



MODBUS

RS485 SERIAL PROTOCOL

ED39DIN
DMM3
VIP39DIN (discontinued)
VIP396
SIRIO
STAR3
STAR3din

VERSION
24 FEBRUARY 2006

The STAR3, STAR3 din , VIP396, VIP39din, DMM3, SIRIO and ED39din instruments have three different MODBUS protocol formats which can be selected with the set-up menu of the instruments.

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This manual describes the RTU and IEEE formats in detail.
We are not providing full details of the ASCII format, as we advise against using this format. The main reason why it was implemented is to make the new instruments compatible with previously developed, existing software, using the format of VIP ENERGY and of many other previous instruments.

“MODBUS RTU” PROTOCOL

CHARACTERISTICS OF THE “MODBUS RTU” PROTOCOL.

- Selected transmission mode: RTU
- Coding system : 8-bit binary
- Error detection method: CRC
- Serial protocol characteristics:
 - Baud-rate: 19200 / 9600 / 4800 / 2400
 - Data bits: 8
 - Parity bit:: None / Odd / Even
 - Stop bits: 1

FORMAT OF THE STRUCTURE OF THE “MODBUS RTU” PROTOCOL MESSAGE.

In the RTU transmission mode, the data structure (Frame) can only be synchronised by simulating a synchronised message.

The receiver controls reception time between characters.

If a time equivalent to 3 characters and a half elapses without a new character being received or the structure (Frame) being completed, the receiver rejects the frame and considers the next byte as an address.

CHECK ERROR (CRC) CALCULATION PROCEDURE.

- 1) Load a 16-bit register with ones only (FFFFH).
- 2) Execute an exclusive OR between the register and the transmission buffer byte.
- 3) Shift the register thus obtained by one bit to the right.
- 4) If the excluded bit on the right is 1, execute an exclusive OR between the register and the 16-bit “A001H” polynomial.
- 5) Repeat steps 3 and 4 eight times.
- 6) Repeat steps 2,3,4 and 5 for all the message bytes.
- 7) The final contents of the 16-bit register is the CRC (error check) and is transmitted at the end of the message, beginning with the least significant byte.

The following C language routine is used for calculating the CRC.

```
/* ***** */
/* Function : CalcCRC */
/* purpose : CRC calculation of a string */
/* Param INP : string of characters */
/* : Number of characters */
/* OUT : WORD with the calculated checksum */
/* Return : */
/* ***** */
unsigned int CalcCRC(char * lpCMD ,unsigned char num_char,unsigned int checksum)
{
#define POLINOMIO 0xA001
#define NUM_SHIFT 8

unsigned char cnt;
unsigned char shift;
unsigned char carat;

for (cnt = 0;cnt < num_char ; cnt++)
{
carat = *lpCMD;
checksum ^= (WORD)carat;
lpCMD++;
for(shift = 1; shift < NUM_SHIFT + 1 ; shift++)
{
```

```

    if((checksum & 0x0001) == 0)
        checksum = checksum >> 1;
    else
        checksum = ((checksum >> 1) ^ POLINOMIO);
}
}
return(checksum);
}

```

AVAILABLE FUNCTIONS OF “MODBUS RTU”.

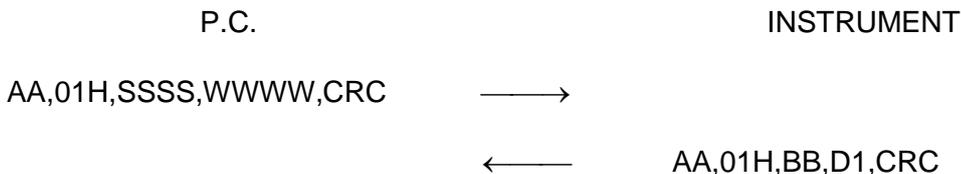
- READ OUTPUT STATUS (01H)
- READ INPUT STATUS (02H)
- READ HOLDING REGISTER (03H)
- READ INPUT REGISTER (04H)
- FORCE SINGLE COIL * (05H)
- PRESET SINGLE REGISTER * (06H)
- READ EXCEPTION STATUS (07H)
- FORCE MULTIPLE COILS * (0FH)
- REPORT SLAVE ID (11H)
- WRITE AN EEPROM (16-BIT) REGISTER (43H)
- READ AN EEPROM (16-BIT) REGISTER (44H)

* messages addressable to all slaves (slave address = 0).

LIST OF IMPLEMENTED “MODBUS RTU” PROTOCOL COMMANDS AND THEIR LIMITATIONS.

READ OUTPUT STATUS (01H).

A function for reading status of digital output coils.



where:

- AA = Address of selected Instrument (1 binary byte)
- 01H = Read command code of read output status (1 binary byte)
- SSSS = Address of the output status from which reading begins (2 binary bytes)
- WWWW = Number of output status to read (2 binary bytes)
- CRC = Cyclical Redundancy Check (2 binary bytes)
- BB = Number of bytes read (1 binary byte)
- D1 = Bytes that were read.

N.B.

The address of the output status is obtained by subtracting 1 from the output status address
E.g.: To read output status 2 (in decimals) $\Rightarrow (2 - 1) = 1$ (in decimals) this is the value for SSSS

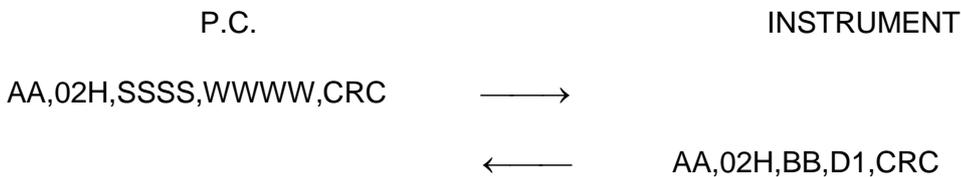
D1...Dn: The answer must be interpreted looking at the single bits
the LSB (less significant bit) correspond to the status of the SSSS input
the next bit is the status of the next input , in case $WWWW > 1$ (more than one input has been requested)

OUTPUT STATUS ADDRESS LIST

Same as list of "Force single coils" command 05H (listed below)

READ INPUT STATUS (02H). (only for OEM models)

A function for reading status of digital input.



where:

- AA = Address of selected Instrument (1 binary byte)
- 02H = Read command code of read input status (1 binary byte)
- SSSS = Address of the input status from which reading begins (2 binary bytes)
- WWWW = Number of input status to read (2 binary bytes)
- CRC = Cyclical Redundancy Check (2 binary bytes)
- BB = Number of bytes read (1 binary byte)
- D1 = Bytes that were read.

N.B.

The address of the input status is obtained by subtracting 1 from the input status address
E.g.: To read input status 2 (in decimals) $\Rightarrow (2 - 1) = 1$ (in decimals) this is the value for SSSS

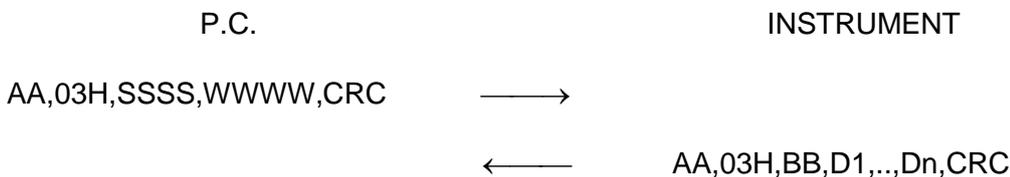
D1: The answer must be interpreted looking at the single bits
the LSB (less significant bit) correspond to the status of the SSSS input
the next bit is the status of the next input , in case $WWWW > 1$ (more than one input has been requested)

INPUT STATUS ADDRESS LIST

- 1 Status of the digital input .**
Valid values: 0 or 1 in binary
N.B.
- 0 means that the external contact is closed
- 1 means that the external contact is open

READ HOLDING REGISTER (03H).

A function for reading registers used for programming operation of the instrument.
The registers are programmed with the "PRESET SINGLE REGISTER (06H)" function.



where:

- AA = Address of selected VIP (1 binary byte)
- 03H = Read command code of N Holding registers (1 binary byte)
- SSSS = Address of the holding register from which reading begins (2 binary bytes)
- WWWW = Number of registers to read (2 binary bytes): max 40 words
- CRC = Cyclical Redundancy Check (2 binary bytes)
- BB = Number of bytes read (1 binary byte)
- D1,...,Dn = Bytes that were read.

N.B.

The address of the holding register is obtained by removing the code (e.g. "3") and subtracting 1 from the register number itself.

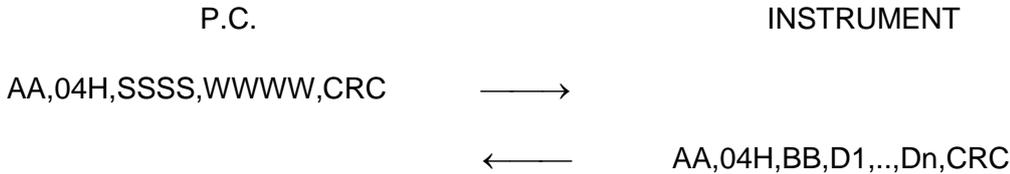
E.g.: Reg. 30003 (in decimals) \Rightarrow 30003 (in decimals) \Rightarrow (0003 – 1) = 0002 (in decimals).

HOLDING REGISTERS LIST

- 30001 KA: amperometric transformation ratio.**
Valid values: 0000 - 9999 (in BCD).
N.B.
- If the set KA has a decimal part, it is rounded to the integer value.
- If KA is greater than 9999 (in BCD), it is saturated at 9999 (in BCD).
- 30002 KV: voltmetric transformation ratio.**
Valid values: 0000 - 9999 (in BCD).
N.B.
- If the set KV has a decimal part, it is rounded to the integer value.
- If KV is greater than 9999 (in BCD), it is saturated at 9999 (in BCD).
- 30003** Integration time for Demand values **(from 1 to 99 min. (in BCD)).**

READ INPUT REGISTER (04H).

This function is used to read the registers in which the measures are stored.
With this instrument, up to 12 registers can be obtained per request.



where:

- AA = Address of selected VIP (1 binary byte)
- 04H = Read command code of N input registers (1 binary byte)
- SSSS = Address of the input register from which reading begins (2 binary bytes)
- WWWW = Number of registers to read (2 binary bytes): max 12 words
- CRC = Cyclical Redundancy Check (2 binary bytes)
- BB = Number of bytes read (1 binary byte)
- D1,...,Dn = Bytes that were read.

N.B.

The address of the input register, to be used to request the data, is obtained by removing the function code (e.g. "4") and subtracting 1 from the register number itself.

E.g.: Reg. 40003 (in decimals) ⇒ 0003 (in decimals) ⇒ (0003 – 1) = 0002 (in decimals).

INPUT REGISTERS LIST

VALID ONLY FOR STAR3, STAR3din , DMM3, SIRIO, ED39din rel 2.00 on; VIP396 rel. 5.01 on, VIP39din rel. 5.0 on

In case of instruments having a firmware release lower than the one mentioned, refer to the list of addresses available at page 9.

The measure in BCD are available in floating point format with two registers : the first is the mantissa the second is the exponent

The mantissa is expressed with 3 BCD numbers on 12 bits . The msb is the sign

The exponent is in binary format . The complement 2 is used for negative exponent.

The counters are expressed with 8 BCD numbers for the integer part and 4 BCD numbers for decimal part .

The counters is available on 3 registers. The first two are the integer part . The last is the decimal part. The magnitude of the counters is always the kilo (kWh, kVArh kVAh)

0001	V (3ph)	Three phase Voltage (mantissa in BCD)
0002	V (3 ph)	Three phase Voltage (exponent in binary format)
0003	A (3 ph)	total Current
0004	A (3 ph)	total Current
0005	kW (3 ph)	total active Power
0006	kW (3 ph)	total active Power
0007	kVAr (3 ph)	total reactive Power
0008	kVAr (3 ph)	total reactive Power

0009	kVA (3 ph)	total apparent Power
0010	kVA (3 ph)	total apparent Power
0011	PF (3 ph)	total power factor
0012	PF (3 ph)	total power factor
0013	kW avg (3 ph)	Demand active power
0014	kW avg (3 ph)	Demand active power
0015	kVA avg (3 ph)	Demand apparent power
0016	kVA avg (3 ph)	Demand apparent power
0017	kW max (3 ph)	Maximum demand active power
0018	kW max (3 ph)	Maximum demand active power
0019	kVA max (3 ph)	Maximum demand apparent power
0020	kVA max (3 ph)	Maximum demand apparent power
0021	kWh (3 ph)	Total active energy counter (integer part in BCD)
0022	kWh (3 ph)	Total active energy counter (integer part in BCD)
0023	kWh (3 ph)	Total active energy counter (decimal part in BCD)
0024	kVArh (3 ph)	Total reactive energy counter
0025	kVArh (3 ph)	Total reactive energy counter
0026	kVArh (3 ph)	Total reactive energy counter
0027	S/N	serial number
0028	S/N	serial number
0029	V (L1)	Voltage L1
0030	V (L1)	Voltage L1
0031	V (L2)	Voltage L2
0032	V (L2)	Voltage L2
0033	V (L3)	Voltage L3
0034	V (L3)	Voltage L3
0035	A (L1)	Current L1
0036	A (L1)	Current L1
0037	A (L2)	Current L2
0038	A (L2)	Current L2
0039	A (L3)	Current L3
0040	A (L3)	Current L3
0041	kW (L1)	Active power L1
0042	kW (L1)	Active power L1
0043	kW (L2)	Active power L2
0044	kW (L2)	Active power L2
0045	kW (L3)	Active power L3
0046	kW (L3)	Active power L3
0047	Frequency	Hz
0048	Frequency	Hz
0049	kVAr (L1)	reactive power L1 measured (includes the power of the distortion, if any . Is the real RMS reactive power))
0050	kVAr (L1)	reactive power L1 measured
0051	kVAr (L2)	reactive power L2 measured
0052	kVAr (L2)	reactive power L2 measured
0053	kVAr (L3)	reactive power L3 measured
0054	kVAr (L3)	reactive power L3 measured
0055	kVA (L1)	apparent power L1
0056	kVA (L1)	apparent power L1
0057	kVA (L2)	apparent power L2
0058	kVA (L2)	apparent power L2
0059	kVA (L3)	apparent power L3
0060	kVA (L3)	apparent power L3
0061	kVAr (L1)	reactive power fnd L1 (not including distortion, only fundamental order)

0062	kVAr (L1)	reactive power fnd L1
0063	kVAr (L2)	reactive power fnd L2
0064	kVAr (L2)	reactive power fnd L2
0065	kVAr (L3)	reactive power fnd L3
0066	kVAr (L3)	reactive power fnd L3
0067	pf (L1)	power factor L1
0068	pf (L1)	power factor L1
0069	pf (L2)	power factor L2
0070	pf (L2)	power factor L2
0071	pf (L3)	power factor L3
0072	pf (L3)	power factor L3
0073	A n	Neutral current (***)
0074	A n	Neutral current (***)
0075	A avg (L1)	Demand Current L1
0076	A avg (L1)	Demand Current L1
0077	A avg (L2)	Demand Current L2
0078	A avg (L2)	Demand Current L2
0079	A avg (L3)	Demand Current L3
0080	A avg (L3)	Demand Current L3
0081	Amax (L1)	Maximum demand current A L1
0082	Amax (L1)	Maximum demand current A L1
0083	Amax (L2)	Maximum demand current A L2
0084	Amax (L2)	Maximum demand current A L2
0085	Amax (L3)	Maximum demand current A L3
0086	Amax (L3)	Maximum demand current A L3
0087	kVAr avg	Demand reactive power (***)
0088	kVAr avg	Demand reactive power (***)
0089	kVAr max	Maximum demand reactive power(***)
0090	kVAr max	Maximum demand reactive power(***)
0091	kWh cog	Exported active energy counter (cogeneration) (*)
0092	kWh cog	Exported active energy counter (*)
0093	kWh cog	Exported active energy counter (*)
0094	kVArh cog	lagging reactive energy counter (cogeneration) (*)
0095	kVArh cog	lagging reactive energy counter (*)
0096	kVArh cog	lagging reactive energy counter (*)
0097	kVAh	Apparent energy counter (***)
0098	kVAh	Apparent energy counter (***)
0099	kVAh	Apparent energy counter (***)
0100	kWh T1	Active energy counter tariff T1 (**)
0101	kWh T1	Active energy counter tariff T1 (**)
0102	kWh T1	Active energy counter tariff T1 (**)
0103	kWh T2	Active energy counter tariff T2 (**)
0104	kWh T2	Active energy counter tariff T2 (**)
0105	kWh T2	Active energy counter tariff T2 (**)
0106	kWh T3	Active energy counter tariff T3 (**)
0107	kWh T3	Active energy counter tariff T3 (**)
0108	kWh T3	Active energy counter tariff T3 (**)
0109	kWh T4	Active energy counter tariff T4 (**)
0110	kWh T4	Active energy counter tariff T4 (**)
0111	kWh T4	Active energy counter tariff T4 (**)
0112	Inp1	Digital input counter 1 (**)
0113	Inp1	Digital input counter 1 (**)
0114	Inp1	Digital input counter 1 (**)
0115	Inp2	Digital input counter 2 (**)
0116	Inp2	Digital input counter 2 (**)

0117	Inp2	Digital input counter 2 (**)
0195	D/I Status	Digital Input Status (****)
0196	D/I Status	Digital Input Status (****)
0197	THD Vtot%	Total harmonic distortion Vtot (****)
0198	THD Vtot %	Total harmonic distortion Vtot (****)
0199	THD Itot%	Total harmonic distortion Itot (****)
0200	THD Itot%	Total harmonic distortion Itot (****)
0201	THD V1%	Total harmonic distortion V1 (*)
0202	THD V1%	Total harmonic distortion V1 (*)
0203	THD V2%	Total harmonic distortion V2 (*)
0204	THD V2%	Total harmonic distortion V2 (*)
0205	THD V3%	Total harmonic distortion V3 (*)
0206	THD V3%	Total harmonic distortion V3 (*)
0207	THD A1%	Total harmonic distortion A1 (*)
0208	THD A1%	Total harmonic distortion A1 (*)
0209	THD A2%	Total harmonic distortion A2 (*)
0210	THD A2%	Total harmonic distortion A2 (*)
0211	THD A3%	Total harmonic distortion A3 (*)
0212	THD A3%	Total harmonic distortion A3 (*)

(*) Available only on STAR 3

(**) Available only on ED39DIN

(***) Available only on STAR 3, DMM3, SIRIO, VIP396 rel. 5.01 on; VIP39DIN rel. 5.00 on, ED39din rel. 2.00 on.

(****) Available only on STAR3 rel 6.03 on

(*****) Available only on OEM models

INPUT REGISTERS HARMONICS DATA

VALID ONLY FOR STAR3 HARMO rel 3.00 on, STAR3din HARMO rel 1.00 on

The harmo version of the instruments STAR3 and STAR3din transmits all the data describing the harmonic spectrum i.e . modules of the voltage vectors, modules of the current vectors and cosinus of the angles between voltage and current vectors of the same harmonics. The data are available per each phase.

Harmonic Voltage data

H01 (fundamental)

0213	V1 h01	phase voltage L1 harmonic 1
0214	V1 h01	phase voltage L1 harmonic 1
0215	V2 h01	phase voltage L2 harmonic 1
0216	V2 h01	phase voltage L2 harmonic 1
0217	V3 h01	phase voltage L3 harmonic 1
0218	V3 h01	phase voltage L3 harmonic 1

H02 harmonic 2

0219	V1 h02	phase voltage L1 harmonic 2
0220	V1 h02	phase voltage L1 harmonic 2
0221	V2 h02	phase voltage L2 harmonic 2
0222	V2 h02	phase voltage L2 harmonic 2
0223	V3 h02	phase voltage L3 harmonic 2
0224	V3 h02	phase voltage L3 harmonic 2

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consecutive addresses for all the harmonics data from 3 until the last :

H25 harmonic 25

0357	V1 h25	phase voltage L1 harmonic 25
0358	V1 h25	phase voltage L1 harmonic 25
0359	V2 h25	phase voltage L2 harmonic 25
0360	V2 h25	phase voltage L2 harmonic 25
0361	V3 h25	phase voltage L3 harmonic 25
0362	V3 h25	phase voltage L3 harmonic 25

Harmonic Current data

H01 (fundamental)

0375	A1 h01	phase current L1 harmonic 1
0376	A1 h01	phase current L1 harmonic 1
0377	A2 h01	phase current L2 harmonic 1
0378	A2 h01	phase current L2 harmonic 1
0379	A3 h01	phase current L3 harmonic 1
0380	A3 h01	phase current L3 harmonic 1

H02 harmonic 2

0381	A1 h02	phase current L1 harmonic 2
0382	A1 h02	phase current L1 harmonic 2
0383	A2 h02	phase current L2 harmonic 2
0384	A2 h02	phase current L2 harmonic 2
0385	A3 h02	phase current L3 harmonic 2
0386	A3 h02	phase current L3 harmonic 2

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consecutive addresses for all the harmonics data from 3 until the last :

H25 harmonic 25

0519	A1 h025	phase current L1 harmonic 25
0520	A1 h025	phase current L1 harmonic 25
0521	A2 h025	phase current L2 harmonic 25
0522	A2 h025	phase current L2 harmonic 25
0523	A3 h025	phase current L3 harmonic 25
0524	A3 h025	phase current L3 harmonic 25

Phase angle Harmonic Current data

the instruments transmits the $\cos \varphi_i$, where φ_i is the angle between the vectors voltage – current of the harmonic order i-th

H01 (fundamental)

0537	Pf1 h01	phase power factor L1 harmonic 1
0538	Pf1 h01	phase power factor L1 harmonic 1
0539	Pf2 h01	phase power factor L2 harmonic 1
0540	Pf2 h01	phase power factor L2 harmonic 1
0541	Pf3 h01	phase power factor L3 harmonic 1
0542	Pf3 h01	phase power factor L3 harmonic 1

H02 harmonic 2

0543	Pf1 h02	phase power factor L1 harmonic 2
0544	Pf1 h02	phase power factor L1 harmonic 2
0545	Pf2 h02	phase power factor L2 harmonic 2
0546	Pf2 h02	phase power factor L2 harmonic 2
0547	Pf3 h02	phase power factor L3 harmonic 2
0548	Pf3 h02	phase power factor L3 harmonic 2

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.....

consecutive addresses for all the harmonics data from 3 until the last :

H25 harmonic 25

0681	Pf1 h25	phase power factor L1 harmonic 25
0682	Pf1 h25	phase power factor L1 harmonic 25
0683	Pf2 h25	phase power factor L2 harmonic 25
0684	Pf2 h25	phase power factor L2 harmonic 25
0685	Pf3 h25	phase power factor L3 harmonic 25
0686	Pf3 h25	phase power factor L3 harmonic 25

INPUT REGISTERS LIST OF FORMER VERSIONS OF THE FIRMWARE.

The following list must be used for instrumenst having a firmware release lower than ED39din rel 2.00 ; VIP36 rel. 5.01, VIP39din rel. 5.0

0001	3-phase voltage (mantissa in BCD).
0002	3-phase voltage (binary exponent as complement of 2)
0003	3-phase current (mantissa in BCD).
0004	3-phase current (binary exponent as complement of 2)
0005	3-phase active power (mantissa in BCD).
0006	3-phase active power (binary exponent as complement of 2)
0007	3-phase reactive power (mantissa in BCD).
0008	3-phase reactive power (binary exponent as complement of 2)
0009	3-phase apparent power (mantissa in BCD).
0010	3-phase apparent power (binary exponent as complement of 2)
0011	3-phase Cospfi (mantissa in BCD).
0012	3-phase Cospfi (binary exponent as complement of 2).
0013	Demand 3-phase active power (mantissa in BCD).
0014	Demand 3-phase active power (binary exponent as complement of 2)
0015	Demand 3-phase apparent power (mantissa in BCD).
0016	Demand 3-phase apparent power (binary exponent as complement of 2)
0017	3-phase active power Maximum demand (mantissa in BCD).
0018	3-phase active power Maximum demand (binary exponent as complement of 2)
0019	3-phase apparent power Maximum demand (mantissa in BCD).
0020	3-phase apparent power Maximum demand (binary exponent as complement of 2)
0021	Counter of 3-phase positive active energy (whole part (MSW) in BCD).
0022	Counter of 3-phase positive active energy (whole part (LSW) in BCD).
0023	Counter of 3-phase positive active energy (decimal part).
0024	Counter of 3-phase positive reactive energy (whole part (MSW) in BCD).
0025	Counter of 3-phase positive reactive energy (whole part (LSW) in BCD).
0026	Counter of 3-phase positive reactive energy (decimal part).
0027-0028	Available (not used). Fixed on 0.
0029	L1 phase voltage (mantissa in BCD).
0030	L1 phase voltage (binary exponent as complement of 2)
0031	L2 phase voltage (mantissa in BCD).
0032	L2 phase voltage (binary exponent as complement of 2)

0033 L3 phase voltage (mantissa in BCD).
 0034 L3 phase voltage (binary exponent as complement of 2)
 0035 L1 phase current (mantissa in BCD).
 0036 L1 phase current (binary exponent as complement of 2)
 0037 L2 phase current (mantissa in BCD).
 0038 L2 phase current (binary exponent as complement of 2)
 0039 L3 phase current (mantissa in BCD).
 0040 L3 phase current (binary exponent as complement of 2)
 0041 L1 phase active power (mantissa in BCD).
 0042 L1 phase active power (binary exponent as complement of 2)
 0043 L2 phase active power (mantissa in BCD).
 0044 L2 phase active power (binary exponent as complement of 2)
 0045 L3 phase active power (mantissa in BCD).
 0046 L3 phase active power (binary exponent as complement of 2)
 0047 Frequency (mantissa in BCD).
 0048 Frequency (binary exponent as complement of 2)
 0049 True active power L1 phase (mantissa in BCD).
 0050 True active power L1 phase (binary exponent as complement of 2)
 0051 True active power L2 phase (mantissa in BCD).
 0052 True active power L2 phase (binary exponent as complement of 2)
 0053 True active power L3 phase (mantissa in BCD).
 0054 True active power L3 phase (binary exponent as complement of 2)
 0055 L1 phase apparent power (mantissa in BCD).
 0056 L1 phase apparent power (binary exponent as complement of 2)
 0057 L2 phase apparent power (mantissa in BCD).
 0058 L2 phase apparent power (binary exponent as complement of 2)
 0059 L3 phase apparent power (mantissa in BCD).
 0060 L3 phase apparent power (binary exponent as complement of 2)
 0061 L1 phase total reactive power (mantissa in BCD).
 0062 L1 phase reactive power (binary exponent as complement of 2)
 0063 L2 phase total reactive power (mantissa in BCD).
 0064 L2 phase reactive power (binary exponent as complement of 2)
 0065 L3 phase total reactive power (mantissa in BCD).
 0066 L3 phase reactive power (binary exponent as complement of 2)
 0067 L1 Cosphi phase (mantissa in BCD).
 0068 L1 Cosphi phase (binary exponent as complement of 2)
 0069 L2 Cosphi phase (mantissa in BCD).
 0070 L2 Cosphi phase (binary exponent as complement of 2)
 0071 L3 Cosphi phase (mantissa in BCD).
 0072 L3 Cosphi phase (binary exponent as complement of 2)

REGISTERS AVAILABLE FOR ED39Din only:

0100 energy_tariff T1 .integers
 0101 energy_tariff T1.integers
 0102 energy_tariff T1.decimals
 0103 energy_tariff T2.integers
 0104 energy_tariff T2.integers
 0105 energy_tariff T2.decimals
 0106 energy_tariff T3.integers
 0107 energy_tariff T3.integers
 0108 energy_tariff T3.decimals
 0109 energy_tariff T4.integers
 0110 energy_tariff T4.integers
 0111 energy_tariff T4.decimals

 0112 digital input counter 1 .integers
 0113 digital input counter 1.integers
 0114 digital input counter 1.decimals
 0115 digital input counter 2.integers
 0116 digital input counter 2.integers
 0117 digital input counter 2.decimals

N.B.

- All register measurements, with the exception of energy counters and some specific registers, are in floating point format with mantissa + exponent.
The mantissa (consisting of 3 BCD digits on 12 bits plus the sign on the register's most significant bit) is the quantity in its fundamental unit of measure.
The exponent is expressed in binary form (as a complement of 2) and determines the position of the dot in the measurement (FFFFH = 10^{-1} ; 0000H = 10^0 ; 0001H = 10^1 ; etc.).

Examples:

- 1) Representation of 221 V 3-phase:
Register 0001 = 0221H (mantissa)
Register 0002 = 0000H (exponent).
- 2) Representation of 70.8 A 3-phase:
Register 0003 = 0708H (mantissa)
Register 0004 = FFFFH (exponent).
- 3) Representation of -0.82 of 3-phase P.F:
Register 0011 = 8082H (mantissa)
Register 0012 = FFFEH (exponent).

- The counters consist of 9 BCD digits which determine the whole value in kWh (always positive only) and 4 BCD digits for the decimal part.

Example:

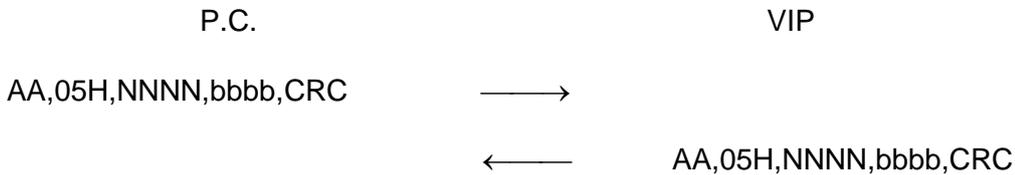
- Representation of 1748206.1500 kWh 3-phase:
- Register 0021 = 0174H (whole part (MSW))
 - Register 0022 = 8206H (whole part (LSW))
 - Register 0023 = 1500H (decimal part).

- If a "Single-phase" instrument is used, all 3-phase measurements equal the measurements of the L1 phase, while the measurements of the L2 and L3 phases have no significance.

FORCE SINGLE COIL (05H).

Function for executing commands on the instrument.

The commands are shown as output coils. The status of the coils can be checked by means of the command Read Output Status 01H



OR THE FOLLOWING “RADIO BROADCASTING” MESSAGE CAN BE USED. IT SENDS A COMMAND SIMULTANEOUSLY TO ALL THE INSTRUMENTS WITHOUT OBTAINING ANY ANSWER:



where:

- AA = Address of selected VIP (1 binary byte)
- 05H = Code of the 1 bit (coil) (1 binary byte) writing command.
- NNNN = Number of the bit (coil) to be written (2 binary bytes):
 $0000H \leq \text{Number of bit} \leq 000FH$
- bbbb = FF00H: bit = 1 (On); 0000H: bit = 0 (Off) (2 binary bytes)
- CRC = Cyclical Redundancy Check (2 binary bytes).

N.B.

The number of the bit (coil) to be written is obtained by subtracting 1 from the number of the coil itself.

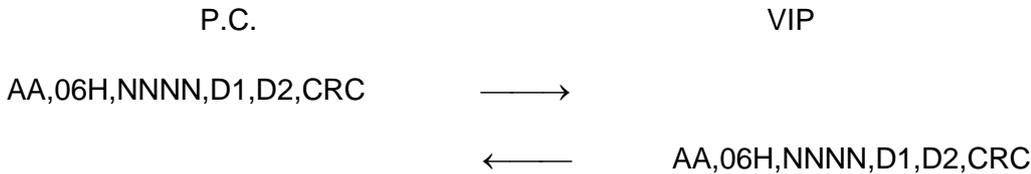
E.g.: Coil 0003 (in decimals) \Rightarrow (0003 – 1) = 0002 (in decimals).

LIST OF COILS:

- | | | |
|------|---|---|
| 0001 | * | Reset of mean active power. |
| 0002 | * | Reset of mean apparent power. |
| 0003 | * | Reset of active power Maximum demand. |
| 0004 | * | Reset of apparent power Maximum demand. |
| 0005 | * | Reset of energy counters. |
| 0006 | * | General reset of the instrument (broadcast only command) |
| 0007 | * | Reset of active power Maximum demand and demand values. |
| 0008 | * | Reset of apparent power Maximum demand and demand values. |
| 0009 | * | NOT USED |
| 0010 | * | Relay N°1 (if available) |
| 0011 | * | Relay N°2 (if available) |

PRESET SINGLE REGISTER (06H).

This function is used for programming a holding type register with the instrument's operating parameters.



where:

- AA = Address of selected VIP (1 binary byte)
- 06H = Code of the 1 holding register (1 binary byte) writing command.
- NNNN = Number of the holding register (coil) to be written (2 binary bytes):
- D1 = 1st datum to be written (MSB) (1 binary byte)
- D2 = 2nd datum to be written (LSB) (1 binary byte)
- CRC = Cyclical Redundancy Check (2 binary bytes).

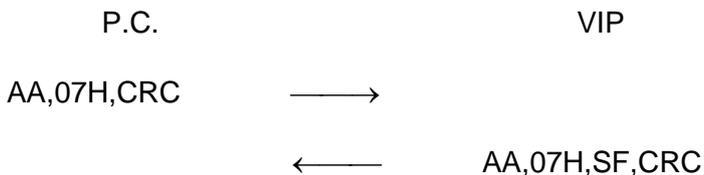
N.B.

The address of the holding register is obtained by removing the code (e.g. "4") and subtracting 1 from the register number itself.

E.g.: Reg. 40003 (in decimals) ⇒ 40003 (in decimals) ⇒ (0003 – 1) = 0002 (in decimals).

READ EXCEPTION STATUS (07H).

This function makes it possible to check the instrument's operating status.

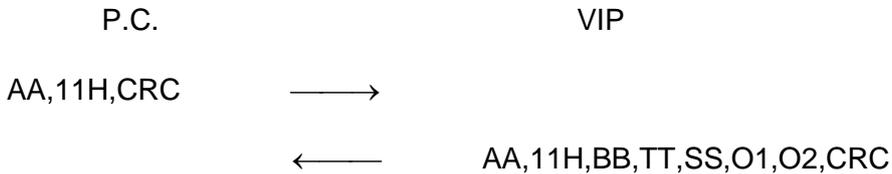


where:

- AA = Address of selected VIP (1 binary byte)
- 07H = Code of the operating status reading commanding (1 binary byte)
- SF = Byte of the operating status of the read instrument (1 binary byte)
 - bits 7 – 2 = 0 (Available (not handled))
 - bit 1 = 1: Operation OK
 - bit 0 = 0 (Available (not handled))
- CRC = Cyclical Redundancy Check (2 binary bytes).

REPORT SLAVE ID (11H).

This function is used to identify the type of instrument and some information associated with it (options, etc.).



where:

- AA = Address of selected VIP (1 binary byte)
- 11H = Code of the "Report slave ID" (1 binary byte) command.
- CRC = Cyclical Redundancy Check (2 binary bytes)
- BB = Number of bytes received for reading = 04H (fixed) (1 binary byte)
- TT = Type of instrument = 0DH (Vip Energy) (fixed) (1 binary byte)
- SS = Slave status (run indicator) = FFH (ON) (fixed) (1 binary byte)
- O1 = 1st option byte of the instrument (1 binary byte)
 - Internal TA option:

bit	7	6	5	4	3	2	1	0	
	0	-	-	-	-	-	-	-	⇒ TA = 5 A
	1	-	-	-	-	-	-	-	⇒ TA = 30 A
 - RPQS option:

bit	7	6	5	4	3	2	1	0	
	-	-	-	-	-	-	0	-	⇒ Option not present
	-	-	-	-	-	-	1	-	⇒ Option present
 - Serial line option:

bit	7	6	5	4	3	2	1	0	
	-	-	-	-	-	-	-	0	⇒ Option not present
	-	-	-	-	-	-	-	1	⇒ Option present
- O2 = 2nd option byte of the instrument (1 binary byte)
 - bit 7 = 1 (fixed) (RTU Option active)
 - bit 6-4 = Available
 - bit 3-0 = Software version (0-15).

LIST OF IMPLEMENTED ERROR STRINGS AND INTERPRETATION

ILLEGAL FUNCTION.

Errors caused by reception of an unrecognised function code.

P.C.	VIP
←	AA,FF,01H,CRC

where:

- AA = Address of selected VIP (1 binary byte)
- FF = Code of command received with bit 7 forced to 1 (1 binary byte);
e.g. 81H: command code for reading 1 bit (unrecognised)
- CRC = Cyclical Redundancy Check (2 binary bytes)

ILLEGAL DATA ADDRESS.

Error caused by reception of an address referring to data which is off the valid range set for that type of command.

E.g.:

If "SSSS = 0FF0H" in an N holding register reading command, this type of error is generated.

P.C.	VIP
←	AA,FF,02H,CRC

where:

- AA = Address of selected VIP (1 binary byte)
- FF = Code of command received with bit 7 forced to 1 (1 binary byte);
e.g.. 83H: reading command code of N holding registers.
- CRC = Cyclical Redundancy Check 2 (2 binary bytes)

ILLEGAL DATA VALUE.

Error caused by reception of a datum which is off the valid range set for that type of command.

E.g.:

If "WWWW > 0028H (40)" in an N holding register reading command, this type of error is generated.

P.C.	VIP
←	AA,FF,03H,CRC

where:

- AA = Address of selected VIP (1 binary byte)
- FF = Code of command received with bit 7 forced to 1 (1 binary byte);
e.g.. 83H: reading command code of N holding registers.
- CRC = Cyclical Redundancy Check

NO RESPONSE.

Communication error caused by:

- Overrun or framing error

Address of selected VIP not valid

- Incorrect CRC

- Any type of error detected on a "broadcasting" command (address = 00H)

- Valid but non-enabled command (e.g. writing of activation command for relays 1/2, when "Local" mode is active).

In this case, the Vip does not answer the PC, thus putting it on time-out (which must be at least 3 seconds from the last transmitted byte).

“MODBUS IEEE” PROTOCOL

CHARACTERISTICS “MODBUS IEEE” PROTOCOL.

- Selected transmission mode: IEEE format INTEL LITTLE ENDIAN
- Coding system : 8-bit binary
- Error detection method: CRC
- Serial protocol characteristics:
 - Baud-rate: 19200 / 9600 / 4800 / 2400
 - Data bits: 8
 - Parity bit:: None / Odd / Even
 - Stop bits: 1

FORMAT OF THE STRUCTURE OF THE “MODBUS IEEE” PROTOCOL MESSAGE.

The IEEE protocol is similar to the RTU version. The functions coincide.

All the measures , including the counters, are expressed using a floating point format and they are saved over 2 registers.

In comparison with the RTU format, the counters are using only two registers instead of three.

Therefore the third register of the counters, used in RTU, has to be ignored.

For instance the active energy counters is available in registers 0021 and 0022.

The register 0023 is not used in IEEE.

Normally is third registers of the counters which has to be ignored except the total reactive energy counter which is the sole exception: in this case is the first register 0024 has to be ignored.

INPUT REGISTERS LIST FOR IEEE FORMAT

0001	V (3ph)	Three phase Voltage
0002	V (3 ph)	Three phase Voltage
0003	A (3 ph)	total Current
0004	A (3 ph)	total Current
0005	kW (3 ph)	total active Power
0006	kW (3 ph)	total active Power
0007	kVAr (3 ph)	total reactive Power
0008	kVAr (3 ph)	total reactive Power
0009	kVA (3 ph)	total apparent Power
0010	kVA (3 ph)	total apparent Power
0011	PF (3 ph)	total power factor
0012	PF (3 ph)	total power factor
0013	kW avg (3 ph)	Demand active power
0014	kW avg (3 ph)	Demand active power
0015	kVA avg (3 ph)	Demand apparent power
0016	kVA avg (3 ph)	Demand apparent power
0017	kW max (3 ph)	Maximum Demand active power
0018	kW max (3 ph)	Maximum Demand active power
0019	kVA max (3 ph)	Maximum Demand apparent power
0020	kVA max (3 ph)	Maximum Demand apparent power
0021	kWh (3 ph)	Total active energy counter
0022	kWh (3 ph)	Total active energy counter
0023	N.U	Not used

0024	N.U	Not used (only for the total reactive energy is the first register the one not used)
0025	kVArh (3 ph)	Total reactive energy counter
0026	kVArh (3 ph)	Total reactive energy counter
0027	S/N	serial number
0028	S/N	serial number
0029	V (L1)	Voltage L1
0030	V (L1)	Voltage L1
0031	V (L2)	Voltage L2
0032	V (L2)	Voltage L2
0033	V (L3)	Voltage L3
0034	V (L3)	Voltage L3
0035	A (L1)	Current L1
0036	A (L1)	Current L1
0037	A (L2)	Current L2
0038	A (L2)	Current L2
0039	A (L3)	Current L3
0040	A (L3)	Current L3
0041	kW (L1)	Active power L1
0042	kW (L1)	Active power L1
0043	kW (L2)	Active power L2
0044	kW (L2)	Active power L2
0045	kW (L3)	Active power L3
0046	kW (L3)	Active power L3
0047	Frequency	Hz
0048	Frequency	Hz
0049	kVAr (L1)	reactive power L1 measured (includes the power of the distortion, if any . Is the real RMS reactive power)
0050	kVAr (L1)	reactive power L1 measured
0051	kVAr (L2)	reactive power L2 measured
0052	kVAr (L2)	reactive power L2 measured
0053	kVAr (L3)	reactive power L3 measured
0054	kVAr (L3)	reactive power L3 measured
0055	kVA (L1)	apparent power L1
0056	kVA (L1)	apparent power L1
0057	kVA (L2)	apparent power L2
0058	kVA (L2)	apparent power L2
0059	kVA (L3)	apparent power L3
0060	kVA (L3)	apparent power L3
0061	kVAr (L1)	reactive power fnd L1 (not including distortion, only fundamental order)
0062	kVAr (L1)	reactive power fnd L1
0063	kVAr (L2)	reactive power fnd L2
0064	kVAr (L2)	reactive power fnd L2
0065	kVAr (L3)	reactive power fnd L3
0066	kVAr (L3)	reactive power fnd L3
0067	pf (L1)	power factor L1
0068	pf (L1)	power factor L1
0069	pf (L2)	power factor L2
0070	pf (L2)	power factor L2
0071	pf (L3)	power factor L3
0072	pf (L3)	power factor L3
0073	A n	Neutral current (***)
0074	A n	Neutral current (***)
0075	A avg (L1)	Demand Current L1
0076	A avg (L1)	Demand Current L1
0077	A avg (L2)	Demand Current L2

0078	A avg (L2)	Demand Current L2
0079	A avg (L3)	Demand Current L3
0080	A avg (L3)	Demand Current L3
0081	Amax (L1)	Maximum Demand current A L1
0082	Amax (L1)	Maximum Demand current A L1
0083	Amax (L2)	Maximum Demand current A L2
0084	Amax (L2)	Maximum Demand current A L2
0085	Amax (L3)	Maximum Demand current A L3
0086	Amax (L3)	Maximum Demand current A L3
0087	kVAr avg	Demand reactive power (***)
0088	kVAr avg	Demand reactive power (***)
0089	kVAr max	Maximum Demand reactive power(***)
0090	kVAr max	Maximum Demand reactive power(***)
0091	kWh cog	Exported active energy counter (cogeneration) (*)
0092	kWh cog	Exported active energy counter (*)
0093	N.U	Not used
0094	kVArh cog	lagging reactive energy counter (cogeneration) (*)
0095	kVArh cog	lagging reactive energy counter (*)
0096	N.U	Not used
0097	kVAh	Apparent energy counter (***)
0098	kVAh	Apparent energy counter (***)
0099	N.U	Not used
0100	kWh T1	Active energy counter tariff T1 (**)
0101	kWh T1	Active energy counter tariff T1 (**)
0102	N.U	Not used
0103	kWh T2	Active energy counter tariff T2 (**)
0104	kWh T2	Active energy counter tariff T2 (**)
0105	N.U	Not used
0106	kWh T3	Active energy counter tariff T3 (**)
0107	kWh T3	Active energy counter tariff T3 (**)
0108	N.U	Not used
0109	kWh T4	Active energy counter tariff T4 (**)
0110	kWh T4	Active energy counter tariff T4 (**)
0111	N.U	Not used
0112	Inp1	Digital input counter 1 (**)
0113	Inp1	Digital input counter 1 (**)
0114	N.U	Not used
0115	Inp2	Digital input counter 2 (**)
0116	Inp2	Digital input counter 2 (**)
0117	N.U	Not used
0195	D/I Status	Digital Input Status (*****)
0196	D/I Status	Digital Input Status (*****)
0201	THD V1%	Total harmonic distortion V1 (*)
0202	THD V1%	Total harmonic distortion V1 (*)
0203	THD V2%	Total harmonic distortion V2 (*)
0204	THD V2%	Total harmonic distortion V2 (*)
0205	THD V3%	Total harmonic distortion V3 (*)
0206	THD V3%	Total harmonic distortion V3 (*)
0207	THD A1%	Total harmonic distortion A1 (*)
0208	THD A1%	Total harmonic distortion A1 (*)
0209	THD A2%	Total harmonic distortion A2 (*)
0210	THD A2%	Total harmonic distortion A2 (*)
0211	THD A3%	Total harmonic distortion A3 (*)

0212 THD A3% Total harmonic distortion A3 (*)

(*) Available only on STAR 3

() Available only on ED39DIN**

(*) Available only on STAR 3, DMM3, SIRIO, VIP396 rel. 5.01 on; VIP39DIN rel. 5.00 on, ED39din rel. 2.00 on.**

(**) Available only on OEM models**

INPUT REGISTERS HARMONICS DATA

VALID ONLY FOR STAR3 HARMO rel 3.00 on, STAR3din HARMO rel 1.00 on

In IEEE mode the registers are the same of the RTU mode. See addresses in the RTU section.

“MODBUS ASCII” PROTOCOL.

The Modbus ASCII protocol was included in the new instruments to maintains the compatibility with the existing softwares and applications developed for the VIP ENERGY, VIP ONE, VIP96 PLUS family.

This compatibility ensures the advantage of replacing old instrument on the serial line, e.g. VIP ENERGY, with a STAR3din without having to modify the software.
It also creates a common language for all instruments.

We advise you not to develop new software to interact with the STAR3, DMM3, SIRIO, Vip396, VIP39din and ED39din instruments, using the ASCII protocol.

The RTU format offer the complete control of the instruments and allows also to read single measures..

The ASCII format is a limited simulation of the VIP ENERGY protocol.

It does not allow to write information into the instrument such as CT and PT ratio.

It does not allow to read directly single measures !!

The only one command recognized is the reading of the string that contains the entire set of measures.

The answer will be a data frame identical to the one transmitted by the Vip Energy.

The measures available only in the new instruments, not available in the Vip Energy data frame, will not be transmitted e.g.: the neutral current

The measures not available in the new instruments, such as single line counters, will be replaced with zeroes

The reference manual to be used for this protocol is the one of the VIP Energy.

The format of the data frame is blocked as 7 data bits and 2 stop bits.

The parity can be adjusted from the instrument's keyboard

The annex Acrobat PDF document contains some pages of this manual that explain how to read the entire string of measures.



D o c u m e n t o A c r o b a t

Contact Elcontrol Energy to receive the complete version