HE 5120

Digital Display Modul with CANopen-Interface

Operating Instructions

(English)

HESCH

AUTOMATION PARTNER

Property rights

Versions

Date / Version	Description
03.06.2014 / 2.0	Layout modifications. Added documenthistory. Chapter 4.2: Added line 4.

General Safety Instructions

Instrument Safety
This instrument was built and tested according to production-specifications and was shipped in safe condition. The protection class mentioned in the operating instructions is applicable.
In order to maintain this condition and to ensure a safe operation, the applicant must follow the hints and warnings given in these safety notes.
The instrument must be operated only by trained personnel. Maintenance and repair should be carried out only by trained, qualified personnel familiar with the relevant hazards.
The instrument may be operated within the specified environmental conditions (see data sheet) without impairing its safety.
The instrument is intended for mounting in an enclosure. Its contact safety is ensured by installation in a housing (switch cabinet, panel etc.).

Unpacking the Instrument
Remove instrument and accessories from the packing. Enclosed standard accessories:
Operating notes or operating instructions for the instrument (if necessary, fixing elements).
Check, if the shipment is o.k. and complete and if the instrument was damaged by improper handling during transport and storage. One instruction manual will be attached to each shipment.

⚠ Warning !
If the instrument is heavily damaged that a safe operation seems impossible, the instrument must not be taken into operation. We recommend to keep the original packing material for shipment in case of maintenance or repair.

Caution !
The instrument contains electrostatically sensitive components. While transport und mounting, the rules for protection against Electric Static Discharge (ESD) must be followed.

Mounting
In order to have a proper function each instrument has to be placed in dustfree and dry rooms, either in a panel or in the relevant socket of a 19-inch instrument carrier.
The ambient temperature at the place of installation should not exceed the permissible nominal operational temperature specified in the data sheet.
When mounting several instruments at high packing density, sufficient ventilation must be provided to ensure a correct function. The sealing devices (e.g. sealing ring) required for the relevant protection type must be applied. Two captive screws are provided at the instrument front for fixing the 19-inch module in the instrument carrier. Generally, the fixing elements delivered with the instrument must be applied. The instrument may be mounted and operated only outside the explosion-hazarded area !

Electrical Connections
All electrical wiring must be conform to local Electrical Standards (e.g. VDE 0100 in Germany).
The input leads must be kept separate from signal and mains leads.
The protective earth must be connected to the relevant terminal (in the instrument carrier).
In order to prevent electrical interferences, we recommend using twisted and screened cables.
The electrical connections must be made according to the relevant connecting diagrams.

Commissioning

Before instrument switch-on, ensure that the advices and specifications given below are followed:
Ensure that the supply voltage corresponds to the specification on the instrument label.
All covers required for contact safety must be applied.
Before instrument switch-on, check if other equipment and / or facilities connected in the same signal loop is / are not affected. If necessary, appropriate measures must be taken.
For instruments with protection class I, the protective earth must be connected with the relevant terminal in the instrument carrier.
The instrument may be operated only when mounted in its enclosure.

Operation

Switch on the supply voltage. The instrument is now ready for operation.
If necessary, a warm-up time of approx. 15 min. should be taken into account.

⚠ Warning !

Any interruption of the protective earth in the instrument carrier can impair the instrument safety. Purposeful interruption is not permissible.

⚠ Warning !

If the instrument is damaged to an extent that safe operation seems impossible, shut it down and protect it against accidental operation.

Trouble Shooting

Before checking the instrument, all possibilities of error in other equipment and connections (input leads, wiring, equipment connected in the output circuit) should be checked. If the trouble cannot be located by checking these points, we recommend returning the instrument to the manufacturer.

Hint

Note that primary elements (especially thermocouples) connected to the energized transmitter are grounded in many cases, i.e. that the insulation resistance during operation can be reduced considerably. In these cases, additional connection to earth is not permissible.

Shut-Down

For permanent shut-down, disconnect the instrument from all voltage sources and protect it against accidental operation.
Before instrument switch-off, check that other equipment and / or facilities connected in the same signal loop is / are not affected. If necessary, appropriate measures must be taken.

1   General

The digital display module HE 5120 with CANopen interface serves the simple and economical display of any process values.

With the development great importance was attached to the fact that the HE 5120 can adapt itself to almost any Fieldbus configurations. Thus the display supports all usual Baud rates, has a switchable bus terminal resistor and can process directly process data in the CANopen typical formats Integer8, Integer16, Integer32, Uint8, Uint16, Uint32 and Float.

As special feature the digital display module HE 5120 is provided with an automatic Baud rate setting and a freely configurable alarm output.

Due to the characteristics mentioned the HE 5120 can be integrated at any time also into systems already consisting, since the CAN display can adapt itself to any bus configurations and a new configuration of the system is avoided in such a way.

2   Switch Settings

The digital display module HE 5120 can be adjusted to the desired node number and Baud rate via a DIP switch and a BCD rotary code switch at the backwall of the device.

DIP switch:

With the DIP switch a node number between 1 and 127 for the device can be selected. With bit 8 a bus terminal resistor can be switched in. This is practical if the CAN display is switched at an end of a line bus topology. Those settings are to be made in the binary format.
The following table informs about the priorities of the individual bits. The node number is calculated by the sum of the individual priorities. E.G. bit 1 and bit 2 are ' on ', all others are 'off', this setting correspond to a node number of 3.

Bit	on (Switch down)	off (Switch up)
1	1	0
2	2	0
3	4	0
4	8	0
5	16	0
6	32	0
7	64	0
8	Bus termination resistor on	Bus termination resistor off

By combination of the bits 1 to 7 valid node numbers from 1 to 127 are adjustable.

Note : The possible node number 0 is not supported and serves the selection of
the desired operating mode (see to chapter 6 'Operating Modes').

BCD rotary code switch :

With the BCD rotary switch the desired Baud rate can be selected.

If the position '0' is selected, the device is able to detect the Baud rate of the CAN network automatically. A prerequisite for this is that at least one bus participant transmits any messages. The following table shows the positions of the rotary switch for the respective Baud rate.

Position	Baud rate
0	automatic Baud rate detection
1	1000 kBaud
2	800 kBaud
3	500 kBaud
4	250 kBaud
5	125 kBaud
6	100 kBaud
7	50 kBaud
8	20 kBaud
9	10 kBaud

3 Object Directory

Communication with CANopen devices is made by objects. Each object has an index and a sub-index, via which the object can be addressed uniquely. In the course of the standardization the CiA divided the total address area into different segments with determined functions. The digital display module HE 5120 uses beside the DS301 V3.0 'CAL-based Communication Profile for Industrial Systems ' and the there described objects also the device profile DSP403 V1.0 'Human Machine Interfaces'(HMI).

For the use of the digital display module HE 5120 the following table with the supported object directory entries is sufficient.
The documents DS301 and DS403 can be obtained from the CiA if necessary.

Meaning of the individual columns:

1. Index   Index of the object, 16 bit, specification in hexadecimal notation
2. subindex   Subindex of the object, 8 bit, specification in hexadecimal notation
3. Designation Designation of the object = variable name
4. Type   Type of variables of the objects: i8, i16, i32, ui8, ui16, ui32, float, string
5. PDO   indicates whether an object can be mapped in a PDO
6. Default   Value of the object at delivery of the device (operating mode 0)
7. EEP   indicates whether the variable is stored non volatile in the EEPROM

Index	Subin-dex	Designation	Type	Access	PDO	Default	EEP
0x0002	0x00	**Dummy**	**ui8**	**rw**	**yes**	**0**	**no**
0x0003	0x00	**Dummy**	**ui16**	**rw**	**yes**	**0**	**no**
0x0004	0x00	**Dummy**	**ui32**	**rw**	**yes**	**0**	**no**
0x0005	0x00	**Dummy**	**i8**	**rw**	**yes**	**0**	**no**
0x0006	0x00	**Dummy**	**i16**	**rw**	**yes**	**0**	**no**
0x0007	0x00	**Dummy**	**i32**	**rw**	**yes**	**0**	**no**
0x0008	0x00	**Dummy**	**float**	**rw**	**yes**	**0.0**	**no**
0x1000	0x00	**Device Type**	**ui32**	**ro**	**no**	**0x00010403**	**no**
0x1001	0x00	**Error Register**	**ui8**	**ro**	**no**	**0**	**no**
0x1003	-	**Predefined Error Field**	**-**	**-**	**-**	**-**	**-**
0x1003	0x00	Number of Errors	ui8	ro	no	3	no
0x1003	0x01	Standard Error Field 1	ui32	ro	no	0	no
0x1003	0x02	Standard Error Field 2	ui32	ro	no	0	no
0x1003	0x03	Standard Error Field 3	ui32	ro	no	0	no
0x1004	-	**Number of PDOs Supported**	**-**	**-**	**-**	**-**	**-**
0x1004	0x00	Number of PDOs Supported	ui32	ro	no	0x00020000	no
0x1004	0x01	Number of Sync PDOs	ui32	ro	no	0x00000000	no
0x1004	0x02	Number of Async PDOs	ui32	ro	no	0x00020000	no
0x1008	-	**Device Name**	**strin**	**ro**	**no**	**HE5120**	**no**

Index	Subin-dex	Designation	Type	Access	PDO	Default	EEP
			g				
0x1009	-	**Hardware-Version**	**string**	**ro**	**no**	**HW-V9739**	**no**
0x100A	-	**Software-Version**	**string**	**ro**	**no**	**SW-V02.00**	**no**
0x100B	-	**Node-ID**	**ui32**	**ro**	**no**	**Switch**	**no**
0x100C	-	**Guard-Time**	**ui16**	**rw**	**no**	**0**	**yes**
0x100D	-	**Life-Time-Factor**	**ui8**	**rw**	**no**	**0**	**yes**
0x100E	-	**COB-ID Node Guarding**	**ui32**	**rw**	**no**	**0x700**	**yes**
0x100F	-	**Number of SDOs Supported**	**ui32**	**ro**	**no**	**0x00010001**	**no**
0x1014	-	**COB-ID Emergency Message**	**ui32**	**rw**	**no**	**0x80 + ID**	**no**
0x1400	-	**Receive PDO1 Parameter**	**-**	**-**	**-**	**-**	**-**
0x1400	0x00	Number of Entries	ui8	ro	no	3	no
0x1400	0x01	COB-ID Receive PDO1	ui32	rw	no	0x200 + ID	yes
0x1400	0x02	Transmission-Type Receive PDO1	ui8	rw	no	0xFF	yes
0x1400	0x03	Inhibit Time Receive PDO1	ui16	rw	no	0	yes
0x1401	-	**Receive PDO2 Parameter**	**-**	**-**	**-**	**-**	**-**
0x1401	0x00	Number of Entries	ui8	ro	no	3	no
0x1401	0x01	COB-ID Receive PDO2	ui32	rw	no	0x300 + ID	yes
0x1401	0x02	Transmission-Type Receive PDO2	ui8	rw	no	0xFF	yes
0x1401	0x03	Inhibit Time Receive PDO2	ui16	rw	no	0	yes
0x1600	-	**Receive PDO1 Mapping**	**-**	**-**	**-**	**-**	**-**
0x1600	0x00	Number of Mapped Objects	ui8	rw	no	1	yes
0x1600	0x01	1. Mapped Object	ui32	rw	no	0x82800110	yes
0x1600	0x02	2. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x03	3. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x04	4. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x05	5. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x06	6. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x07	7. Mapped Object	ui32	rw	no	0x00000000	yes
0x1600	0x08	8. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	-	**Receive PDO2 Mapping**	**-**	**-**	**-**	**-**	**-**
0x1601	0x00	Number of Mapped Objects	ui8	rw	no	1	yes

Index	Subin-dex	Designation	Type	Access	PDO	Default	EEP
0x1601	0x01	1. Mapped Object	ui32	rw	no	0x82800210	yes
0x1601	0x02	2. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x03	3. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x04	4. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x05	5. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x06	6. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x07	7. Mapped Object	ui32	rw	no	0x00000000	yes
0x1601	0x08	8. Mapped Object	ui32	rw	no	0x00000000	yes
0x1800	**-**	**Transmit PDO1 Parameter**	**-**	**-**	**-**	**-**	**-**
0x1800	0x00	Number of Entries	ui8	ro	no	0	no
0x1801	**-**	**Transmit PDO2 Parameter**	**-**	**-**	**-**	**-**	**-**
0x1801	0x00	Number of Entries	ui8	ro	no	0	no
0x1A00	**-**	**Transmit PDO1 Mapping**	**-**	**-**	**-**	**-**	**-**
0x1A00	0x00	Number of Mapped Objects	ui8	ro	no	0	no
0x1A01	**-**	**Transmit PDO2 Mapping**	**-**	**-**	**-**	**-**	**-**
0x1A01	0x00	Number of Mapped Objects	ui8	ro	no	0	no
0x5000	**-**	**Enable Limit Detection**	**-**	**-**	**-**	**-**	**-**
0x5000	0x00	Number of Entries	ui8	ro	no	2	no
0x5000	0x01	Enable Limit Detection 1	ui8	rw	no	0	yes
0x5000	0x02	Enable Limit Detection 2	ui8	rw	no	0	yes
0x5001	**-**	**Upper Limit Settings**	**-**	**-**	**-**	**-**	**-**
0x5001	0x00	Number of Entries	ui8	ro	no	4	no
0x5001	0x01	Set Upper Limit 1	float	rw	no	99999.0	yes
0x5001	0x02	Set Upper Limit Hysteresis 1	float	rw	no	0.0	yes
0x5001	0x03	Set Upper Limit 2	float	rw	no	99999.0	yes
0x5001	0x04	Set Upper Limit Hysteresis 2	float	rw	no	0.0	yes
0x5002	**-**	**Lower Limit Settings**	**-**	**-**	**-**	**-**	**-**
0x5002	0x00	Number of Entries	ui8	ro	no	4	no
0x5002	0x01	Set Lower Limit 1	float	rw	no	-9999.0	yes
0x5002	0x02	Set Lower Limit Hysteresis 1	float	rw	no	0.0	yes
0x5002	0x03	Set Lower Limit 2	float	rw	no	-9999.0	yes
0x5002	0x04	Set Lower Limit Hysteresis 2	float	rw	no	0.0	yes
0x5100	**-**	**Number of Decimal Digits**	**-**	**-**	**-**	**-**	**-**
0x5100	0x00	Number of Entries	ui8	ro	no	2	no
0x5100	0x01	Decimal Digits 1	ui8	rw	no	0	yes
0x5100	0x02	Decimal Digits 2	ui8	rw	no	0	yes

Index	Subin-dex	Designation	Type	Access	PDO	Default	EEP
0x5200	**-**	**Conversion Offset**	**-**	**-**	**-**	**-**	**-**
0x5200	0x00	Number of Entries	ui8	ro	no	2	no
0x5200	0x01	Conversion Offset 1	float	rw	no	0.0	yes
0x5200	0x02	Conversion Offset 2	float	rw	no	0.0	yes
0x5201	**-**	**Conversion Factor**	**-**	**-**	**-**	**-**	**-**
0x5201	0x00	Number of Entries	ui8	ro	no	2	no
0x5201	0x01	Conversion Factor 1	float	rw	no	1.0	yes
0x5201	0x02	Conversion Factor 2	float	rw	no	1.0	yes
0x5300	**0x00**	**Multiplex Time Factor**	**ui8**	**rw**	**no**	**0**	yes
0x5400	**-**	**Restore EEPROM Defaults**	**-**	**-**	**-**	**-**	**-**
0x5400	0x00	Number of Entries	ui8	ro	no	2	no
0x5400	0x01	Restore EEPROM Defaults	ui8	rw	no	0	no
0x5400	0x02	EEPROM Unlock Code	ui16	rw	no	0	no
0x6201	**-**	**Write Lamp**	**-**	**-**	**-**	**-**	**-**
0x6201	0x00	Number of Lamp Byte	ui8	ro	no	2	no
0x6201	0x01	Write Lamp 1	ui8	rw	no	0	yes
0x6201	0x02	Write Lamp 2	ui8	rw	no	0	yes
0x8080	**-**	**Write Output Variable Integer8**	**-**	**-**	**-**	**-**	**-**
0x8080	0x00	Number of Variables	ui8	ro	no	2	no
0x8080	0x01	Status of Variable 1	i8	rw	yes	0	no
0x8080	0x02	Status of Variable 2	i8	rw	yes	0	no
0x8100	**-**	**Write Output Variable Integer16**	**-**	**-**	**-**	**-**	**-**
0x8100	0x00	Number of Variables	ui8	ro	no	2	no
0x8100	0x01	Status of Variable 1	i16	rw	yes	0	no
0x8100	0x02	Status of Variable 2	i16	rw	yes	0	no
0x8180	**-**	**Write Output Variable Integer32**	**-**	**-**	**-**	**-**	**-**
0x8180	0x00	Number of Variables	ui8	ro	no	2	no
0x8180	0x01	Status of Variable 1	i32	rw	yes	0	no
0x8180	0x02	Status of Variable 2	i32	rw	yes	0	no
0x8200	**-**	**Write Output Variable Unsigned8**	**-**	**-**	**-**	**-**	**-**
0x8200	0x00	Number of Variables	ui8	ro	no	2	no
0x8200	0x01	Status of Variable 1	ui8	rw	yes	0	no
0x8200	0x02	Status of Variable 2	ui8	rw	yes	0	no
0x8280	**-**	**Write Output Variable Unsigned16**	**-**	**-**	**-**	**-**	**-**
0x8280	0x00	Number of Variables	ui8	ro	no	2	no
0x8280	0x01	Status of Variable 1	ui16	rw	yes	0	no
0x8280	0x02	Status of Variable 2	ui16	rw	yes	0	no
0x8300	**-**	**Write Output Variable Unsigned32**	**-**	**-**	**-**	**-**	**-**

Index	Subin-dex	Designation	Type	Access	PDO	Default	EEP
0x8300	0x00	Number of Variables	ui8	ro	no	2	no
0x8300	0x01	Status of Variable 1	ui32	rw	yes	0	no
0x8300	0x02	Status of Variable 2	ui32	rw	yes	0	no
0x8380	**-**	**Write Output Variable Float**	**-**	**-**	**-**	**-**	**-**
0x8380	0x00	Number of Variables	ui8	ro	no	2	no
0x8380	0x01	Status of Variable 1	float	rw	yes	0	no
0x8380	0x02	Status of Variable 2	float	rw	yes	0	no

4 Commissioning

4.1 Preparations

Before the commissioning of the digital display module HE 5120 the desired node number as well as the Baud rate of the device has to be adjusted at the rear side.

Here it is to be noted that each node number in the CAN-Network may be assigned only once . Assigning two devices to the same node number will result in bus conflicts. Furthermore it should be paid attention during the adjustment of the Baud rate to the fact that all devices of a CAN network use the same Baud rate. The HE 5120 offers the feature to detect the Baud rate automatically, see for this chapter 2 'Switch Settings' for more information.

For an correct communication between the individual devices, one has to pay attention to the fact that the CAN bus at both ends, set up as a line structure, has to be terminated with a termination resistor. The HE 5120 offers the feature to switch in a bus terminal resistor, see for this chapter 2 'Switch Settings'. Especially at high data transmission rates a wrong bus termination can cause the data communication to cease.

Basically the Baud rate should be selected as high as necessary and not as high as possible to minimize interferences. The following table gives reference values for the maximal network extension at different Baud rates.

Baud Rate [kBit/s]	max. Network Extension [m]
500	100
250	200
100	600
50	1200

4.2 Switch on the Device

After the procedures described under 4.1 'preparations' the device gets connected with the CAN-Bus and the power supply. When switching on to the supply voltage an internal device test is executed and the following messages appear on the display.

Step	7-Segment-Displays	LEDs	Duration [s]
1	all segments on [8.8.8.8.8.]	1,2,3 on	1
2	all segments off [ ]	1,2,3 off	1
3	Device designation [5120]	1,2,3 off	1
4	Device version e.g. [02.05]	1,2,3 off	1
5	adjusted Baud rate in kBaud e.g. [500.]	1,2,3 off	2
6	adjusted node number e.g. [2.]	1,2,3 off	2
7	selected operating mode e.g. [def. 0]	1,2,3 off	2
8	all segments off [ ]	1,2,3 off	0,5

After the run of the self check the device is ready for use and can be parameterized via the CAN Bus if necessary and be switched into 'operational'.

Notes: If the Baud rate is to be detected automatically, the message [auto] appears first before the self check of the device. The self test will only continue if a valid Baud rate could be detected .

Before the first signals appears on the display the EEPROM of the device will be checked. If the self check detects an error with the stored operating mode, the note[err01] appears for approx. 2 seconds.
In this case the standard operating mode is selected and the device test will continue to pass through.

If with the examination of the EEPROM detects a new or a reset EEPROM, a message [load] appears for approx. 2 seconds. After the message [load] the EEPROM is loaded automatically with factory settings. If the EEPROM could be loaded correct the message [ok 02] appears for approx. 2 seconds, in the case of an error the message [err02] appears. After these messages the device test will be continued.

During the settings of particular operating modes further messages are possible. The use and setting of different operating modes are described in detail in chapter 6 'Operating Modes'.

4.3 Display of a Process Value

In order to display any value it is sufficient to write the appropriate object with the desired value. The digital display module HE 5120 operates according to the CAN specification 2.0A with an 11 bit Identifier. The following examples can be easily understood with an extended CAN monitor or analyzer. Suitable programs can be obtained from the HESCH Schröder GmbH. All examples presuppose an adjusted node number of 2 at the HE 5120.

Example 1 (transfer of a process value)

An absolute Integer16-value should be presented on the CAN display.

Since as for default only one process value is displayed, the object for the 'process value 1', appropriate to the type of variable Integer16, has to be written with the index 0x8280 and the subindex 0x01. This value is added with an 'Offset1' and divided by a 'scaling factor 1', before it is shown on the display.

Display value 1 = (process value 1 + offset 1) / scaling factor 1

Note: The possible display range is between –9999. and 99999.
During an exceeding of the display range the message [over], with a droping below the display range the message [under] is displayed.

Since at factory delivery the offset 1 is set to 0.0 and the scaling factor is adjusted to 1.0, the desired value is displayed directly. The object for the 'offset 1' has the index 0x5200 and the subindex 0x01, the object for the 'scaling factor 1' has the index 0x5201 and the subindex 0x01.

Integer16 value to be transferred = 2387dec = 0x0953

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	2B	80	82	01	53	09	00	00
HE5120	582	60	80	82	01	00	00	00	00

After successful data exchange via SDO transfer the message [2387] is displayed.

Note: The table shows the transmitted data in hexadecimal notation.
Meaning of the individual columns:

Transmitter: Message source
Identifier: Identifier of the CAN Message (here for SDO transfers)
to the display: Identifier = 0x600 + Node ID
from the display: Identifier = 0x580 + Node ID
1. Byte: Contains information about the type of the data
Uint8 / Int8   = 0x2F (transmit)
Uint16 / Int16 = 0x2B (transmit)
Uint32 / Int32 = 0x23 (transmit)
Float   = 0x23 (transmit)

2. Byte: Index of the object , Low-Byte
3. Byte: Index of the object , High-Byte
4. Byte: Subindex of the object
5.-8. Byte: Utilizable data

Example 2 (process displayed value)

A process value is to be divided by 100 and to be displayed with 2 post-decimal places.

As in example 1 described the value 2387dec is displayed. This value corresponds e.g. to a temperature level in 1/100 °C. To display the temperature in 1 °C, the value has to be divided by 100.0. For this purpose the object ' Conversion Factor 1 ', index 0x5201, subindex 0x01 is written with 100.0.

scaling factor to be transferred = 100.0 = 0x42C80000

Note: The digital display module HE 5120 processes 32 bit floating point numbers according to IEEE as is common with CANopen. A program for the conversion of hexadecimal numbers in float representation and reverse can be obtained from the HESCH Schröder GmbH company.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	23	01	52	01	00	00	C8	42
HE5120	582	60	01	52	01	00	00	00	00

After successful data exchange via SDO transfer the message [23.] is displayed.

To display the calculated value with 2 post-decimal places the object 'decimal digit 1', index 0x5100, subindex 0x01 has to be written with 0x02.

post-decimal places to be transferred = 2dec = 0x02

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	2F	00	51	01	02	00	00	00
HE5120	582	60	00	51	01	00	00	00	00

After successful data exchange via SDO transfer the message [23.87] is displayed.

Example 3 (Display of 2 values)

Additionally to the value already displayed a second temperature level is to be displayed.

The examples 1 and 2 were completed already and the display represent constantly [23.87].

To distinguish the displayed values in the time multiplexing mode, any LED combination can be displayed with each value. 'Value 1' is to be displayed by the upper LED and 'value 2' by the lower LED. For this the object ' Write Lamp 1', index 0x6201, subindex 0x01 is written with 0x01 and the object 'Write Lamp 2', index 0x6201, subindex 0x02 is written with 0x04. The bits 0, 1 and 2 are allocated to the individual LEDs. Several LEDs can be switched on at the same time.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	2F	01	62	01	01	00	00	00
HE5120	582	60	01	62	01	00	00	00	00
PC	602	2F	01	62	02	04	00	00	00
HE5120	582	60	01	62	02	00	00	00	00

After successful data exchange via SDO transfer the message [23.87] is displayed and the upper LED lights up.
So that the two display values can be switched in time multiplex mode, a time constant has to be defined. The time constant is written into the object 'Multiplex Time Factor' in 1/10 s, index 0x5300, subindex 0x00. For time constants smaller than 10 the time multiplexing mode is switched off. The maximal time constant is 255 = 25.5 seconds. In this example the time constant is to be set at 2 seconds = 20dec = 0x14.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	2F	00	53	00	14	00	00	00
HE5120	582	60	00	53	00	00	00	00	00

After successful data exchange via SDO transfer the messages [23.87] and [0.] are displayed in time multiplexing mode. Depending upon the displayed value additionally either the upper or the lower LED lights up. Switching between the two values takes 2 seconds in this example.

As process value for the second displayed value a Integer32 format is to be transferred.
This value can be written directly into the object 'status variable 2', index 0x8180, subindex 0x02. The value used here is e.g. –9218dec = 0xFFFFDBFE.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	23	80	81	02	FE	DB	FF	FF
HE5120	582	60	80	81	02	00	00	00	00

After successful data exchange via SDO transfer the message[23.87] and [-9218.] is displayed in time multiplex mode. Depending upon the displayed value additionally either the upper or the lower LED lights up. Switching between the two values takes 2 seconds in this example.

4.4 Use of the Alarm Output

The digital display module HE 5120 is provided additionally with a relay output. This output can be used as alarm output. The following application example describes the use of this alarm output.

4.2.1 Example 1 (alarm relay as engine shut-down)

The digital display module HE 5120 is to be used e.g. in connection with a displacement sensor . The work area of the mobile machine part is e.g. between 10.0 mm and 300.0 mm. As soon as the work area is left, the drive motor for safety reasons is to be switched off.

The display module was configured in such a way that the path of the machine part in mm is displayed with one post-decimal place as 'DisplayValue1'. The displacement sensor transmits continuously a PDO with the current position of the position transducer. So that the alarm relay is switched on when value exceeds the determined limit values, the alarm output has to be activated via the object 'Enable limit Detection / Enable limit Detection 1', index 0x5000, subindex 0x01 . For this, the entry 0x01 has to be written. The upper and the lower limit value have to be entered into the objects ' Upper limits Settings / set Upper limit 1 ', index 0x5001, subindex 0x01 and 'Lower limit Settings / set Lower limit 1', index 0x5002, subindex 0x01. The values which can be entered always refers to the value displayed by the device. This means in this case that the upper limit value has to be set to 300.0 and the lower limit value to 10.0.

In order to prevent a continuously switching of the alarm relay in the switching point, additionally a hysteresis can be defined. In this example e.g. the hysteresis for the upper limit value is to be set to 10.0 and the hysteresis for the lower limit value is to be set to 5.0. The hysteresis for the 'DisplayValue1' is determined via the objects 'set Upper limit Hysteresis 1', index 0x5001, subindex 0x02 and 'set Lower limit Hysteresis 1', index 0x5002, subindex 0x02.

The alarm relay, via which e.g. the drive motor is switched, will switch on in this example at a value over 310.0 and then with a value below 290.0 will switch off. Similarly the alarm relay will switch on by dropping below 5.0 and while exceeding 15.0 will switch off again. The alarm relay has a change-over contact, so the logic can be inverted.

4.4.2 Alarm relay when using two display values

The digital display module HE 5120 can display two process values in the time multiplex mode. Each displayed value can be provided with an upper and a lower limiting value.

Exceeding or dropping below a limit value the alarm relay switches on, if the limit-value-detection has been activated. Logically it is an OR interconnection of the limiting value detections of 'DisplayValue1' and 'DisplayValue2'.

The limit value detection for the 'DisplayValue2' is executed only if the time multiplex constant is set to at least 1s (object directory entry = 10). In all other cases the time multiplex mode and also the limit-value-detection for 'DisplayValue2' are deactivated.

4.4.3 Note how to use the switching hysteresis

The switching hysteresis parameters are normally set as amount, without signs.

Example:

The valid measuring range is between −100.0 and +100.0
As limiting values are defined as (-)100.0 and (+)100.0.
The hysteresis for the upper and the lower limiting value is given by +1,0.

The alarm relay will switch on in this example at values smaller than 101.0 or larger than +101.0 and will only switch off if a value is set within the range between -99.0 and +99.0. As hysteresis value is +1.0 to be selected here and not −1.0.

4.5 Read an Object Directory Entry

As described in chapter 4.3 'Display a Process Value', the object directory of the digital display module HE5120 can be written via a SDO data channel.

In order to check individual object directory entries, these can be queried via a SDO data channel.

Example 1 (query of the object 'Write Lamp 1')

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	40	01	62	01	00	00	00	00
HE5120	582	4F	01	62	01	01	00	00	00

In this example a value with the index 0x6201 and the subindex 0x01 is requested.

The response of the HE 5120 contains the looked up value = 0x01 in the 5. Byte. The 1. Byte of the response contains the length of the requested data. For a 8 bit value the first byte has the value 0x4F, for 16 bit values 0x4B and for 32 bit values 0x43.

4.6 Emergency-Messages

The digital display module HE 5120 can transmit an appropriate emergency message at different error states. Transmitting an emergency message takes place independently of whether the device was switched into 'operational' or not. The emergency message is always transmitted from the device with the identifier 0x080 +Node ID. The 'Error register', index 0x1001, subindex 0x00 always contains the latest error code. The 'Predefined Error Field', index 0x1003, subindex 0x00... 0x03 contains the last three error information.

When switching on the device the first emergency message is generated. If the device functions correctly, the displayed values are in a valid range and no limiting values are exceeded, the following emergency message is transmitted.

Identifier	1.Byte	2.Byte	3.Byte
0x80 + Node-ID	00	00	00

In the event of an error, 5 bytes are transferred. The first 3 byte indicate 'generic errors' and the two last bytes give a hint to the error cause. The following emergency message is e.g. generated, if a display value is outside of the valid range.

Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte
0x80 + Node-ID	10	00	01	00	01

Meaning of the 4. Byte

Bit	Error cause
0	BCD or DIP switch possibly incorrect
1	EEPROM detected as new or defect
2	EEPROM cannot be written
3	EEPROM cannot be read correct
4	CANopen-Initialization failed
5	Application error
6	-
7	-

Meaning of the 5. Byte

Bit	Error cause
0	Overflow of the 1.Display value
1	Underflow of the 1. Display value
2	Alarm relay switched on by 1.value
3	-
4	Overflow of the 2.Display value
5	Underflow of the 2.Display value
6	Alarm relay switched on by 2.value
7	-

5 PDO-Processing

5.1 General

As described in chapter 4 'Commissioning', the digital display module HE 5120 can be addressed directly via a SDO data channel. All objects of the HE 5120 can be read out in such a way and read/write entries can also be written.

Communication via SDOs is generally used only for the parameter setting of the device. So e.g. the scaling factor and the offset can be adjusted via SDOs. The process value which can be displayed is transmitted e.g. from a melt pressure tranducer in form of a PDOs from this device.

Since in a CAN network each message will be received from all nodes, it is not necessary to write the process value to the digital display module HE 5120 via a SDO channel. Simply create a reception PDO in the display in such a way that the process value is displayed automatically. The following example describes the necessary steps.

5.2 Create a Reception PDO

To understand the following example as described, the device should be reset beforehand into the delivery status. Especially if some objects, which are stored in the EEPROM, were already written, the results may occur differently. For resetting the device into the delivery status (operating mode 0) see to chapter 6 'Operating Modes'.

Example 1

A melt pressure tranducer with CANopen interface disposes the measured value in form of a PDO. The PDO has the following structure:

Identifier	Byte1	Byte2	Byte3	Byte4
	Value1/Low-Byte	Value1/High-Byte	Value2/Low-Byte	Value2/High-Byte
181	12	3B	A8	01

The melt pressure tranducer generates two Integer16 values and uses the Identifier 181 (180 + Node ID) for the transmit PDO. The PDO is transmitted automatically e.g. whenever a value changes. To display e.g. the 'Value1' of the melt pressure transducer, a reception PDO has to be created. In this example is the 1. Reception PDO to be used.

1. Write COB-ID Receive PDO1 (0x1400/0x01) with the Identifier of the desired PDO.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	23	00	14	01	81	01	00	00
HE5120	582	60	00	14	01	00	00	00	00

Note: All values, in the object directory table which carry a 'yes' in the column 'EEP' will be stored non volatile in the EEPROM. In this way the set parameters of the digital display module HE 5120 are preserved also after a voltage failure. The delivery status of the device can be re-established at any time, see for this chapter 6 'Operating Modes'.

2. Receive PDO1 Mapping (0x1600/0x00...0x08) write with the mapped objects

The PDO transmitted by the melt pressure trancducer contains two Integer16 values. The first value is to be displayed on the digital display module HE 5120. The second value shall be ignored. To display the first value it has to be mapped on the object 'Write output variable Integer16 / status OF variable 1', index 0x8100, subindex 0x01. For the sake of completeness the second value is to be mapped on a Integer16-Dummy with the index 0x0006, subindex 0x00. Because two values are mapped it is necessary to write the object 'Number of Mapped Objects', index 0x1600, subindex 0x00 with 2.

(0x1600/0x01) = 0x81000110 : Index (16Bit) / subindex (8Bit) / length of the entry (8Bit)
(0x1600/0x02) = 0x00060010 : Index (16Bit) / subindex (8Bit) / length of the entry (8Bit)
(0x1600/0x00) = 0x02   : Number of mapped entries (8Bit)

Note: The expression 'length of the entry' means the number of bits of the mapped object. In this example a Integer16 value is to be mapped. The length of the entry is 16 bits or 0x10 in hexadecimal notation.

Transmitter	Identifier	1.Byte	2.Byte	3.Byte	4.Byte	5.Byte	6.Byte	7.Byte	8.Byte
PC	602	23	00	16	01	10	01	00	81
HE5120	582	60	00	16	01	00	00	00	00
PC	602	23	00	16	02	10	00	06	00
HE5120	582	60	00	16	02	00	00	00	00
PC	602	2F	00	16	00	02	00	00	00
HE5120	582	60	00	16	00	00	00	00	00

The reception PDO of the digital display module is now so created that the 'Value1' of the melt pressure trancducer can be represented directly on the display. The mapping parameters are stored non volatile in the EEPROM and remain also after a voltage failure.

Note: In contrast to the writing of individual objects via a SDO data channel, for the PDO data communication the device has to be switched into the 'operational' mode so the device can react on incoming PDO data and can display them.

3. Set the device into operational mode

As mentioned before for the PDO data processing the digital display module has to be switched into 'operational'. To test the executed Mapping, first the device has to be switched into 'operational' and then the PDO from the example is to be transmitted.

Node 2 (Byte2 = 0x02) is switched in 'operational' via the following message (Byte1 = 0x01).

Identifier	Byte1	Byte2
000	01	02

After that the PDO from the example is transmitted.

Identifier	Byte1	Byte2	Byte3	Byte4
181	12	3B	A8	01

If all steps of the example are executed correct, the digital display module HE 5120 should display [15122.] now. The displayed value equivalents the hexadecimal value 0x3B12 in decimal notation.

5.3 Create a Second Reception PDO

Since the digital display module can display two different values in time multiplex mode, the user has the option to map two different process values to the respective objects.

Both process values may origin from a PDO or from two different PDOs, e.g. from two different transducers. The second reception PDO is parameterized similarly to the first reception PDO. Here only the respective entries 'Receive PDO2 Parameter' and 'Receive PDO2 Mapping' are to be used.

With the mapping it should be paid attention to the fact that only one object for the 'DisplayValue1' and one object for the 'DisplayValue2' are to be mapped. With the allocated status LEDs the user can easily distinct the different values. If however e.g. two process values are mapped at the same time to the 'DisplayValue1', the last received value is displayed, so in that case the user generally is not able to assign the displayed value unmistakable.

6   Operating Modes

6.1   General

The digital display module HE 5120 stores all relevant operating parameters non volatile in an EEPROM. This is in particular necessary for the storage of the CANopen operating parameters, so the device has not to be parameterized after each switching on.

All objects are set with determined default values at delivery. The device offers the option to operate with max. 10 different default values. With different default values for the different objects the device can operate in 10 different operating modes without the otherwise necessary parameterization via the CAN bus.

This offers the benefit of a built-in adaptation to different equipment manufacturer requirements. The customer can select between the 10 operating modes depending upon the application.

6.2   Setting of a Certain Operating Mode

In the switched off status the node number 0 (Bit to Bit at off) gets adjusted. With the BCD rotary code switch the desired operating mode 0 to 9 can adjusted now. After that the device gets switched on. On the display appears then [ok x], whereby x stands for the selected operating mode. All status LEDs should now light up. The EEPROM was now loaded with the necessary default values for the respective operating mode.

If on the display appears [err x], the operating mode could not be adjusted and the process should be repeated.

After the correct adjustment of the operating mode the device has to be switched off. Now as described in chapter 2 'Switch Settings' the desired Baud rate and node number are adjusted.

The device operates now with the desired operating mode and can be put into operation.

Note: With the delivery of the digital display module HE 5120 always the operating mode 0 is adjusted. The delivery status can be recreated at any time by setting the operating mode 0.

6.3 Description of the Customized Operating Modes

As example of customized operating modes serves the adaptation of the digital display module HE 5120 of the HESCH Schröder GmbH company to the Transsonar displacement gauge family BTL5-H11x, - H12x and - H13x of the company 'Balluff'.

Depending upon the type, the different displacement gauges transmit different PDOs for the measured units. For a minimum system consisting of a display and a displacement gauge without a 'CANopen-Master' the HE 5120 is able to switch itself and the displacement gauge into 'operational'. In the operating modes 1 to 9 the HE 5120 tries to switch the displacement gauge every 5 seconds into 'operational' if the displacement gauge transmits no data.

Rotary Selector	Displacement Gauge	Configuration of the Display
0	-	HESCH standard (delivery status)
1	BTL5-H11.../12...	Position1
2	BTL5-H11.../12...	Velocity1
3	BTL5-H11.../12...	Position1 & Velocity1 (Time-multiplex)
4	BTL5-H12...	Position2
5	BTL5-H12...	Velocity2
6	BTL5-H12...	Position2 & Velocity2 (Time-multiplex)
7	BTL5-H12...	Position1 & Position2 (Time-multiplex)
8	BTL5-H13...	Position1 & Position2 (Time-multiplex)
9	BTL5-H13...	Position3 & Position4 (Time-multiplex)

6.3.1 Note on the operating modes 1 to 9

The adjusted resolution of the position as factory default is 5μm, the resolution of the velocity is 0.1 mm/s.

The values for position and velocity are converted so that the position is displayed in the unit mm and the velocity in the unit mm/s both with 1 post decimal place.

In the operating modes 3, 6, 7, 8 and 9 the time multiplex constant is 5 seconds. The first measured value is displayed together with the upper, the second measured value is displayed together with the lower LED.

7 CAN Glossary

CAN 'Controller Area Network'

CAN is a serial bus system which origins from the automobile industry. The signals are transmitted via twisted-pair wires. The noise immunity of CAN networks is especially high thanks to a number of provisions which have been taken e.g. CRC-Checks, use of differential signals, etc. CAN describes the physical bus concept incl. data link layer. The application layer, i.e. the protocol which is used is not described by CAN. Therefor one has to distinguish between CAN (physical bus) and CANopen (protocol, application layer).

CAL 'CAN Application Layer'

CAL describes a collection of communication services. CAL specifies the application layer and not the physical bus like CAN. An exact description of CAL specifications can be found in the Draft Standards CiA DS 201...207. CAL is the basic concept for CANopen, but is useable without the CANopen-specification. A CAL device only needs to support the services it actually requires. Therefore the software of a CAL node may be simpler than of a CANopen-node. It has to be noticed that different manufacturers implement different services in their devices.

CANopen

CANopen describes the standardized use of communication services and establishes a communication profile. With CANopen, devices of different manufacturers can be used in one CAN network. Differences may be found in the number of supported communication objects. In contrast to PROFIBUS-DP, CANopen provides the advantage of real multi-master-capability.

CiA 'CAN in Automation'

The international association of manufacturers and applicators, CAN in Automation was founded in 1992. The registered association currently with more than 280 member corporations was and is a strong factor in the fast and wide distribution of CAN knowledge.

Address: Am Weichselgarten 26, D-91058 Erlangen
               Tel. +49-9131-69086-0, Fax. +49-9131-69086-79
               CiA-Homepage: http://www.can-cia.de

Device Profiles

Specification of functions and interpretation of variables for the various device families.
The device profiles are described by 'DS 4xx' (Draft Standard).

DS 401: digital and analog in/outputs, e.g. Fieldbus-Modular HE 5900
DS 402: drives
DS 403: HMI, control and monitor, e.g. CAN-display HE 5120
DS 404: MSR, measure-control-regulate, eg. 8/16-channel temperature controller HE 5620
DS 405: programmable devices, e.g. PLCs such as the system control HE 5950
DS 406: Encoder
DS 4xx: additional device profiles are being worked on

SDO 'Service Data Object'

SDOs serve the exchange of system parameters as are e.g. limit switch values, baud rate settings, PDO mappings, etc. SDOs are of great significance in the initializing phase of a CAN-Network, during the normal operation they play a minor role.

PDO 'Process Data Object'

PDOs serve the exchange of process data e.g. setting and reading of analog or digital inputs, setting of outputs, etc. After the initializing phase of the CAN-networks PDOs serve the fast data transfer between the CAN bus participants. The contents of the messages is relatively high.

PDO-Mapping

PDO-Mapping means to link objects together to one CAN-message of 8 bytes maximum. The application engineer can "pack" the data relevant to him (e.g. digital outputs) in one PDO, i.e. he can map them and so guarantee a fast data exchange of relevant data. PDO mapping needs only to be carried out, if the default values of the PDOs do not comply with the requirements of the respective application.

Communication Objects

In addition to SDOs and PDOs other communication objects have been specified:

- boot-up: specifies starting up the CAN network
- dyn. identifier distribution: automatic identifier distribution per software
- node guarding/life guarding: supervising the functionality of the CAN network
- synchronization: synchronizing of input / output, e.g. for drives
- emergency: emergency telegrams at failures

Node-ID

Each CAN device has its own node number by which it is identified. PDOs communicate with a COB-ID of 'address + offset' on the CAN bus. The 'offset' is equivalent to the allocated Node-ID of the respective device. This results in the necessity of allocating a unique node number to each device to avoid bus conflicts. Valid node numbers are 0 to 127, where 0 is reserved for the 'Bus-Master'.

Baud Rate

CAN is a serial bus system where the data transmission rate is given in bits per second (baud). Valid baud rates are 10k, 20k, 50k, 100k, 125k, 250k, 500k, 800k and 1000 kBaud and are set e.g. with a BCD rotating switch. Devices of the HESCH Schröder GmbH company automatically recognize the baud rate which means that it is not always necessary to set the baud rate manually.

EDS Files 'electronic data sheet'

EDS files describe a CANopen device and are required by the system configuration tools such as ProCANopen. All devices of the HESCH Schröder GmbH company are supplied with the required EDS files.

7.1 Node States / Minimum Boot-Up

The Minimum Boot-Up supports **four node states**. State transitions are either triggered automatically or by a command initiated by the NMT master.

(1) Initialization

In this state the node is initialized. Three sub-states can be distinguished:

- Reset Application

  Before the automatic jump into the state 'Reset Communication', the manufacturer specific and device profile specific part of the object index are initialized with the default values. This state is also run through first after the node has been switched on.

- Reset Communication

  Before the automatic jump into the state 'Init', the communication profile specific part of the object index is initialized with the default values.

- Init

  In this state the rest of node initialization follows. Then the device automatically jumps into the state 'Pre-Operational'.

(2) Pre-Operational

After 'Initialization', this state is achieved automatically. This state serves to parameterize the node. Node-guarding can be switched active or not active. SDO transfers are possible, PDO transfers are not supported. The SYNC telegram can be parameterized, but is not transmitted. The device can jump into every other state except 'Init'.

(3) Operational

This is the normal operational state. Node-guarding can be activated or deactivated. SDO and PDO transfers are possible. If it has been parameterized beforehand, the node sends SYNC telegrams to the bus in this state. If the settings for the PDOs or SYNC telegrams are changed in the object index in this state, i.e. whilst operation, then to keep the data consistent, it must jump once into the state 'Pre-operational' or 'Prepared' until the new settings become valid. It can jump into every other state except 'Init'.

(4) Prepared

In this state neither SDO or PDO transfers are possible, nor SYNC telegrams can be sent. If the node monitoring had been activated previously, it is the only service which is executed. It can jump into every other state except 'Init'.
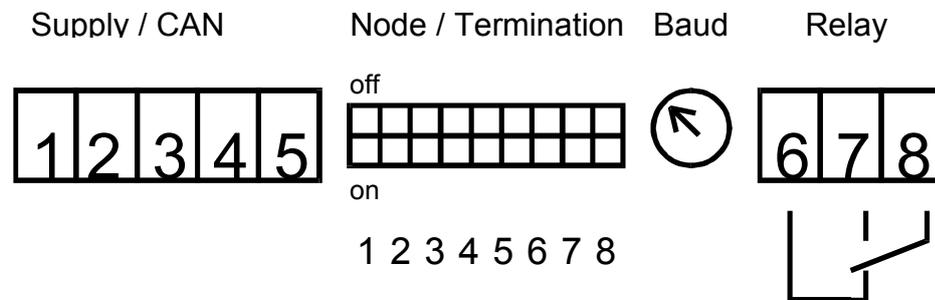
8   Connection Diagram

Terminal Number	Function
1	Supply voltage +24V DC
2	Supply voltage GND
3	CAN (low)
4	CAN (GND)
5	CAN (high)
6	Relay (see sketch)
7	Relay (see sketch)
8	Relay (see sketch)

Position of the Rotary Selector	Baud Rate
0	automatic Baud rate detection
1	1000 kBaud
2	800 kBaud
3	500 kBaud
4	250 kBaud
5	125 kBaud
6	100 kBaud
7	50 kBaud
8	20 kBaud (Default)
9	10 kBaud

DIP-Switch	
1..7	Node number (1..127)
8	Bus termination

Back view of the CAN display:

Supply / CAN   Node / Termination   Baud   Relay

off

1 2 3 4 5

on

1 2 3 4 5 6 7 8

6 7 8

9   Technical Data HE 5120

Displays	• 7-segment-display with 5 digits, 13 mm character height • 3 LED (2 mm)
Display range:	-9999 to 99999, number of decimal places selectable
CAN Bus:	• CAN specification 2.0A (optional: 2.0B) • CANopen protocol according to DS301 and DS403 • physical coupling conforms ISO 11898 • data transmission rate up to 1 MBaud • galvanically isolated • filter for the suppression of line-bound EMC interferences
Adjustments:	• 1 DIP switch (8-pos) for CAN node address and switchable CAN bus termination resistor • 1 rotary code switch (0-9) for CAN Baud rate 10 kBaud to 1 MBaud, automatic Baud rate detection • selection of 10 operating modes
Supply voltage:	24 V DC (20... 30 V DC)
Fuse protection:	315 mA, slow reaction
Switching output:	1 relay, 1 floating change-over contact (250 V AC / 5 A)
Housing:	installation into control panel according to DIN 43700, front: filter glass, red
Dimensions:	96 x 24 x 110 mm (h x w x d)
Class of protection:	IP54 frontside according to EN 60529
Electrical connection:	screw-/plug-in terminal blocks; max. 2.5 mm²
Ambient temperature:	operation: 0 - 50 °C
Humidity:	≤75% humidity, no condensation
Delivery comprises:	device, mounting material, operation manual
Option:	customer specific software adaptation, especially the predefined operating modes

Subject to technical alterations !