ʁʮ® HYDROTECHNIK

MultiXtend A

Instruction manual

Version 1.0 EN

1. safety

This chapter should be read by you in any case, so that the safety in handling electrical devices is ensured.

1.1 General safety instructions

This section contains important information for the proper use of the MultiXtend A modules. It has been prepared for personnel who are trained and qualified in the handling of electrical equipment.

Qualified and trained personnel are persons who meet at least one of the following three requirements:

- You are familiar with the safety concepts of automation technology and as project planning personnel you are familiar with their handling.

- They are operators of the automation equipment and have been instructed in the use of the equipment. They are familiar with the operation of the devices described in this documentation.

- You are a commissioning engineer or assigned to service and have completed training that qualifies you to repair automation equipment. You are also authorized to commission, ground and label circuits and devices in accordance with safety engineering standards.

The devices described in this manual may only be used for the applications intended in this manual and only in conjunction with certified third-party devices and components.

Proper transport, storage, installation and assembly as well as careful operation and maintenance are essential for the safe and reliable operation of the equipment.

It is essential that you observe the applicable safety and accident prevention regulations when commissioning the equipment.

If there are no all-pole mains disconnectors or fuses when operating the equipment on a fixed installation, these must be installed in the installation. The fixed installation must be connected to the protective conductor.

For devices which are operated via mains voltage, make sure that the mains voltage range set on the device corresponds to the local mains.

1.2 Safety instructions

When supplying the devices with 24V auxiliary voltage, make sure that the extra-low voltage is safely separated from other voltage.

The connecting, signal and sensor lines must be installed in such a way that electromagnetic interference does not impair the function of the device.

Devices and equipment of the automation technology must be installed in such a way that they are sufficiently protected against unintentional operation.

Safety precautions must be taken on the hardware and software side to ensure that a line break does not lead to undefined states of the automation equipment.

In the case of systems that can cause major damage to property or even personal injury due to a malfunction, safety precautions must be taken to ensure a safe operating state in the event of a fault. This can be done, for example, by limit switches, mechanical interlocks, etc.

2. Use of the MultiXtend A

2.1 Overview

The MultiXtend A is the ideal device for acquiring standard analog signals 0..20mA or 4..20mA. These are transmitted as current values via the CAN bus.

Fig. 1: MultiXtend A module for acquisition of analog signals

When evaluating the signals, the undercutting and exceeding of limit values is monitored and a CAN message is sent in the event of an error.

The MultiXtend modules are to record the signals remotely from the higher-level system where they are generated. This reduces costs by eliminating the need for sensor cables.

The development in automation towards decentralized systems with their own "intelligence" makes communication between components increasingly important.

The industry demands the possibility of integrating components from different manufacturers in an automation system. The solution to this problem is networking via a common bus.

All these requirements are fully met by the MultiXtend module. The module is fieldbus-compatible on the standardized bus concept CAN.

Typical applications of the MultiXtend A module are mechanical engineering, automotive engineering, food industry and environmental technology.

The module works with the protocol

CANopen

according to DS-301 (version 4.02). Other protocols can be supplied on request.

Space saving and compact

The MultiXtend A is optimally suited for rough industrial use due to its design in the field housing according to protection class IP 66. The housing in its compact and space-saving size offers you the possibility to mount the device anywhere in the field.

Cost effective and service friendly

The fast, unproblematic integration of the MultiXtend A into your application reduces the development effort and the resulting costs. Material and labor costs are reduced to a minimum. Due to the uncomplicated installation, maintenance and replacement of assemblies are no problem.

3. Project planning

The chapter Project planning contains information that is necessary for the developer and user in advance when using the MultiXtend A. This information includes the dimensions of the housing and the optimum operating conditions.

3.1 Function groups of the MultiXtend module

The following figure shows the different function groups of a MultiXtend module. The drawing shows the structure and location of the various setting and operating options.

1: Baud rate setting
2: Setting device address
3: Terminal strip for the analog signals 4: Terminal strip for supply / CAN

5: Termination switch
6: Bi-color LED for module status
7: Bi-color LED for network status
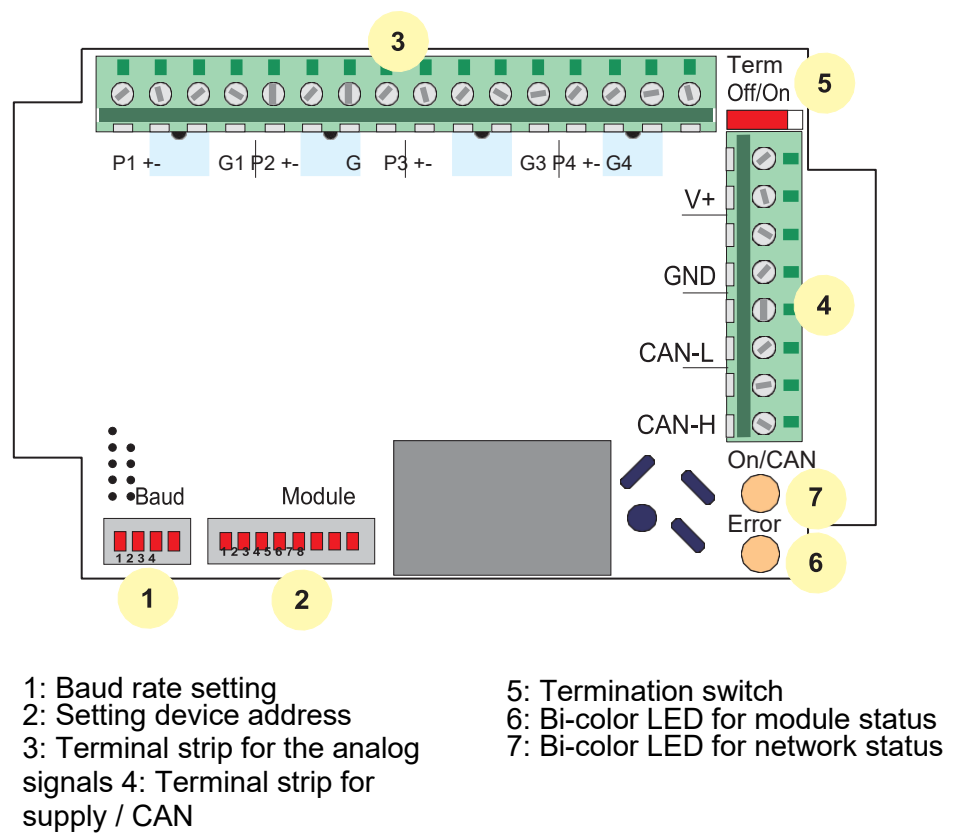
Fig. 2: Overview of the function groups

3.2 General description

The MultiXtend A is a robust device for the acquisition and linearization of analog signals in industrial applications. The following signal types can be acquired:

0..20 mA,

4..20 mA

In this MultiXtend module the analog signals are acquired. The signals are transmitted as current values via the CAN bus as standard.
Falling below / exceeding the limit values is monitored and indicated to the user, see "Monitoring the limit values" on page 31.

The MultiXtend module is installed in a field housing with protection class IP 66. This makes the MultiXtend suitable for installation outside the control cabinet.
The basic idea behind the installation outside the control cabinet is to record the measured variables on site. This eliminates the need for long sensor cables and compensating cables. In addition, interference caused by electromagnetic radiation on long sensor cables is avoided.

The MultiXtend A can be operated on a supply voltage of 9..36V DC. The MultiXtend A should be connected to the power supply and the CAN bus via a four-core cable. This keeps the wiring effort low. Corresponding CAN cables are available as accessories.

3.3 Maximum system expansion

To build up an executable bus, at least one network manager must be present on the bus. This network manager can be either a PLC or a PC with a corresponding CAN card. Each module represents an active CAN device.

A bus line can **logically** manage a maximum of 127 devices. Each device receives its own device address (Node ID, NID), which is set via a DIP switch on the module. The individual MultiXtend modules can be looped through on the bus.
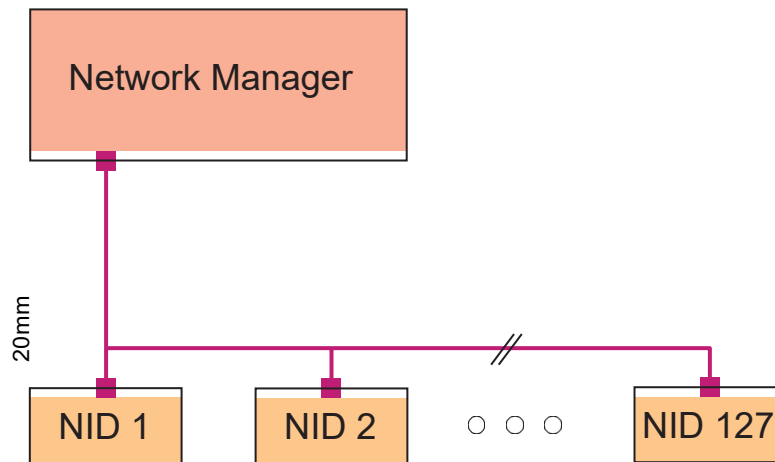
Fig. 3: Maximum system expansion

The maximum bus lengths depending on the baud rate used are listed in the following table. The values are the guide values recommended by CAN in Automation (CiA) and can be realized with the MultiXtend A.

Baud rate	Line length
1000 kBit/s	25 m
800 kBit/s	50 m
500 kBit/s	100 m
250 kBit/s	250 m
125 kBit/s	500 m
100 kBit/s	650 m
50 kBit/s	1000 m
20 kBit/s	2500 m

Table 1: Dependence of the baud rate on the bus length

3.4 Housing dimension

Please refer to the following drawings for the housing dimensions of the MultiXtend A. Due to the housing with protection class IP 66, the installation location of the module is almost freely selectable. You can install the MultiXtend modules both on the plant and permanently in the control cabinet. For the exact environmental conditions, please refer to the technical data of the MultiXtend module.
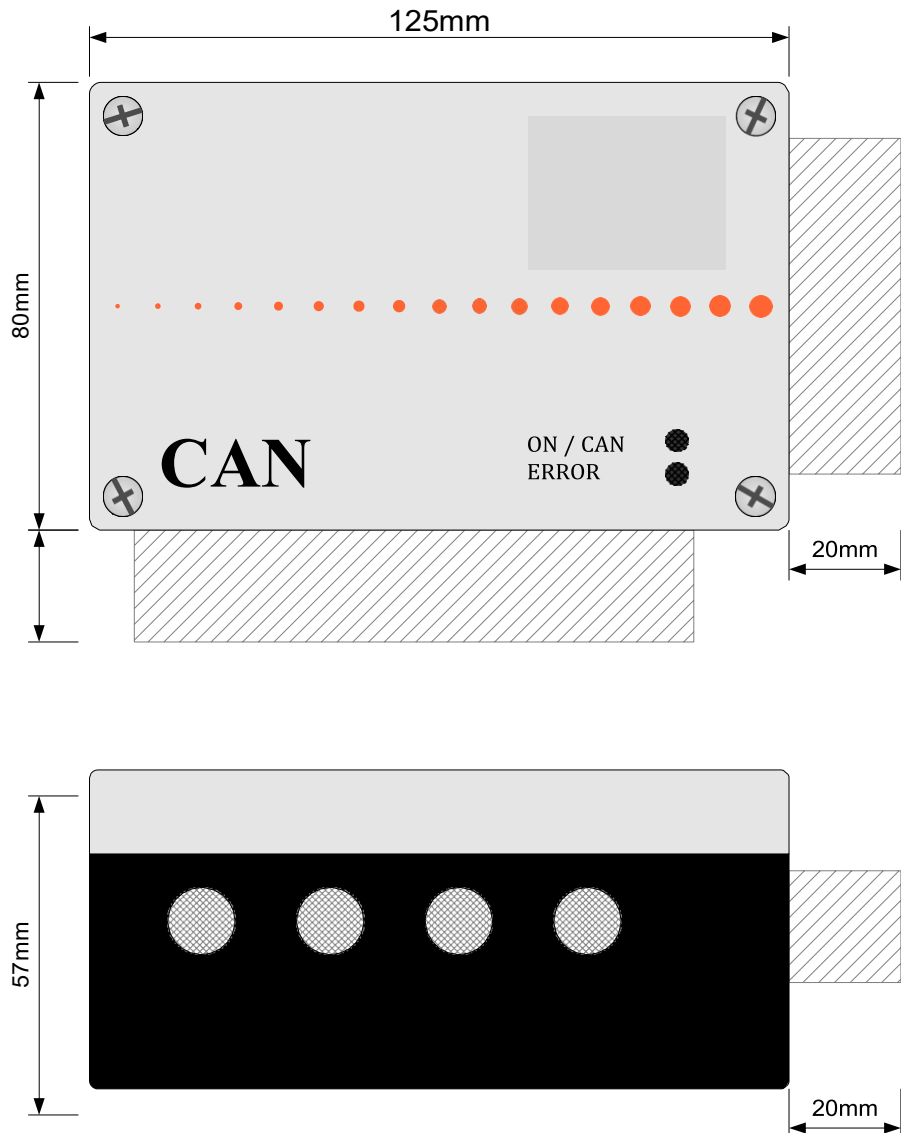
Fig. 4: Housing dimensions

The shaded areas indicate the space required for connectors or cable glands. Since the connections vary depending on the version, only guide values are given in the drawing for the dimensions of the connections.

4. Assembly and disassembly

4.1 General

MountingThe MultiXtend modules should be mounted on a mounting plate at least 2mm thick or directly on the plant. The mounting is done by two screws of type M4, which are inserted directly through the lower part of the housing.

Power supply Power can be supplied via a two-core cable which is connected to the corresponding terminals. However, it makes sense to use four-core cables so that the CAN bus can be routed directly via the same cable.

The PE supply must be made via the grounding screw located outside the housing (see Figure 5, "Feeding in the PE protective conductor"). For EMC reasons, it is not permissible to connect the PE supply inside the housing.

The PE protective conductor must not enter the interior of the housing or be connected to one of the terminals.
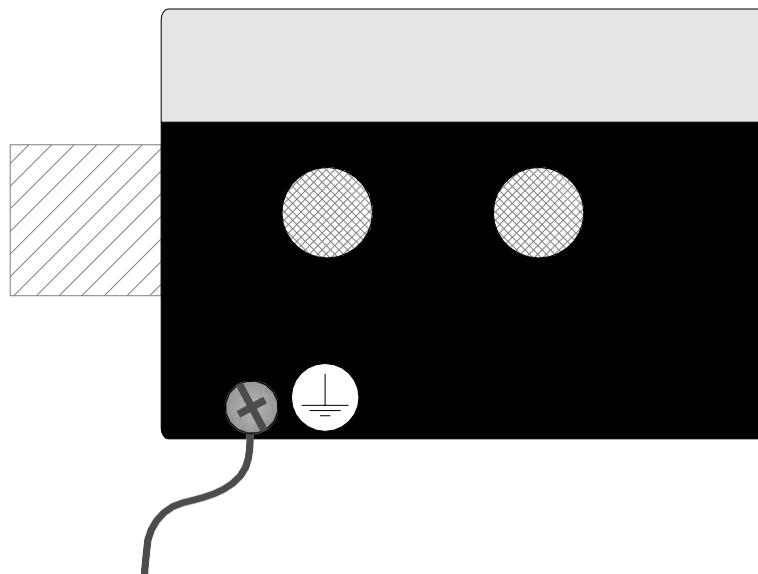
Fig. 5: Feeding the PE protective conductor

Operation of the MultiXtend A module is only permitted with the lid closed.

4.2 Mounting

As a mounting option, the housing has two separate screw channels outside the sealing space.
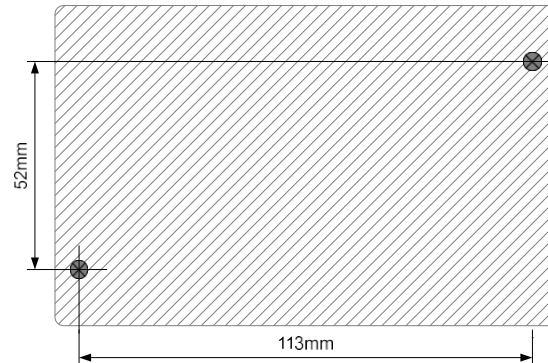
Fig. 6: Fixing points of the housing

When mounting several MultiXtend modules, make sure that the distance between the MultiXtend modules is sufficient to attach the screw fittings/connectors.

To enable quick identification of the MultiXtend modules during operation, the MultiXtend modules should be marked with a sticker on the cover after installation. It makes sense to mark the MultiXtend modules with the respective set device address.

When mounting several MultiXtend modules, make sure that the last module in the bus string is terminated with a terminating resistor on the bus. Further information on termination can be found in the section "Termi- nation".

4.3 Disassembly

First of all, make sure that the power supply is disconnected!

Remove the signal lines from the screw terminals. Then remove the CAN bus and power supply lines from the screw terminal.

5. Installation

5.1 Potential ratios

The potential ratios of the MultiXtend A modules are characterized by the following features:

- The CAN bus connection is electrically isolated from the supply voltage connection.
- The individual MultiXtend modules are galvanically isolated from the supply voltage.
- All MultiXtend modules can be supplied separately.
- The analog inputs are not galvanically isolated from each other.

5.2 EMC-compliant wiring

EMC (Electromagnetic Compatibility) is the ability of a device to operate faultlessly in a given electromagnetic environment without itself affecting the environment in an unacceptable way.

All MultiXtend modules meet these requirements, as all MultiXtend modules are tested for compliance with the legally prescribed limit values. The modules are tested by accredited test laboratories. Nevertheless, EMC planning should be carried out for the system and all potential sources of interference should be excluded.

The coupling of interference signals in automation technology/measurement technology takes place in different ways. Depending on the type of coupling (wired or wireless) and the distance of the interference source to the modules, interference can be coupled into a system in different ways.

Galvanic coupling:

Galvanic coupling occurs when two circuits share a common line. Sources of interference in these cases are
e.g. starting motors, frequency converters (generally clocked devices) and different potentials of the housing of com- ponents and the common voltage supply.

Inductive coupling:

Inductive coupling occurs between conductors carrying current. The currents in one conductor cause a magnetic field, which induces an interference voltage in another conductor (principle of a transformer). Typical sources of interference here are transformers, parallel-running power cables and RF signal cables.

Capacitive coupling:

Capacitive coupling occurs between conductors which are at different potentials (principle of a capacitor). Here, too, the sources of interference occur in the form of parallel-running conductors, static discharges and contactors.

5.2.1 Grounding of inactive metal parts

All inactive metal parts must be connected over a large area and with low impedance (grounding). This measure ensures that a uniform reference potential is guaranteed for all elements of the system.

The ground must never assume a dangerous contact voltage. Therefore, the ground must be connected to a protective earth conductor.

The MultiXtend modules are grounded via a cable lug which is connected to the ground terminal provided for this purpose on the outside of the MultiXtend modules. The ground must never be connected inside the housing of the MultiXtend modules.

All other MultiXtend modules that are not supplied in a metal or aluminum housing do not have to be connected to a common ground potential by ground straps.

5.2.2 Cable shielding

Interference hitting the cable shielding is safely diverted to earth via the connection between the housing parts and the shield busbars. To prevent the shields from acting as sources of interference again, the shields must be connected to the protective conductor with low impedance.

Cable laying

The shield lines should always be connected at both ends. The shielding cable should only be connected at one end if only attenuation in low frequency ranges is required. In addition, it is not possible to connect the shielding at both ends for measuring sensors. Here, the one-sided application is advantageous:

- an equipotential bonding conductor cannot be laid,
- analog signals of some mV or mA are transmitted (e.g. via the measuring probes).

The shield of the CAN bus cable must never get into the housing of the MultiXtend modules. Never place the shielding on the connector strips in the module.

In the case of stationary operation, the shielding of the bus line should be made with metal clamps on the grounding rail.

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5.3 General wiring instructions

All lines used in the overall system should be divided into different groups of line types. A classification could be done in the following groups:
Signal lines, data lines, power lines.

Power lines and data/signal lines should always be laid in separate ducts or bundles (cf. inductive coupling).

Data/signal lines should be routed as closely as possible along ground planes.

Observing the proper cable routing prevents and suppresses as far as possible the influence of cables laid in parallel.

5.3.1 Steering groups

To ensure EMC-compliant cable routing, the cables should be divided into the following groups:

Group 1:   shielded bus and data lines, shielded
             analog lines,
             unshielded DC power lines < 60V,
             unshielded AC power lines < 25V, coaxial lines for monitors.

Group 2:   unshielded DC power lines > 60V and < 400V,
             unshielded AC power lines > 25V and < 400V.

Group 3:   unshielded cables for DC and AC voltage < 400V

Combination of line groups

The following combination possibilities for joint laying in bundles or cable ducts result from the division into the groups:

Group 1 with Group 1, Group 2 with Group 2, Group 3 with

Group 3

Laying cables in separate cable ducts or bundles is possible without maintaining a minimum distance for the following groups:

 Group1 with Group2

All other combinations of groups must be realized by separate laying in cable ducts or bundles. With this separate laying, care must be taken that the permissible limit values are not exceeded.

5.4 Bus connection

The cable that you use to connect the bus nodes on the CAN bus must comply with ISO 11898-2. Accordingly, the cables must have the following electrical properties:

Cable property	Value
Impedance	108 - 132 Ohm (nom. 120 Ohm)
Specific resistance	70 mOhm / meter
Specific signal delay	5 ns/meter

Table 2: CAN cable properties

The bus line is connected to the MultiXtend modules via the terminal strip in the housing. Refer to the terminal assignment you of these instructions.

STOP The potentials of the signal line must not be swapped, otherwise no communication can take place on the bus.

5.5 Supply voltage

The MultiXtend A module is designed for use in industry. By using a DC/DC converter, the CAN bus is galvanically isolated from the supply voltage. The supply voltage can vary in a range 9..36V DC. The input for the voltage supply is protected against polarity reversal.

The supply voltage must be connected to the terminal with the correct polarity. The positive line of the supply voltage for the module is connected to the **V+** terminal. The terminal is internally bridged so that a supply voltage line can be looped through.
The negative supply voltage is connected to the terminals **GND**

is connected. Here, too, the terminals are bridged internally.
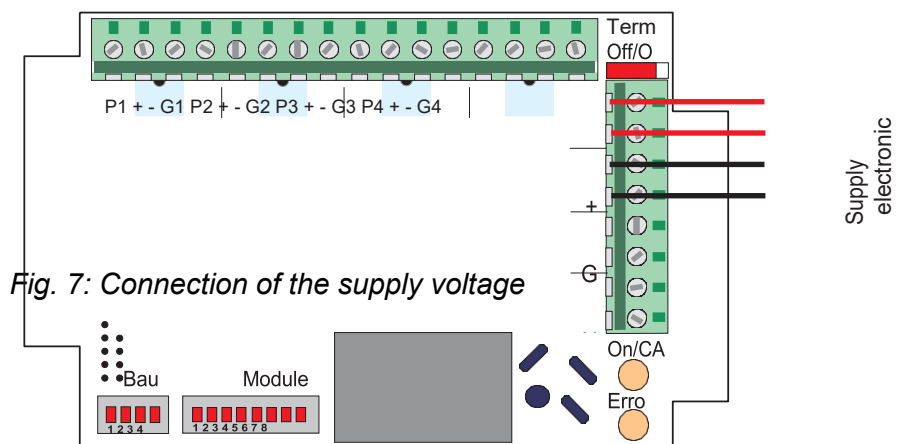
Fig. 7: Connection of the supply voltage

The electronics can be supplied with a maximum of 36V DC. Applying a higher voltage will destroy the module.

Shielding must not enter the MultiXtend module or be connected to one of the terminals. Shields must be connected to an appropriate potential outside the housing via special screw connections.

Rundsteckverbinder M16 x 0.75 mit Schraubverriegelung Ausführung 06-a, 6-polig, Buchse
Circular connectors M16 x 0.75 with screw-locking Layout 06-a, 6 poles, female IEC / DIN EN 61076-2-106

Signaleingänge / signal input 4 x 0/4…20mA				
Signal+	1	Signal +	*Signal +*
GND Ub/Signal	2	Versorgungs- und Signalmasse	*Supply and signal ground*
+Ub	3	Versorgung +	*Supply +*
NC	4	nicht verbunden	*not connected*
NC	5	nicht verbunden	*not connected*
NC	6	nicht verbunden	*not connected*
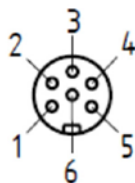
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5.6 CAN line

The CAN bus is connected directly to the corresponding terminal via a two-wire cable.

To avoid coupling of interference signals, make sure when wiring that the bus line is not laid over the signal lines.

The CAN bus line with the high potential must be connected to the **CAN_H** terminal. The bus line with the low potential must be connected to the **CAN_L** terminal.
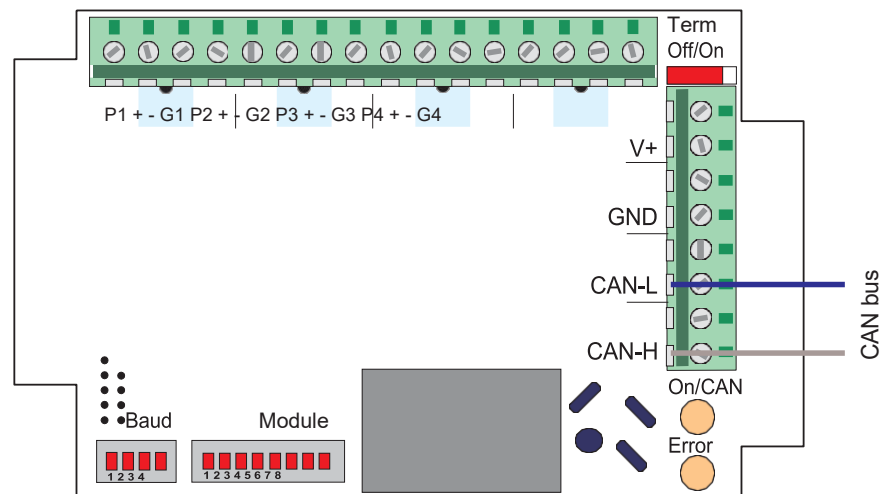
Fig. 8: Connection of the CAN line

Covering up the potential of buses leads to the fact that the Communication on the bus does not occur.

A shield must not enter the module or be connected to one of the terminals. Shields must be connected to an appropriate potential outside the housing via special screw connections.

5.7 Addressing the devices

The MultiXtend modules are addressed via an 8-pin DIP switch located in the lower left corner of the board and labeled "Module ID". The setting of the node ID is best done with a fine screwdriver.

Module ID
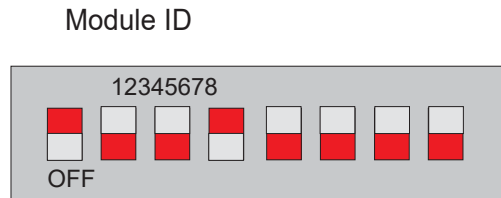
Fig. 9: Setting the device address (device address 9 shown here)

The 8-pole DIP switch is designed as a binary coding switch. The first slider of the switch (marked with '1') represents the bit 0 of a byte. The last slide switch (marked with '8') represents the bit 7 of a byte.

The permissible device addresses range from 1..127, corresponding to 01h..7Fh. Each node in a CAN line must have a unique ID. Two nodes with the same ID are not permitted on one CAN line.

The set device address is taken over during the initialization of the MultiXtend module. The module works with the once set device address until a new one is set and a reset is triggered.

If all "Module ID" switches are in the OFF position and the DIP switches of the baud rate are also in the OFF position, then the MultiXtend A module is started in LSS mode with the preset node ID. This mode allows the reprogramming of the Node-ID and baud rate via CAN commands without having to open the device.
E.g. with the CANopen tool in the 4070 and 5070.

Default Node ID= 112
Default baud rate= 125 kB

DIP switch 8 must always be in the OFF position.

The module for which the switch positions are incorrectly configured cannot be started. This state is signaled by the "ERROR" LED (see "Module status" on page 36).

5.8 Baud rates

The setting of the baud rate on the MultiXtend modules is done via a 4-pole DIP switch, which is located next to the DIP switch for setting the device address in the lower left corner of the board. The best way to set the baud rate is to use a fine screwdriver.
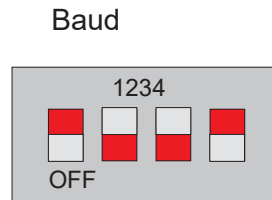
Baud

Fig. 10: Setting the baud rate (here shown 1 MBit/s)

The baud rates supported by the MultiXtend modules are listed in the following table. The values are the guideline values recommended by CiA.

Baud rate	DIP switch position			
	1	**2**	**3**	**4**
Autobaud / LSS	0	0	0	0
Autobaud	1	0	0	0
20 kBit/s	0	1	0	0
50 kBit/s	1	1	0	0
100 kBit/s	0	0	1	0
125 kBit/s	1	0	1	0
250 Kbit/s	0	1	1	0
500 kBit/s	1	1	1	0
800 kBit/s	0	0	0	1
1 MBit/s	1	0	0	1

Table 3: Setting the baud rate

The baud rate 10 kBit/s is not supported by the MultiXtend A. LSS is only used if all module ID switches are also in the OFF position.

In the Autobaud setting, automatic detection of the baud rate used takes place on the CAN bus.

In the LSS mode setting, the baud rate and device address stored in the device are used.

If an invalid baud rate is set on the device, this state is signaled by the "Error" LED

5.9 Termination

The last device on a CAN line must be terminated with a terminating resistor (120 Ohm). In this way, the CAN line is terminated without feedback and no interference can occur in the communication.

To terminate a MultiXtend A module, the slide switch labeled "Term" is set from the Term "Off" position to the Term On position using a fine screwdriver.

Make sure that only on the µCAN module the termination has been switched on, which is mounted at the end of a CAN line. In the de-energized state you can then measure a value of 60 ohms between the CAN-H and CAN-L lines.
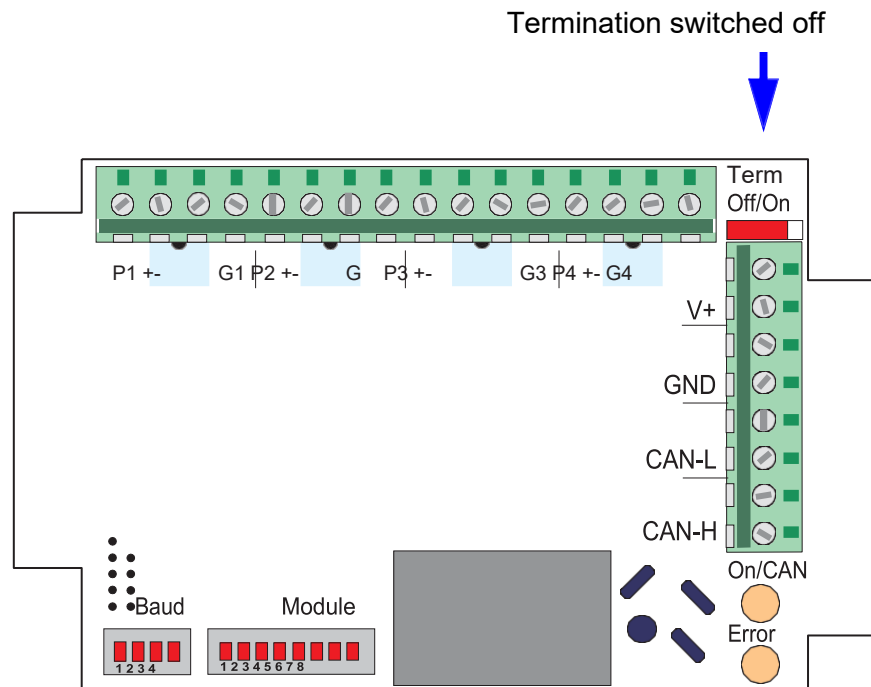
Fig. 11: Setting the scheduling

In the figure shown, the termination is switched off. This module is used in the CAN line as a "T-piece". The CAN string must therefore be terminated by another module with 120 Ohm.

6. Analog inputs

This section of the manual is intended to show you how to connect the various types of signals to the MultiXtend A module. Here it is also important to observe the basic rules of EMC-compliant wiring. Only if the connection is correct and the signal cable is laid in an EMC-compliant manner, the undisturbed functioning of the modules can be guaranteed.

The MultiXtend A module has four analog measuring inputs, which are numbered in ascending order.
The terminal with the designation P1 belongs to the measuring channel 1. Likewise, the following three terminals with the designations +, - and G1 belong to the same measuring channel. The last measuring channel (channel 4) has the terminal designations P4, +, - and G4.

Current measurement
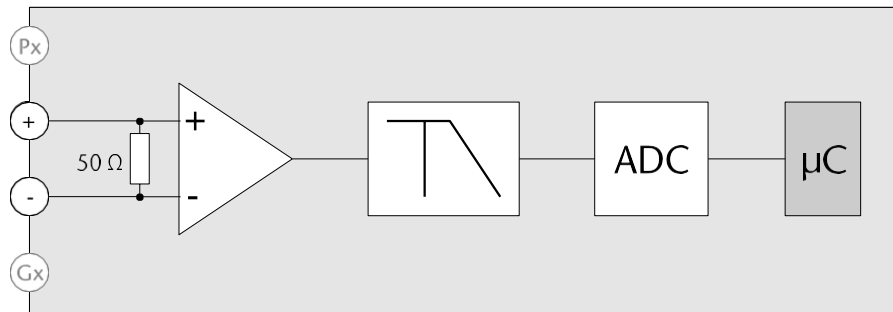
Fig. 13: Input circuit for current measurement

6.1 Connection of the signal lines

When connecting supply lines for the evaluation of the standard signals, only the + and - terminals of the respective channel are to be used. No bridges may be placed between the measuring channels.

he positive signal of the respective measuring zone is applied to the "+" terminal of the desired channel, the negative signal must be applied to the associated terminal with the designation "-".
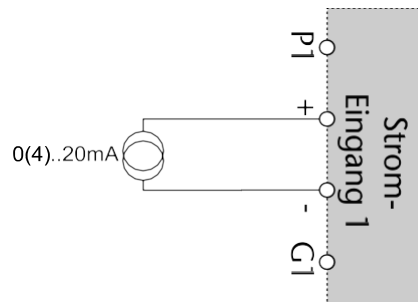
Fig. 14: Connecting the signal lines
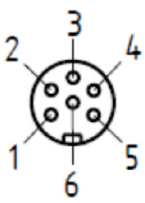
The shielding of the signal lines must not enter the inside of the housing to avoid interference radiation to the electronics. Shields must be connected from the outside to the cable shoes provided for this purpose.

Make sure that the connected signals never exceed the given limits of ± 40 mA for current inputs.
Exceeding the signal quantities can lead to the destruction of the electronics.

Rundsteckverbinder M16 x 0.75 mit Schraubverriegelung Ausführung 06-a, 6-polig, Buchse
Circular connectors M16 x 0.75 with screw-locking Layout 06-a, 6 poles, female IEC / DIN EN 61076-2-106

Signaleingänge / *signal input* 4 x 0/4…20mA	Signal+	1	Signal +	*Signal +*
	GND Ub/Signal	2	Versorgungs- und Signalmasse	*Supply and signal ground*
	+Ub	3	Versorgung +	*Supply +*
	NC	4	nicht verbunden	*not connected*
	NC	5	nicht verbunden	*not connected*
	NC	6	nicht verbunden	*not connected*

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6.2 Monitoring of the limit values

With the MultiXtend A module, depending on the set signal type, the measuring signal is monitored for exceeding its limit values.

The following table summarizes these limits.

Sensor type	Measuring range limit value	Signal limit value
0..20 mA	- 0.001 mA +20.001 mA	- 0.200 mA +20,200 mA
4..20 mA	+ 3.999 mA +20.001 mA	+ 3,800 mA +20,200 mA

Table 4: Overview of the monitored limit values

Exceeding the measuring range limit value results in the corresponding values for the status of the measuring channel being set (see "AI status" on page 64).

Only when the signal limits are exceeded, an emergency message (see "Emergency message" on page 85) is sent, the blink code of the "ERROR" LED (see"Module status"on page 36) is adjusted and the status of the measuring channel is reset.

Furthermore, an invalid measured value 8888h = -30584d (signed) = 34952d (unsigned) is output.

The error remains present until the measured value falls below the signal limit again.

The current status of the respective measuring input can be read out via object 6150h (see"AIstatus"onpage64).

7. Diagnosis

All MultiXtend modules have LEDs to indicate the status of the devices and to signal error conditions.

The MultiXtend A module has two two-color LEDs (green/red) labeled "On/CAN" (network status) and "Error" (module status) on the board.

The designation **ON/CAN** for the network status LED and **ERROR** for the module status LED are printed on the housing cover.

In the following figure, these are marked with 1 and 2.
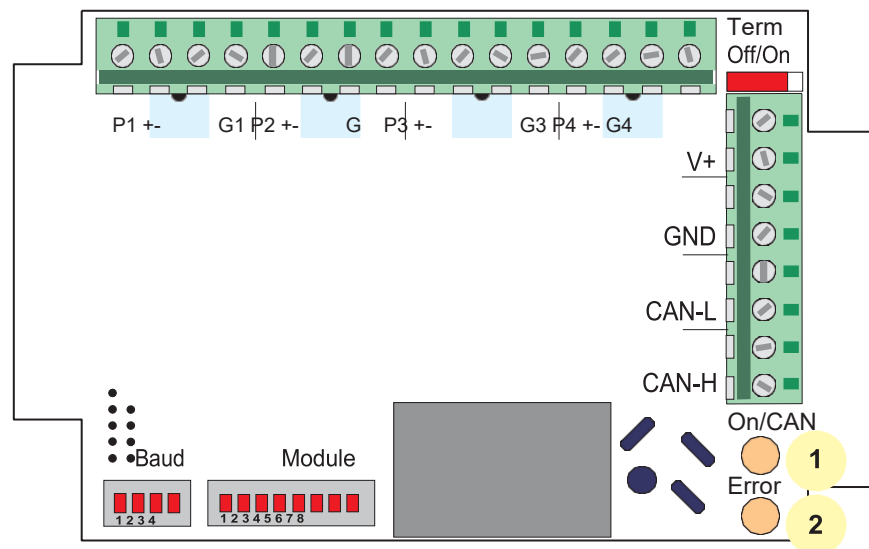
Fig. 15: Position of the LEDs on the module

In normal operation, all LEDs should only light up in the color green. As soon as an LED lights up red or flashes, this indicates an error.

7.1 Network status

The status of the CANopen NMT status machine and the error status of the CAN controller are displayed via the LED labelestatus" (labeled ON/CAN on the housing cover).

7.1.1 Display CANopen NMT status

The green LED indicates the CANopen Network Management (NMT) status.

Initialization (Autobaud Detection)

NMT Status: Device in "Stopped" state

NMT Status: Device in "Pre-operational" state

NMT Status: Device in "Operational" state

7.1.2 Display CAN controller status

The red LED indicates the status of the CAN controller. In error-free status, the red LED is switched off.

CAN Status: Controller in "Warning" state

CAN Status: Controller in "Error Passive" state

CAN status: Controller in "Bus-Off" state

7.1.3 Combined display

In the combination of the red and the green LED the status of the CAN controller is indicated (red LED).

Device in "Pre-operational" state, CAN Controller in "Warning" state

Device in "Operational" state, Controller in "Error Passive" state

7.2 Module status

The LED labeled "Module status" (labeled ERROR on the housing cover) indicates the device status.

Module Status: Function/Power OK

Module status: Incorrect baud rate setting

Module status: Incorrect address setting

Module status: The measured signal is outside the limit values

8. CANopen protocol

The CANopen Protocol chapter contains the most important information that the user needs to connect the modules of the MultiXtend series with a CANopen manager and to put them into operation. The CANopen manager can be a PC with CAN card, a PLC or e.g. a controller.

For information on the CANopen manager, please refer to the documentation of the devices used in each case.

The operating instructions reflect the current status of the implemented functions of the MultiXtend module.

8.1 General

The identifiers are assigned by the device during initial commissioning in accordance with the **Predefined Connection Set** described in the CANopen communication profile DS-301. The following table shows the areas for the different services.

Object	COB ID (dec.)	COB ID (hex)
Network Management	0	0x000
SYNC	128	0x080
EMERGENCY	129 - 255	0x081 - 0x0FF
PDO 1 (send)	385 - 511	0x181 - 0x1FF
PDO 2 (send)	641 - 767	0x281 - 0x2FF
SDO (Send)	1409 - 1535	0x581 - 0x5FF
SDO (Receive)	1537 - 1663	0x601 - 0x67F
Heartbeat / Boot-up	1793 - 1919	0x701 - 0x77F

Table 5: Distribution of identifiers

The transmission direction (send/receive) is specified from the point of view of the MultiXtend A modules.

8.2 Network Management

Network management messages change the state of the module (Stop / Pre-Operational / Operational).

Start Node

Start Node

ID	DLC	B0	B1
0	2	01h	NID

NID = device address, 00h = all CAN devices

Via the command "Start Node" the CAN device is set to the operational mode. In this state the CAN device can communicate via PDOs.

Stop Node

Stop Node

ID	DLC	B0	B1
0	2	02h	NID

NID = device address, 00h = all CAN devices

The "Stop Node" command sets the CAN device to Stop mode. In this state, no communication via SDOs or PDOs can take place.

Pre-Operational

Enter Pre-Operational

ID	DLC	B0	B1
0	2	80h	NID

NID = device address, 00h = all CAN devices

The command "Enter Pre-Operational" sets the CAN device into the Pre-Operational mode. In this state, no communication via PDOs can take place.

Reset Node

Reset Node

ID	DLC	B0	B1
0	2	81h	NID

NID = device address, 00h = all CAN devices

The command "Reset Node" executes a hardware reset of the CAN device. After the reset, the CAN device is in pre-operational mode and sends the "Boot-up Message".

8.3 SDO communication

Access to the parameters of the CAN device (object dictionary) is via an SDO channel (Service Data Object). An SDO telegram has the following extension:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
	8	CMD	Index		Sub-Index	Data bytes			

The Command Byte (**CMD**) has the following meaning:

SDO client (CANopen master)	SDO server (CANopen slave)	Function
22h	60h	Letter, size indeterminate.
23h	60h	Write, 4 byte
27h	60h	Write, 3 byte
2Bh	60h	Write, 2 byte
2Fh	60h	Write, 1 byte
40h	42h	Reading, size indeterminate.
40h	43h	Read, 4 byte
40h	47h	Read, 3 byte
40h	4Bh	Read, 2 byte
40h	4Fh	Read, 1 byte

Table 6: Command for SDO Expedited message

For **index** and **data bytes the** LSB is transmitted first!

The minimum time difference between two SDO messages must not be less than 10 ms.

8.3.1 SDO error messages

If indexes are accessed incorrectly, you will receive an error message in response. An error message always has the following structure:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
	8	80h	Index		Sub-In-dex	Error code			

The ID of the message as well as the index and sub-index refer to the ID to which the erroneous access took place.

The error messages may have the following contents:

Error code	Meaning
0504 0001h	Client / Server Commondo unknown / not valid
0601 0000h	Access to object not supported
0601 0001h	Read access to object not supported
0601 0002h	Write access to object not supported
0602 0000h	Object does not exist in the object dictionary
0609 0011h	Sub-index does not exist in the object dictionary

Table 7: SDO error messages

8.4 Object directory

This chapter describes the objects implemented in the MultiXtend A module. For further information please refer to the CANopen communication profile DS-301 and the device profile DS-404.

EDS   The objects implemented in the MultiXtend A module are stored in an "Electronic Data Sheet" (EDS).

8.4.1 Communication profile

The MultiXtend A module contains the following objects from the DS-301 communication profile:

Index	Name
1000h	Device Profile
1001h	Error Register
1002h	Manufacturer Status
1003h	Predefined error register
1005h	COB-ID SYNC message
1008h	Manufacturer Device Name
1009h	Manufacturer Hardware Version
100Ah	Manufacturer Software Version
100Ch	Guard Time
100Dh	Life Time Factor
1010h	Store parameters
1011h	Restore Default Parameters
1014h	COB-ID Emergency message
1016h	Heartbeat Consumer Time
1017h	Heartbeat Producer Time
1018h	Identity Object
1029h	Error Behaviour
1800h	1st Transmit PDO Parameters
1801h	2nd Transmit PDO Parameters
1A00h	1st Transmit PDO Mapping
1A01h	2nd Transmit PDO Mapping
1F80h	NMT Startup

Table 8: Supported objects of the communication profile

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned32	ro	Device Profile	0002 0194h

The object can only be read. Only sub-index 0 is supported.

An access to other sub-indices is acknowledged with an error message.

Example: Read parameter, device address = 2, index = 1000h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	00h	10h	00h	00h	00h	00h	00h

In response you will receive from the MultiXtend A module:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	43h	00h	10h	00h	94h	01h	02h	00h

Byte 4 + Byte 5 = 0194h = 404d (Device Profile Number) Byte 6
+ Byte 7 = 0002h = 2d (Additional Information)

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Error Register	00h

The object can only be read. Only sub-index 0 is supported.

An access to other sub-indices is acknowledged with an error message.

Example: Read parameter, device address = 2, index = 1001h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	01h	10h	00h	00h	00h	00h	00h

In response you will receive the status of the error register of the device.

The following error types are supported and displayed:

B4	B5	B6	B7	Description
02h	00h	00h	00h	Current Error: triggered by an error in the current measurement.
04h	00h	00h	00h	Voltage Error: triggered by an error in the voltage measurement.
10h	00h	00h	00h	Communication Error: triggered in the event of disruptions in communication on the CAN bus. A precise resolution of the cause of the error is described in the section "Emergency message" on page 85.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Manufacturer Status Register	00h

The object can only be read. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Example: Read parameter, device address = 2, index = 1002h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	02h	10h	00h	00h	00h	00h	00h

In response, you will receive the status of the device.

This register is used to display status information about the two AD converters and the EEPROM.

Different bits can be set in the register, the explanation of which is shown in the following table:

B4	B5	B6	B7	Description
x1h	xxh	xxh	xxh	EEPROM error: a faulty com- munication with the EEPROM has been detected.
x2h	xxh	xxh	xxh	EEPROM error: an error has occurred while writing the data.
1xh	xxh	xxh	xxh	AD converter 1 Error: no communication could be established with the first AD converter.
2xh	xxh	xxh	xxh	AD converter 1 stopped: the first AD converter (channel 1 and 2) was stopped.
xxh	x1h	xxh	xxh	AD converter 2 Error: no communication could be established with the second AD converter.
xxh	x2h	xxh	xxh	AD converter 2 stopped: the second AD converter (channel 3 and 4) was stopped.

Table 10: Status information in the Manufacturer Status Registe r

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	rw	Number of errors	00h
1 .. 4	Unsigned32	ro	Standard error field	0000 0000h

The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message. A write access to sub-index 0 deletes the error list.

Example: Read parameter, device address = 2, index = 1003h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	03h	10h	03h	00h	00h	00h	00h

As an answer you will receive the status of the error register of the 3rd last error of the device s.

Sub-index	Data type	Access	Meaning	Default value
0	Visible String	ro	Device name	MultiXtend A

The object can only be read. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Hardware version

Index 1009h   The hardware version can be queried via the index 1009h.

Sub-index	Data type	Access	Meaning	Default value
0	Visible String	ro	Hardware version	4.02

The object can only be read. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Software version

Index 100Ah   The software version can be queried via index 100Ah.

Sub-index	Data type	Access	Meaning	Default value
0	Visible String	ro	Software version	4.00

The object can only be read. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Number of objects	04h
1	Unsigned32	rw	Save all parameters	0000 0001h
2	Unsigned32	rw	Save communication	0000 0001h
3	Unsigned32	rw	Save application	0000 0001h
4	Unsigned32	rw	Save manufacturer	0000 0001h

Saving is triggered by sending index 1010h with the message "save" (in ASCII) on subindex 1. The message thus has the following structure:

Example: Save all parameters, device address = 2, index = 1010h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	23h	10h	10h	01h	73h	61h	76h	65h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	60h	10h	10h	01h	00h	00h	00h	00h

After saving has been triggered, the parameters are stored in a non-volatile memory (EEPROM).

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Number of objects	04h
1	Unsigned32	rw	Restore all param.	0000 0001h
2	Unsigned32	rw	Restore communic.	0000 0001h
3	Unsigned32	rw	Restore application	0000 0001h
4	Unsigned32	rw	Restore manufacturer	0000 0001h

Loading of the source parameters is triggered by sending index 1011h with the message "load" (in ASCII) on subindex 1. The message thus has the following structure:

Example: Load factory setting, device address = 2, index = 1011h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	23h	11h	10h	01h	6Ch	6Fh	61h	64h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	60h	11h	10h	01h	00h	00h	00h	00h

COB-ID Emergency message

Index 1014hThis object defines the COB-ID for the Emergency messages (EMCY).

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned32	rw	COB ID EMCY	80h + node ID

The default value for the identifier of the emergency message is 80h + set node address (1 - 127).

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned32	ro	Vendor ID	0000 000Eh
2	Unsigned32	ro	Product Code	0012 F779h
3	Unsigned32	ro	Revision Number	0302 0400h
4	Unsigned32	ro	Serial Number	-

The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Vendor ID
The Vendor ID is a unique manufacturer identification that is centrally assigned and managed by CAN in Automation (CiA).

Product Code
The Product Code is a manufacturer-specific code.

Revision Number
software version is stored herechange in the "application software" of the device.

Serial Number
When prompted, you will receive the serial number of the device as a response.

the device is automatically switched to the pre-operational mode. The behavior can be changed via index 1029h.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	number of entries	01h
1	Unsigned8	rw	Communication error	00h

The following values are allowed:

Value	Description
00h	Default behavior, change to pre-operational
01h	The current NMT mode is not changed
02h	Switch to the NMT mode "Stopped

The following operational faults are taken into account:
- Node guarding error
- Heartbeat error

NMT Startup

Index 1F80hThis object defines the NMT startup behavior of the device after power on.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned32	rw	NMT Startup	0000 0000h

Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message. The object defines the startup behavior of the device after initialization (Po- wer-Up / Reset-Node). The following values are permitted:

Value	Description
00h	Standard behavior, change to "Pre-Operational
02h	Send NMT "Start All Nodes
08h	Switch to the NMT "Operational" mode

8.4.2 Manufacturer specific objects

The MultiXtend A module contains the following manufacturer-specific objects.

Index	Name
2010h	Customer Data
201Ah	COB ID Storage
2E00h	PDO Data Format
2E10h	Disable BootUp Message
2E22h	Bus Statistic

Table 11: Manufacturer-specific objects

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned32	rw	Customer Data 1	-
2	Unsigned32	rw	Customer Data 2	-
..	..	..	..	..
8	Unsigned32	rw	Customer Data 8	-

Only sub-index 0 to 8 is supported. Access to other sub-indices is acknowledged with an error message.

A write access to the sub-indices 1 to 8 causes an automatic saving of the value in the EEPROM. Access to object 1010h is not required.

COB ID Storage

Index 201Ah

This object defines the behavior of stored identifiers for the PDO and EMCY services when the device address is changed.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	rw	COB ID Storage	00h

Only sub-index 0 is supported. An access to other sub-indexes is acknowledged with an error message. The following values are allowed:

Value	Description
00h	Keep stored identifiers (PDO/EMCY) when changing module address
01h	Discard stored identifiers (PDO/EMCY) when changing the module address, switch to Predefined Connection Set
02h	Calculate identifier for PDO/EMCY from module address + stored value

Object 201Ah is used in combination with objects 1010h, 1014h, 1800h and 1801h.

Sub-index	Data type	Access	Significance	Default value
0	Unsigned8	rw	PDO Data Format	00h

Only sub-index 0 is supported. An access to other sub-indexes is acknowledged with an error message. The following values are allowed:

Value	Description
00h	PDO data is sent in Intel format
01h	PDO data is sent in Motorola format

The change to Motorola format for the transmission of PDO data is not conform to the CANopen specification.

Disable BootUp Message

Index   2E10hThis object can be used to   specify   whether   or   not   the MultiXtend A module should send a boot-up message   after   the node is switched on or reset.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	rw	Disable BootUp Mes- sage	00h

Only sub-index 0 is supported. An access to other sub-indexes is acknowledged with an error message. The following values are allowed:

Value	Description
00h	BootUp Message is sent after switching on or resetting the node.
01h	The BootUp message is not sent

Disabling the bootup message is not conform to the CANopen specification.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Number of entries	03h
1	Unsigned32	ro	CAN Receive Count	-
2	Unsigned32	ro	CAN Transmit Count	-
3	Unsigned32	ro	CAN Error Count	-

Only sub-index 0 to 3 are supported. Access to other sub-indices is acknowledged with an error message.

The number of received messages is in sub-index 1, the number of sent messages in sub-index 2. The number of CAN error frames is in sub-index 3.

8.4.3 Device profile DS-404

The MultiXtend A module contains the following objects from the DS-404 device profile:

Index	Name
6110h	AI Sensor Type
6112h	AI Operating Mode
6131h	AI Physical Unit Process Value
6132h	AI Decimal Digits Process Value
6150h	AI status
61A0h	AI Filter Type
61A1h	AI Filter Constant
7100h	AI Field Value
7120h	AI Input Scaling 1 Field Value
7121h	AI Input Scaling 1 Process Value
7122h	AI Input Scaling 2 Field Value
7123h	AI Input Scaling 2 Process Value
7124h	AI Input Offset
7130h	AI Process Value

Table 12: Supported objects of the device profile

Fig. 16: Block diagram of the supported functions of an analog input
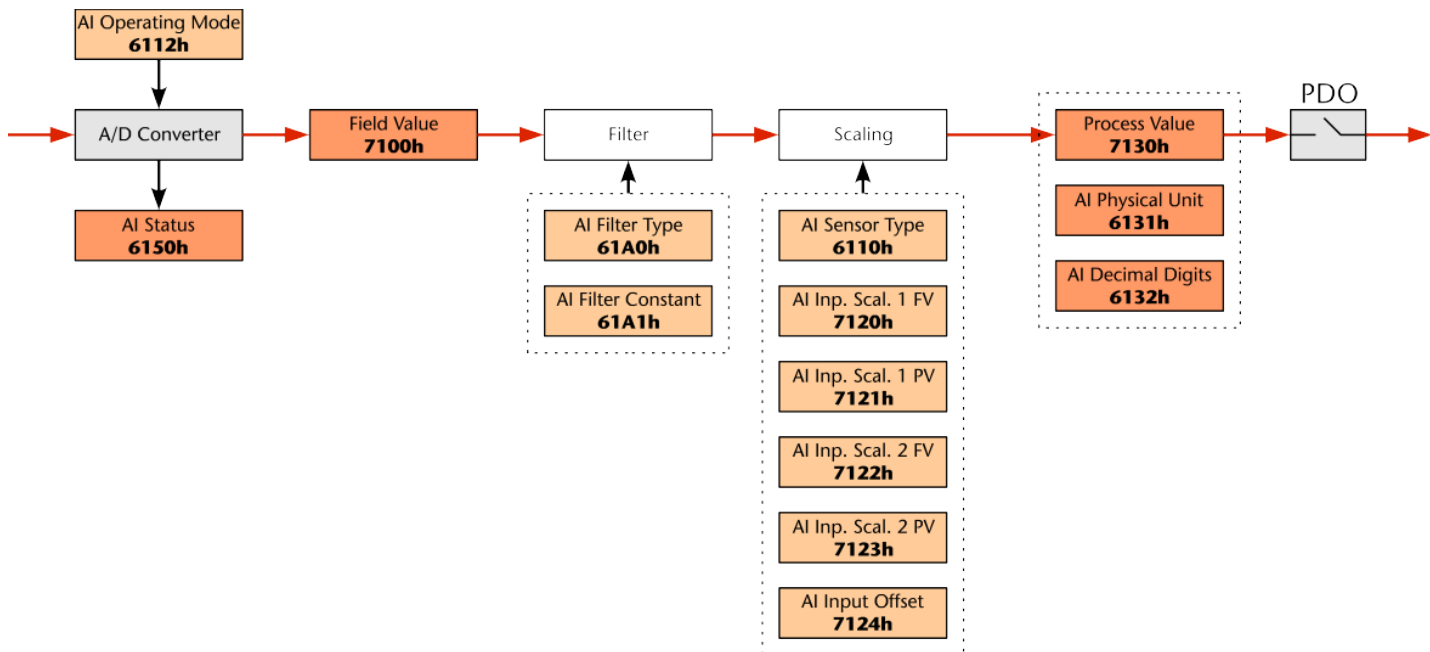
Index 6110h

The index 6110h can be used to set and query the sensor type.

Sub-index	Data type	Access	Meaning	Default value [V] | [mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned16	rw	AI Sensor type of Channel 1	0029h | 0034h
2	Unsigned16	rw	AI Sensor type of Channel 2	0029h | 0034h
3	Unsigned16	rw	AI Sensor type of Channel 3	0029h | 0034h
4	Unsigned16	rw	AI Sensor type of Channel 4	0029h | 0034h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

The sensor type depends on the version of the MultiXtend A module. For the µCAN module for the acquisition of the voltage only sensor type ± 10 V is possible at present. For the module for acquisition of the current sensor type 0...20 mA is set by default.

The following table shows the supported sensor types with corresponding values.

Value	Sensor type
33h	4..20mA
34h	0..20mA

Table 13: Supported sensors

Example: The sensor type of the first measuring channel (sub-index 1) read, device address is 2.

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	10h	61h	01h	00h	00h	00h	00h

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
581h	8	4Bh	10h	61h	01h	33h	00h	00h	00h

In this example, the value of the sensor type is 33h (byte 4). This means that the currently set sensor type is set for the acquisition of variables 4..20 mA.

The sensor type setting is always applied to two channels (1/2 as well as 3/4).

Example: Set the sensor type of the first (and the second) measuring channel (sub-index 1) to signal acquisition of 4..20 mA, device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	2Bh	10h	61h	01h	34h	00h	00h	00h

As confirmation you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	60h	10h	61h	01h	00h	00h	00h	00h

If a value other than that specified in Table 13 on page 59 is transmitted to the µCAN module, the message is acknowledged with an error message.

Saving the set sensor type in a mains fail-safe memory is not automatic. You must trigger saving via index 1010h (see "Saving parameters" on page 50).

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned8	rw	AI Operating Mode of Channel 1	01h
2	Unsigned8	rw	AI Operating Mode of Channel 2	01h
3	Unsigned8	rw	AI Operating Mode of Channel 3	01h
4	Unsigned8	rw	AI Operating Mode of Channel 4	01h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

To switch on a channel, a "1" must be transmitted to the device via the corresponding sub-index, for switching off a "0".

Example: Switch off measurement at measuring channel 3 (sub-index 3) (byte 4 = 00h), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	2Fh	12h	61h	03h	00h	00h	00h	00h

In response, you will receive the following message from the module:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	60h	12h	61h	03h	00h	00h	00h	00h

Channel 3 is now switched off and is no longer evaluated. If an error was caused by this channel, the error is now reset. If you query a measured value from this channel, you will receive the value 0.

The set operating mode is not saved automatically in a fail-safe memory. You must trigger saving via index 1010h (see "Saving parameters" on page 50).

Sub-index	Data type	Access	Meaning	Default value [V]	[mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned32	rw	AI Physical Unit PV of Channel 1	00260000h | FD040000h
2	Unsigned32	rw	AI Physical Unit PV of Channel 2	00260000h | FD040000h
3	Unsigned32	rw	AI Physical Unit PV of Channel 3	00260000h | FD040000h
4	Unsigned32	rw	AI Physical Unit PV of Channel 4	00260000h | FD040000h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Example: Read out physical unit of measurement of the 3rd measuring channel (sub-index 3), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	31h	61h	03h	00h	00h	00h	00h

In response, you will receive the following message from the MultiXtend A:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	31h	61h	03h	00h	00h	26h	00h

Data byte 6 contains the value 26h, this corresponds to a unit of measurement in V.

The complete table of codes can be found in DS-303-2.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned8	rw	AI Decimal Digits PV of Channel 1	03h
2	Unsigned8	rw	AI Decimal Digits PV of Channel 2	03h
3	Unsigned8	rw	AI Decimal Digits PV of Channel 3	03h
4	Unsigned8	rw	AI Decimal Digits PV of Channel 4	03h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Example: Read out the number of decimal places of the 3rd measuring channel (sub-index 3), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	32h	61h	03h	00h	00h	00h	00h

In response, you will receive the following message from the MultiXtend A:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	40h	32h	61h	03h	03h	00h	00h	00h

Data byte 4 contains the value 03h, i.e. the process values are specified with three decimal places.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned8	ro	AI Status of Channel 1	00h
2	Unsigned8	ro	AI Status of Channel 2	00h
3	Unsigned8	ro	AI Status of Channel 3	00h
4	Unsigned8	ro	AI Status of Channel 4	00h

The object can only be read. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Whether the measured values have reached or exceeded the limit values can be determined by the value in the status register. The following values are defined:

Value	Status
00h	No failure
01h	Measuring Value not valid
02h	Positive Overload
04h	Negative Overload

Table 14: Possible values for the status of the measuring channel

Example: Read out status of 3rd measuring channel (sub-index 3), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	50h	61h	03h	00h	00h	00h	00h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	4Bh	50h	61h	03h	03h	00h	00h	00h

The value 03h of data byte 4 means that a positive overflow has occurred and that the measured values at this measuring channel are invalid.

AI Filter Type

Index 61A0hThe filter type of the respective measuring channel can be defined or read out via the   index 61A0h.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned8	rw	AI Filter Type of Channel 1	00h
2	Unsigned8	rw	AI Filter Type of Channel 2	00h
3	Unsigned8	rw	AI Filter Type of Channel 3	00h
4	Unsigned8	rw	AI Filter Type of Channel 4	00h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

The following values are defined for the filter type selection:

Value	Filter	Calculation
00h	No Filter	-
01h	Moving average	$DataN = DataN_{-1} + \dfrac{NewData - DataN_{-1}}{Filterconstant}$

Table 15: Possible filters

Example: Read filter type of the 3rd measuring channel (sub-index 3),

Device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	A0h	61h	03h	00h	00h	00h	00h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	4Bh	A0h	61h	03h	01h	00h	00h	00h

Saving the set filter type in a mains fail-safe memory is not automatic. You must trigger saving via index 1010h (see "Saving parameters" on page 50).

AI Filter Constant

Index 61A1hIndex 61A1h is used to set and query the filter constant of the respective measuring channel.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned8	rw	AI Filter Constant of Channel 1	01h
2	Unsigned8	rw	AI Filter Constant of Channel 2	01h
3	Unsigned8	rw	AI Filter Constant of Channel 3	01h
4	Unsigned8	rw	AI Filter Constant of Channel 4	01h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

The value for the filter constant can be selected between 1 and 50. Writing a different value for the filter constant is acknowledged with an error message.

Example: Write filter constant 5 for measuring channel 3 (sub-index 3), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	2Bh	A1h	61h	03h	05h	00h	00h	00h

In response, you will receive the following message from the MultiXtend A:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	60h	A1h	61h	03h	00h	00h	00h	00h

Saving the set filter constant in a power-failure-proof memory does not take place automatically. You must trigger saving via index 1010h (see "Saving parameters" on page 50).

AI Field Value

Index 7100hThe   index 7100h is an index with read-only access. It outputs   the measured value of the selected channel. This measured value is not li-nearized, but may be filtered. It represents the actual value supplied (and possibly filtered) by the AD converter.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	ro	AI Field Value of Channel 1	0000h
2	Signed16	ro	AI Field Value of Channel 2	0000h
3	Signed16	ro	AI Field Value of Channel 3	0000h
4	Signed16	ro	AI Field Value of Channel 4	0000h

The object can only be read. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Example: Read AD value of 3rd measuring channel (sub-index 3), device address is 2

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	00h	71h	03h	00h	00h	00h	00h

As a possible answer you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	4Bh	50h	61h	03h	11h	0Ah	00h	00h

Data byte 4 (low byte) and 5 (high byte) gives you the measuring value 0A11h of the AD wallle

AI Input Scaling 1 Field Value

Index 7120h

Via the index 7120h the scaling of the measured values for each channel can be made in connection with the objects 7121h, 7122h and 7123h.

Sub-index	Data type	Access	Meaning	Default value [V]	[mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	rw	AI Imput Scaling 1 FV of Channel 1	0000h | 0000h
2	Signed16	rw	AI Imput Scaling 1 FV of Channel 2	0000h | 0000h
3	Signed16	rw	AI Imput Scaling 1 FV of Channel 3	0000h | 0000h
4	Signed16	rw	AI Imput Scaling 1 FV of Channel 4	0000h | 0000h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.
The use of this object in the context of scaling is presented in the section "Scaling" on page 72.

AI Input Scaling 1 Process Value

Index 7121h

Via the index 7121h the scaling of the measured values for each channel can be made in connection with the objects 7120h, 7122h and 7123h.

Sub-index	Data type	Access	Meaning	Default value [V]	[mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	rw	AI Imput Scaling 1 PV of Channel 1	0000h | 0000h
2	Signed16	rw	AI Imput Scaling 1 PV of Channel 2	0000h | 0000h
3	Signed16	rw	AI Imput Scaling 1 PV of Channel 3	0000h | 0000h
4	Signed16	rw	AI Imput Scaling 1 PV of Channel 4	0000h | 0000h

AI Input Scaling 2 Field Value

Index 7122h

Via the index 7122h the scaling of the measured values for each channel can be made in connection with the objects 7120h, 7121h and 7123h.

Sub-index	Data type	Access	Meaning	Default value [V] | [mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	rw	AI Imput Scaling 2 FV of Channel 1	2710h | 4E20h
2	Signed16	rw	AI Imput Scaling 2 FV of Channel 2	2710h | 4E20h
3	Signed16	rw	AI Imput Scaling 2 FV of Channel 3	2710h | 4E20h
4	Signed16	rw	AI Imput Scaling 2 FV of Channel 4	2710h | 4E20h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.
The use of this object in the context of scaling is presented in the section "Scaling" on page 72.

AI Input Scaling 2 Process Value

Index 7123h

Via the index 7123h the scaling of the measured values for each channel can be made in connection with the objects 7120h, 7121h and 7122h.

Sub-index	Data type	Access	Meaning	Default value [V] | [mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	rw	AI Imput Scaling 2 PV of Channel 1	2710h | 4E20h
2	Signed16	rw	AI Imput Scaling 2 PV of Channel 2	2710h | 4E20h
3	Signed16	rw	AI Imput Scaling 2 PV of Channel 3	2710h | 4E20h
4	Signed16	rw	AI Imput Scaling 2 PV of Channel 4	2710h | 4E20h

AI Input Offset

Index 7124h Via index 7124h the process value of each channel can be provided with an offset.

Sub-index	Data type	Access	Meaning	Default value [V] | [mA]
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	rw	AI Imput Offset of Channel 1	0000h | 0000h
2	Signed16	rw	AI Imput Offset of Channel 2	0000h | 0000h
3	Signed16	rw	AI Imput Offset of Channel 3	0000h | 0000h
4	Signed16	rw	AI Imput Offset of Channel 4	0000h | 0000h

The object can be read and written. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

The use of this object in the context of scaling is presented in the section "Scaling" on page 72.

AI Process Value

Index 7130hThe index 7130h is an index with read-only access. It outputs the linearized process variables on the selected channel. The linearization depends on the set process variable. The index has the following structure:

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Signed16	ro	AI Process Value of Channel 1	0000h
2	Signed16	ro	AI Process Value of Channel 2	0000h
3	Signed16	ro	AI Process Value of Channel 3	0000h

Sub-index	Data type	Access	Meaning	Default value
4	Signed16	ro	AI Process Value of Channel 4	0000h

The object can only be read. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Example: Read the process value of the 3rd measuring channel (sub-index 3), device address is 2.

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
602h	8	40h	30h	71h	03h	00h	00h	00h	00h

As a possible answer you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
582h	8	4Bh	30h	61h	03h	45h	03h	00h	00h

Data byte 4 (LowByte) and 5 (High Byte) gives you the process value 0345h = 837d = 0.837 V for the voltage variant and = 0.837 mA for the current variant of the mo- dule.

If a measured value is outside the valid measuring range, the value 8888h = -30584d (signed) = 34952d (unsigned)
transferred.

At the same time, the objects for the error status of the device (see "ErrorRegister"onpage46) and status of the measurement inputs (see "AI Status" on page 64) have corresponding values.

When an analog input error is detected, an emer- gency message is also sent on the bus (see "Emergency bot- hing" on page 85).

8.5 Scaling

Often, voltage or current variables are measured which simulate other process variables.

With the MultiXtend A module it is possible to scale to the desired process size directly in the module.

For this purpose, the straight line with the $mx + b$ uses which form $y =$

passes through two points (x1 | y1) and (x2 | y2). The slope is defined as follows:

$$m = \frac{y2 - y1}{x2 - x1} = \frac{PV2 - PV1}{FV2 - FV1}$$

By adjusting the slope m and the offset b, the scaling and shifting of the process values can be varied as desired.
The following table represents objects and the corresponding sizes.

Variable	Abbreviation	Object	Meaning	Default value [d] [V]	[mA]
m	x1 = FV1	7120h	AI Input Scaling 1 FV	0 | 0
	y1 = PV1	7121h	AI Input Scaling 1 PV	0 | 0
	x2 = FV2	7122h	AI Input Scaling 2 FV	0 | 0
	y2 = PV2	7123h	AI Input Scaling 2 PV	0 | 0
b	b	7124h	AI Input Offset	0 | 0

Table 16: Scaling variables

For the process values to be scaled, at least one of the "AI Input Scaling" values must be unequal to "0".
In the standard version, the Field Value at 0 ,000 V = 0d and at +10,000 V = 32000d.

For the current variant, 0 mA = 0d and +20,000 mA = 31360d.

For the sake of completeness, objects 6131h and 6132h should also be adjusted so that the new process values can also be interpreted correctly in their physical unit and number of decimal places.

The set parameters are not automatically saved in a fail-safe memory. You must trigger saving via index 1010h (see "Saving parameters" on page 50).

8.6 CANopen devices monitoring

Two mechanisms (protocols) are possible for monitoring a CANopen device:

- Heartbeat protocol
- Node Guarding

It is recommended by CAN in Automation to use only the Heartbeat protocol for monitoring (CiA AN 802 V1.0: CANopen statement on the use of RTR-messages)

8.6.1 Heartbeat protocol

Via the heartbeat protocol, other devices in the network can determine whether the module is still functional and in which state it is.

Heartbeat ID

The identifier via which the device sends a heartbeat is fixed at 700h + device address. The repetition time (also called producer heartbeat time) is set via index 1017h.

The heartbeat protocol transmits one byte of user data in which the network state of the device is represented.

Network state	Code (dec.)	Code (hex)
Bootup	0	00h
Stopped	4	04h
Operational	5	05h
Pre-Operational	127	7Fh

Table 17: Status information during heartbeat

After switching on the supply voltage, the module autonomously sends the so-called "Boot-up Message".

Example: Switching on the module with the device address 2

ID	DLC	B0
702h	1	00h

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Number of objects	02h
1	Unsigned32	rw	Heartbeat Cons. 1	0000 0000h
2	Unsigned32	rw	Heartbeat Cons. 2	0000 0000h

The MultiXtend A can monitor two other devices (heartbeat producers). The failure of a heartbeat producer within the set time leads to the transmission of an emergency message with the value 8130h (Life guard error or heartbeat error).
The 32 bit value is used to set the time and the device address of the device to be monitored.

Bit 31 ... 24	Bit 23 ... 16	Bit 15 ... 0
reserved (00h)	Device address	Heartbeat Producer time

The value for the time is specified in milliseconds. If the value 0 is entered for the time or the value 0 or greater than 127 for the device address, the Counsumer Heartbeat Time is not used or activated. The Consumer Heartbeat Time is activated after the first Producer Heartbeat is received.

At 0 ms sc stop the heartbeat protocol.

Sub-index	Data type	Access	Significance	Default value
0	Unsigned16	rw	Producer Time	0000h

The object can be read and written. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Example: Producer Time 1000 ms, device address 1

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
601h	8	22h	17h	10h	E8h	03h	00h	00h	00h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
581h	8	60h	17h	10h	00h	00h	00h	00h	00h

Saving the set Producer Heartbeat Time in a mains fail-safe memory is not automatic. You must trigger saving via index 1010h.

8.6.2 Node Guarding

With cyclic device monitoring (node guarding), the NMT master regularly determines the NMT status of the NMT slaves. The NMT slaves participating in the monitoring process check internally whether the "Node Guarding" takes place in the defined time cycle (Life Guarding). This is necessary to determine whether the NMT master is still "alive".

If no request takes place within the defined time, an emergency message is sent by the device with the value 8130h (Life guard error or heartbeat error).

Time for device monitoring

Index 100Ch   Via the index 100Ch the time multiplied by the value from the index 100Dh can be set for the device monitoring.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned16	rw	Guard time	0000h

The time is specified in milliseconds. The value 0000h disables node monitoring.

Factor fordevice monitoring

Index 100DhThe   factor for the time of the device monitoring, which is set in index 100Ch, is entered via index 100Dh.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	rw	Life time factor	00h

The value 00h deactivates the device monitoring.

8.7 PDO communication

The PDOs (Process Data Objects) are used for the transmission of process data.

Communication via PDOs is only possible in the operational mode of the devices.

8.7.1 Transmission types

Synchronous transmission modes

The synchronous transmission types can be used if a device in the CANopen network can generate the SYNC telegram. The synchronous transmission type is defined by the "PDO transmission type" in the communication parameter of the corresponding process data object. A "transmission type" of 5 means, for example, that a process data object is sent after every five SYNC messages received. Details can be found in the CiA Draft Standard 301.

Cyclic asynchronous transmission

The input information can be transmitted cyclically (e.g. every 100 ms) via transmit PDO. The send cycle time can be set via object 1800h or 1801h of the respective send PDO.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	05h
1	Unsigned32	rw	COB-ID for PDO	180h+Node ID
2	Unsigned8	rw	Transmission Type	01h
5	Unsigned16	rw	Event Timer	0000h

The object can be read and written. The sub-indices 0 to 2 and 5 are supported. Access to other sub-indices is acknowledged with an error message.

COB-ID for PDO

Subindex 1 is used to set the ID on which the PDO is to be received. The entry is defined as follows:

Bit 31	Bit 30	Bit 29	Bit 28 - 0
PDO valid, 0 = valid 1 = not valid	RTR allowed, 0 = yes 1 = no RTR	Frame type, 0 = 11 bit 1 = 29 bit	Identifier,

Table 18: Definition of the COB-ID for PDO

To activate the PDO, the highest bit (b31) must be cleared. To deactivate the PDO, the highest bit must be set. In the default setting, the PDO is active.

Transmission TypeUse subindex 2 to set the type of transmission (Transmission Type).

Transmission Type	Description
00h	acyclic synchronous, The module responds to each SYNC message
01h - F0h (1 - 240 dec)	cyclic synchronous, The module responds to every nth SYNC message
FFh (255 dec)	event-driven, PDO is sent when the event timer expires

Table 19: Setting the transmission type

The transmit PDO 1 transmits an identifier with 8 bytes of user data. The content of the message is copied from object 7130h, sub-index 1 to 4.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	05h
1	Unsigned32	rw	COB-ID for PDO	280h+Node ID
2	Unsigned8	rw	Transmission Type	01h
5	Unsigned16	rw	Event Timer	0000h

The object can be read and written. The sub-indices 0 to 2 and 5 are supported. Access to other sub-indices is acknowledged with an error message.

COB-ID for PDO   Subindex 1 is   used to set the ID on which the PDO is to be received. The entry is defined as follows:

Bit 31	Bit 30	Bit 29	Bit 28 - 0
PDO valid, 0 = valid 1 = not valid	RTR allowed, 0 = yes 1 = no RTR	Frame type, 0 = 11 bit 1 = 29 bit	Identifier,

Table 20: Definition of the COB-ID for PDO

To activate the PDO, the highest bit (b31) must be cleared. To deactivate the PDO, the highest bit must be set. In the default setting, the PDO is active.

Transmission TypeUse subindex 2 to set the type of transmission (Transmission Type).

Transmission Type	Description
00h	acyclic synchronous, The module responds to each SYNC message
01h - F0h (1 - 240 dec)	cyclic synchronous, The module responds to every nth SYNC message
FFh (255 dec)	event-driven, PDO is sent when the event timer expires

Table 21: Setting the transmission type

The transmit PDO 2 transmits an identifier with 8 bytes of user data. The content of the message is copied from object 7100h, sub-index 1 to 4.

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned32	ro	Mapped applica- tion object 1	7130 0110h
2	Unsigned32	ro	Mapped applica- tion object 2	7130 0210h
3	Unsigned32	ro	Mapped applica- tion object 3	7130 0310h
4	Unsigned32	ro	Mapped applica- tion object 4	7130 0410h

The object can only be read. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Objects which are transmitted via PDO can be read here. The structure is shown in the following table.

Bit 31 - Bit 16	Bit 15 - Bit 8	Bit 7 - Bit 0
Index	Sub-index	Length

Table 22: Structure of transmit PDO mapping parameters

In the first PDO, the sub-indices 1 to 4 of object 7130h are transferred (see "AI Process Value" on page 70).

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned8	ro	Largest Sub-Index	04h
1	Unsigned32	ro	Mapped applica- tion object 1	7100 0110h
2	Unsigned32	ro	Mapped applica- tion object 2	7100 0210h
3	Unsigned32	ro	Mapped applica- tion object 3	7100 0310h
4	Unsigned32	ro	Mapped applica- tion object 4	7100 0410h

The object can only be read. The sub-indices 0 to 4 are supported. Access to other sub-indices is acknowledged with an error message.

Objects that are transmitted via PDO can be read here. The structure is shown in the following table.

Bit 31 - Bit 16	Bit 15 - Bit 8	Bit 7 - Bit 0
Index	Sub-index	Length

Table 23: Structure of transmit PDO mapping parameters

In the second PDO the sub-indices 1 to 4 of object 7100h are transmitted (see "AI Field Value" on page 67).

Example: Device address 1, send SYNC

ID	DLC
80h	0

In response, you will receive the following messages:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
181h	8	Index 7130h, Sub 01h		Index 7130h, Sub 02h		Index 7130h, Sub 03h		Index 7130h, Sub 04h	

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
282h	8	Index 7100h, Sub 01h		Index 7100h, Sub 02h		Index 7100h, Sub 03h		Index 7100h, Sub 04h	

The transmission of the PDOs is only possible in the operational mode of the devices.
The transmit PDOs are sent once after the NMT "Start all Nodes", regardless of the transmission type.

Example: A device with device address 2 sends a boot-up message, is then switched to operational by NMT "Start all Nodes" and sends the two PDOs at each SYNC.

```
 1)    Rx    0702  1   00
 2)    Tx    0000  2   01 00
 3)    Rx    0182  8   00 00 00 00 00 00 00 00
 4)    Rx    0282  8   00 00 00 00 00 00 00 00
 5)    Tx    0080  0
 6)    Rx    0182  8   00 00 00 00 00 00 00 00
 7)    Rx    0282  8   00 00 00 00 00 00 00 00
 8)    Tx    0080  0
 9)    Rx    0182  8   00 00 00 00 00 00 00 00
10)    Rx    0282  8   00 00 00 00 00 00 00 00
```

Example 1: Trace: A device is set to operational and sends PDOs

Sub-index	Data type	Access	Meaning	Default value
0	Unsigned32	rw	COB ID SYNC	80h

The object can be read and written. Only sub-index 0 is supported. Access to other sub-indices is acknowledged with an error message.

Example: Set COB-ID to 10 Module address 1

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
601h	8	22h	05h	10h	0Ah	00h	00h	00h	00h

In response, you will receive the following message:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
581h	8	60h	05h	10h	00h	00h	00h	00h	00h

The default value for the SYNC identifier is 80h. This guarantees the SYNC messages a high priority on the CAN bus.

Saving of the set SYNC ID in a mains failure safe memory is not automatic. You must trigger the saving via index 1010h.

Access to an SDO object and the "real" error messages as emergency message. When an error occurs for the first time, an error message is sent. If the reason for the error is eliminated and the error is no longer present, an error message is also sent (error code 0000h).

The identifier of the EMCY message is calculated from the value of the set module address + 128d.

An emergency message has the following structure:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
80h+NID	08h	Error Code		ER	Manufacturer Specific Error Field				

Classified by the "Error Code" error.

The current content of CANopen object 1001h is displayed in the "ER" (error register) field of the emergency telegram.

The "Manufacturer Specific Error Field" contains further manufacturer-specific information for clear localization of the cause of the error.

8.9.1 Error codes overview

The following error codes are supported:

Error Code	Error Field [hex] [b3 b4 b5 b6 b7]	Meaning
0000h	00 00 00 00 00	Error fixed or no error
5030h	0x 0x 0x 0x 00	"Sensor fault", there is a sensor error
8100h	xx 00 00 00	CAN controller is in "Warning" state
8110h	00 00 00 00 00	CAN controller is in "overrun" state, too many messages
8120h	xx 00 00 00	CAN controller is in "Error Passive" state
8130h	00 00 00 00 00	Heartbeat / Node-Guarding Event
8140h	00 00 00 00 00	Recover from Bus-Off
8150h	00 00 00 00 00	Identifier collision (Send identifier was received)

Table 24: Emergency message error codes

The "Error Field" column represents whether the "Manufacturer Specific Error Field" is used or not. In some cases the data of this field is used to describe the cause of the error code.

An error history is stored in the module via the sent emergency telegrams. Object 1003h in the CANopen object directory is used for this purpose.

Error field of "5030h Error Code

5030h Error Code In this error field, in case of an error, the respective measuring channel is masked with 01h and output with.

B3	B4	B5	B6	B7
0xh	0xh	0xh	0xh	00h
Measuring channel 1	Measuring channel 2	Measuring channel 3	Measuring channel 4	-

Table 25: Manufacturer specific error field of the 5030h Error Code

Example: Emergency message with the following content:

ID	DLC	B0	B1	B2	B3	B4	B5	B6	B7
82h	8	50h	30h	08h	00h	01h	01h	00h	00h

The sent emergency indicates that a sensor error is present at the MulitXtend A module with the device address 2 at the measuring channels 2 and 3.

8100h and 8120h Error Code

Error field of "8100h Error Code" and "8120h Error Code".

If an EMCY message is sent with one of the error codes mentioned, the internal values of the CAN controller are output in data byte 3. The following table summarizes these values.

B3	Description
00h	no error
10h	Bit error
20h	Stuffing error
30h	Shape error
40h	CRC error
50h	ACK error

Table 26: Error codes of the 8100h and 8120h Error Code

9. Technical data

Power supply	
Operating voltage	9..36V DC, reverse polarity protected
Power consumption	1.86 W (155 mA @ 12 V DC) 1.92 W (80 mA @ 24 V DC) 2.08 W (65 mA @ 32 V DC)
Potential separation	Fieldbus/control voltage: 500 Vrms
Connection technology	Screw terminals

CAN bus	
Transmission rates	20 kBit/s ... 1 MBit/s
Status on the bus	Active node
Protocol	CANopen according to DS-301 V4.02, DS-404 V1.02
Connection technology	Screw terminals

EMC	
Static electricity	8 kV air discharge, 4 kV relay discharge, according to EN 61000-4-2
Electromagnetic fields	10 V/m, according to EN 61000-4-3
Burst	5 kHz, 2 kV according to EN 61000-4-4
Surge	according to EN 61000-4-5
HF unbalanced	10 V, according to EN 61000-4-6
Interference emission	according to EN 55011, class A

Metrology	
Operating temperature	-40°C to +85°C
Signal type	0(4)..20,000 mA
Resolution	16 bit
Sampling rate	200 Hz on each measuring channel

Housing	
Cast aluminum alloy	EN AC-44300 DIN EN 1706 (GD Al Si 12 / DIN 1725)
Draft angle	1° - Clear internal dimensions are reduced by 1° circumferentially up to the housing base
Screws	Stainless steel cover screws, captive
Protection class	IP 66 / EN 60529
Seal	Tongue and groove system with groove in the housing cover, with oil- and gasoline-resistant silicone seal
Temperature resistance	-50°C to +140° C
Mounting	Through separate screw channels.
Painting	Standard powder coating Pebble gray RAL 7032, silver gray RAL 7001 without extra charge. Textured varnish baked and special colors on request.
Dimensions	125 * 80 * 57 mm (L * W * H) Without PG connections or plugs
Weight	540 g
Weight with connections	640 g