Manual for

DAC-42(A)

DIGITAL AMPLIFIER AND CONTROLLER CARD FOR ALL KIND OF PROPORTIONAL VALVES

	Model Code	SW Version	Remarks
Applicable for SW Versions:	DAC-42(A)-x-EIP-x Operation Mode: 01, 02, 03, 04, 06, 08, 10, 11	**V 12.xx**	xx = 01 or higher * = a, b, …. x = additional options
	DAC-42(A)-14-x-EIP-SPpQ Operation Mode: 14	**V 65.xx**	
	DAC-42(A)-8-x-EIP-SPpQ Operation Mode: 8	**V 68.xx**	
	DAC-42(A)-x-EIP-SSSI Operation Mode: 03, 04, 06	**V 23.xx**	

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Revision History

Revision	Date	Description
R1.0	24.04.2023	First edtition
R1.1	21.08.2024	SW PpQ Modus 8 added.
R2.0	21.01.2026	SW V23.xx added
R2.0	21.01.2026	EtherNet/IP logo changed

Table of Content

1 Abbreviations

Abbreviation	Description
DAC	**D**igital **A**mplifier and **C**ontroller
EMC	**E**lectro **M**agnetic **C**ompatibility; properties of the unit in order to comply with the EMC directive
USB	**U**niversal **S**erial **B**us; interface for communication between a PC and the DAC-4x(A)
PC	**P**ersonal **C**omputer
µC	**M**icro **C**ontroller; CPU used inside the unit to control all functions
mamsl	**m**eters **a**bove **m**edian **s**ea **l**evel
IP65	Protection Class; solid particle protection and protection level against water ingress
LED	**L**ight **E**mitting **D**iode
PWM	**P**ulse **W**idth **M**odulation; method to control the output current at low power losses
Ub	Supply voltage
FS	**F**ull **S**cale

Table 1: Abbreviations

2 Terms and Definitions

Term	Description
Amplifier Card	Amplifier for 19” rack system in Eurocard format
HCSTool	Software tool provided by HCS in order to adjust and parametrize DAC-4x(A) units
CANopen	Bus interface for digital communication, defined by CIA
PROFIBUS	Process Field Bus interface for digital communication, defined by BMBF (German department of education and research) and used by Siemens
PROFINET	Process Field Net interface for digital communication, the standard is maintained and supported by PROFIBUS & PROFINET International
ETHERNET/IP	(IP = Industrial Protocol) is an industrial network protocol that adapts the Common Industrial Protocol to standard Ethernet
USB-C connector	Connector type used on the USB interface

Table 2: Terms and definitions

3 General information

3.1 Abstract

This document describes the function of the HCS digital amplifier and controller card “DAC-4x(A)”.

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.

⚠ DANGER

Read this manual carefully before working with the digital amplifier cards!

The general and especially the safety instructions of this manual have to be observed in any case!

Electronic equipment of all kind can have component failures or software may lead to unpredictable reactions. Secondary safety measures must be taken in order to ensure safety under all circumstances. This is especially the case for safety critical applications.

Furthermore, it is the responsibility of the user to always comply with applicable safety standards (e.g. EN 13849) and to implement a system architecture capable to cover all safety requirements. The unit itself does not comply with any performance level given in EN 13849 or any SIL level as per EN 61508.

Applicable laws and safety standards have to be observed at any time. Before commissioning or using the equipment, the necessary risk analysis must be conducted and suitable protection measures must be taken.

HCS GmbH refuses any liability in case of omission to comply with these requirements.

3.2 Scope

With the help of this document a professional, competent and trained user should be able to install, wire, connect, commission, set parameters, perform fault analysis and fix issues. Also, the document will provide the user any technical and operational details necessary to safely operate the product. It remains the user’s responsibility to set-up a safe working environment while operating the product.

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.

3.2.1 Copyright

3.2.2 Documents 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 digital amplifier and controller card DAC-4x(A) or the equipment in which it is installed.

3.2.3 Warning signs, symbols and notes

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 – with a very high probability - 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!

Identifiers important information

Other identifiers (when applicable):

Identifier	Description
●/ -	Listings
□	References to another chapter, page, table or figure in this manual
blue text	Hyperlink within the document
1., 2., …	Steps in a procedure that should be performed in consecutive order
«ER»	LEDs of the amplifier (for example, «ER»
< >	parameter name
[xx]	Pin number of the rear connector
"…"	Used for references

Table 3: Identifiers

3.2.4 Safety and liability

NOTICE

**The information in this document is subject to change without further notice.
HCS assumes no responsibility for any faults that may appear in this manual.**

This operating manual represents the knowledge of HCS and during the drafting of this operating manual the greatest possible care was taken. Nevertheless, HCS disclaims any responsibility and liability claims for individual applications of the user. This is particularly true in cases of non-compliance, omissions, faults, misinterpretations and misunderstandings.

Applicable laws and safety standards have to be observed at any time. Before commissioning or using the equipment, the necessary risk analysis must be conducted and suitable protection measures must be taken.

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.

HCS GmbH refuses any liability in case of omission to comply with these requirements.

⚠ WARNING

In the case of applications with critical safety requirements or where accident prevention regulations must be observed, it may be necessary to isolate the components from the solenoids with relays in e-stop circuits.

To switch off the enable signal (0 V at terminal 8d) is insufficient. In these cases, hydraulic and/or mechanical safety measures to stop the drive must be provided (e.g. through switching valves with position monitoring).

⚠ WARNING

All types of proportional directional valves, which may be used in all kinds of different environments and applications, can eventually fail and hence are able to cause damage.

It is the customers obligation to analyze all safety related aspects of the application. It is within the full responsibility of the machine builder and/or system integrator to make the final selection of products and reassure and confirm that all requirements regarding safety and performance are met.

The procedure of selecting the proper control system and related safety levels is covered by the machine directive EN 13849.

NOTICE

Liability for any content of this document is rejected!

Any claims against HCS GmbH – based on whatever legal reason – resulting from the use of the information, programs, engineering and performance data etc., described in this document shall be excluded. Exclusion in such cases shall not apply for mandatory liability, e.g. under the "Product Liability Act", in case of intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or breach of a condition. Damages for breach of a substantial contractual obligation are, however, limited to the foreseeable damage, typical for the type of contract, except in the event of intent or gross negligence or injury to life, body or health. The above provisions do not imply a change of the burden of proof to your detriment.

We reserve the right to make changes to this document at any time without prior notice.

3.2.5 General information

⚠ WARNING

ESD (electrostatic discharge) may damage components on the card. In order to prevent any damage please always follow the recommendations below!

Discharge static voltage from your body by using best practice.
Work in safe environment and do not use any devices in the working surrounding which could generate or hold static charge. Avoid using the product in areas where floors or surfaces are composed of materials that could generate static charges.

Handle all equipment very carefully and do not touch exposed pins or components.

Store and transport the units only in its original packaging.

⚠ WARNING

During commissioning, particular attention must be paid to the correct design and realization of the wiring. This must be checked before applying the supply voltage.

To avoid collisions, the safety devices and limit switches must be activated. All safety regulations are to be observed.

Monitoring the fault signal (terminal 14d) is recommended.

Malfunctions can occur with the following:

- Changes to the settings made by the supplier.
- Neglecting of operating parameters (e.g. supply voltage, application of inadmissible signals on inputs or outputs, ambient conditions, wiring, unsafe loads such as motors, contactors, relays, ohm loads, etc.)
- Faults in series-connected controls components and set points or actual values
- Faults in the subsequent hydraulic components
- Removing of solenoids connections.

3.3 Terms and conditions

Please pay attention to our general terms and conditions (available on request).

3.4 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 card is ready for use.

3.5 Correct product use

The digital amplifier and controller cards “DAC-4x(A)” are used for the following applications:

- Controlling of proportional valves (namely directional control valves); with or without feedback (depending of operation mode).
- To convert set point signals into a current signal to control one proportional valve and spool position feedback in the aforementioned valves.
- For industrial applications only.

The operation of other inductive or resistive loads is not recommended (motors, heaters, etc.). If you are considering any applications like this, please contact HCS GmbH.

If used correctly, the safety of the user as well as the safe and proper function of the amplifier DAC-4x(A) is given.

3.6 Non-intended product use

The digital amplifier and controller cards “DAC-4x(A)” should not be used in the following cases:

- if noticeably damaged
- when the electrical connections are damaged
- if they do not function correctly
- after incorrect handling or storage
- in non-appropriate applications or environments.

In these cases, the digital amplifier and controller card must be disabled and secured against accidental restarting.

In the case of applications with critical safety requirements or where accident prevention regulations must be observed, it may be necessary to isolate the components from the solenoids with relays in e-stop circuits. In these cases, hydraulic and/or mechanical safety measures to stop the drive must be provided (e.g. through switching valves with position monitoring).

During commissioning, particular attention must be paid to the correct design and realization of the wiring. This must be checked before applying the supply voltage.

To avoid collisions, the safety devices and limit switches must be activated. All safety regulations are to be observed. Malfunctions can occur when:

- Changes to the settings made by the supplier.
- Neglecting of operating parameters (e.g. supply voltage, application of inadmissible signals on inputs or outputs, ambient conditions, wiring, unsafe loads such as motors, contactors, relays, ohm loads, etc.)
- Faults in series-connected controls components and set points or actual values
- Faults in the subsequent hydraulic components
- Removing of valve connection.

3.7 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.

3.7.1 Inquiries and ordering

To order the product, the complete order code is requested.
See □ Chapter "3.7.1 Inquiries and ordering", page 9

Please pay attention to our general terms and conditions (available on request) and forward orders and enquiries to the companies as listed on our web page:

Sales Partners (h-c-s-gmbh.de)

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

They are our official distributors/partners. We reserve the right to forward any direct inquiries or orders to our distributors/partners. Nevertheless, we will be available for any necessary technical support.

Germany and other countries without distributor/partner:

Neuffener Strasse 29
D-72636 Frickenhausen
Tel: (+49) 7025 - 911 007
Fax: (+49) 7025 - 911 008
Email: info@h-c-s-gmbh.de
www.h-c-s-gmbh.de
HCS Hydraulic Control Systems

3.7.2 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:

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.

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 "3.7.1 Inquiries and ordering", page 9

3.7.3 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.

- Keep the amplifier card away from moisture and dust
- Observe the allowed storage and transportation temperature range
- If it should be necessary to clean the amplifier, we recommend sending it back to the manufacturer or any distributor and partner:

See □ Chapter "3.7.1 Inquiries and ordering", page 9

⚠ CAUTION

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

3.7.4 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 digital amplifier and controller card is ready for use.

3.8 Introduction

The digital amplifier and controller card DAC-4x(A) features leading edge technology. This electronic device meets the industrial standards for EMC. This ensures a high interference security and low interference emission.

The performance characteristics are possible through the use of the most current microprocessor technology (32-bit floating-point CPU) combined with other state of the art components. In addition to all control functions, the microprocessor also handles closed-loop control. The system features are essentially determined by the software and provide reserve capacity for further developments and adaptations.

The following features distinguish the DAC-4x(A) series:

- Fully digitized amplifier card with the advantage of
  - no on-board potentiometer
  - no jumper settings required
  - digital setting and display of all parameters by means of PC with HCSTool
  - user safety during parameterization
- flexible and reliable system:
  - use of a modern 32-Bit floating point µC
  - high performance and yet power reserve
  - high reliability and safety through the use of a integrated watch-dog and reset function
  - variable settings for magnetic systems making high flexibility possible
- functional use of the interface:
  - change of selected parameters “on-the-fly” without interference or interruptions of the working cycle
  - analyzing of system performance through selection of display parameters with the PC and by using the 4-channel oscilloscope function included in HCSTool
  - bus interfaces available (PROFIBUS/PROFIDRIVE, ETHERNET-IP, ETHERNET/IP, CAN-OPEN)

3.9 General Applications

The amplifier card DAC-4x(A) is used for:

- With or without electrical feedback transducers
  - proportional directional valves direct and pilot operated
  - proportional flow control valves
  - proportional pressure reducing valves
  - proportional pressure regulating valves
  - cartridge valves
  - servo valves with torque motors
- Controlling of hydraulic motors, - installations and – systems, e.g.:
  - position
  - speed
  - pressure
  - revolutions per minute
  - torque
  - power etc.
- Volume flow control and pressure control of pumps (if the occasion arrives: power limiting function; controlling valve spool position)
- Controlling of different process values:
  - P/Q controlling
  - pump controlling
  - controlling of pressures
  - controlling of pilot- and main stage
  - cascade controlling of components etc.

4 Product overview and description

Detailed technical data in the "DAC-4x(A) Manual E Rxx yyyymmdd.pdf" please ask HCS GmbH if needed.

4.1.1 Technical data for the Ethernet-IP bus interfaces

Ethernet-IP EtherNet/IP	- Electrical isolated and opto-decoupled - supports all speeds - supports 10 and 100 MBit/s auto detect - 2 x RJ-45 LAN - DHCP functionality in preparation (on request)	- input-object instance 100 - output-object instance 101 - Full performance range of Ethernet/IP is supported - Electrical isolated interface
Connection / Type of connector	In/Out: 2 x RJ45 (integrated switch)	
Status signals	Status (geen)	
Future usage	DIP switch 1- 8, each on/off	

4.2 General CIP support

The DAC-4X(A) versions with Ethernet/IP interface provides „Assembly objects class 4". DAC-4X(A) is using one Input and one Output Assembly Object with attribute (# 3).

- One 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)
- One 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)

5 Installation and connection

For installation and connection of the standard DAC-4x(A) see the "DAC-4x(A) Manual E Rxx yyyymmdd.pdf" or if a special application used, the related manual for this application (e.g. PpQ) please ask HCS GmbH if needed.

5.1 Standard terminal assignment

Pin	d	b	Z
2	0 V (External)	DIO 1 or S1.08	- Sign (direction) digital set values
4	Digital set value 2 (S1.02)	DIO 2	+ Sign (direction) digital set values
6	Digital set value 3 (S1.03)	DIO 3	Digital set value 4 (S1.04)
8	ENABLE (DI 1)	Analog input 1 (Option)	Digital set value 1 (S1.01)
10	Sensor 1 (FB 1) U_E, I_E	Analog output	n/c
12	Analog set value 6 U_{E+} (S1.06)	n/c	Analog set value 5 U_{E+} (S1.05)
14	ERROR (DO 1)	COMPARATOR (DO 2)	Sensor 2 (FB 2) U_E
16	Analog set value 6 U_{E-} (S1.06)	Analog input 2 (Option)	Analog set value 7 I_E (S1.07)
18	Digital GND	PE	Reset Ramp (DI 2)
20	Reference output - 10.0 V	Break output 24 V / 1 A	Reference output + 10.0V
22	Solenoid output A -	Solenoid output A -	Solenoid output A -
24	Solenoid output B -	Solenoid output B -	Solenoid output B -
26	0 V (Power)	0 V (Power)	Analog GND
28	Solenoid output A +	Solenoid output A +	Solenoid output A +
30	Solenoid output B +	Solenoid output B +	Solenoid output B +
32	+ 24 V (Power)	+ 24 V (Power)	24 V (External)

Table 4: Terminal assignment

5.2 Picture of rear connector

Connector: IEC 60603-2 form F 48 pins

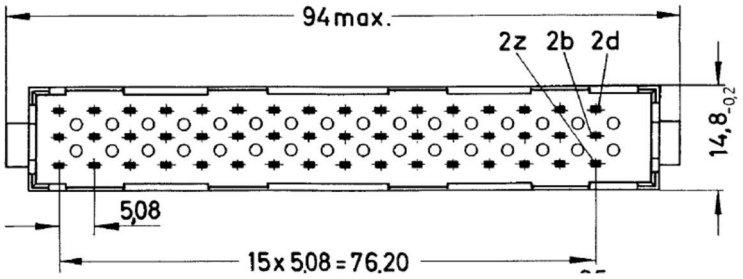

Figure 1 : Connector F48

5.3 Operation modes

The setting of parameter <E00> is determining which operation mode is activated. This parameter is factory preset! Only the mode relevant parameters are made available for each of the modes.

With the use of parameter <E00> any basic mode of operation may be selected. A change in operation modes will be effective immediately. Recalling the parameters for the newly chosen mode takes only a few seconds. During this time, the display flashes. Only the mode relevant parameter is made available.

<E00>	Mode description
1	Open loop, 1 proportional valve with 2 solenoids without feedback
2	Open loop, 2 proportional valves with 1 solenoid each without feedback
3	Closed loop valve, single, 1 proportional valve with 2 solenoids and feedback of spool position
4	Closed loop process, single, 1 proportional valve with 2 solenoids and feedback of process value (position, velocity, pressure, force, torque etc.)
5	Reserved
6	Closed loop valve and process, double, 1 proportional valve with 2 solenoids and feedback of spool position and additional feedback of process value (cascaded controller)
7	Reserved
8	Closed loop processes, double, 2 independent proportional valve with 1 solenoid each and feedback of two independent process values (e.g. two pressure control systems) A version of the PpQ controller is also available in this mode.
9	Reserved
10	Controller function without valve, control of 1 process value; provide set value to follow up electronics (e.g. valve with integrated electronics, frequency converter for AC motor etc.)
11	Controller function without valve, control of 2 process values (cascaded controller, e.g. position and velocity controller); provide set value to follow up electronics (e.g. valve with integrated electronics, frequency converter for AC motor etc.)
14	PpQ controller. Pressure and power or torque limiting function. For this function a special firmware is necessary.

Table 5: Operation modes

5.4 Wiring diagrams for all operation modes

The wiring diagrams are mentioned for the standard DAC-4x(A) in the manual "DAC-4x(A) Manual E Rxx yyyymmdd.pdf"

or if a special application used, in the related manual for this application (e.g. PpQ)

please ask HCS GmbH if needed.

6 Commissioning

6.1 Front elements

⚠ WARNING

The electrical wiring must be checked before switching on the supply voltage. Limit switches and safety devices must be activated to avoid uncontrolled movements. Carefully follow relevant safety regulations. Suitable emergency stop measures must be taken.

6.1.1 DAC-42(A)-x-EIP

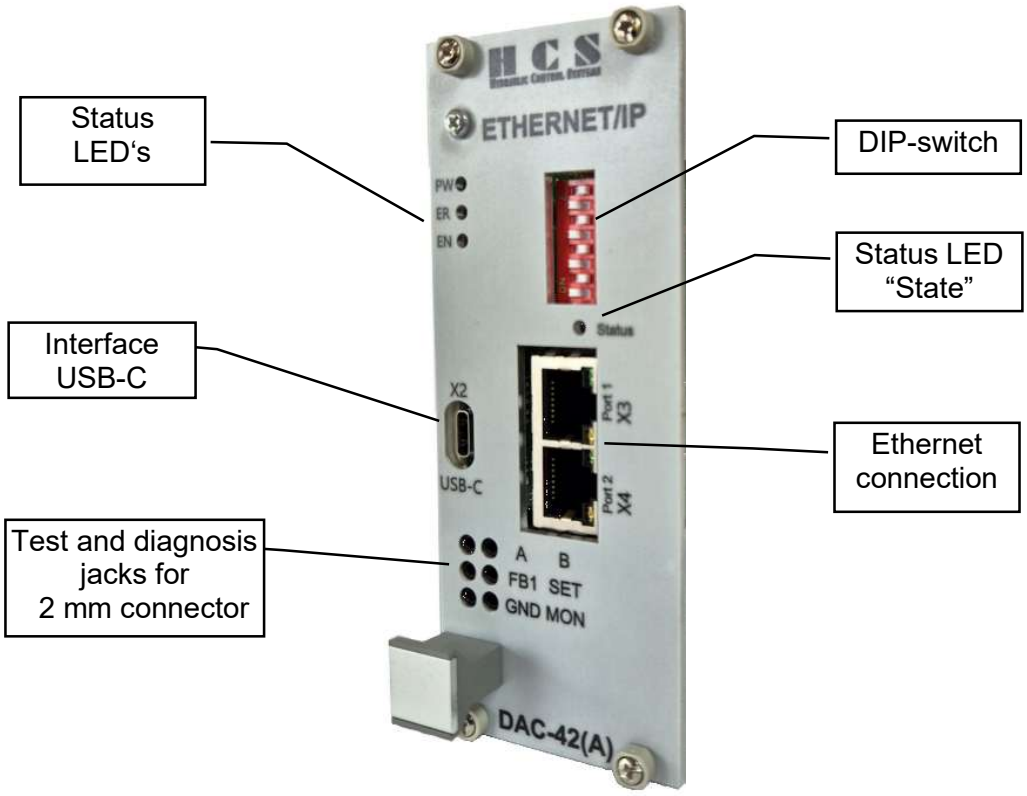

Figure 2 : DAC-42(A)-x-EIP Front elements

Element	Function
Status LED's	Display of status, Power, Enable, Error.
Status LED "State"	Display of status of the Ethernet-IP connection. On = Logical data exchange E/IP Blinking = waiting for connection Fast blinking = Error occurred Off = getting ready
Ethernet connection's	Ethernet 2xRJ45 input/Output to the network
DIP-switch	Setting of the lowest IP byte. Example: On = 1, 3, 5, 7 → Address = 85
USB-C interface	Trough which programing and accessing parameters via PC and HCSTool is been executed. RS232 (optional)
Measuring and test jacks	Direct measurement of set point, actual value, solenoid currents and internal values via the monitor output. Use 2 mm sockets (S1.06, FB1, A, B, d1.01 ... d2.13)

Table 6: Front elements DAC-42(A)-x-EIP explanation

6.1.2 Connection to Ethernet

The connection to the Ethernet-IP is made via the RJ45 plug on the front panel, the lowest byte of the IP address is set by the DIP switch.

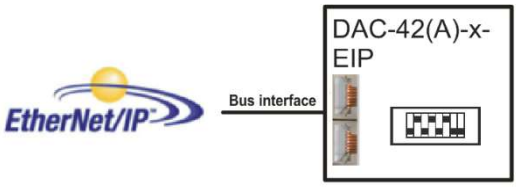

Figure 3 : bus connection

6.1.3 Ethernet connector pinning

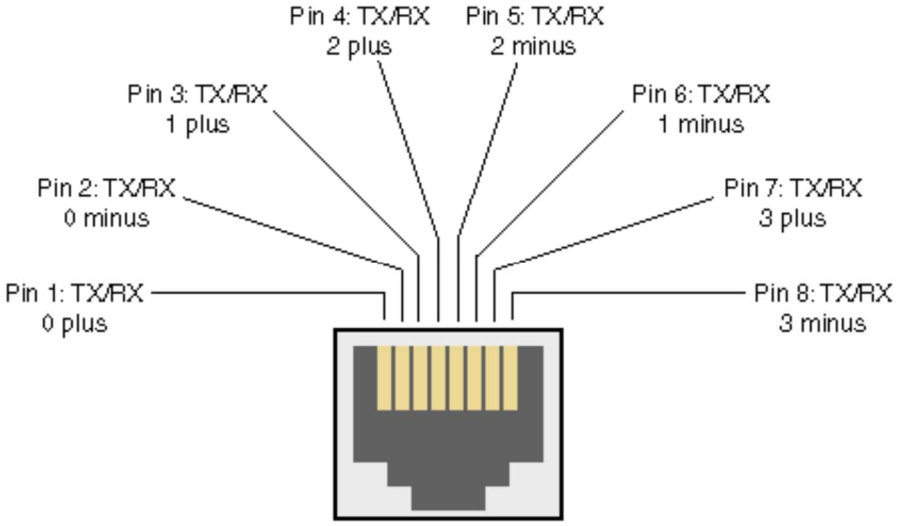

Figure 4 : Connector Ethernet

6.2 Software block diagrams

All functions and parameter inside of the block diagrams are described in detail in the "DAC-4x(A) Manual E Rxx yyyymmdd.pdf"

or if a special application used, in the related manual for this application (e.g. PpQ)

please ask HCS GmbH if needed.

This section specifically describes the signals that can be called up or set via the bus protocol.
E.g.

- Setpoint specifications
- Actual value specifications
- Comparator or status messages

6.2.1 Operation Mode 01; 1 valve with 2 solenoids, open loop

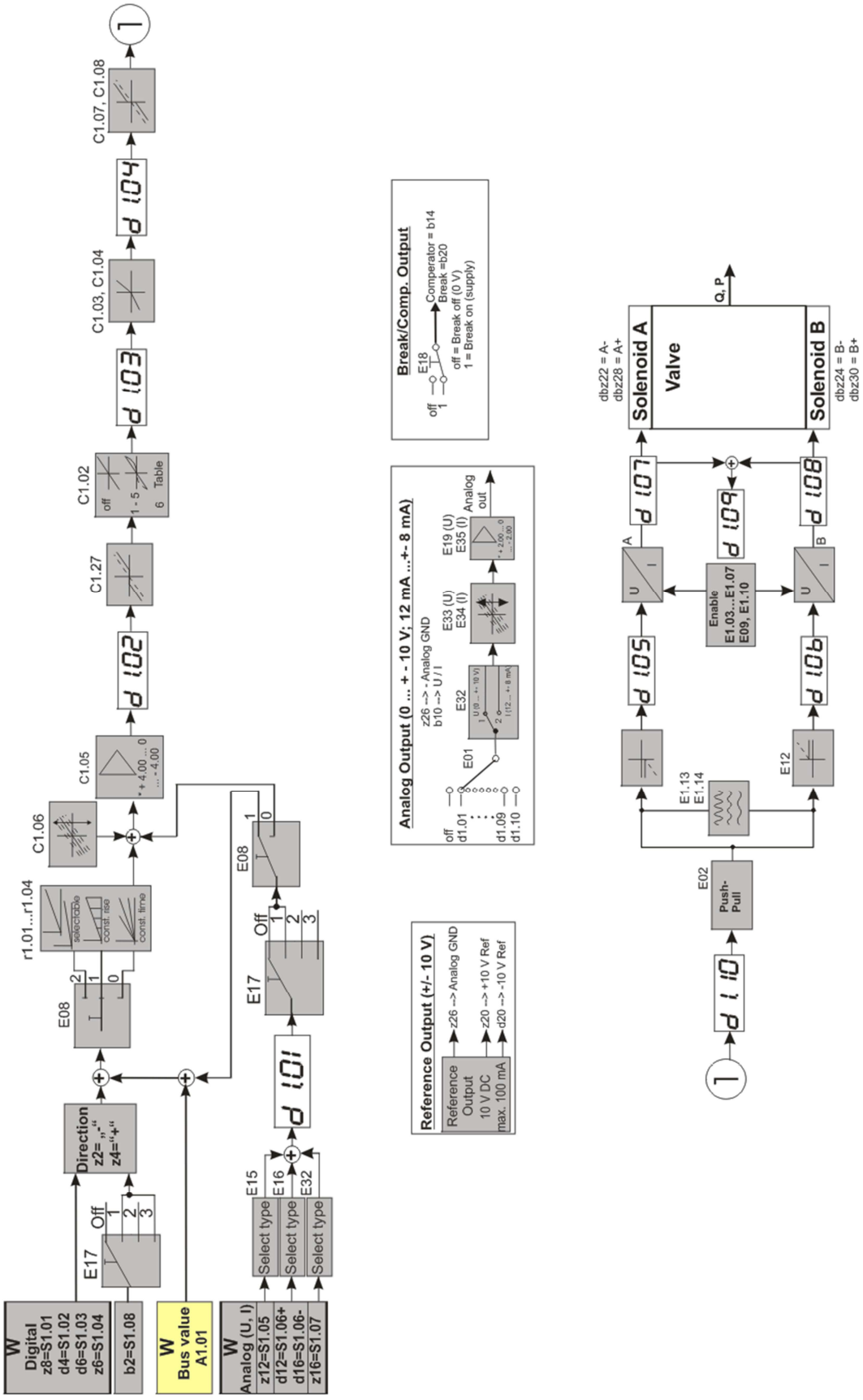

Figure 5 : Software block diagram operation mode 1

6.2.2 Operation Mode 02; 2 valves with 1 solenoid each, open loop

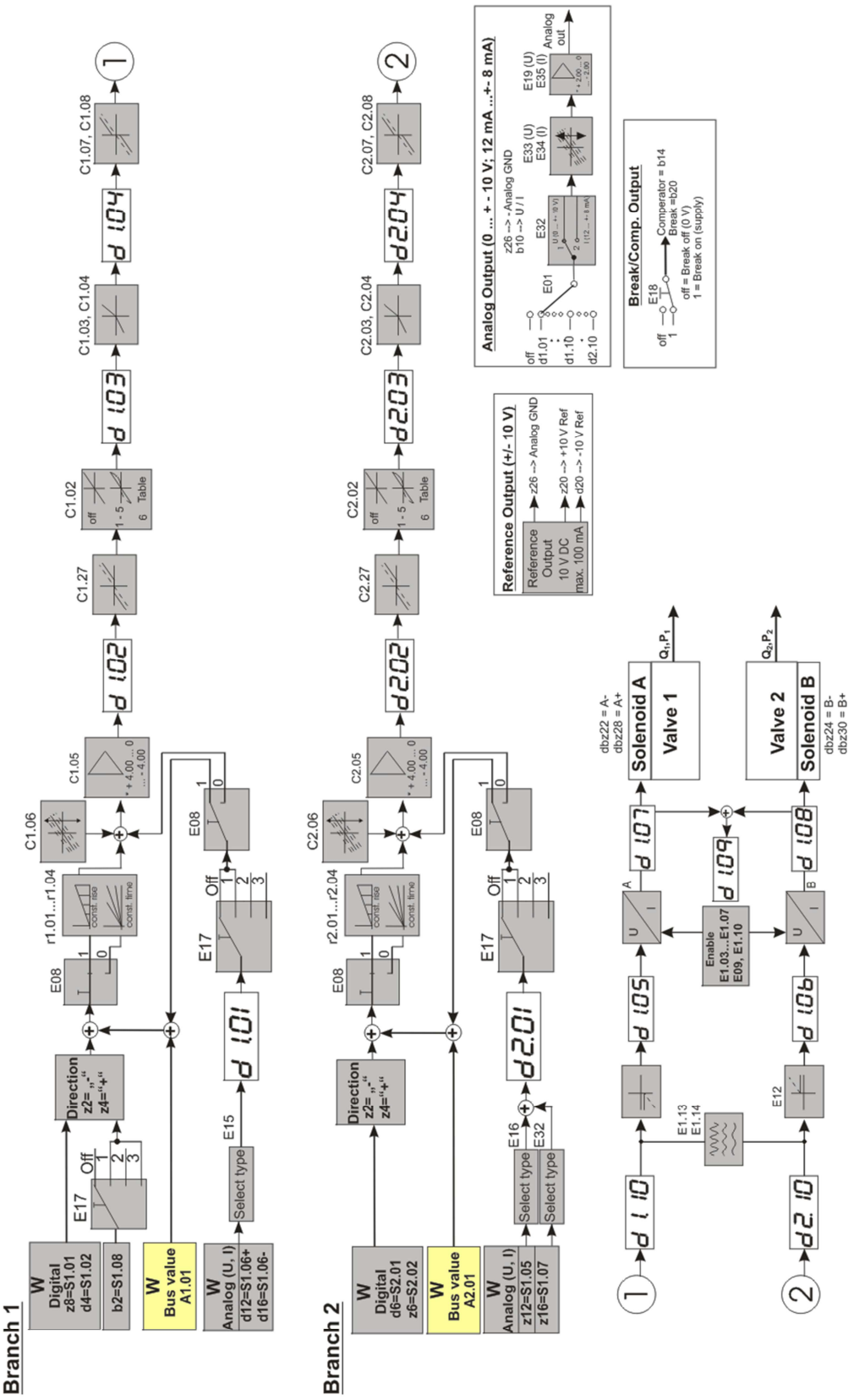

Figure 6 : Software block diagram operation mode 2

6.2.3 Operation Mode 03; 1 valve with 2 solenoids and spool position feedback

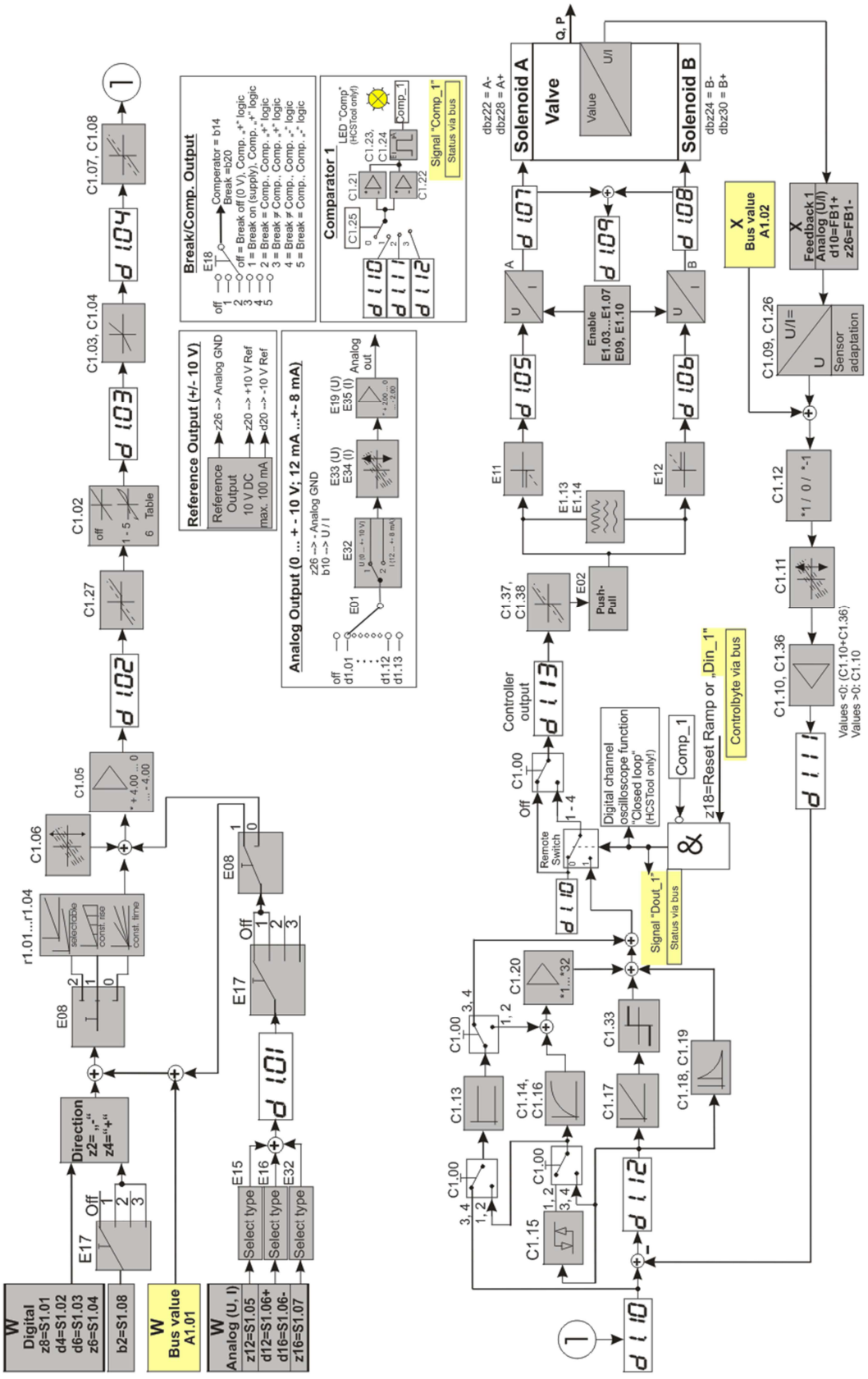

Figure 7 : Software block diagram operation mode 3

6.2.4 Operation Mode 04; 1 valve with 2 solenoids and process value feedback

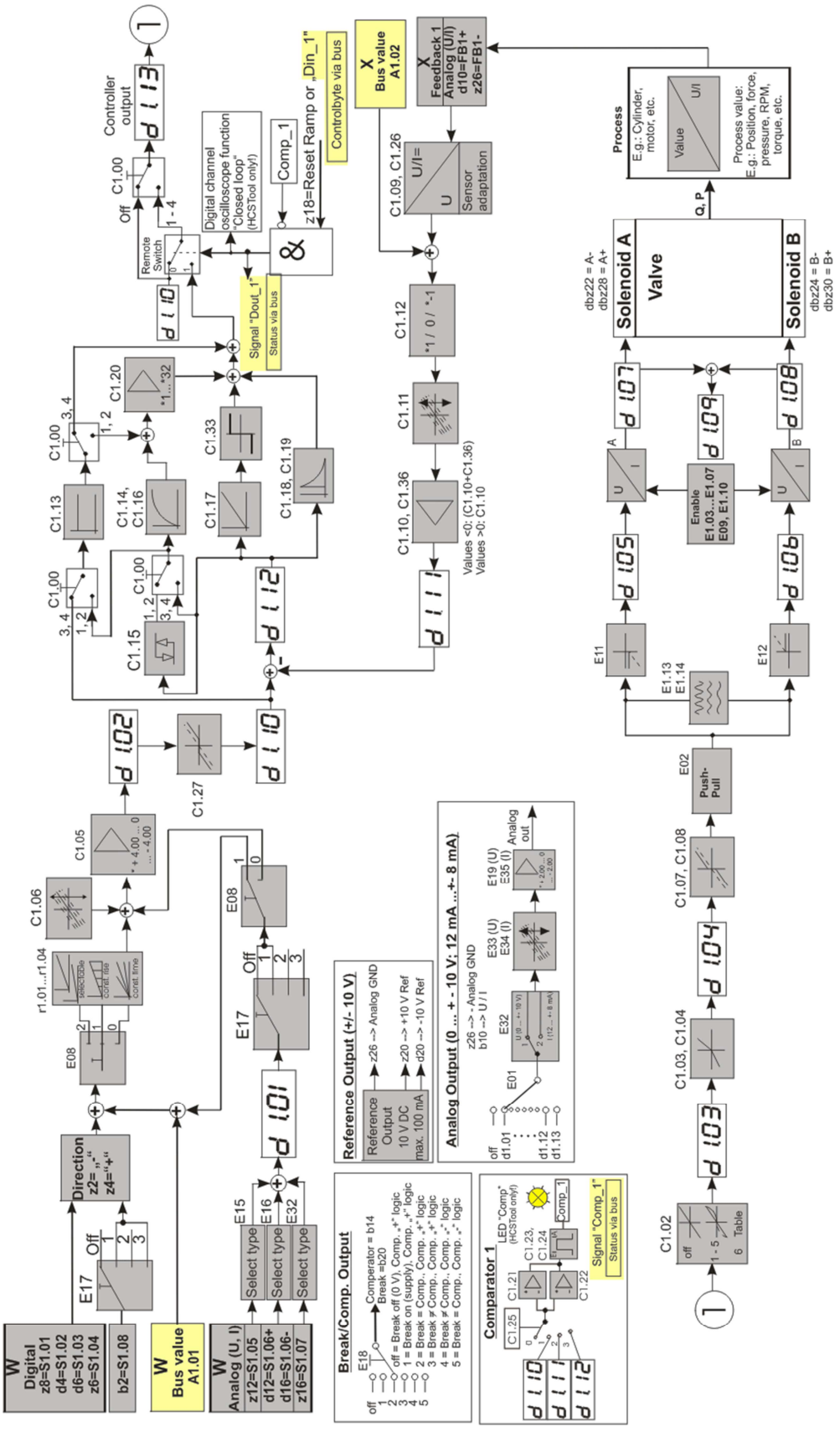

Figure 8 : Software block diagram operation mode 4

6.2.5 Operation Mode 06; 1 valve with 2 solenoids spool position feedback and process value feedback

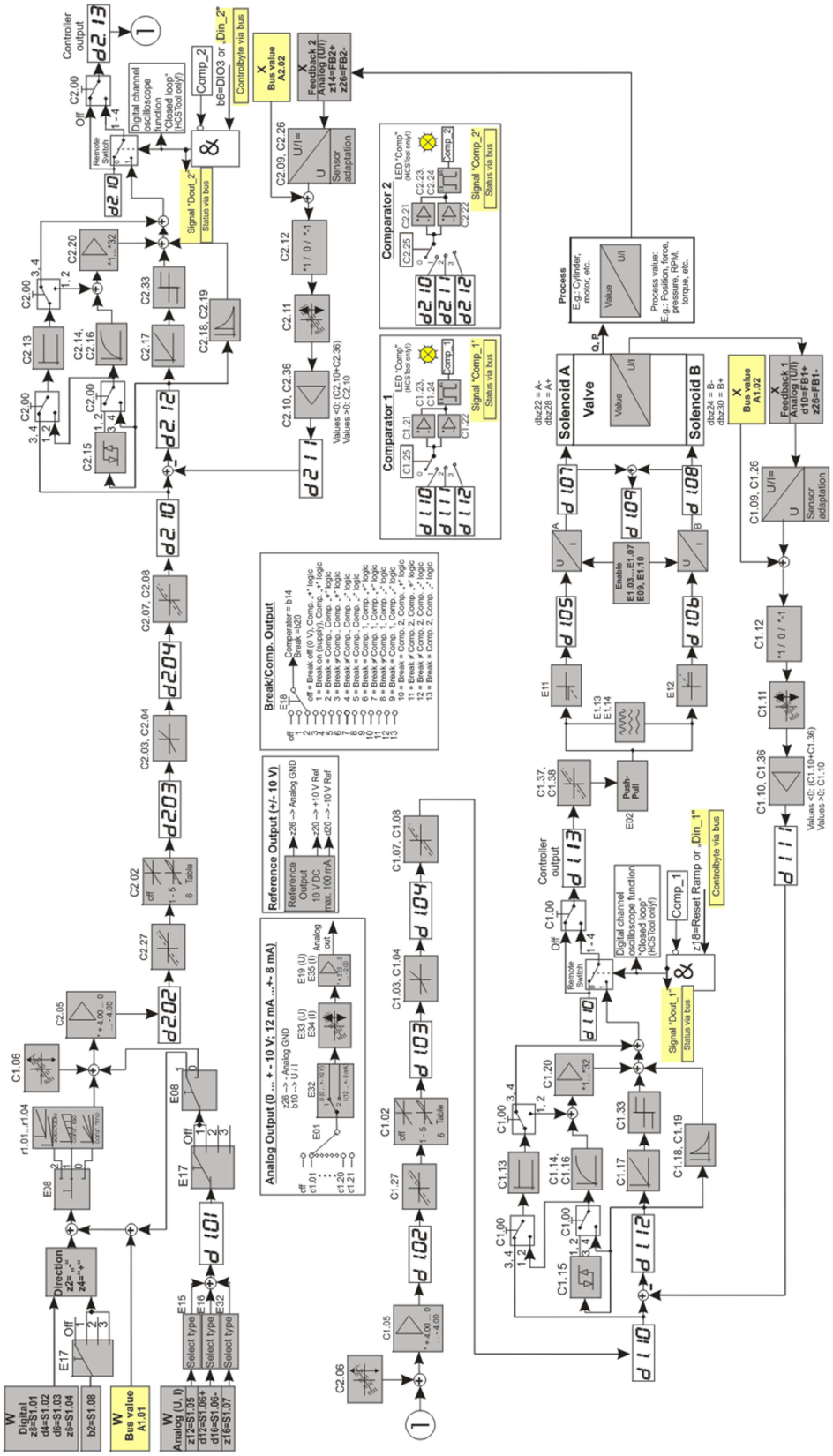

Figure 9 : Software block diagram operation mode 6

6.2.6 Operation Mode 08; 2 valves with 1 solenoid and process value feedback

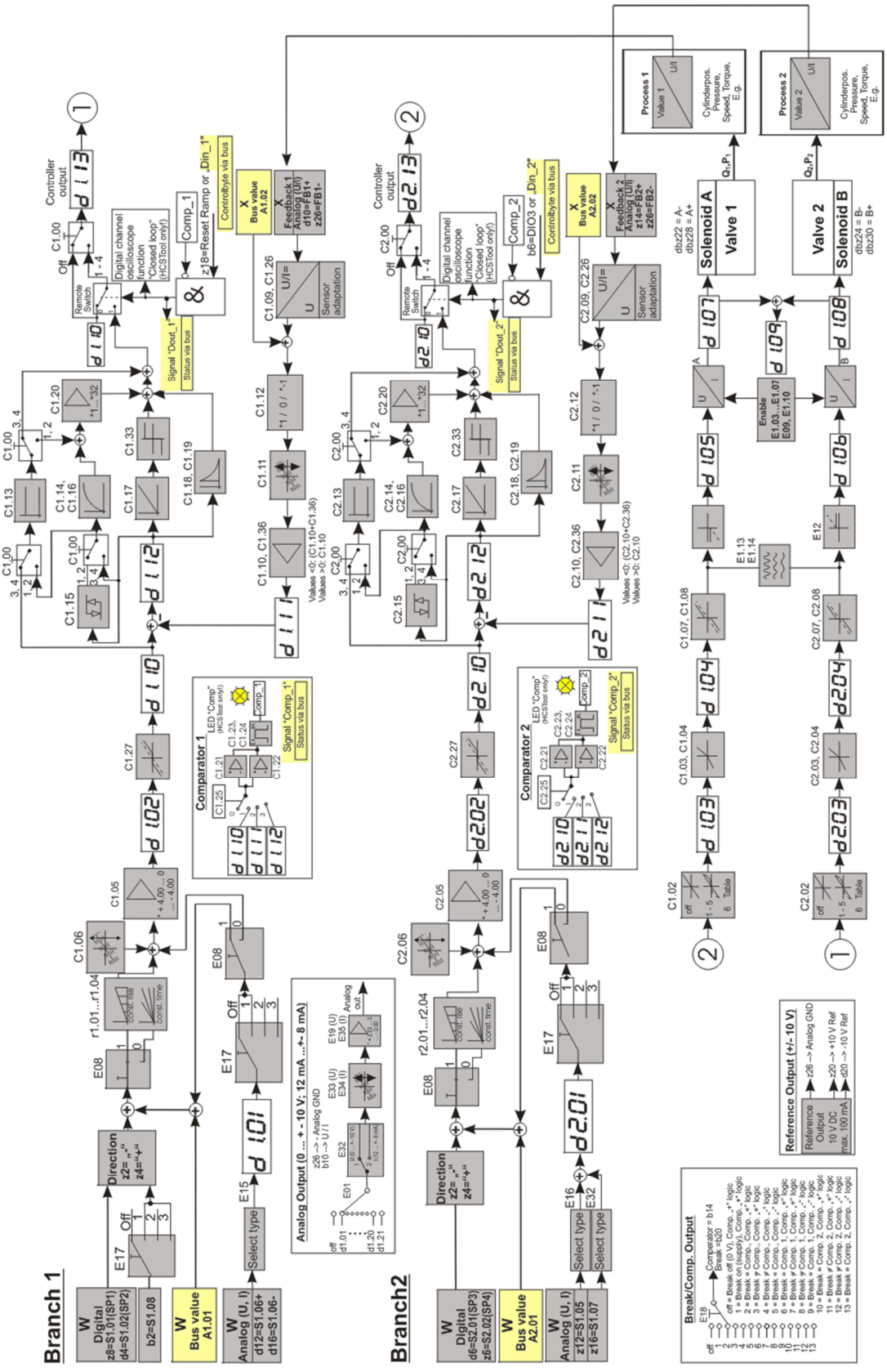

Figure 10 : Software block diagram operation mode 8

6.2.7 Operation Mode 10; stand-alone controller with process feedback

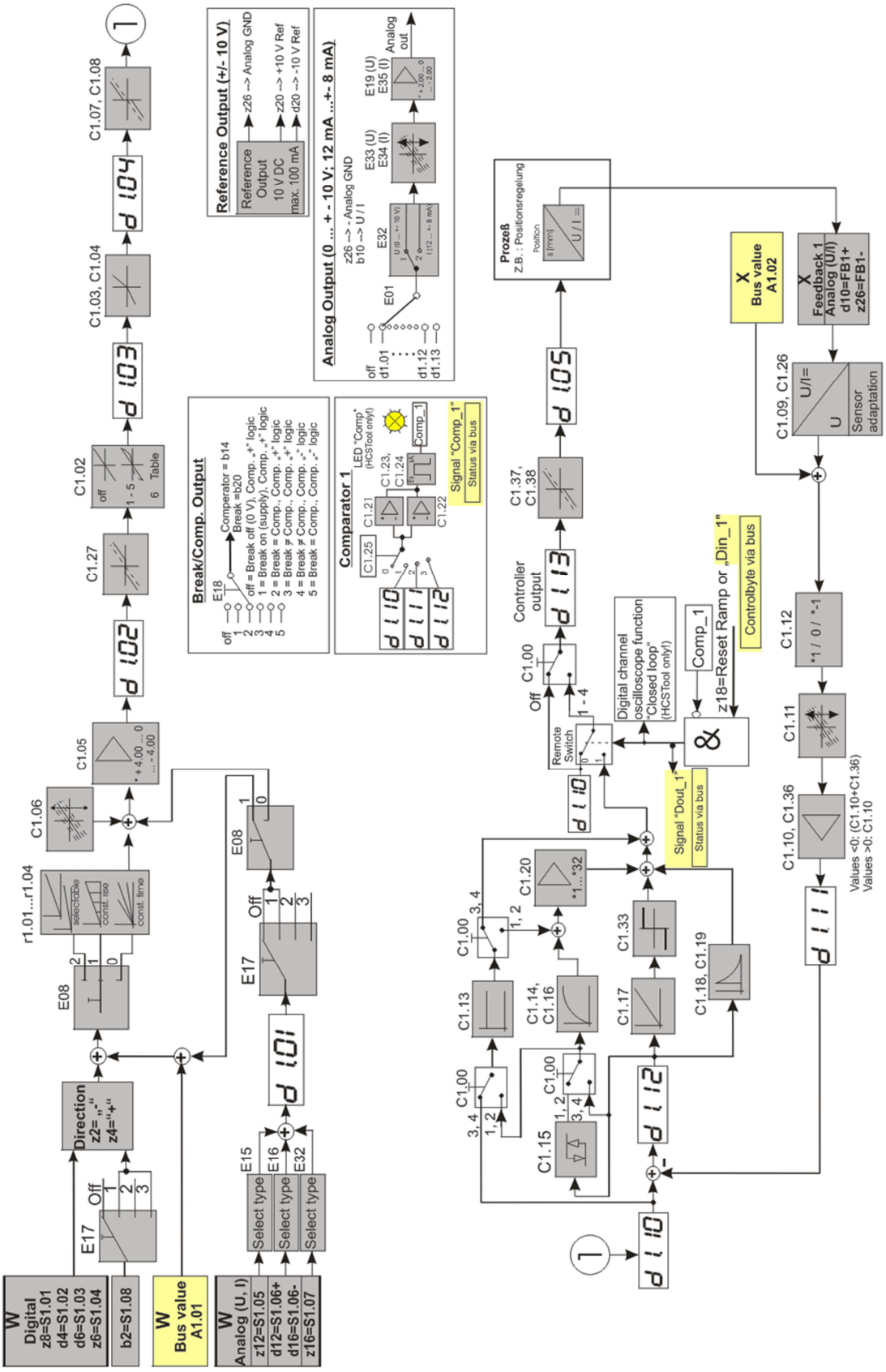

Figure 11 : Software block diagram operation mode 10

6.2.8 Operation Mode 11; stand-alone controller with two process feedbacks

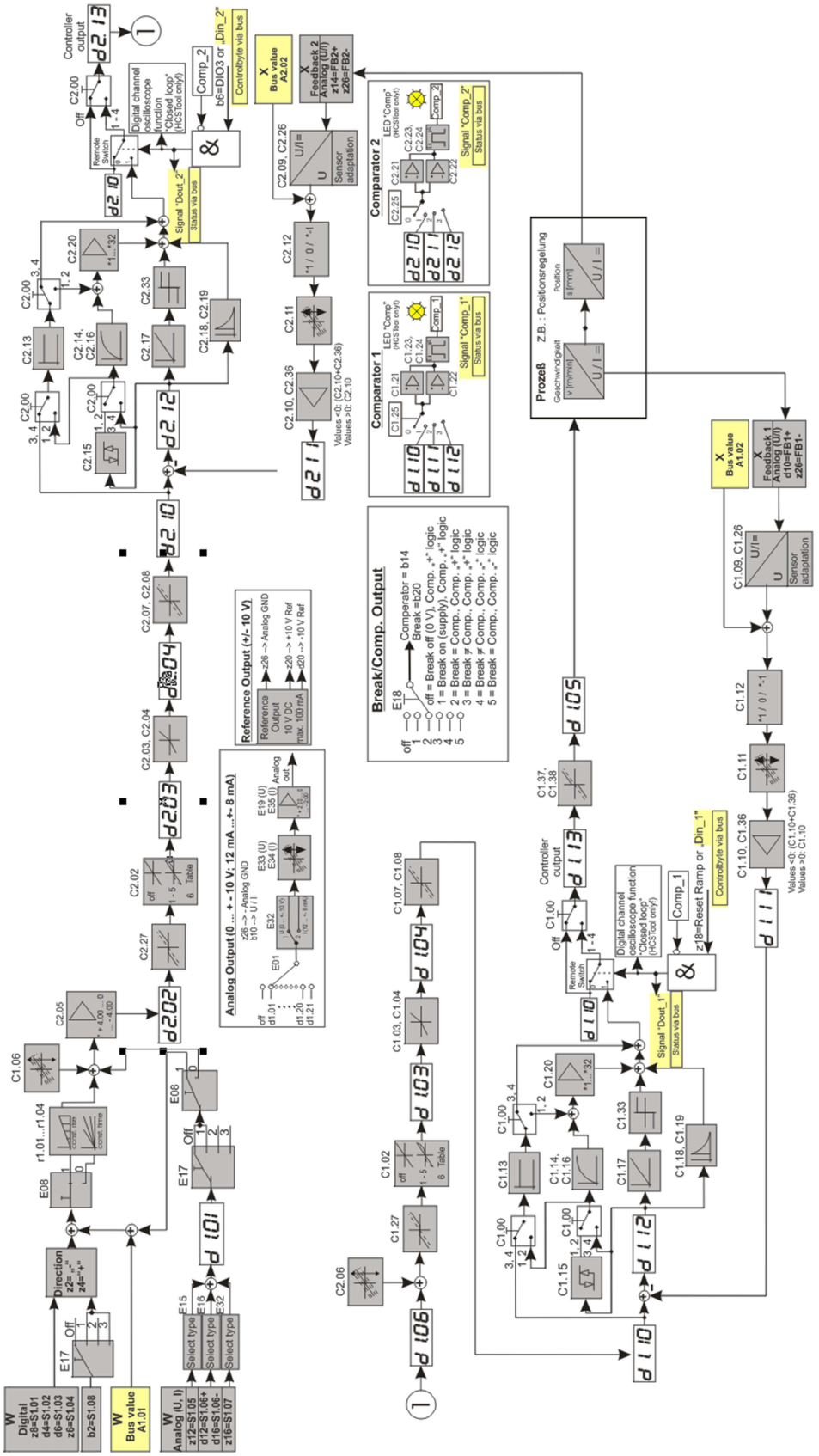

Figure 12 : Software block diagram operation mode 11

6.2.9 Operation Mode 08; PpQ controller

All functions and parameter inside of the block diagrams are described in detail in the “DAC-4x(A)-08-PpQ Manual E Rxx yyyymmdd.pdf”

please ask HCS GmbH if needed.

6.2.10 Operation Mode 14; PpQ controller

All functions and parameter inside of the block diagrams are described in detail in the “DAC-4x(A)-PpQ Manual E Rxx yyyymmdd.pdf”

please ask HCS GmbH if needed.

7 General communication information

7.1 Special information for bus activation <E22>

If communication via Ethernet-IP is required, there must be a connection to the power supply; supply via USB is not sufficient.
The Ethernet-IP-Node connected to the PLC (Error LED is off). In addition, parameter E22 must be set to "on" or “1”.

7.2 Bus timeout parameter <E23>

If a timeout period <E23> is specified, the DAC-42(A) expects a new telegram within this time. If the connection is interrupted, it will be indicated by a blinking Enable LED.
Setting <E23> to 0 disables this function.

7.3 General information setting and changing IP-Addresses or bus size

**Bus settings (e.g. IP-address) are only effective after power down reset.
Data will then be exchanged between
DAC-4x(A) 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 activation
E 23	0,000	s	BUS timeout, at 0s the function is deactivated
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	85		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 13 : Example for parameter setting of module no. 1

The parameter numbering is depending on the SW version of the DAC-4x(A)

7.4 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-IP-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.

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

The SADR is used to address different slaves which are connected to the same Ethernet-IP-node. In case of the DAC-4x(A) the possibility of a Multi-Slave Nodes is not possible. The slave Address in the telegram must always set to “0” or “1”

Different ways of communication between master and slave (DAC-4x(A)) are possible. The difference is in the CMD instruction.

CMD = 6: Writing of a single parameter-ID to the DAC-4x(A). The Ethernet-IP node has only one slave (one DAC-4x(A) connected. In this case SADR is set to 1.
□ Chapter „8.3.1 CMD = 6, Master Write single parameter (7 bytes) ”, page 30

CMD = 3: Reading of one or more parameters with parameter-ID in rising order. The Ethernet-IP node has only one slave (one DAC-4x(A) connected. In this case SADR is set to 1
□ Chapter „**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**”, page **Fehler! Textmarke nicht definiert.**

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 DAC-4x(A); refer also to
□ Chapter „9.5 CMD = 15, structure of Ethernet-IP telegram definition, depending on SW Versions“, page 35
For more information please to □ Chapter „9 Complex commands”, page 33

It is possible to „mix“ the instructions CMD = 3, CMD = 6 and CM = 15 for the DAC-4x(A).

8 Simple commands

8.1 CMD 3 Master Read

8.1.1 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 = 01	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-IP-Master.(Set by the User)

SADR 1 = standard (single slave)

CMD Command: 3 = Read parameter by the master

IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX
0x0000 .. 0x0109 = Valid ID-Range. Please take into account the gaps in the parameter list

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)

8.1.2 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-IP-Master. (Set by the read command)

SADR Slave address, 1 = standard (single slave)

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 .. 0x00109 = Valid ID-Range

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

8.1.3 CMD = 3, Error from DAC-4x(A) (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	**0x01**	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

8.2 Telegram example CMD = 3

Master wants to read parameter „d1.07”:

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

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 (DAC-4(A))
CNT = 2 (2 Bytes)
DATA = 0x0133 (== 0.307A)

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

8.3 CMD = 6, Master Write

8.3.1 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 = 01	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-IP-Master.(Set by the user)

SADR 1 = standard (single slave)

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

8.3.2 CMD = 6, Response from DAC-4x(A) (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-IP-Master.(Set by the write command)

SADR Slave address, 1 = standard (single slave)

CMD Command: 6 = Write parameter by the master

IDH,IDL H-Byte and Low-Byte of parameter-ID in HEX
0x0000 .. 0x0109 Valid ID-Range

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

8.3.3 CMD = 6, Error from DAC-4x(A) (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:

SADR 3 is not valid 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

8.4 Telegram example CMD = 6

8.4.1 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 (DAC-4(A)), 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

8.4.2 Example, write set value

Examples for set value via Ethernet-IP (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

9 Complex commands

9.1 CMD = 15, Master writes multiple parameters (8 bytes) (Fast single-slave command)

Write first…

Byte	Abbreviation	Description	
0	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF	
1	SNUM = 01	Single slave, always 01	
2	CMD	Command: 15 = Write multiple parameters by the master	
3	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
	Overall telegram length in bytes		

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

SNUM Only one slave is connected. SNUM = 01.

CMD Command: 15 = Write multiple parameters by the master

DAT1.1 Control-Byte. One data byte in HEX, for special functions
0x00 == 0
0xFF == 255

DAT1.2H, DAT1.2L Process Value1: Two data bytes in HEX, without decimal sign, for „analogue" values
0x7FFF == +32767
0x8000 == -32768

DAT1.3H, DAT1.3L Process Value1: Two data bytes in HEX, without decimal sign, for „analogue" values
0x7FFF == +32767
0x8000 == -32768

9.2 CMD = 15, Response from DAC-4x(A) (9 bytes)

This response telegram with SADR = 1 is send back by the DAC-4x(A).

Write first…

Byte	Structure	Abbreviation	Description	
0	Telegram header	TADR	Telegram address, defined by the user, Range 0..255, 0..0xFF	
1		SADR = 01	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-IP-Master.(set by the user)

SADR Slave address, normally always 01

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

9.3 CMD = 15, Error from DAC-4x(A) (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-IP 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

9.4 Examples, CMD = 15, single slave, DAC-4x(A)

E22 is set to 1 and hardware Enable is connected to the DAC-4x(A).

Master writes set value of 1.000 V to slave (DAC-4x(A)):

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 (DAC-4x(A)) 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.

9.5 CMD = 15, structure of Ethernet-IP telegram definition, depending on SW Versions

9.5.1 General

9.5.1.1 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 DAC-4x(A).
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	0x07	Wire break at S1.07 (voltage/current depend on setting)
0x0C	0x08	Underload of the solenoid output (if monitoring is activated)
0x0C	0x0A	Timeout error -no Ethernet-IP 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	0x11	Over current at set point S1.07 (current signal >22mA)
0x0C	0x17	Selected Sensor need autocalibration.

Table 7: Error numbers

If parameter E 23 has a value not equal to 0 (Ethernet-IP timeout is activated).
The device reacts with a blinking "Error LED" about to long time between valid Ethernet-IP telegrams. Those versions continue with work if a new valid telegram is detected. No separate acknowledges with the enable signal is needed.

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

9.5.1.2 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.

9.5.1.3 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 pin 8d) is activated at the module.
ERROR	An Error has occurred in the DAC-4x(A). Different possible problems can cause this. Please refer to the manual for the according DAC-4x(A) version.
BUS_DISABLE	Enable signal was reset by means of Ethernet-IP (DAC-4x(A) is disabled). Switching off the HW enable also resets any pending **BUS_DISABLE**
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

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

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM = 1	Single slave = 1
	2		CMD	Command: 15 = Write multiple parameters 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-IP)
	6		DAT1.3H	**A1.02 Module 1 (normally not used)**
	7		DAT1.3L	Set value input (Ethernet-IP)
….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-IP) 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 parameters 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** = d1.07
	6		DAT.2L	Actual current A
	7		DAT.3H	**VALUE2**= d1.08
	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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S1.03 active *) 0x20 = Digital input **SP4** (S1.04 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**

*) The designation and availability of the input depends on the module variant.

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

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM = 1	Single slave = 1
	2		CMD	Command: 15 = Write multiple parameters by the master
	3	Module Data	DAT1.1	**Control byte** | Byte for special functions
	4		DAT1.2H	**A1.01,** set value input (Ethernet-IP) for (Branch 1)
	5		DAT1.2L	
	6		DAT1.3H	**A2.01,** set value input (Ethernet-IP) 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-IP) 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 parameters 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** = d1.07
	6		DAT.2L	Actual current A
	7		DAT.3H	**VALUE2** = d1.08
	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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S2.01) active *) 0x20 = Digital input **SP4** (S2.02) 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

*) The designation and availability of the input depends on the module variant.

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

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM = 1	Single slave = 1
	2		CMD	Command: 15 = Write multiple parameters 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-IP) for (Branch 1)
	6		DAT1.3H	**Process Value2 = A1.02**
	7		DAT1.3L	Feedback value input (Ethernet-IP) 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-IP) 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 parameters 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
	6		DAT.2L	Actual value, feedback value (Branch 1)
	7		DAT.3H	**VALUE2** = d1.10
	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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S2.01) active *) 0x20 = Digital input **SP4** (S2.02) 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

*) The designation and availability of the input depends on the module variant.

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

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM = 1	Single slave = 1
	2		CMD	Command: 15 = Write multiple parameters 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-IP) for (Branch 1)
	6		DAT1.3H	**Process Value2 = A2.02**
	7		DAT1.3L	Feedback value input (Ethernet-IP) 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-IP) 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 parameters 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
	6		DAT.2L	Actual value, feedback value (Branch 1)
	7		DAT.3H	**VALUE2** = d2.11
	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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S2.01) active *) 0x20 = Digital input **SP4** (S2.02) 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

*) The designation and availability of the input depends on the module variant.

9.5.6 Version for Mode 8 (closed loop)

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description	
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF	
	1		SNUM = 1	Single slave = 1	
	2		CMD	Command: 15 = Write multiple parameters 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-IP) for (Branch 1)	
	6		DAT1.3H	**Process Value2 = A2.01 S**	
	7		DAT1.3L	Set value input (Ethernet-IP) 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-IP) 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 parameters 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	
	6		DAT.2L	Actual value, feedback value (Branch 1)	
	7		DAT.3H	**VALUE2** = d2.11	
	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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S2.01) active *) 0x20 = Digital input **SP4** (S2.02) 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

*) The designation and availability of the input depends on the module variant.

9.5.7 Version for Mode 14 (PpQ controller)

Master writes multiple parameters (at all 8 bytes)

Write first…

Comment	Byte	Structure	Abbreviation	Description
	0	Telegram header	TADR	Telegram address, defined by User, Range 0..255, 0..0xFF
	1		SNUM = 1	Single slave = 1
	2		CMD	Command: 15 = Write multiple parameters 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 (ProfiNet) for Q-set value (V)
	6		DAT1.3H	**Process Value2 = A2.01 S**
	7		DAT1.3L	Set value input (ProfiNet) for pressure limit value (V)
….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 = **not used** 0x10 = **Din_2**; Set signal Din_2 to active 0x80 = **BUS_DISABLE** (Module disable via ProfiNet) 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 parameters 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
	6		DAT.2L	Actual value, feedback value swift angle (V)
	7		DAT.3H	**VALUE2** = d2.11
	8		DAT.3L	Actual value, feedback value actual pressure (V)
….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** (S1.01) active *) 0x02 = Digital input **SP2** (S1.02) active *) 0x04 = **HW_ENABLE**, hardware enable active 0x08 = **ERROR**, Error is pending 0x10 = Digital input **SP3** (S2.01) active *) 0x20 = Digital input **SP4** (S2.02) active *) 0x40 = **Slave mode** or input **Ramp_0** active 0x80 = **BUS_DISABLE** is set
Low byte of module state	DAT.1L	if „Error occurred" bit is set: error number otherwise: 0x01 = Digital input **DIO1** active *0x02 = not used* 0x04 = **Comp_1** active 0x08 = Q set value negative **DIR** active 0x10 = not used 0x20 = not used 0x40 = Digital input **DIO2** active 0x80 = Internal signal **I-active**

*) The designation and availability of the input depends on the module variant.

10 Setup the Ethernet communication

10.1 Check the ethernet connection

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

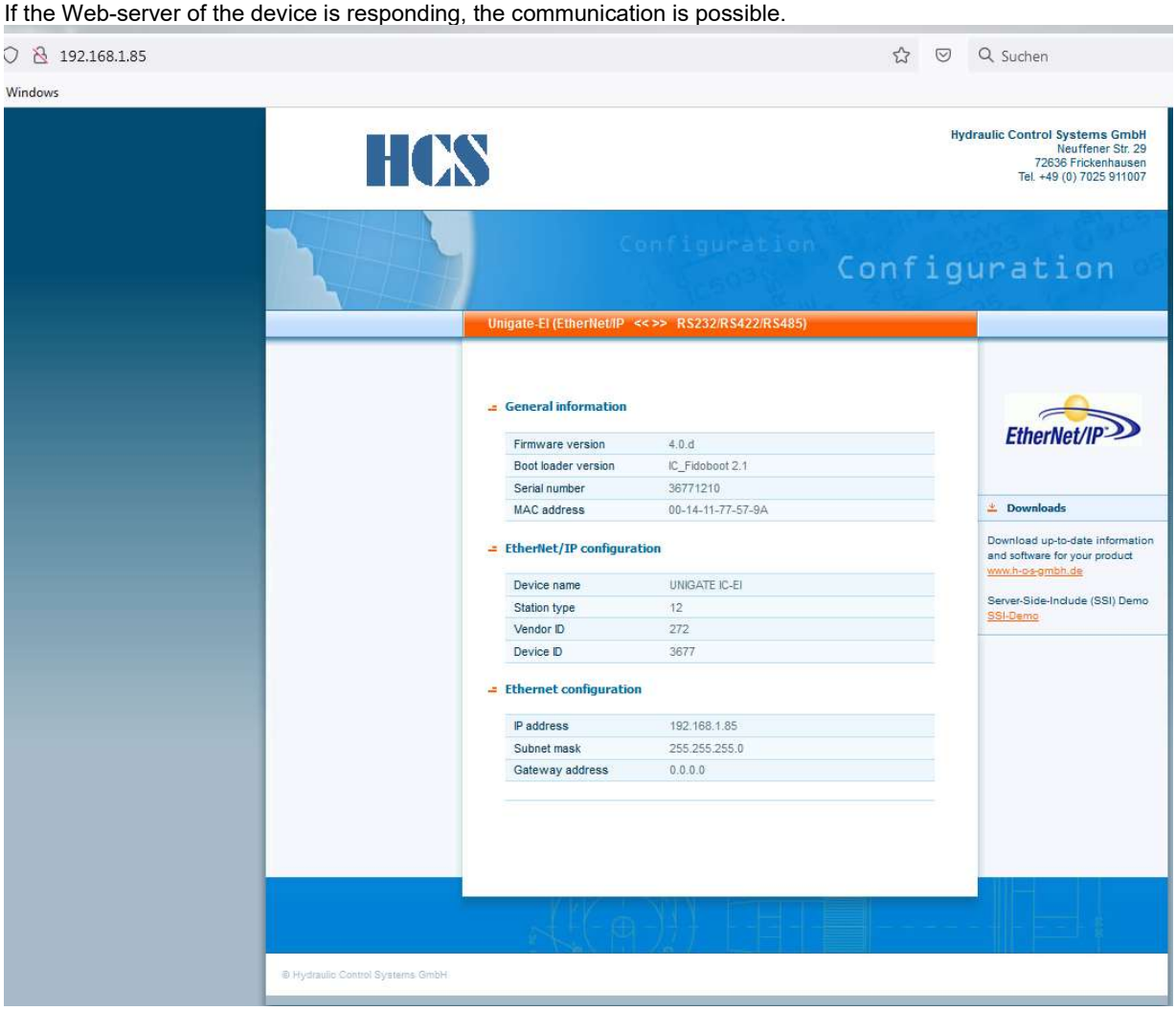

Figure 14: Web server example for address 192.168.1.85

10.2 Example for communication by means “EIPScan”

EIPScan is a product of Pyramid Solutions.

10.2.1 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

10.2.2 Starting „EIPScan“:

Power-up „DAC-4X(A)-Ethernet_IP-extension“ and connect to local net (LAN)
The module is ready for communication as soon as the LED „H1“ starts blinking.

10.2.3 Add new device → add Ethernet node

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

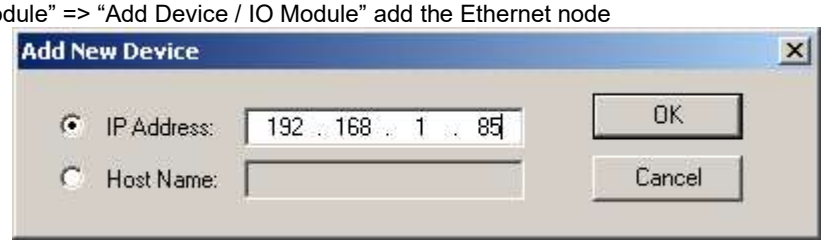

Figure 15: Ethernet IP address

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.

10.2.4 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.

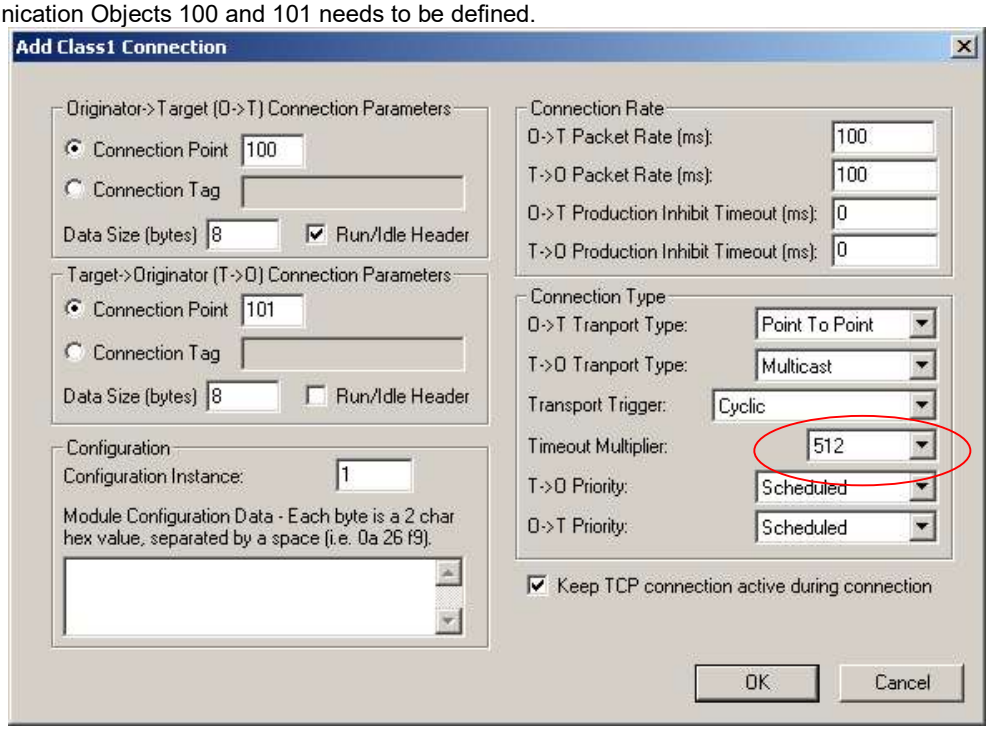

Figure 16: Connection setup

Figure 16 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 DAC-4X(A)) must be set properly.

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

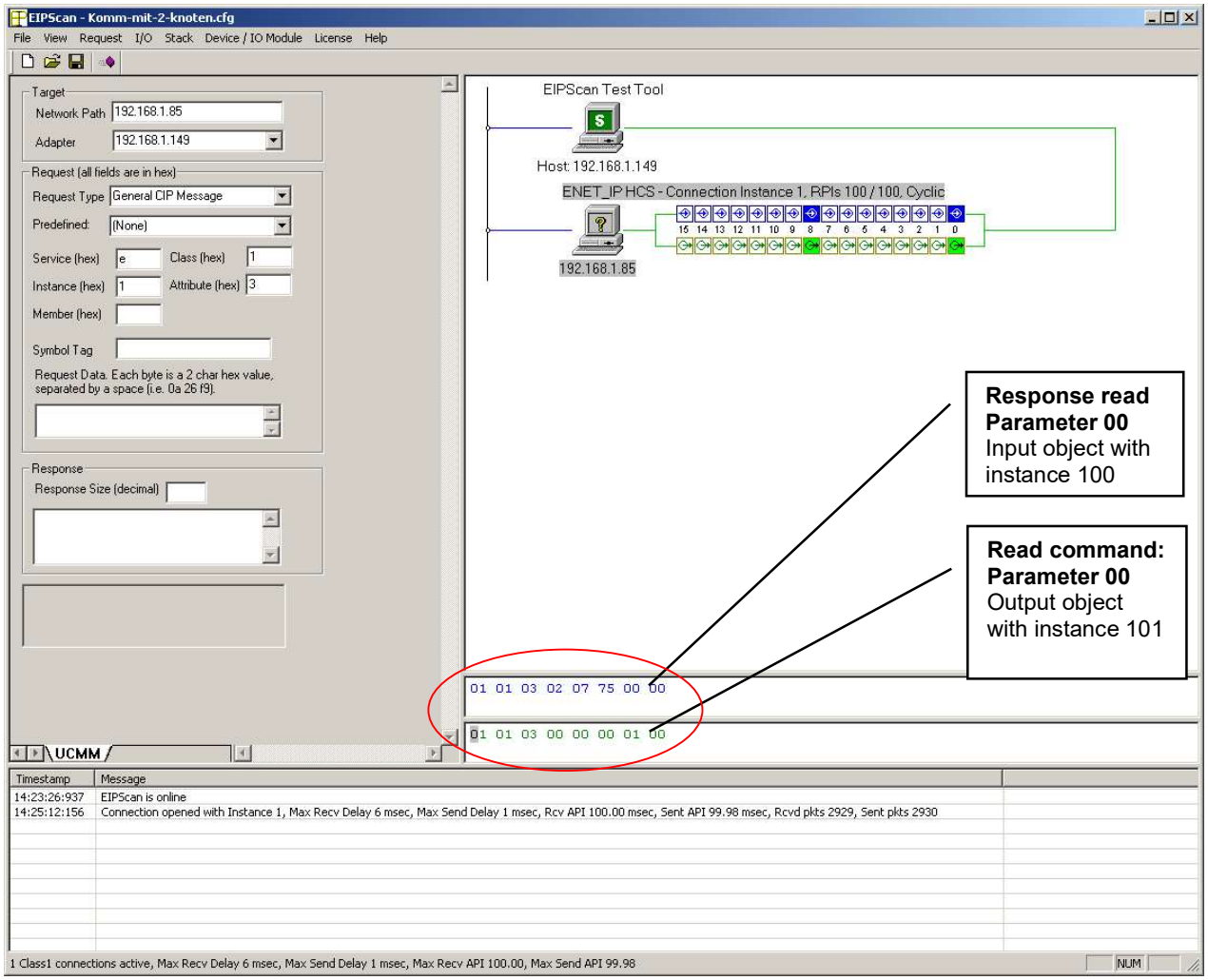

Figure 17: Example parameter read

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 DAC-4x(A) (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	04	DAT1H	Value of the Parameter 0x4B1 == **Softwareversion 1201**
5	B1	DAT1L	
6	00	--	Dummy only for filling up the buffer

7	00	--	Dummy only for filling up the buffer

11 List of parameters mode 01 … 11, without (PpQ)

Please note: The following parameter table does not apply to the DAC-4x(A) with PpQ function.

The applicable parameter table is included in the documentation for the corresponding PpQ version!

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	xx.xx	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	ProfiNet 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	ProfiNet 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	

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x27	39	R/W	A2.01	ProfiNet 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	ProfiNet 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
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 ±5V 9 = 7,5 ±5V> 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
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

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
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!
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 ±5V 9 = 7,5 ±5V> 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

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
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)
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	3	off	off = 4 digital, 3 analog active 1 = 5 digital SP, 3 analog active 2 = only 4 digital active 3 = only 5 digital active
0x71	113	R/W	E18	Error / Comparator output selection Modus 1,2	---	off	1	off	off = break off 1 = break on
				Modus 3,4,10,11	---	off	5	off	off = break off, comp. positive logic 1 = break on, comp. positive logic 2 = break follows comp. positive logic 3 = break not and comp. positive logic 4 = break and comp. negative logic 5 = break not and comp neg. logic
				Modus 6,8	---	off	13	off	off = break off, comp. positive logic 1 = break on (supply) comp. pos. log 2 = break follows comp., comp. pos. log 3 = break log. not comp., comp. pos. log 4 = break log. not comp., comp. neg. log 5 = break a. comp. same, comp. neg. l. 6 = break follow Comp1, comp. pos. log 7 = break log. not Comp1, comp. pos. l. 8 = break log. not Comp1, comp. neg. l. 9 = break a. Comp1 same, comp. neg. l. 10 = break follow Comp2; comp. pos. l. 11 = break log. not Comp2, comp. pos. l. 12 = break log. not Comp2; comp. neg. l. 13 = break a. Comp2 same, comp. neg. l
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!

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0x73	115	X	E20	Reserved	---	---	---	---	
..	..								
0xA2	162	X	---	Reserved	---	---	---	---	
0xA3	163	R/W	E 22	Activate/Deactivate bus function	---	0	1	0	0 = No bus function 1 = Standard bus function
0xB1	177	R/W	E23	BUS timeout	s	0	9999	0	1000 == 1 s, 0 = function off
0xB2	178	R/W	E26	Reserved	---	---	---	---	
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	X	---	Reserved	---	---	---	---	
0xA7	167	X	---	Reserved	---	---	---	---	
0xA8	168	X	---	Reserved	---	---	---	---	
0xA9	169	X	---	Reserved	---	---	---	---	
0xAA	170	X	---	Reserved	---	---	---	---	
0xAB	171	X	---	Reserved	---	---	---	---	
0xAC	172	X	---	Reserved	---	---	---	---	
0xAD	173	X	---	Reserved	---	---	---	---	
0xAE	174	X	---	Reserved	---	---	---	---	
0xAF	175	X	---	Reserved	---	---	---	---	
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 = reserved 0x0010 = Din_2 active (Read/Write) 0x0020 = Dout_2 active (Read only) 0x0040 = Comp_2 active (Read only) 0x0080 = reserved 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) 0x4000 = reserved 0x8000 = Bus Disable Card (Read/Write)
0xB1	177	R/W	E 23	Bus telegram timeout window	S	0	9999	0	0 == function deactivated 1 == 10 ms
0xB2	178	R/W	E 26	Bus Timeout Error handling	---	0	1	0	0 = Blinking Enable Led shows ProfiNet timeout 1 = ProfiNet timeout causes error.
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
..	..								

Number Parameter definition/ numbering for SW V12.xx, V23.xx
Number Parameter definition /numbering for SW V65.xx, V68.xx

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0xCB	203	-	-	reserved	---	---	---	---	
0xCC	204	R/W	E 25 E 37	IP-address "aaa" from "aaa.bbb.ccc.ddd"	---	0	255	192	
0xCD	205	R/W	E 26 E 38	IP-address "bbb" from "aaa.bbb.ccc.ddd"	---	0	255	168	
0xCE	206	R/W	E 27 E 39	IP-address "ccc" from "aaa.bbb.ccc.ddd"	---	0	255	1	
0xCF	207	R	E 28 E 40	IP-address of low-byte DIP switch "ddd" (read only)	---	0	255	85	
0xD0	208	R/W	E 29 E 41	Input buffer length in byte	---	0	32	12	
0xD1	209	R/W	E 30 E 42	Output buffer length in byte	---	0	32	12	

ID_{Hex}	ID_{dec}	W/R	Name	Function	Unit	Min	Max	Def	Description
0xD2	210	R/W	E 31	Mode of the analog output	---	1	2	2	1 = Voltage output at pin 10b 2 = Current output at pin 10b.
0xD3	211	R/W	E 32	Selection set point S1.07 (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.
0xD4	212	R/W	E 33	Offset for analog voltage output (depends on HW + SW version)	V	-9999	9999	0	-1000 == -1.000 V; 1000 == 1.000 V
0xD5	213	R/W	E 34	Offset for analog current output (depends on HW + SW version)	mA	-9999	9999	0	-1000 == -1.000 mA; 1000 == 1.000 mA

Number Parameter definition/ numbering for SW V12.xx, V23.xx

0xD6	214	R	d1.14	Sensor raw value in [mm]	mm	-9999	9999	-	
0xD7	215	R	d1.15	Sensor raw value in [µm]Sensor decimal point value in [µm]	um	-9999	9999	-	
0xD8	216	R/W	E 36	Effective data bits of the SSI sensor	---	16	30	24	
0xD9	217	R/W	E 37	Number of other bis, such as error bit	---	0	2	0	
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; 9.999 V = max. current
0xDD	221	R/W	C1.38	Spool overlap compensation B	V	0	9999	0	depending on solenoid selection
0xDE	222	--	C2.37	reserved	---	---	---	---	
0xDF	223	---	C2.38	reserved	---	---	---	---	
..	..								
0xE5	229	X	E sta	Reserved	---	---	---	---	
0xB6	182	R/W	E 35	Factor analog output current	---	-200	200	100	100 == Factor 1.00
..	..								
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
..	..								

Number Parameter definition/ numbering for SW V12.xx, V23.xx

0xE3	227	R/W	E 38	Sensor resolution in [mm]	mm	0.001	9.999	0.05	
0xE4	228	R/W	E 39	Type of data encoding	---	0	1	0	0: Binary code; 1: GRAY code
0xE5	229	R/W	E 40	Sensor cable length in [m] Sensor cable length in m (The sensor baud rate is adjusted accordingly)	m	1	400	10	
..	..								
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	
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 8: Parameter list, mode 01 … 11

12 Troubleshooting

12.1 General

The status LED in the Front of the DAC-4X(A) 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 DAC-4X(A) 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.

12.2 No Ethernet communication is possible

THE "LINK/ACT" LED IS NOT BLINKING:

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

12.3 Communication ok, but current outputs are inactive

Could the set point/feedback-value be monitored by the DAC-4X(A) 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.
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.

13 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:	**DAC-4X(A)-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)

Figure 18 : Declaration of conformity

- End -