

A/D Converter for M-Bus

AnDi1, AnDi2, AnDi3, AnDi4

With 1,2,3 or 4 input channels



Table of Content

1 Functional description	3
2 Installation and Startup	4
2.1 Mounting.....	4
2.2 Connecting	4
2.3 Opening the case.....	6
3 Parameterization using MBCONF	7
3.1 Installation	7
3.2 Operation.....	7
3.3 Sheet Info	8
3.3 Sheets AnDi4 Port1..4	11
4 M-Bus Telegrams.....	14
5 Technical Data	17
6 CE Declaration.....	18

(Valid from M-Bus generation: \$31)

© Relay GmbH 2017

www.relay.de

1 Functional description

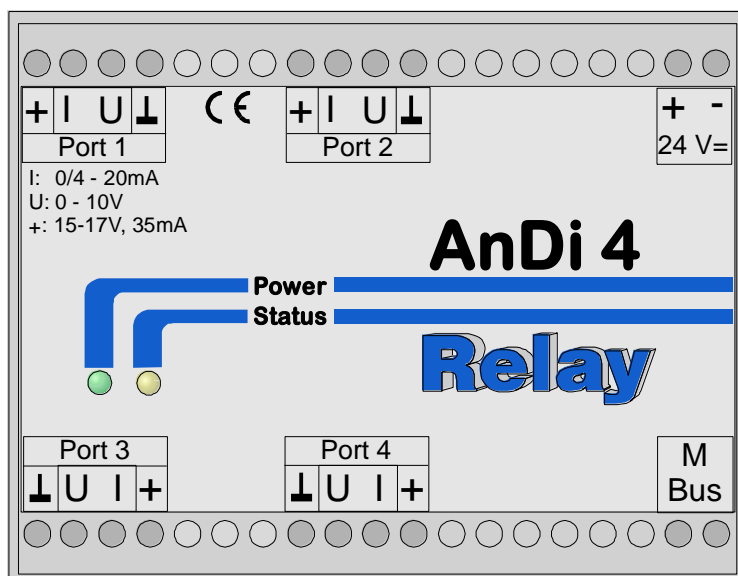
The one to four channel converter from analogue to M-Bus allows capturing of measured data from sensors in the range of 0/4 to 20mA or 0 to 10V by the M-Bus.

Art. no. MB AnDi 1	1 channel A/D converter for M-Bus
Art. no. MB AnDi 2	2 channel A/D converter for M-Bus
Art. no. MB AnDi 3	3 channel A/D converter for M-Bus
Art. no. MB AnDi 4	4 channel A/D converter for M-Bus

The AnDi is able to supply the sensors with power.

Each of the four measuring inputs and therefore each sensor builds up a separate M-Bus slave. The user can program special primary and secondary addresses for the input channels. This configured data is saved permanently into an EEPROM.

The AnDi4 can be mounted either on a wall or a DIN rail according to DIN-EN 50022. The device needs a regulated power supply of 24VDC.



Picture1: Front of AnDi 1..4

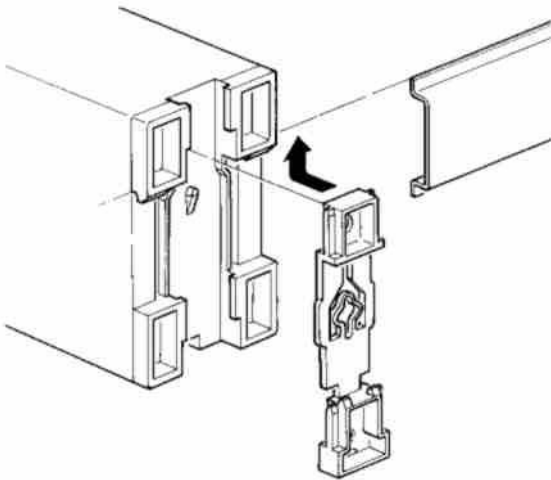
The AnDi 1 to 4 don't differ in the front cover, but the devices are marked with an additional label on the housing showing the article no.

The terminals of the unavailable inputs are also not present.

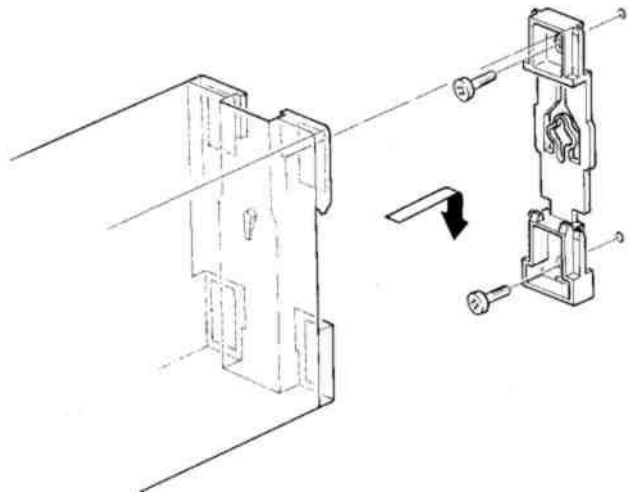
2 Installation and Startup

2.1 Mounting

On the back of the housing there is a special mechanism for mounting the device on a DIN rail according to DIN EN 50022. This mechanism can be removed, turned over and fixed on the wall with two screws. Afterwards you can mount the device without using a rail. The following figures show the two options:



Picture 2: Rail mounting



Picture 3: Wall mounting

2.2 Connecting

2.2.1 Power supply

The AnDi4 needs an external DC supply voltage of 24V (DC) $\pm 5\%$ for operation. It is connected to the terminals + and – labelled with 24V_{DC} (see picture 1). Please take care of the correct polarity. After connecting supply the green LED is on and the yellow LED marked with “Status” lights up for 1 second. The device is initialized and ready for operation when the yellow LED is off again. In normal operation this LED is on during measuring after a read from M-Bus.

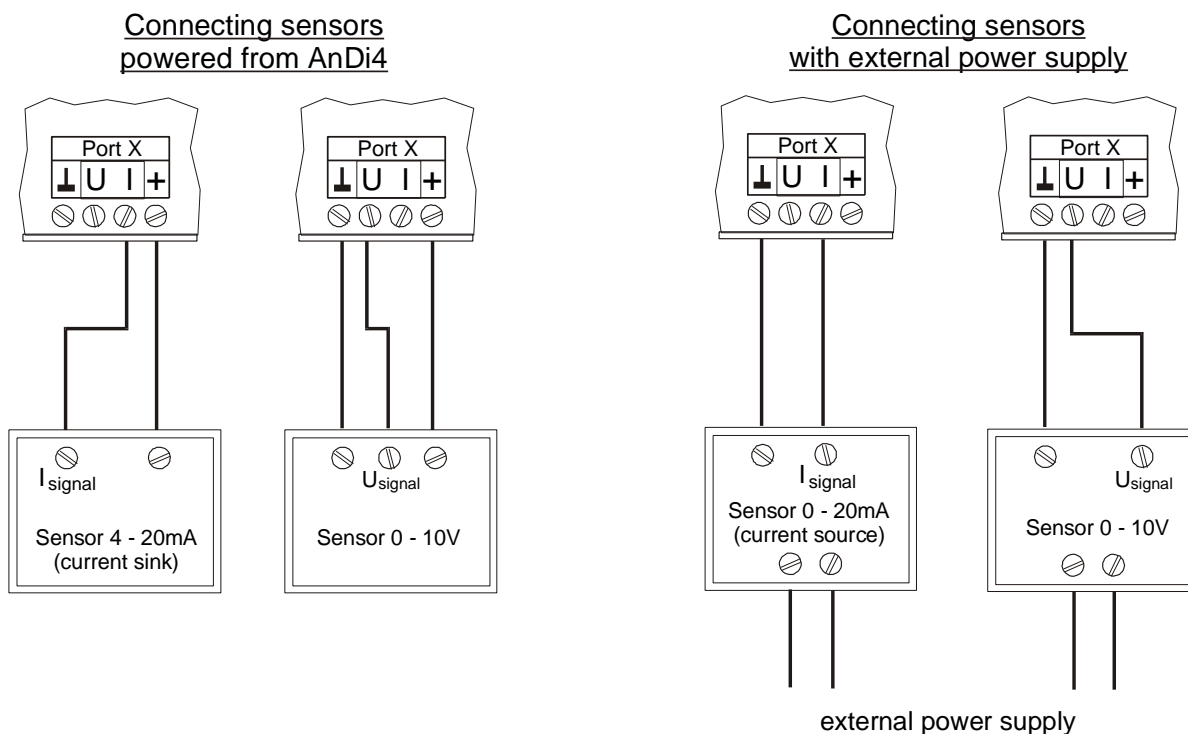
2.2.2 M-Bus

The M-Bus is linked polarity independent to the terminals labelled with “M-Bus”.

2.2.3 Sensors

The sensor inputs of the AnDi4 are made universal. Each sensor can be powered either from the AnDi4 or from an external power supply (see picture 4). The AnDi4 supplies an unregulated DC voltage in the range from 15 to 17 V. This power supply can source a current of minimum 35mA and is protected against short circuit. The type of measured signal has to be considered when the sensors are connected. The AnDi4 can adapt two basic types of measured signals:

- A current which is proportional to the measured quantity:
 - a) In the range from 0 – 20mA or 4 – 20mA with the sensor working as a current sink.
 - b) In the range from 0 – 20mA or 4 – 20mA with the sensor working as a current source.
 These sensors have separate connectors for power supply (U_B , 0V) and for the output signal (current).
- A voltage in the range 0 – 10V which is proportional to the measured quantity.



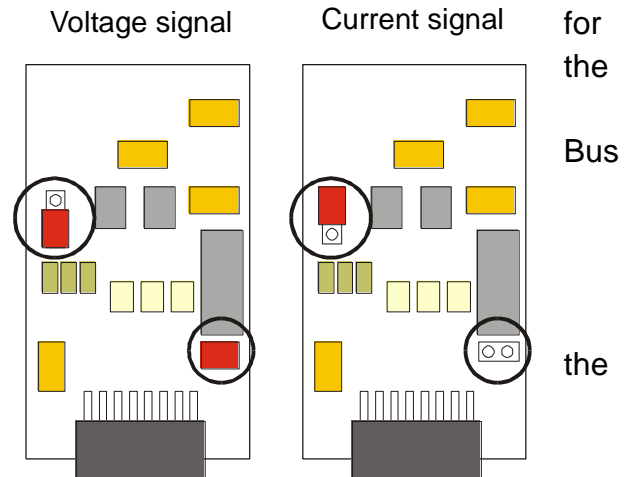
Picture 4: Connecting different type of sensors

+	Power supply for sensor 15- 17VDC, 35mA max
U	Input for voltage measurement
I	Input for current measurement
⏏	Ground potential

Each input channel of the AnDi4 has to be configured either to current or voltage measurement by setting up two jumpers on the measuring module. The factory setup is current mode for all channels. The housing of the AnDi4 must be opened to change the jumper settings (see picture 6).

Picture 5 shows the different jumper positions for current and voltage mode: Please take care that jumpers are placed exactly according to the drawing. The galvanic insulation between M- and A/D converter requires the use of two jumpers to select the measuring mode. The jumper down on the right gives information about the mode to the microcontroller and the jumper in the center left configures the input of channel.

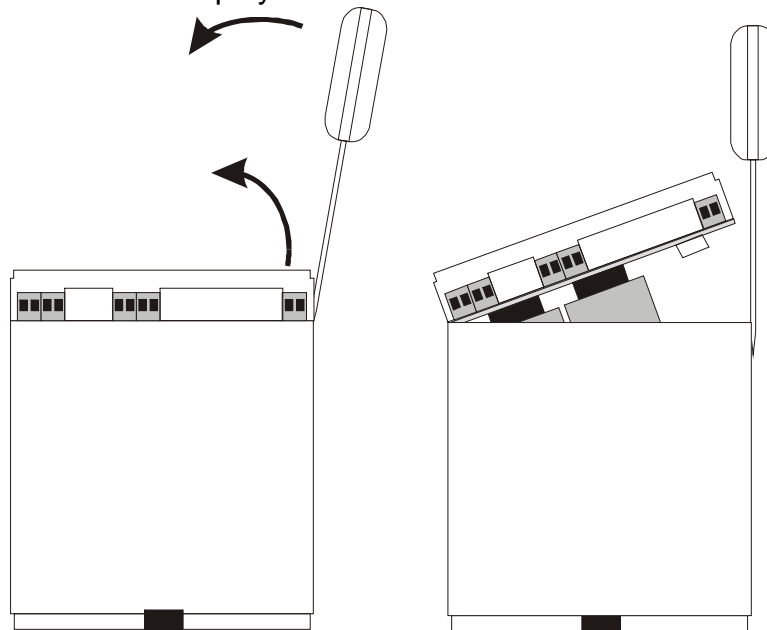
Jumper settings on measuring module



Picture 5: Jumper settings

2.3 Opening the case

The case cover can be removed from the lower housing half with the help of a small screwdriver. The screwdriver is placed, as in the drawing, into the small opening at the cover side. After moving of the screwdriver in the displayed direction the cover can be taken off.



Picture 6: Opening the case

3 Parameterization using MBCONF

The configuration of the device must be adapted by the customer to the respective installation. We include the software MBCONF with delivery. You can get the old software PADCON for MS DOS or MS Windows 3.1 systems from our web page www.relay.de.

3.1 Installation

The software MBCONF for configuration of the analogue adapter is a 32-bit application, which can be executed on IBM-PC compatible computers under the operating systems Windows 95 / 98 / NT 4.0. The desktop PC or laptop must have a free serial RS232C interface to connect the M-Bus level converter. The AnDi4 to be parameterized must be connected directly (i.e. as only M-Bus device) to the M-Bus output of the level converter.

Please start the file "MBCONF_SETUP.EXE" from Windows Explorer or via "Start – Execute" to install the software from version 1.40 up. Subsequently you can select the language of the installation procedure. The setup software can create a program group and a link on the desktop on demand. You can then execute both versions for German and English language either from start menu or desktop.

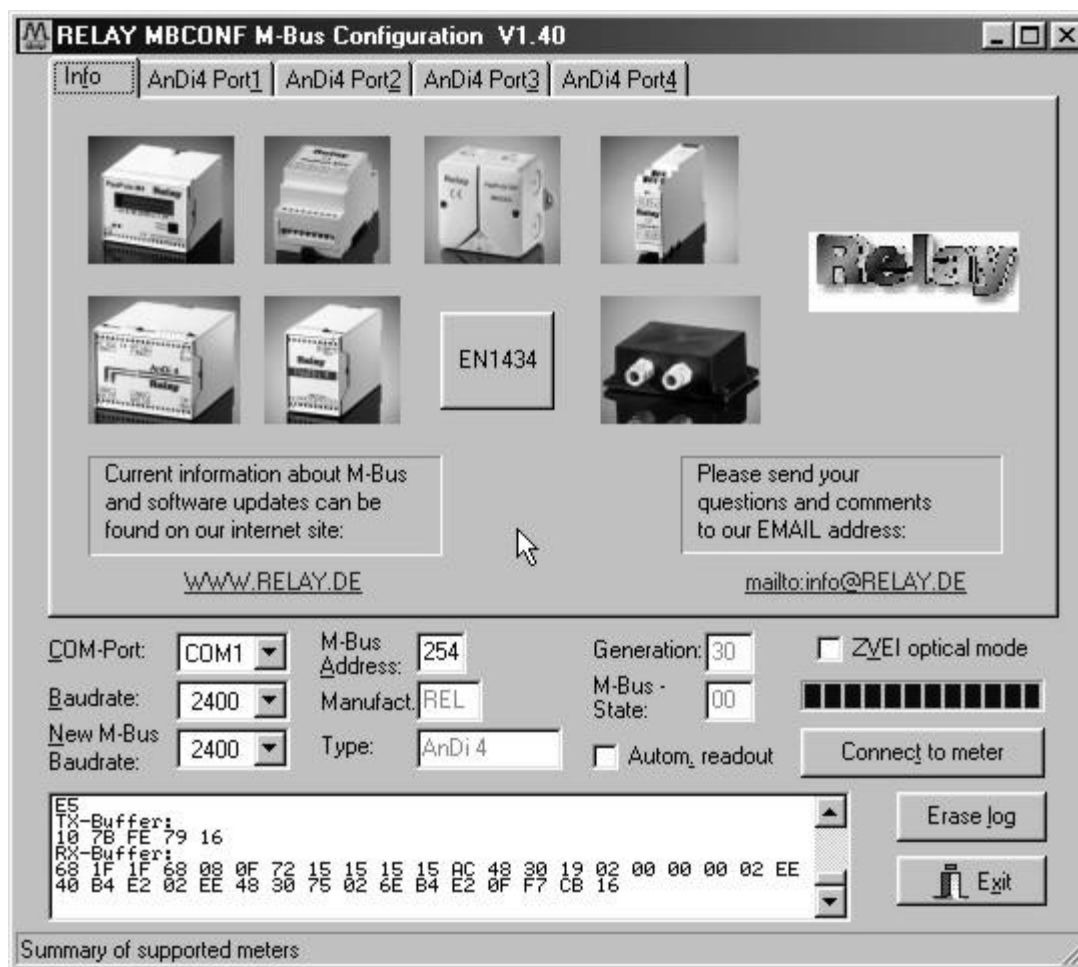
3.2 Operation

After program start the user operates the software according to the Windows conventions with the mouse or the keyboard. If you stay with the mouse on a button or an input field, then a hint to its function appears. Light-grey fields and boxes are not capable for editing.

All input fields and buttons have an underlined letter. The function can be activated by simultaneous pressing of the keys [ALT] and the respective letter. Within dialogs the cursor can be moved with the keys [TAB] or [SHIFT][TAB] forwards and back. [SPACE] activates or deactivates selection boxes. Multiple selection boxes (arrow at the right edge) can be activated with [↓]. The user then selects an entry with [↓] and [↑]. By pressing [RETURN] the selected entry is taken over. With [ESC] the selection box is left without transfer.

The program is arranged as a sheet system. The sheet "Info" contains general options of the communication with the M-Bus device to be configured. In this sheet the user can select the serial port of the PC, the baudrate of the PC, the baudrate of the M-Bus device and the M-Bus primary address which is used for communication. After a successful connection with the M-Bus device, further manufacturer information is shown in the sheet "Info" and additional device-specific sheets are displayed.

3.3 Sheet Info



This sheet shows some photos of supported M-Bus devices from the product range of the Relay GmbH, the PadMess GmbH and further manufacturer. Here are also links to the Internet page, from which the current version of the program can be downloaded, and to the email address for criticism and suggestions to the program.

The lower third of this card is likewise visible in every other card. Here the following input fields and buttons are always attainable:

COM-Port is the serial port of the PC to which the M-Bus level converter is connected. The selected port will be saved in an INI file and will be restored on startup. Therefore the COM-Port has to be configured only once.

Baudrate is the transmission speed of the serial port of the PC used for parameterization. Possible selections for this used M-Bus baudrate are 300, 2400 or 9600 baud. Attention: Baud rates of more than

2400 baud are not supported by all M-Bus level converters which are available on the market! The selected baudrate must be identical to the baudrate of the M-Bus device. (see: "New M-Bus Baudrate"). The AnDi4 supports the baud rates 300 and 2400 Bd.

<u>New M-Bus Baudrate</u>	allows reprogramming the baudrate of the M-Bus device. The new baudrate is sent to the M-Bus device after a change in the appropriate selection box. If the M-Bus slave accepts this command, it acknowledges the telegram with the single character „\$E5“ (\$ for hexadecimal notation) using the old baudrate. Afterwards the device switches to the new Baud rate.
<u>M-Bus Address</u>	is the primary address of the connected M-Bus slave. In a direct connection with only one slave you can use the broadcast address 254. Using this address every M-Bus devices must answer regardless of its own address.
<u>Connect to meter</u>	is used to request data from the slave. The type of device is then automatically recognized. The items "Manufact.", "Generation", "Type" and "M-Bus State" will then be refreshed. New sheets are generated depending on manufacturer and type of the M-Bus device. A single sheet for each channel appears in case of AnDi4. The sheets are labelled "AnDi4 Port1" for the first ... "AnDi4 Port4" for the fourth channel.
<u>Manufact.</u>	is an item that shows the 3-letter manufacturer code after successful reading ("Connect to meter"). The item is read only.
<u>Generation</u>	shows the software revision of the firmware of the connected M-Bus device. The item is read only.
<u>Type</u>	shows the type (here: AnDi4) of the connected device. This item is read only.
<u>M-Bus State</u>	shows the M-Bus state of the connected device. This item is read only.
<u>ZVEI optical mode</u>	If this option is activated, devices with an optical interface and protocol according to EN 1434-3 can be read and programmed using an optical reading head (e.g. PadPuls M4 / M4L).
<u>Autom. Readout</u>	The software always reads the data after writing, if this option is activated (useful for checking the correct programming).

Log-Window

The so-called log window is always visible. All M-Bus communication steps are logged in this window. Data is displayed in hexadecimal notation. It is possible to mark outputs in the log window and copy them with the keys "CTL-C" to the windows clipboard. Then the data can be easily imported to any text editor for documentation. As soon as the max. storage capacity of the window is achieved, no more data is logged. If you want to log further, you must delete the logged data.

The following buttons are also always visible:

Erase log	clears all outputs inside the log window.
Exit	terminates the program and stores the current setting of serial port (port no.) into the INI file.

3.3 Sheets AnDi4 Port1..4

These sheet shows the actual settings and values of the respective input channel of the AnDi 4 (in this example: Port 3). The following input boxes and buttons are used to change the parameters of the A/D converter:

Prim. address is the M-Bus address of the selected port. Values between 1 and 250 can be entered in this field for new assignment of the address. After pressing the “Write” button the software programs this primary address and further variable settings on this sheet into the M-Bus device.

ID (sec. adr.) is the 8 digit M-Bus ID (identification no.), which is also used for secondary addressing of this port.

Medium describes the measured medium of the connected meter. Examples: Oil, Water, Heat, Electricity

<u>Quantity</u>	selects the measured physical quantity (e.g. pressure or external temperature).
<u>Unit</u>	is the physical unit of the counter and of the pulse increment. The selection list offers those units from the DIN EN 1434-3, which correspond to the selected quantity.
Value	is the current measured value. This value must be multiplied by the selected physical unit.
Installed ports	shows the installed and available ports.
Write protection	is marked, if the device is protected against programming. Then you cannot configure the adapter. The protection can be removed after opening the sealable housing and pressing the “Unprotect” pushbutton for a minimum of 4 seconds.
EEPROM error	is marked, if an error occurred while reading the non-volatile memory. In this case you must reconfigure the device !
Calibration required	is marked, if the internal calibration constants are corrupt. In this case the measured values could be wrong. The device has to be recalibrated by the supplier.
Range overflow in last measurement	is marked, if the measured value extends the upper value of the input range.
Operating mode	shows / selects operating mode of the A/D converter: a) Sensor with 4..20mA signal b) Sensor with 0..20mA signal c) Sensor with 0..10V signal You can only switch between current and voltage mode by setting the jumper inside the device !
Value at 0mA/0V	is the lower limit of the measuring range at 0mA or 0V in the operating mode 0..20mA or 0..10V.
Value at 4mA	is the lower limit of the measuring range at 4mA in the operating mode 4..20mA.
Value at 20mA/10V	is the upper limit of the measuring range at 20mA or 10V.
<u>Write protect</u>	Transmits a command to the AnDi4 to activate write protect. The AnDi4 then allows no further configuration. It is protected against unnoticed manipulation.

<u>Read</u>	reads the M-Bus device and refreshes the data on the selected sheet.
<u>Write</u>	sends the current options to the analogue converter, which saves this data into the non-volatile memory. The AnDi4 changes the options only if the write protect is deactivated. It is recommended to read the data after writing and check it.

Notes:

1. Please press first the button „Connect to meter“ after connecting a new M-Bus device. Afterwards all sheets are refreshed.
2. Examples for configuration of measuring ranges:
 - Temperature sensor with 4mA = 0°C and 20mA = 100°C
(Measured quantity: external temperature):
 - a) Resolution 0,01°C: Unit = 0,01°C, Value 4mA = 0, Value 20mA = 10000
 - b) Resolution 0,1°C: Unit = 0,1°C, Value 4mA = 0, Value 20mA = 1000
 - c) Resolution 1°C: Unit = 1°C, Value 4mA = 0, Value 20mA = 100
 - Pressure sensor with 0V = 2bar and 10V = 20bar (Measured quantity: pressure):
 - a) Resolution 0,001 bar: Unit = 1mbar, Value 0V = 2000, Value 20V = 20000
 - b) Resolution 0,01 bar: Unit = 0,01bar, Value 0V = 200, Value 20V = 2000
 - b) Resolution 0,1 bar: Unit = 0,1bar, Value 0V = 20, Value 20V = 200

The examples demonstrate that the selection of the unit has a direct influence to the resolution of the measurement. The optimal settings for these examples are the suggestions marked with “a”).

4 M-Bus Telegrams

Configuration of AnDi 4 with SND_UD:

Position	1	2	3	4	5	6	7	8	9	10	11	12
Name:	Start	Length	Length	Start	C	A	CI	DIF1	VIF1	PAdr	DIF2	VIF2
Value (hex):	68	1C	1C	68	53		51	01	7A		07	79

13	14	15	16	17	18	19	20	21	22	23	24	25	26
ID ₀	ID ₁	ID ₂	ID ₃	Man ₀	Man ₁	Gen	Med	DIF3	VIF3	VIFE3	Offs ₀	Offs ₁	DIF4
				AC	48	3x		02		40			

27	28	29	30	31	32	33	34
VIF4	VIFE4	Max ₀	Max ₁	DIF5	Anw.	CS	Stop
	48			0F			16

Configuration telegram

- A: primary address
- PAdr: new primary address
- ID₀₋₃: identification no. for secondary addressing
- Man₀₋₁: manufacturer code
- Gen: revision of firmware (current: \$31, reserved range: \$30 .. \$3F)
- Med: medium
- VIF3=VIF4: configured VIF with extension bit (MSB) = 1
- Offs₀₋₁: binary value for the offset
- Max₀₋₁: binary value for the maximum (upper limit)
- Anw.: is only used by AnDi4 for addressing with primary address 254 for selection of one channel: (00: Port1, 01: Port2, 02: Port3, 03: Port4).
- CS: checksum

Respond telegram from AnDi4 to Master (RSP_UD)

Position	1	2	3	4	5	6	7	8	9	10	11	12
Name:	Start	Length	Length	Start	C	A	CI	ID ₀	ID ₁	ID ₂	ID ₃	Man ₀
Value (hex):	68	1F	1F	68	08		72					AC

13	14	15	16	17	18	19	20	21	22	23	24	25	26
Man ₁	Gen	Med	TC	Status	Sig ₀	Sig ₁	DIF1	VIF1	VIFE1	Offs ₀	Offs ₁	DIF2	VIF2
48	10				00	00	02		40			02	

27	28	29	30	31	32	33	34	35	36	37
VIFE2	Max ₀	Max ₁	DIF3	VIF3	Mess ₀	Mess ₁	DIF4	Info	CS	Stop
48							0F			16

RSP_UD telegram

Fields analogue to SND_UD

TC: Transmission Counter (no. of transmitted RSP_UD, overflows to 0 at 256)

Status: state of application:

Bit7: direct readout of mean value 128 (only for debug purposes)

Bit6: direct readout of single measurement (only for debug purposes)

Bit5: range overflow

Bit4: permanent error (channel is not calibrated)

Bit3: temporary error (EEPROM checksum error)

Bit2-0: not used

VIF1=VIF2: configured VIF with extension bit (MSB) = 1

VIF3: like VIF1 with extension bit (MSB) = 0

Mess₀₋₁: the measured value in binary format

Info: Byte with the following information:

Bit7-4: Information about the available modules in AnDi4

Bit3: protection bit (1: protected)

Bit2-1: no. of selected channel (0: Port1 ... 3: Port4)

Bit0: operating mode (1: current, 2: voltage)

Activating the protection

Position	1	2	3	4	5	6	7	8	9	10	11
Name.:	Start	Length	Length	Start	C	A	CI	DIF	Prot.	CS	Stop
Value (hex):	68	05	05	68	53		51	0F	55		16

Protection telegramm

Selecting the channel for use with address 254

Position	1	2	3	4	5	6	7	8	9	10	11
Name	Start	Length	Length	Start	C	A	CI	DIF	Anw.	CS	Stop
Value (hex):	68	05	05	68	53		51	0F			16

Selection telegramm

5 Technical Data

Supply voltage:	24V DC \pm 5%, maximum 160mA
Sensor supply:	15..17,5V unregulated, min. 35mA ,short-circuit protected
Galvanic insulation:	1kV
Input ranges:	0 / 4mA – 20mA 0 .. 10V selectable by jumpers
Input resistor:	120 Ω current mode 11k Ω voltage mode
Configurable measuring range:	-32767 .. + 32767
Resolution:	12 bit, \pm 1LSB typ. \pm 2 LSB in the complete temperature range

CE conformity: The AnDi4 is labelled with the CE sign (see chapter 9.3).

Case:

Mounting	Rail 35mm according to DIN EN 50022 or mounting on wall
Material	ABS plastic
Colour	light-grey (similar to RAL 7035)
W x L x H	100 x 75 x 105 mm
Protective class	IP40

Environment:

Operating temperature	0 to 55 °C
Storage temperature	-20 to 60 °C
Humidity (non condensing)	10% to 70%

M-Bus: physical characteristics

M-Bus quiescent current	typ. 1.25 mA, max. 1.5 mA (1 unit load)
Space(0-Bit) current	quiescent current (1.25 mA) plus typ. 13 mA
M-Bus Interface	TI TSS721 with 2 x 215 Ω protection resistors, galvanic insulation 1kV to all other parts

M-Bus Protocol

Standard	EN1434-3
Transmission speed	300 or 2400 Baud
Addressing	Primary and secondary addressing with wildcards, each channel : 1 primary and secondary address
Supported functions	SND_NKE, REQ_UD2, SND_UD

6 CE Declaration

EU DECLARATION OF CONFORMITY for AnDi1 to AnDi4

We the company **Relay GmbH**
Stettiner Str. 38
D-33106 Paderborn

declare that the products **AnDi1, AnDi2, AnDi3, AnDi4**
M-Bus one to four channel A/D converter

are compliant with the requirements of the following directives:

EMC Directive (2014/30/EU)
Low Voltage Directive (2014/35/EU)
RoHS Directive (2011/65/EU)

The products have been tested in accordance with the following standards:

EN 55011:2009	Radio-frequency disturbance characteristics. Limits and methods of measurement (ISM devices)
EN 50561-1:2013	Radio disturbance characteristics. Limits and methods of measurement. Apparatus for in-home use
EN 61000-3-2:2014	EMC - Limits for harmonic current emissions (≤ 16 A per phase)
EN 61000-6-1:2007	EMC - Immunity for residential, commercial and light-industrial environments (generic standard)
EN 61000-6-2:2005+AC:2005	EMC - Immunity for industrial environments (generic standard)
EN 61000-6-3:2007+A1:2011	EMC - Emission standard for residential, commercial and light-industrial environments (generic standard)
EN 61000-6-4:2007+A1:2011	EMC - Emission standard for industrial environments (generic std.)
EN 61000-4-2:2008	Testing and measurement techniques. ESD immunity test
EN 61000-4-3:2010	Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4:2012	Testing and measurement techniques. Electrical fast transient/burst immunity test
EN 61000-4-5:2014	Testing and measurement techniques. Surge immunity test
EN 61000-4-6:2013	Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields)
EN 60950-1:2006/A2:2013	Safety - Information technology equipment (general requirements)
EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Paderborn, 18.10.2017



Matthias Rüther (Development Manager)

Notes:

