Translation of the original instructions

LE3-80

Issue: May 2021

Article no.: 1121323

IEF-Werner GmbH
Wendelhofstraße 6
78120 Furtwangen - Germany
Phone: +49 7723/925-0
Fax: +49 7723/925-100
www.ief.de

Change History

Document Code	Date	Modification
MAN_EN_1121323_LE3-80_R1a.doc	July 25, 2014	Creation of this English document. Translation of the original German instructions („MAN_DE_1121322_LE3-80_R1a.doc“).
MAN_EN_1121323_LE3-80_R1b.doc	March 2015	New chapters added: - Power supply NT5-80 → Installation (see chapter 9.4, page 45 onwards) - Putting into operation (see chapter 6.2, page 19) - New position of rotary encoder (see chapter 6.3, page 20)
MAN_EN_1121323_LE3-80_R1c.doc	October 2016	EU-Declaration of conformity added (see chapter 1, page 6).
MAN_EN_1121323_LE3-80_R1d.doc	February 2017	EU-Declaration of conformity updated (see chapter 1, page 6).
MAN_EN_1121323_LE3-80_R1e.doc	May 2021	Figure 16, page 50 changed.

Trademarks and trade names are used without any warranty of their free usability. Texts and examples have been created with great care. Nevertheless, errors cannot be excluded. IEF-Werner GmbH does not assume legal responsibility nor any liability for missing or incorrect statements or their consequences.

IEF-Werner GmbH reserves the right to modify or improve the software or hardware or parts of it, as well as the supplied documentation or parts of it, without previous notice.

IEF-Werner GmbH expressly reserves all rights for replication and photomechanical reproduction, including in extracts.

We are always grateful for suggestions for improvements and information about errors.

© May 2021, IEF-Werner GmbH

Table of Contents

1 EU-Declaration of Conformity 6
2 General 7
3 Technical data 8
3.1 Ambient conditions and qualifications 8
3.2 Dimensions and weight 8
3.3 Operating and display elements 8
3.4 Supply [X1 / X3] 8
3.5 Motor connection data [X3] 9
3.6 Encoder connection [X1 / X3] 9
3.7 Digital in-/outputs [X1] 9
3.8 Communication interfaces [X2] 9
3.9 Installation sizes 10
3.9.1 Device view from front 11
3.9.2 Device view from top 11
3.9.3 Device view from bottom 11
3.10 Displays 12
3.10.1 LEDs 12
3.11 Setting options 12
3.11.1 CAN terminal resistor 12
3.11.2 CAN address 13
3.11.3 CAN Baud rate 13
4 Mechanical installation 14
5 Electrical installation 15
5.1 Connections 15
5.1.1 System [X1] 15
5.1.2 Motor [X3] 16
5.1.3 CAN-Bus [X2] 16
5.2 Connection circuit diagram 17
6 Adaptation to a PA-CONTROL 18
6.1 Wiring diagram 18
6.2 Putting into operation 19
6.3 The new position of the rotary encoder can be taken over 20
6.3.1 Rotation monitoring is inactive 20
6.3.2 Rotation monitoring is active 20
7 CAN-interface 21
7.1 The NMT status machine 21
7.2 The emergency object 22
7.3 Object list overview 23
7.4 Communication 24
7.4.1 1000 – Device Type 24
7.4.2 1001 – Error Register 24

7.4.3 1003 – Error Storage 25
7.4.4 1005 – SYNC Identifier 25
7.4.5 1006 – SYNC Interval 25
7.4.6 1008 – Device Names 25
7.4.7 1009 – Hardware Version 25
7.4.8 100A – Software Version 26
7.4.9 100C – Guard Time 26
7.4.10 100D – Life Time Factor 26
7.4.11 1014 – Emergency Identifier 26
7.4.12 1017 – Producer Heartbeat 26
7.4.13 1018 – Identity Object 27
7.4.14 1400 – RxPDO1 Communication Parameters 27
7.4.15 1401 – RxPDO2 Communication Parameters 28
7.4.16 1600 – RxPDO1 Mapping 28
7.4.17 1601 – RxPDO2 Mapping 28
7.4.18 1800 – TxPDO1 Communication Parameter 29
7.4.19 1801 – TxPDO2 Communication Parameter 29
7.4.20 1A00 – TxPDO1 Mapping 30
7.4.21 1A01 – TxPDO2 Mapping 30
7.5 Configuration data 31
7.5.1 2000:01 – Starting Frequency 31
7.5.2 2000:02 – Maximum Frequency 31
7.5.3 2000:03 – Ramp Shape 31
7.5.4 2000:04 – Ramp Parameter 31
7.5.5 2000:05 – Acceleration Time 32
7.5.6 2000:06 – Maximum Motor Current 32
7.5.7 2000:07 – Standby current 32
7.5.8 2000:08 – RUN Current 32
7.5.9 2000:09 – Boost Current 32
7.5.10 2000:0A – Resonance Dampening 33
7.5.11 2000:0B – Reference Run 33
7.5.11.1 Reference run 17 33
7.5.11.2 Reference run 18 33
7.5.12 2000:0C – Step Frequency for Reference Run on the Switch 34
7.5.13 2000:0C – Step Frequency for Reference Run from the Switch 34
7.5.14 2000 – Motor Voltage 34
7.5.15 2000:0F – Device Temperature 34
7.5.16 2000:10 – Step Resolution 34
7.5.17 2000:11 – Delay for Quick Stop 35
7.5.18 2000:12 – Invert Inputs 35
7.5.18.1 Limit switch type definition, setting 35
7.5.19 2000:30 – Trigger Position 35

7.5.20 2000:31 – Trigger Delay 35
7.5.21 2000:64 – Invert Turning Direction of the Motor 36
7.5.22 2000:65 – Reference Offset 36
7.5.23 2000:66 – Swap Limit Switches 36
7.5.24 2000:67 – Activate Rotary Encoder 36
7.5.25 2000:68 – Resolution of the Rotary Encoder 37
7.5.26 2000:69 – Invert Rotary Encoder Count Direction 37
7.5.27 2000:70 – Delay when Opening the Brake 37
7.5.28 2000:71 – Delay when Closing the Brake 37
7.5.29 2000:72 – Switch off Limit Switch Monitoring 38
7.6 Input data 39
7.6.1 2001:00 – Target Position 39
7.6.2 2001:01 – Target Frequency 39
7.6.3 2001:02 – Commands 39
7.6.3.1 Commands 39
7.7 Starting data 3 40
7.7.1 2002:00 – Actual Position 40
7.7.2 2002:01 – Actual Frequency 40
7.7.3 2002:02 – Executed Command 40
7.7.4 2002:03 – Actual Status 40
7.7.5 2002:04 – Rotary Encoder Position 41
8 Control of the device 42
8.1 Switch motor on/off 43
8.2 Reference run 43
8.2.1 Reference run type 17 on negative limit switch 43
8.2.2 Reference run type 18 on positive limit switch 43
8.2.3 Reference run type 35 to current position 43
8.3 Positioning 43
8.4 Rotating speed 43
9 Accessories 44
9.1 Plug 44
9.2 Cable 44
9.3 Power supply 44
9.4 Power supply NT5-80 45
9.4.1 Technical data 46
9.4.2 Status display 47
9.4.3 Electrical installation 48
9.4.3.1 Connections 48
9.4.4 Mechanical installation 49
9.4.4.1 Dimensions 49
9.4.4.2 Installation 50

1 EU-Declaration of Conformity

Manufacturer

IEF-Werner GmbH
Wendelhofstraße 6
78120 Furtwangen – Germany

Product Designation	IEF-Werner part number
Power output stage LE3-80	1121320
Power output stage LE8-80	1121321

The manufacturer hereby confirms that the above-mentioned products comply with the relevant provisions of the following directive:

- **Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.**

The following hormonised standards have been applied:

- EN 61000-6-3 (Emission standard)
- EN 61000-6-2 (Immunity standard for industrial environments)
- EN 61000-4-4 (Burst immunity test)
- EN 61000-4-5 (Surge immunity test)

Documentation officer: IEF-Werner GmbH, 78120 Furtwangen / Germany

Furtwangen, February 2017

Manfred Bär (Manager)

2 General

Figure 1: LE3-80

- The LE3-80 is a position control for 2-phase step motors.
- The 4-quadrant power controller in connection with the resonance dampening permits outstandingly calm operation without considerable resonances in the entire speed range.
- Position control is implemented with a signal processor of the latest generation.
- The power end stages are equipped with modern MOS-transistors and permit soundless operation with outstanding efficiency.
- The CAN bus interface (DS301 / DSP402) transfers the position and the running command.
- The ramp shape, acceleration, motor current, … parameters are set via SDOs.
- The PA-CONTROL is used as master control.
- The housing can be installed in the control cabinet with two screws.
- To ensure operational safety, the LE3-80 contains several protection functions.

3 Technical data

3.1 Ambient conditions and qualifications

Description	Value
Storage temperature	(0 … 75) °C
Operating temperature	(0 … 45) °C
Deactivation temperature	Approx. 85 °C
Humidity	(20 … 80) %, non-condensing
Protection class	IP20
Protection class	Protection class 1 (protective ground)

3.2 Dimensions and weight

Description	Value
Dimensions	See drawing
Weight	Approx. 0.65 kg

3.3 Operating and display elements

Description	Function
Dial switch CAN-ADR-High	CAN address high byte
Dial switch CAN-ADR-Low	CAN address low byte
Dial switch CAN Baud rate	CAN Baud rate
Jumper	CAN-Bus terminal resistor
LED red	Condition display
LED yellow	
LED green	

3.4 Supply [X1 / X3]

Type	Value
System supply	24 VDC [+/-10%], (approx. 0.2 A) plus power intake of a parking brake that may be present
Motor supply	(22 … 80) VDC (max. set motor power)

3.5 Motor connection data [X3]

Description	Value
Motor	2 phase step motor (bipolar)
Motor current [A]	Max. 3.5
Step resolution (steps per turn)	200, 400, 800, 1600, 3200
Protection functions of the end stage	- Short circuit between the phases - Over- / undervoltage - Overtemperature
Maximum length of the motor line	20 m

3.6 Encoder connection [X1 / X3]

Description	Value
Rotary encoder interface for turning monitoring	Track signals A, A#, B, B# according to RS422-specification
Voltage supply for rotary encoders	5 VDC, max. 100 mA
Resolution rotary encoder	50, 100, 200, 500, 1000, 1024, 2048

3.7 Digital in-/outputs [X1]

Description	Value
Positive limit switch	24V (8 … 30V)
Negative limit switch	24V (8 … 30V)
Motor brake	24VDC / (max.) 1A, High-side-switch (plus-switching), temperature-monitored, short-circuit proof

3.8 Communication interfaces [X2]

Description	Value
CANopen Controller	Max 1 MBaud
CANopen Protocol	According to DS301 and DSP402

3.9 Installation sizes

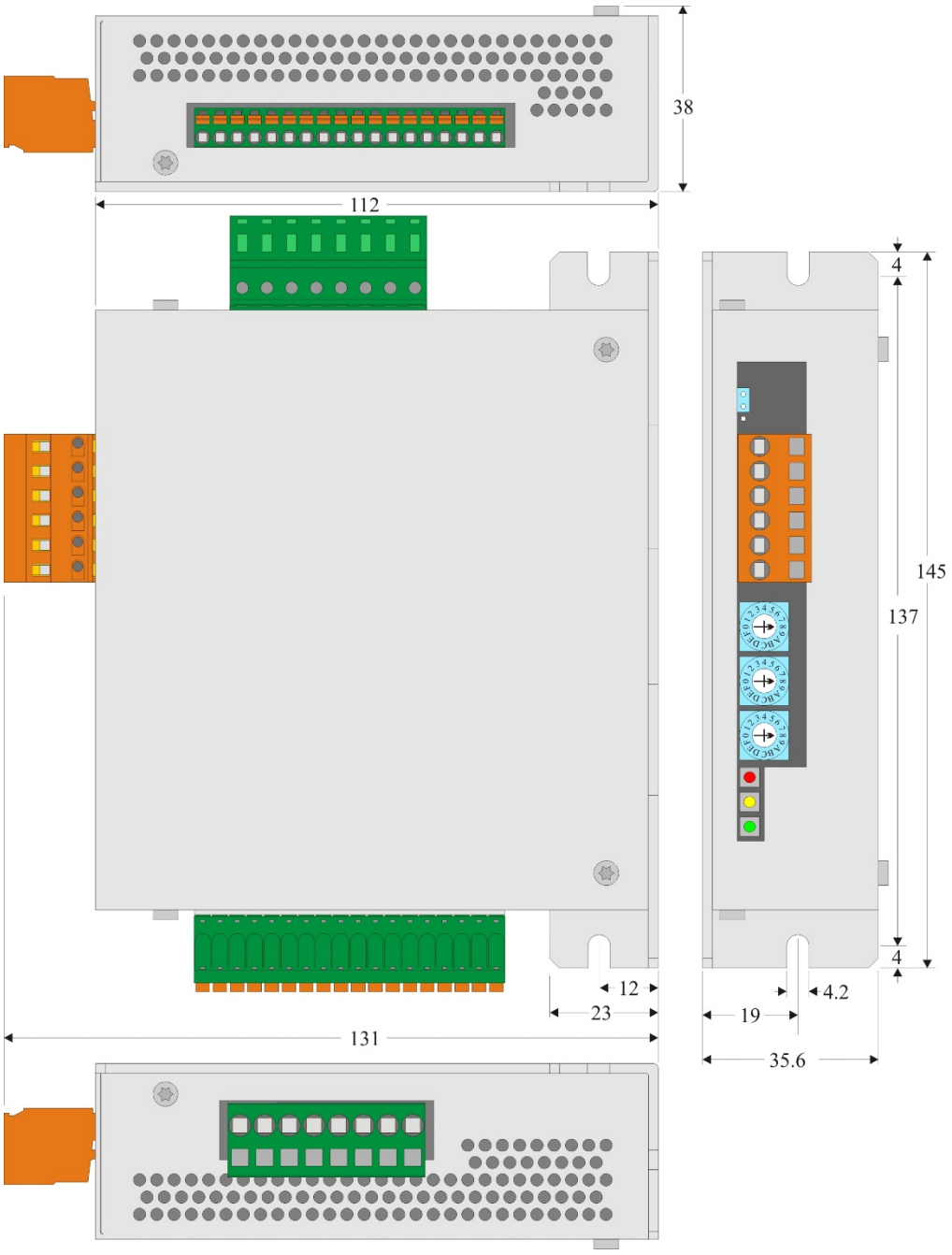
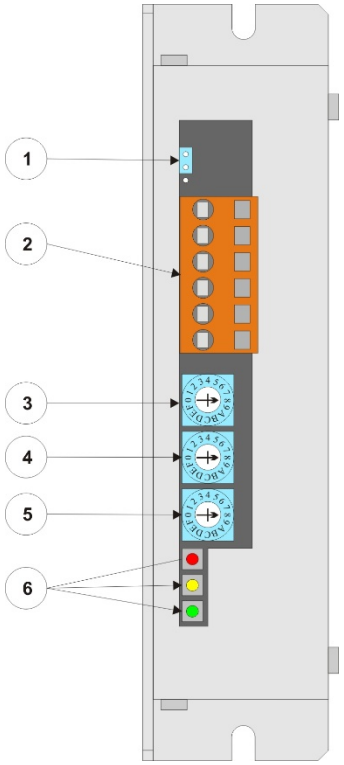


Figure 2: Device view of LE3-80 with installation sizes

3.9.1 Device view from front



1: Jumper for CAN-Bus terminal resistor

2: CAN-Bus interface [X2]

3: High-byte of the CAN-Bus address

4: Low-byte of the CAN-Bus address

5: CAN Baud rate

6: Display of the operating condition

Figure 3: Device view from front

3.9.2 Device view from top

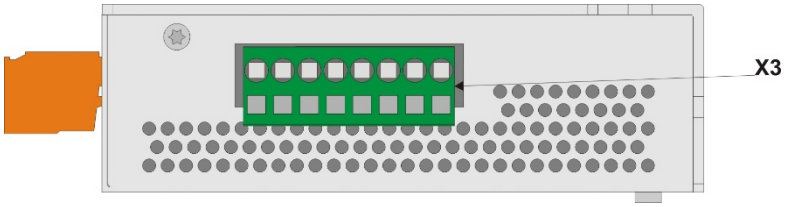


Figure 4: Device view from top

3.9.3 Device view from bottom

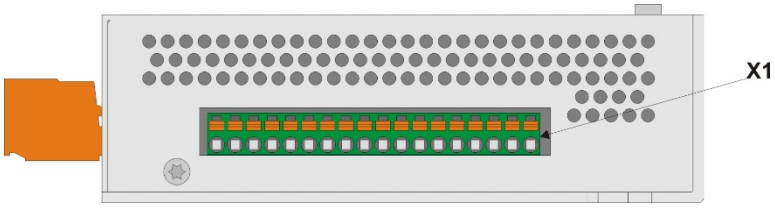
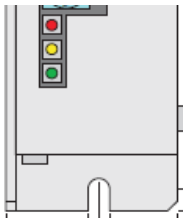


Figure 5: Device view from bottom

3.10 Displays

3.10.1 LEDs



CANopen conditions	LED green	LED yellow	LED red
Power On	off	on	off
Initialise	off	flashes	off
CAN-Bus "Pre-operational"	flashes	flashes	off
CAN-Bus "Stopped"	flashes	flashes	off
CAN-Bus "Operational"	on	off	off
Error	on	off	on

3.11 Setting options

3.11.1 CAN terminal resistor

The terminal resistor can be activated via a jumper on demand.

Jumper		Function
Top	Term-Off	Terminal resistor off
Bottom	Term-On	Terminal resistor on

3.11.2 CAN address

The CAN address is set via two HEX dial switches, address high-byte and address low-byte, and assumed for switching on the device.

Switch position		CAN address	PA-CONTROL axis
Switch high byte	Switch low byte		
0	0	0	invalid
0	1	1	1
0	2	2	2
...	…	…	…
0	A	10	10
0	B	11	11
0	C	12	12
0	D	13	13
0	E	14	14
0	F	15	15
1	0	16	16
1	1	17	invalid
…	…	…	…
F	F	…	invalid

3.11.3 CAN Baud rate

The Baud rate for the CAN-bus is set via the HEX-dial switch "CAN Baud rate".

Switch position	CAN Baud rate
0	20 kBaud
1	50 kBaud
2	125 kBaud
3	250 kBaud
4	**500 kBaud (PA-CONTROL)**
5	800 kBaud
6	1 MBaud
7 … F	Reserved

4 Mechanical installation

- The LE3-80 is only to be used as an integrated device for cabinet installation.
- Any installation position is permitted.
- The LE3-80 is to be installed with the attachment tabs at the cabinet plate.
- For sufficient ventilation of the device, a distance of 100 mm each must be complied with to other assemblies above and below the device.
- The LE3-80 is designed so that it can be directly connected in series at intended use and proper installation on a heat-dissipating assembly rear wall.

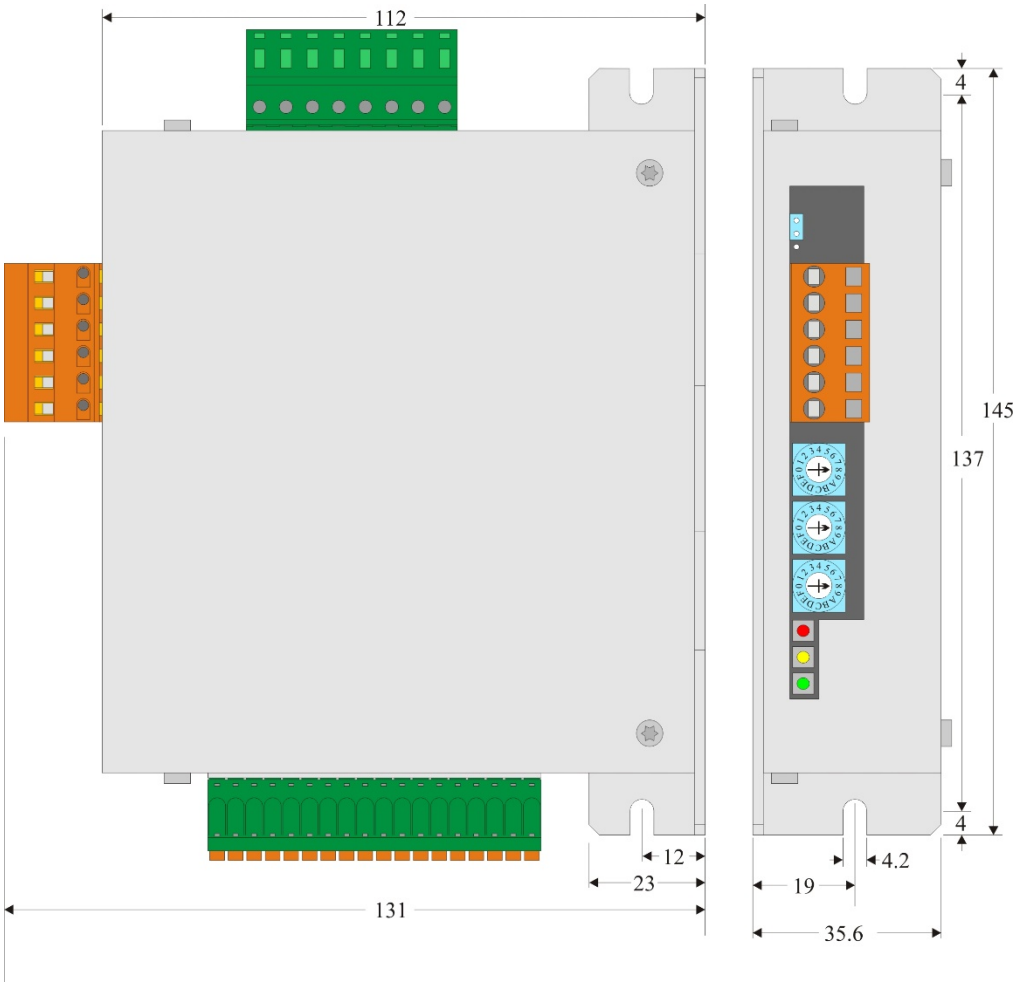


Figure 6: View on LE3-80 with dimensioning

5 Electrical installation

5.1 Connections

5.1.1 System [X1]

Pin-No.	Designation	Value	Specification / function
1	Encoder B#		Track signals A, A#, B, B# according to RS422-specification
2	Encoder B		
3	Encoder A#		
4	Encoder A		
5	Shield encoder	Internally connected to PE	Shield from encoder cable
6	Encoder 0VDC	0 V	Voltage supply for rotary encoders
7	Encoder 5VDC	+5 VDC, max. 100 mA	
8	Negative limit switch	Digital input, 24 VDC	
9	Positive limit switch		
10	Motor brake	24 VDC / max. 1 A	
11	Motor brake	GND motor brake	
12	System 0V	0 VDC	Supply • Control unit • CAN bus • Brake • Rotary encoder
13	System 0V	0 VDC	
14	System 24VDC	+24 VDC (+/-10%),	
15	System 0V	0 VDC	
16	System 24VDC	+24 VDC (+/-10%),	
17	System 0V	0 VDC	
18	System 24VDC	+24 VDC (+/-10%),	

NOTE: System 0 V of X1 and 0 VDC motor of X3 are internally connected.

NOTE: The connections for system 0 V (X1.12, X1.13, X1.15, X1.17) and encoder 0 VDC (X1.6) are internally connected.

NOTE: The connections for system 24 VDC (X1.14, X1.16, X1.18) are internally connected.

5.1.2 Motor [X3]

Pin-No.	Designation	Value	Specification
1	0 VDC motor	0 VDC	Supply for the motor
2	(+22 … 80) VDC motor	(22 … 80) VDC	
3	PE – Shield		PE, supply
4	PE – Shield		PE and shield from motor cable
5	Motor PHASE-A1		Motor coil 1
6	Motor PHASE-A2		
7	Motor PHASE-B1		Motor coil 2
8	Motor PHASE-B2		

NOTE: System 0 V and 0 VDC motor are internally connected.

5.1.3 CAN-Bus [X2]

Pin-No.	Designation	Value	Specification
1	CAN-H		CAN-high signal line
2	CAN-L		CAN-low signal line
3	Shield		Connection for cable shield
4	CAN-H		CAN-high signal line
5	CAN-L		CAN-low signal line
6	Shield		Connection for cable shield

5.2 Connection circuit diagram

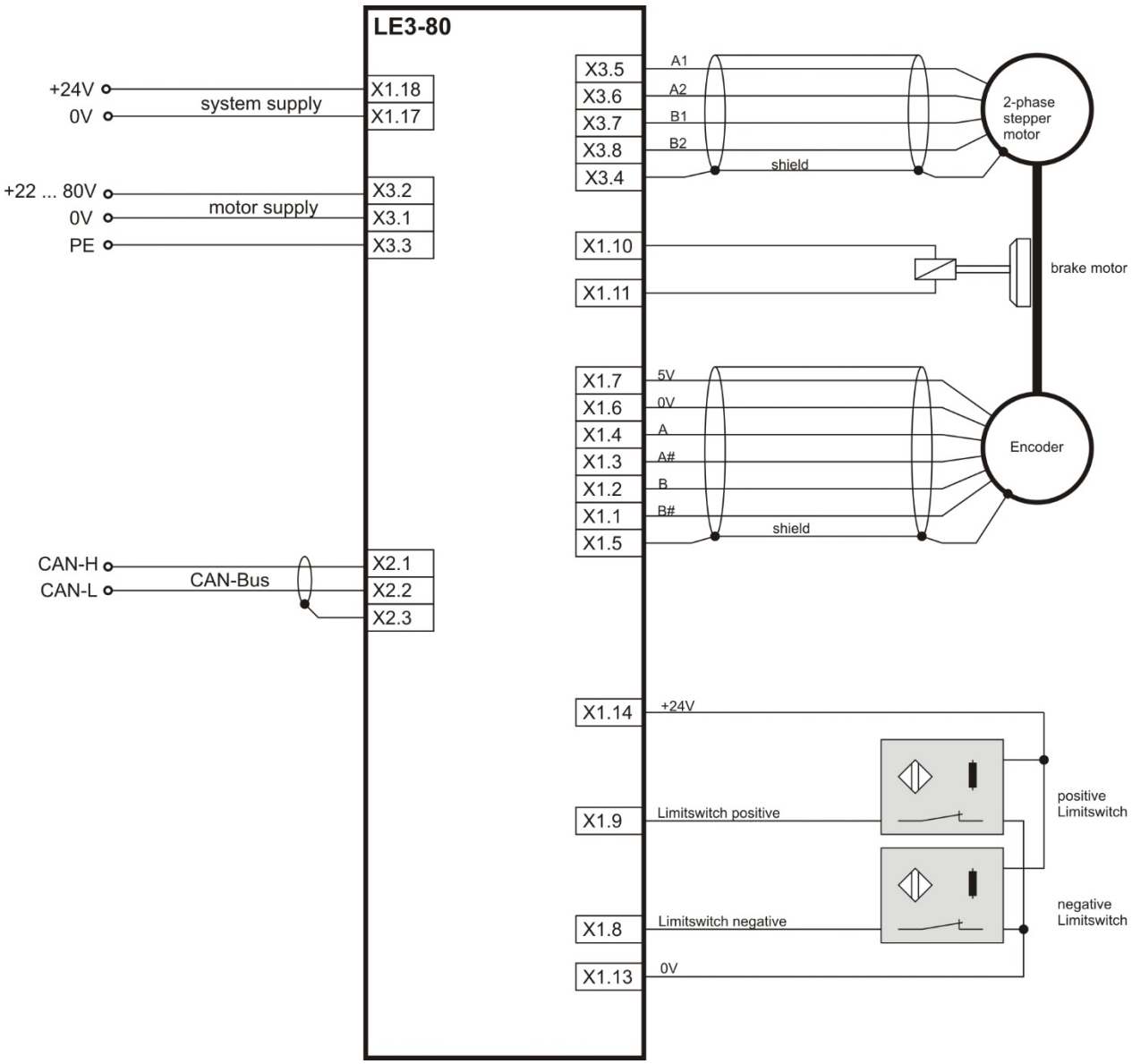


Figure 7: Diagram of connection circuit

6 Adaptation to a PA-CONTROL

6.1 Wiring diagram

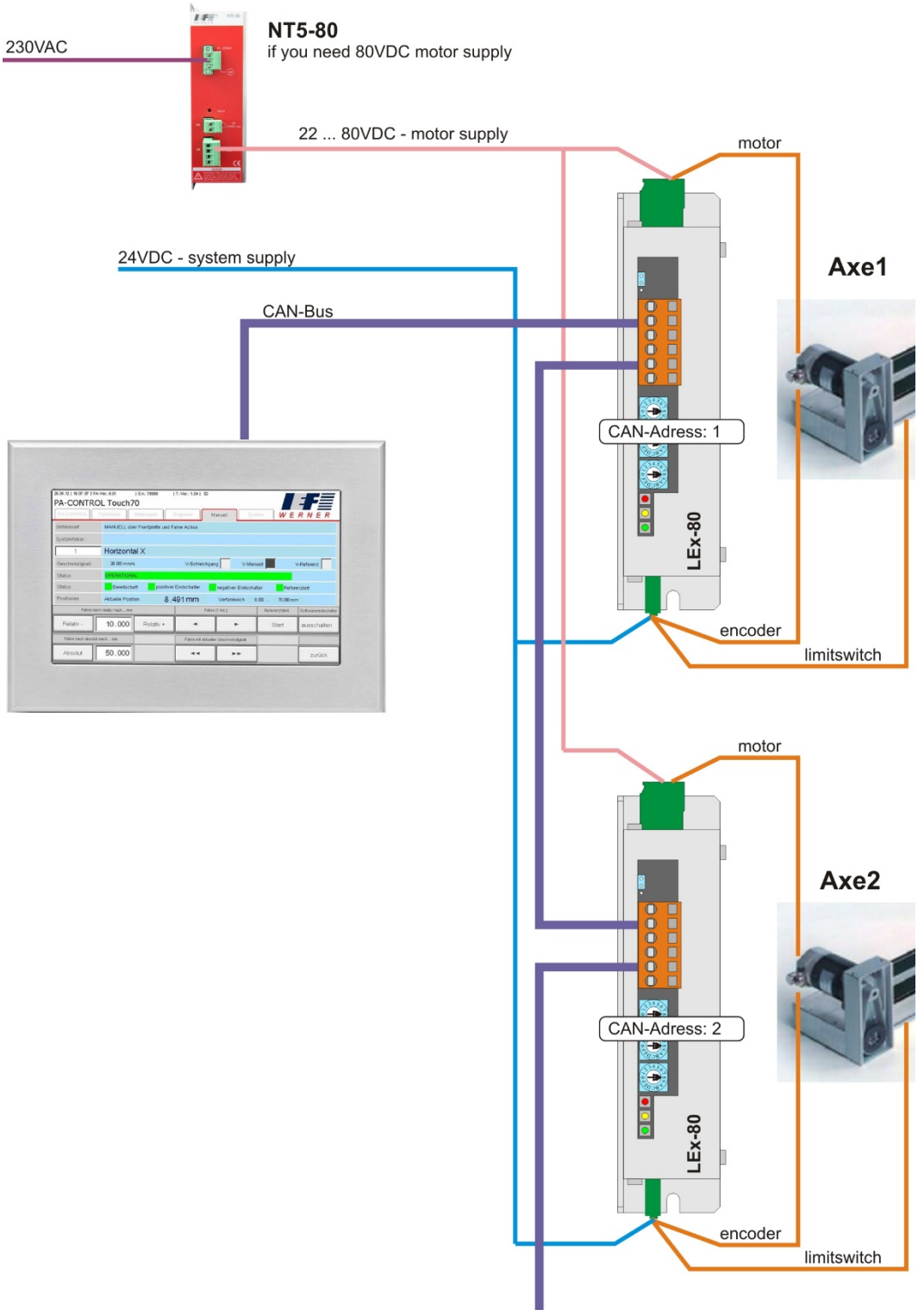


Figure 8: Adaption PA-CONTROL

6.2 Putting into operation

Putting into operation is performed via WINPAC in proven way.

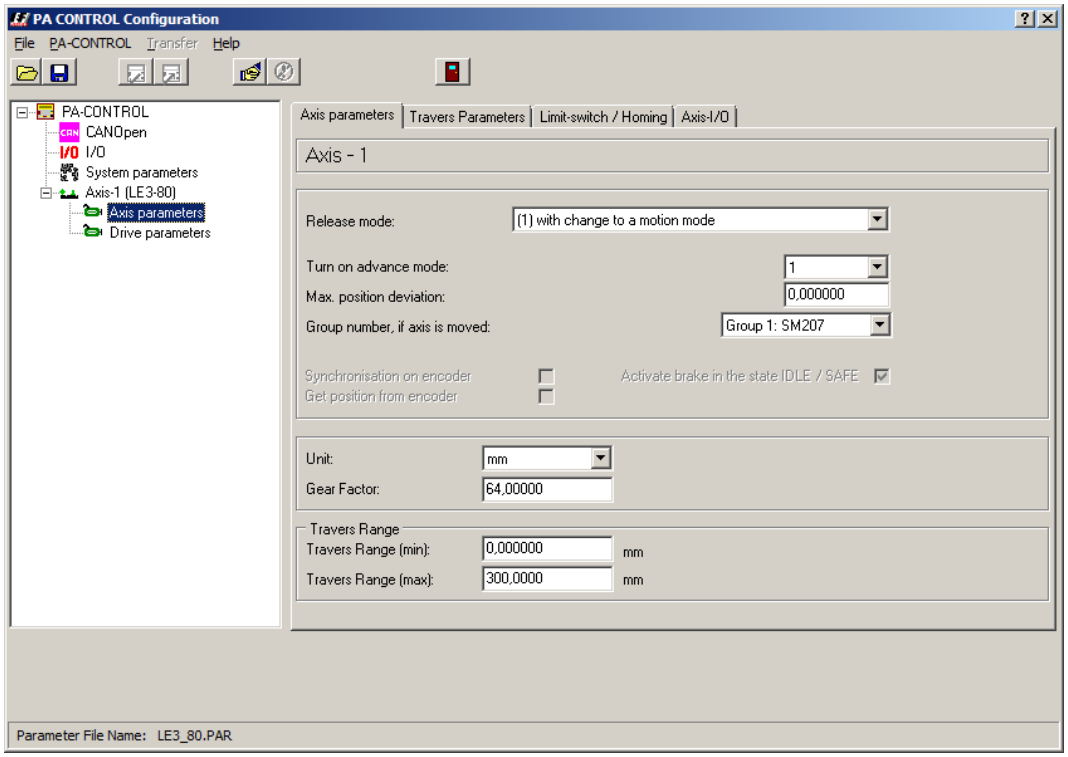


Figure 9: Configuration axis parameters

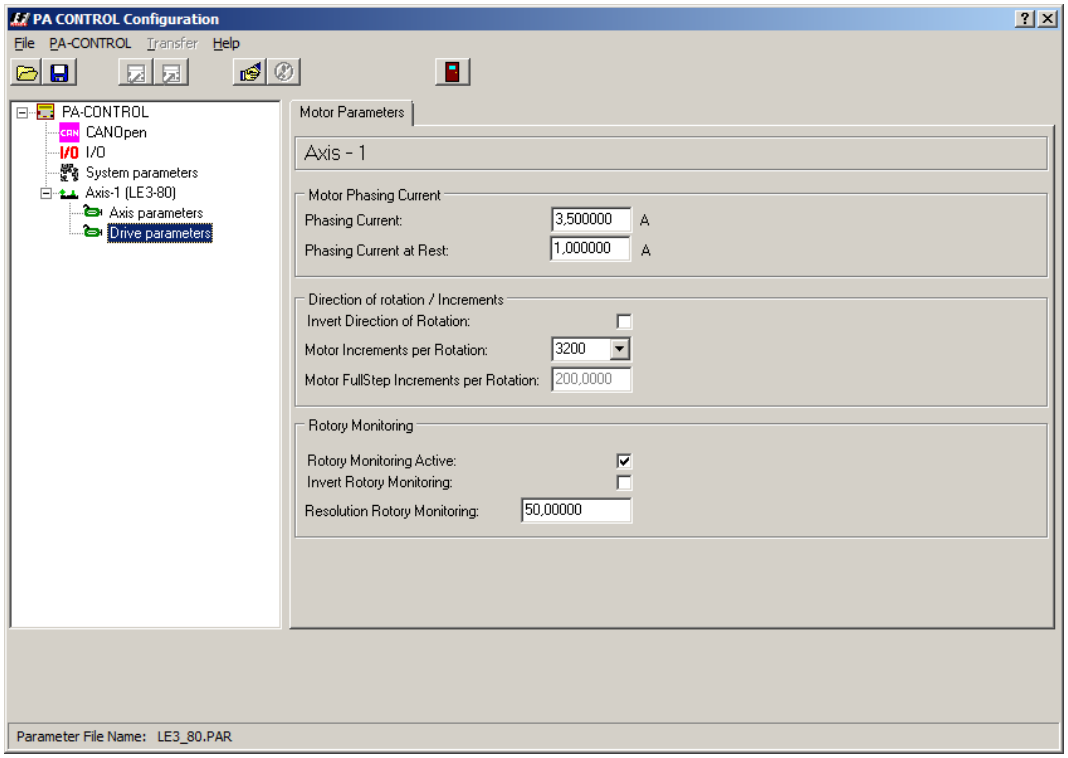


Figure 10: Configuration motor parameters

6.3 The new position of the rotary encoder can be taken over

After switching on (Power ON) the position of the drive is irrespective of the current mechanical position always zero.

The drive can only be operated when a reference run was carried out.

6.3.1 Rotation monitoring is inactive

If the rotation monitoring is inactive, the axis will lose its reference point while the drive is switched off (motor without current, OFF, …). The value of the position remains unaffected.

6.3.2 Rotation monitoring is active

If the rotation monitoring is active, the behaviour for the information “axis is referenced” and “position of axis” will be as follows:

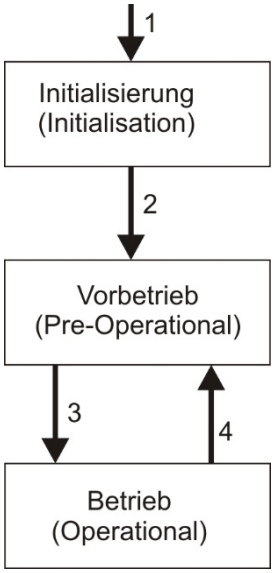
- If the axis is not referenced, because the reference run was not started after switching on, the position of the axis is zero and the rotary encoder is not influenced.
- If the axis is referenced, the axis remains referenced as long as the supply voltage “System 24 VDC” is connected with LE3-80.
- If the axis is switched off (motor is currentless, …) the rotary encoder serves as position source and will be reported as position to the PA-CONTROL.
- If the axis is moved while switched off, the position of the axis moves synchronized.
- When the axis is switched on afterwards, the position of the axis can be taken from the rotary encoder.

The behaviour of the drive encoder is comparable with a servo drive with resolver in case of activated rotary.

If a high-resolution rotary encoder is used (for example: type 400, type 800, ...) the reproducibility of the position is increased after switching on.

7 CAN-interface

7.1 The NMT status machine



The functions of the drive that can be controlled regarding network activities are determined by an internal status machine of the CAN interface, the NMT status machine.

It must not be mistaken for the condition machine of the device or the axis.

Activation (power-on) goes through the condition transfer 1, followed by an internal initialisation phase (initialisation). Then the devices automatically reach the condition "PRE-Operational". In this process, condition transfer 2 is completed as shown in the screen and reported by a boot-up message of the device.

Once the condition "Pre-operational" has been reached, all objects in the object directory can be reached via the SDO-transfer and the device can be parameterised thus.

In this phase, PDO parameters of the device and mapping entry parameters can be set where required.

The condition "Pre-Operational" also permits starting of the SYNC service. PDO transfers are not permitted in this condition.

Condition transfer 3 to the condition "Operational" is only possible via an NMT master. Device-internal events cannot trigger this condition transfer. To switch the devices or drives into the condition ”Operational”, the master may send a ”Start_Remote_Node Telegram” either to all or to individual devices. The condition "Operational" is to be considered a regular operating condition in which all communication services are available.

Condition transfer 4 to the condition "Pre-Operational" is only possible via an NMT master.

Transfer	Trigger
1	Automatic initialisation of the device after start-up
2	Automatic transfer after completed initialisation
3	”Start_Remote_Node” from the NMT master
4	”Enter_PRE-OPERATIONAL_State” from the NMT master

7.2 The emergency object

Each participant monitors the functions of his individual assemblies (voltage supply, end stage, etc.). In a drive system, e.g. the motor (temperature, angle encoder) and the limit switch conditions are reviewed continually, for example.

Defective settings (e.g. controller parameters) may also cause malfunctions.

Once an error occurs at a participant, it sends an EMERGENCY message. The identifier of this message is made up of the value 80h plus the node number of the affected controller. The EMERGENCY message consists of eight data bytes, with the first two bytes being used to break down the error type. In the third byte, the content of the window register (Object 1001h) is displayed. The remaining five bytes contain zeroes.

Setup/content of the error messages								
Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Table of Contents	Error message Emergency Error Code (see table)		Error Register (Object 1001)	Manufacturer-specific error Not defined, always 0				

Error Code (hex)	Description
2300	Overcurrent, short circuit at the end stage
3100	Undervoltage of the motor voltage
4200	Overtemperature
8130	Guarding error (Life-guard or Heartbeat)
8611	Rotary monitoring, drag error
FF00	Positive limit switch actuated
FF01	Negative limit switch actuated

7.3 Object list overview

Index [hex]	Object	Name	Data type	Access
1000	VAR	Device Type	Unsigned 32	ReadOnly
1001	VAR	Error Register	Unsigned 8	ReadOnly
1003	ARRAY	Error Storage	Unsigned 32	ReadOnly
1005	VAR	COB-ID Sync Message	Unsigned 32	ReadOnly
1006	VAR	Communication Cycle Period	Unsigned 32	ReadOnly
1008	STRING	Device Name	Vis-String	ReadOnly
1009	STRING	Hardware Version	Vis-String	ReadOnly
100A	STRING	Software Version	Vis-String	ReadOnly
100C	VAR	Guard Time	Unsigned 16	ReadWrite
100D	VAR	Life Time Factor	Unsigned 8	ReadWrite
1014	VAR	COB-ID Emergency	Unsigned 32	ReadWrite
1017	VAR	Producer Heartbeat Time	Unsigned 16	ReadWrite
1018	RECORD	Identify Object		ReadOnly
:::	:::	:::		
1400	RECORD	RxPDO1 Receive Parameter		ReadWrite
1401	RECORD	RxPDO2 Receive Parameter		ReadWrite
1600	RECORD	RxPDO1 Mapping		ReadWrite
1601	RECORD	RxPDO2 Mapping		ReadWrite
1800	RECORD	TxPDO1 Transmit Parameter		ReadWrite
1801	RECORD	TxPDO2 Transmit Parameter		ReadWrite
1A00	RECORD	TxPDO1 Mapping		ReadWrite
1A01	RECORD	TxPDO2 Mapping		ReadWrite
:::	:::	:::		
2000	ARRAY	Configuration Data		ReadWrite
2001	ARRAY	Command Data		ReadWrite
2002	ARRAY	Status Data		ReadOnly

7.4 Communication

7.4.1 1000 – Device Type

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
0x1000	0	Device Type	Unsigned 32	RO	402 (0x192)	Indicates the device type

The 32Bit-value is separated into two 16Bit-fields

MSB	LSB
Additional Information	**Device profile number**
0x04=4dez →Stepper motor	0x192=402dez → Drive unit

7.4.2 1001 – Error Register

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
0x1001	0	Error Register	Unsigned 8	RW	0x00	

Bit No.	Error cause	Reaction to errors	Removal of the error
0	General error, is set for each error		
1	Current error, short circuit		
2	Voltage error, undervoltage, overvoltage		
3	Temperature error, overtemperature		
4	CAN communication error		
5	Device-specific error Rotating monitoring, drag error		
6			
7			

7.4.3 1003 – Error Storage

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
0x1003	0	Error Storage	Unsigned 8	RW	0x00	Object 1003h contains a description of the errors that occurred in the device The number of saved errors in subindex 0
	1	Current Error	Unsigned 32	RO	None	Last occurred error condition
	…	…	…	…	...	…
	5	Oldest Error	Unsigned 32	RO	None	Only 5 errors are saved here

7.4.4 1005 – SYNC Identifier

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1005	0	COB-Id Sync Message	Unsigned 32	RO	0x00000080	Identifier of the SYNC message

7.4.5 1006 – SYNC Interval

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1006	0	Communication Cycle Period	Unsigned 32	RO	0x0	Length of the SYNC interval in µs

No SYNC producer.

7.4.6 1008 – Device Names

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1008	0	Manufacturer Device Name	Visible String	RO	"LE3-80"	Device names of the step motor drive

7.4.7 1009 – Hardware Version

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1009	0	Manufacturer Hardware Version	Visible String	RO		Hardware version number

7.4.8 100A – Software Version

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
100A	0	Manufacturer Software Version	Visible String	RO		Software version number

7.4.9 100C – Guard Time

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
100C	0	Guard Time [ms]	Unsigned 16	RW	0x0	Distance between two guard telegrams Is set by NMT-master or configura-tion tool.

7.4.10 100D – Life Time Factor

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
100D	0	Life Time Factor	Unsigned 8	RW	0x0	Life Time Factor x Guard Time = Life Time (Watchdog for Life Guarding)

7.4.11 1014 – Emergency Identifier

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1014	0	COB-ID of the Emergency Object	Unsigned 32	RO	0x80+ Node ID	The COB-ID with which the emergency telegram is sent

7.4.12 1017 – Producer Heartbeat

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1017	0	Producer Heartbeat	Unsigned 16	RO	0x0	

The object is not implemented.

7.4.13 1018 – Identity Object

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1018	0	Number of Entries	Unsigned 32	RO		Number of entries
	1	Vendor ID	Unsigned 32	RO	0x0	Vendor ID of the manufacturer
	2	Product Code	Unsigned 32	RO	0x0	
	3	Revisions Number	Unsigned 32	RO	0x0	
	4	Serial Number	Unsigned 32	RO	0x0	Serial number of the device

7.4.14 1400 – RxPDO1 Communication Parameters

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1400	0	Number of Entries	Unsigned 32	RO		Number of entries
	1	COB-ID	Unsigned 32	RO	0x200+ Node-ID	COB-ID of the RxPDO
	2	Transmission Type	Unsigned 8	RW	255	Transmission type of the PDO
	3	Inhibit Time	Unsigned 16	RO	0	Not implemented, used
	4	Compatibility Entry	Unsigned 16	RO	0	Not implemented, used
	5	Event Timer	Unsigned 16	RO	0	Not implemented, used

7.4.15 1401 – RxPDO2 Communication Parameters

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1401	0	Number of Entries	Unsigned 32	RO		Number of entries
	1	COB-ID	Unsigned 32	RO	0x7F	COB-ID of the RxPDO
	2	Transmission Type	Unsigned 8	RW	255	Transmission type of the PDO
	3	Inhibit Time	Unsigned 16	RO	0	Not implemented, used
	4	Compatibility Entry	Unsigned 16	RO	0	Not implemented, used
	5	Event Timer	Unsigned 16	RO	0	Not implemented, used

7.4.16 1600 – RxPDO1 Mapping

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1600	0	Number of Entries	Unsigned 32	RO	3	Number of entries
	1	1 Mapped Object	Signed 32		0x20010020	Target position
	2	2 Mapped Object	Unsigned 24		0x20010118	Target frequency
	3	3 Mapped Object	Unsigned 8		0x20010208	Command

7.4.17 1601 – RxPDO2 Mapping

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1601	0	Number of Entries	Unsigned 32	RO	1	Number of entries
	1	1 Mapped Object	Unsigned 32		0x0000008	"Dummy"

7.4.18 1800 – TxPDO1 Communication Parameter

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1800	0	Number of Entries	Unsigned 32	RO		Number of entries
	1	COB-ID	Unsigned 32	RO	0x180+ Node-ID	COB-ID of the RxPDO
	2	Transmission Type	Unsigned 8	RW	255	Transmission type of the PDO
	3	Inhibit Time	Unsigned 16	RO	0	Not implemented, used
	4	Compatibility Entry	Unsigned 16	RO	0	Not implemented, used
	5	Event Timer [ms]	Unsigned 16	RW	1000	1000 means TxPDO1 is sent once per second

7.4.19 1801 – TxPDO2 Communication Parameter

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1801	0	Number of Entries	Unsigned 32	RO		Number of entries
	1	COB-ID	Unsigned 32	RO	0x7F	COB-ID of the RxPDO
	2	Transmission Type	Unsigned 8	RW	255	Transmission type of the PDO
	3	Inhibit Time	Unsigned 16	RO	0	Not implemented, used
	4	Compatibility Entry	Unsigned 16	RO	0	Not implemented, used
	5	Event Timer [ms]	Unsigned 16	RW	0	Not implemented, used

7.4.20 1A00 – TxPDO1 Mapping

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1A00	0	Number of Entries	Unsigned 32	RO	4	Number of entries
	1	1 Mapped Object	Signed 32		0x20020020	Actual position
	2	2 Mapped Object	Unsigned 16		0x20020110	Actual speed
	3	3 Mapped Object	Unsigned 8		0x20020208	Executed command
	4	4 Mapped Object	Unsigned 8		0x20020308	Actual status

7.4.21 1A01 – TxPDO2 Mapping

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
1A01	0	Number of Entries	Unsigned 32	RO	1	Number of entries
	1	1 Mapped Object	Unsigned 32		0x00000008	"Dummy"

7.5 Configuration data

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	0	Number of Entries	Unsigned 32	RO	71	Number of entries

7.5.1 2000:01 – Starting Frequency

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	1	Starting Frequency	Unsigned 32	RW	500	Fmin, starting frequency permissible range: 1…50000

7.5.2 2000:02 – Maximum Frequency

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	2	Maximum Frequency	Unsigned 32	RW	20000	Fmax, maximum frequency permissible range: 1…80000

7.5.3 2000:03 – Ramp Shape

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	3	Ramp Shape	Unsigned 32	RW	0	Ramp shape 0 : linear 1 : sine shaped 2 : sine square 3 : $sine^3$ 4 : exponential

7.5.4 2000:04 – Ramp Parameter

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	4	Ramp Parameter	Unsigned 32	RW	100	Ramp parameter: $sine^3$: 88…112 (flatter…steeper) exponential: 50…500 (flatter…steeper)

7.5.5 2000:05 – Acceleration Time

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	5	Acceleration Time	Unsigned 32	RW	500	The time in ms from Fmin to Fmax Permissible range 1…100000

7.5.6 2000:06 – Maximum Motor Current

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	6	Maximum Motor Current	Unsigned 32	RO	2500	Maximum motor current of the device, 2500 → 2.5 A

7.5.7 2000:07 – Standby current

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	7	Standby Current	Unsigned 32	RW	500	Motor current in standstill 500 → 500 mA Permissible range <= Run current

7.5.8 2000:08 – RUN Current

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	8	Run Current	Unsigned 32	RW	2000	Motor current during positioning 2000 → 2.0 A

7.5.9 2000:09 – Boost Current

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	9	Boost Current	Unsigned 32	RW	2500	Motor current in boost 2500 → 2.5 A Permissible range >= Run current

7.5.10 2000:0A – Resonance Dampening

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	10	Resonance Dampening	Unsigned 32	RW	100	Resonance dampening Permissible range 80…120

7.5.11 2000:0B – Reference Run

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	11	Reference Run	Unsigned 32	RW	17	Type of reference run 17: on negative limit switch 18: on positive limit switch 35: in current position

7.5.11.1 Reference run 17

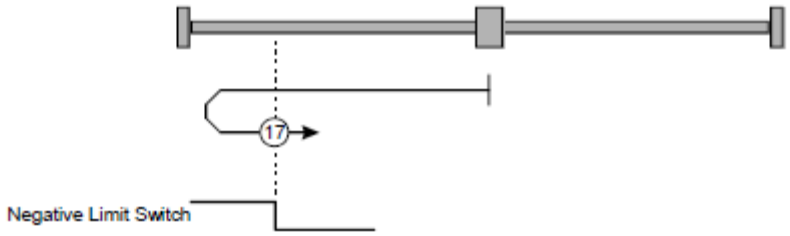


Figure 11: Reference run 17

7.5.11.2 Reference run 18

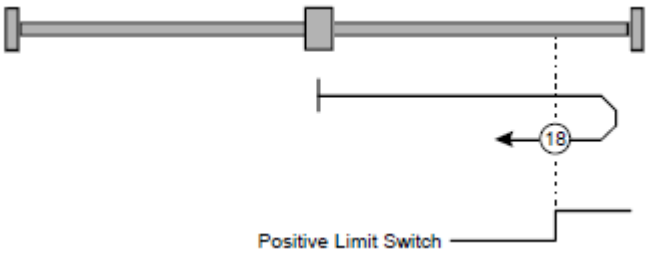


Figure 12: Reference run 18

7.5.12 2000:0C – Step Frequency for Reference Run on the Switch

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	12	Step Frequency at the Run to the End Reference Switch	Unsigned 32	RW	500	Step frequency at the run to the end reference switch Permissible range 1…50000

7.5.13 2000:0C – Step Frequency for Reference Run from the Switch

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	13	Step Frequency at the Run from the End Reference Switch	Unsigned 32	RW	20	Step frequency at the run from the end reference switch Permissible range 1…50000

7.5.14 2000 – Motor Voltage

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	14	Motor Voltage	Unsigned 32	RO	None	Current value of the motor voltage 0…100 corresponds to 0 … 100 VDC

7.5.15 2000:0F – Device Temperature

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	15	Device Temperature	Unsigned 32	RO	None	Current device temperature 0…100 corresponds to 0 … 100 °C

7.5.16 2000:10 – Step Resolution

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	16	Step Resolution	Unsigned 32	RW	1600	Step resolution of the motor in steps per motor turn Possible values 200, 400, 800, 1600, 3200

7.5.17 2000:11 – Delay for Quick Stop

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	17	Delay for Quick Stop	Unsigned 32	RW	50	Time in ms that quick stop needs from Fmax to Fmin Permissible range 1…10000 ms

7.5.18 2000:12 – Invert Inputs

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	18	Invert Inputs	Unsigned 32	RW	0	Invert bit field for inputs Bit0: Invert limit switch Bit1: Invert reference switch Bit2...31: not occupied

7.5.18.1 Limit switch type definition, setting

Object 2000:12	Limit switch type	24VDC at the input	24VDC at the input
Bit0 = 0	Opener	Limit switch free	Limit switch actuated
Bit 0 = 1	Closer	Limit switch actuated	Limit switch free

7.5.19 2000:30 – Trigger Position

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	48	Trigger Position	Signed 32	RW	???	Trigger position: Permissible range +/- 1000000000

7.5.20 2000:31 – Trigger Delay

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	49	Trigger Delay	Unsigned 32	RW	0	Trigger delay in ms Permissible range 0…6000

7.5.21 2000:64 – Invert Turning Direction of the Motor

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	64	Turning Direction of the Motor	Unsigned 32	RW	0	Turning direction of the motor Count direction 0 : positive clockwise 1 : negative clockwise

7.5.22 2000:65 – Reference Offset

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	65	Reference Offset	Signed 32	RW	0	At the end of the reference run, the position is set to this value

7.5.23 2000:66 – Swap Limit Switches

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	66	Swap Limit Switches	Unsigned 32	RW	0	Swap limit switches 0 : not swapped X1.9 → Positive limit switch X1.8 → Negative limit switch 1 : swapped X1.9 → Negative limit switch X1.8 → Positive limit switch

7.5.24 2000:67 – Activate Rotary Encoder

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	67	Activate Rotary Encoder	Unsigned 32	RW	0	Activate rotary encoder 0 : Rotary monitoring not active 1 : Rotary monitoring active

7.5.25 2000:68 – Resolution of the Rotary Encoder

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	68	Resolution of the Rotary Encoder	Unsigned 32	RW	50	Resolution of the rotary encoder: Possible values: 50, 100, 200, 500, 1000, 1024, 2048

7.5.26 2000:69 – Invert Rotary Encoder Count Direction

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2000	69	Invert Rotary Encoder	Unsigned 32	RW	0	Invert rotary encoder Invert the count direction of the rotary encoder 0 : not inverted 1 : inverted

7.5.27 2000:70 – Delay when Opening the Brake

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	70	Delay Time from Current Application to the Motor to Opening of the Brake	Unsigned 32	RW	100	Delay time from current application to the motor to opening of the brake in ms Permissible range 0…5000 ms

7.5.28 2000:71 – Delay when Closing the Brake

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	71	Delay Time from Closing of the Brake to Powering Down of the Motor	Unsigned 32	RW	100	Delay time from closing of the brake to powering down of the motor Permissible range 0…5000 ms

7.5.29 2000:72 – Switch off Limit Switch Monitoring

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
	72	Switch Off Limit Switch Monitoring	Unsigned 32	RW	0	Monitoring of the limit switches can be switched on or off 0 : active 1 : inactive

For a rotary table, e.g. "DT 140", positioning must be possible in either direction after the reference run.

Referencing of the axis takes place via the reference run methods to the negative or positive limit switch (see axis parameters of the I). Then monitoring of the limit switches is switched off and positioning is possible without conflict with the limit switches in either direction.

Programme example from the PA-CONTROL:

```
G25.A1     ; Reference run (e.g. to negative limit switch)
G142.A1    ; Switch off monitoring of the limit switches
A1:=-34.5  ; Run rotary table to "-34.5"
…
A1:=77.8   ; Run rotary table to "77.8"
```

7.6 Input data

7.6.1 2001:00 – Target Position

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2001	0	Target Position	Signed 32	RW	0	Target position in steps Permissible range +/- 1000000000

7.6.2 2001:01 – Target Frequency

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2001	1	Target Frequency	Unsigned 24	RW	0	Target step frequency (maximum) in positioning Permissible range 1…80000 Target step frequency (maximum) for the speed command Permissible range 0…80000

7.6.3 2001:02 – Commands

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2001	2	Command	Unsigned 8	RW	0	Command

7.6.3.1 Commands

Number	Description
0	No function, NOP, no operation, The previously active command is not interrupted
1	Absolute positioning
2	Relative positioning (is not used for the PA-CONTROL)
3	Speed (is not used for the PA-CONTROL)

7.7 Starting data 3

7.7.1 2002:00 – Actual Position

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2002	0	Actual Position	Signed 32	RO	0	Current actual position in steps

7.7.2 2002:01 – Actual Frequency

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2002	1	Actual Frequency	Unsigned 16	RO	None	Current actual frequency of the motor, divided by 10 0…8000 → 0…80000 Hz

7.7.3 2002:02 – Executed Command

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2002	2	Executed Command	Unsigned 8	RO	0	Current or last executed command

7.7.4 2002:03 – Actual Status

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2002	3	Actual Status	Unsigned 8	RO	None	Bit field of the actual status

Bit no.	Function, designation
0	The motor is powered
1	A command is being performed
2	The command has been fully performed
3	Axis is referenced
4	Status negative limit switch (for the status of the limit switches, the swapping (object 2000:xx) and inverting (object 2000:12) has been considered)
5	Status positive limit switch (for the status of the limit switches, the swapping (object 2000:xx) and inverting (object 2000:12) has been considered)
6	Overflow for position counter
7	Error

7.7.5 2002:04 – Rotary Encoder Position

Index	Sub-index	Name	Data type	Attrb	Default value	Meaning
2002	4	Rotary encoder position	Signed 32	RO	0	Current rotary encoder position converted to steps

The rotary encoder position is displayed in motor steps.
The objects "2000:10 – Step resolution" and "2000:68 – Resolution of the rotary encoder" are included accordingly.

To do this without rounding error, the step resolution of the motor and the resolution of the rotary encoder should be at a full-digit ratio to each other.

8 Control of the device

After activation, initialisation is gone through and then automatically switched to the condition "Off".

The following data are described with default in initialisation:

2002:00 Position: 0

2002:02 Axis is referenced: 0 (no)

2002:03 Rotary encoder position: 0

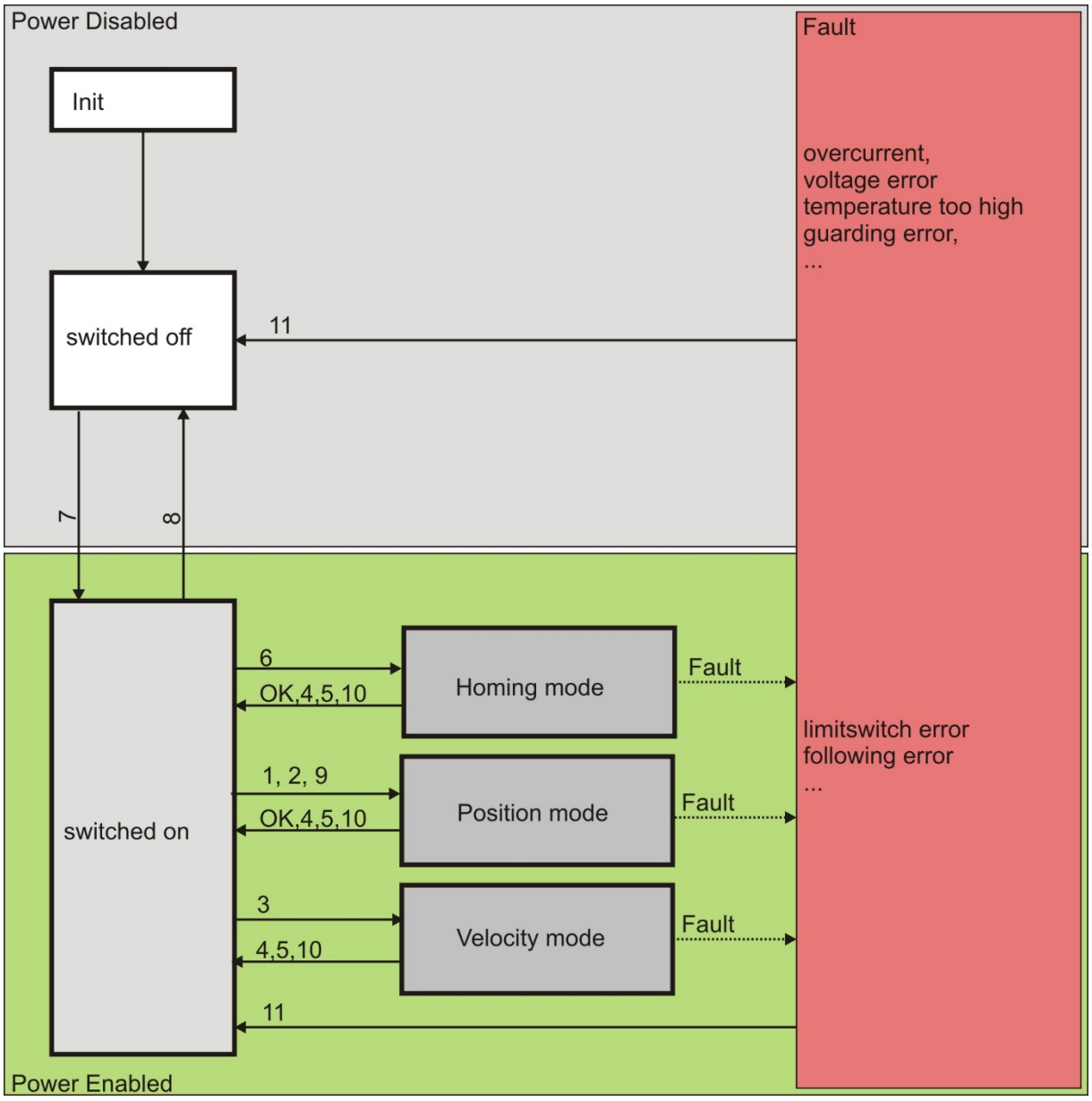


Figure 13: Example of initialisation

8.1 Switch motor on/off

The motor is switched on and off with the commands "Motor on" and "Motor off".

If the rotary monitoring is activated, the position and the condition "Axis is referenced" is retained when switching the motor off and on.

8.2 Reference run

When starting the reference run, the status bit "Axis is referenced" is reset and set again at the end of the reference run, if the reference run is completed without errors.

The axis is set to the position from the object 2000 xx reference offset.

8.2.1 Reference run type 17 on negative limit switch

The axis runs in the negative direction at the speed from object 2000:0C until the negative limit switch is reached. The axis is stopped. The axis then runs from object 2000:0D in the positive direction until the negative limit switch is released again. Then the axis is stopped at once. If the positive limit switch is reached while clearing the negative limit switch, the error "positive limit switch reached" is set.

8.2.2 Reference run type 18 on positive limit switch

The axis runs in the positive direction at the speed from object 2000:0C until the positive limit switch is reached. The axis is stopped. The axis then runs from object 2000:0D in the negative direction until the positive limit switch is released again. Then the axis is stopped at once. The axis is set to the position from the object 2000:65 reference offset.

If the negative limit switch is reached while clearing the positive limit switch, the error "negative limit switch reached" is set.

8.2.3 Reference run type 35 to current position

The axis does not move.

The axis is set to the position from the object 2000:65 reference offset.

8.3 Positioning

When the limit switch of the running direction is reached when positioning the motor, positioning is stopped with the quick-stop ramp and the corresponding error is set.

The device switches to the condition "Error". The error is reset via the command 11 "Error Reset".

8.4 Rotating speed

In the mode rotating speed, the motor can turn in one direction without interruption.

If the area of the position counter (+/- 1000000000) is exceeded, the object 2002:03 actual status sets bit 6 "Overrun at position counter". The motor continues to run.

The frequency can be changed with the motor running.

NOTE: The mode "Rotating speed" is not supported in the PA-CONTROL.

9 Accessories

9.1 Plug

Designation	Plug	Parts number
X1: System	PHOENIX: Mini-Combicon FMC 1.5/18-ST-3.5	1125465
X2: CAN bus	WAGO: 231-306/026-000-010-00	1125467
X3: Motor	Stelvio/Maluska MRT30P5.08-8	1125471

9.2 Cable

Designation	Parts number
Motor cable with M23 plug 6-pin	1125161
Rotating monitoring cable with M23 plug 12-pin	1125162
Limit switch cable	1125163
Brake cable	1125164

9.3 Power supply

Designation	Parts number
Power supply NT5-80 (see next pages)	1126072

9.4 Power supply NT5-80

The power supply NT5-80 was developed to supply electrical drives with the intermediate circuit voltage 80 VDC.

An active ballast circuit (BrakeChopper) prevents the occurrence of inadmissibly high voltages when braking. Short load peaks as they occur when accelerating are quickly adjusted. An integrated automatic fan function controls the fan load- and temperature-dependently. The installation position is mostly uncritical and heat development is kept to a minimum.

A comprehensive diagnosis display provides information about the condition of the power supply.

Depending on operation of the axes, up to 3 LE3-80 step motor end stages can be connected to an NT5-80.

The set motor current is only called when accelerating the power supply. If the motor is standstill, the phase current is lowered to 75%. "Chopping off the end stage" keeps the effective power intake below 50% of the set lowered phase current.

e.g.: Iabs = 2 A → I_{take} from the power supply < 1 A (in standstill)

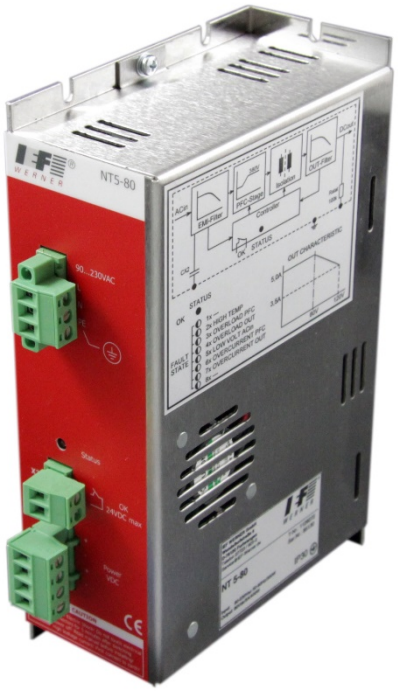


Figure 14: Power supply NT5-80

Example of an application:

- easyLINE 1000 mm stroke, with 10 kg load
- Motor current = 8 A, motor current lowered = 6 A,
- Movement speed = 1000 mm/s
- Acceleration = 2000 mm/ss

9.4.1 Technical data

Description	Value
Storage temperature	(-10 … 65) °C
Operating temperature	(0 … 40) °C
Dew formation	Not permitted
Protection type	IP30
Protection class	Protection class 1 (protective ground)
Weight	1.2 kg
Input voltage	(90 … 230) VAC
Input frequency range	(47...63) Hz
Power factor	> 0.95 @ 300W
Inrush current	(230 V) < 20A @ initial start
Output voltage	80 VDC
Output current	5 A max.
Output power	400 W, short-term 500 W
Short-circuit current	Limited to 5 A

9.4.2 Status display

The condition for OK or error is displayed via LED:

Condition of LED	Screen output	Function, error description
Lights permanently	OK	Power supply supplies voltage and current can be used.
Flashes 2 times	OK	**High temperature (warning)** Power supply supplies voltage and current can be used. If the temperature can be lowered, regular operation can be reached again.
Flashes 2 times	Error	**Overtemperature (error)** The power supply switches off completely before threatening destruction. This condition is retained; a restart, switching off/on is required.
Flashes 3 times	Error	**OverLoad PFC** More power is required at the output than permitted at the input. This may be caused by too low input voltage or too much current tapped. This condition is retained; a restart, switching off/on is required.
Flashes 4 times	Error	**OverLoad OUT** Too much power is required at the output; the output voltage cannot be reached. This condition is retained; a restart, switching off/on is required.
Flashes 5 times	Error	**LowVolt ACin** The input voltage is too low. This condition is retained; a restart, switching off/on is required.
Flashes 6 times	Error	**OverCurrent PFC** Problems in the PFC input stage. This condition is retained; a restart, switching off/on is required.
Flashes 7times	Error	**OverCurrent OUT** Problems in the OUT output stage. This condition is retained; a restart, switching off/on is required.

9.4.3 Electrical installation

9.4.3.1 Connections

9.4.3.1.1 Mains input [X1]

Pin-No.	Designation	Specification
1	L	(90 … 230) VAC, (47...63) Hz
2	N	
3	PE	

9.4.3.1.2 Screen output [X2]

Pin-No.	Designation	Specification
1	Readiness OK-	Relay contact, 24 VDC, I < 100 mA
2	Readiness OK+	Contact closed OK Contact opened: Error

9.4.3.1.3 Voltage output [X3]

Pin-No.	Designation	Specification
1	+U-output	U-output +80 VDC
2	GND-output	I-output: max. 5 A
3	+U-output	
4	GND-output	

9.4.4 Mechanical installation

9.4.4.1 Dimensions

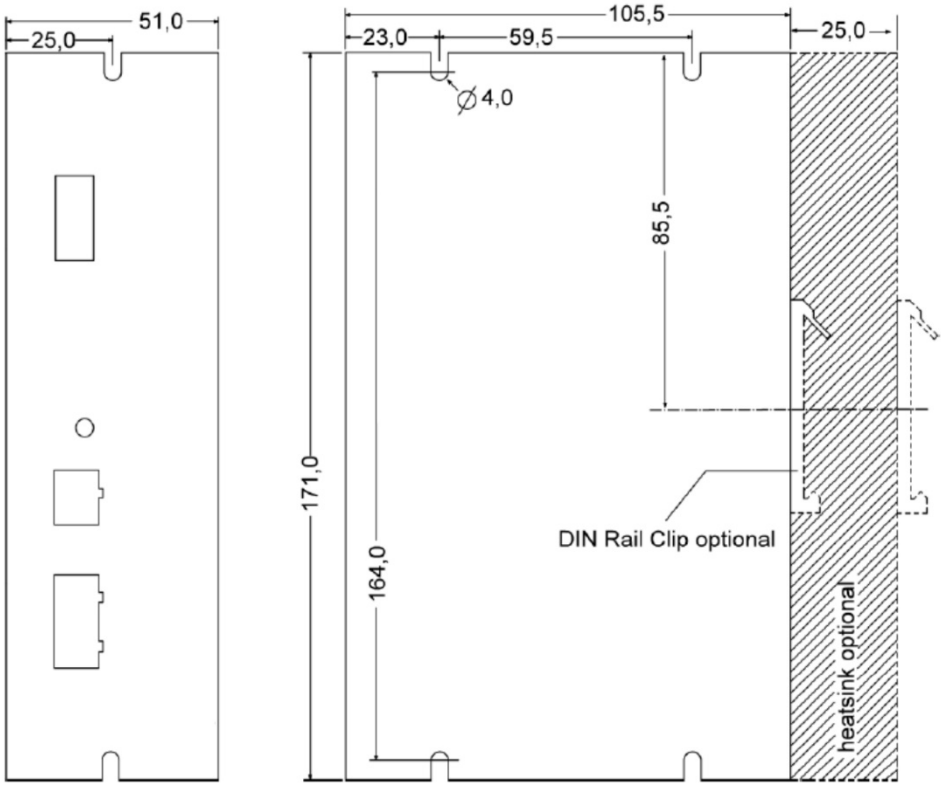


Figure 15: Dimensions of the Power supply

9.4.4.2 Installation

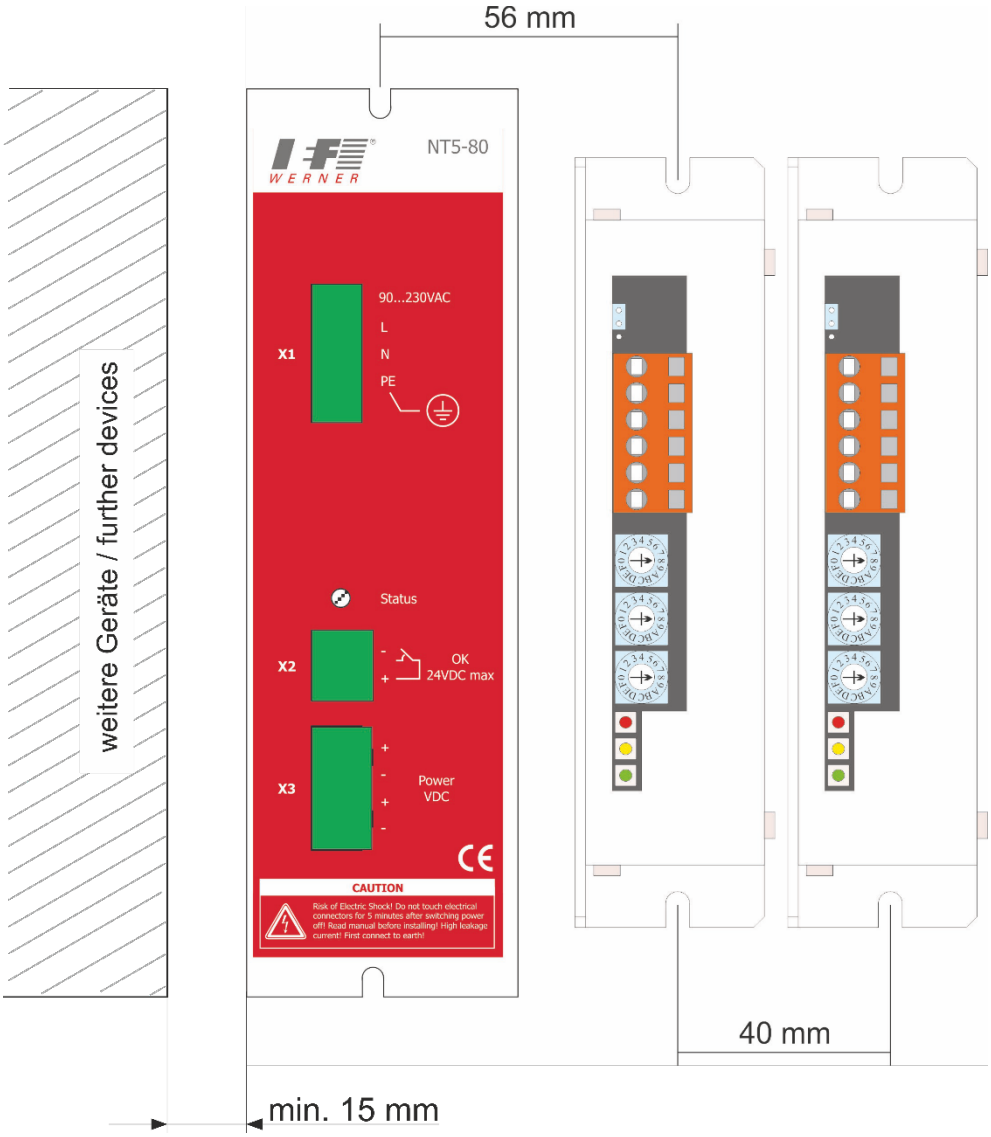


Figure 16: Dimensions and installation space of power supply NT5-80