

CONTADORES DE ENERGIA ELÉTRICA

Equipamentos de monitorização de rede, de telegestão e de contagem, estáticos, combinados, para pontos de BTN monofásicos / trifásicos

EDP Box - Protocolo da interface HAN | *EDP Box - HAN protocol specification*

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| 0 | MAR 2013 | Edition with no reference code. |
| 1 | FEV 2017 | <p>Document renaming to DEF-C44-509/N.</p> <p>3.1 Physical interface - Clarification of the polarization of communication pins A and B and the tolerance of supply voltage on pin 6. Definition of the HAN interface isolation as an auxiliary circuit.</p> <p>3.2 HAN communication module - Definition of the HAN communication module maximum dimensions.</p> <p>4.1 Addressing - Correction of the maximum limit of slave address.</p> <p>5.1.1 General types of data - Correction of the bit string transmission order.</p> <p>5.2 Access profile - Correction in the HAN access profile definition, that must be implemented from left to right. In the filter "HAN interface - Access profile", the left-most byte contains the low order indexes and the right-most byte the high order indexes.</p> <p>5.4.2 Load Profile - Correction of the attribute of "average value" objects used as "capture_object" in the load profile, it should be 3 and not 2: {5,1.0.x.5.0.255,3}.</p> |

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0. INTRODUCTION

This document provides the technical specification of the HAN “Home Area Network” interface of the EDP Box. This edition cancels and replaces the one from March of 2013, which don’t has reference code attributed.

1. PURPOSE

This document defines the functional data model and communication protocol of the HAN interface of the EDP Box, a part of the InovGrid solution developed by EDP Distribuição.

The communication protocol used in this interface is Modbus with some specificities.

2. STANDARDS AND REFERENCE DOCUMENTS

This document includes provisions of other documents referenced in the appropriate places in the text, which are listed below, indicating the issue dates.

- | | | |
|-----|------|---|
| [1] | 2006 | MODBUS over serial line specification and implementation guide V1.02 |
| [2] | 2006 | MODBUS APPLICATION PROTOCOL SPECIFICATION, V1.1b |
| [3] | 2013 | DEF-C44-506/N: Contadores de energia elétrica. Equipamentos de monitorização de rede, de telegestão e de contagem, estáticos, combinados, para pontos de BTN monofásicos / trifásicos – Especificação funcional |
| [4] | 2015 | DEF-C44-507/N: Contadores de energia elétrica. Equipamentos de monitorização de rede e de telegestão estáticos, combinados, para pontos de BTN monofásicos / trifásicos – Complemento aos standards para modelo de dados e <i>interfaces</i> de comunicação |
| [5] | 2013 | DMA-C44-506/N: Contadores de energia elétrica. Equipamentos de monitorização de rede, de telegestão e de contagem, estáticos, combinados, para pontos de BTN monofásicos / trifásicos – Características e ensaios |

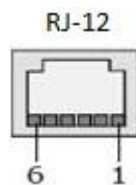
3. HAN INTERFACE

3.1 Physical interface

The physical interface in the EDP Box is available through an RJ-12 socket, uses a one pair EIA-485 specification for half-duplex communication, and has a 5 Volt supply with a tolerance of $\pm 10\%$.

The RJ-12 socket pin-out is available as follows:

| Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 |
|-------|-------|-------|-------|-------|-------------------|
| GND | A (+) | B (-) | B (-) | A (+) | +5 VDC $\pm 10\%$ |



The EDP Box must have an internal line termination resistor of 120Ω between A and B, and the interface should be able to supply current up to 150mA through the “+5 VDC $\pm 10\%$ ” pin and GND.

It must be ensured galvanic isolation of this interface as an auxiliary circuit, according to section 7.3 (Dielectric Characteristics) of [5]. In any case, this physical interface must be in accordance with Annex F of [3].

3.2 HAN communication module

The HAN interface is available under the EDP Box terminal cover and its access is exclusive of EDP Distribuição. This interface supports the connection to customer’s devices through an appropriate HAN communication module, with the purpose of encourage the use of energy management solutions. It will be up to the retailers and interested entities to develop this module and the associated services.

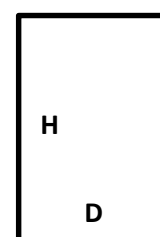
The EDP Box has a reserved space under the terminal cover to accommodate the HAN communication module, therefore the module dimensions must not exceed the following (according to Annex C of [5]):

- Height (H): 30 mm;
- Width (W): 80 mm;
- Depth (D): 20 mm.

Top view



Profile view



The HAN communication module shall only connect wirelessly with external devices or, alternatively, by using PLC technology compliant with legal and regulatory requirements (in any case, it must never interfere with Cenelec-A band).

4. MODBUS PROTOCOL

Modbus is a request/reply protocol and offers services specified by function codes. It is an application layer messaging protocol, positioned at level 7 of the OSI model, which provides client/server communication between devices that can be connected on different types of buses or networks. In this case, an asynchronous serial line protocol over EIA-485 is used.

| Layer | OSI Model | Description |
|-------|--------------|------------------------------|
| 7 | Application | Modbus Application Protocol |
| 6 | Presentation | Empty |
| 5 | Session | Empty |
| 4 | Transport | Empty |
| 3 | Network | Empty |
| 2 | Data link | Modbus Serial Line Protocol |
| 1 | Physical | EIA/TIA 485 (or EIA/TIA 232) |

There can be only one master connected to the bus, and a maximum of 247 slaves (EDP Boxes).

4.1 Addressing

The addressing is done in the first byte of the Modbus frame, and is assigned in the following way:

| Broadcast Address | Slave Individual Addresses | Reserved |
|-------------------|----------------------------|-----------------|
| 0 | From 1 to 247 | From 248 to 255 |

There are two addressing modes available in the protocol:

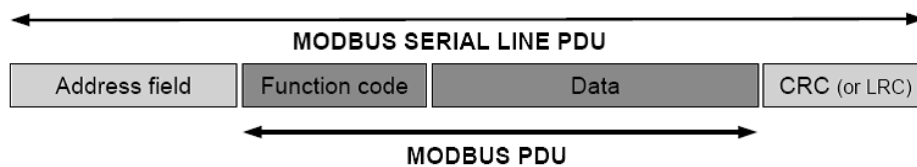
- **Unicast mode:** In this mode the network master addresses only one slave, and for each request there is a reply. Each slave should have a unique address in the bus, otherwise collisions are expected.
- **Broadcast mode:** In this mode the master addresses all slaves connected to the bus with a request and it's not expected a reply from any slave, since it would provoke bus congestion. The address field has the value 0x00 reserved for this feature.

By default, the EDP Box must have the address 0x01.

To change the address in Broadcast mode, make sure the bus has only one slave, otherwise all slaves will assume the same address and the control over the physical layer will be lost.

4.2 Modbus frame

The Modbus frame is based on the following structure:



- Address field: slave address (0x00 if broadcast);
- Function code: Type of request (e.g.: 0x04 for reading registers);
- Data: Data exchanged;
- CRC: Cyclic Redundancy Check for error checking.

| Slave Address | Function Code | Data | CRC | |
|---------------|---------------|-------------------|---------|----------|
| | | | CRC low | CRC high |
| 1 byte | 1 byte | 0 up to 252 bytes | 1 byte | 1 byte |

The maximum size of Modbus serial line PDU frame is 256 bytes.

4.3 Transmission mode

The transmission mode should be RTU in the following configuration (8N2):

- Start bit: 1;
- Data bits: 8;
- Parity: No;
- Stop bit: 2.

| Start bit | Data bits (1 byte) | | | | | | | | Stop bit | Stop bit |
|-----------|--------------------|-------|-------|-------|-------|-------|-------|-------|----------|----------|
| | Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | | |
| | | | | | | | | | | |

The first bit to be sent is the least significant of the byte. When there is more than one byte to be transmitted in the field of the message the most significant byte is sent first, followed by the lower order bytes.

By default, the communication baud rate should be 9600 bps. The communication speed should be configurable, from the minimum 9600 bps at least up to 19200 bps.

4.4 Error checking

The error checking must be done using a 16 bit CRC implemented as two 8 bit bytes.

The CRC is appended to the frame as the last field. The low order byte of the CRC is appended first, followed by the high order byte. Thus, the CRC high order byte is the last byte to be sent in the frame.

The polynomial value used to generate the CRC must be 0xA001.

5. DATA EXCHANGE

5.1 Types of data

5.1.1 General types of data

The general types of data are presented in the table below.

| General types of data | | |
|-----------------------------------|-------------------------------------|--------|
| Type | Values | Bytes |
| Unsigned | 0 to 255 | 1 |
| Integer | -128 to 127 | 1 |
| Long unsigned ¹ | 0 to 65 535 | 2 |
| Long ¹ | -32 768 to 32 767 | 2 |
| Double long unsigned ¹ | 0 to 4 294 967 295 | 4 |
| Double long ¹ | -2 147 483 648 to 2 147 483 647 | 4 |
| Octet string ¹ | Sequence of octets | 1 to n |
| Array ¹ | Ordered sequence of unsigned values | 1 to n |
| Bit string ² | Ordered sequence of boolean values | 1 to n |

Note¹: The first byte to be transmitted is the most significant one, followed by the low order bytes. In an octet string, the left-most byte is the first to be transmitted.

Note²: In a bit string, the first byte to be transmitted is the left-most byte (least significant byte).

5.1.2 Enumerated types of data

The enumerated types of data are presented in the following table. Those are all composed by one byte of unsigned type, whose valid values are indicated in the table.

| Enumerated types of data | |
|--------------------------|---|
| Type | Valid values |
| Demand management status | (0): No active period (1): Non critical period (2): Critical period |
| Disconnect control state | (0): Disconnected (1): Connected (2): Ready for Re-connection (Manually) |
| Type of period | (1): Non critical period (2): Critical period |
| Measurement ID | The valid values for this enumerated type are presented in the subsection 5.6.7 - Load Profile. |

5.1.3 Structured types of data

In the following tables of this subsection are presented the structured types of data used.

The first items present in the tables are the most significant bytes of the structure and the last items are the least significant bytes. The first byte to be transmitted is the most significant followed by the low order bytes, e.g., for the “Clock” (see 5.1.3.1) the first byte transmitted is the most significant byte of the “Year” and the last is the “Clock status”.

5.1.3.1 Clock

The structure “Clock” should be interpreted as follows:

| Structured types of data - Clock | | | |
|----------------------------------|-------|---------------|------------------------------|
| Description | Bytes | Types | Expected values |
| Year | 2 | Long unsigned | 2000 to 2099 |
| Month | 1 | Unsigned | 1 - January to 12 - December |
| Day of month | 1 | Unsigned | 1 to 31 |
| Weekday | 1 | Unsigned | 1 - Monday to 7 - Sunday |
| Hour | 1 | Unsigned | 0 to 23 |
| Minute | 1 | Unsigned | 0 to 59 |
| Second | 1 | Unsigned | 0 to 59 |
| Hundredths of second | 1 | Unsigned | 0 to 99 |
| Deviation (from local to GMT) | 2 | Long | -720 to 720 minutes |
| Clock status | 1 | Unsigned | 0x00 - Winter; 0x80 - Summer |

5.1.3.2 Demand Management period

The structure “Demand management period” should be interpreted as follows:

| Structured types of data - Demand Management period | | |
|---|-------|----------------------|
| Description | Bytes | Types |
| Type of period | 1 | Type of period |
| Start period | 12 | Clock |
| End period | 12 | Clock |
| Decrease percentage | 1 | Unsigned |
| Absolute power value | 4 | Double long unsigned |

5.2 Access profile

The configuration of the access profile, for the information/registers available through the HAN interface, is done through the EDP Box’s DLMS interface, where authentication is required.

All Modbus registers presented in section 5.6 - Registers Address - have an associated index that should be used as the reference index in the access control bit string filter.

For instance, if bit 4 of the string filter (bit string[4]) has the value “1” this means that register with index 4 (address 0x0004) is accessible to the Modbus master. The bit 0 of the array has no meaning, once there is no index 0 or address 0x0000 defined.

In the bit string filter “HAN interface - Access profile”, the left-most byte contains the low order indexes and the right-most byte the high order indexes. The size of this bit string filter is fixed and equal to 256 positions, so the non-meaningful bits should be padded with zeros in the transmission. As defined to the bit strings, the “HAN interface - Access profile” register is transmitted from the left-most byte to the right-most byte.

| HAN interface - Access profile | | | | | | | | | | | | | | | | |
|--------------------------------|---------|---------|---------|---------|---------|---------|---------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Byte 0 | | | | | | | | Byte 1 to 30 | Byte 31 | | | | | | | |
| Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | ... | Bit 248 | Bit 249 | Bit 250 | Bit 251 | Bit 252 | Bit 253 | Bit 254 | Bit 255 |
| 0 | 0 or 1 | 0 or 1 | 0 or 1 | 0 or 1 | 0 or 1 | 0 or 1 | 0 or 1 | ... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Not used | Index 1 | Index 2 | Index 3 | Index 4 | Index 5 | Index 6 | Index 7 | ... | Padding | | | | | | | |

If the Modbus master requests access to a register that is not enabled, an error message with the exception code 0x81 “ACCESS DENIED” must be returned (see subsection 5.5 - **Exception codes**).

5.3 Status control

To allow the Modbus master to perform the management of some functionalities of the EDP Box, there is a specific register which typically will be read frequently to present its current status.

This register is named “Status Control” (address 0x0009) and it is composed by a two positions array (2 bytes) with the structure presented in the following table.

| Status Control | | | | | | | | | | | | | | | |
|-------------------------|-------|-------|-------|--------------------------|-------|------------------------------|-------|--------------------------------|-------|-------|-------|-------|-------|-------|-------|
| Array[1] | | | | | | | | Array[0] | | | | | | | |
| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| Reserved for future use | | | | Demand management status | | Load profile's reset counter | | Load profile's entries counter | | | | | | | |

The right-most position (array[0]) of “Status Control” is assigned to the “Load profile’s entries counter”. This counter should be incremented for each new entry of load profile buffer, so the Modbus master can recognize at any time if there is a newer entry in the buffer. If this counter reaches its limit (value 255) it will overflow and reinitialize (value 0) when incremented again.

The two least significant bits of left-most position (array[1]) of “Status Control” are assigned to the “Load profile’s reset counter”. This 2-bit counter should be incremented for each reset of load profile, which occurs when there is a configuration of the measurements to be captured in the load profile. When the Modbus master detects a change in this counter, it should read the “Load profile - Configured measurements” to recognize the new configuration (see 5.4.2 - Load Profile). If this counter reaches its limit (value 3) it will overflow and reinitialize (value 0) when incremented again.

The bits 2 and 3 of left-most position (array[1]) are assigned to the “Demand management status”, holding information about the currently active demand management period (the admissible values for this status are defined in 5.1.2 - Enumerated types of data).

The Modbus master should read this register with an appropriate frequency to conveniently manage the:

- Load profile access - avoiding the need to read the last entry of load profile to recognize a new entry or a new configuration;
- Demand management status - to eventually take actions according to the active demand management period.

5.4 Function codes description

The functions to be used in the Modbus protocol of EDP Box's HAN interface and the content of the Modbus PDU frame (see 4.2 Modbus frame) are defined in the following subsections.

When addresses and data items larger than a single byte are transmitted, the most significant byte is sent first.

5.4.1 General purpose

The general purpose functions (current subsection) have public function codes, so their definition is according to document [2].

All addresses used in the frames are defined in the subsection 5.6 - Registers Address.

5.4.1.1 Read input registers

This function is used to read registers of the EDP Box.

Request:

| READ INPUT REGISTERS - REQUEST | Bytes | Value |
|--------------------------------|-------|-------------------------------|
| Function code | 1 | 0x04 |
| Starting Address | 2 | 0x0001 to 0xFFFF |
| Quantity of Input Registers | 2 | 0x0001 to 0x007D ¹ |

Note¹: The quantity of registers to be read combined with all other fields in the expected reply must not exceed the 256 bytes of allowable Modbus messages length.

Response:

| READ INPUT REGISTERS - RESPONSE | Bytes | Value |
|---------------------------------|-------|-------|
| Function code | 1 | 0x04 |
| Byte count | 1 | n |
| Input Registers | n | |

n = even number of bytes returned, containing the values of the requested Input Registers.

Note: If the content of returned Input Registers is not a multiple of two bytes, then the PDU frame must be padded in the right-most position with a zero byte (last transmitted byte). The type and size of each register are indicated in subsection 5.6 - Registers Address.

Error:

| READ INPUT REGISTERS - ERROR | Bytes | Value |
|------------------------------|-------|--------------------------------|
| Function code | 1 | 0x84 |
| Exception code | 1 | 0x01, 0x02, 0x03, 0x04 or 0x81 |

Example:

Read the “Active core firmware Id” (register address 0x0004).

| READ INPUT REGISTERS - EXAMPLE | | | |
|-----------------------------------|-------------|--|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| Function code | 04 | Function code | 04 |
| Starting Address (MSB) | 00 | Byte count | 06 |
| Starting Address (LSB) | 04 | Register 0x0004 (MSB - 5 th byte) | XX |
| Quantity of Input Registers (MSB) | 00 | Register 0x0004 (4 th byte) | XX |
| Quantity of Input Registers (LSB) | 01 | Register 0x0004 (3 th byte) | XX |
| | | Register 0x0004 (2 nd byte) | XX |
| | | Register 0x0004 (LSB - 1 st byte) | XX |
| | | Padding | 00 |

5.4.1.2 Write single register

This function is used exclusively to write the EDP Box Modbus address. Therefore, the only admissible address in the “Register Address” field of this function is the 0x0007 (HAN interface - Modbus address).

Request:

| WRITE SINGLE REGISTER – REQUEST | Bytes | Value |
|---------------------------------|-------|-------------------------------|
| Function code | 1 | 0x06 |
| Register Address | 2 | 0x0007 |
| Register Value | 2 | 0x0001 to 0x00F7 ¹ |

Note ¹: Limitation according to 4.1 - Addressing.

Response:

| WRITE SINGLE REGISTER – RESPONSE | Bytes | Value |
|----------------------------------|-------|------------------|
| Function code | 1 | 0x06 |
| Register Address | 2 | 0x0007 |
| Register Value | 2 | 0x0001 to 0x00F7 |

Error:

| WRITE SINGLE REGISTER - ERROR | Bytes | Value |
|-------------------------------|-------|--------------------------------|
| Function code | 1 | 0x86 |
| Exception code | 1 | 0x01, 0x02, 0x03, 0x04 or 0x81 |

Example:

Write the “HAN interface - Modbus address” (register address 0x0007 with value 0x0001).

| WRITE SINGLE REGISTER - EXAMPLE | | | |
|---------------------------------|-------------|------------------------|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| Function code | 06 | Function code | 06 |
| Register Address (MSB) | 00 | Register Address (MSB) | 00 |
| Register Address (LSB) | 07 | Register Address (LSB) | 07 |
| Register Value (MSB) | 00 | Register Value (MSB) | 00 |
| Register Value (LSB) | 01 | Register Value (LSB) | 01 |

5.4.2 Load Profile

There are two different user-defined functions to access the load profile buffer (object with the OBIS code {7,{1.0.99.1.0.255},2}), although no particular register address is explicitly referred in their request frames.

The load profile dimension may depend on the number and type of measurements configured to be captured in the buffer. The maximum load profile entries with current structure are accessible through register 0x0083 “Load profile - Profile entries”. The Modbus master should use the register 0x0082 “Load profile - Entries in use” to know the current number of occupied entries in the load profile buffer. When the load profile buffer is full the register “Load profile - Entries in use” has the same value of “Load profile - Profile entries”.

The load profile buffer is organized in a FIFO structure, so the first entry of the buffer is always the oldest one and the last entry is the newest. Accordingly, the oldest entry of the buffer is always the position 0x0001 and the newest is the correspondent position expressed in the register “Load profile - Entries in use”.

The Modbus register 0x0080 “Load profile - Configured measurements” contains relevant information about the measurements that are being recorded in the EDP Box’s load profile. It displays an array of up to 8 Measurement IDs, enabling the Modbus master to recognize the type of data that is being captured in the load profile.

The size of “Load profile - Configured measurements” array is fixed and equal to 8 positions, where each position has a unique assigned index. The “Clock” and the “AMR profile status” are always the first two objects to be captured in the load profile and consequently assigned with indexes 1 and 2, respectively, within the array. Thus, if less than 6 measurements (excluding “Clock” and “AMR profile status”) are configured to be captured in the EDP Box’s load profile, then the positions of the array with no measurements assigned should have the value 0xFF. The array should be filled considering that the left-most position is the first to be assigned and so on, since empty positions between two configured measurements are not acceptable. The first byte to be transmitted is the left-most position, followed by the next right positions until the last right-most position.

| Load profile - Configured measurements | | | | | | | |
|--|----------|----------|----------|----------|----------|----------|----------|
| Array[7] | Array[6] | Array[5] | Array[4] | Array[3] | Array[2] | Array[1] | Array[0] |
| Index 1 | Index 2 | Index 3 | Index 4 | Index 5 | Index 6 | Index 7 | Index 8 |

The “Load profile - Configured measurements” register address (0x0080) is also used for access profile purposes, either to enable or disable the access to the EDP Box’s load profile buffer through the user-defined functions.

The description of all Measurement IDs and their correspondence with the OBIS code of the captured object (defined in [4]) are presented in the table below. The “Scaler” column is related to the resolution of the received data, i.e., to determine how many decimal digits should be considered. For example, the “Last average power factor” has a scaler of “-2”, so the received data of 0x00000062 (98 in decimal) corresponds to the value 0,98.

| Measurement ID’s of Load Profile | | | | | |
|----------------------------------|--------------------------------------|-------------------------|----------------------|------|--------|
| Measurement ID | Description | OBIS | Type | Unit | Scaler |
| (1) | Clock | {8,{0.0.1.0.0.255},2} | Clock | - | - |
| (2) | AMR profile status | {1,{0.0.96.10.7.255},2} | Unsigned | - | - |
| (3) | Active energy (+A) | {3,{1.0.1.8.0.255},2} | Double long unsigned | Wh | 0 |
| (4) | Active energy (-A) | {3,{1.0.2.8.0.255},2} | Double long unsigned | Wh | 0 |
| (5) | Reactive energy (+Ri) | {3,{1.0.5.8.0.255},2} | Double long unsigned | VARh | 0 |
| (6) | Reactive energy (+Rc) | {3,{1.0.6.8.0.255},2} | Double long unsigned | VARh | 0 |
| (7) | Reactive energy (-Ri) | {3,{1.0.7.8.0.255},2} | Double long unsigned | VARh | 0 |
| (8) | Reactive energy (-Rc) | {3,{1.0.8.8.0.255},2} | Double long unsigned | VARh | 0 |
| (9) | Active energy (+A) inc. | {3,{1.0.1.29.0.255},2} | Double long unsigned | Wh | 0 |
| (10) | Active energy (-A) inc. | {3,{1.0.2.29.0.255},2} | Double long unsigned | Wh | 0 |
| (11) | Reactive energy (+Ri) inc. | {3,{1.0.5.29.0.255},2} | Double long unsigned | VARh | 0 |
| (12) | Reactive energy (+Rc) inc. | {3,{1.0.6.29.0.255},2} | Double long unsigned | VARh | 0 |
| (13) | Reactive energy (-Ri) inc. | {3,{1.0.7.29.0.255},2} | Double long unsigned | VARh | 0 |
| (14) | Reactive energy (-Rc) inc. | {3,{1.0.8.29.0.255},2} | Double long unsigned | VARh | 0 |
| (15) | Last average power factor | {5,{1.0.13.5.0.255},3} | Double long unsigned | - | -2 |
| (16) | Last average voltage L1 ¹ | {5,{1.0.32.5.0.255},3} | Double long unsigned | V | -1 |
| (17) | Last average voltage L2 ¹ | {5,{1.0.52.5.0.255},3} | Double long unsigned | V | -1 |
| (18) | Last average voltage L3 ¹ | {5,{1.0.72.5.0.255},3} | Double long unsigned | V | -1 |
| (19) | Last average any phase voltage | {5,{1.0.12.5.0.255},3} | Double long unsigned | V | -1 |

Note ¹: Measurement ID does only apply to three-phase EDP Boxes.

Measurement ID = 0 can be used by Modbus master to read all the configured measurements in the load profile.

Example:

Read the “Load profile - Configured measurements” (register address 0x0080).

| READ “LOAD PROFILE - CONFIGURED MEASUREMENTS” – EXAMPLE | | | |
|---|-------------|---|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| Function code | 04 | Function code | 04 |
| Starting Address (MSB) | 00 | Byte count | 08 |
| Starting Address (LSB) | 80 | 1 st Measurement ID (“Clock”) | 01 |
| Quantity of Input Registers (MSB) | 00 | 2 nd Measurement ID (“AMR profile status”) | 02 |
| Quantity of Input Registers (LSB) | 01 | 3 rd Measurement ID (“Active energy (+A) inc.”) | 09 |
| | | 4 th Measurement ID (“Last average any phase voltage”) | 13 |
| | | 5 th Measurement ID (not used) | FF |
| | | 6 th Measurement ID (not used) | FF |
| | | 7 th Measurement ID (not used) | FF |
| | | 8 th Measurement ID (not used) | FF |

5.4.2.1 Read last Load Profile entries

This function is used to read the latest entries of the load profile buffer.

Request:

| READ LAST LOAD PROFILE ENTRIES - REQUEST | Bytes | Value |
|--|-------|--------|
| Function code | 1 | 0x44 |
| Measurement ID indexes to retrieve | 1 | 0 to 8 |
| Quantity of Entries | 1 | 1 to 6 |

The Modbus master shall use the “Measurement ID indexes to retrieve” in the request to define the information to be read in each load profile entry, where “Measurement ID indexes to retrieve” = 0 is used to read all the configured measurements in the load profile (up to 6 plus “Clock” and “AMR profile status”).

In order to properly recognize the response when using this function, the Modbus master should read register 0x0080 “Load profile - Configured measurements” in the first place.

The quantity of entries to be read in the load profile is limited to 6.

When the Modbus master requires a “Measurement ID indexes to retrieve” that doesn’t exist (out of scope) or is higher than the number of configured measurements in the EDP Box, an error message must be generated with the exception code 0x82. If the quantity of entries required is greater than the number of load profile’s entries in

use, then an error message must be generated with the exception code 0x83. For more details see subsection 5.5 - Exception codes.

Response:

| READ LAST LOAD PROFILE ENTRIES - RESPONSE | Bytes | Value |
|---|-------|-------|
| Function code | 1 | 0x44 |
| Byte count | 1 | n |
| Entries data | n | |

n = number of bytes returned, containing the data of the requested Entries

The order of the retrieved “Entries data” should be the following: the first entry to be transmitted is the most recent entry of the load profile (the last one to be stored), the second entry to be transmitted is the second most recent entry of the load profile (the penultimate one to be stored) and so on up to the last of entry to be transmitted.

Within the same entry, the first byte to be transmitted is always the most significant byte of the “Clock”, followed by the lower order bytes of the “Clock” and then by the “AMR profile status” byte. Afterwards, the last bytes to be transmitted within the same entry are the ones related to the data from the Measurement IDs configured in the EDP Box up to the selected index, considering the order defined in the “Load profile - Configured measurements”.

When there are multiple bytes to be transmitted on the same field of the message, the most significant byte is sent first followed by the low order bytes.

Error:

| READ LAST LOAD PROFILE ENTRIES - ERROR | Bytes | Value |
|--|-------|--|
| Function code | 1 | 0xC4 |
| Exception code | 1 | 0x01, 0x02, 0x03, 0x04, 0x81, 0x82 or 0x83 |

Example:

Read the last load profile entry for the first three Measurements IDs configured in the load profile. The load profile configuration is according to the “Load profile - configured measurements” presented in the example of page 15.

| READ LAST LOAD PROFILE ENTRIES – EXAMPLE | | | |
|--|-------------|---|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| Function code | 44 | Function code | 44 |
| Measurement ID indexes to retrieve | 03 | Byte count | 11 |
| Quantity of Entries | 01 | Data of last entry 1 st Measurement ID (“Clock” - MSB of “Year”) | XX |
| | | Data of last entry 1 st Measurement ID (“Clock” - LSB of “Year”) | XX |

| READ LAST LOAD PROFILE ENTRIES – EXAMPLE | | | |
|--|-------------|---|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| | | ... | |
| | | (Total of 9 bytes - 8 fields of "Clock" - month, day of month, weekday, hour, minute, second, hundredths of second and deviation) | 9x XX |
| | | Data of last entry 1 st Measurement ID ("Clock" - "Clock status") | XX |
| | | Data of last entry 2 nd Measurement ID ("AMR profile status") | XX |
| | | Data of last entry 3 rd Measurement ID ("Active energy (+A) inc." - MSB - 4 th byte) | XX |
| | | Data of last entry 3 rd Measurement ID ("Active energy (+A) inc." - 3 rd byte) | XX |
| | | Data of last entry 3 rd Measurement ID ("Active energy (+A) inc." - 2 nd byte) | XX |
| | | Data of last entry 3 rd Measurement ID ("Active energy (+A) inc." - LSB - 1 st byte) | XX |

5.4.2.2 Read Load Profile entries

This function is used to read up to 6 entries of the load profile buffer.

Request:

| READ LOAD PROFILE ENTRIES - REQUEST | Bytes | Value |
|-------------------------------------|-------|-----------------------------------|
| Function code | 1 | 0x45 |
| Measurement ID indexes to retrieve | 1 | 0 to 8 |
| Start entry | 4 | 1 to profile entries ¹ |
| Quantity of Entries | 1 | 1 to 6 |

Note¹: The Modbus master should read the register 0x0083 "Load profile - Profile entries" in the first place, to be able to recognize the upper limit of this value.

The Modbus master shall use the "Measurement ID indexes to retrieve" in the request to define the information to be read in each load profile entry, where "Measurement ID indexes to retrieve" = 0 is used to read all the configured measurements in the load profile (up to 6 plus "Clock" and "AMR profile status").

The Modbus master should read the register 0x0082 “Load profile - Entries in use” to know the current number of occupied entries in the load profile buffer and consequently its last entry.

In order to properly recognize the response when using this function, the Modbus master should read register 0x0080 “Load profile - Configured measurements” in the first place.

The quantity of entries to be read in the load profile is limited to 6.

When the Modbus master requires a “Measurement ID indexes to retrieve” that doesn’t exist (out of scope) or is higher than the number of configured measurements in the EDP Box, an error message must be generated with the exception code 0x82. If the start entry of load profile buffer doesn’t exist in the EDP Box (out of scope) or the index of the start entry plus the quantity of entries required is greater than profile entries, then an error message must be generated with the exception code 0x83. For more details see subsection 5.5 - Exception codes.

Response:

| READ LOAD PROFILE ENTRIES - RESPONSE | Bytes | Value |
|--------------------------------------|-------|-------|
| Function code | 1 | 0x45 |
| Byte count | 1 | n |
| Entries data | n | |

n = number of bytes returned, containing the data of the requested Entries

The order of the retrieved “Entries data” should be the following: the first entry to be transmitted is the data from the entry defined in the “Start entry”, the second entry to be transmitted is the data from the very next position of the load profile (previous position plus 1) and so on up to the last of entry to be transmitted.

Within the same entry, the first byte to be transmitted is always the most significant byte of the “Clock”, followed by the lower order bytes of the “Clock” and then by the “AMR profile status” byte. Afterwards, the last bytes to be transmitted within the same entry are the ones related to the data from the Measurement IDs configured in the EDP Box up to the selected index, considering the order defined in the “Load profile - Configured measurements”.

When there are multiple bytes to be transmitted on the same field of the message, the most significant byte is sent first followed by the low order bytes.

Error:

| READ LOAD PROFILE ENTRIES - ERROR | Bytes | Value |
|-----------------------------------|-------|--|
| Function code | 1 | 0xC5 |
| Exception code | 1 | 0x01, 0x02, 0x03, 0x04, 0x81, 0x82 or 0x83 |

Example:

Read the 6000th entry (0x00001770) of the load profile for all configured Measurement IDs in the load profile. The load profile configuration is according to the “Load profile - configured measurements” presented in the example of page 15.

| READ LOAD PROFILE ENTRIES - EXAMPLE | | | |
|--|-------------|--|-------------|
| REQUEST | | RESPONSE | |
| Field name | Value (Hex) | Field name | Value (Hex) |
| Function code | 45 | Function code | 45 |
| Measurement ID indexes to retrieve | 00 | Byte count | 15 |
| Start entry (MSB - 4 th byte) | 00 | Data of entry 6000 1 st Measurement ID ("Clock" - MSB of "Year") | XX |
| Start entry (3 rd byte) | 00 | Data of entry 6000 1 st Measurement ID ("Clock" - LSB of "Year") | XX |
| Start entry (2 nd byte) | 17 | ... (8 fields of "Clock" - month, day of month, weekday, hour, minute, second, hundredths of second and deviation - total of 9 bytes) | ... |
| Start entry (LSB - 1 st byte) | 70 | Data of entry 6000 1 st Measurement ID ("Clock" - "Clock status") | XX |
| Quantity of Entries | 01 | Data of entry 6000 2 nd Measurement ID ("AMR profile status") | XX |
| | | Data of entry 6000 3 rd Measurement ID ("Active energy (+A) inc." - MSB - 4 th byte) | XX |
| | | Data of entry 6000 3 rd Measurement ID ("Active energy (+A) inc." - 3 rd byte) | XX |
| | | Data of entry 6000 3 rd Measurement ID ("Active energy (+A) inc." - 2 nd byte) | XX |
| | | Data of entry 6000 3 rd Measurement ID ("Active energy (+A) inc." - LSB - 1 st byte) | XX |
| | | Data of entry 6000 4 th Measurement ID ("Last average any phase voltage" - MSB - 4 th byte) | XX |
| | | Data of entry 6000 4 th Measurement ID ("Last average any phase voltage" - 3 rd byte) | XX |
| | | Data of entry 6000 4 th Measurement ID ("Last average any phase voltage" - 2 nd byte) | XX |
| | | Data of entry 6000 4 th Measurement ID ("Last average any phase voltage" - LSB - 1 st byte) | XX |

5.5 Exception codes

The available exception codes to be used in all functions are listed and described in the following table.

The exception codes from 0x01 up to 0x04 are according to the standard Modbus protocol (see document [2]) and all other are user defined.

| Exception Codes | | | |
|-----------------|----------------------------|---|----------------------|
| Exception Code | Designation | Description | Admissible functions |
| 0x01 | ILLEGAL FUNCTION | The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values. | All |
| 0x02 | ILLEGAL DATA ADDRESS | The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed a request with offset 96 and length 5 will generate exception 02. | All |
| 0x03 | ILLEGAL DATA VALUE | A value contained in the query data field is not an allowable value for the slave. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register. | All |
| 0x04 | SLAVE DEVICE FAILURE | An unrecoverable error occurred while the slave was attempting to perform the requested action. | All |
| 0x81 | ACCESS DENIED | The master is attempting to access a register that is not enabled in the access profile. | All |
| 0x82 | MEASUREMENT DOES NOT EXIST | Used in the following circumstances: <ul style="list-style-type: none"> - Measurement ID index doesn't exist (out of scope); - Measurement ID index higher than the number of configured measurements in the slave (EDP Box). | 0xC4 0xC5 |
| 0x83 | ENTRY DOES NOT EXIST | Used in the following circumstances: <ul style="list-style-type: none"> - The quantity of entries required is greater than load profile's entries in use; - The start entry doesn't exist (out of scope) - only applies to function 0x45; - The start entry plus the quantity of entries required is greater than profile entries - only applies to function 0x45. | 0xC4 0xC5 |

5.6 Registers Address

The information available through the EDP Box's HAN interface is described in the following tables of this subsection.

All registers have a specific address and an associated index that should be used as reference to the access profile (see 5.2 - Access profile).

Each register address is related to a DLMS object of EDP Box by its OBIS code {Class ID,{Logical name}, Attribute index}. The correspondent type of data, unit and scaler are also defined. The scaler is related to the resolution of the received data, i.e., to determine how many decimal digits should be considered.

5.6.1 General Information

| Registers Address - General Information | | | | | | |
|---|---------|---|-------------------------|------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 1 | 0x0001 | Clock | {8,{0.0.1.0.0.255},2} | Clock | - | - |
| 2 | 0x0002 | Device ID 1 - Device Serial Number | {1,{0.0.96.1.0.255},2} | Octet string[10] | - | - |
| 3 | 0x0003 | Device ID 2 - Manufacturer Model Codes and Year | {1,{0.0.96.1.1.255},2} | Octet string[6] | - | - |
| 4 | 0x0004 | Active core firmware Id. | {1,{1.0.0.2.0.255},2} | Octet string[5] | - | - |
| 5 | 0x0005 | Active app firmware Id. | {1,{1.1.0.2.0.255},2} | Octet string[5] | - | - |
| 6 | 0x0006 | Active com firmware Id. | {1,{1.2.0.2.0.255},2} | Octet string[5] | - | - |
| 7 | 0x0007 | HAN interface - Modbus address | {1,{0.65.0.30.5.255},2} | Unsigned | - | - |
| 8 | 0x0008 | HAN interface - Access profile | {1,{0.65.0.30.7.256},2} | Bit string[256] | - | - |
| 9 | 0x0009 | Status control ¹ | - | Octet string[2] | - | - |

Note ¹: This register is not related to a DLMS object of EDP Box.

5.6.2 Tariff Configuration

| Registers Address - Tariff Configuration | | | | | | |
|--|---------|------------------------------------|-------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 10 | 0x000A | Activity Calendar - Active Name | {20,{0.0.13.0.1.255},2} | Octet string[6] | - | - |
| 11 | 0x000B | Currently active tariff | {1,{0.0.96.14.1.255},2} | Unsigned | - | - |
| 12 | 0x000C | Active demand control threshold T1 | {3,{0.1.94.35.1.255},2} | Double long unsigned | VA | 0 |
| 13 | 0x000D | Active demand control threshold T2 | {3,{0.1.94.35.2.255},2} | Double long unsigned | VA | 0 |

| Registers Address - Tariff Configuration | | | | | | |
|--|---------|------------------------------------|--------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 14 | 0x000E | Active demand control threshold T3 | {3,{0.1.94.35.3.255},2} | Double long unsigned | VA | 0 |
| 15 | 0x000F | Active demand control threshold T4 | {3,{0.1.94.35.4.255},2} | Double long unsigned | VA | 0 |
| 16 | 0x0010 | Active demand control threshold T5 | {3,{0.1.94.35.5.255},2} | Double long unsigned | VA | 0 |
| 17 | 0x0011 | Active demand control threshold T6 | {3,{0.1.94.35.6.255},2} | Double long unsigned | VA | 0 |
| 18 | 0x0012 | Currently apparent power threshold | {3,{0.1.94.35.31.255},2} | Double long unsigned | VA | 0 |

5.6.3 Demand Management

| Registers Address - Demand Management | | | | | | |
|---------------------------------------|---------|-------------------------------------|--------------------------|--------------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 19 | 0x0013 | Demand management status | {1,{0.1.94.35.64.255},2} | Demand management status | - | - |
| 20 | 0x0014 | Demand management period definition | {1,{0.1.94.35.60.255},2} | Demand management period | - | - |
| 21 | 0x0015 | Residual power threshold | {3,{0.1.94.35.61.255},2} | Double long unsigned | VA | 0 |

5.6.4 Total Registers

| Registers Address - Total Registers | | | | | | |
|-------------------------------------|---------|---|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 22 | 0x0016 | Active energy import (+A) | {3,{1.0.1.8.0.255},2} | Double long unsigned | Wh | 0 |
| 23 | 0x0017 | Active energy export (-A) | {3,{1.0.2.8.0.255},2} | Double long unsigned | Wh | 0 |
| 24 | 0x0018 | Reactive energy QI (+Ri) | {3,{1.0.5.8.0.255},2} | Double long unsigned | VARh | 0 |
| 25 | 0x0019 | Reactive energy QII (+Rc) | {3,{1.0.6.8.0.255},2} | Double long unsigned | VARh | 0 |
| 26 | 0x001A | Reactive energy QIII (-Ri) | {3,{1.0.7.8.0.255},2} | Double long unsigned | VARh | 0 |
| 27 | 0x001B | Reactive energy QIV (-Rc) | {3,{1.0.8.8.0.255},2} | Double long unsigned | VARh | 0 |
| 28 | 0x001C | Active energy import (+A) L1 ¹ | {3,{1.0.21.8.0.255},2} | Double long unsigned | Wh | 0 |
| 29 | 0x001D | Active energy import (+A) L2 ¹ | {3,{1.0.41.8.0.255},2} | Double long unsigned | Wh | 0 |
| 30 | 0x001E | Active energy import (+A) L3 ¹ | {3,{1.0.61.8.0.255},2} | Double long unsigned | Wh | 0 |
| 31 | 0x001F | Active energy export (-A) L1 ¹ | {3,{1.0.22.8.0.255},2} | Double long unsigned | Wh | 0 |

| Registers Address - Total Registers | | | | | | |
|-------------------------------------|---------|---|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 32 | 0x0020 | Active energy export (-A) L2 ¹ | {3,{1.0.42.8.0.255},2} | Double long unsigned | Wh | 0 |
| 33 | 0x0021 | Active energy export (-A) L3 ¹ | {3,{1.0.62.8.0.255},2} | Double long unsigned | Wh | 0 |
| 34 | 0x0022 | Max demand active power + (QI+QIV) | {4,{1.0.1.6.0.255},2} | Double long unsigned | W | 0 |
| 35 | 0x0023 | Max demand active power + (QI+QIV) (capture time) | {4,{1.0.1.6.0.255},5} | Clock | - | - |
| 36 | 0x0024 | Max demand active power - (QII+QIII) | {4,{1.0.2.6.0.255},2} | Double long unsigned | W | 0 |
| 37 | 0x0025 | Max demand active power - (QII+QIII) (capture time) | {4,{1.0.2.6.0.255},5} | Clock | - | - |

Note ¹: These registers only apply to three-phase EDP Boxes.

5.6.5 Tariff Registers

| Registers Address - Tariff Registers | | | | | | |
|--------------------------------------|---------|--|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 38 | 0x0026 | Rate 1 contract 1 active energy (+A) | {3,{1.0.1.8.1.255},2} | Double long unsigned | Wh | 0 |
| 39 | 0x0027 | Rate 2 contract 1 active energy (+A) | {3,{1.0.1.8.2.255},2} | Double long unsigned | Wh | 0 |
| 40 | 0x0028 | Rate 3 contract 1 active energy (+A) | {3,{1.0.1.8.3.255},2} | Double long unsigned | Wh | 0 |
| 41 | 0x0029 | Rate 4 contract 1 active energy (+A) | {3,{1.0.1.8.4.255},2} | Double long unsigned | Wh | 0 |
| 42 | 0x002A | Rate 5 contract 1 active energy (+A) | {3,{1.0.1.8.5.255},2} | Double long unsigned | Wh | 0 |
| 43 | 0x002B | Rate 6 contract 1 active energy (+A) | {3,{1.0.1.8.6.255},2} | Double long unsigned | Wh | 0 |
| 44 | 0x002C | Total Rate contract 1 active energy (+A) | {3,{1.0.1.8.10.255},2} | Double long unsigned | Wh | 0 |
| 45 | 0x002D | Rate 1 contract 1 active energy (-A) | {3,{1.0.2.8.1.255},2} | Double long unsigned | Wh | 0 |
| 46 | 0x002E | Rate 2 contract 1 active energy (-A) | {3,{1.0.2.8.2.255},2} | Double long unsigned | Wh | 0 |
| 47 | 0x002F | Rate 3 contract 1 active energy (-A) | {3,{1.0.2.8.3.255},2} | Double long unsigned | Wh | 0 |
| 48 | 0x0030 | Rate 4 contract 1 active energy (-A) | {3,{1.0.2.8.4.255},2} | Double long unsigned | Wh | 0 |
| 49 | 0x0031 | Rate 5 contract 1 active energy (-A) | {3,{1.0.2.8.5.255},2} | Double long unsigned | Wh | 0 |
| 50 | 0x0032 | Rate 6 contract 1 active energy (-A) | {3,{1.0.2.8.6.255},2} | Double long unsigned | Wh | 0 |
| 51 | 0x0033 | Total Rate contract 1 active energy (-A) | {3,{1.0.2.8.10.255},2} | Double long unsigned | Wh | 0 |
| 52 | 0x0034 | Rate 1 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.1.255},2} | Double long unsigned | VARh | 0 |
| 53 | 0x0035 | Rate 2 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.2.255},2} | Double long unsigned | VARh | 0 |
| 54 | 0x0036 | Rate 3 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.3.255},2} | Double long unsigned | VARh | 0 |
| 55 | 0x0037 | Rate 4 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.4.255},2} | Double long unsigned | VARh | 0 |
| 56 | 0x0038 | Rate 5 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.5.255},2} | Double long unsigned | VARh | 0 |

| Registers Address - Tariff Registers | | | | | | |
|--------------------------------------|---------|--|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 57 | 0x0039 | Rate 6 contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.6.255},2} | Double long unsigned | VARh | 0 |
| 58 | 0x003A | Total Rate contract 1 reactive energy QI (+Ri) | {3,{1.0.5.8.10.255},2} | Double long unsigned | VARh | 0 |
| 59 | 0x003B | Rate 1 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.1.255},2} | Double long unsigned | VARh | 0 |
| 60 | 0x003C | Rate 2 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.2.255},2} | Double long unsigned | VARh | 0 |
| 61 | 0x003D | Rate 3 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.3.255},2} | Double long unsigned | VARh | 0 |
| 62 | 0x003E | Rate 4 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.4.255},2} | Double long unsigned | VARh | 0 |
| 63 | 0x003F | Rate 5 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.5.255},2} | Double long unsigned | VARh | 0 |
| 64 | 0x0040 | Rate 6 contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.6.255},2} | Double long unsigned | VARh | 0 |
| 65 | 0x0041 | Total Rate contract 1 reactive energy QII (+Rc) | {3,{1.0.6.8.10.255},2} | Double long unsigned | VARh | 0 |
| 66 | 0x0042 | Rate 1 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.1.255},2} | Double long unsigned | VARh | 0 |
| 67 | 0x0043 | Rate 2 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.2.255},2} | Double long unsigned | VARh | 0 |
| 68 | 0x0044 | Rate 3 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.3.255},2} | Double long unsigned | VARh | 0 |
| 69 | 0x0045 | Rate 4 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.4.255},2} | Double long unsigned | VARh | 0 |
| 70 | 0x0046 | Rate 5 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.5.255},2} | Double long unsigned | VARh | 0 |
| 71 | 0x0047 | Rate 6 contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.6.255},2} | Double long unsigned | VARh | 0 |
| 72 | 0x0048 | Total Rate contract 1 reactive energy QIII (-Ri) | {3,{1.0.7.8.10.255},2} | Double long unsigned | VARh | 0 |
| 73 | 0x0049 | Rate 1 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.1.255},2} | Double long unsigned | VARh | 0 |
| 74 | 0x004A | Rate 2 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.2.255},2} | Double long unsigned | VARh | 0 |
| 75 | 0x004B | Rate 3 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.3.255},2} | Double long unsigned | VARh | 0 |
| 76 | 0x004C | Rate 4 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.4.255},2} | Double long unsigned | VARh | 0 |
| 77 | 0x004D | Rate 5 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.5.255},2} | Double long unsigned | VARh | 0 |
| 78 | 0x004E | Rate 6 contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.6.255},2} | Double long unsigned | VARh | 0 |
| 79 | 0x004F | Total Rate contract 1 reactive energy QIV (-Rc) | {3,{1.0.8.8.10.255},2} | Double long unsigned | VARh | 0 |
| 80 | 0x0050 | Rate 1 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.1.255},2} | Double long unsigned | W | 0 |
| 81 | 0x0051 | Rate 1 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.1.255},5} | Clock | - | - |
| 82 | 0x0052 | Rate 2 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.2.255},2} | Double long unsigned | W | 0 |
| 83 | 0x0053 | Rate 2 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.2.255},5} | Clock | - | - |
| 84 | 0x0054 | Rate 3 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.3.255},2} | Double long unsigned | W | 0 |
| 85 | 0x0055 | Rate 3 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.3.255},5} | Clock | - | - |
| 86 | 0x0056 | Rate 4 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.4.255},2} | Double long unsigned | W | 0 |
| 87 | 0x0057 | Rate 4 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.4.255},5} | Clock | - | - |
| 88 | 0x0058 | Rate 5 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.5.255},2} | Double long unsigned | W | 0 |

| Registers Address - Tariff Registers | | | | | | |
|--------------------------------------|---------|--|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 89 | 0x0059 | Rate 5 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.5.255},5} | Clock | - | - |
| 90 | 0x005A | Rate 6 contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.6.255},2} | Double long unsigned | W | 0 |
| 91 | 0x005B | Rate 6 contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.6.255},5} | Clock | - | - |
| 92 | 0x005C | Total Rate contract 1 Maximum demand active power + (last average) | {4,{1.0.1.6.10.255},2} | Double long unsigned | W | 0 |
| 93 | 0x005D | Total Rate contract 1 Maximum demand active power + (capture time) | {4,{1.0.1.6.10.255},5} | Clock | - | - |
| 94 | 0x005E | Rate 1 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.1.255},2} | Double long unsigned | W | 0 |
| 95 | 0x005F | Rate 1 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.1.255},5} | Clock | - | - |
| 96 | 0x0060 | Rate 2 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.2.255},2} | Double long unsigned | W | 0 |
| 97 | 0x0061 | Rate 2 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.2.255},5} | Clock | - | - |
| 98 | 0x0062 | Rate 3 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.3.255},2} | Double long unsigned | W | 0 |
| 99 | 0x0063 | Rate 3 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.3.255},5} | Clock | - | - |
| 100 | 0x0064 | Rate 4 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.4.255},2} | Double long unsigned | W | 0 |
| 101 | 0x0065 | Rate 4 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.4.255},5} | Clock | - | - |
| 102 | 0x0066 | Rate 5 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.5.255},2} | Double long unsigned | W | 0 |
| 103 | 0x0067 | Rate 5 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.5.255},5} | Clock | - | - |
| 104 | 0x0068 | Rate 6 contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.6.255},2} | Double long unsigned | W | 0 |
| 105 | 0x0069 | Rate 6 contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.6.255},5} | Clock | - | - |
| 106 | 0x006A | Total Rate contract 1 Maximum demand active power - (last average) | {4,{1.0.2.6.10.255},2} | Double long unsigned | W | 0 |
| 107 | 0x006B | Total Rate contract 1 Maximum demand active power - (capture time) | {4,{1.0.2.6.10.255},5} | Clock | - | - |

5.6.6 Instantaneous Values

| Registers Address - Instantaneous Values | | | | | | |
|--|---------|--|------------------------|---------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 108 | 0x006C | Instantaneous Voltage L1 | {3,{1.0.32.7.0.255},2} | Long unsigned | V | -1 |
| 109 | 0x006D | Instantaneous Current L1 | {3,{1.0.31.7.0.255},2} | Long unsigned | A | -1 |
| 110 | 0x006E | Instantaneous Voltage L2 ¹ | {3,{1.0.52.7.0.255},2} | Long unsigned | V | -1 |
| 111 | 0x006F | Instantaneous Current L2 ¹ | {3,{1.0.51.7.0.255},2} | Long unsigned | A | -1 |
| 112 | 0x0070 | Instantaneous Voltage L3 ¹ | {3,{1.0.72.7.0.255},2} | Long unsigned | V | -1 |
| 113 | 0x0071 | Instantaneous Current L3 ¹ | {3,{1.0.71.7.0.255},2} | Long unsigned | A | -1 |
| 114 | 0x0072 | Instantaneous Current (Sum of all phases) ¹ | {3,{1.0.90.7.0.255},2} | Long unsigned | A | -1 |

| Registers Address - Instantaneous Values | | | | | | |
|--|---------|--|------------------------|----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 115 | 0x0073 | Instantaneous Active power + L1 ¹ | {3,{1.0.21.7.0.255},2} | Double long unsigned | W | 0 |
| 116 | 0x0074 | Instantaneous Active power - L1 ¹ | {3,{1.0.22.7.0.255},2} | Double long unsigned | W | 0 |
| 117 | 0x0075 | Instantaneous Active power + L2 ¹ | {3,{1.0.41.7.0.255},2} | Double long unsigned | W | 0 |
| 118 | 0x0076 | Instantaneous Active power - L2 ¹ | {3,{1.0.42.7.0.255},2} | Double long unsigned | W | 0 |
| 119 | 0x0077 | Instantaneous Active power + L3 ¹ | {3,{1.0.61.7.0.255},2} | Double long unsigned | W | 0 |
| 120 | 0x0078 | Instantaneous Active power - L3 ¹ | {3,{1.0.62.7.0.255},2} | Double long unsigned | W | 0 |
| 121 | 0x0079 | Instantaneous Active power + (Sum of all phases) | {3,{1.0.1.7.0.255},2} | Double long unsigned | W | 0 |
| 122 | 0x007A | Instantaneous Active power - (Sum of all phases) | {3,{1.0.2.7.0.255},2} | Double long unsigned | W | 0 |
| 123 | 0x007B | Instantaneous Power factor | {3,{1.0.13.7.0.255},2} | Long unsigned | - | -3 |
| 124 | 0x007C | Instantaneous Power factor L1 ¹ | {3,{1.0.33.7.0.255},2} | Long unsigned | - | -3 |
| 125 | 0x007D | Instantaneous Power factor L2 ¹ | {3,{1.0.53.7.0.255},2} | Long unsigned | - | -3 |
| 126 | 0x007E | Instantaneous Power factor L3 ¹ | {3,{1.0.73.7.0.255},2} | Long unsigned | - | -3 |
| 127 | 0x007F | Instantaneous Frequency | {3,{1.0.14.7.0.255},2} | Long unsigned | Hz | -1 |

Note¹: These registers only apply to three-phase EDP Boxes.

5.6.7 Load Profile

| Registers Address - Load Profile | | | | | | |
|----------------------------------|---------|--|------------------------|-----------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 128 | 0x0080 | Load profile - Configured measurements | {7,{1.0.99.1.0.255},3} | Array[8] ¹ | - | - |
| 129 | 0x0081 | Load profile - Capture period | {7,{1.0.99.1.0.255},4} | Double long unsigned | s | 0 |
| 130 | 0x0082 | Load profile - Entries in use | {7,{1.0.99.1.0.255},7} | Double long unsigned | - | - |
| 131 | 0x0083 | Load profile - Profile entries | {7,{1.0.99.1.0.255},8} | Double long unsigned | - | - |

Note¹: Array of Measurement IDs whose size is fixed and equal to 8. If less than 6 measurements (plus “Clock” and “AMR profile status”) are configured to be captured in the EDP Box’s load profile, then the positions of the array with no measurements assigned should return the value 0xFF (see 5.4.2 - Load Profile).

5.6.8 Disconnecter

| Registers Address - Disconnecter | | | | | | |
|----------------------------------|---------|--------------------------|--------------------------|--------------------------|------|--------|
| Index | Address | Description | OBIS | Type | Unit | Scaler |
| 132 | 0x0084 | Disconnect control state | {70,{0.0.96.3.10.255},3} | Disconnect control state | - | - |
| 133 | 0x0085 | Disconnecter Q parameter | {1,{0.0.128.30.1.255},2} | Double long unsigned | - | - |
| 134 | 0x0086 | Disconnecter K parameter | {3,{0.0.128.30.2.255},2} | Double long unsigned | % | 0 |