ETC2002

Modbus Communications Protocol

Reference Guide

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Table of Contents

1 General

This document specifies a subset of the Modbus serial communications protocol used to transfer data between a master computer station and the ETC2002. The document provides the complete information necessary to develop third-party communications software capable of communication with the ETC2002. Additional information concerning communications operation, configuring the communications parameters, and communications connections is found in "ETC2002 Installation and Operation Manual".

IMPORTANT

Most of the advanced features are configured using multiple setup parameters that can be accessed in a number of contiguous registers. When writing the setup registers, it is recommended to write all the registers at once using a single request.

2 Modbus Protocol Implementation

For detailed information about Modbus protocol, Modbus message framing and error checking, refer to the "Modicon Modbus Protocol Reference Guide". It can be downloaded from the Modicon's Web site at www.modicon.com. The following paragraphs outline some issues concerning the implementation of the Modbus protocol in the ETC2002.

2.1 Transmission Modes

The ETC2002 can be set up to communicate on a Modbus network using ASCII or RTU transmission mode. Refer to the "ETC2002 Installation and Operation Manual " on how to select the transmission mode in your device.

2.2 Address Field

The address field contains a user assigned address of the instrument (1-247) on a Modbus network. Broadcast mode using address 0 is not supported.

2.3 Function Field

The Modbus functions implemented in the ETC2002 are shown in Table 2-1. Function 04 can be used in the same context as function 03.

Table 2-1 Modbus Function Codes

Code (decimal)	Meaning in Modbus	Action
03	Read holding registers	Read multiple registers
04	Read input registers	Read multiple registers
06	Preset single register	Write single register
16	Preset multiple registers	Write multiple registers
08[1]	Loop-back test	Communications test

[1]The ETC2002 supports only diagnostic code 0 - return query data.

2.4 Exception Responses

The instrument sends an exception response when an error is detected in the received message. To indicate that the response is notification of an error, the high order bit of the function code is set to 1. Implemented exception response codes:

1 - Illegal function
2 - Illegal data address
3 - Illegal data value
10 - Gateway is busy. Remote access is temporarily unavailable.

When the character framing, parity, or redundancy check detects a communication error, processing of the master's request stops. The instrument will not act on or respond to the message.

2.5 Modbus Register Addresses

The ETC2002 Modbus registers are numbered in the range of 0 to 65535. From the Modbus applications, the ETC2002 Modbus registers can be accessed by simulating holding registers of the Modicon 584, 884 or 984 Programmable Controller, using a 5-digit “4XXXX” or 6-digit “4XXXXX” addressing scheme. To map the ETC2002 register address to the range of the Modbus holding registers, add a value of 40001 to the ETC2002 register address. When a register address exceeds 9999, use a 6-digit addressing scheme by adding 400001 to the ETC2002 register address.

2.6 Data Formats

The ETC2002 uses two data formats to pass data between a master application and the device: 16-bit short integer and 32-bit long integer formats. Data logged by the ETC2002 Data Server is collected from instruments in 16-bit short integer format.

2.7 Password Protection

The ETC2002 has a password protection option allowing you to protect your setups and logs from being changed or cleared through communications. You can disable or enable password protection through communications or via the Terminal. For details, refer to the ETC2002 "Installation and Operation Manual". When password protection is enabled, the user password you set in the ETC2002 should be written into the device authorization register (44378-44379) before another write request is issued. If the correct password is not supplied while password protection is enabled, the ETC2002 will respond to all write requests with the exception code 01 (illegal operation). It is recommended to clear the password register after you have completed your changes in order to activate password protection.

3 Data Server

3.1 Data Server Features

The Data server allows the user to save the time required for polling multiple devices, especially via slow serial interfaces, by utilizing the ETC2002 non-volatile memory for automatic acquiring data. The user application can then read blocks of ready data directly from the ETC2002 memory without the need to wait until slow devices respond to master requests. The Data server can also perform a delayed write of data so the application needs not to wait until the device would be accessible, but rather can write data to the ETC2002 memory exchanges, and then the ETC2002 takes responsibility for delivering data to the target devices. The Data server can also periodically poll device status registers and record events to a log file or give alerts on specific events.

The following table lists the configurable Data server options.

Table 3-1 Data Server Options

Description	Range
Data server enabled	1=enabled, 0=disabled
Continuous polling	1=enabled, 0=disabled
Data polling interval	1-1000 min
Data logging interval, polls	0-1000, 0=logging disabled

When the Data server is enabled, it acquires data from the connected devices either continuously, or on a periodic basis. If continuous polling is disabled, the devices are requested periodically at predefined poll intervals. If continuous polling is enabled, the ETC2002 retrieves data from the devices in turn without pauses.

Acquired real-time data is normally stored in the ETC2002 exchanges (memory blocks) and is periodically refreshed at programmed intervals. The ETC2002 provides up to 250 real-time data exchanges of 1 to 114 registers long. These exchanges can be directly accessed by the master application.

If the user wishes, acquired data can be periodically moved to historical circular files where it will be kept for a long time until it is overwritten by newer data. Data is stored to historical files at regular intervals. The logging interval is always represented as a whole number of data polling intervals even if the polling itself is not synchronized with polling intervals like in the event of continuous polling. Since the ETC2002 tries to synchronize polling devices with the beginning of an hour, it is recommended to program a logging interval in such a manner that it would be a whole divisor of 60 minutes. Historical records can be accessed one record at a time either in an arbitrary order, or in a sequential manner.

The ETC2002 also provides up to 250 write data exchanges, of 1 to 12 registers long, and up to 250 status event data exchanges of 1 register long. Table 3-2 gives a summary of the available data exchanges.

Table 3-2 Data Server Exchanges

Exchange Type	Number of Exchanges	Exchange Block Size, registers
Real-time data exchange	250	1-114
Status event exchange	250	1
Data write exchange	250	1-12

NOTE:

The real-time, status event and write data exchanges with the same exchange number are internally linked in the ETC2002 to the same device ID. If you change the device ID for one of the exchanges, the same ID will be taken for other configured exchanges that have the same exchange number.

3.2 Using Real-time Data Exchanges

3.2.1 Configuring Real-time Data Exchanges

Real-time data exchanges are used for periodic retrieving data from the connected devices. The following table shows the parameters that should be configured before enabling a data exchange.

Table 3-3 Real-time Data Exchange Setup

Description	Range
Exchange number	0-249
Start device register address	0-65535
Exchange block size, registers	1-114
Device ID	1-247
Polling enabled	1=enabled, 0=disabled
RTC update enabled (optional)	1=enabled, 0=disabled

A data exchange can store from 1 to 114 contiguous 16-bit registers retrieved from a single device. A block of registers for an exchange is defined by the start register address and the exchange block size. Refer to Modbus guides for specific devices for available address ranges.

You can individually enable or disable polling data for a specific exchange. If the device has an onboard real-time clock, you can enable periodic RTC updates from the ETC2002 clock, which may be synchronizes with the precise satellite GPS clock using an optional IRIG-B input.

Each data exchange utilizes 6 extra registers for time stamping and identification as shown in Table 3-4, so the actual memory required for one data exchange is 6 + exchange block size. The total size of all exchanges should not exceed 9000 registers.

Table 3-4 Data Exchange Record

Description	Range
Record heading	
Record status	0=no data, -1=corrupted record, 1-65534 = device response code
Record time, seconds since 1/1/1970	
Record sequence number	0- 65535
Data block (variable size)	
Data registers (up to 114)	

If data logging is globally enabled in the Data server, the retrieved data is periodically moved from the data exchange to a log file in the same format, as it is stored in the exchange (see Table 3-4). Each exchange is provided with a separate data log file.

A data record is always preceded by a status register that indicates whether the data is healthy. Each record may be identified in a file by a unique 16-bit sequence number that is incremented modulo 65536 with each new record.

3.2.2 Accessing Real-time Data Exchanges

Real-time data exchanges occupy a single continuous block of registers without gaps and are located in the ETC2002 memory in the address range of 0 to 9000. Since exchanges may have different size, the location of each exchange in the memory depends on the size of all preceding exchanges. Use the following formula to define the location of the data exchange:

$$\text{Exchange}_N\ \text{Address} = \sum_{n=0}^{N-1} (\text{Exchange}_n\ \text{Block Size} + 6)$$

Note that a location of the exchange in the memory is changed when you change the data exchange setup, so the previously acquired data would be lost.

3.2.3 Accessing Data Log Files

Each data exchange is provided with a separate circular data log file. The Data server allocates a total of 1.5 Mbytes of non-volatile memory for all data log files, which will be equally divided between all active exchanges.

File transfers are performed through two blocks of registers: a master request block and a read-only file transfer block, which are shared by all files. After a master application has written the request with a file exchange number (and possibly a file position) into the file request block, the requested data is available for a read through the file transfer block registers. File transfer functions allow changing the file position in order to point to the desired record in a selected log file. The sequence number of the first (oldest) record available in a file may be inspected via the file request block after the file exchange number is written into the block.

The file transfer block occupies 120 registers in the address range of 9000 to 9119. The following table shows a layout of the data log request block. Refer to Table 3-3 for the file transfer block layout.

Table 3-5 Data Log Request Block

Description	Range
Function	3 = set file position 5 = reset file position 11 = read record
Record sequence number (with functions 3, 11)	0-65535
First (oldest) record sequence number	0-65535
Exchange number	0-249

Data log files can be read either in a sequence record-by-record, or in a random order. Every write to the file request block fills the file transfer block with the data of the record pointed to by the file read pointer. If you want to begin reading a file from a particular record, which sequence number is known, you can change the pointer position by issuing the Set-File-Position request with the desired sequence number. If you want to read a file from the beginning, write the Reset-File-Position request that moves the pointer to the oldest file record. If you use the Read-Record request that does not change the file position, then you will continue reading the file from the record following the one you have read the last time you accessed the file.

You need not explicitly move the file position to the following record if you want to continue reading a file in sequence after you have uploaded the current record. Instead, continue reading the record data through the file transfer block: each access to the file transfer block automatically advances the file pointer to the next record. That's why you should read all data in the file transfer block by a single request: the next read will give you the following file record.

The file transfer is completed after you have read the last record of the file. Before storing a file record to your database, always check the record status word. This word set to 0 indicates that the file read pointer does not point to any record within the file, and you should not store any record that has this word set to 0 or to -1.

The following gives a summary of steps you should perform to read a data log file:

1) If you want to begin reading a file from a particular record or from the first record, use either the Set-File-Position request with the desired record sequence number, or the Reset-File-Position request; otherwise use the Read-Record request.
2) Read the record data from the file transfer block. The file pointer will be moved to the next file record.
3) Repeat step 2 until all the file records are read, i.e., until the record status word indicates the end-of-file.

3.3 Using Status Event Exchanges and Event Logs

3.3.1 Configuring Event Exchanges

The Data server can provide recording binary events asserted by the connected devices and give a notification to the eXpertPower server.

The Data server can periodically poll device status registers and detect a change in the status bits to recognize asserted device events. A binary event mask specifies the critical event bits. Whenever the Data server detects a change in the status bits selected by the event mask, it records an event record to the circular Event log file. If the eXpertPower service is enabled in the ETC2002, this event will initiate a connection to the eXpertPower server.

Polling status events is performed via the status event exchanges. The Data server provides up to 250 event exchanges, each one of 1 register long, with a separate event mask. Table 3-6 shows the setup parameters that are used for configuring status event exchanges.

Table 3-6 Status Event Exchange Setup

Description	Range
Exchange number	0-249
Device status register address	0-65535
Event mask	0x00000000–0x0000FFFF
Device ID	1-247
Polling enabled	1=enabled, 0=disabled
Options flags: Bit 0 – Auto reset enabled (1=enabled, 0=disabled) Bit 1 – Register type: 0=coils (Modbus request type 1) 1=holding register (Modbus request type 3)	

The Data server supports the auto reset option you can use to clear a latched device status register after it has been read. In most devices, critical events are latched into a status register, so the new events are not generated until the register is explicitly cleared by a master application.

Since status registers may be implemented in the device either as coils, or as holding registers, you should specify a register type for each event exchange via the option flags.

3.3.2 Accessing the Event Log File

All event records are stored in a single circular event log file. Along with device status events, the file may contain the ETC2002 self-diagnostic events.

File transfers are performed through two blocks of registers: a master request block and a read-only file transfer block. The file transfer block occupies 12 registers in the address range of 10000-10011. Tables 3-7 and 3-8 show a layout of the event log request block and a layout of the event log record.

Table 3-7 Event Log Request Block

Description	Range
Function	3 = set file position 5 = reset file position 11 = read record
Record sequence number (with functions 3, 11)	0-65535

Table 3-8 Event Log Record Layout

Description	Range
Event Log status	0 = no new events, 1 = have new events, -1 = record corrupted
Event sequence number	0-65535
Event type ID	F2 (See Section 5)
Device ID	0-247
Event time, seconds since 1/1/1970	F1 (See Section 5)
Event data	F3 (See Section 5)

The event log file is accessed in the same manner as data log files. Refer to Section 3.2.3 for details.

3.4 Using Data Write Exchanges

The Data server can provide remote writing data to serviced devices upon user requests. Up to 250 write exchanges are supported with a size of 1 to 12 registers. Table 3-9 shows configuration parameters that can be defined for each write exchange.

Table 3-9 Write Exchange Setup

Description	Range
Exchange number	0-249
Start device register address	0-65535
Exchange block size, registers	1-12
Device ID	1-247
Write enabled	1=enabled, 0=disabled

Configured data exchanges are accessed via the data write exchange block. It occupies 14 registers in the address range of 9200 to 9213. Table 3-10 shows the write exchange layout.

Table 3-10 Write Exchange Block

Description	Range
Exchange number	0-249
Write flag	0 – Data has been written 1 – Data is waiting to be written
Data register 1	
…	
Data register 12	

To send data to a device via a write exchange, write data to the write exchange block with the write flag being set to 1. The write flag is automatically cleared after the data has been successfully transferred to the device. Always check this flag before writing new data to the exchange to ensure it is empty, otherwise previously written data may be lost.

4 Modbus Register Map

4.1 Data Server Registers

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
Real-time Data Exchange Block							
0-9000							
		Data Exchange #1					
...		**...**					
		Data Exchange #N					
		Exchange Layout (120 registers maximum):					
+0,1		Record status	0=No data, -1=corrupted record, 1-65534 = device response code		UINT32	R	Device response: function code or exception code (See 2.3-2.4)
+2,3		Record time, seconds since 1/1/1970	F1	sec	UINT32	R	
+4,5		Record sequence number	0-65535		UINT32	R	
+6		Data register	0-65535		UINT16	R	
		...					
+119		Data register	0-65535		UINT16	R	
Data Write Exchange Block							
9200-9213							
+0		Exchange number	0-249		UINT16	R/W	Defines accessed exchange number
+1		Write flag	0 – Data has been written 1 – Data is waiting to be written		UINT16	R/W	
+2		Data register	0-65535		UINT16	R/W	
		...					
+13		Data register	0-65535		UINT16	R/W	
Data Log Transfer Blocks							
9120-9135		**File Request Block**					
+0		Function	3 = set file position 5 = reset file position 11 = read file		UINT16	R/W	3 - changes the file position 5 - sets the file position at the first (oldest) record 11 - opens the file for reading from the present file position
+1		Record sequence number (with functions 3, 11)	0-65535		UINT16	R/W	The record sequence number with function 11 does not change the file position
+2-12		Reserved					
+13		First (oldest) record sequence number			UINT16	R	
+14		Next sequence number to be used			UINT16	R	
+15		Data exchange number	0-249		UINT16	R/W	Write – sets new exchange number Read – returns exchange number
9000-9119		**File Transfer Block**					
+0,1		Record status	0= No new data, -1=corrupted		UINT32	R	Device response: function code or

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
			record, 1-65534 – device response code				exception code (See 2.3-2.4)
+2,3		Record time, seconds since 1/1/1970	F1	sec	UINT32	R	
+4,5		Record sequence number	0-65535		UINT32	R	
+6		Data register	0-65535		UINT16	R	
		...					
+119		Data register	0-65535		UINT16	R	
Event Log Transfer Blocks							
10016-10031		**File Request Block**					
+0		Function	3 = set file position 5 = reset file position 11 = read file		UINT16	R/W	3 - changes the file position 5 - sets the file position at the first (oldest) record 11 - opens the file for reading from the present file position
+1		Record sequence number (with functions 3, 11)	0-65535		UINT16	R/W	The record sequence number with function 11 does not change the file position
+2-12		Reserved					
+13		First (oldest) record sequence number			UINT16	R	
+14		Next sequence number to be used			UINT16	R	
+15		Reserved					
10000-10009		**File Transfer Block**					
+0,1		Event log status	0 - no new events, 1 – data is valid, -1 – current record corrupted		UINT32	R	
+2,3		Event sequence number	0-65535		UINT32	R	
+4,5		Event type ID	F2		UINT32	R	
+6,7		Device ID	0-247		UINT32	R	
+8,9		Event time, seconds since 1/1/1970	F1	sec	UINT32	R	
+10,11		Event data	F3		UINT32	R	

4.2 Digital Inputs

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
		Digital Inputs					
12544		Digital inputs DI1-DI4	0x0000 - 0x000F		UINT16	R	

The digital input register returns the state of the level-sensitive digital inputs in a 16-bit packed format.

4.3 Device Control and Status Registers

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
Device Mode Control Registers (factory set)							
44134		ETC options	Bit0 = 1 - COM5 enabled Bit1 = 1 - IP-LINK enabled Bit2 = 1 - IRIG-B enabled		UINT16	R	The secondary master port may be either COM5, or IP-LINK enabled
44135		Modem	0 = disabled, 1 = enabled		UINT16	R	
44136-44165		Reserved			UINT16		
44166-44326		**Reserved**			UINT16		
Device Diagnostics Register (bit map)							
44326-44327		Device self-diagnostics flags. When read: 0 = no faults logged, 1 = a fault bit has been set at least once since the last reset. When written: 0 = clear a fault bit, 1 = no effect.	F4		UINT32	R/W	
44328-44341		Reserved					
Device Authorization Register							
44378-44379		When write: 8-digit password. When read: 0 = access permitted, -1 = authorization required.	0 - 99999999 (write) 0/-1 (read)		INT32	R/W	
44380-44385		Reserved					
44386-45951		**Reserved**					
Factory Diagnostic Registers							
45952-46079		Factory diagnostic registers			UINT32	R	

4.4 Device Setup Registers

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
Factory Device Settings and Identification							
46080-46207							
+0, 1		Device serial number			UINT32	R	
+2, 3		Device model ID	2000, 2002		UINT32	R	
+4-11		Device model name	“ETC2000”, “ETC2002”		CHAR16	R	Null-terminated string
+12-19		Reserved			UINT16	R	
+20		Device firmware version number			UINT16	R	
+21		Device firmware build number			UINT16	R	
+22,23		Reserved					
+24		Boot loader version number			UINT16	R	
+25		Boot loader build number			UINT16	R	
+26		RF firmware version number			UINT16	R	
+27		RF firmware build number			UINT16	R	
+28-95		Reserved					
+96		Ethernet MAC address 0-1	0x0500		UINT16	R	
+97		Ethernet MAC address 2-3	0x00F0		UINT16	R	
+98		Ethernet MAC address 4-5	0x0000-0xFFFF		UINT16	R	

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
+99-128		Reserved					
Device Options Setup							
46256-46271							
+0		Log output	Bit 0 = Dumping to console, Bit 2 = Server Log Bit 3 = XP log Bit 4 = IPLINK log Bit 5 = Data Server log Bit 6 = Sharing log		UINT16	R/W	
+1		Number of XP faults for reset	0-200				0 – never (50 - default)
+2		Global reset timer (in hours)	0-24				0 – never (24 - default)
+3-15		Reserved			UINT16	R/W	
Time/Date Setup							
46400-46415							
+0		Local time offset, min	0-+/-720		UINT16	R/W	Offset in minutes from UTC (Universal Coordinated or Greenwich Mean time)
+1		Daylight savings time (DST) option	0 = DST disabled (standard time only), 1 = DST enabled	µsec	UINT16	R/W	
+2		DST start month	1 - 12		UINT16	R/W	
+3		DST start week of the month	1 - 4 = 1st, 2nd, 3rd and 4th week, 5 = the last week of the month		UINT16	R/W	
+4		DST start weekday	1-7 (1= Sun, 7 = Sat)		UINT16	R/W	
+5		DST end month	1 - 12		UINT16	R/W	
+6		DST end week of the month	1 - 4 = 1st, 2nd, 3rd and 4th week, 5 = the last week of the month		UINT16	R/W	
+7		DST end weekday	1-7 (1= Sun, 7 = Sat)		UINT16	R/W	
+8		Clock synchronization source	0 = GPS IRIG-B master clock		UINT16	R/W	
+9-15		Reserved			UINT16		
Clock Setup and Status							
46416-46447							
+0, 1		Local time, in seconds, since Jan 1, 1970	F1	sec	UINT32	R	
+2, 3		Fractional seconds, µsec		µsec	UINT32	R	
+4		Fractional seconds, milliseconds	0-999		UINT16	R/W	
+5		Seconds	0-59		UINT16	R/W	
+6		Minutes	0-59		UINT16	R/W	
+7		Hour	0-23		UINT16	R/W	
+8		Day of month	1-31		UINT16	R/W	
+9		Month	1-12		UINT16	R/W	
+10		Year (calendar year minus 2000)	0-99		UINT16	R/W	
+11		Weekday	1-7 (Sun = 1, Sat = 7)		UINT16	R	
+12		Daylight savings time status	0 = standard time, 1 = daylight savings time is active		UINT16	R	
+13		IRIG-B status	0, 1 = no signal, 2 = time unlocked,		UINT16	R	

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
			3 = time locked				
+14-31		Reserved			UINT16		
Modem Setup							
46448-46479							
+0,1		Device IP Address	0x01000000-0xFFFFFFFF		UINT32	R/W	
+2,3		Network subnet mask	0x00000001-0xFFFFFFFF		UINT32	R/W	
+4,5		Network default gateway	0x00000000-0xFFFFFFFF		UINT32	R/W	
+6,7		Number of dial attempts	0–1000, 0-dial forever		UINT32	R/W	
+8,9		Connection timeout, sec	0-9999		UINT32	R/W	
+10,11		Delay between redials, sec	0-9999		UINT32	R/W	
+12,13		Idle connection timeout, sec	0-9999		UINT32	R/W	
+14,15		Number of rings before answer	0-2		UINT32	R/W	
+16-23		Modem init string	“ATZ0&F”		CHAR16	R/W	Null-terminated string
+24-31		Reserved					
Communication Ports Setup							
46480-46575							
+0-2		Reserved					
+3		Baud rate	1=300, 2=600, 3=1200, 4=2400, 5=4800, 6=9600, 7=19200, 8=38400, 9=57600, 10=115200	bps	UINT16	R/W	
+4		Data format	0 = 7 bits/even parity, 1 = 8 bits/no parity, 2 = 8 bits/even parity		UINT16	R/W	
+5		Port direction	0 = master, 1 = slave (COM4 only)		UINT16	R/W	0 - default
+6		Receive timeout (COM4 master and COM5 only)	500-30000	ms	UINT16	R/W	500 - default
+7-15		Reserved					
46480-46495		**COM3 Setup**					
46496-46511		**COM4 Setup**					
46512-46527		**COM5 Setup**					
46528-46575		Reserved					
Network Setup							
46576-46703							
+0, 1		Device IP Address	0x01000000-0xFFFFFFFF		UINT32	R/W	
+2, 3		Network subnet mask	0x00000001-0xFFFFFFFF		UINT32	R/W	
+4, 5		Network default gateway	0x00000000-0xFFFFFFFF		UINT32	R/W	
+6, 7		Use DHCP	0 = NO, 1 = YES		UINT32	R/W	
+8, 9		TCP service port	502 = Modbus/TCP, 20000 = DNP3.0/TCP		UINT32	R/W	
+10,11		Primary DNS IP address	0x00000000-0xFFFFFFFF		UINT32	R/W	
+12,13		Secondary DNS IP address	0x00000000-0xFFFFFFFF		UINT32	R/W	
+14-31		Reserved			UINT16	R/W	
RF Modem Setup							
46608-46639							

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
+0		MAC net ID	0-255		UINT16	R/W	
+1		MAC node ID	1-255		UINT16	R/W	
+2		Net cluster ID	0-255		UINT16	R/W	
+3		Net node ID	1-255		UINT16	R/W	
+4		Node type	0=Master, 1=RN+, 2=RN-, 3=RFD		UINT16	R/W	
+5		RF channel	0=907MHz, 1=910MHz, 2= 912MHz, 3=915MHz, 4=917MHz, 5=920MHz, 6=922MHz		UINT16	R/W	
+6		RF send power	0–255 (2=-20dBm, 9=-10dBm, 160=0dBm, 255=4dBm)		UINT16	R/W	
+7		Number of cluster child nodes (master only)	0-255		UINT16	R/W	
+8		Network cluster tree depth (master only)	0-255		UINT16	R/W	
+9		Network routing algorithm (master only)	0=AODV (Ad-hoc on-demand vector), 1=cluster tree, 2=hybrid (cluster tree + AODV)		UINT16	R/W	
+10-31		Reserved					
46640-46703		**Reserved**					
Password Setup							
46704-46715							
+0, 1		Communications password (8 digits)	0 - 99999999		UINT32	R/W	
+2		Password protection enabled	0 = disabled, 1 = enabled		UINT16	R/W	
+3		Reserved			UINT16	R/W	
+4-11		ETC2002 local Login name	“”		CHAR16	R/W	Null-terminated string
Expert Power Service Setup							
46768-46783							
+0,1		Expert Power server IP Address	0x01000000-0xFFFFFFFF		UINT32	R/W	
+2,3		Expert Power server TCP service port	0-65535 (5001 – default)		UINT32	R/W	
+4,5		Expert Power client enabled	0=client disabled, 1=client enabled		UINT32	R/W	
+6,7		Expert Power client interval	1- 99999 (0 = close client)	min	UINT32	R/W	
+8,9		Expert Power client time to next session	1- 99999	min	UINT32	R	
+10		Security Key	0-7 (0 = disabled)		UINT16	W	
+11-15		Reserved					
Internet Service Provider (ISP) Accounts							
46784-46879							
+0-15		ISP telephone number			CHAR32	R/W	
+16-31		Login name			CHAR32	R/W	
+32-47		Login password			CHAR32	R/W	
46784-46831		**Account No1**					
46832-46879		**Account No2**					
46880-46927		Reserved					
Data Server Setup							
46928-46943		**Real-time Data Exchange Setup**					

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
+0		Exchange number	0-249		UINT16	R/W	Write an exchange number before reading the setup registers
+1		Reserved					
+2,3		Start device register address	0-65535		UINT32	R/W	
+4,5		Exchange block size, registers	1-114		UINT32	R/W	
+6		Device ID	1-247		UINT16	R/W	
+7		Polling enabled	1=enabled, 0=disabled		UINT16	R/W	
+8		RTC update enabled (optional)	1=enabled, 0=disabled		UINT16	R/W	
+9-15		Reserved					
46944-46959		**Status Event Exchange Setup**					
+0		Exchange number	0-249		UINT16	R/W	Write an exchange number before reading the setup registers
+1		Reserved			UINT16		
+2,3		Device status register address	0-65535		UINT32	R/W	
+4,5		Event mask	0x00000000–0x0000FFFF		UINT32	R/W	Lower 16 bits are used
+6		Device ID	1-247		UINT16	R/W	
+7		Polling enabled	1=enabled, 0=disabled		UINT16	R/W	
+8		Options flags (bitmap)	Bit 0 – auto reset: 0=disabled 1=enabled Bit 1 – register type: 0=holding register (request 3) 1=coils (request 1)		UINT16	R/W	
+9-15		Reserved					
46960-46975		**Write Data Exchange Setup**					
+0		Exchange number	0-249		UINT16	R/W	Write an exchange number before reading the setup registers
+1		Reserved			UINT16		
+2,3		Start device register address	0-65535		UINT32	R/W	
+4,5		Exchange block size, registers	1-12		UINT32	R/W	
+6		Device ID	1-247		UINT16	R/W	
+7		Write enabled	1=enabled, 0=disabled		UINT16	R/W	
+8-15		Reserved					
46976-46991		**Data Server Options**					
+0		Polling interval	1-1000	min	UINT16	R/W	1 min default
+1		Logging interval, polls	0-1000, 0=logging disabled		UINT16	R/W	1 - default
+2		Data Server Enabled	1=enabled, 0=disabled		UINT16	R/W	0- default
+3		Continuous polling	1=enabled, 0=disabled		UINT16	R/W	0- default
+4-15		Reserved					
Gateway Setup							
46992-46999							
+0		ETC2002 device address	1-247		UINT16	R/W	99 default
+1		Gateway device address range start	1-247		UINT16	R/W	1 default
+2		Gateway device address range end	1-247		UINT16	R/W	247- default

Address	Point ID	Description	Options/Range	Units	Type	R/W	Notes
+3		Shared device access enabled [1, 2]	0=enabled, 1=disabled		UINT16	R/W	0 - default
+4		Temporarily override device access restrictions [1]	0=disabled, 1=enabled		UINT16	R/W	Active only within current session
+5		Routing table enabled [2]	0=disabled, 1=enabled		UINT16	R/W	0 - default
+6-7		Reserved					
Device Routing Table							
47000-47249							
+0		Device 1 rout path	Bits 0–3 - destination port: 0=none, 1=Ethernet, 4=COM4, 5=COM5 Bits 4-7 - shared device access rule (see F5) [2] Bits 8-15 - IP entry number in the Routing IP Table for the Ethernet port		UINT16	R/W	
+1		Device 2 rout path			UINT16	R/W	
		...					
+246		Device 247 rout path			UINT16	R/W	
+247-249		Reserved					
Routing IP Table							
47250-47299							
+0,1		IP Address 1	0x00000000-0xFFFFFFFF		UINT32	R/W	
+2,3		IP Address 2	0x00000000-0xFFFFFFFF		UINT32	R/W	
		...					
+30,31		IP Address 16	0x00000000-0xFFFFFFFF		UINT32	R/W	
+32-49		Reserved					
47300-52149		**Reserved**					

1 Shared device access allows several clients to simultaneously access device registers either for a read or a write. It is normally enabled, so different clients can poll data registers in the same device without collisions. However, simultaneous file accesses to the same device could destroy device file buffers so both clients may receive corrupted data. To prevent such collisions, the user can disable shared device accesses so the ETC2002 will reject any additional requests addressed to a device that is being accessed by another client. In this event, the ETC2002 will return an exception response with the error code 10 = “Gateway is busy” until the first client closes the session or points to a different device.

2 Starting with V21.5.4. If the routing table is enabled in the ETC2002 and shared device access is also enabled, then the ETC2002 manages shared device accesses according to the access rules defined in the routing table individually for each device.

5 Data Formats

Format Code	Value	Description	Notes
Timestamp			
F1		Local time in a UNIX-style format. Represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000.	
Event Type ID			
F2		**IRIG-B Sync Event**	
	0x0800	XP client event (See F3 for Event data contents)	
		DI Event	
	0x0A00	Generic DI event (Event data contains a DI status value)	
		Data Server Events	
	0x1400-0x1463	Status polling event (masked), low byte = exchange number. Event data contains the event status value	
		Self-Check Diagnostics Event	
	0x5D00	Action/Cause (See F3 for Event data contents)	
		Self-Update Event	
	0x5E00	RTC DST/Standard time update	
		Run-time Error	
	0x6000	Run-time exception	
		Hardware Diagnostics Event	
	0x6200	Action/Cause (See F3 for Event data contents)	
		External Event	
	0x6300	Action/Cause (See F3 for Event data contents)	
Event Data			
F3	0	Power down	
	1	Reserved	
	2	RAM/Data error	
	3	CPU Watchdog reset	
	4	Reserved	
	5	CPU exception	
	6	Reserved	
	7	Software Watchdog	
	8	Power up	
	9	Device reset	
	10	Configuration reset	
	11	RTC fault	
	12	Configuration fault	
	13	XP fault counter	
	14	Reset Timer expired	
	15	MASTER EEPROM fault	
	16	Event Log corrupted	
	17	Data Log corrupted	
	18	Data Server setup	
	19	Reserved	
	20	C Library error	
	21	RTOS Kernel fatal error	
	22	Task error	
	24	IRIG-B signal lost	
	25	IRIG-B time failed	
	26	IRIG-B time locked	
	27	XP session started	
	28	XP session completed successfully	
	29	XP session failed	
Device Diagnostics (bitmap)			
F4	Bit 0 = 1	Reserved	
	Bit 1 = 1	Permanent fault	
	Bit 2 = 1	RAM/Data error	
	Bit 3 = 1	CPU Watchdog reset	
	Bit 4	Reserved	
	Bit 5 = 1	CPU exception	
	Bit 6	Reserved	
	Bit 7 = 1	Software watchdog	
	Bit 8 = 1	Power down	
	Bit 9 = 1	Device reset	
	Bit 10 = 1	Configuration reset	

Format Code	Value	Description	Notes
	Bit 11 = 1	RTC fault	
	Bit 12 = 1	Configuration fault	
	Bit 13	Reserved	
	Bit 14	Reserved	
	Bit 15 = 1	Master EEPROM fault	
	Bit 16	Reserved	
	Bit 17	Reserved	
	Bit 18	Reserved	
	Bit 19	Reserved	
	Bit 20 = 1	C Library error	
	Bit 21 = 1	RTOS Kernel error	
	Bit 22 = 1	Task error	
	Bit 23	Reserved	
Shared Access Rules			
F5	0	No access limitation	
	1	PM296 Family (PM171, PM172, PM295, PM296/RPM096) locked registers: 1120-1791 3916-4035 4608-5930 6144-6655 28160-28927 29440-32896 35456-35743	
	2	SA300 Family (SA300, EM610, BFM136, PM174, PM175) locked registers: 3072-3259 63120-65151	