EtherControl

User Manual

EtherControl Controlled Node – Mix Module EM1 / EM2

SHF Communication Technologies AG
Division Automation

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Content:

1 General information

1.1 Copyright

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1.2 Intended use

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Any usage or connection not described in this manual has to be coordinated with SHF AG and requires a written confirmation.

Deviations between the product and the manual are possible. Make sure the version of the device is corresponding to the manual. Modifications without essential technical changes do not require any change in the manual.

1.3 Symbols / Abbreviations

EPL	–	Ethernet Powerlink
BI	–	Binary input
BO	–	Binary output
AI	–	Analogue input
AO	–	Analogue output
A,B,Z	–	Counter inputs (channels for incremental position transducers or separate counters
MN	–	Managing Node
CN	–	Controlled Node
H x W x D	–	Height x Width x Depth
SpV	–	Power supply input
GND	–	Ground
STP	–	Shielded twisted pair
Hex	–	Hexadecimal

2 System description

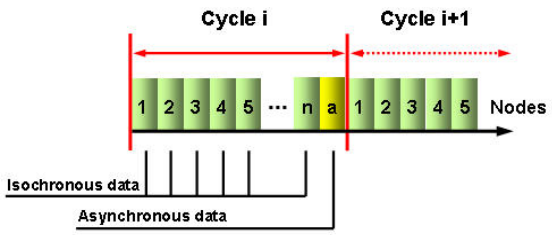
2.1 Ethernet Powerlink Networks

The physical base of the Ethernet Powerlink protocol is the normal Fast Ethernet 100Base-TX network. The difference of the Powerlink protocol is the combination of asynchronous and isochronous parts in a cycle.

In the case of real time requirements in this real time part of the network, only Ethernet Powerlink units can be connected. To integrate other standard Ethernet devices it has to be used an Ethernet to Ethernet Powerlink gateway.

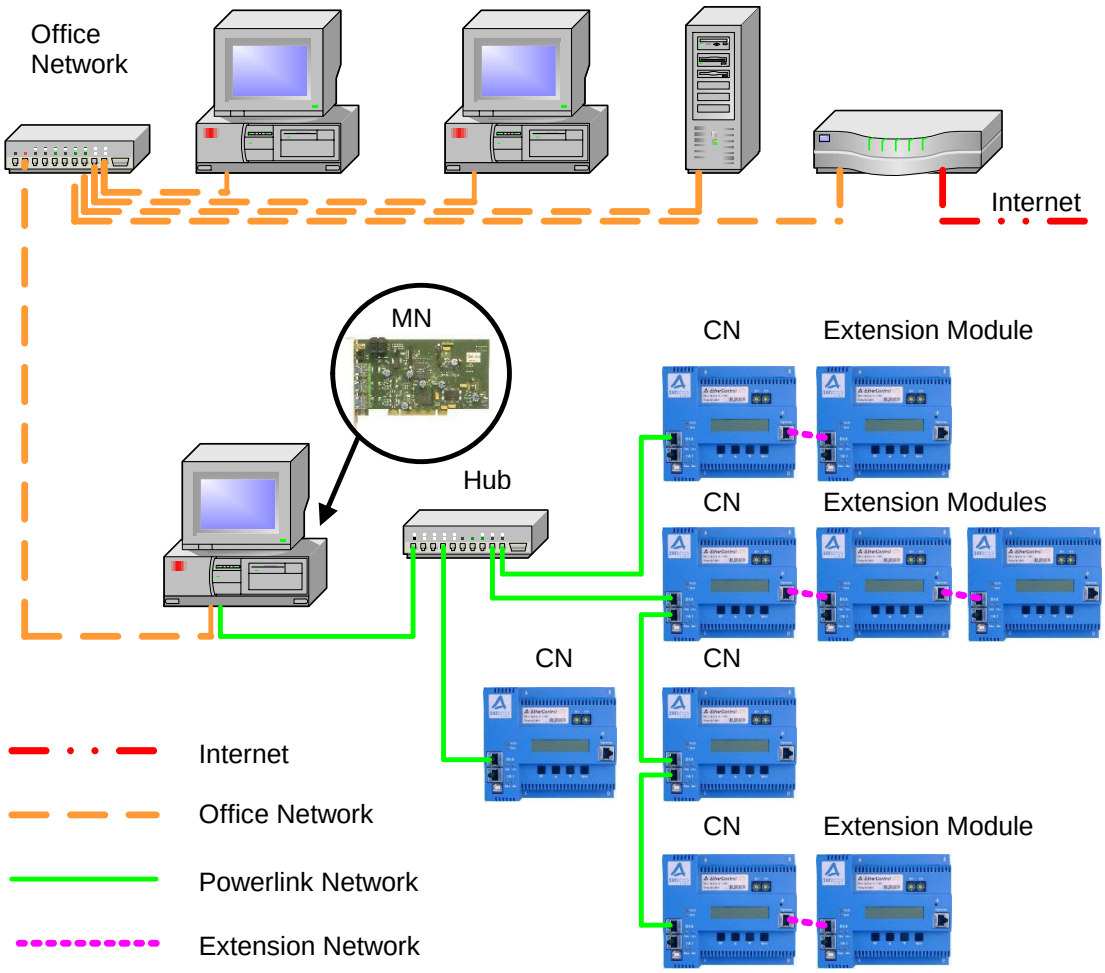
The Ethernet Powerlink network requires one Managing Node (MN) to control the strictly deterministic data traffic. The cycle time is dependent on the number of the connected Controlled Nodes (CN) and the size of the asynchronous data part. With the smallest configuration (1 x MN and 1 x CN), a minimal cycle time of 200 µs can be achieved. The accuracy of the cycles (Jitter) will generally be 1 µs or lower.

By using the asynchronous protocol part, the CN can be IP addressed from each browser through the connection of the Managing Node with the standard Ethernet. In that way by the continuous network structure remote control independent from the Ethernet Powerlink Protocol is possible. Direct access to the individual network units, for example via internet, will be available up to the Ethernet Powerlink network.



If no real time functionality is required, the Ethernet Powerlink units can be used also in standard Ethernet networks.

The topology of the Ethernet Powerlink network is very flexible. Depending on the technical specification of the CN, standard Ethernet Hubs or Switches, a star or daisy-chain topology or a mixture of both will be possible.

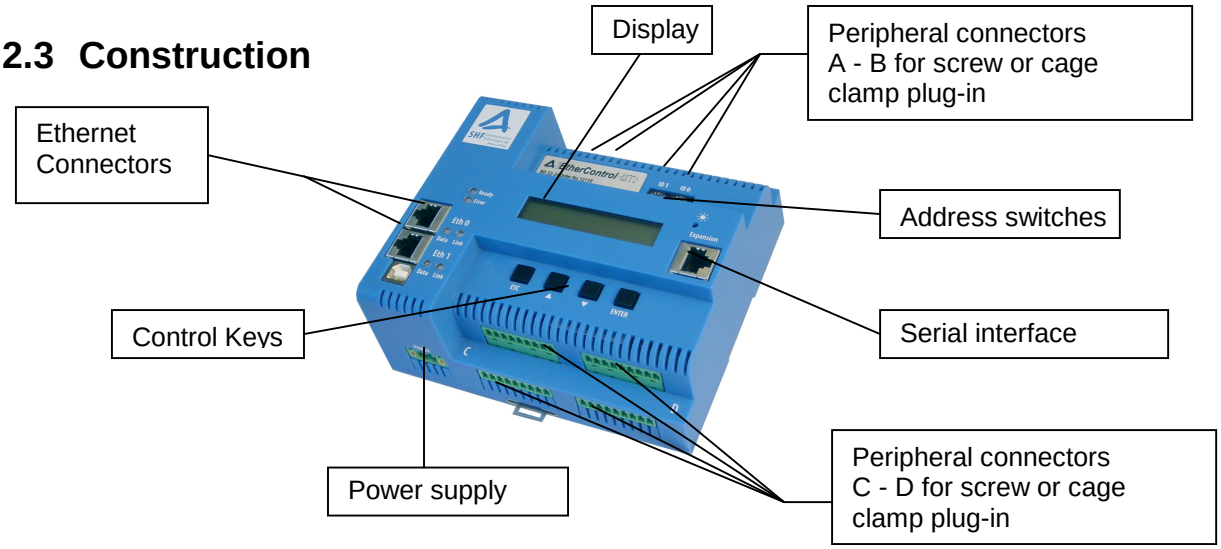


Example of an Ethernet Powerlink Network in connection to a super ordinate Ethernet Network.

2.2 Controlled Node – EtherControl

The EtherControl module is a compact input and output device with own controller and storage area, as well as an Ethernet network connection. It consists of a processor and a peripheral unit.
The module contains an integrated Hub. So it will be possible to create a daisy-chain topology without additional devices.

2.3 Construction



Construction of the EtherControl Module

2.4 Processor unit

The processor unit of the EtherControl modules realises the I/O control, network connections, control of the display and the keys and running customised applications like compact PLC and data storage functions.
On delivery the module is loaded with a basic program, running standard functions.

The display shows basic information of the module as well as information about the inputs and outputs. The keys are used for navigation through the menu. Keys and display can be used also by customised software.

On the module sockets for the network connection are present. Other hardware connections can be used with adapters connected to the RJ45 sockets.

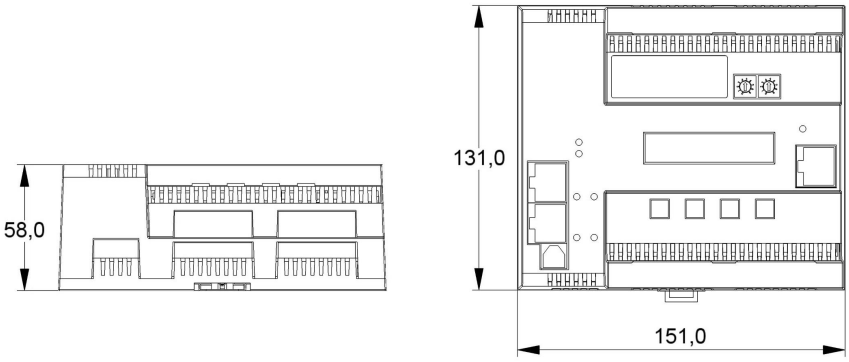
2.5 Periphery unit

The peripheral unit realises the connection to the process periphery. The module has 8 connectors with 9 pins. As standard applications are offered defined combinations of different binary and analogue inputs and outputs and in addition customized combinations are possible.

3 Technical data

3.1 Mechanical parameters

3.1.1 General information



Dimensions H x W x D	131 x 151 x 58 mm
Housing material	ABS
Mounting	Clip mounting on DIN Rail
Installation orientation	Vertically or horizontally
Weight	approx. 465 g without extension options

3.1.2 Distance to the casing wall

Right / Left	0 mm
Top / Bottom	20 mm
Front panel	40 mm

Attention:
The distance between the I/O modules and the casing walls must be kept to ensure sufficient ventilation.

3.1.3 Environmental Specification

Ambient operating temperature	0 ℃ ... 50 ℃ (optio nally -20 ℃ ... +70 ℃)
Relative humidity	5 ... 95 %, non condensing
Operating atmospheric pressure	86 ... 108 hPa
Pollution resistance	Test according IEC 60068-2-42 und IEC 60068-2-43
Vibrations	according IEC 60068-2-6
Shocks	according IEC 60068-2-27
Special conditions	Additional measures have to be taken in the following environments: – dust, corrosive steams or gas – ionising radiation The product must not be used: – in medical applications – in life-supporting systems

3.1.4 Storage and transportation conditions

Temperature	-20 ℃ ... +70 ℃ (optional -30 ℃ ... +80 ℃)
Relative humidity	5 ... 95 %, non condensing
Atmospheric pressure	66 ... 108 hPa

3.1.5 Connectors

Power supply	2-pin plug – Screw- or cage clamp plug-in pluggable for wires up to 2,5 mm²
I/O plugs	9-pin plug – Screw- or cage clamp plug-in pluggable for wires up to 2,5 mm²
Ethernet connections	RJ45 plug
Extension connections	RJ45 plug

3.2 Electrical parameters

3.2.1 Supply of the module

Power supply	nominal 24V (range 9-60V DC)
Supply current (standard system)	< 200 mA at 24 V DC (Modul without load)
Power consumption	Max. 12 W

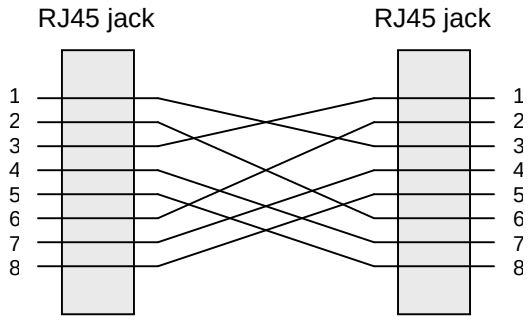
3.2.2 Protection

Protection class according EN 60 529	IP 20
Conformation	CE
Reverse voltage protection	Yes
Air/surface leakage distance	According EN 61131-2 and EN 50178 between circuits and parts and isolated circuits, according overvoltage category II, degree of pollution 2
Isolation	Yes, between digital part and inputs and outputs Test voltage DC 500 V
Electromagnetic emission	Radiated and conducted according EN 55011

3.2.3 Ethernet connection

Transmission hardware	CAT5 STP or better
Transmission rate	10/100 Base-TX, 10/100 MBit
Interface connection	RJ45 plug

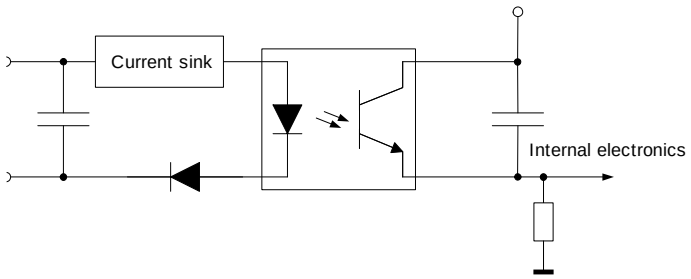
The three Ethernet connections are standard 10/100Base-TX interfaces for CAT5 or better twisted pair cables. Shielded twisted pair (STP) cabling is highly recommended.
The Ethernet Powerlink specification requires use of cross-over cables but in addition standard patch cables can be used with the MN because of the build-in auto-detection of cable type.



Recommended Pin Assignment according Ethernet Powerlink specification

3.2.4 Binary inputs

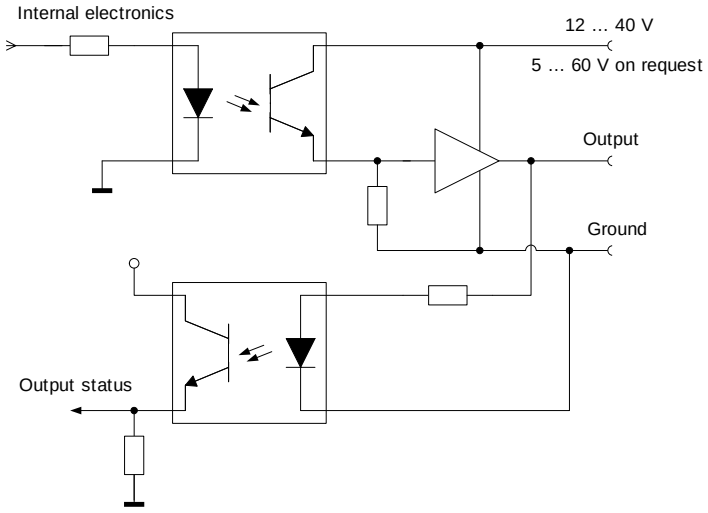
Input voltage	typical 24 V (range 12-60 V DC)
Input current	approx. 2,5 mA
Input frequency	≤ 5 kHz
Input delay	50 µs – 4 ms (adjustable)
Connection	2-wire connection
Number of inputs	16
Isolation	All inputs separated from each other and from the digital part



Binary Input schematic

3.2.5 Binary outputs

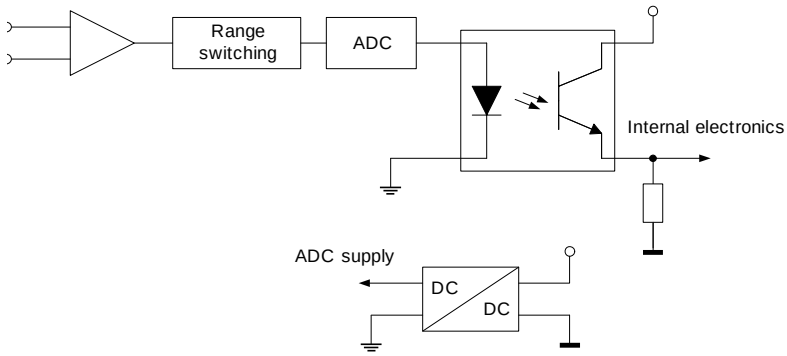
Output voltage	typical 24V (optionally 12-42V)
Output current	≤ 500 mA short-circuit proof
Output frequency	≤ 2 kHz
Output delay	100 µs ± 50 %
Feedback	Short circuit and external power detection
Connection	2-wire connection with separate ground clip - separate output power supply together for each output group
Number of outputs	16 (2 groups ever 8 outputs)
Isolation	Outputs groups separated from each other and from the digital part



Binary output schematic

3.2.6 Analogue inputs

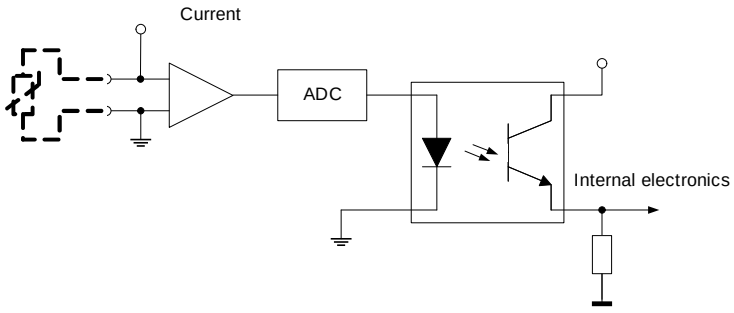
Input voltage ranges	0 – 1 V, 0 – 5 V, 0 – 10 V ± 1 V, ± 5 V, ± 10 V
Input current ranges	0 – 20 mA, 4 – 20 mA
resolution	12 bit (optionally 16 bit)
Common-mode rejection	≤ ± 270 V: typically 80 dB
Dielectric strength	≤ ± 500 V
Connection	2-wire connection
Number of inputs	16
Isolation	separated from the digital part



Analogue input schematic

3.2.7 Temperature sensor inputs (optionally)

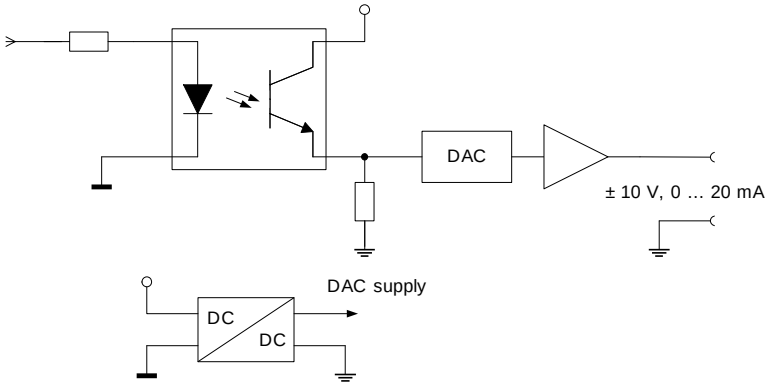
Standard connection	Pt 100 2-wire connection
Isolation	separated from the digital part



Temperature sensor schematic

3.2.8 Analogue outputs

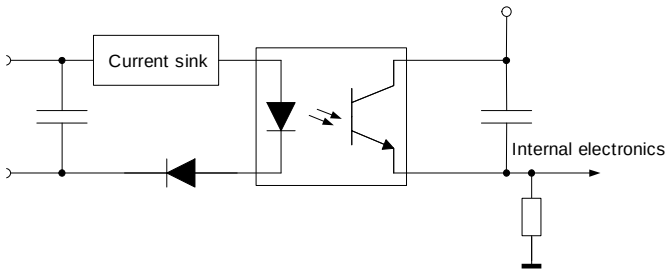
Output voltage ranges	± 10 V (5 mA)
Output current ranges	0 – 20 mA, 4 – 20 mA
resolution	12 bit (optionally 14 bit)
Connection	2-wire connection
Number of outputs	16
Isolation	separated from the digital part



Analogue output schematic

3.2.9 Counter / Incremental inputs

Input voltage ranges	typical 24 V (optionally 5 V)
Counter- / pulse inputs	Differential inputs
Connection	2-wire connection with separate ground
Incremental inputs	Differential inputs (A/B/Z) connected by internal logic
Connection	3 x 2-wire connection
Input frequency	≤ 2 MHz
Isolation	All inputs separated from each other and from the digital part



Counter/Incremental input schematic

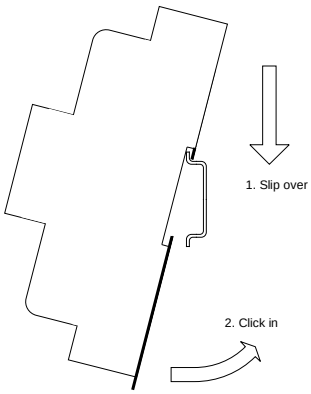
4 Installation

4.1 Mechanical setup

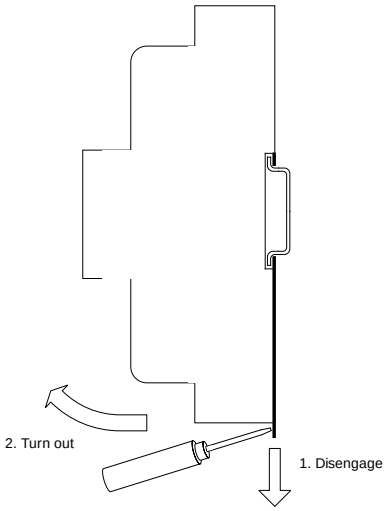
- The modules can be snapped directly onto a carrier rail in accordance with the European standard EN 50022 (DIN 35).
- The spacing between adjacent components, cable conduits, casing and frame sides must be maintained for the complete field bus node according paragraph 3.1.3.
- For disassembly use a screw driver for pulling down the mounting part.

Assembly instructions:

Assembly

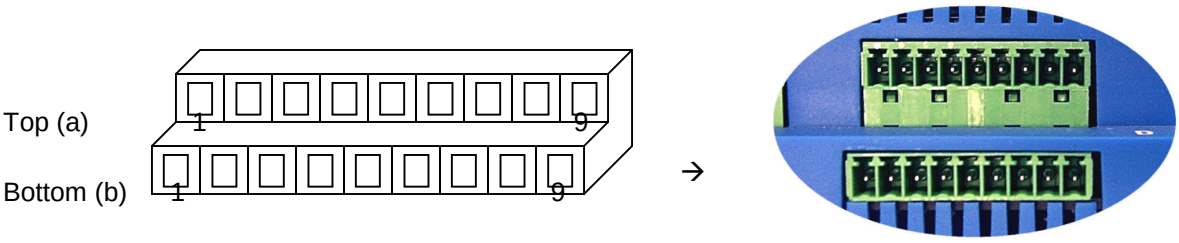


Disassembly



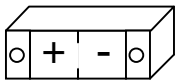
4.2 Electrical installation

4.2.1 Connection of terminals A – D



Connectors with nine contacts are used either with screw or cage clamp wire connection. Normally the modules are delivered with screw plug-in.

4.2.2 Connection of power supply



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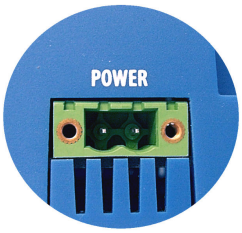
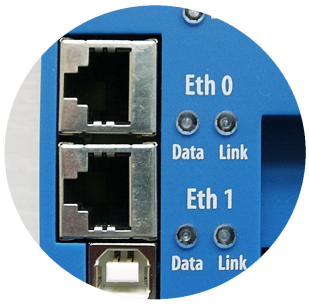


Power supply will be connected with a bipolar plug with either screw or cage clamp wire connection. The connector can be locked with two screws.

4.2.3 Ethernet connectors



In the modules there are two Ethernet sockets belonging to one Ethernet port. They are internally connected via a hub. The connection with the network is done with a RJ45 twisted pair connector.

The network connection has to be done on port Eth 0.
The indicator “Link” lights on network link, the indicator “Data” flashes on data packets.

5 Controls

5.1 Indicators

5.1.1 Display

The modules have an alpha numerical display with two rows / sixteen columns. The display shows the actual process data as well as information’s about the module itself and the communication status, e.g. errors.
The interaction with the module is done by menus shown on the display.
It is possible to write to the display within customer specific software.

5.1.2 Status indicators

5.1.2.1 Error LED

ERROR LED function is controlled by NMT State Machine transitions.

LED OFF	Power On, EPL cycles without errors (NMT_CT11)
LED ON	EPL cycles disturbed/aborted due to communication errors (NMT_CT3,_CT6)

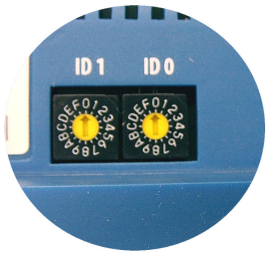
5.1.2.2 STATUS LED

STATUS LED (Ready) function is controlled by NMT State Machine states.

LED off	NMT_GS_OFF NMT_GS_INITIALISING, NMT_CS_NOT_ACTIVE
LED flickering	NMT_CS_BASIC_ETHERNET
LED single flash	NMT_CS_PRE_OPERATIONAL_1
LED double flash	NMT_CS_PRE_OPERATIONAL_2
LED triple flash	NMT_CS_READY_TO_OPERATE
LED on	NMT_CS_OPERATIONAL
LED blinking	NMT_CS_STOPPED

5.2 User elements

5.2.1 Address switches



The both Hex-switches control the last byte of the IP address.
If the module communicates via the Powerlink protocol, this hex switch also determines the module address in the real time network.

5.2.2 Control keys

The keys are used to navigate through the build in menus. For the detailed explanation of the menus see module menu description.

5.2.3 Contrast level

The contrast of the display can be adjusted with a little screw driver.

6 Technical description

There are two kinds of modules:

1. EM1 – Multifunctional Ethernet module with binary inputs, binary outputs analogue inputs and counter / Incremental inputs.
2. EM2 – Multifunctional Ethernet module with binary inputs, binary outputs analogue inputs, analogue outputs and counter / Incremental inputs.

Pt100 input will be realised as analogue input by special request.

6.1 Module EM1

The Mix-Modul EM1 has the following inputs and outputs – 16 binary inputs, 7 binary outputs, 4 analogue inputs, 6 counter inputs or 2 incremental position transducer inputs A/B/Z.

Binary inputs:
The maximum input voltage is defined in production.

Input voltage	5 V	10 V	12 V	24 V Standard	30 V
Switching threshold	2,5 V	5 V	6 V	12 V	15 V

Binary outputs:
The supply voltage for the outputs is provided separately for the output block C via the clamp SpV.

Analogue inputs:
The type of input (voltage / current / Pt100) and the input range are defined in production.

Input range voltage:
0 – 1 V / 0 – 5 V / 0 – 10 V / ± 1 V / ± 5 V / ± 10 V
Input range current:
0 – 20 mA / 4 – 20 mA
Input for Pt100 two wire connection

Maximum input voltage and the selection of counter or incremental inputs are defined in production.

Input voltage	5 V	10 V	12 V	24 V Standard	30 V
Switching threshold	2,5 V	5 V	6 V	12 V	15 V
Switching hysteresis	± 0,2 V	± 0,5 V	± 0,5 V	± 1 V	± 1 V

Port configuration:

	A a (top)	**A b** (bottom)	**B a** (top)	**B b** (bottom)	**C a** (top)	**C b** (bottom)	**D a** (top)	**D b** (bottom)
1	BI1	GND1	BI10	GND10	SpV. C+	GND C	B1+	B1–
2	BI2	GND2	BI11	GND11	BO1	GND1	Z1+	Z1–
3	BI3	GND3	BI12	GND12	BO2	GND2	A2+	A2–
4	BI4	GND4	BI13	GND13	BO3	GND3	B2+	B2–
5	BI5	GND5	BI14	GND14	BO4	GND4	Z2+	Z2–
6	BI6	GND6	BI15	GND15	BO5	GND5	AI1+	AI1–
7	BI7	GND7	BI16	GND16	BO6	GND6	AI2+	AI2–
8	BI8	GND8	–	–	BO7	GND7	AI3+	AI3–
9	BI9	GND9	–	–	A1+	A1–	AI4+	AI4–

6.2 Modul EM2

The Mix-Modul EM2 has additionally 2 analogue outputs

Analogue outputs:
The analogue output voltage or current are defined in production.

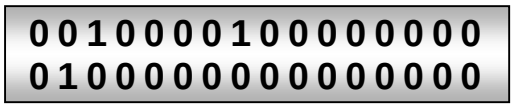
Output range voltage:
± 10 V
Output range current:
0 – 20 mA / 4 – 20 mA

Port configuration:

	A a (top)	**A b** (bottom)	**B a** (top)	**B b** (bottom)	**C a** (top)	**C b** (bottom)	**D a** (top)	**D b** (bottom)
1	BI1	GND1	BI10	GND10	SpV. C+	GND C	B1+	B1–
2	BI2	GND2	BI11	GND11	BO1	GND1	Z1+	Z1–
3	BI3	GND3	BI12	GND12	BO2	GND2	A2+	A2–
4	BI4	GND4	BI13	GND13	BO3	GND3	B2+	B2–
5	BI5	GND5	BI14	GND14	BO4	GND4	Z2+	Z2–
6	BI6	GND6	BI15	GND15	BO5	GND5	AI1+	AI1–
7	BI7	GND7	BI16	GND16	BO6	GND6	AI2+	AI2–
8	BI8	GND8	AO1+	GND1	BO7	GND7	AI3+	AI3–
9	BI9	GND9	AO2+	GND2	A1+	A1–	AI4+	AI4–

7 Menu selection

After power on the display will show the actual status of the inputs (top row) and outputs (bottom row) as standard display for instance



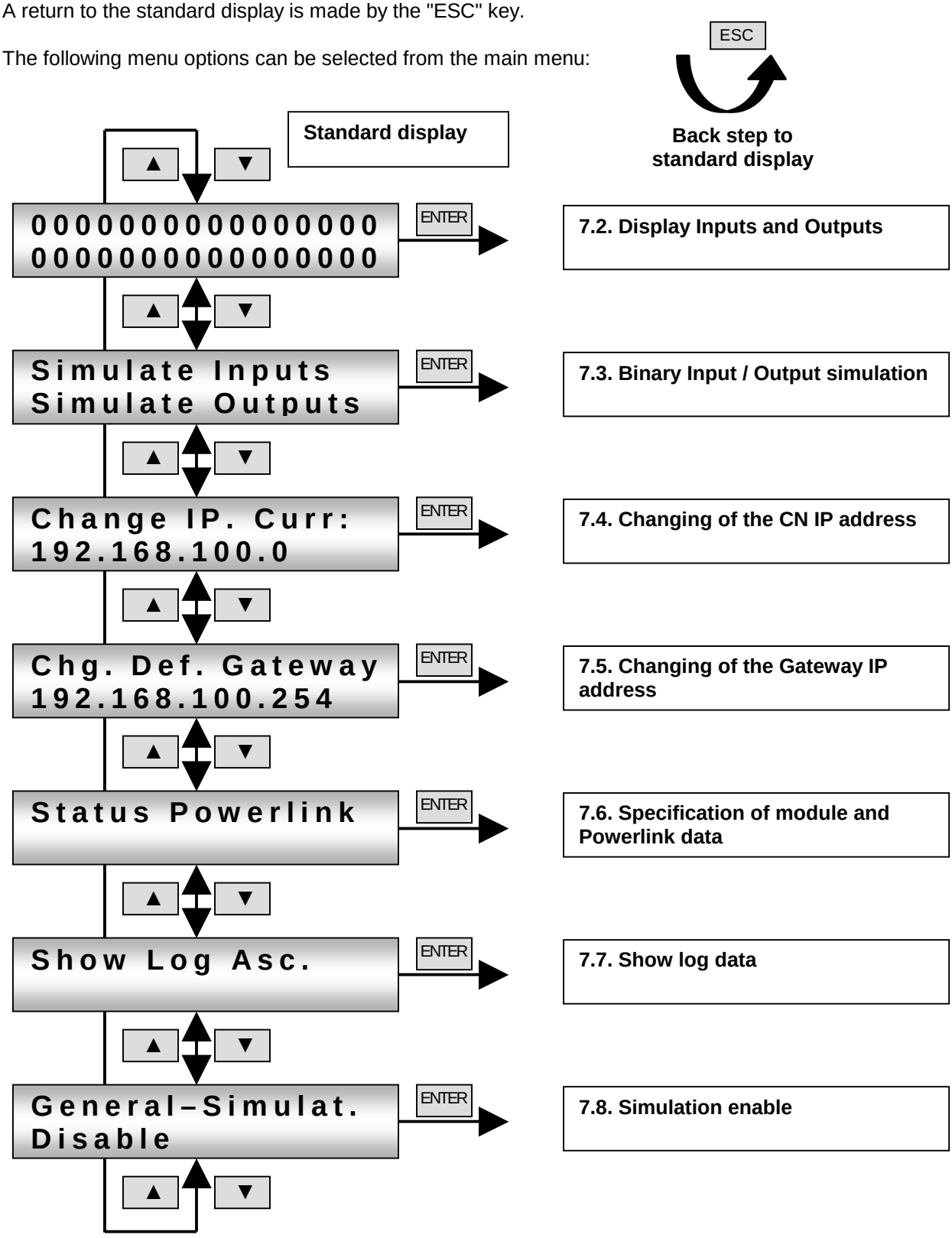
The selection can be made by the keys ESC , ▲ , ▼ and ENTER.

7.1 Main menu

With the arrow keys can be scrolled trough the menu and with the "ENTER" key the appropriate submenu can be selected.

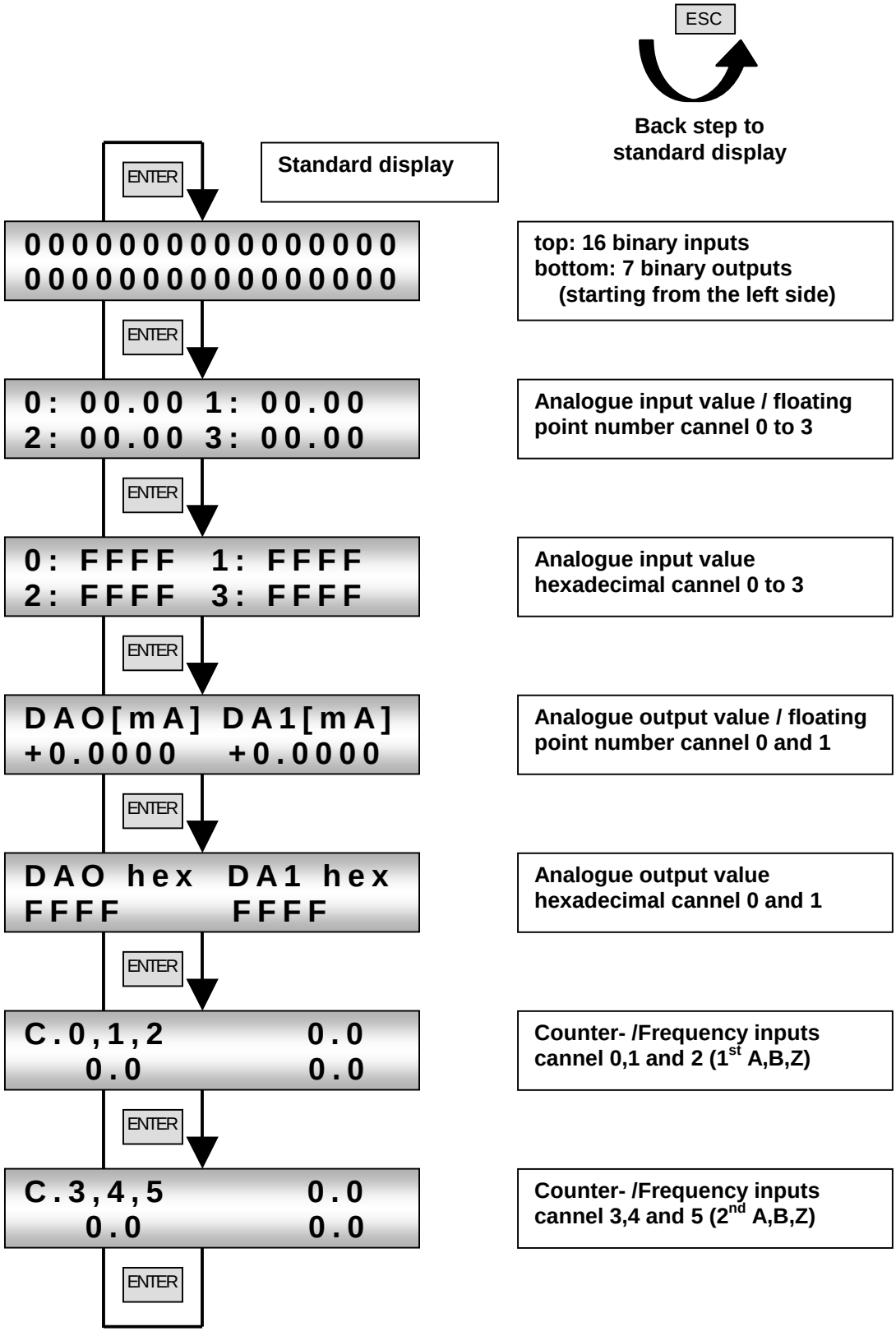
A return to the standard display is made by the "ESC" key.

The following menu options can be selected from the main menu:



7.2 Display Inputs and Outputs

By using the "ENTER" key it is possible to scroll trough the menu as described to display the binary and analogue inputs and outputs and the counter or frequency values.

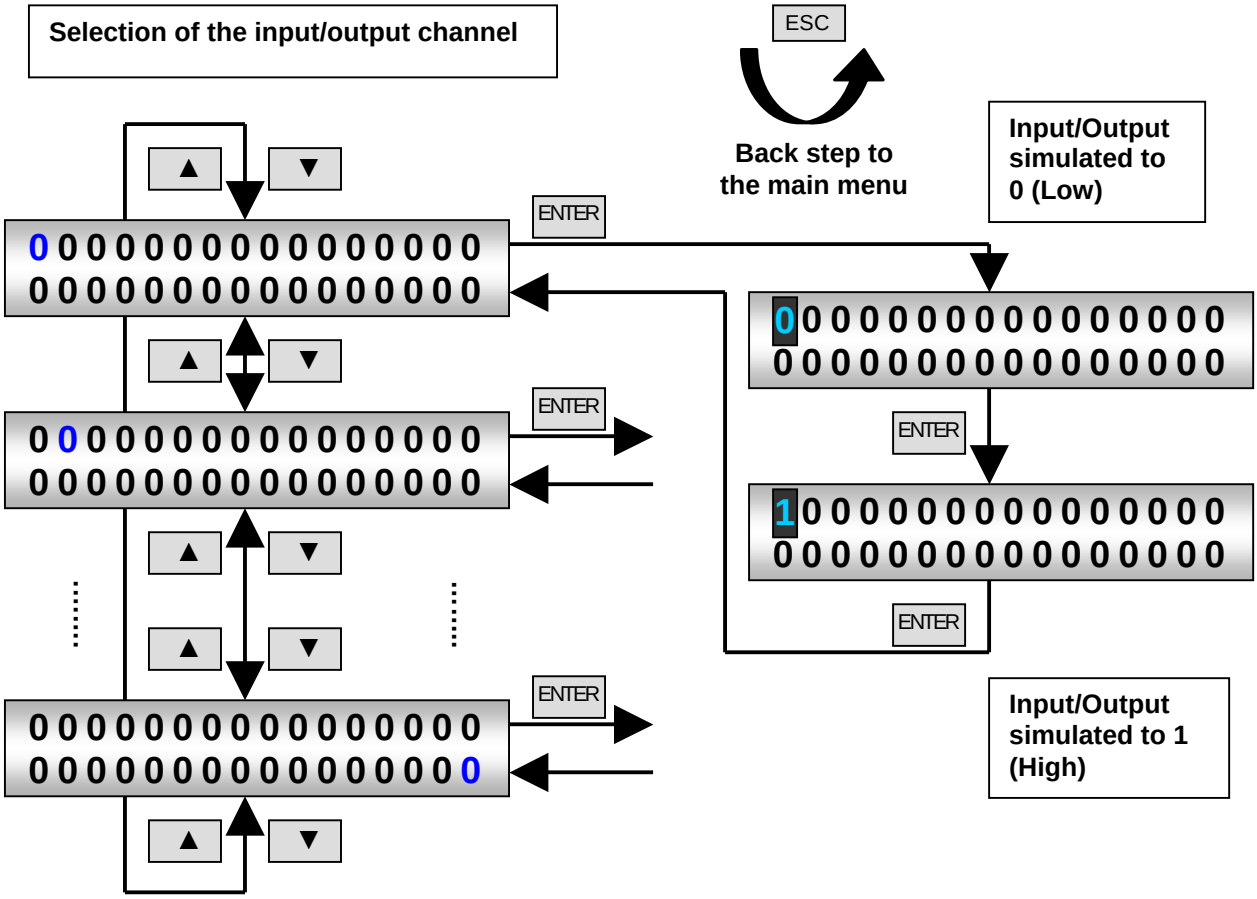


7.3 Binary Input/Output simulation

In this menu the binary inputs and outputs can be pre set for simulation. Only after release under menu point 7.8., the simulation will be activated. It can be simulated only the 7 outputs (bottom raw – starting from the left side).

By operation of the arrow keys selected channel flashes in each case (blue figured) and can be changed over "ENTER". Simulated channels are inversely shown.

With the "ESC" key it is possible to return to the main menu. The simulated values are stored.



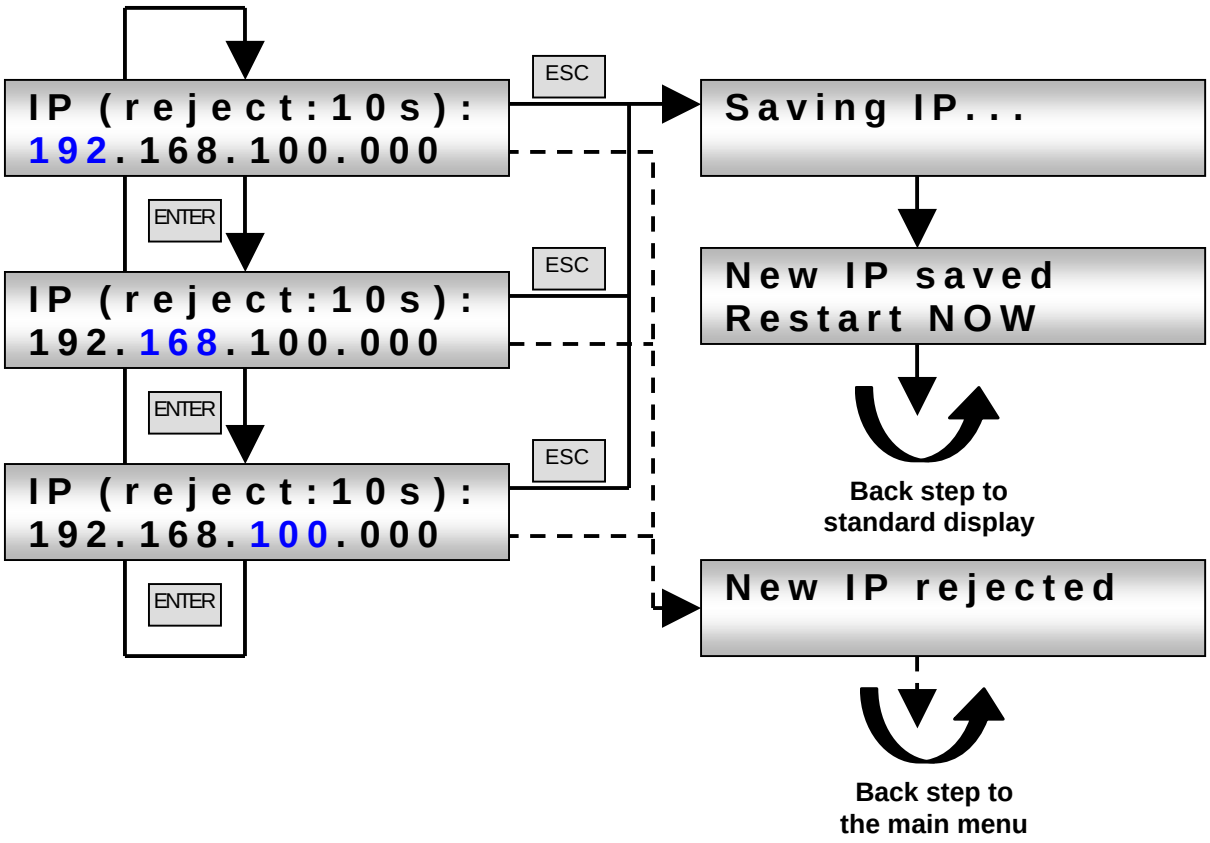
7.4 Changing of the CN IP address

The IP address for Ethernet Powerlink networks is fixed on 192.168.100.XXX. The differentiation of the CN is made by the lowest address byte. This address part is specified individually by the adjustment of the Address switches ID1 and ID2 for each module.

If the modules are used in other networks the three higher bytes can be adjusted by the menu option "Change IP...". The setting takes place byte by byte via increase or decrease of the address part value. By operation of the "ENTER" key selected channel flashes in each case (blue figured).

It is to be noted that without key actuation after 10 seconds the choose values are rejected. Pressing the "ESC" key within the 10 s the new address will be stored. Subsequently, a restart of the software of the module takes place.

If the lowest address byte was changed by the address switches, the new IP address will only be stored after the confirmation by pressing the "ESC" key and the following restart of the software.

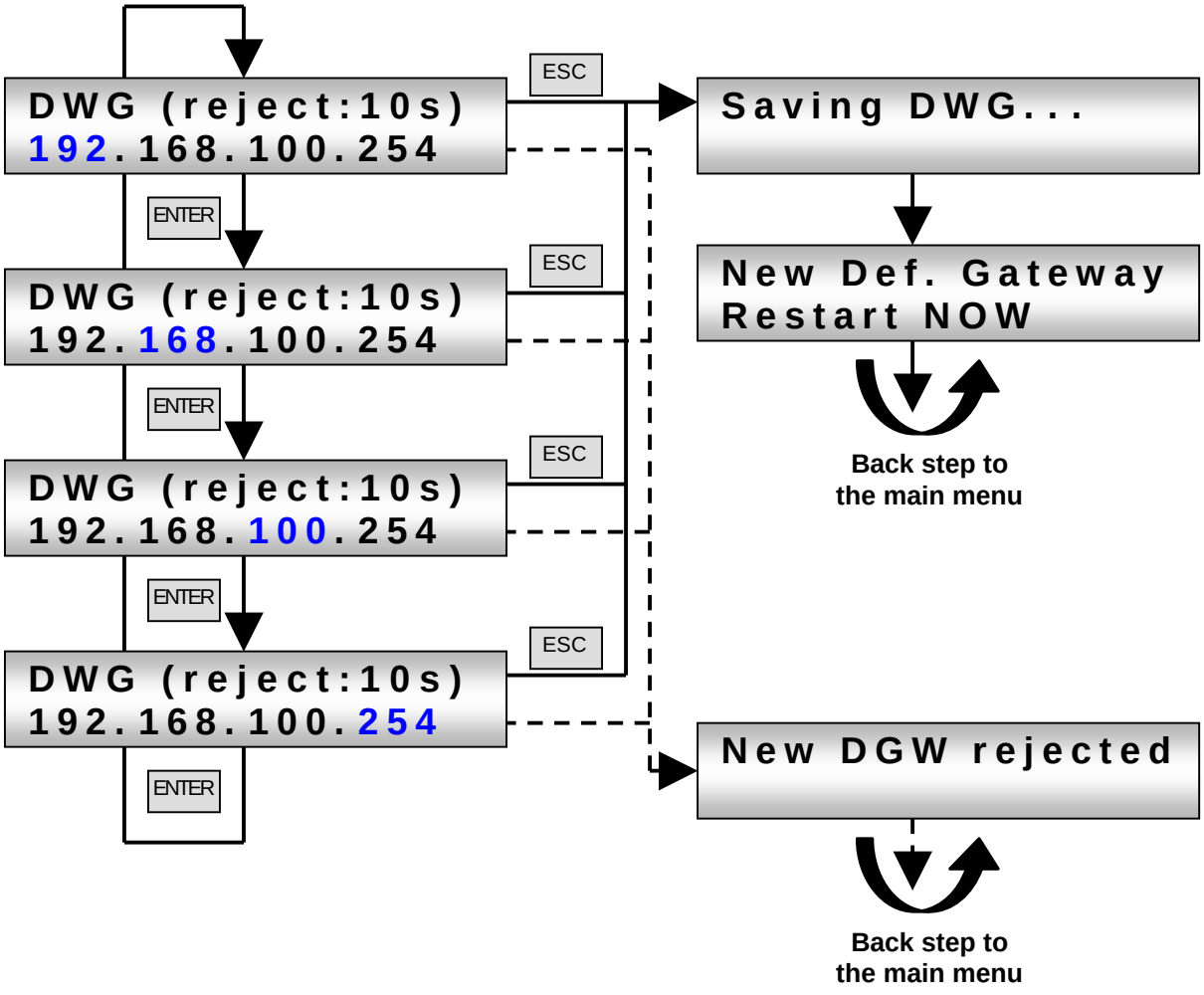


7.5 Changing of the Gateway IP address

The Gateway IP address for Ethernet Powerlink networks is fixed on 192.168.100.254.

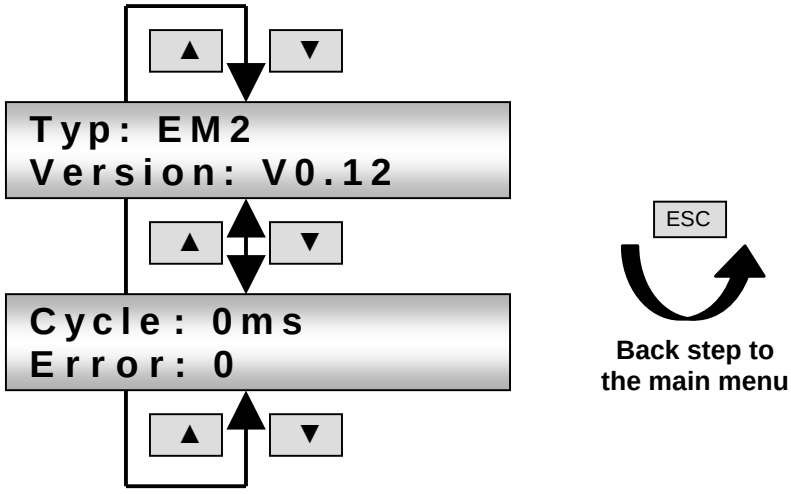
If the modules are used in other networks the three higher bytes can be adjusted by the menu option "Chg. Def. Gateway...". The setting takes place byte by byte via increase or decrease of the address part value. By operation of the "ENTER" key selected channel flashes in each case (blue figured).

It is to be noted that without key actuation after 10 seconds the choose values are rejected. Pressing the "ESC" key within the 10 s the new address will be stored. Subsequently, a restart of the software of the module takes place.



7.6 Specification of module and Powerlink data

Depending on the selection, the type of the module with the implemented software version or cycle and error of Ethernet Powerlink protocol will be displayed.



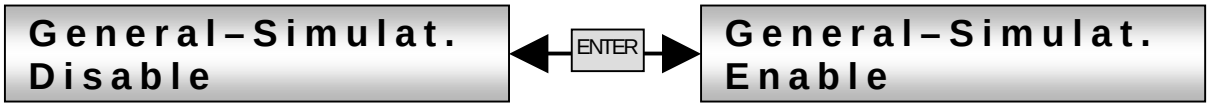
7.7 Show log data

This menu point will be used only for manufacturing and service for error analysing.

7.8 Simulation enable

This item in the main menu controls the simulation of all inputs. The simulation will be enabled or disabled by the "ENTER" key.

The main menu will not be left. With the arrow keys it can be scrolled further thru the main menu.



8 Object dictionary

The object dictionary of the CN is accessible by SDO communication via the MN.
Most objects are statically pre-defined by a configuration file stored on the CN. Objects can be changed dynamically by SDO communication from the MN or a modified file can be downloaded and the CN be restarted.

8.1 Process data objects (PDO), Service data objects (SDO) and module parameters

General List of PDOs and parameter objects addressable via SDO
– Manufacture specific (not all modules implement all objects):

Index	Sub-index	Size	Access	Default	Description
2000h					binary Inputs 0= Off (0V), 1= On (24V)
	0	1	ro	2	number of entries
	1	1	ro	-	Input 0-7
	2	1	ro	-	Input 8-15
2001h					binary output overload 0=ok , 1=overload
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
2002h					binary Output Polarity 0=True, 1=Inverted
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
2003h					binary Input Filter 0=500us, 1=2ms
	1	1	ro	-	Input 0-7
	2	1	ro	-	Input 8-15
2006h					binary Output Error Mode (0=keep output, 1= use error value)
	0	1	ro	1	number of entries
	1	1	rw	7Fh	Output 0-6
2007h					binary Output Error Value
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
2200h					binary Outputs 0= Off (0V), 1= On (24V)
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
2320h					binary Outputs external Read Back
	0	1	ro	1	number of entries
	1	11	ro	0	Outputs 0-6 real value 0= Off (0V), 1= On (24V)

Index	Sub-index	Size	Access	Default	Description
2401h					analog Inputs
	0	1	ro	4	number of entries
	1-4	2	ro	0	Input Channel 0-3 (I16) 0= 0V, 7FFFh= +10V, 8000h= -10V
2411h					analog Outputs
	0	1	ro	2	number of entries
	1-2	2	rw	0	Output Channel 0-3 (I16) 0= 0V, 7FFFh= +10V, 8000h= -10V
2431h					analog Input Offset
	0	1	ro	4	number of entries
	1-4	2	rw	0	Offset Channel 0-3 (I16)
2432h					Analog Input Scale
	0	1	ro	4	number of entries
	1-4	2	rw	1	Scale Channel 0-3 (I16)
2433h					HW range/mode Register
	0	1	ro	4	number of entries
	1-4	1	rw	0	HW range/mode Channel 0-3 (U8)
2461h					analog Input Average Enable
	0	1	ro	4	number of entries
	1-4	2	rw	0	Enable Input Average Channel 0-3 (U16) 0= disabled, 1= enabled
2462h					analog Input Average Depth
	0	1	ro	4	number of entries
	1-4	2	rw	0	Input Average Depth Channel 0-3 (U16)
2463h					analog Input Average Time
	0	1	ro	4	number of entries
	1-4	4	rw	0	Input Average Time (µs) Channel 0-3 (U32)
2464h					analog Input Filter Frequency
	0	1	ro	4	number of entries
	1-4	2	rw	0	Filter Frequency (Hz) Channel 0-3 (U16) possible values for Butterworth: 125 Hz, 500 Hz, 1000 Hz, 2000 Hz
2465h					analog Input Filter Type
	0	1	ro	4	number of entries
	1-4	1	rw	0	Filter Type Channel 0-3 (U8) 0= disabled 1= low pass Butterworth, 2^{nd} order
2800h		4	rw	-	Pulse/Frequency Counter (U32)
	0	1	ro	2	number of entries
	1-2	4	rw	-	Pulse Counter (U32)
2802h					Time Counter (U32)
	0	1	ro	2	number of entries
	1-2	4	ro	-	Time x 250ns (U32)
2803h					Counter Mode (U16)
	0	1	ro	2	number of entries
	1-2	2	rw	00C6h	Mode (U16)

Hardware Range/Mode Register (Object 2433h) :

Bit	Description
2-0	000 : +- 10V 001 : +- 5V 010 : +- 1V 011 : reserved 100 : 0-10V 101 : 0-5V 110 : 0-1V 111 : PT100
7-3	reserved

Counter Mode Register (Object 2803h):

Bit	Description
2-0	000: count A+ 001: count A- 010: count B+ 011: count B- 100: count A+/A- (double evaluation) 101: count B+/B- (double evaluation) 110: count A+-/B+- (quadruple evaluation) 111: A count up, B count down
3	0: Quadrature mode according to bits 2-0 (A/B with 90° offset) 1: A is pulse input, B is direction input (0=up, 1=down) (bits 2-0 are ignored)
4	0: direction normal 1: direction inverted
6-5	00: Frequency measurement (Pulses within Periods of 100ms) 01: Period measurement (Time Counter x 250ns) 10: counting 11: counting with zero-pulse (Z)
7	0: Counter stopped 1: Counter enabled
8	0: no zero-pulse 1: zero-pulse
10-9	reserved (set to 0)
11	0: normal zero-pulse 1: inverted zero-pulse
12	0: no new value available 1: new value available (read only, internal use only – write as 0)
14-13	reserved (set to 0)
15	0: bipolar transducer (differential inputs ±) 1: unipolar transducer (A+/B+/Z+ = Input, A-/B-/Z- = GND)

General List of PDOs and parameter objects addressable via SDO – Standard Device Profiles (not all modules implement all objects):

Index	Sub-index	Size	Access	Default	Description
6000h					binary Inputs 0= Off (0V), 1= On (24V)
	0	1	ro	2	number of entries
	1	1	ro	-	Input 0-7
	2	1	ro	-	Input 8-15
6002h					binary Input Polarity 0=True, 1=Inverted
	0	1	ro	2	number of entries
	1	1	rw	0	Input 0-7
	2	1	rw	0	Input 8-15

Index	Sub-index	Size	Access	Default	Description
6003h					binary Input Filter 0=500us, 1=2ms
	0	1	ro	4	number of entries
	1	1	rw	0	Input 0-7
	2	1	rw	0	Input 8-15
6200h					binary Outputs 0= Off (0V), 1= On (24V)
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
6202h					binary Output Polarity 0=True, 1=Inverted
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
6206h					binary Output Error Mode (0=keep output, 1= use error value)
	0	1	ro	1	number of entries
	1	1	rw	7Fh	Output 0-6
6207h					binary Output Error Value
	0	1	ro	1	number of entries
	1	1	rw	0	Output 0-6
6401h					analog Inputs
	0	1	ro	4	number of entries
	1-4	2	ro	0	Input Channel 0-3 (I16) 0= 0V, 7FFFh= +10V, 8000h= -10V
6411h					analog Outputs
	0	1	ro	2	number of entries
	1-2	2	rw	0	Output Channel 0-3 (I16) 0= 0V, 7FFFh= +10V, 8000h= -10V
6431h					analog Input Offset
	0	1	ro	4	number of entries
	1-4	2	rw	0	Offset Channel 0-3 (I16)
					analogue Input Scale
	0	1	ro	4	number of entries
	1-4	2	rw	1	Scale Channel 0-3 (I16)

RPDO (Poll-Request):

Object Index	Sub-index	Value	Description
1400h			PDO_RxCommParam_00h_REC
	0	2	NumberOfEntries_U8
	1	0	NodeID_U8
	2	0	MappingVersion_U8

Object Index	Sub-index	Value	Description
1600h			PDO_RxMappParam_00h_AU64
	0	3	NumberOfEntries_U8
	1	0008_0000_00_01_6200h	binary Output 0..6 (U8)
	2	0010_0010_00_01_6411h	analogue Output 0 (I16)
	3	0010_0020_00_02_6411h	analogue Output 1 (I16)

TPDO (Poll-Response):

Object Index	Sub-index	Value	Description
1800h			PDO_TxCommParam_00h_REC
	0	2	NumberOfEntries_U8

	1	0	NodeID_U8
	2	0	MappingVersion_U8

Object Index	Sub-index	Value	Description
1A00h			PDO_TxMappParam_00h_AU64
	0	12	NumberOfEntries_U8
	1	0008_0000_00_01_6000h	binary Input 0..7 (U8)
	2	0008_0008_00_02_6000h	binary Input 8..15 (U8)
	3	0008_0010_00_03_6000h	binary Output 0..6 readback (U8)
	4	0008_0018_00_04_6000h	not used (always 0) (U8)
	5	0010_0020_00_01_6401h	analogue Input 0 (I16)
	6	0010_0030_00_02_6401h	analogue Input 1 (I16)
	7	0010_0040_00_03_6401h	analogue Input 2 (I16)
	8	0010_0050_00_04_6401h	analogue Input 3 (I16)
	9	0020_0060_00_01_2800h	Pulse/Frequency Counter 0 (U32)
	10	0020_0080_00_01_2802h	Time Counter 0 (U32)
	11	0020_00A0_00_02_2800h	Pulse/Frequency Counter 1 (U32)
	12	0020_00E0_00_02_2802h	Time Counter 1 (U32)

8.2 PDO Mapping

Rx PDO mapping (Poll-Request-Frame):

Payload Offset	Object Index	Subindex	Size	Description
0	6200h	1	1	binary Outputs
2-3	6411h	1	2	analogue Output 0
4-5	6411h	2	2	analogue Output 1

Tx PDO mapping (Poll-Response-Frame) :

Payload Offset	Object Index	Subindex	Size	Description
0	6000h	1	1	binary Inputs 0..7
1	6000h	2	1	binary Inputs 8..15
2	6000h	3	1	binary Outputs readback
3	6000h	4	1	not used, always 0
4-5	6401h	1	2	analogue Input 0
6-7	6401h	2	2	analogue Input 1
8-9	6401h	3	2	analogue Input 2
10-11	6401h	4	2	analogue Input 3
12-15	2800h	1	4	Pulse/Frequency Counter 0
16-19	2802h	1	4	Time Counter 0
20-23	2800h	2	4	Pulse/Frequency Counter 1
24-27	2802h	2	4	Time Counter 1

8.3 NMT general objects

Object Index 1000h: NMT_DeviceType_U32: 0004.0191h

D31-24	D23-20	D19	D18	D17	D16	D15-0
0	0	0 (Analogue Output)	1 (Analogue Input)	0 (Digital Output)	0 (Digital Input)	Device Profile Number 401d = 191h

Object Index 1008h: NMT_ManufactDevName_VS
Manufacturer Device Name: “SHF AG”

Object Index 1009h: NMT_ManufactHwVers_VS
Manufacturer Hardware Version: “0001”

Object Index 100Ah: NMT_ManufactSwVers_VS
Manufacturer Software Version: “ECIO V0.9 (EPL 0.94, 4NetOS 2.4)”

Object Index 1018h: NMT_IdentityObject_REC

Subindex	Access	Size	Value	Description
0	ro	1	4	Number of Entries
1	ro	4	0EACh	VendorId_U32
2	ro	4	80h	ProductCode_U32
3	ro	4	0001h	RevisionNumber_U32
4	ro	4	0	SerialNumber_U32

Object Index 1F82h: NMT_FeatureFlags_U32 (ro)

Bit	Value	Description
0	1	isochronous
1	0	SDO by UDP/IP
2	1	SDO by ASnd
3	0	SDO by PDO
4	0	NMT Info Services
5	0	Extended NMT State Commands
6	1	Dynamic PDO Mapping
7	0	NMT Service by UDP/IP
8-31	0	reserved

0= not supported, 1= feature supported

Object Index 1F83h: NMT_EPLVers_U8 (ro)
EPL Version 2.0: 20h

Object Index 1F8Ch: NMT_CurrNMTState_U8 (ro)
returns the current state of the NMT state machine

Object Index 1F9Eh: NMT_ResetCmd_U8 (rw)
This may be used to initiate a reset to the CN. The following values are valid:

Name	Value	Description
NMTInvalidService	FFh	returned when read
NMTResetNode	28h	Reset CN
NMTResetConfiguration	2Ah	Reconfigure CN
NMTResetCommunication	29h	Reset Communication

8.4 Timing objects

Object Index 1006h: NMT_CycleLen_U32

This value can be set to enable control of the cycle time by the CN. When the actual cycle time exceeds this value, the CN will signal an error.
The default value is 0 meaning cycle time check is disabled.

Object 1F98h: NMT_CycleTime_REC

Subindex 0: NumberOfEntries = 9
Subindex 1: IsochrTxMaxPayload_U16 (ro) = 32
Subindex 2: IsochrRxMaxPayload_U16 (ro) = 0
Subindex 3: PResMaxLatency_U32 (ro) = 20000
max. response time in ns to a PReq frame
Subindex 4: PReqActPayload_U16 (rw) = 0
Subindex 5: PResActPayload_U16 (rw) = 32
Subindex 6: ASndMaxLatency_U32 (ro) = 100000
max. response time in ns to a SoA frame
Subindex 7: MultipleCycleCnt_U8 (rw) = 0
number of multiplexed cycles (0=no multiplexed cycles)
Subindex 8: AsyncMTUSize_U16 (rw) = 282
max. asynchronous frame size for ASnd frames
Subindex 9: Prescaler_U16 (rw) = 2
toggle rate of the PS bit in SoC frames

8.5 Error signalling and handling

Object Index 1001h: ERR_ErrorRegister_U8

0= No Error
1= Error

Bit	Description
0	Generic Error
1	n/a, always 0
2	Supply Voltage failure
3	n/a, always 0
4	Communication Error
5	n/a, always 0
6	reserved, always 0
7	0

Object Index 1003h: ERR_History_ADOM

Subindex 0: num_entries_U8 (writing a ‘0’ will clear the error history)
Subindex 1-254: HistoryEntry_DOM

Error Handling Objects:

The cumulative counters (...Cum_U32) are counting the total number of errors. The threshold counters (…Thr_U32) are incremented when an error occures and decremented with each correct cycle indicating the relation between erroneous and correct cycles. The threshold value can be set to trigger an action when the threshold counter reaches this value.

Object Index	Sub-index	Size	Name/Description
1C0Ah			**DLL_CNCollision_REC** Monitors the Collision errors
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNCollisionCum_U32
	2	4	DLL_CNCollisionThr_U32
	3	4	DLL_CNCollisionThreshold_U32 When reached state is changed to NMT_GS_RESET_COMMUNICATION
1C0Bh			**DLL_CNLossSoC_REC** Monitors the Loss of SoC events
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNLossSoCCum_U32
	2	4	DLL_CNLossSoCThr_U32
	3	4	DLL_CNLossSoCThreshold_U32 When reached state is changed to NMT_CS_PRE_OPERATIONAL_1
1C0Ch			**DLL_CNLossSoA_REC** Monitors the Loss os SoA events
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNLossSoACum_U32
	2	4	DLL_CNLossSoAThr_U32
	3	4	DLL_CNLossSoAThreshold_U32 When reached state is changed to NMT_CS_PRE_OPERATIONAL_1
1C0Dh			**DLL_CNLossPReq_REC** Monitors the Loss of Poll-Request events
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNLossPReqCum_U32
	2	4	DLL_CNLossPReqThr_U32
	3	4	DLL_CNLossPReqThreshold_U32 When reached state is changed to NMT_CS_PRE_OPERATIONAL_1
1C0Eh			**DLL_CNSoCJitter_REC** Monitors the Jitter error (see object index 1C13h)
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNSoCJitterCum_U32
	2	4	DLL_CNSoCJitterThr_U32
	3	4	DLL_CNSoCJitterThreshold_U32 When reached state is changed to NMT_CS_PRE_OPERATIONAL_1
1C0Fh			**DLL_CNCRCError_REC** Monitors CRC errors
	0	1	NumberOfEntries_U8 = 3
	1	4	DLL_CNCRCErrorCum_U32
	2	4	DLL_CNCRCErrorThr_U32
	3	4	DLL_CNCRCErrorThreshold_U32 When reached state is changed to NMT_CS_PRE_OPERATIONAL_1
1C10h			**DLL_CNLossOfLink_REC** Monitors Loss of Link errors
	0	1	NumberOfEntries_U8 = 1
	1	4	DLL_CNLossOfLink Cum_U32
1C13h		**4**	**DLL_CNSoCJitterRange_U32** (ns) defines the jitter for SoC cycles

8.6 Communication interface description error

Object Index 1030h: NMT_InterfaceGroup_0h_REC
Object Index 1031h: NMT_InterfaceGroup_1h_REC

Subindex 0: Number of Entries = 9
Subindex 1: InterfaceIndex_U16 (ro) = 1
Subindex 2: InterfaceDescription_VS (ro) = “HyNet32XS_EthCtrl”
Subindex 3: InterfaceType_U8 (ro) = 6 (ethernet csmacd)
Subindex 4: InterfaceMTU_U32 (ro) = 1500
Subindex 5: InterfacePhysAddress_OSTR (ro) = MAC Address
Subindex 6: InterfaceName_VS (rw) = “eth0”
Subindex 7: InterfaceOperStatus_U8 (ro) = 0: Down, 1: Up
Subindex 8: InterfaceAdminState_U8 (rw) = 0: Down, 1: Up
Subindex 9: Valid_BOOL (rw) = TRUE

Object Index 1032h – 1039h: NMT_InterfaceGroup_xh_REC

Subindex 9: Valid_BOOL (rw) = FALSE

Object Index 1F93h: NMT_EPLNodeId_REC

Subindex 0: Number of Entries = 2
Subindex 1: NodeId_U8 (ro), set by Hex-Switch
Subindex 2: NodeIdByHW_BOOL (ro) = TRUE

8.7 Others

Object Index 1F99h: NMT_CnStateMachineTimeouts_REC

Subindex 0: NumberOfEntries = 1
Subindex 1: BasicEthernetTimeout_U32
Timeout in µs before changing from NMT_CS_NOT_ACTIVE into NMT_CS_BASIC_ETHERNET state.

Object Index 1F50h: PDL_DownloadProgData_ADOM

Subindex 0: Number of programs
(currently only 1 is supported, the default program)
Subindex 1: Default Program (Firmware)

Object Index 1F51h: PDL_ProgCtrl_AU8

Subindex 0: Number of entries
(currently only 1 is supported, the default program)
Subindex 1: Program Control:

Value	Write Access	Read Access
0	Stop program (n/a)	program stopped
1	Start program	program running
2	Reset program	program stopped

Currently a read access will always return ‘1’ and a write of ‘1’ or ‘2’ will initiate a reset and restart of the CN. This is needed to start a new downloaded firmware (Program 1).

Object Index 1F52h: PDL_LocVerApplSw_REC

Version of the Default Program.
Subindex 0: Number of entries (=2)
Subindex 1: ApplSwDate_U32: Number of days since 1/1/1984
Subindex 2: ApplSwTime_U32: ms since midnight

9 Accessories

As accessories the following materials will be offered:

9.1 2-pin plug for the connection of voltage supply

- screw plug-in
- cage clamp plug-in

9.2 9-pin plug for the connection of the periphery (I/O connection)

- screw plug-in
- cage clamp plug-in

9.3 Ethernet cable CAT 5 STP

(shielded twisted pair), standard length of 2m. Cable of other lengths is available on inquiry.

SHF Communication Technologies AG • Division Automation
Wilhelm-von-Siemens-Str. 23 E • D - 12277 Berlin
☎ +49 30 772 051 19 • +49 30 7702 9848 • automation@shf.de • www.shf.de