



M Y N A HSM

DeltaV I/O Driver for Local Instrument Link (LIL) Protocol

USER MANUAL

Ver. 1.55

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ABOUT THIS MANUAL

Purpose

This manual provides complete instructions and explain how to:

- Install and operate the DeltaV I/O Driver for Local Instrument Link (LIL) Protocol.

Versions Supported

This manual supports the following software:

- DeltaV Programmable Serial Interface Card Driver for LIL, Software Revision 1.55, Series 2 Hardware Revision 4.5 or later.

Audience

The DeltaV *LIL User Manual* is written for Installers, and Operators:

- Who need to install and use LIL driver.
- Who need to troubleshoot communications.

Before attempting to install or operate this I/O Driver, you should be familiar with the operation of your personal computer and be comfortable with your window manager, to do the following tasks:

- Use a mouse.
- Make selections from a dialog box or pull-down menu.
- Manipulate icons.

What's Inside

The main organization of the manual is as follows:

Chapter 1, INTRODUCTION. General introduction to The DeltaV I/O Driver for the Local Instrument Link Protocol. Topics include software and hardware structure.

Chapter 2, DRIVER INSTALLATION. Proper installation of the driver into flash memory in the Programmable Serial Interface Card.

Chapter 3, PSIC OPERATIONS. Overview of the operating states and functions of the Programmable Serial Interface Card.

Chapter 4, PSIC SETUP. Port, device and data set configuration information for configuring communications to Moore Products LIL devices.

Chapter 5, CONFIGURATION REQUIREMENTS. Hardware and Moore Products Device configuration requirements for establishing communications to the DeltaV PSIC.

Chapter 6, DIAGNOSTICS. Realtime diagnostic information available from the DeltaV system for troubleshooting the PSIC.

Document Conventions

Information the user enters from the keyboard appears in a special font, as shown below:

NODE:TAG.FIELD

Throughout the document, keys you must press to perform an action appear between angle brackets:

<F1>

If you must press two keys simultaneously, the two keys appear side-by-side:

<Alt><F1>

This document uses <Enter> to indicate the main key you use to send keyboard input to the system. Your keyboard may substitute a different word or label, such as <Return>, or <↵>.



INTRODUCTION

This document describes the functionality of the DeltaV Programmable Serial-Interface Card, Series 2 (PSIC) as it has been programmed to communicate with Moore Products MYCRO control devices using Moore Products Local Instrument Link (LIL) Protocol. This document contains instructions for supporting configuration of the LIL driver for the Programmable Serial Interface Card.

Purpose

The purpose of this document is to provide a system level analysis of the configuration and processing needed in the DeltaV system to support the DeltaV Series 2 PSIC. Included is an analysis of the functions of the PSIC itself as programmed to support the Moore Products LIL Protocol. It explains the configuration requirements and diagnostic capabilities of the PSIC with regard to communications with Moore Products devices.

Scope

This document covers the configuration requirements and diagnostic capabilities of the PSIC as programmed for communicating serially to Moore Products MYCRO devices over the Moore Products LIL Protocol via the Model 320 Independent Computer Interface (ICI).

Overview

The DeltaV PSIC is based on the standard DeltaV Serial Interface Card. It uses the exact same hardware as the standard product with no changes or modifications of any kind.

The DeltaV System provides a generic set of configuration screens and parameters used for the configuration of any protocol supported by the Series 2 Programmable Serial Interface Card. These configuration screens are based on the DeltaV Serial Card configuration screens and parameters.

A driver has been written for configuring the DeltaV PSIC to support the proprietary communications protocol (LIL) of Moore Products Inc. The Custom Serial Interface driver may be installed into flash memory on the programmable serial interface card using the standard DeltaV Controller Upgrade Utility. NOTE: This driver supports the Series 2 Programmable Serial Interface Card, only.



DRIVER INSTALLATION

The PSIC LIL Driver is packaged on a single CD. The CD contains the following files:

Name ^	Size	Type	Date Modified
 1395.idf	2 KB	IDF File	7/14/2009 10:39 AM
 IO_Compatibility	2 KB	Microsoft Office Exc...	6/27/2007 12:42 PM
 MooreLIL.s2f	2 KB	S2F File	7/14/2009 10:39 AM
 MooreLILApp.hex	472 KB	HEX File	7/14/2009 10:25 AM
 RedSerBoot.HEX	44 KB	HEX File	6/27/2007 12:45 PM
 RedSerReleaseApp.HEX	498 KB	HEX File	6/26/2007 2:33 PM
 RedSerReleaseProgApp.hex	501 KB	HEX File	6/27/2007 10:50 AM
 SampleCustomProtocol.s2f	2 KB	S2F File	6/27/2007 12:42 PM
 StandardModbusApp.s2f	2 KB	S2F File	6/27/2007 12:42 PM
 MooreLil	1,121 KB	Adobe Acrobat Doc...	9/27/2007 10:06 AM

Software Installation

Simple file copies are all that is required to load the LIL Driver software from the CD into the DeltaV system. The following steps should be followed:

1. Locate the folder C:\Deltav\ctl\ProgSerial\
2. Create a new folder under this subdirectory called "Moore-LIL"
3. Copy all files from the CD into the new folder C:\Deltav\ctl\ProgSerial\ Moore-LIL.

Upgrading the Serial Card Flash Memory

The Controller Upgrade Utility, a standard part of the DeltaV package, is used to flash upgrade the Moore LIL driver into the PSIC ROM Memory. Using the Windows XP Start button, select the following:

DeltaV->Installation->Controller Upgrade Utility menu.



Figure A. Starting the Controller Upgrade Utility

The Controller Upgrade Utility will start by allowing the user to select whether the module to be upgraded is a controller or an I/O module. The user should select “Upgrade I/O Modules” as follows in Figure B:

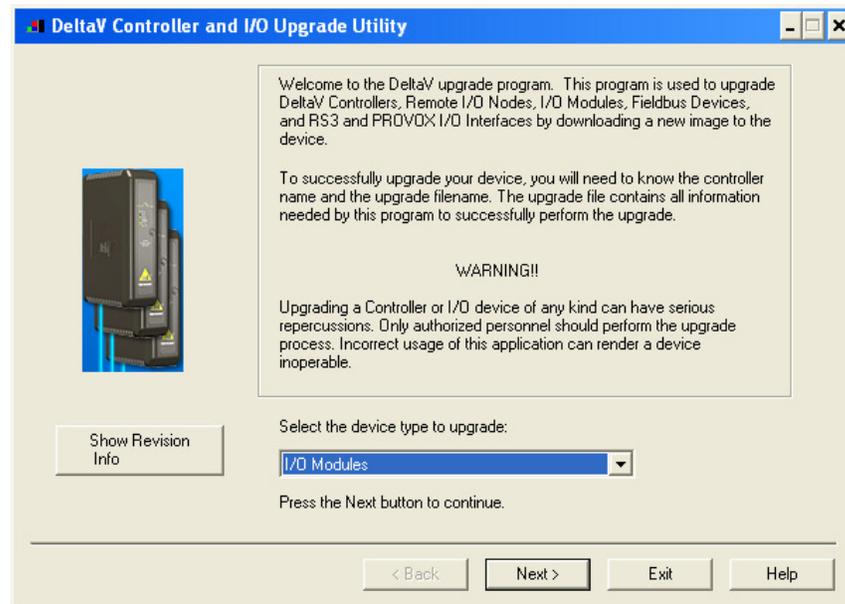
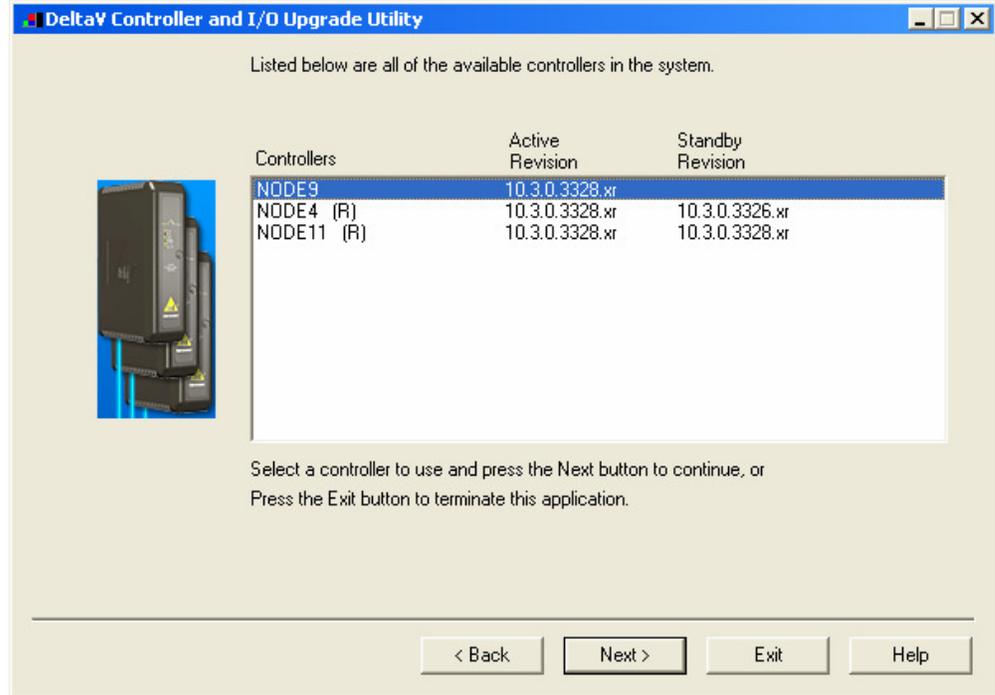


Figure B. Selecting I/O Modules for Upgrade

After selecting “Upgrade I/O Modules” push the <NEXT> button. The Upgrade Utility will present a list of DeltaV controllers configured in the system. The user must select the controller which controls the PSIC to be upgraded as shown in Figure C.



After selecting the correct DeltaV controller push the <NEXT> button to proceed to the I/O Module listing. The upgrade utility will present a list of all the I/O modules sensed by that controller. The user should select the I/O module to be flash upgraded with the LIL driver and push the <NEXT> button as shown in Figure D.

Figure C. Selecting Controller for Upgrade

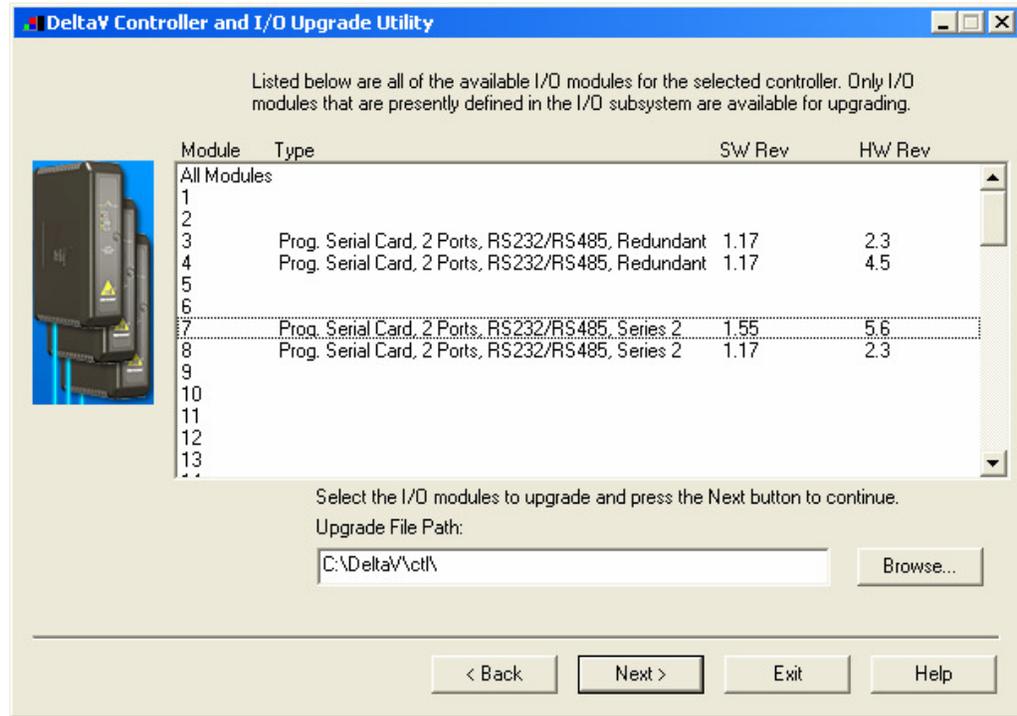


Figure D. Selecting I/O Module for Upgrade

After selecting the module(s) to upgrade, the Upgrade Utility will present a folder selection pop-up as shown in figure E. The user should navigate to the folder C:\DeltaV\ctl\ProgSerial\Moore-LIL\ and select the “MooreLIL.sdf” flash upgrade file. Pushing the <OPEN> button will elicit an “Are you sure...?” pop-up to which a yes answer and pushing the two subsequent <NEXT> buttons will begin the upgrade procedure.

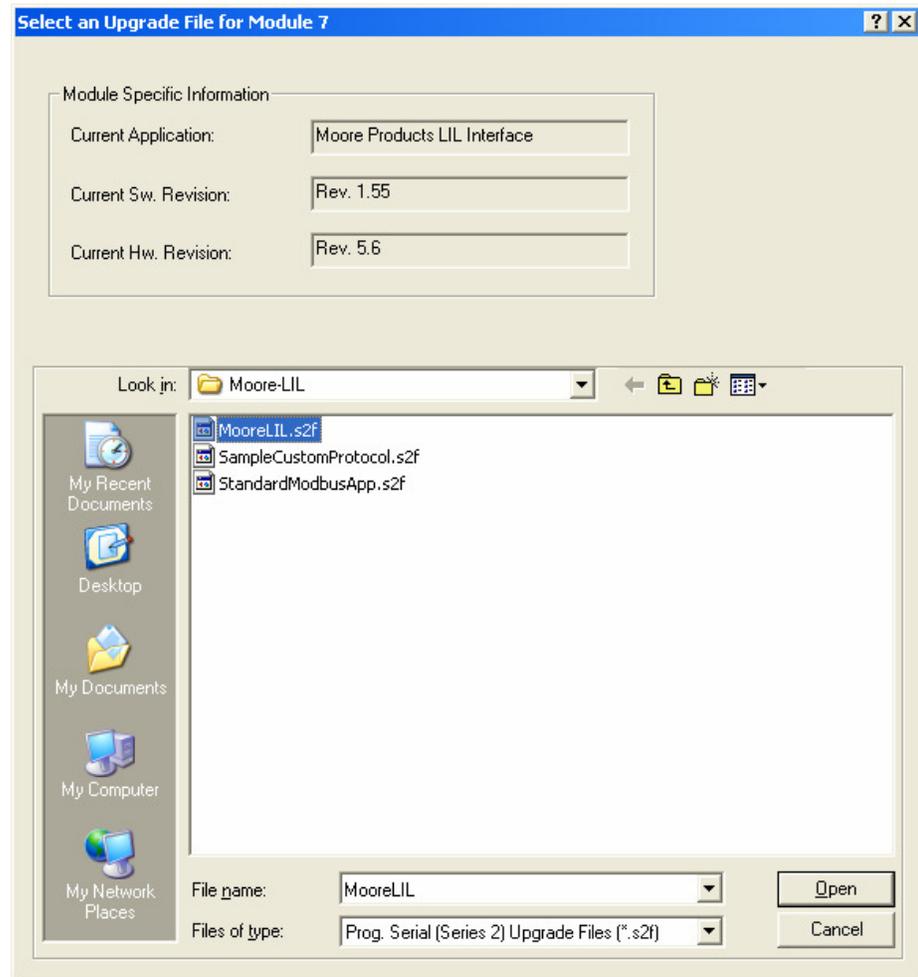


Figure E. Selecting The Moore LIL Protocol Driver

After successfully completing the Flash ROM upgrade of the Programmable Serial Interface Card, the DeltaV upgrade utility will present the following pop-up shown in Figure F. The user may then press the <EXIT> button to close the Controller Upgrade Utility.

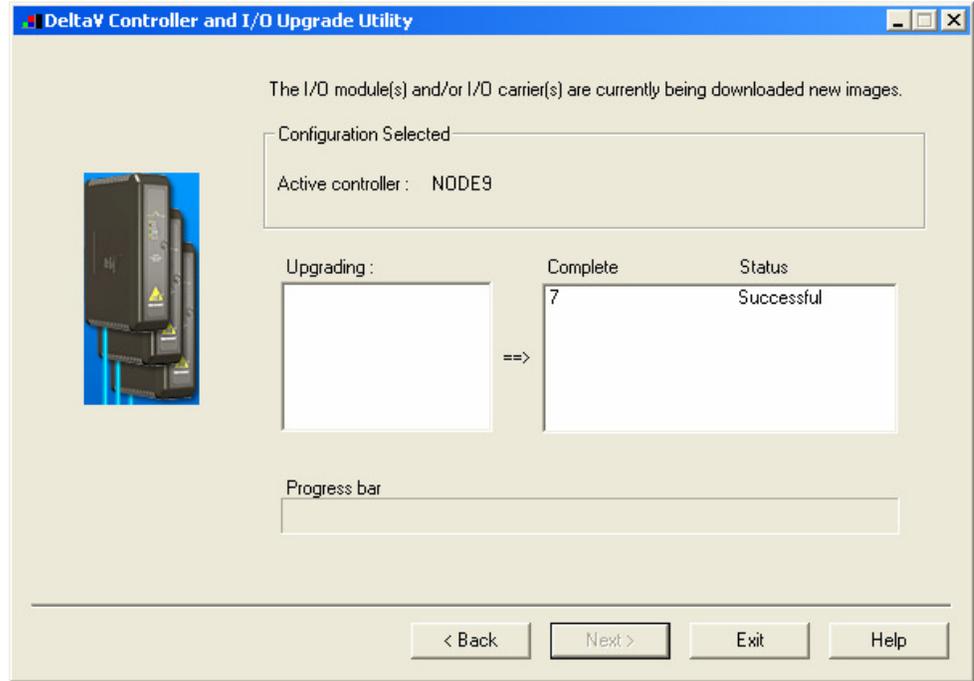


Figure F. Driver Upgrade Completion

PSIC OPERATIONS

The following sections describe the basic operations for the PSIC and Card Diagnostics (*for detailed Diagnostics instruction see Diagnostics section*). The PSIC is a DeltaV I/O card residing on Railbus, it conforms to the standard set of requirements for a Generic Railbus Module as defined in the 8000 Series Generic Module Functional Specification.

Operational Overview

The PSIC operation will be different depending upon which state the card is in and will transition between states as defined. (See Figure H)

The PSIC software has the following operating states:

State / Event	Watchdog Time-out	External Reset	Power up Sequence Complete	Railbus Time-out	Railbus Command	Diagnostic Errors
Cold Power up	Cold Power up	Cold Power up	Power up	N/A	N/A	N/A
Power up	Cold Power up	Cold Power up	Unconfigured	N/A	N/A	Fatal Error
Unconfigured	Cold Power up	Cold Power up	N/A	N/A	Valid Config Command - Active	Fatal Error
Active	Cold Power up	Cold Power up	N/A	Active - red LED on	N/A	Fatal Error
Fatal Error	Cold Power up	Cold Power up	N/A	N/A	N/A	Fatal Error

Figure G. Programmable Serial Interface Card Operating States

- **Cold Power Up** - On power up, reset or a watchdog timer rest, the PSIC will enter the Cold Power up State. While in this operating state the PSIC performs some basic hardware initialization to get the card up and running and records the fact that the card performed a cold restart. On exiting this state, the internal watchdog is initialized and the JPU bit in the Railbus device status register is set. If the Cold Power up State was entered due to a watchdog timer reset, the IWR bit in the Railbus Diagnostics Register will also be set.
- **Power Up** - Once the PSIC has completed all the required functions of the Cold Power Up or Warm Power Up State it will transition to the common Power Up State. While in this state the card performs a complete self test of the hardware including a full ROM and RAM test, initializes all the hardware

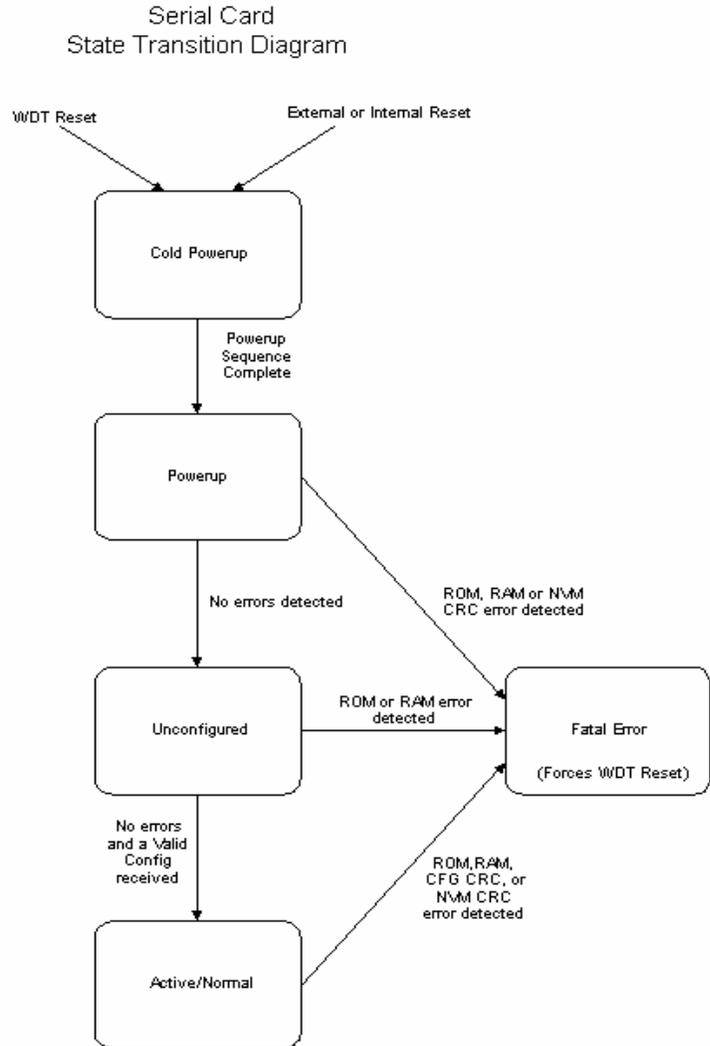
to its initial states and starts execution of the operating system. If the self tests are successful, the PSIC will transition to the Unconfigured State. If the self tests fail the card will transition to the Fatal Error State.

Figure H. States and Transitions

- Unconfigured** - While in the Unconfigured State the PSIC is waiting for a configuration to be sent from the DeltaV Controller via the Railbus. While in the Unconfigured State the PSIC performs normal Railbus communications and runtime self tests. No communications are performed on the Serial Ports connected to the remote Devices and any messages received on these ports while the card is in this state are discarded. The PSIC configuration is downloaded to the card from the DeltaV Controller over the Railbus using the standard Railbus communications messages. The downloaded configuration information is then processed and stored in the PSIC's Database for use while executing in the Active State. Once the Device Attributes Block has been received and processed the PSIC will transition to the Active operating state.

- Active** - The Active operating state is the normal operating state for the PSIC. In this state the PSIC performs normal Railbus

communications, runtime self tests, periodic Configuration CRC tests and communications with the Moore LIL device(s) connected to the serial ports. After transitioning to the Active State, the PSIC first initializes the Serial Ports to their configured state including port type (RS-232, RS-422/485 half duplex, RS-422/485 full duplex), baud rate, parity, etc. Once the serial ports have been configured, the PSIC begins communications with the Moore LIL device(s) connected to each serial port based on the configured mode of the port.



If the port mode is set to Master, the PSIC will continuously read the configured input data sets from the Moore LIL device(s) until an output changes state. The PSIC starts with the first configured data set and reads sequentially through the configured data sets until the last data set has been read in. If an output changes state, the PSIC will interrupt its input scan and write the new output data to the appropriate Moore LIL device. The PSIC checks for output changes after each input data set is read. Once all the outputs have been written, the PSIC will continue with its input scan where it left off. If an output data set is configured for Output Read back then the data set will be marked to be read as input data during the normal input scan of the PSIC.

During normal operation, if a communications error is detected while reading an input data set from a Moore LIL device, the PSIC will set all the data set's DST attributes error fields to the error state. If an error occurs on an output, the PSIC will also set the DST attribute error fields to the error state. When an error occurs the PSIC will retry the number of times that is configured in the Retry Count field of the port configuration before setting any errors. Once the communications error is cleared and normal communications have been restored for the data set in error, the DST attributes error field will be cleared.

A communications error is defined as one of the following:

- No response from the LIL device within the configured time-out time for the port
- An invalid check word in a response message received from a Moore LIL device
- An exception or error response received from a Moore LIL device

Also, when configured in Master mode, the PSIC checks the state of the Send Outputs On Startup setting after transitioning to the Active state. If the Send Outputs On Startup option is set then all output data sets will be sent out to the appropriate Moore LIL device when this state is initially entered. If this option is not set then no outputs will be performed until an actual output change request has been made by the operator.

If the PSIC detects a Railbus Time-out, indicating that communications have been lost with the DeltaV controller over the Railbus, it will turn on the red LED to alert the operator. The card will remain in the Active operating state and will perform all other normal functions, runtime self tests, periodic Configuration CRC tests and communications with the Moore LIL device(s) connected to the serial ports. If the Railbus communications to the DeltaV controller are re-established, the PSIC will turn off the red LED and resume normal Railbus communications.

- **Fatal Error** - This state is entered whenever a fatal error has been detected. Fatal errors include: ROM, RAM or Configuration CRC failures. This state allows the Watch Dog Timer to time-out by disabling interrupts and executing an internal instruction to cause a "Warm Power Up" condition.

Self Tests

Basic DeltaV card self tests are performed by the PSIC as defined in the 8000 Series Generic Module Functional Specification. This includes both power up and runtime self tests.

Power Up Self Tests

The following generic module self tests are performed on power up or reset of the PSIC:

- Verification of Watchdog timer circuits enabled in Microprocessor.
- RAM Verification - All RAM verified by a write/read of different values (00, AA, 55, FF).
- ROM CRC - Calculate ROM CRC and verify against stored value.
- Non-Volatile Memory CRC - The Device ID, Hardware Revision and Serial Number are stored in a separate sector of the Flash with it's own CRC which will be checked on Power Up of the PSIC.

For detailed information about each of these tests refer to the 8000 Series Generic Module Functional Specification. If any of the above power-up tests fail the PSIC will transition to the Fatal Error State.

Periodic Runtime Self Tests

The following generic module self tests are performed periodically by the PSIC during normal operations:

- RAM Test - RAM tested a few bytes at a time. Original contents stored, overwritten with AAH and 55H and verified by reading back the values. Original contents restored after testing completed.
- ROM Test - ROM tested a few bytes at a time. Running CRC kept and verified when the entire contents of ROM have been checked.
- Configuration CRC - The configuration data in the PSIC is protected by a CRC value. The Configuration Data is tested a few bytes at a time. A running Configuration CRC is kept and verified when entire configuration has been checked.
- Non-Volatile Memory CRC - The Flash sector containing the Device ID, Hardware Revision and Serial Number has a

CRC associated with it. The PSIC Software periodically checks this CRC.

For detailed information about each of these tests refer to the 8000 Series Generic Module Functional Specification. If any of the above runtime tests fail the PSIC will transition to the Fatal Error State.

In addition to the generic module periodic self-test, the PSIC performs other PSIC specific self tests as described in the following sections.

RS-232 Communications Cable Present Test

The PSIC performs a Cable Present test on each of its serial ports which are enabled and configured as RS-232 communications ports. The purpose of this test is to verify that there is a physical link (cable) present between the PSIC's serial port and the Moore ICI. The results of this test are communicated back to the controller and made available to the operator. This test checks the Data set-Ready line on each of the serial ports. If this line is not active, the Termination Lost bit is set in the Port Status Register returned to the controller.

For RS-422/485 port configurations and disabled ports, the Termination Lost bit is always cleared in the Port Status.

Serial Communications 5% Error

The PSIC checks the received error rate for messages received on each of its serial ports. If more than 5% of the messages received on a serial port have a CRC, overrun, framing or parity error, the PSIC sets the Serial Communications 5% Error bit in the appropriate Port Status Register returned to the controller.

The algorithm used to determine that greater than 5% communications error rate exists is as follows:

If message received with error then:
 Error percentage = Error percentage + 19%
 If Error percentage > 180% then Error percentage = 180%
Else if message received with no error then
 If Error percentage > 0% then

Error percentage = Error percentage - 1%
 If Error percentage >= 95% then
 Set Serial Communications 5% Error indicator
 Else if Error percentage <= 76% then
 Clear Serial Communications 5% Error indicator.

This algorithm is designed to allow bursts of up to 5 failed messages in a row before the Serial Communications 5% Error indicator is set. Once the burst threshold has been reached, a minimum of 19 good messages must be received before the error condition clears.

Visual Indicators

The PSIC has a set of LEDs used as visual indicators to the operator. These LEDs are used to indicate various operating conditions of the PSIC. There is one green, one red and two yellow LED's used as visual indicators as described in the following sections.

- ❖ Green – Power. This is used to indicate the status of the power being supplied to the card:
 - ON- Power OK
 - OFF - Power failure
- ❖ Red – Fault. This is used to indicate that a fault condition has been detected:
 - ON – A fatal error has been detected and the card is in Fatal Error State or a Railbus time-out error has been detected.
 - OFF - Normal operation, no faults detected
 - FLASH Once - Card has not been assigned an address yet
 - FLASH Twice - LIL address mismatch fault. i.e. The address assigned to a device configured in the card does not exist on the LIL.
- ❖ Yellow - Port Status. The PSIC has two Yellow LED's, one associated with each serial port on the card, to indicate the status of the communications on the associated serial port as follows:
 - ON - Communications OK (no bits set in Port Status Register)
 - OFF - No Communications
 - FLASH - Communications Error on this port, either 5% comms error, termination lost or error response received. (Bit set in Port Status Register)



PSIC SETUP

The Programmable Serial-Interface uses the same card type as the standard Modbus Serial Card and contains two ports with up to 16 devices and 16 data sets configurable on each port, just as the Modbus Serial Card does.

The DeltaV Explorer view of a configuration containing a PSIC is shown below. In figure I, C04 has a card type of Prog Serial Card, P01 and P02 are the ports on the card, DEV01 and DEV02 are the remote devices attached to the ports and DS01, DS02 and DS03 are configured Data Sets for the attached devices:

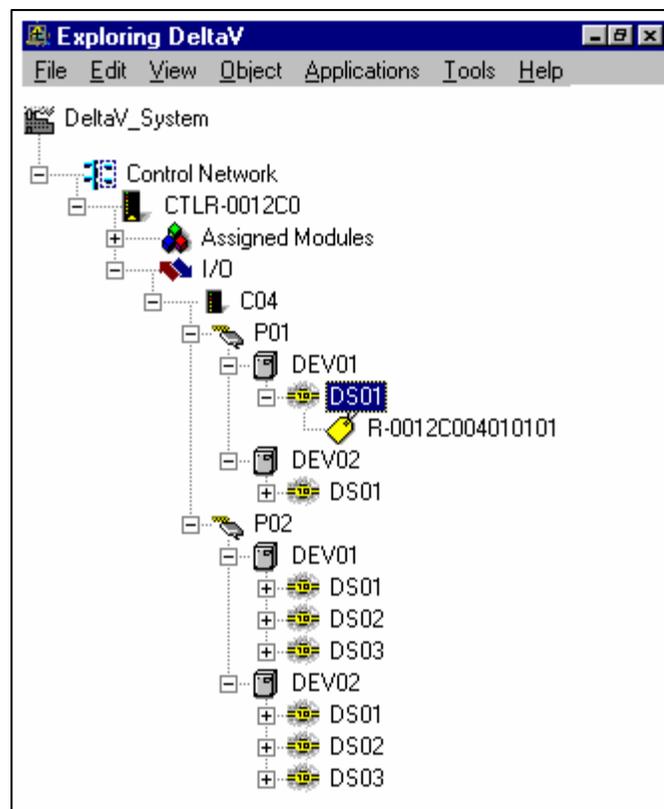


Figure I. DeltaV Explorer View of Control Network

Serial Port Configuration

Three protocol types are included in the implementation of the Programmable Serial-Interface. The Moore LIL protocol type is implemented as the “Custom” type.

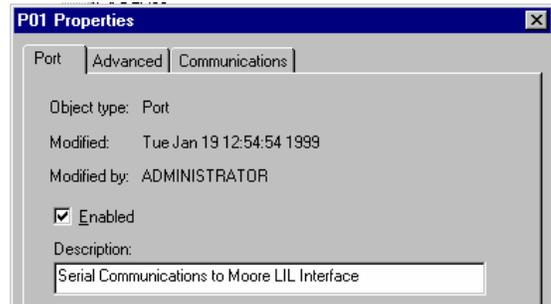
The selection list for the Protocol Type is as follows:

- Protocol Type:
- Modbus RTU
 - Modbus ASCII
 - Custom

Each Custom Moore Products LIL Serial Port has the following configurable options, which are accessible by right mouse-clicking on the serial port and selecting Properties from the floating menu:

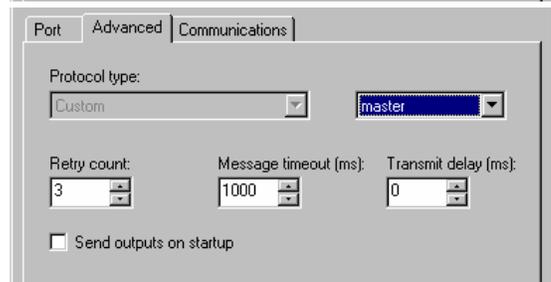
Port Tab:

Enabled: Checked Yes or No.
 Description: Text description of the serial port for documentation.



Advanced Tab:

Protocol Type: Forced to Custom.
 Master/slave: N/A (Default to Master)
 Retry Count: 0 to 255.
 Message Timeout: 100 to 25500 ms.
 Transmit Delay: 0 to 25500 ms.
 Send Outputs on Startup: Checked Yes or No.



Communications Tab:

Port Type: RS-232, RS-422 Full Duplex, RS-422 Half Duplex.
 Baud Rate: 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.
 Parity: even, odd, none.
 Data Bits: 7 or 8.
 Stop Bits: 1 or 2.

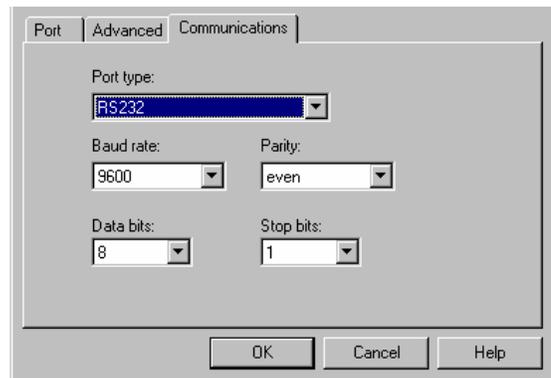


Figure J. Serial Port Configuration Pop-up

- ◆ Port Definition – This pop-up configures the port for the Moore LIL protocol driver in the PSIC which is basically the same as the pop-up for the Standard Serial Interface Card. As many as two ports may be defined. Each port definition contains the following parameters to define the port configuration:
 - PNUM - P01 or P02, indicates which serial port this port script item configures
 - ENABLED - Checked True or False, indicates whether this serial port should be enabled or not
 - DESCRIPTION - This field carries a user supplied description field describing the port.
 - PROTOCOL TYPE - Custom, indicates the Comms Protocol Type is a custom protocol (In this case Moore Products LIL).
 - MODE - MASTER or SLAVE, indicates the communications mode to use. For the custom Moore LIL protocol this field will always be set to MASTER
 - RETRY COUNT - 0 to 255, Number of times to retry a failed message
 - MESSAGE TIMEOUT - 100 to 25500, Message time-out value in milliseconds
 - TRANSMIT DELAY - 0 to 25500, Message transmit delay value in milliseconds
 - SEND OUTPUTS - Checked True or False, Indicates whether outputs should be sent on startup or not
 - PORT TYPE - RS232, RS422/RS485 FULL DUPLEX or RS422/RS485 HALF DUPLEX, Port type to be used for communications
 - BAUD RATE - 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200.
 - PARITY - EVEN, ODD or NONE
 - DATA BITS - 7 or 8, Number of data bits used for communications
 - STOP BITS - 1 or 2, Number of stop bits

Serial Device Configuration

The Programmable Serial Interface Card uses the same device configuration as the standard Serial Card which contains a Device Description and a Device Address ranging from 1 to 255. For practical purposes the Device Address range for the Custom Moore LIL protocol ranges from 1 to 32, or from 1 to 64 for LIL networks using the extended addressing range. This limitation is not enforced by the Programmable Serial Interface Card and is therefore to be maintained strictly by the user.

Each Custom Moore Products LIL Device has the following configurable options, which are accessible by right mouse-clicking on the Device and selecting Properties from the floating menu:

Device Properties Pop-up:

Description: Text description of the device for documentation.

Device Address: 1 to 255.

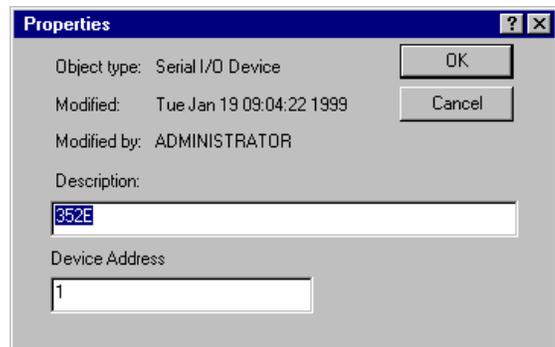


Figure K. Serial Device Configuration Pop-up

The allowable numeric entries listed above represent the maximum and minimum range of values which a user may enter into the Device Pop-up's data entry fields. The Moore Products LIL protocol programmed into the DeltaV PSIC has more practical limitations based on the LIL addressing range being used. The LIL protocol software does not enforce these practical limitations; therefore, it is contingent upon the user to maintain these limitations during the configuration process.

- ◆ Device Definition – Configuration of the Moore Device(s) to be polled using the Moore LIL protocol driver in the PSIC are basically the same as that for the standard DeltaV Serial Card. Since there is a DeltaV imposed limit of sixteen data sets that can be configured for each port, as many as sixteen devices may be defined, depending on the number of data sets configured for each device. Each device definition contains the following parameters to define the device configuration:



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- DESCRIPTION - This field carries a user supplied description field describing the device
- DEVICE ADDRESS - This field carries the LIL address of the Moore device being polled.

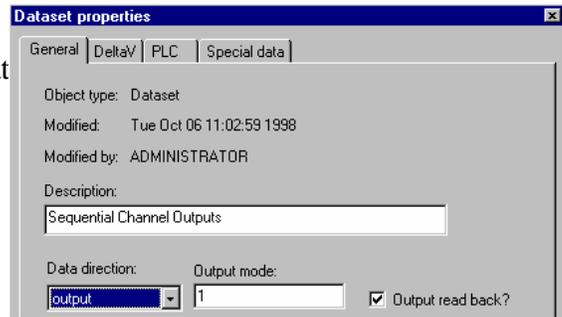
Serial Data Set Configuration

The Serial Data Set configuration differs from the Standard Serial Card Data Set configuration when the protocol type of “Custom” is selected for the serial port configuration. The configuration limits enforced on the Data Set configuration items pertain to those allowable in the standard Serial Card protocol. Therefore, validation checks on the data set configuration for the “Custom” Moore Products LIL protocol mode must be maintained by the user and are specific to the Moore LIL protocol command type configured in the “Device Data Type” field.

Each Custom Moore Products LIL Data Set has the following configurable properties with their uses dependent upon the Moore LIL command type selected in the Device Data Type filed:

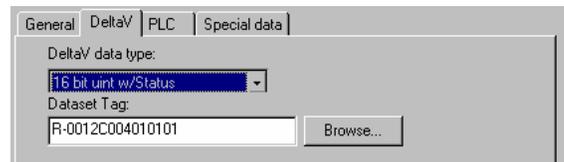
General Tab:

Description: Text description of the data set for documentation.
 Data Direction: Input or Output.
 Output Mode: 0 to 255.
 Output Read Back: Checked Yes or No.



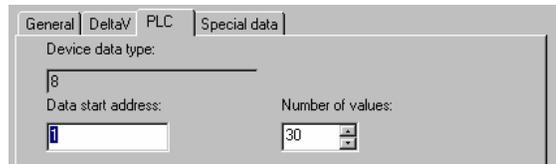
DeltaV Tab:

DeltaV Data Type: Boolean, Discrete, 8 bit signed integer, 16 bit signed integer, 32 bit signed integer, 8 bit unsigned integer, 16 bit unsigned integer, 32 bit unsigned integer, Floating Point, String.
 Data Set Tag: Configurable by user.



PLC Tab:

Device Data Type: 0 to 255.
 Data Start Address: 0 to 65535.
 Number of Values: 1 to 100.



Special Data Tab:

Special Data 1: 0 to 65535.
 Special Data 2: 0 to 65535.
 Special Data 3: 0 to 65535.
 Special Data 4: 0 to 65535.
 Special Data 5: 0 to 65535.

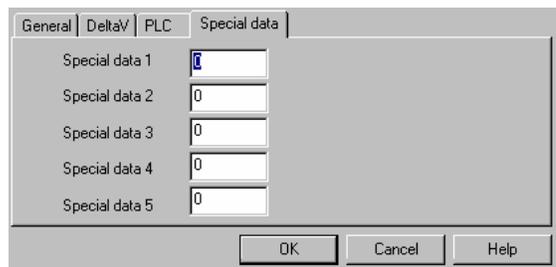


Figure L. Data Set Configuration Pop-up

The allowable numeric entries listed above represent the maximum and minimum range of values which a user may enter into the Data Set Pop-up's data entry fields. The Moore Products LIL protocol programmed into the DeltaV PSIC has more practical limitations based on the LIL command being configured and are described as appropriate in the sections on the data entry fields which follow. The LIL protocol software

does not enforce these practical limitations; therefore, it is contingent upon the user to maintain these limitations during the configuration process.

- ◆ Description Field - A user defined text string which describes the data set.
- ◆ Data Direction Field - Indicates whether this Data Set is input data to be read from the Moore LIL device or output data to be written to the device. The default value is INPUT.
- ◆ Output Mode - Controls the data type being transmitted to the Moore LIL device when **LIL commands 8** or **9** are selected. This is a simple numeric entry ranging from 0 to 255 with the default value being zero. This field is not used when **LIL commands 2, 5, 6** and **7** are selected and may be neglected in those cases. The actual meaning of the Output Mode values is defined as follows:

<u>Output Mode</u>	<u>Description</u>	<u>Number Of Data Words</u>
0	Record Send Acknowledge (not used)	3-4
1	16-Bit Integer, Absolute	1
2	16-Bit Integer, Relative	1
3	16-Bit Multi-Discrete Mask ON	1
4	16-Bit Multi-Discrete Mask OFF	1
5	Unused	
6	32-Bit Floating Point, Absolute	2
7	32-Bit Floating Point, Relative	2
8	Multi-Byte Data (Messages)	1-10
9	32-Bit Integer, Absolute	2
10	12-Bit Integer Plus Range Bits, Absolute	1

Refer to the Moore Products documentation on the LIL Protocol for more information on the proper use of these data types.

- ◆ Output Read Back - Indicates whether the output Data Set should be read back in the Serial Card's input scan or not. If this field is checked then the Data Set will be read back from the Moore LIL devices during the normal input scan of the Serial Card. The values read back will be used to update the current output values. If this field is left unchecked then no output read back will be performed. This selection is available only when the Data Direction is set to "Output". The default setting for the Output Read Back is unchecked.

- ◆ **DeltaV Data Type** – This field is used to tell the PSIC and the DeltaV system what type of data this Data set contains (Boolean, Discrete, Integer, Floating Point, etc.). This field’s value is used to create storage for the data set and to determine how the data is to be accessed by the rest of the DeltaV System. The default value for the Data Type field is Boolean; however, the data type most commonly used with Moore LIL communications is 16-bit unsigned integer.
- ◆ **Data set Address** - PSIC data is accessed through standard DSTs (Device Signal Tags) and DST attributes using the same methods as is provided for the standard Serial Interface Card. The attribute names for the data set data when in “Custom” mode are defined using the R1 to R65535 format. The names are defined using the register designator “R” followed by the address of the data value with regard to the data start address and include an offset of one. For example the attribute names for a data set containing 5 values with a starting address of 10 would be R11, R12, R13, R14 and R15.

The Programmable Serial Interface Card data sets are available for display and control module usage and can also be used as input or output to standard DeltaV function blocks using the I/O reference attribute of the function block. This data is stored in the data set in its “raw” format as transmitted by the Moore LIL device. Any decoding or scaling of the data must be done by the user through configuration of DeltaV function blocks in the Control Module(s) and should be done per the Link Interface Communications User’s Manual documentation for the Moore device.

- ◆ **Device Data Type Field** - Indicates which LIL command is being used to transmit data to or from the LIL device. This is a simple numeric entry ranging from 0 to 255. The default value for Device Data Type is 0. The LIL protocol defines which LIL command corresponds to each number and is limited for practical reasons to the following commands:

Device Data Type	LIL Command	Description
2	2	Give ICI status
5	5	Request Sequential Channel Data
6	6	Request Random Channel Data
7	7	Request Random Parameter Data

<u>Device</u>	<u>LIL</u>	<u>Description</u>
<u>Data Type</u>	<u>Command</u>	
8	N/A	Send Sequential Channel Data
9	9	Send Parameter Data

LIL Commands 2, 5, 6 and 7 are input type demands and the Data Direction selection should be set to “INPUT” when these commands are used. **LIL Commands 8 and 9** are output type demands and the Data Direction selection should be set to “OUTPUT” when these commands are used.

Refer to the Moore Products documentation on the LIL Protocol for more information on the proper use of the LIL commands.

- ◆ Data Start Address Field - Addresses can range from 0 to 65535 with the default value being 0. The Data Start Address field is used with specific regard to the Moore LIL command selected in the Device Data Type field.

When **LIL command 5, Request Sequential Channel Data**, and **LIL command 8, Send Sequential Channel Data**, are selected the Data Start Address field is used to configure the first channel number in the range of channel data to be transmitted. The LIL protocol limit for this field is the largest channel number available from the LIL device being polled.

This field is not used when **LIL commands 2, 6, 7 and 9** are selected and may be neglected in those cases.

- ◆ Number of Values – This field indicates the number of data values to be read or written to/from the Moore LIL device with an acceptable range from 1 to 100. The default value for the Number of Values field is 1.

When **LIL commands 2, 5, 6, 7 or 8** are selected, the Number of Values field is used to configure the total number of channels or parameters in the range of channel/parameter data to be transmitted. For **LIL commands 5 and 8**, this field should be filled out to match the total number of channels in the data set being transmitted to/from the LIL station device being polled. For **LIL Command 2, Give ICI Status**, this field must be set to 1. For **LIL commands 6 and 7**, this field must be filled out to match the number of values requested within the Special Data fields.

When **LIL command 9, Send Parameter Data**, is selected the Number of Values field is used differently when the DeltaV data type is string data as opposed to all other data types. In the case of string type data, the Number of Values is used to configure the total number of characters in the data string being transmitted to the parameter being configured. The LIL protocol range limit for this field is 1 - 20. For all other data types when using **LIL command 9**, this field denotes the total number of parameters of data that is being transferred with a practical range of 1 to 5. The number in this field must match the number of parameters configured in the special data fields for non-string data types.

- ◆ Special Data – Fields 1 through 5 are extra configuration fields available for use with certain LIL commands. These fields accept a simple numeric entry ranging from 0 to 65535 with the default value for each of these fields being 0.

When **LIL command 6, Request Random Channel Data**, is selected the five Special Data fields are used to encode the LIL station numbers and channel numbers with the format **SSCC** (where **SS** denotes the station number and **CC** denotes the channel number being polled). For example, if channel 6 from station number 3 and channel 8 from station number 15 are requested, then enter the number 0306 into Special Data 1 and the number 1508 into Special Data 2. Fill out all remaining Special Data fields with the default value of zero. The range of random channel data points per data set is therefore effectively limited to five.

When **LIL command 7, Request Random Parameter Data**, is selected, the five Special Data fields are used to encode the channel numbers and parameter numbers to be retrieved with the format **CCPP** (**CC** denotes the channel number and **PP** denotes the parameter number). For example, if parameter 2 from channel number 17 and parameter 8 from channel number 20 are requested, then enter the number 1702 into Special Data 1 and the number 2008 into Special Data 2. Fill all remaining Special Data fields with the default value of zero. The range of random parameter data points per Data Set is effectively limited to five.

When **LIL command 9, Send Parameter Data**, is selected the five Special Data fields are used to encode the channel numbers and parameter numbers to be written to with the format **CCPP** (**CC** denotes the channel number and **PP** denotes the parameter number). When the DeltaV data type is string data, then only the



first Special Data field should be used. Fill all remaining Special Data fields that go unused with the default value of zero. This effectively limits the number of random parameters to be written to with **LIL command 9** to one parameter per data set for string data and five parameters per data set for all other data types.

The special data fields are not used **when LIL commands 2, 5 and 8** are selected and may be neglected in those cases.

Mapping to DeltaV Types

The PSIC maps Moore LIL data to DeltaV data using the Moore LIL and DeltaV data types configured for each data set as follows.

Moore LIL channel parameters are 16 bit values read from or written to the Moore LIL Device. Parameters containing either analog data or discrete data will be treated the same for data mapping purposes by the PSIC.

- When mapping Moore LIL Parameter data to DeltaV Boolean values, the PSIC will set the Boolean Value to 0 if the Moore LIL parameter has a value of 0, and to a value of 1 if the Moore LIL parameter has a value other than 0.
- For Discrete values and 8 Bit Signed or 8 Bit Unsigned Integer values, the PSIC will map the lower 8 bits of the Moore LIL Parameter to the DeltaV value with no other conversion taking place.
- For 16 Bit Signed or 16 Bit Unsigned Integer values, the PSIC will simply map all 16 bits of the Moore LIL Parameter directly into the DeltaV integer value.
- For 32 Bit Signed or 32 Bit Unsigned values and Floating point values, the PSIC will map 2 consecutive Moore LIL parameters to the DeltaV value with the first parameter being the least significant word and the second parameter being the most significant word.

For String values, the number of values field in the Data Set configuration indicates the size of the string. The PSIC will map the specified parameters to a single DeltaV string with a length equal to the number of values multiplied by two. The first parameter specified will contain the first two characters of the string, where the high order byte of the parameter contains the 1st character and the low order byte contains the 2nd character. The remaining parameters will contain the remaining string characters, which will be mapped in the same order as the first two characters.

Mapping to Moore LIL Data Types

For write requests, the PSIC mapping of DeltaV data to Moore LIL data is simply the opposite of the Moore LIL to DeltaV data mapping described in the previous section. It is recommended that DeltaV data types used for writing data to Moore channel parameters be restricted to the 16 Bit



Unsigned Integer type. When this data type is used the PSIC will simply map all 16 bits of each DeltaV integer register directly into the corresponding Moore LIL as configured in the Data Set.

Mapping of Moore ICI Diagnostics

The Moore ICI diagnostics supported by the PSIC contains the contents of the ICI status register. The PSIC will treat this data as one word of 16 bits of discrete data. This information is retrieved from the Moore ICI Device using **LIL command code 2**. For data mapping purposes the PSIC will treat this data as if it were a 16 Bit Unsigned Integer value. Therefore the data will be mapped to a DeltaV register exactly as any 16 Bit Unsigned Integer data would be mapped.



CONFIGURATION REQUIREMENTS

This section describes the hardware and configuration requirements external to the PSIC needed for supporting communications with the Moore Products LIL driver.

The PSIC is capable of communicating with any 3rd party device which supports RS-232, RS-422 or RS-485 serial communications. The DeltaV implementation of the Moore Products LIL Protocol supports both RS-232 and RS-422.

Moore ICI

Cabling

One Moore MYCRO 320 Independent Computer Interface (ICI) module is required for communications to the DeltaV programmable serial interface card for each serial port to be used. The ICI converts RS-232C signals to the Moore LIL Protocol. Cabling is shown in Figures M through P.

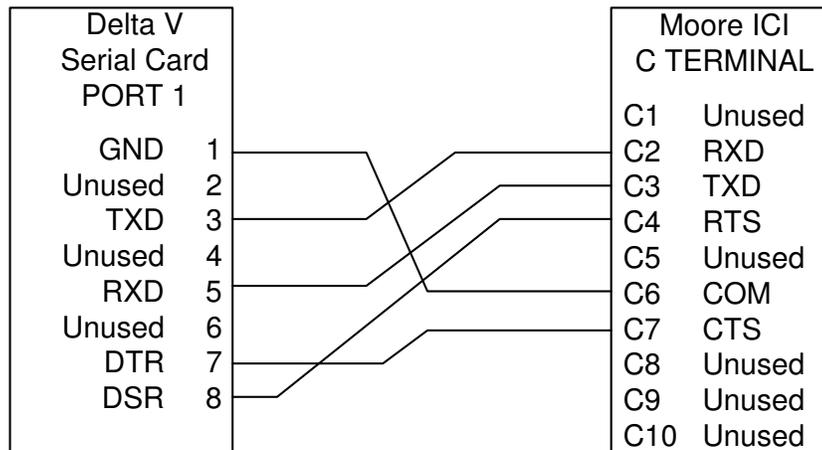
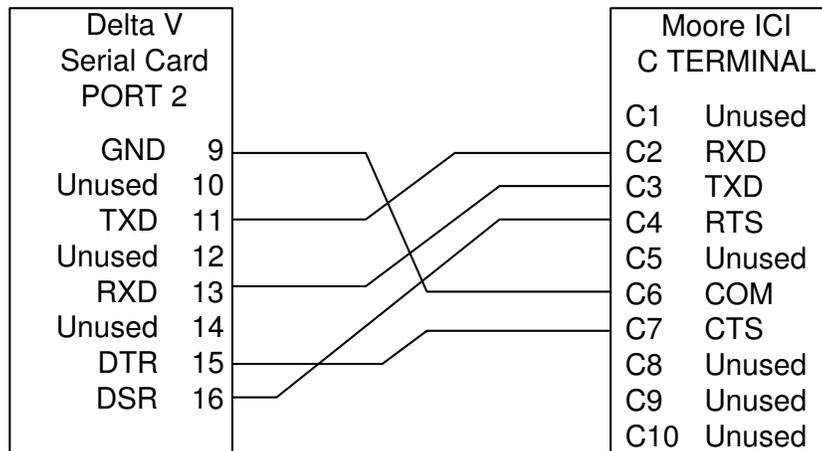


Figure M. RS-232C Cable pin out (DeltaV PORT 1 to ICI)

Figure N. RS-232C Cable pin out (DeltaV PORT 2 to ICI)



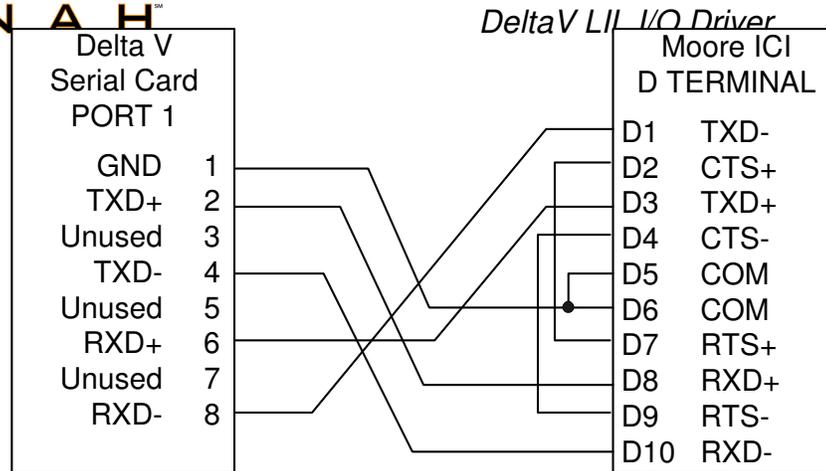


Figure O. RS-422 Full Duplex Cable pin out (DeltaV PORT 1 to ICI)

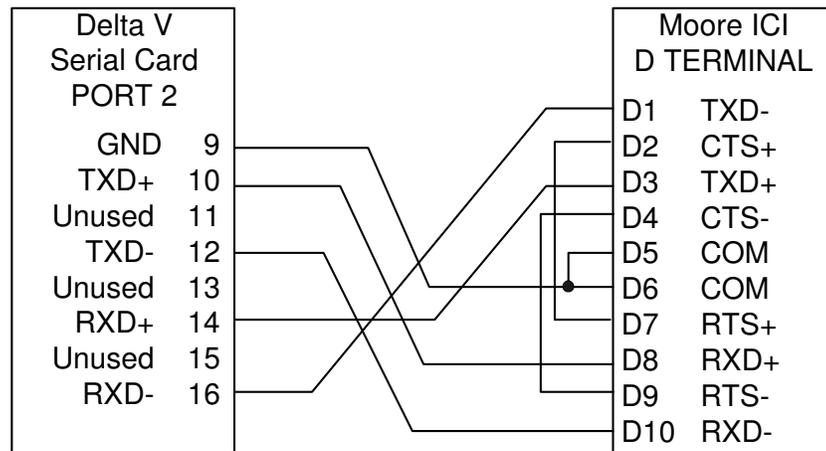


Figure P. RS-422 Full Duplex Cable pin out (DeltaV PORT 2 to ICI)

Station Addressing

From the point of view of the DeltaV Programmable Serial Interface Card, the Moore ICI is “transparent” so communications data sets are configured to communicate directly to an addressed station on the Moore LIL, such as a MYCRO 352 Single Loop Controller. Even so, the Moore ICI must bear a unique LIL station address which is configurable through switches SW2-2 and SW2-1 and switches SW1-1, SW1-2, SW1-4, and SW1-8 on the ICI serial port board.

The Link Station Address is 1 + the sum of the values of the “OPEN” switches on switch bank 1. Switches SW2-2 and SW2-1 determine whether the station is located on the upper link or the lower link.

RS-232C / RS-422 Selection

The DeltaV PSIC may be configured to communicate using either the RS-232C or the RS-422 communications protocols.

- For RS-232C communications set jumpers W5 and W6 to Pins 2 and 3.
- For RS-422 communications set jumpers W5 and W6 to Pins 1 and 2.

Baud Rate Selection

The DeltaV PSIC may be configured to communicate at any selectable rate from 300 Baud to 115200 Baud. The Moore ICI communications rate is configured using jumper W7 on the serial port board. The following table lists the available baud rates:

W7 Position	Baud Rate
Pin 1 to 14	38400
Pin 2 to 13	19200
Pin 3 to 12	9600
Pin 4 to 11	4800
Pin 5 to 10	2400
Pin 6 to 9	1200
Pin 7 to 8	300

Figure Q. ICI Jumper Block – W7

Data Format Selection

The DeltaV PSIC may be configured to communicate with either 7 or 8 data bits, 1 or 2 stop bits, and EVEN, ODD or NONE parity. The Moore ICI communications format is configured using switches 2-8 and 2-4 on the serial port board.

The following table lists the available communications formats:

SW2-8	SW2-4	Start Bits	Data Bits	Parity	Stop Bits
Closed (On)	Closed (On)	1	7	Even	1
Closed (On)	Open (Off)	1	7	Odd	1
Open (Off)	Closed (On)	1	8	None	1
Open (Off)	Open (Off)	1	8	Odd	1

Figure R. Data Format Switch Selection

Transmission Method Selection

The Moore ICI communications transmission method is configurable for either binary or ASCII transmission. The DeltaV PSIC transmission method is not configurable and is fixed at binary, therefore, set the Moore ICI communications transmission format to binary by setting SW5 on the MPU board to Closed (On).

Link Acknowledge Delay Selection

Set switch 4 on the MPU board to the OPEN (Off) position to enable link acknowledge delay. This causes the ICI to not respond to the DeltaV PSIC until the receiving station has acknowledged receiving the message and functions as a data change integrity check.

Null-Filled Data Selection

Set switch 3 on the MPU board to the OPEN (off) position to enable null-filled messages when an error occurs.

Send Command Security

Set switches 1 and 2 on the MPU board to your desired setting. Refer to the following table for switch selections.

Security Level	SW1	SW2
None (default)	Closed (ON)	Closed (ON)
Record	Closed (ON)	Open (OFF)
Parameter	Open (OFF)	Closed (ON)
Local	Open (OFF)	Open (OFF)

Figure S. Security Switch Selection

Each increasing level of security provides greater protection over the previous level as follows:

None - Allows all commands to be used.

Record - Does not allow any record information to be sent from the computer (this is a trivial setting as the DeltaV PSIC LIL driver does not support record transfers).

Parameter - Does not allow any parameter data (such as setpoint changes or mode changes) to be sent from the DeltaV Programmable Serial Interface Card. This level also includes the Record Level.

Local - Does not allow the DeltaV PSIC to contribute any computer-generated data to the LIL database or to set the local channel amount. (The ICI contributes six channels of status information, by default.) This level includes both the record and parameter levels, effectively making the ICI a read only device.

Supported Protocol Commands

The DeltaV LIL Driver supports the Moore ICI protocol commands listed below:

<u>Command</u>	<u>Description</u>
2	Give ICI status
5	Request Sequential Channel Data
6	Request Random Channel Data
7	Request Random Parameter Data
8	Send Sequential Channel Data
9	Send Parameter Data

It should be noted that command number 8, Send Sequential Channel Data, is not a standard Moore LIL command type. Command number 8 as implemented in the PSIC Moore Products LIL Driver is a special command engineered by *PROCONEX* to increase and enhance the functionality of Data Sets configured to Output, or write, data parameters to Moore MYCRO devices. The standard Moore LIL command number 8, Local Channel Data Send, is not supported in this implementation.

Error Checking

The DeltaV PSIC LIL Driver uses the Moore LIL protocol for verifying correct message communications.

The command and reply messages sent and received by the I/O driver are appended with a check word. If the Moore LIL station device receives a message with an invalid check word it ignores the message. In this case the Programmable Serial Interface Card will time-out and retry sending the message for the configured number of retry times.

Similarly, if the Programmable Serial Interface Card receives an invalid or incorrect check word in a message reply from the LIL device, the driver will retry sending the message the configured number of retry times.

Additional checking is done on the reply messages received with good check words. These checks are listed below:

- Is the response command code good?
- Is the response the correct length?
- Does the response status word indicate an error?

When any of these conditions occurs the driver will retry sending the message the configured number of times.

If the driver cannot establish good communications after the configured number of retries, the DeltaV serial card, port, device and data set will all be tagged as invalid.

Refer to the Moore Products documentation for further details on the valid message formats.

Moore Function Block Configuration

This section is included to point-out the requirement of configuring the Moore MYCRO device's function blocks to use external settings with console/local operation. Primarily, details on the Moore MYCRO device's function block configuration can be found in the Moore Products User's Manual for the device being configured. However, a reasonable example of one possible correct device configuration for making full use of DeltaV serial communications for remote computer control of a PID loop can be seen in Factory Configuration 13 (FCO13) for the MYCRO 352 Single Loop Digital Controller. Factory configuration 13 is included in the MYCRO 352 device User's Manual for examination.

DIAGNOSTICS

For the Serial Card, the same basic card and channel (port) diagnostics that is provided for other standard DeltaV I/O cards is supported. In addition, the Programmable Serial Interface Card provides diagnostic information for each Device configured for a serial port and each Data set configured for a Device, as well as various serial communications statistics for each of its serial ports. These Data Set and Device Diagnostics and Communications Statistics are available for display using DeltaV Diagnostics.

The DeltaV Diagnostics view of a controller configuration containing a Serial Card is as follows. Here, C04 has a card type of “Prog Serial Card”, P01 and P02 are the ports on the card, DEV01 and DEV02 are devices configured for a port and DS01, DS02 and DS03 configured data sets for the devices.

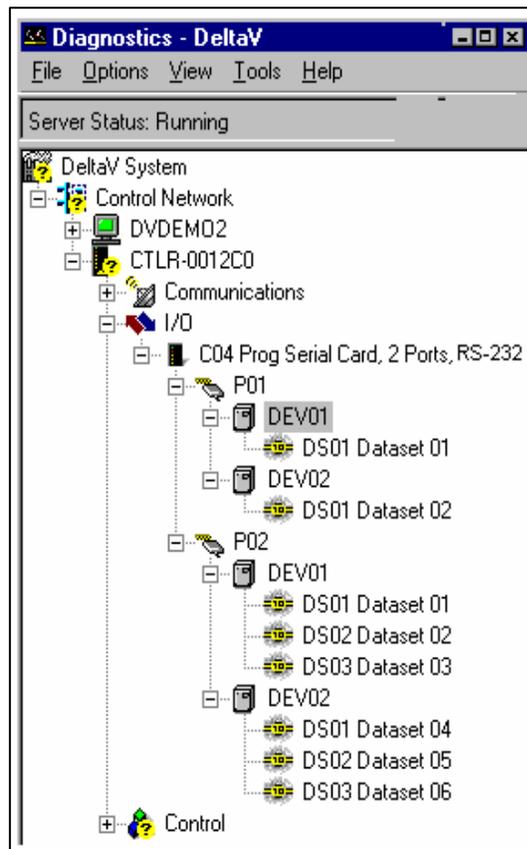


Figure T. DeltaV Diagnostic View of Control Network

Card Level Diagnostics

The following card level diagnostics are supported for the Serial Card and are displayed by the DeltaV Diagnostics when the user mouse clicks on an I/O card which has a card type of “Prog Serial Card, 2 Ports, RS232/RS485.” These diagnostic items are supported as diagnostics attributes for the I/O card in the DeltaV controller.

- **EXIST** - Indicates whether the card exists in the controller’s I/O subsystem or not.
- **OINTEG** - Overall integrity of the Serial Card. The “OR” function applied to the OINTEG of each port on the serial card, either Good or Bad.
- **HWREV** - Hardware Revision number for the serial card hardware.
- **SWREV** - Software Revision number.
- **MODEL** - Type of the I/O card, “Prog Serial Card, 2 Ports, RS232/RS485.”
- **SNUM** - Serial Number of the card
- **STATUS** - String attribute containing a text description of the current overall status of the card, such as “Good”, “Unconfigured”, “Not Communicating”, etc.

Card Level Communications Statistics

The Serial Card supports the Display Real-time Statistics option currently available for all Railbus I/O cards. This diagnostic option displays Railbus communications statistics with a right mouse click on the card.

The following statistics are then display by selecting “Display Real-Time Statistics” from the context menu.

- Valid Responses
- No Responses
- Received CRC Errors
- Transmitted CRC Errors
- Failed Retries
- Successful Retries
- Asynchronous Transactions
- Synchronous Transactions
- Default Transactions
- Transaction Timeouts
- Trans Timeout Value

Card Level Protocol Information

The Serial Card also supports the display of information pertaining to the custom protocol loaded into the card’s flash ROM. This diagnostic option is displayed with a right mouse click on the card followed by selecting “Display Protocol” from the context menu. The following information is displayed:

- Toolkit Software Version

- Protocol Driver Software Version
- Protocol Name (“Moore Products LIL Interface”)
- Manufacturer Name (“**PROCONEX** - King of Prussia”)

Port Level Diagnostics

The following set of diagnostic attributes are supported for each port on the serial card and are displayed by **DeltaV** Diagnostics when the user mouse clicks on a port under an I/O card of type “Prog Serial Card”. These diagnostics items are supported as diagnostics attributes for the Serial Card port in the **DeltaV** controller.

- OINTEG - Overall integrity of this communications port. It is the “OR” function applied to all the status bits in the Port Status Register reported by the Serial Card, either Good or Bad.
- STATUS - String attribute containing a text description of the current overall status of the communications port, such as “Good”, “Disabled”, “Not Communicating”, “Error Response”, “5% Comm Error”, “Termination Lost”, etc. (based on current Port Status Register settings)
- NDEVICES - Number of devices configured for this port.

Communications Statistics

The Serial Card keeps track of a set of communications statistics for each serial port. The **DeltaV** Diagnostics will display these communications statistics when requested by the operator. To display the comm statistics the user should right mouse click on the desired Serial Card port and then left mouse click to select “Display Port Statistics” from the context menu displayed. The following serial communications statistics will be kept for each serial port.

- Number of Registers Requested
- Number of Messages Sent
- Number of Good Messages Received
- Number of Error or Bad Messages Received
- Number of Retries
- Number of Message Time-outs
- Maximum Scan Time
- Minimum Scan Time
- Average Scan Time

The scan times are based on the time it takes to request and process all input data one time through the scan cycle and has a resolution of 1/10 of a second. The average scan time is based on the last 10 scan cycles. A button is provided on the pop-up to allow the operator to clear the statistics and restart the counters.

Access to the communications statistics is provided via Railbus passthrough messaging. The **DeltaV** Diagnostics communicate directly with the Serial Card to retrieve or reset the Communications Statistics.

Port Configuration

A method is provided in the **DeltaV** Diagnostics to display the current port configuration for a selected communications port to aid in diagnosing communications problems. To display the port configuration the user should right mouse click on the desired Serial Card port and then left mouse click to select “Display Port Configuration” from the context menu displayed. The following port configuration parameters will be displayed.

- Enabled - True or False
- Mode - Master or Slave
- Protocol Type - Modbus RTU or Modbus ASCII or Moore Products LIL
- Port Type - RS-232 or RS-422/485 Full Duplex or RS-422/485 Half Duplex
- Baud Rate - 300, 1200, 2400, 4800, 9600, 38400, 57600, 115200
- Parity - None, Odd or Even
- Data Bits - 7 or 8
- Stop Bits - 1 or 2
- Retry Count - 0 to 255
- Send Outputs on Startup - True or False
- Message time-out - 100 to 25500 ms
- Transmit Delay - 0 to 25500 ms

Access to the port configuration data is provided via Railbus passthrough messaging. The **DeltaV** Diagnostics communicate directly with the Serial Card to retrieve the Port Configuration data. This data is static and does not change unless a new configuration is downloaded. Diagnostics will only need to perform a one time retrieval and display of the Port Configuration data.

Device Level Diagnostics

The following set of diagnostic attributes are supported for each serial Device configured for each port on the Serial Card and are displayed by the **DeltaV** Diagnostics when the user mouse clicks on a device under a serial card port. These diagnostics items are supported as diagnostic attributes for the Serial Card device in the **DeltaV** controller.

- OINTEG - Overall integrity of the communications with this device. This is the “OR” function applied to the OINTEG of all the data sets configured for this device.
- STATUS - String attribute containing a text description of the current overall status of the communications with the connected device, such as “Good” or “Not Communicating”.
- NDSETS - Number of data sets configured for this device.

Data Set Level Diagnostics

For each configured Data Set, the Serial Card keeps a Block Status and a Protocol Error Code to reflect the status of the last communication attempt

with the remote device. The Block Status may have any one of the following values:

- Good
- CRC/Checkword Error
- No Response
- Error Response

If the Block Status is “Error Response” then the error code returned in the protocol error response message is saved in the Protocol Error Code field. The Protocol Error Code will have one of the following values:

- 01 - Error Response-Illegal Function
- 02 - Error Response-Illegal Data Address
- 03 - Error Response-Illegal Data Value
- 04 - Error Response-Slave/Link Device Failure
- 05 - Error Response-Acknowledge
- 06 - Error Response-Slave/Link Device Busy
- 07 - Error Response-Negative Acknowledgment
- 08 - Error Response-Memory Parity Error
- 09 - Error Response-Invalid Resp Func Code
- 10 - Error Response- Invalid Resp Msg Size

To maintain consistency with other I/O card diagnostics, an OINTEG attribute is also maintained for each Data Set to indicate the Data Set’s integrity. It is set to “BAD” whenever the Block Status is not Good and “GOOD” when the Block Status is Good.

The STARTREGADDR attribute displays the value of the first DeltaV register contained in the data Set. The REGVALUE field contains the R-type address of the first register in the data set and its contents (e.g. R8:1125 is displayed if the first register in the data set is Register 8 and it contains the value 1125)

DeltaV Diagnostics will display the appropriate OINTEG, STATUS and Protocol Error Code attributes, etc. when the operator selects a Data Set on a Serial Card Port.

Data set Configuration

A method is provided in the DeltaV Diagnostics to display the current data set configuration for a selected data set to aid in diagnosing communications problems. To display the Data set configuration, the user should right mouse click on the desired Data set and then left mouse click and select “Display Data Set Configuration” from the context menu displayed. The following Data Set configuration parameters will be displayed.

- Device Address: 1 - 255



- Data Direction: Input or Output
- Number of Values: 1 to 100
- Output Mode: Mode 0 - Block or Mode 1 - Single Value (should always be “Block”)
- Output Read Back: True or False
- Data Type: Boolean, Discrete, 8 bit signed integer, 16 bit signed integer, 32 bit signed integer, 8 bit unsigned integer, 16 bit unsigned integer, 32 bit unsigned integer, Floating Point, String
- Data Start Reg Address: 0 to 65535
- Device Data Type: LIL Command Type
- Special Data 1: 0 to 65535
- Special Data 2: 0 to 65535
- Special Data 3: 0 to 65535
- Special Data 4: 0 to 65535
- Special Data 5: 0 to 65535

Access to the Data Set configuration data is provided via Railbus passthrough messaging. The DeltaV Diagnostics communicates directly with the Serial Card to retrieve the Data Set configuration data. This data is static and does not change unless a new configuration is downloaded. Diagnostics will only need to perform a one time retrieval and display of the Data Set configuration data.

Data Set Registers

A method is provided in the DeltaV Diagnostics to display the contents of some or all registers configured for a data set. To display the Data Set registers, the user should right mouse click on the desired Data Set and then left mouse click to select “View Data set Registers” from the context menu displayed. A pop-up showing the data set level diagnostics along with the ability to select the data set register scan range for viewing register contents will then be displayed. Double mouse clicking on any named field in the data set level diagnostics display can also display this pop-up.

Technical Support

For technical support or to report a defect, please give MYNAH Technologies a call at (636) 681-1555. If a defect is discovered, please document it in as much detail as possible and then fax your report to us at (636) 681-1660.

You can also send us your questions via e-mail. Our address is:
support@mynah.com