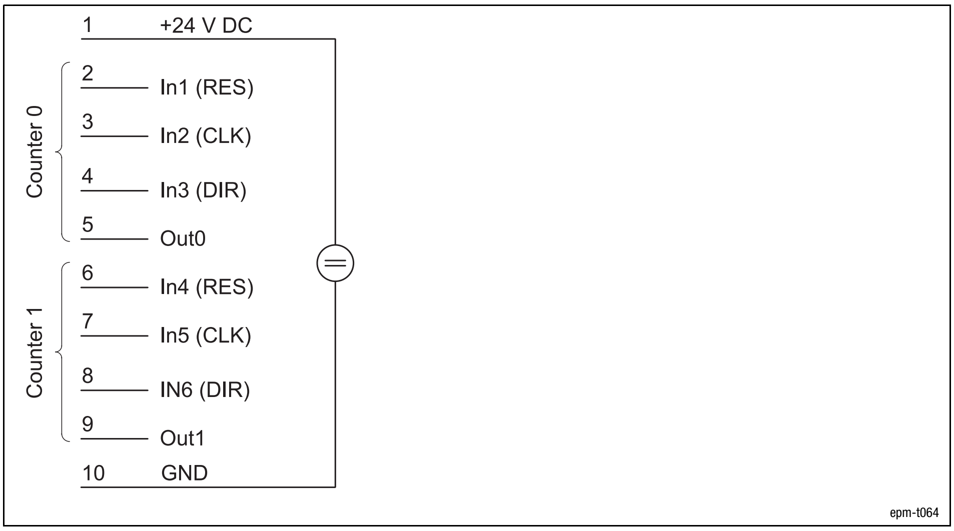

Fig. 13.2-2 Terminal assignment of the 2/4xcounter in the mode 0

The mode 0 offers two 32-bit counters which can be assigned with a starting value.

CLK signal

Each LOW-HIGH edge at input IN2 / IN5 (CLK) increments and/or decrements the counter by 1, respectively.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

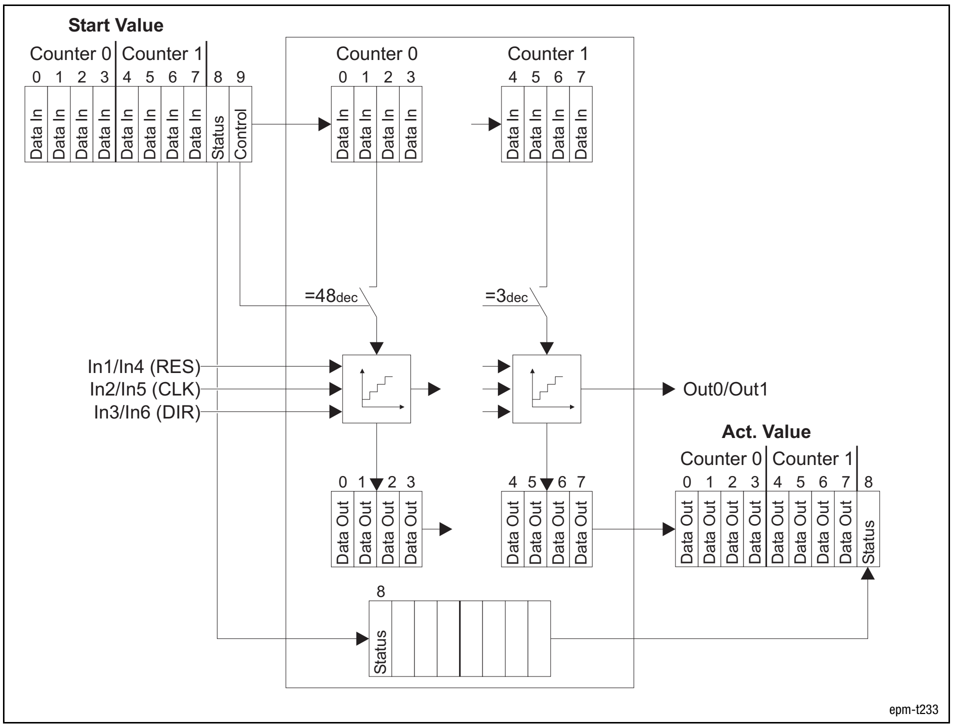

Fig. 13.2-3 Counter access of the 2/4xcounter in the mode 0

Signal characteristic

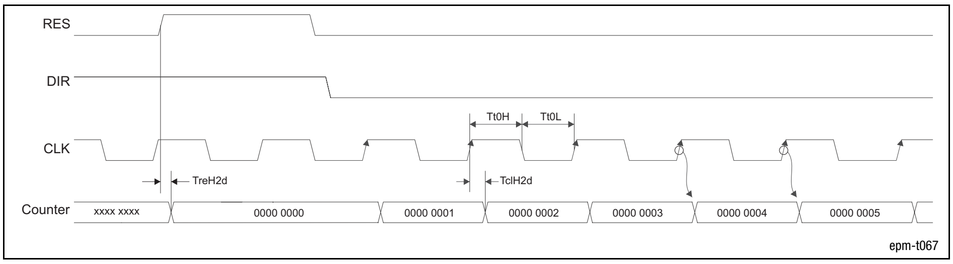

Fig. 13.2-4 Signal characteristic of 2/4xcounter in the mode 0 (upcounter)

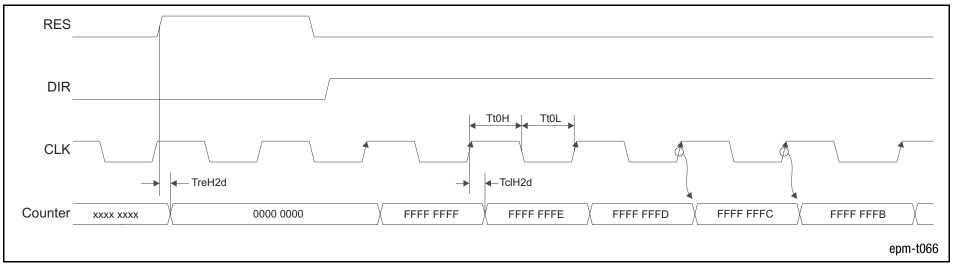

Fig. 13.2-5 Signal characteristic of 2/4xcounter in the mode 0 (downcounter)

13.2.4 Encoder (modes 1, 3, and 5)

Terminal assignment

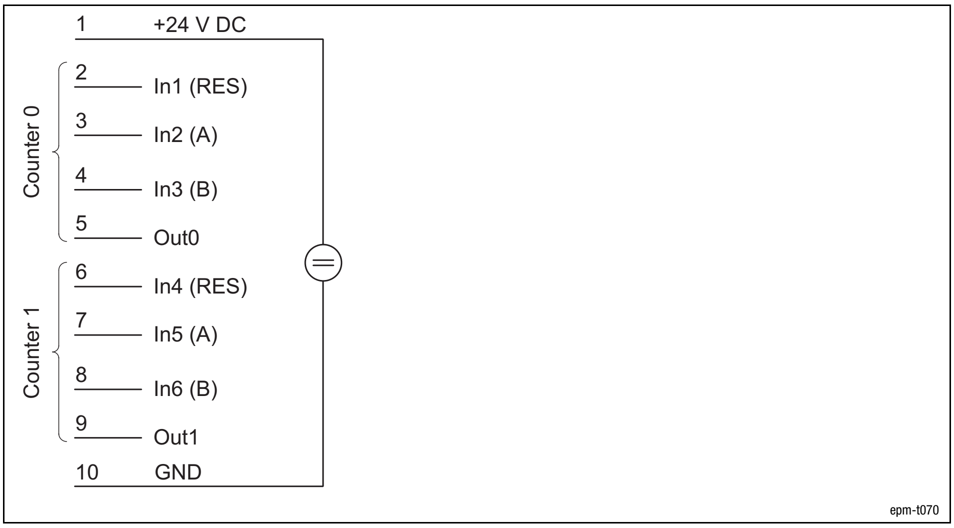

Fig. 13.2-6 Terminal assignment of the 2/4xcounter in the modes 1, 3 and 5

The modes 1, 3, and 5 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 1: 1 edge
Mode 3: 2 edges
Mode 5: 4 edges

A/B signal

See signal characteristics.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

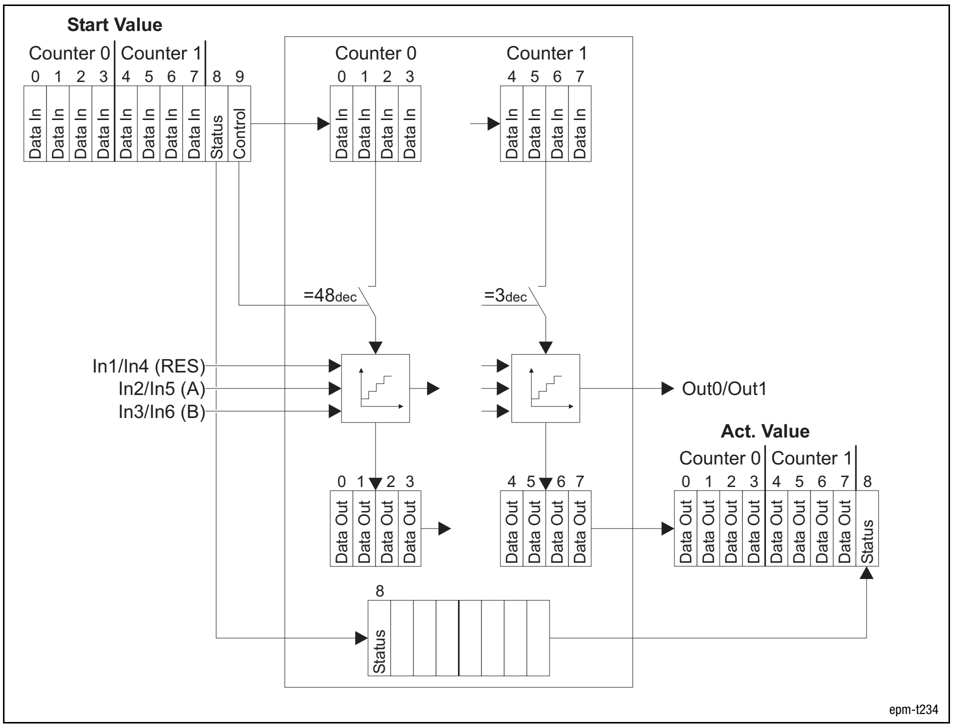

Fig. 13.2-7 Counter access of the 2/4xcounter in the modes 1, 3 and 5

Signal characteristic in mode 1

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

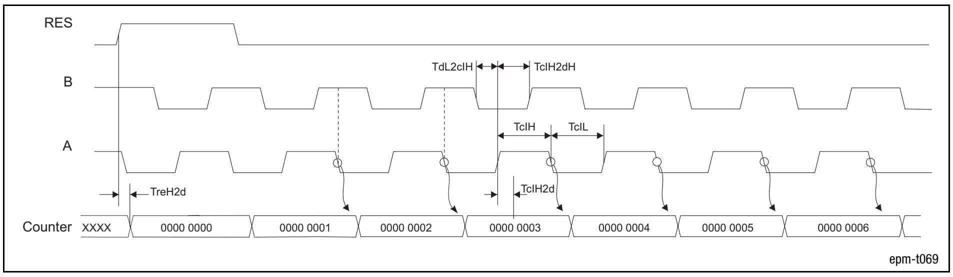

Fig. 13.2-8 Signal characteristic of 2/4xcounter in the mode 1 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

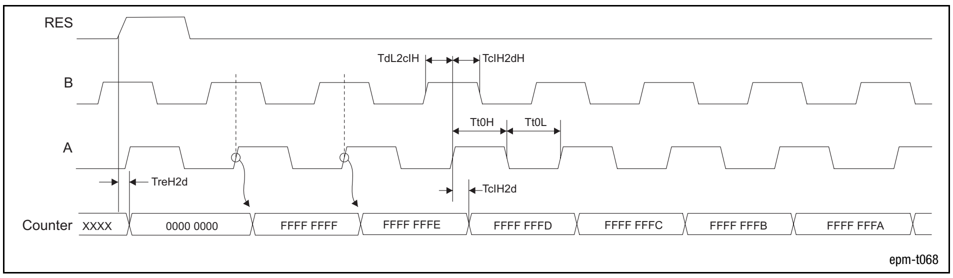

Fig. 13.2-9 Signal characteristic of 2/4xcounter in the mode 1 (downcounter)

Signal characteristic in mode 3

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

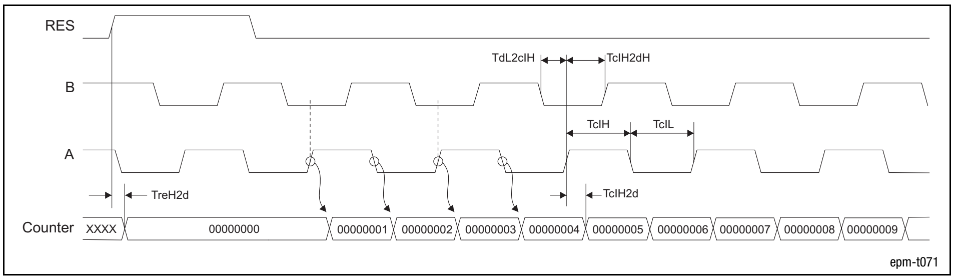

Fig. 13.2-10 Signal characteristic of 2/4xcounter in the mode 3 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

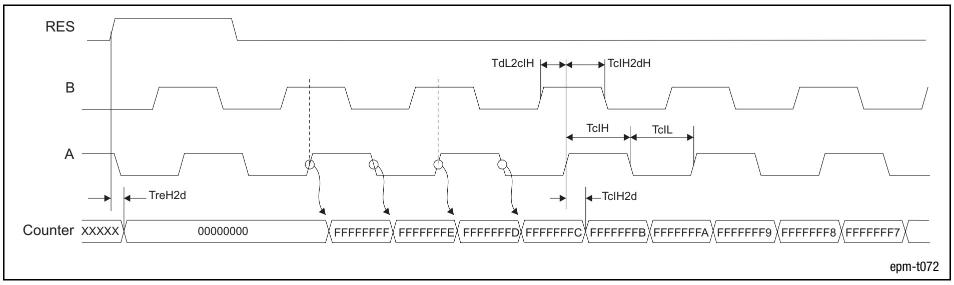

Fig. 13.2-11 Signal characteristic of 2/4xcounter in the mode 3 (downcounter)

Signal characteristic in mode 5

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

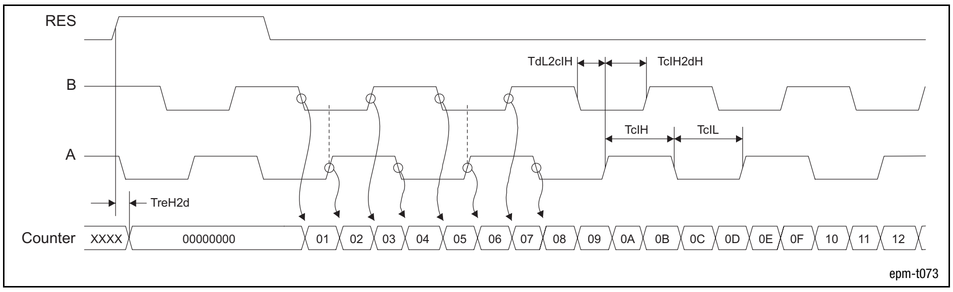

Fig. 13.2-12 Signal characteristic of 2/4xcounter in the mode 5 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

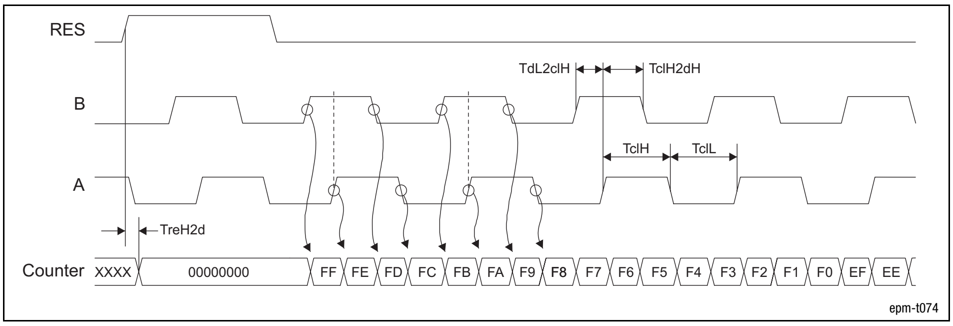

Fig. 13.2-13 Signal characteristic of 2/4xcounter in the mode 5 (downcounter)

13.2.5 Measuring the pulse width, f_{ref} 50 kHz (mode 6)

Terminal assignment

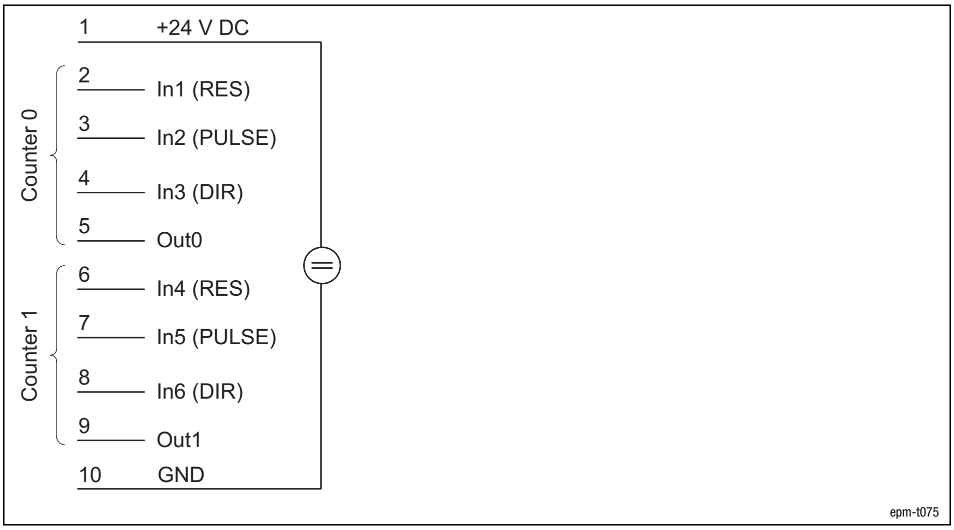

Fig. 13.2-14 Terminal assignment of the 2/4xcounter in the mode 6

The pulse widths of the signals at input IN2 / IN5 (PULSE) are measured with an internal time base.

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit 20 ms (corresponds to a clock frequency of f_{ref} = 50 kHz; the clock frequency cannot be changed). This result is available in the data output range and can be read out until the next new result.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Counter access

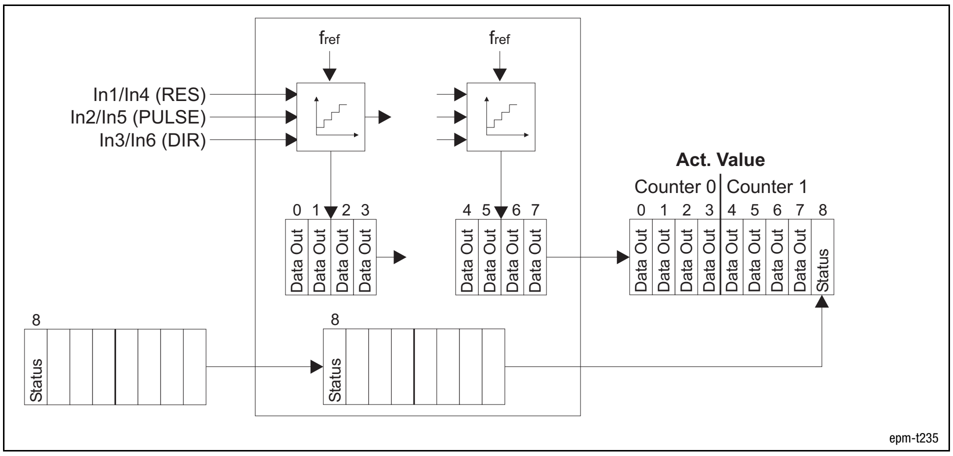

Fig. 13.2-15 Counter access of the 2/4xcounter in the mode 6

Signal characteristic

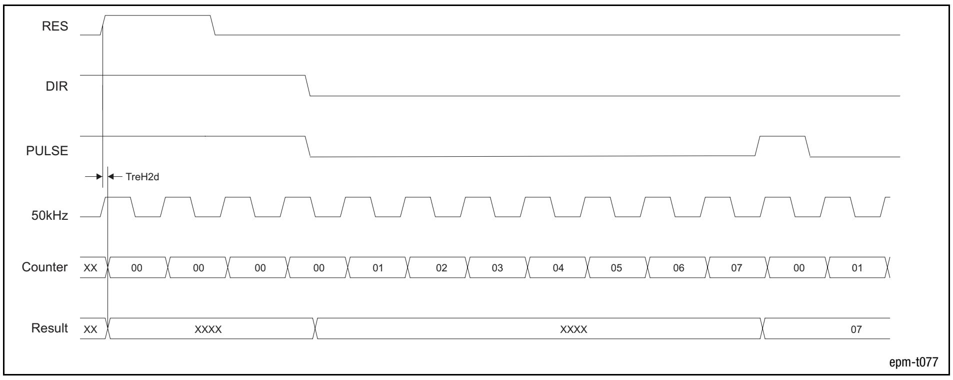

Fig. 13.2-16 Signal characteristic of 2/4xcounter in the mode 6 (upcounter)

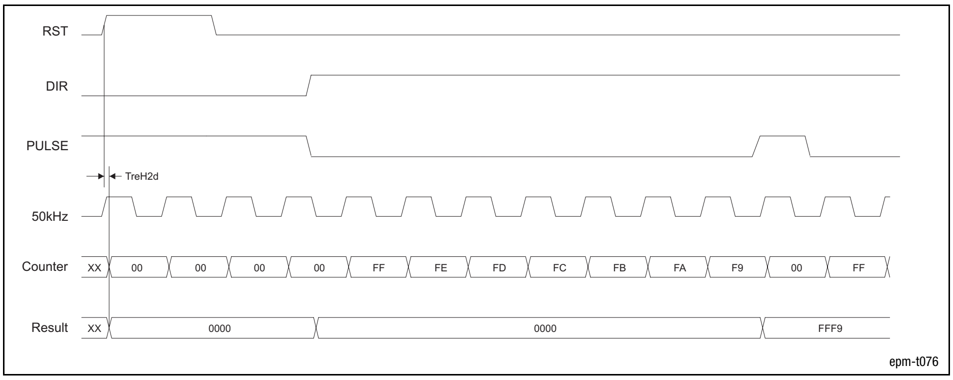

Fig. 13.2-17 Signal characteristic of 2/4xcounter in the mode 6 (downcounter)

13.2.6 4 × 16 bit counter (modes 8 ... 11)

Terminal assignment

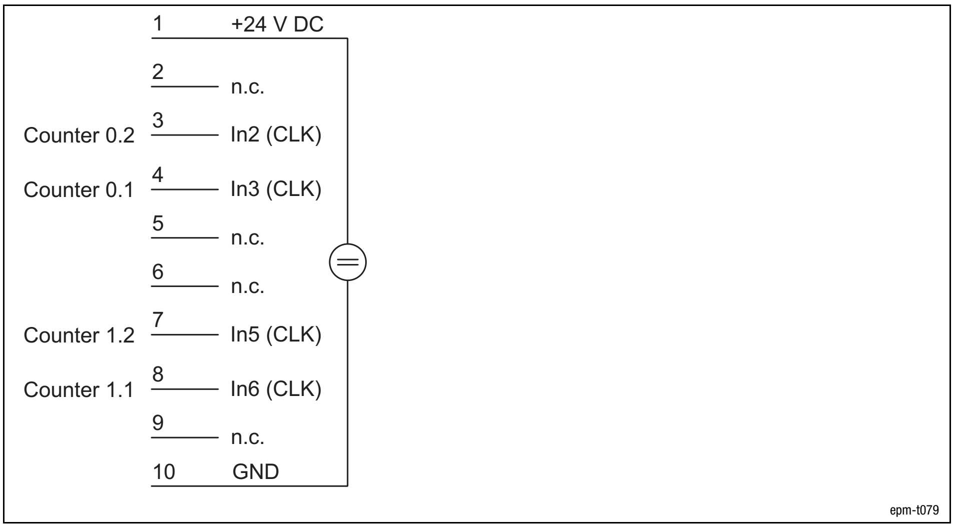

Fig. 13.2-18 Terminal assignment of the 2/4xcounter in the modes 8 ... 11

The modes 8 ... 11 offers four 16-bit counters which can be pre-assigned with a starting value.

The modules differ in having different counting directions:

Mode 8:

- Counters 0.2 and 1.2 count up
- Counters 0.1 and 1.1 count up

Mode 9:

- Counters 0.2 and 1.2 count down
- Counters 0.1 and 1.1 count up

Mode 10:

- Counters 0.2 and 1.2 count up
- Counters 0.1 and 1.1 count down

Mode 11:

- Counters 0.2 and 1.2 count down
- Counters 0.1 and 1.1 count down

CLK signal

Each LOW-HIGH edge at input IN2 / IN3 / IN5 / IN6 (CLK) causes the associated counter to count up and / or down, respectively.

Counter access

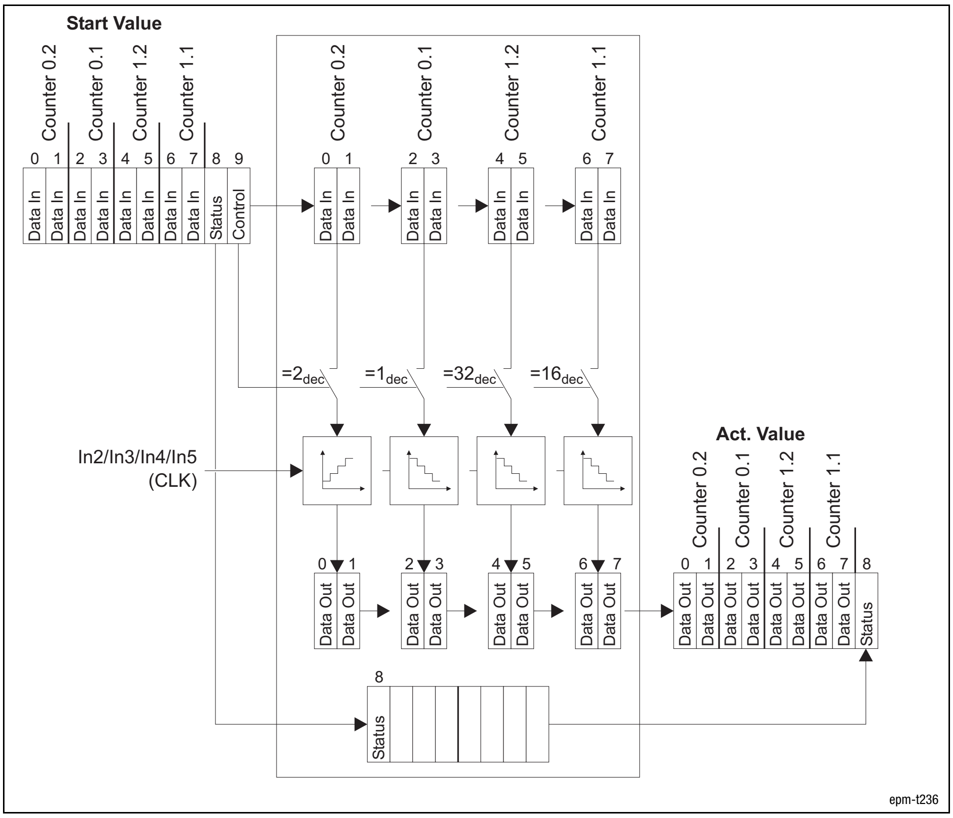

Fig. 13.2-19 Counter access of the 2/4xcounter in the modes 8 ... 11

Signal characteristic

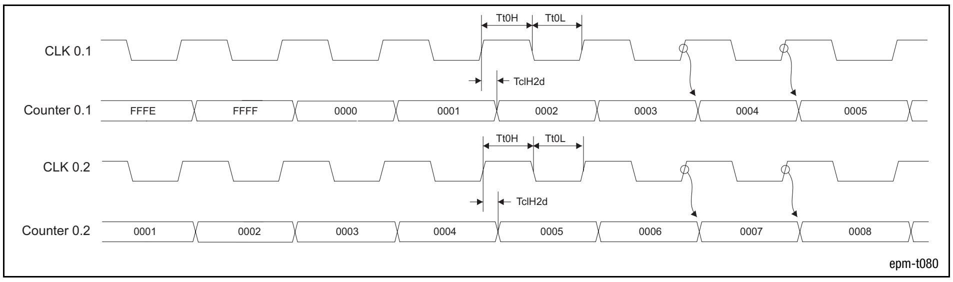

Fig. 13.2-20 Signal characteristic of 2/4xcounter in mode 8 considering as example the counters 0.1 and 0.2

13.2.7 2 × 32 bit counter with GATE and RES level-triggered (modes 12 and 13)

Terminal assignment

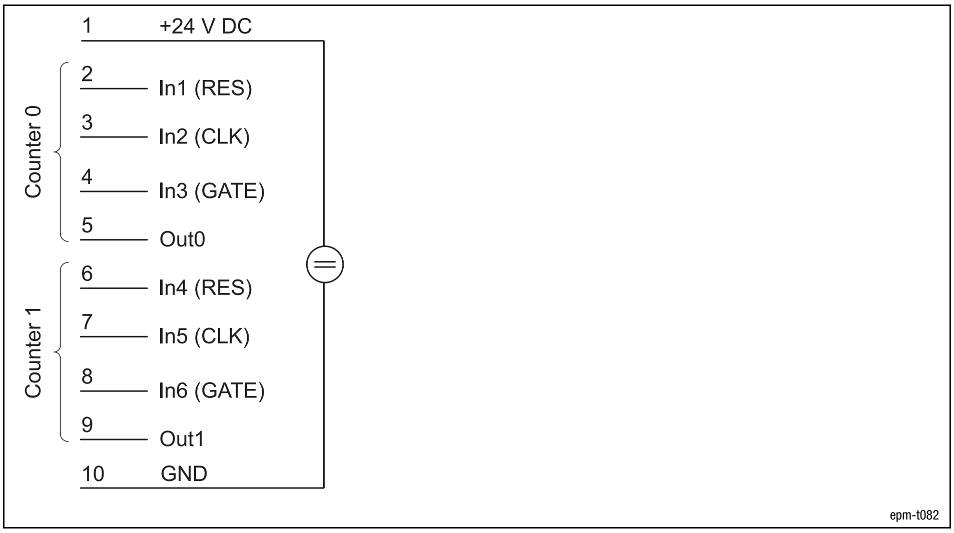

Fig. 13.2-21 Terminal assignment of the 2/4xcounter in the modes 12 and 13

In the modes 12 and 13, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modules differ in having different counting directions:

Mode 12: Upcounter.
Mode 13: Downcounter

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Once the counter reaches the value loaded in the ”Compare” register, output OUT0 / OUT1 is set to HIGH level for at least 100 ms, with the counter continuing its task.

Counter access

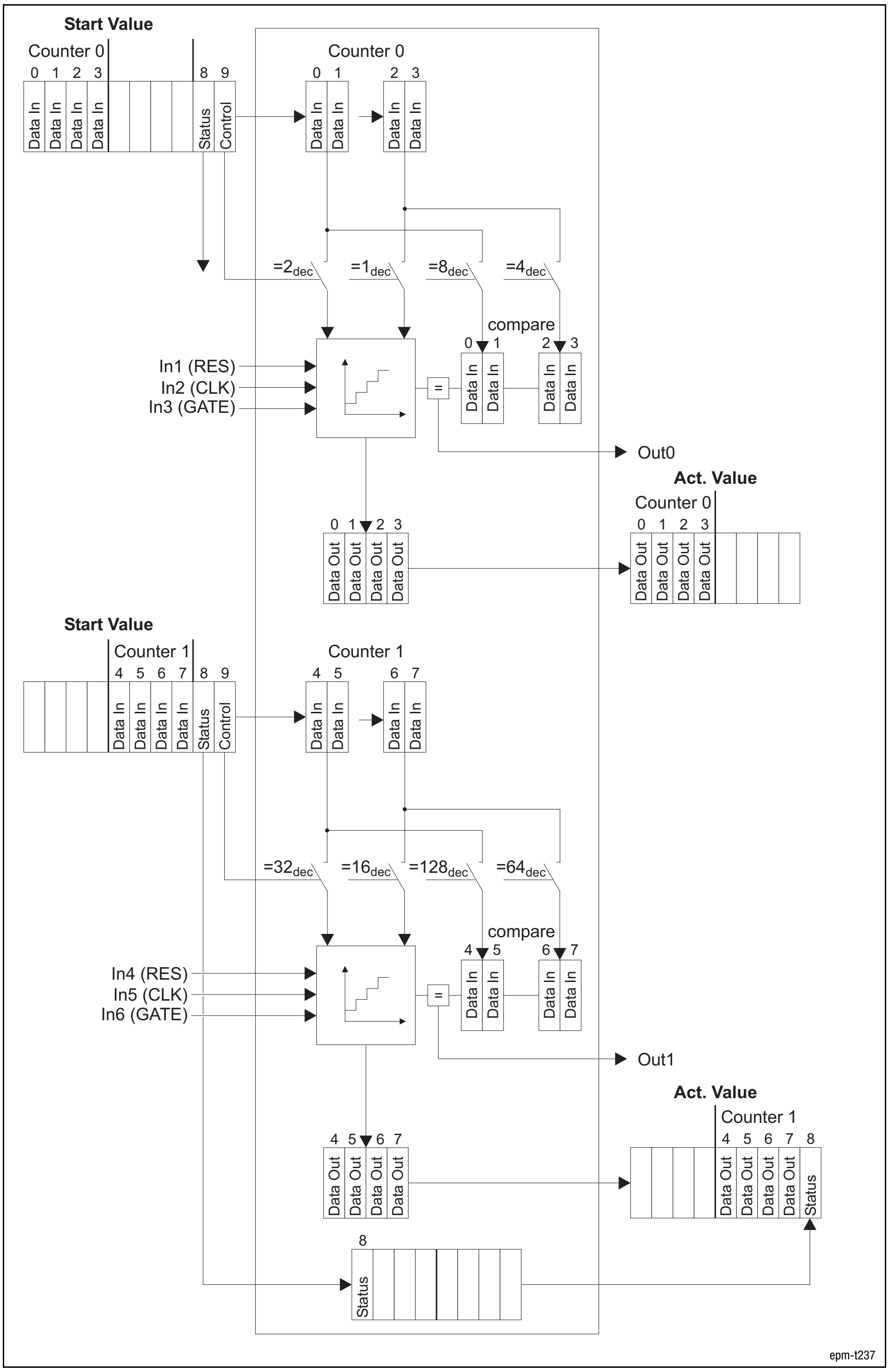

Fig. 13.2-22 Counter access of the 2/4xcounter in the modes 12 and 13

Signal characteristic

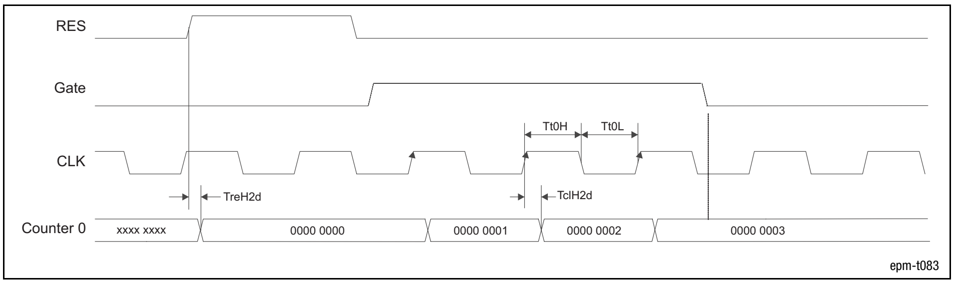

Fig. 13.2-23 Signal characteristic of 2/4xcounter in the mode 12

13.2.8 2 × 32 bit counter with GATE, RES level-triggered and auto reload (modes 14 and 15)

Terminal assignment

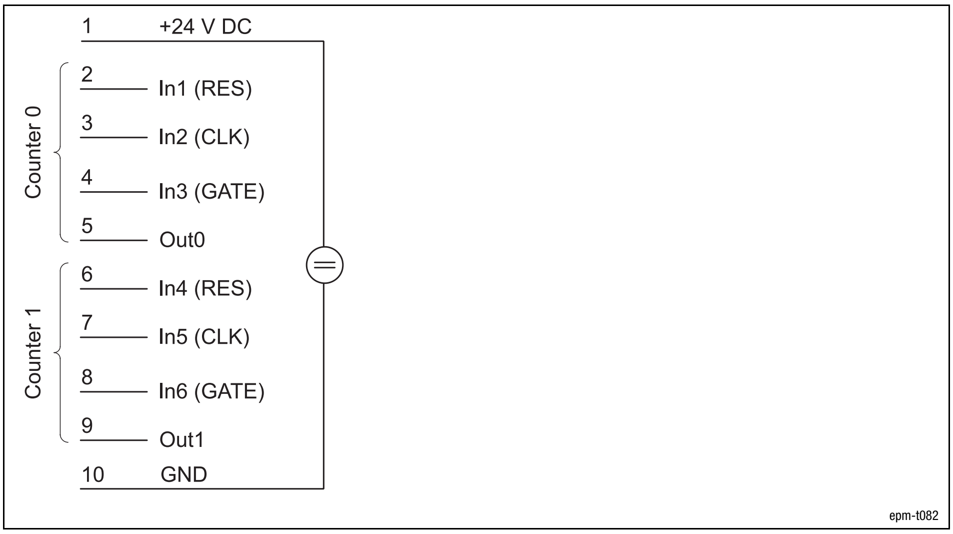

Fig. 13.2-24 Terminal assignment of the 2/4xcounter in the modes 14 and 15

In the modes 14 and 15, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

These modes offer the function "Auto Reload". This means, that the Load Register can be assigned with a value which is automatically loaded into the counter as soon as it reaches the comparison value set.

The modules differ in having different counting directions:

Mode 14: Upcounter.
Mode 15: Downcounter

RES signal

A HIGH level at input IN1 / IN4 (RES) sets the counter to zero.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

The counter counts up to the value set in the compare register. With this last LOW-HIGH edge the counter content is overwritten with the value set in the load register. This is repeated until the input IN3 / IN6 (GATE) receives a LOW signal.

OUT signal

If an "Auto Reload" occurs, the signal level at the output OUT0 / OUT1 changes. (A LOW-HIGH edge at the input IN1 / IN4 (RES) does not reset the output OUT0 / OUT1.)

Counter access

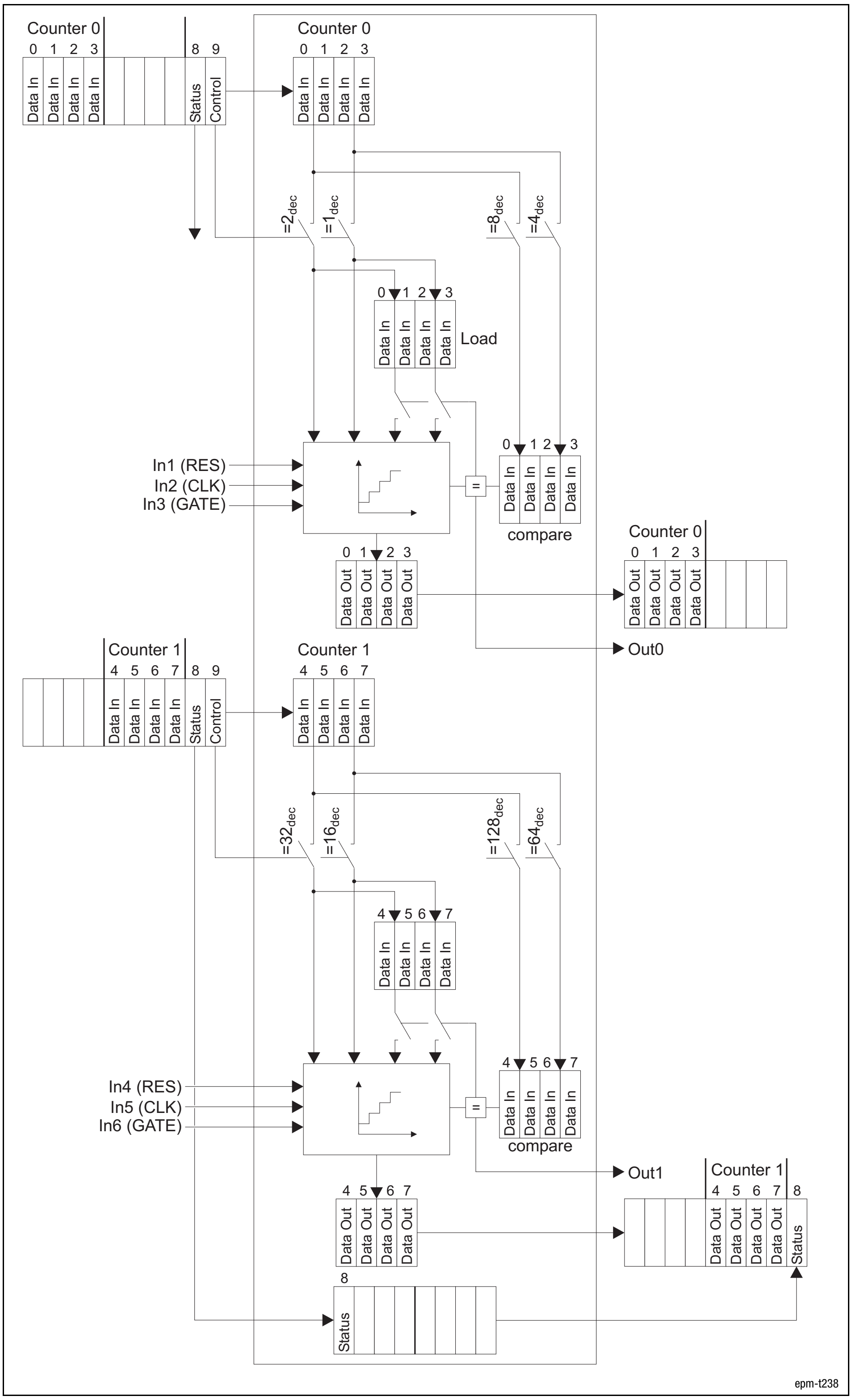

Fig. 13.2-25 Counter access of the 2/4xcounter in the modes 14 and 15

Signal characteristic

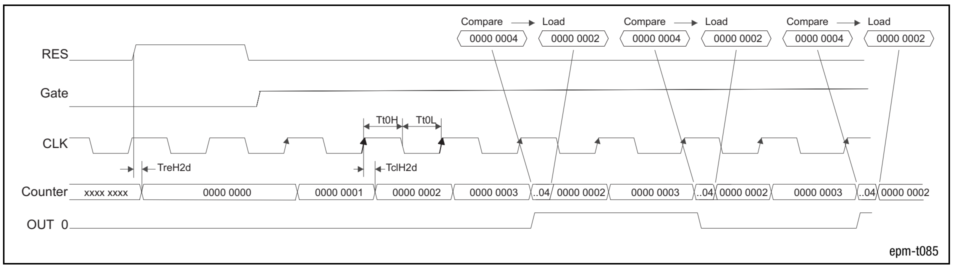

Fig. 13.2-26 Signal characteristic of 2/4xcounter in the mode 14 (upcounter)

13.2.9 Measuring the frequency (modes 16 and 18)

Terminal assignment

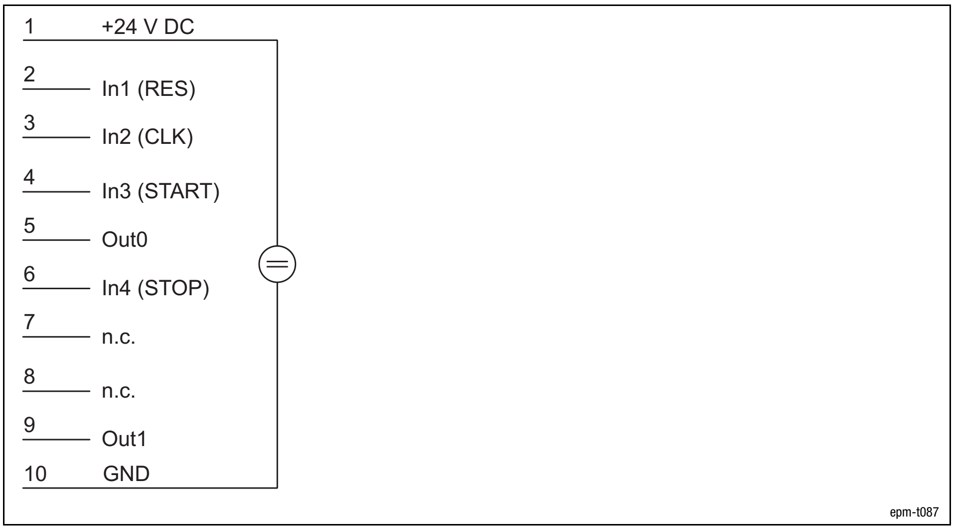

Fig. 13.2-27 Terminal assignment of the 2/4xcounter in the modes 16 and 18

Modes 16 and 18 allow determination of the frequency of a signal at input IN2 (CLK).

The modes differ in triggering the output Out0 / Out1 in different ways.

Note!

For measuring the frequency, counters 0 and 1 are required. For this, both counters must be parameterised to mode 16 or 18. Different modes cannot be set.

With the PDO byte 7 (Data In) a reference frequency (f_{ref}) is transmitted to counter 0 (see figure "counter access"). The number "n" of the reference frequency pulses determines the gate time (period of time the counter 1 is to be released). "n" can be between 1 and 2^{32}-1 and is loaded into the compare register.

RES signal

A LOW-HIGH edge at input IN1 (RES) sets the counter to zero.

START signal

A LOW-HIGH edge at input IN3 (START) starts the measuring process.

CLK signal

During the measuring process the counter 0 counts with the first LOW-HIGH edge at the input IN2 (CLK) the pulses "n" of the reference frequency. Simultaneously the counter 1 counts every LOW-HIGH edge at the input IN2 (CLK).

STOP signal

Both counters are stopped when

- the counter 0 reading reaches the Compare value, or
- input IN4 (STOP) receives a HIGH signal.

OUT signal

Mode 16:

The output OUT 0 is set to HIGH level when the *measuring process* starts, and is set to LOW level, when the *measuring process* is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Mode 18:

The output OUT 0 is set to HIGH level when the *counting process* starts, and is set to LOW level, when the *counting process* is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Computing the frequency

$f = \frac{f_{ref} \cdot m}{n}$	f	Frequency to be computed
	f_{ref}	Reference frequency (see figure ”counter access”)
	m	Content, counter 1 (number of CLK pulses)
	n	Number of reference frequency pulses in counter 0 (corresponds to Compare unless prematurely terminated by a HIGH signal at input IN4 (STOP)

Note!

If the reference frequency [f_{ref}] and the number of reference frequency pulses [n] are selected so that the wanted frequency [f] is exactly 1 Hz, the counter 1 directly displays this frequency.
Example: m = 1,000,000; f_{ref} = 1 MHz.

Counter access

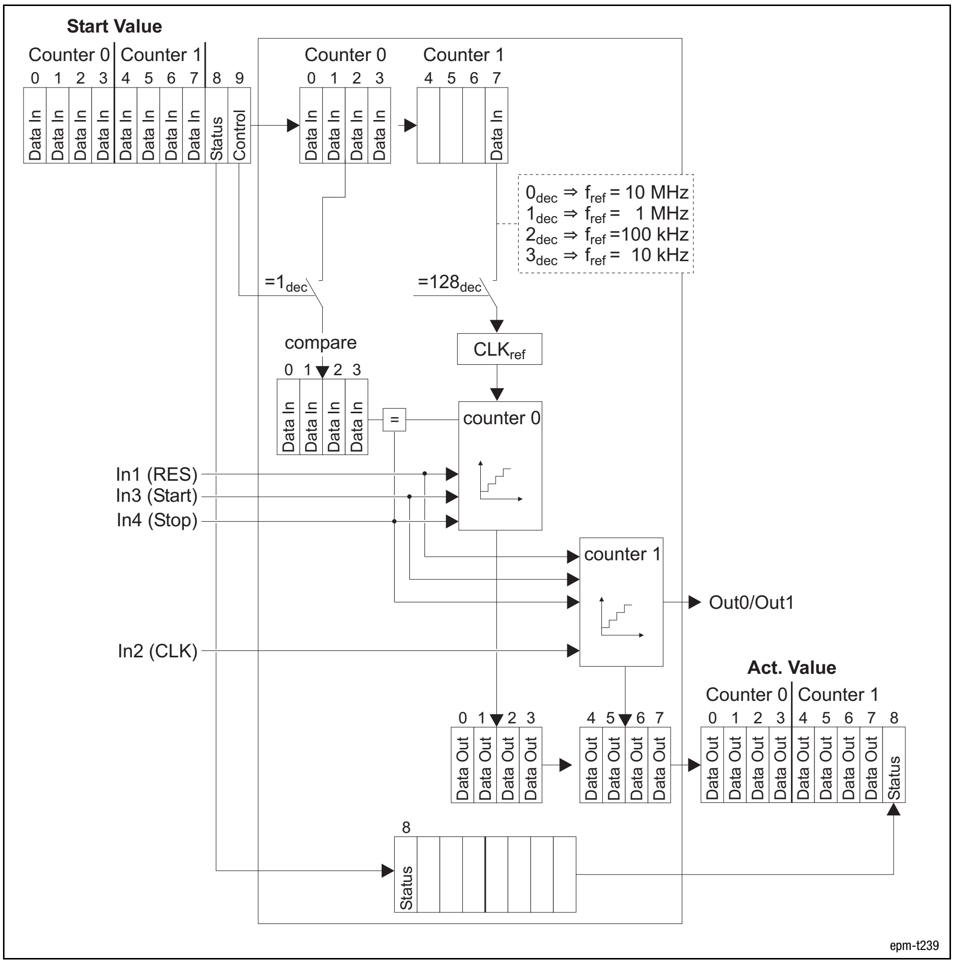

Fig. 13.2-28 Counter access of the 2/4xcounter in the modes 16 and 18

Signal characteristic in mode 16

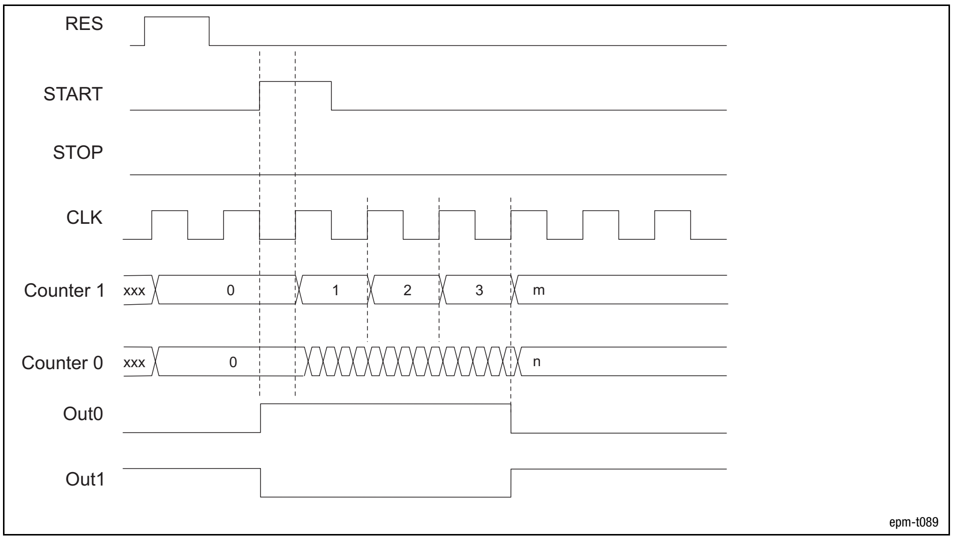

Fig. 13.2-29 Signal characteristic of 2/4xcounter in the mode 16

OUT0 = HIGH Measuring process in progress

Signal characteristic in mode 18

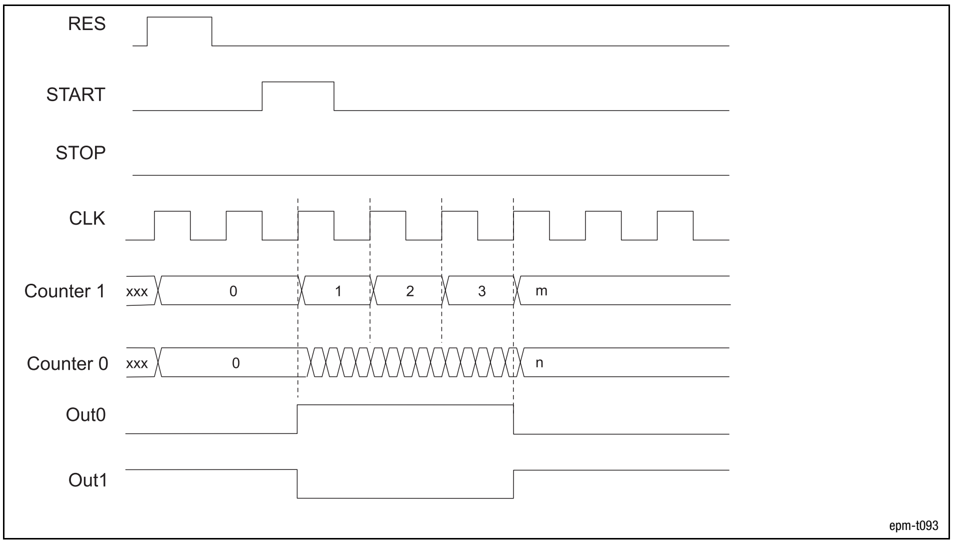

Fig. 13.2-30 Signal characteristic of 2/4xcounter in the mode 18

OUT0 = HIGH Gate open

13.2.10 Measuring the period (modes 17 and 19)

Terminal assignment

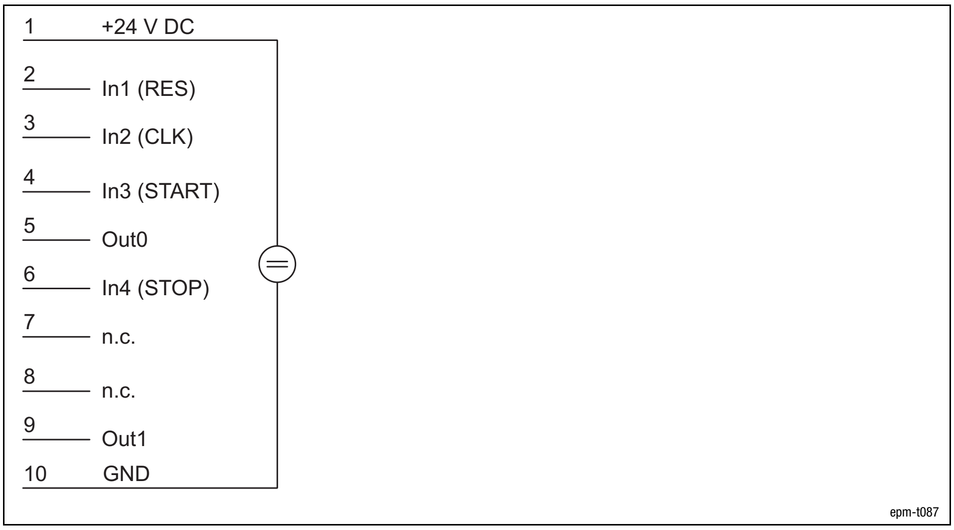

Fig. 13.2-31 Terminal assignment of the 2/4xcounter in the modes 17 and 19

Modes 17 and 19 allow the determination of the average period of "n" measured period of signal at input IN2 (CLK).

The modes differ in triggering the output Out0 / Out 1 differently.

Note!

For measuring the frequency of the period, the counters 0 and 1 are required. For this, both counters must be parameterised to mode 17 or 19. Different modes cannot be set.

With the PDO byte 7 (Data In) a reference frequency (f_{ref}) is transmitted to counter 1 (see figure "counter access"). The number "m" of the reference frequency pulses determines the gate time (period of time the counter 1 is to be released). "m" can be between 1 and 2^{32}-1 and is loaded into the compare register.

RES signal

A LOW-HIGH edge at input IN1 (RES) sets the counter to zero.

START signal

A LOW-HIGH edge at input IN3 (START) starts the measuring process.

CLK signal

During the measuring process the counter 1 counts with the first LOW-HIGH edge at the input IN2 (CLK) the pulses "m" of the reference frequency. Simultaneously the counter 0 counts every LOW-HIGH edge at the input IN2 (CLK).

STOP signal

Both counters are stopped when

- the counter 0 reaches the Compare value, or
- input IN4 (STOP) receives a HIGH signal.

OUT signal

Mode 17:

The output OUT 0 is set to HIGH level when the *measuring process* starts, and is set to LOW level, when the measuring process is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Mode 19:

The output OUT 0 is set to HIGH level when the *counting process* starts, and is set to LOW level, when the counting process is completed. The output OUT1 indicates the output signal of OUT0 in an inverted way.

Computing the period

$T = \frac{n}{f_{ref} \cdot m}$	T	Average period
	f_{ref}	Reference frequency (see figure "counter access")
	m	Content, counter 1 (number of reference frequency pulses)
	n	Number of CLK pulses in counter 0 (corresponds to Compare unless prematurely terminated by a HIGH signal at input IN4 (STOP)

Counter access

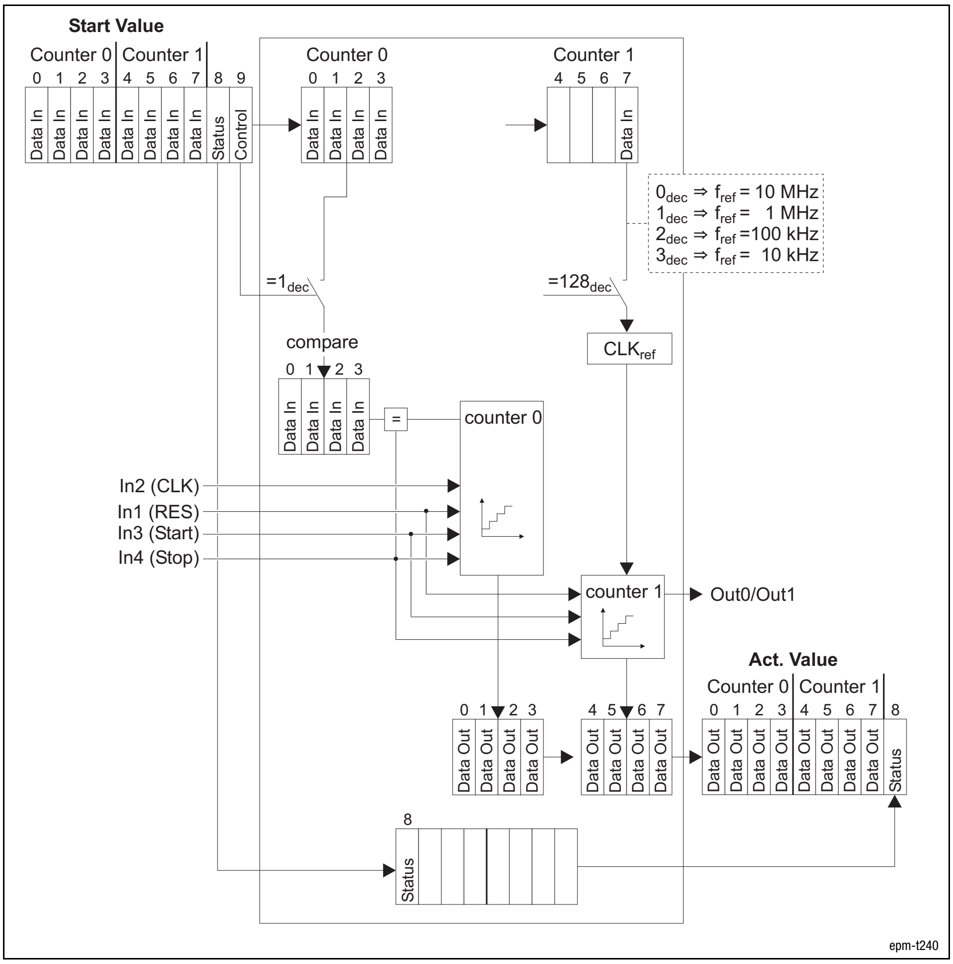

Fig. 13.2-32 Counter access of the 2/4xcounter in the modes 17 and 19

Signal characteristic in mode 17

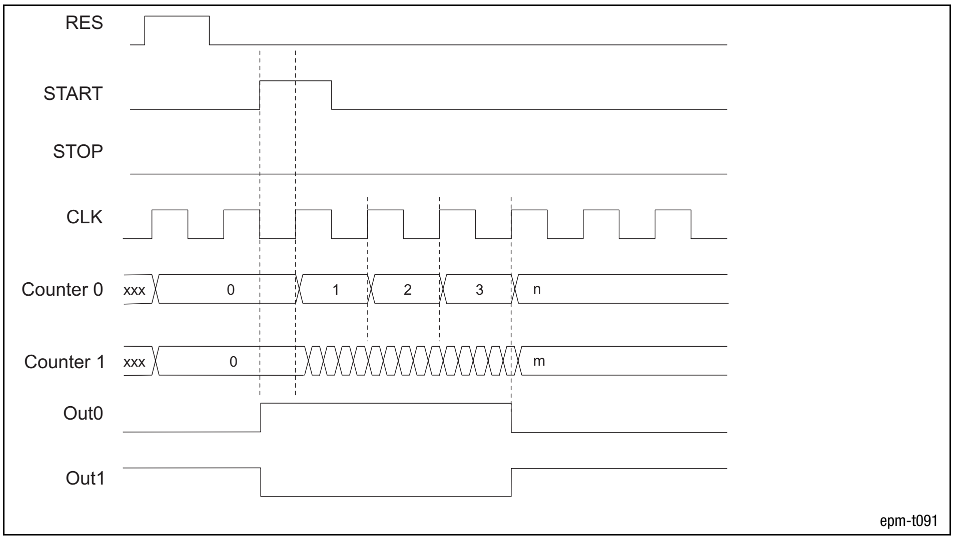

Fig. 13.2-33 Signal characteristic of 2/4xcounter in the mode 17
OUT0 = HIGH Measuring process in progress

Signal characteristic in mode 19

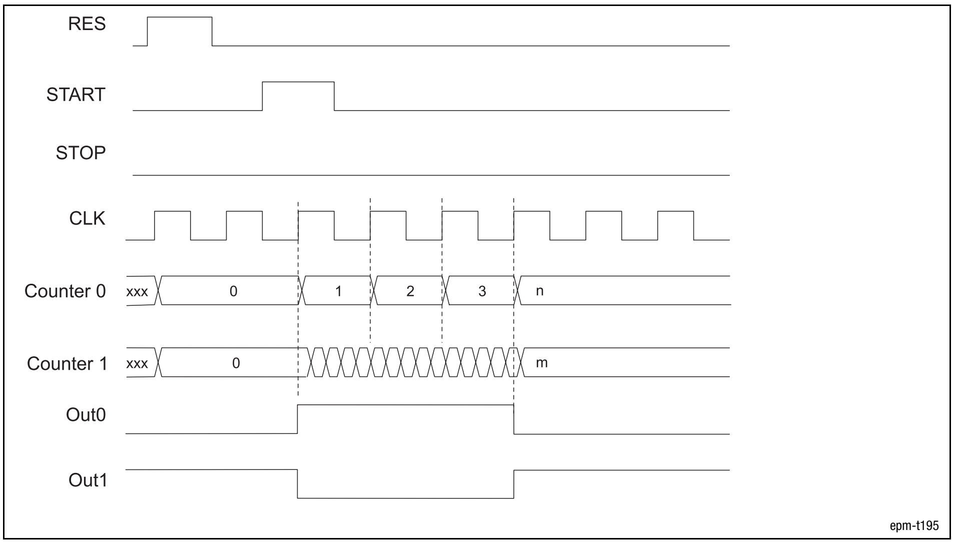

Fig. 13.2-34 Signal characteristic of 2/4xcounter in the mode 19
OUT0 = HIGH Gate open

13.2.11 Measuring the pulse width, f_{ref} programmable (mode 20)

Terminal assignment

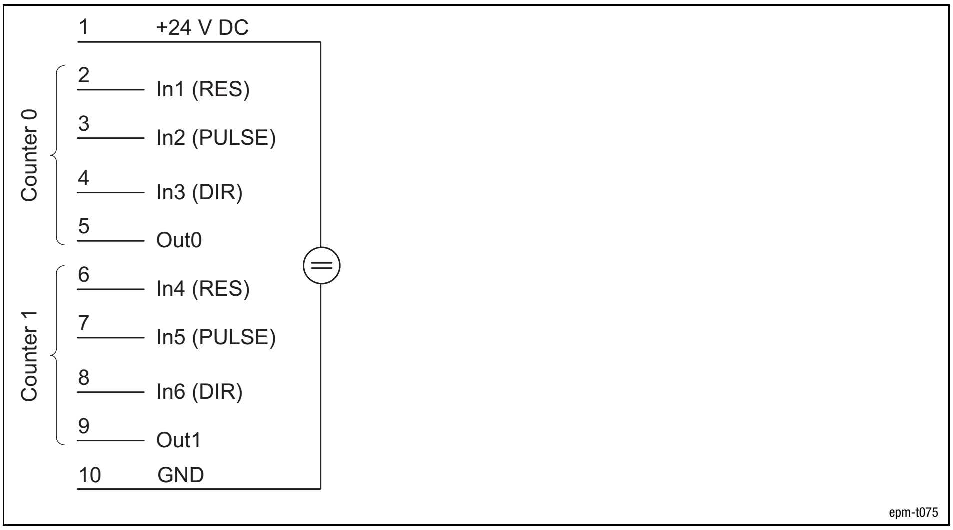

Fig. 13.2-35 Terminal assignment of the 2/4xcounter in the mode 20

The pulse widths of the signal at the input IN2 / IN5 (PULSE) are measured with a programmable time base (f_{ref}, see figure “Counter access”).

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit $1/f_{ref}$. This result can be found and read out in the data output range until the next result appears.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR).

Upcounter: LOW level
Downcounter: HIGH level

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Counter access

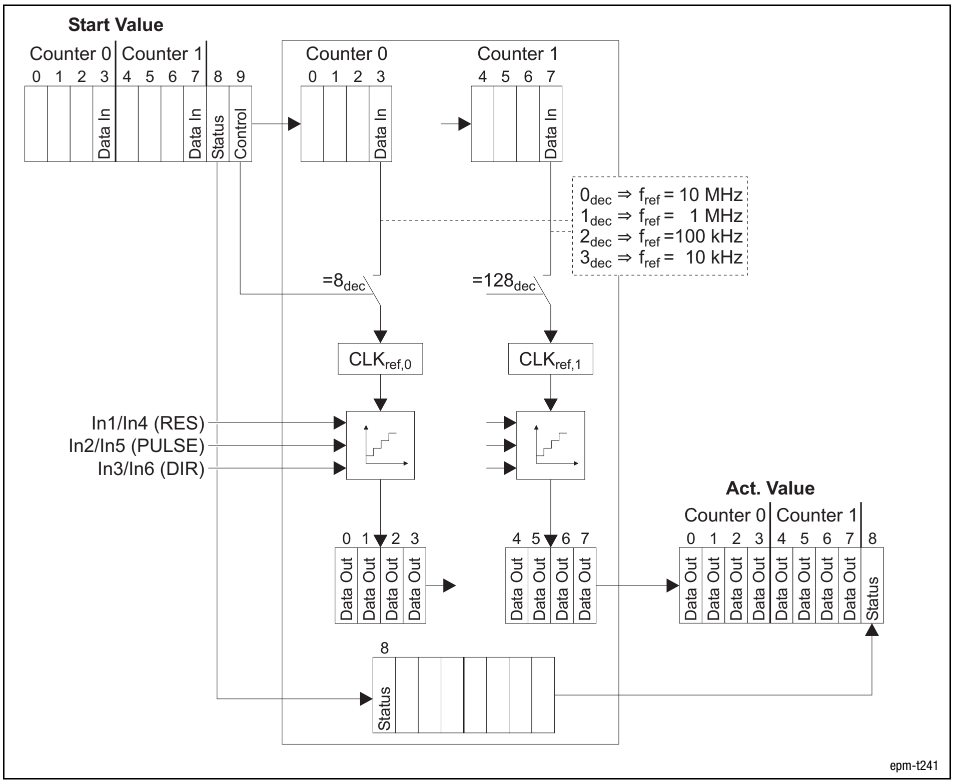

Fig. 13.2-36 Counter access of the 2/4xcounter in the mode 20

Signal characteristic

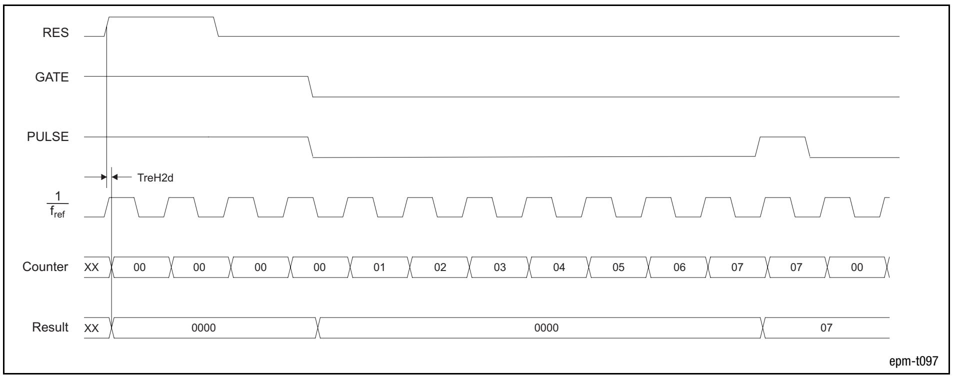

Fig. 13.2-37 Signal characteristic of 2/4xcounter in the mode 20 (upcounter)

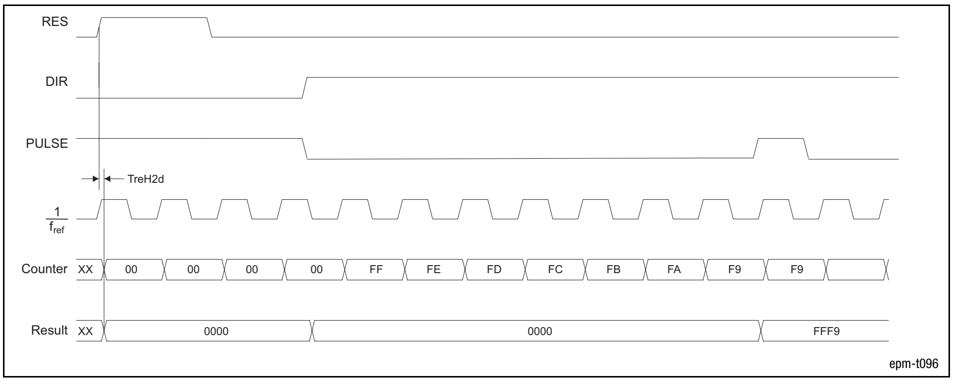

Fig. 13.2-38 Signal characteristic of 2/4xcounter in the mode 20 (downcounter)

13.2.12 Measuring the pulse width with GATE, f_{ref} programmable (modes 21 and 22)

Terminal assignment

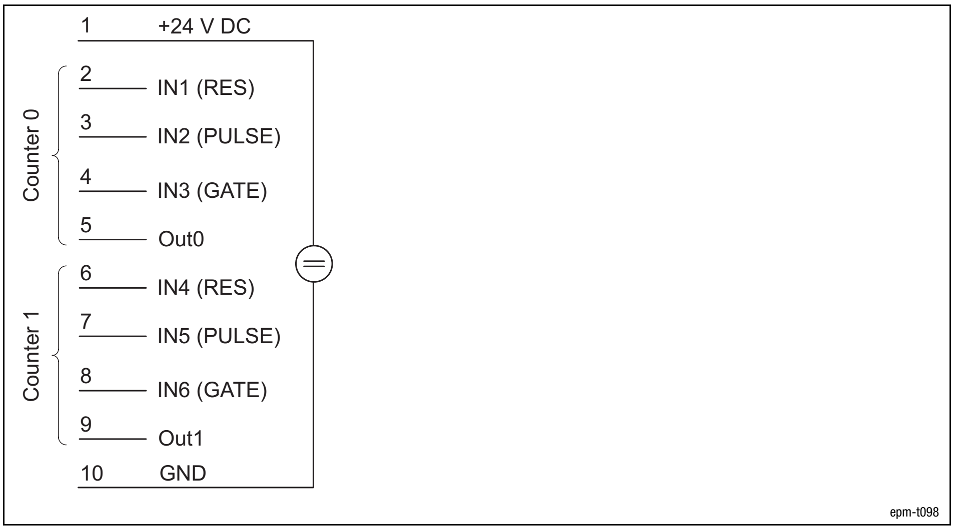

Fig. 13.2-39 Terminal assignment of the 2/4xcounter in the modes 21 and 22

The pulse widths of the signal at the input IN2 / IN5 (PULSE) are measured with a programmable time base (f_{ref}, see figure “Counter access”).

The modules differ in having different counting directions:

Mode 21: Upcounter.
Mode 22: Downcounter

GATE/CLK signal

The measuring process is enabled with a HIGH level at input IN3 / IN6 (GATE).

PULSE signal

The measuring process starts with a HIGH-LOW edge at input IN2 / IN5 (PULSE) and ends with the LOW-HIGH edge.

A LOW-HIGH edge of the measured signal stores the pulse width with the unit $1/f_{ref}$. This result can be found and read out in the data output range until the next result appears.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Output OUT0 / OUT1 has no function.

Note!

The measuring process is terminated only if a HIGH level is applied at input IN3 / IN6 (GATE) for the complete duration of the measuring process.

Counter access

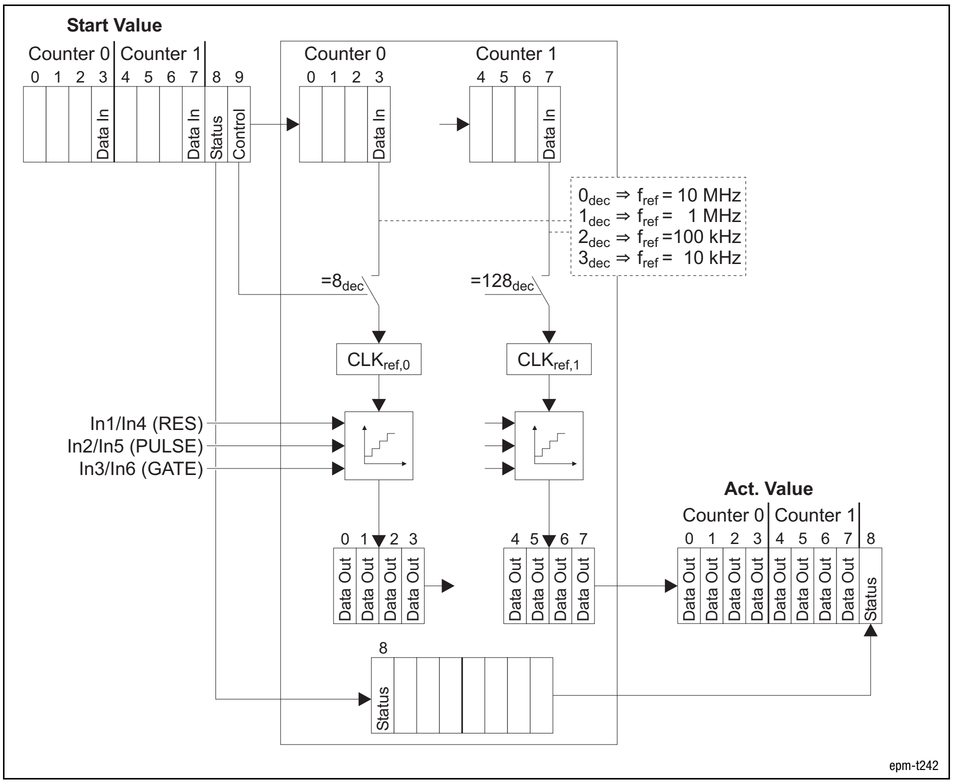

Fig. 13.2-40 Counter access of the 2/4xcounter in the modes 21 and 22

Signal characteristic in mode 21

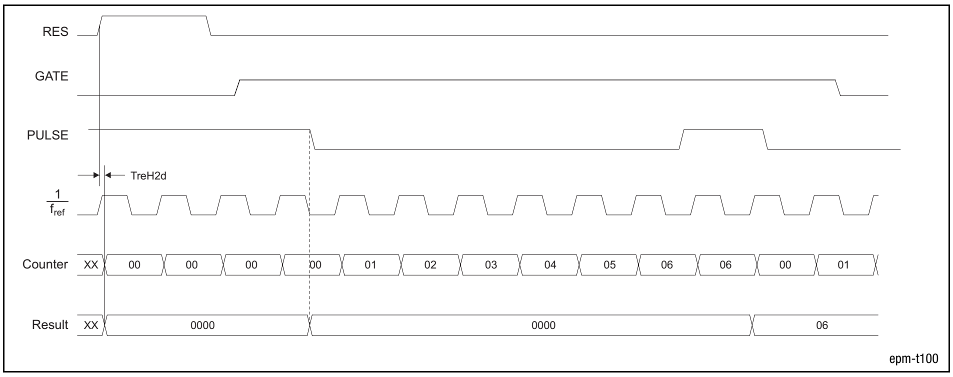

Fig. 13.2-41 Signal characteristic of 2/4xcounter in the mode 21 (upcounter)

Signal characteristic in mode 22

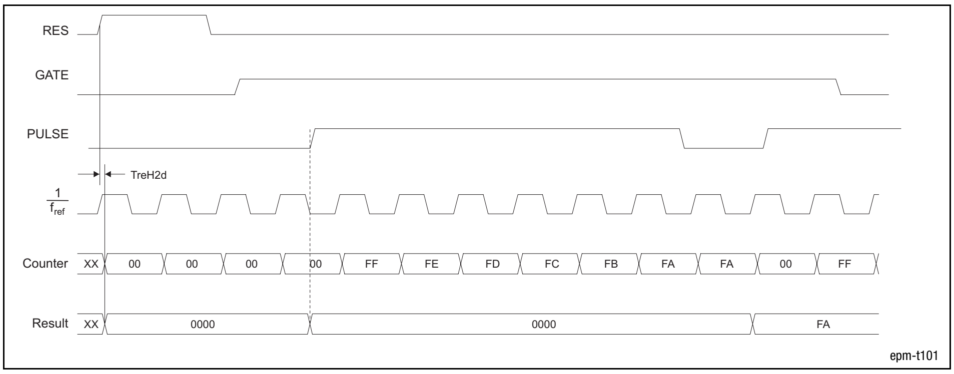

Fig. 13.2-42 Signal characteristic of 2/4xcounter in the mode 22 (downcounter)

13.2.13 2 × 32 bit counter with GATE and set/reset (modes 23 ... 26)

Terminal assignment

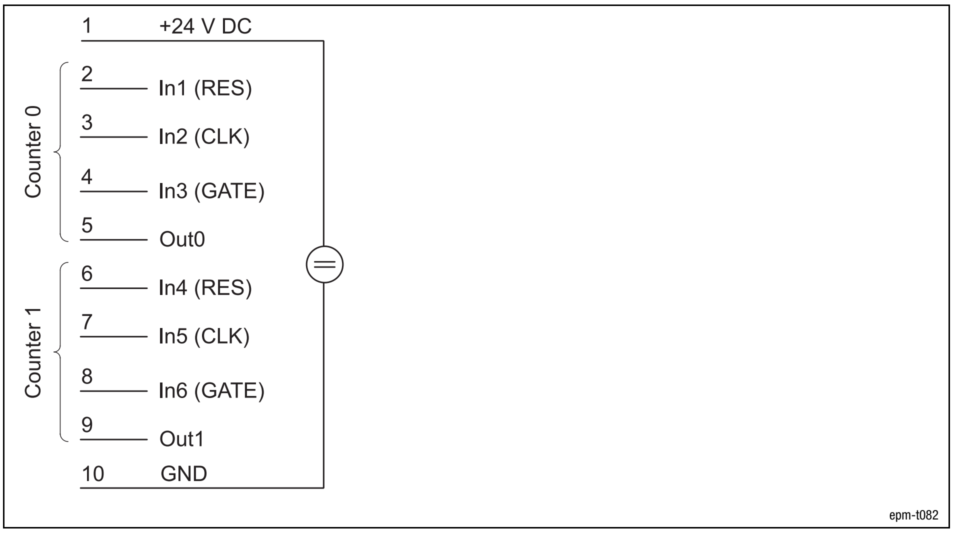

Fig. 13.2-43 Terminal assignment of the 2/4xcounter in the modes 23 ... 26

In the modes 23 to 26, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modes differ in triggering the outputs Out0 / Out 1 differently (set or reset function) and the counting direction:

Modes 23 and 25: Upcounter.
Modes 24 and 26: Downcounter

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

RES signal

During the counting process, a LOW level must be applied to input IN1 / IN4 (RES). A HIGH level deletes the counter.

OUT signal

Modes 23 and 24 (set function):

- The signal at output OUT0 / OUT1 is set to HIGH level on counter loading.
- When reaching the value loaded in Compare, the output signal is set to LOW level. The counter continues to run.

Modes 25 and 26 (reset function):

- The signal at output OUT0 / OUT1 is set to LOW level on counter loading.
- When reaching the value loaded in Compare, the output signal is set to HIGH level (modes 25 and 26). The counter continues to run.

Counter access

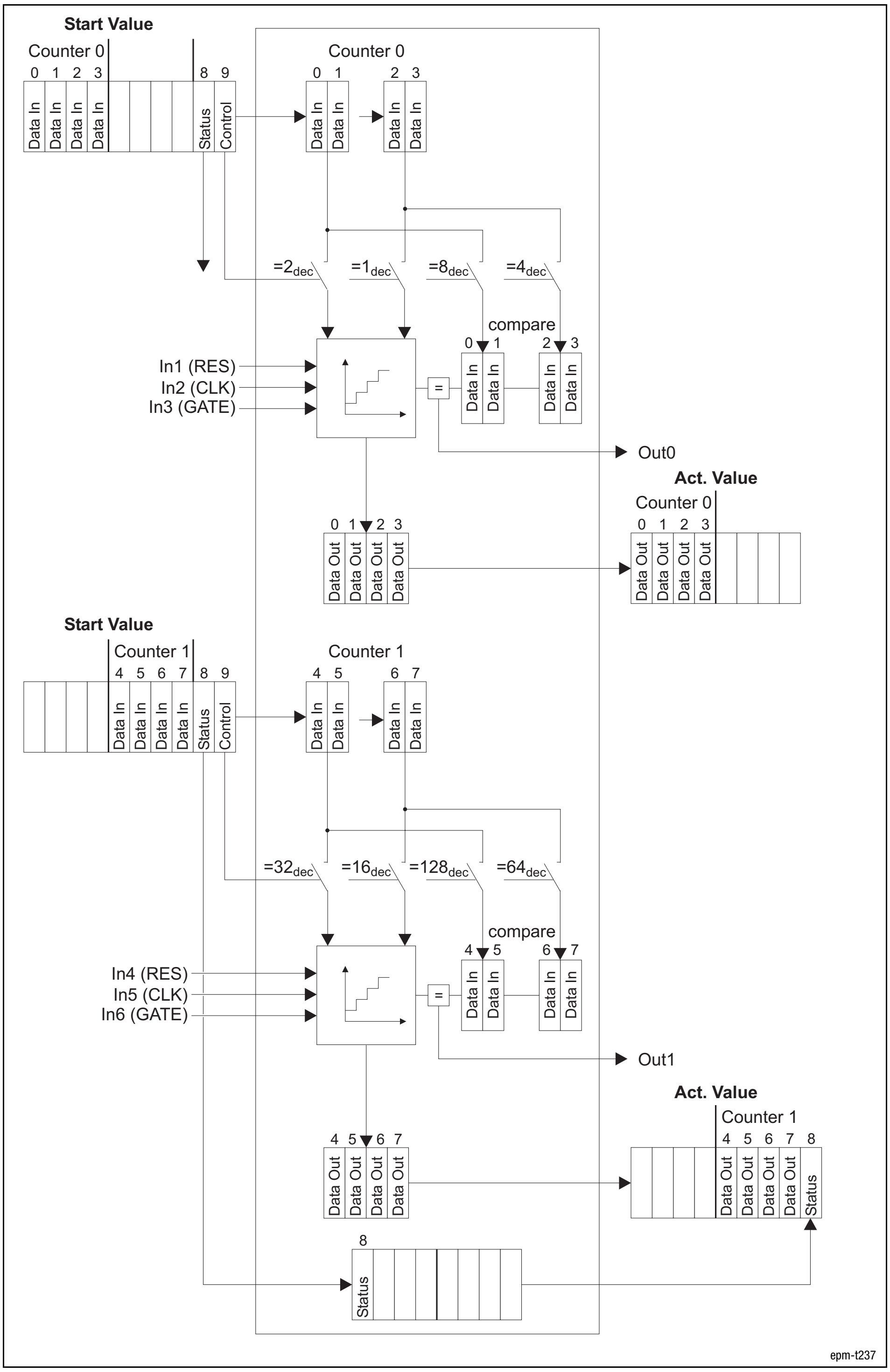

Fig. 13.2-44 Counter access of the 2/4xcounter in the modes 23 ... 26

Signal characteristic in mode 23

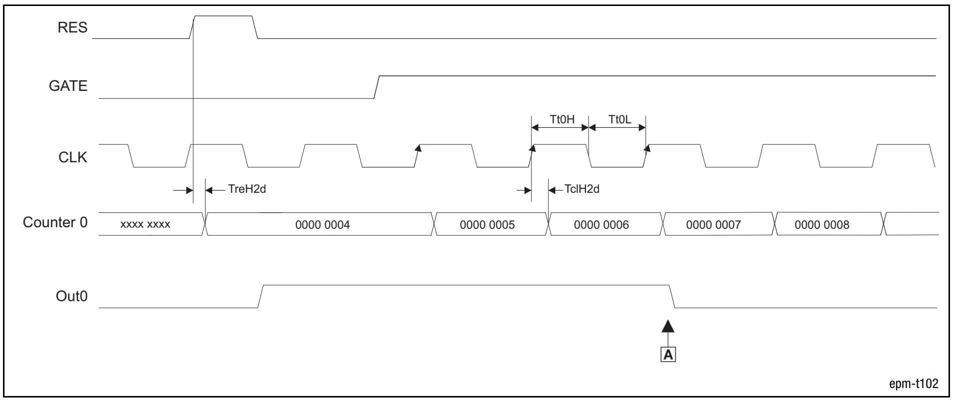

Fig. 13.2-45 Signal characteristic of 2/4xcounter in the mode 23 (upcounter, set function)

A Compare reached

Signal characteristic in mode 24

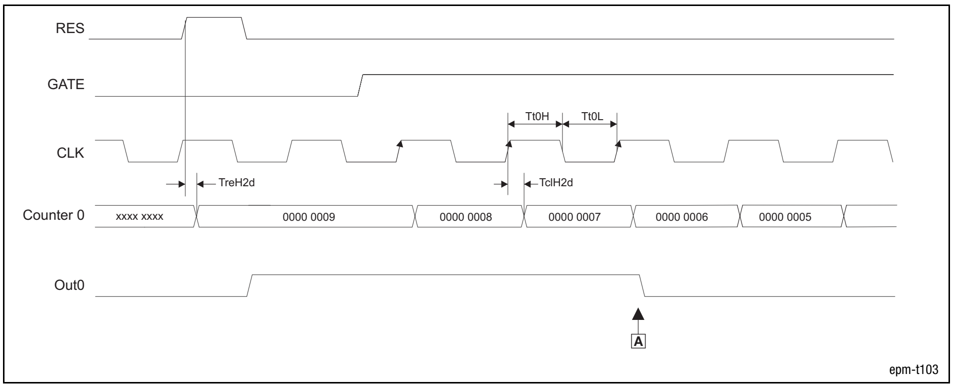

Fig. 13.2-46 Signal characteristic of 2/4xcounter in the mode 24 (downcounter, set function)

A Compare reached

Signal characteristic in mode 25

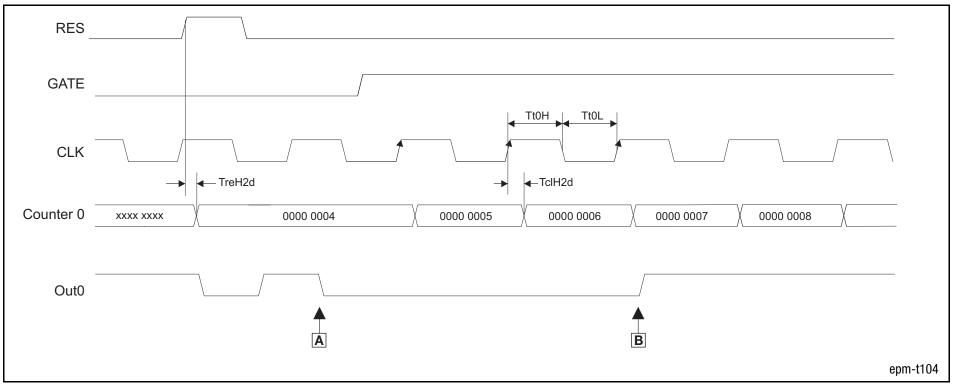

Fig. 13.2-47 Signal characteristic of 2/4xcounter in the mode 25 (upcounter, reset function)

OUT0 LOW active
A Load counter
B Compare reached

Signal characteristic in mode 26

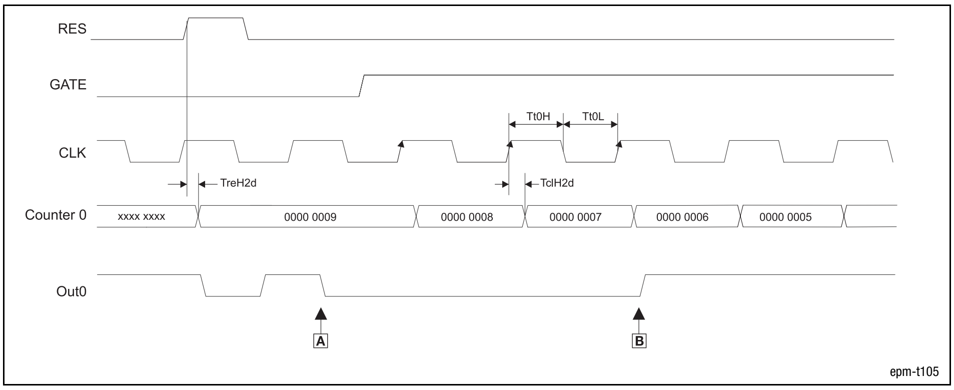

Fig. 13.2-48 Signal characteristic of 2/4xcounter in the mode 26 (downcounter, reset function)

OUT0 LOW active
A Load counter
B Compare reached

13.2.14 2 x 32 bit counter with G/RES (mode 27)

Terminal assignment

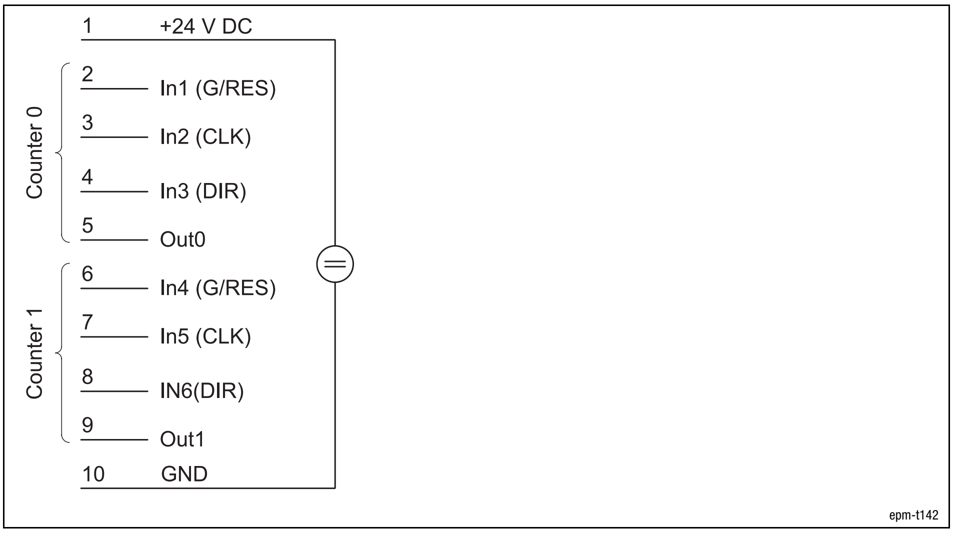

Fig. 13.2-49 Terminal assignment of the 2/4xcounter in the mode 27

The mode 27 offers two 32-bit counters which can be assigned with a starting value.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

CLK signal

If a HIGH level is applied to input IN3 / IN6 (G/RES), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

G/RES signal

During the counting process a HIGH level must be applied to input IN1 / IN4 (G/RES). With a LOW level the counter content is frozen. With a rising edge at the input IN1 / IN4 (G/RES) the counter is deleted.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

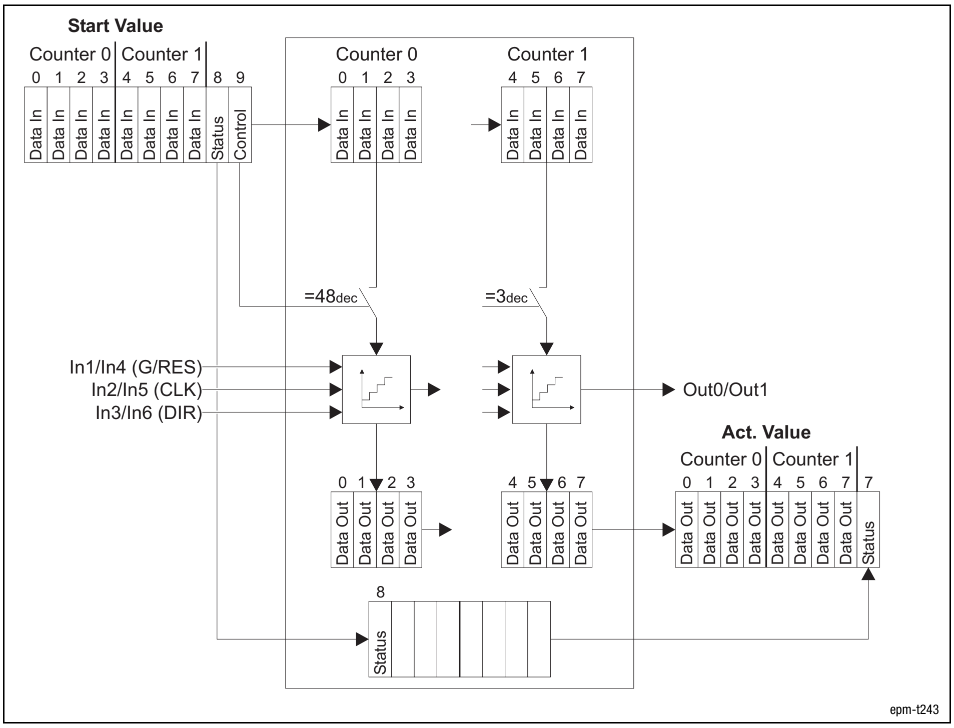

Fig. 13.2-50   Counter access of the 2/4xcounter in the mode 27

Signal characteristic

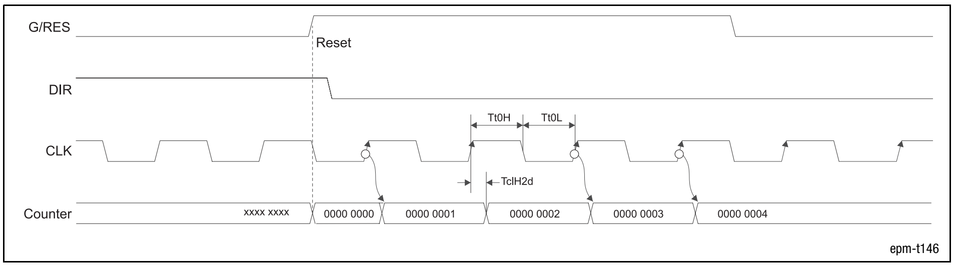

Fig. 13.2-51   Signal characteristic of 2/4xcounter in the mode 27 (upcounter)

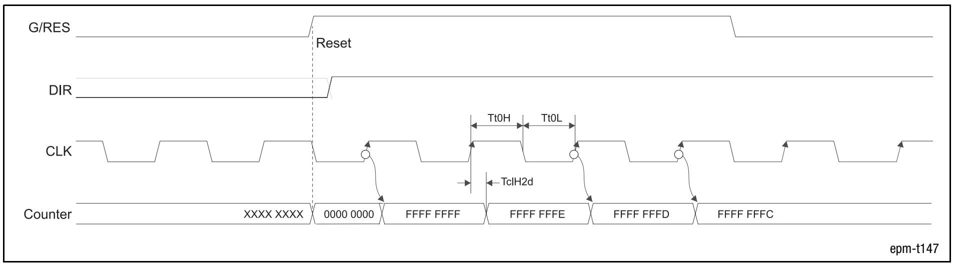

Fig. 13.2-52   Signal characteristic of 2/4xcounter in the mode 27 (downcounter)

13.2.15 Encoder with G/RES (modes 28 ... 30)

Terminal assignment

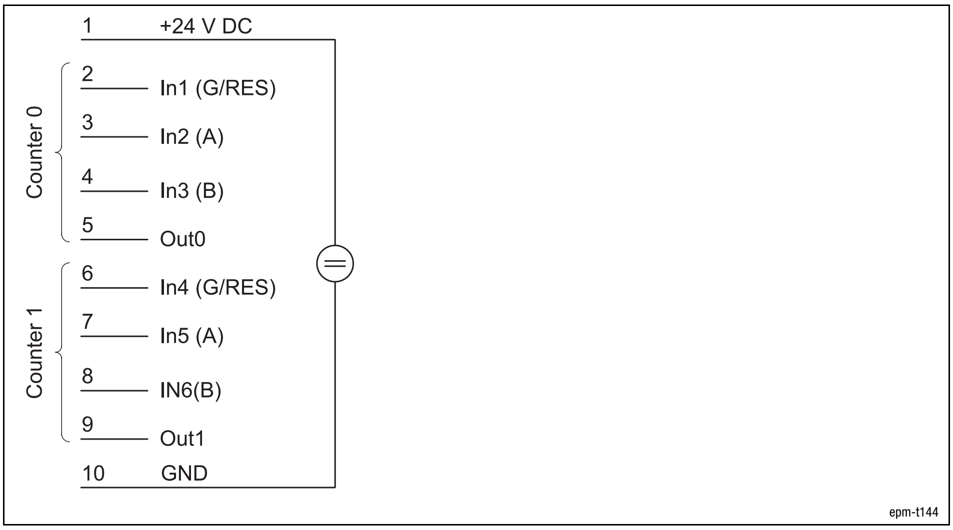

Fig. 13.2-53 Terminal assignment of the 2/4xcounter in the modes 28 ...30

The modes 28 to 30 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 28: 1 edge
Mode 29: 2 edges
Mode 30: 4 edges

A/B signal

See signal characteristics.

G/RES signal

During the counting process a HIGH level must be applied to input IN1 / IN4 (G/RES). With a LOW level the counter content is frozen. With a rising edge at the input IN1 / IN4 (G/RES) the counter is deleted.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

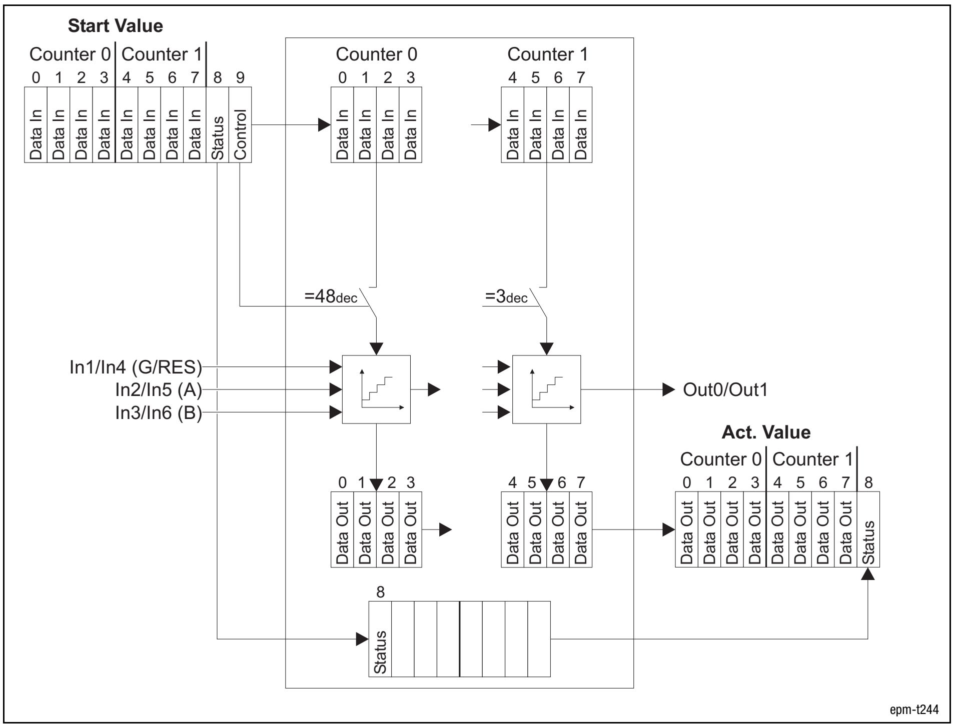

Fig. 13.2-54 Counter access of the 2/4xcounter in the modes 28 ... 30

Signal characteristic in mode 28

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

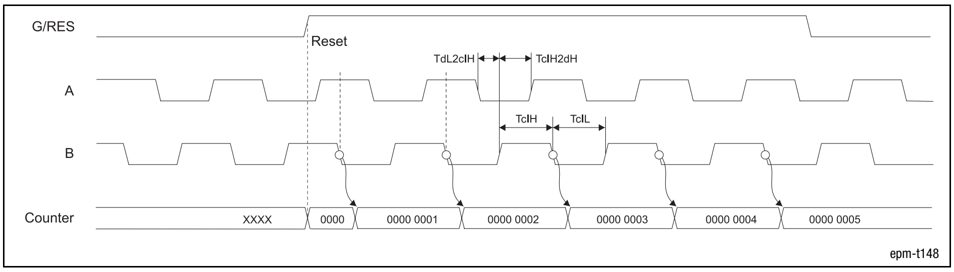

Fig. 13.2-55 Signal characteristic of the 2/4xcounter in the mode 28 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

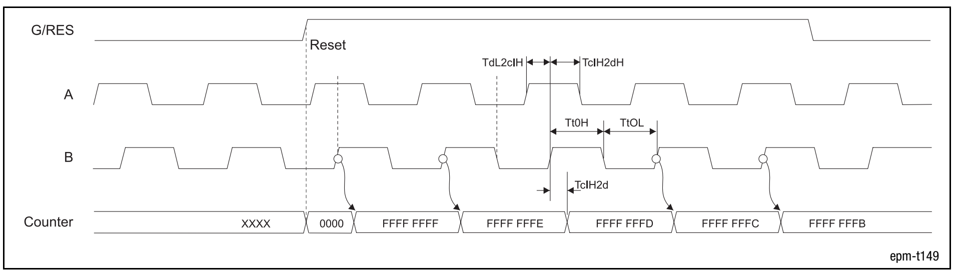

Fig. 13.2-56 Signal characteristic of 2/4xcounter in the mode 28 (downcounter)

Signal characteristic in mode 29

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

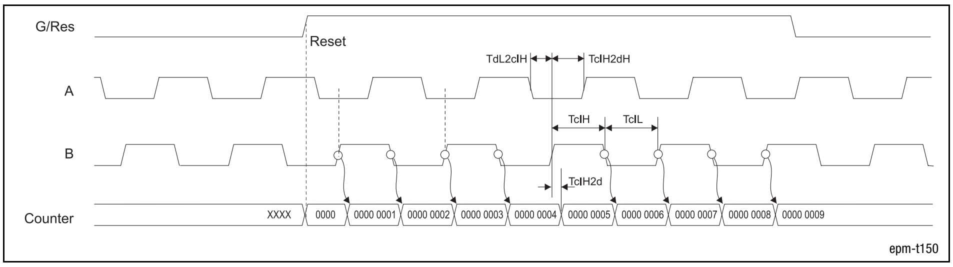

Fig. 13.2-57 Signal characteristic of 2/4xcounter in the mode 29 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

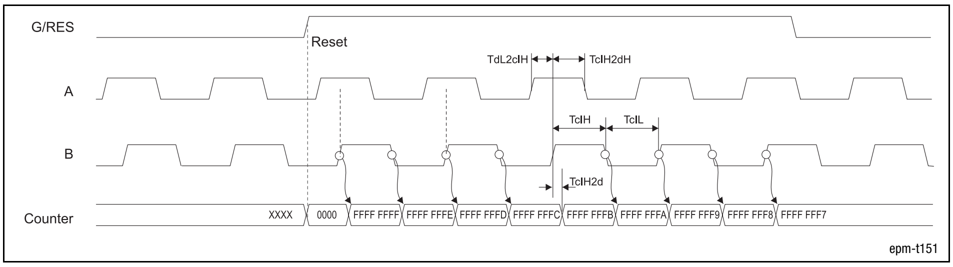

Fig. 13.2-58 Signal characteristic of 2/4xcounter in the mode 29 (downcounter)

Signal characteristic in mode 30

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

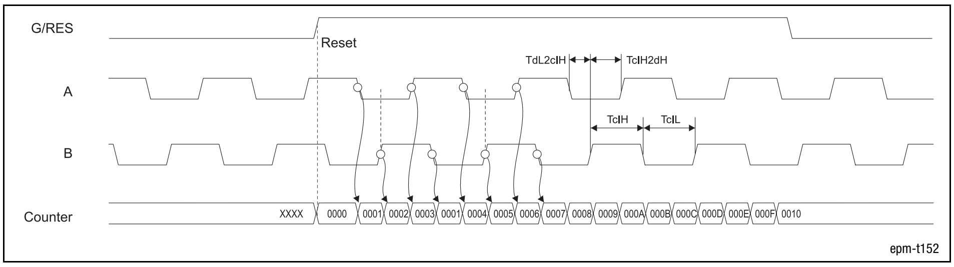

Fig. 13.2-59 Signal characteristic of 2/4xcounter in the mode 30 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

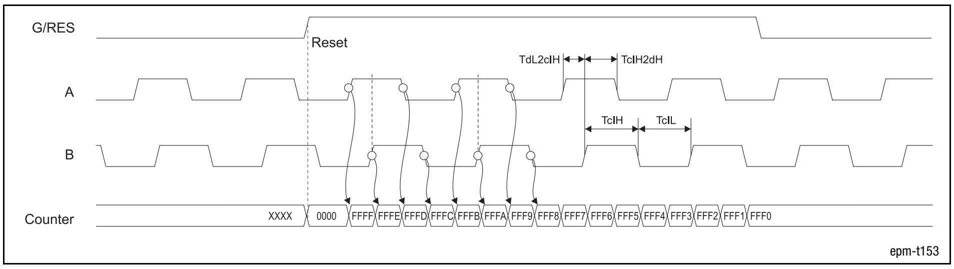

Fig. 13.2-60 Signal characteristic of 2/4xcounter in the mode 30 (downcounter)

13.2.16 2 × 32 bit counter with GATE and RES edge-triggered (modes 31 and 32)

Terminal assignment

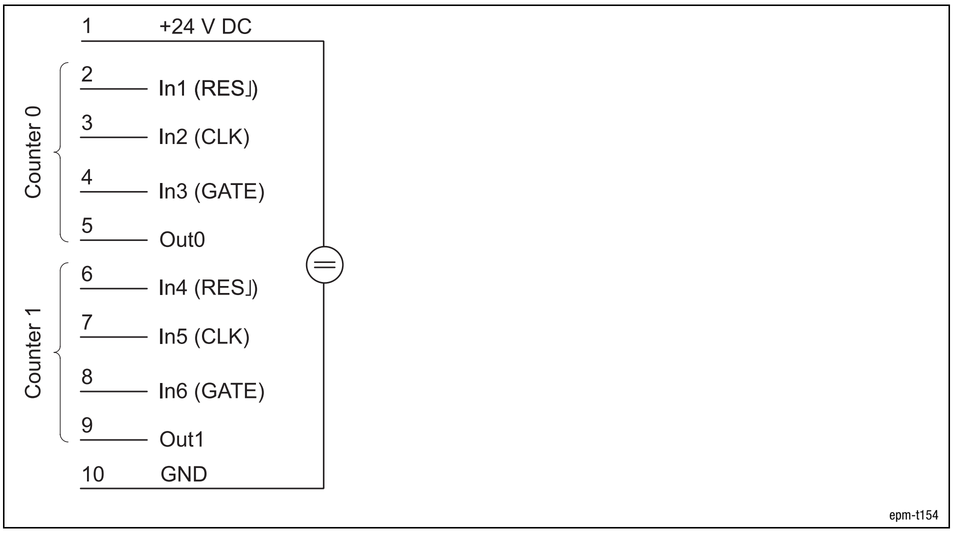

Fig. 13.2-61 Terminal assignment of the 2/4xcounter in the modes 31 and 32

In the modes 31 to 32, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

The modules differ in having different counting directions:

Mode 31: Upcounter.
Mode 32: Downcounter

RES⌋ signal

A LOW/HIGH edge at input IN1 / IN04 (RES⌋) clears the counter.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

OUT signal

Once the counter reaches the value loaded in the ”Compare” register, output OUT0 / OUT1 is set to HIGH level for at least 100 ms, with the counter continuing its task.

Counter access

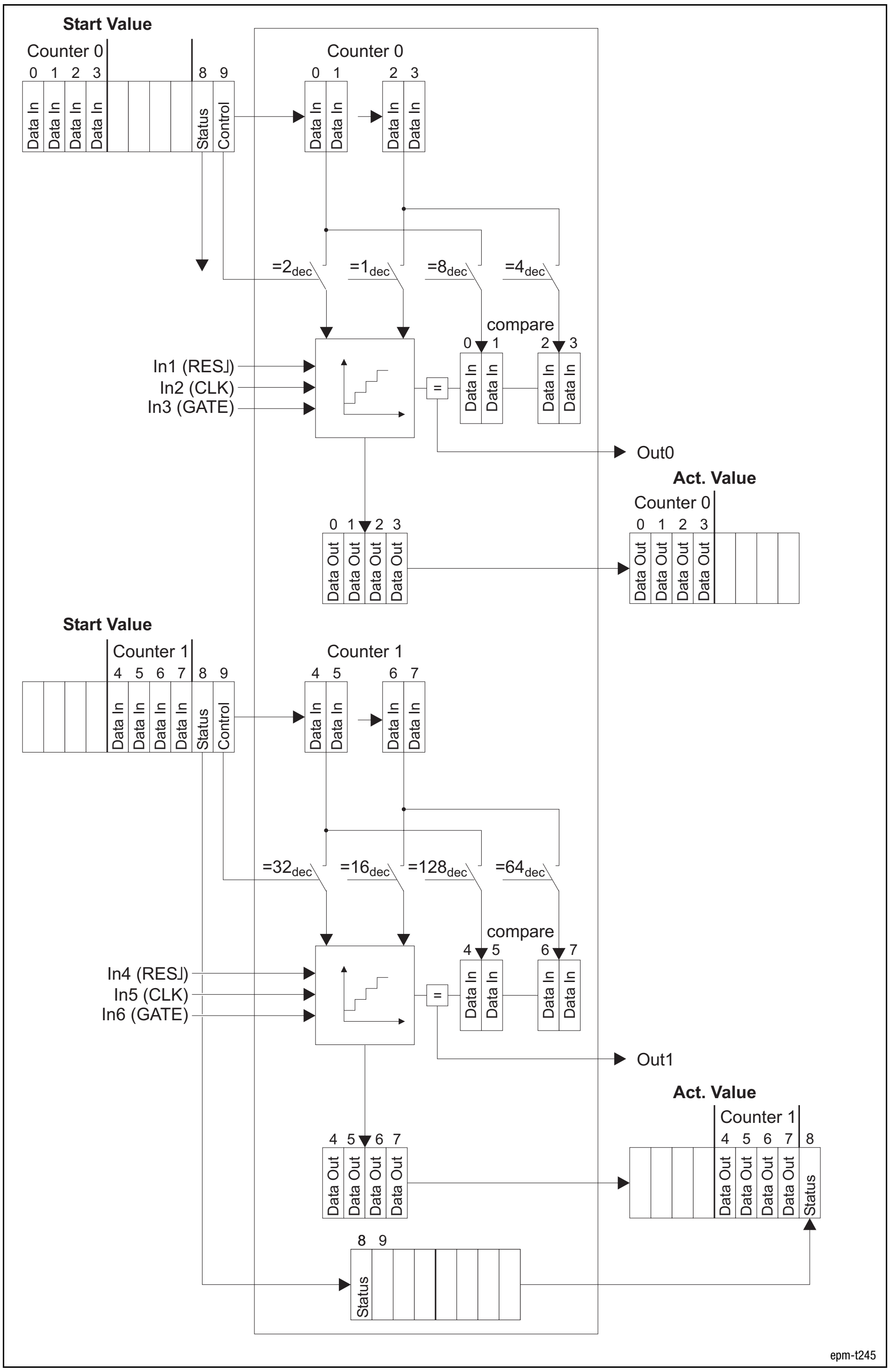

Fig. 13.2-62 Counter access of the 2/4xcounter in the modes 31 and 32

Signal characteristic

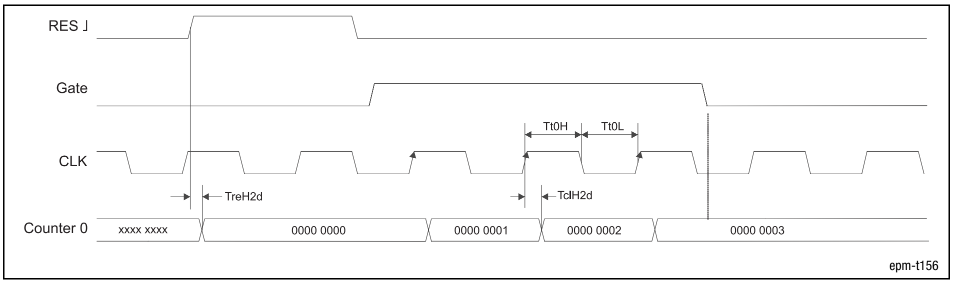

Fig. 13.2-63 Signal characteristic of 2/4xcounter in the mode 31

13.2.17 2 × 32 bit counter with GATE, RES edge-triggered and auto reload (modes 33 and 34)

Terminal assignment

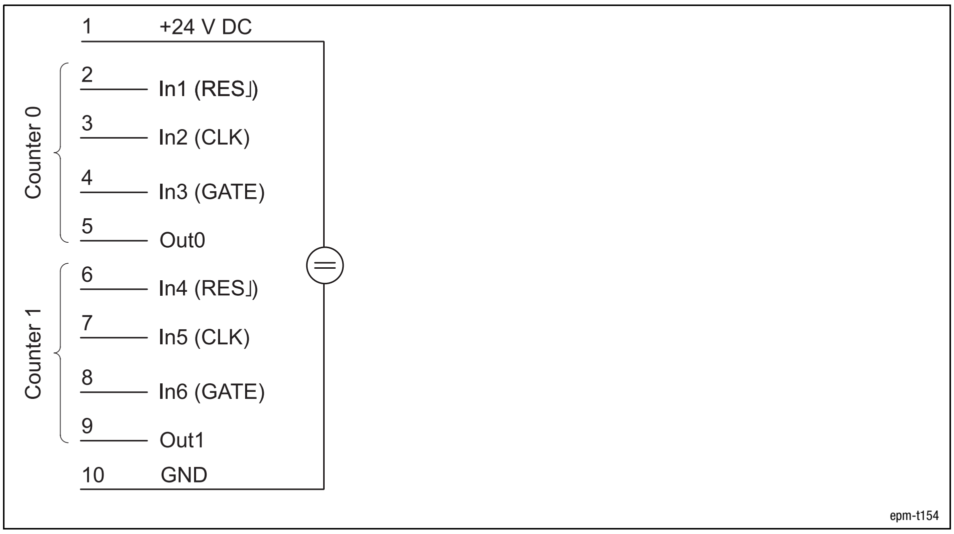

Fig. 13.2-64 Terminal assignment of the 2/4xcounter in the modes 33 and 34

In the modes 33 and 34, two 32-bit counters are available, which are controlled via a gate signal (gate). A starting value and a comparison value can be assigned to each counter.

These modes offer the function ”Auto Reload”. This means, that the Load Register can be assigned with a value which is automatically loaded into the counter as soon as it reaches the comparison value set.

The modules differ in having different counting directions:

Mode 33: Upcounter
Mode 34: Downcounter

RES⌋ signal

A LOW/HIGH edge at input IN1 / IN04 (RES⌋) clears the counter.

GATE/CLK signal

If a HIGH level is applied to input IN3 / IN6 (GATE), the counter is incremented or decremented by 1 with each LOW/HIGH edge.

The counter counts up to the value set in the compare register. With this last LOW-HIGH edge the counter content is overwritten with the value set in the load register. This is repeated until the input IN3 / IN6 (GATE) receives a LOW signal.

OUT signal

If an ”Auto Reload” occurs, the signal level at the output OUT0 / OUT1 changes. (A LOW-HIGH-edge at the output IN1 / IN4 (RES⌋) does **not** reset the output OUT0 / OUT1.)

Counter access

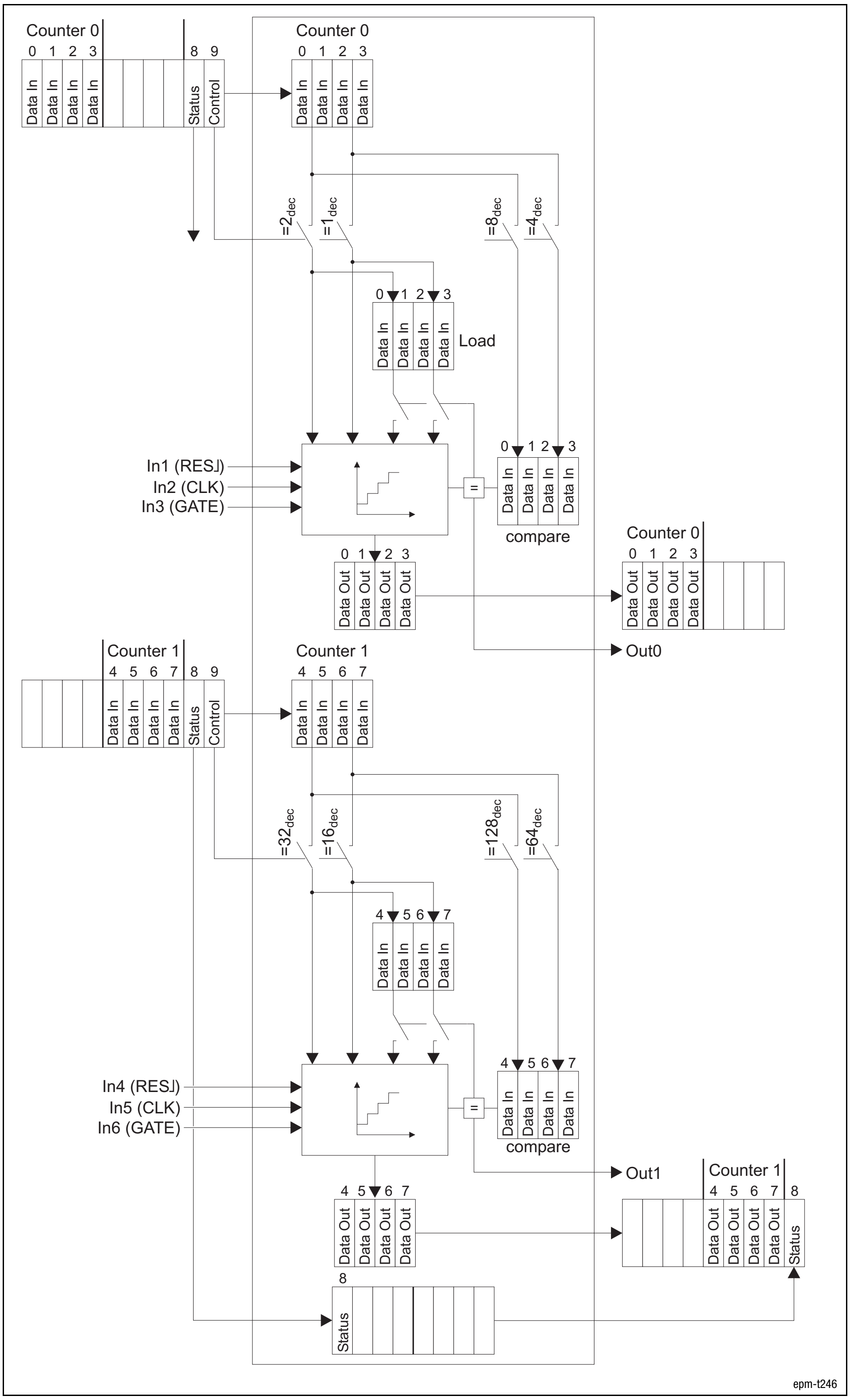

Fig. 13.2-65 Counter access of the 2/4xcounter in the modes 33 and 34

Signal characteristic

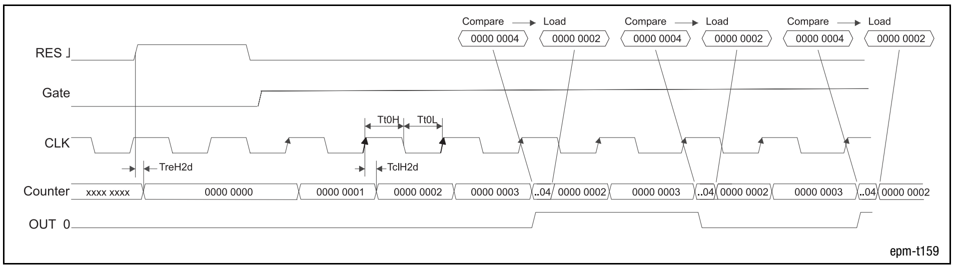

Fig. 13.2-66 Signal characteristic of 2/4xcounter in the mode 33 (upcounter)

13.2.18 2 x 32 bit counter with GATE (mode 35)

Terminal assignment

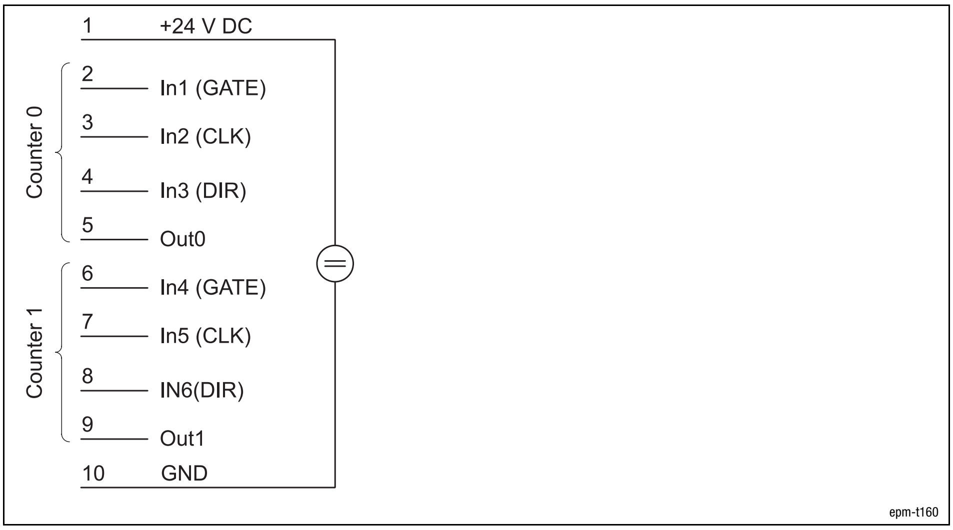

Fig. 13.2-67 Terminal assignment of the 2/4xcounter in the mode 35

The mode 35 offers two 32-bit counters which can be assigned with a starting value.

DIR signal

The counting direction is determined via the signal level at input IN3 / IN6 (DIR):

Upcounter: LOW level
Downcounter: HIGH level

CLK signal

Each LOW-HIGH edge at input IN2 / IN5 (CLK) increments and/or decrements the counter by 1, respectively.

GATE signal

During the counting process, a HIGH level must be applied to input IN1 / IN4 (GATE). With a LOW level the counter content is frozen.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

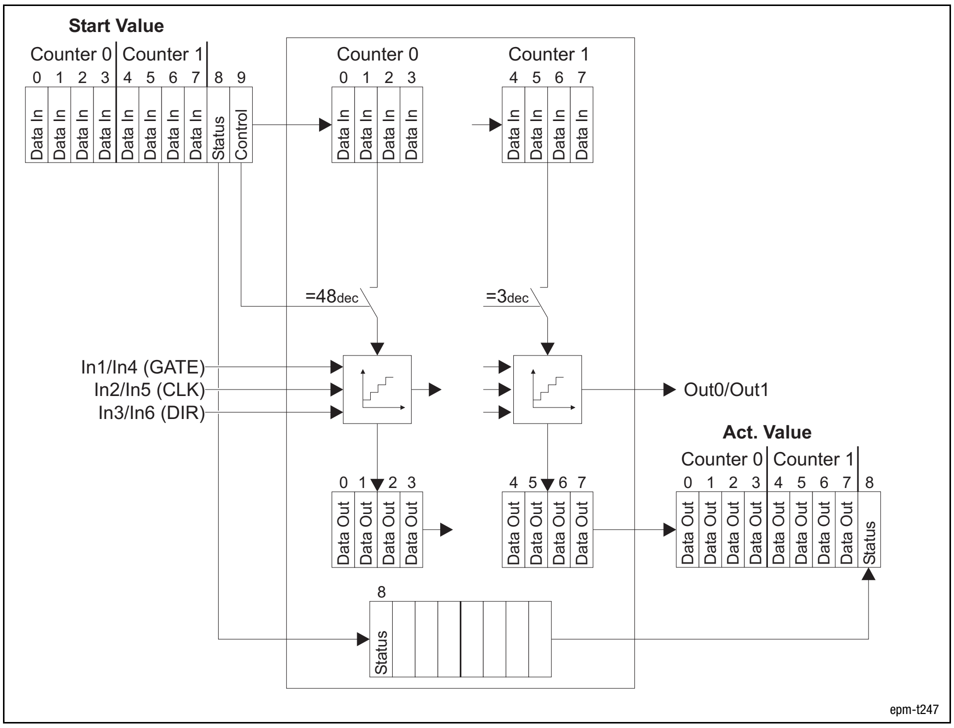

Fig. 13.2-68 Counter access of the 2/4xcounter in the mode 35

Signal characteristic

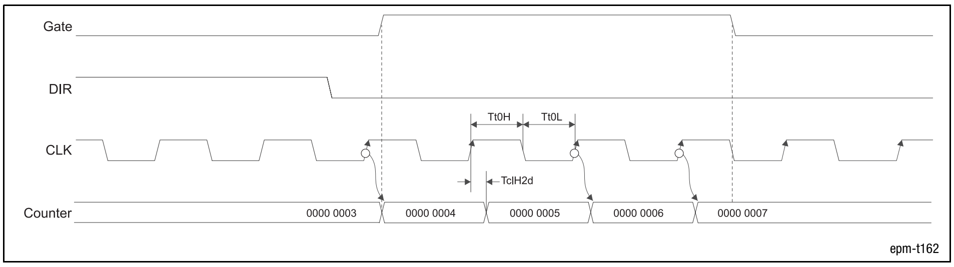

Fig. 13.2-69 Signal characteristic of 2/4xcounter in the mode 35 (upcounter)

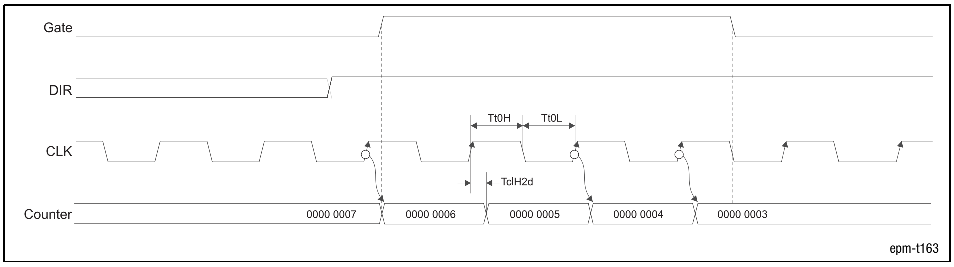

Fig. 13.2-70 Signal characteristic of 2/4xcounter in the mode 35 (downcounter)

13.2.19 Encoder with GATE (modes 36 ... 38)

Terminal assignment

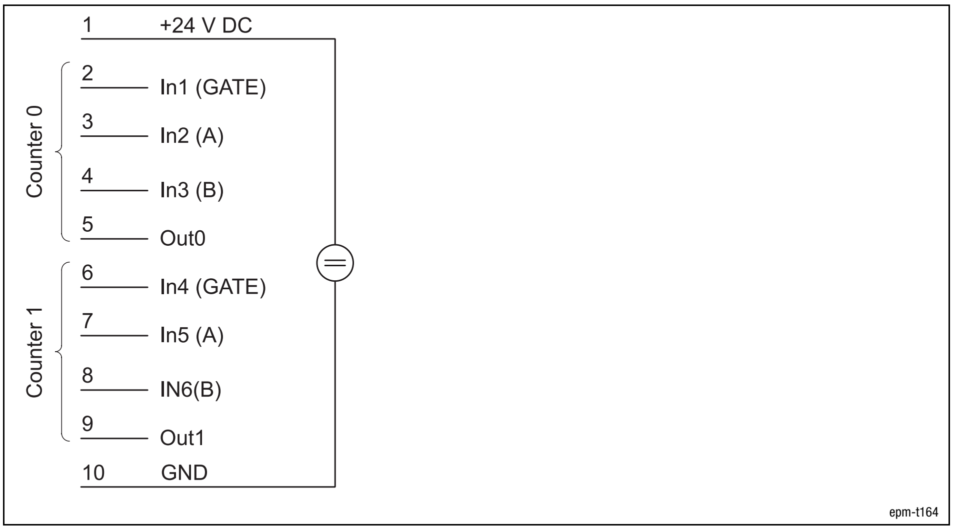

Fig. 13.2-71 Terminal assignment of the 2/4xcounter in the modes 36 ... 38

The modes 36 to 38 offer two encoders that can be pre-assigned with a starting value.

The modes differ in the number of edges which are evaluated:

Mode 36: 1 edge
Mode 37: 2 edges
Mode 38: 4 edges

A/B signal

See signal characteristics.

GATE signal

During the counting process, a HIGH level must be applied to input IN1 / IN4 (GATE). With a LOW level the counter content is frozen.

OUT signal

When the counter reaches zero, the output OUT0 / OUT1 is set to HIGH level for at least 100 ms, even if the counter continues to count. When the counter stops at zero, the output OUT0 / OUT1 remains on the HIGH level.

Counter access

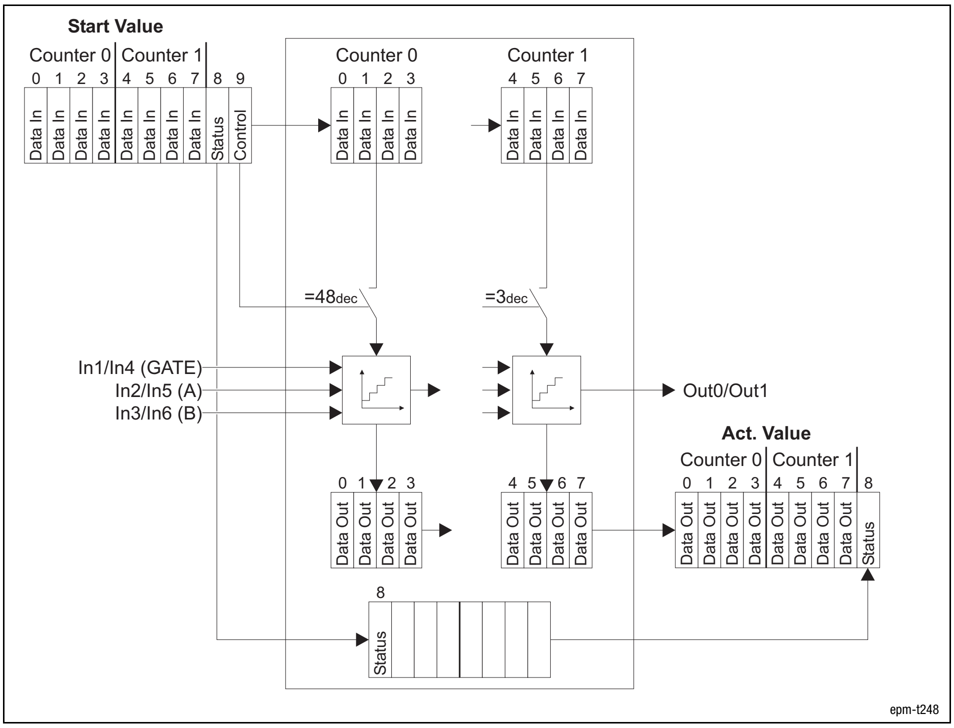

Fig. 13.2-72 Counter access of the 2/4xcounter in the modes 36, 37 and 38

Signal characteristic in mode 36

Every HIGH-LOW edge at input IN2 / IN5 (A) increments the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

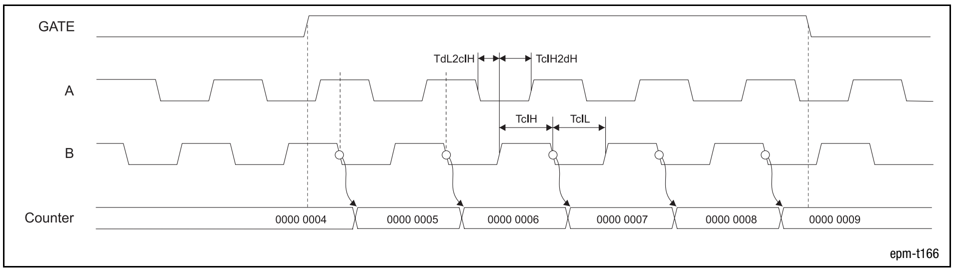

Fig. 13.2-73 Signal characteristic of 2/4xcounter in the mode 36 (upcounter)

Every LOW-HIGH edge at input IN2 / IN5 (A) decrements the counter by 1 if a HIGH level is applied to input IN3 / IN6 (B) at this time.

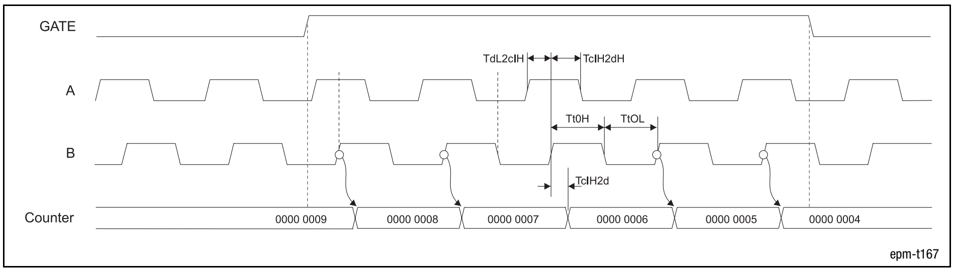

Fig. 13.2-74 Signal characteristic of 2/4xcounter in the mode 36 (downcounter)

Signal characteristic in mode 37

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge (track A) at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

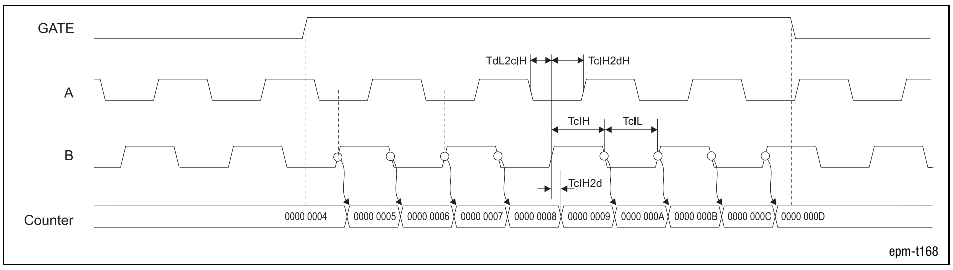

Fig. 13.2-75 Signal characteristic of 2/4xcounter in the mode 37 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

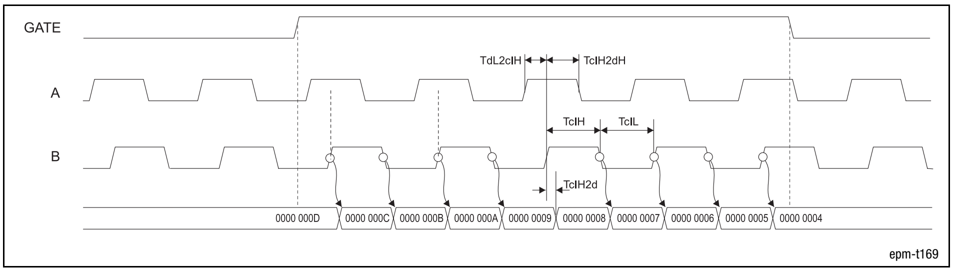

Fig. 13.2-76 Signal characteristic of 2/4xcounter in the mode 37 (downcounter)

Signal characteristic in mode 38

The counter is incremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).

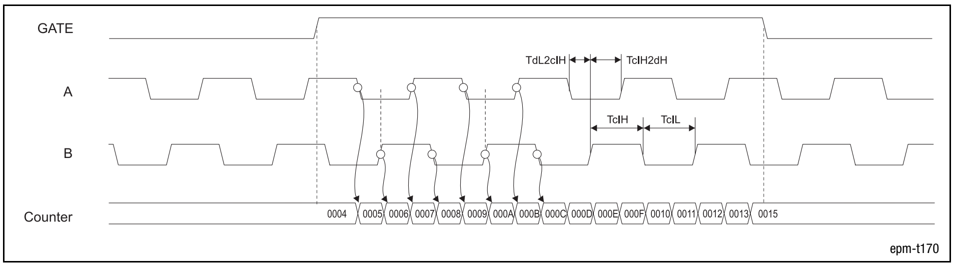

Fig. 13.2-77 Signal characteristic of 2/4xcounter in the mode 38 (upcounter)

The counter is decremented by 1 on

- a LOW-HIGH edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a LOW-HIGH edge at input IN2 / IN5 (A) and a LOW level at the input IN3 / IN6 (B).
- a HIGH-LOW edge at input IN2 / IN5 (A) and a HIGH level at input IN3 / IN6 (B).

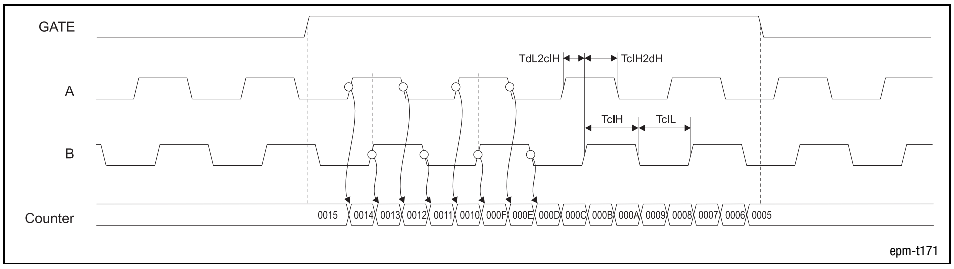

Fig. 13.2-78 Signal characteristic of 2/4xcounter in the mode 38 (downcounter)

13.3 Parameterising SSI interface

13.3.1 Parameter data

- For the SSI interface, 4 bytes of parameter data are available. The following are defined via the parameter data
  - Baud rate
  - Coding type
  - Evaluation of the combined I/O.0
- The module can be parameterised with the configuration tool or via slot and index.
  - To set the parameters via slot and index, the function blocks SFB 52 (read) and SFB 53 (write) are required. (📖 10.5-3)

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

W = write

The parameter data is assigned as follows:

Byte	Assignment		Lenze setting
0	Reserved		
1	Reserved		
2	Baud rate [1]	00_h = 300 kBaud 01_h = 100 kBaud 02_h = 300 kBaud 03_h = 600 kBaud 04_h ... FF_h = 300 kBaud	00_h
3	Coding [2]	Bit 0 0 Binary code 1 Gray code Bit 1 Reserved	00_h
	Hold function [3]	Bit 2 0 Deactivate 1 Activate Bits 3 ... 7 Reserved	

1) The encoder connected to the SSI interface transmits serial data. Therefore the encoder receives a clock pulse from the SSI interface. The clock pulse is determined by you.

2) If the encoder transmits the data in Gray code to the SSI interface, activate the Gray code to ensure that the data will be transferred in binary code from the gateway.

3) If the hold function is activated, the current encoder value will be frozen as soon as +24 V are applied to the input I/O.0 +24 V. For this, the switching function must be parameterised for the input I/O.0.

Note!

The baud rate depends on the cable length and the SSI encoder. The cables must be twisted and shielded in pairs. The following data serve as a guideline:

Cable length	Baud rate
< 400 m	100 kBaud
< 100 m	300 kBaud
< 50 m	600 kBaud

13.3.2 Input data / output data

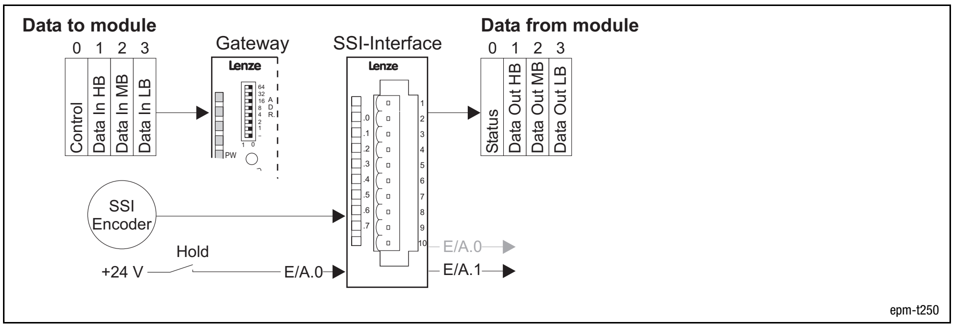

Fig. 13.3-1 Data input /output of SSI interface

For the data input / data output, 4 bytes are available which are transmitted to the module or output by the module.

Note!

Input and output data are lost when the supply voltage is disconnected; they are not saved!

Input data

The input data can be used to control the outputs (I/O.0 and I/O.1) depending on the encoder value.

Byte	Assignment		
0	Control	Bits 0 ... 1 %	Setpoint selection 00: No setpoint selection 01: Setpoint selection for output I/O.0 10: Setpoint selection for output I/O.1 11: Setpoint selection for outputs I/O.0 and I/O.1
		Bit 2	Reserved
		Bit 3	Condition for setting the output = HIGH 0: If SSI encoder value is higher than setpoint 1: If SSI encoder value is lower than setpoint
		Bits 4 ... 7	Reserved
1	Comparison value (HIGH byte)	Bits 0 ... 7	Selection of comparison value
2	Comparison value (MID byte)	Bits 0 ... 7	
3	Comparison value (LOW byte)	Bits 0 ... 7	

Output data

Byte	Assignment		
0	Status	Bit 0	Status I/O.0
		Bit 1	Status I/O.1
		Bits 2 ... 7 %	Reserved
1	SSI encoder value (HIGH byte)	Bits 0 ... 7	Output of SSI encoder value
2	SSI encoder value (MID byte)	Bits 0 ... 7	
3	SSI encoder value (LOW byte)	Bits 0 ... 7	

Counter access

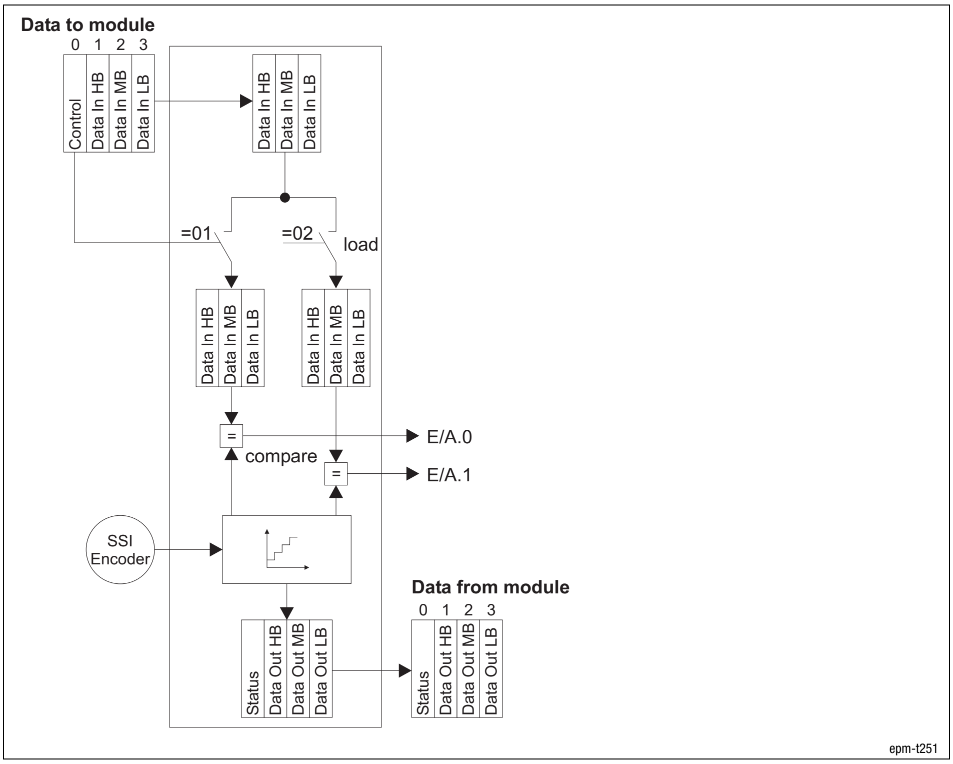

Fig. 13.3-2 Counter access SSI interface, Hold function deactivated

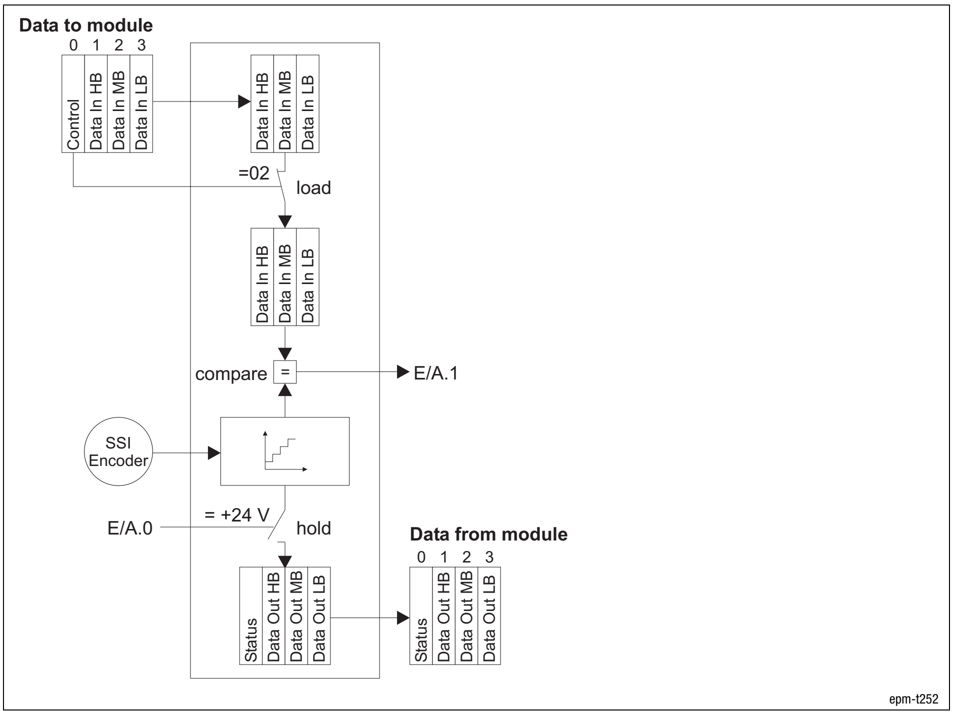

Fig. 13.3-3 Counter access SSI interface, Hold function activated

13.4 Parameterising 1xcounter/16xdigital input module

13.4.1 Parameter data

- For the 1xcounter/16xdigital input, 3 bytes of parameter data are available. The parameter data can be used to assign a mode to the internal counter and to configure the digital input filter.
- The module can be parameterised with the configuration tool or via slot and index.
  – To set the parameters via slot and index, the function blocks SFB 52 (read) and SFB 53 (write) are required. (📖 10.5-3)

Slot number	Index	Access	Description
1 ... 32	00_h	R	Read out diagnostic data record 0
		W	Write parameters to the module
	01_h	R	The corresponding diagnostic data record of the electronic module can be read out via the index. • Example: – Index 01_h: read out diagnostic data record 1 – Index 02_h: read out diagnostic data record 2
	$F1_h$	R	Read out the module parameters
	$F2_h$	R	Read out the process image of the module

R = read

W = write

The parameter data follows the assignment below:

Byte	Assignment			Lenze setting
0	Counter mode	00_h	Encoder with 4 edges	00_h
		01_h	32-bit counter	
		02_h	Clock up/clock down evaluation	
		03_h	Measuring the frequency	
		04_h	Measuring the period	
		05_h ... FF_h	Reserved	
1	Filter factor A	0 ... 255	Configuration of the digital input filters for counter inputs E.0 and E.1	00_h
2	Filter factor B	0 ... 255		00_h

13.4.2 Input data / output data

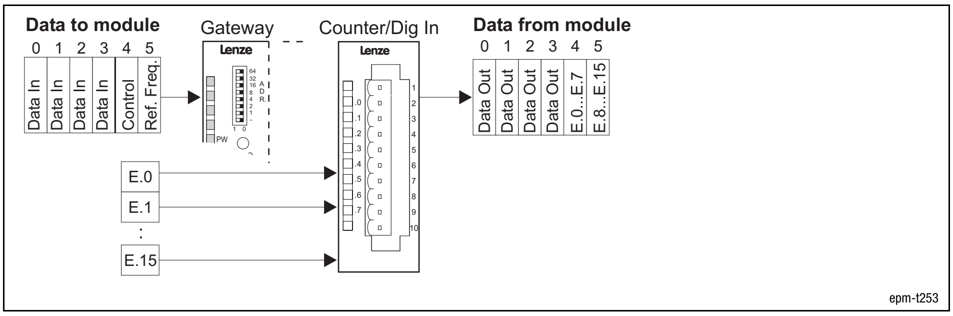

Fig. 13.4-1 Data input / data output 1xcounter/16xdigital input

For the data input / data output, 6 bytes are available which are transmitted to the counter or output by the counter.

Note!

Input and output data are lost when the supply voltage is disconnected; they are not saved!

Input data

The inputs E.0 and E.1 are used as counter inputs and digital inputs.

The counter starting value is located in bytes 0 to 3 (Data In). If a starting value is loaded, the counter counts up or down, starting with this value.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting up) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting down) has been reached, the count value jumps to the upper count limit.

The counter is controlled via byte 4 (control). It is assigned as follows:

Byte	Assignment		
4	Control byte	Bit 0	1 = Start counter (software gate is open) 1)
		Bit 1	1 = Stop counter (software gate is closed) 1)
		Bit 2	1 = Counter is loaded with starting value / comparison value
		Bit 3	1 = Count value is deleted
		Bit 4 ... 7	Reserved

1) If start bit and stop bit = HIGH, "stop" is active. If both bits are LOW, the state of the bit that has been set last, is active.

Via byte 5 the reference frequency for the modes 3 (frequency measurement) and 4 (period measurement) can be set. It is assigned as follows:

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		08_h...FF_h	not permissible

Output data

The current count value is located in bytes 0 to 3 (Data Out) and can be read out there. Bytes 4 and 5 contain the control signals (E.0 ... E.15).

Counter access

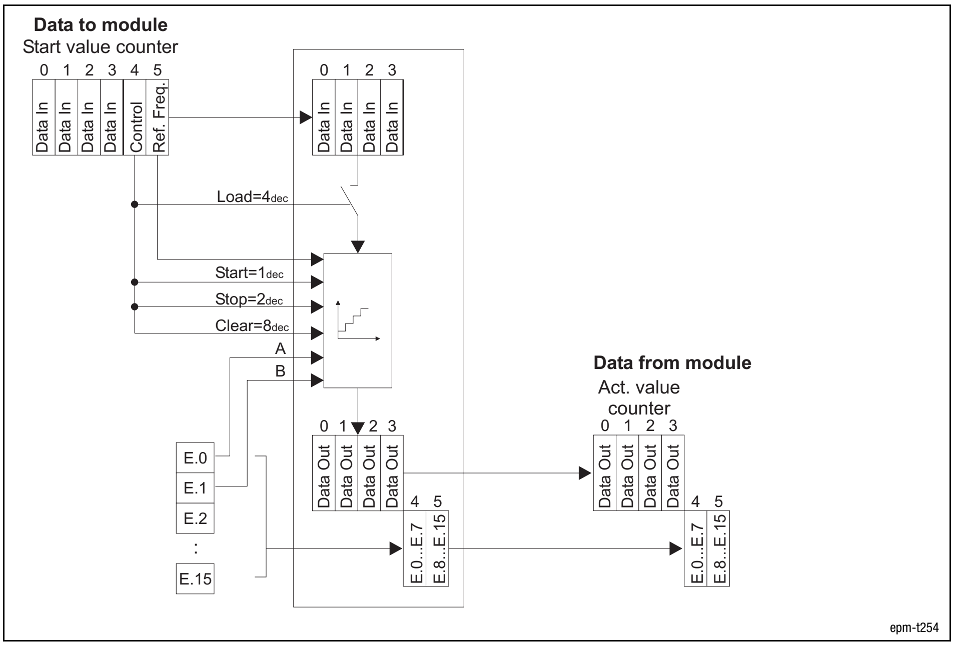

Fig. 13.4-2 Counter access - 1xcounter/16xdigital input

13.4.3 Encoder (mode 0)

In the mode 0, the rising and falling edges of signal A and B are evaluated. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting upwards) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting downwards) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process, is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: Every rising or falling edge of signal A (E.0) and B (E.1) increments or decrements the count value. The counting direction depends on which signal is leading.

Counter access

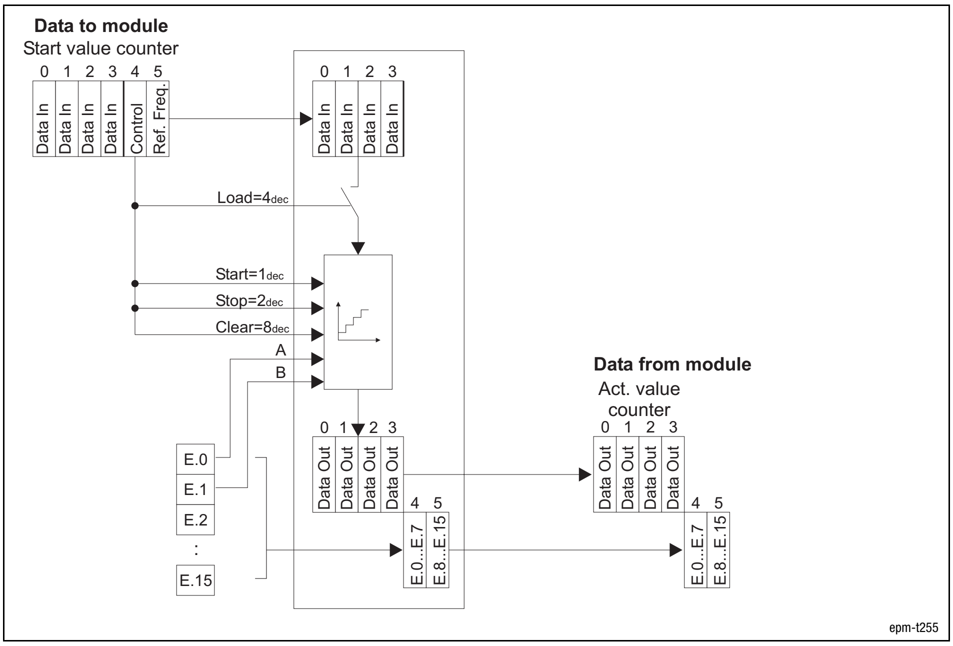

Fig. 13.4-3 Counter access of 1xcounter/16xdigital input in the mode 0

Signal characteristic

The counter is incremented by 1 on

- a LOW-HIGH edge of signal A and a LOW level of signal B.
- a HIGH-LOW edge of signal A and a HIGH level of signal B.
- a LOW-HIGH edge of signal B and a HIGH level of signal A.
- a HIGH-LOW edge of signal B and a LOW level of signal A.

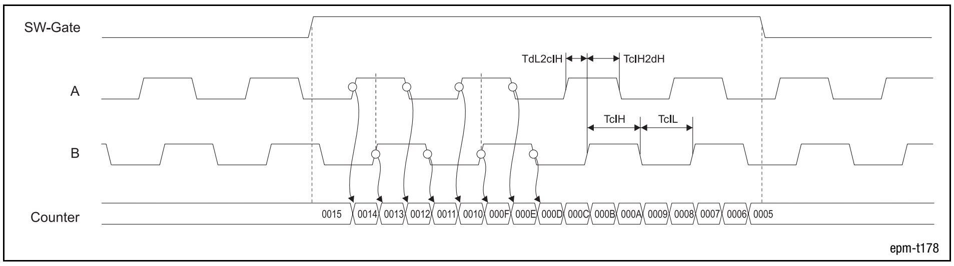

Fig. 13.4-4 Signal characteristic of 1xcounter/16xdigital input in the mode 0 (upcounter)

The counter is decremented by 1 with

- a LOW-HIGH edge of signal A and a HIGH level of signal B.
- a HIGH-LOW edge of signal A and a LOW level of signal B.
- a LOW-HIGH edge of signal B and a LOW level of signal A.
- a HIGH-LOW edge of signal B and a HIGH level of signal A.

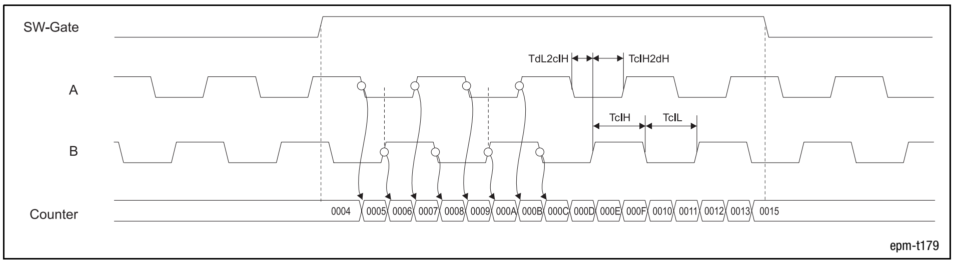

Fig. 13.4-5 Signal characteristic of 1xcounter/16xdigital input in the mode 0 (downcounter)

13.4.4 32 bit counter (mode 1)

In the mode 1 the counter operates as a 32-bit counter. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting upwards) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting downwards) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process, is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: With every rising edge of signal A (E.0) the counter is either incremented or decremented by 1.

The counting direction is determined via the level of signal B (E.1):

Upcounter: LOW level
Downcounter: HIGH level

Counter access

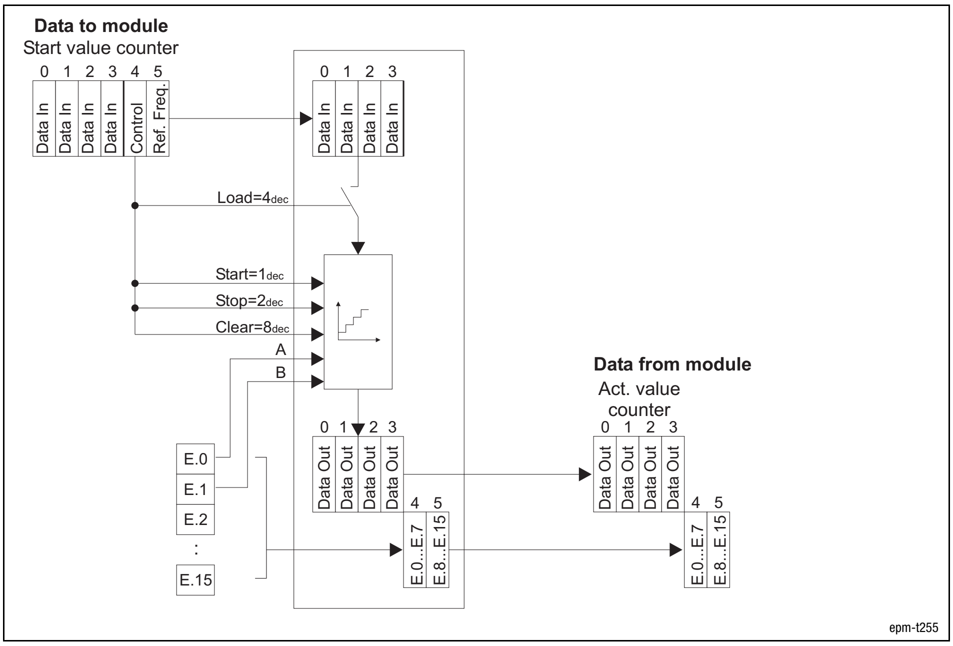

Fig. 13.4-6 Counter access of 1xcounter/16xdigital input in the mode 1

Signal characteristic

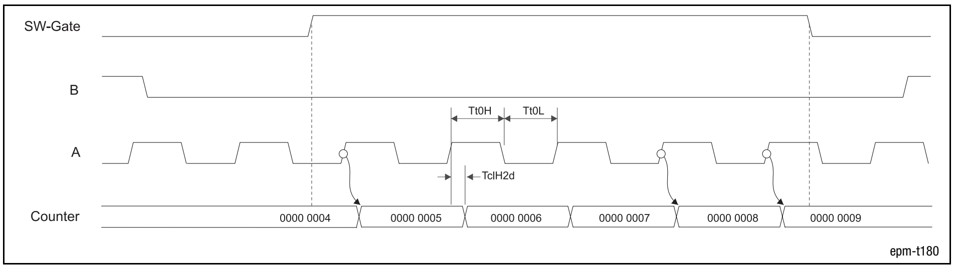

Fig. 13.4-7 Signal characteristic of 1xcounter/16xdigital input in the mode 1 (upcounter)

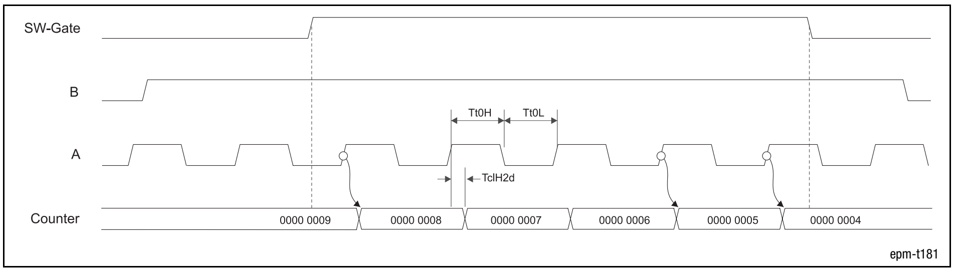

Fig. 13.4-8 Signal characteristic of 1xcounter/16xdigital input in the mode 1 (downcounter)

13.4.5 32 bit counter with clock up/down evaluation (mode 2)

In the mode 2 the counter operates as a clock-up/clock-down counter. The counter can be pre-assigned with a starting value via the Rx PDO.

The counting range lies between 0 and +4.294.967.295. As soon as the upper limit (when counting up) has been reached, the count value jumps to the lower count limit. The moment, the lower count limit (when counting down) has been reached, the count value jumps to the upper count limit.

Clear signal

A HIGH level in byte 4 (Control), bit 3 (Clear) sets the counter to zero.

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process is opened when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A/B signal

With the software gate open: With every rising edge of the signal A (E.0) the counter is incremented by 1. With every rising edge of the signal B (E.1) the counter is decremented by 1.

Counter access

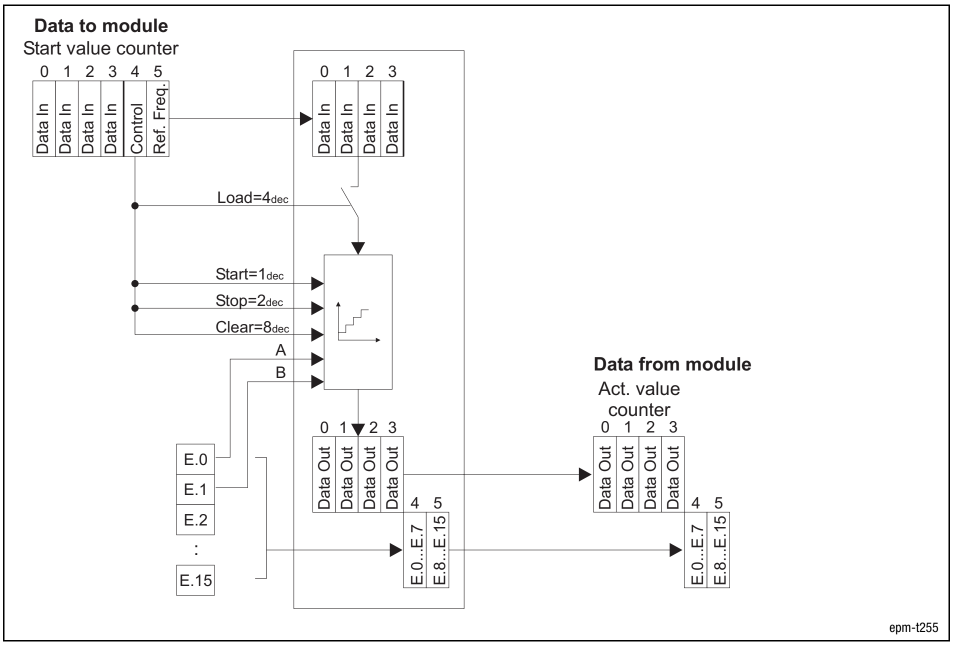

Fig. 13.4-9 Counter access of 1xcounter/16xdigital input in the mode 2

Signal characteristic

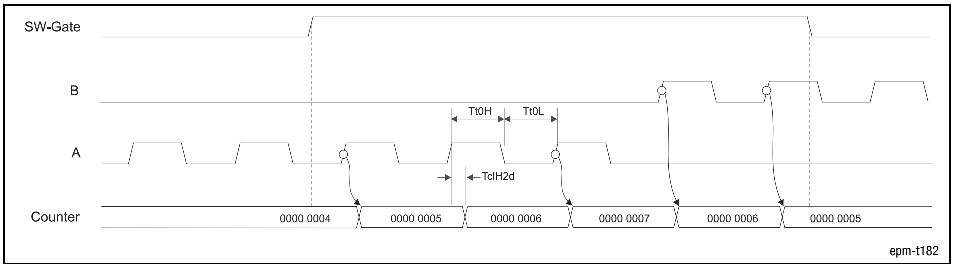

Fig. 13.4-10 Signal characteristic of 1xcounter/16xdigital input in the mode 2

13.4.6 Measuring the frequency (mode 3)

In mode 3, the counter operates as a frequency meter. For this purpose the counter counts the number of rising edges of signal A of a specified time slot.

The time slot can be determined by selecting a starting value (Data In) and a reference frequency (Ref. Freq.) in the Rx PDO.

Reference frequency

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		$08_h ... FF_h$	not permissible

Time slot calculation

$T_W = \frac{1}{f_{ref}} \cdot n$	T_w	Time slot
	f_{ref}	Reference frequency (is transmitted in byte 5)
	n	Starting value (is transmitted in bytes 0 ... 3)

Load signal

When bit 2 (Load) changes from LOW to HIGH in byte 4 (Control), the counter is pre-assigned with the starting value from byte 0 to 3 (Data In).

Start/stop signal

The software gate which releases the counting process is opened, when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A signal

When the software gate is open:

- The reference counter is started by the first rising edge of signal A (E.0) and then incremented with every rising edge of the reference clock.
- When the reference counter reaches the starting value (time T_W has elapsed), the current count value is shifted into the Tx PDO in byte 0 ... 3 (Data Out).
- Then, the counter and reference counter are automatically reset and the next frequency measurement starts with the next rising edge of signal A.
- If two rising edges do not occur in the signal A within the time slot T_W, the count value for this measurement is interpreted with zero.

Clear signal

The counter can be cleared at any time via a HIGH level in byte 4 (Control), bit 3 (Clear). The loaded value remains valid until a new value is loaded.

Frequency calculation

$f = f_{ref} \cdot \frac{m}{n}$	f	Frequency of signal A
	f_{ref}	Reference frequency
	m	Count value
	n	Starting value

Example: Reference frequency f_{ref} = 1 MHz, starting value n = 1,000,000, count value m = 10,000

$$f = 1\ \text{MHz} \cdot \frac{10000}{1000000} = 10\ \text{kHz}$$

Counter access

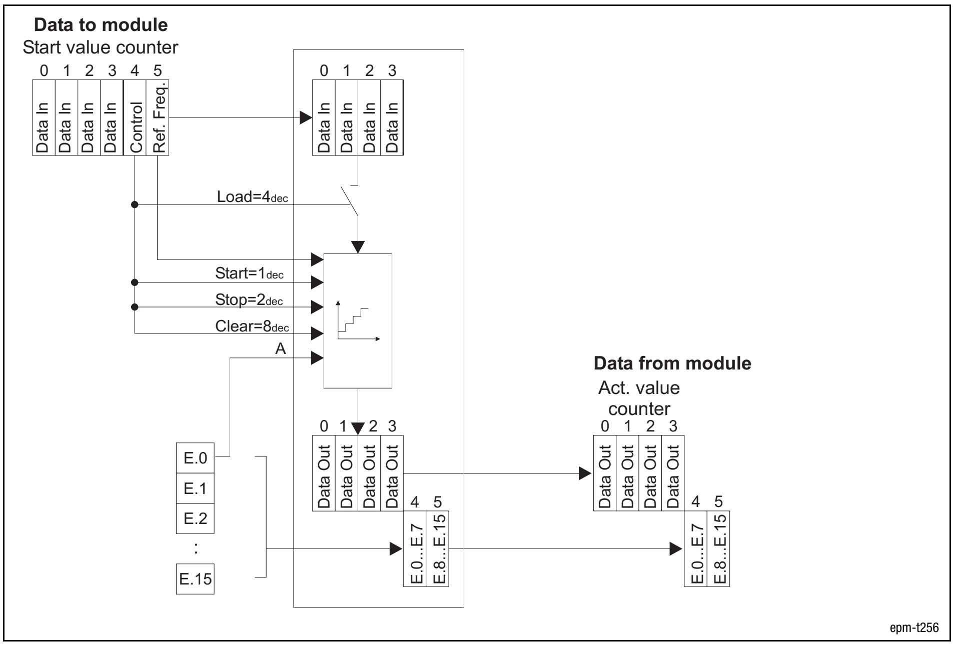

Fig. 13.4-11 Counter access of 1xcounter/16xdigital input in the mode 3

Signal characteristic

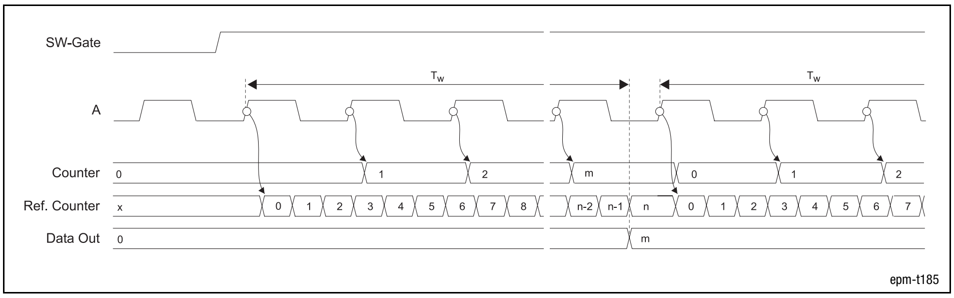

Fig. 13.4-12 Signal characteristic of 1xcounter/16xdigital input in the mode 3

13.4.7 Measuring the period (mode 4)

In mode 4 the counter operates as a permanent period meter. The counter counts the number of rising edges of a reference counter between two rising edges of signal A (E.0).

The frequency of a reference counter can be preset in the Rx PDO in byte 5 (Ref. Freq.).

Reference frequency

Byte	Assignment		
5	Reference frequency	00_h	16 MHz
		01_h	8 MHz
		02_h	4 MHz
		03_h	1 MHz
		04_h	100 kHz
		05_h	10 kHz
		06_h	1 kHz
		07_h	100 Hz
		$08_h ... FF_h$	not permissible

Start/stop signal

The software gate which releases the counting process is opened when bit 0 (Start) in the byte 4 (Control) has HIGH level. It is closed as soon as bit 1 (Stop) has HIGH level.

A signal

When the software gate is open:

- The reference counter is started by the first rising edge of signal A and then incremented with every rising edge of the reference clock.
- The next rising edge of signal A stops the reference counter.

Clear signal

The counter can be cleared at any time via a HIGH level in byte 4 (Control), bit 3 (Clear). Then the measuring process is restarted with the next rising edge of signal A.

Period calculation

$T = \frac{1}{f_{ref}} \cdot n$	T	Period
	f_{ref}	Reference frequency
	n	Count value

Example: Reference frequency f_{ref} = 1 MHz, count value n = 10,000

$$T = \frac{1}{1\ \text{MHz}} \cdot 10000 = 10\ \text{ms}$$

Note!

The count value remains valid until the next measurement is completed or the counter is reset via the clear signal; this means that you do not receive the current count value, but the one from the previous measurement if a measurement has not been completed, e.g. because no second rising edge of signal A has occurred.

Parameterising 1xcounter/16xdigital input module 13.4

Measuring the period (mode 4) 13.4.7

Counter access

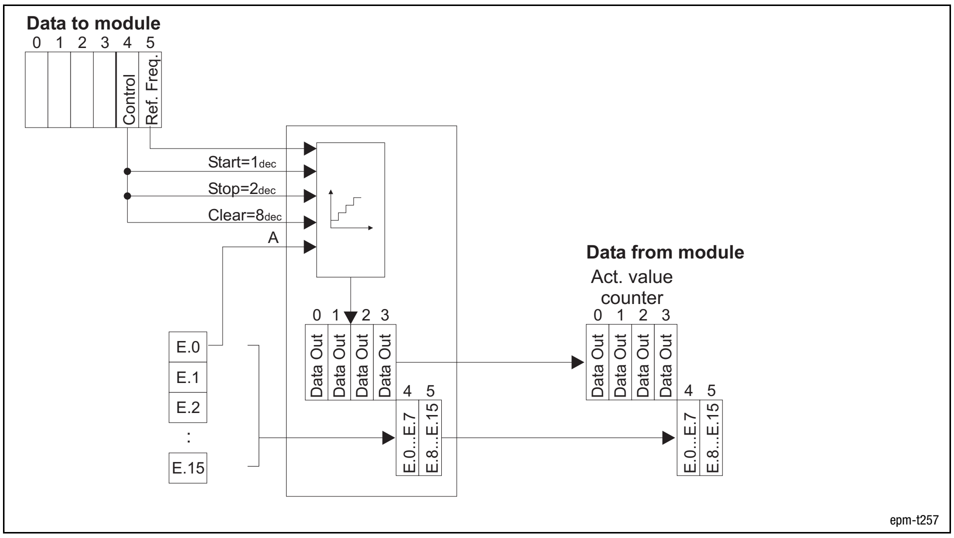

Fig. 13.4-13 Counter access of 1xcounter/16xdigital input in the mode 4

Signal characteristic

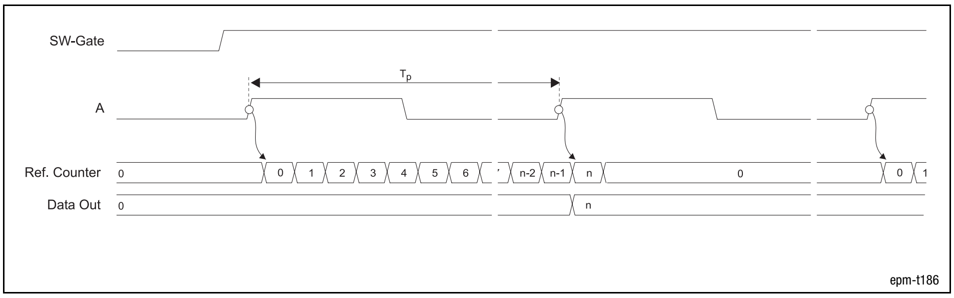

Fig. 13.4-14 Signal characteristic of 1xcounter/16xdigital input in the mode 4

13.4.8 Parameterising digital input filters

Counting pulses at the inputs E.0 and E.1 must have a specific minimum length to be evaluated. The pulse length T_{Pulse} is set via digital input filters.

- Lenze setting: T_{Pulse} = 2.5 μs
- Filter factor A is defined via byte 1 of the parameter data:
  – Permissible values: 0 ... 255 (Lenze setting: 0)
- Filter factor B is defined via byte 2 of the parameter data:
  – Permissible values: 0 ... 255 (Lenze setting: 0)

Formula for calculation

$T_{Pulse} \geq (\textit{Filter factor A} + 1) \times (\textit{Filter factor B} + 1) \times 2.5\ \mu s$

Example

Filter factor settings:

- Filter factor A = 3
- Filter factor B = 0

Counting pulses with the following minimum length are evaluated:

$T_{Pulse} \geq (3 + 1) \times (0 + 1) \times 2.5\ \mu s$

$T_{Pulse} \geq 10\ \mu s$

14 Troubleshooting and fault elimination

Contents

14.1 Fault messages

Module	Fault	Display	Cause	Remedy
CAN gateway	No data transfer	No LED is lit.	No supply voltage.	Make sure that the module is supplied with 24 V DC.
	Incorrect data transmission to the backplane bus.	LED ”ER” is lit.	No module contact with the backplane bus.	Place module on DIN rail, turn downward until it audibly engages with the DIN rail. Next, restart the module by disconnecting and reconnecting the supply voltage.
	No process data is transmitted.	LED ’BA’ is blinking.	System bus in ”Pre-Operational” state.	Transmit telegram 00 01 00 from master to change into the ”Operational” state.
	Parameter changes were not saved after supply voltage disconnection.	–	Parameter changes were not saved.	Save all settings via index I2003$_h$.
8×digital input 16×digital input 1×counter/16×digital input 8×digital input / output	HIGH signal at a digital input is not transmitted/indicated.	The green status LED of the output is not lit.	High signal lacks reference potential (GND) via pin 10.	Establish reference potential.
8×digital output 0.5A 16×digital output 0.5A 8×digital output 1A 16×digital output 1A 8×digital output 2A 8×digital input / output	No HIGH level output at the digital output.	The red status LED ’F’ is lit.	Short circuit at a digital output due to incorrect wiring. The output remains off until the error has been eliminated.	Check wiring.
			Connected load defective.	Check load.
			Digital output overload as load’s current consumption is too high.	Select load with lower current consumption. When using the module 8×digital output 1A, exchange it, if possible, by a module 8×digital output 2A.
4×relay	Relay contact does not open.	–	Excess load has lead to relay contact fusing.	Replace module and reduce load on the relay contact.
4×analog input 4×analog input ±10V 4×analog input ±20mA 4×analog input / output	Signal at analog input is not transmitted.	The red LED of the corresponding input is lit.	Open circuit within measuring range 4 ... 20 mA.	Check wiring.
			No sensor connected.	Connect sensor. Short-circuit the plus and minus terminals of an input if it is not to be used.
		The red LED of the associated input is blinking.	Input current >40 mA.	Reduce input current.
2/4×counter	If networking takes place via system bus (CAN) or CANopen, the value 0 is not transmitted to the master via the digital input IN1 / IN4 after a reset. The transmission only starts at the next count value.	–	Process data transfer to the master (PDO-Tx) is event-controlled.	Setting cyclic process data change (I1800$_h$ ... I1809$_h$).

15 Appendix

Contents

15.1 Index table

- The indices are numbered in ascending order for reference purposes.
- How to read the index table:

Column	Abbreviation		Meaning
Index	$Ixxxx_h$		Index $Ixxxx_h$
	1		Subindex 1 of $Ixxxx_h$
	2		Subindex 2 of $Ixxxx_h$
	$Ixxxx_h$ ↵		After entry, the index parameter value is stored in the EEPROM
	$Ixxxx_h$ *		Index parameter value is stored in the EEPROM with $I2003_h$ = 1
Name			Index name
Lenze			Lenze setting, setting on delivery
Selection	1 {%} 99		min. value {unit} max. value
Important	–		Brief, important explanations
	🕮 Page x		Reference to detailed explanations

Index	Name	Possible settings: Lenze	Possible settings: Selection	Important	
$I1000_h$	Device type			Display only Type	
$I1001_h$	Error register			Display only	🕮 8.10-2
			Bit 0 Generic An unspecified error has occurred (flag set on each error message)		
			Bit 1 Reserved		
			Bit 2 Reserved		
			Bit 3 Reserved		
			Bit 4 Comm. Communication error (Overrun CAN)		
			Bit 5 Reserved		
			Bit 6 Reserved		
			Bit 7 ManSpec. Manufacturer-specific error	Shown in detail in $I1003_h$	
$I1003_h$				Display only History buffer	
1	Actual errors				
$I1004_h$	Number of supported PDOs			Display only	
1	Number of synchronous PDOs supported				
2	Number of synchronus PDOs supported				
$I1005_h$ *	Sync COB-ID	128	128 {1} 2047		
$I1006_h$ *	Sync interval (µs)	0	0 {1 µs} 4294967295	• I/O system IP20 acts as sync consumer: – Set bit 30 = 0 under $I1005_h$ – After the time set under $I1006_h$, I/O system IP20 switches to the communication status set under $I1029_h$ – A reset will be carried out with the next sync telegram – With $I1006_h$ = 0, the monitoring is deactivated • I/O system IP20 acts as sync producer: – Set bit 30 = 1 under $I1005_h$ (Lenze setting) – I/O system IP20 transmits the sync telegram after the time set under $I1006_h$	

Index	Name	Possible settings		Important	
		Lenze	Selection		
I1008h	DIS: Device name			Display only Device name	
I1009h	DIS: Hardware version			Display only Hardware version	
I100Ah	DIS: Software version			Display only Software version	
I100Bh	Node ID	0	0 {1} 63	Display only System bus node address	
I100Ch *	Guard time	0	0 {1 ms} 65535	Node Guarding Monitoring time 0 = monitoring not active	🕮 8.6-1
I100Dh *	Life time factor	0	0 {1} 255	Node Guarding Response time computation factor 0 = monitoring not active The response time is computed as: monitoring period x factor	🕮 8.6-1
I100Eh	Node Guarding identifier			Display only Identifier = Basic identifier + node address (basic identifier cannot be modified)	🕮 8.6-1
I1010h ↵	Store parameter	0		Store in accordance with CANopen (communication protocol DS301/DS401)	
I1011h ↵	Restore parameter	0		Load factory setting in accordance with CANopen (communication protocol DS301/DS401)	
I1014h	COB ID emergency			Emergency telegram Identifier 80h + node address is displayed after boot-up.	🕮 8.10-2
I1016h ↵	Heartbeat consumer time		Data contents Heartbeat time: Byte 0 = 00h, Byte 1 = 00h Node ID: Byte 2 = 00h Reserved: Byte 3 = 00h	I/O system IP20 can monitor up to five nodes (subindex 1 ... 5). If the monitored node does not respond, I/O system IP20 changes to the status ”Pre-Operational”. The outputs switch to a defined state.	🕮 8.7-1
1	Heartbeat time	0	0 {1 ms} 65535	• In the compact system, only subindex 1 is available • Heartbeat time: – The monitored node must respond within the time set. The time is set in byte 0 and 1. – If the monitored node does not respond within the set time, I/O system IP20 switches to the communication status set under I1029h – The communication status is reset when a new heartbeat telegram is received • Node ID: – Node address of the node to be monitored. The address is set in byte 2.	
	Node ID	0	0 {1} 255		
2	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
3	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
4	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
5	Heartbeat time	0	0 {1 ms} 65535		
	Node ID	0	0 {1} 255		
I1017h ↵	Heartbeat producer time	0	0 {1 ms} 65535 0 Function is not active	I/O system IP20 can be monitored by other nodes. Within this time the device status of I/O system IP20 is transmitted to the fieldbus. Not available for system bus (CAN) communication protocol	🕮 8.7-1

Index	Name	Possible settings		Important	
		Lenze	Selection		
I1018h				Display only Device identification	
1	Vendor ID				
2	Product code				
3	Revision number				
I1027h	Type of			Display only Module list Subindices 1 ... 32 Module identifiers of the plugged modules	8.10-3
1	Module no. 1				
2	Module no. 2				
...	...				
32	Module no. 32				
I1029h *	Error behaviour		0 Pre-Operational 1 No state changed 2 Stopped 3 Reset	Error behaviour	
1	Communication error	0		I/O system IP20 switches to the status set if the communication with the master fails or "node guarding", "heartbeat", or the output monitoring have been activated.	
2	Manufacturer-specific error	0		Only available for the compact system. If a digital output has a short circuit and the time set in I2410h has been exceeded, the module switches to the status set.	
I1200h	Server SDO parameter 1			Display only Current identifiers for SDO communication	
1	SDO1-Rx		1536 (basic identifier) + node address		
2	SDO1-Tx		1408 (basic identifier) + node address		
I1201h	Server SDO parameter 2			Display only Current identifiers for SDO communication	
1	SDO2-Rx		1600 (basic identifier) + node address		
2	SDO2-Tx		1472 (basic identifier) + node address		
I1400h ↵				Index is available in the modular and compact system	8.3-3
1	COB-ID used by RxPDO 1	768	385 {1} 2047	Defining the individual identifiers for process data object 1	
2	Transmisson type	255	0 {1} 255	Defining the transmission mode	
			0 ... 240 Process data update on sync telegram transmission	The input data are accepted on sync telegram transmission.	
			241 ... 254 Reserved		
			255 Process data update on occurrence of an event	Every received value is accepted	
I1401h ↵				Index is only available in the modular system	8.3-3
1	COB-ID used by RxPDO 2	640	385 {1} 2047	Defining the individual identifiers for process data object 2	
2	Transmisson type	255	0 {1} 255	Defining the transmission mode	
			0 ... 240 Process data update on sync telegram transmission	The input data are accepted on sync telegram transmission.	
			241 ... 254 Reserved		
			255 Process data update on occurrence of an event	Every received value is accepted	

Index		Name	Possible settings				Important	
			Lenze	Selection				
I1402h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 3	512	385	{1}	2047	Defining the individual identifiers for process data object 3	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	
I1403h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 4	830	385	{1}	2047	Defining the individual identifiers for process data object 4	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	
I1404h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 5	1024	385	{1}	2047	Defining the individual identifiers for process data object 5	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	
I1405h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 6	1080	385	{1}	2047	Defining the individual identifiers for process data object 6	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	
I1406h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 7	1152	385	{1}	2047	Defining the individual identifiers for process data object 7	
	2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission		The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved			
				255	Process data update on occurrence of an event		Every received value is accepted	

Index		Name	Possible settings					Important	
			Lenze	Selection					
I1407$_h$ ↵								Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 8	1280	385		{1}	2047	Defining the individual identifiers for process data object 8	
	2	Transmisson type	255	0		{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission			The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved				
				255	Process data update on occurrence of an event			Every received value is accepted	
I1408$_h$ ↵								Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 9	1344	385		{1}	2047	Defining the individual identifiers for process data object 9	
	2	Transmisson type	255	0		{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission			The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved				
				255	Process data update on occurrence of an event			Every received value is accepted	
I1409$_h$ ↵								Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by RxPDO 10	1665	385		{1}	2047	Defining the individual identifiers for process data object 10	
	2	Transmisson type	255	0		{1}	255	Defining the transmission mode	
				0 ... 240	Process data update on sync telegram transmission			The input data are accepted on sync telegram transmission.	
				241 ... 254	Reserved				
				255	Process data update on occurrence of an event			Every received value is accepted	
I1600$_h$ ↵								Mapping parameters for receive PDOs	
	0	Number of mapped RxPDO1		0		{1}	255	8 bit value	
	1	1st mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	2	2nd mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	3	3rd mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	4	4th mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	5	5th mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	6	6th mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	7	7th mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	
	8	8th mapped object		00000000$_h$		{1}	FFFFFFFF$_h$	32 bit value	

Index	Name	Possible settings				Important	
		Lenze	Selection				
I1800$_h$ ↵							📖 8.3-3
1	COB-ID used by TxPDO 1	767	385	{1}	2047	Defining the individual identifiers for process data object 1	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180x$_h$, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180x$_h$, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time		0	{1 ms}	65535	Cycle time	
I1801$_h$ ↵						Index is only available in the modular system	📖 8.3-3
1	COB-ID used by TxPDO 2	639	385	{1}	2047	Defining the individual identifiers for process data object 2	
2	Transmission type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180x$_h$, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180x$_h$, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	
I1802h ↵						Index is only available in the modular system	📖 8.3-3
1	COB-ID used by TxPDO 3	384	385	{1}	2047	Defining the individual identifiers for process data object 3	
2	Transmission type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180x$_h$, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180x$_h$, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	

Index	Name	Possible settings				Important	
		Lenze	Selection				
I1803h ↵						Index is only available in the modular system	🕮 8.3-3
1	COB-ID used by TxPDO 4	896	385	{1}	2047	Defining the individual identifiers for process data object 4	
2	Transmission type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	
I1804h ↵						Index is only available in the modular system	🕮 8.3-3
1	COB-ID used by TxPDO 5	448	385	{1}	2047	Defining the individual identifiers for process data object 5	
2	Transmission type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	
I1805h ↵						Index is only available in the modular system	🕮 8.3-3
1	COB-ID used by TxPDO 6	704	385	{1}	2047	Defining the individual identifiers for process data object 6	
2	Transmission type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	

Index		Name	Possible settings				Important	
			Lenze	Selection				
I1806h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by TxPDO 7	960	385	{1}	2047	Defining the individual identifiers for process data object 7	
	2	Transmission type	255	0	{1}	255	Defining the transmission mode	
				0	Function deactivated		The output data are accepted on sync telegram transmission.	
				1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
				254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
				255	Event-controlled process data transfer			
				255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
	3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
	5	Event time	0	0	{1 ms}	65535	Cycle time	
I1807h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by TxPDO 8	1216	385	{1}	2047	Defining the individual identifiers for process data object 8	
	2	Transmission type	255	0	{1}	255	Defining the transmission mode	
				0	Function deactivated		The output data are accepted on sync telegram transmission.	
				1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
				254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
				255	Event-controlled process data transfer			
				255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
	3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
	5	Event time	0	0	{1 ms}	65535	Cycle time	
I1808h ↵							Index is only available in the modular system	📖 8.3-3
	1	COB-ID used by TxPDO 9	1728	385	{1}	2047	Defining the individual identifiers for process data object 9	
	2	Transmission type	255	0	{1}	255	Defining the transmission mode	
				0	Function deactivated		The output data are accepted on sync telegram transmission.	
				1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
				254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
				255	Event-controlled process data transfer			
				255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
	3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
	5	Event time	0	0	{1 ms}	65535	Cycle time	

Index	Name	Possible settings				Important	
		Lenze	Selection				
I1809h ↵						Index is only available in the modular system	📖 8.3-3
1	COB-ID used by TxPDO 10	1984	385	{1}	2047	Defining the individual identifiers for process data object 10	
2	Transmisson type	255	0	{1}	255	Defining the transmission mode	
			0	Function deactivated		The output data are accepted on sync telegram transmission.	
			1 ... 240	Process data transfer after sync no. 1 ... Process data transfer after sync no. 240		The output data are accepted after transmission of the set number (1 ... 240) of sync telegrams.	
			254	Time-controlled process data transfer		Only if a cycle time is set in I180xh, subindex 5	
			255	Event-controlled process data transfer			
			255	Event-controlled process data transfer with cyclic overlay		Only if a cycle time is set in I180xh, subindex 5	
3	Inhibit time	0	0	{1 ms}	65535	Inhibit time	
5	Event time	0	0	{1 ms}	65535	Cycle time	
I1A00h ↵						Mapping parameters for receive PDOs	
0	Number of mapped TxPDO1		0	{1}	255	8 bit value	
1	1st mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
2	2nd mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
3	3rd mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
4	4th mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
5	5th mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
6	6th mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
7	7th mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
8	8th mapped object		00000000h	{1}	FFFFFFFFh	32 bit value	
I2001h	CAN baud rate	1	0	{1}	255	Display only System bus baud rate	
			0 1 2 3 4 5 6 7 8	1000 kbits/s 500 kbits/s 250 kbits/s 125 kbits/s 100 kbits/s 50 kbits/s 20 kbits/s 10 kbits/s 800 kbits/s			
I2003h *	Save	0	0 1	No function Save		I2003h = 1: Non-volatile saving of parameter changes in the EEPROM	
I2004h ↵	Mode setting	0	0 1 2	No function Lenze system bus CAN mode CANopenmode		Change-over of the CAN mode • The set mode will only be accepted after a CAN reset node (I2358h = 1).	
I2100h *	Default setting	0	0 1	No function Default setting		Loading factory setting The EEPROM content is cleared	📖 12.8-1
I2358h *	CAN reset node	0	0 1	No function CAN reset node		Reset node	📖 8.8-1
I2359h	CAN state		0	{1}	3	Display only System bus status	📖 8.10-3
			0 1 2 3	Operational Pre-Operational Warning Bus off			

Index	Name	Possible settings		Important	
		Lenze	Selection		
I2360$_h$ *	Property function forcing	0	0 {1} 1	• Forcing of digital outputs (I6200$_h$) and analog outputs (I6411$_h$) • After a restart, I2360$_h$ is set 0	
			0 Forcing deactive in "Pre-Operational" state	Forcing only possible in "Operational" state	
			1 Forcing active in "Pre-Operational" state	Forcing only possible in "Pre-Operational" state	
I2361$_h$	CAN mode	0	0 {1} 1	Display only Active communication mode	
			0 Lenze system bus mode		
			1 CANopenmode		
I2400$_h$ ↵	Timer value		0 {1 ms} 65535	Monitoring time for process data input objects For the compact system, only index I2400$_h$, subindex 1 is available	📖 8.9-1
1	PD01	0			
2	PD02	0			
3	PD03	0			
4	PD04	0			
5	PD05	0			
6	PD06	0			
7	PD07	0			
8	PD08	0			
9	PD09	0			
10	PD10	0			
I2410$_h$ *	Time-out short circuit monitoring	2	0 {1 ms} 65535	Only available for the compact system. If a digital output has a short circuit and the time set has been exceeded, the module switches to the status set in I1029$_h$, subindex 2.	
I2500$_h$	Dummy object for PDO mapping			Display only Index is only available in the compact system	
I3001$_h$ ↵	Config analog/counter module 1		00000000$_h$ {1$_h$} FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 1 • I3001$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I3001$_h$ is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0$_h$			
2		0$_h$			
3		0$_h$			
4		0$_h$			
I3002$_h$ ↵	Config analog/counter module 2		00000000$_h$ {1$_h$} FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 2 • I3002$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I3002$_h$ is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0$_h$			
2		0$_h$			
3		0$_h$			
4		0$_h$			
I3003$_h$ ↵	Config analog/counter module 3		00000000$_h$ {1$_h$} FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 3 • I3003$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I3003$_h$ is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0$_h$			
2		0$_h$			
3		0$_h$			
4		0$_h$			

Index	Name	Possible settings		Important	
		Lenze	Selection		
I3004h ↵	Config analog/counter module 4		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 4 • I3004h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3004h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			
I3005h ↵	Config analog/counter module 5		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 5 • I3005h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3005h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			
I3006h ↵	Config analog/counter module 6		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 6 • I3006h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3006h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			
I3007h ↵	Config analog/counter module 7		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 7 • I3007h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3007h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			
I3008h ↵	Config analog/counter module 8		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 8 • I3008h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3008h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			
I3009h ↵	Config analog/counter module 9		00000000h {1h} FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 9 • I3009h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3009h is only available for the modular system.	📖 12.3-1 📖 12.4-1 📖 12.5-1 📖 12.6-1
1		0h			
2		0h			
3		0h			
4		0h			

Index	Name	Possible settings				Important	
		Lenze	Selection				
I300A$_h$ ↵	Config analog/counter module 10		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 10 • I300A$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300A$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					
I300B$_h$ ↵	Config analog/counter module 11		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 11 • I300B$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300B$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					
I300C$_h$ ↵	Config analog/counter module 12		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 12 • I300C$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300C$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					
I300D$_h$ ↵	Config analog/counter module 13		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 13 • I300D$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300D$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					
I300E$_h$ ↵	Config analog/counter module 14		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 14 • I300E$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300E$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					
I300F$_h$ ↵	Config analog/counter module 15		00000000$_h$	{1$_h$}	FFFFFFFF$_h$	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 15 • I300F$_h$ can only be accessed via Global Drive Control (GDC). Use I3401$_h$ in CoDeSys programming systems. • I300F$_h$ is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0$_h$					
2		0$_h$					
3		0$_h$					
4		0$_h$					

Index	Name	Possible settings				Important	
		Lenze	Selection				
I3010h ↵	Config analog/counter module 16		00000000h	{1h}	FFFFFFFFh	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module on slot 16 • I3010h can only be accessed via Global Drive Control (GDC). Use I3401h in CoDeSys programming systems. • I3010h is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1		0h					
2		0h					
3		0h					
4		0h					
I3401h ↵	Config analog / counter module		0	{1h}	255	Configuration of analog module, 2/4xcounter module, SSI interface module or 1xcounter/16xdigital input module • I3401h can only be accessed via CoDeSys programming systems. The index is not available in Global Drive Control (GDC). • I3401h is only available for the modular system.	🕮 12.3-1 🕮 12.4-1 🕮 12.5-1 🕮 12.6-1
1	1st mapped object	0h					
2	2nd mapped object	0h					
...	...	0h					
64	64th mapped object	0h					
I4000h	Digital counter value 16DI/1C		0	{1}	255	Display only • Module 1×counter/ 16×digital input • Count display	🕮 12.6-1
1	Module 1						
2	Module 2						
...	...						
8	Module 8						
I4001h	Digital input 16DI/1C		0	{1}	255	Display only • Module 1×counter/ 16×digital input • Display of digital input states	🕮 12.6-1
1	Module 1 Bits 0 ... 7						
2	Module 1 Bits 8 ... 15 %						
3	Module 2 Bits 0 ... 7						
4	Module 2 Bits 8 ... 15 %						
...	...						
15	Module 8 Bits 0 ... 7						
16	Module 8 Bits 8 ... 15 %						
I4002h *	Change polarity input 16DI/1C		0	{1}	255	Module 1×counter/ 16×digital input • Setting of digital input polarity: – Bit x = 0: Input HIGH active – Bit x = 1: Input LOW active	🕮 12.6-1
1	Module 1 Bits 0 ... 7						
2	Module 1 Bits 8 ... 15 %						
3	Module 2 Bits 0 ... 7						
4	Module 2 Bits 8 ... 15 %						
...	...						
15	Module 8 Bits 0 ... 7						
16	Module 8 Bits 8 ... 15 %						

Index	Name	Lenze	Selection		Important	
$I4003_h$ *	Set counter value 16DI/1C		0 {1} 4294967295		Module 1×counter/ 16×digital input • Selection of the counter value	🕮 12.6-1
1	Module 1					
2	Module 2					
3	Module 3					
...	...					
8	Module 8					
$I4004_h$ *	Control byte 16DI/1C		0 {1} 255 Bit		Module 1×counter/ 16×digital input	🕮 12.6-1
1	Module 1	0	0	Start counter		
2	Module 2	0	1	Stop counter		
3	Module 3	0	2	Load set counter value		
...	...	...	3	Reset counter		
8	Module 8	0	4 ... 7	Reserved		
$I4005_h$ *	Fref 16DI/1C		0 {1} 255		Module 1×counter/ 16×digital input • Selection of the reference frequency for ”Period measuring”mode	🕮 12.6-1
1	Module 1					
2	Module 2					
3	Module 3					
...	...					
8	Module 8					
$I4100_h$	SSI counter value		00000000_h FFFFFFFFh Bit		Display only	🕮 12.5-1
1	Module 1		0	Control status I/O0 (LSB)	Status display only for SSI mapping PLC ($I4104_h$ = 0)	
2	Module 2		1	Control status I/O1		
3	Module 3		2 ... 7	Reserved		
4	Module 4		8 ... 15	SSI value HB	Display of current counter value of SSI encoder	
...	...		16 ... 23	SSI value MB		
9	Module 9		24 ... 31	SSI value LB		
$I4101_h$ *	SSI set counter value		00000000_h {1_h} $FFFFFFFF_h$ Bit			🕮 12.5-1
1	Module 1	0_h	0	SSI control setpoint selection I/O0 (LSB)	Bit value 0: No selection via I/O.x Bit value 1: Selection via I/O.x • Settings only apply to SSI mapping PLC mode ($I4104_h$ = 0)	
2	Module 2	0_h	1	SSI control setpoint selection I/O1		
3	Module 3	0_h	2	Reserved		
4	Module 4	0_h	3	SSI control output condition 0 SSI > setpoint	Bit value 0: I/O.x is set 1, if counter value > setpoint Bit value 1: I/O.x is set 1, if counter value < setpoint • Settings only apply to SSI mapping PLC mode ($I4104_h$ = 0)	
5	Module 5	0_h	4 ... 7	Reserved		
6	Module 6	0_h	8 ... 15	SSI value HB	Setting of counter value	
7	Module 7	0_h	16 ... 23	SSI value MB		
8	Module 8	0_h	24 ... 31	SSI value LB		
$I4102_h$	SSI status		Bit		Display only • Status display only for SSI mapping standard 1 and 2 ($I4104_h$ = 1 and 2) • Current counter value of SSI encoder is indicated under $I4100_h$	🕮 12.5-1
1	Module 1		0	Control status I/O0		
...	...		1	Control status I/O1		
9	Module 9		2 ... 7	Reserved		

Index	Name	Possible settings				Important	
		Lenze	Selection				
I4103h *	SSI control		0	{1}	255	SSI interface module • Settings only apply to SSI mapping standard 1 and 2 mode (I4104h = 1 and 2) • Counter value is set under I4101h	📖 12.5-1
			Bit				
1	Module 1	0	0	SSI control setpoint selection I/O0 (LSB)		Bit value 0: No selection via I/O.x Bit value 1: Selection via I/O.x	
2	Module 2	0	1	SSI control setpoint selection I/O1			
3	Module 3	0	2	Reserved			
...	...	...	3	SSI control output condition 0 SSI > setpoint		Bit value 0: I/O.x is set 1, if counter value > setpoint Bit value 1: I/O.x is set 1, if counter value < setpoint	
8	Module 8	0	4 ... 7	Reserved			
I4104h *	SSI mapping	0				Mapping for communication with Lenze devices	📖 12.5-1
			0	SSI mapping PLC		Data exchange with PLC units using the function blocks "L_IOSSIDataToIO" and "L_IOSSIDataFromIO".	
			1	SSI mapping standard 1		Data exchange with 9300 controllers using the function blocks CAN-IN/CAN-OUT	
			2	SSI mapping standard 2			
I6000h	Digital input		0	{1}	255	Display only Digital input status	📖 8.10-3
1	Module 1						
2	Module 2						
...	...						
64	Module 64						
I6002h ↵	Change polarity digital input		0	{1}	255	Inverts digital input signals	📖 12.2-1
1	Module 1	0					
2	Module 2	0					
...	...	...					
64	Module 64	0					
I6200h *	Digital output		0	{1}	255	• Digital output status • The outputs can be set manually (forcing): – Depends on CAN status and I2360h	📖 8.10-4
1	Module 1						
2	Module 2						
...	...						
64	Module 64						
I6202h ↵	Change polarity digital output		0	{1}	255	Inverts digital output signals	📖 12.2-1
1	Module 1	0					
2	Module 2	0					
...	...	...					
64	Module 64	0					
I6206h ↵	Error mode digital output		0	{1}	255	Configures digital output monitoring For the compact system, only index I6206h, subindex 1 is available	📖 8.9-2
			0	All digital outputs retain the last status output.			
			255	Response from I6207h		In I6207h, the response can be configured individually for each digital output	
1	Module 1	0					
2	Module 2	0					
...	...	...					
64	Module 64	0					

Index	Name	Possible settings		Important	
		Lenze	Selection		
I6207$_h$ ↵	Error value digital output	0	0 {1} 255 8 bits of information Bit value 0 – Output switches to LOW Bit value 1 – Output retains last status output	Configures the individual digital output responses For the compact system, only index I620$_{7h}$, subindex 1 is available	8.9-2
1	Module 1	0			
2	Module 2	0			
...	...	...			
64	Module 64	0			
I6401$_h$	Analog input		-32768 {1} 32767	Display only Analog input status Index is only available in the modular system	8.10-5
1	Channel 1				
2	Channel 2				
...	...				
36	Channel 36				
I6411$_h$ *	Analog output		-32768 {1} 32767	• Analog output status • The outputs can be set manually (forcing): – Depends on CAN status and I2360$_h$ • Index is only available in the modular system	8.10-5
1	Channel 1				
2	Channel 2				
...	...				
36	Channel 36				
I6421$_h$ ↵	Trigger selection		0 {1} 255	Enables interrupt for analog inputs/outputs Index is only available in the modular system	
1	Channel 1	0			
2	Channel 2	0			
...	...	...			
36	Channel 36	0			
I6423$_h$ ↵	Global interrupt enable		0 {1} 255 0 – Event-controlled process data transfer deactivated 255 – Event-controlled process data transfer activated	Global activation/deactivation of the event-controlled process data transfer of the analog input signals. The setting in I6423$_h$ has a higher priority than the settings in the TxPDOs. • Lenze setting: – System bus (CAN): I6423$_h$ = 255 – CANopen: I6423$_h$ = 0 • I6423$_h$ is only available for the modular system.	
I6424$_h$ ↵	Upper limit analog input		00000000$_h$ {1} FFFFFFFF$_h$	Index is only available in the modular system	
1	Channel 1	0			
2	Channel 2	0			
...	...	...			
36	Channel 36	0			
I6425$_h$ ↵	Lower limit analog input		00000000$_h$ {1} FFFFFFFF$_h$	Index is only available in the modular system	
1	Channel 1	0			
2	Channel 2	0			
...	...	...			
36	Channel 36	0			
I6426$_h$ ↵	Delta limit analog input		00000000$_h$ {1} FFFFFFFF$_h$	Index is only available in the modular system	
1	Channel 1	0			
2	Channel 2	0			
...	...	...			
36	Channel 36	0			

Index	Name	Possible settings				Important	
		Lenze	Selection				
I6443h ↵	Error mode analog output		0	{1}	255	Configures analog output monitoring Index is only available in the modular system	📖 8.9-3
			0	All analog outputs retain the last value output			
			255	Response from I6444h		In I6444h the response can be configured individually for each analog output	
1	Channel 1	0					
2	Channel 2	0					
...	...	...					
36	Channel 36	0					
I6444h ↵	Error value analog output		-32768	{1}	32767	Configures the individual analog output responses The analog outputs provide the set value Index is only available in the modular system	📖 8.9-3
1	Channel 1	0					
2	Channel 2	0					
...	...	...					
36	Channel 36	0					

15.2 Glossary

15.2.1 Terminology and abbreviations used

AI	Analog input data
AIO	Analog input and output data
AO	Analog output data
CAN	Control Area Network
CANopen	Communication profile to DS 301, published by CiA (CAN in Automation)
CE	Communauté Européene
Controller	Any frequency inverter, servo inverter or DC speed controller
DC	DC current or DC voltage
DI	Digital input data
DIN	Deutsches Institut für Normung
DIO	Digital input and output data
DO	Digital output data
EMC	Electromagnetic compatibility
EN	European standard
f_{ref} [Hz]	Reference frequency
IEC	International Electrotechnical Commission
IP	International Protection Code
$Ixxxx/y_{hex}$	Subindex y of index Ixxxx (e. g. I1004/2 = Subindex 2 of index I1004)
NMT	Network management
Node ID	Node address which serves to clearly assign each node in the network
PDO	Process Data Object
PDO-Rx	Process data input object
PDO-Tx	Process data output object
PES	HF shield termination through large-surface connection to PE
R [Ω]	Resistor
SDO	Service Data Object (parameter data object)
SDO-Rx	Parameter data input object

SDO-Tx	Parameter data output object
SSI	Synchronous serial interface
System bus (CAN)	Lenze system bus
T	Period
UL	Underwriters Laboratories
VDE	Verband deutscher Elektrotechniker
🕮	Cross-reference to a chapter with the corresponding page number

15.3 Total index

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EDSPM-TXXX ▪ 13321201 ▪ EN ▪ 9.0-11/2009 ▪ TD23

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