3100/3101- CAS
Revision 1.1
3150/3151- CAS
Revision 1.1

September 1995

Teledyne CA Slave

USER MANUAL

Please Read This Notice   Successful application of the CAS card requires a reasonable working knowledge of the Allen-Bradley PLC or SLC hardware and the application in which the combination is to used. For this reason, it is important that those responsible for implementing the CAS 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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I   Card Overview

The 3100/3150-CAS ("CA Slave") product family allows Allen-Bradley 1771 and 1746 I/O compatible processors to easily interface with Teledyne CA protocol compatible hosts. The product is available from ProSoft Technology as either a module or a firmware solution. The firmware solution allows standard Allen-Bradley 1771-DB/B and 1746-BAS modules to be used as hardware platforms.

The CAS product includes the following standard features:

<u>General Specifications</u>
- Two fully configurable serial ports, each capable of supporting the Teledyne CA Slave protocol.

- RS-232C handshaking for SCADA radio/modem applications

- RS-422/RS-485 compatible for multidrop applications with up to 32 slaves per port

- Software configuration (From processor ladder logic)
Slave Addr	:	1 to 254 (255 is broadcast)
Parity	:	None, odd, or even,
Stop Bit	:	1 or 2
Baud Rate	:	300 TO 38,400
RTS to TxD	:	0-65535 ms, 1 ms resolution
RTS Off	:	0-65535 ms, 1 ms resoluton

- 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

<u>Protocol Driver Specifications</u>
- Protocol:
  Teledyne CA Slave

- Function codes:
1	Read Status Data
2	Read Analog Data
3	Read Meter Data
10	Read Frozen Analog Values
11	Read Frozen Meter Data
16	Read All Data
20	Read Tank Data from RTU
30	Control - Momentary Select
31	Control - Momentary Operate
32	Control - Continuous Select

33	Control - Continuous Operate
34	Setpoint - Select
35	Setpoint - Operate
43	Freeze Meters
44	Freeze Analogs
45	Freeze Meters/Analogs

- Supports broadcast commands from Master

- Register addressing

Status	:	Up to 250 words
Analog	:	Up to 250 words
Meter	:	Up to 250 values (2 words per value)
Tank	:	Up to 250 words

- Supports Write Commands from Host
    - Operates in both Direct or Indirect Modes
    - Setpoint Select and Operate
    - Control Point - Continuous and Momentary

- Error Status and Communication Statistics for each port returned to the ladder processor

II   Configuring the Module

2.1   Hardware Overview

When purchasing the CAS product, there are two available choices for each platform. These choices are as follows:

		ProSoft Cat Num	
Description		**PLC**	**SLC**
Module provided by ProSoft		3100-CAS	3150-CAS
Firmware only		3101-CAS	3151-CAS

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-CAS module (See Appendix C for details on jumper locations):

Jumper	**3100-CAS**	**3101-CAS**
JW1	N/A	Enabled
JW2	N/A	32K PROM
JW3	N/A	Turbo
JW4	Not Used	ASCII/ASCII
JW5	16 Pt	16 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 CAS 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   16 Point
The module has only been tested in the 8 and 16 point modes and has
successfully operated in both positions. The 8 point mode should be
used when installing the module into old PLC-2 installations.

JW6   Port 2 Baud Rate   Not Used
This jumper is not used by the CAS 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
CAS 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-CAS module (See Appendix C for
details on jumper locations):

Jumper	**3150-CAS**	**3151-CAS**
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
CAS 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 <u>essential</u> 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 identi-fication 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 Programming Considerations

The CAS product family is very easy to implement. In both the PLC and the SLC platforms, the addition of several simple ladder rungs and the configuration of several configuration registers enables the module to operate as a very effective Modbus Master and Slave protocol interface. To ease initial contact with the product we have included a demonstration ladder program in Appendix A. An electronic copy of the ladder logic is available on disk with each product purchase.

The following discussion covers the example logic located in Appendix A in an overview fashion. In addition, an explanation is given on how to adjust the ladder logic for a different application.

3.1   3100-CAS Overview

Programming of the 3100-CAS is less complicated than our previous products for the PLC-5 environment. Once all of the jumpers have been setup and the chip installed, the module is ready to be configured and run. See Section 4 for details on configuring the module.

In order to get the CAS operating with the example ladder logic only one modification should be necessary. The ladder logic BTR and BTW instructions may need to be modified to ensure that the Block Transfer instructions are set up for the correct rack and group (slot) address.

3.2   3150-CAS Overview

The 3150-CAS is also very easy to get operational. After the lens cover and firmware are installed and the jumpers have been configured, the module is ready to be configured. See Section 4 for details on configuring the module.

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 CAS module, the user should be certain to configure the correct slot as a 1746-BAS 5/02 Configuration.

3.2.1 SLC Processor I/O 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 CAS module.

> It is important that the slot containing the ProSoft module be configured as follows:
> -   1746-BAS module or enter 13106 for the module 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 CAS 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

3.3   Ladder Logic Considerations

Those familiar with our 1100 family of products will observe that the ladder logic requirements for the CAS are substantially less. Much of the simplification of the ladder logic is due to:

- The module now controls and feeds the Block ID numbers to the ladder logic. All ladder logic associated with manipulating the Block ID number has been eliminated

The number of data registers transferred to/from the module is controlled through the setup of several configuration registers (See Section 4):

1. Write Data Block Count

3.3.1 Operational Overview

On power up the module moves a 255 into Word 1 of the BTR data file. This is a signal that the module needs to receive configuration data before proceeding any further. Once the configuration is received the module will begin transferring data to and from the processor.

IV   *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/SLC must be in the RUN/REM RUN mode to configure the module. Once configured, if the processor is in any other mode (Fault/PGM), the block transfers between the PLC and the module will time out, and a error condition will be returned to the Host.

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**
	0-19	Module 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	Slave Address
2	N[]:2	Baud Rate
3	N[]:3	RTS to TxD Delay
4	N[]:4	RTS off Delay
5	N[]:5	Message Response Timeout
6	N[]:6	Inter-character timing
7	N[]:7	Direct Control
8	N[]:8	Not Used
9	N[]:9	Not Used

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Port 2

        10 N[]:10 Port Configuration Word
        11 N[]:11 Slave Address
        12 N[]:12 Baud Rate
        13 N[]:13 RTS to TxD Delay
        14 N[]:14 RTS off Delay
        15 N[]:15 Message Response Timeout
        16 N[]:16 Inter-character timing
        17 N[]:17 Direct Control
        18 N[]:18 Not Used
        19 N[]:19 Not Used

System Configuration

        20 N[]:20 Not Used
        21 N[]:21 Data Block Count
        22 N[]:22 Not Used
        23 N[]:23 Not Used
        24 N[]:24 Not Used
        25 N[]:25 Block Transfer Delay Counter
        26 N[]:26 Status Data File Length
        27 N[]:27 Analog Data File Length
        28 N[]:28 Meter Data File Length
        29 N[]:29 Tank Data File Length

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:

> **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

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```
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 <u>1 ms increments</u> 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 <u>1 ms time delay increments</u> 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).

Message Response Timout: This register represents the message response timeout period in 1 ms increments. This is the time which a port configured as a Master will wait before re-transmitting a command if no response is received from the addressed slave. The value is set depending on the expected slave response times.

The allowable range of values is 0 to 65535(0xffff). If a zero value is entered, the module will default to a one second timeout value (1000 ms).

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 satallite 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.

Direct Control : This parameter configures the module to accept the Control-Operate commands from a Master without first receiving a Control-Select command first. To disable the need for the Control-Select command, set this parameter to a value of 1.

System Configuration

Data Block Count: This value represents the number of 50 word data blocks which are to be transferred from the processor to the CAS Module. The module will use this value to return a BTW Block ID Number to the processor. The ladder logic can use this value to determine which data to move to the CAS via the Block Transfer Write. The maximum block count is 80.

As an example, if a value of 5 is entered, the CAS will return Block ID numbers 0, 1, 2, 3, and 4 to the ladder logic (See Section 4.2).

> If a value greater than 80 is entered, a System Configuration Error is activated

Block Transfer Delay Counter: This value is used by the module to slow down the block transfer loading between the module and the processor. Excessive Block Transfers can slow down the response time of the CAS's communication ports. This parameter has been provided to allow the Block Transfer timing to be determined on an application basis. A value of 0 is normally used at the factory and is recommended as a starting point.

Status Data File Length, Analog Data File Length, Meter Data File Length, and Tank Data File Length : These parameters allow the user to configure the logical size of the respective data tables in the module. Each table has a maximum size of 250 words, but can be downsized to any size below this. The size

optimization is useful under some implementations requesting all available data.

4.1.2 Moving Data to the Module [Block ID Codes 0-19]

Writing register data to the ProSoft Technology module is a simple Block Transfer Write with Block ID codes from 0 to 19 followed by 50 words of data. The actual data table starts at word 0 (Block ID #0, word 0), and is built incrementally after this.

For a maximum configuration, the Block ID codes are broken down as follows:

Data Type	Block ID	Max Size
Status Data	0 to 4	250 words
Analog Data	5 to 9	250 words
Meter Data	10 to 14	250 words
Tank Data	15-19	250 words

Assuming a smaller configuration with the following requirements:

Status File	3 words
Analog File	3 words
Meter File	2 values (4 words)
Tank File	2 words

The data for this configuration will all map into Block ID#0. Assuming we are using N10 as the data file in the PLC, the data will map as follows:

PLC Addr	Type/Addr
N10:0	Status - Word 0
N10:1	Status - Word 1
N10:2	Status - Word 2
N10:3	Analog - Word 0
N10:4	Analog - Word 1
N10:5	Analog - Word 2
N10:6	Meter - Value 0 high
N10:7	Meter - Value 0 low
N10:8	Meter - Value 1 high
N10:9	Meter - Value 1 low
N10:10	Tank - Word 0
N10:11	Tank - Word 1

With this configuration, the user need only send Block ID #0 to the module.

4.2 Reading Data from the Module

This section discusses how to get data written to the ProSoft module by a Master into the PLC. Supported TCAP Functions include 30, 31, 32, 33, 34, and 35.

The transfer of data from the ProSoft Technology module to the processor is executed through the Block Transfer Read function. Three

basic different types of data are read from the module into the processor;

- Module Status Data [Block ID 0]
- Write Data from Host [Block ID 1, 2 or 4]
- Configuration Request [Block ID 255]

The data structure for the block transfer depends on the type of block data. The following sections detail the different types of data.

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

The ladder logic must be programmed to look at the BTR buffer, decode several words, and then take action.   The BTR buffer definition is:

Word	Description
0	Block ID Code
1	BTW Block ID Number
2-62	Data

Where:

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 22 of Block 255 (See Section 4.1.1). This value is intended to only be a suggestion and to ease the ladder logic programming requirements. If it is desired to develop a different data transfer series, this may be easily accomplished in ladder logic.

Data: The contents of the module's Register Data space (0 - 999). This data will contain data received from the slaves and data moved from the processor.   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.

4.2.1 Momentary/Continuous Control(Func 30, 31, 32 and 33)

When a Momentary or a Continuous Control command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with. The Control command will not be transferred to the buffer unless the Operate Command (31 or 33) is received immediately after a Select Command (30 or 32), or if Direct Control is enabled in the module's configuration. *The ladder logic must provide the logic to enable the momentary action. The ProSoft module will not provide the command to the PLC to clear or reset the bit).*

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

WORD	DESCRIPTION
0	Control Type
	1 = Momentary Control
	2 = Continuous Control
1	BTW Block ID Number
2	Bit Addressed
3	Control Action

Control Type: Word 0 of the BTR buffer is used to tell the PLC what type of Control action has been commanded from the Master. When the value is equal to 1, a new Momentary Control command has been received. When the value is equal to 2, a new Continuous Control command has been received. With simple ladder logic to decode this value, the appropriate word/bit can be acted upon. The exact location that the PLC will act upon is determined by the next two words.

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

Control Action: The action commanded by the Master is transferred in this word. When the value is a 0, the addressed bit is to be reset, and when the value is a 1, the addressed bit is to be set. The value is always set to one for Momentary Control.

4.2.2 Setpoint Control (Func 34 and 35)

When a Setpoint Control command is received from a Master, the ProSoft module transfers the command immediately to the BTR buffer for the ladder logic to work with. The Setpoint Control command will not be transferred to the buffer unless the Operate Command (35) is received immediately after the Select Command (34), or if Direct Control is enabled in the module's configuration.

WORD	DESCRIPTION
0	Control Type
	4 = Setpoint Control
1	BTW Block ID Number
2	Word Addressed
3	Setpoint Value

Where:

Contorl Type: Word 0 of the BTR buffer is used to tell the PLC what type of Control action has been commanded from the Master. When the value is equal to 4, a new Setpoint Control command has been received. With simple ladder logic to decode this value, the appropriate action can be taken.

Word Address: 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.

4.2.3 Slave Error Code Table

The CAS 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 returned to the processor whenever the BTR Block ID is 0.

WORD	DESCRIPTION
0	BTR Block ID
	0 = Module Status
1	BTW Block ID Number
2	Begin Status Data Block

The structure of the data block is as follows:

WORD	DESCRIPTION
Port 1	
0	Port Scan/Error 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	Port Scan/Error 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:

Port Scan/Error Status: This register contains the port's Scan status in the upper byte and the port's current error status in the lower byte. The Scan Status is encoded in the upper byte as follows:

Bit	Description
13	Status Data scan
14	Analog Data scan
15	Read All Data scan

Port error status codes 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 CAS product, the letters ' CAS ' 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.

4.2.4 Error Status Codes

The Error Codes returned in the Slave and Master Error Code Tables reflect 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	Illegal Function An illegal function code request has been received from the master
2	Illegal Data Address The address, or the range of addresses, covered by a request from the master are not within allowed limits
3	Illegal Data Value The value in the data field of the command is not allowed.
6	Module Busy The module busy status code is returned when a write command from the master has not yet been completed when a second write command is received
7	Illegal Command An illegal function code request has been received from the master
9	Data Sequence Error The Operate command was received out of sequence (not immediately after a Select)
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.

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V   *Protocol Commands*

The ProSoft Technology CAS module communication driver supports several data read and write commands. When configuring an application, it may be important to understand how the commands function in order to determine how to structure the application data.

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   Function 1 : Read Status Data

The module supports access to a total of up to 250 words of status data from the ladder processor. In TCAP vernacular, the 'Start Card Address' is used to identify the starting word, and the 'Number of Cards' is used to identify the number of words.

5.1.2   Function 2 : Read Analog Data

The module supports access to a total of up to 250 words of analog data from the ladder processor. In TCAP vernacular, the 'Start Card No.' and the 'Start Point No.' (Upper and lower four bits, respectively) are treated as one byte to develop a starting word address, while the 'Number of Analogs' is used to determine the number of words to be returned to the Master.

5.1.3   Function 3 : Read Meter Data

The module supports access to a total of up to 250 words of Meter data (125 meter readings) from the ladder processor. In TCAP vernacular, the 'Starting Meter Number' is used to determine the first word to be accessed, while the 'Number of meters to be returned' value is used to determine the number of words to be returned to the Master.

5.1.4   Function 10: Read Frozen Analog Data

This function provides the Master access to the contents of up to a 250 word buffer maintained in the module. This buffer contains the analog values stored as a result of the last 'Freeze Analogs' command (44/45) received from the Master. It is addressed in the same fashion as Function 2.

5.1.5   Function 11: Read Frozen Meter Data

This function provides the Master access to the contents of up to a 250 word buffer maintained in the module. This buffer contains the meter values stored as a result of the last 'Freeze Meters'

command (43/45) received from the Master. It is addressed in the same fashion as Function 3.

5.1.6 Function 16: Read All Data

This general purpose command is partially supported in the ProSoft Module. The following Data Select Types are available from the module:

- Status Inputs (Data Select bit 7)
- Analog Inputs (Data Select bit 6)
- Meter Accumulator Inputs (Data Select bit 5)

The command allows up to 63 analog values to be requested and up to 7 meters. If no data quantity is requested (length fields are zero), all of the available data, as defined in the Configuration Parameters, will be returned. When the Status Inputs are requested, the full status table is returned.

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 within the Status Data block.

5.2.1 Function 30/31 : Momentary Control Select/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 Select command), the command is disregarded. If the module is configured for Direct Control, then the Master need only send the Operate command for action to occur. In TCAP vernacular, the 'Card Number' and the 'Point Number' are combined to identify the bit number. The action value is always set to 1, so the action will always be to set a bit true momentarily. With this decoding, indirect addressing can be used(in PLC5) to decode the addressed bit:

B13 / [N7:x]

where N7:x is Word 1 of the BTR data block from the module.

5.2.2 Function 32/33 : Continuous Control Select/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 Select command), the command is disregarded. If the module is configured for Direct Control, then the Master need only send the Operate command for action to occur. In TCAP vernacular, the 'Card Number' and the 'Point Number' are combined to identify the bit number. With

this decoding, indirect addressing can be used(in PLC5) to decode the addressed bit:

B13 / [N7:x+1]

where N7:x is Word 1 of the BTR data block from the module.

5.2.3   Function 34/35 : Setpoint Select/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 Select command), the command is disregarded. If the module is configured for Direct Control, then the Master need only send the Operate command for action to occur. In TCAP vernacular, the 'Card Number' (upper 7 bits) is combined with the 'Point Number' (low 1 bit) to obtain an effective addressing range of 256 registers. The value written to the ladder logic limited to a 12 bit value by the protocol specification.

5.3   Freeze Data Commands

These general purpose commands are used to initiate the movement of data within buffers in the ProSoft Technology module. These buffers are maintained for access by related read commands, discussed above.

The module one-shots the freeze commands from the Master, enable the movement of the buffers only if the Master has previously issued a read to the previously frozen buffer.

5.3.1   Function 43 : Freeze Meters

Moves the Meter Data buffer to the Freeze Meter buffer.

5.3.2   Function 44 : Freeze Analogs

Moves the Analog Data buffer to the Freeze Analog buffer.

5.3.3   Function 45 : Freeze Meters and Analogs

Moves the Meter Data buffer and the Analog Data buffer to their respective Freeze buffers.

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 CAS 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

Table 6.1 : PLC Platform LED Indication (Cont'd)

ProSoft Name	DB Name	Color	Status	Indication
CFG	DH485	Green	Off	<u>Normal state</u> : 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	<u>Normal State</u> : 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	<u>Normal State</u> : 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 CAS slave • Recurring error condition on CAS 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 CAS 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-CAS

COMMUNICATIONS

	ACT		FAULT
	CFG		BPLN
	PRT1		ERR1
	PRT2		ERR2

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

Table 6.2 : SLC Platform LED Indication (Cont'd)

LED Name	Color	Status	Indication
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 CAS slave • Recurring error condition on CAS 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
<u>Corporate</u>
ProSoft Technology, Inc.
9801 Camino Media
Suite 105
Bakersfield, CA 93311
(805) 664-7208
(800) 326-7066
(805) 664-7233 (fax)

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 hierachy
4.   Physical connection information
    -   RS-232, 422 or 485
    -   Cable configuration
5.   Module Operation
    -   Block Transfers operation
    -   LED patterns

A BBS is available for the latest information on updates and new products. The phone number for the Bulletin Board is (805) 664-7234. Access is available 24 hours per day.

In addition to 24 hour access to the BBS, an after-hours answering service (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 CAS 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 at (805) 664-7208 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

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

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

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APPENDIX A-1

PLC-5 Example Ladder Logic

APPENDIX A-2

SLC-5/02 Example Ladder Logic

APPENDIX B

CABLE DIAGRAMS

RS-232
-
RS-422
-
RS-485

Definitions of RS-232C Handshaking Signals

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 CAS product family does not require the DSR signal to operate correctly. This signal is disregarded by the CAS units.
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. This signal is disregarded by the CAS units.

(Excerpted form Allen-Bradley Publication 1785.6.5.2)

RS-232C Cable Configuration

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
20DTR	4	------------------	20

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

Without 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
		|	
		-----	20 DTR
7 GND	5	------------------	7 GND

RS-422/RS-485 Cable Configuration

Two Wire Mode :

	ProSoft Module		**Foreign Device**

```
       25-Pin    9-Pin
         4  RTS    7     ----
                            |
         5  CTS    8     ----

         14 TxRxD+ 9     --------------------    A(+) TxRxD+

         25 TxRxD- 1     --------------------    B(-) TxRxD-

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

Four Wire Mode :

	ProSoft Module		**Foreign Device**

```
       25-Pin    9-Pin
         4  RTS    7     ----
                            |
         5  CTS    8     ----

         14 TxD+   9     --------------------    RxD+

         16 RxD+   6     --------------------    TxD+

         18 RxD-   2     --------------------    TxD-

         25 TxD-   1     --------------------    RxD-

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

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

APPENDIX C

Jumper Configurations

1771 Platform
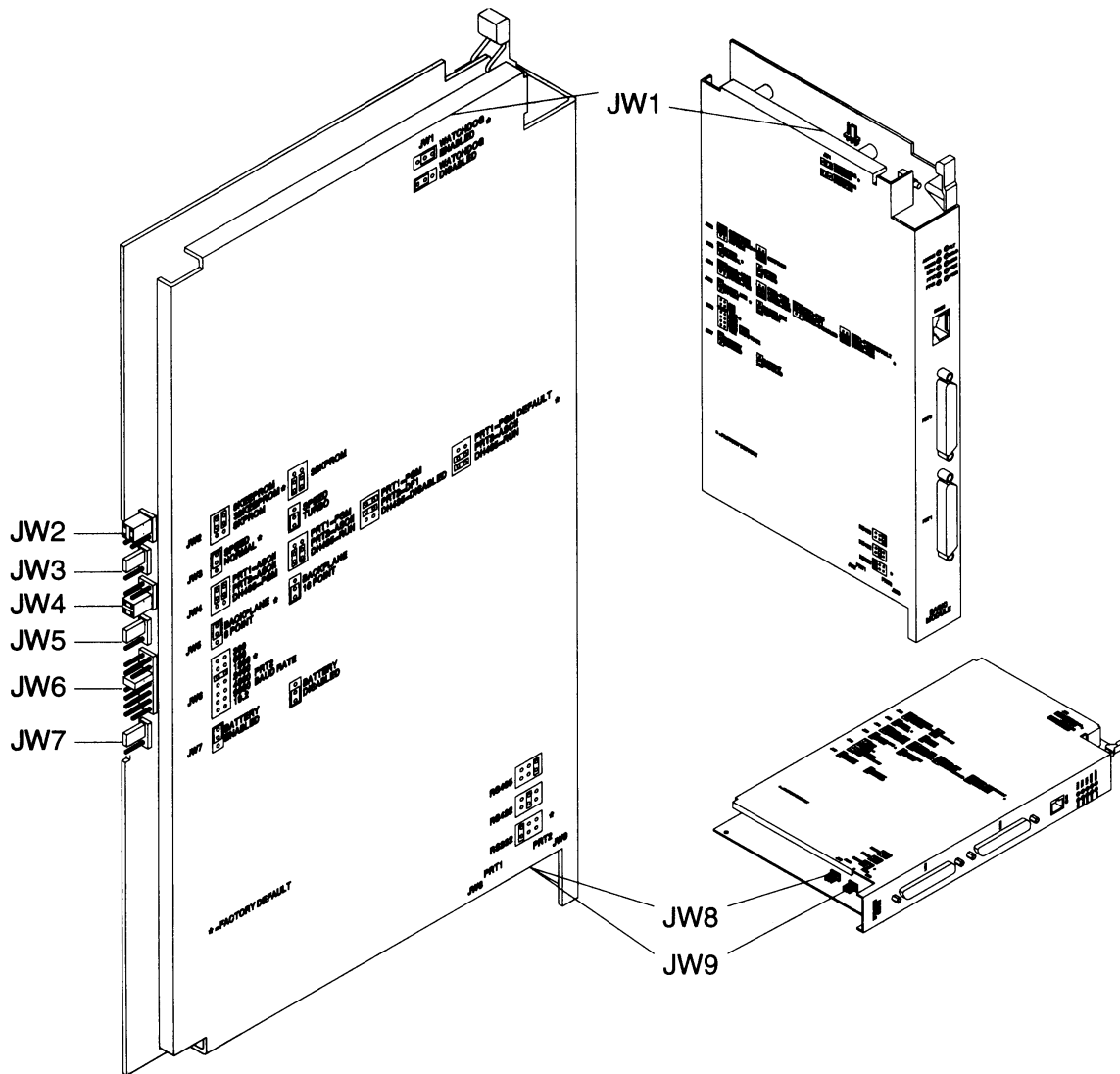- **3100 Module**
- **1771-DB Revision B Module**

1746 Platform
- **3150 Module**
- **1746-BAS Module**

3100 Module from ProSoft Technology

The 3100 module from ProSoft Technology is shipped from the factory as a complete unit including any applicable firmware resident in the module.
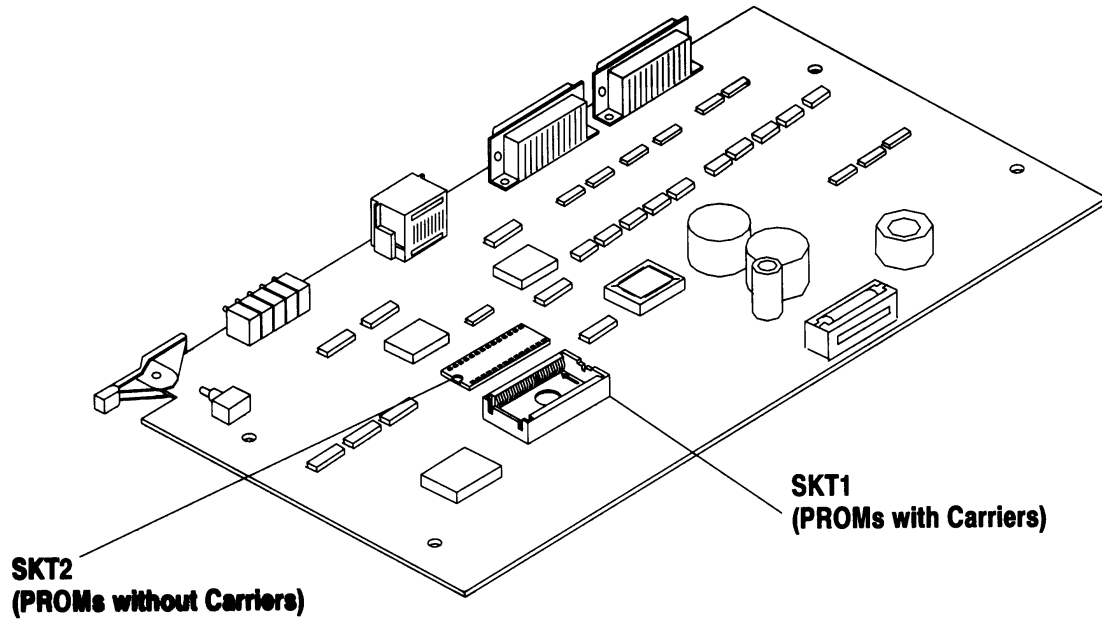
All jumper configurations have been preset for the module to pass a functional test at the factory. Verify jumper placement with Section 2 of the manual for application specific changes.

1771-DB Revision B Module from Allen-Bradley

The 3101 firmware solution is installed into an Allen-Bradley 1771-DB Revision B module. To successfully operate the module, the firmware must be installed and the jumpers must be configured.

Section 2 of the manual details the correct positioning for the jumpers.

In addition, Section 2 also details the steps necessary to install the firmware chip. The ProSoft Technology firmware is shipped in a plastic carrier to help minimize erroneous installations.

The following diagrams help to identify the physical location of the jumpers on the module and location of the firmware socket.

1771-DB Revision B Module from Allen-Bradley (Cont'd)

Firmware installation diagrams:

SKT1
(PROMs with Carriers)

SKT2
(PROMs without Carriers)

20371-M

Firmware Socket Location (SKT1)

SKT1
(PROMs with Carriers)
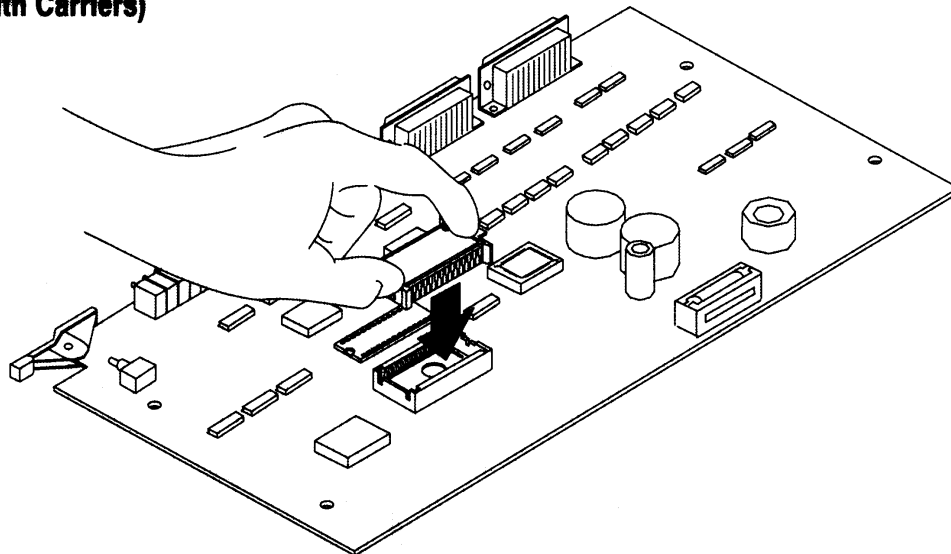
20372-M

Firmware Installation

3150 Module from ProSoft Technology

Jumpers JW 1 and JW 2: Port 1 and Port 2 Configuration

Both of these ports operate electrically in a very similar fashion. The following diagrams depict the appropriate jumper placement.
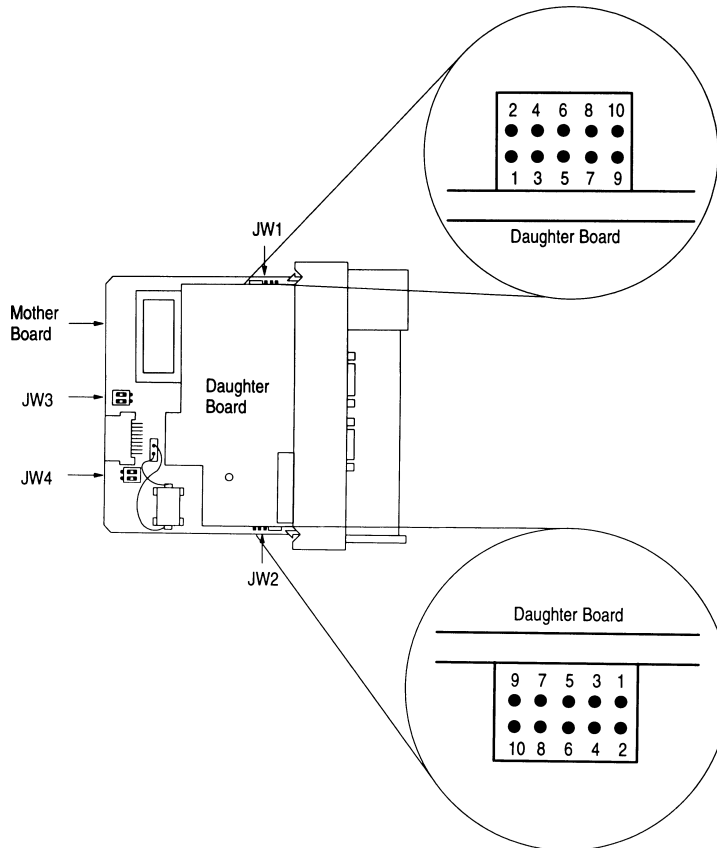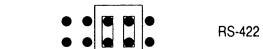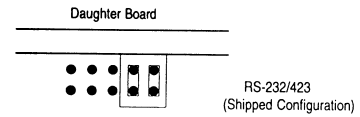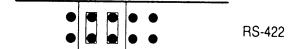
Jumper JW1 Settings

RS-232/423
(Shipped Configuration)

Daughter Board

RS-422

Daughter Board

RS-485

Daughter Board

2 4 6 8 10

1 3 5 7 9

JW1

Daughter Board

Mother Board

JW3

Daughter Board

JW4

JW2

Daughter Board

9 7 5 3 1

10 8 6 4 2

Jumper JW2 Settings

Daughter Board

RS-232/423
(Shipped Configuration)

Daughter Board

RS-422

Daughter Board

RS-485
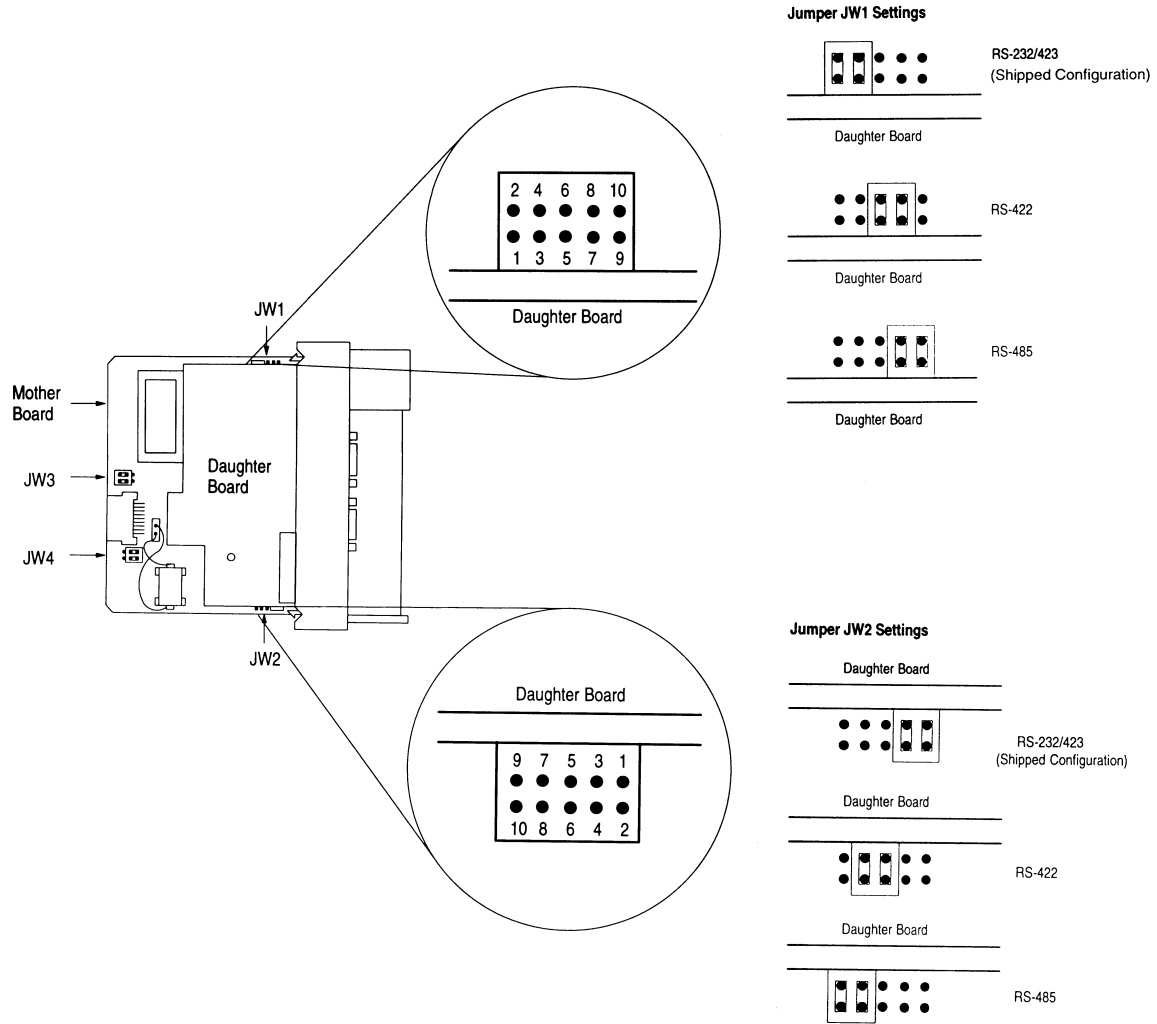
Jumpers JW 3 and JW 4 are not used by 3150 module

1746-BAS Module from Allen-Bradley

Jumpers JW 1 and JW 2: Port 1 and Port 2 Configuration
Both of these ports operate electrically in a very similar fashion. The following diagrams depict the appropriate jumper placement.

Jumper JW1 Settings

RS-232/423
(Shipped Configuration)

Daughter Board

RS-422

Daughter Board

RS-485

Daughter Board

JW1

```
2  4  6  8  10
●  ●  ●  ●  ●
●  ●  ●  ●  ●
1  3  5  7  9
```
Daughter Board

Mother
Board

JW3

Daughter
Board

JW4

JW2

Daughter Board

```
9  7  5  3  1
●  ●  ●  ●  ●
●  ●  ●  ●  ●
10 8  6  4  2
```

Jumper JW2 Settings

Daughter Board

RS-232/423
(Shipped Configuration)
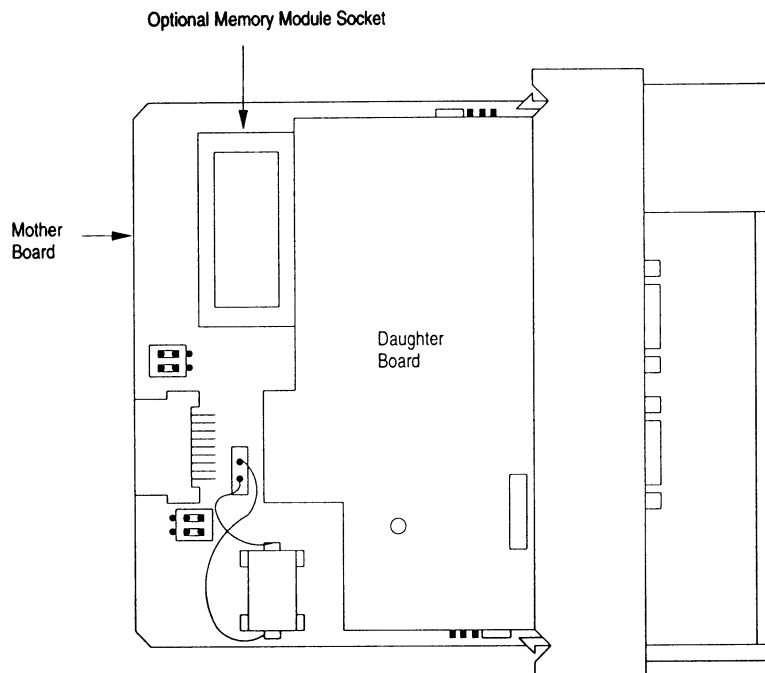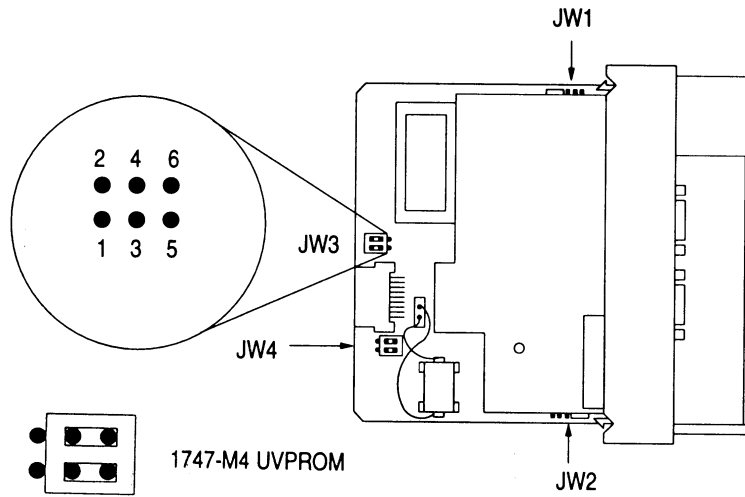
Daughter Board

RS-422

Daughter Board

RS-485
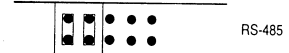
1746-BAS Module from Allen-Bradley (Cont'd)

Jumpers JW 3 : Memory Selection Jumper

This jumper must be selected for the 1747-M4 UVPROM. The jumper must be as follows:
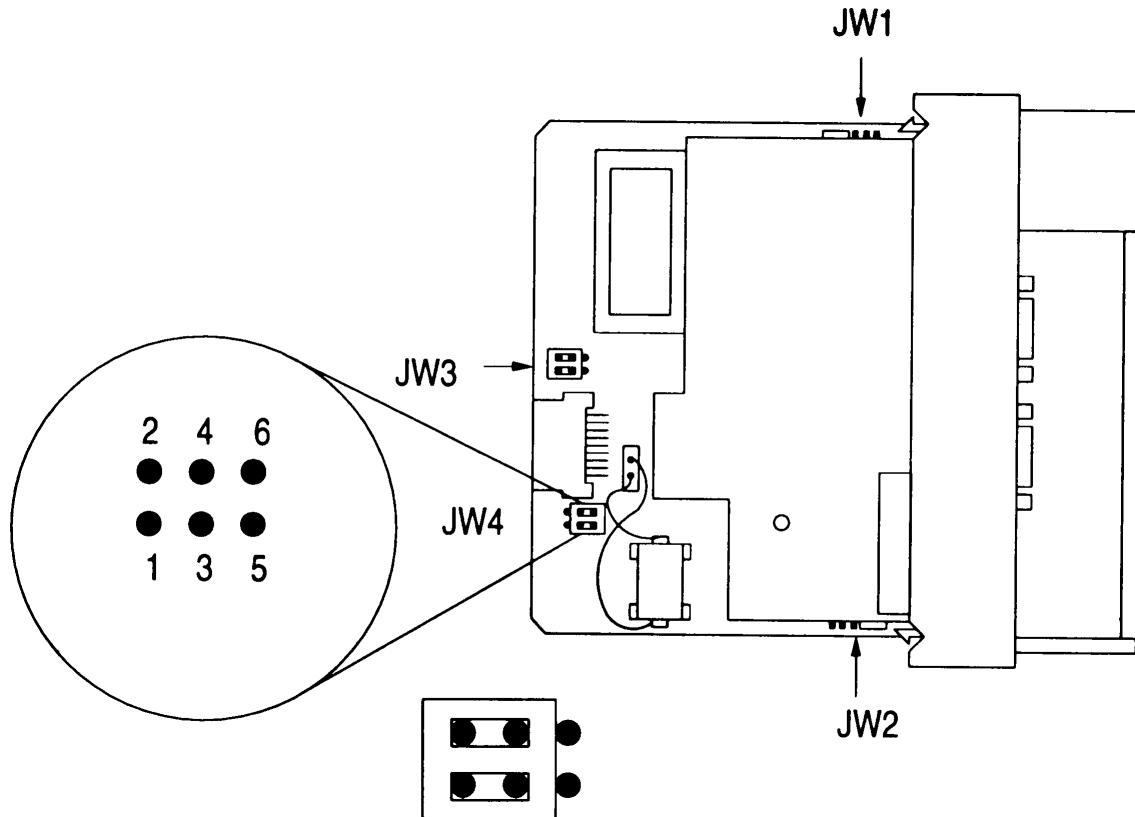
Jump 4 to 6
Jump 3 to 5

1746-BAS Module from Allen-Bradley (Cont'd)

Jumpers JW 4 : Module Port Configuration
This jumper must be selected as follows:

Jump 2 to 4
Jump 1 to 3

APPENDIX D

Product Revision History

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Product Revision History

09/05/95   Revision 1.10
Initial release of product
Started w/ CAS code and original CA Slave Driver code

04/04/96   Revision 1.11 Minor Upgrade
Modified the CAS code for SLC to support the use of DSR signal instead
of DCD. The SLC platform hardware does not have a DCD signal

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