Manual for

DMA-22(A)

Universal On-Board and Stand-Alone Digital Amplifier and Controller

Applicable for SW Versions
V50.xx*
V51.xx*

(xx == 00 or higher)

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Revision History

Revision	Date	Description
V1.0	21.07.2022	First edtition
R1.0	24.08.2022	Connection diagram changed
R1.0	12.09.2022	Wiring diagrams, technical data, supply voltage range updated

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1 General information

1.1 About this manual

This document describes the Ethernet-IP interface of the HCS digital amplifier.
It describes and explains the general structure of the Ethernet-IP interface and in a second part the device specific

This manual was prepared with great care and the contents reflect the author's best knowledge. However, the possibility of error remains and improvements are possible. Please feel free to submit any comments regarding errors or possibly incomplete information to HCS GmbH.

1.1.1 Reservation of changes and validity

The information contained in this manual is valid at the time of this version's release. See footer for version number and release date of this manual.
We reserve the right to make changes to this manual at any time without specified reasons.

1.1.2 Completeness

This manual is complete only when used in conjunction with the product related hardware and software documentation required for the relevant application.

1.1.3 Place of storage

This manual and all other associated documentation for hardware and software must always be kept in a location where they will be readily accessible and close to the amplifier or the equipment in which it is installed.

1.1.4 Warranty and liability

This manual only describes the functionality and influence of the parameters. The described software functionality can be used in various amplifier models which can be implemented in a vast range of applications. Hence it is not possible to assume liability for the influence of the parameters. Please refer to the safety instructions and remarks in the related operating instructions.

1.1.5 Typographical conventions

⚠ DANGER

Identifies safety instructions that are intended to warn of an immediate and impending danger to life and limb.
Failure to observe these safety instructions will inevitably lead to death, serious personal injury (disablement)!

⚠ WARNING

Identifies safety instructions that are intended to warn of potential danger to life and limb.
Failure to observe these safety instructions might lead to death, serious personal injury (disablement)!

⚠ CAUTION

Identifies safety instructions that are intended to warn of slight personal injury.
Failure to observe these safety instructions might lead to slight personal injury.

NOTICE
Failure to observe this safety notice can result in property damage!

Identifies important information

●/ -	Identifies listings
□	Identifies references to another chapter, page, table or figure in this manual
blue text	Identifies a hyperlink within the PDF file
1., 2., …	Identifies steps in a procedure that should be performed in consecutive order
'STATE'	Identifies states of a state machine
«ES»	Identifies LEDs of the amplifier (for example, «ES»)
< >	Identifies a parameter name
„…“	Used for references

1.2 Structure of warning notices

1 ⚠ DANGER 2
Moving machine parts! 3
Entrapment hazard! 4
□ Do not enter danger zone! 5

Legend:

1	Warning symbol
2	Signal word
3	Type and source of hazard
4	Possible consequences if a potential hazard
5	Hazard prevention measures

1.3 Selection and qualification of personnel

Only qualified users may work with the amplifier. Qualified users are properly trained experts with the required knowledge and experience. In particular, these experts must have the authorization to bring into operation systems and power circuits in accordance with safety engineering standards. They must be familiar with safety concepts common in automation.

1.3.1 Service and repair

⚠ WARNING
Do not attempt - under any circumstances - to repair the product yourself

After repair, certain adjustments and test procedures must be performed; this can only be made by qualified and authorized personnel. Products that need repair can be sent to the addresses:

See □ Chapter „11 HCS distributors and partners„, page 45

Please enclose a detailed description of the error, malfunction or failure with the sent item and state the serial number and the purchase date. This will speed up the process and guarantees a fast and reliable repair.
See □ Chapter „11 HCS distributors and partners„, page 45

In the case of a fault or a malfunction, your distributor can give you instructions on the phone or in writing before accepting a repair order. For service and repair, we offer experienced and qualified personnel. In case you need our assistance, please contact the address:
See □ Chapter „11 HCS distributors and partners„, page 45

1.3.2 Cleaning, storage, transport

The product should only be transported and stored in the original packaging to ensure suitable protection against mechanical damage as well as electrostatic discharge.
If it should be necessary to clean the amplifier, we recommend sending it back to the manufacturer or any distributor and partner:
See □ Chapter „11 HCS distributors and partners„, page 45

⚠ CAUTION

Unpacking and handling should be left to suitably trained personnel.
Beware of damaging the module by electrostatic

1.3.3 Delivery state (default setting)

The product is shipped in a ready-to-use state (default settings). After correct installation and setting of all parameters relevant for the application, the amplifier module is ready for use.

2 Technical data

2.1 Technical data overview

Feature	Range, characteristics
Model	Modular digital amplifier in snap-on mounting technology
Supply voltage	10 V DC ... 32 V DC; residual ripple < 10 % (max. 50 VA power draw)
Duty cycle	100 %
Preliminary fuse	3.15 A; quick blowing
Ambiant operating temperature	- 40 °C ... + 70 °C
Storage temperature	- 45 °C ... 85 ° C
Humidity (relative air humidity)	max. 95 % non condensing
Max. elevation	2,000 m (mamsl)
Class of protection	IP20 (EN60529)
EMC	In accordance with the applicable industrial standards (CE - conformity) *1
Connection, type of connector	16 pole (4 x 4); screw terminals for 0.2 - 2.5 mm² (AWG 24 -12) Phoenix Combicon connector with screw terminals, type: MSTBT 2,5/ 4-ST for detailed technical data refer to Phoenix Contact Combicon Product Catalog
Cable specification	1.5 mm² (AWG16) for supply and solenoids, shielding recommended, max length: 50 m 0.5 mm² (AWG20) for analog and digital signals, shielding mandatory, max length: 50 m
Mounting/housing	Mounting: top-hat rail (mounting rail) in accord. with EN50022 with inetgrated PE contact Housing configuration: ventilated (IP20) Material: PA 66 - FR (blue); flammability in accordance with UL94V0 Dimensions approx.: (w x h x d) 22,5 x 100 x 114 mm Weight: approx. 0.13 kg (inlcuding mating connectors)
Mounting postion	Any; preferably vertical for better heat dissipation through convection
Analog set value input	0 … +-10 V or 4 ... 20 mA (parameter selectable) with 16 Bit resolution (volt. = differential) Input resistance: voltage input = 200 kOhm; current input = 255 Ohm
Analog feedback input	12 V ... +- 2.5 V Special input for PRL2 LVDT spool position transducer with filter function
Digital inputs	1 input (ENABLE);
Signal range for digital inputs	0 ... 2.6 V = low; > 9 V = high; current draw input < 20 mA; input resistance: 20 kOhm
Solenoid current (output)	2 PWM output stages, each for up to 3,5 A (with over-energ. and quick de-energization)
Solenoid system selection	0.8 A; 1.1 A; 1.3 A; 1.6 A; 2.4 A; 2.7 A and 3.5 A (intermediate values adjustable) Servo valve current ranges available!
Digital output	1 output, Uout @ 10 mA load = USupply – 6 V; output = 0 V in case of error! (ERROR / COMPARATOR funcion combined)
Status signals	1 multi color „STATUS“ LED at front. Run/OK = green; Enable = yellow; Error = red
Interface 1	USB-C at front
Interface 2 (for versions with option CANopen only)	CANopen (CiA 408 or Device Profile Fluid Power); connection to DMA using standard CAN frames according to ISO 11898-1…3 and ISO 11898-5
PWM frequency	22.2 kHz - independant from dither frequency (customer specific frequencies available)
Dither frequency range	1 ... 300 Hz - independant from PWM frequency (other frequency range on request)
Cycle times	General and closed loop 1: 0.1 msec

*1: details on request

Remark:
all values nominal if not stated otherwise!

Table 1: Properties

2.1 Features of the device

- The Gateway uses the full data width of 500 Byte
- supports all speeds
- full performance range of Ethernet/IP is supported
- supports 10 and 100 MBit/s auto detect
- DHCP functionality in preparation (on request)
- Electrical isolated and opto-decoupled
-

2.2 General CIP support

The DMA versions with Ethernet/IP interface provides „Assembly objects class 4“. DMA is using one Input and one Output Assembly Object with attribute (# 3).

- A input-object instance 100 (attribute # 3) (PLC --> Slave (shown in the Pyramid Solution software line at the top in blue) (see also section 5.3)
- A output-object instance 101 (attribute #3) (Slave -->SPS shown in the Pyramid Solution software line at the bottom in green) (see also section 5.3)

2.2 Programming PC Interfaces

Onboard USB interface in cooperation with HCSTool or HyperTerminal.

2.3 Connection diagram Standard

⚠ CAUTION

The connection diagram may vary due to specific hardware or software specifications. The corresponding connection diagram for the hardware you are using is always printed on the side of the DMA module.

Please always follow the connection plan printed on the module.

Example for the standard connection:

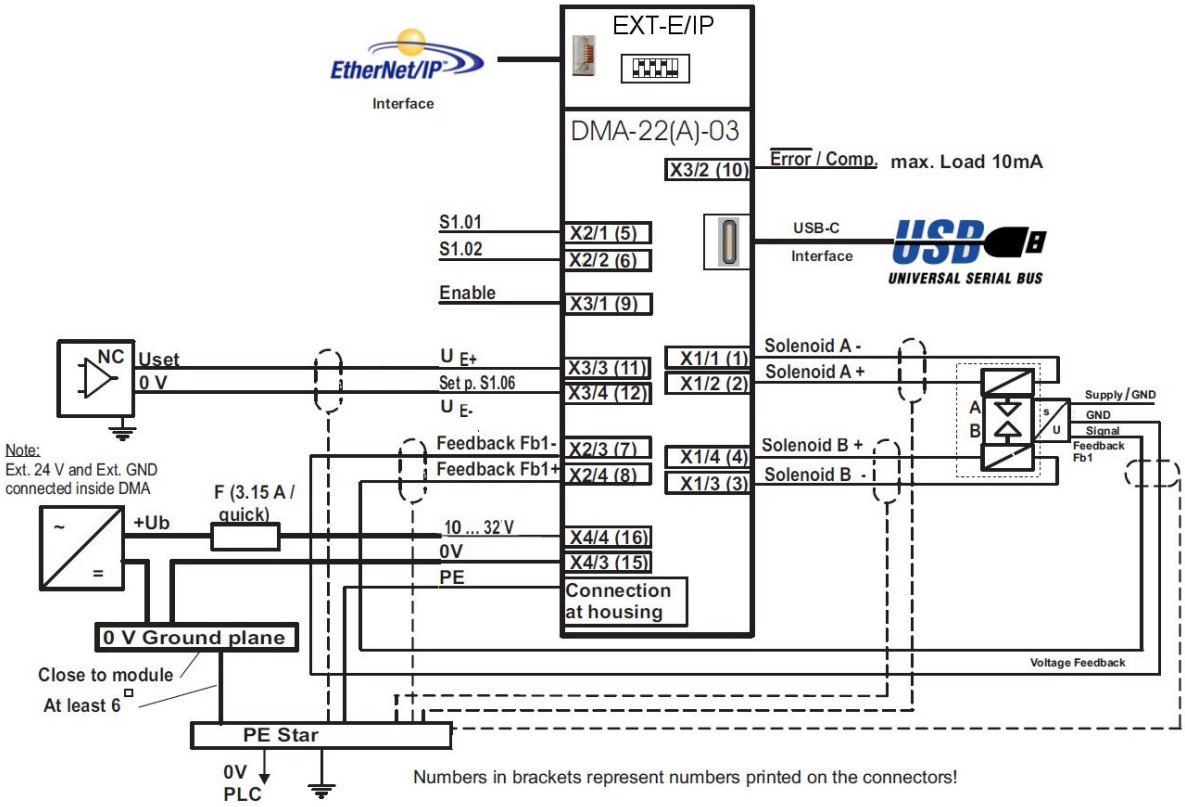


Figure 1 : Connection diagram

2.3 Possible connector options (on customer request)

Options are only possible if the hardware offers the possibility!
The possibility of some options is depending on the combination of all needed options.

Usage	Standard	Option 1	Connector	PIN
Solenoid 4pol	Output A-	-	X1	1(1)
	Output A+	-		2(2)
	Output B-	-		3(3)
	Output B+	-		4(4)
Analog Feedback 1 4pol	S1.01	-	X2	1(5)
	S1.02	-		2(6)
	FB1 -	-		3(7)
	FB1 +	-		4(8)
Analog Set Value, Analog Feedback 2, Error, Enable 4 pol	Enable Input	-	X3	1(9)
	\Error/Comp. Output	-		2(10)
	S1.06 + / FB2 +	-		3(11)
	S1.06 - / FB2 -	-		4(12)
Power, Digital-Input 4 pol	-	Analogue GND	X4	1(13)
	-	Analog Output-		2(14)
	Power 0V	-		3(15)
	Power 24V	-		4(16)

Table 2: Connection definition, part 1

2.4 Inputs

Digital Input, normally used as enable signal.
For more information see □ Chapter „5.6 Digital inputs“, page 31

2.5 Outputs:

- for error indication. In case of error this line is connected to ground with 1K input resistance. See □ Chapter „5.7 Digital outputs”, page 32

Options (only possible if the hardware offers the possibility)

- Internal supply output:
  Output for internal sensor or potentiometer
  10 V / 10 mA, current limited. (Output voltage defined by hardware revision)
- Analog voltage output:
  Output for checking the internal control loop values. Output for control an external controller.
  +-10 V / 6 mA

2.6 Ethernet connector pinning

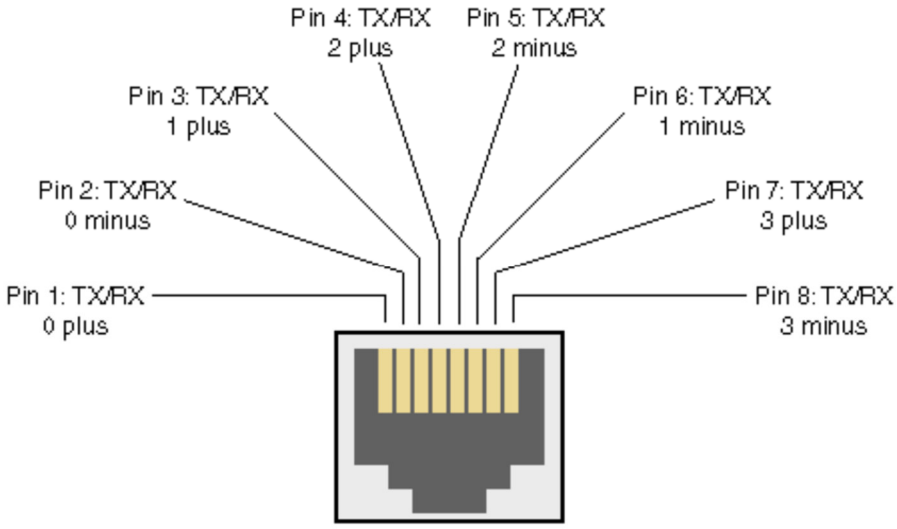
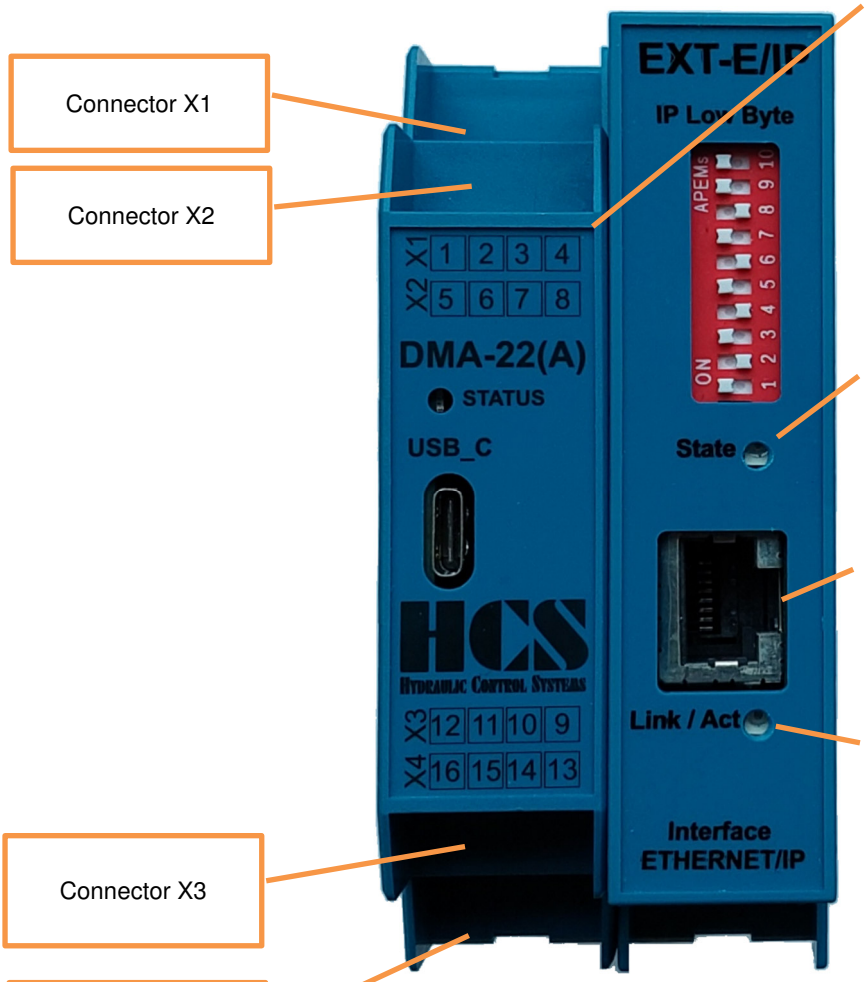


Figure 2 : Connector Ethernet

2.4 Front View: address selection and connectors

2.4.1 Single module Version (node with one module connected)



Low Byte Address Selector:
1 = Bit 0
2 = Bit 1
3 = Bit 2
4 = Bit 3
5 = Bit 4
6 = Bit 5
7 = Bit 6
8 = Bit 7
9 = not used
10 = not used

Example:
On = 1, 3, 5, 7 ♉
Address = 85

Status LED "State":
On = Logical data exchange E/IP
Blinking = waiting for connection
Fast blinking = Error
Off = getting ready

Connector

Ethernet

Status LED "Link/Act":
On = LAN connected
Blinking = Communication via LAN

Figure 3 : Connector position layout, single module

2.4.2 Multiple module Version (node with multiple modules connected)

Example:
1 Ethernet-IP-Node and 3 DMA-22(A) Modules (Slaves) connected

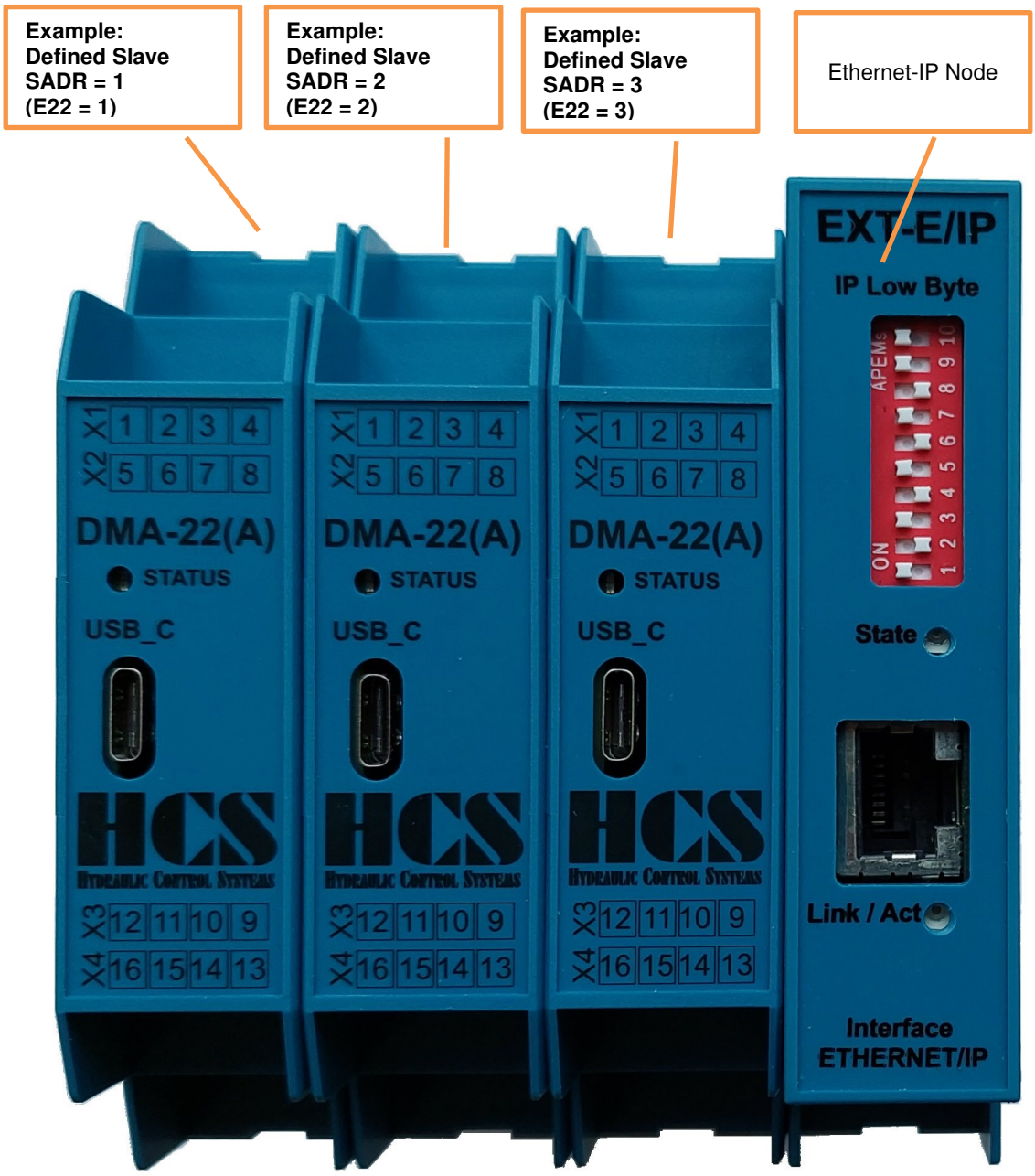


Figure 4 : Multiple module defintion

3 General communication information

3.1 General information setting and changing IP-Addresses

⚠ CAUTION

**Settings performed at slave with E22 = 1 are only effective after power down reset.
Data will then be exchanged between
DMA and Ethernet/IP node.**

For the parameter setting of the node the slave (module) with the address E22 =1 is relevant. Only this module communicates the necessary information regarding IP-address and buffer size. The configuration of the DIP switch (lowest IP-address) can only be read out via this slave. The parameters E24 to E30 of the other slaves in the package are not relevant.

Settings performed at slave with E22 = 1 are only effective after power down reset. Data will then be exchanged between DMA and Ethernet/IP node.

To activate the new data inside the EIP-Node, another power down reset is necessary.
Approximately 5 seconds after power-up the Ethernet communication will be ready.

Parameter setting example with HCSTool:

E 22	1		BUS slave address
E 23	0,000	s	BUS timeout, at 0s the function is deactivated
E 24	off		DHCP activation
E 25	192		IP-address "aaa" from "aaa.bbb.ccc.ddd"
E 26	168		IP-address "bbb" from "aaa.bbb.ccc.ddd"
E 27	1		IP-address "ccc" from "aaa.bbb.ccc.ddd"
E 28	0		IP-address of low-byte DIP switch "ddd" (read only)
E 29	12		Input buffer length in byte
E 30	12		Output buffer length in byte

Figure 5 : Example for parameter setting of module no. 1

3.2 Special information for Multi-Slave Nodes

In cases where the Ethernet node has more than one slave (modules) connected all slaves **must** be active (connected to the power supply). The hardware enable is connected to all of the DMA modules. Other wise communication is not possible and the node-module will respond with a timeout error message.
The Profinet-Node connected to the PLC (Error LED is off).
If 3 modules are used then E22 must be set to „1“ for the first module on the left, to „2“ for the second module in the middle and to „3“ for the third module closest to the slave.

3.3 General information about TADR (Telegram Address)

TADR is a value which may be written (changed) with each cycle but changing of this value is optional and not mandatory. The value will be defined by the Ethernet-Master.
The purpose is to either check the telegrams by the master or also in order to force sending of a new telegram from the node.
The design of the node is made in a way that the slave or slaves (module or modules in case of multi-slave version) are only responding if a received message from the master contains changed (different) data compared to the previous message.
So TADR can be used to force a response from a slave for example in order to get an update on the current status of the slave even if the other data in the message remain unchanged.
TADR value is valid in the range of 0 to 255 or in hexadecimal 0x00 to 0xFF.

3.4 General information about CMD (Command) and SADR (Slave Address)

Different ways of communication between master and slaves (modules) are possible. The difference is in the CMD instruction.

CMD = 6: Writing of a single parameter-ID of a slave (module) at a node. The selected SADR in the telegram will define which slave is selected for the communication. In the slave itself the address is set by parameter E22,
Special case: the Ethernet node has only one slave (module) connected. In this case SADR is set to 1 (defined in parameter E22). SADR also could be set to any value between 1 and 32.
Theoretically up to 32 slaves (modules) can be connected to one of the Ethernet nodes. Which of the slaves (modules) is selected for communication is again defined in the telegram by the SADR and in the slaves (modules) by setting of parameter E22. For more information please refer to □ Chapter „4.3.1 CMD = 6, Master Write single parameter (7 bytes)“, page 17

CMD = 3: Reading of one ore more parameters with parameter-ID in rising order. All other definitions from CMD = 6 are also applicable. For more information please refer to □ Chapter „4.1.1 CMD = 3, Master Read parameters (7 bytes)”, page 15

CMD = 15: This instruction allows writing or reading of a (pre-defined) set of parameters. The set of parameters itself is depending on the software version of the slaves (modules); refer also to □ Chapter „5.5 CMD = 15, structure of Ethernet telegram definition, depending on SW Versions”, page 24
With this instruction all slaves (modules) at a given node with the SADR from 1 to 5 can be reached. This instruction cannot be used for slaves (modules) with a SADR > 5. In this case CMD = 3 and CMD = 6 must be used!
The best is to set SADR at the slaves in rising and consecutive order beginning with SADR =1 (E22 = 1).
In the telegram itself the number of slaves (modules) at the node is defined by SNUM. This at the same time will also define the length of the telegram itself (number of bytes in the telegram).
For more information please refer to □ Chapter „5 Complex commands”, page 20.

It is possible to „mix“ the instructions CMD = 3, CMD = 6 and CM = 15 for one node.
So for example the slaves (modules) with E22 =1, E22 = 2 and E22 = 3 are actuated by CMD =15 or CMD = 3 and CMD =6 but another slave (module) with address E22 = 12 is only actuated either by CMD =3 or CMD = 6.

3.5 Additional information of using instance #100, #101

These instances are also proposed by the Pyramid Solutions software. By means of these instances basically unlimited sized data blocks can be exchanged but the size of the data blocks itself is limited by the parameters E29 and E30.
Buffer sizes also must be defined in the PLC (or Pyramid Solutions software).
Input instance (100) is then filled with the content as described in this manual.
The response is placed in the output instance (101).
If a telegram is sent to the DMA (e.g. “command 15”) then instance 100 must be used.
The buffer size in the PLC and DMA (here parameter 29) must be defined. For DMA-3-fold modules ≥ 18 bytes.
Data from the DMA are transferred to the PLC by means of instance 101. Buffer size also must be adapted to the maximum data size (for DMA with parameter E30). 9 bytes is sufficient in this case.

4 Simple commands

4.1 CMD 3 Master Read

4.1.1 CMD = 3, Master Read parameters (7 bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF
1	SADR	Slave address
2	CMD	Command: 3 = Read multiple parameters by the master
3	IDH	High byte parameter ID of first parameter
4	IDL	Low byte parameter ID of first parameter
5	N-high	High-Byte Number parameters
6	N-low	Low-Byte Number parameters

…Write last

TADR Telegram address, defined by the Ethernet-Master.(Set by the User)

SADR Slave address, if more than one Slave is connected to the Ethernet port
1 = standard (single slave)
2 to 32 = also possible (E22 defines the slave address)

CMD Command: 3 = Read parameter by the master

IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX

0x0000 .. 0x00A2 = Valid ID-range

N-high High-Byte Number parameters (words), normally zero

N-low Low-Byte Number parameters (words), 1 to 8 (0x08)
(maximal 8 parameters readable at once)

4.1.2 CMD = 3, Response from Slave (4 + CNT bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the read command, Range 0..255, 0..0xFF
1	SADR	Slave address
2	CMD	Command: 3 = Read multiple parameters by the master
3	CNT	N*2, Number of data bytes
4	DAT1H	High byte value of first parameter
5	DAT1L	Low Byte value of first parameter

If CNT > 2: ……

CNT+2 = N	DATnH	High byte value of last (n)parameter
CNT+3 = N	DATnL	Low Byte value of last (n)parameter

…Write last

TADR Telegram address, defined by the Ethernet-Master. (Set by the read command)

SADR Slave address, if more than one Slave is connected to the Ethernet port
1 = standard (single slave)
2 to 32 = also possible (E22 defines the slave address)

CMD Command: 3 = Read parameter by the master

CNT N*2, Number of data bytes (Maximal 16 data bytes)

IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX
0x0000 .. 0x00B0 = Valid ID-Range

DAT1H.. DAT nH,
DAT1L.. DAT nL, Two data bytes in HEX, without decimal sign
0x7FFF == +32767
0x8000 == -32768

4.1.3 CMD = 3, Error from Slave (4 bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the read command, Range 0..255, 0..0xFF
1	SADR	Slave address
2	ERR	Error code
3	EXCE	Exception

…Write last

ERR Error code: 0x83 = Read failed

EXCE Exception:
1 = Command not supported
2 = Wrong ID
3 = CNT== 0 or CNT > 16 (0x10)
4 = Reading of ID failed
5 = timeout slave, address wrong or not installed or
Invalid number of connected slaves
6 = Internal checksum error (Modbus)

Example for error response:

Module 3 is not installed and **SADR** in the master telegram is set to 3

Byte	Data	Abbreviation	Description
0	0x23	TADR	Response telegram address (defined by the read command)
1	**0x03**	SADR	Actual slave address
2	0x83	ERR	Error, Bit „7“ with command 0x03 is set
3	0x05	EXCE	timeout slave, address wrong or not installed

4.2 Telegram example CMD = 3

Master wants to read parameter „d1.07”:

ID = 0x0007
N = 1, one parameter
TADR = 0x24
SADR = 0x01

Byte	Data	Abbreviation
0	0x24	TADR
1	0x01	SADR
2	0x03	CMD
3	0x00	IDH
4	0x07	IDL
5	0x00	N-high
6	0x01	N-low

Response from slave (module)
CNT = 2 (2 Bytes)
DATA = 0x0133 (==0.307Af)

Byte	Data	Abbreviation
0	0x24	TADR
1	0x01	SADR
2	0x03	CMD
3	0x02	CNT
4	0x01	DAT1H
5	0x33	DAT1L

4.3 CMD = 6, Master Write

4.3.1 CMD = 6, Master Write single parameter (7 bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF
1	SADR	Slave address
2	CMD	Command: 6 = Write single parameter by the master
3	IDH	High byte parameter ID
4	IDL	Low byte parameter ID
5	DATH	High byte of parameter value
6	DATL	Low byte of parameter value

…Write last

TADR Telegram address, defined by the Ethernet-Master.(Set by the user)

SADR Slave address, if more than one Slave is connected to the Ethernet port
1 = standard (single slave)
2..32 = also possible (E22 defines the slave address)

CMD Command: 6 = Write single parameter by the master

IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX
0x0000 .. 0x00B0 = Valid ID-Range

DATH,DATL Two data bytes in HEX, without decimal sign
0x7FFF == +32767
0x8000 == -32768

4.3.2 CMD = 6, Response from Slave (7 bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the write command, Range 0..255, 0..0xFF
1	SADR	Slave address
2	CMD	Command: 6 = Write single parameter by the master
3	IDH	High byte parameter ID
4	IDL	Low byte parameter ID
5	DATH	High byte of second analogue value
6	DATL	Low byte of first analogue value

…Write last

TADR Telegram address, defined by the Ethernet-Master. (Set by the write command)

SADR Slave address, if more than one Slave is connected to the Ethernet port
1 = standard (single slave)
2..32 = also possible (E22 defines the slave address)

CMD Command: 6 = Write single parameter by the master
IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX
0x0000 .. 0x00A2 Valid ID-Range

DATH,DATL Two data bytes in HEX, without decimal sign
0x7FFF == +32767
0x8000 == -32768

4.3.3 CMD = 6, Error from Slave (4 bytes)

Write first…

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the write command, Range 0..255, 0..0xFF
1	SADR	Slave address
2	ERR	Error code
3	EXCE	Exception

…Write last

ERR Error code: 0x86 = write failed

EXCE Exception:
1 = Command not supported
2 = Wrong ID
3 = Wrong Data Value
4 = Writing of ID failed
5 = timeout slave, address wrong or not installed or
Invalid number of connected slaves
6 = Internal checksum error (Modbus)

Example for error response:

Module 3 is not installed and **SADR** in the master telegram is set to 3

Byte	Data	Abbreviation	Description
0	0x23	TADR	Response telegram address (defined by the write command)
1	**0x03**	SADR	Actual slave address
2	0x86	ERR	Error, Bit „7“ with command 0x06 is set
3	0x05	EXCE	timeout slave, address wrong or not installed

4.4 Telegram example CMD = 6

4.4.1 Example, write parameter

Master wants to write parameter „C1.07” with value 1.000 V:

ID = 0x0030
DATA = 0x3E8 (= 1000 in decimal)
TADR = 0x23
SADR = 0x01

Byte	Data	Abbreviation
0	0x23	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x30	IDL
5	0x03	DATL
6	0xE8	DATH

Response from slave (module), command was successful executed
ID = 0x0030
DATA = 0x3E8 (= 1.000 V)

Byte	Data	Abbreviation
0	0x23	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x30	IDL
5	0x03	DATL
6	0xE8	DATH

4.4.2 Example, write set value

Examples for set value via Ethernet (ID = 0x0027):

1.) Command signal 0.000 V = 0x0000:

Byte	Data	Abbreviation
0	0x12	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x27	IDL
5	0x00	DATL
6	0x00	DATH

2.) Set value 5.000 V = 0x1388:

Byte	Data	Abbreviation
0	0x12	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x27	IDL
5	0x13	DATL
6	0x88	DATH

3.) Set value 9.999 V = 0x270F:

Byte	Data	Abbreviation
0	0x12	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x27	IDL
5	0x27	DATL
6	0x0F	DATH

4.) Set value –9.999 V = 0xD8F1

Byte	Data	Abbreviation
0	0x12	TADR
1	0x01	SADR
2	0x06	CMD
3	0x00	IDH
4	0x27	IDL
5	0xD8	DATL
6	0xF1	DATH

5 Complex commands

5.1 CMD = 15, Master writes multiple parameters (3+5·module bytes) (Fast multi-slave command)

Parameter E22 in the related DMA-22(A)-module has to be set to the correct value within the range of 1 to 5 depending on the number of connected slaves (modules). The slave at the left side has the address „1" and the slave closest to the Ethernet node will have the highest address setting.

Example: If 3 modules are used than E22 must be set to „1" for the first module on the left, to „2" for the second module in the middle and to „3" for the third module closest to the slave (refer also to
□ Chapter „2.4.2 Multiple module Version (node with multiple modules connected)", page 12).
Response telegrams are automatically multiplexed by the Ethernet node (refer also to
□ Chapter „5.4.2 Multiple-slave (3 DMA modules, working in operation mode 3)", page 22).

Write first…

Byte	Structure					Abbreviation	Description	
0	0..0xFF					TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF	
1	1	2	3	4	5	SNUM	Number of connected slaves (Maximum 5)	
2	15					CMD	Command: 15 = Write multiple parameter by the master	
3	1	1	1	1	1	DAT1.1	Control-Byte	Byte for special functions
4						DAT1.2H	Process Value1	High byte of first „analogue" value
5						DAT1.2L		Low byte of first „analogue" value
6						DAT1.3H	Process Value2	High byte of second „analogue" value
7						DAT1.3L		Low byte of second „analogue" value
8		2	2	2	2	DAT1.1	Control-Byte	Byte for special functions
9						DAT1.2H	Process Value1	High byte of first „analogue" value
10						DAT1.2L		Low byte of first „analogue" value
11						DAT1.3H	Process Value2	High byte of second „analogue" value
12						DAT1.3L		Low byte of second „analogue" value
13			3	3	3	DAT3.1	Control-Byte	Byte for special functions
14						DAT3.2H	Process Value1	High byte of first „analogue" value
15						DAT3.2L		Low byte of first „analogue" value
16						DAT3.3H	Process Value2	High byte of second „analogue" value
17						DAT3.3L		Low byte of second „analogue" value
18				4	4	DAT4.1	Control-Byte	Byte for special functions
19						DAT4.2H	Process Value1	High byte of first „analogue" value
20						DAT4.2L		Low byte of first „analogue" value
21						DAT4.3H	Process Value2	High byte of second „analogue" value
22						DAT4.3L		Low byte of second „analogue" value
23					5	DAT5.1	Control-Byte	Byte for special functions
24						DAT5.2H	Process Value1	High byte of first „analogue" value
25						DAT5.2L		Low byte of first „analogue" value
26						DAT5.3H	Process Value2	High byte of second „analogue" value
27						DAT5.3L		Low byte of second „analogue" value
	8	13	18	23	28	Overall telegram length in bytes		

TADR Telegram address, defined by the Ethernet-Master. (defined by the user) Range 0..255

SNUM Number of connected slaves (Maximum 5).
Here for multi slave operation the number of present slaves has to be set properly.

CMD Command: 15 = Write multiple parameters by the master

DATx[1].1 Control-Byte. One data byte in HEX, for special functions
0x00 == 0
0xFF == 255

DATx[1].2H, DATx[1].2L Process Value1: Two data bytes in HEX, without decimal sign, for „analogue" values
0x7FFF == +32767
0x8000 == -32768

DATx[1].3H, DATx[1].3L Process Value1: Two data bytes in HEX, without decimal sign, for „analogue" values
0x7FFF == +32767
0x8000 == -32768

x[1].= Module address (set by parameter E22 in each DMA-22(A)-Module) range 1 to 5.

5.2 CMD = 15, Response from Slave (9 bytes)

Please pay attention to the fact that in case of multiple slave operation SADR will be changed automatically with each new response.

Example:
When using 3 slaves than the slave with the module address „1" (E22 = 1) will respond first. After the next „Master-Write" the slave with module address „2" (E22 = 2) will respond and finally the last slave with address „3" (E22 = 3). Then it starts again with slave „1".

This means that the multiplexer for answering is implemented in the Ethernet node. SADR indicates which of the modules has actually send the response.

Write first...

Byte	Structure	Abbreviation	Description	
0	Telegram header	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF	
1		SADR	Slave address	
2		CMD	Command: 15 = Write multiple parameter by the master	
3	Data of SADR	DAT.1H	Status Word	High byte of module state
4		DAT.1L		Low byte of module state
5		DAT.2H	VALUE1	High byte of first „analogue" value
6		DAT.2L		Low byte of first „analogue" value
7		DAT.3H	VALUE2	High byte of second „analogue" value
8		DAT.3L		Low byte of second „analogue" value

...Write last

TADR Telegram address, defined by the Ethernet-Master.(set by the user)

SADR Slave address, if more than one Slave is connected to the Ethernet port
1 to max 5 depending on number of slaves

CMD Command: 15 = Write multiple parameters by the master

DAT.1H,DAT.1L Status word. Two data bytes in HEX, , for module state
0x0000 == 0
0xFFFF == 65535

DAT.2H, DAT.2L, DAT.3H, DAT.3L VALUE1
VALUE2. Two data bytes in HEX, without decimal sign, for analogue values
0x7FFF == +32767
0x8000 == -32768

5.3 CMD = 15, Error from Slave (4 bytes)

Write first...

Byte	Abbreviation	Description
0	TADR	Telegram address, defined by the write command, Range 0..255, 0..0xFF
1	SADR	Slave address
2	ERR	Error code
3	EXCE	Exception

...Write last

ERR Error code: 0x8F = write failed

EXCE Exception:
1 = Command not supported
2 = Wrong ID
3 = Wrong Data Value
4 = Writing of ID failed
5 = timeout (Modbus)
6 = Internal checksum error (Modbus)
7 = Invalid number of connected slaves
8 = timeout slave, address wrong or not installed
9 = Ethernet node (SADR = 0) send, received data length to small. The data length of the selected GSD module is too small.

Example for error response:

Module 3 is not installed and SNUM in the master telegram is set to 3

Byte	Data	Abbreviation	Description
0	0x23	TADR	Response telegram address (defined by the write command)
1	**0x03**	SADR	Actual slave address
2	0x8F	ERR	Error, Bit „7" with command 0x0F in decimal 15 is set
3	0x08	EXCE	timeout slave, address wrong or not installed

5.4 Examples, CMD = 15

5.4.1 Single slave

The Ethernet Address Selector in front of the Ethernet-Node is set to the right value (bus error LED is off).
E22 of the DMA-22(A) module is set to 1.
Hardware Enable is connected to the DMA-22(A) module.

Master writes set value of 1.000 V to slave (module):

Byte	Data	Abbreviation	Description
0	0x23	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF
1	0x01	SNUM	0x01 means single slave
2	0x0F	CMD	0x0F in decimal 15
3	0x00	DAT1.1	**Control byte** , 0x00 (default value, no bus-disable)
4	(1000)	DAT1.2H	**Process Value1 = A1.01, set value branch 1**
5		DAT1.2L	0x03E8 (= 1000 in decimal = 1.000V)
6	(0)	DAT1.3H	**Process Value2 = A1.02, feedback value branch 1**
7		DAT1.3L	0x0000 (= 0 in decimal = 0.000V)

Response slave (module) no.1:

Byte	Data		Abbreviation	Description	
0	0x23		TADR	Response telegram address (defined by the write command)	
1	0x01		SADR	Actual slave address	
2	0x0F		CMD	0x0F in decimal 15	
3	0x40		DAT1.1H	**Status word**	High byte of module state = 0x40 (HW enable = active)
4	0x00		DAT1.1L		Low byte of module state = 0x00
5	0x00	(0)	DAT1.2H	**VALUE1** = d1.11	
6	0x00		DAT1.2L	0x0000 (= 0 in decimal = 0.000V)	
7	0x03	(1000)	DAT1.3H	**VALUE2** = d1.10	
8	0xE8		DAT1.3L	0x03E8 (= 1000 in decimal = 1.000V)	

(x) = value in decimal.

5.4.2 Multiple-slave (3 DMA modules, working in operation mode 3)

The Ethernet Address Selector in front of the Ethernet-Node is set to the right value (bus error LED is off).
E22 of the three modules is set to 1, 2, 3.
All modules are powered on, hardware enable is connected all of the DMA-22(A)modules.

Master first write cycle: set value 1.000 V to slave1, 2.000 V to slave2 and - 3.000 V to slave3:

Byte	Data		Abbreviation	Description
0	0x23		TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF
1	0x03		SNUM	0x03 means three slaves (modules) are connected
2	0x0F		CMD	0x0F in decimal 15
3	0x00		DAT1.1	**Control byte** , 0x00 (default value, no bus-disable)
4	0x03	(1000)	DAT1.2H	**Process Value1 = A1.01, set value branch 1**
5	0xE8		DAT1.2L	0x03E8 (= 1000 in decimal = 1.000V)
6	0x00	(0)	DAT1.3H	**Process Value2 = A1.02, feedback value branch 1**
7	0x00		DAT1.3L	0x0000 (= 0 in decimal = 0.000V)
8	0x00		DAT2.1	**Control byte** , 0x00 (default value, no bus-disable)
9	0x07	(2000)	DAT2.2H	**Process Value1 = A1.01, set value branch 1**
10	0xD0		DAT2.2L	0x07D0 (= 2000 in decimal = 2.000V)
11	0x00	(0)	DAT2.3H	**Process Value2 = A1.02, feedback value branch 1**
12	0x00		DAT2.3L	0x0000 (= 0 in decimal = 0.000V)
13	0x00		DAT3.1	**Control byte** , 0x00 (default value, no bus-disable)
14	0xF4	(-	DAT3.2H	**Process Value1 = A1.01, set value branch 1**
15	0x48	3000)	DAT3.2L	0xF448 (= - 3000 in decimal = - 3.000V)
16	0x00	(0)	DAT3.3H	**Process Value2 = A1.02, feedback value branch 1**
17	0x00		DAT3.3L	0x0000 (= 0 in decimal = 0.000V)

(x) = value in decimal.

The node will only send a response if **any** data in the telegram received from the master has be changed! If the data in a telegram have to remain unchanged then a response from the node to a "Master write" can be enforced due to a change of the data TADR.
The data of the write command will be immediately forwarded to all slaves (modules). Each response telegram to a write command will automatically contain „new data" from the next slave (module). The slaves are automatically multiplexed.

Response telegrams are automatically multiplexed by the DMA-22(A)-Ethernet node.
In this example, module 1 answers first

Byte	Abbreviation		Abbreviation	Description
0	0x23		TADR	Response telegram address (defined by the write command)
1	**0x01**		SADR	Actual slave address
2	0x0F		CMD	0x0F in decimal 15
3	0x40		DAT1.1H	High byte of module state, Hardware Enable is active, no error
3	0x00		DAT1.1L	Low byte of module state, not used, in this case always zero
4	0x00	(0)	DAT1.2H	**VALUE1** = d1.11
5	0x00		DAT1.2L	0x0000 (= 0 in decimal = 0.000V)
6	0x03	(1000)	DAT1.3H	**VALUE2** = d1.10
7	0xE8		DAT1.3L	0x03E8 (= 1000 in decimal = 1.000V)

(x) = value in decimal.

Change telegram address TADR to 0x24 and send same message as before. Next module no. 2 will answer.

Byte	Abbreviation		Abbreviation	Description
0	0x24		TADR	Response telegram address (defined by the write command)
1	**0x02**		SADR	Actual slave address
2	0x0F		CMD	0x0F in decimal 15
3	0x40		DAT1.1H	High byte of module state, Hardware Enable is active, no error
3	0x00		DAT1.1L	Low byte of module state, not used, in this case always zero
4	0x00	(0)	DAT1.2H	**VALUE1** = d1.11
5	0x00		DAT1.2L	0x0000 (= 0 in decimal = 0.000V)
6	0x07	(2000)	DAT1.3H	**VALUE2** = d1.10
7	0xD0		DAT1.3L	0x07D0 (= 2000 in decimal = 2.000V)

(x) = value in decimal.

Change telegram address TADR to 0x25 and send same message as before. Next module no. 3 will answer.

Byte	Abbreviation		Abbreviation	Description
0	0x25		TADR	Response telegram address (defined by the write command)
1	**0x03**		SADR	Actual slave address
2	0x0F		CMD	0x0F in decimal 15
3	0x40		DAT1.1H	High byte of module state, Hardware Enable is active, no error
3	0x00		DAT1.1L	Low byte of module state, not used, in this case always zero
4	0x00	(0)	DAT1.2H	**VALUE1** = d1.11
5	0x00		DAT1.2L	0x0000 (= 0 in decimal = 0.000V)
6	0xF4	(-	DAT1.3H	**VALUE2** = d1.10
7	0x48	3000)	DAT1.3L	0xF448 (= - 3000 in decimal = - 3.000V)

(x) = value in decimal.

Change telegram address TADR to 0x26 and send same message as before. Next module no. 1 will answer.

Byte	Abbreviation		Abbreviation	Description
0	0x26		TADR	Response telegram address (defined by the write command)
1	**0x01**		SADR	Actual slave address
2	0x0F		CMD	0x0F in decimal 15
3	0x40		DAT1.1H	High byte of module state, Hardware Enable is active, no error
3	0x00		DAT1.1L	Low byte of module state, not used, in this case always zero
4	0x00	(0)	DAT1.2H	**VALUE1** = d1.11
5	0x00		DAT1.2L	0x0000 (= 0 in decimal = 0.000V)
6	0x03	(1000)	DAT1.3H	**VALUE2** = d1.10
7	0xE8		DAT1.3L	0x03E8 (= 1000 in decimal = 1.000V)

(x) = value in decimal.

5.5 CMD = 15, structure of Ethernet telegram definition, depending on SW Versions

5.5.1 General

5.5.1.1 Error Message (indication by „Error occurred")

Errors which are indicated in the Bit (Error occurred) like for example „Over Current" or „Cable Fraction" can be reset with the following action :

- Set input signal for the hardware enable at the according module at terminal X3/1 (9) to „Low" and then go back to „High"
- Setting and resetting of the Bits (0x80) Bus-Disable

Mandatory condition for resetting an error is that the failure causing the error has been cleared or removed.

Error numbers:
The corresponding error numbers can be found in the respective manual of the DMA-22(A) Modules.
Generally, the following error table is valid:

SLAVE (MODULE) STATUS		Description
Hi-Byte (DAT.1H)	Low-Byte (DAT.1L)	
0x0C	0x01	Error of Operation
0x0C	0x02	Wire break at FB1 (voltage/current depend on setting)
0x0C	0x03	Excess current or short circuit at the output stages (peak current >8A!)
0x0C	0x04	Wire break at FB2 (voltage/current depend on setting)
0x0C	0x05	Wire break at S1.05 (voltage/current depend on setting)
0x0C	0x06	Wire break at S1.06 (voltage/current depend on setting)
0x0C	0x08	Underload of the solenoid output (if monitoring is activated)
0x0C	0x0A	Timeout error -no Ethernet command recognized- (defined with parameter E23)
0x0C	0x0B	Over current at feedback FB1 (current signal >22mA)
0x0C	0x0C	Over current at feedback FB2 (current signal >22mA)
0x0C	0x0F	Over current at set point S1.05 (current signal >22mA)
0x0C	0x10	Over current at set point S1.06 (current signal >22mA)
0x0C	0x17	Selected Sensor need autocalibration.

Table 3: Error numbers

If parameter E 23 has a value not equal to 0 (Ethernet timeout is activated). Depending on parameter E 26, there are different responses from the device.

- E 26 = off (0)
  The device reacts with a blinking enable LED about to long time between valid Ethernet telegrams. Those versions continue with work if a new valid telegram is detected. No separate acknowledges with the enable signal is needed.
- E 26 = 1
  The device reacts with a shining Error LED about to long time between valid Ethernet telegrams. Those versions do not continue with work if a new valid telegram is detected. A separate acknowledge with the enable signal is needed.

Generally, the electronic discards every set point in error case and the outputs will be disabled.

5.5.1.2 Explanation for „Hardware Enable" and „Software Disable":

Generally speaking the hardware enable must be present („high" level) in order to get a signal (current) at the output stages. Besides the hardware enable a software disable can be used in order to „override" the hardware enable. So even if the hardware signal is present, with the according software command the module can be disabled!

This means that the hardware enable can be hardwired and the software disable can be used in order to drop the output signal to zero or also in order to quit errors.

5.5.1.3 Explanation of special functions and module state bits

Attention: Functions and module state bits depend on the used SW version

HW_ENABLE	The „Enable" signal (HW Enable X3/1 (9)) is activated at the module.
ERROR	An Error has occurred in the DMA module. Different possible problems can cause this. Please refer to the manual for the according DMA version.
BUS_DISABLE	Enable signal was reset by means of Ethernet (DMA module is disabled).
Din_1	To enable the function for the „remote loop controller" (function switches from open loop to closed loop) via the comparator „Comp_1" is enabled and can be used. Additional mandatory condition: C1.00 must be set to 2 or 4! Remark: d1.12 and d1.13 remain at „0.000 V" as long as the condition for activation „Din_1" has not be set. This will prevent a premature activation of the comparator „Comp_1".
Dout_1/CL	Indicates that the function „loop controller" for the branch 1 is active. When the module is working in „remote loop", the module is now working in closed loop mode. Additional mandatory conditions for transition from open loop to closed loop: • C1.00 must be set to 2 or 4 • Signal Din_1 must be present • Comparator Comp_1 has to be outside of the window, hence signal Comp_1 = 0. The module will remain in closed loop operation as long as signal Din_1 stays on „High".
Comp_1	Output signal of comparator „Comp_1", s used in order to monitor the signal defined by C1.25. This signal can also be used in order to switches over from open to closed loop: 0 = comparator is not active (out of the determined limits and time delays) 1 = comparator is active (inside the determined limits and time delays).
Comp_11	Output signal of comparator „Comp_11", is used in order to monitor the signal defined by C1.32 0 = comparator is not active (out of the determined limits and time delays) 1 = comparator is active (inside the determined limits and time delays).
Din_2	To enable the function for the „remote loop controller" (function switches from open loop to closed loop) via the comparator „Comp_2" is enabled and can be used. Additional mandatory condition: C2.00 must be set to 2 or 4! Remark: d2.12 and d2.13 remain at „0.000 V" as long as the condition for activation „Din_2" has not be set. This will prevent a premature activation of the comparator „Comp_2"..
Dout_2	Indicates that the function „loop controller" for the branch 2 is active. When the module is working in „remote loop", the module is now working in closed loop mode. Additional mandatory conditions for transition from open loop to closed loop: • C2.00 must be set to 2 or 4 • Signal Din_2 must be present • Comparator Comp_2 has to be outside of the window, hence signal Comp_2 = 0. The module will remain in closed loop operation as long as signal Din_2 stays on „High".
Comp_2	Output signal of comparator „Comp_2", s used in order to monitor the signal defined by C2.25. This signal can also be used in order to switches over from open to closed loop: 0 = comparator is not active (out of the determined limits and time delays) 1 = comparator is active (inside the determined limits and time delays).
Comp_22	Output signal of comparator „Comp_22", is used in order to monitor the signal defined by C2.32 0 = comparator is not active (out of the determined limits and time delays) 1 = comparator is active (inside the determined limits and time delays).
TST_CMP	This bit can be used to test the Set Error/Comp output. When set, the output is set to 24V, independent of the Comp_1/Comp_2 signal. To activate this function the parameter E 18 must be set to a value > 0 and no error is present.
CNTRL_4	Reserved for special function
STAT_1..5	Reserved for special functions

5.5.2 Version for Mode 1 (open loop, one valve with two solenoids)

Telegram structure example with 1 DMA module (SNUM = 1),
Master writes multiple parameters (3+5·module bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM	Number of connected slaves (Maximum 5)
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**A1.01 Module 1**
	5		DAT1.2L	Set value input (Ethernet)
	6		DAT1.3H	**A1.02 Module 1 (normally not used)**
	7		DAT1.3L	Set value input (Ethernet)
….Write last		8	Overall telegram length in bytes	

Explanation of Byte for special functions (**Control byte**)

Description	Abbreviation	Function of each bit
Byte for special functions	DATx.1	Can be set only if the hardware enable is active. 0x01 = **not used** 0x04 = **TST_CMP**; Set Error/Comp output direct to 24V (disable signalizing of error output) 0x10 = **not used** 0x80 = **BUS_DISABLE** (Module disable via Ethernet) In this mode not applicable, reserved: 0x02 = CNTRL_1 0x08 = CNTRL_2 0x20 = CNTRL_3 0x40 = CNTRL_4
		The special function byte will be set to internal 0x00 (reset) when the hardware enable is inactive.

Response telegram:

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by the write command
	1		SADR	Slave address
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Data of SADR Module	DAT.1H	**Status word** | High byte of module state
	4		DAT.1L	Low byte of module state
	5		DAT.2H	**d1.07 from module with related SADR**
	6		DAT.2L	Actual current A
	7		DAT.3H	**d1.08 from module with related SADR**
	8		DAT.3L	Actual current B
….Write last		9	Overall telegram length in bytes	

Explanation of High and low byte of module state (**Status word**):

Description	Abbreviation	Explanation of each bit
High byte of module state	DAT.1H	0x01 = Digital input **SP1** active 0x02 = Digital input **SP2** active 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** active 0x20 = Digital input **SP4** active 0x80 = **BUS_DISABLE** is set In this mode not applicable, reserved: 0x40 = STAT_5
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = **not used** 0x02 = **not used** 0x04 = **not used** 0x08 = **not used** 0x10 = **not used** 0x20 = **not used** 0x40 = **not used** 0x80 = **not used**

5.5.3 Version for Mode 2 (open loop, two valves with one solenoid each)

Telegram structure example with 1 DMA module (SNUM = 1),
Master writes multiple parameters (3+5·module bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM	Number of connected slaves (Maximum 5)
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**A1.01,** set value input (Ethernet) for (Branch 1)
	5		DAT1.2L	
	6		DAT1.3H	**A2.01,** set value input (Ethernet) for (Branch 2)
	7		DAT1.3L	
….Write last		8	Overall telegram length in bytes	

Explanation of Byte for special functions (**Control byte**)

Description	Abbreviation	Function of each bit
Byte for special functions	DATx.1	Can be set only if the hardware enable is active. 0x01 = not used 0x04 = **TST_CMP**; Set Error/Comp output direct to 24V (disable signalizing of error output) 0x10 = not used 0x80 = **BUS_DISABLE** (Module disable via Ethernet) In this mode not applicable, reserved: 0x02 = CNTRL_1 0x08 = CNTRL_2 0x20 = CNTRL_3 0x40 = CNTRL_4
		The special function byte will be set to internal 0x00 (reset) when the hardware enable is inactive.

Response telegram:

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by the write command
	1		SADR	Slave address
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Data of SADR Module	DAT.1H	**Status word** | High byte of module state
	4		DAT.1L	Low byte of module state
	5		DAT.2H	**d1.07 from module with related SADR**
	6		DAT.2L	Actual current A
	7		DAT.3H	**d1.08 from module with related SADR**
	8		DAT.3L	Actual current B
….Write last		9	Overall telegram length in bytes	

Explanation of High and low byte of module state (**Status word**):

Description	Abbreviation	Explanation of each bit
High byte of module state	DAT.1H	0x01 = Digital input **SP1** active 0x02 = Digital input **SP2** active 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** active 0x20 = Digital input **SP4** active 0x80 = **BUS_DISABLE** is set In this mode not applicable, reserved: 0x40 = STAT_5
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = not used 0x02 = not used 0x04 = not used 0x08 = not used 0x10 = not used 0x20 = not used 0x40 = not used 0x80 = not used

5.5.4 Version for Mode 3, 4, 10 (closed loop)

Telegram structure example with 1 DMA module (SNUM = 1), Master writes multiple parameters (3+5·module bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM	Number of connected slaves (Maximum 5)
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**Process Value1 = A1.01**
	5		DAT1.2L	Set value input (Ethernet) for (Branch 1)
	6		DAT1.3H	**Process Value2 = A1.02**
	7		DAT1.3L	Feedback value input (Ethernet) for (Branch 1)
….Write last		8	Overall telegram length in bytes	

Explanation of Byte for special functions (**Control byte**)

Description	Abbreviation	Function of each bit
Byte for special functions	DATx.1	Can be set only if the hardware enable is active. 0x01 = **Din_1**; Set signal Din_1 to active 0x04 = **TST_CMP**; Set Error/Comp output direct to 24V (disable signalizing of error output) 0x10 = **Din_2**; Set signal Din_2 to active 0x80 = **BUS_DISABLE** (Module disable via Ethernet) In this mode not applicable, reserved: 0x02 = CNTRL_1 0x08 = CNTRL_2 0x20 = CNTRL_3 0x40 = CNTRL_4
		The special function byte will be set to internal 0x00 (reset) when the hardware enable is inactive.

Response telegram:

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by the write command
	1		SADR	Slave address
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Data of SADR Module	DAT.1H	**Status word** | High byte of module state
	4		DAT.1L	Low byte of module state
	5		DAT.2H	**VALUE1** = d1.11 from module with related SADR
	6		DAT.2L	Actual value, feedback value (Branch 1)
	7		DAT.3H	**VALUE2** = d1.10 from module with related SADR
	8		DAT.3L	Set value (internal value) (Branch 1)
….Write last		9	Overall telegram length in bytes	

Explanation of High and low byte of module state (**Status word**):

Description	Abbreviation	Explanation of each bit
High byte of module state	DAT.1H	0x01 = Digital input **SP1** active 0x02 = Digital input **SP2** active 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** active 0x20 = Digital input **SP4** active 0x80 = **BUS_DISABLE** is set In this mode not applicable, reserved: 0x40 = STAT_5
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = **Din_1** active 0x02 = **Dout_1** active 0x04 = **Comp_1** active 0x08 = **Comp_11** active 0x10 = **Din_2** active 0x20 = **Dout_2** active 0x40 = **Comp_2** active 0x80 = **Comp_22** active

5.5.5 Version for Mode 6, 11 (two closed loops)

Telegram structure example with 1 DMA module (SNUM = 1), Master writes multiple parameters (3+5·module bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM	Number of connected slaves (Maximum 5)
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**Process Value1 = A1.01**
	5		DAT1.2L	Set value input (Ethernet) for (Branch 1)
	6		DAT1.3H	**Process Value2 = A2.02**
	7		DAT1.3L	Feedback value input (Ethernet) for (Branch 2)
….Write last		8	Overall telegram length in bytes	

Explanation of Byte for special functions (**Control byte**)

Description	Abbreviation	Function of each bit
Byte for special functions	DATx.1	Can be set only if the hardware enable is active. 0x01 = **Din_1**; Set signal Din_1 to active 0x04 = **TST_CMP**; Set Error/Comp output direct to 24V (disable signalizing of error output) 0x10 = **Din_2**; Set signal Din_2 to active 0x80 = **BUS_DISABLE** (Module disable via Ethernet) In this mode not applicable, reserved: 0x02 = CNTRL_1 0x08 = CNTRL_2 0x20 = CNTRL_3 0x40 = CNTRL_4
		The special function byte will be set to internal 0x00 (reset) when the hardware enable is inactive.

Response telegram:

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by the write command
	1		SADR	Slave address
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Data of SADR Module	DAT.1H	**Status word** | High byte of module state
	4		DAT.1L	**Status word** | Low byte of module state
	5		DAT.2H	**VALUE1** = d1.11 from module with related SADR
	6		DAT.2L	Actual value, feedback value (Branch 1)
	7		DAT.3H	**VALUE2** = d2.11 from module with related SADR
	8		DAT.3L	Actual value, feedback value (Branch 2)
….Write last		9	Overall telegram length in bytes	

Explanation of High and low byte of module state (**Status word**):

Description	Abbreviation	Explanation of each bit
High byte of module state	DAT.1H	0x01 = Digital input **SP1** active 0x02 = Digital input **SP2** active 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** active 0x20 = Digital input **SP4** active 0x80 = **BUS_DISABLE** is set In this mode not applicable, reserved: 0x40 = STAT_5
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = **Din_1** active 0x02 = **Dout_1** active 0x04 = **Comp_1** active 0x08 = **Comp_11** active 0x10 = **Din_2** active 0x20 = **Dout_2** active 0x40 = **Comp_2** active 0x80 = **Comp_22** active

5.5.6 Version for Mode 8 (closed loop)

Telegram structure example with 1 DMA module (SNUM = 1), Master writes multiple parameters (3+5·module bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM	Number of connected slaves (Maximum 5)
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**Process Value1 = A1.01**
	5		DAT1.2L	Set value input (Ethernet) for (Branch 1)
	6		DAT1.3H	**Process Value2 = A2.01 S**
	7		DAT1.3L	Set value input (Ethernet) for (Branch 2)
….Write last		8	Overall telegram length in bytes	

Explanation of Byte for special functions (**Control byte**)

Description	Abbreviation	Function of each bit
Byte for special functions	DATx.1	Can be set only if the hardware enable is active. 0x01 = **Din_1**; Set signal Din_1 to active 0x04 = **TST_CMP**; Set Error/Comp output direct to 24V (disable signalizing of error output) 0x10 = **Din_2**; Set signal Din_2 to active 0x80 = **BUS_DISABLE** (Module disable via Ethernet) Not applicable, reserved: 0x02 = CNTRL_1 0x08 = CNTRL_2 0x20 = CNTRL_3 0x40 = CNTRL_4
		The special function byte will be set to internal 0x00 (reset) when the hardware enable is inactive.

Response telegram:

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by the write command
	1		SADR	Slave address
	2		CMD	Command: 15 = Write multiple parameter by the master
	3	Data of SADR Module	DAT.1H	**Status word** | High byte of module state
	4		DAT.1L	Low byte of module state
	5		DAT.2H	**VALUE1** = d1.11 from module with related SADR
	6		DAT.2L	Actual value, feedback value (Branch 1)
	7		DAT.3H	**VALUE2** = d2.11 from module with related SADR
	8		DAT.3L	Actual value, feedback value (Branch 2)
….Write last		9	Overall telegram length in bytes	

Explanation of High and low byte of module state (**Status word**):

Description	Abbreviation	Explanation of each bit
High byte of module state	DAT.1H	0x01 = Digital input **SP1** active 0x02 = Digital input **SP2** active 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** active 0x20 = Digital input **SP4** active 0x80 = **BUS_DISABLE** is set In this mode not applicable, reserved: 0x40 = STAT_5
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = **Din_1** active 0x02 = **Dout_1** active 0x04 = **Comp_1** active 0x08 = **Comp_11** active 0x10 = **Din_2** active 0x20 = **Dout_2** active 0x40 = **Comp_2** active 0x80 = **Comp_22** active

5.6 Digital inputs

The DMA-22(A) has three digital inputs

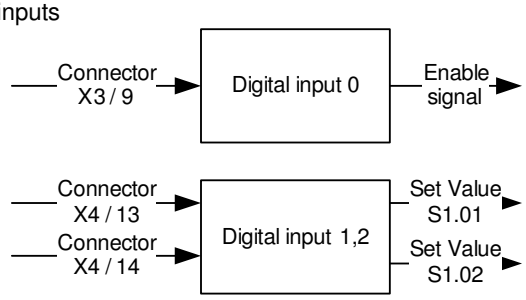


Figure 6: Digital inputs

5.6.1 Digital input 0 (enable signal) input 1,2 (set Value selection)

The digital enable signal incorporates the following functions:

- Removes the hardware locking of the output stages
- Start the solenoid current controller
- Start the control loop of branch 1 and/or branch 2

The set value selection signal incorporates the following functions:

- Select the set value of parameter S1.01, S1.02
- Set the signal Din_1, Din_2 when the “remote controller” is selected.

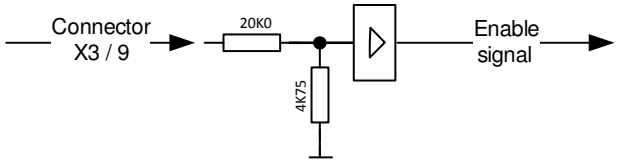


Figure 7: schematic of digital input 0,1,2

Enable Signal	Description
ON	Signal of digital input > 8V
OFF	Signal of digital input < 3V

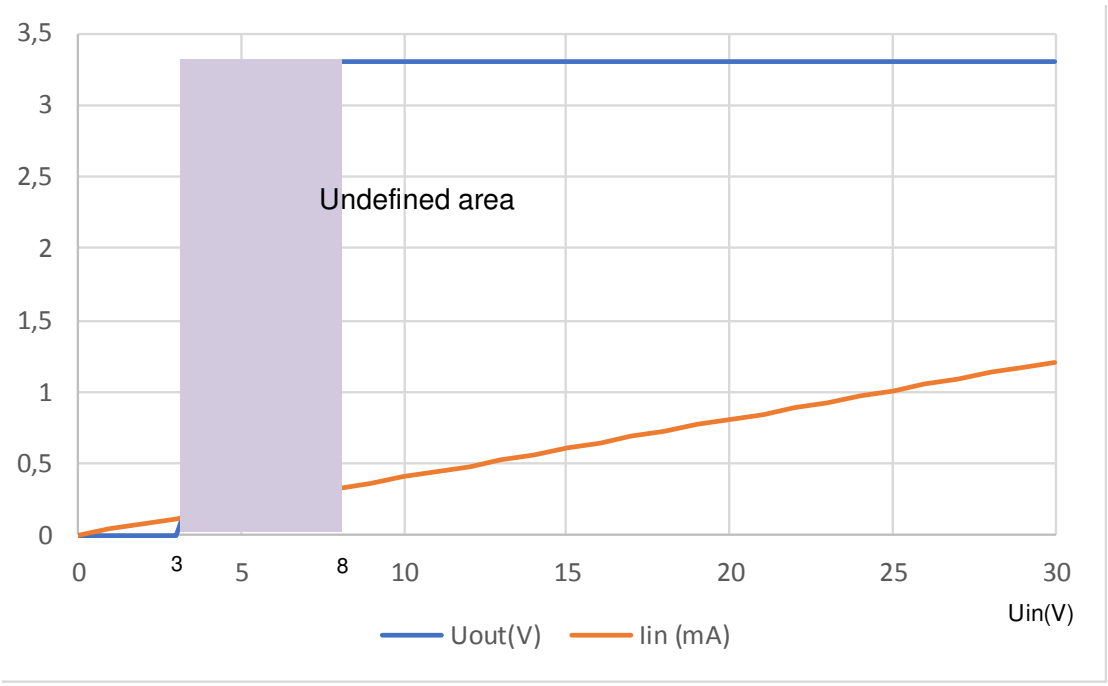


Figure 8: Input Signal curve

5.7 Digital outputs

The following digital output is available.

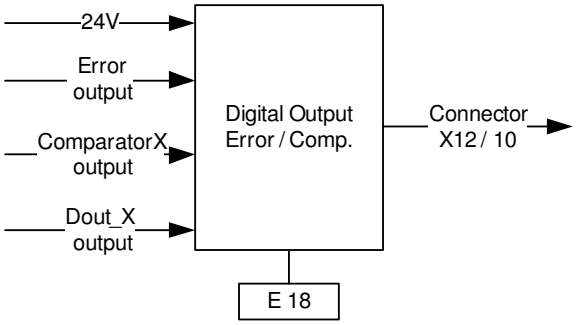


Figure 9: Digital outputs

5.7.1 Digital output: \Error or Comparator output

At the terminal X12 / 10 the error output or comparator is available (Depending on setting E18)
If an error occurred, the output is low (negative logic).

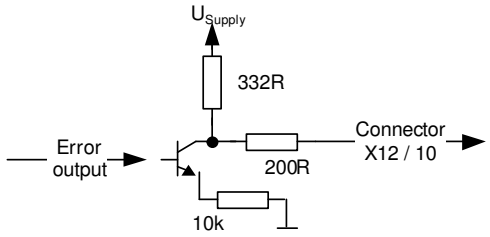


Figure 10: schematic of digital output \Error/comp.

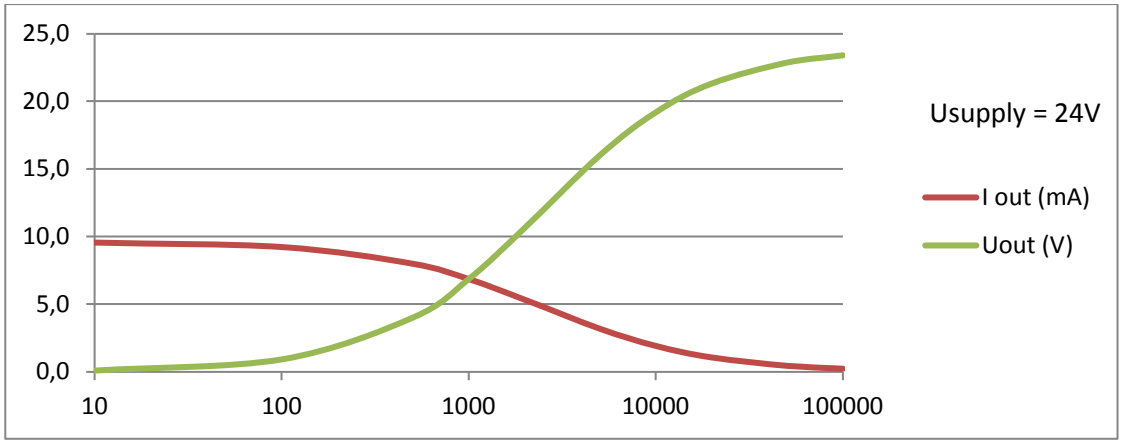


Figure 11: Output high, voltage and current curve at 24V supply

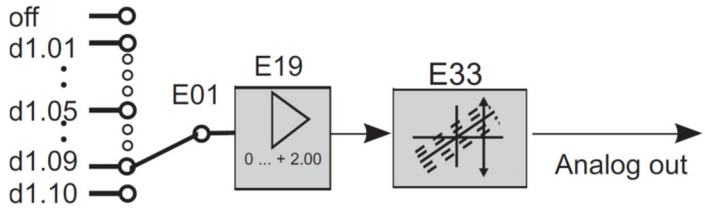
On the output pin X12 / 10 can also be used as a universal output.

5.7.2 Internal supply output

Normally the output voltage is fixed to 10V ref. (on customer request the output voltage can be changed). The connector pin for the outputis not fix. Please refer the label on the DMA module.

5.7.3 Analog voltage output

Maximal output current 6mA.
The connector pin for the output is not fix. Please refer the label on the DMA module.



5.8 Status display LEDs

The network and the amplifier states are indicated by light emitting diodes (status display LEDs) on the electronics housing.

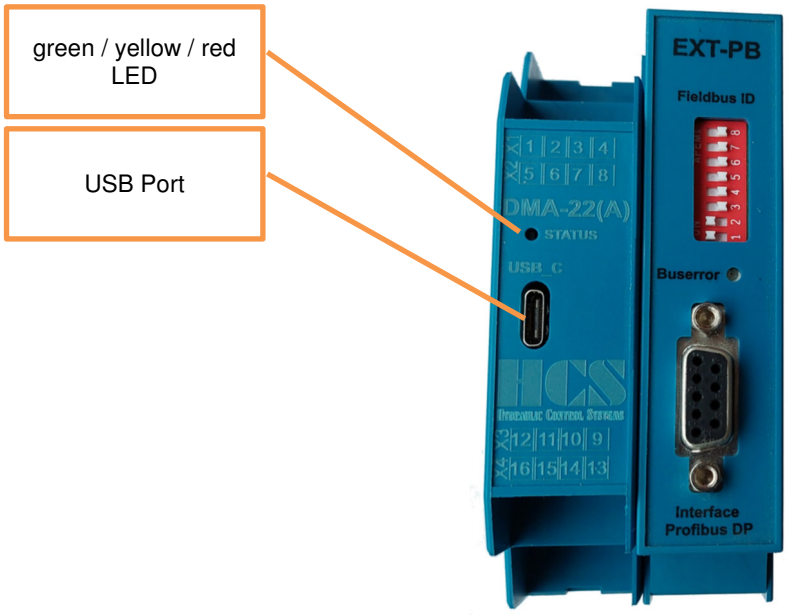


Figure 12: Top view, status LEDs and USB Port

5.8.1 LED definition

LED	Definition
ON	constantly ON
OFF	constantly OFF
Blinking	equal ON and OFF times with a frequency of 1.0 Hz: ON/OFF = 500 ms.
Fast Blinking	equal ON and OFF times with a frequency of 4.0 Hz: ON/OFF = 125 ms.
Flashing	Different ON and OFF times: ON = 50 ms, OFF = 250 ms.
Flicker flash	Different ON and OFF times: ON = 100 ms, OFF = 400 ms.

Table 4: LED definitions

5.8.2 LED status definition

Definition « Enable Signal » see □ Chapter “5.6.1 Digital input 0 (enable signal)“, page 31

EXT-PB	DMA-22(A)			Enable Signal	Description
Red LED	Green LED	Yellow LED	Red LED		
OFF	OFF	OFF	OFF	---	No power is applied to the amplifier
OFF	ON	OFF	OFF	OFF	Power is applied via external source or the USB interface.
OFF	OFF	Blinking	OFF	ON	The device is in the semiautomatic sensor calibration process.
OFF	OFF	Fast Blinking	OFF	ON	Enable signal is on, and the parameter E 09 is set to a certain value. Or, the device is disabled by bus command.
OFF	OFF	ON	OFF	ON	Enable of the device is active.
--	OFF	OFF	ON	ON	Internal error occurred.
ON	--	--	--	--	No Ethernet connection discovered

6 Setup the Ethernet communication

6.1 Check the ethernet connection

If the Web-server of the device is responding, the communication is possible.

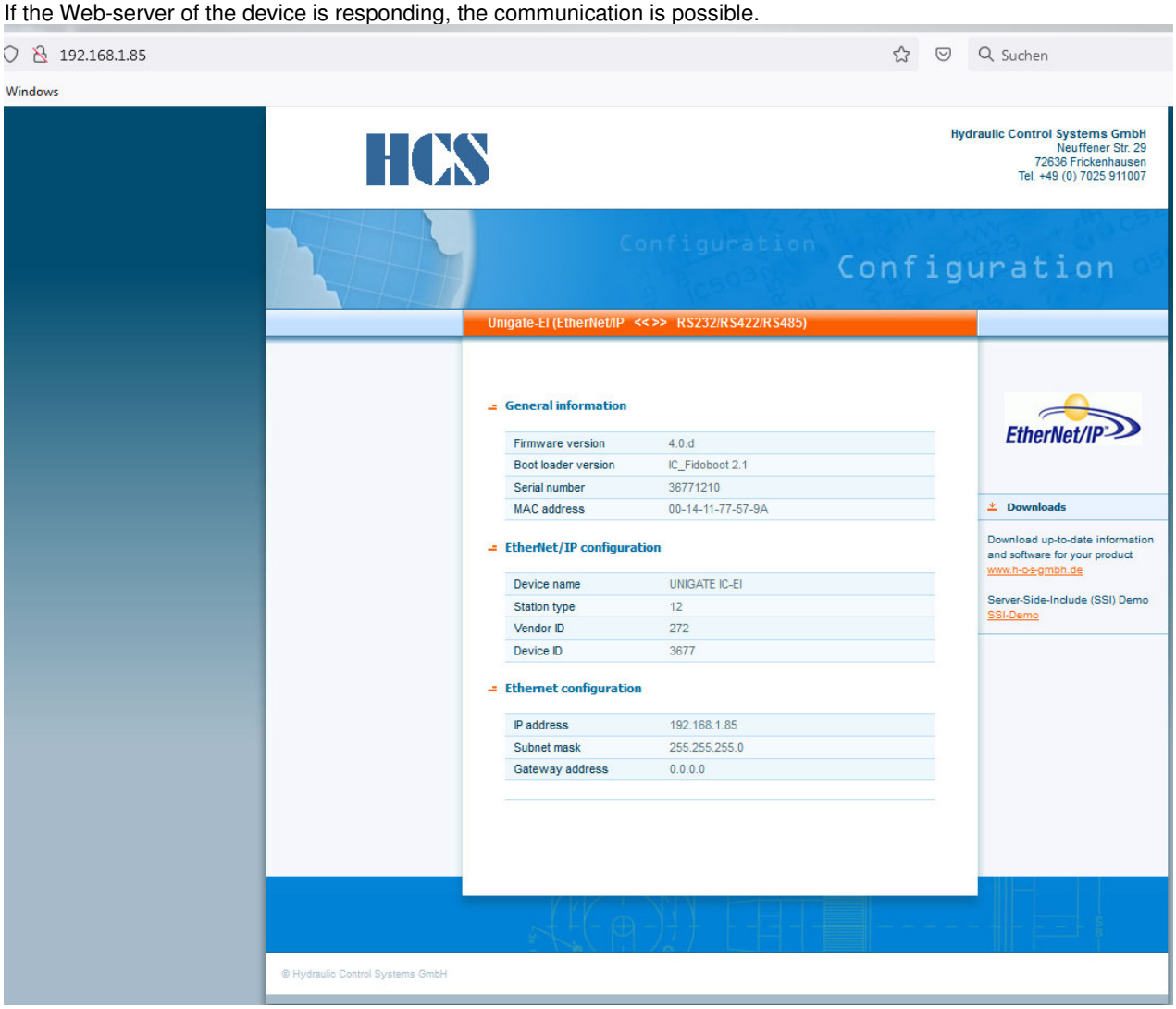


Figure 13: Web server example for address 192.168.1.85

6.2 Example for communication by means “EIPScan”

EIPScan is a product of Pyramid Solutions.

6.2.1 General information “EIPScan”

Supplier of EIP Scan:
Pyramid Solutions, Inc.
Headquarters
30150 Telegraph Road, Suite 200
Bingham Farms, Michigan 48025
Phone: (248) 549-1200
1-888-PYRASOL
FAX: (249)549-1400
Web: www.pyramidsolutions.com

6.2.2 Starting „EIPScan“:

Power-up „DMA-Ethernet_IP-extension“ and connect to local net (LAN)
The module is ready for communication as soon as the LED „H1“ starts blinking.

6.2.3 Add new device → add Ethernet node

Via „Device / IO Module" => "Add Device / IO Module" add the Ethernet node

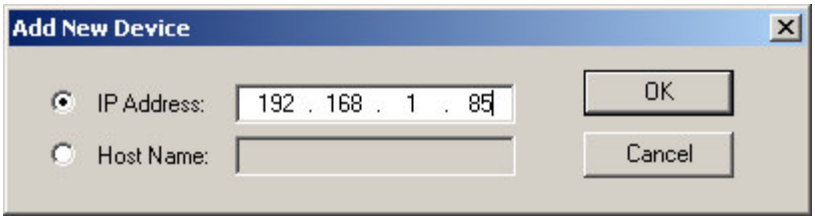


Figure 14: Ethernet IP address

In our example the software tool „EIPScan", takes care of the complete Ethernet-IP communication. The user only needs to take care of his data.

6.2.4 Setup new Class Connection

Insert data as shown in picture below.
The large value for „Timeout Multiplier “(here 512) is necessary due to manual testing. In automated communication mode, this value can possibly be reduced.

The communication Objects 100 and 101 needs to be defined.

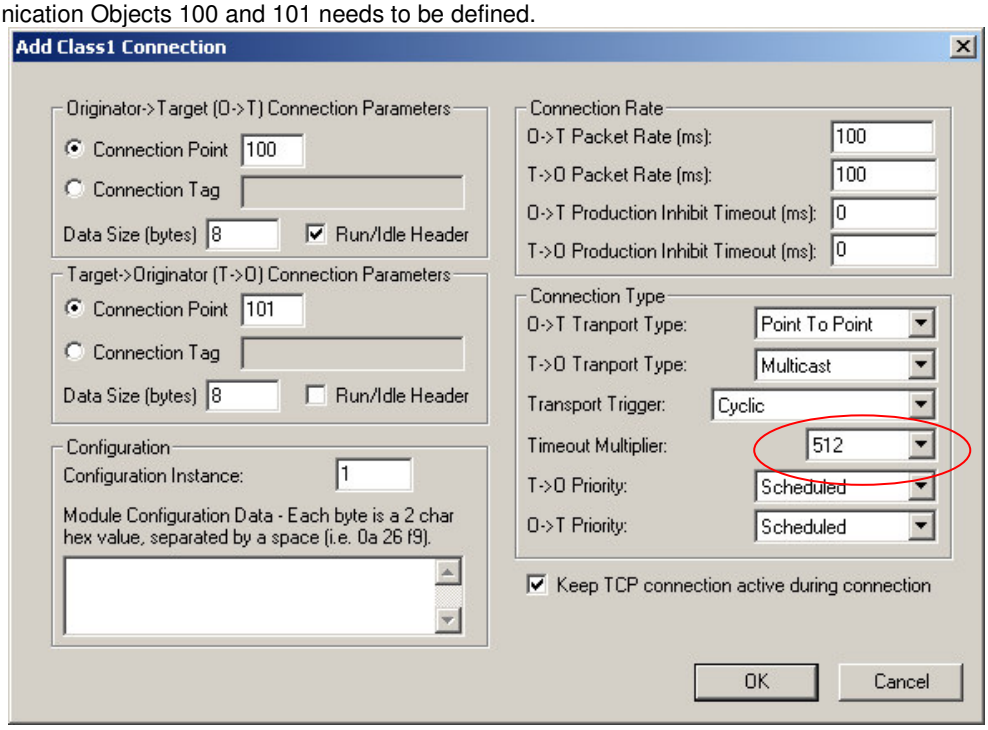


Figure 15: Connection setup

Figure 15 shows:

- output object with instance 101
- input object with instance 100

These instances are automatically proposed default values by EIPScan (during establishing the connection). Data-size in the Pyramid software and buffer size (parameters E29, E30 in the DMA) must be set properly.

6.3 Telegram example for “Parameter Read” via software EIPScan:

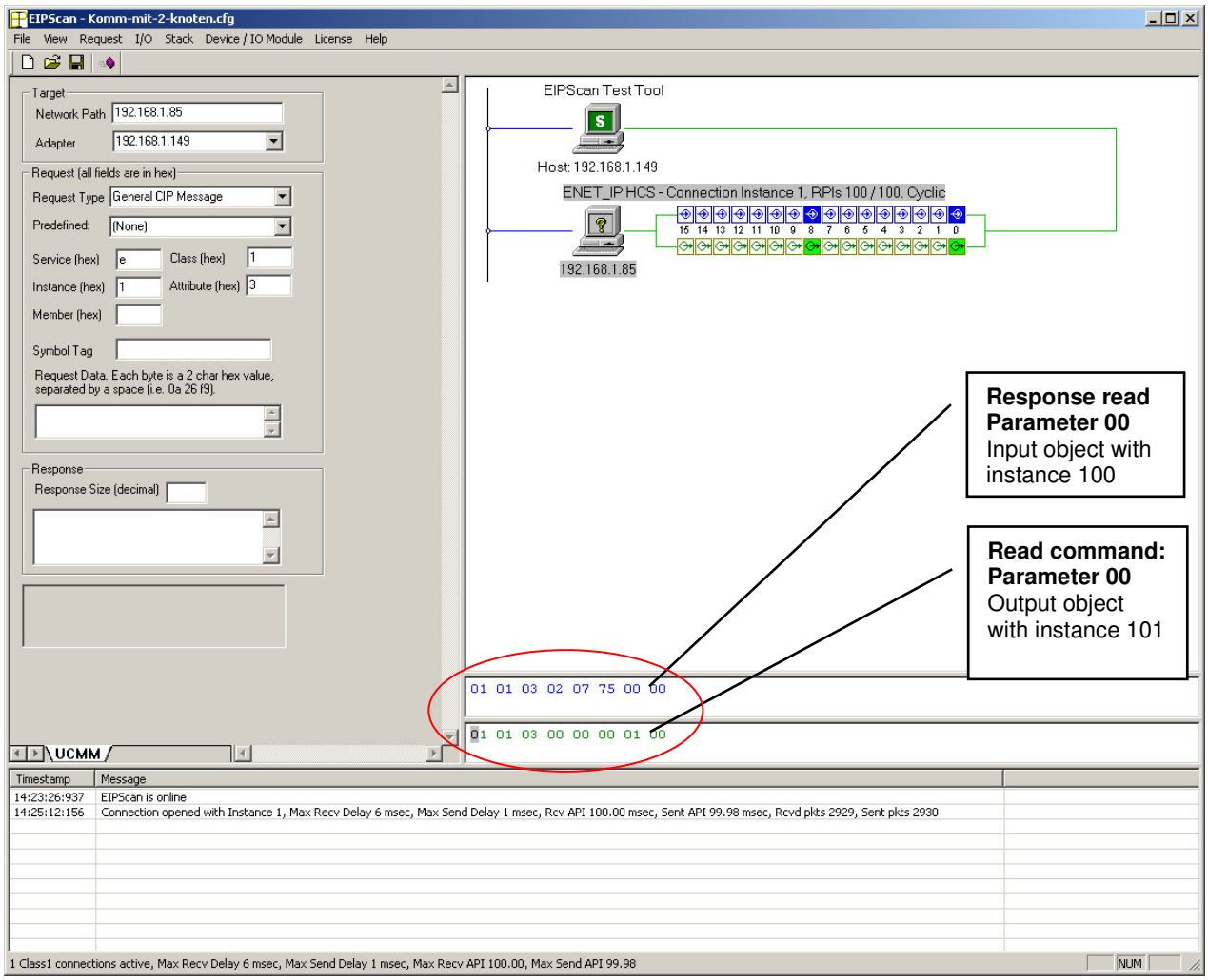


Figure 16: Example parameter read

Input object with instance 100 (attribute # 3) (PLC --> Slave (in the example screen of the EIPScan the line in blue)
Output object with instance 101 (attribute # 3) (slave --> PLC) (in the example screen of the EIPScan the line in green)

Example: request for software version from module # 1 (E22 = 1) via parameter 00

Read Command: “01 01 03 00 00 00 01 00“:

Byte	Value	Abbreviation	Description
0	0x01	TADR	Response telegram address (defined by the write command)
1	**0x01**	SADR	Slave address, slave with E22 =1
2	0x0F	CMD	Command: 3 = Read multiple parameters by the master
3	00	IDH	Parameter ID 00
4	00	IDL	
5	00	N-high	One Parameter should be read
6	01	N-low	
7	00	--	Dummy only for filling up the buffer

Response: “01 01 03 02 07 75 00 00“:

Byte	Value	Abbreviation	Description
0	0x01	TADR	Response telegram address (defined by the write command)
1	**0x01**	SADR	Actual slave address
2	0x03	CMD	Command: 3 = Read multiple parameters by the master
3	02	CNT	2 bytes of data
4	07	DAT1H	Value of the Parameter 0x775 == **Softwareversion 1909**
5	75	DAT1L	
6	00	--	Dummy only for filling up the buffer
7	00	--	Dummy only for filling up the buffer

7 List of parameters

Parameters in grey letters are not yet implemented in the DMA Software.
All values in decimal, for usage as data values they must be converted into Hex
R = read only parameter.
X = implemented, but not active (no access)
W/R = writing and reading possible.

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x00	0	R	Vers	Software version	---	xx.xx	xx.xx	10.01	Depends on HW and SW version
0x01	1	R	d1.01	Sum of analogue set value	V	-9999	9999	-	-1000 == -1.000 V;
0x02	2	R	d1.02	Sum of all post ramp set values	V	-9999	9999	-	1000 == 1.000 V
0x03	3	R	d1.03	Set values after linearization	V	-9999	9999	-	
0x04	4	R	d1.04	Value after gain adjustment.	V	-9999	9999	-	
0x05	5	R	d1.05	Signal A	V	-9999	9999	-	
0x06	6	R	d1.06	Signal B	V	-9999	9999	-	
0x07	7	R	d1.07	Current A	A	0	5000	-	1000 == 1.000 A
0x08	8	R	d1.08	Current B	A	0	5000	-	
0x09	9	R	d1.09	Total current	A	0	5000	-	
0x0A	10	R	d1.10	Desired value	V	-9999	9999	-	-1000 == -1.000 V; 1000 == 1.000 V
0x0B	11	R	d1.11	Actual value, feedback value	V	-9999	9999	-	
0x0C	12	R	d1.12	Lag error	V	-9999	9999	-	
0x0D	13	R	d1.13	Controller output	V	-9999	9999	-	
0x0E	14	R	d2.01	Sum of analogue set value	V	-9999	9999	-	
0x0F	15	R	d2.02	Sum of all post ramp set values	V	-9999	9999	-	
0x10	16	R	d2.03	Set values after linearization	V	-9999	9999	-	
0x11	17	R	d2.04	Value after gain adjustment.	V	-9999	9999	-	
0x12	18	R	d2.10	Desired value	V	-9999	9999	-	
0x13	19	R	d2.11	Actual value, feedback value	V	-9999	9999	-	
0x14	20	R	d2.12	Lag error	V	-9999	9999	-	
0x15	21	R	d2.13	Controller output	V	-9999	9999	-	
0x16	22	R/W	S1.01	Set Value1	V	-9999	9999	0	
0x17	23	R/W	S1.02	Set Value2	V	-9999	9999	0	
0x18	24	R/W	S1.03	Set Value3	V	-9999	9999	0	
0x19	25	R/W	S1.04	Set Value4	V	-9999	9999	0	
0x1A	26	---	S1.08	reserved		---	---	---	---
0x1B	27	R/W	r1.01	Ramp from 0 ⇒ -	s	0	3950	0	1 == 10ms
0x1C	28	R/W	r1.02	Ramp from – ⇒ 0	s	0	3950	0	0 == Ramp function off
0x1D	29	R/W	r1.03	Ramp from 0 ⇒ +	s	0	3950	0	
0x1E	30	R/W	r1.04	Ramp from + ⇒ 0	s	0	3950	0	
0x1F	31	R/W	A1.01	Ethernet set value (Branch 1)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V This value is, when written, always active. Cleared by reset, or writing “0”. For switching off of the analogue set-value, set E17 = “2”
0x20	32	R/W	A1.02	Ethernet feedback value (Branch 1)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V C1.09 has to be switched off in order to avoid interferences
0x21	33	R/W	S2.01	Set Value1 (Branch 2)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x22	34	R/W	S2.02	Set Value2 (Branch 2)	V	-9999	9999	0	
0x23	35	R/W	r2.01	Ramp from 0 ⇒ -	s	0	3950	0	1 == 10ms
0x24	36	R/W	r2.02	Ramp from – ⇒ 0	s	0	3950	0	0 == Ramp function off
0x25	37	R/W	r2.03	Ramp from 0 ⇒ + (Branch 2)	S	0	3950	0	
0x26	38	R/W	r2.04	Ramp from + ⇒ 0 (Branch 2)	S	0	3950	0	
0x27	39	R/W	A2.01	Ethernet set value (Branch 2)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V This value is, when written, always active. Cleared by reset, or writing “0”. For switching off of the analogue set-value, set E17 = “2”
0x28	40	R/W	A2.02	Ethernet feedback value (Branch 2)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V C2.09 has to be switched off in order to avoid interferences
0x29	41	R/W	C1.00	Controller selection	---	0	4	1	0 = off 1 = P-PT_1-I-DT_1 2 =Remote 3 =dff 4 =Remote + dff
0x2A	42	R/W	C1.01	Safety function	---	0	1	0	0 = off; 1 = on
0x2B	43	R/W	C1.02	Linearization	---	0	6	0	0 = linear 1 ... 5 = standard curves 6 = customized curve

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x2C	44	R/W	C1.03	Gain A	V/V	0	200	100	100 == Factor 1.00
0x2D	45	R/W	C1.04	Gain B	V/V	0	200	100	100 == Factor 1.00
0x2E	46	R/W	C1.05	Set value sign and gain	V/V	-400	400	100	100 == Factor 1.00 Sign and gain!
0x2F	47	R/W	C1.06	Set value offset	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x30	48	R/W	C1.07	Dead band compensation A	V	0	9999	0	1000 == 1.000 V
0x31	49	R/W	C1.08	Dead band compensation B	V	0	9999	0	9.999 V = max. current depending on solenoid selection
0x32	50	R/W	C1.09	Sensor type Attention: No negative controller output possible when 10, 11 or 12 is selected!	---	1	28	4	off = Deactivated 1 = 0...20mA 2 = 4...20mA 3 = 12mA +-8mA 4 = 0...10V 5 = 0...+-10V 6 = 6V +-2.5V 7 = 7.5V +-2.5V 8 = 6V +-4V 9 = reserved 10 = 0..20mA (positive contr. outp. only) 11 = 4..20mA (positive contr. outp. only) 12 = 0..10V (positive contr. outp. only) 13 = reserved 14 = 5V+-3.0V 15..20 = reserved 21 = Bipolar voltage semiautomatic calibration 22 = Unipolar voltage semiauto. calibration 23 = Unipolar volt. semiauto. calibration (positive contr. outp. only) 24 = Bipolar (internal) current semiauto. calibration 25 = Unipolar current semiauto. calibration 26 = Unipolar current semiauto. calibration (positive contr. outp. only) 27 = reserved 28 = 5V+-2.6V
0x33	51	R/W	C1.10	Actual value gain	V/V	0	400	100	100 == Factor 1.00
0x34	52	R/W	C1.11	Actual value offset	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x35	53	R/W	C1.12	Actual value sign	---	- 1	+ 1	1	- 1 = negative 0 = off + 1 = positive
0x36	54	R/W	C1.13	P-Portion K_{P1}	V/V	0	400	0	100 == Factor 1.00
0x37	55	R/W	C1.14	T-Portion for PT1 (to C1.16)	S	0	1000	0	100 == 1.00
0x38	56	R/W	C1.15	Threshold (C1.13, C1.16)	V	0	9999	9999	1000 == 1.000 V
0x39	57	R/W	C1.16	P-Portion K_{P2}	V/V	0	400	0	100 == Factor 1.00
0x3A	58	R/W	C1.17	I-Portion	V/s	0	4000	0	1000 == 1.000
0x3B	59	R/W	C1.18	D-Portion	Vs	0	400	0	100 == 1.00
0x3C	60	R/W	C1.19	T-Portion for DT1	S	0	1000	0	100 == 1.00
0x3D	61	R/W	C1.20	Gain (C1.13 and C1.16)	V/V	1	32	1	2 = Factor 2.00
0x3E	62	R/W	C1.21	Comparator upper level	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x3F	63	R/W	C1.22	Comparator lower level	V	-9999	9999	0	
0x40	64	R/W	C1.23	Comparator delay into window	S	0	9999	0	1 == 10 ms
0x41	65	R/W	C1.24	Comparator delay out of window	S	0	9999	0	0 == no delay
0x42	66	R/W	C1.25	Comparator selection COMP_1	---	0	3	0	0 = off 1 = Set value 2 = Actual value 3 =Lag error
0x43	67	R/W	C1.26	Cable fracture detection feedback	---	0	1	0	0 = off; 1 = active
0x44	68	R/W	C2.00	Controller selection	---	0	4	0	0 = off 1 = P-PT_1-I-DT_1 2 =Remote 3 =dff 4 =Remote + dff
0x45	69	R/W	C2.01	Safety function	---	0	1	0	0 = off; 1 = on
0x46	70	R/W	C2.02	Linearization	---	0	6	0	0 = linear 1 ... 5 = standard curves 6 = customized curve
0x47	71	R/W	C2.03	Gain A	V/V	0	200	100	100 == Factor 1.00
0x48	72	R/W	C2.04	Gain B	V/V	0	200	100	100 == Factor 1.00
0x49	73	R/W	C2.05	Set value sign and gain	V/V	-400	400	100	100 == Factor 1.00 Sign and gain!

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x4A	74	R/W	C2.06	Set value offset	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x4B	75	R/W	C2.07	Dead band compensation A	V	0	9999	0	1000 == 1.000 V
0x4C	76	R/W	C2.08	Dead band compensation B	V	0	9999	0	9.999 V = max. current depending on solenoid selection
0x4D	77	R/W	C2.09	Sensor type Attention: No negative controller output possible when 10, 11 or 12 is selected!	---	0	12	4	off = Deactivated 1 = 0...20mA 2 = 4...20mA 3 = 12mA +-8mA 4 = 0...10V 5 = 0...+-10V 6 = 6V +-2.5V 7 = 7.5V +-2.5V 8 = 6V +-4V 9 = reserved 10 = 0..20mA (positive contr. outp. only) 11 = 4..20mA (positive contr. outp. only) 12 = 0..10V (positive contr. outp. only) 13 = reserved 14 = 5V+-3.0V 15..27 = reserved 28 = 5V+-2.6V
0x4E	78	R/W	C2.10	Actual value gain	V/V	0	400	100	100 == Factor 1.00
0x4F	79	R/W	C2.11	Actual value offset	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x50	80	R/W	C2.12	Actual value sign	---	- 1	+ 1	1	- 1 = negative 0 = off + 1 = positive
0x51	81	R/W	C2.13	P-Portion K_{P1}	V/V	0	400	0	100 == Factor 1.00
0x52	82	R/W	C2.14	T-Portion for PT1 (to C1.16)	S	0	1000	0	100 == 1.00
0x53	83	R/W	C2.15	Threshold (C1.13, C1.16)	V	0	9999	9999	1000 == 1.000 V
0x54	84	R/W	C2.16	P-Portion K_{P2}	V/V	0	400	0	100 == Factor 1.00
0x55	85	R/W	C2.17	I-Portion	V/s	0	4000	0	1000 == 1.000
0x56	86	R/W	C2.18	D-Portion	Vs	0	400	0	100 == 1.00
0x57	87	R/W	C2.19	T-Portion for DT1	S	0	1000	0	100 == 1.00
0x58	88	R/W	C2.20	Gain (C1.13 and C1.16)	V/V	1	32	1	2 = Factor 2.00
0x59	89	R/W	C2.21	Comparator upper level	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0x5A	90	R/W	C2.22	Comparator lower level	V	-9999	9999	0	
0x5B	91	R/W	C2.23	Comparator delay into window	S	0	9999	0	1 == 10 ms
0x5C	92	R/W	C2.24	Comparator delay out of window	S	0	9999	0	0 == no delay
0x5D	93	R/W	C2.25	Comparator selection COMP_2	---	0	3	0	0 = off 1 = Set value 2 = Actual value 3 =Lag error
0x5E	94	R/W	C2.26	Cable fracture detection feedback	---	0	1	0	0 = off; 1 = active
0x5F	95	R	E00	Operation mode (depends on HW + SW version)	---	1	11	3	1 = Open loop one valve 2 = Open loop two valves 3 = Closed loop one valve 4 = Closed loop on application 6 = Closed loop valve/application 8 = Closed loop application/ application 10 = Controller function only, one feedback 11 = Controller function only, two feedback
0x60	96	R/W	E01	Analogue output (depends on HW + SW version)	---	1 and 14	13 and 21	1	1 = d1.01 to 13 = d1.13 and 14 = d2.01 to 21 = d2.13
0x61	97	R/W	E02	Push-Pull function (depends on HW + SW version)	---	0	1	0	0 = off v(no push pull) 1 = active 2 = common “+” for solenoids (Remark: only for max 0,8 A current) 3 = full bridge 4 = off + detection low current to solenoid 5 = active + detection low current to solenoid
0x62	98	R/W	E03 E1.03	Solenoid selection Solenoid selection A (depends on HW + SW version)	---	1	7	6	Standard solenoid definition 1 = 0,8 A 2 = 1,1 A 3 = 1,3 A 4 = 1,6 A 5 = 2,4 A 6 = 2,7 A 7 = 3,5 A (depends on HW + SW version)

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x63	99	R	E04 E1.04	P-Portion current contr. Energization A	---	500	9999	500	Default for 2,700 A solenoid
0x64	100	R	E05 E1.05	I-Portion current contr. Energization A	---	500	9999	500	
0x65	101	R	E06 E1.06	P-Portion cur. contr. de- energization A	---	1300	9999	1300	
0x66	102	R	E076 E1.07	I-Portion cur. contr. De- energization A	---	500	9999	500	
0x67	103	R/W	E08	Ramp selection	---	1	2	1	0 = digital set v. (time constant) 1 = all set v. (rise constant.) 2 = selectable ramps
0x68	104	R/W	E09	Time delay enable signal	s	0	9999	0	1000 = 1.00s
0x69	105	R/W	E10 E1.10	Solenoid current adaptation A	---	50	110	100	Variable adjustment of max. current 100 == Factor 1.00
0x6A	106	R/W	E11	Initial current solenoid A	V	0	9999	0	3.000 V = 30 % of max. rated current
0x6B	107	R/W	E12	Initial current solenoid B	V	0	9999	0	
0x6C	108	R/W	E13 E1.13	Dither Amplitude A	V	0	3000	0	
0x6D	109	R/W	E14 E1.14	Dither Frequency A	Hz	1	300	0	---
0x6E	110	R/W	E15	Selection set point S1.06 (U/I)	---	0	11	1	off = Deactivated 1 = Voltage -10V..+10V 2 = Voltage 0..10V 3 = Voltage 5V+-5V 4 = Voltage 5V+-4.5V w/o signal observation 5 = Voltage 5V+-4.5V with signal observation 6 = 0..20mA w/o cable fract. det. 7 = 10+-10mA w/o cable fract. det. 8 = 4..20mA w/o cable fract. det. 9 = 4..20mA with cable fract. det. 10 = 12+-8mA w/o cable fract. det. 11 = 12+-8mA with cable fract. det.
0x6F	111	R/W	E16	Reserved	---	---	---	---	---
0x70	112	R/W	E17	Set value activation mode	---	0	2	0	0 = digital and analog set value input active 1 = reserved 2 = only digital set value input active
0x71	113	R/W	E18	Error/Comparator Output	---	0	8	0	0 = Error 1 = Comp_1 positive logic 2 = Comp_1 negative logic 3 = Comp_2 positive logic 4 = Comp_2 negative logic 5 = Dout_1 positive logic 6 = Dout_1 negative logic 7 = Dout_2 positive logic 8 = Dout_2 negative logic
0x72	114	R/W	E19	Factor for analog output (depends on HW + SW version)	V/V	-400	400	100	100 == Factor 1.00 Sign and gain!
0x73	115	X	E20	Reserved	---	---	---	---	
..	..								
0xA2	162	X	---	Reserved	---	---	---	---	
0xA3	163	R/W	E 22	Ethernet Slave Address	---	0	32	0	0 = No bus function 1 = Standard Ethernet 2..5 = Multiple Slave Ethernet
0xA4	164	R/W	C1.27	Hysteresis command A	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0xA5	165	R/W	C2.27	Hysteresis command B	1	-9999	9999	0	
0xA6	166	R/W	C1.28	Comparator upper level	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0xA7	167	R/W	C1.29	Comparator lower level	V	-9999	9999	0	
0xA8	168	R/W	C1.30	Comparator delay into window	S	0	9999	0	1 == 10 ms
0xA9	169	R/W	C1.31	Comparator delay out of window	S	0	9999	0	0 == no delay
0xAA	170	R/W	C1.32	Comparator selection Comp_11	---	0	3	0	0 = off 1 = Set value 2 = Actual value 3 =Lag error
0xAB	171	R/W	C2.28	Comparator upper level	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0xAC	172	R/W	C2.29	Comparator lower level	V	-9999	9999	0	
0xAD	173	R/W	C2.30	Comparator delay into window	S	0	9999	0	1 == 10 ms
0xAE	174	R/W	C2.31	Comparator delay out of window	S	0	9999	0	0 == no delay

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0xAF	175	R/W	C2.32	Comparator selection Comp_22	---	0	3	0	0 = off 1 = Set value 2 = Actual value 3 =Lag error
0xB0	176	R/W	E Int	Internal Digital Switches (Read/Set)	---	0	0xFFFF		0x0001 = Din_1 active (Read/Write) 0x0002 = Dout_1 active (Read only) 0x0004 = Comp_1 active (Read only) 0x0008 = Comp_11 active (Read only) 0x0010 = Din_2 active (Read/Write) 0x0020 = Dout_2 active (Read only) 0x0040 = Comp_2 active (Read only) 0x0080 = Comp_22 active (Read only) 0x0100 = Input SP1 active (Read only) 0x0200 = Input SP2 active (Read only) 0x0400 = Enable active (Read only) 0x0800 = Error active (Read only) 0x1000 = Input SP3 active (Read only) 0x2000 = Input SP4 active (Read only) 0x8000 = Bus Disable Card (Read/Write)
0xB1	177	R/W	E 23	Ethernet telegram timeout window	S	0	9999	0	0 == function deactivated 1 == 10 ms
0xB2	178	X	---	Reserved	---	---	---	---	
0xB3	179	R/W	C1.33	I-portion limitation	V	0	9999		0 == 0.000 V; 9999 == 9.999 V
0xB4	180	R/W	C2.33	I-portion limitation	V	0	9999		0 == 0.000 V; 9999 == 9.999 V
..	..								
0xCB	203	R/W	E 24	Ethernet DHCP function		1	0	1	0 = off; 1 = on (in preparation; available third quarter 2011)
0xCC	204	R/W	E 25	Ethernet-IP “aaa.bbb.ccc.ddd”		1	0	255	Value of “aaa”
0xCD	205	R/W	E 26	Ethernet-IP “aaa.bbb.ccc.ddd”		1	0	255	Value of “bbb”
0xCE	206	R/W	E 27	Ethernet-IP “aaa.bbb.ccc.ddd”		1	0	255	Value of “ccc”
0xCF	207	R	E 28	Ethernet-IP “aaa.bbb.ccc.ddd”		1	0	255	Value of “ddd” DIP switch (only read) (Readable after 4s after power on).
0xD0	208	R/W	E 29	Ethernet input buffer length		1	0	32	Value in byte
0xD1	209	R/W	E 30	Ethernet Output buffer length		1	0	32	Value in byte
..	..								
0xD4	212	R/W	E 33	Offset for analog output (depends on HW + SW version)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
..	..								
0xDA	218	R/W	C1.36	Sensor signal correction factor for signal < 0. branch 1	V/V	-100	100	100	100 == Factor 1.00
0xDB	219	R/W	C2.36	Sensor signal correction factor for signal < 0. branch 2	V/V	-100	100	100	100 == Factor 1.00
0xDC	220	R/W	C1.37	Spool overlap compensation A	V	0	9999	0	1000 == 1.000 V
0xDD	221	R/W	C1.38	Spool overlap compensation B	V	0	9999	0	9.999 V = max. current depending on solenoid selection
0xDE	222	R/W	C2.37	Spool overlap compensation A	V	0	9999	0	1000 == 1.000 V
0xDF	223	R/W	C2.38	Spool overlap compensation B	V	0	9999	0	9.999 V = max. current depending on solenoid selection
..	..								
0xE6	230	R/W	L1.x0	Linearization curve branch 1 [0,0]	V	0	0	0	1000 == 1.000 V
0xE7	232	R/W	L1.y0	Linearization curve [0,0]	V	0	9999	0	
0xE8	232	R/W	L1.x1	Linearization curve [1,1]	V	0	9999	1250	
0xE9	233	R/W	L1.y1	Linearization curve [1,1]	V	0	9999	1250	
0xEA	234	R/W	L1.x2	Linearization curve [2,2]	V	0	9999	2500	
0xEB	235	R/W	L1.y2	Linearization curve [2,2]	V	0	9999	2500	
0xEC	236	R/W	L1.x3	Linearization curve [3,3]	V	0	9999	3750	
0xED	237	R/W	L1.y3	Linearization curve [3,3]	V	0	9999	3750	
0xEE	238	R/W	L1.x4	Linearization curve [4,4]	V	0	9999	5000	
0xEF	239	R/W	L1.y4	Linearization curve [4,4]	V	0	9999	5000	
0xF0	240	R/W	L1.x5	Linearization curve [5,5]	V	0	9999	6250	
0xF1	241	R/W	L1.y5	Linearization curve [5,5]	V	0	9999	6250	
0xF2	242	R/W	L1.x6	Linearization curve [6,6]	V	0	9999	7500	
0xF3	243	R/W	L1.y6	Linearization curve [6,6]	V	0	9999	7500	
0xF4	244	R/W	L1.x7	Linearization curve [7,7]	V	0	9999	8750	
0xF5	245	R/W	L1.y7	Linearization curve [7,7]	V	0	9999	8750	
0xF6	246	R/W	L1.x8	Linearization curve [8,8]	V	0	9999	9999	
0xF7	247	R/W	L1.y8	Linearization curve [8,8]	V	9999	9999	9999	

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0xF8	248	R/W	L2.x0	Linearization curve branch 2 [0,0]	V	0	0	0	1000 == 1.000 V
0xF9	249	R/W	L2.y0	Linearization curve [0,0]	V	0	9999	0	
0xFA	250	R/W	L2.x1	Linearization curve [1,1]	V	0	9999	1250	
0xFB	251	R/W	L2.y1	Linearization curve [1,1]	V	0	9999	1250	
0xFC	252	R/W	L2.x2	Linearization curve [2,2]	V	0	9999	2500	
0xFD	253	R/W	L2.y2	Linearization curve [2,2]	V	0	9999	2500	
0xFE	254	R/W	L2.x3	Linearization curve [3,3]	V	0	9999	3750	
0xFF	255	R/W	L2.y3	Linearization curve [3,3]	V	0	9999	3750	
0x100	256	R/W	L2.x4	Linearization curve [4,4]	V	0	9999	5000	
0x101	257	R/W	L2.y4	Linearization curve [4,4]	V	0	9999	5000	
0x102	258	R/W	L2.x5	Linearization curve [5,5]	V	0	9999	6250	
0x103	259	R/W	L2.y5	Linearization curve [5,5]	V	0	9999	6250	
0x104	260	R/W	L2.x6	Linearization curve [6,6]	V	0	9999	7500	
0x105	261	R/W	L2.y6	Linearization curve [6,6]	V	0	9999	7500	
0x106	262	R/W	L2.x7	Linearization curve [7,7]	V	0	9999	8750	
0x107	263	R/W	L2.y7	Linearization curve [7,7]	V	0	9999	8750	
0x108	264	R/W	L2.x8	Linearization curve [8,8]	V	0	9999	9999	
0x109	265	R/W	L2.y8	Linearization curve [8,8]	V	9999	9999	9999	
..	..								

Table 5: Parameter list

8 Troubleshooting

8.1 General

The status LED in the Front of the DMA don't lit:  or 
=> Are all modules supplied with power? (Supply 24V / Supply 0V)
To be sure the power is applied, disconnect the USB interface!

The status LED at the slave module don't lit yellow: 
=> Is the Enable input powered with 24 V?
=> Is the Software enable switched off? (See the special byte in CMD-15-mode)

The current of the solenoid did not reach the desired value:
=> Could the power supply provide enough power?
=> Is the selected type of solenoid type correct?

The status LED of one of the DMA slave modules show red color: 
=> The slave module is in error state.
=> To acknowledge this error, the enable signal of the module must be switched off/on - Then the error should disappear.

8.2 No Ethernet communication is possible

THE "LINK/ACT" LED IS NOT BLINKING:

=> Check the wiring of the Ethernet (termination, length of cables, connectors)

8.3 Communication ok, but current outputs are inactive

Could the set point/feedback-value be monitored by the DMA module? (parameter d1.11, d1.01, d1.02):
Yes => Please check the setting of the Ex.xx, Cx.xx parameters.
Check also the "Bus slave address" E22 of each module.
No => Apply a manual signal to the analogue inputs, please be sure that the parameter E17 is set to "off".
Otherwise analogue inputs would be ignored.

Are the set point/feedback-value now visible?
Yes => The PLC don't send a correct telegram. Please check you PLC program, and modify the PLC commands in your program.

9 Declaration of Conformity

EC Declaration of Conformity in accordance with EMC Directive 2014/30/EU

HCS Hydraulic Control Systems GmbH
Neuffener Str. 29
D-72636 Frickenhausen

Hereby declares that the product described as follows complies in terms of its design, as well as in the version placed in the stream of commerce by us, with the relevant requirements of the directive. This declaration is void in the event of any change to the product without our written agreement.

Product:	Digital Amplifier and Controller Module
Intended use	Automation systems (industrial applications)
Model:	**DMA-22(A)-x**
Rated voltage:	24 V DC; SELV, PELV
Rated power:	max. 100 VA
Protection class:	III
Protection degree:	IP00 (IP20 on request)
Relevant EU Directive:	EMC Directive 2014/30/EU
Applicable EU Standards:	
Emissions:	EN 61000-6-4:2007 + A1:2011; EN 61000-6-3:2007 + A1:2011
Immunity:	EN 61000-6-2: 2019

Date/manufacturers signature

01.01.2022
Details of signatory: Dipl.-Ing. (FH) Peter Deuschle (General Manager)

10 ***Notes:***

11 HCS distributors and partners

Please refer to:

https://www.h-c-s-gmbh.de/en/sales-partners

on our web side.

- End -