Operating instructions

PW20i

Part 2:

Communication commands

B1561-1.0 en

Contents

Safety informations

See operating instructions Part 1

All the factory settings are stored at the factory so that they are safe from power failure and cannot be deleted or overwritten. They can be reset at any time by using the command TDD0.

For more information, see ”Individual Command Descriptions”.

The factory set production number must not be changed.

Residual risks are indicated in these mounting instructions by the following symbols:

Symbol:  **CAUTION**

Meaning: **Possible dangerous situation**

Warns of a potentially dangerous situation in which failure to comply with safety requirements **could** result in damage to property or some form of physical injury.

Symbols for operating instructions and useful information:

Symbol:  **NOTE**

Means that important information about the product or its handling is being given.

1 Introduction

The PW20i load cells are part of the digital load cell family that digitally conditions measurement values and networks them with bus capability.

These operating instructions describe the function and connections of the PW20i digital load cells.

This section describes the commands for serial communication.

These operating instructions apply to the following designs of the PW20i digital load cells:

PW20IR5/5K	PW20IR2/5K
PW20IR5/10K	PW20IR2/10K
PW20IR5/20K	PW20IR2/20K

Load cell description-Identification on the type plate:

PW20i/YY/ZZ

ZZ = 5K, 10K, 20K (max. capacities, K = kg)

YY = (Interfaces)

R2 = RS-232

R5 = RS-485

Example: PW20i/R5/10K

Load cell PW20i with interface RS-485 and max. capacity 10 kg

2 Command set for the PW20i

Commands can be roughly divided into:

- Interface commands (ADR, BDR, COF, CSM, Sxx, TEX)
- Commands for adjustment and scaling (SZA, SFA, LDW, LWT, NOV, CWT, LIC)
- Commands for measurement operation
  (MSV, MAV, ASF, ICR, TAR, TAS, TAV, FMD, MTD, ZSE, ZTR)
- Inputs and trigger functions (IMD, POR, TRC, MAV)
- Special commands (TDD, RES, DPW, SPW, IDN, ENU, ESR)
- Commands for legal for trade applications (LFT, TCR, CRC)

2.1 Command format

General advice:

Commands are not case-sensitive, so either format can be used for input.

Each command entry must be concluded by a delimiter. This can either be a line feed (**LF**) or a semi-colon (**;**).

If an end label is all that is sent to the PW20i, the PW20i input buffer is cleared.

The data provided in round brackets () for the commands are mandatory and must be entered. Parameters in pointed brackets <> are optional and do not have to be provided. **The brackets themselves are not part of the input.**

Text must be enclosed in quotes ” ”.

With numeric input, preceding zeroes are suppressed. Numbers can either be entered directly or as an exponential representation, e.g ±12000lf or ±1.2e4lf.

The exponent **e** can have 1 or 2 digits, but must not be a number greater than 10 characters, including the sign and the exponent.

Responses consist of ASCII characters and close with **CRLF**. An exception to this is binary character output (see MSV and COF commands).

Each command consists of the command shortform, one or more parameters and the delimiter.

	Command shortform	Parameter	End label
Input	ABC	X,Y	LF or ;
Output	ABC?	X,Y	LF or ;

Example: MSV?20;
On this command, 20 measured values will be output.
All ASCII characters ≤ 20H (blank) are allowed between the command shortform, the parameters and the end label, apart from 11H (Ctrl q) and 13H (Ctrl s). H: Hexadecimal

2.2 Response to commands

Responses to inputs (exception COF64...COF79):

	Response	End label
correct input	0 (zero)	CRLF
incorrect input	?	CRLF

Exceptions: The commands **RES, STP, S00 ... S99** do not bring a response.
The command **BDR** brings a response in the new baud rate.

The command ESR will identify the error.

Responds to output commands:

correct command	Parameter1, ... Parameter n, or measured values **CRLF**
incorrect command	**? CRLF** (error identification via ESR command)

2.3 Output types for measured values

You can choose two output types and one separator (**TEX** command).

Output type 1:

The measured values are arranged one below the other for output.

Measured value1 CRLF
Measured value2 CRLF
. . . . . .
Measured value n CRLF

Output type 2:

The measured values are arranged next to each other for output.

Measured val.1 (separator) Measured val.2 (separator) ... Measured val. n CRLF

Data output works with fixed output lengths (see COF command):

Format command	PW20i response		No. bytes
COF0; msv?;	yyyy CR LF	(y- binary)	6
COF2; msv?;	yy CR LF	(y-binary)	4
COF3; msv?;	xxxxxxxx CR LF	(x-ASCII)	10
COF9; msv?;	xxxxxxxx,xx,xxx CR LF	(x-ASCII)	17

The end label for data output is always CRLF or the separator defined using the TEX command. But these characters must not be filtered out as end labels during binary output, as these characters can also be included in the binary code of the measured value. So, as with binary output, the bytes have to be counted. In the subsequent syntax check, the relevant places after CR or LF or the separator can then be queried.

Password protection:

PW20i password protection includes important settings for the characteristic curve of the scale and its identification. Commands with password protection are only activated once the password is entered (SPW command). If the password is not entered, these commands are answered with ”?”.

2.4 Command overview

Com-mand	PW	TDD1	Function	Page
ADR		x	Device address	12
ASF		x	Filter selection limit frequencies	38
BDR		x	Baud rate	13
COF		x	Output format for data outputs	14
CRC			Checksum	70
CSM		x	Checksum in measurement status for binary output	19
CWT	x	x	Calibration weight	24
DPW			Define password	58
ENU			User definition of units	61
ESR			Output of error messages	67
FMD		x	Filter mode	40
ICR		x	Sampling rate	41
IDN			Identification of transducer type and serial number	62
IMD		x	Set the function of the inputs	52
LDW	x		User characteristic curve zero point = scale chracteristic curve	26
LFT		x	“Legal for trade” application	68
LIC	x		Linearization	31
LWT	x		User characteristic curve full scale = scale charact. curve	27
MAV			Measured value trigger function	55
MSV			Data output	33
MTD		x	Standstill monitoring	47
NOV	x	x	Resolution of the user characterisic curve	29
POR		x	Set and read digital inputs and outputs	51
RES			Reset	60
RSN		x	Increment	30
S...			Selection of PW20i in bus mode	21

SPW			Write enable for all password-protected parameters	59
STP			Stop data output	37
TAR			Tare	43
TAS		x	Gross / net selection	46
TAV		x	Tare value	44
TCR			”Legal for trade” counter	69
TDD1/2			Saving setting in EEPROM, Reading EEPROM	63
TDD0	x		Factory setting	63
TEX		x	Separator for data output	20
TRC		x	Trigger settings	53
ZSE		x	Zero on start-up	49
ZTR		x	Automatic zero tracking	48

Save with TDD1, otherwise on input

Password protection via commands DPW/SPW

3 Individual command descriptions

3.1 Interface commands (asynchronous, serial)

Interface characteristics:

Start bit: 1

Word length: 8 Bit

Parity: none / even

Stop bit: 1

Software handshake (XON/XOFF) is possible

Baud rate: 1200; 2400; 4800; 9600; 19200; 38400; 57600; 115200 baud

The asynchronous interface of the PW20i is a serial interface, i.e. data is transferred bit by bit, one after the other and asynchronously. Asynchronous means that the transmission works without a clock signal. A start bit is set before each data byte. Then come the word bits, a parity bit for the transmission check (optional) and a stop bit.

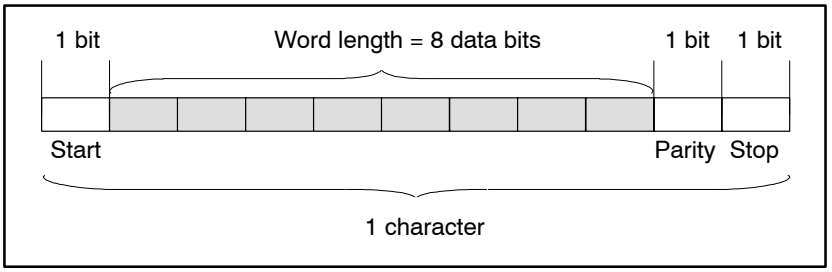


Fig. 1: Composition of a character

As the data is transferred serially, the speed of transmission must match the speed of reception. The number of bits per second is called the baud rate.

The input buffer is synchronized with the start bit for every character transferred. Next come the data bits, these all have the same length. When the stop bit is reached, the receiver goes into the ”wait state”, until it is reactivated by the next start bit.

The number of characters per measured value ranges between 2 and 17 and depends on the output format selected (**COF** command) (see also **COF** command).

The interface must be configured to establish communication between the PW20i and the computer. The following commands are available in the PW20i for this purpose: **ADR; BDR; COF; TEX; S..**;

ADR

Address
(Device address)

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

Input: **ADR(new address),<"Serial No.">;**

Input of device address as decimal number 0...31.

The serial number can also be entered as an optional second parameter. The new device address is then only entered for the PW20i with the serial number specified. This then means that if there are several PW20i with the same address (initializing bus mode), it is possible to change device addresses without addressing several PW20i .

The serial number must be given in quotes, as for the IDN command.

Example: *ADR25,"007" CRLF*

Query: **ADR?;**

Effect: Input of device address as decimal number 0...31

BDR

Baud Rate
(Baud rate)

Baud rates	1200,2400,4800,9600,19200,38400,57600,115200
Factory setting:	9600 Baud and parity bit even
Response time:	<10 msec
Parameter:	2
Password protection:	no
Parameter backup:	with command **TDD1**

Input: **BDR<Baud rate>,<Parity>**

Input required baud rate as decimal number.

The following baud rates are possible: 1200, 2400, 4800, 9600, 19200, 38400 Baud.

Input required parity: 0 - no parity bit
1 -parity bit even

Caution: *The response is given at the new setting (baud rate, parity). Once the baud rate is changed, communication is not possible initially. The processor also has to be changed over to the newly selected baud rate setting.*
For the change in baud rate to become permanent, it has to be saved in the EEPROM with the TDD1 command. This procedure ensures that you do not set baud rates in the PW20i which are not supported by the remote station. If the new baud rate entry is not saved, the PW20i will go back to the previously valid baud rate after a reset or a power-up.

Query: **BDR?;**

Effect: Output of set baud rate,
Parity bit identifier

Example: *BDR?;* *9600,1crlf* *equals 9600 Baud, parity bit even*

COF

Configurate Output Format
(Output format for data outputs)

Range:	0...255
Factory setting:	9
Response time:	<10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with command **TDD1**

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

Input of output format for measured value command **MSV?**

The available formats and the decimal number to be entered are listed in the following table.

Query: **COF?;**

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

COF-formats:
Inputs from **COF0** to **COF15** result in the following combinations:

- MSB = highest value position
- LSB = lowest value position

In the binary output, the sequence of the bytes can be selected as MSB ⇾ LSB or LSB ⇾ MSB. With ASCII output, the device address and/or measurement status information can be output as well as the measured value.

Format binary:

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

Format ASCII:

With ASCII output, the separator of your choice is placed between the parameters (see TEX command). CRLF, or the chosen separator, follows the last parameter.

T = separator () = number of characters

	1st parameter	D	2nd parameter	D	3rd parameter	End label
COF1	Measured value (8)	T(1)	Address(2)		——	CRLF or T
COF3	Measured value (8)		——		——	CRLF or T
COF5	Identical to COF1					
COF7	Identical to COF3					
COF9	Measured value (8)	T(1)	Address(2)	T(1)	Status(3)	CRLF or T
COF11	Measured value (8)	T(1)	–	–	Status(3)	CRLF or T

Data output is related to the nominal value set for the PW20i (see NOV command).

Output format	Output on max. load	
	NOV > 0	**NOV= 0**
2 byte binary	NOV value	20000
4 byte binary	NOV value	5120000
ASCII	NOV value	1000000

With the 2-Byte binary output, the NOV value must be $\leq$ 30000, otherwise the measured value will be output with Overflow or Underflow ($7fff_H$ or 8000_H). With NOV30000, the overflow reserve is still ca. 2700d.

Caution: *With bus mode, the output format must not be set to COF9.*

COF16 to COF 28 Bus mode:

If you add the decimal number 16 to the COF0...COF12 output formats specified above, the PW20i switches to bus output mode. A measured value is output. The PW20i changes over to partially active mode (each new measured value is stored in the output buffer, but is not output). The measured value is output to the bus when the Select command S... is given. The data output is without CR/LF.

Example (2 PW20i):

Command	Effect
S98;	All PW20i are partially active (listening, but not transmitting)
COF18;	Output as 2–byte binary output
ICR0;	Highest sampling rate
MSV?0;	Continuous measurement in the PW20i
S01;	Read measured value of 1st PW20i
S02;	Read measured value of 2nd PW20i, when response from first PW20i is received in full
S01;	Read measured value of 1st PW20i, when response from 2nd PW20i is received in full
S02;	Read measured value of 2nd PW20i, when response from first PW20i is received in full
.....	
STP;	End data output
S01;	Possible new PW20i 1 setting

COF32 to COF44, binary data output without CRLF:

If you add the decimal number 32 to the COF0...COF12 binary output formats specified above, the PW20i switches to the following output modes for the measurement data.

With **binary data output** the end label CR LF is omitted, so that only 2 or 4 characters per measured value are output. This action increases the output speed of the measured values.

Format	Length	Sequence for data 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 you add the decimal number 64 to the COF0...COF12 output formats specified above, the PW20i switches to 2-wire bus mode. This means that when commands are entered, the PW20i no longer responds with ”0” or ”?”. Only command queries such as ASF? obtain the response with the parameter, or in the case of MSV?, with the measured value. The command MSV?0; (continuous measured value transmission) must not be used in this mode, as otherwise it will no longer be possible to stop this output (unless you switch off the supply voltage).

COF128 to COF 140 continuous output after power on:

Caution: *Not for bus mode*

If you add the decimal number 128 to the COF0...COF12 output formats specified above, the PW20i switches to continuous output mode. After a power-up or RES command, the PW20i sends out the measured values *without* an MSV? prompt. Continuous output can be deactivated with the STP command.

Settings are made with the following inputs (COF ≥128):

- .... (Make necessary settings)
- ICRi (Set PW20i sampling rate)
- COF+128 (The PW20i sends continuous measured values, interval like ICR)
- STP (Stop continuous sending)
- TDD1 (Store protected against power failure)
- COF+128 (The PW20i sends continuous measured values, interval like ICR)

When power is connected, the PW20i also starts data output without a separate prompt. These output formats have another special feature (depending on the trigger setting, TRC command):

Trigger switched off: continuous, automatic data output

Trigger switched on: automatic data output only when a new measured value has been produced after triggering

Output speed of measured values:

The maximum output rate of the PW20i is 600 measured values per second. This data transfer rate also depends on the baud rate (BDR), the data output format, the set mean-value calculation (ICR) and the filter mode (fmd = 0).

Table 1 shows the relationships with continuous data output (**MSV?**):

Measured value(s)	**600**	**300**	**150**	**75**	**37.5**	**18.75**	**9.375**	**4.688**
(ICR)	**(0)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Time in ms	**1.66**	**3.33**	**6.66**	**13.33**	**26.66**	**53.33**	**106.7**	**213.3**
Output format (COF)	**Requisite baud rates for MSV?0; (BDR)**							
Binary format 2 characters with COF2/COF6	19200	9600	4800	2400	1200	1200	1200	1200
Binary format 4 characters with COF0/COF4	38400	19200	9600	4800	2400	1200	1200	1200
ASCII format measured value 10 characters with COF3	———	38400	19200	9600	4800	2400	1200	1200
ASCII format measured value + address 13 characters with COF1	———	———	38400	19200	9600	4800	2400	1200
ASCII format Measured value + Address + Status 17 characters with COF9	———	———	38400	19200	9600	4800	2400	1200
	Requisite baud rates for MSV?1; (BDR)							
Binary format 6 characters MSV?1 with COF0/COF4	———	38400	19200	9600	4800	2400	1200	1200

Table 1: Baud rate dependent on measured value and output format

Information for evaluating binary measured values:

With data output in binary format, the binary codes for CR and LF may occur within the bytes that are representing the measured value. So the data output content must not be tested for the CR/LF characters, in the event of checking for an end to data transmission. With binary output, it is more a case of recording the number of characters received. Also with binary output, the control character CR/LF is appended to the measured value (sole exception: MSV?0;).

CSM

Checksum
(Checksum in measurement status for binary output)

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

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

Query: **CSM?;**

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

Checksum calculation can be used to find transmission errors during 4-byte binary output.

When CSM=0, checksum calculation in the measurement status is deactivated. The standard measurement status is output (see MSV).

With CSM=1, a checksum (EXOR) is formed over the measured value covering three bytes and this is output instead of the measurement status. This checksum output can only be used for output formats COF8 and COF12 (+i*16, i=0,1...7).

TEX

Terminator Execution
(Separator for data output)

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

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

The required separator is input decimally as a ASCII character (e.g. comma = $2C_H$ = 44 $_D \rightarrow$ input **TEX44;** H: Hexadecimal, D: Decimal). Every ASCII character from 0...127_D (0...$7F_H$) can be used as a separator. The separator is placed between the parameters for data output (also see MSV and COF commands).

Example: *tex 44;*
data output: –0123456, 12, 000, –0123457, 12, 000 etc. (with COF9)

If the chosen ASCII character is entered with an offset of 128 (above example: comma = 44 $_D$ + 128 $_D$ = 172 $_D \rightarrow$ input **TEX172;**), then the parameters of a measured value will continue to be separated by a comma, but CRLF will be output at the end of the measured value.

Example: *tex 172*
Data output: *–123456,12,000*
–123457,12,000 etc.

Query: **TEX?;**

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

S...

Select
(Selecting of PW20i in bus mode)

Range: 0...31, 98
Factory setting: ——
Response time: <10 msec
Parameter: 1
Password protection: no
Parameter backup: no data to back up

Input: S(00...31, 98);

The Select command does not generate a response. When several PW20i are connected together to a bus, this can be used to address them individually or jointly. One PW20i is always active after reset or power-up (except when COF>127) and in bus mode, this must be addressed by the Select command, so that the other bus nodes do not respond. If there is only one PW20i, the S command is not needed. The command ADR can be used to assign up to 31 addresses (00...31).

Note: *The S... command alone does not generate a response. Only when it is used together with another command, does the selected PW20i respond. Exception in bus mode: COF16...COF28 (after MSV?0;)*

Selection	Effect for PW20i	Effect for PC
s00 to s89	Only the PW20i with the specified address executes all the commands and responds. All the other PW20i only understand Select commands S00 to S99 and do not respond.	1:1 communication with a selected PW20i.
s98	**All the PW20i execute all the commands, but do not respond.**	

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

Command S98; is intended for special functions (broadcast). All PW20i connected to the bus are addressed. All PW20i execute the subsequent commands. No PW20i responds. This continues until an individual PW20i is addressed with S00 ... S31.

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

- S98; all PW20i selected,
- MSV?; Measured value query, all PW20i generate the measured value and place this value in the output buffer after the integration time (ICR), but no PW20i sends,
- S01; PW20i with address 01 is selected and outputs the measured value,
- S02; PW20i with address 02 is selected and outputs the measured value, etc.

3.2 Adjustment and calibration

The following commands are used to set the default characteristic curve and the user curve.
Commands for adjusting the user characteristic curve: **LDW**, **LWT**
Command for adjusting the user curve characteristic with partial load: **CWT**
The command NOV is used to scale the measured value.

Characteristic curve setting:

The PW20i initially works with a default curve set to the max. load of the PW20i. The default characteristic curve can be restored at any time with TDD0.

The user can adapt the PW20i characteristic curve to their requirements (user characteristic curve) with the command pair LDW, LWT.

Using the command CWT, the user characteristic curve can also be set with partial load.

Caution: *The characteristic curve commands LDW and LWT must be entered or executed in the sequence LDW followed by LWT. The input data is only offset when the two parameters have been entered or measured in pairs.*
When defining the characteristic curve, scaling must be deactivated (NOV0).

Once values for the zero point and end value of the user curve have been successfully entered or measured, the range LDW → LWT (with NOV=0) is assigned to the following number ranges:

Output format (COF)	Output with max. 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 output, the NOV value must be ≤ 30000, otherwise the measured value will be output with Overflow or Underflow ($7fff_H$ or 8000_H); H: Hexadecimal). With NOV30000, the overflow reserve is only about 2700 digits.

Set user characteristic curve with LDW, LWT

Action sequence	Command
Enter password	SPW ”AED”;
Load= zero load scale ;	LDW
Load= max. load scale	LWT;

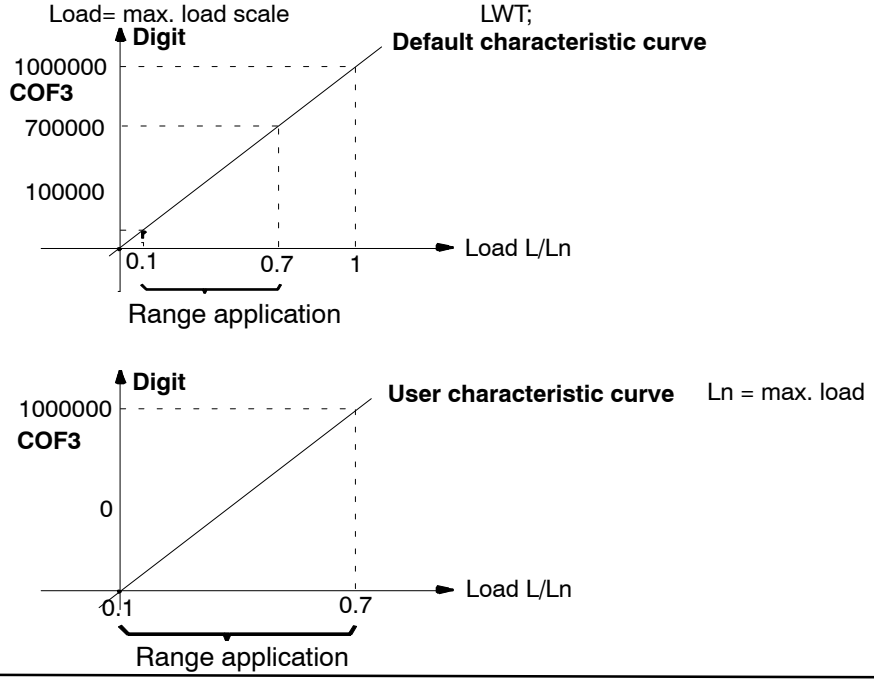


Fig. 2: Setting the user characteristic curve

CWT

Calibration Weight
(Calibration weight)

Range:	200 000...1 200 000 (20...120%)
Factory setting:	1000000 (100%)
Response time:	<10 msec
Parameter:	1(2)
Password protection:	yes
Parameter backup:	with input

Input: **CWT < calibration weight in % · 10000 >;**

If 100% of the end value cannot be reached when setting the user curve, it is possible, using the CWT command, to set the PW20i with a load in the range from 20% to 120% of the required end value of the user curve (partial load calibration).

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

Effect: **Value1,Value2crlf**

Value1 and Value2 are two 7-digit decimal numbers in the range 200 000 to 1 200 000.

Value1 is the percentage of the max. load, at which the next LDW/LWT adjustment is to be implemented.

Value2 is the percentage of the max. load, at which the last LDW/LWT adjustment is to be implemented. Value2 cannot be entered.

The CWT value used to implement the LDW/LWT adjustment is part of the LDW/LWT characteristic curve pair.

Example: *with delivery, the LDW value = 0, the LWT value = 1000000 and the CWT value = 1000000.*
The LDW/LDT user curve for a scale should be set so that a load of 100kg is assigned an output value of 1 million.
However, only a 50kg balancing weight is available for the calibration. For the calibration, the CWT value is set to 500000 (50%) and then a LDW/LWT calibration is implemented using 50 kg.
After the calibration, the PW20i outputs at 50kg 500000 digit and at 100kg 1000000 digit as the measured value.
Following the calibration, the response to CWT? is 500000,500000crlf.

Note: If the values for LDW and LWT have to be input again at some time, the CWT value must be entered first, followed by the value for LDW and then the value for LWT.

LDW

Load cell Dead Load Weight
(User charact. curve zero point = scale charact. curve)

Range:	0...1599999e6
Factory setting:	0
Response time:	<15 msec...4.2 s
Parameter:	1
Password protection:	yes
Parameter backup:	after input of **LWT**

Input: **LDW;** (Response time: <4.2 sec)
This command is used to measure and save the output signal of the unloaded PW20i. It is only offset after the parameters for **LWT** are entered.

Input: **LDW<zero point>;** (Response time: <15 msec)
The value is entered here instead of the output signal being taken over. The value entered is stored, but only offset after the parameter for LWT is entered.

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

Effect: The value used in the PW20i to calculate the user curve for the unloaded scale is output as 7 digits with a sign (e.g.–0000345 crlf). The value is not converted via **NOV.**

Note: If the LDW/LWT calibration is not implemented with a 100% input signal, the CWT value must be set first. (see CWT Calibration Weight)

LWT

Load cell weight
(User characteristic curve full scale = scale characteristic curve)

Range:	0...1599999e6
Factory setting:	1000000
Response time:	<15 msec...4.2 s
Parameter:	1(0)
Password protection:	yes
Parameter backup:	with input

Input: **LWT;** (Response time <4.2 sec)

Effect: This command is used to measure the output signal, when the scale is loaded, with the user curve end value. This measured value is offset with the previously determined LDW value to create a new characteristic curve.

Input: **LWT<End value>; (Response time <1.5 sec)**
Instead of taking over the output signal, the value for the loading of the scale with the user characteristic curve end value is entered. It is offset with the previously determined LDW value to create a new characteristic curve.

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

Effect: The value used in the PW20i to calculate the user curve for the end value is output as 7 digits with sign (e.g. 0800345 crlf). The value is not converted via NOV.

Note: If the LDW/LWT calibration is not implemented with a 100% input signal, the CWT value must be set first. (see CWT Calibration Weight)

There are two ways of setting a user curve:

1. Measuring the user characteristic curve (CWT, LDW, LWT)

1.1 Enter password with command SPW;

1.2 Enter NOV 0; (scaling off)

1.3 Set the filter ASF so that the display is as smooth as possible

1.4 Enter the CWT<Calibration weight>; if setting with a partial load.

1.5 Unloaded scale, enter LDW; (the output signal for the unloaded scale is measured)

1.6 Load scale, enter LWT; (the output signal for the loaded scale is measured and the user curve calculated)

1.7 Set ASF and NOV as required for the application, power failure protected backup of parameters NOV, ASF with the command TDD1

2. Input of the user characteristic curve (CWT, LDW , LWT)

2.1 Enter password with command SPW;

2.2 Enter NOV 0; (scaling off)

2.3 Enter CWT 1000000 (partial load calibration off)

2.4 Switch off user curve with LDW0; and LWT1000000;

2.5 Set the filter ASF so that the display is as smooth as possible

2.6 Scale unloaded, wait for standstill

2.7 Determine measured value with MSV?; , note Value1 for LDW

2.8 Load the scale with max. load, wait for standstill:

2.9 Determine measured value with MSV?; , note Value2 for LWT

2.10 Enter CWT if the LWT value is not equal to 100% max. load

2.11 Enter new curve with: LDW <Value1>; then LWT<Value2>;

2.12 Set ASF and NOV as required for the application, power failure protected backup of parameters NOV, ASF with the command TDD1

NOV

Nominal value
(Resolution of the user charact. curve)

Range: 0...1599999e6
Factory setting: 0 (= switched off)
Response time: <10 msec
Parameter: 1
Password protection: yes
Parameter backup: with command TDD1

Input: **NOV<Value>;**

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

Effect: The value stored in the PW20i is output as 7 digits with sign (e.g. 1001000 crlf).
The NOV value is used to scale the output value during data output. When NOV=0, this output scaling is deactivated. ASCII data output is scaled at the factory to 1000000 at max. load. If a data output of 2000 digits is required at max. load, the nominal value NOV2000; must be set with this command. This scaling does not modify the input parameters or the tare value.

Output format (COF)	Output with max. load	
	NOV= 0	NOV > 0
2 byte binary	20000	NOV value
4 byte binary	5120000	NOV value
ASCII	1000000	NOV value

Note: For 2-byte binary output, the NOV value must be $\leq$ 30000,
otherwise the measured value will be output with Overflow or Underflow ($7fff_H$ or 8000_H ; H: Hexadecimal). With NOV30000, the overflow reserve is only about 2700 digits.

RSN

Resolution
(Increment)

Range:	1, 2, 5, 10, 20, 50, 100
Factory setting:	1
Response time:	<10 msec
Parameter:	1
Password protection:	no
Parameter backup:	With command TDD1

Input: **RSN<value>;**

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

Effect: The value stored in the PW20i is output with 3 digits (e.g. 001 crlf).
The increment limits the measured value resolution during output:
Example: NOV = 10000 d and RSN 5 → measured values 0, 5, 10 .... 9990, 9995, 10000

LIC

Linearization Coefficients
(Linearization)

The characteristic curve set as the factory setting is specified as a straight line at 2 points. The user can adjust for a linearity error of the scale with the command LIC. The PW20i has a third order polynomial for linearization:

Calculation: output value = $LIC0 + LIC1 \cdot x + LIC2 \cdot x^2 + LIC3 \cdot x^3$

x - input value

With the aid of a third order polynomial, even a linearity error with an inflection point can be corrected. Increased measurement errors are to be expected outside the linearization interval.

The coefficients LIC0,...,LIC3 are entered as ASCII numbers with the LIC command.

The coefficients are defined when the scale is calibrated. The calculation of the coefficients is not implemented in the PW20i, but with the aid of the HBM program AED Panel 32, and the result is then loaded into the PW20i. The exact procedure is described in the AED_Panel32 program.

Linearization Coefficient, Compensation for a linearity error

Range:	±0...1999990
Factory setting:	0,1000000,0,0 (= LIC off)
Response time:	Output: <15 msec Input: <35 msec
Parameter:	2(4)
Password protection:	yes
Data backup:	with input

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

Typical input example:

LIC(0),(+10);	*Input coefficient 0*
LIC(1),(+1000345);	*Input coefficient 1*
LIC(2),(–345);	*Input coefficient 2*
LIC(3),(+45);	*Input coefficient 3*

Query: **LIC?;**
Response: **LIC0,1000000,0,0;**
Effect: Output of linearization coefficients in the sequence:
Coefficient 0, coefficient 1, coefficient 2, coefficient 3 CRLF

3.3 Measuring

Measuring includes all commands that act directly on a measured value:

- MSV Data output
- STP (stop data output)
- ASF Filter setting
- FMD Filter mode
- ICR Sampling rate setting
- TAR Taring
- TAV Tare memory setting
- TAS Gross / Net selection
- MTD Standstill monitoring
- ZTR Zero tracking
- ZSE Zero on startup

MSV

Measured Signal Value
(Data output)

Range:	Integer ± 32767
	Long Integer ± 8388607
	ASCII ±1000000
Factory setting:	ASCII
Response time:	with fmd0: < 2^{ICR} x 1.67msec + 1.67 msec
	with fmd1: < 2^{ICR} x asf(1..9)*1.67msec+1.67msec
Parameter:	1
Password protection:	no
Parameter backup:	no data to back up

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

Effect: Continuous output of measured values until output cancelled with the command STP.

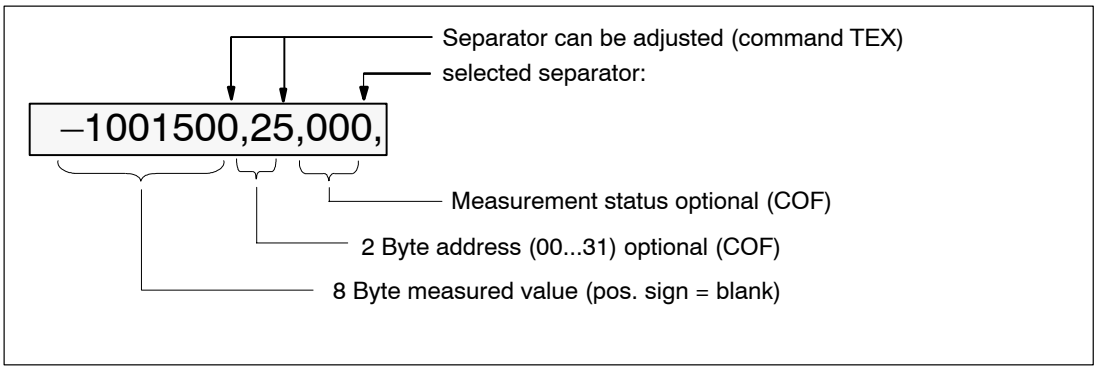
Query: **MSV?(1...65535);**

Effect: Delivers specified number of measured values.
The measured value is output in ASCII format or binary format (see COF command).

Example: ASCII format
*The output format for the measured value must be set **beforehand** via the command **COF**. The measured value is output in relation to the particular measuring range. The measured value can be a gross or net measured value (command TAS). This command generates responses with constant length.*
The **output length** for the command **MSV?;** is dependent here on the output format (see COF command):

Output format	PW20i response	Character count
Binary 4 Byte	yyyy CR LF (y- binary)	6
Binary 2 Byte	yy CR LF (y-binary)	4
ASCII (COF3;)	xxxxxxxx CR LF (x- ASCII)	10
ASCII (COF9;)	xxxxxxxx,xx,xxx CR LF (x- ASCII)	17

CR: Carriage Return, LF: Line Feed



The **output scaling** is dependent on the parameter of the command NOV.

Output format	Output value with max. 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 output, the NOV value must be ≤ 30000, otherwise the measured value will be output with Overflow or Underflow (7fff $_H$ or 8000$_H$); H: Hexadecimal). With NOV30000, the overflow reserve is only about 2700 digits.

The **response time** during the measurement query is determined by the integration time (command ICR) and the filter mode (fmd), and also the filter level asf if fmd=1:

Filter mode (fmd) = 0

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

Filter mode (fmd) = 1

ICR	Response time ca. [ms] with 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, which are dependent on fmd, asf and icr, are shown in the ICR command description.

If you use the command MSV?(number);, a predefined number of measured values can be output. The time between the output of two measured values is the measurement time. The total recording time for the selected number of measured values will depend on the filter mode set (fmd) and is calculated as follows:

where fmd=0 and fmd=1 with asf 0:

$$\textbf{Measurement time [ms]} = \textbf{number} \cdot 2^{\textbf{ICR}} \cdot \textbf{1.666 ms} + \textbf{1.666 ms}$$

where fmd=1 and asf 1 to 9:

$$\textbf{Measurement time [ms]} = \textbf{number} \cdot \textbf{asf} \cdot 2^{\textbf{ICR}} \cdot \textbf{1.666 ms} + \textbf{1.666 ms}$$

With MSV?0; measured values are output continuously. This output can only be stopped with the STP or RES commands or by switching off the voltage. During continuous output, no other parameters can be entered or queried.

In 4-byte binary output and in ASCII output, the measurement status can be transferred with the measured value (see COF command).

Bit assignment in measurement status (with IMD 0)		
Bit No.	**Bit value in status byte ***	**Significance**
0	1 = Net Overflow	Tare value too high
1	2 = Gross Overflow	Scaling too sensitive
2	4 = ADU Overflow	ADU overdriven (Load > nominal value + reserve)
3	8 = Standstill	Bit set: Standstill (see command MTD)
4	16 = limit value 1	Internal limit value, see command LIV
5	32 = limit value 2	Internal limit value, see command LIV
6/7	192 = measured values have no relationship (with MSV?xx or MSV?0)	Transfer rate too low. Measured value output is not conclusive in the chosen configuration. **

* When several conditions occur simultaneously, the measurement status is equal to the sum of the resp. bit values.

** The output measured values are not equidistant and must not be used to calculate an FFT.

Bit assignment in measurement status (with IMD 1)		
Bit No.	**Bit value in status byte ***	**Significance**
0	1 = Net Overflow	Tare value too high
1	2 = Gross Overflow	Scaling too sensitive
2	4 = ADU Overflow	ADU overdriven (Load > nominal value + reserve)
3	8 = Standstill	Bit set: Standstill (see command MTD)
4	16 = limit value 1	Internal limit value, see command LIV
5	32 = limit value 2	Internal limit value, see command LIV
6	64 = Trigger (only when Bit 7 is not set)	Triggering has occurred. Remains set, until the trigger output value MAV is generated.
6/7	192 = measured values have no relationship (with MSV?xx or MSV?0)	Transfer rate too low. Measured value output is not conclusive in the chosen configuration. **

* When several conditions occur simultaneously, the measurement status is equal to the sum of the resp. bit values.

** The output measured values are not equidistant and must not be used to calculate an FFT.

STP

Stop
(Stop data output)

This command ends data output. STP; only works on the MSV command. If a measured value has started, it is output in full.

ASF

Amplifier Signal Filter
(Filter selection limit frequencies)

Range:	0...9
Factory setting:	5
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with command **TDD1**

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

There are two filter ranges, dependent on the filter mode.

FMD 0 (standard filter)	selectable filter levels 0...8
FMD 1 (fast-settling digital filter)	selectable filter levels 0...9

Query: **ASF?;**

Effect: **Output of set filter level (0...9)**

The PW20i has a multi-level filter chain:

- an average value determination over 2 measured values (with 1200 Hz sampling, fixed setting)
- Standard filter (FMD0) or a fast filter (FMD=1); limit frequency selectable via ASF, sampling rate fixed = 600 Hz
- an average value determination for sampling rate reduction (selectable via ICR, sampling rate <=600 Hz)

The required filter effect and output rate can be set using the commands ASF, ICR and FMD. In addition to the standard filter properties, additional new, more powerful digital filters have been implemented. The command FMD: is used to toggle between the two filter methods.

FMD 0; Standard filter

FMD 1; Fast-settling filter

Filter characteristics of standard filter (FMD0):

ASF	Settling time in [ms] to 1 ‰	Limit frequency [Hz] at –3dB	Max. attenuation [dB] at 300 Hz
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

With ASF0, the filter is deactivated. The limit frequency of the filter determines the settling time. The higher the filter index, the better the filter effect, but the longer the settling time when changing the weight. The filter setting should be chosen to be as low as possible, while still being able to ensure non-operation (standstill) at a weight that does not change.

The FIR filters (**FMD1**) can be described with the following table:

ASF	Settling time in [ms]	Limit frequency at –3 dB [Hz]	20 dB attenuation at Frequency [Hz]	40 dB attenuation at Frequency [Hz]	Attenuation in stop band [dB]	Stop band [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

With ASF0, the filter is deactivated.

➧ The average value determination (ICR) does not influence the settling time of the filter.

The specified settling times refer to the PW20i. The total settling time is also dependent on the mechanical construction of the load cell, on the dead load of the scale and on the weight to be weighed.

FMD

Filter mode
(Filter mode)

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

Input: **FMD(0/1);**
Input of filter type as decimal number of 0 or 1
0 = Standard filter
1 = Fast-settling digital filter

Query: **FMD?;**

Effect: **Output of set filter type (0 or 1)**
The description of the filter type can be found in the ASF command description.

ICR

Internal Conversion Rate
(Sampling rate)

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

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

Input of sampling rate as decimal number from 0...7

The integration time determines the output data rate of the measured values and therefore also the response time for a measurement query using the command MSV?;.

ICRx = av. value determination using 2^x measured values with x = 0...7 where FMD = 0

This results in the following setting options:

Filter mode (fmd) = 0

ICR	Output rate Mw/s
0	600
1	300
2	150
3	75
4	37.5
5	18.75
6	9.38
7	4.69

Filter mode (fmd) = 1

ICR	Output rate Mw/s									
	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

The baud rate setting must be taken into consideration when setting the measurement data rate. With high measurement data rates, the baud rate setting must also be high, to prevent loss of measurement data (see COF command).

Query: **ICR?;**

Effect: Output of set sampling rate (0...7)

Note: With ICR>=1, this results in very good suppression of a possible interfering mains frequency of 50 Hz.

TAR

Tare
(Tare)

Range:	——
Factory setting:	——
Response time:	with fmd0: < 2^{ICR} x 1.67msec + 1.67 msec
	with fmd1 and asf0 < 2^{ICR} x 1.67msec + 1.67 msec
	with fmd1: <2^{ICR} x asf(1..9)*1.67msec+1.67msec
Parameter:	0
Password protection:	no
Parameter backup:	no data to back up

The TAR; command tares the current measured value. After taring, the system changes back to the net measured value (TAS0). The current value is stored in the tare memory (also see TAV command) and subtracted from the measured value and from all subsequent measured values.

TAV

Tare Value
(Tare value)

Range: 0...± 1638399
Factory setting: 0
Response time: < 20 msec
Parameter: 1
Password protection: no
Parameter backup: with command **TDD1**

Input: **TAV(±Tare value);**

Enter tare value 7 digits with sign (max. ±8 388 607). The value is on the LDW/LWT characteristic curve scaled with the NOV parameter (0...NOV). After the commands SZA, SFA or LDW, LWT have been used for characteristic curve input, the tare memory is cleared (content=0).

Query: **TAV?;**

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

Output format Measured value with max. load	Nominal taring range with NOV > 0	Maximum taring range with NOV > 0	Nominal taring range with NOV=0	Maximum taring range with NOV=0
2 byte binary	+/– NOV value	+/– 150% NOV value	+/– 1000000	±1 599999
4 byte binary	+/– NOV value	+/– 150% NOV value	+/– 1000000	±1 599999
ASCII	+/– NOV value	+/– 150% NOV value	+/– 1000000	±1 599999

Example:	*NOV3000;*		*(scale scaling)*
	TAS1;		*(Gross output activated)*
	MSV?;	*1500crlf*	*(measured value lies at 50% = max. load of scale)*
	TAR;		*(Tare and select net output)*
	TAV?;	*1500crlf*	*(query tare value)*
	MSV?;	*0crlf*	*(net measured value)*
	TAS?;	*0crlf*	*(net is activated)*
	TAS1;	*0rrlf*	*(select gross)*
	MSV?;	*3000crlf*	*(measured value lies at 100% = nom. load of scale)*
	TAV?;	*1500crlf*	*(query tare value, unchanged)*

TAS

Tare Set
(Gross / net selection)

Range:	0...1
Factory setting:	1 (gross)
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with command **TDD1**

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

0 = net measured value, value in tare memory subtracted von current measured value.

1 = gross measured value, the value in tare memory is not offset.

The tare value remains unchanged when the gross/net switch is made.

Query: **TAS?;**

Effect: Current settings output

MTD

Motion Detection
(Standstill monitoring)

Range: 0...5
Factory setting: 0
Response time: < 10 msec
Parameter: 1
Password protection: no
Parameter backup: with TDD1

Input: MTD(0...5);

0 – Standstill monitoring deactivated
1 - Standstill monitoring ± 0.25 d/sec from NOV value,
2 - Standstill monitoring ± 0.5 d/sec from NOV value,
3 - Standstill monitoring ± 1 d/sec from NOV value,
4 - Standstill monitoring ± 2 d/sec from NOV value
5 - Standstill monitoring ± 3 d/sec from NOV value

Query: MTD?;

Effect: Output of set standstill increments (0...5)

If the standstill monitoring is switched off (MTD0;) no standstill monitoring will take place in the PW20i. The standstill bit (Bit 3) in the measurement status is then always = 1. If the standstill monitoring is switched on (MTD1...5), it refers to the nominal value set with the NOV command.

If the user scaling is switched off (NOV =0) or NOV is used to select a scaling > 100 000, then the standstill monitoring is implemented with 1 d/sec for 100 000d scaling.

Information about whether the measured values during a second fall within the selected standstill range is transferred in the measurement value status information.
Transfer BIT 3.

ZTR

Zero tracking
(Automatic zero tracking)

Range:	0/1
Factory setting:	0
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with TDD1

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

0 - Zero tracking deactivated
1 - Zero tracking activated

Query: **ZTR?;**

Response 0/1

Function:

Automatic zero tracking occurs for a gross or net measured value < 0.5d in the range ± 2% of the nominal value of the scale (NOV). The maximum reset speed is 0.5d/s at scale standstill. Standstill detection can be set using the MTD command. The unit d (digit) relates to the nominal value (NOV). When the NOV value is deactivated (NOV=0) or the NOV value is >100 000 d, standstill monitoring is related to a nominal value of 100 000 d.

ZSE

Zero Setting
(Zero on start-up)

Range:	0...4
Factory setting:	0
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with input

Input: ZSE(0...4);

0 -Zeroing deactivated,
1 -Zeroing range ± 2 % of the NOV value,
2 -Zeroing range ± 5 % of the NOV value,
3 -Zeroing range ± 10 % of the NOV value,
4 -Zeroing range ± 20 % of the NOV value,

Query: ZSE?; Response 0...4

Function: After cutting in the voltage, after a RESET or after the command RES, zeroing in the selected range is performed after about 2.5s at standstill. A change to the zero on startup correction range only takes effect after the voltage cut-in or after the RES command.

If there is no standstill or if the gross value falls outside the selected limits, zero is not set. The internal zero memory is always cleared before automatic zeroing. If the gross value at standstill falls within the selected range, the gross value is accepted into the zero memory. Zero memory cannot be read out. Scale standstill is fixed at 1d/s. The unit d (digit) relates to the nominal value (NOV). When the NOV value is deactivated (NOV=0) or the NOV value >100 000 d, standstill monitoring is then related to a nominal value of 100 000 d.

3.4 Trigger functions and limit values

This group includes the following commands:

- POR Read/set inputs/outputs
- IMD Select input mode
- TRC Trigger setting
- MAV Measured value trigger function
- LIV Limit values

POR

Port Set and Read
(Set and read digital inputs and outputs)

Response time: < 10 msec
Parameter: 4
Password protection: no
Parameter backup: no

The PW20i has a digital input which can be read using the POR command.

Input: **not intended**

Query: **POR?;**

Effect: Output of signal level at input.

The response contains four parameters. The third value indicates the electrical status of the trigger input. The fourth parameter has no significance for the PW20i.

The first two parameters can be used to read the limit value states (LIV command).

Example: *Response to **por?** is 0,1,1,x*

i.e.	*Limit value1*	*off*
	Limit value2	*on*
	IN1	*high*

IMD

Input Mode
(Set the function of the inputs)

Range:	0...1
Factory setting:	0
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	with TDD1

This command is used to select the function of the PW20i digital input.

Input: **IMD(0...1):**

IMD 0; The logic state at the input can be queried with the POR command. Any change in the level has no effect on the PW20i.

IMD 1; The input IN1 is set up as an external trigger input for the trigger function (TRC). A low/high flank at the trigger input activates the measurement procedure.

(See also the MAV and TRC commands)

Query: **IMD?;**

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

TRC

Trigger Command
(Trigger settings)

Range:	0/1, 0/1, 0...1599999, 0..99, 0...99
Factory setting:	0,0,0,0,0
Response time:	< 10 msec
Parameter:	5
Password protection:	no
Parameter backup:	with TDD1

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

P1= 0	Trigger function off
P1=1	Trigger function on
P2=0	Level triggering
P2=1	External trigger input (IN1)
	(Trigger input IN1 is only active when IMD=1!)
P3=0...NOV	Trigger level (with P2=0 and NOV>0))
P3=0...1599999	Trigger level (with P2=0 and NOV=0)
P4=0...99	Delay time:=P4 x 1.66ms x 2 $^{I\,CR}$ (with FMD=0)
	Delay time:=P4 x 1.66ms x 2 I CR x ASF (with FMD=1 and ASF>0)
P5=0...99	Measurement time:= P5 x 1.66ms x 2 ^{ICR}
	Measurement time:= P5 x 1.66ms x 2 $^{I\,CR}$ x ASF (with FMD=1 and ASF>0)

Query: **TRC?;** Response: P1,P2,P3,P4,P5 CRLF

Function: The general function is described in the operating instructions Part 1.

The position of the trigger level depends on the output scaling (NOV). When NOV=0 (scaling off), the trigger level is on the characteristic curve 0...1000000. When NOV>0, the trigger level is in the range 0...NOV. The external trigger is only enabled again when the output value has been calculated (no re-trigger function). The trigger status (ext. or level trigger) is output for IMD1; in the measurement status of MSV? or MAV? in bit 6. The bit becomes active when triggering occurs; it becomes inactive when a new trigger value (MAV) has been calculated. This allows the trigger function to be monitored over time.

Note:

If the COF command (128..140) has been used to select automatic output and the trigger function is activated, the PW20i outputs the measured value once only, after triggering and subsequent measurement. This means that it is not necessary to use the MAV? command to query the measured value. The connected processor only needs to receive this measured value.

To set this operating mode, see the COF command.

COF128 to COF 140 continuous output after power on:

Caution: *Not for bus mode*

Example (external triggering with automatic output):

....	*Set PW20i parameters (ASF,ICR,...)*
TRC1,1,0,20,5;	*Activate external trigger*
COF128+i;	*i dependent on binary/ASCII output, see COF command, parameter setting not possible,*
...	*the result is automatically output after every trigger event (without MAV? command)*
STP;	*Stops automatic output*
TDD1;	*Power failure protected storage of automatic output in EEPROM*
RES;	*Restarts automatic output*
...	*the result is automatically output after every trigger event (without MAV? command)*
STP;	*Stops automatic output*
....	*Parameter settings possible*
COF3	*deactivate automatic output*
TDD1;	*Power failure protected storage (if required)*
MSV?; or MAV?;	*Individual data output or individual trigger query (if required)*

MAV

Measured Alternative Value
(Measured value trigger function)

Range:	Integer ± 32767
	Long Integer ± 8388607
	ASCII ±1638399
Factory setting:	Overflow value
Response time:	<25 msec
Parameter:	–
Password protection:	no
Parameter backup:	no data to back up

Query: **MAV?;**

Effect: If a new trigger measured value is calculated, the measured value is output once only. If no new measured value has yet been calculated, the output value corresponds to the overflow value (binary = 800000h or ASCII = –1638400). This value is also output after the measured value is read out and the query is repeated.
The measured value is output in ASCII format or binary format (see COF command).

This command only returns measured values when the trigger function is activated (see TRC command).

LIV

Limit Values
(Limit value settings)

Range:	1/2,0/1,0/2, ±0...1599999, ±0...1599999
Factory setting:	1,0,0,0,0 for limit value 1
	2,0,0,0,0 for limit value 2
Response time:	< 10 msec
Parameter:	5
Password protection:	no
Parameter backup:	with TDD1

The PW20i contains 2 limit value switches with selectable hysteresis. These can monitor gross or net measured values.

The limit values are set internally and can be queried in the measurement status (MSV/COF) or with the POR command. P4 should normally be larger than P5. The limit value switch will in this case switch to ON when the measured value exceeds the P4 value and reset when P5 is undershot (see Notes).

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

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

P2 Limit value monitoring on/off

0=off

1=a limit value bit is set in the measurement status.

P3 Input signal of limit value switch (0..1)

0=Net measured value

1=Gross measured value

2= MAV value, see trigger function

P4 Activation level

When the measured value exceeds P4, the limit value bit in the measurement status is set = 1.

P4 = 0...NOV Activation level (with NOV>0)

P4 = 0...1599999 Activation level (with NOV=0)

P5 Deactivation level

When the measured value undershoots P5, the limit value bit in the measurement status is reset = 0.
P5=0...NOV Activation level (with NOV>0)
P5=0...1599999 Activation level (with NOV=0)

The measurement status is output with the measured value in certain formats (see COF).

Example: *LIV **1,1,0,120000,110000;***
Limit value1 is set.
The switching state of limit value 1 is only shown in the measurement status.
The limit value 1 switches dependent on the gross measured value.
Limit value 1 switches on with a gross measured value > 120000
and off with gross measured value < 110000.

Query: **LIV?1;**

Effect Output of limit value switch 1 settings in the sequence
P1,P2,P3,P4,P5

Query: **LIV?2;**

Effect Output of limit value switch 2 settings in the sequence
P1,P2,P3,P4,P5

Notes:

The switching function of the limit value switch is inverted when P4 is smaller than P5. When P4 < P5 the status bit is set as long as the measured value is smaller than P4. When P4 > P5 the status bit is set as long as the measured value is greater than P4 (see example). The switching hysteresis is determined by the difference between P4 and P5.

3.5 Special functions

DPW

Define Password
(Define password)

Range:	1...7 digits or numbers (ASCII characters)
Factory setting:	AED
Response time:	< 70 ms
Parameter:	1
Password protection:	no
Parameter backup:	with input

Input: **DPW(”Password”)**

With this command, the user can enter any password with maximum 7 digits. All ASCII characters are permitted. The input must be made in quotes (”...”).

SPW

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

Range:	The password specified with **DPW**
Factory setting:	AED
Response time:	< 10 msec
Parameter:	1
Password protection:	no
Parameter backup:	no data to back up

Input: **SPW(”Passwd”);**

The command SPW, with the correctly entered password, authorizes data input with all commands. The command SPW with an incorrect password inhibits data input for protected commands. A password is not necessary for output. Password input is case sensitive.

The use of protected commands is also inhibited after RES or power-up.

The following commands are protected by a password:

CWT, LDW, LWT, LIC, NOV, SFA, SZA, TDD0

RES

Restart
(Reset)

Range: ———
Factory setting: ———
Response time: <3 s
Parameter: ———
Password protection: no
Parameter backup: no data to back up

The RES command restarts the device (warm restart). This command does not generate a response. All the parameters are set in the way in which they were saved the last time the TDD command was used, i.e. the EEPROM values are transferred to the RAM.

ENU

Engineering Unit
(User definition of units)

Range:	4 digits or numbers (ASCII characters)
Factory setting:	none
Response time:	Output: <15 msec Input: <40 msec
Parameter:	1
Password protection:	no
Parameter backup:	with input

Input: **ENU(”abcd”);**

Input of a unit. Any unit with a maximum of four characters can be entered. If less than four characters are entered, blanks are added to the input. The unit entered is not appended to the measured value. The characters must be entered in quotes (”...”).

Query: **ENU?;**

Effect: Output of unit with 4 characters.

IDN

Identification
(Identification of transducer type and serial number)

Range:	15 or 7 digits or numbers (ASCII characters)
Factory setting:	dependent on transducer
Response time:	Output: < 15 msec Input: <180 msec
Parameter:	1
Password protection:	no
Parameter backup:	with input

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

Enter the transducer type.

The transducer type and serial number are stored in the EEPROM of the transducer electronics. The type name must have maximum 15 characters and must be entered as a string in quotes (”...”).

The serial number is set at the factory and must not be changed. If less than 15 characters are entered for the type designation, the input is automatically filled with blanks up to the maximum permitted number. The manufacturer and the software version cannot be entered.

Query: **IDN?;**

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

Sequence: Manufacturer, transducer type, serial number, software?version,

e.g. HBM, ”PW20i”,”0001234”, P62crlf

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

TDD

Transmit Device Data
(Saving setting in EEPROM, Reading EEPROM)

Range:	0...2
Factory setting:	——
Response time:	**TDD0** < 0.5 sec **TDD1** < 0.5 sec **TDD2** < 0.1 sec
Parameter:	1
Password protection:	**TDD0** yes , **TDD1** no, **TDD2** no
Parameter backup:	no data to back up

Input: **TDD(0);** cold start, the parameters are reset as per the following table.

After the factory settings have been made, the settings are stored in a second, write-protected EEPROM. The TDD0 command copies the actual factory settings to the working EEPROM. (Write-protected EEPROM ➧ working EEPROM ➧ RAM) The settings for communication, such as address (ADR) and baud rate (BDR), as well as the standard meter (TCR) are not reset.

If there are no valid data in the write-protected EEPROM, the default parameter set is copied from the ROM ➧ EEPROM ➧ RAM. This command overwrites parameters with the default values from the ROM.

Command	Factory setting	Remarks
ADR	31	Address 31
ASF	5	Filter 1 Hz
BDR	9600,1	9600 Baud, even parity
COF	9	Measured value output decimal format, address, error status
*CRC	0	External checksum
CSM	0	Checksum in measurement status off
*DPW	”AED”	Password
*ENU	XXXX	Unit
FMD	0	Filter mode standard filter
ICR	2	Sampling rate 150 measurements/s
*IDN	HBM, ..., ..., ..	Device type 15 characters, production number 7 characters, program version
IMD	0	Trigger input inactive
*LDW	0	User characteristic curve zero point
*LWT	1000000	User characteristic curve end value
*LFT	0	Obligation of verification deactivated
*LIC	0,1000000,0,0	Linearization deactivated
LIV	0,0,0,0	Limit value 1 and 2 deactivated
MTD	0	Standstill monitoring off
NOV	0	User scaling off
RSN	1	Increment
TAS	1	Gross measured value
TAV	0	Tare memory cleared
TCR	xxx [1)]	Standard meter (starts with 0)
TEX	172	Separators, output in columns with crlf
TRC	0,0,0,0,0	Trigger function off, all parameters = 0
ZSE	0	Zeroing on startup deactivated
ZTR	0	Zero tracking deactivated

1)any value

The parameters marked with a * are stored immediately on input (EEPROM).
For these parameters, TDD1; or TDD2; do not apply.

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

Query: **TDD?**

Effect: An output is not possible.

Command: TDD(1);

Effect: With the following parameters, the changed settings are stored first only in the working memory (RAM), i.e. not power failure protected. Using the TDD1 command, the settings changed in the working memory are saved power failure protected in the EEPROM.

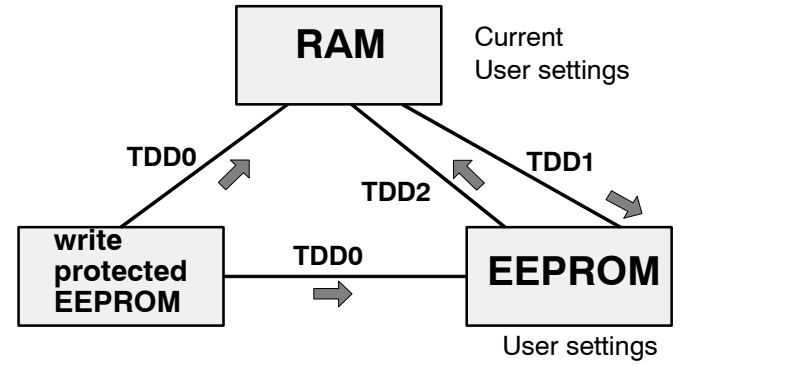
ADR Address
ASF Filter setting
BDR Baud rate
COF Configuration of data output
CSM Checksum in measurement status
FMD Filter mode
ICR Sampling rate
IMD Function of inputs IN1 and IN2
LIV Limit value settings for limit values 1 and 2
MTD Standstill monitoring
NOV User scaling
TAS Gross/net switch position
TAV Tare memory contents
TEX Output separator
TRC Trigger function
ZSE Zero on startup
ZTR Automatic zero tracking

Command: TDD(2);

Effect: Transferring parameters from the EEPROM to the RAM. The parameters listed under TDD1 are copied from the EEPROM to the RAM.
This happens automatically after Reset and power-up.

Parameter backup without battery

Storage of all settings such as filter limit frequency, sampling rate, baud rate, ...



Saving the setup parameters

3.6 Error messages

ESR

Event Status Register
(Output of error messages)

Query: **ESR?;**

Effect: This function delivers, as defined by the IEC standard, error messages as 3 digit decimal numbers. The 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 (error on parameter input)
032	Command Error (command error, command not available)

Example: *024 = Hardware and parameter error*
After RES, power-up or error status readout, the contents of the register are cleared.

3.7 Commands for “Legal for trade” applications

LFT

Legal for Trade
(”Legal for trade” applications)

Range:	0/1
Factory setting:	0 (off)
Response time:	<50 msec
Parameter:	1
Password protection:	no
Parameter backup:	with input

Query: **LFT?**

Effect: **0/1 crlf**

Command: **LFT0/1;**

Effect: 0 = mandatory calibration switched off,
1 = mandatory calibration switched on

Each time the LFT command is changed, the standard meter (TCR) is increased by 1. With LFT1 (application subject to mandatory calibration), the standard meter is increased by one for each parameter input of the following commands:

CRC, DPW, IDN, LDW, LWT, LIC, NOV, ZSE, ZTR

This means that every change to these calibration-relevant parameters can be detected by the standard meter TCR, which cannot be reset.

TCR

Trade Counter
(”Legal for trade” counter)

Range:	no input possible
Response time:	<10 msec
Parameter:	none
Password protection:	no
Parameter backup:	not required

Query: **TCR?**

Effect: **xxxxxxxx crlf (8 characters + crlf)**

This counter cannot be reset and it marks the parameter changes of the commands relevant to calibration (see LFT command). The maximum count is 8388607 (7F FF FF hex). If this count is reached, the counter stops; then, at the next MSV?; data output, only overflow values are output. This situation can only be remedied at the factory.

CRC

Cyclic Redundancy Check
(Checksum)

Range:	+/– 8 388 607
Response time:	< 50 msec
Parameter:	1
Password protection:	no
Parameter backup:	with input

Query: **CRC?**

Effect: **xxxxxxxx crlf (8 characters + crlf)**

Input: **CRCxxxxx;**

Effect: **0crlf**

This command gives the user the opportunity to externally calculate a checksum over all the PW20i parameters and store it in the PW20i. It is up to the user how this checksum is calculated.

If the command LFT1 has activated the application subject to mandatory calibration, the change to the CRC also increases the standard meter (TCR).

This allows every attempted manipulation of the PW20i parameters to be detected.

3.8 Other commands

The commands SZA, SFA, TCZ, TCC and TMP are commands used within HBM. The settings for SZA, SFA, TCZ, TCC and TMP are set by HBM and must not be changed.

The commands listed here are only included in the PW20i for reasons of compatibility.

They have no function.

COR, STR, ACL, CAL

3.9 Communication examples

Settings for bus mode (for RS485 interface only):

The PW20i load cell is able to work with up to 32 modules in one bus. The interface wires (RS485 4-wire) are connected in parallel to a physical circuit, the connection to the PC is implemented with an interface converter (e.g. HBM 1-SC232/422A). The individual PW20i function as slaves, i.e. without prompting by the bus master (e.g. PC or PLC) the PW20i remain inactive on their transmission line. The master selects a PW20i by using the SELECT command (S00...31). This is why it is essential to enter a communication address for each PW20i load cell before connecting to the bus. Each address may only be assigned once in the bus, factory setting is 31.

There are two options for entering the communication addresses:

1. Connect the load cells to the bus one after the other:

– Connect the first PW20i load cell to the bus line
(the factory setting is ADR31, baud rate 9600)
– Initialize the master interface with 9600 Bd, 8, e,1
– Output command ;S31;
– Set required address with the command ADR (e.g. ADR01;)
– Select the PW20i load cell with the new address: ;S01;
– Save address power failure protected with the command TDD1;
– Connect next PW20i load cell to the bus, output ;S31;, set ADR02, etc.

or

2. Enter addresses when all PW20i load cells are connected to the bus:

– Read production numbers of PW20i load cells (as given on type plate)
(e.g. 1.PW20i...: 0021, 2.PW20i...: 4273, ...)
– Initialize the master interface with 9600 Bd, 8, e,1
– Output broadcast command ;S98;
– Set required address with the command ADR (e.g. ADR01 ”0021”;)
– Set required address with the command ADR (e.g. ADR02,”4273”;), etc.
– Save addresses power failure protected with the command TDD1;

Caution: *With S98; none of the PW20i respond; but all the PW20i execute the command.*

Load cells that do not respond in this manner may have a different baud rate. They can be recognized via a bus scan with the possible baud rates.

Once all the addresses have been set correctly and there is a uniform baud rate, the bus is ready for action. The output format must now be set for the measurement query.

The output format must be set in all the modules before the MSV?; command can be used for data output.

2. Output broadcast command S98; (all PW20i load cells execute the command, but do not send a response)
2. Output command for output format (e.g. COF3; for ASCII output)
3. Command TDD1; when this setting must be stored power failure protected

Changing the baud rate:

The PW20i load cells can work at different baud rates. The settings can only be modified via the serial interface, using the BDR command.

In bus mode, the baud rate of all the connected nodes must be the same. To make sure that the PW20i load cells in a bus are set to the desired baud rate during initialization (activation) of the system (in this example 9600), please proceed as follows:

1. Set the baud rate of the master interface to 2400 Bd, 8 data bits, 1 parity bit even, 1 stop bit
2. Output of command sequence:
   ; (clears the input buffer of the PW20i)
   S98; (selects all PW20i load cells in bus)
   BDR9600; (output of required baud rate)
   (wait ca. 150 ms)
3. Set the baud rate of the master interface to 4800 Bd, 8 data bits, 1 parity bit even, 1 stop bit
4. Output of command sequence:
   ; (clears the input buffer of the PW20i)
   S98; (selects all PW20i load cells in bus)
   BDR9600; (output of required baud rate)
   (wait ca. 150 ms)
5. Set the baud rate of the master interface to 19200 Bd, 8 data bits, 1 parity bit even, 1 stop bit
6. Output of command sequence:
   S98; (selects all PW20i load cells in bus)
   BDR9600; (output of required baud rate)
   (wait ca. 150 ms)

7. Set the baud rate of the master interface to 38400 Bd, 8 data bits, 1 parity bit even, 1 stop bit

8. Output of command sequence:

;	(clears the input buffer of the PW20i)
S98;	(selects all PW20i load cells in bus)
BDR9600;	(output of required baud rate)

9. Set the baud rate of the master interface to 9600 Bd, 8 data bits, 1 parity bit even, 1 stop bit

10. Output of command sequence: (clears the input buffer of the PW20i)

11. Command TDD1; when this setting must be stored power failure protected.

It is absolutely essential to output the semicolon before command S98; because if the PW20i have been triggered at different baud rates, there may be undefined characters in the PW20i input buffer. These will be rejected when the semicolon is received.

Caution: *With S98; none of the PW20i respond; but all the PW20i load cells execute the command.*

In the example given above, all the PW20i on this bus are set to the baud rate 9600Bd, whatever their previous settings.

Of course, other baud rates can be set. To do this, set the required baud rate in the BDR command and modify the initialization of the master interface accordingly.

The baud rate is the transmission speed of the interface. This does not change the number of measured values that the PW20i load cell takes per second.

A faster baud rate merely makes it possible to query a greater number of PW20i load cells per time unit in bus mode.

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

With this information, it is possible to estimate the transmission time for a command sequence. To do this, determine the number of characters in the command and multiply by the transmission time. In addition to this, the PW20i load cell has a Response time for each command. These times can be found in the command descriptions (total time = transmission time + Response time).

Determining bus occupancy (Bus Scan):

It is often useful, each time the bus is activated or when the PW20i load cell fails to respond, to determine the bus configuration. The address occupancy of the bus can be determined with the aid of Bus Scan. This is on condition that all the modules are set to the same baud rate.

1. Initialization of master interface with set PW20i baud rate
3. Scan an address with the command sequence: ;S00; (Select Address)
   X; (output of invalid command)

   The PW20i load cell sensed at the address responds with "?CRLF" because it does not know the command. If there is no response after a period of ca. 100 ms, there is no PW20i present at this address. If the master receives undefined characters or no ? character, there may be a bus malfunction or multiple occupancy of the address. The bus master must react accordingly.
4. Repeat point 2 with subsequent addresses 01...31.

If only a few load cells are connected and their addresses known, the bus scan can be reduced to the known addresses. Once all the PW20i load cells are successfully established as bus nodes, the PW20i load cell identification string can be read in (measuring point identification and production number).

The time-out setting for the master interface driver is crucial for the speed of the bus scan. The Select command needs max. 20...30ms for output at 2400 baud. The PW20i load cell does not respond to this Select command.

Measurement query in bus mode:

The previous chapter has ensured that all PW20i load cells are ready for bus mode and have been detected by the bus scan.

The output format for a simple measurement query with the command MSV? has been set with the COF command. The command sequence is now:

S00; MSV?; The PW20i load cell with the address 00 responds with the measured value

S01; MSV?; The PW20i load cell with the address 01 responds with the measured value, etc.

This gives the following approximate query times:

Master transmission:	S00; MSV?;	(9 characters + 1 character Pause)
Response time PW20i...:	ca. 6.7ms	(with ICR2, FMD0)
PW20i... Transmission:	xxCRLF (4 characters with COF2) (6 characters with COF8) (10 characters with COF3)	

Baud rate	Output format	Query time measured value for a PW20i load cell with ICR2
9600	COF2	23 ms
19200	COF2	15 ms
9600	COF3	30 ms
19200	COF3	18 ms

These times should only be used as a guide.

For a faster **measurement query** using the command **MSV?** the command sequence is:

S98; MSV?; All PW20i load cells generate a measured value, but do not respond

S01; The PW20i load cell with the address 01 responds with the measured value

S02; The PW20i load cell with the address 02 responds with the measured value

S03; The PW20i load cell with the address 03 responds with the measured value,

etc.

The following protocol displays the data traffic on the bus for this application. It must be remembered that the Response time of the load cells is used only once in the time calculation.

Master transmission:	**;S98; MSV?; S01;**			**S02;**		**S03;**	
Response time PW20i (ICR0):		**approx. 1.67ms**					
PW20i transmissions:			**xxCRLF**		**yyCRLF**		**zzCRLF**

The Master can only send a new Select command once the measured value has been fully received.

This gives the following approximate query times (COF2, ICR0, 3 load cells):

Baud rate	Output format	Query time measured values for three PW20i load cells with ICR0
9600	COF2	48 ms
19200	COF2	29 ms
38400	COF2	20 ms
9600	COF4	54 ms
19200	COF4	32 ms
38400	COF4	21 ms

(Query time = total character count x time for one character + PW20i Response time)

These times should only be used as a guide.

Setting a parameter in all the connected PW20i:

The optimized procedure with the S98; command can also be used to set a parameter in all PW20i connected to the bus:

1. Output broadcast command S98; (all PW20i load cells execute the command, but do not send a response)
2. Output parameter command (e.g. ICR3;)
3. Output TDD1; command when this setting is to be stored power failure protected
5. (Sii; select next PW20i load cell in order to e.g. test read the parameter)

This sequence can, for example, also be used when taring with the aid of the TAR command, or when switching between gross and net output (TAS).

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Hottinger Baldwin Messtechnik GmbH

PO Box 10 01 51, D-64201 Darmstadt, Germany
Im Tiefen See 45, D-64293 Darmstadt, Germany
Tel.: +49 6151/ 8 030; Fax: +49 6151/ 8039100
E–mail: support@hbm.com www.hbm.com

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