GOSSEN METRAWATT

A2000

Multifunctional Power Meter
Communications Protocol per DIN Draft 19244

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1 Overview of Telegrams (Commands) to the A2000 per DIN Draft 19244

Telegrams to the A2000	**Applies to following data** (where parameter index PI = ..h)	**Response from the A2000** (via → ... record)	**Comments**
Execute **instrument reset** → via abbreviated record	Execute hardware reset	None	See chap. 5.1, page 9
Query, **instrument OK?** → via abbreviated record	Instrument address	OK with indication of address → abbreviated record	See chap. 5.2, page 9
Most important measurement values and errors (cyclical data) transmitted → via abbreviated record	U, I, W, P, Q, PF, f dep. upon 4 or 3-wire configuration	→ full record	See chap. 5.3, page 10
Events data for **error analysis** transmitted → via abbreviated record	Values exceeded or fallen short of, pole reversal, HW error	error messages, limit value statuses → full record	See chap. 5.4, page 11
All measurement values transmitted → via control record	U⏜, U△, I_{AVG}, P, Q, S, PF, f, E_P, E_Q, E_{INTP}, E_{INTQ} → PI = 00h ... 0Fh	→ full record	See chap. 5.5, page 14
Output parameters transmitted → via control record acknowledgement → full record	**Relays:** hysteresis, limit values, source, configuration **Analog outputs:** start and end values, source, configuration **S0 pulse outputs** → PI = 10h ... 1Fh	→ full record	See chap. 6.4, page 23
Control commands acknowledge → via full record **Statuses** transmitted → via control record	Delete measurement and max. values, set analog outputs, read out relay/S0 status → PI = 20h ... 2Fh	→ full record	See chap. 6.5, page 27
Instrument specifications transmitted → via control record	Software version, connection type, voltage/current range, display brightness, ... → PI = 30h ... 3Fh	→ full record	See chap. 6.6, page 30
Real-time clock values transmission → via control record acknowledge → via full record	read out and set real-time clock → PI = 90h ... 9Fh	→ full record	See chap. 6.8, page 34

The contents of the telegrams (commands) vary, and various types of telegrams are used depending upon content and signal direction.

see chap. 2, page 5 regarding abbreviated, full and control records
see chap. 3.2, page 6 regarding contents of the function field (FF).

2 Telegram Types: Abbreviated, Control and Full Records

All telegrams, whether in the query or the response direction, consist of one of three different types of records, which vary from one another in their basic structure. Use of these records is defined for each available interface function for the A2000. Structure and use of the record types are described below.

2.1 Abbreviated Records

Abbreviated records are transmitted in the query direction (from the master)

- in order to communicate brief commands to the instruments (e.g. reset).
- in order to query important data from the instruments (e.g. events data).

Abbreviated records are transmitted in the response direction (from the A2000).

- in order to acknowledge queries which do not require any response data.

Abbreviated Record Layout:

Char. No.	Content	Meaning		Comment
1	10h	Start bit		Special for abbreviated-records
2	0 ... FAh, FFh	Instrument address	(IA)	***Addr*** or 255, compare chap. 3.1, page 6
3		Function field	(FF)	Compare chap. 3.2, page 6
4		Checksum	(CS)	= instrument address + function field (FF)
5	16h	End mark		Common to all record types

2.2 Control Records

Control records are only transmitted in the query direction from the A2000, and allow for the querying of all data which cannot be queried with abbreviated records, because they require more detailed specification.
Control Record Layout:

Char. No.	Content	Meaning		Comment
1	68h	Start bit		
2	03h	Length		Number of characters starting with address up to and excl. checksum
3	03h	Length (repeat)		
4	68h	Start bit (repeat)		
5	0 ... FAh, FFh	Instrument address	(IA)	***Addr*** or 255, compare chap. 3.1, page 6
6		Function field	(FF)	Compare chap. 3.2, page 6
7		Parameter index	(PI)	Compare chap. 6, page 17
8		Checksum	(CS)	The checksum is arrived at by means of a byte by byte summation of all characters starting with the instrument address up to and including the last data byte without overflow summation.
9	16h	End mark		

2.3 Full Records

Full records are used by the A2000:

- in order to transmit commands and parameters to the instrument.
- in order to download data from the instrument.

Full Record Layout:

Char. No.	Content	Meaning		Comment
1	68h	Start bit		
2		Length		Number of characters starting with address up to and excl. checksum
3		Length (repeat)		
4	68h	Start bit (repeat)		
5	0 ... FAh, FFh	Instrument address	(IA)	***Addr*** or 255, compare chap. 3.1, page 6
6		Function field	(FF)	Compare chap. 3.2, page 6
7		Parameter index	(PI)	Compare chap. 6, page 17
. . .		n char., data block	(DB)	Compare chap. 3.4, page 8
Length + 5		Checksum	(CS)	The checksum is arrived at by means of a byte by byte summation of all characters starting with the instrument address up to and including the last data byte without overflow summation.
Length + 6	16h	End mark		

Gray areas represent the primary data included within the protocol, see chap. 3, page 6.

3 Primary Data Included within the Protocol – IA, FF, PI, DB

3.1 Instrument Address (IA)

- 0 ... 250 Individual instrument address range = interface address ***Addr***.
- 255 All instruments connected to a single bus can be queried simultaneously with this address. Data and commands transmitted to this address are uploaded to all instruments, but no acknowledgement is transmitted to the master.

3.2 Function Field (FF)

The function field includes

- For abbreviated records: actual user information which has been predefined bit by bit and which varies depending upon direction (query or response.
- For control and full records: direction and control information for the transmitted data block.

Function Field Coding (FF) for the Query Direction:

Query or Command	Code	Record Type	Comment
Reset instrument	09h	Abbreviated	Only the indicated codes can be evaluated by the A2000. Invalid codes are acknowledged with an error message.
Query: Instrument OK?	29h		
Request cycle data from instrument	89h		
Request events data from instrument	A9h		
Transmit data to A2000	69h	Control or full	
Request data from A2000	89h		

Function Field Coding (FF) for the Response Direction:

Bit No.	Function	Value	Comment
0 ... 2	Reserved	0, 0, 0	(prescribed allocation)
3	Requests disabled	0	Job completed, instrument ready
		1	Instrument not ready for this job, repeat job if applicable
4	Job acknowledgement	0	Job completed, instrument ready
		1	Job could not be executed, instrument ready
5	Transmission error	0	Request telegram OK
		1	Request telegram faulty
6	Not in use	0	
7	Operator request	0	Neither of the errors included in error status words 1 and 2 occurred.
		1	One or more errors occurred, request error status for exact identification.

3.3 Parameter Index (PI)

The type of data to be transmitted is determined by means of the parameter index. The parameter index groups encompass data related to functions, as well as instrument parameter settings.
The parameter indexes documented in chap. 6, page 17 are the only indexes which can be queried in the A2000. All others are acknowledged with an error message.

- Example: PI = 00h queries phase voltage, PI = 01h queries delta voltage and PI = 02h queries phase current ...

3.4 Data Block Length and Format (DB)

Length and format are variable and are dependent upon PI and FF.
Transmitted values can be formatted as bytes or words:

8 bits		Number without sign
± 7 bits	Two's compliment representation	Number with sign
16 bits	LS byte first	Number without sign
± 15 bits	LS byte first, two's compliment representation	Number with sign
32 bits	LS byte first	Number without sign
± 31 bits	LS byte first, two's compliment representation	Number with sign
8 / 16 bits	LS byte first	Bit array

4 Telegram Validity – Units and Data Ranges

The A2000 checks the characters of the received telegram in accordance with the following tables:

Abbreviated Records:

Char. No.	Criterion
1	10h
2	Address ***Addr*** or 255, compare chapter 3.1 page 6 Instrument Address (IA)
3	FF = valid function coding, chap. 3.2, page 6
4	PS = Addr or 255 + FF
5	16h

Control and Full Records:

Char. No.	Criterion
1	68h
2	Note length of CS and end mark
3	Character 3 = Character 2
4	68h
5	Interface address ***Addr*** or 255, compare chapter 3.1
6	FF = 69h or 89h, compare chapter 3.1 page 6 Instrument Address (IA)
7	PI = parameter index, chap. 6, page 17
. . .	Data block
Length + 5	PS = byte summation without overflow for all characters starting with instrument address (***Addr*** or 255) up to and including checksum
Length + 6	16h

If incorrect values for FF, PI and CS are received, the A2000 responds with an abbreviated record including a flagged transmission error bit. If the user data do not lie within their specified ranges, the A2000 responds with an abbreviated record including a flagged operator request bit. The "invalid value" bit is flagged in error status word 2. If other deviations or parity errors occur, the telegram is invalid and the A2000 does not respond.

5 Telegram Contents (commands)

5.1 Reset Instrument

The addressed instrument executes a hardware reset (similar to brief interruption of auxiliary power supply.

Example: instrument address = 2

Query from master (abbreviated record):	10h	02h	09h	0Bh	16h
		GA	FF	PS	
Response from A2000:	none				

5.2 Query: Instrument OK?

The addressed instrument responds with the function field only.

Example: instrument address = 3

Query from master (abbreviated record):	10h	03h	29h	2Ch	16h
		GA	FF	PS	
Response from A2000 (abbreviated):	10h	03h	„FF“	„FF“+3	16h

5.3 Request Cycle Data

The most important measurement and output data from the A2000 are included in a single packet. Cyclical queries for these values can thus be executed in a compact fashion (abbreviated record query).

Example: instrument address = 2

Query from master (abbreviated record):	10h	02h	89h	8Bh	16h
		GA	FF	PS	

Response from A2000 (full record): (compare chapter 2.3)	68h	09h	09h	68h	02h	„FF“	Data Block	„PS“	16h

19 or 29 characters

see chap. 3.2, page 6 regarding the content of the function field (FF)

5.3.1 Cycle Data

The cycle data block is selected from the 0xh PI group (parameter index), and is independent of the selected measurement configuration: 4-wire or 3-wire system.

The 29 characters included in the cycle data have the following format for 4-wire configuration:

Bit No.	Content	Format	Comment	
7, 8	FCh, 08h	± 15 bits	Uph1 = 230.0 V	Assumption: Dim. U = –1 see chap. 6.2, page 20
9, 10	0Bh, 09h	± 15 bits	Uph2 = 231.5 V	
11, 12	FAh, 08h	± 15 bits	Uph3 = 229.8 V	
13, 14	ECh, 13h	± 15 bits	Iph1 = 5.100 A	Assumption: Dim. I = –3 see chap. 6.2, page 20
15, 16	E7h, 13h	± 15 bits	Iph2 = 5.095 A	
17, 18	71h, 13h	± 15 bits	Iph3 = 4.977 A	
19, 20	95h, 04h	± 15 bits	P1 = 1173 W	Assumption: Dim. P = –0 see chap. 6.2, page 20
21, 22	9Bh, 04h	± 15 bits	P2 = 1179 W	
23, 24	61h, 04h	± 15 bits	P3 = 1121 W	
25, 26	00h, 00h	± 15 bits	Q1 = 0 W	
17, 28	00h, 00h	± 15 bits	Q2 = 0 W	
29, 30	E3h, 00h	± 15 bits	Q3 = 227 W	

Bit No.	Content	Format	Comment	
31	100	± 7 bits	PF1 = 1.00	
32	100	± 7 bits	PF2 = 1.00	
33	98	± 7 bits	PF3 = 0.98	
34, 35	8Ah, 13h	16 bits	Frequency = 50.02 Hz	

The 19 characters included in the cycle data have the following format for 3-wire configuration:

Bit No.	Content	Format	Comment	
7, 8	9Dh, 0Fh	± 15 bits	U12 = 399.9 V	Assumption: Dim. U = –1 see chap. 6.2, page 20
9, 10	9Bh, 0Fh	± 15 bits	U23 = 399.5 V	
11, 12	8Eh, 0Fh	± 15 bits	U31 = 398.2 V	
13, 14	ECh, 13h	± 15 bits	Iph1 = 5.100 A	Assumption: Dim. I = –3 see chap. 6.2, page 20
15, 16	E7h, 13h	± 15 bits	Iph2 = 5.095 A	
17, 18	71h, 13h	± 15 bits	Iph3 = 4.977 A	
19, 20	7Dh, 0Dh	± 15 bits	P_Σ = 3453 W	Assumption: Dim. P = –0 see chap. 6.2, page 20
21, 22	4Fh, 01h	± 15 bits	Q_Σ = 335 VA	
23	100	± 7 bits	Pf_Σ = 0.995 ≈ 1,00	
24, 25	8Ah, 13h	16 bits	Frequency = 50.02 Hz	

5.4 Request Events Data

Events data are summarized in 2 words and include all instrument error messages and alarms.
They can be queried with an abbreviated record in order to identify a specific error or alarm.
This request can be made in an asynchronous fashion, if the operator request bit (group alarm) was previously flagged within the function field (FF) of any given response telegram.
Example: instrument address = 5

Query from master (abbreviated record):

10h	05h	A9h	AEh	16h
	GA	FF	PS	

Response from A2000
(full record, compare chapter 2.3):

68h	06h	06h	68h	05h	„FF“	Data Block	„PS“	16h

4 characters

The 4 characters in the events data block are bit arrays which are combined into error status words 1 and 2. These 4 characters can also be read by querying data with the parameter index: PI = 21h.

Error Status Word 1 (measuring circuit), Read Only

Char.	Bit No.	Value	Meaning	Comment
1.	0	1	U1 < 0.7% of measuring range or none	
	1	1	U2 < 0.7% of measuring range or none	
	2	1	U3 < 0.7% of measuring range or none	
	3	1	I1 < 0.8% of measuring range or none	
	4	1	I2 < 0.8% of measuring range or none	
	5	1	I3 < 0.8% of measuring range or none	
	6	1	DC offset too large (bits 0 ... 5 indicate channel) [1)]	Defective measuring input
	7	1	Frequency < 40 Hz or none	
2.	8	1	U1 overflow	
	9	1	U2 overflow	
	10	1	U3 overflow	
	11	1	I1 overflow	
	12	1	I2 overflow	
	13	1	I3 overflow	
	14	1	Frequency > 70 Hz	
	15	1	Instrument not calibrated	Re-calibration required

[1)] If bit 6 = 1., bits 0 through 5 have a different meaning

For content of function field (FF) see chap. 3.2, page 6

Error Status Word 2 (miscellaneous), Read only (0, 1 write bits)

Char.	Bit No.	Value	Meaning	Comment
3.	0	1	Alarm 1 (relay 1) active	[1]
	1	1	Alarm 2 (relay 2) active	[1]
	2	1	Condition for alarm 1 fulfilled	Not stored to memory
	3	1	Condition for alarm 2 fulfilled	Not stored to memory
	4	1	3-wire connection in following order: L1, L3, L2	0 after correction and instrument restart
	5	0		
	6	0		
	7	0		
4.	8	1	Defective measuring input	0 after error correction
	9	1	Invalid parameter value, value not accepted	0 after value has been read
	10	0		
	11	1	Power failure at real-time clock, indicated time incorrect	0 after real-time has been written (PI = 90h, 91h)
	12	1	Real-time clock error	0 after error correction
	13	1	Faulty parameter setting from EEPROM	0 after error correction
	14	1	Faulty meter reading from EEPROM	0 after error correction
	15	1	Defective EEPROM	

[1] Bit 0, 1 = 1 - writing event resets alarm message 1, 2 (required for alarm memory mode)

5.5 Request Data from A2000

All values, parameters, configurations, conditions, instrument identification etc. can be queried with this form of communication. The data are queried individually by means of the parameter index (PI).
A complete list of all parameter indexes is included in chapter 6.

- Example: **Request Instrument Identification**
  Query for instrument identification with address = 33 = 21h (compare chapter 6.6)

Query from master (control record, compare chapter 2.2):

68h	03h	03h	68h	21h	89h	30h	DAh	16H
				GA	FF	PI	PS	

Response from instrument (full record, compare chapter 2.3):

68h	04h	04h	68h	21h	„FF“	30h	A2h	„PS“	16H
						PI	Data block		

The data block consists of an A2h character as identification for the A2000(compare chapter 3.4)

- Example: **query current for all 3 phases including peak values**
  Query phase currents at the A2000 with address = 33 = 21h (compare chapter 6.3)

Query from master (control record, compare chapter 2.2):

68h	06h	06h	68h	21h	89h	02h	AEh	16H
				GA	FF	PI	PS	

Response from instrument (full record, compare chapter 2.3):

68h	12h	12h	68h	21h	„FF“	02h
						PI

ECh	13h	E7h	13h	71h	13h	F5h	13h	F0h	13h	98h	13h	„PS“	16h

12 character data block

The 12 characters included in the data block (ECh, 13h, E7h, 13h, 71h, 13h, F5h, 13h, F0h, 13h, 98h, 13h) result in the following current values, as described in chap. 6.2, page 20 (Measurement Value Units) and chap. 3.4, page 8 (Data Block Format) under the assumption that DIM.I = –3:

The multiplier for current is, for example 10^{-3} $\rightarrow$ unit = 0.001 A

Iph1 = ECh, 13h $\Rightarrow$ Iph1 = 13ECh = 5100

When multiplied by the unit, the resulting value for Iph1 is = 5.100 A

The following applies as well:

Iph2 = E7h, 13h $\Rightarrow$ Iph2 = 5.095 A

Iph3 = 71h, 13h $\Rightarrow$ Iph3 = 4.977 A

$I1_{max}$ = F5h, 13h $\Rightarrow$ $I1_{max}$ = 5.109 A

$I2_{max}$ = F0h, 13h $\Rightarrow$ $I2_{max}$ = 5.104 A

$I3_{max}$ = 98h, 13h $\Rightarrow$ $I3_{max}$ = 5.016 A

5.6 Transmit Data to the A2000

All parameters, configurations and operating conditions which can be changed by the operator, can be set with this type of communication. The data are queried individually by means of the parameter index (PI). A complete list of parameter indexes is included in chapter 6.

No protection is provided against overwriting data. The LOCK switch position is irrelevant.

The transmitted value is checked by the A2000 as regards its setting range. If the value is not within the allowable range, it is not stored to memory – bit 9, "invalid value", is flagged in error status word 2, and the "operator request" bit is flagged in the function field of the abbreviated acknowledgement record.

- Example: **transmit instrument identification** (PI = 30h ... 3Fh)
  Select type of connection at the instrument, e.g. "4L" with address = 0 (compare chapter 6.6)

Query from master (full record, compare chapter 2.3):

68h	04h	04h	68h	00h	69h	33h	AAh	46h	16H
				GA	FF	PI	Data block	PS	

Acknowledgement (abbreviated record):

10h	00h	„FF“	„FF“	16H
			PS	

- Example: **transmit a parameter setting**
  Transmit pulse rate (e.g. 500/kWh) for outputs 1 and 2 to the A2000 with address = 1
  (compare chapter 6.4)

Query from master (full record, compare chapter 2.3):

68h	07h	07h	68h	01h	69h	12h	F4h	01h	F4h	01h	66h	16H
				GA	FF	PI	Data block				PS	

Acknowledgement (abbreviated record):

10h	01h	„FF“	„FF“ + 1	16H
			PS	

see chap. 3.2, page 6 regarding the content of the function field (FF)

6 Data and Corresponding Parameter Index

In addition to the parameter index (PI) for the individual data, the format and the length of the data blocks in the full record are also important for the querying of data from, or the transmission of data to the A2000. See also column „Number of Characters“ in the overview table (chapter 6.1). The sequence and contents of the characters in the data block can be determined from the “Format” column in the parameters tables, as well as from chap. 3.4, page 8.

6.1 Overview (PI = 00h up to 95h)

Main Group	PI	No. of Characters	Value	Comment
0			**Measurement Values**	Read only
	00h	12	Phase voltages	
	01h	12	Delta voltages	
	02h	12	Phase currents	
	03h	12	Averaged phase currents	
	04h	16	Active powers	
	05h	16	Reactive powers	
	06h	16	Apparent powers	
	07h	16	Power factors	
	08h	32	Energy meter	
	09h	24	Interval active powers	
	0Ah	24	Interval reactive powers	
	0Bh	24	Interval apparent powers	
	0Dh	8	Neutral conductor currents	
	0Fh	2	Line frequency	
1			**Limit values**	
	10h	8	Relay hysteresis / limit	
	11h	4	Relay source / configuration	
	12h	4	Pulse output rate	
	13h	2	Pulse output source	
	14h	8	Analog output lower range limit	Not for Feature L2
	15h	8	Analog output upper range limit	Not for Feature L2
	16h	8	Analog output source / configuration	Not for Feature L2
	18h	1	Pulse output length	
	1Dh	4	Analog input: Lower range limit/offset	
	1Eh	4	Analog input: Upper range limt	
	1Fh	2	Analog input: Configuration	

Main Group	PI	No. of Characters	Value	Comment
2			**Control Commands/ Status Queries**	
	20h	2	Control status	
	21h	4	Error status	Read only
	24h	2	Max. voltages, delete currents	Write only
	25h	3	Max. powers / delete FFT	Write only
	26h	2	Delete energy meter	Write only
	27h	2	Set standard parameters	Write only
	28h	8	Control analog outputs	Not for Feature L2
	29h	1	Data logger start / stop	Only for Feature R1
	2Ah	1	Trigger interval	Write only
	2Fh	8	Measured values analog input	Read only, write deletes both maximum values
3			**Device Specification**	
	30h	1	Device ID	Read only
	31h	1	Equipped with	Read only
	32h	4	Measured value dimension	Read only
	33h	1	Connection type	
	34h	1	Synchronizing interval	
	35h	1	Software version	Read only
	36h	1	Energy meter mode	
	37h	4	Low tariff time interval	Only for Feature R1
	38h	1	Type of measurement for reactive power	
	39h	1	Frequency source	
	3Bh	4	Voltage measuring range	
	3Ch	4	Current measuring range	
	3Fh	1	Display brightness/filter	

Main Group	PI	No. of Characters	Value	Comment
8			**Harmonic waves, FFT**	Read only
	80h	24	THD / Fundamental wave	
	81h	32	U1 THD / Distortion factors	
	82h	32	U2 THD / Distortion factors	
	83h	32	U3 THD / Distortion factors	
	84h	32	I1 THD / Harmonic waves	
	85h	32	I2 THD / Harmonic waves	
	86h	32	I3 THD / Harmonic waves	
	87h	24	Maximum values THD / fundamental wave	
	88h	32	Maximum values U1 THD / distortion factors	
	89h	32	Maximum values U2 THD / distortion factors	
	8Ah	32	Maximum values U3 THD / distortion factors	
	8Bh	32	Maximum values I1 THD / harmonic waves	
	8Ch	32	Maximum values I2 THD / harmonic waves	
	8Dh	32	Maximum values I3 THD / harmonic waves	
9			**Real-Time Clock / Data Logger**	Only for Feature R1
	90h	3	Time	
	91h	4	Date	
	92h	15	Setup parameters for data logger	
	93h	23	Current recording setup	Read only
	94h	34	Current setup of a recording window	Read only
	95h	223 ... 243	Recording data of transmission block	Read only
A			**Sampling Values**	
	A0	64	U1	Read only
	A1	64	U2	Read only
	A2	64	U3	Read only
	A3	64	I1	Read only
	A4	64	I2	Read only
	A5	64	I3	Read only
	A6	1	freeze/update sampling values	

6.2 Units, Ranges and Resolution of Measurement Values

These data apply to all telegram contents, both for measurement values and for parameters.
The multipliers (position of decimal points, „dim“ parameters) are established by entering the primary measuring ranges (compare PI = 3Bh, 3Ch) and can be read with PI = 32h.

Measuring Quantity	Basic Unit	Multiplier Range	Corrensponding Value of the „dim“ Parameter PI = 32h	Value Range of Data Field	Physical Value Range	Display Resolution comp. PI = 32h
Line frequency	Hz	0.01	—	4000 ... 7000	40,00 ... 70,00 Hz	0.01 Hz
Power factor	1	0.01	—	–100 … 0 … +100	1,00 … cap … 0 … ind … 1,00	0.01
Voltage	V	10^{-1} ... 10^{2}	dim.U = –1 ... 2	0 ... 9999	0 V ... 999.9 V ... 999.9 kV	dim. U (V)
Voltage distortion factor	%	0.1	—	0 ... 1000	0 ... 100.0 %	0.1 %
Current, current harmonic wave	A	10^{-3} ... 10^{2}	dim.I = –3 ... 2	0 ... 9999	0 A ... 9.999 A ... 999.9 kA	dim. I (A)
Power, interval Power	W, VA, VAr	10^{-1} ... 10^{8}	dim.P = –1 ... 8	–9999 ... 0 ... 9999	0 ... 999.9 W / VA / VAr ... 999.9 GW / GVA / GVAr	dim. P (W)
Energy meter	Wh, VArh	10^{-1} ... 10^{8}	dim.E = –1 ... 8	–99999999 ... 0 ... 999999999	0 ... 99999999.9 Wh / VArh ... 99999999.9 GWh / GVArh	dim. E (Wh)

6.3 Measurement Value Table (PI = 00h ... 0Fh)

The parameter index PI = 00h extends up to 0Fh for measurement values. Measurement values can only be read. Writing of measurement values is not possible.

PI	Measurement Value	Format
00h	Phase voltage:	
	U1	16 bits
	U2	16 bits
	U3	16 bits
	$U1_{max}$	16 bits
	$U2_{max}$	16 bits
	$U3_{max}$	16 bits
01h	Delta voltage:	
	U12	16 bits
	U23	16 bits
	U31	16 bits
	$U12_{max}$	16 bits
	$U23_{max}$	16 bits
	$U31_{max}$	16 bits
02h	Phase current:	
	I1	16 bits
	I2	16 bits
	I3	16 bits
	$I1_{max}$	16 bits
	$I2_{max}$	16 bits
	$I3_{max}$	16 bits

PI	Measurement Value	Format
03h	Averaged phase current:	
	$I1_{avg}$	16 bits
	$I2_{avg}$	16 bits
	$I3_{avg}$	16 bits
	$I1_{avg\ max}$	16 bits
	$I2_{avg\ max}$	16 bits
	$I3_{avg\ max}$	16 bits
04h	Active power:	
	P1	± 15 bits
	P2	± 15 bits
	P3	± 15 bits
	P_{Σ}	± 15 bits
	$P1_{max}$	± 15 bits
	$P2_{max}$	± 15 bits
	$P3_{max}$	± 15 bits
	$P_{\Sigma\ max}$	± 15 bits
05h	Reactive power:	
	Q1	16 bits
	Q2	16 bits
	Q3	16 bits
	Q_{Σ}	16 bits
	$Q1_{max}$	16 bits
	$Q2_{max}$	16 bits
	$Q3_{max}$	16 bits
	$Q_{\Sigma\ max}$	16 bits

PI	Measurement Value		Format
06h	Apparent power:		
	S1		16 bits
	S2		16 bits
	S3		16 bits
	S_{Σ}		16 bits
	$S1_{max}$		16 bits
	$S2_{max}$		16 bits
	$S3_{max}$		16 bits
	$S_{\Sigma max}$		16 bits
07h	Power factor:		
	PF1		± 7 bits
	PF2		± 7 bits
	PF3		± 7 bits
	PF_{Σ}	PF<0: capacitive [1]	± 7 bits
	$PF1_{min}$	PF>0: inductive [1]	± 7 bits
	$PF2_{min}$		± 7 bits
	$PF3_{min}$		± 7 bits
	$PF_{\Sigma min}$		± 7 bits
08h	Energy meter: [2]		
	L123 mode	LTHT mode	
	E_{P1}	$E_{P\Sigma L-}$	± 31 bits
	E_{P2}	$E_{P\Sigma L+}$	± 31 bits
	E_{P3}	$E_{P\Sigma H-}$	± 31 bits
	$E_{P\Sigma}$	$E_{P\Sigma H+}$	± 31 bits
	E_{Q1}	$E_{Q\Sigma L-}$	32 bits
	E_{Q2}	$E_{Q\Sigma L+}$	32 bits
	E_{Q3}	$E_{Q\Sigma H-}$	32 bits
	$E_{Q\Sigma}$	$E_{Q\Sigma H+}$	32 bits

PI	Measurement Value		Format
09h	$P_{Int\,\Sigma\,current}$	[3]	1 x ± 15 bits
	$P_{Int\,\Sigma\,expired}$	[4]	10 x ± 15 bits
	$P_{Int\,\Sigma\,max}$	[5]	1 x ± 15 bits
0Ah	$Q_{Int\,\Sigma\,current}$	[3]	1 x 16 bits
	$Q_{Int\,\Sigma\,expired}$	[4]	10 x 16 bits
	$Q_{Int\,\Sigma\,max}$	[5]	1 x 16 bits
0Bh	$S_{Int\,\Sigma\,current}$	[3]	1 x 16 bits
	$S_{Int\,\Sigma\,expired}$	[4]	10 x 16 bits
	$S_{Int\,\Sigma\,max}$	[5]	1 x 16 bits
0Dh	Neutral conductor current		
	I_N		16 bits
	$I_{N\,max}$		16 bits
	$I_{N\,avg}$		16 bits
	$I_{N\,avg\,max}$		16 bits
0Fh	Line frequency		16 bits

[1] To obtain the PF, multiply the result (± 7 bits) by 0.01.
[2] Active energy exports are displayed with a negative sign in the L123 mode. All energy values are positive in the LTHT mode
[3] Current interval
[4] 1. – 10. Interval before
[5] Max. interval value since switching on or reset of the value, see chap. 6.5, page 27, PI=25h

6.4 Table for Relay, Pulse and Analog Output Quantities (PI = 10h ... 1Fh)

PI	Parameter	Format	Unit	Value Range	Comment
10h	Relay 1 hysteresis	16 bits	unit of quantity to be monitored (source)	0 ... 9999	
	Relay 2 hysteresis	16 bits			
	Relay 1 limit	± 15 bits		–1999 ... 9999	
	Relay 2 limit	± 15 bits			
11h	Relay 1 source	8 bits		See chap. 6.4.3, page 25	
	Relay 2 source	8 bits			
	Relay 1 configuration	8 bits		See chap. 6.4.1, page 24	
	Relay 2 configuration	8 bits			
12h	Pulse output 1 rate	16 bits	1 / kWh (MWh)	0 ... 5000	Unit see chap. 6.4.4, page 26
	Pulse output 2 rate	16 bits	1 / kWh (MWh)		
13h	Pulse output 1 source	8 bits		See chap. 6.4.4, page 26	
	Pulse output 2 source	8 bits			
14h	Analog outputs:		unit of quantity to be monitored (source)	–9999 ... 9999	Lower range limit 3 / 4 = 0 Where characteristic A1 does not apply Lower range limit 3 / 4 are not read or written where Feature A3
	Lower range limit 1	± 15 bits			
	Lower range limit 2	± 15 bits			
	Lower range limit 3	± 15 bits			
	Lower range limit 4	± 15 bits			
15h	Analog outputs:		unit of quantity to be monitored (source)	–9999 ... 9999	Upper range limit 3 / 4 = 0 where characteristic A1 does not apply Upper range limit 3 / 4 are not read or written where Feature A3
	Upper range limit 1	± 15 bits			
	Upper range limit 2	± 15 bits			
	Upper range limit 3	± 15 bits			
	Upper range limit 4	± 15 bits			
16h	Analog outputs:			See chap. 6.4.3, page 25	Source 3 / 4 = 0 Where characteristic A1 does not apply Source 3 / 4 are not read or written where Feature A3
	Source 1	8 bits			
	Source 2	8 bits			
	Source 3	8 bits			
	Source 4	8 bits			
	Configuration 1	8 bits		See chap. 6.4.2, page 24	Configuration 3 / 4 = 0 where characteristic A1 does not apply Configuration 3 / 4 are not read or written where Feature A3
	Configuration 2	8 bits			
	Configuration 3	8 bits			
	Configuration 4	8 bits			
18h	Pulse length	8 bits		0 ... 7	0.1 s ... 0.8 s

PI	Parameter	Format	Unit	Value Range	Comment
1Dh	Analog inputs	± 15 bits	depending on configuration	depending on configuration	@ PT1000: Offset of measurement Format: Offset (in °C) *90 or Offset (in °F) *50 Lower range limit –200 °C fixed
	Lower range limit 1				
	Lower range limit 2				
1Eh	Analog inputs	± 15 bits	depending on configuration	depending on configuration	not with PT1000 Upper range limit 850 °C fixed
	Upper range limit 1				
	Upper range limit 2				
1Fh	Analog inputs	8 bits	depending on configuration	see chap. 6.4.5, page 26	
	Configuration 1				
	Configuration 2				

6.4.1 Relay Configuration (PI = 11h)

Bit No.	Value	Meaning	Function
0	0	low	Low/high alarm function
	1	high	
1	0	nonstore	Alarm memory
	1	store	
2	0	depending on DIP switch	Alarm release
	1	always free	
3	0		No function
4 ... 7	0 ... 15	0 = none 1 = 1 s 2 = 2 s 3 = 3 s 4 = 5 s 5 = 8 s 6 = 15 s 7 = 25 s 8 = 40 s 9 = 1 min 10 = 2 min 11 = 3 min 12 = 5 min 13 = 8 min 14 = 15 min 15 = 30 min	Alarm delay

6.4.2 Analog Output Configuration (PI = 16h)

Bit No.	Value	Meaning	Function
0 ... 1	00	4 ... 20 mA (2 ... 10 V)	Output type
	01	0 ... 20 mA (0 ... 10 V)	
	10	–20 ... 20 mA (–10 ... 10 V)	
	11	–10 ... 10 mA (–5 ... 5 V)	
2 ... 7	0		No function

6.4.3 Relay and Analog Output Sources (PI = 11h or 16h)

Bit No.	Value	Meaning	Function
0 ... 3	000	Phase 1 or 1→2	Phase number of the source value (no function for frequency)
	001	Phase 2 or 2→3	
	010	Phase 3 or 3→1	
	011	Sum	
	100	Neutral conductor current	Only for source value = 2, 3 (current)
	101	for all 3 phases	Only for relay (PI = 11h)
4 ... 7	0000	Delta voltage	Type of source value
	0001	Phase voltage	
	0010	Phase current	
	0011	Averaged phase current	
	0100	Active power	
	0101	Reactive power	
	0110	Apparent power	
	0111	Power factor	
	1000	Frequency	
	1001	Total active power interval [1)]	
	1010	Ttotal reactive power interval [1)]	
	1011	Total apparent power interval [1)]	
	1100	External value (can be driven via interface)	

[1)] The current interval (- 0) is used for the relay output, the interval (- 1) is used for the analog output

6.4.4 Pulse Output Source (PI = 13h)

Bit No.	Value	Meaning	Function
3 ... 0	000	Phase 1 or 1→2	Phase number of the source value
	001	Phase 2 or 2→3	
	010	Phase 3 or 3→1	
	011	Sum	
4	0	Active energy	Type of source value
	1	Reactive energy	
5	0	Import	
	1	Export	
6	0	Pulses per kWh	
	1	Pulses per MWh	
7	0	High tariff	
	1	Low tariff	

6.4.5 Configuration of Analog Input (PI = 1Fh)

Bit No.	Value	Meaning	Function
0, 1	00	4 ... 20 mA / 2 ... 10 V / 0 °C	Input type
	01	0 ... 20 mA / 0... 10 V / 0 °F	
	10	–20 ... 20 mA / –10 ... 10 V / 0 °C	
	11	–10 ... 10 mA / –5 ... 5 V / 0 °F	
2	0	Standard signal 20 mA/10 V	Input type
	1	Temperature sensor Pt1000	
3	—	—	no function
4, 5	00	0 places behind the decimal point / integral degrees	Decimal point, resolution
	01	1 place behind the decimal point / tenths of degree	
	10	2 places behind the decimal point / integral degrees	
	11	3 places behind the decimal point / tenths of degree	
6, 7	—	—	no function

6.5 Control Commands and Status Queries (PI = 20h ... 29h)

Control commands and status queries are included in parameter index group 20h ... 29h.

PI	Parameter	Format	Value Range	Comment
20h	A2000 control status	16 bits	See next page	
21h	A2000 error status	2 x 16 bits		Read only, compare events data chap. 5.4, page 11
24h	$U \triangle_{max}$ clear	bit array with 2 x 8 bits	See next page: Command, Peak Voltage Values, ...	Write only
	U_{max} clear			
	I_{max} clear			
	$I_{avg\ max}$ clear			
25h	P_{max} clear	bit array with 3 x 8 bits	See next page: Command, Peak Voltage Values, ...	Write only
	Q_{max} clear			
	S_{max} clear			
	PF_{max} clear			
	$P_{int\ max}$ clear			
	$Q_{int\ max}$ clear			
	$S_{int\ max}$ clear			
	FFT clear			
26h	Energy clear all	16 bits	=55AAh	Write only
27h	Restore default parameters	16 bits	=A965h	Write only, sets 1st and 2nd parameter sets to default values, except for address (Set – default, – user)
28h	Analog outputs		± 2000 100 corresponds to 1 mA ot 0.5 V	Writing only if source Analog outputs = external Not for Feature L2
	Direct output value 1	± 15 bits		
	Direct output value 2	± 15 bits		
	Direct output value 3	± 15 bits		
	Direct output value 4	± 15 bits		
29h	Data logger start / stop	8 bits	=55h: Stop =AAh: Start	Only for Feature R1 Restart only after previous stop!
2Ah	Trigger interval	8 bits	=AAh: Trigger	Write only
2Fh	Analog inputs		same as in the display, without taking the decimal point into account	Read only. Writing on any value deletes both maximum values.
	Measured value 1	± 15 bits		
	Measured value 2	± 15 bits		
	Maximum measured value 1	± 15 bits		
	Maximum measured value 2	± 15 bits		
	Status	16 bits	see chapter 6.5.3	

6.5.1 A2000 Control Status (PI = 20h)

Bit No.	Value	Function	Comment
0 ... 6	0	—	
7	1	Pulse input active	Read only
8	0 / 1	Relay 1 active / inactive	Can only be set via interface, if source = external
9	0 / 1	Relay 2 active / inactive	Can only be set via interface, if source = external
10 ... 15	0	—	

6.5.2 Delete Maximum Voltages, Currents, Powers (PI = 24h, 25h)

Command: Peak Voltage Values, Reset Current (PI = 24h)

Bit No.	Value	Function
0	1	$U12_{max} = 0$
1	1	$U23_{max} = 0$
2	1	$U31_{max} = 0$
3	0	—
4	1	$U1_{max} = 0$
5	1	$U2_{max} = 0$
6	1	$U3_{max} = 0$
7	0	—
0	1	$I1_{max} = 0$
1	1	$I2_{max} = 0$
2	1	$I3_{max} = 0$
3	1	$I_{N\,max} = 0$
4	1	$I1_{avg\,max} = 0$
5	1	$I2_{avg\,max} = 0$
6	1	$I3_{avg\,max} = 0$
7	1	$I_{N\,avg\,max} = 0$

Command: Peak Power Values, Reset Power Factors (PI = 25h)

Bit No.	Value	Function
0	1	$P1_{max} = 0$
1	1	$P2_{max} = 0$
2	1	$P3_{max} = 0$
3	1	$P\Sigma_{max} = 0$
4	1	$Q1_{max} = 0$
5	1	$Q2_{max} = 0$
6	1	$Q3_{max} = 0$
7	1	$Q\Sigma_{max} = 0$
0	1	$S1_{max} = 0$
1	1	$S2_{max} = 0$
2	1	$S3_{max} = 0$
3	1	$S\Sigma_{max} = 0$
4	1	$PF1_{max} = 0$
5	1	$PF2_{max} = 0$
6	1	$PF3_{max} = 0$
7	1	$PF\Sigma_{max} = 0$
0	1	$P_{int\,max} = 0$
1	1	$Q_{int\,max} = 0$
2	1	$S_{int\,max} = 0$
3	1	Max. FFT = 0
4 ... 7		not in use

6.5.3 Status of Analog Inputs (PI = 2Fh)

Bit No.	Value	Meaning	Comment
0	1	Measured value 1 fallen short of and/or sensor short circuit	Momentary state, indicated as lower or upper lines
1	1	Measured value 2 fallen short of and/or sensor short circuit	
2, 3	0	—	
4	1	Measured value 1 exceeded and/or sensor break	
5	1	Measured value 2 exceeded and/or sensor break	
6, 7	0	—	
8	1	Measured value 1 fallen short of and/or sensor short circuit	Accumulated state, can be deleted in the same way as maximum values.
9	1	Measured value 2 fallen short of and/or sensor short circuit	
10, 11	0	—	
12	1	Measured value 1 exceeded and/or sensor break	
13	1	Measured value 2 exceeded and/or sensor break	
14, 15	0	—	

6.6 Instrument Specifications (PI = 30h ... 3Fh)

PI	Parameter	Format	Value Range	Comment
30h	Instrument identification	8 bits	A2h	Read only
31h	Equipment	8 bits	See variants	Read only
32h	Measurement value - dimension			Read only – determined from primary voltage and current measuring ranges (PI = 3Bh, 3Ch)
	Dim. U	± 7 bits	– 1 … 2	
	Dim. I	± 7 bits	– 3 … 2	
	Dim. P	± 7 bits	– 1 … 8	
	Dim. E	± 7 bits	– 1 … 8	
33h	3-L/4-L/3L-1/3L13/4L13 connection	8 bits	55h/AAh/33h/CCh/66h	
34h	Energy synchronizing interval	8 bits	0,1 ... 60	= external, 1 ... 60 minutes
35h	Software version	8 bits	0 ... 255	Read only
36h	Energy meter mode	8 bits		Mode / Low tariff active
			00h	L123 / by time setting [1]
			04h	LTHT / by time setting [1]
			08h	L123 / with SYNC input
			0Ch	LTHT / with SYNC input
37h	Low tariff time interval			Only active, if feature R1
	Start time, minutes	8 bits	0 ... 59	
	Start time, hours	8 bits	0 ... 23	
	End time, minutes	8 bits	0 ... 59	
	End time, hours	8 bits	0 ... 23	
38h	Representation of reactive power	8 bits	see “Representation of Reactive Power (PI = 38h)” on page 31	
39h	Frequency source	8 bits	00h	All phases are taken into account
			40h	Synchronization only in relation to voltages
3Bh	Voltage measuring range			
	U_{tprim}	100 V/16 bits	– 600 ... 0 / 1 ... 8000	= 100 V ... 700 V / 100 V ... 800 kV
	U_{tsek}	1 V/16 bits	100 ... 500	= 100 V ... 500 V
3Ch	Current measuring range			
	I_{tprim}	1 A, 5 A/16 bits	0,1 ... 30000	= 1 A, 5 A ... 150000 A
	I_{tsek}	bit 0	0.1	= 5 A, 1 A
		bit 1 ... 7	—	—
		bit 8 ... 15	– 100 ... 100	0.900 ... 1.100 adjustment
3Fh	Display brightness	bit 0 ... 2	0 ... 7	0.5 brightness levels
	Display filter	bit 3 ... 7	0 ... 30	Time constant in sec.

[1]) No low tariff function included in version without data logger

Equipment (PI = 31h)

Bit No.	Value	Function	Characteristic
0	1	Equipped with analog outputs 3 and 4	A1
1	1	Equipped with S0 outputs	P1
2	1	Equipped with synchronizing output	S1
3	1	Equipped with LON interface	L1
4	1	Equipped with data logger	R1
5	0	Real-time clock	R1
6	1	Profibus model	L2
7	1	Equipped with analog inputs	A3

Representation of Reactive Power (PI = 38h)

Value	Representation	Comment
00h	per DIN 40110	$Q=\sqrt{S^2-P^2}$
10h	with sign	$Q=\frac{1}{TN}\cdot\int_0^{TN}U(t)\cdot J\left(t-\frac{TN}{4}\right)c$ [1)]
20h	Equalizing reactive power	
30h	with sign	Power factor same as Ferraris meters

[1)] TN is the period duration of the basic frequency of U or I, respectively.

6.7 FFT, Harmonics (PI = 80h ... 8Dh)

PI	Parameter	Format	Comment	PI	Parameter	Format	Comment
80h	**Instantaneous values THD/ fundamental wave:** I1 THD	16 bits	read only	87h	**Maximum values THD/ fundamental wave:** I1 THD	16 bits	read only
	I1 Fundamental wave	16 bits			I1 Fundamental wave	16 bits	
	I2 THD	16 bits			I2 THD	16 bits	
	I2 Fundamental wave	16 bits			I2 Fundamental wave	16 bits	
	I3 THD	16 bits			I3 THD	16 bits	
	I3 Fundamental wave	16 bits			I3 Fundamental wave	16 bits	
	U1 THD	16 bits			U1 THD	16 bits	
	U1 Fundamental wave	16 bits			U1 Fundamental wave *	16 bits	
	U2 THD	16 bits			U2 THD	16 bits	
	U2 Fundamental wave	16 bits			U2 Fundamental wave *	16 bits	
	U3 THD	16 bits			U3 THD	16 bits	
	U3 Fundamental wave	16 bits = 24 bytes			U3 Fundamental wave *	16 bits = 24 bytes	
81h	**Instantaneous values U1 THD/ harmonic waves:** U1 THD	16 bits	read only	88h	**Maximum values U1 THD/ harmonic waves:** U1 THD	16 bits	read only
	U1 Fundamental wave	16 bits			U1 Fundamental wave *	16 bits	
	U1 2nd harmonic	16 bits			U1 2nd harmonic	16 bits	
	...	...			...	...	
	U1 15th harmonic	16 bits = 32 bytes			U1 15th harmonic	16 bits = 32 bytes	
82h	**Instantaneous values U2 THD/ harmonic waves:** U2 THD	16 bits	read only	89h	**Maximum values U2 THD/ harmonic waves:** U2 THD	16 bits	read only
	U2 Fundamental wave	16 bits			U2 Fundamental wave *	16 bits	
	U2 2nd harmonic	16 bits			U2 2nd harmonic	16 bits	
	...	...			...	...	
	U2 15th harmonic	16 bits = 32 bytes			U2 15th harmonic	16 bits = 32 bytes	

* Since the maximum value would always be 100% here, the minimum is determined for the voltage fundamental wave.

PI	Parameter	For-mat	Comment	PI	Parameter	For-mat	Comment
83h	**Instantaneous values U3 THD/ harmonic waves:** U3 THD	16 bits	read only	8Ah	**Maximum values U3 THD/ harmonic waves:** U3 THD	16 bits	read only
	U3 Fundamental wave	16 bits			U3 Fundamental wave *	16 bits	
	U3 2nd harmonic	16 bits			U3 2nd harmonic	16 bits	
	...	...			...	...	
	U3 15th harmonic	16 bits = 32 bytes			U3 15th harmonic	16 bits = 32 bytes	
84h	**Instantaneous values I1 THD/ harmonic waves:** I1 THD	16 bits	read only	8Bh	**Maximum values I1 THD/ harmonic waves:** I1 THD	16 bits	read only
	I1 Fundamental wave	16 bits			I1 Fundamental wave	16 bits	
	I1 2nd harmonic	16 bits			I1 2nd harmonic	16 bits	
	...	...			...	...	
	I1 15th harmonic	16 bits = 32 bytes			I1 15th harmonic	16 bits = 32 bytes	
85h	**Instantaneous values I2 THD/ harmonic waves:** I2 THD	16 bits	read only	8Ch	**Maximum values I2 THD/ harmonic waves:** I2 THD	16 bits	read only
	I2 Fundamental wave:	16 bits			I2 Fundamental wave	16 bits	
	I2 2nd harmonic	16 bits			I2 2nd harmonic	16 bits	
	...	...			...	...	
	I2 15th harmonic	16 bits = 32 bytes			I2 15th harmonic	16 bits = 32 bytes	
86h	**Instantaneous values I3 THD/ harmonic waves:** I3 THD	16 bits	read only	8Dh	**Maximum values I3 THD/ harmonic waves:** I3 THD	16 bits	read only
	I3 Fundamental wave	16 bits			I3 Fundamental wave	16 bits	
	I3 2nd harmonic	16 bits			I3 2nd harmonic	16 bits	
	...	...			...	...	
	I3 15th harmonic	16 bits = 32 bytes			I3 15th harmonic	16 bit = 32 bytes	

* Since the maximum value would always be 100 % here, the minimum is determined for the voltage fundamental wave.

6.8 Real-Time Clock / Data Logger (PI = 90h ... 9Fh) Value ranges with 512 kB memory

PI	Parameter	Format	Value Range	Comment
90h	Seconds	8 bits	0 ... 59	Recording restarts RTC
	Minutes	8 bits	0 ... 59	
	Hours	8 bits	0 ... 23	
91h	Day	8 bits	1 ... 31	Recording restarts RTC
	Month	8 bits	1 ... 12	
	Year	8 bits	0 ... 99	
	Millennium	8 bits	19 ... 20	
92h	Data logger, parameter settings			
Infofeld	Sampling interval	8 bits	0 ... 19	See page 37 Data Logger, Sampling Interval
	Current recording duration for one window in trigger mode [1)]	8 bits	8 ... 24	See page 37 Data Logger, Recording Duration
	Trigger specification	8 bits	00h ... 3Fh	See page 37 Data Logger, Trigger Specification
	Selection and assignment of measurement values to recording channels 1 through 12			See page 38 Data Logger, Selection and Assignment of Measurement Values
	Channel 1	8 bits		
	Channel 2	8 bits		
	Channel 3	8 bits		
	Channel 4	8 bits		
	Channel 5	8 bits		
	Channel 6	8 bits		
	Channel 7	8 bits		
	Channel 8	8 bits		
	Channel 9	8 bits		
	Channel 10	8 bits		
	Channel 11	8 bits		
	Channel 12	8 bits		

[1)] Not valid for recording without trigger

PI	Parameter	Format	Value Range	Comment
93h	Data Logger, general configuration for recording memory			Read only
Info field	Number of avail. windows (v)	8 bits	1 ... 99	
	Number of windows used or % occupancy of logger	8 bits	1 ... v, 100 and/or 0 ... 100	Trigger mode * Free run
	Number of 16 bit values per sample	8 bits	0 ... 24	
	Channel assignments:			See page 38 Data Logger, Selection and Assignment of Measurement Values
	Channel 1	8 bits		
	Channel 2	8 bits		
	Channel 3	8 bits		
	Channel 4	8 bits		
	Channel 5	8 bits		
	Channel 6	8 bits		
	Channel 7	8 bits		
	Channel 8	8 bits		
	Channel 9	8 bits		
	Channel 10	8 bits		
	Channel 11	8 bits		
	Channel 12	8 bits		
	Trigger 1 – source	8 bits	00h ... C5h	See page 25 Relay and Analog Output Sources (PI = 11h or 16h)
	Trigger 2 – source	8 bits	00h ... C5h	
	Sampling interval	1 s/16 bits	0,0,1 ... 43200	=0: [2] 0.3 s ... 12 h; 20864 ≙ 24 h
	Recording duration for • one window (in trigger mode) • maximum duration (without triggering)	1 s/32 bits	60 ... 3.12 x 10^9	1 min ... 99 years
	Max. number of samples per window	32 bits	0 ... 260754	

[1] In trigger mode: Number of windows used since start of logging, 100 after first overwrite
[2] Interval dependent upon measuring frequency, 16 or 32 periods, compare page 37 Data Logger, Sampling Interval

PI	Parameter	Format	Value Range	Comment
94h	Data Logger, specific parameters for a recording window			Read only
PE top	Window number	8 bits	1 ... v	[3]
Info field	Time stamp for first trigger	6 x 8 bits		See page 39 Data Logger, Time Stamp Format
	Time stamp for last trigger	6 x 8 bits		See page 39 Data Logger, Time Stamp Format
	Time stamp for last sample	6 x 8 bits		See page 39 Data Logger, Time Stamp Format
	Sample position for first trigger	32 bits	0 ... 195566	
	Sample position for last trigger	32 bits	0 ... 260754	< max. number
	Position of last sample	32 bits	0 ... 260754	< max. number, number of samples – 1
	Number of samples per data transmission block	8 bits	5 ... 120	Last block may have fewer samples
	Number of data transmission blocks per window	16 bits	1 ... approx. 2200	
95h	Data field,data logger data transmission block			Read only
PE top	Window number Data block number	8 bits 16 bits	1 ... 99 0 ... 2169	
Info field	1st measurement value for the 1st sample in the block	16 bits		2 x t x s characters are transmitted [4]
	…	…		
	Last measurement value for the 1st sample	16 bits		The less significant word is quoted first in the case of energy measurement values
	1st meas. value for the 2nd sample	16 bits		
	…	…		
	Last measurement value for the last samples	16 bits		

[3] 1 = Window number = 1: oldest window; v = current window

[4] t = Number of 16 bit values per sample; s = number of samples per data transmission block

6.8.1 Data Logger, Sampling Interval

Index	Interval	Index	Interval	Index	Interval	Index	Interval
0	1 meas. cycle *	2	1 second	8	1 minute	14	1 hour
1	2 meas. cycles *	3	2 seconds	9	2 minutes	15	2 hours
		4	5 seconds	10	5 minutes	16	4 hours
		5	10 seconds	11	10 minutes	17	8 hours
		6	15 seconds	12	15 minutes	18	12 hours
		7	30 seconds	13	30 minutes	19	24 hours

* 1 measuring cycle ≙ 16 periods

6.8.2 Data Logger, Recording Duration

Index	Recording Duration	Index	Recording Duration	Index	Recording Duration
8	1 minute	14	1 hour	19	1 day
9	2 minutes	15	2 hours	20	2 days
10	5 minutes	16	4 hours	21	4 days
11	10 minutes	17	8 hours	22	7 days
12	15 minutes	18	12 hours	23	14 days
13	30 minutes			24	31 days

6.8.3 Data Logger, Trigger Specification

Bit No.	Function	Comments
0...2	0: no trigger 1: Alarm 1 trigger 2: Alarm 2 trigger 3: Alarm 1 and 2 trigger 4: no trigger and logger start via Sync input 5: Alarm 1 trigger and trigger lock via Sync input 6: Alarm 2 trigger and trigger lock via Sync input 7: Alarm 1 and 2 trigger and trigger lock via Sync input	
3	=0: Memory mode “one time only” =1: Memory mode “cyclical”	
5,4	=0,0: Pre-trigger 00% =0,1: Pre-trigger 25% =1,0: Pre-trigger 50% =1,1: Pre-trigger 75%	Position of first triggers in % relative to number of sampling steps per window
6	=0	Not in use
7	=0	Not in use

6.8.4 Data Logger, Selection and Assignment of Measurement Values

For recording channels 1 - 12 in the channel list:
Recording is performed with all channels starting with channel 1 and up to the first channel in the list flagged ≙ "OFF". All subsequent entries to the list are disregarded!

Bit No.	Function	Coding (1)	Comments	Coding (2)
0 ... 3	Phase number for the measurement value	=0: Phase 1 or U_{12} =1: Phase 2 or U_{23} =2: Phase 3 or U_{31} =3: Sum of 3 phases =4: Neutral conductor current	= L– for energies and LTHT mode = L+ = H– = H+ Only for type of measurement value = 2, 3 (current)	= 8: Current harmonic waves phase 1 = 9: Current harmonic waves phase 2 =10: Current harmonic waves phase 3 =12: Voltage distortion factor phase 1 =13: Voltage distortion factor phase 2 =14: Voltage distortion factor phase 3
4 ... 7	Type of measurement value	=0: Delta voltage =1: Phase voltage =2: Phase current =3: Phase current (avg.) =4: Active power =5: Reactive power =6: Apparent power =7: Power factor		=0: thd (total harmonic distortion) =1: 1st harmonic . . . =15: 15th harmonic
		=8: Frequency =9: Intervalic active power =10: Intervalic reactive power =11: Intervalic apparent power	Independent of phase number The last completed power interval is used.	
		=12: No measurement value assigned to this channel	≙ "OFF" If one recording channel is deactivated, the subsequent recording channels are equally regarded as being deactivated.	
		=13: Active energy =14: Reactive energy		

6.8.5 Data Logger, Time Stamp Format

Byte No.	Content	Format	Byte No.	Content	Format
1	Seconds	8 bit binary	4	Day (of month)	8 bit binary
2	Minutes	8 bit binary	5	Month	8 bit binary
3	Hours	8 bit binary	6	Decade & year	8 bit binary

6.9 Sampling Values

PI	Value	WA	Comment
A0	**U1 – Sampling Values:** 1st Sampling value U1 ... 32nd Sampling value U1	 ±15 bits ... ±15 bits = 64 bytes	Read only
A1	**U2 – Sampling Values:** 1st Sampling value U2 ... 32nd Sampling value U2	 ±15 bits ... ±15 bits = 64 bytes	Read only
A2	**U3 – Sampling Values:** 1st Sampling value U3 ... 32nd Sampling value U3	 ±15 bits ... ±15 bits = 64 bytes	Read only
A3	**I1 – Sampling Values:** 1st Sampling value I1 ... 32nd Sampling value I1	 ±15 bits ... ±15 bits = 64 bytes	Read only
A4	**I2 – Sampling Values:** 1st Sampling value I2 ... 32nd Sampling value I2	 ±15 bits ... ±15 bit = 64 bytes	Read only
A5	**I3 – Sampling Values:** 1st Sampling value I3 ... 32nd Sampling value I3	 ±15 bits ... ±15 bit = 64 bytes	Read only
A6	Sampling values freeze = 55h update = AAh	8 bits	

7 Product Support Industrial Division

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