EXDUL-584E

EDP-No: A-371940

EXDUL-584S

EDP-No: 371920

8 A/D inputs 16 bit (single ended) or
4 A/D outputs16 bit (differential)
8 D/A outputs16 bit
1 optocoupler isolated digital input
1 optocoupler isolated digital output
counter 32 bit
LCD display (EXDUL-584E only)

wasco®

user's guide

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Disclaimer

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Important Information:

This manual was made up for the modules EXDUL-584E and EXDUL-584S. EXDUL-584E additionally features an LCD display, all other functions are identical. For the EXDUL-584S all commands and functions concerning the LCD display are not applicable.

Inhaltsverzeichnis

1. Introduction

The modules EXDUL-584E and EXDUL-584S are network-compatible digital I/O modules with Ethernet interface. Each module features either eight ground referenced or four differential 16-bit A/D input channels. You can adjust several bipolar input voltage ranges (+/-0.63 V, +/-1.27 V, +/-2.55 V, +/-5.1 V, +/-10.2 V). The conversion process including the associated configuration of the A/D components (selection of range and channel) is triggered by software commands. The output voltage ranges (+/-2.55 V, +/-5.1V, +/-10.2 V) of all of the eight 16-bit D/A outputs are software-selectable as well.
Additionally the module has one digital input and one digital output galvanically opto-isolated by high-quality optocouplers and additional protection diodes. Special high power output optocouplers cope with a switching current up to 150 mA. If necessary, the optocoupler input can be programmed and used as a counter input. The programmable LCD display of the EXDUL-584E shows either digital I/O status information or programmable user-specific data.
An external power supply is required to supply the necessary operating voltage. The module comes with a 24-pin screw terminal block for connecting the external power supply as well as the input and output optocouplers.
The compact casing enables the module to be used as a portable device with a notebook. For mechanical or control engineering it can also be easily wall mounted or attached to DIN mounting rail.

2. Connection Terminals

2.1 Terminal Assignments of CN1

AIN01+	2	1	AIN00+
AIN03+	4	3	AIN02+
AIN05+	6	5	AIN04+
AIN07+	8	7	AIN06+
AOUT01+	10	9	AOUT00+
AOUT03+	12	11	AOUT02+
AOUT05+	14	13	AOUT04+
AOUT07+	16	15	AOUT06+
DAGND	18	17	ADGND
OUT00-	20	19	OUT00+
IN00-	22	21	IN00+ / Zähler0
GND_EXT	24	23	Vcc_EXT

Vcc_EXT:
Connector for external voltage source
GND_EXT:
Ground connection

3. System Components

3.1 Block Diagram EXDUL-584E

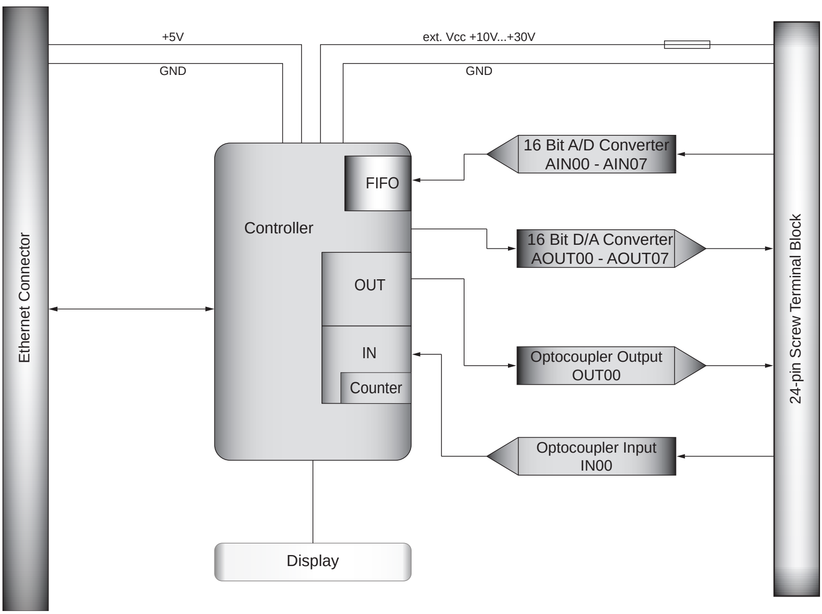


Fig. 3.1 Block diagram EXDUL-584E

3.2 Block Diagram EXDUL-584S

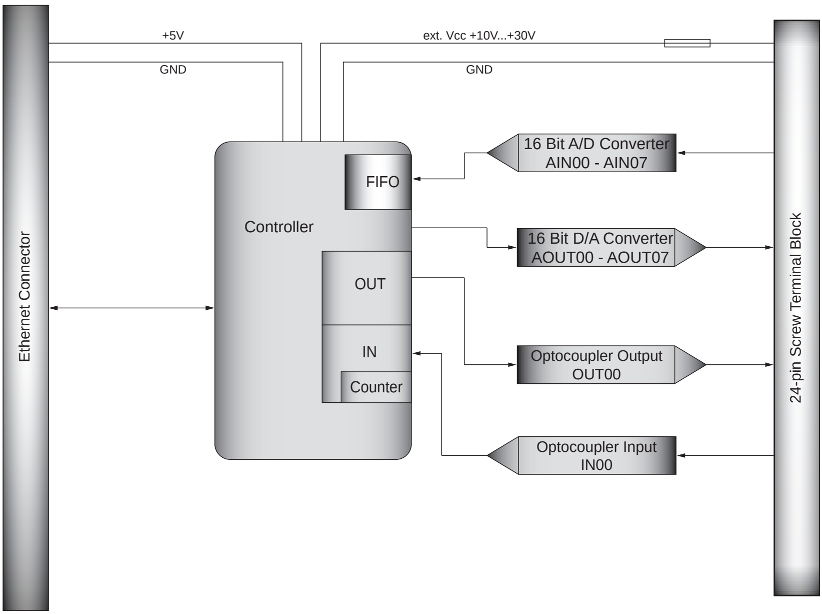


Fig. 3.2 Block diagram EXDUL-584S

3.3 A/D Inputs

8 inputs single-ended (se) or 4 inputs differential (diff) or combined se/diff software-selectable
Resolution: 16 bit
Input voltage ranges bipolar: +/-0.63 V, +/-1.27 V, +/-2.55 V, +/-5.1 V, +/-10.2 V
+/-20.4V (differential inputs only)
FIFO: 10000 measuring values
Input resistance: > 500 MΩ
Over voltage protection: +/- 50V
maximum sampling rate: 100kSps

3.4 D/A Outputs

8 outputs
Resolution: 16 bit
Output voltage ranges bipolar: +/-2.55 Volt, +/-5.1 Volt, +/-10.2 Volt
Output current: max +/-5 mA

3.5 Digital Optocoupler Input

1 bipolar channel, galvanically isolated
Over voltage protection diodes
Input voltage range
high = 10..30 Volt
low = 0..3 Volt

3.6 Digital Optocoupler Output

1 channel, galvanically isolated
High capacity optocoupler
Reverse polarity protection
Output current: max. 150 mA
Switching voltage: max. 50 V

3.7 Counter

1 programmable counter 32 bit
Counting frequency: max. 5 kHz

3.8 LCD Display (only EXDUL-584E)

Matrix display with 2 lines and 16 columns displaying 16 characters each line
Programmable to display user specific data or I/O state

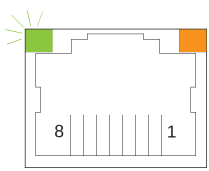
4. Deployment

Connection to a network or to a computer is made in an easy and convenient way via an Ethernet interface, the configuration is made via any web browser. An external power supply unit is required for the necessary operating voltage.

4.1 Connecting to an Ethernet Port

The module EXDUL-584E / EXDUL-584S features a 10Base-T Ethernet interface with RJ45 connection (8P8C modular connector) and you can connect directly to a PC, Ethernet hub or Ethernet switch using a network cable.

After the operating voltage is applied the module will boot up. Once a stable connection is established, the green LED on the left side of the RJ45 jack is lit continuously.



4.2 Connecting the Operating Voltage

The EXDUL-584E / EXDUL-584S requires a power supply of +10V ... +30V across terminal 23 (Vcc) and terminal 24 (GND).

4.3 Integrated Webpage of EXDUL-584E / EXDUL-584S

Any web or internet browser such as Mozilla Firefox, Internet Explorer, Safari etc. can access to the web page of EXDUL-584 via a TCP/IP connection. The web page enables to read out connection information and to modify configuration data under password protection. The settings made are stored in the internal EEPROM of EXDUL-584 and are loaded during the booting process. The EXDUL-584 web page enables you to write, read-out and to display the user memory areas UserA, UserB, UserLCD1 and UserLCD2 as well as to start and to stop the counter or to monitor the digital inputs and outputs.

4.4 Password Protection - Access Code

As mentioned before, using the EXDUL web page enables to configure the network, to set up the LCD display, to write into user specific memory areas as well as to set up the inputs and outputs or the counter. To prevent unauthorised access, these setting sections are password protected.

Following default access code is preset:

User name: **admin**
Password: **11111111**

Please observe upper and lower case!

If you don’t succeed in accessing with this access code, your system administrator changed the settings of the access code.

4.5 Default Setting of the Network Configuration

In the factory setting the EXDUL-584 is set to DHCP (Dynamic Host Configuration Protocol), i.e. to dynamic IP address. During initialization, the EXDUL-584 sends a request to the network (LAN). A network with active DHCP service will then automatically assign an IP address to the module. This setting allows an easy and convenient connection of the module and to adjust custom-fit configuration data.

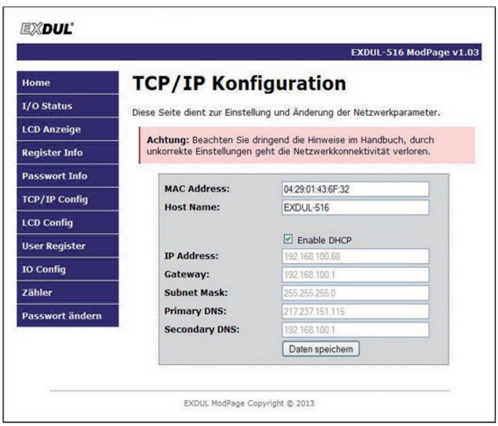
4.6 Composition and Structure of the IP Address

IPv4 addresses consist of 32 Bits = 4 Bytes (octets). Each Byte can range from 0 to 255. It is shown as four decimal numbers separated by dots (e.g. 192.168.1.83).
Each IP address consists of a network and a host part (host identifier). A subnet mask divides network part and host part. All devices located in the same network can communicate with each other.

Example:
If subnet mask 255.255.0.0 is allocated to the IP address 192.168.1.83, then the device is located in the network 192.168.-.- as device -.-.1.83.

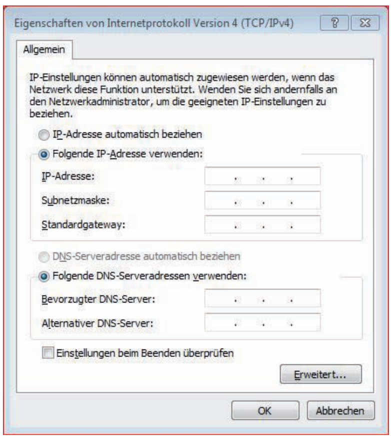
4.7 How to Change the Network Configuration

To change the factory default configuration settings, connect the EXDUL-584 to a local network using the enclosed standard network cable and connect the power supply (+10 V ...+30 V) across terminal 23 (Vcc) and terminal 24 (GND) of the module.The EXDUL boots up immediately. Once a stable Ethernet connection is established, the green LED on the left side of the RJ45 jack is lit green continuously. Access to the EXDUl-584 web page is possible using any web or internet browser by prompting the hostname **http://EXDUL-584**. Click the TCP/IP Config button to open the following configuration screen:



You can use the enclosed standard network cable to connect EXDUL-584 also directly to a host PC with an Ethernet interface. If you connect directly, normally no DHCP service is available, for neither the PC nor the EXDUL provides one. In this case, the last set static IP address can be used for addressing the EXDUL-584. The IP address 169.254.1.1 is applicable for factory-new EXDUL devices.

Important Information:
The PC used and the connected EXDUL are to be located in the same network to be able to communicate. For this purpose, DHCP has to be deactivated on the computer and the first two number blocks (192.168) of EXDUL IP address 192.168.1.83 (Subnet mask 255.255.0.0) are to be transferred to the computer's IP address. The next two number blocks can be assigned with values between 0 and 255 adjusted to your current requirements.

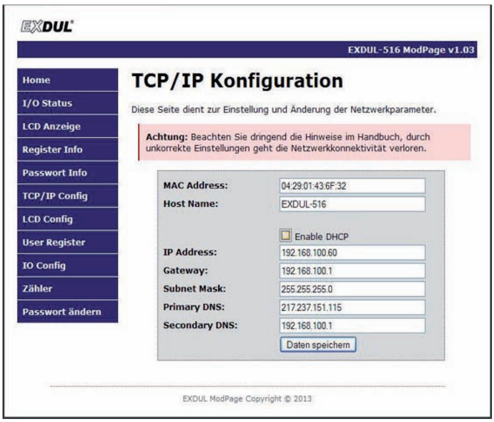


The network part of the IP address depends on the subnet mask. From the IP address of the Exdul-584 all octets that are assigned 255 in the subnet mask are to be transferred to the computer's IP address (see chapter 4.6 Composition and structure of IP address)

4.8 Configuration with Static IP Address (DHCP deactivated)

To configure EXDUL-584 to the static IP address, DHCP has to be deactivated in the EXDUL-584 configuration screen. To change the configuration, connect the EXDUL-584 to a LAN or PC as per description in chapter 4.7 (How to change the network configuration).

Once a stable Ethernet connection is established, you can access the EXDUL-584 web page via any Internet browser. Upon prompting the hostname **http://EXDUL-584**, the browser should open the EXDUL-584 web page. Click the button TCP/IP Config to open following configuration screen:



Once you disable DHCP, you can enter your desired IP address, subnet mask, and the desired hostname. By clicking the button **Konfiguration speichern,** the currently entered data will be transferred to the internal memory of the EXDUL-584. From this point on, the module only can be addressed via the IP address set here, or via the indicated hostname, respectively. The used PC or LAN must be located in the same network.

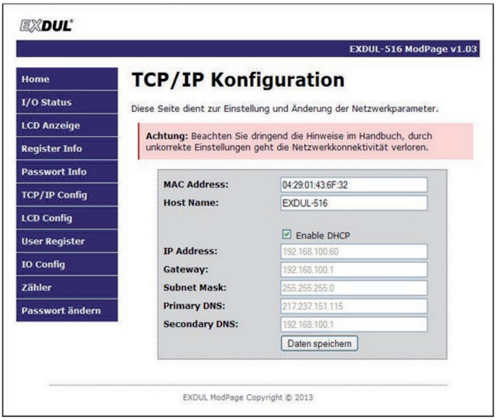
Important note: Each device or module in a network must have its unique IP address or hostname, second assignment is not permitted! The host-name may be chosen arbitrarily, but may contain only the ASCII digits 0 through 9 and the letters A through Z (leave out upper and lower case) and - (hyphen-minus).
Some IP addresses are reserved or have special functions such as: 127.0.0.1 (local host).
192.168.1.0 (0 is the network address) with 255.255.255.0 (subnet mask).

Please consult your network administrator which IP address you may use. If you use an invalid IP address the access to the module may then be impossible. The setting of the most important impermissible addresses is blocked by the module.

4.9 Configuration with Dynamic IP Address (DHCP enabled)

If you want to implement the EXDUL-584 into an existing network with an already active DHCP server and to map it via a dynamic IP address, DHCP (Dynamic Host Configuration Protocol) has to be activated in the configuration screen of the web page. In factory default setting, DHCP is already activated and there is no need to change.

If the IP address is set statically, activate DHCP as follows:
Connect the EXDUL-584 to a computer using a network cable (older computers may need a crossover network cable). Please make sure that the computer is set to: **Folgende IP-Adresse verwenden: (DHCP deaktiviert)**
The network part of the IP address (see chapter 4.6 Composition and structure of IP address) has to be transferred from the IP address of the EXDUL-584, because the computer and the EXDUL are to be located in the same network.
Connect the power supply (+10 V ...+30V) across terminals 23 (Vcc) and 24 (GND) of the module. The EXDUL will boot up immediately. Once a stable connection is established, the LED on the left side of the RJ45 jack is lit green continuously.
Access to the EXDUl-584 web page is possible using any internet browser entering the hostname or IP address of the EXDUL-584. The browser now should open the EXDUL web page. Clicking the TCP/IP Config button opens the configuration screen and you can acitivate DHCP by setting the checkmark **Enable DHCP** as shown in the following figure:



Important note:
We strongly recommend to consult your network administrator before activating DHCP. If you want to embed several identical modules of the series EXDUL-5xx into one network, the presetted hostname of each module has to be changed. Each hostname within a network must be assigned to only one device or module. The hostname can be chosen arbitrarily, but may contain only the ASCII digits 0 through 9 and the letters A through Z (leave out upper and lower case) and - (hyphen-minus).

4.10 LCD Display during the Booting Process (EXDUL-584E only)

During booting-up the module, the display shows information data. Line 1 indicates the module name, line 2 displays the information that the module is being initialized. After having completed the boot process, in both cases the display shows either I/O status information or UserLCD information depending on your configuration.

4.11 LCD Display during Operation (EXDUL-584E only)

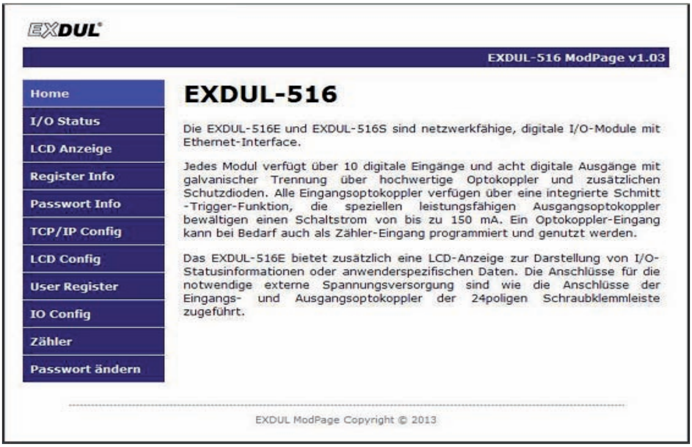
After having completed the boot process, the display switches from information display to I/O status display or UserLCD display depending on the setting. If the I/O status is displayed, line 1 indicates the current states of the inputs, line 2 the states of the outputs. If the UserLCD mode is activated in the EXDUL-584 web page, the display shows UserLCD data with the values from the memory areas UserLCD1m and UserLCD2m instead of I/O status display.
You can see the values of UserLCD1m and UserLCD2m on the LCD display unless you write new user data in UserLCD line1 and line2 of the LCD display. In order to avoid „screen-burn“ during operation, the display alternates from I/O status display or UserLCD display to information display with the current IP address for approx. 5 seconds every minute.

5. Accessing the EXDUL-584

As mentioned before, access to the configuration set-up and to the inputs and outputs of the EXDUL-584 is possible via EXDUL-584 web page or via TCP/IP sockets. For this you need to know IP address, hostname or MAC address.

5.1 Accessing via the EXDUL Web Page

The web page of the EXDUL-584 allows to read inputs, set outputs, read out memory areas UserA, UserB and UserLCD as well as to read out connection or module information or to change configuration data. You can access to the web page via any internet browser from any computer connected to the module. The computer used has to be set to „**IP-Adresse automatisch beziehen (DHCP-aktiviert)**“ as long as the module still is in its delivery state (DHCP enabled) and if it is integrated in a network with active DHCP service. Entering the hostname (in default state **http://EXDUL-584**, otherwise the name you chosed, or you might determine it via ExdulUtility_v2_xx or later) you can open the web page. If you don‘t succeed in opening the EXDUL-584 web page, please check the network connections or the entered hostname. For more details see chapter FAQ - trouble shooting.

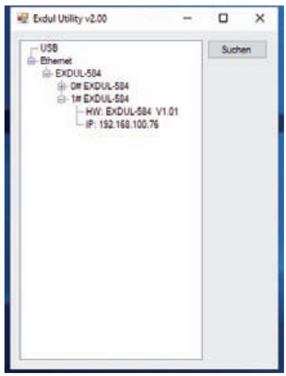


5.2 Accessing via TCP/IP Sockets

Using the TCP protocol, a reliable connection between the computer and the EXDUL-584 will be achieved. The protocol automatically takes actions in case of data loss. The module is mapped via a 4 Byte IP address (IPv4) or via the assigned hostname respectively and a port number 9760. The computer transmits one byte array for every command via this connection. The module processes the command and always sends a response. In combination with a high-level language, the TCP/IP connection allows to read the inputs, set the outputs, start, stop and to read out the counter, to write user specific memory areas, to read out the connection or module information and to change configuration settings as well.

5.3 How to Identify Hostname, IP Address and MAC Address

If you don‘t know neither the hostname nor the IP address or the Mac address of the EXDUL-5xx modules, the search tool ExdulUtility_v2_xx (or later) enables you to detect these addresses. If your firewall prevents the search program from communicating with the EXDUL-5xx, the program needs to be deallocated.



The **ExdulUtility_v2_xx** search program (or a later version) is provided on the EXDUL software CD or available for download at www.messcomp.com

6. 8 A/D Inputs 16 Bit

The EXDUL-584 provides 8 multiplexed single ended or 4 differential 16-bit A/D input channels with programmable input voltage range. When the conversion is triggered, the computer will transfer configuration data for conversion (channel, range) in the form of two bytes. After error corrections (such as offset error) the module transmits the measured value transformed in a voltage value in µV as a response or stores it in a FIFO.

6.1 Single ended Operation

In single ended operation mode, a maximum of 8 input channels are available. All input voltage ranges are measured against the ground (ADGND) of the A/D components (see figure 6.1). Find a more detailed description of the circuitry in chapter 12.4

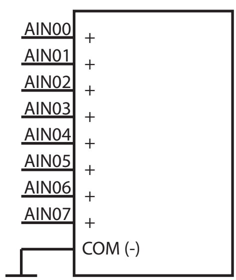


Figure 6.1 A/D converter single ended

As mentioned before, one byte for channel selection will be added to the command for measuring the voltage.
Please see table 6.1 to choose the appropriate value for each channel when single ended measuring is used.

Channel Byte	Channel selection single ended								
	1	2	3	4	5	6	7	8	ADGND
0_{dez}	+								-
1_{dez}		+							-
2_{dez}			+						-
3_{dez}				+					-
4_{dez}					+				-
5_{dez}						+			-
6_{dez}							+		-
7_{dez}								+	-

Table 6.1 A/D converter single ended measurement

For example, for a single ended measurement of channel 3, the positive pole of the voltage source has to be connected to AIN02 and the negative pole to ADGND. The channel byte of the command then is 2_{dez}.

6.2 Differential Operation

In differential operation, a maximum of 4 input channels are available. In differential mode each channel provides one positive and one negative input (see figure 6.2-1). Please note, all channels must be referenced to ground (ADGND) as well. Find a more detailed description of circuitry in chapter 12.5.

The differential measurement can reduce generally occurring interference voltages on both of the signal lines and the analog ground.

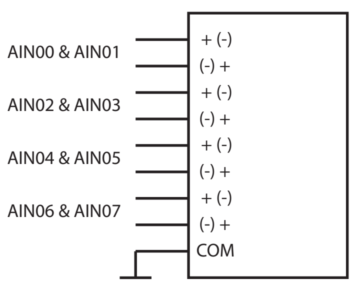


Figure 6.2-1 A/D converter differential measurement

Here too, the channel is selected via the channel byte added to the command for measuring the voltage. You can find the corresponding values in following table:

Channel Byte	Differential channel selection								
	1	2	3	4	5	6	7	8	ADGND
8_{dez}	+	-							
9_{dez}	-	+							
10_{dez}			+	-					
11_{dez}			-	+					
12_{dez}					+	-			
13_{dez}					-	+			
14_{dez}							+	-	
15_{dez}							-	+	

Table 6.2 A/D converter differential measurement

Serving as an example now the difference between two voltages shall be measured at the inputs AIN05 and AIN06. For this purpose, connect the first voltage to AIN05 and the second one to AIN06 (see figure 6.2-2).
Now either the value 12_{dez} (AIN05+ / AIN06-) or 13_{dez} (AIN05- / AIN06+, the result is a negative differential voltage!) can be used as channel byte.

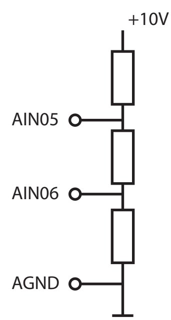


Fig. 6.2-2

Attention:
Please take particular care to ensure, that the difference between the inputs is whithin the input voltage range. An input voltage of +10V at AIN05 and an input voltage of -10V at AIN06 results in a difference of +20V, i.e. an input voltage range of +/- 20.4V must be chosen (see chapter 6.4)

6.3 Combination of Single Ended and Differential Measurement

If required, the measurement methods can also be varied channel by channel as in fig. 6.3 or even changed „on the fly“ between the individual measurements.

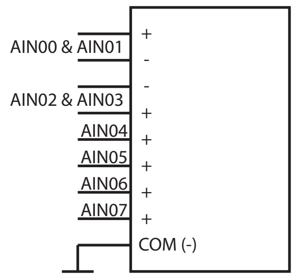


Fig. 6.3

6.4 Input Voltage Range

To measure a voltage, several input voltage ranges are available (+/-0.63 V, +/-1.27 V, +/-2.55 V, +/-5.1 V, +/-10.2 V). This permits the range to be adjusted to the input signal, thus optimizing the measuring accuracy. Along with the measuring command, the computer sends a range byte to the module to select the voltage range.
Following the individual ranges and the corresponding byte values are listed:

Input Voltage Range	
Byte Value	Voltage
0	+/- 20.4V (differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Table 6.4 A/D converter input voltage ranges

a) Single-Ended Measurement

As shown in Fig. 6.4.1, when measuring single-ended, the input signal is referenced to the ground. The maximum or minimum voltage to be measured at a voltage range of +/- 10.2V is +10.2V and -10.2V respectively.

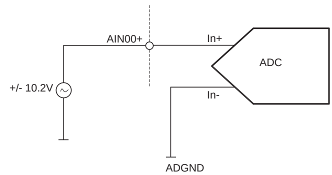


Fig. 6.4.1

Attention: since the maximum voltage to be measured at the analog input (e.g. AIN00+) is 10.2V, a voltage range of +/- 20.4V is not available for a single-ended measurement!

b) Differential measurement

For differential measurements, the input voltage range used corresponds to the maximum difference between the selected inputs. For this, as shown in Fig. 6.4.2, an input voltage range of +/- 0.63V can be chosen, although a voltage of up to +/- 10.2V is applied at the inputs.

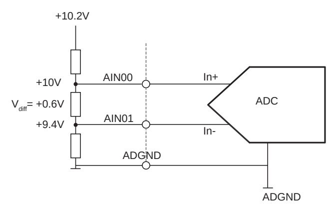


Fig. 6.4.2

When using differential measurement, in contrast to the single-ended measurement, there is also an input voltage range of +/- 20.4V.

Attention: For an input voltage range of +/-20.4V the maximum or minimum input voltage of +10.2V resp. -10.2V is true. Only the difference between two inputs may be +20.4V or -20.4V (e.g. AIN00 = +10.2V and AIN01 = -10.2V, V_{diff} = 20.4V)

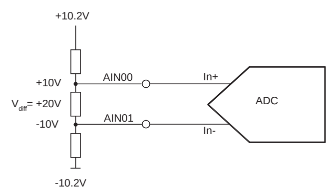


Fig. 6.4.3

6.5 Modes of Measurement

To facilitate the application, the EXDUL-584 provides several modes of measurement.

6.5.1 Single voltage measurement

In the single measurement, upon receiving the appropriate command, the module performs a measurement on the selected input, calibrates it and returns the value in µV to the user.

6.5.2 Single voltage measurement with averaging

In this measurement mode, the module performs 32 measurements at the user-selected input at scan intervals of 10 µs each, forms an average, calibrates the measurement and provides the result in µV to the user.
This measurement mode is particularly suitable for smaller input voltage ranges in order to suppress interferences such as noise.

6.5.3 Block measurement with averaging

This measurement mode is intended for applications, in which voltages at several inputs are to be measured as precisely as possible and in a timely manner. Along with transmitting the command to the module, the selected channels (up to 8) with the respective voltage range are transferred. Upon receiving the command, the module starts sampling each desired channel successively 32 times in 10µs increments.

Duration = Number of channels*32*10µs

After completion, the values are calibrated and returned to the user in µV.

Example:

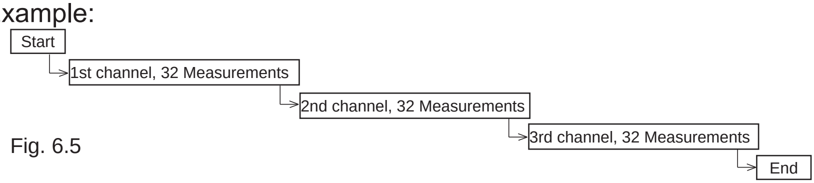


Fig. 6.5

In this example, three channels are to be sampled (e.g. AIN01+, AIN03+, AIN05+). These channels are transferred along with the command, and the module starts running 32 measurements of the first channel (here AIN01+). As soon as the measurements of the first channel have been completed, the sampling of the second channel is started. Once all of the channels have been sampled (duration here 960µs = number of channels*32*10µs), offset and gain errors are calibrated and the voltages in µV are transferred.

6.5.4 Multiple measurement

In the multiple measurement mode, up to 8 channels can be sampled several times (up to 65,535 times). Along with the command, the desired sampling rate (1 - 100kS/s) and the desired channels with the respective voltage range are transmitted. Upon receiving the command, the module performs the measurements and stores the calibrated values in µV into the FIFO. These values can be retrieved from the FIFO at any time. It is important to ensure that the FIFO does not overflow. It is recommended to operate this measurement mode with a sampling rate of up to 20kS/s only at a measurement count of more than 10,000 measurements. Additionally, you must not write to any EXDUL information register during this period.

6.5.5 Continuous measurement

In the continuous measurement mode, up to 8 channels with any measuring range and up to 100kS/s can be sampled in a continuous operation. For this purpose, there is a start and a stop command. The calibrated measured values in µV are written to the FIFO and can be retrieved from there at any time. It is important to ensure that the FIFO does not overflow. It is recommended to operate this measurement mode with a sampling rate of up to 20kS/s only. Additionally, you must not write to any EXDUL information register during this period.

6.6 Adjustment of the A/D Inputs

The module is calibrated at an ambient temperature of approx. 20°C during the final test of our production. If there are larger temperature deviations in the end application, the A/D component can be adapted to the environment by subsequent adjustment. The required software is provided on the enclosed CD or on the Internet.

7. 8 D/A Outputs 16 Bit

The EXDUL-584 features a total of eight digital-to-analog converter (DAC) outputs, each of which can be operated with different output voltage ranges.

7.1 Output Voltage Range

The DAC outputs each provide a variable output voltage range, which can be configured via a range byte in a special intended command.
This selection can be changed „on-the-fly“, that is, for one voltage output (e.g. -7V) you can apply the range bipolar +/-10.2V and for the next voltage output (e.g. -3V) the range bipolar +/-5.1V to achieve a higher resolution.
Following table shows the assignment of the range byte value and the output voltage range:

Output Voltage Range	
Range Byte	bipolar
0	+/-10.2V
1	+/-5.1V
2	+/-2.55V (default)

Table 7.1 D/A converter output voltage ranges

7.2 Adjustment of the D/A Outputs

The module is calibrated at an ambient temperature of approx. 20°C during the final test of our production. If there should be larger temperature deviations in the end application, the D/A component can be adapted to the environment by subsequent adjustment. The required software is provided on the CD or on the Internet.

8. 1 Optocoupler Input

The EXDUL-584 provides one input channel, which is optically isolated by optocouplers. The isolation voltage between the ground of the computer ad the and input is 500 volts.

8.1 Pin assignment of the input optocoupler

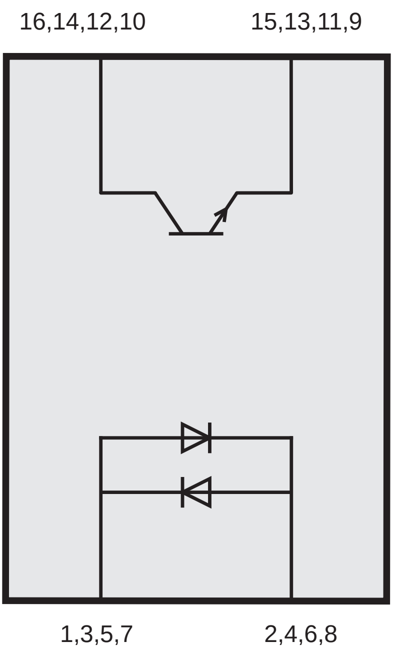


Fig. 8.1

8.2 Input Circuitry

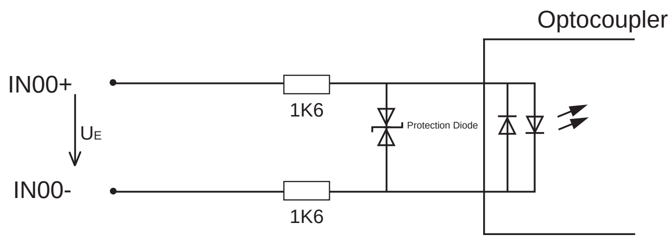


Fig 8.2

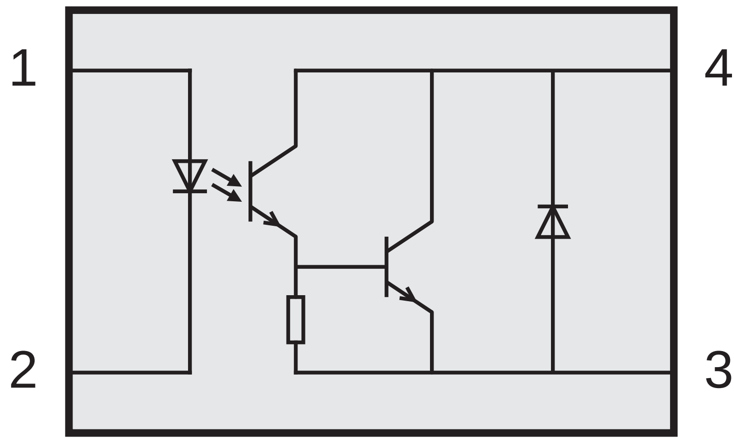
8.3 Input Current

$$I_E \approx \frac{U_E - 1{,}1V}{3200\Omega}$$

9. 1 Optically Isolated Output

The EXDUL module provides one output channel which also is optically isolated by optocouplers. The isolation voltage between the ground of the module the and output is 500 volts.

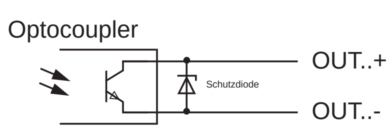
9.1 Pin assignment of the output optocoupler



9.2 Optocoupler specifications

Voltage collector-emitter: max. 50V
Voltage emitter-collector: 0,1V
Current collector-emitter: 150 mA

9.3 Output circuitry



10. Information, LCD and User Register

10.1 Register HW Identification and Serial Number

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
HW Identification	E	X	D	U	L	-	5	8	4			V	1	.	0	1
	45_{hex}	58_{hex}	44_{hex}	55_{hex}	$4C_{hex}$	$2D_{hex}$	35_{hex}	38_{hex}	34_{hex}	20_{hex}	20_{hex}	56_{hex}	31_{hex}	$3E_{hex}$	30_{hex}	31_{hex}
S/N	1	0	4	4	0	2	6									
	31_{hex}	30_{hex}	34_{hex}	34_{hex}	30_{hex}	32_{hex}	36_{hex}									

Table10.1 Register HW identification and serial number

The module name as well as the firmware version are stored in the HW identification register and can be used to determine the product identity by the user. The table above serves as an example as for the module EXDUL-584 with firmware version 1.01. The line HW identification shows each Hex value and the corresponding ASCII character.

The register Serial Number is a read-only register. The serial number in the table above serves as a format example. The line S/N shows each Hex value and the corresponding ASCII character as for the serial number 1044026.

10.2 Memory areas UserA, UserB, UserLCD1m* und UserLCD2m*

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
UserA																
	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}
UserB																
	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}
UserLCD1m*																
	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}
UserLCD2m*																
	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}	20_{hex}

Each of the registers UserA and UserB hold 16 digits (16 byte) for customizing. The data is retained when you switch off, registers can be set back to their factory settings (delivery state) by a default reset. In delivery state in all of the user memory areas each digit is set to the Hex value 20 corresponding to a blank in ASCII code.
The table above shows each Hex value and the corresponding ASCII character.

10.3 Display Register UserLCD-line1*, UserLCD-line2* and LCD Contrast*

If UserLCD mode is activated you can write to both of the UserLCD-line1 and UserLCD-line2 registers any 16 characters. Once transmitted, this will be displayed instead of the data from UserLCD1m* and UserLCD2m*. The data in the registers UserLCD-line1 and UserLCD-line2 is **not** retained when switching off.
You can adjust the LCD display contrast in register LCD contrast. This adjustment is retained when switching off.

*: EXDUL-584E only, no application for EXDUL-584S

11. Installing the Driver

The Ethernet module EXDUL-584 does not require any driver.
Precondition is a provided network connection from the computer (network interface card with driver) or from a mobile device. For direct access to the module, the TCP/IP libraries are required, which are available in many high-level languages such as C, C++, C#, Visual Basic or Java.
Access examples in several programming languages are provided on the enclosed CD or on our website www.mewsscomp.com.

12. Programming

12.1 Introduction

You can program under Windows using the so-called TCP/IP sockets, for which many commonly used programming languages provide standard libraries. The use of .Net Frameworks of Microsoft permits a simple and fast implementation. Using the default protocol, additionally to the Windows system the module can be connected to many other operating systems such as Ubuntu (based on Linux) or Android. You can find various programming examples on the enclosed CD and on our website.

12.2 Modes of Programming

There are several ways to access to the EXDUL module. So the library EXDUL.dll can be used for programming under Windosw and .NET. This allows a quick and easy start to program the access to the module. Furthermore, you can use TCP and Socket libraries which are available in many programming languages such as C# or Java. They often allow a wide range of interface settings and in parts also an event programming (read buffer does not need to be polled).
LabVIEW user also easily can access to the module using the EXDUL.dll or VISA function blocks (Serial Port).

12.3 Programming under Windows using the .NET EXDUL.dll Library

If you use a .NET programming language (C#, C++, .NET or VB.NET) to access to the module, you can use the EXDUL.dll Library. It is structured object-oriented, so each EXDUL module is represented by an object with its methods.
Developing the library, special regard was paid to an API between the different EXDUL modules as uniform as possible. This facilitates the user, if necessary, to switch from e.g. a USB EXDUL module to an Ethernet EXDUL module (for example EXDUL-384 -> EXDUL-584) without extensive programming efforts.

Open:
bool Open()
Returned values: true if successful / false at error
Description: Establishes the connection to the module

Close
void Close()
Description: Closes the connection to the module

Write to Info register:
void SetModulInfo (byte type, string info)
Parameter: type: Info Type (see manual)
info: Info string with up to 16 characters
Description: writes to the information registers

Info Area	Info Byte
UserA	0
UserB	1

Read Info Register:
string GetModulInfo(byte type)
Parameter: type: Info-Typ (see manual)
Returned values: Returns the register "type" as a string
Description: Reads the Module Information Register

Info Area	Info Byte
UserA	0
UserB	1
Hardware Identifier	3
Serial Number	4

Write to LCD Register UserLCD:

void SetUserLCD(byte *line*, string *text*)

Parameter: *line*: 0 = 1st line / 1 = 2nd line
text: LCD text up to 16 characters long

Description: Writes to the UserLCD registers. The parameter *line* determines the line (0 or 1) and *text* the text of 16 characters.

- -

Write to LCD-Register UserLCDm:

void SetUserLCDm(byte *line*, string *text*)

Parameter: *line*: 0 = 1st line / 1 = 2nd line
text: LCD text up to 16 characters long

Description: Writes to the UserLCDm registers. The parameter *line* determines the line (0 or 1) and *text* the text of 16 characters.

- -

Write the LCD-Modes:

void SetLCDMode(byte *mode*)

Parameter: *mode*: LCD mode

Description: sets the LCD mode

LCD Mode	LCD Mode Byte
IO Mode	0
User Mode	1

Read the LCD Mode:

byte GetLCDMode()

Returned values: LCD-Modus

Description: Reads the LCD mode

LCD Mode	LCD Mode Byte
IO Mode	0
User Mode	1

- -

Write the LCD Contrast Value:

void SetLCDContrast(ushort *contrast*)

Parameter: contrast:Values between 0 and 4095 (recommended 800 to 1800)

Description: Sets the LCD contrast

- -

Read the LCD Contrast Value:

ushort GetLCDContrast()

Returned values: LCD contrast

Description: Reads the LCD contrast

- -

Read the Optocoupler outputs:

uint GetOptoOut()

Returned values:	State of the optocoupler outputs
Description:	Reads the state of the optocoupler outputs

Write the Optocoupler outputs:

void SetOptoOut(uint *value*)

Parameter:	*value*: state of the outputs
Description:	Sets the optocoupler outputs

Read the Optocoupler inputs:

uint GetOptoIn()

Returned values:	current state of the optocoupler inputs
Description:	Reads the current state of the optocoupler inputs

----

Start Counter:

void StartCounter(byte *index*)

Parameter:	*index*: Counter index
Description:	Starts the counter with the number index

Stop Counter:

void StopCounter(byte *index*)

Parameter:	*index*: Counter index
Description:	Stopps the counter with the number index

Reset Counter:

void ResetCounter(byte *index*)

Parameter:	*index*: Counter index
Description:	Sets the counter reading of the counter with the number index back to 0

- -

Read Counter:

uint ReadCounter(byte *index*)

Parameter:	*index*: Counter index
Returned values:	Counter reading
Description:	Reads the counter reading of the counter with the number index

- -

Read Overflow Flag:

bool ReadOverflowFlagCounter(byte *index*)

Parameter:	*index*: Counter index
Returned values:	Overflow flag false = no Overflow true = Overflow
Description:	Reads the Overflow Flag of the counter with the number index

- -

Reset Overflow Flag:

void ResetOverflowFlagCounter(byte *index*)

Parameter:	*index*: Counter index
Description:	Resets the Overflow Flag of the counter with the number index

- -

AD Single Measurement:

int GetADC(byte channel, byte range)

Parameter: *channel*: Channel

range: Measurement range

Returned values: Measured value in µV

Description: Performs an ADC measurement.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

AD Single measurement averaging 32 measurements:
public int GetADC_Mean(byte channel, byte range)
Element of EXDUL.EXDUL584

Parameter:	*channel*: Channel *range*: Measurement range
Returned values:	Measured value in µV
Description:	Performs an ADC measurement averaging 32 single measurements.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

AD block measurement with averaging:

int[] GetADC_BlockMean(EXDUL.ADC_CHANNEL_CONFIG_1[] *config*)

Parameter: *config*:

Returned values: Measured value in µV

Description: Performs an ADC block measurement over several channels (see manual)

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Reset ADC-FIFO:

void ResetFIFO()

Description	This command performs a reset of the FIFO. This shoud be done after an overflow.

- -

Read ADC-FIFO Overflow flag:

bool ReadOverflowFlagFIFO()

Returned values:	Overflowflag false = no Overflow / true = Overflow
Description:	Reads the overflow flag of the ADC FIFO. Along with the readout, the overflow flag is reset automatically.

- -

Readout ADC-FIFO:

int[] ReadFIFO()

Returned values:	Returns an array with the measured values. The size of the array depends on the number of measurements
Description:	Reads the ADC-FIFO

- -

AD Multiple Measurement

int[] GetADC_Multi(ushort *counts*, uint *samplerate*, EXDUL.ADC_CHANNEL_CONFIG_1[] *config*)

Parameter: *counts*: number of measurements
samplerate: sampling rate
config: channel configurations

Returned values: Measured value in µV

Description: performs an ADC multiple measurement over one or more channels. The measured values can be retrieved by the function ReadFIFO.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Start AD Continuous sampling

void StartADC(uint *samplerate*,
EXDUL.ADC_CHANNEL_CONFIG_1[]*config*)

Parameter: *samplerate*: sampling rate
config: channel configurations

Description: Starts an ADC continuous sampling over one or more channels. The measured values can be retrieved by the function ReadFIFO. The function StopADC is needed to stop the continuous sampling.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Stop AD Continuous Sampling
void StopADC()
Description: Ends an ADC continuous sampling

- -

Set DAC Output Voltage:
void SetDAC(byte *channel*, int *voltage*)
Parameter: *channel*: Output channel 0 to 7
voltage: Output voltage

Description: Applies a voltage „voltage“ to the DAC channel "channel". The voltage has to be within the set range.

- -

Determinate the DAC Output Voltage Range:
void SetDACRange(byte *channel*, byte *range*)
Parameter: *channel*: Output channel 0 to 7
range: Output voltage range

Description: Sets the range on the DAC channel „channel“

- -

Factory Reset:
void DefaultReset()
Description: Resets the module to the factory settings. After this command the module has to be shut down and restarted again.

12.4 Programming with TCP-Libraries

Due to the access to the module via standard TCP/IP socket libraries, you can program your application across a variety of languages on different platforms. So under Windows, you can use Delphi or Java besides the .Net Framework. Also on Linux based operation systems like C or Java applications can be designed. Please pay attention to your module acting as a server.

12.4.1 Communication with the EXDUL-584

Data is exchanged by transmitting or receiving byte arrays of variable length via the TCP/IP interface.

Each permitted transmission string is replied by a defined result or confirmation string.

The last result or confirmation string has to be read before transmitting a new string.

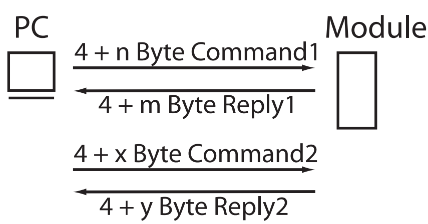


Fig. 12.4 Communication model

12.4.2 Command and Data Format

Data is exchanged by transmitting and receiving byte arrays. Each byte array to be transmitted or received consists of at least 4 bytes. The first three bytes represent the command and the fourth byte indicates the number of the following 4 byte blocks.

Command Byte 0	Command Byte 1	Command Byte 2	Length Byte

The number of the 4 byte blocks varies from command to command and depends in part on the volume of data to be transmitted. More detailed information can be found in the individual command descriptions.

12.4.3 Password protection

In order to protect the module from unauthorized access, a simple password protection can be used for data exchange. If this is activated (see security configuration command), the correct password (+8 Bytes) has to be appended to each transmitted byte array. If the password is wrong or it has not been added to the command string, an error reply will be returned. The response of the command remains unchanged.

Example: writing optocoupler outputs with activated password protection and default password „11111111“

Byte	Transmitting	Receiving	Representing
0	08	08	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	00	00	Command code 3rd Byte
3	03 (→ 12Byte)	00	Length prefix byte
4	00		r/w Byte
5	0w 00 (locked) 01 (enabled)		Optocoupler state
6	00		reserved
7	00		reserved
8	31_{hex}		Password 1st character 1_{asci}
9	31_{hex}		Password 2nd character 1_{asci}
10	31_{hex}		Password 3rd character 1_{asci}
11	31_{hex}		Password 4th character 1_{asci}
12	31_{hex}		Password 5th character 1_{asci}
13	31_{hex}		Password 6th character 1_{asci}
14	31_{hex}		Password 7th character 1_{asci}
15	31_{hex}		Password 8th character 1_{asci}

The regular command without password protection contains of 8 bytes only, and in the length prefix byte the value is 1. As shown in the above table, now 8 more bytes have been appended holding the password. Additionally, the length byte has to be increased by 2 (+8 bytes). The response does not contain a password and corresponds to the usual response array without a password.

12.4.4 Command Overview

Hexcode	Representing
0C 00 00	Read and write info register
0C 00 03	Read and write LCD register
0C 00 08	Read and write network configuration
0C 00 0C	Read and write security configuration
0C 00 0D	Change password
08 00 00	Read and write optocoupler outputs
08 00 01	Edit optocoupler inputs
0A 00 00	AD Single measurement
0A 00 01	AD Single measurement with averaging
0A 00 02	AD block measurement with averaging
0A 00 06	ADC FIFO Reset
0A 00 07	ADC FIFO read out overflow flag
0A 00 08	Read out ADC FIFO
0A 00 09	AD Multiple measurement
0A 00 0A	Start AD continuous sampling
0A 00 0B	Stop AD continuous sampling
0A 80 00	Configurate DA input voltage range
0A 80 01	Output DA voltage
09 00 00	Counter0

12.4.5 Structure of commands

Writing into the info registers

The EXDUL module provides several writable information registers. UserA/B are two 16-byte areas for the user to store information into a non-volatile memory (FLASH). The registers are writable only as a whole 16-byte block.

Info area	Info Byte
UserA	0
UserB	1

Example: enter the character string EXDUL-584 into register UserA and UserB

Byte	Transmit	Receive	Representing
0	0C	0C	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	00	00	Command code 3rd Byte
3	05	00	Lenght prefix byte => 20 Byte
4	00 (UserA) 01 (UserB)		Info byte
5	00		reserved
6	00		reserved
7	00		Info area of write operation
8	45		Data 1st character E_{asci}
9	58		Data 2nd character X_{asci}
10	44		Data 3rd character D_{asci}
11	55		Data 4th character U_{asci}
12	4C		Data 5th character L_{asci}
13	2D		Data 6th character $-_{asci}$
14	35		Data 7th character 5_{asci}
15	38		Data 8th character 8_{asci}
16	34		Data 9th character 4_{asci}
17	20		Data 10th character $[blank]_{asci}$
18	20		Data 11th character $[blank]_{asci}$
19	20		Data 12th character $[blank]_{asci}$
20	20		Data 13th character $[blank]_{asci}$
21	20		Data 14th character $[blank]_{asci}$
22	20		Data 15th character $[blank]_{asci}$
23	20		Data 16th character $[blank]_{asci}$

Reading from the information registers

The EXDUL module provides several 16-byte wide information areas which hold module information such as serial number or Hardware identifier. Additionally, the user can also read out the writable user registers.

Info Area	Info Byte
UserA	0
UserB	1
Hardware ID	3
Serial Number	4

Information: All of the information areas can only be read as a whole 16-byte block.

Example: Read information area UserA (User string = „EXDUL-584“)
An 8-byte block is transmitted and a 20-byte block is received with content from UserA or UserB

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte → 4Byte	04	Length byte → 16 Byte
4	00 (UserA) 01 (UserB)	Information byte	45	Data 1st character E$_{asci}$
5	00	reserved	58	Data 2nd character X$_{asci}$
6	00	reserved	44	Data 3rd character D$_{asci}$
7	01	Read function info area	55	Data 4th character U$_{asci}$
8			4C	Data 5th character L$_{asci}$
9			2D	Data 6th character -$_{asci}$
10			35	Data 7th character 5$_{asci}$
11			38	Data 8th character 8$_{asci}$
12			34	Data 9th character 4$_{asci}$
13			20	Data 10th character [blank]$_{asci}$
14			20	Data 11th character [blank]$_{asci}$
15			20	Data 12th character [blank]$_{asci}$
16			20	Data 13th character [blank]$_{asci}$
17			20	Data 14th character [blank]$_{asci}$
18			20	Data 15th character [blank]$_{asci}$
19			20	Data 16th character [blank]$_{asci}$

Example: Read out information area hardware identifier
An 8-byte block is transmitted and a 20-byte block is received with hardware identifier

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte → 4Byte	04	Length byte → 16 Byte
4	04	Information byte	45	Data 1st character E_{asci}
5	00	reserved	58	Data 2nd character X_{asci}
6	00	reserved	44	Data 3rd character D_{asci}
7	01	Read function info area	55	Data 4th character U_{asci}
8			4C	Data 5th character L_{asci}
9			2D	Data 6th character $-_{asci}$
10			35	Data 7th character 5_{asci}
11			38	Data 8th character 8_{asci}
12			34	Data 9th character 4_{asci}
13			20	Data 10th character $[blank]_{asci}$
14			20	Data 11th character $[blank]_{asci}$
15			20	Data 12th character $[blank]_{asci}$
16			20	Data 13th character $[blank]_{asci}$
17			20	Data 14th character $[blank]_{asci}$
18			20	Data 15th character $[blank]_{asci}$
19			20	Data 16th character $[blank]_{asci}$

Example: Read out information area serial number
An 8-byte block is transmitted and a 20-byte block is received with serial number

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte → 4Byte	03	Length byte → 16 Byte
4	04	Information byte	31	Data 1st character 1_{dez}
5	00	reserved	30	Data 2nd character 0_{dez}
6	00	reserved	34	Data 3rd character 4_{dez}
7	01	Read function info area	34	Data 4th character 4_{dez}
8			30	Data 5th character 0_{dez}
9			32	Data 6th character 2_{dez}
10			36	Data 7th character 6_{dez}
11				reserved
12				reserved
13				reserved
14				reserved
15				reserved
16				reserved
17				reserved
18				reserved
19				reserved

Writing into LCD registers

The EXDUL module provides several writable LCD registers. UserLCD1 and UserLCD2 correspond to the two lines when using UserMode LCD display. UserLCD1m and UserLCD2m are two 16 byte wide areas, which are stored directly to a non-volatile memory (FLASH) and are loaded into the registers UserLCD1m or UserLCD2m at module start. All of the registers are writable as a whole 16-byte block only.

LCD Command	LCD Command Byte
UserLCD1	0
UserLCD2	1
UserLCD1m	2
UserLCD2m	3

Example: enter the character string EXDUL-584 to the register

Byte	Transmit	Receive	Representing
0	0C	0C	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	03	03	Command code 3rd Byte
3	05	00	Lenght prefix byte => 20 Byte
4	00 (UserLCD1) 01 (UserLCD2) 02 (UserLCD1m) 03 (UserLCD2m)		LCD command
5	00		reserved
6	00		reserved
7	00		write operation
8	45		Data 1st character E_{asci}
9	58		Data 2nd character X_{asci}
10	44		Data 3rd character D_{asci}
11	55		Data 4th character U_{asci}
12	4C		Data 5th character L_{asci}
13	2D		Data 6th character $-_{asci}$
14	35		Data 7th character 5_{asci}
15	38		Data 8th character 8_{asci}
16	34		Data 9th character 4_{asci}
17	20		Data 10th character $[blank]_{asci}$
18	20		Data 11th character $[blank]_{asci}$
19	20		Data 12th character $[blank]_{asci}$
20	20		Data 13th character $[blank]_{asci}$
21	20		Data 14th character $[blank]_{asci}$
22	20		Data 15th character $[blank]_{asci}$
23	20		Data 16th character $[blank]_{asci}$

Reading from LCD registers

The EXDUL module provides several writable and readable LCD registers. UserLCD1 and UserLCD2 correspond to the two lines when using UserMode LCD display. UserLCD1m and UserLCD2m are two 16-byte areas, which are stored directly in a non-volatile memory (FLASH) and are loaded into the registers UserLCD1m or UserLCD2m at module start. All of the registers are readable as whole 16-byte blocks only.

LCD Command	LCD Command Byte
UserLCD1 & UserLCD2	0
UserLCD1m & UserLCD2m	2

Example: reading the character string EXDUL-584 from register

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	03	Command code 3rd Byte	03	Command code 3rd Byte
3	01	Length byte → 20 Byte	08	Length byte → 20 Byte
4	00 (UserLCD1&2) 02 (UserLCD1m&2m)	LCD Command	45	Data Line1 1st character E$_{asci}$
5	00	reserved	58	Data Line1 2nd character X$_{asci}$
6	00	reserved	44	Data Line1 3rd character D$_{asci}$
7	01	Read function LCD registers	55	Data Line1 4th character U$_{asci}$
8			4C	Data Line1 5th character L$_{asci}$
9			2D	Data Line1 6th character -$_{asci}$
10			35	Data Line1 7th character 5$_{asci}$
11			38	Data Line1 8th character 8$_{asci}$
12			34	Data Line1 9th character 4$_{asci}$
13			20	Data Line1 10th character [blank]$_{asci}$
14			20	Data Line1 11th character [blank]$_{asci}$
15			20	Data Line1 12th character [blank]$_{asci}$
16			20	Data Line1 13th character [blank]$_{asci}$
17			20	Data Line1 14th character [blank]$_{asci}$
18			20	Data Line1 15th character [blank]$_{asci}$
19			20	Data Line1 16th character [blank]$_{asci}$
20			45	Data Line2 1st character E$_{asci}$
21			58	Data Line2 2nd character X$_{asci}$
22			44	Data Line2 3rd character D$_{asci}$
23			55	Data Line2 4th character U$_{asci}$
24			4C	Data Line2 5th character L$_{asci}$
25			2D	Data Line2 6th character -$_{asci}$
26			35	Data Line2 7th character 5$_{asci}$
27			38	Data Line2 8th character 8$_{asci}$
28			34	Data Line2 9th character 4$_{asci}$
29			20	Data Line2 10th character [blank]$_{asci}$
30			20	Data Line2 11th character [blank]$_{asci}$
31			20	Data Line2 12th character [blank]$_{asci}$
32			20	Data Line2 13th character [blank]$_{asci}$
33			20	Data Line2 14th character [blank]$_{asci}$
34			20	Data Line2 15th character [blank]$_{asci}$
35			20	Data Line2 16th character [blank]$_{asci}$

Writing the LCD Mode

The module‘s LCD display provides several display modes. These can be set by the following command. The LCD mode is stored in a non-volatile memory and is also employed after a restart of the module.

LCD Mode	LCD Mode Byte
I/O Mode	0
User Mode	1

Example: writing the LCD Mode

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	03	Command code 3rd Byte	03	Command code 3rd Byte
3	02	Length byte → 8 Byte	00	Length byte → 0 Byte
4	04	LCD Command LCD mode		
5	00	reserved		
6	00	reserved		
7	00	Write function		
8	00 (IO Mode) 01 (User Mode)	LCD mode		
9	00	reserved		
10	00	reserved		
11	00	reserved		

Reading the LCD Mode

The module's LCD display provides several modes of display. The set LCD mode can be read out by following command.

LCD Mode	LCD Mode Byte
I/O Mode	0
User Mode	1

Example: reading the LCD Mode

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	03	Command code 3rd Byte	03	Command code 3rd Byte
3	01	Length byte → 4 Byte	01	Length byte → 4 Byte
4	04	LCD command LCD mode	00 (IO-Mode) 01 (User-Mode)	LCD mode
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	01	read function	00	reserved

Writing the LCD contrast value

This command is used to adjust the display contrast. Values between 0 and 4095 are accepted. The display contrast decreases with increasing values. A comfortable display is achieved in the range 800 to 1800.

Example: writing display contrast value 800

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	03	Command code 3rd Byte	03	Command code 3rd Byte
3	02	Length byte → 8 Byte	00	Length byte → 0 Byte
4	0B	LCD command LCD contrast		
5	00	reserved		
6	00	reserved		
7	00	write function		
8	50	Contrast value (Lowbyte - 00...FF)		
9	03	Contrast value (Highbyte - 00...0F)		
10	00	reserved		
11	00	reserved		

Reading the LCD contrast value

This command is used to read out the display contrast. The value can be between 0 and 4095. The display contrast decreases with increasing values. A comfortable display is achieved in the range 800 to 1800.

Example: reading display contrast value 800

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	03	Command code 3rd Byte	03	Command code 3rd Byte
3	01	Length byte → 4 Byte	01	Length byte → 4 Byte
4	0B	LCD command LCD contrast	50	Contrast value (Lowbyte - 00...FF)
5	00	reserved	03	Contrast value (Highbyte - 00...0F)
6	00	reserved	00	reserved
7	01	read function	00	reserved

Writing the network configuration

This command is used to modify all of the network configurations such as IP address, subnet mask, hostname, Gateway, DNS addresses and the setting of the DHCP client function.

Example: writing the network configuration
Hostname = „EXDUL-584“, IP = 192.168.0.63, Subnet mask = 255.255.255.0,
Gateway = 192.168.0.1, Primary DNS = 192.168.0.1, Secondary DNS = 217.237.151.115

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	08	Command code 3rd Byte	08	Command code 3rd Byte
3	0B	Length byte → 44 Byte	00	Length byte → 0 Byte
4	00	reserved		
5	00	reserved		
6	00	reserved		
7	00	write function		
8	45	Hostname 1st character E_{asci}		
9	58	Hostname 2nd character X_{asci}		
10	44	Hostname 3rd character D_{asci}		
11	55	Hostname 4th character U_{asci}		
12	4C	Hostname 5th character L_{asci}		
13	2D	Hostname 6th character $-_{asci}$		
14	35	Hostname 7th character 5_{asci}		
15	38	Hostname 8th character 8_{asci}		
16	34	Hostname 9th character 4_{asci}		
17	20	Hostname 10th character [blank]$_{asci}$		
18	20	Hostname 11th character [blank]$_{asci}$		
19	20	Hostname 12th character [blank]$_{asci}$		
20	20	Hostname 13th character [blank]$_{asci}$		
21	20	Hostname 14th character [blank]$_{asci}$		
22	20	Hostname 15th character [blank]$_{asci}$		
23	20	Hostname 16th character [blank]$_{asci}$		
24	3F	4th Byte IP address decimal value 63		
25	0	3rd Byte IP address decimal value 0		
26	A8	2nd Byte IP address decimal value168		
27	C0	1st Byte IP address decimal value 192		

28	00	4th Byte Subnetmask decimal value 0		
29	FF	3rd Byte Subnetmask decimal value 255		
30	FF	2nd Byte Subnetmask decimal value 255		
31	FF	1st Byte Subnetmask decimal value 255		
32	01	Gateway 4th Byte decimal value 1		
33	00	Gateway 3rd Byte decimal value 0		
34	A8	Gateway 2nd Byte decimal value 168		
35	C0	Gateway 1th Byte decimal value 192		
36	01	Primary DNS 4th Byte decimal value 1		
37	00	Primary DNS 3rd Byte decimal value 0		
38	A8	Primary DNS 2nd Byte decimal value 168		
39	C0	Primary DNS 1st Byte decimal value 192		
40	73	Secondary DNS 4th Byte decimal value 115		
41	97	Secondary DNS 3rd Byte decimal value 151		
42	ED	Secondary DNS 2nd Byte decimal value 237		
43	D9	Secondary DNS 1st Byte decimal value 217		
44	0w 00 (DHCP disable) 01 (DHCP enable)	DCHP client configuration		
45	00	reserved		
46	00	reserved		
47	00	reserved		

Reading the network configuration

This command is used to read all of the network configurations such as IP address, subnet mask, hostname, Gateway, DNS addresses and the setting of the DHCP client function or MAC address.

Example: reading the network configuration
Hostname = „EXDUL-584“, IP = 192.168.0.63, Subnet mask = 255.255.255.0,
Gateway = 192.168.0.1, Primary DNS = 192.168.0.1, Secondary DNS = 217.237.151.115

Byte	Transmit	Representing	Receive	Representing
0	0C	Command code 1st Byte	0C	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	08	Command code 3rd Byte	08	Command code 3rd Byte
3	01	Length byte → 4 Byte	0C	Length byte → 48 Byte
4	00	reserved	45	Hostname 1st character E_{asci}
5	00	reserved	58	Hostname 2nd character X_{asci}
6	00	reserved	44	Hostname 3rd character D_{asci}
7	01	Read function	55	Hostname 4th character U_{asci}
8			4C	Hostname 5th character L_{asci}
9			2D	Hostname 6th character $-_{asci}$
10			35	Hostname 7th character 5_{asci}
11			38	Hostname 8th character 8_{asci}
12			34	Hostname 9th character 4_{asci}
13			20	Hostname 10th character [blank]$_{asci}$
14			20	Hostname 11th character [blank]$_{asci}$
15			20	Hostname 12th character [blank]$_{asci}$
16			20	Hostname 13th character [blank]$_{asci}$
17			20	Hostname 14th character [blank]$_{asci}$
18			20	Hostname 15th character [blank]$_{asci}$
19			20	Hostname 16th character [blank]$_{asci}$
20			3F	4th Byte IP address decimal value 63
21			0	3rd Byte IP address decimal value 0
22			A8	2nd Byte IP address decimal value168
23			C0	1st Byte IP address decimal value 192
24			00	4th Byte Subnetmask decimal value 0
25			FF	3rd Byte Subnetmask decimal value 255
26			FF	2nd Byte Subnetmask decimal value 255
27			FF	1st Byte Subnetmask decimal value 255

28			01	Gateway 4th Byte decimal value 1
29			00	Gateway 3rd Byte decimal value 0
30			A8	Gateway 2nd Byte decimal value 168
31			C0	Gateway 1th Byte decimal value 192
32			01	Primary DNS 4th Byte decimal value 1
33			00	Primary DNS 3rd Byte decimal value 0
34			A8	Primary DNS 2nd Byte decimal value 168
35			C0	Primary DNS 1st Byte decimal value 192
36			73	Secondary DNS 4th Byte decimal value 115
37			97	Secondary DNS 3rd Byte decimal value 151
38			ED	Secondary DNS 2nd Byte decimal value 237
39			D9	Secondary DNS 1st Byte decimal value 217
40			0w 00 (DHCP disable) 01 (DHCP enable)	DCHP client Configuration
41			00	Reserved
42			00	Reserved
43			00	Reserved
44				Reserved
45				Reserved
46			00	MAC address 6th character
47			00	MAC address 5th character
AA			00	MAC address 4th character
49			3E	MAC address 3rd character
50			B4	MAC address 2nd character
51			D4	MAC address 1st character

Writing of the security configuration

The EXDUL module features a password protection for secure communication. If this is activated, each transfer to the module requires the correct password. It is deactivated in default state.

Security configuration	Security Byte
Password deactivated	0
Password activated	1

Example: writing the security configuration

Byte	Transmit	Receive	Representing
0	0C	0C	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	0C	0C	Command code 3rd Byte
3	01	01	Length byte → 20 Byte
4	00 (Password deactivated) 01 (Password activated)		Security Byte
5	00		reserved
6	00		reserved
7	00		Write function Security configuration

Reading the Security configuration

The EXDUL module features a password protection for secure communication. If this is activated, each transfer to the module requires the correct password. It is deactivated in default state.

Security configuration	Security Byte
Password deactivated	0
Password activated	1

Example: Reading the security configuration

Byte	Transmit	Receive	Representing
0	0C	0C	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	0C	0C	Command code 3rd Byte
3	01	01	Length byte → 20 Byte
4	00	00 (Password deactivated) 01 (Password activated)	Security Byte
5	00	00	reserved
6	00	00	reserved
7	01	00	Read function Security configuration

Changing the Access Code (Password)

The EXDUL module features a password protection for secure communication. If this is activated, each transfer to the module requires the correct password. In default state the password is „11111111“ in ASCII and corresponds to that of the web page. This function is used to change the password.

Example: changing the password to „EXDUL584“

Byte	Transmit	Receive	Representing
0	0C	0C	Command code 1st Byte
1	00	00	Command code 2nd Byte
2	0D	0D	Command code 3rd Byte
3	02	00	Length byte → 20 Byte
4	45_{hex}		Password 1st character E_{asci}
5	58_{hex}		Password 2nd character X_{asci}
6	44_{hex}		Password 3rd character D_{asci}
7	55_{hex}		Password 4th character U_{asci}
8	$4C_{hex}$		Password 5th character L_{asci}
9	35_{hex}		Password 6th character 5_{asci}
10	38_{hex}		Password 7th character 8_{asci}
11	34_{hex}		Password 8th character 4_{asci}

Reading the Optocoupler Output Port

This command is used to read the current state of the optocoupler output.

Example: reading the optocoupler output state
An 8-byte block is transmitted and an 8-byte block is received holding the current optocoupler output state

Byte	Transmit	Representing	Receive	Representing
0	08	Command code 1st Byte	08	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01 (→ 4Byte)	Length byte	01 (→ 4Byte)	Length byte
4	01	r/w Byte (1→ read)	0w 00 (LOW at DIN00) 01 (HIGH at DIN00)	optocoupler output state
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	00	reserved	00	reserved

Writing the Optocoupler Output Port

This command is used to disable or to enable the output optocoupler

Example: output the state at the optocoupler output
An 8-byte block is transmitted and a 4-byte block is received as confirmation

Byte	Transmit	Receive	Representing
0	08	08	Command code 1st Byte
1	00	0	Command code 2nd Byte
2	00	00	Command code 3rd Byte
3	01 (→ 4Byte)	00	Length byte
4	00		r/w Byte
5	0w 00 (disabled) 01 (enabled)		optocoupler state
6	00		reserved
7	00		reserved

Reading the Optocoupler Input Port

This command is used to read the current state of the optocoupler input

Example: reading the optocoupler input state
An 4-byte block is transmitted and an 8-byte block is received holding the current optocoupler input state

Byte	Transmit	Representing	Receive	Representing
0	08	Command code 1st Byte	08	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	01	Command code 3rd Byte	00	Command code 3rd Byte
3	00	Length byte	01 (→ 4Byte)	Length byte
4			0w	Optocoupler input state
5			00	reserved
6			00	reserved
7			00	reserved

Counter0

This command is used to access the counter0. The counter can be started, stopped, reset an read out. Furthermore, you can read in and reset the overflow flag.

Code	Counter command
00	start counter
01	stop counter
02	reset counter
03	read counter value
04	reserved
05	read overflow flag
06	reset overflow flag

Counter Start / Stop / Reset

Byte	Transmit	Representing	Receive	Representing
0	09	Command code 1st Byte	09	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte	01	Length byte
4	bb 00 01 02	Counter command code start counter0 stop counter0 reset counter0	bb	Counter command code
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	00	reserved	00	reserved

Reading the counter

Byte	Transmit	Representing	Receive	Representing
0	09	Command code 1st Byte	09	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte	02 (→ 8Byte)	Length byte
4	03	Counter command code	03	Counter command code
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	00	reserved	00	reserved
8			ww	Counter value Byte0
9			ww	Counter value Byte1
10			ww	Counter value Byte2
11			ww	Counter value Byte3

Counter reading = counter status Byte3 * 0x1000000 + counter status Byte2 * 0x10000 + counter status Byte1 * 0x100 + counter status Byte0

Reading the overflow flag

Byte	Transmit	Representing	Receive	Representing
0	09	Command code 1st Byte	09	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte	02 (→ 8Byte)	Length byte
4	05	Counter command code Reading the overflow flag	05	Counter command code Reading the overflow flag
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	00	reserved	0f	overflow flag

Reset the overflow flag

Byte	Transmit	Representing	Receive	Representing
0	09	Command code 1st Byte	09	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte	01 (→ 4Byte)	Length byte
4	06	Counter command code reset the overflow flag	06	Counter command code reset the overflow flag
5	00	reserved	00	reserved
6	00	reserved	00	reserved
7	00	reserved	00	reserved

AD Single measurement

The command AD single measurement performs a voltage measurement on a desired analog input channel and returns the value calibrated as an integer in µV to the computer. The desired channel as well as the measuring range are to be transferred with the command.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Example of measuring a voltage at an input signal

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01 (→ 4Byte)		01 (→ 4Byte)	Length byte
4	cc	Channel byte	ww	Measured value Byte0
5	bb	Range byte	ww	Measured value Byte1
6	00		ww	Measured value Byte2
7	00		ww	Measured value Byte3

Voltage = (integer) (Byte3 * 0x1000000 + Byte2 * 0x10000 + Byte1 * 0x100 + Byte0) [µV]

AD Single measurement with averaging

The command single measurement with averaging performs 32 voltage measurements on a desired analog input channel at a sampling rate of 100kS/s, averages the value and returns it calibrated as an integer in µV to the PC. The desired channel as well as the measuring range are to be transferred with the command.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Example of measuring the voltage at an input signal

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	01	Command code 3rd Byte	01	Command code 3rd Byte
3	01 (→ 4Byte)	Length byte	01 (→ 4Byte)	Length byte
4	cc	Channel byte	ww	Measured value Byte0
5	bb	Range byte	ww	Measured value Byte1
6	00	reserved	ww	Measured value Byte2
7	00	reserved	ww	Measured value Byte3

Voltage = (integer) (Byte3 * 0x1000000 + Byte2 * 0x10000 + Byte1 * 0x100 + Byte0) [µV]

AD block measurement with averaging

This command performs sampling of up to 8 channels in quick succession. Each channel to be measured is sampled 32 times, each averaged (see chapter 5.2) and the value returned as an integer in µV to the computer

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Command structure n = 1 8

Byte	Transmit	Representing
0	0A	Command code 1st Byte
1	00	Command code 2nd Byte
2	02	Command code 3rd Byte
3	(n*4)	Length byte (n = number of channels)
4	00	reserved
5	00	reserved
6	c_0c_0	Channel byte
7	b_0b_0	Range byte
	:	
	:	
3 + n*4	$c_{n-1}c_{n-1}$	Channel byte
4 + n*4	$b_{n-1}b_{n-1}$	Range byte

Byte	Recieve	Representing
0	0A	Command code 1st Byte
1	00	Command code 2nd Byte
2	02	Command code 3rd Byte
3	(n*4)	Length byte (n = number of channels)
4	w_1w_1	Measured value$_1$ Byte0$_1$
5	w_1w_1	Measured value$_1$ Byte1$_1$
6	w_1w_1	Measured value$_1$ Byte2$_1$
7	w_1w_1	Measured value$_1$ Byte3$_1$
	:	
	:	
3 + n*4	w_nw_n	Measured value$_n$ Byte0$_n$
4 + n*4 +1	w_nw_n	Measured value$_n$ Byte1$_n$
4 + n*4 +2	w_nw_n	Measured value$_n$ Byte2$_n$
4 + n*4 +3	w_nw_n	Measured value$_n$ Byte3$_n$

Example:
In the following example, AIN01, AIN02 and AIN04 may be be sampled. The measuring range for all values shall be +/- 10.2V.

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	02	Command code 3rd Byte	02	Command code 3rd Byte
3	03 (→ 12Byte)	Length byte	03 (→ 12Byte)	Length byte
4	00	reserved	w_1w_1	Measured value AIN01 Byte0_1
5	00	reserved	w_1w_1	Measured value AIN01 Byte1_1
6	01	Channel byte AIN01	w_1w_1	Measured value AIN01 Byte2_1
7	01	Range byte +/- 10.2V	w_1w_1	Measured value AIN01 Byte3_1
8	00	reserved	w_2w_2	Measured value AIN02 Byte0_2
9	00	reserved	w_2w_2	Measured value AIN02 Byte1_2
10	02	Channel byte AIN02	w_2w_2	Measured value AIN02 Byte2_2
11	01	Range byte +/- 10.2V	w_2w_2	Measured value AIN02 Byte3_2
12	00	reserved	w_3w_3	Measured value AIN04 Byte0_3
13	00	reserved	w_3w_3	Measured value AIN04 Byte1_3
14	04	Channel byte AIN04	w_3w_3	Measured value AIN04 Byte2_3
15	01	Range byte +/- 10.2V	w_3w_3	Measured value AIN04 Byte3_3

Measured value AIN01
= (integer) (Byte3_1 * 0x1000000 + Byte2_1 * 0x10000 + Byte1_1 * 0x100 + Byte0_1) [µV]
Measured value AIN02
= (integer) (Byte3_2 * 0x1000000 + Byte2_2 * 0x10000 + Byte1_2 * 0x100 + Byte0_2) [µV]
Measured value AIN04
= (integer) (Byte3_3 * 0x1000000 + Byte2_3 * 0x10000 + Byte1_3 * 0x100 + Byte0_3) [µV]

Reset of the ADC FIFO

The following command is used to reset of the ADC FIFO.
This should be done after an overflow.

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	06	Command code 3rd Byte	06	Command code 3rd Byte
3	00	Length byte	00	Length byte → 0 Bytes

Reading of the ADC FIFO overflow flag

The following command is used to read out the overflow flag of the ADC-FIFO. Along with the reading, the overflow flag is reset.

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	07	Command code 3rd Byte	07	Command code 3rd Byte
3	00	Length byte	01	Length byte → 4 Bytes
4			0w	Overflow flag 00 FIFO not overflown 01 FIFO overflown
5			00	reserved
6			00	reserved
7			00	reserved

Read out the ADC FIFO

Some commands do not return the measurement results directly along with the response command, but store the measured values into a FIFO. As a command example, multiple measurement or continuous measurement can be mentioned. The FIFO can be read out with the ADC FIFO readout command. The values hold in the FIFO are appended directly to the response of the command (up to 255 readings). If the FIFO does not contain any data, only a 4-byte response is returned to the computer.

Command structure

4 bytes are to be transmitted, 4 + n*4 bytes are to be received in the FIFO depending on the amount of data n.

n = 1 8

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	08	Command code 3rd Byte	08	Command code 3rd Byte
3	00	Length byte	nn	Length byte → n*4 Bytes
4			ww_1	Measured value$_1$ Byte0$_1$
5			ww_1	Measured value$_1$ Byte1$_1$
6			ww_1	Measured value$_1$ Byte2$_1$
7			ww_1	Measured value$_1$ Byte3$_1$
			:	
			:	
n*4			ww_n	Measured value$_n$ Byte0$_n$
n*4 + 1			ww_n	Measured value$_n$ Byte1$_n$
n*4 + 2			ww_n	Measured value$_n$ Byte2$_n$
n*4 + 3			ww_n	Measured value$_n$ Byte3$_n$

Example 1:
FIFO is empty:

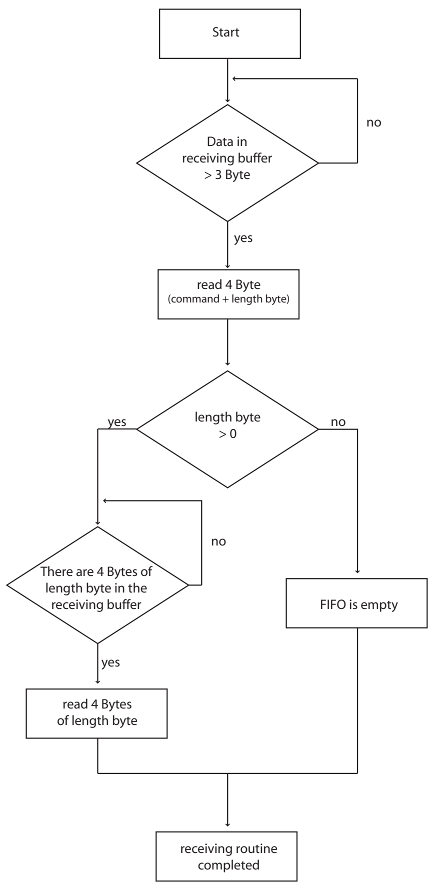
Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	08	Command code 3rd Byte	08	Command code 3rd Byte
3	00	Length byte	00	Length byte

Example 2:
The FIFO holds two measured values

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	08	Command code 3rd Byte	08	Command code 3rd Byte
3	00	Length byte	2	Length byte → 8 bytes
4			ww_1	Measured value$_1$ Byte0$_1$
5			ww_1	Measured value$_1$ Byte1$_1$
6			ww_1	Measured value$_1$ Byte2$_1$
7			ww_1	Measured value$_1$ Byte3$_1$
8			ww_2	Measured value$_2$ Byte0$_2$
9			ww_2	Measured value$_2$ Byte1$_2$
10			ww_2	Measured value$_2$ Byte2$_2$
11			ww_2	Measured value$_2$ Byte3$_2$

Programming:

- Transmitting: a 4 byte holding command is to be sent to the module in order to read out data from the FIFO
- Receiving the data: since the array length of the data to be received may vary, the reception of the entire data block has to be partitioned.



AD Multiple Measurement

The A/D multiple measurement allows the user to sample one or more channels several times (up to 65,535 times) in an adjustable clock (1 - 100000kHz). The measured values are stored by the module into the internal FIFO and can be retrieved there during and after the sampling process. The values are buffered in the FIFO until they either have been fetched or a new sampling command has been called.

Attention: it must be ensured that the FIFO can be cleared fast enough, since the FIFO is limited to 10,000 readings. Furthermore, no EXDUL information register (e.g. UserA, UserB) may be written during the process.

Channel:

Channel	**Channel byte**
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	**Voltage**
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Command structure

n = 1 8

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	09	Command code 3rd Byte	09	Command code 3rd Byte
3	n + 2	Length byte	00	Length byte
4	ff	Sampling rate Byte0		
5	ff	Sampling rate Byte1		
6	ff	Sampling rate Byte2		
7	00	reserved		
8	aa	Number of readings Byte0		
9	aa	Number of readings Byte1		
10	00	reserved		
11	00	reserved		
12	00	reserved		
13	00	reserved		
14	cc_n	Channel byte$_1$		
15	bb_n	Range byte$_1$		
	:			
	:			
n*4 + 8	00	reserved		
n*4 + 9	00	reserved		
n*4 + 10	cc_n	Channel byte$_1$		
n*4 + 11	bb_n	Range byte$_1$		

Sampling rate = Byte2 * 65536 + Byte1 * 256 + Byte0
Number of readings = Byte1 * 256 + Byte0

Start AD continuous measurement

The A/D continuous measurement allows the user to sample one or more channels at regular intervals (1s - 10µs). The measured values are stored by the module into the internal FIFO and can be retrieved there during and after the sampling process. The values are buffered in the FIFO until they either have been fetched or a new sampling command has been called. To stop the continuous measurement the command „stop continuous A/D measurement“ must be sent to the module.

Attention: it must be ensured that the FIFO can be cleared quickly enough since the FIFO is limited to 10,000 readings. Furthermore, no EXDUL information register (e.g. UserA, UserB) may be written during the process.

Channel:

Channel	Channel byte
Single Ended	
AIN00	0
AIN01	1
AIN02	2
AIN03	3
AIN04	4
AIN05	5
AIN06	6
AIN07	7
Differential measuring	
AIN00+ / AIN01-	8
AIN00- / AIN01+	9
AIN02+ / AIN03-	10
AIN02- / AIN03+	11
AIN04+ / AIN05-	12
AIN04- / AIN05+	13
AIN06+ / AIN07-	14
AIN06- / AIN07+	15

Measuring range:

Range byte	Voltage
0	+/- 20.4V (Differential measuring only max +/- 10.2V → GND)
1	+/-10.2V
2	+/- 5.1V
3	+/-2,55V
4	+/-1.27V
5	+/- 0.63V

Command structure

n = 1 8

Byte	Transmit	Meaning	Receive	Meaning
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	0A	Command code 3rd Byte	0A	Command code 3rd Byte
3	n + 1	Length byte	00	Length byte
4	ff	Sampling rate Byte0		
5	ff	Sampling rate Byte1		
6	ff	Sampling rate Byte2		
7	00	reserved		
8	aa	reserved		
9	aa	reserved		
10	cc_1	Channel byte$_1$		
11	bb_1	Range byte$_1$		
	:			
	:			
n*4 + 4	00	reserved		
n*4 + 5	00	reserved		
n*4 + 6	cc_n	Channel byte$_1$		
n*4 + 7	bb_n	Range byte$_1$		

Sampling rate = Byte2 * 65536 + Byte1 * 256 + Byte0

Stop A/D continuous measurement

This command stops the A/D continuous measurement.

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	00	Command code 2nd Byte	00	Command code 2nd Byte
2	0B	Command code 3rd Byte	0B	Command code 3rd Byte
3	00	Length byte	00	Length byte

Configuration of the D/A output voltage range

This command is use to configurate the output voltage ranges of each single DAC channels. The new voltage range of a channel is applied as soon as a new voltage is output on the respective channel.
A further 4-byte block is added to the command holding a channel byte (0 up to 7) and a range byte (see table)

Output voltage range	
Range byte	bipolar
0	+/-10.2V
1	+/-5.1V
2	+/-2.55V

Command structure

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	80	Command code 2nd Byte	80	Command code 2nd Byte
2	00	Command code 3rd Byte	00	Command code 3rd Byte
3	01	Length byte	00	Length byte
4	cc	Channel byte (0 ... 7)		
5	bb	Range byte		
6	00	reserved		
7	00	reserved		

DA Voltage output

This command is used to output a desired voltage to one of the available channels. The command on one hand holds a 4-byte block for the channel to be changed and on the other hand the voltage in µV.

Command structure

Byte	Transmit	Representing	Receive	Representing
0	0A	Command code 1st Byte	0A	Command code 1st Byte
1	80	Command code 2nd Byte	80	Command code 2nd Byte
2	01	Command code 3rd Byte	01	Command code 3rd Byte
3	02	Length byte	00	Length byte
4	cc	Channel byte (0 ... 7)		
5	00	reserved		
6	00	reserved		
7	00	reserved		
8	ww	voltage Byte0		
9	ww	voltage Byte1		
10	ww	voltage Byte2		
11	ww	voltage Byte3		

voltage = (integer) (Byte3 * 0x1000000 + Byte2 * 0x10000 + Byte1 * 0x100 + Byte0) [µV]

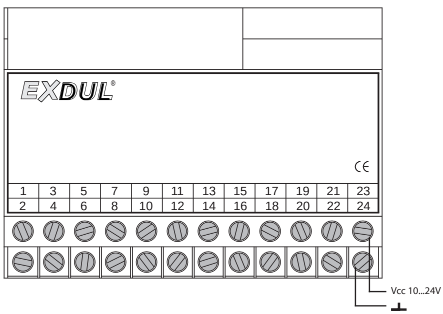
12.5 Access to the Module via LabVIEW and EXDUL.dll

Due to the EXDUL.dll., the module can be integrated into a LABView project without much effort. Along with the .NET Framework additionally LABView and the EXDUL.dll file is required on the computer.
We refer to the EXDUL-LABView Tutorial for more detailed information.

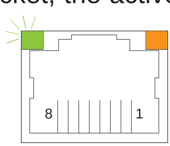
13. FAQ - Trouble Shooting

Following you can find a short compilation of the most common causes of failure that may appear during commissioning or when accessing the EXDUL-584 or to the EXDUL web page. At first, please check following points before contacting your distributor:

Is the supply voltage of the EXDUL-584 connected properly?
A voltage supply of +10 V ... +24 V DC across terminal 23 (Vcc) and terminal 24 (GND) is required for operation. Please check the screw terminal connections on the module as well as the power supply unit and the connections to the power supply.



Is the connection LED on the RJ45 jack lit green continuously?
After operating voltage is applied, the EXDUL-584 will boot up. Once a stable Ethernet connection is established, the LED on 8P8C module jack (RJ45 jack) is lit green continuously.
If this is not the case, please check the direct cable connection between EXDUL-584 and computer (a crossover cable might be required). For network operation, check network cables between EXDUL-584 and the wall-mounted network socket, the active Ethernet switch or the Ethernet hub.



Is there a stable Ethernet connection between PC and network?
Check the network cable between EXDUL-584 and the network socket (RJ45 wall outlet), the active Ethernet switch or Ethernet hub. The Ethernet cable has to be suitable for the Ethernet connnection, undamaged and properly plugged in at both ends. Current computers mostly provide two LED‘s on the network socket of the network adapter. If connection to the network is established, the green LED is lit continuously. If the network socket of the computer provides only one LED it flashes or flickers when network connection is working.

Is the network cable used suitable for the connection?
When connecting EXDUL-584 to a switch, hub or PC with auto MDI-X supporting Ethernet interface, a standard network cable (Cat 5 or above) can be used. Older computers whose Ethernet interface does not automatically cross the transmission and receiver lines, may require a crossover cable or crossover adapter.

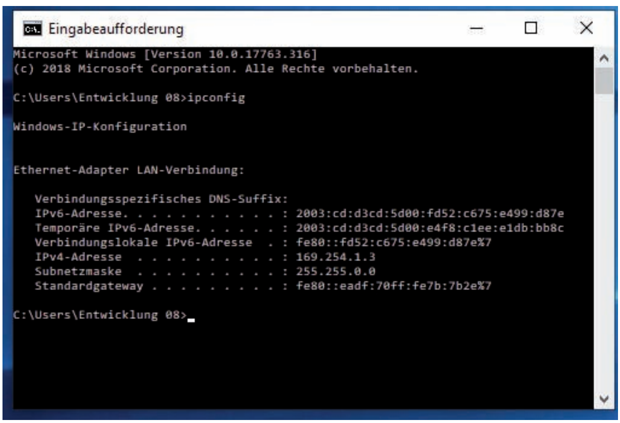
Is the wall-mounted network socket active?
If you connect the EXDUL-584 to a permanent installed network via a wall outlet, together with your network administrator check whether the wall socket is active and connected to an active Ethernet switch or Ethernet hub.

Is the computer‘s Ethernet interface activated?
The Ethernet adapter has to be activated in the BIOS of your PC. Check the Windows Device Manager whether it is listed under Network Adapter. The entry must not be marked with an exclamation mark!

Are the computer‘s network settings correct?
Each active device in a TCP-IP based network requires a unique IP address, which is structured into a network ID and a device ID. The Subnet mask separates the IP address in a network part (network prefix, network ID) and a device part (device ID). By default, the EXDUL-584 is set to DHCP client. To access the EXDUL-584 the used PC has to be set to ‚**IP-Adresse automatisch beziehen (DHCP-aktiviert)‘** and the network has to provide a DHCP server (integrated in most of the routers). The DHCP server automatically assigns a subnet mask and an IP address to the EXDUL-584 and to the computer.
If the basic setting has been changed to static IP address, the used computer also has to be set to static address (**Folgende IP-Adresse verwenden**).
Example: The static IP address for the EXDUL-584 is 192.168.1.199 (network ID: 192.168.1., device ID 199). To access the EXDUL-584 the used PC has to be set to subnet mask 255.255.255.0 and to static IP address ranging from 192.168.1.1 up to 192.168.1.244

How to check the network configuration of the PC

You can monitor the TCP/IP settings of your computer via the Internet Protocol Version 4 (TCP/IPv4) Properties window or the status of the LAN connection respectively (see „How to check and to change IP address of the PC“). Alternatively type the simple command IPCONFIG to the command-line. For this, switch to the MS-DOS prompt (see „How to switch to MS-DOS prompt“), type ipconfig and press enter to confirm. The response should look similar to the following figure:

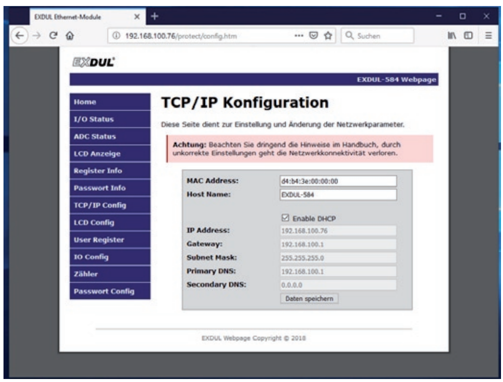


How to check and to change IP address of the PC

Windows7:

Start -> Control Panel -> Network Connections (monitoring network status and tasks) -> change adapter settings -> select required LAN connection in the window network connections (double-click or right mouse button) -> properties -> highlight Internet Protocol Version 4 (TCP(IPV4) -> properties

Please note: you have to own administrator privileges for changing TCP/IP settings!



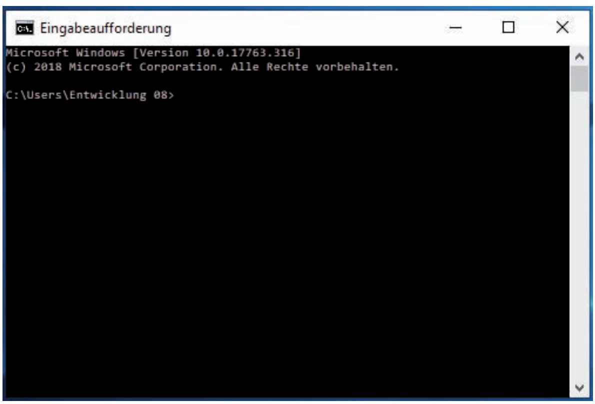
WindowsXP:

Start -> control panel -> network connections (network and Internet connections) -> select required LAN connection (double-click or right mouse button) -> properties -> highlight Internet Protocol (TCP/IP) -> properties

Please note: you have to own administrator privileges for changing TCP/IP settings!

How to switch to MS-DOS prompt
Windows7:
Start -> type in cmd in input box (program and file searching) -> press enter to confirm
or
Start -> All Programs -> Accessories -> prompt

WindowsXP:
Start -> Run -> type in cmd in run box-> OK
or
Start -> All Programs -> Accessories -> prompt



Is it possible to locate modules EXDUL-5xx in an existing network and to detect the network data?
All EXDUL-5xx modules send detection signals at certain intervals. The program **ExdulUtility**_v2_xx (or above) evaluates the identification data and compiles a list with host name, IP address and MAC address. It is suitable for any single EXDUL-5xx directly connected to a PC as well as for a network connected via hub or switch with several modules. In case the firewall prevents the searching program from communicating with the EXDUL-5xx a release is required.

14. Specifications

A/D Inputs
8 inputs single-ended (se) or 4 inputs differential (diff)
or combined se/diff software-sectable
Resolution: 16 Bit
Input voltage range bipolar:
+/-0,63 Volt, +/-1,27 Volt, +/-2,55 Volt, +/-5.1 Volt, +/-10.2 Volt
+/-20.4V (differential inputs only)
FIFO: 10000 readings
Input resistance: > 500 MΩ
Over voltage protection: +/- 50V
Sampling rate: max 100 kS

D/A Outputs
8 outputs
Resolution: 16 bit
Output voltage range bipolar: +/-2.55 Volt, +/-5.1 Volt, +/-10.2 Volt
Output current: max +/-5 mA

Optocoupler input
1 channel galvanically isolated
Over voltage protection diodes
Input voltage range
high = 10..30 Volt
low = 0..3 Volt

Optocoupler outputs
1 channel, galvanically isolated
High capacity optocoupler
Reverse polarity protection
Output current: max. 150 mA
Switching voltage: max. 50 V

Operating voltage
+10 V...+30 V (external power supply required)

Ethernet Interface
100Base-T Ethernet Interface

Connection Terminals
1 * 24pin screw terminal block
Ethernet RJ45 socket

Ethernet connection line
RJ45 network cable Cat5 or above

Dimensions
105 mm x 89 mm x 59 mm (l x b x h)

Casing
Insulating plastic housing with integrated snap-in technology for DIN EN top hat rail mounting.
Suitable for control and engineering technology mounted to control and distribution boxes, surface mounting or mobile use on a desk.

15. Circuitry Examples

15.1 Wiring of the Optocoupler Input

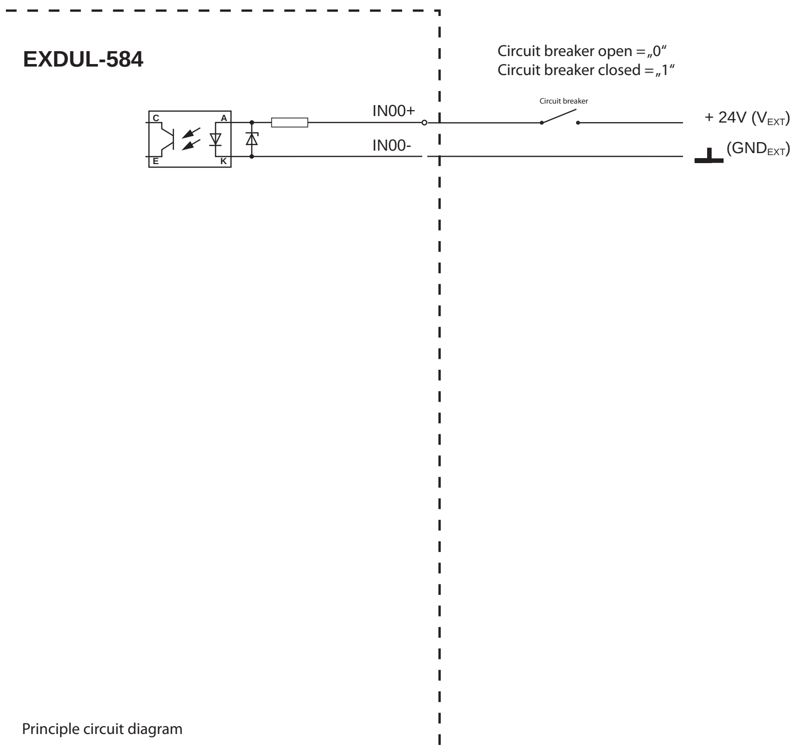


Figure 15.1 Optocoupler input wiring

15.2 Wiring of the Optocoupler Output

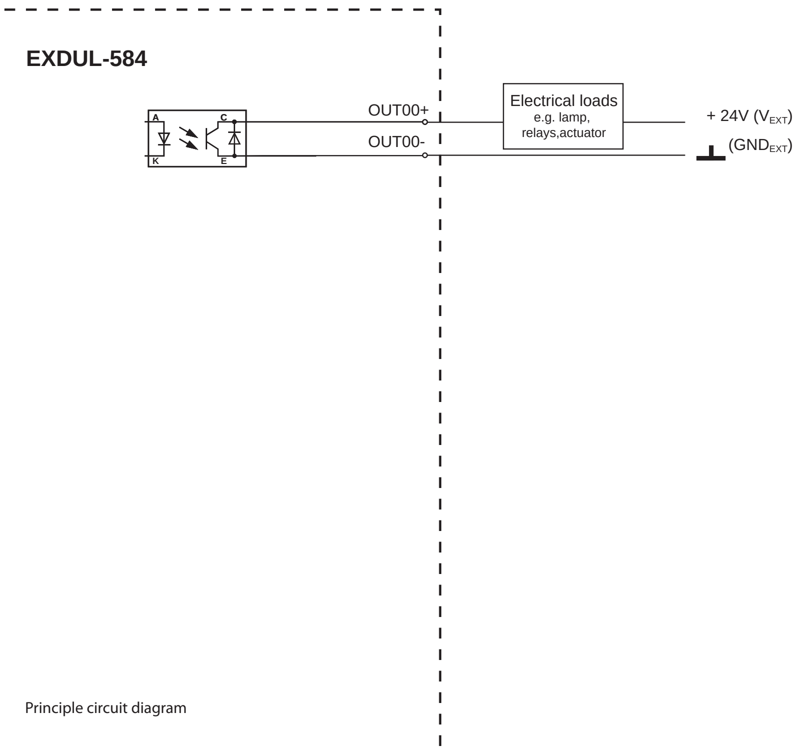


Figure 15.2 Optocoupler output wiring

15.3 Wiring of the D/A Outputs

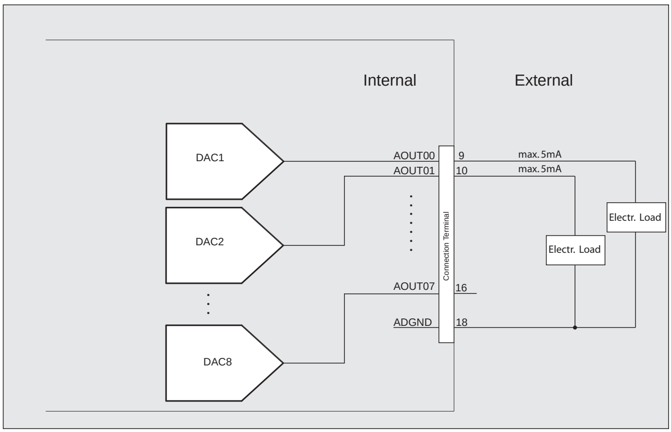


Figure 15.3 Wiring of the D/A outputs

15.4 Wiring of the A/D Inputs single ended

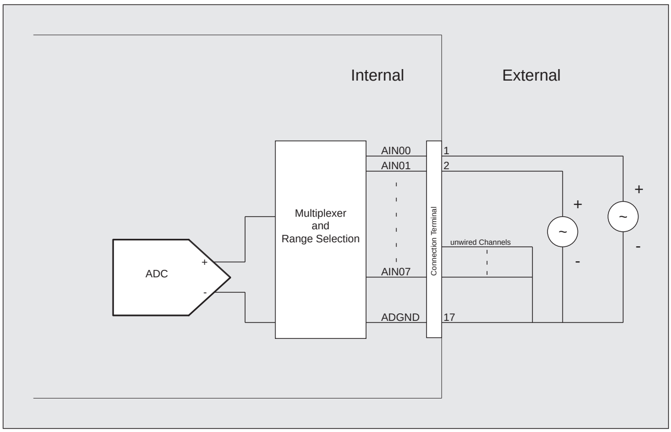


Figure 15.4 Wiring of the A/D inputs (single ended)

15.5 Wiring of the A/D Inputs differential

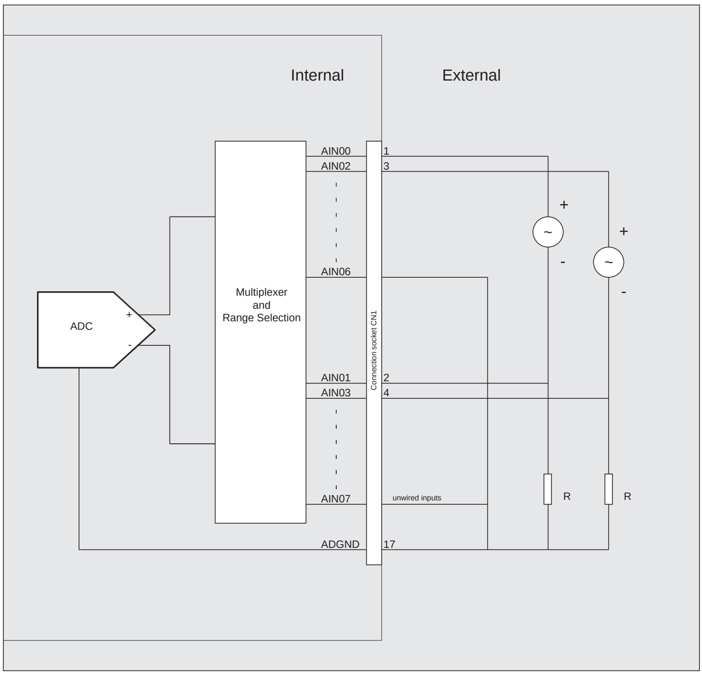


Figure 15.5 Wiring of the A/D inputs (differential)

16. ASCII Table

Hex	Dec	Binary	Character
00	0	00000000	
01	1	00000001	
02	2	00000010	
03	3	00000011	
04	4	00000100	
05	5	00000101	
06	6	00000110	
07	7	00000111	
08	8	00001000	
09	9	00001001	
0A	10	00001010	
0B	11	00001011	
0C	12	00001100	
0D	13	00001101	
0E	14	00001110	
0F	15	00001111	
10	16	00010000	
11	17	00010001	
12	18	00010010	
13	19	00010011	
14	20	00010100	
15	21	00010101	
16	22	00010110	
17	23	00010111	
18	24	00011000	
19	25	00011001	
1A	26	00011010	
1B	27	00011011	
1C	28	00011100	
1D	29	00011101	
1E	30	00011110	
1F	31	00011111	
20	32	00100000	[space]
21	33	00100001	!
22	34	00100010	”
23	35	00100011	#
24	36	00100100	$
25	37	00100101	%
26	38	00100110	&
27	39	00100111	’

Hex	Dec	Binary	Character
28	40	00101000	(
29	41	00101001	)
2A	42	00101010	*
2B	43	00101011	+
2C	44	00101100	,
2D	45	00101101	-
2E	46	00101110	.
2F	47	00101111	/
30	48	00110000	0
31	49	00110001	1
32	50	00110010	2
33	51	00110011	3
34	52	00110100	4
35	53	00110101	5
36	54	00110110	6
37	55	00110111	7
38	56	00111000	8
39	57	00111001	9
3A	58	00111010	:
3B	59	00111011	;
3C	60	00111100	<
3D	61	00111101	=
3E	62	00111110	>
3F	63	00111111	?
40	64	01000000	@
41	65	01000001	A
42	66	01000010	B
43	67	01000011	C
44	68	01000100	D
45	69	01000101	E
46	70	01000110	F
47	71	01000111	G
48	72	01001000	H
49	73	01001001	I
4A	74	01001010	J
4B	75	01001011	K
4C	76	01001100	L
4D	77	01001101	M
4E	78	01001110	N
4F	79	01001111	O

Hex	Dec	Binary	Character
50	80	01010000	P
51	81	01010001	Q
52	82	01010010	R
53	83	01010011	S
54	84	01010100	T
55	85	01010101	U
56	86	01010110	V
57	87	01010111	W
58	88	01011000	X
59	89	01011001	Y
5A	90	01011010	Z
5B	91	01011011	[
5C	92	01011100	
5D	93	01011101	]
5E	94	01011110	^
5F	95	01011111	_
60	96	01100000	`
61	97	01100001	a
62	98	01100010	b
63	99	01100011	c
64	100	01100100	d
65	101	01100101	e
66	102	01100110	f
67	103	01100111	g
68	104	01101000	h
69	105	01101001	i
6A	106	01101010	j
6B	107	01101011	k
6C	108	01101100	l
6D	109	01101101	m
6E	110	01101110	n
6F	111	01101111	o
70	112	01110000	p
71	113	01110001	q
72	114	01110010	r
73	115	01110011	s
74	116	01110100	t
75	117	01110101	u
76	118	01110110	v
77	119	01110111	w
78	120	01111000	x
79	121	01111001	y
7A	122	01111010	z
7B	123	01111011	{

Hex	Dec	Binary	Character
7C	124	01111100	|
7D	125	01111101	}
7E	126	01111110	
7F	127	01111111	
80	128	10000000	
81	129	10000001	
82	130	10000010	
83	131	10000011	
84	132	10000100	
85	133	10000101	
86	134	10000110	
87	135	10000111	
88	136	10001000	
89	137	10001001	
8A	138	10001010	
8B	139	10001011	
8C	140	10001100	
8D	141	10001101	
8E	142	10001110	
8F	143	10001111	
90	144	10010000	
91	145	10010001	
92	146	10010010	
93	147	10010011	
94	148	10010100	
95	149	10010101	
96	150	10010110	
97	151	10010111	
98	152	10011000	
99	153	10011001	
9A	154	10011010	
9B	155	10011011	
9C	156	10011100	
9D	157	10011101	
9E	158	10011110	
9F	159	10011111	
A0	160	10100000	
A1	161	10100001	
A2	162	10100010	
A3	163	10100011	
A4	164	10100100	
A5	165	10100101	
A6	166	10100110	
A7	167	10100111	

Hex	Dec	Binary	Character
A8	168	10101000	
A9	169	10101001	
AA	170	10101010	
AB	171	10101011	
AC	172	10101100	
AD	173	10101101	
AE	174	10101110	
AF	175	10101111	
B0	176	10110000	
B1	177	10110001	
B2	178	10110010	
B3	179	10110011	
B4	180	10110100	
B5	181	10110101	
B6	182	10110110	
B7	183	10110111	
B8	184	10111000	
B9	185	10111001	
BA	186	10111010	
BB	187	10111011	
BC	188	10111100	
BD	189	10111101	
BE	190	10111110	
BF	191	10111111	
C0	192	11000000	
C1	193	11000001	
C2	194	11000010	
C3	195	11000011	
C4	196	11000100	
C5	197	11000101	
C6	198	11000110	
C7	199	11000111	
C8	200	11001000	
C9	201	11001001	
CA	202	11001010	
CB	203	11001011	
CC	204	11001100	
CD	205	11001101	
CE	206	11001110	
CF	207	11001111	
D0	208	11010000	
D1	209	11010001	
D2	210	11010010	
D3	211	11010011	

Hex	Dec	Binary	Character
D4	212	11010100	
D5	213	11010101	
D6	214	11010110	
D7	215	11010111	
D8	216	11011000	
D9	217	11011001	
DA	218	11011010	
DB	219	11011011	
DC	220	11011100	
DD	221	11011101	
DE	222	11011110	
DF	223	11011111	
E0	224	11100000	
E1	225	11100001	
E2	226	11100010	
E3	227	11100011	
E4	228	11100100	
E5	229	11100101	
E6	230	11100110	
E7	231	11100111	
E8	232	11101000	
E9	233	11101001	
EA	234	11101010	
EB	235	11101011	
EC	236	11101100	
ED	237	11101101	
EE	238	11101110	
EF	239	11101111	
F0	240	11110000	
F1	241	11110001	
F2	242	11110010	
F3	243	11110011	
F4	244	11110100	
F5	245	11110101	
F6	246	11110110	
F7	247	11110111	
F8	248	11111000	
F9	249	11111001	
FA	250	11111010	
FB	251	11111011	
FC	252	11111100	
FD	253	11111101	
FE	254	11111110	
FF	255	11111111	

17. Product Liability Act

Information for Product Liability

The Product Liability Act (Act on Liability for Defective Products - ProdHaftG) in Germany regulates the manufacturer‘s liability for damages caused by defective products.

The obligation to pay compensation can already be given, if the product’s presentation could cause a misconception of safety to a non-commercial end-user and also if the end-user is expected not to observe the necessary safety instructions when handling this product.

It must therefore always be verifiable, that the end-user has been made familiar with the safety rules.

In the interest of safety, please always point out the following safety instructions to your non-commercial customers:

Safety instructions

The applicable VDE-instructions must be observed, when handling products that come into contact with electrical voltage.

Particular attention must be drawn to the following instructions:
VDE100; VDE0550/0551; VDE0700; VDE0711; VDE0860.
You can obtain the instructions from:
vde-Verlag GmbH
Bismarckstr. 33
10625 Berlin

* pull the mains plug before you open the unit or make sure, there is no current to/in the unit.

* You only may put into operation any components, boards or devices, if they have been installed inside a secure touch-protected casing before. During installation there must be no current to the equipment.

* Make sure that the device is disconnected from the power supply before using any tools on any components, boards or devices. Any electric charges saved in components in the device are to be discharged prior.

* Live cables or wires, which are connected to the unit, the components or the boards, must be inspected for insulation faults or breakages. In case of any defect in a line the device must be taken out of operation immediately until the defective line has been replaced.

* When using components or boards you must strictly adhere to the characteristic data for electrical parameters specified in the corresponding description.

* As a non-commercial end-user, if it is not clear whether the electrical parameters given in the description provided are applicable for a component, you must consult an expert.

Apart from that, compliance with consruction regulations and safety instructions of all kinds (VDE, TÜV, professional associations, industrial injuries corporation, etc.) is subject to the user/customer.

18. CE Declaration of Conformity

This is to certify, that the products

EXDUL-584E EDP Number A-371940
EXDUL-584S EDP Number A-371920

comply with the requirements of the relevant EC directives. This declaration will lose its validity, if the instructions given in this manual for the intended use of the products are not fully complied with.

EN 5502 Class B
IEC 801-2
IEC 801-3
IEC 801-4
EN 50082-1
EN 60555-2
EN 60555-3

The following manufacturer is responsible for this declaration:

Messcomp Datentechnik GmbH
Neudecker Str. 11
83512 Wasserburg

issued by

Dipl.Ing.(FH) Hans Schnellhammer

Wasserburg, 31.01.2018

Reference system for intended use

The multi functional modules EXDUL-584E and EXDUL-584S are not stand-alone devices. The CE-conformity only can be assessed when using additional computer components simultaneously. Thus the CE conformity only can be confirmed when using the following reference system for the intended use of the multi functional modules:

Control Cabinet:	Vero IMRAK 3400	804-530061C 802-563424J 802-561589J
19“ Casing:	Vero PC-Casing	145-010108L
19“ Casing:	Additional Electronic	519-112111C
Motherboard:	GA-586HX	PIV 1.55
Floppy-Controller:	on Motherboard	
Floppy:	TEAC	FD-235HF
Grafic Card:	Advantech	PCA-6443
Interface:	EXDUL-584E EXDUL-584S	A-371940 A-371920