

# *El Paso Natural Gas Protocols Manual*

---

- *El Paso Master (EMTU)*
- *El Paso Slave (ERTU)*

**Bristol Babcock Inc.**

D4086 Issue: July, 1998

# Notice

---

## *Copyright Notice*

The information in this document is subject to change without notice. Every effort has been made to supply complete and accurate information. However, Bristol Babcock assumes no responsibility for any errors that may appear in this document.

Bristol Babcock does not guarantee the accuracy, sufficiency or suitability of the software delivered herewith. The Customer shall inspect and test such software and other materials to his/her satisfaction before using them with important data.

There are no warranties, expressed or implied, including those of merchantability and fitness for a particular purpose, concerning the software and other materials delivered herewith.

## Request for Additional Instructions

Additional copies of instruction manuals may be ordered from the address below per attention of the Sales Order Processing Department. List the instruction book numbers or give the complete model, serial or software version number. Furnish a return address that includes the name of the person who will receive the material. Billing for extra copies will be according to current pricing schedules.

ACCOL is a trademark and Bristol is a registered trademark of Bristol Babcock. Other trademarks or copyrighted products mentioned in this document are for information only, and belong to their respective companies, or trademark holders.

Copyright (c) 1998, Bristol Babcock, 1100 Buckingham St., Watertown, CT 06795. No part of this manual may be reproduced in any form without the express written permission of Bristol Babcock.

---

## **A Few Words About Bristol Babcock**

For over 100 years, Bristol<sup>®</sup> has been providing innovative solutions for the measurement and control industry. Our product lines range from simple analog chart recorders, to sophisticated digital remote process controllers and flow computers, all the way to turnkey SCADA systems. Over the years, we have become a leading supplier to the electronic gas measurement, water purification, and wastewater treatment industries.

On off-shore oil platforms, on natural gas pipelines, and maybe even at your local water company, there are Bristol Babcock instruments, controllers, and systems running year-in and year-out to provide accurate and timely data to our customers.

## **Getting Additional Information**

In addition to the information contained in this manual, you may receive additional assistance in using this product from the following sources:

## **Contacting Bristol Babcock Directly**

Bristol Babcock's world headquarters are located at 1100 Buckingham Street, Watertown, Connecticut 06795 USA.

Our main phone numbers are:

**(860) 945-2200**

**(860) 945-2213 (FAX)**

Regular office hours are Monday through Friday, 8:00AM to 4:30PM Eastern Time, excluding holidays, and scheduled factory shutdowns. During other hours, callers may leave messages using Bristol's voice mail system.

## **Telephone Support - Technical Questions**

During regular business hours, Bristol Babcock's Application Support Group can provide telephone support for your technical questions.

For technical questions regarding Bristol's **ACCOL software products** (as well as Open BSI and UOI) call **(860) 945-2265**.

For technical questions regarding Bristol's **Enterprise Server<sup>®</sup>** and **Enterprise Workstation<sup>®</sup>** products, call **(860) 945-2286**.

For technical questions regarding Bristol **hardware call (860) 945-2463.**

You can e-mail our Application Support Group at **bsupport@bristolbabcock.com**

The Application Support Group also maintains a **bulletin board** for downloading software updates to customers. To access the bulletin board, dial (860) 945-2251 (Modem settings: 14.4K baud maximum, No parity, 8 data bits, 1 Stop bit).

For assistance in interfacing Bristol Babcock hardware to radios, **contact Communication Technologies in Orlando, FL** at (407) 629-9463 or (407) 629-9464.

### **Telephone Support - Non-Technical Questions, Product Orders, etc.**

Questions of a non-technical nature (product orders, literature requests, price and delivery information, etc.) should be directed to the nearest regional sales office (listed below) or to your local Bristol sales office or Bristol-authorized sales representative.

#### **U.S. Regional Sales Offices**

Northeast (Watertown) (860) 945-2262  
Southeast (Birmingham) (205) 980-2010  
Midwest (Chicago) (630) 571-6052  
Western (Los Angeles) (909) 923-8488  
Southwest (Houston) (713) 685-6200

#### **Principal International Sales Offices:**

Bristol Babcock Ltd (UK): (011-441) 562-820-001  
Bristol of Canada: (416) 675-3820  
Bristol Babcock SA Mouy (France): (011-334) 431-1515

Please call the main Bristol Babcock number (860-945-2200) if you are unsure which office covers your particular area.

### **Visit our Site on the World Wide Web**

For general information about Bristol Babcock and its products, please visit our site on the World Wide Web at:

[www.bristolbabcock.com](http://www.bristolbabcock.com)

### **Training Courses**

Bristol Babcock's Training Department offers a wide variety of courses in Bristol hardware and software at our Watertown, Connecticut headquarters, and at selected Bristol regional offices, throughout the year. Contact our Training Department at (860) 945-2385 for course information, enrollment, pricing, and schedules.

## Who Should Read This Manual?

This manual is intended for use by a system engineer who is responsible for configuring a Network 3000 series controller to interface with an El Paso Natural Gas network.

It assumes familiarity with the following subjects:

- Use of personal computers, DOS, and Windows.
- Configuration and use of the foreign device or network.
- Use of ACCOL software tools, and ACCOL structures, such as signals, signal lists, and data arrays.
- Configuration of Bristol communication ports. This subject is discussed in the *ACCOL II Reference Manual* (document# D4044).
- Installation of protocols. The method for installing custom protocol system firmware varies depending upon the type of controller you have. Some units require insertion of a custom EPROM in a socket; other units require system firmware to be downloaded using the FLASH program.

## Table of Contents

### **Chapter 1 - El Paso Natural Gas Master (EMTU)**

Introduction .....	1-1
ACCOL Configuration Overview .....	1-1
Defining the Custom Port .....	1-2
Defining the Custom Module .....	1-2
Defining the EMTU Command List .....	1-3
Defining the EMTU Database .....	1-5
Format Descriptors .....	1-6
Error and Status Codes .....	1-8
Portstatus Module Support .....	1-9
Protocol Information .....	1-10

### **Chapter 2 - El Paso Natural Gas Slave (ERTU)**

Introduction .....	2-1
ACCOL Configuration Overview .....	2-1
Defining the Custom Port .....	2-2
Defining the Custom Module .....	2-3
Defining the ERTU Custom List .....	2-3
Defining the ERTU Database .....	2-5
Format Descriptors .....	2-8
Error and Status Codes .....	2-10
Portstatus Module Support .....	2-11
Protocol Information .....	2-12

# El Paso Natural Gas Master (EMTU)

## Introduction

The Custom Module and Custom port are used to interface the Bristol Babcock process controller with RTUs that emulate the El Paso Natural Gas (EPNG) communications protocol. The Bristol Babcock controller functions as the master terminal unit on the communication line (EMTU). Any number of Custom modules and Custom ports may be used in the EMTU mode.

*The information contained here assumes the reader is familiar with the El Paso Natural Gas communications protocol as described in the following documents:*

*Miller, Morris G., A Distributed Data Gathering System for Pipeline Telemetry, Revision 6, March 18, 1993.*

*Miller, Morris G., Data Communication Protocol: Data Communication Procedures, Revision 6, March 18, 1993.*

*Specifications and Requirements for Electronic Flow Measurement, Appendix A for single run AGA 3 Custody Transfer Requirements, Version 2.005, September 30, 1993.*

The Custom module configured for EMTU mode supports the following commands:

READ ID\$    Read selected data lines (ID\$s are specified).  
READ        Read fixed number of data lines (ID\$s are not specified).  
READ ALL    Read all the data lines (ID\$s are not specified).

## ACCOL Configuration Overview

There are four steps in configuring the ACCOL load in order to make the 33XX controller act as an EMTU:

1. Define a Custom Port. This is described in the sub-section 'Defining the Custom port.'
2. Define the Custom Module. This is described in the subsection 'Defining the Custom Module'.
3. Define the EMTU Command List. This is described in the subsection 'Defining the EMTU Command List'.
4. Create and configure the EMTU DataBase. This involves defining the Data Line List, the Data Item Lists, the Data Format List and the Formats. This is described in the subsection 'Defining the EMTU DataBase'.

# El Paso Natural Gas Master (EMTU)

## Defining the Custom Port

The EMTU port is defined via the Communications Configuration menu of The ACCOL II interactive Compiler (AIC) or in the \*COMMUNICATIONS section of the ACCOL source file, if you are using ACCOL Workbench (RM).

Configure the custom port according to the following instructions:

**MODE** - Set the mode to 17.0 for the Bristol Babcock controller to act as an El Paso Master Terminal Unit (EMTU).

**BAUD** - Set this field to 110, 150, 300, 600, 1200, 2400, 4800, 9600, or 19200 to indicate the communication baud rate.

**CHARACTER LENGTH** - Set this field to 8 to select 8 data bits per character, or set this field to 7 to select 7 data bits per character.

**STOP BITS** - Set this field to 1 or 2 to indicate the number of character stop bits to use.

**PARITY** - Set this field to Odd, Even, or None to indicate the type of character parity to use.

**P1** - Set this field to a value with range from 0 to 255 with units of 0.01 seconds (0 to 2.55 seconds). This value represents the delay between asserting the Request To Send (RTS) signal and the transmission of the first character. Note that this value may be necessary when communicating at low baud rates (e.g. 600 bps and below).

**P2** - Set this field to a value with range from 0 to 255. A value from 1 to 255 corresponds to a signal list number. This list includes a string signal (as its first signal) that would be used as a software Data Line Monitor signal. The length of the DLM string signal can be up to 64 characters. The firmware uses this string signal to store response messages sent by the slave RTUs. The response message is stored in the DLM signal in ASCII form.

*The DLM signals serve a very useful role during the communication troubleshooting. In normal operations the DLM signals should be set in Control Inhibit state. This way the firmware does not incur any overhead associated with displaying the message. When it is desired to monitor the messages being received, the DLM signal should be changed to the Control Enable state. The firmware recognizes this change and starts displaying the received messages.*

## Defining the Custom Module

In order to configure the 33XX to send/receive messages from RTUs, using the EMTU interface, the ACCOL Custom Module must be configured as follows:

# El Paso Natural Gas Master (EMTU)

**MODE** - Enter the constant 17 on this terminal, or create an analog signal for this terminal, with an initial value of 17.

**LIST** - Enter a constant which represents a signal list number, or create an analog signal for this terminal which has a signal list number as its initial value. List numbers can range from 1-255. The signal list referenced is referred to as the 'EMTU Command List'.

**STATUS** - Create an analog signal for this terminal which will be used to report a single error or status code which indicates the status of the EMTU communication interface. If the signal reports a status code of 0, the communication interface is functioning properly. If a value other than 0 appears, refer to the 'Error and Status Codes' sub-section to see what the error means.

## Defining the EMTU Command List

The EMTU Command List is an ACCOL signal list used to declare several parameters required for the proper operation of the Custom Module when executed for communications with slave RTUs. The EMTU Command List number must be identified on the LIST terminal of the Custom Module (See 'Defining the Custom Module'). The EMTU Command List must contain the exact number of signals (of the proper signal type) as described below:

**Signal 1 (Port Assignment)** - An analog signal whose value identifies the port to be used for communication with the slave RTUs. The port must be configured as a Custom port with mode 17 (EMTU mode).

Signal Value	Port(s) Enabled
1.0	A
2.0	B
3.0	C
4.0	D

*NOTE: An EMTU port can simultaneously be used by an EL PASO Remote Terminal Unit (ERTU) to support the passthrough global communication between the System MTU and the subsystem RTUs. For detailed information on this refer to the ERTU's user manual.*

**Signal 2 (Subsystem RTU Name)** - A string signal whose value is the RTU name to which this request is directed.

**Signal 3 (Subsystem RTU Number)** - An analog signal whose value is the RTU number of the RTU defined in the previous "Subsystem RTU Name" signal.

**Signal 4 (Command)** - An analog signal whose value specifies which read command to send. Only three commands are available:

## El Paso Natural Gas Master (EMTU)

Signal Value	Command	Description
1.0	READ	No arguments; read fixed number of data lines. This number is fixed and dependent on each RTU.
2.0	READ ALL	Read all data lines.
3.0	READ	Selected data lines. Selection made using the Read Line List and the Data Line Index signal.

**Signal 5 (Read Line List)** - An analog signal whose value is the number of a signal list. This list includes the signals that define the Data Lines.

**Signal 6 (Read Format List)** - An analog signal whose value is the number of a signal list. This list includes the signals that define the formats for the data lines defined in the Read Line List.

**Signal 7 (Data Line Index)** - An analog signal whose value identifies the starting signal in the Read Line List. A value of 1 identifies the first signal in the Read Line List, a value of 2 the second signal and so on. The value of this signal must not be greater than the number of signals in the Read Line List. If it is 0 or an illegal value then it is set to 1.

**Signal 8 (Number of Data Lines to Read/Expect)** - This is an analog signal that is interpreted differently depending on the command code. It is set to the number of Data Lines to be read or expected to be received from the RTU. An illegal value, defaults the signal's value to 1. For detail description of this signal refer to the subsection "Defining the EMTU Database".

**Signal 9 (Number of Data Lines Received)** - This is an analog signal. It outputs the number of data lines received from the RTU in response to the read request.

**Signal 10 (EMTU Local Time-out)** - An analog signal whose value represents the amount of time the module will wait for the response from the subsystem RTU. The value is in units of seconds and fractional values are truncated. The value may range from 1 to 300. The timeout will default to 5 seconds if the value is out of range or not specified.

**Signal 11 (Module Retries)** - An analog signal whose value represents the number of times the Custom Module will retry communication before it flags any data items as manually inhibited, when a communication failure occurs. The value may range from 0 to 255.

**Signal 12 (Communication Done Signal)** - This is a logical signal maintained by the EMTU driver. It is set OFF when the EMTU module is called and is set ON when servicing is complete.

# El Paso Natural Gas Master (EMTU)

## Defining the EMTU Database

When the Bristol Babcock 33XX controller that emulates the EMTU mode, requests data from a slave RTU, the returned data values are stored in ACCOL structures. These ACCOL structures comprise the EMTU database and are the following:

**Read Line List** - The Read Line List includes the analog signals that define the Data Lines in the slave RTU. The extension names of those signals must be the same as the Data Line IDs in the slave RTU. Values of these analog signals are signal list numbers which correspond to signal lists known as Data Item Lists.

The Number of signals in the Read Line List depends on the command issued:

**For READ with no arguments (01) command**, the Read Line List must define as many signals as Data lines expected to be returned from the slave RTU. The value of "Number Of Data Lines To Read/Expect" signal in the EMTU Command List should reflect that expected number of Data Lines.

**For READ ALL (02) command**, The Read Line List must define as many signals as Data Lines exist in the slave RTU. The value of "Number Of Data Lines To Read/Expect" signal in the EMTU Command List should reflect the number of Data Lines that exist in the slave RTU.

**For selective READ (03) command**, the Read Line List must define one analog signal for each Data Line to read. The number of Data Lines to be read from the slave RTU is defined by the "Number Of Data Lines To Read/Expect" signal in the EMTU Command List. Selection starts at the Data Line indicated by the "Data Line Index" signal in the EMTU Command List.

NOTE: If the number of data lines requested is greater than those received, the remaining data lines are flagged to indicated communication failure. Also if the number of data lines requested is less than those received, only the ones requested are updated.

**Data Item Lists** - Data Item Lists define signals that are Data Items to the corresponding Data Line. Data Item values received from the slave RTU for each Data Line are stored in these Data Item signals in the Data Item Lists. The received Data Item values for a particular Data Line are interpreted according to ACCOL Format structures. The Read Format List is the beginning point for defining (configuring) these format structures.

**Read Format List** - The Read Format List defines the analog signals whose values are the ACCOL Formats for the Data Lines defined in the Read Line List. Each Format uses standard ACCOL Format Descriptors to interpret the received Data Item values for a single Data Line when storing them in the Data Item signals. The Read Format List must have the same number of

# El Paso Natural Gas Master (EMTU)

signals as the Read Line List, i.e. one Format per Data Line. Note that it is possible to use the same Format number for more than one Data Line.

**Format Descriptors** - The Format Descriptors are defined in the Format statements of the Format. The Format statements tell the EMTU how to interpret the Data Item values in order to store them in the Data Item signals or Data Item arrays. The first Format Descriptor is used for the first signal in the Data Item List or the first column of the Data Item array row. Each subsequent Format Descriptor is used for the subsequent signals in the list or elements in the array. Errors detected in a Format statement are reported at the Custom Module's Status terminal. The following section describes the Format descriptors available for the El Paso Custom Module.

## **Format Descriptors**

**()** - Parentheses are used to group Descriptors in the format for repetition. Parentheses may be nested up to five levels.

**r** - Repeat Count: This Descriptor is an integer which may immediately precede the VL, VS, VU, and X format descriptors. It indicates that the descriptors following it will be used 'r' times to process 'r' Data Item values, or to skip 'x' signals or array rows. If the repeat count does not precede another Descriptor, that Descriptor is only used to process a single Data Item value.

**DA** - The value of the current signal in the Data Item List is considered the number of an analog data array. Array mode becomes active. Subsequent format descriptors are applied against this data array until the Descriptor DE is encountered. These arrays have 'm' rows and 'n\*2' columns, where 'm' is generally equivalent to the number of Data Lines and 'n' is equivalent to the number of Data Items in a Data Line. Each Data Item is assigned 2 columns: the first column is to store the Data Item status, and the second column is used to store the actual Data Item value. This is necessary as the arrays do not have the Manual Inhibit flag as do the analog signals.

**DL** - The value of the current signal in the Data Item List is considered the number of a logical data array. Array mode becomes active. Subsequent Format Descriptors are applied against this data array until the Descriptor DE is encountered. These arrays have 'm' rows and 'n\*3' columns, where 'm' is generally equivalent to the number of Data Lines and 'n' is equivalent to the number of Data Items in a Data Line. Each Data Item is assigned 3 columns. Two of these three columns are used to store the status because, unlike logical signals, the logical arrays do not have any flags. The first column is used to store communication status for the data item (0 = Success; 1 = Failure), the second column is used to indicate if a Data Item is fixed (0 = Control Enabled; 1 = Control Inhibited) and the third column is used to store the Data Item's value (ON/OFF).

**DE** - Array mode is ended. Subsequent Format Descriptors are applied against the next signal in the Data Item List. When switching the usage from an array to a list this Descriptor must first be used. If the next Descriptor is not DA or DL then subsequent Descriptors are applied against the

# El Paso Natural Gas Master (EMTU)

subsequent signal of the Data Item List. If the next Descriptor is DA or DL then the value of the next signal in the Data Item List is used as the data array number.

**rVL** - Used for interpreting logical values. All logical values are always in bit mode. They are handled either in groups of 8-bits (byte) if repeat count is 2, or in groups of 16-bits (word) if repeat count is anything else. If array mode is active (DL) then the Data Item values in the response record are mapped to the elements of the logical data array, otherwise they are mapped to the logical signals (Data Items) in the Data Item list. When array mode is active the least significant bit (lsb) of the byte is mapped to column 1 and the most significant bit (msb) of the byte is mapped to column 8, while the lsb of a word is mapped to column 1 and the msb of the word is mapped to column 16. When array mode is not active then the lsb of a byte or a word is mapped to the specified logical signal in the Data Item List and the subsequent bits of the byte or word are mapped to the subsequent logical signals in the Data Item List.

**VS<sub>n</sub>** - This field descriptor is used for interpreting analog values in signed format with a field width of 'n' digits. The value of 'n' can range from 1-32. If the value of 'n' is not specified then it defaults to 4. If array mode is active (DA) then the Data Item values in the response record are mapped to the elements of the analog data array, otherwise they are mapped to the analog signals (Data Items) in the Data Item list. If an error byte follows the received Data Item value and array mode is not active, internal signal's flags are set based on that error. Those flags, and the reasons they are set, are listed below:

ACCOL Flags	Description
QB - Questionable bit flag	Questionable bit flag is set if Data Item value is questionable.
CI - Control Inhibit flag	Control Inhibit flag is set if Data Item requested is fixed.
MI - Manual Inhibit flag	Manual Inhibit flag is set if a communications failure has been declared. The failure is declared because the Custom Module has executed (without successful communications) the number of times specified by the 'Module Retries' signal in the EMTU Command List.
LL - Low Low Alarm flag	Low Low Alarm flag is set if the requested Data Item is in Low-Low alarm state, or a negative Data Item Value has been treated by the slave RTU as unsigned. In the later case, the Data Item value will be received as zero.
HH - High High Alarm flag	High High Alarm flag is set if the requested Data Item is in High-High alarm state, or the received Data Item value has been truncated.

If the error byte follows the received Data Item value and array mode is active, the associated status column for the received Data Item is updated with the value of that error byte.

# El Paso Natural Gas Master (EMTU)

**VUn** - This field descriptor is similar to the VSn descriptor except that it is used to interpret unsigned Data Item values.

**rX** - This field descriptor is used to skip signals or rows in the target structure. This descriptor is useful when the same structure is used for multiple data lines or multiple subsystem RTUs. If array mode is not active then 'r' signals are skipped in the Data Item List. If array mode is active then 'r' number of rows are skipped.

## **Error and Status Codes**

The following status codes appearing in the Status signal in the Custom module and indicate intermediate and final communication stages:

<b>Error Code</b>	<b>Error Description</b>
0	Communication completed successfully.
1	Error End Of File (EOF) received.
2	Comment Record received.
3	EMTU module is being serviced.
4	EMTU module awaiting service.

The following list of status codes indicate errors that are externally, environmentally, or hardware generated. Any of those errors will abort communications:

<b>Error Code</b>	<b>Error Description</b>
-1	PROM does not support the EMTU mode.
-2	I/O error due to receive character overrun.
-3	I/O error due to receive character parity error.
-4	I/O error due to receive character framing error.
-5	I/O error due to CRC error.
-6	I/O error due to response timeout.
-7	I/O error due to invalid response message.
-8	I/O error due to transmit failure (time out).

The following code indicates errors in the Read Line List or Read Format List:

<b>Error Code</b>	<b>Error Description</b>
-31	ACCOL configuration error in EMTU's database.

# El Paso Natural Gas Master (EMTU)

The following list of status codes are reported during validation of the EMTU Command List. Any of the following errors will abort communications:

Error Code	Error Description
-19	EMTU Custom List does not exist or is not full.
-20	Subsystem RTU Name signal is of the wrong type or is an empty string.
-21	EMTU port number is invalid.
-22	Subsystem's RTU number is invalid.
-24	Read Line List does not exist or it is empty.
-25	Read Format List does not exist or it is empty.
-26	Extension is missing from signals in Read Line List.
-27	Some signals in the Read Line List are not analog.
-28	Some signals in the Read Format List are not analog.
-29	Value of 'Module Retries' signal is invalid.

The following codes indicate errors in Format statements or in the ACCOL structures that the Format Descriptors refer to:

Error Code	Error Description
-101	Unsupported field descriptor.
-102	Unmatched right parenthesis.
-103	Too many levels of parentheses.
-104	Invalid data array number selected.
-105	Attempt to use signal beyond end of list.
-106	Attempt to use cell beyond end of array.
-107	Attempt to go beyond end of buffer.
-108	Signal or cell type must be analog.
-109	Signal or cell type must be logical.
-110	Signal or cell must be analog or logical.
-111	Invalid floating point value.
-112	Unexpected error in the message buffer.

## **Portstatus Module Support**

The ACCOL Portstatus Module can be used to collect on-line statistics for any port that has been defined as an El Paso master (EMTU port). The Portstatus Module can also change some of the port characteristics such as the baud rate and parameter P1. The LIST terminal of this module will contain the analog signals that will receive port communication statistics. The signals in the list refer to the following statistics:

SIGNAL 1: Messages received  
SIGNAL 2: Messages transmitted

## **El Paso Natural Gas Master (EMTU)**

SIGNAL 3: Parity, overrun, framing errors

SIGNAL 4: CRC errors

SIGNAL 5: Message Length errors

SIGNAL 6: Message receive timeout errors

SIGNAL 7: Message transmit timeout errors

SIGNAL 8: Bad parameter errors

For more information on the Portstatus Module refer to the *ACCOL II Reference Manual* (document# D4044).

### **Protocol Information**

A comment record received in response to a READ ALL command is ignored.

# El Paso Natural Gas Slave (ERTU)

## Introduction

The Custom Module and Custom port are used to interface the Bristol Babcock process controller with a host computer (MTU/EMTU) that emulates the El Paso Natural Gas (EPNG) communications protocol. The Bristol Babcock controller functions as a slave unit on the communication line. Any number of Custom modules and Custom ports may be used in ERTU mode.

*The information contained here assumes the reader is familiar with the El Paso Natural Gas communications protocol as described in the following documents:*

*Miller, Morris G., A Distributed Data Gathering System for Pipeline Telemetry, Revision 6, March 18, 1993.*

*Miller, Morris G., Data Communication Protocol: Data Communication Procedures, Revision 6, March 18, 1993.*

*Specifications and Requirements for Electronic Flow Measurement, Appendix A for single run AGA 3 Custody Transfer Requirements, Version 2.005, September 30, 1993.*

The Custom module configured for ERTU mode supports the following commands:

READ ID\$	Read selected data lines (ID\$s are specified).
READ	Read fixed number of data lines (ID\$s are not specified).
READ ALL	Read all the data lines (ID\$s are not specified).
READ TIME	Read system date and time.
SET	Prepare to set specified signal to specified value.
SET DATE	Prepare to set system date.
SET TIME	Prepare to set system time.
LOAD	Prepare to set specified signals to specified values.
ACT	Activate pending changes for SET/LOAD command.
CANCEL	Abort (ESC/CR or CTRL-C/CR) pending changes for SET/LOAD command and do not make the necessary changes.

## ACCOL Configuration Overview

There are four steps in configuring the ACCOL load in order to make the 33XX controller act as an ERTU:

1. Define a Custom Port. This is described in the sub-section 'Defining the Custom port.'
2. Define the Custom Module. This is described in the subsection 'Defining the Custom Module'.

## El Paso Natural Gas Slave (ERTU)

3. Define the ERTU Custom List. This is described in the subsection 'Defining the ERTU Custom List'.
4. Create and configure the ERTU DataBase. This involves defining the Data Line List, the Data Item Lists, the Data Format List and the Formats. This is described in the subsection 'Defining the ERTU DataBase'.

### Defining the Custom Port

The ERTU port is defined via the Communications Configuration menu of The ACCOL II interactive Compiler (AIC), or in the \*COMMUNICATIONS section of the ACCOL source file, if you are using ACCOL Workbench (RM).

Configure the custom port according to the following instructions:

**MODE** - Set the mode to 1.0 for the Bristol Babcock controller to act as an EL PASO Remote Terminal Unit (ERTU).

**BAUD** - Set this field to 110, 150, 300, 600, 1200, 2400, 4800, 9600, or 19200 to indicate the communication baud rate.

**CHARACTER LENGTH** - Set this field to 8 to select 8 data bits per character, or set this field to 7 to select 7 data bits per character.

**STOP BITS** - Set this field to 1 or 2 to indicate the number of character stop bits to use.

**PARITY** - Set this field to Odd, Even, or None to indicate the type of character parity to use.

**P1** - Set this field to a value within the range from 0 to 255 with units of 0.01 seconds (0 to 2.55 seconds). This value represents the delay between asserting the Request To Send (RTS) signal and the transmission of the first character. Note that this value may be necessary when communicating at low baud rates (e.g. 600 bps and below).

**P2** - Set this field to a value within the range from 0 to 255. A value from 1 to 255 corresponds to a signal list number. This list includes a string signal (as its first signal) that would be used as a software Data Line Monitor signal. The length of the DLM string signal can be up to 64 characters. The firmware uses this string signal to store response messages sent by the slave RTUs. The response message is stored in the DLM signal in ASCII form.

*The DLM signals serve a very useful role during communication troubleshooting. In normal operations the DLM signals should be set to the Control Inhibit state. This way the firmware does not incur any overhead associated with displaying the message. When it is desired to monitor the messages being*

# El Paso Natural Gas Slave (ERTU)

*received, the DLM signal should be changed to the Control Enable state. The firmware recognizes this change and starts displaying the received messages.*

## Defining the Custom Module

In order to configure the 33XX to accept messages from an MTU using the ERTU mode, the ACCOL Custom Module must be configured as follows:

**MODE** - Enter the constant 1.0 on this terminal, or create an analog signal for this terminal, with an initial value of 1.0

**LIST** - Enter a constant which represents a signal list number, or create an analog signal for this terminal which has a signal list number as its initial value. List numbers can range from 1-255. The signal list referenced is referred to as the 'ERTU Custom List'.

**STATUS** - Create an analog signal for this terminal which will be used to report a single error or status code which indicates the status of the ERTU communication interface. Refer to the 'Error and Status Codes' sub-section to see what those codes mean.

## Defining the ERTU Custom List

The ERTU Command List is an ACCOL signal list used to declare several parameters required for the proper operation of the Custom Module when executed for communications with an MTU. The ERTU Custom List number must be identified on the LIST terminal of the Custom Module (See 'Defining the Custom Module'). The ERTU Custom List must contain the exact number of signals (of the proper signal type) as defined below:

**Signal 1 (Port Assignment)** - An analog signal whose value identifies the port to be used for communication with the MTU. The port must be configured as a Custom port with mode 1 (ERTU mode).

Signal Value	Port(s) Enabled
1.0	A
2.0	B
3.0	C
4.0	D

*NOTE: An ERTU port can accept messages from the MTU that are referred to this RTU (local messages) or to a Subsystem RTU (passthru global messages).*

## **El Paso Natural Gas Slave (ERTU)**

**Signal 2 (ERTU Name)** - A string signal whose value is the ERTU name to which this module will respond. Only the first eight characters of this signal's value are used.

*NOTE: If multiple Custom Modules, configured for ERTU mode, use signals with the same value for RTU names, only the first module to be defined will respond to commands on ports for which they are both enabled.*

**Signal 3 (Read Line List)** - An analog signal whose value is the number of a signal list. This list includes the signals that define the Data Lines.

**Signal 4 (Read Format List)** - An analog signal whose value is the number of a signal list. This list includes the signals that define the formats for the Data Lines defined in the Read Line List.

**Signal 5 (Data Line Selector Array Signal)** - An analog signal whose value is the number of a one dimensional analog array (Data Line Selector Array). The values in the cells of this array correspond to Data Line numbers for the Data Lines to be sent to an MTU in response to a 'READ with no arguments' command. Data Line numbers should be deposited in this array in ascending order. If a Data Line number is not included in this array, it will not be sent.

*NOTE: If the 'Data Line Selector Array' signal references an invalid array or the first element of the array indicates an invalid Data Line number then the first 'n' Data Lines from the Read Line List, are sent to the MTU, where 'n' is the value of the 'Read Count' signal (Signal 6).*

**Signal 6 (Read Count)** - An analog signal whose value determines the number of Data Lines to be sent in response to 'READ with no arguments' commands, in case the Data Line Selector Array does not specify any Data Line numbers. The value of this signal may range from 0 to the number of signals in the Read Line List. Fractional values are truncated. If the value of this signal is out of range, all Data Lines in the Read Line List will be sent in response to a 'READ without arguments' command.

**Signal 7 (Act Timeout)** - An analog signal whose value represents the amount of time the module will wait for an ACT command following a SET or LOAD command. The wait for an ACT command is canceled if the timer expires before the ACT command is received. The value of this signal is in units of seconds and fractional values are truncated. The value may range from 1 to 255. The Act Timeout value will default to 18 seconds if an out of range value is specified.

**Signal 8 (Set List)** - An analog signal whose value is the number of the signal list used to specify the signals which may be changed by a SET or LOAD command. The signals in the list may be analog or logical.

**Signal 9 (Global Date/Time Name)** - A string signal whose value is the global name for which the ERTU will accept the global SET DATE and SET TIME commands and set the system date and time for this RTU. Only the first eight characters of this signal's value are

# El Paso Natural Gas Slave (ERTU)

used. If this signal is of the wrong type or its length is 0, global date and time commands will not be accepted. If EMTU ports are also defined then this command is broadcast to all subsystem RTUs served by any defined EMTU ports (refer to **Subsystem RTU Name List** in the 'Defining the ERTU Database' sub-section).

*Note: A global SET DATE or a global SET TIME command changes the system date and time of this ERTU first, without waiting for an ACT command. When system date and time is changed through these global commands, DATE.. and TIME.. signals do not have to exist in the "Set List" for the settings to take place.*

**Signal 10 (Comment record)** - A string signal. The value of this signal (comment text record) is sent ahead of any data records in response to a READ or READ ALL request. If the value of this string signal is NUL, the comment record is not generated.

**Signal 11 (Subsystem RTU Name List)** - An analog signal whose value is the number of a signal list. This list is used as a table that maps an ERTU port to one or more EMTU ports and the subsystem RTUs that can be accessed through these EMTU ports. Refer to the subsection 'Defining the ERTU Database' to see how to configure the 'Subsystem RTU Name List'.

## Defining the ERTU Database

When the Bristol Babcock 33XX controller that emulates the ERTU mode, accepts requests from an MTU, these requests are acted upon by ACCOL structures. These ACCOL structures comprise the ERTU database and are the following:

**Read Line List** - The Read Line List includes the analog signals that define the Data Lines of this ERTU. For each signal in this list, the extension name is the name of the Data Line, while the values of these signals are signal list numbers which correspond to signal lists known as Data Item Lists. All the Data Lines required by the MTU must be included in the Read Line List. A Data Line's position in the Read Line List is equivalent to the ID# of that Data Line. All of the Data Lines in the Read Line List are sent in response to a READ ALL command.

Only the Data lines specified in the Data Line Selector Array are sent in response to a 'READ with no arguments' command. In a case where the Data Line Selector Array does not specify any Data Line Numbers, the first "n" Data Lines in the Read Line List are sent, where n is equivalent to the value of the 'Read Count' signal defined in the ERTU Custom List.

**Data Item Lists** - Data Item Lists define signals that are either Data Items themselves, or the signal value are used to reference ACCOL data arrays that contain the Data items of the corresponding Data Line. The Data Item List can contain any combination of Data Items (e.g. signals which are the actual Data Items, or signals whose value is an

## El Paso Natural Gas Slave (ERTU)

analog/logical array whose cells' value is the value of the Data item). Values of Data Items for the corresponding Data Line are sent to the MTU in response to a READ command. The Data Item values for a particular Data Line are formatted and sent according to ACCOL Format structures. The Read Format List is the beginning point for defining (configuring) these format structures.

**WARNING:** If the value of a Data Line signal in the Read Line List is 0, No Data item List is associated with that Data line and therefore no response will be sent to the MTU for that Data Line.

**Read Format List** - The Read Format List defines the analog signals whose values are the ACCOL Formats for the Data Lines defined in the Read Line List. Each Format uses standard ACCOL Format Descriptors to interpret the received Data Item values for a single Data Line when storing them into the Data Item signals. The Read Format List must have the same number of signals as the Read Line List, i.e. one Format per Data Line. Note that it is possible to use the same Format number for more than one Data Line.

**Format Descriptors** - The Format Descriptors are defined in the Format statements of the Format. The Format statements tell the ERTU how to format the Data Item values in order to send them to the MTU. The first Format Descriptor is used for the first signal in the Data Item List or the first column of the Data Item array row. Each subsequent Format Descriptor is used for the subsequent signals in the list or elements in the array. Errors detected in a Format statement are reported at the Custom Module's Status terminal (see section 'Error and Status Codes'). The section 'Format Descriptors' describes the Format descriptors available for the El Paso Custom Module.

**Set List** - This List contains signals that can be changed by a SET/LOAD command. The signals in the Set List may be analog or logical. The signal's base, extension and attribute names must match the name in the SET command sent by the MTU. The base, extension and attribute are separated by periods. A signal name does not need the extension and/or the attribute portion, but if used, the SET command should include them too.

The following rules and restrictions apply to the Set List:

The value of the signal to be changed must be within the signal's Low-Low and High-High alarm limits, in case the signal is an Alarm signal.

A logical signal value is set to ON if the command verb in message sent by the MTU is either "ON" or the signal's ON text, and it is set to OFF if the command verb is either "OFF" or the signal's OFF text.

A signal named DATE..., of any type, must appear in this list in order to change the system's date via a SET DATE command.

# El Paso Natural Gas Slave (ERTU)

A signal named TIME.., of any type, must appear in this list in order to change the system's time via the SET TIME command.

All signals in this List (signals whose value will be changed by the MTU) except the DATE.. and TIME.. signal, should be Control Inhibited, in order for the values to be changed. If they are not, an Error End of File response is sent to the MTU.

The LOAD command always applies to the first eight (8) signals in this list.

**Subsystem RTU Name List** - This list is used as a table that maps an ERTU port to one or more EMTU ports and the subsystem RTUs that can be accessed through the EMTU ports. Messages received by the ERTU and forwarded to a subsystem RTU through an EMTU port, are called Passthru Global Messages (PGMs).

The Subsystem RTU Name List should be configured as follows, when PGMs are received by the ERTU:

**Signal 1 (Port Number)** - An analog signal whose value is the EMTU port number to which PGMs will be directed. The port must be configured as a Custom port with mode 17 (EMTU mode).

Signal Value	Port(s) Enabled
1.0	A
2.0	B
3.0	C
4.0	D

**Signal 2 (Global Timeout)** - A analog signal whose value is used as the timeout period for how long to wait for a response from the subsystem RTU. The value is in units of seconds and fractional values are truncated. The value may range from 1 to 255. The timeout will default to 18 seconds if the value is out of range.

**Signal 3 (Number of Subsystem RTUs)** - An analog signal whose value is the number of subsystem RTUs served by this EMTU port.

**Signal 4 (Name of Subsystem RTU)** - A string signal with a maximum length of eight (8) characters, whose value is the name of the Subsystem RTU.

**Signal 5 (Subsystem RTU address)** - An analog signal whose value is the RTU number (address) of the RTU defined in the previous "Name of a Subsystem RTU" signal.

Repeat the "Name of a Subsystem RTU" and the "Subsystem RTU Number" signals for each subsystem RTU declared on this EMTU port. The "Number of Subsystem RTUs" signal should reflect the repetition number.

# El Paso Natural Gas Slave (ERTU)

Repeat all of the above set of signals for each EMTU port declared in the ACCOL load.

## **Format Descriptors**

( ) - Parentheses are used to group Descriptors in the format for repetition. Parentheses may be nested up to five levels.

**r** - Repeat Count: This Descriptor is an integer which may immediately precede the VL, VS, VU, and X format descriptors. It indicates that the descriptors following it will be used 'r' times to process 'r' Data Item values, or to skip 'x' signals or array rows. If the repeat count does not precede another Descriptor, that Descriptor is only used to process a single Data Item value.

**DA** - The value of the current signal in the Data Item List is considered the number of an analog data array. Array mode becomes active. Subsequent format descriptors are applied against this data array until the Descriptor DE is encountered. These arrays have 'm' rows and 'n\*2' columns, where 'm' is generally equivalent to the number of Data Lines and 'n' is equivalent to the number of Data Items in a Data Line. Each Data Item is assigned 2 columns: the first column is to store the Data Item status, and the second column is used to store the actual Data Item value. This is necessary as the arrays do not have the Manual Inhibit flag as do the analog signals.

**DL** - The value of the current signal in the Data Item List is considered the number of a logical data array. Array mode becomes active. Subsequent Format Descriptors are applied against this data array until the Descriptor DE is encountered. These arrays have 'm' rows and 'n\*3' columns, where 'm' is generally equivalent to the number of Data Lines and 'n' is equivalent to the number of Data Items in a Data Line. Each Data Item is assigned 3 columns. Two of these three columns are used to store the status because, unlike logical signals, the logical arrays do not have any flags. The first column is used to store communication status for the data item (0 = Success; 1 = Failure), the second column is used to indicate if a Data Item is fixed (0 = Control Enabled; 1 = Control Inhibited) and the third column is used to store the Data Item's value (ON/OFF).

**DE** - Array mode is ended. Subsequent Format Descriptors are applied against the next signal in the Data Item List. When switching the usage from an array to a list this Descriptor must first be used. If the next Descriptor is not DA or DL then subsequent Descriptors are applied against the subsequent signal of the Data Item List. If the next Descriptor is DA or DL then the value of the next signal in the Data Item List is used as the data array number.

**rVL** - Used for formatting logical values when a READ command is received by the ERTU. All logical values are always in bit mode. They are handled either in groups of 8-

# El Paso Natural Gas Slave (ERTU)

bits (byte) if repeat count is 2, or in groups of 16-bits (word) if repeat count is anything else. If array mode is active (DL) then the Data Item values are the values of successive cells starting at column 1, otherwise they are the values of successive logical signals (Data Items) in the Data Item list. When array mode is active the first 3 columns of the logical array refer to the first status/flag (lsb) of the byte or word. When array mode is not active, the value of each logical signal is the status/flag of the byte or word, with the first accessed signal in the Data Item List being the lsb and the last accessed signal in the Data Item List being the msb.

**VS<sub>n</sub>** - This field descriptor is used for formatting analog values in signed format with a field width of 'n' digits when a READ command is received by the ERTU. The value of 'n' can range from 1-32. If the value of 'n' is not specified then it defaults to 4. If the number of significant digits of the Data Item's value is less than 'n' then the result is padded with leading zeros. Floating point values are rounded to the nearest whole number before they are sent to MTU. If array mode is active (DA) then the value of the signal in the Data Item List is an analog array that contains the Data Item values. If array mode is not active then the signals in the Data Item List are the actual Data items. The values of these signals are the Data Item values.

A trailing error flag byte is attached to a Data Item's value when it is sent to MTU if one of the Data Item signal's applicable flags are set when array mode is not active, or the associated status column of the analog array contains an error value when array mode is active.

The associated bits of the error flag byte and the reasons they are set are as follows:

Value of Error Flag Byte in Hex	Description of Error Flag Byte	Flag is set when...
02	Questionable Data	the Data Item's questionable data bit is set.
04	Data Item value Fixed	the Data Item's Control Inhibit flag is set.
08	Communication Error	the Data Item's Manual Inhibit flag is set.
10	Underrange	the Data Item is in Low-Low alarm state or a negative value was going to be reported when the format descriptor VUn was specified. In the latter case the value will be reported as 0.
20	Overrange	the Data Item is in High-High alarm state or its value has been truncated because it cannot be reported with the specified format descriptor's field width

# El Paso Natural Gas Slave (ERTU)

		'n'.
--	--	------

**VUn** - This field descriptor is similar to the VSn descriptor with the difference that is used to process unsigned Data Item values and all negative values are sent to MTU as 0 with the underrange flag set.

**rX** - This field descriptor is used to skip signals or rows in the target structure. This descriptor is useful when the same structure is used for multiple data lines or multiple subsystem RTUs. If the array mode is not active then 'r' signals are skipped in the Data Item List. If the array mode is active then 'r' number of rows are skipped and the column number is reset to 1.

## Error and Status Codes

The following status codes appear in the Status signal in the Custom module and indicate intermediate and final communication stages:

Error Code	Error Description
1	The response to a READ command is in progress.
2	The response to a READ command has completed successfully.
3	The interface is waiting for an ACT command.
4	An ACT command has been processed successfully.
5	The response to a READ ALL command is in progress.
6	The response to a READ ALL command has completed successfully.
7	The response to a READ TIME command is in progress.
8	The response to a READ TIME command has completed successfully.
9	A global message is in progress.
10	A global transaction has been completed.
11	Global date/time message has been received.
12	Global 'check back' sent to the prime system, global ACT timer started.
13	Global ACT command received and queued at the EMTU's

The following list of status codes indicate errors that are reported by the ERTU in response to an MTU/EMTU request:

Error Code	Error Description
-2	The standard error response was sent due to an ACCOL configuration error. This can be caused by an invalid signal type, an invalid list number, not enough signals in a list, or an invalid READ format value.
-3	The standard error response was sent due to an error in the received command.
-4	A command being processed was canceled.

## El Paso Natural Gas Slave (ERTU)

-5	The ACT timer expired causing an automatic cancel of the wait for an ACT command.
-6	The wait for an ACT command was canceled.
-7	Analog signal to be SET has to be Control inhibited.
-8	Configuration error in the Subsystem RTU Name List.
-9	Global transaction has been canceled.
-10	Timed out while waiting for a global ACT command.
-11	Input command ignored, a global transaction is in progress.

The following codes indicate errors in Format statements or in the ACCOL structures that the Format Descriptors refer to:

Error Code	Error Description
-101	Unsupported field descriptor.
-102	Unmatched right parenthesis.
-103	Too many levels of parentheses.
-104	Invalid data array number selected.
-105	Attempt to use signal beyond end of list.
-106	Attempt to use cell beyond end of array.
-107	Attempt to go beyond end of buffer.
-108	Signal or cell type must be analog.
-109	Signal or cell type must be logical.
-110	Signal or cell must be analog or logical.
-111	Invalid floating point value.
-112	Unexpected error in the message buffer.

### **Portstatus Module Support**

The ACCOL Portstatus Module can be used to collect on-line statistics for any port that has been defined as an El Paso slave (ERTU port), as well as changing some of the port characteristics such as the baud rate and parameter P1. The LIST terminal of this module will contain the analog signals that will receive port communication statistics. The signals in the list refer to the following statistics:

- SIGNAL 1: Messages received
- SIGNAL 2: Messages transmitted
- SIGNAL 3: Cancel commands received
- SIGNAL 4: Bad parameter errors

For more information on the Portstatus Module refer to the *ACCOL II Reference Manual* (document# D4044).

# El Paso Natural Gas Slave (ERTU)

## **Protocol Information**

The first Read data Line is sent in response to an ACT command if the signal being changed in the SET list cannot be found in any Read Line's Data List or there is an ACCOL configuration error with the signal's Data Line.

The RTU number returned in all response records is the same as the node address selected via jumpers on the PMC board



**Bristol Babcock Inc.**

an FKI company

1100 Buckingham Street  
Watertown, CT 06795  
Telephone: (860) 945-2200

[Return to the Table of Contents](#)

[Return to the List of Manuals](#)