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Revision 1.98
Revision 2.08

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AGA Gas Flow Processor and Communications Module

AGA 3, 7 and 8

USER MANUAL

Please Read This Notice

Successful application of the Flow Processor card requires a reasonable working knowledge of the Modbus protocol, the AGA 3, 7 and 8 flow calculations, and the application in which they are being applied. For this reason, it is important that those responsible for configuring the module satisfy themselves that the module's functionality will meet the application's requirements.

This manual is provided to assist the user. Every attempt has been made to assure that the information provided is accurate and a true reflection of the product's installation requirements. In order to assure a complete understanding of the operation of the product, the user should familiarize themselves with the Modbus protocol and the AGA 3, 7 and 8 Gas Flow specifications.

Under no conditions will ProSoft Technology, Inc. be responsible or liable for indirect or consequential damages resulting form the use or application of the product.

Information in this manual is subject to change without notice and does not represent a commitment on the part of ProSoft Technology, Inc. Improvements and/or changes in this manual or the product may be made at any time. These changes will be made periodically to correct technical inaccuracies or typographical errors.

WARNING

This product will allow remote access to binary and register data which may have Control-related implications in the devices connected to the card. The User is responsible for assuring that any applicable regulations and safety practices concerning the remote operation of equipment are adhered to.

Preface

Getting Started

The key to successfully getting started with this product is to install the example ladder logic, and to experiment with the ladder logic and the module.

Through this experimentation, you will learn how the PLC communicates with the module, the layout of the AGA and Modbus memory map and the relationship between the module memory and the PLC memory.

As you familiarize yourself with the product, begin to adapt the configuration data to your application.

What to Read

Section III and IV are the most important chapters of the manual to understand and to familiarize yourself with. If you have experience with any of our other products, you will probably be able to get by with these chapters and the example ladder logic.

If you have not used one of products previously, you should add Section II to the list of important reading, while scanning the remaining sections.

The key concepts to understand that will help you the most in working with our module is the memory paging between the PLC and the module. This is discussed in an overview fashion in Section II, while the actual data structures are discussed in Section III and IV.

The AGA Calculations

The Flow and Compressibility calculations used in this product have been implemented as published in the 1992 American Gas Association Report No. 3 and No. 8 publications, including the latest known erratas, and the latest AGA 7 publication. These equations are quite extensive and based on years of work by experts in their fields.

We recommend that key decisions involving the configuration data and/or the operation of the product should be made by those familiar with the ramifications, and therefore familiar with the AGA Reports.

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Product Revision History

Revision	Date	Description of Changes
1.9		Added the Modbus Master functionality
1.92	7/25/95	Added the code necessary to support the Energy rate and totalization. Added several configuration control bits to disable BTU calc and to enable the Fw Calculation.(AGA 8 Configuration Word) AGA 3 and 7 results can be modified by the Fw Factor (English Units Only) Added a new variable called Totalized Energy - Daily Contract Period to current data. Used up spare register to do this
1.93	1/6/95	Added ability to disable contract period rollover (End of Day) on a per meter basis. The bit to enable and disable the rollover was added to the Meter Configuration Word (bit 4).
1.94	8/30/96	Fix MBM driver to support ASCII protocol. Compile MBMDRV.C and PCMAIN.C (rev/date) only -Modified mbm.cfg file to add mode selection
1.95	7/12/97	Fix AGA7 rollover at 1000000. Had constant entered with commas and compiler did not like it. Changed to 10000000 entry and changed working number (flow_pulses) to unsigned long int. Problem has gone away Worked on protecting against date lockup when PLC is first init with month/day as 0. This was causing an invalid lookup in day calc handling routine. Also put some logic in to account better for year 2000
2.01	01/12/98	Fix PCAGA where it calls Pf_calc() no matter if run is cfg for AGA3 or AGA7. Causes a problem if cfg for AGA 7 w/ AGA 8 turned on
2.02	04/12/98	Fix AGA7.C and the handling of energy calculation. Was only occuring in aga3 mode and not in aga7
1.98/2.03		09/13/98 Fix Energy calc value as is not getting zeroed out when the AGA3 gas flow rate goes to 0 due to low flow cutoff
2.04	12/02/98	Added logic in BT routine to count up to 5 times of bad time before flagging to screen. Put in to address problem that seems to be arising with EIP modules with old PLC5 units.
2.05	06/01/99	
2.06	07/01/99	Fix Modbus Slave driver problem where rx_sum() was not called in time to prevent response bytes to be sent even w/ bad crc/fc.
2.07	04/08/00	Add logic to allow the BTU value to be input from the PLC. code detects if value is > 0 and uses PLC value. For questar.
2.08	01/19/01	Fixed Modbus master so that it would read more than one slaves command list from the MBM.CMD file

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APPENDICES

I. *PRODUCT OVERVIEW*

The ProSoft Technology, Inc. 2100 family of Flow Processor products gives Allen-Bradley 1771 I/O compatible processors the ability to:

1. Perform the American Gas Association Report No. 3 (1992) and the American Gas Association Report No. 7 (1984) gas flow rate equations
2. Perform the American Gas Association Report No. 8 (1992) compressibility calculations
3. Interface to a Modbus Master device

1.1 Product Specifications

The product performs per the following specifications:

Modbus Slave Specifications

- RTU mode with CRC-16, or ASCII mode with LRC
- Function codes:

1	Read Output Status	(Future)
2	Read Input Status	(Future)
3	Read Multiple Data Registers	
4	Read Input Registers	
5	Force Single Coil	(Future)
6	Preset (Write) Single Data Register	
8	Loopback Test	(Future)
15	Multiple Bit Write	(Future)
16	Preset (Write) Multiple Data Register	

- Supports broadcast commands from Master
- Software configuration (From PLC)

Address	:	1 to 247 (0 is broadcast)
Parity	:	None, odd, or even,
Stop Bit	:	1 or 2
Baud Rate	:	300 TO 19,200

- Hardware RS-232C handshaking for modem and radio applications
- RS-422/RS-485 compatible for multidrop applications
- Supports the addressing of up to 1000 registers from the PLC data table, while giving read access directly to the Flow Processor's memory

AGA - 3, 7 & 8 Specifications

- Support for ten independently configured and operated meter runs
- AGA 3 Flange-Tapped Orifice Metering, Report No.3-1992

  User configurable parameters
  - Orifice and Meter run materials and base conditions
  - Compressibility calculation type

    AGA Report No. 8

    User entered densities

  - Static pressure Up/Down stream
  - English or Metric units
- AGA 7 Turbine Meter Gas Flow Measurement, Report No. 7-1984
  Pulse data based on Allen-Bradley 1771-CFM module
  Configurable for analog or pulse signal
  User configurable parameters :
  - Meter K Factor
- AGA 8 Compressibility Factors, Report No. 8-1992
  Based on *Detailed Characterization Method*
  User configurable parameters :
  - 21 component gas composition
  - Z Factor recalculation ranges, Pres and Temp
- Independent meter run calculation control and status, including Enable and Accumulator Reset
- Uses PLC Analog Input values or 1771-CFM module and Block Transfer file transfer capabilities to update real time data
- Modbus Slave port provides read access to all meter run data and calculation results for easy upload to Modbus Master
- Provides historical status, run time and accumulated flow data to PLC
- Stores 10 days of historical status, run time and accumulated flow data for retrieval (PCMCIA retrieval to be added in future upgrade)

<u>Environmental Requirements</u>

• Operating Temperature :	0 to 60 C (32 to 140 F)
• Storage Temperature :	-40 to 85 C (-40 to 185 F)
• Relative Humidity (Operating) :	5 - 95% non-condensing
• Vibration (Operating) :	10 to 150 Hz 2 g max peak acceleration 0.012 in (peak to peak) displacement

1.2 Items included as part of 2100 module

The 2100 product is shipped as one complete unit from the factory, with hardware, software and several items needed to support the product long term. Included in the 2100 package from ProSoft should be the following items:

Item	Description
1	Allen-Bradley 1771-DSX2 Module The hardware used as the platform for the 2100 module
2	PCMCIA Flash Ram Card This card, marked with a ProSoft sticker indicating the serial number and revision level, must be installed in the DSX2 per Section 2.8 of this User Manual

3 Utility Diskette (3.5”)
This diskette contains the files necessary to setup and Interlink connection between the 2100 module and a PC. This utility will be used when it is necessary to upgrade the AGA software

4 Serial Cable - Rev ACT302
This cable is used in combination with the Interlink utility to connect a PC to the 2100 module during the software upgrade process described in Section 2.8.

5 Remote Reset Connector Kit
These components are used to interface an I/O module to the 2100 reset circuitry. Please call us at (661) 664-7208 if you desire to install this option. We will fax you a connection diagram

6 9-25 Pin Converter
This converter is provided at assist in connecting the Serial Cable to the PC during the software upgrade.

7 Example Ladder Logic diskette
This diskette contains example PLC 5 ladder logic to implement up to 10 flow meters on the 2100 module. Also included is an Excel spreadsheet of the register listing in Appendix A-1

8 This User Manual

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II. INSTALLING THE MODULE

Installing the 2100-AGA module into a 1771 I/O platform is straightforward and procedural in nature. The following sections detail the step-by-step procedures that must be followed to take a 2100 module out of the shipping box to the point of being operational. Many aspects of this section are excerpted from the 1771-DSX2 User Manual.

2.1 Locating the Module in I/O Chassis

Place the 2100 module in a chassis in one of the slots closest to the PLC.

Group similar modules to minimize adverse effects from radiated electrical noise and heat. It is recommended that you:

- Group analog and low voltage DC modules away from AC modules or high voltage DC modules to minimize electrical noise
- Do not place the 2100 module in the same even-odd slot pair with:
  - A 16-bit I/O module when using 2-slot addressing
  - A 32-bit I/O module when using 1-slot addressing
- Consider the environmental requirements outlined in Section 1

2.2 Placing the Keying Bands

Once you have designated a slot for the module, steps should be taken to assure other modules are not accidentally inserted into this slot. It is recommended that the plastic keying bands shipped with each I/O chassis be used to key the I/O slot for the 2100 module.

The module is slotted in two places on the lower rear edge of the card. The position of the keying bands on the backplane connector must correspond to the slots in the board to allow the module to be inserted in the chassis.

For the 2100, snap the keying bands onto the lower backplane connector between 2-4 and between 14-16.

2.3 Installing Battery Backup Jumper

The 2100 module has a replaceable 3.6 V lithium battery (A-B part 1770-XZ) that provides backup power for the clock and configuration information.

When the module is shipped from ProSoft Technology, the battery jumper is located in the Enabled position. This is the result of the testing procedure the module has been placed through at the factory. Use the following information to adjust the battery jumper if ever required or to locate the battery if you need to change it.

2.4 Inserting Module in Chassis

To insert the 2100 module into the I/O chassis, use the following procedure:

1. Remove power from the 1771 I/O chassis
2. Place the module in the card guides on the top and bottom of the slot. Slide the module into the slot.
3. Snap the chassis latch over the top of the module to secure it

SAFETY NOTICE

Remove power from the 1771 I/O chassis backplane before installing the module.

Failure to remove power could cause :

- Injury
- equipment damage from unexpected operation
- degradation of performance

2.5 Connecting a Monitor

A VGA compatible monitor is supported by the 2100 module to display meter run calculation results directly out of the module. This section details the hardware connection, while a later section details how the VGA interface functions with a keyboard.

Use only VGA compatible monitors with an analog-type interface. Generic analog monitors are listed as either analog-interlaced or analog-non-interlaced with a dot-pitch resolution. The following monitors are listed by Allen-Bradley as having been tested, 'but are not supported by Allen-Bradley:'

- NEC Multisync II - Model NEC JC-1402
- IBM PS/2 Monochrome display - IBM 8503-001
- Panasonic Panasync C1395
- Panasonic Panasync C1381i
- Samsung CJ4681 Color Monitor

Some analog monitors have a 9 pin connector rather than the 15 pin connector. To convert from the 9 pin to the 15 pin head, the G&C #45-590 9-15 pin adapter is recommended.

If a TTL type monitor is used, the video will be distorted and equipment could be damaged if connected under power for a prolonged period of time

2.6 Connecting a Keyboard

Any AT style keyboard can be connected to the 2100. PS/2 keyboards require a special adapter (Radio Shack #90-2441).

2.7 Serial Port Connectors and Jumpers

The 2100 module has three 9 pin connectors for serial ports. Each serial port maintains 500 volts of isolation from the backplane, and is isolated from the other serial port by 500 volts.

At this time, only COM1 is activated, supporting Modbus Slave functionality.

Each serial port can be configured by setting a jumper located on the top of the module. The jumpers are easily reached without disassembly of the module when the module is removed from the I/O chassis.

Appendix B details the cabling necessary to support RS-232, RS-422 and RS-485.

The RS-422 transmitter is controlled by the RTS line. In the RS-422 mode, the receiver is always enabled.

In the RS-485 mode, the transmitter and receiver are controlled by the RTS line, with the transmitter enabled when RTS is true, and the receiver enabled when RTS is false.

2.8 Installing the AGA Software

The 2100 module's software is supplied with the initial purchase of the module on a PCMCIA Flash Memory Card.

2.8.1 Initial Installation

In order to install the software on the module:

1. Insert the PCMCIA card into the slot on the module
2. Power up the I/O rack or press the reset button on the module
3. Leave the card in the PCMCIA slot in case of system power fail. With the card in the slot, the system will automatically power up and re-start the AGA calculation process

2.8.2 Upgrading an Operating Module

Provisions in the implementation of the 2100 module have been made to allow Users to easily update the AGA software to the latest release. The update software will be made available through our Bulletin Board (BBS) to all User's who have completed one of our Product Registration Forms.

> Special software provided with the 2100 module is used to perform the upgrade. Appendix D in this manual includes a detailed explanation on how this software works.

In order to execute an upgrade, please follow the following procedure:

Items needed to perform Upgrade:

- Serial Cable supplied with 2100 module
- PC, laptop or otherwise
- Downloaded file from ProSoft BBS loaded on PC
- Spare keyboard

1. Download the new EXE file from the ProSoft BBS and place file on PC to be used to connect to 2100 module. The procedure and passwords for this will be provided upon receipt of completed Product Registration Form
2. Make sure the ProSoft Flash Ram card is in the PCMCIA socket
3. Plug the Serial Cable supplied with the module into COM 3 on the front of the 2100 module
4. Plug the other end of the cable into COM 1 of a PC containing the upgrade EXE file
5. Plug the spare keyboard into the 2100 module and press the F10 key. The F10 key will take the 2100 out of the AGA run mode, and invoke the Interlink server program, INTERSVR.EXE
6. On the PC, invoke the INTERLNK utility supplied with the 2100 module on the 'System Utilities' diskette. Prior to invoking INTERLNK, several changes may have to be made to your system configuration files. Appendix D includes a detailed explanation of the INTERLINK utility to assist you in this effort
7. From the PC, invoke the following command:

   COPY [pathname]\PCMAIN.EXE [dest drivr]:

8. Once the copy command is complete (may take about one minute), disconnect the Serial Cable from the 2100 module, and press the Reset Push-button located behind the card removal handle.
9. When the 2100 module completes the reset process, it will boot up into the AGA software and begin the calculation process.

2.9 Using the VGA Data Display Capabilities

The 2100-AGA package supports the display of data to the VGA port on the front of the 2100 module.

In order to see this data and make the most use of it, install a VGA monitor and keyboard as outlined earlier in this Section. Once the monitor warms up, the 'AGA Module Status Screen' should be displaying the status of the enabled meter runs.

At this point, the following keystrokes may be used to navigate through the available display options:

Key	Meaning
a	AGA Module Status Screen

This screen displays four meter calculation results per screen. To view more meters, use the Right Arrow (->) or Left Arrow (<-) keys.

h AGA Historical Storage Display Screen
This screen displays the historical storage results for four meters per screen. To view more meters, use the Right Arrow (->) or Left Arrow (<-) keys. To scroll through the historical records (up to 10 days worth) use the PG UP and PG DN keys.

d Modbus Data Table screen
This screen is a 'Data Table' Format screen, similar to what you would see with PLC programming software. The registers which are displayed consist of the Modbus data registers. The 0 - 999 registers will be the data that has been written from the PLC, and the 1000+ registers will be the AGA data space.

The display context can be changed by selecting one of the following keys:

I	Integer Mode
h	Hex Mode
b	Binary Mode

c Communication Status Screen
This screen displays the Modbus slave port status information. In addition to receive and transmit counters, error status information is also displayed. The error status/counters can be reset by pressing the 'r' key.

SCREEN UPDATE TIMING

The data display routines for the local VGA screen are called every 5 seconds in order to minimize processor loading. This automatic update timing can be overridden by simply hitting the key for the active screen. Once one of these keys are pressed, the screen update will occur immediately.

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III. MODULE FUNCTIONAL OVERVIEW

3.1 Modbus Slave Communications

The 2100 Flow Processor's Modbus Slave port runs the RTU and ASCII versions of the Modbus protocol. This capability allows the module to communicate data to a Modbus Master (as available in most SCADA Master packages), and vice-versa. The module supports both point-to-point implementations as well as multi-drop implementations.

The following discussion centers on the functional capabilities of the Modbus Slave port.

3.1.1 Command/Reply Cycle

Successful communications between a Modbus Slave and a Master will always consist of the following two transactions:

Command: Message from master giving instruction to slave.

Reply: Response to command.

A slave station will respond to a master issued command in several ways.

Data Message: If the command was executed by the slave, the response message will include the data requested, or an acknowledgment that the command was executed.

Error Message: If the command could not be executed by the slave, for whatever reason, an error response message is transmitted to the master. The error response message consists of the original function code (or'd with 80hex) and an error code.

No Reply: If the master does not detect a reply within its timeout period, the master should re-transmit the command, before a time out error is issued. If the Slave could not decode the message or an error occurred preventing the Slave from recognizing the message, no response will be issued.

3.1.2 Command Types

The Modbus Slave can respond to three types of commands from the master; read data, write data, and a diagnostic command. These are overviewed below and detailed in Appendix C.

Read : The following data read commands are supported:

1 Read Output Status
2 Read Input Status
3 Read Multiple Registers

4 Read Input Registers

Write Data: The following data write commands are supported:

5 Single Bit Write
6 Single Register Write
16 Multiple Register Write

Diagnostics: The following diagnostic command is supported:

8 Loopback Test - Code 0

3.1.3 Command Error Checking

When the Modbus Slave cannot execute a command, an error code is generated and returned to the master. Error codes generated at the slave will usually be indicative of an illegal function, an illegal address, bad data, or the inability to complete a transaction because of a network problem. Error codes are note returned under states of failed or tentative communications, such as bad checksum.

3.1.4 Data Integrity

As in all good protocols, there must exist a level of data integrity checking to verify, with some degree of assurance, the quality of the transmitted data. The Modbus protocol supports two types of error checking:

- RTU Mode : 16 bit cyclic redundancy check (CRC-16)
  ASCII Mode : 8 bit longitudinal redundancy check (LRC)
- One bit parity check

CRC-16: When the master generates a message, a 16 bit CRC value is added to the end of the transmitted packet. The CRC value is generated using a series of bit shifts and manipulations. The receiving station executes the same calculation on the data and verifies the transmitted CRC. Any discrepancy will cause the message to be disregarded.

LRC: When the master generates a message in the ASCII mode, an 8 bit LRC value is added to the end of the transmitted packet. The LRC value is generated by two's complementing the result of a binary summation on the characters. The receiving station executes the same calculation on the data and verifies the transmitted LRC. Any discrepancy will cause the message to be disregarded.

Parity: Parity checking can be added as an additional level of data security. If parity checking is selected, even or odd parity can be implemented.

3.2 Module Memory Layout

This section serves to explain the different segments of the memory which are utilized in the PLC and in the 2100 Module.

The 2100 module maintains several segments of memory:

- Modbus Data Memory
- Communications Configuration Memory
- AGA Data Memory

Data values are moved over the backplane between the module and the processor using the Block Transfer capabilities of the PLC.

3.2.1 Modbus Data Memory

The Modbus register address range of 0 to 999 is considered the Modbus Data Memory. In order to understand how the module handles the data memory, it is easier if the discussion is broken down into Read and Write Memory.

Read Memory: This memory contains the data which services read data requests from a Master (i.e., Function Codes 1,2,3, and 4). This memory is maintained in the 2100 module, and services the data read requests directly.

Data is transferred from the PLC to the module asynchronously from the Master's data read requests. This allows the application ladder logic to manipulate and position the data as needed before transfer to the module. Since the module stores the data from the ladder logic in local memory, read requests from the Master can be serviced immediately.

Write Memory: Write commands are sent directly to the PLC, bypassing the module's Modbus Data memory. The Write Memory shall accept the data received by the slave as the result of a write data command from a Master (i.e., Function Codes 5,6,15 and 16). This memory is a one (1) command buffer in the 2100 module that holds the data until the PLC performs a BTR file read.

> Write data from a master does not go directly into the module's Modbus Data Memory. PLC ladder logic must be used to accept the write data and place it in appropriate registers if the master is to be able to read back the data it has written.

The 2100 module controls the data which is transferred from the module to the PLC. The only time valid 'data' is transferred to the ladder logic is when a write command is issued from the Master.

Section IV and V of this manual provides further information on the data transfer mechanism, while Appendix A contains a PLC program showing an example of the logic to transfer data registers to and from the module.

3.2.2 Communications Configuration Memory

The Communication Configuration Memory contains the parameter data necessary for the module to set up the module's communications port (Port 1 on the 2100 module).

On power up, the module will not proceed without receiving the configuration block (Block ID 255) and the Meter Run Data Initialization blocks (Block ID 256 to 266)

This memory can only be accessed by the PLC, and is Write Only (i.e., the configuration memory contents in the 2100 module are not accessible for reading by the PLC).

3.2.3 AGA Data Memory

The 2100 module maintains the AGA Data Memory accessible for the flow calculation logic. The AGA Memory consists of several different types of data. The input and output values are available to the PLC ladder logic through Block ID Numbers 20 through 29.

In addition to the data that is transferred to the PLC, historical storage data and all relevant working data is available to the Modbus Slave port. AGA Data Memory is addressed on the Modbus Slave port starting at Register Address 1000.

The AGA Data Memory structure is overviewed in the following table (A detailed breakdown of the register/address assignments is provided in the Appendix):

				Modbus	
Block ID		**Description**	**Cnt**	**Start**	**Finish**
Write data from PLC					
255	W	i_sys_config	20	1000	1019
		i_time	10	1020	1029
20,21,22,23	W	i_loop_data structure [10] (70/run)			
24,25,26,27		i_loop_config (31 words)	Run 1-10	1030	1729
28,29		i_loop_update (9 words per)			
		aga_8_config (23 words per)			
		Space[7]			
		r_time	10	1730	1739
		space	60	1740	1799
Read Data To PLC					
20,21,22,23	R	f_loop_output[10] (40 words per)	Run 1-10	1800	2199
24,25,26,27		space	40	2200	2239
28,29	R	loop_storage[10] (300 words per)	Run 1-10	2240	5239
		space	100	5240	5339

3.3 PLC Data Transfer Interface

Data transfer between the PLC processor and the 2100 module occur using the Block Transfer functionality. This functionality allows the transfer of 64 *physical* registers per transfer. The *logical* data length changes depending on the data transfer function, as will be explained in this and later sections in the manual.

The following discussion details the mechanism and data structures used to transfer the different types of data between the 2100 module and the PLC.

An example PLC ladder logic is included in Appendix A-2.

> In order for the Flow Processor module to function, the PLC must be in the RUN mode, or in the REM RUN mode. If in any other mode (Fault/PGM), the Block Transfer instructions will stop. Under this condition, the meter calculation will increment the Time Away counter once per minute.
> The Modbus Slave port will continue to communicate.

3.3.1 Writing Data to the 2100 Module

This section discusses how to transfer data to the Flow Processor module to: 1)Configure the module, 2) To be accessed by a Master through Modbus Function Codes 1,2,3, and 4, and 3) For use by the AGA calculation.

The different types of data which are transferred require slightly different data block structures, but the basic data structure is:

WORD	DESCRIPTION
0	Block ID code
1-63	Data

> The BTW file length must be configured for 64 words when programming the instruction. Module operation will be unpredictable otherwise.

Where:

BLOCK ID CODE: A block identifier code between 0 and 255 in value. This code is used by the 2100 module to determine what to do with the data block. Valid codes are:

CODE	DESCRIPTION
0-19	Modbus Data Memory
20-29	AGA Data Memory
255	Module Configuration Memory
256-266	Meter Run Initialization Data

DATA: The data to be written to the module. The structure of the data is dependent on the Block ID code. Section IV provides details on the structure of the data depending on the data type.

3.3.2 Receiving Master Write Commands from the Module

This section discusses how to get data written to the Flow Processor module by a Master into the PLC's memory. Supported Modbus Function Codes include 5, 6, and 16.

The transfer of data from the 2100 Flow Processor module to the PLC is executed through the Block Transfer Read function. Four basic different types of data are read from the module into the processor. The data structure for the block transfer depends on the type of data to be transferred and the Block ID. The following provides an introduction to the data transfer, while Section IV details the data structures.

The different types of data which are transferred require slightly different data block structures, but the basic structure is:

WORD	DESCRIPTION
0	Block ID code
1-63	Data

> The BTR file length must be configured for 64 words when programming the instruction. Module operation will be unpredictable otherwise.

Where:

BLOCK ID CODE: A block identifier code used by the Flow Processor module to determine what to do with the data block. Valid codes are:

CODE	DESCRIPTION
1	Register Write command from Master (FC 6 or 16)
2	Bit Set or Reset Write command from Master (FC 5)
4	Multiple Bit Write command from Master (FC 15)
20-29	AGA Data Memory read
255	Module is requesting configuration data
256-266	Module request for Meter Run initialization data

DATA: The data to be written to the PLC. The structure of the data is dependent on the block ID code. Section IV details the different structures.

IV. DATA MOVEMENT - PLC TO THE 2100 MODULE

4.0 Section Overview

This section is dedicated to the movement of data from the PLC Ladder Logic to the 2100 module. Several different types of data are required to be transferred to the 2100 module, and this Section is broken down accordingly:

- 4.1 Moving Data to Modbus Data Memory
  - 4.1.1 Real Time Clock
- 4.2 Configuring the 2100 Module
  - 4.2.1 Slave Port Configuration
  - 4.2.2 Flow Calculation Configuration - System Parms.
- 4.3 Configuring the Meter Runs
  - 4.3.1 Meter Run Config Data - AGA 3
  - 4.3.2 Meter Run Config Data - AGA 7
  - 4.3.3 Real Time Update Data
  - 4.3.4 AGA 8 Configuration

4.1 Moving Data to Modbus Data Memory - Block ID 0 to 19

Writing to the Modbus Data Memory in the 2100 module is a simple Block Transfer Write with Block ID Codes from 0 to 19 followed by 50 words of data. The data that is to be made available to the Modbus Master for reading is written into the module in this fashion. The actual data table is built starting at word 0 (Block ID #0, word 0), and is built incrementally after this. The full range of the table is 0 to 999.

As an example, the following memory table demonstrates the relationship between the processor data table, the module data table, and the protocol addressing. Assuming we are using N10 as the data file in the PLC, the data will map as follows:

Proc Addr	Blk ID /Word	Module Addr	Modbus Addr
N10:0	0/0	0	0
N10:1	0/1	1	1
N10:2	0/2	2	2
--	--	--	--
N10:49	0/49	49	49
N10:50	1/0	50	50
N10:51	1/1	51	51
--	--	--	--
N10:99	1/49	99	99

By paging the different data blocks into the module on a continuous basis, the module will always contain relatively current data.

The example ladder logic in Appendix A demonstrates how to execute the data write for Block ID 0 (50 words of data)

4.1.1 Real Time Clock

The module uses the PLC's real time clock as the basis for the module's time. The real time value is updated to the module by the PLC ladder logic as part of every Block Transfer with a Block ID between 0 and 19, with the PLC clock registers being copied to the tail end of every block transfer data block.

The real time clock values are copied in the BTW transfer buffer, starting at word 58 of the buffer (Data word 57).

Real Time Clock

Data Word	Description	Format/Units
57	Time - year	xxxx
58	Time - month	xx
59	Time - day	xx
60	Time - hour	xx
61	Time - minute	xx
62	Time - second	xx
63		

Where:

Time Data Values: (xx)

The Time Set Data values to be used by the module for all decisions based on real time clock values. These functions include End of Day, Hourly data accumulations (future), and Rollover timestamping. The time data is copied straight from the PLC's Status File.

4.2 Configuring the 2100 Module - Block ID 255

The ProSoft Technology firmware must be configured at least once when the card is first powered up, and any time thereafter when the configuration parameters must be changed.

> The Module Configuration data block consists of data necessary to configure the Modbus Slave port as well as key Flow Measurement calculation setup values.

On power up, the module enters into a logical loop waiting to receive configuration data from the PLC. While waiting, the module sets the first word of the BTR buffer to 255, telling the PLC that the module must be configured before anything else will be done. The module will continuously perform block transfers until the Module Configuration block is received. Upon receipt, the module will execute a Modbus port initialization, reset the Modbus error counters, and then proceed to request the Meter Run Initialization Data.

Transferring the Module Configuration block to the module will force a reset of the communication port.

In order to initiate the configuration process from the PLC, the Block Transfer Write must be setup with a value of 255 in the data buffer's first word (the Block ID position). Configuration data will follow the Block ID, as outlined in the following sections. A full listing of the configuration block is contained in Appendix A-1.

4.2.1 Slave Port Configuration - COM 1

The data to configure the Modbus Slave port (COM 1) must be transferred from the PLC to the module. The structure of the data is as follows:

Module Configuration Data

Data Word	Description	Format/Units	Modbus Address
Modbus Slave Configuration			
0	Modbus Slave Address		N/A
1	Parity		N/A
2	Stop Bits		N/A
3	Baud Rate		N/A
4	RTS to TxD delay		N/A
5	RTS Off Delay		N/A
6	Input Table Offset		N/A
7	Output Table Offset		N/A
8	RTU/ASCII Mode Select		N/A
9	Spare		N/A

Where:

SLAVE ADDRESS: The module's slave address. The valid Slave addresses are 1 to 247

PARITY: The parity mode to be used by the module is defined by this word as follows:

0 No parity
1 Odd parity
2 Even parity

STOP BITS: The number of stop bits to be used is defined as follows:

1 One stop bit
2 Two stop bits

BAUD RATE: The baud rate at which the module is to operate. The baud rate is configured as follows:

VALUE	BAUD RATE
0	300 Baud

1	600 Baud
2	1200 Baud
3	2400 Baud
4	4800 Baud
5	9600 Baud
6	19200 Baud

RTS TO TXD DELAY: This value represents the time in *1 ms* increments to be inserted between asserting RTS and the actual transmission of data. The delay, if greater in duration than the hardware time delay associated with CTS, will override the CTS line until the timeout is complete. This configurable parameter is useful when interfacing with modem based devices, or anytime line noise must be allowed to subside before data is transmitted.

RTS OFF-DELAY: The value in this word represents the number of *1 ms* time delay increments inserted after the last character is transmitted and before RTS is dropped. The delay serves an important function in modem and multidrop line driver applications (RS-422/RS-485 applications). *Recommended* values to be placed in the configuration register are as follows:

CONNECTION TYPE	VALUE
RS-232C	0
All others (Modem, RS-422/485, etc.)	
300 Baud	25-50
600 Baud	14-16
1200 Baud	9-10
2400 Baud	3-4
4800 Baud	2-3
9600 Baud	1-2
19200 Baud	1

> If an incorrect value is used in a system which requires a time delay, communications will most likely fail completely, or at least on an intermittent basis.

The values presented here have been empirically determined, and should therefore only be used as starting points. The maximum value that can be used is 65535.

INPUT MEMORY START ADDRESS: This value defines the offset address into the 1000 word data space that the Modbus slave will use when responding to Function Code 2 and 4 commands. As an example, to start the address space at word 150, enter a 150. A Function Code 2 or 4 command with an address of zero will then start reading at word 150.

OUTPUT MEMORY START ADDRESS: This value defines the offset address into the 1000 word data space that the Modbus slave will use when responding to the Function Code 1 command. As an example, to locate the output image at word 100, enter a 100. A Function Code 1 command with an address of zero will start reading at word 100.

RTU/ASCII MODE SELECT: The module will operate as either an RTU or an ASCII mode slave. The following values control the selection:

Value	Mode
0	RTU Mode (Default mode)
1	ASCII 8 bit Mode
2	ASCII 7 bit Mode

4.2.2 Flow Calculation Configuration - System Parameters

The Flow Processor must receives certain Meter Run configuration parameters prior to execution. This information consists of meter run independent calculation setup data. The configuration data received through the 255 Module Configuration is as follows:

Flow Calculation Configuration

Data Wd/	Description	Format/Units		Modbus Address
10	Flow Calc Control Word			1000
11	Delta T3- for AGA 3 recalc resolution	xxx.x	Deg F(Deg C)	1001
12	Delta T8- for AGA 8 recalc resolution	xxx.x	Deg F(Deg C)	1002
13	Delta P8 - for AGA 8 recalc resolution		xxx.x	PSIA (kPa)
1003				
14	Base T - Contract base Temperature	xxx.x	Deg F(Deg C)	1004
15	Base P - Contract Base Pressure	xxx.x	PSIA (kPa)	1005
16	Time Zone - Hours behind GMT	xx.x	hrs	1006
17	End of Day Rollover - Hours (0 to 23)	xx	hr	1007
18	Number of Active Meter Runs(1-10)	xx		1008
19	Number of Modbus Read Data Blocks	xx	1-80	1009
20	Gauge Press to Absolute Press Offset	xx.x	PSIA(kPa)	1010
21	Modbus Master Read Data Block Cnt	xx		1011

Where:

Flow Calc Control Word: (Binary pattern)

This Control Word is used to perform several overall setup functions. The active bits have the following meanings:

Bit 0/1 These bits are not used in 2100 at this time

Bit 2 Force End of Day Rollover : When this bit is set, the module executes an End of Day data rollover. This forced rollover does not begin a new day, but does add the values to the historical data array, and reinitializes the daily accumulators for **all** meter runs. The normal End of Day rollover will still occur based on the configured Hour value (See Configuration Word 17). The bit must be cleared by the ladder logic or manually.

Bit 3 English or Metric Mode Select : The Flow Processor support both modes of operation. When bit 3 is clear, the module will be configured for English units, while a 1 is for metric.

Bit 4 Display Mode : A text line display mode can be enabled to assist debugging the module's operation under conditions when the module's operation becomes unreliable. The bit is normally reset to 0 to display the data display screens. When set to 1, the text line display mode (debug mode) is enabled.

Bit 5 Disk Log Mode (Future) : Event logging to the PCMCIA disk is disabled when the bit is reset to 0. When this bit is set, the module will log events and data to the PCMCIA disk. This data is in a ASCII format and may be extracted for use in other packages. Contact the Factory for further information.

Bit 6 Hard Debug Mode : This bit causes the module to shut down in the case of a math error. This bit will be removed in the future, but is currently to be set only when requested by the factory during debug sessions.

Bit 7 Modbus Master Enable : The COMM 2 port on the module can be enabled as a Modbus Master port. In this mode, the port will execute a series of commands as configured in the MBM.CMD file on the PCMCIA card. Full documentation on this feature will be provided in later editions of this manual.

DeltaT3: (xxx.x Deg F [Deg C])

The DeltaT3 value is used by the module in a Greater Than test to determine when to recalculate the AGA 3 temperature dependent parameters. This optimization can be performed with minimum loss on accuracy. A value of 0 will cause the recalculation to be performed every time a temperature change is detected. The value is entered as an integer with a 0.1 resolution.

An entered value of 50 means 5.0 to the module

DeltaT8: (xxx.x Deg F [Deg C])

The DeltaT8 value is used by the module in a Greater Than test to determine when to recalculate the AGA 8 temperature dependent equations. This optimization can be performed with minimum loss on accuracy. A value of 0 will cause the recalculation to be performed every time a temperature change is detected. The value is entered as an integer with a 0.1 resolution.

An entered value of 50 means 5.0 to the module

DeltaP8: (xxx.x PSI [kPa])

The DeltaP8 value is used by the module in a Greater Than test to determine when to recalculate the AGA 8 pressure dependent equations. This optimization can be performed with minimum loss on accuracy. A value of 0 will cause the recalculation to be performed every time a temperature change is detected. The value is entered as an integer with a 0.1 resolution.

An entered value of 50 means 5.0 to the module

Base T: Contract Base Temperature (xxx.x Deg F[Deg C])

This value represents the Contract Base Temperature condition. Normal values for this parameter are 68.0 Deg F, or 20.0 Deg C.

An entered value of 680 means 68.0 to the module

Base P: Contract Base Pressure (xxx.x PSIA[kPa])

This value represents the Contract Base Pressure condition. Normal values for this parameter are 14.7 PSIA, or 101.3 kPa.

An entered value of 147 means 14.7 to the module

Time Zone: (xx.x Hours)

The Time Zone parameter is used to correct the timestamp calculation from GMT to local time. The entered value represents the number of hours behind GMT.

An entered value of 80 means 8.0 hours to the module

End of Day Rollover: (xx Hour)

The End of Day Rollover parameter is used to configure the Hour of the day when the daily flow accumulation values will be placed into the historical storage buffer and the current values will be reset. The rollover occurs as soon as the module logic detects the beginning of the configured hour.

Number of Active Meter Runs: (xx Meter Runs)

The Number of Active Meter Runs parameter is used by the module to optimize calculation time and the number of block transfers that are executed at the end of each calculation sequence. Valid values for this parameter are 1-10, with the module defaulting to 10 if a value of zero is entered.

Number of Modbus Data Read Blocks: (xx Blks)

The Number of Modbus Data Read Blocks parameter is used by the module, in combination with the Number of Active Meter Runs parameter, to determine the total number of block transfers to be executed at the end of each calculation sequence. Valid values are from 1 to 80, with the module defaulting to 2 if a value of 0 is entered.

> The sum of the Number of Active Meters and the Number of Modbus Read Data Blocks determines the total number of block transfers executed at the end of each calculation sequence.

Gauge Press to Absolute Press Offset (xx.x PSIA[kPa])
The Statis Pressure for each meter run can be entered in either Gauge or Absolute Pressure. If it is desired to provide the Static Pressure in Gauge form, then the local atmospheric pressure can be entered in this register to conver the Gauge pressure to Absolute. Note that if Abosulte pressure is provided to the module then this register should contain a zero.

Modbus Master Read Block Count (xx. Blks)
This register will be used to determine the number of block transfers required to move the results from the Modbus Master port read commands to the PLC ladder logic.

4.3 Configuring the Meter Runs (Block ID 20 - 29)

Configuring the meters runs is accomplished by writing to the AGA Data Memory in the 2100 module using the Block Transfer Write with the Block ID Code between 20 and 29, followed by the necessary data.

The relationship between the Block ID number and the meter run is:

	Block ID
Meter Run #1	20
Meter Run #2	21
Meter Run #3	22
Meter Run #4	23
Meter Run #5	24
Meter Run #6	25
Meter Run #7	26
Meter Run #8	27
Meter Run #9	28
Meter Run #10	29

The data structure for each meter is exactly the same. In order to more easily explain the data structure, we have broken it down into the following types:

Data Type	Data Word
Meter Run Configuration Data	0 - 30
AGA 3 block type	
AGA 7 block type	
Real Time Update Data	31 - 39
AGA 8 Composition Data	40 - 62

4.3.1 Meter Run Configuration Data - AGA 3 Diff. Pressure

The Meter Run Configuration Data block consists of meter run specific configuration data. Data must be entered for each meter run that will be operational. The structure of the data block is different between the AGA 3 and AGA 7 equations after the Flow Calc Select bit. This bit determines which equation set will be used.

> Values entered in words 0-9 are not used by the module until the Configuration Enable bit (word 10, Section 4.4.2) is set.

Meter Run Configuration Data - AGA 3 Meter type
(Modbus addresses shown only for Meter #1)

Data Wrd	Description	Format/Units		Modbus Address
0	Meter Configuration Control Word			1030
1,2	Dm - Meter tube pipe ID @ TDm	Float	inches(mm)	1031
3,4	TDm - Meter tube measuring temp	Float	Deg F (Deg C)	1033
5,6	dm - Orifice plate bore @ Tdm	Float	inches (mm)	1035
7,8	Tdm - Orifice plate measuring temp	Float	Deg F (Deg C)	1037
9,10	Viscosity	Float	cP (cP)	1039
11,12	Density @ T, P(if 'User Entered' selected)	Float	lb/ft3(kg/m3)	1041
13,14	Density @ base(if 'User Entered' selected)	Float	lb/ft3(kg/m3)	1043
15,16	Low Flow Cutoff	Float	in H2O (kPA)	1045
17,18	Diff P Scaling - Min value	Float	in H2O (kPa)	1047
19,20	Diff P Scaling - Max value	Float	in H2O (kPa)	1049
21,22	Tf Scaling - Min value	Float	Deg F (Deg C)	1051
23,24	Tf Scaling - Max Value	Float	Deg F (Deg C)	1053
25,26	Pf Scaling - Min value	Float	PSIA (kPa)	1055
27,28	Pf Scaling - Max Value	Float	PSIA (kPa)	1057
29,30	Spare	Float		1059

Where:

Meter Configuration Control Word: (Binary pattern)
This Control Word is used to perform/control several meter specific setup functions. The active bits have the following meanings:

Bit	Description
1	PLC/User Config Select : This bit determines if the module uses configuration data from the PLC or from the Modbus port. <u>This value should be set to a 1</u> as User configuration through Modbus Port is not enabled in this release. PLC Configuration Data = 1 * User Modbus Config Data = 0 (Inactive)
2	AGA 3 or AGA 7 Flow Calculation Select : This bit is used to select the flow measurement equations which will be performed for this meter. AGA 3 = 0 (Differential Pressure) AGA 7 = 1 (Turbine pulses or analog)
4	Disable End of Day Rollover : This bit is used to disable the End of Day Rollover that the module

executes automatically based on the Real Time Clock and the configured End of Day Hour.

Enable End of Day Rollover = 0
Disable End of Day Rollover = 1

5 Static Pressure Location : Selects the Static Pressure measurement location for the Flange tap. If the downstream location is selected, the module adds the Delta P value to determine the Upstream pressure.

Downstream = 1
Upstream = 0

6/7 Orifice Plate Material : These bits allow the user to select the Orifice Plate material. Available selections are:

Bit 7	Bit 6	Description
0	0	304/316 SS
0	1	Monel
1	0	Carbon Steel
1	1	Invalid

8/9 Meter Run Material Select : These bits allow the user to select the Meter Run material. Available selections are:

Bit 9	Bit 8	Description
0	0	304/316 SS
0	1	Monel
1	0	Carbon Steel
1	1	Invalid

10/11 Compressibility Calculation Type Select : These bits allow the user to select the compressibility factor/density calculation method for the meter run. The available selections are:

Bit 11	Bit 10	Description
0	0	Use 'USER' entered values
0	1	AGA 8
1	0	Invalid
1	1	Invalid

13 Output Value Scaling : In AGA 3 calculation, this bit determines the Output Flow rate and accumulation scaling factor. The changes are reflected in the data returned from the module.

MCFD and MCF = 0 (Default in AGA 7)
MMCFD and MMCF = 1 (Not used in AGA 7)

14 Compressible Fluid Flag : This bit is used select the fluid type in the AGA 3 calculations:

Liquid (Incompressible) = 0
Gas (Compressible) = 1

Dm : Meter Tube Internal Diameter (inches[mm])
The entered value represents the Meter Tube Internal Diameter measured at TDm.

TDm : Meter Tube ID Measurement Temp (Deg F [Deg C])
The entered value represents the temperature at which the Meter Tube Internal Diameter (Dm) was measured.

dm : Orifice Plate Internal Diameter (inches [mm])
The entered value represents the Orifice Plate Internal Diameter measured at Tdm.

Tdm : Orifice Plate ID Measurement Temp (Deg F [Deg C])
The entered value represents the temperature at which the Orifice Plate Internal Diameter (dm) was measured.

Viscosity : Base and Exponent (cP)
The viscosity base and exponent values are used together to enter the fluid viscosity in centipoise. Appendix C contains a chart from the GPSA manual for gas viscosities.

Density @ T,P - User Entered (lbm/ft3 [kg/m3])
This value is the User Entered density which will be used to calculate flow at process conditions if the meter run 'Compressibility Calc Type' (word 0, bits 10/11) is set for User Entered Values.

Density @ Base - User Entered (lbm/ft3 [kg/m3])
This value is the User Entered density which will be used to calculate flow at base conditions if the meter run 'Compressibility Calc Type' (word 0, bits 10/11) is set for User Entered Values.

Low Flow Cutoff (inches of water [kPa])
The entered value represents the low flow cutoff differential pressure. Any measured differential pressure less than the Low Flow Cutoff value will force the measured flow to zero(0.0).

Diff Pressure Scaling Min/Max (inches of water [kPa])
The Minimum and Maximum scaling values represent the range of the Differential Pressure Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

Tf Scaling Min/Max (Deg F [Deg C])
The Minimum and Maximum scaling values represent the range of the Temperature Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

Pf Scaling Min/Max (PSIA [kPa])

The Minimum and Maximum scaling values represent the range of the Pressure Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

4.3.2 Meter Run Configuration Data - AGA 7 Turbine/Linear Analog Meters

The Meter Run Configuration Data block consists of meter run specific configuration data. Data must be entered for each meter run that will be operational. The structure of the data block is different between the AGA 3 and AGA 7 equations after the Flow Calc Select bit. This bit determines which equation set will be used.

> Values entered in words 0-9 are not used by the module until the Configuration Enable bit (word 10, Section 4.4.2) is set.

Meter Run Configuration Data - AGA 7 Meter type
(Modbus addresses shown only for Meter #1)

Data Wrd	Description	Format/Units		Modbus Address
0	Meter Configuration Control Word			1030
1,2	Dm - Meter tube pipe ID	Float	inches(mm)	1031
3,4	K Factor	Float	pulses/ft3	1033
5,6	Spare	Float	pulses/m3	1035
7,8	Spare	Float		1037
9,10	Spare	Float		1039
11,12	Density @ T, P(if 'User Entered' selected)	Float	lb/ft3(kg/m3)	1041
13,14	Density @ base(if 'User Entered' selected)	Float	lb/ft3(kg/m3)	1043
15,16	Low Flow Cutoff	Float	in H2O (kPA)	1045
17,18	Analog Pulse rate Scaling - Min value	Float	ft3/s (m3/hr)	1047
19,20	Analog Pulse rate Scaling - Max value	Float	ft3/s (m3/hr)	1049
21,22	Tf Scaling - Min value	Float	Deg F (Deg C)	1051
23,24	Tf Scaling - Max Value	Float	Deg F (Deg C)	1053
25,26	Pf Scaling - Min value	Float	PSIA (kPa)	1055
27,28	Pf Scaling - Max Value	Float	PSIA (kPa)	1057
29,30	Spare	Float		1059

Where:

Meter Configuration Control Word: (Binary pattern)

This Control Word is used to perform/control several meter specific setup functions. The active bits have the following meanings:

Bit	Description
1	PLC/User Config Select : This bit determines if the module uses configuration data from the PLC or from the Modbus port. <u>This value should be set to a 1</u> as User configuration through Modbus Port is not enabled in this release. PLC Configuration Data = 1 * User Modbus Config Data = 0 (Inactive)
2	AGA 3 or AGA 7 Flow Calculation Select : This bit is used to select the flow measurement equations which will be performed for this meter.

AGA 3 = 0 (Differential Pressure)
AGA 7 = 1 (Turbine pulses or analog)

3 AGA7 Input Type Select : Selects if the meter calculation logic will be looking for pulse values or for analog values.
Pulse = 0 (example, 1771-CFM module)
Analog = 1

4 Disable End of Day Rollover : This bit is used to disable the End of Day Rollover that the module executes automatically based on the Real Time Clock and the configured End of Day Hour.
Enable End of Day Rollover = 0
Disable End of Day Rollover = 1

10/11 Compressibility Calculation Type Select : These bits allow the user to select the compressibility factor/density calculation method for the meter run. The available selections are:

Bit 11	Bit 10	Description
0	0	Use 'USER' entered values
0	1	AGA 8
1	0	Invalid
1	1	Invalid

13 Output Value Scaling : In AGA 3 calculation, this bit determines the Output Flow rate and accumulation scaling factor. The changes are reflected in the data returned from the module.
MCFD and MCF = 0 (Default in AGA 7)
MMCFD and MMCF = 1 (Not used in AGA 7)

Dm : Meter Tube Internal Diameter (inches [mm])
The entered value represents the Meter Tube Internal Diameter measured at TDm. This value is included in the data set for historical logging purposes

K Factor (pulses / ft3 [pulses / m3])
The value represents the pulses per cubic foot or per cubic meter for the turbine meter. If the analog type is selected, the module defaults the K factor to 1.0.

Density @ T,P - User Entered (lbm/ft3 [kg/m3])
This value is the User Entered density which will be used to calculate flow at process conditions if the meter run 'Compressibility Calc Type' (word 0, bits 10/11) is set for User Entered Values.

Density @ Base - User Entered (lbm/ft3 [kg/m3])
This value is the User Entered density which will be used to calculate flow at base conditions if the meter run 'Compressibility Calc Type' (word 0, bits 10/11) is set for User Entered Values.

Low Flow Cutoff (inches of water [kPa])
The entered value represents the low flow cutoff differential pressure. Any measured differential pressure less than the Low Flow Cutoff value will force the measured flow to zero(0.0).

Analog Scaling Min/Max (ft3/Sec [m3/hr])
The Minimum and Maximum scaling values represent the range of the Analog signal that will be received from the meter's pulse to analog Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

Tf Scaling Min/Max (Deg F [Deg C])
The Minimum and Maximum scaling values represent the range of the Temperature Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

Pf Scaling Min/Max (PSIA [kPa])
The Minimum and Maximum scaling values represent the range of the Pressure Transmitter for the meter run. These values are used to range the unscaled 0-4095 real time value.

4.3.3 Real Time Update Data - AGA 3 and AGA 7

The Meter Run Real Time Update Data block contains the pressure, temperature and differential pressure data that the module requires to determine the instantaneous flow rates. In addition, the data block contains a control word which can be used to control the operation of the meter.

Real Time Update Data- AGA 3 and AGA 7
(Modbus addresses shown only for Meter #1)

Data Wrd	Description	Format/Units	Modbus Address
31	Meter Control Word		1061
32	Delta P(AGA 3) or Analog value (AGA7)	0-4095	1062
33	Tf - Flowing temp : real time value	0-4095	1063
34	Pf - Flowing Pressure : real time value	0-4095	1064
35	Turbine Frequency - High (AGA 7)	0-120	1065
36	Turbine Frequency - Low (AGA 7)	0-999	1066
37	Turbine pulse total - High (AGA 7)	0-999	1067
38	Turbine pulse total - Low (AGA 7)	0-9999	1068
39	Spare		1069

Where:

Meter Control Word: (Binary pattern)

This Control Word is used to perform/control several meter specific setup functions. The active bits have the following meanings:

Bit	**Description**
0	Configuration Enable : This bit will instruct the module to perform a re-configuration of the meter run flow equations using the new values that have been entered in words 0-9 (See Section 4.2.1 and 4.2.2). The module will return a Configuration Done bit which can be used to unlatch this bit.
1	AGA 8 Configuration Enable : This bit will instruct the module to perform a re-configuration of the meter run AGA 8 Compressibility equations using the new values that have been entered (See Section 4.4.4). The module will return an AGA 8 Configuration Done bit which can be used to unlatch this bit.
2	Meter Freeze : This bit will freeze the meter flow rate to 0, and will disable the compressibility and flow rate calculations while the bit is set.
3	Meter Reset : This bit, when set, will reset the meter accumulators to 0. No historical storage of the values is done. This function is to assist in the metering of batches. The module will return a Meter Reset Done bit which can be used to unlatch this bit.
15	Instrument Fail Detected : This bit, when set by the PLC ladder logic, will be transferred into the *Meter Status Word* for logging with the historical data. No action is taken by the meter except to store the bit in status. This indication may be used later when analyzing data to determine if any readings may be bad.

Delta P (AGA 3) or Pulse/Analog (AGA 7) 0-4095

The entered number is the unscaled value for the Differential Pressure or the Pulse/Analog signal. This value should be updated by the ladder logic from measurements taken by an analog input module. Analog signal coming from instrument may need to be scaled to correct units for module to handle.

Tf - Flowing Temperature 0-4095

The entered value represents the process fluid temperature, in engineering units, as measured in the process stream. This value should be updated by the ladder logic from measurements taken by an analog input module.

Pf - Flowing Pressure 0-4095

The entered value represents the Gauge or Aboslute pressure as measured in the process stream. The pressure may be measured upstream or downstream of the orifice plate. The location can be configured in the *Meter Configuration Word* (Word 0, bit 5). This value should be updated by the ladder logic from measurements taken by an analog input module. If the pressure is provided in Gauge form, then see module configuration registers to enter the Gauge to Absolute offset.

4.3.4 AGA 8 Configuration Data

The AGA 8 Composition Data block contains the gas composition data necessary for the module to perform the *Detailed Characterization Method* compressibility calculations. The *Detailed Method* requires a total gas analysis, with composition in either mole percents or mole fractions.

> Values entered in words 40-61 are not used by the module until the AGA 8 Configuration Enable bit (word 10, Section 4.4.2) is set, or until the Configuration Enable bit(Word 10, bit 0) is set.

AGA 8 Configuration Data
(Modbus addresses shown only for Meter #1)

Data Wrd	Description	Format/Units	Modbus Address
40	AGA 8 Update Control Word		1070
41	Concentration - Methane	xx.xx Mole %	1071
42	Concentration - Nitrogen	xx.xx Mole %	1072
43	Concentration - Carbon Dioxide	xx.xx Mole %	1073
44	Concentration - Ethane	xx.xx Mole %	1074
45	Concentration - Propane	xx.xx Mole %	1075
46	Concentration - Water	xx.xx Mole %	1076
47	Concentration - Hydrogen Sulfide	xx.xx Mole %	1077
48	Concentration - Hydrogen	xx.xx Mole %	1078
49	Concentration - Carbon Monoxide	xx.xx Mole %	1079
50	Concentration - Oxygen	xx.xx Mole %	1080
51	Concentration - i-Butine	xx.xx Mole %	1081
52	Concentration - n-Butane	xx.xx Mole %	1082
53	Concentration - i-Pentane	xx.xx Mole %	1083
54	Concentration - n-Pentane	xx.xx Mole %	1084
55	Concentration - n-Hexane	xx.xx Mole %	1085
56	Concentration - n-Heptane	xx.xx Mole %	1086
57	Concentration - n-Octane	xx.xx Mole %	1087
58	Concentration - n-Nonane	xx.xx Mole %	1088
59	Concentration - n-Decane	xx.xx Mole %	1089
60	Concentration - Helium	xx.xx Mole %	1090
61	Concentration - Argon	xx.xx Mole %	1091
62	Spare	xx.xx Mole %	1092 to 1099

Where:

AGA 8 Update Control Word: (Binary pattern)

This Control Word is used to control the use of the AGA 8 configuration parameters. The active bits have the following meanings:

Bit	Description
0	Not Used
1	PLC/User Config Select : This bit determines if the module uses configuration data from the PLC or from the Modbus port. This value should be set to a 1 as User configuration through Modbus Port is not enabled in this release. PLC Configuration Data = 1 * User Modbus Config Data = 0 (Inactive)
2	BTU Calculation Disable : This bit determines if the module will perform the energy calculations on the gas mixture. This value, when defaulted to 0 will perform the calcuations. In order to disable the calculations, place a value of 1 in this bit position
3	Fw Factor Calculation Enable : When this bit is clear, the Volumetric flow values will be returned to the PLC as they are calculated straight from the AGA 3, 7 and 8 equations. When the bit is set, the Fw equation will be applied to the volumetric flow

Concentration - Fluid Component: (xxx.xx %)

The values entered are the individual gas component concentrations obtained from a detailed gas analysis. The values are entered as a percentage number. Care should be taken in rounding concentration values to assure the best accuracy possible.

A value of 9651 means 96.51%.

If no conversation data is found. The data will assume 100% methane for calculation purposes.

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V. DATA MOVEMENT - 2100 MODULE TO PLC

5.0 Section Overview

This section is dedicated to the movement of data from the 2100 module to the PLC Data Table. Several different types of data can be expected from the 2100 module, and this Section is broken down accordingly:

- 5.1 Modbus Write Commands
  - 5.1.1 Register Writes - FC 6 and 16
  - 5.1.2 Single Bit Writes - FC 5
  - 5.1.3 Multiple Bit Writes - FC 15
- 5.2 Communication Status Data
  - 5.2.1 Reading Module Status Data
  - 5.2.2 Resetting Module Status Data
  - 5.2.3 Module Status Codes
- 5.3 Meter Run Results
  - 5.3.1 Real Time Meter Data
  - 5.3.2 Meter Run Summary Data - Current Period
  - 5.3.3 Meter Run Summary Data - Last Period

5.1 Modbus Write Commands

This section discusses how to get data written to the ProSoft module by a Modbus Master into the PLC processor. Supported Modbus Function Codes include 5, 6, 15 and 16.

Data transfer from the 2100 module to the PLC is executed through the Block Transfer Read function. Four different types of data are read from the module into the processor. The data structure for the Block Transfer depends on the type of data. The following sections detail the different types of data.

5.1.1 Register Writes (Func. Code 6 and 16)

When a register write command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with, bypassing the module's own Modbus and AGA Memory.

The ladder logic must be programmed to look at the BTR buffer, decode several words, and then take action. The BTR buffer definition, as it pertains to the Momentary and Continuous Control commands, is:

WORD	DESCRIPTION
0	Write Type 1 = Register Write
1	Count
2	Destination Address
3-62	Write Data (60 contiguous registers)

WRITE TYPE: Word 0 of the BTR buffer is used to tell the processor the type of data which has been written from the Master. When the value is equal to 1, a register write Function Code (6 or 16) has been received. With simple ladder logic to decode this value, the appropriate action can be taken.

COUNT: The number of registers being written by the Master. Valid numbers which will be received will range from 1 to 60. Any numbers outside this range will result in a protocol error response from the Slave to the Master.

DESTINATION ADDRESS: This value is used by the ladder logic to determine the address in the processor data in which to start the data write. The processor ladder logic must decode this word to determine where to begin locating the data from the Master.

DATA: The data values written from the Master. The values will be 16 bit register values, and should be placed into an integer file.

5.1.2 Single Bit Write (Func. Code 5)

When a Single Bit Control command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with.

The ladder logic must be programmed to look at the BTR buffer, decode several words, and then take action. The BTR buffer definition, as it pertains to the Single Bit Control command is:

WORD	DESCRIPTION
0	Control Type 2 = Single Bit Control
1	Bit Address
2	Control Action

Where:

CONTROL TYPE: Word 0 of the BTR buffer is used to tell the processor the type of Control action has been commanded from the Master. When the value is equal to 2, a new Single Bit Control command has been received. With simple ladder logic to decode this value, the appropriate action can be taken.

BIT ADDRESS: The Bit Address represents the bit which will be acted on within the word addressed in the previous parameter.

CONTROL ACTION: The action commanded by the Master is transferred in this word. When the value is a 0, the addressed bit is to be reset, and when the value is a 1, the addressed bit is to be set.

5.1.3 Multiple Bit Write (Func. Code 15) (Future)

When a Multiple Bit Control command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with.

The ladder logic must be programmed to look at the BTR buffer, decode several words, and then take action. The BTR buffer definition, as it pertains to the Multiple Bit Control command is:

WORD	DESCRIPTION
0	Control Type 4 = Multiple Bit Control
1	Word Count
2	Word Start Address
3-32	Data (30 words of bit sets/resets)
33-62	Mask image for 30 data words

Where:

CONTROL TYPE: Word 0 of the BTR buffer is used to tell the processor the type of Control action has been commanded from the Master. When the value is equal to 4, a new Multiple Bit Control command has been received. With simple ladder logic to decode this value, the appropriate action can be taken.

COUNT: This value represents the number of words in the data block that contain valid bit write data. Valid numbers will range from 1 to 30. Note that because a master can write a bit length that is not equal to a full word, it is possible that only a part of a data word will contain valid data. The ladder logic should mask out the invalid bits should they be used elsewhere.

START ADDRESS: This value represents the offset word address into which the bit write data block will start to be written. When the master addresses a bit write, it sends the starting bit address. The starting bit address is used by the module to generate this word start address (Bit address / 16).

DATA: These registers contain the bit write data received from the master. Note that partial word length bit writes are acceptable. The mask bits and some PLC logic protects unaddressed bits within a common word.

MASK: These words mask off the addressed bits. This allows for starting addresses which are not on a word boundary, and lengths which do not end on a word boundary. The example logic shows how to use the mask bits.

5.2 Module Status Data (Read Block ID 0)

The module maintains communications status for the PLC. This section discusses how to get this module status data from the ProSoft Technology module into the PLC.

The module maintains several pieces of status information that can be useful for module debugging purposes, as well as determining communication integrity.

5.2.1 Reading Module Status Data

The Status Data block is transferred to the processor with a Block ID of 0. The structure of the data block is as follows:

DATA WORD	DESCRIPTION
0	Current module status
1	Last transmitted error condition
2	Total Messages to this slave
3	Total Msg responses from this slave
4	Total Msgs seen by this slave
5	Spare
6	Spare
7	MBM Error Code
8	MBM Receive Counter
9	MBM Block ID

Where:

BLOCK ID: When the Block ID number in the BTR buffer (Word 0) is 0, the module is transferring the Status Data block.

CURRENT MODULE ERROR STATUS: This value represents the current value of the error code inside the module. The possible values are detailed in the following section.

LAST TRANSMITTED ERROR CONDITION: This value is the last error code transmitted to the master by this slave. Error codes which can be expected in this field are 0, 1, 2, 3, and 6. The field will only be cleared by re configuring the module (Block ID 255).

TOTAL MESSAGES TO THIS SLAVE: This value represents the total number of messages that have matched this slaves address, whether the slave actually determined them to be good (worthy of response) or not.

TOTAL MESSAGE RESPONSES FROM THIS SLAVE: This value represents the number of good (non-error) responses that the slave has sent to the master. The presumption is that if the slave is responding, the message was good.

TOTAL MESSAGES SEEN BY THIS SLAVE: This value represents the total number of commands seen by the slave, regardless of the slave address.

> Note : All accumulators will rollover to 0 after reaching 65535 (-1 in PLC Integer File)

MBM Error Code : This value represents the current error code status fo the Modbus Master port

MBM Receive Counter : This value increments upon each successful reception from a Modbus Slave device. Monitoring the value in this register with a timer can be used to determine if communications on the Modbus Master port are troubled.

MBM Block ID : This value is used to page Modbus Master read data blocks from the 2100 module into the ladder logic memory. As with all Block ID values in the 2100 module, each data block is 50 words and the Block ID value can be used to decode which 50 word block is being received from the module

5.2.2 Resetting Module Status Data

The module Communications Status accumulators are reset to 0 anytime the module receives a new configuration data block from the processor (Block ID 255).

5.2.3 Module Status Codes

The possible communication status codes returned in fields 1 and 2 of the Module Status Data block are detailed below:

Code	Description
0	All OK The module is operating as desired.
1	Illegal Function An illegal function code request has been received from the master
2	Illegal Data Address The address, or the range of addresses, covered by a request from the master are not within allowed limits
3	Illegal Data Value The value in the data field of the command is not allowed.

6	Module Busy The module busy status code is returned when a write command from the master has not yet been completed when a second write command is received
254	Checksum Error The slave determined that the message checksum was in error, and therefore discarded the message

5.3 Meter Run Results (Block ID 20 - 29)

The ProSoft module maintains the results of the AGA flow calculation in data blocks for the PLC. This section discusses how to get the Meter Run Flow calculation results from the 2100 module into the PLC, and the meaning of the data.

The ProSoft module maintains several pieces of status and output information that are designed to provide detailed instantaneous data, current period summary data, and last period summary data.

Reading the Meter Run Results from the AGA Data Memory in the 2100 module is accomplished using the Block Transfer Read command and decoding the Block ID codes between 20 and 29. The PLC ladder logic controls the selection of the Meter Run data block. In a one for one relationship, Meter run data is returned to the PLC every time the corresponding meter run AGA Data Memory is written into (i.e., when the PLC ladder logic executes a BTW write to Block ID 20, meter #1, the next BTR will contain the read data for Block ID 20).

The relationship between the Block ID number and the meter run is:

	Block ID
Meter Run #1	20
Meter Run #2	21
Meter Run #3	22
Meter Run #4	23
Meter Run #5	24
Meter Run #6	25
Meter Run #7	26
Meter Run #8	27
Meter Run #9	28
Meter Run #10	29

The data structure for each meter is exactly the same. In order to more easily explain the data structure, we have broken it down into the following types:

Data Type	Data Word
Meter Data - Real Time	0 - 13
Meter Summary Data - Current	14 - 37
Meter Summary Data - Last Period	38 - 63

5.3.1 Real Time Meter Data

The Real Time Meter Results data block contains current status word and output flow values for the meters. The structure of the data block is as follows:

Meter Run Real Time Data

(Modbus Addresses shown only for Meter #1)

Data Wrd	Description	Format/Units		Modbus Address
0	Meter Status word			1800
1	Spare Control/Status word			1801
2/3	Volumetric Flow Rate @ Contract Conditions	float		1802
4/5	Energy Flow Rate	float	(future)	1804
6/7	Z- AGA 8 Compressibility Factor	float		1806
8/9	Gas Density @ Flowing T, P	float		1808
10/11	Gas Density @ Base conditions (14.7 psia, 60 F)	float		1810
12/13	Spare	float		1812

Where:

Meter Status Word: (Binary pattern)

This *Meter Status Word* is used to toggle and flag the status of meter specific events occurring in the module. The active bits have the following meanings:

Bit	Description
0	Configuration Done : This bit will toggle after the module has completed a re-configuration of the meter run flow equations using the new values that have been entered. The module has performed this configuration as a result of receiving a Configuration Enable bit from the *Meter Control Word.*
1	AGA 8 Configuration Done : This bit will toggle after the module has completed a re-configuration of the AGA 8 compressibility equations using the new values that have been received from the PLC. The module has performed this configuration as a result of receiving an AGA 8 Configuration Enable bit from the *Meter Control Word.*
2	Meter Freeze Status : This bit indicates the Run status of the meter. When set (1) the meter is stopped with the meter flow rate at 0, and the compressibility and flow rate calculations not being performed. The module is in this state as a result of

receiving the Meter Freeze bit from the *Meter Control Word.*

3 Meter Reset : This bit will toggle after the module has completed resetting the flow accumulators for the meter. The module has performed this step as a result of receiving a Meter Reset bit from the *Meter Control Word.*

5 Meter Configuration Status : This bit indicates the Configuration status of the meter. When set (1) the meter has successfully been configured.

The following 'Rollover Status' bits are one-shot latch bits that indicate the occurrence of an event sometime since the last End of Day Rollover. These bits can be used to qualify/disqualify flow accumulation values, or to explain otherwise inexplicable events. These bits are also stored in the Historical Data 'Stat' field for historical purposes.

10 Rollover Power Up/Module Config Status : This bit indicates that a 255 Block ID configuration data block was received and processed from the PLC.

11 Rollover Meter Configuration Status : This bit indicates that the Configuration Enable bit in the *Meter Control Word* has been set.

12 Rollover AGA 8 Configuration Status : This bit indicates that the AGA 8 Configuration Enable bit in the *Meter Control Word* has been set.

13 Rollover Meter Freeze Status : This bit indicates that the Meter Freeze bit in the *Meter Control Word* has been set.

14 Rollover Meter Reset Status : This bit indicates that the Meter Reset bit in the *Meter Control Word* has been set.

15 Rollover Instrument Fail Status : The PLC ladder logic has set the Instrument Fail bit in the *Meter Control Word.*

Spare Control/Status Word: (Binary pattern)
This *Spare Control/Status Word* is used to toggle and flag the occurrence of an 'end of period', a rollover, where data is shifted from the Current Period registers to the Historical registers. The active bits have the following meanings:

Bit	Description
0	New Data Status Flag : This bit will toggle after the module has completed a rollover at the End of Day. During this rollover, data is transferred internally in the module, and the Current Period registers are re-initialized. The Status Flag is cleared by the module.
4	Last Calc Time Bad On Power Up : On power up the Last Calc Time is retrieved from battery backed memory. If this time is determined to be bad, the module defaults the Last Calc Time to the current PLC time, and then sets this flag. When this flag is set, there is a good change the Time Away value is in error.
6-15	Instrument Fail Overflow and Underflow : These bits store the occurrence of an Overflow and/or an Underflow condition during the current period. These conditions are detected based on bits 15 and 14 in the real time analog data. The bits are simply or'd into the status word, and maintained until daily rollover.

Volumetric Flow Rate @ Contract: ((M)MCFD [(E3)m3/h)

The Volumetric Flow Rate @ Contract conditions is the output of the AGA 3 and 7 flow calculation equations, compensated for compressibility and density. as measured at flowing (actual) conditions. This value is defined as Q_b in the AGA 3-1992 specifications. The value is presented in MCFD [m3/h] or MMCFD[(E3)m3/h], depending on the scaling selection made in the *Meter Configuration Control Word*.

Energy Flow Rate: ((M)MBTUD)

The Energy Flow Rate is the output of the AGA 3 flow calculation equations, compensated for compressibility and density, as measured at flowing (actual) conditions. The value is presented in MBTUD or MMBTUD, depending on the scaling selection made in the *Meter Configuration Control Word*.

Z AGA 8 Compressibility Factor: (factor)

The Z Compressibility Factor represents the output value from the AGA 8 calculations. This value is provided for information purposes only, as its effect is already built into the gas flow rate and total values.

Density at Flowing T,P: (lbm/ft3 [kg/m3])

The Density at Flowing T,P represents the value calculated by the AGA 8 calculations. This value is provided for information purposes only, as its effect is already built into the gas flow rate and total values.

Density at Base T,P: (lbm/ft3 [kg/m3])
The Density at Base T,P represents the value calculated by the AGA 8 calculations. This value is provided for information purposes only, as its effect is already built into the gas flow rate and total values.

5.3.2 Meter Run Summary Data - Current Period

The Meter Run Summary Data for the Current Period block contains the accumulated and average results for the current 'Contract Period'. Unless overridden by meter control bits (whenever the Force End of Day Rollover bit in the *Flow Calc Control Word* is set), the 'Contract Period' is one day in length, starting and ending at the End of Day Rollover Hour as detailed in Section 4.2.2. The structure of the data block is as follows:

Meter Run Summary Data

(Modbus Addresses shown only for Meter #1)

Data Wrd	Description	Format/Units	Modbus Address
14/15	Totalized Flow	float	1814
16/17	Totalized Energy	float	1816
18/19	Average Diff Press	float	1818
20/21	Average Flowing Pressure	float	1820
22/23	Average Flowing Temperature	float	1822
24/25	Totalized Energy - Daily Contract Period	float	1824
26/27	Time Away	float	1826
28/29	Meter On Production Time	float	1828
30/31	Sequence Counter	float	1830
32/33	Meter On ProductionTime - Daily Contract Period	float	1832
34/35	Totalized Flow - Daily Contract Period	float	1834
36/37	Timestamp-current seq	long int	1836

Where:

Totalized Flow: ((M)MCF [(E3)m3])
The Accumulated Flow volume represents the summation over time of the Volumetric Flow Rate. The value is reset during the End of Day Rollover process, or whenever the Reset Meter command is received in the *Meter Control Word*.

Totalized Energy: ((M)MBTU)
The Accumulated Energy represents the summation over time of the heating value of the gas. This value is reset during the End of Day Rollover process, or whenever the Reset Meter command is received in the *Meter Control Word*.

Average Diff Press: (PSI [kpa])
The Average Diff Pressure represents the Flow-dependent time-weighted linear average of the measured differential pressure. The differential pressure is sampled once per second.

Average Flowing Temperature: (Deg F [Deg C])
The Average Flowing Temperature represents the Flow-dependent time-weighted linear average of the flowing temperature. The temperature is sampled once per second from the module's data, independent of the update data rate from the PLC.

Average Flowing Pressure: (PSIA [kPa])
The Average Flowing Pressure represents the Flow-dependent time-weighted linear average of the flowing pressure. The pressure is sampled once per second from the module's data, independent of the update data rate from the PLC.

> The Flow-dependent time-weighted linear average calculation method used does not increment the averages during the sampling period if there is a no or low flow condition.
> In all average value cases, the actual values are sampled once per second and accumulated in the module, but the calculated output values returned to the PLC and to the VGA display are only updated once per minute

Totalized Energy - Daily Contract Period : ((M)BTU [(E3)J3])
This Totalized Energy value represents the summation of the Energy Flow Rate since the last End Of Day Rollover. This value is reset during the End Of Day Rollover process

Time Away Time: (Minutes)
The Time Away value represents the amount of time in minutes that the meter/module has detected a failed block transfer or power down/reset condition. The block transfer failure condition may be caused by the PLC being taken out of Run. The power down/reset condition could be an actual power failure, or if the module is taken out of run, such as for a software upgrade.

> The 2100-AGA module stores the current calculation time in battery backed ram once per minute. When the module is reset or powered up, these registers are read to determined how long the module has been down, and therefore the 'Time Away'.

Meter On Production Time - Sequence Period (Minutes)
The Meter On Production Time represents the duration of the 'sequence period', in minutes. During which flow has been > = to the low flow cut off. This value may be used to determine actual flow times in cases where contract period interruptions are detected.

The 2100-AGA module clears all of its internal registers on power up. To overcome the potential loss of valuable flow data, the ladder logic is used to detect the power up or reset condition of the 2100 module. When this condition is detected, the ladder logic shifts all Current Period data into the Historical data and timestamps it.

Sequence Counter :
This value is used to monitor the number of re-configurations that have occurred in the middle of 'Contract' periods (24 hour). Upon detecting a re-configuration request from the PLC (on command or on power up) the 2100 module increments the Sequence Counter, and cuts a new historical record, shifting all current period Summary Data to the 1st day of historical storage.

Meter On Production Time - Daily Contract Period : (Minutes)
This value represents the measured duration of the true 'contract' period in minutes as measured from the last End Of Day Rollover. Qualified by the low flow cut off configuration value (> =) and no stock transfer error. This value is not reset on a module re-configuration, and is therefore a true representation of the Meter On Production Time for the Contract Period, independent of the Sequence Counter. This value is reset during the End Of Day Rollover process.

Totalized Flow - Daily Contract Period : ((M)MCF [(E3)m3])
This Totalized Flow value represents the summation of the Volumetric Flow Rate since the last End Of Day Rollover. This value is reset during the End Of Day Rollover process.

Timestamp-Current Seq: (Seconds since 1/1/70)
This is the timestamp value for the beginning of the current accumulation sequence. This value is used in a power down situation to provide the timestamp for the historical record when the module is powered back up.

5.3.3 Meter Run Summary Data - Last Period

The Meter Run Summary for the Last Period data block contains the accumulated and average results for the last 'Contract Period'. Unless overridden by meter control bits (whenever the Force End of Day Rollover bit in the *Flow Calc Control Word* is set), the 'contract period' is one day in length, starting and ending at the End of Day Rollover Hour as detailed in Section 4.2.2. The structure of the data block is as follows:

Meter Run Summary Data - Last Period				
(Modbus Addresses shown only for Meter #1)				
Data Wrd	Description	Format/Units		Modbus Address
38	Status flags			2240
39	Status flags - word 2			2241
40/41	Timestamp	Long int		2242
42/43	Totalized Flow	float		2244
44/45	Totalized Energy	float	(future)	2246
46/47	Average Flow Rate	float		2248
48/49	Average Flowing Pressure	float		2250
50/51	Average Flowing Temperature	float		2252
52/53	Spare	float		2254
54/55	Time Away	float		2256
56/57	Meter On Production Time	float		2258
58/59	Sequence Counter	float		2260
60/61	Spare	float		2262

Where:

Control Status Flags: (Binary pattern)

The Control Status Flags word is contains several different values encoded and embedded within the word. The bit fields are defined as follows:

Bit	Description
2	Meter Freeze Status : This bit indicates the Run status of the meter. When set (1) the meter is stopped with the meter flow rate at 0, and the compressibility and flow rate calculations not being performed. The module is in this state as a result of receiving the Meter Freeze bit from the *Meter Control Word.*
5	Meter Configuration Status : This bit indicates the Configuration status of the meter. When set (1) the meter has successfully been configured and the compressibility and flow rate calculations not being performed. The module is in this state as a result of receiving the Meter Freeze bit from the *Meter Control Word.*
10-15	Rollover Status : The bits from the Rollover bits in Section 5.3.1 are stored in these bits. See 5.3.1 for details on the bits.

All other values are as detailed in the Current Period discussion above.

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VI. MODBUS SLAVE COMMANDS

The 2100 module Modbus Slave functionality supports several data read and write commands. The decision on which commands to use is made depending on the type of data being addressed, and the level of Modbus support in the slave and master equipment. The following sections detail the different commands supported by the module.

6.1 MODBUS Commands

The Modbus Slave driver supports the following commands. As stated in earlier sections, the data for responding to read commands is taken directly out of module memory, while write data from the Master is sent directly to the processor ladder logic, bypassing the module memory table.

6.1.1 Function Code 1 - Read Output Status

The slave returns bit data from the data space pointed to by the "Output memory start address" configuration word. The module will support up to 125 words per requests, and will support starting bit addresses not on a word boundary.

6.1.2 Function Code 2 - Read Input Status

The slave returns bit data from the data space pointed to by the "Input memory start address" configuration word. The module is subjected to the same operating criteria as outlined in Section 6.1.1.

6.1.3 Function Code 3 - Read Multiple Registers

The module will return up to 125 words of data from anywhere within the module's data space.

This command will also support the reading of Floating Point data from the module. In order to retrieve a Floating Point value (2 words per value), add 7000 to the desired address, and increment the count field to represent the actual number of words to be retrieved. When the module receives a read request addressed above 7000, it will swap the words before returning them to the host. This swapping is essential in order to successfully transfer floating point data to many host packages.

6.2.4 Function Code 4 - Read Input Registers

The module returns word data from the data space pointed to by the "Input memory start address" configuration word. The module will return up to 125 words per request.

6.2.5 Function Code 5 - Single Bit Write

This message turns individual bits on or off. The Modbus protocol calls for this code to force a bit, overriding all other conditions. The module is capable only of communicating the write data (starting address and bit condition) to the ladder logic. Ladder logic in the processor must act upon the data and actually set or clear the bit. See Section 5.1 for a more thorough discussion of this command.

6.2.6 Function Code 6 - Single Register Write

The module supports the single data register write command. The data value and destination address written from the master will be transferred directly to the processor. The ladder logic must actively move the data from the BTR buffer to the correct Data Table location in order for the write command to be completed.

6.2.7 Function Code 15 - Multiple Bit Write (Future)

The module supports the multiple bit write command. Section 5.1 discusses implementation of this command in detail.

6.2.8 Function Code 16 - Write Multiple Registers

The module supports a data register write request from 1 to 60 words in length (Note that the actual MODBUS protocol limitation is 125 registers per communications transaction).

This command will also support the writing of Floating Point data to the PLC. In order to write a Floating Point value (2 words per value), add 7000 to the desired address, and increment the count field (2 words per write) to represent the actual number of words. Note the limit of 30 Floating Point values due to the word length.

6.2 Reading and Writing Floating Point Data

The movement of Floating Point data to and from the 2100 module requires some special consideration. Floating Point (FP) data is stored in the module in IEEE 784 format, with two words per value. Depending on the host package, the orientation of these two words may need to be swapped in order to successfully use the data value.

6.2.1 Reading Floating Point Values

Function Code 3 is used to read FP values from the 2100 module. In order to access FP values, the command must be configured to request 2 words per desired value with a starting address offset by 7000. The base starting address can be determined from Appendix A.

With a starting address offset by 7000 the word pairs will be swapped by the module while building the response message. If no swapping is required, the host can read the data in pairs without including the 7000 offset in the address.

6.2.2 Writing Floating Point Values

Function Code 16 is used to write FP values to the 2100 module. In order to access FP values, the command must be configured to write 2 words per desired value with a starting address offset by 7000. The base starting address can be determined from Appendix A.

As the data is received by the module it is moved into the BTR buffer space. Up to 15 FP values may be written at a time in this fashion.

With a starting address offset by 7000 the word pairs will be swapped by the module while moving the data to the BTR buffer. If no swapping is required, the host can write the data in pairs without including the 7000 offset in the address.

Once the data is received in the PLC, a COP command must be used to copy the data from the Integer File space to a Floating Point File type. Examples of COP commands to move data from/to Integer files are included in the Appendix A ladder logic.

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7.0 SUPPORT, SERVICE AND WARRANTY

7.1 Technical Support

ProSoft Technology survives on its ability to provide meaningful support to its customers. Should any questions or problems arise, please feel free to contact us at:

Factory/Sales

California

ProSoft Technology, Inc.
9801 Camino Media
Suite 105
Bakersfield, CA 93311
(661 664-7208
(800) 326-7066
(661) 664-7233 (fax)
Email: prosoft@prosoft-technology.com

Before calling for support, please prepare yourself for the call. In order to provide the best and quickest support possible, we will most likely ask for the following information (you may wish to fax it to us prior to calling):

1. Product Serial and Version Number
2. Hardware Information
   - Dip Switches
   - Jumpers
   - Communication cabling
3. Application specific information
   - Configuration
   - Ladder listing
   - AGA setup data
   - etc.

An after-hours answering service (on the Bakersfield number) can patch you to one our qualified technical and/or application support engineers at any time to answer the questions that are important to you.

7.2 Service and Repair

The 2100 product is a product designed and manufactured to function under somewhat adverse conditions. As with any product, through age, misapplication, or any one of many possible problems, the product may require repair.

The 2100 product has a 90 day upgrade warranty and a one year parts and labor warranty according to the limits specified in the warranty.

Replacement and/or returns should be directed to the distributor from whom the product was purchased. If you need to return the card for repair, it is first necessary to obtain an RMA number from ProSoft Technology. Please call the factory for this number and display the number prominently on the outside of the shipping carton used to return the card.

7.3 Warranty

7.3.1 General Warranty Policy

ProSoft Technology, Inc. (Hereinafter referred to as ProSoft) warrants that the Product shall conform to and perform in accordance with published technical specifications and the accompanying written materials, and shall be free of defects in materials and workmanship, for the period of time herein indicated, such warranty period commencing upon receipt of the Product.

This warranty is limited to the repair and/or replacement, at ProSoft's election, of defective or non-conforming Product, and ProSoft shall not be responsible for the failure of the Product to perform specified functions, or any other non-conformance caused by or attributable to: (a) any misapplication of misuse of the Product; (b) failure of Customer to adhere to any of ProSoft's specifications or instructions; (c) neglect of, abuse of, or accident to, the Product; or (d) any associated or complementary equipment or software not furnished by ProSoft.

Limited warranty service may be obtained by delivering the Product to ProSoft and providing proof of purchase or receipt date. Customer agrees to insure the Product or assume the risk of loss or damage in transit, to prepay shipping charges to ProSoft, and to use the original shipping container or equivalent. Contact ProSoft Customer Service for further information.

7.3.2 Limitation of Liability

EXCEPT AS EXPRESSLY PROVIDED HEREIN, PROSOFT MAKES NO WARRANT OF ANY KIND, EXPRESSED OR IMPLIED, WITH RESPECT TO ANY EQUIPMENT, PARTS OR SERVICES PROVIDED PURSUANT TO THIS AGREEMENT, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANT ABILITY AND FITNESS FOR A PARTICULAR PURPOSE. NEITHER PROSOFT OR ITS DEALER SHALL BE LIABLE FOR ANY OTHER DAMAGES, INCLUDING BUT NOT LIMITED TO DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, WHETHER IN AN ACTION IN CONTRACT OR TORT (INCLUDING NEGLIGENCE AND STRICT LIABILITY), SUCH AS, BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS OR BENEFITS RESULTING FROM, OR ARISING OUT OF, OR IN CONNECTION WITH THE USE OR FURNISHING OF EQUIPMENT, PARTS OR SERVICES HEREUNDER OR THE PERFORMANCE, USE OR INABILITY TO USE THE SAME, EVEN IF PROSOFT OR ITS DEALER'S TOTAL LIABILITY EXCEED THE PRICE PAID FOR THE PRODUCT.

Where directed by State Law, some of the above exclusions or limitations may not be applicable in some states. This warranty provides specific legal rights; other rights that vary from state to state may also exist. This warranty shall not be applicable to the extent that any provisions of this warranty is prohibited by any Federal, State or Municipal Law that cannot be preempted.

7.3.3 Hardware Product Warranty Details

Warranty Period : ProSoft warranties hardware product for a period of one (1) year.

Warranty Procedure : Upon return of the hardware Product ProSoft will, at its option, repair or replace Product at no additional charge, freight prepaid, except as set forth below. Repair parts and replacement Product will be furnished on an exchange basis and will be either reconditioned or new. All replaced Product and parts become the property of ProSoft. If ProSoft determines that the Product is not under warranty, it will, at the Customer's option, repair the Product using current ProSoft standard rates for parts and labor, and return the Product freight collect.

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APPENDICES

APPENDIX A
- Block Transfer Buffer Register Mapping
- Modbus Register Mapping

Note that all Register Map spreadsheet files are available on the ProSoft Technology, Inc BBS. See Section 7 for instructions.

2100-AGA Module
Example Ladder Logic Data Table Usage

Integer File Setup

	0	1	2	3	4	5	6	7	8	9
N[]:0	Config Wrd	Control Wrd	Delta P	Tf - Temp	Pf - Pressure	Pulse Rate - H	Pulse Rate- L	Pulse Total - H	Pulse Total - L	Spare
N[]:10	AGA8 Control	Methane	Nitrogen	Carbon Dioxide	Ethane	Propane	Water	H2S	Hydrogen	Carbon Monoxide
N[]:20	Oxygen	i-Butane	n-Butane	i-Pentane	n-Pentane	n-Hexane	n-Heptane	n-Octane	n-Nonane	n-Decane
N[]:30	Helium	Argon								
N[]:40										
N[]:50										
N[]:60	Mtr Status 1	Mtr Status 2	Mtr Stat 1 Last P	Mtr Stat 2 Last P						

Floating Point File Setup

	0	1	2	3	4	
F[]:0	Mtr Tube ID	Mtr Tube Temp	Orifice ID	Orifice Temp	Viscosity	Configuration
F[]:5	Density @ T,P	Density @ Base	Low Flow Cutoff	Diff P Min	Diff P Max	
F[]:10	Temp Min	Temp Max	Press Min	Press Max	Spare	
F[]:15						
F[]:20	Flow Rate	Energy Flow	Z Factor	Density @ T,P	Density @ Base	Meter Results
F[]:25	Spare	Total Flow	Total Energy	Avg DP	Avg Press	
F[]:30	Avg Temp	Tot Energy-Daily	Time Away	On Prod T-Cur	Sequence Cntr	
F[]:35	On Prod T-Daily	Tot Flow-Daily	Timestamp-Cur			
F[]:40	Timestamp	Total Flow	Total Energy	Avg DP	Avg Press	Historical Last Period
F[]:45	Avg Temp	Spare	Time Away	On Prod Time	Sequence Cntr	
F[]:50	Spare	Spare				

Updated: 7/29/95
Revision 1.92

2100-AGA Module
Block Transfer Buffer
Register Map

Block ID		Description	Wrd cnt	Modbus Start	Modbus Finished
Block Transfer Write data					
255	W	i_sys_config	20	1000	1019
		i_time	10	1020	1029
20,21,22,23,24	W	i_loop_data structure [10] (70 words per meter)	70		
25,26,27,28,29		i_loop_config (31 words)	Run 1	1030	1099
		i_loop_update (9 words per)	Run 2	1100	1169
		aga_8_config (23 words per)	Run 3	1170	1239
		Space[7]	Run 4	1240	1309
			Run 5	1310	1379
			Run 6	1380	1449
			Run 7	1450	1519
			Run 8	1520	1589
			Run 9	1590	1659
			Run 10	1660	1729
		r_time	10	1730	1739
		sys (data not transferred to ladder)	40	1740	1779
		space	20	1780	1799
Block Transfer Read Data					
20,21,22,23	R	f_loop_output[10] (40 words per)	40	400 total	
25,26,27,28,29			Run 1	1800	1839
			Run 2	1840	1879
			Run 3	1880	1919
			Run 4	1920	1959
			Run 5	1960	1999
			Run 6	2000	2039
			Run 7	2040	2079
			Run 8	2080	2119
			Run 9	2120	2159
			Run 10	2160	2199
		space	40	2200	2239
	R	loop_storage[10] (300 words per) for 10 days	300		
			Run 1	2240	2539
			Run 2	2540	2839
			Run 3	2840	3139
			Run 4	3140	3439
			Run 5	3440	3739
			Run 6	3740	4039
			Run 7	4040	4339
			Run 8	4340	4639
			Run 9	4640	4939
			Run 10	4940	5239
		space	100	5240	5339
Internal Working Registers					
		loop_config[MAX_LOOP_CNT] (70 words per)	280		
		i_space4	10		
		loop_update[MAX_LOOP_CNT] (15 words per)	60		
		sys_config	15		
		loop_calc[MAX_LOOP_CNT] (320 words per)	1280		
		sys	30		

2100-AGA Module
Block Transfer Buffer
Register Map

BTW BLOCK ID 255 - Modbus and AGA configuration data

File Loc	BT Word		Description	Format	Units	Modbus Address
N7:0	0		Modbus Slave Address			
N7:1	1		Parity			
N7:2	2		Stop Bits			
N7:3	3		Baud Rate			
N7:4	4		RTS to TxD delay			
N7:5	5		RTS Off Delay			
N7:6	6		Input Table Offset			
N7:7	7		Output Table Offset			
N7:8	8		RTU/ASCII Mode Select			
N7:9	9					
N7:10	10		Flow Calc Co-Pro System Setup			1000
		0	N/A			
		1	N/A			
		2	Force End of Day Rollover	Set to enable, clear in PLC logic		
		3	English or Metric Units	0 = English, 1 = Metric		
		4	Display Mode	0 = Normal, 1 = Debug		
		5	Disk Log Mode (PCMCIA)	0 = no log, 1 = log to PCMCIA		
		6	Hard debug - Shuts down on a Math-Error			
		7	MBM Enable	1=Enable		
N7:11	11		Delta T3 - for AGA 3 recalc resolution	xxx.x	Deg F (Deg C)	1001
N7:12	12		Delta T8 - for AGA 8 recalc resolution	xxx.x	Deg F (Deg C)	1002
N7:13	13		Delta P8 - for AGA 8 recalc resolution	xxx.x	psia (kPa)	1003
N7:14	14		Base T - Contract base Temperature	xxx.x	Deg F (Deg C)	1004
N7:15	15		Base P - Contract Base Pressure	xxx.x	psia (kPa)	1005
N7:16	16		Time Zone - Hours behind GMT	xxx.x	hrs	1006
N7:17	17		End of Day Rollover - Hours (0 to 23)	xx		1007
N7:18	18		Active Meter Runs (1 - 10)	xx		1008
N7:19	19		Modbus Slave Port Read Data Blocks (0 to 80)	xx		1009
N7:20	20		Gauge Press to Absolute Pressure Offset	xx.x	psia (kPa)	1010
N7:21	21		Modbus Master Port Read Data Block Cnt (0-20)			1011
N7:22	22		Spare			1012
N7:23	23		Spare			1013
N7:24	24		Spare			1014
N7:25	25		Spare			1015
N7:26	26		Spare			1016
N7:27	27		Spare			1017
N7:28	28		Spare			1018
N7:29	29		Spare			1019

BTW BLOCK ID 0 to 19

File Loc	BT Word	Description		Units
	0 to 49	Modbus Data (Registers 0 - 999)		
	50	Spare		
	51	Spare		
	52	Spare		
	53	Spare		
	54	Spare		
	55	Spare		
	56	Spare		
	57	PLC date and time -	N7:368 in BTW buffer	
	58	PLC date and time -	N7:369	
	59	PLC date and time -	N7:370	
	60	PLC date and time -	N7:371	
	61	PLC date and time -	N7:372	
	62	PLC date and time -	N7:373	

AGA 3 - Differential Pressure Meters

BTW BLOCK ID 20 to 29 File Loc	BT Word		Description			Units	Modbus Address
N[]:0	0		**Meter Configuration Word**				1030
		0					
		1	Use PLC Config (1) or User Port Config(0)	(Future)			
		2	AGA 3 or 7 Flow Calc Select	0 = AGA3, 1 = AGA7			
		5	Static pressure upstream(0) or downstream(1)				
		6	Orifice Plate Material - bit 0	00 - 304/316 SS		10 - Carbon Steel	
		7	- bit 1	01 - Monel			
		8	Meter Run Material - bit 0	00 - 304/316 SS		10 - Carbon Steel	
		9	- bit 1	01 - Monel			
		10	Compress. Calc Type - bit 0	00 - Use entered values			
		11	- bit 1	01 - AGA 8			
		12					
		13	Output Value Scaling (0 = MCF, 1 = MMCF)				
		14	Compressible Fluid Flag (Yes = 1, No = 0)				
		15					
F[]:0	1,2		Dm - meter tube pipe ID measured @ TDm	Float		inches (mm)	1031
F[]:1	3,4		TDm - meter tube measuring temp	Float		Deg F (Deg C)	1033
F[]:2	5,6		dm - Orifice plate bore measured @Tm	Float		inches (mm)	1035
F[]:3	7,8		Tdm - Orifice plate measuring temp	Float		Deg F(Deg C)	1037
F[]:4	9,10		Viscosity	Float		cP (cP)	1039
F[]:5	11,12		Density @ T,P - Used if 'Entered' selected	Float		lb/ft3 (kg/m3)	1041
F[]:6	13,14		Density @ base T,P - Used if 'Entered' selected	Float		lb/ft3 (kg/m3)	1043
F[]:7	15,16		Low Flow Cutoff	Float		in H2O (kPa)	1045
F[]:8	17,18		Diff P Scaling - Min Value	Float		in H2O (kPa)	1047
F[]:9	19,20		Diff P Scaling - Max Value	Float		in H2O (kPa)	1049
F[]:10	21,22		Tf Scaling - Min Value	Float		Deg F (Deg C)	1051
F[]:11	23,24		Tf Scaling - Max Value	Float		Deg F (Deg C)	1053
F[]:12	25,26		Pf Scaling - Min Value	Float		PSIA (kPa)	1055
F[]:13	27,28		Pf Scaling - Max Value	Float		PSIA (kPa)	1057
F[]:14	29,30		Spare	Float			1059
N[]:1	31		**Meter Control Word**				1061
		0	Configuration Enable	Set to enable Config (words 0 - 9)			
		1	AGA8 Configuration Enable	Set to enable new AGA 8 values			
		2	Meter Freeze	Set to freeze meter / Clear to run meter			
		3	Force Meter Reset	Set to reset meter to 0			
		15	Instrument Fail Detected	Set when detect any instrument failure			
N[]:2	32		Delta P : real time value	0-4095	Upper 2 bits for alarms		1062
N[]:3	33		Tf - Flowing temp : real time value	0-4095	Upper 2 bits for alarms		1063
N[]:4	34		Pf - Flowing Pressure : real time value	0-4095	Upper 2 bits for alarms		1064
N[]:5	35		Spare				1065
N[]:6	36		Spare				1066
N[]:7	37		Spare				1067
N[]:8	38		Spare				1068
N[]:9	39		Spare				1069
N[]:10	40		**AGA 8 Update Control Word**				1070
		1	Control bit - User (0) or PLC (1)		1 = Must be set		
		2	Control bit - BTU Calc Disable		0 = enable, 1 = disable		
		3	Control bit - Fw Factor Calc Enable(English Units Only)		0 = disable, 1 = enable		
N[]:11	41		Concentration (Mole %) - Methane	Integer	xx.xx Mole %		1071
N[]:12	42		Concentration (Mole %) - Nitrogen	Integer	xx.xx Mole %		1072
N[]:13	43		Concentration (Mole %) - Carbon Dioxide	Integer	xx.xx Mole %		1073
N[]:14	44		Concentration (Mole %) - Ethane	Integer	xx.xx Mole %		1074
N[]:15	45		Concentration (Mole %) - Propane	Integer	xx.xx Mole %		1075
N[]:16	46		Concentration (Mole %) - Water	Integer	xx.xx Mole %		1076
N[]:17	47		Concentration (Mole %) - Hydrogen Sulfide	Integer	xx.xx Mole %		1077
N[]:18	48		Concentration (Mole %) - Hydrogen	Integer	xx.xx Mole %		1078
N[]:19	49		Concentration (Mole %) - Carbon Monoxide	Integer	xx.xx Mole %		1079
N[]:20	50		Concentration (Mole %) - Oxygen	Integer	xx.xx Mole %		1080
N[]:21	51		Concentration (Mole %) - i-Butane	Integer	xx.xx Mole %		1081
N[]:22	52		Concentration (Mole %) - n-Butane	Integer	xx.xx Mole %		1082
N[]:23	53		Concentration (Mole %) - i-Pentane	Integer	xx.xx Mole %		1083
N[]:24	54		Concentration (Mole %) - n-Pentane	Integer	xx.xx Mole %		1084
N[]:25	55		Concentration (Mole %) - n-Hexane	Integer	xx.xx Mole %		1085
N[]:26	56		Concentration (Mole %) - n-Heptane	Integer	xx.xx Mole %		1086
N[]:27	57		Concentration (Mole %) - n-Octane	Integer	xx.xx Mole %		1087
N[]:28	58		Concentration (Mole %) - n-Nonane	Integer	xx.xx Mole %		1088
N[]:29	59		Concentration (Mole %) - n-Decane	Integer	xx.xx Mole %		1089
N[]:30	60		Concentration (Mole %) - Helium	Integer	xx.xx Mole %		1090
N[]:31	61		Concentration (Mole %) - Argon	Integer	xx.xx Mole %		1091
N[]:32	62		space				1092 to 1099

AGA 7 - Turbine Meters

BTW BLOCK ID 20 to 29

File Loc	BT Word	Bit	Description		Units	Modbus Address
N[]:0	0		**Meter Configuration Word**			1030
		0				
		1	Use PLC Config (1) or User Port Config(0)	(Future)		
		2	AGA 3 or 7 Flow Calc Select	0 = AGA3, 1 = AGA7		
		3	AGA7 Input Type	0 = Turbine, 1 = Analog		
		5	Static pressure upstream(0) or downstream(1)			
		10	Compress. Calc Type - bit 0	00 - Use entered values		
		11	- bit 1	01 - AGA 8		
		12				
		13	Output Value Scaling (0 = MCF, 1 = MMCF)			
		14	Compressible Fluid Flag (Yes = 1, No = 0)			
		15				
F[]:0	1,2		Dm - meter tube pipe ID measured @ TDm	Float	inches (mm)	1031
F[]:1	3,4		K Factor	Float	pulses/ft3	1033
F[]:2	5,6		Spare	Float		1035
F[]:3	7,8		Spare	Float		1037
F[]:4	9,10		Spare	Float		1039
F[]:5	11,12		Density @ T,P - Used if 'Entered' selected	Float	lb/ft3 (kg/m3)	1041
F[]:6	13,14		Density @ base T,P - Used if 'Entered' selected	Float	lb/ft3 (kg/m3)	1043
F[]:7	15,16		Low Flow Cutoff	Float		1045
F[]:8	17,18		Analog flow rate Scaling - Min Value	Float		1047
F[]:9	19,20		Analog flow rate Scaling - Max Value	Float		1049
F[]:10	21,22		Tf Scaling - Min Value	Float	Deg F (Deg C)	1051
F[]:11	23,24		Tf Scaling - Max Value	Float	Deg F (Deg C)	1053
F[]:12	25,26		Pf Scaling - Min Value	Float	PSIA (kPa)	1055
F[]:13	27,28		Pf Scaling - Max Value	Float	PSIA (kPa)	1057
F[]:14	29,30		Spare	Float		1059
N[]:1	31		**Meter Control Word**			1061
		0	Configuration Enable	Set to enable Config (words 0 - 9)		
		1	AGA8 Configuration Enable	Set to enable new AGA 8 values		
		2	Meter Freeze	Set to freeze meter / Clear to run meter		
		3	Force Meter Reset	Set to reset meter to 0		
		15	Instrument Fail Detected	Set when detect any instrument failure		
N[]:2	32		Turbine analog : real time value	0-4095	Upper 2 bits for alarms	1062
N[]:3	33		Tf - Flowing temp : real time value	0-4095	Upper 2 bits for alarms	1063
N[]:4	34		Pf - Flowing Pressure : real time value	0-4095	Upper 2 bits for alarms	1064
N[]:5	35		Turbine frequency - high	0-120	Upper 2 bits for alarms	1065
N[]:6	36		Turbine frequency - low	0-999		1066
N[]:7	37		Turbine pulse total - high	0-999	Upper 2 bits for alarms	1067
N[]:8	38		Turbine pulse total - low	0-9999		1068
N[]:9	39		Spare			1069
N[]:10	40		**AGA 8 Update Control Word**			1070
		1	Control bit - User (0) or PLC (1)		1 = Must be set	
		2	Control bit - BTU Calc Disable		0 = enable, 1 = disable	
		3	Control bit - Fw Factor Calc Enable(English Units Only)		0 = disable, 1 = enable	
N[]:11	41		Concentration (Mole %) - Methane	Integer	xx.xx Mole %	1071
N[]:12	42		Concentration (Mole %) - Nitrogen	Integer	xx.xx Mole %	1072
N[]:13	43		Concentration (Mole %) - Carbon Dioxide	Integer	xx.xx Mole %	1073
N[]:14	44		Concentration (Mole %) - Ethane	Integer	xx.xx Mole %	1074
N[]:15	45		Concentration (Mole %) - Propane	Integer	xx.xx Mole %	1075
N[]:16	46		Concentration (Mole %) - Water	Integer	xx.xx Mole %	1076
N[]:17	47		Concentration (Mole %) - Hydrogen Sulfide	Integer	xx.xx Mole %	1077
N[]:18	48		Concentration (Mole %) - Hydrogen	Integer	xx.xx Mole %	1078
N[]:19	49		Concentration (Mole %) - Carbon Monoxide	Integer	xx.xx Mole %	1079
N[]:20	50		Concentration (Mole %) - Oxygen	Integer	xx.xx Mole %	1080
N[]:21	51		Concentration (Mole %) - i-Butane	Integer	xx.xx Mole %	1081
N[]:22	52		Concentration (Mole %) - n-Butane	Integer	xx.xx Mole %	1082
N[]:23	53		Concentration (Mole %) - i-Pentane	Integer	xx.xx Mole %	1083
N[]:24	54		Concentration (Mole %) - n-Pentane	Integer	xx.xx Mole %	1084
N[]:25	55		Concentration (Mole %) - n-Hexane	Integer	xx.xx Mole %	1085
N[]:26	56		Concentration (Mole %) - n-Heptane	Integer	xx.xx Mole %	1086
N[]:27	57		Concentration (Mole %) - n-Octane	Integer	xx.xx Mole %	1087
N[]:28	58		Concentration (Mole %) - n-Nonane	Integer	xx.xx Mole %	1088
N[]:29	59		Concentration (Mole %) - n-Decane	Integer	xx.xx Mole %	1089
N[]:30	60		Concentration (Mole %) - Helium	Integer	xx.xx Mole %	1090
N[]:31	61		Concentration (Mole %) - Argon	Integer	xx.xx Mole %	1091
N[]:32	62		space			1092 to 1099

2100-AGA Module
Block Transfer Buffer
Register Map

BTR BLOCK ID 20 to 29

File Loc	BT Word	Bit	Description	Run 1	Units	Modbus Address
N[]:60	0		**Status word**	**Run 1**		1800
		0	Configuration Done Toggle			
		1	AGA8 Configuration Done Toggle			
		2	Meter Freeze Status	= 1 when meter is frozen		
		3	Meter Reset Done Toggle			
		5	Meter Configuration Status	= 1 when meter has been configured		
		10	Rollover : Power Up Status	Power up or 255 Config since rollover		
		11	Rollover : Configuration status	Configuration has occured since rollover		
		12	Rollover : AGA8 Configuration status	AGA 8 configuration has occured since rollover		
		13	Rollover : Meter Freeze Status	Meter has been frozen since rollover		
		14	Rollover : Meter Reset Status	Meter reset has occured since rollover		
		15	Rollover : Instrument Fail status	Instrument fail has been detected since rollover		
N[]:61	1		Spare Control/Status word			1801
		0	Last Period Data New Data Status Flag (new = 1)	cleared after BTW w/ Last Period Data Accepte		
		4	Last Calc Time bad on power up	1 if bad time detected, defaulted to current time		
		6	Pulse rate instrument fail - underflow			
		7	Pulse rate instrument fail - overflow			
		8	Pulse total instrument fail - underflow			
		9	Pulse total instrument fail - overflow			
		10	dp/pulse analog instrument fail - underflow			
		11	dp/pulse analog instrument fail - overflow			
		12	Tf instrument fail - underflow			
		13	Tf instrument fail - overflow			
		14	Pf instrument fail - underflow			
		15	Pf instrument fail - overflow			
F[]:20	2,3		Volumetric Flow Rate	Float	(M)MCFD	1802
F[]:21	4,5		Energy Flow rate	Float	(M)MBTUD	1804
F[]:22	6,7		Z - AGA 8 Compressibility Factor	Float		1806
F[]:23	8,9		Gas Density @ flowing T,P	Float	lb/ft3	1808
F[]:24	10,11		Gas Density @ Base Conditions	Float	lb/ft3	1810
F[]:25	12,13		Spare	Float		1812
F[]:26	14,15		Totalized Flow - Current	Float	(M)MCF	1814
F[]:27	16,17		Totalized Energy - Current	Float	(M)MBTU	1816
F[]:28	18,19		Average Diff Press - Current	Float	(M)MCFD	1818
F[]:29	20,21		Average Flowing Pressure - Current	Float	PSIA	1820
F[]:30	22,23		Average Flowing Temperature - Current	Float	DEG F	1822
F[]:31	24,25		Totalized Energy - Daily Contract Period	Float	rst only on cont rollover	1824
F[]:32	26,27		Time away - Current	Float	Min	1826
F[]:33	28,29		On Production Time - Current	Float	Min	1828
F[]:34	30,31		Sequence Counter	Float		1830
F[]:35	32,33		On Production Time - Daily Contract Period	Float	rst only on cont rollover	1832
F[]:36	34,35		Totalized Flow - Daily Contract Period	Float	rst only on cont rollover	1834
F[]:37	36,37		Time Stamp- Current Period	long int	Seconds since 1/1/70	1836
N[]:62	38		Status flags - Last Period	LoopStorage Data Section		2240
N[]:63	39		Status flags - word 2			2241
F[]:40	40,41		Timestamp	Long Int	Seconds since 1/1/70	2242
F[]:41	42,43		Totalized Flow - Last Period	Float	(M)MCF	2244
F[]:42	44,45		Totalized Energy - Last Period	Float		2246
F[]:43	46,47		Average Diff Press - Last Period	Float	(M)MCFD	2248
F[]:44	48,49		Average Flowing Pressure - Last Period	Float	PSIA	2250
F[]:45	50,51		Average Flowing Temperature - Last Period	Float	DEG F	2252
F[]:46	52,53		Spare	Float	Sec.	2254
F[]:47	54,55		Time away - Last Period	Float	Min	2256
F[]:48	56,57		On Production Time - Last Period	Float	Min	2258
F[]:49	58,59		Sequence Counter	Float		2260
F[]:50	60,61		Spare	Float		2262
	62,63					

2100-AGA Module
Block Transfer Buffer
Register Map

BTW BLOCK ID 256 to 266

File Loc	BT Word	Description		
F[]:26	14,15	Totalized Flow - Current	Float	(M)MCF
F[]:27	16,17	Totalized Energy - Current	Float	(M)MBTU
F[]:28	18,19	Average Diff Press - Current	Float	(M)MCFD
F[]:29	20,21	Average Flowing Pressure - Current	Float	PSIA
F[]:30	22,23	Average Flowing Temperature - Current	Float	DEG F
F[]:31	24,25	Time Stamp- Current Period	long int	Seconds since 1/1/70
F[]:32	26,27	Time away - Current	Float	Min
F[]:33	28,29	On Production Time - Current	Float	Min
F[]:34	30,31	Sequence Counter	Float	
F[]:35	32,33	On Production Time - Daily Contract Period	Float	
F[]:36	34,35	Totalized Flow - Daily Contract Period	Float	
F[]:37	36,37	Totalized Energy - Daily Contract Period	Float	

Description

i_sys_config
i_time
i_loop_data structure [10] (70 words per meter)
i_loop_config (31 words)
i_loop_update (9 words per)
aga_8_config (23 words per)
Space[7]

r_time
sys (data not transferred to ladder)
space

f_loop_output[10] (40 words per)

space
loop_storage[10] (300 words per) for 10 days

space

loop_config[MAX_LOOP_CNT] (70 words per)
i_space4
loop_update[MAX_LOOP_CNT] (15 words per)
sys_config
loop_calc[MAX_LOOP_CNT] (320 words per)
sys

	Module Configuration	Modbus Address
N7:0	Modbus Slave Address	
N7:1	Parity	
N7:2	Stop Bits	
N7:3	Baud Rate	
N7:4	RTS to TxD delay	
N7:5	RTS Off Delay	
N7:6	Input Table Offset	
N7:7	Output Table Offset	
N7:8	RTU/ASCII Mode Select	
N7:9		
N7:10	Flow Calc Co-Pro System Setup	1000
N7:11	Delta T3- for AGA 3 recalc resolution	1001
N7:12	Delta T8- for AGA 8 recalc resolution	1002
N7:13	Delta P8 - for AGA 8 recalc resolution	1003
N7:14	Base T - Contract base Temperature	1004
N7:15	Base P - Contract Base Pressure	1005
N7:16	Time Zone - Hours behind GMT	1006
N7:17	End of Day Rollover - Hours (0 to 23)	1007
N7:18	Active Meter Runs (1 - 10)	1008
N7:19	Modbus Read Data Blocks (0 to 80)	1009
N7:20	Gauge Pressure to Absolute Press Offset	1010
N7:21	Modbus Master Read Data Block Count	1011
N7:22	Spare	1012
N7:23	Spare	1013
N7:24	Spare	1014
N7:25	Spare	1015
N7:26	Spare	1016
N7:27	Spare	1017
N7:28	Spare	1018
N7:29	Spare	1019

BTW BLOCK ID 0 to 19

Description

Modbus Data (Registers 0 - 999)
Spare
Spare
Spare
Spare
Spare
Spare
Spare
PLC date and time -
PLC date and time -
PLC date and time -
PLC date and time -
PLC date and time -
PLC date and time -

AGA 3 - Differential Pressure Meters		**Meter 1**	**Meter 2**	**Meter 3**	**Meter 4**	**Meter 5**	**Meter 6**	**Meter 7**	**Meter 8**	**Meter 9**	**Meter 10**
N[]:0	Meter Configuration Word	1030	1100	1170	1240	1310	1380	1450	1520	1590	1660
F[]:0	Dm - meter tube pipe ID measured @ TDm	1031	1101	1171	1241	1311	1381	1451	1521	1591	1661
F[]:1	TDm - meter tube measuring temp	1033	1103	1173	1243	1313	1383	1453	1523	1593	1663
F[]:2	dm - Orifice plate bore measured @Tm	1035	1105	1175	1245	1315	1385	1455	1525	1595	1665
F[]:3	Tdm - Orifice plate measuring temp	1037	1107	1177	1247	1317	1387	1457	1527	1597	1667
F[]:4	Viscosity - Base	1039	1109	1179	1249	1319	1389	1459	1529	1599	1669
F[]:5	Density @ T,P - Used if 'Entered' selected	1041	1111	1181	1251	1321	1391	1461	1531	1601	1671
F[]:6	Density @ base T,P - Used if 'Entered' selected	1043	1113	1183	1253	1323	1393	1463	1533	1603	1673
F[]:7	Low Flow Cutoff	1045	1115	1185	1255	1325	1395	1465	1535	1605	1675
F[]:8	Diff P Scaling - Min Value	1047	1117	1187	1257	1327	1397	1467	1537	1607	1677
F[]:9	Diff P Scaling - Max Value	1049	1119	1189	1259	1329	1399	1469	1539	1609	1679
F[]:10	Tf Scaling - Min Value	1051	1121	1191	1261	1331	1401	1471	1541	1611	1681
F[]:11	Tf Scaling - Max Value	1053	1123	1193	1263	1333	1403	1473	1543	1613	1683
F[]:12	Pf Scaling - Min Value	1055	1125	1195	1265	1335	1405	1475	1545	1615	1685
F[]:13	Pf Scaling - Max Value	1057	1127	1197	1267	1337	1407	1477	1547	1617	1687
F[]:14	Spare	1059	1129	1199	1269	1339	1409	1479	1549	1619	1689
N[]:1	Meter Control Word	1061	1131	1201	1271	1341	1411	1481	1551	1621	1691
N[]:2	Delta P : real time value	1062	1132	1202	1272	1342	1412	1482	1552	1622	1692
N[]:3	Tf - Flowing temp : real time value	1063	1133	1203	1273	1343	1413	1483	1553	1623	1693
N[]:4	Pf - Flowing Pressure : real time value	1064	1134	1204	1274	1344	1414	1484	1554	1624	1694
N[]:5	Spare	1065	1135	1205	1275	1345	1415	1485	1555	1625	1695
N[]:6	Spare	1066	1136	1206	1276	1346	1416	1486	1556	1626	1696
N[]:7	Spare	1067	1137	1207	1277	1347	1417	1487	1557	1627	1697
N[]:8	Spare	1068	1138	1208	1278	1348	1418	1488	1558	1628	1698
N[]:9	Spare	1069	1139	1209	1279	1349	1419	1489	1559	1629	1699
N[]:10	AGA 8 Update Control Word	1070	1140	1210	1280	1350	1420	1490	1560	1630	1700
N[]:11	Concentration (Mole %) - Methane	1071	1141	1211	1281	1351	1421	1491	1561	1631	1701
N[]:12	Concentration (Mole %) - Nitrogen	1072	1142	1212	1282	1352	1422	1492	1562	1632	1702
N[]:13	Concentration (Mole %) - Carbon Dioxide	1073	1143	1213	1283	1353	1423	1493	1563	1633	1703
N[]:14	Concentration (Mole %) - Ethane	1074	1144	1214	1284	1354	1424	1494	1564	1634	1704
N[]:15	Concentration (Mole %) - Propane	1075	1145	1215	1285	1355	1425	1495	1565	1635	1705
N[]:16	Concentration (Mole %) - Water	1076	1146	1216	1286	1356	1426	1496	1566	1636	1706
N[]:17	Concentration (Mole %) - Hydrogen Sulfide	1077	1147	1217	1287	1357	1427	1497	1567	1637	1707
N[]:18	Concentration (Mole %) - Hydrogen	1078	1148	1218	1288	1358	1428	1498	1568	1638	1708
N[]:19	Concentration (Mole %) - Carbon Monoxide	1079	1149	1219	1289	1359	1429	1499	1569	1639	1709
N[]:20	Concentration (Mole %) - Oxygen	1080	1150	1220	1290	1360	1430	1500	1570	1640	1710
N[]:21	Concentration (Mole %) - i-Butane	1081	1151	1221	1291	1361	1431	1501	1571	1641	1711
N[]:22	Concentration (Mole %) - n-Butane	1082	1152	1222	1292	1362	1432	1502	1572	1642	1712
N[]:23	Concentration (Mole %) - i-Pentane	1083	1153	1223	1293	1363	1433	1503	1573	1643	1713
N[]:24	Concentration (Mole %) - n-Pentane	1084	1154	1224	1294	1364	1434	1504	1574	1644	1714
N[]:25	Concentration (Mole %) - n-Hexane	1085	1155	1225	1295	1365	1435	1505	1575	1645	1715
N[]:26	Concentration (Mole %) - n-Heptane	1086	1156	1226	1296	1366	1436	1506	1576	1646	1716
N[]:27	Concentration (Mole %) - n-Octane	1087	1157	1227	1297	1367	1437	1507	1577	1647	1717
N[]:28	Concentration (Mole %) - n-Nonane	1088	1158	1228	1298	1368	1438	1508	1578	1648	1718
N[]:29	Concentration (Mole %) - n-Decane	1089	1159	1229	1299	1369	1439	1509	1579	1649	1719
N[]:30	Concentration (Mole %) - Helium	1090	1160	1230	1300	1370	1440	1510	1580	1650	1720
N[]:31	Concentration (Mole %) - Argon	1091	1161	1231	1301	1371	1441	1511	1581	1651	1721
N[]:32	space	1092	1162	1232	1302	1372	1442	1512	1582	1652	1722
N/A	Spare in 2100 module	1093	1163	1233	1303	1373	1443	1513	1583	1653	1723
N/A	Spare in 2100 module	1094	1164	1234	1304	1374	1444	1514	1584	1654	1724
N/A	Spare in 2100 module	1095	1165	1235	1305	1375	1445	1515	1585	1655	1725
N/A	Spare in 2100 module	1096	1166	1236	1306	1376	1446	1516	1586	1656	1726
N/A	Spare in 2100 module	1097	1167	1237	1307	1377	1447	1517	1587	1657	1727
N/A	Spare in 2100 module	1098	1168	1238	1308	1378	1448	1518	1588	1658	1728
N/A	Spare in 2100 module	1099	1169	1239	1309	1379	1449	1519	1589	1659	1729

AGA 7 - Turbine Meters		**Meter 1**	**Meter 2**	**Meter 3**	**Meter 4**	**Meter 5**	**Meter 6**	**Meter 7**	**Meter 8**	**Meter 9**	**Meter 10**
N[]:0	Meter Configuration Word	1030	1100	1170	1240	1310	1380	1450	1520	1590	1660
F[]:0	Dm - meter tube pipe ID measured @ TDm	1031	1101	1171	1241	1311	1381	1451	1521	1591	1661
F[]:1	K Factor	1033	1103	1173	1243	1313	1383	1453	1523	1593	1663
F[]:2	Spare	1035	1105	1175	1245	1315	1385	1455	1525	1595	1665
F[]:3	Spare	1037	1107	1177	1247	1317	1387	1457	1527	1597	1667
F[]:4	Spare	1039	1109	1179	1249	1319	1389	1459	1529	1599	1669
F[]:5	Density @ T,P - Used if 'Entered' selected	1041	1111	1181	1251	1321	1391	1461	1531	1601	1671
F[]:6	Density @ base T,P - Used if 'Entered' selected	1043	1113	1183	1253	1323	1393	1463	1533	1603	1673
F[]:7	Low Flow Cutoff	1045	1115	1185	1255	1325	1395	1465	1535	1605	1675
F[]:8	Analog flow rate Scaling - Min Value	1047	1117	1187	1257	1327	1397	1467	1537	1607	1677
F[]:9	Analog flow rate Scaling - Max Value	1049	1119	1189	1259	1329	1399	1469	1539	1609	1679
F[]:10	Tf Scaling - Min Value	1051	1121	1191	1261	1331	1401	1471	1541	1611	1681
F[]:11	Tf Scaling - Max Value	1053	1123	1193	1263	1333	1403	1473	1543	1613	1683
F[]:12	Pf Scaling - Min Value	1055	1125	1195	1265	1335	1405	1475	1545	1615	1685
F[]:13	Pf Scaling - Max Value	1057	1127	1197	1267	1337	1407	1477	1547	1617	1687
F[]:14	Spare	1059	1129	1199	1269	1339	1409	1479	1549	1619	1689
N[]:1	Meter Control Word	1061	1131	1201	1271	1341	1411	1481	1551	1621	1691
N[]:2	Turbine analog : real time value	1062	1132	1202	1272	1342	1412	1482	1552	1622	1692
N[]:3	Tf - Flowing temp : real time value	1063	1133	1203	1273	1343	1413	1483	1553	1623	1693
N[]:4	Pf - Flowing Pressure : real time value	1064	1134	1204	1274	1344	1414	1484	1554	1624	1694
N[]:5	Turbine frequency - high	1065	1135	1205	1275	1345	1415	1485	1555	1625	1695
N[]:6	Turbine frequency - low	1066	1136	1206	1276	1346	1416	1486	1556	1626	1696
N[]:7	Turbine pulse total - high	1067	1137	1207	1277	1347	1417	1487	1557	1627	1697
N[]:8	Turbine pulse total - low	1068	1138	1208	1278	1348	1418	1488	1558	1628	1698
N[]:9	Spare	1069	1139	1209	1279	1349	1419	1489	1559	1629	1699
N[]:10	AGA 8 Update Control Word	1070	1140	1210	1280	1350	1420	1490	1560	1630	1700
N[]:11	Concentration (Mole %) - Methane	1071	1141	1211	1281	1351	1421	1491	1561	1631	1701
N[]:12	Concentration (Mole %) - Nitrogen	1072	1142	1212	1282	1352	1422	1492	1562	1632	1702
N[]:13	Concentration (Mole %) - Carbon Dioxide	1073	1143	1213	1283	1353	1423	1493	1563	1633	1703
N[]:14	Concentration (Mole %) - Ethane	1074	1144	1214	1284	1354	1424	1494	1564	1634	1704
N[]:15	Concentration (Mole %) - Propane	1075	1145	1215	1285	1355	1425	1495	1565	1635	1705
N[]:16	Concentration (Mole %) - Water	1076	1146	1216	1286	1356	1426	1496	1566	1636	1706
N[]:17	Concentration (Mole %) - Hydrogen Sulfide	1077	1147	1217	1287	1357	1427	1497	1567	1637	1707
N[]:18	Concentration (Mole %) - Hydrogen	1078	1148	1218	1288	1358	1428	1498	1568	1638	1708
N[]:19	Concentration (Mole %) - Carbon Monoxide	1079	1149	1219	1289	1359	1429	1499	1569	1639	1709
N[]:20	Concentration (Mole %) - Oxygen	1080	1150	1220	1290	1360	1430	1500	1570	1640	1710
N[]:21	Concentration (Mole %) - i-Butane	1081	1151	1221	1291	1361	1431	1501	1571	1641	1711
N[]:22	Concentration (Mole %) - n-Butane	1082	1152	1222	1292	1362	1432	1502	1572	1642	1712
N[]:23	Concentration (Mole %) - i-Pentane	1083	1153	1223	1293	1363	1433	1503	1573	1643	1713
N[]:24	Concentration (Mole %) - n-Pentane	1084	1154	1224	1294	1364	1434	1504	1574	1644	1714
N[]:25	Concentration (Mole %) - n-Hexane	1085	1155	1225	1295	1365	1435	1505	1575	1645	1715
N[]:26	Concentration (Mole %) - n-Heptane	1086	1156	1226	1296	1366	1436	1506	1576	1646	1716
N[]:27	Concentration (Mole %) - n-Octane	1087	1157	1227	1297	1367	1437	1507	1577	1647	1717
N[]:28	Concentration (Mole %) - n-Nonane	1088	1158	1228	1298	1368	1438	1508	1578	1648	1718
N[]:29	Concentration (Mole %) - n-Decane	1089	1159	1229	1299	1369	1439	1509	1579	1649	1719
N[]:30	Concentration (Mole %) - Helium	1090	1160	1230	1300	1370	1440	1510	1580	1650	1720
N[]:31	Concentration (Mole %) - Argon	1091	1161	1231	1301	1371	1441	1511	1581	1651	1721
N[]:32	space	1092	1162	1232	1302	1372	1442	1512	1582	1652	1722
N/A	Spare in 2100 module	1093	1163	1233	1303	1373	1443	1513	1583	1653	1723
N/A	Spare in 2100 module	1094	1164	1234	1304	1374	1444	1514	1584	1654	1724
N/A	Spare in 2100 module	1095	1165	1235	1305	1375	1445	1515	1585	1655	1725
N/A	Spare in 2100 module	1096	1166	1236	1306	1376	1446	1516	1586	1656	1726
N/A	Spare in 2100 module	1097	1167	1237	1307	1377	1447	1517	1587	1657	1727
N/A	Spare in 2100 module	1098	1168	1238	1308	1378	1448	1518	1588	1658	1728
N/A	Spare in 2100 module	1099	1169	1239	1309	1379	1449	1519	1589	1659	1729

Meter Run Real Time Data		Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6	Meter 7	Meter 8	Meter 9	Meter 10
N[]:60	Status word	1800	1840	1880	1920	1960	2000	2040	2080	2120	2160
N[]:61	Spare Control/Status word	1801	1841	1881	1921	1961	2001	2041	2081	2121	2161
F[]:20	Volumetric Flow Rate	1802	1842	1882	1922	1962	2002	2042	2082	2122	2162
F[]:21	Energy Flow rate (future)	1804	1844	1884	1924	1964	2004	2044	2084	2124	2164
F[]:22	Z - AGA 8 Compressibility Factor	1806	1846	1886	1926	1966	2006	2046	2086	2126	2166
F[]:23	Gas Density @ flowing T,P	1808	1848	1888	1928	1968	2008	2048	2088	2128	2168
F[]:24	Gas Density @ Base Conditions	1810	1850	1890	1930	1970	2010	2050	2090	2130	2170
F[]:25	Spare	1812	1852	1892	1932	1972	2012	2052	2092	2132	2172
Meter Run Summary Data - Current Period											
F[]:26	Totalized Flow - Current	1814	1854	1894	1934	1974	2014	2054	2094	2134	2174
F[]:27	Totalized Energy - Current	1816	1856	1896	1936	1976	2016	2056	2096	2136	2176
F[]:28	Average Flow Rate - Current	1818	1858	1898	1938	1978	2018	2058	2098	2138	2178
F[]:29	Average Flowing Pressure - Current	1820	1860	1900	1940	1980	2020	2060	2100	2140	2180
F[]:30	Average Flowing Temperature - Current	1822	1862	1902	1942	1982	2022	2062	2102	2142	2182
F[]:31	Totalized Energy - Daily Contract Period	1824	1864	1904	1944	1984	2024	2064	2104	2144	2184
F[]:32	Time away - Current	1826	1866	1906	1946	1986	2026	2066	2106	2146	2186
F[]:33	On Production Time - Current	1828	1868	1908	1948	1988	2028	2068	2108	2148	2188
F[]:34	Sequence Counter	1830	1870	1910	1950	1990	2030	2070	2110	2150	2190
F[]:35	On Production Time - Daily Contract Period	1832	1872	1912	1952	1992	2032	2072	2112	2152	2192
F[]:36	Totalized Flow - Daily Contract Period	1834	1874	1914	1954	1994	2034	2074	2114	2154	2194
F[]:37	Timestamp - Current	1836	1876	1916	1956	1996	2036	2076	2116	2156	2196
N/A	Spare in 2100 module	1838	1878	1918	1958	1998	2038	2078	2118	2158	2198
N/A	Spare in 2100 module	1839	1879	1919	1959	1999	2039	2079	2119	2159	2199
Meter Run Summary Data - Historical Last Period											
N[]:62	Status flags - Last Period	2240	2540	2840	3140	3440	3740	4040	4340	4640	4940
N[]:63	Status flags - word 2	2241	2541	2841	3141	3441	3741	4041	4341	4641	4941
F[]:40	Timestamp	2242	2542	2842	3142	3442	3742	4042	4342	4642	4942
F[]:41	Totalized Flow - Last Period	2244	2544	2844	3144	3444	3744	4044	4344	4644	4944
F[]:42	Totalized Energy - Last Period	2246	2546	2846	3146	3446	3746	4046	4346	4646	4946
F[]:43	Average Flow Rate - Last Period	2248	2548	2848	3148	3448	3748	4048	4348	4648	4948
F[]:44	Average Flowing Pressure - Last Period	2250	2550	2850	3150	3450	3750	4050	4350	4650	4950
F[]:45	Average Flowing Temperature - Last Period	2252	2552	2852	3152	3452	3752	4052	4352	4652	4952
F[]:46	Spare	2254	2554	2854	3154	3454	3754	4054	4354	4654	4954
F[]:47	Time away - Last Period	2256	2556	2856	3156	3456	3756	4056	4356	4656	4956
F[]:48	On Production Time - Last Period	2258	2558	2858	3158	3458	3758	4058	4358	4658	4958
F[]:49	Sequence Counter	2260	2560	2860	3160	3460	3760	4060	4360	4660	4960
F[]:50	Spare	2262	2562	2862	3162	3462	3762	4062	4362	4662	4962
N/A	Dm - Meter Tube ID	2264	2564	2864	3164	3464	3764	4064	4364	4664	4964
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2266	2566	2866	3166	3466	3766	4066	4366	4666	4966
N/A	spare	2268	2568	2868	3168	3468	3768	4068	4368	4668	4968

Meter Run Summary Data - Day 2		Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6	Meter 7	Meter 8	Meter 9	Meter 10
N/A	Status flags - Last Period	2270	2570	2870	3170	3470	3770	4070	4370	4670	4970
N/A	Status flags - word 2	2271	2571	2871	3171	3471	3771	4071	4371	4671	4971
N/A	Timestamp	2272	2572	2872	3172	3472	3772	4072	4372	4672	4972
N/A	Totalized Flow - Last Period	2274	2574	2874	3174	3474	3774	4074	4374	4674	4974
N/A	Totalized Energy - Last Period	2276	2576	2876	3176	3476	3776	4076	4376	4676	4976
N/A	Average Flow Rate - Last Period	2278	2578	2878	3178	3478	3778	4078	4378	4678	4978
N/A	Average Flowing Pressure - Last Period	2280	2580	2880	3180	3480	3780	4080	4380	4680	4980
N/A	Average Flowing Temperature - Last Period	2282	2582	2882	3182	3482	3782	4082	4382	4682	4982
N/A	Spare	2284	2584	2884	3184	3484	3784	4084	4384	4684	4984
N/A	Time away - Last Period	2286	2586	2886	3186	3486	3786	4086	4386	4686	4986
N/A	On ProductionTime - Last Period	2288	2588	2888	3188	3488	3788	4088	4388	4688	4988
N/A	Sequence Counter	2290	2590	2890	3190	3490	3790	4090	4390	4690	4990
N/A	Spare	2292	2592	2892	3192	3492	3792	4092	4392	4692	4992
N/A	Dm - Meter Tube ID	2294	2594	2894	3194	3494	3794	4094	4394	4694	4994
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2296	2596	2896	3196	3496	3796	4096	4396	4696	4996
N/A	spare	2298	2598	2898	3198	3498	3798	4098	4398	4698	4998
Meter Run Summary Data - Day 3											
N/A	Status flags - Last Period	2300	2600	2900	3200	3500	3800	4100	4400	4700	5000
N/A	Status flags - word 2	2301	2601	2901	3201	3501	3801	4101	4401	4701	5001
N/A	Timestamp	2302	2602	2902	3202	3502	3802	4102	4402	4702	5002
N/A	Totalized Flow - Last Period	2304	2604	2904	3204	3504	3804	4104	4404	4704	5004
N/A	Totalized Energy - Last Period	2306	2606	2906	3206	3506	3806	4106	4406	4706	5006
N/A	Average Flow Rate - Last Period	2308	2608	2908	3208	3508	3808	4108	4408	4708	5008
N/A	Average Flowing Pressure - Last Period	2310	2610	2910	3210	3510	3810	4110	4410	4710	5010
N/A	Average Flowing Temperature - Last Period	2312	2612	2912	3212	3512	3812	4112	4412	4712	5012
N/A	Spare	2314	2614	2914	3214	3514	3814	4114	4414	4714	5014
N/A	Time away - Last Period	2316	2616	2916	3216	3516	3816	4116	4416	4716	5016
N/A	On Production Time - Last Period	2318	2618	2918	3218	3518	3818	4118	4418	4718	5018
N/A	Sequence Counter	2320	2620	2920	3220	3520	3820	4120	4420	4720	5020
N/A	Spare	2322	2622	2922	3222	3522	3822	4122	4422	4722	5022
N/A	Dm - Meter Tube ID	2324	2624	2924	3224	3524	3824	4124	4424	4724	5024
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2326	2626	2926	3226	3526	3826	4126	4426	4726	5026
N/A	spare	2328	2628	2928	3228	3528	3828	4128	4428	4728	5028
Meter Run Summary Data - Day 4											
N/A	Status flags - Last Period	2330	2630	2930	3230	3530	3830	4130	4430	4730	5030
N/A	Status flags - word 2	2331	2631	2931	3231	3531	3831	4131	4431	4731	5031
N/A	Timestamp	2332	2632	2932	3232	3532	3832	4132	4432	4732	5032
N/A	Totalized Flow - Last Period	2334	2634	2934	3234	3534	3834	4134	4434	4734	5034
N/A	Totalized Energy - Last Period	2336	2636	2936	3236	3536	3836	4136	4436	4736	5036
N/A	Average Flow Rate - Last Period	2338	2638	2938	3238	3538	3838	4138	4438	4738	5038
N/A	Average Flowing Pressure - Last Period	2340	2640	2940	3240	3540	3840	4140	4440	4740	5040
N/A	Average Flowing Temperature - Last Period	2342	2642	2942	3242	3542	3842	4142	4442	4742	5042
N/A	Spare	2344	2644	2944	3244	3544	3844	4144	4444	4744	5044
N/A	Time away - Last Period	2346	2646	2946	3246	3546	3846	4146	4446	4746	5046
N/A	On Production Time - Last Period	2348	2648	2948	3248	3548	3848	4148	4448	4748	5048
N/A	Sequence Counter	2350	2650	2950	3250	3550	3850	4150	4450	4750	5050
N/A	Spare	2352	2652	2952	3252	3552	3852	4152	4452	4752	5052
N/A	Dm - Meter Tube ID	2354	2654	2954	3254	3554	3854	4154	4454	4754	5054
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2356	2656	2956	3256	3556	3856	4156	4456	4756	5056
N/A	spare	2358	2658	2958	3258	3558	3858	4158	4458	4758	5058

Meter Run Summary Data - Day 5		Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6	Meter 7	Meter 8	Meter 9	Meter 10
N/A	Status flags - Last Period	2360	2660	2960	3260	3560	3860	4160	4460	4760	5060
N/A	Status flags - word 2	2361	2661	2961	3261	3561	3861	4161	4461	4761	5061
N/A	Timestamp	2362	2662	2962	3262	3562	3862	4162	4462	4762	5062
N/A	Totalized Flow - Last Period	2364	2664	2964	3264	3564	3864	4164	4464	4764	5064
N/A	Totalized Energy - Last Period	2366	2666	2966	3266	3566	3866	4166	4466	4766	5066
N/A	Average Flow Rate - Last Period	2368	2668	2968	3268	3568	3868	4168	4468	4768	5068
N/A	Average Flowing Pressure - Last Period	2370	2670	2970	3270	3570	3870	4170	4470	4770	5070
N/A	Average Flowing Temperature - Last Period	2372	2672	2972	3272	3572	3872	4172	4472	4772	5072
N/A	Spare	2374	2674	2974	3274	3574	3874	4174	4474	4774	5074
N/A	Time away - Last Period	2376	2676	2976	3276	3576	3876	4176	4476	4776	5076
N/A	On Production Time - Last Period	2378	2678	2978	3278	3578	3878	4178	4478	4778	5078
N/A	Sequence Counter	2380	2680	2980	3280	3580	3880	4180	4480	4780	5080
N/A	Spare	2382	2682	2982	3282	3582	3882	4182	4482	4782	5082
N/A	Dm - Meter Tube ID	2384	2684	2984	3284	3584	3884	4184	4484	4784	5084
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2386	2686	2986	3286	3586	3886	4186	4486	4786	5086
N/A	spare	2388	2688	2988	3288	3588	3888	4188	4488	4788	5088
Meter Run Summary Data - Day 6											
N/A	Status flags - Last Period	2390	2690	2990	3290	3590	3890	4190	4490	4790	5090
N/A	Status flags - word 2	2391	2691	2991	3291	3591	3891	4191	4491	4791	5091
N/A	Timestamp	2392	2692	2992	3292	3592	3892	4192	4492	4792	5092
N/A	Totalized Flow - Last Period	2394	2694	2994	3294	3594	3894	4194	4494	4794	5094
N/A	Totalized Energy - Last Period	2396	2696	2996	3296	3596	3896	4196	4496	4796	5096
N/A	Average Flow Rate - Last Period	2398	2698	2998	3298	3598	3898	4198	4498	4798	5098
N/A	Average Flowing Pressure - Last Period	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100
N/A	Average Flowing Temperature - Last Period	2402	2702	3002	3302	3602	3902	4202	4502	4802	5102
N/A	Spare	2404	2704	3004	3304	3604	3904	4204	4504	4804	5104
N/A	Time away - Last Period	2406	2706	3006	3306	3606	3906	4206	4506	4806	5106
N/A	On Production Time - Last Period	2408	2708	3008	3308	3608	3908	4208	4508	4808	5108
N/A	Sequence Counter	2410	2710	3010	3310	3610	3910	4210	4510	4810	5110
N/A	Spare	2412	2712	3012	3312	3612	3912	4212	4512	4812	5112
N/A	Dm - Meter Tube ID	2414	2714	3014	3314	3614	3914	4214	4514	4814	5114
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2416	2716	3016	3316	3616	3916	4216	4516	4816	5116
N/A	spare	2418	2718	3018	3318	3618	3918	4218	4518	4818	5118
Meter Run Summary Data - Day 7											
N/A	Status flags - Last Period	2420	2720	3020	3320	3620	3920	4220	4520	4820	5120
N/A	Status flags - word 2	2421	2721	3021	3321	3621	3921	4221	4521	4821	5121
N/A	Timestamp	2422	2722	3022	3322	3622	3922	4222	4522	4822	5122
N/A	Totalized Flow - Last Period	2424	2724	3024	3324	3624	3924	4224	4524	4824	5124
N/A	Totalized Energy - Last Period	2426	2726	3026	3326	3626	3926	4226	4526	4826	5126
N/A	Average Flow Rate - Last Period	2428	2728	3028	3328	3628	3928	4228	4528	4828	5128
N/A	Average Flowing Pressure - Last Period	2430	2730	3030	3330	3630	3930	4230	4530	4830	5130
N/A	Average Flowing Temperature - Last Period	2432	2732	3032	3332	3632	3932	4232	4532	4832	5132
N/A	Spare	2434	2734	3034	3334	3634	3934	4234	4534	4834	5134
N/A	Time away - Last Period	2436	2736	3036	3336	3636	3936	4236	4536	4836	5136
N/A	On Production Time - Last Period	2438	2738	3038	3338	3638	3938	4238	4538	4838	5138
N/A	Sequence Counter	2440	2740	3040	3340	3640	3940	4240	4540	4840	5140
N/A	Spare	2442	2742	3042	3342	3642	3942	4242	4542	4842	5142
N/A	Dm - Meter Tube ID	2444	2744	3044	3344	3644	3944	4244	4544	4844	5144
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2446	2746	3046	3346	3646	3946	4246	4546	4846	5146
N/A	spare	2448	2748	3048	3348	3648	3948	4248	4548	4848	5148

		Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6	Meter 7	Meter 8	Meter 9	Meter 10
Meter Run Summary Data - Day 8											
N/A	Status flags - Last Period	2450	2750	3050	3350	3650	3950	4250	4550	4850	5150
N/A	Status flags - word 2	2451	2751	3051	3351	3651	3951	4251	4551	4851	5151
N/A	Timestamp	2452	2752	3052	3352	3652	3952	4252	4552	4852	5152
N/A	Totalized Flow - Last Period	2454	2754	3054	3354	3654	3954	4254	4554	4854	5154
N/A	Totalized Energy - Last Period	2456	2756	3056	3356	3656	3956	4256	4556	4856	5156
N/A	Average Flow Rate - Last Period	2458	2758	3058	3358	3658	3958	4258	4558	4858	5158
N/A	Average Flowing Pressure - Last Period	2460	2760	3060	3360	3660	3960	4260	4560	4860	5160
N/A	Average Flowing Temperature - Last Period	2462	2762	3062	3362	3662	3962	4262	4562	4862	5162
N/A	Spare	2464	2764	3064	3364	3664	3964	4264	4564	4864	5164
N/A	Time away - Last Period	2466	2766	3066	3366	3666	3966	4266	4566	4866	5166
N/A	On Production Time - Last Period	2468	2768	3068	3368	3668	3968	4268	4568	4868	5168
N/A	Sequence Counter	2470	2770	3070	3370	3670	3970	4270	4570	4870	5170
N/A	Spare	2472	2772	3072	3372	3672	3972	4272	4572	4872	5172
N/A	Dm - Meter Tube ID	2474	2774	3074	3374	3674	3974	4274	4574	4874	5174
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2476	2776	3076	3376	3676	3976	4276	4576	4876	5176
N/A	spare	2478	2778	3078	3378	3678	3978	4278	4578	4878	5178
Meter Run Summary Data - Day 9											
N/A	Status flags - Last Period	2480	2780	3080	3380	3680	3980	4280	4580	4880	5180
N/A	Status flags - word 2	2481	2781	3081	3381	3681	3981	4281	4581	4881	5181
N/A	Timestamp	2482	2782	3082	3382	3682	3982	4282	4582	4882	5182
N/A	Totalized Flow - Last Period	2484	2784	3084	3384	3684	3984	4284	4584	4884	5184
N/A	Totalized Energy - Last Period	2486	2786	3086	3386	3686	3986	4286	4586	4886	5186
N/A	Average Flow Rate - Last Period	2488	2788	3088	3388	3688	3988	4288	4588	4888	5188
N/A	Average Flowing Pressure - Last Period	2490	2790	3090	3390	3690	3990	4290	4590	4890	5190
N/A	Average Flowing Temperature - Last Period	2492	2792	3092	3392	3692	3992	4292	4592	4892	5192
N/A	Spare	2494	2794	3094	3394	3694	3994	4294	4594	4894	5194
N/A	Time away - Last Period	2496	2796	3096	3396	3696	3996	4296	4596	4896	5196
N/A	On Production Time - Last Period	2498	2798	3098	3398	3698	3998	4298	4598	4898	5198
N/A	Sequence Counter	2500	2800	3100	3400	3700	4000	4300	4600	4900	5200
N/A	Spare	2502	2802	3102	3402	3702	4002	4302	4602	4902	5202
N/A	Dm - Meter Tube ID	2504	2804	3104	3404	3704	4004	4304	4604	4904	5204
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2506	2806	3106	3406	3706	4006	4306	4606	4906	5206
N/A	spare	2508	2808	3108	3408	3708	4008	4308	4608	4908	5208
Meter Run Summary Data - Day 10											
N/A	Status flags - Last Period	2510	2810	3110	3410	3710	4010	4310	4610	4910	5210
N/A	Status flags - word 2	2511	2811	3111	3411	3711	4011	4311	4611	4911	5211
N/A	Timestamp	2512	2812	3112	3412	3712	4012	4312	4612	4912	5212
N/A	Totalized Flow - Last Period	2514	2814	3114	3414	3714	4014	4314	4614	4914	5214
N/A	Totalized Energy - Last Period	2516	2816	3116	3416	3716	4016	4316	4616	4916	5216
N/A	Average Flow Rate - Last Period	2518	2818	3118	3418	3718	4018	4318	4618	4918	5218
N/A	Average Flowing Pressure - Last Period	2520	2820	3120	3420	3720	4020	4320	4620	4920	5220
N/A	Average Flowing Temperature - Last Period	2522	2822	3122	3422	3722	4022	4322	4622	4922	5222
N/A	Spare	2524	2824	3124	3424	3724	4024	4324	4624	4924	5224
N/A	Time away - Last Period	2526	2826	3126	3426	3726	4026	4326	4626	4926	5226
N/A	On Production Time - Last Period	2528	2828	3128	3428	3728	4028	4328	4628	4928	5228
N/A	Sequence Counter	2530	2830	3130	3430	3730	4030	4330	4630	4930	5230
N/A	Spare	2532	2832	3132	3432	3732	4032	4332	4632	4932	5232
N/A	Dm - Meter Tube ID	2534	2834	3134	3434	3734	4034	4334	4634	4934	5234
N/A	dm - Orifice plate ID (AGA 3)/K factor (AGA 7)	2536	2836	3136	3436	3736	4036	4336	4636	4936	5236
N/A	spare	2538	2838	3138	3438	3738	4038	4338	4638	4938	5238

Definitions of RS-232C Handshaking Signals

(Excerpted form Allen-Bradley Publication 1785.6.5.2)

SIGNAL	TITLE	DESCRIPTION
TXD	Transmitted Data	Carries serialized data. It is an output from the module.
RXD	Received Data	RXD is serialized data input to the module. RXD is isolated from the rest of the circuitry on the modules.
RTS	Request To Send	RTS is a request from the module to the modem to prepare to transmit. RTS is turned ON when the module has a message to transmit. Otherwise, RTS is OFF.
CTS	Clear to Send	CTS is a signal from the modem to the module that indicates the carrier is stable and the modem is ready to transmit. The module will not transmit until CTS is on. If CTS is turned off during transmission, the module will stop transmitting until CTS is restored.
DTR	Data Terminal Ready	DTR is a signal to the modem to indicate that the module is operational and ready for communication. *The module will continually assert DTR*.
DSR	Data Set Ready	DSR is a signal from the modem to the module to indicate that the modem is operational and ready for communication. The module will not transmit or receive unless DSR is on. This signal is typically continually asserted by the modem. *The module will continually assert DSR.* If the modem does not properly control DSR, or if no modem is used, DSR must be jumpered to a high signal at the module's RS-232-C connector. Since DTR is held high by the module, DSR can be jumpered to DTR.
DCD	Data Carrier Detect	DCD is a signal from the modem to the module to indicate that the carrier from another modem is being sensed on the link. *The module will continually assert DCD.*

RS-232C CABLE CONFIGURATION

(WITH HANDSHAKING)

<u>ProSoft Module</u>			**<u>MODEM</u>** (25 Pin)
2	RxD	-------------------	2 (Verify)
3	TxD	-------------------	3 (Verify)
7	RTS	-------------------	4
8	CTS	-------------------	5
5	GND	-------------------	7
4	DTR	-------------------	20

(WITHOUT HANDSHAKING)

```
ProSoft Module                          RS-232 Device
                                           (25 Pin)

  2  RxD      -------------------   2 RxD

  3  TxD      -------------------   3 TxD

  7  RTS      -----           -----  4 RTS
                  |           |
  8  CTS      -----           -----  5 CTS

                              ----   6 DSR
                              |
                              -----  20 DTR

  5  GND      --------------------  7 GND
```

RS-422/RS-485 CABLE CONFIGURATION (Two Wire Mode)

ProSoft Module		Foreign Device
7 RTS	----	
	|	
8 CTS	----	
9 TxRxD+	--------------------	TxRxD+
1 TxRxD-	--------------------	TxRxD-
5 GND	--------------------	GND

RS-422 CABLE CONFIGURATION (Four Wire Mode)

ProSoft Module		Foreign Device
7 RTS	----	
	|	
8 CTS	----	
1 TxD+	--------------------	RxD+
2 RxD+	--------------------	TxD+
6 RxD-	--------------------	TxD-
9 TxD-	--------------------	RxD-
5 GND	--------------------	GND

NOTES: If communication in RS-422/RS-485 do not work, despite all attempts, try switching termination polarities. Some manufacturers interpret (+) and (-) differently.

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APPENDIX C
Gas Viscosity Chart

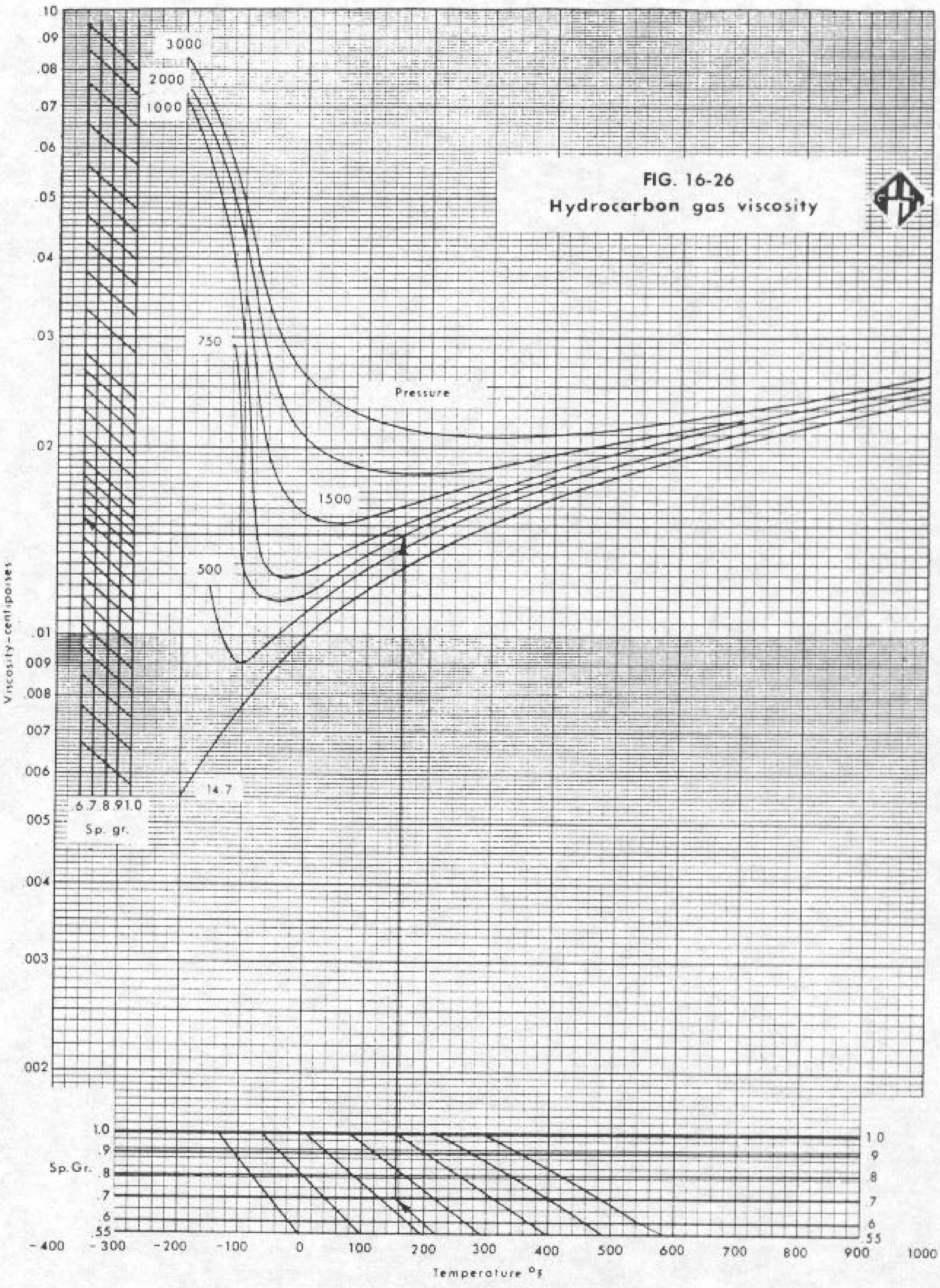


FIG. 16-26
Hydrocarbon gas viscosity

Courtesy of Western Supply Co. Tulsa

APPENDIX D

Use Interlink to Connect a Computer

Excerpted from Allen-Bradley Publication 1771-6.5.100 - Dec 1992

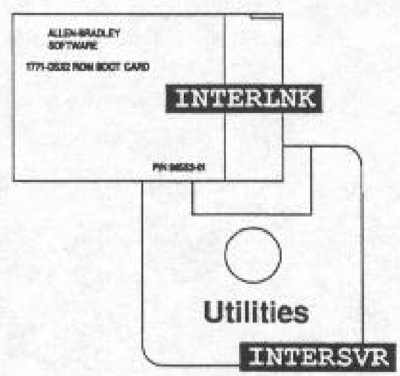
Chapter 4

Use Interlnk Software To Connect a Computer

What's In This Chapter

This chapter contains instructions on using Interlnk software to connect the main module (1771-DSX2) to a host computer.

About Interlnk



Using Interlnk software, you can:

- easily transfer files between the main module and a computer
- use a computer to run programs on the main module
- use a computer to access information on the main module

You need these two files:

- **INTERLNK.EXE** — a device driver that you install in the CONFIG.SYS file on the main module. The program is resident on the boot ROM card.
- **INTERSVR.EXE** — a program that you run from the command line or batch file on the computer. The program is resident on the utility diskette.

What You Need to Use Interlnk

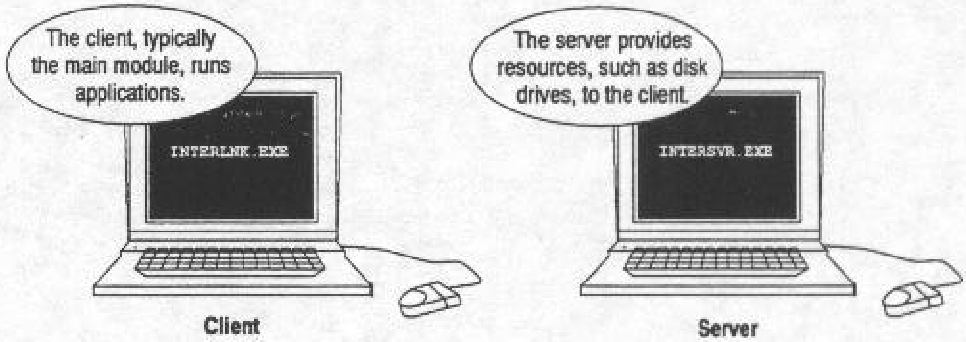
To use Interlnk, you need:

- serial ports on both the main module and the computer (the serial port you use on the main module must be set to RS-232)
- the provided Interlnk serial cable (see wiring diagram on page D-12).

  If you want to use a parallel cable, you can use a Laplink™ parallel cable or make a cable using the wiring diagram on page D-12.
- MS-DOS version 3.0 or later on both the main module and the computer.
- 16 Kbytes (main module) and 130 Kbytes (computer) of available RAM after MS-DOS software, any applications, and TSR programs are loaded. Use the MS-DOS MEM.EXE command to check memory.

Setting Up Interlnk

1. Connect the main module to the computer with the Interlnk serial cable.
2. Copy INTERLNK.EXE to the client (main module) and INTERSVR.EXE to the server computer.



3. On the client (main module), use any text editor to add another line to the CONFIG.SYS file that contains a device command for INTERLNK.EXE. The CONFIG.SYS file is located in the root directory of the start-up disk of your main module. The device command should be on a line by itself.

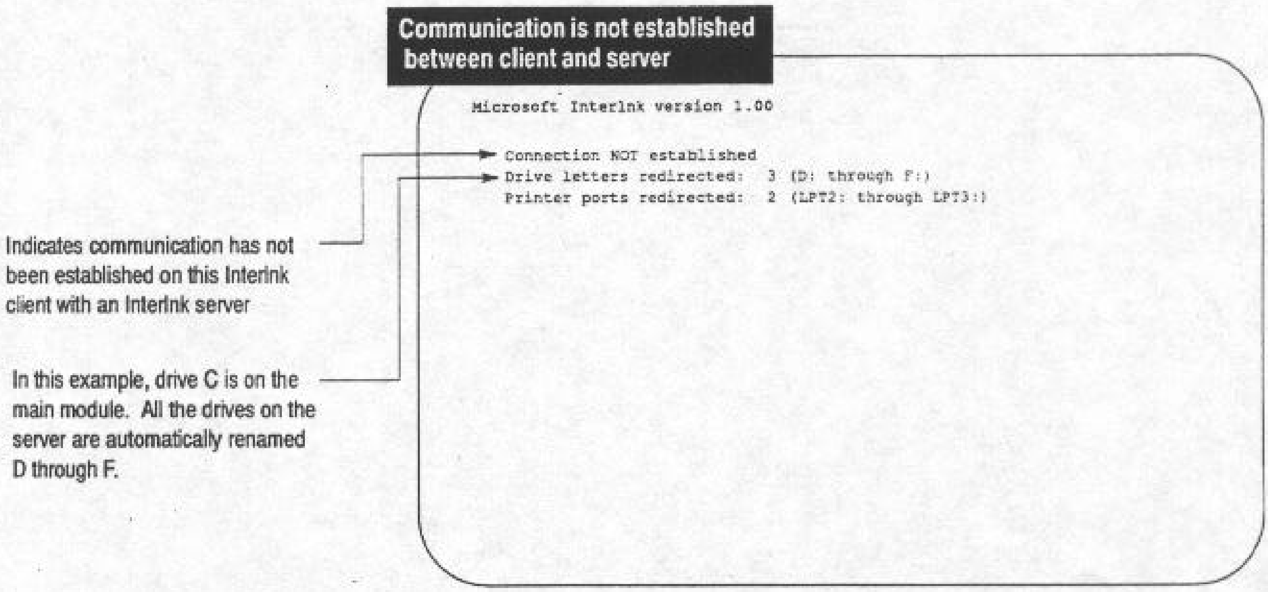
Example

This command specifies that INTERLNK.EXE is located in the root directory on drive C:

```
device=c:\interlnk.exe
```

4. Reboot the client (main module) by pressing [Ctrl-Alt-Del]

You see:

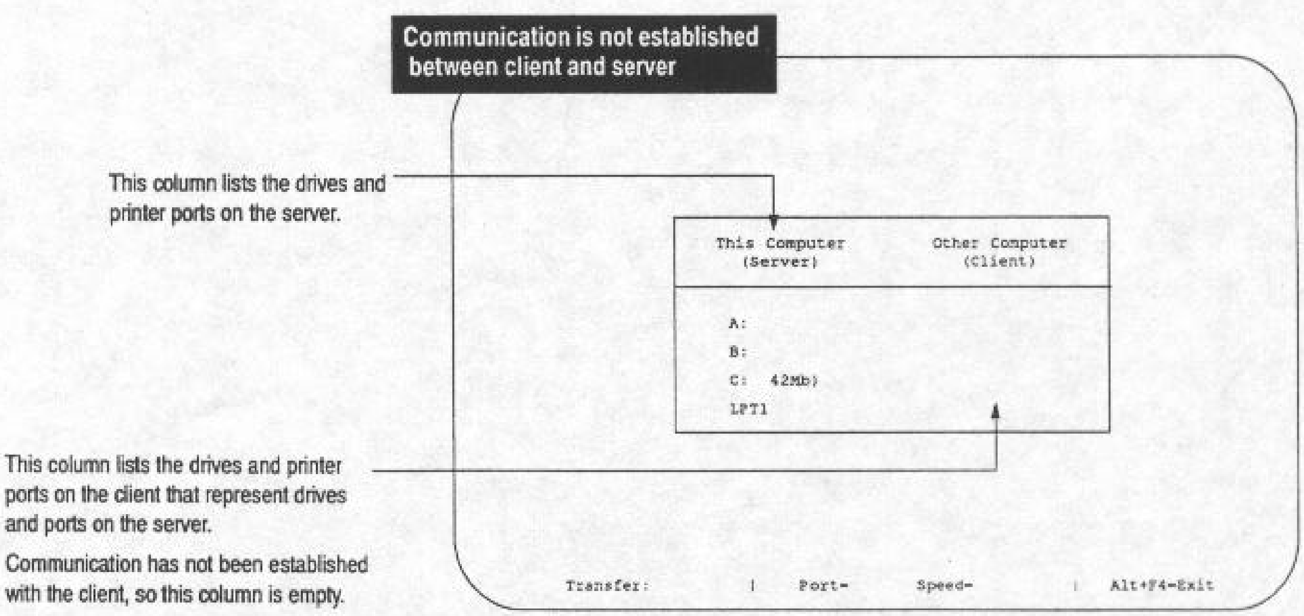


5. Start the server. Change to the directory where you copied the intersvr command. At the command prompt, type:

intersvr [Return]

See page 4-9 for more information about the intersvr command.

You see:



6. Establish communication between the client and server. Change to the directory where you copied the interlnk file. At the command prompt, type:

`interlnk` Return

See page 4-8 for more information about the interlnk command.

Example

Drive D on the client is redirected to drive A on the server. This means that any command given to drive D on the client will actually be performed on drive A of the server. To establish a connection, type the drive letter of the redirected drive, which is drive D:

`d:` Return

Interlnk automatically connects to the server when you specify a redirected drive.

Interlnk also establishes connections between all redirected drives and ports when you:

- restart the client while the server is running
- make a redirected drive on the client the active drive

You see this screen when you start the client:

Communication is established between client and server

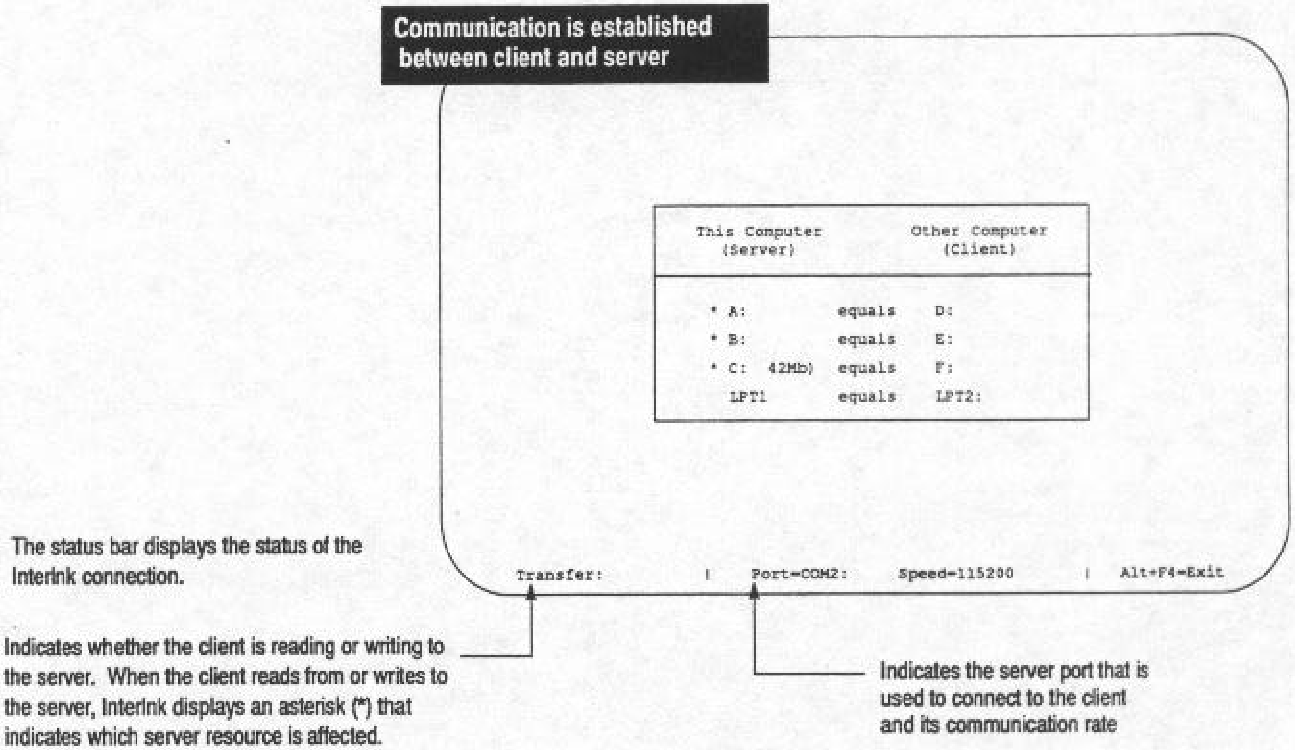
```
Microsoft Interlnk version 1.00

    Port=COM1
    Drive letters redirected:  3 (D: through F:)
    Printer ports redirected:  2 (LPT2: through LPT3:)

    This Computer          Other Computer
      (Client)                (Server)
    -------------    -------------------------
      D:    equals    A:
      E:    equals    C: (85Mb)  SYSTEM DISK
```

Indicates which port is used to connect to the other computer

Indicates the size and volume labels of the hard-disk drives on the server.

Interlnk software determines this mapping.

You see this screen when you start the server:



Changing Redirected Devices

If a device was assigned when you started Interlnk, you can change the redirection of the device on the client. Use the `interlnk` command (see page 4-8) to specify the server drive to which you want to redirect the client drive.

Example

Suppose that client drive F is redirected to server drive C. To redirect client drive F to server drive D, type:

`interlnk f=d` [Return]

To cancel the redirection of client drive F, type:

`interlnk f=` [Return]

Breaking The Connection Between Computers

To break the Interlnk connection, stop the server. On the server computer keyboard, press Alt-F4 .

Using The Remote Copy Procedure

If the Interlnk programs are located on only one of the two computers that you want to connect, you can use the Interlnk copy procedure to copy Interlnk programs to the other computer.

To use the remote copy program:

- the computers must be connected through their serial ports by the Interlnk serial cable.
- the MS-DOS MODE command must be available on the computer where you are installing the Interlnk program.
- if you are using a port other than COM1 on the computer that you are copying files to, make sure that you are not running Microsoft Share software on that computer. If you are, remove the share command from your AUTOEXEC.BAT or CONFIG.SYS file and restart your computer.

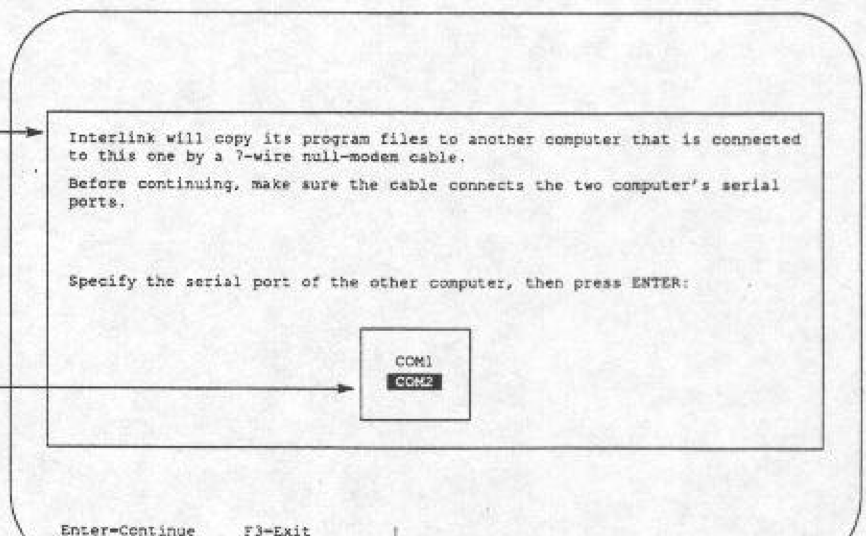
1. Change to the directory where you want the interlnk files to reside.
2. At the command prompt of the computer that has the Interlnk programs, type:

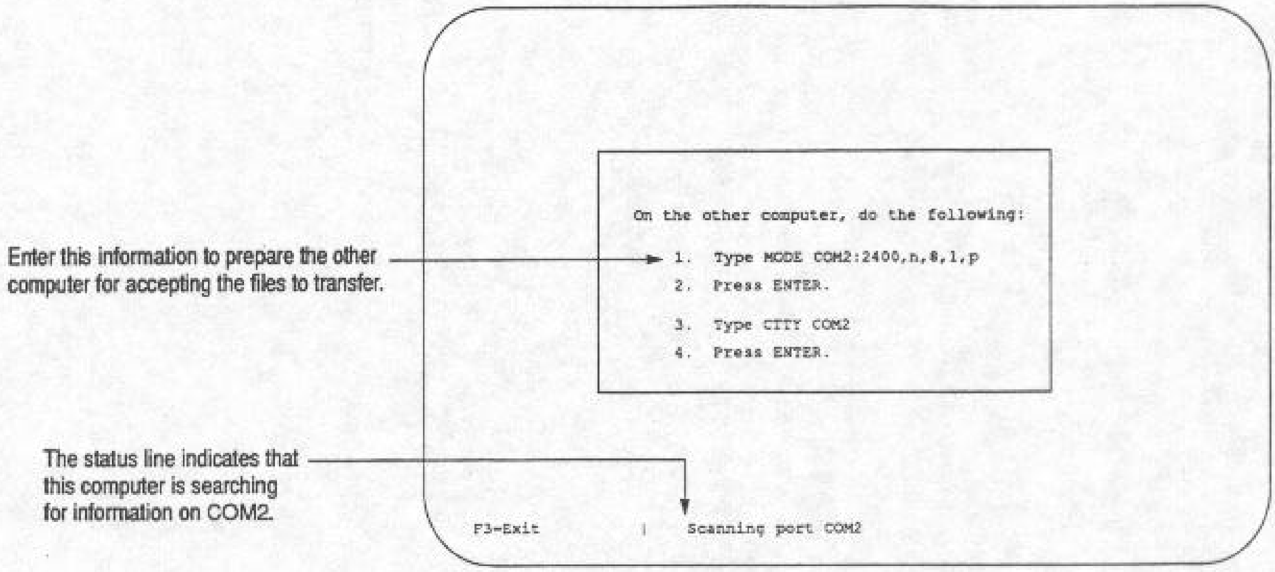
   intersvr /rcopy Return

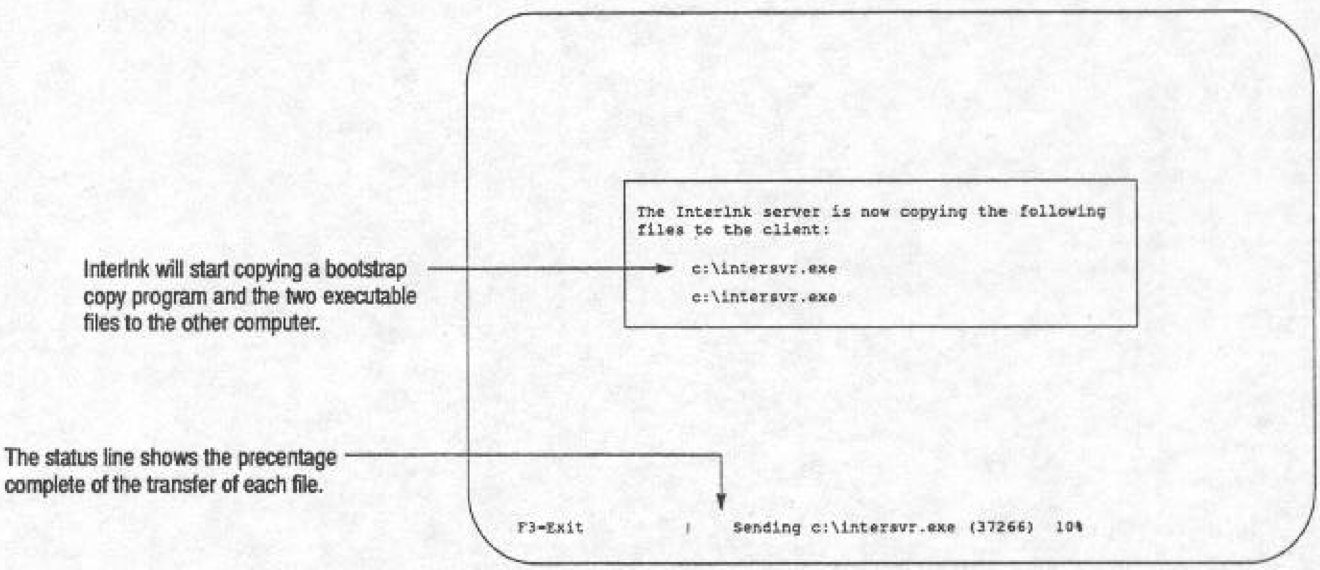
   You see:

The supplied Interlnk serial cable is a 7-wire null-modem cable (see page D-12).

Use the up or down arrow keys to select the serial port to use on the other computer and press Return







When the file transfer is complete, both computers return to DOS.

Interlnk Commands

INTERLNK.EXE — a device driver that you install in the CONFIG.SYS file on the client (main module). The program is resident on the boot ROM card.

Syntax

```
interlnk [[client:]=[server:]]
```

Parameter:	Description:
client	Specifies the letter of the client drive that is redirected to a drive on the server. The drive must be one that was redirected when you started Interlnk.
server	Specifies the letter of the drive on the Interlnk server that will be redirected.

Notes

Installing the INTERLNK.EXE device driver: You must use the device command to install the INTERLNK.EXE device driver in the config.sys file and restart the computer before you can use the interlnk command.

Canceling redirection on a drive: To cancel redirection of a client drive to a server drive, specify only the client drive and the equal sign (=).

Examples

To cancel the redirection of client drive F, type:

interlnk f:= [Return]

To display the current status of the Interlnk program, type:

interlnk [Return]

INTERSVR.EXE — a program that you run from the command line or batch file on the server computer. The program specifies the operation of the server and is resident on the utility diskette.

Syntax

intersvr *[drive:]*[**/x=***drive:]*[**/lpt***[n|address]]* *[***/com***[n|address]]*[**/baud:***rate]*[**/b**][**/v**][**/rcopy**]

Parameter/Switch:		**Description:**
Parameter	*[drive:]*	Specifies the letter of a drive that will be redirected. By default, all drives are redirected.
Swtiches	/x=*drive:*	Specifies a drive that will not be redirected. By default, all drives are redirected.
	/lpt *[n|address]*	Specifies a parallel port to use. *n* specifies the number of the parallel port. *address* specifies the address of the parallel port. If you omit *n* or *address*, the Interlnk server uses the first parallel port that it finds connected to the client. If you specify the */lpt* switch and omit the */com* switch, the server searches only for parallel ports. By default, all parallel and serial ports are scanned.
	/com *[n|address]*	Specifies a serial port to use. *n* specifies the number of the serial port. *address* specifies the address of the serial port. If you omit *n* or *address*, the Interlnk server searches all serial ports and uses the first port that it finds connected to the client. If you specify the /com switch and omit the */lpt* switch, the server searches only for serial ports. By default, all serial ports are scanned.
	/baud: *rate*	Sets a maximum serial baud. Valid values are 9600, 19200, 38400, 57600, and 115200. The default value is 115200.
	/b	Displays the Interlnk server screen in black and white. You use this switch if you are having problems reading your monochrome monitor.
	/v	Prevents conflicts with a computer's timer. Specify this switch if you have a serial connection between computers and one of them stops running when you use Interlnk to access a drive or printer port.
	/rcopy	Copies Interlnk files from one computer to another, provided that the computers are connected with the interlnk serial cable and that the mode command is available on the computer where you are installing Interlnk.

Notes

Specifying the order of drives: Interlnk redirects drives in the order that you specify. The first server drive specified is redirected to the first available client drive, the second server drive specified is redirected to the second available client drive, and so forth.

Redirected devices: Interlnk does not redirect network, CD-ROM drives, or any other device that uses a redirection interface.

Using a serial mouse with Microsoft Windows™: If you are using a serial mouse with Microsoft Windows, and you start the Interlnk server while Windows is running, specify the `/com` switch that designates a COM port other than the one the mouse is using.

Using Interlnk in a task-switching or multitasking environment: If you start the Interlnk server in a task-switching or multitasking environment, task switching and key combinations that switch you out of your current task are disabled. To restore these functions, quit the server.

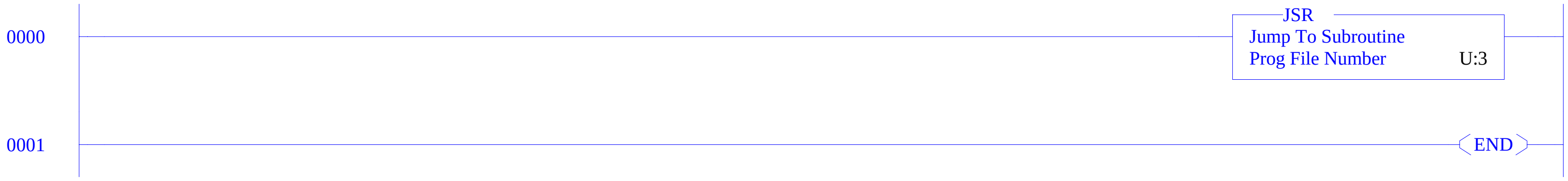
These commands do not work with the Interlnk server:

- chkdsk
- mirror
- diskcomp
- sys
- diskcopy
- undelete
- format
- unformat

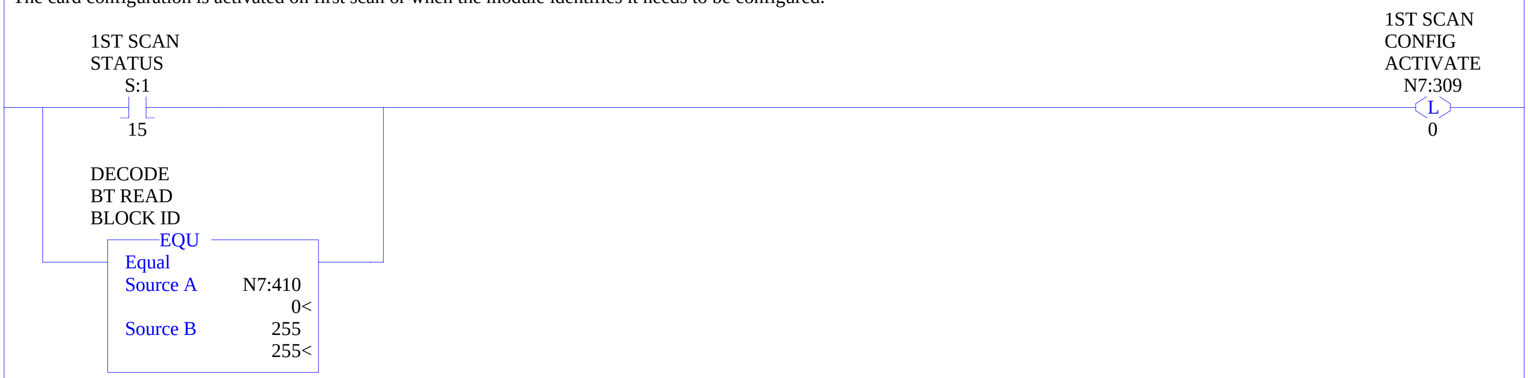
APPENDIX E
PLC-5 Example Ladder Logic

Note that the example PLC 5 ladder program files are available on the ProSoft Technology, Inc BBS. See Section 7 for instructions.

LAD 2 - MAIN --- Total Rungs in File = 2



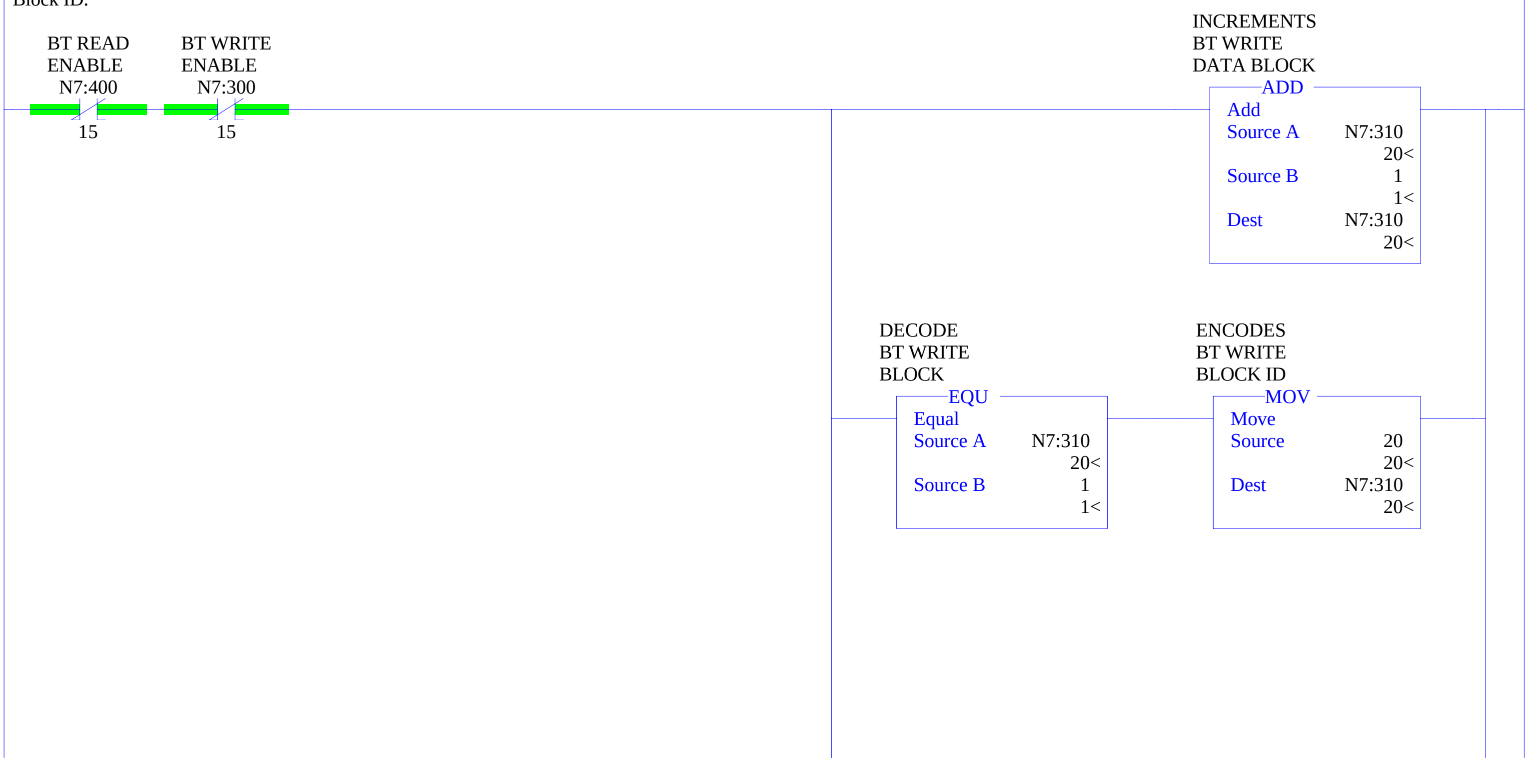
CONFIGURATION
The card configuration is activated on first scan or when the module identifies it needs to be configured.

0000


FORCE METER CONFIGURATION
On Power Up or when module is reset for some reason, this rung forces a configuration of the individual meter. Until this logic is executed, the meter will be considered unconfigured, and will not operate. To activate more meters, simply add the appropriate branches to this rung

0001


BT WRITE DATA AND CONFIGURATION ENCODING
The BTW Data Block is incremented prior to each BTW command being executed in rung 2. If the card configuration is activated (first scan or N7:410=255), then 255 is written into the BTW Block ID.

0002


DECODES BT WRITE DATA BLOCK
GEQ
Grtr Than or Eql (A>=B)
Source A N7:310
20<
Source B 22
22<

ENCODES BT WRITE BLOCK ID
MOV
Move
Source 0
0<
Dest N7:310
20<

DECODE BT READ BLOCK ID
LIM
Limit Test
Low Lim 256
256<
Test N7:410
0<
High Lim 266
266<

ENCODES BT WRITE BLOCK ID
MOV
Move
Source N7:410
0<
Dest N7:310
20<

1ST SCAN CONFIG DETECT
N7:309
0

ENCODES BT WRITE BLOCK ID
MOV
Move
Source 255
255<
Dest N7:310
20<

WRITES DATA TO MODBUS SLAVE REGISTERS 0 - 999
Based on the value in the BTW Block ID, either data is moved to the module, or configuration parameters are moved to the module. To move additional data, add a new branch with EQU N7:310,2 and COP #N10:100,#N7:311,50.

0003

BT READ ENABLE N7:400 15
BT WRITE ENABLE N7:300 15

LIM
Limit Test
Low Lim 0
0<
Test N7:310
20<
High Lim 19
19<

WRITE TO BT WRITE BUFFER
COP
Copy File
Source #N10:0
Dest #N7:311
Length 50

0004

BT READ ENABLE N7:400 15
BT WRITE ENABLE N7:300 15

LIM
Limit Test
Low Lim 0
0<
Test N7:310
20<
High Lim 19
19<

COP
Copy File
Source #S:18
Dest #N7:368
Length 6

WRITING METER RUN DATA BLOCKS TO 2100 MODULE
This rung moves the integer and floating point data for meter runs 1-10 to the 2100 module. The actual data files which are pointed to are determined by the range allowed on n7:310 in the ADD rung above.

0005

BT READ ENABLE N7:400 15
BT WRITE ENABLE N7:300 15

LIM
Limit Test
Low Lim 20
20<
Test N7:310
20<
High Lim 29
29<

CPT
Compute
Dest N7:307
30<
Expression N7:310 + 10

MOV
Move
Source N[N7:310]:0
17410<
Dest N7:311
17410<

COP
Copy File
Source #N[N7:310]:1
Dest #N7:342
Length 32

COP
Copy File
Source #F[N7:307]:0
Dest #N7:312
Length 30

0006

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 15

DECODE BT WRITE BLOCK
EQU
Equal
Source A N7:310
20<
Source B 255
255<

WRITE TO BT WRITE BUFFER
COP
Copy File
Source #N7:0
Dest #N7:311
Length 30

1ST SCAN CONFIG DEACTIVATE
N7:309
U
0

LIM
Limit Test
Low Lim 256
256<
Test N7:310
20<
High Lim 266
266<

CPT
Compute
Dest N7:307
30<
Expression N7:310 - 226

WRITE TO BT WRITE BUFFER
COP
Copy File
Source #F[N7:307]:26
Dest #N7:311
Length 24

BLOCK TRANSFER WRITE TO 2100 MODULE

0007

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 15

BT WRITE TO MODULE
BTW
Block Transfer Write
Module Type Generic Block Transfer
Rack 000
Group 2
Module 0
Control Block N7:300
Data File N7:310
Length 64
Continuous No

EN
DN
ER

BT READ AND MODBUS FC 6/16 REGISTER WRITE DECODING
BT READ from module. If BT READ Block ID is 1, then decodes length and destination address of write data from master.

0008

BT WRITE ENABLE N7:300 —|/|— 15
BT READ ENABLE N7:400 —|/|— 15

BT READ FROM MODULE
BTR
Block Transfer Read
Module Type Generic Block Transfer
Rack 000
Group 2
Module 0
Control Block N7:400
Data File N7:410
Length 64
Continuous No
(EN) (DN) (ER)

BT READ DONE BIT N7:400 —| |— 13

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410
0<
Source B 1
1<

FC 6 & 16 COPY WRITE LENGTH
MOV
Move
Source N7:411
0<
Dest R11:0.LEN
0<

FC 6 & 16 COPY WRITE DATA
FAL
File Arith/Logical
Control R11:0
Length 0<
Position 0<
Mode ALL
Dest #N10:[N7:412]
0<
Expression #N7:413
(EN) (DN) (ER)

BLOCK 0 - MODULE STATUS READ and MODBUS MASTER DATA
When BTR Block ID is 0, the Modbus slave status is available as well as the Modbus Master port data

0009

BT READ DONE BIT N7:400 —| |— 13

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410
0<
Source B 0
0<

COPYING MODULE STATUS
COP
Copy File
Source #N7:411
Dest #N7:800
Length 5

EQU
Equal
Source A N7:419
16899<
Source B 0
0<

COP
Copy File
Source #N7:420
Dest #N16:0
Length 50

EQU
Equal
Source A N7:419
16899<
Source B 1
1<

COP
Copy File
Source #N7:420
Dest #N16:50
Length 50

MODBUS FC 5 - BIT SET/RESET COMMAND
When the BT READ Block ID is 2, the action (set/reset) and bit address are decoded, and excecuted.

0010

BT READ DONE BIT N7:400 —| |— 13

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410
0<
Source B 2
2<

DECODE SET/RESET BIT CMD N7:412 —| |— 0
EXECUTE SET/RESET BIT B13 (L) [N7:411]

DECODE SET/RESET BIT CMD N7:412 —|/|— 0
EXECUTE SET/RESET BIT B13 (U) [N7:411]

MODBUS FC 15 - MULTIPLE BIT SET/RESET COMMAND
When the BT READ Block ID is 4, the logic necessary to combine the existing data registers with the new masked data is executed.

0011

BT READ DONE BIT N7:400 13 —] [—

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410
0<
Source B 4
4<

FC 15 CONTROL REG #5
FAL
File Arith/Logical
Control R11:5
Length 4<
Position 0<
Mode ALL
Dest #R11:1.LEN
1<
Expression N7:411
(EN) (DN) (ER)

FC 15 CONTROL REG #1
FAL
File Arith/Logical
Control R11:1
Length 1<
Position 0<
Mode ALL
Dest #N12:0
0<
Expression NOT #N7:443
(EN) (DN) (ER)

FC 15 CONTROL REG #2
FAL
File Arith/Logical
Control R11:2
Length 1<
Position 0<
Mode ALL
Dest #N12:30
0<
Expression #N10:[N7:412] AND #N12:0
(EN) (DN) (ER)

FC 15 CONTROL REG #3
FAL
File Arith/Logical
Control R11:3
Length 1<
Position 0<
Mode ALL
Dest #N10:[N7:412]
0<
Expression #N7:413 AND #N7:443
(EN) (DN) (ER)

FC 15 CONTROL REG #4
FAL
File Arith/Logical
Control R11:4
Length 1<
Position 0<
Mode ALL
Dest #N10:[N7:412]
0<
Expression #N10:[N7:412] OR #N12:30
(EN) (DN) (ER)

2100 MODULE METER DATA
The meter results are returned in BTR blocks with block ID codes 20-29. This rung decodes the data and moves the data into the appropriate integer and floating point registers.

0012

BT READ DONE BIT N7:400 13 —] [—

DECODE BT READ BLOCK ID
LIM
Limit Test
Low Lim 20
20<
Test N7:410
0<
High Lim 29
29<

CPT
Compute
Dest N7:406
31<
Expression N7:410 + 10

TIMESTAMP
COP
Copy File
Source #N7:411
Dest #N[N7:410]:60
Length 2

REAL TIME
OUTPUT
VALUES
COP
Copy File
Source #N7:413
Dest #F[N7:406]:20
Length 18

COP
Copy File
Source #N7:449
Dest #N[N7:410]:62
Length 2

COP
Copy File
Source #N7:451
Dest #F[N7:406]:40
Length 11

METER CONFIG DONE N[N7:410]:60 0 — METER CONFIG ENABLE N[N7:410]:1 (U) 0

METER AGA 8 CONFIG DONE N[N7:410]:60 1 — METER AGA 8 CONFIG ENABLE N[N7:410]:1 (U) 1

METER RESET DONE N[N7:410]:60 3 — METER RESET ENABLE N[N7:410]:1 (U) 3

0013 END

APPENDIX F
Modbus Master Port Example

2100-AGA Modbus Master
with
Daniels 2251 Analyzer

The 2100-AGA (revision 1.9 and later) has been configured with a Modbus Master port on COM2 of the module. Configuration of the port communication parameters is accomplished by editing the MBM.CFG file. Also included with the unit is a file called MBM.CMD. This file contains the Modbus Master command configurations, instruction the Master driver on what data to read from the Daniels and where to put it in the modules buffer memory.

Configuring Communications

The PCMAIN.EXE looks for a file called MBM.CFG in the local directory. If this file is not found or a problem is encountered in loading the file, the EXE file will abort with an error message. The MBM.CFG may be edited with any dos editor which does not add characters (hidden or otherwise) to the file. We normally use the DOS EDIT command, which is provided with DOS 5.0+.

The structure of the file as originally provided is as follows (Note that if your file gets corrupted, you may clip out the following text and save to MBM.CFG. This first line of the file should be 'Modbus Master'):

```
Modbus Master
        bits:        1
        par:         0
        stop:        0
        baud:        5
        rtson:       1
        rtsoff:      1
        timout:   2000
        retry:       1
        mode:        0
```

The meaning of these parameters is as follows:

bits: 1 The number of data bits each character should have. In RTU this should always be a 1, representing 8 data bits.

- 0 7 bits
- 1 8 bits

par: 0 The parity which the Modbus Slave should operate with. Valid values are:

- 0 None
- 1 Odd
- 2 Even

stop: 0 The number of stop bits. Valid values are:

- 0 1 Stop bit
- 1 2 Stop bits

baud: 7 The baud rate at which the slave port should operate. Valid values are:

0	300 baud
1	600 baud
2	1200 baud
3	2400 baud
4	4800 baud
5	9600 baud
6	19200 baud

rtson: 1 RTS to TXD delay for modem warmup or otherwise are required. Time interval is in ms (5 = 5ms)

rtsoff: 1 RTS OFF DELAY for delaying turning off modems or line drivers. Time interval is in ms (5 = 5ms)

timeout: 2000

Number of ms to wait after issuing a command to a slave before considering the slave non-responsive

retry: 1 Number of times that the master should retry the command before considering the slave non-responsive

mode: 0 Selects between RTU and ASCII modes

0	RTU
1	ASCII

Configuring Commands

The PCMAIN.EXE looks for a file called MBM.CMD in the local directory. If this file is not found or a problem is encountered in loading the file, the EXE file will abort with an error message. The MBM.CFG may be edited with any dos editor which does not add characters (hidden or otherwise) to the file. We normally use the DOS EDIT command, which is provided with DOS 5.0+.

The structure of the file as originally provided is as follows (Note that if your file gets corrupted, you may clip out the following text and save to MBM.CFG. The CMD files is setup to support up to 10 slaves, with each slave setup to handle 10 commands. Each slave can be named with a 10 character name, followed by the slave address (Note spacing is very important. Do not alter spacing in the file).

Following the definition of the slave name and address, the CMD file contains up to 10 commands for the slave. The command structure consists of the following:

```
DANIEL2251     1                ← 10 char slave name, slave address
     1          3          0        27       3032          10
     1          3         30        16       7000          10
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     0          0          0         0          0           0
     |          |          |         |          |           |
     |          |          |         |          |           Frequency
     |          |          |         |          Remote Address
     |          |          |         Count
     |          |          Local Address
     |          Function Code
     Enable
```

Enable: 1
Enables(1) or disables(0) the command

Function: 3
The Function Code to be executed by the MBM program

Local Addr: 0
The address in the MBM programs data buffer here the read data Will be deposited or where the write data will get its data

Count: 10
The number of words that the MBM program will request from the Slave

Remote Addr: 0
The register address in the slave where the MBM is requesting the Data to come from Frequency: 2 The number of 1/2 second intervals between executions of the command. A value of two should cause the command to be executed once per second.

Receiving Modbus Data from the Slave

The 2100 module returns the data received from the slave device embedded in the block ID 0 data block. The structure of Block 0 is as follows:

(The Following section has been excerpted from the 2100-AGA manual and modified to include the Modbus Master specific information)

5.2.1 Reading Module Status Data

The Status Data block is transferred to the processor with a Block ID of 0. The structure of the data block is as follows:

BT Buf	Offset	DESCRIPTION
N7:410	0	Current module status
N7:411	1	Last transmitted error condition
N7:412	2	Total Messages to this slave
N7:413	3	Total Msg responses from this slave
N7:414	4	Total Msgs seen by this slave
N7:415	5	Spare
N7:416	6	Spare
N7:417	7	MBM Error Code
N7:418	8	MBM Receive Counter
N7:419	9	MBM Block ID
N7:420	10-59	MBM Data Block[0 to 49]

Where:

BLOCK ID: When the Block ID number in the BTR buffer (Word 0) is 0, the module is transferring the Status Data block.

CURRENT MODULE ERROR STATUS: This value represents the current value of the error code inside the module. The possible values are detailed in the following section.

LAST TRANSMITTED ERROR CONDITION: This value is the last error code transmitted to the master by this slave. Error codes which can be expected in this field are 0, 1, 2, 3, and 6. The field will only be cleared by re configuring the module (Block ID 255).

TOTAL MESSAGES TO THIS SLAVE: This value represents the total number of messages that have matched this slaves address, whether the slave actually determined them to be good (worthy of response) or not.

TOTAL MESSAGE RESPONSES FROM THIS SLAVE: This value represents the number of good (non-error) responses that the slave has sent to the master. The presumption is that if the slave is responding, the message was good.

TOTAL MESSAGES SEEN BY THIS SLAVE: This value represents the total number of commands seen by the slave, regardless of the slave address.

> Note : All accumulators will rollover to 0 after reaching 65535 (-1 in PLC Integer File)

MBM Error Code : This value represents the current error code status for the Modbus Master port

MBM Receive Counter : This value increments upon each successful reception from a Modbus Slave device. Monitoring the value in this register with a timer can be used to determine if communications on the Modbus Master port are troubled.

MBM Block ID : This value is used to page Modbus Master read data blocks from the 2100 module into the ladder logic memory. As with all Block ID values in the 2100 module, each data block is 50 words and the Block ID value can be used to decode which 50 word block is being received from the module

Steps to Implement Modbus Master

The Steps to implement the Modbus Master port capabilities are as follows:

1. Layout the memory map for the device/instrument that the MBM port is going to read data from. This map will assist in the development of the commands.
2. Edit the MBM.CMD file to configure the commands. Through this configuration, the placement of data from the slave into the MBM memory buffer can be controlled.
3. Edit the MBM.CFG file to configure the communication parameters for the slave device.
4. Add the logic to the PLC ladder to support the decoding of the MBM data block and the movement of data into the PLC data table.
5. Set the MNM enable bit in the module configuration word (Bit 7).
6. Connect the device to COM2 using either RS232,422 or 485. Set the jumper on the module for the appropriate position.

BLOCK 0 - Module Status Read and Modbus Master Data
When BTR Block ID is 0. the Modbus Slave Status is available as well as the Modbus Master port data