3100/3150 - HAR
Harris RTU Slave
Protocol Module

Revision 1.0

USER MANUAL

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ProSoft Technology, Inc.
1675 Chester Ave.
Fourth Floor
Bakersfield, CA 93301
prosoft@prosoft-technology.com

Please Read This Notice

Successful application of the HAR card requires a reasonable working knowledge of the Allen-Bradley PLC or SLC hardware and the application in which the combination is to be used. For this reason, it is important that those responsible for implementing the HAR satisfy themselves that the combination will meet the needs of the application without exposing personnel or equipment to unsafe or inappropriate working conditions.

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 read all applicable Allen-Bradley documentation on the operation of the A-B hardware.

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TABLE OF CONTENTS

I. Card Specifications 1
II Configuring the HAR Module 1
2.1 Hardware Overview 1
2.2 Module Jumper Configurations 2
2.2.1 3100/3101 for the 1771 Platform 2
2.2.2 3150/3151 for the 1746 Platform 3
2.3 Firmware Installation Procedure (3101 & 3151) 3
2.3.1 1771-DB Revision B Module 3
2.3.2 1746-BAS Module 4
III. Harris Slave Card Functions 4
3.1 HARRIS Communications 4
3.1.1 Command/Reply Cycle 4
3.1.2 Command Types in the Harris Slave 4
3.1.3 Command Error Checking 5
3.1.4 Data Integrity 5
3.2 Module Memory Layout 5
3.2.1 Data Memory 5
3.2.2 Communications Configuration Parameters 6
IV HAR Theoretical Operation 6
4.1 Writing Data to the Module 6
4.1.1 Communications Configuration (Block ID Code 255) 7
4.1.2 Writing Port Register Data (Block ID Codes 0-27) 11
4.2 Reading Data From the ProSoft Technology Module 13
4.2.1 Setpoint Arm/Operate - Op Codes 9/0AH 13
4.2.2 Raise/Lower Command - Op Code 8 14
4.2.3 Control Point Arm/Operate - Op Codes 6/7 15
4.2.4 Power Fail Reset Command - Op Codes 0Bh 16
4.2.5 Time Synchronization- Op Codes 11h&13h and 17h 16
4.2.6 Set Freeze Interval - Op Code 18h 16
4.2.7 Slave Error Code Table 17
4.2.8 Error Status Codes 18
V. Harris Commands 19
5.1 Data Read Functions 19
5.1.1 Op Code 0 : Data Dump 19
5.1.2 Op Code 3 : Status Change Check 19
5.1.3 Op Code 4 : Status Change Dump 20
5.1.4 Op Code 5 : Status Dump 20
5.2 Control Commands From Master 20
5.2.1 Op Code 6 and 7 : Control Point Arm/Operate 20
5.2.2 Op Code 8 : Raise/Lower (Port Type 3) 21
5.2.3 Op Code 9/0Ah : Setpoint Arm/Operate 21
5.2.4 Op Code 0Bh : Power Fail Reset 22
5.2.5 Op Code 11h/13h/17h : Time Sync 22
5.2.6 Op Code 18h : Set Freeze Interval 23
VI Hardware Diagnostics 23
6.1 3100/3101 PLC Platform 23
6.2 3150/3151 SLC Platform 24
VII Support, Service and Warranty 26
7.1 Technical Support 26
7.2 Module Service and Repair 26
7.3 Warranty 27
7.3.1 General Warranty Policy 27

7.3.2 Limitation of Liability 27
7.3.3 Hardware Product Warranty Details 27

Appendices

Appendix A
PLC 5 Example Ladder Logic
SLC Example Ladder Logic

Appendix B
Definitions of RS-232C Handshaking Signals
RS-232 Cabling
RS-422 and RS-485 cable

I. Card Specifications

The Harris Slave firmware upgrade gives Allen-Bradley 1771 and 1746 I/O compatible processors the ability to interface to a Harris M9000 Master device, or any device emulating this master function. The card includes the following capabilities:

- Supported Op Codes:
  - 0 : A/D and Accumulator Data Dump
  - 3 : Status Check
  - 4 : Status Change Dump
  - 5 : Status Dump
  - 6 : Trip/Close Control Arm
  - 7 : Trip/Close Control Operate
  - 8 : AGC Raise/Lower
  - 9 : Set Point Control Arm
  - 0A : Set Point Control Operate
  - 0B : Power Fail Reset
  - 0C : Port On-Line Status Scan
  - 11 : Time Synchronization (SOE)
  - 13 : Time Sync Adjust (SOE)
  - 17 : Time Synchronization (Non SOE)
  - 18 : Set Freeze Interval
- Supports broadcast commands from Master
- Software configuration (From PLC)
  - Address : 1 to 63 (0 is broadcast)
  - Parity : Odd
  - Stop Bit : 1
  - Baud Rate : 300 TO 19,200
- Hardware RS-232C handshaking for modem and radio applications
- RS-422/RS-485 compatible for multidrop applications
- Logical RTU addressing : Up to 4 slave addresses
- Register addressing
  - Up to 7 ports, each port with one of following:
  - Status : Up to 63 words
  - Analog : Up to 63 words
  - Accumulator
    - 12 bit : Up to 63 words
    - 24 bit : Up to 34 values
    - 32 bit : Up to 12 values
- Response time

  The communication driver is written in assembly and in a compiled higher level language. As such, the interrupt capabilities of the hardware are fully utilized to minimize response delays to message requests from the master.

II Configuring the HAR Module

2.1 Hardware Overview

When purchasing the module from ProSoft Technology, many of the jumper configurations will have been factory set. When purchasing the firmware from ProSoft Technology and the Allen-Bradley module from another source, particular attention must be paid to hardware configuration.

2.2 Module Jumper Configurations

The following section details the available jumper configurations for the 1771 and 1746 platform solutions. As needed, differences between the module based solutions and the firmware based solutions are highlighted.

2.2.1 3100/3101 for the 1771 Platform

Following are the jumper positions for the 1771-DB Rev B module and the ProSoft Technology 3100-HAR module (See Appendix C for details on jumper locations):

Jumper	3100-HAR	3101-HAR
JW1	N/A	Enabled
JW2	N/A	32K PROM
JW3	N/A	Turbo
JW4	Not Used	ASCII/ASCII
JW5	8 Pt	8 Pt
JW6	Not Used	Not Used
JW7	Enabled	Enabled
JW8	As Needed	As Needed
JW9	As Needed	As Needed

JW1 Watchdog Enable / Disable **Enable**

The position of this jumper does not affect the operation of the unit under normal operations. In order to enable the watchdog function, simply place the jumper in the Enabled position.

JW2 PROM select **32K PROM**

The position of this jumper is very important to the successful operation of the module. In order to operate with our HAR EPROM, the jumper must be in the 32K PROM position.

JW3 Speed select (Normal / Turbo) **Turbo**

The position of this jumper does not affect the operation of the unit under normal operations. Unless there are reasons not to operate in the Turbo mode, we recommend operating in the Turbo mode.

JW4 Port 1 and 2 configuration **Position A**

The position of this jumper set must be changed from the shipped default position (D) to the A position. Operation of the module will be unpredictable if the jumper set is not in the A position.

A	PRT 1 = ASCII	PRT 2 = ASCII	DH485 = PGM
B	PRT 1 = PGM	PRT 2 = ASCII	DH485 = RUN
C	PRT 1 = PGM	PRT 2 = DF1	DH485 = DISABLED
D	PRT 1 = PGM DEFAULT	PRT 2 = ASCII	DH485 = RUN

JW5 Backplane 8/16 point **8 Point**

8 point mode should be used.

JW6 Port 2 Baud Rate **Not Used**

This jumper is not used by the HAR firmware. All baud rate configuration is performed through the ladder logic data table.

JW7 Battery Enable / Disable **Enabled**
This jumper should be placed in the Enabled position when the module is powered up. Although not critical to the operation of the module, this will back up some data registers in the module during a power failure or reset.

JW8/9 RS Configuration for Port 1 and 2 **See options on module**
The default from factory is RS-232, but all options are supported by the HAR firmware

2.2.2 3150/3151 for the 1746 Platform

Following are the jumper positions for the 1746-BAS module and the ProSoft Technology 3150-HAR module (See Appendix C for details on jumper locations):

Jumper	3150-HAR	3151-HAR
JW1	As Needed	As Needed
JW2	As Needed	As Needed
JW3	N/A	3-5, 4-6
JW4	N/A	1-3, 2-4

JW1/2 RS configuration for port 1 and 2 **See Appendix C**
The default from factory is RS-232, but all options are supported by the HAR firmware

JW3 Memory Selection **3-5, 4-6**
When using the 3151 firmware solution with a 1746-BAS module, the EPROM is plugged into the User Socket. When in this configuration, it is essential that the jumper be in the correct position.

With the 3150 module, this jumper will not affect operation of the product.

JW4 Mode Configuration **1-3, 2-4**
When using the 3151 firmware solution with a 1746-BAS module, it is essential that the jumper be in the correct position.

With the 3150 module, this jumper will not affect operation of the product.

2.3 Firmware Installation Procedure (3101 & 3151)

The following section details the available jumper configurations for the 1771 and 1746 platform solutions. As needed, differences between the module based solutions and the firmware based solutions are highlighted.

2.3.1 1771-DB Revision B Module

The firmware installation steps are as follows:

1. Remove the card cover from the module
2. Plug the ProSoft Technology EPROM into the module's User Socket. Align the notches on the EPROM plastic carrier with the notches in the User socket. Make sure the EPROM is well seated
3. Replace the card cover
4. Turn the module over and locate the identification sticker in the unused indent. This

sticker will be important should the module ever require service.

2.3.2 1746-BAS Module

The firmware installation steps are as follows:

1. Plug the ProSoft Technology EPROM into the module's User Socket. Align the notches on the EPROM plastic carrier with the notches in the User socket. Make sure the EPROM is well seated
2. Remove the plastic lens cover from the 1746-BAS module and slip on the new cover provided with the firmware. Make sure the cover is firmly affixed to the module

Once the firmware has been installed and the module's jumpers have been verified, the hardware is ready to be inserted into the I/O rack.

III. Harris Slave Card Functions

3.1 HARRIS Communications

The ProSoft HARRIS module runs the slave version of the HARRIS protocol. This capability allows the module to communicate data from a PLC/SLC to a HARRIS Master (Such as the M9000 Series Master Station), and vice-versa. The module supports both point-to-point implementations as well as multi-drop implementations.

The following discusses the functional capabilities of the ProSoft Harris Slave card.

3.1.1 Command/Reply Cycle

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

Command: Message from master 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, the slave does not send any response.

No Reply: If the master does not detect a reply within its timeout period (approx. 50 ms) , the master will 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 in the Harris Slave

The Harris Slave can respond to two basic types of commands from the master; read data and write data. These are overviewed below, and discussed in detail in the Harris Protocol Specification.

Read Data: The Harris Slave supports the following types of data reads:

OpCode	Description
0	Data Dump
3	Status Change Check
4	Status Change Dump
5	Status Dump
Bh	Power Fail Reset
Ch	Port On-Line Status Scan

Write Data: The Harris Slave supports the following types of data writes:

OpCode	Description
6	Control Point Arm
7	Control Point Operate
8	Raise/Lower
9	Setpoint Arm
Ah	Setpoint Operate
11/17h	Time Sync
13h	Time Sync Adjust
18h	Set Freeze Interval

3.1.3 Command Error Checking

When the Harris Slave cannot execute a command, an the module does not generate a response. The lack of a response 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.

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 HARRIS protocol supports two types of error checking:

- Longitudinal Redundancy Check (LRC)
- One bit parity check (Odd only)

LRC : When the master generates a message, a 8 bit LRC value is added to the end of the transmitted packet. The LRC value is a vertical parity check on the 6 data bit field of the message, generating an even vertical parity for the message. 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: Odd parity checking is added as an additional level of data security.

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 Harris Slave module.

3.2.1 Data Memory

Data is transferred to the HARRIS module asynchronously from the Master's read requests. This allows the application ladder logic to manipulate and position the data as needed before transfer to the module. Since the HARRIS module stores the data from the ladder

logic in local memory, read requests from the Master are serviced immediately.

The data registers are moved over the backplane between the card and the processor using the standard Block Transfer read and write functions, in the case of a PLC, and M0/M1 file transfers in the case of an SLC.

The HARRIS module controls the data which is transferred from the module to the PLC/SLC during a read (BTR or M1 instruction) from the module. Being a slave module, the only time valid 'data' is transferred to the ladder logic is when a write command is issued from the Master.

When writing data from the ladder logic to the module (BTW or M0 instruction), the ladder logic controls the data written to the HARRIS module. Appendix A contains a PLC5 and a SLC program showing an example of the logic to transfer data registers to and from the module. Section III discusses the transfer mechanism in detail, as well as several important relationships between PLC/SLC addressing and HARRIS addressing.

3.2.2 Communications Configuration Parameters

The communications configuration parameter data block contains the information necessary for the module to set up the HARRIS communications port (peripheral port on the 1771-DB, and Port 1 on the 1746-BAS), as well as the Harris 'Port' configuration information necessary for the module to operate. *On power up, the module will not proceed without receiving this configuration block*.

IV HAR Theoretical Operation

Data transfers between the processor and the ProSoft Technology module occur using the Block Transfer commands, in the case of the PLC, and M0/M1 data transfer commands, in the case of the SLC. These commands transfer up to 64 physical registers per transfer. The logical data length changes depending on the data transfer function.

The following discussion details the data structures used to transfer the different types of data between the ProSoft Technology module and the processor. The term 'Block Transfer' is used generically in the following discussion to depict the transfer of data blocks between the processor and the ProSoft Technology module. Although a true Block Transfer function does not exist in the SLC, we have implemented a pseudo-block transfer command in order to assure data integrity at the block level. Examples of the PLC and SLC ladder logic are included in Appendix A.

> In order for the ProSoft Technology 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 transfers between the PLC and the module will stop, and communications will halt until block transfers resume.

4.1 Writing Data to the Module

This section discusses how the transfer mechanism functions, and how to transfer data, command list and configuration data to the ProSoft module.

Data transfer to the module from the processor is executed through the Block Transfer Write function. 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

> In a PLC, the BTW length must be configured for 64 words, otherwise module operation will be unpredictable.

Where:

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

Code	Description
0-27	Harris Port Data Memory
255	Module Communication Configuration

Data: The data to be written to the module. The structure of the data is dependent on the Block ID code. The following sections provide details on the different structures.

4.1.1 Communications Configuration (Block ID Code 255)

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

On power up, the module enters into a logical loop waiting to receive configuration data from the processor. While waiting, the module sets the first word of the BTR buffer to 255, telling the processor that the module must be configured before anything else will be done. The module will continuously perform block transfers until the communications configuration parameters block is received. Upon receipt, the module will begin execution of the command list if present, or begin looking for the command list from the processor.

> Transferring the Communications Configuration Parameters to the module will force a reset of the communication port, as well as dropping DTR for 200 ms pulses to reset any attached hardware.

The configuration data block structure which must be transferred from the processor to the module is as follows:

Data Word		Description
		Block ID Header = 255
Port 1		
0	N[]:0	Port Configuration Word
1	N[]:1	Undefined
2	N[]:2	Baud Rate
3	N[]:3	RTS to TxD Delay
4	N[]:4	RTS off Delay

5	N[]:5	Future
6	N[]:6	Inter-character timing

Port 2

10	N[]:10	Port Configuration Word
11	N[]:11	Undefined
12	N[]:12	Baud Rate
13	N[]:13	RTS to TxD Delay
14	N[]:14	RTS off Delay
15	N[]:15	Future
16	N[]:16	Inter-character timing

System Configuration

20	N[]:20	Future
21	N[]:21	Future
22	N[]:22	Future
23	N[]:23	Future
24	N[]:24	Future
25	N[]:25	Number of Active Slaves
26	N[]:26	Harris RTU #1 Slave Address
27	N[]:27	Harris RTU #2 Slave Address
28	N[]:28	Harris RTU #3 Slave Address
29	N[]:29	Harris RTU #4 Slave Address
30	N[]:30	RTU #1 Port 0 Data Type
31	N[]:31	RTU #1 Port 1 Data Type
32	N[]:32	RTU #1 Port 2 Data Type
33	N[]:33	RTU #1 Port 3 Data Type
34	N[]:34	RTU #1 Port 4 Data Type
35	N[]:35	RTU #1 Port 5 Data Type
36	N[]:36	RTU #1 Port 6 Data Type
37	N[]:37	RTU #2 Port 0 Data Type
38	N[]:38	RTU #2 Port 1 Data Type
39	N[]:39	RTU #2 Port 2 Data Type
40	N[]:40	RTU #2 Port 3 Data Type
41	N[]:41	RTU #2 Port 4 Data Type
42	N[]:42	RTU #2 Port 5 Data Type
43	N[]:43	RTU #2 Port 6 Data Type
44	N[]:44	RTU #3 Port 0 Data Type
45	N[]:45	RTU #3 Port 1 Data Type
46	N[]:46	RTU #3 Port 2 Data Type
47	N[]:47	RTU #3 Port 3 Data Type
48	N[]:48	RTU #3 Port 4 Data Type
49	N[]:49	RTU #3 Port 5 Data Type
50	N[]:50	RTU #3 Port 6 Data Type
51	N[]:51	RTU #4 Port 0 Data Type
52	N[]:52	RTU #4 Port 1 Data Type
53	N[]:53	RTU #4 Port 2 Data Type
54	N[]:54	RTU #4 Port 3 Data Type
55	N[]:55	RTU #4 Port 4 Data Type
56	N[]:56	RTU #4 Port 5 Data Type
57	N[]:57	RTU #4 Port 6 Data Type

Where:

For Port 1 and Port 2

Port Configuration Word: This register contains several communication configuration parameters encoded into the word. These are as follows:

Type: The operating mode of the port is selected by these bits:

Bits 3210	
0001	Harris Slave - 8 bit
0011	Harris Slave - 7 bit (should use this mode)

Debug Mode: When configured in the debug mode, the other serial port on the module will transmit the data that has been received by the module. This is useful for determining communication problems:

Bit 8	
0	Disable Debug Mode
1	Enable Debug Mode

Disable Receive LRC Calculation : When configured in the LRC Disable mode, the receive string is processed without the benefit of the LRC calculation. This has been provided because of problems encountered with several of the available test programs. This may be taken out in the future if not needed.

Bit 9	
0	Enable LRC Calculation
1	Disable LRC Calculation

Stop Bits: The number of stop bits to be used is defined as follows:

Bits 13 12		
0	0	One stop bit
0	1	Two stop bits
1	x	Invalid Port Configuration

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

Bits 15 14		
0	0	No parity
0	1	Odd parity
1	0	Even parity
1	1	Invalid Port Configuration

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
7	38400 Baud

The module's two ports are limited to an upper baud rate of either 19200 or 38400 baud. The module cannot be configured with one port at 19200 and the other at 38400. If an attempt is made to configure the module in this fashion, a Port Configuration Error will be returned.

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 time-out 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 module automatically inserts a one character width Off Delay, assuring that RTS does not drop until after the last character has been completely sent. Unless working under unusual conditions, this value will normally be configured with a value of 0. The maximum value to be used is 65535 (0xffff).

Inter-character Timing: This register is used in situations where the end of message character timeout delay must be extended beyond the normal 3.5 character widths. The value entered represents the number of 1 ms intervals of 'no transmission' which will be counted prior to accepting a message. This parameter will be useful in satellite or packet radio installation where a data transmission may be split between two packets. Increasing this value beyond the system's packet handling time will eliminate timeout errors.

System Configuration

Number of Active Slaves: The module supports up to four valid slave addresses. This value allows the number of active slaves to be configured. Valid values range from 1 - 4.

RTU #x Slave Address: The module supports up to four valid slave addresses. This allows a PLC to effectively increase its data handling capacity by a factor of four. Valid slave address are 1 to 63, with 0 reserved for broadcasts.

RTU #x Port Data Type: These parameters are used to configure the module with the types of ports that the module is emulating. The Data Type word is broken down into a high byte and a low byte (it is easiest to setup these values in the hex display mode while in the A-B programming software) as follows:

High Byte:	Port Type
Low Byte:	Port Size

Unused ports should be initialized to a value of 0 to insure that their is no invalid port configurations received by the module.

Valid configurations are as follows:

Port Type	Port Size	Description	Data Value
1		Control and Indication(C&I)	
	1	32 Point C&I	257
	2	63 Point C&I	258
2		Analog Port	
	1	16/32 Point	513
	2	63 Point	514
3		Raise/Lower Port	
	1	6 Point R/L Port	769
4		Accumulator Port	
	1	63 12-bit Accumulators	1025
	2	31 24-bit Accumulators	1026
	3	31 32-bit Accumulators	1027
6		Set Point Port	
	1	16 setpoints	1537

4.1.2 Writing Port Register Data (Block ID Codes 0-27)

Writing data to the ProSoft Technology module is a simple Block Transfer Write with Block ID codes from 0 to 27 followed by 63 words of data. The data that is to be made available to the master for reading is written into the module in this fashion.

Word	Description
0	BTW Block ID code
1	Port Status

BIT	DESCRIPTION
0	Online(0) or Offline (1)
1	Power Fail 0 = No power fail restart 1 = RTU has had a restart. This will remain set until a Power Fail Reset command is received (See Appendix A logic)

2-63	Data

Each separate Block ID represents an individual port in the Harris vernacular.

Block ID Number: The Block ID codes correspond to the port addressing as follows:

Block ID	RTU Slave #	Port
0	1	0
1	1	1
2	1	2
3	1	3
4	1	4
5	1	5
6	1	6
7	2	0
8	2	1

9	2	2
10	2	3
11	2	4
12	2	5
13	2	6
14	3	0
15	3	1
16	3	2
17	3	3
18	3	4
19	3	5
20	3	6
21	4	0
22	4	1
23	4	2
24	4	3
25	4	4
26	4	5
27	4	6

Data: The information to be moved to the module to be used for responses to the host commands. The structure of the data is a function of the port type selected:

Indication Points

Word	**Description**
0	BTW Block ID
1	Port Status
2	Indicator points 1-16
3	Indicator points 17-32
4	Indicator points 33-48
5	Indicator points 49-63

Analog Points

Word	**Description**
0	BTW Block ID
1	Port Status
2	Analog Point 1
3	Analog Point 2
4	Analog Point 3
-	-
63	Analog Point 62 (max possible)

Accumulator Points - 12 bit values

Word	**Description**
0	BTW Block ID
1	Port Status
2	Accumulator 1
3	Accumulator 2
4	Accumulator 3
-	-
63	Accumulator 62 (max possible)

Accumulator Points - 24/32 bit values

Word	**Description**
0	BTW Block ID
1	Port Status
2	Accumulator 1 - Low Word
3	Accumulator 1 - High Word
4	Accumulator 2 - Low Word

5	Accumulator 2 - High Word
-	-
62	Accumulator 31 - Low Word
63	Accumulator 31 - High Word

4.2 Reading Data From the ProSoft Technology Module

This section discusses how to get data written to the ProSoft module by a Master into the PLC.

The transfer of data from the ProSoft Technology 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 PLC.

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	BTW Block ID Number
2-62	Data

In a PLC, the BTR length must be configured for a length of 64 words, otherwise module operation will be unpredictable

Where:

Block ID Code: A block identifier code between 0 and 255 in value. This code is used by the ladder logic to determine what to do with the data block. Valid codes are:

Code	Description
0	Slave Port Error Status
128	Setpoint Write
129	Raise/Lower Command
130	Control Point Command
131	Power Fail Reset
132	Time Sync
255	Communication configuration

BTW Block ID Number: The module returns this value to the processor to be used to enable the movement of register data and command list blocks to the module. The BTW Block ID number is developed by the module based on the parameters entered in parameter 25 of Block 255 (See Section 4.1.1).

Data: The data corresponding to the command to be executed. The structure and content of this data block is dependent on the command to be executed. The following sections detail the command structures.

4.2.1 Setpoint Arm/Operate - Op Codes 9/0AH

When a Setpoint Arm/Operate sequence is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with. The Setpoint command will not be transferred to the buffer unless the Operate Command is received immediately after a Arm Command.

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 Setpoint command is:

Word	Description
0	Setpoint write Block ID =128
1	BTW Block ID Number
2	Port Address
3	Point (Register) address
4	Setpoint Value

Port Address : The Port Address value represents the port number for the addressed RTU which the Master is sending a control value. Within each RTU, there are 7 valid ports (0-6). This value is calculated as follows :

= Slave ID Position * 7 + requested port

The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.

Point (Register) Address: The Point Address represents the register address into which the Value field will be written. This value is used by the ladder logic to determine which word to act upon.

Setpoint Value: The data value received from the Master. The values will be 12 bit value, and should be placed into an integer or BCD file.

4.2.2 Raise/Lower Command - Op Code 8

When a Raise/Lower 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 Raise/Lower command is:

Word	Description
0	Raise/Lower Command Block ID = 129
1	BTW Block ID Number
2	Port Address
3	Direction - RL 1
4	Duration - RL 1
5	Direction - RL 2
6	Duration - RL 2
-	-
13	Direction - RL 6
14	Duration - RL 6

Port Address : The Port Address value represents the port number for the addressed RTU which the Master is sending a control value. Within each RTU, there are 7 valid ports (0-6). This value is calculated as follows :

= Slave ID Position * 7 + requested port

The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.

Direction : Each Raise/Lower port address has 6 points, and the values for all six are transmitted at the same time. The direction of each point is communicated to the ladder logic through the direction value. The values that should be expected in these words are:

Word	Description
0	Raise
1	Lower

Duration : Each Raise/Lower port address has 6 points, and the values for all six are transmitted at the same time. The duration of the raise or lower period for each point is communicated to the ladder logic through the duration value.

The value represents the number of milliseconds which a timer should be activated. This value may be moved directly into the preset for a timer. Note that a value of zero is the equivalent of a do-nothing command.

4.2.3 Control Point Arm/Operate - Op Codes 6/7

When a Control Point Arm/Operate sequence is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with. The Control Point command will not be transferred to the buffer unless the Operate Command is received immediately after a Arm Command.

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 Control Point command is:

Word	Description
0	Control (Bit) command Block ID = 130
1	BTW Block ID Number
2	Port Address
3	Point (Bit) Address
4	Set or Reset Value

Port Address : The Port Address value represents the port number for the addressed RTU which the Master is sending a control value. Within each RTU, there are 7 valid ports (0-6). This value is calculated as follows :

= Slave ID Position * 7 + requested port

The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.

Point Address: The Point Address represents the bit address which the Master is controlling. This value is used by the ladder logic to determine which bit address to act upon.

Set or Reset Value : The value in this field is used to determine the action to be taken on the Point Address location. Valid values are either a 0 (Reset) or a 1 (Set).

4.2.4 Power Fail Reset Command - Op Codes 0Bh

When a Power Fail Reset command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with. Use for this command in the Allen-Bradley environment is relatively limited. As a minimum, the command should be used to reset the Power Fail Status bit to satisfy the needs of the Master.

The ladder logic must be programmed to look at the BTR buffer, decode the Block ID, and then take action. The BTR buffer definition, as it pertains to the Control Point command is:

Word	Description
0	131 : Power Fail Reset command

4.2.5 Time Synchronization- Op Codes 11h&13h and 17h

When a Time Synchronization command is received from a Master, the ProSoft module first converts the time value received into hh:mm:ss format and then transfers the values 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 Time Synchronization command is:

Word	Description
0	Time Sync Block ID = 132
1	BTW Block ID Number
2	HH - hour
3	MM - Minute
4	SS - Seconds

4.2.6 Set Freeze Interval - Op Code 18h

When a Set Freeze Interval command is received from a Master, the ProSoft module transfers the value received 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 Set Freeze Interval command is:

Word	Description
0	Set Freeze Interval Block ID = 133
1	BTW Block ID Number
2	Freeze Interval - Minutes
3	Minutes converted into Seconds

Freeze Interval: The value received from the host. The possible values and associated actions are as follows:

Value	Action
0	Freeze immediate

1,2,3, 4,5,6, 10,12, 15,20, 30,60	Valid intervals in minutes
63	Stop Freeze processing

4.2.7 Slave Error Code Table

The HAR Module monitors the status of all Slave port commands. This status is communicated to the processor in the form of a Slave Error Code Table.

> The Slave Error Code Table is initialized to zero on power up, and every time the module receives the 255 configuration data block.

The Slave Error Table is a 20 word block. The structure of the data block is as follows:

Word	**Description**
Port 1	
0	Current port 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
Port 2	
5	Current port status
6	Last transmitted error condition
7	Total Messages to this slave
8	Total Msg responses from this slave
9	Total Msgs seen by this slave
System Information	
10-11	Product Name (ASCII)
12-13	Revision (ASCII)
14	(blank)
15	Production Run Number
16-19	Spare

Where:

Current Port Error Status: This value represents the current value of the error code for the port. This value will only be valid if the port is configured as a Slave. The possible values are detailed in the following section.

Last Transmitted Error Code: This value is the last error code transmitted to the master by this slave port. 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 on this port, 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 on this port. 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 on this port, regardless of the slave address.

> All counters in the Slave Error Table will rollover to 0 after reaching 65535

Product Name: These two words represent the product name of the module in an ASCII representation. In the case of the HAR product, the letters ' HAR ' should be displayed when placing the programming software in the ASCII data representation mode.

Revision : These two words represent the product revision level of the firmware in an ASCII representation. An example of the data displayed would be '1.40' when placing the programming software in the ASCII data representation mode.

Blank: Not used at this time

Production Run Number: This number represents the 'batch' number that your particular chip belongs to. This number should appear as a number equal or greater than 2. This should help the factory determine when the User's chip was created.

4.2.8 Error Status Codes

The Error Codes returned in the Slave Error Code Table reflects the outcome of the commands and responses executed by the module. Note that in all cases, if a zero is returned, there was not an error. Valid Error Status Codes are as follows:

Code	Description
0	All OK The module is operating as desired.
1	Control Invalid Point The Master is attempting to control a point which cannot be addressed by the slave
2	Control Timeout The Operate command was not received within the required time frame
3	Invalid Function The Function received from the Master is not supported by the slave
4	Data Sequence Error The Operate command was received out of sequence (not immediately after a Arm)
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
8	Message Time-out

Communications with the addressed slave have been unsuccessful due to a lack of response from the slave. When this Error Code is received, the command has been attempted three times.

10 Buffer Overflow
The communications buffer has overflowed and reset the character counter to 0. If this condition occurs, the message size needs to be checked.

16 Port Configuration Error
If this value is returned from the module, one or both of the serial ports have been misconfigured. To determine the exact source of the problem, verify the following:

- Parity configuration
- Stop bit configuration
- Baud rate configuration
- Start Input Register Address
- Start Output Register Address

18 System Configuration Error
If this value is returned from the module, one of the system configuration parameters has been determined to be out of range. To determine the exact source of the problem, verify the following:

- Read Block Count
- Write Block Count
- Command Block Count
- Slave Error Pointer
- Master Error Pointer

254 Checksum Error
The slave determined that the message checksum was in error, and therefore discarded the message

255 TX Hardware Time-out
A time-out has occurred in the transmission of the command from the master, and the command has been aborted. This error is usually an indication that the CTS signal is not being received by the module.

V. Harris Commands

The ProSoft Technology Harris Slave module supports the most commonly used data read/write commands. The following sections discusses the commands supported in the Harris Slave module, and their implementation in the Allen-Bradley platform.

5.1 Data Read Functions

As stated in earlier sections, the data sent to the master is taken directly out of the module's memory at the time a response is sent.

5.1.1 Op Code 0 : Data Dump

The Data Dump command will return the data values for the requested number of points on each configured A/D or Accumulator data port. The Harris Slave module supports access to 62 words of data per configured port. With the module supporting 7 data ports per slave address, and four slave addresses, the module is capable of transferring up to 1736 words of data.

5.1.2 Op Code 3 : Status Change Check

The Status Change Check command will return the number of status changes currently stored in the module, up to 31. The Op Code 4 command will retrieve these changes. If more than 31 changes have occurred, the module will return a value of 63 in the count field.

5.1.3 Op Code 4 : Status Change Dump

The Status Change Dump command will return the status change data to the Master. The count field will contain the value obtained by Op Code 3.

5.1.4 Op Code 5 : Status Dump

The Status Dump command will return the current status of all points on the requested Status port or ports. This command can also clears the status change queue on those ports returning status data.

5.2 Control Commands From Master

When Control commands are received from a Master, their action is immediately communicated to the PLC/SLC for action. No modification is made directly to the ProSoft Module's memory as a result of a Control Command. In order for any Control action to be reflected in the module's memory, it must be transferred to the module as part of the regular data transfer mechanism.

5.2.1 Op Code 6 and 7 : Control Point Arm/Operate

These control commands are recognized by the module. If the Operate command is received out of sequence (must be received in next communication sequence after Arm command), the command is disregarded.

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 130, representing a Control point Operate command (Bit Set/Reset).
1	BTW Block ID
2	Port Number : This value is calculated as follows : = Slave ID Position * 7 + requested port The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.
3	Point Number : This value represents the point, or bit address, to be controlled.
4	State : This value, either a 0 or 1, represents the state to which the bit address is to be placed.

Example:

Word	Value
0	130
1	1
2	3
3	2
4	1

This command is instructing the ladder logic to set bit 2 of Port 3. In our ladder logic, we could decode this as an instruction to set B13/2, or map the command as needed for our application.

5.2.2 Op Code 8 : Raise/Lower (Port Type 3)

The Raise/Lower command will allow from one to six points to be controlled. In a Harris RTU, there are special modules dedicated to this function (Raise/Lower modules). In the Allen-Bradley platform, these commands are implemented through the use of timers and binary/IO files.

> Please note that no timing functions related to the implementation of the raise/lower command are performed by the module. All timing must be implemented in the application ladder logic.

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 129, representing a Raise/Lower command.
1	BTW Block ID
2	Port Address : This value is calculated as follows : = Slave ID Position * 7 + requested port The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.
3/4	Raise/Lower data pairs, where first word represents direction(0 = raise, 1 = lower), and the second word represents the duration in ms. Through ladder logic and the use of timers, this function can be implemented.
5/6 7/8 9/10 11/12 13/14	Raise/Lower data pairs as above

Example:

Word	Value
0	129
1	2
2	3
3	1
4	100

This command is instructing the ladder logic to turn on the Port Address 3 Lower timer for 100 ms. In our ladder logic, we could move the duration value to a T[].PRE and then enable the timer for this period.

5.2.3 Op Code 9/0Ah : Setpoint Arm/Operate

These control commands are recognized by the module and are used to move register values from the Master to the slave. If the Operate command is received out of sequence (must be received in next

communication sequence after the Arm command), the command is disregarded.

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 128, representing a Setpoint Operate command (Bit Set/Reset).
1	BTW Block ID
2	Port Address : This value is calculated as follows : = Slave ID Position * 7 + requested port The Slave ID Position is the between 0 and 3, representing one of the four valid configurable slaves. The requested port value can range from 0 to 6.
3	Point Address : This value represents the point, or register address, to be controlled.
4	Value : This represents the 12 bit value to be written into the addressed register.

Example:

Word	Value
0	128
1	3
2	3
3	0
4	1234

This command is instructing the ladder logic to write a value of 1234 into register 0 of port 3. In our ladder logic, we could decode this as an instruction to set word 0 of a file, or map the command as needed for our application.

5.2.4 Op Code 0Bh : Power Fail Reset

This command is recognized by the module and passed on to the ladder logic application. Use for this command in the Allen-Bradley environment is relatively limited. As a minimum, the command should be used to reset the Power Fail Status bit to satisfy the needs of the Master.

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 131, representing a Power Fail Reset command.

5.2.5 Op Code 11h/13h/17h : Time Sync

These time synchronization commands are recognized by the module and are used to move register values from the Master to the slave.

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 132, representing a Time Sync command
1	BTW Block ID
2	HH - Hours
3	MM - Minutes
4	SS - Seconds

Note that the time values may be copied directly to the processor status registers.

5.2.6 Op Code 18h : Set Freeze Interval

The Set Freeze Interval command is recognized by the module and can be used to support the implementation in the PLC

The command data is presented to the ladder logic through the Block Transfer Read buffer as follows:

Word	Description
0	Value of 133, representing a Set Freeze Interval command
1	BTW Block ID
2	Freeze Interval in minutes
3	Freeze Interval converted into seconds

VI Hardware Diagnostics

Several hardware diagnostics capabilities have been implemented using the LED indicator lights on the front of the module. The following sections explain the meaning of the individual LEDs for both the PLC and the SLC platforms.

6.1 3100/3101 PLC Platform

The PLC platform HAR product is available in two forms:

- ProSoft Technology Module (3100-CIM)
- Allen-Bradley 1771-DB Revision B card

Operation of the two modules is nearly identical, but labeling on the status LEDs is different. The following table documents the differences between LEDs on the two hardware platforms and explains the operation of the LEDs.

ProSoft CIM Card			A-B 1771-DB Rev B Card		
ACTIVE	○ ○	FLT	ACTIVE	○ ○	FLT
CFG	○ ○	BPLN	DH485	○ ○	BTLO
ERR1	○ ○	ERR2	LED1	○ ○	LED2
TXD1	○ ○	TXD2	PT1X	○ ○	PT2X
RXD2	○ ○	RXD2	PT1R	○ ○	PT2R

Table 6.1 : PLC Platform LED Indication

ProSoft CIM	A-B DB/B	Color	Status	Indication
ACT	ACT	Green	Blink (Fast)	Normal state : The module is operating normally and successfully Block Transferring with the PLC
			On	The module is receiving power from the backplane, but there may be some other problem
			Blink (1/Sec)	Indicates the module has somehow entered the Basic Programming Mode. Verify jumper JW4 (DB/B only) configuration. If all are correct, then contact the factory
			Off	The module is attempting to Block Transfer with the PLC and has failed. The PLC may be in the PGM mode or may be faulted
FLT	FLT	Red	Off	Normal State : No system problems are detected during background diagnostics
			On	A system problem was detected during background diagnostics. Please contact factory for technical support
CFG	DH485	Green	Off	Normal state : No configuration related activity is occurring at this time
			Blink	This light blinks every time a Module Configuration block (ID = 255) is received from the processor ladder logic
			On	The light is on continuously whenever a configuration error is detected. The error could be in the Port Configuration data or in the System Configuration data. See Section 4 for details
BPLN	BTLO	Red	Off	Normal State : When this light is off and the ACT light is blinking quickly, the module is actively Block Transferring data with the PLC
			On	Indicates that Block Transfers between the PLC and the module have failed.(Not activated in the initial release of the product)
ERR1 ERR2	LED1 LED2	Amber	Off	Normal State : When the error LED is off and the related port is actively transferring data, there are no communication errors
			Blink	Periodic communication errors are occurring during data communications. See Section 4 to determine the error condition
			On	This LED will stay on under several conditions: • CTS input is not being satisfied • Port Configuration Error • System Configuration Error • Unsuccessful comm on HAR slave • Recurring error condition on HAR master
Tx1 Tx2	PT1X PT2X	Green	Blink	The port is transmitting data.
Rx1 Rx2	PT1R PT2R	Green	Blink	The port is receiving data

6.2 3150/3151 SLC Platform

The PLC platform HAR product is available in two forms:

- ProSoft Technology Module (3150-CIM)
- Allen-Bradley 1746-BAS card

Operation of the two modules is nearly identical and labeling on the status LEDs is the same. The following table documents the differences between LEDs on the two hardware platforms and explains the operation of the LEDs.

3150-HAR

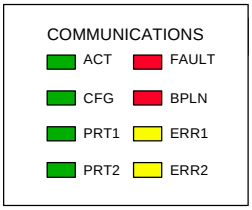


Table 6.2 : SLC Platform LED Indication

LED Name	Color	Status	Indication
ACT	Green	Blink (Fast)	Normal state : The module is operating normally and successfully Block Transferring with the SLC
		On	The module is receiving power from the backplane, but there may be some other problem
		Blink (1/Sec)	Indicates the module has somehow entered the Basic Programming Mode. Verify jumper JW3 (BAS only) configuration. If all are correct, then contact the factory
		Off	The module is attempting to Block Transfer with the SLC and has failed. The SLC may be in the PGM mode or may be faulted (*Not in initial release)*
FLT	Red	Off	Normal State : No system problems are detected during background diagnostics
		On	A system problem was detected during background diagnostics. Please contact factory for technical support
CFG	Green	Off	Normal state : No configuration related activity is occurring at this time
		Blink	This light blinks every time a Module Configuration block (ID = 255) is received from the processor ladder logic
		On	The light is on continuously whenever a configuration error is detected. The error could be in the Port Configuration data or in the System Configuration data. See Section 4 for details
BPLN	Red	Off	Normal State : When this light is off and the ACT light is blinking quickly, the module is actively Block Transferring data with the SLC
		On	Indicates that Block Transfers between the SLC and the module have failed
ERR1 ERR2	Amber	Off	Normal State : When the error LED is off and the related port is actively transferring data, there are no communication errors
		Blink	Periodic communication errors are occurring during data communications. See Section 4 to determine the error condition
		On	This LED will stay on under several conditions: • CTS input is not being satisfied • Port Configuration Error • System Configuration Error • Unsuccessful comm on HAR slave • Recurring error condition on HAR master
TxRx1 TxRx2	Green	Blink	The port is communicating, either transmitting or receiving data

VII 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/Technical Support

Corporate
ProSoft Technology, Inc.
9801 Camino Media, Suite 105
Bakersfield, CA 93311
(661) 664-7208
(800) 326-7066
(661) 664-7233 (fax)
E-mail address: 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. Configuration Information
   - Communication Configuration
   - Master Command List
   - Jumper positions
3. System hierarchy
4. Physical connection information
   - RS-232, 422 or 485
   - Cable configuration
5. Module Operation
   - Block Transfers operation
   - LED patterns

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

7.2 Module Service and Repair

The HAR card is an electronic 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 card may require repair.

When purchased from ProSoft Technology, the module has 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.

Appendix

A Example Ladder Logic

PLC-5
SLC-5/03

Provides a working example of the ladder logic needed to implement a solution

B Port Connection Diagrams

Appendix A

Example PLC 5 Ladder Logic

Example SLC Ladder Logic

Block Transfer Read
In addition to executing the BTR instruction, this rung also begins the process of setting up the BTW Block ID by moving the 2nd value in the BTR buffer to the first value in the BTW buffer

0000

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 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

DECODE BT READ BLOCK ID

EQU
Equal
Source A N7:410 0<
Source B 0 0<

COP
Copy File
Source #N7:412
Dest #N7:70
Length 20

DECODE BT READ BLOCK ID

LIM
Limit Test
Low Lim 128 128<
Test N7:410 0<
High Lim 132 132<

JSR
Jump To Subroutine
Prog File Number U:5

ENCODES BT WRITE BLOCK ID

MOV
Move
Source N7:411 3<
Dest N7:310 0<

1ST SCAN CONFIG DETECT N7:309 0

ENCODES BT WRITE BLOCK ID

MOV
Move
Source 255 255<
Dest N7:310 0<

Call to the routine which handles some of the command specific functionality

0001

JSR
Jump To Subroutine
Prog File Number U:4

Build file pointer depending on the port number being processed. In this example, 0-6 are for file 10 and 7-13 are for file 11

0002

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 15

DECODE BT WRITE BLOCK

LIM
Limit Test
Low Lim 0 0<
Test N7:310 0<
High Lim 6 6<

FILE POINTER

MOV
Move
Source 10 10<
Dest N7:307 10<

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.

0003

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 15

DECODE BT WRITE BLOCK

LIM
Limit Test
Low Lim 7 7<
Test N7:310 0<
High Lim 13 13<

FILE POINTER

MOV
Move
Source 11 11<
Dest N7:307 10<

ADJUST PORT NUM

SUB
Subtract
Source A N7:310 0<
Source B 7 7<
Dest N7:310 0<

Move data from data table into the module.

0004

BT READ ENABLE N7:400 15

BT WRITE ENABLE N7:300 15

DECODE BT WRITE BLOCK

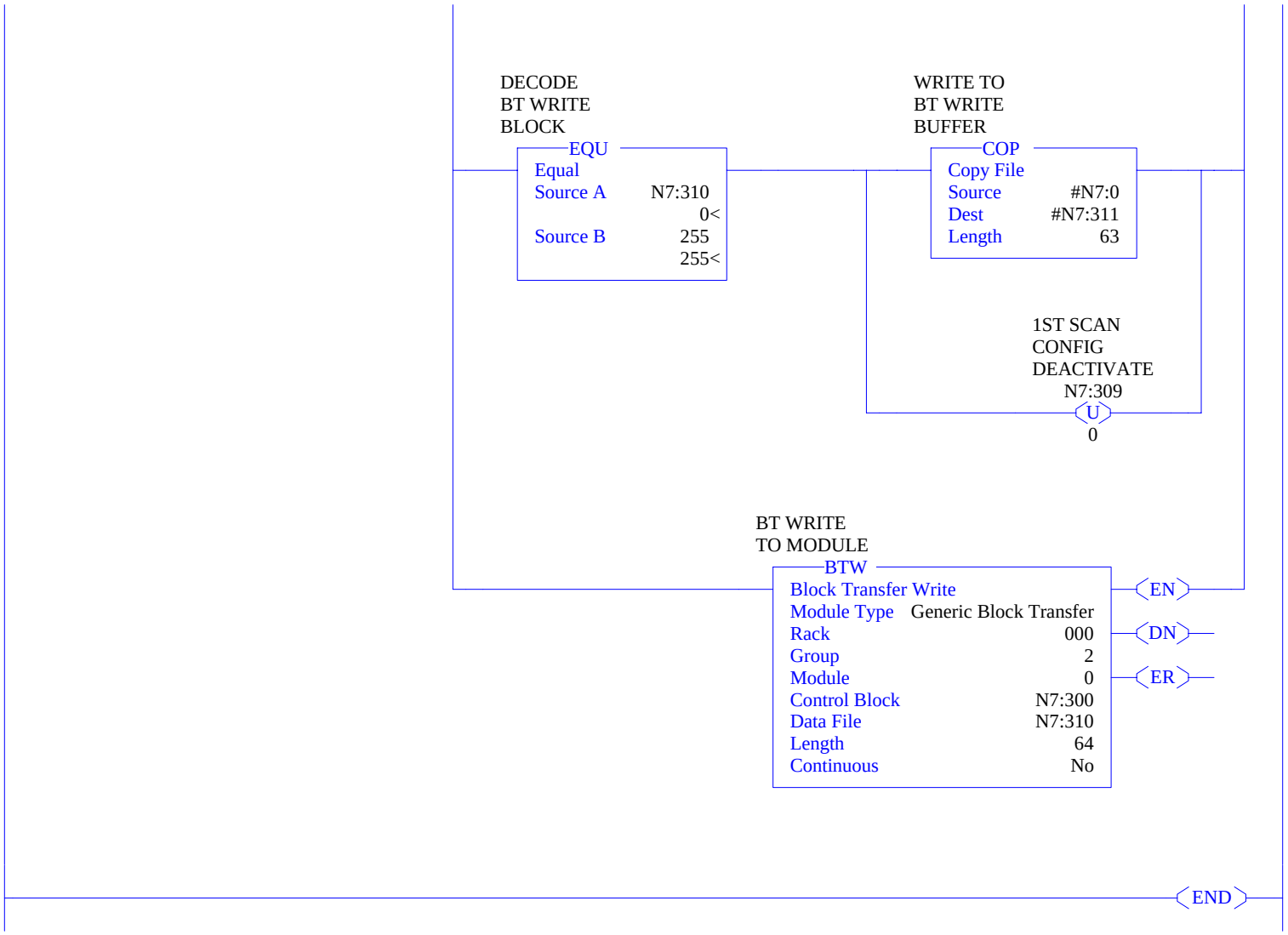
LIM
Limit Test
Low Lim 0 0<
Test N7:310 0<
High Lim 7 7<

HARRIS RTU/PORT POINTER

MUL
Multiply
Source A N7:310 0<
Source B 50 50<
Dest N7:308 300<

WRITE TO BT WRITE BUFFER

COP
Copy File
Source #N[N7:307]:[N7:308]
Dest #N7:311
Length 50


DECODE
BT WRITE
BLOCK
EQU
Equal
Source A N7:310
0<
Source B 255
255<
WRITE TO
BT WRITE
BUFFER
COP
Copy File
Source #N7:0
Dest #N7:311
Length 63
1ST SCAN
CONFIG
DEACTIVATE
N7:309
U
0
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
0005
END

LATCH THE POWER FAIL STATUS BITS FOR THE ACTIVE RTU NUMBERS. THIS RUNG TAKES CARE OF FIRST BIT AND FOLLOWING RUNG DISTRIBUTES TO OTHER PORTS FOR THE RTU

0000

1ST SCAN STATUS S:1 15

POWER FAIL STATUS FOR RTU #0 PORT #0 N10:0 L 1

POWER FAIL STATUS FOR RTU #1 PORT #0 N11:0 L 1

THIS LOGIC IS A MIMIC OF RTU #0 PORT #0 POWER FAIL DATA FOR THE OTHER 6 PORTS ASSOCIATED WITH RTU #0.

0001

DECODE BT WRITE BLOCK

LIM
Limit Test
Low Lim 1 1<
Test N7:310 0<
High Lim 6 6<

SET/RESET THE POWER FAIL BITS FOR PORTS #1-#6

MVM
Masked Move
Source N10:0 2<
Mask 02H 2<
Dest N10:[N7:308] 2<

MVM
Masked Move
Source N11:0 3<
Mask 02H 2<
Dest N11:[N7:308] 2<

RAISE/LOWER SETPOINT (OP CODE 8) OPERATION

0002

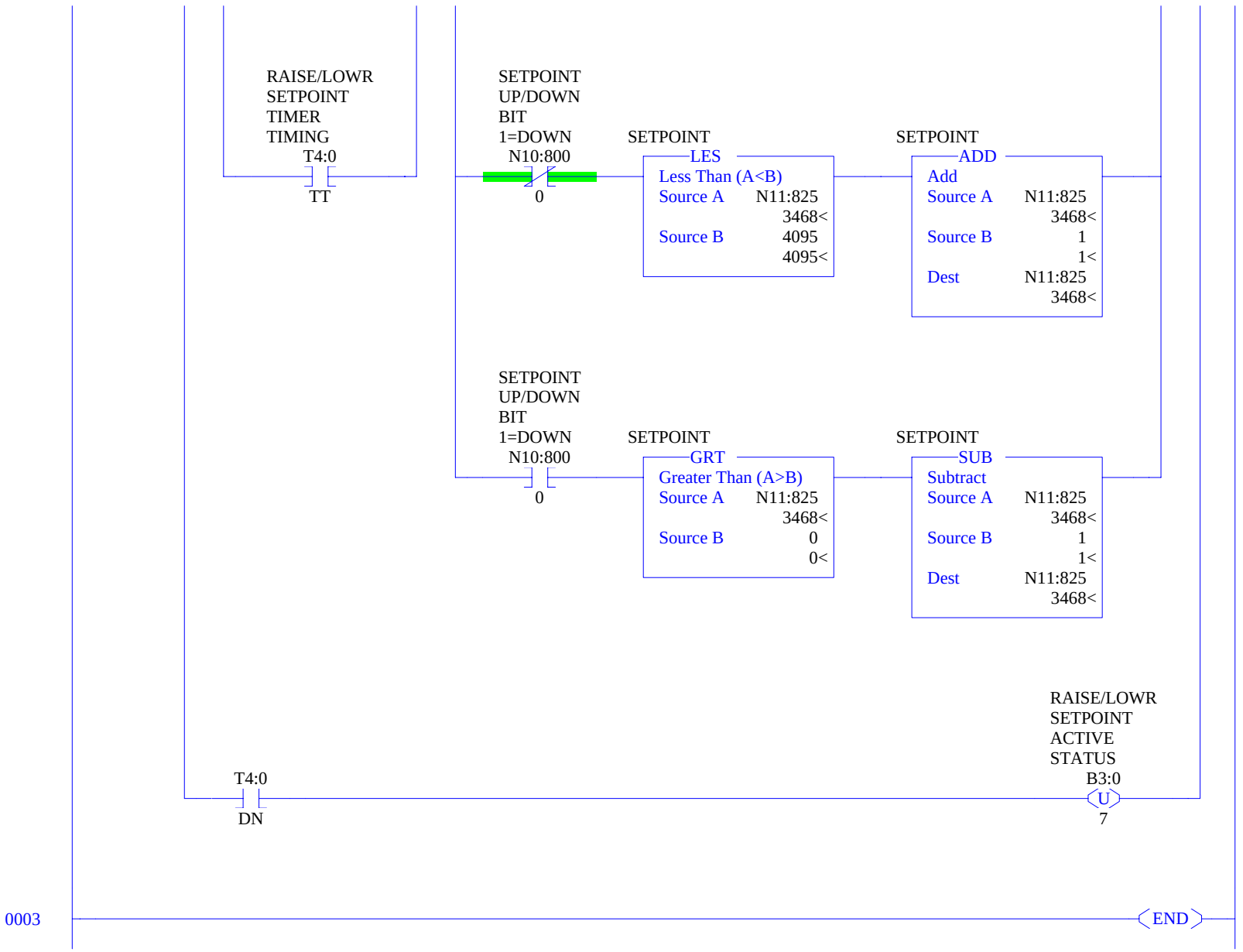
RAISE/LOWR SETPOINT TIMER PRESET

MOV
Move
Source N10:801 150<
Dest T4:0.PRE 150<

RAISE/LOWR SETPOINT ACTIVE STATUS B3:0 7

RAISE/LOWR SETPOINT TIMER

TON
Timer On Delay
Timer T4:0
Time Base 0.01
Preset 150<
Accum 0<
EN
DN


RAISE/LOWR
SETPOINT
TIMER
TIMING
T4:0
TT
SETPOINT
UP/DOWN
BIT
1=DOWN
N10:800
0
SETPOINT
LES
Less Than (A<B)
Source A N11:825
3468<
Source B 4095
4095<
SETPOINT
ADD
Add
Source A N11:825
3468<
Source B 1
1<
Dest N11:825
3468<
SETPOINT
UP/DOWN
BIT
1=DOWN
N10:800
0
SETPOINT
GRT
Greater Than (A>B)
Source A N11:825
3468<
Source B 0
0<
SETPOINT
SUB
Subtract
Source A N11:825
3468<
Source B 1
1<
Dest N11:825
3468<
RAISE/LOWR
SETPOINT
ACTIVE
STATUS
B3:0
U
7
T4:0
DN
0003
END

RAISE/LOWER SETPOINT (OP CODE 8) DECODING

0000

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410 0<
Source B 129 129<

PORT NUMBER
EQU
Equal
Source A N7:412 0<
Source B 3 3<

RAISE/LOWR SETPOINT ACTIVE STATUS
B3:0
7

RAISE/LOWR SETPOINT CONFIG DATA
COP
Copy File
Source #N7:413
Dest #N10:800
Length 12

RAISE/LOWR SETPOINT ACTIVE STATUS
B3:0
L
7

CONTROL POINT OPERATE COMMAND SETS AND RESETS BITS

0001

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410 0<
Source B 130 130<

PORT NUMBER
EQU
Equal
Source A N7:412 0<
Source B 0 0<

SET BIT ACTIVE N7:414
0

LATCH BIT
L
[N7:413]

RESET BIT ACTIVE N7:414
0

UNLATCH BIT
B13
U
[N7:413]

POWER FAIL RESET COMMAND CLEARS THE POWER FAIL STATUS BITS. LOGIC IN FILE 4 TAKES CARE OF CLEARING THE STATUS BITS IN OTHER PORTS

0002

DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410 0<
Source B 131 131<

POWER FAIL STATUS FOR RTU #0 PORT #0
N10:0
U
1

POWER FAIL STATUS FOR RTU #1 PORT #0
N11:0
U
1

TIME SYNC COMMAND MOVES NEW HH:MM:SS VALUES TO PROCESSOR

0003

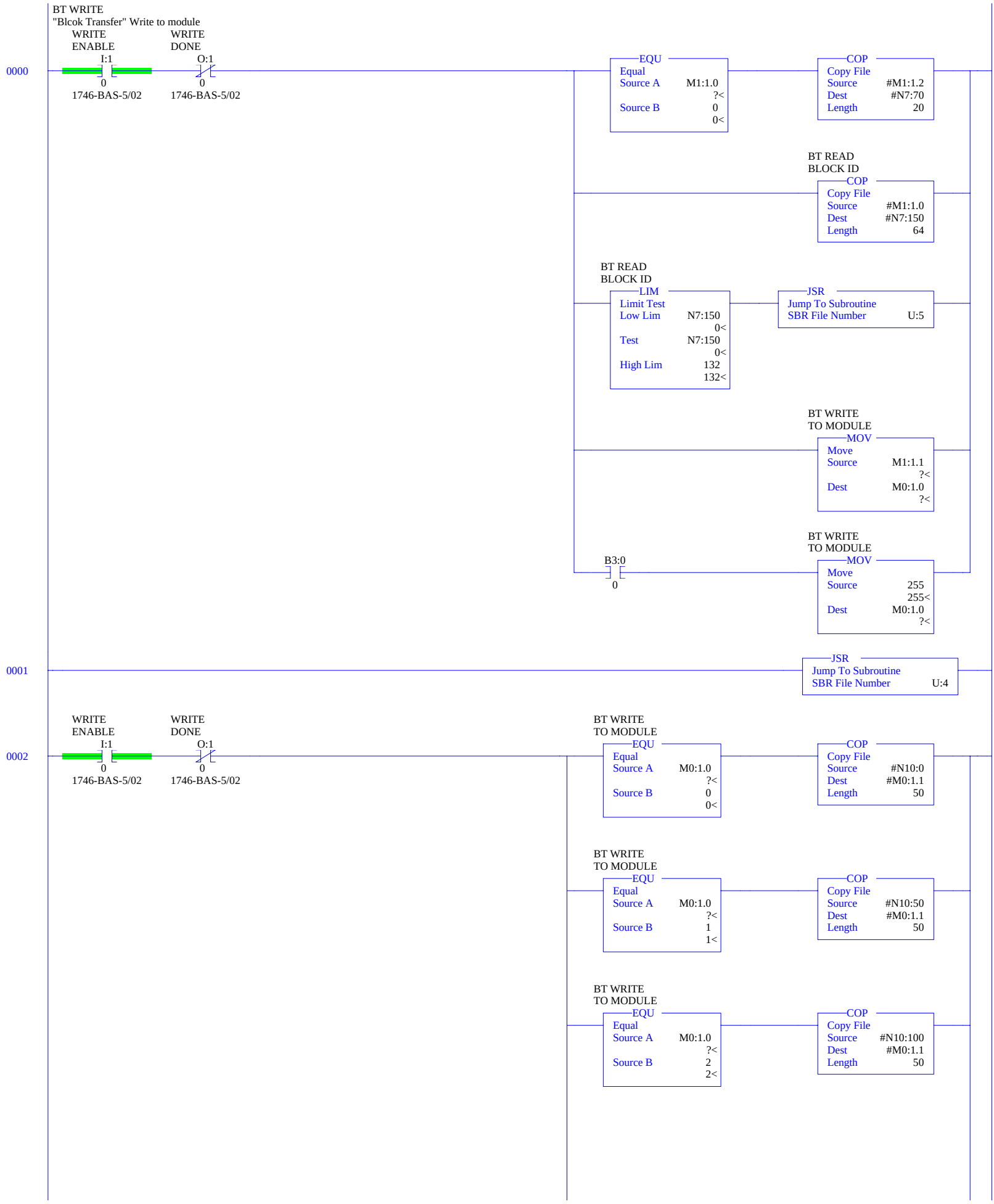
DECODE BT READ BLOCK ID
EQU
Equal
Source A N7:410 0<
Source B 132 132<

PLC TIME REGISTERS
COP
Copy File
Source #N7:413
Dest #S:21
Length 3

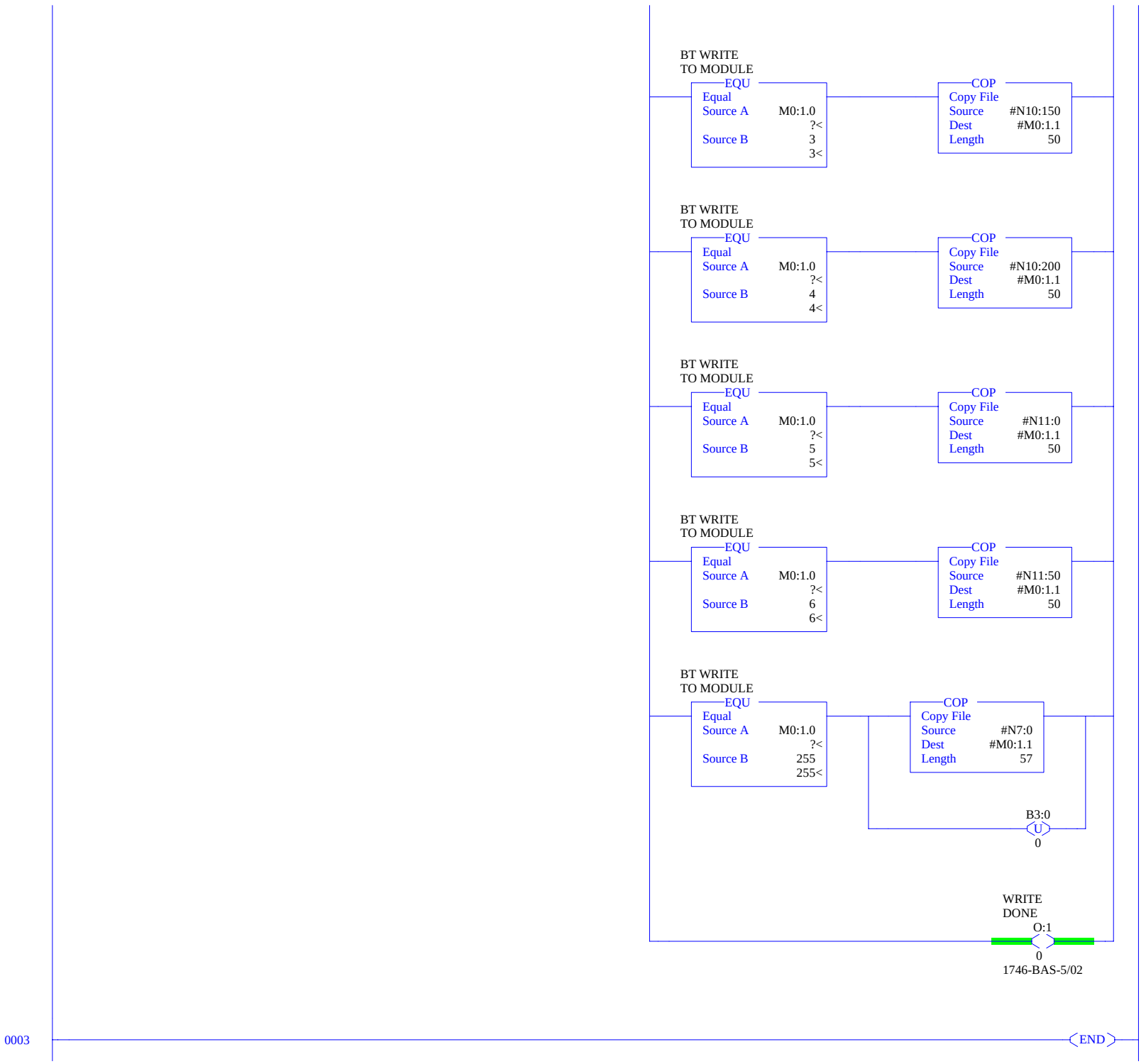
0004

END

LAD 3 - M0_M1 --- Total Rungs in File = 4



LAD 3 - M0_M1 --- Total Rungs in File = 4



LATCH THE POWER FAIL STATUS BITS FOR THE ACTIVE RTU NUMBERS. THIS RUNG TAKES CARE OF THE FIRST BIT AND FOLLOWING RUNG DISTRUBUTE TO OTHER PORTS FOR THE RTU

0000

FIRST SCAN S2:1 15

N10:0 L 1

THIS LOGIC IS A MIMIC OF RTU #0 PROT #0 POWER FAIL DATA FOR THE OTHER 6 PORTS ASSOCIATED WITH RTU #0

0001

BT WRITE TO MODULE

LIM
Limit Test
Low Lim 1 1<
Test M0:1.0 ?<
High Lim 6 6<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N10:50 0<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N10:100 0<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N10:150 0<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N10:200 0<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N11:0 0<

MVM
Masked Move
Source N10:0 0<
Mask 0002h 2<
Dest N11:50 0<

RAISE/LOWER SETPOINT (OP CODE 8) OPERATION

0002

Duration

MOV
Move
Source N12:101 10<
Dest T4:0.PRE 10<

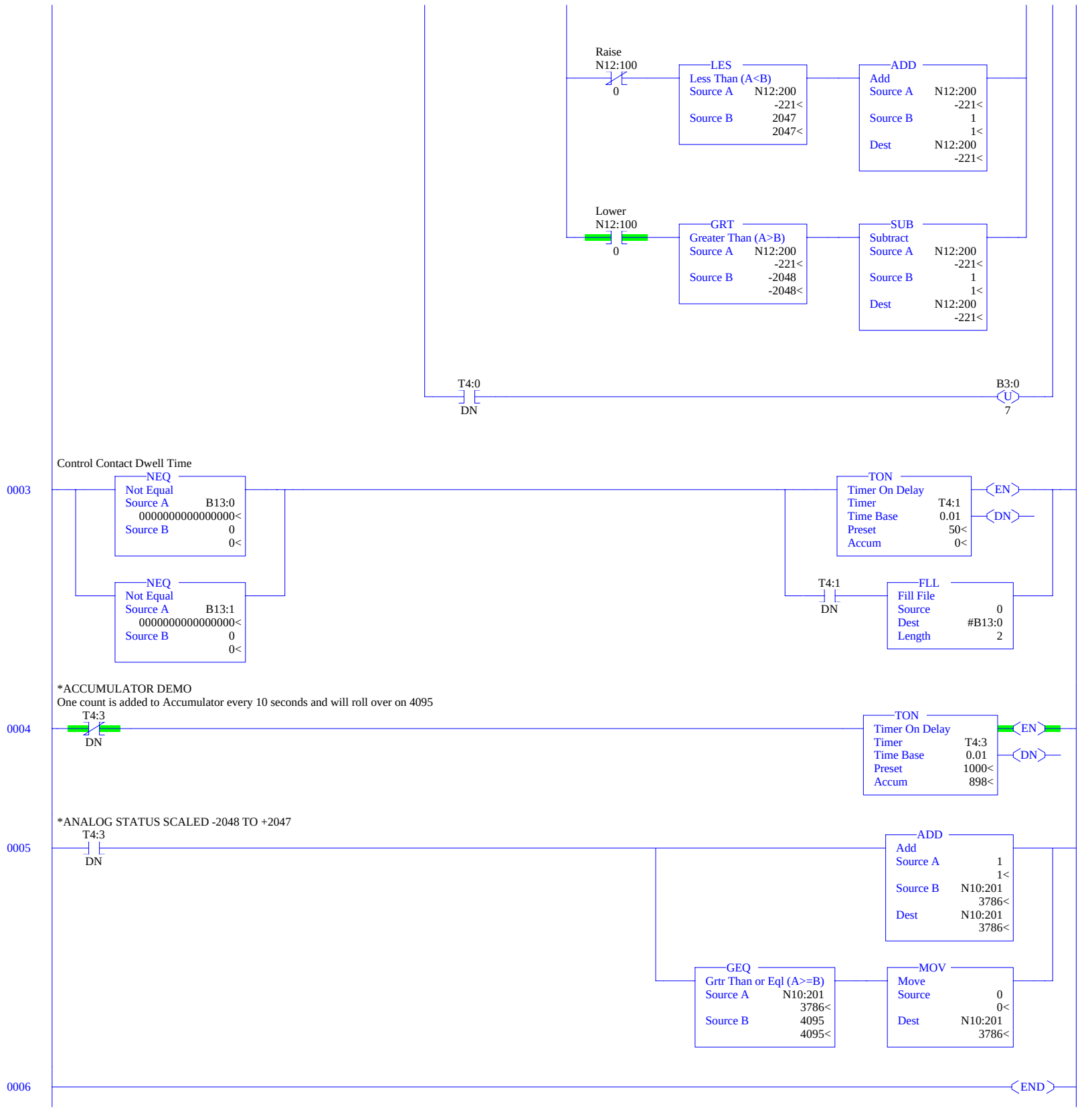
B3:0 7

T4:0 TT

TON
Timer On Delay
Timer T4:0
Time Base 0.01
Preset 10<
Accum 0<

EN

DN


Raise
N12:100
0
LES
Less Than (A<B)
Source A N12:200 -221<
Source B 2047 2047<
ADD
Add
Source A N12:200 -221<
Source B 1 1<
Dest N12:200 -221<
Lower
N12:100
0
GRT
Greater Than (A>B)
Source A N12:200 -221<
Source B -2048 -2048<
SUB
Subtract
Source A N12:200 -221<
Source B 1 1<
Dest N12:200 -221<
T4:0
DN
B3:0
U
7
Control Contact Dwell Time
0003
NEQ
Not Equal
Source A B13:0 0000000000000000<
Source B 0 0<
NEQ
Not Equal
Source A B13:1 0000000000000000<
Source B 0 0<
TON
Timer On Delay
Timer T4:1
Time Base 0.01
Preset 50<
Accum 0<
EN
DN
T4:1
DN
FLL
Fill File
Source 0
Dest #B13:0
Length 2
*ACCUMULATOR DEMO
One count is added to Accumulator every 10 seconds and will roll over on 4095
0004
T4:3
DN
TON
Timer On Delay
Timer T4:3
Time Base 0.01
Preset 1000<
Accum 898<
EN
DN
*ANALOG STATUS SCALED -2048 TO +2047
0005
T4:3
DN
ADD
Add
Source A 1 1<
Source B N10:201 3786<
Dest N10:201 3786<
GEQ
Grtr Than or Eql (A>=B)
Source A N10:201 3786<
Source B 4095 4095<
MOV
Move
Source 0 0<
Dest N10:201 3786<
0006
END

**RAISE/LOWER (OP CODE 8) DECODING
Output goes to N12:200 with value being raised or lowered based on timer preset.
BT READ
BLOCK ID

0000

EQU
Equal
Source A N7:150
0<
Source B 129
129<

EQU
Equal
Source A N7:152
1<
Source B 3
3<

COP
Copy File
Source #N7:153
Dest #N12:100
Length 12

B3:0
L
7

CONTROL POINT OPERATE COMMAND SET BITS
READ
DONE
O:1
1
1746-BAS-5/02

BT READ
BLOCK ID

0001

EQU
Equal
Source A N7:150
0<
Source B 130
130<

EQU
Equal
Source A N7:152
1<
Source B 0
0<

N7:154
0

EQU
Equal
Source A N7:153
1<
Source B 0
0<

B13:0
L
0

EQU
Equal
Source A N7:153
1<
Source B 1
1<

B13:0
L
2

EQU
Equal
Source A N7:153
1<
Source B 2
2<

B13:0
L
4

EQU
Equal
Source A N7:153
1<
Source B 3
3<

B13:0
L
6

EQU
Equal
Source A N7:153
1<
Source B 4
4<

B13:0
L
8

EQU
Equal
Source A N7:153
1<
Source B 5
5<

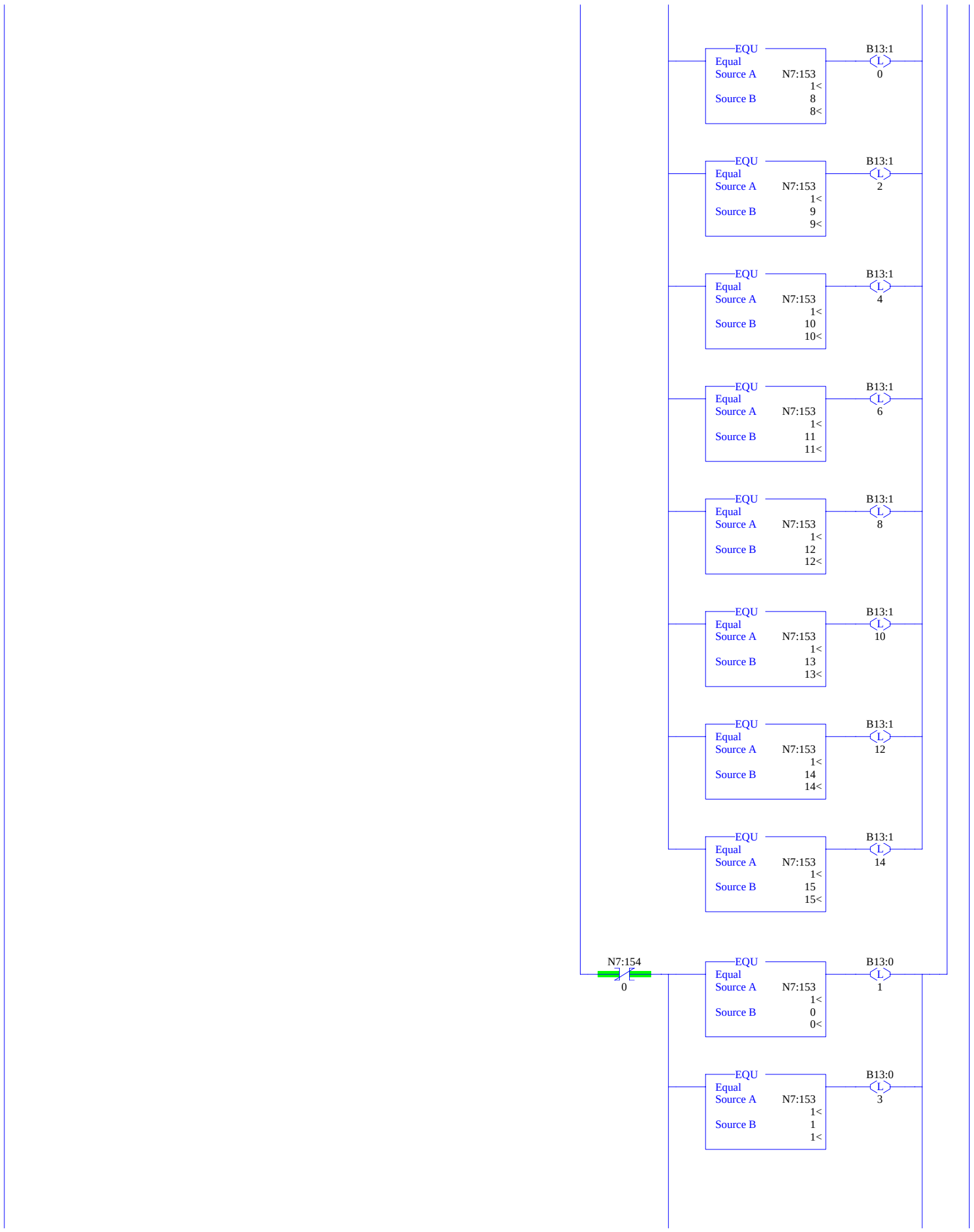
B13:0
L
10

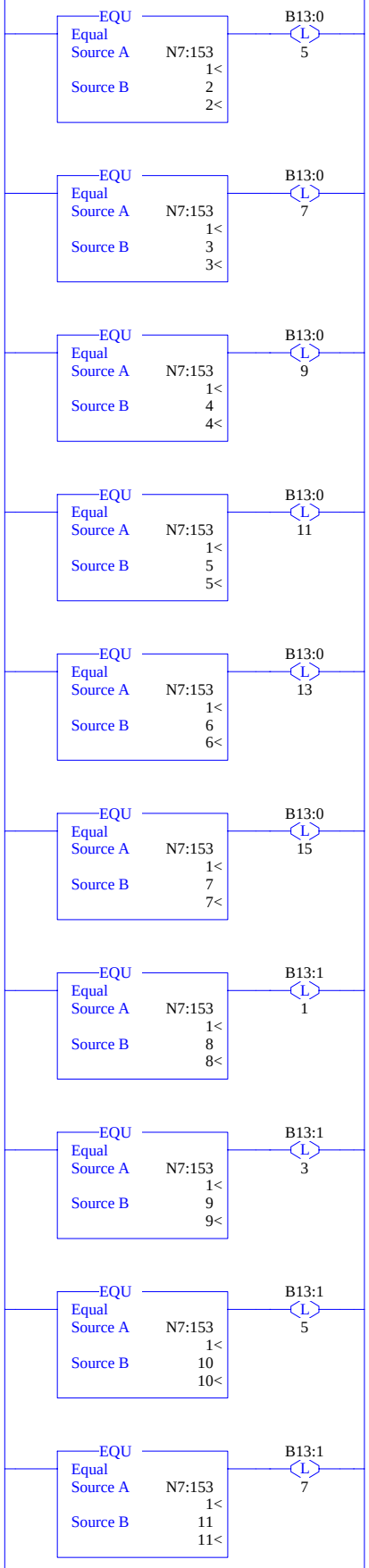
EQU
Equal
Source A N7:153
1<
Source B 6
6<

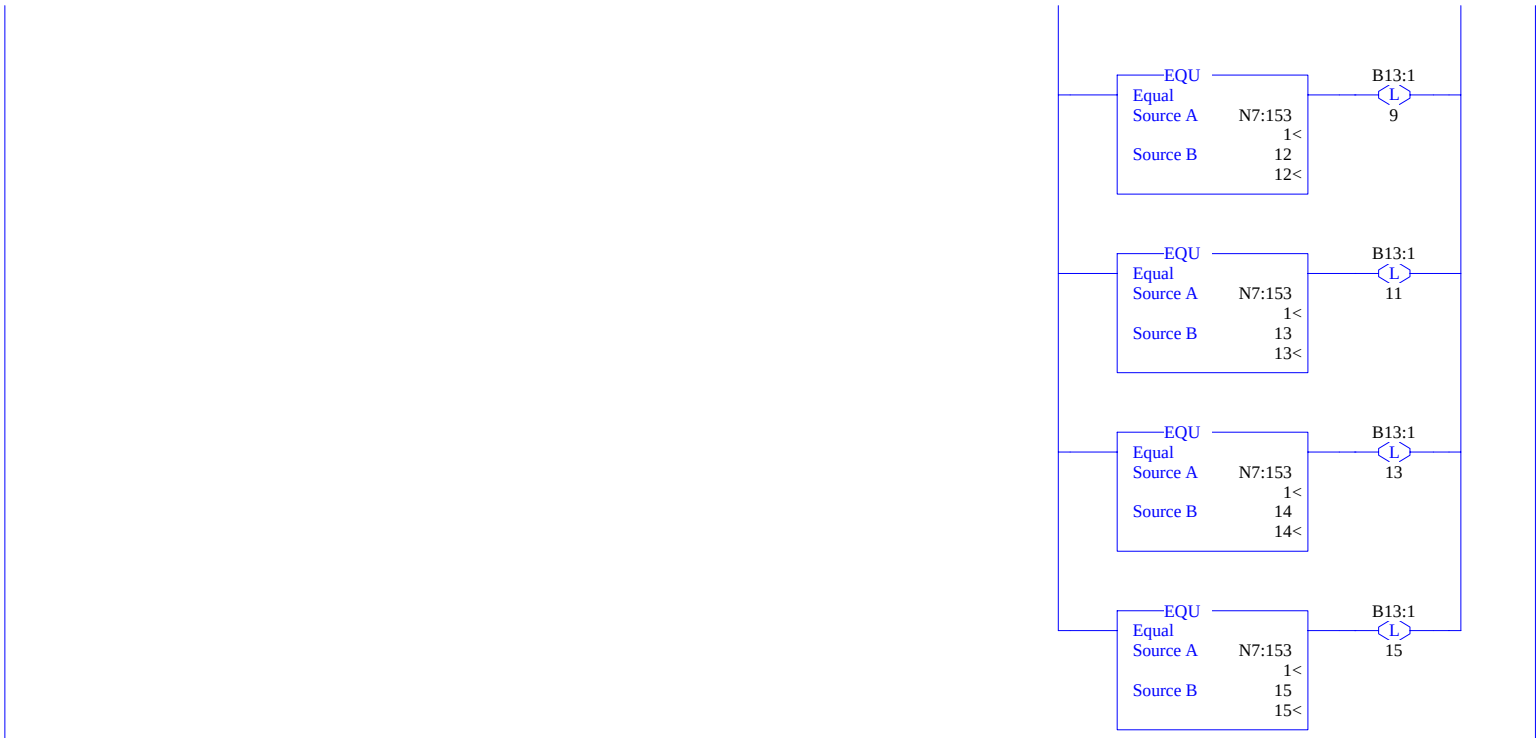
B13:0
L
12

EQU
Equal
Source A N7:153
1<
Source B 7
7<

B13:0
L
14


EQU
Equal
Source A N7:153
1<
Source B 8
8<
B13:1
L
0
EQU
Equal
Source A N7:153
1<
Source B 9
9<
B13:1
L
2
EQU
Equal
Source A N7:153
1<
Source B 10
10<
B13:1
L
4
EQU
Equal
Source A N7:153
1<
Source B 11
11<
B13:1
L
6
EQU
Equal
Source A N7:153
1<
Source B 12
12<
B13:1
L
8
EQU
Equal
Source A N7:153
1<
Source B 13
13<
B13:1
L
10
EQU
Equal
Source A N7:153
1<
Source B 14
14<
B13:1
L
12
EQU
Equal
Source A N7:153
1<
Source B 15
15<
B13:1
L
14
N7:154
0
EQU
Equal
Source A N7:153
1<
Source B 0
0<
B13:0
L
1
EQU
Equal
Source A N7:153
1<
Source B 1
1<
B13:0
L
3


EQU
Equal
Source A N7:153
1<
Source B 2
2<
B13:0
L
5
EQU
Equal
Source A N7:153
1<
Source B 3
3<
B13:0
L
7
EQU
Equal
Source A N7:153
1<
Source B 4
4<
B13:0
L
9
EQU
Equal
Source A N7:153
1<
Source B 5
5<
B13:0
L
11
EQU
Equal
Source A N7:153
1<
Source B 6
6<
B13:0
L
13
EQU
Equal
Source A N7:153
1<
Source B 7
7<
B13:0
L
15
EQU
Equal
Source A N7:153
1<
Source B 8
8<
B13:1
L
1
EQU
Equal
Source A N7:153
1<
Source B 9
9<
B13:1
L
3
EQU
Equal
Source A N7:153
1<
Source B 10
10<
B13:1
L
5
EQU
Equal
Source A N7:153
1<
Source B 11
11<
B13:1
L
7



POWER FAIL RESET COMMAND CLEARS THE POWER FAIL STATUS BITS. LOGIC IN FILE 4 TAKES CARE OF CLEARING THE STATUS BITS IN OTHER PORTS.

BT READ
BLOCK ID

0002

EQU
Equal
Source A N7:150
0<
Source B 131
131<

N10:0
U
1

N11:0
U
1

TIME SYNC COMMAND MOVES NEW HH:MM:SS VALUES TO PROCESSOR

BT READ
BLOCK ID

0003

EQU
Equal
Source A N7:150
0<
Source B 132
132<

Debug
Fault/
Powerdown
File

COP
Copy File
Source #N7:153
Dest #S2:21
Length 3

0004

END

APPENDIX B
Port Cable Configuration

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. 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.

RS-232 with Handshaking:

ProSoft Module				Modem	
25-Pin		9-Pin			25-Pin
2	TxD	3	----------		2 (Verify pins 2 and 3)
3	RxD	2	----------		3
4	RTS	7	----------		4
5	CTS	8	----------		5
7	GND	5	----------		7
20	DTR	4	----------		20

Note

Do not connect pins 14, 16, 18, or 25 on the 25 pin connector to a modem. These pins are used by the RS-422/485 drivers and may impact the operation of the modem.

RS-232 w/o Handshaking:

ProSoft Module				Device	
25-Pin		9-Pin			25-Pin
2	TxD	3	----------		2 RxD (Verify pins 2 and 3)
3	RxD	2	----------		3 TxD
4	RTS	7	-----	-----	4 RTS
			|	|	
5	CTS	8	-----	-----	5 CTS
				----	6 DSR
			Instal Jumper	|	
				-----	20 DTR
7	GND	5	----------		7 GND

Two Wire Mode (RS-485):

Please be sure the jumper on the module is in the RS-485 mode.

ProSoft Module				Foreign Device	
25-Pin		9-Pin			
4	RTS	7	----		
			|	Jumper RTS to CTS	
5	CTS	8	----		
14	TxRxD+	9	----------		A(+) TxRxD+
25	TxRxD-	1	----------		B(-) TxRxD-
7	GND	5	----------		GND

Four Wire Mode (RS-422):

Please be sure the jumper on the module is in the RS-485 mode.

ProSoft Module				Foreign Device	
25-Pin		9-Pin			
4	RTS	7	----		
			|	Jumper RTS to CTS	
5	CTS	8	----		
14	TxD+	9	----------		RxD+
16	RxD+	6	----------		TxD+
18	RxD-	2	----------		TxD-
25	TxD-	1	----------		RxD-
7	GND	5	----------		GND

NOTE

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