Operating instructions

Digital Transducer
Electronics

AD103B

Part 3
Communication commands

HBM

Part 1

Description of the hardware of the AED basic set

Part 2

Description of the hardware and the functions of the measurement amplifier board AD103B

Part 3

Description of the commands for the serial communication with the measurement amplifier board AD103B

Contents **Page**

Part 4

Description of the filling and dosing functions

Important notes

The complete factory settings are stored at the works such that they are protected against mains power failures and cannot be deleted or overwritten; they can be reset at any time by means of the command **TDD0**.

Further hints please find in chapter *Individual descriptions of the commands.*

The factory adjustment (SZA, SFA) must not to be changed.

The AD103B is the successor of the AD103. The differences are

- Power supply voltage range, AD103B: **5V+/-5%**
- Higher baudrate (**BDR**): in addition 57600 and 115200 baud
- Zero setting (+/- 2%, **CDL**)
- Memory for MAX and MIN values (**PVA, PVS, CPV**)
- No calibration function (ACL, CAL) needed
- Redosing function (**RDS**)
- Valve control setting for dosing function(**VCT**)

A new internal function guarantees the accuracy of amplifier board AD103B. So the commands ACL and CAL are not longer needed. But they are implemented.

The software version from the identifcation string (**IDN?**) give the hint of the new type of amplifier:

AD103: P30, P31

AD103B: P32...P39

All other functions are fully identical to the AD103 !

Safety notes

See operating instructions Part 1 and Part 2

1 Introduction

The digital transducer electronic unit AD103B belong to the family of AED components which digitally condition and network as bus-capable the signals from mechanical measurement transducers.

This includes digital measurement amplifier boards, base units, and intelligent sensors with integrated signal processing. The objective of these components is the digitization and conditioning of the measuring signals directly at the transducer location. Via the digital transducer electronics, SG[1)] transducers can be connected directly to a computer or PC within a full bridge circuit. This enables you to build up complete measurement chains – fast and at low cost.

The measurement amplifier board AD103B can be operated independent of the basic devices AED9201A and AED9301A. The basic device provides mechanical protection, shields the measurement amplifier board (EMC protection) and offers the option to select additionally the serial interfaces (RS 485, Profibus).

The correction procedures linearisation, limit value monitoring, and the digital filters with fast settling time open up additional areas of application. Moreover, the AED103B provides the option to control filling and dosing processes.

The transducer electronic unit AD103B is also abbreviated with **AED** in the following text.

1) **S**train **G**ages

2 Command set for AD103B

The commands can be classified roughly into:

- Interface commands
  (**ADR**, **BDR**, **COF**, **CSM**, **GRU**, **S...**, **TEX, STR**)
- Commands for factory setup
  (**SZA**, **SFA**, **LIC**)
- Commands for user adjusting and scaling
  (**CWT**, **LDW**, **LWT**, **NOV**, **ENU, RSN**)
- Commands for setup the measuring mode
  (**ASF**, **ASS**, **ICR**, **FMD**, **MTD**, **ZSE**, **ZTR**)
- Commands for the measurement
  (**MSV**, **TAR**, **TAS**, **TAV**, **CDL**)
- Commands for the trigger measurement
  (**TRC**, **MAV**)
- Commands for the peak value detection
  (**PVA**, **PVS, CPV**)
- Inputs/outputs, and limit values
  (**IMD**, **POR**, **LIV**)
- Special commands
  (**TDD**, **RES**, **DPW**, **SPW**, **IDN**, **ESR**)
- Commands for legal for trade applications
  (**LFT**, **TCR**, **CRC**)
- Commands for dosing / filling (see manual Part 4)

2.1 Command format

The commands can be input in uppercase or lowercase type.

Each command requires an end character as conclusion of the input. This can be optionally a line feed (**LF**) or a semicolon (**;**).

If only an end identification is sent to the AED, then the input buffer of the AED is deleted.

The statements made in round brackets () in the commands are urgently necessary and must be entered. Parameters in pointed brackets <> are optional and can also be dispensed with. The brackets themselves are not entered.

Text must be included in **" "**.

With numerical entries, leading zeros are suppressed. Numbers can be entered either directly or in exponent format, e.g. ±12000lf or ±1,2e4lf.

The exponent **e** can be one- or two-digit, but a number including sign and exponent must not exceed more than 10 characters in length.

Answers consist of ASCII characters and are terminated with **CRLF.** The binary character output is an exception (see command **MSV** or **COF**).

Each command consists of the command initials, the parameter(s) and the end character.

	Command initials	**Parameter**	**End character**
Input	ABC	X, Y	LF or ;
Output	ABC?	X, Y	LF or ;

Example: MSV?20;

20 measured values are output after this command.

All ASCII characters - 20_H (blank) may stand between command initials, parameters and end character, except for 11_H (ctrl q) and 13_H (ctrl s).
H: Hexadecimal.

2.2 Answers to commands

2.2.1 Answers to inputs (exception COF64...COF79):

	Answer	**End character**
Correct input	0 (zero)	CRLF
Faulty input	?	CRLF

Exceptions:

The commands **RES, STP, S00 ... S99** deliver no answer.
The command **BDR** delivers the answer in the new baud rate.

An error flag is received through the command **ESR.**

2.2.2 Answers to output commands:

Correct command	Parameter1, ... Parameter n, or meas. values **CRLF**
Faulty command	**? CRLF** (error flag via command **ESR**)

2.3 Output modes for the measured values

You can select two types of output and a data delimiter (command **TEX**).

2.3.1 Output mode 1:

The measured values are output arranged one underneath the another:

Measured value 1 CRLF

Measured value 2 CRLF

...

Measured value n CRLF

2.3.2 Output mode 2

The measured values are output arranged next to one another:

Measured value1 (data delimiter) Measured value2 (data delimiter) ...
Measured value n CRLF

The measured value query works with fixed output lengths
(see command **COF**):

Format command		AED response		No. of Bytes
COF 0;	**MSV?**	yyyy CR LF	(y – binary)	6
COF 2;	**MSV?**	yy CRLF	(y – binary)	4
COF 3;	**MSV?**	xxxxxxxx CRLF	(x – ASCII)	10
COF 9;	**MSV?**	xxxxxxxx,xx,xxx CRLF	(x – ASCII)	17

There is always a CRLF or the data delimiter defined by the command **TEX** as end identification of the measured value output. However these characters must not be filtered out as end identification in the binary output, since these characters can also be contained in the binary code of the measured value. Therefore only counting the bytes helps in the binary output. The corresponding places after CR or LF or the data delimiter can then be enquired for subsequent syntax testing.

2.3.3 Password protection:

The password protection of the AED comprises important settings for the characteristic of the scale and its identification. Commands with password protection are activated only after the password is entered. These commands are answered with “?“ without entry of the password through the command **SPW**.

2.4 Command overview

Comm.	TCR	PW	TDD 1	Function	Page
ADR			x	Adress	14
ASF			x	Filter select Limit frequencies	48
ASS			x	Input signal	46
BDR			x	Baud rate	15
CDL;				Zeroing	65
COF			x	Output format (at **MSV?)**	16
CPV;				Clear peak values	81
CRC	x			Check sum	93
CSM			x	Check sum with mes. status with binary output (at **MSV?)**	21
CWT	x	x	x	Calibration weight	38
DPW				Define password	82
ENU	x			Engineering unit	42
ESR				Status	90
FMD			x	Filter mode	47
GRU			x	Group adress	22
ICR			x	Measuring rate	50
IDN	x			Identification of type of transducer and serial number	85
IMD			x	Function of inputs	68
LDW	x	x		Zero, user characteristic	34
LFT	x		x	Legal for trade application	91
LIC	x	x		Linearization	43
LIV			x	Limit value setting	70
LWT	x	x		Nominal value, user characteristic	34
MAV?				Measured value, trigger function	89
MSV?				Current measured value	55
MTD	x		x	Motion detection	52
NOV	x	x	x	Nominal value scaling	40
POR			x	Set and read digital inputs and outputs	72
PVA?				Output peak values	81
PVS			x	Setup peak value detection	80
RES;				Reset	84
RSN				Output Resolution	41
S...				Select	24
SFA	x	x		Internal nominal value, factory characteristic	31
SPW				Password entry	83
STP;				Stop measured value output	60
STR			x	Bustermination – resistors switched on / of	27
SZA	x	x		Internal zero value, factory characteristic	30

Comm.	TCR	PW	TDD 1	Function	Page
TAR				Taring	61
TAS			x	Gross/net switch-over	64
TAV			x	Tare value	62
TCR				Trade Counter	92
TDD1/2				Store setting in EEPROM, read EEPROM	86
TDD0	x	x		Factory setting	86
TEX			x	Data delimiter for measured value output	23
TRC			x	Trigger setting	76
ZSE	x		x	Initial zero setting	54
ZTR	x		x	Automatic zero tracking	53

TDD 1: Storing with **TDD1**, otherwise on entry

PW: Password protection through commands **DPW/SPW**

TCR: Change of the legal for trade counter if **LFT**=1

The following commands result in no change to the AED setting:
COR, ACL, CAL (compatibility with preceding AED versions).

Commands for the dosing function are described in the manual part 4.

3 Individual descriptions of the commands

3.1 Interface commands (asynchronous, serial)

The asynchronous interface of the AED is a serial interface, i.e. the data are transmitted bit by bit one after another, and asynchronously. Asynchronous means that the transmission works without a clock signal.

The interface must be configured to build up the communication between AED and computer.

- Communication address for bus mode **ADR**
- Baudrate **BDR**
- Output format measured values(ASCII / Binary) **COF**
- Checksum status measured values **CSM**
- Group address **GRU**
- Select command for bus members **S..**
- Data delimiter for measured values(ASCII) **TEX**
- Bus termination, RS485 bus **STR**

Characteristic data of the interfaces (RS232, RS485):

Start bit:	1
Word length:	8 Bit
Parity:	none / even
Stop bit:	1
	Software handshake (X_{ON}/X_{OFF}) is possible
Baud rate:	1200 ... 115200 Baud

A start bit is set before each data byte. The bits of the word, a parity bit for the transmission protocol (optional) and a stop bit then follow.

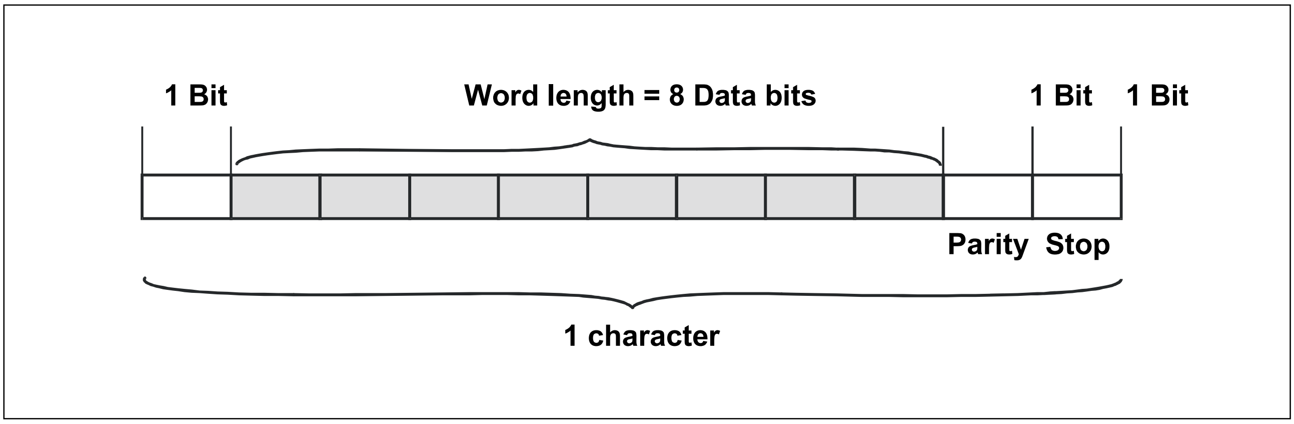


Fig. 3.1-1: Composition of a character

Since the data are transmitted one after another, the transmission speed must agree with the reception speed. The number of bits per second is called baud rate.

The exact baud rate of the receiver is synchronized with the start bit for each transmitted character. The data bits which all have the same length then follow. After the stop bit is reached, the receiver goes into a ‘waiting position’ until it is reactivated by the next start bit.

The number of characters per measured value depends upon the selected output format (**COF** command) and can be 2 to 17 characters (see also **COF** command).

ADR

Address
(device address)

Range:	0...31
Factory setting:	31
Response time:	<10ms
Parameters:	2
Password protection:	no
Parameter protection:	with command **TDD1**

Input: **ADR(new address), <"Serial number">;**

Entry of the device address as decimal number 0...31.

The serial number can also be stated optionally as 2nd parameter. The new address is then entered only for the AED with the stated serial number. This makes it possible to change device addresses without several AEDs being addressed in the case of several AEDs with the same address (initialization of the bus mode).

The serial number must be stated in **“ “** as in the command **IDN**.

Example: ADR25,"007" CRLF

Query: **ADR?; 25CRLF (example)**

Effect: Output of the device address as decimal number 0...31

BDR **Baud Rate**
(Baud rate)

Baud rates:	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
Facrory setting:	9600 Baud and Even Parity Bit
Response time:	<10ms
Parameters:	2
Password protection:	no
Parameter protection:	with command **TDD1**

Query: BDR <Baud rate>,<Parity>

Entry of the required baud rate as decimal number.

The following baud rates are possible:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bauds

Entry of the parity required:

0= without parity bit
1=with parity bit even

Important note

The answer is given in the new setting (baud rate, parity). Communication is no longer possible initially after a changed baud rate. The computer also has to be changed over to the new selected baud rate setting. To maintain the new baud rate, it must be stored in the EEPROM with the command **TDD1**. This procedure serves also as safeguard that no baud rates can be set in the AED which the remote station does not support. If the new entered baud rate is not stored, the AED reports after a reset or power On again in the previously valid baud rate.

Query: BDR?;

Effect: Output of the set baud rate, Identification for parity

Example: BDR?; 9600,1 CRLF *corresponds to 9600 bauds, Even Parity*

COF

Configurate Output Format
(Output format for the measured value)

Range: 0...255
Factory setting: 9
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD 1**

Query: COF(0...255);

Entry of the output format for measured value command **MSV?**

The possible formats and the decimal number to be entered for them are listed in the following table. The measured value output refers to the set nominal value of the AED (see command **NOV**).

Output at max. capacity	NOV> 0	NOV= 0
2 Byte binary	NOV value	20000
4 Byte binary	NOV value	5120000
ASCII	NOV value	1000000

For the 2-bytes binary output, the **NOV** value must be $\leq$ 30000, otherwise the measured value is output with overflow or underflow ($7fff_H$ or 8000_H). With NOV30000, the overload range is only approx. 2700 digits.

Query: COF?;

Effect: Output of the selected output format as three-digit decimal number from 0...255

<u>Overview:</u>

COF0…COF12 standard output formats
COF16…COF28 output formats for bus mode
COF32…COF44 binary measured value output without CRLF
COF64…COF76 output formats for 2 wire bus mode
COF128…COF140 continuous output after power On

COF-formats:

The following combinations result on entry of **COF0** to **COF12**:

- MSB= most significant byte
- LSB= least significant byte

In binary output, the sequence of the bytes MSB → LSB or LSB → MSB can be selected. In ASCII output, the device address and/or measured value status information can be output in addition to the measured value.

Binary format:

	Parameter	Length	Sequence of the measured value output
COF0	Measured value	4 Byte	MSB before LSB LSB=0 (no status)
COF2	Measured value	2 Byte	MSB/LSB
COF4	Measured value	4 Byte	LSB before MSB LSB=0 (no status)
COF6	Measured value	2 Byte	LSB/MSB
COF8	Measured value	4 Byte	MSB before LSB LSB=status/CRC
COF12	Measured value	4 Byte	LSB before MSB LSB=status/CRC

ASCII format:

In ASCII output, a freely selectable data delimiter is set between the parameters (see command **TEX**). crlf or the selected data delimiter follows after the last parameter.

T= Data delimiter

()= Number of characters

	1. Parameter	T	2. Parameter	T	3. Parameter	End character
COF1	Meas. value (8)	T(1)	Adress(2)		—	CRLF or T
COF3	Meas. value (8)		—		—	CRLF or T
COF5	Identical with **COF1**					
COF7	Identical with **COF3**					
COF9	Meas. value (8)	T(1)	Adress(2)	Stat.(3)		CRLF or T
COF11	Meas. value (8)	T(1)	—	Stat.(3)		CRLF or T

Important note

In bus mode, the output format must not be set to **COF9**.

COF16 to COF28, bus mode:

If the decimal number 16 is added to the above stated output formats **COF0...COF12**, then the AED is switched into the bus output mode. The AED switches over to the partially active mode (each new measured value is stored in the output buffer but not output). The measured value is output on the bus with the select command **S..;**. The measured value is output without CR/LF.

Example: *2 AED in bus mode*

Command	Effect
S98;	All AED are partially active (listening but no transmission)
COF18;	Output in 2 byte binary output
ICR0;	Maximum measuring rate
MSV?0;	Continuous measurement in AED
S01;	Read measured value of 1st AED
S02;	Read meas. value from 2. AED, when answer from 1. AED has been received compl.
S01;	Read meas. value from 1. AED, when answer from 2. AED has been received compl.
S02;	Read meas. value from 2. AED, when answer from 1. AED has been received compl.
...	...
STP;	Stop measured value output
S01;	Poss. new setting for 1st AED

COF32 to COF44, binary measured value output without CRLF:

If the decimal number 32 is added to the above stated binary output formats COF0...COF12, the AED is switched into the following output mode for the measured values.In the binary measured value output, the end character CR LF is left out, so that only 2 or 4 characters per measured value are output. This mode increases the output speed of the measured values.

Format	Length	Sequence of the measured value output	
COF32	4 Byte	MSB before LSB	LSB=0 (no status)
COF34	2 Byte	MSB/LSB	
COF36	4 Byte	LSB before MSB	LSB=0 (no status)
COF38	2 Byte	LSB/MSB	
COF40	4 Byte	MSB before LSB	LSB=status/CRC
COF44	4 Byte	LSB before MSB	LSB=status/CRC

COF64...COF76, 2-wire-bus mode:

If the decimal number 64 is added to the above stated output formats **COF0...COF12**, then the AED is switched into the 2-wire bus output mode. This means that the AED answers no longer with “0“ or “?“ on command inputs. The answer with the parameter or in the case of **MSV?** with the measured value occurs only for command enquiries (e.g. **ASF?**). The command **MSV?0;** (continuous measured value transmission) may no longer be used in this case since otherwise it is no longer possible to stop this output (apart from supply voltage off).

COF128 to COF 140 continuous output after power On (not for bus operation):

If the decimal number 128 is added to the above stated output formats **COF0...COF12**, then the AED is switched into the continuous output mode. After the power On or **RES** command, the AED outputs the measured values *without* **MSV?** request. The continuous output can be switched off with the command STP. The setting is made with the following entries (**COF** ≥128):

1.	...	Make necessary settings.
2.	ICRi;	Set measuring rate of the AED.
	COFx+128;	The AED transmits measured values continuously, time interval corresponding to ICR, x=0...12
3.	STP;	Stop continuous transmission
4.	TDD1;	Store protected against power failure
5.	**COF+128;**	The AED transmits measured values continuously, time interval corresponding to **ICR**.

The AED starts with the measured value output without separate request even after switching on the voltage. These output formats have another special feature (depending on how triggering is set, command **TRC**):

Trigger deactivated:	continuous automatic measured value output
Trigger activated:	automatic measured value output only if a new measured value has been created after triggering (**MAV?**)

Output speed of measured values:

The AED can output a maximum of 600 measured values per second. This data rate also depends on the baud rate (**BDR**), the data format of the measured value output (**COF**) and the set averaging (**ICR**), and filter mode (**FMD** = 0).

The table bellow shows this relationship in the continuous meas. value output (**MSV?**):

Measured values/s (ICR)	**600 (0)**	**300 (1)**	**150 (2)**	**75 (3)**	**37,5 (3)**	**18,75 (4)**	**9,375 (5)**	**4,688 (6)**
Time in ms	1,66	3,33	6,66	13,33	26,66	53,33	106,7	213,3
Output format (**COF**)	necessary baud rates for **MSV0;** (**BDR**)							
Binary format 2 characters for **COF2**/**COF6**	19200	9600	4800	2400	1200	1200	1200	1200
Binary format 4 characters for **COF0**/**COF4**	38400	19200	9600	4800	2400	1200	1200	1200
ASCII format Meas. Values, 10 charact. for **COF3**	57600	38400	19200	9600	4800	2400	1200	1200
ASCII format Meas. value + Adres,s 13 characters for **COF1**	---	57600	38400	19200	9600	4800	2400	1200
ASCII format Meas. value + Adress + status	—	—	38400	19200	9600	4800	2400	1200
	necessary baud rates for **MSV?1;** (**BDR**)							
Binary format 6 charact. MSV?1; for **COF0**/**COF4**	—	38400	19200	9600	4800	2400	1200	1200

Note for the evaluation of the binary measured values

During measured value output in binary format, the binary codes for CR and LF can occur within the bytes representing the measured value. Therefore the contents of the measured value output must not be tested for the characters CR/LF in order to check for any end of the measured value transmission. Rather, for binary output, the number of characters which are received should be registered. Also for binary output, the control characters CR/LF are appended to the measured value (sole exception: **MSV?0;**).

CSM

Checksum
(Check sum in measured value status during binary output)

Range: 0/1
Factory setting 0
Response time: <10ms
Parameters: 1
Password ptotection: no
Parameter protection: with command **TDD1**

Input: **CSM(0/1);**

Query: **CSM?;**

Effect: The preset function is output as a single digit decimal number (0/1).

The check sum can be used for identifying transmission faults in 4 byte binary output mode.

For **CSM**=0, check sum in measured value status is deactivated. The normal measured value status is output (see **MSV**).

For **CSM**=1, a check sum (EXOR) is formed from the three byte measured value and output instead of the measured value status. This check sum can only be utilized with the output formats **COF8** and **COF12** (+i*16, i=0,1...7).

GRU

Group Address
(Group address)

Range: 0...32
Factory setting: 32
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD1**

Input: GRU(Group-Addr.);

Entry of the device address as decimal number 0...32.

By defining a group address, several AEDs can be assigned to a group. This group assignment remains in force until it is superseded by entering a new group address.

Group address 32 has a special position. An AED with group address 32 does not belong to any group as this address cannot be assigned as a unit address.

In general, in bus mode all connected AEDs listen in. An AED is activated if its address matches the address sent by the master. It executes a subsequent command and sends its answer to the master. If the address sent by the master matches the group address, then the following command is executed, the answer is placed in the output memory, but it will only be transmitted to the master (**S...**) on request (example: see Chap. 5.3).

TEX

Terminator Execution
(Data delimiter between measured values)

Range: 0...255
Factory setting: 172
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD1**

Input: **TEX(0...255);**

The required data delimiter is input in decimal form as an ASCII character (e.g. comma = $2C_H$ = 44_D → input **TEX44;** H: Hexadecimal, D: Decimal). Any ASCII character from $0...127_D$ ($0...7F_H$) can be taken as data delimiter. The data delimiter is set between the parameters in the measured value output (see also commands **MSV** and **COF**).

Example: TEX44;

Measured value output: -0123456, 12, 000, -0123457, 12, 000, etc. (for ***COF9****)*

If the selected ASCII character is entered with an offset of 128 (above example: comma = 44_D + 128_D = 172_D → entry **TEX172;**), then the parameters of a measured value are separated by comma as before, but crlf is output at the end of the measured value.

Example: TEX172

Measured value output: -123456, 12, 000, -123457, 12, 000, usw.

Query: **TEX?;**

Effect: The preset function is output as a three digit decimal number (0...255).

S...

Select
(Selection of AEDs in bus mode)

Range: 0...31, 98
Factory setting: —
Response time: <10ms
Parameters: 1
Password protection: no
Parameter prtotection: no data to be protected

Input: **S(00...31, 98);** (only with semicolon, not with CRLF!)

The select command generates no answer. Several AEDs connected together to form a BUS can be addressed individually or jointly with this command. An AED is always passive after reset or power On (except for **COF**>127) and, in bus mode, must therefore be addressed through the select command to prevent the other bus subscribers from responding. For just one AED the **S...** command is not required. A maximum of 32 addresses (00...31) can be allocated through the command **ADR**.

Important note

The command **S...** alone generates no answer. The selected AED answers only together with a further command. Exception in bus mode: **COF16...COF28** (after. **MSV?0;**).

Selection	Effect for AED	Effect for PC
S00 to **S31**	only the AED with the address stated executes all commands and responds. All AEDs with the same group address execute all commands and do not respond. All other AEDs only understand the Select commands **S00** to **S99** and do not respond.	1:1 communication with a selected AED.
S32 to **S63**	only the AED with the address stated executes all commands and responds. All other AEDs execute all commands but do not respond.	1:1 communication with a selected AED representative for all AEDs.
S64 to **S95**	only the AED with the address stated is accepted as a subscriber who executes all commands but does not respond. All other AEDs remain unchanged This applies until this AED is addressed with the command **S00..S31** A permanent group can only be built up via the group address (command **GRU**).	a) if, with **S00** to **S31**, an AED is selected, then 1:1 communication with this AED representative for the AEDs additionally selected. b) if, with **S00** to **S31**, no AED is selected, then the commands are processed in all additionally selected AEDs, but there will be no response.
S96	All AEDs only understand the select command	no communication except the command select
S97, **S98**	All AEDs execute all commands but do not respond.	
S99		Collision in bus mode

Example: *Select 00*
Command 1
Commandl 2...n
Select 01
Command 1 etc.

The command **S98**; is provided for special functions (broadcast). In this case all AEDs connected to the bus are addressed. All AEDs execute the following commands. No AED answers. This occurs as long as only one AED is addressed through **S00 ... S31** again.

A measured value query in the bus can be performed as follows:

1. Select all AED via **S98** command.

2. Measured value query via **MSV?.** All AED form the measured value and place this value after the integration time (**ICR**) in the output buffer, but no AED transmits.

3. Select the AED with address 01 via **S01** command. The AED with address 01 outputs the measured value.

4. Select the AED with address 02 via **S01** command. The AED with address 02 outputs the measured value. Etc.

STR

Set Termination Resistor
(Bus termination resistors)

Range:	0/1
Factory setting:	0 (off)
Response time:	<15ms
Parameters:	1
Password protection:	yes
Parameter protection:	with command TDD1

Query: **STR?** **Effect: 0/1 crlf**

Command: **STR0/1;**

Effect: 0 = Bus termination switched off,
1 = Bus termination switched on

The necessary measures for the electrical bus termination (resistors) were described in Section 5.3. These resistors protect the zero-signal level on the master line if none of the connected modules is transmitting. Observe here that this bus termination must be switched on only twice per bus system (master line), and is generally located at the line ends of the master line.

Normally the interface of the master contains such a bus termination and the termination is switched on at the most remote AED via the command STR1;.

(please refer also the manual of the basic unit, part 1

3.2 Adjustment and scaling

The commands described below serve for setting the factory characteristic as well as the user characteristic:

- Commands for adjusting the factory characteristic: **SZA**, **SFA**
- Commands for adjusting the user characteristic: **LDW**, **LWT**
- Command for part load adjustment for the user charact.: **CWT**
- Scaling the measured output value: **NOV, RSN**
- Engineering unit: **ENU**
- Linearization: **LIC**

Setting the characteristic:

The AED works initially with a factory characteristic **SZA / SFA**. This factory characteristic should not be changed. Using **TDD0** the factory setting can be restored. The factory characteristic is set to 2mV/V.

The user can adapt the AED characteristic to his requirements with the command pair **LDW, LWT**.
Using the command **CWT**, the user characteristic can also be set with a partial load.

Important note

The characteristic commands **LDW, LWT** must be entered or executed in the sequence **LDW** , then **LWT...** The input data are not computed until both parameters have been entered or measured in pairs.

The scaling must be switched off when determining the characteristic (**NOV0**).

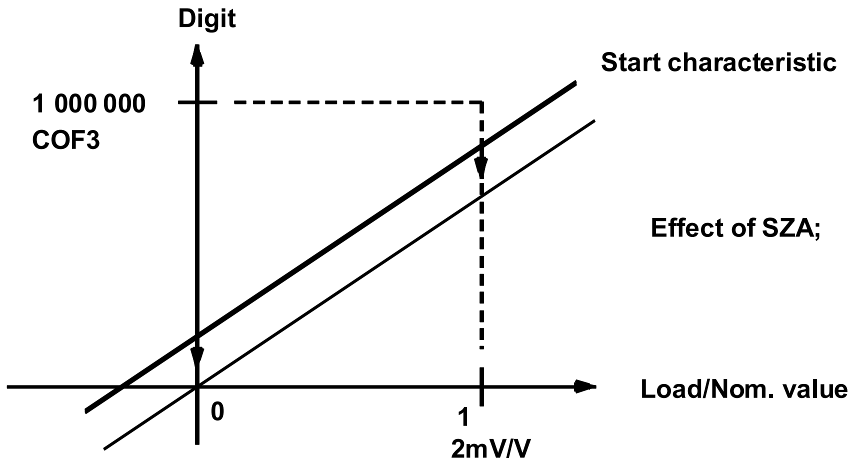
After the values for zeropoint and nominal value of the user characteristic have been measured or entered, the range **LDW** → LWT (at **NOV**=0) is mapped to the following numerical ranges:

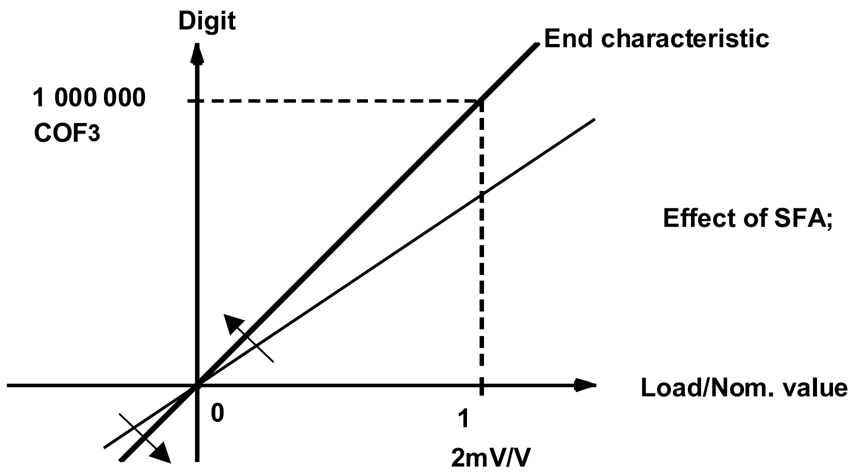
Output at max. capac. (COF)	NOV=0	NOV>0
2 Byte binary	20000	NOV value
4 Byte binary	5120000	NOV value
ASCII	1000000	NOV value

Set factory characteristic SZA, SFA

Absolute value calibration in mV/V

Action	Command sequ.	
Enter password	SPW"AED"	
Load = 0	SZA	
Load = nominal value	SFA	





SZA

Sensor Zero Adjust
(Factory characteristic zero point)

Range:	0...1,599999e6
Factory setting:	Calibration to 0mV/V
Response time:	<15ms...4.2s
Parameters:	1/0
Password protection:	yes
Parameter protection:	after entry of **SFA**

For an entry signal of 0mV/V, the internal measured value is assigned to the output value 0 Digit.

Accepting an applied signal with SZA (response time<4.2s):

1. Connect the transducer electronics to a calibration standard.
2. Set the calibration standard to 0mV/V staggering.
3. Accept the applied signal by means of the command **SZA**.

   The applied signal is measured and filed in the memory, but accounted for only after measuring or entering the **SFA** value.

Manual input of the zero point via SZA (response time<15ms):

1. Use the command **SZA<zero value>** to enter the zero point.

The entered value is stored, but accounted for only after measuring or entering the parameter for **SFA**.

Query: **SZA?;** (Response time <15ms)

Effect: The value used in the AED for calculating the factory characteristic is output with ±7 digits (e.g. - 0000345crlf).

Important note

The characteristic commands SZA, SFA must be entered or executed in the sequence SZA , then SFA. The input data are not computed until both parameters have been entered or measured in pairs.

SFA

Sensor Fullscale Adjust
(Factory characteristic end value)

Range:	0...1,599999e6
Factory setting:	Calibration to 2mV/V
Response time:	<15ms...4.2s
Parameters:	1/0
Password protection:	yes
Data backup:	on entry

Accepting an applied signal with SFA (response time<4.2s):

1. Connect the transducer electronics to a calibration standard.
2. Set the calibration standard to 2mV/V staggering.
3. Accept the applied signal by means of the command **SFA**.

   The applied signal is measured and filed in the memory, and offset against the previously measured or entered **SZA** value.

Manual input of the zero point via SZA (reaction time<15ms):

1. Use the command SFA<nominal value> to enter the measured value for 2mV/V.

   The entered value is stored, and offset against the previously measured or entered **SZA** value.

Query: **SFA?;** (Response time<10ms)

Effect: The value used in the AED for calculating the factory characteristic is output with ±7 digits (e.g. - 0950246crlf).

Important note

The characteristic commands SZA, SFA must be entered or executed in the sequence SZA , then SFA. The input data are not computed until both parameters have been entered or measured in pairs.

An entry or measurement of the factory characteristic with **SZA/SFA** resets the user characteristic to the default values **LDW**=0, **LWT**=1000000, and **CWT**=1000000.

Procedure for entering the factory characteristic: (**SZA**, **SFA**):

1. Connect AED to a calibration standard (e.g. K3608 or K3607)
2. Enter password by means of command **SPW**
3. **NOV 0;** (scaling off)
4. Deactivate part. load calibration by means of **CWT1000000;**
5. Deactivate user characteristic by means of **LDW0;** and **LWT1000000;**
6. Adjust the **ASF** filter such that a maximally quiescent display is effected
7. Set calibration standard to 0mV/V, wait until standstill
8. Determine measured value with **MSV?;** , note value1 for **SZA**
9. Set calibration standard to 2mV/V, wait until standstill
10. Determine measured value with **MSV?;** ,note value2 for **SFA**
11. Enter new characteristic with: **SZA value1;** subsequently
    SFA value2;

The points 3...9 are not applicable if the factory characteristic is entered anew using already known parameters.

An entry or measurement of the factory characteristic with **SZA/SFA** resets the user characteristic to the default values **LDW**=0, **LWT**=1000000, and **CWT**1000000.

3.2.1 Adjust user characteristic with LDW, LWT

Action	Command
Set Password , e.g..	**SPW"AED";**
Loading with scale dead load	**LDW;**
Loading with max. capacity of scale	**LWT;**

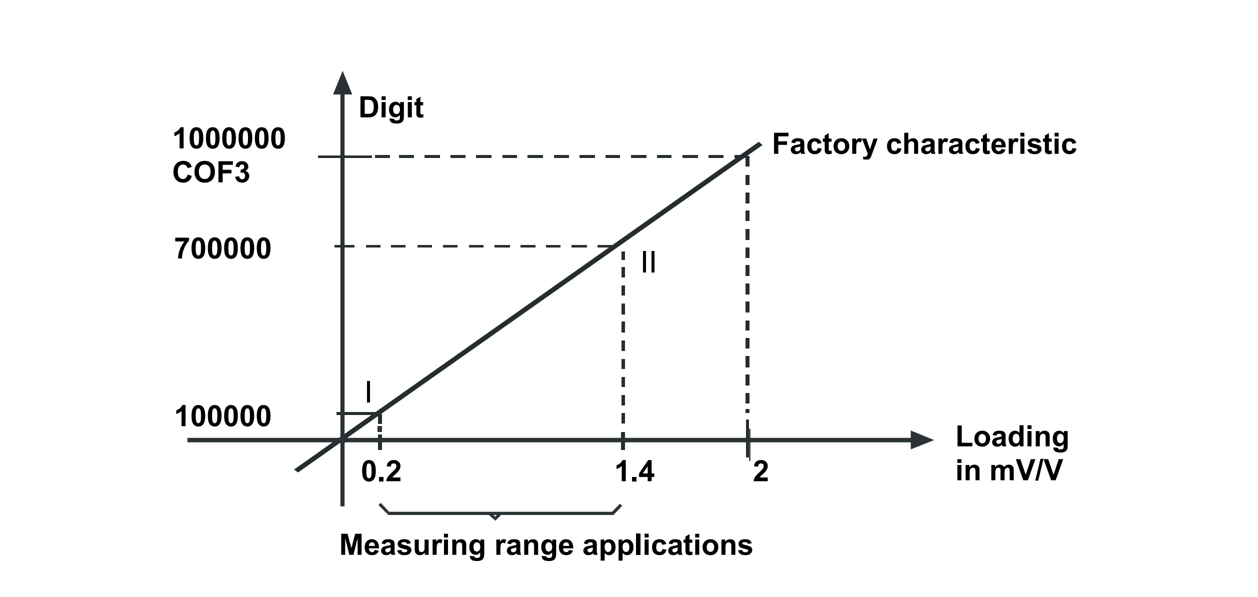


Fig.. 3.2-3: Facrory setting with dead load

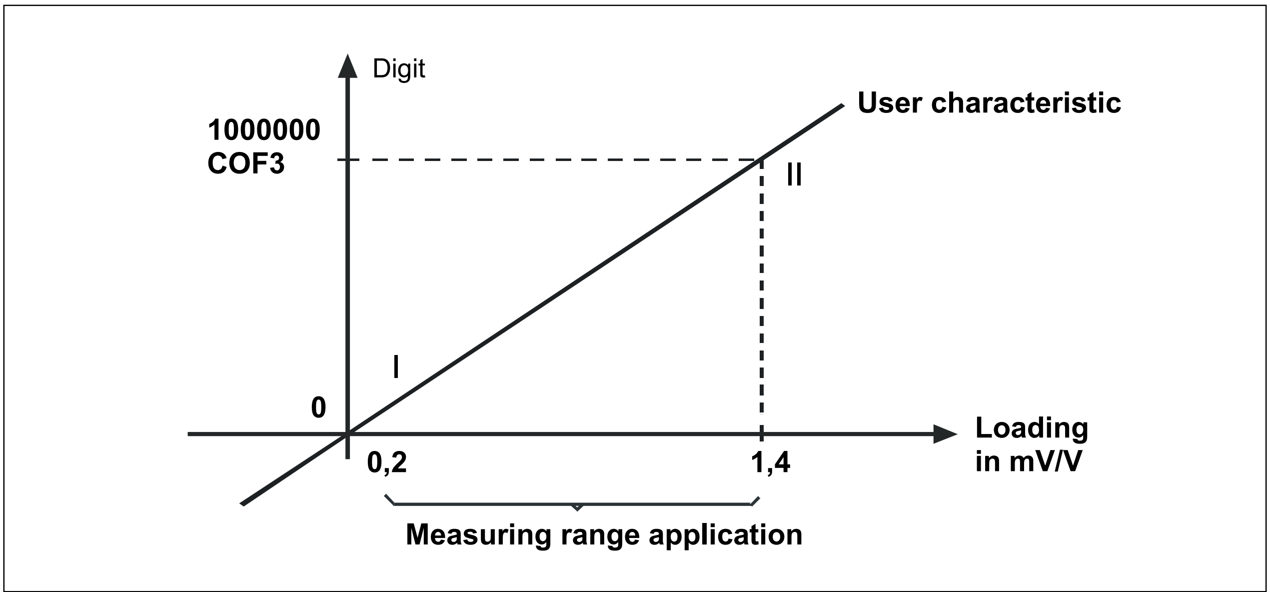


Fig. 3.2-4: User characteristics with max. capacity

LDW

Load Cell Dead Weight
(Zeropoint of the user characteristic or scale characteristic)

Range:	0...1,599999e6
Factory setting:	0
Response time:	<15ms...4.2s
Parameters:	1
Password protection:	yes
Parameter protection:	after entry of **LWT**

Saving the zero point of user characteristic with LDW command (Response time<10ms):

1. The scale is unloaded.
   Save the zero point signal with command **LDW;**.
   Using this command, the transducer electronics measures an input signal between ±2.5mV/V or zero and nominal load of the scale, stores the measured value, but will calculate the same only after entering the parameter for **LWT**.

Input of the zero point of the user characterisic with LDW (Response time <15ms):

1. Enter the value for the zero point signal of the scale with **LDW<zero point>.**
   The entered value is stored, but accounted for only after entry of the parameter for **LWT**

Query: **LDW?;** (Response time <15ms)

Effect: The value used in the AED for calculating the user characteristic is output for user zero digit or preloaded transducer (dead load) in 7 digits with sign (e.g. –0000345 crlf). The value is not converted via NOV.

Important note

If the **LDW/LWT** calibration is not to be executed with 100% input signal, the **CWT** value needs to be set initially. (see **CWT** Calibration Weight)

LWT

Load Cell Weight
(End value of the user characteristic = scale characteristic)

Range:	0...1,599999e6
Factory setting:	1000000
Response time:	<15ms...4,2s
Parameters:	1/0
Password protection:	yes
Parameter protection:	on entry

Saving the full scale value of the user characteristic with LWT command (Response time <4.2s):

Input: **LWT;**

The command functions in analogy to the command **LDW**. Using this command, the transducer electronics measures an input signal between ±3,0 mV/V or zero and nominal load, and caculates this measured value with the previously entered value for **LDW** to form a new characteristic. The values for **SZA** and **SFA** are not changed.

Input of the full scale value of the user characteristicc with LWT command (Response time<1.5s):

Input: **LWT<End value>;**

Instead of causing the AED to measure the applied signal, the value for the user resolution is entered directly here and calculated with the previously entered value for **LDW** to form a new characteristic.

Query: **LWT?;** (Response time <15ms)

Effect: The value used in the AED for calculating the user characteristic is output for user nominal digit or preloaded transducer (user – nominal load) in 7 digits with sign (e.g.0000345 crlf). The value is not converted via **NOV**.

Important note

If the **LDW/LWT** calibration is not to be executed with 100% input signal, the **CWT** value needs to be set initially. (see **CWT** Calibration Weight).

An entry or measurement of the factory characteristic with **SZA/SFA** resets the user characteristic to the default values **LDW**=0, **LWT**=1000000, and **CWT**=1000000.

Input of the user characteristic (LDW, LWT, CWT):

1. Enter password by means of command **SPW**
2. Enter **NOV 0;** (scaling off)
3. Enter **CWT1000000** (partial load calibration off)
4. Deactivate user characteristic by means of **LDW0;** and **LWT1000000;**
5. Adjust the **ASF** filter such that a maximally quiescent display is effected
6. Scale at no load , wait for standstill.
7. Determine measured value with **MSV?;** note value 1 for **LDW**.
8. Load scale with nom. load; wait for standstill.
9. Determine measured value with **MSV?;** note value 2 for **LWT**.
10. If the measured LWT value does not correspond to 100% of nom. Load, enter **CWT** command (see chapter Individual descriptions of the commands – **CWT**).
11. Enter the new characteristic with **LDW<value1>;** and then **LWT<value2>;.**
12. Set **ASF, NOV, RSN** in accordance with the application, power-failure-protected storage of the parameters with the command **TDD1**.

Measurement of the user characteristic (LDW, LWT, CWT):

1. Enter password by means of command **SPW**.
2. Enter **CWT<partial load>** for partial load range (see chapter Individual descriptions of the commands – **CWT**).
3. Scale at no load , wait for standstill.
4. Determine the measuring value of the zero signal of the user characterisic with **LDW;** command. The signal of the unloaded scale is measured and stored.
5. Load scale with nominal load; wait for standstill.
6. Determine the measuring value for end value of the user characteristic with **LWT;** command. The inputsignal of the loaded scale is measured, stored and the characteristic is calculated.
7. Set **NOV, RSN** in accordance with the application, power-failure-protected storage of the parameter with the command TDD1.

CWT

Calibration Weight
(Calibration weigh)

Range:	200000...1200000 (20...120%)
Factory setting:	1000000 (100%)
Response time:	<10ms
Parameters:	1/2
Password protection:	yes
Parameter protection:	on entry

Input: **CWT <calibration weight in %>;**

If, when calibrating the user characteristic **(LDW/LWT),** 100% input signal cannot be achieved, then the cwt command provides the option to adjust the AED with an input signal within the range of 20% to 120% of the required nominal value (partial load calibration).

Query: **CWT?;** (Response time<10ms)

Effect: Value1,Value2 CRLF

Value1 and Value2 are two 7digit decimal numbers within the range 200 000 to 1 200 000.
Value1 is the percentage share of the nominal load which is used to execute the next **LDW/LWT** calibration.
Value2 is the percentage share of the nominal load which was used to execute the last **LDW/LTW** calibration. Value2 cannot be entered.

For **LDW/LWT** pair of characteristics there is the **CWT** value which compairs with the balance of **LDW/LWT**.

Example:

*Factory settings **LDW** value = 0, **LWT** value = 1000000, and*

CWT value = 1000000. The user characteristic LDW/LWT of a scale is to be calibrated with 100kg = 1 million digits.

1. However, only a 50kg calibration weight is available for calibration.
For calibration, the **CWT** value is set to 500000 (50%); then a LDW/LWT calibration is executed.

2. With 50kg, the AED will output 500000 digit as a measured value, and with 100kg, 1 000 000 digit are output as a measured value.
*The response to **CWT?** is now 500 000,500 000crlf.*

Important note

If the values for **LDW** and **LWT** are to be re-entered at a later date, then the **CWT** value needs to be entered first, followed by the value for **LDW**, and finally by the value for **LWT**.
Users of the existing AD101/102 can execute the **LDW/LWT** calibration normally, as the **CWT** value is set by factory default to 1 000 000 = 100%.

An entry or measurement of the factory characteristic with **SZA/SFA** resets the user characteristic to the default values **LDW**=0, **LWT**=1000000, and **CWT**=1000000.

NOV

Nominal Output Value
(Resolution of the user characteristic)

Range:	0...1,599999e6
Factory setting:	0 (=switched off)
Response time:	<10ms
Parameters:	1
Password protection:	yes
Parameter protection:	with command **TDD1**

Input: **NOV<value>;**

Query: **NOV?;** (Response time <10ms)

Effect: The value stored in the AED is output in 7 digits complete with sign (e.g. 0000345crlf).

The **NOV** value is used for scaling the output value during measured value output. At **NOV**=0 this output scaling is deactivated. The ASCII measured value output is scaled to 1000000 at the factory. If a measured value output of 2000 digit at nominal load is required, then use this command to set the nominal value **NOV2000**. The input parameters or tara values are not changed by this scaling.

Meas. value output format at nom. load	NOV=0	NOV>0
2 Byte binary	20000	**NOV** value
4 Byte binary	5120000	**NOV** value
ASCII	1000000	**NOV** value

With the 2 byte binary type of output, the **NOV** value must be $\leq$ 30000. Otherwise the measured value will be output complete with overflow or underflow ($7fff_H$ or 8000_H ; H: Hexadecimal). With **NOV30000**, the overload range is only approx. 2700 digits.

RSN

Resolution
(Resolution of the measured values)

Range:	1, 2, 5, 10, 50, 100 d
Factory setting:	1
Response time:	<10ms
Parameters:	1
Password protection:	no
Parameter protection:	with command **TDD1**

Input: **RSN<value>;**

Query: **RSN?;** (Response time <10ms)

Effect: The value stored in the AED is output in 3 digits (e.g. 001 crlf).

The RSN limits the measured value resolution:

Example: NOV*=10000d and* ***RSN2***
→ measured value output in 5 digits: 0, 2, 4, 6, ... 9996, 9998, 10000

Example: NOV*=10000d and* ***RSN5***
→ measured value output in 5 digits: 0, 5, 10 .... 9990, 9995, 10000

ENU

Engineering Unit
(User unit)

Range:	4 letters or numbers (ASCII-character)	
Factory setting:	none	
Response time:	output:	<15ms
	input:	<40ms
Parameters:	1	
Password protection:	no	
Parameter protection:	on entry	

Input: **ENU("abcd");**

Entry of a unit. An arbitrary unit with max. 4 characters can be entered. If less than 4 characters are input, the entry is supplemented with blanks. The entered unit is not appended to the measured value. The characters must be entered in quotation marks (“...“).

Query: **ENU?;**

Effect: Output of the unit with 4 characters.

LIC

Linearization Coefficients
(Compensation of a linearity error)

Range:	±0...1999990	
Factory setting:	0, 1000000, 0, 0 (=**LIC** off)	
Response time:	with output:	<15ms
	with input:	<35ms
Parameters:	2/4	
Password protection:	yes	
Data backup:	on entry	

Input: **LIC(0...3),(Coefficient);**

Example for an entry:

Entry coefficient 0 = +10:	***LIC0,+10;***
Entry coefficient 1 = +1000345:	***LIC1,+1000345;***
Entry coefficient 2 = -345:	***LIC2,-345;***
Entry coefficient 3 = +45:	***LIC3,+45;***

Query: **LIC?;**

Response: **LIC0,1000000,0,0;**

Effect: Output of the linearity coefficient in the sequence:
Coefficient 0, coefficient 1, coefficient 2, coefficient 3 CRLF.

The characteristic curve defined by means of the command pair **SZA** and **SFA** is initially determined in two points. Using the AED, the linearity error of a scale can be compensated. For linearisation, the AD103B contains a polynomial of the 3rd order:

Measured value = ***LIC0 + LIC1*** ** x +* ***LIC2*** ** x^2 +* ***LIC3*** ** x^3, with x = input value*

Using a polynomial of the 3rd order, it is also possible to correct a linearity error with a turning point. Outside the linearisation interval, an increase in measurement errors is to be expected.

The coefficients **LIC0...LIC3** are entered as ASCII numbers by means of the command **LIC**.

Important note

The coefficients are determined during the calibration of the measuring chain. The calculation of the factors is not effected in the AED but must be done by means of the HBM software AED_Panel32 and then loaded into the AED. The precise procedure is described in the operating instructions *AED_Panel32*.

3.3 Measuring

Measuring includes all commands acting directly on a measured value; these are:

Commands for setup the measuring mode:

- Select input signal **ASS**
- Filter mode **FMD**
- Filter selection cut-off frequencies **ASF**
- Measuring rate **ICR**
- Motion detection **MTD**
- Automatic Zero tracking **ZTR**
- Initial zero setting **ZSE**

Commands for the measurement:

- Measured value output **MSV?**
- Stop measured value output **STP;**
- Tare mode **TAR;**
- Tare value **TAV**
- Gross/net switch-over **TAS**
- Zeroing (+/-2%) **CDL**

3.3.1 Commands for setup the measuring mode

ASS

Amplifier Signal Selection
(Signal selection)

Range:	0...3	
Factory setting:	2	
Response time:	Output:	<10ms
	Input:	<220ms
Parameters:	1	
Password protection:	no	
Parameter protection:	with command **TDD1**	

Input: **ASS(0...3);**

Select signal from amplifier input

Input	Input signal
0	Internal zero signal
1	Internal calibration signal
2	Measuring signal (SG-Bridge)
3	Internal calibration signal (this switch setting exists for reasons of compatibility with AD101)

FMD

Filter Mode
(Filter mode)

Range: 0/1
Factory setting: 0
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD1**

Input: **FMD(0/1);**

Entry of the filter type as a decimal number 0 or 1.

FMD0: Standard filters (as AD101)

FMD1: Digital filters with fast settling time

The description of the filter type can be found in the **ASF** command description.

Query: **FMD?;**

Effect: Output of selected filter type (0 or 1)

ASF

Amplifier Signal Filter
(Digital filter setting)

Range:	0...9
Factory setting:	5
Response time:	<10ms
Parameters:	1
Passwortschutz:	no
Parameter protection:	with command **TDD1**

Input: **ASF(0...9);**

Depending on the filter moder, there are 2 filter ranges.
FMD 0 (standard Filter) selectable filter stages 0...8
FMD 1 (fast transient digital filters) selectable filter stages 0...9

Query: **ASF?;**

Effect: response: 9 crlf (example)

The AED has a multi-stage filter chain:

- Mean value formation through 2 measured values (at 1200 Hz ADC scan rate, fixed setting)
- Standard filter (**FMD0**) or a fast filter (**FMD=1**); cut-off frequency selectable through **ASF**, fixed scan rate = 600Hz
- Mean value formation for scan rate reduction (selectable through **ICR**, scan rate <=600 Hz)

Thus the required filter effect and output rate can be set through the commands (**ASF, ICR,FMD**). In addition to the standard filter properties, further new efficient digital filters have been implemented. The command **FMD** is used for switching over between the two filter.

Filter characteristics of standard filters FMD0

ASF	Settling time in ms to 0.1%	Cut-off frequency in Hz at –3dB	max. damping in dB at 300Hz
1	22	40	-20
2	53	18	-34
3	115	8	-48
4	238	4	-60
5	485	2	-72
6	970	1	-82
7	1897	0,5	-90
8	3800	0.25	-96

At **ASF0** the filter is deactivated. The cut-off frequency of the filter determines the settling time. The higher the filter index, the better is the filter effect; but the longer is the settling time on changing the weight. The filter setting should be chosen as small as possible, with the measured value quiescence (standstill) being guaranteed if the weight does not change.

Filter characteristic of FIR filter with FMD1

ASF	Settling time in ms	Cut-off frequency in Hz at -3dB	20dB damping at frequency in Hz	40dB damping at frequency in Hz	Damping in dB in the stop band	Stop band in Hz
1	62	18	47	63	>90	>90
2	90	11	32	45	>90	>70
3	119	9	24	31	>90	>60
4	147	7	18	24	>90	>60
5	208	5	12	17	>90	>40
6	240	4	10,5	13	>90	>34
7	295	3,5	8	10	>90	>34
8	330	3	7	9	>90	>30
9	365	2,5	6,2	8	>90	>30

At **ASF0** the filter is deactivated.

In addition, the total settling time is dependent on the mechanical structure of the transducer, the dead weight of the scale and the weight to be weighed.

ICR

Internal Conversion Rate
(Measuring output rate)

Range: 0...7
Factory setting: 0
Response time: <10ms
Parametersw: 1
Password protection: no
Parameter protection: with command **TDD1**

Input: **ICR(0...7);**

Entry of the measuring rate as a decimal number from 0...7

The integration time determines the output data rate of the measured values and thus also the response time to the measured value query with the command **MSV?;.**

ICRx = Mean value formation through 2^x *measured values,*

with x=0...7 and **FMD**=0

The following setting possibilities result from this:

Filter mode for FMD0

ICR	Output rate Mw/s (for MSV?x; with x=0..65536)
0	600
1	300
2	150
3	75
4	37.5
5	18.75
6	9.38
7	4.69

Filter mode for FMD1

ICR	Output rate Mw/ s (for MSV?x; with x=0..65536)									
	ASF0	ASF1	ASF2	ASF3	ASF4	ASF5	ASF6	ASF7	ASF8	ASF9
0	600	600	300	200	150	120	100	85.71	75	66.67
1	300	300	150	100	75	60	50	42.86	37.5	33.33
2	150	150	75	50	37.5	30	25	21.43	18.75	16.67
3	75	75	37.5	25	18.75	15	12.5	10.71	9.38	8.33
4	37.5	37.5	18.75	12.5	9.38	7.5	6.25	5.36	4.69	4.17
5	18.75	18.75	9.38	6.25	4.69	3.75	3.13	2.68	2.34	2.08
6	9.38	9.38	4.69	3.13	2.34	1.88	1.56	1.34	1.17	1.04
7	4.69	4.69	2.34	1.56	1.17	0.94	0.78	0.67	0.59	0.52

Observe the baud rate setting when setting the measured value rate. A high baud rate must be set at high measured value rates to avoid measured data losses (see command **COF**).

Query: **ICR?;**

Effect: Output of the selected measuring rate (0...7)

MTD

Motion Detection
(Standstill monitoring)

Range:	0...5
Factory setting:	0
Response time:	<10ms
Parameters:	1
Password protection:	no
Parameter protection:	with command **TDD1**

Input: **MTD(0...5);**

MTD0: **Standstill monitoring deactivated**

MTD1: Standstill monitoring ± 0.25 d/sec from NOV value

MTD2: Standstill monitoring ± 0.5 d/sec from NOV value

MTD3: Standstill monitoring ± 1 d/sec from NOV value

MTD4: Standstill monitoring ± 2 d/sec from NOV value

MTD5: Standstill monitoring ± 3 d/sec from NOV value,

Query: **MTD?;**

Effect: Output of the set standstill step width 0...5

If standstill monitoring is deactivated (**MTD0;**), then no standstill monitoring is executed in the AED and set to standstill in the measured value status. The standstill bit 8 will then always be = 1.
If standstill monitoring is activated (**MTD1...5**) it refers to the nominal value set with the **NOV** command. If user scaling is deactivated (**NOV** =0) or if, with **NOV**, a scaling greater 100 000 is selected, a standstill view with 1d/sec for 100 000d scaling is executed.
The information whether the measured values are within the selected standstill range within one second is transmitted in the measured value status information BIT 3.

ZTR

Zero Tracking
(Automatic zero tracking)

Range:	0/1
Factory setting:	0
Response time:	<10ms
Parameters:	1
Password protection:	no
Parameter protection:	with **TDD1**

Input: **ZTR(0/1);**

ZTR0: Zero tracking deactivated

ZTR1: Zero tracking activated

Query: **ZTR?;**

Answer: **0/1**

Automatic zero tracking is effected at a gross or net measured value of < 0.5d within a range of ± 2% from the nominal value (**NOV**) of the scale. The maximum adjustment velocity is 0.5 d/second when the scale is at a standstill. Standstill detection can be set via the command **MTD**. The unit ‘d’ (digit) refers to the nominal value (**NOV**). If the nominal value is deactivated (**NOV**=0) or **NOV** value > 100 000d , then there will be a standstill monitoring relative to a nominal value of 100 000d (Range: 0...4).

ZSE

Zero Setting
(Initial zero setting)

Factory setting: 0
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: on entry

Input: ZSE(0...4);

ZSE0: zero setting deactivated

ZSE1: zero setting range ± 2% from NOV value

ZSE2: zero setting range ± 5% from NOV value

ZSE3: zero setting range ± 10% from NOV value

ZSE4: zero setting range ± 20% from NOV value

Query: ZSE?;

Answer: 0...4

After voltage switch-on, or following a RESET, or after the RES command, and on expiry of a 2.5s delay period the initial zero setting will be executed within the selected range at a standstill. A change in the initial zero setting range will only become effective after voltage switch-on or following the command **RES**.

If there is no standstill, or if the gross value is outside the selected limits, there will be no zero setting. The internal zero memory is always deleted before any automatic zero setting. If the gross value at standstill is within the selected range, this gross value will be stored in the zero memory. The zero memory cannot be read out. Scale standstill is fixed at 1d/second. The unit ‘d’ (digit) refers to the nominal value (**NOV**). If the nominal value is deactivated (**NOV**=0) or **NOV** value > 100 000d , then there will be a standstill monitoring relative to a nominal value of 100 000d .

3.3.2 Commands for the measurement

MSV

Measured Signal Value
(Output measured values)

Range:	Integer	±32767
	Long Integer	±8388607
	ASCII	±1638399
Factory setting:	ASCII	
Response time:	for **FMD0**: < $2^{ICR} \ast 1{,}67ms + 1{,}67ms$	
	for **FMD1**: < $2^{ICR} \ast$ **ASF**(1...9) $\ast 1{,}67ms + 1{,}67ms$, with ICR = Measuring rate	
Parameters:	1	
Password protection:	no	
Parameter protection:	no data to be protected	

Query: **MSV?(0);** (not in 2-wire mode)

Effect: Continuous output of measured values until output is stopped by means of the **STP** command.

Query: **MSV?(1...65535);**

Effect: Outputs the stated number of measured values.

The measured value will be output in ASCII or binary format (see command **COF**).

Example: *Definition of measuring signal output in ASCII format*

1. *The output format for the measured value must be set* ***previously*** *via the command* ***COF****.*

The measured value is output with direct reference to the relevant measuring range. The measured value can be a gross or net measured value (command **TAS**). This command generates responses of constant length.

2. *Define the output length of the measured value via* ***MSV?;*** *command.*

In this case, the **output length** for the command **MSV?;** depends upon the output format (see **COF** command):

Output format	**AED response**		**Number of characters**
Binary 4 Byte	yyyy CRLF	(y – binary)	6
Binary 2 Byte	yy CRLF	(y – binary)	4
ASCII (**COF3;**)	xxxxxxxx CRLF	(x - ASCII)	10
ASCII (**COF9;**)	xxxxxxxx,xx,xxx CR LF	(x - ASCII)	17

CR: Carriage Return, LF: Line Feed

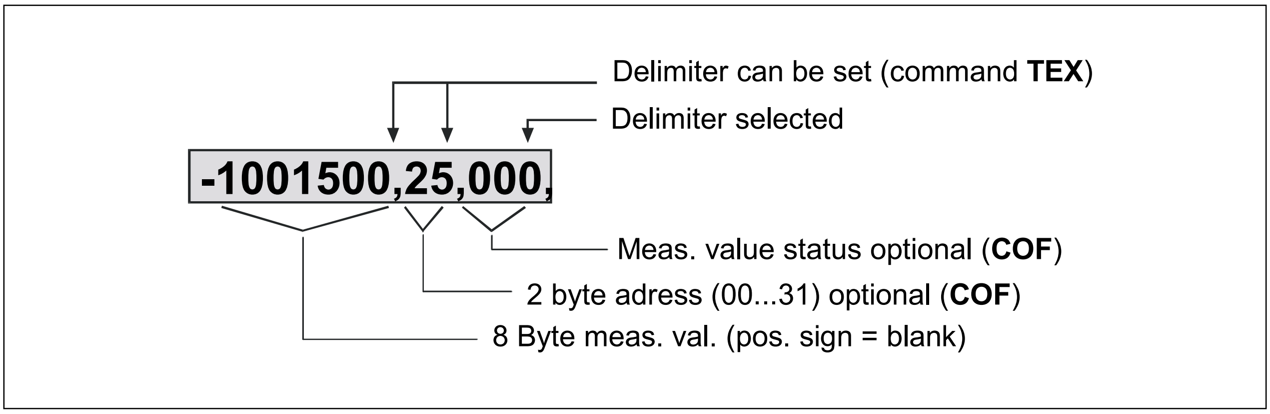


Fig. 3.3-1: ASCII – Output format of the measured value (**COF9**)

*3. Define the output scaling with **NOV** command.*

The **output scaling** depends on the parameter of the command **NOV**.

Output format meas. value with nom. load	NOV=0	NOV>0
2 Byte binary	20000	NOV value
4 Byte binary	5120000	NOV value
ASCII	1000000	NOV value

With the 2 byte binary type of output, the **NOV** value must be ≤ 30000. Otherwise the measured value will be output complete with overflow or underflow ($7fff_H$ or 8000_H ; H: Hexadecimal). With **NOV30000**, the overloding range is only approx. 2700 digits.

4. Define the output rate with the ICR command.

The **response time** for the measured value query is determined by the integration time (command **ICR**) and the filter mode (**FMD**) and, for **FMD**=1, also the filter stage **ASF**:

Filter Mode (FMD) (Single query MSV?;)

ICR	Max. Meas. time [ms] for MSV?;
0	3.3
1	5
2	8.3
3	15
4	28.3
5	55
6	108.3
7	215

Filter mode for FMD1 (Single query MSV?;)

ICR	**Max. Measuring time [ms] for MSV?;**									
	ASF0	**ASF1**	**ASF2**	**ASF3**	**ASF4**	**ASF5**	**ASF6**	**ASF7**	**ASF8**	**ASF9**
0	3.3	3.3	5	6.7	8.3	10	11.7	13.3	15	16.7
1	5	5	8.3	11.7	15	16.3	21.7	25	28.3	31.7
2	8.3	8.3	15	21.7	28.3	35	41.7	48.3	55	61.7
3	15	15	28.3	41.7	55	68.3	81.7	95	108.3	121.7
4	28.3	28.3	55	81.7	108.3	135	161.7	188.3	215	241.7
5	55	55	108.3	135	188.3	241.7	321.7	375	428.3	481.7
6	108.3	108.3	188.3	321.7	428.3	535	641.7	748.3	855	961.7
7	215	215	428.3	641.7	855	1068.3	1281.7	1495	1708	1921.7

The output rates possible in dependence on **FMD**, **ASF**, and **ICR** are detailed in the description of the **ICR** command.

5. Define the measuring signal ouput with ***MSV***

A predefined number of measured values can be output via a command **MSV?(number);** . The measuring time lies between the output of two measured values. The total time for the acquisition of the selected number of measured values depends on the preset filter mode (**FMD**) and is calculated as:

For **FMD**=0 and **FMD**=1 with **ASF**=0 for:

Measuring time [ms] = Number $* \; 2^{ICR} \; *$ *1.666ms + 1.666ms*, with

ICR = Measuring rate

For **FMD**=1 and **ASF**=1...9 is:

Measuring time [ms] = Number $*$ ***ASF*** $* \; 2^{ICR} \; *$ *1.666ms + 1.666ms*, with

ICR = Measuring rate

There is a continuous output of measured values with **MSV?0;.** This output can be stopped only through the commands **STP, RES** or voltage switch-off. No other parameters can be entered or retrieved during the continuous output.

In the 4-byte binary output or in the ASCII output, the measured value status can be transmitted with the measured value (see command **COF**, depending on **IMD**).

Messages in measured value status for IMD0

Contents of the status byte in the measured value output	**Possible cause**
Bit 0 1= Net overflow	Tare value to large
Bit 1 1= Gross overflow	Scaling to sensitive
Bit 2 1= ADU overflow	ADU overflow (input > ±2.9mV/V)
Bit 3 1= Standstill	Measured values are within the standstill range in d/s, preset by the command **MTD**.
Bit 4 1= Limit value 1 active	Status of limit value 1 if activated (see **LIV**)
Bit 5 1= Limit value 2 active	Status of limit value 2 if activated (see **LIV**)
Bit 7/6 1 = Measured values not coherent	Do not fit together. Measured values cannot be output justified in the selected configuration (see BDR, ICR, COF).

Messages in measured value status for IMD1

Contents of the status byte in the measured value output	**Possible cause**
Bit 0 1 = Net overflow	Tare value to large
Bit 1 1= Gross overflow	Scaling to sensitive
Bit 2 1 = ADU overflow	ADU overflow (input > ±2.9mV/V)
Bit 3 1 = Standstill	Measured values are within the standstill range in d/s, preset by the command **MTD**.
Bit 4 1 = Limit value1 active	Status of limit value 1 if activated (see **LIV**)
Bit 5 1 = Limit value 2 active	Status of limit value 2 if activated (see **LIV**)
Bit 6 1 = Trigger function active	Triggering effected, remains active until trigger output value has been determined (MAV)
Bit 6/7 = 1 = Measured values not coherent (! overwrites trigger Bit 6*) [1)]	Do not fit together. Measured values cannot be output justified in the selected configuration (see BDR, COF, ICR).

1) * only occurs with **MSV?i;** if baud rate is too low (see **BDR**).

Messages in measured value status for IMD2 (dosing function)

Contents of the status byte in the measured value output	**Possible cause**
Bit 0 1 = Net overflow	Tare value to large
Bit 1 1= Gross overflow	Scaling to sensitive
Bit 2 1 = ADU overflow	ADU overflow (input > ±2.9mV/V)
Bit 3 1 = Standstill	Measured values are within the standstill range in d/s, preset by the command **MTD**.
Bit 4 1 = Coarse flow active	Coarse flow output activated
Bit 5 1 = Fine flow active	Fine flow output activated
Bit 6 1 = Ready	Filling Ready or emtying active
Bit 7 = 1 = Measured values not coherent	Do not fit together. Measured values cannot be output justified in the selected configuration (see BDR, COF, ICR).

STP

Stop
(Stop of the measured value output)

The measured value output is terminated with this command. **STP** acts only on the command **MSV**. A started measured value is output completely.

TAR

Tare
(Taring)

Range: —
Factory setting: —
Response time: for **FMD0:** < $2^{ICR} * 1.67$ms + 1.67 ms
for **FMD1** and **ASF0:** < $2^{ICR} * 1.67$ms + 1.67 ms
for **FMD1:** < 2^{ICR} * **ASF(1...9)** * 1.67ms + 1.67ms,
with ICR=Measuring rate
Parameters: 0
Password protection: no
Parameterprotection: no data to be protected

The current measured value is tared with the command **TAR**. After taring, the system switches over to "Net measured value" (**TAS0**). The current value is filed in the tare memory (see also command **TAV**) and subtracted from the measured value and all following measured values.

Moreover, the AD103B provide the option to initiate taring via an external contact (digital input IN2).

TAV

Tare Value
(Set/read tare memory)

Range:	0...±8388607
Factory setting:	0
Respnse time:	<20ms
Parameters:	1
Password protection:	no
Parameter protection:	with command **TDD1**

Input: **TAV(±Tare value);**

Enter tare value 7digit with sign (max. ±8 388 607). This value is set off with the **LDW/LWT** characteristic scaled with the parameter **NOV** (0...**NOV**). The tare memory is deleted (contents = 0) after characteristic entries with the commands **SZA, SFA** or **LDW, LWT**.

Query: **TAV?;**

Effect: The contents of the tare memory is output. The tare value is converted to the NOV value.

Output format of meas. value at nominal load	Nomin. Tare range at NOV>0	Max. tare range at NOV>0	nomin. Tare range at NOV=0	Max. tare range at NOV=0
2 Byte binary	±**NOV** value	±150% **NOV** value	±1000000	±8388607
4 Byte binary	±**NOV** value	±150% **NOV** value	±1000000	±8388607
ASCII	±**NOV** value	±150% **NOV** value	±1000000	±1599999

Example:

NOV3000*;*		*(Scaling the scale)*
TAS1;		*(Gross output switched on)*
MSV?;	*1500 CRLF*	*(Measured value lies at 50% = nominal load of the scale)*
TAR;		*(Taring and switching over to net output)*
TAV?;	*1500 CRLF*	*(Enquire tare value)*
MSV?;	*0 CRLF*	*(Net measured value)*
TAS?;	*0 CRLF*	*(Net is switched on)*
TAS1;	*0 CRLF*	*(Switching over to gross)*
MSV?;	*3000 CRLF*	*(Measured value is at 100% = nominal load of scale)*
TAV?;	*1500 CRLF*	*(Enquire tare value, without change)*

TAS

Tare Set
(Gross-/net switch-over)

Range:	0...1
Factory setting:	1 (Gross)
Response time:	<10ms
Parameters:	1
Password protection:	no
Parameter protection:	with command **TDD1**

Input: **TAS(0...1);**

TAS0: Net-Measured value

The value in tara memory is subtracted from the current.

TAS1: Gross-Measured value

The value in the tare memory is not subtracted.
The tare value remains unchanged during gross/net switch-over.

Query: **TAS?;**

Effect: Current setting is output.

CDL

Clear Dead Load

(Zeroing)

Range: —
Factory setting: —
Response time: for **FMD0:** < $2^{ICR} * 1.67$ms + 1.67 ms
for **FMD1** and **ASF0:** < $2^{ICR} * 1.67$ms + 1.67 ms
for **FMD1:** < 2^{ICR} * **ASF(1...9)** * 1.67ms + 1.67ms,
with ICR=Measuring rate
Parameters: 0
Password protection: no
Parameterprotection: no data to be protected

Input: **CDL;**

Answer: 0CRLF;

The current gross value is stored in the zero memory and subtracted from the measured value and all following measured values.

This command needs stand still condition (**MTD**). The Gross value must be in the range of +/- 2% of the weighing range (**NOV**).

After power up the AED or after a reset (**RES**) the zero memory is cleared (=0).

If a adjustment (SZA/SFA, or LDW/LWT) is performed the zero memory is also cleared.

CDL?; is not allowed.

There is no access to this internal zero memory.

3.4 Signal conditioning

This group includes the following commands:

Commands for limit switches and digital inputs and outputs:

- mode digital inputs / activating dosing function **IMD**
- limit switches **LIV**
- direct access inputs and outputs **POR**

Commands for the trigger measurement :

- setup trigger function **TRC**
- Trigger result **MAV?**

Commands for the peak value detection:

- setup peak value detection **PVS**
- clear peak values **CPV**
- request peak values (MIN and MAX) **PVA?**

The speed of all signal conditioning functions depends from the following commands: **FMD, ASF, ICR**

3.4.1 Limit values and digital inputs/outputs

- mode digital inputs / activating dosing function **IMD**
- limit switches **LIV**
- direct access inputs and outputs **POR**

The speed of the signal conditioning function **LIV** depends from the following commands: **FMD, ASF, ICR**

IMD

Input Mode
(Set function of inputs)

Range: 0/1/2
Factory setting: 0
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD1**

Using this command, the function of the digital inputs IN1 (connector 1 PIN16) and IN2 (connector 1 PIN17) of the AED is switched over (See also the manual part 2)

Input: IMD(0/1/2):

IMD0; The logical states on the inputs IN1 and IN2 can be retrieved by means of the **POR** command. A modification of the levels on IN1 or IN2 does not have any effect on the AED.

IMD1; The input IN1 is an external trigger input for the trigger function (**TRC**)
The input IN2 is an input for an external taring command
The taring command via the input IN2 has the same effect as the command **TAR**.

The waiting period until the taring command is executed depends on the measuring rate selected and the filter. (see also the descriptions for the commands **TAR,ICR,ASF,FMD**)

IMD2; This setting activate the dosing and filling function. Now the digital input IN1 has the function of Break dosing (**BRK**) and IN2 is the start signal (**RUN**). Please refer the manual AD103B part 4 (dosing function).

Using the command **POR?**, it is always possible to query the logical state of inputs IN1 and IN2.

Query: **IMD?;**

Effect: The preset function is output as a single digit decimal number (0/1/2)

Note:

The IMD command has an influence to the contents of the measuring state (see **MSV?**)

LIV

Limit Values
(Limit values)

Range:	1/2, 0/2, 0/1, ±0...1599999, ±0...1599999
Factory setting:	1, 0, 0, 0, 0 für Grenzwert 1 2, 0, 0, 0, 0 für Grenzwert 2
Response time:	<10ms
Parameters:	5
Password protection:	no
Parameter protection:	with command **TDD1**

The AED contains 2 limit value switches with selectable hysteresis. These can monitor gross or net measured values.

Input: LIV(P1),<P2, P3, P4, P5>;

P1: Number of the limit switch (1 or 2)

P2: limit value monitoring on/off

0=off

1=on: a limit value bit only in measured value status not at OUT1 or OUT2

2=on: a limit value bit in measured value status and limit value 1 at OUT1, imit value 2 at OUT2

P3: input value of the limit switch (0..1)

0= Net measured value

1= Gross measured value

2= Triggered value (from MAV?, TRC is switched on)

P4:

Switch-on level limit value bit is set to = 1 in measured value status and the output OUT1 or OUT2 goes into the condition "high"=5V=GW (if function is activated (P2))

P4=0...**NOV**: switch on level at **NOV**>0

P4=0...1599999: switch on level at **NOV**=0

P5: Switch-off level limit value bit is set to =0 in measured value status and the output OUT1 or OUT2 goes into the condition "low"=0V=GW (if function is activated (P2))

P5=0...**NOV:** switch on level at **NOV**>0

P5=0...1599999: switch on level at **NOV**=0

The measured value status can be a component part of the measured value (see command **COF**).

The limit value 1 output OUT1 is applied to connector 1/4 and
the limit value 2 output OUT2 is applied to connector 1/5

Example: LIV(1),1,0,900000,100000;

The sample command sets limit value 1 (P1=1)
The switching condition of limit value 1 is only shown in measured value status.
Limit value 1 switches over to gross measured value.
Limit value 1 switches on at a gross measured value > 900000 (P4=900000) and off again at a gross measured value < 1000000 (P5=1000000).

Query: **LIV?1;**

Effect: Output of setting for limit switch 1 in the sequence P1,P2,P3,P4,P5

Query: **LIV?2;**

Effect: Output of setting for limit switch 2 in the sequence P1,P2,P3,P4,P5

POR

Port Set and Read
(Setting of outputs and reading of inputs)

Range: 0/1,
Factory setting: 0, 0 (outputs to Low=0V)
Response time: <10ms
Parameters: 2/4
Password protection: no
Parameter protection: with command **TDD1**

The AED offers two digital inputs and outputs which can be read or set via the command **POR** .
The outputs OUT1 (connector 1 pin 4) and OUT2 (connector 1 pin 5) can be modified by means of the port command only if the limit value functions is deactivated (**LIV**) and **IMD**=0/1.

Input: **POR<P1>,<P2>;**

The parameters P1 and P2 can be 0 or 1; the following holds 0=low=0V and 1=high=+5V.
Using this command, the outputs OUT1 and OUT2 on connector 1 can be set to the required levels. If the outputs are used by the limit value function (**LIV**), the AED answers with “?”.

Query: **POR?;**

Effect: Output of the switching states of 2 outputs and signal levels on 2 inputs.
The outputs are OUT1 and OUT2 on connector 1 PIN4 and PIN5.
The inputs are IN1 and IN2 on connector 1 PIN16 and PIN17. The answer comprises 4 parameters.
If limit values are activated (**LIV**), the limit value states are output.

Examples:

*Respnse to **POR?;** is 0, 1, 1, 0*

OUT1(GW1)	OUT2(GW2)	IN1	IN2
Low	High	High	Low

Both limit values (LIV1/2) are deactivated:

POR0,0; *OUT1 and OUT2 are set to Low*
POR,1; *OUT2 is set to High, OUT1 remains unchanged*
POR1; *OUT1 is set to High, OUT2 remains unchanged*

LIV1 activated, LIV2 deactivated:

POR0,0; *not allowed, is answered with ?*
POR,1; *OUT2 is set to High, OUT1 is LIV1*

LIV2 activated, LIV1 deactivated:

POR0,0; *not allowed, is answered with ?*
POR1; *OUT1 is set to High, OUT2 is LIV2*

After deactivating the limit value function, a port command is to be transmitted in order to set the port to the required state.

3.4.2 Trigger function

The general function is described in the operating instructions Part 2.

- setup trigger function **TRC**
- Trigger result **MAV?**

The speed of the trigger function depends from the following commands: **FMD, ASF, ICR**

additional documents

- Application note APPN001 (Checkweigher),
- Application note APPN002 (trigger function),
- Application note APPN011 (querry of trigger results).

Hint:

Use **IMD**1 for the trigger function.

MAV

Measured Alternative Data
(Meas. value of the trigger function)

Range:	Integer	±32767
	Long Integer	±8388607
	ASCII	±1638399

Factory setting: ASCII
Response time: <25ms
Parameters: —
Password protection: no
Parameter protection: no data to be protected

Query: **MAV?;**

Effect: If a new trigger measured value has been formed, this measured value will be output once. If no new measured value has been formed, the output value is the overflow value (binary = 800000h or ASCII < -1638400). This value will be output also after the measured value has been read out and a new query is received.

The measured value will be output in ASCII or binary format (see command **COF**). This command provides measured values only when the trigger function is activated (see command **TRC**).

TRC

Trigger Command
(Trigger setting)

Range: 0/1, 0/1, 0...1599999, 0..99, 0...99
Factory setting: 0, 0, 0, 0, 0
Response time: <10ms
Parameters: 5
Password protection: no
Parameter protection: with command **TDD1**

Input: **TRC P1,P2, P3,P4, P5;**

P1: Trigger function On/Off

0=Off

1=On

P2: Trigger

0=Level-Trigger

1=External Trigger input (IN1)

P3: Trigger level

0...NOV=Trigger level (at P2=0 and **NOV**>0)

0...1599999=Trigger level (at P2=0 and **NOV**=0)

P4: Delay period

0...99: Delay period = P4 ∗ 1,66ms ∗ 2 ∗ **ICR** (at **FMD**=0)

Delay period = P4 ∗ 1,66ms ∗ 2 ∗ **ICR** ∗ **ASF**
(at **FMD**=1 and **ASF**>0)

P5: Measur. period

0...99: Measur. period = P5 ∗ 1,66ms ∗ 2 ∗ **ICR** (at **FMD**=0)
Measur. period:= P5 ∗ 1,66ms ∗ 2 ∗ **ICR** ∗ **ASF**
(at **FMD**=1 and **ASF**>0)

Query: **TRC?;**

Response: P1, P2, P3, P4, P5 CRLF

The position of the trigger level depends on the output scaling (**NOV**). At **NOV**=0 (scaling off) the trigger level will be on the characteristic 0...1000000. At **NOV**>0 the trigger level will be in the range 0...**NOV**

The external trigger will only be released again when the output value has been formed (no re-trigger function).

The trigger status (ext. or level trigger) is output at **IMD1**, in the measured value status of **MSV?** or **MAV?** in bit 6 . The bit becomes active, if a triggering has been effected, and it becomes inactive, if a new trigger value (**MAV**) was formed. In this way, the time bevavior of the trigger function can be monitored.

Important note

If the command **COF** (128..140) was used to select automatic output and the trigger function is activated, then the AD103B will output the measured value once after triggering and subsequent measurement. Thus a measured value query by means of the command **MAV?** will not be necessary. The connected computer only needs to receive this measured value.

For details on how to set this mode, see command **COF**

COF128 to **COF 140** continuous output after power On

Example: *external triggering with automatic output*

1. *Set the parameters of the AED (ASF, ICR etc).*

2. *Use the command i.e. TRC1,1,0,20,5; to activate the external trigger.*

3. *Use the command COF128+I; to define the output format for the measured values. i depends on the binary / ASCII output (see COF command) (no parameter setting possible, following each trigger event the result is output automatically (without the command MAV?;).*

4. *Use the command STP; to stop the automatic measured value output.*

5. *Use the command TDD1; to store the output in the EEPROM, nonvolatile.*

6. *Use the command RES; to restart the automatic measured value output. Following each trigger event the result is output automatically (without the command MAV?;).*

7. *Use the command STP; to stop the automatic measured value output. Parameter settings are again possible.*

8. *Use the command COF3; to switch off the automatic measured value output.*

9. *If required, use the command TDD1; to store the change nonvolatile.*

10. *If required, retrieve the measured values by means of the command MSV?; or MAV?; (single measured value output or single trigger retrieval).*

3.4.3 Peak value detection

- setup peak value detection **PVS**
- clear peak values **CPV**
- request peak values (MIN and MAX) **PVA?**

The speed of the trigger function depends from the following commands: **FMD, ASF, ICR**

PVS

Peak Value Setting
(Set function of peak value detection)

Range: 0/1/2
Factory setting: 0
Response time: <10ms
Parameters: 1
Password protection: no
Parameter protection: with command **TDD1**

Function:

This command activates the peak value detection.

Parameter:

Input: PVS P1,P2;

P1: peak value detection
- 0= OFF
- 1= ON

The change of this parameter has no influence of the peak values.

P2: Source
- 0= Net values
- 1= Gross values

After Reset (RES) or Power ON both peak values are cleared.

Query: PVS?;

Answer: P1,P2CRLF (one char./ parameter)

CPV

Clear Peak Values
(Clear current peak values)

Range:	no
Factory setting:	-
Response time:	<10ms
Parameters:	no
Password protection:	no
Parameter protection:	no

Input: **CPV;**

Answer: 0 CRLF

CPV? Is not allowed.

PVA

Peak Value Output
(request for detected peak values)

Range:	ASCII	±1599999
Factory setting:	-	
Response time:	<10ms	
Parameters:	no	
Password protection:	no	
Parameter protection:	no	

Input: not allowed

Query: **PVA**?;

Answer: MIN,MAX CRLF with MIN=MAX= 7 char. + sign

Example: -000355, 1000344CRLF

The output values are scaled with **NOV**.

3.5 Special functions

This group includes the following commands:

- Define password **DPW**
- Set Password for access of parameters **SPW**
- Restart the device **RES**
- Identification device **IDN**
- Backup device parameters **TDD**

DPW

Define Password
(Defining a password)

Range:	1...7 letters or numbers (ASCII characteristics)
Factorx setting:	AED
Response time:	<70ms
Parameters:	1
Password protection:	no
Parameter protection:	on entry

Input: **DPW("Passwd");**

The user can enter an arbitrary max. 7digit password with this command. All ASCII characters are permissible. The entry must be in quotation marks (“...“). DPW? is not allowed.

SPW

Set Password
(Write enable for all password-protected parameters)

Range:	The defined password with **DPW** command
Factory setting:	AED
Response time:	<10m
Parameters:	1
Password protection:	no
Parameter protection:	no data to be protected

Input: **SPW("Passwd");**

The command SPW with the correctly entered password authorizes data entry with all commands. The command SPW with a wrong password disables the data entry for protected commands. No password is required for outputs. A distinction is made between uppercase and lowercase letters in the password entry.

Use of the protected commands is also disabled after **RES** or power On

The following commands are protected by a password:

CWT, **LDW**, **LWT**, **LIC**, **NOV**, **SFA**, **SZA**, **TCC**, **TCZ**, **TDD0**

RES

Restart
(Device start)

Range: —
Factory setting: —
Response time: <3s
Parameters: —
Password protection: no
Parameter protection: no data to be protected

The command **RES** produces a warm start. This command generates no answer. All parameters are set as they were stored with the last **TDD** command, i.e. EEPROM values are taken over into the RAM.

IDN

Identification
(Identification of transducer type and serial number)

Range:	Transducer type:	15 ASCII characters
	Serial number:	7 ASCII characters
Fctory setting:	according to transducer	
Respone time:	output:	<15ms
	input:	<180ms
Parameters:	1	
Passwortschutz:	no	
Parameter protection:	on entry	

Input: **IDN<" Transducer type ">,<" Serial number ">;**

Entry of the transducer type and of the serial number.

The type and serial number of the transducer are filed in the EEPROM of the transducer electronic unit. The type designation must not exceed 15 characters in length; it must be entered as a string in quotation marks ("..."). If only the serial number is to be changed, then a comma is entered for the parameter Transducer Type, e.g. **IDN,“4711“;.**

The serial number is entered at the factory and must not exceed 7 characters in length; it is entered in the same way as the type designation. The serial number must not be changed. If less than the maximum number of characters permitted are entered for the type designation or serial number, then the relevant entry is automatically filled with blanks until the maximum permitted nr. of characters is reached. It is not possible to enter the manufacturer and software version.

Query: **IDN?;**

Effect: An identification string is output. (33 characters).

Effect: Manufacturer, transducer type, serial number, software version, e.g. HBM, "AED103B   ","1234   ",P3x [1)]

The number of the output characters is fixed. The transducer type is always output with 15 characters, the serial number always with 7 characters.

1) P3x for AD103B (x=2...9);

TDD

Transmit Device Data
(Backup unit parameters)

Range:	0...2	
Factory setting:	—	
Response time:	**TDD0**:	<2.2s
	TDD1:	<0.1s
	TDD2:	<1.3s
Parameters:	1	
Password protection:	**TDD0**:	yes
	TDD1:	no
	TDD2:	no
Parameter protection:	no data to be protected	

Input: **TDD(0);**
Cold start, the parameters are reset to the following values

When calibration has been effected, the settings are stored in a 2nd write-protected EEPROM. The command **TDD(0)** copies the factory settings into the working EEPROM. Write-protected EEPROM → working EEPROM → RAM setting for the communication such as the address (**ADR**) and baud rate (**BDR**) and the calibration counter (**TCR**) are not reset. The mV/V characteristic preset at the factory is maintained.

If no valid data are in the write-protected EEPROM, the default parameter set is copied from ROM → EEPROM → RAM. Use this command to overwrite the parameters with default values from ROM.

Com.	Factory setting	Remark
ACL	1	Auto calibration on
ADR	31	Adress 31
ASF	5	Filter 1Hz
ASS	2	Amplifier input signal = measuring signal
BDR	9600,1	9600 baud, even parity
COF	9	Measured value output decimal format, address, error status
CRC[2)]	0	External checksum
CSM	0	Checksum off in measured value status
DPW[2)]	"AED"	Password
ENU[2)]	XXXX	Unit
FMD	0	Filter mode: Standard filter
ICR	2	Meas. rate: 25 Measurements/s
IDN[2)]	HBM, ..., ..., ..	Device type 15 characters, manufacturing No. 7 characters, program version
IMD	0	IN1 and IN2 are only inputs
LDW[2)]	0	User characteristic zeropoint
LWT[2)]	100000	User characteristic end value
LFT[2)]	0	Legal for trade off
LIC[2)]	0,1000000,0,0	Linearization deactivated
LIV	0,0,0,0	Limit values 1 and 2 deactivated
MTD	0	Standstill monitoring off
NOV	0	User scaling off
POR	0,0	Outputs=0 (low)
PVS	0,0	Peak value detection deactivated
SFA[2)]	xxx[1)]	End value (for 2mV/V characteristic)
SZA[2)]	xxx[1)]	Zero value (for 2mV/V characteristic)
STR	0	Termination resistors deactivated
TAS	1	Gross measured value
TAV	0	Tare memory deleted
TCR	xxx[1)]	Calibration counter (starts with 0)
TEX	172	Data delimiter, output in columns with crlf
TRC	0,0,0,0,0	Trigger function off, all parameters =0
ZSE	0	initial zero setting deactivated
ZTR	0	Zero tracking deactivated

1) Arbitrary value

2) The parameters marked with * are stored immediately on entry (EEPROM). **TDD1;** or **TDD2;** does not apply for these parameters.

The commands **CAL, MSV, MAV, STP, S.., RES** cannot be stored.

Query: **TDD?;**

Effect: no ouptut possible

Command: **TDD(1);**

Effect: With the following parameters the changed settings are initially stored in working memory (RAM) only, that is they are not protected against power failure. Using the command TDD1, the settings you have changed in the working memory are stored in the EEPROM protected against power failure.

ACL	Auto calibration
ADR	Adress
ASF	Filter setting
ASS	Amplifier input signal
BDR	Baud rate
COF	Configuration of the data output
CSM	Checksum in the measured value status
FMD	Filter mode
ICR	Measuring rate
IMD	Function of inputs IN1 and IN2
LIV	Limit value setting for limit values 1 and 2
MTD	Standstill monitoring
NOV	User scaling
POR	Setting the digital outputs OUT1 und OUT2
PVS	Setting the peak value detection
STR	Bus termination resistors on/off
TAS	Gross/net switch position
TAV	Contents of tare memory
TEX	Output data delimiter
TRC	Trigger function
ZSE	Initial zero setting
ZTR	Automatic zero tracking

Command: **TDD(2);**

Effect: Transfer of the parameters from the EEPROM into the RAM. The parameters listed under **TDD1** are copied from the EEPROM into the RAM. This occurs automatically after reset and power On.

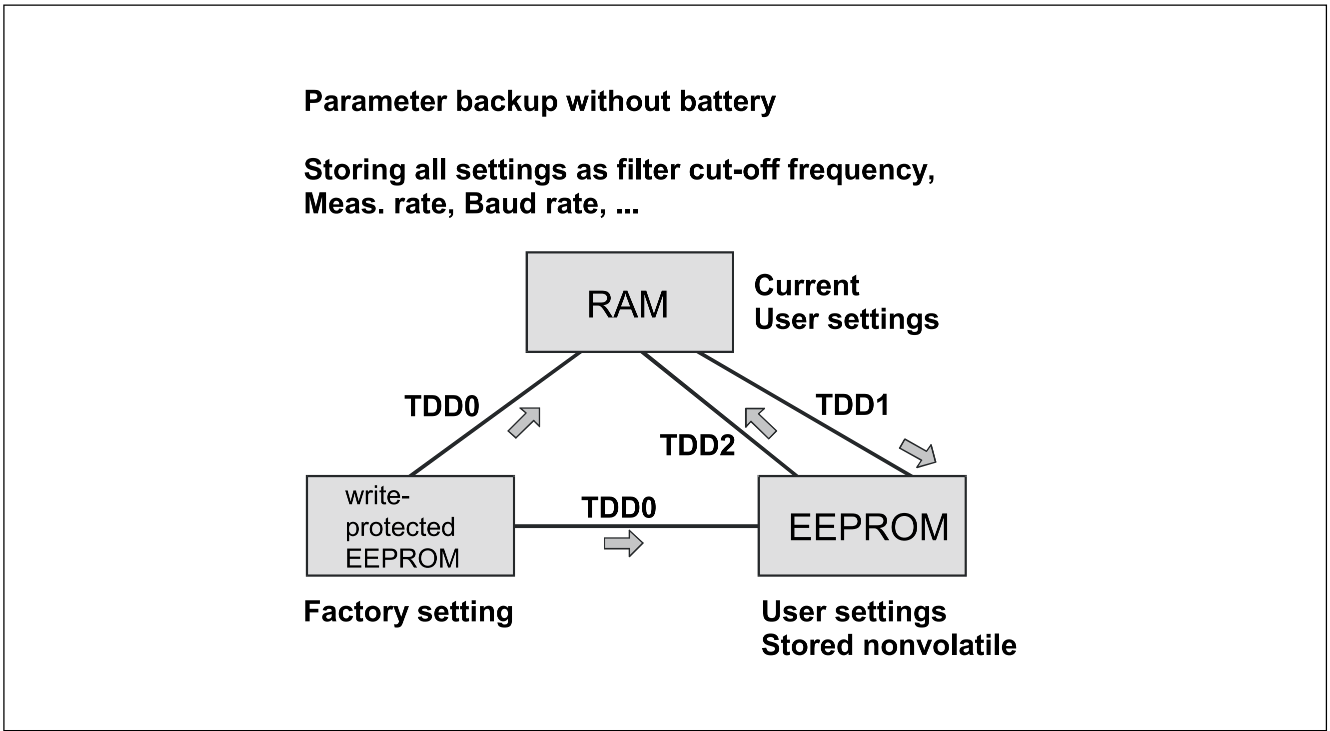


Fig. 3.4-1: Protecting the set parameters

3.6 Error messages

ESR

Event Status Register
(Output of error messages)

Query: **ESR?;**

Effect: This function outputs the error messages, defined according to the IEC standard, as a 3-digit decimal. The occurring errors are linked by "Or".

Error message	**Error**
000	No error
004	Not in use
008	Device Dependent Error (hardware error, e.g. EEPROM error)
016	Execution Error (parameter entry error)
032	Comand Error (command does not exist)

Example:

024 → Hardware- and parameter error

After **RES**, power On or reading the error status, the contents of the register is deleted.

3.7 Command for legal for trade applications

LFT

Legal for Trade
(legal for trade applications)

Range:	0/1
Factory settings:	0 (aus)
Response time:	<50ms
Parameters:	1
Password protection:	no
Parameter protection:	on entry

Query: **LFT?**

Effect: 0/1 CRLF

Command: **LFT0/1;**

Effect: 0=legal for trade application switched off,
1= legal for trade application switched on

At each modification of the command LFT the calibration counter (TCR) is increased by 1. At LFT1 the calibration counter is increased by one for each parameter input of the following commands:

CRC, DPW, IDN, LDW, LWT, LIC, NOV, SZA, SFA, ZSE, ZTR, RSN

In this way, all modifications of these calibration-relevant parameters can be detected by means of the non-resettable **TCR** calibration counter.

TCR

Trade Counter
(Calibration counter)

Range:	no parameter setting possible
Response time:	<10ms
Parameters:	none
Password protection:	no
Parameter protection:	—

Query: TCR?;

Effect: xxxxxxxx CRLF (8 characters+CRLF)

This non-resettable counter marks the parameter changes of the calibration-relevant commands (see command **LFT**). The maximum counter setting is 8388607 (7F FF FF hex). If this counter setting is reached, the counter comes to a standstill and at measured value output **MSV?;** only overflow values are output. This condition can only be released at the factory.

CRC

Cyclic Redundancy Check
(Chechsum)

Range: ±8388607
Response: <50ms
Parameters: 1
Password protection: no
Parametersicherung: on entry

Query: **CRC?;**

Effect: xxxxxxxx CRLF (8 character+CRLF)

Input: **CRCxxxxx;**

Response: 0 CRLF

Using this command, users will be able to form a checksum externally across all parameters of the AED and to store the said checksum in the AED. How this checksum is created, is to be decided by each user individually.

If the command **LFT1** was used to activate an legal for trade application, then the modification of the **CRC** results in an additional increase of the calibration counter (**TCR**).

In this way, any attempt to manipulate the AED parameters can be detected.

3.8 Further commands

The commands listed here are contained in the AD103B only for compatibility reasons. **They have no function in the AD103B.**

Command **COR:**

Input: **COR**0/1;

Response: 0 CRLF

Query: **COR?;**

Response: 0/1CRLF

The answers are output in a fixed fashion and independent of possible entries.

Command **ACL:**

Input: **ACL**0/1;

Response: 0 CRLF

Query: **ACL?;**

Response: 0/1CRLF

The answers are output in a fixed fashion and independent of possible entries.

Command **CAL:**

Input: **CAL;**

Response: 0 CRLF

Query: **CAL?; not allowed**

Response: ?CRLF

3.9 Examples for communication

3.9.1 Settings for the bus mode

The AED is able to work in a bus with up to 32 modules. A prerequisite for this is that each AED is connected to the bus through a RS-485 interface driver. In this case each AED works as slave, i.e. without request by the bus master (e.g. PC or PLC), the AED remains inactive on its transmission line. An AED is selected by the master via the command **SELECT (S00...31)**. Therefore it is absolutely necessary to enter a communication address for each AED before the bus coupling. Naturally each address in the bus may be allocated only once.

3.9.2 Connect AED to the bus:

There are two ways to connect the AED to the bus:

Connect AED consecutively to the bus

1. Connect first AED to the bus line (The factory setting is **ADR31**, baud rate 9600)
2. Initialize interface of the master with 9600 Bd, 8, e,
3. Output command **;S31;**
4. Set wanted address with the command **ADR** (e.g. **ADR01;**)
5. Select AED with the new address: **;S01;**
6. Store address nonvolatile with the command **TDD1;**
7. Connect next AED to the bus, output **;S31;**, set **ADR02**, etc.

All AED are interfaced to the bus:

1. Read out serial number of the AED (max. 7-digit) (→ 1st AED: xxxxx, 2nd AED: yyyyy, ...).
2. Initialize interface of the master with 9600 Bd, 8, e,1.
3. Output broadcast command **;S98;**.
4. Set required address with the command ADR (e.g. ADR01,“xxxxx“; ADR02,”yyyyy”; etc.).
5. Store addresses nonvolatile with the command **TDD1;**

Important note

With **S98;** no AED answers, but each AED executes the command. If there is no communication, then the address or the baud rate can be incorrect.

After successful setting of all addresses and with uniform baud rates, the bus is ready. Now it must be determined how the measured values are read out.

3.9.3 Setting measured value output

With the measured value output via the command **MSV?;,** the output format must be set previously in all modules:

1. Output broadcast command **S98;** (all AED execute the command, but send no answer).
2. Output command for the output format (e.g. **COF3;** for ASCII output).
3. Command **TDD1;** if this setting should be stored nonvolatile in the EEPROM.

3.9.4 Changing the baud rate:

The AED can work with different baud rates. The setting can be changed only through the serial interface with the aid of the command BDR.

Naturally the baud rate of all connected subscribers should be the same in the bus mode. The following procedure can be helpful to always certainly set the AEDs in a bus to the required baud rate on initialization (switching on) of the system (e.g. 9600), the following procedure can be helpful:

1. Set baud rate of the master interface to 1200 Bd, 8 data bits, 1 parity bit even, 1 stop bit.
2. Output of the command string:

   ; deletes the input buffer of the AED
   S98; selects all AED on the bus
   BDR9600; output of the required baud rate

   Wait approx. 150ms.
3. Set baud rate of the master interface to 2400 Bd, 8 data bits, 1 parity bit even, 1 stop bit.
4. Output of the command string:

   ; deletes the input buffer of the AED
   S98; selects all AED on the bus
   BDR9600; output of the required baud rate

   Wait approx. 150ms.
5. Set baud rate of the master interface to 4800 Bd, 8 data bits, 1 parity bit even, 1 stop bit.
6. Output of the command string:

   ; deletes the input buffer of the AED
   S98; selects all AED on the bus
   BDR9600; output of the required baud rate

   Wait approx. 150ms.

7. Set baud rate of the master interface to 19200 Bd, 8 data bits, 1 parity bit even, 1 stop bit.
8. Output of the command string:

;	deletes the input buffer of the AED
S98;	selects all AED on the bus
BDR9600;	output of the required baud rate

   Wait approx. 150ms.
9. Set baud rate of the master interface to 38400 Bd, 8 data bits, 1 parity bit even, 1 stop bit
10. Output of the command string:

;	deletes the input buffer of the AED
S98;	selects all AED on the bus
BDR9600;	output of the required baud rate

11. Set baud rate of the master interface to 9600 Bd, 8 data bits, 1 parity bit even, 1 stop bit.
12. Output of the command string:

;	deletes the input buffer of the AED

13. Command TDD1; if this setting should be stored nonvolatile in EEPROM.

Important notes

The output of the semicolon before the **S98;** command is absolutely necessary, since driving the AED with different baud rates may cause undefined characters to occur in the input buffer of the AED which, however, are rejected by the reception of the semicolon.

With **S98;** no AED answers but executes the command.

With the example listed above, all AED on this bus are set to the baud rate of 9600, independent of their previous setting.

Naturally another baud rate can also be set. Then the required baud rates must be provided in the command **BDR** and the initialization of the master interface must be changed accordingly.

The baud rate is the transmission speed of the interface. This has no effect on the number of measured values which the AED determines per second.

A high baud rate simply enables a larger number of AED to be inquired per time unit in the bus mode.

Baud rate	Transmission time for one ASCII character
2400	4.4ms
4800	2.2ms
9600	1.1ms
19200	0.6ms

The transmission time for a command string can be calculated approximately with this information. Determine the number of characters in the command and multiply it with the transmission time. Moreover, the AED has a processing time for each command. Refer to the command description for these times (times = transmission plus processing times).

3.9.5 Determining the bus occupancy (Bus Scan):

Frequently it is expedient to determine the bus configuration each time the bus is switched on or if answers of the AED are not received. The address occupancy of the bus can thus be determined with the aid of the Bus Scan. A prerequisite for this is that all modules are set to the same baud rate.

1. Initialization of the master interface with the set baud rate of the AEDs
2. Scanning an address with:
   ;S00; select adress
   ADR?; query adress

   The AED addressed with the address answers with a ‘?CRLF’, since it does not know the command. If no answer comes after a time of approx. 100ms, then no AED is present at this address. If undefined characters or no ? characters are received by the master, then there can be a bus fault or a multiple occupancy of the address. The bus master must react accordingly.

3. Repetition of item 2 with the following addresses 01...31.

If only a few AED are connected and the addresses are known, then the BusScan can naturally refer to these addresses only. If all AED are determined successfully as bus subscribers, then the identification string of the AED can possibly be read (measuring point identification and manufacturing number).

The time-out setting for the interface driver of the master is decisive for the speed of the Bus Scan. The select command requires max. 20...30ms for the output (for 2400 Bd). The AED does not answer to this select command.

3.9.6 Measured value query in bus mode:

All AED have been prepared for bus operation with the aid of the preceding chapter and the BusScan has found all connected AED. The output format is set with the command COF for the **single measured value query** with the command **MSV?**. The command string is now:

S00; MSV?; The AED with the address 00 answers with the measured value

S01; MSV?; The AED with the address 01 answers with the meas. value etc.

The following approximate query times result:

Master transmission	Response time AED	AED Transmission	remarks
S00; MSV?;			(9 char. + 1 char. pause)
	approx. 6.7ms		(with **ICR2**, **FMD0**)
		xx CRLF	xx = No. of Character (4 charact. for **COF2**) (6 charact. for **COF8**) (10 charact. for **COF3**)

Baud rate	Output format	Measured value query time for one AED at ICR2,FMD0
9600	**COF2**	23ms
19200	**COF2**	15ms
9600	**COF3**	30ms
19200	**COF3**	18ms

Use these times only as orientation values.

For the faster **measured value query** with the command **MSV?**, the command string is:

S98; MSV?; All AED form a measured value but do not answer

S01; The AED with the address 01 answers with the measured value

S02; The AED with the address 02 answers with the measured value

S03; The AED with the address 03 answers with the measured value etc.

The following approximate query times result (ICR0, FMD0) for 9600 baud:

Master transmission	Measuring time of all AED (ICR0)	AED Transmissions
S98; MSV?;		
	approx. 1.67ms	
S01;		
	-	xx CRLF
S02;		
	-	yy CRLF
S03;		
	-	zz CRLF

The master may then transmit a new select command, if the measured value has been received. The answer of the AED comes immediately after the commands S01, S02 and S03.

Query time = Numb. of all charact. x Time for one charact. + Resp. time AED

Baud rate	Output format	Measured value query time for three AED at ICR0, FMD0
9600	**COF2**	42ms
19200	**COF2**	22ms
38400	**COF2**	12ms
9600	**COF4**	49ms
19200	**COF4**	25ms
38400	**COF4**	13ms

Use these times only as orientation values.

3.9.7 Setting a parameter in all connected AEDs:

Now that the measured value query no longer represents a problem, setting a parameter in all AEDs connected to the bus is also no longer a problem:

1. Output broadcast command **S98;** (all AED execute the command, but send no answer).
2. Output parameter command (e.g. **ICR3;**)
3. Output command **TDD1;** if this setting should be stored protected against power failure in EEPROM.
4. Sii; select next AED to read parameters as a check, for instance.

This string can also be used for taring with the aid of the command **TAR** or for switching over between gross and net output (**TAS**).

4 Indices

Hottinger Baldwin Messtechnik GmbH

Postfach 100151   D-64201 Darmstadt
Im Tiefen See 45   D-64293 Darmstadt
Tel.: +49/6151/803-0   Fax: +49/6151/8039100
E-mail: support@hbm.com · www.hbm.com

HBM
measurement with confidence