

PRM Integration Guide with MTL 4840 Series HART Multiplexer

This manual explains how to connect the MTL4840 Series HART Multiplexer and configure Yokogawa's Plant Resource Manager (PRM) software. This document is based on MTL's Technical Support Note No. 205.

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1 Introduction

This note is intended to help the user with connection details for the use of the MTL4840 System for partial stroke testing of Emergency Shut Down (ESD) Valves.

Partial Stroke testing has been gaining in popularity over the past few years. It enables users who have HART capabilities in their control valve or Emergency Shutdown Valves, (ESD Valves), to perform partial stroke testing.

Valves such as the Fisher DVC6000 allow partial stroking to ensure the valves availability and thus avoiding any potential catastrophic situations.

Partial Stroke testing can significantly reduce costs for predictive maintenance and also improves reliability of the valves; as a consequence productivity can be improved due to the improved performance of the valve.

Partial stroke tests check the valve movement with a small ramp, this ramp does not affect the general operation of the valve and thus there will be no disruption in production.

The Partial Stroke test can be initiated with a pushbutton remotely located from the valve or using a HART Communicator and appropriate software such as AMS ValveLink software.

2 Overview of MTL4840 System

The MTL4840 Hart maintenance system provides interconnection, addressing and scanning of HART smart devices.

This allows the user to monitor, calibrate and maintain an entire network from a single maintenance workstation or local area network independently of the main control system.

MTL's HART connection system allows you to implement HART capabilities in both intrinsic safety and general-purpose applications by connecting up to 7936 HART instrument loops to a control system and a variety of process automation maintenance software.

This means better use of maintenance resources with reduced commissioning time and process downtime and consequently lower costs for commissioning and loop maintenance.

The MTL4841 HART Communications Module and MTL4842 HART Interface Module and several of the HART Connection units are SIL 3 BASEEFA Certified in accordance with IEC61508.

3 Hardware and Software Requirements

3.1 Hardware

The hardware requirements will depend on a few factors, is the application IS or non-IS? Is the application a 2-wire or 4-wire application? This Note covers Non _IS applications only and the detailed hardware requirements for 2 or 4 wire applications are shown in section 5

The key elements of the MTL HART Multiplexer system for this application are the MTL4841, (HART Communication Module), and the MTL4842, (HART Interface Module). Both of these modules offer a compact plug-in style thus providing quick and easy installation onto the HMU16 backplanes.

Between one and sixteen ESD Valves can be connected via the HMU16 backplane to the MTL4841 HART Communication Module Node. A further 15 HMU's can also be daisy chained to the MTL4841 to give expansion of the system. However due to the speed of HART communications and the number of variables that can be scanned from the positioner it is advisable to restrict the number of connections to less than 64 devices per MTL4841.

With the HMU16 backplane, the MTL4841 Communications Module and MTL4842 Interface Module provide the HART data interface between smart devices in the field and the HART Instrument Management Software.

Also required is a HART capable Control Valve or ESD Valve such as the Fisher DVC6000 Series. These can be controlled by either a DCS Analogue Output Card or via a Logic Solver or ESD DO Module with a 24Vdc output.

A Line Conditioner, may also be required in the circuit, this is used to boost the impedance in the loop to facilitate HART Communications. However this is not always necessary if a backplane with the necessary impedance is included.

3.2 Software

ESD Valves can be interfaced with a number of HART Asset Management Systems including Yokogawa PRM Software.

PRM offers the user not only Partial Stroke testing but many other sophisticated diagnostic options.

4 2-Wire non-IS Application Layout

This solution can be used for connection to Positioners in a safe area.

HMU16-P250

MTL4841 (can connect to 16 MTL4842's thus giving you a total of 256 devices per Node)

MTL4842 (can connect up to 16 positioners)

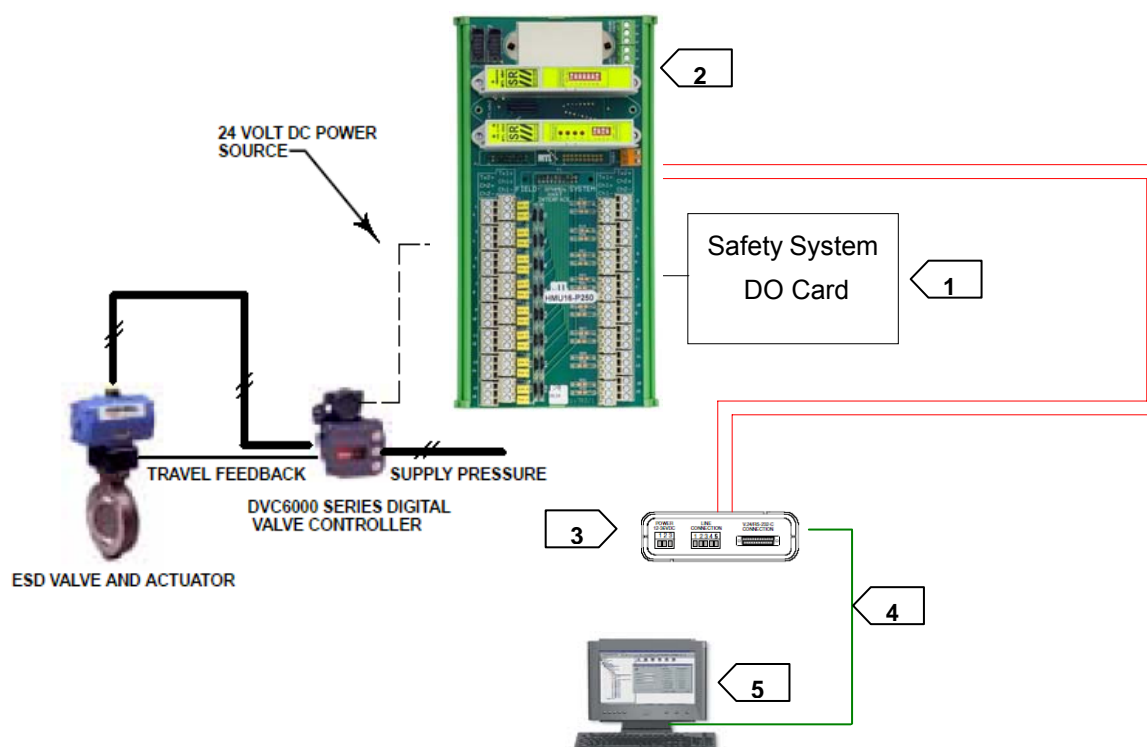


Figure 1

Key:

Item 1 – Safety System DO Card

Item 2 – MTL HMU16-P250 HART Connection Unit (with 250 ohm parallel resistor) and
MTL4842 HART Interface Module and MTL4841 HART Communication Module

Item 3 – Westermo RS485/232 Converter

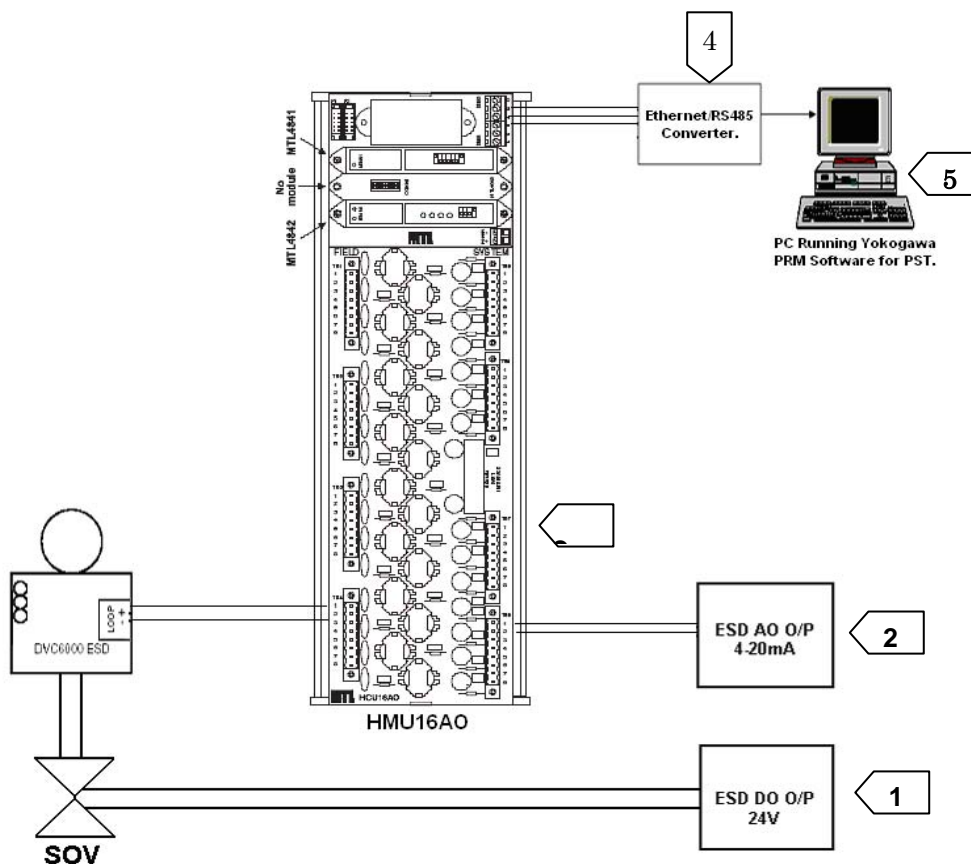
Item 4 – RS232 Cable, Max 33ft (approx. 10metres)

Item 5 – PRM Software PC Workstation

Note: In this configuration the Emerson DVC6000 must be set to Multidrop mode.

Certain DO cards may generate a LFD pulse, in these cases the configuration may need to be altered. Contact MTL for further details.

5 4-Wire non-IS Application Layout



In this diagram the relevant Hardware components for a 4-Wire non-IS Application are shown.

Figure 2

Key:

- Item 1 – Safety System DO Card
- Item 2 – Safety System AO Card
- Item 3 – MTL HMU16-AO HART Connection Unit and
MTL4842 HART Interface Module and MTL4841 HART Communication Module
- Item 4 – Westermo RS485/232 Converter
- Item 5 – PRM Software PC Workstation

The difference between the 2-Wire and 4-Wire applications is that the Valve is powered via an Analogue Output Card producing 4-20mA rather than a 24Vdc signal as in the 2-Wire Application.

Some Analogue Output current sources can interfere with the HART Signal or the HART Signal can interfere with the Current Source. Therefore a HART Filter is added in the loop to make sure this can't happen, in the above drawing the HCU16AO is used. This allows connection to 16 Devices and as per the other applications the system can be built up to connect up to a total of 7936 Devices.

In this application the Logic Solver provides two separate signals, one 4-20mA to the Valve and a 24Vdc signal for a solenoid valve.

6 Installation

6.1 HMU Backplanes

The HMU range of connection units is designed for applications where only a small number of HART signals need to be connected. Consult the Appendix for field and system connections to these backplanes.

An HMU16 backplane uses one MTL4841 module and one MTL4842 module. The type of HART signals handled depends on the HMU model chosen, as shown below.

HMU16 provides connection for up to 16 AI signals

HMU16AO provides connection for up to 16 AO signals

HMUs are supplied on a DIN-rail mounting carrier and may be mounted anywhere in the cabinet in any orientation.

6.2 DC Power Connections

Each HMU backplane has DC POWER terminals for the connection of a (nominal) 24V dc supply.

Power requirements: Voltage: 21–35V dc

Current: 72mA @ 24V dc

Connect the dc power to the board as shown in Figure 3. Observe polarity

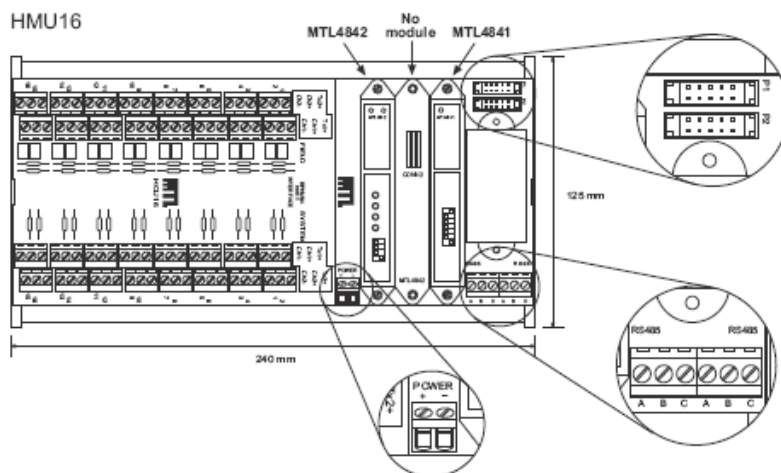


Figure 3

6.3 Links to other HMU Backplanes

HMU backplanes may be linked together to provide a total of sixteen MTL4842 modules under one MTL4841 communications module. (Consequently, other HMUs do not need an MTL4841 module to be fitted.) 10-way connectors **P1** and **P2** - see Figure 3 - are used to link the additional HMU backplanes together.

See Section 6.6 for cabling recommendations and limits. MTL can provide 10-way cables in a range of different lengths on request.

Up to 16 may be connected in this way but the sum of all the interconnecting cable lengths between the first and last unit must not exceed four (4) meters.

6.4 MTL484x modules fitting

Place the MTL4841 over its connector, in the position marked on the HMU16. Ensure that the module is not tilted, which could damage the connector pins, then press it carefully to the HMU16. All safe-area circuit and power connections are made through this connector.

Tighten the two (captive) mounting screws. Repeat this procedure for the MTL4842 module but please note: When fitting the MTL4842 module on the HMU16 and HMU16AO backplanes, DO NOT place the MTL4842 beside the MTL4841 - see Figure 3.

6.5 RS485 communication connections

Two RS485 ports are provided on the board - see Figure 3. These are used to connect the HMU backplane to the PC running the maintenance software and, possibly, to onward link to MTL4841 communications modules on other backplanes.

Full details of this communications link are provided in Section 6.7

6.6 HMU Cable Connections

The interface bus provides a connection between a single MTL4841 communications module and up to 16 MTL4842 HART interface modules/backplanes. This connection is made via a ten-way ribbon cable.

Standard lengths of this 10-way cable are available from MTL using the part number HM64RIB10-x.x, where the x.x denotes lengths between 0.5 and 4.0 metres.

Note: The ribbon cables connecting the HMUs are not suitable for running outside of the cabinet or under control room floors. Generally this will not be necessary, as to maintain integrity, each group of cabinets would interface their HART signals via independent MTL4841 communication modules.

Each MTL4841 module is linked by standard communications cables suitable for RS485 data at 9.6, 19.2 or 38.4 kbaud.

6.7 RS485 connection

The RS485 physical layer

Most PCs running instrument maintenance software masters use RS232C for serial communication; however, this interface type does not allow the communications network to extend beyond 10 to 20 metres in length. MTL have chosen to use an RS485 serial interface, which includes tri-state operation, and allows network lengths of up to 1000 metres and operates with data rates between 1200 baud and 39.4 kbaud when used with the MTL4841. RS485 also allows the simple parallel connection of a number of units.

Note: When an RS232 master is used, a data converter must be inserted.

The RS485 serial interface standard

For the purposes of this document RS485 can be regarded as a 2-wire, half-duplex, differential, multi-drop (32 nodes), communications standard. The RS485 standard defines the characteristics of the drivers and receivers that can be connected to the bus. It does not define the cabling or connectors used, nor does it specify a particular data rate or signal format.

Terminations

RS485 interfaces should ideally be provided with a ‘matched’ termination to prevent reflections and ringing of the signal on the bus cabling. The termination is usually a simple resistive terminator, with an impedance that matches the characteristic of the cable - this will normally be in the range of 100 - 200Ω.

Biasing

When no communication is taking place, the bus is in an undefined, floating state and, consequently, noise on the bus may be decoded as real characters. Well-written software should discard most of these characters, but the system may be further protected by biasing the bus to a known state and thereby preventing the reception of ‘false’ characters.

MTL4841 communication modules from MTL have no built-in facility for terminating or biasing the network; as this is often provided by the RS232/RS485 converter.

RS485 2-wire interconnection

The MTL4840 system uses a 2-wire connection as shown below in Figure 4



Figure 4

This 2-wire bus uses the same pair of wires to transmit queries from the master and responses from the slave.

The MTL4841 communications module connects to the maintenance workstation via a 2-wire link, accessible from the RS485 Port connections on the backplane. Up to 31 MTL4841 modules (slaves) can be connected to a single Master maintenance workstation.

Connect the bus to the backplane as follows using a screened cable, for example Belden 8132 or

9841.

Connect the two cores of the RS485 cable to screw terminals A & B of Port 1 on the HMU - see Figure 5.

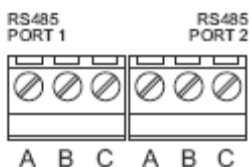


Figure 5

Connect the cable screen to terminal C.

If multiple backplanes are to be connected, use Port 2 to loop to Port 1 of the next backplane. To avoid spending time in troubleshooting, it is suggested that the same color convention is used for all connections to backplane terminals A and B, e.g. red to A, black to B.

Note: No damage will occur if the signalling lines are connected with the wrong polarity. The system will not operate in this case but all that has to be done is to reverse the two connections to make it operate correctly

Data converters

Many RS232/485 data converters are available but the one that has received the most extensive testing and which is recommended for use with the MTL4841 is the Westermo MA45 RS232/485.

Follow the manufacturer's instructions for setting up the RS232 connection to the controlling PC. The RS485 connection should be configured to suit the MTL4841 settings, which are discussed in Section 5.7 of this Note.

If preferred a RS485/Ethernet converted can be utilized.

6.8 Module Configuration

MTL4841 – setting and configuration

The baud rate for the RS485 interface is selected using switches A & B top of the MTL4841 communications module. Set the switches to one of the options given here.

Switches		Baud rate
A	B	
ON	OFF	1200
OFF	ON	9600
ON	ON	19200
OFF	OFF	38400

6.8.1 MTL4841 address switch

Up to 31 MTL4841 communications modules can be connected to a single maintenance workstation. Each MTL4841 must be configured with a unique address by using the five switches located on the top of the module. See Table 1 for settings.

Switch Number					Address
1	2	3	4	5	
ON	OFF	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	4
ON	OFF	ON	OFF	OFF	5
OFF	ON	ON	OFF	OFF	6
ON	ON	ON	OFF	OFF	7
OFF	OFF	OFF	ON	OFF	8
ON	OFF	OFF	ON	OFF	9
OFF	ON	OFF	ON	OFF	10
ON	ON	OFF	ON	OFF	11
OFF	OFF	ON	ON	OFF	12
ON	OFF	ON	ON	OFF	13
OFF	ON	ON	ON	OFF	14
ON	ON	ON	ON	OFF	15
OFF	OFF	OFF	OFF	ON	16
ON	OFF	OFF	OFF	ON	17
OFF	ON	OFF	OFF	ON	18
ON	ON	OFF	OFF	ON	19
OFF	OFF	ON	OFF	ON	20
ON	OFF	ON	OFF	ON	21
OFF	ON	ON	OFF	ON	22
ON	ON	ON	OFF	ON	23
OFF	OFF	OFF	ON	ON	24
ON	OFF	OFF	ON	ON	25
OFF	ON	OFF	ON	ON	26
ON	ON	OFF	ON	ON	27
OFF	OFF	ON	ON	ON	28
ON	OFF	ON	ON	ON	29
OFF	ON	ON	ON	ON	30
ON	ON	ON	ON	ON	31

6.8.2 MTL4842 – setting and configuration

Up to 16 MTL4842 HART interface modules can be connected to a single MTL4841 communications module. Each MTL4842 must be configured with a unique address by using the four switches located on the top of the module. Table 2 shows the switch settings for the individual addresses.

Switch Number				Address
1	2	3	4	
ON	OFF	OFF	OFF	1
OFF	ON	OFF	OFF	2
ON	ON	OFF	OFF	3
OFF	OFF	ON	OFF	4
ON	OFF	ON	OFF	5
OFF	ON	ON	OFF	6
ON	ON	ON	OFF	7
OFF	OFF	OFF	ON	8
ON	OFF	OFF	ON	9
OFF	ON	OFF	ON	10
ON	ON	OFF	ON	11
OFF	OFF	ON	ON	12
ON	OFF	ON	ON	13
OFF	ON	ON	ON	14
ON	ON	ON	ON	15
OFF	OFF	OFF	OFF	16

6.9 Operation at power-up

The MTL4840 system is controlled by a host computer running instrument management software. Although the software is needed to operate the system, some checks can be made on the correct functioning of the hardware in isolation. These checks are made by observing the operation of the LEDs on top of the MTL4841 and MTL4842.

Self-test checks

When power is applied to the MTL4841 and MTL4842, the following events should happen:

The green PWR LED on these modules will light.

The red ACTIVE LED on the MTL4842 will light to show that it is being addressed by the MTL4841. LEDs A to D light in sequence as shown in Figure 6, as the MTL4842 scans once around all the loop addresses 1 to 16.

The sequence is repeated with each MTL4842.

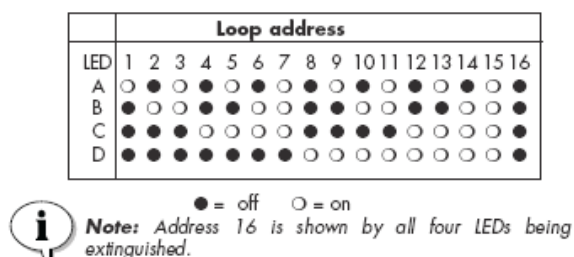


Figure 6

7 Software Connectivity

The MTL HART system provides access from a PC to the HART field devices for configuration, diagnostics and the monitoring of device performance. HART devices may be selected for regular status monitoring, and an alert issued if the status changes.

For this application the MTL HART connection system communicates with Yokogawa PRM software to support Partial Stroke testing of Fisher DSC6000 ESD Valves.

Having connected the MTL4841/MTL4842 system, as described in this TSN, set up the software as described in the PRM user’s manual.

7.1 MTL HART Multiplexer support on PRM

MTL HART Multiplexer will provide RS485 serial communication link. PRM Field Communication Server (FCS) computer will have RS232 COM port so RS485 to RS232 converter is used to convert the serial communication to RS232.

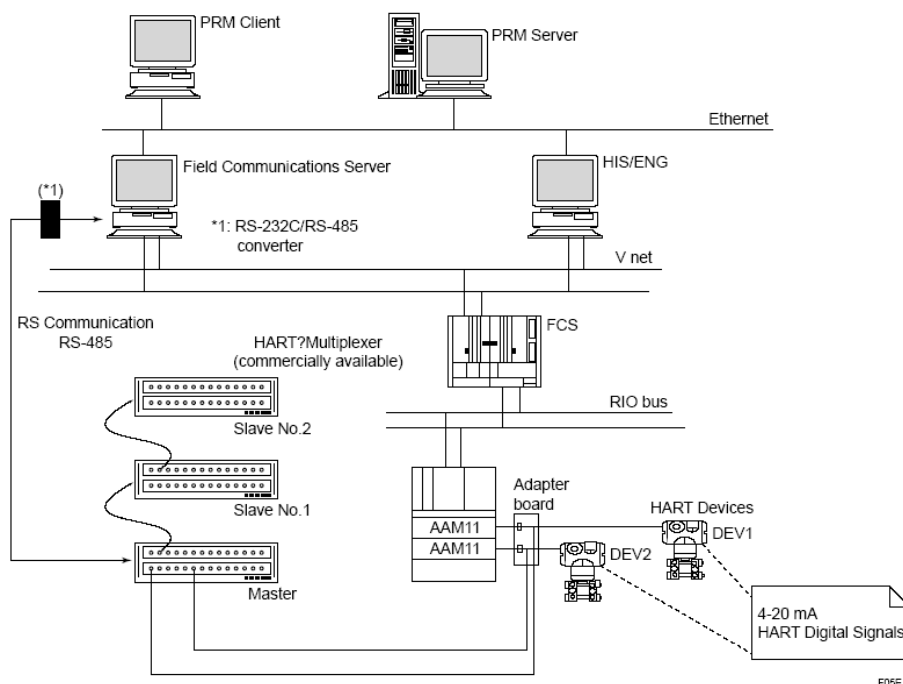


Figure Serial Port Connection via HART Multiplexer (Parallel Connection and Two-way Data Flow)

Figure 7

PRM Field Communication Server will use a baud rate of 19200 for serial communication with the MTLHART multiplexer so the Com port setting on the computer as well as baud rate setting on multiplexer should be set at baud rate of 19200.

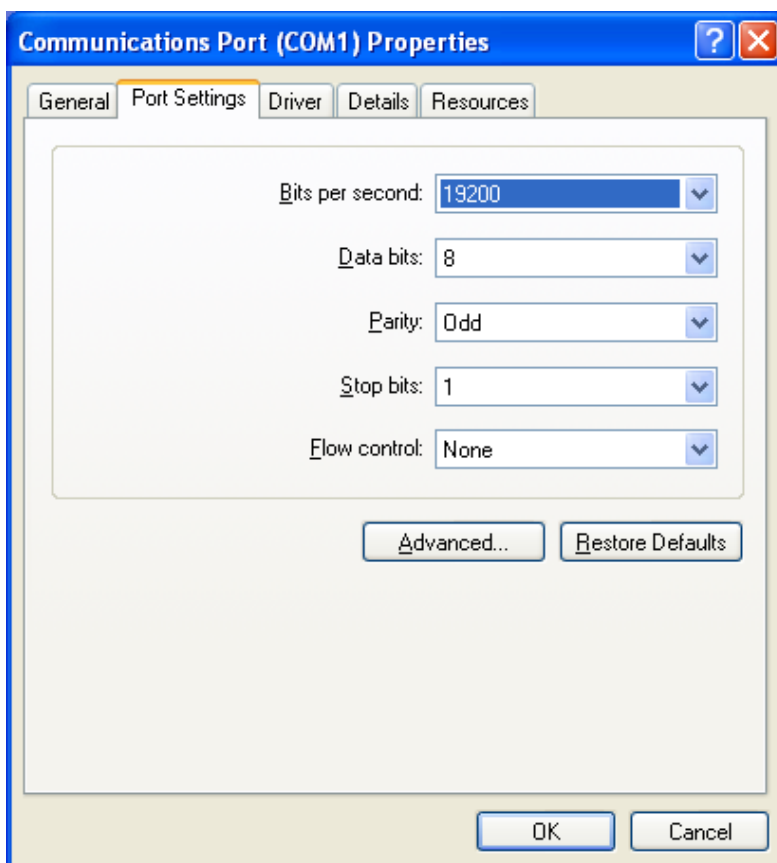


Figure 8

After the com port setting is done on FCS computer, you need to configure the device path for PRM. Create a project under Local and select IOM type for MTL 4840.

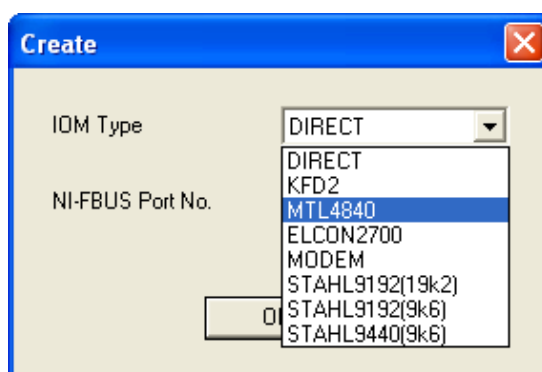


Figure 9

Also configure MTL 4840 for master and slave configuration as per dip switch setting and select COM port where RS232 9 pin cable is connected. Select Preamble 10 for HART device communication.

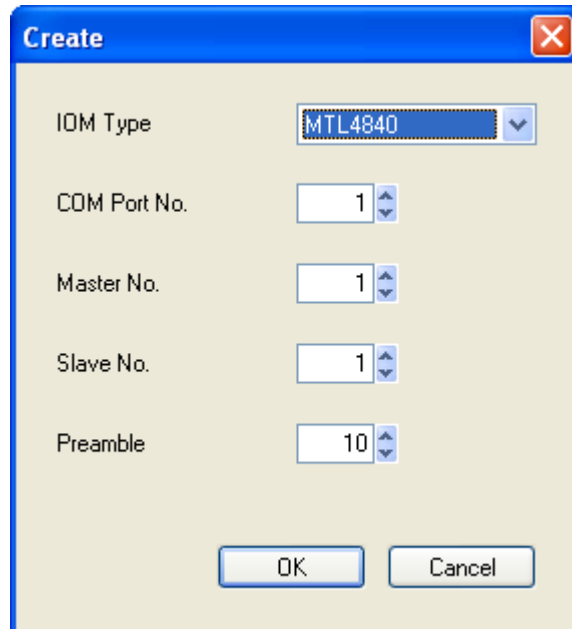


Figure 10

Save the information on Device Path Configuration Tool and restart the field communication server.

Log on to PRM client and go to Network view. Select HART network and go to Register → Read Device Path. When message window pop up informing that it may take long time, please select “Yes”.

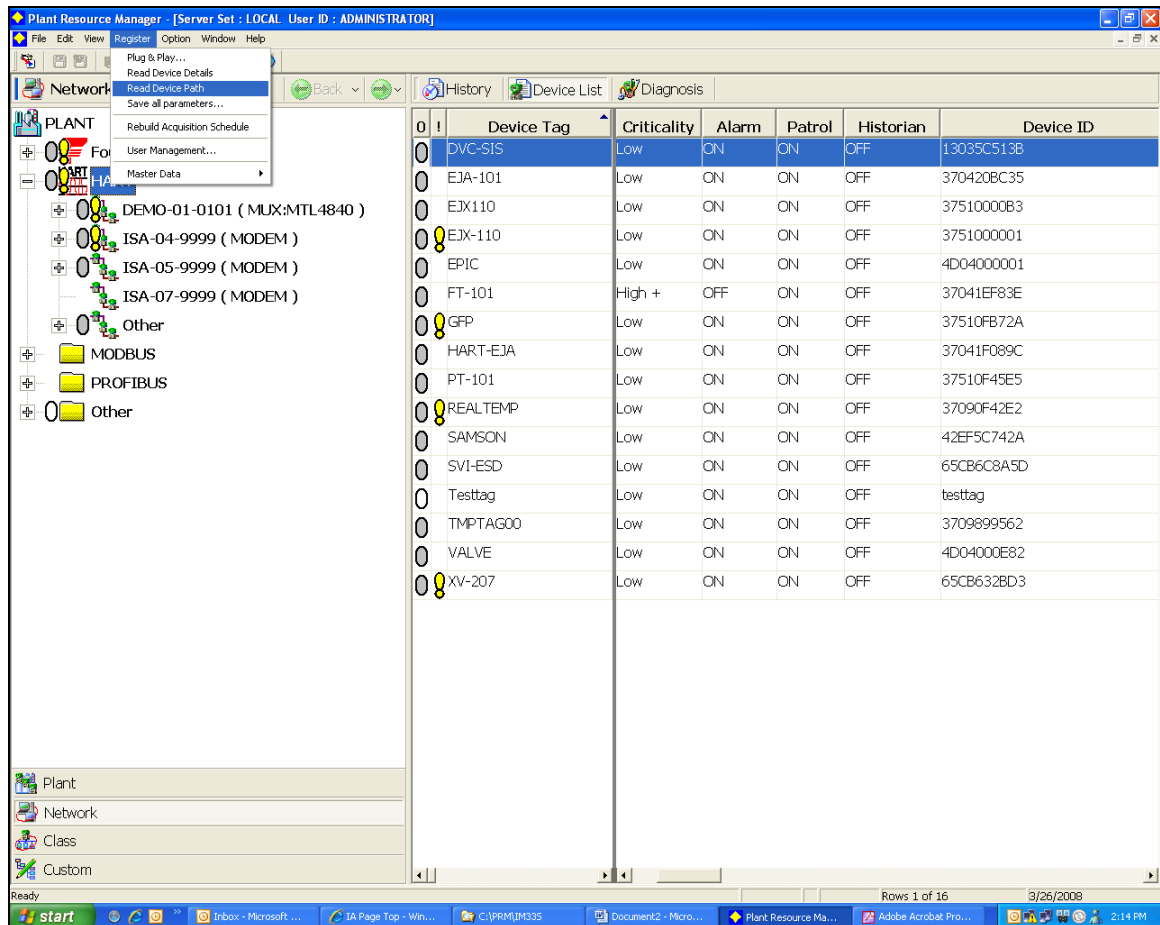


Figure 11

After the project and Multiplexer is registered as device path under HART network view, go to windows explorer and select PmHartMuxMaintTool.exe which is located at under folder PRM/Tool.

MTL4841 supports two kinds of protocols which are Arcom protocol and ASTEC protocol.

Please order MTL4841-PRM of MTL4841 version to use with PRM. If you ordered other MTL4841 version, then select Arcom protocol using “HART Multiplexer Maintenance Tool”.

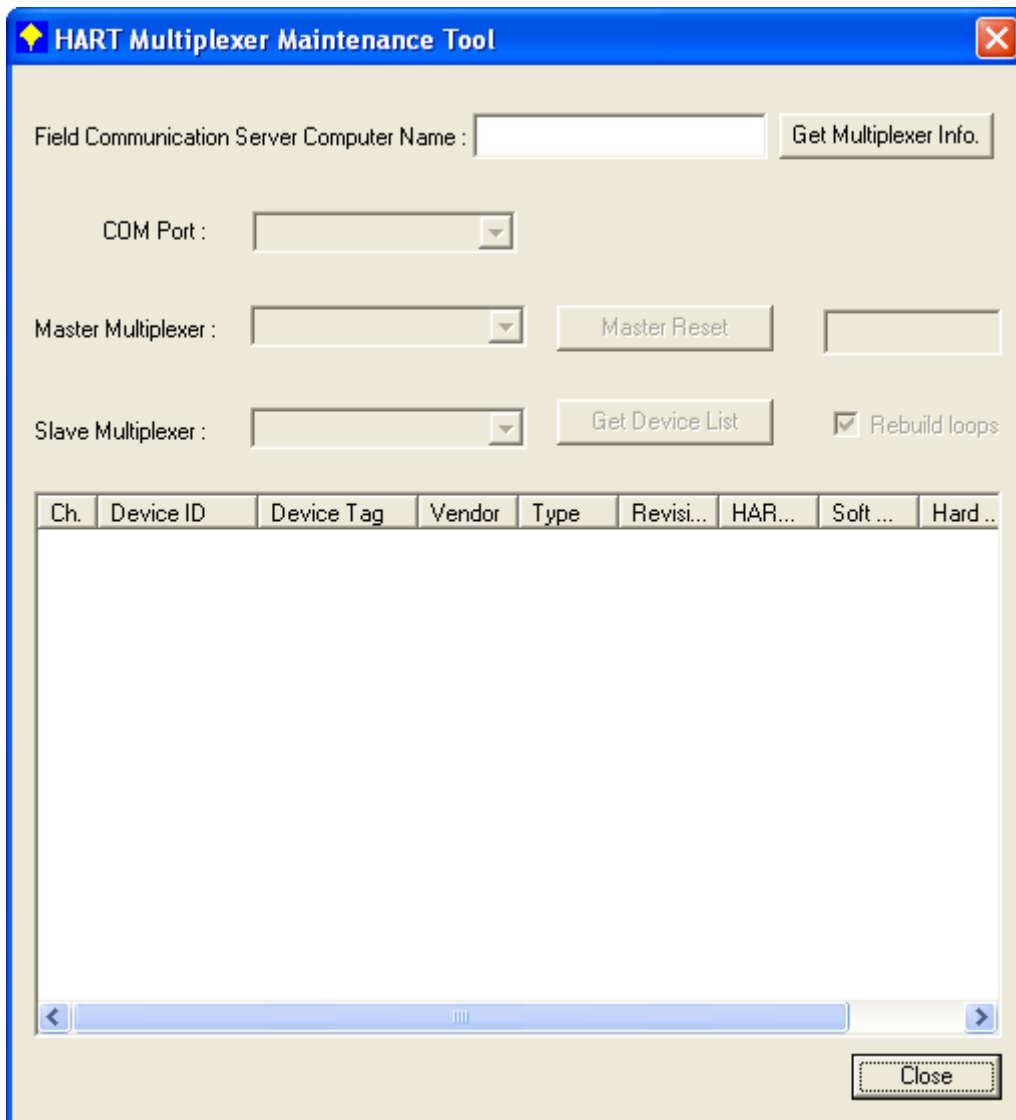


Figure 12

Type PRM FCS computer name and select Get Multiplexer Info. You will get COM port, master and Slave Multiplexer information. When FCS computer will start communication with HART Multiplexer, the lights on the multiplexer will blink indicating that PRM FCS is communicating with multiplexer. Select the Get Device List and all the HART devices connected to Slave Multiplexer will be registered with proper device tag. This test will confirm that PRM FCS is communicating with HART Multiplexer system and HART devices.

Please refer to the MTL Document, INM4840 for further details of the MTL4840 HART Maintenance System.

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NOTE: If you have any queries, please contact your local MTL representative or email us at systemsupport@mtl-inst.com

8 References/Acknowledgements

MTL Publications

- INM4840** Installation Manual for MTL4840 HART Multiplexer System
TSN205 MTL4840 HART Multiplexer System with Fisher DVC6000 SIS.
-