DeltaV™ CHARMs Commissioning

This document explains the field commissioning of CHARM I/O in the DeltaV system.

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Introduction

This document looks at the features of DeltaV's Electronic Marshalling and discusses how CHARM I/O can help reduce the cost of installation by facilitating and in some cases eliminating the various tasks surrounding the installation and commissioning of field instrumentation. It focuses on the hardware and software features of CHARMs during the field wiring checkout and device commissioning process. It is not intended to cover all aspects of the E&I responsibilities during a project.

Project Execution and I/O Marshalling

In traditional control systems, the I/O subsystem is tightly integrated into the controller architecture, with dedicated multi-channel I/O cards physically connected/assigned to one controller. The system design team is faced with a significant challenge to define the required control system hardware because of this dedicated I/O architecture. The process and instrumentation diagrams provide an early view of the control elements and how they are intended to be used in the control strategies. The instrument list is derived from these engineering drawings, which is a detailed list of each element, including the device type, manufacturer, calibration ranges, etc., as well as the physical location of the instrument with in the process equipment. However, the field wiring design cannot be completed until the I/O subsystem is defined. This cannot be completed until the field signal usage is defined in the control strategies so that the signal and the control strategy can be assigned to a controller. Once the signal count for each controller is known, only then can the actual I/O subsystem for each controller be specified and the field wiring design is completed.

In a typical project, the field wiring activities often need to begin long before the I/O subsystem design can be completed. This creates a period of uncertainty in the design, where assumptions are made based on available information, but is subject to change due to project scope changes, or control logic changes resulting in hardware changes. These late changes can be quite costly, especially if I/O must be redistributed to new controllers. Not only due to the rewiring of the signals to new I/O cards, but also in the available cabinet space required to accommodate the additional equipment. Traditional I/O marshalling provides a level of separation between the control strategy design and the field wiring design and installation. There are different approaches to marshalling field wiring, but the common goal is to bind the field signal to the correct I/O channel in a way that minimizes the impact of a late change. However, any addition of I/O hardware to accommodate late changes will add cost as these changes impact the engineering drawings, the field wiring and sometimes the system cabinet footprint.

Figure 1 – *Project schedule impact of I/O design on field wiring.*

Inevitably, every project sees its share of late changes. These can come from:

- Changes in the control strategy design

- Late definition of skid equipment requirements

- Underestimation of the required control CPU capacity

- Additions to field instrumentation

- Change to device types (replace limit switch with analog transmitter).

No matter the reason, late changes to the I/O subsystem are disruptive to the project schedule and occur when such changes are the most expensive.

Project Execution with Electronic Marshalling

DeltaV Electronic Marshalling addresses two key issues of traditional I/O subsystems: delays in finalizing the field signal assignment to I/O channels and late changes after wiring is complete. By separating the I/O subsystem design from the Control Strategy design, the CHARM I/O Card (CIOC) allows the field instrumentation design to begin long before the control strategy is finalized. The number and type of I/O in each process area or unit is defined early in the project based on the Process and Instrumentation Diagrams, and this determines the number of I/O channels required. The E&I engineers can determine the number of CIOC's they require with a high degree of accuracy because the type of signals can change without affecting the I/O count. Field wiring design and installation can begin, including the design of multi-core home run cables and field junction boxes, even though the control strategies have not yet been designed.

The CIOC replaces the physical cross wiring between traditional marshaling terminals and the controller's I/O card, and allows the channel to be assigned to the appropriate controller at a later time when the location of the control strategy is known. Since the I/O channel wiring is complete, the field checkout can be performed even though the control logic is not yet available.

When assigning spares, each spare channel can be used for any signal type. This allows 100% usability of all spare channels as the mix of I/O for future projects is not known. If you need 10 AI signals and 6 AO, you would need two 8-channel cards of each type. With CHARMs, you can do this project with 16 CHARMs no matter what the ratio of signal types is.

The CIOC changes the I/O design from a controller based exercise to a process centric activity. Design looks at the process requirements and groups related signals together on a CIOC. Then, all these I/O can be assigned to the controller tasked with the control strategy of that process cell or unit. If additional controller capacity is required, a second controller can be installed and control strategies redistributed to meet system performance goals. The I/O signals can be re-assigned as needed without affecting any physical wiring.

This eliminates the need to add I/O hardware when adding a new controller. This can be a huge challenge with traditional card based I/O since the existing I/O cards are physically dedicated to the original controller. A major redesign of the I/O subsystem and rewiring would be required to optimize the cabinet space and reallocate I/O to this new controller. In the end, addition I/O cards will likely be required, leaving unused channels on the original controller and increasing the foot print of the I/O. Finally, all signals affected must be rewired to the new I/O card locations. Electronic Marshalling eliminates all this work and leaves the I/O subsystem unchanged. Simply add the new controller, re-distribute the control modules as needed along with their I/O channel assignments. There is no change to the I/O footprint and no wiring changes.

CIOC Installation

CHARM hardware is designed for easy installation. A column of 96 channels can be mounted on a single, standard DIN rail mounted vertically in a cabinet, creating an Electronic Marshalling terminal strip. At the top is the CIOC Carrier which holds a redundant pair of CHARM I/O Cards. Connected to the carrier are up to 8 CHARM Baseplates with 12 individually configurable channels, each channel having a dedicated terminal block. A CHARM Bus terminator is placed at the end of the last baseplate.

The baseplates form a fully redundant bus for CHARM power, field power and communication. Each channel can be tasked to accept a wide variety of traditional instrumentation signal types, including 2-wire, 3-wire or 4-wire RTD's, Thermocouples incl. their Cold Junction compensation, analog 4-20 mA HART inputs and outputs, various discrete I/O, both system powered and isolated.

The carrier and baseplates are connected with an interlocking connector that slides together toward the DIN rail. The connector prevents the components from separating once they are connected to each other, creating a secure bus that will not separate during operation. Installation is quick because components snap onto the DIN rail, requiring no tools. The baseplates come quipped with twelve terminal blocks ready to accept field wiring. A DIN rail stop is recommended to lock the entire assembly in place.

Figure 2 – *CHARM I/O Card (CIOC) with CHARMs.*

CHARM Baseplate features

CHARM Baseplates are designed with 12 channels to align with the predominant use of 12, 24 and 36 core cables. Each baseplate can be identified using a Baseplate label mounted over the connector. This label also covers the connector to protect from dust. A CHARM Label is also available to identify each channel.

Figure 3 – *CHARM Baseplate and Channel Identifier labels.*

The CHARM baseplate provides the infrastructure that connects all the CHARMs and their field signal to the CIOC, and by extension to the controllers. Each baseplate has an addressing module that identifies the logical address of its 12 CHARMs. This module is clearly numbered to allow the technician to quickly find a CHARM location.

Figure 4 – *CHARM Baseplate with bottom Terminator.*

The baseplate supports any combination of standard, fused injected power or relay output terminal blocks. Standard terminal blocks are compatible with all CHARM types. The Fused injected power terminal block is used with isolated discrete CHARMs to provide system powered circuits, typically for 1 Amp DO 24VDC or for AC powered field circuits. The Relay Output Terminal block is used for high current AC outputs, such as motor starters, needing up to 5 Amps per channel.

Because any channel position can be modified to accommodate any field signal, the primary criteria for initial design and installation is the number of I/O signals. It is recommended that AC powered discrete circuits be installed separately from low voltage instrument signals. Therefore the number of each type of signal should be determined. Late changes to I/O types do not need to affect actual wiring.

One of the advantages of CHARMs I/O is that signals can be grouped together based on their process relationship, and not the signal type. A solenoid value with two limit switches can be wired to three adjacent CHARMs: DO, DI and DI. This greatly simplifies field maintenance and reduces user error because all pertinent signals are together. During the design phase of the field wiring infrastructure, signal rationalization to specific card types is completely eliminated and field wiring connections are simple and straight forward.

The field wiring design for Electronic Marshalling will typically use multi-core cables to bring field junction box terminals to the CHARM I/O card. Signal wire pairs are landed on terminal blocks, typically based on the numbering of the individual cores. (i.e. Signal core #1 is assigned to CHARM 1-1, core #2 to CHARM 1-2, and so on) In the field Junction box, the signal cores are also wired to a terminal block strip, to which the final wiring to the instrument will be connected. By maintaining a simple one to one relationship, the position of the instrument in the junction box corresponds directly to the position on the CIOC baseplate. There is no need to scramble the incoming wires to group like signals together. In the case of the solenoid valve, the DO and two DI signals can be wired together in the JB, resulting in them being adjacent on the baseplate, keeping all three signals together all the way to the control module where the logic runs.

Certain signals, such as RTD's and Thermocouples may require special multi-core cables such as triad cores, or Thermocouple wire. These cores are also landed on the standard CHARM Terminal block, which supports 2, 3 and 4-wire RTD's, or a cold junction compensator for the TC wires.

The following section discusses the terminal block options available for CHARMs:

CHARM Standard Terminal Block

The CHARM terminal blocks provide the field wiring terminals for each CHARM. The Standard terminal block has 4 terminals that provide flexibility to handle different wiring configurations, though the majority of 2-wire pairs are connected to the same upper level terminals (terminals 1 and 2). This provides easy access to terminals/wires and avoids stacked wires.

Figure 5 – *CHARM Standard Terminal Block.*

The following diagram is used to describe the terminal assignments for each CHARM.

Figure 6 – *Standard Terminal block wiring terminals.*

Pre-wiring of the field multi-cores can be completed by connecting the two wires to terminals 1 (+) and 2 (-). The shield is connected to the Baseplate shield bar. The additional terminals are used for three or four wire connections (i.e. RTD's) or for alternative connections, such as a 4-wire transmitter that provides an isolated 4-20 mA signal, as shown in figure 7.

Figure 7 – *Standard terminal block with AI CHARM accepts either 2-wire or 4-wire devices.*

CHARM Fused Injected Power Terminal Block

The fused injected power terminal block allows a standard isolated discrete CHARM to be used in a system powered circuit. The terminal block connects the positive terminal of the CHARM to the baseplates internal injected power bus through a field replaceable fuse. The injected power is provided from a fused 10 Amp max circuit that is connected to the baseplates Address Plug terminal block, and can be any voltage, 24 VDC, 20 to 250 VAC, and is therefore available to any of the 12 channels of the baseplate.

The Fused Injected power terminal block has two terminals to which the field device is connected. The other terminals are replaced with internal connections to the baseplate power bus.

Figure 8 – *CHARM Fused Injected Power Terminal Block.*

The following diagram is used to describe the fused injected power terminal assignments for each CHARM.

Figure 9 – *Fused Injected Power Terminal block wiring terminals.*

Notice that the terminals 1 and 3 are now replaced with internal connections to the Baseplate power bus. A 2 amp fuse provides circuit wiring protection for DO channels. DI CHARMs inherently limit the current so that a wiring short circuit will never blow the fuse. By having one terminal type, each channel can be used for input or output circuits simply by installing the correct CHARM. Both DI and DO circuits will be sourcing circuits. Figure 10 shows the completed circuit with the CHARM installed.

Figure 10 – *Fused Injected power terminal block with Isolated AC input.*

Relay Output Terminal Block

The standard and power injected terminal blocks handle most instrumentation signals, including DC and AC discrete circuits. However, because the field signal is connected through the baseplate and into the CHARM, the signal power is limited to 1 Amp on DC discrete outputs and 0.5 A for AC circuits.

Figure 11 – *Relay Output Terminal Block.*

To handle higher currents such as motor starters, the Relay Output Terminal block provides an integrated interposing relay that provides Form C contacts rated to 5 A continuous loads at 250 VAC. This Terminal block is used exclusively with the DO 24 VDC High Side CHARM. The DO CHARM drives the relay coil, providing local indication when the coil is energized and performing diagnostics to detect if the coil were to fail to an open circuit.

Figure 12 – *Relay Output Terminal Block with DO 24 VDC High Side CHARM.*

The intended use of the relay output terminal block is in a CIOC that is mounted relatively close to the equipment, such as in an MCC cabinet, where traditional interposing relays may have been installed in the past. This reduces the length of the signal wires carrying these higher current loads. For each high current output, install the Relay Output terminal block in place of the standard terminal block. DI isolated CHARMs for feedback signals would install in Standard terminal blocks. You can mix and match the terminal blocks in any order on the CHARM baseplates.

CHARM Terminal Block test points: CHARM terminal blocks are equipped with test points that accept standard meter probes. The test points provide a convenient connection that holds 2mm probes in place to allow technician to operate the meter or perform other tasks while monitoring the signal.

Figure 13 – *Meter connected to CHARM Terminal Block test points.*

The Analog Input CHARMs have a 250 Ohm internal load resistance so that the field signal can be monitored with a volt meter using the 1-5 V scale, corresponding to the 4-20 mA signal. The probe is inserted on terminals 2 and 4 for this reading.

Wiring continuity test: Wiring continuity testing is straight forward and detects if a signal wiring pair is open circuited or otherwise incorrectly wired. During this test, it is typically best to not have any of the signal wiring connected to the system. In addition to the overall closed loop integrity of the wiring, each segment of wiring must be verified to ensure all intermediate connections have the correct polarity.

CHARMs help with continuity testing by completely isolating all conductors connected to the terminal block when the CHARM is removed. There is no need to disconnect one or both wires from the channel. This saves time and avoids error when reconnecting the wires. The DeltaV CHARM acts as a knife-edge disconnect for all four terminals of the terminal block, not just the power terminal. At any time, the field wiring can be isolated by ejecting the CHARM. The CHARM terminal block also provides a convenient intermediate position for the CHARM that allows it to be locked in a disconnected position. The CHARM remains in its terminal, but is prevented from falling out or accidently connecting the terminals to the system.

Insulation integrity test: In some cases, an insulation test is desired to ensure the installation process did not damage wiring insulation. This might be performed on a sampling of installed wiring and not typically on all wiring pairs. During this test, the electronic equipment such as transmitters and DCS I/O channels should not be connected.

With CHARMs I/O, the field wiring can remain connected to the CHARM terminal block while this high voltage test of the insulation is performed. Simply remove the CHARM to completely isolate all the field wires from the system and from each other. Ensure the field wiring is not connected to the field device to avoid damage to electronics. This saves time and avoids errors on reconnection.

Instrument Checkout

Once the field wiring has been installed and tested, it is time to connect the field instruments and confirm their proper operation with the CIOC. CHARM I/O provides great flexibility and helps manage the field commissioning activities. By allowing any signal to be placed into service on an individual basis and in any order, the order of device commissioning can easily adjust to the process equipment availability, where the field instruments are mounted. The installed CHARMs can also represent the completed work as the CHARM will be configured and operational with the field device.

Instrument check out typically requires two individuals working together, one working at the field device and the other confirming the signals at the IO card. With HART devices, digital communication can be used to verify the field devices and allow one technician to quickly verify the system. The field device names can be verified, signals generated and feedback confirmed all from the CIOC. Simple devices need visual confirmation or manual activation in the field.

To fully verify all I/O channels, you will need a laptop computer with DeltaV Pro Plus software installed and an S-series controller. The CIOC will require a dual port Copper IOP to allow both the laptop and the controller to be connected. The controller is required to allow HART communication with AMS Device Manager and to run a control module to drive output channels. The following sections discuss some of the activities each channel type requires and how CHARMs assist in the checkout process.

Commissioning the CIOC

The CIOC must be powered so that it can communicate with the database. Connect the 24 VDC field power the CIOC Carrier Primary and Secondary power terminals. Install the CIOC's and allow them to complete their initialization.

Figure 14 – *CIOC 24 VDC power connection.*

Connect the DeltaV Pro Plus laptop to the primary IOP (left hand Ethernet connection) and launch DeltaV Explorer. If the CIOC has Fiber Optic IOP's, replace the primary IOP with the Copper IOP and connect to the top RJ45 connector. The CIOC will then appear in the Decommissioned Nodes list of DeltaV Explorer:

Figure 15 – *Explorer view of Decommissioned CIOC.*

Locate the "I/O Network", under "Physical Network/Control Network". Right click this container and select Commission I/O. The dialogue will show the list of available connected CIOC's as shown in figure 16 below.

Figure 16 – *ECommissioning CIOC to the I/O Network.*

Select the correct I/O card and press OK. There is no need to auto sense the CHARMs at this point because there are none installed. The Properties dialog allows you to name the CIOC and provide a description.

Figure 17 – *CIOC Properties Dialog.*

Once the CIOC is commissioned, be sure to select the "Enable cascade port" option so that the controller can also be connected to the CIOC along with the laptop. Alternatively, you can connect to the CIOC using a separate switch where the laptop, controller and CIOC are all connected. Download the IO card to establish communication.

At this point, the 96 channels of the I/O card will appear as "undefined". After a CHARM is added to the card, it can be autosensed to read the channel type and confirm the correct CHARM type has been installed in the correct location. The CHARM properties dialog will allow any specific options to be selected. The CHARM is then downloaded to enable it. The local Green LED will go from blinking to solid green, confirming the CHARM is configured and functioning properly. If the field wiring is not properly connected, the CHARM LED will blink red, indicating either a short or open circuit. Verify the actual issue using diagnostics. Once the field wiring issue is resolved, the LED will go to a solid Green.

Using diagnostics, the input channels can be monitored as a signal is applied at the field instrument to confirm the signal is connected to the correct CHARM position. HART transmitters can be used to generate a 4-20 mA signal that will be displayed in the DeltaV diagnostic screen. You can autosense the HART device and assign the channel to the controller. This allows AMS Device Manager to access the transmitter for signal checkout.

For output signals, a control module is needed to drive the channel and confirm that the field element is responding. This can be a simple module with AO or DO function blocks configured to the output channels.

The following sections discuss some of the activities each channel type requires and how CHARMs assist in the checkout process.

Field Device Commissioning with CHARMs

CHARMs provide a unique set of features designed to simplify and accelerate the check-out of field devices to the system. For instance, the AI CHARM performs an automatic field signal wiring check to detect wiring errors on AI and AO signals. (For discrete inputs, this feature is only available with NAMUR sensors or with end of line resistor circuits.) AO CHARMs will detect an open circuit, indicating if the device is disconnected. Each CHARM has a local LED indication that helps identify wiring faults during check-out.

With the field wiring connected to the field devices, a basic functional check is required to confirm the correct device is wired the correct channel, and that the channel is working with the device. Because CHARMs are electronically bound to their controller when the control strategy is completed, the physical installation of the I/O is complete with the installation of the CIOC. This allows the commissioning of the devices to be performed before the control strategy is delivered.

The commissioning process is similar for each charm:

- Install CHARM and auto-sense the CIOC (one or multiple CHARMs)

Figure 18 – *Auto-Sense CHARMs.*

The Auto-sense dialog displays the newly added CHARM and compares it to the database. This dialog helps resolve any conflicts with the configured CIOC CHARMs when the CIOC is pre-configured in the checkout database. Click OK to accept and enable this CHARM type in this position, or replace the CHARM with the correct type as defined in the database and autosense again.

Figure 19 – *CHARM Properties Dialog.*

- Download the CHARM to the CIOC to enable the hardware and start checkout.

- For inputs, launch Diagnostics to view the channel and the current primary value. Apply a simulated signal on the field wiring to confirm the signal is on the correct channel.

Figure 20 – *CHARM Diagnostic Parameter view.*

- For outputs, assign the channel to a controller where you can use a generic module to drive the output value.

A commissioning module is required to allow output signals to be manipulated during field device checkout, prior to the availability of the control strategies. This temporary module can be preconfigured to match the expected CHARM assignments or can be created AD HOC as CHARMs are commissioned. An AO or DO block is used to provide an interface to the output channel.

- Autosense the AO charm

- Assign the CHARM to the controller and download it

- Open the AO Commissioning module in DeltaV Control Studio

- Bind an AO block to this output

- Download the module to the controller and go online to manipulate the output

Figure 21 – *AO Commissioning Module example.*

The Module can be redefined to any analog CHARM address and downloaded as needed. A similar DO commissioning module provides a Boolean parameter to toggle the output as needed.

The following sections look at commissioning activities for specific CHARM types.

AI 4-20 mA Checkout: Standard 4-20 mA transmitters require traditional methods of field checkout. A signal simulator is used to generate the 4-10 mA signal that is sensed by the input CHARM. A differential pressure transmitter may allow a pressure signal to be applied to the sensor, thus using the transmitter to generate the 4-20 mA signal. Whatever the method or apparatus used, the signal must be generated by a technician at the transmitter location, while a second person monitors and confirms the signals are properly received.

- Insert the AI 0/4-20 mA HART CHARM in the appropriate Terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Analog Input 4-20 mA CHARM"

- Download the CHARM to enable it

- Open DeltaV Diagnostics and select the CHARM to view the parameter view

- At the transmitter, apply appropriate simulation signals

- Observe that the expected values are seen on the correct channel

AI HART Checkout: HART transmitters provide both traditional 4-20 mA signals and digital data. With CHARMs, each channel has a dedicated HART modem to improve HART digital communications update rates to 1.5 seconds. In addition, during commissioning, the CIOC allows the user to autosense the field device and confirm the correct device has been connected to the correct channel. The HART device can be used to generate the 4-20 mA signal to confirm channel operation.

- Insert the AI 0/4-20 mA HART CHARM in the appropriate Terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "HART Analog In CHARM"

- Download the CHARM to enable HART communications

- From Explorer, select the CHARM and auto-sense the HART device

Figure 22 – *Auto-Sense HART Device*

The HART Long Tag will be retrieved from the transmitter, along with the device model, manufacturer and revision. The reconciliation dialog will allow the device long tag to be pulled into DeltaV signal tag. The Device model, manufacturer and revision can also be confirmed under the HART device properties.

At this point, the HART device is confirmed to be correctly installed. The AI CHARM is electronically calibrated at the factory. There is no need to simulate a field signal as the wiring has already been confirmed correct through the HART communication.

AO 4-20 ma Checkout: For standard 4-20 mA output signals to non-HART devices, a technician must visually confirm the position of the field element to confirm it is responding correctly to the signal. If feedback sensors are used, the input signal(s) must be known and can be used to help confirm the proper operation. With HART enabled positioners like the Fisher DVC 6000 the actual valve position is provided over the digital communications and this can be used to verify proper response of the field element, saving time and money. The HART data also allows the user to verify the correct valve has been connected by confirming the device tag, model, manufacture and revision.

- Insert the AO 0/4-20 mA HART CHARM in the appropriate Terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Analog Output 4-20 mA CHARM"

- Assign the CHARM to the controller

- Download the CHARM to enable it

- Open the AO_COMMISSION module in Control Studio and assign the CHARM to AO1

- Download the module and launch the Control Studio On-line view

- Select the TEST_VALUE parameter and drive desired test signals

- Confirm device has responded to requested test signals

AO HART Checkout: HART enabled positioners like the Fisher DVC 6000, provide the actual valve position over the digital communication link, allowing for remote verification the field element is properly responding, saving time and money. The HART device information also allows the user to verify the correct valve has been connected by confirming the device tag, model, manufacture and revision.

- Insert the AO 0/4-20 mA HART CHARM in the appropriate Terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "HART Analog Output CHARM"

- Assign the CHARM to the controller

- Download the CHARM to enable HART communications

- From Explorer, select the CHARM and auto-sense the HART device and confirm the correct device has responded

The HART information reported by the device confirms the wiring is correctly installed. This also confirms that the related HART DD information is present in the DeltaV database. If the field device is not recognized by the DeltaV database, the missing DD file must be downloaded from the support website and installed on the system when it arrives on site. To further exercise the field device, follow the AO 4-20 mA checkout steps to assign the device to the AO_COMMISSION module.

Discrete Input Checkout: By default, discrete input channels do not have their field wiring diagnostic enabled. If NAMUR devices are to be tested, or if line fault resistors are installed at the field device, fault detection should be enabled so that the field device and wiring can be verified completely.

- Insert the DI NAMUR, DI 24 VDC Dry Contact, or DI Isolated CHARM into the terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Discrete Input CHARM"

- Set the LINEFAULT_DETECT parameter appropriately

- Download the CHARM to enable it

- Launch DeltaV Diagnostics and select the parameter view for this CHARM

- Force a state change on the field device and confirm the value is seen to change, including open and short circuit conditions for Fault detection enabled channels

Discrete Output Checkout: Discrete output devices do not provide inherent feedback. If the field device is equipped with limit switch feedback signals, these can be used to speed verification, however, a manual confirmation of the field device operation is advised to confirm the correct device is being activated.

- Insert the DO 24 VDC HSS, DO 24 VDC Isolated CHARM into the terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Discrete Output CHARM"

- Assign the CHARM to the controller

- Download the CHARM to enable it

- Open the DO_COMMISSION module in Control Studio and assign the CHARM to DO1

- Download the module and launch the Control Studio On-line view

- Select the TEST_VALUE parameter and toggle the channel state

- Confirm device has responded to requested test signals

RTD Checkout: An RTD sensor can be connected to the standard Terminal block with either 2, 3 or 4 wires. The same RTD CHARM type can be configured to work with these wiring configurations as well as with a wide range of RTD types. To check out the RTD wiring, an RTD simulator or resistance decade box should be used to introduce expected resistance loads to confirm the channel is correctly wired and is reading the expected temperatures.

- Insert the RTD CHARM into the terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Pt 100 RTD Input CHARM" or other appropriate RTD Type

- Set the NUM_WIRES parameter appropriately

- Download the CHARM to enable it

- Launch DeltaV Diagnostics and select the parameter view for this CHARM

- In the field, connect an RTD Simulator and confirm the simulated signal values are properly displayed in the Diagnostic view

Thermocouple Checkout: A Thermocouple sensor should be connected to the Thermocouple / mV Terminal Block with built in cold junction compensaton. The same TC CHARM type can be configured to work with a wide range of TC types. To check out the TC wiring, a TC simulator should be used to introduce expected millivoltage signals to confirm the channel is correctly wired and is reading the expected temperatures.

- Insert the TC/mV CHARM into the terminal block and auto-sense the CHARM

- In the CHARM Properties dialog, set the CHARM Functionality to "Type J Thermocouple Input CHARM" or other appropriate TC Type

- Configure the CJT_CHARM parameter if needed for remote compensation

- Download the CHARM to enable it

- Launch DeltaV Diagnostics and select the parameter view for this CHARM

- In the field, connect an TC Simulator and confirm the simulated signal values are properly displayed in the Diagnostic view

LED indicators

To facilitate the diagnosis of CHARM installation issues, CHARMs have local LED indicators. Every CHARM has a bi-color LED with red and green colors. Discrete channel CHARMs have an additional Yellow LED that reflects the state of the field channel. The following table identifies the meaning of each color and associated blink pattern. The basic indications follow NE44 recommendations, with additional indications that relate specifically to CHARMs.

CHARM LED indicators		
Color	**Pattern**	**Descripton**
Green	Solid	CHARM is functioning normally.
Green	Flashing (2 Hz)	CHARM is healthy but configuration is incomplete. Check configuration.
Red	Solid	CHARM communication fault, may require replacement.
Red	Flashing (2 Hz)	Signal wiring fault, but CHARM passes all self-tests Possibly open circuit or short circuit on field wiring.
Red	Flashing (5 Hz)	CHARM failed to get Address assignment. Check cables, Address Plug, reset CHARM, replace CHARM.
Green/Red	Alternating (5 Hz)	Non-fatal fault detected. Verify diagnostics to identify source. Process data is still available.

When initially installed, the CHARM LED indications will show the following:

- Green/Red will alternate several times until CHARM is recognized by CIOC (2-3 seconds)

- Green flashing at 2 Hz until CHARM is configured and downloaded

- Green solid once downloaded and field device connected

  o Red Flashing at 2 Hz if channel has line fault present and detected. Correct field wiring to clear fault and allow CHARM to go to Green LED state

- Green solid, indicating the CHARM is functioning normally: Passing self-test, valid Field signal and communicating with the CIOC

Under normal operation, the CHARM will have a solid Green LED, indicating normal activity and valid field wiring. If a Red LED appears, Diagnostics should be consulted to obtain more detailed information about the fault. The channel status word will indicate the likely source of the fault to help speed resolution. Field commissioning should be done with the field wiring connected and no outstanding faults with the CHARM I/O.

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