
USER GUIDE

Diamond Logic® Builder Software (Advanced Logic Programming)

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SAFETY INFORMATION

This manual provides general and specific maintenance procedures essential for reliable engine operation and your safety. Since many variations in procedures, tools, and service parts are involved, advice for all possible safety conditions and hazards cannot be stated.

Read safety instructions before doing any service and test procedures for the engine or vehicle. See related application manuals for more information.

Obey Safety Instructions, Warnings, Cautions, and Notes in this manual. Not following Warnings, Cautions, and Notes can lead to injury, death, or damage to the engine or vehicle.

Safety Terminology

Terms are used to stress your safety and safe operation of the engine: Warning, Caution, and Note.

WARNING: A warning describes actions necessary to prevent or eliminate conditions, hazards, and unsafe practices that can cause personal injury.

CAUTION: A caution describes actions necessary to prevent or eliminate conditions that can cause damage to the engine or vehicle.

NOTE: A note describes actions necessary for correct, efficient operation.

Work Area

- Keep work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure that the work area is ventilated and well lit.
- Make sure that a First Aid Kit is available.

Protective Measures

- Wear protective safety glasses and shoes.
- Wear correct hearing protection.
- Wear cotton work clothing.
- Wear sleeved, heat protective gloves.
- Do not wear rings, watches, or other jewelry.
- Restrain long hair.

Vehicle

- Shift transmission to Neutral, set parking brake, and block wheels before doing diagnostic or service procedures.
 - Clear the area before starting the engine.
-

Safety Equipment

- Use correct lifting devices.
- Use wheel chocks and stands.

Engine

- The engine should be operated or serviced only by qualified individuals.
- Provide necessary ventilation when operating engine in a closed area.
- Keep combustible material away from engine exhaust system and exhaust manifolds.
- Install all shields, guards, and access covers before operating engine.
- Do not run engine with unprotected air inlets or exhaust openings. If unavoidable for service reasons, put protective screens over all openings before servicing engine.
- Shut engine off and relieve all pressure in the system before removing panels, housing covers, and caps.
- If an engine is not safe to operate, tag the engine and ignition key.

Fire Prevention

- Make sure that charged fire extinguishers are in the work area.

NOTE – Check the classification of each fire extinguisher to make sure that the following fire types can be extinguished:

1. Type A – Wood, paper, textiles, and rubbish
2. Type B – Flammable liquids
3. Type C – Electrical equipment

Batteries

- Always disconnect the main negative battery cable first.
 - Always connect the main negative battery cable last.
 - Avoid leaning over batteries.
 - Protect your eyes.
 - Do not expose batteries to flames or sparks.
 - Do not smoke in workplace.
-

INTRODUCTION TO ADVANCED LADDER LOGIC



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This book is designed to explain the fundamentals of writing and applying custom logic for the purpose of performing body equipment integration with International® truck chassis.

This is an advanced topic for users of the Diamond Logic® Builder (DLB) software. For an introduction to using DLB, please see the Diamond Logic Builder Software User Guide (Basic Programming and Diagnostics Only).

This manual is presented in a building block approach. The elements of a ladder logic diagram are described, followed by a discussion on the use of signals to create the desired advanced logic. Once the basics of using ladder logic are explained are provided to help the Diamond Logic Builder user adopt the best practices to perform common logic operations. Diamond Logic Builder provides extensive flexibility to build very complex features. All users are encouraged to follow the suggested practices listed in this manual to help ensure that the most efficient and safest solution for your application is created. Navistar, Inc. shall not be liable for any equipment damage or personal injury resulting from the use of Diamond Logic Builder. It is imperative that the Diamond Logic Builder user thoroughly test all advanced logic solutions on a vehicle before releasing the product for public sale or usage.

REVIEW OF VIN AND TEMPLATE FILES

A template is a separate file that captures and stores vehicle configuration changes that have been performed and applied to a vehicle configuration using the Diamond Logic® Builder software. You can save a template for future use on additional vehicles.

Configuration changes can be any of the following:

- Adding / Deleting 59XXXX Features
- Adding or Modifying Advanced Logic Blocks
- Changing Programmable Parameters
- Reconfiguring Center Panel Layouts

Only VIN files may be programmed into a vehicle. Templates must be applied to a VIN file and then the updated VIN file may be programmed into the vehicle. Each vehicle or VIN may have one or more templates applied; however extreme caution must be taken when using multiple templates on the same vehicle. Using the same resources in two different templates and then programming the templates on a vehicle will result in a resource conflict. Applying more than one template is not a recommended practice. If multiple templates are used, you must ensure that resources are used only once per vehicle.

The vehicle program is made up of the following discrete software components: Base Kernel Program, a Configuration Program consisting of Features and Logic Blocks, and a Programmable Parameter file. The version of these components is verified at load ensure that the latest version of each is installed on the vehicle. If the kernel program on the vehicle already contains the latest version available from International, then only the configuration file and programmable parameters would be loaded into the vehicle.

A vehicle may be reprogrammed if at least one of the following conditions has been met:

- A newer version of the Kernel Program is available from International.
- A newer version of the Configuration Features is available from International.
- One or more features have been added or deleted from the vehicle.
- One or more programmable parameters have been modified.
- Advanced logic is changed, added, or deleted.

After you save a template or VIN, you can export it using the EXPORT option in the File menu. Once exported to a desired directory it can be emailed or copied like any other data file. When exporting a VIN or template file, best practice is to name the file the same as the template or VIN number. Template and VIN files can be imported using IMPORT option in the File menu.

LOGIC BLOCKS

PURPOSE

A logic block is a package of software containing custom logic that is written in order to control the behavior of the vehicle. Logic blocks are created and edited using the Advanced Logic tab.

The Advanced Logic Menu

The Advanced Logic menu allows you to add, remove, and print logic blocks. Although the menu is visible to all users with Level III access, you cannot select its options until:

1. You select a template or VIN on the SELECT tab (required to view the Advanced Logic tab).
2. You select the ADVANCED LOGIC tab.

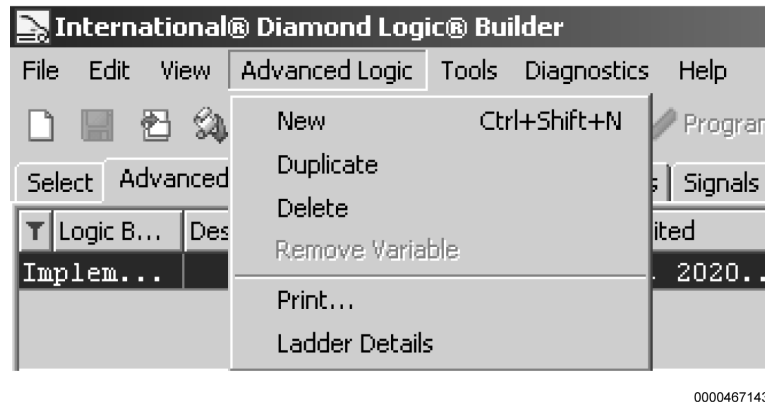


Figure 2 Advanced Logic Menu

Options in this menu include the following:

Name / Shortcut	Description
New	Creates a new (empty) logic block in the template.
Duplicate	Duplicates the selected logic block in the template.
Delete	Deletes the selected logic block from the template or VIN.
Remove Variable	Removes an unused variable from the list on the My Variables tab.
Print	Prints ladder logic and the selected logic block.
Ladder Details	Show mapped signals on ladder.

NOTE – The items in this menu can also be accessed by right-clicking on a logic block or an unused custom variable.

When multiple logic blocks are added to a vehicle, the result is a combination of software packages that perform specific tasks in addition to the tasks performed by pre-engineered software features provided by International. Multiple logic blocks provide a way to organize advanced programming. For example: vehicle lighting in one block, Power Take-Off (PTO) functions in another, and emergency lighting in yet another.

USING TEMPLATES WITH ADVANCED LOGIC BLOCKS

Diamond Logic® Builder allows you to make, edit, and apply templates using the procedures outlined in the Diamond Logic Builder Users Guide (Basic Programming and Diagnostics Only). However, there are a few additional rules concerning advanced logic.

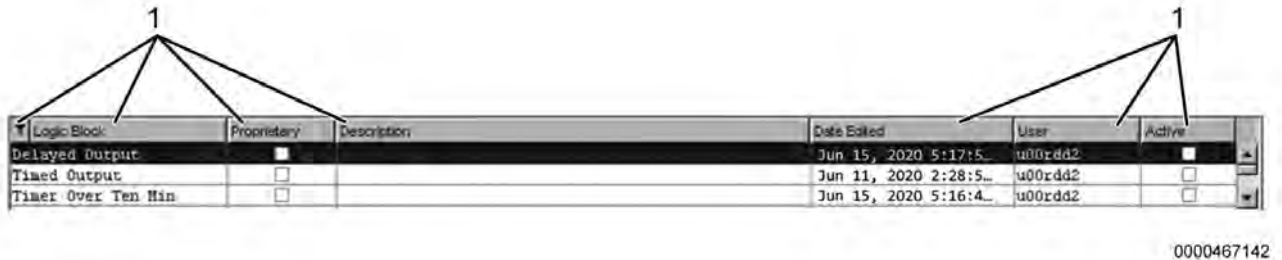
- You must be trained, tested, and certified to have access to write advanced ladder logic.
- Ladder logic may only be edited or modified on a template, not on a VIN.
- If the Proprietary check box is checked, then only the original author of a logic block may revise ladder logic in a template.
- Anyone that applies a template to a VIN that contains advanced logic will have their user ID attached to the configuration file and therefore assumes responsibility for the performance of those advanced ladder logic features.

USAGE

When creating blocks of logic, take care to only populate a logic block with enough logic to implement the smallest optional feature that is offered by your company. For example, if you have a scene light feature that contains a collection of interlocks, then populate a logic block that only contains the advanced logic to perform the scene light feature. This allows you to add or delete custom features by checking or unchecking a box rather than having to recreate programming files. Refer to Remapping Signals to Physical Input and Output Pins (page 33) to learn more about the impacts of adding and deleting logic blocks in a vehicle configuration file.

COLUMN DEFINITION

The headings under the Advanced Logic tab are selectable and the column widths are adjustable.



1. Column headers

Figure 3 Columns

Right-clicking any of the column headers (Figure 3, Item 1) displays a drop-down menu that shows the column selections available. The first six options in the menu are column headings. Select one of these to show or hide the corresponding column (a check mark appears next to currently displayed columns).

Name	Description
Logic Block	Logic block file name.
Proprietary	Contains a check box that allows you to mark logic blocks as proprietary. NOTE – If you make a logic block proprietary, the ladder logic view will be restricted to the individual who created it. Therefore, proprietary advanced logic will not be visible, easily diagnosed, or serviceable by International® dealers.
Description	Logic block description.
Date Edited	Date created or edited.
User	The ID of the user who created the logic block.
Active	If this box is checked, the logic block will be included in the vehicle configuration.

OVERVIEW OF SIGNALS

PURPOSE

The right side of the Advanced Logic tab provides a list of signals. These signals are the building blocks that are used to create ladder logic. The signals are divided into a series of categories that may be viewed by selecting the desired tab. For example, signals that are associated with the chassis such as park brake or door switch are found on the CHASSIS tab.

Other RPMs		RPM1	RPM2	RPM4	Switches	Transmission
My Variables		AWARE	Advanced	Bus	Chassis	Cluster
		Engine				
	Custom Variable	...	Signal/Value		Unit	
II		✓	ABS_Warning_Lamp		On/Off	
II		✓	AC_Clutch		On/Off	
II		✓	AC_Request		On/Off	
II	Accessory	✓	Accessory		On/Off	
II		✓	Air_Horn		On/Off	
▶		✓	Air_Horn_Request		On/Off	
II			Air_Solenoid_St...		On/Off	
II		✓	Aux_Discrete_In...		On/Off	
II		✓	Aux_Discrete_In...		On/Off	
○		✓	Aux_Relay_Driver_1		On/Off	
○	Low_Voltage...	✓	Aux_Relay_Driver_2		On/Off	
▶			Body_Up_Light		On/Off	
II		✓	Brake_Lights		On/Off	
II		✓	Brake_Switch		List	
II	City_Horn	✓	City_Horn		On/Off	
▶		✓	City_Horn_Request		On/Off	
II			DUAL_OUTPUT_SWI...		A	

Figure 4 Right Side: Chassis Tab

A signal will also be listed on the My Variables tab if you have done either of the following:

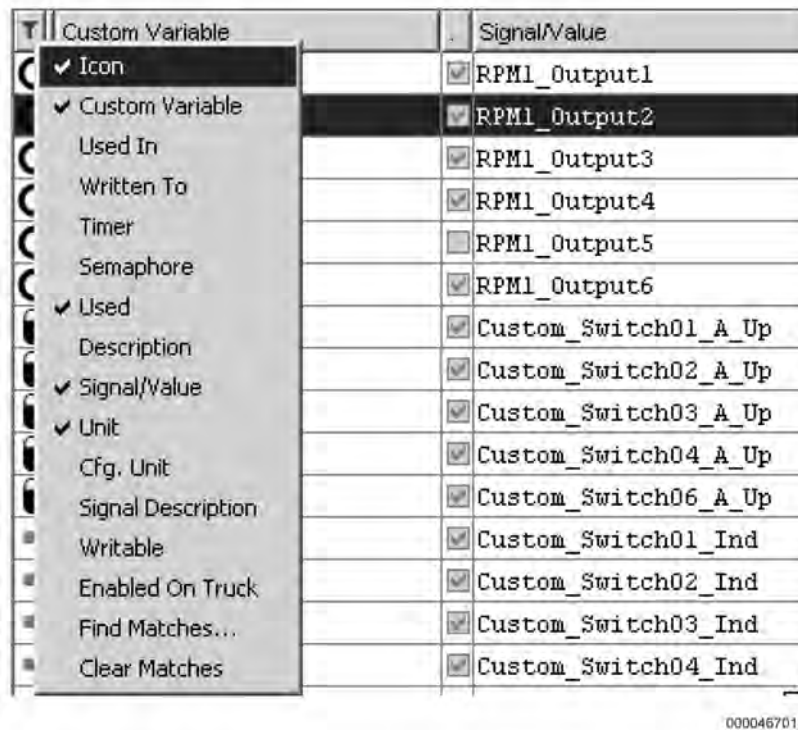
- Added the signal to a rung of logic.
- Renamed the signal by typing the new name in the Custom Variable column.

There are two main categories of signal:

READ ONLY	The value of the signal may be used as an input in ladder logic, but cannot be changed.
READ or WRITE	The signal may be used as an input or the signal may be Written To as an output. Many of the WRITE signals have built in interlocks, which means that you may not have unconditional access to write a value to the signal. See Using Signals with Limited Write Access (page 93) for additional information.

COLUMNS ON THE RIGHT SIDE

Each of the tabs on the right side of Advanced Logic can show a number of different columns. Right-click on any of the column headers to select the columns displayed.



Custom Variable	Signal/Value
<input checked="" type="checkbox"/> Icon	<input checked="" type="checkbox"/> RPM1_Output1
<input checked="" type="checkbox"/> Custom Variable	<input checked="" type="checkbox"/> RPM1_Output2
<input type="checkbox"/> Used In	<input checked="" type="checkbox"/> RPM1_Output3
<input type="checkbox"/> Written To	<input checked="" type="checkbox"/> RPM1_Output4
<input type="checkbox"/> Timer	<input type="checkbox"/> RPM1_Output5
<input type="checkbox"/> Semaphore	<input checked="" type="checkbox"/> RPM1_Output6
<input checked="" type="checkbox"/> Used	<input checked="" type="checkbox"/> Custom_Switch01_A_Up
<input type="checkbox"/> Description	<input checked="" type="checkbox"/> Custom_Switch02_A_Up
<input checked="" type="checkbox"/> Signal/Value	<input checked="" type="checkbox"/> Custom_Switch03_A_Up
<input checked="" type="checkbox"/> Unit	<input checked="" type="checkbox"/> Custom_Switch04_A_Up
<input type="checkbox"/> Cfg. Unit	<input checked="" type="checkbox"/> Custom_Switch06_A_Up
<input type="checkbox"/> Signal Description	<input checked="" type="checkbox"/> Custom_Switch01_Ind
<input type="checkbox"/> Writable	<input checked="" type="checkbox"/> Custom_Switch02_Ind
<input type="checkbox"/> Enabled On Truck	<input checked="" type="checkbox"/> Custom_Switch03_Ind
<input type="checkbox"/> Find Matches...	<input checked="" type="checkbox"/> Custom_Switch04_Ind
<input type="checkbox"/> Clear Matches	

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Figure 5 Column Definitions

OVERVIEW OF SIGNALS

These columns are defined as follows:

Name	Description
Icon	The icon that is displayed for this signal in ladder logic.
Custom Variable	A custom name that you have given to the signal. NOTE – No spaces or symbols such as +, -, &, *, or # may be used.
Used In	The logic block in which the signal is used.
Written To	Whether it is possible to write to this signal or not.
Timer	Whether the signal is a timer or not.
Semaphore	A check indicates that this variable can be written too. However, other internal variables may take precedence over the value set in ladder logic.
Used	A check indicates that this variable is used in a logic block or the mapped signal is used on the vehicle.
Description	A custom description you have given to this signal (if any).
Signal / Value	The system name for the selected signal.
Unit	Displayed unit of measure for the variable (such as seconds or ON / OFF).
CFG Unit	The system unit of measure for the selected variable.
Signal Description	Description for the variable. If no text is in this field, the parameter is an internal value.
Writable	Indicates whether you can write to this variable.
Enabled On Truck	Checked if the variable is enabled and used on the truck.

ICONS

Ladder logic is constructed by dragging signal icons to the display area on the left side of the Advanced Logic tab. These icons represent various signals including inputs, outputs, status, and indicators. Refer to Signal Icon Types (page 11) for detailed descriptions of these icons.

NAMING

NOTE – It is not recommended to change system names for self-explanatory chassis signals. This safe practice will help avoid problems when combining templates or creating templates from VIN configurations that have advance logic blocks installed.

The signals in the advanced logic view have pre-assigned general-purpose system names. It is not recommended to change system names for self-explanatory chassis signals. This safe practice will help avoid problems when combining templates or creating templates from VIN configurations that have advance logic blocks installed.

Custom Variable	Signal/Value	Unit
	<input type="checkbox"/> Aux_Air_Pressure	psi
New_Signal_Name_Example	<input type="checkbox"/> Battery_Current	A
	<input checked="" type="checkbox"/> Battery_Voltage	V
	<input checked="" type="checkbox"/> Current_Gear	gears
	<input checked="" type="checkbox"/> Fuel_Gauge	percent
	<input type="checkbox"/> Primary_Air_Pressure	psi
	<input type="checkbox"/> Secondary_Air_Pressure	psi
	<input type="checkbox"/> Trans_Oil_Temp	F

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Figure 6 Assigning a Custom Signal Name

You can enter a new signal name by typing it in the Custom Variable column on the right side of the Advanced Logic view (Figure 6).

1. Double-click in the CUSTOM VARIABLE field for the desired signal.
2. Type the new name and press ENTER.

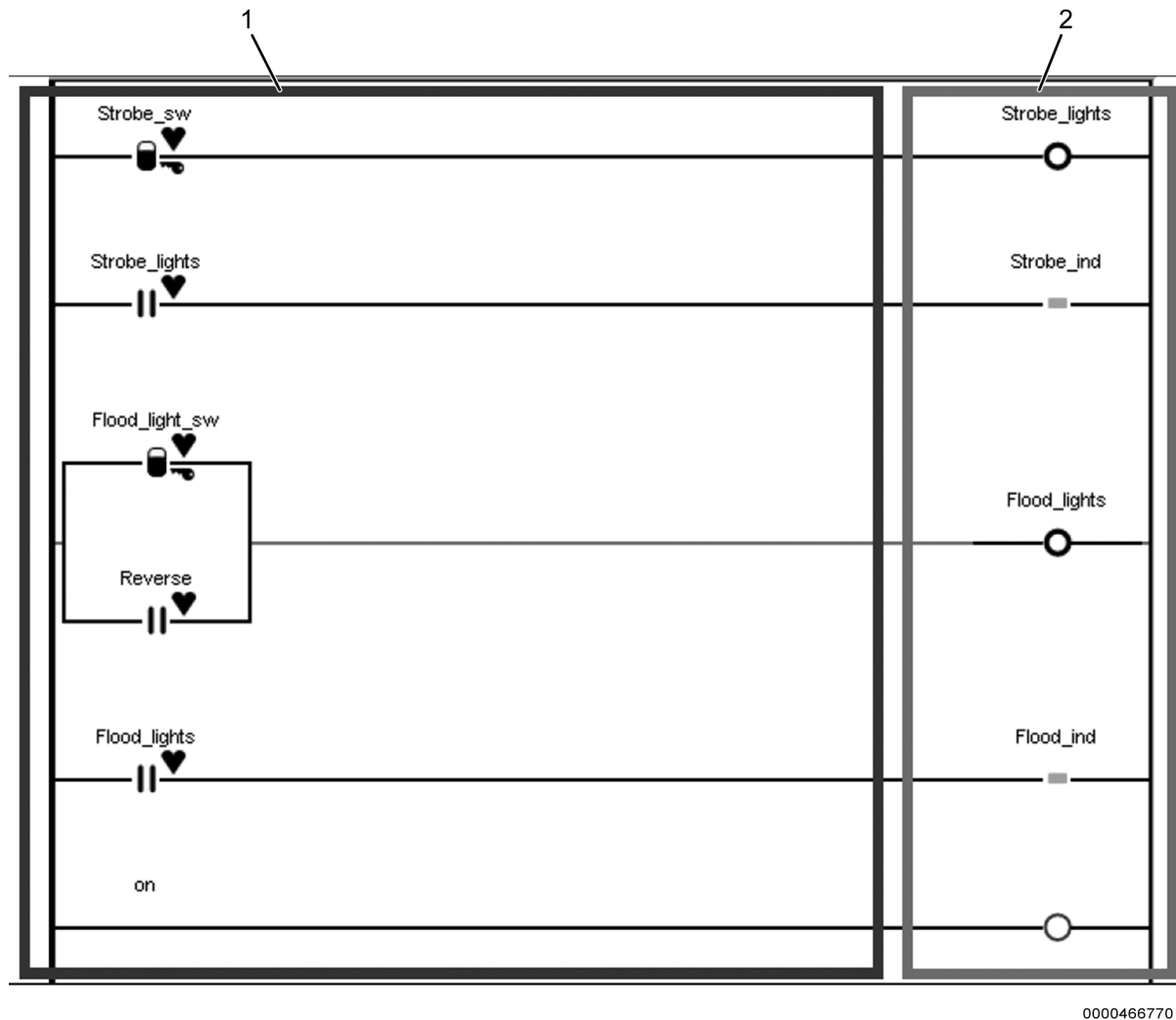
Custom signal naming must follow certain rules:

- Signal names must begin with an alphabetical letter. Numbers and letters may be used thereafter.
- Special characters (@#\$%^&*), punctuation marks (!?,,:;) and spaces may not be used.
- Underscore marks (_)are acceptable to break up longer names.

OVERVIEW OF LADDER LOGIC

WHAT IS LADDER LOGIC?

Ladder logic is a way to simplify programming by using signal icons and a graphical display. In other words, ladder logic is a graphical method for drawing an electrical circuit.



1. Input signal area

2. Output signal area

Figure 7 Ladder Logic

If we thought of the example in Figure 7 as an electrical circuit diagram, the left side of the ladder is like a battery voltage connection. The right side is like the ground connection. Each rung of the ladder is like an individual circuit. In the first rung of the ladder, we start with battery voltage that is connected to one side of the strobe switch (Strobe_sw). The other side of the strobe switch is connected to one side of an output called strobe light (Strobe_lights). The other side of the Strobe_lights output is connected to the right side of the ladder, which is ground. Thus, this simple series of picture icons and lines represent a realistic wiring circuit diagram. This and all other rungs of advanced ladder logic are executed or run fifty times per second. Ladder logic symbols may be organized in multiple forms of AND / OR relationships. Many arrangements of input icons may be placed on a single rung. However, only one output may be written to on any given rung.

Diamond Logic Builder also contains a Structured Logic tab.

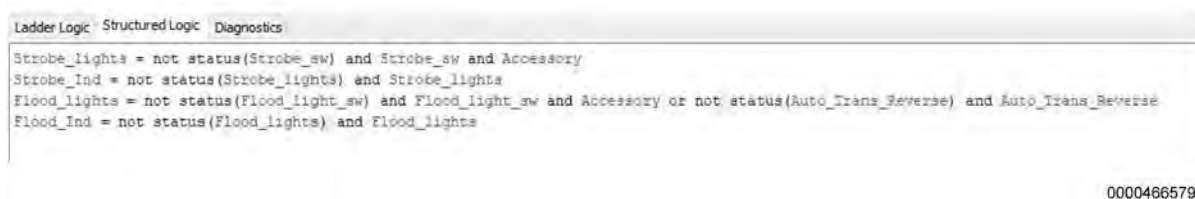


Figure 8 Structured Logic

The Structured Logic tab allows for programming using a traditional text method if desired. Only advanced programmers should attempt to use structured logic.

HOW DO YOU USE LADDER LOGIC?

Using ladder logic is as simple as choosing the signals you want to work with and clicking and dragging that signal icon to the right place on the display area.

SIGNAL ICON TYPES

The following three tables illustrate each of the signal icons available in the Diamond Logic Builder software: main signals, input modifiers and output modifiers. A short description of each signal is included in each table. When using the icons as listed below on a ladder rung, the signals must be TRUE or ACTIVE to allow the logic to progress further down the rung toward the output. When any of the icons are TRUE, they are analogous to a closed switch contact.














NOTE – For printable versions of these tables with room to make your own notations, see Signal Icons (page 243).

Icons for Main Signals

Main signals are those that are available to the programmer for selection.











Icon	Main Signals Description
	Switch Up
	Switch Down
	Switch Middle
	<p>NOTE – This signal is created by Diamond Logic® Builder when the flash function is used.</p> <p>Flasher Function</p>

OVERVIEW OF LADDER LOGIC



Icon	Main Signals Description
	Input Signal
	(BLUE) Internal Input Signal
	Special Function Signal
	Output Signal
	(BLUE) Internal Output Signal
	Remote Power Module input that is active with 12 Volts present
	Remote Power Module input that is active with Ground present
	Signal with limited WRITE ACCESS
	(GREEN) Rocker Switch Indicator
	(GREEN) Rocker Indicator Light Flash Fast
	(GREEN) Rocker Indicator Light Flash Slow
	Timer Function
	(RED) Warning Light in the Gauge Cluster

Input Signal Modifiers

Input signal modifiers are shown in the table below.




Icon	Input Modifiers Description
	(RED) Negate. When this symbol appears on top of an ON / OFF type signal, the signal is inverted. Applies to INPUT signal. For example: 
	Signal that is turned OFF with error
	Signal that is turned ON with error
(none displayed)	Signal will be maintained with error
	Positive Edge: Capture one event when the signal turns ON
	Negative Edge: Capture one event when the signal turns OFF
Edg	Edge: Capture one event each time the signal turns ON or OFF
	Good Status: Signal will be ON with a GOOD status
	Bad Status: Signal will be OFF with a BAD status
Alt	Altered: Signal goes active each time the value changes for one iteration
	Enabled: Checks if a timer function is enabled
	Running: Checks if a timer is running

OVERVIEW OF LADDER LOGIC

Icon	Input Modifiers Description
	Expired: Checks if a timer is expired
Rec	Receive: Not usable at this time
	Accessory: Signal is interlocked to ACCESSORY so it is always OFF when ACCESSORY is OFF

Output Signal Modifiers

Output signal modifiers are shown in the table below.

Icon	Output Modifiers Description
Set	Set a signal to a specific value, such as ON, OFF, or some numerical value.
	(GREEN) Start a timer
	(RED) Stop a timer
Snd	Send a request to turn on a signal that has limited write access.
	Toggle the output state once
Load	Load Manager: Manager turns loads ON
Shed	Load Manager: Manager turns loads OFF
Flash	Flash Feature: Creates a flasher function with a programmable time period
Seq	Load Sequence Feature: Sequences multiple outputs ON and OFF

POPULATING A RUNG — ADDING AND DELETING SIGNALS

Custom logic in the Diamond Logic® Builder software is created using signals in the display area and following a few simple steps:

1. Find the desired signal from the signal categories on the right side of the advanced logic view.
2. Select the signal and (while holding the mouse button down) drag it to the desired ladder rung on the left side of the screen.
3. Release the left mouse button and a copy of the signal will now be populated on the rung. Where you release the button will determine whether this signal will be an input or an output.

See Rules for Reading and Writing Signals in Ladder Logic (page 20).

ADDING A RUNG

To add a rung,

1. Right-click inside the display area. A short menu is displayed.
2. Select ADD RUNG.

DELETING A RUNG

To remove a ladder rung:

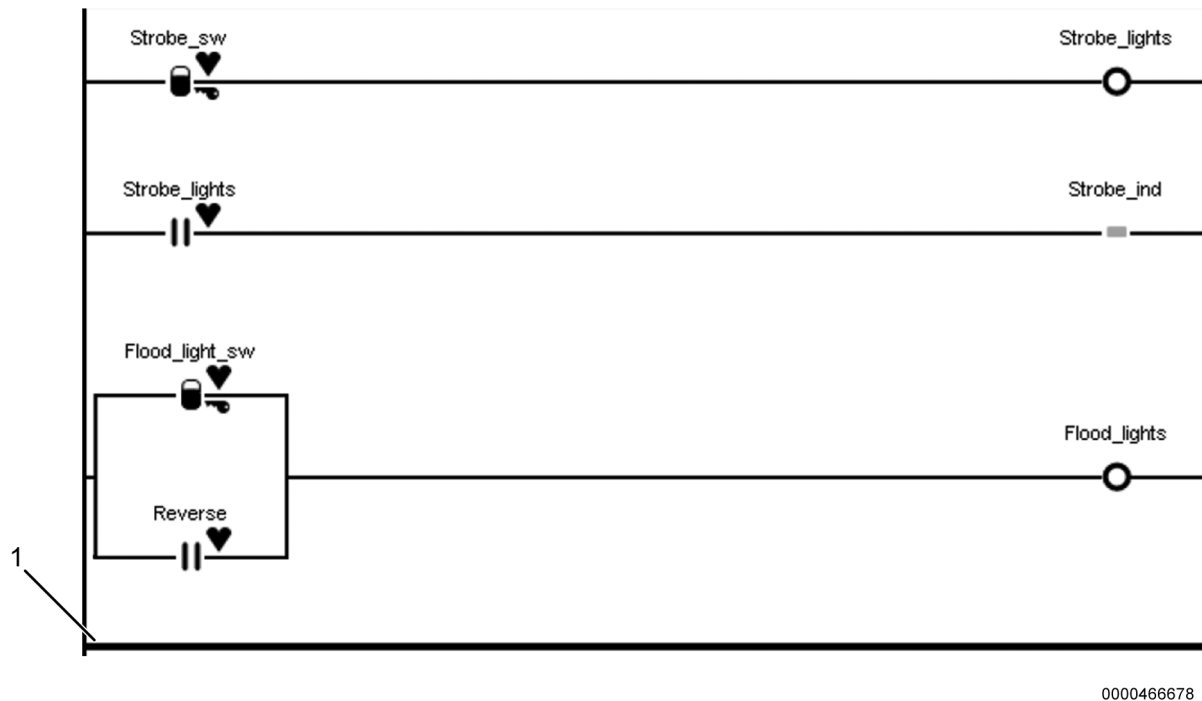
1. Select the rung to be removed by clicking on it
2. Right-click in the display area. A short menu is displayed.
3. Select REMOVE RUNG.

MOVING A RUNG

Diamond Logic® Builder allows you to move rungs either by dragging and dropping the ladder logic or by cutting and pasting the structure logic code.

NOTE – The order of rungs is important because the logic is executed in the order it is displayed.

Moving a Rung by Dragging and Dropping



1. Heavy line

Figure 9 Moving a Rung

To move a ladder rung:

1. Click on the rung to be moved and hold the mouse button down.
2. Drag the rung to the new location. As you drag, a heavy line (Figure 9, Item 1) will show where the rung will be dropped.
3. When the line shows the desired position, release the mouse button.

Moving a Rung by Cutting and Pasting

NOTE – Moving a rung by cutting and pasting rungs of logic is not recommended.

Diamond Logic® Builder also allows you to cut and paste rungs of logic. However, this cannot be done in the Ladder Logic view.

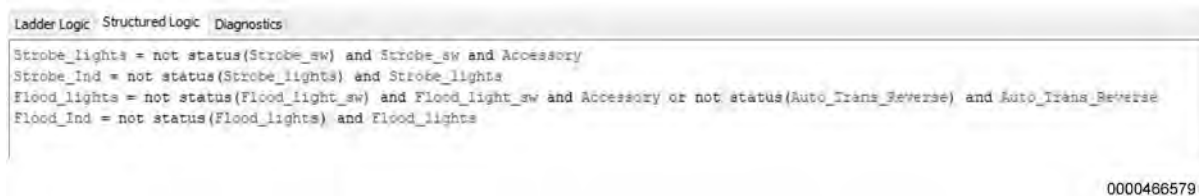


Figure 10 Structured Logic

To cut and paste rungs of logic:

1. Select the Structured Logic tab.
2. Locate and highlight the logic to be moved.
3. In the menu bar, select EDIT > CUT.
4. Move the cursor to the new location for this logic.
5. In the menu bar, select EDIT > PASTE.
6. Return to the Ladder Logic tab to verify results.

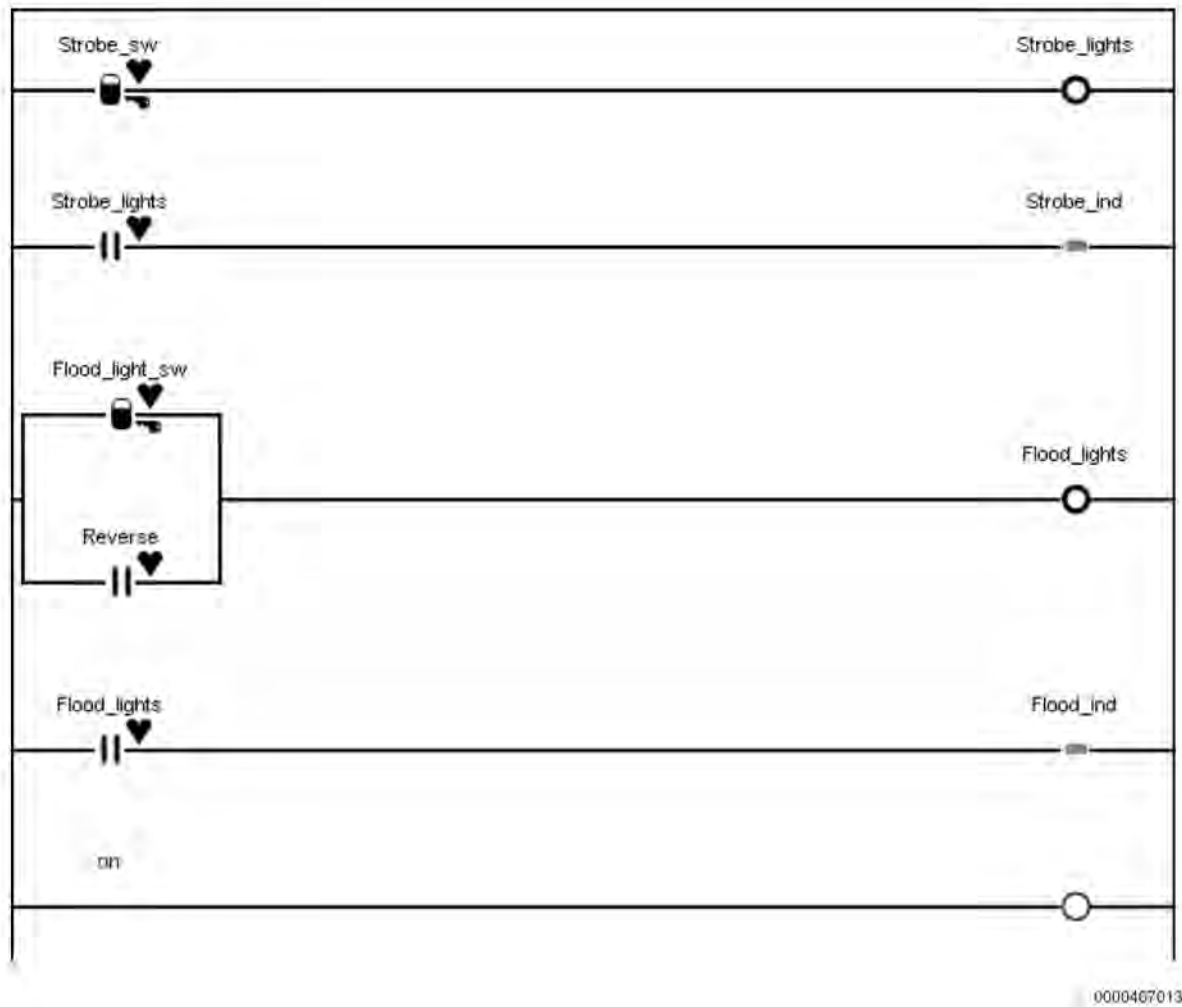


Figure 11 Cut and Paste Example: Ladder Logic

For example, If you wanted to move the top two rungs in the image above, you would select the corresponding lines on the Structured Logic tab and paste them in the desired location.

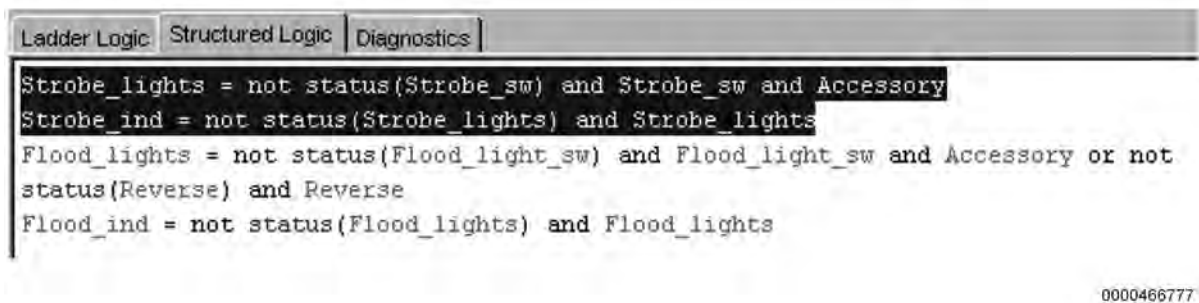


Figure 12 Cut and Paste Example: Structured Logic

VIEWING MULTIPLE TABS SIMULTANEOUSLY

Whether in the Ladder Logic view or in the resources tabs, you can double-click on any of the tabs to split the tab off of the main list and view it separately. This allows viewing of two tabs at once.

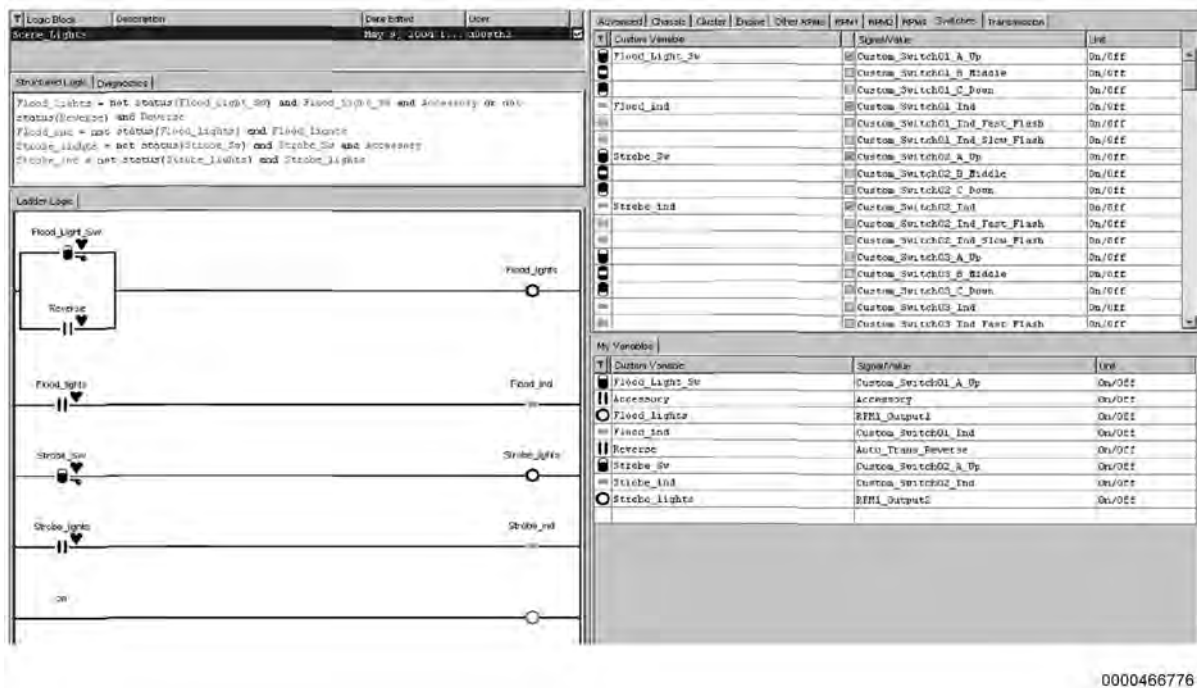


Figure 13 Viewing Multiple Tabs

The figure above shows two examples. On the left, we double-clicked on the Ladder Logic tab to allow viewing the Ladder Logic tab with either the Structured Logic tab or the Diagnostic tab. On the right, when you double-click on the My Variables tab, you can view the My Variables tab with any other resource tab.

RULES FOR READING AND WRITING SIGNALS IN LADDER LOGIC

There are a number of rules concerning the use of ladder logic. Please review the following list:

- Different signals, whether inputs or outputs cannot have the same name.
- Signal names cannot contain special characters or spaces.
- Any ladder rung can have only one output on the right side of the ladder. Outputs can only be used one time in the entire vehicle. Outputs are located on the right-side of the ladder rung.
- Only one rung in an entire vehicle configuration can write to each output that is connected to a physical pin or output.
- If the input logic is too long to fit on a single rung, an internal variable can be used as the output on the first rung and used as an input on the second rung before adding additional input logic.
- Internal variables must be used when multiple rungs control a single signal. The internal variable can then be used as input to control the signal that drives the physical output.




USING SIGNAL STATUS IN LADDER LOGIC

Every signal in Diamond Logic® Builder has a status associated with it. This is a diagnostic indicator that describes the health or condition of each signal. A zero indicates good status and the data provided by this signal can be trusted as valid. Bad status is indicated when the status value is any number other than zero. A variety of numbers have been established to describe various failure modes for the signal. Signal status can be checked to ensure that conditions such as short to ground, datalink disconnect, power loss, or failed module have not occurred. When a signal has bad status, the signal is generally not valid and should not be used for controlling outputs. Examine the following methods for using the signal status indicator.

Checking for Status Instead of State

Checking just the status of a signal can be done in the ladder logic view by right-clicking and then selecting either GOOD STATUS or BAD STATUS. A hollow heart icon will be added to the rung indicating this icon is now checking ONLY the status of the signal and not the state of the signal.

Status checking of signals should be done whenever a signal is used as an input. Including chassis signals, engine signals, transmission signals, switches, and remote power module outputs / inputs.

	If a hollow heart is not displayed, the state of the signal is being evaluated. So, this input is TRUE if the switch is in the UP position and FALSE if the switch is not in the UP position.
	If an unbroken hollow heart is displayed, the signal is being checked for Good Status. If the signal status of the switch is good, then this input is TRUE, but if the status is bad, then this input is FALSE.
	If a broken hollow heart is displayed, the signal is being checked for Bad Status. If the signal status of the switch is bad, then this input will be TRUE, but if the status is good, then this input will be FALSE.




Checking for Both Status and State

Status can also be checked in addition to the state or value of a signal. As long as status is good, the input reflects the state of the signal. But, if the status is bad, the status is reported instead of the state.

By default, this is used to force the input Off With Error. For example, an input that checks whether a switch is in the UP position would be TRUE if the switch is in the up position unless there is an error. If an error occurs, the input would evaluate as FALSE, so the contact would look like an open (OFF) switch

However, the response to an error can be changed by right-clicking on the icon and selecting MAINTAIN WITH ERROR or ON WITH ERROR. These two options should be used only when the operation of the input is critical and the results of the selected error response are well understood. It is recommended you select OFF WITH ERROR unless the application requires a different response to bad status conditions.

NOTE – Negating an icon does not negate the hearts. Therefore, a solid heart is still Off With Error if the icon is negated. The icon will look like an open switch if the status goes bad.

	An unbroken solid heart indicates Off With Error. If an error occurs, this input will evaluate as FALSE.
	A broken solid heart indicates On With Error. If an error occurs, this input will evaluate as TRUE.
	No heart to the right of the icon indicates Maintain With Error. The input will always reflect the state of the signal, whether an error occurs or not. So, the switch icon on the left would always be TRUE if the switch is in the up position and FALSE if it is not.

INDEPENDENT VARIABLES: USAGE, TYPES, NAMING, AND LIMITATIONS

NOTE – Independent variables will not keep the Body Control Module (BCM) awake. Therefore, these independent variables can be set ON and set OFF without causing the controller to stay awake with the ignition key in the OFF position. This contrasts with physical outputs that will keep the controller awake and potentially drain the battery.

Independent variables are internal signals that are not tied to any specific physical input or output signals. A BLUE hollow circle icon or a parallel pair of BLUE lines identifies these variables as internal signals. These internal signals are used as placeholders for internal processing operations or as a starting point for making a special signal like a timer or a load manager signal.

It is recommended that independent variable names be prefixed with something like IND_ or ADV_ to prevent the variable from having the same name as a standard signal. Programming that has independent variables which use the same name as that a standard DLB signal can cause programming issues.

Common Usage: Independent variables should be used when more than one rung is required to write to a single output. A physical output cannot be used in more than one rung; therefore, independent variables must be used. For example: a three-position momentary switch will require one rung to set the output ON and another rung to set the output OFF. This will require using an independent variable. Below is a ladder logic example demonstrating the use of independent variables.

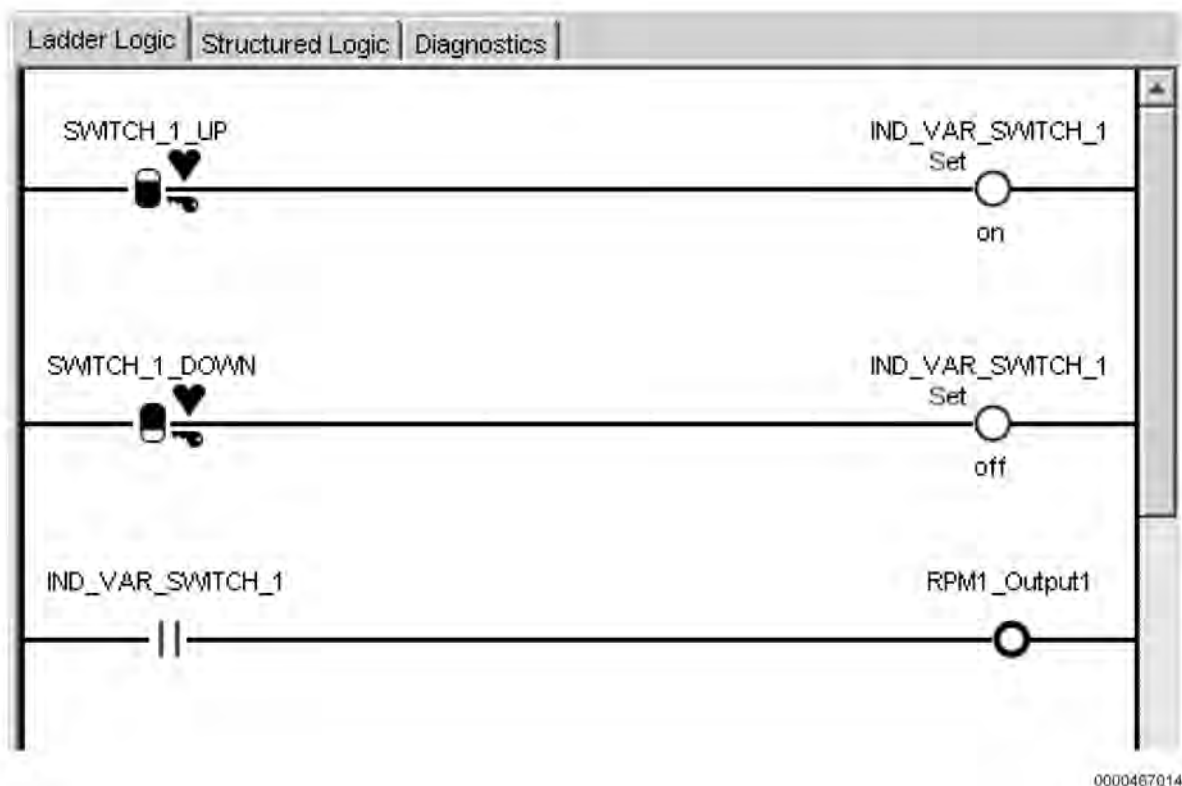


Figure 14 Independent Variable Example

OVERVIEW OF LADDER LOGIC

Using Independent Variables as Custom Programmable Parameters

Independent variables can also be used to configure custom variables that can be changed by level two DLB users.

A custom variable can be used as a value under a contact. Once it is configured, this value can be changed under the Features tab and Custom Logic sub-tab. This is handy, if a value in a logic block is likely to need changing. It will prevent the need to change the logic block in a template and reapply it. The parameter value can be changed directly on the VIN.

To create an independent variable:

1. Select the MY VARIABLES tab. The last table row on this tab will always be blank.
2. Double-click the CUSTOM VARIABLE column in the blank row and type the desired name (Parameter is the name used in this example).

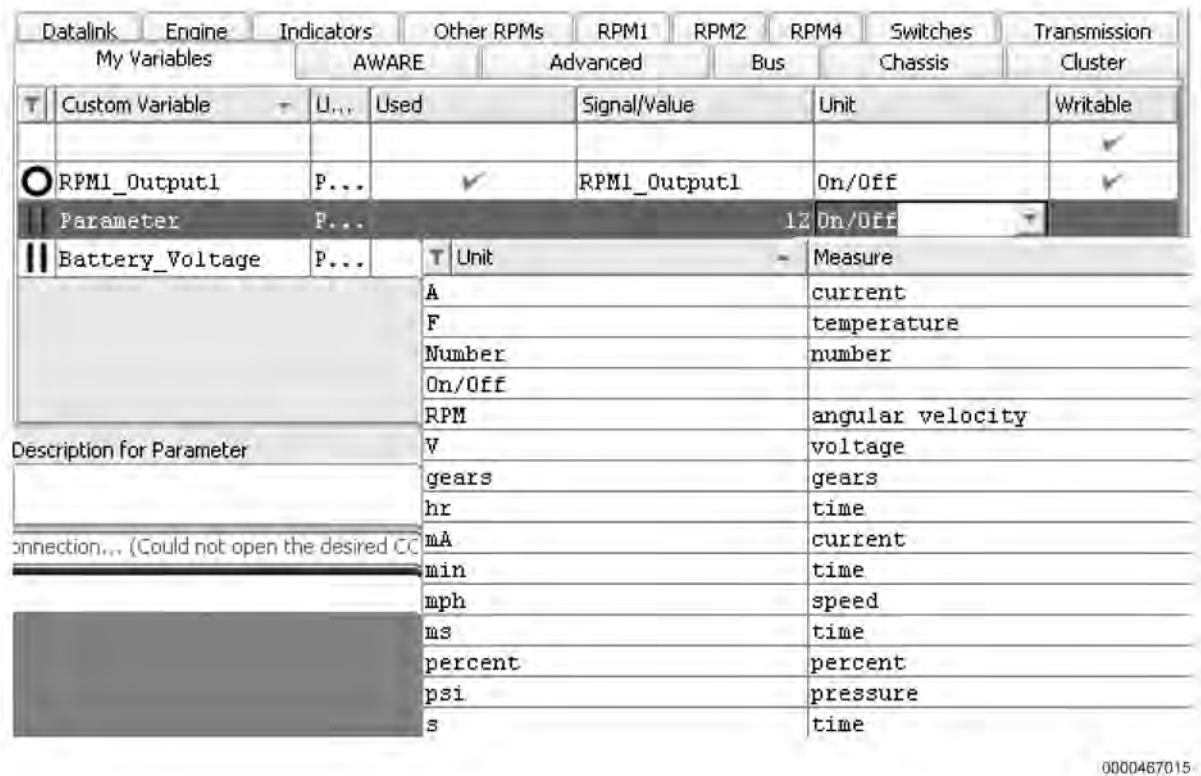
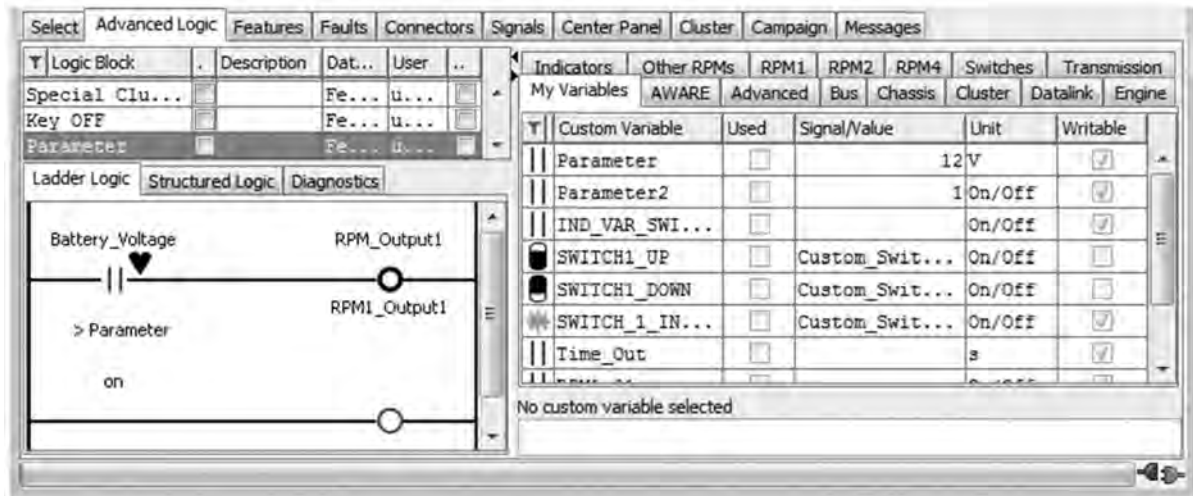


Figure 15 Creating the Variable Parameter

3. Double-click On / Off and then click the drop-down arrow to display a list of unit types (Figure 15).
4. Select a unit of measurement from the list.
5. Double-click the SIGNAL / VALUE field and enter a value for this parameter. This value will serve as the default until changed by you or by custom logic.

The custom parameter name can be typed to replace a numerical value for a contact value. The best practice is to exactly match the name created under the My Variables tab. Parameter is the name in this example below.

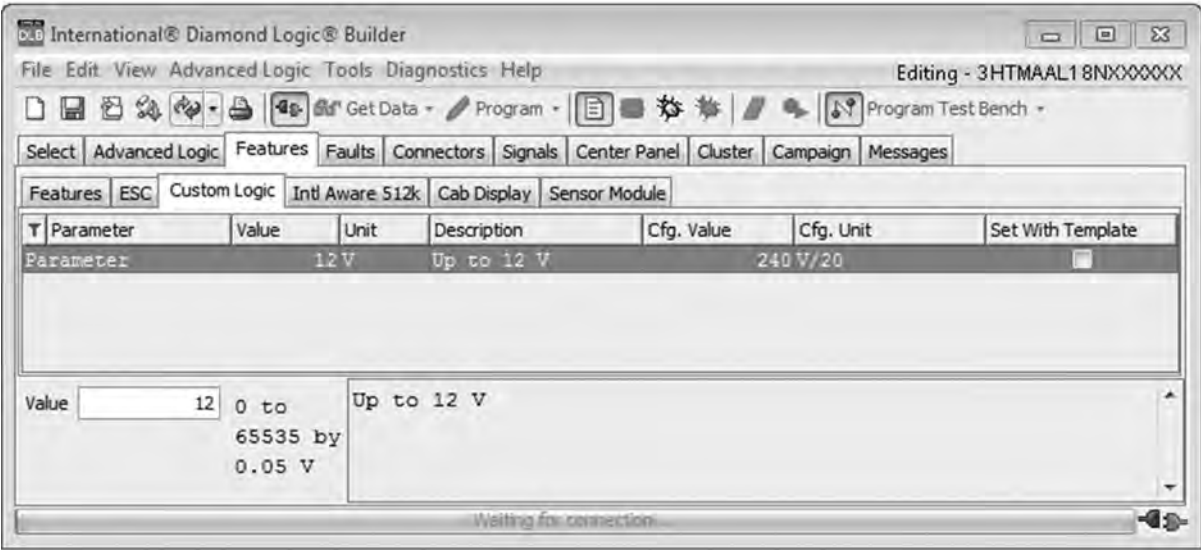


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Figure 16 Typed Parameter Name

OVERVIEW OF LADDER LOGIC

The value of the custom parameter can be viewed and changed by selecting the FEATURES tab, then the CUSTOM LOGIC tab. The custom parameter will only be displayed if it is configured correctly and the spelling is correct when it is used in the logic block.



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Figure 17 Viewing and Setting the Parameter Value

This value can be adjusted to suit the customer's specific need and can be modified by any DLB user with level two or greater permissions.

SIGNAL ATTRIBUTES AND SPECIAL FUNCTIONS

Signals that are accessible in Diamond Logic® Builder may be categorized as input or outputs. Using the input signals as bare switch contacts or driving the outputs, as simple output devices, will not provide the functionality required by most body builders. Therefore, Diamond Logic Builder provides a means to customize input and output signals with special attributes that change the way signals perform when used in ladder logic.

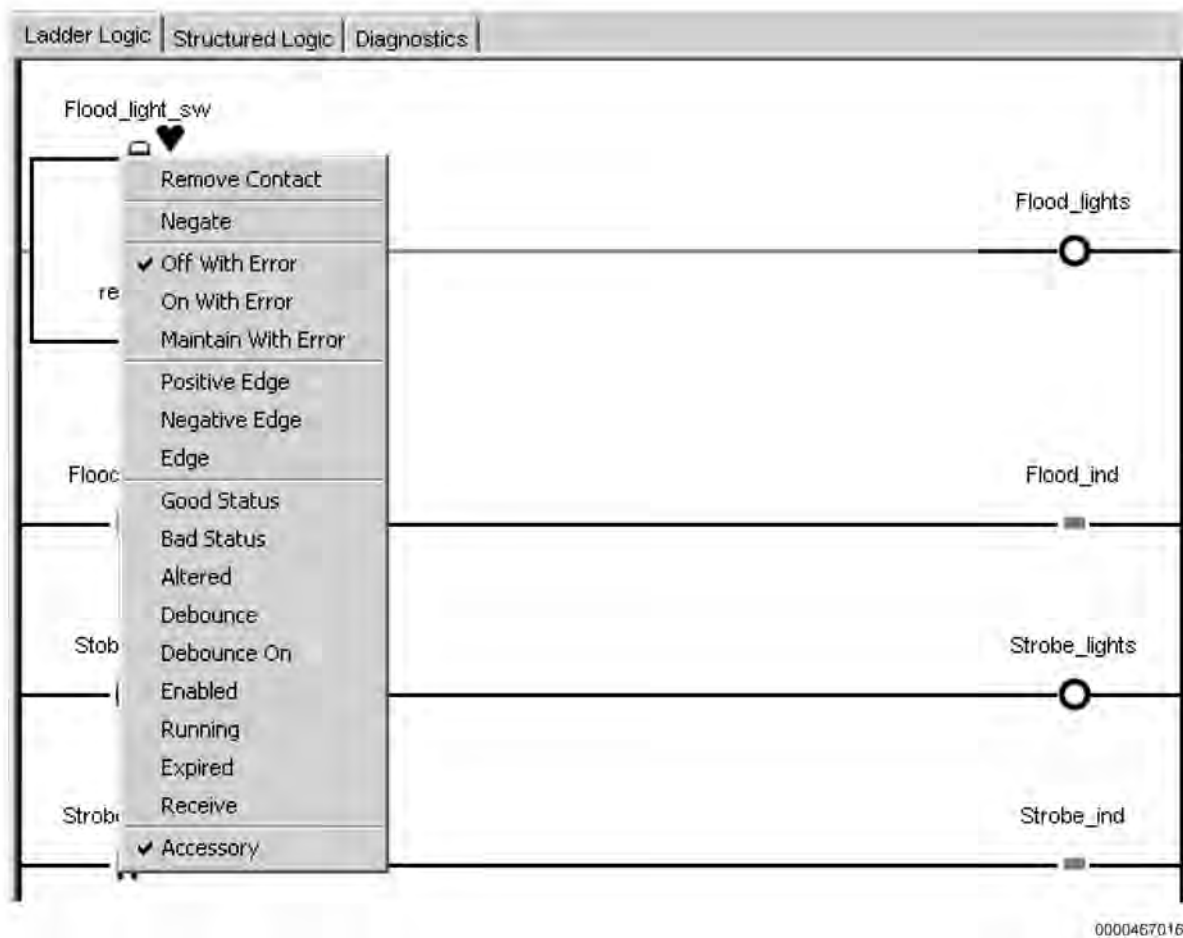


Figure 18 Input Signal Attributes

Right-clicking on the icon for an input signal produces list of attributes that are available (Figure 18). Checked items have been applied to the input signal.

Please note this list is general purpose in nature and provides options for multiple signal types. Not all attributes listed will be applicable to all signal types. Diamond Logic Builder will provide an error message if an attribute is applied to an input that is not possible for that signal type. For example, timer attributes may not be applied to the park brake signal since it is a simple switch contact type signal.

OVERVIEW OF LADDER LOGIC

Attributes of Input Signals

Attribute	Use
Remove Contact	Removes the signal from the ladder rung.
Negate	Applies a logical inversion to signals. This attribute may be applied to any signal type.
Off With Error	When this attribute is applied, Diamond Logic® Builder will check the status of a signal in conjunction with the condition or state of the signal. If a signal has a BAD STATUS, the signal state is forced to an open contact state. Therefore, the contact will be treated as an open circuit on the ladder rung no matter what the signal state may be. Checking OFF WITH ERROR in the menu will place a BLACK heart on the right side of the signal icon.
On With Error	When this attribute is applied, Diamond Logic® Builder will check the status of a signal in conjunction with the condition or state of the signal. If a signal has a BAD STATUS, the signal state is forced to a closed contact state. Therefore, the contact will be treated as a closed circuit on the ladder rung no matter what the signal state may be. Checking ON WITH ERROR in the menu will place a broken heart on the right side of the signal icon.
Maintain With Error	When this attribute is applied, Diamond Logic® Builder will check the status of a signal in conjunction with the condition or state of the signal. If a signal has a BAD STATUS, the signal state that was present before the status went bad will be used until the accessory signal is turned OFF. Thus the label Maintain With Error indicates that the last state of the signal will be maintained on the ladder rung. Checking Maintain with Error from the pick list will remove all heart icons on the right side of the signal.
Positive Edge	The positive edge attribute provides a means to capture a single transitional event of the signal going true or in other words turning ON. This is valuable when a single event is needed to start a timer or toggle an output. This signal is true or ON for only one processing cycle of .020 seconds when the signal condition transitions from an inactive state to an active state. Therefore, it is not possible to monitor the state of signals with a positive edge attribute in the diagnostic or simulate mode. Note in those modes, Diamond Logic® Builder applies a BROWN background with question marks since the actual state of the signal cannot be accurately displayed. A positive edge attribute is displayed as a positive going edge icon on the left side of the signal.
Negative Edge	The negative edge attribute provides a means to capture a single transitional event of the signal going false or in other words turning OFF. This is valuable when a single event is needed to start a timer or toggle an output. This signal is true or ON for only one processing cycle of .020 seconds when the signal condition transitions from an active state to an inactive state. Therefore, it is not possible to monitor the state of signals with a positive edge attribute in the diagnostic or simulate mode. Note in those modes, Diamond Logic® Builder applies a BROWN background with question marks since the actual state of the signal cannot be accurately displayed. A negative edge attribute is displayed as a negative going edge icon on the left side of the signal.
Edge	The edge attribute provides a means to capture a single transitional event of the signal going false or true. This attribute is valuable when a single event is needed to toggle an output from a momentary switch. This signal is true or ON for only one processing cycle of .020 seconds when the signal condition transitions from an active state to an inactive state. Therefore, it is not possible to monitor the state of signals with a positive edge attribute in the diagnostic or simulate mode. Note in those modes, Diamond Logic® Builder applies a BROWN background with question marks since the actual state of the signal cannot be accurately displayed. The letters edge are displayed on the left side of the signal.

Attribute	Use
Good Status	This attribute provides the ability for the Diamond Logic® Builder user to check for good status on a signal as a stand-alone operation. This means that the logical state of this signal is not evaluated with this attribute. In this case, if a signal has a good status, the signal is forced to be a closed contact state. Thus the label GOOD STATUS indicates that if the status of the signal is GOOD, the contact will be treated as a closed circuit on the ladder rung. Checking Good Status from the pick list will place a heart outline on the left side of the signal icon.
Bad Status	This attribute provides the ability for the Diamond Logic® Builder user to check for bad status on a signal as a stand-alone operation. This means that the logical state of this signal is not evaluated with this attribute. In this case, if a signal has a Bad STATUS, the signal is forced to be a closed contact state. Thus the label BAD STATUS indicates that if the status of the signal is bad for any reason, the contact will be treated as a closed circuit on the ladder rung. Checking Bad Status from the pick list will place a broken heart outline on the left side of the signal icon.
Altered	The altered attribute provides a means to capture multiple transitional events of the signal going false or true. This attribute is valuable when it is desired to capture the events of a signal value that has changed. This signal is true or ON for only one processing cycle of .020 seconds when the signal condition transitions from one state to another. Therefore, it is not possible to monitor the state of signals with an altered attribute in the diagnostic or simulate mode. Note in those modes, the Diamond Logic® Builder software applies a BROWN background with question marks since the actual state of the signal cannot be accurately displayed. The letters ALT are displayed on the left side of the signal.
Debounce	This attribute provides you a defined delay of response to a signal transition from either Off to On or On to Off. See Signal Debounce Functions (page 195) for more detail.
Debounce On	This attribute allows you a defined delay of response to a signal transition from Off to On only. See the Signal Debounce Functions (page 195) for more detail.
Enabled	The enabled attribute is used with timers. The enabled attribute is used to check when a timer is in any state other than stopped. The timer with the enabled attribute will be true if the state of the timer is started, running or expired. The timer with the enabled attribute applied will display a clock outline on the left side of the timer signal.
Running	The running attribute is used with timers. The running attribute is used to check when a timer is in the running mode. The timer with the running attribute will be true if the state of the timer has been started and has not yet expired. The timer with the running attribute applied will display a clock outline on the left side of the timer signal with two hands showing a filled time segment between the 12 and 3 o'clock positions.
Expired	The expired attribute is used with timers. The expired attribute is used to check when a timer has timed out and is expired. The timer will stay in the expired state until the timer is stopped or restarted. The timer with the expired attribute applied will display a clock outline on the left side of the timer signal with two hands pointing to the 12 o'clock positions.
Receive	Receive is used with signals with limited access. This function should not be used with the current version of the Diamond Logic® Builder program.

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Attribute	Use
Accessory	The Accessory attribute applies the accessory signal to the signal under evaluation. This attribute is defaulted ON for most input signals to ensure that the ladder rungs are OFF when the ignition key is turned OFF. This action will prevent the Body Controller (BC) / Body Control Module (BCM) from running when not required and thus prevent draining of the vehicle batteries. When enabled this attribute will apply a key symbol to the lower right side of the signal.

Attributes of Output Signals

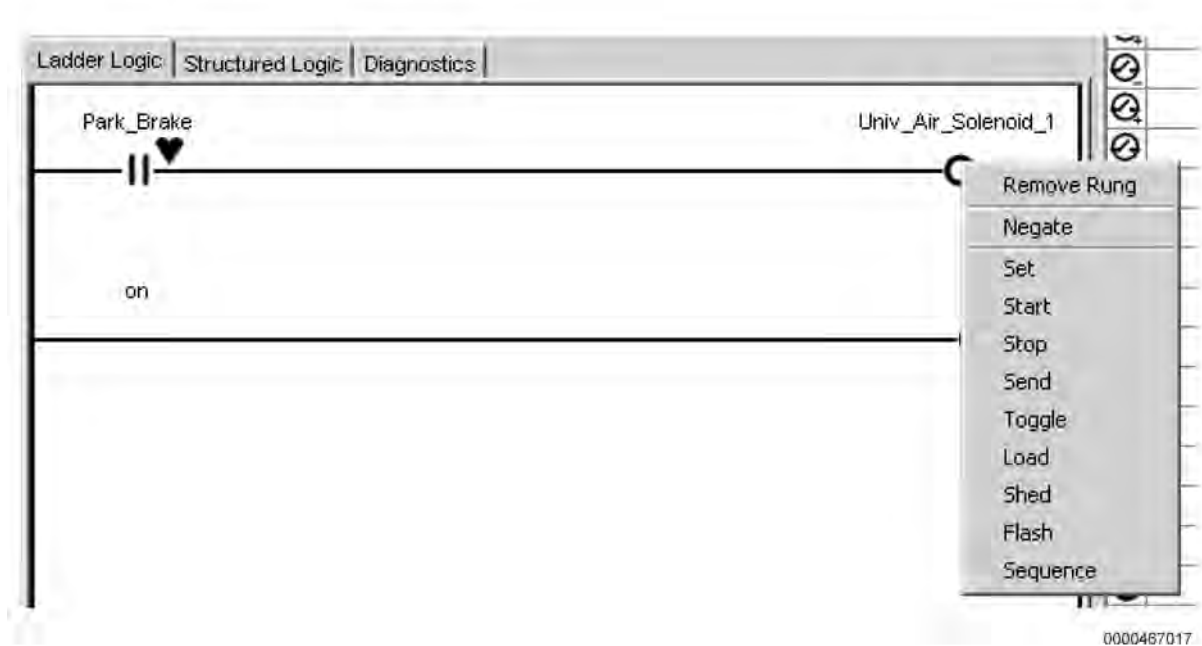


Figure 19 Output Signal Attributes

Attribute	Use
Remove Rung	The remove-rung selection will erase the complete rung from the ladder.
Negate	Applies a logical inversion to output signal. This attribute may be applied to any signal type.
Set	<p>The Set function allows you to save or latch a logical condition. This is valuable when it is desired to save a transitional event from a momentary switch. The set function may be used in a variety of modes as follows:</p> <ul style="list-style-type: none"> • Set ON: Turns ON an output • Set OFF: Turns OFF an output • Set 1: Turns ON an output • Set 0: Turns OFF an output • Set (any numerical value): Sets an internal variable to a desired value • Set A+1: Increments the variable A by 1 (Other math expressions are valid, i.e. -, *, /) <p>When the set attribute is applied to an output, the letters Set will be located on the left side of the output signal. In addition, the word ON will be located below the signal. You can modify the set function by double-clicking on the word ON. The word will be highlighted and a new value may be typed in. Hitting enter saves the entry. The set function may be applied to advanced features like load managers or load sequencers to force the counter variables to specific values.</p>
Start	The start attribute starts a timer. The timer with the start attribute applied will display a GREEN clock on the left side of the timer signal with two hands showing a filled time segment between the 12 and 3 o'clock positions. See Timers (page 188)
Stop	The stop attribute stops a timer. The timer with the stop attribute applied will display a RED stop sign on the left side of the timer signal with two hands pointing to the 1 o'clock position. See Timers (page 188)
Send	The send attribute is used with signals that have limited access. These signals are identified with a small flag icon. See Using Signals with Limited Write Access (page 93)
Load	The load attribute is used with load managers. See Load Management (page 178)
Shed	The shed attribute is used with load managers. See Load Management (page 178)
Flash	The flash attribute is used with flashers. See Flashers (page 167)
Sequence	The sequence attribute is used with load sequencers. See Master Switch with Load Sequencing (page 173)

KEEPING TRACK OF SWITCH AND PIN USAGE

The Diamond Logic® Builder program allows you to create custom logic. However, the Diamond Logic electrical system also contains pre-engineered features that utilize many of the same components and signal pins that are accessible using advanced logic. When creating advanced logic with Diamond Logic Builder, it is essential to keep track of inputs and outputs used by pre-engineered features and not map signals to the same pins.

Preventing Pin Usage Conflicts with Pre-engineered Features

Diamond Logic Builder makes every attempt to warn you when a signal or pin has a conflict in usage. You should perform the following steps to prevent undesired system performance or compile errors.

1. Install all desired pre-engineered features to speed up the body to chassis integration process. The pre-engineered features have been thoroughly developed and tested to provide error free operation.
2. Select the CONNECTOR view of the template and print it out.
3. Make note of the BC / BCM, air solenoid, and remote power module inputs and outputs that have been used by pre-engineered features.
4. Select the CENTER PANEL view and print it out.
5. Note which switches and gauge cluster warning lights have been used by pre-engineered features.

IMPORTANT – Editing and / or resetting the pin mapping in your vehicle may undo previous customization.

6. Refer to these printouts before you begin using signals in the advanced logic view. Do not try to map the Diamond Logic Builder software signal to pins that have already been used by pre-engineered features.

Default Pin Mapping

IMPORTANT – Editing and / or resetting the pin mapping in your vehicle may undo previous customization.

Diamond Logic Builder allows you to reset pin assignments with the priority rules that are used by the data processing systems at International. This capability is valuable when you have added air solenoids and the total have exceeded the space available on the four-pack solenoid base. Prior to 2007 or export units with original Electronic System Controller (ESC) / BCM electrical architecture, the seven-pack base is meant to be located in the same general spot on the frame rail, it MAY be desirable to remove the four-pack and install a seven-pack. In order to force all the air solenoids onto the seven-pack, select EDIT > USE DEFAULT > PIN MAPPING in the menu bar. Now all the solenoids will be located on the seven-pack and the signals will be removed from the direct drive relay driver pins of the ESC / BCM configuration.

This capability may be used to independently restore factory default selections for pin mapping, programmable parameters or switch and gauge locations. Be aware that Diamond Logic Builder assigns pin and switch locations in the next available spot as you install additional pre-engineered features.

If you need all vehicles to have the same pin assignments without regard to the order that the features were added, it is important that you use the default pin mapping feature on all of them.

Conversely, if you have already wired your vehicles in a particular manner based upon a specific order for adding features, then be sure that you do not use the default pin mapping feature. In this case, it would be best to make a template from the vehicle that matches the desired pin mapping and then apply it to all subsequent vehicles to ensure consistent pin assignments.

REMAPPING SIGNALS TO PHYSICAL INPUT AND OUTPUT PINS

IMPORTANT – Editing and / or resetting the pin mapping in your vehicle may undo previous customization.

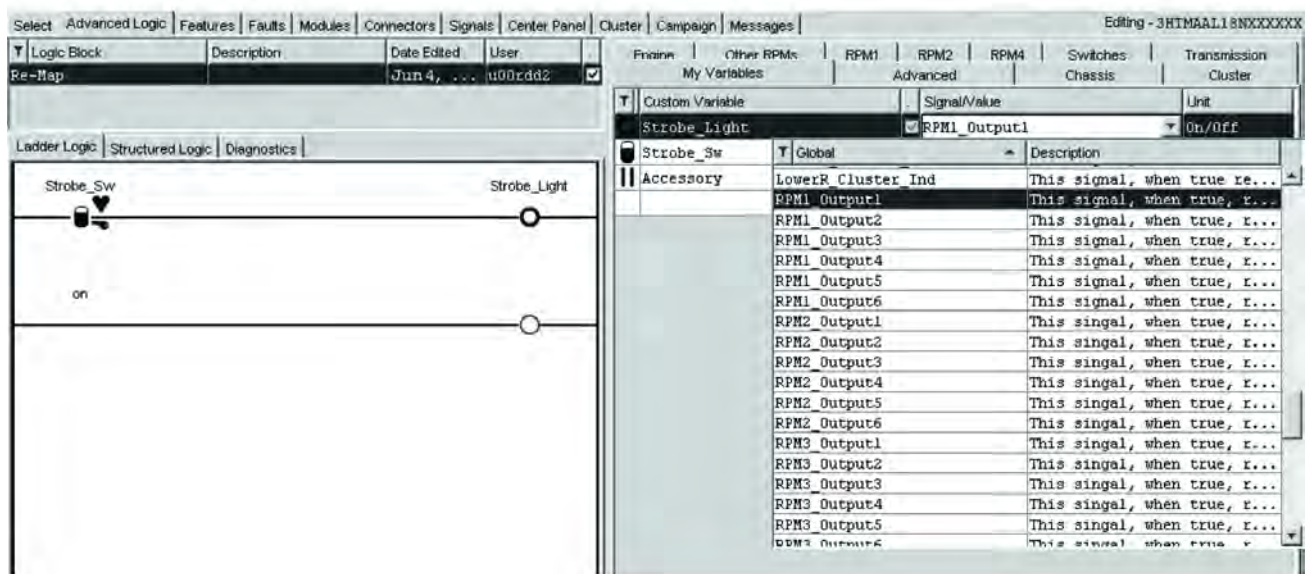
Most signals in Diamond Logic® Builder are mapped to specific physical output pins. Some exceptions to this rule are internal variables and special functions such as timers, flashers, load managers, and load sequencers. For those signals that are mapped to physical output pins, it may be necessary to relocate a signal to another pin based upon your available module resources and option content on a specific vehicle. A physical output pin may only have one signal mapped to it.

Process for Remapping a Physical PIN

1. Select the ADVANCED LOGIC tab.
2. Select the logic block that contains the ladder logic to be remapped.

NOTE – The signals on the right half of the window have a number of available columns that may be displayed. The physical pin that is associated with a signal is listed in the Signal / Value column. Not all signals will show a pin destination such as RPM1_Output1. Many signals are provided from other International designed pre-engineered features such as Park_Brake or Door_Switch. You should not try to re-map these signals. Doing so will cause unexpected logic operation.

3. Find the signal to be relocated in the SIGNAL / VALUE list on the MY VARIABLES tab.



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Figure 20 List of Outputs

4. Double-click on the SIGNAL / VALUE field for the selected signal. This produces a list of outputs (Figure 20). The output currently used by this signal will be highlighted.

OVERVIEW OF LADDER LOGIC

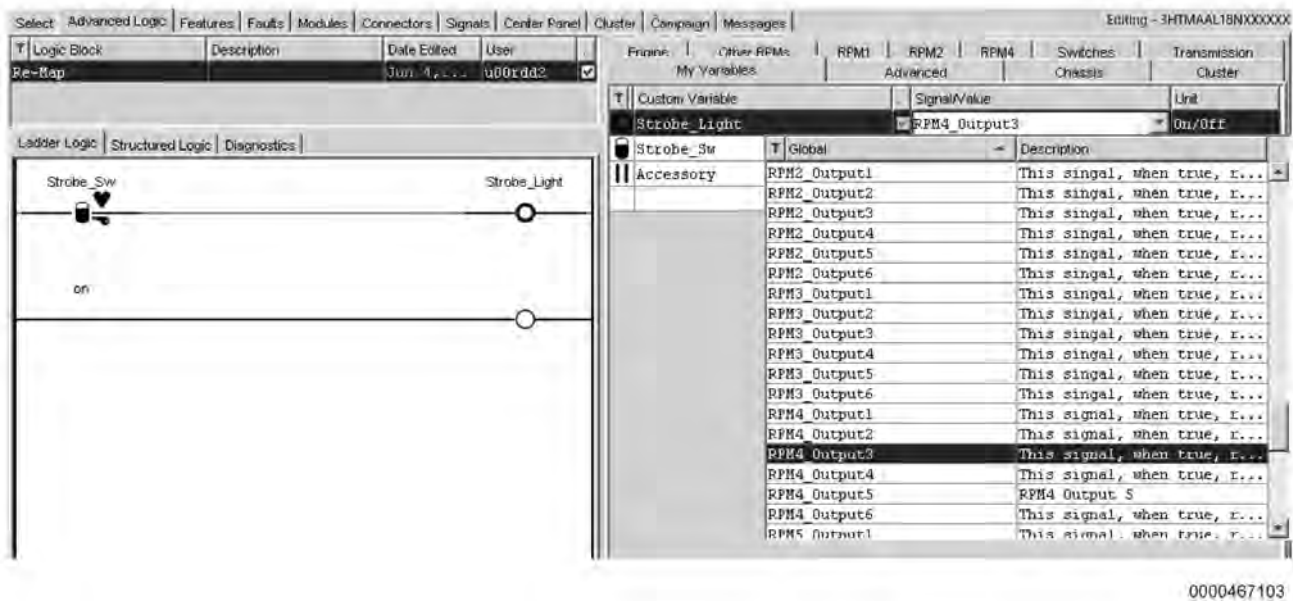


Figure 21 New Output for Signal

5. Select the new output pin (Figure 21).

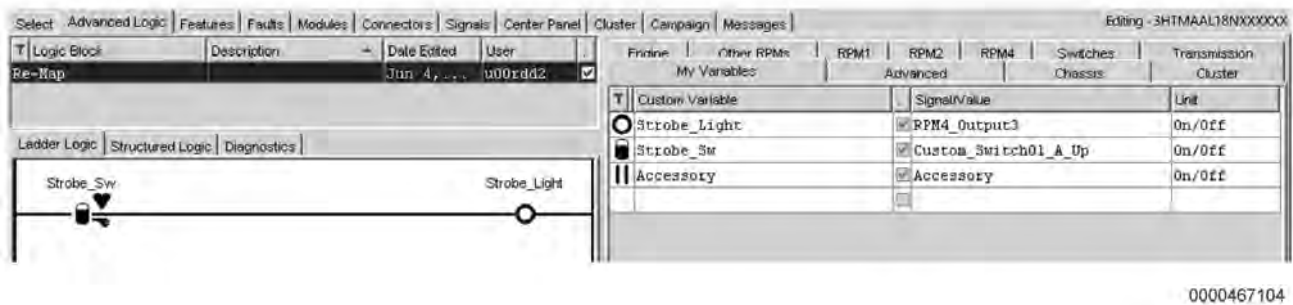


Figure 22 Signal with Remapped Output

6. Press the ENTER key. The Signal / Value tab will now display the new output pin (Figure 22).

Remapping Outputs When Multiple Logic Blocks are Enabled

Remote Power Modules, switch packs and air solenoids all have a finite number of physical input and output signals. It may be necessary to re-arrange signal inputs and outputs based upon pin availability for a vehicle configuration. As advanced logic blocks are designed, you may find that you have mapped signals from different features to the same physical pin on a remote power module or other device. Diamond Logic® Builder will not allow the configuration to compile with two features trying to use the same physical output pin. The net result is that if both logic blocks are enabled on the vehicle, then either an error message will appear on the Message tab or one of the logic blocks outputs will automatically be remapped as internal variables. This means these outputs will not be connected to any output pin or device. Therefore, it is essential that these outputs be remapped to available outputs. This condition may happen when you duplicate a logic block or copy advanced logic in the structured logic mode.

If two logic blocks are mapped to the same output (RPM1_Output1) a conflict will occur. To review the conflict de-activate one of the blocks and leave the second block enabled. As shown below the Flasher Block is active. First we have two logic blocks loaded into a vehicle configuration but only the Flasher block is enabled. We can view the mapping of signals on the ladder by turning on the ladder details under the Advanced Logic pull down tool bar along the top of the screen.

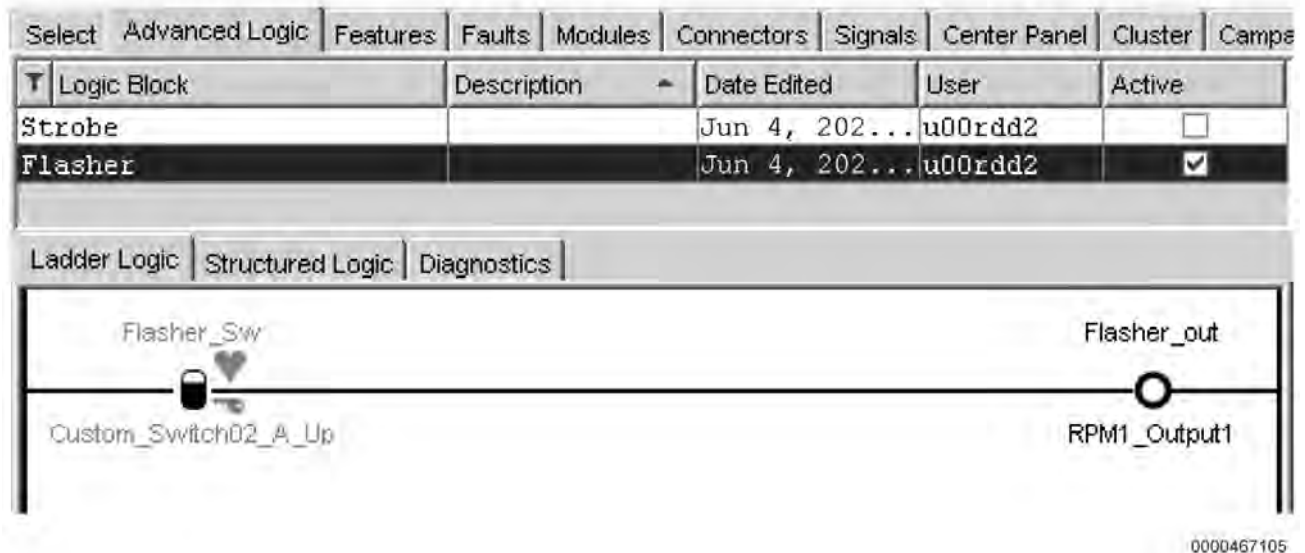


Figure 23 Flasher Feature

Next we see the strobe light is also mapped to RPM1_Output1.

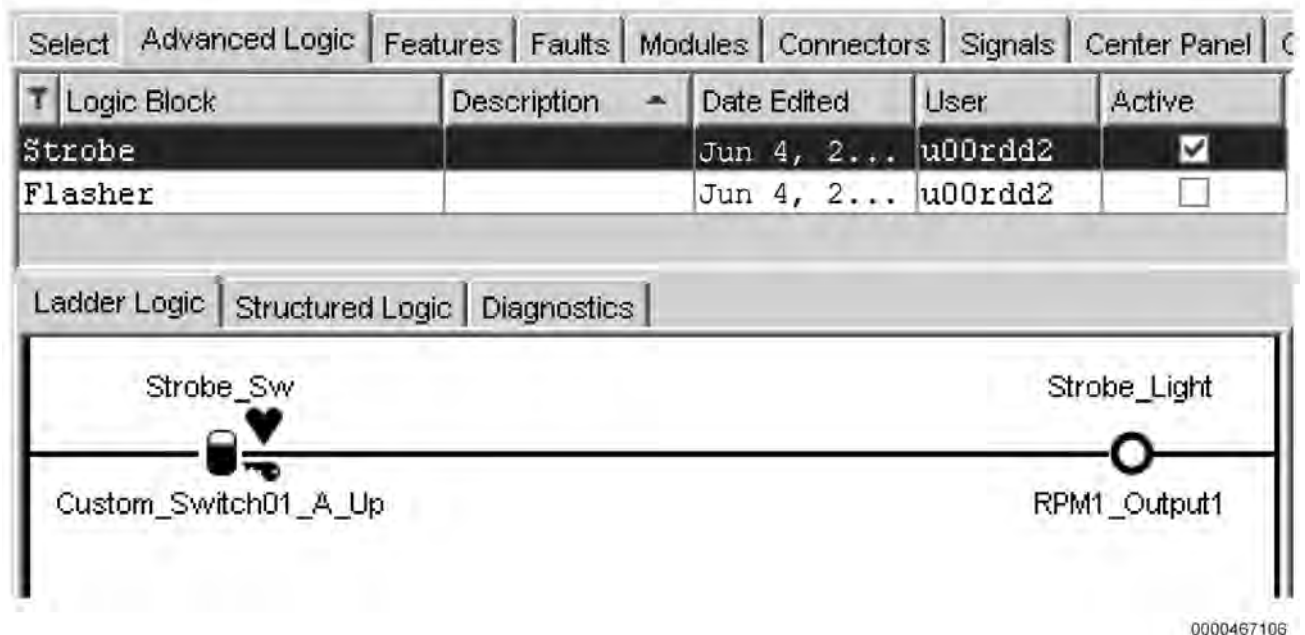


Figure 24 Strobe Light Feature

OVERVIEW OF LADDER LOGIC

When both logic blocks are turned ON, we see that the last one to be enabled will lose its mapping and cause a conflict message. Here the Flasher_Out appears to be the Strobe_Light output.

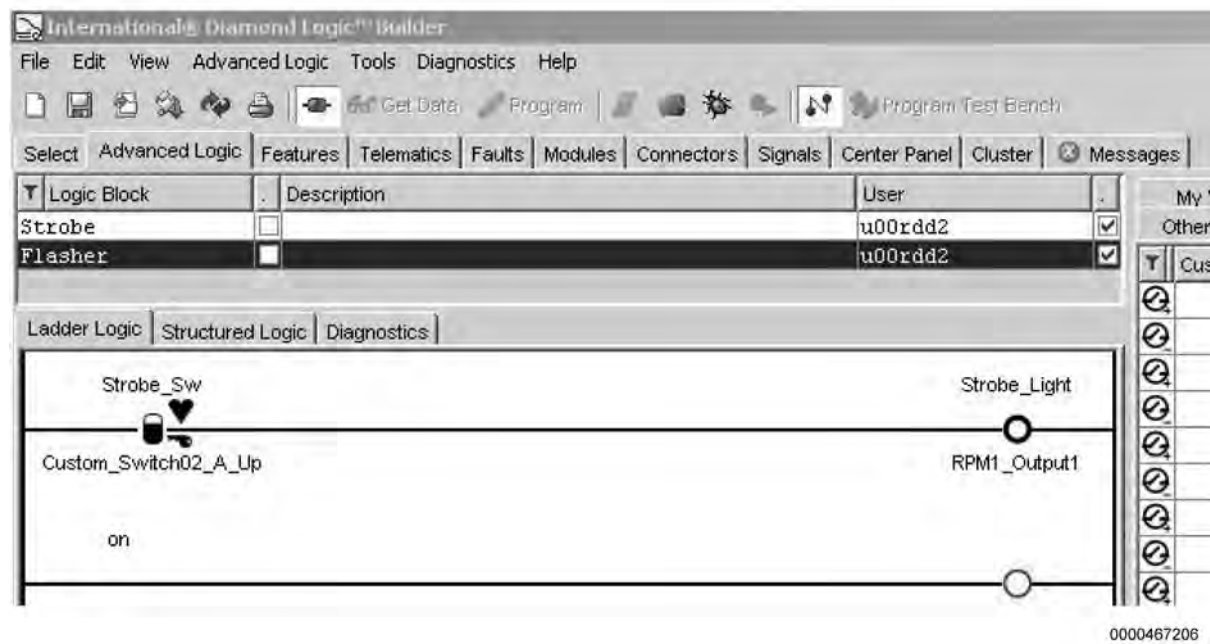


Figure 25 Output Mapping Conflict

If we remap one of the features to RPM1_Output2, then both features will function on the same vehicle.

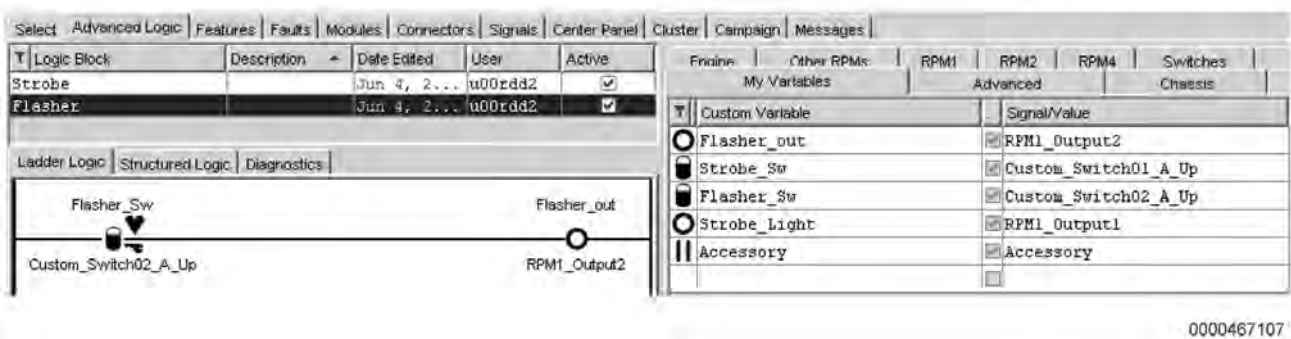
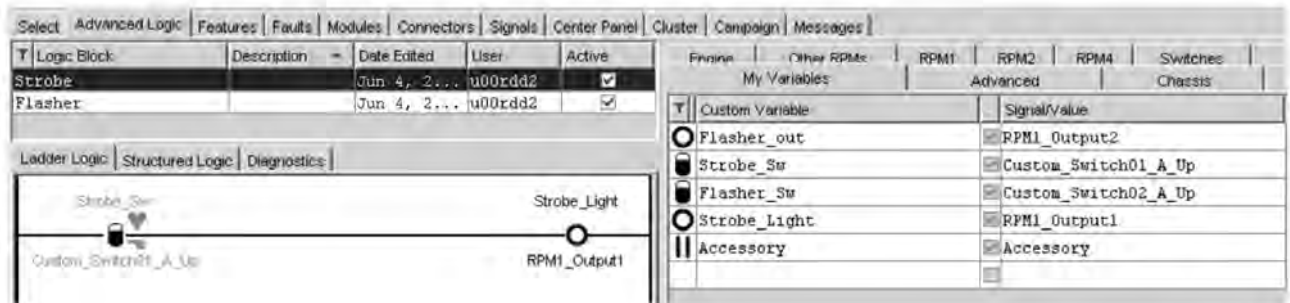


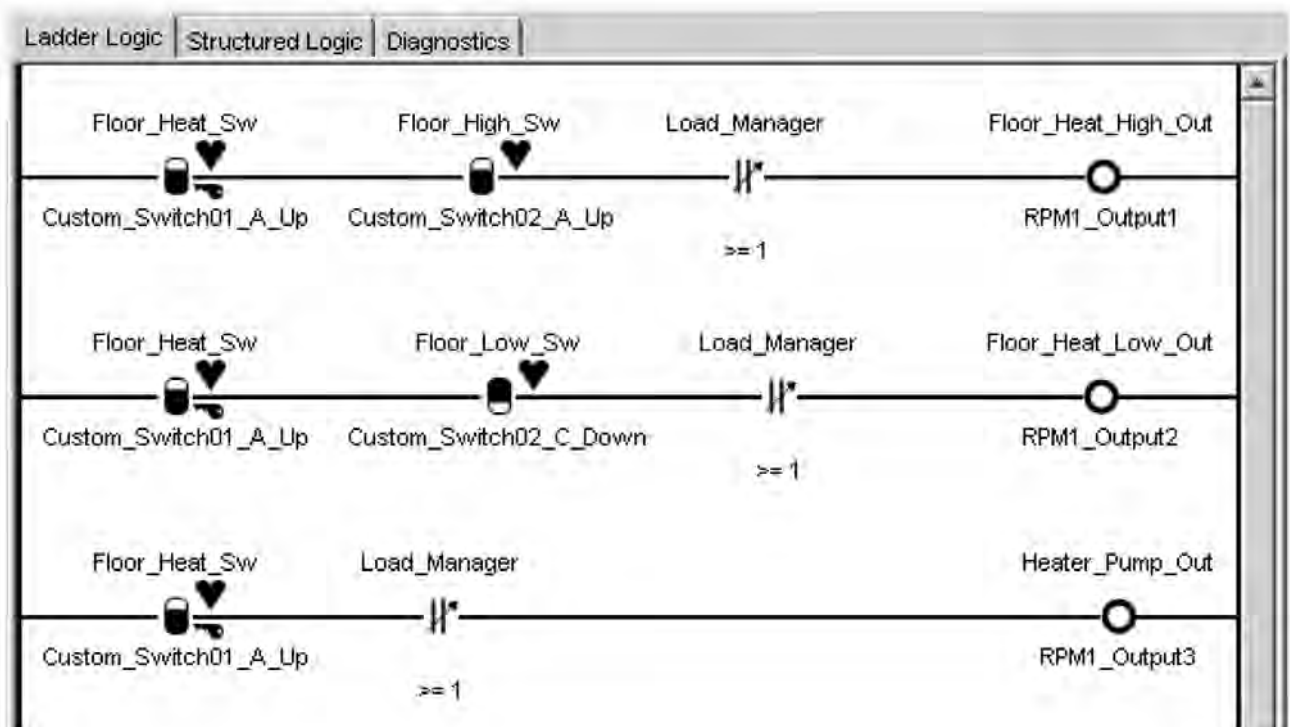
Figure 26 Flasher Feature Enabled



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Figure 27 Strobe Light Feature Enabled

The following diagram shows a logic block before and after it has been copied into a vehicle configuration that conflicts with another set of features.



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Figure 28 (Before) Floor Heater Before Conflict With Other Features

Before the conflict with other features, the outputs are mapped to Remote Power Module (RPM) outputs (Figure 28).

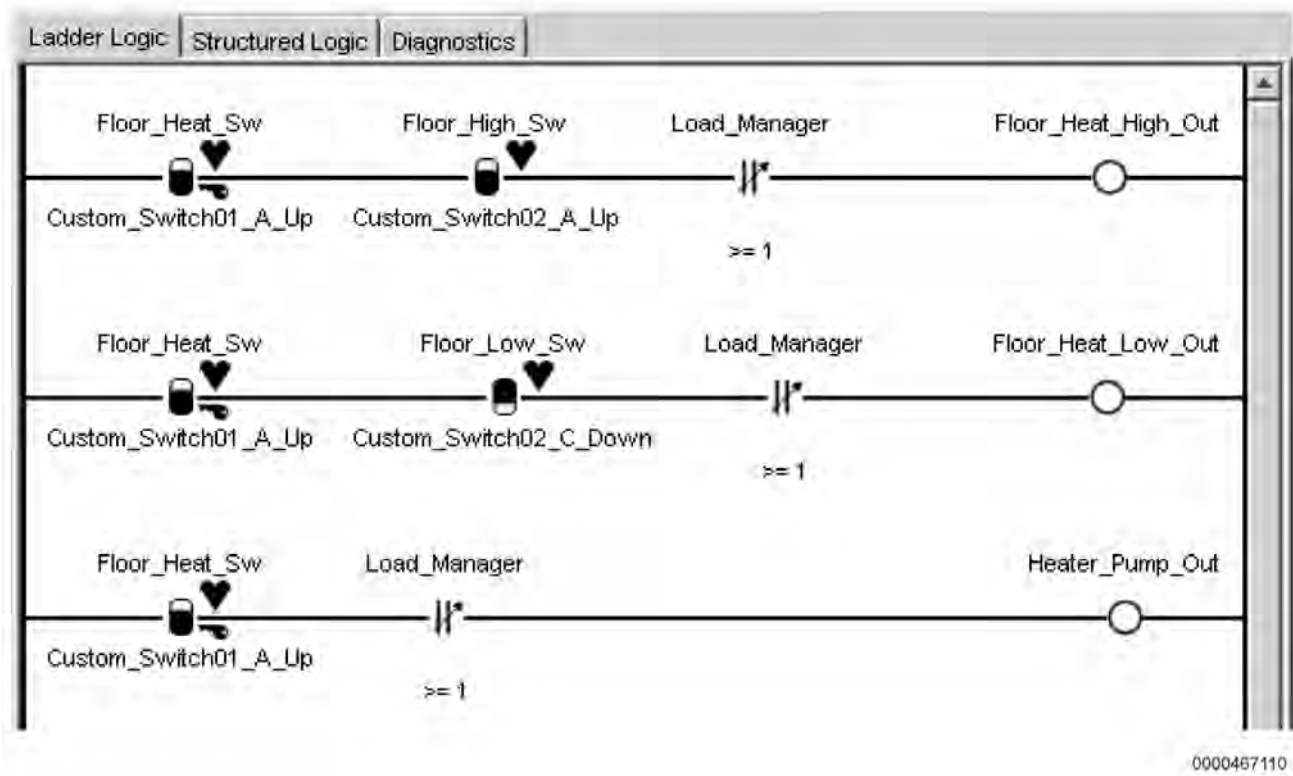
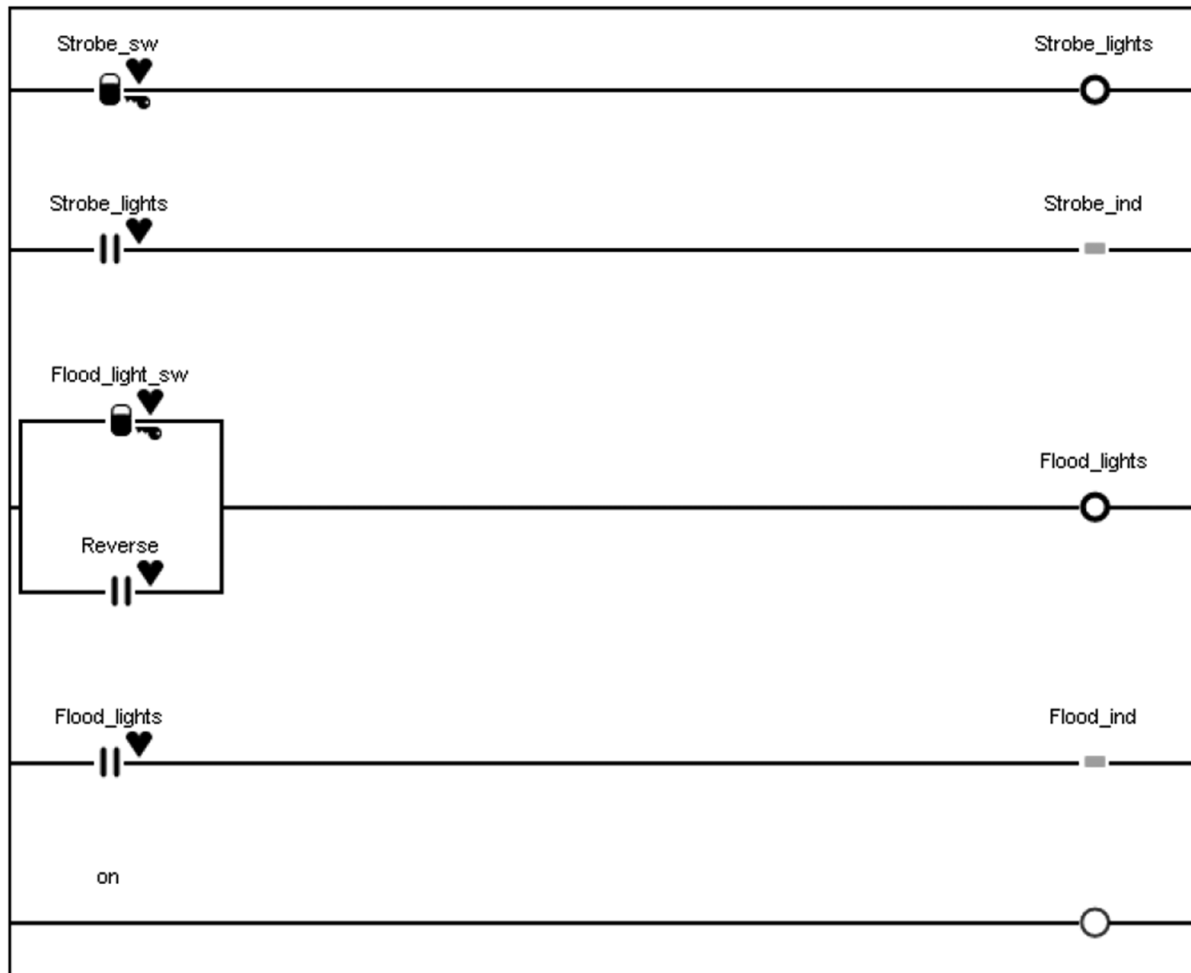


Figure 29 (After) Floor Heater After Conflict With Other Features

After the conflict, the outputs are mapped to internal variables (Figure 29).

SIMPLE EXAMPLE OF LADDER LOGIC



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Figure 30 Sample Ladder Logic Rungs for a Waste Collection Vehicle

OVERVIEW OF LADDER LOGIC

To study this example, let's look at each of the rungs individually:



Figure 31 Sample Rung One

Input	Output
The icon Strobe_sw signal input switch pushed up will be true as long as the key is in the accessory or ignition position and the status on the switch signal is good (off with error). If any of these elements are false the signal contact is like an open switch.	The icon StrobeLights signal output is an RPM output. The output is ON only when the strobe light signal contact is ON.



Figure 32 Sample Rung Two

Input	Output
The Strobe-lights output from Figure 31 has been used as an input in Figure 32. If StrobeLights is ON...	...then the GREEN indicator of the ON lamp in the strobe light switch will be illuminated.



Figure 33 Sample Rung 3

Input	Output
The input side shows an OR condition. In this case when the Flood light switch is ON or the transmission is in REVERSE...	...then the flood lights will be ON.

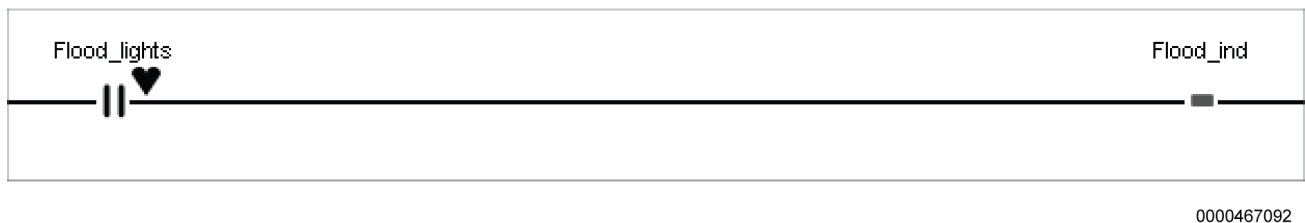


Figure 34 Sample Rung 3

Input	Output
When the Flood Light output is ON...	...then the GREEN indicator of ON lamp in the Flood light switch will be illuminated.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

PROGRAMMING WITH VARIOUS ROCKER SWITCH TYPES

The Diamond Logic® electrical system has two types of in-cab switch configurations; two-position latched switches and three-position momentary switches. Both of these switches can be used to control body equipment.

Two-position Latched Switches

This switch is the most commonly used version. A latched switch is latched ON or latched OFF. This functionality is required when it is critical for the system to maintain the last state of the switch in the event of a power loss. For example, when using Remote Start / Stop, a latched switch for the PTO is critical to use so that the last position of the switch is remembered after cranking of the engine. The BCM may go through a system reset during engine cranking and all signals are initialized to OFF during this event. In addition, the ON / OFF state of these switches is visible to the vehicle operator. A two-position latched switch is recommended for the majority of switching requirements. See the three-position switch section below for exceptions to this rule.

Using a Two-Position Latched Switched in Advanced Logic

NOTE – For a two-position latched switch, only the up and down switch icons are applicable, since the switch will never be in the middle position.

NOTE – Add diagnostic text in the Diagnostics tab to describe this functionality. See Diagnostic Feature Descriptions: Writing Useful Text

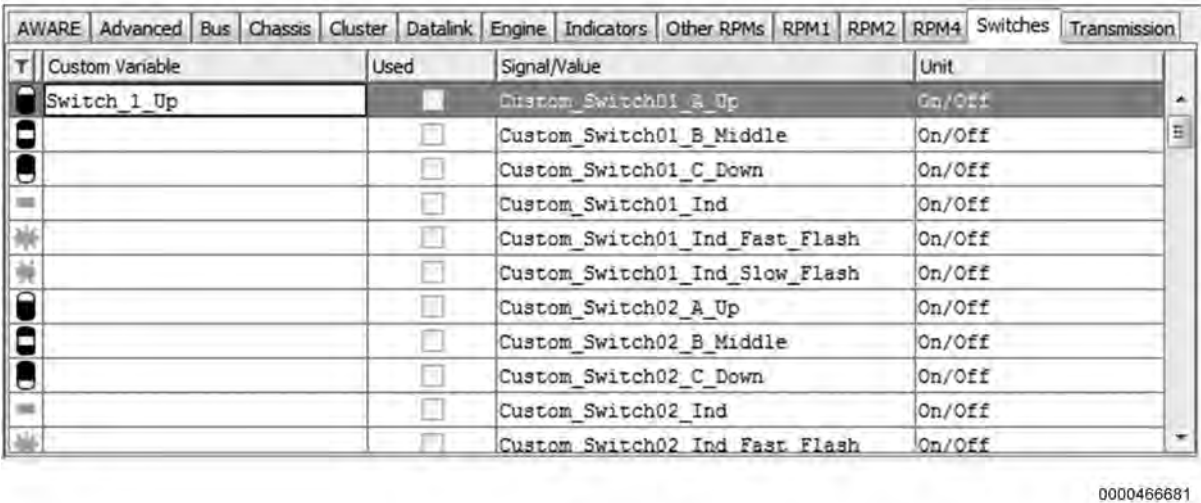


Figure 35 Selecting and Renaming a Switch Icon

1. Select the SWITCHES tab.
2. Select the up position of the next available switch icon.
3. Double-click in the CUSTOM VARIABLE field.

NOTE – If no custom name is added, then the name in the Signal / Value column will be copied to the Custom Variable field, but these names are often long. It is desirable to keep the names short so the switch labeling in the Center Panel View is more readable.

4. Type the new name for the switch and press ENTER.
 - To identify it as a switch, include SW or SWITCH in the switch name.
 - No spaces can be used in the custom variable. However, an underscore (_) may be used.

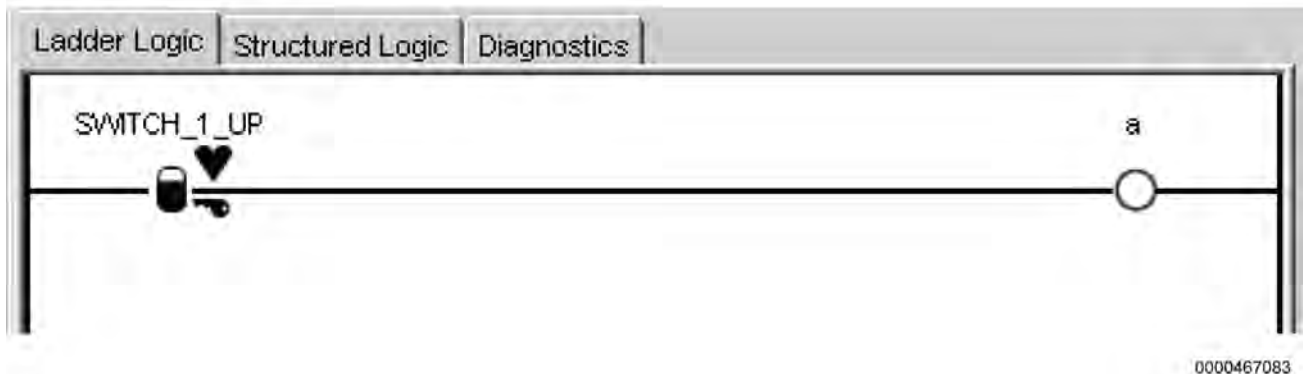


Figure 36 Adding a Switch to a New Rung in Ladder Logic View

5. Drag the Switch Up icon to the next available rung in the ladder logic field, as the input. The following input modifier icons will be added automatically:
 - A heart indicating that the circuit (signal) will be forced open if the switch status goes bad. See Using Signal Status in Ladder Logic (page 21).
 - A key indicating that the switch is interlocked to ACCESSORY key position. See the description of the Accessory attribute on page 30.

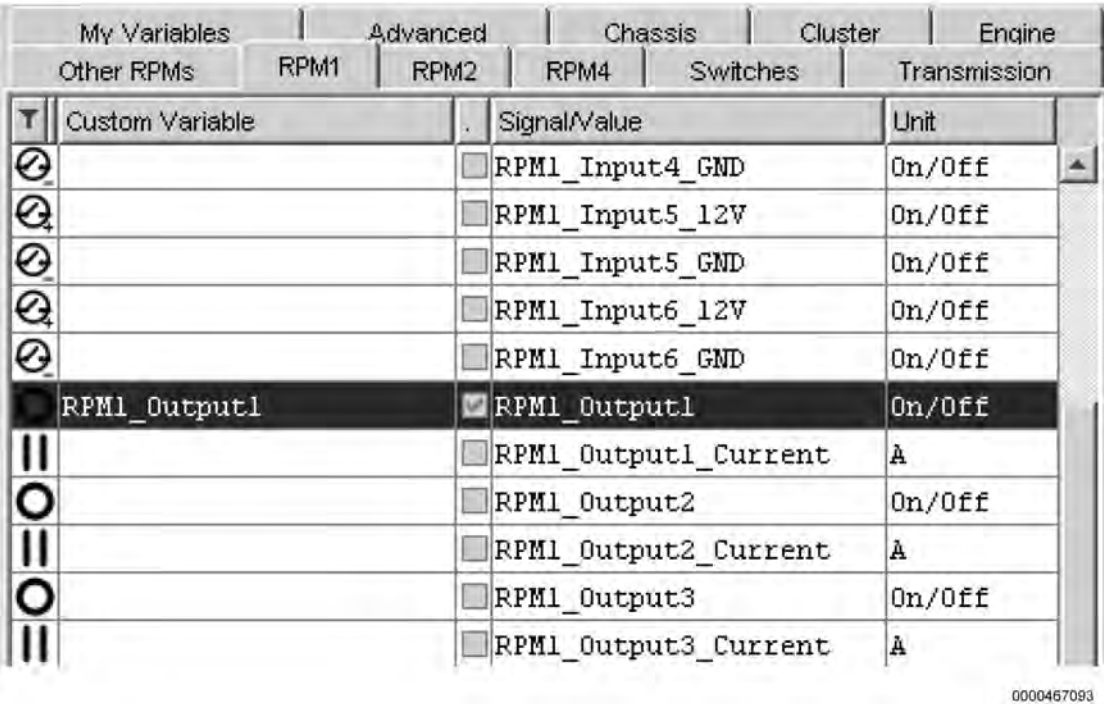


Figure 37 Selecting an Output

6. Select an output in the SIGNAL / VALUE tab. The next available Remote Power Module output is the most common selection.

NOTE – If the vehicle is equipped with any other Remote Power Module features that will not be removed, first select the connector tab to determine the next available Remote Power Module Output. See the Keeping Track of Pin and Switch Usage.

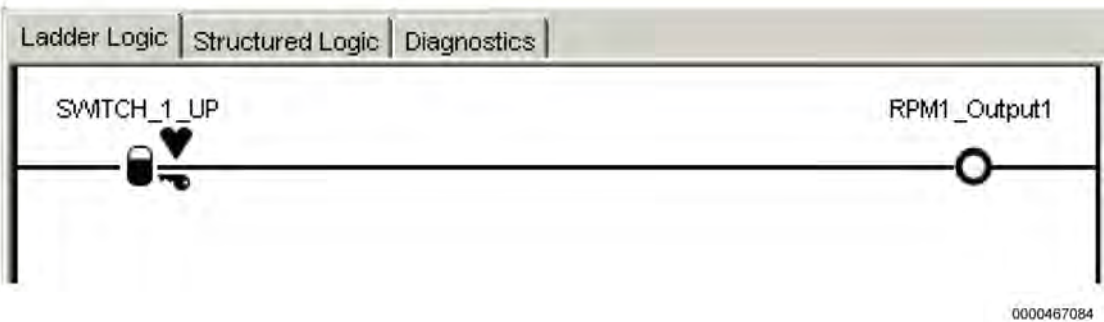










Figure 38 Adding an Output to the Ladder Logic View

7. Add the selected output to the right end of the rung. Click the selected output and then drag it to the desired position in the ladder logic view. The logic rung now indicates that when the switch is in the up position (True), Remote Power Module 1, Output 1 will be TRUE and turn on. When the switch is in the down position, the up switch icon will be FALSE and therefore, the Remote Power Module 1 output will turn off.

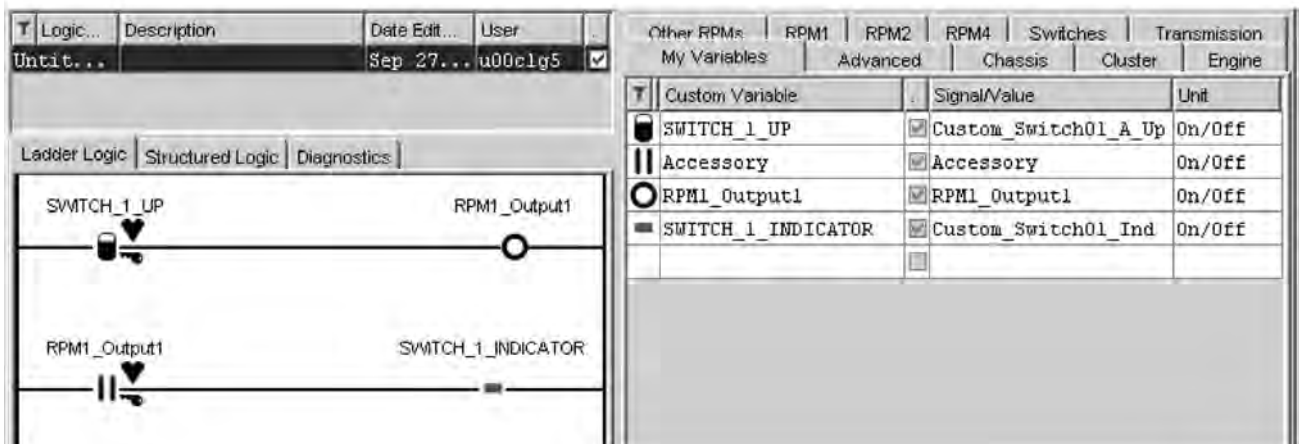
8. An additional rung that turns the switch indicator ON when the output is ON should be added to demonstrate to the operator that this output is engaged. On the SWITCHES tab, select the non-flashing indicator for the switch selected in Step 2.
9. If desired, add a custom name to for the indicator in the Custom Variable field. It is recommended to include IND or some other identifier to the end of the Custom Variable.

My Variables		Advanced		Chassis	Cluster
Engine	Other RPMs	RPM1	RPM2	RPM4	Switches
Custom Variable	Used	Signal/Value			Unit
 SWITCH_1_UP	<input checked="" type="checkbox"/>	Custom_Switch01_A_Up			On/Off
	<input checked="" type="checkbox"/>	Custom_Switch01_B_Middle			On/Off
	<input checked="" type="checkbox"/>	Custom_Switch01_C_Down			On/Off
 SWITCH_1_INDICATOR	<input checked="" type="checkbox"/>	Custom_Switch01_Ind			On/Off
	<input checked="" type="checkbox"/>	Custom_Switch01_Ind_Fast_...			On/Off
	<input checked="" type="checkbox"/>	Custom_Switch01_Ind_Slow_...			On/Off
	<input type="checkbox"/>	Custom_Switch02_A_Up			On/Off
	<input type="checkbox"/>	Custom_Switch02_B_Middle			On/Off

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Figure 39 Selecting and Renaming the Switch Indicator Light

10. Drag the Switch Indicator to the output side of the next available rung.



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Figure 40 Illuminating the Indicator Light in the Switch

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

11. Since the light should be ON when the output is ON, the output that was used on the first rung should be used as the input on the second rung. Select the My Variables tab and drag the output to the left end of the second rung.
12. When using an output as an input, it is recommended that the accessory interlock be added to this output. To do this, right-click on the icon on the left side of the second rung and select ACCESSORY. When the output in rung one is ON, the switch indicator will illuminate. However, if the ignition key is turned OFF or the status of either the switch or the RPM output goes bad, the output will not be ON and therefore the indicator light will not illuminate.

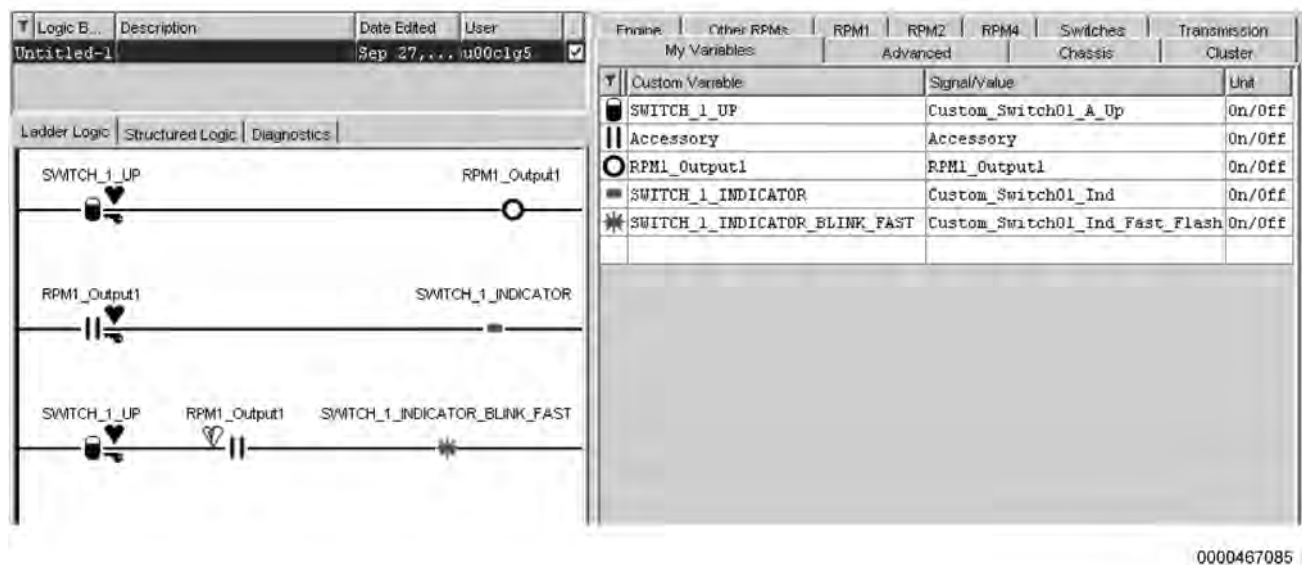


Figure 41 Diagnostics: Blinking the Indicator Light in the Switch Fast with Bad Status

The indicator lights in the switches should be used for diagnostic purposes as well to alert the vehicle operator that a failure has occurred in a particular vehicle feature. If a signal that drives the output goes BAD, then the switch indicator light should blink fast (see Switch indicator light section for more information).

13. On the Switches tab, select the fast blinking indicator for the switch selected in Step 2.
14. If desired, add a custom name to for the indicator in the Custom Variable field.
15. Drag the fast blink icon to the output of the next available rung.

16. Select the MY VARIABLE tab and drag the icon for the switch selected in Step 2 to the left side of rung three. We need to verify that the switch is ON. The indicator light should blink fast when the switch is ON, but the status of the output has gone bad.
17. Click on the output you used for rung one and drag it onto rung three, just to the right of the switch placed in Step 16. Since we also need to check the status of the output, we will need to use it as an additional input on rung 3.

NOTE – Add diagnostic text in the Diagnostics tab to describe this functionality. See Diagnostic Feature Descriptions: Writing Useful Text

18. Right-click on the icon added in Step 17 and select BAD STATUS. We don't want to check whether the switch's output is ON or OFF, we want to check whether the output signal has BAD STATUS or GOOD STATUS. A broken heart will be added before the icon. This icon will now be TRUE only when the Status of the switch's output goes BAD. The indicator light will blink fast if the switch is ON and the status of the switch's output is BAD.

Three-Position Momentary Switch (Using Up and Down for Separate Outputs)

With a three-position momentary switch, the down switch icon can also be used to control a second output.

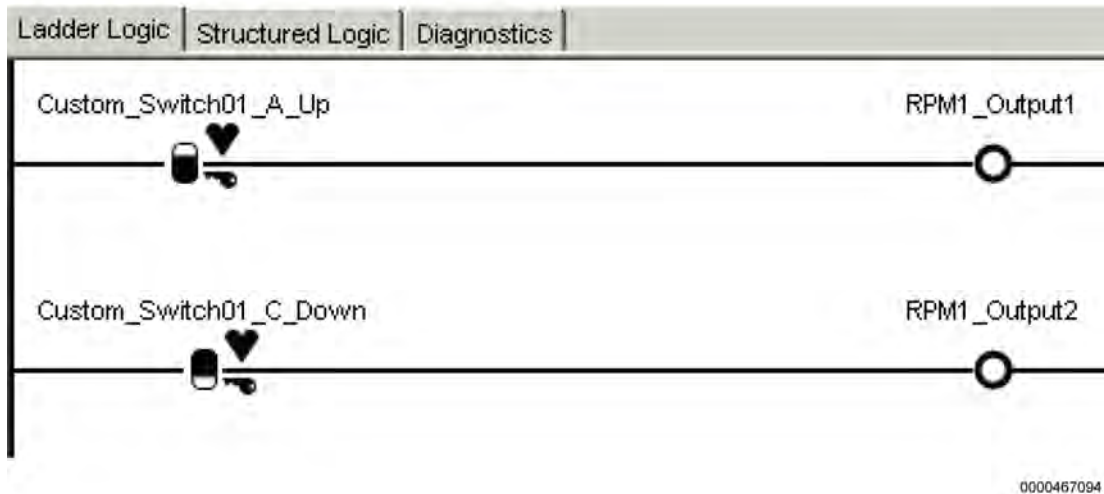


Figure 42 Single Momentary Switch Controlling Two Outputs

In the example shown above, pushing the switch up could control RPM1_Output1, pushing the switch down could control RPM1_Output2. This action may be useful for a winch or other device that requires one switch to perform two actions (Figure 42). When the switch is depressed to the up position, Remote Power Module 1, Output 1 is TRUE. When the switch is depressed to the down position, Remote Power Module 1, Output 2 is TRUE. When the switch is not depressed, the switch will return to the center stable position and both outputs will be OFF. On vehicles built between 2007 and 2016, the switch indicator light in the top of the switch should not be used, since more than one output is controlled. A YELLOW backlit LED should be used to illuminate the switch identifier decal. On vehicles built in 2017 or later, the switch indicator is located in the center of the switch. The switch indicator can be programmed to different colors for top and bottom indicators.










Text should be added to the DIAGNOSTICS Tab to indicate what is turning these outputs on. See Diagnostic Feature Descriptions: Writing Useful Text .

Three Position Latched Switches

These switches are available from International Parts Catalog or International® dealers and can be ordered with the vehicle as part of the switch pack. They should only be used when it is required to provide latched control of two or three different outputs from a single switch. A different custom signal may be assigned to the up, middle and down positions of the switch. The current switch state will be active once the ACCESSORY power has been turned ON and the BCM has completed a reset cycle.

Three-Position Momentary Switch Controlling a Single Output

A three-position momentary switch may be actuated up or down but returns to a center stable position. A three position momentary switch may be used to control a single output in a latching fashion, even though the physical switch does not remain latched up or down. In this case, the output is latched ON or OFF by the software. The up switch icon will set the output ON. The down switch icon should set the output OFF. The float or middle position of the switch does nothing.

My Variables		Advanced			Chassis	Cluster
Engine	Other RPMs	RPM1	RPM2	RPM4	Switches	Transmission
T	Custom Variable	Used	Signal/Value		Unit	
	SWITCH_1_UP	<input checked="" type="checkbox"/>	Custom_Switch01_A_Up		On/Off	
		<input type="checkbox"/>	Custom_Switch01_B_Middle		On/Off	
	SWITCH_1_DOWN	<input checked="" type="checkbox"/>	Custom_Switch01_C_Down		On/Off	
	SWITCH_1_INDICATOR	<input type="checkbox"/>	Custom_Switch01_Ind		On/Off	
	SWITCH_1_INDICATOR_FAST	<input type="checkbox"/>	Custom_Switch01_Ind_Fas...		On/Off	
		<input type="checkbox"/>	Custom_Switch01_Ind_Slo...		On/Off	
		<input type="checkbox"/>	Custom_Switch02_A_Up		On/Off	
		<input type="checkbox"/>	Custom_Switch02_B_Middle		On/Off	
		<input type="checkbox"/>	Custom_Switch02_C_Down		On/Off	

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Figure 43 Selecting and Renaming a 3-Position Momentary Switch

1. Select the SWITCHES tab.
2. Select the up position of the next available switch icon.
3. Double-click in the CUSTOM VARIABLE field.
4. Type the new name for the switch and press Enter.
5. Repeat Steps 2 through 4 for the down position.
6. Select the solid on indicator for this switch and enter a new name in the Custom Variable field.
7. Select the fast flash indicator for this switch and enter a new name in the Custom Variable field.

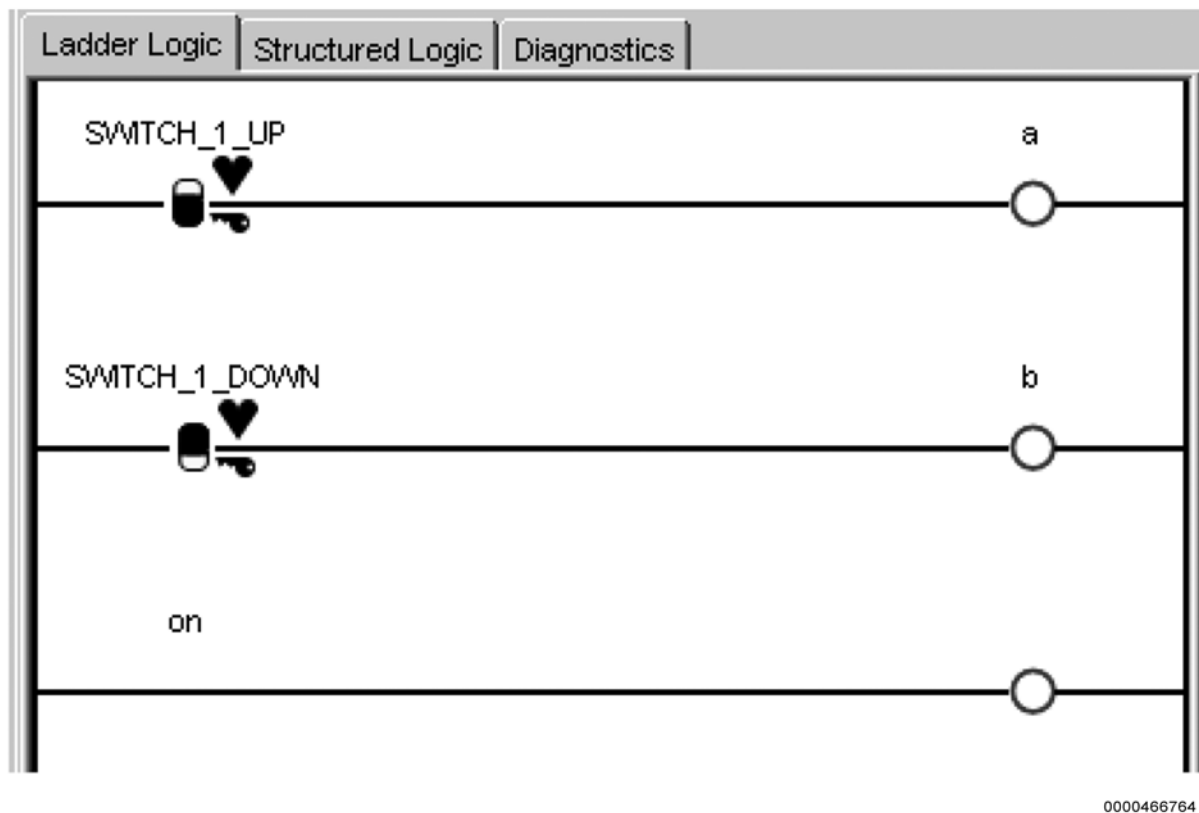


Figure 44 Adding a 3-Position Momentary Switch to the Ladder Logic Rungs

8. Drag the switch up icon to the left side of the next available rung in ladder logic.
9. Drag the switch down icon to the left side of the rung below.

Since more than one rung will be needed to control the load (one rung for turning it ON and one for turning it OFF), an Independent Variable is required. This is because only one rung can control a physical signal. For example: RPM1_Output1 can be the output of one and only one rung. When using a momentary switch with latching software (not a true momentary) more than one rung is required to control the output and therefore an independent variable is required. See Independent Variables (page 23) for more information.

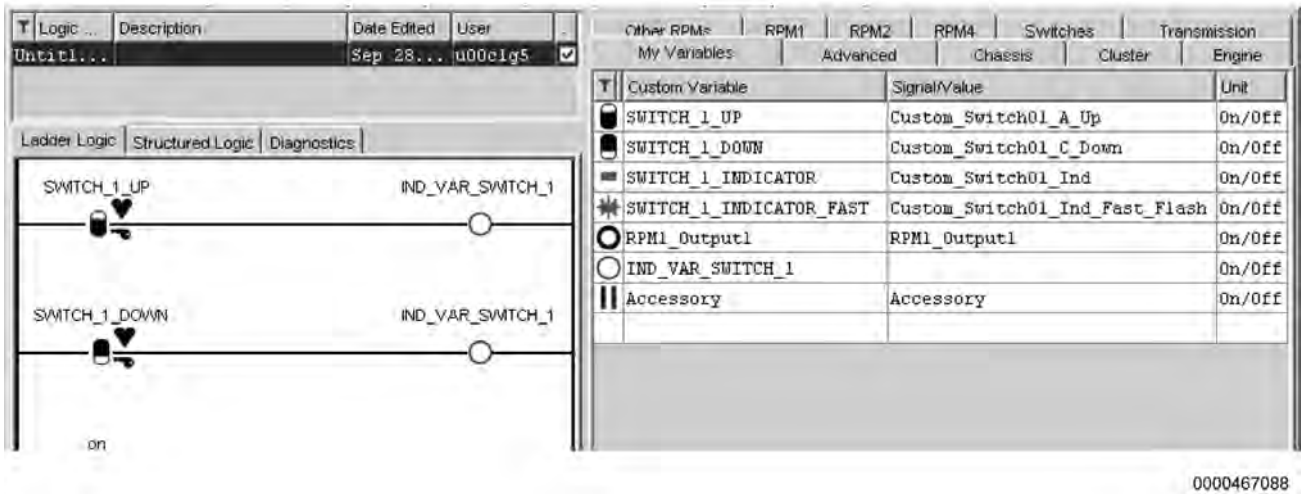


Figure 45 Renaming the Independent Variables

NOTE – It is not recommended to rename the variable name.

Both rungs used so far will have automatically generated independent variables as outputs.

10. Double-click on the name of the output for the first rung. A box that allows entry of a custom name appears.
11. Type a descriptive name and press Enter. In Figure 45, variable A was renamed IND_VAR_SWITCH_1.
12. In the MY VARIABLES tab, select the independent variable you just renamed and drag it to the right-side of the second rung.

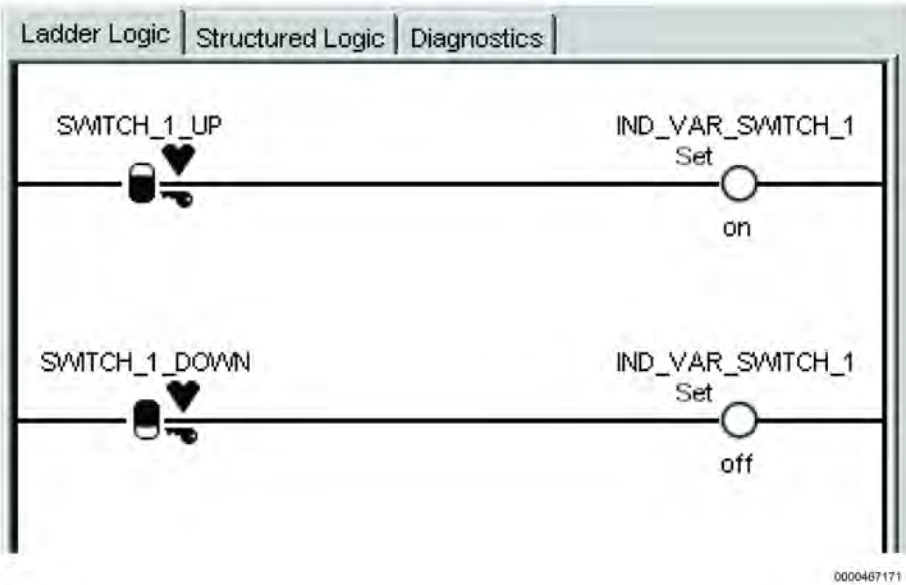


Figure 46 Setting the Variable ON and OFF for a 3-Position Momentary Switch

To latch the output ON or OFF with software (in lieu of a latched switch), the SET function is used.

13. Right-click the output in the first rung and select SET. The word ON appears below the output, indicating that the default is SET ON. This is the appropriate setting for this rung.
14. Right-click the output in the second rung and select SET. Then double-click on the word ON in the second rung and type OFF.



Figure 47 Setting the Variable OFF if Accessory Removed or the Switch is Bad

Always include a rung that sets the independent variable OFF if the key is removed (ACCESSORY check) or one of the input signals status goes bad. Since the independent variable is SET on (and latched on), the conditions need to be rechecked to ensure that they have not changed since the variable was SET ON.

15. Find the ACCESSORY icon in the Chassis tab and drag it to the left side of the next available rung.
16. Right-click the ACCESSORY icon and select NEGATIVE EDGE. This icon will now be TRUE when ACCESSORY is turned OFF (when the key is removed or switched OFF).
17. Drag the switch up icon used in the first rung to the ladder logic pane and position it just below the ACCESSORY icon added in Step 16. As you prepare to drop the icon in this position, the word OR should appear behind it.
18. Right-click on the switch icon that was just added and select BAD STATUS. This will add a broken hollow heart to the left side of the icon.
19. Repeat Steps 17 and 18 using the switch down icon.

Now these switch icons will be checking for BAD STATUS. Therefore, if the status goes bad on either one of these switch signals, the contact will be TRUE.

20. Drag the independent variable icon to the right side of this rung.
21. In the MY VARIABLES tab, find the independent variable used as the output of the first two rungs and drag it to the output of the current rung.
22. Right-click on the icon added in Step 21 and select SET.
23. Double-click the word ON and change to OFF. This rung will now check to see if ACCESSORY was removed or one of the inputs is communicating BAD STATUS; and set the independent variable OFF.

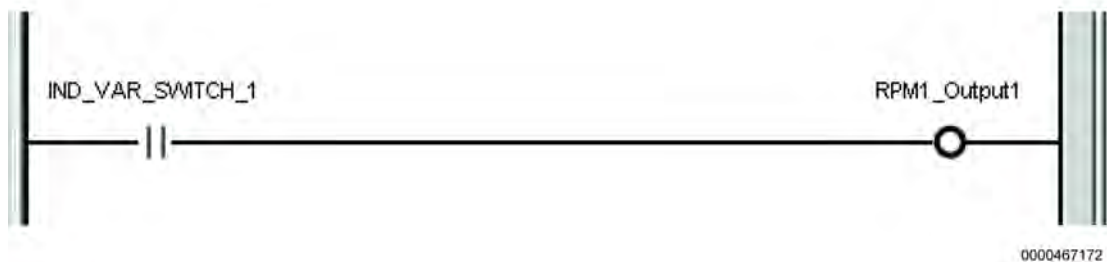


Figure 48 Turning ON RPM1_Output1 when the Independent Variable is ON

The next rung should control the actual output or load that this switch will control. It should turn the output ON if the Independent variable is ON, and OFF if the Independent variable is OFF.

24. In the MY VARIABLES tab, find the independent variable used in the previous three rungs and drag it to the left-side of the next available rung.
25. In the RPM tabs, find the output that the switch will control and drag it to the right side of the rung. Figure 48 shows output 1 on RPM 1 being used for this purpose.



Figure 49 Controlling the Indicator Light for a 3-Position Momentary Switch

Since the temporary movement of the switch sets the output ON, the output will reset OFF during power loss or engine re-start.

The switch indicator light should be ON when the physical output is ON.

26. Find the output used in Step 26 and drag it to the right side of the next available rung.
27. Right-click on the icon just added and select ACCESSORY. This will add a key to this icon and interlock the input to ACCESSORY only.
28. In the MY VARIABLES tab, find the solid on indicator for the switch being used and drag it to the right side of the rung.

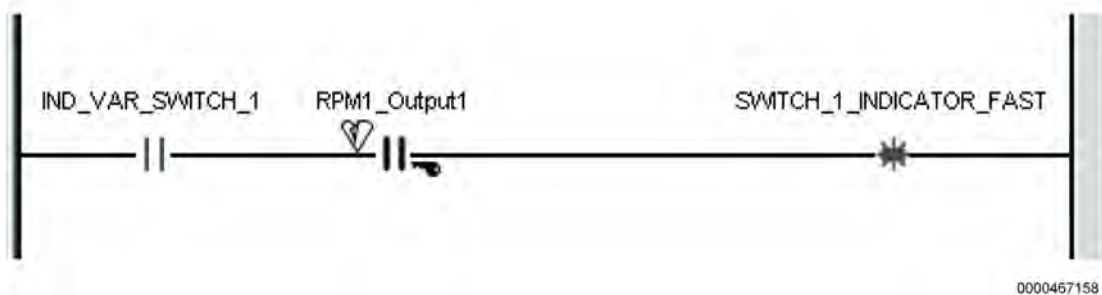


Figure 50 Diagnostics for the Switch Indicator Light with 3-Position Momentary Switch

To provide a diagnostic function, the indicator for this switch should blink fast if a bad status occurs on one or more of the signals.

29. In the My Variables tab, find the independent variable used in the previous four rungs and drag it to the left side of the next available rung. The switch will only blink fast if its output should be ON.

All icons that could cause the output to be OFF if the status goes bad should be additional inputs that are an AND condition to the independent variable, but an OR condition to each other. In this procedure, the icons that could communicate a bad status are switch up, switch down, and the RPM output. However, if the switches are communicating a bad status, then the indicator light will also be communicating a bad status. Therefore, the only icon whose status needs to be checked in this line is the RPM output.

30. In the MY VARIABLES tab, find the RPM output used in the previous rungs and drag it onto the rung, just to the right of the independent variable added in Step 29.

31. Right click on the RPM output icon added in Step 30 and select BAD STATUS. A broken heart will be added in front of the icon.
32. In the My Variables tab, select the fast-blinking indicator icon for the switch used in this procedure and drag it to the right end of the rung.

When the Independent Variable is ON, but the status of the output is BAD, the indicator light will blink fast.

NOTE – Add a description of the feature in the Diagnostics tab to describe this functionality. See Diagnostic Feature Descriptions: Writing Useful Text .

USING THE REMOTE POWER MODULE SWITCH INPUTS

Remote Power Module inputs are the gateway into the Diamond Logic® electrical system. These inputs can be used for proximity switches, pressure switches, remote switches, and other applications. To use a Remote Power Module input to drive a load, the icon for Remote Power Module input 12V or Ground must be selected and added to a rung. Then, the load that this input will drive should be added to the output of this rung, for example Remote Power Module 1 output1.

The Remote Power Module input 12V icon and the Remote Power Module input Ground icons have two modifiers by default:

- Accessory interlocked (key)
- OFF with error (heart)

Therefore, the input will be OFF with error and will only look for a signal when the key is in the accessory or ignition position.

NOTE – When renaming a Remote Power Module Input in the Custom Variable column, the new name should include whether the switch is 12V or Ground. For example: Switch1_12V or Switch1_Gnd.

To drive an output using a Remote Power Module Input, drag the next available Remote Power Module input to left side of the next available rung as the Input. Add a Remote Power Module output to the output side of the rung. In this example: RPM1_Input1_12V is the input and RPM1_Output1 is the output. When the body switch is hooked up to RPM1_Input1 is 12V, then RPM1_Output1 will be ON. If the input is Ground or Floating, then the RPM1_Output1 will be OFF.

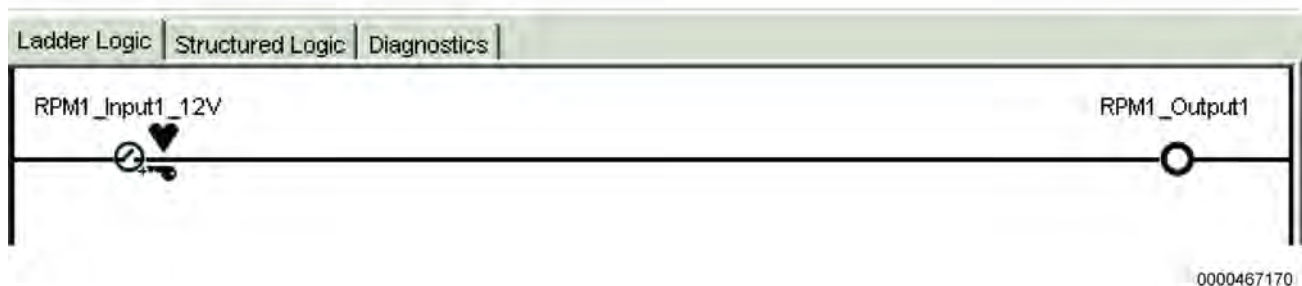


Figure 51 Remote Power Module Input (12V) Driving a Remote Power Module Output

Modified Example: Ground Remote Power Module Input 1 drives Remote Power Module Output1

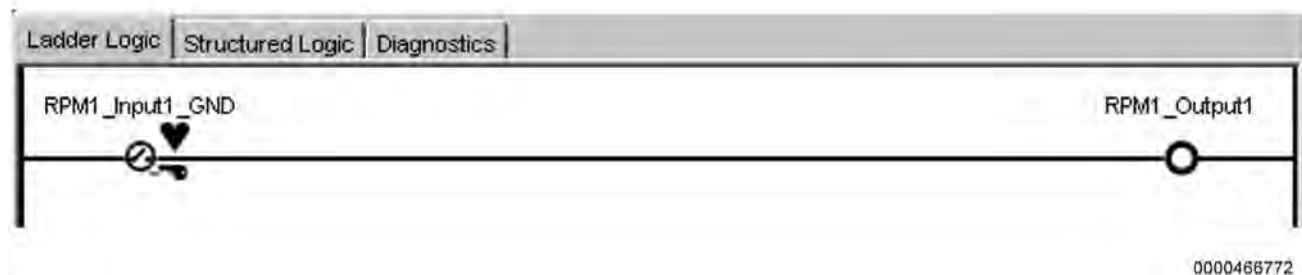


Figure 52 Remote Power Module Input (Ground) Driving a Remote Power Module Output

Three-way Switching with In-Cab Switches and Remote Mounted Switches

Three-way switching refers to a remote mounted switch on the body and a switch in-cab to control a load. In addition, the type and operation of the remote mounted switch needs to be considered when selecting a solution for three-way switching.

Options covered in this section:

- Momentary switch in cab and momentary switch on body (no priority)
- Switch in cab has priority over switch on body
- Body or chassis signal switch is latched and in-cab switch is momentary

The additional switch could be a body-mounted switch or a chassis signal (like vehicle in Reverse or PTO engaged). This type of switch control is slightly more difficult to program in Advanced Logic.

Momentary Switch in Cab and Momentary Switch on Body (No Priority)

This configuration is a true OR configuration; therefore, both switches can turn the output ON, and both switches can turn the output OFF. Since both switches are momentary center stable, neither will have a memory and therefore, no priority over the other switch.

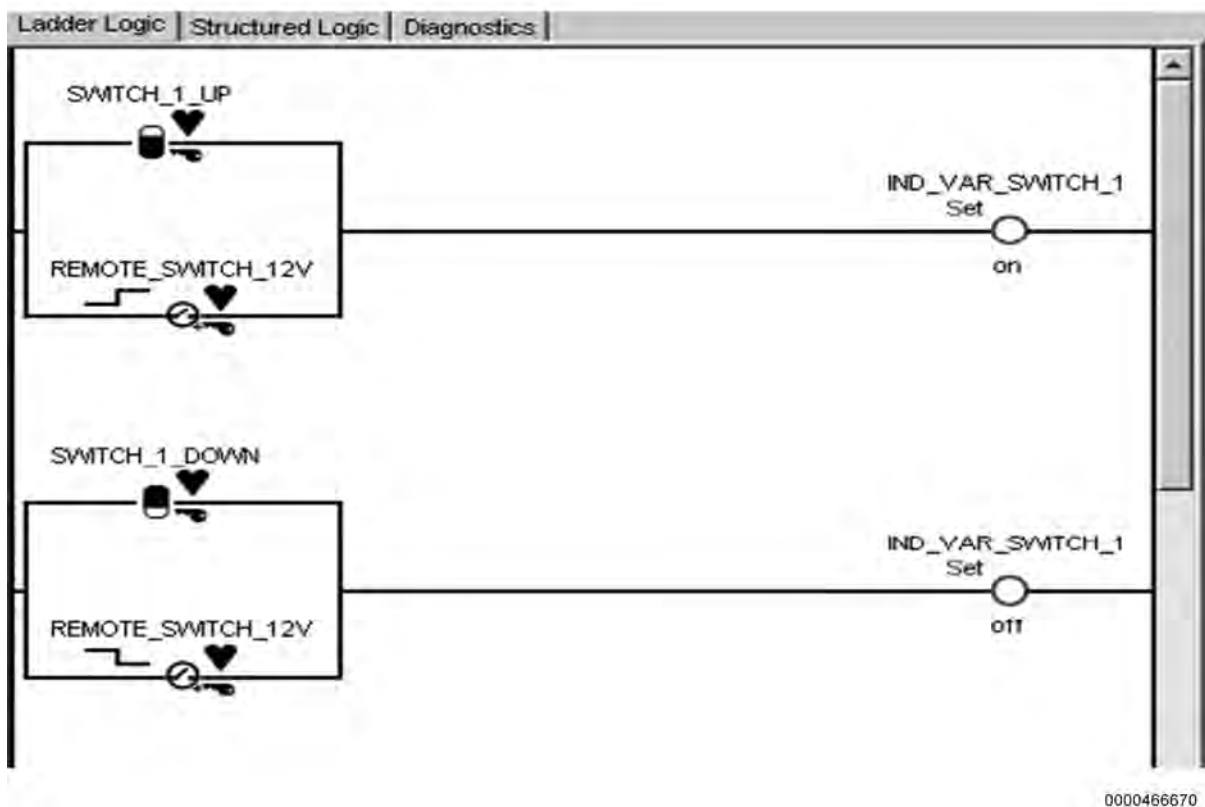


Figure 53 Three-Way Switching with Momentary In-Cab and Remote Switches

Figure 53 shows an example of the first two logic rungs needed.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

The first rung shows the switch inputs that set the Independent Variable on the right ON. Since the two inputs are set up as an OR condition, either input will set the variable ON.

- The in-cab switch (momentary three-position) being pushed up.
- The Remote Power Module input used for the remote switch receiving an input of 12V. (This could also be a three-position momentary switch where up = 12V and center-float, down = Ground.)

The second rung shows the switch inputs that set the same variable OFF. Either of the following conditions will set the variable OFF:

- The in-cab switch being pushed down.
- The Remote power Module Input used for the remote switch receiving a Ground signal.

Notice the convention of doing the ON setting before the OFF setting. The output will turn OFF when one switch is held ON and the other is held OFF.

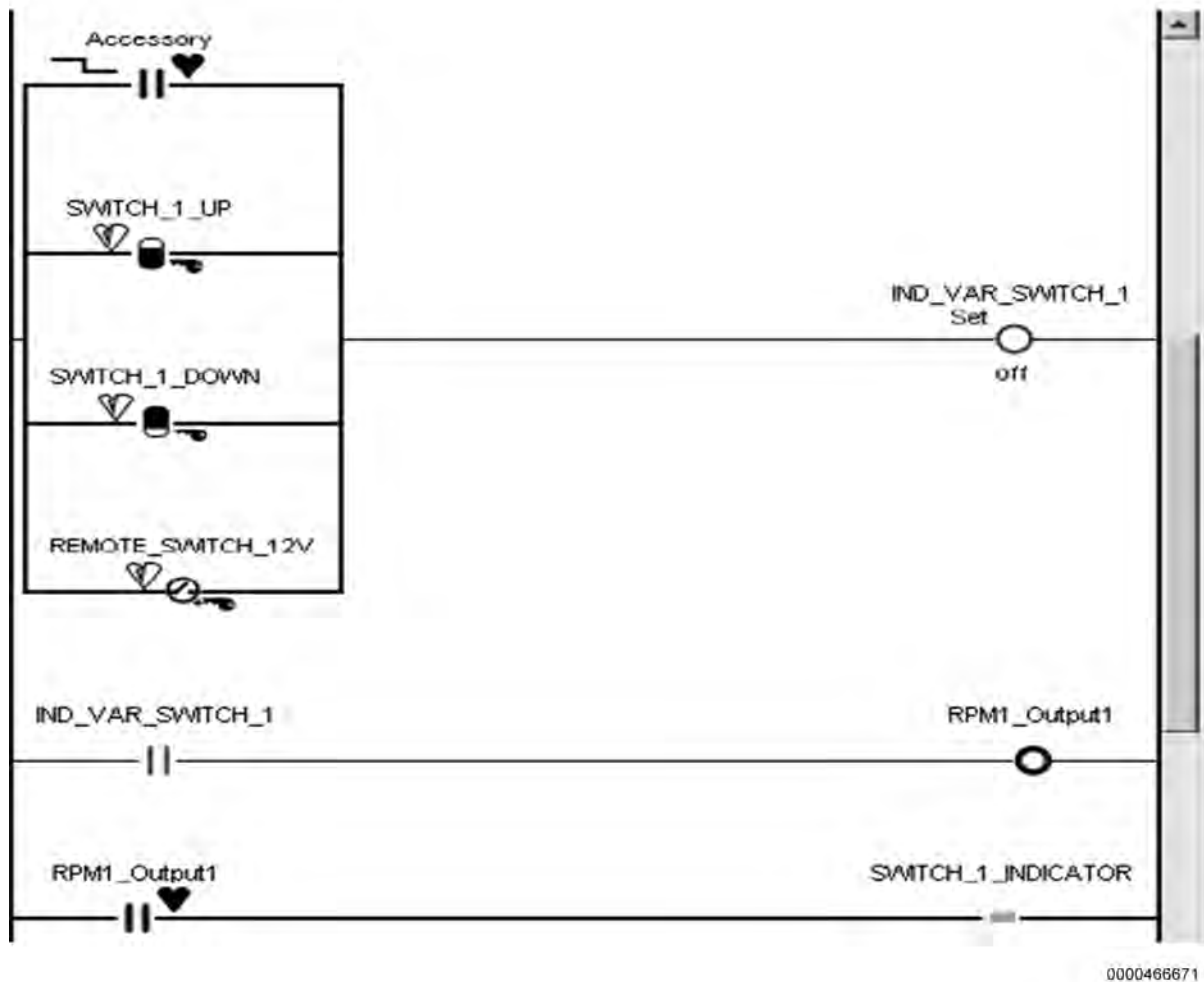


Figure 54 Three-Way Switching with Momentary In-Cab and Remote Switches

Figure 54 shows the next three rungs needed for this example.

The top rung in this figure has additional conditions that will set the variable OFF. Since this is an OR configuration, any of the following conditions will set the variable OFF:

- The NEGATIVE EDGE of the Accessory is detected (Accessory switches OFF). This ensures that Accessory was not removed after the variable was set ON and should be included in all ladder logic that uses the SET function.
- The status of the in-cab switch up position is bad.
- The status of the in-cab switch down position is bad.
- The status of the RPM input used for the remote switch is bad.

The middle rung sets the physical output (In this case, RPM1_Output1) to the current value of the independent variable.

The bottom turns on the indicator light in the switch ON solid if the physical output is ON.

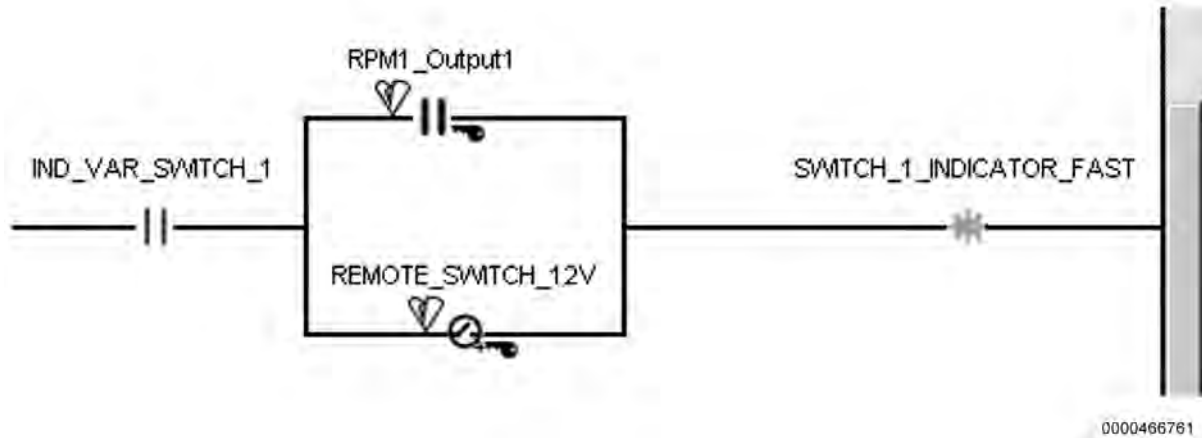


Figure 55 Fault Indication

Figure 55 shows the logic needed to fast flash the indicator for the in-cab switch when a fault has occurred. The indicator light in the switch should blink fast if both of the following are true:

- The Independent Variable is set ON. (An attempt was made to set the physical output ON.)
- The physical output has bad status. (This could also mean that one or both of the in-cab switch positions have bad status.)
- The RPM input for the remote switch has bad status.

NOTE – To change an icon from signal state to the detected status of the signal, right-click the signal icon and select BAD STATUS. This will add a broken heart to the icon. Now this icon will be TRUE if the status of the signal is BAD and FALSE if the status of the icon is TRUE.

Momentary Switch in Cab and a Chassis Signal (Latched)

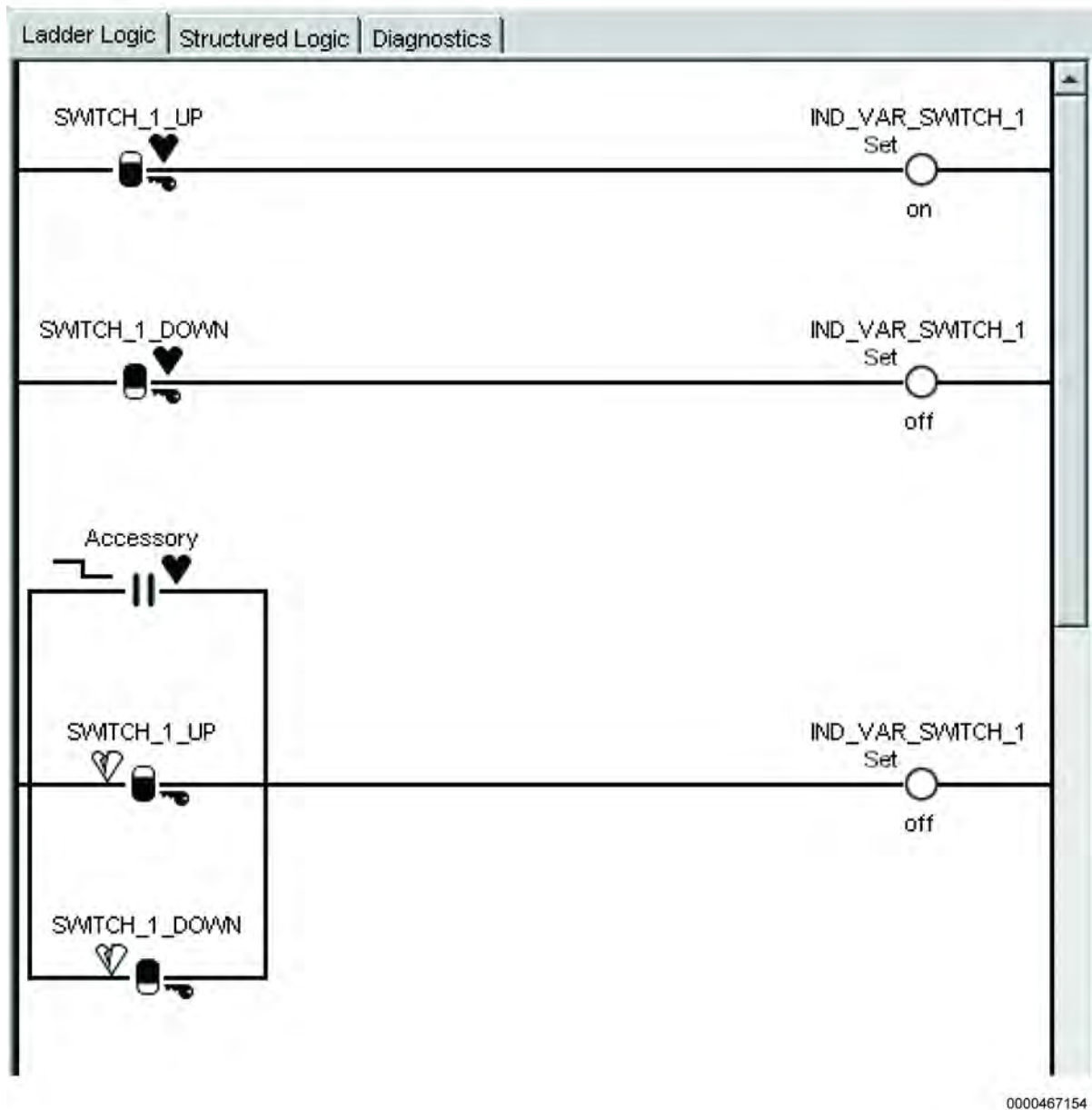


Figure 56 Setting the Independent Variable Based on the In-Cab Switch Position

Another version of three-way switching uses a chassis signal as the alternate switching device. Figure 56 shows an example of the first three rungs for an application like this. These rungs handle the input from the in-cab switch.

Rung one sets the independent variable ON if the switch is in the up position.

Rung two sets the independent variable OFF if the switch is in the down position.

Rung three sets the independent variable OFF if any of the following conditions are true:

- The NEGATIVE EDGE of the Accessory is detected (Accessory switches OFF). This ensures that Accessory was not removed after the variable was set ON and should be included in all ladder logic that uses the SET function.
- The status of the in-cab switch up position is bad.
- The status of the in-cab switch down position is bad.

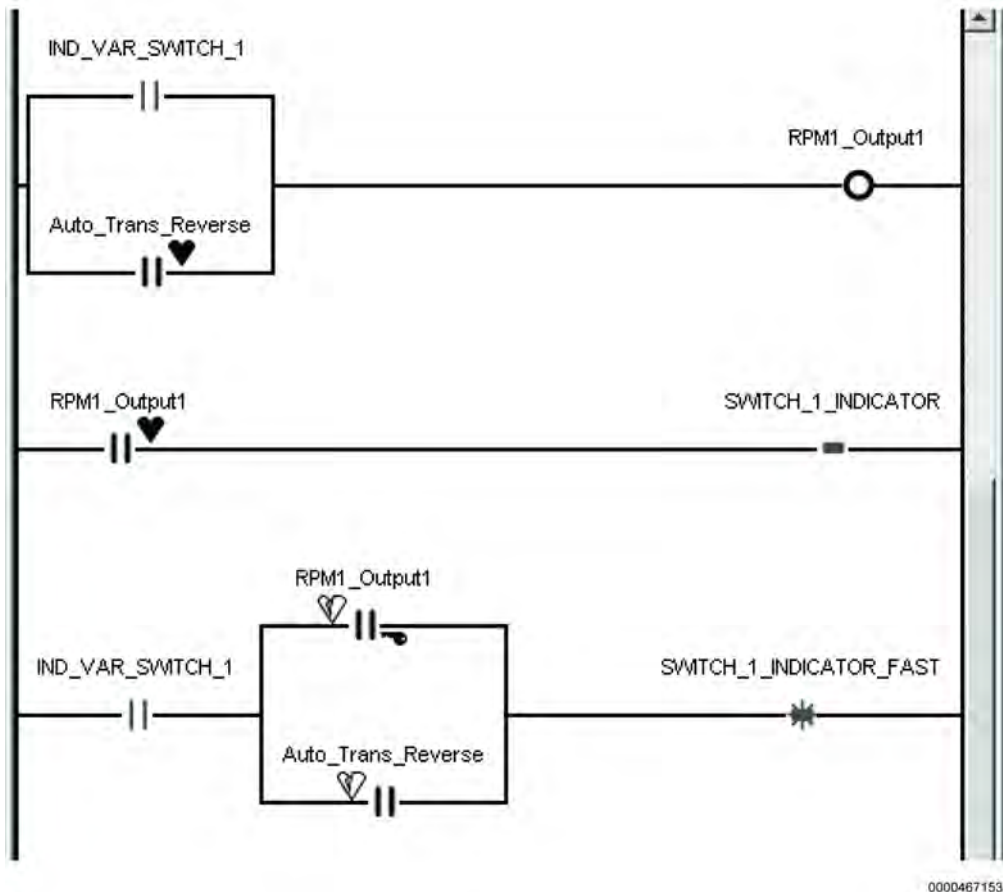


Figure 57 Three-Way Switching Using an In-Cab Switch and a Chassis Signal

Figure 57 shows the final three rungs of this example.

Rung 4 sets the physical RPM output ON if either of the following conditions are met:

- The independent variable is ON. (The in-cab switch is in the up position with Accessory ON, and good status.)
- The chassis signal is TRUE. (In this example, the signal is TRUE if the transmission is in REVERSE.) Since the chassis signal is latched ON or latched OFF, it needs to be in the rung that drives the physical RPM output.

NOTE – The switch will not be able to turn the output OFF if the chassis (reverse) signal is still TRUE.

Rung 5 turns the indicator light in the in-cab switch ON solid if the physical RPM output is ON.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

Rung 6 fast flashes the indicator light in the in-cab switch if the physical RPM output is supposed to be ON (the independent variable is ON), but exhibits one of the following fault conditions:

- The physical RPM output has bad status. (This could also mean that one or more of the contributing signals, such as switch up or switch down, have bad status.)
- The chassis signal has bad status.

Momentary Switch in Cab and a Latched Switch on the Body (In-Cab Switch has Priority)

Another type of three-way switching grants the In-cab switch priority over the remote mounted switch. This functionality is useful if the driver wants the in-cab switch to provide an override function to a latched remote mounted switch. Therefore, if the remote mounted switch is left ON, the In-cab switch will override the remote switch to control the output. To turn the output ON again with the remote mounted switch, the switch must be cycled OFF and then back ON again.

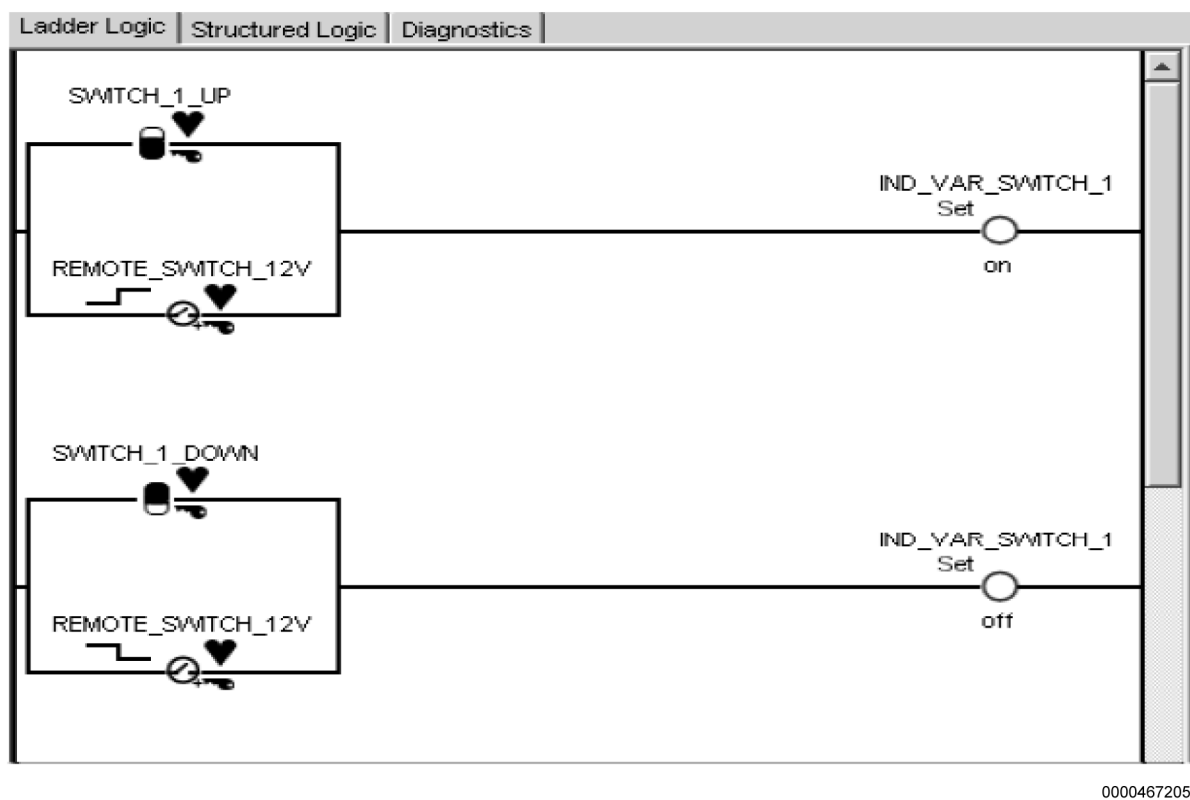


Figure 58 Logic to Give In-Cab Switch Priority Over the Remote Mounted Switch

Figure 58 shows an example of the logic that grants the in-cab switch priority.

The first rung shows the conditions which set the independent variable ON.

- The in-cab (three-position momentary) switch being in the up position.
- The Remote Power Module input is used for the remote switch switching to 12V. Since we are detecting the transition to 12V, this rung will be TRUE only if the remote switch is switched / flipped ON during the cycle. The switch will be ignored if it remains in the same position during the whole cycle.

The second rung shows the switch inputs that set the same variable OFF. Either of the following conditions will set the variable OFF:

- The in-cab switch being pushed down

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

- The Remote power Module Input used for the remote switch switching OFF. Because we're detecting the transition away from 12V rather than the absence of 12V, this will be TRUE only if the switch is turned OFF during the cycle. The switch will be ignored if it remains in the same position the whole cycle.

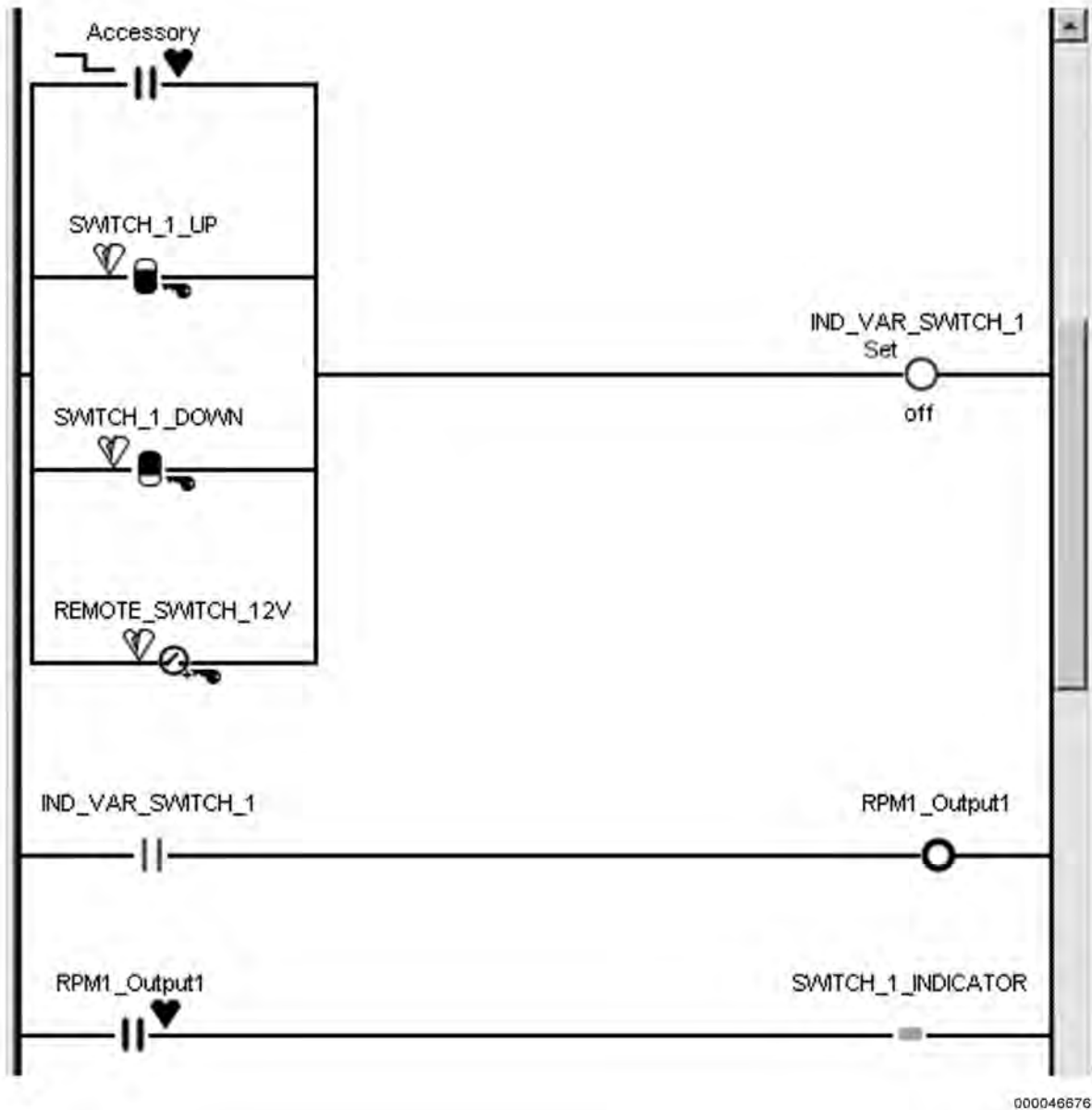


Figure 59 Logic for the Physical RPM Output

Figure 59 shows additional logic for this example.

Rung 3 sets the independent variable OFF if any of the following conditions are true:

- The NEGATIVE EDGE of the Accessory is detected (Accessory switches OFF). This ensures that Accessory was not removed after the variable was set ON and should be included in all ladder logic that uses the SET function.

- The status of the in-cab switch up position is bad.
- The status of the in-cab switch down position is bad.
- The status of the RPM input used for the remote switch is bad

Rung 4 sets the physical output (In this case, RPM1_Output1) to the current value of the independent variable.

Rung 5 turns the indicator light in the switch ON solid if the physical output is ON.

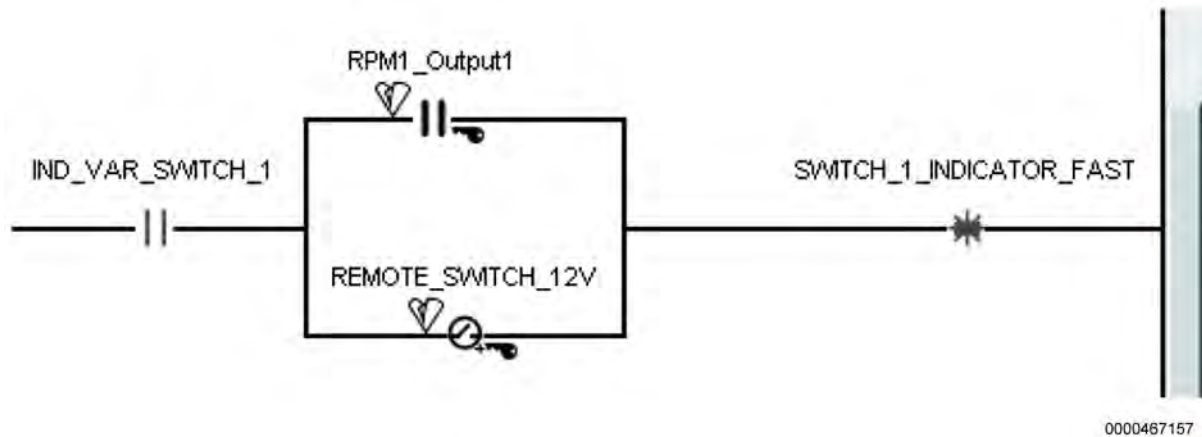


Figure 60 Fault Indication Logic

Figure 60 shows the fault indication logic for this example. This rung fast flashes the indicator light in the in-cab switch if the physical RPM output is supposed to be ON (the independent variable is ON), but exhibits one or both of the following fault conditions:

- The physical RPM output has bad status. This could also mean that one or more of the contributing signals, such as switch up or switch down, have bad status.
- The remote switch has bad status.

ILLUMINATING THE INDICATOR LIGHT IN ROCKER SWITCHES

Illuminating the Indicator Light in Rocker Switch Locations – Basics

The indicator lights in the switches should be used to confirm that a specific action has occurred. The indicator light should be solid ON when the output is actually engaged. In addition, the indicator light should blink slowly if the output should be engaged, but an interlock is not TRUE. The indicator light should blink fast if the output should be engaged, but a BAD STATUS has occurred on one or more of the inputs or the output.

Standard GREEN switch indicator illumination and Flashing can be selected from the Switches tab that is under the Advanced Logic Tab.

Slow flashing switch indicators on International® LT®, RH™, HV™, and MV™ Series trucks will automatically Flash YELLOW instead of GREEN.

Fast flashing switch indicators on International® LT®, RH™, HV™, and MV™ Series trucks will automatically Flash RED instead of GREEN.

NOTE – Fast flashing will override the constant ON regardless of which order the rungs are placed.

Diagnostic text should be added to the information under the Diagnostic tab to indicate what the switch indicator lights are displaying. See Diagnostic Feature Descriptions: Writing Useful Text

Illuminating the Indicator light in Rocker Switches – Custom Colors with International® LT®, RH™, HV™, and MV™ Series Trucks

On International® LT®, RH™, HV™, and MV™ Series trucks, the indicators in switch locations can be set up as warning indicators that illuminate with eight different color options.

Description	Value
Black	0
Blue	1
Green	2
Cyan	3
Red	4
Magenta	5
Amber	6
White	7

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Figure 61 Illuminating Indicator Color Options

Illuminating the Indicator light in Rocker Switches – Custom Colors with International® LT®, RH™, HV™, and MV™ Series Trucks

When the required 59XXXX feature is added, to support the number of indicators that are used, the Tricolor contacts may be selected from the Indicators tab under the Advanced Logic tab.

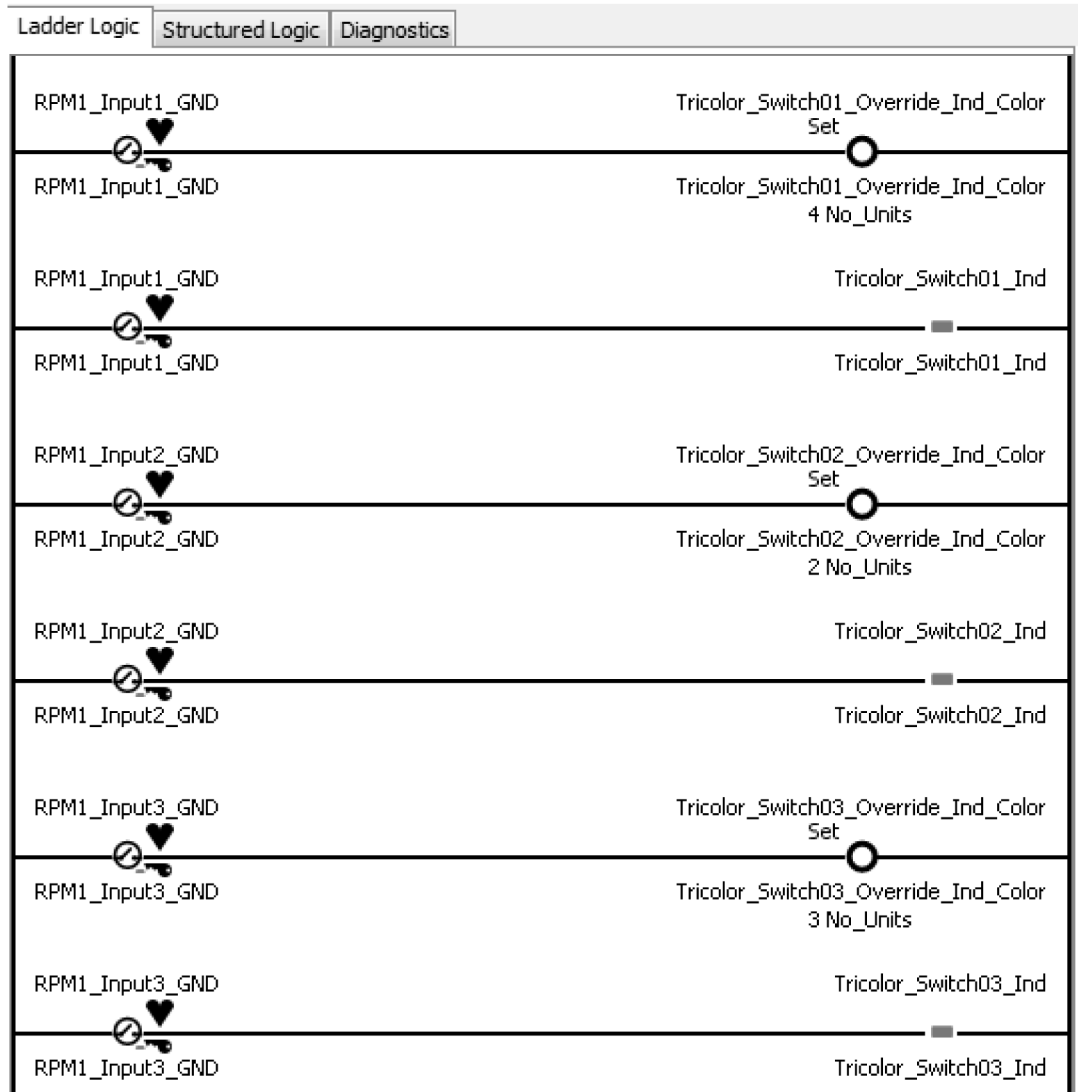
To add one Tricolor Indicator, use 597349.

To add five Tricolor Indicators, use 597353.

The switch labels that show in DLB cannot be customized.

Contacts are under the “Indicators” Tab.

Indicators cannot be used to illuminate an indicator that works with a switch, in the same location.



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Figure 62 Sample Logic



Figure 63 Color Indicator Result from Logic

Illuminating the Indicator light in Switch Locations as Warning Lights – Custom Colors Using Advanced Logic only with International® LT®, RH™, HV™, and MV™ Series Trucks

Use custom switches as warning lights. In this case you will turn off the standard feature 597 codes for the tri-color warning lights. Now you can use custom switches as warning lights or add a custom color to a switch indicator. You can also put a custom label on the switch locations that are used as warning lights.

These contacts are under the “Switches” tab.

Use custom switches as warning lights. In this case you will turn off the factory 597 codes for the tri-color warning lights. Then start using custom switches as warning lights. Now you can put a custom label on the switches that are used as warning lights. You will have to place at least one switch signal on a dummy rung to make the switch labels show up on the center panel view.

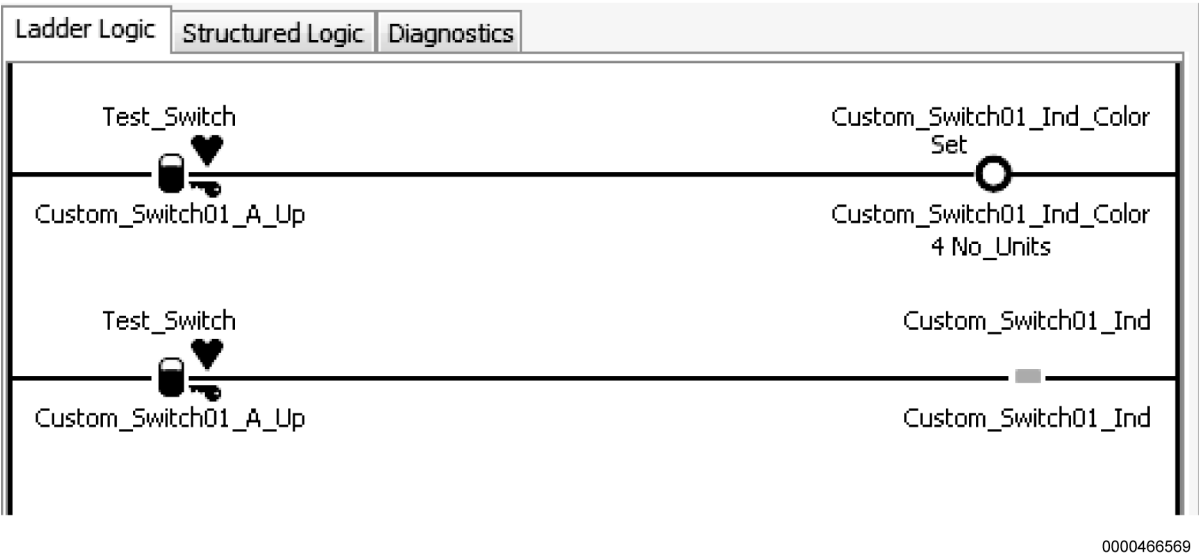


Figure 64 Sample Logic



Figure 65 Color Indicator Result from Logic

INTERLOCKED SWITCHES

A switch can also have an interlock. An interlock is an additional requirement for the output to engage. For example, PTO engaged, Door open, Park Brake set, Vehicle Speed < 3 mph, etc. are all interlocks.

Two-position Latched Switch with One Interlock

To use an interlock with a latched switch, simply drag the signal icon for the required interlock to the middle of the rung that turns on the Output as an AND condition. The output will only engage (turn ON) when the switch is in the up position and the required signal interlock is TRUE.

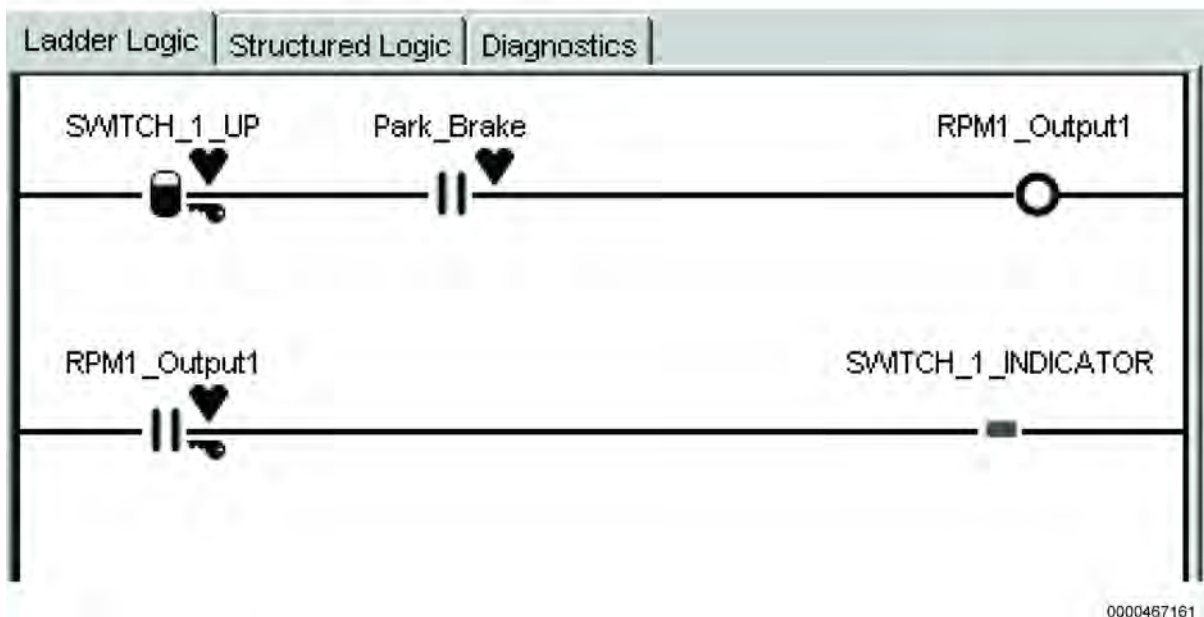


Figure 66 Interlocked Two-position Latched Switch

Figure 66 shows an example in which the parking brake must be set for Remote Power Module Output to be ON even if the switch is in the ON position.

1. Select the SWITCHES tab and drag the up position icon for the switch to be used to the left side of the first rung.
2. Drag the icon for the desired interlock to the middle of the first rung, just to the right of the switch icon. In this example, we selected the Park_Brake signal from the Chassis tab.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

3. Select the RPM output to use and drag it to the right end of the rung.

The second rung lights the switch indicator when the output is ON.

4. Drag the RPM output to the left end of the second rung.
5. Right-click on the newly-added icon and select ACCESSORY. (This adds the requirement that the key be in the ACCESSORY position).
6. Add the solid on indicator for the switch used to the right end of the second rung.

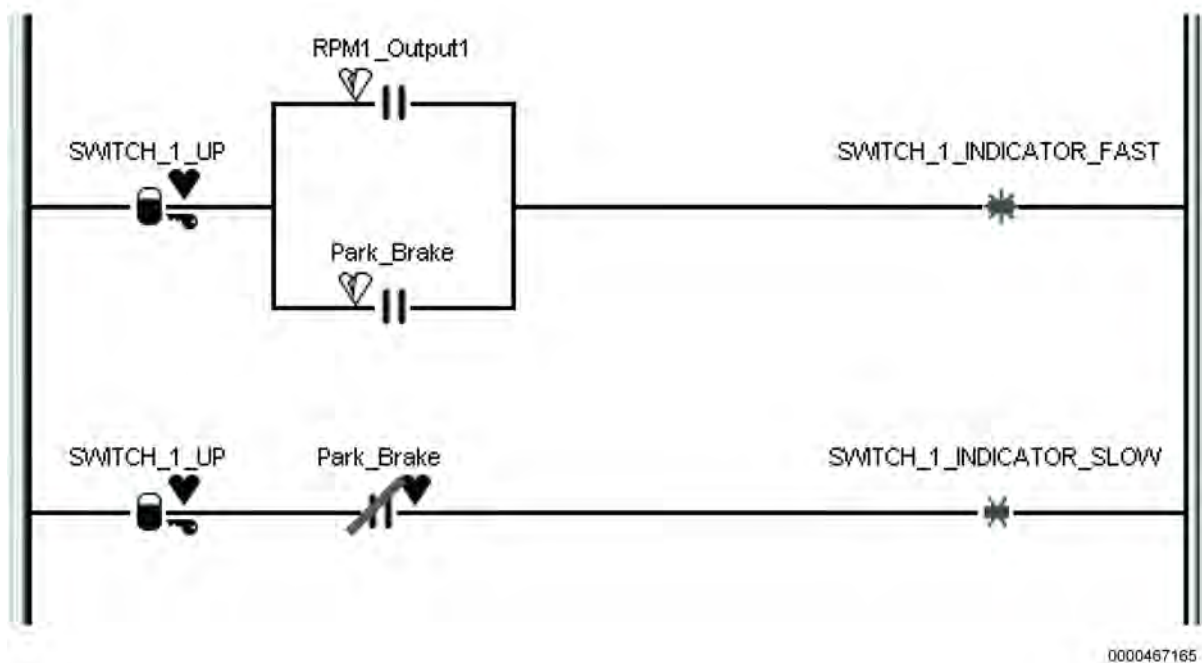


Figure 67 Interlocked Two-position Latched Switch Diagnostics

Figure 67 shows the diagnostic logic for this example: blink fast if a Bad status occurs on one or more of the signals, and blink slowly if the interlock is not ON.

7. Add the switch up icon as the input on rung 3.
8. Drag the icon for the RPM output to the immediate right of the icon added in Step 7. Right click on this icon and select BAD STATUS. (This icon will now check the status of the signal rather than its state.)
9. Drag the icon for the interlock used in Step 2 over the lower half of the icon added in Step 8. When the word OR appears, drop the interlock icon. Right click on the newly added icon and select BAD status.
10. Drag the blink fast icon for the switch used to the right end of rung 3.

For the blink slowly rung, the switch should be rocked up (TRUE), but the interlock is NOT TRUE (in this case the Park Brake is NOT set), the indicator in the switch should blink slow, indicating the output is not ON, even though the switch is rocked up.

11. Drag the UP Switch Icon to the left end of rung 4.

12. Drag the icon for the interlock to the right of the icon added in Step 11. Right click on this icon and select NEGATE. (This will be true when the interlock is OFF.)
13. Drag the blink slow indicator for the switch to the right end out the rung.

NOTE – Diagnostic text should be added to the Diagnostic tab and include the interlock for the output.

Example: RPM1_Output1 - This output is ON when the Switch labeled (SWITCH_1_UP) is rocked up AND the Park Brake is set. If the park brake is not set, the output will be OFF and the indicator light in the switch will blink slowly. If this output signal is reporting BAD STATUS or if the Switch is reporting BAD STATUS, then the output will be OFF and the indicator light in the switch will blink fast.

Interlock Switch with a Three-Position Momentary Switch (Re-Engaging Type)

A three-position momentary switch can be interlocked to various chassis signals as well. If the output requires that the interlock engage and you want the output to re-engage when the interlock is TRUE even though the momentary switch is no longer being pressed, then the interlock should be added to the rung that controls the actual output.

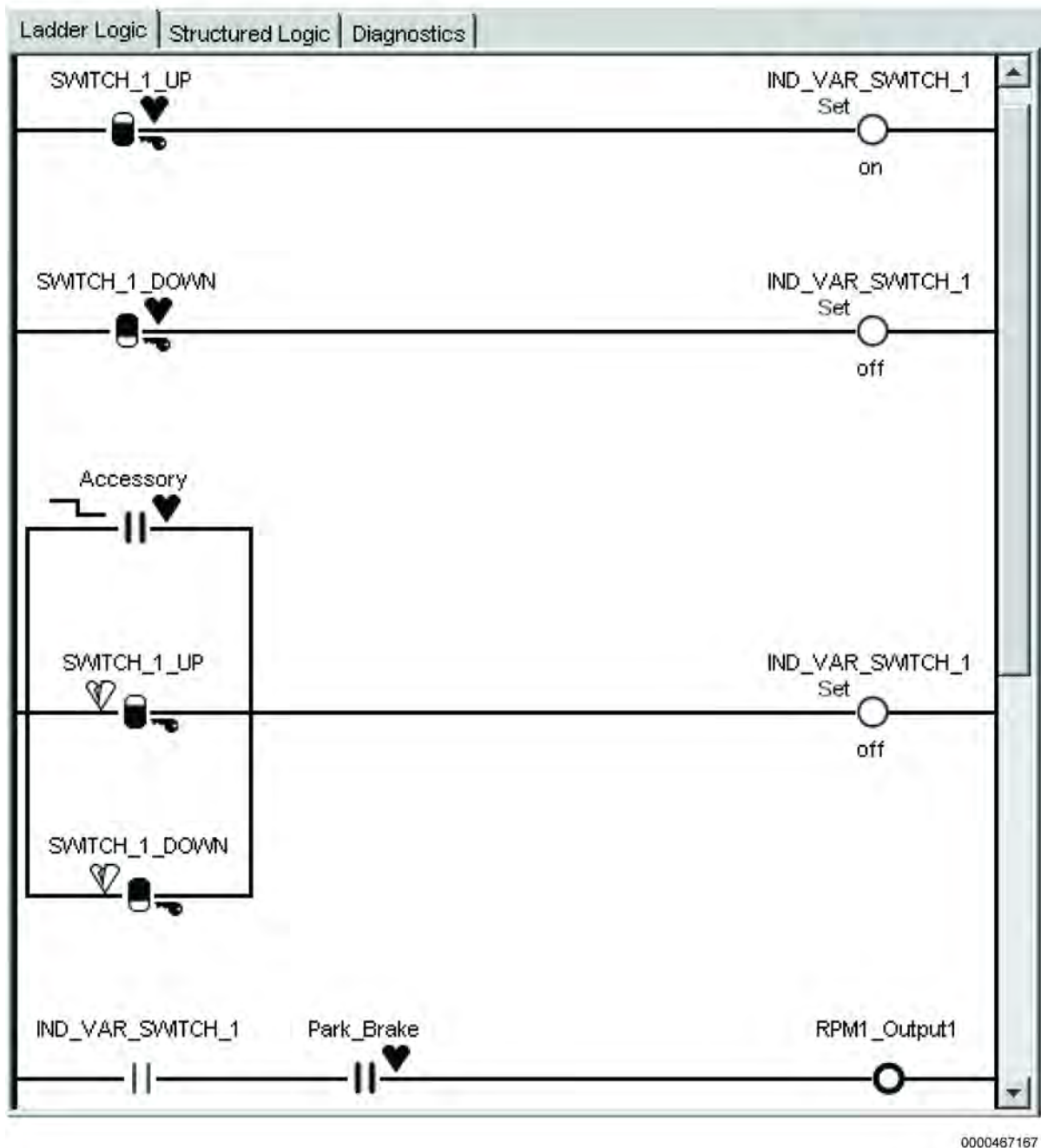


Figure 68 Interlocked Three-Position Momentary Switch (Re-engaging Type)

Figure 68 shows typical three-position momentary switch logic. To add the interlock, the icon for the desired interlock signal (Park_Brake) has been added to the final rung, which outputs directly to the physical RPM output.

- If the independent variable is SET ON, the output will still require the interlock to be TRUE before the output will be ON.
- If the interlock is FALSE (OFF), the output will not be ON. However, the output will re-engage (turn ON again) when the interlock is re-introduced. In other words, the output will re-engage if the interlock is ON after being OFF.

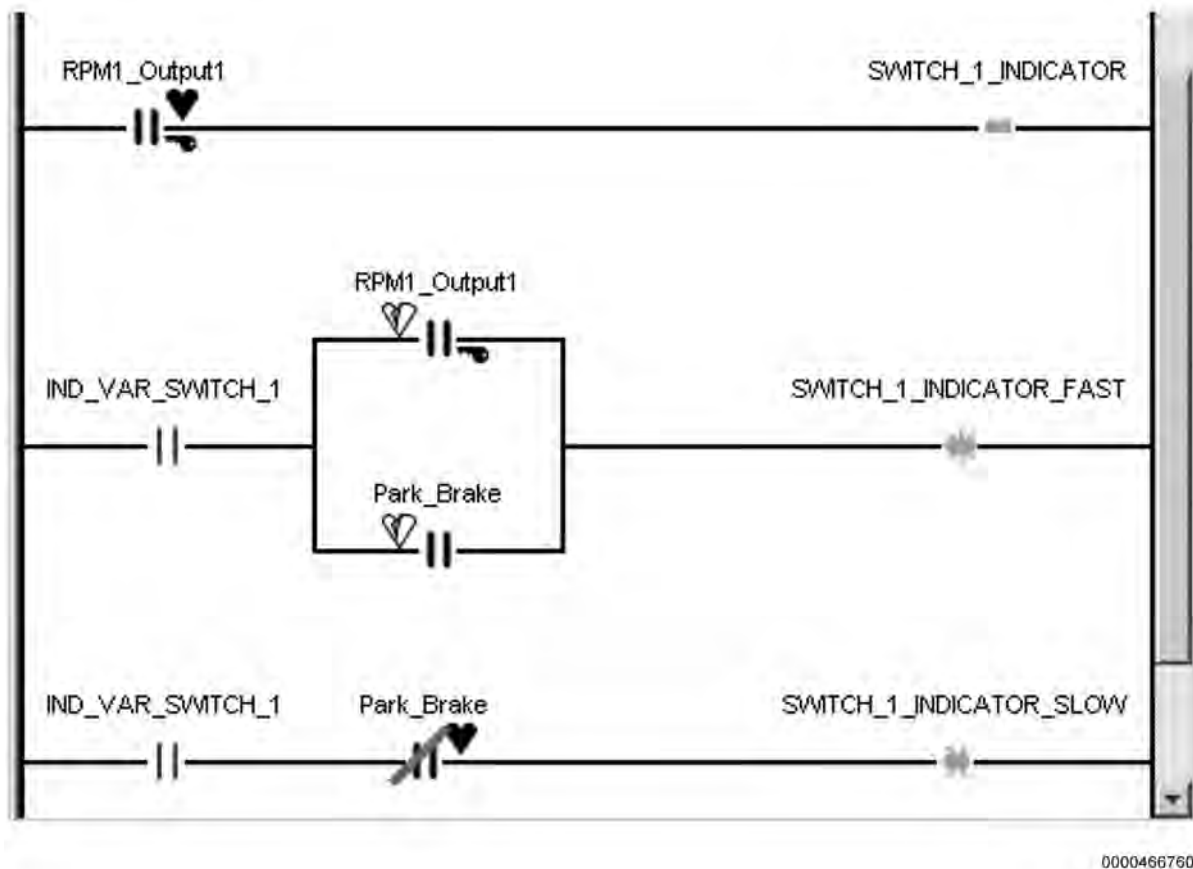


Figure 69 Interlocked Three-Position Momentary Switch Diagnostics

NOTE – Diagnostic text should be added to the Diagnostic tab and include the interlock for the output. Example: RPM1_Output1: This output is ON when the Switch labeled (SWITCH_1_Up) is rocked up AND the Park Brake is set. If the park brake is not set, the output will be OFF and the indicator light in the switch will blink slowly. If the park brake is re-set, then the output will re-engage. If this output signal is reporting BAD STATUS or if the Switch is reporting BAD STATUS, then the output will be OFF and the indicator light in the switch will blink fast.

For this example, the switch Indicator light should be ON solid when the physical RPM output is ON. The logic for this is in the top rung of Figure 69:

- The RPM output is the input of the rung.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

- The solid switch indicator light is the output of the rung.

The switch indicator should blink fast to indicate a fault if the independent variable is ON (the operator has pressed the ON button), but a bad status occurs on one or more of the input signals. The logic for this is in the middle rung of Figure 69.

- The independent variable is the input of the rung.
- The bad status conditions that could cause the output to be OFF are added to the middle of the rung. Right click on each of these icons and select BAD STATUS. A broken heart will appear in front of each icon. In this example, the signals that could communicate a BAD STATUS are the interlock (Park_Brake) and the RPM output (RPM1_Output1). (If the switches themselves have a bad status, the switch indicator lamp will fast flash anyway. So, they do not need to be checked by the ladder logic). Note that since the icons are stacked vertically, the fault indication is triggered if either the interlock signal OR the RPM output has a bad status.
- The blank fast icon is the output of the rung.

The switch indicator should blink slowly if the independent variable is ON (the operator has pressed the ON button), but the interlock is NOT TRUE (in this example, Park_Brake is NOT set). The logic for this is shown on the bottom rung of Figure 69.

- The independent variable is the input of the rung.
- The interlock (Park_Brake) is added the rung as an additional input. In this case, however, we're checking that the input is NOT TRUE / OFF. So, right click on the interlock icon and select NEGATE.
- The blink slow icon is the output of the rung.

Interlock Switch with a Three-position Momentary Switch (NON Re-Engaging Type)

A three-position momentary switch can be interlocked to various chassis signals as well. If the output requires that the interlock be engaged and you want the output to NOT re-engage when the interlock is turned ON again after being turned OFF (unless the up position of the switch is also pressed again).

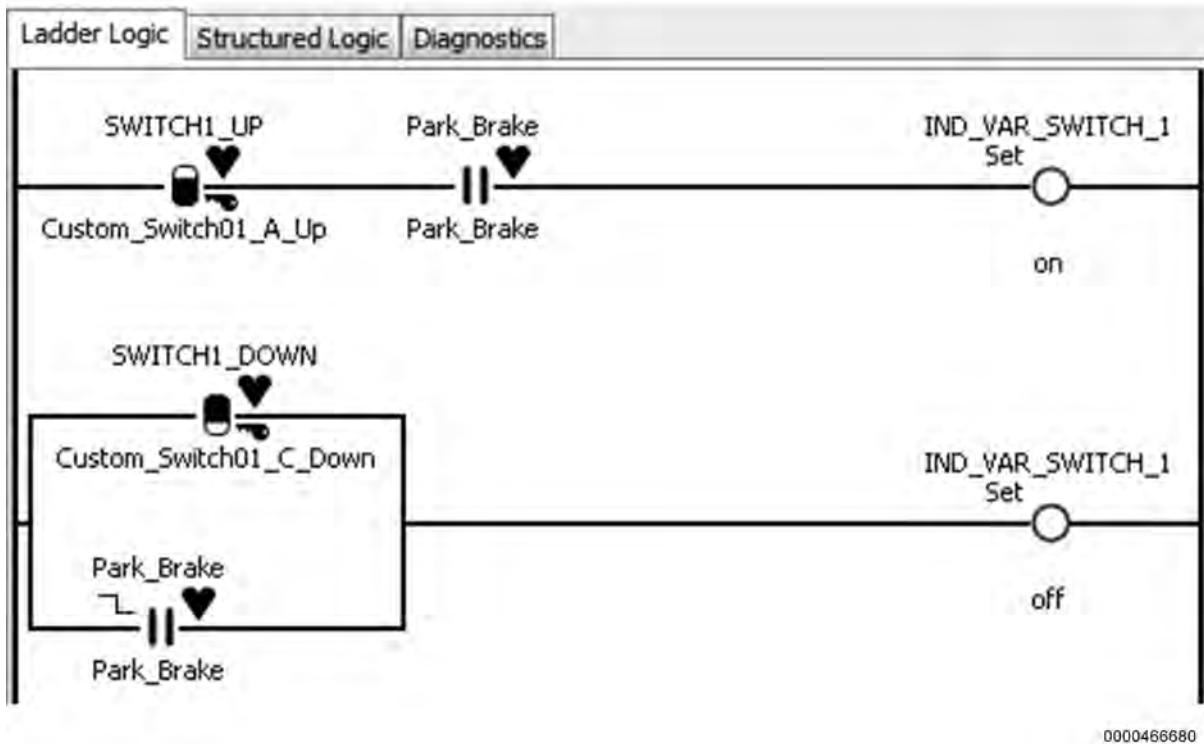


Figure 70 ON / OFF logic for Three-Position Momentary Switch (Non-Re-Engaging)

As shown in Figure 70, this application requires that the interlock be added to the rungs that set the independent variable ON and OFF.

- The first rung shows the conditions that set the independent variable ON. Notice that engaging the interlock (Park_Brake) by itself will not set the variable ON. Setting the independent variable ON requires that both signals be TRUE. In other words, the interlock must already be engaged when the switch is pressed.
- The second rung shows the conditions that set the independent variable OFF. Either the switch down position must be pressed OR the interlock (Park_Brake) must be switched OFF. Right-click the interlock icon and select NEGATIVE EDGE. This will be TRUE when the interlock transitions from engaged to disengaged. Therefore, if the interlock is removed at any point, the independent variable will be set OFF.

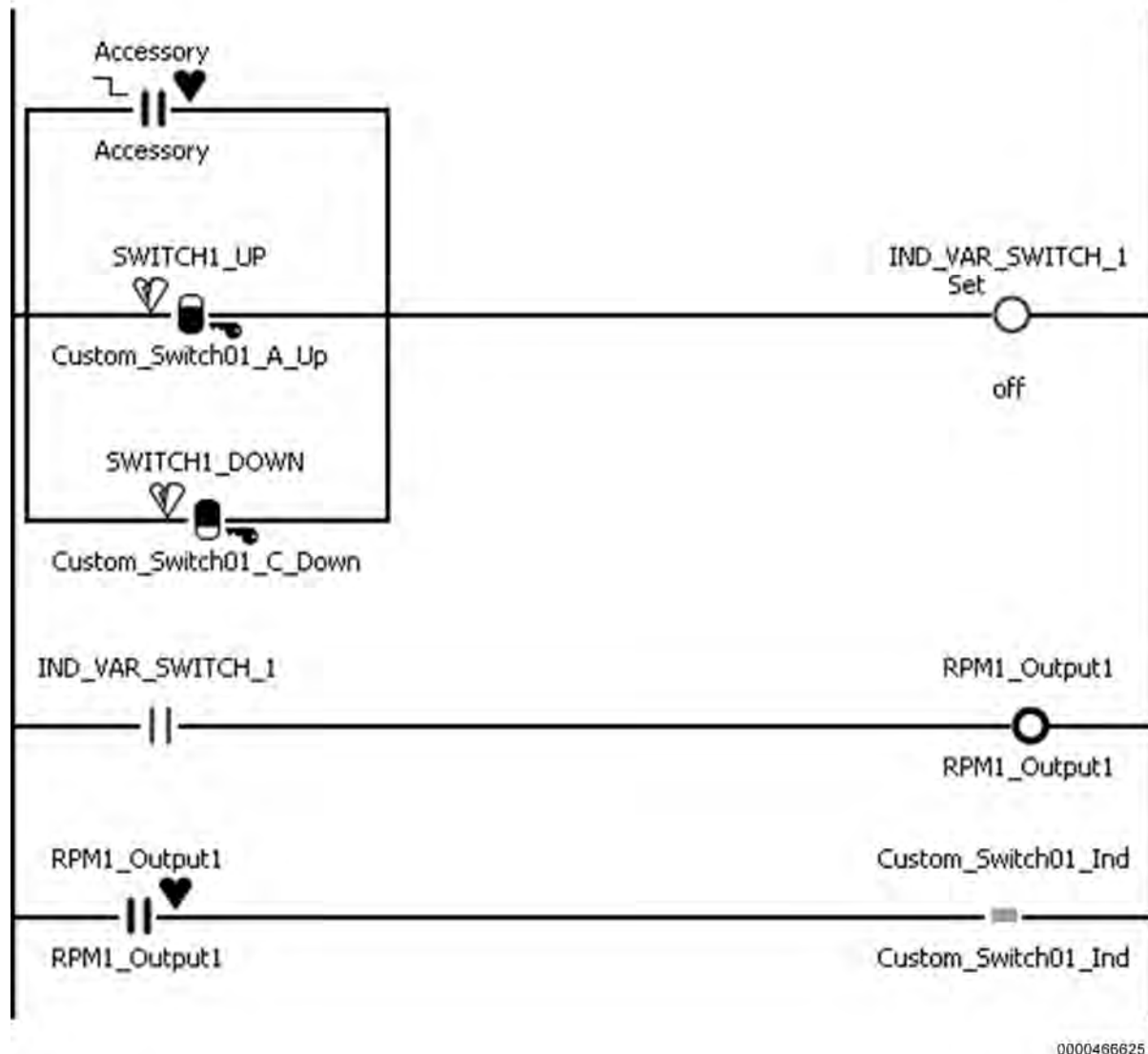


Figure 71 Setting the Physical Output

Figure 71 shows additional logic related to the output of the switch.

The top rung shows additional conditions that can force the output OFF. The independent variable will be set OFF if one or more of these conditions are TRUE.

- The Accessory signal switches OFF
- The up position for the switch has bad status
- The down position for the switch has bad status

The middle rung sets the physical RPM output equal to the value of the independent variable.

The bottom rung sets the switch indicator light ON solid if the physical RPM output is ON. The RPM output is used as the input of this rung. The output of this rung is the solid on indicator for the switch. The indicator light in the switch will illuminate when the output is actually ON.

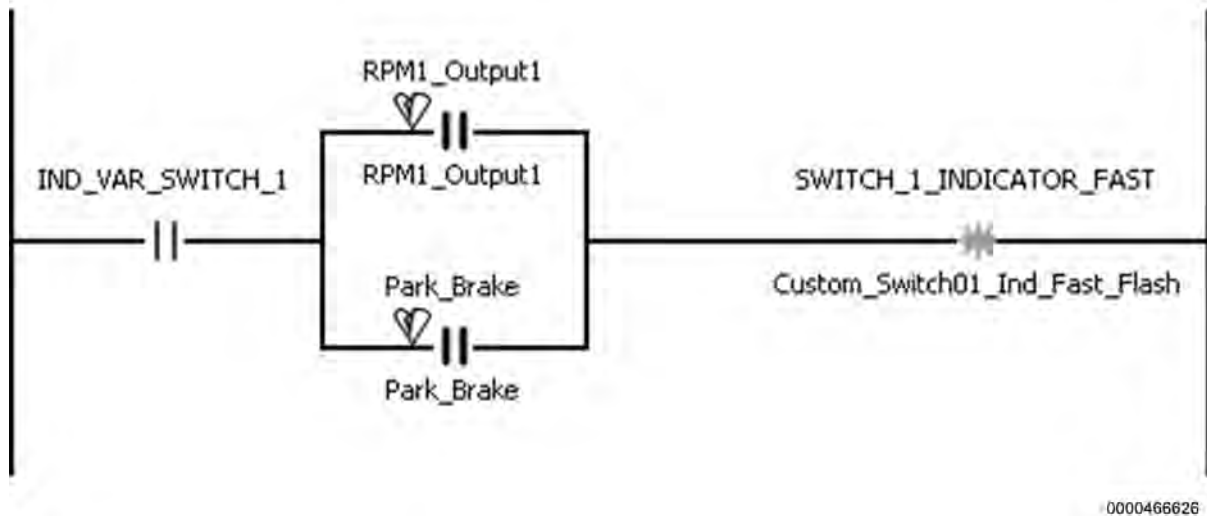


Figure 72 Status Check

NOTE – Diagnostic text should be added to the Diagnostic tab and include the interlock for the output. Example: RPM1_Output1: This output is ON when the Switch labeled (SWITCH_1_Up) is rocked up AND the Park Brake is set. If the park brake is not set, the output will be OFF. If the Park Brake is released and re-set, then the switch must be pushed up again to turn on the output. If this output signal is reporting **BAD STATUS** or if the Switch is reporting **BAD STATUS**, then the output will be OFF and the indicator light in the switch will blink fast.

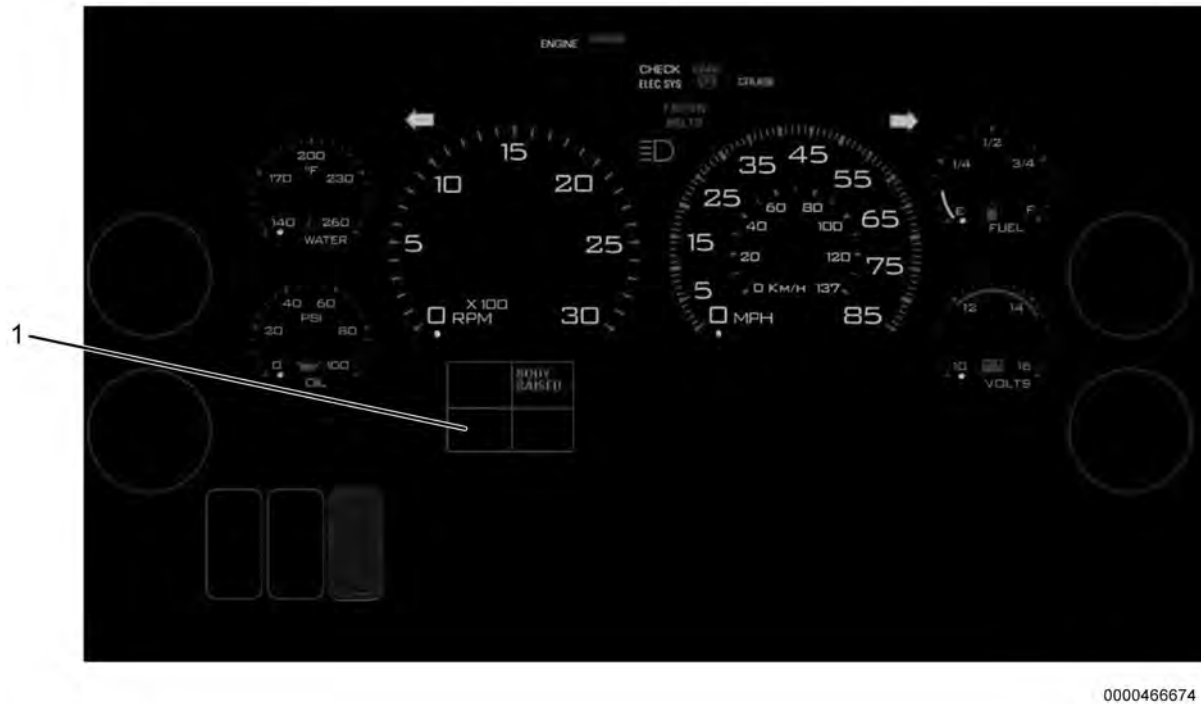
As shown in Figure 72, the indicator light in the switch should blink fast if the physical RPM output should be ON, but some condition prevents it from being ON.

- The independent variable is used as the input for this rung. This means the RPM output should be ON.
- The bad status conditions that could cause the RPM output to be OFF are added to the middle of the rung. Right-click on each of these icons and select **BAD STATUS**. A broken heart will appear in front of each icon. In this example, the signals that could communicate a **BAD STATUS** are the interlock (Park_Brake) and the RPM output (RPM1_Output1). (If the switches themselves have a bad status, the switch indicator lamp will fast flash anyway. So, they do not need to be checked by the ladder logic). Note that since the icons are stacked vertically, the fault indicator is triggered if either the interlock signal OR the RPM output has a bad status.
- The output of this rung is the fast blinking indicator for the switch.

Since the independent variable requires that the interlock be engaged, but the switch will not re-engage if the interlock is reintroduced, blink slow functionality is not applicable for this application.

SPECIAL GAUGE CLUSTER INDICATORS AND ALARMS

Illuminating Gauge Cluster Indicator Lights



1. Special indicators

Figure 73 Gauge Cluster View (vehicles built prior to 2007)



Figure 74 Special Indicators

NOTE – This feature is only applicable (with the exception of the PTO indicator) to vehicles built prior to January 2007. Indicators (with the exception of the PTO indicator) on vehicles, built after January 2007, will have to be incorporated into the switch pack. Refer to Illuminating the Service Parts Indicator Lights (page 83).

This feature allows the instrument cluster to be customized for certain specialized alerts. Three indicator lights are allocated for use with body equipment (Figure 73, Item 1).

The three signals are found in the Cluster tab in Advanced Logic and are labeled as follows:

- LowerL_Cluster_Ind (Lower Left Indicator)
- LowerR_Cluster_Ind (Lower Right Indicator)
- UpperR_Cluster_Ind (Upper Right Indicator)

On some vehicles, one of these signals may be used for Transmission Retarder and should not be used for body equipment.

If the vehicle is equipped with 60AJC (Waste Indicator light package) or 60AJD (Utility Indicator light package), the following signals may be available:

- Boom_Not_Stowed_Warning_light
- Outriggers_Deployed_Warning_Light
- Rear_Alert_Cluster_Indicator
- Gate_Open_Light (as a read signal)

However, these are not available for use as an output.

If the vehicle is equipped with one or more of the following 595XXX codes, the LowerL_Cluster_Ind, LowerR_Cluster_Ind, and / or UpperR_Cluster_Ind signals are not accessible. The following chart details which features to remove to use these signals.

	Waste & Refuse	Utility	Dump & Plow
Feature Code	60AJC	60AJD	60AJK
Equipment Options	<ul style="list-style-type: none"> • Gate Open • Rear Alert 	<ul style="list-style-type: none"> • Outriggers Out • Boom not Stowed 	<ul style="list-style-type: none"> • Body Up • Gate Open
Software Codes	595197, 595255, or 595198	595201 or 595202	595301, 595299, 595255 or 595197

Refer to the applicable Body Builder Electrical guide available at bodybuilder.navistar.com

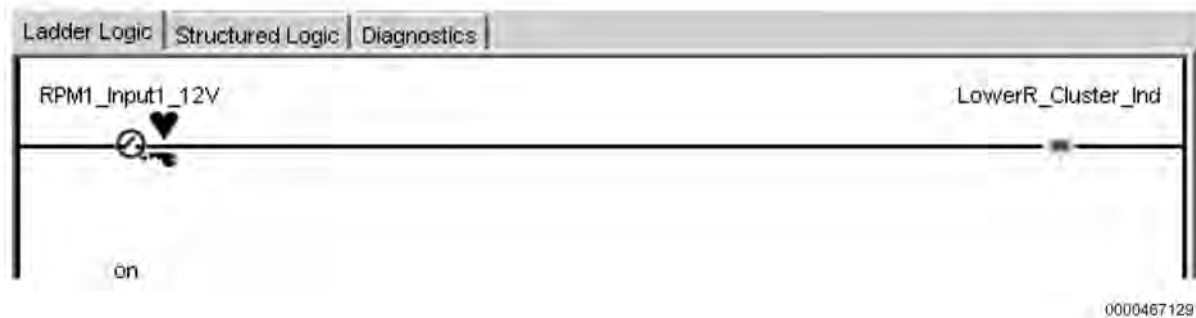


Figure 75 Illuminating the Indicator Lights in the Gauge Cluster

The LowerR_Cluster_Ind is typically labeled PTO on High Performance Vehicles. When this indicator is illuminated and the engine is running, the indicator will accumulate PTO hours in the digital display.

To turn on the LowerR_Cluster_Ind and drive the PTO Hour meter in the LCD display, drag this icon to the output of the next available rung in the Ladder Logic tab. Typically a Remote Power Module input will drive this light. However, many other inputs can illuminate this light (including chassis signals and / or Remote Power Module outputs).

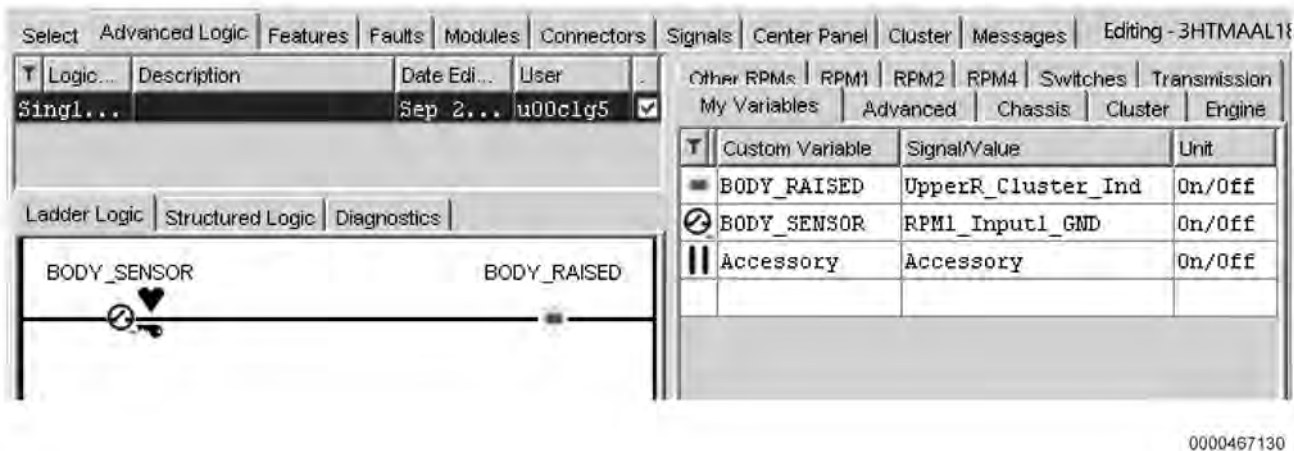


Figure 76 Ladder Logic for Illuminating the Gauge Cluster Indicator Lights

The other two indicator lights can also be illuminated by a Remote Power Module input.

The example in Figure 76 shows a body-mounted BODY RAISED switch that provides a ground (GND) signal on RPM Input 1 when the body is raised. This ground signal is used to drive the UpperR_Cluster_Ind, which would illuminate every time the body is raised.









To specify the text that appears for this light in Gauge Cluster View, enter the new name in the Custom Variable column for the indicator. For the example in Figure 76, a more appropriate name might be BODY UP. Although it won't be displayed in the cluster view, the input could be renamed more appropriately as well (BODY_SWITCH might make the intent clearer).

A description of this feature should be added to the Diagnostic tab in Ladder Logic. See Diagnostic Feature Descriptions: Writing Useful Text .

Gauge Cluster Alarm

Advanced logic to control the beeper in the instrument cluster can be created. However, the beeper signal is a semaphore signal, which means that the ESC will ignore such logic when it needs to take control of the beeper. When the ESC no longer needs the beeper, it will return control of the signal to any Advanced Logic created for it.

The Alarm Beeper signals can be found under the Cluster Tab in Advanced Logic.

Engine		Indicators		Other RPMs		RPM1	RPM2	RPM4	Switches	Transmission
AWARE		Advanced		Bus		Chassis		Cluster		Datalink
T	Custom Variable	Used	Signal/Value					Unit		
		<input checked="" type="checkbox"/>	Alarm_3Long_Beeps					On/Off		
		<input checked="" type="checkbox"/>	Alarm_5Short_Beeps					On/Off		
		<input checked="" type="checkbox"/>	Alarm_Always_Beep					On/Off		
		<input checked="" type="checkbox"/>	Alarm_Steady					On/Off		
		<input checked="" type="checkbox"/>	Ambient_Air_Temperature					F		
		<input type="checkbox"/>	Brake_Fluid_Indicator_Light					On/Off		
		<input type="checkbox"/>	Brake_Pressure_Warning_Lamp					On/Off		
		<input type="checkbox"/>	PTO_Throttle_Light_Cmd					On/Off		

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Figure 77 Cluster Tab

There are four signals available:

- Alarm_3Long_Beeps The alarm will activate and sound 3 long beeps.
- Alarm_5Short_Beeps The alarm will activate and sound 5 short beeps.
- Alarm_Always_Beep This will activate a consistent short beeping alarm.
- Alarm_Steady This will activate a consistent monotone alarm.

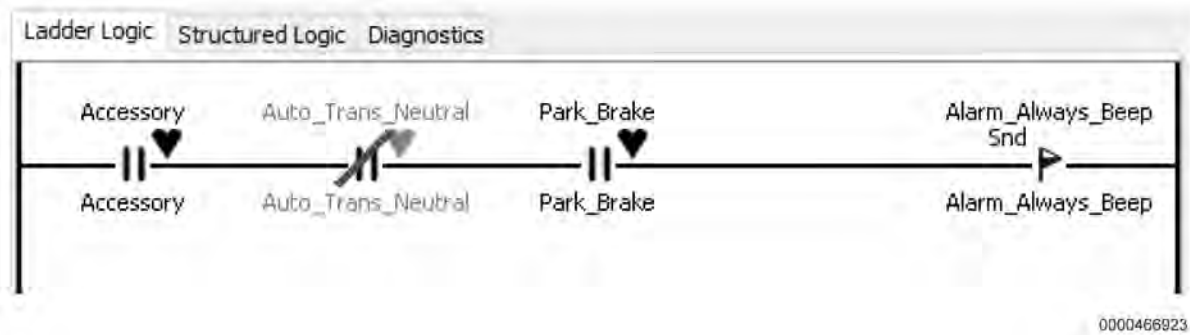


Figure 78 Example of controlling Cluster Alarms with Advance Logic

Figure 78 shows an example of using a continuous beep, when certain conditions are met. The conditions that must be met in order to activate the alarm are:

- Key in ignition or accessory position
- Transmission in gear
- Parking brake is set

When these conditions are met, the Alarm_Always_Beep signal will be activated and the cluster will always beep until one of these conditions are no longer true.

ILLUMINATING THE SERVICE PARTS INDICATOR LIGHTS – PRE INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

Indicator Light Assemblies that fit in the switch packs are available in RED, YELLOW and GREEN from the Parts Department at your local International dealer. Affix switch name labels as required from switch label sheets.



Figure 79 Indicator Light Assemblies

Illuminating lights from these Service Parts Indicator light kits, is similar to illuminating the indicator lights in the switches. Simply use the switch indicator lights as the output.

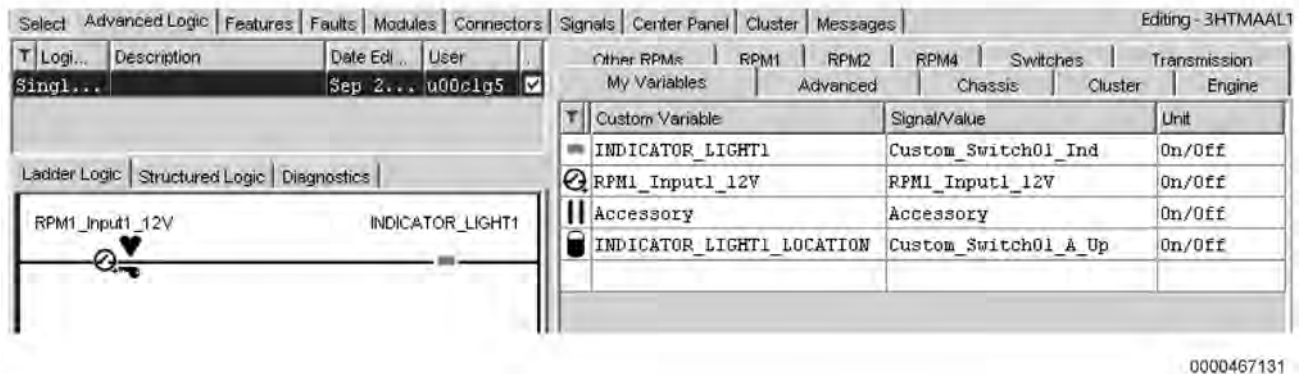


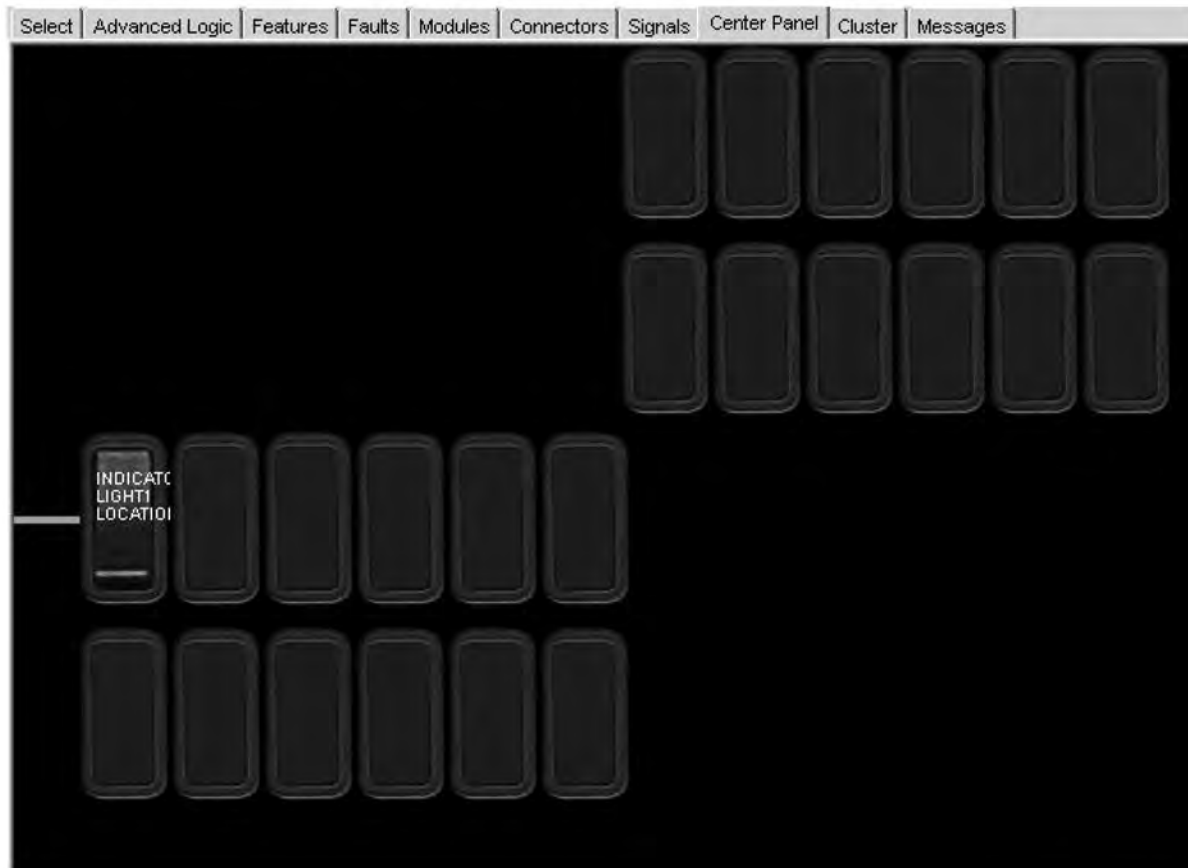
Figure 80 Ladder Logic for the Service Parts Indicator Lights

For example, if a Remote Power Module input should illuminate one of these aftermarket lights:

1. On the SWITCHES tab, find the next available custom indicator light. Enter a new name for the solid ON state of this indicator in the CUSTOM VARIABLE Column.
2. To indicate the location of the indicator light (and to ensure this switch is not used anywhere else), enter a new name for the corresponding Switch Up indicator in the Custom Variable column (such as INDICATOR LIGHT1 LOCATION). Although this switch will not be used, this name will indicate in the center panel view where the indicator light should be mounted.
3. Drag the switch UP icon to an unused rung that is not connected to any physical output so that this custom name will show up in the CENTER PANEL VIEW for the vehicle.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

4. Drag the solid ON indicator light to the next available ladder logic rung as the output. Add a Remote Power Module Input (either 12V or Ground) as the input for this rung.



0000467132

Figure 81 Location of Unused Switch

5. Check the CENTER PANEL view for the location of the Indicator Light (labeled as the unused switch).
6. A description of this feature should be added to the Diagnostic tab in Ladder Logic. See Diagnostic Feature Descriptions: Writing Useful Text .

CONTROLLING THE WORK LIGHT

NOTE – Not applicable to International® HV™ Series and MV™ Series trucks. International® HV™ Series and MV™ Series trucks will have rocker switches only.

The work light power output is a special purpose output on the Electrical System Controller or Body Control Module (BCM). The work light power output and universal air / relay drivers are the only power channels of the BCM that are functional with the ignition key in the OFF position.

The work light is an optional pre-engineered feature, but the feature is different on pre-2007 vehicles than it is on post-2007 vehicles:

- On pre-2007 vehicles, the feature provides a momentary rocker switch in the lower left three pack of switches on the left-side of the gauge cluster. The switch drives a 10 amp power feed on the ESC.
- On post-2007 vehicles, the feature has two possible configurations. The first option provides a momentary rocker switch in the first position of the lower right (two pack) of switches, on the right-side of the gauge cluster. The second option provides a push button control on the left-side of the gauge cluster. Both versions of the switch drive a 10 amp power feed on the ESC.

This feature, when ordered from the factory, is delivered with a wire harness that contains a two-pin weather sealed connector for the body builder to attach a body lamp or other load to this output. It has a programmable parameter to shut this output OFF with key OFF after a prescribed amount of time. The default is two hours.

Diamond Logic® Builder allows you to write to the work light channel using a unique methodology that is different from writing to other outputs in the system. You may write to the work light channel using an OR relationship with the rocker switch in the cluster. This means that the driver can turn the work light output channel OFF or ON by actuation of the rocker switch in the gauge cluster or by writing to two individual signals in Diamond Logic® Builder.

To turn the work light channel ON, the user may employ any single transitional event of logic to activate the output signal called Work_Light_On or Worklight_on_sem SND.

To turn the work light channel OFF, the user may employ a single transitional event of logic to activate the signal called Work_Light_Off or Worklight_off_sem SND.

Steady state (latched) logic events, may also be used to activate the work light ON or OFF signals. When this approach is used, however, the ON / OFF requests from the rocker switch will be ignored. Also, any latched events that may be driving the work light signals should be interlocked with the Accessory signal or there is a risk that the ladder logic will keep the ESC functioning with the ignition key in the OFF position and thus drain the vehicle batteries over time.

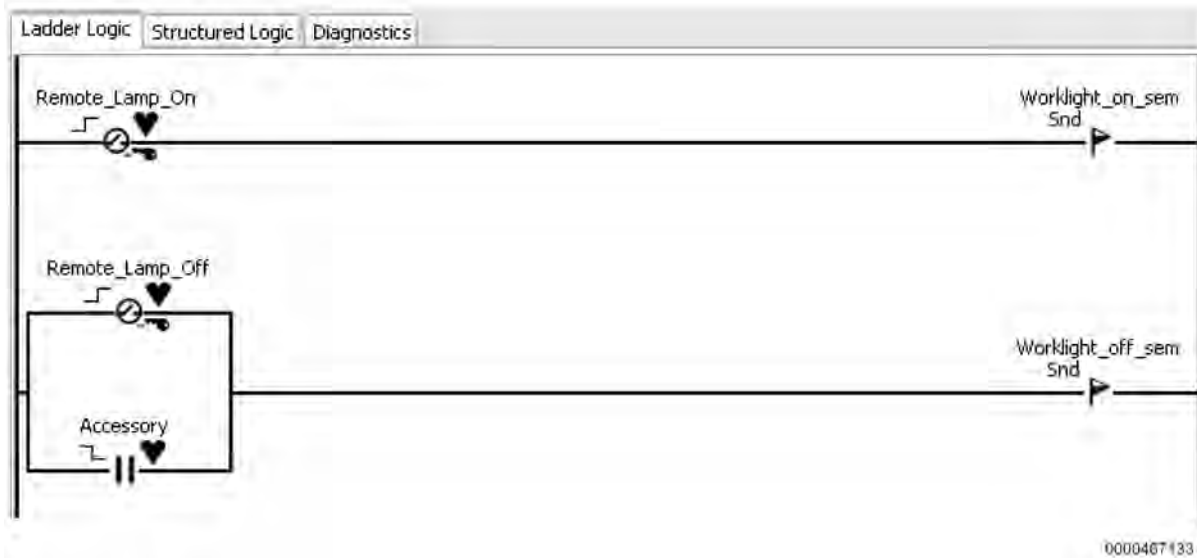


Figure 82 Example of Controlling the Work Light Channel Post 2007 Vehicles

Figure 82 shows an example of advanced logic being used to control the work light channel on a post 2007 vehicle. In this example, we have chosen to use one set of logic to turn the work light channel ON and a different set of logic to shut the channel OFF:

- The first rung shows that the first transitional event activation of the remote power module switch input will start the chain of logic to activate the Worklight_on_sem SND signal. The work light will be latched ON in a steady state fashion by the software, even though the logic of the rung is only true for one processing cycle.
- The second rung is used for shutting off the work light. In this case, we used the transitional event activation of another remote power module switch input or de-activation of the ACCESSORY signal to activate the Worklight_off_sem SND signal and thus, shut OFF the work light.

In summary, two individual rungs using transitional logic events are required to control the Work Light Channel.

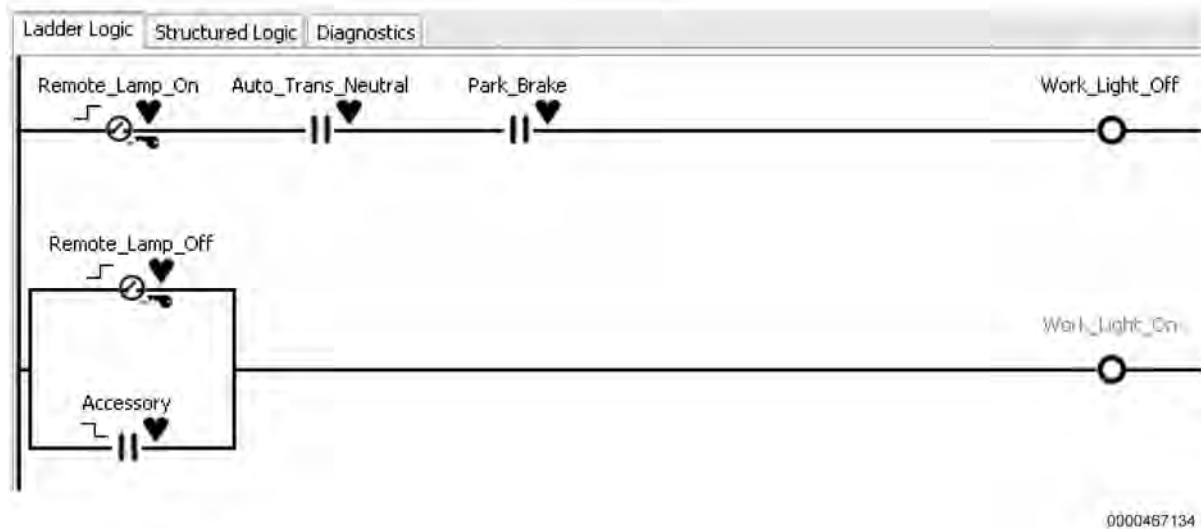


Figure 83 Example of Controlling the Work Light Channel Pre 2007 Vehicles

Figure 83 shows the same example on a pre 2007. Notice the following differences for these older vehicles:

- Work_Light_On and Work_Light_Off must be used as the outputs rather than Worklight_on_sem SND and Worklight_off_sem SND.
- Interlocks were added to the first rung to ensure that the transmission is in Neutral and the Park Brake is set in order for the channel to be activated.

You can employ the Diamond Logic® signals to control the work light channel without the interaction of the work light rocker switch by merely removing the work light switch and installing a switch blank. If the third switch position of the gauge cluster is required for use by another feature and yet the controlling of the work light channel is still desired, you may move the work light switch from the gauge cluster to another location in a switch pack in the center panel using the following process:

1. Place the cursor over the work light switch in the gauge cluster and then click and hold the left mouse switch.
2. Drag the work light switch to the center panel tab with the mouse switch still depressed. The switch panel view will now be displayed.
3. Drag the work light switch to the desired location in the switch packs. If the switch will not be used, select an unused location in a switch pack that is already in the vehicle and then install a switch blank.

In order to locate another switch function from the switch packs to the third position of the gauge cluster, reverse the above procedure. Remember the rocker switch should be a momentary type and all supporting logic should shut OFF the channel with key OFF.

NOTE – The programmable parameter for shutting OFF the work light channel will be active with the key OFF, even when the channel is controlled by advanced ladder logic. The default is two hours and is adjustable by modifying the programmable parameter Work_Light_Timeout_Enable located in the work light feature 595250 or 595AMU, and 595AMU.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

Key points to remember when working with the work light channel:

- If you choose to insert a blank switch in your advanced logic and move the pre-engineered work light switch to an unused location and that location is in a switchpack that is not installed on the vehicle, you will get an active error message for a switchpack that is not installed on the vehicle. This is not recommended.
- Most outputs such as RPM or air solenoid modules can be used to drive items such as switch indicators in advanced logic. The work light outputs are special due to the software that controls the pre-engineered feature and the timer software. The output cannot be used as an input to control items like the work light indicator in the switch. The output that is displayed on the ladder logic is actually a temporary variable that is only active for one processing cycle. You must use items such as a positive edge of the work light switch or an edge of the output to control other rungs of logic.

USING THE KEY FOB BUTTONS IN ADVANCED LADDER LOGIC PRE INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

Feature code 595ABZ provides the key fob with the following buttons that control the vehicle over a wireless interface:

- Door lock and unlock buttons
- A panic button
- An Auxiliary (AUX) button that typically controls either the work light channel or a lift gate.

Diamond Logic® Builder provides a means to use the key FOB for a number of purposes. The key FOB provides four read-only signals in the CHASSIS tab of signals. The four signals are labeled:

- Keyless_Remote_Aux_Button
- Keyless_Remote_Lock_Button
- Keyless_Remote_Panic_Button
- Keyless_Remote_Unlock_Button

These signals may be used as read-only signals to construct any form of logic for the control of body locks or other equipment. However, it must be understood that the door locks will be activated anytime the key FOB lock buttons are pressed, even if advanced logic uses these signals for other purposes.

Using the Key FOB Lock and Unlock Buttons to Control Reversing Polarity Relays

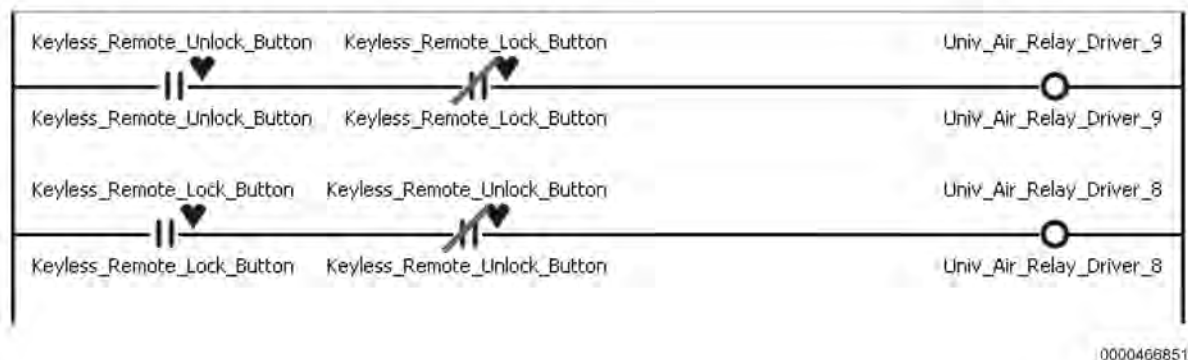


Figure 84 Using the Key FOB to Generate a Reversing Polarity Output for Driving Two Relays

Figure 84 shows an example of the Key FOB Lock and Unlock buttons being used to control ESC relay drivers for the purpose of creating a reversing polarity output to control body lock mechanisms.

- The first rung indicates that the Lock button must be active and the Unlock button must be OFF in order for the output to be active. This prevents the driver from causing any switch action by pushing two key FOB buttons at once.
- The second rung is used to unlock the doors using the inverse logic of the first rung.

Note that for this example, the vehicle must be ordered with the Diamond Logic® Builder Expansion Pack Feature (595283 / 595AKH) to gain access to the spare relay drivers on the ESC. The Expansion Pack feature may not be added later, by the body builder, using the Diamond Logic® Builder software. The body lock

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

mechanisms should be connected to two customer-supplied relays in a standard H bridge configuration to provide the reversing polarity drive for the body locks.

Using the AUX Button

The AUX button on the key FOB is the only button that may be used for two independent purposes. As stated before, if the vehicle is equipped with a work light feature, then the AUX button will control the work light channel in an OR relationship with the rocker switch in the cluster OR with any Diamond Logic® Builder program advanced logic that is controlling the work light ON / OFF signals. If the vehicle is not equipped with the work light feature, the AUX button may be used as an input to control any output that is available in the Diamond Logic® Builder software.

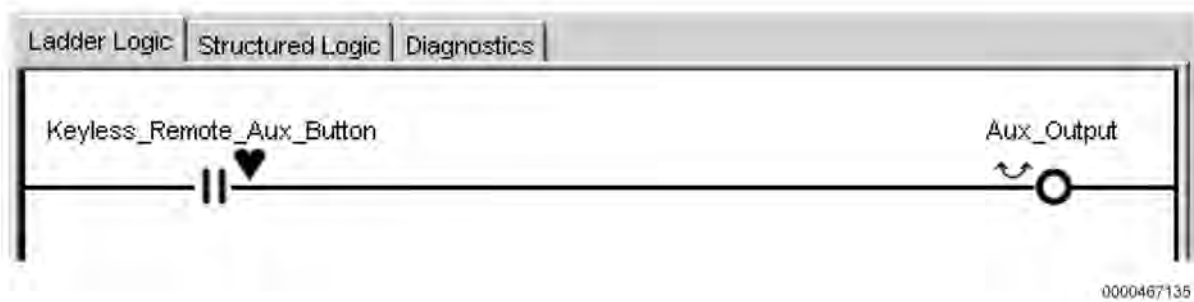


Figure 85 Aux Key FOB Button Toggles Remote Power Module Output

Figure 85 shows an example of the AUX button being used to control a remote power module output. In this example, we can provide control of a remote power module output with the ignition key OFF. Momentarily depressing the AUX button on the key FOB will toggle the remote power module output OFF and ON. The Aux button signal is active for only as long as the button is depressed. You should employ the SET function or the TOGGLE function if a latched output is desired due to the activation of this switch.

USING THE KEY FOB BUTTONS IN ADVANCED LADDER LOGIC INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

Feature code 597103 provides the key fob with a wireless interface to lock or unlock the doors, a button to activate a panic button and two AUX buttons that normally control the work light channel or a lift gate.

The Diamond Logic® Builder program provides a means to use the key FOB for several purposes. The key FOB provides five read-only signals in the CHASSIS tab of signals. The five signals are labeled:

- Aux_Cmd_1
- Aux_Cmd_2
- Keyless_Remote_Lock_Button
- Keyless_Remote_Panic_Button
- Keyless_Remote_Unlock_Button

USING THE KEY FOB LOCK AND UNLOCK BUTTONS TO CONTROL REVERSING POLARITY RELAYS

In the following example the Key FOB Lock and Unlock buttons are used to control ESC relay drivers to create a reversing polarity output to control body lock mechanisms. The first rung indicates that the Lock button must be active and the Unlock button must be OFF for the output to be active. This prevents the driver from causing any switch action by pushing two key FOB buttons at once. The second rung is used to unlock the doors using the inverse logic of the first rung.

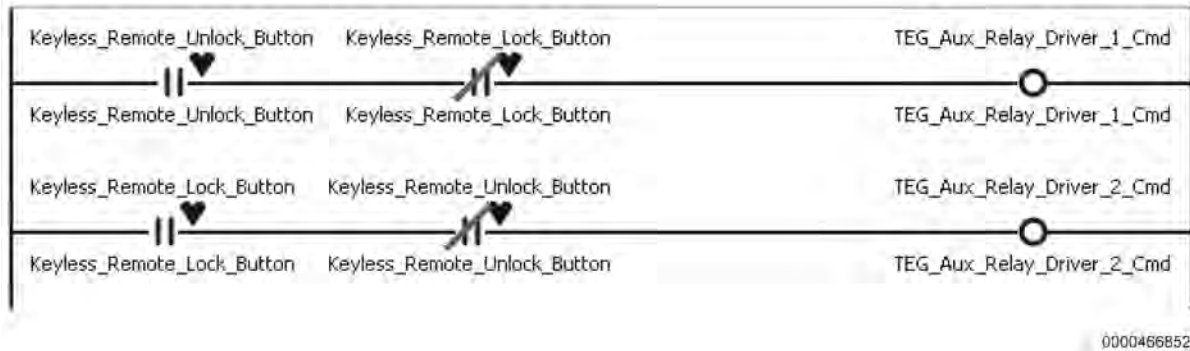


Figure 86 Using the Key FOB to Generate a Reversing Polarity Output for Driving Two Relays

USING THE KEY FOB AUX BUTTONS

The AUX buttons, on the key FOB, are the only buttons that may be used for two independent purposes. As stated before, if the vehicle is equipped with a work light feature, the AUX 1 button can be programmed with 597107 to control the work light channel in an OR relationship with the rocker switch in the cluster OR with any Diamond Logic® Builder program advanced logic that is controlling the work light ON / OFF signals. If the vehicle is not equipped with the work light feature any AUX button may be used as an input to control any output that is available in the Diamond Logic® Builder software. See the following example that uses the AUX button to control an Aux Relay Driver output. In this example we can provide control of a remote power module output with the ignition key OFF. Momentarily depressing the AUX button on the key FOB will toggle the Aux Relay Driver output OFF and ON. The Aux Button signal is only active while the button is depressed. You should use the SET function or TOGGLE function if a latched output is desired with the activation of this switch.

You must use the DLB Keep Awake Sem semaphore to wake up the truck. Depending on how the switch is intended to be used, the logic should be written to turn off DLB Keep Awake Sem semaphore. This could be done with the lagging edge of accessory or with a timer.

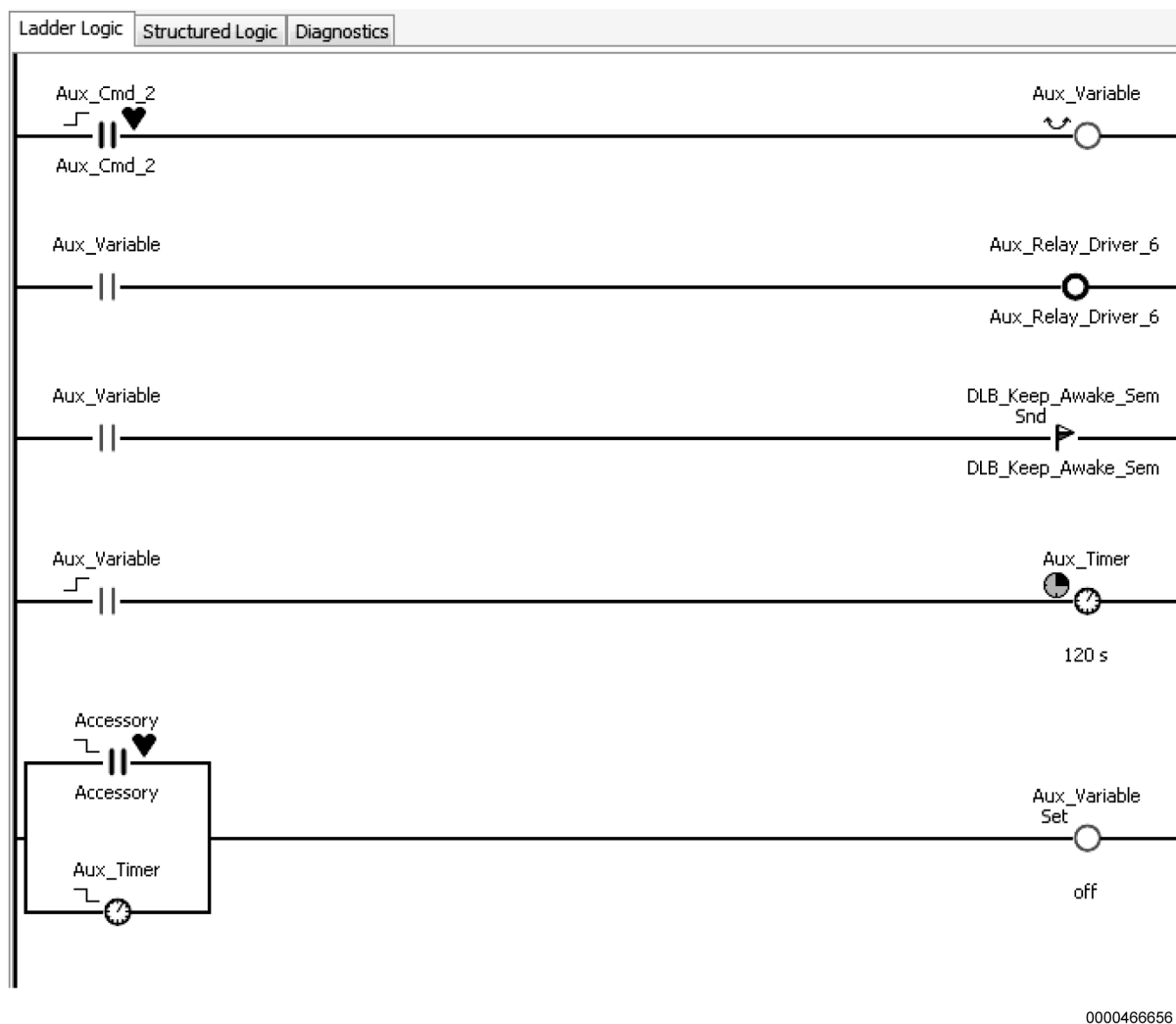


Figure 87 Aux Key FOB Button Toggles Aux Relay Driver Outputs

USING SIGNALS WITH LIMITED WRITE ACCESS

Diamond Logic® Builder is designed to make a broad variety of electrical system signals accessible to you. Some of the signals are READ Only, which means that these signals may only be used as inputs on the left side of the ladder rungs. Others are provided with WRITE access. This means that these signals are mapped to outputs in the electrical system.

Signals that have unconditional write access in ladder logic are tagged with an icon that looks like an O in the signal tabs of Diamond Logic Builder.

Other signals have limited WRITE access using ladder logic and are identified with an icon that looks like a small flag. Signals in this category include the city horn, air horn, the beeper cadences in the gauge cluster and other electrical signals that may be introduced in the future.

A signal with limited access provides a secondary control of the output. This means that if a primary vehicle feature has activated an output such as City Horn, ladder logic is not permitted to shut it OFF. In simple terms, the relationship between Diamond Logic Builder signals with limited access is a true OR condition with the logical control by the related vehicle feature. Either the Diamond Logic Builder signal or the vehicle feature can turn an output ON, but both signals must be off in order to disable the related output. The advanced logic inputs that are used to drive the output signals with limited access must employ latching techniques such as signals driven by latched switches or the use of the SET function. These limited access signals do not have any features to stay ON with a momentary type of logical activation.

SWITCHES THAT FUNCTION WITH IGNITION IN KEY OFF POSITION

If it is necessary to set up a switch that will function when the ignition is in the Key OFF position, there are two methods for doing so:

- In-cab switches must be in specific gauge cluster locations to function while the ignition is in the key OFF position. See Providing Key OFF Functionality for Gauge Cluster Switches (page 95).
- Body-mounted switches can be granted key OFF functionality by the RPM. See Providing Key OFF Functionality to Remote Body Mounted Switches (page 100).

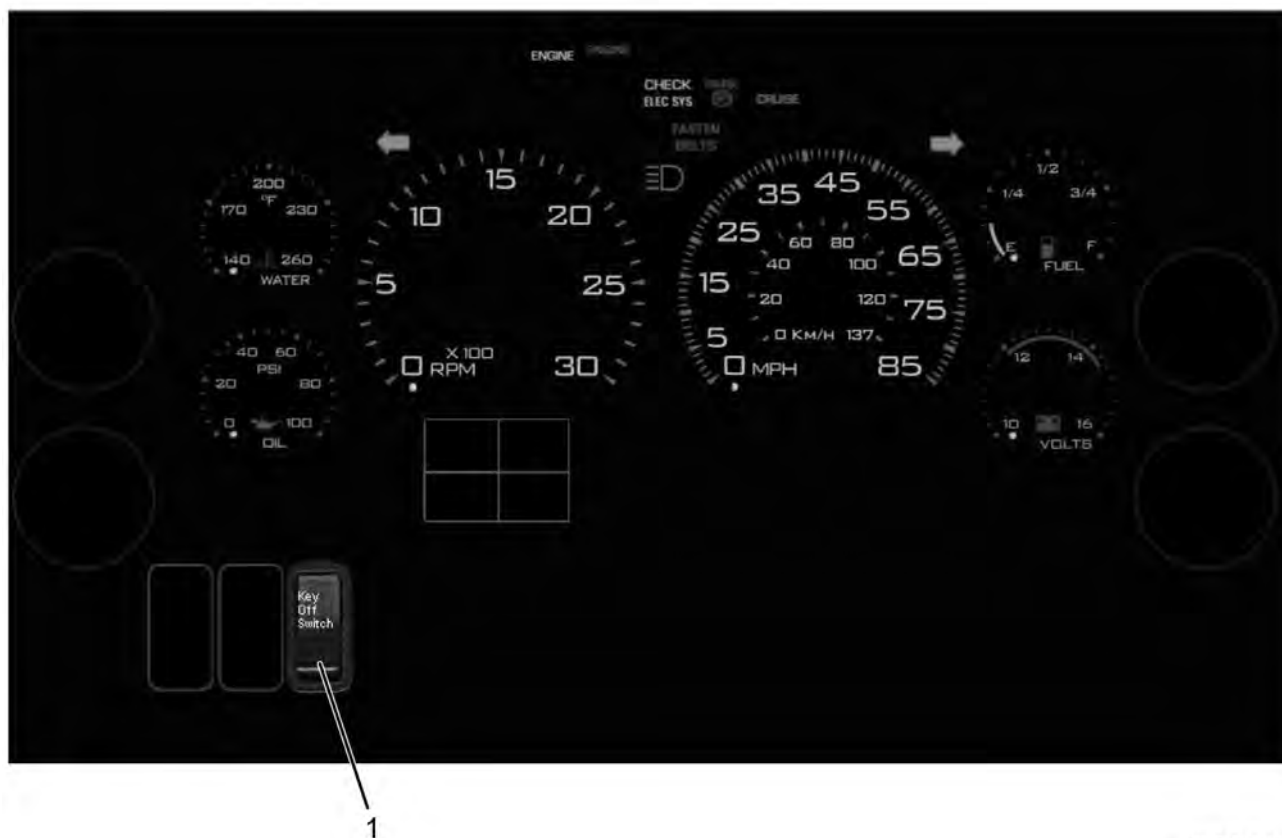
If you wish to provide key OFF functionality for a switch in the center panel, the switch must be relocated to the gauge cluster. Switches in the center panel cannot operate in the key OFF position (the center panel requires the key in the ACCESSORY or IGNITION position).

To relocate the switch,

1. Select the switch in the center panel.
2. Drag the switch to the Cluster tab (do not release the mouse button yet). The gauge cluster view appears.
3. Drop the switch in an available Key OFF position (see Figures 88 and 89).

Providing Key OFF Functionality for Gauge Cluster Switches Pre International® LT®, RH™, HV™, and MV™ Series Trucks

Switches that must function when the ignition is in the key OFF position must be installed in a gauge cluster location that supports key OFF loads.



1. Switch position supporting key OFF loads

Figure 88 Key Off Functionality in the Gauge Cluster (Pre 2007)

There is one instrument panel switch location available for pre 2007 vehicles (Figure 88, Item 1).



Figure 89 Key Off Functionality in the Gauge Cluster (Post 2007)

There are two switch locations available the post 2007 vehicles.

NOTE – The lower right switch locations may be occupied by Diesel Particulate Filter Regeneration switches. These switches can be relocated to a switch pack in the center panel if necessary to free up these locations.

Only 3-position momentary switches should be placed in these locations. Typical use of this functionality is for a Strobe Light, Work Light or Spot Light. To add key OFF functionality to a rung,

1. Add logic for a 3-position momentary switch.
2. Remove the accessory interlocks from the switch by right-clicking on the switch icons and then selecting ACCESSORY. This will allow the switch to operate without being interlocked to accessory.
3. In addition, a timer should be added before the output to ensure the battery is not drained. See Timers (page 188) for more information.

Example of Key OFF Functionality in the Gauge Cluster**Figure 90 Gauge Cluster Key Off: ON Switch**

Figure 90 shows the first rung of an example of a gauge cluster switch that provides Key OFF functionality. Notice that this is similar to the first rung of any other 3-position momentary switch. In this case, however, we're setting a timer on rather than setting an independent variable on.

1. Select an available 3-position momentary switch
2. Drag the up position icon for this switch to the left end of the top rung.
3. Right-click on the newly-added icon and select Positive Edge (this is a momentary switch).
4. Right-click on the newly-added icon and select Accessory. This removes the key from the icon. Having the ignition in Key ON or ACCESSORY position will no longer be a requirement for this switch.
5. Select the MY VARIABLES tab and click in the CUSTOM VARIABLE column of the last (empty) row.
6. Enter a name for the timer that will be used to automatically time out this signal.
7. Drag this new variable to the right end of the top rung.
8. Right-click on the newly-added icon and select start. The variable icon is now replaced with a timer icon. The GREEN clock to the left of the timer indicates that this timer is being started. The timer will be started when the driver presses the ON button.
9. Beneath the new timer icon, ladder logic displays the number of seconds that the timer will run before it expires (default is 1 second). Click on this value and enter the number of seconds you want the function activated by this switch to keep running before it shuts off to preserve the battery. In this example, we've entered 300 seconds or a five minute timer.

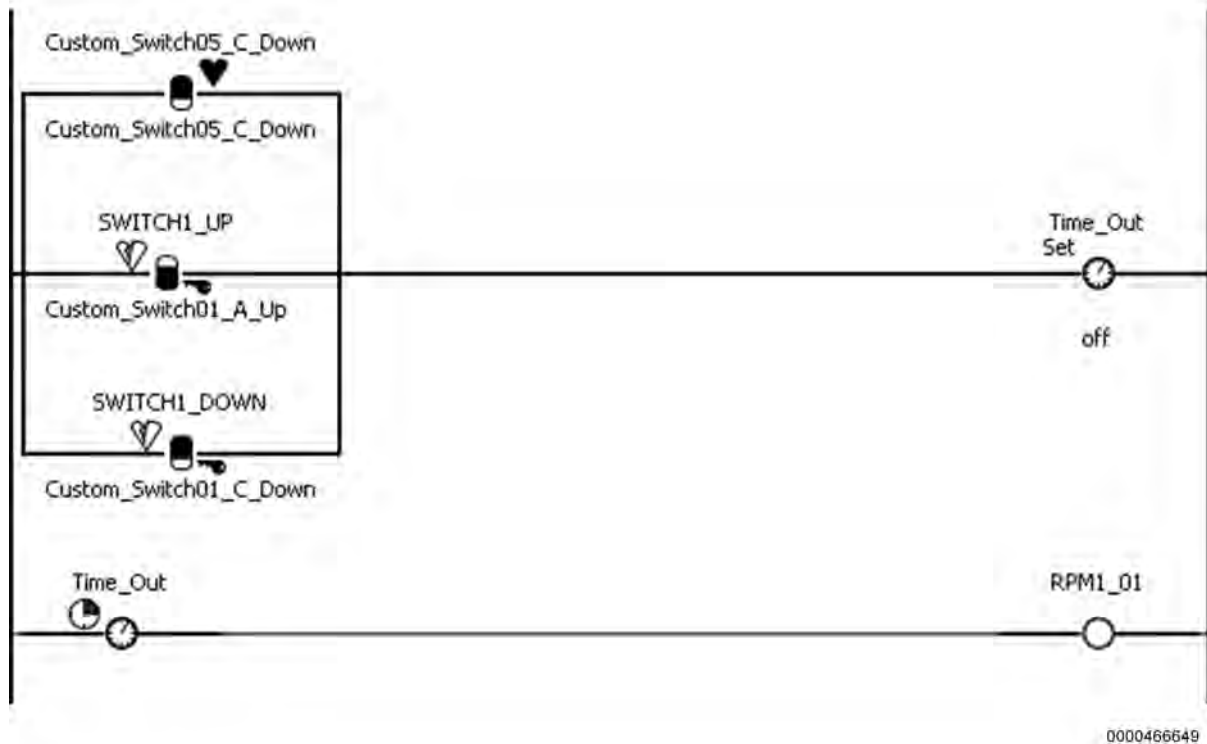


Figure 91 Gauge Cluster Key Off: More Timer Logic

10. Drag the icon for the down position of the switch to the left end of the next rung.
11. Right-click on the newly-added icon and select Accessory. (Remove the Accessory interlock. The OFF position of the switch must also function when the key is in the OFF position.)
12. Drag the icon for the up position of the switch to the left side of the same rung and drop just below the icon added in Step 10.
13. Right-click on the newly-added icon and select BAD STATUS. Bad status for the switch will also turn the switch off.
14. Drag the icon for the down position of the switch to the left side of the same rung and drop just below the icon added in Step 10.
15. Right-click on the newly-added icon and select BAD STATUS.
16. Drag the icon for the timer created earlier to the right end of this rung.
17. Right-click on the newly-added icon and select SET.
18. Double-click on the word ON below the timer icon.
19. Type OFF in the space provided. Immediately expire the timer if the switch output should be turned OFF.
20. Drag the icon for the timer to the left end of the next rung.

21. Right-click on the newly-added icon and select RUNNING.
22. Rename the independent variable on the end of this line to something appropriate. In this case, we used the name RPM1_01.

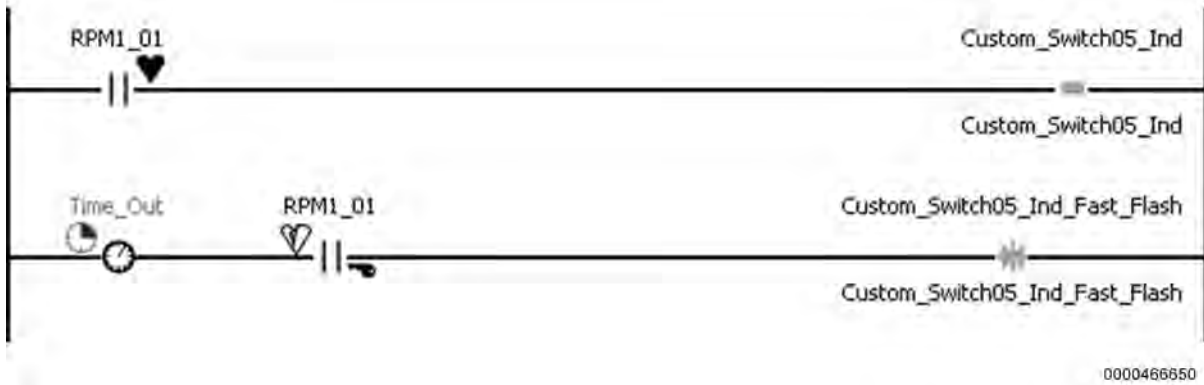


Figure 92 Gauge Cluster Key Off: More Switch Indicator Logic

The indicator light should be illuminated when the output is ON and fast flash in case of a fault.

NOTE – It is recommended that the rungs that slow flash or fast flash the indicator light in the switch still contain an ACCESSORY interlock when checking status or interlock conditions. These indicator lights could drain the battery.

23. Drag the icon for the independent variable to the left end of the next rung.
24. Right-click on the newly-added icon and select OFF WITH ERROR.
25. Drag the solid on indicator icon for the switch to the right end of the rung.
26. Drag the timer indicator to the left end of the next rung.
27. Right-click on the newly-added icon and select RUNNING.
28. Drag the icon for the independent variable onto the rung as an additional input condition.
29. Right-click on the newly-added icon and select BAD STATS.
30. Right-click on the icon again and select ACCESSORY.
31. Drag the icon for the switch's fast flash indicator to the right end of the rung.

Providing Key OFF Functionality to Remote Body Mounted Switches Pre International® LT®, RH™, HV™, and MV™ Series Trucks

Since Remote Power Modules will wake-up the BCM when necessary, an RPM can provide key OFF function to the switches it receives inputs from. However, this method cannot be used for in cab switches.

To change a remote switching solution to one that will work with key OFF, remove the interlock to ACCESSORY from the remote power module input icons and remote power module output icons (when used as inputs).

A time-out should always be added to any key OFF functionality to ensure that this switch does not drain the battery. See Timers (page 188) for more information.

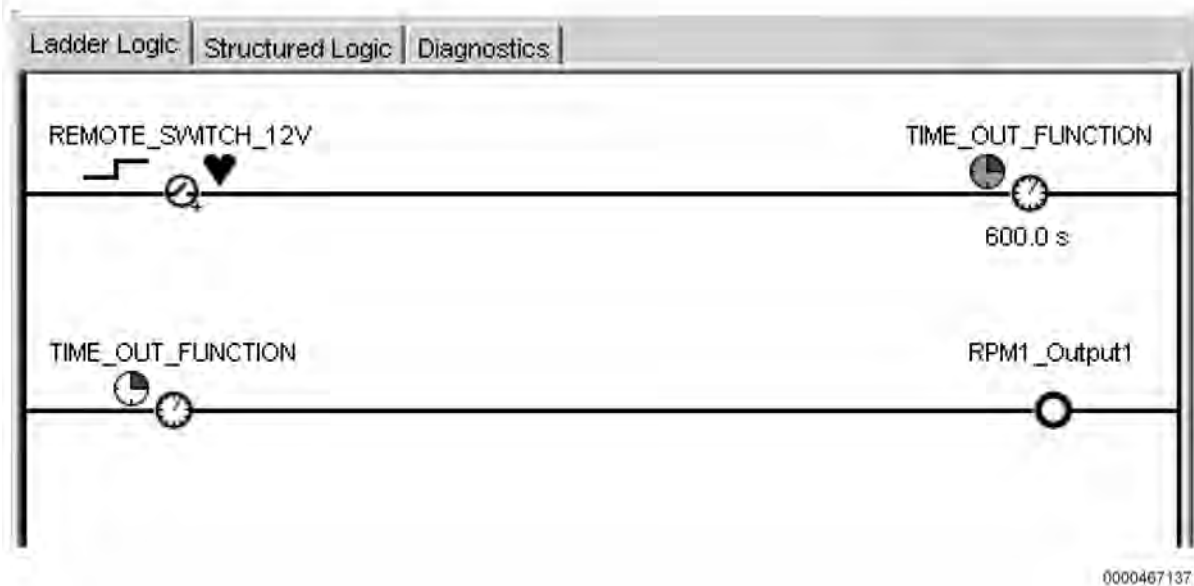


Figure 93 Key-OFF Functionality Using a Timer to Control the Remote Power Module Output

Figure 93 shows an example in which a remote body-mounted switch operates a remote power module output in key OFF position. This example provides a 10 minute timeout. For a longer timer, see Timers (page 188).

1. Add the RPM input as the input on the first rung.
2. Right-click the new icon and select ACCESSORY. (This will remove the key symbol from the icon).
3. Right-click on the new icon and select POSITIVE EDGE. (Start the timer when the switch turns ON.)
4. Select the MY VARIABLES tab and click in the Custom Variable column of the last (empty) row.
5. Enter a name for the timer that will be used to automatically time out this signal.
6. Drag this new variable to the right end of the top rung.
7. Right-click on the newly-added icon and select START. The variable icon is now replaced with a timer icon. The GREEN clock to the left of the timer indicates that this timer is being started. The timer will be started when the driver presses the ON button.

8. Beneath the new timer icon, ladder logic displays the number of seconds that the timer will run before it expires (default is one second). Click on this value and enter the number of seconds you want the function activated by this switch to keep running before it shuts off to preserve the battery. In this example, we've entered 600 seconds or a 10 minute timer.
9. Drag the timer icon to the left end of the next rung.
10. Drag the RPM output to the right side of the rung.

PROVIDING KEY OFF FUNCTIONALITY INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

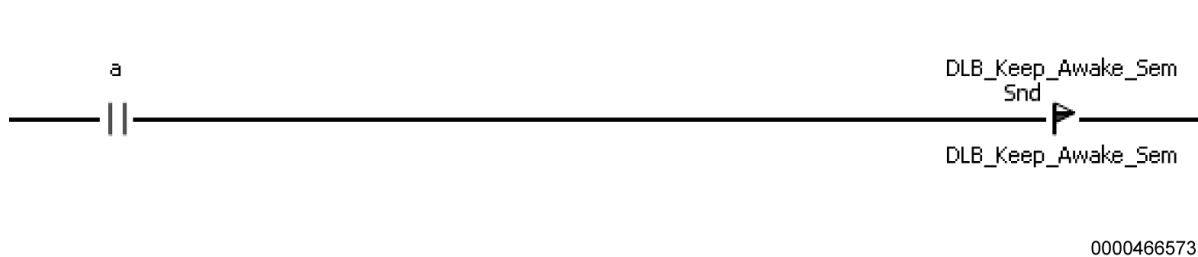


Figure 94 DLB_Keep_Awake_Sem Ladder Logic

The DLB_Keep_Awake_Semaphore signal, from the Advanced TAB in DLB must be used if you want to wake up the system and / or have the system stay awake with key off. This can be used with any of the following interfaces:

- Rocker switches
- Aux 1 or Aux 2 on the Key FOB
- RPM Inputs
- TEG_Discrete_Input_1
- TEG_Discrete_Input_2

The DLB_Keep_Awake_Sem must be turned off if you want the system to go to sleep, unless the customer really wants it on indefinitely and is willing to risk draining the batteries. A timer or the lagging edge of accessory could be used to turn off the DLB_Keep_Awake_Semaphore.

If you want multiple switches or inputs to wake up the system, a latched version of that signal will need to be OR'ed onto the rung that drives the semaphore.

When the switch is turned off on this application, the system goes to sleep in about a minute.

USING A KEY OFF SWITCH IN LADDER LOGIC

Any switch positions can be used with the Key OFF.

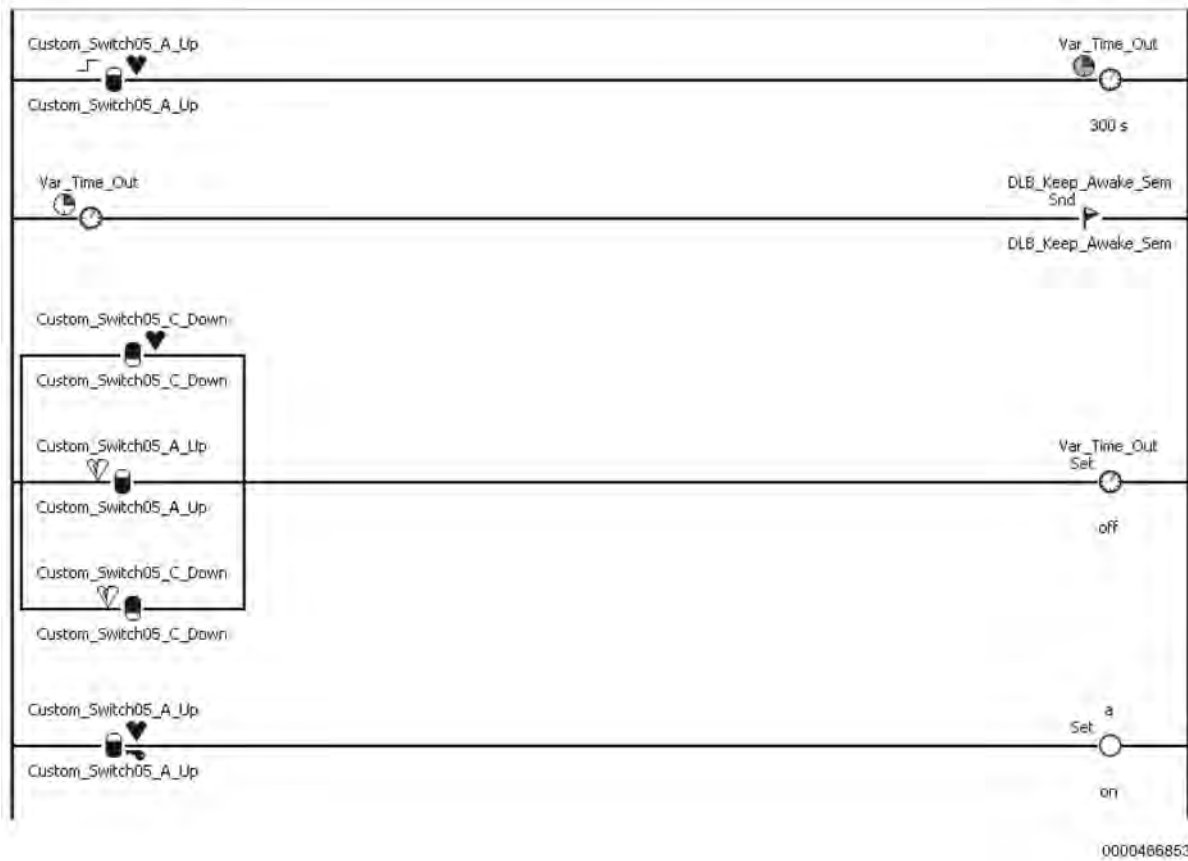


Figure 95 Key OFF Momentary Switch with Timer

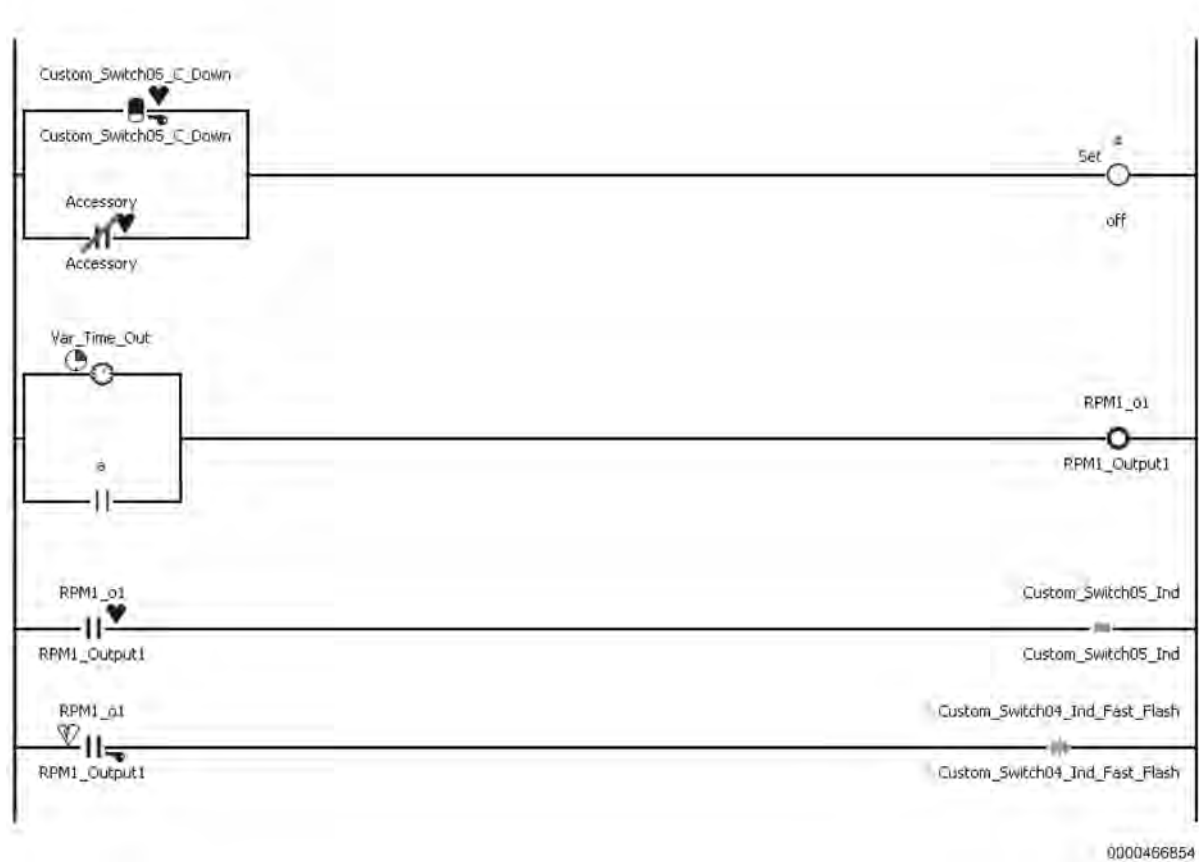


Figure 96 Key OFF Momentary Switch with Timer

Only 3-position momentary switches should be used for this function. Typical use of this functionality is for a Strobe Light, Work Light or Spot Light.

1. Add logic for a 3-position momentary switch.
2. Remove the accessory interlocks from the switch by right-clicking on the switch icons and then selecting ACCESSORY. This will allow the switch to operate without being interlocked to accessory.
3. The indicator light should be illuminated when the output is ON, but the accessory interlock needs to be removed from the rpm1_o1 icon.
4. In addition, a timer should be added before the output to ensure the battery is not drained. See Timers (page 188) for more information.

NOTE – It is recommended that the rungs that slow flash or fast flash the indicator light in the switch still contain an ACCESSORY interlock when checking status or interlock conditions, because these indicator lights could drain the battery.

5. Add a rung to activate the DLB Keep Awake Sem to allow the input to wake up the truck.

PROVIDING, KEY OFF, FUNCTIONALITY USING RPM INPUTS

Another option for key OFF switch functionality is using the Remote Power Modules. These modules will wake up the BCM; therefore, these can be used in a key OFF type functionality. In-cab switches can be used for this type of operation; however, RPM inputs can be used.

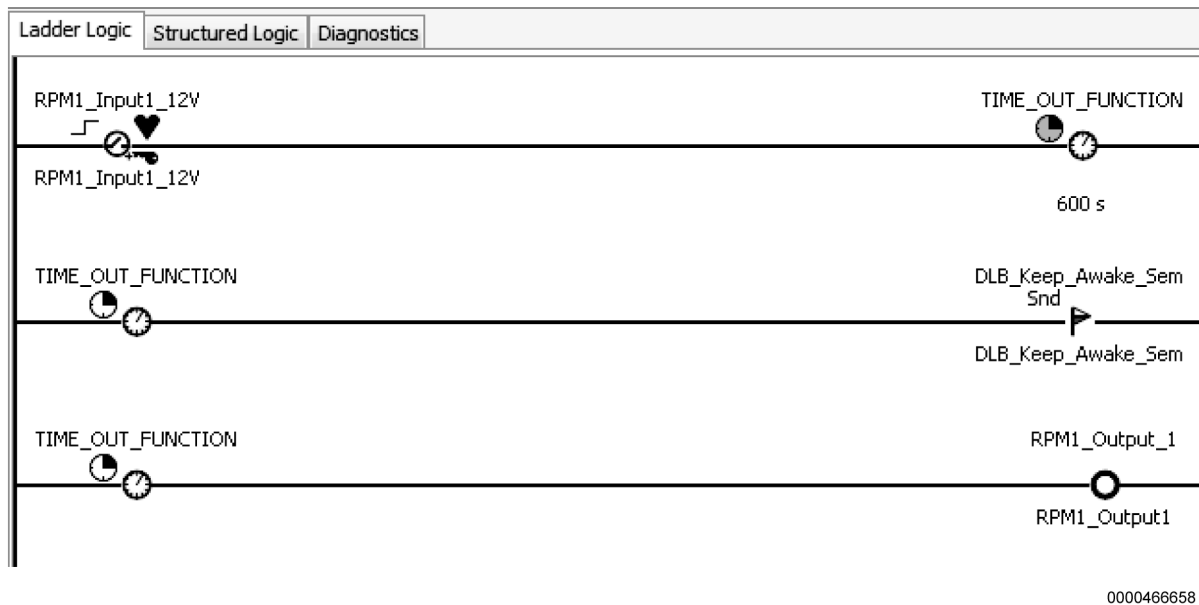


Figure 97 Key-OFF Functionality Using a Timer to Control the RPM Output

To change a Remote Switching solution to one that will work with key OFF:

1. Remove the interlock to accessory from the RPM input icons and RPM output icons (when used as inputs).
2. Remove the accessory interlocks from the switch by right-clicking on the switch icons and then selecting ACCESSORY. This will allow the switch to operate without being interlocked to accessory.
3. For a remote body-mounted switch to operate a RPM output in key OFF position, add the next available RPM input icon as the input.
4. Right-click the icon and select ACCESSORY (this will remove the key from the icon).
5. Add the next available RPM output to the right side of the rung as the output.
6. A time-out should always be added to any key OFF functionality to ensure that this switch does not drain the battery. See Timers (page 188) for more information.
7. Add a rung to activate the DLB Keep Awake Sem to allow the input to wake up the truck.

PROGRAMMING WITH THE INPUT / OUTPUT SIGNAL EXPANSION HARNESS FEATURE PRE INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

Diamond Logic® Builder provides access to additional general-purpose inputs and outputs on the ESC. A feature may be purchased when the vehicle is built that provides two active low digital inputs and two active low relay driver outputs that will sink up to 0.5 amps each. The software to access these signals may be added later by the body builder using Diamond Logic® Builder. The sales feature to order this feature (595283 / 505AKH) is 60ACW. In addition, a zero volt reference wire is provided in the bundle as a ground to be used with switches connected to the digital inputs. The wire bundle is provided with blunt cut wires and is packaged under the instrument panel on the left side of the steering column.

The general purpose digital inputs are READ ONLY and the associated signals are:

Table 18 Inputs for Pre International® LT®, RH™, HV™, and MV™ Series Trucks

Advanced Logic Signal Name (Cannot be Renamed)	Connector View Signal Name (Cannot be Renamed)	Location
Aux_Discrete_Input_1	TEG_Aux_Digital_Input_1	GEN 1 ESC, Connector 1600, Pin 26 GEN 2 BC, Connector 1602, Pin F14
Aux_Discrete_Input_2	TEG_Aux_Digital_Input_2	GEN 1 ESC, Connector 1600, Pin 31 GEN 2 BC, Connector 1602, Pin F12

The general-purpose relay drivers are both Readable and Writable. The signals associated with the relay drivers are:

Table 19 Outputs for Pre International® LT®, RH™, HV™, and MV™ Series Trucks

Advanced Logic Signal Name (Cannot be Renamed)	Connector View Signal Name (Cannot be Renamed)	Location
Aux_Relay_Driver_1	Aux_Relay_Driver_1	GEN 1 ESC, Connector 1601, Pin A GEN 2 BC, Connector 1601, Pin E2
Aux_Relay_Driver_2	Aux_Relay_Driver_2	GEN 1 ESC, Connector 1601, Pin E GEN 2 BC, Connector 1601, Pin E1

All of these signals are only useable when the ignition key is in the Accessory or Run positions. Each of these signals is located in the CHASSIS tab of Advanced Logic.

PROGRAMMING WITH THE INPUT / OUTPUT SIGNALS INTERNATIONAL® LT®, RH™, HV™, AND MV™ SERIES TRUCKS

Diamond Logic® Builder provides access to additional general-purpose inputs and outputs on the BCM. Unlike the previous models a DLB feature does not need to be purchased, when the vehicle is built.

The I / O Expansion harness code 60ACW can be ordered to include circuits that are installed at the factory. 60ACW includes a harness with five blunt cut wires routed on lower left of instrument panel. Two ground active inputs and two (.5 Amp) relay driver outputs are provided.

In addition, a zero volt reference wire is provided in the bundle as a ground to be used with switches connected to the digital inputs.

On International® LT®, RH™, HV™, and MV™ Series Trucks, there is not any DLB feature code programming required to allow access to these circuits.

Advanced Logic can be written to use two digital inputs, one analog input and six digital active low relay driver outputs that will sink up to 0.5 amps each.

These signals can be used with the DLB_Keep_Awake_Sem signal to provide key off functionality.

The general purpose digital inputs associated signals are:

Table 20 Inputs for International® LT®, RH™, HV™, and MV™ Series Trucks

Advanced Logic Signal Name (Cannot be Renamed)	Connector View Signal Name (Cannot be Renamed)	Location
TEG_Aux_Digital_Input_1	TEG_Aux_Digital_Input_1	GEN 4 BC, Connector 1602, Pin F14
TEG_Aux_Digital_Input_2	TEG_Aux_Digital_Input_2	GEN BC, Connector 1602, Pin F12

The general-purpose relay drivers are both Readable and Writable. The signals associated with the relay drivers are:

NOTE – TEG_Aux_Relay_Driver_1_Cmd and TEG_Aux_Relay_Driver_2_Cmd always populate as SET configurations. Remove the SET configuration if you do not want SET operation.

Table 21 Outputs for International® LT®, RH™, HV™, and MV™ Series Trucks

Advanced Logic Signal Name (Cannot be Renamed)	Connector View Signal Name (Cannot be Renamed)	Location
TEG_Aux_Relay_Driver_1_Cmd	TEG_Aux_Relay_Driver_1_Cmd	GEN 4 BC, Connector 1601, Pin E2
TEG_Aux_Relay_Driver_2_Cmd	TEG_Aux_Relay_Driver_2_Cmd	GEN 4 BC, Connector 1601, Pin E1
Aux_Relay_Driver_3	Aux_Relay_Driver_3	GEN 4 BC, Connector 1601, Pin E3
Aux_Relay_Driver_4	Aux_Relay_Driver_4	GEN 4 BC, Connector 1601, Pin E4

Table 21 Outputs for International® LT®, RH™, HV™, and MV™ Series Trucks (cont.)

Advanced Logic Signal Name (Cannot be Renamed)	Connector View Signal Name (Cannot be Renamed)	Location
Aux_Relay_Driver_5	Aux_Relay_Driver_5	GEN 4 BC, Connector 1601, Pin E5
Aux_Relay_Driver_6	Aux_Relay_Driver_6	GEN 4 BC, Connector 1601, Pin E8

Each of these signals is located in the CHASSIS tab of Advanced Logic.

Advanced Logic Signal Name (Cannot be Renamed)	Location
TEM_AIN25_Signal	BC Connector 1607, Pin B1

The Analog input for TEM_AIN25_Signal is located in the ADVANCED Tab of Advanced Logic.

The values read on the analog input are 720 with no input, 772 with 14 volts, 708 with 5 volts, and 0 with a ground applied.

PROGRAMMING CONTROL OF THE TWO SPEED AXLE

Diamond Logic® Builder provides a means to control the two-speed axle of the vehicle using advanced logic. Control may be achieved whether the vehicle is equipped with a manual or automatic transmission.

The control of the two-speed axle is performed through a combination of two signals.

Advanced Logic Signal Name (Cannot be Renamed)	Description
Two_Speed_Axle_High_Request	This signal in advanced logic will be true whenever the logic on the ladder rung is true
Two_Spd_Axle_Solenoid	This signal contains several interlocks. It will be true only when the transmission is in neutral, vehicle speed is less than 3 MPH, and the brake pedal is depressed.

Both signals must be true before the two-speed axle will be shifted to the high gear position. If either signal is OFF or false, the axle will be shifted to the low gear position. The programmer must be aware of possible gear bind in the vehicle differential and may need to employ specific ladder logic to ensure that the axle is shifted to the correct position when requested to overcome gear bind.

NOTE – The Two_Speed_Axle_High_Request signal cannot be used with vehicles that require the ability to shift the two-speed axle with the vehicle in motion.

Programming the Two Speed Axle with Manual Transmissions

Vehicles with a two-speed axle and a manual transmission come from International equipped with a two speed axle switch on the gearshift lever; an air solenoid mounted on the frame rail and either software features 597181, 595039, 595166, 595ANL or 595ALN loaded into the BCM.

Programming the control of the two-speed axle may be accomplished using advanced logic. However, the pre-engineered software feature 597181, 595039, 595166, 595ANL or 595ALN must first be removed from the vehicle by selecting the two-speed axle features in the FEATURE screen and unchecking the installation boxes. This allows use of the Two_Spd_Axle_High_Request signal as the control of the two-speed axle.

You may use combinations of advanced ladder logic to decide when you want the axle to shift. Be sure to refer to the CONNECTOR view to ensure that the advanced logic solenoid is mapped to the solenoid that was removed. If you still wish to use the gearshift lever switch as the main input control of the two-speed axle, then the wire from pin 18 of the Electronic System Controller connector 4004 or pin f8 of BC connector 1601 will need to be rewired to an available input on a RPM.

In summary, you can control the two-speed axle air solenoid with your choice of inputs through advanced logic, however, the vehicle must be stopped with the brake pedal depressed before the shift will occur.

Programming the Two Speed Axle with Automatic Transmissions

Vehicles with a two-speed axle and an automatic transmission come from International equipped with a two speed axle switch in the switch pack; an air solenoid mounted on the frame rail and either software features 597181, 595039, 595ANL, 595ALN or 595166 and 514011 loaded into the BCM.

Programming the control of the two-speed axle may be accomplished using advanced logic. However, the pre-engineered software feature 597181, 595039, 595ANL, 595ALN or 595166 and 514011 must first be removed from the vehicle by selecting the two-speed axle features in the FEATURE screen and unchecking

the installation boxes. This allows use of the Two_Spd_Axle_High_Request signal as the control of the two-speed axle.

You may use combinations of advanced ladder logic to decide when you want the axle to shift. Be sure to refer to the CONNECTOR view to ensure that the advanced logic solenoid is mapped to the solenoid that was removed. If you still wish to use the factory supplied two-speed axle switch as the main input control of the two-speed axle, then re-map an available custom switch to the position occupied by the actual two speed switch that is in the switch pack.

In summary, you can control the two-speed axle air solenoid with your choice of inputs through advanced logic, however, the vehicle must be stopped, the transmission must be in neutral with the brake pedal depressed before the shift will occur.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

USING AIR SOLENOIDS

NOTE – Advanced Logic solenoid feature codes are not available on the International® LT®, RH™, HV™, and MV™ Series Trucks.

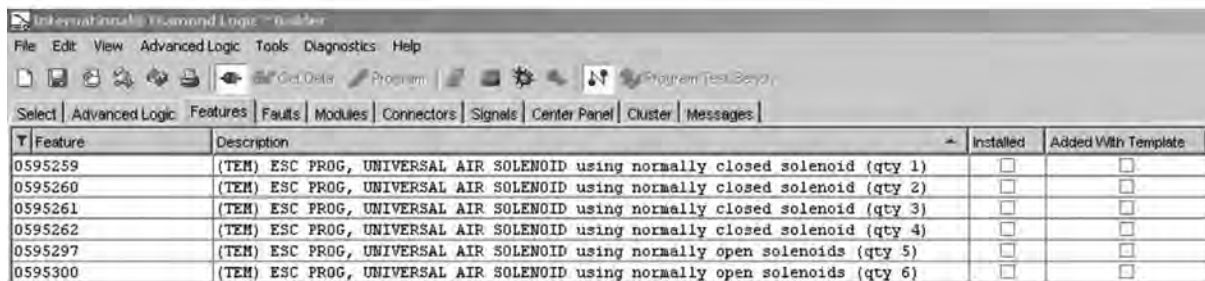
Within DLB there are two choices for use with air solenoids; solenoids that have common functionality or solenoids that are added with Advanced Logic.

Solenoid Features

NOTE – Using the 59XXXX features will not allow you to write to or use the solenoids within advanced logic. Again, functionality is switch activation to open and close the solenoids.

Solenoids that have common functionality; meaning a switch opens and closes the solenoid can be provided by adding one of the following codes under the Features Tab. These should be based on the customer's requirements:

Feature Code	Description
595259 / 595AHX / 597256	1 Normally Closed Solenoid (08WGA)
595260 / 595AHY / 597257	2 Normally Closed Solenoids (08WGB)
595261 / 595AHZ / 597258	3 Normally Closed Solenoids (08WGC)
595262 / 595AJA / 597303	4 Normally Closed Solenoids (08WGD)
595297 / 595AKZ / 597262	5 Normally Open Solenoids (08WGP)
595300 / 595AJC / 597261	6 Normally Open Solenoids (08WGR)
595BBD	6 Normally Closed Solenoids (08WKM)



Feature	Description	Installed	Added With Template
0595259	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally closed solenoid (qty 1)	<input type="checkbox"/>	<input type="checkbox"/>
0595260	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally closed solenoid (qty 2)	<input type="checkbox"/>	<input type="checkbox"/>
0595261	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally closed solenoid (qty 3)	<input type="checkbox"/>	<input type="checkbox"/>
0595262	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally closed solenoid (qty 4)	<input type="checkbox"/>	<input type="checkbox"/>
0595297	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally open solenoids (qty 5)	<input type="checkbox"/>	<input type="checkbox"/>
0595300	(TEH) ESC PROG, UNIVERSAL AIR SOLENOID using normally open solenoids (qty 6)	<input type="checkbox"/>	<input type="checkbox"/>

0000466698

Figure 98 Universal Air Solenoid Features as Displayed for Pre 2007 Vehicles



0000467138

Figure 99 Center Panel View of 595262 / 595AJA / 597303**Universal Air Solenoids and Advanced Logic**

The other choice, when it comes to the use of air solenoids, is to use them within Advanced Logic. By using Advanced Logic to control the universal air solenoids, you have many more options for control and functionality as opposed to the basic open and closed functionality that is provided with the 59XXXX codes.

As with any other features that are used in Advanced Logic, you can tie whatever interlocks and or conditions to these solenoids that they want. The user can write to the air solenoids just as if they were writing to a RPM output. The limitation to using air solenoids in advance logic is that you can currently only write to four solenoids maximum.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

Engine	HEV	Indicators	Other RPMs	RPM1	RPM2	RPM4	Switches	Transmission
My Variables		AWARE	Advanced	Bus	Chassis		Cluster	Datalink
Y	Custom Variable	Used In	Used	Signal/Value		Unit	Signal ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_1		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_10		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_11		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_12		On/Off	Air ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_13		On/Off	Air ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_14		On/Off	Air ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_15		On/Off	Air ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_16		On/Off	Air ...	
			<input checked="" type="checkbox"/>	Univ_Air_Relay_Driver_2		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_3		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_4		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_5		On/Off	Air ...	
			<input type="checkbox"/>	Univ_Air_Relay_Driver_6		On/Off	Air ...	

Figure 100 Chassis Tab

The user will find the Air Solenoid signals under the Chassis Tab in Advanced Logic.

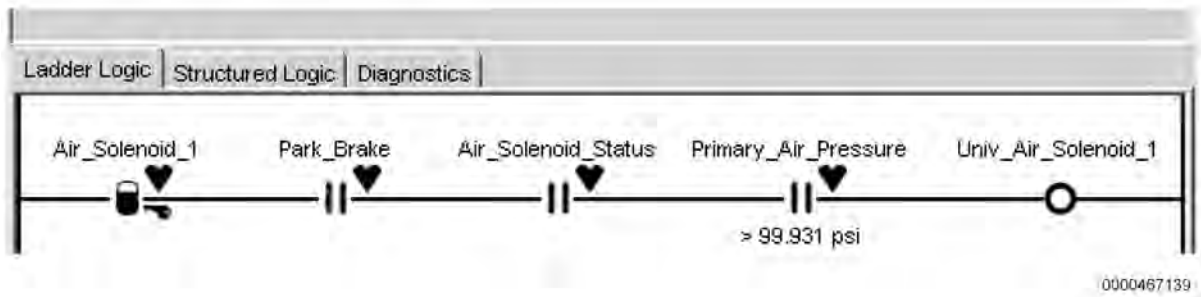


Figure 101 Example of Air Solenoid Logic

In the example above with the key in the ignition or accessory position, the switch (custom named Air Solenoid 1) is in the up position, the park brake is applied, Air Solenoid Status is good (meaning the solenoids have power and air) and the pressure in the primary air tank is above 100 psi then the air solenoid will activate.



0000467140

Figure 102 Center Panel View for Air Solenoid Logic Example

USING THE DOOR LOCK / UNLOCK SIGNALS

Many vehicle applications have compartments and doors equipped with electrically actuated locks. In most cases, a remote mounted three-position momentary switch is utilized to lock and unlock these compartments. Often this control switch is also used to control locking and unlocking the cab doors and vice versa. In a completely hardwired system, this requires the Truck Equipment Manufacturer (TEM) to splice into the wiring of both cab doors and the addition of numerous relays. The Diamond Logic® Builder advanced logic software provides you access to signals for locking and unlocking the cab doors. The system can be further extended to utilize RPM inputs and outputs to control locking and unlocking body compartment and doors.

Using the Door Lock / Unlock Signals Pre International® LT®, RH™, HV™, and MV™ Series Trucks

The lock and unlock signals, from the cab doors, are provided by the Door_Lock_Pressed and the Door_Unlock_Pressed signals. The controls for unlocking and locking of the cab doors are reversing polarity. The inputs to the RPM are provided from the body lock switches. To achieve dual control of lock / unlock requests for body compartment and door locks, the remote mounted switch input for lock request OR the input for lock request from the cab door will turn on an RPM output.

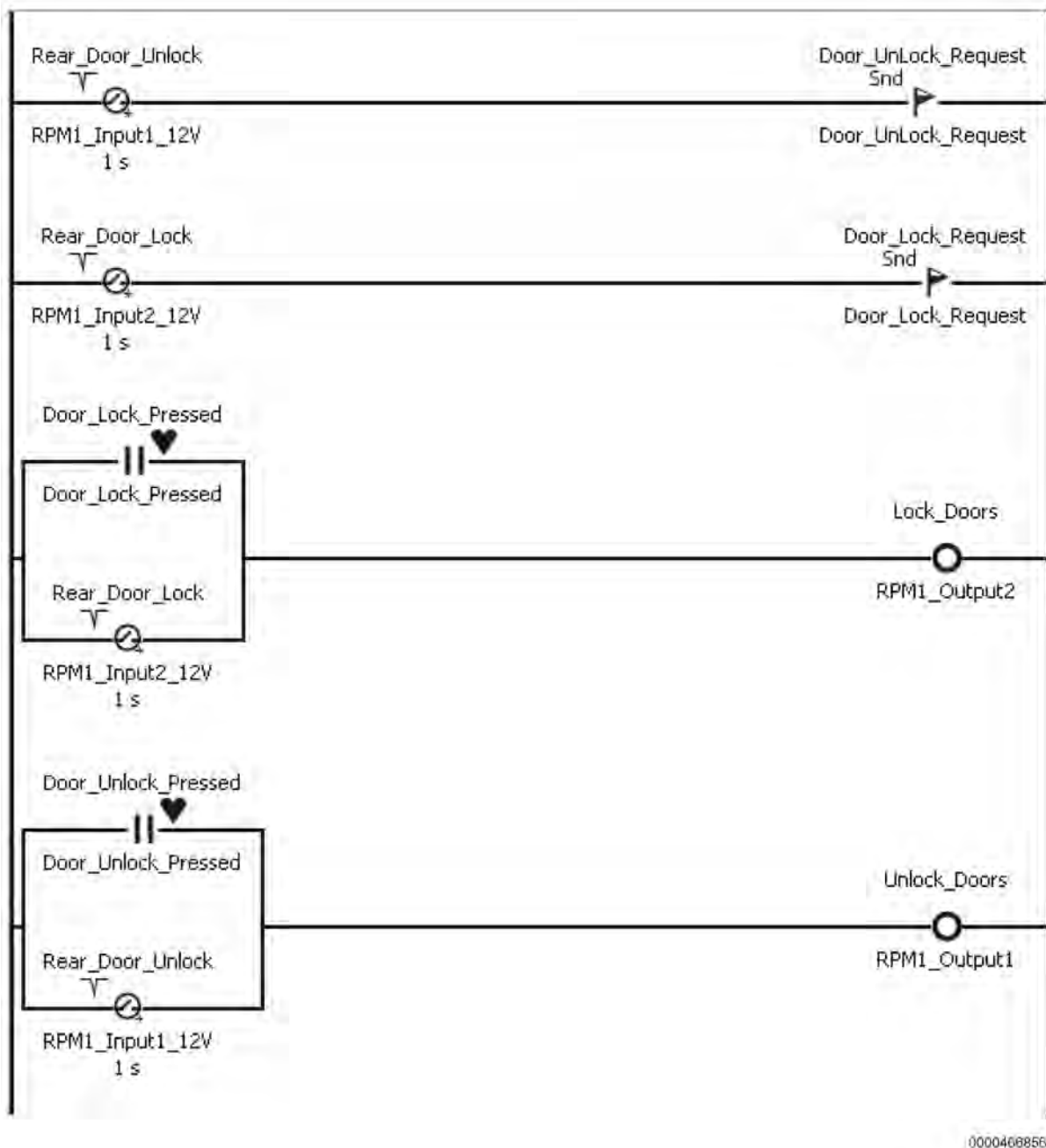
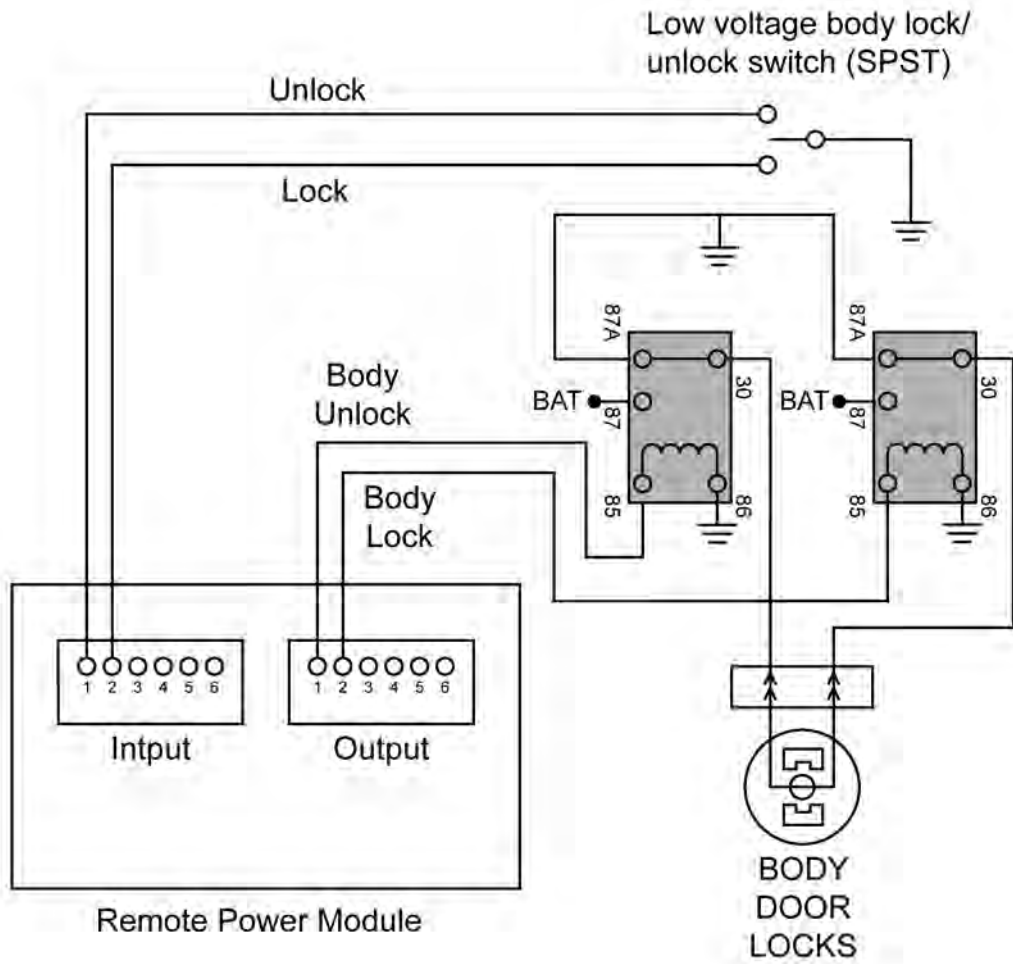


Figure 103 Door Lock / Unlock Request Advanced Logic

The advanced logic required to lock and unlock the cab doors from a remote mounted switch is very simple. The lock and unlock switch inputs are fed into RPM inputs and can be either active ground or 12V. The Door_Lock_Request and Door_Unlock_Request signals are found on the chassis tab of the advanced logic screen. When a lock or unlock input is received on the RPM inputs, the electrical system controller will send a message to the cab door pods to lock or unlock the cab doors. Remote power module inputs and outputs can also be utilized to control body compartment and door locks from the cab door pods and a remote mounted switch.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

To control body compartment locks and door locks from the cab door pods, a lock and unlock input must be fed into RPM inputs from either the driver-side or passenger-side door lock control circuits. The RPM output controls the state of a relay to provide a lock request to the body electric locks. The same is true for the unlock request. Refer to the figure above for an example of door lock / unlock advanced logic for **pre International® LT®, RH™, HV™, and MV™ Series trucks only**.



000046857

Figure 104 Door Lock / Unlock Circuit

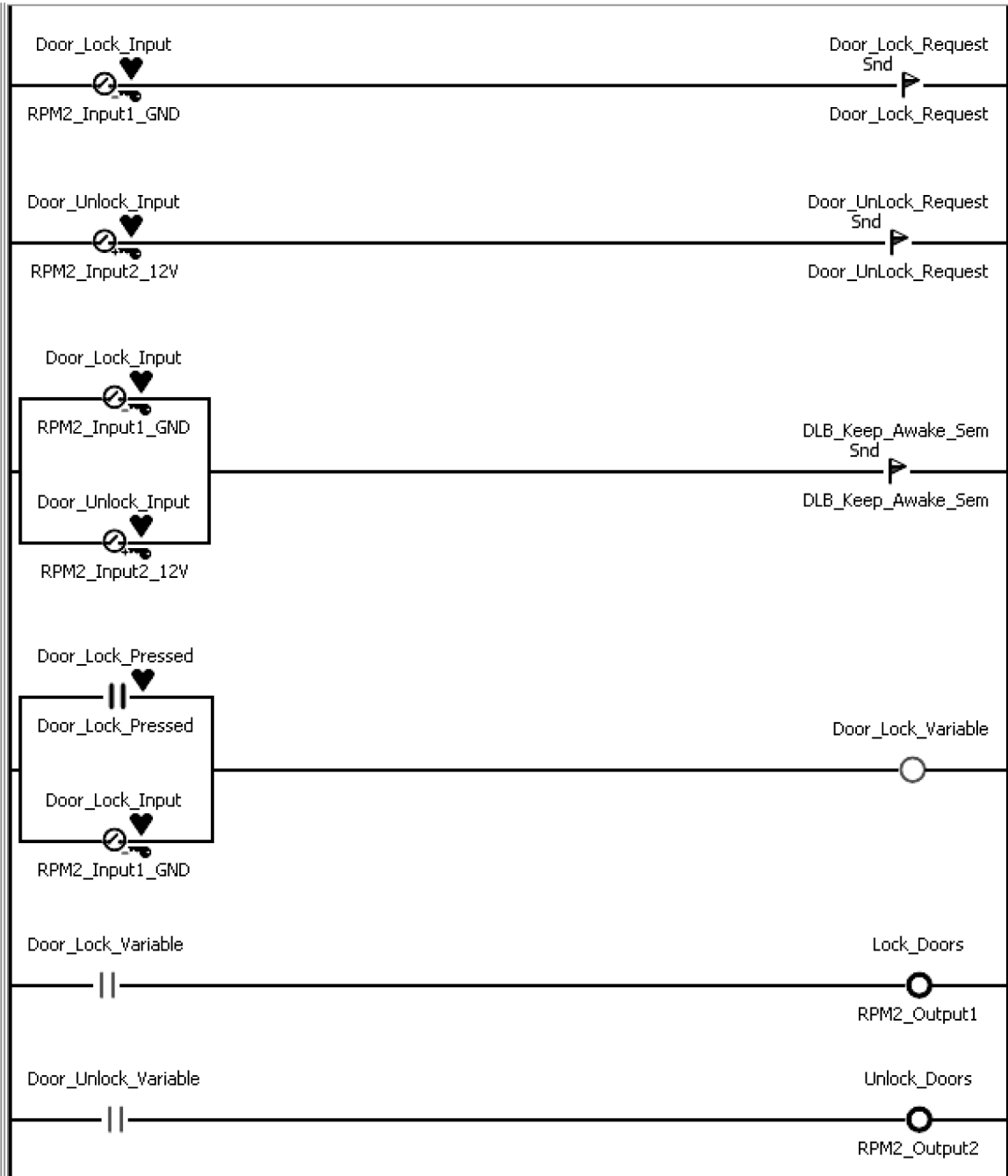
Input	Description
Input 1	Activated by an unlock request from the body unlock switch and sends an unlock request thru the datalink to the cab door pod to unlock the cab doors.
Input 2	Activated by a lock request from the body lock switch and sends a lock request thru the datalink to the cab door pod to lock the cab doors.

NOTE – Remember to fuse the battery leads to the relays

The schematic illustrates the required electrical wiring to complete the advanced logic circuitry. The relay controlled by RPM output 1 provides proper polarity to lock the doors. The relay controlled by RPM output 1 provides proper polarity to unlock the doors. The function of each input into the RPM is listed in the table above.

Using the Door Lock / Unlock Signals International® LT®, RH™, HV™, and MV™ Series Trucks

NOTE – Use the DLB_Keep_Awake_Sem semaphore to wake up the system when remote lock switches are used.



0000466660

Figure 105 Door Lock / Unlock Request Advance Logic

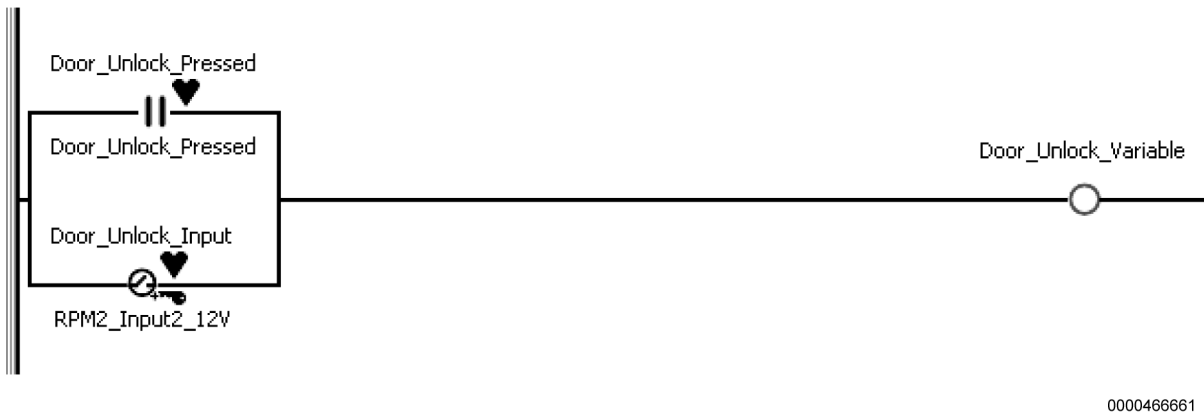
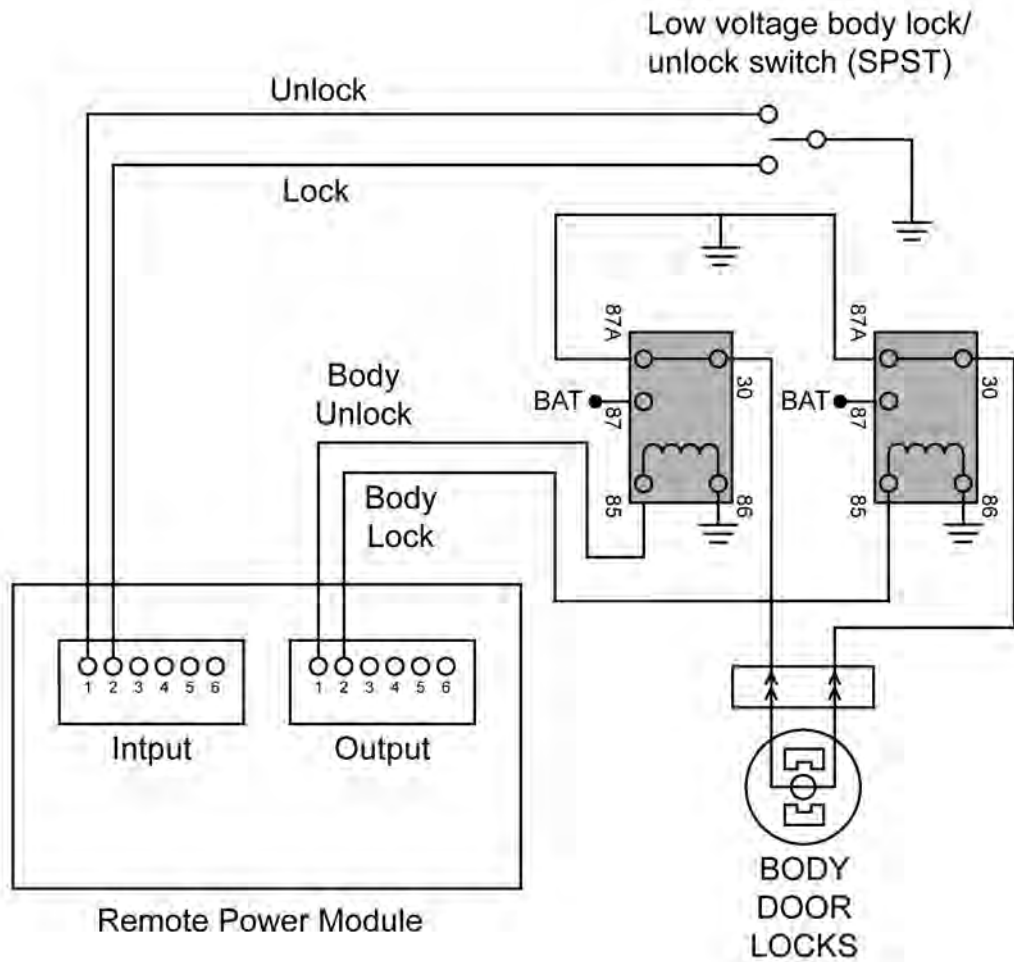


Figure 106 Door Lock / Unlock Request Advance Logic

NOTE – Remember to fuse the battery leads to the relays

The advanced logic required to lock and unlock the cab doors, from a remote mounted switch, is very simple. The lock and unlock switch inputs are fed into RPM inputs and can be either active ground or 12V. The Door_Lock_Request and Door_Unlock_Request signals are found on the chassis tab of the advanced logic screen. When a lock or unlock input is received on the RPM inputs, the electrical system controller will send a message to the cab door pods to lock or unlock the cab doors. RPM inputs and outputs can also be utilized to control body compartment and door locks from the cab door pods and a remote mounted switch.

To control the body compartment locks and door locks, from the cab door pods, a lock and unlock input must be fed into RPM inputs from either the driver-side or passenger-side door lock control circuits. The controls for unlocking and locking of the cab doors are reversing polarity. The inputs to the RPM are spliced into the door lock motor circuits. To achieve dual control of lock / unlock requests for body compartment and door locks, the remote mounted switch input for lock request OR the input for lock request from the cab door will turn on an RPM output. The RPM output controls the state of a relay to provide a lock request to the body electric locks. The same is true for the unlock request. Refer to the figure above for an example of door lock / unlock advanced logic.



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Figure 107 Door Lock / Unlock Circuit

Door lock / unlock circuit allow cab door pod switches or body switch to lock and unlock both cab and body doors.

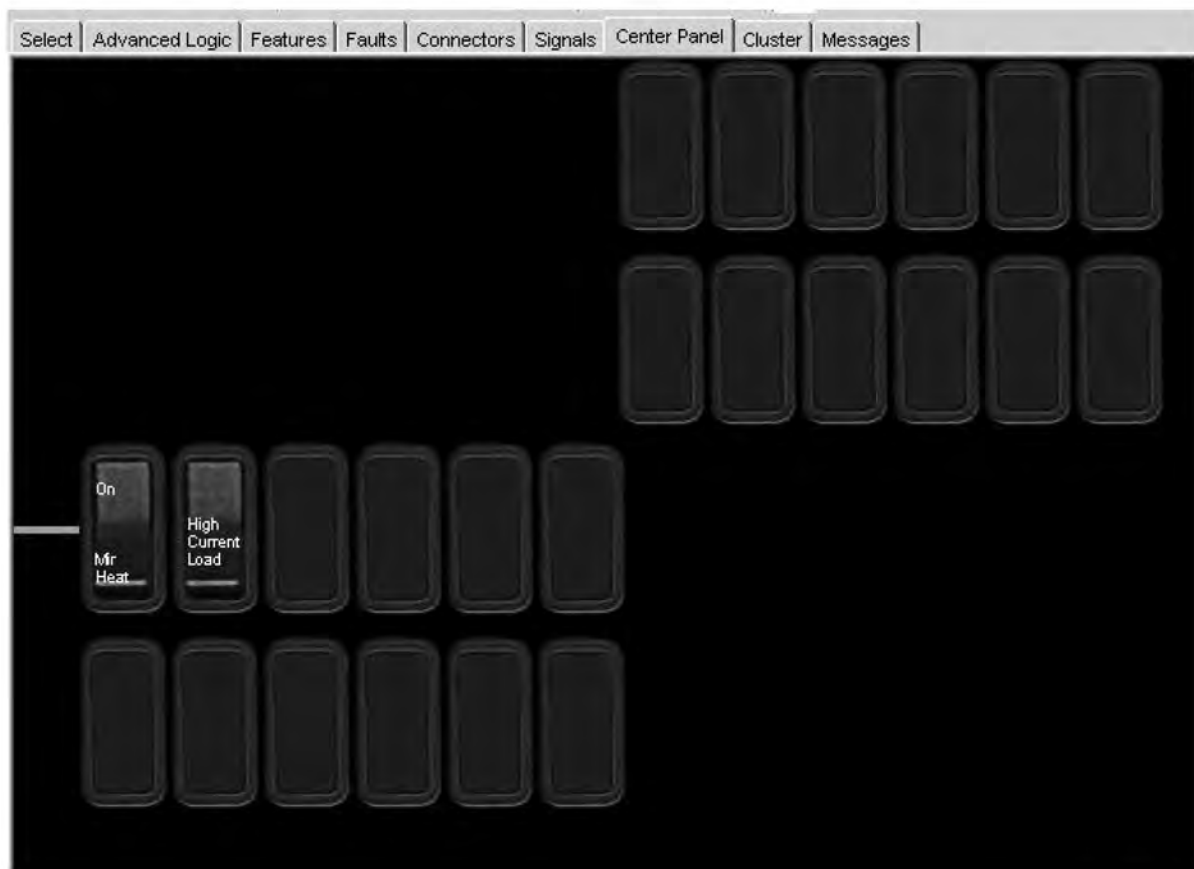
Input	Description
Input 1	Activated by an unlock request from the body unlock switch and sends an unlock request thru the datalink to the cab door pod to unlock the cab doors.
Input 2	Activated by a lock request from the body lock switch and sends a lock request thru the datalink to the cab door pod to lock the cab doors.

CONTROLLING THE AUXILIARY 40 AMP CIRCUIT

Diamond Logic® Builder provides the ability to control the AUXILIARY 40 AMP CIRCUIT using advanced ladder logic programming. If the vehicle was ordered with the AUXILIARY 40 AMP CIRCUIT, feature code 08XBK, then all wiring and components will already be in place. For vehicles not ordered with this feature, refer to the applicable circuit diagrams and the applicable guides at bodybuilder.navistar.com.

Vehicles ordered with feature 08XBK will have feature code listed in the table below.

Feature Code	Description
595265	ESC PROG, SWITCH AUXILIARY In Center Panel, with 40 amp Fuse Circuit, Accessory Controlled - GEN 1
595AJH	BC PROG, SWITCH AUXILIARY In Center Panel, with 40 amp Fuse Circuit, Accessory Controlled - GEN 2
597310	BCM PROG, SWITCH AUXILIARY In Center Panel, with 40 amp Fuse Circuit, Accessory Controlled - GEN 4



0000467141

Figure 108 Center Panel Tab

This can be verified by looking in the CENTER PANEL tab, CONNECTORS tab and the FEATURES Tab as shown above.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

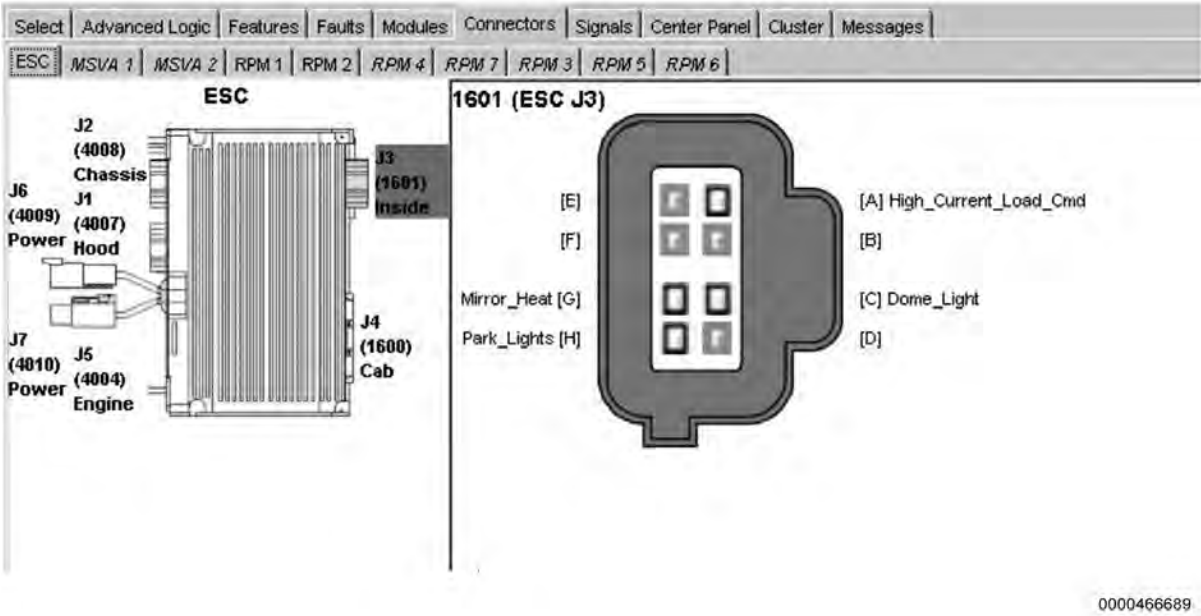


Figure 109 Connector Tab (Pre 2007 Vehicles)

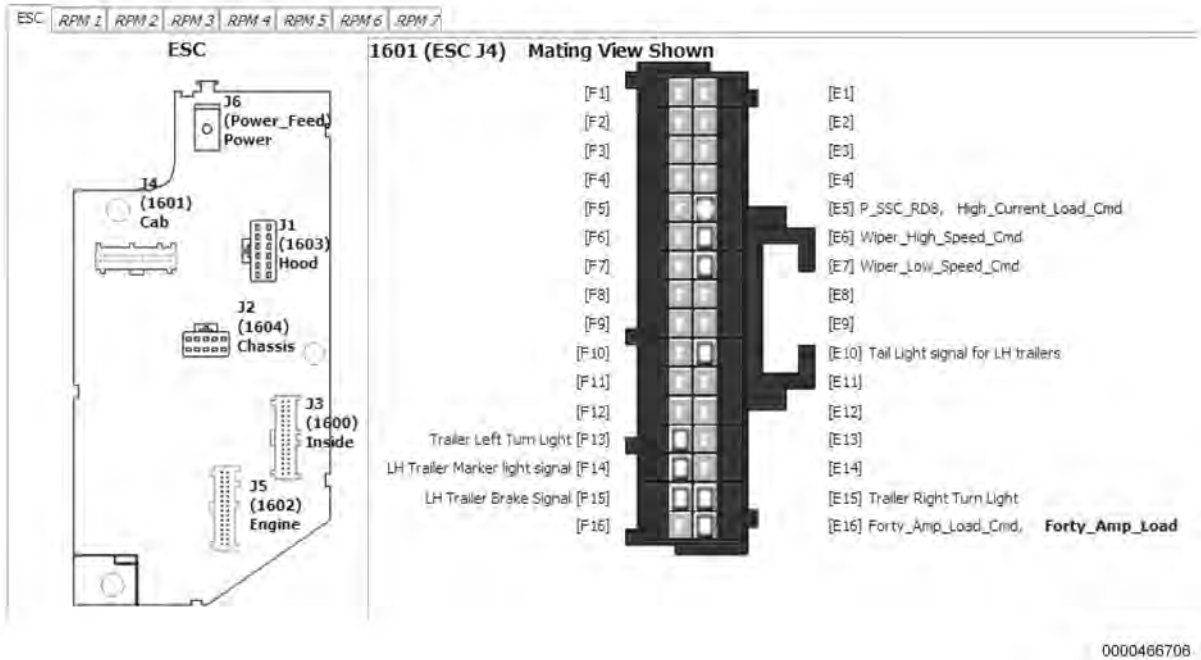


Figure 110 Connector Tab Post 2007 Vehicles – Pre International® LT®, RH™, HV™, and MV™ Series Trucks

The Forty_Amp_Load signal is only available in Advanced Logic.



The Forty Amp Load signal is only available in Advanced Logic.

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COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

In pre-2007 trucks that were ordered with the pre-engineered feature, it is necessary to un-install feature code 595265 to avoid conflicts with the ladder logic. To un-install this feature in the template under development check the box in the Removed With Template column of the feature of interest.

Post 2007 trucks can use the standard feature as well as the Advanced Logic to control outputs for a Forty Amp relay driver, without causing any conflicts. The connector pinouts will have separate outputs for the standard feature and the Advanced Logic option.

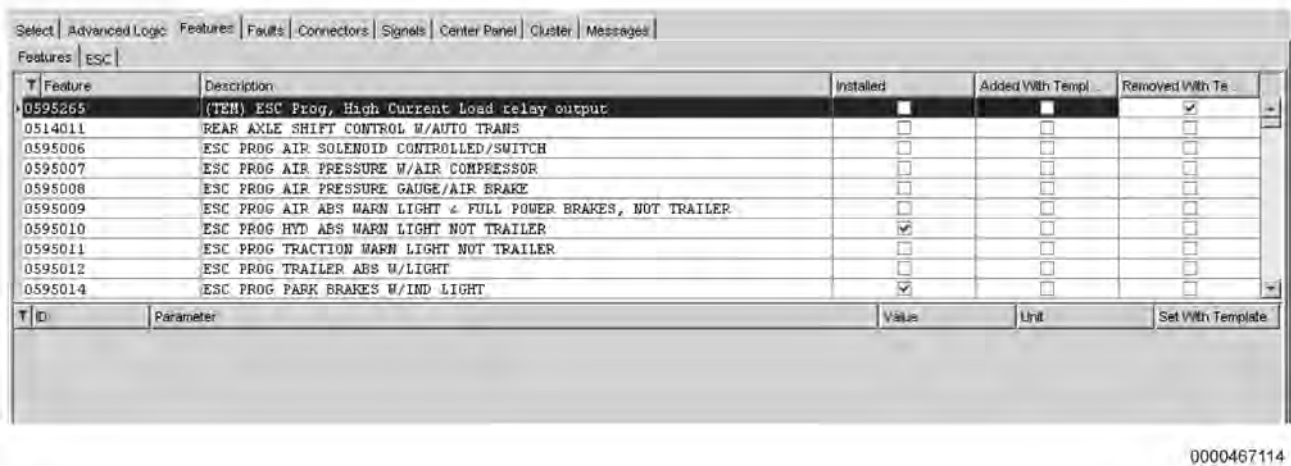


Figure 113 Features Tab

The Uninstall can then be verified by again looking at the Center Panel and Connector tabs. Once this uninstall is completed the Advanced Logic development process is straight forward and the same for both types of circuit installations.

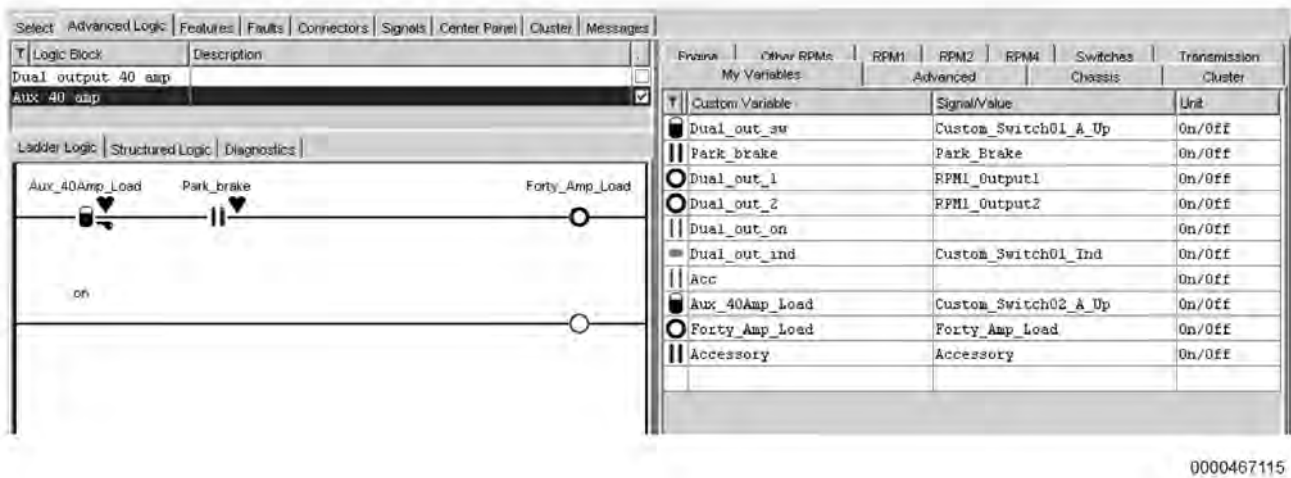


Figure 114 40 Amp Control Rung With Park_Brake Interlock

Figure 114 is an example of creating a 40-amp control rung with a Park_brake interlock.

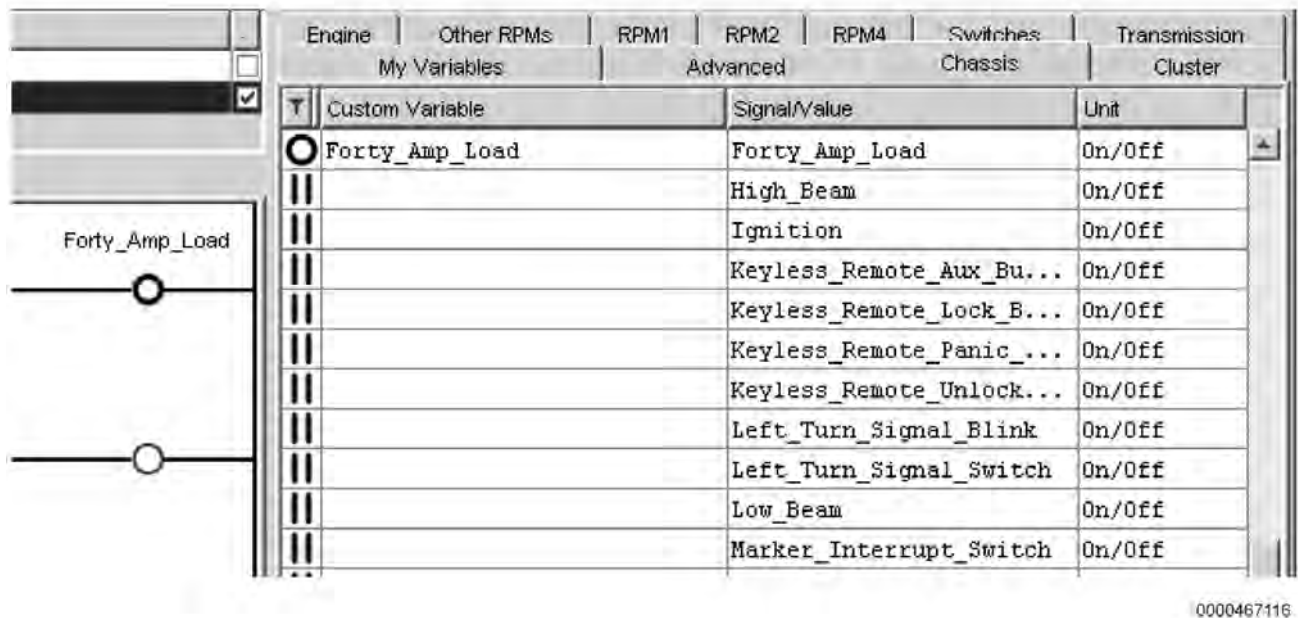


Figure 115 Chassis Tab Showing 40 Amp Load

The Forty_Amp_Load, output side of rung, is found in the CHASSIS tab. In this case the automatic default of the Custom Variable name to the signal name was accepted by doing a drag and drop without assigning a custom name.

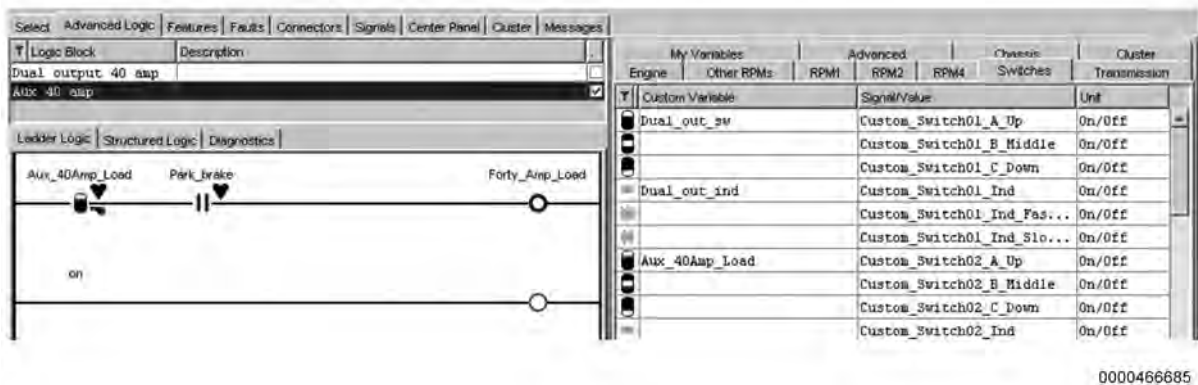


Figure 116 40 Amp Rung Completed

Custom_Switch02_A_Up was chosen as the control or input side of the rung and has been assigned the custom variable name Aux_40Amp_Load. Placement of the Park_Brake completed the rung.

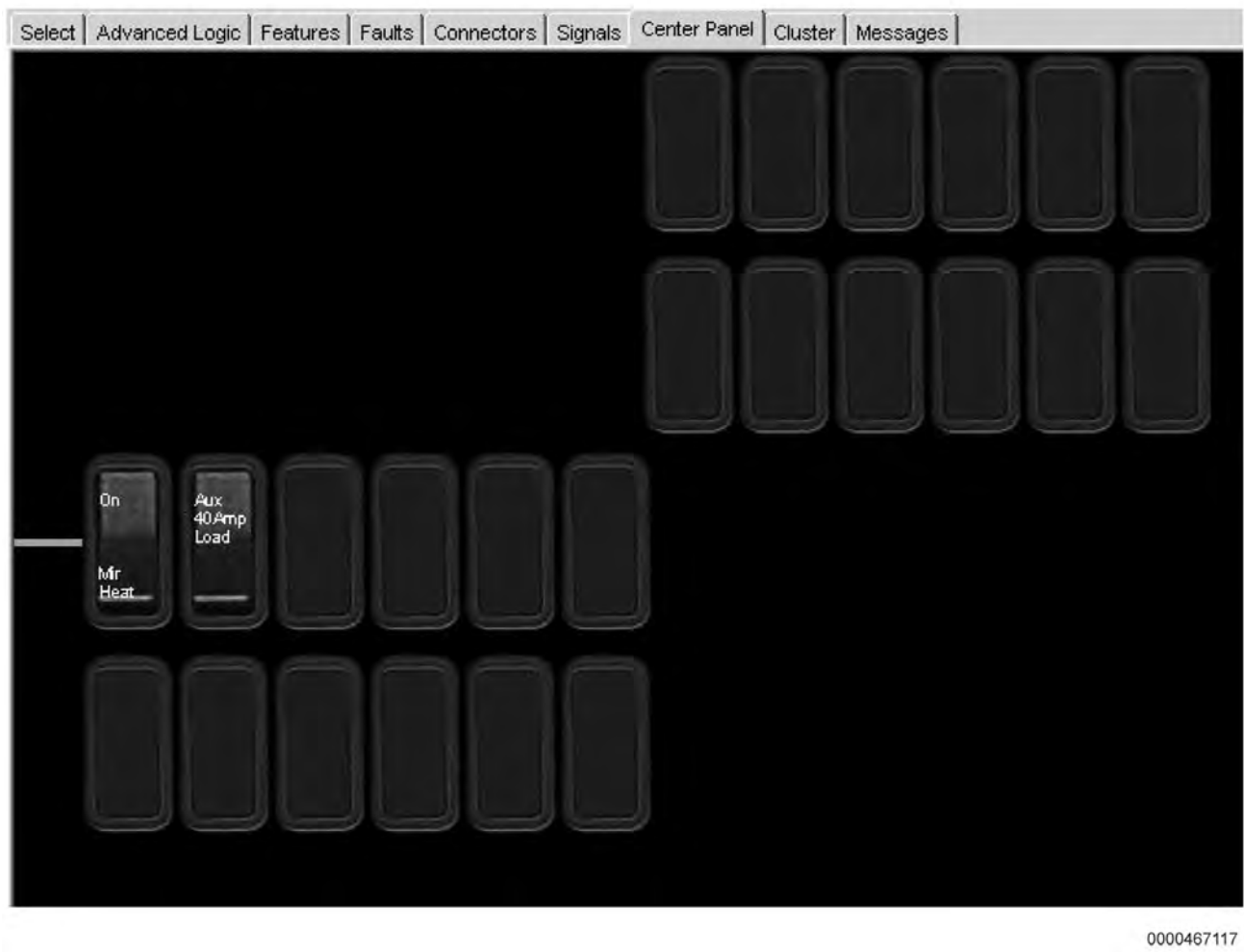
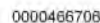


Figure 117 Center Panel with Custom Switch

By looking at the CENTER PANEL view it can be seen that the custom switch has been place in the assigned location.



In the CONNECTOR Tab view, for pre 2007 trucks, pin A still has the signal name used by the pre-engineered feature with the addition of the bold face signal name from Advanced Logic; indicating this output is controlled by custom ladder logic.



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COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

In the CONNECTOR tab view, for post 2007 vehicles, pin E16 still has the signal name used by the pre-engineered feature with the addition of the bold face signal name from Advanced Logic; indicating this output is controlled by custom ladder logic.

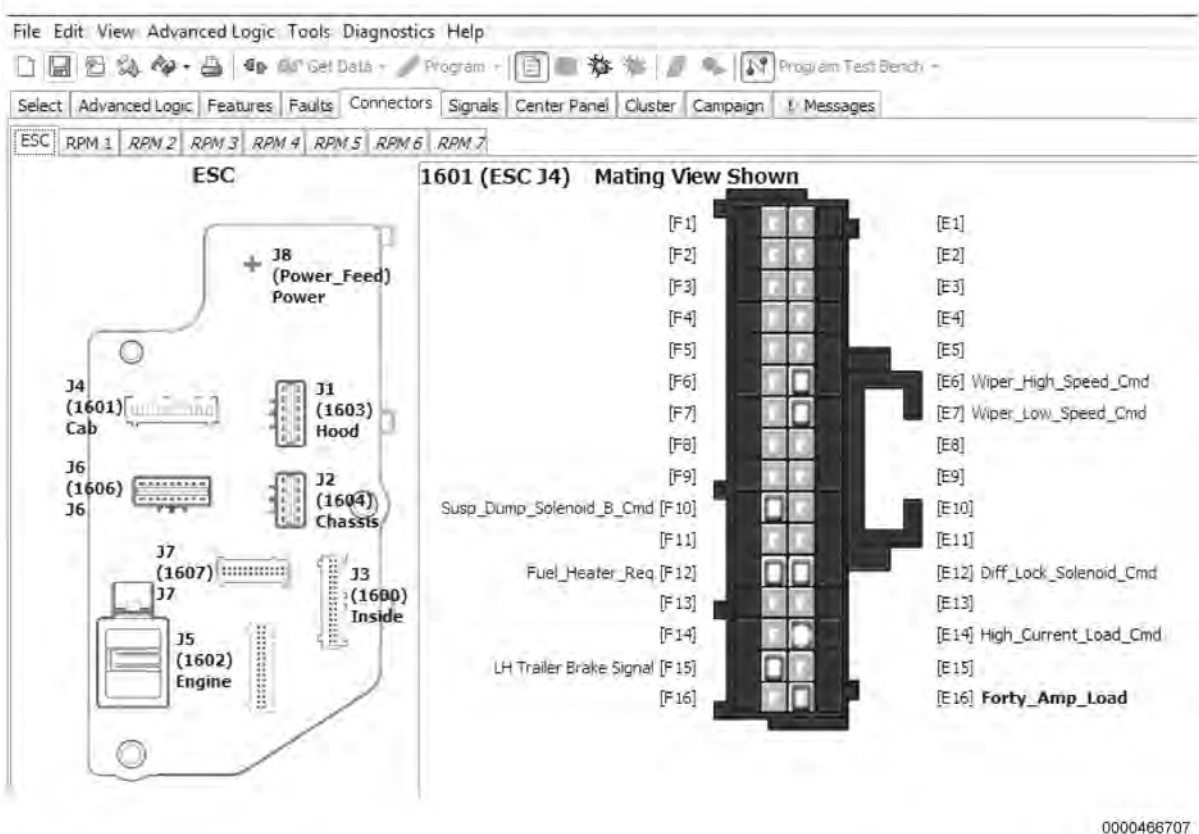


Figure 120 Connector Tab International® LT®, RH™, HV™, and MV™ Series Trucks

This was a very simple example of controlling the 40-amp circuit. With Advanced Logic there are many ways to provide interlocks, alarms and control engagement, disengagement and re-engagement parameters. The complexity of the control logic depends on the requirements.

When using Advanced Logic to control the 40-amp circuit in a vehicle that was ordered with feature code 08XBK it is recommended that the original switch location be used if possible. For Truck Equipment Manufacturer (TEM) installed 40-amp circuits a windowed switch actuator is needed for custom labeling or to change the labeling of the factor installed switch.

REMOTE ENGINE SPEED CONTROL

Preset Engine Speed Control

Diamond Logic® Builder provides a means to control engine speed using advanced ladder logic. The DLB engine speed control signals operate in conjunction with the cruise control switches in the steering wheel. This means that you are activating the same signals that are used by the steering wheel switches to control engine speed. Just like the cruise control switches in the steering wheel, the DLB engine speed control signals can only control the engine in either the PRESET or VARIABLE modes. This choice is set in the engine control module programmable parameters. Therefore the following Engine ECM parameters must be programmed as a minimum:

- CAB Controls: Enabled
- Preset or Variable Engine Speed Selection
- Engine Ramping RPM per second
- Preset 1 and Preset 2 Engine Speeds (when PRESET Mode is selected)

Diamond Logic® Builder uses four signals for controlling engine speed:

Engine_Speed_Enable_Disable

The Engine_Speed_Enable_Disable signal is used to request control of the engine speed. This signal correlates to the CRUISE ON and OFF switches in the steering wheel. When active, the cruise enable signal is active and other forms of vehicle engine speed controls will not be allowed to control the engine speed. When inactive, the cruise enable signal will be turned OFF. This signal is a READ / WRITE type. This signal must be held active as long as engine speed control, from DLB advanced ladder logic, is desired. Once the Engine_Speed_Control_Inhibited signal becomes active, this enable signal must be driven inactive and then active again in order to regain control of the engine speed.

Engine_Speed_Control_Inhibited

The Engine_Speed_Control_Inhibited signal is used to indicate when other engine speed control interfaces have active control of the engine. When other vehicle interfaces have control of engine speed, no requests from ladder logic will be acknowledged. This signal will be true for a variety of reasons:

- 060 Body Integration Remote Engine Speed Control features are active
- Remote Engine Speed Control Module (12VXY) interfaces are true
- Hard-wired interfaces connected directly into the engine control module such as 12VYC or 12VWW are true
- Park Brake is released
- Transmission is not in neutral (when vehicle is equipped with an automatic transmission)
- Road Speed is greater than 3MPH
- Brake pedal has been depressed
- A bad STATUS exists on any of the above listed signals

Once the inhibit signal has become active, the ladder logic cannot take control of the engine speed again until the Engine_Speed_Enable_Disable signal has been placed into an inactive state.

Engine_Speed_Function_1

The Engine_Speed_Function_1 signal is used to request control of engine speed. This signal correlates to the Cruise SET switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

When the engine is programmed in the PRESET speed mode, this signal requests that the engine should ramp to the preprogrammed PRESET 1 engine speed. A single active transition of this signal is all that is needed to enable the PRESET 1 engine speed.

When the engine is programmed in the VARIABLE speed control mode, this signal requests that the engine should ramp down toward an idle RPM. The rate at which the engine slows down is determined by the value of the RPM step decrement in the engine programmable parameters. Since ladder logic is executed 50 times per second, the DLB user should use a small step in the engine programmable parameter for RPM steps to ensure that engine speed can be adequately controlled using this signal. If an RPM limit is not used, engine speed will be driven to idle very quickly. See the Variable Engine Speed control logic as an example of one method to control engine speed assuming the engine is programmed in the VARIABLE mode.

Engine_Speed_Function_2

The Engine_Speed_Function_2 signal is used to request control of engine speed. This signal correlates to the Cruise RESUME switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

When the engine is programmed in the PRESET mode, this signal requests that the engine should ramp to the preprogrammed PRESET 2 engine speed. A single active transition of this signal is all that is needed to enable the PRESET 2 engine speed.

When the engine is programmed in the VARIABLE mode, this signal requests that the engine should ramp up toward an RPM. The rate at which the engine speeds up is determined by the value of the RPM step increment in the engine programmable parameters. Since ladder logic is executed 50 times per second, the DLB user should use an RPM limit with this signal along with a small engine incrementing value to ensure that engine speed can be adequately controlled using this signal. If an RPM limit is not used, engine speed will be driven to the maximum governed speed very quickly. See the Variable Engine Speed control logic as an example of one method to control engine speed assuming the engine is programmed in the VARIABLE mode.

Preset Engine Speed Control

The following is a simple form of engine speed control that involves engaging PRESET 1 RPM for engine speed control.

It is complex enough to add a .5 second delay between when the request for Engine_Speed_Enable_Disable is sent and the .5 second pulse for Engine_Speed_function_1 is sent. This is required to support the big bore engines.

NOTE – Any time a ladder logic engine speed request is activated and another engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, then the Other_Speed_Control signal will be set active. Once this signal is active, the Ramp_Engine signal must be set inactive and then active again to regain control of the engine speed.

This example uses the following naming convention for engine speed control signals.

System Signal Name
Engine_Speed_Control_Inhibited
Engine_Speed_Enable-Disable
Engine_Speed_Function_1
Ramp_Enable

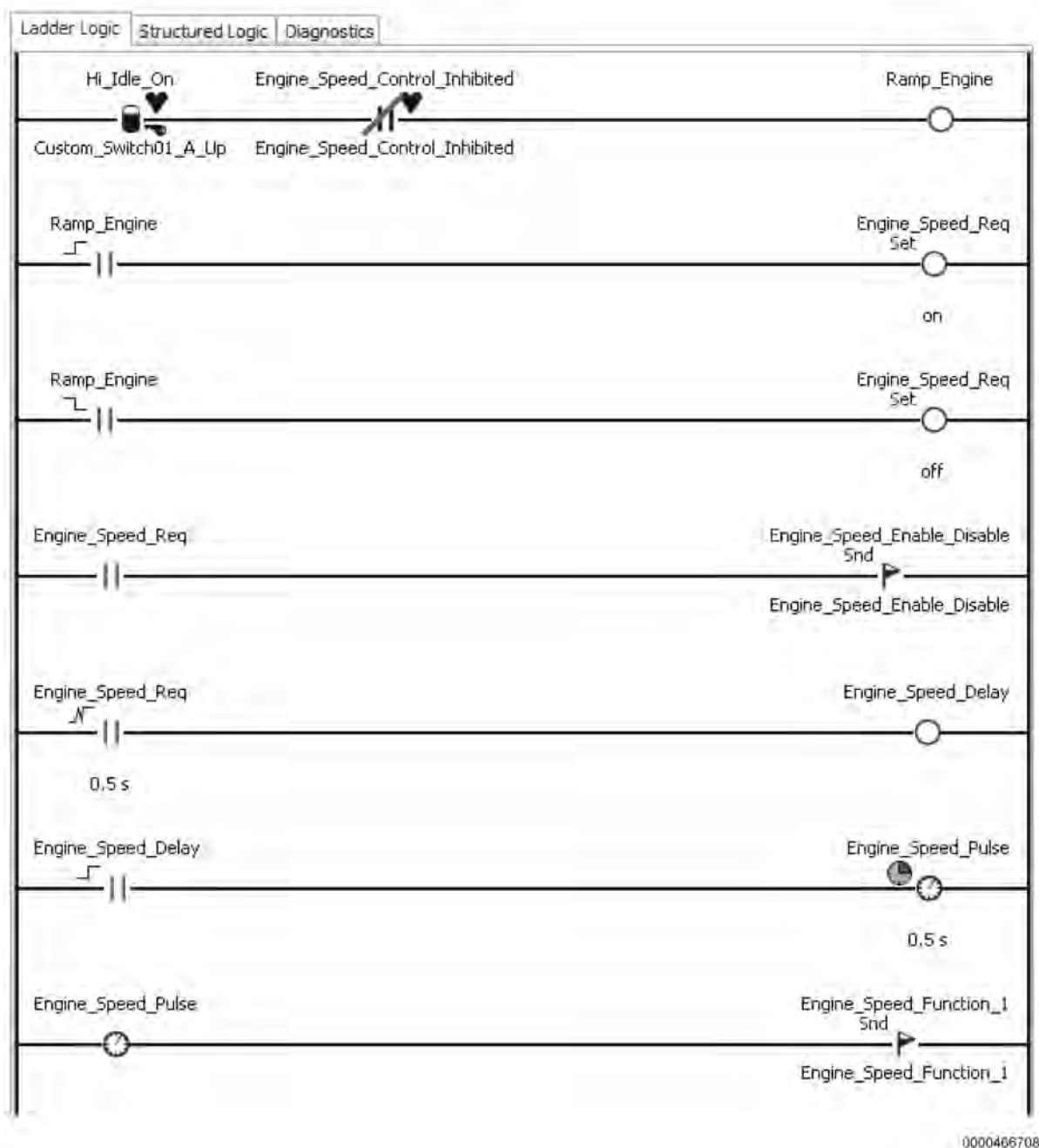


Figure 121 Preset 1 Engine Speed Control Example

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

This sample uses a rocker switch to cause the engine to ramp to the first Preset engine speed.

1st Rung

Pushing the High_Idle_On switch to the up position, while the Engine_Speed_Control_Inhibited signal is off, causes an internal variable, Ramp_Engine, to be set ON.

2nd Rung

The leading edge of Ramp_Engine will set the Engine_Speed_Req, internal variable, to ON.

3rd Rung

The lagging edge of Ramp_Engine will set the Engine_Speed_Req, internal variable, to OFF.

4th Rung

The state of the internal variable, Engine_Speed_Req, then drives the Engine_Speed_Enable_Disable semaphore to enable the engine ramp.

5th Rung

The debounced, for 0.5 seconds, Engine_Speed_Req is used to turn on the Engine_Speed_Delay internal variable.

6th Rung

The leading edge of Engine_Speed_Delay is used to start the Engine_Speed_Pulse 0.5 sec timer.

7th Rung

The the Engine_Speed_Pulse, 0.5 sec timer, is used to apply a pulse to the Engine_Speed_Function_1 semaphore to request engine preset speed 1.

The engine will then ramp to the PRESET 1 if no other vehicle interfaces have control of engine speed.

Other inputs or logical interlocks may be used to control each of these engine speed control signals.

Variable Engine Speed Control

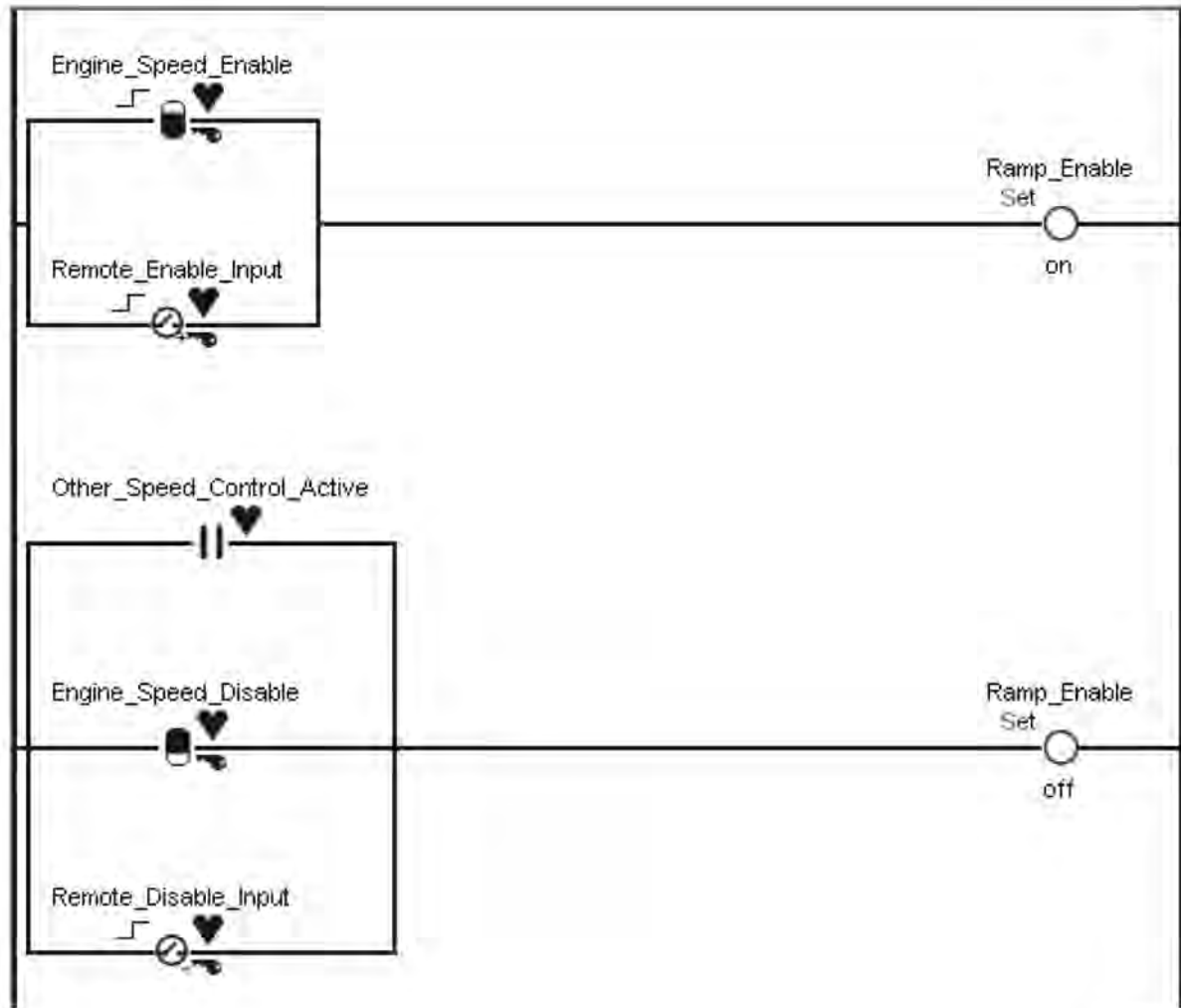
Another form of engine speed control involves ramping the engine speed up or down upon activation of a few input signals. See the example below for a method to provide a Variable Engine Speed Control logic block.

NOTE – Any time a ladder logic engine speed request is activated and another engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, then the Other_Speed_Control_Active signal will be set ON. Once this signal is active, the Ramp_Engine signal must be set inactive and then active again to regain control of the engine speed.

This example uses the following naming convention for engine speed control signals.

System Signal Name	Custom Name for the Signal
Engine_Speed_Control_Inhibited	Other_Speed_Control_Active
Engine_Speed_Enable-Disable	Engine_Control_Request

System Signal Name	Custom Name for the Signal
Engine_Speed_Function_1	Decrease_Speed
Engine_Speed_Function_2	Increase_Speed



0000466858

Figure 122 Variable Engine Speed Control Example Part One

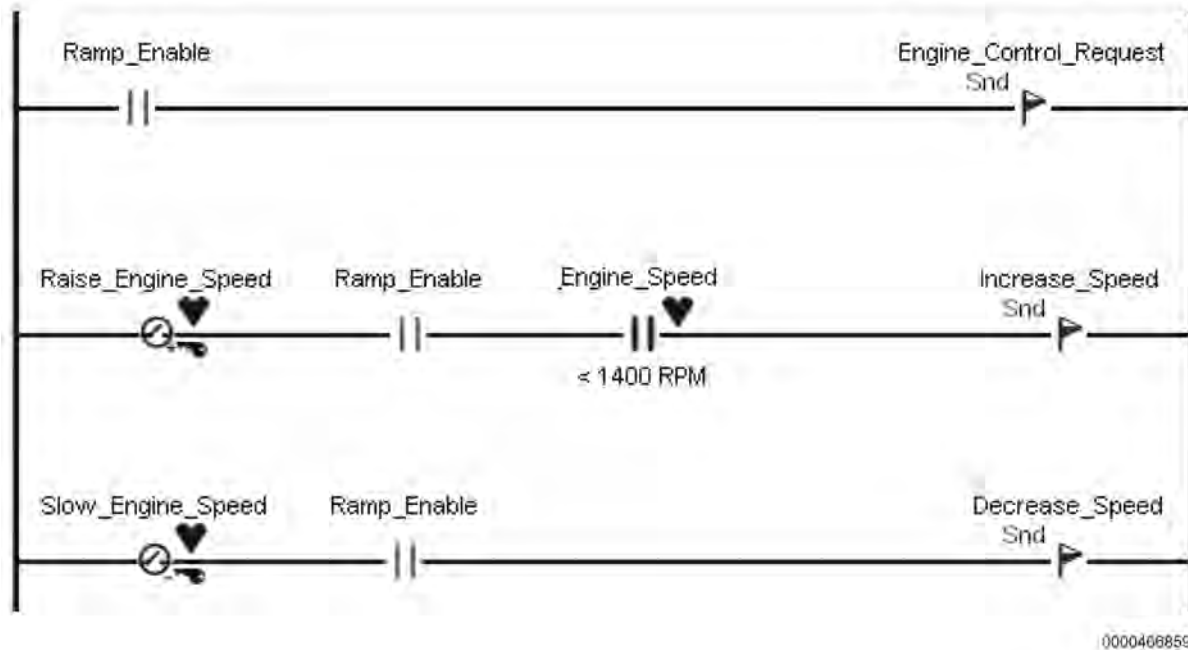


Figure 123 Variable Engine Speed Control Example Part Two

This sample uses a momentary rocker switch in the cab or a remote switch input to a RPM to enable controlling of the engine speed.

1st Rung

Pushing the switch to the up position or connecting 12 volts to an RPM input causes an internal variable to be set ON.

2nd Rung

Pushing the cab switch down or placing a ground on the RPM input or the activation of the Other_Speed_Control_Active signal by the ESC will cause the internal variable, Ramp_Enable, to be set OFF.

The state of the internal variable Ramp_Enable, determines whether the main speed control inputs will be allowed to control engine speed.

3rd Rung

Once Ramp_Enable is true, then Engine_Control_Request is turned ON.

4th Rung and 5th Rung

The last two rungs show that the engine speed may now be increased or decreased based upon which input signal is active as long as the Ramp_Enable signal is true. The Engine_Speed interlock speed set to 1400 ensures that the engine is not ramped higher than this limit. Since advanced ladder logic is executed 50 times per second, an RPM limit is a good practice to incorporate to prevent a runaway engine speed to the maximum governed engine speed. Other inputs or logical interlocks may be used to control each of these engine speed control signals.

Cummins Remote Engine Speed Control International® LT®, RH™, HV™, and MV™ Series Trucks

Diamond Logic® Builder provides a means to control engine speed using advanced ladder logic. The DLB engine speed control signals operate similar to the way the cruise control switches in the steering wheel do.

Just like the cruise control switches in the steering wheel, the DLB engine speed control signals can only control the engine in either the PRESET or VARIABLE modes. This choice is set in the engine control module programmable parameters. Therefore, the following ECM parameters must be programmed as a minimum.

- CAB Controls: Enabled
- Engine Ramping RPM per second
- Preset or Variable Engine Speed Selection
- Preset 1 and Preset 2 Engine Speeds (when PRESET Mode is selected)
- Review all J1939 parameters to allow address 33 or CAN bus for Auxiliary Engine Speed Control in the engine software

Diamond Logic Builder uses several possible signals that can be used for controlling the Cummins engine speed, with advanced logic

DLB_EngCtrl_ID_Sem

The DLB_EngCtrl_ID_Sem signal is used to signal the ECM that the advanced logic will be controlling the engine speed requests. This signal must be held active as long as engine speed control from DLB advanced ladder logic is desired. Once the DLB_EngCtrlReq_PTO_Disable signal becomes active, the enable signal must be driven inactive and then active again in order to regain control of the engine speed.

This signal correlates to the CRUISE ON and OFF switches in the steering wheel. When active, the cruise enable signal is active and other forms of vehicle engine speed controls will not be allowed to control the engine speed. When inactive, the cruise enable signal will be turned OFF. This signal is a READ / WRITE type.

DLB_EngCtrlID_DLB

The DLB_EngCtrlID_DLB signal goes active when the DLB_EngCtrl_ID_Sem is active.

DLB_EngCtrlReq_PTO_Enable

The DLB_EngCtrlReq_PTO_Enable signal is used to enable control of the engine speed. This signal acts like the CRUISE ON switch operation from the steering wheel.

DLB_EngCtrlReq_PTO_Disable

The DLB_EngCtrlReq_PTO_Disable signal is used to disable control when other engine speed control interfaces have active control of the engine. When other vehicle interfaces have control of engine speed, no requests from ladder logic will be acknowledged. This signal acts like the CRUISE OFF switch operation from the steering wheel.

This signal will be true for a variety of reasons:

- 060 Body Integration Remote Engine Speed Control Features are active
- Hard-wired interfaces connected directly into the engine control module such as 12CGB or 12XAT are true
- Park Brake is released

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

- Transmission is not in neutral (when vehicle is equipped with an automatic transmission)
- Road Speed is greater than 3 MPH
- Brake pedal has been depressed
- A bad STATUS exists on any of the above listed signals

Once the inhibit signal has become active, the ladder logic cannot take control of the engine speed again until the Engine_Speed_Enable_Disable signal has been placed into an inactive state.

DLB_EngCtrlReq_PTO_SetCoast

The DLB_EngCtrlReq_PTO_SetCoast is used to request control of engine speed. This signal's function acts like the Cruise SET switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

DLB_EngCtrlReq_PTO_ResumeAccel

The DLB_EngCtrlReq_PTO_ResumeAccel signal is used to request control of engine speed. This signal correlates to the Cruise RESUME switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

When the engine is programmed in the PRESET mode, this signal requests that the engine should ramp to the preprogrammed PRESET 2 engine speed. A single active transition of this signal is all that is needed to enable the PRESET 2 engine speed.

Cummins Preset Engine Speed Control

NOTE – There must be a delay between when the DLB_EngCtrlReq_PTO_Enable is active and the DLB_EngCtrlReq_PTO_SetCoast or DLB_EngCtrlReq_PTO_ResumeAccel is requested. The DLB_EngCtrlReq_PTO_SetCoast or DLB_EngCtrlReq_PTO_ResumeAccel signals must be pulsed signals.

Cummins ECM has to be programmed so the cruise switches work in preset mode.

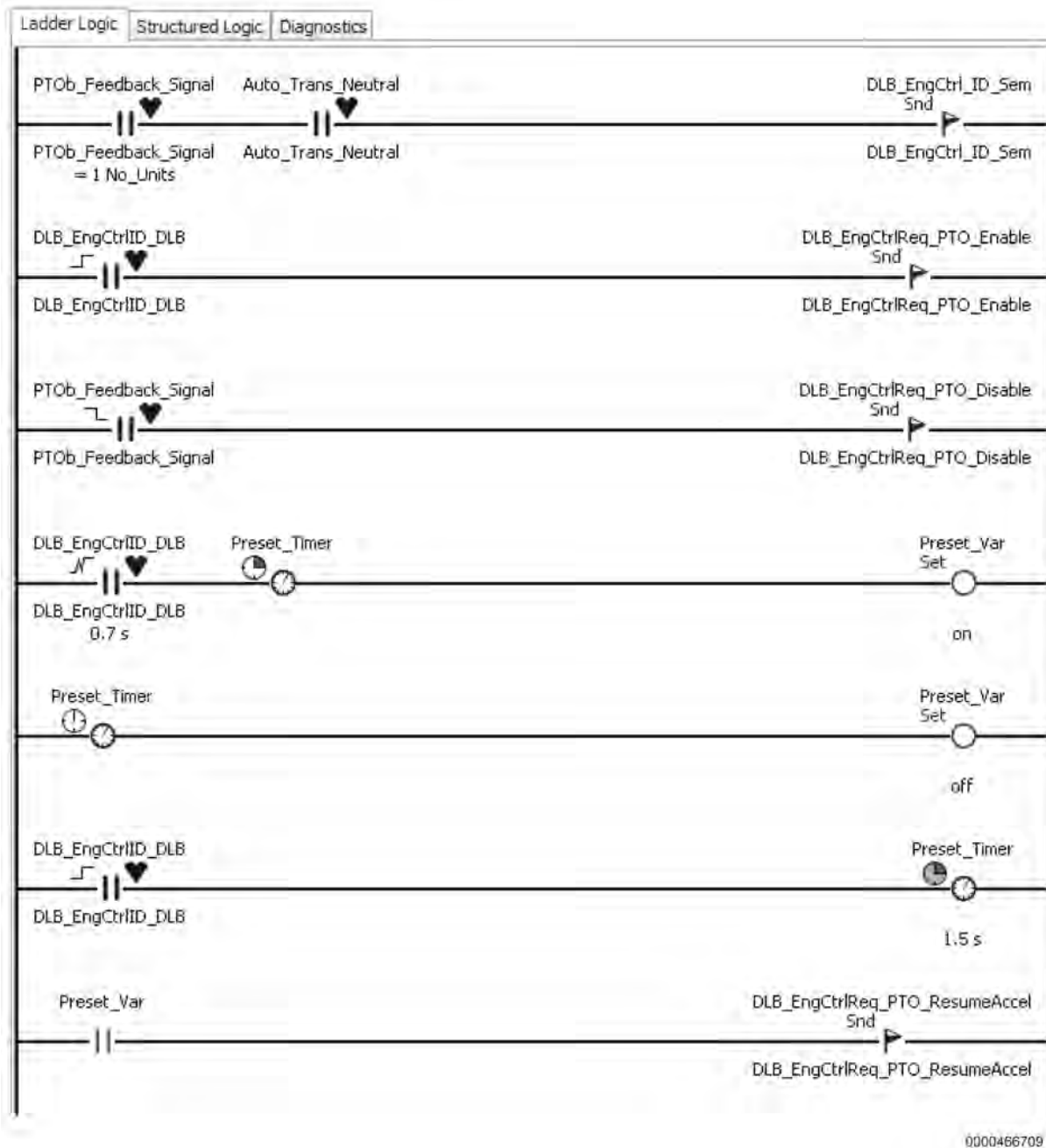


Figure 124 Cummins Preset Engine Speed Control

NOTE – Any time a ladder logic engine speed request is activated, and any other engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, the `Other_Speed_Control` signal will be set active. Once this signal is active, the `Ramp_Engine` signal must be set inactive and then active again to regain control of the engine speed.

The simplest form of engine speed control involves engaging the PRESET 1 RPM for engine speed control.

The functionality of this logic is to ramp the engine speed to present 1 after the PTO B is engaged.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

NOTE – SPN 980 is a latching message, no need to constantly make this rung true.

1st Rung

Once the PTO B feedback input is active and the transmission is in neutral the semaphore for DLB Engine Speed Control ID is set to 2. See below for values for EngCtrl_ID.

1 = Cruise control switches commanding Engine Speed Control

2 = DLB commanding Engine Speed Control

4 = Auto Start / Stop is commanding Engine Speed Control

8 = Low Battery (bus only) is commanding Engine Speed Control

16 = HVAC (bus only) is commanding Engine Speed Control

32 = Wipers on will cancel Cruise / Engine Speed Control

NOTE – SPN 980 is a latching message, no need to constantly make this rung true.

2nd Rung

- The positive edge of DLB Engine Speed Control ID being set to 2 activates the semaphore for Engine Speed Control PTO Enable (SPN 980 = 01).

NOTE – SPN 980 is a latching message, no need to constantly make this rung true.

3rd Rung

Negative edge of PTO B input or the transmission is in a forward gear or the transmission is in a reverse gear will activate the Engine Speed Control PTO Disable (SPN 980 = 00).

4th Rung

700ms Debounce On for DLB Engine Speed Control ID equal to 2 and preset timer is running activates Preset_Var to On state. This rung creates an 800ms pulse in conjunction with rung 6.

5th Rung

Preset timer expires and activates Preset_Var to an Off state.

6th Rung

The positive edge of DLB Engine Speed Control ID being set to 2 activates a 1.5 second Preset_Timer.

7th Rung

When Preset_Var is enabled, it will activate Engine Speed Control PTO Resume / Accel message (SPN 982 = 01). This rung creates an 800ms pulse in conjunction with rung 6.

Cummins Variable Engine Speed Control

NOTE – Anytime a ladder logic engine speed request is activated, and any other engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, the **Other_Speed_Control_Active** signal will be set ON. Once this signal is active, the **DLB_EngCtrl_ID_SEM** must be set inactive and then active again to regain control of the engine speed.

Another form of engine speed control involves using an input to enable variable engine speed control while using to other inputs to adjust the engine speed up or down.

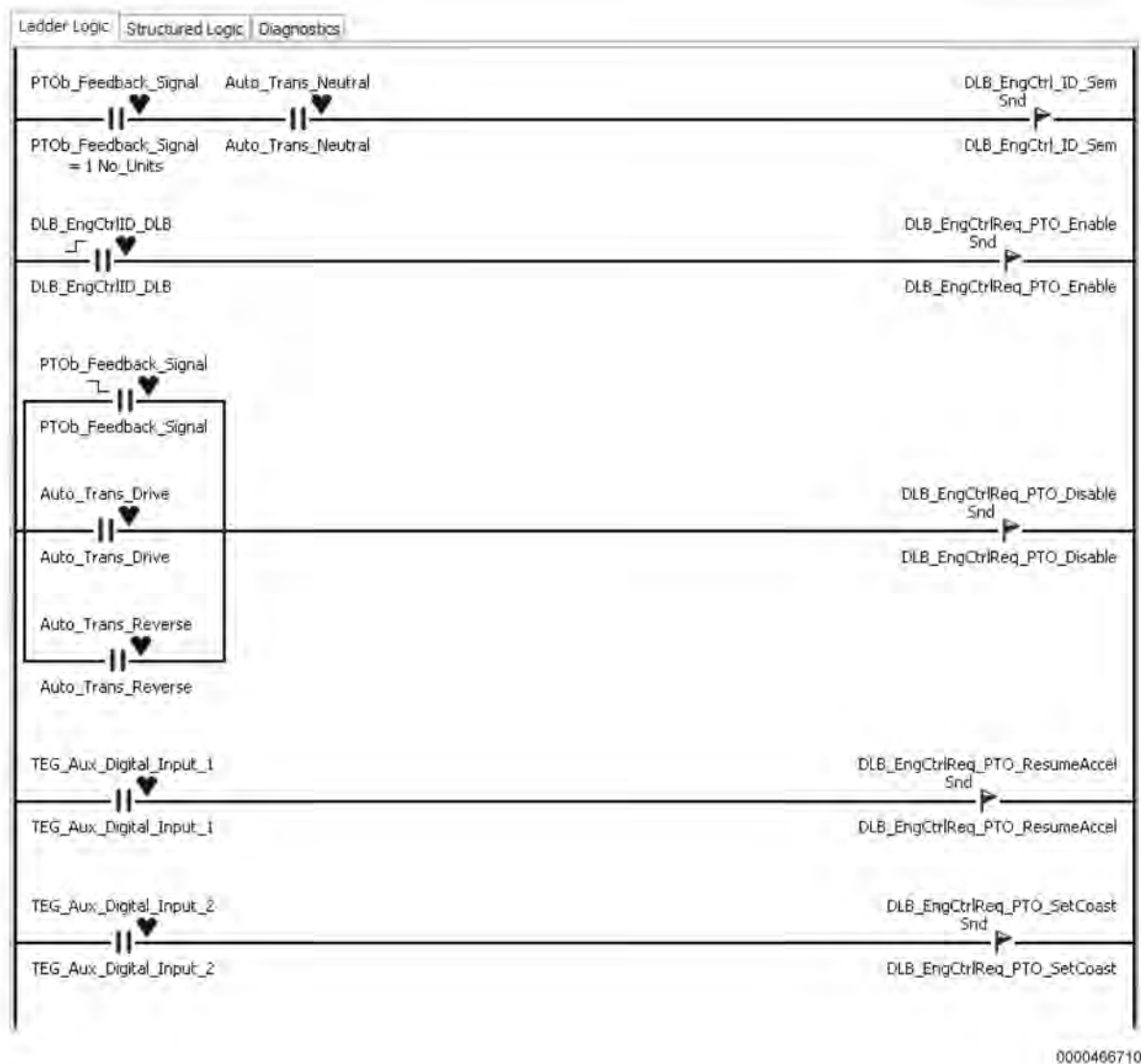


Figure 125 Cummins Variable Engine Speed Control

See above for a method to provide a Variable Engine Speed Control logic block.

This sample uses a ground signal, to the RPM, to enable engine speed control in a variable mode.

Cummins ECM has to be programmed so the cruise switches work in variable mode.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

The functionality of this logic is to ramp the engine speed to present 1 after the PTO B is engaged.

1st Rung

Once the PTO B feedback input is active, and the transmission is in neutral the semaphore for DLB Engine Speed Control ID is set to on.

NOTE – This is a latching message, no need to constantly make this rung true.

2nd Rung

The positive edge of DLB Engine Speed Control ID being set to 2 activates the semaphore for Engine Speed Control PTO Enable semaphore.

3rd Rung

Negative edge of PTO B input or the transmission is in a forward gear or the transmission is in a reverse gear will activate the Engine Speed Control PTO Disable semaphore. This is a latching message, no need to constantly make this rung true.

4th Rung

Applying a ground to TEG_Aux_Digital_Input_1 will send the DLB_EngCtrlReq_PTO_ResumeAccel request and increase the engine speed while it is held on.

5th Rung

Applying a ground to TEG_Aux_Digital_Input_2 will send the DLB_EngCtrlReq_PTO_SetCoast request and decrease the engine speed while it is held on.

A26 Remote Engine Speed Control International® LT®, RH™, HV™, and MV™ Series Trucks

Diamond Logic® Builder provides a means to control engine speed using advanced ladder logic. The DLB engine speed control signals operate similar to the way the cruise control switches in the steering wheel do. Review all J1939 parameters to allow address 33 or CAN bus for Auxiliary Engine Speed Control in the engine software. The following Engine ECM parameters must be programmed as a minimum:

- Engine Ramping RPM per second
- Preset 1 and Preset 2 Engine Speeds (when PRESET Mode is selected)
- Review all J1939 parameters to allow address 33 or CAN bus for Auxiliary Engine Speed Control in the engine software

Diamond Logic Builder uses eight possible signals for controlling engine speed.

DLB_EngCtrl_ID_Sem

The DLB_EngCtrl_ID_Sem signal is used to signal the ECM that the advanced logic will be controlling the engine speed requests. This signal must be held active as long as engine speed control from DLB advanced ladder logic is desired. Once the DLB_EngCtrlReq_PTO_PresetDisable or DLB_EngCtrlReq_PTO_Variable_Disable signals become active, this enable signal must be driven inactive and then active again in order to regain control of the engine speed.

ON and OFF switches in the steering wheel. When active, the cruise enable signal is active and other forms of vehicle engine speed controls will not be allowed to control the engine speed. When inactive, the cruise enable signal will be turned OFF. This signal is a READ / WRITE type.

DLB_EngCtrlID_DLB

The DLB_EngCtrl_IDDLB signal goes active when the DLB_EngCtrl_ID_Sem is active.

DLB_EngCtrlReq_PTO_PresetEnable

The DLB_EngCtrlReq_PTO_PresetEnable signal is used to enable preset control of the engine speed. This signal acts like the CRUISE ON switch operation from the steering wheel.

DLB_EngCtrlReq_PTO_PresetDisable

The DLB_EngCtrlReq_PTO_PresetDisable signal is used to disable preset control when other engine speed control interfaces have active control of the engine. When other vehicle interfaces have control of engine speed, no requests from ladder logic will be acknowledged. This signal acts like the CRUISE OFF switch operation from the steering wheel.

This signal will be true for a variety of reasons:

- 060 Body Integration Remote Engine Speed Control Features are active
- Hard-wired interfaces connected directly into the engine control module such as 12CGB or 12XAT are true
- Park Brake is released
- Transmission is not in neutral (when vehicle is equipped with an automatic transmission)
- Road Speed is greater than 3 MPH
- Brake pedal has been depressed
- A bad STATUS exists on any of the above listed signals

Once the inhibit signal has become active, the ladder logic cannot take control of the engine speed again until the Engine_Speed_EnableDisable signal has been placed into an inactive state.

DLB_EngCtrlReq_PTO_VariableEnable

DLB_EngCtrlReq_PTO_VariableEnable signal is used to enable variable control of the engine speed. This signal acts like the CRUISE ON switch operation from the steering wheel.

DLB_EngCtrlReq_PTO_VariableDisable

DLB_EngCtrlReq_PTO_VariableDisable signal is used to disable preset control when other engine speed control interfaces have active control of the engine. When other vehicle interfaces have control of engine speed, no requests from ladder logic will be acknowledged. This signal acts similarly to the CRUISE OFF switch operation from the steering wheel.

This signal will be true for a variety of reasons:

- 060 Body Integration Remote Engine Speed Control Features are active
- Hard-wired interfaces connected directly into the engine control module such as 12CGB or 12XAT are true

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

- Park Brake is released
- Transmission is not in neutral (when vehicle is equipped with an automatic transmission)
- Road Speed is greater than 3 MPH
- Brake pedal has been depressed
- A bad STATUS exists on any of the above listed signals

Once the inhibit signal has become active, the ladder logic cannot take control of the engine speed again until the Engine_Speed_EnableDisable signal has been placed into an inactive state.

DLB_EngCtrlReq_PTO_SetCoast

The DLB_EngCtrlReq_PTO_SetCoast is used to request control of engine speed. This signal's function acts like the Cruise SET switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

When the DLB_EngCtrlReq_PTO_PresetEnable is active, this signal requests that the engine should ramp to the preprogrammed PRESET 1 engine speed. A single active transition of this signal is all that is needed to enable the PRESET 1 engine speed.

When the DLB_EngCtrlReq_PTO_VariableEnable is active, this signal requests that the engine should ramp down toward an idle RPM. The rate at which the engine slows down is determined by the value of the RPM step decrement in the engine programmable parameters. Since ladder logic is executed 50 times per second, the DLB user should use a small step in the engine programmable parameter for RPM steps to ensure that engine speed can be adequately controlled using this signal. If an RPM limit is not used, engine speed will be driven to idle very quickly. See the Variable Engine Speed control logic as an example of one method to control engine speed.

DLB_EngCtrlReq_PTO_ResumeAccel

The DLB_EngCtrlReq_PTO_ResumeAccel signal is used to request control of engine speed. This signal correlates to the Cruise RESUME switch on the steering wheel. A custom name should be assigned to this signal to make reading the ladder logic more understandable.

This signal requests that the engine should ramp to the preprogrammed PRESET 2 engine speed. A single active transition of this signal is all that is needed to enable the PRESET 2 engine speed.

When the DLB_EngCtrlReq_PTO_VariableEnable is active, this signal requests that the engine should ramp up toward an RPM. The rate at which the engine speeds up is determined by the value of the RPM step increment in the engine programmable parameters. Since ladder logic is executed 50 times per second, the DLB user should use an RPM limit with this signal along with a small engine incrementing value to ensure that engine speed can be adequately controlled using this signal. If an RPM limit is not used, engine speed will be driven to the maximum governed speed very quickly. See the Variable Engine Speed control logic as an example of one method to control engine speed.

International® A26 Preset Engine Speed Control

NOTE – The A26 engine needs to have engine parameter 99322 set to CAN, for preset control to work.

NOTE – There must be a delay between when the DLB_EngCtrlReq_PTO_PresetEnable is active and the DLB_EngCtrlReq_PTO_SetCoast is requested. The DLB_EngCtrlReq_PTO_SetCoast or DLB_EngCtrlReq_PTO_ResumeAccel signals must be pulsed signals.

NOTE – Any time a ladder logic engine speed request is activated, and any other engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, then the **Other_Speed_Control** signal will be set active. Once this signal is active, the **Ramp_Engine** signal must be set inactive and then active again to regain control of the engine speed.

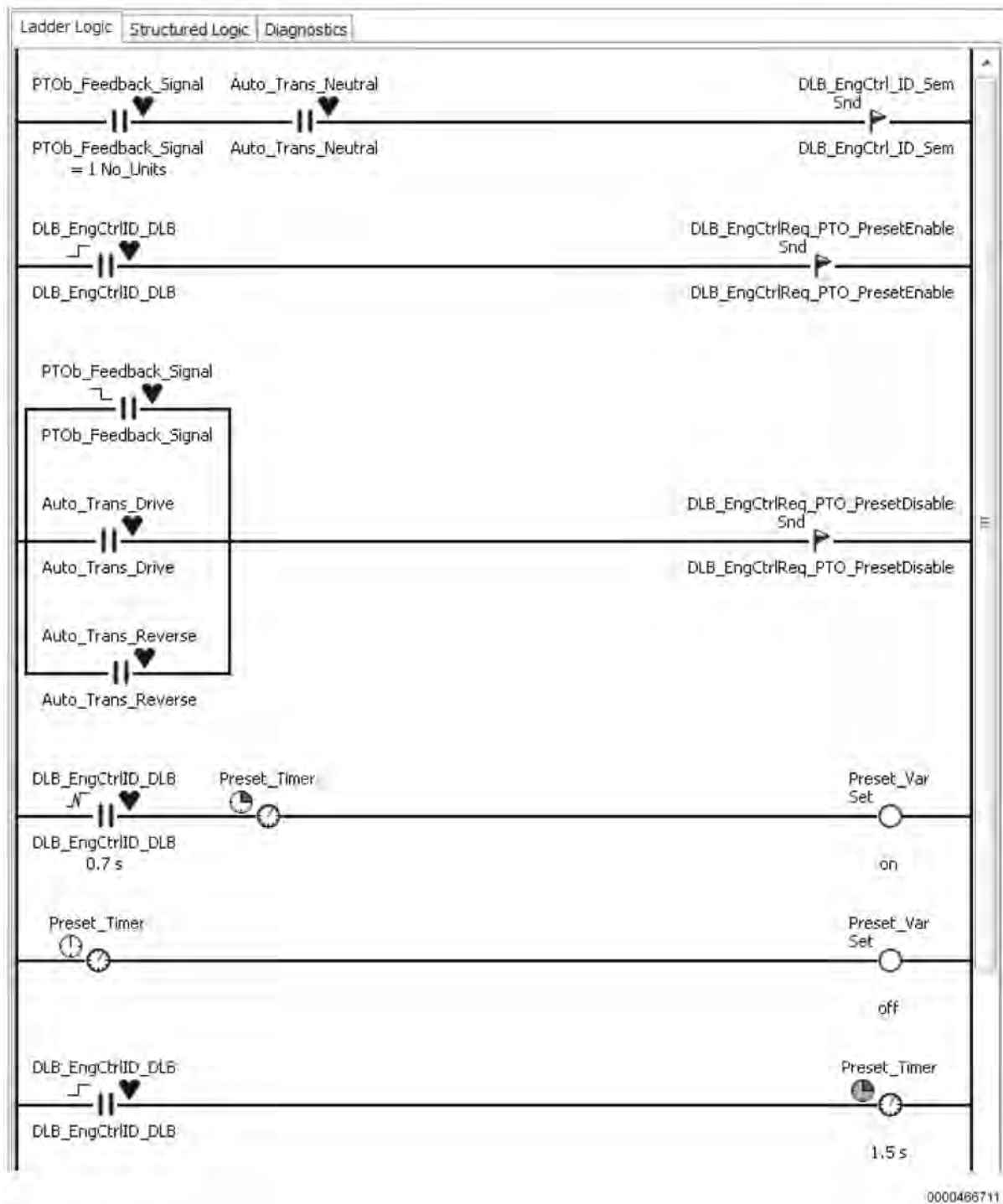


Figure 126 A26 Preset Engine Speed Control



Figure 127 A26 Preset Engine Speed Control

The simplest form of engine speed control involves engaging the PRESET 1 RPM for engine speed control. See the example above.

The functionality of this logic is to ramp the engine speed to present 1 after the PTO B is engaged.

1st Rung

Once the PTO B feedback input is active and the transmission is in neutral the semaphore for DLB Engine Speed Control ID is set on.

2nd Rung

The positive edge of DLB Engine Speed Control ID being set to 2 activates the semaphore for Engine Speed Control PTO Enable. Note: This is a latching message, no need to constantly make this rung true.

3rd Rung

Negative edge of PTO B input or the transmission is in a forward gear or the transmission is in a reverse gear will activate the Engine Speed Control PTO Disable Note: This is a latching message, no need to constantly make this rung true.

4th Rung

700ms Debounce On for DLB Engine Speed Control ID equal to 2 and preset timer is running activates Preset_Var to On state.

NOTE – This rung creates an 800ms pulse in conjunction with rung 6.

5th Rung

Preset timer expires and activates Preset_Var to an Off state.

6th Rung

The positive edge of DLB Engine Speed Control ID being set to 2 activates a 1.5 second Preset_Timer

7th Rung

When Preset_Var is enabled it will activate Engine Speed Control PTO Resume / Accel message (SPN 982 = 01).

Variable Engine Speed Control

NOTE – The A26 engine needs to have engine parameter 99332 set to CAN, for variable control to work.

NOTE – Any time a ladder logic engine speed request is activated, and another engine speed control interface has control of the engine or an engine speed control signal interlock has been violated, the `Other_Speed_Control_Active` signal will be set ON. Once this signal is active, the `DLB_EngCtrl_ID_SEM` must be set inactive and then active again to regain control of the engine speed.

Another form of engine speed control involves ramping the engine speed up or down upon activation of a few input signals. See the example below for a method to provide a Variable Engine Speed Control logic block.

This sample uses a ground signal, to the RPM, to control the engine speed in a variable mode.

This sample uses a ground signal, to the RPM, to enable engine speed control in a variable mode.

Resume needs a double bump to enable ramp up. This is written into the logic.





Figure 129 A26 Variable Engine Speed Control

1st Rung

Applying a ground RPM1 Pin 18, while the park brake is set and the service brake switch is not active, causes DLB_EngCtrl_ID_SEM to be set ON.

2nd Rung

When DLB_EngCtrl_ID_Sem sets ON, the leading edge of DLB_EngCtrl_ID_DLB turning ON will force DLB_EngCtrlReq_PTO_VariableEnable to be enabled.

3rd Rung

Removing the ground from RPM1 Pin 18 or releasing the park brake or applying the service brake switch is not active, will force DLB_EngCtrlReq_PTO_VariableDisable to be enabled. This will kill the engine ramp.

4th Rung

Applying a ground to RPM1 Pin 19 will start the .5 second Initial_Resume timer.

5th Rung

One second after applying a ground to RPM1 Pin 19, it will turn on the Resume variable.

6th Rung

The interaction between the Initial_Resume timer and the Resume variable will cause the DLB_EngCtrlReq_PTO_ResumeAccel signal to be requested twice. Once with a .5 second pulse and then constantly after another 0.5 seconds. This is similar to double tapping the Cruise switch resume and is required to make the engine respond and increase the engine speed while the ground to RPM1 Pin 19 is active. Releasing the ground from RPM1 Pin 19 will stop the speed increase and the engine will hold at that speed.

7th Rung

Applying a ground RPM1 Pin 20 will send the DLB_EngCtrlReq_PTO_ResumeAccel signal which will decrease the engine speed. Releasing the ground from RPM1 Pin 20 will stop the speed decrease and the engine will hold at that speed.

SUSPENSION DUMP FEATURE

Certain applications, such as ambulance, require the ability to activate suspension dump from a remote input. The current factory suspension dump feature does not readily offer the Truck Equipment Manufacturer (TEM) the ability to integrate remote activation of the suspension dump and requires the use of additional air solenoids or relays. Diamond Logic® Builder Advanced Logic can be utilized to customize the suspension dump feature to accept a remote input from a RPM requiring no additional relays or air solenoids. Advanced logic can also be written to request the suspension to dump after other parameters are met e.g. PTO is engaged.

There are currently two versions of the factory suspension dump feature. Chassis built prior to September 2003 utilize a single air solenoid. Chassis built September 2003 or after utilize two air solenoids plumbed through a shuttle valve.

Any vehicle retrofits should incorporate the two solenoids, with shuttle valve, configuration.

Simple Suspension Dump

The Suspension_Dump_Request Signal can be used for simple Suspension Dump requirements on vehicles with the single or dual solenoid Suspension Dump. This signal can be used with switch inputs, remote inputs on RPMs or in conjunction with other parameters.

The logic below is an example of suspension dump control activated when the PTO is requested.

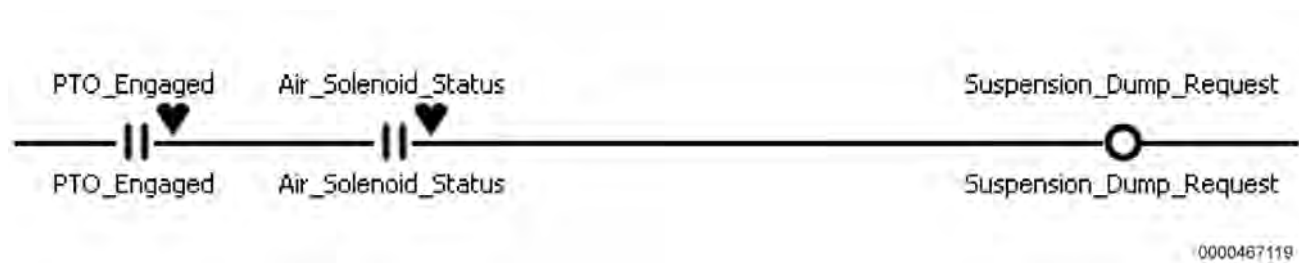


Figure 130 Simple Suspension Dump

The Air_Solenoid_Status signal is used to identify that the air solenoid pack has power and air pressure is applied.

Controlling Standard Feature Suspension Dump with Advanced Logic

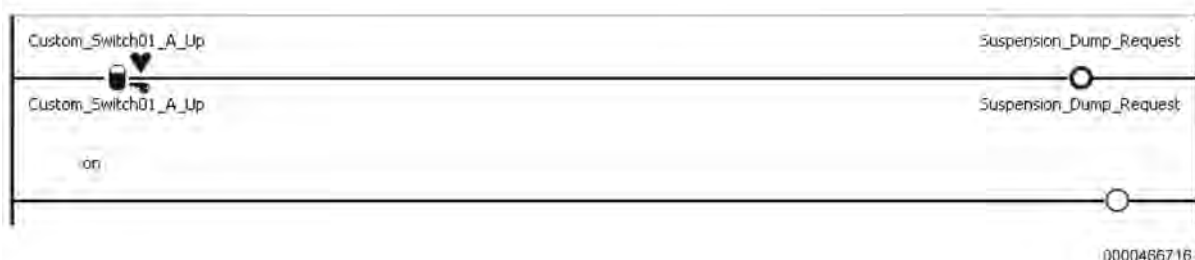


Figure 131 Suspension_Dump_Request

Suspension dump on vehicles that are programmed with any of the following standard suspension dump feature codes, 595273 / 595ACA / 597010 / 597313, can be controlled by using the Suspension_Dump_Request signal.

Complex Suspension Dump Control via Dual Solenoids

NOTE – This method of controlling the suspension dump is more complex and may not be necessary if the Simple Suspension Dump meets your requirements.

Chassis built September 2003, or after, utilize dual air solenoids that control a shuttle valve for suspension dump control. One solenoid is normally open and the other is normally closed. The solenoids control the position of the shuttle valve and the dump operation. The location of the air solenoid control wiring that controls suspension dump can be verified with the Diamond Logic® Builder software. If the chassis is equipped with a hard-wired four-pack air solenoid module, the solenoid control wire pin locations can be viewed from the Connectors tab by selecting the ESC tab and the 4004 connector. If the chassis is equipped with a multiplexed seven-pack remote air solenoid module, pre 2007, the suspension dump air solenoids can be viewed from the Connectors tab by selecting the Modular Solenoid Valve Assembly (MSVA) 1 tab.

Verifying the location of the solenoids is important prior to applying the advanced logic template to the VIN. The factory suspension dump software feature must be removed as part of the advanced logic template. The hardware and solenoid plumbing will remain in place. After applying the template re-verify the location of the solenoid wiring to ensure the proper solenoids are controlling the suspension dump operation. To replace the factory suspension dump feature, a new template must be created from the specific VIN that it will be replaced on. This is to ensure the appropriate combination of features requiring air solenoids is accounted for.

Remove with template must be selected for feature 595273 / 595ACA / 597010 / 597313 as part of the template. Two solenoid controls are created using Univ_Air_Solenoid_1 and Univ_Air_Solenoid_2 located on the chassis tab in the advanced logic screen. The solenoids work in opposition of each other and are never energized at the same time. The switch in the dash is re-created using a custom switch from the switches tab. An available RPM input is used to provide a remote input to enable a suspension dump. The logic can be customized to any appropriate interlocks but MUST be minimally interlocked to park brake and vehicle speed less than five miles per hour. The logic below is an example of suspension dump control with dual air solenoids.

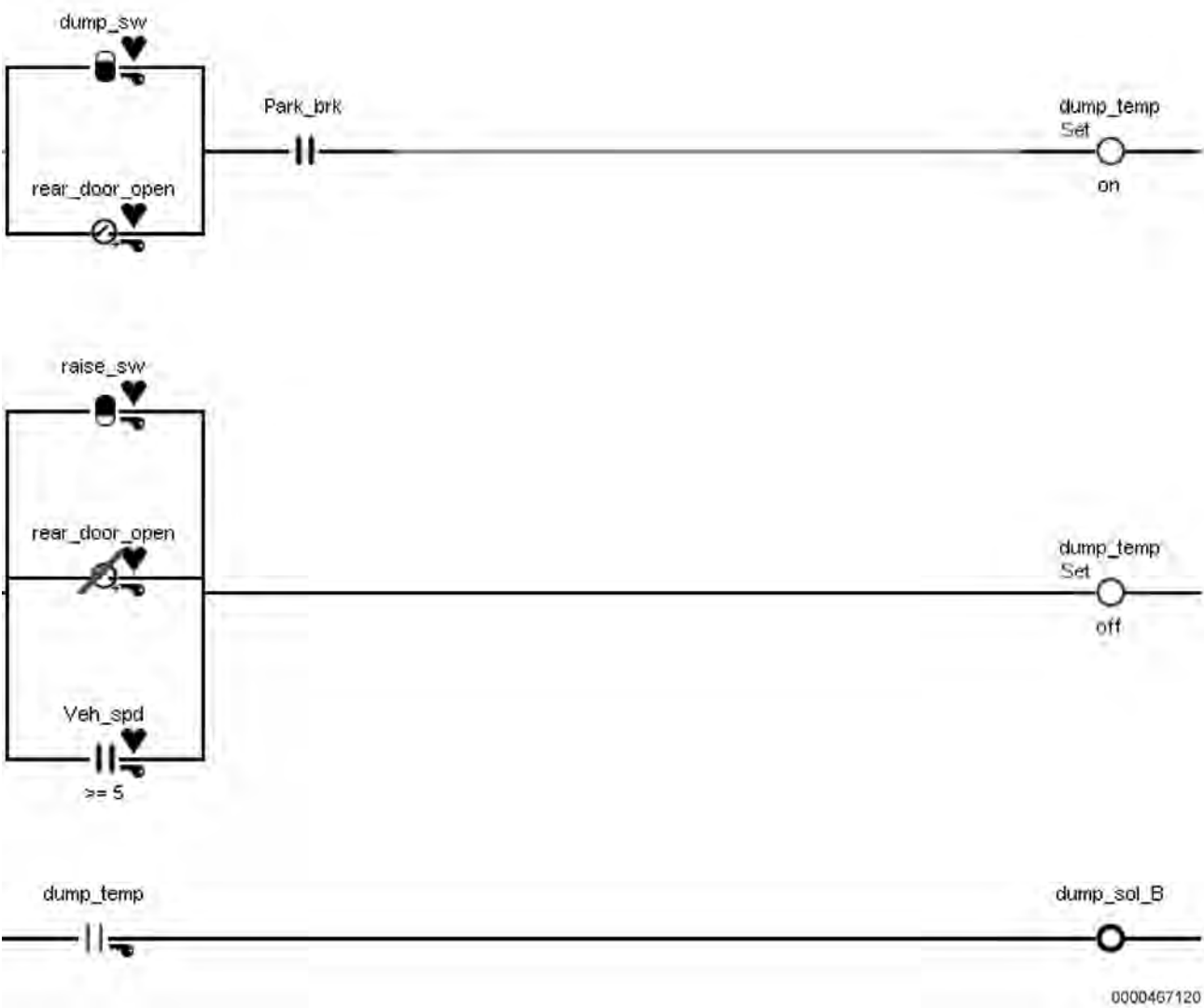


Figure 132 Suspension Dump via Dual Solenoids (Part 1)

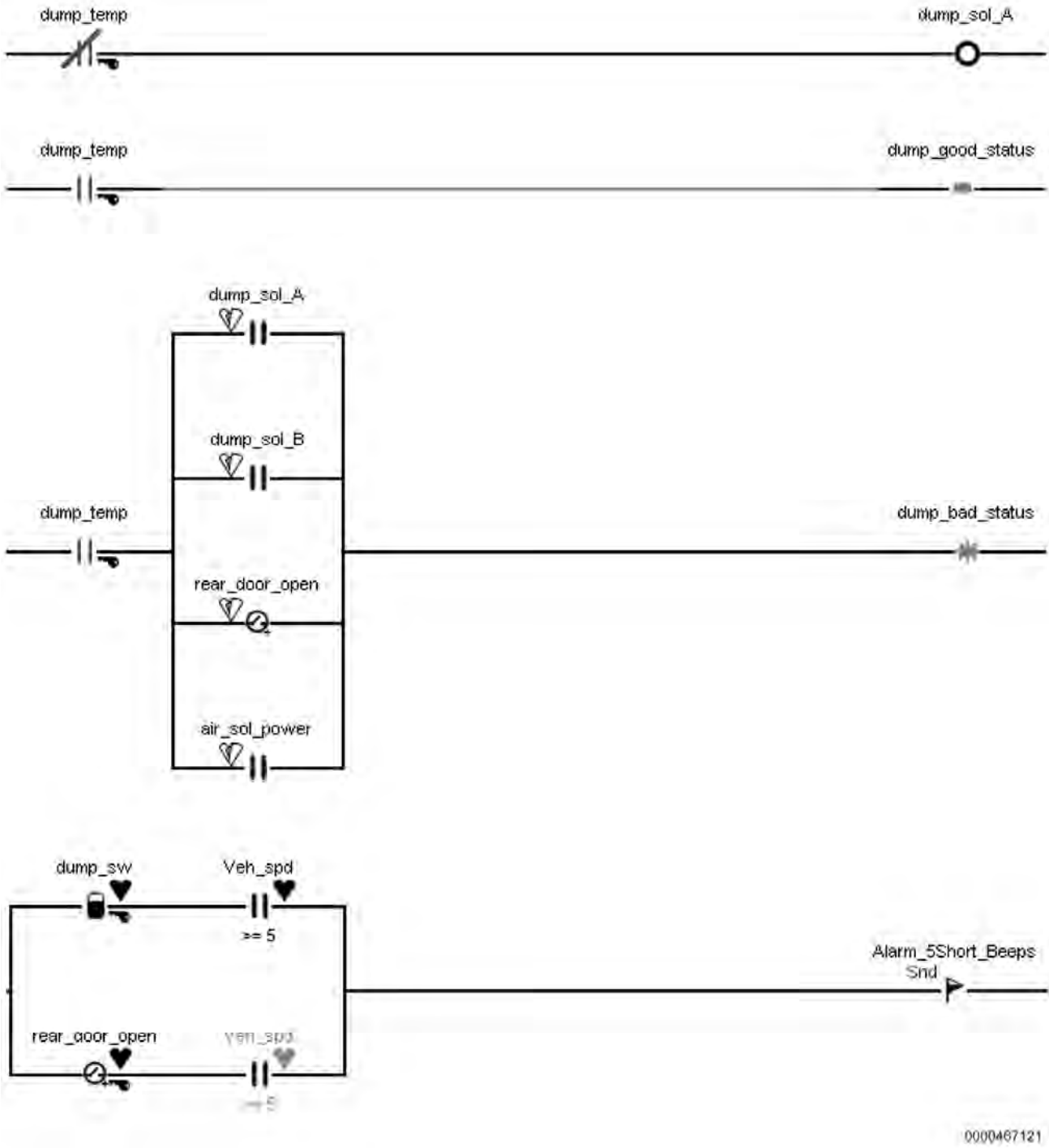


Figure 133 Suspension Dump via Dual Solenoids (Part 2)

CONTROLLING HEADLIGHTS AND EXTERNAL LIGHTING WITH ADVANCED LOGIC

Controlling Headlights and External Lighting with Advanced Logic - Pre International® LT®, RH™, HV™, and MV™ Series Trucks

NOTE – Contact your Diamond Logic Builder representative if controlling headlights and external lighting require additional features.

Certain applications, such as ambulances and Fire Trucks, require the ability to control the headlights and turn signals beyond what is provided with standard features. One example is setting up a headlight Wig-Wag function. There are contacts, within DLB, to add this to advanced logic rungs.

Feature Code 595BHJ, LOGIC BUILDER FOR DLB LIGHT ACCESS, must be enabled to allow the system to respond to these contacts.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

International® Diamond Logic® Builder

File Edit View Advanced Logic Tools Diagnostics Help

Editing - 3HTMAAL18NXXXXXX

Select Advanced Logic Features Faults Connectors Signals Center Panel Cluster Campaign Messages

Pr... Logic Block Des... Date Ed... Act... User

Truck Lighting Mar 1... u...

Ladder Logic Structured Logic Diagnostics

on Left_Highbeam_Output_Request_Snd
Left_Highbeam_Output_Request

on Left_Lowbeam_Output_Request_Snd
Left_Lowbeam_Output_Request

on Right_Highbeam_Output_Request_Snd
Right_Highbeam_Output_Request

on Right_Lowbeam_Output_Request_Snd
Right_Lowbeam_Output_Request

on Left_Turn_Signal_Enable_Request
Left_Turn_Signal_Enable_Request

on Right_Turn_Signal_Enable_Request
Right_Turn_Signal_Enable_Request

on Stop_Lamp_Enable_Request
Stop_Lamp_Enable_Request

on Marker_Lamp_Control_Enable_Request
Marker_Lamp_Control_Enable_Request

on Tail_and_Park_Lamp_Enable_Request
Tail_and_Park_Lamp_Enable_Request

HEV Indicators Other RPMs RPM1 RPM2 RPM4 Switches Transmission

My Variables AWARE Advanced Bus Chassis Cluster Datalink Engine

T	Cu...	Us...	Used	Signal/Value
			<input type="checkbox"/>	Air_Horn_Request	...	
			<input type="checkbox"/>	City_Horn_Request	...	
			<input type="checkbox"/>	Door_Lock_Request	...	
			<input type="checkbox"/>	Door_UnLock_Request	...	
	L...	I...	<input type="checkbox"/>	Left_Highbeam_Output_Request	...	
	L...	I...	<input type="checkbox"/>	Left_Lowbeam_Output_Request	...	
	R...	I...	<input type="checkbox"/>	Right_Highbeam_Output_Request	...	
	R...	I...	<input type="checkbox"/>	Right_Lowbeam_Output_Request	...	
			<input type="checkbox"/>	Traction_Control_Disable_DLB...	...	
	L...	I...	<input type="checkbox"/>	Left_Turn_Signal_Enable_Request	...	
	M...	I...	<input type="checkbox"/>	Marker_Lamp_Control_Enable_R...	...	
	R...	I...	<input type="checkbox"/>	Right_Turn_Signal_Enable_Requ...	...	
			<input type="checkbox"/>	Snow_Valve_Motor_Req	...	
	S...	I...	<input type="checkbox"/>	Stop_Lamp_Enable_Request	...	
			<input type="checkbox"/>	Suspension_Dump_Request	...	
	T...	I...	<input type="checkbox"/>	Tail_and_Park_Lamp_Enable_Re...	...	
			<input type="checkbox"/>	Two_Speed_Axle_High_Request	...	
			<input type="checkbox"/>	AC_Request	...	
			<input type="checkbox"/>	Left_Lowbeam_Req	...	
			<input type="checkbox"/>	Low_Beam_Handler_Req	...	
			<input type="checkbox"/>	Right_Lowbeam_Req	...	
			<input type="checkbox"/>	TEM_Dual1_Output1_Req	...	
			<input type="checkbox"/>	TEM_Dual1_Output2_Req	...	
			<input type="checkbox"/>	Body_Up_Light	...	
			<input type="checkbox"/>	Boom_Not_Stowed_Warning_Light	...	
			<input type="checkbox"/>	Exhaust_Brake_Switch_Ind_Cmd	...	
			<input type="checkbox"/>	Gate_Open_Light	...	
			<input type="checkbox"/>	Outriggers_Deployed_Warning_...	...	
			<input type="checkbox"/>	Rear_Alert_Indicator	...	
			<input type="checkbox"/>	Worklight_off_sem	...	
			<input type="checkbox"/>	Worklight_on_sem	...	
			<input type="checkbox"/>	Aux_Relay_Driver_1	...	
			<input type="checkbox"/>	Aux_Relay_Driver_2	...	
			<input type="checkbox"/>	Aux_Relay_Driver_3	...	
			<input type="checkbox"/>	Aux_Relay_Driver_4	...	
			<input type="checkbox"/>	Aux_Relay_Driver_5	...	
			<input type="checkbox"/>	Aux_Relay_Driver_6	...	

No custom variable selected

Waiting for connection...

0000466718

Figure 134 Light Control Logic

Controlling Exterior Lighting with Advanced Logic International® LT®, RH™, HV™, and MV™ Series Trucks

Certain applications, such as ambulances and Fire Trucks, require the ability to control the exterior truck lighting beyond what is provided with standard features. There are contacts, within DLB, to add some lighting requests to advanced logic rungs.

Controlling Individual Exterior Lighting with Advanced Logic International® LT®, RH™, HV™, and MV™ Series Trucks

NOTE – Contacts used to request operation of the individual, left or right, headlights, in Wig Wag mode, are covered in the next two sections.

Unlike previous models, these models do not require any special feature programming to allow the system to respond to these contacts.

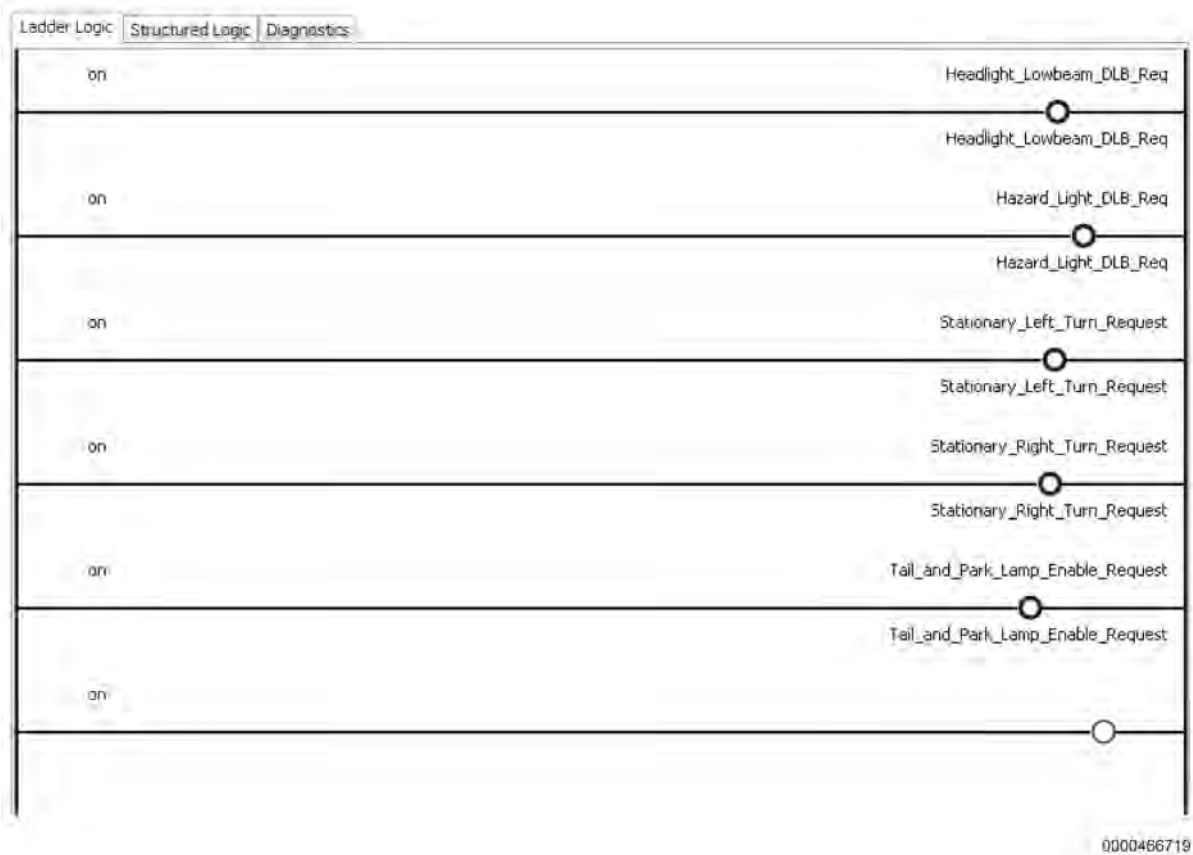


Figure 135 Light Control Logic

Controlling Wig-Wag Lighting with Advanced Logic, Using Wig Wag Request With HV™, and MV™ Series Trucks

NOTE – Not compatible on MV™ Series Trucks with 597075 or 597394 for LED Headlights.

Features 597448 and 597449 are added and enabled, in DLB, advanced logic must be written to turn on the Wig_Wag_DLB_Signal. Activating the Wig_Wag_DLB_Signal will make the headlights operate as they are set

up in the 597448 or 597449 programming. When 597448 or 597449 are added, they do not add any switches or add any functionality if the advanced logic Wig_Wag_DLB_Signal is not used.

You must install either feature 597448 (high beam only) or 597449 (low beam or high beam flash) to use the Wig_Wag_DLB_Signal from the Advanced tab. There are 13 different available flash patterns under each feature, that are assigned with parameter 2629. See the tables below.

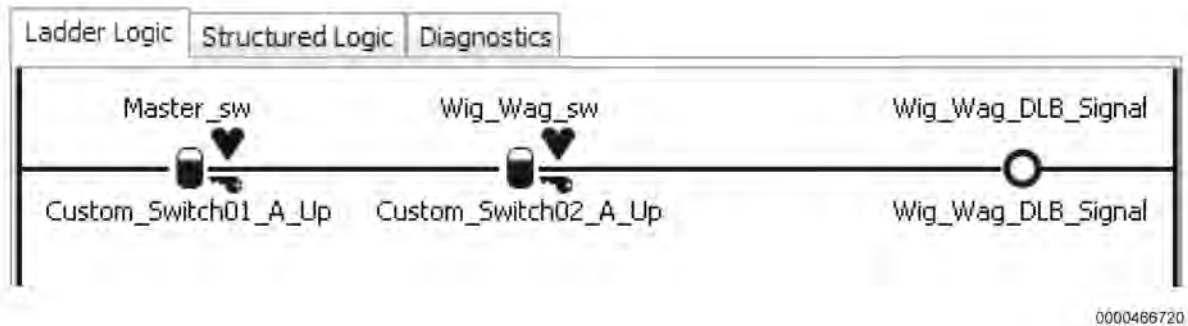


Figure 136 Wig Wag Control Logic

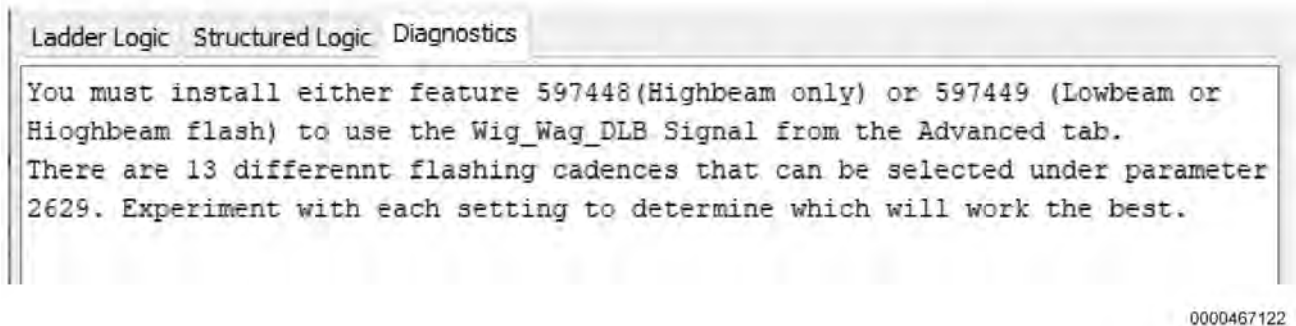


Figure 137 Wig Wag Control Logic

My Variables	AWARE	Advanced	Bus	Chassis	Cluster	Datalink	Engine	HEV	Indicators	Other RPMs	RPM1	RPM2	RPM4	Switches	Transmission
Custom Variable	Used	Signal/Value	Unit	Signal Description											
Wig_Wag_DLB_Signal	<input checked="" type="checkbox"/>	Wig_Wag_DLB_Signal	On/Off	For NGV platform this internal DLB signal provide...											
	<input checked="" type="checkbox"/>	Wipers_circuit_feedback	A												
	<input checked="" type="checkbox"/>	Right_Rear_Turn_Lamp_circuit_feedback	A												
	<input type="checkbox"/>	Right_Mirror_Heat_Current_Signal	A												
	<input checked="" type="checkbox"/>	Right_Lowbeam_Current_Signal	A	Right Lowbeam Current Signal for Gen 2.											

Figure 138 Wig Wag Control Logic

NOTE – For NGV platform this internal WIG_WAG_DLB_Signal provides the ability to disable the headlights wig wag.

NOTE – For Horizon platform this internal WIG_WAG_DLB_Signal provides the ability to enable the headlights wig wag.

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)

The system will define Wig Wag State Inactive as Left Low Beam (LLB) =Inactive, Left High Beam (LHB) = Inactive, Right Low Beam (RLB) = Inactive and Right High Beam (RHB) = Inactive.

The system will define Wig Wag Output State Active as Left Low Beam (LLB) =Active, Left High Beam (LHB) = Active, Right Low Beam (RLB) = Active and Right High Beam (RHB) = Active.

The headlight beam is ON when the BCM sees the key is in Ignition or accessory mode, and battery voltage is supplied to the specific headlight.

The headlight beam is OFF when the BCM sees the key is in Ignition or accessory mode, and no battery voltage is supplied to the specific headlight.

Table 30 Wig Wag Output States

Output State	Description of Output State	Duration of State (Seconds)
Output State 1	Left Low Beam (LLB) = OFF Right Low Beam (RLB) = ON Left High Beam (LHB) = ON Right High Beam (RHB) = OFF	0.4 s
Output State 2	LLB = ON RLB = OFF LHB = OFF RHB = ON	0.4 s
Output State 3	LLB = OFF RLB = ON LHB = ON RHB = OFF	0.2 s
Output State 4	LLB = ON RLB = OFF LHB = OFF RHB = ON	0.2 s
Output State 5	LLB = OFF RLB = OFF LHB = ON RHB = ON	0.4 s

Table 30 Wig Wag Output States (cont.)

Output State	Description of Output State	Duration of State (Seconds)
Output State 6	LLB = OFF RLB = OFF LHB = ON RHB = ON	0.2 s
Output State 7	LLB = OFF RLB = ON LHB = ON RHB = OFF	0.6 s
Output State 8	LLB = ON RLB = OFF LHB = OFF RHB = ON	0.6 s
Output State 9	LLB = OFF RLB = ON LHB = ON RHB = OFF	0.8 s
Output State 10	LLB = ON RLB = OFF LHB = OFF RHB = ON	0.8 s
Output State 11	LLB = OFF RLB = OFF LHB = ON RHB = ON	0.6 s

COMMONLY USED FUNCTIONALITY (INFORMATION, PROGRAMMING)**Table 30 Wig Wag Output States (cont.)**

Output State	Description of Output State	Duration of State (Seconds)
Output State 12	LLB = OFF RLB = OFF LHB = ON RHB = ON	0.8 s

Table 31 Wig Wag OFF States

OFF State	Description of OFF State	Duration of State (Seconds)
OFF State 1	All headlight beams inactive	0.4
OFF State 2	All headlight beams inactive	0.2
OFF State 3	All headlight beams inactive	0.6
OFF State 4	All headlight beams inactive	0.8

Headlights will cycle between Output States and OFF States. Refer to the table below

Table 32

Diamond Logic Builder (DLB) Value	Description of Value
1	Headlights cycles between Output State 1 and Output State 2.
2	Headlights cycles between Output State 3 and Output State 4.
3	Headlights cycles between Output State 1, OFF State 1, Output State 1, Output State 2, OFF State 1 and Output State 2.
4	Headlights cycles between Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, and Output State 4.
5	Headlights cycles between Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2 and Output State 4.
6	Headlights cycles between Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, and Output State 4, OFF State 2, Output State 4, OFF State 2 and Output State 4.
7	Headlights cycles between Output State 1, Output State 2, Output State 1, Output State 2, Output State 1, Output State 2, OFF State 1, Output State 5, OFF State 1, Output State 5, OFF State 1, Output State 5, and OFF State 1.
8	Headlights cycles between Output State 3, Output State 4, Output State 3, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, and OFF State 2.

Table 32 (cont.)

Diamond Logic Builder (DLB) Value	Description of Value
9	Headlights cycles between Output State 3, Output State 4, Output State 3, Output State 4, Output State 3, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 6 and OFF State 2.
10	Headlights cycles between Output State 3, Output State 4, Output State 3, Output State 4, Output State 3, Output State 4, Output State 3, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 6 and OFF State 2.
11	Headlights cycles between Output State 3, Output State 4, Output State 3, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2 and Output State 6.
12	Headlights cycles between Output State 1, Output State 2, Output State 1, Output State 2, OFF State 1, Output State 5, OFF State 1, Output State 5, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 1, Output State 2, Output State 1, Output State 2, OFF State 1, Output State 5, OFF State 1, Output State 5, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 1, Output State 2, Output State 1, Output State 2, OFF State 1, Output State 5, OFF State 1, Output State 5, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 6, OFF State 2, Output State 6, OFF State 2 and Output State 6.

Table 32 (cont.)

Diamond Logic Builder (DLB) Value	Description of Value
13	Headlights cycles between Output State 9, Output State 10, Output State 9, Output State 10, Output State 7, Output State 8, Output State 7, Output State 8, Output State 1, Output State 2, Output State 1, Output State 2, Output State 3, Output State 4, Output State 3, Output State 4, OFF State 2, Output State 12, OFF State 4, Output State 12, OFF State 4, Output State 11, OFF State 3, Output State 11, OFF State 3, Output State 5, OFF State 1, Output State 5, OFF State 1, Output State 6, OFF State 2, Output State 6, OFF State 2, Output State 9, OFF State 4, Output State 9, Output State 10, OFF State 4, Output State 10, Output State 9, OFF State 4, Output State 9, Output State 10, OFF State 4, Output State 10, Output State 7, OFF State 3, Output State 7, Output State 8, OFF State 3, Output State 8, Output State 7, OFF State 3, Output State 7, Output State 8, OFF State 3, Output State 8, Output State 1, OFF State 1, Output State 1, Output State 2, OFF State 1, Output State 2, Output State 1, OFF State 1, Output State 1, Output State 2, OFF State 1, Output State 2, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, Output State 3, OFF State 2, Output State 3, Output State 4, OFF State 2, Output State 4, OFF State 2, Output State 12, OFF State 4, Output State 12, OFF State 4, Output State 11, Output State 3, Output State 11, OFF State 3, Output State 5, OFF State 1, Output State 5, OFF State 1, Output State 6, OFF State 2, Output State 6 and OFF State 2.

Controlling Wig-Wag Lighting with Advanced Logic, Using individual Head Light Requests – With International® LT®, RH™, HV™, and MV™ Series trucks.

NOTE – Not compatible on MV™ Series Trucks with 597075 or 597394 for LED Headlights.

Feature 597479 can only be added by individuals with Engineering permissions. When feature 597479 is enabled, in DLB, advanced logic must be written to turn on the individual High and Low beam requests. When 597479 is added, it does not add any switches or functionality when used without advanced logic that uses rungs that use the headlight semaphores.

The Park Brake must be released for the High Beam requests to work. Low beam requests will work regardless of the park brake state.

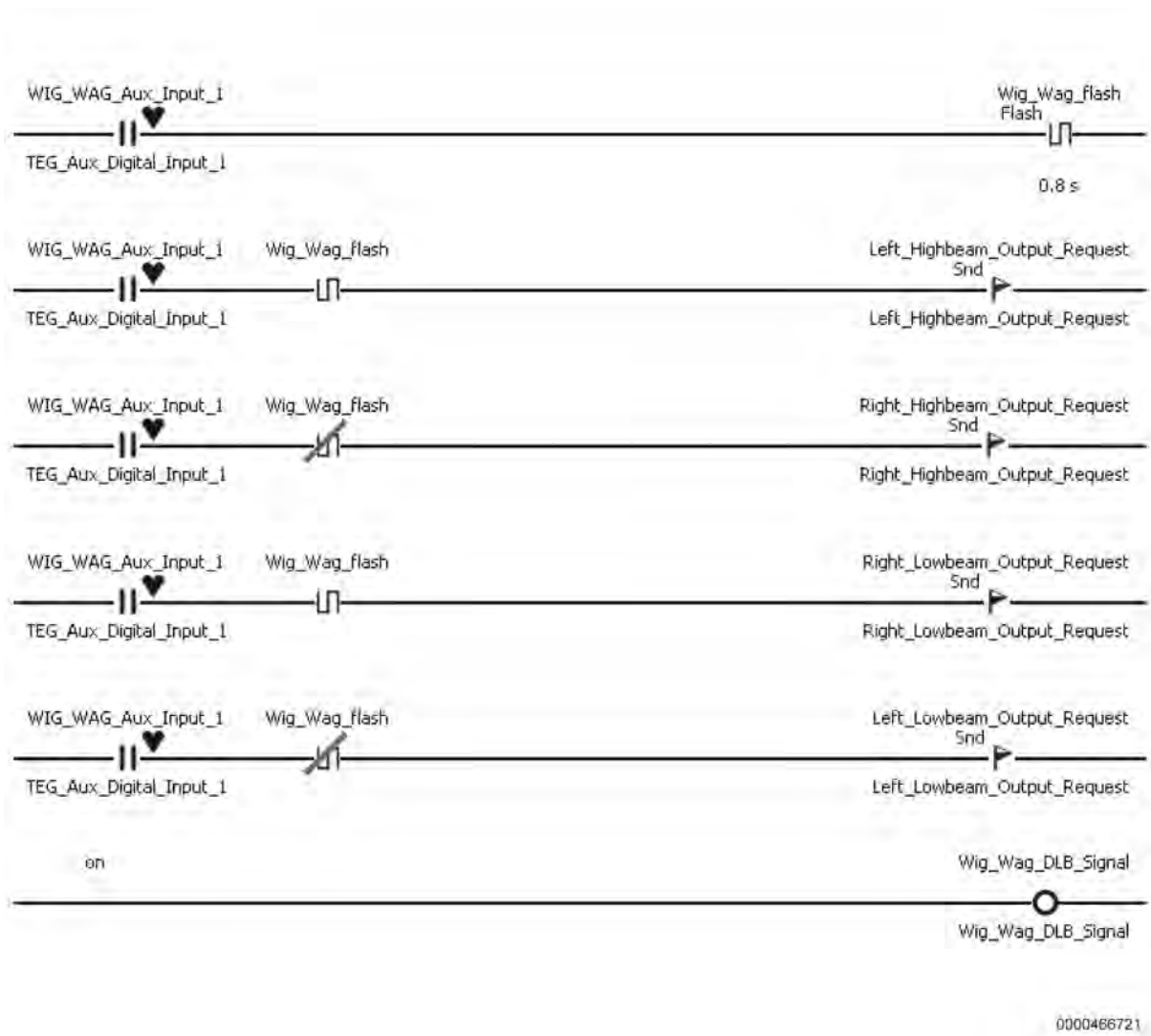


Figure 139 Individual Head Light Requests




CUSTOM STEERING WHEEL SWITCH FEATURE

Steering Wheel Switch Pod Configurations

NOTE – Clock spring part numbers and steering column harnesses may need to be changed, depending on the desired changes and vehicle configuration.

Custom steering wheel switch feature includes a right-side pod and a left-side pod. The pods are attached to the steering wheel discretely and contain normally open momentary contact switches. The pods have several configurations and part numbers.

Customer applications can be customized by using the part number configurations in the table.

Body Builder Configuration	Part Number	Configuration Layout
Body Builder Variant 1 — Blank	4307659C91	 0000474699
Body Builder Variant 2 — Cruise, Marker Interrupt, Blank	4324016C91	 0000474700
Body Builder Variant 3 — Cruise, Blank	4330394C91	 0000474701

Steering Wheel Switch Label Configurations

NOTE – The switches can be labeled using the stickers provided with part number 4333919C1.

NOTE – Refer to the appropriate integration guide for the most current information.

Labels are available for each steering wheel switch pod. Depending on the customer application, different labels will be used. Refer to the appropriate integration guide for detailed steering wheel switch label configurations.



0000474702

Figure 140 Steering Wheel Switch Label Sheet

Body Controller Software Feature Codes

NOTE – The cruise control functionality can be relocated from the steering wheel pods to the Aux Switch Pack in the instrument panel using feature code 597528.

Custom switch configuration requires combinations of various feature codes. Feature code 597080 refers to left-side pod and 597098 refers to right-side pod. These feature codes are needed if the corresponding pod is required in the steering wheel. These feature codes set up the analog inputs to the BCM from the switches.

All features associated with steering wheel switch pods that are intended to be used for custom application must be removed and / or not included in the configuration. Feature codes include, but may not be limited to:

- Feature code 597071– Marker Interrupt Switch
- Feature code 597078 – Headlight Interrupt Switch
- Feature code 597081 – Cruise Control Steering Wheel
- Feature code 597145 – Radio Controls
- Feature code 597177 – Cruise Control Switch
- Feature code 597619 – Adaptive Cruise Selectable Following Distance
- Feature code 597620 – Adaptive Cruise Selectable Following Distance for Fusion 3.0

The feature for the installed pod and the use of that pod for custom application must be configured. Refer to the table for detailed information.

	Feature Code to Add Pod to Configuration	Feature Code to Enable Pod for Custom Application
Left-Side Pod	597080	597649
Right-Side Pod	597098	597650

T	Feature	Description	Installed	Added Wit... =	Removed With ...
▶	0597080	BCM PROG, STEER WHEEL SWITCHES, Left Hand Pod	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
▶	0597098	BCM PROG, STEER WHEEL SWITCHES, Right Hand Pod	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
▶	0597649	BCM PROG, STEER WHEEL SWITCHES, Left Hand Pod use for c...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
▶	0597650	BCM PROG, STEER WHEEL SWITCHES, Right Hand Pod use for ...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
▶	0597071	BCM PROG, MARKER INTERRUPT SW Located in Steering Wheel	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
▶	0597078	BCM PROG, HEADLIGHT INTERRUPT Located in Steering Wheel	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
▶	0597081	BCM PROG, CRUISE CONT STEER WHEEL	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
▶	0597177	BCM PROG, CRUISE CONT STEER WH Cluster Version #2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
▶	0597619	BCM PROG, CRUISE CONT STEER WH Adaptive Cruise Follow C...	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

0000474703

Figure 141 Features Shown in DLB

Advanced Logic Programming

NOTE – Advanced logic programming, written with DLB, is required to enable the steering wheel switch customer applications.

The input signals used in DLB that read the switches are normally open contacts.

If latching operation of the output is desired a software latch must be used. One method is to use an intermediate variable with a toggle modifier and an edge modifier on the input to ensure proper controlled operation.

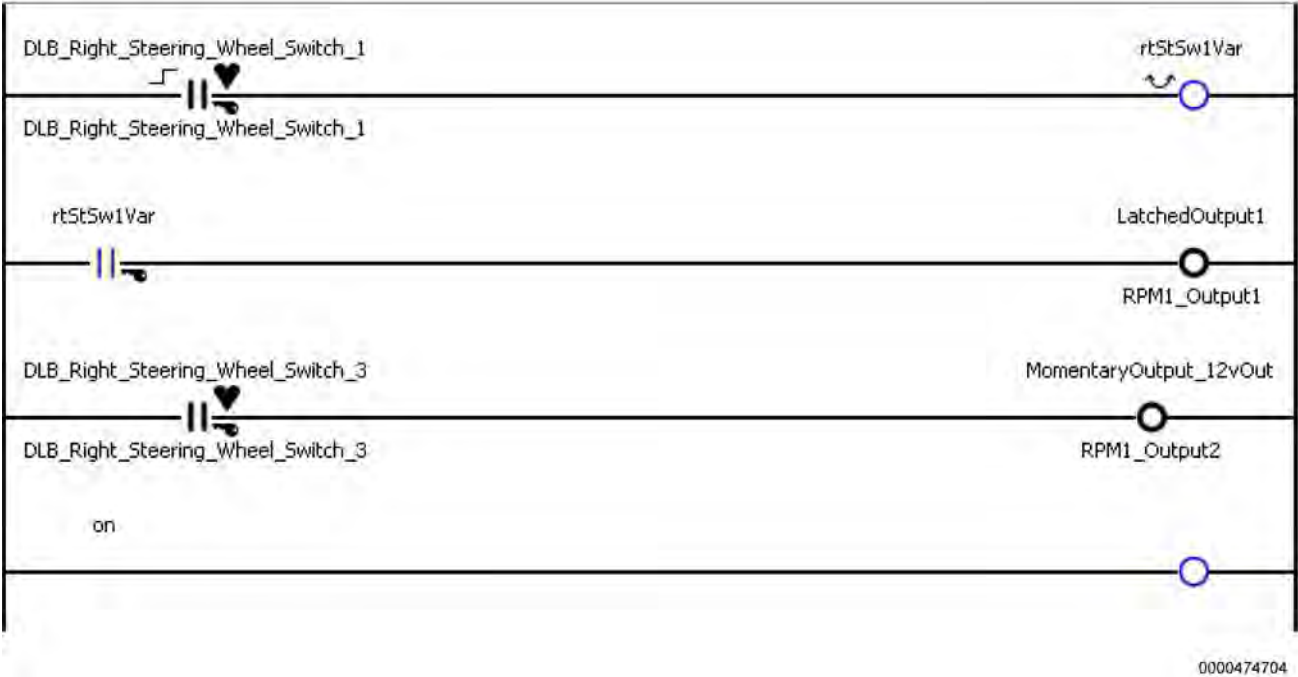


Figure 142 Advanced Ladder Logic Sample

ADVANCED PROGRAMMING FEATURES

FLASHERS

The Diamond Logic® Builder program offers a number of advanced functions that make ladder logic programming quick and easy for performing specific body equipment control features. The Diamond Logic Builder software user can configure these canned features to function as required by the vehicle application. Using these features eliminates the need to add third party control modules and / or components. The Diamond Logic Builder program provides a flexible flasher function that is useful for multiple applications. The flasher function may be used to control a single output or by using additional logic, a synchronized alternating flasher may be constructed to drive two or more outputs. The flasher may be used for body lamps, audible alarms or even to make the city horn beep in a repetitive manner. The flasher function provides a duty cycle of 50% ON and 50% OFF. Therefore, if the flasher is set to 1.0 second, the output will be ON for 0.5 seconds and OFF for 0.5 seconds. The time period of the flasher is adjustable by entering a value between 0.1 second and 600 seconds. Flashers may be constructed with a multitude of combinations of ladder logic signals before the flasher function is enabled. However for the purpose of training we shall examine two simple examples of turning on a flasher from a single rocker switch in the instrument panel. See the following examples.

Single Output Flasher

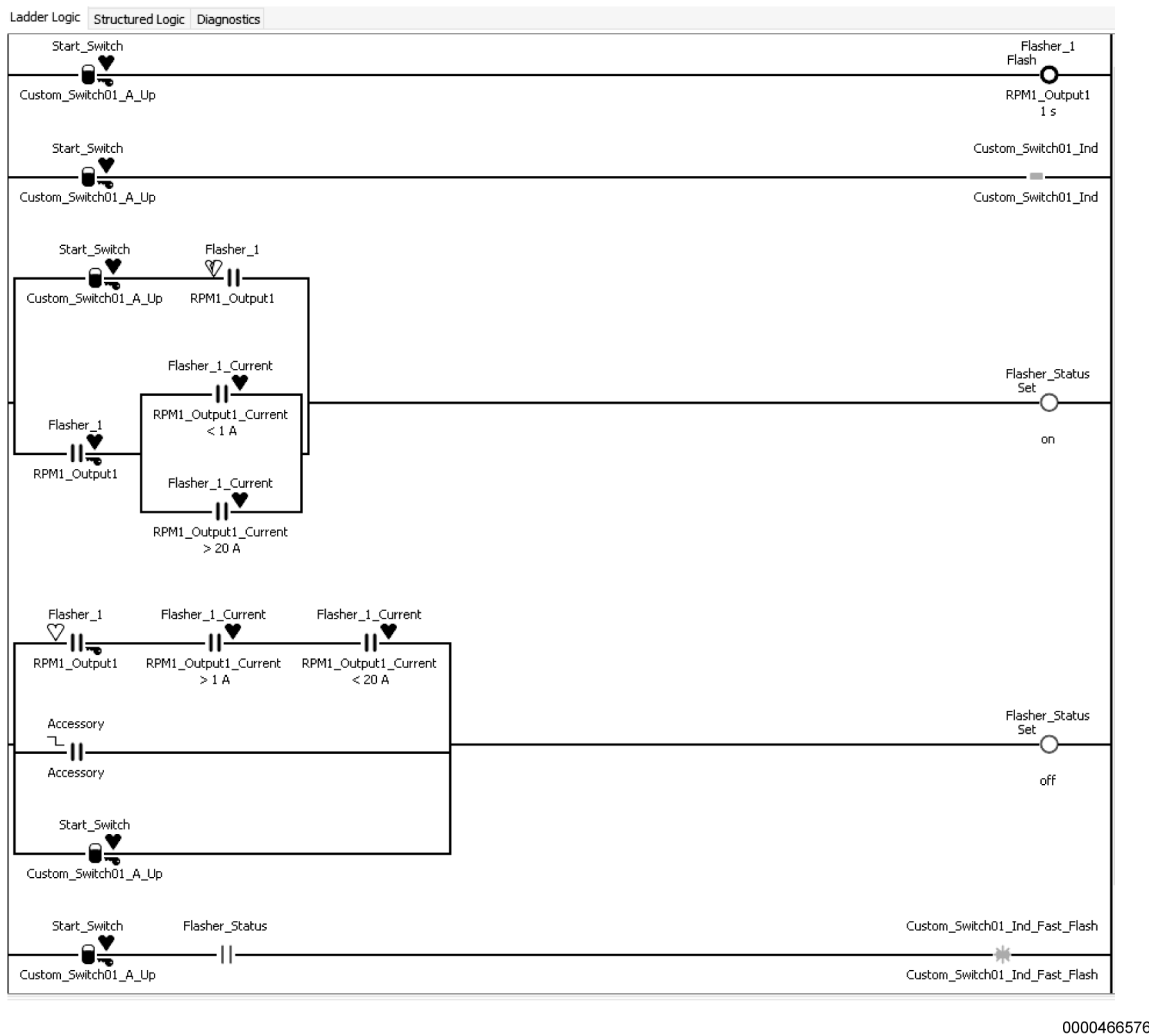


Figure 143 Single Output Flasher Example

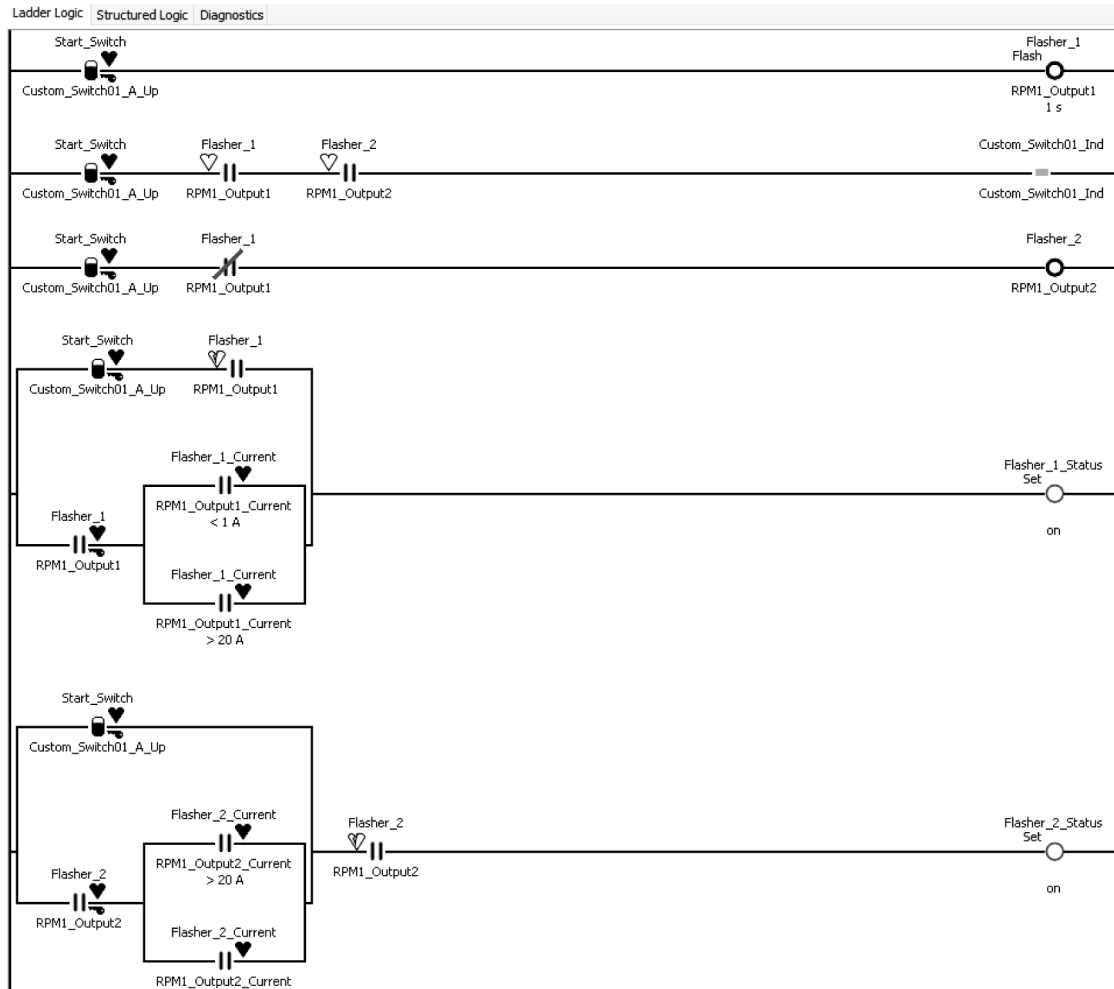
The first example shows a single output flasher. This flasher has a one second time period and directly controls one RPM output. The first rung will start the flasher as long as the rocker switch named Start_Switch is latched ON and the key is in the IGNITION or ACCESSORY position. The second rung serves as an indicator to the Operator that the flasher is ON when the rocker switch is ON.

Note that the flasher output could not be used directly to drive the GREEN indicator in the Start_Switch since it will be blinking OFF and ON as a flasher.

The third rung serves as an indicator to the driver when the Flasher_1 output is not functioning due to a bad status condition on the RPM output OR if the flasher output has a burned out bulb or is overloaded. A bad status will occur if the RPM has failed internally, the RPM Flasher_1 output is overloaded or shorted to ground, the communication link to the RPM has been broken or the RPM has lost its heavy current battery feed. A diagnostic fault code will accompany many of these failure modes. Other failure modes could occur in the electrical system that would render the Flasher_1 output signal inoperative. Failures within the switch pack or cabling to the switch pack would also cause the Flasher_1 output to be OFF, even though the Start_Switch

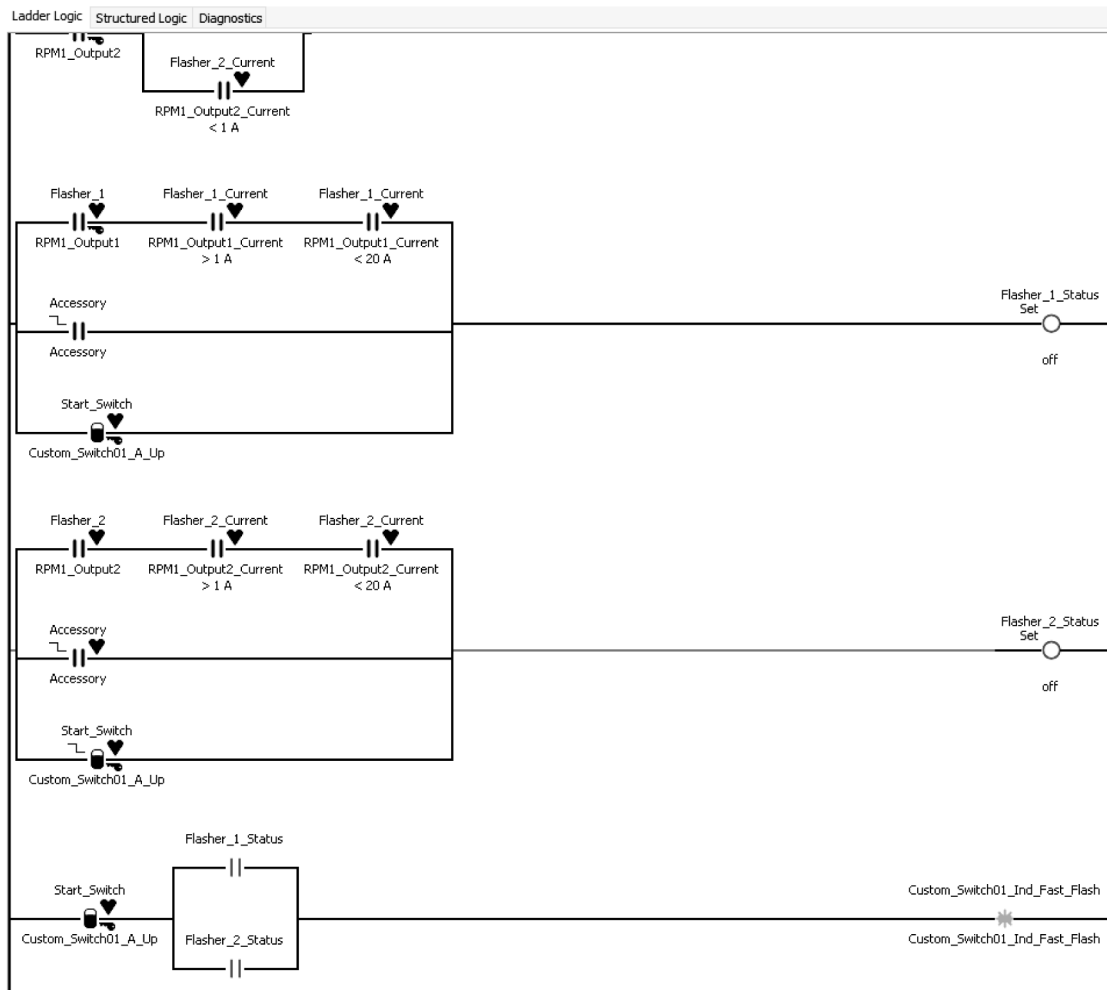
is latched ON. However, if a fault exists in the switch pack, it is not likely that communication between the BCM and the switch pack can be established to flash the GREEN indicator in the switch about the problem. Therefore, the third, fourth and fifth rung merely check for bad status on the Flasher_1 signal.

Dual Output Alternating Flasher



0000466574

Figure 144 Alternating Dual Output Flasher Example (Part 1)



0000466575

Figure 145 Alternating Dual Output Flasher Example (Part 2)

This example shows a synchronized alternating flasher. This flasher has a one second time period and directly controls two RPM outputs. The first rung will start the flasher as long as the rocker switch is ON. The second rung provides an indicator to the driver that the flasher is ON when the rocker switch is ON. The third rung will turn on a second RPM output if the rocker switch is ON and the key is in the ACCESSORY or the IGNITION position. The second output is driven by the inverted state of Flasher_1.

NOTE – Note the use of the Negate attribute has been applied to the Flasher_1 output on this rung.

Therefore, when Flasher_1 is ON, Flasher_2 is forced OFF. When Flasher_1 is OFF, Flasher_2 is forced ON. Including the rocker switch with the ACCESSORY check is required on this rung because Flasher_2 would always be ON with the ignition key and / or the rocker switch turned OFF. Placing the rocker switch on both rungs ensures that both flasher outputs will be OFF when the flashers are meant to be OFF. The state of these outputs will change every 0.5 seconds if the flasher period is set to 1.0 second. This method provides a well-controlled alternating flasher for two or more outputs.

NOTE – Note that the check for bad status on the fourth rung uses an OR condition, meaning that a bad status on either of the two flasher outputs will cause the GREEN indicator in the Start_Switch to display a fast flashing pattern to indicate that a problem exists in the flasher circuits.

The fourth rung provides an indicator to the driver when the RPM is not functioning due to a BAD STATUS condition on either the Flasher_1 signal or the Flasher_2 signal or if either flasher output has a burned out bulb or is overloaded. A bad status will occur if the RPM has failed internally, the RPM Flasher_1 or Flasher_2 outputs are overloaded or shorted to ground, the communication link to the RPM has been broken or the RPM has lost its heavy current battery feed. A diagnostic fault code will accompany many of these failure modes. Other failure modes could occur in the electrical system that would render the Flasher_1 or Flasher_2 output signals inoperative. Failures within the switch pack or cabling to switch pack would also cause the outputs to be OFF, even though the Start_Switch is latched ON. However, if a fault exists in the switch pack, it is not likely that communication between the BCM and the switch pack can be established to flash the GREEN indicator in the switch about the problem. Therefore, the third, fourth and fifth rungs check for bad status on the Flasher_1 and Flasher_2 signals as well as open or short circuit.

Diagnostic Descriptions for Flashers

The diagnostic description for flashers should be entered in the Diagnostics Tab of the ladder logic view. This description should contain an overall summary of all the signal elements or interlocks that must be true before the flasher will operate. In our example, the description is very simple and would indicate that a rocker switch shall control a RPM output in a one second flasher sequence as long as the ignition key is in the ACCESSORY or IGNITION position. List in detail all inputs and outputs including switch position in a specific switch pack, plus signal assignments to an output of a specific RPM address. This text description should contain all AND & OR logical terms in conjunction with specific signal names. Finally a diagnostic summary should be included to identify what indicators the driver or technician might witness during various failure modes. In our example, only a fast flashing sequence would be visible to the vehicle user while there are fault conditions present that are associated with the RPM that is powering the flasher output(s).

Diagnosing Flasher Circuits

Diagnosing flasher circuits may be accomplished with a few simple checks:

1. Check that the RPM has battery voltage at the RED power feed input.

NOTE – The module is protected with a fusible link at the battery box or starter stud.

2. Check for a fast flashing GREEN indicator in the rocker switch that controls the flasher. Check for burned out bulbs in the flasher system. No electrical system fault codes will be generated for burned out bulbs or open wiring between the RPM and the bulbs.
 - a. If yes, perform Step 3.
 - b. If there are no fast flash indicators and the flasher does not operate, go to Step 4.
3. Check for fault codes associated with the RPM used with the flasher. Resolve using the appropriate Service / Technician Manual Diagnostic Troubleshooting information.
4. Check for fault codes associated with the switch pack module used with the flasher. Resolve using the appropriate Service / Technician Manual Diagnostic Troubleshooting information.

ADVANCED PROGRAMMING FEATURES

5. If Diamond Logic® Builder is available to the technician, select the Advanced Logic View and place the program in Diagnostic mode while connected to the vehicle under test. Examine the signals on each ladder and verify that the indicator of OFF or ON is displayed based upon physical state of each input. Note whether the flasher outputs are blinking ON and OFF as desired. Note that the ON / OFF indicators will respond at a slower pace than real time for flashers faster than two seconds.

MASTER SWITCH WITH LOAD SEQUENCING

The Diamond Logic® Builder program provides a load sequencing function that may be coupled with a Master Switch control. Certain vehicle applications require the convenience of using a single master switch to enable a number of other switch controlled outputs for enabling body lamps or other loads. Load sequencing is valuable when a master switch will enable multiple high current outputs. Load sequencing is necessary to prevent large voltage dips, due to in-rush currents, that would occur if all outputs were enabled at the same instant. The voltage dips could be great enough to set off low voltage alarms or cause some vehicle circuit modules to go into a reset mode. Sequentially turning power outputs OFF or ON will keep the vehicle battery levels more constant during these modes and prevent electrical malfunctions. The Diamond Logic® Builder software makes incorporating this feature very easy by providing the user a canned special function icon to perform this load-sequencing task. A common rocker switch is used as the master switch element.

Master Switch with Load Sequencing Example

The following illustration is an example of a four-stage load sequencer with a master switch. This means that a single master switch will turn ON or OFF four additional outputs based upon the state of that switch. Each output can also be independently controlled using its respective rocker switch as long as the master switch is ON. The sequencer allows the user to enter a time in seconds between sequence steps. The same time shall be used for turning outputs OFF as well as ON. The sequence number entered with the icon is used as the starting point for a count up or count down control algorithm, i.e. a four means that there will be four levels of sequencing; see the illustration below.

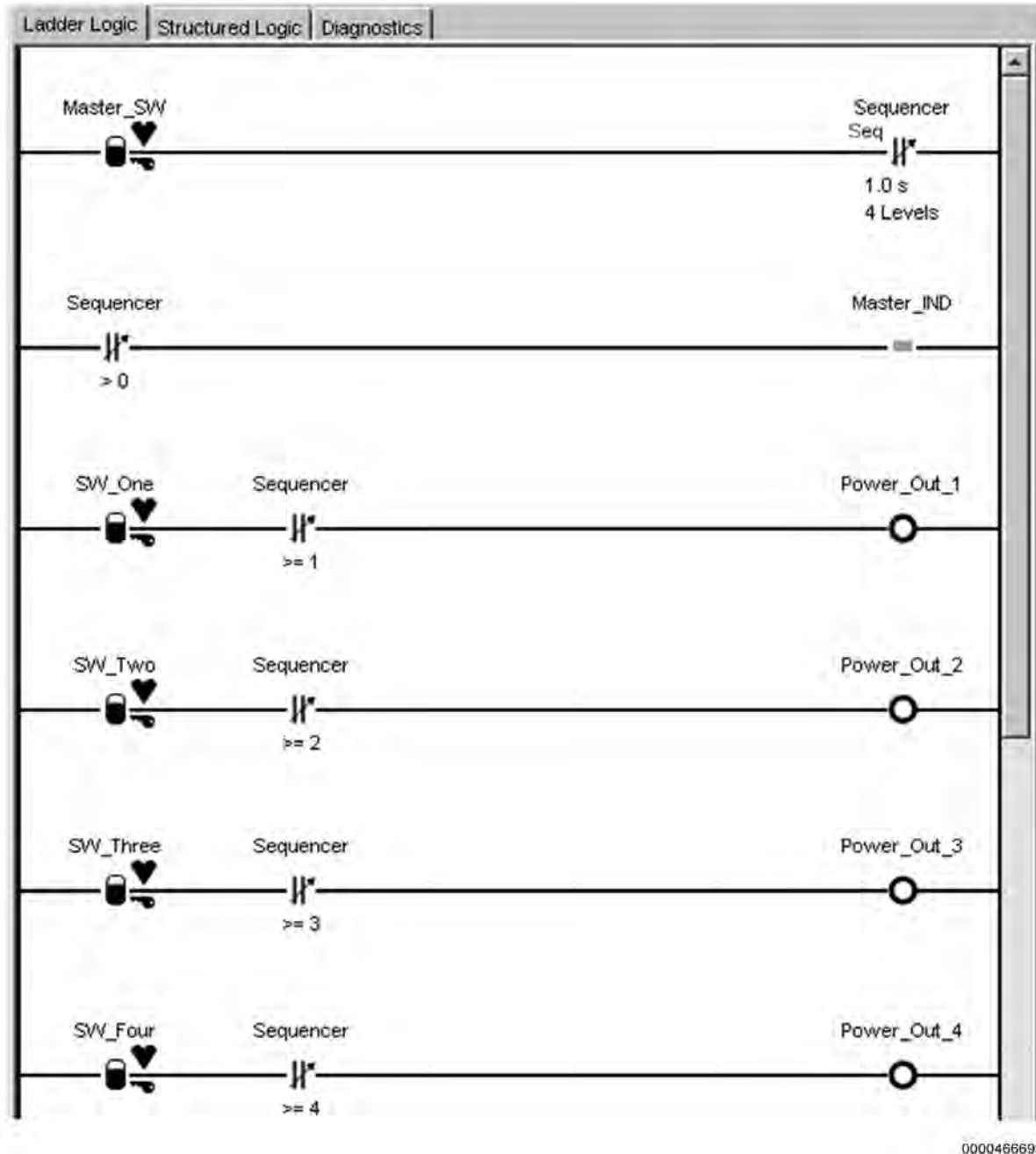


Figure 146 Four Level Load Sequencing Controlled by a Master Switch

The master sequence example listed above shows the basic method of creating sequenced outputs. This diagram does not show all possible uses of the switch indicators to develop a fully operational solution. Refer to the diagnostic portion of this section for a complete example of a switch channel that is fully outfitted with diagnostic monitoring.

As with other examples, load sequencing does not need to be controlled by a single rocker switch. Any number of logical signals may be arranged as input interlocks to enable this function. However, for this example, a master switch will be used to control the sequencing. The sequencer works in the following fashion:

1. The Master Rocker switch is a two position latched switch that must be turned ON.
2. The first rung shows that a master switch enables a special icon signal that is labeled sequencer. To create a sequencer signal select the My Variables tab and moving the cursor to the bottom of the Custom Variables list. Type in your sequencer name in the open space of the Custom Variable column. Using the left mouse switch, drag your sequencer signal to an open rung on the OUTPUT SIDE of your ladder logic view. You must drag your signal to the output side of a rung to make it into a sequencer function. Keeping the cursor over this signal, right-click your mouse to expose a number of signal options. Check the entry labeled as sequence. Now your newly created signal is a load sequencing function. Note that the signal icon changed from a circle on the ladder rung to two vertical lines with an arrow through it.
3. Once you have created a load sequencer signal, you must now enter the number of outputs that you wish to be controlled by the sequencer function. The default number is two but you can change this value by placing your cursor over the numeral two and performing a left switch double-click with your mouse. The number will now be highlighted. Enter your new number as a whole number or integer, no fractional tenths. Press enter to lock in your new selection.
4. Next you need to review the time between steps of the load sequencer. The default time is 1.0 second per step. If this is acceptable leave the entry as is. If you wish to change the value, place your cursor over the 1 sec numeral and left double-click with your mouse. The time will now be highlighted. Type in your new time with a value between 0.1 s and 600.0 s. Note that longer times will prevent outputs from being powered up until the time intervals have elapsed. This may be a nuisance when a vehicle is powered up and needed for service in a short time period. It is suggested that the 1.0 second time period is adequate for a load sequencer.
5. The next step is to place the same sequencer signal on THE INPUT SIDE of the ladder rungs that are to be managed with the load sequencer function. Using your mouse, drag and drop the sequencer to the first rung that is to be controlled. Note that the icon only has a number 2 located below it. This is the number that will decide when this rung is turned OFF or ON. Low numbers will be turned ON first and turned OFF last. Conversely, high numbers will be turned ON last and will be turned OFF first. Placing your cursor over the sequence number and performing left switches double-click will change the sequence number. The sequence number will now be highlighted. Type in your new number with a value between 1 and some reasonable maximum number like 24. Note in the example above, you must use the >= in front of the sequencer number in order to ensure that output remains ON or OFF as the sequence number counts up or down.

NOTE – Note that the GREEN indicator in the Master switch will be ON anytime the sequencer count is any number greater than zero, i.e. anytime a sequenced output is still ON.

6. Now that the sequencer signal has been configured and a sequencer signal icon has been placed on all ladder rungs that are to be controlled, lets review the theory of operation. Once the master switch has been latched ON and the key is in the ACCESSORY or IGNITION position, the sequencer function will begin counting up from zero to the maximum number located in the first sequencer icon. The time between steps is also found in the first sequencer icon. See the first rung in the example above. As the sequencer number is equal to or greater than the number attached in each ladder rung, the respective output will be enabled. Once the sequencer reaches the maximum count, the sequencer count will stay at that number.
7. Once the Master rocker switch has been turned OFF or the ignition key has been placed in the OFF position, the sequencer function will begin to count down toward zero using the same time period between steps that is listed in the first rung. As the sequencer number falls to a value that is less than the number on each rung that is controlled, the respective output will be disabled and turned OFF. Once the count has reached zero, all outputs will be turned OFF.

Diagnostic Description for Master Switch & Load Sequencing

The diagnostic description for Master Switch and Load Sequencer should be entered in the Diagnostics Tab of the ladder logic view. This description should contain an overall summary of all the signal elements or interlocks that must be true before the sequencer will operate. In our example, the description is very simple and would indicate that a Master rocker switch will control a four-step load sequencing function. A detailed listing of all inputs and outputs should be listed, including switch position in a specific switch pack, plus signal assignments to an output of a specific RPM address. This text description should contain all AND & OR logical terms in conjunction with specific signal names. Finally a diagnostic summary should be included to identify what indicators the driver or technician might witness during various failure modes.

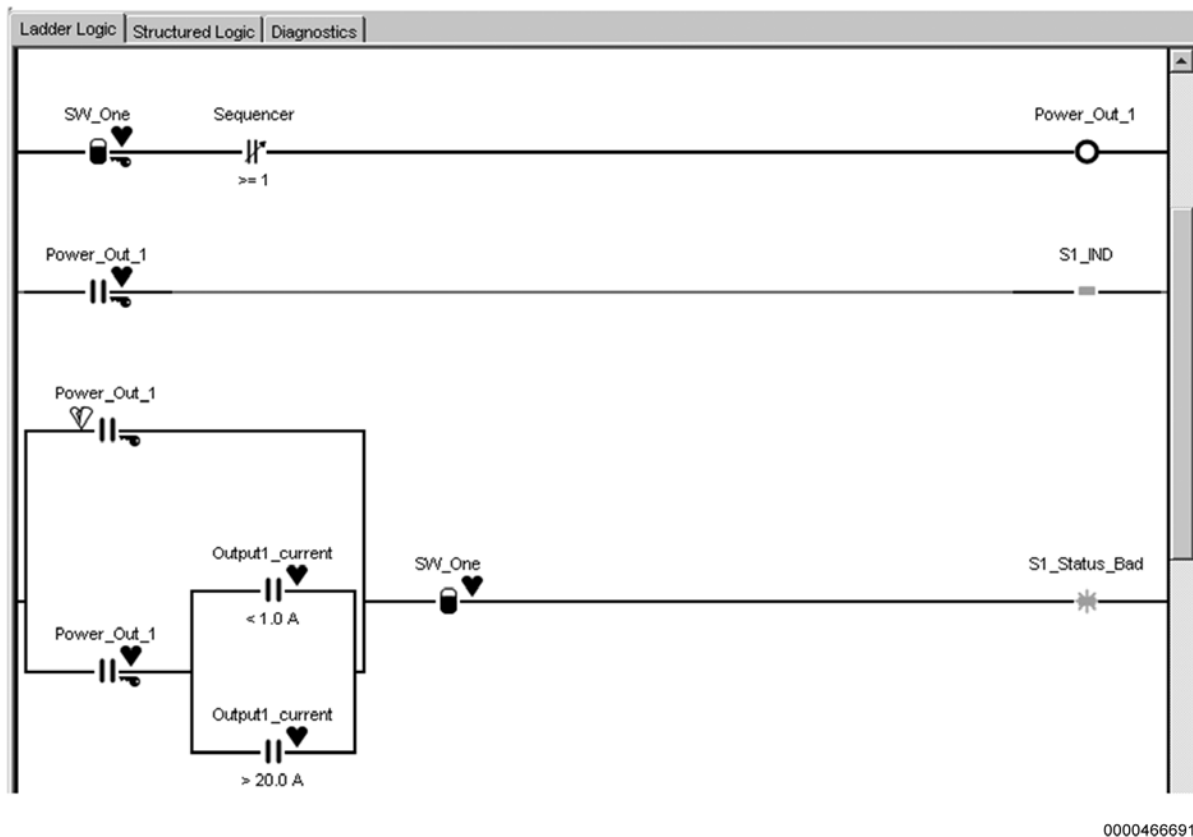


Figure 147 Diagnostic Design for a Load Sequencer

See the example above for a single channel load sequencer that has diagnostic monitoring built in using the full capabilities of the GREEN indicator in the rocker switch. The third rung in the diagram below checks for BAD STATUS of the RPM output. A bad status will occur if the RPM has failed internally, the RPM output is overloaded or shorted to ground, the communication link to the RPM has been broken or the RPM has lost its heavy current battery feed. A diagnostic fault code will accompany many of these failure modes. Other failure modes could occur in the electrical system that would render the sequencer output signal inoperative. Failures within the switch pack or cabling to the switch pack would also cause the outputs to be OFF, even though the Master Switch and SW_One are latched ON. Other diagnostic methods must be used if this is the case. However, if a fault exists in the switch pack, it is not likely that communication between the BCM and the switch pack can be established to flash the GREEN indicator in the switch about the problem.

In addition, the fast flashing sequence would also be displayed while an output is turned ON, but the load has a burned out bulb or otherwise open circuit OR the output is overloaded and drawing more than 20 amps. In our example, the load must draw at least one amp when the output is ON or it is assumed that the output has an open circuit.

Diagnosing a Master Switch & Load Sequencing Feature

Diagnosing a Master Switch and Load Sequencer Circuit requires knowledge of all interlocks that are implemented with the design. In addition, the driver or technician must be trained on the diagnostic indicators that are being displayed by the system. In this example, diagnostic indicators are provided with a fast or slow flash indicator on each rocker switch that controls an output. Diagnosing load sequencer circuits may be accomplished with a few simple checks:

1. Verify that the RPM has battery voltage at the RED power feed input. Note the module is protected with a fusible link at the battery box or starter stud.
2. Check for a fast flashing GREEN indicator in any of the rocker switches. This indicates a possible burned out bulb or open circuit wiring in the outputs that are controlled by the sequencer. No electrical system fault codes will be generated for burned out bulbs or open wiring between the RPM and the bulbs. The open circuit and overloaded diagnostic check will only operate when the respective RPM output is driven ON.
3. If a fast flashing GREEN indicator in the rocker switch is present, perform Step 4. If there are no fast flash indicators and the output still does not operate, go to Step 5.
4. Check for fault codes associated with the RPM used with the sequencer. Resolve using the appropriate Service / Technician Manual Diagnostic Troubleshooting information.
5. Check for fault codes associated with the switch pack module used with the sequencer. Resolve using the appropriate Service / Technician Manual Diagnostic Troubleshooting information.
6. If the Diamond Logic® Builder software is available to the technician, select the Advanced Logic View and place the program in Diagnostic mode while connected to the vehicle under test. Examine the signals on each ladder and verify that the indicator of OFF or ON is displayed based upon physical state of each input.

LOAD MANAGEMENT

IMPORTANT – Please note that load managing can only be accomplished at this time while the ignition key is in the ACCESSORY or IGNITION position. With key off, the battery voltage signal will be measured as zero volts.

The Load Management feature of the Diamond Logic® Builder program provides a valuable means to shut OFF RPM loads based upon low battery voltage or other logic driven events. The Diamond Logic® Builder software makes incorporating this feature very easy by providing the user a pair of canned special function icons to perform the load-managing task. This software-driven function eliminates the costs of third party after market modules, all associated relays and the wiring that must be added by the body builder. The load manager is completely flexible in that you may configure the shedding of loads based upon a single logical event such as low voltage or you can use multiple copies of the load manager feature to load or shed multiple outputs based upon multiple voltage events or various logic driven conditions.

Single Point Load Manager

The Single Point Load Manager provides a means of turning OFF RPM loads based upon a single low voltage trip point. The feature also provides the ability to turn outputs back ON based upon a higher voltage trip point. It is recommended that a dead band range of at least 0.5 volts be entered to ensure that the load manager does not continually shed and re-enable the outputs as the battery voltage hovers near the trip point.

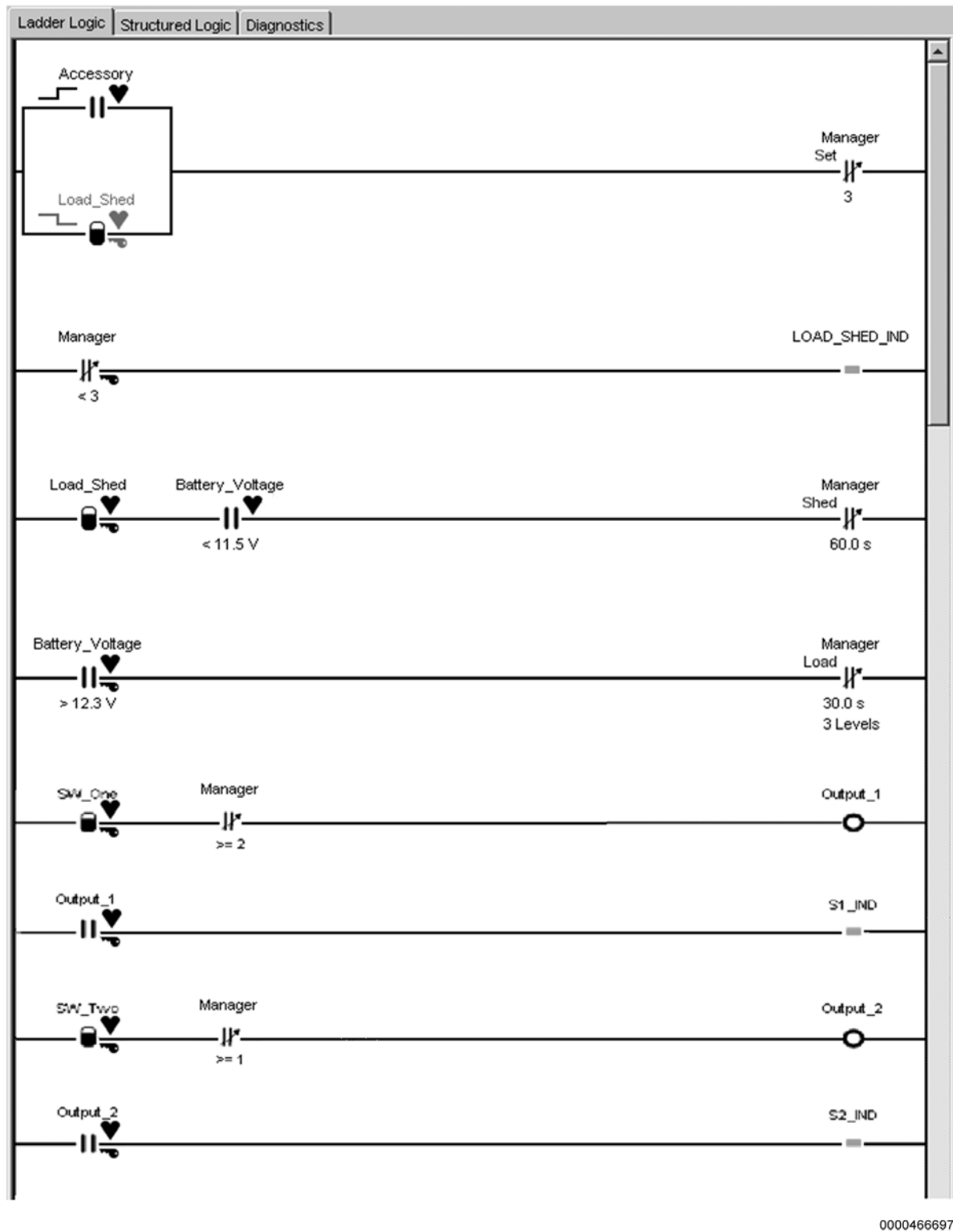


Figure 148 Single Point Load Manager

ADVANCED PROGRAMMING FEATURES

The above figure is an example of a single point load manager that will shed two outputs when the battery voltage falls below 11.5 volts and will re-enable the outputs ON when the battery voltage is greater than 12.3 volts. The body builder should choose the actual trip points based upon past practice, the current draw of the vehicle loads and the charging ability of the alternator. In addition, the load manager feature provides the ability to enter a time between each step of load shedding or load enabling. These times may be independent of each other.

The load manager operates by incrementing or decrementing a manager variable. The process of shedding loads is done by decrementing a variable by a count of one each time the specified time interval has elapsed. Enabling the outputs is achieved by incrementing the same variable. When the count reaches zero, all outputs will be OFF. When the count reaches three, the incrementing will stop and all outputs will be ON.

The first rung shows that either the action of turning the ignition key to the ACCESSORY or RUN position OR turning OFF the load manager switch in the instrument panel will set the load manager to the maximum load number or in other words, turn ON all the outputs being controlled by the load manager. This action is necessary to force the outputs ON every time the ignition key is cycled through the OFF position so all outputs will be operational when the vehicle is initially started. Likewise, if it is desired to stop the load manager function with the LOAD SHED rocker switch, the act of turning that switch OFF will also force all the outputs ON immediately. It must be noted that the load manger count variable should always be set to one count greater than the number of outputs that are to be controlled. The load manager does not apply the time interval to the first count reduction once the logical conditions are met to begin shedding.

The second rung shows the conditions for setting up the load shedding function. The logical requirements on the left side of the ladder rung indicate that the LOAD SHED switch in the instrument panel must be ON and the battery voltage must be less than 11.5 volts. The load-shed variable on the right side of the rung is created in the following manner. Select the MY VARIABLES tab and move your cursor to the end of the list to the blank space. Enter the desired name of your load shedder variable in the CUSTOM VARIABLE column. Using the left switch of the mouse to drag and drop the new load shedder signal to the output side of a blank rung. Now place the cursor over the variable and perform a right switch mouse click to reveal a number of options. Select the SHED option to make this rung a load shedder. Next you will see that the variable is now a load shedder with a default time between sheds of 1 second. You can change this time by double-clicking on the 1 second number until it is highlighted. Now enter your desired time interval in seconds, being careful to include the s for a unit of measure. The range for the time interval is from 0.1 second to 600 seconds. The time interval between shedding outputs is chosen to be 60 seconds for this example. Repeat the process on another rung, except select the LOAD option to make the variable enable outputs based upon new logic conditions that may be entered on the left side of the rung.

NOTE – Note that the time between the loads turning ON is 30 seconds and that the battery voltage must be greater than 12.3 volts.

See the third rung for an example of setting up the loading function.

The fourth rung shows the usage of the load managing variable with switches and RPM outputs. See that the variable called Manager has been placed between the input switch and the RPM output. Used on the input side, the Manager variable has a sequence number attached to it. This number is incremented in order to turn outputs ON and decremented in order to turn outputs OFF. As we stated before, in order for the first output to be turned OFF with the correct timing, the sequence number below the variable must be one less than the number entered above in the setup rungs for the load manager. Therefore, our first output to be shed has a number 2 attached to it. The second output on rung 6 has a 1 attached to the same load manager variable. Therefore the sequence of events for load shedding will be:

- If the load manager switch is ON, the ignition key is in the RUN or in the ACCESSORY position and the battery voltage falls below 11.5 volts, the load manager variable will be decremented to 2 immediately.

- If the battery voltage stays below 11.5 volts for 60 seconds, the load manager variable will be decremented to 1. Now the 4th rung will not be enabled and the Output_1 will be turned OFF.
- If the battery voltage stays below 11.5 volts for 60 more seconds, the load manager variable will be decremented to 0. Now the 6th rung will not be enabled and the Output_2 will be turned OFF.
- The variable called Manager will stay at 0 for as long as battery voltage is less than 11.5 volts.

Once the battery voltage is higher than 12.3 volts, the events for enabling outputs are:

- If the load manager switch is ON, the ignition key is in the RUN or in the ACCESSORY position and the battery voltage rises above 12.3 volts, the load manager variable will be incremented to 1 after 30 seconds. Now the 6th rung will be enabled and the Output_2 will be turned ON.
- If the battery voltage stays above 12.3 volts for 30 more seconds, the load manager variable will be incremented to 2. Now the 4th rung will be enabled and the Output_1 will be turned ON.
- After another 30 seconds of battery voltage above 12.3 volts the variable called Manager will be incremented to 3 and stay at that value.

NOTE – Note in the diagram above that the GREEN indicators for SW_One and SW_Two will be ON only when the RPM outputs are ON.

See the diagnostic description listed below for additional ways to use these indicators to alert the driver that an output has been turned OFF due to an active load manager function.

Multi-Point Load Manager

The Multi-Point Load Manager example provides a means to turn OFF RPM outputs based upon multiple low voltage trip points. Conversely, the example provides the ability to turn outputs back ON based upon multiple higher voltage trip points. It is recommended that a dead band range of at least .5 volts be entered to ensure that the load manager does not continually shed and re-enable the outputs as the battery voltage hovers near the trip point.

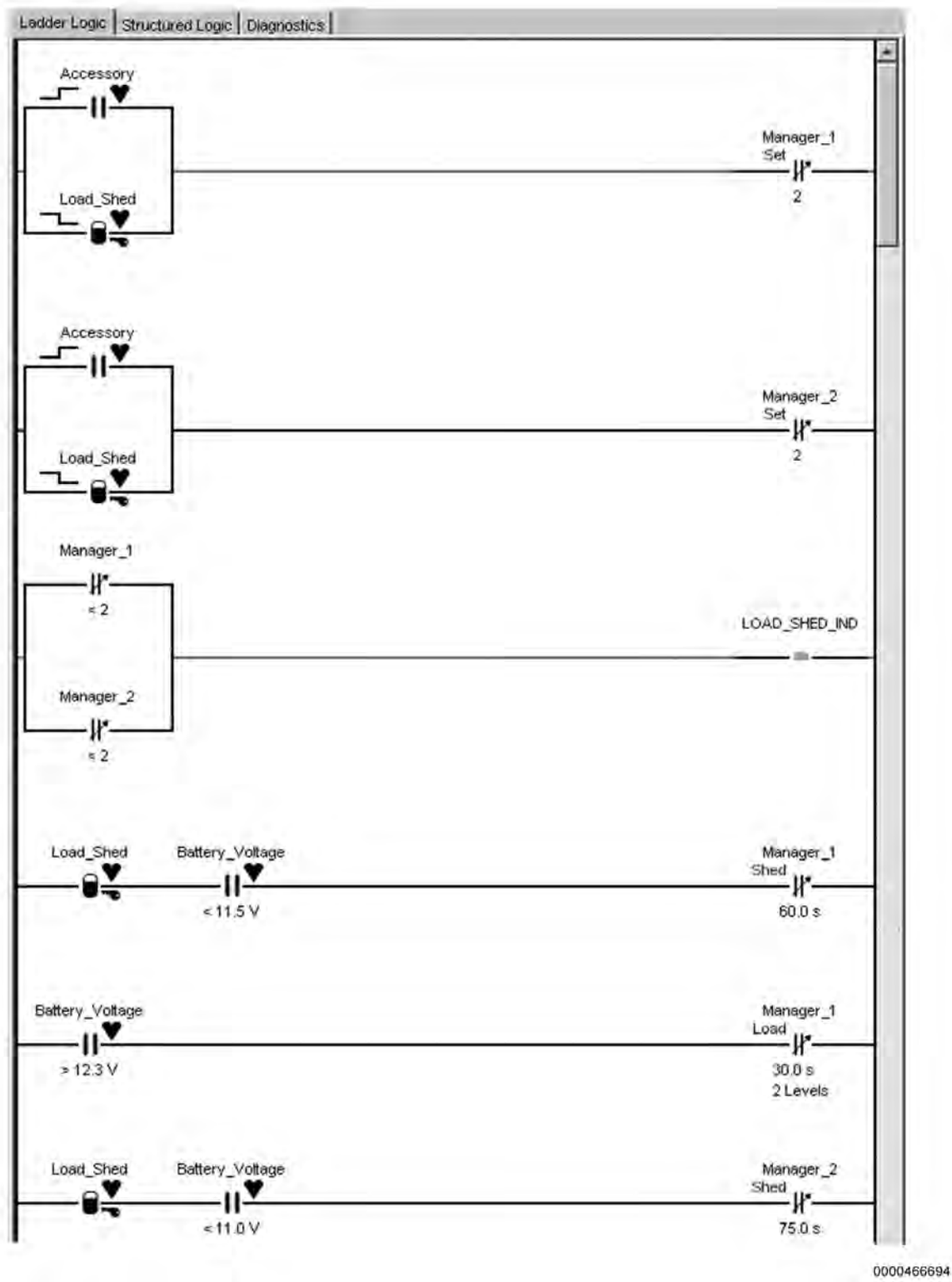


Figure 149 Multi-Point Load Manager (Part 1)

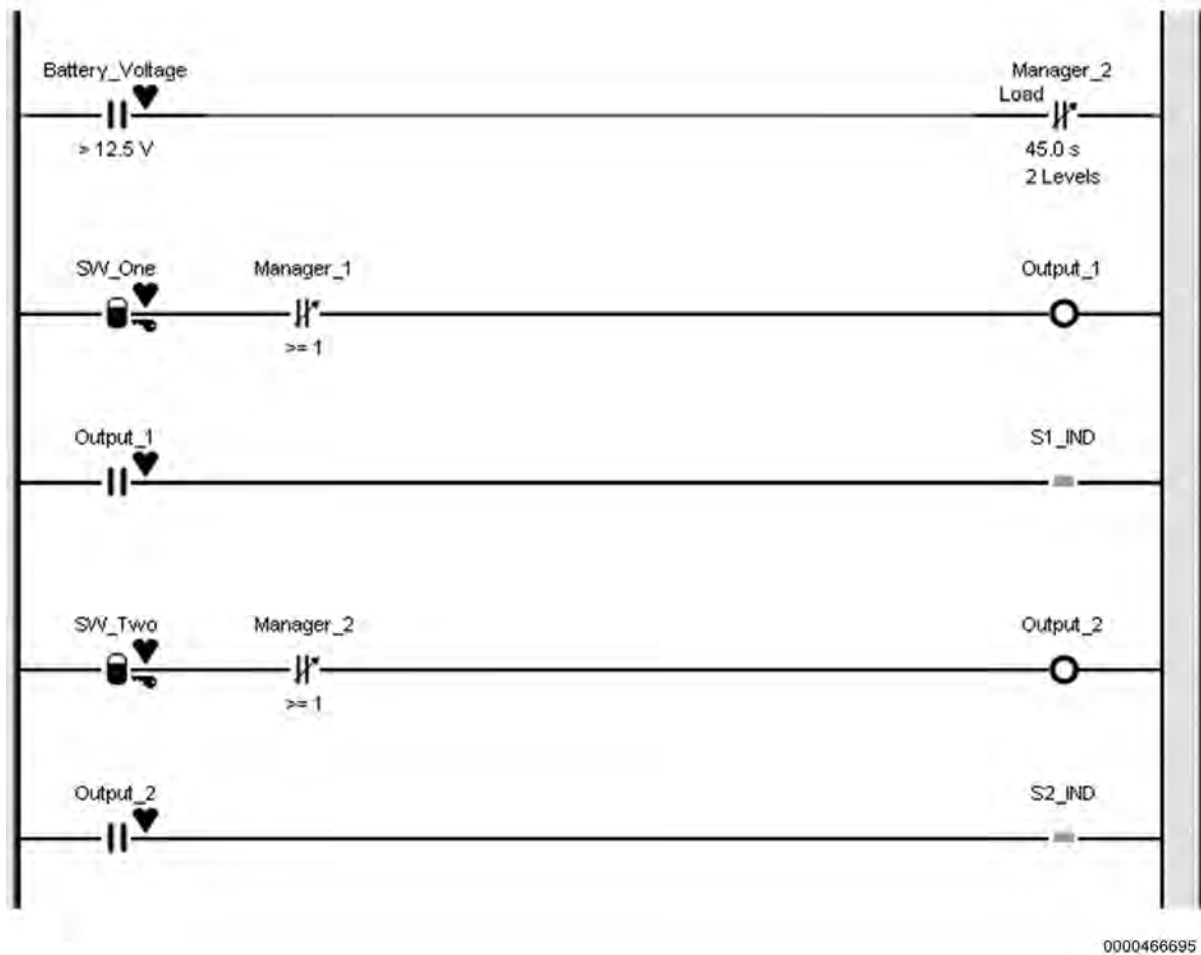


Figure 150 Multi-Point Load Manager (Part 2)

See the example above of a multi-point load manager that will shed one output when the battery voltage falls below 11.5 volts and will shed the second output when the battery voltage falls below 11.0 volts. The outputs will be turned back ON when the battery voltage is greater than 12.3 volts for the first output and 12.5 volts for the second output. The body builder should choose the actual trip points based upon past practice, the current draw of the vehicle loads and the charging ability of the alternator. In addition, the load manager feature provides the ability to enter a time between each step of load shedding or load enabling. The times may be independent of each other.

The multi-point load manager operates by incrementing or decrementing two different manager variables independently. The process of shedding loads is done by decrementing a variable by a count of one each time the specified time interval has elapsed. When the count reaches zero, all outputs will be OFF. Enabling an output is achieved by incrementing the same manager variable. When the count reaches two, the incrementing will stop and the outputs will be ON.

ADVANCED PROGRAMMING FEATURES

The first and second rungs show that either the action of turning the ignition key to the Accessory or Run position OR turning OFF the load manager switch in the instrument panel will set the load managers to the maximum load number or in other words, turn ON all the outputs being controlled by the load managers. This action is necessary to force the outputs ON every time the ignition key is cycled through the OFF position so all outputs will be operational when the vehicle is initially started. Likewise, if it is desired to stop the load manager function with the LOAD SHED rocker switch, the act of turning that switch OFF will also force all the outputs ON immediately. It must be noted that the load manger count variable should always be set to one count greater than the number of outputs that are to be controlled. The load manager does not apply the time interval to the first count reduction once the logical conditions are met to begin shedding.

The third, fourth, fifth and sixth rungs show the conditions for setting up the two independent load-managing functions. The logical requirements on the left side of the third and fifth ladder rung indicate that the LOAD SHED switch in the instrument panel must be ON and the battery voltage must be less than 11.5 volts for load manager 1 and less than 11.0 volts for load manager 2. The load-shed variables on the right side of the rung are created in the following manner. Select the My Variables TAB and move your cursor to the end of the list to the blank space. Enter the desired name of your load-shed variable in the Custom Variable Column. Use the left switch of the mouse to drag and drop the new load shed signal to the output side of a blank rung. Now place the cursor over the variable and perform a right switch mouse click to reveal a number of options. Select the Shed option to make this rung a load shedder. Next you will see that the variable is now a load shedder with a default time between sheds of 1 second. You can change this time by double-clicking on the 1 second number until it is highlighted. Now enter your desired time interval in seconds, being careful to include the s for a unit of measure. The range for the time interval is from .1 second to 600 seconds. The chosen time interval between shedding outputs is chosen to be 60 seconds for load manager 1 and 75 seconds for load manager 2. Repeat the process on another rung, except select the LOAD option to make variable enable outputs based upon new logic conditions that may be entered on the left side of the rung. See the fourth and sixth rung for an example of setting up the loading function. Note that the time between the loads turning ON is 30 seconds and that the battery voltage must be greater than 12.3 volts for manager 1 and 45 seconds with battery voltage greater than 12.5 volts for manager 2.

The seventh and ninth rungs show the usage of the load managing variables with switches and RPM outputs. See that the variables called Manager_1 and Manager_2 have been placed between the input rocker switches and the RPM outputs respectively. Used on the input side, the Manager variable has a sequence number attached to it. This number is incremented in order to turn outputs ON and decremented in order to turn outputs OFF. As we stated before, in order for the first output to be turned OFF with the correct timing, the sequence number below the variable must be one less than the number entered above in the setup rungs for the load manager. Therefore, we have attached a number of 1 to each manager variable that is to be shed. The sequence of events for load shedding will be:

- If the load manager switch is ON, the ignition key is in the RUN or in the ACCESSORY position and the battery voltage falls below 11.5 volts, the load manager variable will be decremented to 1 immediately.
- If the battery voltage stays below 11.5 volts for 60 seconds, the load manager 1 variable will be decremented to 0. Now the 7th rung will not be enabled and the Output_1 will be turned OFF.
- If the battery voltage drops below 11.0 volts for 75 seconds, the load manager 2 variable will be decremented to 0. Now the 9th rung will not be enabled and the Output_2 will be turned OFF.

The load Manager variables will stay at 0 for as long as battery voltage is less than 12.3 volts for manager 1 and 12.5 volts for manager 2.

Once the battery voltage is higher than 12.3 volts, the events for re-enabling outputs will be:

- If the load manager switch is ON, the ignition key is in the RUN or in the ACCESSORY position and the battery voltage rises above 12.3 volts, the load manager 1 variable will be incremented to 1 after 30 seconds. Now the 7th rung will be enabled and Output_1 will turn ON.
- If the battery voltage rises above 12.5 volts for 45 seconds, the load manager 2 variable will be incremented to 1. Now the 9th rung will be enabled and Output_2 will turn ON.
- After 30 more seconds of battery voltage above 12.3 volts the Manager 1 variable will be incremented to 2 and stay at that value.
- After 30 more seconds with battery volts above 12.5 volts the Manager 2 variable will be incremented to 2 and stay at that value.

NOTE – Note in the diagram above that the GREEN indicator in SW_One and SW_Two will be ON only when the RPM outputs are ON.

See the diagnostic description listed below for additional ways to use these indicators to alert the driver that an output has been turned OFF due to an active load manager event.

Diagnostic Descriptions for Load Managers

The diagnostic description for Load Managers should be entered in the Diagnostics Tab of the ladder logic view. This description should contain an overall summary of all the signal elements or interlocks that must be true before the load manager will operate. In our example, the description would indicate that a Load Shed rocker switch and vehicle battery voltage control a two-level load manager function. A detailed listing of all inputs and outputs should be listed, including switch position in a specific switch pack, plus signal assignments to outputs of a specific RPM address. This text description should contain all AND & OR logical terms in conjunction with specific signal names. Finally a diagnostic summary should be included to identify what indicators the driver or technician might witness during various failure modes.

See the example below for a single point load manager with diagnostic monitoring built in using the full capabilities of the GREEN indicator in the rocker switch. The third rung in the diagram below checks for BAD STATUS of the RPM output. A bad status will occur if the RPM has failed internally, the RPM output is overloaded or shorted to ground, the communication link to the RPM has been broken or the RPM has lost its heavy current battery feed. A diagnostic fault code will accompany many of these failure modes. Other failure modes could occur in the electrical system that would render the load manager output signals inoperative. Failures within the switch pack or cabling to switch pack would also cause the outputs to be OFF, even though a rocker switch is latched ON. However, if a fault exists in the switch pack, it is not likely that communication between the BCM and the switch pack can be established to flash the GREEN indicator in the switch about the problem. Other diagnostic methods must be used if this is the case. In addition, the fast flashing sequence would be displayed while an output is turned ON, but the load has a burned out bulb or otherwise open circuit OR if the output is overloaded and is drawing more than 20 amps. In our example, the load must draw at least one amp when the output is ON or it is assumed that the output has an open circuit. The indicator will display a slow flashing pattern if the switch is ON but the load manager has the output turned OFF.

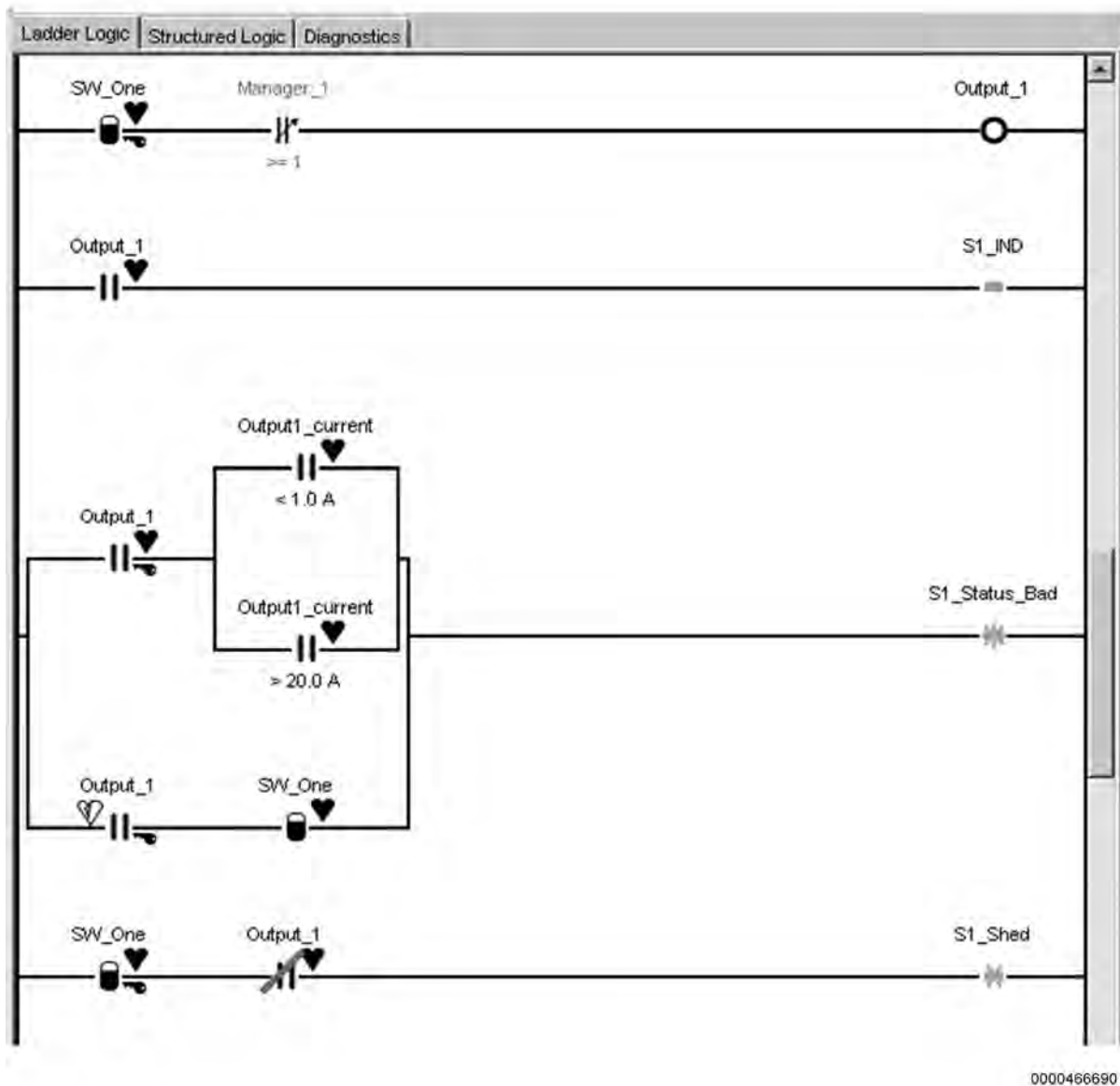


Figure 151 Diagnostic Design for Load Managers

Diagnosing Load Managers

Diagnosing a Master Switch and Load Sequencer Circuit requires knowledge of all interlocks that are implemented with the design. In addition, the driver or technician must be trained on the diagnostic indicators that are being displayed by the system. In this example, diagnostic indicators are provided with a fast or slow flash indicator on each rocker switch that controls an output. Diagnosing load manager circuits may be accomplished with a few simple checks:

1. Verify that the RPM has battery volts at the RED power feed input. Note the module is protected with a fusible link at the battery box or starter stud.

2. Check for a fast flashing GREEN indicator in any of the rocker switches. This indicates a possible burned out bulb, open circuit wiring in the outputs or overloaded outputs that are controlled by the sequencer. No electrical system fault codes will be generated for burned out bulbs or open wiring between the RPM and the bulbs. The open circuit diagnostic will only operate when the respective RPM output is driven ON.
 - a. If yes, perform Step 3.
 - b. If there are no fast flash indicators and the output still does not operate, go to Step 4.
3. Check for fault codes associated with the RPM used with the sequencer. Resolve using appropriate Service / Technician Manual Diagnostic Troubleshooting information.
4. Check for fault codes associated with the switch pack module used with the sequencer. Resolve using Service / Technician Manual Diagnostic Troubleshooting information.
5. If any of the GREEN switch indicators in the rocker switches display a slow flashing pattern, the load manager function has disabled the outputs. Restore battery voltage to normal operational levels to allow the load manager to re-enable the outputs.
6. If Diamond Logic® Builder is available to the technician, select the Advanced Logic View and place the program in Diagnostic mode while connected to the vehicle under test. Examine the signals on each ladder and verify that the indicator of OFF or ON is displayed based upon physical state of each input.

TIMERS

Timer Basics

The Diamond Logic® Builder program allows the user to measure time intervals in a variety of ways. The two main purposes for a timer are to enable an output FOR a prescribed amount of time or to enable an output AFTER a specific amount of time has elapsed.

Timers in the Diamond Logic® Builder program are designed as count down timers, much like an egg timer in your kitchen. A timer can be placed into the following states:

- Start the Timer
- The Timer is Running
- The Timer is Expired
- The Timer is Stopped

Each of these modes may be enabled or monitored by enabling key attributes to a signal that has been created to be a timer function.

Implementing the usage of timers in advanced logic writing requires that the user must understand some basic operational principles. Remember that advanced logic rungs are executed every .020 seconds. Therefore, steps must be taken to ensure that timers are not continuously re-started with every processing cycle. Likewise, logical signal icons must be arranged in a manner to prevent the stopping of a timer before the cycle is complete. If desired, signal icons may be fashioned in manner to allow a timer to manipulate an output in a variety of ways; either delay the engagement of an output or force an output on for a prescribed length of time. The following paragraphs provide detailed descriptions of how to use timers in various modes of operations.

Creating a Timer

1. Select the ADVANCED LOGIC tab.
2. Select the MY VARIABLES on the right-side of the screen.
3. Move your cursor to the end of the list where a blank space is found.
4. Type in the name of your timer in the Custom Signal column.
5. Using your mouse, drag the icon of this timer signal to the right-side of an open ladder rung.
6. Place the cursor over this new signal and right-click the mouse to reveal possible options.
7. Select the START attribute if you wish this signal to start the timer. The signal icon now appears to be a clock with a GREEN circle beside it and that 1.0 s is visible below the icon.
8. If desired, change this default time of one second to any value between 0 and 600 seconds. The time may be entered with a resolution of 0.020-second intervals. Timer values must be entered with a complete notation, such as . 5s or 12s. The unit of measure must be included with the numerical value. Letter case must be maintained with your entry.

The timer icon will have a GREEN circle beside the clock to denote the timer is started.

Checking to See if a Timer is Running

1. Using your mouse, drag the icon of this timer signal to the left-side of an open ladder rung.
2. Place the cursor over this new signal and right-click the mouse to reveal possible options.
3. Select the appropriate attributes:
 - Select RUNNING if you wish to check that the timer is running.
 - Select the NEGATE and RUNNING if you want to check that the timer is not running.

The timer icon will have a smaller clock with the hands showing elapsed time to denote the timer is running.

Checking a Timer for Expiration

1. Using your mouse, drag the icon of this timer signal to the left-side of an open ladder rung.
2. Place the cursor over this new signal and right-click the mouse to reveal possible options.
3. Select the EXPIRED attribute.

If the timer has expired, it will have a smaller clock with the hands at 12.

A timer will stay in the expired mode until the timer is stopped or restarted.

Stopping a Timer

1. Using your mouse, drag the icon of this timer signal to the right-side of an open ladder rung.
2. Place the cursor over this new signal and right-click the mouse to reveal possible options.
3. Select the STOP attribute if you wish the timer to be stopped by the logic on the left side of the rung. The timer icon will have a RED stop sign beside the clock.

The timer will stay in the stopped mode until it is restarted.

Delayed Engagement of an Output Using a Timer

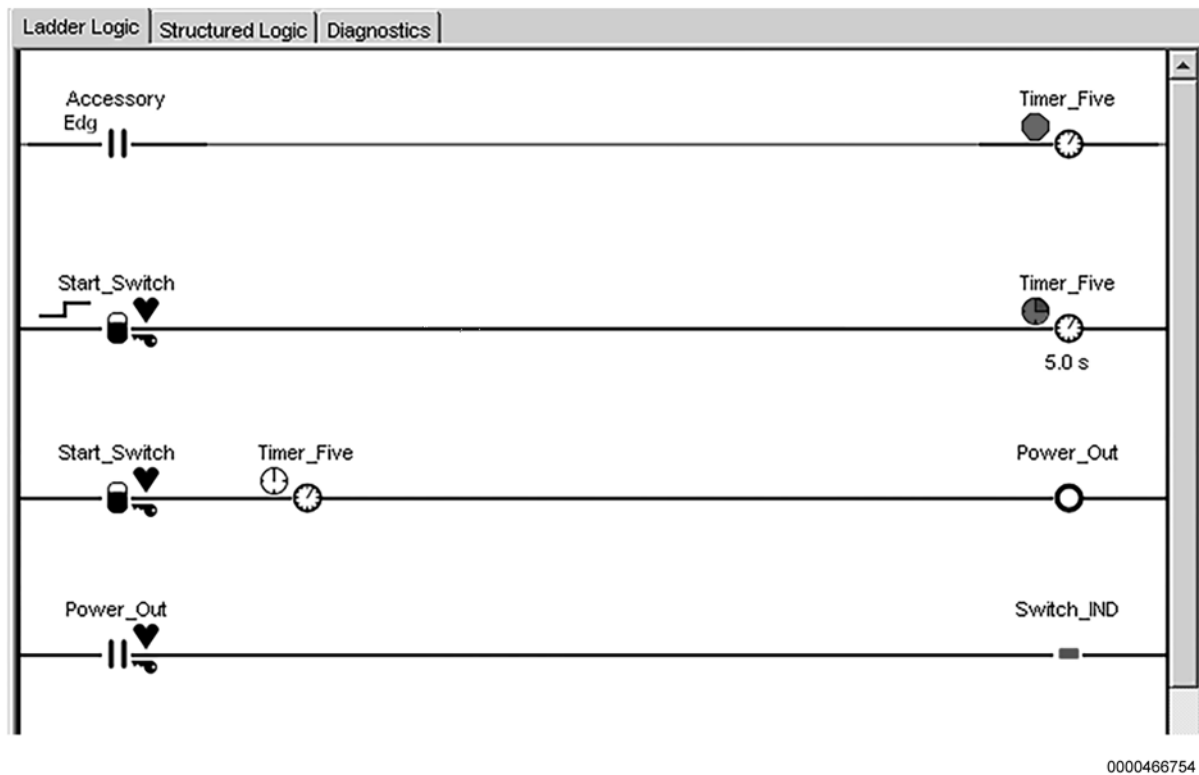


Figure 152 Delayed Output Using a Timer

Timers may be used to turn on an output AFTER a prescribed length of time. See the following example. This exercise will turn on a RPM output exactly five seconds after a latched rocker switch is activated ON. It only requires three advanced logic ladder rungs to perform this operation. The example assumes that a rocker switch or other input is available in a latched ON or OFF condition. The first rung is used to initialize the timer as OFF or stopped. The second rung detects the rocker switch has been turned ON using the positive edge detection attribute. This single active edge detection method is used so that we start the five-second timer only once. When the logic is executed in subsequent processing cycles after starting the timer, this second rung will not be true and thus the timer will not be re-started. Note that the switch input shall be turned OFF when the ignition key is in the OFF position or if the switch pack experiences a status error condition. The third rung enables the Remote Power Module output to be turned ON as long as the rocker switch is ON and the timer has expired. The timer stays in the expired mode until it is re-started. Thus the output is turned on after five seconds and stays on as long as the rocker switch is ON and the key is in the RUN or ACCESSORY position.

Enabling of an Output for a Specified Time

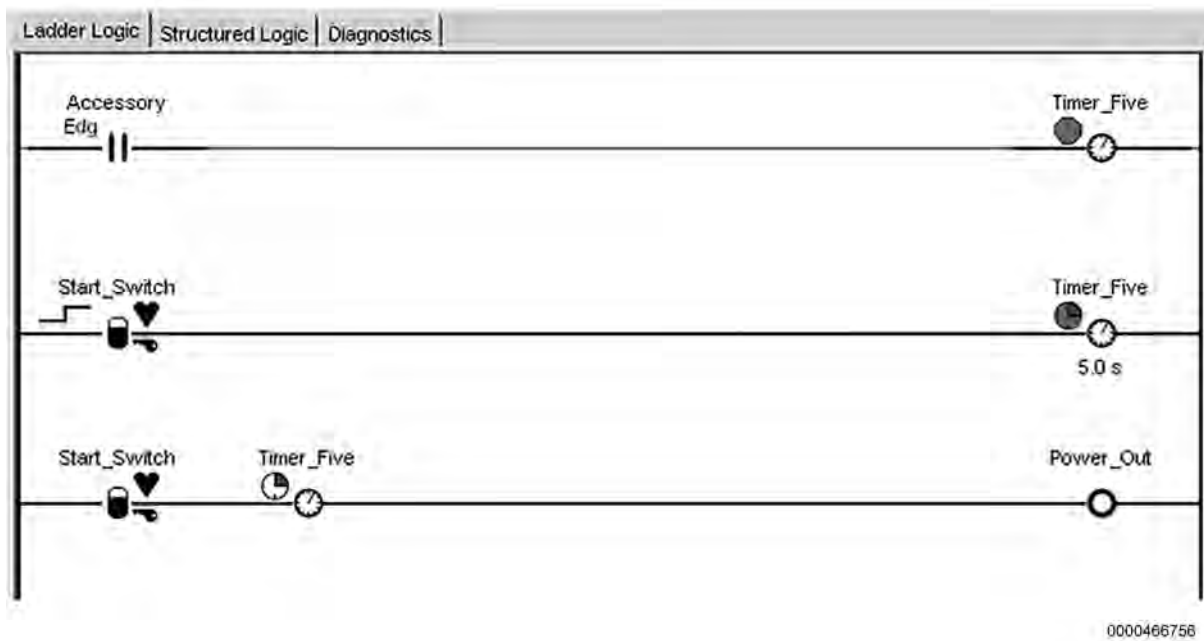
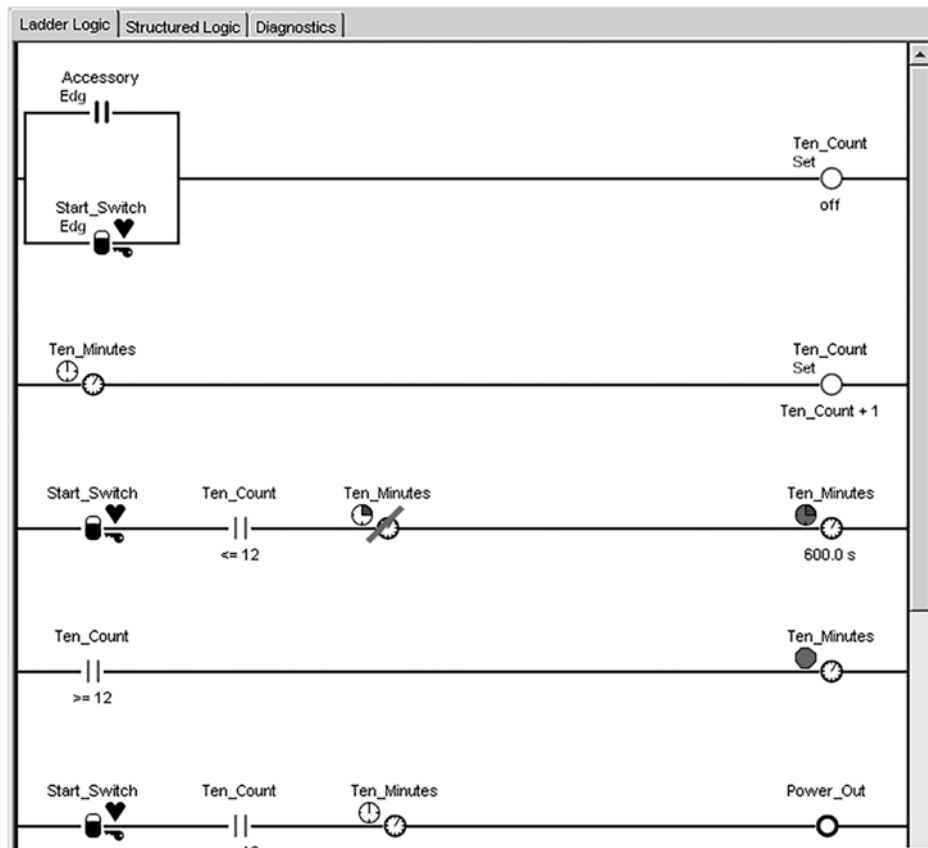


Figure 153 Output Enabled for a Specified Time

Timers may be used to turn ON an output FOR a prescribed length of time. See the following example. This exercise will turn on a Remote Power Module output for exactly five seconds when a latched rocker switch is activated ON. It only requires three advanced logic ladder rungs to perform this operation. The example assumes that a rocker switch or other input is available in a latched ON or OFF condition. The first rung is used to initialize the timer as OFF or stopped. The second rung detects the rocker switch has been turned ON using the positive edge detection attribute. This single active edge detection method is used so that we start the five-second timer only once. When the logic is executed in subsequent processing cycles after starting the timer, this second rung will not be true and thus the timer will not be re-started. Note that the switch input shall be turned OFF when the ignition key is in the OFF position or if the switch pack experiences a status error condition. The third rung enables the Remote Power Module output to be turned ON as long as the rocker switch is ON and the timer is running. The timer stays in the expired mode until it is re-started. Thus the output is turned on for only five seconds as long as the rocker switch is ON and the key is in the RUN or ACCESSORY position.

Creating Timers Longer Than Ten Minutes



0000466759

Figure 154 Two-Hour Timer Example

NOTE – The rocker switch input will be turned OFF when the ignition key is in the OFF position or if the switch pack experiences a status error condition. Thus the output is turned on for two hours as long as the rocker switch is ON and the key is in the RUN or ACCESSORY position. Changing all entries of Ten_count will change the length of the timer in 10 minute increments.

The Diamond Logic® electrical system has extensive capabilities to construct custom logic to meet your body equipment control needs. However, the system can currently only measure time periods of up to 10 minutes with a simple timer signal function. If your application requires a timer longer than 10 minutes, it is possible to construct ladder logic that will count for very large periods of time. See the following example. This exercise will turn on a Remote Power Module output for exactly two hours when a latched rocker switch is activated ON. The two-hour timer is accomplished by allowing a 10 minute timer to elapse twelve times, which is 120 minutes (2 hours). It only requires five advanced logic ladder rungs to perform this operation.

The example assumes that a rocker switch or other input is available in a latched ON or OFF condition. The first rung is used to initialize a counter variable, Ten_count, as OFF or stopped whenever the key is cycled OFF or the rocker switch has been placed in the ON or OFF position. Ten_count is used to count a ten minute time period. The second rung checks for when the ten-minute timer has expired or in other words, has a ten minute time period elapsed. If yes, then Ten_count is incremented by one using the Set function. The third rung enables the basic ten-minute timer. The ten minute timer called Ten_Minutes will be started only if the rocker switch is ON, Ten_count is less than or equal to 12 and the ten minute timer is not running. The fourth rung checks if the final timer period has elapsed as defined by Ten_count. In this case, once Ten_count is greater than or equal to 12, the timer Ten_Minutes is stopped. The fifth rung controls the final Remote Power Module output. The output will be ON as long as the rocker switch is ON, Ten_Count is less than twelve and Ten_Minutes is still running.

Diagnostic Descriptions for Timers

Writing detailed and effective diagnostic descriptions for timers is very important since the performance of the outputs may appear rather confusing to the technician who is troubleshooting the vehicle. In the advanced logic view, select the diagnostics tab above the ladder logic. This is where you should enter your diagnostic descriptions. The text should include an overall summary of how the timed output is expected to perform. The description of our first example would state that a Remote Power Module output would be turned on five seconds after the Start_Switch is turned ON. The description of our second example would state that a Remote Power Module output would be turned ON for only five seconds after the Start_Switch is turned ON. The description of the third example would state that a Remote Power Module output would be ON for two hours after the Start_Switch is turned ON. Each of these descriptions should contain an overall summary of all the signal elements or interlocks that must be true before the timer will operate. A detailed listing of all inputs and outputs should be listed, including switch position in a specific switch pack, plus signal assignments to an output of a specific Remote Power Module address. This text description should contain all AND & OR logical terms in conjunction with specific signal names. It is up to the user to decide how the GREEN indicator in the rocker switch might be used in conjunction with a timer. A diagnostic summary should be included to identify what indicators the driver or technician might witness during various failure modes if flashing modes of the GREEN indicator of the rocker switch are used. See the example below for the diagnostic design for a five second delayed output timer that drives a Remote Power Module output.

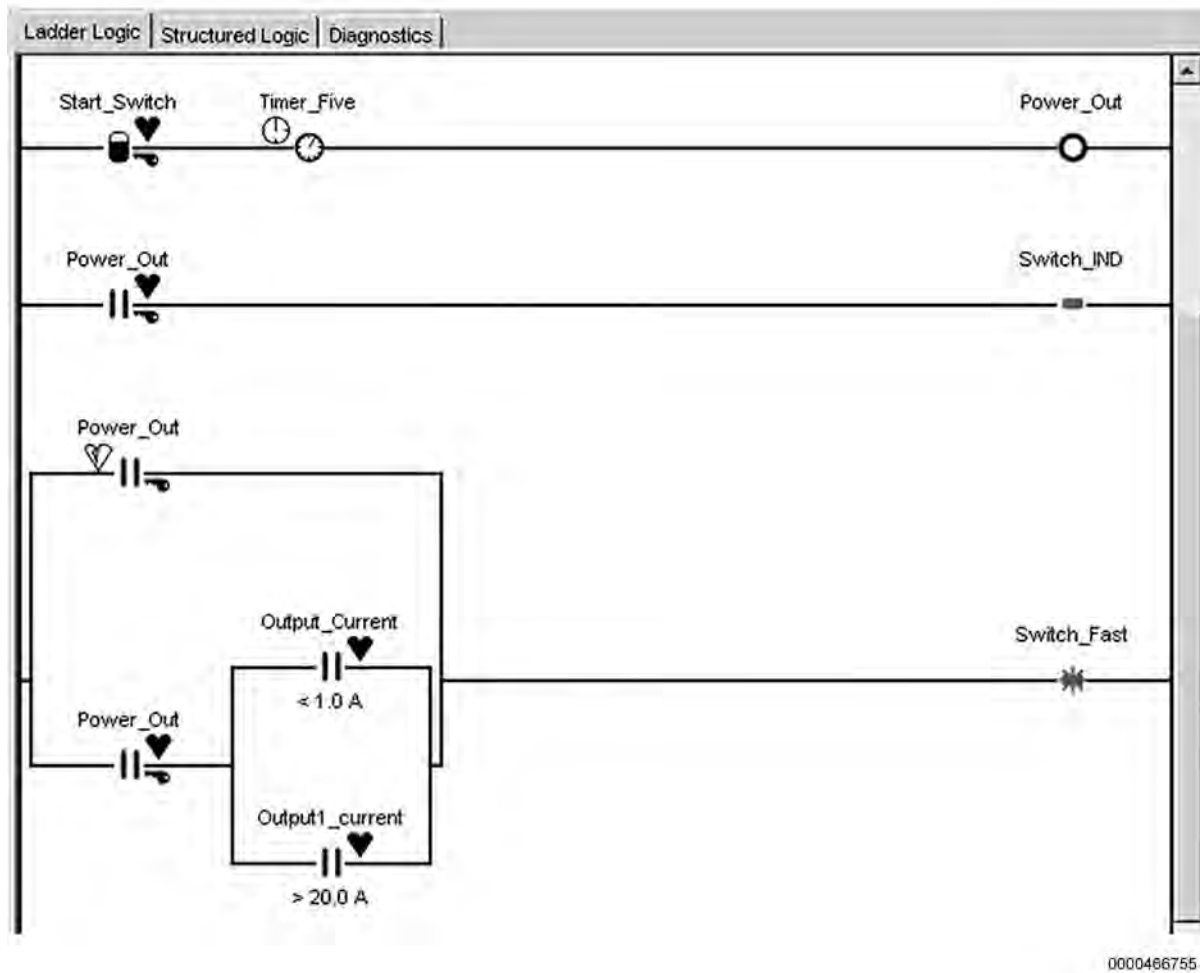


Figure 155 Diagnostic Design for a Delayed Output Timer

In this example, the GREEN indicator for Start_Switch is used to show that the Remote Power Module output has come ON after the five-second-delay period elapsed. If the status of the power module output is good, then the indicator will be ON steady. If the Remote Power Module output has a bad status or the output has a burned out bulb or open circuit OR the output is overloaded and drawing more than twenty amps, then the GREEN indicator in the Start_Switch will be displaying a fast flashing pattern. A bad status will occur if the Remote Power Module has failed internally, the Remote Power Module output is overloaded or shorted to ground, the communication link to the RPM has been broken or the Remote Power Module has lost its heavy current battery feed. A diagnostic fault code will accompany many of these failure modes. Other failure modes could occur in the electrical system that would render the timer output signals inoperative. Failures within the switch pack or cabling to the switch pack would also cause the outputs to be OFF, even though the Start_Switch is latched ON. However, if a fault exists in the switch pack, it is not likely that communication between the BCM and the switch pack can be established to flash the GREEN indicator in the switch about the problem.

Diagnosing Timers

Diagnosing a timer requires knowledge of all interlocks that are implemented with the design. In addition, the driver or technician must be trained on the diagnostic indicators that are being displayed by the system. In this example, diagnostic indicators are provided with a fast or slow flash indicator on each rocker switch that controls an output. Diagnosing load sequencer circuits may be accomplished with a few simple checks:

NOTE – Note the module is protected with a fusible link at the battery box or starter stud.

1. Verify that the Remote Power Module has battery volts at the RED power feed input.
2. Check for a fast flashing green indicator in any of the rocker switches. This indicates a possible burned out bulb, open circuit wiring in the outputs or overloaded outputs that are controlled by the sequencer. No electrical system fault codes will be generated for burned out bulbs or open wiring between the RPM and the bulbs. The open circuit diagnostic will only operate when the respective Remote Power Module output is driven ON.
 - a. If a fast flashing green indicator in the rocker switch is present, then perform Step 3.
 - b. If there are no fast flash indicators and the output still does not operate, go to Step 4.
3. Check for fault codes associated with the Remote Power Module used with the sequencer. Resolve using Service / Technician Manual Diagnostic Troubleshooting information.
4. Check for fault codes associated with the switch pack module used with the sequencer. Resolve using Service / Technician Manual Diagnostic Troubleshooting information.
5. If Diamond Logic® Builder software is available to the technician, select the ADVANCED LOGIC view and place the program in Diagnostic mode while connected to the vehicle under test. Examine the signals on each ladder and verify that the indicator of OFF or ON is displayed based upon physical state of each input.

Signal Debounce Functions

Debounce refers to the delaying of two transitional scenarios of the same signal. Those transitions are On to Off which could also be referred to as the signal going from True to False, and Off to On which could also be referred to as the signal going from False to True. There are two types of Debounce functions: Debounce and Debounce On. The Debounce functions are simply delay timers that can be attached to Diamond Logic® Builder ladder logic (read not write) signals. It is the purpose of the Debounce functions to dampen or filter out unwanted momentary switch state changes and logic activations that occur before they are desired. The Debounce functions allow a Diamond Logic® Builder user to reduce the amount of ladder logic that would ordinarily be required to create such a filtering system through the implementation of timers.

Debounce Example

An example of the Debounce function in practice would be that of a remote power model input signal being used to report to the multiplex electrical architecture the status of a body builder installed discrete hydraulic oil reservoir oil level indicator. Because of the strong propensity for hydraulic oil to slosh in its reservoir, it is very likely that periodic oil movement will cause the level indicator switch to make switch transitions momentarily indicating the hydraulic oil level is low. Conversely, the opposite scenario can exist where the oil level is low and because of the unstable nature of the oil, the oil level indicator would sense that the oil level is satisfactory. In practice, because of the normal movement of oil, it would be very difficult to use such an erratic signal beneficially without some form of dampening or Debounce function.

NOTE – In this example we will be working with an advanced logic version of a hydraulic oil level indicator system that uses a discrete (On / Off) type level sensor switch.

NOTE – In this example, the Debounce function will be added only to the Hyd_Oil_Level_Sensor signal icon in order for this feature to function correctly.

To implement this example:

ADVANCED PROGRAMMING FEATURES

1. Create the necessary ladder logic needed to support the requirements base functionality as illustrated below.

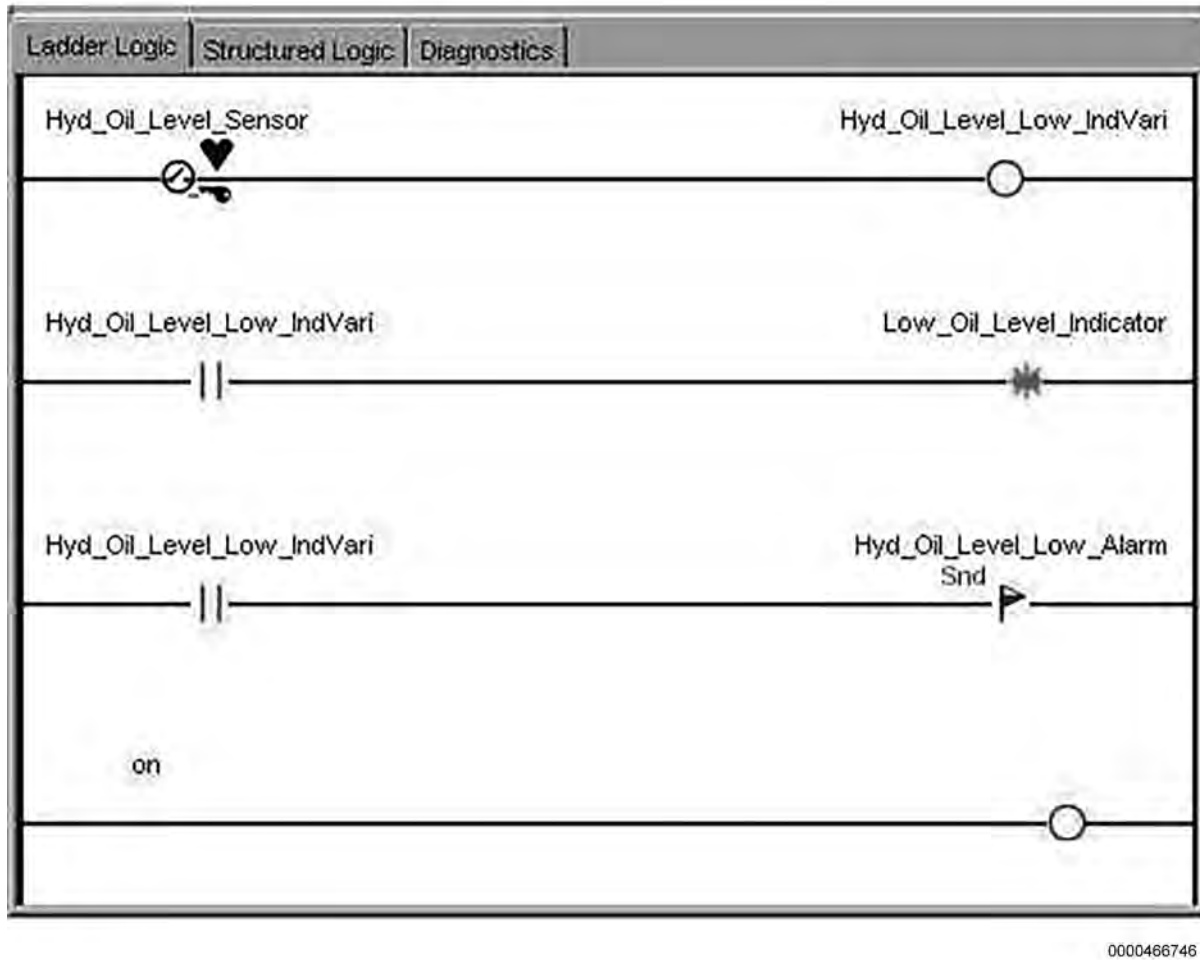
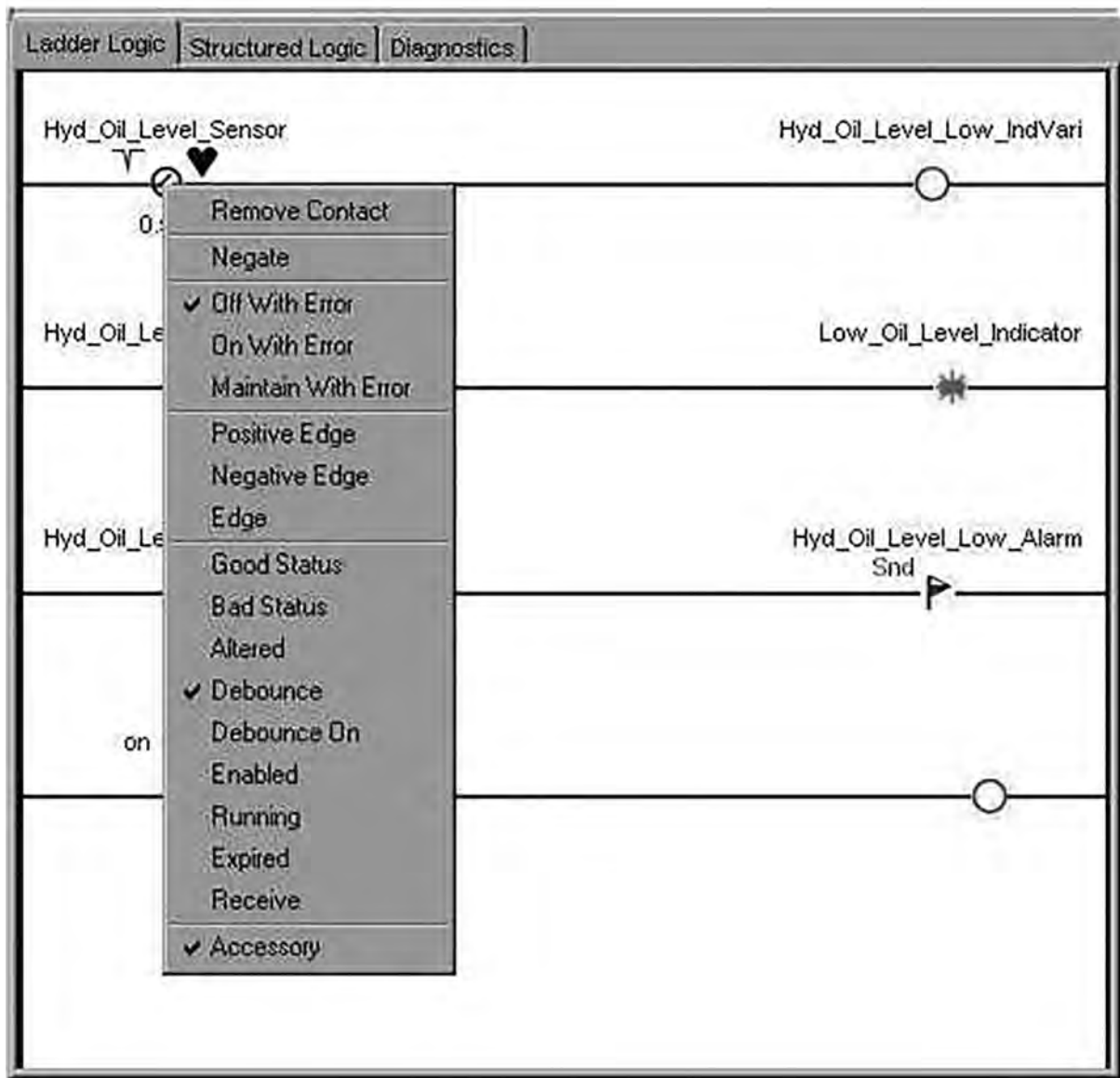


Figure 156 Ladder Logic for Hydraulic Oil Level Indicator

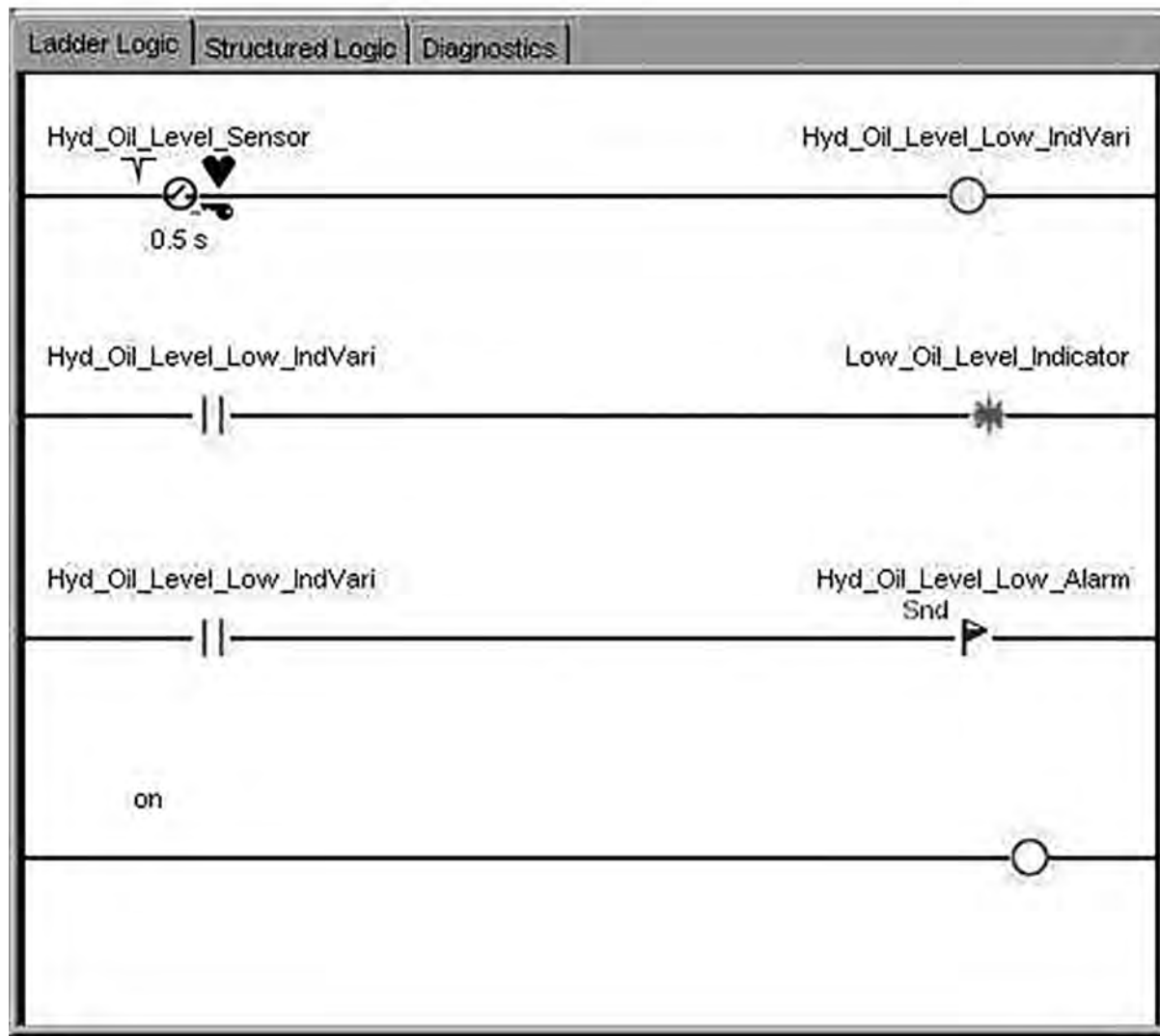
2. Right-click on the signal to be debounced. A pop-up menu containing a list of host of signal modification functions appears.



0000466747

Figure 157 Pop Up Menu

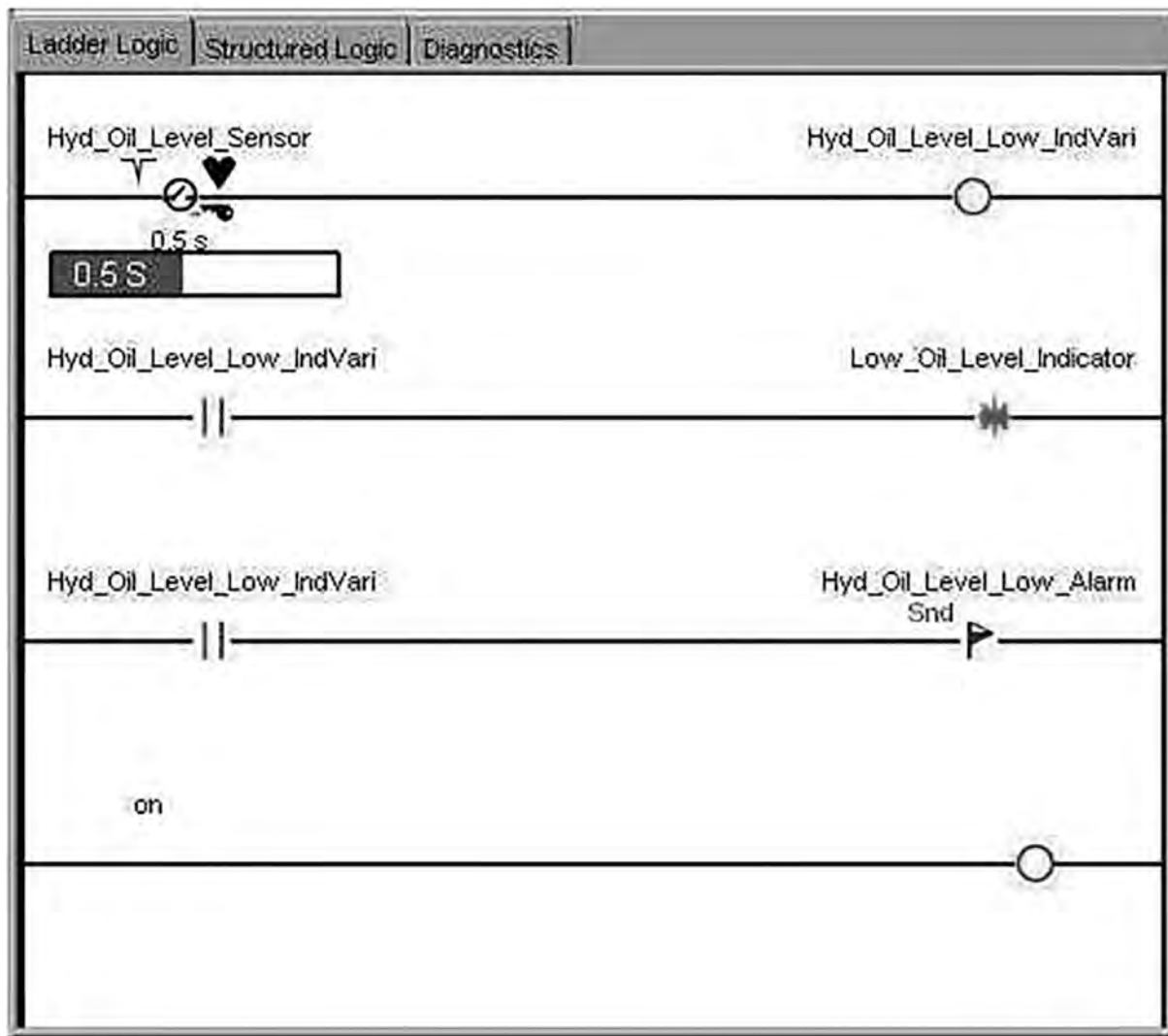
3. Check the DEBOUNCE option. The pop-up menu will disappear, leaving the signal icon with two new icons near it. The first is the Debounce icon, located at approximately the 10 o'clock position and the second is the Debounce time interval, defaulted to 0.5 seconds, which is located beneath the signal icon.



0000466748

Figure 158 New Information on Signal Icon

4. In order to change the interval time value from its default value of 0.5 seconds, first double-click on the time interval value, this will reveal a rectangular text box where a new interval value may be entered.



0000466749

Figure 159 Debounce Interval Entry

5. Enter the desired Debounce interval value into the text box.
6. Press the Enter key or click the mouse button while not on the signal icon. The value will be set in the Debounce function and the rectangular text box will disappear leaving only the interval value visible.

Once the Debounce interval value has been set in the signal icon, it can be changed again if desired by double-clicking on the interval value. This action will once again reveal the rectangular text box at which time a new value may be entered.

7. Save the changes to the configuration.

Debounce On Example

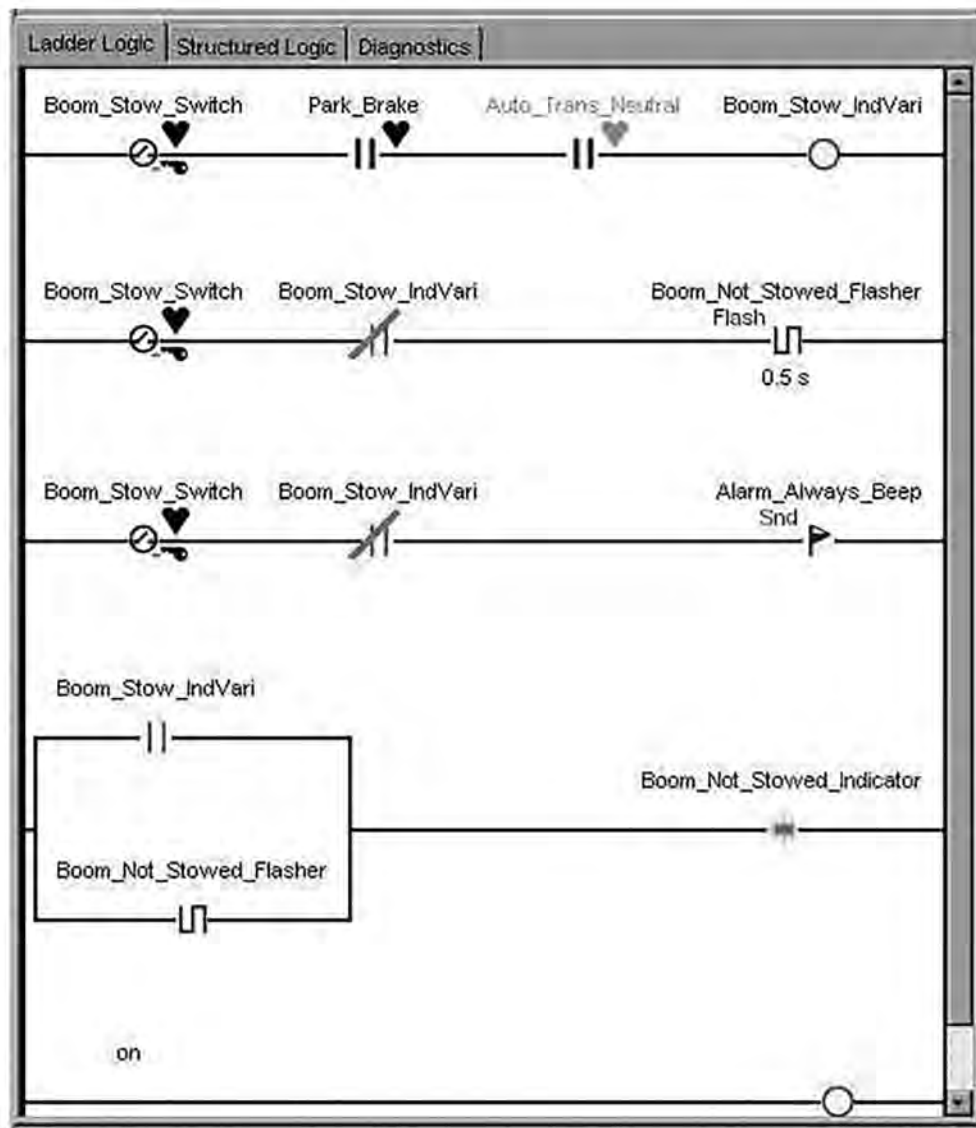
Debounce On refers to the delaying of a single signal state transition. This transition is from Off to On which could also be referred to as the signal going from False to True only. This function only delays the Off to On signal status and not the On to Off . Hence, Debounce On.

An example of the Debounce On function would be a boom out of stow sensing system. Because of the forces normally imposed during travel and the normal flexing of a truck chassis and its integrated body equipment the boom may on occasion become momentarily un-stowed. The Debounce On function allows for the filtering out of these occasional bounces as the boom position switch senses the booms movement. However, once the boom is back in its stowed position, there is no delay in the software's signal status, it immediately transitions Off and waits for the next occurrence when the boom comes out of stow

NOTE – In this example we will be working with an advanced logic version of the released boom- out of-stow feature code 60AXX.

To implement this example:

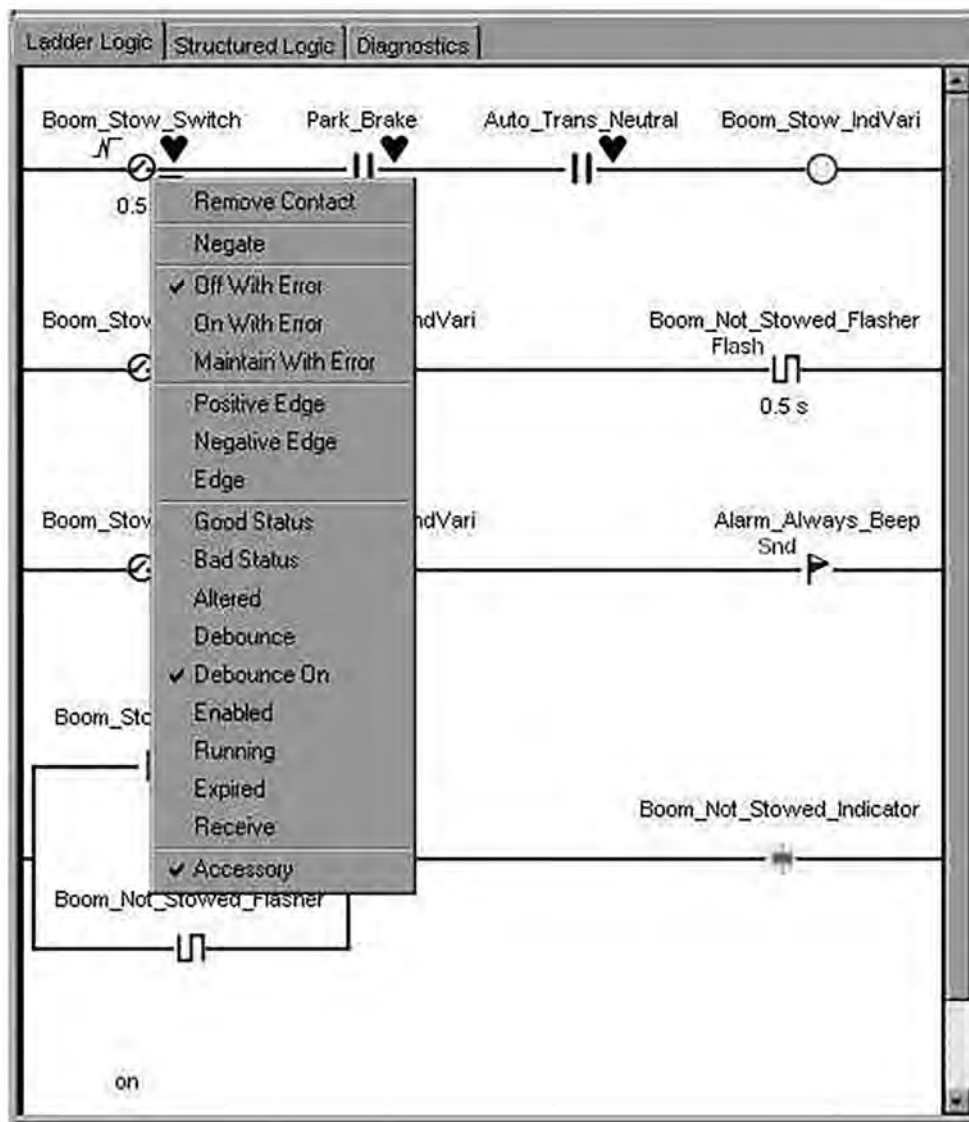
1. Create the necessary ladder logic needed to support the requirements base functionality.



0000466750

Figure 160 Ladder Logic for Boom Out of Stow Feature

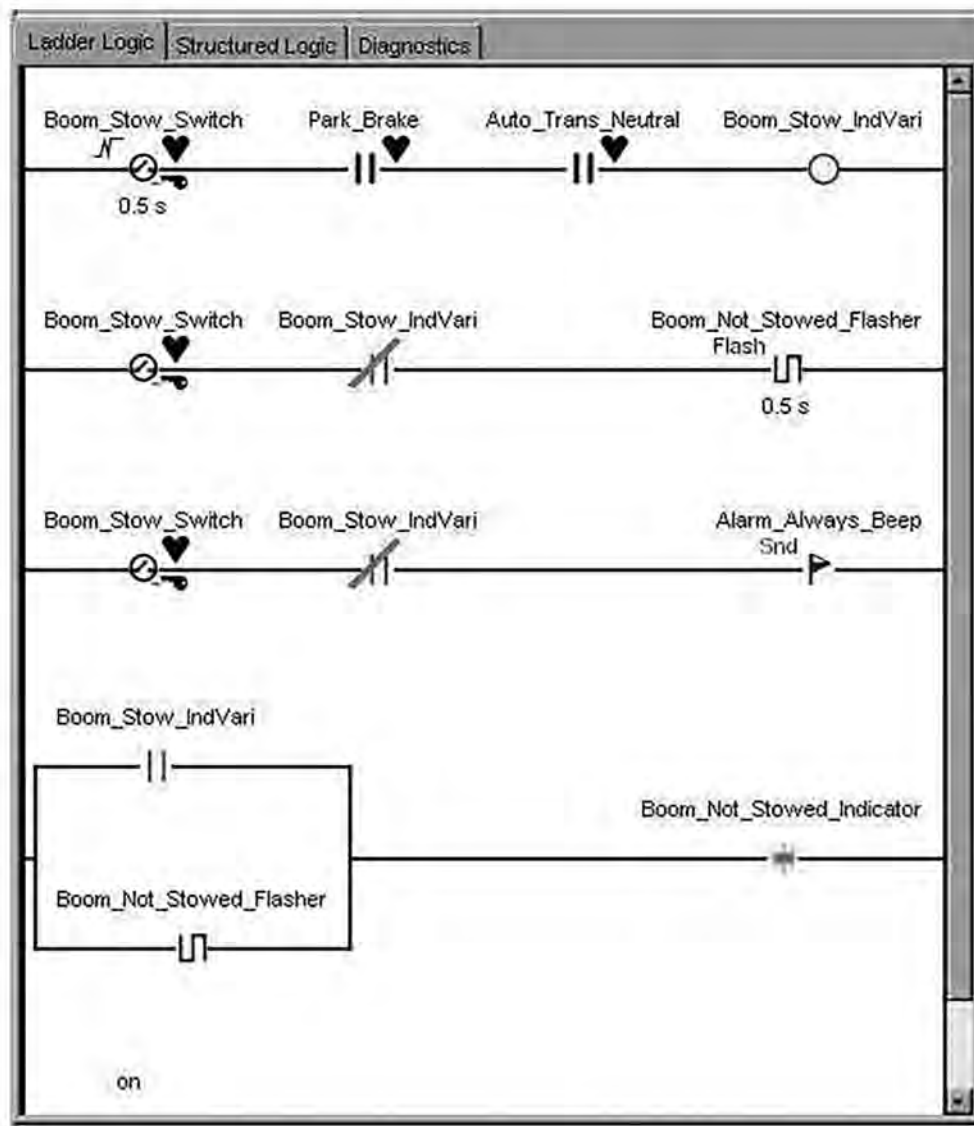
2. Right click on the signal to be debounced. A pop-up menu containing a list of host of signal modification functions appears.



0000466751

Figure 161 Pop Up Menu

3. Check the DEBOUNCE ON option. The pop-up menu will disappear, leaving the signal icon with two new icons near it. The first being the Debounce On icon, located at approximately 10 o'clock relative to the signal icon; the second is a Debounce On time interval, defaulted to 0.5 seconds, located directly beneath the signal icon.

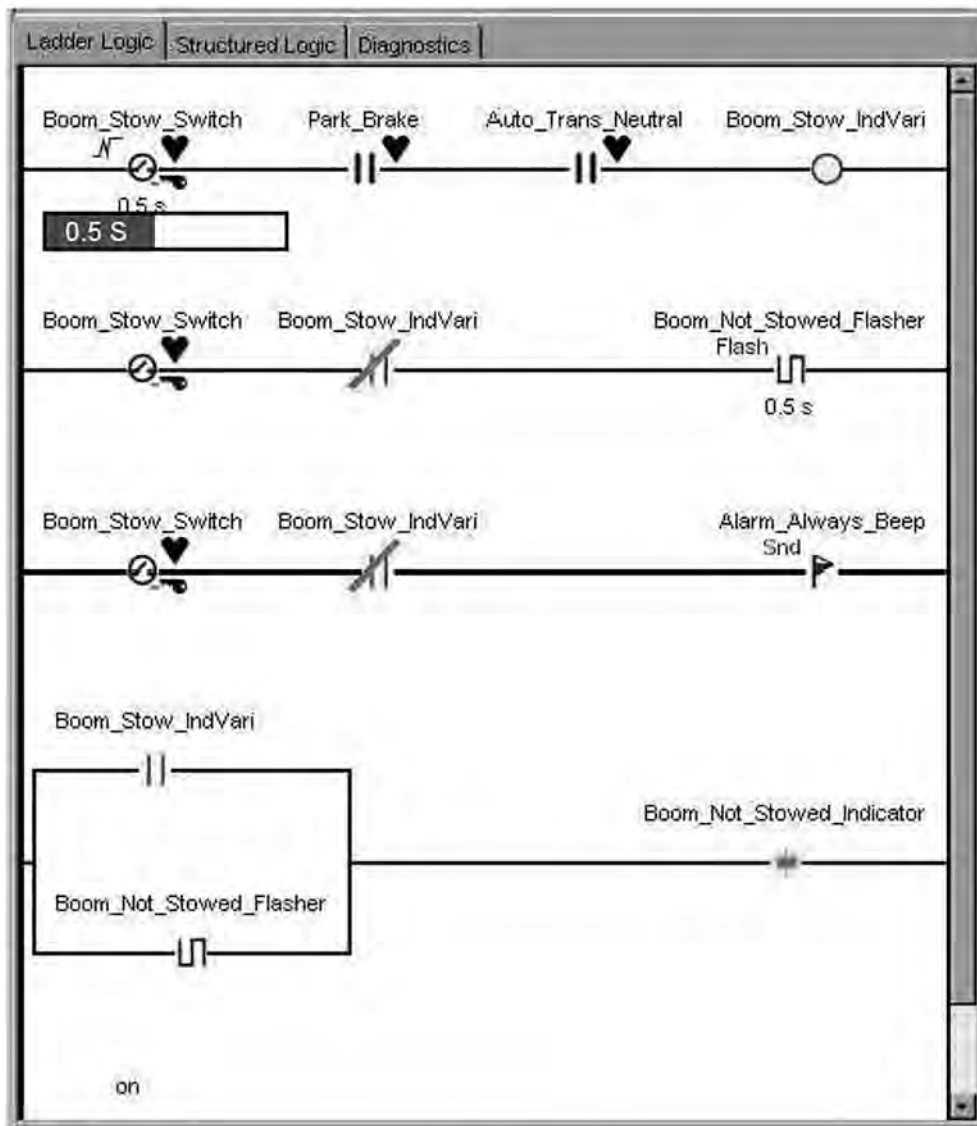


0000466752

Figure 162 New Information on Signal Icon

4. If you want to change the interval from its default value of 0.5 seconds, double-click on the time interval value. This will reveal a rectangular text box where a new interval value may be entered.

NOTE – In this example the Debounce On function will have to be added to all three of the Boom_Stow_Switch signal icons in order for this feature to function correctly.



0000466753

Figure 163 Debounce On Interval Entry

5. Enter the desired Debounce On interval value into the text box.
6. Press the ENTER key or click the mouse button while not on the signal icon. The value will be set in the Debounce On function and the rectangular text box will disappear leaving only the interval value visible.

Once the Debounce On interval value has been set, it can be changed again if desired by double-clicking on the interval value. This action will once again reveal the rectangular text box at which time a new value may be entered.

7. Save the changes to the configuration.

PTO CONTROL FEATURE



WARNING

To prevent personal injury and / or death, or damage to property, consult with the manufacturer of the PTO mechanism for application notes on using the device before creating ladder logic to control it. Navistar, Inc. shall not be liable for any equipment damage or personal injury due to events arising from the control of a PTO.



WARNING

To prevent personal injury and / or death, or damage to property, do not use any ladder logic examples in this document for controlling PTOs until you are confident of the logic required to control the PTO mechanism in the vehicle under development.

International has developed a variety of pre-engineered PTO features that control many kinds of PTO engagement mechanisms. These pre-engineered features have 42 different engagement, disengagement, re-engagement and alarm parameters available for use as interlocks. However, interlocks such as Hydraulic Oil Level, Hydraulic Oil Temperature, and Fire Pump Controls are some examples of what are not available with the pre-engineered International PTO features. In order to implement these interlocks, it may be necessary create a PTO feature using Advanced Ladder Logic.

Before we begin to discuss creating the Advanced Ladder Logic for PTO control, let's examine what is included in the pre-engineered features. All of the available programmable parameters for PTO controls are the same for all features whether an electric, air or hydraulic engaged PTO is used. Parameters may be turned ON or OFF to achieve the level of PTO control desired. For example, feature code 60 ABE is an electric over clutched hydraulically engaged PTO control. If it is desired to disengage the PTO when the park brake is released and allow re-engagement when the Park Brake is set, then programmable parameters ID 2108, TEM_Pk_Brake_Disengages, 2149 TEM_Pk_Brake_Allow_ReEng and 2108 TEM_Pk_Brake_Engmnt_Inhibit must be turned ON. Refer to the following graphic. Be sure to use Set With Template when using this template on multiple vehicles. See the PTO section of the Electrical Body Builder Book CT-471 for a full description of PTOs and the application of pre-engineered International PTO control features. The pre-engineered PTOs should always be used whenever possible since the interlock parameters have been thorough extensive validation testing.

ADVANCED PROGRAMMING FEATURES

T	Feature	Description	Installed	Added With Temp...	Removed With Te...
0595193	(TEM) ESC PROG, PTO SHIFT for Hydraulic Clutch engagement mechanism		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
0595295	ESC PROG, WATER IN FUEL LIGHT With #1939, for 2004 International I6 ...		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595179	(TEM) ESC PROG, PTO LOGIC With dash switch and engagement and disenga...		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
0595170	(TEM) ESC PROG, PTO MONITOR With indicator and alarm		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
0514011	FEAR AXLE SHIFT CONTROL W/AUTO TRANS		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595006	ESC PROG AIR SOLENOID CONTROLLED/SWITCH		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595007	ESC PROG AIR PRESSURE W/AIR COMPRESSOR		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595008	ESC PROG AIR PRESSURE GAUGE/AIR BRAKE		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595009	ESC PROG AIR ABS WARN LIGHT & FULL POWER BRAKES, NOT TRAILER		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0595010	ESC PROG HYD ABS WARN LIGHT NOT TRAILER		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Show					
<input type="radio"/> All Parameters <input checked="" type="radio"/> Parameters For Selected Features <input type="radio"/> Parameters For Custom Logic					
T	ID	Parameter	Value	Unit	Set With Temp...
	2123	TEM PTO Mast Switch Allow ReEng	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2118	TEM PTO Mast Switch Disengages	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2099	TEM PTO Mast Switch Engmnt Inhib	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2089	TEM PTO Non Mast Engmnt Inhib	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2132	TEM PTO Non Mast Alarms	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2148	TEM PTO Non Mast Allow ReEng	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2109	TEM PTO Non Mast Disengages	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2088	TEM PTO Non Mast Engmnt Inhib	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2149	TEM PTO Pk Brake Allow ReEng	<input checked="" type="checkbox"/>	On/Off	<input checked="" type="checkbox"/>
	2108	TEM PTO Pk Brake Disengages	<input checked="" type="checkbox"/>	On/Off	<input checked="" type="checkbox"/>
	2087	TEM PTO Pk Brake Engmnt Inhib	<input checked="" type="checkbox"/>	On/Off	<input checked="" type="checkbox"/>
	2133	TEM PTO Veh Spd Alarms	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2119	TEM PTO Veh Spd Allow ReEng	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2111	TEM PTO Veh Spd DisEng Limit		0mph	<input type="checkbox"/>
	2110	TEM PTO Veh Spd Disengages	<input type="checkbox"/>	On/Off	<input type="checkbox"/>
	2090	TEM PTO Veh Spd Engmnt Inhib	<input checked="" type="checkbox"/>	On/Off	<input type="checkbox"/>
	2091	TEM PTO Veh Spd Engmnt Limit		3mph	<input type="checkbox"/>
	2147	TEM RPM PTO Engaged Param		1List	<input type="checkbox"/>

0000486758

Figure 164 PTO Parameters

Basic PTO Fundamentals

The first example is designed to control an electric over hydraulic PTO with a clutch type engagement. The feature provides control of the PTO mechanism from either a rocker switch in the cab or else a ground active switch on the body. First create a Logic Block named PTO Control. The required component inputs and outputs include a two position latched PTO rocker switch located in the Center Panel of the instrument panel, a latched two position switch located in the body that is connected to an RPM Input to actuate the PTO from the body, an RPM output named PTO Output connected to the PTO hydraulic engagement solenoid, an RPM Input to verify that the PTO is engaged and an indicator light in the gauge cluster that is labeled PTO. Additionally we will need to add indicator lights to indicate the PTO status to the PTO rocker switch in the cab. This includes the LED located behind the PTO switch located in the Center Panel.

Clutch Type PTO Requirements

The first step in creating an advanced logic block for controlling PTOs is to gather the performance and interlock requirements. It is essential that the rules for PTO engagement, disengagement and re-engagement be specifically identified for the vehicle under development. Next the type of PTO engagement mechanism that is to be used for the vehicle must be identified. There are many types of PTO mechanisms and the logic to control them is very different.

The main types of PTOs are:

- Electric over Hydraulic with a clutch type engagement
- Electrically actuated gear engagement with a pull-in coil and a holding coil (Lectra-Shift)

- Air shifted with a clutch type engagement.
- Air shifted with a gear to gear engagement
- Cable Shifted with gear to gear engagement

The type of transmission that is used in the vehicle limits the type PTO mechanism that may be used. Some transmissions such as the Allison WTEC cannot use a non-clutched PTO since the PTO gear is constantly turning while the engine is running. Non-clutched PTOs can be used with an Allison LCT transmission as long as the transmission is in gear and the vehicle is parked while the PTO is engaged, then the transmission must be placed in neutral. Non-Clutched PTOs may also be used with manual transmissions as long as the clutch is depressed when the PTO is engaged. It becomes obvious that the control logic is very different from one PTO type to another.

Building the Logic for a Clutch Type PTO

As stated before, this first example is designed to control an electric over hydraulic PTO with a clutch type engagement. This example employs a variety of interlocks to ensure that the PTO may only be operated when the vehicle is in a stationary position. Additional interlocks could be added to this logic but for the sake of keeping the example simple, a limited number of interlocks have been included. The list of total requirements for the Clutch Type PTO example include:

1. Transmission must be in Neutral to engage the PTO.
2. Park Brake must be Set to engage the PTO.
3. Engine must be running (Engine RPM > 600 RPM) to engage the PTO.
4. PTO will not engage unless Engine RPM is less than 900 RPM.
5. PTO will disengage with Engine RPM greater than 1800 RPM.
6. Either the Cab Rocker Switch OR the body-mounted switch will engage the PTO.
7. Both PTO switch controls must be OFF to turn off the PTO.
8. Bad status on any of the Interlocking signals shall turn off the PTO.
9. The PTO will re-engage if all interlocks are met.
10. PTO light in the gauge cluster shall illuminate when the PTO is engaged.
11. PTO light shall flash and a beeper shall alarm when the park brake is released, the engine speed is greater than 1800 RPM, or the transmission is placed in gear while the PTO is engaged.
12. The Green indicator in the cab PTO switch shall flash fast when a signal fault has occurred.
13. The Green indicator in the cab PTO switch shall flash slowly when an interlock is violated.

The first rung in the illustration below allows control of an independent variable when all the interlocks are met.

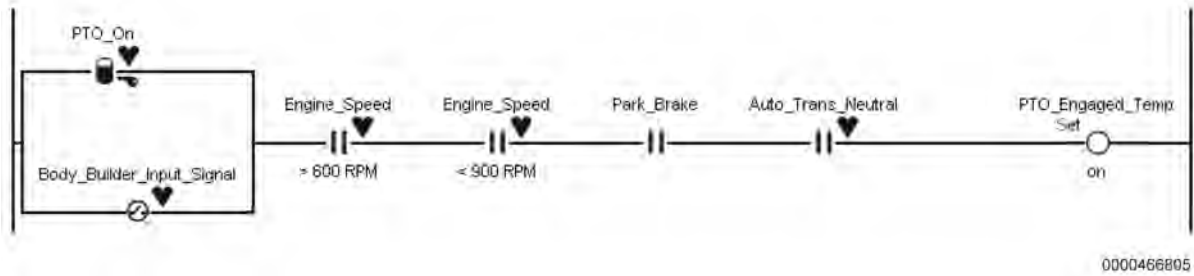


Figure 165 Set the Variable ON when All Interlocks Are Met

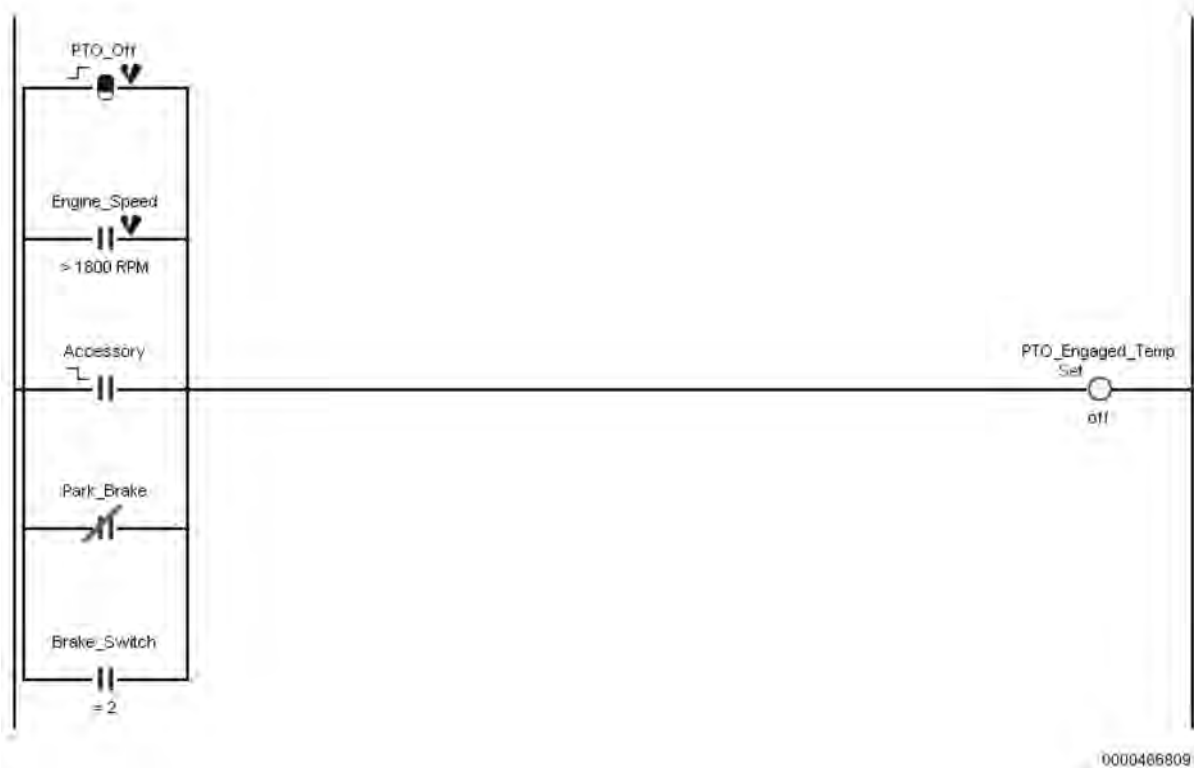


Figure 166 Set the Variable OFF when One or More Interlocks Are Not Met

Logic must be included to disable the PTO when an interlock is not met. Note that the rung below, uses the ON with Error Icon on each signal so that either the signal condition or a bad signal status will shut off the PTO. Also see that the shutting off the ignition key will also force the PTO OFF so that it is in a known safe state when the vehicle is restarted. If auto re-engagement after a remote start stop sequence is required, then the Accessory signal would not be used.



Figure 167 Controlling The PTO Output

The internal variable PTO_engaged_temp is then used to control the RPM output which drives the PTO mechanism.

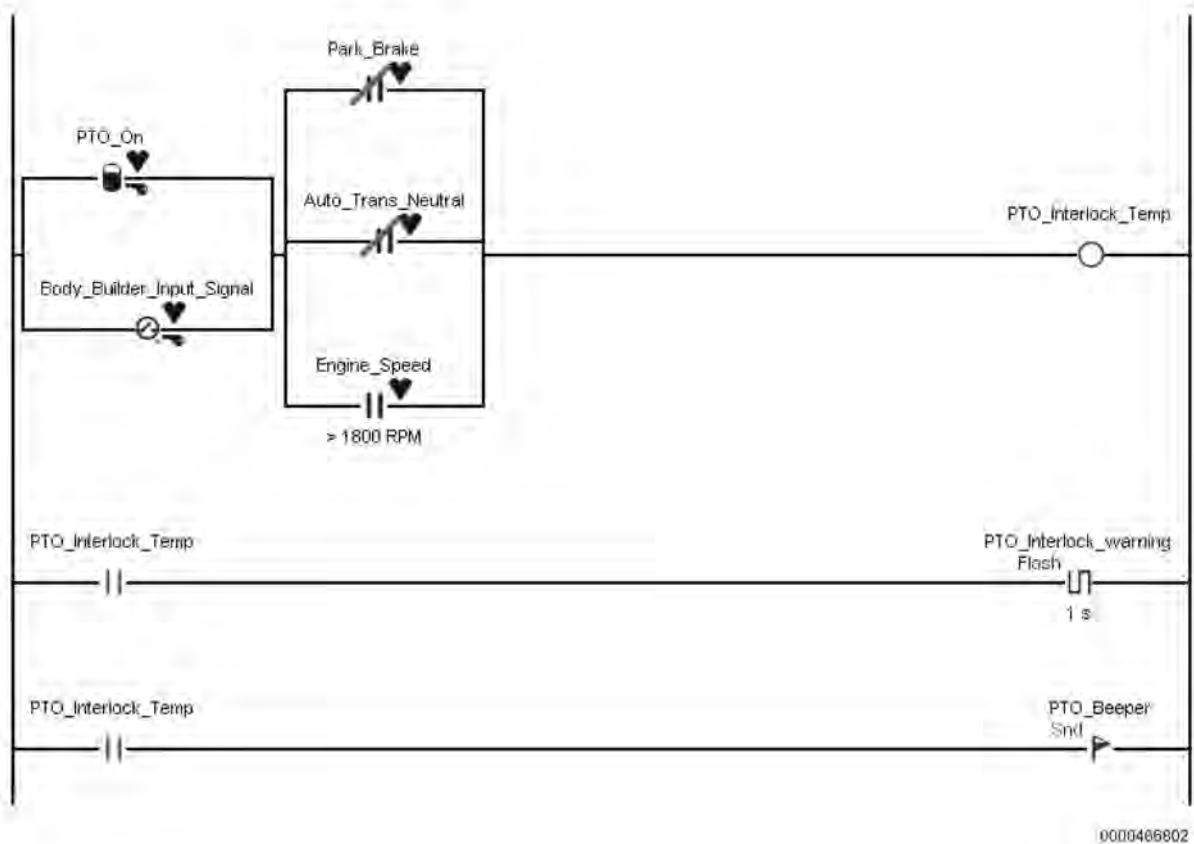


Figure 168 Response to Interlocks Not Being Met

The rungs are used to detect when various signal interlocks have not been met. When either the cab switch or the body switch is activated and one of the three listed interlocks is not true, an internal variable PTO_Interlock_Temp is turned ON. This variable is then used to start a flasher function and to drive the beeper in the gauge cluster with a repetitive beeper cadence.

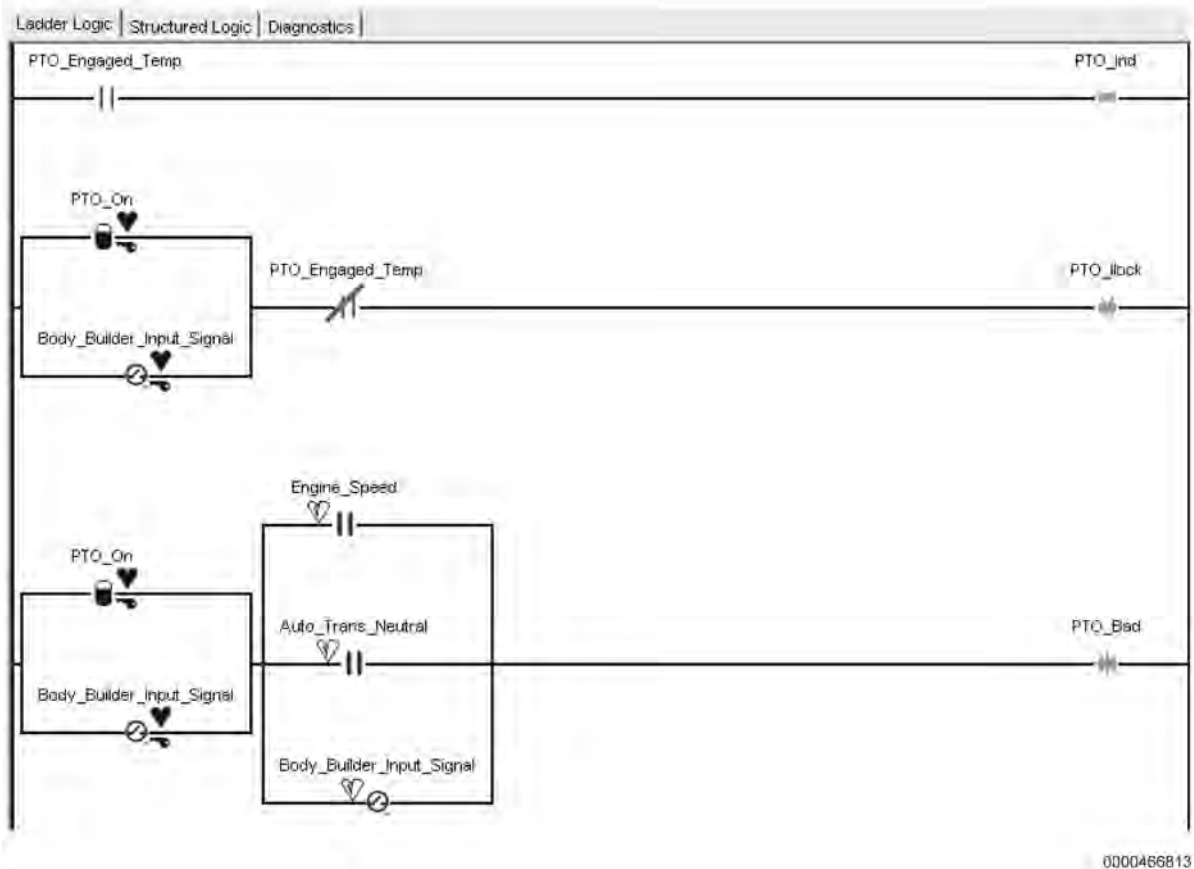


Figure 169 PTO Indicator Logic

The visual indicator in the rocker switch may be used to alert the operator if the PTO mechanism is or is not engaged. To accomplish this task we will need to name three more icons. We will need to create a “Steady On”, “Fast Flash” and a “Slow Flash” signal for the PTO switch. The “Steady On” indicator indicates that the PTO is requested ON and all interlocks are true. The “fast flash” indicator will be used to alert the driver the PTO was requested ON with the switch in the center panel or the body switch, but the Remoter Power Module output has been turned OFF due to a component failure with one or more of the devices used in the PTO system. The “slow flash” indicator will be used to alert the driver the PTO is not engaged due to an interlock that is not true

	PTO_On	Custom_Switch01_A_Up	On/Off
	PTO_Off	Custom_Switch01_B_Middle	On/Off
	PTO_Ilock	Custom_Switch01_C_Down	On/Off
	PTO_Ind	Custom_Switch01_Ind	On/Off
	PTO_Bad	Custom_Switch01_Ind_Fast_Flash	On/Off
	PTO_Ilock	Custom_Switch01_Ind_Slow_Flash	On/Off

Figure 170 PTO Switch Assignment List

The fast and slow flash LED's are located in the tab called "Switches". You must associate the fast and slow flash PTO indicators with the custom switch used with PTO rocker switch. See the PTO switch assignment list above.

Non-Clutch Type PTO Requirements

The second example is designed to control an electric over air PTO with a non-clutch or gear-to-gear type engagement on an Allison LCT transmission. This example employs a variety of interlocks to ensure that the PTO may only be operated when the vehicle is in a stationary position. Additional interlocks could be added to this logic but for the sake of keeping the example simple, a limited number of interlocks have been included. Once the PTO is engaged, the driver must place the transmission in Neutral. The list of total requirements for the Non-Clutch Type PTO example include:

- Park Brake must be Set to engage the PTO
- Engine must be running (Engine RPM > 600 RPM) to engage the PTO
- PTO will not engage unless Engine RPM is less than 900 RPM
- Transmission must be in a forward or reverse gear to engage the PTO
- Driver must have brake pedal depressed to engage the PTO
- PTO will disengage with Engine RPM greater than 1800 RPM
- Pushing the upper portion of the Cab Rocker Switch will engage the PTO
- Pushing the lower portion of the Cab Rocker Switch will dis-engage the PTO
- Bad status on any of the Interlocking signals shall turn off the PTO
- The PTO will not re-engage after a dis-engagement unless the PTO switch is depressed again while all interlocks are true
- PTO light in the gauge cluster shall illuminate when the PTO is engaged
- The Green indicator in the cab PTO switch shall flash fast when a signal fault has occurred.

The required component inputs and outputs include a three position, center stable, momentary PTO rocker switch located in the Center Panel of the instrument panel, an RPM output named PTO Output connected to the electrically activated air solenoid, an RPM Input to verify that the PTO is engaged and an indicator light in the gauge cluster that is labeled PTO. Additionally we will need to add indicator lights to indicate the PTO status to the PTO rocker switch in the cab.

See the first rung below that allows the control of an independent variable when all the interlocks are met. Remember the PTO switch must be a momentary type.

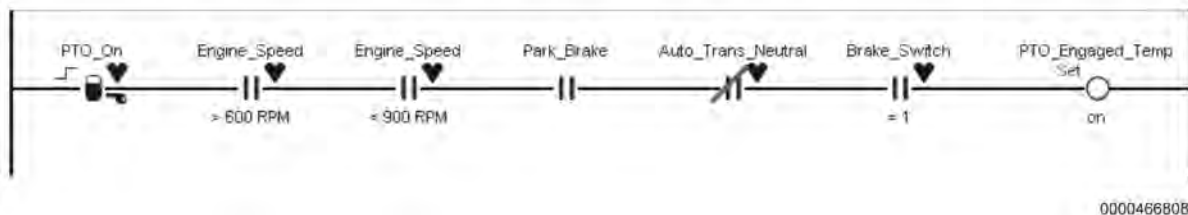


Figure 171 Set the Variable ON when All Interlocks Are Met

ADVANCED PROGRAMMING FEATURES

Logic must be included to disable the PTO when an interlock is not met. Note that the rung below, uses the ON with Error Icon on each signal so that either the signal condition or a bad signal status will shut off the PTO. Also see that the shutting off the ignition key will also force the PTO OFF so that it is in a known safe state when the vehicle is restarted. If auto re-engagement after a remote start stop sequence is required, then a non-clutched PTO cannot be used. Note that a value of 2 indicates a bad status on the Brake Switch.

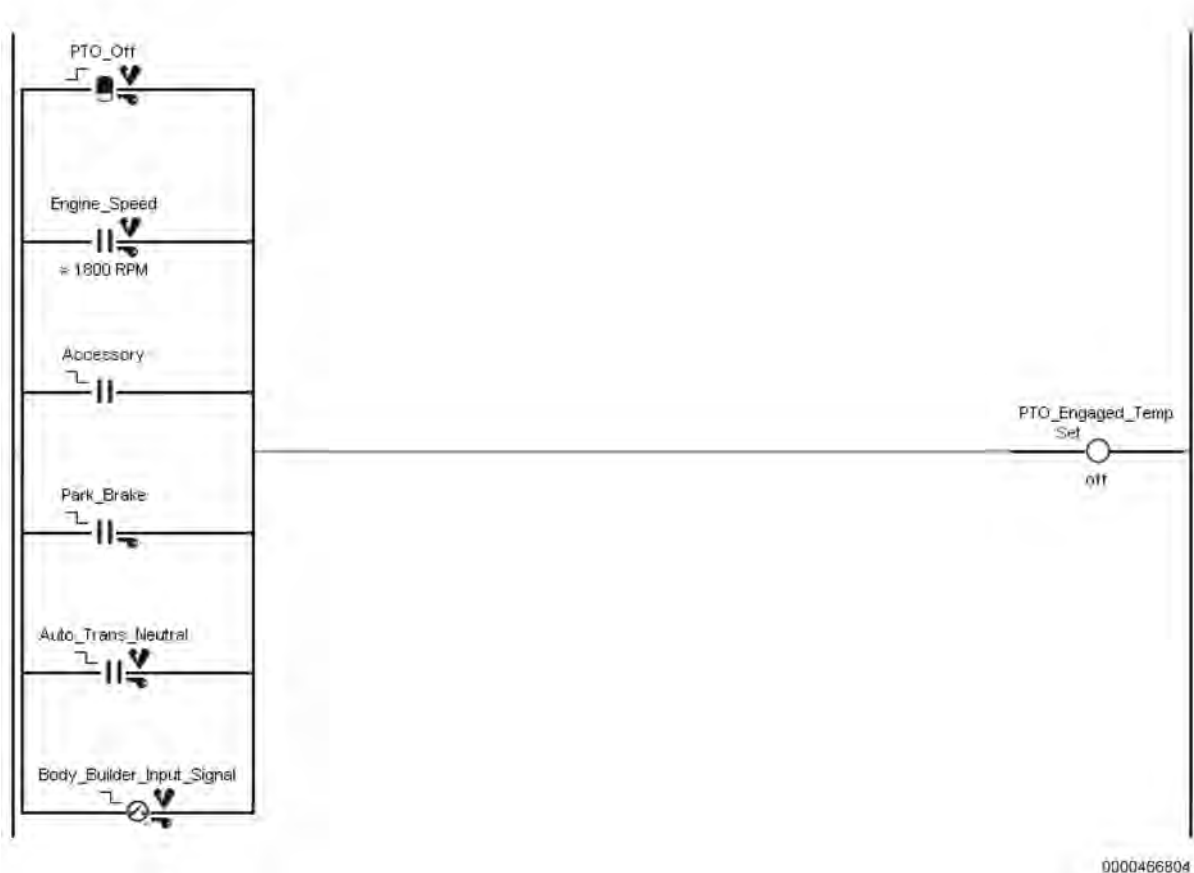


Figure 172 Set the Variable OFF when One or More Interlocks Are Not Met

Building the Logic for a Non-Clutch Type PTO

Creating an advanced ladder logic block for a non-clutched type PTO is more difficult. The logic rules for controlling a gear-to-gear type PTO are much more restrictive in order to prevent gear grind while engaging the PTO. Some transmissions such as the Allison WTEC cannot use a non-clutched PTO since the PTO gear is constantly turning while the engine is running. Non-clutched PTOs can be used with an Allison LCT transmission as long as the transmission is in gear and the vehicle is parked while the PTO is engaged, then the transmission must be placed in neutral. Non-Clutched PTOs may also be used with manual transmissions as long as the clutch is depressed when the PTO is engaged. A non-clutched PTO should never employ logic rules that would allow automatic re-engagement after being dis-engaged by an interlock that was not true such as the park brake being released. Since engaging a non-clutched PTO requires stopping the transmission PTO gear, using driver involvement, this type of PTO cannot be engaged from body-mounted controls. A momentary switch should be used in the cab to prevent accidental re-engagement.

PTO Visual Indicator in the Cluster, Using Advanced Logic

NOTE – This function does not currently work with International® LT®, RH™, HV™, and MV™ Series Trucks.

NOTE – An alternative to this would be to use the standard PTO monitor / feedback features and add a feedback circuit to the BCM or RPM. Also advised to add the PTO hour meter feature.

NOTE – The Gauge cluster lamp will flash when the interlock internal variable is flashing.

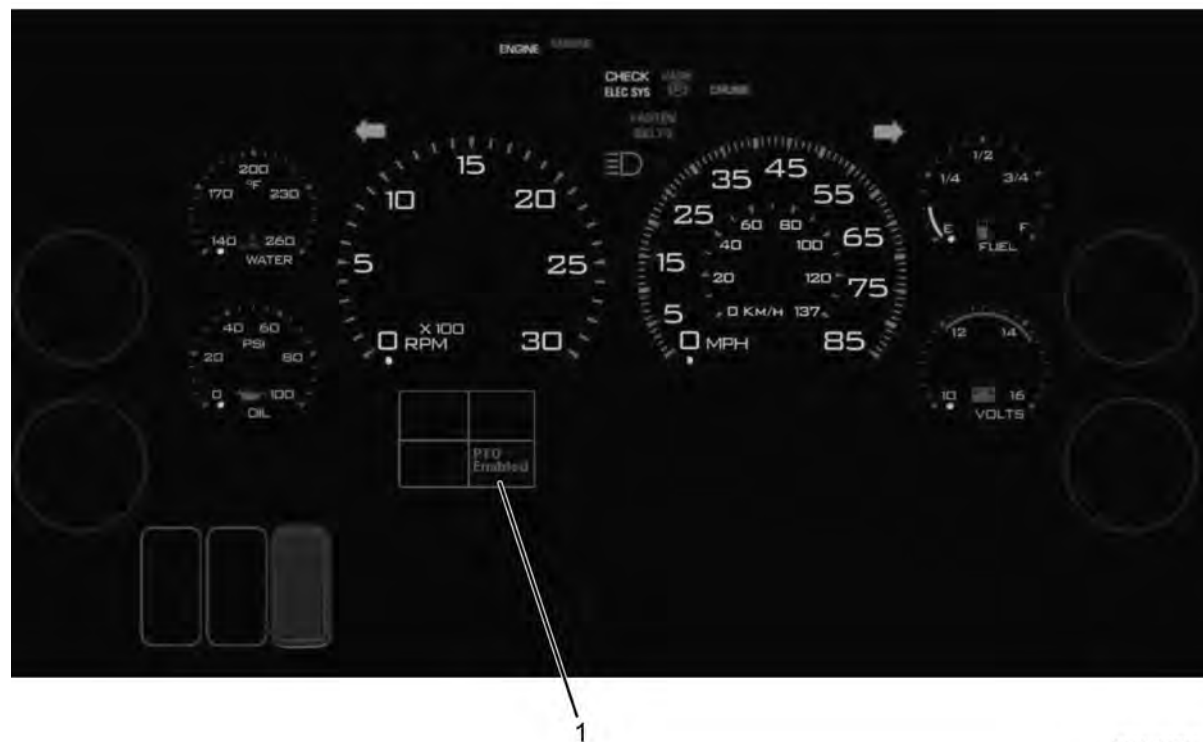
A visual indicator should be provided to alert the operator that the PTO is engaged. Most PTOs have a feedback switch. The switch should have one side of the switch hooked to chassis ground.



Figure 173 Logic for PTO Gauge Cluster Lamp

When mapping to the PTO indicator in the Instrument Cluster you will need to write to the PTO_Throttle_Light_Cmd located in the Cluster Tab within the variable tab named Advanced Logic.

The new input named PTO_Confirm is used to drive the PTO lamp in the gauge cluster.



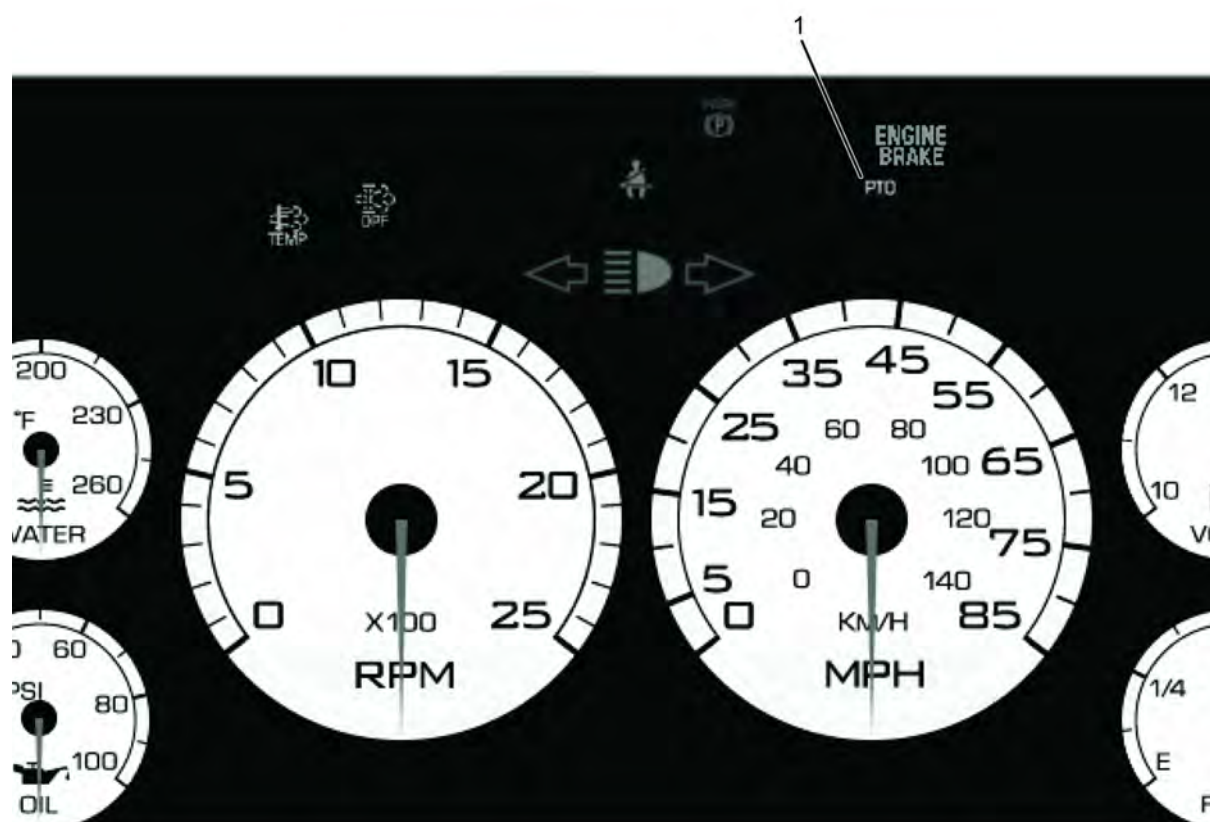
0000466798

1. PTO light indicator

Figure 174 Gauge Cluster View with PTO Light (Built Prior to 2007)



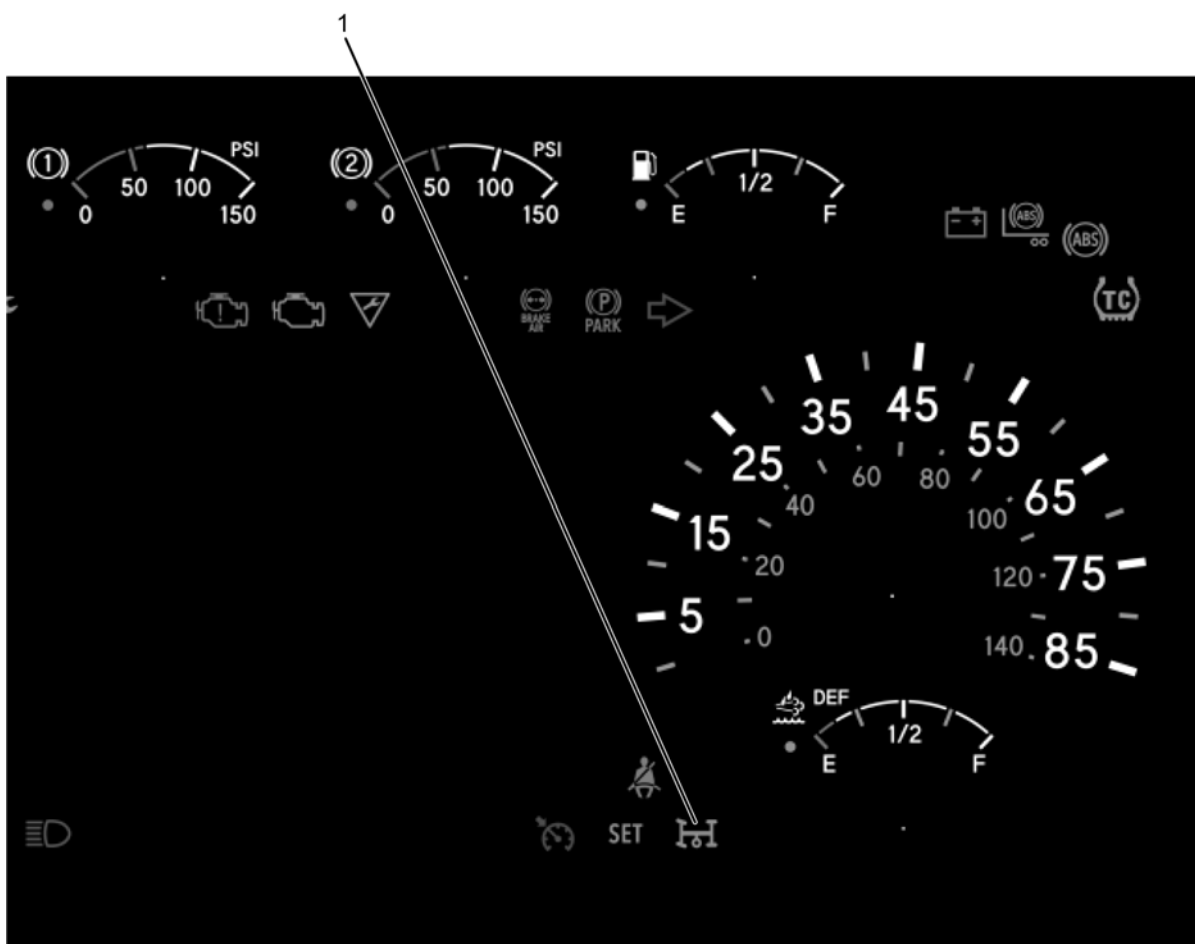
Figure 175 Gauge Cluster View with PTO Light (Built 2007 or Later)



0000466662

1. PTO light indicator

Figure 176 ProStar / LoneStar Gauge Cluster View with PTO Light



0000466714

1. PTO light indicator

Figure 177 International® LT®, RH™, HV™, and MV™ Series Trucks Gauge Cluster View with PTO Light

The PTO indicator lights, located in the Instrument Cluster, are shown above.

In the graphic above you can see the remote input turns on the indicator in the instrument cluster (orange ladder logic icon indicator).

Entering the Feature and Diagnostic Description

There is one last crucial piece of information that needs to be installed to the logic. And that information would be the synopsis, diagnostics, pin out, and switch locations that you will manually type in the Diagnostics tab on the ladder logic screen. Remember, failure to complete this step will result in the logic designers user id being disabled by Navistar, Inc. If the user id is disabled the user will no longer be able to create Advanced Logic solutions. The diagnostics tab is used by truck technicians as a troubleshooting manual, should the truck be in need of repair. If the logic description is not provided with the ladder logic, the technician may not be able to troubleshoot the vehicle problem. This will result in excessive truck downtime, repair time as well as elevated repair costs. You hold the key to managing the success of the Diamond Logic® solutions you create. It is desirable that the name and company phone number of the advanced ladder logic should be included in the diagnostic description. See the chapter on diagnostics for a full description of the information that should be included in the diagnostic description.

PTO Conclusions

As you can see in this chapter, there is a lot of thought that needs to be placed in designing ladder logic. What we have reviewed in this section is just the beginning! We covered just five interlocked parameters. Navistar, Inc. did this with forty-two different parameters! It would be very beneficial to use the parameters that were designed by Navistar, Inc. whenever possible.

DIAGNOSTICS, SIMULATION AND VALIDATING SOLUTIONS

A significant feature of the Diamond Logic® Builder software is its ability to diagnose and validate both hardware and software elements of the Diamond Logic® electrical system. By leveraging the factory-installed modules on the vehicle along with the bodybuilder installed components it becomes much easier to diagnose and validate software and hardware programmed on the vehicle. The following section will explain proper techniques for diagnosing and validating complete electrical solutions.

A very effective tool found in both the diagnostic and simulate mode is the ability to print any portion of the vehicle programming file. You can print the entire vehicle architecture or just a piece of the logic. If you print the entire vehicle, be advised that it can be up to 60 pages long. Individual items that can be printed include the advanced logic blocks, which include the actual ladder logic (graphical view of the logic), the structured logic (text version of the ladder logic) or the diagnostics text descriptions for the ladder logic. The diagnostics portion is a critical piece that should be printed after a vehicle file or template is created. The diagnostic portion of ladder logic will be discussed later in this section. Other portions that can be printed are features, faults, modules, connectors, signals, center panel, cluster and messages. It is highly suggested that after creating advanced logic, to print the advanced logic, connectors and center panel and add these items to the vehicle packet that you ship with the vehicle. This is the minimum suggested; if there is more complexity to your particular vehicle, you may find it useful to print additional sections to send with the vehicle. These printouts will assist your service locations or International® dealers in diagnosing issues after the vehicle leaves the bodybuilder.

SIMULATE MODE: PURPOSE, DEFINITION AND USAGE



Figure 178 Simulate Mode Toolbar Icon

Simulate mode allows a Diamond Logic® Builder program user to test pre-engineered features as well as advanced logic solutions. Vehicle files can be retrieved from history and then a template can be created using the Diamond Logic® Builder software and simulated to ensure that all the features and interlocks are set to your particular preference. Certain features contain interlocks such as the PTO feature. The PTO feature has 42 programmable parameters that are selectable to a Diamond Logic® Builder software user. Engagement, disengagement and reengagement parameters are a few examples of PTO interlocks that the simulate mode can test out to ensure that they are set to your specifications before you program a vehicle. Simulate mode can be a useful tool to ensure that the right codes are ordered on your vehicle so you know all the items that you will be adding will work when the vehicle gets to your location. Simulate works independently of a vehicle so you can test solutions even before a vehicle is ordered. Being able to work through a vehicle file or template before applying it to a vehicle is a huge time saver. It allows you to actually troubleshoot any inconsistencies in your programming and not interfere with the production of the vehicle. The controls and procedures in simulate and diagnostic are very similar and will be explained in the rest of section 8.

DIAGNOSTIC MODE: PURPOSE, DEFINITION AND USAGE



Figure 179 Diagnostic Mode Toolbar Icon

DIAGNOSTICS, SIMULATION AND VALIDATING SOLUTIONS

Diagnostic mode gives the technician the ability to diagnose vehicle faults and verify driver complaints quickly and easily. The first step in diagnostics is to connect to the vehicle. Do this by using an interface device such as the IC3 Com, IC4 Com, IC4 USB or NEXIQ USB-Link 2 cable. The interface cable should be one that is approved by International. When diagnosing or programming, always start with the key in the accessory position. A key in the ON position or a vehicle started should only be used when you must test a feature that requires this. The primary reason for this is that with the vehicle started or the key in the on position, all vehicle modules including the engine, transmission, ABS and all multiplex modules are communicating on the data link. With all this data traffic, it can take up to 4 times as long to do diagnostics or programming.

Diagnostic mode can show short and open circuits, amperage loads that are too high or too low, or custom logic that has not been properly written. The diagnostic mode allows you to view switches, contacts, outputs and many other signals that are on the vehicle. It allows you to view and override signals to test and diagnose problems with multiplex features on the vehicle. Later in this section we will discuss diagnosing different components such as switches, gauges and connector outputs.

One of the first things we can do with the Diamond Logic® Builder software in the diagnostic mode is to read a list of faults that are on the vehicle by clicking on the fault tab. The fault tab can show diagnostic trouble codes, whether a fault is active or inactive, pin locations, probable causes and comments etc.

Select	Advanced Logic	Features	Faults	Connectors	Signals	Center Panel	Cluster	Messages		
T	SPN	...	B...	B...	Message	Probable Cause	Module
639	14	228	254	✓	1			Failed to receive PGN 65252.		Body Cont...
612	14	25	2	✓	1			Analog channel 25 is out of range high.	Shorted h...	Body Cont...
625	14	130	0	✓	1			Driver Door Module (two-door or four-door) (address 130)...		Driver Do...
625	14	64	0	✓	1			Front Passenger Door Module (address 64) not communicati...		Front Pas...
613	14	1	5	✓	1			HVAC Control Head diagnostic circuit loss of communicati...		Body Cont...
639	14	255	254	✓	1			Failed to receive PGN 65279.		Body Cont...
639	14	192	254	✓	1			Failed to receive PGN 65216.		Body Cont...
612	14	2	2	✓	1			Analog channel 2 is out of range high.	Shorted h...	Body Cont...
612	14	30	2	✓	1			Analog channel 30 is out of range high.	Shorted h...	Body Cont...

0000410489

Figure 180 The Faults Tab – Pre 2007 International® LT®, RH™, HV™, and MV™ Series Trucks

International® Diamond Logic® Builder									
File Edit View Advanced Logic Tools Diagnostics Help									
Select Advanced Logic Features Faults Connectors Signals Center Panel Cluster Campaign Messages									
T	SPN	FM	Byte 7	Byte 8	Active	DC	Message	Probable Cause	Module
	524205	14			✓		1Unknown fault	Special instructio...	Unknown module
	1552	2					1HVAC Control Head Temperature Mix DML	HVAC Motor in Wron...	ESC

0000466572

Figure 181 The Faults Tab – Pre 2007 International® LT®, RH™, HV™, and MV™ Series Trucks

The columns on this tab are described below:

Name	Description
SPN	Suspect Parameter Number: Number that indicates the Major System that is experiencing a failure mode.
FMI	FMI is a number for "Fault Mode Indicator." For pre 2007 International® LT®, RH™, HV™, and MV™ Series Trucks the value is always 14 for "Indeterminate" as per the SAE J1939 specification. For International® LT®, RH™, HV™, and MV™ Series trucks the value is a specific FMI. The FMI for the Diamond Logic® electrical system is currently displayed under the Byte 8 column listed below.
Byte 7	Number that indicates the sub-system that is experiencing a failure mode.
Byte 8	Number to describe the detailed fault mode such as open circuit or shorted to ground.
Active	Indicator to show whether a fault is currently active or inactive.
OC	Occurrence Count: Number of times a fault has gone active and then inactive.
Message	Text description of the numerical fault code.
Comment	Explanation of Message Description.
Probable Cause	Probable cause of the fault.
Pins	Module pin and connector associated with the fault code, if applicable.
Module	Text name of module associated with the fault code, if applicable.
Address	Text name of module associated with the fault code, if applicable. Address of the module logging the fault. Currently, this number is always 33 for the BCM.

DIAGNOSTIC FEATURE DESCRIPTIONS: WRITING USEFUL TEXT

It is extremely important to write detailed descriptions of any advanced logic you create. All the items written in Advanced Logic should be documented in the Description tab. If the diagnostic description is detailed and explains the advanced logic well, it will go a long way to assist technicians in troubleshooting your advanced logic. If the advanced logic is hidden, this document is the only way that a technician can diagnose and troubleshoot the advanced logic.

Recommended Format for Documentation on the Description Tab
<p>Synopsis</p> <p>A general overview of each advanced logic block. The synopsis should give the technician an idea of the overall vehicle configuration. Fault Detection Management</p> <p>Fault Detection Management</p> <p>The fault detection management portion of the document should explain the use of the switch indicators and how they will respond in a fault situation.</p> <p>Any exceptions to the standard fault indicators.</p> <p>The virtual fusing set for RPM outputs.</p> <p>Feature Extended Descriptions</p> <p>Each Logic Block should be explained in detail.</p> <p>Features should be described so that anyone reading the description could tell you what input, switches and outputs are used and what each item does in the feature Items such as load management and master switching should be explained in full to include voltages and all rungs that are incorporated in the management or switching.</p> <p>Contact Information</p> <p>Contact information should be provided so technician or customer questions about the operation or settings within the advanced logic can be answered.</p> <p>Recommended contact information should include: Name of the person who created the advanced logic, address and phone number of the bodybuilder and or the call center number so the technician or customer can obtain answers.</p>

Sample Text For the Description Tab**Synopsis**

The following electrical loads are to be connected to one Remote Power Module, RPM mounted under the cab, with five (2 POS) latched rocker switches and one switch pack din warning indicator light assembly. Each body builder electrical circuit attached to the RPM will provide on-board self-diagnostics consisting of each circuit signal input status utilized for each circuit, which will cause the circuit to default to one of the two following conditions:

Fault Detection Management

1. Slow flashing switch indicator will represent that the driver desired requests is out of specific parameters or circuit function interlocks.
2. Fast flashing switch indicator will represent an electrical circuit fault is present.
3. Exceptions to switch circuit self-diagnostics will be the door open warning light circuit. On-board diagnostics can be exercised via the vehicles system Diagnostics Trouble Codes cluster LCD display.

Virtual fusing parameters for RPM outputs as follows:

Output 1: 20A virtual accessory

Output 2: 10A Siren horn

Output 3: 10A Beacon light

Output 4: 5A upper flashers

Output 5: 10A step lights

Output 6: 15A park lights

Feature Extended Descriptions

Fan & Interior Lighting

RPM 1 Output 1 (BROWN 8-way Pin A) is controlled by the key switch in Ignition or Accessory position, with continuous power to two aftermarket interior fans with individual H / M / L fan speed switches on each fan housings and two aftermarket interior fluorescent dome light fixtures located in the roof of the body, with individual ON / OFF switch. No interlocks are tied to this circuit other than key state.

Beacon

RPM 1 Output 2 (BROWN 8-way Pin B) will control an exterior body builder installed beacon light. This circuit will be connected to a single RPM output, and utilize the second in-dash advanced logic latched rocker switch. The key switch in Ignition or Accessory position will control this RPM output; no interlocks will be tied to this circuit other than key state.

Sample Text For the Description Tab
<p>Siren</p> <p>RPM 1 Output 3 (BROWN 8-way Pin C) will control an exterior body builder installed siren. This circuit will be connected to a single RPM output, and utilize the third in-dash advanced logic latched rocker switch. The key switch in Ignition or Accessory position will control this RPM output; no interlocks will be tied to this circuit other than key state.</p>
<p>Panic Circuit</p> <p>RPM 1 Output 4 (BROWN 8-way Pin D) will control an emergency driver switch activated Panic Circuit to flash the clearance light circuits at a rate cycle of 0.3 seconds, it will be on for .15 of second and OFF for .15 of second. This circuit is interlocked logic to vehicle speed below 10 mph, and the park brakes set. This circuit will be connected to a single RPM output, and utilize the first in-dash advanced logic latched rocker switch.</p>
<p>Door Open Warning System / Step Light</p> <p>RPM 1 Output 5 (BROWN 8-way Pin E) will control the exterior body builder installed rear step light and utilize the fourth in-dash advanced logic switch location with a service parts switch blank tooled with a RED domed lens and illuminated with a single 3 candle power LED. The body builder installed remote switches located at each door assembly all tied to the same RPM input circuit (BLACK 23-way Pin 18) to control circuit functionality. This RPM output will be controlled by the key switch in Ignition or Accessory position and the following circuit function interlocks are as follows:</p> <ol style="list-style-type: none">1. Anytime a door connected to this system is opened, the rear step light will illuminate, also activating the in-dash flashing RED warning lamp indicator.2. The door open warning light system is programmed with an BCM internal software clock in conjunction with the cluster audible alarm; activated when any door connected to this system is opened for more than 30 seconds. The BCM internal software clock will reset when the open door is closed or if power is cycled.

Sample Text For the Description Tab**Marker / Park Lights**

RPM 1 Output 6 (BROWN 8-way Pin H) will control the vehicles marker / park light circuit. This function does not utilize an advanced logic switch to control the circuit function, other than the vehicles headlight switch. The Panic Circuit switch function is interlocked to this circuit. The RPM output is spliced into the center chassis harness clearance marker light circuit at the BCM connector 4007, pin H, circuit wire J58. The marker / park light circuit function will be controlled via the RPM output circuit instead of the BCM. Based on the state of marker / park light request and based on the state of the Panic Circuit switch, will determine if the RPM output channel will activate or not. If the marker/park light switch is on and the park lights request are not flashing the output should be on steady. If the marker / park light is OFF and the Panic Switch is active the output will flash the mid-body upper marker light.

Contact Information

John Doe

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2911 Meyer Rd.

Fort Wayne, In. 46801







260-461-0000

Call center: 1-800-123-4567

An example of good documentation practice can be seen below.

DIAGNOSTICS: SUGGESTION FOR USING SWITCH INDICATORS (SLOW / FAST BLINK)

An excellent way to write fault indicators for switch outputs in advanced logic is to use the switch indicator lights. Normally the steady on indicator (green light in the upper portion of the switch) indicates that the switch output is on. There are also two additional light states that can be used. The light can blink slow or fast. The slow and fast blink can be programmed in the Diamond Logic® Builder program to represent an error state such as a bad output status on an RPM output or when the switch is in the on position but the output is not on due to an interlock requirement that has not been met for the output, i.e. you have selected the switch ON but because of load shedding, the output is not ON.

My Variables	Advanced	Chassis	Cluster	Engine	Other RPMs	RPM1	RPM2	RPM4	Switches	Transmission
T	Custom Variable				Used In		.	.	Signal/Value	
	Light_Bar_Sw								<input type="checkbox"/>	Custom_Switch01_A_Up
									<input type="checkbox"/>	Custom_Switch01_B_Middle
									<input type="checkbox"/>	Custom_Switch01_C_Down
	Light_Bar_Ind								<input type="checkbox"/>	Custom_Switch01_Ind
	Light_Bar_Bad_Status								<input type="checkbox"/>	Custom_Switch01_Ind_Fast_Flash
	Light_Bar_Shed								<input type="checkbox"/>	Custom_Switch01_Ind_Slow_Flash

0000466682

Figure 182 Switch Tab Example

DIAGNOSTICS IN THE LADDER VIEW

Diagnostics in the ladder view are simple and straightforward:

1. Connect to the truck.
2. Enter DIAGNOSTIC MODE.
3. Select the ADVANCED LOGIC tab. On this tab, gray OFF or BROWN question mark shadow blocks will be seen over most items. BROWN shadow blocks indicate items that the present state cannot be determined. On the right of the window, you will see the tabs that contain all the signals that can be used in advanced logic.
4. At this point, you can observe actual signals received from the truck.

For example: while hooked up to the vehicle, in Diagnostic Mode and on the Advanced tab, you can observe the actions on the vehicle.

An example is, while hooked up to the vehicle, in diagnostic mode and on the advanced tab, you can observe the actions on the vehicle.

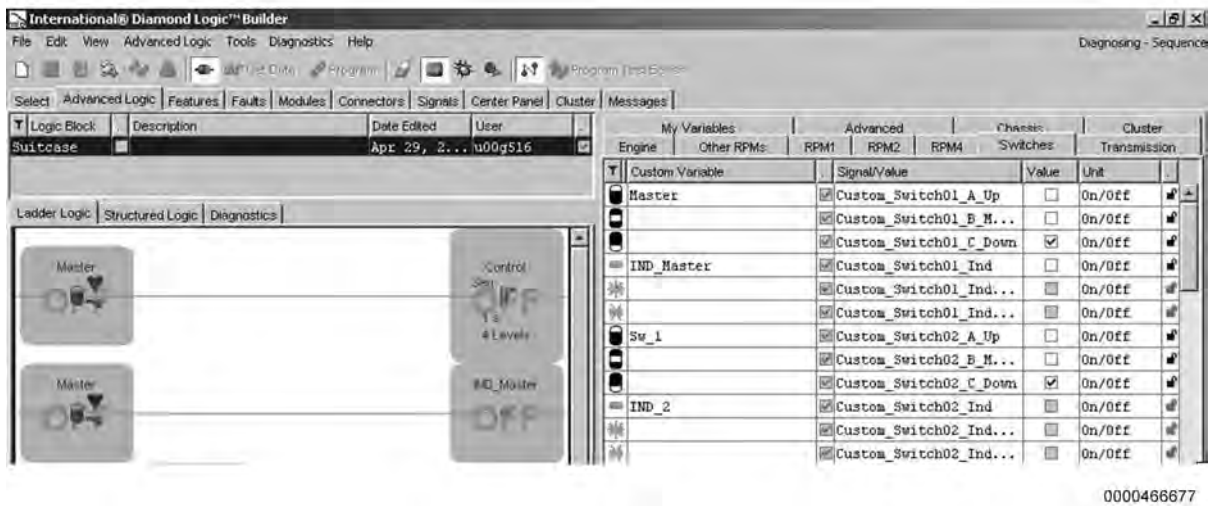


Figure 183 Advanced Logic Block with a Switch in the First Rung

The figure above shows an advanced block with a switch in the first rung of the ladder logic. There are two ways of testing to ensure the vehicle is working properly. The first is to actually activate the switch in the vehicle and watch for the outcome on the screen. The second is to override the switch and click the checkbox in the value column on the right of the screen. Clicking the checkbox is the way to test out the advanced logic in the simulate mode. This tells the BCM / BC to ignore the switch state and activate the circuit regardless of switch location

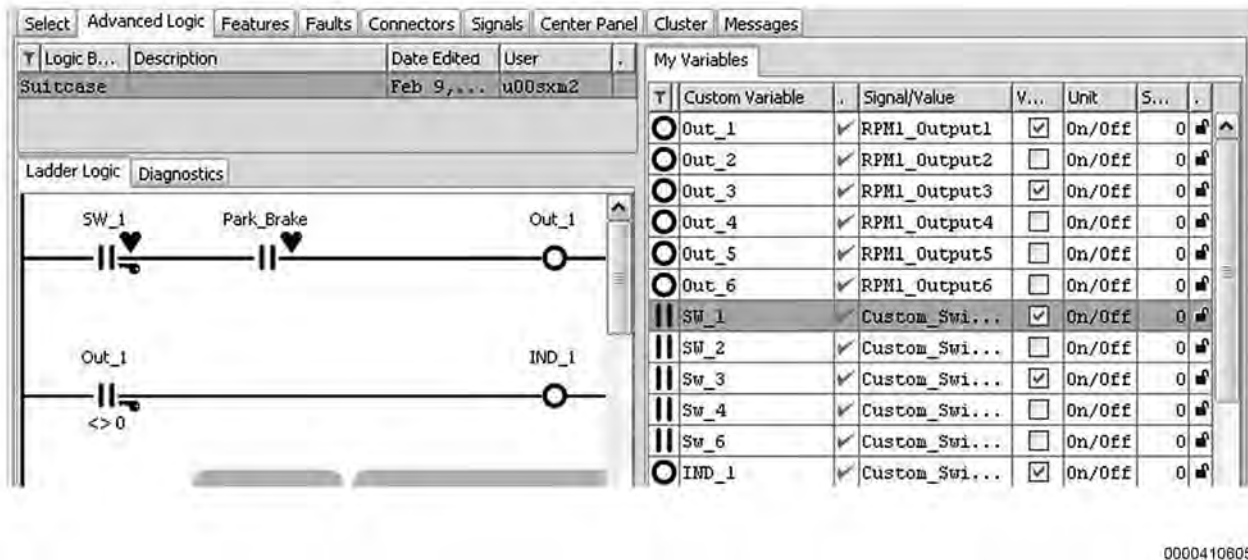


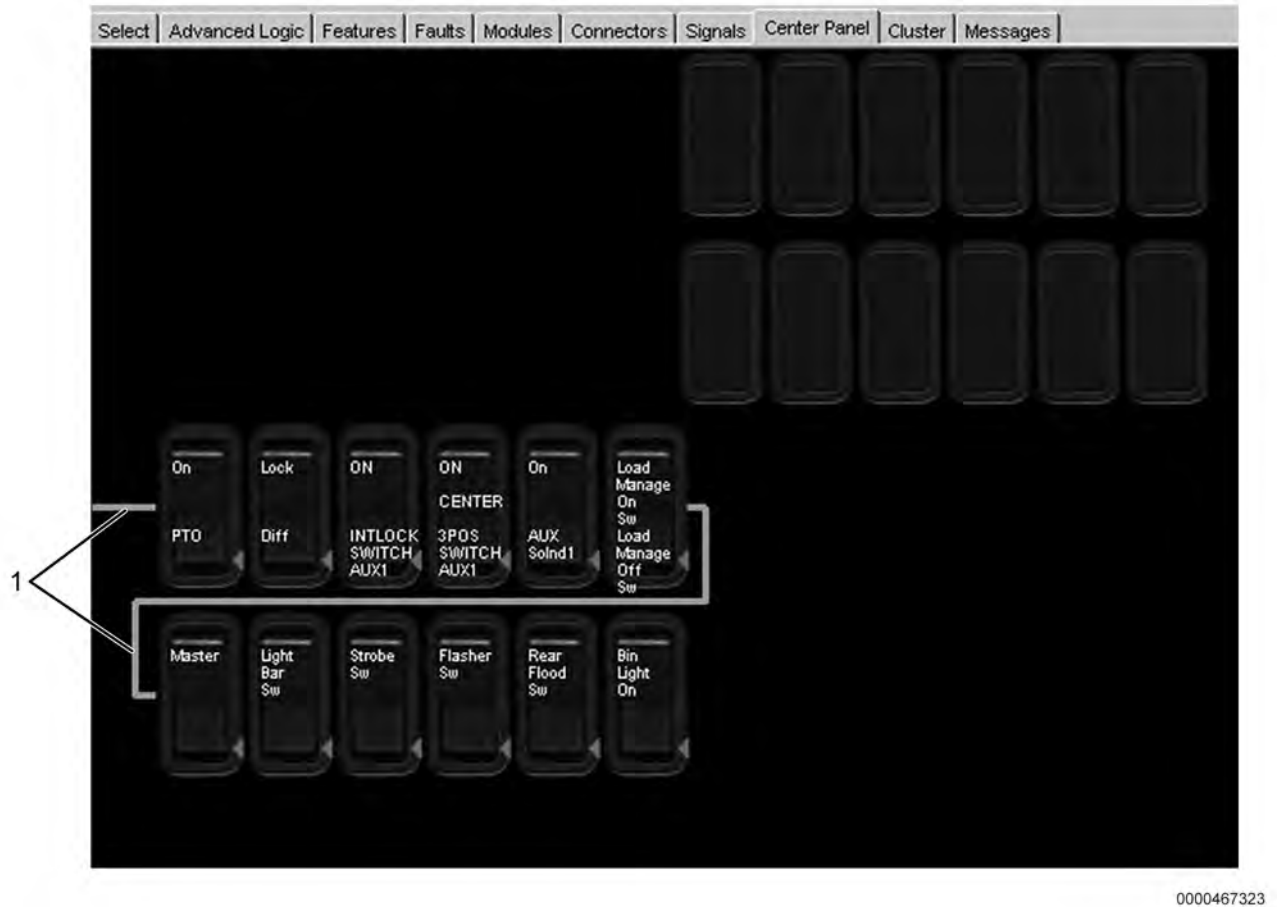
Figure 184 Switch in First Rung is Now ON

The next figure shows the same view with the switch in the up position. Notice on the left side of the window, the graphic display shows that the switch and corresponding outputs are now in the ON position. The right side of the screen now has checkmarks in the items that have been set to ON. Returning the switch to the OFF position will once again turn OFF the switch and the switch outputs.

Each of these techniques has value. For items such as switches and the park brake, it is very easy to either turn them ON or OFF. However, for items such as intermediate variables created in the ladder logic and RPM input signals, the value column is an excellent option. This overrides the vehicle signal. By observing the reaction of the logic rung, you can diagnose the vehicle. If all the items on the left side of the logic block are properly set, the value on the right should be either ON or OFF. If the contact, light, or output indicator is on in the Diagnostics tab, then the output should also be on; if not, check for a fault code in the Faults tab.

DIAGNOSTICS IN THE CENTER PANEL VIEW

In Diagnostics Mode, the Center Panel tab displays images of the switches.



1. YELLOW line

Figure 185 Center Panel Tab

A YELLOW line (Figure 182, Item 1) represents the multiplex data link tying the switch packs together. Arrows indicate the current switch setting of each switch. When the state of the actual switch is changed, the arrows and images will change and indicate the new state.

Diamond Logic® Builder can override switches.

When Diamond Logic Builder is used to cycle switches, the arrows and images will change, indicating the new state. Additionally, the padlock icon will appear, indicating a locked condition.

To override a switch, either left-click on the desired switch setting or right-click on the switch and select a desired setting from the right-click menu.



Figure 186 Switch Right-Click Menu

Clicking the top portion of the switch will activate that switch output and the arrow will move to the up position. This overrides the switch and allows you to determine if there is a switch problem.



Figure 187 Switch in ON Position, with Lock

The padlock, which appears on a switch, allows you to lock that signal in any of the switch's valid positions. Click on the lock to remove it.

When diagnosing switches, it is important to remember a few facts:

- The switch rocker is nothing more than a pair of plungers. When a switch is pushed, it pushes one of the two plungers in and contacts a micro switch in the switch pack.
- Each switch location has two micro switches. The switch can be in 1 of 3 valid states; micro switch 1 is depressed, micro switch 2 is depressed, or neither micro switch is depressed.
- When diagnosing a switch by checking the box in the Signals tab, the Features tab, or the Advanced Logic tab (while in either Diagnostic Mode or Simulate Mode), you must select the switch position you want, such as the switch up position. You must also make sure that the switch middle and switch down boxes are not checked. If you have more than one switch state selected in the Advanced Logic tab or the Signals tab, your switch will show YELLOW in the Center Panel tab. This tells you that you have put the switch in an illegal state.
- Turn OFF or unlock the individual switch signals in the Signals tab before you continue with diagnostics or simulation with the Center Panel tab.

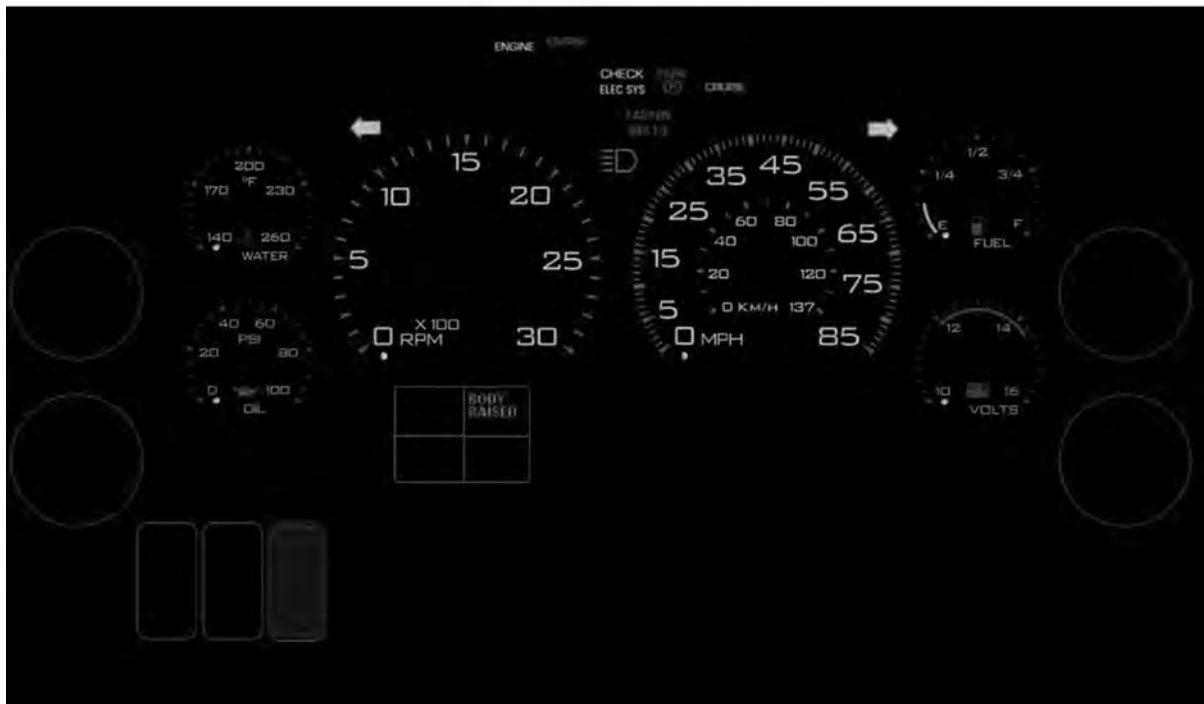
When diagnosing switches, it is important to remember a few facts about the switches. The switch rocker is nothing more than a plunger, when a switch is pushed; it pushes one of two plungers in and contacts a micro switch in the switch pack. Each switch location has two micro switches. There are 3 states that the switch can be in, micro switch 1 is depressed, micro switch 2 is depressed or neither micro switch is depressed. The other thing to remember with switches is that when diagnosing a switch by checking the box in the signals, features, or advanced logic tabs while in either diagnostic or simulate mode; you must select the switch position you want, i.e. switch up position.

You must also make sure that the switch middle and switch down check boxes are not selected. If you have more than one switch state selected in the advanced logic or signal view, your switch will show YELLOW in the center panel view. This tells you that you have put the switch in an illegal state. Turn OFF or unlock the individual switch signals in the advanced logic view of signals view before you continue with the diagnostics or simulation with the Center Panel View.

DIAGNOSTICS IN THE GAUGE CLUSTER VIEW

When the Cluster tab is selected in Diagnostic Mode, the movement of the gauges mirrors the movements of the actual gauges. For example, if the fuel gauge does not appear to be working, you can check the gauge cluster view and see if the signal is driving the Diagnostic Mode gauge. If the gauge is working in Diagnostic Mode, but the actual gauge is not, follow the Navistar® troubleshooting guide to complete the diagnosis.

By placing the cursor on the outer ring of a gauge and clicking the left mouse button, the user can override the actual gauge signal. This forces the gauge to the reading indicated by the cursor location. In the illustration below, the tachometer has been clicked at the 1300 RPM mark.



0000466673

Figure 188 Cluster Tab

When observing the gauges in Diagnostic Mode, a gauge may momentarily dip to 0. This occurs because of the high update rate required by some gauges and an update may occasionally be missed. The speedometer and the tachometer are most susceptible to this anomaly because of their high update requirements. This is a normal condition and is not an indicator of a defective gauge.

Double-clicking in an area around the center of a gauge will bring up a text box in which a specific gauge set value can be entered. The gauge should follow the diagnostic gauge setting. If the gauge does not follow the diagnostic gauge, then follow the Navistar® troubleshooting guide.



Figure 189 Temperature Gauge Double-Click Box

DIAGNOSTICS IN THE CONNECTOR VIEW

Signal values that are present on physical pins of various electrical modules can be observed by selecting the Connectors tab. Note that there is a tab for each module. Use the connector view to help isolate the problem. The connector views provide the ability to monitor system values without the use of breakout boxes. Scaled voltages, temperatures, and pressures are presented for analog voltages and check boxes are provided for ON / OFF values.

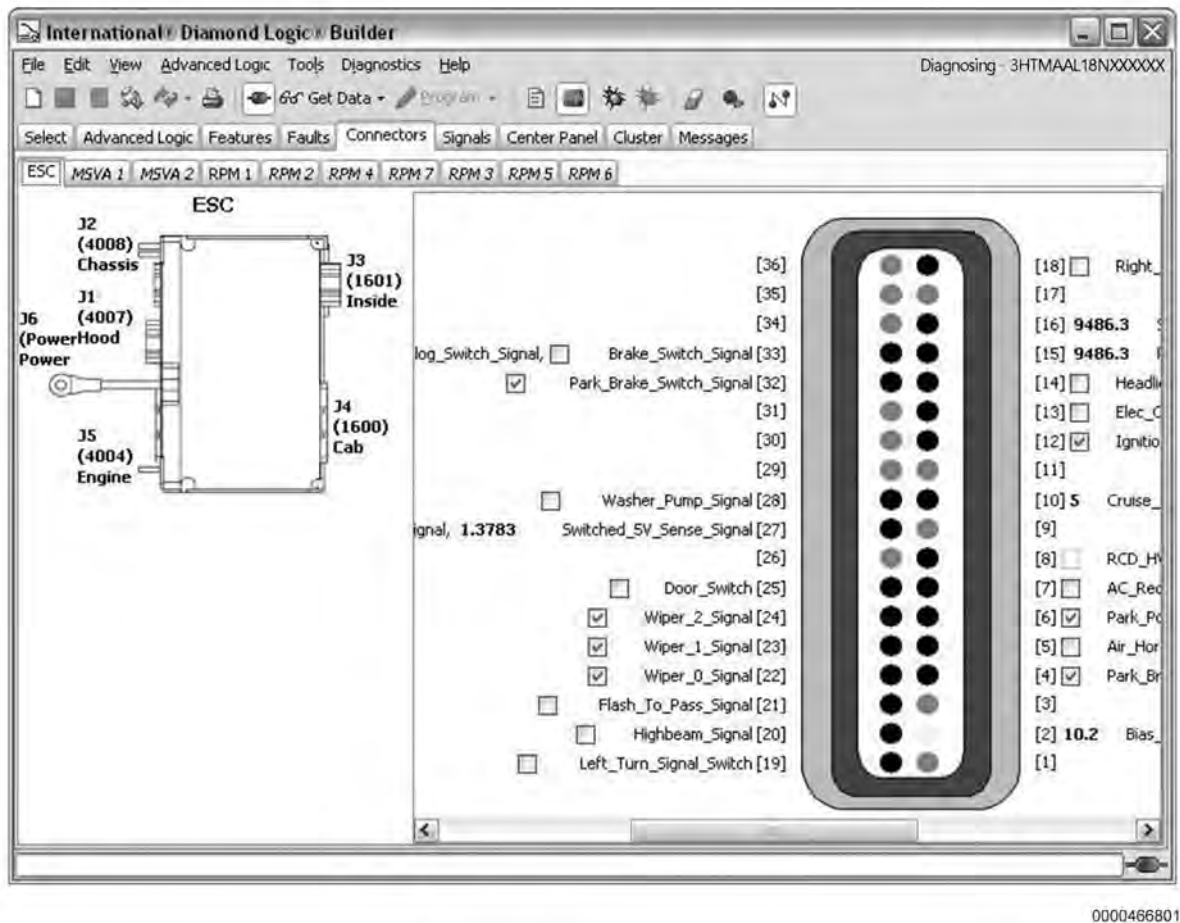


Figure 190 Connectors Tab

On the CONNECTORS tab, you can observe the state of each input and output from the BCM and each RPM and Modular Solenoid Valve Assembly (MSVA). You can also override each input and output.

Viewing Individual Inputs and Outputs

1. Select the sub-tab for the module that you wish to view. The sub-tab displays an image of the module and its connectors on the left.
2. Select a connector in the image on the left by clicking on it. The selected connector becomes shaded in gray and is displayed on the right.

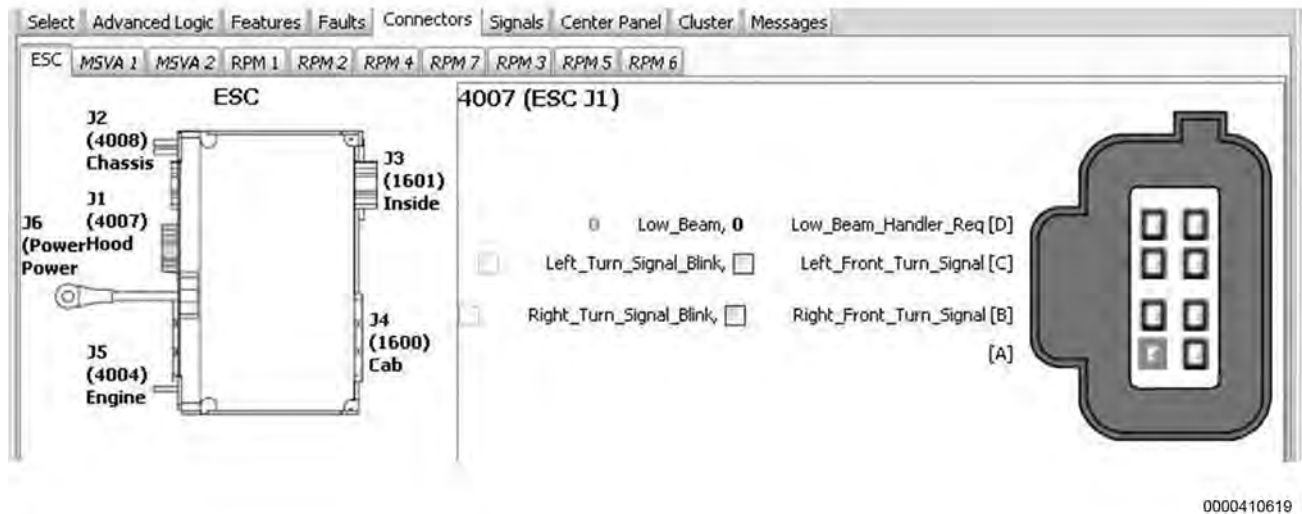
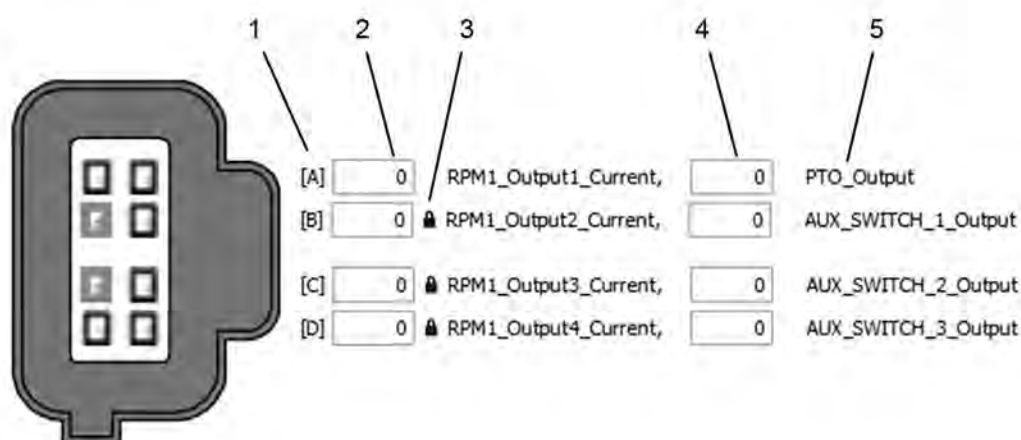


Figure 191 Selected Connector Displayed on Right

RPM Output Connector View

The figure below shows the output connector for RPM 1. To select an output, click on its name. The selected name and the corresponding pin in the connector drawing will appear highlighted in YELLOW. Selecting an output in this way will also automatically select this output in the Signals tab. This is very helpful if you are not sure of the feature code that controls a particular RPM output. To turn off the YELLOW highlight, hold down the Ctrl key while selecting an output.



0000410621

Figure 192 RPM Output Connector View, Outputs on Right (Typical)

Several pieces of information are displayed for each output: refer to figure above for numbered items.

Item	Description
1	Cavity pin numbers (shown in brackets)
2	Entering a voltage here sets the value of this output to the entered value.
3	<p>The lock icon is used to lock and unlock the output to the value entered to the left (Item 2). When locked, no other signal can drive that output. (When unlocked, a blank space appears here. Click the blank space to lock the output.)</p> <p>NOTE – If you are having trouble with outputs not turning ON or OFF as expected, check to make sure those outputs are unlocked.</p>
4	The current level (in Amps) that this output must reach in order to trigger the virtual fuse configured for this output. The default is 20.
5	<p>The name assigned by the feature that is using this output.</p> <p>NOTE – A bold output name would indicate that a custom name has been assigned to this signal by advanced logic.</p>

Information about the outputs on the left of the connector are displayed in roughly the opposite order.

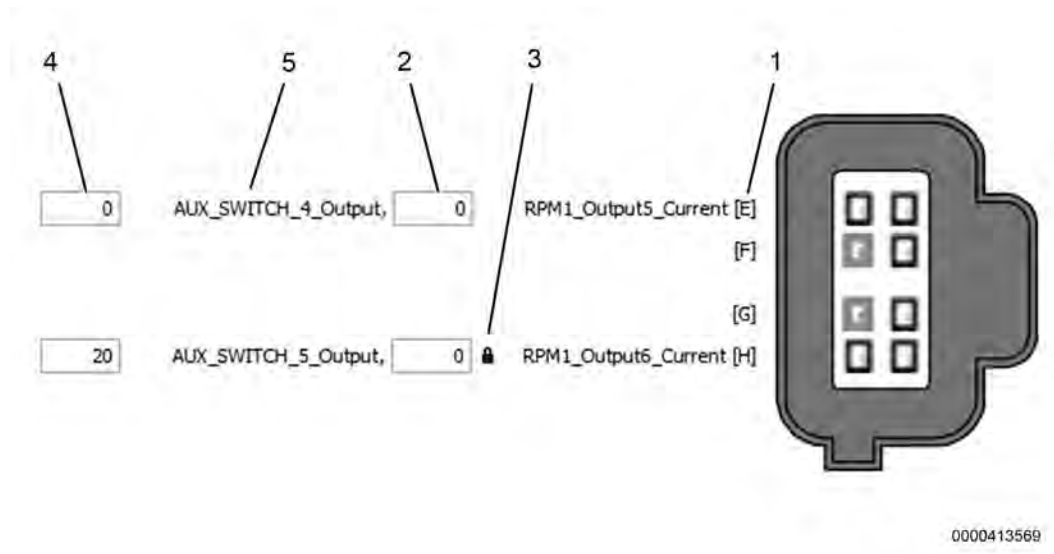


Figure 193 RPM Output Connector View, Outputs on Left (Typical)

RPM Input Connector View

Input connectors, like the example shown below, are represented in a similar manner as output connectors, with some minor differences.

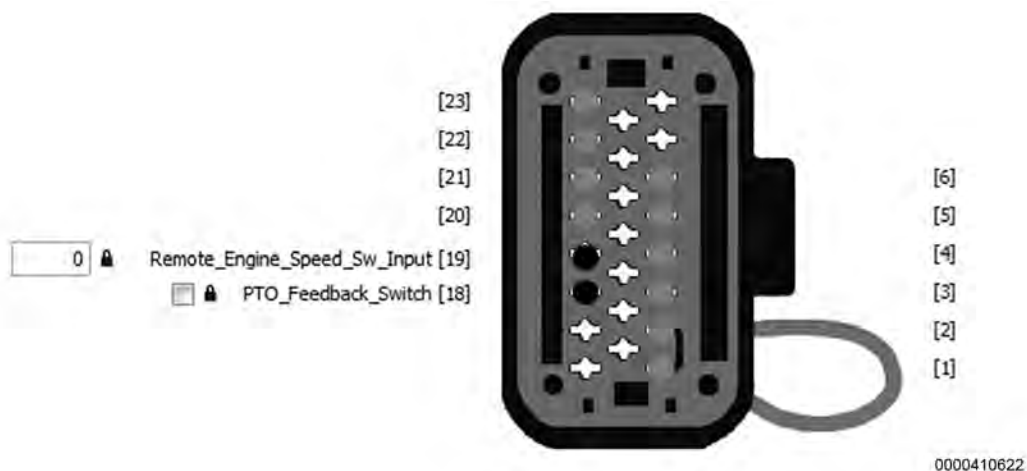


Figure 194 RPM Input Connector View (Typical)

Each pin of an input connector can be programmed in the BCMto respond to either a 12V signal or a ground signal.

The lock works the same as it does on the output connector.

The input connector will also show the addressing; note the jumper wire between pins 1 and 2. Jumper wires on the input connector determine how an RPM is addressed. Addressing is extremely important. RPM input connectors should not be moved around. Doing so will move all inputs and outputs programmed to that particular RPM.

USING THE SIGNALS TAB TO DIAGNOSE LADDER LOGIC

The signals tab is a very useful screen when diagnosing a vehicle. There are two parts to the screen, the signal list on top and the ladder logic view on the bottom. On the signal tab, you can observe specific signals in two different ways. You can observe the status of a signal by watching the value column, or by observing the ladder logic at the bottom of the screen. To view the signal responses, you must click on the closed eye in the watch column. When you click on the closed eyelid, an eyeball will appear. If you do not select the watch feature, you will not be able to see the status change. The second and most important thing is to be aware of the lock feature. If a signal is locked on or OFF, you will not be able to change that signal state no matter what you do to the switch or the input / output. Use caution when locking signals. If you are activating a signal or switch and think that you have checked all the locks on all the pages and the feature still does not work, try clicking OFF of diagnostics, disconnecting from the vehicle for 10 seconds, reconnecting and then running diagnostics again. This will reset all the locks and test values that you have entered. From there you can start with a clean slate and ensure that only the values and locks you want set, are in fact set.

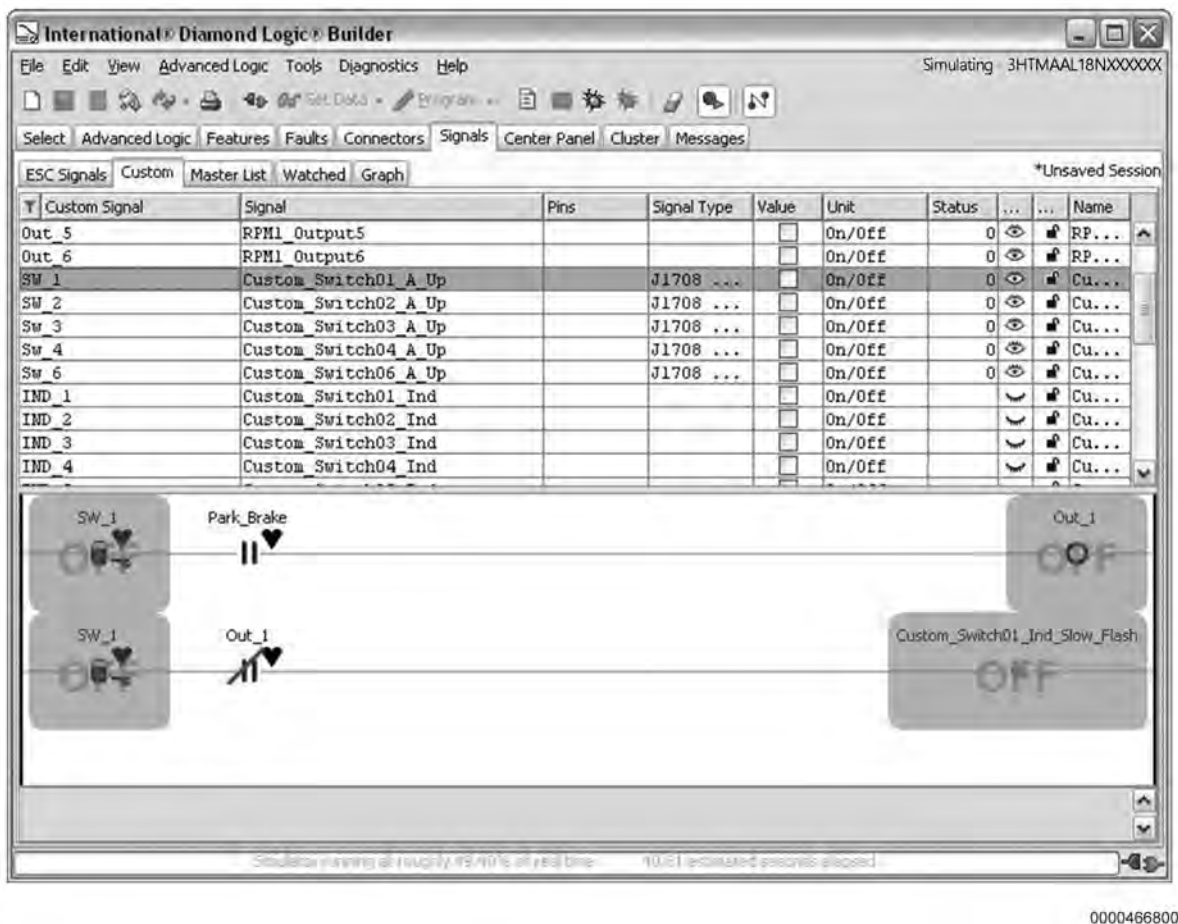


Figure 195 Signals Tab

With the exception of the Graph sub-tab, all of the sub-tabs on the Signals tab present data in a tabular format. All of these tables have the same column headings:

DIAGNOSTICS, SIMULATION AND VALIDATING SOLUTIONS

Name	Description
Custom Signal	Displays the custom signal name assigned by the Diamond Logic® Builder software user.
Signal	Displays internal system name for each signal.
Pins	Displays internal pin assignment on ESC or BCM.
Signal Type	Displays, if applicable, generated signal type such as analog, digital, J1939, or 1708.
Physical Signal	Name of the signal used by the system controller. This column would normally not be displayed since it is of no use to the Diamond Logic® Builder software user.
Index	Entry in the electrical system data table. This column would normally not be displayed since it is of no use to the Diamond Logic® Builder software user.
Description	Displays the logic description.
Unit	Unit in which the variable is displayed, such as seconds or On / Off.
Watch	Displays the watched / not watched selection icon.
Cfg.	The unit of the raw data value used by the system. This column would normally not be displayed since it is of no use to the Diamond Logic® Builder software user.
Name	Displays the signal name.

DOS AND DON'TS

Do

- Test all designs thoroughly before selling equipment controlled by Diamond Logic® Builder programming. Exercise inputs and outputs under ALL possible combinations and conditions. Someone in addition to the advanced logic writer should test the design on the vehicle with the equipment that is to be controlled with the Diamond Logic® Builder software.
- Use timers when key OFF functionality is required to ensure that the system will shut down before the batteries are drained.
- Use the Accessory signal once on each rung that does not require key OFF operation to ensure that the system will shut down with the ignition key OFF.
- Attach warning labels on the vehicle if logic is employed that could cause unexpected equipment action as a result of time delayed events, use of interlocks, control of engine speed, etc.
- Before the vehicle is built, order the Diamond Logic® Expansion Pack Feature, 060ACW, to gain access to two general-purpose inputs and two general-purpose relay driver outputs. The Diamond Logic® Builder program cannot add it later.
- To gain access to the work light channel with the Diamond Logic® Builder software order the Work Light Accommodation Feature, 08WMA, before the vehicle is built. The Diamond Logic® Builder program cannot add it later.
- Initialize load manager functions to their full ON condition using the SET function to ensure that all outputs are functional at each ignition cycle. It is recommended that a load manager disable switch be employed in your design to provide a means to turn outputs ON during emergency conditions.
- Keep switch and advanced logic names short so the switches in the CENTER PANEL VIEW will be more readable and so that more logic signals may be placed on a single advanced logic rung.
- Expand the ladder logic panel so both sides of the ladder are always visible. This will ensure that the outputs are plainly visible and there is no confusion about whether a signal has been used as an input or as an output.
- Pre-order pre-engineered 060 codes as much as possible before writing advanced logic to provide the necessary hardware and software on the vehicle to minimize the need to write advanced logic.

Don't

- Don't use a latching switch in the switch positions, on the gauge cluster. This position is functional, with ignition key OFF. If these switches are left up or down, with key OFF, the batteries will be drained, since this switch will keep the system awake and consume power continuously.

Don't leave outputs ON with the ignition key OFF, to prevent draining the batteries. Any output left ON will keep the system awake. Some examples of using the Diamond Logic® Builder software that will keep the system running are:

- Switch indicators driven ON while the ignition key is OFF.
- Outputs that have been set ON by inputs but have not been set OFF when the key is OFF.
- Rocker switch inputs that have maintain with error assigned for the switch signal.
- Latched Remote Switch inputs that do not have ACCESSORY enabled on the signal.
- Using a latched switch in the third position of the gauge cluster switch pack.
- Not setting the Work_Light_OFF signal with the ignition key OFF.

Important Notes

- The BCM is not guaranteed to operate through engine crank cycles. Advanced Logic must be written such that equipment control is not adversely affected if the BCM should perform a reset cycle during the starting of the vehicle.
- Do not try to program a vehicle during Key ON Engine Running (KOER). Data traffic from power train system may prevent successful programming of the BCM. Always program the BCM with the ignition key in the ON or ACCESSORY position.
- Air solenoids used with the Diamond Logic® Builder program will turn OFF and air will be exhausted when the ignition key is turned to the OFF position. Provide operator warning labels and instructions when personnel may be exposed to unexpected equipment movement or operation.
- Air solenoid outputs deliver pilot air of about four CFM. Ensure that air solenoids are not used for primary air sources that could quickly empty the air brake tank supply. Universal air solenoids should only be used with closed cavity applications such as air shifted PTO mechanisms, air controlled sprayer heads, etc.
- The signal BATTERY_VOLTAGE cannot be used while the ignition key is OFF. The value drops to two or three volts and should not be used for advanced logic with the ignition key OFF. This signal should always have the ACCESSORY signal enabled when used.
- Disable load manager that uses the BATTERY_VOLTS signal during key OFF operation with the ACCESSORY signal. Since battery voltage will be very low with the ignition key OFF, an active load manager will shut OFF outputs if the load shedder function is used during key OFF operation.
- A variety of signals are invalid with the ignition key OFF since either the inputs are biased to ACCESSORY or else the internal programming of the software disables the signal during key OFF operation. These signals include:
 - Park_Brake
 - Aux_discrete_input1
 - Aux_discrete_input2
 - AC_Clutch
 - AC_Request
 - Air_horn_switch
 - All wiper signals
 - Plow_Lights
 - Marker_Interrupter
 - Suspension_Dumped
 - Vehicle_Speed
 - All engine signals
 - All transmission signals
 - All custom rocker switch signals, unless one is place in the gauge cluster three-pack of switches
- It is not apparently obvious when Remote Power Module inputs and outputs are used by International electrical features, while working in the Advanced Logic view in the Diamond Logic Builder software. Print out the Connector view of the VIN before you begin writing advanced logic to ensure that you map inputs and outputs that are not used by International engineered features.

- Ensure that existing International software is removed from the Electronic System Controller (ESC) feature configuration file when implementing similar but different body control features using the Diamond Logic® Builder software and you wish to use the same hardware resources. Refer to the Electrical Body Builder Book for a listing of all 59XXXX features that are associated with body control features. Be sure to use Removed With Template when replacing International body control features with advanced logic on a repetitive basis.
- When creating internal variables, ensure that the correct unit of measure has been assigned to your new variable in the UNIT column of advanced logic, i.e. number should be assigned for numerical variables; ON / OFF should be assigned for binary variables.
- Certain signals cannot be forced off by advanced logic. Signals such as the audible alarm in the gauge cluster, the city horn, air horn, etc. may engage the outputs while custom logic is not requesting the output. See Signals With Limited Access above in this document.
- When using the SET function to turn ON a variable, ensure that a status check and the ACCESSORY signal are used to set the output OFF.

Information

- The order in which rungs are placed on a ladder can sometimes affect the logical performance of the ladder. See the Timer section above in this document for a detailed explanation of this effect.
- The ACCESSORY signal is automatically attached to all rocker switch signals and Remote Power Module switch inputs.
- For switch indicators, flash fast overrides flash slow, which overrides the normal ON.
- All ladder logic and International developed electrical features are executed 50 times per second.
- Advanced logic cannot be edited when applied to a VIN.
- Only the original advanced logic writer may edit advanced logic on a template.
- International features and programmable parameters may be added or deleted directly on a VIN.
- Changing programmable parameters in advanced logic may be accomplished by editing the list of parameters under code 595231 / 595BJR / 597136. This list is primarily used for setting output fuse levels for Remote Power Modules.
- Standard timer functions can only be set to run for a maximum of 655 seconds. Timers of longer duration may be constructed by referring to the Timer section above in this document.
- Some signals have a special encoding built into the signal definition. Using these signals requires knowledge of the data content. Some examples are:

DOS AND DON'TS

Brake Switch:













Data Value	Definition
0	Brake switch OFF, Good Status
1	Brake switch ON, Good Status
2	Brake switch OFF, Bad Status
3	Brake switch ON, Bad Status

Clutch Switch:






Data Value	Definition
0	Clutch switch OFF, Good Status
1	Clutch switch ON, Good Status
2	Clutch switch OFF, Bad Status
3	Clutch switch ON, Bad Status

SIGNAL ICONS











MAIN SIGNALS

Icon	Main Signals Description
	Switch Up
	Switch Down
	Switch Middle
	Flasher Function
	Input Signal
	(BLUE) Internal Input Signal
	Special Function Signal
	Output Signal
	(BLUE) Internal Output Signal
	Remote Power Module input that is active with 12 Volts present
	Remote Power Module input that is active with Ground present
	Signal with limited WRITE ACCESS



SIGNAL ICONS

Icon	Main Signals Description
	(GREEN) Rocker Switch Indicator
	(GREEN) Rocker Indicator Light Flash Fast
	(GREEN) Rocker Indicator Light Flash Slow
	Timer Function
	(RED) Warning Light in the Gauge Cluster

INPUT SIGNAL MODIFIERS




Icon	Input Modifiers Description
	(RED) Negate. When this symbol appears on top of an ON / OFF type signal, the signal is inverted. Applies to both INPUT and output signal. For example: 
	Signal that is turned OFF with error
	Signal that is turned ON with error
(none displayed)	Signal will be maintained with error
	Positive Edge: Capture one event when the signal turns ON
	Negative Edge: Capture one event when the signal turns OFF
Edg	Edge: Capture one event each time the signal turns OFF
	Good Status: Signal will be ON with a GOOD status
	Bad Status: Signal will be OFF with a BAD status
Alt	Altered: Signal goes active each time the value changes for one iteration
	Enabled: Checks if a timer function is enabled
	Running: Checks if a timer is running

SIGNAL ICONS

Icon	Input Modifiers Description
	Expired: Checks if a timer is expired
Rec	Receive: Not usable at this time
	Accessory: Signal is interlocked to ACCESSORY so it is always OFF when ACCESSORY is OFF

OUTPUT SIGNAL MODIFIERS

These signals may be used as read only signals to construct any form of logic for the control of body locks or other equipment. It must be understood that though these signals may be used for various functions, the door locks will be activated anytime the key FOB lock buttons are activated.

Icon	Output Modifiers Description
Set	Set a signal to a specific value, such as ON, OFF, or some numerical value.
	(GREEN) Start a timer
	(RED) Stop a timer
Snd	Send a request to turn on a signal that has limited write access.
	Toggle the output state once
Load	Load Manager: Manager turns loads ON
Shed	Load Manager: Manager turns loads OFF
Flash	Flash Feature: Creates a flasher function with a programmable time period
Seq	Load Sequence Feature: Sequences multiple outputs ON and OFF

ACRONYMS

ABS – Antilock brake system

AMP – Ampere

ATC – Automatic Traction Control

BC – Body Controller (Replaces ESC in most 2007 and newer trucks)

BCM – Body Control Module

BOC – Back of Cab

DLB – Diamond Logic® Builder

EGC – Electronic Gauge Cluster

ESC – Electronic System Controller

FET – Field Effect Transistor

FR – Front

GA – Gauge

GND – Ground

HVAC – Heating, Ventilation and Air Conditioning

HYD – Hydraulic

I/O – Input / Output

IGN – Ignition

KOER – Key ON Engine Running

MSVA – Modular Solenoid Valve Assembly (also known as RATM in other areas)

OnCommand® Service Information – Navistar's website that provides service and diagnostics information.

PDC – Power Distribution Center

RAM – Random Access Memory

RASM – Remote Air Solenoid Module

ROF – Rear of Frame

RPM – Remote Power Module

RR – Rear

SW – Switch

VIN – Vehicle Identification Number

VSS – Vehicle Speed Sensor

CONTACT INFORMATION

CONTACT INFORMATION

Navistar, Inc. maintains a customer service technical support line for assistance with Advanced Logic and programming issues. Please use the following number to contact the Navistar Product Support Center:

1-800-336-4500 option 3, then option 5.