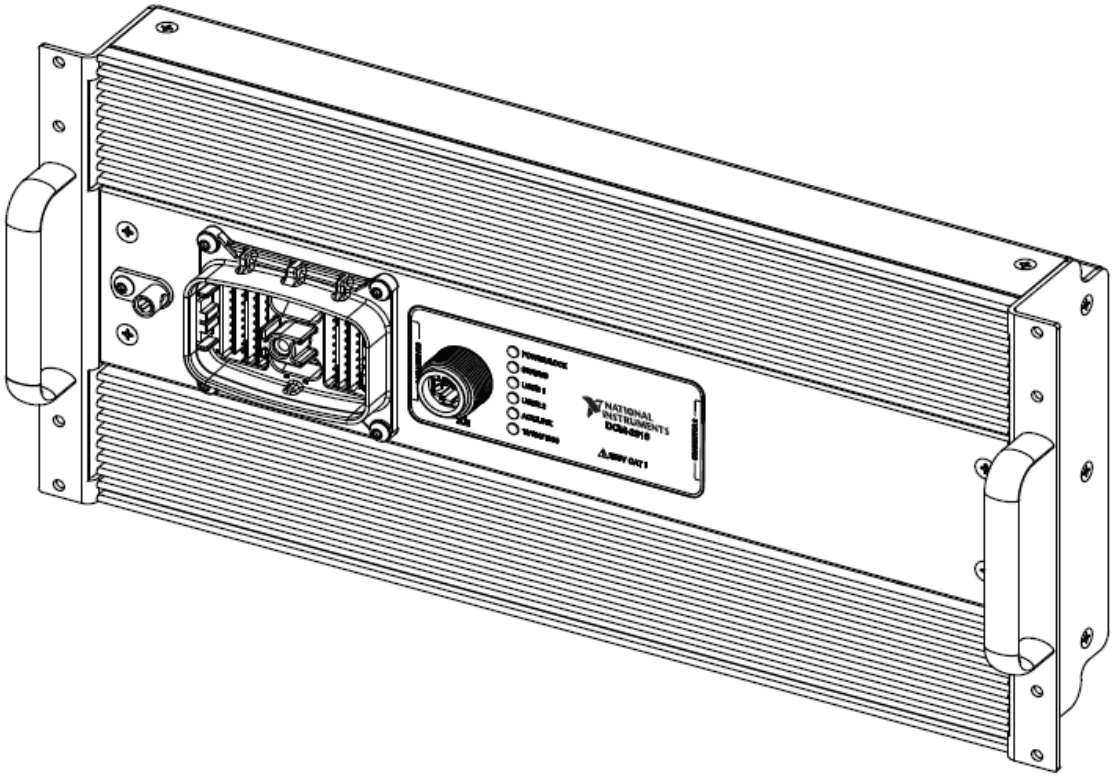
USER GUIDE

NI DCM DSI



Contents

About the DCM DSI

The NI DCM Default Software Image (DSI) is a configuration-based application for operating the NI DCM without LabVIEW programming. The DCM DSI is configured using NI Software Calibration Management Toolkit for LabVIEW (SCM). Each DCM is shipped with DSI installed and provides users the simplest means of operating the DCM I/O.

The DCM DSI is primarily focused on providing a fully implemented, user-friendly execution of the DCM device drivers. In addition, several real-time engine control algorithms are provided to leverage the DCM I/O, including basic fueling, direct injector calibration, rail pressure, and electronic throttle control.

Users wishing to extend the capabilities of the DCM DSI have two options using NI LabVIEW. First, plug-ins may be used with the unmodified DCM DSI to add required functionality while maintaining compatibility with future DCM DSI updates. Alternatively, the most recent DCM DSI source code is provided by National Instruments. It can be modified to suit a users' particular needs.

About the DCM DSI User Guide

The primary objective of the NI DCM DSI User Guide is to provide users with information required to successfully operate the NI DCM using DCM DSI. This includes topics such as Software Maintenance, User Interface, Plug-ins, etc. For information on topics which extend beyond software details (e.g., hardware specifications, features, etc.), refer to the relevant hardware manuals in the Related Documentation section below.

> **TIP** While operating the DCM DSI, refer to Tip Strip and/or Context Help (Ctrl+H) information as a quick reference about specific controls and indicators.

Related Documentation

Hardware

1. *NI DCM Getting Started Guide*– This document explains how to install and configure NI DCM devices. This document is available at www.ni.com/manuals.
2. *DCM-2316 Specifications Guide*—Lists the technical specifications of the device. This document is available at www.ni.com/manuals.
3. *NI DCM User Guide*—This document provides detailed information about the NI DCM hardware. This document is available at www.ni.com/manuals.

Warnings

Safety Guidelines

> **High Voltage** The DCM normally operates at voltages up to 240 V. Take care to protect against shock. Even when the DCM is completely powered off, allow approximately 120 seconds for the internal high voltage to dissipate. Do not touch any of the connector pins or injector terminals while the DCM is powered on.

Caution Do not operate the DCM in a manner not specified in this document or the datasheet. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.

Caution Do not disconnect the power supply wires and connectors from the controller unless power has been switched off.

For a full list of warnings and safety guidelines, consult the document *DCM-23XX--Specifications* for your particular model DCM.

Getting Started

For initial DCM setup, including software installation, review the *NI DCM Getting Started* document. It is available at ni.com/manuals.

Software Maintenance

This section describes how to maintain the software on your DCM. This includes firmware updates and image backup and restoration to NI DCM hardware using NI Software Calibration Management Toolkit for LabVIEW (NI SCM).

TIP NI recommends creating a backup image of your DCM, especially before updating your system image.

Backing up the NI DCM DSI Software

Complete the following steps to backup the DCM DSI.

1. Open NI SCM
2. Select File>>Real-Time Backup and Restore
3. Select your DCM from the Target drop-down

TIP You must enter the system username and password if changed from default.

TIP If desired, the encryption passphrase may be used to protect your backup files.

4. Select Backup
5. Choose a file name and folder
6. Click OK

Updating or Restoring the NI DCM DSI

Complete the following steps to update or restore the DCM DSI.

NOTE Installing the new image on the DCM will eliminate any saved files on the DCM. Please save any important files before installing the new image.

1. Navigate to the resources tab of the NI DCM website, ni.com/powertrain-controls, and click on the link for 'NI DCM DSI Software Update.' On the following page, select and download the latest DCM Default System Image file (.zip). Save the file to a convenient location.
2. Open NI MAX
3. Right click on the DCM to be updated and select 'File Transfer'

4. Navigate to <DCM IP address>/home/lvuser/natinst/LabVIEW Data in File Explorer
5. Copy all important files to the host computer before installing the new image (.cdl, .EPTx, etc.)
6. Open NI SCM
7. Select File>>Real-Time Backup and Restore
8. Select your DCM from the Target drop-down

   TIP You must enter the system username and password if changed from default.

   TIP You must enter the encryption passphrase of the image if used. DCM DSI updates do not require an encryption passphrase.

9. Click Restore
10. Navigate to the saved image file (.zip)
11. Click OK
12. Wait for the image to be restored
13. Transfer any saved user data back to the target data directory using File Explorer.

Updating the Firmware on the NI DCM

Some DCM DSI image may require that the DCM firmware be updated. Updating the DCM Firmware requires installing two distinct firmware updates.

WARNING Do not disconnect power while performing firmware updates.

Complete the following steps to update the firmware on your DCM's NI sbRIO-9651 System-on-Module (SOM).

1. Navigate to the website www.ni.com/downloads/ni-drivers/. In the NI Drivers search field, enter 'CompactRIO'. Download and install the latest CompactRIO device drivers to your host PC.
2. Open NI MAX.
3. Highlight the DCM to be updated. On the System Settings tab, click 'Update Firmware.' Follow the remaining prompts to update to the latest SOM firmware.

Complete the following steps to update the DCM I/O board firmware.

1. Install the latest available DCM DSI to the target using SCM. New firmware is included in the DCM DSI installation. See Updating or Restoring the DCM DSI section above for more details.
2. Navigate to the controller using an FTP browser and download the entire DCM Tools directory. The directory will be located in the following location on the RT target: **home/lvuser/natinst/LabVIEW Data/DCM Tools/**.
3. Run the Firmware Update.exe utility in <…/DCM Tools/Firmware Update/> on your host PC and follow the prompts to update the DCM I/O board firmware. Your DCM may reset several times during this process.

Wiring the DCM

The NI DCM DSI is designed to drive a host of automotive actuators: direct fuel injectors, synchronous fuel pumps, fuel metering valves, port fuel injectors, throttle valves, and smart ignition coils among others. Additionally, the DCM DSI can read both digital and analog input signals from various sensors including hall effect sensors, rail pressure sensors, knock sensors, manifold pressure sensors, etc.

Understanding how to wire these devices properly to the DCM is important for successful implementation of the NI DCM.

Direct Injectors

The NI DCM has multiple configurations for direct injector control. The DCM can drive both solenoid and piezoelectric injectors with its DI channels, and it can command either unipolar or bipolar drive signals to either type of injector. Additionally, some configurations channels are multiplexed, or muxed, to increase the number of injectors the DCM drives. Figure 1 shows all injector configurations available for the NI DCM-2316.

Selecting DI Channels

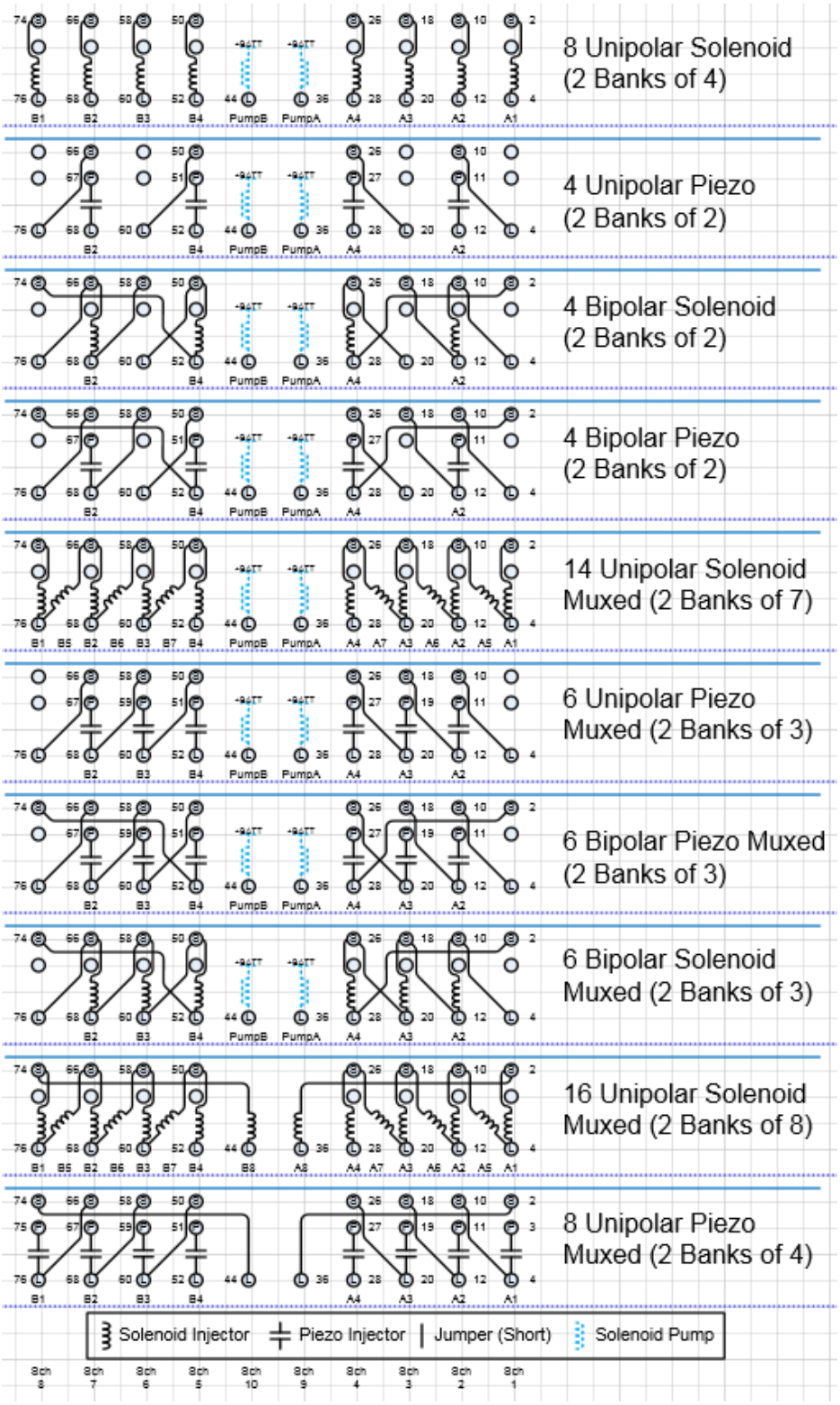
One consideration to make when wiring the DCM is which direct injectors (if any) need to operate simultaneously. In the various multiplexed modes of operation, not all of the injectors are capable of operating simultaneously. Specifically, two injectors sharing either a high or low side circuit cannot be operated simultaneously. Thus, care should be taken when wiring the DCM so that each channel will have the maximum window for operation by ensuring that injectors which need to fire sequentially do not use the same high or low side connections.

These concerns only apply to the multiplexed modes of operation. All other modes are capable of driving all injectors simultaneously.

DI Pump Channels

In some DI configurations, synchronous fuel pumps can be driven with the low side PumpA/PumpB pins, as shown in Figure 1.

Figure 1. DCM-2316 Injector Configuration Pinouts



General-Purpose Half H-Bridge Drivers

The DCM is capable of driving fuel metering valves, port fuel injectors, throttles, and EGR valves with the Half-H channels. The Half-H channels can be used individually to drive unipolar loads like port fuel injectors or fuel metering valves, or they can be combined to drive bipolar loads like throttles.

Differential Digital I/O

The Differential Digital I/O channels can individually be configured as inputs or outputs. When configured as inputs, they can read various digital signals from sources like hall effect sensors for tracking engine position or from other devices sending command signals for fuel injectors. When configured as outputs, they can be used as PWM outputs, or they can be synchronized with an engine position tracking algorithm to drive ignition coils with logic-level signals.

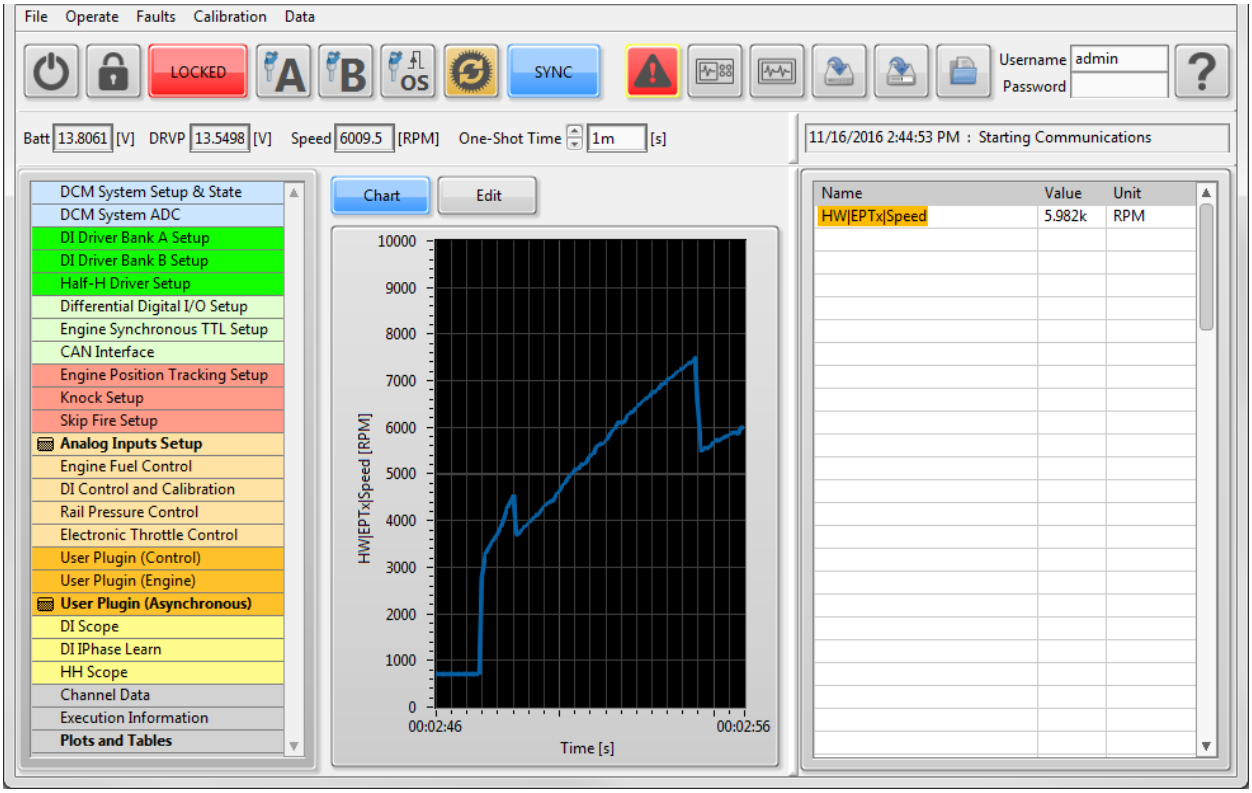
Analog Input

The analog input channels are capable of reading signals from analog sensors. These channels can be used to measure things like fuel pressure, manifold pressure, knock, needle lift, cylinder pressure, and more.

For information on how to wire each of these types of signals to the NI DCM, please consult with the NI DCM User Guide, available at www.ni.com/manuals.

DSI System Interface

Main Panel



The DCM DSI Main Panel is the panel through which all DCM DSI features are accessed. It consists of several parts: two control strips, subhost list, panel viewer, and variable list, all of which are described below.

Hardware Control Strip

The control strip features these controls and indicators:

Power Button: Enables the Main Power Relay Driver

IO Lock Button: Sets the IO Lock State. IO Lock can also be set by a hardware switch.

IO Lock Indicator: Shows the IO Lock State. IO Lock can also be set by a hardware switch.

DI Bank A Enable Button: Enables all DI Driver Bank A channels.

DI Bank B Enable Button: Enables all DI Driver Bank B channels.

One Shot Button: Generates One Shot command on all enabled DI channels.

EPTx Sync Enable Button: Sets the state of EPTx sync.

EPTx Sync Enabled Indicator: Shows the state of EPTx sync.

Software Control Strip

The software control strip features these controls and indicators:

Fault Indicator: Indicates the presence of faults. When clicked, opens the Faults subhost.

CalScope Control: Opens the CalScope subhost.

CalTrend Control: Opens the CalTrend subhost.

Save Calibration Control: Saves the existing state of CalPoints to the current CalFile.

Save Calibration as Control: Saves the existing state of CalPoints per a new file name.

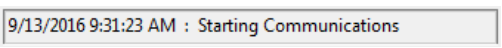
Load Calibration: Loads a calibration file from memory on the target.

Username: Allows users to enter the DCM's username.

Password: Allows users to enter DCM's password.

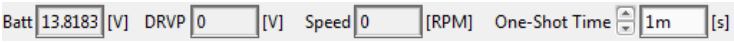
Help Control: Opens the user manual.

Status Bar



The status bar displays the most recent message from NI SCM.

Basic Indicators



The basic indicators show:

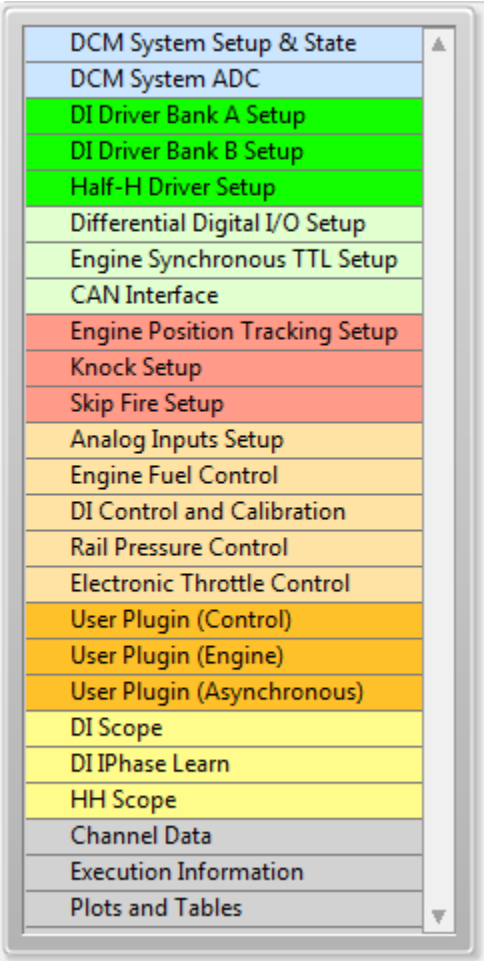
Batt: the measured battery voltage.

DRVP: the measured voltage applied to DRVP.

Speed: The current engine speed (either measured or simulated).

One-Shot Time: The present duration for a one shot direct injection command.

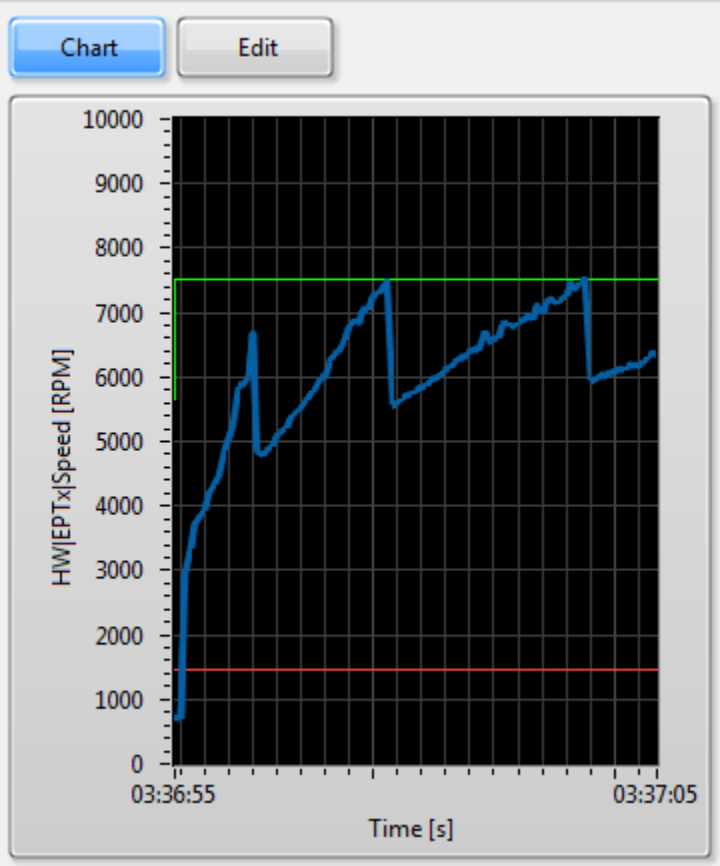
Subhost Selector List



Left clicking on an item in this list will open a panel within the panel viewer pane. Right clicking on an item in this list and choosing the “Undock” option will open the panel in its own window.

An icon will appear next to panels that are currently floating (not docked).

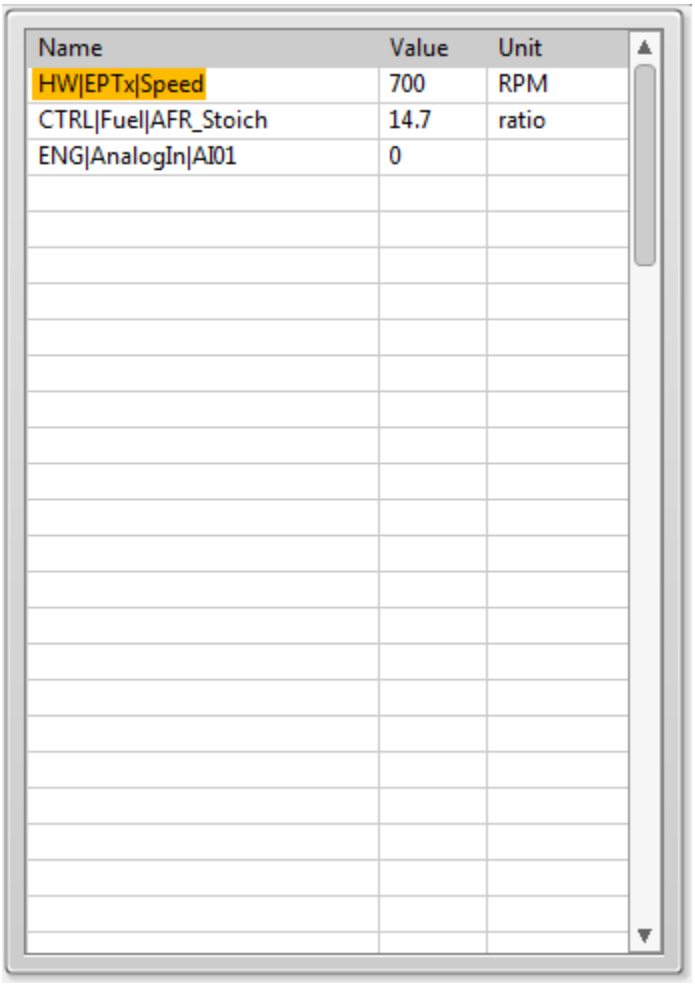
Panel Viewer



The panel viewer shows the values of the variables selected in the variable list. The limits of the vertical axis of the panel viewer can be changed by clicking on them and typing in a new value. When multiple variables are entered the variable list, the axis of the highlighted variable is shown, and the plot of the highlighted variable is shown as a thicker line.

In Edit mode, the value of certain constant values can be changed.

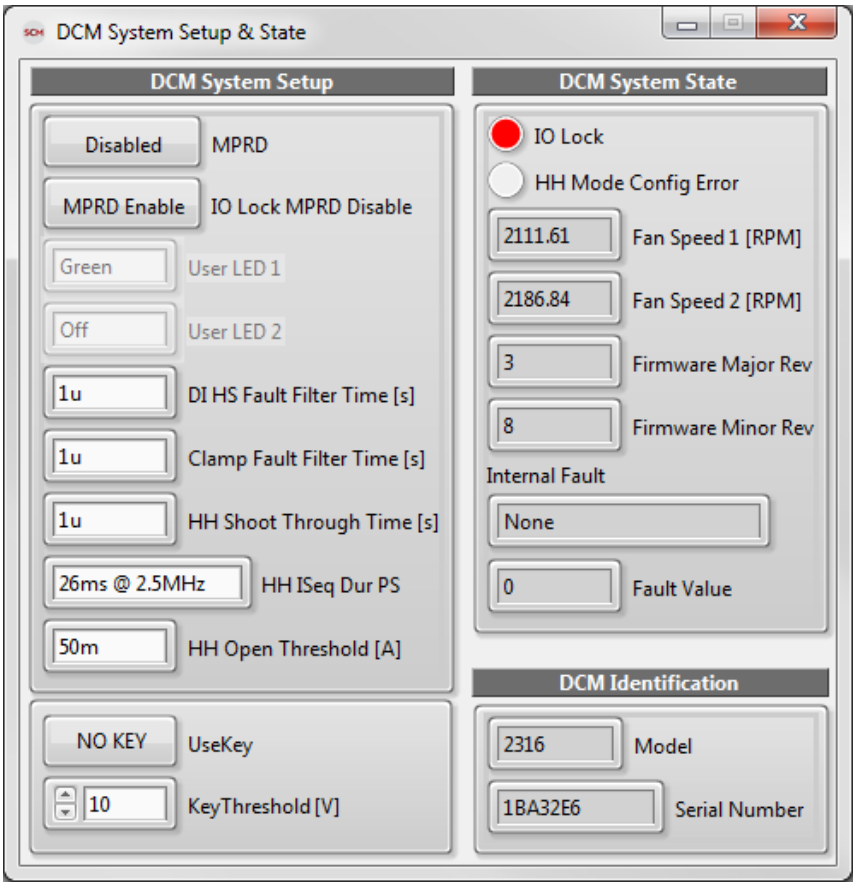
Variable List



The variable list shows which variables are displayed in the Plots and Tables host. Variables are added to the list by right clicking and selecting **Insert/Delete**. Variables are deleted by right clicking and selecting **Delete.**

Subhosts

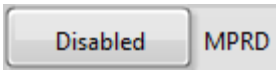
DCM System Setup & State



The DCM System Setup & State shows high-level critical information about the way the DCM is configured and about the state of the DCM.

System Setup

MPRD



Tip strip: Enables Master Power Relay Driver

Controls the external relay that connects BATT to the DRVP pin, which powers the driver circuits.

IO Lock MPRD Disable

Tip strip: When Enabled, IO Lock pins status will dictate MPRD. Otherwise, MPRD operates regardless of IO Lock status.

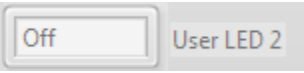
When Enabled, IO Lock pins status will dictate MPRD. Otherwise, MPRD operates regardless of IO Lock status.

User 1 LED

Tip strip: Selects LED State: Off, Amber LED On, Green LED On

Tells the state of the USER 1 LED of the DCM for remote monitoring. Continuous alternating between **Green** and **Off** means the DCM DSI RT application is running properly.

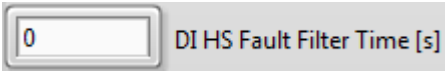
User 2 LED



Tip strip: Selects LED State: Off, Amber LED On, Green LED On

Tells the state of the USER 2 LED of the DCM for remote monitoring. This LED is used to indicate different faults; for more information, see the *Troubleshooting* section.

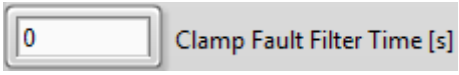
DI HS Fault Filter Time



Tip strip: Half H Shoot Through Time Threshold in seconds

Specifies glitch filter time in seconds for High Side driver circuitry fault signal.

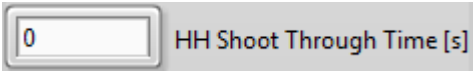
Clamp Fault Filter Time



Tip strip: (Max=8, Min=1)

Specifies glitch filter time in seconds for clamp fault.

HH Shoot Through Time



Tip strip: Half H Open Circuit Threshold in Amps

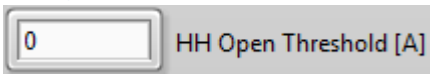
Half H Shoot Through Time Threshold in seconds.

HH ISeq Dur PS

Tip strip: Selects Clock Rate which determines precision of Half H current control

The HH ISeq Dur PS control selects the clock rate for determining Half H current control. Higher clock rates allow for greater resolution in changing pulse widths, but with the tradeoff of allowing shorter maximum pulse durations. Conversely, lower clock rates allow for longer maximum pulse durations, but with the tradeoff of less resolution in changes in commanded pulse widths.

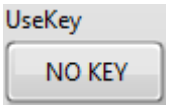
HH Open Threshold



Tip strip: Specifies Half H Open Circuit current threshold

Specifies the current level (or lower) that would appear to be open circuit for the HH channels.

Use Key (Key/No Key)



Tip strip: Enables user of the Key input to manipulate MPRD

Enables user of the Key input to manipulate MPRD

Key Threshold

Tip strip: Specifies the voltage threshold above which key switches TRUE

Specifies the voltage threshold above which key switches TRUE

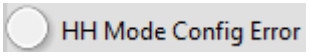
System State

IO Lock

Tip strip: IO Lock Pins status

When illuminated, IO lock has taken place.

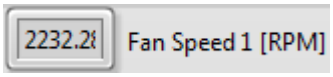
HH Mode Config Error



Tip strip: Collection of Half-H Configuration error

Indicates a configuration error on at least one Half-H channel

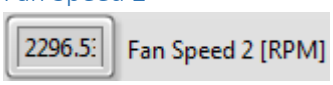
Fan Speed 1



Tip strip: Case fan speed in RPM (if applicable).

Case fan #1 speed in RPM (if applicable). Fan speed varies based on on-board temperatures.

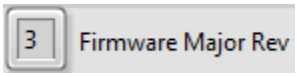
Fan Speed 2



Tip strip: Case fan speed in RPM (if applicable).

Case fan #2 speed in RPM (if applicable). Fan speed varies based on on-board temperatures.

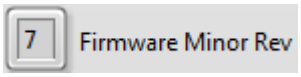
Firmware Major Rev



Tip strip: DCM major firmware revision

DCM major firmware revision

Firmware Minor Rev



Tip strip: DCM minor firmware revision

DCM minor firmware revision

Internal Fault

Tip strip: Indicates an internal fault state for the DCM.

Indicates an internal fault state for the DCM. To clear latched faults, toggle the software IO Lock control ON and then OFF

Fault Value

Tip strip: Context-sensitive value relevant to the indicated fault state.

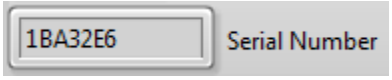
Context-sensitive value relevant to the indicated fault state.

Model

Tip strip: DCM Model information

DCM Model number.

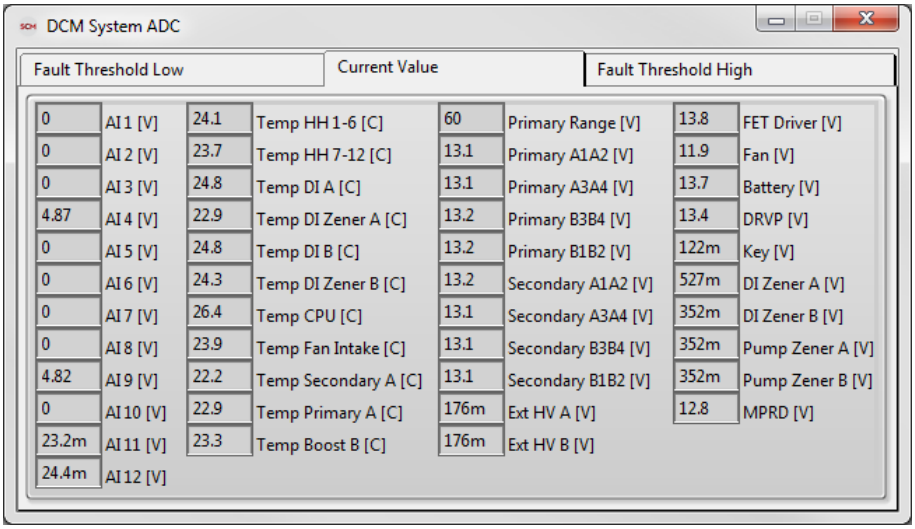
Serial Number



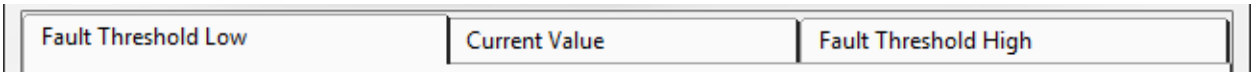
Tip strip: DCM Serial Number information

DCM serial number.

DCM System ADC



The DCM System ADC window provides users with two functions. First, it reports the values of all the values being measured by the System ADC. Second, it allows users to set fault threshold values that will then trigger faults when the values read by the System ADC go above or below the thresholds.



Fault Threshold Low Tab

This tab is where you can set lower limits for System ADC inputs to trigger a fault.

Current Value Tab

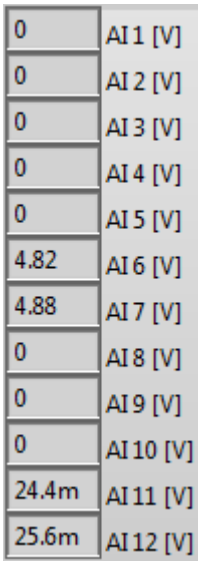
The current value for the System ADC inputs.

Fault Threshold High Tab

This tab is where you can set upper limits for System ADC inputs to trigger a fault.

System ADC

AI 1 to AI 12



Tip strip: Internal Analog Input reading

Internal Analog Input reading of analog input channels 1-12.

Temp HH1-6

Tip strip: Temperature in the proximity of Half-H channels 1-6

Temperature in the proximity of Half-H channels 1-6

Temp HH 7-12

Tip strip: Temperature in the proximity of Half-H channels 7-12

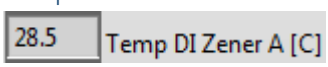
Temperature in the proximity of Half-H channels 7-12

Temp DI A

Tip strip: Temperature in the proximity of DI Bank A channels on the main IO board.

Temperature in the proximity of DI Bank A channels on the main IO board.

Temp DI Zener A



Tip strip: Temperature in the proximity of DI Bank A zener supply and pump channel on the main IO board.

Temperature in the proximity of DI Bank A zener supply and pump channel on the main IO board.

Temp DI B

Tip strip: Temperature in the proximity of DI Bank B channels on the main IO board.

Temperature in the proximity of DI Bank B channels on the main IO board.

Temp DI Zener B

Tip strip: Temperature in the proximity of DI Bank B zener supply and pump channel on the main IO board.

Temperature in the proximity of DI Bank B zener supply and pump channel on the main IO board.

Temp CPU

Tip strip: Temperature in the proximity of the DCM CPU.

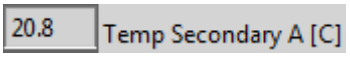
Temperature in the proximity of the DCM CPU.

Temp Fan Intake

Tip strip: Temperature in the proximity of the DCM enclosure air intake.

Temperature in the proximity of the DCM enclosure air intake.

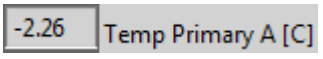
Temp Secondary A



Tip strip: Temperature in the proximity of DI Bank A secondary boost supply.

Temperature in the proximity of DI Bank A secondary boost supply.

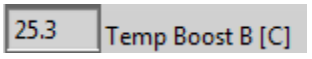
Temp Primary A



Tip strip: Temperature in the proximity of DI Bank A primary boost supply.

Temperature in the proximity of DI Bank A primary boost supply.

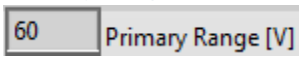
Temp Boost B



Tip strip: Temperature in the proximity of DI Bank B primary and secondary boost supplies.

Temperature in the proximity of DI Bank B primary and secondary boost supplies.

Primary Range



Tip strip: Maximum operating voltage of the primary stage for all DI channels.

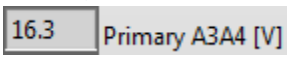
Maximum operating voltage of the primary stage for all DI channels.

Primary A1A2

Tip strip: Voltage of the primary stage for DI channels A1A2 boost supply.

Voltage of the primary stage for DI channels A1A2 boost supply.

Primary A3A4



Tip strip: Voltage of the primary stage for DI channels A3A4 boost supply.

Voltage of the primary stage for DI channels A3A4 boost supply.

Primary B3B4

Tip strip: Voltage of the secondary stage for DI channels B3B4 boost supply.

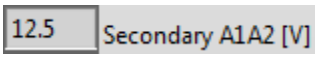
Voltage of the secondary stage for DI channels B3B4 boost supply.

Primary B1B2

Tip strip: Voltage of the primary stage for DI channels B1B2 boost supply.

Voltage of the primary stage for DI channels B1B2 boost supply.

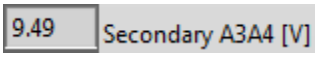
Secondary A1A2



Tip strip: Voltage of the secondary stage for DI channels A1A2 boost supply.

Voltage of the secondary stage for DI channels A1A2 boost supply.

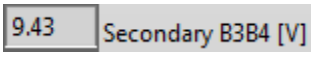
Secondary A3A4



Tip strip: Voltage of the secondary stage for DI channels A3A4 boost supply.

Voltage of the secondary stage for DI channels A3A4 boost supply.

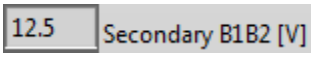
Secondary B3B4



Tip strip: Voltage of the secondary stage for DI channels B3B4 boost supply.

Voltage of the secondary stage for DI channels B3B4 boost supply.

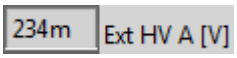
Secondary B1B2



Tip strip: Voltage of the primary stage for DI channels B1B2 boost supply.

Voltage of the primary stage for DI channels B1B2 boost supply.

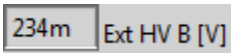
Ext HV A



Tip strip: Voltage of the external DI-A boost supply pin.

Voltage of the external DI-A boost supply pin.

Ext HV B



Tip strip: Voltage of the external DI-B boost supply pin.

Voltage of the external DI-B boost supply pin.

FET Driver

Tip strip: Voltage of the FET Driver power supply (internally regulated 12V).

Voltage of the FET Driver power supply (internally regulated 12V).

Fan

Tip strip: Voltage of the internal 12V case fans.

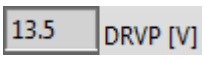
Voltage of the internal 12V case fans.

Battery

Tip strip: Voltage of the Battery (9-48V) pin.

Voltage of the Battery (9-48V) pin.

DRVP



Tip strip: Voltage of the switched Drive Power (DRVP) (9-48V) pins.

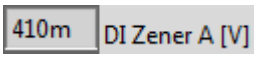
Voltage of the switched Drive Power (DRVP) (9-48V) pins.

Key

Tip strip: Voltage of the dedicated key analog input (9-48V).

Voltage present on the dedicated key analog input (9-48V).

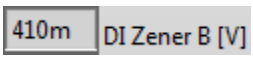
DI Zener A



Tip strip: Voltage of the programmable DI-A backboost zener circuit.

Voltage of the programmable DI-A backboost zener circuit.

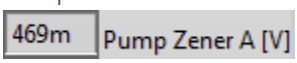
DI Zener B



Tip strip: Voltage of the programmable DI-B backboost zener circuit.

Voltage of the programmable DI-B backboost zener circuit.

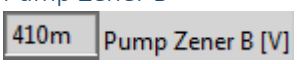
Pump Zener A



Tip strip: Voltage of the programmable Pump-A backboost zener circuit.

Voltage of the programmable Pump-A backboost zener circuit.

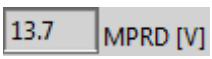
Pump Zener B



Tip strip: Voltage of the programmable Pump-B backboost zener circuit.

Voltage of the programmable Pump-B backboost zener circuit.

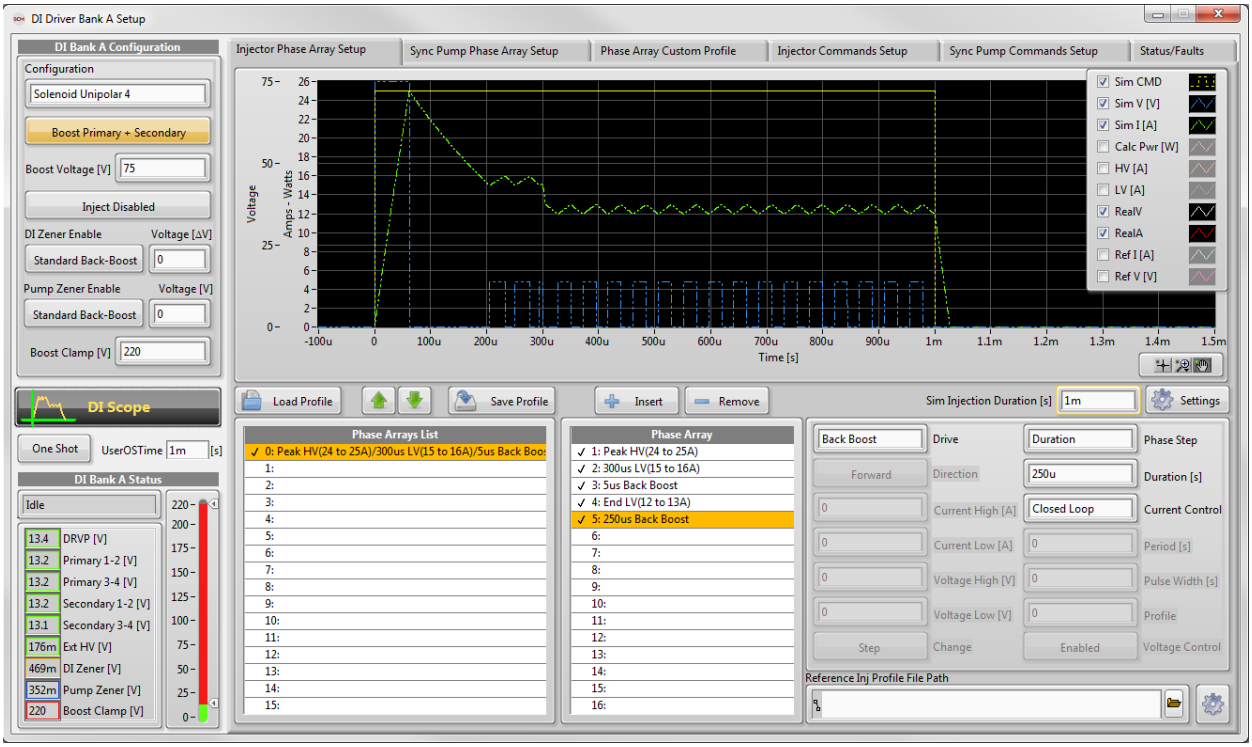
MPRD



Tip strip: Voltage of the lowside of the MPRD relay coils.

Voltage of the lowside of the MPRD relay coils.

DI Driver Bank X Setup



The NI DCM can have up to two independent banks of Direct Injector (DI) Driver circuitry – Bank A and Bank B. Each bank can be configured to user-desired settings in the DI Driver Bank X Setup window. The settings in this window include Bank configuration (i.e. permutation of Solenoid or Piezo injector type, Unipolar or Bipolar drive and Independent or Multiplexed configuration), boost voltage control settings and feedback, Phase array settings for injector and pump current/voltage control, Injector commands settings for each available injector and pump channel as well as relevant faults.

Configuration

Tip Strip: Selects DI Bank mode of operation Note: May only be changed when DCM is idle

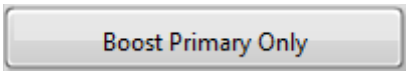
The bank configuration selects a permutation of:

- Load (injector) type: inductive load (Solenoid) or capacitive load (Piezo)
- Unipolar or bipolar current drive

- Independent or multiplexed drive channels. Note: Multiplexing of channels will increase the number of available channels. The number on each of the bank configuration selection denotes the number of available channels. For example, Solenoid Unipolar 4 selection means that there are four independent channels to drive current through an inductive load unidirectionally.

For safety, this parameter can only be changed when the DCM is in an idle state. Please refer to the DCM Users Guide for wiring instructions for each Bank Configuration.

Boost Select



Tip strip: Enables Secondary boost supply operation.

This button enables the secondary high voltage supplies of a DCM DI Driver Bank. When disabled, the DI Driver Bank will operate only using the primary high voltage power supplies. For primary and secondary supplies to be enabled, the following conditions must be met:

-IO Lock is inactive (OFF)

-MPRD (Main Power Relay) is enabled

-Boost Voltage [V] is set to a level higher than DRVP (Drive Power Supply)

Boost Voltage

Tip Strip: Specifies target boost level [V]

This parameter sets the boost voltage target for a DI bank. The boost supplies in a bank will attempt to reach the specified voltage when the following conditions are met:

- -IO Lock is inactive (OFF)
- -MPRD (Main Power Relay) is enabled
- -Boost Voltage [V] is set to a level higher than DRVP (Drive Power Supply).

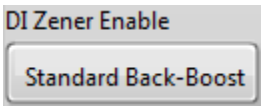
Note: If secondary boost supplies are not enabled, Boost Voltage [V] is limited to the primary boost supply range. The primary boost supply range is shown in the DCM System ADC window.

Injector Enable Button

Tip Strip: Enables injection in the DI Bank

This button enables DCM injection control circuitry. This parameter does not generate any injection pulses, but only enables the driver circuitry to operate when fuel commands are generated.

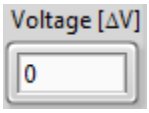
DI Zener Enable



Tip Strip: Toggles between Standard and Zener back-boost operation for DI channels.

Toggles between Standard and Zener back-boost operation for DI channels. Standard back-boost operation enables solenoid back-EMF to dissipate into the boost power supply to facilitate faster solenoid injector closing. Alternatively, Zener back-boost operation enables solenoid back-EMF to dissipate through a programmable zener circuit set to a Delta-V above the actual boost voltage.

DI Zener Voltage

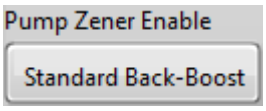


Tip Strip: Specifies the setpoint of the DI Zener circuitry. DI Zener V + 5V + Boost V = DI Back-Boost V

Specifies the setpoint of the DI Zener circuitry. When DI Zener is enabled, the back-boost voltage is calculated by adding the DI Zener setpoint to the actual boost voltage plus 5V. This parameter is to be used in conjunction with DI Zener Enable button and is only applicable to an inductive (solenoid) load type.

Example: 75V Boost + 5V + 40V DI Zener = 120V DI Back-Boost

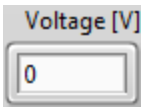
Pump Zener Enable



Tip Strip: Toggles between Standard and Zener back-boost operation for Pump channels.

Toggles between Standard and Zener back-boost operation for Pump channels. Standard back-boost operation enables solenoid back-EMF to dissipate into the boost power supply to facilitate faster solenoid injector closing. Alternatively, Pump Zener back-boost operation enables solenoid back-EMF to dissipate through a programmable Zener circuit set to a voltage relative to 0V.

Pump Zener Voltage



Tip Strip: Specifies the setpoint of the Pump Zener circuitry. Pump Zener V = Pump Back-Boost V

Specifies the setpoint of the Pump Zener circuitry. When Pump Zener is enabled, the pump back-boost voltage is the Pump Zener voltage. This parameter is used in conjunction with Pump Zener Enable button and is only applicable to an inductive (solenoid) load type.

Example: 25V Pump Zener = 25V Pump Back-Boost

Boost Clamp

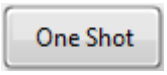
Tip Strip: Specifies the boost clamp voltage target.

This parameter clamps the bank power supplies to the specified level. The boost clamp circuitry prevents boost power supply over-voltage above the specified target in cases where back-boost energy is captured faster than can be dissipated.

DI Scope

Press to open Internal DI Scope Analog Measurement

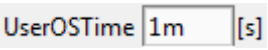
One Shot



Tip Strip: Generates One Shot Command

When pressed, the NI DCM will internally generate a one-shot pulse with a duration specified by UserOSTime. This button is a momentary switch. This pulse can be routed to the DI Command when configured to Direct or Triggered Multi-Pulse command mode.

UserOSTime



Tip Strip: User One Shot time

This parameter is to be used with the One-Shot button.

DI Bank Run State

Tip Strip: DI Bank run state

Drive Power

Tip strip: Voltage of the switched Drive Power (DRVP) (9-48V) pins.

Voltage of the switched Drive Power (DRVP) (9-48V) pins.

Primary Voltage 1-2

Tip strip: Voltage of the primary stage of the boost supply for DI channels 1 & 2 of the particular bank.

Voltage of the primary stage of the boost supply for DI channels 1 & 2 of the particular bank.

Primary Voltage 3-4

Tip strip: Voltage of the primary stage of the boost supply for DI channels 1 & 2 of the particular bank.

Voltage of the primary stage of the boost supply for DI channels 1 & 2 of the particular bank.

Secondary Voltage 1-2

Tip strip: Voltage of the secondary stage of the boost supply for DI channels 1 & 2 of the particular bank.

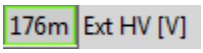
Voltage of the secondary stage of the boost supply for DI channels 1 & 2 of the particular bank.

Secondary 3-4

Tip strip: Voltage of the secondary stage of the boost supply for DI channels 3 & 4 of the particular bank.

Voltage of the secondary stage of the boost supply for DI channels 3 & 4 of the particular bank.

Ext HV



Tip strip: Voltage of the external DI bank boost supply pin.

Voltage of the external DI bank boost supply pin.

DI Zener

Tip strip: Voltage of the programmable DI backboost zener circuit.

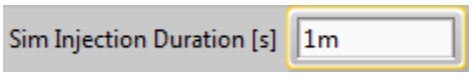
Voltage of the programmable DI backboost zener circuit.

Pump Zener

Tip strip: Voltage of the programmable Pump backboost zener circuit of the particular bank.

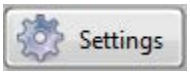
Voltage of the programmable Pump backboost zener circuit of the particular bank.

Simulation Injection Duration



Tip Strip: Max = 0.05, Min = 0

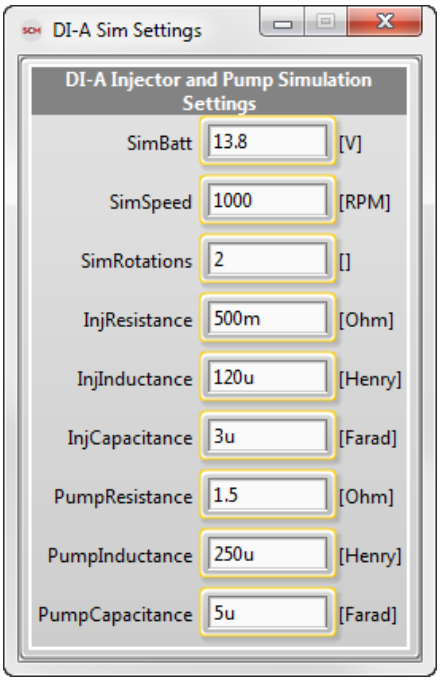
DI Simulation Settings



Tip Strip: Launches DI and Pump Simulation Settings

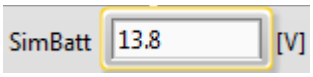
Press to launch DI and Pump Simulation Settings

DI Simulation Settings



The DI Simulation Settings window contains parameters used for simulating injector and pump current and voltage profiles based on their electrical properties – Resistance, Inductance and Capacitance (see Injector and Sync Pump Phase Array plots) In addition, it also allows user to preview the engine-synchronous command pulses for injector and pump channels in the Injector Commands and Sync Pump Commands plots.

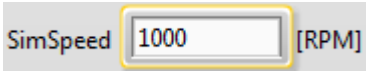
SimBatt



Tip Strip: Battery voltage level for current profile simulation

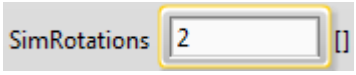
Battery voltage level for current profile simulation

SimSpeed



Tip Strip: Engine speed for injection/pump command illustration

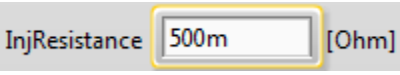
SimRotations



Tip Strip: Number of engine rotations per cycle used to display angle-based injection pulses (EPT Mode Only)

Number of engine rotations per cycle used to display angle-based injection pulses (EPT Mode Only)

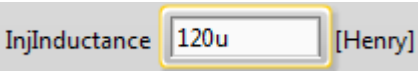
InjResistance



Tip Strip: Injector Resistance for current profile simulation purpose

Injector Resistance for current profile simulation purpose

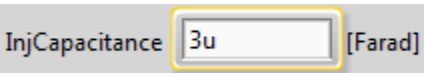
InjInductance



Tip Strip: Injector Inductance for current profile simulation purpose

Injector Inductance for current profile simulation purpose

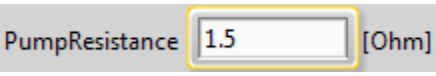
InjCapacitance



Tip Strip: Injector Capacitance for current profile simulation purpose

Injector Capacitance for current profile simulation purpose

PumpResistance



Tip Strip: Pump Resistance for current profile simulation purpose

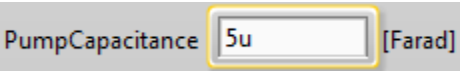
Pump Resistance for current profile simulation purpose

PumpInductance

Tip Strip: Pump Inductance for current profile simulation purpose

Pump Inductance for current profile simulation purpose

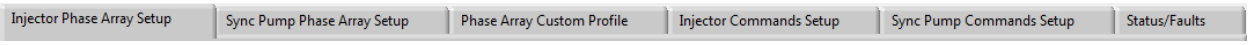
PumpCapacitance



Tip Strip: Pump Capacitance for current profile simulation purpose

Pump Capacitance for current profile simulation purpose

Selector Tab

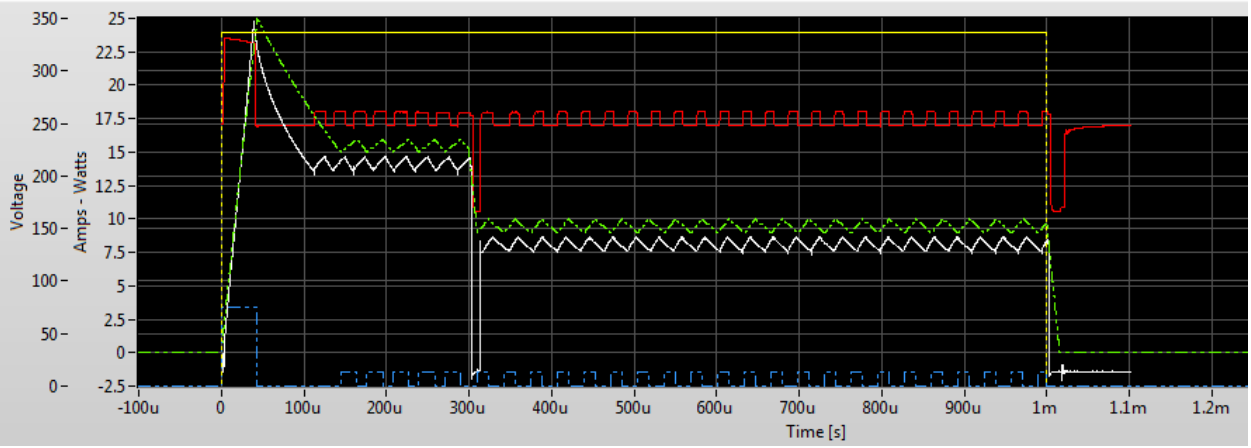


Selects tab to navigate through various Bank settings.

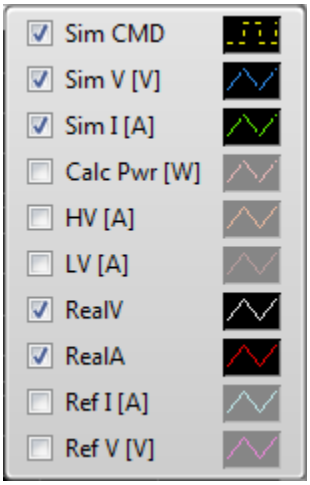
- **Injector Phase Array Setup** contains settings related to current/voltage control depending on the type of load (Bank Configuration)
- **Sync Pump Phase Array Setup** contains settings related to current/voltage control. This tab is only applicable when a pump channel is available and therefore, is dependent on selected Bank Configuration. For example, pump channel becomes unavailable when Bank Configuration is selected to Solenoid Unipolar 8 (Muxed) and Piezo Unipolar 4 (Muxed).
- **Phase Array Custom Profile tab** contains settings, in an array format, related to DI Driver FETs ON time for current control when current control phase is set to Profile.
- **Injector Commands Setup tab** contains channel settings for generating injector command pulses
- **Sync Pump Commands Setup tab** contains pump channel settings for generating pump command pulses. Same as before, this tab is only applicable when a pump channel is available and therefore, is dependent on selected Bank Configuration. For example, pump channel becomes unavailable when Bank Configuration is selected to Solenoid Unipolar 8 (Muxed) and Piezo Unipolar 4 (Muxed).
- **Status/Faults tab** contains channel specific faults and relevant DI Bank temperature readouts.

Injector Phase Array Setup

Graph



Legend



The Phase Array graph is a collection of overlaid plots consisting of:

i. Simulated command specified by Simulation Duration [s] as denoted by Sim CMD
ii. Simulated voltage drop across the inductive or capacitive load based on electrical 1-D model as denoted by Sim V [V]
iii. Simulated current through the inductive or capacitive load based on electrical 1-D model as denoted by Sim I [A]
iv. Estimated power required to drive current through the load for duration specified by Simulation Duration [s], as denoted by Calc Pwr [W]
v. Graphic illustration of region in the simulated current profile that is driven by High (Boost) Voltage, as denoted by HV [A]
vi. Graphic illustration of region in the simulated current profile that is driven by Low Voltage DRVP, as denoted by LV [A]
vii. Plot of high-speed analog measurement selected on Channel 1 of DCM 5MHz Internal DI Scope. As shown in the above screenshot, the measurement selected in channel 1 of the DI Scope is that of current through channel A1/A5 of DI Driver Bank A
viii. Plot of high-speed analog measurement selected on Channel 2 of DCM 5MHz Internal DI Scope. As shown in the above screenshot, the measurement selected in channel 2 of the DI Scope is that of voltage drop across the inductive load (S) in channel A1 of DI Driver Bank A
ix. Plot of high-speed analog measurement selected on Channel 3 of DCM 5MHz Internal DI Scope. As shown in the above screenshot, the measurement selected in channel 3 of the DI Scope is that of current through channel B2/B6 of DI Driver Bank B
x. Plot of high-speed analog measurement selected on Channel 4 of DCM 5MHz Internal DI Scope. As shown in the above screenshot, the measurement selected in channel 4 of the DI Scope is that of voltage drop across the capacitive load (PZ) in channel B2 of DI Driver Bank B

The first six plots are based on simulation data while the last four are plots of real analog from the DCM high-speed analog measurement buffers. The plots can be shown/hidden by checking/unchecking the plot visibility checkbox on the legend.

Plot Controls

Use the plot controls palette to zoom and pan the graph.

Load Profile

Tip Strip: List of predefined current/voltage profiles

Loads a Phase Array from disk on host PC

Move Up List

Tip Strip: Moves a Phase Array up through the Phase Arrays List

Moves a Phase Array up through the Phase Arrays List

Move Down List

Tip Strip: Moves a Phase Array down through the Phase Arrays List

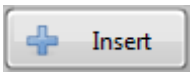
Moves a Phase Array down through the Phase Arrays List

Save Profile

Tip Strip: Saves a Phase Array to disk on host PC

Saves a Phase Array to disk on host PC

Insert



Tip Strip: Inserts a Phase into a Phase Array

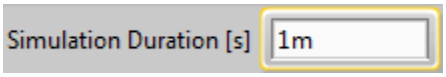
Inserts a Phase into a Phase Array

Remove

Tip Strip: Removes a Phase from a Phase Array

Removes a Phase from a Phase Array

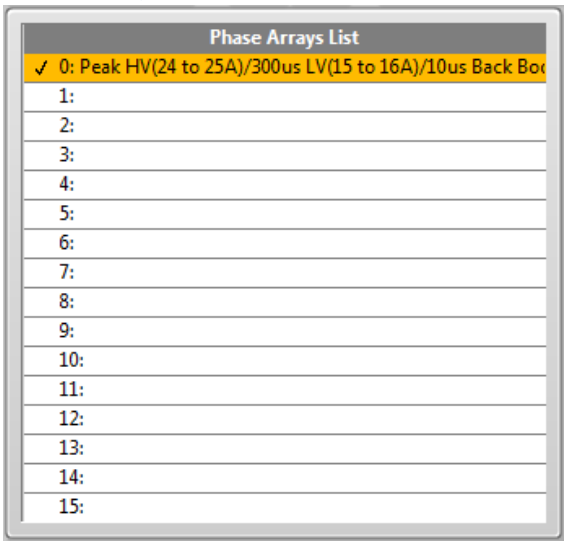
Simulation Duration



Tip Strip: Duration of simulated injection (Min = 0, Max = 0.05).

Specifies injection duration for simulation of DI load current/voltage profile

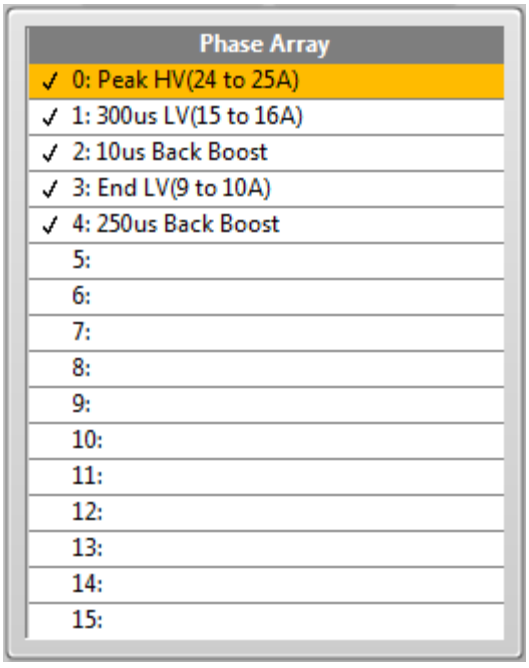
Phase Arrays List



Tip Strip: List of predefined current/voltage profiles

The NI DCM allows up to sixteen current/voltage profiles that the user can use in an injection event. The list is called Phase Arrays List. Each Phase Array has a string of brief descriptions for each phase that the user configures in the Phase Array Listbox. Depending on the Bank Configuration, a phase array may not be appropriate. For example, when a bank is configured to any Solenoid selection, piezo voltage control profile will not be able to drive the inductive load. There will be an "*X*" symbol next to the Phase Array indicating that the Phase Array (profile) is erroneous for the selected Bank Configuration.

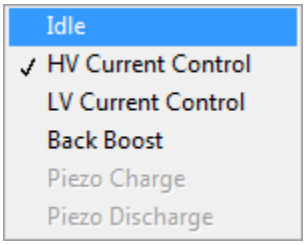
Phase Array



Tip Strip: Current/Voltage phase Array setting for a given current/voltage profile

Each of the DCM Phase Array can contain up to sixteen phases. Idle Phase (See Drive) will not have any description while for each non-Idle Phases will have a short description pertaining to current/voltage levels and duration associated with them.

Drive



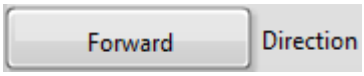
Tip Strip: Selects Phase Drive

The Phase Drive selection consists of:

- **Idle:** No action will be performed for this phase
- **HV Current Control:** Current control will be performed in this phase with High Voltage Supply specified in the Configuration Cluster.
- **LV Current Control:** Current control will be performed in this phase with DRVP supplied to the DCM.
- **Back Boost:** For this phase, any generated back-emf will be captured and stored in the internal capacitors, causing current to drop rapidly.
- **Piezo Charge:** Phase will be used to charge a Piezo (capacitive) load
- **Piezo Discharge:** Phase will be used to discharge a Piezo (capacitive) load

Certain selections may be disabled and grayed out depending on the Bank Configuration. In the screenshot above, the Bank Configuration is set to a Solenoid (inductive load) mode and consequently, Piezo Charge and Piezo Discharge are disabled and grayed out.

Direction



Tip Strip: Selects Current or Voltage drive direction

A typical application of Reverse Direction in a phase is for driving bipolar solenoid or piezo load.

Current High

Tip Strip: Current dithering maximum limit

High limit for current dithering

Current Low

Tip Strip: Current dithering minimum limit

Low limit for current dithering

Voltage High

Tip Strip: Voltage maximum limit

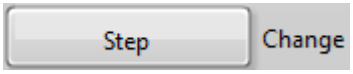
High limit for voltage dithering

Voltage Low

Tip Strip: Voltage minimum limit

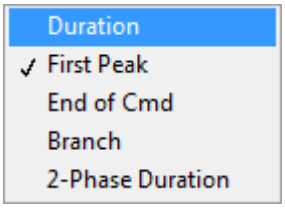
Low limit for voltage dithering

Change



Tip Strip: Selects whether phase executes instantaneously or following a set ramp rate

Phase Step



Tip Strip: Determines start and end of phase method

Start and End phase method includes:

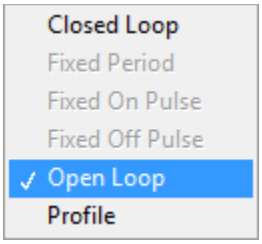
- **Duration:** Sets the duration of a phase. 0 = hold to the End of Cmd
- **First Peak:** Causes the next phase to begin after current reaches first peak.
  Note: Duration has to be long enough for current to reach first peak or it will be shortened.
- **End of Cmd:** Hold phase to End of Cmd. This is the same as setting Duration =0.
- **Branch:** Allows transition to another Phase Array within a Commanded Pulse. Typical application is Precharge.
- **2-Phase Duration:** Duration timer is not reset at the start of this phase but instead carrying over from the previous phase

Duration

Tip Strip: Phase duration when Phase Step is set to "Duration"

When the duration is reached, operation proceeds to the next phase. A special duration value of zero means that operation will remain in that phase until the end of the injection command.

Current Control



Tip Strip: Selects DI FET switching strategy to achieve a current/voltage control

Selections include:

- **Closed Loop:** The DI FET control will be fully automatic to achieve desired current/voltage
- **Fixed Period:** The DI FET will switch at a user-defined period while the pulse width will continuously adjust to achieve current dithering max limit (Current High [A])
- **Fixed on Pulse:** The DI FET will be ON for the desired duration set by the Pulse Width [s] if the current is above the minimum dithering limit (Current Low [A])
- **Fixed Off Pulse:** The DI FET will be ON to achieve the maximum current dithering limit and will go OFF at a fixed period set by the Pulse Width [s]
- **Open Loop:** The FET will switch per desired Period [s] and Pulse Width [s]
- **Profile:** The DI FET will switch per user-defined Period [s] but the pulse width will be set per one of 16 allowable custom patterns in Custom Profiles

Note: Depending on other parameters, in the Phase Cluster, certain items in this drop-down list may be disabled and greyed out. For example, when First Peak is selected in the Phase Step, the Fixed Period, Fixed on Pulse and Fixed Off Pulse become inapplicable and therefore grayed out from the selection.

Period

Tip Strip: Specifies period which controls the FET switching frequency. Not applicable to "Closed Loop", "Fixed On Pulse" and "Fixed Off Pulse" Control

Pulse Width

Tip Strip: Specifies ON time of FET within switching "Period [s]" but sets OFF time for "Fixed off pulse" Control mode

Profile

Tip Strip: Selects one of sixteen allowable profiles when "Control" is set to "Profile"

Voltage Control

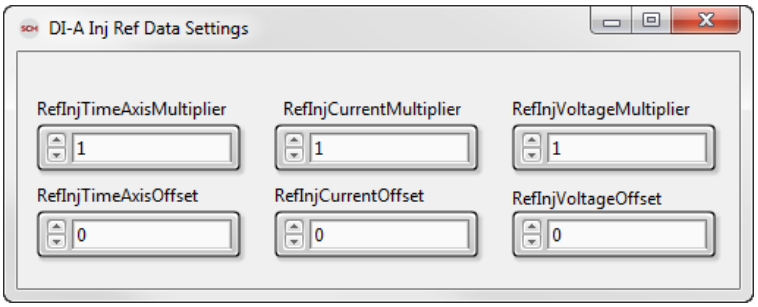
Tip Strip: Enables Voltage High and Voltage Low control limits in addition to Current High and Current Low control limits when driving capacitive (Piezo) loads.

When in current and voltage control mode, i.e. driving capacitive (Piezo) load, this button tells the NI DCM to exercise voltage control based on Voltage High [V] and Voltage Low [V] OR to ignore the limits completely

DI-A Inj Ref Data Settings

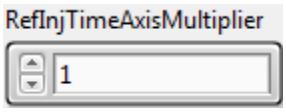
Tip Strip: Click to launch settings for injector reference plots. The injector current/voltage reference plots can be added to the Phase Array Plots from a .csv file on the host PC to compare how well the traces from real loads driven by the DCM matches the respective reference.

DI-A Inj Ref Data Settings



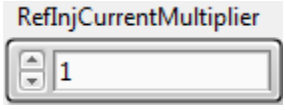
This window contains parameters to manipulate DI current or voltage reference plots

RefInjTimeAxisMultiplier



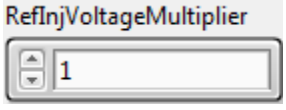
Tip Strip: Reference Injection Time Axis scaling factor

RefInjCurrentMultiplier



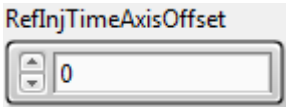
Tip Strip: Reference Injection Current scaling factor

RefInjVoltageMultiplier



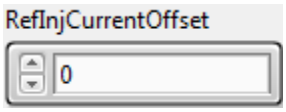
Tip Strip: Reference Injection Voltage scaling factor

RefInjTimeAxisOffset



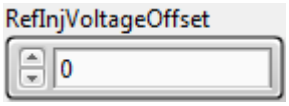
Tip Strip: Reference Injection Time Axis offset

RefInjCurrentOffset



Tip Strip: Reference Injection Current offset

RefInjVoltageOffset



Tip Strip: Reference Injection Voltage offset

Reference Inj Profile File Path

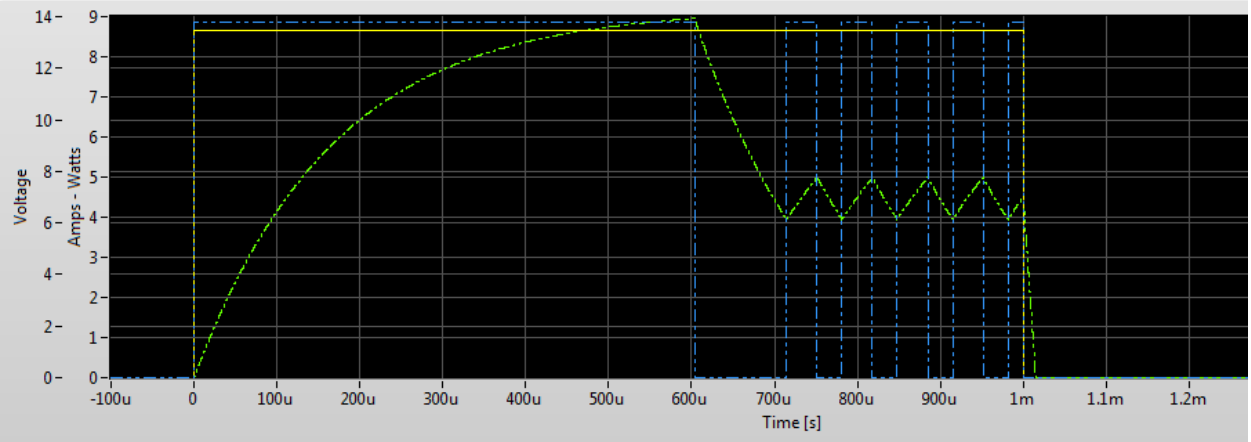
Tip Strip: Path to .csv file to add reference injection traces.

Copy and paste file path for .csv file to add reference injection traces to the Phase Array Graph or click icon to browse on disk.

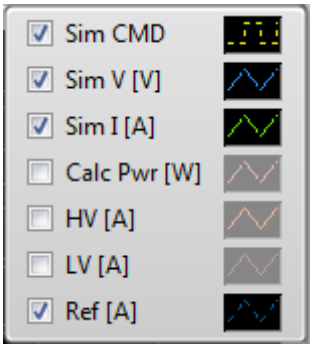
Sync Pump Phase Array Setup

The Sync Pump Phase Array Setup tab allows users to configure the pump channel on each bank to drive an engine synchronous fuel pump. The tab is unavailable in the DI Bank Configurations of Solenoid Unipolar 8 (Muxed) and Piezo Unipolar 4 (Muxed) because in those configurations the pump channel is used to control an injector.

Plot



Legend



The Phase Array graph is a collection of overlaid plots consisting of:

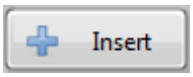
i. Simulated command specified by Simulation Duration [s] as denoted by Sim CMD
ii. Simulated voltage drop across the inductive or capacitive load based on electrical 1-D model as denoted by Sim V [V]
iii. Simulated current through the inductive or capacitive load based on electrical 1-D model as denoted by Sim I [A]
iv. Estimated power required to drive current through the load for duration specified by Simulation Duration [s], as denoted by Calc Pwr [W]
v. Graphic illustration of region in the simulated current profile that is driven by High (Boost) Voltage, as denoted by HV [A]
vi. Graphic illustration of region in the simulated current profile that is driven by Low Voltage DRVP, as denoted by LV [A]
vii. Plot of reference pump current loaded from disk in Host PC

The first six plots are based on simulation data. The plots can be shown/hidden by checking/unchecking the plot visibility checkbox on the legend.

Plot Controls

Use the plot controls palette to zoom and pan the graph.

Insert



Tip Strip: Inserts a Phase into a Phase Array

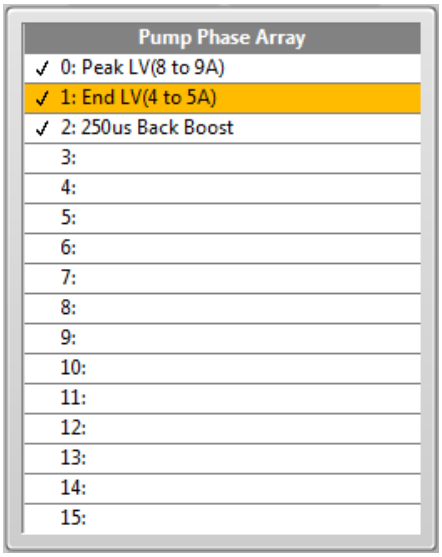
Inserts a Phase into a Phase Array

Remove

Tip Strip: Inserts a Phase into a Phase Array

Inserts a Phase into a Phase Array

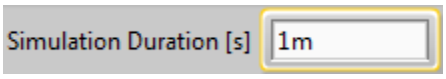
Pump Phase Array



Tip Strip: Current/Voltage Pump Phase Array

The NI DCM allows one current/voltage profiles that the user can use in an injection event. The list is called Phase Arrays List. The Phase Array has a string of brief descriptions for each phase that the user configures in the Phase Array Listbox. Depending on the Bank Configuration, a phase array may not be appropriate. For example, when a bank is configured to any Solenoid selection, piezo voltage control profile will not be able to drive the inductive load. There will be an "*X*" symbol next to the Phase Array indicating that the Phase Array (profile) is erroneous for the selected Bank Configuration.

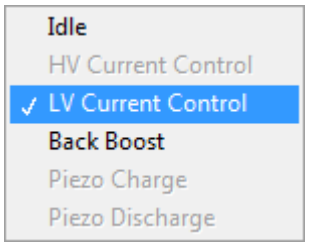
Simulation Duration



Tip Strip: Duration of simulated synchronous pump pulse (Min = 0, Max = 0.05).

Specifies sync pump pulse duration for simulation of DI load current/voltage profile

Drive



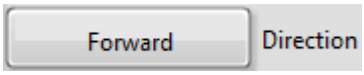
Tip Strip: Selects Phase Drive

The Phase Drive selection consists of:

- **Idle:** No action will be performed for this phase
- **LV Current Control:** Current control will be performed in this phase with DRVP supplied to the DCM.
- **Back Boost:** For this phase, any generated back-emf will be captured and stored in the internal capacitors, causing current to drop rapidly.

Certain selections may be disabled and greyed out depending on the Bank Configuration. In the screenshot above, the Bank Configuration is set to a Solenoid (inductive load) mode and consequently, Piezo Charge and Piezo Discharge are disabled and greyed out. Furthermore, because synchronous pump channel is a low side channel, it does not have access to the high voltage drive source, and that option is grayed out.

Direction



Tip Strip: Selects Current or Voltage drive direction

Not applicable for driving low voltage synchronous fuel pumps.

Current High

Tip Strip: Current dithering maximum limit

Sets the maximum current level through the channel.

Current Low

Tip Strip: Current dithering minimum limit

Sets the minimum current level through the channel.

Voltage High

Tip Strip: Voltage maximum limit

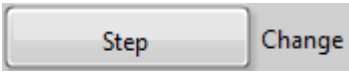
Not applicable for driving low voltage synchronous fuel pumps.

Voltage Low

Tip Strip: Voltage maximum limit

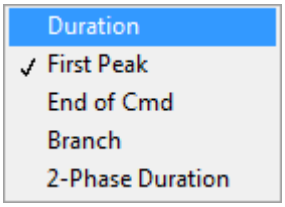
Not applicable for driving low voltage synchronous fuel pumps.

Change



Tip Strip: Selects whether phase executes instantaneously or following a set ramp rate

Phase Step



Tip Strip: Determines start and end of phase method

Start and End phase method includes:

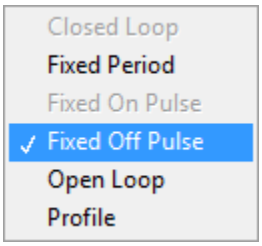
- **Duration:** Sets the duration of a phase. 0 = hold to the End of Cmd
- **First Peak:** Causes the next phase to begin after current reaches first peak.
  Note: Duration must be long enough for current to reach first peak or it will be shortened.
- **End of Cmd:** Hold phase to End of Cmd. This is the same as setting Duration =0.
- **Branch:** Allows transition to another Phase Array within a Commanded Pulse. Typical application is Precharge.
- **2-Phase Duration:** Duration timer is not reset at the start of this phase but instead carrying over from the previous phase

Duration

Tip Strip: Phase duration when Phase Step is set to "Duration"

When the duration is reached, operation proceeds to the next phase. A special duration value of zero means that operation will remain in that phase until the end of the injection command.

Current Control



Tip Strip: Selects DI FET switching strategy to achieve a particular current/voltage control

Selections include:

- **Fixed Period:** The DI FET will switch at a user-defined period while the pulse width will continuously adjust to achieve current dithering max limit (Current High [A])
- **Fixed Off Pulse:** The DI FET will be ON to achieve the maximum current dithering limit and will go OFF at a fixed period set by the Pulse Width [s]
- **Open Loop:** The FET will switch per desired Period [s] and Pulse Width [s]
- **Profile:** The DI FET will switch per user-defined Period [s] but the pulse width will be set per one of 16 allowable custom patterns in Custom Profiles

A pump channel only has Low-Side FET and when the FET is OFF, it has no current feedback. Therefore, any Current Control mode that inherently requires current feedback when the FET is OFF, such as Closed Loop and Fixed on Pulse mode are inapplicable, hence disabled and greyed out.

Period

Tip Strip: Specifies period which controls the FET switching frequency. Not applicable "Fixed Off Pulse" Control

Specifies period which controls the FET switching frequency.

Pulse Width

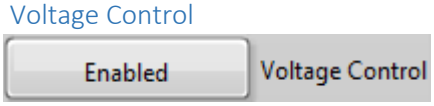
Tip Strip: Specifies OFF time for "Fixed Off pulse" Control mode

Specifies OFF time for "Fixed Off pulse" Control mode

Profile

Tip Strip: Selects one of sixteen allowable profiles when "Control" is set to "Profile"

Voltage Control



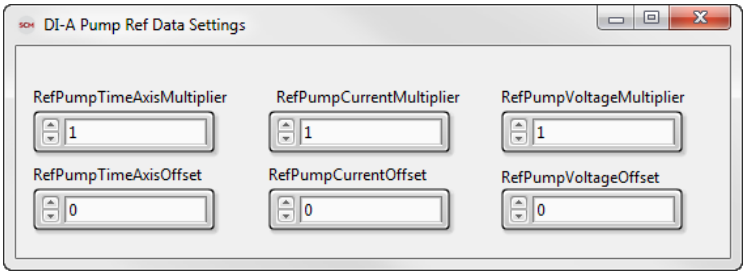
Tip Strip: Enables Voltage High and Voltage Low control limits in addition to Current High and Current Low control limits when driving capacitive (Piezo) loads.

Not applicable for driving low voltage synchronous fuel pumps.

DI-A Pump Ref Data Settings

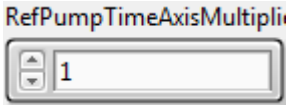
Tip Strip: Click to launch settings for injector reference plots. The injector current/voltage reference plots can be added to the Phase Array Plots from a .csv file on the host PC to compare how well the traces from real loads driven by the DCM matches the respective reference.

DI-A Pump Ref Data Settings VI



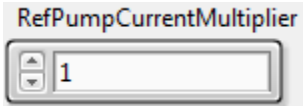
This window contains parameters to manipulate pump current or voltage reference plots

RefPumpTimeAxisMultiplier



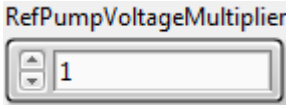
Tip Strip: Reference Pump Time scaling factor

RefPumpCurrentMultiplier



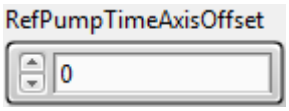
Tip Strip: Reference Pump Current scaling factor

RefPumpVoltageMultiplier



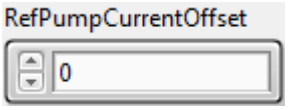
Tip Strip: Reference Pump Voltage scaling factor

RefPumpTimeAxisOffset



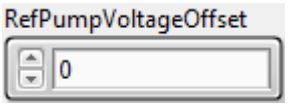
Tip Strip: Reference Pump Time offset

RefPumpCurrentOffset



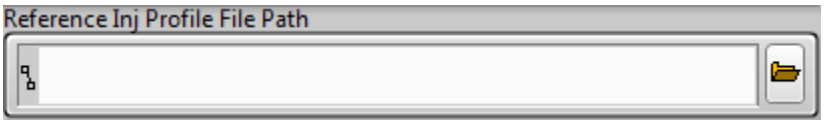
Tip Strip: Reference Pump Current offset

RefPumpVoltageOffset



Tip Strip: Reference Pump Voltage offset

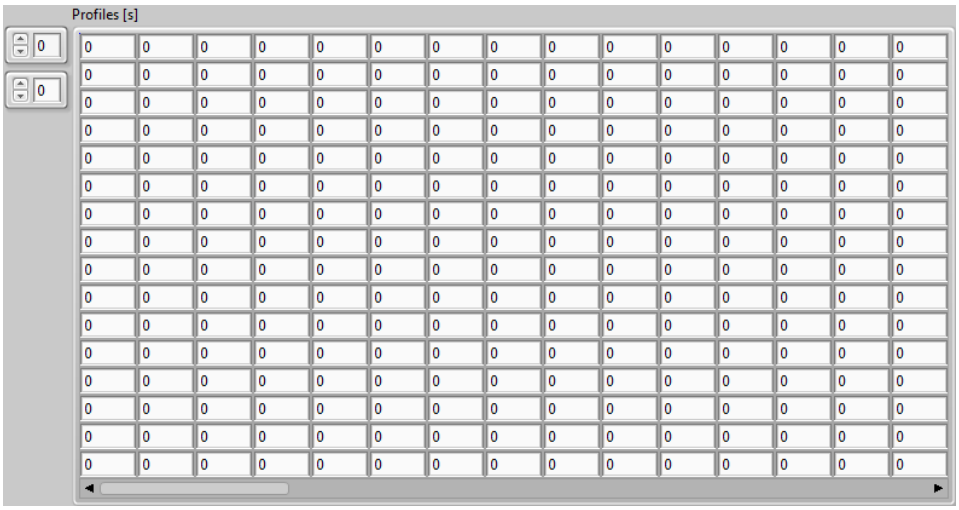
Reference Inj Profile File Path



Copy and paste file path for .csv file to add reference injection traces to the Phase Array Graph or click icon to browse on disk.

Phase Array Custom Profile

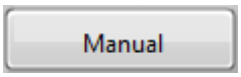
Profiles



Tip Strip: Open Loop pulse width profile applicable to DI/Sync Pump phase array element in Open Loop mode.

This parameter is a 16x64 two-dimensional array. Each element of this 2-D array specifies a FET On Time within a period of a phase when the Current Control is set to “Profile”. The switching period of this profile is specified by the Period [s] in a phase. Each row of the 2-D array is an independent custom profile that can be implemented in Phase set to run “Profile”. NI DCM allows up to sixteen profiles as shown in 16 total rows in the 2-D array. Each profile consists of 64 elements that can be run every period in a Phase running the profile. The “Profile” index in a Phase selects one of the sixteen profiles corresponding to the row index of the 2-D array.

ProfilesAdapt



Tip Strip: False = Manual, True = Adapt from RT

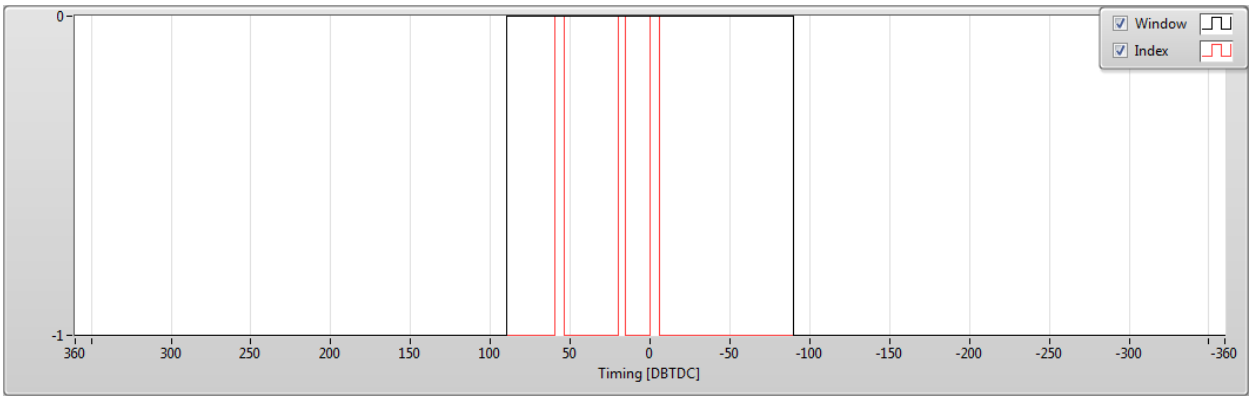
When set to False = Manual, the DSI software accepts manual user input. When set to True = Adapt from RT, the DSI software will adapt the 2-D Array from the output of profile-learning algorithm (see DI IPhase Learn window)

Profile Usage Tracker

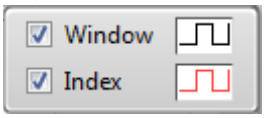
The Profile Usage Tracker reports custom profile usage by any Phase in the Phase Array List.

Injector Commands Setup

Plot



Legend



The Injector Commands Plot allows user to preview the DI command pulses by entering simulated speed “SimSpeed” and number of crankshaft rotations per engine cycle “SimRotations” (note: SimSpeed and SimRotations are strictly the purpose of plotting command pulses for preview). The “SimSpeed” and “SimRotations” parameters are accessible from the DI Sim Settings window, which is launched from the Injector Phase Array Setup tab. By default, the plot is set to display “EPT mode”, i.e. it assumes that the DI pulses will be engine-synchronous. Therefore, the plot will show square pulses with selected phase array index on the Y-axis and pulse timing in Degrees Before Top Dead Center (DBTDC). The plot can be switched to display pulses in Triggered Multi Pulse Command (TMP) Mode with a click of a button. The TMP plot will show similar plots except that the X-axis will be time after Trigger in seconds.

Plot Controls

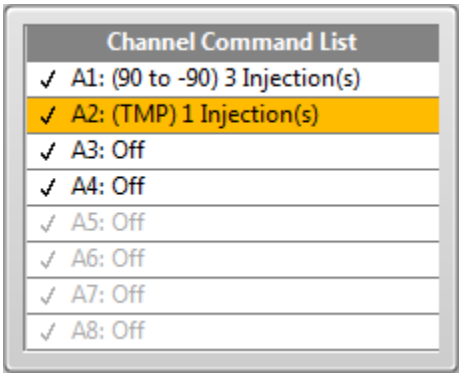
Use the plot controls palette to zoom and pan the graph.

Plot Mode

Tip Strip: Toggles plot between engine synchronous and TMP DI commands.

This button switches the plot between engine-synchronous DI command and time-based TMP command pulses

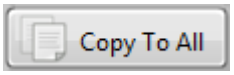
Channel Command List



Tip Strip: Shows command configurations for each enabled DI channel on bank.

The Channel Command List shows a list of available channels in a DI Driver Bank depending on selected Configuration. For each of the channels, there is a brief description of command mode and pulses.

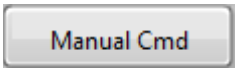
Copy to All



Tip Strip: Copies DI command settings from selected channel to all other available DI channels.

This button copies DI command settings from selected channel to all other available DI channels.

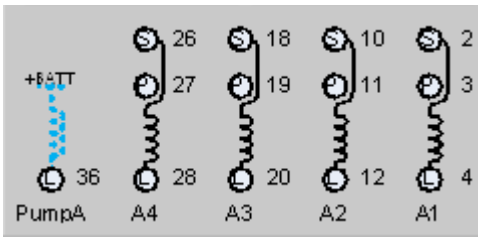
Manual Cmd



Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

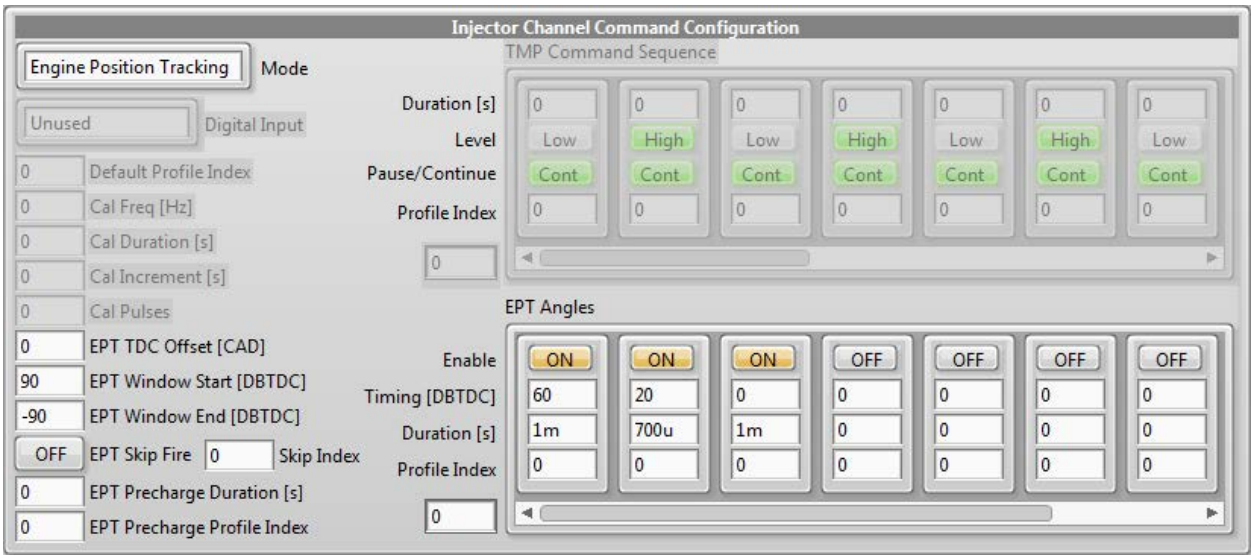
When set to False = Manual Cmd, the DSI software accepts input from the window user interface. When set to True = Adapt Cmd, the DSI software will overwrite the Injector Channel Command Configuration from the output of another control algorithm, such as the output of multi-pulse fuel-split strategy in DI Control and Calibration window.

DI Wiring Schematic



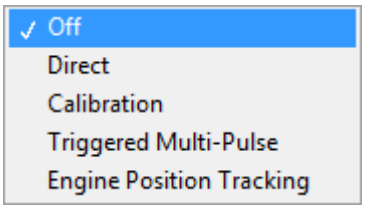
The DI Wiring Schematic illustrates how user can wire the load based on selected Bank Configuration.

Injector Channel Command Configuration



The Injector Channel Command Configuration cluster is where users can configure DI command modes and set configuration parameters based on the selected mode. Parameters not applicable to the selected active mode will be disabled and grayed out.

Mode



Tip Strip: Selects the DI command mode for the selected channel. (Off, Direct, Calibration, TMP, or EPT)

The selections of the DI command mode are as follow:

- Off: Channel disabled
- Direct: Uses the selected Digital Input to command the timing of the DI channel.
- Calibration: Uses Frequency, Duration, Sweep, and Injections controls to generate a pattern of DI control. The pattern is triggered using the selected Digital Input.
- Triggered Multi-Pulse (TMP): Uses the Command Sequence to generate a pattern of DI control. The pattern is triggered using the selected Digital Input. Profile Index defines the phase array index to use for each injection.
- Engine Position Tracking (EPT): Uses TDC Offset, Window Start, Window End, Angle Commands (up to 8), and Skip Fire commands to create complex engine-synchronous pulse sequences in the crank-angle domain. Profile Index defines the phase array index to use for each injection.

Digital Input

Tip Strip: Digital channels available to drive the selected channel in Direct, Calibration, and TMP modes.

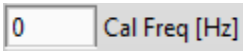
Digital channels available to drive the selected channel in Direct, Calibration, and TMP modes.

Default Profile Index

Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

Defines the phase array index (0 to 15) to use for each injection event. This parameter is only applicable to Direct and Calibration Command Mode.

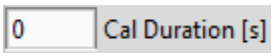
Cal Freq



Tip Strip: Controls the frequency in Hz of the Calibration output pattern.

Controls the frequency in Hz of the Calibration output pattern. This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

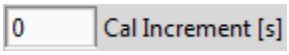
Cal Duration



Tip Strip: Controls the base injection duration in seconds of the Calibration output pattern.

Controls the base injection duration in seconds of the Calibration output pattern. This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

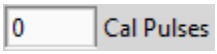
Cal Increment



Tip Strip: A non-zero Sweep value will cause the injection duration to 'sweep' throughout the Calibration pattern, incrementing from the base injection duration by the 'sweep' value in seconds after each injection event.

A non-zero Sweep value will cause the injection duration to 'sweep' throughout the Calibration pattern, incrementing from the base injection duration by the 'sweep' value in seconds after each injection event. This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

Cal Pulses



Tip Strip: Total number of injection events in the Calibration output pattern.

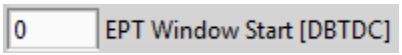
Total number of injection events in the Calibration output pattern. This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

EPT TDC Offset

Tip Strip: The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This offset is referenced to the absolute '0 CAD' engine position of EPTx.

The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

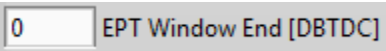
EPT Window Start



Tip Strip: The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

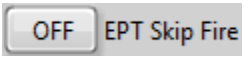
EPT Window End



Tip Strip: The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

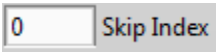
EPT Skip Fire



Tip Strip: Enables skip-fire operation for the selected channel.

Enables skip-fire operation for the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

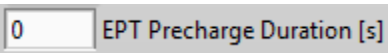
Skip Index



Tip Strip: During skip-fire operation, Skip Index selects the Skip Fire Pattern configured in the Skip Fire Setup subhost.

During skip-fire operation, Skip Index selects a particular Skip Fire Pattern configured in the Skip Fire Setup subhost. The total number of cycles and the number of on cycles are configured in the Skip Fire subhost. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

EPT Precharge Duration

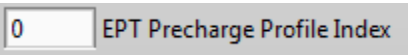


Tip Strip: Sets the duration for a precharge event prior to the main injection event.

The Precharge Duration control sets the amount of time of a precharge event prior to the angle at which the injection event takes place. When the Precharge Duration is set to a value greater than zero, a precharge event will occur prior to the injection event angle for the specified duration per the specified current profile.

This control is only applicable in EPT mode.

EPT Precharge Profile Index

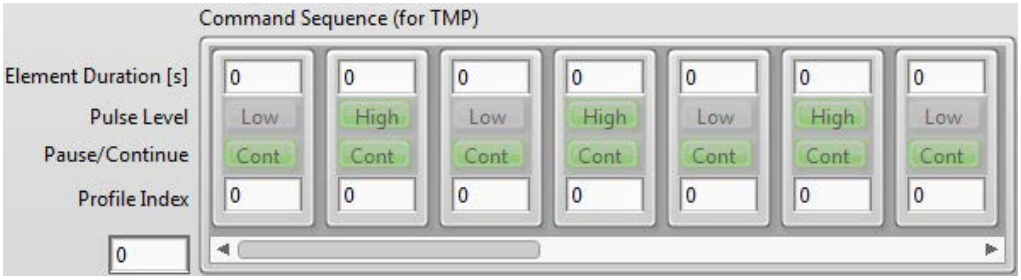


Tip Strip: Selects the current profile for a precharge event prior to the main injection event. The selected profile should have its final Phase Step set to 'Branch', and the total current profile duration should be longer than the desired precharge duration.

The Precharge Profile Index control selects the current profile for a precharge event prior to the angle at which the injection event takes place. When the Precharge Duration is set to a value greater than zero, a precharge event will occur prior to the injection event angle for the specified duration according to the specified current profile. In order for the current command not to fall to zero amps after the precharge event, configure the precharge current profile to have a Phase Step value of 'Branch,' which will allow the primary injection event current profile to begin immediately after the precharge event.

This control is only applicable in EPT mode.

Command Sequence (for TMP)



Tip Strip: The Command Sequence generates a multi-pulse strategy based on 16 command sequence elements. Each element is comprised of a duration, pulse level, pause/continue element, and profile index. The command sequence is triggered using the selected Digital Input channel.

This cluster is applicable to TMP Command Mode only.

Element Duration

Tip Strip: Command sequence element duration in seconds.

Element Duration specifies duration, in seconds, of a command sequence state.

Pulse Level (Not configurable)

Tip Strip: Output level for this element: Low means the channel will not source current; High means it will.

Pulse Level specifies a High or Low state. By default, the 16-element sequence is set to a series of Low state and High state beginning with a Low state. The first Low state is intended to be delay of the first pulse with respect to the command trigger. The successive Low states are intended to be used as delays between subsequent pulses. Pulse levels are non-configurable.

Pause/Continue (Not configurable)

Tip Strip: Determines whether to wait for an external trigger before continuing to the next element in the sequence. Cont means continue automatically; Pause means wait for an external trigger before starting the next element.

When executed, each element of the Command Sequence is evaluated to determine whether to continue (TRUE) or pause (FALSE) execution of the sequence. The Pause/Continue parameter is non-settable and is set to Continue (TRUE) by default.

Profile Index

Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

The Profile Index select the phase array (index 0 to 15) to use for each active injection event defined in the Command Sequence cluster array.

Angles (for EPT)

Tip Strip: Up to 8 engine-synchronous pulses may be specified for each DI channel. Pulse Enable, Timing, Duration, and Profile Index must be specified for each pulse.

The Angles cluster array is used to configure multi-pulse injection events (up to 8 pulses) when Command Mode is set to Engine Position Tracking (EPT). This cluster is to be used in conjunction with TDC Offset, Window Start and Window End.

Pulse Enable

Tip Strip: Enables/disables individual engine synchronous pulses.

For the engine -synchronous output pulse to be generated, Enable must be TRUE.

Pulse Timing

Tip Strip: Engine synchronous pulse timing in Degrees Before Top Dead Center (DBTDC), or "degrees advance". This value is relative to the specified TDC Offset value.

Pulse Timing specifies the desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse.

Pulse Duration

Tip Strip: Engine synchronous pulse duration in seconds.

Pulse Duration specifies the desired duration, in seconds, of the engine-synchronous pulse.

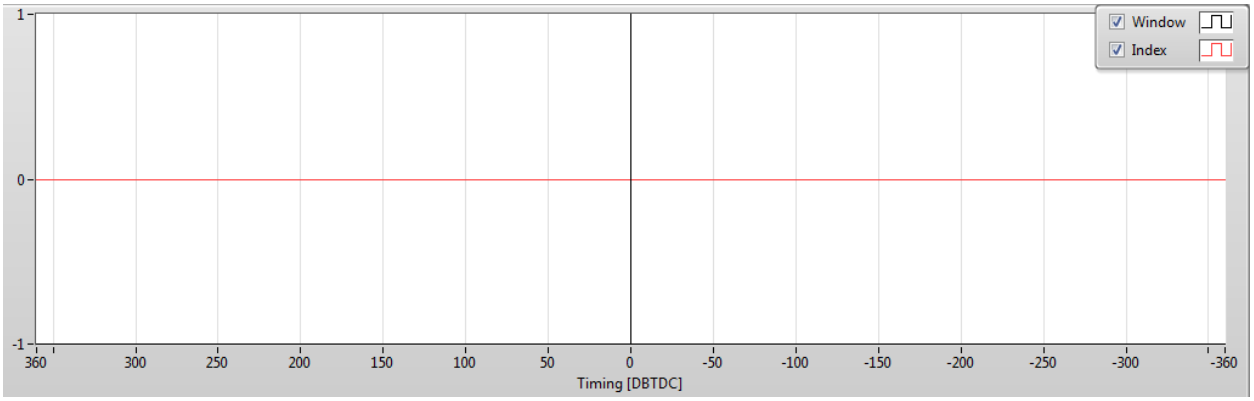
Profile Index

Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

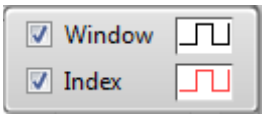
The Profile Index select the phase array (index 0 to 15) to use for each active injection event defined in the Angles cluster array.

Sync Pump Commands Setup

Plot



Legend



The Injector Commands Plot allows user to preview the Pump command pulses by entering simulated speed “SimSpeed” and number of crankshaft rotations per engine cycle “SimRotations” (note: SimSpeed and SimRotations are strictly the purpose of plotting command pulses for preview). By default, the plot is set to display “EPT mode”, i.e. it assumes that the Pump pulses will be engine-synchronous. Therefore, the plot will show square pulses with selected phase array index on the Y-axis and pulse timing in Degrees Before Top Dead Center (DBTDC). The plot can be switched to display pulses in Triggered Multi Pulse Command (TMP) Mode with a click of a button. The TMP plot will show similar plots except that the X-axis will be time after Trigger in seconds.

Plot Controls

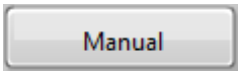
Use the plot controls palette to zoom and pan the graph.

EPT Plot Shown

Tip Strip: Toggles plot between engine synchronous and TMP DI commands.

This button switches between plot engine-synchronous Pump command and time-based TMP command pulses

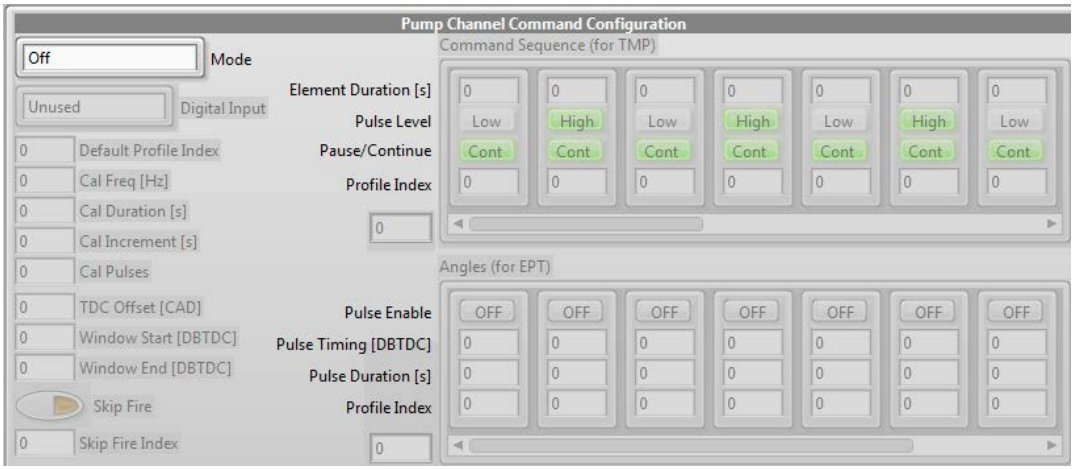
Manual



Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

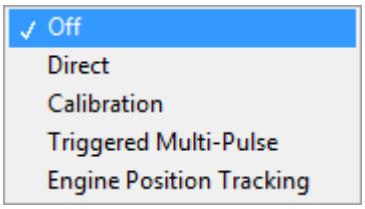
When set to False = Manual, the DSI software accepts input from the window user interface. When set to True = Adapt, the DSI software will overwrite the Injector Channel Command Configuration from the output of another control algorithm, such as the output of Sync Pump in Rail Pressure Control window.

Pump Channel Command Configuration



The Pump Channel Command Configuration cluster is where user can configure pump command modes and set configuration parameters based on the selected mode. Parameters not applicable to selected active mode will be disabled and greyed out.

Mode



Tip Strip: Selects the DI command mode for the selected channel. (Off, Direct, Calibration, TMP, or EPT)

The selections of the DI command mode are as follow:

- Off: Channel disabled
- Direct: Uses the selected Digital Input to command the timing of the DI channel.
- Calibration: Uses Frequency, Duration, Sweep, and Injections controls to generate a pattern of DI control. The pattern is triggered using the selected Digital Input.
- Triggered Multi-Pulse (TMP): Uses the Command Sequence to generate a pattern of DI control. The pattern is triggered using the selected Digital Input. Aux data defines the phase array index to use for each injection.
- Engine Position Tracking (EPT): Uses TDC Offset, Window Start, Window End, Angle Commands (up to 4), and Skip Fire commands to create complex engine-synchronous pulse sequences in the crank-angle domain. Aux data defines the phase array index to use for each injection.

Digital Input

Tip Strip: Digital channels available to drive the selected channel in Direct, Calibration, and TMP modes.

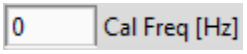
Digital channels available to drive the selected channel in Direct, Calibration, and TMP modes.

Default Profile Index

Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

This parameter is only applicable to Direct and Calibration Command Mode.

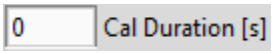
Cal Freq



Tip Strip: Controls the frequency in Hz of the Calibration output pattern.

This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

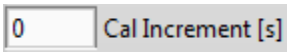
Cal Duration



Tip Strip: Controls the base injection duration in seconds of the Calibration output pattern.

This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

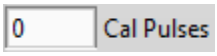
Cal Increment



Tip Strip: A non-zero Sweep value will cause the injection duration to 'sweep' throughout the Calibration pattern, incrementing from the base injection duration by the 'sweep' value in seconds after each injection event.

This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

Cal Pulses



Tip Strip: Total number of injection events in the Calibration output pattern.

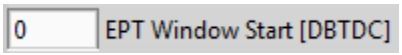
This parameter is only applicable to Calibration Command Mode and will be disabled in other modes.

EPT TDC Offset

Tip Strip: The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This offset is referenced to the absolute '0 CAD' engine position of EPTx.

The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

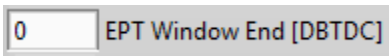
EPT Window Start



Tip Strip: The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

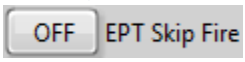
EPT Window End



Tip Strip: The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

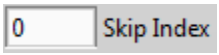
EPT Skip Fire



Tip Strip: Enables skip-fire operation for the selected channel.

Enables skip-fire operation for the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

Skip Index



Tip Strip: During skip-fire operation, Skip Index selects the Skip Fire Pattern configured in the Skip Fire Setup subhost.

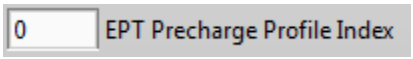
During skip-fire operation, Skip Index selects a particular Skip Fire Pattern configured in the Skip Fire Setup subhost. The total number of cycles and the number of on cycles are configured in the Skip Fire subhost. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

EPT Precharge Duration

Tip Strip: Sets the duration for a precharge event prior to the main injection event.

The Precharge Duration control sets the amount of time of a precharge event prior to the angle at which the injection event takes place. When the Precharge Duration is set to a value greater than zero, a precharge event will occur prior to the injection event angle for the specified duration according to the specified current profile. This control is only applicable in EPT mode.

EPT Precharge Profile Index

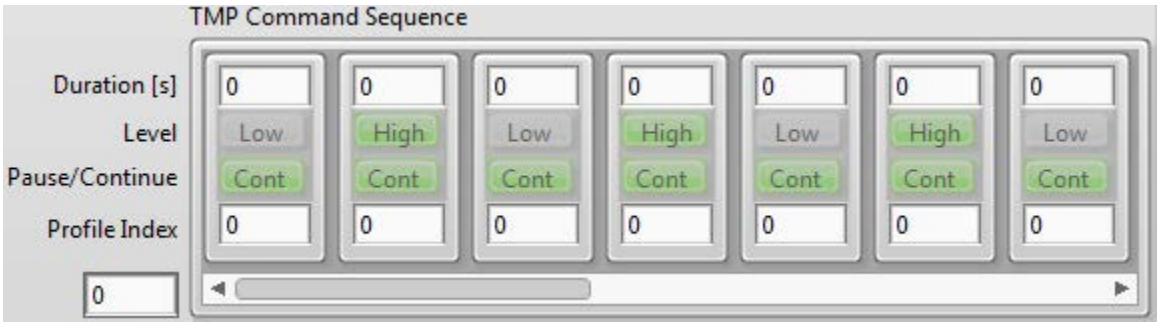


Tip Strip: Selects the current profile for a precharge event prior to the main injection event. The selected profile should have its final Phase Step set to ‘Branch’, and the total current profile duration should be longer than the desired precharge duration.

The Precharge Profile Index control selects the current profile for a precharge event prior to the angle at which the injection event takes place. When the Precharge Duration is set to a value greater than zero, a precharge event will occur prior to the injection event angle for the specified duration according to the specified current profile. In order for the current command not to fall to zero amps after the precharge event, configure the precharge current profile to have a Phase Step value of ‘Branch,’ which will allow the primary injection event current profile to begin immediately after the precharge event.

This control is only applicable in EPT mode.

TMP Command Sequence



Tip Strip: The Command Sequence generates a multi-pulse strategy based on 16 command sequence elements. Each element is comprised of a duration, pulse level, pause/continue element, and profile index. The command sequence is triggered using the selected Digital Input channel.

The Command Sequence generates a multi-pulse strategy based on 16 command sequence elements. Each element is comprised of a duration, pulse level, pause/continue element, and profile index. The command sequence is triggered using the selected Digital Input channel. This cluster is applicable to TMP Command Mode only.

Element Duration

Tip Strip: Command sequence element duration in seconds.

Element Duration specifies duration, in seconds, of a command sequence state.

Pulse Level (Not configurable)

Tip Strip: Output level for this element: Low means the channel will not source current; High means it will.

Pulse Level specifies a High or Low state. By default, the 16-element sequence is set to a series of Low state and High state beginning with a Low state. The first Low state is intended to be delay of the first pulse with respect to the command trigger. The successive Low states are intended to be used as delays between subsequent pulses. Pulse levels are non-configurable.

Pause/Continue (Not configurable)

Tip Strip: Determines whether to wait for an external trigger before continuing to the next element in the sequence. Cont means continue automatically; Pause means wait for an external trigger before starting the next element.

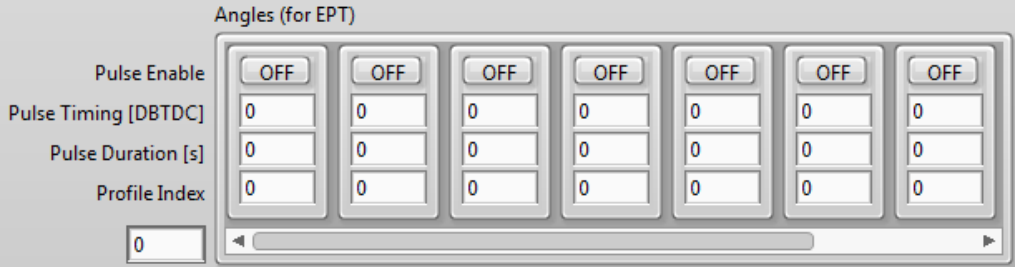
When executed, each element of the Command Sequence is evaluated to determine whether to continue (TRUE) or pause (FALSE) execution of the sequence. The Pause/Continue parameter is non-settable and is set to Continue (TRUE) by default.

Profile Index

Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

The Profile Index selects the phase array (index 0 to 15) to use for each active injection event defined in the Command Sequence cluster array.

Angles (for EPT)



Tip Strip: Up to 8 engine-synchronous pulses may be specified for each DI channel. Pulse Enable, Timing, Duration, and Profile Index must be specified for each pulse.

The Angles cluster array is used to configure multi-pulse injection events (up to 8 pulses) when Command Mode is set to Engine Position Tracking (EPT). This cluster is to be used in conjunction with TDC Offset, Window Start and Window End.

Pulse Enable

Tip Strip: Enables/disables individual engine synchronous pulses.

For the engine -synchronous output pulse to be generated, Enable must be TRUE.

Pulse Timing

Tip Strip: Engine synchronous pulse timing in Degrees Before Top Dead Center (DBTDC), or "degrees advance". This value is relative to the specified TDC Offset value.

Pulse Timing specifies the desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse.

Pulse Duration

Tip Strip: Engine synchronous pulse duration in seconds.

Pulse Duration specifies the desired duration, in seconds, of the engine-synchronous pulse.

Profile Index

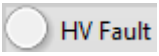
Tip Strip: Defines the phase array index (0 to 15) to use for each injection event.

The Profile Index select the phase array (index 0 to 15) to use for each active injection event defined in the Angles cluster array.

Bank X DI Fault Clear

The Bank X DI Fault Clear cluster comprises of channel-specific button in a DI Driver Bank. In Solenoid Unipolar 8 (Muxed) and Piezo Unipolar 4 (Muxed) Bank Configuration, DI-X-8 Clear is used for the 8th channel but in other Bank Configurations, it is used to clear faults in the respective Pump Channel.

HV Fault



Tip Strip: Indicates a fault on the high side high voltage driver. This fault is caused by excessive current flow. Wiring should be checked for a short from the high side pin to ground.

Indicates a fault on the high side high voltage driver. This fault is caused by excessive current flow. Wiring should be checked for a short from the high side pin to ground.

LV Fault

Tip Strip: Indicates a fault on the high side low voltage driver. This fault is caused by excessive current flow. Wiring should be checked for a short from the high side pin to ground.

Indicates a fault on the high side low voltage driver. This fault is caused by excessive current flow. Wiring should be checked for a short from the high side pin to ground.

LS Fault

Tip Strip: Indicates a fault on the low side driver. This fault is caused by excessive current flow. Wiring should be checked for a short from battery to low side pin.

Indicates a fault on the low side driver. This fault is caused by excessive current flow. Wiring should be checked for a short from battery to low side pin.

MUX Fault

Tip Strip: Indicates a fault on the injector control. The fault is caused by a command on a channel that is locked due to the MUX configuration.

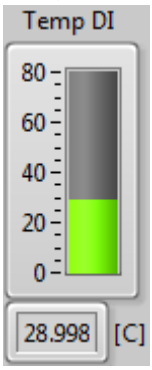
Indicates a fault on the injector control. The fault is caused by a command on a channel that is locked due to the MUX configuration.

Open Warning

Tip Strip: Indicates a warning that the expected current flow was not met after starting the injection command. This warning may result from an open circuit or a high impedance injector.

Indicates a warning that the expected current flow was not met after starting the injection command. This warning may result from an actual open circuit or an injector with high impedance which results in current being saturated to a level below target values (Current High and Current Low).

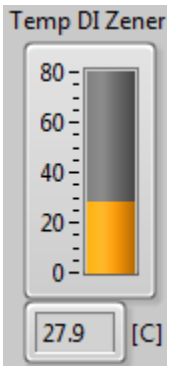
Temp DI



Tip Strip: Temperature in the proximity of DI channels in a Driver Bank on the main IO board.

Temperature in the proximity of DI channels in a Driver Bank on the main IO board.

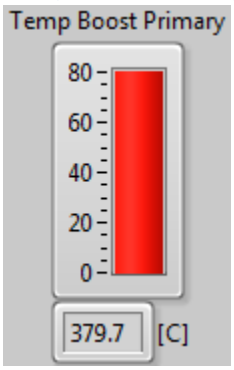
Temp DI Zener



Tip Strip: Temperature in the proximity of DI Driver Bank zener supply and pump channel on the main IO board.

Temperature in the proximity of DI Driver Bank zener supply and pump channel on the main IO board.

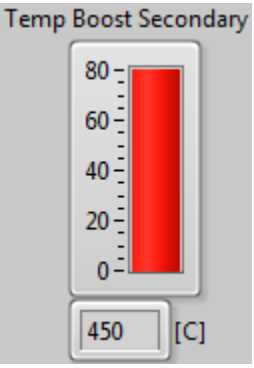
Temp Boost Primary



Tip Strip: Temperature in the proximity of DI Driver Bank primary boost supply.

Temperature in the proximity of DI Driver Bank primary boost supply.

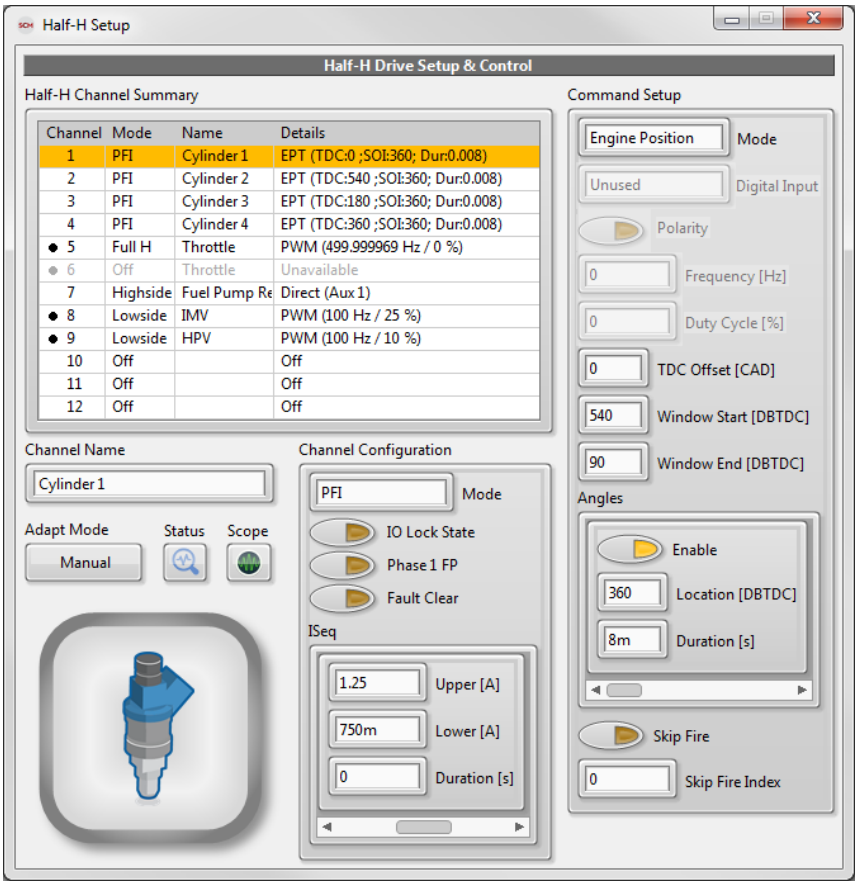
Temp Boost Secondary



Tip Strip: Temperature in the proximity of DI Driver Bank secondary boost supply.

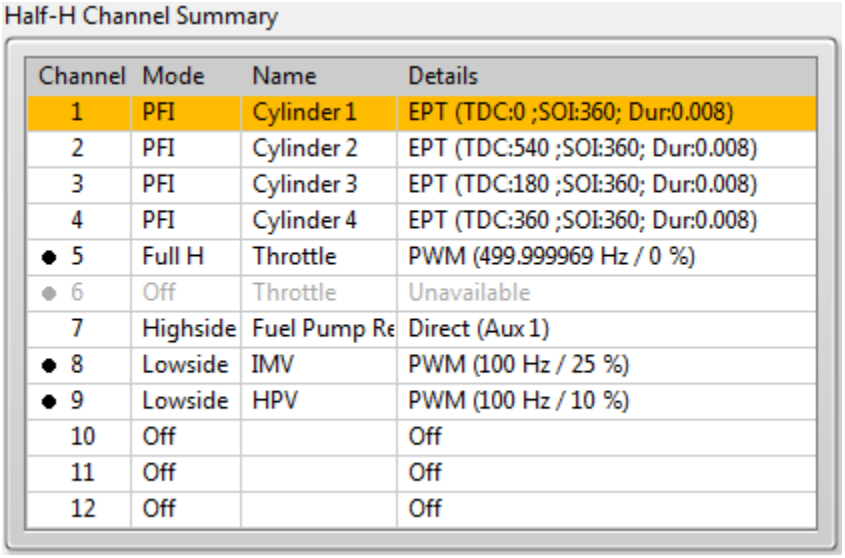
Temperature in the proximity of DI Driver Bank secondary boost supply.

Half-H Driver Setup



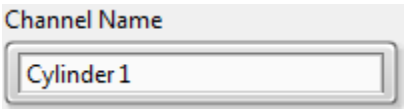
The NI DCM has twelve independent Half-H circuits that can be configured as Low-side, High-side or Port Fuel Injector driver. Adjacent channels can also be combined as a Full H driver or 3-phase DC motor driver. The Half-H Driver Setup window allows user to configure each of the Half-H channel as well as the command to trigger the Half-H output.

Half-H Channel Summary



To apply a configuration or command settings, user may select a channel by clicking a row in the Half-H Channel Summary table. To apply the same settings to multiple adjacent channels, click the first row and then hold the SHIFT and click on the last row. User may also hold the CTRL button while clicking on any channels that are not necessarily to each other.

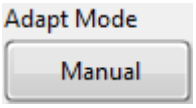
Channel Name



Tip Strip: Displayed name of channel.

User may assign a name associated with a Half-H channel

Adapt Mode



Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

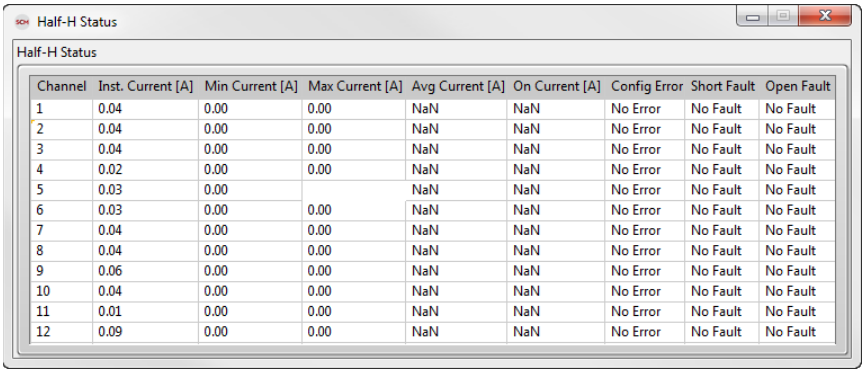
When set to False = Manual, the DSI software accepts input from the window user interface. When set to True = Adapt, the DSI software will overwrite the Half-H Channel Command Setup from the output of another control algorithm, such as the output of a PWM Pump in Rail Pressure Control window or PWM output set in the Electronic Throttle Control. While the Command Setup is overwritten, it will be greyed out and there will be a "•" symbol denoting a command being adapted.

Status

Tip Strip: Launches Half-H Status monitoring window

Click to launch Half-H Status monitoring window

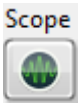
Half-H Status



Channel	Inst. Current [A]	Min Current [A]	Max Current [A]	Avg Current [A]	On Current [A]	Config Error	Short Fault	Open Fault
1	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
2	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
3	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
4	0.02	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
5	0.03	0.00		NaN	NaN	No Error	No Fault	No Fault
6	0.03	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
7	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
8	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
9	0.06	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
10	0.04	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
11	0.01	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault
12	0.09	0.00	0.00	NaN	NaN	No Error	No Fault	No Fault

This Half-H Status table lists current draw statistics, error and faults associated with each Half-H channel.

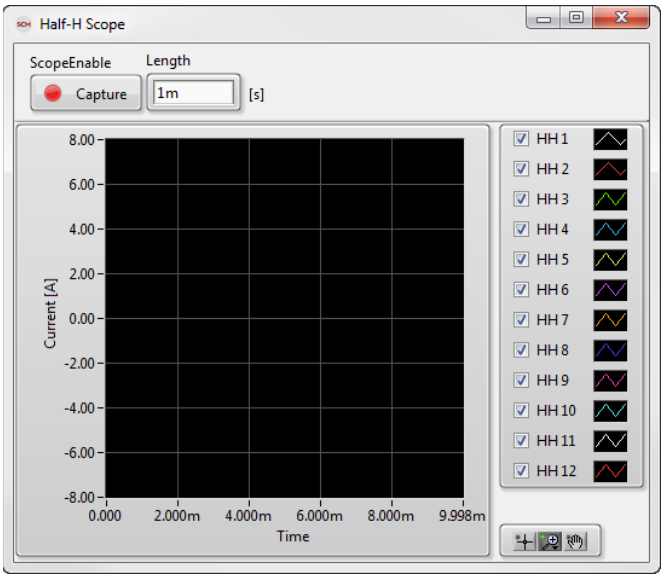
Scope



Tip Strip: Launch Half-H Scope.

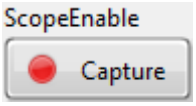
Click to launch Half-H Scope.

Half-H Scope



The Half-H Scope plots instantaneous current flow through all Half-H channels. Check plot visibility option to show/hide any plots.

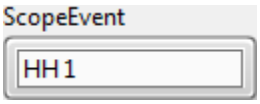
ScopeEnable



Tip Strip: Command to capture selected event

This button enables data capture and buffering of Half-H Scope.

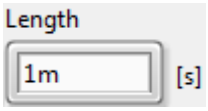
ScopeEvent



Tip Strip: Selects event to use as a trigger.

This parameter selects which channel will trigger Half-H Scope captures. The scope will plot the current levels in any selected channels for the specified length.

Length



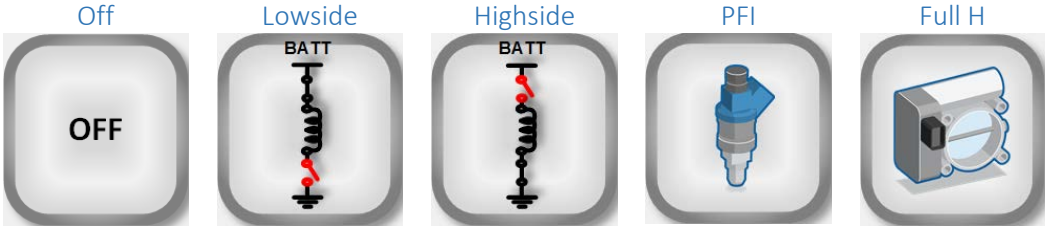
Tip Strip: Sets the scope capture duration. If set above 8.5 ms (or 5kS @ 1.7us/S), the HH Scope will downsample to maintain RT performance.

This parameter specifies the Half-H Scope data buffer length in seconds.

Plot Controls

Use the plot controls palette to zoom and pan the graph.

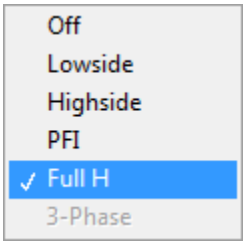
Channel Type Indicator



This indicator illustrates channel type depending on selected Channel Configuration mode.

Channel Configuration

Mode



Tip Strip: Selects Half H mode

Details:

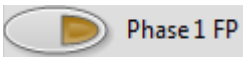
- Off: Channel is not active
- High Side: Enables high side drive
- Low Side: Enables low side drive
- PFI: The same as Low Side drive except that back emf is allowed to quickly dissipate through a Zener Diode for faster closing of solenoid. Mode is dedicated to Port Fuel Injector application.
- Full H: Enables coupling of two adjacent Half H channels to make a full H bridge circuit typically for actuating motors on Throttle bodies. Adjacent channels have to be consecutive i.e. coupling of channel 1 and 12, for example, is not allowed.

IO Lock State

Tip Strip: When enabled, IO lock status will be ignored

When set to FALSE, Half-H driver circuitry will be disabled if IO Lock is active (ON). When set to True, Half H channels will operate regardless IO Lock status as if IO Lock is disabled. This way, Half H channels which are connected to relays can continue to drive those relays while other IO, such as DI injectors, are disabled.

Phase 1 FP



Tip Strip: Causes the next phase to begin after current reaches first peak. Note: Duration has to be long enough for current to reach first peak or it will be shortened.

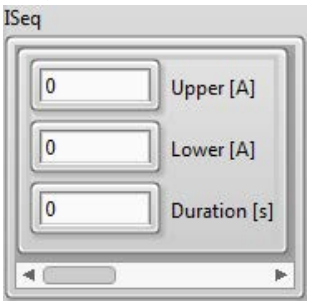
Causes the next phase to begin after current reaches first peak. Note: Duration has to be long enough for current to reach first peak or it will be shortened.

Fault Clear

Tip Strip: Clears Half H fault

Clears Half H fault

Iseq



The Iseq is a two-element cluster array consisting of the upper current dithering threshold, the lower current dithering threshold, and the duration of each current phase. The setpoints are used for current control in a Half-H channel.

Upper

Tip Strip: Specifies maximum current dithering limit [A].

Once current reaches this threshold or exceeds it, The FET in the associated Half-H circuit will turn OFF.

Lower

Tip Strip: Specifies minimum current dithering limit [A].

Once current reaches this threshold or dips below, The FET in the associated Half-H circuit will turn ON.

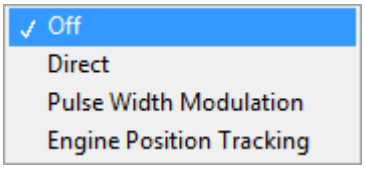
Duration

Tip Strip: Sets current phase duration

This parameter defines a duration, in seconds, to execute a current phase.

Command Setup

Mode



Tip Strip: Selects the Half-H command mode for the selected channel. (Off, Direct, PWM, or EPT)

Details:

- Off: Channel disabled
- Direct: Uses the selected Digital Input to command the timing of the Half-H (HH) channel.

- Pulse Width Modulation (PWM): Uses Frequency, Duty Cycle, and Polarity controls to create a periodic digital output signal in the time domain.
- Engine Position Tracking (EPT): Uses TDC Offset, Window Start, Window End, Angle Commands (up to 4), and Skip Fire commands to create complex engine-synchronous pulse sequences in the crank-angle domain.

Digital Input

Tip Strip: Digital channels available to drive the selected channel in Direct mode.

Digital channels available to drive the selected channel in Direct mode.

Polarity

Tip Strip: FALSE = Active High; TRUE = Active low

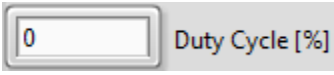
This button inverts the polarity of the PWM output signal as specified according to Frequency and Duty Cycle setpoints. This button is applicable to PWM Mode only.

Frequency

Tip Strip: Controls the frequency in Hz of the PWM output signal

Controls the frequency in Hz of the PWM output signal. Applicable to PWM Mode only

Duty Cycle



Tip Strip: Controls the duty cycle in % of the PWM output signal

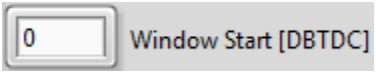
Controls the duty cycle in % of the PWM output signal. Applicable to PWM Mode only

TDC Offset

Tip Strip: The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel.

This parameter specifies the desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This offset is referenced to the absolute '0 CAD' engine position of EPTx. Applicable to EPT mode only.

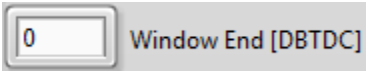
Window Start



Tip Strip: The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

This parameter specifies the desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel. Applicable to EPT mode only.

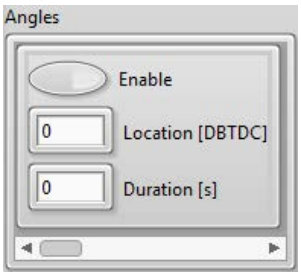
Window End



Tip Strip: The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

This parameter specifies the desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel. Applicable to EPT mode only.

Angles



Tip Strip: Up to 4 engine-synchronous pulses may be specified for each HH channel. Pulse Enable, Location, and Duration must be specified for each pulse.

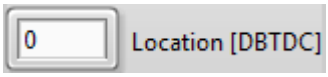
Up to 4 engine-synchronous pulses may be specified for each Half-H channel. Pulse Enable, Location, and Duration must be specified for each pulse. Applicable to EPT mode only.

Enable

Tip Strip: For the output pulse to be generated, Enable must be TRUE.

For the output pulse to be generated, Enable must be TRUE.

Location



Tip Strip: The desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse.

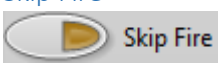
The desired position, in Degrees Before Top Dead Center (DBTDC), of the start of the engine-synchronous pulse.

Duration

Tip Strip: The desired duration, in seconds, of the engine-synchronous pulse.

The desired duration, in seconds, of the engine-synchronous pulse.

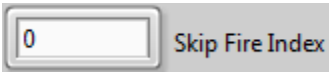
Skip Fire



Tip Strip: Enables skip-fire operation for the selected channel.

Enables skip-fire operation for the selected channel. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

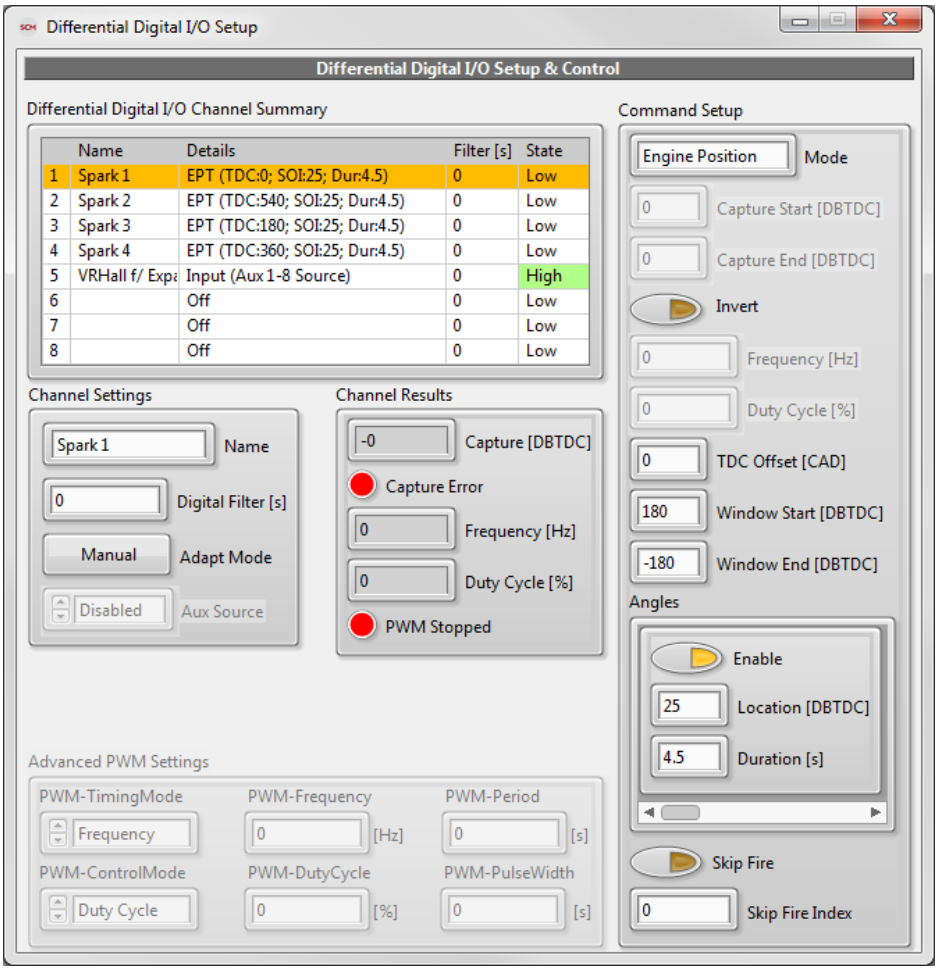
Skip Fire Index



Tip Strip: During skip-fire operation, Total Cycles is used to determine the number of engine cycles which comprise one skip-fire period.

During skip-fire operation, Skip Index selects a particular Skip Fire Pattern configured in the Skip Fire Setup subhost. The total number of cycles and the number of on cycles are configured in the Skip Fire subhost. This parameter is only applicable to EPT Command Mode and will be disabled in other modes.

Differential Digital I/O Setup



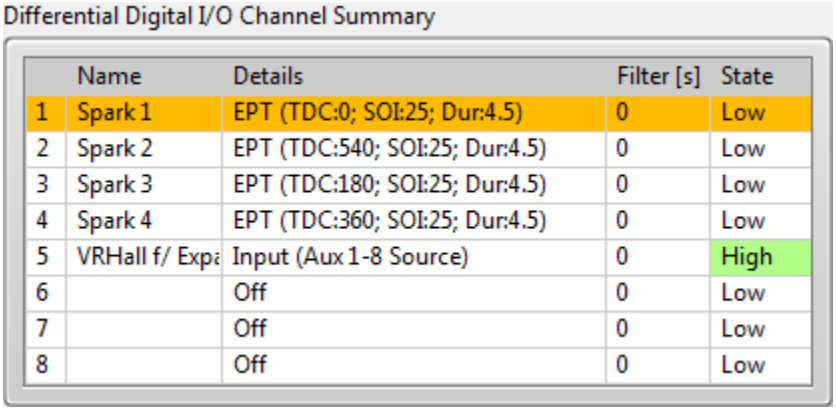
The Differential Digital I/O Setup & Control window enables users to configure each of the differential digital input/output channels. Each channel can be individually configured as either an input or an output. Input channels can be configured as digital inputs or as serial inputs. Output channels can either be triggered by the engine position tracking core, by an internal pulse width modulation (PWM) counter, can be configured as serial outputs, or can be configured to output the status of EPTx Sync.

Each channel is configured by first highlighting the desired channel in the Differential Digtial I/O Channel Summary table. Then, users enter in whatever information they need in the controls to set each channel

up according to their needs. Controls are disabled and grayed out depending on the assigned mode for the channel. Only the items that are relevant for the selected mode are active.

The serial input and output features are intended to be used with an expansion RIO chassis and an assortment of other NI modules. The serial input mode is intended to be used as a way to interface signals from the expansion RIO chassis to EPTx to achieve engine sync. Meanwhile, the serial output features are intended to be used with the ESTTL Setup functions to expand the digital output channel count of the DCM.

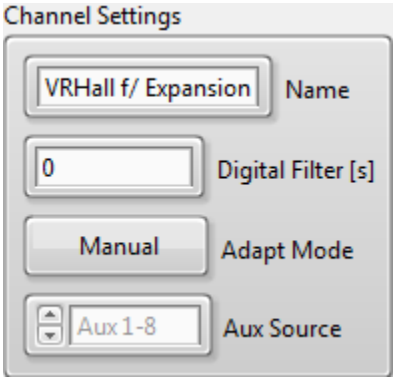
Differential Digital I/O Channel Summary



Tip Strip: Summary of settings for Differential Digital I/O channels

The Differential Digital I/O Channel Summary table displays top level information about each of the eight differential digital I/O channels. It shows the user-assigned channel name, the mode of operation, relevant information based upon the selected mode, and channel's current state (high or low).

Channel Settings



The Channel Settings cluster allows users to assign a name, apply a digital filter, and enable the adapt mode for the highlighted channel in the Differential Digital I/O Channel Summary table.

When the channel mode, located in the Command Setup cluster, is set to Input, then the Aux Source control can be set to one of three states: Disabled, Aux 1-8, or Aux 9-16. When set to Disabled, the channel is configured as a standard digital input channel. When set to Aux 1-8 or Aux 9-16, the channel is configured to act as a serial input and collect data from an expansion RIO chassis.

Name

Tip Strip: Channel name

The Name control allows users to assign a name to the highlighted channel.

Digital Filter

Tip Strip: Low pass digital filter period

The Digital Filter control allows users to configure a digital filter for each channel. The Digital Filter control accepts a period duration as an input, and the filter will remove signal content that switches states in a shorter period than the entered time.

Adapt Mode

Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

The Adapt Mode control allows users to determine the data source for the information in Command Setup cluster. When the Adapt Mode control is set to Manual (the control's state is FALSE), then the user-configured values in the Command Setup cluster are used to configure the channels. When the control is set to Adapt (the control's state is TRUE), the values in that cluster are determined programmatically by the DSI real-time software.

Allowing the DSI real-time software to manipulate the Command Setup cluster enables some important benefits. For example, the RT software can change the Skip Fire pattern on its own or modify the angles at which digital outputs are triggered, which could be helpful for automatically adjusting spark timing two examples.

Aux Source

Tip Strip: Selects Aux Source to assign to incoming serial signal

The Aux Source control is used to configure an input signal as a serial signal. It is a selectable setting, and can take one of three values:

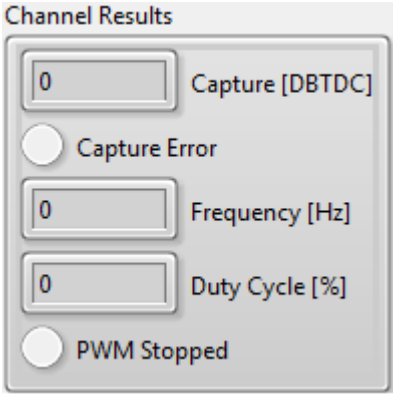
Disabled: The signals being received by the selected digital input channel is not routed to the auxiliary digital signals in the DCM DSI software. The selected channel operates as a standard digital input channel.

Aux 1-8: The signals being received by the selected digital input channel are serial signals are routed to the auxiliary digital signals 1-8 in the DSI software. The information in Aux 1-8 can be used in other

places in the DCM DSI software, specifically in the EPTx Setup window, where it can be used to get the DCM DSI in sync with an engine.

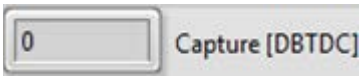
Aux 9-16: The signals being received by the selected digital input channel are serial signals are routed to the auxiliary digital signals 1-8 in the DSI software. The information in Aux 9-16 can be used in other places in the DCM DSI software, specifically in the EPTx Setup window, where it can be used to get the DCM DSI in sync with an engine.

Channel Results



The Channel Results cluster shows users the activity occurring on the highlighted channel.

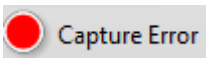
Capture DBTDC



Tip Strip: Reports the EPTx current position in CAD of the most recent rising edge observed during the Capture window.

Reports the EPTx current position in CAD of the most recent rising edge observed during the Capture window. The Capture result holds its value after the operating window, between Capture Start and Capture End, returns to FALSE. The Capture result will be cleared when the EPTx is loses sync.

Capture Error



Tip Strip: Indicates that less or more than 1 rising edge event was observed within the Capture window.

The Capture Error indicator shows the presence of an error, which occurs when either zero edges or two or more edges are captured in the specified capture window as defined by Capture Start and Capture End in the Command Setup Cluster.

Frequency

Tip Strip: Measured signal frequency on the selected DiffIO channel.

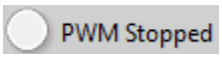
The Frequency indicator shows the frequency of both input and output signals for the highlighted channel.

Duty Cycle

Tip Strip: Measured signal duty cycle on the selected DiffIO channel.

The Duty Cycle indicator shows the Duty Cycle of both input and output signals for the highlighted channel.

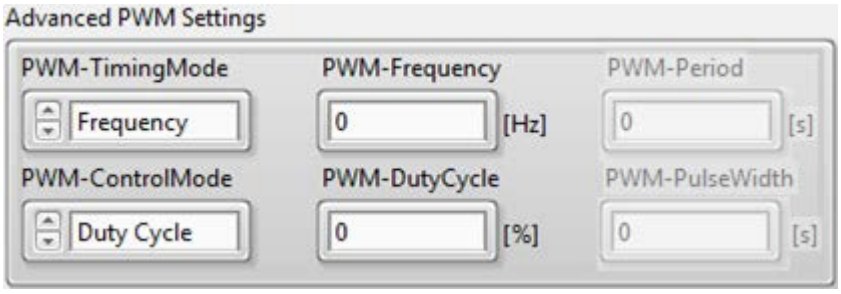
PWM Stopped



Tip Strip: Indicates a timeout of 1.67 seconds where no activity is seen on the DiffIO line.

The PWM Stopped indicator shows when either the input or output signal has dropped below a certain frequency (approximately 0.6 Hz).

Advanced PWM Settings



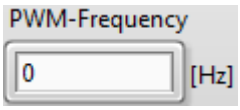
The Advanced PWM Settings cluster allows users to set the timing mode, control mode, frequency or period, and duty cycle or pulse width for the highlighted channel in the Differential Digital I/O Channel Summary table.

PWM Timing Mode

Tip Strip: PWM timing mode

The PWM Timing Mode control allows users to choose between frequency-based and period-based timing modes.

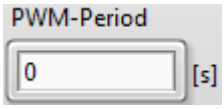
PWM Frequency



Tip Strip: PWM frequency

The PWM Frequency control sets the frequency of the PWM signal when the PWM Timing Mode is set to Frequency.

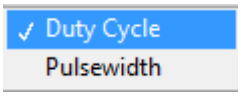
PWM Period



Tip Strip: PWM period

The PWM Period control sets the period of the PWM signal when the PWM Timing Mode is set to Period.

PWM Control Mode



Tip Strip: PWM control mode

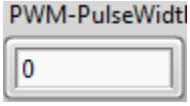
The PWM Control Mode control allows users to choose between duty-cycle-based and pulse-width-based modes for determining the active portion of the signal.

PWM Duty Cycle

Tip Strip: PWM duty cycle

The PWM Duty Cycle control sets the frequency of the PWM signal when the PWM Control Mode is set to Duty Cycle.

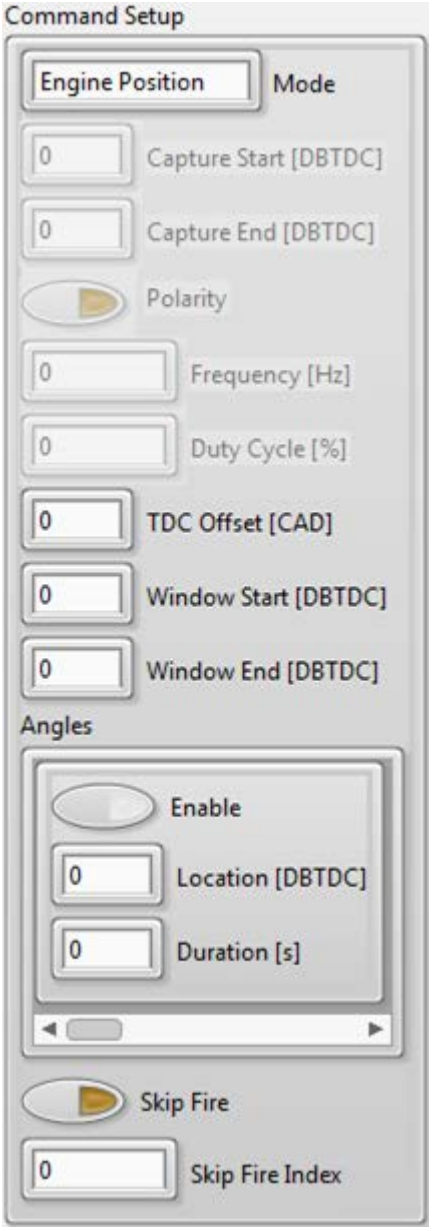
PWM Pulse Width



Tip Strip: PWM pulse width

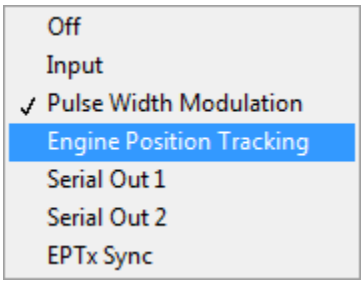
The PWM Pulse Width control sets the pulse width of the PWM signal when the PWM Timing Mode is set to Pulse Width.

Command Setup



The Command Setup cluster input allows users to configure the highlighted channel for use as a digital input or output. Additionally, the cluster contains the controls for setting up various attributes of the signal depending upon the selected mode.

Mode



Tip Strip: Selects the DiffIO mode for the selected channel. (Off, Input, PWM, EPT, Serial, or EPT Sync)

The Mode control selects the mode of operation for the highlighted channel. The options are:

Off: This mode disables the channel. The channel's hardware is set to input mode, but the acquired data is not accessible.

Input: This mode is used for capturing digital input signals.

Pulse Width Modulation: This mode configures the channel for outputting a signal from an internally generated PWM source. The controls in the Advanced PWM Settings cluster characteristics of the PWM signal.

Engine Position Tracking: This mode configures the channel for outputting signals generated by the internal Engine Position Tracking core.

Serial Out 1: Outputs the signals from ESTTL Channels 1-8 to an expansion RIO, where those signals are be converted to standard digital output signals on NI 9753 Differential Digital Input/Output modules.

Serial Out 2: Outputs the signals from ESTTL Channels 9-16 to an expansion RIO, where those signals are be converted to standard digital output signals on NI 9753 Differential Digital Input/Output modules.

EPTx Sync: Outputs the state of EPTx Sync. Useful when debugging a loss-of-sync issue with engine position sensors.

Capture Start DBTDC

Tip Strip: The desired Capture Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The Capture Start control allows users to set the beginning of the input angle capture window when the highlighted channel is in **Input** mode. Along with the Capture End control, users set up a window in which they expect to see exactly one engine synchronous rising edge. The angle of the captured edge is reported by the Capture indicator in the Channel Results cluster. If either no rising edge is found or two or more edges are found, then an error will result.

Capture End DBTDC

Tip Strip: The desired capture window end, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The Capture End control allows users to set the end of the input angle capture window when the highlighted channel is in **Input** mode. Along with the Capture Start control, users set up a window in which they expect to see exactly one engine synchronous rising edge. The angle of the captured edge is reported by the Capture indicator in the Channel Results cluster. If either no rising edge is found or two or more edges are found, then an error will result.

Invert

Tip Strip: FALSE = Active High; TRUE = Active low

Inverts the polarity of the PWM output signal.

FALSE = Active High; TRUE = Active low.

Used in PWM Mode only.

TDC Offset CAD

Tip Strip: The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel.

The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This offset is referenced to the absolute '0 CAD' engine position of EPTx.

Used in EPT mode only.

Window Start DBTDC

Tip Strip: The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

Used in EPT Mode only.

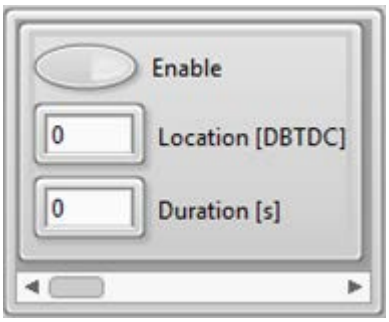
Window End DBTDC

Tip Strip: The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

Used in EPT Mode only.

Angles



Tip Strip: Up to 4 engine-synchronous pulses may be specified for each ESTTL channel.

Up to 4 engine-synchronous pulses may be specified for each ESTTL channel. Pulse Enable, Location, and Duration must be specified for each pulse.

Used in EPT Mode Only.

Enable

Tip Strip: For the output pulse to be generated, Enable must be TRUE.

For the output pulse to be generated, Enable must be TRUE.

Location DBTDC

Tip Strip: The desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse.

The desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse. The value and the entire resulting pulse width must fall within the specified firing window.

Duration

Tip Strip: The desired duration, in seconds, of the engine-synchronous pulse. Positive = end-angle; negative = start-angle.

The desired duration, in seconds, of the engine-synchronous pulse. Positive values will generate a rising edge in advance of the specified pulse location, resulting in an end-angle pulse. Negative values will generate a rising edge coinciding with the specified pulse location, resulting in a start-angle pulse.

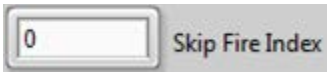
The specified duration must not cause the rising or falling edge of the pulse to be advanced or retarded from the specified position by more than MaxCAD.

Skip Fire

Tip Strip: Enables skip-fire operation for the selected channel.

Enables skip-fire operation for the selected channel. Used in EPT Mode only.

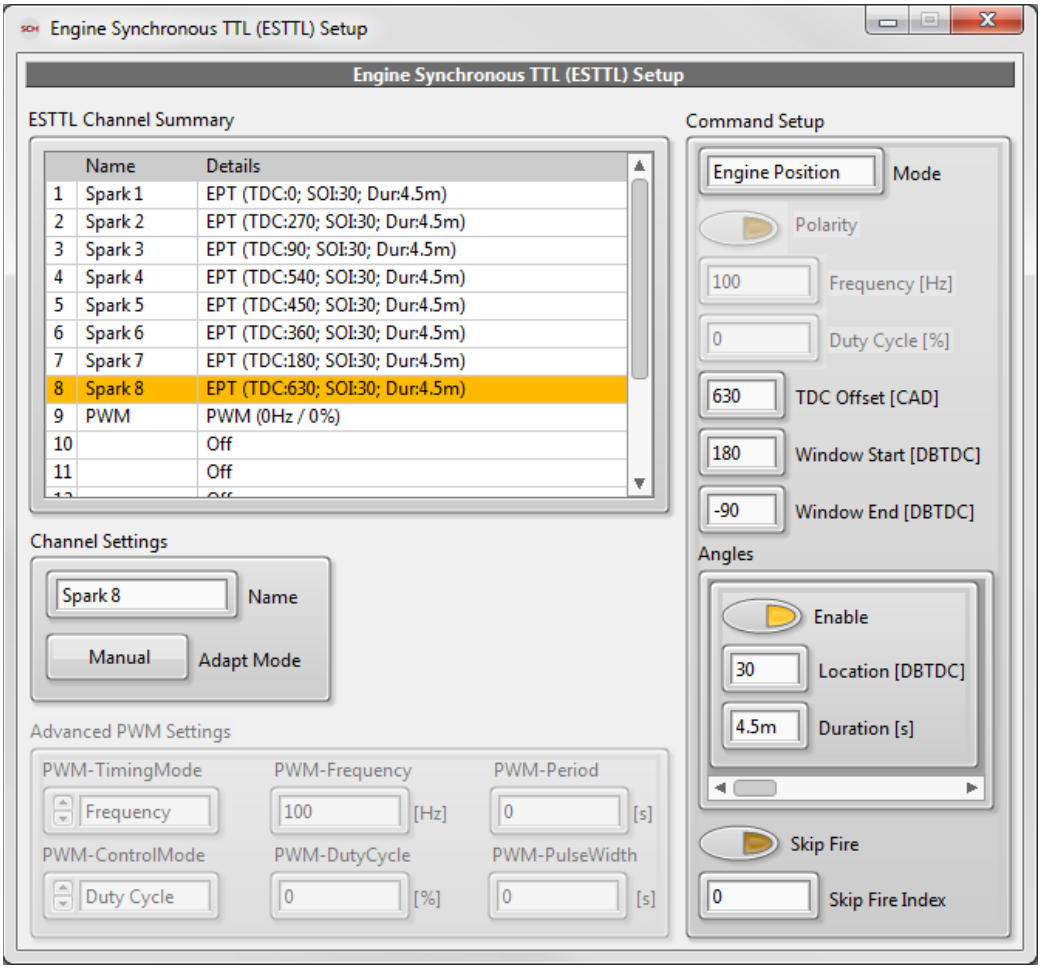
Skip Fire Index



Tip Strip: Specifies the Skip Fire Signal to use to determine which cycles to disable.

Specifies the Skip Fire Signal to use to determine which cycles to disable. Used in EPT Mode only.

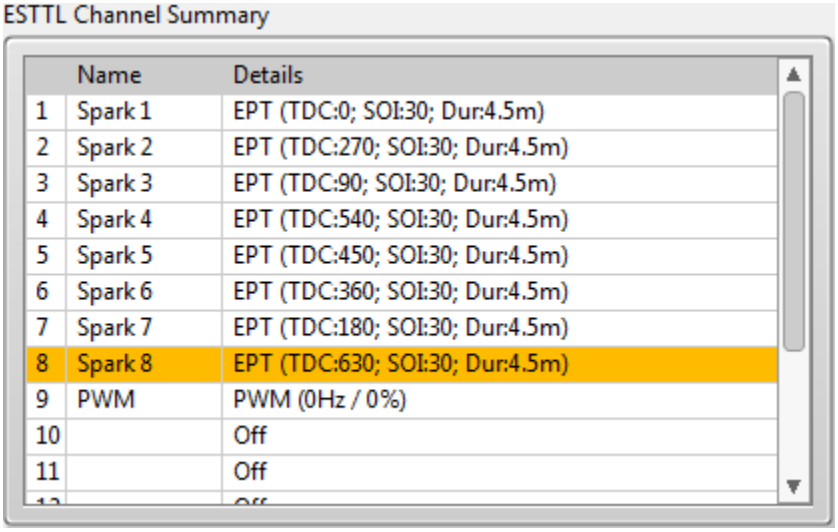
Engine Synchronous TTL (ESTTL) Setup



The Engine Synchronous TTL (ESTTL) Setup window allows users to configure up to sixteen TTL signals. Each of the channels can be configured as either an engine synchronous output signal or as a pulse width modulation (PWM) signal.

The signals are output using the Differential Digital I/O pins when those pins are set in Serial Out mode. ESTTL Channels 1-8 are transmitted through a Differential Digital I/O channel whose mode is set as **Serial Out 1,** while ESTTL Channels 9-16 are transmitted through a Differential Digital I/O channel whose mode is set as **Serial Out 2.** Additional NI hardware beyond the NI DCM is required to use the ESTTL output feature.

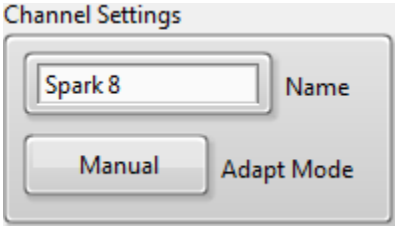
ESTTL I/O Channel Summary



Tip Strip: Summary of settings for ESTTL output channels

The ESTTL Channel Summary table displays top level information about each of the sixteen ESTTL channels. It shows the user-assigned channel name, the mode of operation, and relevant information based upon the selected mode.

Channel Settings



The Channel Settings cluster allows users to assign a name and enable the adapt mode for the highlighted channel in the ESTTL Channel Summary table.

Name

Tip Strip: Channel name

The Name control allows users to assign a name to the highlighted channel.

Adapt Mode

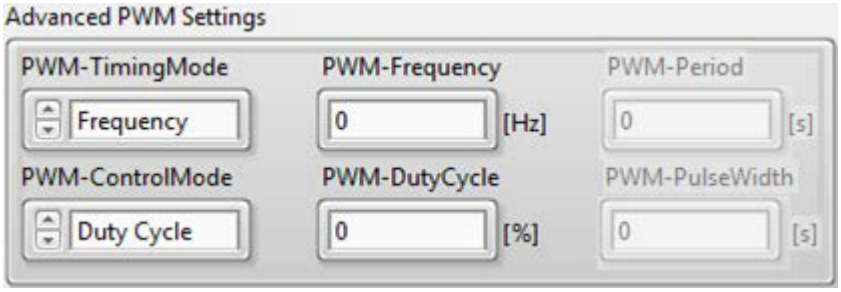
Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

The Adapt Mode control allows users to determine the data source for the information in Command Setup cluster. When the Adapt Mode control is set to Manual (the control's state is FALSE), then the

user-configured values in the Command Setup cluster are used to configure the channels. When the control is set to Adapt (the control's state is TRUE), the values in that cluster are determined programmatically by the DSI real-time software.

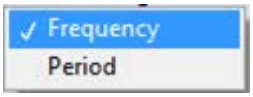
Allowing the DSI real-time software to manipulate the Command Setup cluster enables some important benefits. For example, the RT software can change the Skip Fire pattern on its own or modify the angles at which digital outputs are triggered, which could be helpful for automatically adjusting spark timing two examples.

Advanced PWM Settings



The Advanced PWM Settings cluster allows users to set the timing mode, control mode, frequency or period, and duty cycle or pulse width for the highlighted channel in the Differential Digital I/O Channel Summary table.

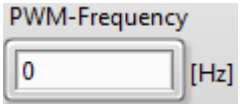
PWM Timing Mode



Tip Strip: PWM timing mode

The PWM Timing Mode control allows users to choose between frequency-based and period-based timing modes.

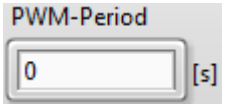
PWM Frequency



Tip Strip: PWM frequency

The PWM Frequency control sets the frequency of the PWM signal when the PWM Timing Mode is set to Frequency.

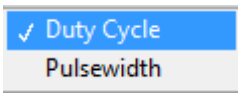
PWM Period



Tip Strip: PWM period

The PWM Period control sets the period of the PWM signal when the PWM Timing Mode is set to Period.

PWM Control Mode



Tip Strip: PWM control mode

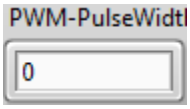
The PWM Control Mode control allows users to choose between duty-cycle-based and pulse-width-based modes for determining the active portion of the signal.

PWM Duty Cycle

Tip Strip: PWM duty cycle

The PWM Duty Cycle control sets the frequency of the PWM signal when the PWM Control Mode is set to Duty Cycle.

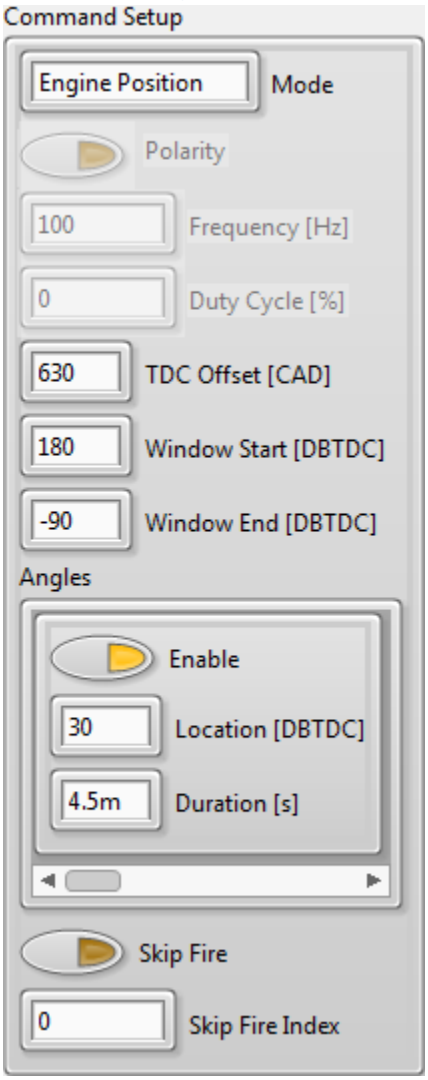
PWM Pulse Width



Tip Strip: PWM pulse width

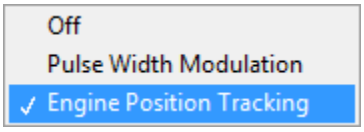
The PWM Pulse Width control sets the pulse width of the PWM signal when the PWM Timing Mode is set to Pulse Width.

Command Setup



The Command Setup cluster input allows users to configure the highlighted channel for use as a digital input or output. Additionally, the cluster contains the controls for setting up various attributes of the signal depending upon the selected mode.

Mode



Tip Strip: Selects the ESTTL mode for the selected channel. (Off, PWM, or EPT)

The Mode control selects the mode of operation for the highlighted channel. The options are:

Off: This mode disables the channel. The channel's hardware is set to input mode, but the acquired data is not accessible.

Pulse Width Modulation: This mode configures the channel for outputting a signal from an internally generated PWM source. The controls in the Advanced PWM Settings cluster characteristics of the PWM signal.

Engine Position Tracking: This mode configures the channel for outputting signals generated by the internal Engine Position Tracking core.

Polarity

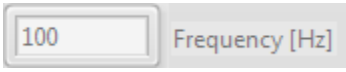
Tip Strip: FALSE = Active High; TRUE = Active low

Inverts the polarity of the PWM output signal.

FALSE = Active High; TRUE = Active low.

Used in PWM Mode only.

Frequency

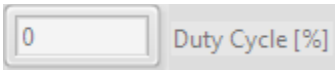


Tip Strip: Controls the frequency of a PWM signal in Hz.

Controls the frequency in Hz of the PWM output signal.

Used in PWM Mode only.

Duty Cycle



Tip Strip: Controls the duty cycle in % of the PWM output signal.

Controls the duty cycle in % of the PWM output signal.

Used in PWM Mode only.

TDC Offset CAD

Tip Strip: The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel.

The desired offset, in Crank Angle Degrees (CAD) retard, of the cylinder associated with the selected channel. This offset is referenced to the absolute '0 CAD' engine position of EPTx.

Used in EPT mode only.

Window Start DBTDC

Tip Strip: The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The desired firing Window Start, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

Used in EPT Mode only.

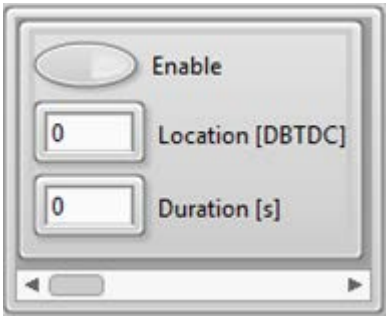
Window End DBTDC

Tip Strip: The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel.

The desired firing Window End, in Degrees Before Top Dead Center (DBTDC), relative to the cylinder associated with the selected channel. The designated firing window should encompass all engine-synchronous pulses during a given engine cycle on the selected channel.

Used in EPT Mode only.

Angles



Tip Strip: Up to 4 engine-synchronous pulses may be specified for each ESTTL channel.

Up to 4 engine-synchronous pulses may be specified for each ESTTL channel. Pulse Enable, Location, and Duration must be specified for each pulse.

Used in EPT Mode Only.

Enable

Tip Strip: For the output pulse to be generated, Enable must be TRUE.

For the output pulse to be generated, Enable must be TRUE.

Location DBTDC

Tip Strip: The desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse.

The desired position, in Degrees Before Top Dead Center (DBTDC), of the engine-synchronous pulse. The value and the entire resulting pulse width must fall within the specified firing window.

Duration

Tip Strip: The desired duration, in seconds, of the engine-synchronous pulse. Positive = end-angle; negative = start-angle.

The desired duration, in seconds, of the engine-synchronous pulse. Positive values will generate a rising edge in advance of the specified pulse location, resulting in an end-angle pulse. Negative values will generate a rising edge coinciding with the specified pulse location, resulting in a start-angle pulse.

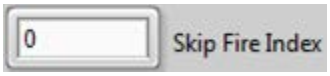
The specified duration must not cause the rising or falling edge of the pulse to be advanced or retarded from the specified position by more than MaxCAD.

Skip Fire

Tip Strip: Enables skip-fire operation for the selected channel.

Enables skip-fire operation for the selected channel. Used in EPT Mode only.

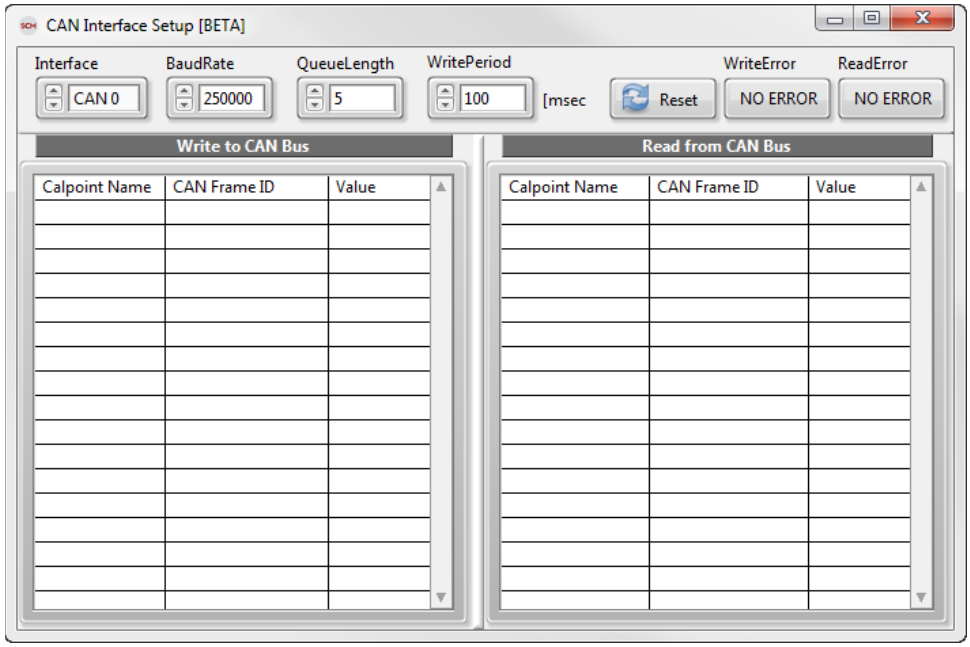
Skip Fire Index



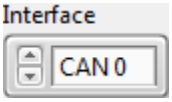
Tip Strip: Specifies the Skip Fire Signal to use to determine which cycles to disable.

Specifies the Skip Fire Signal to use to determine which cycles to disable. Used in EPT Mode only.

CAN Interface



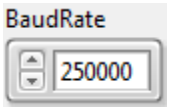
Interface Selector



Tip Strip: Physical CAN Interface to use for communication with other device(s)

Physical CAN Interface to use upon application start or upon use of the Reset button.

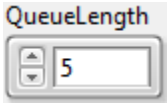
Baud Rate Selector



Tip Strip: Baud rate of the CAN interface.

Baud rate of the CAN interface, both read and write. Changes to this parameter only take effect upon use of the Reset button.

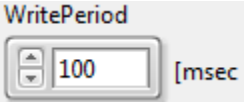
Queue Length Setting



Tip Strip: Specifies the number of frames to store in the receive queue.

Specifies the number of frames to store in the receive queue. If the receive queue is greater than 5, the receive interrupt is enabled and the receive queue is allocated in RAM. When a frame is received, it is pushed into the receive queue. The timestamp when it was moved also is stored and is returned upon a CAN read. If receive queue size is 5, the receive interrupt is disabled, and a hardware receive queue is used. A frame is retrieved from the hardware receive queue each time there is a CAN read.

Write Period



Tip Strip: Time period between frame writes.

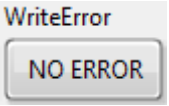
This is the time between frame writes. If a frame is missed, it will be written on the next multiple of the write period.

Reset

Tip Strip: Initializes a CAN session.

Initializes a CAN session. If any changes to the interface selector, baud rate, or queue length have been made, the new values will take effect.

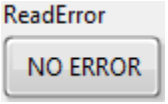
Write Error Status



Tip Strip: Indicates an error occurred during a write attempt.

Indicates an error occurred during a write attempt.

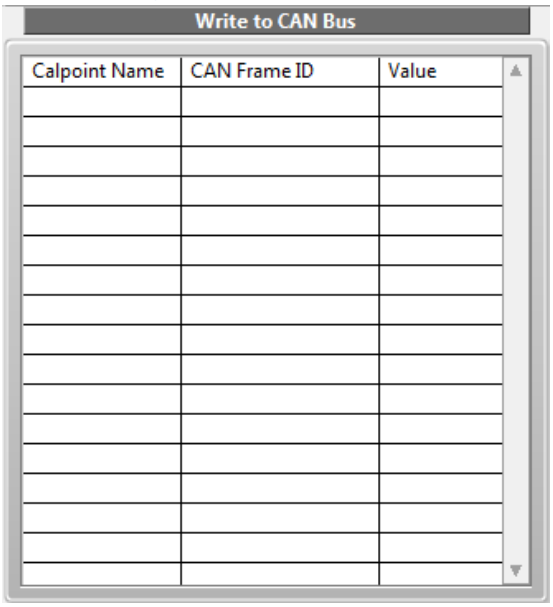
Read Error Status



Tip Strip: Indicates an error occurred during a read attempt.

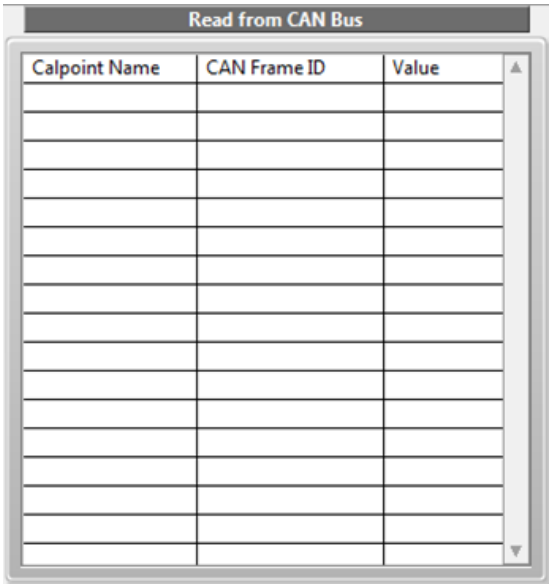
Indicates an error occurred during a read attempt.

Write Messages



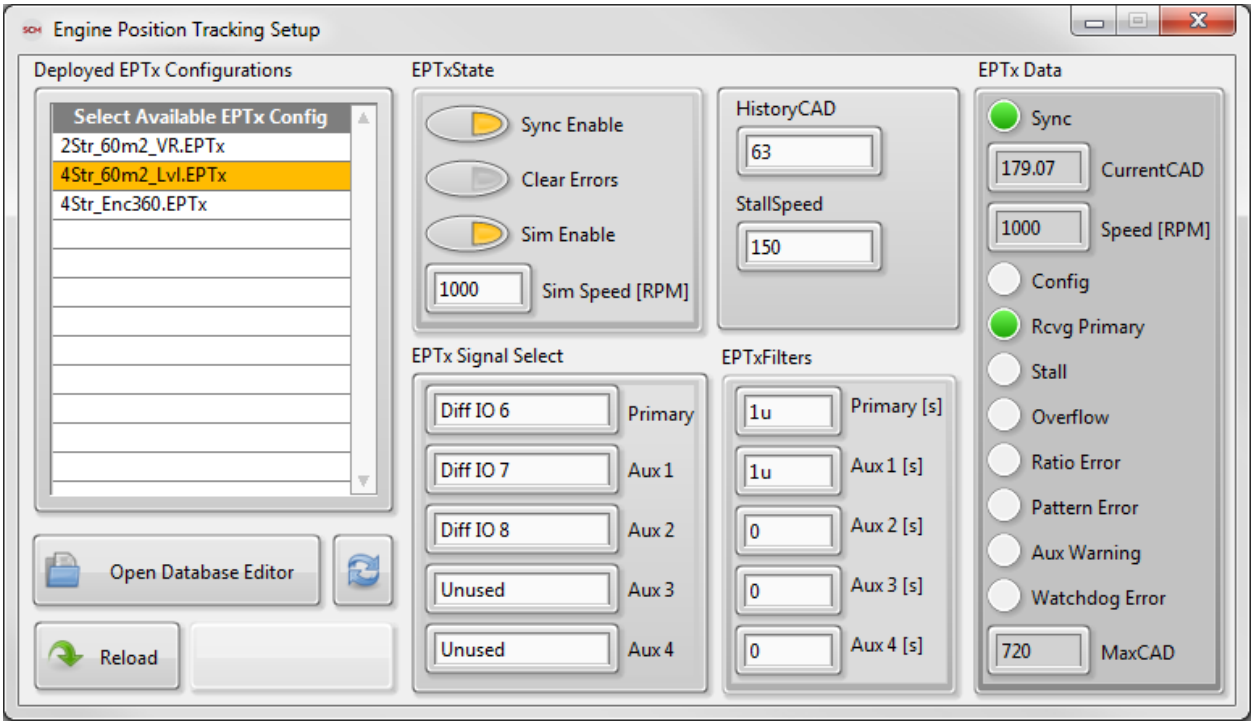
Tip Strip: List of Calpoints, CAN Frame IDs, and Values being written to the CAN Bus.

Read Messages



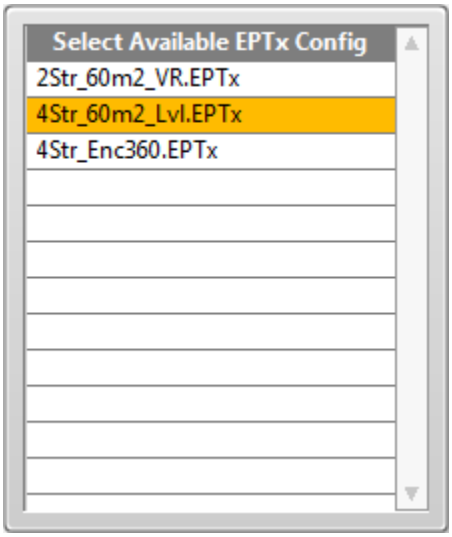
Tip Strip: List of Calpoints, CAN Frame IDs, and Values being read from the CAN Bus.

Engine Position Tracking Setup



The Engine Position Tracking Setup window allows users to configure the NI DCM DSI to track the position of an engine using NI's EPTx Engine Position Tracking software. With EPTx, users can create engine trigger wheel patterns that match nearly any engine trigger wheels and use the patterns to synchronize the NI DCM DSI to the engine's cam and crank positions.

Available EPTx Configurations List

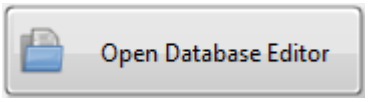


Tip Strip: Shows available EPTx Configurations in loaded EPTx database file.

Allows users to select available EPTx configurations available on the DCM. Each EPTx Configuration contains the necessary camshaft and crankshaft signal patterns to ensure that the DSI software gets in

sync with the engine position. Configurations can be created and modified with the EPTx Database Editor, which is included the DSI software distribution.

Open Database Editor



Tip Strip: Opens the EPTx Database Editor.

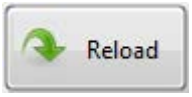
Opens the EPTx Database Editor. From the Database Editor, users can specify the particular signals their engines produce for the DSI to achieve sync with the engine hardware.

Refresh Configurations List

Tip Strip: Refreshes the Configurations List to show available configurations on the target.

Refreshes the Configurations List to show available configurations on the target. Is useful after creating new configurations in the Database Editor and then transferring those configurations to the target.

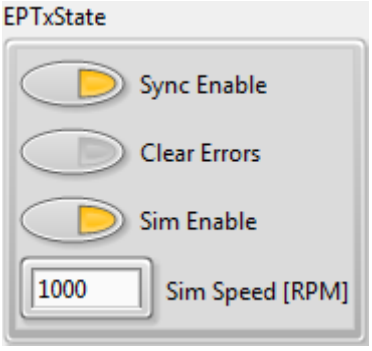
Reload Configuration



Tip Strip: When TRUE, commands the EPTx - Core Control.vi to load the EPTx configuration file to the FPGA EPTx - Core.vi.

Reloads the EPTx configuration file to the FPGA EPTx Core.

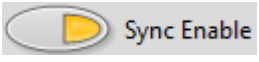
EPTx State



Tip Strip: Cluster of high level EPTx control parameters

Allows users to enable sync, clear EPTx errors, and set EPT simulation parameters.

Sync Enable



Tip Strip: Sets the state of EPTx sync.

TRUE: Enables the EPTx to achieve sync when the engine is spinning.

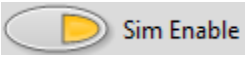
FALSE: Prevents the EPTx from achieving sync when the engine is spinning, and sets the EPTxSupervisor to default values.

Clear Errors

Tip Strip: Clears EPTx errors.

Clears all errors indicated within the EPTxSupervisor. It is not recommended to leave this control set to TRUE, otherwise errors will not be identified. This control should be used manually, or with limited programmatic use.

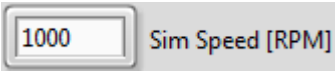
Sim Enable



Tip Strip Enables EPTx speed simulation.

When Sim Enable is TRUE, the external position signals are ignored and the EPTxSupervisor position is simulated according to the specified Sim Speed (RPM).

Sim Speed



Tip Strip: Sets the EPTx simulation speed in RPM.

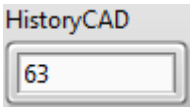
When Sim Enable is TRUE, the external position signals are ignored and the EPTxSupervisor position is simulated according to the specified Sim Speed (RPM).

EPTx Signal Select (Primary, Aux1, Aux2, Aux3, Aux4)

Tip Strip: Selects the input channel carrying the desired EPTx signal.

List of channels available for each EPTx signal. The available choices are the Differential Digital I/O channels, the Aux channels, and the User OS channel. The signals (Primary, Aux 1, etc.) for which users select available channels should match the patterns in the EPTx Configuration.

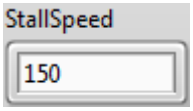
History CAD



Tip Strip: Specifies a span of Crank Angle Degrees (CAD) in the recent past, with respect to CurrentCAD. When an angle-one-shot function event is scheduled for the future and then changed to the recent past, a late one-shot event will be triggered if the newly scheduled event (in the past) is within HistoryCAD range of CurrentPosition.

Specifies a span of Crank Angle Degrees (CAD) in the recent past, with respect to CurrentCAD. When an angle-one-shot function event is scheduled for the future and then changed to the recent past, a late one-shot event will be triggered if the newly scheduled event (in the past) is within HistoryCAD range of CurrentPosition.

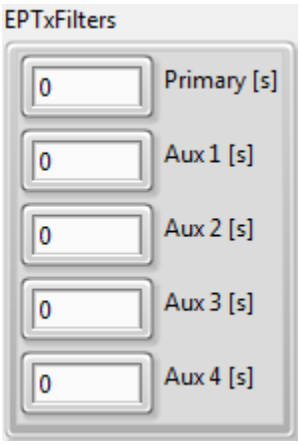
Stall Speed



Tip Strip: Sets the EPTx stall speed in RPM. The stall speed is the minimum crankshaft speed required to enable synchronous I/O.

Sets the EPTx stall speed in RPM. The stall speed is the minimum crankshaft speed required to enable synchronous I/O.

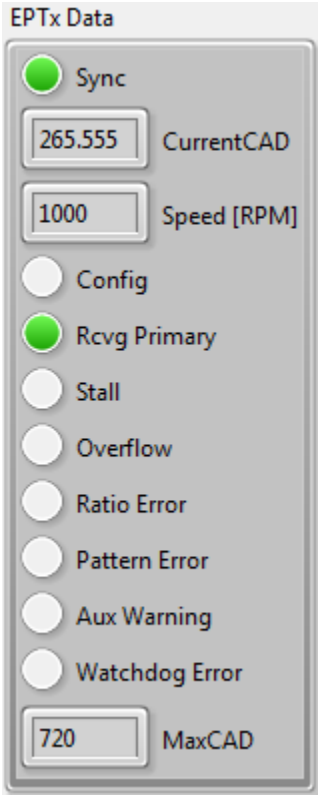
EPTx Filters (Primary, Aux1, Aux2, Aux3, Aux4)



Tip Strip: Low pass digital filter period

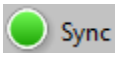
Specifies the glitch filter time, in seconds, for the associated signal. As the signal changes state, the filter algorithm will reject any positive or negative glitches less than the filter time. It is recommended to use a non-zero value for this parameter, on the order of 1 to 5 microseconds. Larger values may be used. However, if values exceeding 20 microseconds are required to achieve reliable pattern signals, then there may be a problem related to external wiring paths or grounding. Each filter corresponds to the EPTx Signal of the same name.

EPTx Data



Cluster of parameters which indicate the status of sync, position, speed and errors.

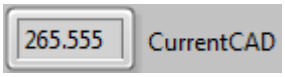
Sync



Tip Strip: Indicates the state of EPTx sync.

Indicates the state of EPTx sync.

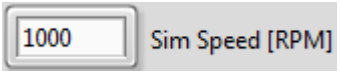
Current CAD



Tip Strip: Indicates the current position tracked by the EPTx in Crank Angle Degrees (CAD).

Indicates the current position tracked by the EPTx in Crank Angle Degrees (CAD).

Speed



Tip Strip: Indicates the most recent calculated rotational rate of the crankshaft in RPM.

Indicates the most recent calculated rotational rate of the crankshaft in RPM.

Config

Tip Strip: Indicates that the EPTx has been configured by the RT level device driver.

Indicates that the EPTx has been configured by the RT level device driver.

Receiving Primary

Tip Strip: Indicates that the primary signal is changing states, which indicates that the crankshaft is spinning.

Indicates that the primary signal is changing states, which indicates that the crankshaft is spinning.

Stall

Tip Strip: Indicates that the engine speed is less than the Stall Speed specified to the EPTx - Core Control.vi at the RT level.

Indicates that the engine speed is less than the Stall Speed specified to the EPTx - Core Control.vi at the RT level, which is specified by the StallSpeed control.

Overflow

Tip Strip: Indicates that the EPTx has encountered a fixed-point math result overflow. This condition causes a loss of sync.

Indicates that the EPTx has encountered a fixed-point math result overflow. This condition causes a loss of sync.

Ratio Error

Tip Strip: Indicates that the actual signal event ratio does not match the expected nominal signal event ratio. This error causes a loss of sync.

Indicates that the actual signal event ratio cannot be matched to any possible nominal signal event ratios within the primary signal pattern. This error causes a loss of sync.

Pattern Error

Tip Strip: Indicates that the actual signal event ratio cannot be matched to any possible nominal signal event ratios within the primary signal pattern. This error causes a loss of sync.

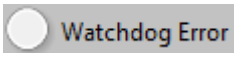
Indicates that the actual signal event ratio cannot be matched to any possible nominal signal event ratios within the primary signal pattern. This error causes a loss of sync.

Aux Warning

Tip Strip: Indicates that the EPTx received an auxiliary signal rising edge, falling edge or level at an unexpected location.

Indicates that the EPTx received an auxiliary signal rising edge, falling edge or level at an unexpected location.

Watchdog Error



Tip Strip: Indicates that the EPTx watchdog has not been reset by the EPTx - Core Control.vi at the RT level within 100 milliseconds.

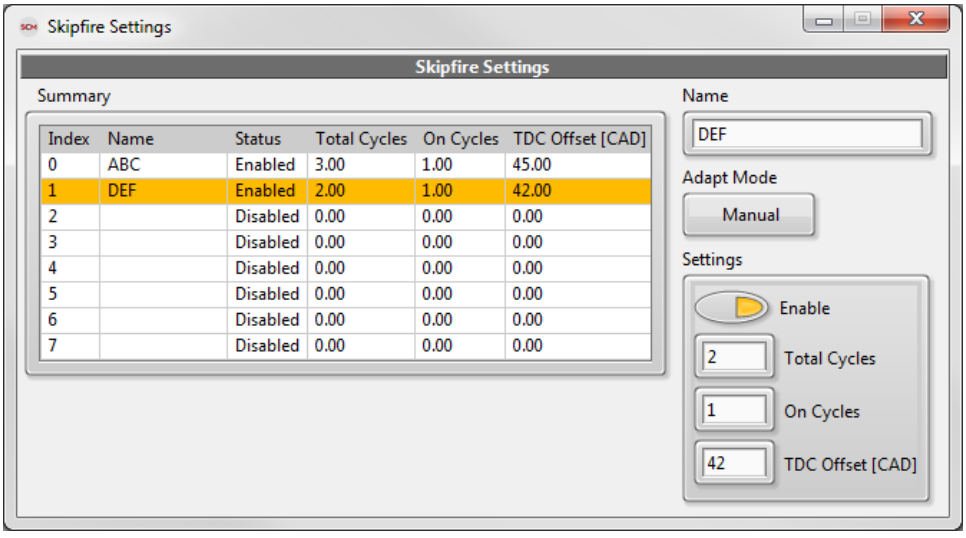
Indicates that the EPTx watchdog has not been reset by the EPTx - Core Control.vi at the RT level within 100 milliseconds.

Maximum CAD

Tip Strip: Indicates the maximum Crank Angle Degrees (CAD) for the complete engine cycle as specified by the EPTx configuration file.

Indicates the maximum Crank Angle Degrees (CAD) for the complete engine cycle as specified by the EPTx configuration file.

Skip Fire Setup



The Skip Fire Settings window allows users to configure up to eight different skip fire patterns for all engine synchronous output signals. Each of the patterns can be configured to have a specified duration and number of on cycles. The patterns can then be accessed from the DI Driver Setup, Half-H Driver

Setup, Differential Digital I/O Setup, and ESTTL Setup windows and assigned to those channels when operating in EPT mode. One skip fire pattern can be assigned to multiple output channels.

Channel Summary

Channel Summary

Index	Name	Status	Total Cycles	On Cycles	TDC Offset [CAD]
0	ABC	Enabled	3.00	1.00	45.00
1	DEF	Enabled	2.00	1.00	42.00
2		Disabled	0.00	0.00	0.00
3		Disabled	0.00	0.00	0.00
4		Disabled	0.00	0.00	0.00
5		Disabled	0.00	0.00	0.00
6		Disabled	0.00	0.00	0.00
7		Disabled	0.00	0.00	0.00

Tip Strip: Summary of settings for Skip Fire patterns

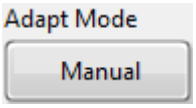
The channel summary table shows the status for each of the eight skip fire channels or patterns available on the DSI. It lists the name, status, total number of cycles, number of on cycles, and the TDC offset. Additionally, the channel highlighted in the table is the channel currently being edited in the other fields in the window.

Name

Tip Strip: Skip fire pattern name

The name control allows users to enter a name for the skip fire pattern. Naming the pattern may be useful to keep track of the channels to which the pattern is assigned (e.g. DiffIO 0 or DI-A1).

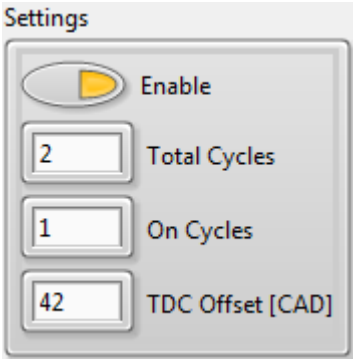
Adapt Mode



Tip Strip: Determines which set of commands to use. Manual Cmd uses user configured commands from this window; Adapt Cmd uses commands from RT algorithms.

The Adapt Mode control allows users to determine the data source for the information in the skip fire pattern. When the Adapt Mode control is set to Manual (the control's state is FALSE), then the user-configured values in the skip fire pattern are used to configure the channels. When the control is set to Adapt (the control's state is TRUE), the values in that pattern are determined programmatically by the DSI real-time software.

Settings



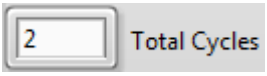
The Settings cluster allows user to configure skip fire pattern for each channel.

Enable

Tip Strip: Enables Skip Fire pattern

This button enables a skip fire operation in a channel.

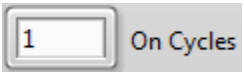
Total Cycles



Tip Strip: Specifies the total number of engine cycles in in a skip fire pattern.

The “Total Cycles” parameter specifies the number of cycles in a skip fire pattern.

On Cycles



Tip Strip: Specifies the number of On Cycles in a skip fire pattern. All On Cycles are consecutive.

The “On Cycles” parameter specifies the number of consecutive on cycles out of “Total Cycles” in a skip fire pattern. For example, entering On Cycles =1 and Total Cycles = 2 means that there will be one firing event every two cycles in a skip fire pattern.

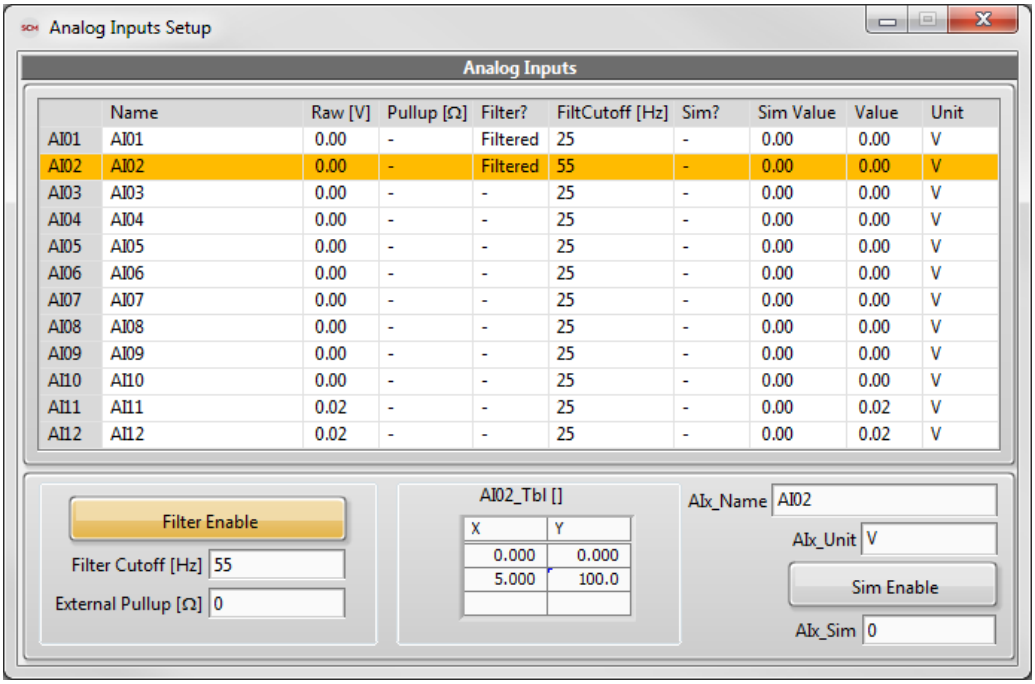
TDC Offset [CAD]

Tip Strip: Engine angle at which skip fire cycle count increments

The TDC Offset specifies a location in an engine cycle that the skip fire algorithm uses to increment a cycle in a skip fire pattern. The TDC Offset is relative to a Zero CAD reference in a primary signal pattern defined in the EPTx Database Editor and is in units of Crank Angle Degrees retard. For example, entering TDC Offset = 42 CAD, On Cycles =1 and Total Cycles = 2 would mean that every time CurrentCAD = 42

CAD, the cycle will increment by one starting from cycle = 1 to cycle = 2 (specified Total Cycles) and reset to 1.

Analog Inputs Setup



	Name	Raw [V]	Pullup [Ω]	Filter?	FiltCutoff [Hz]	Sim?	Sim Value	Value	Unit
AI01	AI01	0.00	-	Filtered	25	-	0.00	0.00	V
AI02	AI02	0.00	-	Filtered	55	-	0.00	0.00	V
AI03	AI03	0.00	-	-	25	-	0.00	0.00	V
AI04	AI04	0.00	-	-	25	-	0.00	0.00	V
AI05	AI05	0.00	-	-	25	-	0.00	0.00	V
AI06	AI06	0.00	-	-	25	-	0.00	0.00	V
AI07	AI07	0.00	-	-	25	-	0.00	0.00	V
AI08	AI08	0.00	-	-	25	-	0.00	0.00	V
AI09	AI09	0.00	-	-	25	-	0.00	0.00	V
AI10	AI10	0.00	-	-	25	-	0.00	0.00	V
AI11	AI11	0.02	-	-	25	-	0.00	0.02	V
AI12	AI12	0.02	-	-	25	-	0.00	0.02	V

The purpose of the Analog Inputs Setup window is to configure input processing of the analog signals to the twelve analog input channels. The data presented in the table is sampled by the System AI analog converter; for more information, see the document *NI-DCM 2301 and 2316 Operating Instructions and Specifications*. The table has twelve rows, and each row is associated with one channel of AI. The rows provide signal identification, monitoring, filtering, simulation capabilities, and conversion to engineering units.

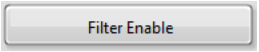
Analog Inputs Status Display

	Name	Raw [V]	Filter?	FiltCutoff [Hz]	Sim?	Sim Value	Value	Unit
AI01	AI01	0.00	Filtered	20.00	-	0.00	0.00	V
AI02	AI02	0.00	Filtered	55.00	-	0.00	0.00	V
AI03	AI03	0.00	-	0.00	-	0.00	0.02	V
AI04	AI04	0.00	-	0.00	-	0.00	0.02	V
AI05	AI05	0.00	-	0.00	-	0.00	0.00	V
AI06	AI06	4.87	-	0.00	-	0.00	97.41	V
AI07	AI07	4.89	-	0.00	-	0.00	97.80	V
AI08	AI08	0.00	-	0.00	-	0.00	0.00	V
AI09	AI09	0.00	-	0.00	-	0.00	0.00	V
AI10	AI10	0.00	-	0.00	-	0.00	0.02	V
AI11	AI11	0.02	-	0.00	-	0.00	0.49	V
AI12	AI12	0.03	-	0.00	-	0.00	0.51	V

Tip Strip: Shows names, voltages, filtering information, and output values for all analog channels

The Analog Inputs Status Display shows the summary status of all the AI channels. That includes an assigned name, the raw voltage, filtering state, filter cutoff frequency, simulation state, simulation value, final value, and units for each channel. Users click on a channel to select one to modify with the controls at the bottom of the window; the selected channel is highlighted.

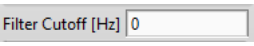
Filter Enable



Tip Strip: Enable AI filter

The Filter Enable control enables and disables the digital, second order Butterworth, low pass filter associated with the selected channel.

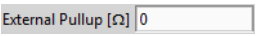
Filter Cutoff Frequency



Tip Strip: AI filter cutoff frequency

The Filter Cutoff Frequency control sets the corner frequency in Hertz (Hz) for the digital, second order Butterworth, low pass filter associated with the selected channel.

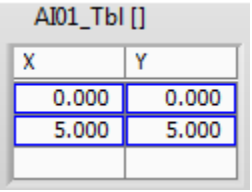
External Pullup



Tip Strip: External 5V pullup reference. (0 = disabled)

The External Pullup control allows users to enter in the value of an external pullup resistor attached between a voltage supply and the voltage input. When entering a value in this cell, the DCM DSI software converts the measured voltage automatically into a resistance value. The external pullup control is typically used with thermistor-type temperature sensors. When the value of the external pullup is set to 0, the AI input channel will read the voltage and process the data as a voltage.

Channel Table



Tip Strip: Analog input conversion lookup table

The Channel Table accomplishes two tasks. First, it allows users to enter a conversion from voltage to whatever unit they choose. Second, the table scales the input voltage according to the entered conversion so that the measurement is available to the rest of the DSI software in engineering units.

Channel Name

Tip Strip: Brief channel name (30 characters).

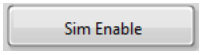
The Channel Name control assigns a name to the signal in the highlighted channel. This name is reflected in the corresponding Analog Inputs Status Display table row.

Channel Units

Tip Strip: Channel unit (15 characters).

The Channel Units control allows users to enter the engineering units associated with a particular converted analog input measurement. These units are reflected in the corresponding Analog Inputs Status Display table row.

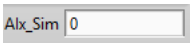
Channel Simulator Enable



Tip Strip: Enable simulated AI value

The channel simulator allows users to simulate a table output value in engineering units for a specified analog measurement. The Channel Simulator Enable control enables and disables the simulated output specified in the Channel Simulator Value control, and its state is displayed in the Analog Inputs Status Display table.

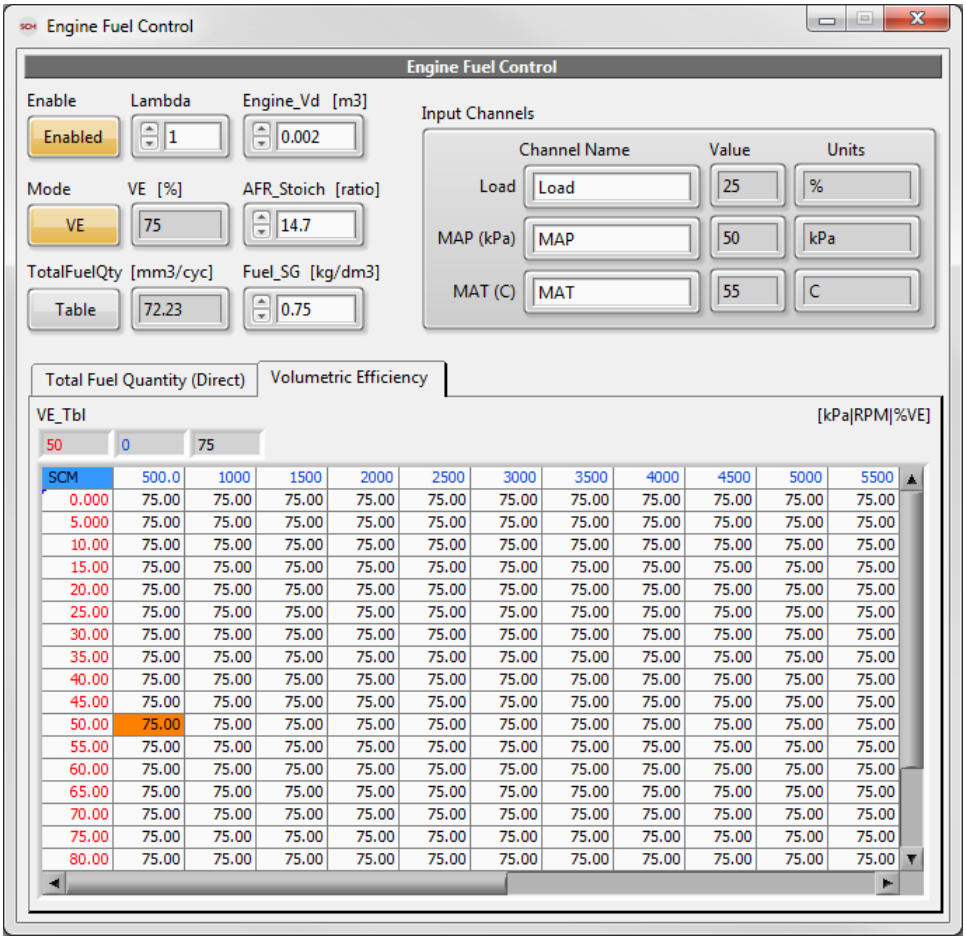
Channel Simulator Value



Tip Strip: Simulated AI value

The Channel Simulator Value control sets the value to be simulated in engineering units, and its value is displayed in the Analog Inputs Status Display table.

Engine Load and Fueling

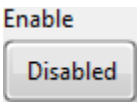


This VI is for setting up the engine fueling strategy. When enabled, users can choose between two different fueling strategies: either a direct total fuel quantity strategy or a charge-density strategy. The controls and indicators on this front panel are used to interface with one or both of these fueling strategies.

In the charge-density algorithm, the volumetric efficiency is determined from a 2D lookup table based upon engine speed and desired load. Then, the desired relative air-fuel ratio (lambda), engine displacement volume, engine speed, stoichiometric air-fuel ratio, fuel density, and air pressure and temperature are combined to give a resulting total fuel quantity for the engine.

In the direct algorithm, the total fuel quantity is determined in one of two ways. Either it is manually input, or it is determined from a 2D lookup table based upon engine speed and desired load.

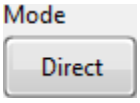
Enable



Tip strip: Enables DSI fueling control algorithms

Enables DSI fueling control algorithms. When enabled, either the direct total fuel or charge-density fueling algorithm will determine the total fuel quantity to be injected. When disabled, neither will be active.

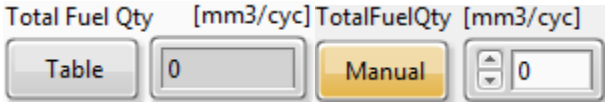
Mode



Tip Strip: Switches between fueling control modes.

This control switches between direct total fueling and charge-density modes. When **FALSE**, the button will read 'Direct' and the mode will be in direct total fueling. When **TRUE**, the button will read 'VE' and the mode will be charge-density.

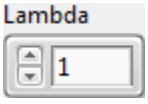
Total Fuel Qty



Tip strip: Manual input value enable

Selects whether the total fuel quantity in mm^3 per cycle is determined from the TotalFuelQty_Tbl or from a manual input. When in table mode, the indicator to the right will show the value returned from the lookup table based upon engine speed and desired load. When in manual mode, the indicator to the right will turn in to a control for inputting the total fuel quantity value.

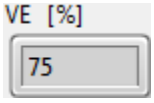
Lambda



Tip Strip: Sets the lambda feed-forward target for fuel-follows-air mode (Max=2, Min=0.5)

This control sets the lambda target for the charge-density algorithm. In both fuel control algorithm modes, the lambda value is passed to the rest of the DSI software, although in direct mode is may not accurately reflect the actual air-fuel ratio.

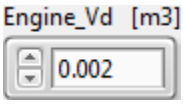
VE



Tip Strip: Table output

This indicator shows the output of the volumetric efficiency (VE) table based on the engine speed and desired load.

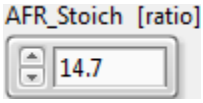
Engine_Vd



Tip Strip: Total engine displacement in meters cubed. (Max=Inf, Min=0)

This control shows the total engine displacement volume in cubic meters. It is only active in VE mode.

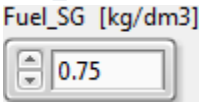
AFR_Stoich



Tip Strip: Stoichiometric air-fuel ratio

This control allows users to enter the stoichiometric air-fuel ratio for the fuel they are using in their tests. It is only active in VE mode.

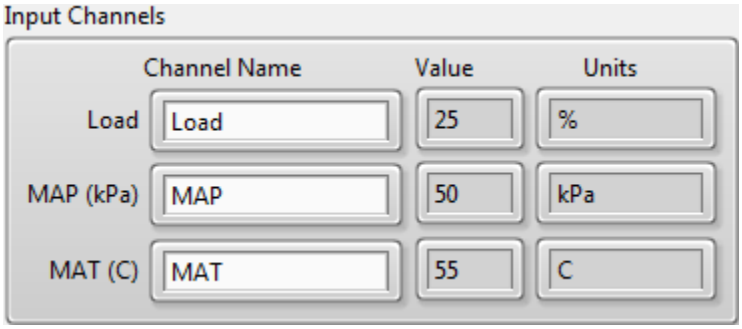
Fuel_SG



Tip Strip: Specific gravity of fuel in kg/dm^3

This control allows users to enter the specific gravity of the fuel they are using in their tests. It is only active in VE mode.

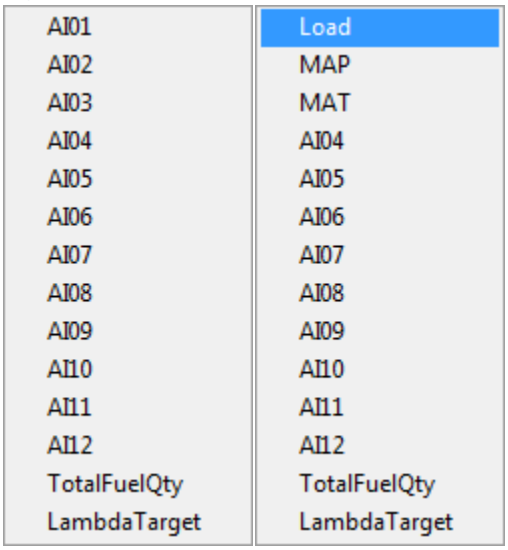
Input Channels



The input channels cluster lets users select inputs for desired load, intake manifold pressure (MAP), and intake manifold temperature (MAT) to be used in the engine fueling algorithms. The direct total quantity table uses the desired load, while the charge-density algorithm uses the desired load, MAP, and MAT to calculate the fuel quantity.

The available input channels are the twelve analog input channels. When the name of one of the analog input channels is set in the Analog Inputs Setup window, that name is propagated through the DCM DSI software to this list.

Input Selector



These two input selectors illustrate the options available for setting the Load, MAP, or MAT inputs. On the left are the default options. On the right, channel AI01 has been given the name Load, channel AI02 has been given the name MAP, and channel AI03 has been given the name MAT from the Analog Inputs Setup window.

Load

Tip Strip: Channel name for load input e.g. pedal, MAF, etc. (Right-Click to modify)

The Load channel name control lets users pick a channel to input into the fuel control algorithm. The Value indicator shows the current value of that channel, and the Units indicator shows the units of that channel. The load input is used for both direct total fueling control and charge-density control.

MAP

Tip Strip: Channel name for manifold absolute pressure (kPa) (Right-Click to modify.)

The MAP channel name control lets users pick a channel to input into the fuel control algorithm. The Value indicator shows the current value of that channel, and the Units indicator shows the units of that channel. In order to work properly in the algorithm, the units of the selected channel need to be kPa. The MAP input is used only for charge-density control.

MAT

Tip Strip: Channel name for intake air temperature (degC) (Right-Click to modify.)

The MAT channel name control lets users pick a channel to input into the fuel control algorithm. The Value indicator shows the current value of that channel, and the Units indicator shows the units of that

channel. In order to work properly in the algorithm, the units of the selected channel need to be degrees C. The MAT input is used only for charge-density control.

TotalFuelQty_Tbl

TotalFuelQty_Tbl [Load|RPM|mm3/stroke]

25 | 0 | 0

SCM	500.0	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Tip strip: Fuel quantity calibration based on engine speed (RPM) and relative engine load.

This table returns a fuel quantity value based on relative load (%) and engine RPM. Points between entries on the table are calculated by linear extrapolation. See the SCM manual for details.

VE_Tbl

VE_Tbl [kPa|RPM|%VE]

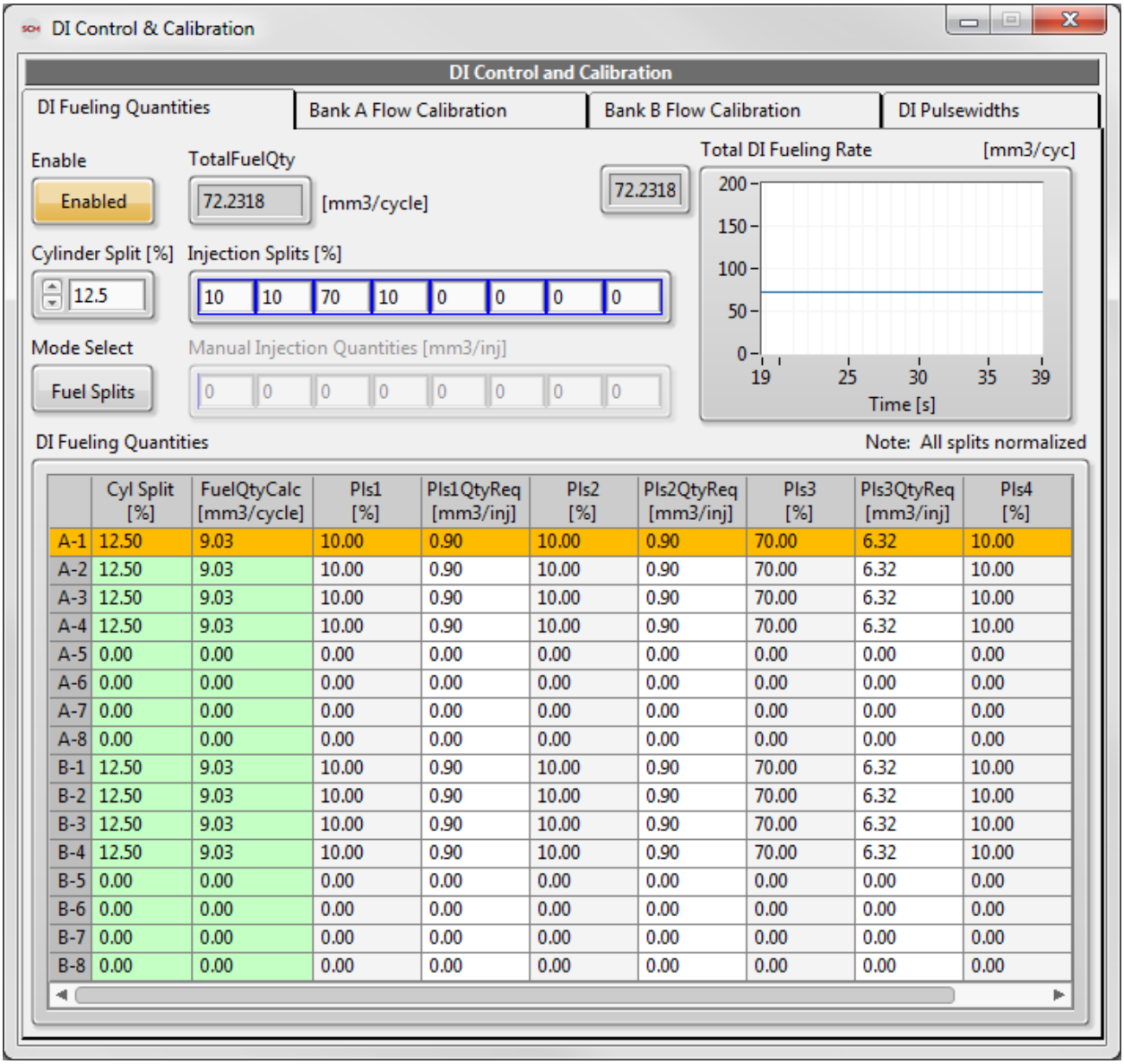
50 | 0 | 75

SCM	500.0	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
0.000	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
5.000	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
10.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
15.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
20.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
25.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
30.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
35.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
40.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
45.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
50.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
55.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
60.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
65.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
70.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00
80.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00

Tip Strip: Volumetric Efficiency calibration based on engine speed (RPM) and MAP (kPa).

This table returns a volumetric efficiency based on manifold absolute pressure (kPa) and engine RPM. Points between entries on the table are calculated by linear extrapolation. See the SCM manual for details.

DI Control and Calibration



	Cyl Split [%]	FuelQtyCalc [mm3/cycle]	PIs1 [%]	PIs1QtyReq [mm3/inj]	PIs2 [%]	PIs2QtyReq [mm3/inj]	PIs3 [%]	PIs3QtyReq [mm3/inj]	PIs4 [%]
A-1	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
A-2	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
A-3	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
A-4	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
A-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-1	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
B-2	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
B-3	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
B-4	12.50	9.03	10.00	0.90	10.00	0.90	70.00	6.32	10.00
B-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The DI Control and Calibration window is designed to allow users to specify the quantity of fuel for a particular injection event and then convert that quantity of fuel into a pulse width for the injector. Users can either enter cylinder and injection splits for the total fuel quantity calculated in the Engine Fuel Control window, or they can enter their own manual injection quantities for each injection for each injector.

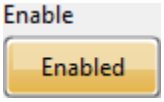
Selector Tabs

Use the selector tab to choose what grouping of controls to monitor and manipulate.

DI Fueling Quantities

Direct injector controls and indicators.

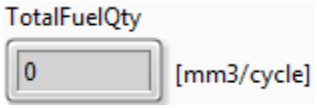
Enable



Tip Strip: Enables DSI direct injector control algorithms.

The Enable control enables the DSI direct injector control algorithms. If left disabled, then the durations for each injection pulse can be configured from the DI Driver Bank Setup windows. If enabled, then the values calculated and entered in this window will determine the durations.

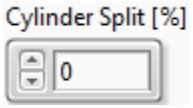
TotalFuelQty



Tip strip: Total fuel quantity requested (mm3/cycle).

Total fuel quantity requested. This is set up from the Engine Fuel Control VI.

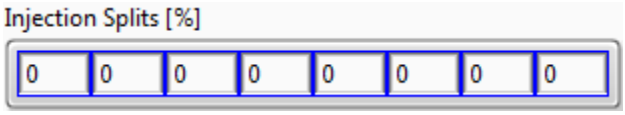
Cylinder Split



Tip strip: Percentage fuel to be applied to selected injector.

When “Mode Select” (3.3.12.2.5) is set to “Fuel Splits”, this is used to control the percent of the total fuel that will be used for each cylinder. This will be displayed in the “Cyl Split %” column of the Cylinder Fueling Control table (3.3.12.2.7). The total of all cylinders splits should total 100%.

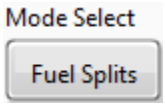
Injection Splits



Tip strip: Injected fuel splits (%) per injection event (up to 8). These values are normalized.

When “Mode Select” (3.3.12.2.5) is set to “Fuel Splits”, these values will split each cylinder’s fuel quantity per cycle in to separate fuel quantities per injection. The total of all injections per cylinder should total 100%.

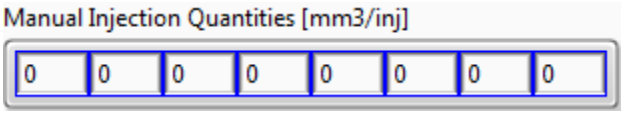
Mode Select (Fuel Splits/Manual Qty)



Tip strip: Selects whether to use 1 quantity and fuel splits, or manual injection quantities.

Controls whether fueling per injection is derived from a percentage of total fuel required or a fixed amount.

Manual Injection Quantities



Tip strip: Manually applied injection quantities per event (up to 8).

When “Mode Select” (3.3.12.2.5) is set to “Manual Qty”, these value define the actually fuel quantity injected per injection event per cylinder.

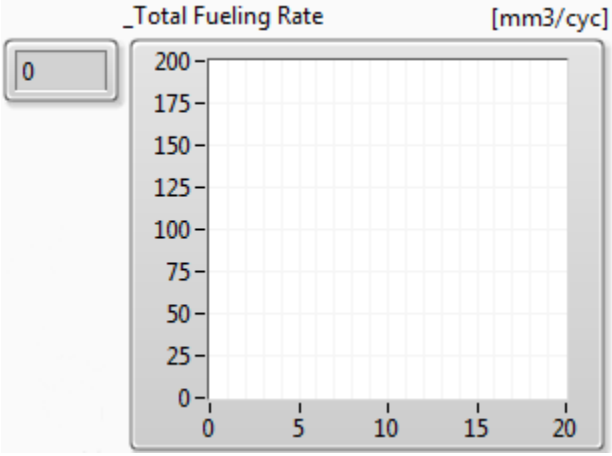
Cylinder Fueling Control

Cylinder Fueling Control

	Cyl Split [%]	FuelQtyCalc [mm3/cycle]	Pls1 [%]	Pls1QtyReq [mm3/inj]	Pls2 [%]	Pls2QtyReq [mm3/inj]			
A-1	20.00	2.00	50.00	1.00	50.00	1.00			
A-2	20.00	2.00	100.00	2.00	0.00	0.00			
A-3	30.00	3.00	100.00	3.00	0.00	0.00			
A-4	30.00	3.00	100.00	3.00	0.00	0.00			
A-5	0.00	0.00	0.00	0.00	0.00	0.00			
A-6	0.00	0.00	0.00	0.00	0.00	0.00			
A-7	0.00	0.00	0.00	0.00	0.00	0.00			
A-8	0.00	0.00	0.00	0.00	0.00	0.00			
B-1	0.00	0.00	0.00	0.00	0.00	0.00			
B-2	0.00	0.00	0.00	0.00	0.00	0.00			
B-3	0.00	0.00	0.00	0.00	0.00	0.00			
B-4	0.00	0.00	0.00	0.00	0.00	0.00			
B-5	0.00	0.00	0.00	0.00	0.00	0.00			
B-6	0.00	0.00	0.00	0.00	0.00	0.00			
B-7	0.00	0.00	0.00	0.00	0.00	0.00			
B-8	0.00	0.00	0.00	0.00	0.00	0.00			

This table shows the fuel quantities injected per injection event for each cylinder. This table is also used to specify which cylinder is being updated when changing values in the “Cylinder Split”, “Injection Splits”, or “Manual Injection Quantities” controls. You can select which cylinder to edit by clicking on a row (A-1 through A-8, B-1 through B-8).

Total Fueling Rate

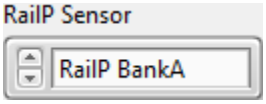


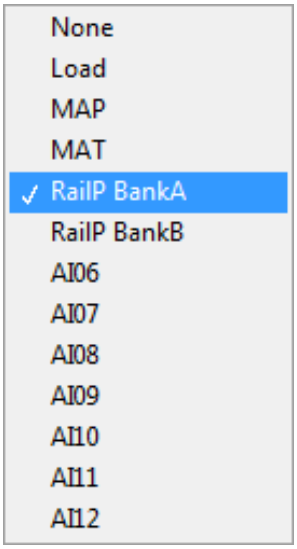
This plot shows the amount of fuel being used in mm3/cycle vs. time (previous 20 seconds).

Bank X Flow Calibration

Allows users to input the calibration for their injector to determine pulse width as a function of fuel volume per event and rail pressure. Only one calibration is allowed per bank.

Bank X Rail Pressure Sensor

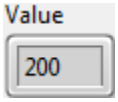




Tip strip: selects the analog channel representing Rail Pressure.

Use this selector to specify which analog channel is being used to measure rail pressure.

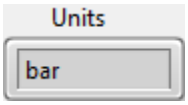
Value



Tip strip: Rail pressure sensor for Bank A

Value of selected analog channel.

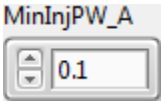
Unit



Tip strip: Rail pressure sensor for Bank A

Units of selected analog channel.

MinInjPW_X



Tip strip: Sets the minimum injection pulse width for injection. (Max=Inf, Min = 0)

Sets the minimum injection pulse width for injection.

InjFlowCal_X

InjFlowCal_A

0.90289 | 200 | 0.87051 [mm3/stroke|sensorunit|msec]

SCM	0.000	100.0	200.0	300.0	400.0	500.0	600.0	700.0	800.0	900.0	1000
0.000	1.000	0.920	0.840	0.760	0.680	0.600	0.520	0.440	0.360	0.280	0.200
10.00	1.400	1.289	1.178	1.067	0.956	0.845	0.734	0.623	0.512	0.401	0.290
20.00	1.800	1.658	1.516	1.374	1.232	1.090	0.948	0.806	0.664	0.522	0.380
30.00	2.200	2.027	1.854	1.681	1.508	1.335	1.162	0.989	0.816	0.643	0.470
40.00	2.600	2.396	2.192	1.988	1.784	1.580	1.376	1.172	0.968	0.764	0.560
50.00	3.000	2.765	2.530	2.295	2.060	1.825	1.590	1.355	1.120	0.885	0.650
60.00	3.400	3.134	2.868	2.602	2.336	2.070	1.804	1.538	1.272	1.006	0.740
70.00	3.800	3.503	3.206	2.909	2.612	2.315	2.018	1.721	1.424	1.127	0.830
80.00	4.200	3.872	3.544	3.216	2.888	2.560	2.232	1.904	1.576	1.248	0.920
90.00	4.600	4.241	3.882	3.523	3.164	2.805	2.446	2.087	1.728	1.369	1.010
100.0	5.000	4.610	4.220	3.830	3.440	3.050	2.660	2.270	1.880	1.490	1.100
110.0	5.400	4.979	4.558	4.137	3.716	3.295	2.874	2.453	2.032	1.611	1.190
120.0	5.800	5.348	4.896	4.444	3.992	3.540	3.088	2.636	2.184	1.732	1.280
130.0	6.200	5.717	5.234	4.751	4.268	3.785	3.302	2.819	2.336	1.853	1.370
140.0	6.600	6.086	5.572	5.058	4.544	4.030	3.516	3.002	2.488	1.974	1.460
150.0	7.000	6.455	5.910	5.365	4.820	4.275	3.730	3.185	2.640	2.095	1.550
160.0	7.400	6.824	6.248	5.672	5.096	4.520	3.944	3.368	2.792	2.216	1.640
170.0	7.800	7.193	6.586	5.979	5.372	4.765	4.158	3.551	2.944	2.337	1.730
180.0	8.200	7.562	6.924	6.286	5.648	5.010	4.372	3.734	3.096	2.458	1.820
190.0	8.600	7.931	7.262	6.593	5.924	5.255	4.586	3.917	3.248	2.579	1.910
200.0	9.000	8.300	7.600	6.900	6.200	5.500	4.800	4.100	3.400	2.700	2.000

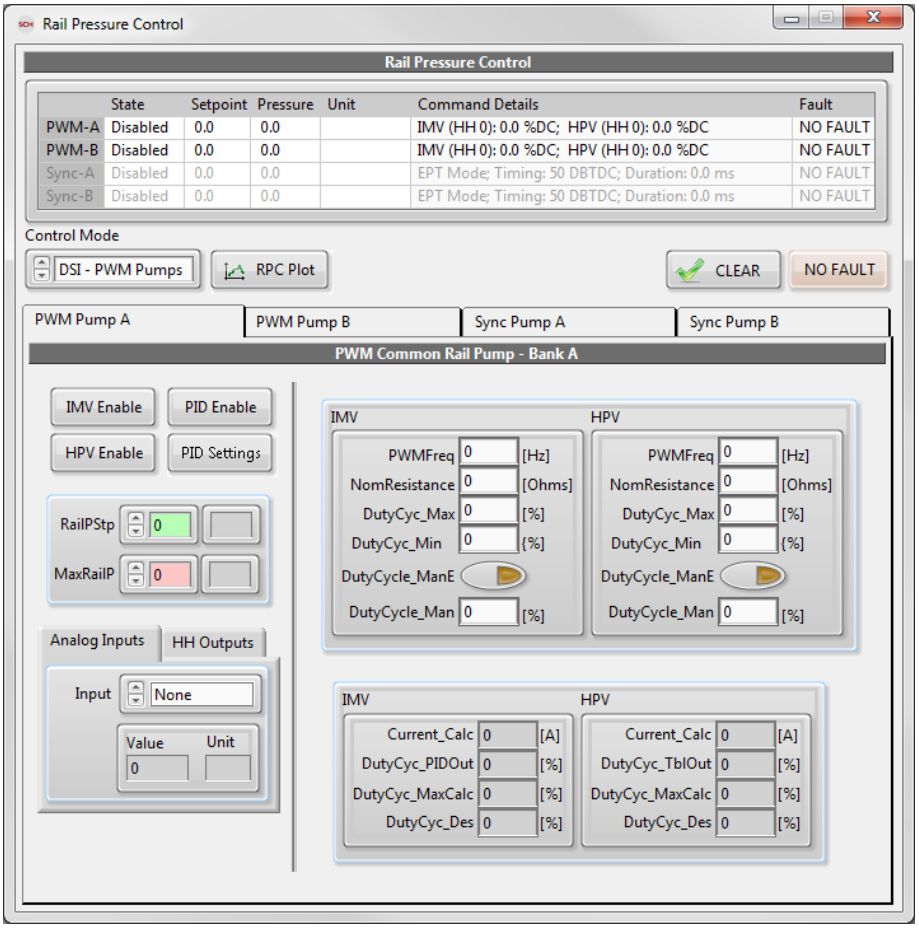
This is the injector calibration table. It outputs the injection duration required (in msec) for a desired fuel quantity and rail pressure.

DI Pulsewidths

	Pls1 [msec]	Pls2 [msec]	Pls3 [msec]	Pls4 [msec]	Pls5 [msec]	Pls6 [msec]	Pls7 [msec]	Pls8 [msec]
A-1	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
A-2	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
A-3	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
A-4	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
A-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-1	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
B-2	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
B-3	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
B-4	0.87	0.87	1.05	0.87	0.00	0.00	0.00	0.00
B-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This table shows the pulse width commands for each pulse for each injector.

Rail Pressure Control

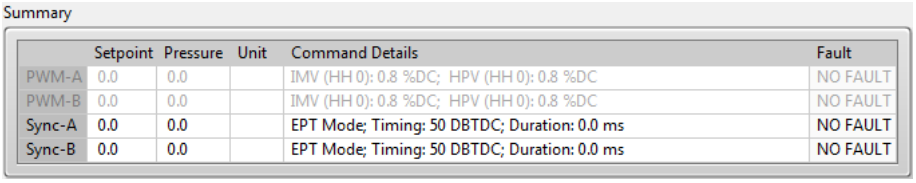


The purpose of the Rail Pressure Control (RPC) Setup window is to configure a dedicated direct injection common-rail fuel pressure control function. The function controls driver circuits on the DCM which can be connected to a high pressure pump Inlet Metering Valve (IMV), a High Pressure Valve (HPV), or a synchronous pump Fuel Quantity Valve (FQV).

For PWM applications typically, RPC is performed using IMV PID control while applying a constant duty cycle to the HPV. The RPC function implements a PID controller to determine the command for the IMV and a lookup table to determine the command for the HPV; those commands drive the selected half H channels that are connected to the valves. For synchronous pumps, a PID controller adjusts the timing of fuel injection for a FQV connected to a Pump channel.

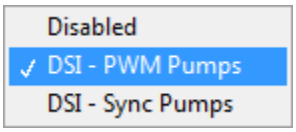
In both PWM and Synchronous modes, the RPC function needs to have rail pressure feedback from of an analog sensor mounted to the fuel rail. The analog signal can be connected to any of the channels listed in the Analog Inputs selector.

Summary



Setpoint, pressure, units, command details, and fault states for A and B PWM and Sync channels can be observed here.

Control Mode



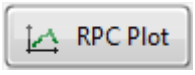
Tip strip: Selects RPC algorithm for Bank A and Bank B

Disabled: no RPC control is to be used

DSI – PWM Pumps: an IMV and HPV will be used for RPC

DSI – Snyc Pumps: a synchronous pump and FQV will be used for RPC

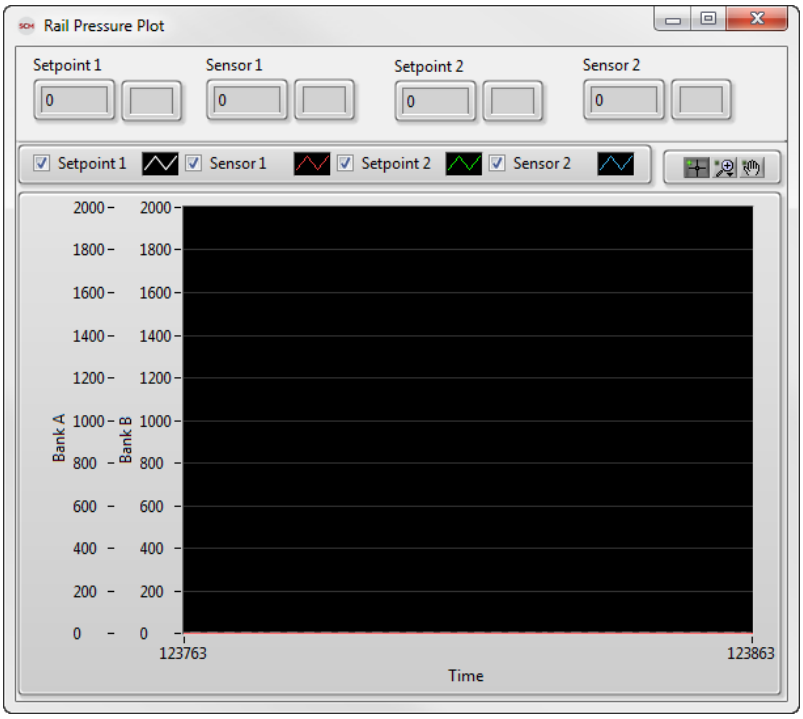
RPC Plot



Tip strip: Displays the RPC Plot Sub VI

Displays the RPC Plot Sub VI

RPC Plot Sub VI

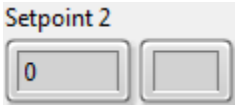


Plot of Setpoints and Sensor readings for the sensors in use vs. time.

Setpoint 1

Numerical reading and units for Setpoint 1.

Setpoint 2



Numerical reading and units for Setpoint 2.

Sensor 1

Numerical reading and units for Sensor 1.

Sensor 2

Numerical reading and units for Sensor 2.

Clear

Tip strip: Clears RailP fault

Clear any rail pressure control faults.

Fault Indicator

Tip strip: Indicates RailP fault

Indicates the presence of a rail pressure control fault.

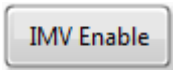
Pump Channel Selector Tabs

These tabs are used to select which control strategy to change settings on.

PWM Pump

This section will describe the operation of PWM Pump A and B.

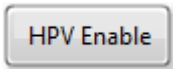
IMV Enable



Tip strip: Enables PWM control of IMV

Turns on the HH channel assigned to the IMV valve utilizing settings on this tab.

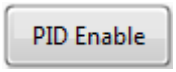
HPV Enable



Tip strip: Enables HPV open loop control

Turns on the HH channel assigned to the HPV valve utilizing settings on this tab.

PID Enable



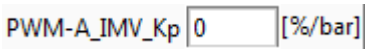
Tip strip: Enables PID control of IMV

Activates the PID controller for IMV.

PWM PID Settings

IMV PID

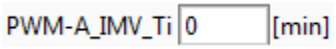
PWM-IMV_Kp



Tip strip: IMV PID proportional gain

Proportional gain. A value of zero disables proportional, integral, and derivative contributions to the PID output. Smaller values cause less proportional contribution to the PID output. Larger values cause more proportional contribution to the PID output. Negative values will generate PID outputs that are inversely proportional to the error (Setpoint – Process Variable).

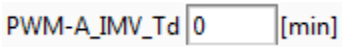
PWM - IMV_Ti



Tip strip: Integral time constant for IMV PID controller (lower = stronger action, 0=disabled.)

Integral time constant for the IMV PID controller. A value of zero disables integral contribution to the PID output. Smaller non-zero values cause more contribution to the PID output. Larger values cause less contribution to the PID output. Negative values should not be used.

PWM - IMV _Td



Tip strip: Derivative time constant for IMV PID controller (higher = stronger action, 0=disabled.)

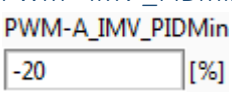
Derivative time constant for the IMV PID controller. A value of zero disables derivative contribution to the PID output. Smaller values cause less contribution to the PID output. Larger values cause more contribution to the PID output. Negative values should not be used.

PWM - IMV _PIDMax

Tip strip: PID output maximum limit (before feed forward is added) (Max=30, Min=0)

Maximum output allowed from the PID controller, before the feed forward (IMV_PIDFF) is added.

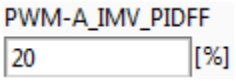
PWM - IMV _PIDMin



Tip strip: PID output minimum limit (before feed forward is added) (Max=0, Min=-30)

Minimum output allowed from the PID controller, before the feed forward (IMV_PIDFF) is added.

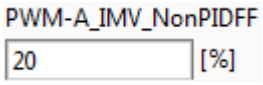
PWM-IMV_PIDFF



Tip strip: Duty cycle feed forward added to the IMV PID output (Max=100, Min=0)

Feed forward value that is added to the PID output value.

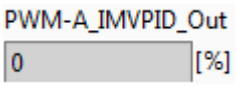
PWM - IMV _NonPIDFF



Tip strip: Duty cycle feed forward for the IMV while PID control is off(Max=100, Min=0)

Feed forward value added to the output duty cycle when the PID controller is switched off.

PWM - IMVPID_Out



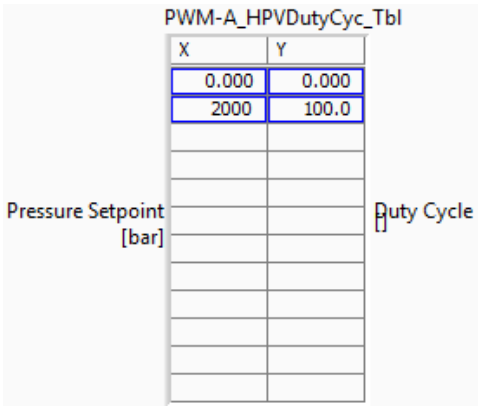
Tip strip: PWM pump IMV PID duty cycle output

Output value from the PID controller. This value is limited by the values in IMV_PIDMin and IMV_PIDMax. This value is added to IMV_PIDFF and the result is placed in IMV_DC.

HPV Lookup Table

Specifies a duty cycle for the HPV valve based on the rail pressure setpoint.

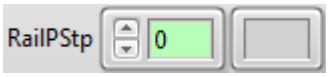
PWM-A_HPVDutyCyc_Tbl



Tip strip: HPV lookup table. Input = Pressure Setpoint. Output = Duty Cycle

Table to determine the duty cycle of the HPV based on the rail pressure set point.

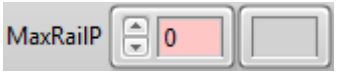
RailStp



Tip strip: Rail Pressure Setpoint

This is the target rail pressure for the RPC controller.

MaxRailP

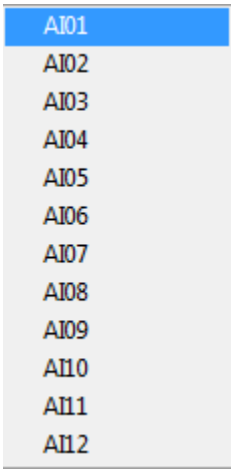


Tip strip: Maximum Rail Pressure Setpoint

This is the rail pressure that will trigger a rail pressure fault, shutting off the IMV and HPV.

Analog Inputs

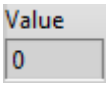
Input



Tip strip: Rail pressure sensor select

Selects one of the DCM's twelve analog input channels to be assigned to rail pressure PID control feedback.

Value



Tip strip: Rail pressure sensor

Current reading of the rail pressure sensor.

Unit

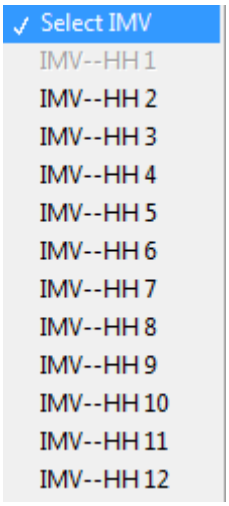
Tip strip: Rail Pressure sensor

Unit assigned to the rail pressure sensor.

HH Outputs

These selectors allow the user to choose which HH channels are assigned for IMV and HPV use.

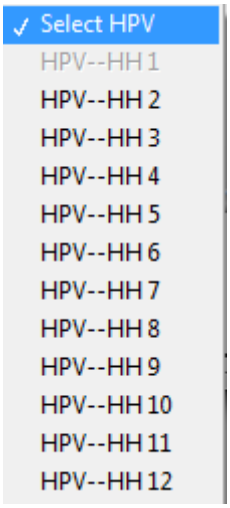
IMV Selector



Tip strip: IMV HH channel index (Max=11, Min=-1)

Selects which HH channel will be driven by the IMV control strategy.

HPV Selector



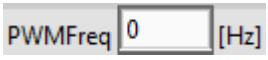
Tip strip: HPV HH channel index (Max=11, Min=-1)

Selects which HH channel will be driven by the HPV control strategy.

IMV

This section refers to the IMV.

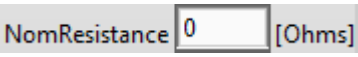
PWM Freq



Tip strip: PWM drive frequency

Frequency of the PWM signal to the IMV solenoid.

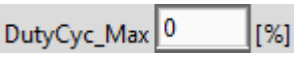
NomResistance



Tip strip: Nominal solenoid resistance

Nominal resistance of the IMV solenoid. This value is used to calculate the maximum final duty cycle allowed to the IMV. It is important to measure this resistance within +/-0.5 ohms

DutyCyc_Max



Tip strip: Maximum PWM duty cycle

Maximum allowed duty cycle for IMV. When PWM - IMVPID_Out is higher than this value, the output duty cycle will be DutyCyc_Max.

MinDuty Cycle

Tip strip: Manual PWM duty cycle enable

Minimum allowed duty cycle for IMV. When PWM - IMVPID_Out is lower than this value, the output duty cycle will be DutyCyc_Min.

DutyCycle_ManE

Tip strip: Manual PWM duty cycle enable

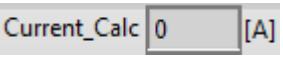
Override the PID controller and output the duty cycle specified in DutyCyle_Man.

DutyCycle_Man

Tip strip: Manual PWM duty cycle

Duty cycle output to the IMV when DutyCycle_ManE is enabled, regardless of PID controller settings.

Current_Calc



Tip strip: Estimated average current through solenoid

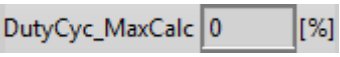
An estimate of the current flowing through the IMV based on the duty cycle, battery voltage, and the nominal resistance of the valve.

DutyCyc_PIDOut

Tip strip: IMV PID PWM duty cycle output

Duty cycle calculated by the IMV PID.

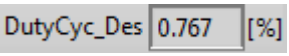
DutyCyc_MaxCalc



Tip strip: Max allowable duty cycle to solenoid

Maximum duty cycle calculated to limit current to the IMV to under 4 amps RMS.

DutyCyc_Des



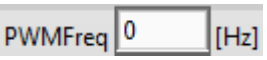
Tip strip: Duty cycle commanded to solenoid

Duty cycle commanded to the IMV through the specified HH channel.

HPV

This section refers to the HPV.

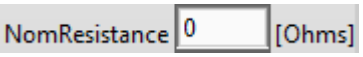
PWMFreq



Tip strip: PWM drive frequency

Frequency of the PWM signal to the HPV solenoid.

NomResistance



Tip strip: Nominal solenoid resistance

Nominal resistance of the HPV solenoid. This value is used to calculate the maximum final duty cycle allowed to the HPV. It is important to measure this resistance within +/-0.5 ohms

DutyCyc_Max

Tip strip: Maximum PWM duty cycle

Maximum allowed duty cycle for HPV. This value is effective if lower than PWM - HPVPID_Out.

Min Duty Cycle

Tip strip: Minimum PWM duty cycle

Minimum allowed duty cycle for HPV. This value is effective if higher than PWM - HPVPID_Out.

DutyCycle_ManE

Tip strip: Manual PWM duty cycle enable

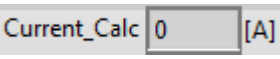
Override the PID controller and output the duty cycle specified in DutyCyle_Man.

DutyCycle_Man

Tip strip: Manual PWM duty cycle

Duty cycle output to the HPV when DutyCycle_ManE is enabled, regardless of PID controller settings.

Current_Calc



Tip strip: Estimated average current through solenoid

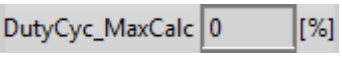
An estimate of the current flowing through the HPV based on the duty cycle, battery voltage, and the nominal resistance of the valve.

DutyCyc_TblOut

Tip strip: HPV Table PWM duty cycle output

Duty cycle output of table PWM-A_HPVDutyCyc_Tbl.

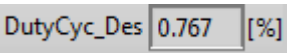
DutyCyc_MaxCalc



Tip strip: Max allowable duty cycle to solenoid

Maximum duty cycle calculated to limit current to the IMV to under 4 amps RMS.

DutyCyc_Des



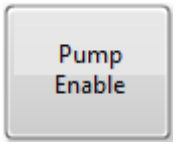
Tip strip: Duty cycle commanded to solenoid

Duty cycle commanded to the HPV through the specified HH channel.

Sync Pump

This section will explain the controls and indicators to set up a synchronous pump for RPC.

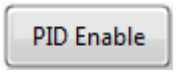
Pump Enable



Tip strip: Enables control of FQV duration angle

Turns on FQV commands.

PID Enable



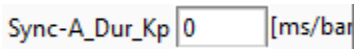
Tip strip: Enable PID control for the FQV duration

Turns on PID control FQV injection duration.

Synchronous Pump PID Settings

Duration PID

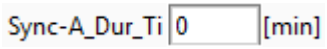
Sync-A_Dur_Kp



Tip strip: FQV duration proportional gain

Proportional gain. A value of zero disables proportional, integral, and derivative contributions to the PID output. Smaller values cause less proportional contribution to the PID output. Larger values cause more proportional contribution to the PID output. Negative values will generate PID outputs that are inversely proportional to the error (Setpoint – Process Variable).

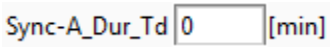
Sync-A_Dur_Ti



Tip strip: Integral time constant for FQV duration PID controller (lower = stronger action, 0=disabled.)

Integral time constant for the FQV PID controller. A value of zero disables integral contribution to the PID output. Smaller non-zero values cause more contribution to the PID output. Larger values cause less contribution to the PID output. Negative values should not be used.

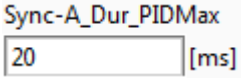
Sync-A_Dur_Td



Tip strip: Derivative time constant for FQV duration PID controller (higher = stronger action, 0=disabled.)

Derivative time constant for the FQV PID controller. A value of zero disables derivative contribution to the PID output. Smaller values cause less contribution to the PID output. Larger values cause more contribution to the PID output. Negative values should not be used.

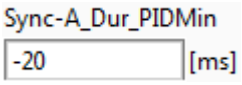
Sync-A_Dur_PIDMax



Tip strip: FQV duration PID output maximum limit (before feed forward is added) (Max=50, Min=0)

Maximum output allowed from the PID controller, before the designated feed forward from Sync-A_FlowCal_TblOut is added.

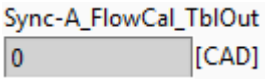
Sync-A_Dur_PIDMin



Tip strip: FQV duration PID output minimum limit (before feed forward is added) (Max=0, Min=-50)

Minimum output allowed from the PID controller, before the designated feed forward from Sync-A_FlowCal_TblOut is added.

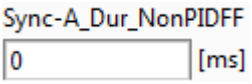
Sync-A_FlowCal_TblOut



Tip strip: Designated feed forward for FQV duration angle PID.

Feed forward in milliseconds duration derived from lookup table indexed by rail pressure and desired fuel quantity per stroke.

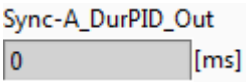
Sync-A_Dur_NonPIDFF



Tip strip: FQV duration non-PID feed forward value.

Feed forward value added to the output duration when the PID controller is switched off.

Sync-A_DurPID_Out

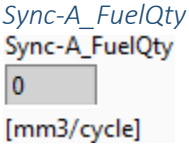


Tip strip: Sync pump duration PID output

PID output duration.

Flow Calibration (Feed Forward) Lookup Table

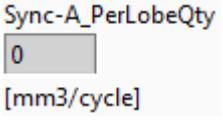
Sync-A_FuelQty



Tip strip: Requested fuel quantity for bank A.

Total fuel quantity requested for bank A.

Sync-A_PerLobeQty



Tip strip: Indicates the total fuel requested for bank A injectors divided by the number lobes on the pump cam.

Fuel flow rate for the bank of injectors divided by the number of lobe on the pump cam.

Sync-A_FlowCal_Tbl

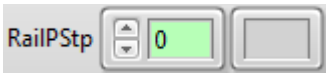
Sync-A_FlowCal_Tbl

0	0	0			[bar|mm3/stroke|ms]
SCM	20.00	40.00	60.00	80.00	100.0
20.00	15.00	15.56	16.11	16.67	17.22
40.00	16.43	16.98	17.54	18.10	18.65
60.00	17.86	18.41	18.97	19.52	20.08
80.00	19.29	19.84	20.40	20.95	21.51
100.0	20.71	21.27	21.83	22.38	22.94
120.0	22.14	22.70	23.25	23.81	24.37
140.0	23.57	24.13	24.68	25.24	25.79
160.0	25.00	25.56	26.11	26.67	27.22

Tip strip: Fuel quantity valve flow calibration based on desired quantity and rail pressure.

The user can enter calibration data for the FQV, specifying the output duration necessary for a specified rail pressure and fuel flow rate.

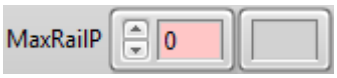
RailStp



Tip strip: Rail pressure setpoint

This is the target rail pressure for the RPC controller.

MaxRailP

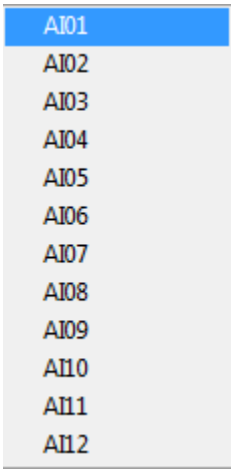


Tip strip: Maximum rail pressure threshold

This is the rail pressure that will trigger a rail pressure fault, shutting off the FQV.

Analog Inputs

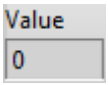
Input



Tip strip: Rail pressure sensor select

Selects one of the DCM's twelve analog input channels to be assigned to rail pressure PID control feedback.

Value



Tip strip: Rail pressure sensor

Current reading of the rail pressure sensor.

Unit

Tip strip: Rail pressure sensor

Unit assigned to the rail pressure sensor.

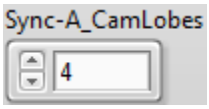
Digital Inputs

Sync-A Digital Input

Tip strip: Digital input select

Use this to select which digital signal to synchronize to in “TMP” timing mode.

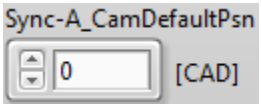
Sync-A_CamLobes



Tip strip: Sets the number and distribution of pulses per cycle based on the number of cam lobes. (Max=8, Min=1)

This specifies the number of cam lobes that are used for pump strokes in the synchronous pump.

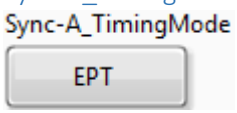
Sync-A CamDefaultPsn



Tip strip: Default cam position

This is the default cam position when not manipulated by any advance or retardation of the cam.

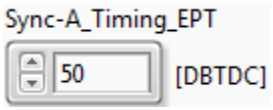
Sync-A_TimingMode (EPT/TMP)



Tip strip: Toggles pump command mode. “TMP” mode uses a digital input to trigger a pulse after a known delay (% of period). “EPT” mode use the crank position to trigger a pulse at a Start or End Angle timing.

EPT command mode: Uses a crank angle reference for the start or end of an FQV open duration.
TMP command mode: Uses a digital input to start the FQV open duration.

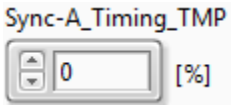
Sync-A Timing_EPT



Tip strip: Synchronous pump EPT timing in DBTDC

This is the crank angle reference for the start or end of the FQV open duration, depending on the setting of “EndAngle?”.

Sync-A_Timing_TMP



Tip strip: Sync pump TMP timing in percent of trigger period. (Max=90, Min=0)

Specifies how long after a digital input trigger, in percent of trigger period, to start the FQV open duration.

Duration Controls

Dur_Max

Tip strip: Maximum pulse duration

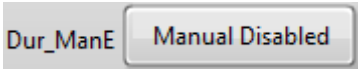
Maximum duration allowed for the FQV to be open.

Dur_Min

Tip strip: Minimum pulse duration

Minimum duration allowed for the FQV to be open.

Dur_ManE



Tip strip: Manual duration enable

Output of the PID is ignored and the value specified in Dur_Man is used instead.

Dur_Man

Tip strip: Manual duration

When manual duration is enabled, this is used for the FQV open time.

Timing Controls

WindowStart

Tip strip: FQV pulse window start

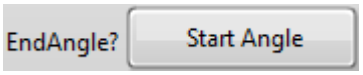
Earliest possible time in the crank rotation that the FQV can be open.

WindowEnd

Tip strip: FQV pulse window end

Latest possible time in the crank rotation that the FQV can be open.

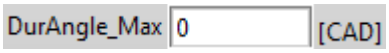
EndAngle?



Tip strip: Toggles between start angle and end angle timings

This selects whether Sync-A Timing_EPT is specifying the start angle or end angle of the FQV being open.

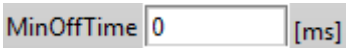
DurAngle_Max



Tip strip: Maximum duration of FQV pulse in CAD

This limits the maximum duration in CAD that the FQV can be open.

MinOffTime

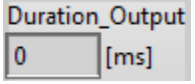


Tip strip: Minimum duration of FQV pulse in CAD

Specifies a minimum time that the FQV must be closed between openings.

Duration Output

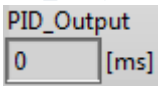
Duration_Output



Tip strip: FQV pulse duration

Duration in that the FQV will be open per pump stroke.

PID_Output

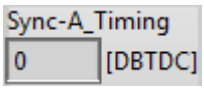


Tip strip: PID Duration

Duration output of the PID controller.

EPT Mode Output

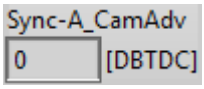
Sync-A_Timing



Tip strip: FQV pulse timing

Final crank position timing for EPT mode.

Sync-A CamAdv

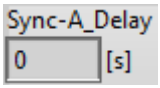


Tip strip: FQV pulse cam advance

Final cam advance for EPT mode.

TMP Mode Output

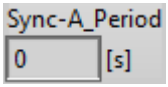
Sync-A_Delay



Tip strip: Final delay for TMP mode.

Final delay for TMP mode.

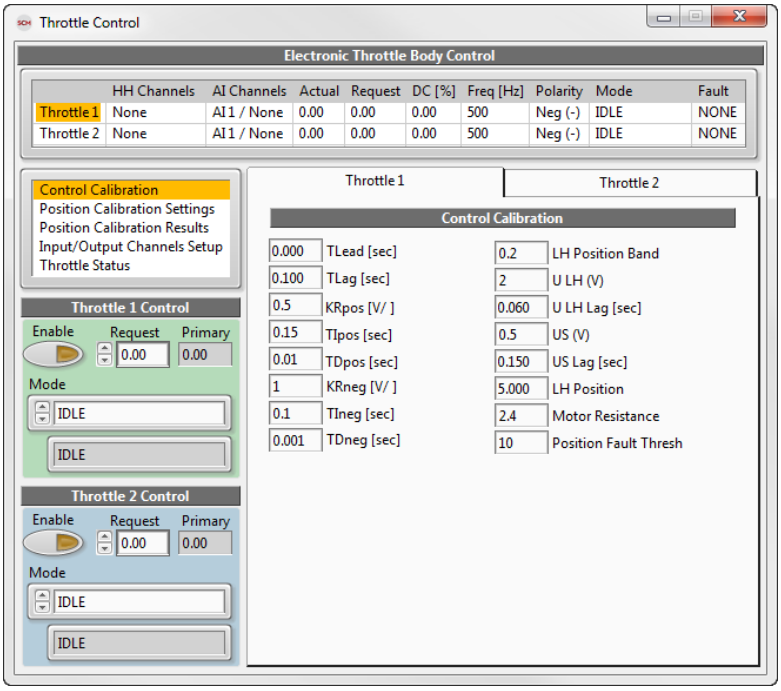
Sync-A_Period



Tip strip: Final period for TMP mode.

Final period for TMP mode.

Electronic Throttle Control



Electronic throttle position controller uses three algorithms. The first algorithm is PID control using two sets of gains. One set of gains is for positions above the LH Position (Limp-Home Position), and the other set is for positions below LH Position. The second control algorithm is to compensate the output for travel through the vicinity of the LH Position, as there is a change in spring return force at that position. The third control algorithm is to compensate the output for stiction which is most effective while positional errors are small.

A position calibration mode is also provided which will automatically discover the minimum, maximum and limp-home positions of a throttle body, guided by the parameters within the Position Cal Settings input cluster.

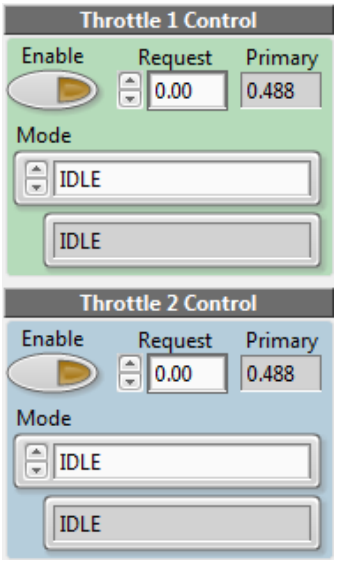
Throttle Channel Summary

	HH Channels	AI Channels	Actual	Request	DC [%]	Freq [Hz]	Polarity	Mode	Fault
Throttle 1	None	AI 1 / None	0.00	0.00	0.00	500	Neg (-)	IDLE	NONE
Throttle 2	None	AI 1 / None	0.00	0.00	0.00	500	Neg (-)	IDLE	NONE

Tip strip: Displays summary of throttle setup

This displays a summary of the throttle setup. For both throttles, the HH assigned, the analog inputs assigned for position feedback, the current throttle position, the requested position, the duty cycle and frequency of the HH channel's output, the polarity of the analog input, the current mode of operation, and any faults will be displayed.

Throttle 1 and 2 Control



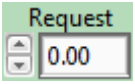
Each throttle control grouping has the same.

Enable

Tip strip: Enables the throttle HH output.

Enable the output of the HH channels assigned to drive the throttle.

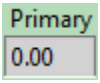
Request



Tip strip: Desired throttle position (Max=90, Min=0)

Requested throttle position.

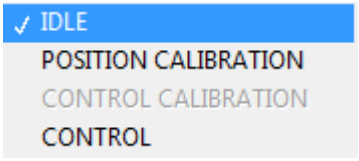
Primary



Tip strip: Throttle primary position output.

Displays current throttle position as determined from the analog input selected as the primary input. Use the Primary Select button under the Input/Output Channels Setup to select which analog input is the primary.

Mode



Tip strip: Selects the throttle algorithm mode of operation.

Requested operating mode.

IDLE: The throttle motor voltage is 0V. Primary Position is calculated according to Position Cal Out parameters.

POSITION CALIBRATION: This mode can only be entered when Mode Status is IDLE. Starts the position calibration process, guided by Position Cal Settings cluster parameters. When the position calibration process is complete, Mode Status returns to IDLE.

CONTROL CALIBRATION: This mode can only be entered when Mode Status is IDLE. Starts the control calibration process, guided by Control Cal Settings cluster parameters. When the control calibration process is complete, Mode Status returns to IDLE. This operating mode is not currently implemented and forces the Mode Status back to IDLE.

CONTROL: This mode can only be entered when Mode Status is IDLE. This mode controls the throttle position to the Position Setpoint input. This mode is exited only when Mode Request is set to IDLE. It is not possible to move directly from this mode to a calibration mode.

Note: For typical engine control operation, the external software can set Mode Request to POSITION CALIBRATION to start the position calibration process. Once position calibration starts, as indicated by Mode Status, Mode Request can immediately be set to CONTROL. The control process will start after the calibration process is complete

Status

Tip strip: Selects the throttle algorithm mode of operation.

Status operating mode.

IDLE: The throttle motor voltage is 0V. Primary Position is calculated according to Position Cal Out parameters.

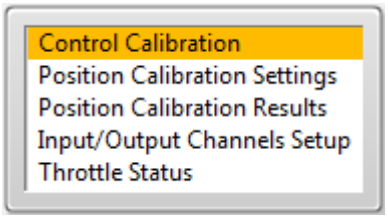
POSITION CALIBRATION: This mode can only be entered when Mode Status is IDLE. Starts the position calibration process, guided by Position Cal Settings cluster parameters. When the position calibration process is complete, Mode Status returns to IDLE.

CONTROL CALIBRATION: This mode can only be entered when Mode Status is IDLE. Starts the control calibration process, guided by Control Cal Settings cluster parameters. When the control calibration process is complete, Mode Status returns to IDLE. This operating mode is not currently implemented and forces the Mode Status back to IDLE.

CONTROL: This mode can only be entered when Mode Status is IDLE. This mode controls the throttle position to the Position Setpoint input. This mode is exited only when Mode Request is set to IDLE. It is not possible to move directly from this mode to a calibration mode.

Note: For typical engine control operation, the external software can set Mode Request to POSITION CALIBRATION to start the position calibration process. Once position calibration starts, as indicated by Mode Status, Mode Request can immediately be set to CONTROL. The control process will start after the calibration process is complete

Control Group Selector



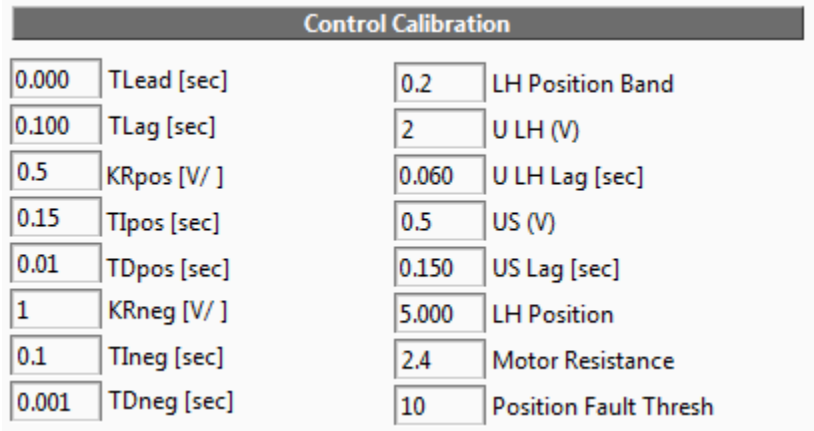
Tip strip: Selects the group of tabbed panels to display

Selects what grouping will be displayed in the tabbed panels.

Throttle Channel Selector Tabs

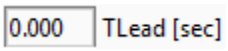
Use these tabs to select the throttle you wish to change the settings on.

Control Calibration Group



Collection of calibration parameters for initializing the Control Cal Out. Some of the Control Cal Out parameters will be modified following a position calibration and/or control calibration.

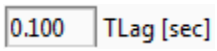
TLead [sec]



Tip strip: Adjusts the lead compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLead can be increased to intensify the change in Position Setpoint.

Adjusts the lead compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLead can be increased to intensify the change in Position Setpoint.

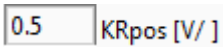
TLag [sec]



Tip strip: Adjusts the lag compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLag can be increased to slow the change in Position Setpoint.

Adjusts the lag compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLag can be increased to slow the change in Position Setpoint.

KRpos [V/]



Tip strip: Proportional gain for the throttle control PID function while Position Setpoint is greater than LH Position.

Proportional gain for the throttle control PID function while Position Setpoint is greater than LH Position.

TIpos [sec]

Tip strip: Integral time for the throttle control PID function while Position Setpoint is greater than LH Position. The integral time is equivalent to the electro-mechanical time-constant of the throttle body. Smaller integral times intensify the integral action. When TI is set to zero, the integral action is disabled.

Integral time for the throttle control PID function while Position Setpoint is greater than LH Position. The integral time is equivalent to the electro-mechanical time-constant of the throttle body. Smaller integral times intensify the integral action. When TI is set to zero, the integral action is disabled.

TDpos [sec]

Tip strip: Derivative time for the throttle control PID function while Position Setpoint is greater than LH Position. The derivative time is proportional to the electro-mechanical time-constant of the throttle body. Larger times intensify the derivative action. When TD is set to zero, the derivative action is disabled.

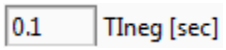
Derivative time for the throttle control PID function while Position Setpoint is greater than LH Position. The derivative time is proportional to the electro-mechanical time-constant of the throttle body. Larger times intensify the derivative action. When TD is set to zero, the derivative action is disabled.

KRneg [V/]

Tip strip: Proportional gain for the throttle control PID function while Position Setpoint is less than or equal to LH Position.

Proportional gain for the throttle control PID function while Position Setpoint is less than or equal to LH Position.

TIneg [sec]



Tip strip: Integral time for the throttle control PID function while Position Setpoint is less than LH Position. The integral time is equivalent to the electro-mechanical time-constant of the throttle body. Smaller integral times intensify the integral action. When TI is set to zero, the integral action is disabled.

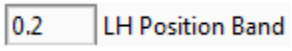
Integral time for the throttle control PID function while Position Setpoint is less than LH Position. The integral time is equivalent to the electro-mechanical time-constant of the throttle body. Smaller integral times intensify the integral action. When TI is set to zero, the integral action is disabled.

TDneg [sec]

Tip strip: Derivative time for the throttle control PID function while Position Setpoint is less than LH Position. The derivative time is proportional to the electro-mechanical time-constant of the throttle body. Larger times intensify the derivative action. When TD is set to zero, the derivative action is disabled.

Derivative time for the throttle control PID function while Position Setpoint is less than LH Position. The derivative time is proportional to the electro-mechanical time-constant of the throttle body. Larger times intensify the derivative action. When TD is set to zero, the derivative action is disabled.

LH Position Band



Tip strip: Limp-home compensation (uLHc) is updated when Position Setpoint is within LH Position Band of LH Position (above or below).

Limp-home compensation (uLHc) is updated when Position Setpoint is within LH Position Band of LH Position (above or below).

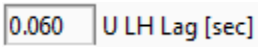
U LH (V)

Tip strip: Voltage added or subtracted to the PID output when Position Setpoint is in the vicinity of LH Position. As Position Setpoint moves through the limp-home region, ULHc is updated to a positive or negative value (negative=closing force, positive=opening force) and added to the PID output in order to assist throttle control through the region.

Voltage added or subtracted to the PID output when Position Setpoint is in the vicinity of LH Position. As Position Setpoint moves through the limp-home region, ULHc is updated to a positive or negative value

(negative=closing force, positive=opening force) and added to the PID output in order to assist throttle control through the region.

U LH Lag [sec]



Tip strip: Lag filter time applied to the limp-home compensation. A lag time prevents uLHc from reversing directions too fast.

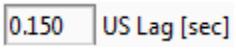
Lag filter time applied to the limp-home compensation. A lag time prevents uLHc from reversing directions too fast.

US (V)

Tip strip: Voltage added to or subtracted from the PID output when Primary Position is outside the vicinity of LH Position. US is a stiction compensation value. This parameter assists throttle control during small position errors to overcome stiction. Parameter uFc is updated to a positive or negative value according to the sign of Position Setpoint - Primary Position error and added to the PID output.

Voltage added to or subtracted from the PID output when Primary Position is outside the vicinity of LH Position. US is a stiction compensation value. This parameter assists throttle control during small position errors to overcome stiction. Parameter uFc is updated to a positive or negative value according to the sign of Position Setpoint - Primary Position error and added to the PID output.

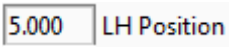
US Lag [sec]



Tip strip: Lag filter time applied to the stiction compensation. A lag time prevents uFc from reversing directions too fast.

Lag filter time applied to the stiction compensation. A lag time prevents uFc from reversing directions too fast.

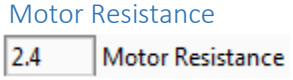
LH Position



Tip strip: Limp-Home Position. This is the default throttle position which results from no power being applied to the motor. If this parameter is not known, it can be set to any value and the Position Calibration process must be executed. The calculated LH Position will be updated in the Control Calibration Output cluster.

Limp-Home Position. This is the default throttle position which results from no power being applied to the motor. If this parameter is not known, it can be set to any value and the Position Calibration process must be executed. The calculated LH Position will be updated in the Control Calibration Output cluster.

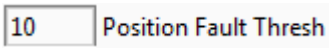
Motor Resistance



Tip strip: The resistance of the motor winding must be entered here. A digital multi-meter (DMM) can be used to measure this. This value is used to determine safe output ranges.

The resistance of the motor winding must be entered here. A digital multi-meter (DMM) can be used to measure this. This value is used to determine safe output ranges.

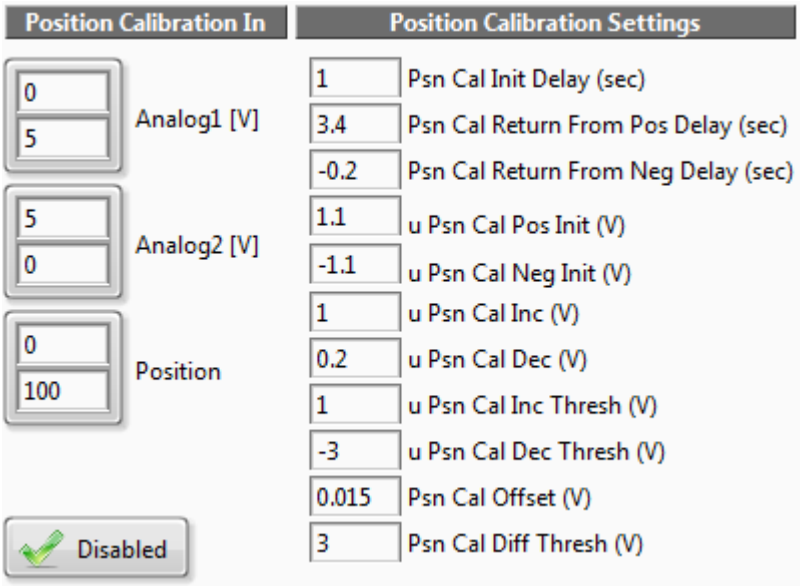
Position Fault Thresh



Tip strip: If the Secondary Position disagrees with the Primary Position by more than Position Fault Thresh, then Position Fault will be set to TRUE. Position Fault is not a latching Boolean output. It is continuously updated according to the latest position readings.

If the Secondary Position disagrees with the Primary Position by more than Position Fault Thresh, then Position Fault will be set to TRUE. Position Fault is not a latching Boolean output. It is continuously updated according to the latest position readings.

Position Calibration Settings



ATTENTION: This parameter should only be modified during IDLE mode. If this input is modified, then initialize must be set to TRUE for the new value to take effect.

This cluster provides position calibration data for both analog input signals within the Module Data cluster. This cluster contains three two-element arrays.

Typically, electronic throttle bodies have two position sensors for redundancy. If redundancy is required, the two analog input channels will be consumed for a single throttle body. If redundancy is not required, only one analog input channel needs to be used with a single position sensor signal on the throttle body.

The first two arrays, Analog1 (V) and Analog2 (V), contain the minimum and maximum position sensor signal voltages for Analog1 and Analog2, respectively.

Element 0: The position sensor signal voltage which corresponds to the minimum position of the throttle plate.

Element 1: The position sensor signal voltage which corresponds to the maximum position of the throttle plate.

The third array contains the position range of the throttle plate. The units for Position Range are arbitrary and correspond to the same units for Position Setpoint input and Primary Position output.

Element 0: The minimum position.

Element 1: The maximum position.

Notes:

If accurate position sensor signal voltages are already known, then they should be entered to this cluster and a position calibration process is not necessary. If it is desired to run a calibration process, then the AnalogX (V) values should be initialized with proper values for the calibration process to be successful. The analog input range for the DCM analog input channels is 0 to 5V.

If the polarity of the position sensor output is positive, then enter 0V for element-0 and 5V for element-1.

If the polarity of the position sensor output is negative, then enter 5V for element-0 and 0V for element-1.

Typically, electronic throttle bodies have redundant position sensors such that one of the signals will have positive polarity and the other will have negative polarity. The default values of the Position Cal In cluster is positive polarity of Analog1 and negative polarity of Analog2.

Analog1 [V]

Tip strip: Initial throttle position cal settings before auto-calibration.

Analog1 (V) contains the minimum and maximum position sensor signal voltages for Analog1.

Element 0: The position sensor signal voltage which corresponds to the minimum position of the throttle plate.

Element 1: The position sensor signal voltage which corresponds to the maximum position of the throttle plate.

Analog2 [V]

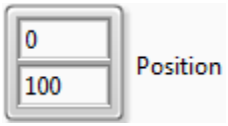
Tip strip: Initial throttle position cal settings before auto-calibration.

Analog2 (V) contains the minimum and maximum position sensor signal voltages for Analog2.

Element 0: The position sensor signal voltage which corresponds to the minimum position of the throttle plate.

Element 1: The position sensor signal voltage which corresponds to the maximum position of the throttle plate.

Position



Tip strip: Initial throttle position cal settings before auto-calibration.

Contains the position range of the throttle plate. The units for Position Range are arbitrary and correspond to the same units for Position Setpoint input and Primary Position output.

Element 0: The minimum position.

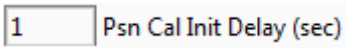
Element 1: The maximum position.

Disabled

Tip strip: Initialize calibration settings.

When TRUE, captures the Position Cal In and Primary Position inputs for proper position calibration. Do not set this input to TRUE during CONTROL mode.

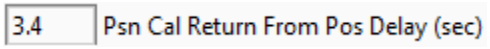
Psn Cal Init Delay (sec)



Tip strip: Throttle auto-position calibration settings

Time delay from the start of position calibration initialization phase to start of positive calibration. This time allows the throttle plate to return to the limp-home position before positive calibration.

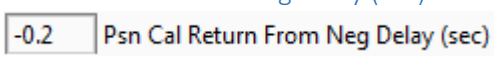
Psn Cal Return from Pos Delay (sec)



Tip strip: Throttle auto-position calibration settings

Time delay from the end of positive position calibration to start of negative calibration. This time must be long enough to allow the throttle plate to return to the limp-home position before negative calibration. Otherwise the limp-home position will not be properly detected.

Psn Cal Return from Neg Delay (sec)



Tip strip: Throttle auto-position calibration settings

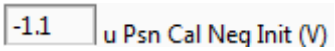
Time delay from the end of negative position calibration to start of post calibration phase. This time must be long enough to allow the throttle plate to return to the limp-home position before post calibration. Otherwise the limp-home position will not be properly detected.

u Psn Cal Pos Init (V)

Tip strip: Throttle auto-position calibration settings

The initial drive voltage to the throttle motor for positive position calibration. This voltage should be selected to move the throttle plate most of the way toward maximum position without hitting maximum position. This parameter should be a positive value.

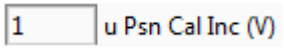
u Psn Cal Neg Init (V)



Tip strip: Throttle auto-position calibration settings

The initial drive voltage to the throttle motor for negative position calibration. This voltage should be selected to move the throttle plate most of the way toward minimum position without hitting minimum position. This parameter should be a negative value.

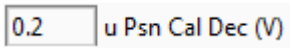
u Psn Cal Inc (V)



Tip strip: Throttle auto-position calibration settings

The incremental drive voltage to the throttle motor to keep the throttle plate moving toward maximum position. This incremental value is applied as necessary after the throttle plate stops moving due to the u Pos Cal Positive Init voltage. This parameter should be a positive value.

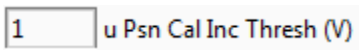
u Psn Cal Dec (V)



Tip strip: Throttle auto-position calibration settings

The decremental drive voltage to the throttle motor to keep the throttle plate moving toward minimum position. This decremental value is applied as necessary after the throttle plate stops moving due to the u Pos Cal Negative Init voltage. This parameter should be a negative value.

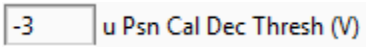
u Psn Cal Inc Thresh (V)



Tip strip: Throttle auto-position calibration settings

Threshold for incremental throttle motor positive voltage after the throttle plate stops moving. When this incremental threshold is reached, the drive stops and transitions to the negative calibration phase. This parameter should be a positive value.

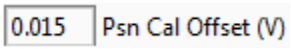
u Psn Cal Dec Thresh (V)



Tip strip: Throttle auto-position calibration settings

Threshold for decremental throttle motor positive voltage after the throttle plate stops moving. When this decremental threshold is reached, the drive stops and transitions to the post calibration phase. This parameter should be a negative value.

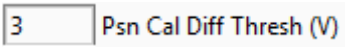
Psn Cal Offset (V)



Tip strip: Throttle auto-position calibration settings

The position calibration process tracks the primary position sensor signal as the throttle plate moves toward the minimum and maximum positions. This offset is the amount that the signal must change before the motor voltage increment/decrement reaches the specified threshold, terminating the calibration process for that direction. Typically, 0.005 V is adequate. If this parameter is 0, then the calibration process will push harder toward the minimum/maximum positions. The result of this can be that the minimum and maximum positions are difficult to achieve during control, and cause the final output to the throttle motor to exceed the limit. This parameter should be a positive value.

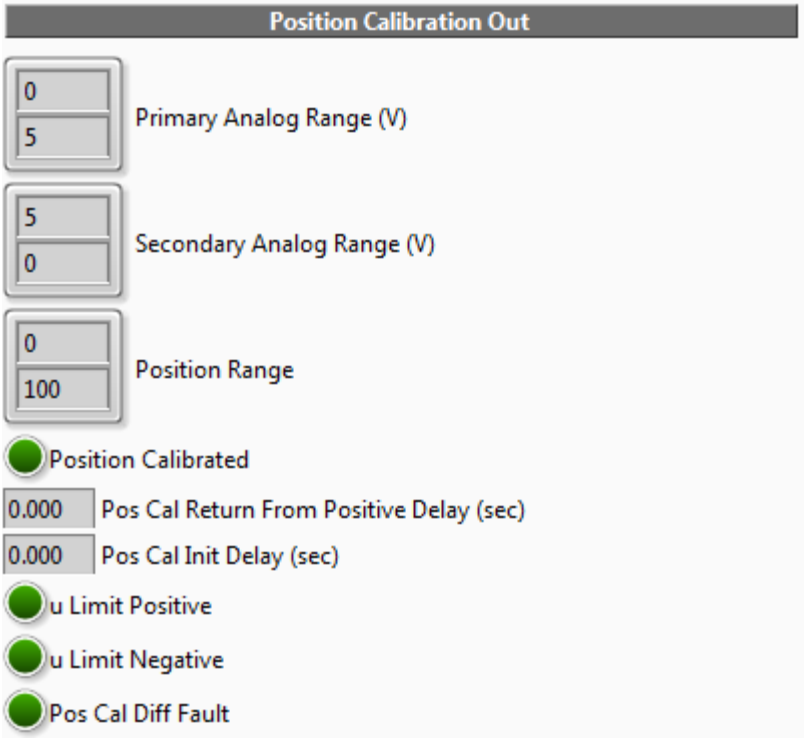
Psn Cal Diff Thresh (V)



Tip strip: Throttle auto-position calibration settings

At the completion of the position calibration process, the absolute value of the difference between the maximum and minimum position sensor signal voltages is compared against this threshold. If it is less than the threshold, then there was something wrong with the position calibration process because the throttle plate did not move through the expected range of travel, or the position sensor is faulty. This fault is indicated by the Pos Cal Diff Fault Boolean indicator within the Position Cal Out cluster.

Position Calibration Results



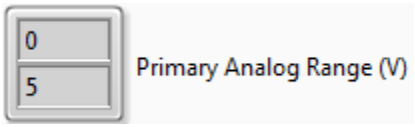
Initially, Position Cal Out will reflect the corresponding values of Position Cal In.

If the calibration process is not run, then Position Cal Out will continue to reflect the corresponding values of Position Cal In.

If the calibration process is run, then Position Cal Out parameters will be updated to the values learned from the calibration process.

The Primary Analog Range (V) and Secondary Analog Range (V) arrays will be set according to the value of Primary Position Boolean input.

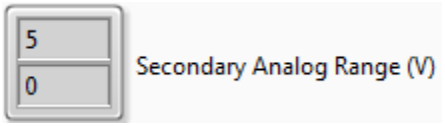
Primary Analog Range (V)



Tip strip: Final throttle position cal settings after auto-calibration

Values of the primary analog range learned during the calibration process.

Secondary Analog Range (V)



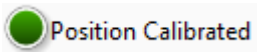
Tip strip: Final throttle position cal settings after auto-calibration

Values of the secondary analog range learned during the calibration process.

Position Range

Tip strip: Final throttle position cal settings after auto-calibration

Position Calibrated



Tip strip: Final throttle position cal settings after auto-calibration

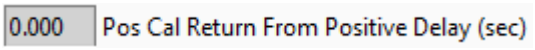
Indicates whether a successful calibration process was completed. This Boolean will NOT be set to TRUE if either of the following Booleans are set to TRUE:

u Limit Positive

u Limit Negative

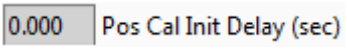
Pos Cal Diff Fault

Pos Cal Return from Positive Delay (sec)



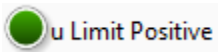
Tip strip: Adjusts the lag compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLag can be increased to slow the change in Position Setpoint.

Pos Cal Init Delay (sec)



Tip strip: Adjusts the lead compensation on the Position Setpoint value. A lead/lag compensation function is internally inserted in the Position Setpoint value to the internal PID function. TLead can be increased to intensify the change in Position Setpoint.

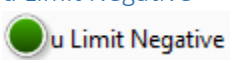
u Limit Positive



Tip strip: Final throttle position cal settings after auto-calibration

If throttle driver voltage limits are exceeded during the positive calibration process before the maximum position is discovered, then the u Limit Positive Boolean will be set to TRUE and Position Calibrated will be set to FALSE upon completion of the calibration process.

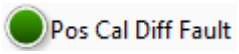
u Limit Negative



Tip strip: Final throttle position cal settings after auto-calibration

If throttle driver voltage limits are exceeded during the negative calibration process before the minimum position is discovered, then the u Limit Negative Boolean will be set to TRUE and Position Calibrated will be set to FALSE upon completion of the calibration process.

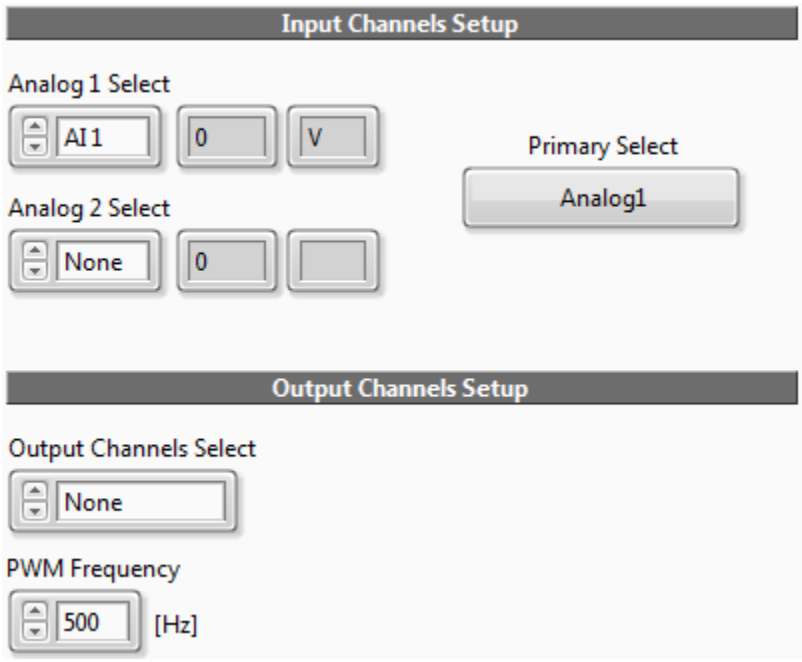
Pos Cal Diff Fault



Tip strip: Final throttle position cal settings after auto-calibration

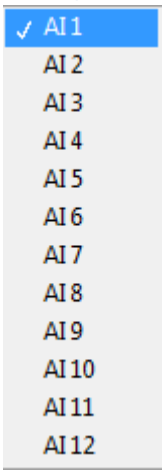
At the completion of the position calibration process, the absolute value of the difference between the maximum and minimum position sensor signal voltages is compared against the Pos Cal Diff Thresh (V) within the Position Cal Settings cluster. If it is less than the threshold, then there was something wrong with the position calibration process because the throttle plate did not move through the expected range of travel, or the position sensor is faulty. Such a fault is indicated by this Boolean when TRUE, and Position Calibrated will be set to FALSE upon completion of the calibration process.

Input/Output Channels Setup



This grouping specifies which analog inputs will be used for Analog 1 and Analog 2 (if applicable), which analog input is the primary, and which output channels will drive the throttle motor. A drive frequency can be specified as well.

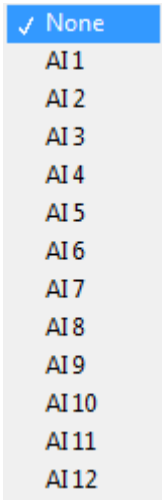
Analog 1 Select



Tip strip: Select Analog1 value

Specifies which analog input channel will be used for position sensor 1.

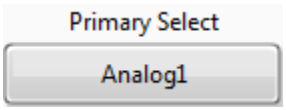
Analog 2 Select



Tip strip: Select Analog2 value

Specifies which analog input channel will be used for position sensor 2.

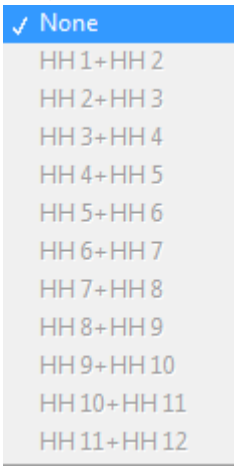
Primary Select



Tip strip: Selects Analog1 or Analog2 as the primary input. The secondary analog input is used as a redundancy check.

Selects Analog1 or Analog2 as the primary input. The secondary analog input is used as a redundancy check.

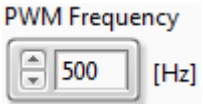
Output Channels Select



Tip strip: Index of selected FullH channel. (Max=10, Min=-2)

Selects which pair of HH (FullH) channels will drive the throttle motor.

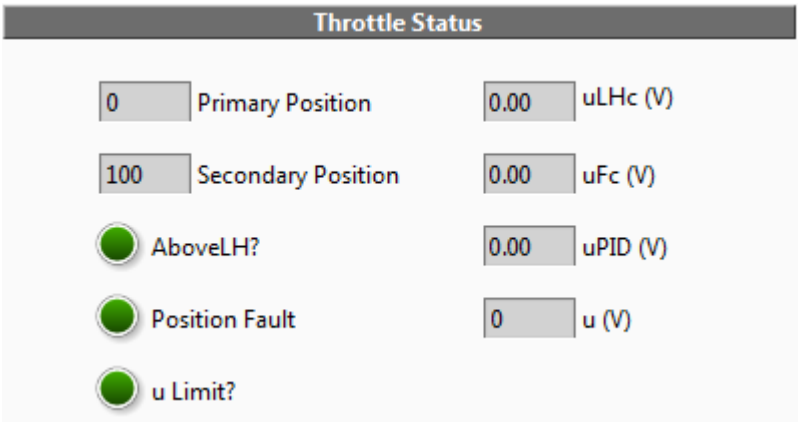
PWM Frequency



Tip strip: Specifies the throttle PWM operating frequency. (Max=5000, Min=50)

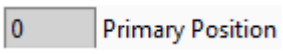
Specifies the drive frequency for the throttle channel.

Throttle Status



Tip strip: Throttle control algorithm results

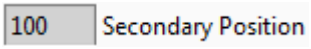
Primary Position



Tip strip: Primary Position reports the position of the throttle valve according to the primary calibration data stored in Position Cal Out cluster.

Primary Position reports the position of the throttle valve according to the primary analog input.

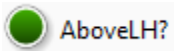
Secondary Position



Tip strip: Secondary Position reports the position of the throttle valve according to the secondary calibration data stored in Position Cal Out cluster.

Secondary Position reports the position of the throttle valve according to the secondary analog input.

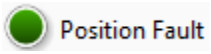
AboveLH?



Tip strip: Indicates whether Primary Position is above LH Position.

Indicates whether Primary Position is above LH Position.

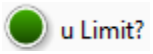
Position Fault



Tip strip: If the Secondary Position disagrees with the Primary Position by more than Position Fault Thresh, then Position Fault will be set to TRUE.

If the Secondary Position disagrees with the Primary Position by more than Position Fault Thresh, then Position Fault will be set to TRUE.

u Limit?



Tip strip: Indicates whether the final desired voltage output to the throttle motor exceeds the current limit of the driver.

Indicates whether the final desired voltage output to the throttle motor exceeds the current limit of the driver, which is 4A.

uLHc (V)

Tip strip: Contribution from limp-home compensation algorithm.

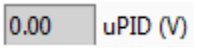
Contribution from limp-home compensation algorithm.

uFc (V)

Tip strip: Contribution from friction compensation algorithm.

Contribution from friction compensation algorithm.

uPID (V)



Tip strip: Contribution from PID control algorithm.

Contribution from PID control algorithm.

u (V)

0 u (V)

Tip strip: Total calculated output voltage from three contributions.

The final voltage output, u (V), to the throttle motor is according to the following:

u (V) = uPID (V) + uLHc (V) + uFc (V)

where:

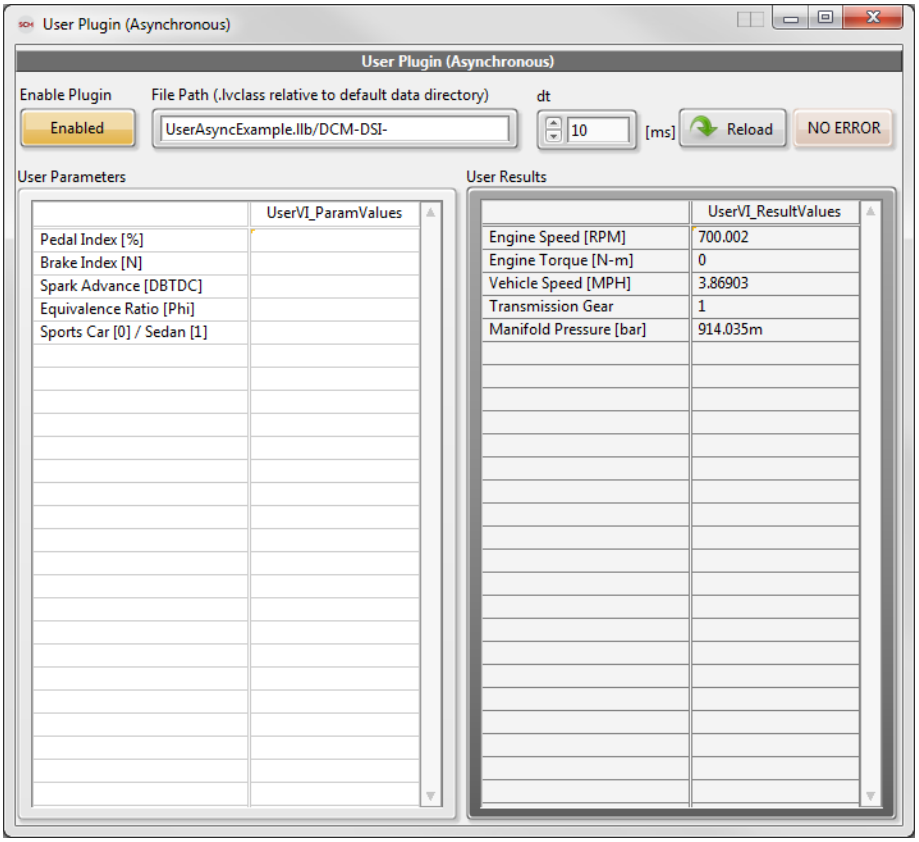
u (V): Total calculated output voltage from three contributions.

uPID (V): Contribution from PID control algorithm.

uLHc (V): Contribution from limp-home compensation algorithm.

uFc (V): Contribution from friction compensation algorithm.

User Plugin



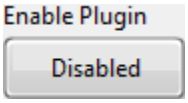
The User Plugins allow DCM DSI users to add their own custom VIs into the DSI software in three different places: the control layer, the engine layer, and an asynchronous layer. In the control layer, users can add different control algorithms to the DSI code, such as a fuel trim algorithm or a spark timing algorithm. In the engine layer, users can add engine-specific algorithms to enhance the

capabilities of the DSI, such as a rail pressure control algorithm that takes advantage of the particular hardware on the engine the DSI is running. The asynchronous plugin can be used to add an asynchronous model to the software; the DSI includes a vehicle simulation model that can be used to simulate a vehicle interfacing with the DCM while it drives loads connected to its I/O channels.

All three User Plugins (Control, Engine, and Asynchronous) have the same user inputs and operate in largely the same way. The DCM ships with three default user plug ins. The User Plugin (Control) has a fuel control algorithm that requires a UEGO sensor lambda input on one of the analog input channels and then calculates the total fuel quantity for the engine. The User Plugin (Engine) has a PID rail pressure controller very similar to the ones available in the Rail Pressure Control Setup windows. The User Plugin (Asynchronous) has a vehicle simulation that takes pedal position and brake force inputs from analog input channels and then calculates engine speed, vehicle speed, and other parameters which can be used by the injection and other channels to simulate a vehicle driving while pulsing the injectors.

Users can develop their own User Plugins by downloading the NI DCM DSI LabVIEW open source example project. The project contains template User Plugin VIs for each of the three instances for users to modify. Users must take care when producing their own User Plugin VIs that they keep the same VI names and maintain the same inputs and outputs. The object-oriented framework in which the User Plugin VIs operate requires them to have the specific names that the template VIs already have and identical inputs and outputs in order to execute properly. For more information about how to create User Plugin VIs, look for the NI Powertrain Controls Group Community Page and the tutorial videos on how to use the DCM DSI software.

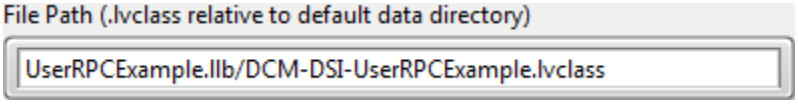
Enable



Tip Strip: Enables the User plugin

This control enables the user plugin to operate.

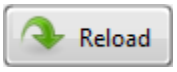
File Path



Tip Strip: Custom user VI filename (with extension) or relative path with respect to the LabVIEW default data directory.

This control enables the user to input the file path to their User Plugin VI.

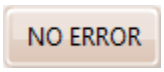
Reinitialize



Tip Strip: Reinitializes the User plugin at the specified path

This control reinitializes the User Plugin at the specified path.

Error



Tip Strip: Indicates if there is an error loading or running the selected plugin.

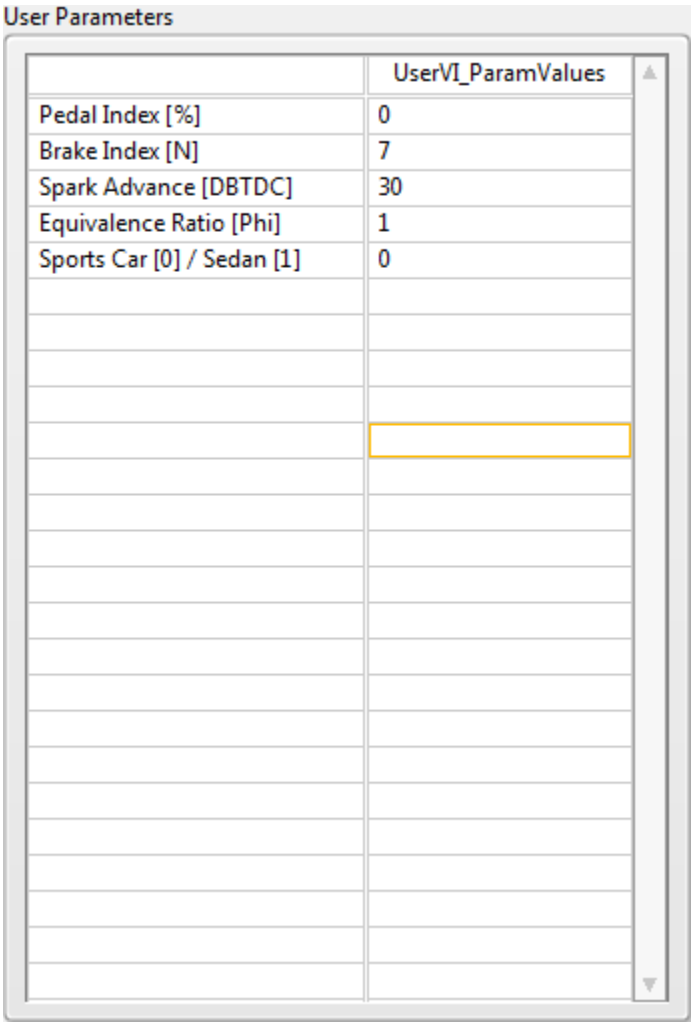
This control indicates the presence of an error either loading or running the selected plugin.

Asynchronous Loop Period

Tip Strip: Specified Asynchronous Loop Period in ms. Loop times are not guaranteed.

This control sets the asynchronous loop time in milliseconds for the asynchronous user plugin. The exact loop time is not guaranteed to be exactly the value in the control.

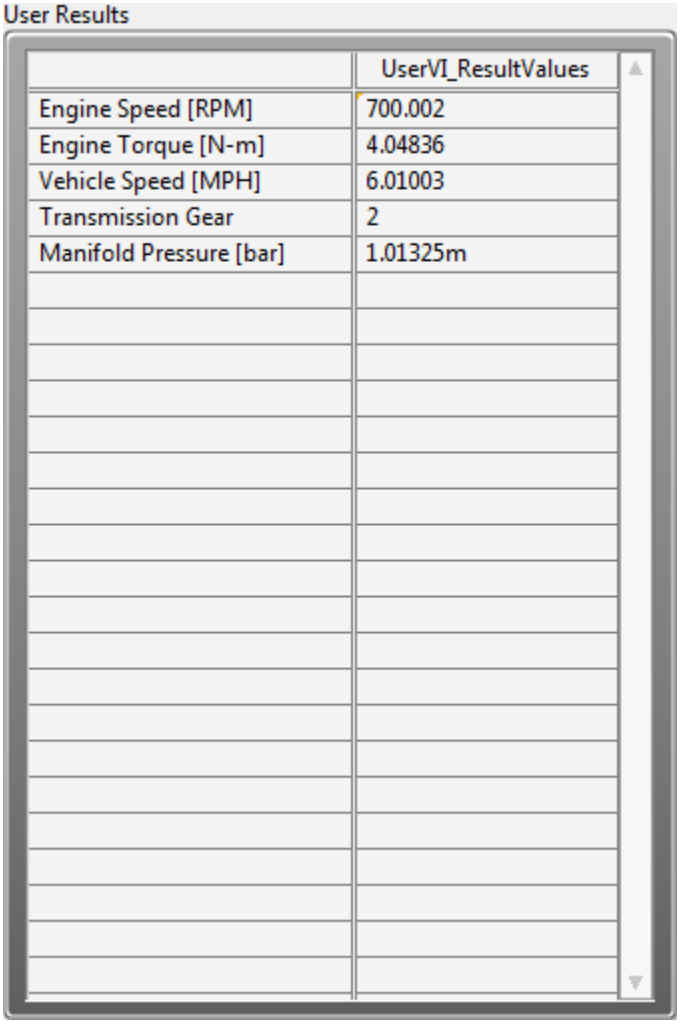
User Parameters



Tip Strip: List of customizable parameter names and values.

This control shows all the parameters and inputs accepted by the User Plugin VI. The list is populated from the User Plugin VI, and the names in the list are editable in User Plugin VI. The values, however, are editable from the User Plugin window in SCM.

User Results



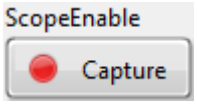
Tip Strip: List of customizable user results.

This list shows the outputs of the User Plugin VI. Depending upon how the User Plugin VI is programmed, the results are accessible to other parts of the DCM DSI software.

DI Scope

The DI scope gives you visibility in to what the various DCM channel output waveforms look like. The chart update rate is approximately one update per second. Up to 4 channels can be plotted at the same time.

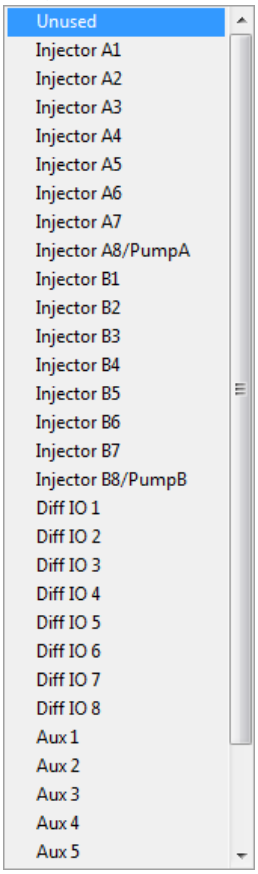
ScopeEnable



Tip strip: Command to capture selected event

Analogous to arming the trigger on an oscilloscope. The waveforms plots will be updated with every new scope event.

ScopeEvent



Tip strip: Selects event to capture

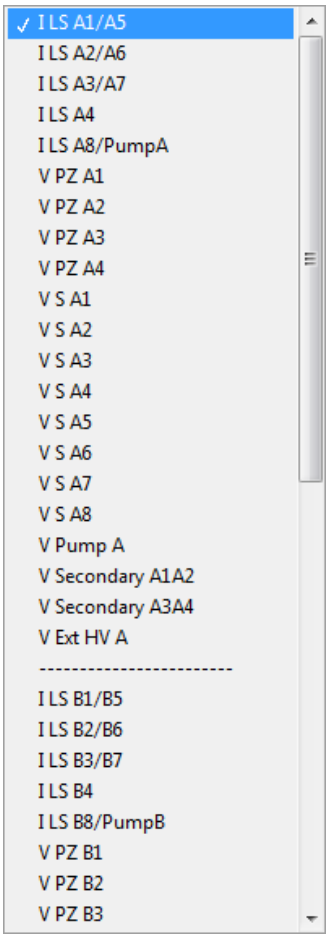
Specifies which type of event will trigger a waveform capture.

Injector A1 through A8/PumpA and Injector B1 through B8/PumpB: When these types of events are selected, the scope will attempt to capture each injection event from that channel and scale the time axis to display the entire event.

Diff IO X: When these types of events are selected, the scope will attempt to capture the signals that occur at the rising edge of the digital input signal and scale the time axis to display the duration of the signal manipulation. The DiffIO setup has an invert function that can be used to manipulate the way an external signal triggers the scope.

Aux X: When these types of events are selected, the scope will attempt to capture the signals that occur at the rising edge of the digital input signal and scale the time axis to display the duration of the signal manipulation.

ChanSelect1-4



Tip strip: Selects fast ADC channel to be displayed to the graph

Specifies which internal channel or analog input to display on the graph. Selections beginning with an “I” will display their current and selections begging with a “V” will display their voltage.

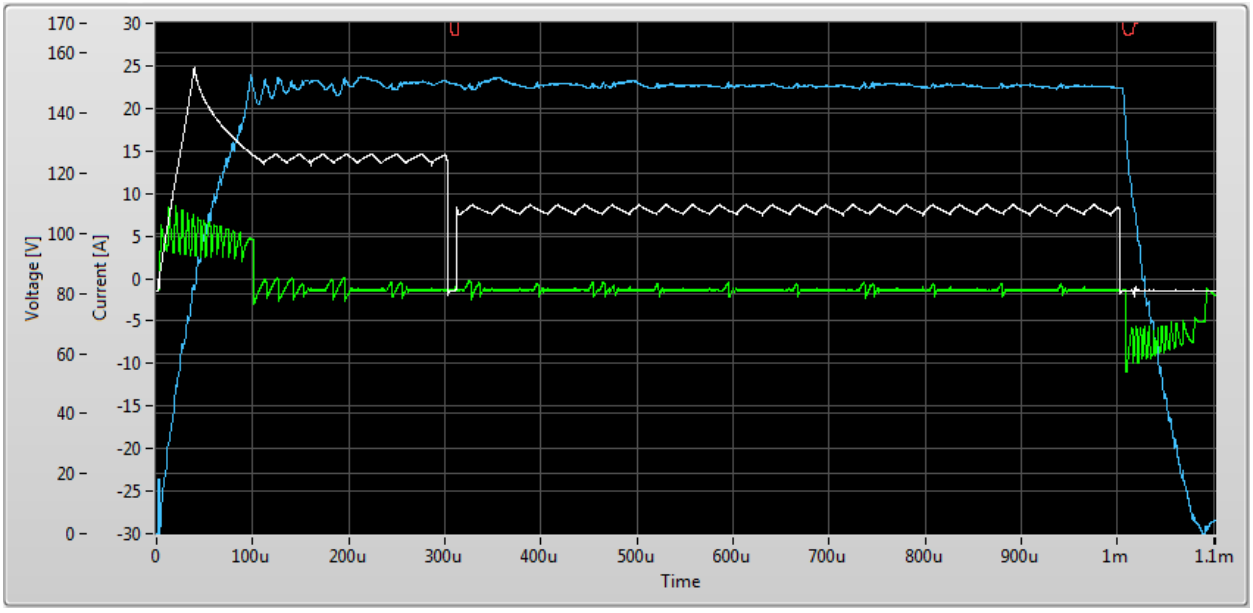
Plot Controls

Controls to zoom in, zoom out, and pan the plot area.

Legend

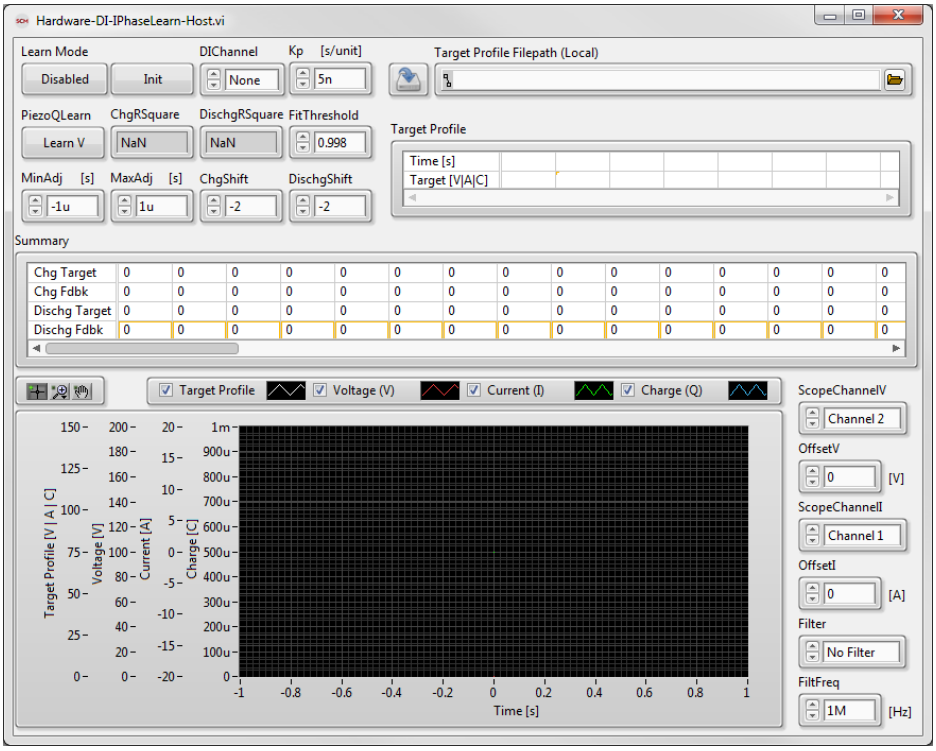
Controls to display or hide a waveform.

Plot



Tip strip: Displays selected high speed analog waveforms

DI IPhase Learn



Target Profile Filepath

Tip strip: Local file path to load/save a target profile CSV.

Specifies a file path on the local (host) computer to a text file containing target profile data. CSV file format is as follows:

t0,X0
t1,X1
t2,X2
…

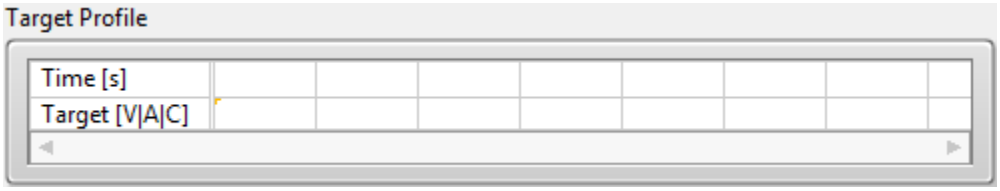
Where t = time in seconds and X = Volts, Amps, or Coulombs

Save File

Tip strip: Save Profile

Saves to an existing file path or prompts to create a new file.

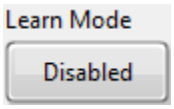
Target Profile



Tip strip: View / edit target profile

Editable display of the loaded target profile CSV. Changes must be saved.

Learn Mode



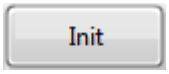
Tip strip: Enables profile learn mode

Profile learn mode enables a user to leverage the DI Phase Array Custom Profile settings in order to closely match a desired nominal injector current, voltage, or charge waveform. When enabled, learn mode will gradually adjust the custom profile based on DI Scope feedback and a proportional constant. To use learn mode, the following settings must first be manually configured on the relevant host VIs:

- All settings normally required to enable injection (MPRD, I/O Lock, etc.)
- DI Phase Settings (custom profile, etc.)
- DI Custom Profile Adapt (enabled)
- DI Scope Settings (triggering, channel selection)
- DI Command Settings (cal duration, default phase index, etc.)

CAUTION: It is highly recommended to use a one-shot command when first using the learn feature. If improperly configured or tuned, the algorithm may apply rapid changes to the current profile and could possibly damage injector hardware if left to continue unchecked.

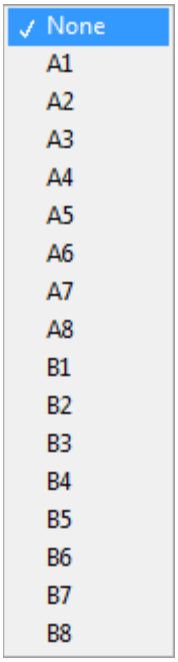
Initialize



Tip strip: Re-Initialize (zero) learned profile data

Resets the learned profile to a baseline waveform of zero duration for all elements.

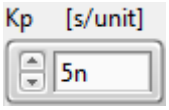
DIChannel



Tip strip: Selects the DI channel used for IPhase learning.

DI channel selection is used to index command and phase array information from DI settings and route custom profile information to the correct DI bank.

Kp



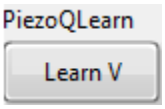
Tip strip: Proportional constant. Piezo(V) ~5ns/V; Piezo(Q) ~500us/C; Solenoid(I) ~5ns/A

This parameter controls the rate at which the learning algorithm attempts to adjust to the target profile. Different proportional constants may be required depending on target profile units. Recommended values are given below:

- Piezo(V) ~ 5 ns/V
- Piezo(Q) ~ 500 us/V

- Solenoid(I) ~ 5 ns/A

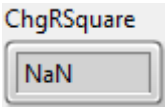
PiezoQLearn



Tip strip: Toggles between piezo learn modes Voltage (V) and Charge (Q).

Allows the user to select between Voltage(V) and Charge(Q) modes when learning piezo injector profiles. In Voltage mode, feedback information is based directly on DI Scope measurements. In Charge mode, feedback information is calculated by integrating DI Scope current measurements.

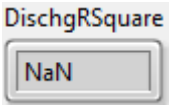
ChgRSquare



Tip strip: Charge fit "goodness"

R-Square result of a line fit performed on the feedback waveform versus the target waveform of the charge phase.

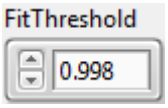
DischgRSquare



Tip strip: Discharge fit "goodness"

R-Square result of a line fit performed on the feedback waveform versus the target waveform of the discharge phase.

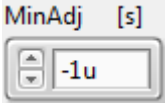
FitThreshold



Tip strip: When this R-square value is met, learning is disabled. (Max=1, Min=0)

When Min (ChgRSquare, DischgRSquare) is greater than this threshold, Learn Mode is coerced to Disabled (though injection may continue and all values are retained).

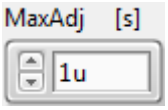
MinAdj



Tip strip: Minimum profile adjustment per step. (Max=0, Min=-Inf)

Sets the minimum duration adjustment (or maximum negative adjustment) of each Custom Profile element per step during the learning process.

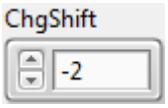
MaxAdj



Tip strip: Maximum profile adjustment per step. (Max=Inf, Min=0)

Sets the maximum duration adjustment (or maximum positive adjustment) of each Custom Profile element per step during the learning process.

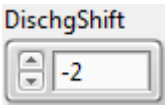
ChgShift



Tip strip: Shifts learned profile adjustment phasing by N elements. (Max=63; Min=-63)

Shifts learned profile adjustment phasing by N elements. Each element has length Period [s] as specified by the IPhase array. This accounts for lag in scope traces with respect to the real signal. (Max=63, Min=-63)

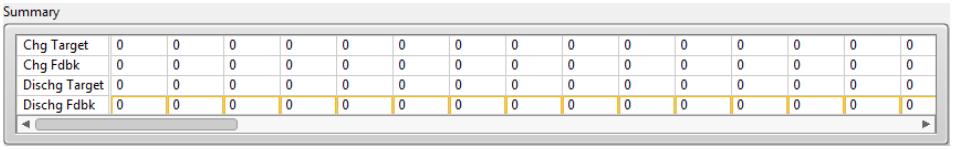
DischgShift



Tip strip: Shifts learned profile adjustment phasing by N elements. (Max=63; Min=-63)

Shifts learned profile adjustment phasing by N elements. Each element has length Period [s] as specified by the IPhase array. This accounts for lag in scope traces with respect to the real signal. (Max=63, Min=-63)

Summary



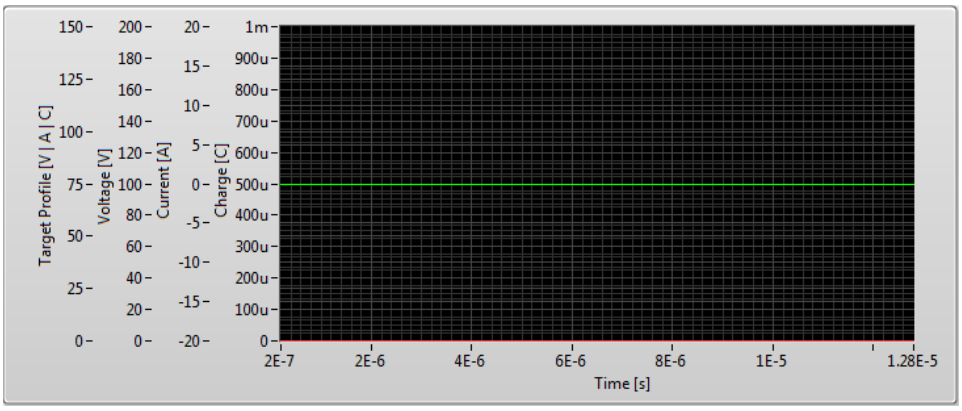
Tip strip: Summary of binned target vs feedback data in Volts, Amps, or Coulombs.

Summary of binned target vs feedback data in Volts, Amps, or Coulombs for both charge (solenoid/piezo) and discharge (piezo only) phases.

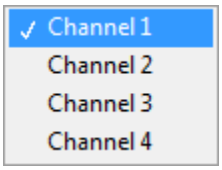
Plot Controls

Legend

Plot

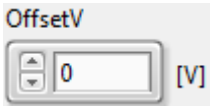


ScopeChannelV



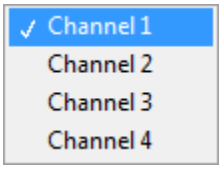
Tip strip: Selects the scope channel used for measuring injector voltage. (Max=3, Min=0)

OffsetV



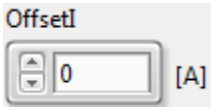
Tip strip: Scope offset to account for DC error.

ScopeChannelI



Tip strip: Selects the scope channel used for measuring injector current. (Max=3, Min=0)

OffsetI



Tip strip: Scope offset to account for DC error.

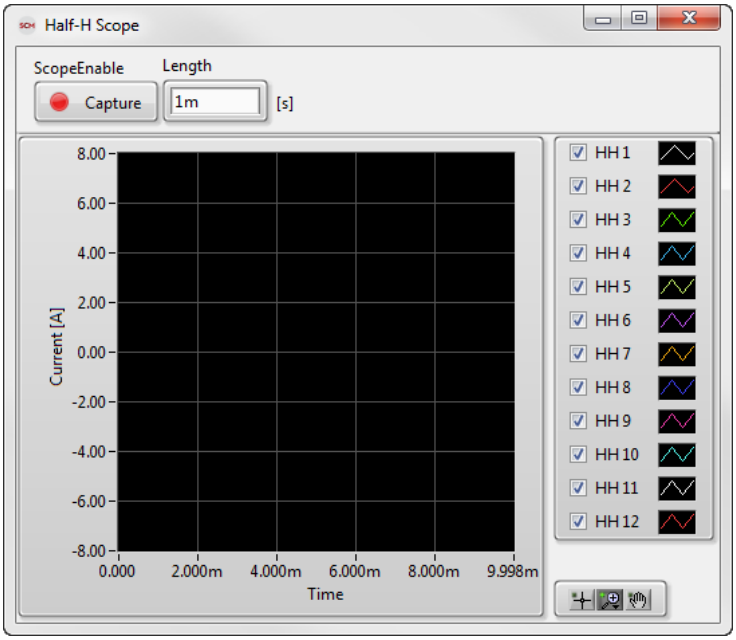
Filter

Tip strip: Selects a filtering option for incoming scope signals.

FiltFreq

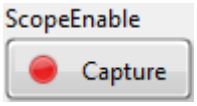
Tip strip: Sets the lowpass filter frequency for incoming scope signals.

HH Scope



The HH scope gives you visibility in to what the various DCM HH channel output waveforms look like. The chart update rate is approximately one update per second. Up to 12 channels can be plotted at the same time.

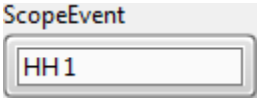
Scope Enable



Tip strip: Command to capture selected event

Analogous to arming the trigger on an oscilloscope. The waveforms plots are updated when a new scope event occurs.

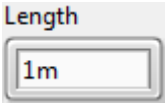
Scope Event



Tip strip: Selects event to capture

Selects the Half-H channel whose events will trigger the scope to update.

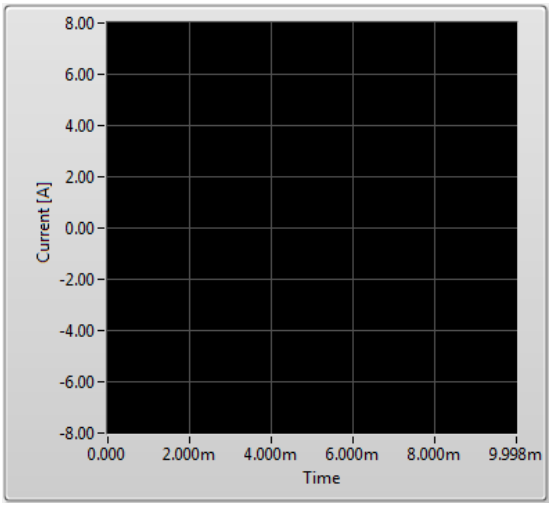
Length



Tip strip: Sets the scope capture duration. If above 8.5ms (or 5kS @ 1.7us/S), the HH Scope will downsample to maintain RT performance.

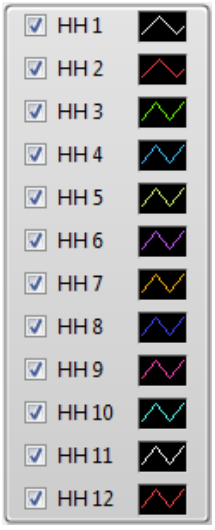
Specifies the time length to capture.

Plot



Tip strip: Shows Half-H channel current values

Legend/Signal Display Selection

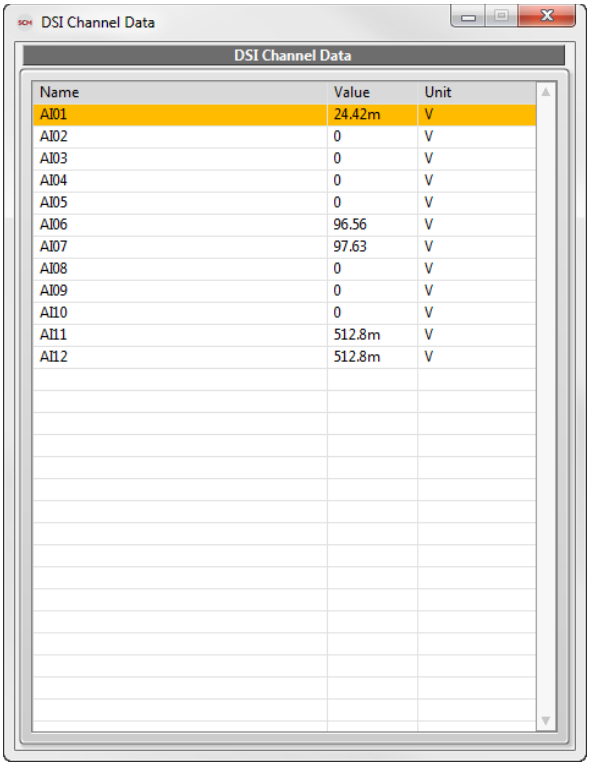


Controls to display or hide a waveform.

Plot Controls

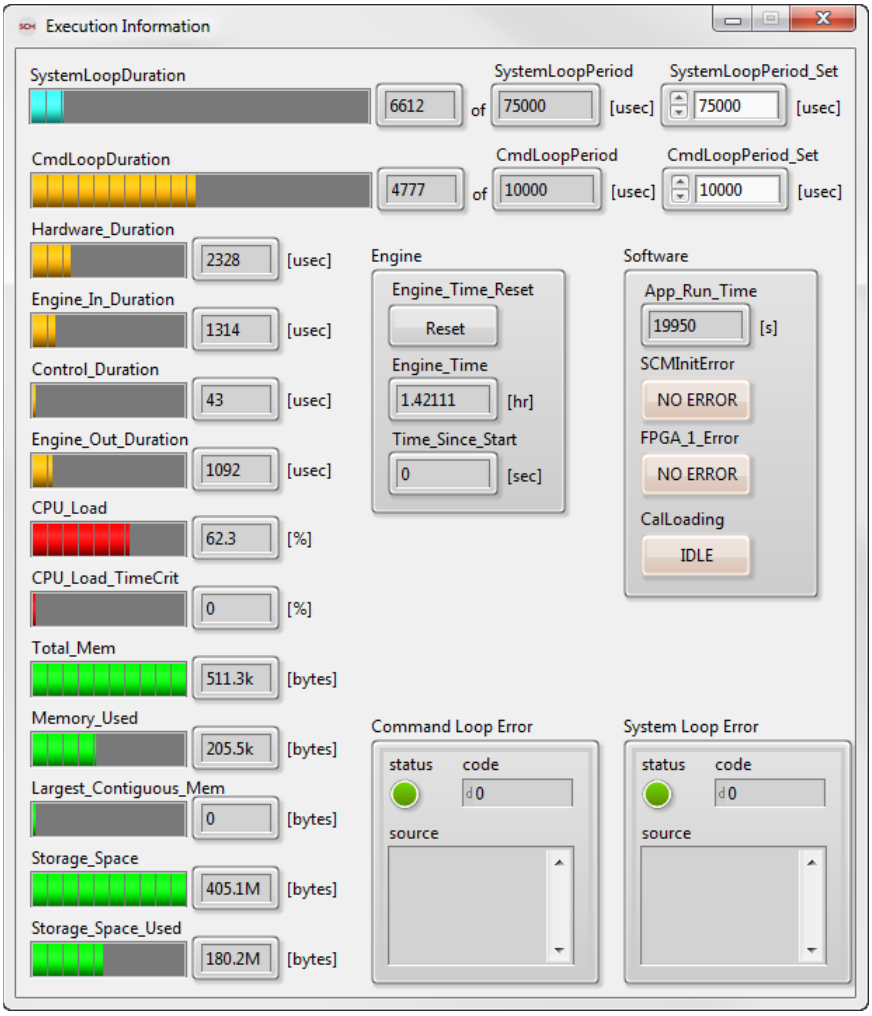
Controls to display or hide a waveform.

Channel Data



This is a list of analog input values, their current reading, and applicable units.

Execution Information



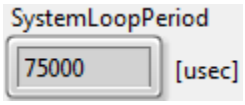
This VI is a summary of the status of the controller and the DSI application.

System Loop Duration

Tip Strip: Main RT loop period

How long the execution length of the previous iteration of the System Loop was in microseconds. The duration is relative to the start of the iteration.

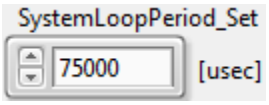
System Loop Period



Tip Strip: Main RT loop period

The amount of time that has elapsed in microseconds between two subsequent iterations of the System Loop.

System Loop Period Setting



Tip Strip: System RT loop period setpoint (Max=100000, Min=50000)

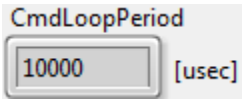
Specifies the amount of time in microseconds that elapses between two subsequent iterations of the System Loop.

Command Loop Duration

Tip Strip: Control RT loop execution time

How long the execution length of the previous iteration of the Command Loop was in microseconds. The duration is relative to the start of the iteration.

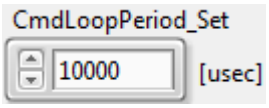
Command Loop Period



Tip Strip: Control RT loop period

The amount of time that has elapsed in microseconds between two subsequent iterations of the Command Loop.

Command Loop Period Setting



Tip Strip: Control RT loop period setpoint (Max=15000, Min=5000)

Specifies the amount of time in microseconds that elapses between two subsequent iterations of the Command Loop.

Hardware Duration

Tip Strip: Hardware Frame process time in the Main RT Timed Loop

The amount of time in microseconds that are spent in the Hardware In/Hardware Out frame of the Command Loop.

Engine In Duration

Tip Strip: Engine In Frame process time in the Main RT Timed Loop

The amount of time in microseconds that are spent in the Engine In frame of the Command Loop.

Control Duration

Tip Strip: Control Frame process time in the Main RT Timed Loop

The amount of time in microseconds that are spent in the Control frame of the Command Loop.

Engine out Duration

Tip Strip: Engine Out Frame process time in the Main RT Timed Loop

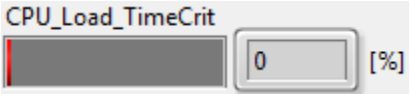
The amount of time in microseconds that are spent in the Engine Out frame of the Command Loop.

CPU Load

Tip Strip: CPU Load

The percentage of the CPU's load capacity that is being utilized.

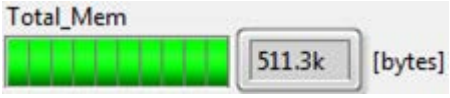
CPU Critical Load Time



Tip Strip: CPU Load

The percentage of the CPU's load capacity that is dedicated to time critical operations.

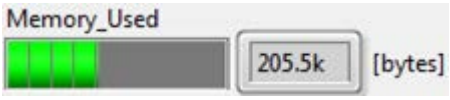
Total Memory Available



Tip strip: Total CPU memory

Total amount of physical memory available on the target.

Memory Used



Tip strip: Memory used

Amount of free physical memory available on the target.

Storage Space

Tip strip: Controller (remote target) storage space total

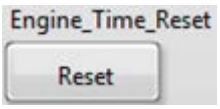
Total storage space available on the target's non-volatile memory (file system).

Storage Space Used

Tip strip: Controller (remote target) storage space used

Space used on the target's non-volatile memory (file system).

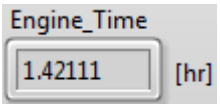
Engine Time Reset



Tip strip: Resets the total engine run time logged in the .ini file

Resets the total engine run time logged in the .ini file on the target to zero.

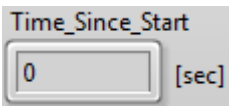
Engine Time



Tip strip: Indicates the total engine run time in hours

Indicates the total engine run time in hours. Time is added only while the engine is in SYNC.

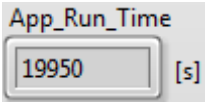
Time Since Start



Tip strip: Engine Run Time since Engine Status = RUNNING

Indicates the time elapsed since the last engine start. Time is added only while the engine is RUNNING.

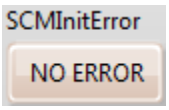
Application Run Time



Tip strip: Application run time (seconds)

Elapsed time since the RT application started execution.

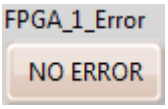
SCM Initialization Error



Tip strip: Indicates whether or not SCM initialization is successful

Indicates if any errors occurred during initialization of SCM.

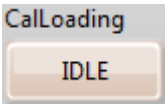
FPGA 1 Error



Tip strip: Indicates FPGA did not load. FPGA Recompile may be required.

Indicates whether an error occurred while attempting to open a FPGA reference to the DCM hardware.

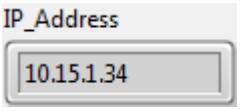
Calibration File Loading Error



Tip strip: Indicates SCM is live-loading a calibration file.

Indicates the status of live-loading a calibration file.

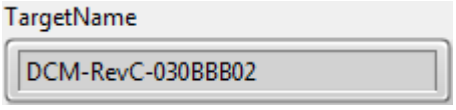
IP Address



Tip strip: Network IP Address

IP address of the connected DCM.

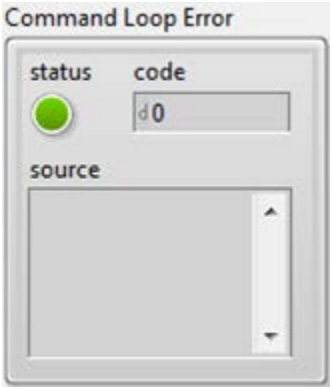
Target Name



Tip strip: Indicates the target name as shown in MAX

This is the DCM Target's name as it appears in MAX.

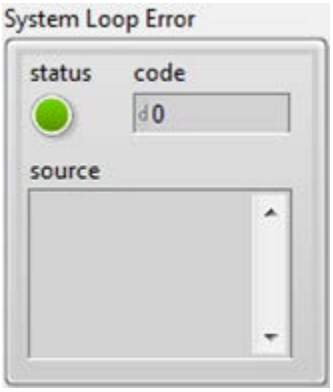
Command Loop Error



Tip strip: Command loop error message

Any error reported from the command loop is shown here.

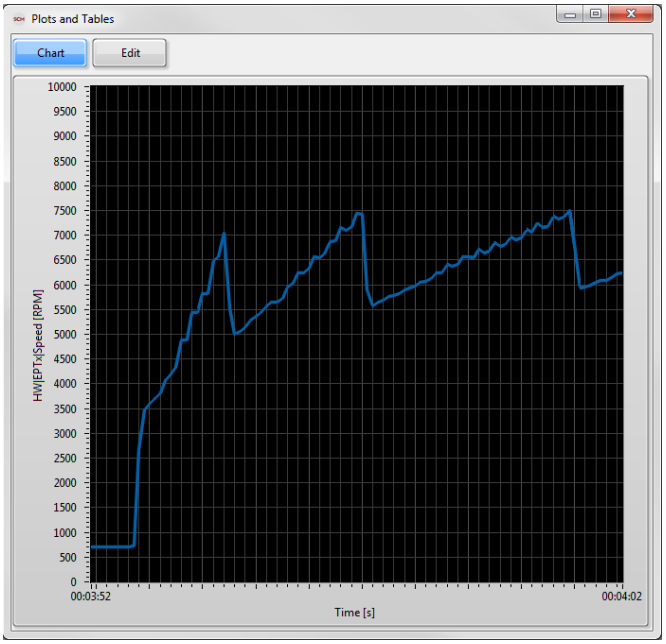
System Loop Error



Tip strip: System loop error message

Any error reported from the system loop is shown here.

Plots and Tables

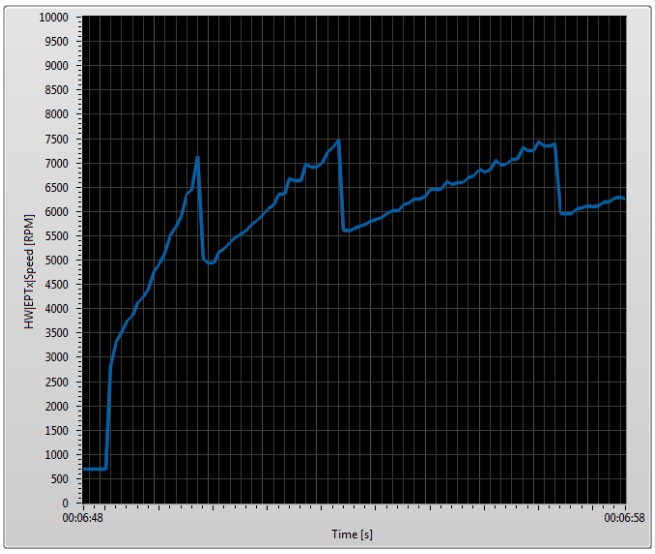


The plots and tables subhost allows users to plot specific pieces of data of interest together in one window.

Mode Buttons

The mode buttons switch between showing the selected signals on a chart and showing their instantaneous values in a table.

Chart



The chart shows the selected signals evolving over time. Its vertical axis can be resized by clicking on the maximum value and resetting it.

Plot List

The Plot List allows users to add and remove signals to be plotted by right clicking on the list and selecting either ‘Insert/Edit’ or ‘Delete.’ It remains docked in the main DCM DSI host window.

Customizing the NI DCM DSI

There are two primary ways to customize the DCM DSI. Users can add functionality by creating plug-ins in LabVIEW or make significant changes by modifying the source code.

NOTE LabVIEW development licenses are required to create or modify DCM plug-ins and source code

User Plug-ins

User plug-ins allow users to add functionality to the DCM DSI without needing to modify the DCM DSI source code. Plug-in templates are required to generate a plug-in and are available in conjunction with the open source project.

TIP Open the DCM DSI source code in LabVIEW to better understand the real-time architecture

User Plug-in (Asynchronous)

This plug-in allows users to add functionality that executes independently of the timed loops executing in the DCM DSI. Because this VI executes outside of timed loops, its determinism is greatly reduced compared to the in-line plugins.

User Plug-in (Control)

This plug-in allows users to add functionality that executes in-line with the Command timed loop in the DCM DSI. The User Plug-in (Control) is the last item to execute in the Control frame of the Command timed loop.

User Plug-in (Engine)

This plug-in allows users to add functionality that executes in-line with the Command timed loop in the DCM DSI. The User Plug-in (Engine) is the last item to execute in the Engine Out frame of the Command timed loop.

TIP The Command timed loop consists of four frames executed in the following order: (1) Hardware I/O, (2) Engine In, (3) Control, (4) Engine Out

Open Source Software

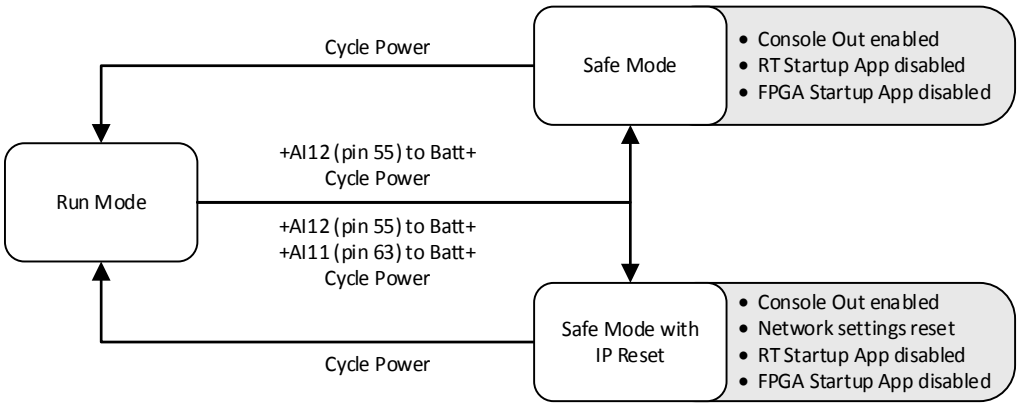
The latest version of the DCM DSI project is provided open source by National Instruments. The download link is available on ni.com.

Troubleshooting the NI DCM DSI

Safe Mode and IP Reset

The following figure shows the reset behavior of the DCM.

Figure 2 Reset Behavior



LED Indicators

The following table describes the DCM LED indicators.

Table 1. LED Indicators

LED Name	LED Color	LED Pattern	Indication
POWER/LOCK	Green	Solid	The DCM is powered on and I/O is Unlocked
	Amber	Solid	The DCM is powered on and I/O is Locked
	-	Off	The DCM is powered off.
STATUS	Amber	2 Flashes	The DCM has detected an error in its software. This usually occurs when an attempt to update the software is interrupted. Reinstall software on the DCM. Refer to the *Measurement & Automation Explorer Help* for information about installing software on the chassis.
	Amber	3 Flashes	The chassis is in safe mode. Refer to the *Measurement & Automation Explorer Help* for information about safe mode.
	Amber	4 Flashes	The software has crashed twice without rebooting or cycling power between crashes. This usually occurs when the chassis runs out of memory. Review your RT VI and check the memory usage. Modify the VI as necessary to solve the memory usage issue.

	Amber	Continuous Flashing or Solid	The DCM has detected an unrecoverable error. Contact National Instruments.
USER 1 (DSI App)	Green	Continuous Flashing	The DCM DSI real-time application has booted and is operating normally.
USER 2 (DSI App)	-	Off	No faults
	Amber	2 Flashes	Indicates DI Bank A fault
	Amber	3 Flashes	Indicates DI Bank B fault
	Amber	4 Flashes	Indicates Half-H Driver fault
	Amber	5 Flashes	Indicates DCM system fault
	Amber	Long Flash	Indicates Miscellaneous fault
ACT/LINK	-	Off	No Ethernet link
	Green	Solid	Ethernet link established
	Green	Blink	Ethernet activity occurring
10/100/1000	-	Off	10 Mbps
	Green	Solid	100 Mbps
	Amber	Solid	1000 Mbps

DCM Tools

Included as part of the DCM DSI, the DCM Tools are executable files stored in the real-time target's default data directory and downloaded along with the DCM DSI host files to <My Documents>/LabVIEW Data/SCM Data.

DCM EEPROM Calibration

The DCM *Calibration* tool allows users to customize the gains and offsets of analog to digital converters (ADCs) and digital to analog converters (DACs) stored in the DCM's EEPROM. The objective of the *Calibration* tool is to give users the ability to precisely calibrate their circuits in the event of drift. Calibration values can be tuned by +/- 5% of factory defaults.

DI Simulation

The *DI Simulation* tool allows users to test injector settings (e.g., current/voltage phase, pulsewidths, frequencies, etc.) on the host computer without DCM hardware. The *DI Simulation* tool uses the same software implemented in the DCM FPGA along with an injector model to simulate injector behavior, including power estimation. The simulator also gives users the ability to configure and save injection profiles without having access to the DCM hardware.

DCM Firmware Updates

The NI DCM requires two separate firmware packages, one for the sbRIO-9651 SOM and a second for the DCM I/O board. To update the firmware on the SOM, view the *System Settings* window in MAX and click the *Update Firmware* control. To update the DCM I/O board firmware, use the *Firmware Update* executable in the SCM Data directory.

Frequently Asked Questions

Q: How long does it take for my DCM to boot DSI?

A: Approximately 60 seconds.

Q: What version of SCM should I install for my DCM?

A: The first four digits of the DCM DSI release number indicate SCM compatibility (e.g., DCM DSI 2016.X.X.X indicates SCM 2016 compatibility).

Q: What should I do if I do not know the version of SCM needed for my DCM's software?

A: Download and install the most recent version of SCM. Then, follow the process for *Updating or Restoring the DCM DSI* to update the software on the DCM to the latest version available.

Q: Do I need a license for NI SCM?

A: Basic DCM DSI operation using the SCM Console does not require a development license of SCM. When installing SCM without a development license, select *evaluation* when prompted. A development license is required, however, to modify the DCM DSI source code or use SCM features when developing user plug-ins.

Q: I just updated the image on my DCM. Now I can't connect to it with SCM. What do I do?

A:
First, make sure the recently installed image is compatible with installed version of SCM. Next, check that the DCM User 1 LED is flashing, which indicates the real-time software is running. If the User 1 LED is not flashing, you may need to update the firmware on your DCM. See the section *Software Maintenance for the NI DCM DSI* for more information.