# 3100/3150 – MDA-4
## MDA Scientific CM4
## Master Module
**Revision 1.0**

# USER MANUAL

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ProSoft Technology, Inc.
9801 Camino Media
Suite 105
Bakersfield, CA 93311
prosoft@prosoft-technology.com
http://www.prosoft-technology.com

**Please Read This Notice**

Successful application of the MDA-4 module requires a reasonable working knowledge of the Allen-Bradley PLC/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 MDA-4 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.

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



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

# Quick Start Implementation Guide

Integration of the 3100/3150-MDA-4 module into a PLC/SLC application is easier if a series of steps are followed. In order to assist the first time users of our products in getting operational quickly, we have come up with this step-by-step implementation guide.

**First Time Users**

Although the following steps are to assist you in implementing the module, we recommend that you attempt to experiment with the example logic provided on disk with the module or available off our FTP site before laying out your application. This step will allow you to gain insight into how the module works prior to making decisions that will impact the long term success of the installation.

Starting with one of the ladder logic programs provided on disk with the module, complete the following steps:
If hand entering the ladder logic by hand for the SLC, remember the following:

- Configure the slot as follows:

| | |
|---|---|
| Other | ID Code xxxxx |
| Input File Length | 8 |
| Output File Length | 8 |
| Scanned Input File Length | 8 |
| Scanned Output File Length | 8 |
| M0 File Length | 64 |
| M1 File Length | 64 |

a) Starting with one of the ladder logic programs provided on disk with the MDA-4 complete the following steps:

| | |
|---|---|
| PLC 5 | MDA4 |
| SLC 5/03 | MDA4_503 (See Appendix for SLC programming tips) |

b) Edit the ladder logic provided on disk as needed for the application
   Verify rack and slot location in program
   Modify ladder instruction addresses as needed

c) Setup the Communication Configuration parameters
   Determine each port's communication configuration requirements

d) Setup the Polling List for each port

e) Identify the jumper requirements (See Appendix)

f) Make up the communication cables

g) Place processor into the run mode

h) Monitor the data table for the Data and Error Status values

# Product Revision History

| | |
|---|---|
| 06/01/97 | Revision 1.0<br>Initial release of product |

# Table of Contents

# 1 Product Specifications

The 3100/3150-MDA-4 (“MDA Scientific CM4 Master Module”) product family allows Allen-Bradley 1771 and 1746 I/O compatible processors to easily interface as a host with MDA Scientific CM4 gas monitoring hardware (See 3100/3150-MDA-16 for a System 16 solution).

## 1.1 Operating Specifications

The MDA-4 product includes the following standard features:

- Two fully configurable serial ports, each capable of supporting the CM4 Master functionality
- Supports up to x CM4 units per serial port
- Support movement of binary, integer, ASCII, and floating point data types
- Memory mapping will be pre-defined in the module to ease implementation in the ladder program
- RS-485 connection from each port directly to the CM4 units
- Software configuration (From processor ladder logic)

| | | |
|---|---|---|
| Slave Addr | : | 0 to 31 |
| Command | : | Select command to be executed |
| Char Size | : | 8 bits (fixed) |
| Parity | : | None (fixed) |
| Stop Bit | : | 1 (fixed) |
| Baud Rate | : | 300 TO 9,600 |
| RTS to TxD | : | 50 ms (fixed) |
| Timeout | : | 1 second |
| Polling Rate | : | 1 second (fixed) |

- Response time
  The protocol drivers are written in Assembly and in a compiled higher level language. As such, the interrupt capabilities of the hardware are fully utilized to minimize delays, and to optimize the product's performance
- Supported CM4 command codes:

Read Comands

| | |
|---|---|
| 0x30 | Get System Information |
| 0x31 | Get Unit Status |
| 0x36 | Get Alarm History |
| 0x37 | Get Current Point Status |

Write Commands

| | |
|---|---|
| 0x51 | Reset Fault or Alarm |
| 0x52 | Set Key-Code |
| 0x53 | Lock Keyboard |
| 0x60 | End Point Lock-On |
| 0x61 | Start Point Lock-On |

- Operating Mode returned to ladder processor
- Error Codes returned to the ladder processor

## 1.2 Hardware Specifications

- Backplane Current Load :
  3100 : 0.65 A
  3150 : 0.15 A at 5 V
  0.04 A at 24 V
- Operating Temperature : 0 to 60 °C
- Storage Temperature : -40 to 85 °C
- Connections :
  3100 : 2 - DB25 Female Connectors
  3150 : 2 - DB9 Male Connectors

# 2 Writing Data to the Module

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.

## 2.1 Block Transferring Data to the 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 | Name | Description |
|---|---|---|
| 0 | BTW Block ID | A block page identifier code. This code is used by the ProSoft module to determine what to do with the data block. Valid codes are:<br>BTW Code — Description<br>0-1 — Command Control and Data<br>255 — Module Communication Configuration |
| 1 to 63 | 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. |

> Although the full physical 64 words of the data buffer may not be used, the BTW and M0 lengths must be configured for 64 words, otherwise module operation will be unpredictable.

### 2.1.1 Communications Configuration [ BTW Block ID 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.

Power Up

On power up, the module enters into a logical loop waiting to receive configuration data from the processor. While waiting, the module sets the second word of the BTR buffer (the BTW Block ID) 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.

Changing parameters during operation

Changing values in the configuration table can be done at any time. The module does not accept any of the changes until the 're-configuration' process is initiated. This can be accomplished in several ways, including:

1. Cycle power to the rack
2. Press the reset pushbutton on the module ( 3100 only)
3. Move 255 into BTW Block ID position (See example logic when B3/0 is set)

During this process, the 'CFG' LED will toggle, giving a visual indication that the module has received the configuration block.

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:

| BTW Buffer | Example Data Addr | Name |
|---|---|---|
| 0 | | BTW Block ID |
| | | **Port / Module Configuration** |
| 1 | N7:0 | Baud Rate – Port 1 |
| 2 | N7:1 | Baud Rate – Port 2 |
| 3 | N7:2 | Number of Active Slaves |
| 4 | N7:3 | Spare |
| 5 | N7:4 | Spare |
| 6 | N7:5 | Spare |
| 7 | N7:6 | Spare |
| 8 | N7:7 | Spare |
| 9 | N7:8 | Spare |
| 10 | N7:9 | Spare |
| | | **Pollling List / Port Select** |
| 11 | N7:10 | Slave 1 |
| 12 | N7:11 | Slave 2 |
| 13 | N7:12 | Slave 3 |
| 14 | N7:13 | Slave 4 |
| 15 | N7:14 | Slave 5 |
| 16 | N7:15 | Slave 6 |
| 17 | N7:16 | Slave 7 |
| 18 | N7:17 | Slave 8 |
| 19 | N7:18 | Slave 9 |
| 20 | N7:19 | Slave 10 |

The structure of the Port and Module Configuration Data block, and the meaning of each of the configuration parameters is outlined in the following table.

| Data Addr | Name | Description |
|---|---|---|
| N7:0<br>N7:1 | Baud Rate – Port 1<br>Baud Rate - Port 2 | The baud rate at which the port is to operate. The available configurations are as follows:<br>Value — Baud Rate<br>0 — 300 Baud<br>1 — 600 Baud<br>2 — 1200 Baud<br>3 — 2400 Baud<br>4 — 4800 Baud<br>5 — 9600 Baud |
| N7:2 | Number of Active Slaves | This value should represent the total number of slaves which this module will be polling between the two ports. The module will support up to 10 CM4 units between the two ports. If not all 10 slots are being used, the operation of the module can be optimized by accurately selecting the number of slaves.<br><br>The optimization comes primarity from reduced number of data block transfers.<br><br>Valid values range from 0 to 10. If 0 is configured the module assumes that all 10 slots are active. |

The Polling List / Port Select data structure for the module is outlined in the following table. These configuration values are used to select the slave address for each of the 10 possible slaves (i.e., what device addresses to poll for data), and to select which port to poll the slave address on.

| Data Addr | Name | Description |
|---|---|---|
| N7:10<br>N7:11<br>N7:12<br>N7:13<br>N7:14<br>N7:15<br>N7:16<br>N7:17<br>N7:18<br>N7:19 | Slave Address – Low Byte<br>Port Select – High Byte | This is a high byte / low byte type of selection. The Port Select byte (high byte) is configured as follows:<br>**Value** — **Description**<br>0 — Port 1 selected<br>1 — Port 2 selected<br><br>The Slave Address byte (low byte) is configured as follows:<br>**Value** — **Description**<br>0 — Inactive – (Master Address)<br>1-255 — Slave Device Address<br><br>Example :<br>N7:10 — 3 — Poll Slave #3 on Port 1<br>N7:11 — 257 — Poll Slave #1 on Port 2<br>= 256( Port 2 )+ Slave Address |

### 2.1.2 Writing Control Block to Module[ BTW Block ID 0 and 1 ]

The BTW Block ID 0 and 1 blocks are used to transfer Command Control/Data information to the module for the 10 possible slaves. This data is used by the module to determine which Read and Write protocol commands to execute, as well as what data values to write to the slave.

The following tables show how the data for all 10 slaves is moved up into the module. The example ladder logic in the Appendix also shows by example the ladder logic needed to implement this functionality.

| BTW Buffer | Example Data Addr | Name |
|---|---|---|
| 0 | | BTW Block ID = 0 |
| 1 to 10 | N9:0 To N9:9 | Slave #1 Command Block |
| 11 to 20 | N9:10 To N9:19 | Slave #2 Command Block |
| 21 to 30 | N9:20 To N9:29 | Slave #3 Command Block |
| 31 to 40 | N9:30 To N9:39 | Slave #4 Command Block |
| 41 to 50 | N9:40 To N9:49 | Slave #5 Command Block |

| BTW Buffer | Example Data Addr | Name |
|---|---|---|
| 0 | | BTW Block ID = 1 |
| 1 to 10 | N9:50 To N9:59 | Slave #6 Command Block |
| 11 to 20 | N9:60 To N9:69 | Slave #7 Command Block |
| 21 to 30 | N9:70 To N9:79 | Slave #8 Command Block |
| 31 to 40 | N9:80 To N9:89 | Slave #9 Command Block |
| 41 to 50 | N9:90 To N9:99 | Slave #10 Command Block |

| Data Addr | Name | Description |
|---|---|---|
| N9:0<br>N9:10<br>N9:20<br>N9:30<br>N9:40<br>N9:50<br>N9:60<br>N9:70<br>N9:80<br>N9:90 | Read Command Enable Bits<br>Slaves 1 to 10 | This register is a bit mapped set of enable bits that will allow the application programmer to control the execution of the read commands, and therefore the relative update timing.<br>**Bit** — **Description**<br>0 — Get System Information – 0x30<br>1 — Get Unit Status – 0x31<br>2 — Get Point #1 Status – 0x37<br>3 — Get Point #2 Status – 0x37<br>4 — Get Point #3 Status – 0x37<br>5 — Get Point #4 Status – 0x37<br>6 — Get Alarm History – 0x36<br>7 — Get Point Cfg #1 – 0x35<br>8 — Get Point Cfg #2 – 0x35<br>9 — Get Point Cfg #3 – 0x35<br>10 — Get Point Cfg #4 – 0x35 |
| N9:1<br>N9:11<br>N9:21<br>N9:31<br>N9:41<br>N9:51<br>N9:61<br>N9:71<br>N9:81<br>N9:91 | Write Command Enable Bits<br>Slaves 1 to 10 | This register is a bit mapped set of enable bits that will allow the application programmer to control the execution of the write commands to a slave.<br>**Bit** — **Description**<br>0 — Alarm/Fault Reset – 0x51<br>1 — Lock Keyboard – 0x53<br>2 — Start Point #1 Lock – 0x61<br>3 — Start Point #2 Lock – 0x61<br>4 — Start Point #3 Lock – 0x61<br>5 — Start Point #4 Lock – 0x61<br>6 — End Point Lock – 0x60 |
| N9:2<br>N9:12<br>N9:22<br>N9:32<br>N9:42<br>N9:52<br>N9:62<br>N9:72<br>N9:82<br>N9:92 | Alarm/Fault Reset Selection<br>Slaves 1 to 10 | This register is a bit mapped set of bits that will allow the application programmer to control which point alarms are cleared and if the faults are to be cleared.<br>**Bit** — **Description**<br>0 — Point 1 Alarms<br>1 — Point 2 Alarms<br>2 — Point 3 Alarms<br>3 — Point 4 Alarms<br>4 — Faults |
| N9:3<br>N9:13<br>N9:23<br>N9:33<br>N9:43<br>N9:53<br>N9:63<br>N9:73<br>N9:83<br>N9:93 | Lock Keyboard Command<br>Slaves 1 to 10 | This register is a bit mapped set of enable bits that will allow the application programmer to control the locking/unlocking of the keyboard. This selection is used in conjunction with the configurable keycode parameter in the next register.<br>**Bit** — **Description**<br>0 — 0 = Unlocked<br>1 = Locked |
| N9:4<br>N9:14<br>N9:24<br>N9:34<br>N9:44<br>N9:54<br>N9:64<br>N9:74<br>N9:84<br>N9:94 | Lock Keyboard Keycode<br>Slaves 1 to 10 | This register is a bit mapped set of enable bits that will allow the application programmer to control the execution of the write commands to a slave.<br>**Value** — **Description**<br>0 to 9999 — Keycode entry sent to CM4 |

The following diagram shows the relative positioning of the data structure in the example ladder logic. Note that any data file can be used in an application. Simply changing the mapping of the COP commands in the example ladder logic will account for any file selection.

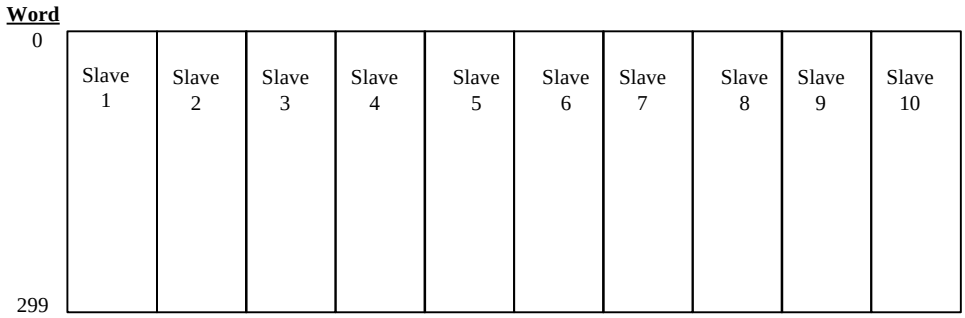
| | Read Cmd Enable | Write Cmd Enable | Alarm Fault Reset | Lock Keyboard Cmd | Keycode | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | |
| **N9:0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #1 Command Control |
| **N9:10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #2 Command Control |
| **N9:20** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #3 Command Control |
| **N9:30** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #4 Command Control |
| **N9:40** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #5 Command Control |
| **N9:50** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #6 Command Control |
| **N9:60** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #7 Command Control |
| **N9:70** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #8 Command Control |
| **N9:80** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #9 Command Control |
| **N9:90** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave #10 Command Control |

# 3 Reading From the Module

This section provides reference level details on the transfer of data from the PLC/SLC processor to the module.

## 3.1 Transferring data from the module

When the Master port driver reads data from a slave the resulting data is placed into the ProSoft module's data space. This data space is broken down into ten(10) 300 word data blocks, with each 300 word block representing the data from one(1) slave. The following diagram shows this structure:

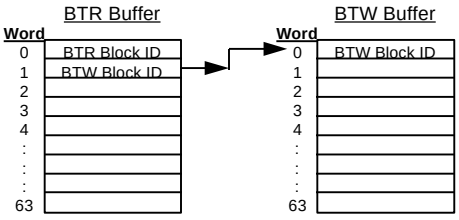



In order to get this data into the PLC/SLC, the blocks are broken down into 50 word 'pages' and transferred to the ladder logic across the backplane using the standard BTR or M1 instructions. The following sections detail the structure of this data and the mechanism by which all of the data is transferred.

Although the full physical 64 words of the data buffer may not be used, the BTR and M1 lengths must be configured for a length of 64 words, otherwise module operation will be unpredictable

### 3.1.1 The Read Data Block Structure

The BTR buffer definition is:

| Word | Name | Description |
|---|---|---|
| 0 | BTR Block ID | The ladder logic uses this value to determine the contents of the data portion of the BTR buffer. With some conditional testing in ladder logic, the data from the module can be placed into the PLC/SLC data table.<br>  <br><br>The relationship between the BTR Block ID number and the register table can be put into an equation:<br>Starting Register Address = Block ID Number * 50<br><br>Valid codes are between 0 and 59 (Each slave will consume up to 6 blocks). |

**(Continued)**

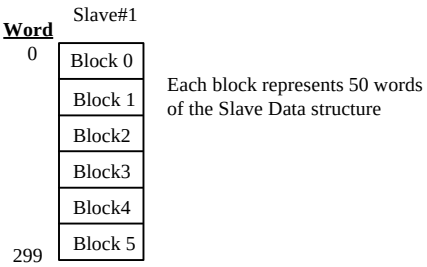
| Word | Name | Description |
|---|---|---|
| 1 | BTW Block ID | The module returns this value to the processor to be used to enable the movement of Command data to the module. The BTW Block ID number is developed by the module.<br><br>Valid codes are:<br>**BTW Code** — **Description**<br>0-1 — Command Data<br>255 — Module Configuration |
| 2 to 51 | Data | This data will contain data received from the slaves. The values will be 16 bit register values, and should be placed into integer files. Note that the user application ladder logic controls the placement and use of the data registers. |

## 3.2 Reading Data from the Module[ BTR Block ID 0 and 59 ]

In order to understand the movement of data from the module to the ladder memory, it is important to understand the building of the memory map in the module. Shown earlier in the diagram above is that fact that the module stores the Slave Data in individual 300 word blocks.

The transfer of this data is accomplished by breaking each of the 300 word blocks down into six(6) 50 words blocks. These individual 50 word blocks are 'paged' across the backplane within the BTR Buffer structure discussed above. Using the BTR Block ID number, the ladder logic is able to determine where to place the data in the ladder logic memory.

The following diagram shows the Slave #1 Data block broken down into its 50 word blocks, and the corresponding BTR Block ID number for each of the blocks.




The following table shows the BTR Block ID numbering for all 10 slaves:

| Words | Slave 1 | Slave 2 | Slave 3 | Slave 4 | Slave 5 | Slave 6 | Slave 7 | Slave 8 | Slave 9 | Slave 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 to 49 | 0 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 |
| 50 to 99 | 1 | 7 | 13 | 19 | 25 | 31 | 37 | 43 | 49 | 55 |
| 100 to 149 | 2 | 8 | 14 | 20 | 26 | 32 | 38 | 44 | 50 | 56 |
| 150 to 199 | 3 | 9 | 15 | 21 | 27 | 33 | 39 | 45 | 51 | 57 |
| 200 to 249 | 4 | 10 | 16 | 22 | 28 | 34 | 40 | 46 | 52 | 58 |
| 250 to 299 | 5 | 11 | 17 | 23 | 29 | 35 | 41 | 47 | 53 | 59 |

### 3.2.1 The Slave Data Block Structure

The data structure for each slave is predefined and was developed during the development of the module. As discussed above, the individual slave data is stored in a 300 word data block. The structure of the data block is as follows:

| Data Addr Offset | Name | Description |
|---|---|---|
| 0 | Communication Counter | This value represents a 0 to 32767 rollover counter that increments each time communication with the slave occurs. Incrementing is independent of the command executed. |
| 1 | Communicaton Status Error | This register is used to indicate that status of communications between the module and the particular slave. A non-zero number indicates the type of communicatoin problem which is occuring. This value is not latched and will therefore clear to 0 on the first successful communications. The values which can be expected in the field are:<br>**Value** — **Description**<br>0 — All OK<br>1 — TBD<br>2 — TBD<br>3 — Error in Response<br>8 — Timeout Error<br>16 — Module Config Error<br>254 — Checksum Error<br>255 — TX Fail (Verify RTS/CTS jumper) |
| 2 | Read Command Done Bits | These bits indicate the execution of the particular command. The module will clear the bits immediately after the block transfer to assure that they are not held on.<br>**Value** — **Description**<br>0 — Get System Information – 0X30<br>1 — Get Unit Status – 0x31<br>2 — Get Point #1 Status – 0x37<br>3 — Get Point #2 Status – 0x37<br>4 — Get Point #3 Status – 0x37<br>5 — Get Point #4 Status – 0x37<br>6 — Get Alarm History – 0x36<br>7 — Get Point Cfg #1 – 0x35<br>8 — Get Point Cfg #2 – 0x35<br>9 — Get Point Cfg #3 – 0x35<br>10 — Get Point Cfg #4 – 0x35 |
| 3 | Write Command Done Bits | These bits indicate the execution of the particular write command. The module will clear its bit image immediately after the block transfer to assure that they are cleared during the subsequent block transfers.<br>**Value** — **Description**<br>0 — Alarm/Fault Reset – 0x51<br>1 — Lock Keyboard – 0x53<br>2 — Start Point #1 Lock – 0x61<br>3 — Start Point #2 Lock – 0x61<br>4 — Start Point #3 Lock – 0x61<br>5 — Start Point #4 Lock – 0x61<br>6 — End Point Lock – 0x60 |
| 4 | Alarm Reset Status | Value returned from a 0x51 |
| 5 | Lock Keyboard Status | Value returned from a 0x53 |
| 6 | End Point Lock-on Results | Value returned from a 0x60 |
| 7 | Start Point Lock-on Results | Value returned from a 0x61 |
| 8 | Spare | |
| 9 | Spare | |

| Data Addr Offset | Name | Description |
|---|---|---|
| 10<br>11<br>12 | Month<br>Day<br>Year | Date returned from the instrument during the last execute read command. Each read command returns the date, so these registers should continuously be getting updated by the CM4. |
| 13<br>14<br>15 | Hour<br>Minute<br>Second | Time returned from the instrument during the last execute read command. Each read command returns the time, so these registers should continuously be getting updated by the CM4. |
| 16 | Number of Alarms | Value returned from a 0x36 – Get Alarm History command. |
| 17 | Spare | |
| 18 | Spare | |
| 19 | Spare | |
| 20 | Serial Num | |
| 21 | software rev | |
| 22 | VIP | |
| 23 | Prom csum msb | |
| 24 | Prom csum lsb | |
| 25 | Status - read verified | |
| 26 | General Status | |
| 27 | Flash Mem remaining | |
| 28 | Chemcassette windows remaining | |
| 29 | Chemcassette days remaining | |
| 30 | Internal Filter Days in Use | |
| 31 | External Filter Days in Use | |
| 32 | Flow Rate Point 1 | |
| 33 | Flow Rate Point 2 | |
| 34 | Flow Rate Point 3 | |
| 35 | Flow Rate Point 4 | |
| 36 | Status - Optics Cal and Maint Status | Optics in High byte and Maintenance in Low byte |
| 37 | Spare | |
| 38 | Spare | |
| 39 | Spare | |
| 40 | MDA Gas Abbrev | Pt 1 |
| 41 | MDA Gas Abbrev | Pt 1 |
| 42 | MDA Gas Abbrev | Pt 1 |
| 43 | Format code | Pt 1 |
| 44 | Flow Rate - Current Flow | Pt 1 |
| 45 | TWA Start Data | Pt 1 |
| 46 | TWA Start Time | Pt 1 |
| 47 | TWA End Date | Pt 1 |
| 48 | TWA End Time | Pt 1 |
| 49 | TWA Concentration | Pt 1 |
| 50 | Last Concentration | Pt 1 |
| 51 | Alarm Status | Pt 1 |
| 52 | Point Status | Pt 1 |
| 53 | Point Cfg Status | Pt 1 |
| 54 | Alarm Level 1 | Pt 1 |
| 55 | Alarm Level 2 | Pt 1 |
| 56 | Spare | Pt 1 |
| 57 | Spare | Pt 1 |
| 58 | Spare | Pt 1 |
| 59 | Spare | Pt 1 |
| 60 | MDA Gas Abbrev | Pt 2 |
| 61 | MDA Gas Abbrev | Pt 2 |
| 62 | MDA Gas Abbrev | Pt 2 |
| 63 | Format code | Pt 2 |
| 64 | Flow Rate - Current Flow | Pt 2 |
| 65 | TWA Start Data | Pt 2 |
| 66 | TWA Start Time | Pt 2 |

| | | |
|---|---|---|
| 67 | TWA End Date | Pt 2 |
| 68 | TWA End Time | Pt 2 |
| 69 | TWA Concentration | Pt 2 |
| 70 | Last Concentration | Pt 2 |
| 71 | Alarm Status | Pt 2 |
| 72 | Point Status | Pt 2 |
| 73 | Point Cfg Status | Pt 2 |
| 74 | Alarm Level 1 | Pt 2 |
| 75 | Alarm Level 2 | Pt 2 |
| 76 | Spare | Pt 2 |
| 77 | Spare | Pt 2 |
| 78 | Spare | Pt 2 |
| 79 | Spare | Pt 2 |
| 80 | MDA Gas Abbrev | Pt 3 |
| 81 | MDA Gas Abbrev | Pt 3 |
| 82 | MDA Gas Abbrev | Pt 3 |
| 83 | Format code | Pt 3 |
| 84 | Flow Rate - Current Flow | Pt 3 |
| 85 | TWA Start Data | Pt 3 |
| 86 | TWA Start Time | Pt 3 |
| 87 | TWA End Date | Pt 3 |
| 88 | TWA End Time | Pt 3 |
| 89 | TWA Concentration | Pt 3 |
| 90 | Last Concentration | Pt 3 |
| 91 | Alarm Status | Pt 3 |
| 92 | Point Status | Pt 3 |
| 93 | Point Cfg Status | Pt 3 |
| 94 | Alarm Level 1 | Pt 3 |
| 95 | Alarm Level 2 | Pt 3 |
| 96 | Spare | Pt 3 |
| 97 | Spare | Pt 3 |
| 98 | Spare | Pt 3 |
| 99 | Spare | Pt 3 |
| 100 | MDA Gas Abbrev | Pt 4 |
| 101 | MDA Gas Abbrev | Pt 4 |
| 102 | MDA Gas Abbrev | Pt 4 |
| 103 | Format code | Pt 4 |
| 104 | Flow Rate - Current Flow | Pt 4 |
| 105 | TWA Start Data | Pt 4 |
| 106 | TWA Start Time | Pt 4 |
| 107 | TWA End Date | Pt 4 |
| 108 | TWA End Time | Pt 4 |
| 109 | TWA Concentration | Pt 4 |
| 110 | Last Concentration | Pt 4 |
| 111 | Alarm Status | Pt 4 |
| 112 | Point Status | Pt 4 |
| 113 | Point Cfg Status | Pt 4 |
| 114 | Alarm Level 1 | Pt 4 |
| 115 | Alarm Level 2 | Pt 4 |
| 116 | Spare | Pt 4 |
| 117 | Spare | Pt 4 |
| 118 | Spare | Pt 4 |
| 119 | Spare | Pt 4 |
| | | |
| | | |
| 120 | Alarm 1 | See Alarm Data block structure below |
| 130 | Alarm 2 | See Alarm Data block structure below |
| 140 | Alarm 3 | See Alarm Data block structure below |
| 150 | Alarm 4 | See Alarm Data block structure below |
| 160 | Alarm 5 | See Alarm Data block structure below |
| 170 | Alarm 6 | See Alarm Data block structure below |
| 180 | Alarm 7 | See Alarm Data block structure below |
| 190 | Alarm 8 | See Alarm Data block structure below |
| 200 | Alarm 9 | See Alarm Data block structure below |

| | | |
|---|---|---|
| 210 | Alarm 10 | See Alarm Data block structure below |
| 220 | Alarm 11 | See Alarm Data block structure below |
| 230 | Alarm 12 | See Alarm Data block structure below |
| 240 | Alarm 13 | See Alarm Data block structure below |
| 250 | Alarm 14 | See Alarm Data block structure below |
| 260 | Alarm 15 | See Alarm Data block structure below |
| 270 | Alarm 16 | See Alarm Data block structure below |
| 280 to 289 | Spare | |
| 290 to 299 | Product Information Structure | This data is only returned for Slave #1. See below for structure. |

### 3.2.2 Alarm Data Block Structure

Up to 16 Alarm Data Blocks are returned from each CM4. The Alarm Data has been turned into a 10 word structure to allow viewing in the PLC/SLC data table to be easier. The structure of this data is as follows:

Note that the Alarm Data structure is shown only for Alarm #1. This structure repeats itself 16 times on 10 words offsets.

| Data Addr Offset | Name | Description |
|---|---|---|
| 120 | Date Stamp | MDA format Date field (2 bytes packed with MDY) |
| 121 | Time Stamp | MDA format Time field (2 bytes packed with HMS) |
| 122<br>123<br>124 | Gas Abbreviation | |
| 125 | Point Number | Point number in alarm.<br>**Value** — **Description**<br>0 — Point #1<br>1 — Point #2<br>2 — Point #3<br>3 — Point #4 |
| 126 | Format Code | |
| 127 | Concentration | |
| 128 | Alarm Level | Alarm level:<br>**Value** — **Description**<br>0 — Level 1<br>1 — Level 2 |
| 129 | Spare | |

### 3.2.3 Product Information Data Structure

Product revision information which may be useful during debuging and troubleshooting in the future is included in this data structure. This data block is only returned with the data from slave #1. Therefore it will be returned at the tail end of BTR Block ID 5. If all 300 words are being read from the unit, this data will automatically be included.

| Data Addr Offset | Name | Description |
|---|---|---|
| 290<br>291 | Product Name | These two words represent the product name of the module in an ASCII representation. In the case of the 3750 product, the letters ' MDA4' should be displayed when placing the programming software in the ASCII data representation mode. |
| 292<br>293 | Product Revision | These two words represent the product revision level of the firmware in an ASCII representation. An example of the data displayed would be '1.00' when placing the programming software in the ASCII data representation mode. |
| 294 | Product Operating System | This word represents the module's internal operating system revision level in an ASCII representation. |
| 295 | Product Run Number | This number represents the 'batch' number that your particular chip belongs to in an ASCII representation. |

# 4 Protocol Commands

The ProSoft Technology MDA-4 module Master driver supports several commands from the MDA-4 Command set.

## 4.1 MDA-4 Read Data Commands

The MDA-4 module supports a command subset of the Protocol Specification consisting primarily of the commands required to intialize and read data from several units. The following sections detail the different commands supported by the module.

### 4.1.1 0x30 – Get System Information

This command requests information about the slave system only and the software revision currently in use.

### 4.1.2 0x31 – Get Unit Status

This command requests the current conditoin or status of the salve. This command allows the master to inquire about the general operating condition of the system.

### 4.1.3 0x36 – Get Alarm History

This command queries the unit for any alarms. The unit saves only the 16 most recent alarms regardless of point. The alarms can all be on one point or there can be alarsm from several points.

### 4.1.4 0x37 – Get Current Point Status

The command queries an individual point for its current status.

### 4.1.5 0x35 – Get Point Configuration

The command queries an individual point for its current configuration.

## 4.2 MDA-4 Write and Control Commands

The MDA-4 module supports a command subset of the Protocol Specification consisting primarily of the commands required to intialize and read data from several units. The following sections detail the different

### 4.2.1 0x51 – Reset Faults or Alarms

This command allows a remote reset of any faults or alarm conditions.

### 4.2.2 0x53 – Lock Keyboard

This command allows the ladder program to lock out the keyboard. The keyboard can be disabled, preventing unauthorized user intervention by enabling the keypad lock out and sending a valid key code.

### 4.2.3 0x60 – End Point Lock-on

This command unlocks the unit from a single pont lock-on to all other points that are enabled. When this command is issued, a new TWA start for all points.

### 4.2.3 0x61 – Start Point Lock-on

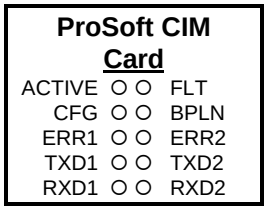
This command locks the unit to one specific pont. When this command is issued, all other points are disabled and locked-on point continues to moniotr for concentration and TWA.

# 5 Diagnostics & Troubleshooting

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.

## 5.1 3100 PLC Platform

The following table documents the LEDs for the 3100-MDA-4 module.



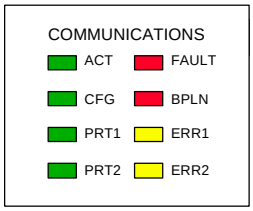

| ProSoft CIM | A-B DB/B | Color | Status | Indication |
|---|---|---|---|---|
| ACT | ACT | Green | Blink (Fast) | Normal state : The module is operating normally and successfully Block Transferring with the PLC |
| | | | On | The module is receiving power from the backplane, but there may be some other 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. |
| | | | On | This LED will stay on under several conditions:<br>• CTS input is not being satisfied<br>• Port Configuration Error<br>• System Configuration Error<br>• Unsuccessful comm on MDA-4 slave<br>• Recurring error condition on MDA-4 master |

| | | | | |
|---|---|---|---|---|
| Tx1<br>Tx2 | PT1X<br>PT2X | Green | Blink | The port is transmitting data. |
| Rx1<br>Rx2 | PT1R<br>PT2R | Green | Blink | The port is receiving data |

## 5.2 3150 SLC Platform

The following table documents the LEDs for the 3150-MDA-4 module.

**3150-MDA-4**




| 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<br>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:<br>• CTS input is not being satisfied<br>• Port Configuration Error<br>• System Configuration Error<br>• Unsuccessful comm on MDA-4 slave<br>• Recurring error condition on MDA-4 master |
| TxRx1<br>TxRx2 | Green | Blink | The port is communicating, either transmitting or receiving data |

## 5.3 Troubleshooting

In order to assist in the troubleshooting of the module, the following tables have been put together to assist you. Please use the following to help in using the module, but if you have additional questions or problems please do not hesitate to contact us.

The entries in this section have been placed in the order in which the problems would most likely occur after powering up the module.

| Problem Description | Steps to take |
|---|---|
| BPLN light is on (SLC) | The BPLN light comes on when the module does not think that the SLC is in the run mode (i.e., SLC is in PGM or is Faulted). If the SLC is running then verify the following:<br>• Verify the SLC Status File to be sure the slot is enabled<br>• The Transfer Enable/Done Bits (I/O Bits 0 for the slot with the module) must be controlled by the ladder logic. See Section 2.x for details or the example ladder logic in the Appendix.<br>• If the ladder logic for the module is in a subroutine file verify that there is a JSR command calling the SBR |
| CFG light does not clear after power up (no ERR LED) | The 255 BTW Block ID number is not being detected by the module. This could be due to a Block Transfer failure (PLC) or to an error in the ladder logic preventing the 255 value from being moved to the BTW buffer |
| CFG light does not clear after power up (w/ ERR LED) | If the BPLN light has been cleared, then several of the Port and System configuration values are value checked by the module to be sure that legal entries have been entered in the data table. Verify the Error Status Table for an indication of a configuration error. |
| CFG light toggles | Under normal conditions, the CFG LED will clear immediately after receipt. If the CFG light toggles, this usually indicates that the logic condition which places the 255 Block ID value in the BTW buffer is not being cleared. Check the ladder logic to be sure that the condition moving the 255 value is not held true. |
| Module is not transmitting | Presuming that the processor is in run, verify the following:<br>• CTS input is not satisfied (check RTS/CTS jumper)<br>• Check Error Status codes for 255 code. If so see next problem<br>• If in slave mode, verify the slave address being requested from the Host<br>• If in master mode, verify the command list configuration and that the Command List is being moved into the module (i.e., check the Command Block Cnt and associated ladder logic) |
| Error Code 255 in Status Table | This is caused by only one thing, a missing CTS input on the port. If a cable is connected to the port, then verify that a jumper has been installed between the RTS and CTS pins. If so then there may be a hardware problem. |
| Overwriting data blocks | This condition normally occurs when it is forgotten that the BTW Block ID value is being manipulated by the module, and that it always starts at 0. Please verify that the configuration of the module (Read and Write Block Counts) is not causing data from the PLC/SLC to overwrite data being returned from the module. A simple method for verifying this is to perform a histogram on the BTW Block ID register. |
| Data swapping is occurring (3100 only) | Under several circumstances data swapping in the module has occurred. This swapping has always been associated with the 8/16 pt jumper on the back of the card. Please verify that the jumper is in the 8pt position |

| Problem Description | Steps to take |
|---|---|
| New configuration values are not being accepted by the module | In order for new values to be moved to the module a Block Transfer Write with a Block ID of 255 must be transmitted to the module. The 'User Config Bit' in the example logic accomplishes this. In the example logic the bit must either be set in the data table manually or the module must be powered down/reset.<br><br>In order to download the configuration upon transitioning from PGM to RUN, simply add a run to set the 'User Config Bit' based on the First Scan Status Bit (S1:1/15) |
| Error Codes being returned in locations with no commands (Master Configuration) | Be sure that the Command Block Count configuration value is setup correctly. There should be one branch of logic in the Write Rung corresponding to each Command Block to be written (i.e., a Command Block Count of 2 should have two branches of logic to handle BTW Block IDs 80 and 81.<br><br>If the Command Block Count configuration value exceeds the number of branches in logic, the Command List is inadvertently being duplicated. To resolve the issue, either add more branches of logic or reduce the Command Block Count value to match the number of BTW logic branches. |
| RX1 or RX2 on continuously (3100 only) | The TX and RX LEDs on the module are tied to the hardware state of the ports (i.e., are not controlled directly by firmware). When the RX LED is on continuously is normally indicates that the polarity of the cable connection to the port is swapped.<br><br>This is particularly true in RS-485 and RS-422 modes. |

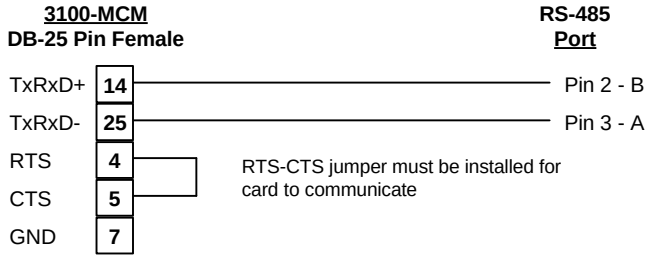
# 6 Cable Connections

The following diagrams show the connection requirements for the ports on the 3100 and 3150 modules.

## 3100 Module

**RS-485/2-Wire Connection**

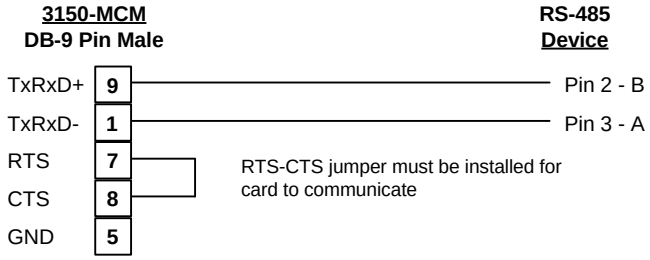
The jumper on the module must be set in the RS-485 position for all 2-wire applications




## 3150 Module

**RS-485/2-Wire Connection**

The jumper on the module must be set in the RS-485 position for all 2-wire applications




**RS-485 and RS-422 Tip**

If communication in the RS-422/RS-485 mode does not work at first, despite all attempts, try switching termination polarities. Some manufacturers interpret +/- and A/B polarities differently.

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**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.

# B Jumper Configurations

## Hardware Overview

When purchasing the MDA-4 product, there are two choices. These choices are as follows:

| | ProSoft Cat Num | |
|---|---|---|
| **Description** | **PLC** | **SLC** |
| Module provided by ProSoft | 3100 | 3150 |

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.

## 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.

### 3100 for the 1771 Platform

Following are the jumper positions for the ProSoft Technology 3100-MDA-4 module:

| **Jumper** | **3100** |
|---|---|
| JW1 | N/A |
| JW2 | N/A |
| JW3 | N/A |
| JW4 | Not Used |
| JW5 | 8 Pt |
| JW6 | Not Used |
| JW7 | Enabled |
| JW8 | As Needed |
| JW9 | As Needed |

**JW5 Backplane 8/16 point 8 Point**
The module should be operated in the 8 pt mode only.

**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 MDA-4 firmware

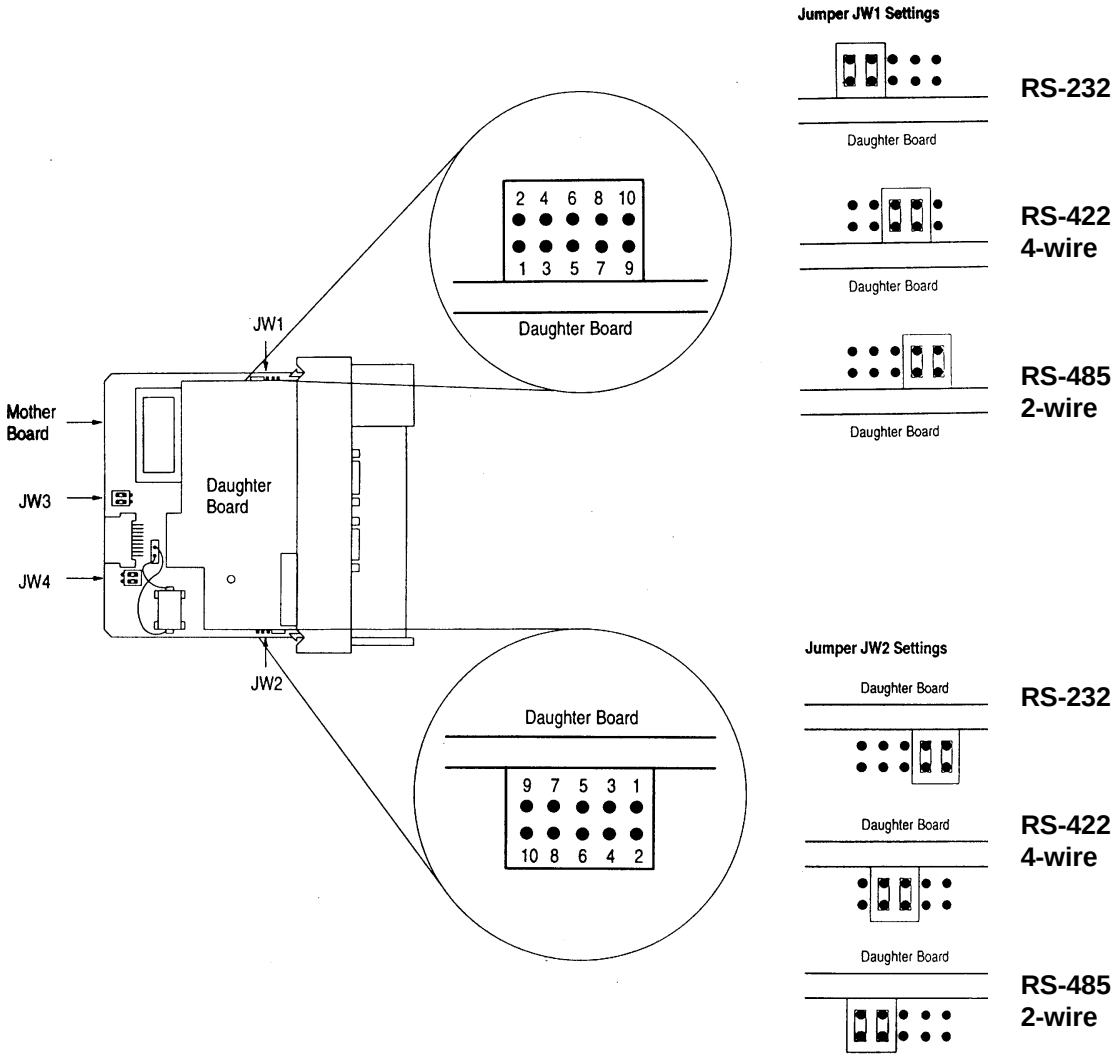
### 3150 for the 1746 Platform

Following are the jumper positions for the ProSoft Technology 3150-MDA-4 module:

| **Jumper** | **3150-MDA-4** |
|---|---|
| JW1 | As Needed – See Below |
| JW2 | As Needed – See Below |
| JW3 | N/A |
| JW4 | N/A |

**JW1/2 RS configuration for port 1 and 2**
The default from factory is RS-232, but all options are supported by the MDA-4 firmware.

**Communication Port**
**Jumper Settings for 3150 Modules - JW1 & JW2**



# C SLC Programming Considerations

The 3150-MDA-4 is also very easy to get operational.

In order to implement the sample logic, the user must make sure that the correct processor and rack size match up. Also, should it be necessary to re-locate the MDA-4 module, the user should be certain to configure the correct slot as a 1746-BAS 5/02 Configuration.

When initially setting up the SLC program file, or when moving the module from one slot to another, the user must configure the slot to accept the MDA-4 module.

It is important that the slot containing the ProSoft module be configured as follows:

- 1746-BAS module or enter 13106 for the module ID code
- Configure the M0/M1 files for 64 words
- Configure I/O for 8 words

The following is a step by step on how to configure these files using Allen-Bradley APS software. ICOM software users should follow similar steps.

From the Main Menu:

1) Select the correct processor program and F3 for Offline programming
2) F1 for Processor Functions
3) F1 for Change Processor
   Modify the processor here if necessary (Note the MDA-4 will only work with 5/02 or greater processors
4) F5 for Configure I/O
   Select 1746-BAS module for SLC 5/02 or greater, or enter 13106 for module code
5) F9 for SPIO Config when the correct slot is highlighted
6) F5 Advanced Setup
7) F5 for M0 file length - type in 64 and Enter
8) F6 for M1 file length - type in 64 and Enter

Esc out and save configuration

# D Example Ladder Logic

**Overview**

The following ladder logic provides an example for the ladder logic necessary to integrate the 3100-MDA-4 and the 3150-MDA-4 modules into their respective processor platforms. This logic can be incorporated directly as is, or if desired modified as needed for the application.

**Data Files**

The examples use the same memory map for both of the platforms, with the exception of the actual block transfer data and control files.

The memory map for the example application has been detailed in the attached data table listing.

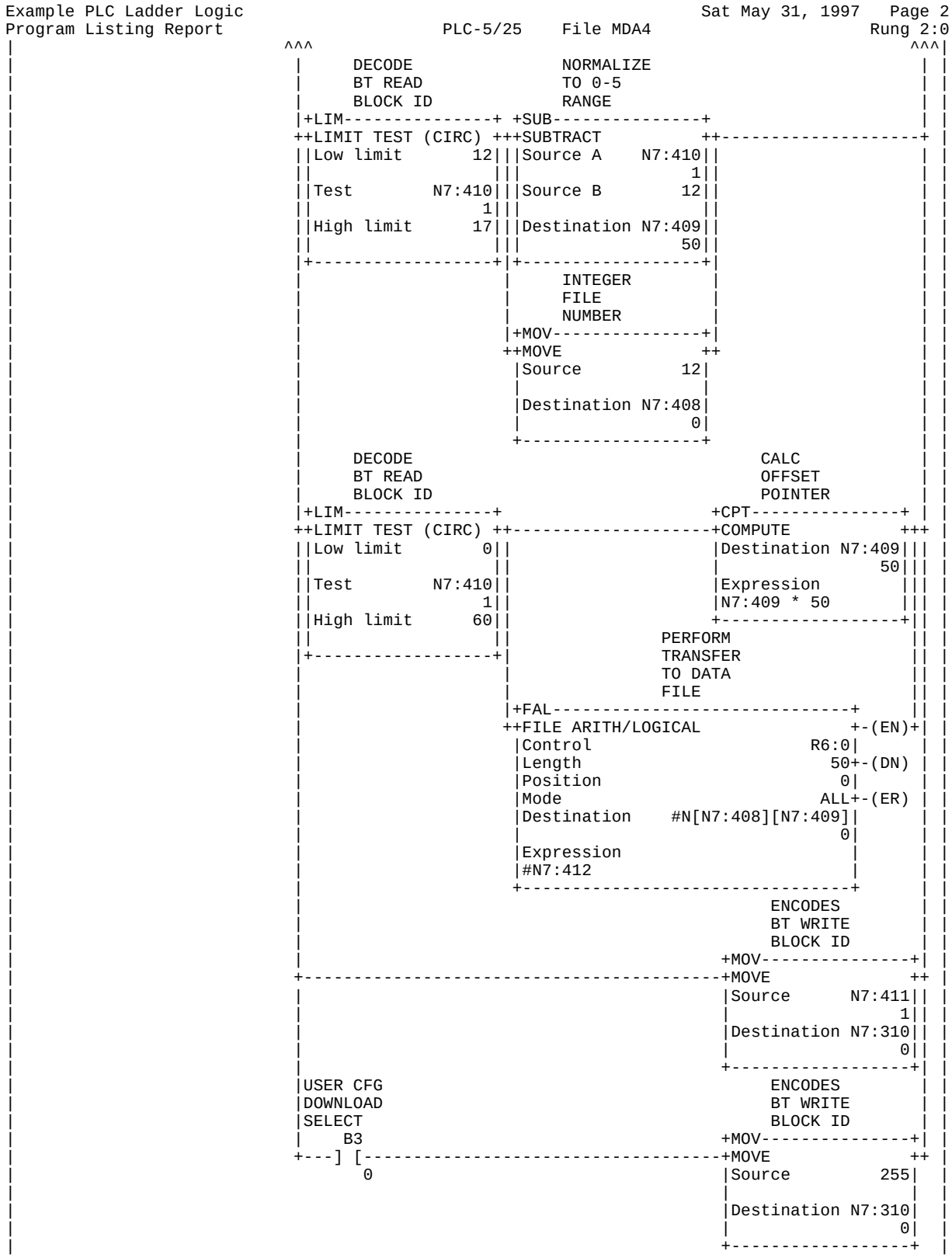
In this example application, the following configuration and data table layout is used (Note that the application programmer may select any PLC data files (Integer) if the files used in the example are not available):

(Note that the data file listings that are included in this manual do not reflect actual values collected from the CM4 instruments.)

| Word | Slave 1 | Slave 2 | Slave 3 |
|---|---|---|---|
| 0 | Block0 | Block6 | Block12 |
| | Block1 | Block7 | Block13 |
| | Block2 | Block8 | Block14 |
| | Block3 | Block9 | Block15 |
| | Block4 | Block10 | Block16 |
| 299 | Block5 | Block11 | Block17 |
| | N10 | N11 | N12 |

```
Example PLC Ladder Logic                                        Sat May 31, 1997   Page 1
Program Listing Report                    PLC-5/25    File MDA4                  Rung 2:0

Rung 2:0
       BT READ AND REGISTER TRANSFER FROM MODULE DECODING
       BT READ from module.  This rung of logic is responsible for transferring data
       from the module into the PLC data table.  The paging is controlled by the BTR
       Block ID number(word 0 in Data file).  See manual for complete explanation.
|                                                                          BT READ                |
| BT WRITE  |BT READ                                                       FROM                   |
| ENABLE    |ENABLE                                                        MODULE                 |
|   N7:300     N7:400                                          +BTR--------------------+        |
+----]/[--------]/[----------+-------------------------------+BLOCK TRANSFER READ    +-(EN)+-+
|      15         15         |                               |Rack                 00|     | |
|                            |                               |Group                 0+-(DN)| |
|                            |                               |Module                0|     | |
|                            |                               |Control block    N7:400+-(ER)| |
|                            |                               |Data file        N7:410|     | |
|                            |                               |Length               64|     | |
|                            |                               |Continuous            N|     | |
|                            |                               +-----------------------+     | |
|                            |     DECODE              TRANSFER                            | |
|                            |     BT READ             BTR BLOCK                           | |
|                            |     BLOCK ID            ID VALUE                            | |
|                            |+LIM---------------+ +MOV---------------+                   | |
|                            ++LIMIT TEST (CIRC) +++MOVE              ++-------------------+ |
|                            ||Low limit        0|||Source      N7:410||                   | |
|                            ||                  |||                 1||                   | |
|                            ||Test        N7:410|||Destination N7:409||                   | |
|                            ||                 1|||                50||                   | |
|                            ||High limit       5||+------------------+|                   | |
|                            ||                  ||     INTEGER         |                   | |
|                            |+------------------+|     FILE            |                   | |
|                            |                    |     NUMBER          |                   | |
|                            |                    |+MOV---------------+|                   | |
|                            |                    ++MOVE               ++                   | |
|                            |                     |Source          10|                    | |
|                            |                     |                  |                    | |
|                            |                     |Destination N7:408|                    | |
|                            |                     |                 0|                    | |
|                            |                     +------------------+                    | |
|                            |     DECODE              NORMALIZE                           | |
|                            |     BT READ             TO 0-5                              | |
|                            |     BLOCK ID            RANGE                               | |
|                            |+LIM---------------+ +SUB---------------+                   | |
|                            ++LIMIT TEST (CIRC) +++SUBTRACT          ++-------------------+ |
|                            ||Low limit        6|||Source A    N7:410||                   | |
|                            ||                  |||                 1||                   | |
|                            ||Test        N7:410|||Source B         6||                   | |
|                            ||                 1|||                  ||                   | |
|                            ||High limit      11|||Destination N7:409||                   | |
|                            ||                  |||                50||                   | |
|                            |+------------------+|+------------------+|                   | |
|                            |                    |     INTEGER         |                   | |
|                            |                    |     FILE            |                   | |
|                            |                    |     NUMBER          |                   | |
|                            |                    |+MOV---------------+|                   | |
|                            |                    ++MOVE               ++                   | |
|                            |                     |Source          11|                    | |
|                            |                     |                  |                    | |
|                            |                     |Destination N7:408|                    | |
|                            |                     |                 0|                    | |
|                            |                     +------------------+                    | |
|                           vvv                                                           vvv|
```


Example PLC Ladder Logic
Sat May 31, 1997 Page 2
Program Listing Report
PLC-5/25 File MDA4
Rung 2:0
DECODE
BT READ
BLOCK ID
LIM
LIMIT TEST (CIRC)
Low limit 12
Test N7:410
1
High limit 17
SUB
SUBTRACT
Source A N7:410
1
Source B 12
Destination N7:409
50
INTEGER
FILE
NUMBER
MOV
MOVE
Source 12
Destination N7:408
0
DECODE
BT READ
BLOCK ID
LIM
LIMIT TEST (CIRC)
Low limit 0
Test N7:410
1
High limit 60
CALC
OFFSET
POINTER
CPT
COMPUTE
Destination N7:409
50
Expression
N7:409 * 50
PERFORM
TRANSFER
TO DATA
FILE
FAL
FILE ARITH/LOGICAL
Control R6:0
Length 50
Position 0
Mode ALL
Destination #N[N7:408][N7:409]
0
Expression
#N7:412
EN
DN
ER
ENCODES
BT WRITE
BLOCK ID
MOV
MOVE
Source N7:411
1
Destination N7:310
0
USER CFG
DOWNLOAD
SELECT
B3
0
ENCODES
BT WRITE
BLOCK ID
MOV
MOVE
Source 255
Destination N7:310
0

```
Example PLC Ladder Logic                                        Sat May 31, 1997   Page 3
Rung 2:1
       This rung calls a subroutine that toggles the Enable bits on the writes based
       on the done bit being received.
| N7:400                                                                  +JSR--------------+ |
+--] [-------------------------------------------------------------------+JUMP TO SUBROUTINE+-+
|    13                                                                  |Prog file number 3| |
|                                                                        |Input parameter   | |
|                                                                        |Return parameter  | |
|                                                                        +------------------+ |

Rung 2:2
       WRITES DATA,COMMAND LIST OR CONFIGURATION BLOCK TO MODULE
       This rung is responsible for transferring data to the module.  This data
       includes the command blocks (0 and 1) and the configuration block (255).
|                                          DECODE                  WRITE TO            |
| BT READ   |BT WRITE                      BT WRITE                BT WRITE            |
| ENABLE    |ENABLE                        BLOCK                   BUFFER              |
|   N7:400     N7:300                     +EQU---------------+  +COP--------------------+  |
+----]/[--------]/[-------------------------++EQUAL             +--+COPY FILE              ++-+
|      15         15                      ||Source A    N7:310|  |Source            #N9:0|| |
|                                          ||                  0|  |Destination     #N7:311|| |
|                                          ||Source B          0|  |Length                50|| |
|                                          ||                   |  +-----------------------+| |
|                                          |+------------------+                           | |
|                                          |     DECODE                  WRITE TO          | |
|                                          |     BT WRITE                BT WRITE          | |
|                                          |     BLOCK                   BUFFER            | |
|                                          |+EQU---------------+  +COP--------------------+| |
|                                          ++EQUAL             +--+COPY FILE              ++ |
|                                          ||Source A    N7:310|  |Source            #N9:50|| |
|                                          ||                  0|  |Destination     #N7:311|| |
|                                          ||Source B          1|  |Length                50|| |
|                                          ||                   |  +-----------------------+| |
|                                          |+------------------+                           | |
|                                          |     DECODE                  WRITE TO          | |
|                                          |     BT WRITE                BT WRITE          | |
|                                          |     BLOCK                   BUFFER            | |
|                                          |+EQU---------------+ +COP--------------------+ | |
|                                          ++EQUAL             +++COPY FILE               +++ |
|                                          ||Source A    N7:310|||Source             #N7:0||| |
|                                          ||                  0|||Destination     #N7:311||| |
|                                          ||Source B        255|||Length                30||| |
|                                          ||                   ||+-----------------------+|| |
|                                          |+------------------+|               USER CFG  || |
|                                          |                    |               DOWNLOAD  || |
|                                          |                    |               SELECT    || |
|                                          |                    |                  B3    || |
|                                          |                    +------------------(U)----+| |
|                                          |                                       0    | |
|                                          |                           BT WRITE         | |
|                                          |                           TO MODULE        | |
|                                          |                 +BTW--------------------+  | |
|                                          +-----------------+BLOCK TRANSFER WRITE   +-(EN)+ |
|                                                            |Rack                 00|       |
|                                                            |Group                 0+-(DN)  |
|                                                            |Module                0|       |
|                                                            |Control block    N7:300+-(ER)  |
|                                                            |Data file        N7:310|       |
|                                                            |Length               64|       |
|                                                            |Continuous            N|       |
|                                                            +-----------------------+       |
Rung 2:3
|                                                                                             |
+---------------------------------------------[END OF FILE]-------------------------------+
|                                                                                             |

Rung 3:0
|                                                                                             |
+---------------------------------------------[END OF FILE]-------------------------------+
|                                                                                             |
```

Example PLC Ladder Logic — Sat May 31, 1997
Data Table Report — PLC-5/25 File MDA4 — Data Table

**File N7:0**

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| N7:0 | 5 | 5 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| N7:10 | 257 | 257 | 257 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N7:20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N7:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**File N9:0**

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| N9:0 | 63 | 0 | 31 | 0 | 768 | 0 | 0 | 0 | 0 | 0 |
| N9:10 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:20 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N9:90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

**File N10:0**

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| N10:0 | 3864 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| N10:10 | 6 | 2 | 1997 | 6 | 40 | 28 | 0 | 0 | 0 | 0 |
| N10:20 | 1211 | 516 | -1 | -32296 | -16334 | 0 | 24257 | -1 | 0 | 0 |
| N10:30 | -1 | -1 | 152 | 121 | 132 | 135 | 0 | 0 | 0 | 0 |
| N10:40 | 20040 | 13101 | 18761 | 129 | 153 | 8898 | 2624 | 8898 | 3356 | 0 |
| N10:50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:60 | 20040 | 13101 | 18761 | 129 | 122 | 8898 | 2624 | 8898 | 3356 | 0 |
| N10:70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:80 | 20040 | 13101 | 18761 | 129 | 131 | 8898 | 2624 | 8898 | 3356 | 0 |
| N10:90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:100 | 20040 | 13101 | 18761 | 129 | 135 | 8898 | 2624 | 8898 | 3356 | 0 |
| N10:110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N10:290 | 19780 | 16692 | 12590 | 12336 | 12594 | 12338 | 0 | 0 | 0 | 0 |

**File N11:0**

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| N11:0 | 1751 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:10 | 6 | 2 | 1997 | 6 | 40 | 29 | 0 | 0 | 0 | 0 |
| N11:20 | 1211 | 516 | -1 | -32296 | -16334 | 0 | 24257 | -1 | 0 | 0 |
| N11:30 | -1 | -1 | 153 | 121 | 132 | 134 | 0 | 0 | 0 | 0 |
| N11:40 | 20040 | 13101 | 18761 | 129 | 152 | 8898 | 2624 | 8898 | 3357 | 0 |
| N11:50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:60 | 20040 | 13101 | 18761 | 129 | 121 | 8898 | 2624 | 8898 | 3357 | 0 |
| N11:70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:80 | 20040 | 13101 | 18761 | 129 | 131 | 8898 | 2624 | 8898 | 3354 | 0 |
| N11:90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:100 | 20040 | 13101 | 18761 | 129 | 135 | 8898 | 2624 | 8898 | 3354 | 0 |
| N11:110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N11:290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**File N12:0**

| Address | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| N12:0 | 1740 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:10 | 6 | 2 | 1997 | 6 | 40 | 27 | 0 | 0 | 0 | 0 |
| N12:20 | 1211 | 516 | -1 | -32296 | -16334 | 0 | 24257 | -1 | 0 | 0 |
| N12:30 | -1 | -1 | 152 | 123 | 131 | 135 | 0 | 0 | 0 | 0 |
| N12:40 | 20040 | 13101 | 18761 | 129 | 154 | 8898 | 2624 | 8898 | 3355 | 0 |
| N12:50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:60 | 20040 | 13101 | 18761 | 129 | 122 | 8898 | 2624 | 8898 | 3355 | 0 |
| N12:70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:80 | 20040 | 13101 | 18761 | 129 | 131 | 8898 | 2624 | 8898 | 3355 | 0 |
| N12:90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:100 | 20040 | 13101 | 18761 | 129 | 133 | 8898 | 2624 | 8898 | 3355 | 0 |
| N12:110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:120 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:170 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:190 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:210 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:230 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:270 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:280 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N12:290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |