MODBUS SLAVE MODULE

Registers for Scaling Information

MODBUS Register	Parameter	Description	Format
40001	VX (Low)	Voltage scaling (NA)	Unsigned 16b
	VX (High) & DI	Voltage scaling (Exponent)	
40002	IX (High)	Current scaling (Exponent.)	Unsigned 16b
	IX (Low)	Current scaling (Divisor)	
40003	PX (High)	Power scaling (Exponent)	Unsigned 16b
	PX (Low)	Power scaling (Divisor)	
40004	MF(High)	Energy Multiplier (Exponent)	Unsigned 16b
	MF (Low)	Demand divisor	

Registers for Meter Information

MODBUS	Parameter	Description	Format
40005 to 40008	SrN	Meter Serial Number	ASCII (8 bytes)
40009 to 40012	SfN	Meter Software Name	ASCII (8 bytes)
40013 to 40014	RT	Real Time	Unsigned 32 bit
40015 to 40018	FwName	Firmware - Name	ASCII (8 bytes)
40019	Pver_rev	MODBUS Protocol Version and Revision	Unsigned 16 bit
40020	nFxRegs	Numbers of valid registers for fixed information	Unsigned 16 bit
40021	nInstRegs	Numbers of valid registers for Instantaneous Parameters	Unsigned 16 bit
40022	nCumRegs	Numbers of valid registers for cumulative parameters.	Unsigned 16 bit

Standard registers for instantaneous parameters

MODBUS	Parameter	Description	Format
40050	V1	Voltage (nominal mV)	Unsigned 32 bit
40052	V2	Voltage (nominal mV)	Unsigned 32 bit
40054	V3	Voltage (nominal mV)	Unsigned 32 bit
40056	L1	Line current (nom. mA)	Unsigned 32 bit
40058	L2	Line current (nom. mA)	Unsigned 32 bit
40060	L3	Line current (nom. mA)	Unsigned 32 bit
40062	LN	Neutral current (mA)	Unsigned 32 bit
40064	KW	Resistive power(0.1 W)	Signed 24 bit
40066	KT	Resistive power(0.1 W)	Signed 24 bit
40068	KV	Reactive power (0.1 var)	Signed 24 bit
40070	KA	Apparent power (0.1 VA)	UnSigned 24 bit
40072	Q1	Power factor (X 1000)	Signed 16 bit
40073	Q2	Power factor (X 1000)	Signed 16 bit
40074	Q3	Power factor (X 1000)	Signed 16 bit

40075	QA	Avg power fact (X1000)	Signed 16 bit
40076	A12	RY ph ang (360/65536)	Unsigned 16b
40077	A23	YB ph ang (360/65536)	Unsigned 16b
40078	A31	BR ph ang (360/65536)	Unsigned 16b
40079	FQ	Frequency Hz (X 1000)	Unsigned 16b
40080	BR	Baudrate	Unsigned 16b

Cumulative parameters - instantaneous (energy + counters)

MODBUS	Parameter	Description	Format
40218	kWhT(I)	Active Total - Import	Unsigned 32b
40220	kWhT(E)	Active Total - Export	Unsigned 32b
40222	kWh(I)	Active Fundamental - Import	Unsigned 32b
40224	kWh(E)	Active Fundamental - Export	Unsigned 32b
40226	kVArh(I)_WI	Reactive - Import While Active Import	Unsigned 32b
40228	kVArh(E)_WI	Reactive - Export While Active Import	Unsigned 32b
40230	kVArh(I)_WE	Reactive - Import While Active Export	Unsigned 32b
40232	kVArh(E)_WE	Reactive - Export While Active Export	Unsigned 32b
40234	kVAh(I)	Apparent - Import	Unsigned 32b
40236	kVAh(E)	Apparent - Export	Unsigned 32b
40238	PONMins	Cumulative Power ON Minutes	Unsigned 32b
40240	POFFMins	Cumulative Power OFF Minutes	Unsigned 32b
40242	InpCnt1	Input Counter - 1	Unsigned 16b
40243	InpCnt2	Input Counter - 2	Unsigned 16b
40244	InpCnt3	Input Counter - 3	Unsigned 16b

Exception status coils

Coil Number	Description	Format
0	R-Phase voltage missing	Bit
1	Y-Phase voltage missing	Bit
2	B-Phase voltage missing	Bit
3	R-Phase CT Reverse	Bit
4	Phase CT Reverse	Bit
5	B-Phase CT Reverse	Bit
6	Voltage Unbalance	Bit
7	Voltage Invalid	Bit

NOTE:-- Definitions of additional parameters would be available in separate document.

Interpretations of MODBUS registers in external units

Elite doesn’t measure the values of voltage, current and power, which are in the circuit – it can’t, they’re too big for it. It measures much smaller quantities, which it needs to interpret as the large quantities in the circuit. Commissioning sets up Elite so that it interprets the values it measures as the values in the circuit. Following calculations are required to get data in external unit.

Different values of MF High (Meter Factor) and their resolutions are as follows

Meter Factor MF (High)	Energy Multiplier
2D	1 Wh
2E	0.01 kWh
2F	0.1 kWh
30	1 kWh
31	0.01 MWh
32	0.1 MWh
33	1 MWh
34	0.01 GWh
35	0.01 GWh

NOTE: All values send by ELITE in MODBUS registers are in hexadecimal. Exponents and Divisors are occupies one nibble i.e. four bits. All the exponents are singed, 2's complement values. All divisors are unsigned values.

Scaling information received from meter using MODBUS protocol

VX (Low) Voltage scaling (Exponent)
VX (High) Voltage scaling (Exponent) in the MS nibble & DI in the LS nibble
IX (High) Current scaling (Exponent)
IX (Low) Current scaling (Divisor)
PX (High) Power scaling (Exponent)
PX (Low) Power scaling (Divisor)
MF (High) Energy multiplier (Exponent)
MF (Low) Demand Divisor

Example

If Elite is commissioned at 11KV/110V and 100Amp/5Amp then the above factor send by Elite will be as follows

VX (High) = 0F = -1; DI =2; IX (High) = 0F = -1; IX (Low) = 05 = 5; PX (High) = 01 = 1; PX (Low) = 05 = 5; MF (High) = 30 = 0 and MF (Low) = 28 = 40.

Derive following factor from above information

IFAC = IX (High) = -1
PFAC = MF (High) + 1 = 0 + 1 = 1
If DI =10 then PFAC = PFAC-1
VFAC = PFAC– IFAC = 1 – (-1) = 2

Meter information

Meter Serial Number

Meter Serial number SrN and SfN will be in ASCII HEX (8 bytes)

Example

Value returned 50 52 49 30 39 31 35 31 will be interpreted as PRI39151

Meter Software Name

Meter software name will be in ASCII HEX (1+7 bytes)

Example

Value returned 01 41 33 30 41 47 30 31 will be interpreted as 1st byte will be reading type which is 01 and remaining 7 will be A30AG01.

Meter Real Time

Real time will be in unit of seconds since 1 JAN 1988 00:00:00 Hr. this will be treated as zero.

Example

Value returned 19 38 CF C5 will be interpreted as 14:40:04 hr of 29th May 2001

Firmware Name Interpretation:

Firmware name will be in ASCII HEX (1+7 bytes)

Example

Value returned 31 41 33 48 45 58 30 34 will be interpreted as “ 1A3HEX04”.

Protocol Version and Revision:

Value returned 01 00 will be interpreted as “Version – 01 and Revision – 00”.

Instantaneous Parameters

Voltage value = Received value*10^(VFAC-3) Volts

Example: If Value received from MODBUS registers are ‘0001B90C’. It will interpreted as follows
Voltage value = (01B90C) * 10^(2 – 3) = 11290.8 Volts = 11.2908 kVolts

Line current

Current value = ((Received value/IX low)*10^(IFAC-3)) Amps

Example: If Value received from MODBUS registers are ‘0002952E’. It will interpreted as follows
Current value = ((02952E/5)*10^(-1-3)) = ((169262/5)*10^(-4)) = 3.38524 Amps

Instantaneous Power value

Power value = ((Received value/PX low)*10^(PFAC-1)) Watts,

Example: If Value received from MODBUS registers are ‘00046E84’. It will interpreted as follows
Power value = ((046E84/5)*10^(1-1) = ((290436/5)*1) = 58087.2 = 58.0872 kWatts
If the received value is greater than ‘007FFFFF’ then 2’s complement of LS 24 bits should be taken & number would be negative.

Power factor

Power factor value verification = (Value)/1000

Example: Value received from MODBUS register is ‘FC8C’ which will be ‘-0.883’.
If power factor is leading then received values will be 2’s complement as illustrated in above example.

Phase angles

Phase Angle Value = ((Value * 360) / 65535)

Example: Value received from MODBUS register is 'D543h= 54595d'. It will be interpreted as Phase Angle Value = ((54595 * 360) / 65535) = 299.9 Degree.

Frequency

Supply Frequency = (Value / 1000)

Example: Value received from MODBUS register is 'C49C' which will be '50.332 Hz'

Baudrate

BR (baudrate)	0,1 and 2 0 for 1200 baudrate 1 for 2400 baudrate 2 for 4800 baudrate

Energy values

Energy value = (Received value * Meter Factor)

Example: Value received from MODBUS register is '0000 0058h = 88d' and MF (High) = 30, from MF (high) table multiplier of energy will be 1 kWh. This will give energy value = 88 kWh.

APPENDIX A:

CRC-16 CALCULATION

This appendix describes the procedure for obtaining the CRC-16 error check field for a MODBUS RTU frame.

PROCEDURE

A frame can be considered as a continuous, serial stream of binary data (ones and zeros). The 16-bit checksum is obtained by multiplying the serial data stream by 2^{16} (10000000000000000) and then dividing it by ***the. generator polynomial*** $x^{16} + x^{15} + x^{2} + 1$, which can be expressed as the

16-bit binary number 11000,000000000101. The quotient is ignored and the 16-bit remainder is the checksum, which is appended to the end of the frame.

In calculating the CRC, all arithmetic operations (additions and subtractions) are performed using MODULO TWO, or EXCLUSIVE OR operation. A step-by-step example is provided to show how to obtain the checksum for a simple MODBUS RTU frame.

Steps for generating the CRC-16 checksum:

1) Form a new polynomial by dropping the MSB (Most Significant Bit) of the generator polynomial and reversing the bit sequence. This yields the binary number 1010 0000 0000 0001, or AO 01 (hex).
2) Load a 16-bit register with initial value FF FF (hex).
3) Exclusive OR the first data byte with the low-order byte of the 16-bit register, storing the result in the 16-bit register.
4) -Shift the 16-bit register one bit to the right.
5) If the hit shifted out to the right is one. Exclusive OR the 16-bit register with the new generator polynomial, with the result stored in the 16-bit registers. Return to step 4.
6) If the bit shifted out to the right is zero, return to step 4.
7) Repeat steps 4 and 5 until 8 shifts have been performed.
8) Exclusive OR the next data byte with the 16-bit register.
9) Repeat steps 4 through 7 until all bytes of the frame have been Exclusive Ored with the 16-bit register and shifted 8 times.
10) The content of the 16-bit register is the checksum and is appended to the end of the frame.

PSEUDOCODE FOR CRC-16 GENERATION

For the users who are familiar with computer programming, the following is the pseudocode for calculating the 16-bit Cyclic Redundancy Check.

```
Initialize a 16-bit register to FFFF Hex
Initialize the generator polynomial to A001 Hex
FOR n=l to # of bytes in packet
BEGIN
XOR nth data byte with the 16-bit register
FOR bits_shifted = 1 to 8
BEGIN
SHIFT 1 bit to the right
IF (bit shifted out EQUAL 1)
XOR generator polynomial with the 16-bit register and store
result in the 16-bit register
END
END
```

The resultant 16-bit register contains the CRC-16 checksum.