Profibus communication protocol for EMS-96 series

EMS MULTIMETER PROFIBUS DP-V0

This manual describes the communication protocol for the EMS-96 profibus interface.
This interface implement the DP-V0 slave in profibus DP network.

PROFIBUS AND EMS-96

Profibus-DP is a multi-master systems. In the networks it's possible to have up to 126 devices on the same bus.
In profibus-DP networks, the interchange of data between peripheral modules and the master is made automatically by the profibus controller, which 'virtualise' the data exchange memory of the DP devices in the memory of the master.
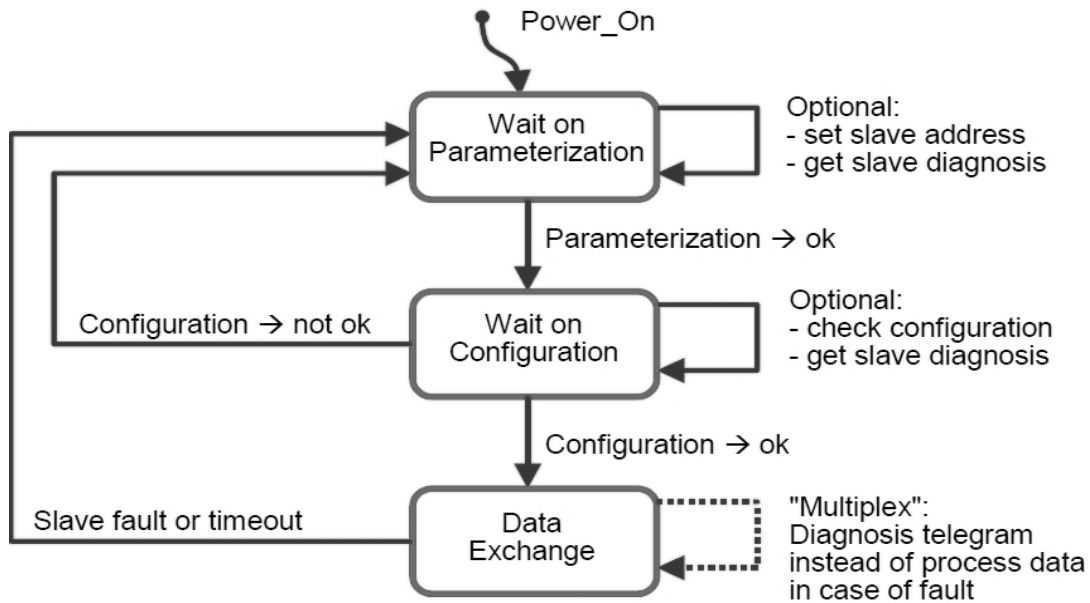
EMS-96 Baudrate Supported

The EMS-96 supported the following communication baud rate:

| 9,6 Kbit/s	19.2 Kbit/s	45,45 Kbit/s	93,75 Kbit/s	187.5 Kbit/s	500 Kbit/s	1.5 Mbit/s	3 Mbit/s

The EMS-96 detect the baud rate network **automatically**.

**Example of Profibus Parameterization and Configuration Sequence:**

Data exchange handshake from Master to EMS-96:

1) The Master place in output memory the indexes (or indexes + values)
2) Data are transferred from output memory of the master to input memory of the EMS-96 slave
3) EMS-96 read the indexes send by the master and write on its output memory area the data (measures) requested
4) Measures are transferred from output data of the EMS-96 to profibus master input memory area.
5) The application program, present in the master profibus, read the data from input memory and show the measures to the user
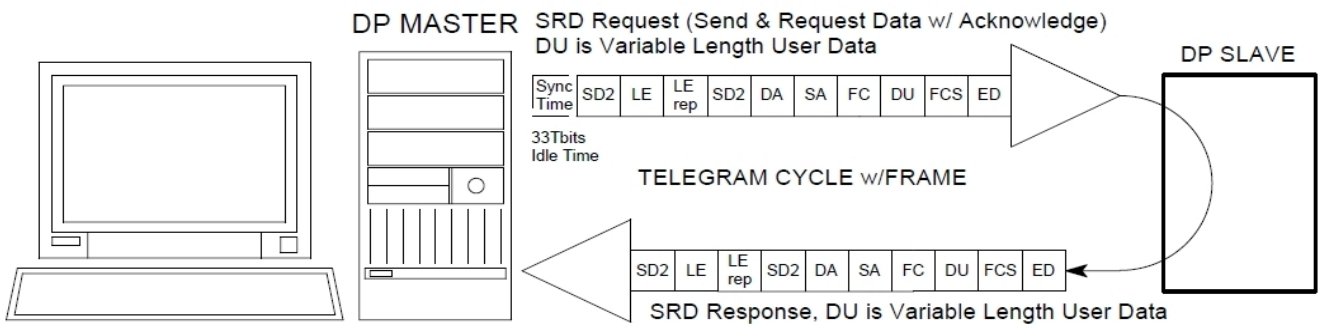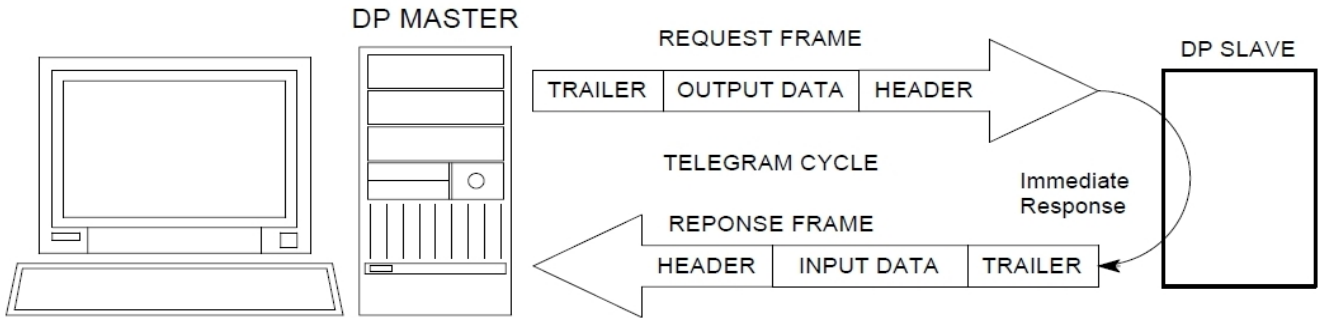
Format Message - Data Exchange
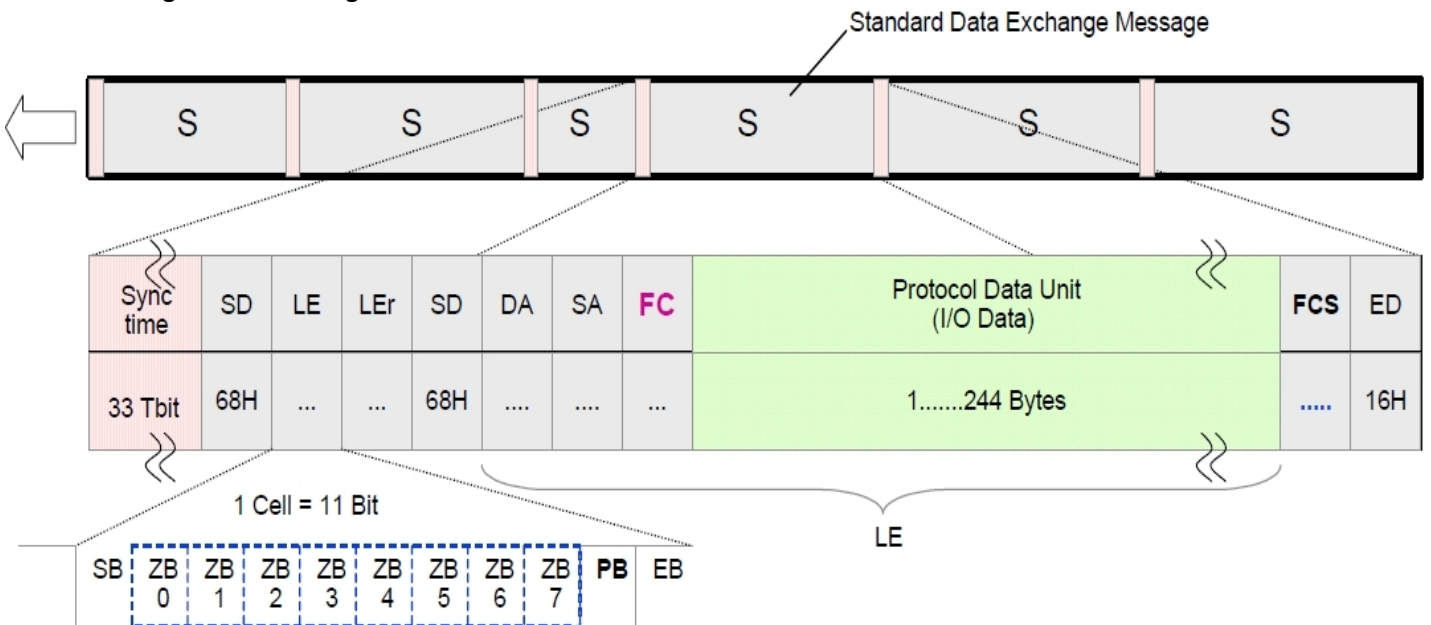
Tbit	= Clock-Bit = 1 / Baudrate
SD	= Start Delimiter (here SD2, var. data length)
LE	= Length of Process Data
LEr	= Repetition of Length; no check in FCS
DA	= Destination Address
SA	= Source Address
FC	= **Frame Control** (Message type)

Data Unit	= I/O Data, max. 244 Bytes
FCS	= Frame Checking Sequence (across data within LE)
ED	= End Delimiter
SB	= Start-Bit
ZB0...7	= Character-Bit
PB	= (even) Parity Bit
EB	= Stop-Bit

Communication Structure EMS-96:
The communication with the instrument is projected "in Module". The input (master) module is 4 byte long and the output (master) module is 6 byte long. Each "write" module allow to send one index (see Read Commands Table) corresponding at the measure that it must read from master module (input). If it sent the index value in the *first master* output module the read value will be return in the *first master input module*, if it sent the index value in the *second master output module* the read value will be return in the *second master input module*, etc.

<table>
<tr><td align="center">*Master Output*</td><td></td><td align="center">*Master Input*</td></tr>
<tr><td align="center">*Write "Master Output Module 1"*
in the
1° Write Module</td><td align="center">⟹</td><td align="center">*Read "Master Input Module 1"*
in the
1° Read Module</td></tr>
<tr><td align="center">*Write "Master Output Module 2"*
in the
2° Write Module</td><td align="center">⟹</td><td align="center">*Read "Master Input Module 2"*
in the
2° Read Module</td></tr>
<tr><td align="center">*Write "Master Output Module n"*
in the
n° Write Module</td><td align="center">⟹</td><td align="center">*Read "Master Input Module n"*
in the
n° Read Module</td></tr>
</table>
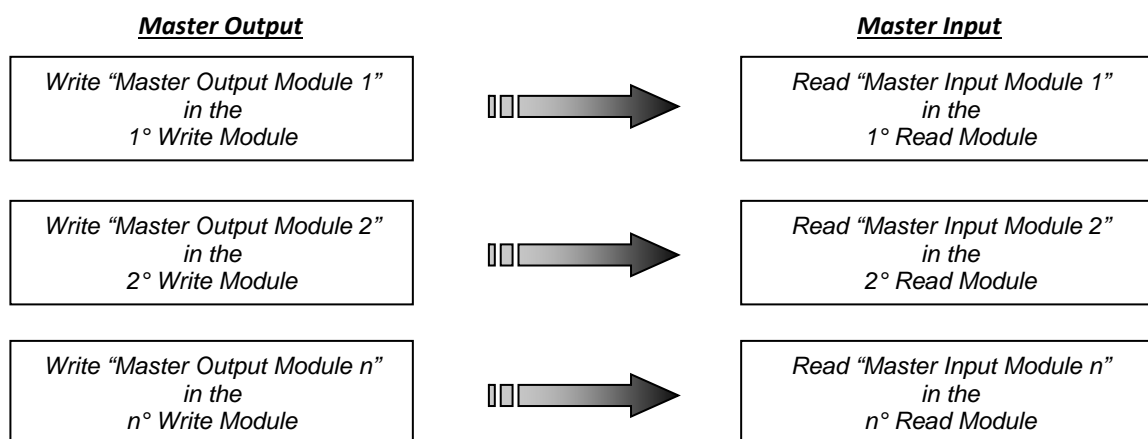
Comunication Structure Example

This structure allow to change in "real time" order and type of measure to read from EMS-96 instrument.
Each *Master Input Module* is formed by **4 Byte / 2 Word** (it's possible to read max 28 module at the same time) and the *Master Output Module* is format by **6 Byte / 3 Word** (it's possible to write max 28 module at the same time).

*WARNING: Before read the measures (*Master Input Module*), the Master must send the indexes corresponding (*Master Output Module*). From Firmware V01r02 If you don't send any indexes the EMS-96 will be return the first 40 measures.*

WARNING: If it send a only wrong Index or Parameter the instrument won't return any value until all Indexes and Parameters will be corrected. The EMS-96 will produce a Diagnostic Message for notify the error presence.

For example if you send:

n° Master Output Module	Index Value	Measure to Read	n° Master Input Module	Measure Value
1	0x0002	PHASE VOLTAGE L$_{1-N}$	1	Long Value (4 byte)
2	0x0006	LINE TO LINE VOLTAGE L$_{2-3}$	2	Long Value (4 byte)
3	0x0001	3-PHASE SYSTEM VOLTAGE	3	Long Value (4 byte)
4	0x0008	3-PHASE SYSTEM CURRENT	4	Long Value (4 byte)

This is the Master Outputs Structure for Read the measures:

N° Master Output Module	N° Measure	Measure	Used Byte
Index 1	0x0002	PHASE VOLTAGE L$_{1-N}$	1° - 2° Byte
Parameter 1.1	xxxx	Not Necessary	3° - 4° Byte
Parameter 1.2	xxxx	Not Necessary	5° - 6° Byte
Index 2	0x0006	LINE TO LINE VOLTAGE L$_{2-3}$	7° - 8° Byte
Parameter 2.1	xxxx	Not Necessary	9° - 10° Byte
Parameter 2.2	xxxx	Not Necessary	11° - 12° Byte

WARNING: It is necessary to send at least 3 words (index1+parameter1.1+parameter1.2).

WARNING: The read or write operation must be completed without interruption by other parts of the program.

GSD File

The GSD files supplied with the EMS-96 instrument:
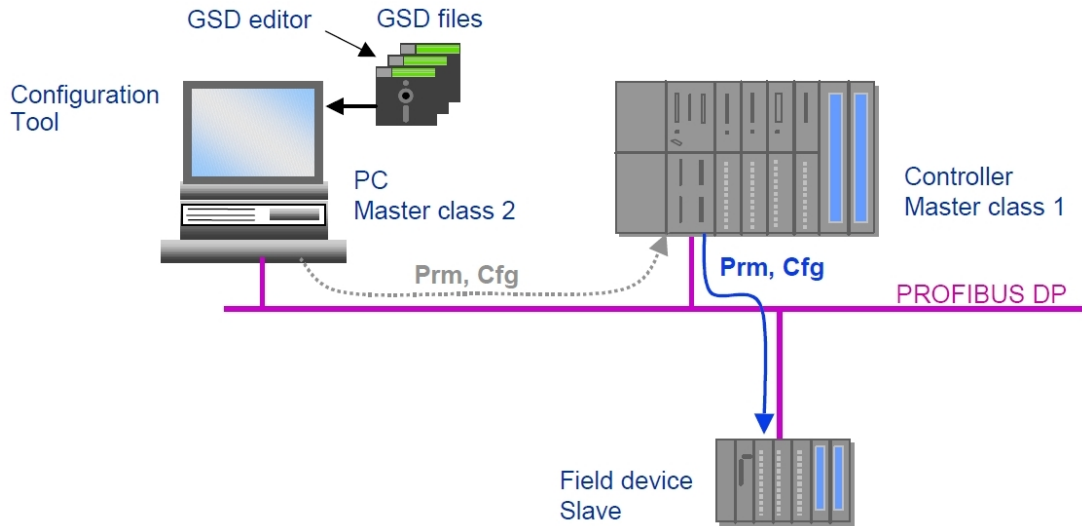
GSD Name	N° Input Byte	N° Master Input Module	N° Output Byte	N Master Output Module	N° Tot Module
EMS-PFS	112 Byte	28	168 Byte	28	56

The GSD file designed for improve the input/output space and speed on profibus master, because it is possible to insert from 1 to 28 module for input and from 1 to 28 module to output.

Flow Chart Configuration EMS-96
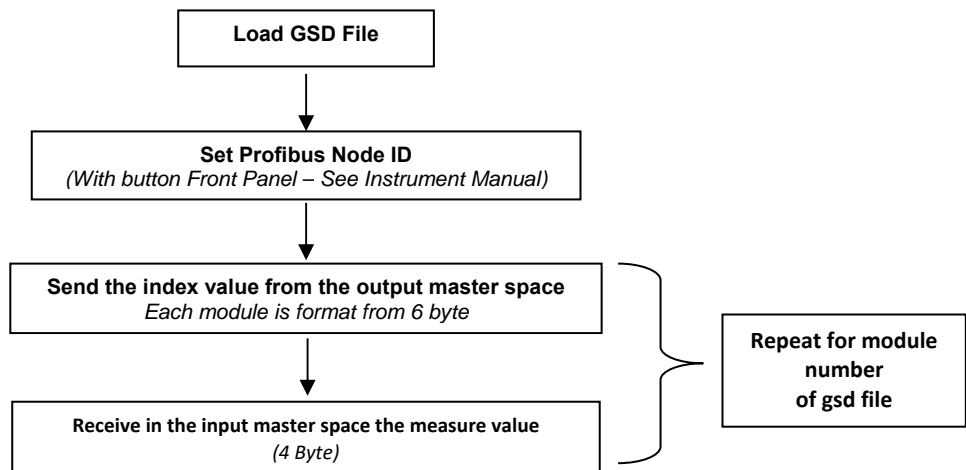
In the Master Program:
1) Load GSD File.
2) Setting the EMS-96 Node Id in you project (Node ID on the instrument is setting with frontal panel).
3) Insert the Module that it necessary for application (if not insert automatically from program during loading gsd file).
4) Write the module index (corresponding at the measure that must read) in the master output space.
5) Receive in the master the measure value (first module if you send the first module in master output).
6) Repeat point 4 and 5 for all modules.

For example see the following figure (Master Output – **DB2** Step 7 File):

Fig.1: File DB2 (Step7)

For each measure to read it's necessary to send the corresponding index (the first 2 bytes for each module). In this example are read the first nine measures, but it's possible to read any measure (max 28) in any order.
In this way it's possible to read the measures in the Master input space (**DB1** Step 7 File).

Fig.2: File DB1 (Step7)

In the same way the master can write the parameter. The master must send the corresponding indexes, followed by the two parameters (Index [2 byte] + First Parameter [2 byte] + Second Parameter [2 byte]).

This is the Write Commands Structure for Write the measure.

N° Module	N° Measure	Measure	Command Type	Used Byte
Index 1	5009	KCT TRANSFORM RATIO CURRENT	Write	1° - 2° Byte
Parameter 1.1	xxxx	Setting Value	-	3° - 4° Byte
Parameter 1.2	xxxx	Setting Value	-	5° - 6° Byte
Index 2	5010	KCT TRANSFORM RATIO NEUTRAL CURRENT	Write	7° - 8° Byte
Parameter 2.1	xxxx	Setting Value	-	9° - 10° Byte
Parameter 2.2	xxxx	Setting Value	-	11° - 12° Byte

Index Measures Table

EMS-96 Indexes corresponding at the measures:

- READ COMMANDS –

Instantaneous measures

Index HEX	Index DEC	Description	Measure Unit	Type	Acronym	Reference Number
0x0001	1	SYSTEM VOLTAGE	mV	Unsigned	V	1
0x0002	2	PHASE VOLTAGE L_{1-N}	mV	Unsigned	V L1	2
0x0003	3	PHASE VOLTAGE L_{2-N}	mV	Unsigned	V L2	3
0x0004	4	PHASE VOLTAGE L_{3-N}	mV	Unsigned	V L3	4
0x0005	5	LINE TO LINE VOLTAGE L_{1-2}	mV	Unsigned	V L1-L2	5
0x0006	6	LINE TO LINE VOLTAGE L_{2-3}	mV	Unsigned	V L2-L3	6
0x0007	7	LINE TO LINE VOLTAGE L_{3-1}	mV	Unsigned	V L3-L1	7
0x0008	8	SYSTEM CURRENT	mA	Unsigned	A	8
0x0009	9	LINE CURRENT L_1	mA	Unsigned	A L1	9
0x000A	10	LINE CURRENT L_2	mA	Unsigned	A L2	10
0x000B	11	LINE CURRENT L_3	mA	Unsigned	A L3	11
0x000C	12	SYSTEM POWER FACTOR [**]	±1000	Signed	PF	12
0x000D	13	POWER FACTOR L_1 [**]	±1000	Signed	PF L1	13
0x000E	14	POWER FACTOR L_2 [**]	±1000	Signed	PF L2	14
0x000F	15	POWER FACTOR L_3 [**]	±1000	Signed	PF L3	15
0x0010	16	SYSTEM COS φ [**]	±1000	Signed	COS	16
0x0011	17	PHASE COS $φ_1$ [**]	±1000	Signed	COS L1	17
0x0012	18	PHASE COS $φ_2$ [**]	±1000	Signed	COS L2	18
0x0013	19	PHASE COS $φ_3$ [**]	±1000	Signed	COS L3	19
0x0014	20	SYSTEM APPARENT POWER	VA	Unsigned	VA	20
0x0015	21	APPARENT POWER L_1	VA	Unsigned	VA L1	21
0x0016	22	APPARENT POWER L_2	VA	Unsigned	VA L2	22
0x0017	23	APPARENT POWER L_3	VA	Unsigned	VA L3	23
0x0018	24	SYSTEM ACTIVE POWER	W	Signed	W	24
0x0019	25	ACTIVE POWER L_1	W	Signed	W L1	25
0x001A	26	ACTIVE POWER L_2	W	Signed	W L2	26
0x001B	27	ACTIVE POWER L_3	W	Signed	W L3	27
0x001C	28	SYSTEM REACTIVE POWER	VAR	Signed	VAR	28
0x001D	29	REACTIVE POWER L_1	VAR	Signed	VAR L1	29
0x001E	30	REACTIVE POWER L_2	VAR	Signed	VAR L2	30
0x001F	31	REACTIVE POWER L_3	VAR	Signed	VAR L3	31
0x0021	32	NEUTRAL CURRENT [*]	mA	Signed	N	32
0x0022	33	FREQUENCY	mHz	Unsigned	Hz	33
0x0023	34	TEMPERATURE	°C * 10	Signed	TEMP	34
0x0024	35	THD VOLTAGE L_1 [***]	% * 100	Unsigned	THD V L1	35
0x0025	36	THD VOLTAGE L_2 [***]	% * 100	Unsigned	THD V L2	36
0x0026	37	THD VOLTAGE L_3 [***]	% * 100	Unsigned	THD V L3	37
0x0027	38	THD CURRENT L_1 [***]	% * 100	Unsigned	THD A L1	38
0x0028	39	THD CURRENT L_2 [***]	% * 100	Unsigned	THD A L2	39
0x0029	40	THD CURRENT L_3 [***]	% * 100	Unsigned	THD A L3	40
0x002A	41	ANGLE$_{1-2}$ [****]	0 - 3600	Unsigned	DEG L1-L2	41
0x002B	42	ANGLE$_{2-3}$ [****]	0 - 3600	Unsigned	DEG L2-L3	42
0x002C	43	ANGLE$_{3-1}$ [****]	0 - 3600	Unsigned	DEG L3-L1	43
0x002D	44	SYSTEM TANGENT φ [**]	±100000	Signed	TAN	44
0x002E	45	PHASE TANGENT $φ_1$ [**]	±100000	Signed	TAN L1	45
0x002F	46	PHASE TANGENT $φ_2$ [**]	±100000	Signed	TAN L2	46
0x0030	47	PHASE TANGENT $φ_3$ [**]	±100000	Signed	TAN L3	47
0x002F	48	EXPECTED SYSTEM ACTIVE POWER (MOBILE OR FIXED PREVISION)	W	Signed	EXP W	48
0x0030	49	EXPECTED ACTIVE POWER L_1 (MOBILE OR FIXED PREVISION)	W	Signed	EXP W L1	49
0x0031	50	EXPECTED ACTIVE POWER L_2 (MOBILE OR FIXED PREVISION)	W	Signed	EXP W L2	50
0x0032	51	EXPECTED ACTIVE POWER L_3 (MOBILE OR FIXED PREVISION)	W	Signed	EXP W L3	51

[*]: calculated or measured, according with EMS version and command NEUTRAL CURRENT USED

[**]: Examples: +1000 is equal to +1.000
        -200 is equal to -0.200

[***]: Examples: 100'00 equal to 100,00% - 50'00 equal to 50,00%

[****]: Example: 1200 equal to 120,0°

Sag detection log (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0034	52	SAG DETECTED HOUR 1st (*)	---	Unsigned
0x0035	53	SAG DETECTED DATE 1st (**)	---	Unsigned
0x0036	54	SAG DETECTED HOUR 2nd (*)	---	Unsigned
0x0037	55	SAG DETECTED DATE 2nd (**)	---	Unsigned
---	---	---	---	---
0x0044	68	SAG DETECTED HOUR 9th (*)	---	Unsigned
0x0045	69	SAG DETECTED DATE 9th (**)	---	Unsigned
0x0046	70	SAG DETECTED HOUR 10th (*)	---	Unsigned
0x0047	71	SAG DETECTED DATE 10th (**)	---	Unsigned

(*): byte order: Empty, Hour, Minute, Second

(**): byte order: Day, Month, Year, Year

   line monitored: see setting frequency monitor command

Harmonics (option)

Harmonics voltage L1 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0048	72	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
0x0049	73	2ND HARMONIC	% * 100	Unsigned
0x004A	74	3RD HARMONIC	% * 100	Unsigned
0x004B	75	4TH HARMONIC	% * 100	Unsigned
0x004C	76	5TH HARMONIC	% * 100	Unsigned
0x004D	77	6TH HARMONIC	% * 100	Unsigned
0x004E	78	7TH HARMONIC	% * 100	Unsigned
0x004F	79	8TH HARMONIC	% * 100	Unsigned
0x0050	80	9TH HARMONIC	% * 100	Unsigned
0x0051	81	10TH HARMONIC	% * 100	Unsigned
0x0052	82	11TH HARMONIC	% * 100	Unsigned
0x0053	83	12TH HARMONIC	% * 100	Unsigned
0x0054	84	13TH HARMONIC	% * 100	Unsigned
0x0055	85	14TH HARMONIC	% * 100	Unsigned
0x0056	86	15TH HARMONIC	% * 100	Unsigned
0x0057	87	16TH HARMONIC	% * 100	Unsigned
0x0058	88	17TH HARMONIC	% * 100	Unsigned
0x0059	89	18TH HARMONIC	% * 100	Unsigned
0x005A	90	19TH HARMONIC	% * 100	Unsigned
0x005B	91	20TH HARMONIC	% * 100	Unsigned

Harmonics voltage L2 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x005C	92	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
---	---	---	---	---
0x006F	111	20TH HARMONIC	% * 100	Unsigned

Harmonics voltage L3 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0070	112	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
---	---	---	---	---
0x0083	131	20TH HARMONIC	% * 100	Unsigned

Harmonics current L1 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0084	132	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
---	---	---	---	---
0x0097	151	20TH HARMONIC	% * 100	Unsigned

Harmonics current L2 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0098	152	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
---	---	---	---	---
0x00AB	171	20TH HARMONIC	% * 100	Unsigned

Harmonics current L3 (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x00AC	172	1ST HARMONIC *(Fundamental)*	% * 100	Unsigned
---	---	---	---	---
0x00BF	191	20TH HARMONIC	% * 100	Unsigned

Warning: All Harmonics are update every 60 Sec. [Read Examples: 10000 equal to 100,00% - 5000 equal to 50,00%].

Note: fundamental harmonic is ALWAYS considered at 100.00%.

Energies

Total energies

Index HEX	Index DEC	Description	Measure Unit	Type	Acronym	Reference Number
0x00C0	192	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned	Wh IN	52
0x00C1	193	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned	Wh OUT	53
0x00C2	194	SYSTEM REACTIVE ENERGY IN	100*VARh	Unsigned	VArh IN	54
0x00C3	195	SYSTEM REACTIVE ENERGY OUT	100*VARh	Unsigned	VArh OUT	55
0x00C4	196	SYSTEM APPARENT ENERGY	100*VAh	Unsigned	VAh	56
0x00C5	197	ACTIVE ENERGY IN L_1	100*Wh	Unsigned	Wh L1 IN	57
0x00C6	198	ACTIVE ENERGY OUT L_1	100*Wh	Unsigned	Wh L1 OUT	58
0x00C7	199	REACTIVE ENERGY IN L_1	100*VARh	Unsigned	VArh L1 IN	59
0x00C8	200	REACTIVE ENERGY OUT L_1	100*VARh	Unsigned	VArhL1OUT	60
0x00C9	201	APPARENT ENERGY L_1	100*VAh	Unsigned	VAh L1	61
0x00CA	202	ACTIVE ENERGY IN L_2	100*Wh	Unsigned	Wh L2 IN	62
0x00CB	203	ACTIVE ENERGY OUT L_2	100*Wh	Unsigned	Wh L2 OUT	63
0x00CC	204	REACTIVE ENERGY IN L_2	100*VARh	Unsigned	VArh L2 IN	64
0x00CD	205	REACTIVE ENERGY OUT L_2	100*VARh	Unsigned	VArhL2OUT	65
0x00CE	206	APPARENT ENERGY L_2	100*VAh	Unsigned	VAh L2	66
0x00CF	207	ACTIVE ENERGY IN L_3	100*Wh	Unsigned	Wh L3 IN	67
0x00D0	208	ACTIVE ENERGY OUT L_3	100*Wh	Unsigned	Wh L3 OUT	68
0x00D1	209	REACTIVE ENERGY IN L_3	100*VARh	Unsigned	VArh L3 IN	69
0x00D2	210	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned	VArhL3OUT	70
0x00D3	211	APPARENT ENERGY L_3	100*VAh	Unsigned	VAh L3	71

Warning: All the energy values restart from 0 after the 100'000'000 kWh [1'000'000'000 * 100*Wh]

Timeband 1 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x00D4	212	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x00D5	213	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
0x00D6	214	SYSTEM REACTIVE ENERGY IN	100*VARh	Unsigned
0x00D7	215	SYSTEM REACTIVE ENERGY OUT	100*VARh	Unsigned
0x00D8	216	SYSTEM APPARENT ENERGY	100*Vah	Unsigned
0x00D9	217	ACTIVE ENERGY IN L_1	100*Wh	Unsigned
0x00DA	218	ACTIVE ENERGY OUT L_1	100*Wh	Unsigned
0x00DB	219	REACTIVE ENERGY IN L_1	100*VARh	Unsigned
0x00DC	220	REACTIVE ENERGY OUT L_1	100*VARh	Unsigned
0x00DD	221	APPARENT ENERGY L_1	100*Vah	Unsigned
0x00DE	222	ACTIVE ENERGY IN L_2	100*Wh	Unsigned
0x00DF	223	ACTIVE ENERGY OUT L_2	100*Wh	Unsigned
0x00E0	224	REACTIVE ENERGY IN L_2	100*VARh	Unsigned
0x00E1	225	REACTIVE ENERGY OUT L_2	100*VARh	Unsigned
0x00E2	226	APPARENT ENERGY L_2	100*Vah	Unsigned
0x00E3	227	ACTIVE ENERGY IN L_3	100*Wh	Unsigned
0x00E4	228	ACTIVE ENERGY OUT L_3	100*Wh	Unsigned
0x00E5	229	REACTIVE ENERGY IN L_3	100*VARh	Unsigned
0x00E6	230	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x00E7	231	APPARENT ENERGY L_3	100*Vah	Unsigned

Warning: All the energy values restart from 0 after the 100'000'000 kWh [1'000'000'000 * 100*Wh]

Timeband 2 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x00E8	232	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x00E9	233	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
---	---	---	---	---
0x00FA	250	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x00FB	251	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 3 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x00FC	252	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x00FD	253	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
---	---	---	---	---
0x010E	270	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x010F	271	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 4 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0110	272	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0111	273	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x0122	290	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x0123	291	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 5 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0124	292	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0125	293	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x0136	310	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x0137	311	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 6 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0138	312	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0139	313	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x014A	330	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x014B	331	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 7 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x014C	332	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x014D	333	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	--- --- --- ---	-	-
0x015E	350	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x015F	351	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 8 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0160	352	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0161	353	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x0172	370	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x0173	371	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 9 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0174	372	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0175	373	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x0186	390	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x0187	391	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 10 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0188	392	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0189	393	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x019A	410	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x019B	411	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 11 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x019C	412	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x019D	413	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x01AE	430	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x01AF	431	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 12 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x01B0	432	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x01B1	433	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x01C2	450	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x01C3	451	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 13 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x01C4	452	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x01C5	423	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x01D6	470	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x01D7	471	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 14 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x01D8	472	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x01D9	473	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x01EA	490	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x01EB	491	APPARENT ENERGY L_3	100*Vah	Unsigned

Timeband 15 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x01EC	492	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x01ED	493	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x01FE	510	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x01FF	511	APPARENT ENERGY L_3	100*VAh	Unsigned

Timeband 16 – energies (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0200	512	SYSTEM ACTIVE ENERGY IN	100*Wh	Unsigned
0x0201	513	SYSTEM ACTIVE ENERGY OUT	100*Wh	Unsigned
	---	---	---	---
0x0212	530	REACTIVE ENERGY OUT L_3	100*VARh	Unsigned
0x0213	531	APPARENT ENERGY L_3	100*VAh	Unsigned

Warning: All the energy values restart from 0 after the 100'000'000 kWh [1'000'000'000 * 100*Wh]

Input counters (option)

Total input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0214	532	INPUT COUNTER 1	---	Unsigned
0x0215	533	INPUT COUNTER 2	---	Unsigned
0x0216	534	INPUT COUNTER 3	---	Unsigned
0x0217	535	INPUT COUNTER 4	---	Unsigned

Ton_{min} Input Signal: 30 mS
$Toff_{min}$ Input Signal: 30 mS

Timeband 1 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0218	536	INPUT COUNTER 1	---	Unsigned
0x0219	537	INPUT COUNTER 2	---	Unsigned
0x021A	538	INPUT COUNTER 3	---	Unsigned
0x021B	539	INPUT COUNTER 4	---	Unsigned

Ton_{min} Input Signal: 30 mS
$Toff_{min}$ Input Signal: 30 mS

Timeband 2 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x021C	540	INPUT COUNTER 1	---	Unsigned
0x021D	541	INPUT COUNTER 2	---	Unsigned
0x021E	542	INPUT COUNTER 3	---	Unsigned
0x021F	543	INPUT COUNTER 4	---	Unsigned

Timeband 3 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0220	544	INPUT COUNTER 1	---	Unsigned
0x0221	545	INPUT COUNTER 2	---	Unsigned
0x0222	546	INPUT COUNTER 3	---	Unsigned
0x0223	547	INPUT COUNTER 4	---	Unsigned

Timeband 4 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0224	548	INPUT COUNTER 1	---	Unsigned
0x0225	549	INPUT COUNTER 2	---	Unsigned
0x0226	550	INPUT COUNTER 3	---	Unsigned
0x0227	551	INPUT COUNTER 4	---	Unsigned

Timeband 5 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0228	552	INPUT COUNTER 1	---	Unsigned
0x0229	553	INPUT COUNTER 2	---	Unsigned
0x022A	554	INPUT COUNTER 3	---	Unsigned
0x022B	555	INPUT COUNTER 4	---	Unsigned

Timeband 6 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x022C	556	INPUT COUNTER 1	---	Unsigned
0x022D	557	INPUT COUNTER 2	---	Unsigned
0x022E	558	INPUT COUNTER 3	---	Unsigned
0x022F	559	INPUT COUNTER 4	---	Unsigned

Timeband 7 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0230	560	INPUT COUNTER 1	---	Unsigned
0x0231	561	INPUT COUNTER 2	---	Unsigned
0x0232	562	INPUT COUNTER 3	---	Unsigned
0x0233	563	INPUT COUNTER 4	---	Unsigned

Timeband 8 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0234	564	INPUT COUNTER 1	---	Unsigned
0x0235	565	INPUT COUNTER 2	---	Unsigned
0x0236	566	INPUT COUNTER 3	---	Unsigned
0x0237	567	INPUT COUNTER 4	---	Unsigned

Timeband 9 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0238	568	INPUT COUNTER 1	---	Unsigned
0x0239	569	INPUT COUNTER 2	---	Unsigned
0x023A	570	INPUT COUNTER 3	---	Unsigned
0x023B	571	INPUT COUNTER 4	---	Unsigned

Timeband 10 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x023C	572	INPUT COUNTER 1	---	Unsigned
0x023D	573	INPUT COUNTER 2	---	Unsigned
0x023E	574	INPUT COUNTER 3	---	Unsigned
0x023F	575	INPUT COUNTER 4	---	Unsigned

Timeband 11 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0240	576	INPUT COUNTER 1	---	Unsigned
0x0241	577	INPUT COUNTER 2	---	Unsigned
0x0242	578	INPUT COUNTER 3	---	Unsigned
0x0243	579	INPUT COUNTER 4	---	Unsigned

Timeband 12 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0244	580	INPUT COUNTER 1	---	Unsigned
0x0245	581	INPUT COUNTER 2	---	Unsigned
0x0246	582	INPUT COUNTER 3	---	Unsigned
0x0247	583	INPUT COUNTER 4	---	Unsigned

Timeband 13 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0248	584	INPUT COUNTER 1	---	Unsigned
0x0249	585	INPUT COUNTER 2	---	Unsigned
0x024A	586	INPUT COUNTER 3	---	Unsigned
0x024B	587	INPUT COUNTER 4	---	Unsigned

Timeband 14 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x024C	588	INPUT COUNTER 1	---	Unsigned
0x024D	589	INPUT COUNTER 2	---	Unsigned
0x024E	590	INPUT COUNTER 3	---	Unsigned
0x024F	591	INPUT COUNTER 4	---	Unsigned

Timeband 15 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0250	592	INPUT COUNTER 1	---	Unsigned
0x0251	593	INPUT COUNTER 2	---	Unsigned
0x0252	594	INPUT COUNTER 3	---	Unsigned
0x0253	595	INPUT COUNTER 4	---	Unsigned

Timeband 16 - input counters (option)

Index HEX	Index DEC	Description	Measure Unit	Type
0x0254	596	INPUT COUNTER 1	---	Unsigned
0x0255	597	INPUT COUNTER 2	---	Unsigned
0x0256	598	INPUT COUNTER 3	---	Unsigned
0x0257	599	INPUT COUNTER 4	---	Unsigned

Relative minimums

Index HEX	Index DEC	Description	Measure Unit	Type
0x0258	600	SYSTEM VOLTAGE	mV	Unsigned
0x0259	601	PHASE VOLTAGE L_1	mV	Unsigned
0x025A	602	PHASE VOLTAGE L_2	mV	Unsigned
0x025B	603	PHASE VOLTAGE L_3	mV	Unsigned
0x025C	604	LINE TO LINE VOLTAGE L_{1-2}	mV	Signed
0x025D	605	LINE TO LINE VOLTAGE L_{2-3}	mV	Signed
0x025E	606	LINE TO LINE VOLTAGE L_{3-1}	mV	Signed
0x025F	607	SYSTEM CURRENT	mA	Unsigned
0x0260	608	LINE CURRENT L_1	mA	Unsigned
0x0261	609	LINE CURRENT L_2	mA	Unsigned
0x0262	610	LINE CURRENT L_3	mA	Unsigned
0x0263	611	SYSTEM POWER FACTOR *[max negative value]*	±1000	Signed
0x0264	612	POWER FACTOR L_1 *[maximum negative value]*	±1000	Signed
0x0265	613	POWER FACTOR L_2 *[maximum negative value]*	±1000	Signed
0x0266	614	POWER FACTOR L_3 *[maximum negative value]*	±1000	Signed
0x0267	615	SYSTEM COS φ *[maximum negative value]*	±1000	Signed
0x0268	616	PHASE COS $φ_1$ *[maximum negative value]*	±1000	Signed
0x0269	617	PHASE COS $φ_2$ *[maximum negative value]*	±1000	Signed
0x026A	618	PHASE COS $φ_3$ *[maximum negative value]*	±1000	Signed
0x026B	619	SYSTEM APPARENT POWER	VA	Unsigned
0x026C	620	APPARENT POWER L_1	VA	Unsigned
0x026D	621	APPARENT POWER L_2	VA	Unsigned
0x026E	622	APPARENT POWER L_3	VA	Unsigned
0x026F	623	SYSTEM ACTIVE POWER	W	Signed
0x0270	624	ACTIVE POWER L_1	W	Signed
0x0271	625	ACTIVE POWER L_2	W	Signed
0x0272	626	ACTIVE POWER L_3	W	Signed
0x0273	627	SYSTEM REACTIVE POWER	VAR	Signed
0x0274	628	REACTIVE POWER L_1	VAR	Signed
0x0275	629	REACTIVE POWER L_2	VAR	Signed
0x0276	630	REACTIVE POWER L_3	VAR	Signed
0x0277	631	NEUTRAL CURRENT	mA	Unsigned
0x0278	632	FREQUENCY	mHz	Unsigned
0x0279	633	TEMPERATURE	°C * 10	Signed
0x027A	634	THD VOLTAGE L_1	0 ÷ 10000	Unsigned
0x027B	635	THD VOLTAGE L_2	0 ÷ 10000	Unsigned
0x027C	636	THD VOLTAGE L_3	0 ÷ 10000	Unsigned
0x027D	637	THD CURRENT L_1	0 ÷ 10000	Unsigned
0x027E	638	THD CURRENT L_2	0 ÷ 10000	Unsigned
0x027F	639	THD CURRENT L_3	0 ÷ 10000	Unsigned
0x0280	640	ANGLE$_{1-2}$	0 - 3600	Unsigned
0x0281	641	ANGLE$_{2-3}$	0 - 3600	Unsigned
0x0282	642	ANGLE$_{3-1}$	0 - 3600	Unsigned
0x0283	643	SYSTEM TANGENT φ	±100000	Signed
0x0284	644	PHASE TANGENT $φ_1$	±100000	Signed
0x0285	645	PHASE TANGENT $φ_2$	±100000	Signed
0x0286	646	PHASE TANGENT $φ_3$	±100000	Signed

Relative maximums

Index HEX	Index DEC	Description	Measure Unit	Type
0x0287	647	SYSTEM VOLTAGE	mV	Unsigned
0x0288	648	PHASE VOLTAGE L_1	mV	Unsigned
0x0289	649	PHASE VOLTAGE L_2	mV	Unsigned
0x028A	650	PHASE VOLTAGE L_3	mV	Unsigned
0x028B	651	LINE TO LINE VOLTAGE L_{1-2}	mV	Signed
0x028C	652	LINE TO LINE VOLTAGE L_{2-3}	mV	Signed
0x028D	653	LINE TO LINE VOLTAGE L_{3-1}	mV	Signed
0x028E	654	SYSTEM CURRENT	mA	Unsigned
0x028F	655	LINE CURRENT L_1	mA	Unsigned
0x0290	656	LINE CURRENT L_2	mA	Unsigned
0x0291	657	LINE CURRENT L_3	mA	Unsigned
0x0292	658	SYSTEM POWER FACTOR *[max positive value]*	±1000	Signed
0x0293	659	POWER FACTOR L_1 *[maximum positive value]*	±1000	Signed
0x0294	660	POWER FACTOR L_2 *[maximum positive value]*	±1000	Signed
0x0295	661	POWER FACTOR L_3 *[maximum positive value]*	±1000	Signed
0x0296	662	SYSTEM COS φ *[maximum positive value]*	±1000	Signed
0x0297	663	PHASE COS $φ_1$ *[maximum positive value]*	±1000	Signed
0x0298	664	PHASE COS $φ_2$ *[maximum positive value]*	±1000	Signed
0x0299	665	PHASE COS $φ_3$ *[maximum positive value]*	±1000	Signed
0x029A	666	SYSTEM APPARENT POWER	VA	Unsigned
0x029B	667	APPARENT POWER L_1	VA	Unsigned
0x029C	668	APPARENT POWER L_2	VA	Unsigned
0x029D	669	APPARENT POWER L_3	VA	Unsigned
0x029E	670	SYSTEM ACTIVE POWER	W	Signed
0x029F	671	ACTIVE POWER L_1	W	Signed
0x02A0	672	ACTIVE POWER L_2	W	Signed
0x02A1	673	ACTIVE POWER L_3	W	Signed
0x02A2	674	SYSTEM REACTIVE POWER	VAR	Signed
0x02A3	675	REACTIVE POWER L_1	VAR	Signed
0x02A4	676	REACTIVE POWER L_2	VAR	Signed
0x02A5	677	REACTIVE POWER L_3	VAR	Signed
0x02A6	678	NEUTRAL CURRENT	mA	Unsigned
0x02A7	679	FREQUENCY	mHz	Unsigned
0x02A8	680	TEMPERATURE	°C * 10	Signed
0x02A9	681	THD VOLTAGE L_1	0 ÷ 10000	Unsigned
0x02AA	682	THD VOLTAGE L_2	0 ÷ 10000	Unsigned
0x02AB	683	THD VOLTAGE L_3	0 ÷ 10000	Unsigned
0x02AC	684	THD CURRENT L_1	0 ÷ 10000	Unsigned
0x02AD	685	THD CURRENT L_2	0 ÷ 10000	Unsigned
0x02AE	686	THD CURRENT L_3	0 ÷ 10000	Unsigned
0x02AF	687	ANGLE$_{1-2}$	0 - 3600	Unsigned
0x02B0	688	ANGLE$_{2-3}$	0 - 3600	Unsigned
0x02B1	689	ANGLE$_{3-1}$	0 - 3600	Unsigned
0x02B2	690	SYSTEM TANGENT φ	±100000	Signed
0x02B3	691	PHASE TANGENT $φ_1$	±100000	Signed
0x02B4	692	PHASE TANGENT $φ_2$	±100000	Signed
0x02B5	693	PHASE TANGENT $φ_3$	±100000	Signed

Absolute minimums

Index HEX	Index DEC	Description	Measure Unit	Type
0x02B6	694	TIME*	---	Unsigned
0x02B7	695	DATE**	---	Unsigned
0x02B8	696	SYSTEM VOLTAGE	mV	Unsigned
0x02B9	697	TIME*	---	Unsigned
0x02BA	698	DATE**	---	Unsigned
0x02BB	699	PHASE VOLTAGE L_1	mV	Unsigned
0x02BC	700	TIME*	---	Unsigned
0x02BD	701	DATE**	---	Unsigned
0x02BE	702	PHASE VOLTAGE L_2	mV	Unsigned
0x02BF	703	TIME*	---	Unsigned
0x02C0	704	DATE**	---	Unsigned
0x02C1	705	PHASE VOLTAGE L_3	mV	Unsigned
0x02C2	706	TIME*	---	Unsigned
0x02C3	707	DATE**	---	Unsigned
0x02C4	708	LINE TO LINE VOLTAGE L_{1-2}	mV	Signed
0x02C5	709	TIME*	---	Unsigned
0x02C6	710	DATE**	---	Unsigned
0x02C7	711	LINE TO LINE VOLTAGE L_{2-3}	mV	Signed
0x02C8	712	TIME*	---	Unsigned
0x02C9	713	DATE**	---	Unsigned
0x02CA	714	LINE TO LINE VOLTAGE L_{3-1}	mV	Signed
0x02CB	715	TIME*	---	Unsigned
0x02CC	716	DATE**	---	Unsigned
0x02CD	717	SYSTEM CURRENT	mA	Unsigned
0x02CE	718	TIME*	---	Unsigned
0x02CF	719	DATE**	---	Unsigned
0x02D0	720	LINE CURRENT L_1	mA	Unsigned
0x02D1	721	TIME*	---	Unsigned
0x02D2	722	DATE**	---	Unsigned
0x02D3	723	LINE CURRENT L_2	mA	Unsigned
0x02D4	724	TIME*	---	Unsigned
0x02D5	725	DATE**	---	Unsigned
0x02D6	726	LINE CURRENT L_3	mA	Unsigned
0x02D7	727	TIME*	---	Unsigned
0x02D8	728	DATE**	---	Unsigned
0x02D9	729	SYSTEM POWER FACTOR *[max negative value]*	±1000	Signed
0x02DA	730	TIME*	---	Unsigned
0x02DB	731	DATE**	---	Unsigned
0x02DC	732	POWER FACTOR L_1 *[maximum negative value]*	±1000	Signed
0x02DD	733	TIME*	---	Unsigned
0x02DE	734	DATE**	---	Unsigned
0x02DF	735	POWER FACTOR L_2 *[maximum negative value]*	±1000	Signed
0x02E0	736	TIME*	---	Unsigned
0x02E1	737	DATE**	---	Unsigned
0x02E2	738	POWER FACTOR L_3 *[maximum negative value]*	±1000	Signed
0x02E3	739	TIME*	---	Unsigned
0x02E4	740	DATE**	---	Unsigned
0x02E5	741	SYSTEM COS φ *[maximum negative value]*	±1000	Signed
0x02E6	742	TIME*	---	Unsigned
0x02E7	743	DATE**	---	Unsigned
0x02E8	744	PHASE COS $φ_1$ *[maximum negative value]*	±1000	Signed
0x02E9	745	TIME*	---	Unsigned
0x02EA	746	DATE**	---	Unsigned
0x02EB	747	PHASE COS $φ_2$ *[maximum negative value]*	±1000	Signed
0x02EC	748	TIME*	---	Unsigned
0x02ED	749	DATE**	---	Unsigned
0x02EE	750	PHASE COS $φ_3$ *[maximum negative value]*	±1000	Signed
0x02EF	751	TIME*	---	Unsigned
0x02F0	752	DATE**	---	Unsigned
0x02F1	753	SYSTEM APPARENT POWER	VA	Unsigned
0x02F2	754	TIME*	---	Unsigned
0x02F3	755	DATE**	---	Unsigned
0x02F4	756	APPARENT POWER L_1	VA	Unsigned
0x02F5	757	TIME*	---	Unsigned
0x02F6	758	DATE**	---	Unsigned
0x02F7	759	APPARENT POWER L_2	VA	Unsigned
0x02F8	760	TIME*	---	Unsigned
0x02F9	761	DATE**	---	Unsigned
0x02FA	762	APPARENT POWER L_3	VA	Unsigned
0x02FB	763	TIME*	---	Unsigned
0x02FC	764	DATE**	---	Unsigned
0x02FD	765	SYSTEM ACTIVE POWER	W	Signed

0x02FE	766	TIME*	---	Unsigned
0x02FF	767	DATE**	---	Unsigned
0x0300	768	ACTIVE POWER L_1	W	Signed
0x0301	769	TIME*	---	Unsigned
0x0302	770	DATE**	---	Unsigned
0x0303	771	ACTIVE POWER L_2	W	Signed
0x0304	772	TIME*	---	Unsigned
0x0305	773	DATE**	---	Unsigned
0x0306	774	ACTIVE POWER L_3	W	Signed
0x0307	775	TIME*	---	Unsigned
0x0308	776	DATE**	---	Unsigned
0x0309	777	SYSTEM REACTIVE POWER	VAR	Signed
0x030A	778	TIME*	---	Unsigned
0x030B	779	DATE**	---	Unsigned
0x030C	780	REACTIVE POWER L_1	VAR	Signed
0x030D	781	TIME*	---	Unsigned
0x030E	782	DATE**	---	Unsigned
0x030F	783	REACTIVE POWER L_2	VAR	Signed
0x0310	784	TIME*	---	Unsigned
0x0311	785	DATE**	---	Unsigned
0x0312	786	REACTIVE POWER L_3	VAR	Signed
0x0313	787	TIME*	---	Unsigned
0x0314	788	DATE**	---	Unsigned
0x0315	789	NEUTRAL CURRENT	mA	Unsigned
0x0316	790	TIME*	---	Unsigned
0x0317	791	DATE**	---	Unsigned
0x0318	792	FREQUENCY	mHz	Unsigned
0x0319	793	TIME*	---	Unsigned
0x031A	794	DATE**	---	Unsigned
0x031B	795	TEMPERATURE	°C * 10	Signed
0x031C	796	TIME*	---	Unsigned
0x031D	797	DATE**	---	Unsigned
0x031E	798	THD VOLTAGE L_1	0 ÷ 10000	Unsigned
0x031F	799	TIME*	---	Unsigned
0x0320	800	DATE**	---	Unsigned
0x0321	801	THD VOLTAGE L_2	0 ÷ 10000	Unsigned
0x0322	802	TIME*	---	Unsigned
0x0323	803	DATE**	---	Unsigned
0x0324	804	THD VOLTAGE L_3	0 ÷ 10000	Unsigned
0x0325	805	TIME*	---	Unsigned
0x0326	806	DATE**	---	Unsigned
0x0327	807	THD CURRENT L_1	0 ÷ 10000	Unsigned
0x0328	808	TIME*	---	Unsigned
0x0329	809	DATE**	---	Unsigned
0x032A	810	THD CURRENT L_2	0 ÷ 10000	Unsigned
0x032B	811	TIME*	---	Unsigned
0x032C	812	DATE**	---	Unsigned
0x032D	813	THD CURRENT L_3	0 ÷ 10000	Unsigned
0x032E	814	TIME*	---	Unsigned
0x032F	815	DATE**	---	Unsigned
0x0330	816	ANGLE$_{1-2}$	0 - 3600	Unsigned
0x0331	817	TIME*	---	Unsigned
0x0332	818	DATE**	---	Unsigned
0x0333	819	ANGLE$_{2-3}$	0 - 3600	Unsigned
0x0334	820	TIME*	---	Unsigned
0x0335	821	DATE**	---	Unsigned
0x0336	822	ANGLE$_{3-1}$	0 - 3600	Unsigned
0x0337	823	TIME*	---	Unsigned
0x0338	824	DATE**	---	Unsigned
0x0339	825	SYSTEM TANGENT φ	±100000	Signed
0x033A	826	TIME*	---	Unsigned
0x033B	827	DATE**	---	Unsigned
0x033C	828	PHASE TANGENT $φ_1$	±100000	Signed
0x033D	829	TIME*	---	Unsigned
0x033E	830	DATE**	---	Unsigned
0x033F	831	PHASE TANGENT $φ_2$	±100000	Signed
0x0340	832	TIME*	---	Unsigned
0x0341	833	DATE**	---	Unsigned
0x0342	834	PHASE TANGENT $φ_3$	±100000	Signed

*: byte order/meaning: EMPTY, HOUR, MINUTE, SECOND

**: byte order/meaning: DAY, MONYH, YEAR,YEAR

Absolute maximums

Index HEX	Index DEC	Description	Measure Unit	Type
0x0343	835	TIME*	---	Unsigned
0x0344	836	DATE**	---	Unsigned
0x0345	837	SYSTEM VOLTAGE	mV	Unsigned
0x0346	838	TIME*	---	Unsigned
0x0347	839	DATE**	---	Unsigned
0x0348	840	PHASE VOLTAGE L_1	mV	Unsigned
0x0349	841	TIME*	---	Unsigned
0x034A	842	DATE**	---	Unsigned
0x034B	843	PHASE VOLTAGE L_2	mV	Unsigned
0x034C	844	TIME*	---	Unsigned
0x034D	845	DATE**	---	Unsigned
0x034E	846	PHASE VOLTAGE L_3	mV	Unsigned
0x034F	847	TIME*	---	Unsigned
0x0350	848	DATE**	---	Unsigned
0x0351	849	LINE TO LINE VOLTAGE L_{1-2}	mV	Signed
0x0352	850	TIME*	---	Unsigned
0x0353	851	DATE**	---	Unsigned
0x0354	852	LINE TO LINE VOLTAGE L_{2-3}	mV	Signed
0x0355	853	TIME*	---	Unsigned
0x0356	854	DATE**	---	Unsigned
0x0357	855	LINE TO LINE VOLTAGE L_{3-1}	mV	Signed
0x0358	856	TIME*	---	Unsigned
0x0359	857	DATE**	---	Unsigned
0x035A	858	SYSTEM CURRENT	mA	Unsigned
0x035B	859	TIME*	---	Unsigned
0x035C	860	DATE**	---	Unsigned
0x035D	861	LINE CURRENT L_1	mA	Unsigned
0x035E	862	TIME*	---	Unsigned
0x035F	863	DATE**	---	Unsigned
0x0360	864	LINE CURRENT L_2	mA	Unsigned
0x0361	865	TIME*	---	Unsigned
0x0362	866	DATE**	---	Unsigned
0x0363	867	LINE CURRENT L_3	mA	Unsigned
0x0364	868	TIME*	---	Unsigned
0x0365	869	DATE**	---	Unsigned
0x0366	870	SYSTEM POWER FACTOR *[max positive value]*	±1000	Signed
0x0367	871	TIME*	---	Unsigned
0x0368	872	DATE**	---	Unsigned
0x0369	873	POWER FACTOR L_1 *[maximum positive value]*	±1000	Signed
0x036A	874	TIME*	---	Unsigned
0x036B	875	DATE**	---	Unsigned
0x036C	876	POWER FACTOR L_2 *[maximum positive value]*	±1000	Signed
0x036D	877	TIME*	---	Unsigned
0x036E	878	DATE**	---	Unsigned
0x036F	879	POWER FACTOR L_3 *[maximum positive value]*	±1000	Signed
0x0370	880	TIME*	---	Unsigned
0x0371	881	DATE**	---	Unsigned
0x0372	882	SYSTEM COS φ *[maximum positive value]*	±1000	Signed
0x0373	883	TIME*	---	Unsigned
0x0374	884	DATE**	---	Unsigned
0x0375	885	PHASE COS $φ_1$ *[maximum positive value]*	±1000	Signed
0x0376	886	TIME*	---	Unsigned
0x0377	887	DATE**	---	Unsigned
0x0378	888	PHASE COS $φ_2$ *[maximum positive value]*	±1000	Signed
0x0379	889	TIME*	---	Unsigned
0x037A	890	DATE**	---	Unsigned
0x037B	891	PHASE COS $φ_3$ *[maximum positive value]*	±1000	Signed
0x037C	892	TIME*	---	Unsigned
0x037D	893	DATE**	---	Unsigned
0x037E	894	SYSTEM APPARENT POWER	VA	Unsigned
0x037F	895	TIME*	---	Unsigned
0x0380	896	DATE**	---	Unsigned
0x0381	897	APPARENT POWER L_1	VA	Unsigned
0x0382	898	TIME*	---	Unsigned
0x0383	899	DATE**	---	Unsigned
0x0384	900	APPARENT POWER L_2	VA	Unsigned
0x0385	901	TIME*	---	Unsigned
0x0386	902	DATE**	---	Unsigned
0x0387	903	APPARENT POWER L_3	VA	Unsigned
0x0388	904	TIME*	---	Unsigned
0x0389	905	DATE**	---	Unsigned
0x038A	906	SYSTEM ACTIVE POWER	W	Signed

0x038B	907	TIME*	---	Unsigned
0x038C	908	DATE**	---	Unsigned
0x038D	909	ACTIVE POWER L_1	W	Signed
0x038E	910	TIME*	---	Unsigned
0x038F	911	DATE**	---	Unsigned
0x0390	912	ACTIVE POWER L_2	W	Signed
0x0391	913	TIME*	---	Unsigned
0x0392	914	DATE**	---	Unsigned
0x0393	915	ACTIVE POWER L_3	W	Signed
0x0394	916	TIME*	---	Unsigned
0x0395	917	DATE**	---	Unsigned
0x0396	918	SYSTEM REACTIVE POWER	VAR	Signed
0x0397	919	TIME*	---	Unsigned
0x0398	920	DATE**	---	Unsigned
0x0399	921	REACTIVE POWER L_1	VAR	Signed
0x039A	922	TIME*	---	Unsigned
0x039B	923	DATE**	---	Unsigned
0x039C	924	REACTIVE POWER L_2	VAR	Signed
0x039D	925	TIME*	---	Unsigned
0x039E	926	DATE**	---	Unsigned
0x039F	927	REACTIVE POWER L_3	VAR	Signed
0x03A0	928	TIME*	---	Unsigned
0x03A1	929	DATE**	---	Unsigned
0x03A2	930	NEUTRAL CURRENT	mA	Unsigned
0x03A3	931	TIME*	---	Unsigned
0x03A4	932	DATE**	---	Unsigned
0x03A5	933	FREQUENCY	mHz	Unsigned
0x03A6	934	TIME*	---	Unsigned
0x03A7	935	DATE**	---	Unsigned
0x03A8	936	TEMPERATURE	°C * 10	Signed
0x03A9	937	TIME*	---	Unsigned
0x03AA	938	DATE**	---	Unsigned
0x03AB	939	THD VOLTAGE L_1	0 ÷ 10000	Unsigned
0x03AC	940	TIME*	---	Unsigned
0x03AD	941	DATE**	---	Unsigned
0x03AE	942	THD VOLTAGE L_2	0 ÷ 10000	Unsigned
0x03AF	943	TIME*	---	Unsigned
0x03B0	944	DATE**	---	Unsigned
0x03B1	945	THD VOLTAGE L_3	0 ÷ 10000	Unsigned
0x03B2	946	TIME*	---	Unsigned
0x03B3	947	DATE**	---	Unsigned
0x03B4	948	THD CURRENT L_1	0 ÷ 10000	Unsigned
0x03B5	949	TIME*	---	Unsigned
0x03B6	950	DATE**	---	Unsigned
0x03B7	951	THD CURRENT L_2	0 ÷ 10000	Unsigned
0x03B8	952	TIME*	---	Unsigned
0x03B9	953	DATE**	---	Unsigned
0x03BA	954	THD CURRENT L_3	0 ÷ 10000	Unsigned
0x03BB	955	TIME*	---	Unsigned
0x03BC	956	DATE**	---	Unsigned
0x03BD	957	ANGLE$_{1-2}$	0 - 3600	Unsigned
0x03BE	958	TIME*	---	Unsigned
0x03BF	959	DATE**	---	Unsigned
0x03C0	960	ANGLE$_{2-3}$	0 - 3600	Unsigned
0x03C1	961	TIME*	---	Unsigned
0x03C2	962	DATE**	---	Unsigned
0x03C3	963	ANGLE$_{3-1}$	0 - 3600	Unsigned
0x03C4	964	TIME*	---	Unsigned
0x03C5	965	DATE**	---	Unsigned
0x03C6	966	SYSTEM TANGENT φ	±100000	Signed
0x03C7	967	TIME*	---	Unsigned
0x03C8	968	DATE**	---	Unsigned
0x03C9	969	PHASE TANGENT $φ_1$	±100000	Signed
0x03CA	970	TIME*	---	Unsigned
0x03CB	971	DATE**	---	Unsigned
0x03CC	972	PHASE TANGENT $φ_2$	±100000	Signed
0x03CD	973	TIME*	---	Unsigned
0x03CE	974	DATE**	---	Unsigned
0x03CF	975	PHASE TANGENT $φ_3$	±100000	Signed

*: byte order/meaning: EMPTY, HOUR, MINUTE, SECOND

**: byte order/meaning: DAY, MONYH, YEAR,YEAR

Last average (mobile or fixed window)

Index HEX	Index DEC	Description	Measure Unit	Type	Acronym	Reference Number
0x03D0	976	SYSTEM VOLTAGE	mV	Unsigned	AVG V	68
0x03D1	977	PHASE VOLTAGE L$_{1-N}$	mV	Unsigned	AVG V L1	69
0x03D2	978	PHASE VOLTAGE L$_{2-N}$	mV	Unsigned	AVG V L2	70
0x03D3	979	PHASE VOLTAGE L$_{3-N}$	mV	Unsigned	AVG V L3	71
0x03D4	980	SYSTEM CURRENT	mA	Unsigned	AVG A	72
0x03D5	981	LINE CURRENT L$_1$	mA	Unsigned	AVG A L1	73
0x03D6	982	LINE CURRENT L$_2$	mA	Unsigned	AVG A L2	74
0x03D7	983	LINE CURRENT L$_3$	mA	Unsigned	AVG A L3	75
0x03D8	984	SYSTEM POWER FACTOR	±1000	Signed	AVG PF	76
0x03D9	985	POWER FACTOR L$_1$	±1000	Signed	AVG PF L1	77
0x03DA	986	POWER FACTOR L$_2$	±1000	Signed	AVG PF L2	78
0x03DB	987	POWER FACTOR L$_3$	±1000	Signed	AVG PF L3	79
0x03DC	988	SYSTEM COS ϕ	±1000	Signed	AVG COS	80
0x03DD	989	PHASE COS ϕ_1	±1000	Signed	AVG COS L1	81
0x03DE	990	PHASE COS ϕ_2	±1000	Signed	AVG COS L2	82
0x03DF	991	PHASE COS ϕ_3	±1000	Signed	AVG-COS-3	83
0x03E0	992	SYSTEM APPARENT POWER	VA	Unsigned	AVG VA	84
0x03E1	993	APPARENT POWER L$_1$	VA	Unsigned	AVG VA L1	85
0x03E2	994	APPARENT POWER L$_2$	VA	Unsigned	AVG VA L2	86
0x03E3	995	APPARENT POWER L$_3$	VA	Unsigned	AVG VA L3	87
0x03E4	996	SYSTEM ACTIVE POWER	W	Signed	AVG W	88
0x03E5	997	ACTIVE POWER L$_1$	W	Signed	AVG W L1	89
0x03E6	998	ACTIVE POWER L$_2$	W	Signed	AVG W L2	90
0x03E7	999	ACTIVE POWER L$_3$	W	Signed	AVG W L3	91
0x03E8	1000	SYSTEM REACTIVE POWER	VAR	Signed	AVG VAR	92
0x03E9	1001	REACTIVE POWER L$_1$	VAR	Signed	AVG VAR L1	93
0x03EA	1002	REACTIVE POWER L$_2$	VAR	Signed	AVG VAR L2	94
0x03EB	1003	REACTIVE POWER L$_3$	VAR	Signed	AVG VAR L3	95
0x03EC	1004	NEUTRAL CURRENT	mA	Unsigned	AVG N	96
0x03ED	1005	FREQUENCY	mHz	Unsigned	AVG Hz	97
0x03EE	1006	SYSTEM TANGENT ϕ	±100000	Signed	AVG TAN	98
0x03EF	1007	PHASE TANGENT ϕ_1	±100000	Signed	AVG TAN L1	99
0x03F0	1008	PHASE TANGENT ϕ_2	±100000	Signed	AVG TAN L2	100
0x03F1	1009	PHASE TANGENT ϕ_3	±100000	Signed	AVG TAN L3	101

Max demand (mobile or fixed window)

Index HEX	Index DEC	Description	Measure Unit	Type
0x03F2	1010	TIME*	---	Unsigned
0x03F3	1011	DATE**	---	Unsigned
0x03F4	1012	SYSTEM VOLTAGE	mV	Unsigned
0x03F5	1013	TIME*	---	Unsigned
0x03F6	1014	DATE**	---	Unsigned
0x03F7	1015	PHASE VOLTAGE L_{1-N}	mV	Unsigned
0x03F8	1016	TIME*	---	Unsigned
0x03F9	1017	DATE**	---	Unsigned
0x03FA	1018	PHASE VOLTAGE L_{2-N}	mV	Unsigned
0x03FB	1019	TIME*	---	Unsigned
0x03FC	1020	DATE**	---	Unsigned
0x03FD	1021	PHASE VOLTAGE L_{3-N}	mV	Unsigned
0x03FE	1022	TIME*	---	Unsigned
0x03FF	1023	DATE**	---	Unsigned
0x0400	1024	SYSTEM CURRENT	mA	Unsigned
0x0401	1025	TIME*	---	Unsigned
0x0402	1026	DATE**	---	Unsigned
0x0403	1027	LINE CURRENT L_1	mA	Unsigned
0x0404	1028	TIME*	---	Unsigned
0x0405	1029	DATE**	---	Unsigned
0x0406	1030	LINE CURRENT L_2	mA	Unsigned
0x0407	1031	TIME*	---	Unsigned
0x0408	1032	DATE**	---	Unsigned
0x0409	1033	LINE CURRENT L_3	mA	Unsigned
0x040A	1034	TIME*	---	Unsigned
0x040B	1035	DATE**	---	Unsigned
0x040C	1036	SYSTEM POWER FACTOR	±1000	Signed
0x040D	1037	TIME*	---	Unsigned
0x040E	1038	DATE**	---	Unsigned
0x040F	1039	POWER FACTOR L_1	±1000	Signed
0x0410	1040	TIME*	---	Unsigned
0x0411	1041	DATE**	---	Unsigned
0x0412	1042	POWER FACTOR L_2	±1000	Signed
0x0413	1043	TIME*	---	Unsigned
0x0414	1044	DATE**	---	Unsigned
0x0415	1045	POWER FACTOR L_3	±1000	Signed
0x0416	1046	TIME*	---	Unsigned
0x0417	1047	DATE**	---	Unsigned
0x0418	1048	SYSTEM COS φ	±1000	Signed
0x0419	1049	TIME*	---	Unsigned
0x041A	1050	DATE**	---	Unsigned
0x041B	1051	PHASE COS $φ_1$	±1000	Signed
0x041C	1052	TIME*	---	Unsigned
0x041D	1053	DATE**	---	Unsigned
0x041E	1054	PHASE COS $φ_2$	±1000	Signed
0x041F	1055	TIME*	---	Unsigned
0x0420	1056	DATE**	---	Unsigned
0x0421	1057	PHASE COS $φ_3$	±1000	Signed
0x0422	1058	TIME*	---	Unsigned
0x0423	1059	DATE**	---	Unsigned
0x0424	1060	SYSTEM APPARENT POWER	VA	Unsigned
0x0425	1061	TIME*	---	Unsigned
0x0426	1062	DATE**	---	Unsigned
0x0427	1063	APPARENT POWER L_1	VA	Unsigned
0x0428	1064	TIME*	---	Unsigned
0x0429	1065	DATE**	---	Unsigned
0x042A	1066	APPARENT POWER L_2	VA	Unsigned
0x042B	1067	TIME*	---	Unsigned
0x042C	1068	DATE**	---	Unsigned
0x042D	1069	APPARENT POWER L_3	VA	Unsigned
0x042E	1070	TIME*	---	Unsigned
0x042F	1071	DATE**	---	Unsigned
0x0430	1072	SYSTEM ACTIVE POWER	W	Signed
0x0431	1073	TIME*	---	Unsigned
0x0432	1074	DATE**	---	Unsigned
0x0433	1075	ACTIVE POWER L_1	W	Signed
0x0434	1076	TIME*	---	Unsigned
0x0435	1077	DATE**	---	Unsigned
0x0436	1078	ACTIVE POWER L_2	W	Signed
0x0437	1079	TIME*	---	Unsigned
0x0438	1080	DATE**	---	Unsigned
0x0439	1081	ACTIVE POWER L_3	W	Signed

0x043A	1082	TIME*	---	Unsigned
0x043B	1083	DATE**	---	Unsigned
0x043C	1084	SYSTEM REACTIVE POWER	VAR	Signed
0x043D	1085	TIME*	---	Unsigned
0x043E	1086	DATE**	---	Unsigned
0x043F	1087	REACTIVE POWER L_1	VAR	Signed
0x0440	1088	TIME*	---	Unsigned
0x0441	1089	DATE**	---	Unsigned
0x0442	1090	REACTIVE POWER L_2	VAR	Signed
0x0443	1091	TIME*	---	Unsigned
0x0444	1092	DATE**	---	Unsigned
0x0445	1093	REACTIVE POWER L_3	VAR	Signed
0x0446	1094	TIME*	---	Unsigned
0x0447	1095	DATE**	---	Unsigned
0x0448	1096	NEUTRAL CURRENT	mA	Unsigned
0x0449	1097	TIME*	---	Unsigned
0x044A	1098	DATE**	---	Unsigned
0x044B	1099	FREQUENCY	mHz	Unsigned
0x044C	1100	TIME*	---	Unsigned
0x044D	1101	DATE**	---	Unsigned
0x044E	1102	SYSTEM TANGENT φ	±100000	Signed
0x044F	1103	TIME*	---	Unsigned
0x0450	1104	DATE**	---	Unsigned
0x0451	1105	PHASE TANGENT $φ_1$	±100000	Signed
0x0452	1106	TIME*	---	Unsigned
0x0453	1107	DATE**	---	Unsigned
0x0454	1108	PHASE TANGENT $φ_2$	±100000	Signed
0x0455	1109	TIME*	---	Unsigned
0x0456	1110	DATE**	---	Unsigned
0x0457	1111	PHASE TANGENT $φ_3$	±100000	Signed

*: byte order/meaning: EMPTY, HOUR, MINUTE, SECOND

**: byte order/meaning: DAY, MONYH, YEAR,YEAR

Device State

Index HEX	Index DEC	Description	Note:
0x0458	1112	STATE	Bit 00: calibration corrupted [B] Bit 01: calibration corrupted [A] Bit 02: calibration corrupted [P] Bit 03: --- Bit 04: --- Bit 05: --- Bit 06: alarm temperature Bit 07: --- Bit 08: --- Bit 09: Warning voltage connection * Bit 10: Warning current connection ** Bit 11: Warning CT 1 inversion *** Bit 12: Warning CT 2 inversion *** Bit 13: Warning CT 3 inversion *** Bit 14: No Voltages Apply Bit 15: No Currents Apply

*: The order of voltage connections not be correct (don't respect 120° between the phases) in the following insertion:

- Three phase
- Three phase balanced
- Three phase multi load balanced
- Single phase multi load
- Multi single phase

Must be apply all voltage inputs.

**: The order of current connections not be correct in the following insertion:

- Three phase
- Three phase balanced
- Three phase multi load balanced
- Single phase multi load
- Multi single phase

Must be apply all current and all voltage inputs and the loads to be balanced.

***: The current in the CT has the opposite sign respect others two phase.
Must be apply all current and all voltage inputs.

Switch On/Off Events

Index HEX	Index DEC	Description	Note:
0x0459	1113	TIME	byte order/meaning: EMPTY, HOUR, MINUTE, SECOND
0x045A	1114	DATE	byte order/meaning: DAY, MONYH, YEAR,YEAR
0x045B	1115	1st SWITCH ON/OFF DETECTED	1: Instument switched on 0: Instument switched off
0x045C	1116	TIME	byte order/meaning: EMPTY, HOUR, MINUTE, SECOND
0x045D	1117	DATE	byte order/meaning: DAY, MONYH, YEAR,YEAR
0x045E	1118	2nd SWITCH ON/OFF DETECTED	1: Instument switched on 0: Instument switched off
---	---	---	---
---	---	---	---
0x04B3	1203	TIME	byte order/meaning: EMPTY, HOUR, MINUTE, SECOND
0x04B4	1204	DATE	byte order/meaning: DAY, MONYH, YEAR,YEAR
0x04B5	1205	31th SWITCH ON/OFF DETECTED	1: Instument switched on 0: Instument switched off
0x04B6	1206	TIME	byte order/meaning: EMPTY, HOUR, MINUTE, SECOND
0x04B7	1207	DATE	byte order/meaning: DAY, MONYH, YEAR,YEAR
0x04B8	1208	32th SWITCH ON/OFF DETECTED	1: Instument switched on 0: Instument switched off

- WRITE COMMANDS -

Device setup

Index HEX	Index DEC	Description	Parameters
0x1388	5000	RESET	**Reset:** 00000001h: To Default 00000002h: Setup 00000004h: All Energies 00000008h: All Energies TB *(no total energies)* 00000010h: All Counters 00000020h: All Counters TB *(no total energies)* 00000040h: Minimums and Maximum 00000080h: Maximum Demand 00000100h: Energy Log 00000200h: Setpoint Log 00000400h: Generic and Smart Log
0x1389	5001	HOUR	00 to 23 hours (00=Midnight)
0x138A	5002	MINUTE	00 to 59 minutes
0x138B	5003	SECOND	00 to 59 seconds
0x138C	5004	DAY OF WEEK	0001h = Monday 0005h = Friday 0002h = Tuesday 0006h = Saturday 0003h = Wednesday 0007h = Sunday 0004h = Thursday
0x138D	5005	DAY	01 to 31 day-of-month
0x138E	5006	MONTH	01 to 12 month
0x138F	5007	YEAR	2000 to 2099 year
0x1390	5008	SYNCRONIZE CLOCK	00000000h: only valid parameter (set to 00 second)
0x1391	5009	KCT TRANSFORM RATIO CURRENT	1 ÷ 10'000 *[Default: 1]* with KVT * KCT equal or less 350'000
0x1392	5010	KCTN TRANSFORM RATIO NEUTRAL CURRENT	1 ÷ 10'000 *[Default: 1]*
0x1393	5011	KVT TRANSFORM RATIO VOLTAGE	1 ÷ 5'000 *[Default: 1]* with KVT * KCT equal or less 350'000
0x1394	5012	WINDOW UPDATE TIME	Options: 00: 1 min 06: 12 min 01: 2 min 07: 15 min *[Default]* 02: 3 min 08: 20 min 03: 5 min 09: 30 min 04: 6 min 10: 60 min 05: 10 min After this time: - the relative max and min will be reset. - the average, max demand and expected power (if fixed window is selected) will be reset.
0x1395	5013	WINDOW TYPE (average, max demand, expected power)	0: Fixed window (synchronized with RTC) *[Default]* 1: Shifting window
0x1396	5014	TIMEBAND ENERGY MODE	00h: Manual 01h: Selection from Digital Input 02h: Preset
0x1397	5015	TIMEBAND COUNTER MODE	00h: Manual 01h: Selection from Digital Input
0x1398	5016	TIMEBAND ENERGY USED	01h: Timeband 1 Used *[Default]* --- - - - - - - - - - - - - - 10h: Timeband 16 Used
0x1399	5017	TIMEBAND COUNTER USED	01h: Timeband 1 Used *[Default]* --- - - - - - - - - - - - - - 10h: Timeband 16 Used
0x139A	5018	FUNDAMENTAL FREQUENCY	0000h: 50 Hz *[Default]* 0001h: 60 Hz
0x139B	5019	MONITORED PHASE	Select phase for frequency and sag monitor: 0000h: Phase A *[Default]* 0001h: Phase B 0002h: Phase C
0x139C	5020	SAG THRESHOLD (see monitored phase)	30 ÷ 400: Volt RMS value (send 200 for 200V RMS) See Fig.3 for detail. **Warning**: The new value will be valid after the next Power Up *[Default: 210]*
0x139D	5021	SAG PERIOD (see monitored phase)	1 ÷ 1000 uS *[Default: 32 mS]* - See Fig.3 for detail. **Warning**: The new value will be valid after the next Power Up
0x139E	5022	WIRING	0000h: Three-Phase *[Default]*. 0001h: Aron 0002h: Three Phase Balanced 0003h: Three-Phase Multi Load Balanced 0004h: Single-Phase 0005h: Single-Phase - Multi Load (from 1 to 3) 0006h: Multi Single-Phase 0007h: Two-Phase
0x139F	5023	NEUTRAL CURRENT	0000h: computed 0001h: measured (if Neutral CT is present). *[Default]*

Pulse/State digital output setup (DO-1, DO-2, DO-3, DO-4)

Index HEX	Index DEC	Description	Parameters
0x13A0	5024	STATUS	Bit 00: State DO-1 *[Default: 0]* Bit 01: State DO-2 *[Default: 0]* Bit 02: State DO-3 *[Default: 0] (option)* Bit 03: State DO-4 *[Default: 0] (option)* Bit 04-31: Not Used Set the bit XX for set the corresponding DO
0x13A1	5025	LEVEL	0000h: Active Low (Initial State: High Level) 0001h: Active High (Initial State: Low Level) *[Default]* **WARNING**: when change this parameter the STATUS is go back to default.
0x13A2	5026	MODE	0000h: State (see STATE command) *[Default]* 0001h: Pulse 0002h: Setpoint
0x13A3	5027	PULSE WEIGHT (used only in Pulse Mode)	Weight from 1 to 10000: - 1: pulse every 1 Wh, 1 VARh, 1 VAh. - 10: pulse every 10 Wh, 10 VARh ,10 VAh. - 100: pulse every 100 Wh, ... [Default] - 1k: pulse every 1 kWh, …. - 10k:pulse every 10 kWh, ….
0x13A4	5028	PULSE PERIOD (used only in Pulse Mode)	60 mSec ÷ 1000 mSec with 50% of duty cicle *[Default: 500mSec]* For example if it send: 100 mSec → T$_{On}$ 50 mSec – T$_{Off}$ 50 mSec 500 mSec → T$_{On}$ 250 mSec – T$_{Off}$ 250 mSec
0x13A5	5029	MEASURE ASSOCIATED WITH DO-1 (used only in Pulse Mode)	48: Wh IN [Default] 58: Wh IN L2 49: Wh OUT 59: Wh OUT L2 50: VArh IN 60: VArh IN L2 51: VArh OUT 61: VArh OUT L2 52: VAh 62: VAh L2 53: Wh IN L1 63: Wh IN L3 54: Wh OUT L1 64: Wh OUT L3 55: VArh IN L1 65: VArh IN L3 56: VArh OUT L1 66: VArh OUT L3 57: VAh L1 67: VAh L3
0x13A6	5030	MEASURE ASSOCIATED WITH DO-2 (used only in Pulse Mode)	See Previous Modbus Command *[Default: S-Wh-O]*
0x13A7	5031	MEASURE ASSOCIATED WITH DO-3 (used only in Pulse Mode) (option)	See Previous Modbus Command *[Default: S-VARh-I]*
0x13A8	5032	MEASURE ASSOCIATED WITH DO-4 (used only in Pulse Mode) (option)	See Previous Modbus Command *[Default: S-VARh-O]*

(**):Read the OPTIONS register for hardware EMS configuration. Bits don't used (not input or output present) are fixed to 0.

Digital output setup (DO-5, DO-6, DO-7, DO-8) (option)

Index HEX	Index DEC	Description	Parameters
0x13A9	5033	STATUS (**)	Bit 00: State DO-5 *[Default: 0]* Bit 01: State DO-6 *[Default: 0]* Bit 02: State DO-7 *[Default: 0]* Bit 03: State DO-8 *[Default: 0]* Bit 04-31: Not Used Set the bit XX for set the corresponding DO
0x13AA	5034	LEVEL	0000h: Active Low (Initial State: High Level) 0001h: Active High (Initial State: Low Level) *[Default]* **WARNING**: when change this parameter the STATUS is go back to default.
0x13AB	5035	MODE	0000h: State *[Default]* (see STATE command) 0001h: Not used 0002h: Setpoint

(**):Read the Ordering Code register for hardware EMS configuration. Bits don't used (not input or output present) are fixed to 0.

Digital input setup (DI-1, DI-2, DI-3, DI-4) (option)

Index HEX	Index DEC	Description	Parameters
0x13AC	5036	MODE	0000h: Status *[Default]* 0001h: Counter 0002h: Select Energy Timeband Used (DI bit logic) 0003h: Select Counter Timeband Used (DI bit logic) 0004h: Select Energy and Counter Timeband Used (DI bit logic) Examples: DI-4 = 1, DI-3, = 0 DI-2 = 0, DI-1 = 1 TB selected is 1001bin → TB 9 DI-4 = 0, DI-3, = 0 DI-2 = 1, DI-1 = 1 TB selected is 0011bin → TB 3
0x13AD	5037	MULTIPLIER	1 ÷ 1000 *[Default: 1]*

(**):Read the Ordering Code register for hardware EMS configuration. Bits don't used (not input or output present) are fixed to 0.

Setpoint setup 1

Index HEX	Index DEC	Description	Parameters
0x13AE	5038	ENABLED	0: No *[Default]* 1: Yes
0x13AF	5039	MEASURE GROUP	0: Not used *[Default]* 1: Instantaneous measure 2: Total energy 3: Last average
0x13B0	5040	MEASURE CONTROLLED	If Group is equal to: 1: see acronym group 1 table 2: see acronym group 2 table 3: see acronym group 3 table
0x13B1	5041	HIGH THRESHOLD (signed)	Value: ± 9999'9999 Do ACTION after the value exceed the value

0x13B2	5042	HIGH MULTIPLIER	Possible choise:
			- for voltage measure
			   0: mV, 1: V, 2: kV, 3: MV
			- for current measure
			   0: mA, 1: A, 2: kA, 3: MA
			- for cos phi and power factor:
			   0, 1,2,3: no unit
			- for power:
			   0: VA, W, VAr, 1: kVA, kW, kVAr,
			   2 : MVA, MW, GVAr, 3: GVA, GW, GVAr
			- for frequency:
			   0,1,2,3: mHz
			- for THD and harmonics:
			   0,1,2,3: %*100
			- for angle degree:
			   0,1,2,3: degree*10
			- for tan phi
			   0,1,2,3: no unit
			- for energy:
			   0: VAh*100, kWh*100, kVArh*100, 1: kVAh, kWh, kVArh,
			   2 : MVAh, MWh, GVArh, 3: GVAh, GWh, GVArh

0x13B3	5043	LOW THRESHOLD (signed)	Value: ± 9999'9999 Do ACTION after the value exceed the value
0x13B4	5044	LOW MULTIPLIER	See HIGH MULTIPLIER
0x13B5	5045	DEBOUNCE HIGH THRESHOLD	0: Instantaneous ACTION 1÷10000: do ACTION after the condition persist for n Sec
0x13B6	5046	DEBOUNCE LOW THRESHOLD	0: Instantaneous ACTION 1÷10000: do ACTION after the condition persist for n Sec
0x13B7	5047	HYSTERESIS THRESHOLD	0: No hysteresis 1: 50,000% of threshold value (high & low) 2: 25,000% of threshold value (high & low) 3: 12,500% of threshold value (high & low) 4: 6,250%of threshold value (high & low) 5: 3,125%of threshold value (high & low)
0x13B8	5048	LOGIC OPERATION ACTION OVER	0: Logic operation disabled [Default] 1: operation OR between operands selected 2: operation AND between operands selected **WARNING**: if use a LOGIC OPERATION must set ACTION in a only set point.
0x13B9	5049	LOGIC OPERATION ACTION ENTRY	0: Logic operation disabled. [Default] 1: operation OR between operands selected. 2: operation AND between operands selected. **WARNING**: if use a LOGIC OPERATION must set ACTION in a only set point.
0x13BA	5050	LOGIC OPERANDS	Set (**binary format**): Bit 00: for include set point 01 in the logic. --- --- --- Bit 15: for include set point 16 in the logic. **WARNING**: if use a LOGIC OPERATION **must** be set ACTION in **all** set point.
0x13BB	5051	ACTION OVER (high or low threshold)	It possible to select **one, more or anything** action: Set bit 00: visualize and save setpoint overcoming in log page. Set bit 01: change DO-X state at over Set bit 02: Increase events Set bit 03: Increase timer
0x13BC	5052	ACTION ENTRY (high or low threshold)	It possible to select **one, more or anything** action: Set bit 00: visualize and save setpoint entry in log page. Set bit 01: recovery DO-XX state at entry
0x13BD	5053	DIGITAL OUTPUT USED	It possible to select one **or** more DO: Bit 00: DO-1 Bit 02: DO-3*(option)* Bit 04: DO-5*(option)* Bit 06: DO-7*(option)* Bit 01: DO-2 Bit 03: DO-4*(option)* Bit 05: DO-6*(option)* Bit 07: DO-8*(option)* **WARNING**: before set must be sure to select the setup MODE with Setpoint controlled for DO 1-4 group and DO 5-8 group (according with DO used). And correct startup LEVEL. *Example: if is set 0x0003 the DO-1 and DO-2 are use for ACTION.*
0x13BE	5054	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 2

Index HEX	Index DEC	Description	Parameters
0x13BF	5055	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x13CF	5071	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 3

Index HEX	Index DEC	Description	Parameters
0x13D0	5072	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x13E0	5088	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 4

Index HEX	Index DEC	Description	Parameters
0x13E1	5089	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x13F1	5105	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 5

Index HEX	Index DEC	Description	Parameters
0x13F2	5106	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x1402	5122	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 6

Index HEX	Index DEC	Description	Parameters
0x1403	5123	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x1413	5139	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 7

Index HEX	Index DEC	Description	Parameters
0x1414	5140	ENABLED	0: No *[Default]* 1: Yes
---		---	---
0x1424	5156	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 8

Index HEX	Index DEC	Description	Parameters
0x1425	5157	ENABLED	0: No *[Default]* 1: Yes
---		---	---
0x1435	5173	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 9

Index HEX	Index DEC	Description	Parameters
0x1436	5174	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x1446	5190	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 10

Index HEX	Index DEC	Description	Parameters
0x1447	5191	ENABLED	0: No *[Default]* 1: Yes
---		---	---
0x1457	5207	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 11

Index HEX	Index DEC	Description	Parameters
0x1458	5208	ENABLED	0: No *[Default]* 1: Yes
---		---	---
0x1468	5224	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 12

Index HEX	Index DEC	Description	Parameters
0x1469	5225	ENABLED	0: No *[Default]* 1: Yes
---		---	---
0x1479	5241	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 13

Index HEX	Index DEC	Description	Parameters
0x147A	5242	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x148A	5258	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 14

Index HEX	Index DEC	Description	Parameters
0x148B	5259	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x149B	5275	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 15

Index HEX	Index DEC	Description	Parameters
0x149C	5276	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x14AC	5292	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Setpoint setup 16

Index HEX	Index DEC	Description	Parameters
0x14AD	5293	ENABLED	0: No *[Default]* 1: Yes
---	---	---	---
0x14BD	5309	MULTIPLIER EVENT	1 ÷ 1000 *[default 1]*

Acronyms table of Instantaneous group

Index	Acronym	Explanation	Index	Acronym	Explanation	Index	Acronym	Explanation
0	---	Not used	18	COS L2	COSφ L2	36	THD V L2	THD Voltage L2
1	V	System Voltage	19	COS L3	COSφ L3	37	THD V L3	THD Voltage L3
2	V L1	Voltage L1	20	VA	System Apparent Power	38	THD A L1	THD Current L1
3	V L2	Voltage L2	21	VA L1	Apparent Power L1	39	THD A L2	THD Current L2
4	V L3	Voltage L3	22	VA L2	Apparent Power L2	40	THD A L3	THD Current L3
5	V L1-L2	L1-L2 Voltage	23	VA L3	Apparent Power L3	41	DEG L1-L2	Phase Angle L1-L2
6	V L2-L3	L2-L3 Voltage	24	W	System Active Power	42	DEG L2-L3	Phase Angle L2-L3
7	V L3-L1	L3-L1 Voltage	25	W L1	Active Power L1	43	DEG L3-L1	Phase Angle L3-L1
8	A	System Current	26	W L2	Active Power L2	44	TAN	System Tanφ
9	A L1	Current L1	27	W L3	Active Power L3	45	TAN L1	Tanφ L1
10	A L2	Current L2	28	VAR	System Reactive Power	46	TAN L2	Tanφ L2
11	A L3	Current L3	29	VAR L1	Reactive Power L1	47	TAN L3	Tanφ L3
12	PF	System Power Factor	30	VAR L2	Reactive Power L2	48	EXP W	System Expected Power
13	PF L1	Power Factor L1	31	VAR L3	Reactive Power L3	49	EXP W L1	Expected Power L1
14	PF L2	Power Factor L2	32	N	Neutral Current	50	EXP W L2	Expected Power L2
15	PF L3	Power Factor L3	33	Hz	Frequency	51	EXP W L3	Expected Power L3
16	COS	System COSφ	34	TEMP	Temperature			
17	COS L1	COSφ L1	35	THD V L1	THD Voltage L1			

Acronyms table of Energies and TB (from 1 to 16) groups

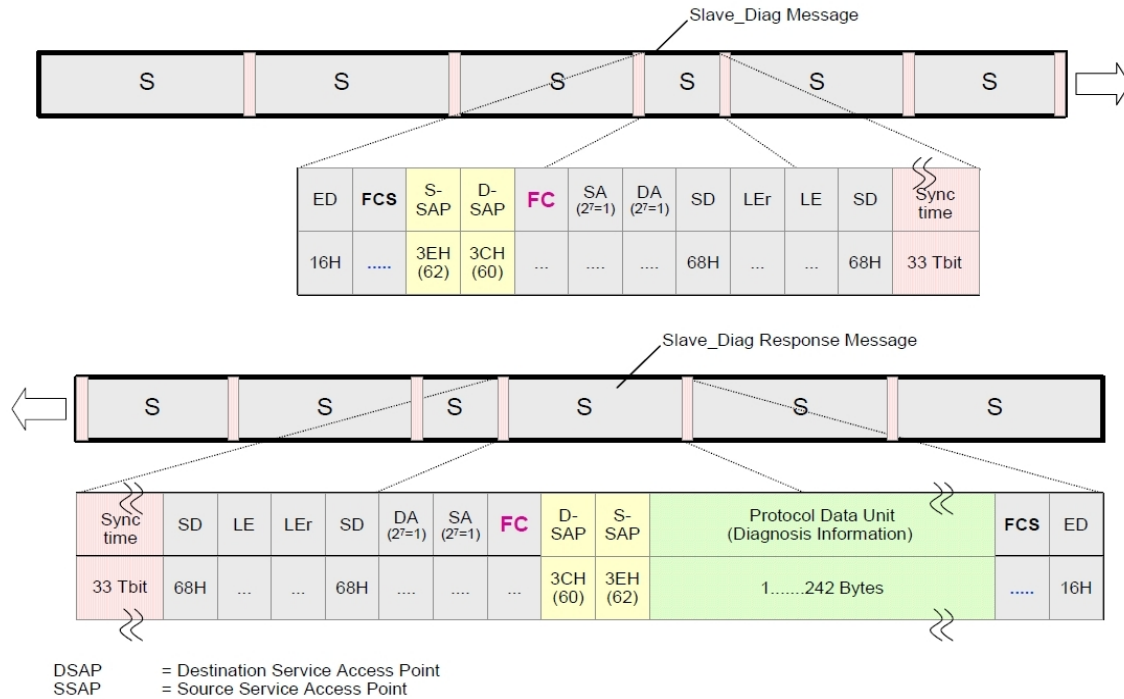| Index	Acronym	Explanation	Index	Acronym	Explanation	Index	Acronym	Explanation
0	---	Not used	7	Wh L1 OUT	Active Energy L1 OUT	14	VArh L2 OUT	Reactive Energy L2 OUT
1	Wh IN	System Active Energy IN	8	VArh L1 IN	Reactive Energy L1 IN	15	VAh L2	Apparent Energy L2
2	Wh OUT	System Active Energy OUT	9	VArh L1 OUT	Reactive Energy L1 OUT	16	Wh L3 IN	Active Energy L3 IN
3	VArh IN	System Reactive Energy IN	10	VAh L1	Apparent Energy L1	17	Wh L3 OUT	Active Energy L3 OUT
4	VArh OUT	Syst. Reactive Energy OUT	11	Wh L2 IN	Active Energy L2 IN	18	VArh L3 IN	Reactive Energy L3 IN
5	VAh	System Apparent Energy	12	Wh L2 OUT	Active Energy L2 OUT	19	VArh L3 OUT	Reactive Energy L3 OUT
6	Wh L1 IN	Active Energy L1 IN	13	VArh L2 IN	Reactive Energy L2 IN	20	VAh L3	Apparent Energy L3

Acronyms table of Average group

Index	Acronym	Explanation	Index	Acronym	Explanation	Index	Acronym	Explanation
0	---	Not used	13	AVG COS	System Average COSφ	26	AVG VAR L1	Average Reactive Power L1
1	AVG V	System Average Voltage	14	AVG COS L1	Average COSφ L1	27	AVG VAR L2	Average Reactive Power L2
2	AVG V L1	Average Voltage Phase 1	15	AVG COS L2	Average COSφ L2	28	AVG VAR L3	Average Reactive Power L3
3	AVG V L2	Average Voltage Phase 2	16	AVG COS L3	Average COSφ L3	29	AVG N	Average Neutral Current
4	AVG V L3	Average Voltage Phase 3	17	AVG VA	System Average Apparent Power	30	AVG Hz	Average Frequency
5	AVG A	System Average Current	18	AVG VA L1	Average Apparent Power L1	31	AVG TAN	Average System Tanφ
6	AVG A L1	Average Current L1	19	AVG VA L2	Average Apparent Power L2	32	AVG TAN L1	Average Tanφ L1
7	AVG A L2	Average Current L2	20	AVG VA L3	Average Apparent Power L3	33	AVG TAN L2	Average Tanφ L2
8	AVG A L3	Average Current L3	21	AVG W	System Average Active Power	34	AVG TAN L3	Average Tanφ L3
9	AVG PF	System Average Power Factor	22	AVG W L1	Average Active Power L1	35	EXP W	System Expected Active Power
10	AVG PF L1	Average Power Factor L1	23	AVG W L2	Average Active Power L2	36	EXP W L1	Expected Active Power L1
11	AVG PF L2	Average Power Factor L2	24	AVG W L3	Average Active Power L3	37	EXP W L2	Expected Active Power L2
12	AVG PF L3	Average Power Factor L3	25	AVG VAR	System Average Reactive Power	38	EXP W L3	Expected Active Power L3

DIAGNOSTIC

The EMS-96 is able to generate, in case of errors, some diagnostics, automatically. These diagnostics can be send to the Master profibus through a standard mechanism expected from the profibus protocol.

Format Message – Slave Diagnosis

ED	FCS	S-SAP	D-SAP	FC	SA (2⁷=1)	DA (2⁷=1)	SD	LEr	LE	SD	Sync time
16H	.....	3EH (62)	3CH (60)	...	....	....	68H	...	...	68H	33 Tbit

Sync time	SD	LE	LEr	SD	DA (2⁷=1)	SA (2⁷=1)	FC	D-SAP	S-SAP	Protocol Data Unit (Diagnosis Information)	FCS	ED
33 Tbit	68H	...	...	68H	....	....	...	3CH (60)	3EH (62)	1.......242 Bytes	.....	16H

DSAP = Destination Service Access Point
SSAP = Source Service Access Point

Diagnostics generation mechanism

In the polling normal cycle, done by a Master station, there is not the request of the diagnostics message. It is the slave that informs the master that a diagnostics variation is occurred and that this message has to be asked.

When there is a diagnostics variation (appears or disappears), during the formatting of the answer message from a normal data request, the EMS-96 set the field FC (Frame Control).

The EMS-96 generates a diagnostic message with this format (6+12 Byte long):

Default Profibus Diagnostic Data-Unit:

1° Byte	2° Byte	3° Byte	4° Byte	5° Byte	6° Byte
Station Status 1	Station Status 2	Station Status 3	Diag. Master Add	Ident Number High	Ident Number Low

Specific Profibus Diagnostic:

7° Byte	8° Byte	9° Byte	10° Byte	11° Byte	12° Byte
N° Byte Instrument Diag	Status High 31-24 bit	Status High 23-16 bit	Status High 15-8 bit	Status High 7-0 bit	Status Low 31-24 bit

13° Byte	14° Byte	15° Byte	16° Byte	17° Byte	18° Byte
Status Low 23-16 bit	Status Low 15-8 bit	Status Low 7-0 bit	In/out error	Module	N° Error

The Master could receive the following error:

- Internal Communication break   31° bit = 1 in Status Low
- Communication fail   30° bit = 1 in Status Low
- Illegal index   29° bit = 1 in Status Low
- Illegal data   28° bit = 1 in Status Low

EXTERNAL DIAGNOSTIC (LED)

Data Exchange 1	Data Exchange 2	Parameterized	Instrument Status
Blinking	Blinking	Fixed ON	Parameterized and communication
Fixed	Blinking	Fixed ON	Parameterized but not receive a query
Blinking one led at time			Not parameterized

Contrel elettronica srl
I-26900 Lodi - ITALY - Via S. Fereolo, 9
Tel. +39 0371 30207 / 30761 Fax +39 0371 32819
http://www.contrel.it   -   E-mail: contrel@contrel.it