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Xemtec Serial Protocol

Serial Protocol definition

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1 Introduction

1.1 Purpose

This document describes the serial communication protocol in use by the Xemtec devices at the lower level.
To avoid any further compatibility issue, it is recommended to use the Xemtec provided SDK (Software Development Kit) in order to write a third party application rather than use these raw low level commands.

1.2 Definitions, Acronyms and Abbreviations

1.3 References

All hexadecimal values are represented using the ANSI C representation (i.e. lead by 0x)

2 Serial Protocol Description

2.1 UART Definition

2.1.1 Physical Layer

The Serial protocol uses a regular Serial Communication physical layer (a.k.a. RS-232). This physical link uses 3 wires: TX to transmit data to the Xemtec device, RX to receive data from the Xemtec device and the ground level.

Pos #	Function	Wire colour	Interface			
			RS232			
1	RX signal	white	X			
5	GND	brown	X			
6	TX signal	green	X			

Table 1 - Xemtec Device Serial Link

The Xemtec device is equipped with a connector (type RJ12 male).

Pin 1	Xemtec device Rx (Tx for external device)
Pin 2	unused
Pin 3	GND
Pin 4	unused
Pin 5	unused
Pin 6	Xemtec device Tx (Rx for external device)

Table 2 - Xemtec Device RJ12 Pinout

The hardware protocol layer is defined as follows:

Baudrate: 19200 bauds in regular communication (2400 bauds in wake up mode)
Parity: none
Data bits: 8
Stop Bits: 1
Hardware flow control: none
Software flow control: none

2.1.2 Logical Layer

The software communication layer is defined as follows:
The communication is initiated by the requester. The Xemtec device always sends a response packet.
The request packet consists of a preamble character ($) followed by a command character, then zero or a variable number of data characters depending of the requested command, followed by a 2 character postamble (EOT/DLE ASCII characters 0x04 and 0x10 respectively).

Example: To request the Xemtec device firmware version.

Request	
ASCII	'$' 'V' EOT DLE
Hex	0x24 0x56 0x04 0x10

The Xemtec device returns the requested information using a similar type packet starting with the $ character preamble, a completion code, zero or a variable number of data characters depending of the requested command, followed by a 2 character postamble (EOT/DLE ASCII characters 0x04 and 0x10 respectively).

Example:

Answer	
ASCII	'$' 'a' 'C' 'O' 'M' 'E' 'T' '-' 'E' 'P' '-' 'V' '3' '.' '1' '2' EOT DLE
Hex	0x24 0x61 0x43 0x4F 0x4D 0x45 0x54 0x2D 0x45 0x50 0x2D 0x56 0x33 0x2E 0x31 0x32 0x04 0x10

List of completion codes:

'a'	0x61	Acknowledge complete
'u'	0x75	Unknown Command
'p'	0x70	Packet Error
's'	0x73	Packet Size Error
'c'	0x63	CRC error in Radio response packet
'i'	0x69	Radio Timeout
't'	0x74	OCR Timeout
'g'	0x67	GOA Error
'j'	0x6A	GOA no acknowledge Error

Table 3 – Serial Protocol Completion Codes

2.1.3 Wake up command

In order to save battery power, the Xemtec device goes into sleep mode between each communication session.
In sleep mode, the UART goes in a lower baudrate (i.e. 2400 bauds). In order to wake up the Xemtec device back, the requestor must send a WakeUp command consisting in a 0xA2 character at the speed of 2400 bauds and wait for 1.5 seconds before sending any request packet to the Xemtec device at 19200 bauds.
As the Xemtec device is awake, it stays in this mode for 5 seconds of inactivity (short timeout typical value) on the line before falling back to sleep mode, unless a UART mode command has been issued. If the UART init command is sent, the Xemtec device stays awake for 4 minutes of inactivity (long timeout typical value) on the line before going back to sleep or until the GoToSleep command is sent.

Note: Always terminate a communication session with a Xemtec device with the GoToSleep command to save Xemtec device batteries.

When putting a Comet device is in Remote Mode, the UART is set to 2400 bauds permanently, no WakeUp command is required. This mode is ideal when the Comet device is connected to a dumb terminal such as a modem (PSTN or GSM).

2.2 Xemtec Device Generic Command List

This section lists all available commands recognized by all Xemtec devices. All requests are shown in both ASCII and Hexadecimal mode.
All Xemtec device answer examples are given as possible values with a positive acknowledge, the actual result of the transaction may be different.

2.2.1 General Purpose Commands

2.2.1.1 GetVersion

This command gets the Xemtec device Firmware version.

Request	
ASCII	'$' 'V' EOT DLE
Hex	0x24 0x56 0x04 0x10
Answer	
ASCII	'$' 'a' 'C' 'O' 'M' 'E' 'T' '-' 'E' 'P' '-' 'V' '3' '.' '1' '2' EOT DLE
Hex	0x24 0x61 0x43 0x4F 0x4D 0x45 0x54 0x2D 0x45 0x50 0x2D 0x56 0x33 0x2E 0x31 0x32 0x04 0x10

2.2.1.2 LowPowerUART

This command sets the Xemtec device immediately in sleep mode. In this mode, the Xemtec device reverts to 2400 bauds and puts the unit in low power consumption.
In order to restart any communication the requester shall send a WakeUp Command (0xA2) and then after 1.5 sec. perform some requests at 19200 bauds making sure that the unit will not be left without any inactivity on the serial line for more than 5 sec. or send the UARTInit command to expand this timeout to 4 min.

Request	
ASCII	'$' 'Q' EOT DLE
Hex	0x24 0x51 0x04 0x10
Answer	
ASCII	'$' 'a' 'L' 'P' '-' 'O' 'N' EOT DLE
Hex	0x24 0x61 0x4C 0x50 0x2D 0x4F 0x4E 0x04 0x10

2.2.1.3 UARTInit

This command wakes up the Xemtec device and sets its UART at 19200 bauds to wait for any further command. The Xemtec device will go back to sleep mode when there is no activity on the serial line for more than 4 min. or immediately when a LowPowerUART command is received.

Request	
ASCII	'$' 'U' EOT DLE
Hex	0x24 0x55 0x04 0x10
Answer	
ASCII	'$' 'a' 'U' 'A' 'R' 'T' '-' 'O' 'N' EOT DLE
Hex	0x24 0x61 0x55 0x41 0x52 0x54 0x2D 0x4F 0x4E 0x04 0x10

2.2.1.4 SetStandbyMode

This command sets the Xemtec device immediately in standby mode. In this mode, the Comet device reverts to 2400 bauds, stops any further activity (Real time clock, Datalogger, Pulse generation, etc.) and puts the unit in low power consumption.
In order to restart the Xemtec device, the requester shall send a WakeUp Command (0xA2) and then after 1.5 sec. perform some requests at 19200 bauds making sure that the unit will not be left without any inactivity on the serial line for more than 5 sec. or send the UARTInit command to expand this timeout to 4 min.

Note: The Xemtec device does not send any answer to that request.

Request	
ASCII	'$' 'Z' EOT DLE
Hex	0x24 0x5A 0x04 0x10
Answer	
ASCII	No answer is sent back by the unit
Hex	

2.2.1.5 GetCapabilities

This command allows the requester to determine what functions are supported by the currently interrogated Xemtec device.
The Xemtec device answer contains a 4 byte buffer representing a long integer (low order first) that consists in a bitmap flag. This flag has a bit set if the corresponding function is available.
The bitmap values are defined as follows:

Bit value	Description
0x00000000	Function GetCapabilities not implemented
0x00000001	Serial interface (RS232) and serial protocol support
0x00000002	Pulse emulation output
0x00000004	Datalogger functions
0x00000008	MBus protocol support
0x00000010	n/a
0x00000020	GSM modem interface or SMS Interface for Comet units
0x00000040	Infra-Red interface
0x00000080	Radio Interface
0x00000100	Wide Screen mode
0x00000200	Pulse input interface
0x00000400	Data concentrator support
……	
0x80000000	New API protocol support

Table 4 - Capability Flag Values

Example:

Request	
ASCII	'$' 'c' 'c' EOT DLE
Hex	0x24 0x63 0x63 0x04 0x10
Answer (typical answer for XPS unit)	
ASCII	'$' 'a' '"' NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x27 0x00 0x00 0x00 0x04 0x10

2.2.1.6 SaveParameters

This command forces the Xemtec device to store in permanent memory the current parameter set.

Request	
ASCII	'$' 's' EOT DLE
Hex	0x24 0x73 0x04 0x10
Answer	
ASCII	'$' 'a' '" NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x27 0x00 0x00 0x00 0x04 0x10

2.2.1.7 GetDeviceConfiguration

This command gets the Xemtec device hardware configuration. The request contains a 1 byte buffer representing the type of requested information out of the following choice:

Command	Description
'p'	Processor type
'r'	Size of RAM (in Ko)
'o'	Size of ROM (in Ko)
'f'	Size of non volatile RAM (in Ko)

Table 5 – Device Configuration Commands

The Xemtec device answer contains a 2 bytes buffer representing a binary integer (low byte first).

Example: Request RAM size. *In this example, the Xemtec device returns 4 for 4 Ko.*

Request	
ASCII	'$' 'i' 'r' EOT DLE
Hex	0x24 0x69 0x72 0x04 0x10
Answer	
ASCII	'$' 'a' EOT NULL EOT DLE
Hex	0x24 0x61 0x04 0x00 0x04 0x10

2.2.1.8 ReloadFirmware

This command allows the requester to force the Xemtec device to execute the bootloader program that will allow loading a new version of the Xemtec device firmware.
If no password was defined the Xemtec device request shall contains a 16 byte buffer representing the Xemtec device serial number as a 16 ASCII character string, otherwise a login procedure must have been initiated and successful before trying to reload the firmware.

Note: If successful the Xemtec device does not answer and falls directly in Bootloader mode.

Note: Reloading the firmware does not reset the device programmed password.

Request	
ASCII	'$' 'R' EOT DLE
Hex	0x24 0x52 0x04 0x10
Answer	
ASCII	No answer is sent back by the unit
Hex	

2.3 Comet C&I Command List

This section lists all available commands recognized by the Comet C&I devices.

2.3.1 Comet Status Commands

2.3.1.1 GetCometTime

This command gets the date and time of the Comet device. The Comet device returns a buffer of 7 binary values representing the year (2 bytes, low order byte first), month, day, hour, min. and sec. This function is available in firmware version 3.12 or later.

In the following example, the date and time value is 08Jan07 14:05:12.

Request	
ASCII	'$' 'r' EOT DLE
Hex	0x24 0x72 0x04 0x10
Answer	
ASCII	'$' 'a' '-|' BELL SOH BS SO ENQ FF EOT DLE
Hex	0x24 0x61 0xD7 0x07 0x01 0x08 0x0E 0x05 0x0C 0x04 0x10

2.3.1.2 SetCometTime

This command sets the date and time of the Comet device. The command provides a buffer of 7 binary values representing the year (2 bytes, low order byte first), month, day, hour, min. and sec. The Comet device responds by returning the date and time. This function is available in firmware version 3.12 or later.

In the following example, the date and time value is 08Jan07 14:05:12 returned time 14:05:13

Request	
ASCII	'$' 'w' '-|' BELL SOH BS SO ENQ FF EOT DLE
Hex	0x24 0x77 0xD7 0x07 0x01 0x08 0x0E 0x05 0x0C 0x04 0x10
Answer	
ASCII	'$' 'a' '-|' BELL SOH BS SO ENQ FF EOT DLE
Hex	0x24 0x61 0xD7 0x07 0x01 0x08 0x0E 0x05 0x0D 0x04 0x10

2.3.2 OCR Related Commands

2.3.2.1 GOA Command

This command invokes the GOA chip functions from the Comet device. These are 5 possible sub commands:

'l' – 0x6C – to capture the left side of the image and store it in the GOA chip memory
'r' – 0x72 – to capture the right side of the image and store it in the GOA chip memory
'b' – 0x62 – to capture both sides of the image and perform the character recognition (a.k.a. OCR) process on the captured images
'o' – 0x6F – to put the GOA chip in sleep mode
'v' – 0x76 – to get the GOA board firmware version

Request	
ASCII	'$' 'A' 'b' EOT DLE
Hex	0x24 0x41 0x56 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

2.3.2.2 GetOCRResult

This command gets from the Comet device the result of the latest OCR processing as a long integer (32 bits) representing the index read and a status byte having the following values:

- 0 – No plausibility check
- 1 – Reading is OK
- 3 – Some digit(s) has(have) inter-digit situation
- 5 – Some digit(s) has(have) low confidence level situation
- 9 – The read value is higher than the last read value plus the hourly delta.

The status byte can also have a combination of these values.

Since firmware 3.12 this command has been extended to return the index as a long integer and the raw reading in BCD format representing the digits recognized. A code of 0xD is returned for an unrecognized character (such as an inter-digit condition) and 0xF is representing a low confidence level digit.

The long integer is coded in little endian format (the first byte is the high order and the last byte is the low order byte).
The BCD code represents a fixed number of 8 digits (4 bytes).

In the following examples, the reading value is 00012345

Request	
ASCII	'$' 'M' EOT DLE
Hex	0x24 0x4D 0x04 0x10
Answer	
ASCII	'$' 'a' NULL NULL '0' '9' SOH EOT DLE
Hex	0x24 0x61 0x00 0x00 0x30 0x39 0x01 0x04 0x10

Request (extended call)	
ASCII	'$' 'M' 'M' EOT DLE
Hex	0x24 0x4D 0x4D 0x04 0x10
Answer	
ASCII	'$' 'a' NULL NULL '0' '9' SOH NULL SOH '#' 'E' EOT DLE
Hex	0x24 0x61 0x00 0x00 0x30 0x39 0x01 0x00 0x01 0x23 0x45 0x04 0x10

2.3.2.3 GetOCRDiagnostic

This command gets the diagnostic values of the latest OCR process. The Comet device returns a buffer of 48 binary values. The first 16 values represent the 8 recognized digits and the 8 confidence levels for these digits (from left to right). The remaining data is empty and can be ignored.

In the following example, the reading value is 00012345 with 5 ROIs defined and a confidence value of 98 for each digit.

Request	
ASCII	'$' 'O' EOT DLE
Hex	0x24 0x4F 0x04 0x10
Answer	
ASCII	'$' 'a' NULL NULL NULL SOH STX ETX EOT ENQ NULL NULL NULL 'b' 'b' 'b' 'b' 'b' EOT DLE
Hex	0x24 0x61 0x00 0x00 0x00 0x01 0x02 0x03 0x04 0x05 0x00 0x00 0x00 0x62 0x62 0x62 0x62 0x62 0x04 0x10

2.3.2.4 GetLastReadTime

This command gets the date and time of the latest OCR process. The Comet device returns a buffer of 7 binary values representing the year (2 bytes, low order byte first), month, day, hour, min. and sec. of the last OCR read. This function is available in firmware version 3.12 or later.

In the following example, the date and time value is 08Jan07 14:05:12.

Request	
ASCII	'$' 'I' EOT DLE
Hex	0x24 0x6F 0x04 0x10
Answer	
ASCII	'$' 'a' '-|' BELL SOH BS SO ENQ FF EOT DLE
Hex	0x24 0x61 0xD7 0x07 0x01 0x08 0x0E 0x05 0x0C 0x04 0x10

2.3.3 Pulse Output Commands

2.3.3.1 InitPulseMode

This command is obsolete and is provided for compatibility with Comet devices with a firmware version lower than 3.12. For other Comet devices, the Configuration Command shall be used.
The request provides a buffer of 4 bytes representing a long integer (32 bits, high order first) to set the current reading that shall be used for further OCR processes and plausibility checking to compute de number of pulses.

In the following example, the original reading value is 00012345.

Request	
ASCII	'$' 'B' NULL NULL '0' '9' EOT DLE
Hex	0x24 0x42 0x00 0x00 0x30 0x39 0x04 0x10
Answer	
ASCII	'$' 'a' 'P' 'U' 'L' 'S' '-' 'O' 'N' EOT DLE
Hex	0x24 0x61 0x50 0x52 0x4F 0x53 0x2D 0x4F 0x4E 0x04 0x10

2.3.3.2 Send10Pulses

This command forces the Coemt device to immediately issue 10 pulses on the pulse output for test purpose.

Request	
ASCII	'$' 'C' EOT DLE
Hex	0x24 0x43 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

2.3.3.3 SetPulseOutputLevel

This command is available on Comet devices with a firmware version later than 3.12.
The request provides a buffer of 1 byte consisting on the desired output level on the pulse output regardless of the pulse counting status: 0 sets it to low, 1 sets it to high.

Request (to set pulse output to low level)	
ASCII	'$' 'P' NULL EOT DLE
Hex	0x24 0x50 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

2.3.4 Comet C&I Configuration Commands

All the following commands are available on Comet devices with a firmware version 3.12 or higher.

A configuration command consists in a regular request command with code 'c' (0x63) followed by a sub command code before zero or a variable number of bytes depending on the requested command.

2.3.4.1 SetUARTParameters

This new compound command allows the user to set the UART speed and activity timeouts:

- *UART Speed* – (2 bytes low order first) A 16 bits integer representing the wanted baudrate. Only baudrates of 2400, 4800, 9600 and 19200 bauds are possible values.
- *Short Timeout* – (1 byte) This value determines the value in seconds of the short timeout. This value is used when the requester sent a wake up character and did not send the UART mode command. The minimal accepted value is 2 seconds and the maximum accepted value is 255 seconds (4 min. 15 sec.)
- *Long Timeout* – (1 byte) This value determines the value in seconds of the long timeout. This value is used when the Comet device received a UART mode command. The minimal accepted value is short timeout as described above and the maximum accepted value is 255 seconds (4 min. 15 sec.)

Note: Care must be taken as a high value of short timeout could have an impact on the Comet device overall consumption.

In the following example, the Comet device is set to 9600 bauds, a short timeout of 5 seconds and a long timeout of 240 seconds (4 min.).

Request	
ASCII	'$' 'c' 'u' SOH 'W' Ç % ENQ ú EOT DLE
Hex	0x24 0x63 0x75 0x01 0x80 0x25 0x05 0xF0 0x04 0x10
Answer	
ASCII	
Hex	

No answer is sent back by the unit if the command has been accepted. A packet error message is sent back by the Comet device.

2.3.5 RF Configuration commands

This section lists some extra commands recognized by the Xemtec device equipped with an integrated radio interface (i.e. XRS and XRF modules).

2.3.5.1 Set Radio Channel

This command is available on COMET radio units with a firmware version later than 3.30. The request provides a buffer of 1 byte consisting on the desired receiving and transmitting channel number (from 1 to 10) out of the 10 channels of 60 kHz each from 868.030 MHz to 868.570 MHz. Default manufacturing channel is set to 6 (i.e. 868.330 MHz)

Setting this value to 0 will disable the radio capability of the module and a value of 15 will force the unit to set the channel to 6 (default manufacturing setting) and to be in receiver mode for 1 second in order to read the actual module frequency using a spectrum analyser for instance.

Request (to set channel to 6)	
ASCII	'$' 'I' ACK EOT DLE
Hex	0x24 0x49 0x06 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

This command "resets" the Radio Parameters immediately and is therefore not available from radio transmission.

2.3.6 EEPROM Memory Access Commands

This section lists some extra commands recognized by the Xemtec device. These commands shall not be used as a corresponding API function shall exist to avoid any memory direct access.
All requests are shown in both ASCII and Hexadecimal mode. All Xemtec devices answer examples are given as possible values with a positive acknowledge, the actual result of the transaction may be different.

2.3.6.1 EEPROMRead

This command reads the Xemtec device EEPROM at the specified address for the specified length.

The request provides a buffer of 3 bytes parameters such as:

- *EEPROM Address* – (2 bytes **high** order first) A 16 bits integer representing the EEPROM memory address the requester wants to read from.
- *Memory Dump Size* – (1 byte) This value represents the maximum number of values to read from memory. This value can be set from 1 to 50 bytes maximum.

The Xemtec device answer contains a buffer of variable size depending of the requested number of bytes.

In this example, the requester read the EEPROM address 0x0000 for 1 byte.

Request	
ASCII	'$' 'K' NULL NULL SOH EOT DLE
Hex	0x24 0x4B 0x00 0x00 0x01 0x04 0x10
Answer	
ASCII	'$' 'a' NULL EOT DLE
Hex	0x24 0x61 0x00 0x04 0x10

2.3.6.2 EEPROMWrite

This command writes the Xemtec device EEPROM at the specified address for the specified length. Care must be taken as erroneous data stored in memory can prevent the Xemtec device from working or even damage the unit.

The request provides a buffer of 3 bytes parameters such as:

- *EEPROM Address* – (2 bytes **high** order first) A 16 bits integer representing the EEPROM memory address the requester wants to write to.
- *Memory Dump Size* – (1 byte) This value represents the maximum number of values to write to memory. This value can be set from 1 to 50 bytes maximum.

These parameters are followed by the raw data to be written.

In this example, the requester writes 0x00 in the EEPROM address 0x0000 for 1 byte.

Request	
ASCII	'$' 'D' NULL NULL SOH NULL EOT DLE
Hex	0x24 0x44 0x00 0x00 0x01 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

2.3.6.3 EEPROMWriteProtect

This command sets and removes the Xemtec device EEPROM write protection. Care must be taken as erroneous data stored in memory can prevent the Xemtec device from working or even damage the unit.

The request provides a character command ‘s’ (0x73) to seal (write protect) the EEPROM, or ‘u’ (0x75) to unseal (write enable) the EEPROM.

In this example, the requester write protects the EEPROM memory.

Request	
ASCII	‘$’ ‘Y’ ‘s’ EOT DLE
Hex	0x24 0x59 0x73 0x04 0x10
Answer	
ASCII	‘$’ ‘a’ EOT DLE
Hex	0x24 0x61 0x04 0x10

2.3.7 EEPROM Memory Map

WARNING: ***This EEPROM memory map is given as an example and may change in future versions of the Xemtec device firmware. Care must be taken not to base any development on this map and use generic API function to access a COMET parameter instead.***

The description of the memory map is given as standard C include file format.
Please contact Xemtec AG for any further details.

```
#define ADDR_LOGSPACESTART    0x0000  // 6000 Bytes for Datalogger
#define ADDR_LOGSPACESTOP     0x1770  // Last address for Datalogger
#define ADDR_LOGTIMESTAMP     0x1780  // Last log time stamp
#define ADDR_MAXLOGSPACE      0x1784  // Maximum number of records
#define ADDR_LOGMODE          0x1786  // Datalogger Mode
#define COMET_SERIAL_NUMBER   0x1800  // COMET Serial number
#define COMET_SUB_ID          0x1810  // COMET Serial sub ID
#define METER_SERIAL_NUMBER   0x1820  // Meter Serial number (16 bytes)
// Acquisition parameters
#define ADDR_OCRPARAM         0x1832  // OCR parameters
#define NUMBER_OF_DIGITS      0x1832  // Number of digits
#define PLAUSIBILITY_FLAG     0x1833  // Plausibility check on/off flag
#define PLAUSIBILITY_THRESHOLD 0x1834 // Plausibility Confidence threshold
#define PLAUSIBILITY_MAX_DELTA 0x1835 // Max reading difference for
plausibility check (16 bits)
#define ADDR_PULSEFACTOR      0x1837  // Pulse factor
#define OCR_RETRY             0x1838  // Number of OCR reading attemps
// Pulse mode parameters
#define ADDR_PERIOD           0x1839  // Capture period (16 bits in ms)
#define ADDR_PULSEHIGH        0x183B  // Pulse high period
#define ADDR_PULSELOW         0x183C  // Pulse low period
#define PULSE_LED_ON          0x183D  // Flag to have LED flashing monitoring
#define ADDRCOMMODE           0x183E  // Communication mode
#define PLAUSIBILITY_MAX_LIMIT 0x183F // Max reading difference limit (16
bits)
#define ADDR_RETRIES          0x1841  // Number of current OCR retries
#define ADDR_RFPARAM          0x1850  // RF parameters
#define ADDR_RTPARAM1         0x1850
#define ADDR_RTPARAM2         0x1851
#define ADDR_FSPARAM1         0x1852
#define ADDR_RF_CHANNEL       0x1853
#define ADDR_FSPARAM2         0x1853
#define ADDR_FSPARAM3         0x1854
#define ADDR_ADPARAM1         0x1855
#define ADDR_ADPARAM2         0x1856
#define ADDR_RSSI_THERSHOLD   0x1857
#define ADDR_RFIFF_MODE       0x1858
#define ADDR_RF_WAKEUP        0x1859
#define ADDR_RF_TIMEOUT       0x185A
#define ADDR_RF_FREQ_SHIFT    0x185B
#define ADDR_RF_LAST_FREQ     0x185E
#define COMET_HW_ASSEMBLY     0x1EDE  // COMET Hardware variant assembly
#define COMET_HW_VERSION      0x1EDF  // COMET Hardware version
#define ADDR_MBUS_ID          0x1EE0  // COMET MBUS ID (4 bytes)
#define ADDR_MBUS_PRODUCT_NB  0x1EE4  // COMET MBUS Product Number (20 bytes)
#define ADDR_MBUS_MEDIUM      0x1EF8  // COMET MBUS Medium id (03 = Gas)
#define ADDR_MBUS_MANUFACTURER 0x1EF9 // COMET MBUS Manufacturer code (2
bytes Low-High)
#define ADDR_MBUS_SW_VERSION  0x1EFB  // COMET MBUS Software Version
#define ADDR_MBUS_BUS_ADDR    0x1EFC  // COMET MBUS Bus Address
```

```
#define ADDR_MBUS_CUSTOMER_ID 0x1F00  // COMET MBUS freeform customer ID (255
bytes)
// GOA - PCB EEPROM Memory Map
#define OCR_RESULT_BUFFER     0x2000  // OCR result RAM space
#define OCR_END_RESULT_BUFFER 0x2FFF
#define OCR_NUMBER_ROI        0x3020  // OCR Total number of ROIs
#define OCR_NUMBER_ROI_RIGHT  0x3021  // OCR Number of ROIs on the right
image part
#define OCR_BLACK_BACKGROUND  0x3022  // OCR Black or White background
#define OCR_ROI_XSIZE         0x3023  // OCR Width of ROI boxes
#define OCR_ROI_YSIZE         0x3024  // OCR Height of ROI boxes
#define GOA_CHIP_REGISTERS    0x3030  // This is internally used
#define GOA_MAX_SHUTTER_LEFT  0x3035  // OCR maximum shutter delay left
#define GOA_MAX_SHUTTER_RIGHT 0x3036  // OCR maximum shutter delay right
#define GOA_MIN_SHUTTER_LEFT  0x3037  // OCR minimum shutter delay left
#define GOA_MIN_SHUTTER_RIGHT 0x3038  // OCR minimum shutter delay right
#define GOA_EDGE1_LEVEL       0x304D  // OCR Edge1 parameter
#define OCR_ROI_LEFT          0x3080  // OCR ROI positions for left image
#define OCR_ROI_RIGHT         0x30A0  // OCR ROI positions for right image
#define OCR_ROI_FULL          0x30D0  // OCR ROI positions for full image
#define OCR_ROI_COL           0x30C0  // OCR ROI column position
#define OCR_WEIGHT_SET        0x3400  // OCR Weight Set start location
#define OCR_WEIGHT_SET_END    0x3EFA
#define ADDR_END_ EEPROM      0x3FFF
```

Other address value may be internally used or reserved for future use.

2.4 Configuration Commands

A configuration command consists in a regular request command with code 'c' (0x63) followed by a sub command code before zero or a variable number of bytes depending on the requested command.

2.4.1.1 SetupDatalogger

The request provides a buffer of 6 bytes, or 13 bytes in extended mode, to set datalogging function parameters such as:

- *Function Version* – (1 byte). Must be set to 1
- *Datalogger Mode* – (1 byte). This parameters has 3 different possible values :
  - 0 – To stop the Datalogger
  - 1 – To set the Datalogger in ring buffer mode. In this mode, values are stored in memory replacing the oldest record when the memory is full.
  - 2 – To set the Datalogger in watermark mode. In this mode, values are stored in memory up to the maximum number of records. Then the Datalogger stops.
- *Acquisition Period* – (2 bytes low order first) A 16 bits integer representing the periodicity in seconds between two OCR processes to be recorded. If this value is set to zero, the previous acquisition period value is preserved. This value can bet set between 1 min. (60 sec.) and 12 hours (43200 sec.)
- *Datalogger Maximum Records* – (2 bytes low order first) A 16 bits integer representing the maximum number of values to record in memory. This value can be set from 0 to 1500 records. If 0 is chosen, the Xemtec device will periodically perform an OCR but won't store the result in memory.
- *Starting Date & Time* – (Optional parameter – 7 bytes) A structure of data representing the year (as a 16 bits integer low order first), the month, the day, the hour, the minute and second at which the first record shall be stored.

Note: The Acquisition Period parameter is shared between Datalogger and Pulse function.

The Xemtec device answer contains a buffer of 4 bytes.

In the following example, the requester starts immediately the Datalogger function in ring buffer mode, for 100 records with a periodicity of 5 min. (300 sec.).

Request	
ASCII	'$' 'c' 'd' SOH SOH ',' SOH 'd' NULL EOT DLE
Hex	0x24 0x63 0x64 0x01 0x01 0x2C 0x01 0x64 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

In the following example, the requester starts the Datalogger function in ring buffer mode, for 100 records with a periodicity of 5 min. (300 sec.). The first record shall be on the 08Jan07 at 14:00:00

Request	
ASCII	'$' 'c' 'd' SOH SOH ',' SOH 'd' NULL '-|' BELL SOH BS SO NULL NULL EOT DLE
Hex	0x24 0x63 0x64 0x01 0x01 0x2C 0x01 0x64 0x00 0xD7 0x07 0x01 0x08 0x0E 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' EOT DLE
Hex	0x24 0x61 0x04 0x10

2.4.1.2 GetDataloggerStatus

This command allows the requester to read the current status of the Datalogger of the Xemtec device.
The Xemtec device answer contains a 16 byte buffer containing the following information:

- *Function Version* – (1 byte) This value is always set to one.
- *Datalogger Mode* – (1 byte). This parameters has 3 different possible values :
  - 0 – Datalogger stopped
  - 1 – Datalogger in ring buffer mode. In this mode, values are stored in memory replacing the oldest record when the memory is full.
  - 2 – Datalogger in watermark mode. In this mode, values are stored in memory up to the maximum number of records. Then the Datalogger stops.
- *Acquisition Period* – (2 bytes low order first) A 16 bits integer representing the periodicity in seconds between two OCR processes to be recorded.
- *Datalogger Maximum Records* – (2 bytes low order first) A 16 bits integer representing the maximum number of values in memory.
- *Last Record Date & Time* – (7 bytes) A structure of data representing the year (as a 16 bits integer low order first), the month, the day, the hour, the minute and second at which the last record has been stored.
- *Number of Actual Records* – (2 bytes) A 16 bits integer representing the maximum number of stored values.
- *Maximum Number of Records per Request* – (1 byte) This value represents the maximum number of Datalogger records that can be expected per GetDataloggerRecord request.

In the following example, the Xemtec device returns a Datalogger started in ring buffer mode, with a periodicity of 5 min. (300 sec.) and a storage of 100 records maximum. A last read date of 01Jan2000 at 00:00:00 (= no date), no current record and a maximum record per request of 14 (typical data for XPS-60)

Request	
ASCII	'$' 'c' 's' EOT DLE
Hex	0x24 0x63 0x73 0x04 0x10
Answer	
ASCII	'$' 'a' SOH SOH ',' SOH 'd' NULL 'u' BELL SOH SOH NULL NULL NULL NULL NULL SO EOT DLE
Hex	0x24 0x61 0x01 0x01 0x2C 0x01 0x64 0x00 0xD0 0x07 0x01 0x01 0x00 0x00 0x00 0x00 0x00 0x0E 0x04 0x10

2.4.1.3 GetDataloggerRecord

This command allows the requester to read one or more records from the Datalogger of the Xemtec device.

The request provides a buffer of 3 bytes to select Datalogger records:

- *Record Number* – (2 bytes) A 16 bits integer (low order first) that represents the first record number to transmit. The latest record (newer in time) is record number 0.
- *Number of Records* – (1 byte) This value represents the number of records to transmit. Should this value exceed the maximum number of available records or the maximum number of records that could be transmitted per request, the maximum number of records is transmitted.

The Xemtec device answer contains a variable length buffer, depending on the requested number of records, representing the following information:

- *Number of Transmitted Records* – (1 byte) This value represents the number of records contained in this data packet.
- *Datalogger Record* – (4 bytes * number of records) Each group of 4 bytes represents the reading in BCD format. A code of 0xD is returned for an unrecognized character (such as an inter-digit condition) and 0xF is representing a low confidence level digit.

If no record is available, an empty ACK answer is sent back.

In the following example, the requester asks for the record number 1 and the Xemtec device returns 1 record with a value of 00012345.

Request	
ASCII	'$' 'c' 'r' SOH NULL SOH EOT DLE
Hex	0x24 0x63 0x72 0x01 0x00 0x01 0x04 0x10
Answer	
ASCII	'$' 'a' '"' SOH NULL SOH '#' 'E' EOT DLE
Hex	0x24 0x61 0x01 0x00 0x01 0x23 0x45 0x04 0x10

2.4.1.4 SetPulseParameters

This new compound command allows the user to set or get all parameters at once to initiate the pulse emulation output mode. The request contains the following parameters:

- *Function Version* – (1 byte) Must be set to 1
- *Function Mode* – (1 byte) This value determines whether this command will set ('W' or a value of 1) or get ('R' or a value of 0) the pulse mode information.
- *Acquisition Period* – (2 bytes low order first) A 16 bits integer representing the periodicity in seconds between two OCR processes to compute delta value and send pulses. If this value is set to zero, the previous acquisition period value is preserved. This value can bet set between 1 min. (60 sec.) and 12 hours (43200 sec.)
- *Pulse Factor* – (2 bytes low order first) A 16 bits integer representing the number of the pulses to be sent for each unit difference.
- *Pulse High Delay* – (1 byte) This value represents, in 128th of seconds, the duration of the high level state of the pulse output.
- *Pulse Low Delay* – (1 byte) This value represents, in 128th of seconds, the duration of the low level state of the pulse output (between two pulses).
- *Current Reading* – (4 bytes) A 32 bits long integer (high order first) that represents the starting reading value. If this parameter is set to zero, it is ignored and the currently recorded value in the Xemtec device is used.

Note: Depending of the Xemtec device, the Acquisition Period parameter can be shared between Datalogger and Pulse function.

In the following example, the Xemtec device is set with a periodicity of 5 min. (300 sec.), a pulse factor of one, a high and low delay of 100 / 128 seconds.

Request	
ASCII	'$' 'c' 'p' SOH 'W' ',' SOH SOH 'd' 'd' NULL NULL NULL NULL EOT DLE
Hex	0x24 0x63 0x70 0x01 0x57 0x2C 0x01 0x01 0x64 0x64 0x00 0x00 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' SOH 'R' ',' SOH SOH NULL 'd' 'd' EOT DLE
Hex	0x24 0x61 0x01 0x52 0x2C 0x01 0x01 0x00 0x64 0x64 0x04 0x10

2.5 New API Commands

Starting with Comet C&I with a firmware version greater than 3.12, and for all other Xemtec devices, the protocol uses a new format of commands called new API.
This new format allows the Xemtec device to be programmed (get and set parameters) regardless of the hardware structure of the device (memory type and size, device capability, etc.)

A Get/Set Parameter command consists of a regular request command with code 'p' (0x70) followed by a sub command code (16 bits integer value low byte first), a read/write flag (1 byte) before zero or a variable number of bytes depending on the requested command.
The Xemtec device answer consists in a variable size buffer returning the requested value for read mode or the written value for write mode.

Note: The Read/Write flag value is checked against the lowest order bit of the byte allowing the requester to use either a binary 0/1 value (0 = read, 1= write) or ASCII values such as '0' or '1', 'R' or 'W', 'r' or 'w', etc. Some commands are read only commands, a write request will result in a read command instead.

Example:

This command reads the device serial number.

Request	
ASCII	'$' 'p' NULL NULL 'R' EOT DLE
Hex	0x24 0x70 0x00 0x00 0x52 0x04 0x10
Answer	
ASCII	'$' 'a' '0' '6' '0' '1' '1' '8' '0' '0' '0' '0' '0' '0' '0' '0' '1' EOT DLE
Hex	0x24 0x61 0x30 0x36 0x30 0x31 0x31 0x38 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x31 0x04 0x10

2.5.1 Xemtec Device General Parameters

2.5.1.1 SerialNumber (Code 0)

This read-only command allows the requester to read the serial number of the Xemtec device.
The Xemtec device answer contains a 16 byte buffer representing a 16 ASCII character string.

2.5.1.2 CometSubID (Code 1)

This command allows the requester to read or write the Xemtec device sub ID string (typically XEMTEC).
The Xemtec device request and answer contains an 8 byte buffer representing an 8 ASCII character string.

2.5.1.3 MeterSerialNumber (Code 2)

This command allows the requester to read or write the Meter serial number associated with the Xemtec device.
The Xemtec device request and answer contains an 8 byte buffer representing an 8 ASCII character string

2.5.1.4 DeviceHardwareAssembly (Code 3)

This read-only command allows the requester to read the Xemtec device hardware assembly version.
The Xemtec device answer contains 1 byte representing the hardware assembly version

2.5.1.5 DeviceHardwareVersion (Code 4)

This read-only command allows the requester to read the Xemtec device hardware platform version.
The Xemtec device answer contains 1 byte representing the Xemtec device hardware platform version.

2.5.1.6 DeviceDescription (Code 5)

This command allows the requester to read or write the description associated with the Xemtec device.
The Xemtec device request and answer contains up to 48 bytes representing an ASCII character string

2.5.1.7 DevicePassword (Code 6)

This write only command allows the requester to write the Meter serial number associated with the Xemtec device.
The Xemtec device request contains up to 16 bytes representing the password that will protect any further write command.

Note: The Xemtec device never returns the actual password, but always an empty ACK response if the password change was successful.

Warning: It is impossible to overcome any forgotten password. The unit will remain in read mode forever.

2.5.1.8 BootloaderVersion (Code 8)

This read only command allows the requester to read the Xemtec device bootloader microcode version. The answer contains a variable length buffer representing the Xemtec device bootloader program version as a NULL terminated ASCII character string .

2.5.2 Xemtec Device Status Parameters

2.5.2.1 DateTime (Code 10)

This command allows the requester to read or write the Xemtec device internal RTC (Real Time Clock).
The Xemtec device request and answer contains a 7 byte binary values representing the year (2 bytes, low order byte first), month, day, hour, min. and sec.

2.5.2.2 DeviceLogin (Code 11)

This command allows the requester to initiate the login procedure to the Xemtec device. This login procedure takes place in two steps using the Get Parameter and then the Set Parameter scheme to perform a Challenge/Response type of operation:

- The requester sends a read request (Get Parameter) at which the Xemtec device will answer by sending out a challenge key composed of 16 bytes.
- The requester sends a write request (Set Parameter) containing as a response the previous 16 bytes XORed with the known password padding right the password with NULL bytes, XORed with 0xFF, XORed with the Xemtec device serial number and XORed with 0xAA.

2.5.2.3 EventList (Code 12)

This read only command allows the requester to read the Xemtec device event list.
The Xemtec device answer contains a byte representing the number of records and a variable number of records composed of 9 bytes each representing:

- *Event Type* – (1 byte) Represents the type of event (see hereunder for description)
- *Next Event Timestamp* – (4 bytes) representing the date and time of the next event trigger. This value is the number of elapsed seconds since 01Jan2000.
- *Event Period* – (4 bytes) representing the periodicity of the event expressed in seconds. A value of 0xFFFFFFFF represents a one time event.

As of the time of writing, the event type can have one of the following values:

Event Type	Value	Event Description
UNKNOWN_EVENT	0x00	No description for that event is provided
DATALOGGER_EVENT_TYPE	0x01	Scheduled OCR read used to store data in the device datalogger
PULSE_OUT_EVENT_TYPE	0x02	Scheduled OCR read used to issue output pulse count
PULSE_IN_EVENT_TYPE	0x03	Scheduled pulse input count integration used to store result in datalogger
FIRMWARE_UPDATE_EVENT_TYPE	0x0A	One time scheduled date and time for automatic firmware update (future extension)
GPRS_CALL_EVENT_TYPE	0x14	Scheduled date and time of next GPRS call
GPRS_TIMEOUT_EVENT_TYPE	0x15	One time scheduled date and time of maximum GPRS connection global timeout
DATALOGGER_SCAN_EVENT_TYPE	0x1E	Scheduled date and time of regular low power radio scan through all attached Xemtec sensors to collect locally their datalogger data

Table 6 - Xemtec Device Event Types

2.5.2.4 Device Status (Code 13)

This read only command allows the requester to read the Xemtec device status byte.
The Xemtec device answer contains a byte representing:

Bit 0	Low Battery
Bit 1	Stack Overflow error
Bit 2	Unused
Bit 3	Unused
Bit 4	SIM card error
Bit 5	GSM network attach error
Bit 6	GPRS connection error
Bit 7	GPRS Server connection error

Table 7 - Device Status Flag Values

2.5.2.5 DeviceRemoteData (Code 15)

This read-only command allows the requester to read the basic information describing the Xemtec device.
The Xemtec device answer contains up to 23 bytes representing the following:

- Device serial number – (16 bytes)
- Filler – (1 byte) unused
- Decimal point position – (1 byte)
- Number of digits – (1 byte)
- MBus address – (1 byte) – A value of 0xFF means serial interface.
- RF Channel – (1 byte)
- Maximum Hourly Delta – (2 bytes)

2.5.3 OCR Related Commands

2.5.3.1 OCRRetries (Code 100)

This command allows the requester to read or write the Xemtec device number of OCR processes retries. This value goes from 0 to 9.
The Xemtec device request and answer contains a 1 byte buffer representing this value in binary format.

2.5.3.2 OCRPlausibilityFlag (Code 101)

This command allows the requester to read or write the Xemtec device OCR plausibility flag.
The Xemtec device request and answer contains a 1 byte buffer representing a Boolean value only in binary format.

2.5.3.3 OCRConfidenceLevelThreshold (Code 102)

This command allows the requester to read or write the Xemtec device OCR Confidence Level Threshold value. This value is used during the plausibility check. It goes from 0 to 100.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.3.4 OCRMaxDelta (Code 103)

This command allows the requester to read or write the Xemtec device OCR Maximum Hourly Flow value. This value is used during the plausibility check.
The Xemtec device request and answer contains a 2 byte buffer representing a 16 bit integer (low byte first) being the value in binary format.

2.5.3.5 OCREdge1 (Code 104)

This command allows the requester to read or write the Xemtec device OCR Edge1 value. This value is used during the image capture. It goes from 60 to 110 (typically 80). Care must be taken while setting this value as a wrong parameter might prevent the Xemtec device from performing a correct OCR.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.3.6 OCRShutterDelay (Code 105)

This command allows the requester to read or write the Xemtec device OCR Shutter Delay value. This value is used during the image capture. It goes from 16 to 48. Care must be taken while setting this value as a wrong parameter might prevent the Xemtec device from performing a correct OCR.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.3.7 OCRLastRetries (Code 106)

This read-only command allows the requester to read the Xemtec device OCR Last Retries value. This value represents the number of retries that the OCR process did to validate the plausibility test.
The Xemtec device answer contains a 1 byte buffer representing the value in binary format.

2.5.3.8 OCRNumberOfDigits (Code 107)

This command allows the requester to read or write the Xemtec device OCR Number Of Digits used in the OCR process.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. This value goes from 1 to 8.

2.5.3.9 OCRNumberOfROIs (Code 108)

This command allows the requester to read or write the Xemtec device the OCR total Number Of ROIs (Regions Of Interest).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value goes from 1 to 8. Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

2.5.3.10 OCRNumberOfRightROIs (Code 109)

This command allows the requester to read or write the Xemtec device the OCR Number Of ROIs (Regions Of Interest) for the right hand side image.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value goes from 1 to 4. Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

2.5.3.11 OCRBlackBackground (Code 110)

This command allows the requester to read or write the Xemtec device OCR Black Background flag.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value shall be 1 for white digits on black background and 0 for black digits on white background for each digits bit0 is the rightmost digit.

2.5.3.12 OCRROIWidth (Code 111)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Width.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value goes from 8 to 18. Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

2.5.3.13 OCRROIHeight (Code 112)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Height.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value goes from 16 to 28. Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

2.5.3.14 OCRROIsLeftMask (Code 113)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Mask for the left hand side of the image.
The Xemtec device request and answer contains a 32 byte buffer representing the array of binary values representing the ROI mask (on a row of 248 pixels, each bit set to 1 represents an active pixel). Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

In this example, the left ROI mask sets two 16 width pixels ROIs located at horizontal coordinates 12 and 36 (from upper left corner)
i.e.
00000000000111111111111111000000001111111111111110000000…0000000000
0x001FFFE001FFFE00000000000000000000000000000000000000000000000000

Request (set ROI Left Mask)	
ASCII	'$' 'p' 'q' NULL 'W' NULL US ' ' 'α' US ' ' 'α' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x70 0x71 0x00 0x57 0x00 0x1F 0xFF 0xE0 0x1F 0xFF 0xE0 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' NULL US ' ' 'α' US ' ' 'α' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x00 0x1F 0xFF 0xE0 0x1F 0xFF 0xE0 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10

2.5.3.15 OCRROIsRightMask (Code 114)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Mask for the right hand side of the image.
The Xemtec device request and answer contains a 32 byte buffer representing the array of binary values representing the ROI mask (on a row of 248 pixels, each bit set to 1 represents an active pixel). Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device from performing correctly.

In this example, the right ROI mask sets two 16 width pixels ROIs located at horizontal coordinates 112 and 136 (from upper left corner)
i.e.
00000000…000111111111111111100000000111111111111111000000000000000
0x00000000000000000000000000000FFFF00FFFF00000000000000000000000000

Request (set ROI Right Mask)	
ASCII	'$' 'p' 'r' NULL 'W' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL ' ' ' ' NULL ' ' ' ' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x70 0x72 0x00 0x57 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL ' ' ' ' NULL ' ' ' ' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10

2.5.3.16 OCRROIsTotalMask (Code 115)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Mask for both sides of the image. It is a combination of the two previous masks.
The Xemtec device request and answer contains a 32 byte buffer representing the array of binary values representing the ROI mask (on a row of 248 pixels, each bit set to 1 represents an active pixel). Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device to perform correctly.

In this example, the ROI mask sets four 16 width pixels ROIs located at horizontal coordinates 12, 36, 112 and 136 (from upper left corner)
i.e.
`0x001FFFE001FFFE00000000000000FFFF00FFFF00000000000000000000000000`

Request (set ROI Total Mask)	
ASCII	'$' 'p' 's' NULL 'W' NULL US ' ' 'α' US ' ' 'α' NULL NULL NULL NULL NULL NULL NULL ' ' ' ' NULL ' ' ' ' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x70 0x73 0x00 0x57 0x00 0x1F 0xFF 0xE0 0x1F 0xFF 0xE0 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' NULL US ' ' 'α' US ' ' 'α' NULL NULL NULL NULL NULL NULL NULL ' ' ' ' NULL ' ' ' ' NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x00 0x1F 0xFF 0xE0 0x1F 0xFF 0xE0 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0xFF 0xFF 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10

2.5.3.17 OCRROIsColumnMask (Code 116)

This command allows the requester to read or write the Xemtec device OCR ROIs (Regions Of Interest) Column Mask (Height) for both side of the image.
The Xemtec device request and answer contains a 8 byte buffer representing the array of binary values representing the ROI mask (on a row of 48 pixels, each bit set to 1 represents an active pixel). Care must be taken to set a valid value for this parameter as it may prevent the Xemtec device to perform correctly.

In this example, the column ROI mask sets a global height of 10 pixels starting at position 9 from the top of the image.
i.e.
000000001111111110000000000000000000000000000000
0x00FFFF0000000000

Request (set ROI Column Mask)	
ASCII	'$' 'p' 't' NULL 'W' NULL ' ' ' ' NULL NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x70 0x74 0x00 0x57 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x04 0x10
Answer	
ASCII	'$' 'a' NULL ' ' ' 'NULL NULL NULL NULL NULL EOT DLE
Hex	0x24 0x61 0x00 0xFF 0xFF 0x00 0x00 0x00 0x00 0x00 0x00 0x04 0x10

2.5.3.18 OCRWeightSetInformation (Code 117)

This command allows the requester to read the weightset parameter file info stored in the Xemtec device or write a new one.
The Xemtec device answer contains 6 bytes representing:

- Weightset location – (2 bytes)
- Weightset length – (2 bytes)
- Weightset checksum value – (2 bytes)

A write command from the requester will place the Xemtec device in receive mode to receive the weightset file using the standard XModem protocol.

2.5.3.19 OCRResults (Code 118)

This read-only command allows the requester to read the results of the last OCR performed by the Xemtec device.
The Xemtec device answer contains 16 bytes representing 8 characters interpreted by the OCR from right to left, and the respective 8 confidence levels.

2.5.3.20 OCRDateTime (Code 119)

This read-only command allows the requester to read the date and time of the last OCR performed by the Xemtec device.
The Xemtec device answer contains 7 bytes representing the year (in 2 bytes), month, day, hour, minutes and seconds.

2.5.3.21 OCRDecimalPoint (Code 120)

This command allows the requester to read or write the virtual position of the decimal point to place in the OCR result of the Xemtec device.
The Xemtec device request and answer contains 1 byte representing the virtual position (from 0 to 7).

2.5.3.22 OCRValue (Code 121)

This read-only command allows the requester to read the last known OCR result and the associated date and time performed by the Xemtec device.
The Xemtec device answer contains 16 bytes representing:

- The current reading as a long integer (4 bytes)
- The reading status (1 byte)
- The date and time of the read (7 bytes) composed of year (2 bytes), month, day, hour, minutes and seconds.

2.5.3.23 OCRFlipDigits (Code 122)

This command allows the requester to read or write the “flip digits flag” used by the OCR function to process the digits image upside down.
The Xemtec device request and answer contains 1 byte representing the value of the flag.
When this flag is set, the image is processed upside down, allowing to place the Xemtec device upside down on the meter.

2.5.3.24 OCRWideScreen (Code 124)

This command allows the requester to read or write the “wide screen flag” used by the OCR of the Xemtec device.
The Xemtec device request and answer contains 1 byte representing the value of the flag.
When this flag is not set, a reservation of 16 pixels is done on the right hand side of the OCR image for downward compatibility.

2.5.4 MBus Protocol Related Commands

2.5.4.1 MBusID (Code 150)

This red-only command allows the requester to read the Xemtec device MBus unique ID.
The Xemtec device answer contains an 8 byte buffer representing by default the lower part of the Xemtec device serial number as an ASCII string.

2.5.4.2 MBusManufacturer (Code 151)

This read-only command allows the requester to read the Xemtec device MBus manufacturer ID coded on 2 bytes as per the MBus protocol definition. Xemtec has a registred manufacturer ID of XEM (0x60AD).

2.5.4.3 MBusSoftwareVersion (Code 152)

This read-only command allows the requester to read the Xemtec device Mbus software version as 1 byte value. Default value is 1.

2.5.4.4 MBusMedium (Code 153)

This command allows the requester to read or write the Xemtec device MBus medium type value as per the MBus protocol definition (ex.: 0x03 = Gas).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.4.5 MBusUnit (Code 154)

This command allows the requester to read or write the Xemtec device MBus unit id type value as per the MBus protocol definition (m3, kWh, etc.).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.4.6 MBusCustomerID (Code 155)

This command allows the requester to read or write the Xemtec device MBus freeform information. This command is a copy of the DeviceDescription command (Code 5).
The Xemtec device request and answer contains up to 48 bytes representing an ASCII character string.

2.5.4.7 MBusRSPUDType (Code 156)

This command allows the requester to read or write the Xemtec device RSPUD response type flag.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. If the flag is set to 1 the RSPUD request will send the last known value in BCD format, otherwise the last OCR result in BCD format (including 0xD and 0xF values) is sent.

2.5.4.8 MBusAddress (Code 157)

This command allows the requester to read or write the Xemtec device MBus address value (from 0 to 250).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.5 Radio Related Commands

2.5.5.1 RFChannel (Code 200)

This command allows the requester to read or write the Xemtec device RF channel to use (from 0 to 10).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. A value of 0 will switch off the RF interface.

2.5.5.2 RFRSSI (Code 201)

This command allows the requester to read or write the Xemtec device minimum level of RSSI (RF channel reception energy) that will trigger the Xemtec device receiver to scan for incoming messages.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. The value signification varies depending on the type of device.

2.5.5.3 RFShift (Code 202)

This command allows the requester to read or write the Xemtec device RF central frequency shift.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. This value is set during the manufacturing process and shall not be modified.

2.5.5.4 RFLastFrequency (Code 203)

This read-only command allows the requester to read the last value of the received central frequency by the Xemtec device.
The Xemtec device request and answer contains a 2 bytes buffer representing the value in binary format. This value is used for manufacturing controls only.

2.5.5.5 RFWakeUp (Code 204)

This command allows the requester to read or write the Xemtec device RF WakeUp signal wait duration.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. This value is set during the manufacturing process and shall not be modified.

2.5.5.6 RFTimeout (Code 205)

This command allows the requester to read or write the Xemtec device RF overall timeout value.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. This value is set during the manufacturing process and shall not be modified.

2.5.5.7 RFRepeaterMode (Code 210)

This command allows the requester to read or write the Xemtec device RF repeater function flag.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format. If the flag is set to 1 the Xemtec device will behave as a repeater (if this feature is available).

2.5.6 GSM/GPRS Related Commands

2.5.6.1 GPRSAPN (Code 300)

This command allows the requester to read or write the Xemtec device GPRS APN value.
The Xemtec device request and answer contains up to 24 bytes representing the APN as a NULL terminated ASCII string.

2.5.6.2 GPRSUser (Code 301)

This command allows the requester to read or write the Xemtec device GPRS user name value that shall be used for the GPRS connection.
The Xemtec device request and answer contains up to 24 bytes representing the user name as a NULL terminated ASCII string.

2.5.6.3 GPRSPassword (Code 302)

This command allows the requester to read or write the Xemtec device GPRS user password value that shall be used for the GPRS connection.
The Xemtec device request and answer contains up to 24 bytes representing the user password as a NULL terminated ASCII string.

2.5.6.4 GPRSServer (Code 303)

This command allows the requester to read or write the Xemtec device GPRS server name or IP value to contact for a GPRS connection.
The Xemtec device request and answer contains up to 64 bytes representing the server name or IP address as a NULL terminated ASCII string.

2.5.6.5 GPRSPort(Code 304)

This command allows the requester to read or write the Xemtec device remote server TCP port to connect to during the GPRS connection.
The Xemtec device request and answer contains a 2 bytes buffer representing the TCP port as a binary integer value (low byte first).

2.5.6.6 GPRSSessionTimeout (Code 305)

This command allows the requester to read or write the Xemtec device GPRS session timeout value. This value represents, in seconds, the maximum duration of the overall GPRS connection.
The Xemtec device request and answer contains a 2 bytes buffer representing the session timeout as a binary integer value (low byte first).

2.5.6.7 GPRSTimeout (Code 306)

This command allows the requester to read or write the Xemtec device GPRS idle timeout value. This value represents, in seconds, the maximum delay between two characters received using the GPRS connection.
The Xemtec device request and answer contains a 2 bytes buffer representing the idle timeout as a binary integer value (low byte first).

2.5.6.8 GPRSNextCall (Code 307)

This command allows the requester to read or write the Xemtec device date and time of the next GPRS connection.
The Xemtec device request and answer contains a 7 bytes buffer representing the date and time in the following format: year (2 bytes), month, day, hours, minutes, seconds.

2.5.6.9 GPRSEncryptionKey(Code 308)

This command allows the requester to read or write the Xemtec device GPRS encryption key used during the GPRS communication.
The Xemtec device request and answer contains up to 32 bytes buffer representing the binary key to use.
The key can be 16, 24 or 32 bytes long depending on the length of the AES encryption (respectively 128, 192 or 256 bits).
A value of all zeros will remove any encryption during the communication.
A value of all 0xFF will set the default Xemtec AES key (undisclosed).

Note: for security reasons, the read function always returns 32 NULL bytes.

2.5.7 SMS Parameters

2.5.7.1 SMSRecipient (Code 310)

This command allows the requester to read or write the Xemtec device SMS recipient phone number, eventually including the country code. This recipient will receive an alert SMS message if the GPRS connection cannot be achieved.
The Xemtec device request and answer contains up to 24 bytes representing the SMS recipient phone number as a NULL terminated ASCII string.

2.5.8 GSM Daily Reporting Parameters

2.5.8.1 GSMDailyMask (Code 320)

This command allows the requester to read or write the Xemtec device GSM daily report mask value. This 4 byte value is a long integer representing bit per bit a day of the month. Bit0 is the 1st day of the month, bit1 the second, etc. When a bit is set to 1, a GSM connection will occur for that day of the month.
The Xemtec device request and answer contains a 4 bytes buffer representing the daily mask as a binary long integer value (low byte first).

2.5.8.2 GSMDailyCallTime (Code 321)

This command allows the requester to read or write the Xemtec device GSM daily report call time.
The Xemtec device request and answer contains a 2 bytes buffer representing the hour and minute of the time of the day when the daily report shall occur as a binary value.

2.5.8.3 GSMDailyPeriod (Code 322)

This command allows the requester to read or write the Xemtec device GSM daily report calls periodicity value. This value represents, in minutes, the delay between two daily report calls.
The Xemtec device request and answer contains a 2 bytes buffer representing the periodicity as a binary integer value (low byte first).

2.5.8.4 GSMDailyWakeup (Code 323)

This command allows the requester to read or write the Xemtec device GSM daily report call minimum connection wait.
The Xemtec device request and answer contains a 2 bytes buffer representing the wakeup timeout in seconds as a binary integer value (low byte first).

2.5.8.5 GSMDataloggerStep (Code 324)

This command allows the requester to read or write the Xemtec device GSM datalogger step for daily reporting (if applicable).
The Xemtec device request and answer contains a 1 byte buffer representing the datalogger step as a binary value.

2.5.8.6 GSMDataloggerSize (Code 325)

This command allows the requester to read or write the Xemtec device GSM datalogger maximum number of records to transmit during a daily report call (if applicable).
The Xemtec device request and answer contains a 2 bytes buffer representing the maximum number of datalogger records to transmit as a binary integer value (low byte first).

2.5.8.7 GSMStatusFlags (Code 326)

This read-only command allows the requester to read the Xemtec device GSM status flags.
The Xemtec device request and answer contains a 1 byte buffer representing the GSM status flag as a binary value.

Bit Value	Description
Bit0	Installed flag. This flag is set when a successful GPRS connection has occurred
Bit1	This flag is set when the last GPRS connection finished successfully
Bit2	n/a
Bit3	n/a
Bit4	n/a
Bit5	n/a
Bit6	n/a
Bit7	n/a

Table 8 - GSM Status Flag Values

2.5.9 Pulse Input Related Commands

2.5.9.1 PulseInputChannels (Code 350)

This read-only command allows the requester to read the maximum number of pulse input channels supported by the Xemtec device.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.9.2 PulseInputSetup (Code 351)

This command allows the requester to read or write the pulse input setup in the Xemtec device.
The Xemtec device request and answer contains up to 22 bytes representing:

- *Function Version* – (1 byte) Must be set to 1
- *Channel Number* – (1 byte) This value determines the pulse channel number.
- *Acquisition Period* – (2 bytes low order first) A 16 bits integer representing the periodicity in seconds between two pulse input integration and storage. If this value is set to zero, the previous acquisition period value is preserved. This value can bet set between 1 min. (60 sec.) and 12 hours (43200 sec.)
- *Pulse Factor* – (2 bytes low order first) A 16 bits integer representing the number of the pulses to be received before the reading is incremented.
- *Current Reading* – (4 bytes) A 32 bits long integer (high order first) that represents the starting reading value.
- *Number Of Digits* – (1 byte) This value represents the number of significant digits in the reading value.
- *Decimal Point Position* – (1 byte) This value represents the virtual decimal point position.
- *Maximum Hourly Delta* – (2 bytes low order first) A 16 bits integer representing the maximum reading difference in one hour.
- *Pulse Date & Time* – (7 bytes) A structure of data representing the year (as a 16 bits integer low order first), the month, the day, the hour, the minute and second at which the first record shall be stored in write mode, or at which the last pulse input occurred in read mode.
- *Pulse Status* – (1 byte in read mode only) This value represents the pulse input channel tamper status.

2.5.9.3 PulseInputStatus (Code 352)

This command allows the requester to read or write the tamper status of the input channel of the Xemtec device.
The Xemtec device request and answer contains a 1 byte buffer representing the flag value in binary format.

2.5.10 Xemgate Related Commands

2.5.10.1 XEMGATEDevice(Code 1000)

This command allows the requester to read the serial number of the associated Xemtec device at a specific location or write (add) a new Xemtec device to be associated to the Xemgate device.
The read request contains a 1 byte buffer representing the position of the requested associated Xemtec device serial number in binary format.
The write request contains an 18 bytes buffer representing the serial number (16 bytes), the RF channel number (1 byte) and the eventual MBus address (1 byte) to use.
An RF channel value of 0 will select automatically the corresponding RF channel by using the last digit of the serial number as the channel number (0 corresponds to channel 10).
Use 0xFF as MBus address to use serial protocol between the Xemgate and the associated Xemtec Device.

2.5.10.2 XEMGATEGetList (Code 1001)

This read-only command allows the requester to read the list of Xemtec devices associated with the Xemgate.
The Xemgate answer contains a variable length buffer representing an array of flags values. A non-zero value means that a Xemtec device is associated on that position. A value of zero means that this position is empty.

2.5.10.3 XEMGATEDeleteDevice (Code 1002)

This write-only command allows the requester to write (delete) the Xemtec device associated to the Xemgate at the selected position.
The request contains a 1 byte buffer representing the position of the requested associated Xemtec device to remove from the Xemgate. The answer contains a 1 byte buffer always set to the binary value 1.

2.5.10.4 XEMGATEDeleteAll (Code 1003)

This write-only command allows the requester write (delete) all Xemtec devices associated with the Xemgate.
The Xemtec device request is empty whereas the answer contains a 1 byte buffer always set to the binary value 1.

2.5.10.5 XEMGATECommStats (Code 1004)

This command is not implemented yet.

2.5.10.6 XEMGATERetries (Code 1005)

This command allows the requester to read or write the Xemgate number of RF retries during the communication with the associated Xemtec devices.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.10.7 XEMGATERFChannel (Code 1006)

This command allows the requester to read or write the Xemgate device own RF channel from 0 to 10. A value of zero means that the RF communication is off. However the RF communication will still occur between the Xemgate and its associated Xemtec devices.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.10.8 XEMGATERFTimeout (Code 1007)

This command allows the requester to read or write the Xemgate RF communication timeout (expressed in seconds).
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.10.9 XEMGATEVersion (Code 1008)

This read-only command allows the requester to read the Xemgate device version string regardless of the currently selected associated Xemtec device.
The Xemtec device answer contains up to 16 bytes representing the device version as an ASCII string.

2.5.10.10 XEMGATESendDevice (Code 1009)

This write-only command allows the requester to write (send) to the selected associated Xemtec device a command using the RF communication.
The request constains a variable length buffer containing the command to send (without any protocol related information as the Xemgate will take care of this).
The answer contains a variable length buffer containing the raw response from the associated Xemtec device (without protocol overhead).

2.5.10.11 XEMGATESerialNumber (Code 1010)

This read-only command allows the requester to read the Xemgate device serial number regardless of the currently selected associated Xemtec device.
The Xemtec device answer contains a 16 bytes buffer representing the Xemgate serial number as an ASCII string.

2.5.10.12 XEMGATESelectDevice (Code 1011)

This command allows the requester to read or write the current associated Xemtec device that is selected for any further commands. Zero represents the Xemgate device itself. Any other value represents the associated Xemtec device that is attached to the Xemgate. When a device is selected, any further commands are related to that device. The result of any subsequent commands is either simulated by the Xemgate (serial number, meter serial number, datalogger information for example), or rejected, or sent via radio to get the information.
The Xemtec device request and answer contains a 1 byte buffer representing the value in binary format.

2.5.10.13 XEMGATESyncDatalogger (Code 1012)

This write-only command allows the requester to write (synchronize) the Xemgate device to read from an associated Xemtec device its datalogger information and store locally the latest datalogger records.
The request contains a 1 byte buffer representing the associated Xemtec device number to synchronize the datalogger information with. If zero is used, then all associated Xemtec devices will be interrogated in turn to synchronize their datalogger information.
The answer contains a 2 byte buffer representing the number of synchronized datalogger records as a binary integer format.

2.5.10.14 XEMGATESyncDateAndTime (Code 1013)

This write-only command allows the requester to write (synchronize) the Xemgate device current date and time with its associated Xemtec devices.
The request buffer is empty. The answer contains a 1 byte buffer always set to binary zero.

2.5.10.15 XEMGATEScanPeriod (Code 1014)

This command allows the requester to read or write the Xemgate device datalogger scan period value (expressed in minutes). When this value is set, the Xemgate device will periodically scan all associated Xemtec devices and synchronize their datalogger information locally.
The Xemtec device request and answer contains a 2 bytes buffer representing the value as a binary integer. A value of zero stops the periodic datalogger scan function.

2.5.10.16 XEMGATEScanDateAndTime (Code 1015)

This command allows the requester to read or write the Xemgate device next datalogger scanning date and time.
The Xemtec device request and answer contains a 7 bytes buffer representing the value in binary format such as: year (2bytes), month, day, hours, minutes and seconds.

2.5.10.17 XEMGATEStatus (Code 1016)

This read-only command allows the requester to read the Xemgate device information.
The Xemgate device answer contains a 16 bytes buffer representing:

- *GSM Status Flag* – (1 byte) See GSM Status command for details
- *GPRS Call Retries* – (1 byte) The number of retries during the last GPRS call
- *GPRS Last Call Date and Time* – (7 bytes) The date and time of the last GPRS call in the following format: year (2 bytes), month, day, hours, minutes and seconds
- *Last Datalogger Scan Date and Time* – (7 bytes) the date and time of the last periodic datalogger scan in the following format: year (2 bytes), month, day, hours, minutes and seconds

If any of these does not apply to the current Xemgate device, a value of zero is returned instead (dates are set to the 1st of January 2000)

2.5.10.18 XEMGATEMaxDevices (Code 1017)

This read-only command allows the requester to read the maximum number of Xemtec devices that can be associated to the Xemgate device.
The Xemgate device answer contains a 1 byte buffer representing the value in binary format.