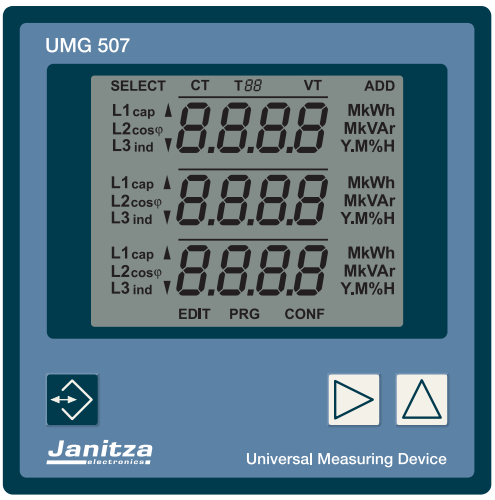
Janitza electronics

Universal Measuring Device

UMG507

Functional description

Structure of storage



Dok. Nr. 1.032.309.0

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Generals

The UMG507 supports the protocols Modbus RTU, Modbus TCP/IP, Modbus over TCP/IP (Modbus Gateway) or Profibus DP V0, depending in the version. This functional description is an addition to the manual and describes the configuration of the corresponding function step by step.
More functional descriptions can be found on the CD-ROM PSWbasic/professional. At present, the following functional descriptions are available:

- UMG507 used as remote data display for external Modbus slaves
- OPC Server Port 502
- OPC Server Port 8000 (Modbus Gateway Function)
- The webserver of UMG507
- Description of the storage of UMG507
- Description of Profibus with examples

Issue Note:	
18.11.2004	First edition / Wagner
22.11.2004	Correction

The storage of UMG507

The UMG507 is available with FLASH memory (UMG507E and EP) and without FLASH memory (UMG507 L/AD/P). For the types with Flash memory, up to 16MB of data (saved on the internal FLASH DISK, and 1MB is used for the administration of the file system). For the types without FLASH memory, the data are saved in a battery secured 256k RAM memory.

The UMG507 is devided into the following memory groups for both types:

Work buffer	=	Energy values (Real energy consumption, supply etc.)
Ring buffer	=	Measured values (Mean values of current, voltage etc.)
Trigger buffer	=	Trigger events (True RMS values of short interruptions)
Vector buffer	=	Vector values (waveform of short interruptions)
Event buffer	=	Events (Parameter values)

Version with FLASH DISK (UMG507E/EP):

The file system of the FLASH DISK versions can be compared with a file system of a PC. Files can be created, deleted or copied. Each memory group has its own abbreviation. A further description of possible command can be found in chapter „commands for configuration of the FLASH DISK“. The evaluation of the files is carried out with PSWbasic/professional or via JAVA Applets.

The files have the following structure:

<Abbreviation memory group><Time in seconds since 1970>.dat
Example: wb109710633.dat

Possible abbreviations and file size:
wb = Work buffer
File with 3200 values at maximum, each 10 Byte = 32000 Byte per file

rb = Ring buffer
File with 3200 values at maximum, each 20 Byte = 64000 Byte per file

tb = Trigger buffer
File with 76 values at maximum, each 528 Byte = 40128 Byte per file

vb = Vector buffer
File with 58 values at maximum, each 684 Byte = 39672 Byte per file

eb = Event buffer
File with 4800 values at maximum, each 10 Byte = 48000 Byte per file

The saved data are saved in RAM at first, and automatically written in a file, when the maximum number is reached. If the memory is read via PSWbasic/professional, the writing into a file is mandatory, allthough the maximum number of measured values per file might not yet been reached. So it is made sure, that PSW always reads all memory values until the time of reading. All in all, the file system supports 800 files. The number of measured values to save is therefore limited to 15MB or 800 files. Exceeding one of these limits, the oldest files will be overwritten.

One of the most frequently asked question is how many measured values can be saved in a certain time interval. The duration can be calculated exactely while saving mean values. But if short interruptions (trigger buffer) or events (event buffer) are saved additionally, the time can only be astimated, as it is usually not known, how many short interruptions can be expected.
Please find a few examples in the next chapter.

Example 1:

Storage of voltage in phase 1 with an time interval of 5 minutes. Mean, maximum and minimum values are saved within this time interval.

How long would be the maximum storage duration?

12 measured values per hour = 288 values per day
Each ring buffer file saves 3200 values before being written.
The file would be filled after 11 days (3200/288) with 64000 Bytes.
The FLASH Disk has a size of 15Mb (15728640 Bytes).
--> 15728640 / 64000 Bytes = 245 Files = 2695 days.
This means, the UMG507E would save about 7 years before overwriting the oldest file.
As explained before, the data are written from RAM into a file automatically, while reading with PSW. The storage duration of a measured value is therefore however not only depending on the memory of the FLASH DISK, but also on the number of saved files. Up to 800 files can be administrated. If the device is read daily, the period of storage for this example would be 2 years.

Example 2:

Storage of voltage and current in phase 1 with an time interval of 5 minutes. Mean, maximum and minimum values are saved within this time interval.

How long would be the maximum storage duration?

24 measured values per hour = 576 values per day.
Each ring buffer file saves 3200 measured data before being written. The file would be written after 5 days (3200/576) with 64000 Bytes. So the duration would be 1225 days (3,3 years). If the device is read daily, the duration again depends on the file system. Allthough an additional value is saved, the duration remains 2 years.

Example 3:

Storage of voltage, current, power and cosphi in all three phases with an time interval of 1 minute. Mean, maximum and minimum values are saved within this time interval.

How long would be the maximum storage duration?

720 (4 values x 3 Phases x 60) measured values per hour = 17280 measured values per day.
Each ring buffer file saves 3200 measured data before being written. So there are 5.4 files (17280/3200) per day with 64000 Bytes = 345600 Bytes per day
The FLASH Disk has a memory of 15Mb (15728640 Bytes).
--> 15728640 / 345600 Bytes = 45,5 days
This means, the UMG507E/EP would be able to save 12 values per minute for 45,5 days, before the oldest file would be overwritten.

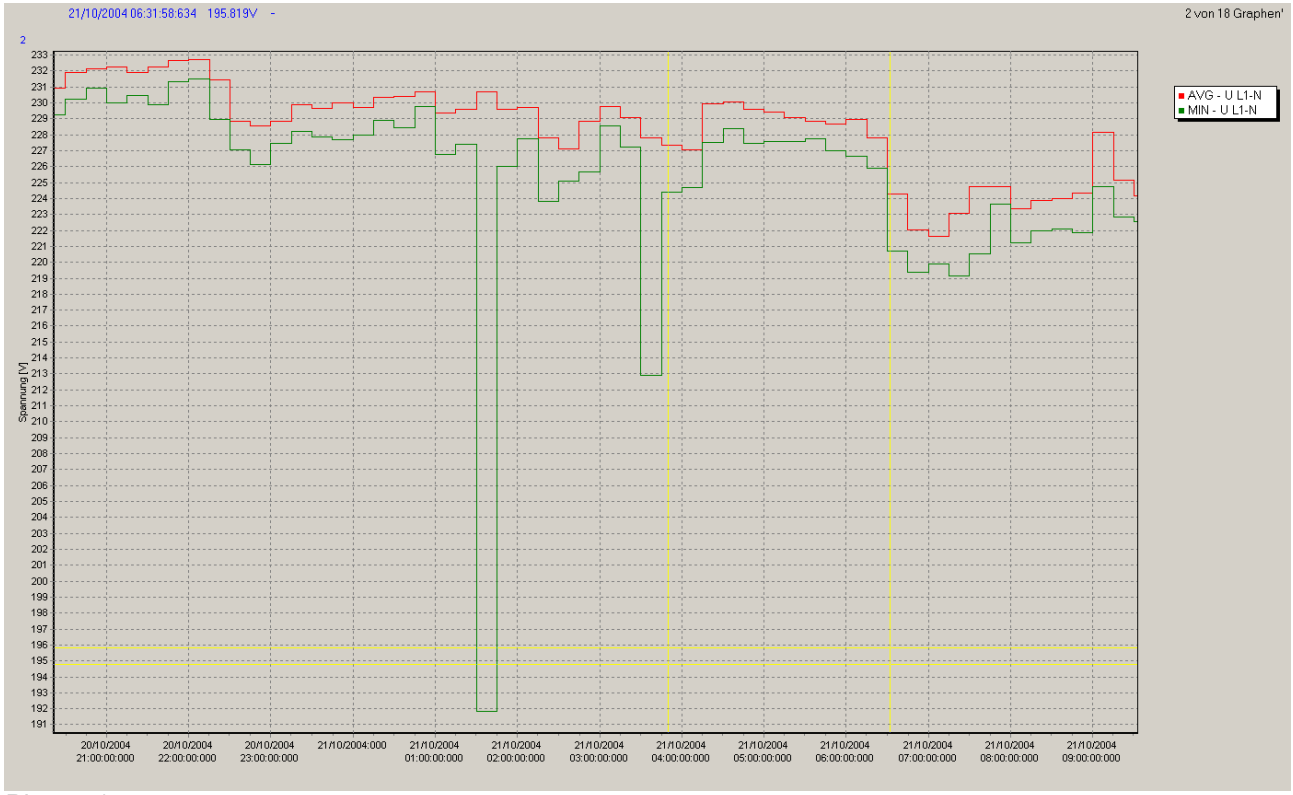
Example 4:
Compare UMG 503 to UMG507E/EP:

The UMG503 saves the following measured data in the manufacturer's settings:
Mean value current L1 (15 Minutes)
Mean value current L2 (15 Minutes)
Mean value current L3 (15 Minutes)
Mean value voltage L1 (15 Minutes)
Mean value voltage L2 (15 Minutes)
Mean value voltage L3 (15 Minutes)
Mean value real power L1 (15 Minutes)
Mean value real power L2 (15 Minutes)
Mean value real power L3 (15 Minutes)
With this configuration the storage duration of the UMG 503 is **462 days.**

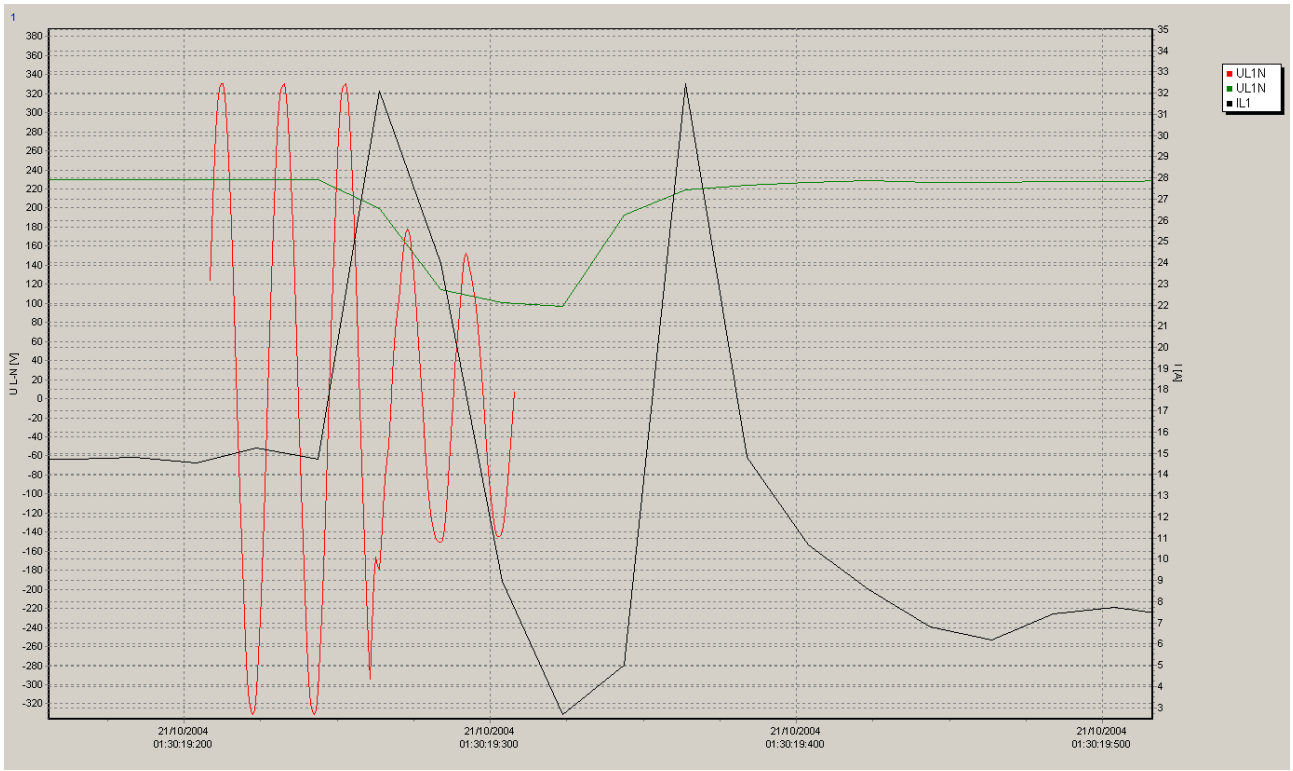
The UMG507E with the same configuration:

36 values per hour = 864 values per days.
Each ring buffer file saves 3200 measures values before being written. The file would be written after 3,7 days with 64000 Bytes.
The FLASH Disk has a memory of 15Mb (15728640 Bytes).
--> 15728640 / 64000 Bytes = 245 Files at 3,7 days = **906,5 days.**

Note:
For rach mean value, additionally the minimum and maximum value is saved (measured over 10 periods) within an interval. During the resulting graphical evaluation you can control by the minimum value, if the measured value must be analysed by the trigger values. Picture 1 shows the indication of measured values in software PSWprofessional. Only in the mean value of voltage (red line), the voltage drop from 230V to 100V would not have been visible.



Picture 1



Picture 2

Bild 2 shows the true RMS values (over 128 periods with 64 periods Pretrigger) and the waveform of a trigger event. The trigger event was detected during heavy wheather. As a result of the voltage drop a consumer with 7A has switched off (see current waveform).

Version without FLASH DISK (UMG507L/AD/P):

For versions without FLASH DISK (UMG507 L/AD/P) the measured values are saved in a battery buffered RAM. The number of saved measured values is as follows:

3600	**Energy values**
10000	**Ring buffer values**
90	**Trigger events (Short interruptions)**
90	**Vector values (Waveform of short interruptions)**
5000	**Events (Parameter memory)**

If the same values as in example UMG507E/EP are saved, (see example 4), the maximum duration is **11,5 days.** Also here the minimum and maximum values are saved automatically with the corresponding mean value (measured over 10 periods).
The battery has a typical life expectance of 8 years. The battery enclosure is accessible at the back of the device. The battery should be exchanged all 5 years, which does not delete the setting of the transformers.

Commands for the configuration of the FLASH DISK :

It is possible to access the file system via every Telenet program entering the IP address followed by Port 1239. Example: Telnet 192.168.1.175 **1239**

The following commands are supported by UMG507E/EP at the moment:

1.	ls	=	Shows the directory structure.
2.	cd	=	Change between directory.
3.	rm	=	Removes a file from Flash disk.
4.	mkdir	=	Opens a new subdirectory on the Flash disk.
5.	rmdir	=	Deletes empty subdirectory.
6.	cat	=	Reads the contents of a file.
7.	pcat	=	Reads the contents of a file and transmits on Port 1230.
8.	cp	=	Copies a file.
9.	ev	=	Indication of actual measured data within Telnet surroundings. Example : ev <ul1,4> <il1,4>.
10.	fschk	=	Checks Flash Disk.
11.	mout	=	Mount the drive .
12.	flush	=	Write data from RAM to Flash Disk.
13.	cleanstart	=	Resets the device to manufacturer's settings.
14.	setpar	=	Set parameters.
15.	quit	=	Finish program.
16	debug	=	Output Debug Informations in Telnet.

Read out memory via Modbus RTU and TCP/IP

Measured values and events of the UMG 507 can be saved with date and time. Those data can be read over the serial interface (Modbus-Protocol). For devices with option Ethernet connection, the data can be read via Ethernet with the help of MOD/TCP-Protockol.
If the UMG 507 has option Flash-Disk, the data are transmitted onto the flash disk after overflow of the memory, and can be accessed via Ethernet.
A further possibility for devices with the options Ethernet/Flash-Disk is, that UMG507 sends an Email in case of certain events with the files of the Flash-Disk as attachment.

Save data

Mean value buffer
The UMG507can be configured in a way, that the mean values are deposited in data memory in fixed time intervals (1 second or longer). The storage of the mean value from the corresponding time interval is carried out together with minimum and maximum value (depending on device configuration).

Voltage	: L1-N,L2-N,L3-N,L1-L2,L2-L3,L3-L1
Current	: L1,L2,L3,Neutral
Real power	: L1,L2,L3,Sum
Reactive power	: L1,L2,L3,Sum
Apparent power	; L1,L2,L3,Sum
Frequency	: L1
cos phi	: L1,L2,L3,Sum
K-Factor	: L1,L2,L3
Rotation field values	: Positive sequence, negative sequence, zero sequence, assymetry
THD U	: L1,L2,L3
THD I	: L1,L2,L3
Temperature	: Inner temperature, external temperature sensor
Analogue input	
Power pulse input	: input 1...input 6

Energy buffer
The UMG507 can be configured, so that in fixed time intervals (1 hour) the the energy values are saved in the data memory.

Real energy	: Tariff 0..Tariff 4
Real energy consumption	: Tariff 0..Tariff 4
Real energy supplied	: Tariff 0..Tariff 4
Reactive energy	: Tariff 0..Tariff 4
Reactive energy ind.	: Tariff 0..Tariff 4
Reactive energy cap.	: Tariff 0..Tariff 4

Event memory
The UMG507 can be configured, so that in case of a certain fixed event the actual value of any parameter (modbus address) is saved in memory with date and time.
The event might be:

Set a digital input
Occurence of a trigger event
Switching clock channel
Comparator result
Switching of a digital EMAX cnannel
Set a flag via Profibus

Trigger events (True RMS value line and waveform)
The UMG507 can be configured, so that in case of a trigger event the true RMS value and/or the waveform is saved with date and time in memory.

Reading data via Modbus RTU

Read mean value memory:

Step 1. Initialize reading procedure.
Initialising the reading procedure by writing address 20000
--> write 2 Bytes.
Bytes 0..1 : value <> 0 -> initialize reading procedure
The UMG507 sets the reading pointer onto the last written data and delivers the data in exchanged order during reading procedure.

Step 2. Reading single data sets
Reading address 20003. Number of Bytes : 2 Bytes + (number of desired data sets *size of a data set (20 Bytes))
-->UMG507 sends back data set

Structure of the delivered data set:
Bytes 0..1 : The value at this place must be interpreted as integer value (16-bit) and can hold various values.
a) If this value is 0xFFFF, it means, that no data sets are available.
b) If this value is between 0 and 32767, this number is the first data set in package (X). Saved data sets are available for reading.
c) If this value is between 32768 and 0xFFFF-1, it means, that there was at least one overflow.. The Bit with the highest number Bit (0x8000) must be removed to achieve the number of the 1st data set (X).
Bytes 2..21 : 1. data set (X)
Bytes 22..41 : 2. data set (X-1)

Step 3.
By repeating the reading procedure from step 2, all data sets up to number 0 can be read. If there was a memory overflow, further data sets are available, which can be achieved by a further reading, until the number of the first read data set (X) is reached.
If a data package is lost due to a bus failure, it can be demanded again by setting the reading pointer onto the desired data set:

Write onto address 20000 -> write 4 Bytes
Bytes 0..1 : value = 0 -> set reading pointer
Bytes 2..4 : Number of the desired data set

Read energy memory :
The reading procedure corresponds to the reading of the mean value memory, but the reading procedure starts at address 20006 and the size of the data set is 10 Bytes.

Read event memory :
The reading procedure corresponds to the reading of the mean value memory, but the reading procedure starts at address 20007 and the size of the data set is 12 Bytes.

Read trigger events (true RMS line) :
The reading procedure corresponds to the reading of the mean value memory, but the reading procedure starts at address 20005. Due to the size of the single data sets (528 Bytes) several Modbus readings are neccessary to transmit a complete data set.

Step 1. initialize reading procedure
Initialising of the reading procedure by writing address 20000
-> write 2 Bytes
Bytes 0..1 : Value <> 0 -> initiate reading procedure.
The UMG507 sets the reading pointer onto the last written data and delivers the data in exchanged order during reading procedure.

Step 2. Reading single data sets
Reading address 20005. Number of Bytes : 2 Bytes + (Number of desired data sets * size of a data set (20 Bytes))
-->UMG507 delivers data package

Structure of the delivered data package :
Bytes 0..1 : The value at this place must be interpreted as integer value (16-bit) and can hold various values.
a) If this value is 0xFFFF, it means, that no data sets are available.
b) If this value is between 0 and 32767, this number is the first data set in package (X). Saved data sets are available for reading.
c) If this value is between 32768 and 0xFFFF-1, it means, that there was at least one overflow.. The Bit with the highest number Bit (0x8000) must be removed to achieve the number of the 1st data set (X).
Bytes 2..4 : This value stands for the Byte-Index of the delivered data within a data set
Bytes 5.. : Data

Stept 3.
By repeating the reading procedure from step 2, all data sets up to number 0 can be read. If there was a memory overflow, further data sets are available, which can be achieved by a further reading, until the number of the first read data set (X) is reached.
If a data package is lost due to a bus failure, it can be demanded again by setting the reading pointer onto the desired data set:

Write onto address 20000 -> Write 6 Bytes
Bytes 0..1 : value = 0 -> set reading pointer
Bytes 2..4 : Number of the desired data set
Bytes 4..5 : Index within data set

Trigger events (waveform)
The reading procedure corresponds to the reading of the mean value memory, but the reading procedure starts at address 20004 and the size of the data set is 684 Bytes.

Reading of data from Flashdisk (UMG507E/EP)
This chapter is relevant for devices with the options Ethernet and Flashdisk.

The reading procedure is divided into several steps:
1) Establish connection to the device over TCP-Port 1239
2) Send command "Flush"to the device, which actualizes all data on Flashdisk
3) Send command "cd /Data" to the device
4) Send command "ls" -> The device delivers an overview over the available ring buffer data
Creating of a line in file structure : '-' , file length , file date , file time , file name

The first two letters of the file name give information about the kind of data :
'rb' : Ring buffer
'wb' : Energy values
'eb' : Event buffer
'tb' : Trigger buffer
'vb' ; Vector buffer
The last 10 numbers in the file name provide the date of creation in seconds since 1.1.1970 (GMT)

Reception of the desired files:
1.) Reading the file from device
-> example getting file rb1093800000 -> "cat rb1093800000"
2.) Evaluation of data sets i n a file

Reading of Email files

This chapter is only relevant for devices equipped with the options Ethernet and Flashdisk. The Flash disk files sent by UMG 507 as Email attachment must be saved on PC.

The structure of the file:

Byte-Index 0..9 : This position contains the device type as zero terminated String ('UMG507')
Byte-Index 10..19 : These positions contain the serial number of the device as zero terminated String (e.g '5900- 999')
Byte-Index 20..29 : These positions contain the firmware release of the device as zero terminated String
Byte-Index 30..56 : These positions contain the original file names as zero terminated String (e.g. 'rb1090833909')
Byte-Index 57.. : Here are the data sets

Structure data sets ring buffer (size 20 Bytes):

Bytes 0..3 : time UTC 4 Bytes (En of interval)
Bytes 4..5 : Identification of the saved value
Bytes 6..7 : Duration of averaging interval
Bytes 8..11 : Mean value over interval (floating point value with normal accuracy)
Bytes 12..15 : Minimum value in interval (floating point value with normal accuracy)
Bytes 16..19 : Maximum value in interval (floating point value with normal accuracy)

Index of values:

1 , 2 , 3	: UL1N , UL2N , UL3N
4 , 5 , 6	: CurrL1 , CurrL2 , CurrL3
7 , 8 , 9	: CosphiL1 , CosPhiL2 , CosPhiL3
10 , 11 , 12	: UL1L2 , UL3L3 , UL3L1
13	: CurrN
14 , 15 , 16	: PL1 , PL2 , PL3
17 , 18 , 19	: QL1 , QL2 , QL3
20 , 21 , 22	: SL1 , SL2 , SL3
23	: SSum
24	: PSum
25	: QSum
26	: FreqL1
27	: CosPhiSum
28 , 29 , 30	: KFactorL1 , KFactorL2 , KFactorL3
31	: Zero system
32	: Negative system
33	: Positive system
34	: Asymmetry
35 , 36 , 37	: THDUL1 , THDUL2 , THDUL3
38 , 39 , 40	: THDIL1 , THDIL2 , THDIL3
41	: TempInt
42	: TempExt
43	: AnalogIn
50	: Power pulse input 1
51	: Power pulse input 2
52	: Power pulse input 3
53	: Power pulse input 4
54	: Power pulse input 5
55	: Power pulse input 6
60	: Partial harmonic IL1 1st harmonic (fundamental)
61	: Partial harmonic IL1 3rd harmonic
62	: Partial harmonic IL1 5th harmonic
63	: Partial harmonic IL1 7th harmonic
64	: Partial harmonic IL1 9th harmonic
65	: Partial harmonic IL1 11th harmonic
66	: Partial harmonic IL1 13th harmonic
67	: Partial harmonic IL1 15thharmonic
70	: Partial harmonic UL1 1st harmonic (fundamental)

71 : Partial harmonic UL1 3rd harmonic
72 : Partial harmonic UL1 5th harmonic
73 :Partial harmonic UL1 7th harmonic
74 : Partial harmonic UL1 9th harmonic
75 : Partial harmonic UL1 11th harmonic
76 : Partial harmonic UL1 13th harmonic
77 :Partial harmonic UL1 15th harmonic
80 : Partial harmonic IL2 1st harmonic (fundamental)
81 : Partial harmonic IL2 3rd harmonic
82 : Partial harmonic IL2 5th harmonic
83 : Partial harmonic IL2 7th harmonic
84 : Partial harmonic IL2 9th harmonic
85 : Partial harmonic IL2 11th harmonic
86 :Partial harmonic IL2 13th harmonic
87 : Partial harmonic IL2 15th harmonic
90 : Partial harmonic UL2 1st harmonic (fundamental)
91 : Partial harmonic UL2 3rd harmonic
92 :Partial harmonic UL2 5th harmonic
93 : Partial harmonic UL2 7th harmonic
94 : Partial harmonic UL2 9th harmonic
95 : Partial harmonic UL2 11th harmonic
96 : Partial harmonic UL2 13th harmonic
97 : Partial harmonic UL2 15th harmonic
100 : Partial harmonic IL3 1st harmonic (fundamental)
101 : Partial harmonic IL3 3rd harmonic
102 : Partial harmonic IL3 5th harmonic
103 : Partial harmonic IL3 7th harmonic
104 : Partial harmonic IL3 9th harmonic
105 :Partial harmonic IL3 11th harmonic
106 : Partial harmonic IL3 13th harmonic
107 : Partial harmonic IL3 15th harmonic
110 : Partial harmonic UL3 1st harmonic (fundamental)
111 :Partial harmonic UL3 3rd harmonic
112 : Partial harmonic UL3 5th harmonic
113 : Partial harmonic UL3 7th harmonic
114 : Partial harmonic UL3 9th harmonic
115 : Partial harmonic UL3 11th harmonic
116 : Partial harmonic UL3 13th harmonic
117 : Partial harmonic UL3 15th harmonic

Structure data set ring buffer energy (size 10 Bytes):

Bytes 0..3 : Time UTC 4 Bytes (End of interval)
Bytes 4..7 : Value of energy at the end of the interval (floating point value with normal accuracy)
Bytes 8..9 : Index of the saved energy value

Index of the values

10..14 : Real energy Tariff 0..Tariff 4
20..24 : Real energy consumed Tariff 0..Tariff 4
30..34 : Real energy supplied Tariff 0..Tariff 4
40..44 : Reactive energy Tarif 0..Tariff 4
50..54 : Reactive energy ind. Tariff 0..Tariff 4
60..64 : Reactive energy cap. Tariff 0..Tariff 4

Structure data set event memory (size 12 Bytes):

Bytes 0..3 : Time UTC 4 Bytes
Bytes 4..5 : Time milliseconds 2 Bytes
Bytes 6..7 : Identification of saved values
Bytes 8..11 : Saved values (floating point value)

Selection data set trigger buffer (size 528 Bytes):

Bytes 0..3 : Time UTC 4 Bytes (Time for the last point of storage)
Bytes 4..5 : Time milliseconds 2 Bytes (Time for the last point of storage)
Bytes 6..7 : Kind of data
0x0010 : UL1N
0x0020 : UL2N
0x0040 : UL3N
0x0080 : IL1
0x0100 : IL2
0x0200 : IL3
Bytes 8..9 : Reason for storage
0x0001 : Minimum UL1 exceeded
0x0002 : Minimum UL2 exceeded
0x0004 : Minimum UL3 exceeded
0x0010 : Maximum UL1 exceeded
0x0020 : Maximum UL2 exceeded
0x0040 : Maximum UL3 exceeded
0x0100 : Maximum IL1 exceeded
0x0200 : Maximum IL2 exceeded
0x0400 : Maximum IL3 exceeded
Bytes 10..11 : Distance of the last data of the storage since the effecting event
(given in number of data)
Bytes 12..15 ; Distance of data points between each other (floating point value) in seconds
Bytes 16..527 : 128 saved true RMS values (floating point value)

Structure data set waveform (size 684 Bytes):

Bytes 0..3 : Time UTC 4 Bytes (Time for last storage)
Bytes 4..5 : Time milliseconds 2 Bytes (Time for last storage)
Bytes 6..7 : Kind of data
0x1000 : UL1N & IL1
0x2000 : UL2N & IL2
0x4000 : UL3N & IL3
Bytes 8..9 : Reason for storage
0x0001 : Minimum UL1 exceeded
0x0002 : Minimum UL2 exceeded
0x0004 : Minimum UL3 exceeded
0x0010 : Maximum UL1 exceeded
0x0020 : Maximum UL2 exceeded
0x0040 : Maximum UL3 exceeded
0x0100 : Maximum IL1 exceeded
0x0200 : Maximum IL2 exceeded
0x0400 : Maximum IL3 exceeded
Bytes 10..11 : Distance of the last data of the storage since the effecting event
(given in number of data)
Bytes 12..15 ; Distance of data points between each other (floating point value) in seconds
Bytes 16..19 : Scale factor for saved voltage values (floating point value)
Bytes 20..21 : Scale factor for saved current values (floating point values)
Bytes 24..353 : 165 saved voltage values
(2-Byte integer values ; must be multiplied with the above mentioned scale factor)
Bytes 354..683 : 165 saved current values
(2-Byte integer values ; must be multiplied with the above mentioned scale factor)