ASCII Driver
Programmable Serial Interface Card

USER MANUAL

Rev. P1.0

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1 INTRODUCTION

1.1 Scope

This document is the User Manual for the ASCII driver firmware for the Emerson Process Management (EPM) DeltaV Control System; it provides information required to install, configure, and maintain the driver firmware on the DeltaV Programmable Serial Interface Card (PSIC). The reader should be familiar with EPM's DeltaV PSIC and connected ASCII devices. Specifically, this driver is custom built to communicate with Allen Bradley PLC/2 and SLC 500 devices using ASCII commands detailed below. Any usage beyond the documented commands is not supported.

The section *Document Format* briefly describes the contents of each section of this manual. *System Specifications* outlines hardware and software requirements for the ASCII Driver (P1.0) firmware.

1.2 Document Format

This document is organized as follows:

Table 1

Introduction	Describes the scope and purpose of this document.
Theory of Operation	Provides a general functional overview of the ASCII Driver.
Downloading Firmware	Describes downloading procedures for the ASCII Driver firmware on to the DeltaV PSIC.
Configuration Information	Describes procedures and guidelines for configuring the DeltaV PSIC.
Operational Check	Provides tips and assistance to ensure PSIC is properly setup and configured.
DeltaV–Field Device Electrical Interface	Describes the electrical interface between DeltaV and the field device. Also describes the cable pin assignments for RS-232 communications.
Technical Support	Describes who to call if you need assistance.

1.3 System Specifications

The following table lists the minimum system requirements for the ASCII Driver:

Table 2

Firmware	ASCII Driver Firmware (P1.0)
Protocol Compatibility	None – Data is sent out in raw ASCII as described below.
Software Requirements	DeltaV System Software (Release 4.2 or later) installed on a hardware-appropriate Windows NT workstation configured as a ProfessionalPlus for DeltaV Serial Interface Port License (VE4102)
Minimum DeltaV Hardware Requirements	DeltaV Serial Module, Hardware Rev 1.1r DeltaV M3, M5, M5+ or MD Controller, Power Supply and 8 wide controller carrier

2 THEORY OF OPERATION

The Programmable Serial Interface Card (PSIC) has 2 ports which can be configured for RS-232, RS-422/RS-485 Half Duplex or RS-422/RS-485 Full Duplex communications with external devices. For communications with ASCII devices, any mode may be used. The ASCII driver will utilize both ports. Each port is designed to support communications with a maximum of 16 PLC devices. Actual number of PLC devices connected is user defined and limited by the switching device described below.

The driver will use a multiplexing method to communicate with PLC devices. Each port will support 1 Code Operated Switch II (Black Box part # SW591C, or COS-II), including a 4-port expansion board. The switching device has 1 RS-232 master communication line coming in, and 8 RS-232 slave communication lines going out to the field. With both PSIC ports available, a total of 16 PLC's can be connected to the DeltaV Serial Card. A unique 1-character prefix code will be configured in the DeltaV Serial Card to switch between 8 slave lines. The ASCII driver will send this prefix sequence to the COS-II, thereby enabling or selecting a given PLC line. Note that the prefix must be such that the PLC does not interpret it as a valid message and ignores it.

Under each PSIC port, there exist 16 datasets. Because the COS-II has capability for 8 slave connections, only 8 datasets will be used. Each dataset will be configured with 100 Registers. The dataset will be sub-divided into 4 groups of 25 Registers, representing Ranges, Setpoints, Flows and Miscellaneous data.

The DeltaV Serial Card Driver functionality will be as follows.

1. The I/O driver will be flashed into the PSIC.

2. The I/O driver will run in Master mode only and be responsible for continuous polling of the PLC's. The purpose of polling will be to read Flow and Miscellaneous data from the PLC's.

3. The I/O driver will also, on detecting changes in Range and/or Setpoint values, write this information to the PLC. On startup, the user can elect to download all Range and Setpoint values as part of establishing communications.

4. The driver will perform error checking on data received. Identical to the present DEC system, the driver will compare response packets. If an error is detected, it will be reported back to DeltaV as status of the Flow and Miscellaneous data registers. The driver will continue to poll the PLC. If response packet comparisons show no error, the error status will be cleared.

2.2 PLC Commands

The following PLC commands will be used to communicate with the PLC/2 and SLC 500 devices. These commands were documented by Jim Boyce, IMC Belle Plaine, in his email dated April 4, 2001.

If the PLC detects an error in communications, an ER<CR> response is sent back to the PSIC. In this case, the driver will retry the command based on Port configuration parameters. If the driver determines that a response is in error, it will abandon this PLC for this cycle and continue to the next PLC. This PLC will be retried during the next scan cycle.

Table 3 - PLC/2 Range Transfer Commands

Direction	Command	Notes
1. PSIC to PLC:	OO~n234n234…n234<CR>	The value n234 is the 4 character range value (with leading zeros). Only the configured number of range values are sent out. The maximum sent is 25.
2. PLC to PSIC:	CC<CR>	PLC response to request confirmation of command.
3. PSIC to PLC:	OO~n234n234…n234<CR>	PSIC resends previous command as confirmation
4. PLC to PSIC	OO<CR>	PLC indicates success

Table 4 - PLC/2 Setpoint transfer Commands

Direction	Command	Notes
1. PSIC to PLC:	SO~n234n234…n234<CR>	The value n234 is the 4 character range value (with leading zeros). Only the configured number of range values are sent out. The maximum sent is 25.
2. PLC to PSIC:	CC<CR>	PLC response to request confirmation of command.
3. PSIC to PLC:	SO~n234n234…n234<CR>	PSIC resends previous command as confirmation
4. PLC to PSIC	SO<CR>	PLC indicates success

Table 5 - PLC/2 Flow Read Commands

Direction	Command	Notes
1. PSIC to PLC:	FI<CR>	PSIC requests that all flows be sent
2. PLC to PSIC:	FI~n234n234…n234<CR>	PLC response to request
3. PSIC to PLC:	CC<CR>	PSIC response to request confirmation of message
4. PLC to PSIC	FI~n234n234…n234<CR>	PLC resends previous response as confirmation.

Table 6 - PLC/2 Miscellaneous Flow Read Commands

Direction	Command	Notes
1. PSIC to PLC:	MI<CR>	PSIC requests that all miscellaneous data be sent
2. PLC to PSIC:	MI~n234n234…n234<CR>	PLC response to request
3. PSIC to PLC:	CC<CR>	PSIC response to request confirmation of message
4. PLC to PSIC	MI~n234n234…n234<CR>	PLC resends previous response as confirmation.

Table 7 – SLC/500 Range Transfer Commands

Direction	Command	Notes
1. PSIC to PLC:	RA~n234n234…n234<CR>	The value n234 is the 4 character range value (with leading zeros). Only the configured number of range values are sent out. The maximum sent is 19 in a single command. For the first 19 values, the command sequence is RA~. For the second 19, the command changes to RB~. The total values supported by a single dataset will not exceed 25.
2. PLC to PSIC:	CC~<CR>	PLC response to request confirmation of command.
3. PSIC to PLC:	RA~n234n234…n234<CR>	PSIC resends previous command as confirmation
4. PLC to PSIC	RA~<CR>	PLC indicates success

Table 8 - SLC/500 Setpoint transfer Commands

Direction	Command	Notes
1. PSIC to PLC:	SA~n234n234…n234<CR>	The value n234 is the 4 character range value (with leading zeros). Only the configured number of range values are sent out. The maximum sent is 19 in a single command. For the first 19 values, the command sequence is SA~. For the second 19, the command changes to SB~. The total values supported by a single dataset will not exceed 25.
2. PLC to PSIC:	CC~<CR>	PLC response to request confirmation of command.
3. PSIC to PLC:	SA~n234n234…n234<CR>	PSIC resends previous command as confirmation
4. PLC to PSIC	SA~<CR>	PLC indicates success

Table 9 - SLC/500 Flow Read Commands

Direction	Command	Notes
1. PSIC to PLC:	FA~<CR>	PSIC requests that all flows be sent. A maximum of 19 can be sent in one message. For all additional values, the command changes to FB~. The maximum flows which can be read into a single dataset is 25.
2. PLC to PSIC:	FA~n234n234…n234<CR>	PLC response to request
3. PSIC to PLC:	CC~<CR>	PSIC response to request confirmation of message
4. PLC to PSIC	FA~n234n234…n234<CR>	PLC resends previous response as confirmation.

Table 10 - SLC/500 Miscellaneous Flow Read Commands

Direction	Command	Notes
1. PSIC to PLC:	MA~<CR>	PSIC requests that all miscellaneous flows be sent. A maximum of 19 can be sent in one message. For all additional values, the command changes to MB~. The maximum flows which can be read into a single dataset is 25.
2. PLC to PSIC:	MA~n234n234…n234<CR>	PLC response to request
3. PSIC to PLC:	CC~<CR>	PSIC response to request confirmation of message
4. PLC to PSIC	MA~n234n234…n234<CR>	PLC resends previous response as confirmation.

2.2 Error Messages In DeltaV

Various levels of error messages will be detected by the ASCII driver and indicated in the DeltaV Diagnostics display. The following table describes the errors:

Table 11

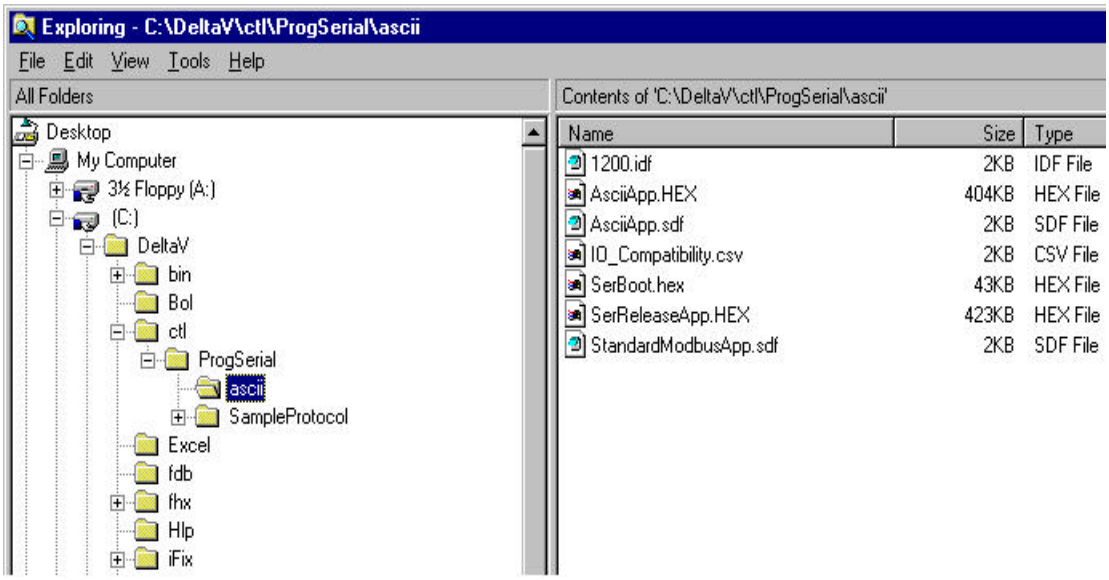
Message Text in diagnostics	Description
Error Response	This is a general error in response
Error Response – Zero Length Response	This is an internal driver error indicating that a response buffer was received without any data in it.
Error Response – ER<CR> Response	This indicates that the PLC sent an ER back.
Error Response – Invalid Response Size	This indicates that the response buffer length did not match what was expected. The expected length is based on the number registers being read or written.
Error Response – Write Error	This indicates that the response received from PLC while writing a buffer was not an ER, or CC
Error Response – Read Error	This indicates that the response received from PLC while reading a buffer was not an ER, or the command echo characters.
Error Response – Write Confirm Error	This indicates that the response received from PLC while writing a buffer was not an ER, or CC during the confirmation cycle
Error Response – Read Confirm Error	This indicates that the response received from PLC while reading a buffer was not identical during the confirmation cycle.
Error – Invalid Device Address	This indicates that the configured device address is not in range (1-8).

3 Downloading the firmware

The driver software distribution comprises 7 files, distributed on a 3.5" diskette. These files must be copied to the DeltaV directory on your ProPlus Workstation. The path is:

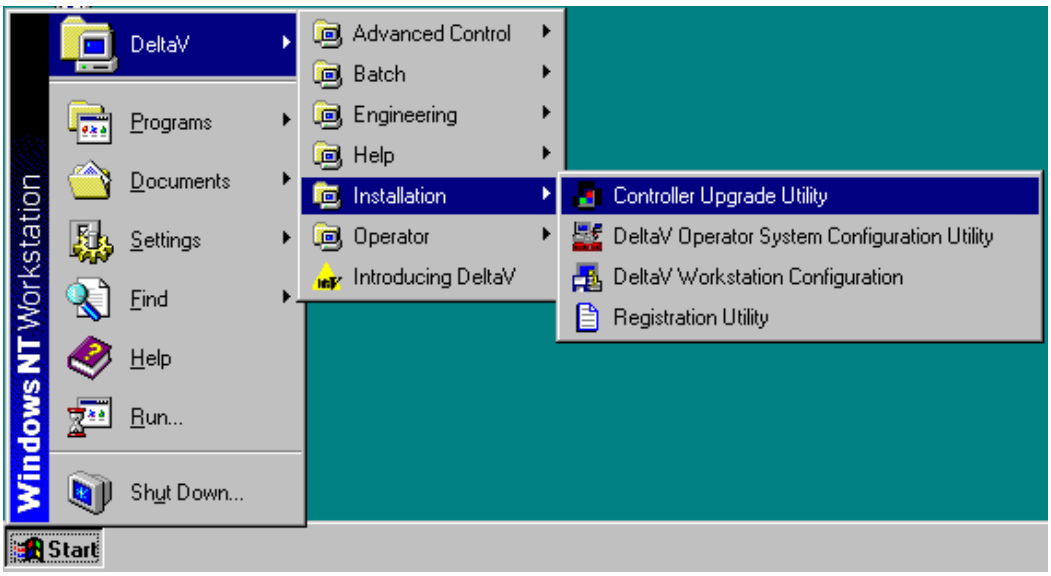
\DeltaV\ctl\ProgSerial\SampleProtocol\Ascii

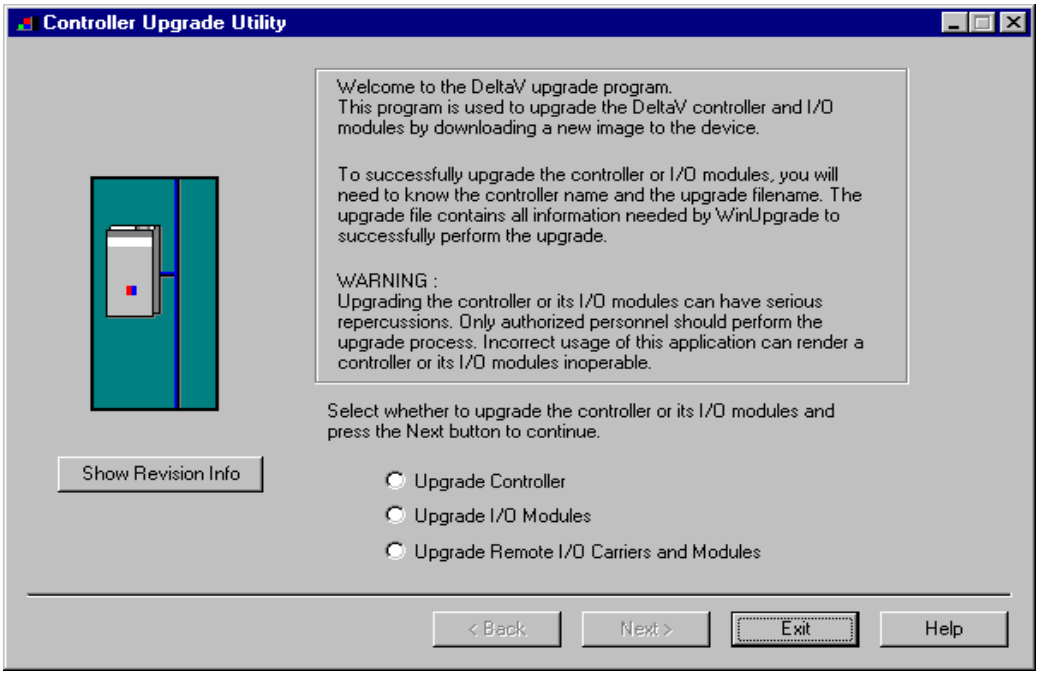
Note that you will have to create the \Ascii subdirectory. The following files will be copied:



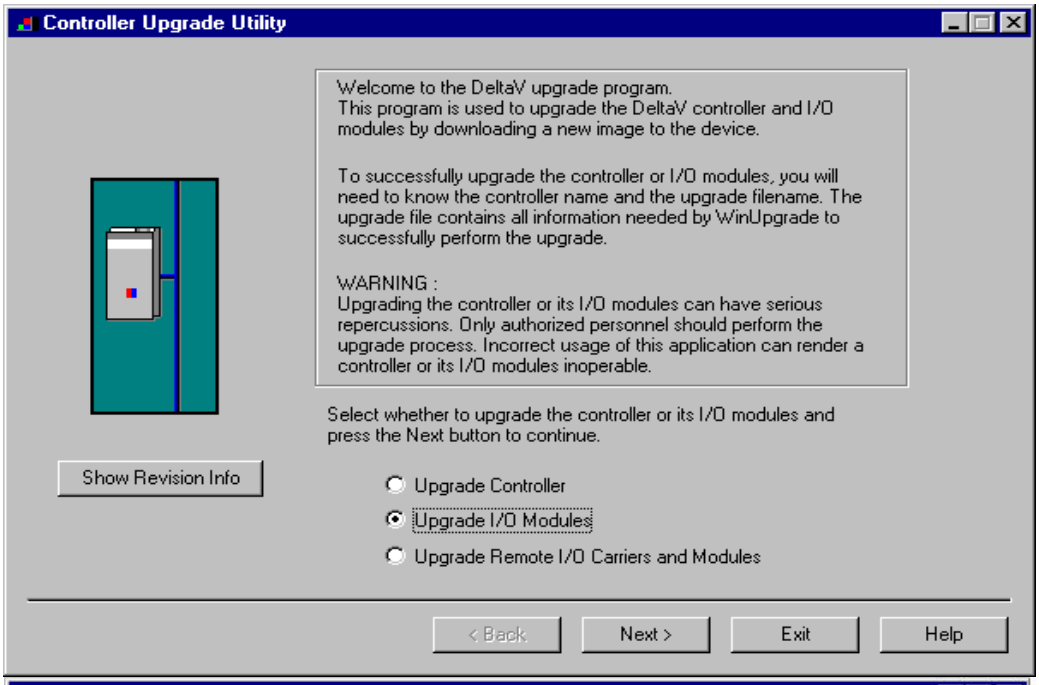
After copy completion, you are ready to program (or upgrade) the Programmable Serial Card with the supplied custom driver software. The steps are as follows:

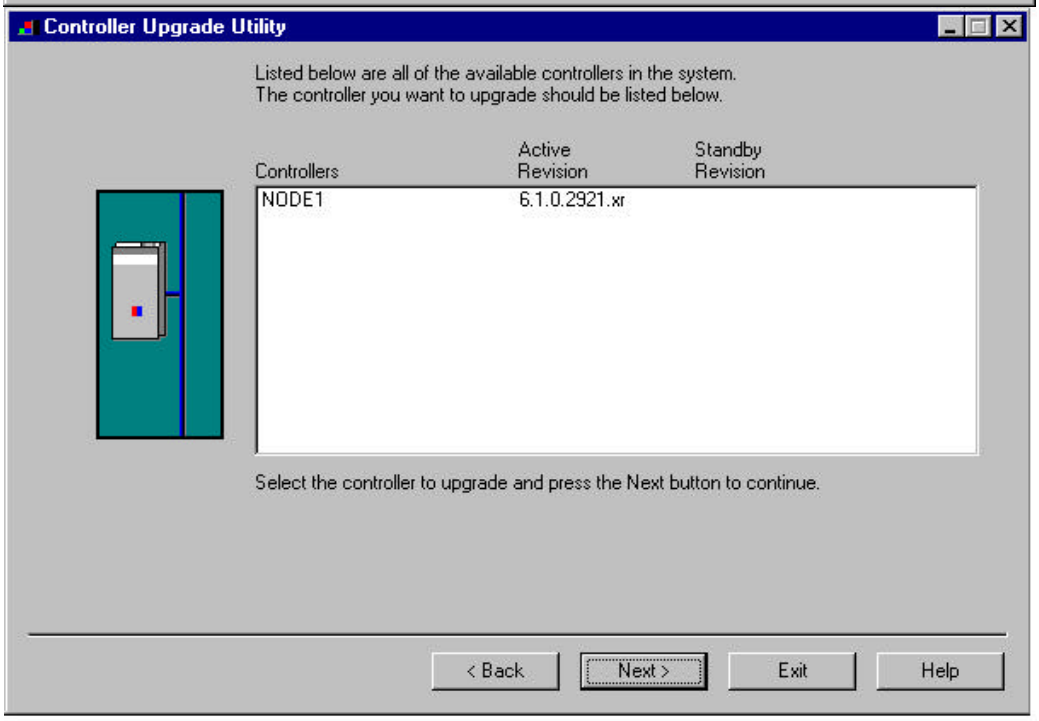
1. Click on the Start button and select DeltaV-> Installation-> Controller Upgrade Utility as shown below, and the following dialog will appear:





2. Click on the Upgrade I/O Modules radio button, and then click Next.

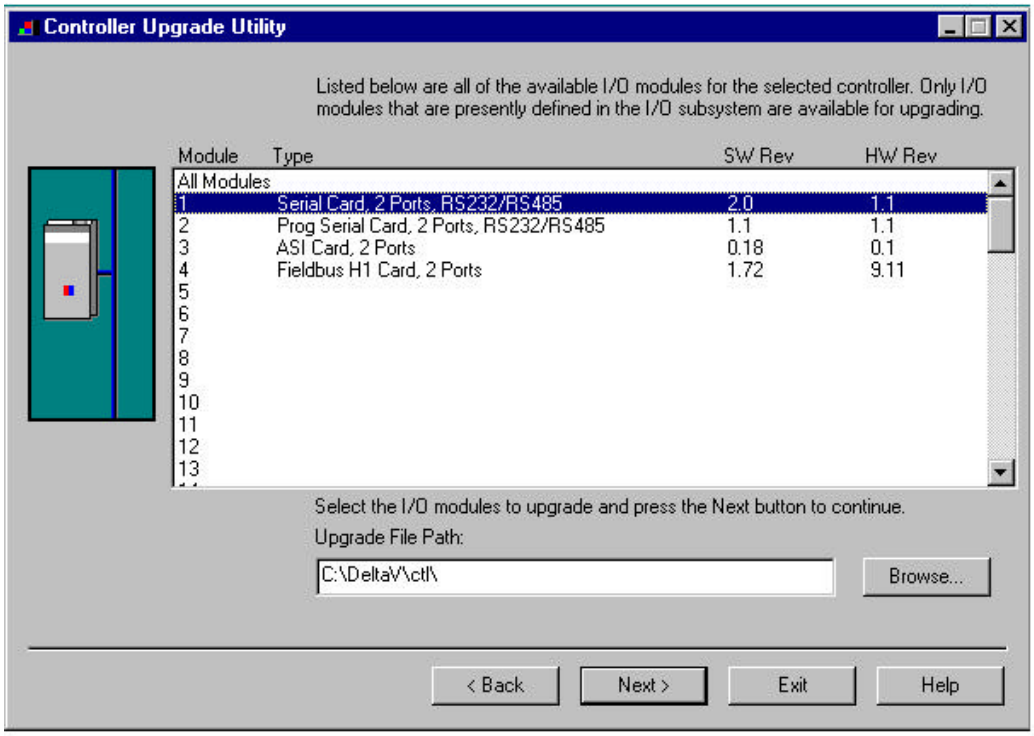




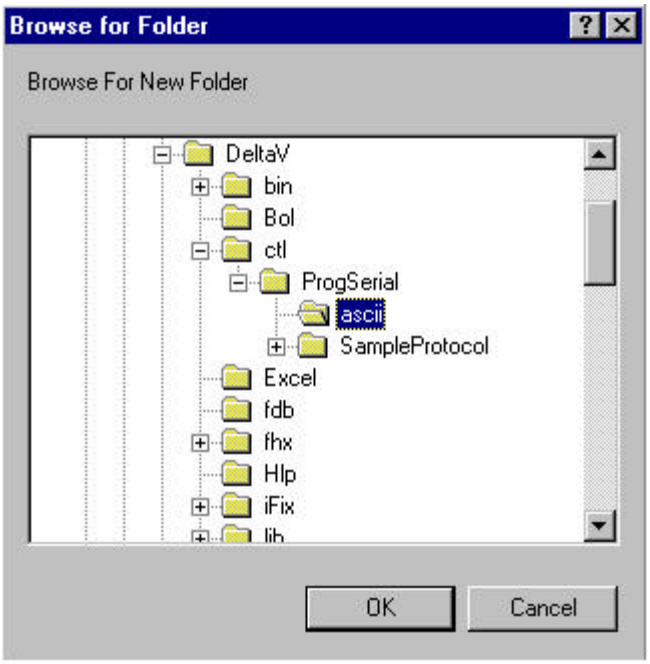
3. The above dialog will appear, listing all the available Controllers in your network. From this dialog, select the appropriate Controller and then Click Next.

4. The following dialog will appear, listing all the I/O modules in your selected Controller. The shown list of I/O modules is an example only. Your list will be different.

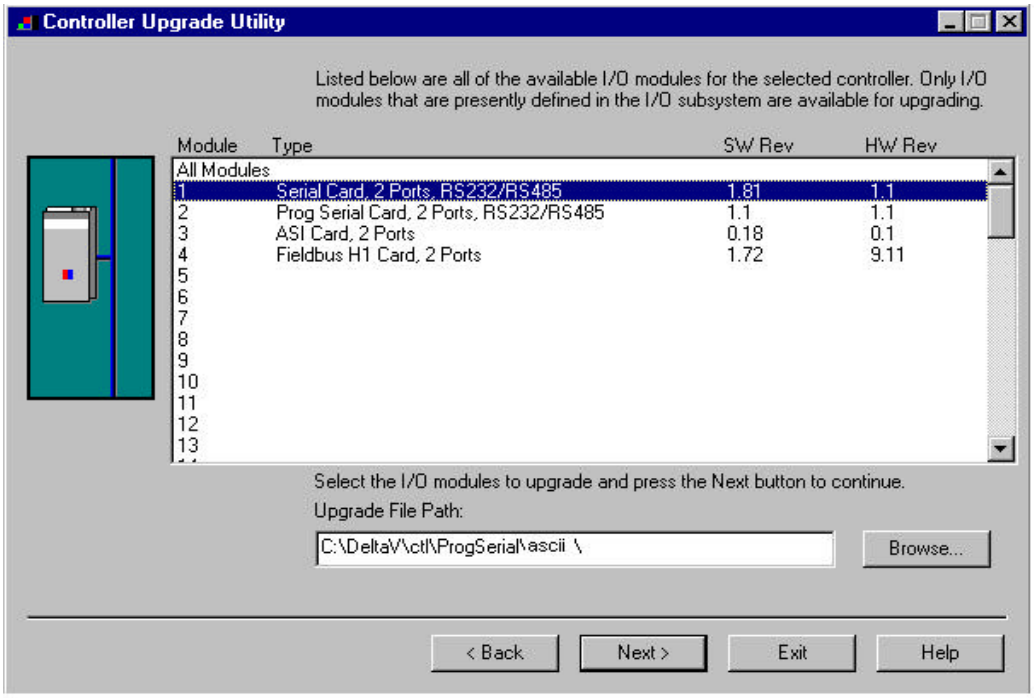
Note: The first time a standard Serial card is upgraded to the ASCII Driver, the dialog will be as shown below. When upgrading an existing Programmable Serial Card, skip Steps 4, 5 and 6, and go to Step 7.



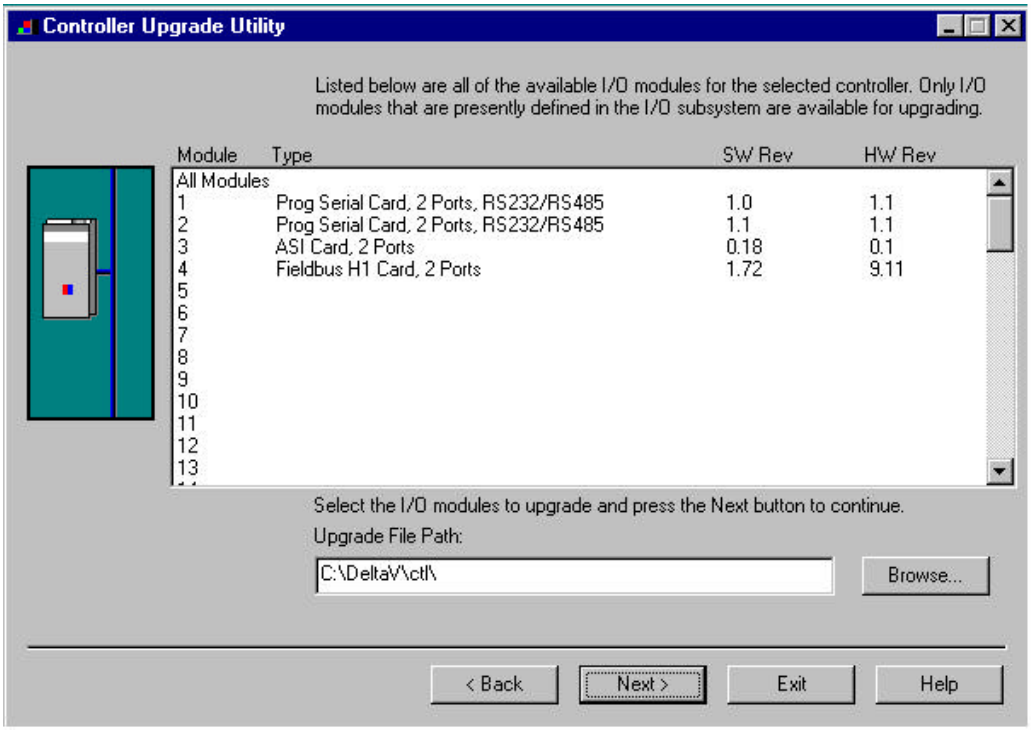
5. Click the Browse button and select the DeltaV path as shown below, and then click Ok. Note that the disk drive could be C or D.



6. Select the I/O module again as shown below and then click Next. Go to Step 9.


Controller Upgrade Utility
Listed below are all of the available I/O modules for the selected controller. Only I/O modules that are presently defined in the I/O subsystem are available for upgrading.
Module
Type
SW Rev
HW Rev
All Modules
1 Serial Card, 2 Ports, RS232/RS485 1.81 1.1
2 Prog Serial Card, 2 Ports, RS232/RS485 1.1 1.1
3 ASI Card, 2 Ports 0.18 0.1
4 Fieldbus H1 Card, 2 Ports 1.72 9.11
5
6
7
8
9
10
11
12
13
Select the I/O modules to upgrade and press the Next button to continue.
Upgrade File Path:
C:\DeltaV\ctl\ProgSerial\ascii \
Browse...
< Back
Next >
Exit
Help

7. If you are upgrading an existing Programmable Serial Card, the dialog will be as shown below. From this dialog, select the Programmable Serial Card I/O Module in the list.



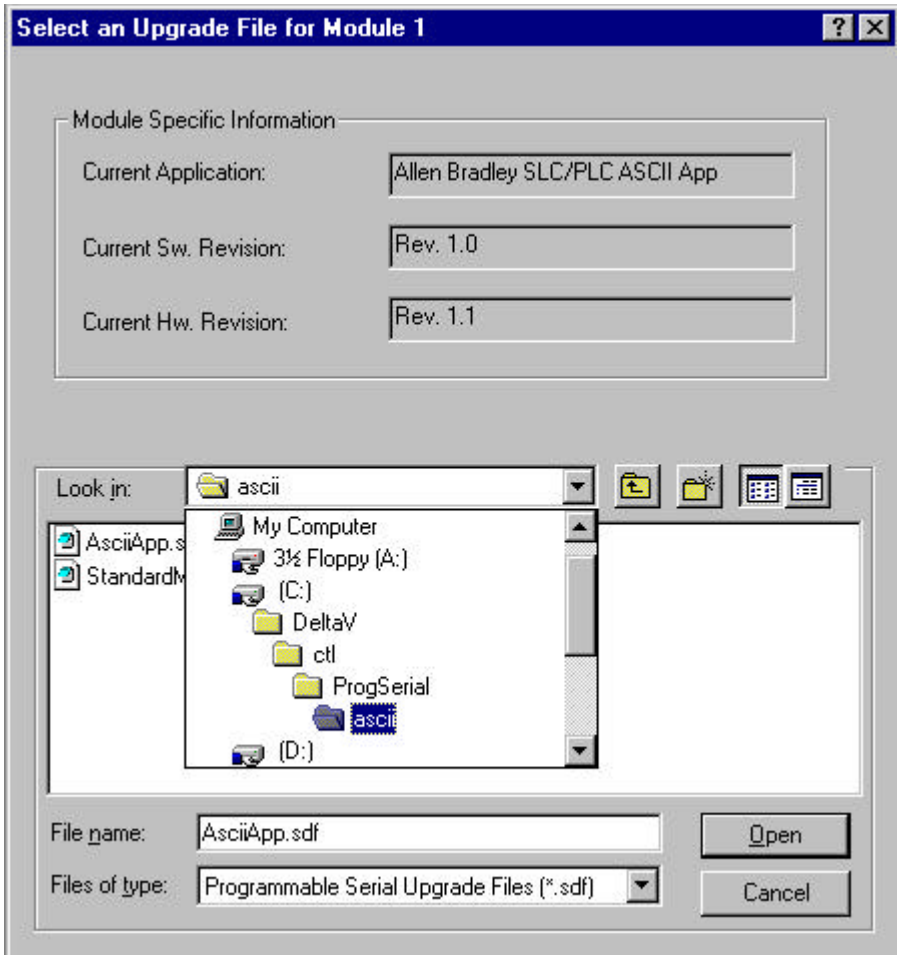
For example, we will select I/O Module 1. This will give you a dialog, from which you will select the file path to where the driver software is located. This path will be:

\DeltaV\ctl\ProgSerial\Ascii.

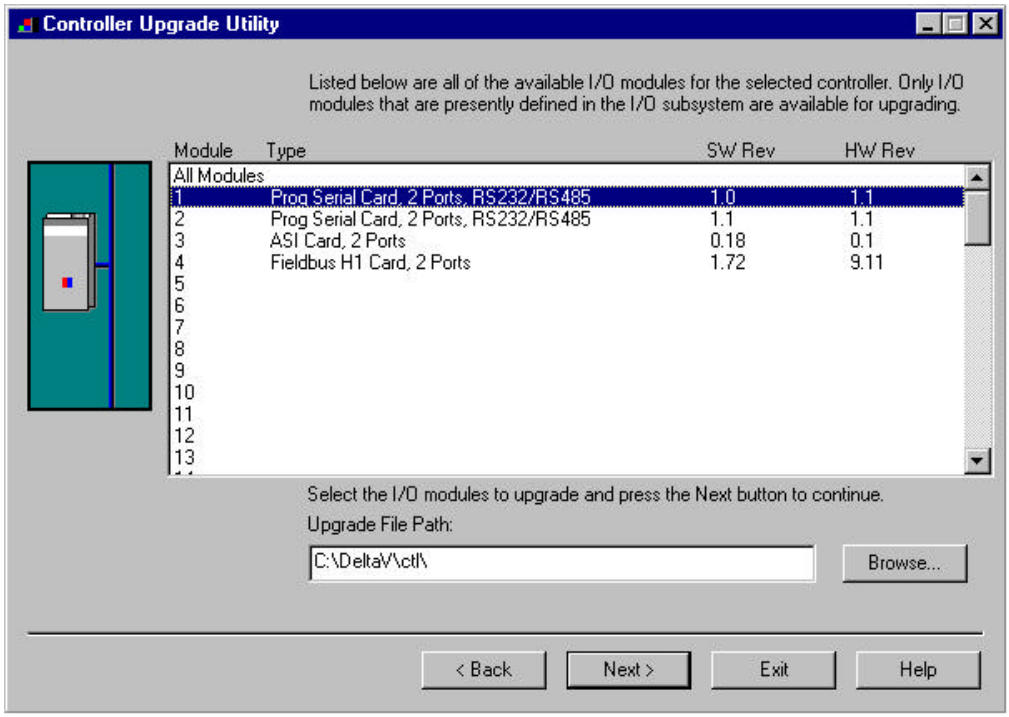
Once you are in the specified directory, you will need to select the following file:

AsciiApp.SDF

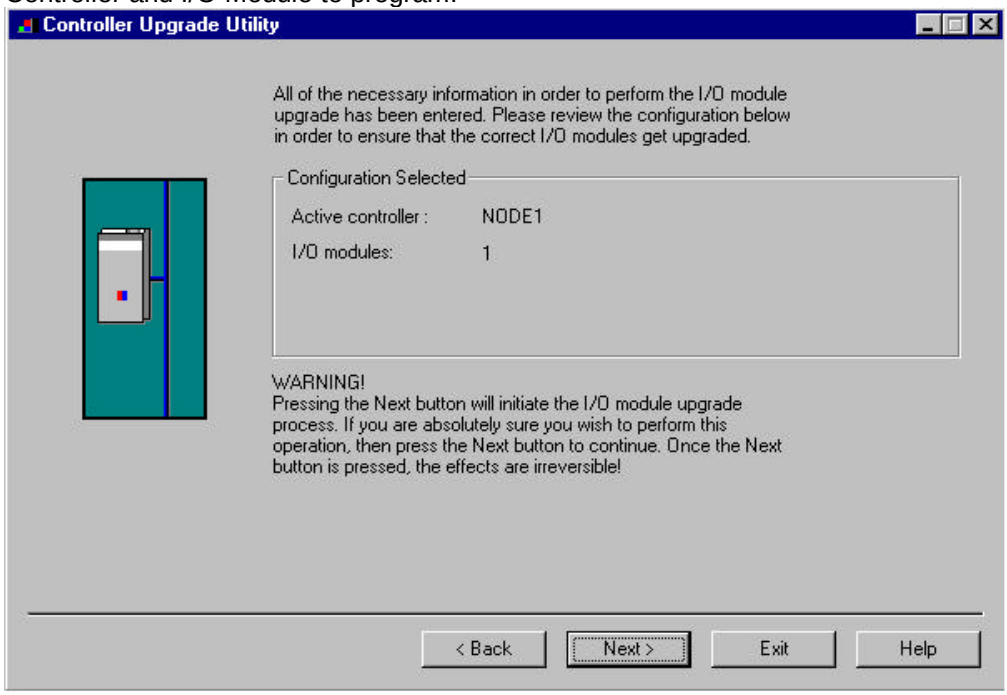
This is shown in the following dialog.



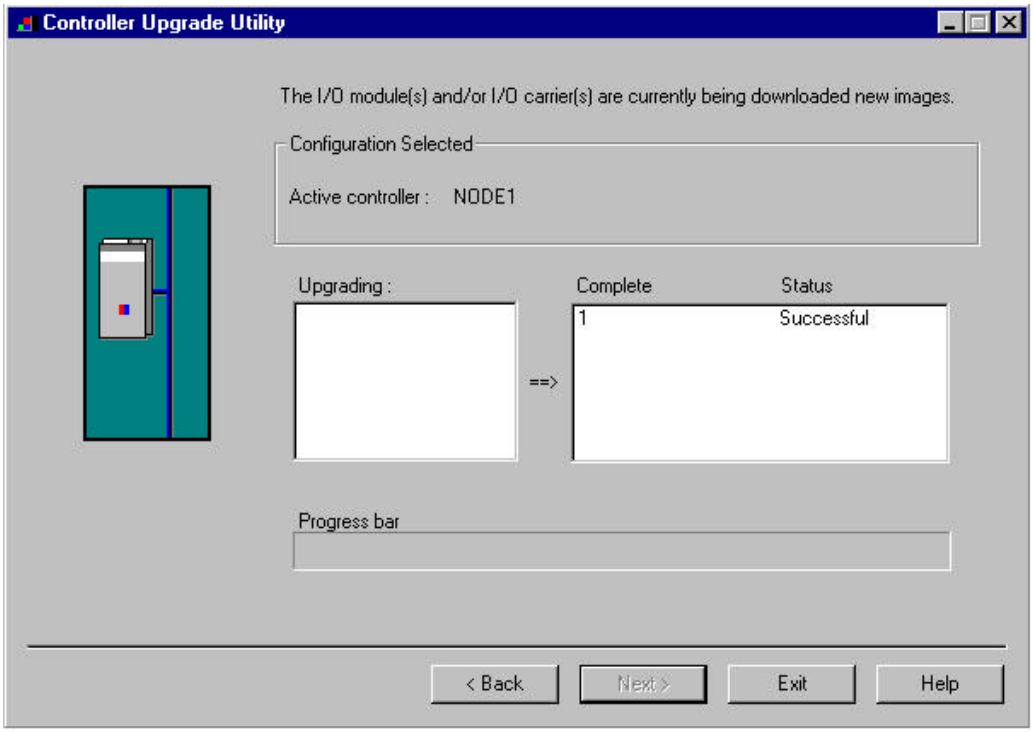
8. After selecting the .SDF file, Click on Open. This dialog will close and you will be back to the following:



9. In this dialog, Click Next again. You will get the following dialog, confirming the Controller and I/O Module to program.



10. Click Next and the I/O Module upgrade process will begin. After completion, you will receive the following dialog, indicating success.

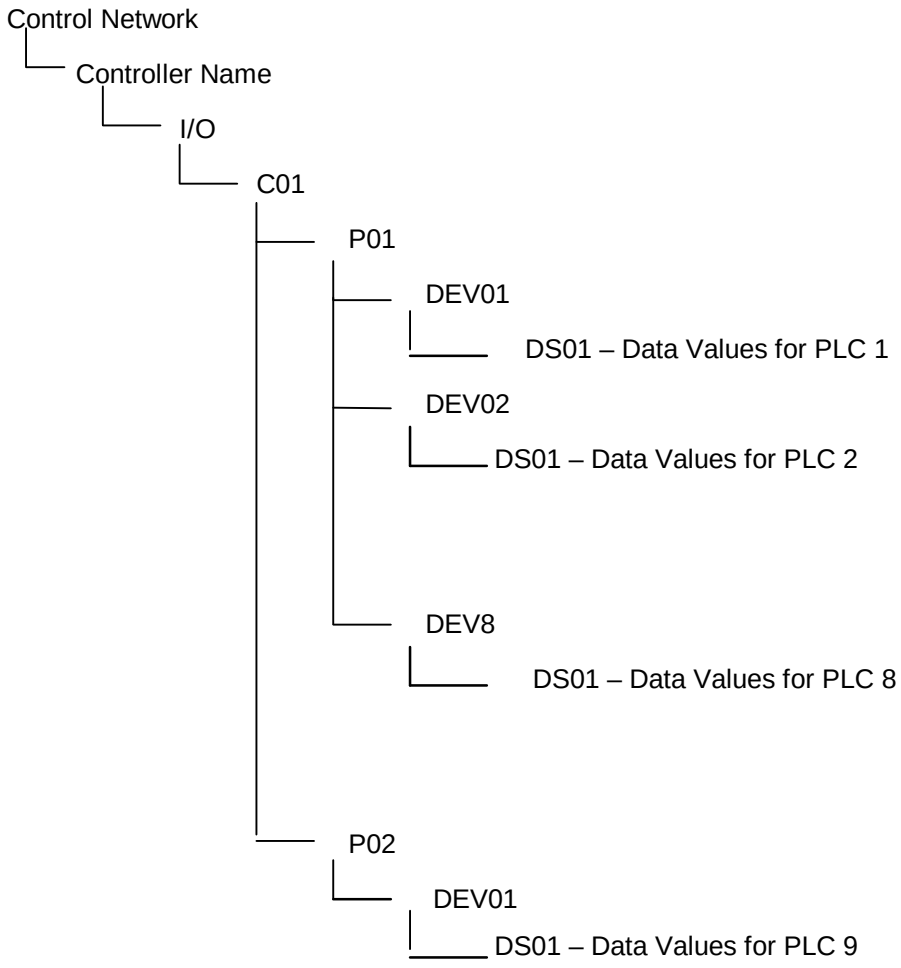


11. This completes the I/O Module upgrade process.

4 CONFIGURATION INFORMATION

Each Serial Card in the I/O subsystem contains two channels or ports. Each port will be enabled or disabled individually and each port will contain some port specific configuration parameters. These are defined below. The configuration parameters will determine what type of PLC is attached, e.g., PLC/2 or SLC/500. This will determine the message formatting used by the driver.

For this application, a fixed configuration format will be used. The DeltaV Explorer view of a configuration containing a Serial Card will be as follows, where C1 has a card type of Programmable Serial Card, P01 and P02 are the ports on the card, DEVXX are PLC devices attached to the ports, and DSXX are configured Datasets, one for each PLC:



4.1 Port Configuration

First, enable the port. Then click on the Advanced Tab and select Master. Slave mode is not supported. Specify the retry count, message timeout value in milliseconds, and message delay time. In most cases, you can leave these at their default values. Next, click on the Communications Tab and specify the Port type. The Port type will be RS-232 because the COS-II does not support any other mode. Lastly, select the Baud rate, Parity, Data bits and Stop bits parameters; these must match the external device settings.

4.2 Device Configuration

Create one device per PLC. Specify the device address between 1 and 8. This address is not the PLC address. Instead, it is used to determine which slave port to use for communications. For example, device address 1 will select slave port 0 on the COS-II and device address 8 will select slave port 7. Any device address outside this range will be ignored.

4.3 Dataset Configuration

Datasets contain the actual registers being written out or read back.

4.3.1 Data Direction:

The Data Direction for dataset should always be defined as output.

4.3.2 Output Mode:

Output mode and Readback items are not used. These should be left as default.

4.3.3 DeltaV Data Type:

All datasets will be configured as type 16 bit unsigned integer with Status

4.3.4 DeviceDataType

All Device Data Type values will be configured as 0 or 1. Type 0 indicates a PLC/2 and type 1 indicates SLC 500.

4.3.5 Data Start Address and Number of Values

The Start Address for each dataset will always be 0, and the Number of values will be 100.

By default, the dataset values will be used as:
Registers 1-25: Range Values
Registers 26-50: Setpoint Values
Registers 51-75: Flows Values
Registers 76-100: Misc Values

Values 1-50 will be written to PLC
Values 51-100 will be read from PLC

4.3.6 Special Data 1-5

Under the Special data tab, configure the data values as described in Table below.

Table 12

Special Data Value	Usage
1	# of configured Range Values (1-25) If this value is 0, no Ranges are written out. This block of PSIC registers (R1-R25) will remain unused. Otherwise, the configured # of range registers will be written.
2	# of configured SP values (1-25) If this value is 0, no SPs are written out. This block of PSIC registers (R26-R50) will remain unused. Otherwise, the configured # of SP registers will be written.
3	# of configured Flows values (1-25) If this value is 0, no Flows are read from the PLC. This block of PSIC registers (R51-R75) will remain unused. Otherwise, the configured # of registers will read and reported to DeltaV.
4	# of configured Misc values (1-25) If this value is 0, no Misc data are read from the PLC. This block of PSIC registers (R76-R100) will remain unused. Otherwise, the configured # of registers will read and reported to DeltaV.
5	Data 5 – Serial Switch prefix code. If this value is left at its default of 0, the ASCII driver will use the default prefix of 0x02 (ASCII STX). The COS-II should be configured (via dip-switches) with the correct prefix code. For example, if the prefix code configured in the COS-II is ASCII ESC (0x1B) then configure Special Data 5 as 27.

5 Operational Check

5.1 Scope

The following sections provide some assistance to ensure the interface is working properly.

5.2 Verify Hardware and Software Version Number

The user can verify that the ASCII Print driver has been installed using the DeltaV Diagnostics tool. The Diagnostics tool will show the Hardware Revision No. (HwRev) and the Software Revision No. (SwRev).

To begin the DeltaV Diagnostic tool select Start-> DeltaV-> Operator-> Diagnostics. In the Diagnostics tool expand the Controller, I/O and then double click on the Programmable Serial Interface Card that has the driver installed.

The following information will be displayed:

:	:	:	
HwRev	Hardware Revision	1.1	(or later)
SwRev	Software Revision	P1.0	(or later)

5.3 Verify Configuration

- Verify port configuration: The serial port must be enabled. User needs to make sure communication settings such as baud rate, parity, and number of data bits match the field device settings.
- Verify dataset configuration: The datasets configured must be as shown above.

5.4 Verify I/O Communication With Control Studio

User can create I/O modules in the control studio to verify correct values are being written out. An example module is shipped with the distribution. This module shows methods for writing text to the datasets and also how to handle time.

5.5 Using Diagnostics

- Verify PSIC communication: Select the PSIC on Diagnostics and press the right mouse button. Select Display Real -Time Statistics from the drop down menu. If the

Programmable Serial Interface Card is functioning then the user will see the Valid Responses counter and the Async and/or Sync Transactions counters incrementing. There will not be any error counting up.

- Verify port statistics: Select the Port on the Programmable Serial Interface Card and press the right mouse button. Then select Display Port Statistics form the drop down menu. Verify that the port communications statistics are being displayed properly and are counting as expected for the protocol's functionality.

- Verify dataset values: Select a dataset and press the right mouse button. Select View Dataset Registers from the Drop down window. Verify that the dataset values are displayed as expected.

5.6 LED Indication

The Yellow LED for the port should be on solid when all communications on that port are valid. The Yellow LED should be blinking if there is some valid communications and some communications with errors on that port. The Yellow LED should be OFF if there are no valid communications on that port.

6 DeltaV–Field Device Electrical Interface

The electrical interface between DeltaV and field devices conforms to the RS-232 and RS-422/485 standards.

Each PSIC has 2 ports, which function independently. The distance between the serial card and the field device can be as much as 5000 feet, per the RS-422/485 standard. When using RS-232, the distance is limited to 50 feet. Section 6.1 shows the pin assignments for the PSIC serial terminal block.

6.1 Pin Assignments for DeltaV PSIC

Table 13 - RS-232 Standard

Terminal Number	Signal Description
1	Port 1 - Isolated Ground (GND)
2	Unused
3	Port 1 – Transmit Data (TxD)
4	Unused
5	Port 1 – Receive Data (RxD)
6	Unused
7	Port 1 – Data Terminal Ready (DTR)
8	Port 1 – Data Set Ready (DSR)
9	Port 2 - Isolated Ground (GND)
10	Unused
11	Port 2 – Transmit Data (TxD)
12	Unused
13	Port 2 – Receive Data (RxD)
14	Unused
15	Port 2 – Data Terminal Ready (DTR)
16	Port 1 – Data Set Ready (DSR)

Table 14 - RS-422/485 Half Duplex Standard

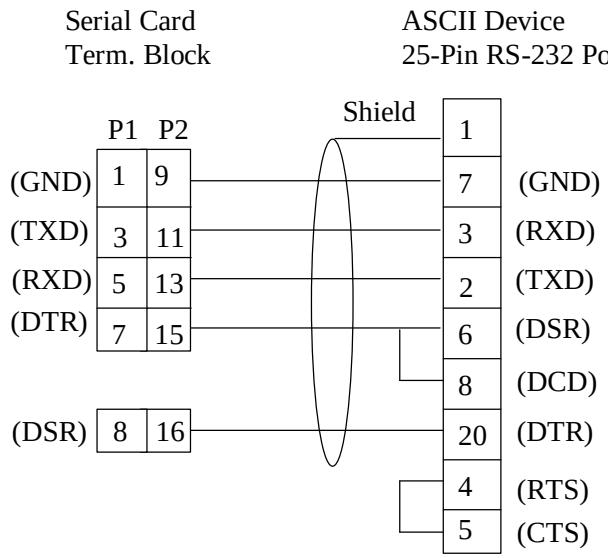
Terminal Number	Signal Description
1	Port 1 - Isolated Ground (GND)
2	Port 1 - Data +
3	Unused
4	Port 1 - Data -
5	Unused
6	Unused
7	Unused
8	Unused
9	Port 2 - Isolated Ground (GND)
10	Port 2 – Data +
11	Unused
12	Port 2 - Data -
13	Unused
14	Unused
15	Unused
16	Unused

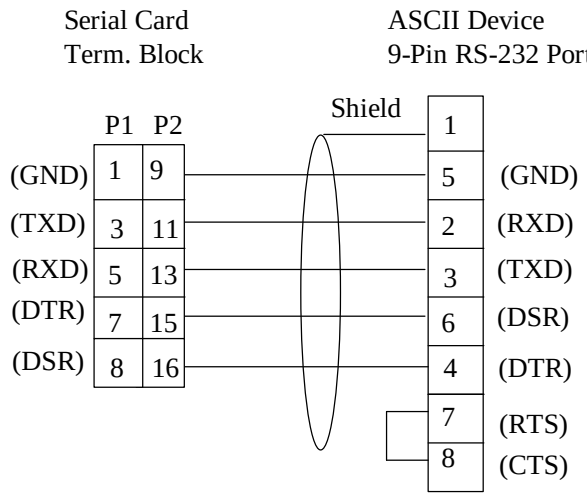
Table 15 - RS-422/485 Full Duplex Standard

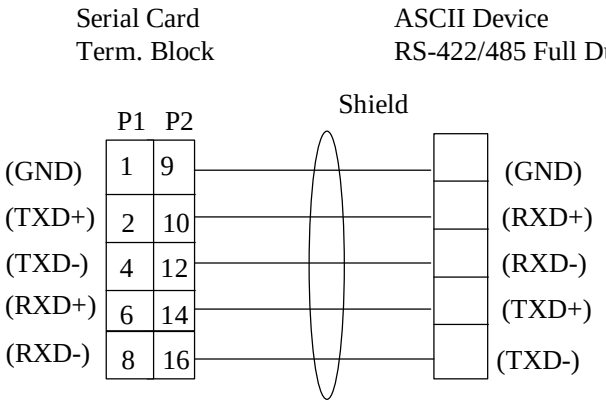
Terminal Number	Signal Description
1	Port 1 - Isolated Ground (GND)
2	Port 1 – TxD +
3	Unused
4	Port 1 – TxD -
5	Unused
6	Port 1 – RxD +
7	Unused
8	Port 1 – RxD -
9	Port 2 - Isolated Ground (GND)
10	Port 2 – TxD +
11	Unused
12	Port 2 – TxD -
13	Unused
14	Port 2 – RxD +
15	Unused
16	Port 2 – RxD -

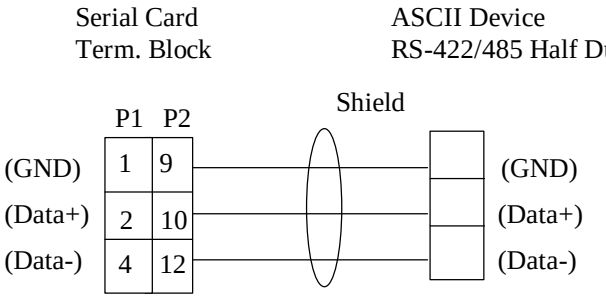
6.2 Wiring Connections

In general, the figure below shows the connections between the Field Device and the PSIC termination block. In some cases, RxD and TxD signals need to be swapped to create a NULL cable. This can be done easily at the PSIC termination block.






Serial Card
Term. Block
ASCII Device
RS-422/485 Full Duplex
Shield
P1 P2
(GND) 1 9 (GND)
(TXD+) 2 10 (RXD+)
(TXD-) 4 12 (RXD-)
(RXD+) 6 14 (TXD+)
(RXD-) 8 16 (TXD-)


Serial Card
Term. Block
ASCII Device
RS-422/485 Half Duplex
Shield
P1 P2
(GND) 1 9 (GND)
(Data+) 2 10 (Data+)
(Data-) 4 12 (Data-)

7 Technical Support

For technical support or to report a defect, please give Munger Company, Inc. a call at (314) 961-8100. If a defect is discovered, please document it in as much detail as possible and then fax your report to us at (314) 961-0903.

For Product functionality questions, ask for the people in the following order:
1. Nobin William
2. Martin Berutti
3. Dean Cook

For Commercial issues, ask for people in the following order:
1. Nobin William
2. Martin Berutti

For all other driver and related questions, ask for Nobin William.

You can also send us your questions via e-mail. Our addresses are:

nobin.william@munger.com
dean.cook@munger.com
david.story@munger.com

Thank you for using DeltaV.