Stand Alone Direct Injector Driver System
User's Manual
D000103 3 Channel
D000100 6 Channel
D000101 9 Channel
D000102 12 Channel

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HIGH VOLTAGE: This device normally operates at voltages up to 150 volts. Extreme care should be taken to protect against shock. Even when the device is completely powered down, allow approximately three minutes for the internal high voltage to dissipate. Do not touch any of the module screw terminals or injector terminals while the device is powered.

Introduction

The Drivven CompactRIO DI Driver Module Kits are intended to be used within a full authority engine control system where the CompactRIO controller or PXI controller are performing the engine control algorithms. However, some customers have requested a stand-alone driver system which allows them to use another external controller to generate digital fuel control signals to interface to our DI Driver Modules. Drivven now offers a family of driver systems that enable this configuration.

Drivven offers 3 channel, 6 channel, 9 channel and 12 channel Stand-Alone Direct Injector (SADI) driver systems. Each system includes the following:

3 Channel Stand Alone DI Driver System

- 1 cRIO-9012 RT Controller
- 1 cRIO-9101 4-Slot FPGA Chassis
- 1 Drivven DI Driver Module
- 1 cRIO-9411 Digital Input Module

6 Channel Stand Alone DI Driver System

- 1 cRIO-9012 RT Controller
- 1 cRIO-9101 4-Slot FPGA Chassis
- 2 Drivven DI Driver Modules
- 1 cRIO-9411 Digital Input Module

9 Channel Stand Alone DI Driver System

- 1 cRIO-9012 RT Controller
- 1 cRIO-9102 8-Slot FPGA Chassis
- 3 Drivven DI Driver Modules
- 2 cRIO-9411 Digital Input Modules

12 Channel Stand Alone DI Driver System

- 1 cRIO-9012 RT Controller
- 1 cRIO-9102 8-Slot FPGA Chassis
- 4 Drivven DI Driver Modules
- 2 cRIO-9411 Digital Input Modules

Each system is delivered with an installed executable application which allows an external digital fuel control signal to be input to the digital input module and routed directly to the DI Driver modules. The installed application provides a user interface which allows the user to calibrate the injector current profile and save the settings. The calibration settings are stored on the RT controller and used immediately upon system boot. The user interface is accessed by using Drivven's CalVIEW software, communicating with the RT controller over Ethernet. LabVIEW development tools are NOT required, but the free LabVIEW Run-time Engine is required. Drivven will provide a free CalVIEW license for SADI Driver customers. The CalVIEW user interface is not required to connect and run for normal driver operation. The system is ready to run after the 20 second power-on boot time. It will run according to the previously saved calibrations. No other products from National Instruments or Drivven are required for this system to operate. You just provide an external power source from 9V to 32V, connect your injectors, and connect your external controller digital commands. If you send Drivven your injector ahead of time, Drivven will calibrate the current profile for you so that you can run right out of the box, for no additional charge.

CalVIEW and the Direct Injector Driver modules have separate user manuals for their individual use. The information in this manual may overlap in some areas, but please refer to those other product documents for product-specific information. The four hardware system configurations available are shown below in figure 1.

System Configurations

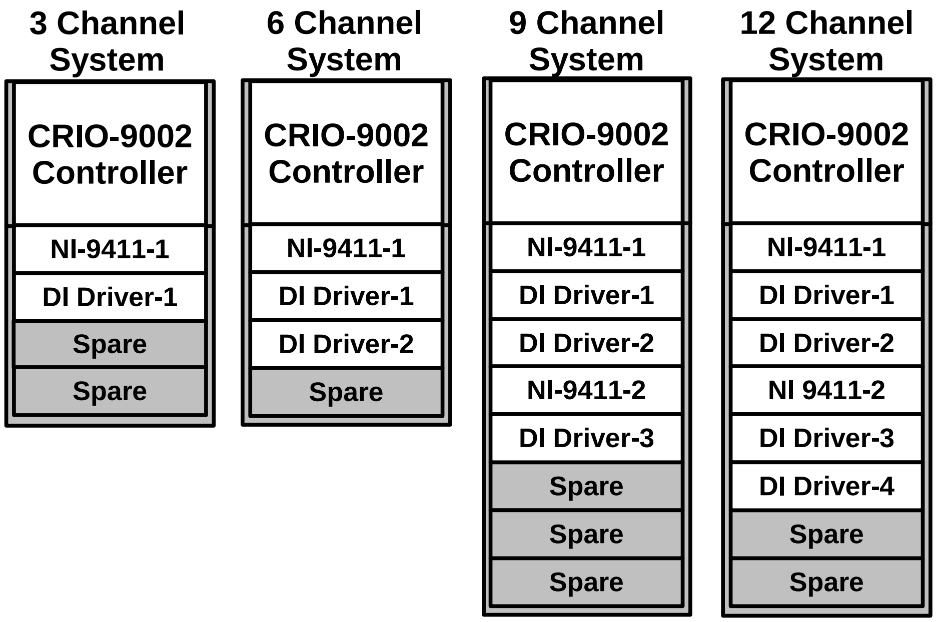


Figure 1. Available system configurations

NI 9411 Digital Input Module Pinout

The pinout for the connectors of the NI 9411 module is shown below in Tables 1 and 2.

Table 1. NI 9411 DB-15 connector pinout

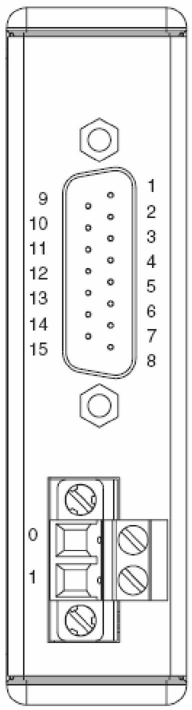
Module	DSUB Pins	Signal
	1	DI0a
	2	DI1a
	3	DI2a
	4	Supply (+5 V_{out})
	5	Supply (+5 V_{out})
	6	DI3a
	7	DI4a
	8	DI5a
	9	DI0b
	10	DI1b
	11	DI2b
	12	Common (COM)
	13	DI3b
	14	DI4b
	15	DI5b

Table 2. NI 9411 power screw terminal pinout

Screw Terminal Pins	Signal
0	BATT
1	GND

DI Driver Module Pinout

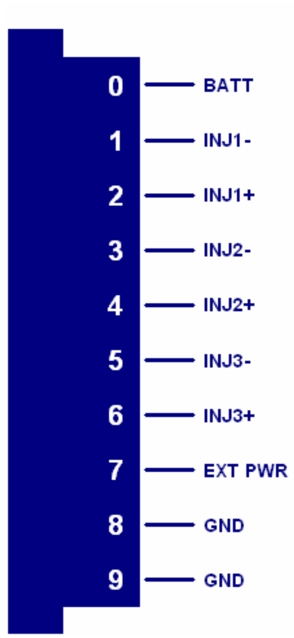
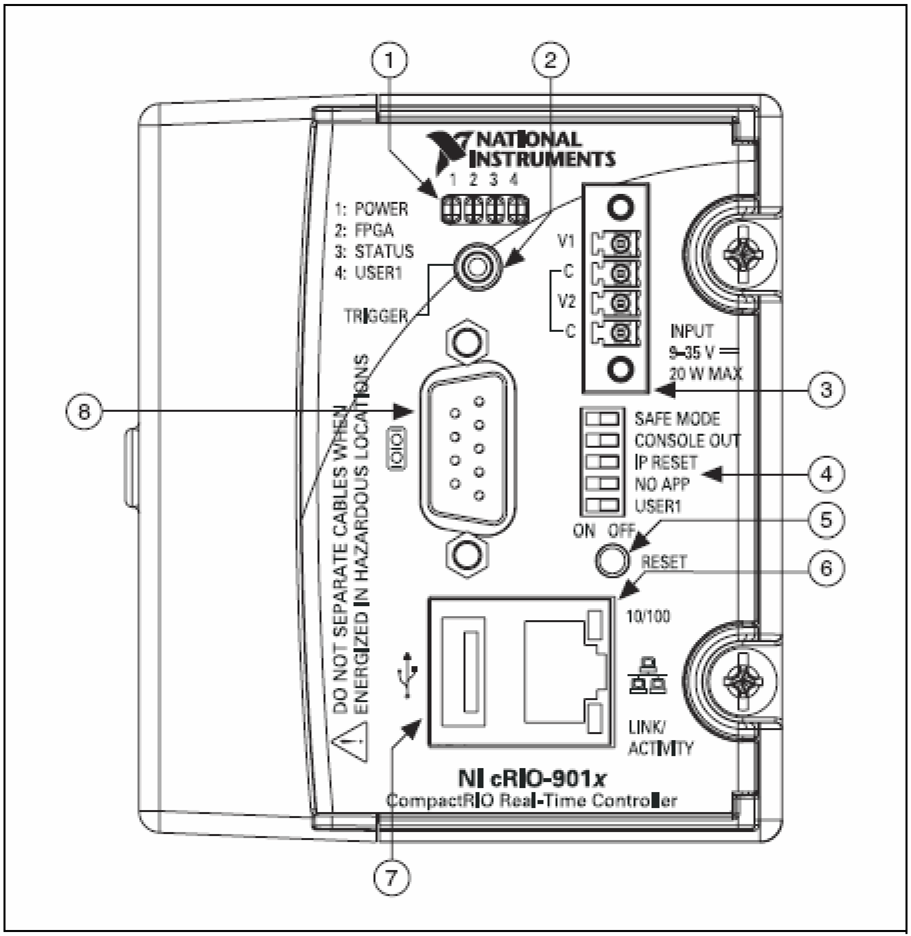


Figure 2. DI Driver module screw terminal pinout

CRIO-9012 Controller Pinout



1	LEDs	5	Reset Button
2	SMB Connector	6	RJ-45 Ethernet Port
3	Power Connector	7	USB Port
4	DIP Switches	8	RS-232 Serial Port

Figure 3. CRIO-9012 controller pinout

Powering the System

The SADI Driver System requires power from a single battery source ranging from 9V to 32V. If the source is ever expected to drop briefly below 9V, such as during engine cranking, then a backup power source should be supplied to the CRIO-9012 controller's V2 power input to prevent controller reset. As long as the main power source does not drop below 6V, the NI 9411 and Drivven DI Driver modules will not reset.

Each component in the system requires battery power – CRIO-9012, NI 9411 modules, Drivven DI Driver modules. Refer to the component pinouts above for proper screw terminal connections for power and ground. Powers and grounds may be connected in a star fashion or daisy-chained. If daisy-chained, Drivven recommends soldering the daisy-chain connections. Even further, Drivven recommends using soldered or well-crimped ferrules on all screw terminal connections as shown below in figure 4.

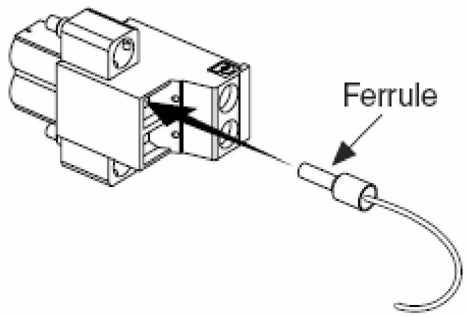


Figure 4. Use of ferrules on screw terminal connections

Warning: The battery supply input terminals for all components are not reverse voltage polarity protected. Connecting power to the components in reverse polarity will certainly damage them.

Connecting Injectors

Each common rail diesel injector will have two leads. The polarity of the injector leads typically does not matter. Each DI Driver module has 3 pairs of screw terminals for 3 injectors. The screw terminals are labeled INJX– and INJX+. Please note that each module can only drive one injector at a time. Therefore, if any injection events overlap or require simultaneous operation, then they must be operated from different modules.

Connecting Digital Commands

Each NI 9411 digital input module has six digital inputs. Each SADI Driver System always contains a 9411 module in slot one. Each 9411 module commands DI Driver modules in the next two slots. The first three input channels of a 9411 module command the DI Driver module in the next adjacent slot. The last three input channels of the 9411 module command the DI Driver in the second adjacent slot. Refer to table 3 for the routing of digital input channels to DI Driver channels. The table applies to 3, 6, 9 and 12 channel systems.

Table 3. Routing of NI 9411 digital inputs to DI driver channels

NI 9411 Digital Input Channel	DI Driver Channel
NI-9411-1 Channel 0	DI Driver-1 Channel 1
NI-9411-1 Channel 1	DI Driver-1 Channel 2
NI-9411-1 Channel 2	DI Driver-1 Channel 3
NI-9411-1 Channel 3	DI Driver-2 Channel 1
NI-9411-1 Channel 4	DI Driver-2 Channel 2
NI-9411-1 Channel 5	DI Driver-2 Channel 3
NI-9411-2 Channel 0	DI Driver-3 Channel 1
NI-9411-2 Channel 1	DI Driver-3 Channel 2
NI-9411-2 Channel 2	DI Driver-3 Channel 3
NI-9411-2 Channel 3	DI Driver-4 Channel 1
NI-9411-2 Channel 4	DI Driver-4 Channel 2
NI-9411-2 Channel 5	DI Driver-4 Channel 3

The COM pin (12) of each NI 9411 module should be tied to the system ground. The "b" pins of the NI 9411 digital input channels must always be left floating unless used as a differential input channel. If active-high logic is used for commanding the injectors, then any unused digital input channels MUST have their "a" pins tied to ground. Otherwise, the channel will float high, causing the driver to attempt an injection pulse.

If active-low logic is used for commanding injectors, then any unused digital input channels MUST be pulled to 5V via a 1K resistor. The 5V output pins (4, 5) of the NI 9411 module may be used for this purpose.

The maximum allowed injection pulse is internally limited to 5 msec, therefore if any channels are commanded continuously, a 5 msec injection may occur on an injector. As long as the input remained active, no other injection events would be allowed, because only one injector is allowed to be commanded at one time. If any injection commands to the same DI Driver module overlap, then all injection events for that module will be turned off for the portion where overlap occurs.

When using another engine control system to command the SADI Driver System, it is likely that the port fuel injector or ignition driver outputs of the engine controller will be used. Typically, port fuel injector or ignition driver outputs are low-side driver circuits. This means that one side of the port fuel injector solenoid or ignition coil primary is connected to battery while the other side (low-side) is connected to the engine controller and programmatically switched to ground during fuel injection pulses or ignition dwell, respectively. In order to utilize these low-side driver outputs to command the SADI Driver System, a pullup resistor must be connected between a constant voltage source (such as 5V or battery) and each of the digital input “a” pins of the 9411 module. Then, the port fuel injector or ignition output pin of the engine controller must be connected to the “a” pin of the digital input channel to be commanded. The pullup resistors act as a low-current load to the fuel injector or ignition outputs of the engine controller.

This physical arrangement provides for an active-low injection command because the engine controller’s low-side drivers will pull the digital inputs of the 9411 module low when injection events are desired. This configuration requires the “DIX_TriggerPolarity” boolean to be set to “ACTIVE LOW” within the SADI Driver System calibration interface.

Since most engine controllers have diagnostic features to detect fault conditions with the fuel injector or ignition loads, and pullup resistors are not inductive loads, the engine controller may report open-circuit faults. Those should be ignored. Figure 5 below illustrates this configuration.

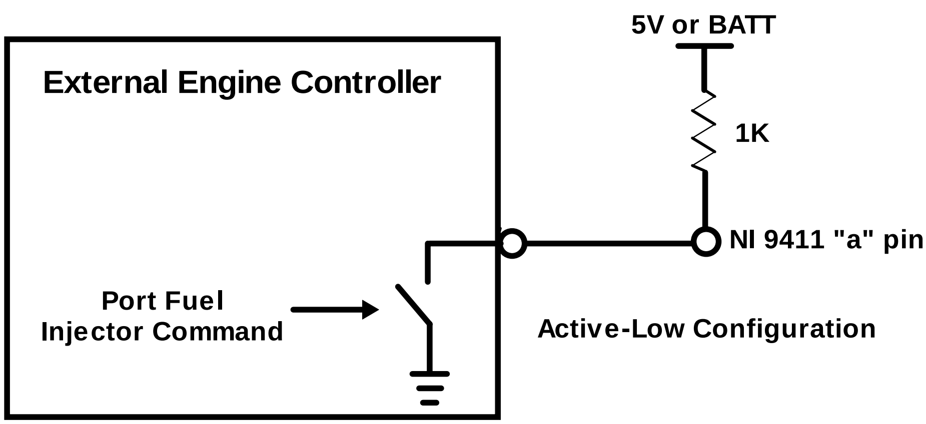


Figure 5. Connecting an engine controller port fuel injector output to the SADI Driver System

If general purpose TTL commands are used from an external controller, then the TTL commands may be directly connected to the “a” pins of the 9411 module. Trigger polarity should be set according to the controller output polarity. Pullup or pulldown resistors should be used on each “a” pin for further robustness in case commands are accidentally disconnected.

Using the SADI Driver System

The SADI Driver System is delivered with an installed executable which is marked to begin execution when the system boots. The power and boot sequence takes approximately 20 seconds. When the SADI Driver System application is running, the User LED on the CRIO-9012 controller will begin blinking at a rate of approximately 4 Hz. If the application detects a critical fault, such as a short circuit, the system will prevent any further injection events and shutdown the internal boost power supplies. This state is signaled by a steady ON User LED on the CRIO-9012 controller. This condition can be cleared by cycling power to the entire system or by connecting to the calibration interface and manually clearing the fault.

The SADI Driver System is delivered to customers with a calibration such that the individual DI Driver modules are not enabled when the system powers up. Therefore, the customer must connect to the calibration interface to enable the modules, make injection current profile modifications, if necessary, and save the calibration before the system may be used stand-alone in the field. After calibrations are saved, those calibrations will be loaded and used each time the system powers up. For example, if the user wants DI Driver modules 1 and 2 to be enabled upon power up, but modules 3 and 4 to be disabled, then those settings must be saved within the calibration interface. If the customer provided Drivven with an injector for current profile calibration before-hand, then those calibrations will already be saved when the customer receives the system.

Connecting to the System Calibration Interface

The SADI Driver System CRIO-9012 controller is delivered to customers with an IP address of 192.168.X.X, unless otherwise specified by the customer. The controller can also be configured to operate in DHCP mode. The first thing that must be done in order to connect to the calibration interface is install the National Instruments Run-time Engine 8.5 or later (as required by the version of CalVIEW being used). Go to the National Instruments website support page at www.ni.com/support/ and select the "Drivers and Updates" from the left column. Enter a search term of "Run-time Engine" and then select the appropriate Run-time Engine version required by CalVIEW. This is shown below in figure 6, properly configured to search for the LabVIEW Run-time Engine.

Search within Results: Runtime engine GO

1-10 of **34** Next >> Sort by: Product

Product	**Download Version**	**Operating System**	**Download Type**	**Release Date**	**Software Download Language**
NI-DAQmx Run-time Engine - (Runtime 3)	8.7.1	Windows 2000/Vista x64/Vista x86/XP	Hardware Driver	January 2008	English, French, German, Japanese, Korean
NI-DAQmx Run-time Engine - (Runtime 5)	8.7.1	Windows 2000/Vista x64/Vista x86/XP	Hardware Driver	February 2008	English, French, German, Japanese, Korean
LabVIEW Run-Time Engine	8.5	Windows 2000/Vista x64/Vista x86/XP	Run-Time	August 2007	English, Chinese (Simplified), French, German, Japanese, Korean
NI-VISA Run-time Engine	4.3	Mac OS X	Run-Time	January 2008	English
LabVIEW Run-Time Engine	8.5.1	Windows 2000/Vista x64/Vista x86/XP	Run-Time	April 2008	English, Chinese (Simplified), French, German, Japanese, Korean

Figure 6. Searching for the LabVIEW Run-time Engine

Select the proper Runtime Engine and proceed to download and install the full (standard) version for supporting all executables (such as CalVIEW).

Go to Drivven's website and download and install the latest version of CalVIEW at: http://www.drivven.com/Downloads.htm. Please follow the instructions in the CalVIEW user manual for properly activating CalVIEW on your computer.

Connect the CRIO-9012 controller to an Ethernet network using the RJ-45 Ethernet port on the controller. Use a Category 5 (CAT-5) Ethernet cable to connect the controller to an Ethernet hub, or use an Ethernet crossover cable to connect the controller directly to a computer.

Open CalVIEW and right click inside the target item list and select "Set New Target Address." If the cRIO-9012 controller and your computer are on the same subnet (default = 192.168.0.X) then CalVIEW will locate the SADI Driver System on the network automatically. The pop-up CalVIEW dialog box should also locate a host VI and a CalVIEW paring on the cRIO controller. Press the button to tell CalVIEW to download these files and press OK. CalVIEW will take a few seconds to transfer these files from the cRIO controller to your computer and use them to make the proper user interface connection. Then press the green "run" button at the top of the CalVIEW console to start the user interface. The cRIO target must be powered and the user LED on the front must be blinking in order for a connection to be made with CalVIEW.

The user interface will look similar to the panel shown in figure 7. Figure 7 shows a calibration interface for a 12 channel SADI Driver System. Systems with fewer channels will have fewer tabs.

Note: The IP address of the host computer must be on the same subnet as the cRIO-9012 controller in order to connect to the calibration interface.

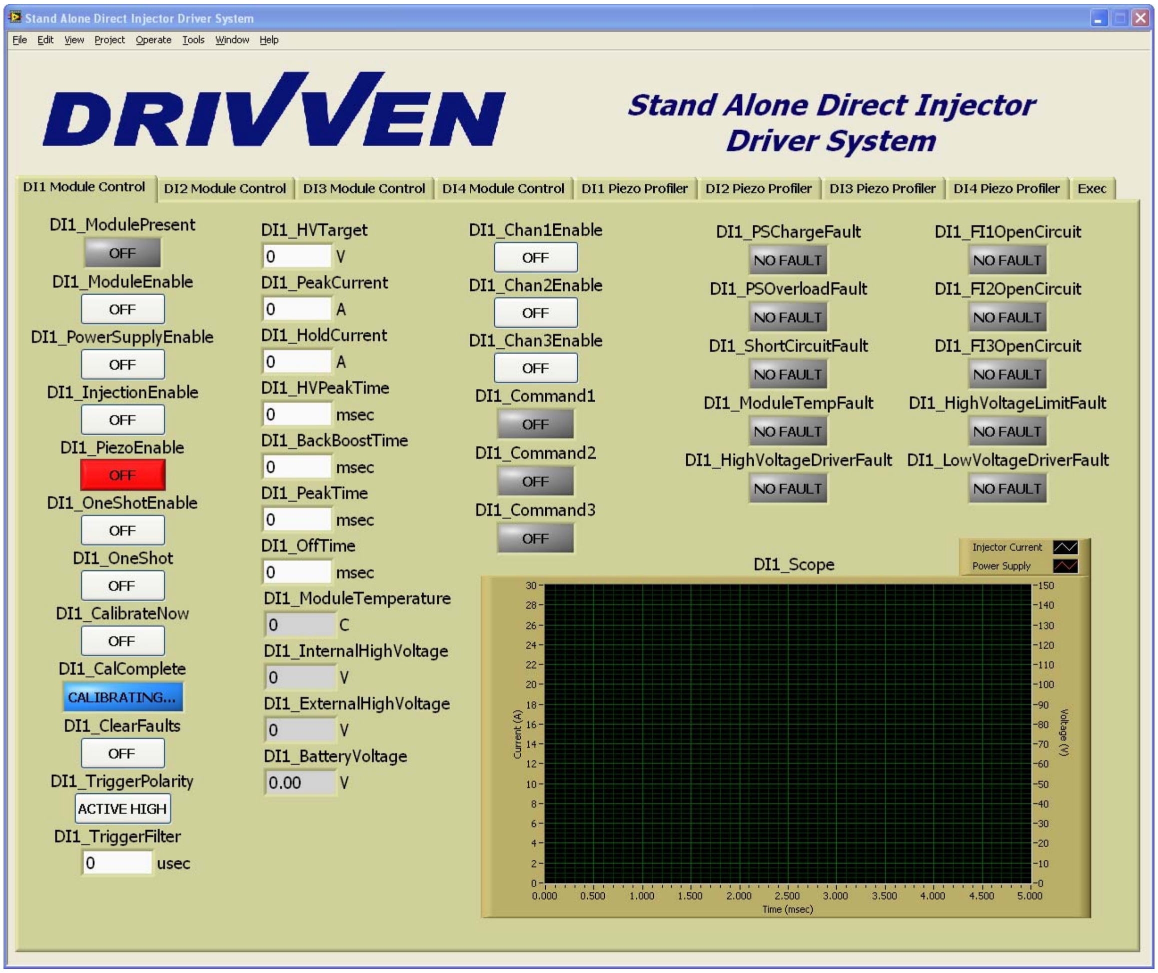


Figure 7. Calibration interface screen shot

The user may press the square red stop button on the CalVIEW console to stop the host user interface. This will not stop the cRIO-9012 target application from continuing to run. If the user desires to also stop the target application, then the red "Stop Target" button should be pressed.

Other than being manually stopped ("Stop Target") or powered down by the user, the CalVIEW interface is always available to the user, even during normal system operation in the field. Viewing the calibration interface does not limit the performance of the system in any way. The CalVIEW interface may be started and stopped any number of times while the target application is running.

When the user makes changes to the settings through the user interface host VI, they may be saved to the target by pressing the "DEF" (Save Calibration as Target Default) button on the CalVIEW console.

Changing the IP Address

If the customer needs to change the TCP/IP settings for the CRIO-9012 controller, then an additional software component from National Instruments must be installed. It is the NI-RIO driver. The properly configured software search from the National Instruments website is shown below in figure 8. Select and install the latest version available. It's a large file, so take a break and come back in an hour or so.

Search within Results: NI-RIO GO

1-10 of 22 Next >> Sort by: Product

Product	Download Version	Operating System	Download Type	Release Date	Software Download Language
NI-RIO	2.4	Real-Time OS, Windows	Hardware Driver	February 2008	English
NI-RIO	2.3	Windows, Real-Time OS	Hardware Driver	August 2007	English
NI-RIO	2.3.1	Windows, Real-Time OS	Hardware Driver	October 2007	English

Figure 8. Searching for the NI-RIO Driver

When installing NI-RIO, accept all of the default components to install. After installing NI-RIO, you will be able to run the National Instruments program called Measurement and Automation Explorer, or MAX.

There is a series of dip-switches on the front panel of the cRIO-9012 controller. Turn the dip-switch labeled IP RESET to ON (to the left). Using a small Phillips screwdriver, press the recessed RESET button to reset the controller. This will cause the controller to reboot and the IP address to be cleared. Wait for about 10 seconds and set the IP RESET dip-switch back to OFF. Assuming that the CRIO-9012 controller is already on your network, or directly connected to your computer using a Ethernet crossover cable, you can use MAX to navigate to the controller settings window.

Within MAX, you can navigate to the Remote Systems and find your CRIO-9012 controller having the special IP address of 0.0.0.0. Click on this system to view the system identification and IP settings in the window to the right. Proceed to make any necessary changes and apply them.

Note that the IP RESET procedure is only necessary if the preconfigured IP address from Drivven is not compatible with your network or your computer's sub net. If it is compatible, then you should be able to find the system within MAX without resetting the IP address. Then you can proceed to make the necessary changes and apply them. Keep in mind that if you are connecting to the cRIO system point-to-point, directly with your computer, then be sure to leave the Gateway and DNS fields empty. Otherwise, CalVIEW will have difficulty locating the system. If the cRIO is placed on an existing network, be sure that the Gateway and DNS fields are correct, or CalVIEW will still have difficulty. It may be best to leave the DNS field empty at all times, unless required for a specific reason.

Note: The IP address of the host computer must be on the same subnet as the cRIO-9012 controller in order to find the system within MAX (except for the case where the cRIO-9012 controller IP address is reset to 0.0.0.0).

Using the Calibration Interface

DIX Module Control Tab

DIX_ModuleEnable (boolean): If a DI driver module is inserted in the proper slot, externally powered, and DIX_ModuleEnable is TRUE, then the controller begins communicating with the module and allows the module to operate. When the module is properly recognized, then the DIX_ModulePresent boolean will be set to TRUE. Also, after a few seconds, the DIX_CalComplete boolean will be set to TRUE.

DIX_PowerSupplyEnable (boolean): When TRUE, the module internal boost power supply is enabled and will maintain the working voltage specified by DIX_HVTarget. When FALSE, the module internal boost power supply is disabled.

DIX_InjectionEnable (boolean): When TRUE, the module injection control circuitry is enabled. When FALSE, the module injection control circuitry is disabled. This parameter does not generate any fuel pulses. It only enables the driver circuitry to operate when fuel commands are generated.

DIX_CalibrateNow (boolean): When this one-shot is pressed, the DI Driver module will be calibrated with HVTarget, PeakCurrent, Hold Current, HVPeakTime, BackBoostTime, PeakTime, Offtime and various piezo settings. The DIX_CalComplete output boolean will be FALSE during calibration and will be set TRUE when calibration is complete. The calibration procedure is automatically performed when modules are enabled and also when the system is powered up. Whenever a DI Driver module parameter listed above is changed, then the CalibrateNow button must be pressed in order to see its effect on injection current profiles.

DIX_ClearFaults (boolean): When this one-shot is pressed, all critical faults of the DI Driver module will be cleared.

DIX_HVTarget (V): The working voltage set point of the internal boost power supply

DIX_PeakCurrent (A): The target current level which is driven through the injector solenoid, using battery voltage, during PeakTime, but after HVPeakTime. Often, this target value is not actually reached, depending on the injector requirements. The DIX_HVPeakTime is the parameter most critical for reaching the desired peak current using high voltage.

DIX_HoldCurrent (A): The target current level which is driven through the injector solenoid after the expiration of PeakTime, and until the end of the injection pulse.

DIX_HVPeakTime (msec): The time period at the beginning of the injection pulse during which the high voltage supply is used to drive current through the injector solenoid. HVPeakTime may range from 0msec to 0.4msec. This parameter should be adjusted in small increments/decrements (0.005 msec) to achieve the initial peak current level using high voltage.

DIX_BackBoostTime (msec): The time period at the end of the injection pulse for which the back-emf of the injector solenoid is directed to the internal boost power supply. BackBoostTime may range from 0msec to 1.6msec.

DIX_OneShotEnable (boolean): When TRUE, the OneShot mode is enabled and the OneShot boolean may be pressed to generate a 1 msec one-shot pulse to channel 1 of the module.

DIX_OneShot (boolean): When pressed, and OneShotEnable is TRUE, the DI Driver module will deliver a 1 msec one-shot pulse to channel 1. This boolean returns to the FALSE state automatically.

DIX_PeakTime (msec): Determines the length of time that the driver circuit will use peak current as the current control threshold. PeakTime may range from 0 msec to 0.6 msec.

DIX_TriggerFilter (usec): Determines the amount of digital input command signal noise rejection. For example, a value of 1 would reject a low or high signal glitch of up to 1 usec width. Please note that the filter also causes a signal delay of the same amount of time. This value can range from 0 to 1638 usec.

CriticalFault (boolean): Indicates that a critical fault occurred with any of the DI Driver modules. This boolean will sometimes indicate TRUE while the modules are being calibrated. This is normal behavior and can be ignored.

DIX_ChanXEnable (boolean): When ON, channel X is enabled and is operated according to TriggerPolarity and the respective external command.

DIX_PiezoEnable (boolean): When ON, the DI Driver module will operate in piezo mode according to the settings on the DIX Piezo Profiler tab. This button is highlighted red when OFF to provide warning that solenoid injectors are being controlled. This is because piezo injectors can be damaged when controlled in solenoid mode.

DIX_CommandX (boolean): These boolean indicators show the high/low level of the external command.

DIX_XXXXFault (boolean): These boolean indicators show various fault conditions with the DI Driver module.

DIX_ModuleTemperature (C): Indicates the internal DI Driver module temperature. The shutdown fault threshold is 85 C.

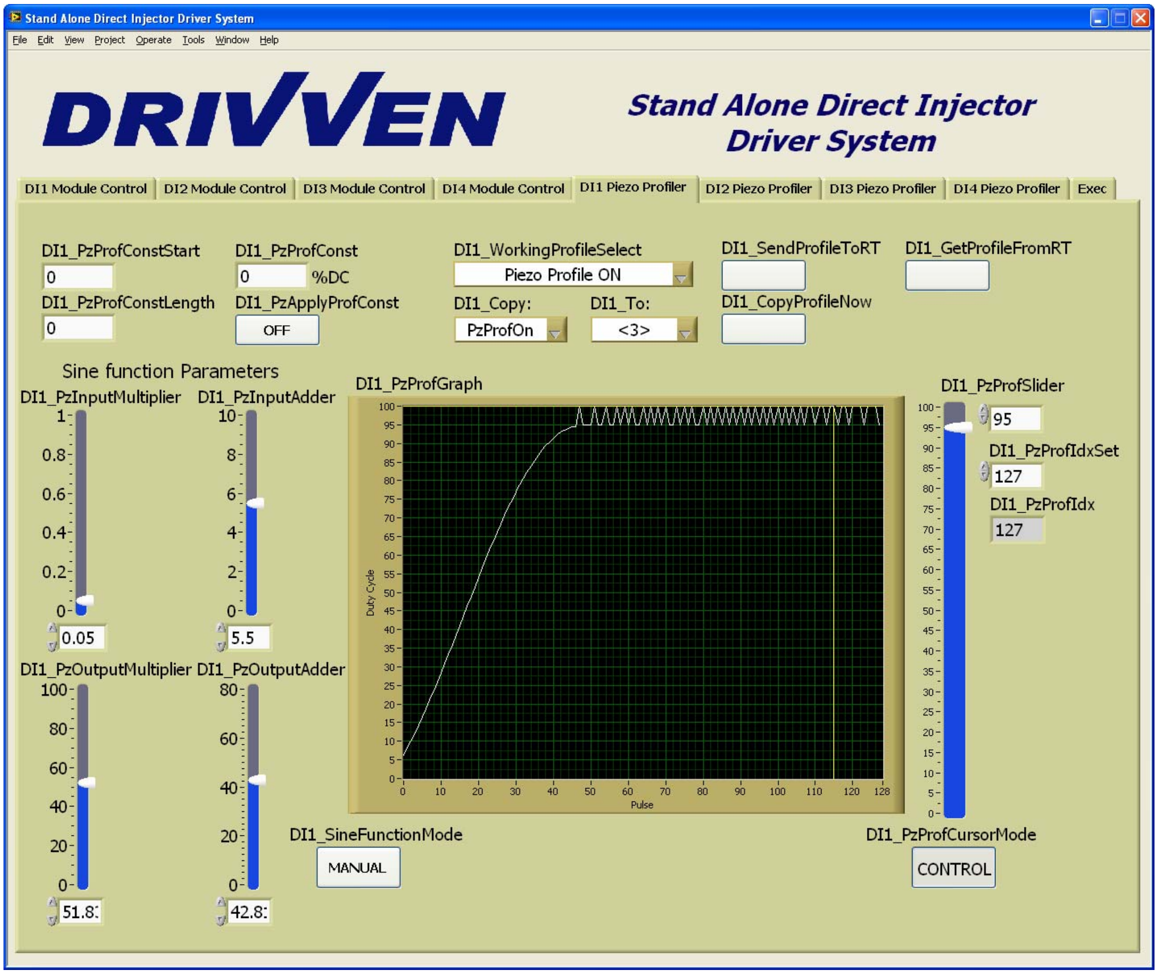
DIX_InternalHighVoltage (V): Indicates the internal boost power supply voltage.

DIX_ExternalHighVoltage (V): Indicates the external high voltage supply level. If the external high voltage supply pin is connected to a level greater than 6V, then the internal boost power supply will automatically shutdown and rely on external power.

DIX_BatteryVoltage (V): Indicates the external battery voltage supply level. This should be in the range of 9-32V. The internal boost power supply will operate more efficiently, with less module temperature rise, if the battery voltage is in the range of 24-32V. It depends on the solenoid load and rate of injection events.

DIX_Scope (A, V): The scope updates at the interval of approximately 2 seconds to show the latest current and voltage profile stored by the DI Driver module.

DIX Piezo Profiler Tab



Please refer to the DI Driver User Manual for further information on calibrating for piezo injectors.

DIX_PzProfConstStart (Pulse): Sets the start location (0-128) for the constant duty cycle value to be applied to the piezo profile.

DIX_PzProfConstLength (Pulses): Sets the length for the constant duty cycle value to be applied to the piezo profile.

DIX_PzProfConst (%DC): Sets the duty cycle constant to be applied to the piezo profile.

DIX_PzApplyProfConst (boolean): Applies the constant duty cycle value to the piezo profile.

DIX_SineFunction Mode (boolean): When set to FUNCTION, then a sine wave is applied to the piezo profile. When set to MANUAL, then the piezo profile may be adjusted manually at individual points.

DIX_PzInputMultiplier (SGL): Scales the input to the sine function.

DIX_PzInputAdder (SGL): Offsets the input to the sine function.

DIX_PzOutputMultiplier (SGL): Scales the output of the sine function.

DIX_PzOutputAdder (SGL): Offsets the output of the sine function.

DIX_PzProfCursorMode (boolean): When in DRAG mode, allows the user to drag the cursor to profile locations for setting new manual duty cycle values. When in CONTROL mode, allows the user to set the manual profile position using DIX_PzProfIdx.

DIX_PzProfIdx (SGL): When in CONTROL mode, sets the manual profile position for editing.

DIX_PzProfIdxSet (I32): Sets the manual duty cycle for the profile location specified by DIX_PzProfIdx.

DIX_WorkingProfileSelect (U8): Selects the local ON or OFF profile to work with.

DIX_Copy: (U8): Selects the local ON or OFF profile to copy to the other selected profile in DIX_To:. This copy procedure is only happening on the local computer, not on the target.

DIX_To: (U8): Selects the local ON or OFF profile to be copied from the other selected profile in DIX_Copy:. This copy procedure is only happening on the local computer, not on the target.

DIX_CopyProfileNow (boolean): Copies the local profile selected in DIX_Copy: to the profile selected in DIX_To:.

DIX_SendProfileToRT (boolean): Sends the selected working profile to the cRIO RT target. However, it is not used by the DI Driver module until the CalibrateNow button is pressed. Also, this profile is not saved to the cRIO target calibration file (for use at power up) until the CalVIEW Console Save Default Calibration button is pressed. For typical experimentation with piezo profiles, the user will press the DIX_SendProfileToRT button, followed by the CalibrateNow button. When an acceptable profile is achieved, the CalVIEW Console Save Default Calibration button should be pressed.

DIX_GetProfileFromRT (boolean): Retrieves the default profile from the cRIO target for experimenting with the profile within the user interface. This button should be pressed when first starting the user interface via CalVIEW to bring the profile into local memory.

DIX_PzProfGraph (SGL): Displays the local memory piezo profile selected in DIX_WorkingProfileSelect.

Execution Tab

FPGAError (boolean): Indicates a fault with loading the FPGA portion of the application to the cRIO FPGA chassis. This error should never happen and is only an internal development diagnostic.

MainLoopExecTime (msec): Indicates the amount of time required to execute the main control loop on the cRIO target.

MainLoopPeriod (msec): Indicates the actual period measured for the main control loop on the cRIO target.

DB-15 Connector Parts

Table 4 below is a list of the connector parts includes with the SADI Driver System to connect external digital commands to the NI 9411 modules. The crimper tool and pin positioner are available from Mouser but are not included with the SADI Driver System.

All parts are available from Mouser Electronics at www.mouser.com

Table 4. Connector parts list

Description	Mfr.'s Part #	Mouser's Part #
AMP HDP-20 Series 109 15P Receptacle Housing	205163-1	571-2051631
AMP HDP-20 Series 109 Crimp Socket Contact	205090-1	571-2050901
Norcomp D-Sub Connector Hood, 15P 45 Degree	971-015-020R121	636-971-015-020R121
AMP D-Sub Insert/Extract Tool	91067-2	571-910672
AMP Crimp Tool	601966-1	571-6019661
AMP Crimp Tool Pin Positioner	601966-5	571-6019665

Table 5. NI 9411 Module Pigtail Description

Pin Description	Pin #	Wire Color
DI0a	1	Brown
DI1a	2	Orange
DI2a	3	Yellow
Supply (+5 V Out)	4	Red
DI3a	6	Green
DI4a	7	Blue
DI5a	8	Purple
Common (COM)	12	Black