A-B Interface Module

(M/N 57C418)

Industrial CONTROLS

Instruction Manual J2-3016

RELIANCE ELECTRIC

The information in this user's manual is subject to change without notice.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL WHO ARE FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

THE USER MUST PROVIDE AN EXTERNAL, HARDWIRED EMERGENCY STOP CIRCUIT OUTSIDE THE PROGRAMMABLE CONTROLLER CIRCUITRY. THIS CIRCUIT MUST DISABLE THE SYSTEM IN CASE OF IMPROPER OPERATION. UNCONTROLLED MACHINE OPERATION MAY RESULT IF THIS PROCEDURE IS NOT FOLLOWED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING

INSERTING OR REMOVING A MODULE MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

CAUTION

THIS MODULE CONTAINS STATIC-SENSITIVE COMPONENTS. CARELESS HANDLING CAN CAUSE SEVERE DAMAGE. DO NOT TOUCH THE CONNECTORS ON THE BACK OF THE MODULE. WHEN NOT IN USE, THE MODULE SHOULD BE STORED IN AN ANTI-STATIC BAG. THE PLASTIC COVER SHOULD NOT BE REMOVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

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1.0 INTRODUCTION

The products described in this instruction manual are manufactured or distributed by Reliance Electric Industrial Company.

The A-B® Interface module is used to interface the AutoMax® System to Allen-Bradley® Data Highway® and Data Highway Plus® networks. It provides an interface to the Allen-Bradley Asynchronous Link supported by Allen-Bradley Data Highway and Data Highway Plus Asynchronous Interface modules. Figures 1.1 and 1.2 illustrate how an AutoMax System can be connected to Data Highway and Data Highway Plus, respectively.

The Allen-Bradley Asynchronous Link physical layer is based on the RS-232-C standard. (See Appendix C for the RS-232 cable connections.) The Data Link protocol version supported by the module is referred to in Allen-Bradley documentation as full-duplex or DF-1 protocol. The application layer protocol subset supported by the module consists of ten commands: seven from the Data Highway/Data Highway Plus basic command set and three from the PLC-3® command set. These commands are listed in section 4.3.

The A-B Interface module can be placed in any slot in an AutoMax rack that contains at least one AutoMax Processor. Each AutoMax Processor has access to the look-alike PLC-3 registers through the AutoMax rack backplane. The A-B Interface module will transfer data between the look-alike PLC-3 image and remote A-B equipment via a subset of the commands mentioned above. The individual command formats are described in the various Allen-Bradley instruction manuals.

The remainder of this manual describes the functions and specifications of the A-B Interface module. It also includes a detailed description of module installation and servicing procedures, as well as programming methods.

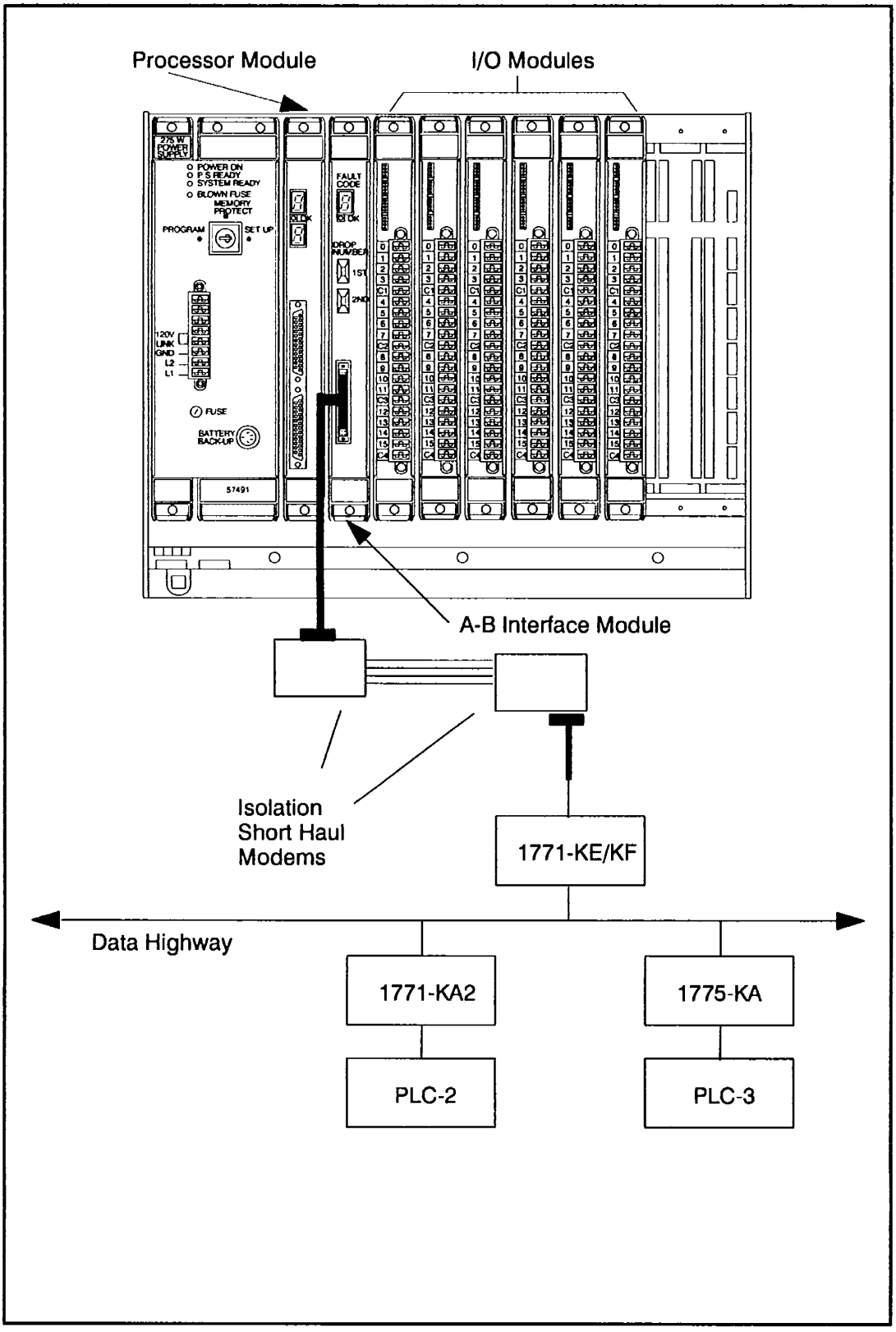


Figure 1.1 - Interfacing the AutoMax System to A-B Data Highway Network

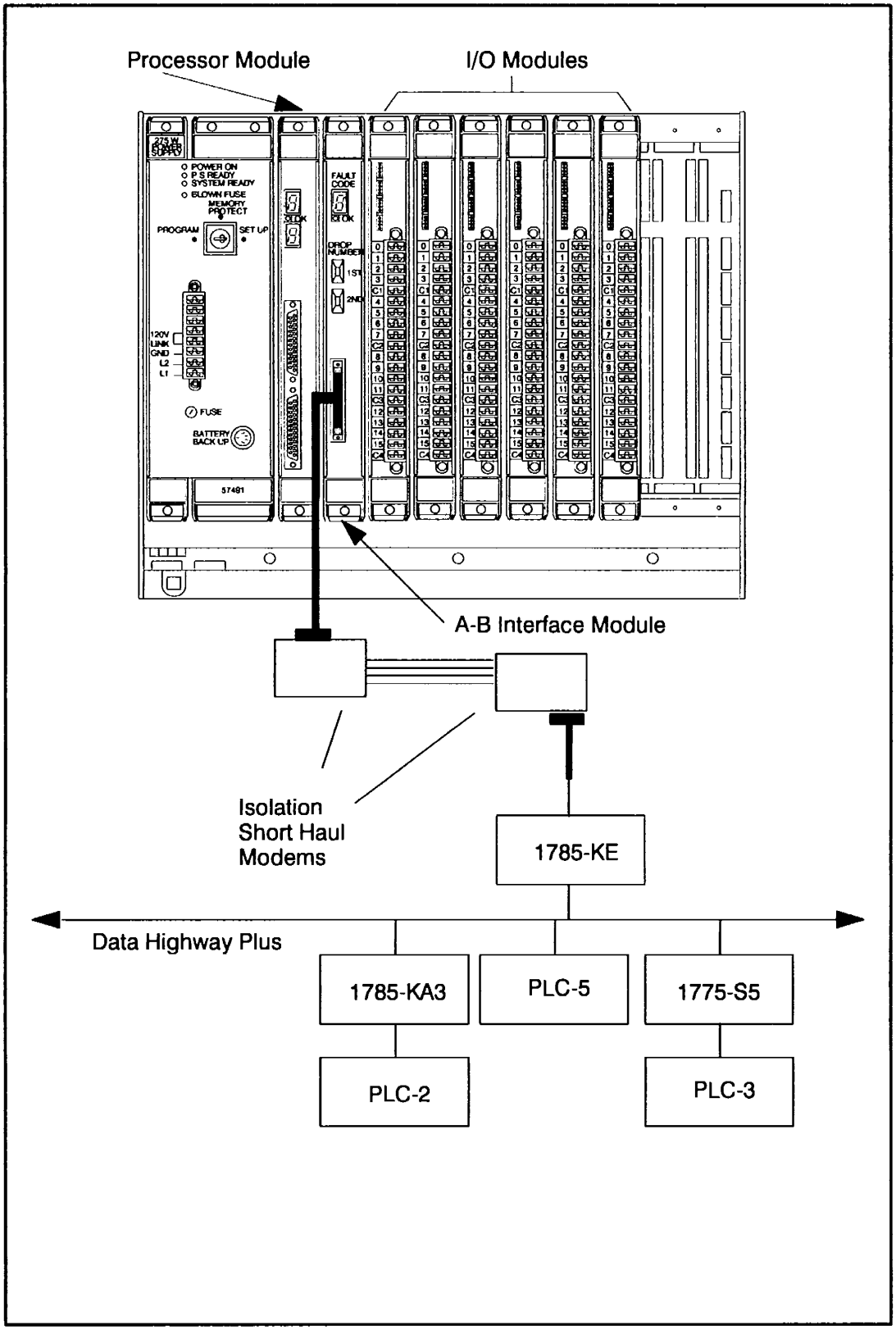


Figure 1.2 - Interfacing the AutoMax System to A-B Data Highway Plus Network

1.1 Additional Information

You must be familiar with all the instruction manuals that describe your system configuration. This may include, but is not limited to, the following:

- J-3616 KERMIT™ COMMUNICATIONS SOFTWARE INSTRUCTION MANUAL
- J-3618 NORTON EDITOR INSTRUCTION MANUAL
- J-3636 COMMON MEMORY MODULE INSTRUCTION MANUAL
- J-3649 AutoMax CONFIGURATION TASK INSTRUCTION MANUAL
- J-3650 AutoMax PROCESSOR MODULE INSTRUCTION MANUAL
- J-3669 AutoMax Pocket Reference
- J-3675 AutoMax ENHANCED BASIC LANGUAGE INSTRUCTION MANUAL
- J-3676 AutoMax CONTROL BLOCK LANGUAGE INSTRUCTION MANUAL
- J-3677 AutoMax LADDER LOGIC LANGUAGE INSTRUCTION MANUAL
- J-3684 ReSource™ AutoMax PROGRAMMING EXECUTIVE INSTRUCTION MANUAL VERSION 2.0
- J-3692 ISOLATION SHORT HAUL MODEM INSTRUCTION MANUAL
- J-3750 ReSource AutoMax PROGRAMMING EXECUTIVE INSTRUCTION MANUAL VERSION 3.0
- IEEE 518 GUIDE FOR THE INSTALLATION OF ELECTRICAL EQUIPMENT TO MINIMIZE ELECTRICAL NOISE INPUTS TO CONTROLLERS
- Your personal computer and DOS operating system manual(s)
- Other instruction manuals applicable to your hardware configuration

1.2 Related Hardware and Software

M/N 57C418 contains one A-B Interface Module. The module can be used with the following hardware and software:

1. M/N 57C430A, 57C431, 57C435 AutoMax Processor.
2. M/N 61C128 ReSource Portable Computer, or other IBM-XT® or AT-compatible personal computer running DOS version 3.1 or later.
3. M/N 61C127 RS-232C ReSource Interface Cable. This cable is used to connect the personal computer to the Processor module. Item 2 above includes this cable, but it can be purchased separately.
4. M/N 57C413 Common Memory Module. This module is used when there is more than one Processor module in a rack.
5. M/N 57C382 Isolation Short Haul Modem. Two Short Haul Modems are required per application. This modem provides isolation for the communications port on the A-B Interface module.
6. M/N 57C383 Module Interface Cable. This cable is used to connect the A-B Interface module to the Short Haul Modem.
7. M/N 57C301 - 57C303 DCS System Operation Manual.
8. M/N 57C304 - 57C307 AutoMax Programming Executive Version 1.0.
9. M/N 57C390 - 57C393 AutoMax Programming Executive Version 2.0.
10. M/N 57C395, 57C397 AutoMax Programming Executive Version 3.0.

2.0 MECHANICAL/ELECTRICAL DESCRIPTION

This section describes the mechanical and electrical characteristics of the A-B Interface module.

2.1 Mechanical Description

The A-B Interface module is a printed circuit assembly that plugs into the backplane of the DCS 5000/AutoMax Rack. The module consists of a printed circuit board, faceplate, and protective enclosure. The faceplate contains ejector tabs at the top and bottom to simplify removing the module from the rack. See figure 2.1 for an illustration of the module faceplate.

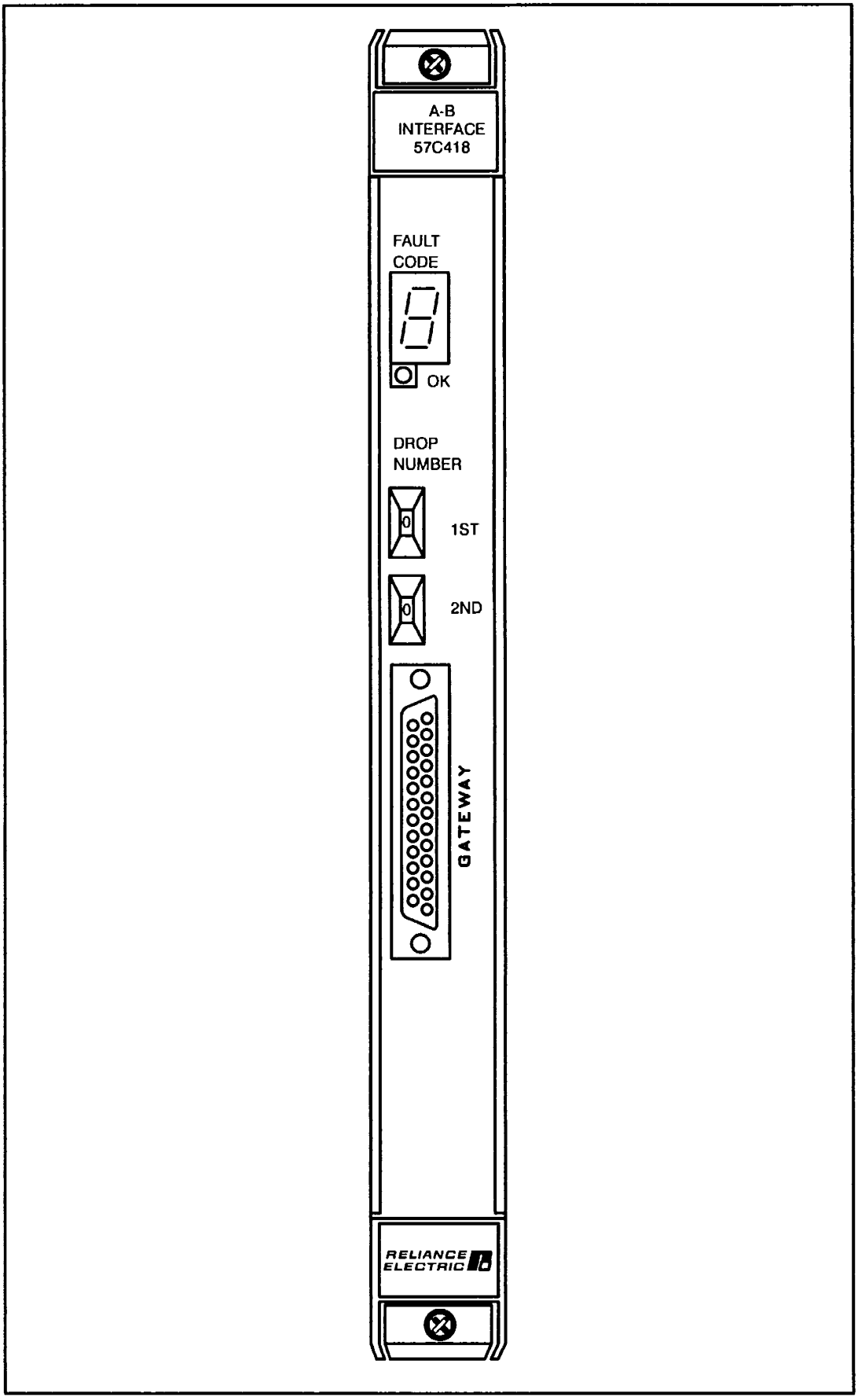


Figure 2.1 - A-B Interface Module Faceplate

The 25-pin D-shell connector on the faceplate supports the RS-232-compatible serial port. The two thumbwheel switches on the faceplate are used to set the station address in decimal. The upper thumbwheel switch represents the most significant digit; the lower thumbwheel switch represents the least significant digit. On the back of the module are two edge connectors that attach to the system backplane.

For diagnostic purposes, the faceplate contains a seven-segment LED which displays error codes. The error codes are defined in Appendix D. A green status LED on the faceplate indicates when the module is operational (ON) or should be replaced (OFF).

2.2 Electrical Description

The A-B Interface module contains a 4 MHz Z80A microprocessor. The Z80A connects to one port of the module's dual port memory, while the other port interfaces with the Multibus™ backplane. A block diagram is shown in Appendix B.

The module contains a watchdog timer which is enabled when power is turned on to the module. The on-board Z80A processor must reset the watchdog timer within a specified time or the Z80A will shut down and the status LED on the faceplate will turn off.

At power-up, the on-board processor will run diagnostics on the CPU, EPROM, RAM, serial I/O, memory management unit, and dual port memory, as well as perform system-level diagnostics. As each test is run, a number is written out to the seven-segment display. If there is a fault during the diagnostics, the Z80A will halt, the watchdog will time out, and the seven-segment display will show the code of the failed diagnostic.

3.0 INSTALLATION

This section provides instructions for how to install the A-B Interface module and its cable assembly.

3.1 Wiring

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING WITH THE NATIONAL ELECTRICAL CODE AND ALL OTHER APPLICABLE LOCAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVER-CURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

To reduce the possibility of electrical noise interfering with the proper operation of the control system, exercise care when installing the wiring from the system to the external devices. For detailed recommendations, refer to IEEE 518.

3.2 Initial Installation

Use the following procedure to install the module:

Step 1. Stop any application tasks that may be running.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

INSERTING OR REMOVING A MODULE MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Step 2. Turn off power to the rack. All power to the rack as well as all power to the wiring leading to the rack should be off.

CAUTION

THIS MODULE CONTAINS STATIC-SENSITIVE COMPONENTS. CARELESS HANDLING CAN CAUSE SEVERE DAMAGE. DO NOT TOUCH THE CONNECTORS ON THE BACK OF THE MODULE. WHEN NOT IN USE, THE MODULE SHOULD BE STORED IN AN ANTI-STATIC BAG. THE PLASTIC COVER SHOULD NOT BE REMOVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

Step 3. Take the module out of its shipping container. Take it out of the anti-static bag, being careful not to touch the connectors on the back of the module.

Step 4. Insert the module into the desired slot in the rack, making sure it is well-seated in the rack. The module may reside in any slot in the rack. Use a screwdriver to secure the module into the rack.

Step 5. Set the station number of the A-B Interface module using the two thumbwheel switches on the module faceplate. The upper switch is the most significant digit and the lower switch is the least significant digit. The station number set on the module faceplate must be equivalent to the station number on the A-B hardware to which it is directly connected. Note that the station number on the A-B hardware will be in octal. The station number on the A-B Interface module, however, must be entered in decimal.

Step 6. Connect one end of the interface cable (M/N 57C383) to the 25-pin connector on the module faceplate and the other end to a Short Haul Modem (M/N 57C382). Connect the other Short Haul Modem to the connector on the A-B hardware. Connect the two modems using two twisted pairs of solid or stranded conductors (see J-3692 for modem wiring instructions).

Step 7. Turn on power to the rack. An internal diagnostic routine is automatically executed by the module. If an error is encountered, an error code will be displayed on the seven-segment LED. If the green status LED is OFF and no seven-segment error code is displayed, a local watchdog failure has occurred. If a diagnostic fault code 0 through 9 or b is displayed, the A-B Interface module must be replaced. (Refer to Appendix D for a description of the error codes.)

If the thumbwheel switches are set to an invalid station number, the "A" fault code will be displayed on the seven-segment LED on the module faceplate after power-up. To clear the invalid station number fault code, refer to section 5.2.

Step 8. Verify the installation by monitoring registers on the module. Refer to Appendix G.

3.3 Module Replacement

Use the following procedure to replace the A-B Interface module.

Step 1. Stop any application tasks that may be running.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED. DISCONNECT AND LOCK OUT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

INSERTING OR REMOVING A MODULE MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Step 2. Turn off power to the rack. All power to the rack as well as all power to the wiring leading to the rack should be off.

Step 3. Disconnect the cable from the module faceplate.

CAUTION

THIS MODULE CONTAINS STATIC-SENSITIVE COMPONENTS. CARELESS HANDLING CAN CAUSE SEVERE DAMAGE. DO NOT TOUCH THE CONNECTORS ON THE BACK OF THE MODULE. WHEN NOT IN USE, THE MODULE SHOULD BE STORED IN AN ANTI-STATIC BAG. THE PLASTIC COVER SHOULD NOT BE REMOVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DAMAGE TO OR DESTRUCTION OF THE EQUIPMENT.

Step 4. Use a screwdriver to loosen the screws that hold the module in the rack. Take the module out of the slot in the rack.

Step 5. Take the new module out of its shipping container. Take it out of the anti-static bag, being careful not to touch the connectors on the back of the module.

Step 6. Insert the module into the rack, making sure it is wellseated in the rack.

Step 7. Set the station number of the module by using the two thumbwheel switches on the module faceplate. The upper switch is the most significant digit, the lower switch is the least significant digit.

Step 8. Attach the cable to the module faceplate.

Step 9. Turn on power to the rack.

Step 10. Verify the installation by monitoring registers on the module. Refer to Appendix G. After the powerup diagnostics are completed, the green status LED will go on.

4.0 PROGRAMMING

This section describes how the data is organized in the module and provides examples of how the module is accessed by the application software. For more detailed information on programming, refer to the AutoMax Programming Reference Binder (J-3686).

4.1 Register Organization

The A-B Interface module contains a dual port memory that can be accessed through the AutoMax rack backplane by application programs running on the AutoMax Processor as well as by the A-B device attached to the 25-pin connector. The dual port memory contains the status and control data, the PLC-3 image data, and the command message buffer area. The dual port memory map is shown in figure 4.1.

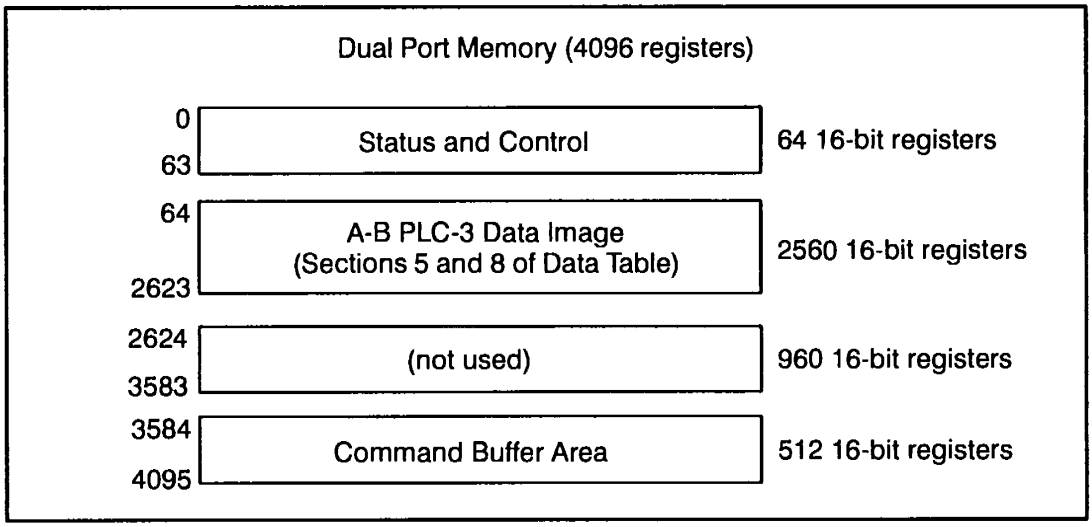


Figure 4.1 - Dual Port Memory Map

4.1.1 Status and Control Registers

All registers are mapped as READ ONLY with the exception of registers 20-24. This means that the AutoMax Processor cannot write to any other registers in the module. Refer to figure 4.2 for status and control register assignments.

Status and Control Register Assignments

R/W	Reg. #	Description
R	0	Status and Control Register 1 (System use only)
R	1	Status and Control Register 2 (System use only)
R	2	Status and Control Register 3 (System use only)
R	3	Status and Control Register 4 (System use only)
R	4	Device Status (bit 0)
R	5-11	Not used
R	12	Station number
R	13	Program mode (keyswitch position 1 = memory protect, 2 = setup, 3 = program)
R	14	Messages received
R	15	Receive timeouts
R	16	CRC/parity errors
R	17	Overrun errors
R	18	Framing errors
R	19	Messages transmitted
R/W	20	Link Configuration/Update Request
R/W	21	Link Baud Rate
R/W	22	Response Timeout (seconds)
R/W	23	Number of retries
R/W	24	ACK/NAK Timeout (25 ms. increments)
R	25-49	Not used
R	50-59	Used for Display Mode
R	60	Software Part Number
R	61	Revision Level (ASCII)
R	62-63	Interface Card Identification (ASCII 'GTWY')

Figure 4.2 - Status and Control Register Assignments

Register 4, the device status register, defines the state of the link configuration. Bit 0 will be set to "1" after you have properly configured the module.

Register 12 contains the station number set on the faceplate of the module.

Register 13 contains the status of the keyswitch on the Power Supply in the AutoMax rack.

Registers 14-19 are error and status registers that should be monitored to ensure the communication link is functioning properly.

Register 20 is the link configuration/update request register. The module continually monitors this register and will reconfigure the link any time the update flag (bits 0-7) is set. Bit 13 determines what kind of parity error checking will be used and must match the remote A-B device to which the A-B Interface module is connected. When bit 15 is set, the first 10 bytes of the last message received will be stored in registers 50-54, and the first 10 bytes of the last message transmitted will be stored in registers 55-59. See appendix F for how to monitor registers 50-59. Figure 4.3 illustrates register 20.

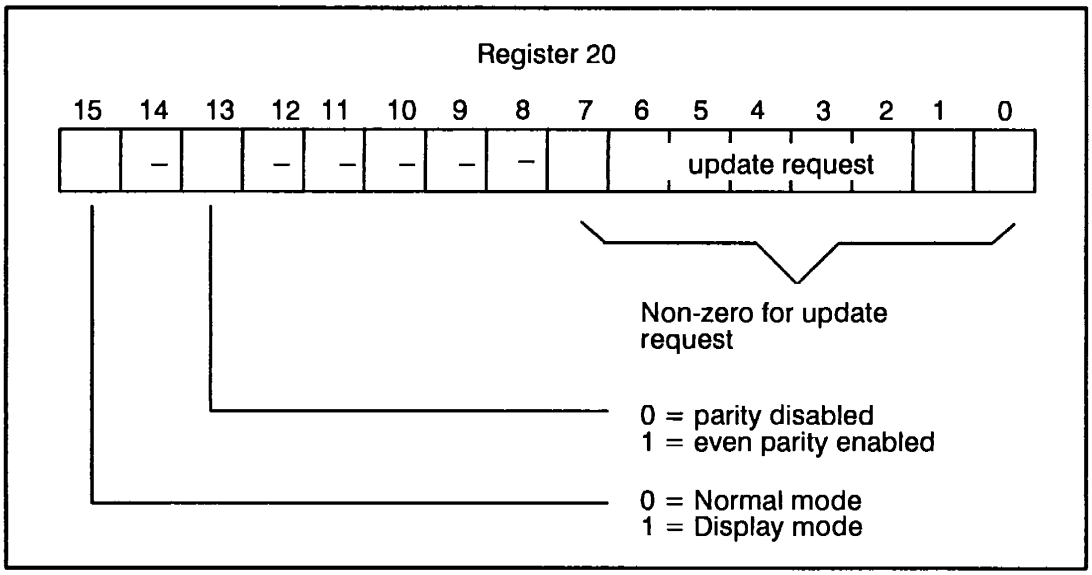


Figure 4.3 - Link Configuration/Update Request

Register 21 defines the baud rate for the RS-232 link. Acceptable baud rates are 1200, 2400, 4800, 9600, and 19200. The baud rate specified must match the baud rate configured for the A-B device on the other end of the link.

Register 22 defines the time in which a response must be received from a request command initiated by the BASIC function GATEWAY_CMD_OK@ in an AutoMax application program (see section 4.4). The units are seconds and the range of acceptable values is 1-10 (default = 3).

Register 23 defines the number of retries when initiating a command from the GATEWAY_CMD_OK@ function. The range is 0-3, and the default value is 2.

Register 24 defines the time that the A-B Interface module will wait for an ACK/NAK response from the device on the other end of the link. The value is expressed in units of 25 milliseconds. The default value is 40, which is equivalent to one second.

Registers 50-61 are used to aid in diagnosing communication problems with the interface and to store the module's software version number. These registers are described in Appendix F.

4.1.2 Allen-Bradley PLC-3 Image

The data image in the dual port memory appears as a subset of the PLC-3 data table (Area 3). The first 512 words of the data image (64 - 576) are designated as the Binary section (PLC-3 Section 8), and will be divided into two files, each containing 256 16- bit words, or 4096 bits.

The next 2048 words of dual port memory are designated as the Integer section (PLC-3 Section 5), and are divided into two files of 1024 words each. Data in the Integer section is interpreted as 2s complement binary by AutoMax application programs. Figure 4.4 provides a map of the PLC-3 image areas in the dual port memory along with access limitations.

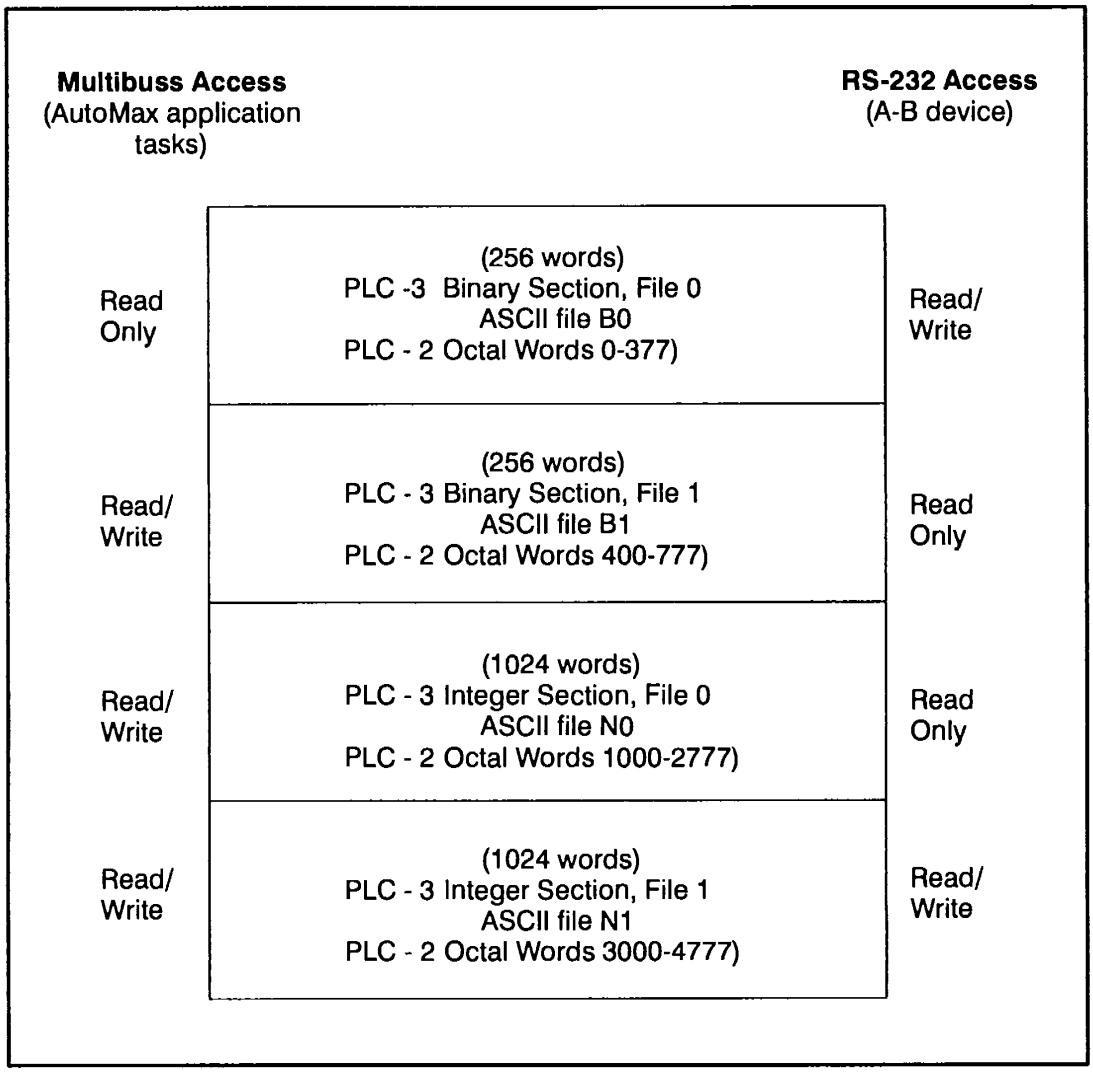


Figure 4.4 - PLC-3 Image Areas

In Version 2.1 and earlier of the AutoMax Executive software, the PLC-3 register image on the A-B Interface module's dual port is mapped via ABDEF statements in the rack's configuration task. In Version 3.0 and later of the AutoMax Executive software, the A-B Interface module is configured by using the Programming Executive software. Any variables contained in the rack configuration are accessible by any task within the rack. When variables are referenced in AutoMax application tasks, the data is directly obtained from or written to the PLC-3 register image. The data storage for an AutoMax variable mapped to a PLC-3 register will always exist in the A-B Interface module's dual port memory.

All of the PLC-3 register image's registers are readable from the A-B device. However, it will not be possible to write to the discrete inputs (File B1) and input registers (File N0) from the A-B device or to write to the discrete outputs (File B0) from the Multibus backplane.

The registers in the A-B Interface PLC-3 image may be displayed using the AutoMax Programming Executive's Monitor I/O function. Refer to Appendix G for the method used to convert PLC-3 register numbers so they can be viewed using the monitor.

4.2 Data Update Rate

The time required for a data transfer between the A-B Interface module and a remote device is dependent on the following parameters:

- Formulation of the request message from the GATEWAY_CMD_OK@ function.
- Transmission time of a request message on the RS-232 link.
- Transmission time of a request message on the Data Highway®.
- Turn-around time at the destination.
- Transmission time of a response message on the Data Highway.
- Transmission time of a response message on the RS-232 link.
- Processing of a response message.

Appendix H describes methods for estimating the time required for transmitting request and response messages.

4.3 A-B Commands Supported by the A-B Interface Module

The A-B Interface module will not respond to all incoming Data Highway or Data Highway Plus commands on the asynchronous link. The subset of the Allen-Bradley command codes supported by the module consists of both Data Highway/Data Highway Plus basic and PLC-3 commands. Refer to figure 4.5.

A-B Cmd.	A-B Fnc.	Type	A-B Name	Register Restrictions
01	-	Basic	Unprotected Read	none
00	-	Basic	Protected Write	0-377, 3000-4777 (octal) (files B0, N1)
08	-	Basic	Unprotected Write	0-377, 3000-4777 (octal) (files B0, N1)
02	-	Basic	Protected Bit Write	0-377 (octal) (files B0)
05	-	Basic	Unprotected Bit Write	0-377 (octal) (files B0)
06	0	Basic	Diagnostic Loop	n/a
06	3	Basic	Diagnostic Status	n/a
15	0	PLC-3	Word Range Write	0-377, 3000-4777 (octal) (files B0, N1)
15	1	PLC-3	Word Range Read	none
15	2	PLC-3	Bit Writes	0-377, 3000-4777 (octal) (files B0, N1)

Figure 4.5 - A-B Command Codes Supported by the A-B Interface Module

Incoming commands from the basic command set are assumed to contain a logical address in the Address field. Unprotected writes are processed in the same manner as Protected writes and are not permitted to store data in the protected areas of the PLC-3 image in the dual port memory.

For PLC-3 commands, both ASCII File Name and PLC-3 Extended Addressing formats are supported with some restrictions. The ASCII File Name must be "B0" or "B1" for Binary Section files 0 or 1, or "N0" or "N1" for Integer Section files 0 or 1. The Binary Section files are 256 words, while the Integer Section files are 1024 words. Files "B1" and "N0" are read-only files as viewed from the A-B device.

For PLC-3 Extended Addressing, the following restrictions apply when referencing the PLC-3 image:

Level 1 - Only Area #3 (Data Table) is permitted.
Level 2 - Current context only. Must be equal to 1.
Level 3 - Only Sections 5 (Integer) and 8 (Binary) permitted.
Level 4 - Only file 0 or 1 permitted.
Level 5 - Must be 0.
Level 6 - For Section 5, only values 0-1023 are permitted.
For Section 8, only values 0-255 are permitted.

4.4 AutoMax System to A-B Interface Communication

AutoMax application programs communicate with the A-B Interface module by defining the PLC-3 image registers in the dual port memory. In Version 3.0 and later of the AutoMax Executive software, you define these registers using the Programming Executive software. If you are using Version 2.1 or earlier of the AutoMax Exective software, this is done using ABDEF satements in the rack configuration task. The format for the ABDEF statement is as follows:

```
nnn     ABDEF var_name [ SLOT=slot_number, FILE=file,          &
        REGISTER=register number, BIT=bit number]
```

where

nnnn = configuration task line number.

var_name = integer, double integer or boolean name for register or bit. Boolean variable assignments are limited to the binary section of the A-B interface area, while integer and double integer variables are limited to the integer section of the interface area (see "file" below).

WARNING

IF YOU USE DOUBLE INTEGER VARIABLES IN THIS INSTANCE, YOU MUST IMPLEMENT A SOFTWARE HANDSHAKE BETWEEN THE TRANSMITTER AND RECEIVER TO ENSURE THAT BOTH THE LEAST SIGNIFICANT AND MOST SIGNIFICANT 16 BITS HAVE BEEN TRANSMITTED BEFORE THEY ARE READ BY THE RECEIVING APPLICATION PROGRAM. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY OR DAMAGE TO EQUIPMENT.

slot_number = slot number of the A-B interface module. This number may range from 0 to 15.

file = file designation for the dual port (A-B interface) area, must be enclosed in single or double quotes.

File	Multibus Access	A-B Link
'B0' = binary file 0	read only	read/write
'B1' = binary file 1	read/write	read only
'N0' = integer file 0	read/write	read only
'N1' = integer file 1	read/write	read/write

register number = register number within the file. Register numbers 0 to 255 are reserved for files B0 and B1. Register numbers 0 to 1023 are reserved for files N0 and N1.

bit number = bit number within the register. This number may range from 0 to 15. Bit number is specified for boolean variables only.

Read and write commands to the module are initiated from a BASIC application program by executing the GATEWAY_CMD_OK@ function:

```
GATEWAY_CMD_OK@(status, cmd_code, slave_drop,          &
                slave_reg, master_var, num_regs)
```

where:

status is an integer variable representing the location where the resulting command status is stored; status will contain a zero if the transfer operation is successful and an error code if it is unsuccessful

cmd_code is a variable name or expression of type integer representing the command sent to the Interface module; the commands available are found in figure 4.6

slave_drop is a variable name or expression of type integer representing the station number of the hardware the Interface module is communicating with

slave_reg is a variable name or expression of type string representing the starting register in the device that is to be read from/written to

master_var is a variable name or expression (via the BASIC language VARPTR! function) of type double integer, representing the physical address of the first register that is to be read from/written to in the Interface module

num_regs is variable name or expression of type integer that defines the number of bits or registers (16 bits each) to be transferred; cmd_code determines whether the variable represents bits or registers

The starting register in the PLC-3 may be specified in either the Filename format or PLC-3 Extended Address format. The Filename format is:

slave_reg$ = "filename:word"

where:

filename = name of the file in the PLC-3 (8 characters max.)
: = delimiter
word = desired word in the file (0 - max. size)

The PLC-3 Extended Address format is :

slave_reg$ = "E3.c.s.f.w"

where:

E3 = Data Table (area 3) Extended Address key word
c = Context. Must be equal to 1 for Current Context
s = Section of the Data Table. Set equal to 5 for Integer Section or 8 for Binary Section.
f = File Number in Section (0-15)
w = Desired word in the file (0-9999)

For example, the task statements that follow will read 5 registers from the PLC-3 with station number 12, beginning with register 2976 in Integer section File 2, and store the data in the A-B Interface module starting at register M_XXX%.

```
:
500    COMMON M_XXX% :
600    LOCAL   RET_STAT%, RDREG_CMD%, AB_STA%,          &
       SLAVE_REG$
610    LOCAL   GTWY_REG!, XFER_SIZE%
:
1000   RDREG_CMD% = 3
:
2000   SLAVE_REG$ = "E3.1.5.2.2976"
2010   IF NOT GATEWAY_CMD_OK@( RET_STAT%,               &
       RDREG_CMD%, 12,SLAVE_REG$, VARPTR!(M_XXX%), 5)
```

```
        THEN 20000 !{process errors}
:
```

The GATEWAY_CMD_OK@ function will return a value of "true" (1) if the command was successfully completed. If the function returns to a value of "false" (0), the returned status will contain an error code. See appendix E for the error codes returned by the GATEWAY_CMD_OK@ function.

4.4.1 Link Configuration

The link between the A-B Interface module and the A-B device is configured through an AutoMax BASIC application program. The program must first set the baud rate for the link in Status and Control register 21, then set the A-B Interface Link Configuration/Update flag in register 20. If values other than the default for registers 22 through 24 are desired, the new values should be written before setting the flag in register 20. In the example that follows, the link will operate at 9600 baud with no parity. The response timeout is set to two seconds, and the number of re-tries is one. The default value of ACK/NAK timeout is used.

If you are using AutoMax Version 2.1 or earlier, the following statements would appear in the Configuration task. If you are using AutoMax Version 3.0 or later, these registers would be defined using the Variable Configurator within the Programming Executive.

```
:
040   IODEF   LINK_CONF%[ SLOT = 5, REGISTER = 20]
050   IODEF   BAUD_RATE%[ SLOT = 5, REGISTER = 21]
060   IODEF   RESP_TIME%[ SLOT = 5, REGISTER = 22]
070   IODEF   RETRIES% [ SLOT = 5, REGISTER = 23]
:
```

The application task would contain the following statements:

```
:
100   RESP_TIME% = 2
110   BAUD_RATE% = 9600
120   RETRIES%  = 1
130   LINK_CONF% = 00FFH
:
```

Registers 20 and 22-24 are continually monitored by the A-B Interface module software, and new values may be written to these registers at any time using the Monitor I/O function in the AutoMax Programming Executive (see instruction manual J-3684 or J-3750). Appendix G describes how to convert PLC-3 register numbers to monitor register numbers.

4.4.2 Commands Used with the GATEWAY_CMD_OK@ Function

Figure 4.6 describes the commands used by AutoMax in the GATEWAY_CMD_OK@ function to initiate a command on the A-B Interface module.

GATEWAY_CMD_OK@ Cmd_Number	Command_Description	Equivalent A-B Command Function	
1	Read Discrete Data from PLC-3	15	1
2	Write Discrete Data to PLC-3	15	2
3	Read Register Data from PLC-3	15	1
4	Write Register Data to PLC-3	15	0
:			
9	Command 1 with High Priority		
10	Command 2 with High Priority		
11	Command 3 with High Priority		
12	Command 4 with High Priority		
:			
255	(all others undefined)		

Figure 4.6 - Commands Used with GATEWAY_CMD_OK@

Note that only PLC-3 type commands are initiated by the A-B Interface module over the link. It is not possible to initiate a command from AutoMax BASIC to a PLC-2 (or to a PLC-5).

Command 1 will transfer discrete (bit) data from the PLC-3's registers to the A-B Interface module's File B0 data area. The PLC-3 register number may be any legal register, while the A-B Interface register destination must be within the File B0 area. The transfer size is the number of bits to transfer from the PLC-3. The value of the bit specified in the A-B Interface module will be updated with the corresponding bit from the PLC-3 register. Successive bits will be updated until the transfer is complete. The maximum transfer size for this command is 1936 bits.

Command 2 will transfer discrete (bit) data from either of the A-B Interface discrete data areas to any legal PLC-3's register(s). The transfer size is the number of bits to transfer to the PLC-3 word. The value of the bit specified in the A-B Interface module will be transferred to the corresponding bit in the PLC-3 register. Successive bits will be transferred until the transfer is complete or until bit 15 of the PLC-3 register has been updated. Therefore, the maximum transfer size for this command is 16 minus the bit number (0-15) of the A-B Interface register.

Command 3 will transfer the value of any legal PLC-3 register(s) to the A-B Interface module's File N1 or File B0 data area. The PLC-3 register number may be any legal register, while the A-B Interface register destination must be within the A-B Interface register area (File B0 or File N1). The transfer size is the number of registers to transfer from the PLC-3, and must not exceed 122. Note that if data is being written into the A-B Interface's File B1 area, the variable name of the first bit written to must specify bit 0 in a 16-bit word.

Command 4 will transfer 16-bit data from any A-B Interface data area to any legal PLC-3 register(s). The transfer size is the number of 16-bit values to transfer to the PLC-3, and must not exceed 113. Note that if data is being transferred from the A-B Interface's File B0 or B1

areas, the variable name of the bit to begin with must be bit 0 in a 16-bit word.

Commands 9-12 perform the same transfers as commands 1-4, respectively, but with the priority bit set to give the command high priority.

4.4.3 Restrictions

The remote A-B device linked to the A-B Interface module must be configured to use full duplex, no parity or even parity, no duplicate message detection, and no embedded responses. Refer to the appropriate A-B documentation for the appropriate switch settings.

5.0 DIAGNOSTICS AND TROUBLESHOOTING

This section describes how to troubleshoot the A-B Interface module. See Appendix D for a list of the error codes that can be displayed by the module. If the problem cannot be corrected using the procedures below, the unit is not user-serviceable.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL, ADJUST, OPERATE, AND/OR SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

5.1 The OK LED is Off

Problem: The green OK status LED on the A-B Interface module faceplate is off. This LED should be on when the module has passed its internal diagnostics after power-up. If the green OK status LED is off, and no error code is displayed, a local watchdog failure has occurred. Try cycling power to the rack. If the OK status LED remains off, replace the module.

5.2 Invalid Station Number

Problem: Error code "A" appears on the A-B Interface module's LED display at power-up. This error code indicates an invalid station number. Use the following procedure to clear the error code:

Step 1. Turn off all power to the rack.

Step 2. Set the correct station number on the thumbwheel switches.

Step 3. Turn on power to the rack.

5.3 Transmission Link Failures

Problem: Error code "09" is returned by the GATEWAY_CMD_OK@ function. This error code indicates a Response Timeout.

Verify that the cable connections to each station are secure. Check the cable connection at the A-B Interface module faceplate and at the remote device.

See sections 5.3.1 and 5.3.2 for information on rack failure and remote device failure.

5.3.1 Rack Failure

If the AutoMax Processor in the rack that contains the A-B Interface module fails or issues a BOARD RESET command (clears all outputs in the rack), the entire image in the A-B Interface module's dual port memory will be cleared. The device will remain off-line for at least 1 second to allow the application task to recognize that the device went off-line.

5.3.2 Remote Device Failure

When the A-B Interface module operates in a slave mode, i.e., where it only responds to incoming request messages, a failure in the master device cannot be detected by the module itself. When the A-B Interface module is initiating request messages, a link failure would be indicated by a Response Timeout error (see section 5.3).

5.4 Bus Error

Problem: Error code "31" or "51" through "58" appears on a Processor module's LED display. These errors indicate the system has a problem accessing a module in the rack though the backplane bus. A bus error may be caused by removal of an I/O module, an I/O module failure, or a rack backplane failure.

Use the following procedure to isolate a bus error:

Step 1. Verify that all the modules are in the correct slots.

Verify that the slot number being referenced in the application tasks agrees with the slot number defined during configuration.

Step 2. Verify that the application software is correct.

Verify that the application software is not attempting to write to READ ONLY registers on the module.

Step 3. Verify that the hardware is working correctly.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN AC POWER IS CONNECTED. DISCONNECT AND LOCKOUT ALL UNGROUNDED CONDUCTORS OF THE AC POWER LINE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

INSERTING OR REMOVING A MODULE MAY RESULT IN UNEXPECTED MACHINE MOTION. POWER TO THE MACHINE SHOULD BE TURNED OFF BEFORE INSERTING OR REMOVING THE MODULE. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

Make certain that power is off before removing any module from the rack. Systematically replace the A-B Interface module, the Processor module(s), and the backplane, one at a time with a corresponding module or assembly know to be operating correctly. After replacing each module, if the problem is not corrected, replace the original before going on to the next item.

Appendix A

Technical Specifications

A-B Interface Module M/N 57C418

Ambient Conditions

- Storage Temperature : 0°C to 60°C
- Operating Temperature: −40°C to 85°C
- Humidity: 5% to 95%, non-condensing
- Altitude: 3300 feet (1000 meters) without derating

Dimensions

- Height: 11.75 inches (29.845 cm)
- Width: 1.25 inches (3.175 cm)
- Depth: 7.375 inches (18.733 cm)
- Weight: 2 pounds (.9 kg)

Maximum Power Dissipation

- 20 W

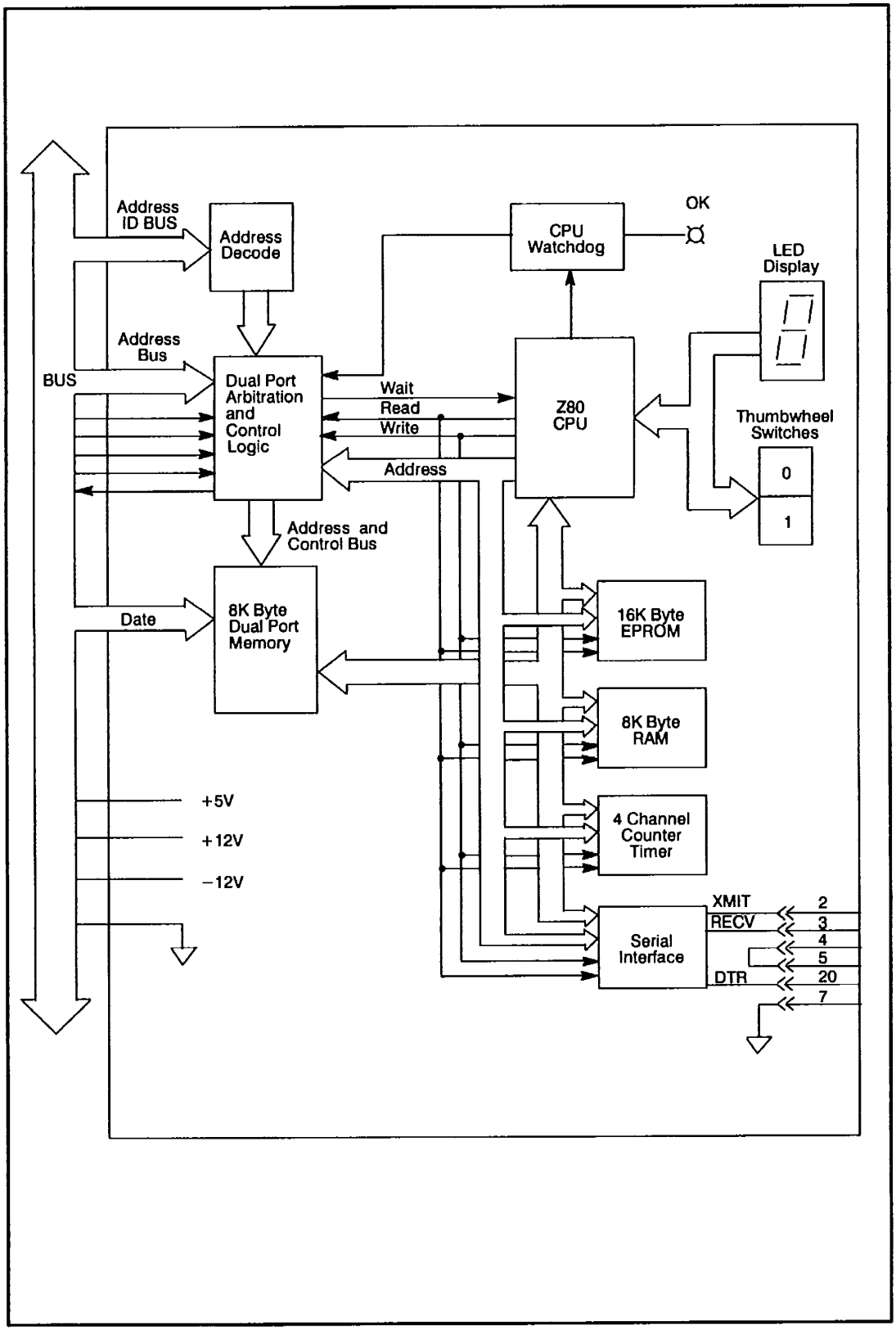
System Power Requirements

- +5 VDC: 2.5 A
- +12 VDC: 53 mA
- −12 VDC: 7.5 mA

Appendix B

Block Diagram

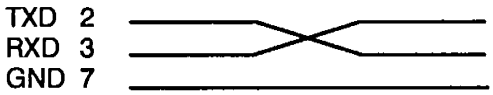
A-B INTERFACE MODULE (57C418)



Appendix C

RS-232 Port Pinout

A-B Interface Module 25-pin Male connector Pin #		A-B Device 25-pin Male connector Pin #
TXD 2		2 TXD
RXD 3		3 RXD
GND 7		7 GND



Appendix D

A-B Interface Module Error Codes

0	CPU failed power-up diagnostic
1	EPROM failed power-up diagnostic
2	RAM failed power-up diagnostic
3	CTC failed power-up diagnostic
4	SIO port failed power-up diagnostic
5	DMA failed power-up diagnostic
6	Dual port memory failed power-up diagnostic
7	Memory management unit failed power-up diagnostic
9	Parallel I/O port failed power-up diagnostic
A	Invalid station number. Hardware failure.
b	Watchdog timer failed power-up diagnostic.
C	Communication line failure. Displayed only if the link has not been configured by the AutoMax application program.
d	System (backplane) watchdog failed; board is operational but will not transmit or receive any data until the watchdog is reset.
E	Power failure. This code is normally present from the time that a low voltage is detected until power is completely lost.

If, at power-up of the rack, any diagnostic fault code remains displayed (0-9, or b), the A-B Interface module must be replaced.

Appendix E

GATEWAY_CMD_OK@ Error Codes

A-B Device or Network Errors

01 (not defined)
02 No ACK received from remote
03 Contention on Data Highway
04 Local port disabled
05 (not defined)
06 (not defined)
07 (not defined)
09 Response timeout
10 ACK/NAK timeout
11 NAK error

GATEWAY_CMD_OK@ Errors

18 Destination string format error
19 Context/section/file number error
20 Dual port address error
21 Interface card not found or not accessible
22 No available Interface channel
23 Illegal register number
24 Illegal number of registers
25 Illegal command number
26 Illegal command number/Register set
27 Illegal register number/Number of registers
28 Illegal Station number

A-B Status (STS) Errors

31 Illegal command, command size, or data size
32 (not defined)
33 (not defined)
34 PLC-3 backplane fault
35 Read/write file does not exist; PLC-2 addressing violation
36 Memory protect keyswitch disallows access
37 PLC-3 in Program mode
38 No file assigned to source station

A-B Extended Status Errors

41 Error in conversion of block address
42 Improper format for PLC-3 word
43 Error in conversion of file address
44 Invalid symbol
45 Improper symbol specification format
46 Invalid PLC-3 word address
47 Improper file size
48 File size changed during message
49 File size too large
50 Message size too large
51 Write privilege not granted to remote

Appendix F

Monitoring Dual Port Registers 50-61

The A-B Interface module has the ability to display portions of both the received and transmitted commands to aid in diagnosing communication problems with the interface.

When the "Display" mode is selected by setting register 20, bit 15, the first 10 bytes of the last message received are stored in registers 50-54. The first 10 bytes of the last message transmitted are stored in registers 55-59. The contents of either set of registers may be a request or response message, depending on where the request was initiated. When the registers are displayed in hexadecimal using the AutoMax Monitor I/O function, a response message can be identified by a "4" in the first digit of the Command byte. The contents of the registers are as follows:

Register 50/55	DST | SRC	Destination / Source
Register 51/56	CMD | STS	Command / Status
Register 52/57	TNS	Transaction Number
Register 53/58	(Command	Refer to applicable
Register 54/59	Dependent	A-B documentation

The software revision level is designated by the last four characters of the software part number. On power-up, the first two ASCII characters are stored in register 60 and the last two in register 61. For example, if the software part number is 419463- 012A, the contents of these registers would be:

Register 60 3031H - ASCII 0, 1
Register 61 3241H - ASCII 2, A

Appendix G

Converting A-B Register Numbers to Decimal Format for Monitoring

The registers in the A-B Interface PLC-3 image may be displayed using the AutoMax Monitor I/O function. The table below provides the conversion from the PLC-3 register number to the decimal format required to use the Monitor I/O function.

PLC-3 Image 'File:Reg'	Monitor I/O Register	Example
'B0:n'	n + 64	'B0:12' = Reg 76
'B1:n'	n + 320	'B1:100' = Reg 420
'N0:n'	n + 576	'N0:421' = Reg 997
'N1:n'	n + 1600	'N1:984' = Reg 2584

For a PLC-2 type register, convert the Word number from octal to decimal, then add 64 to determine the Monitor I/O register number. Note that the starting address contained in the command display (registers 50-59) is two times the Word number. For example,

Word number	= 245 (octal)	= 165 decimal
Monitor I/O register	= 165 + 64	= 229
Starting address	= 732 (octal)	= 474 decimal
Word number	= 474 / 2	= 237
Monitor I/O register	= 237 + 64	= 301

Appendix H

Calculating Message Transmission Times

This appendix will provide a means of estimating the time required for transmission of messages.

RS-232 Link

The transmission time for a message on the RS-232 link may be approximated from the following equation:

TIME (ms) = (C * B * 1000) / Baud Rate

where:

C = Number of characters in the message
B = Number of bits per character (normally 10 if no parity, 11 if parity is specified)

The number of characters in a message is dependent on the message type (A-B command code, described in section 4.3) and the number of registers being transmitted. Refer to Table H.1.

Table H.1 - Message Length

A-B Cmd	Func	Name	# of Characters In Request	# of characters In Response
00	-	Protected Write	13 + (2 * NR)	11
08	-	Unprotected Write	13 + (2 * NR)	11
01	-	Unprotected Read	14	11 + (2 * NR)
02	-	Protected Bit Write	11 + (4 * NBY)	11
05	-	Unprotected Bit Write	11 + (4 * NBY)	11
15	0	Word Range Write	23 + (2 * NR)	11
15	1	Word Range Read	23	11 + (2 * NR)
15	2	Bit Write	23	11

where:

NR = Number of Registers
NBY = Number of Bytes

Incoming Request Messages

For the A-B Interface module, the turn-around time for an incoming request message is dependent on the number of messages already queued for processing. There may be up to three messages in the queue that must be processed before the latest incoming request can be processed.

Once the request message processing is begun, the time required is dependent on the number of registers in the response message. Table H.2 provides an estimate of the processing time:

Table H.2 - Request Message Processing Time

A-B Cmd	Func	Name	Time (in milliseconds)
00	-	Protected Write	t = (0.026 * NR) + 0.6
08	-	Unprotected Write	t = (0.026 * NR) + 0.6
01	-	Unprotected Read	t = (0.034 * NR) + 0.6
02	-	Protected Bit Write	t = (0.134 * NBY) + 0.6
05	-	Unprotected Bit Write	t = (0.134 * NBY) + 0.6
15	0	Word Range Write	t = (0.025 * NR) + 0.8
15	1	Word Range Read	t = (0.022 * NR) + 0.9
15	2	Bit Write	t = 0.6

where:

NR = Number of Registers
NBY = Number of Bytes

Request Message Initiated from an Application Task

When a request message is formulated from the GATEWAY_CMD_OK@ function, there may be a delay before the message is transmitted, depending on how many messages (maximum of three) are already queued for transmission. Likewise, when the response is received, up to three messages may be queued for processing before the response is processed.

The time required to formulate the request messages from the GATEWAY_CMD_OK@ function is as follows:

CMD_CODE	Command Name	Time (in milliseconds)
1	Read Discrete Data from PLC-3	t = 2.0
2	Write Discrete Data to PLC-3	t = 2.0
3	Read Register Data from PLC-3	t = 2.0
4	Write Register Data to PLC-3	t = (0.034 * NR) + 2.0

where:

NR = Number of Registers

The time required to process the response message in the A-B Interface module is as follows:

CMD_CODE	Command Name	Time (in milliseconds)
1	Read Discrete Data from PLC-3	t = (0.006 * NB) + 0.9
2	Write Discrete Data to PLC-3	t = 0.4
3	Read Register Data from PLC-3	t = (0.026 * NR) + .07
4	Write Register Data to PLC-3	t = 0.4

where:

NB = Number of Bits
NR = Number of Registers

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