DIAMOND LOGIC® CONTROL SYSTEMS
ENGINE SPEED CONTROL FEATURES

What International® is doing for you

International provides a variety of engine speed control features to operate auxiliary equipment. Auxiliary equipment is typically powered by a Power Take Off (PTO) which is interfaced either to the vehicle transmission or tailshaft. PTO features are provided to permit precise management and control of auxiliary equipment.

This document provides information needed to integrate International® electronically controlled engines with auxiliary equipment such as air compressors, hydraulic pumps, generators, and the equipment they power. The features for engine speed control offer:

1. More flexible installation locations. Control stations can be installed anywhere you can run wires or where a Remote Engine Speed Controller can be mounted. International provides two ways to integrate on these vehicles. The first provides a RESCM located near the back of the cab. The second is a hard–wired solution located in the engine compartment. Both features have the same functionality. Engine speed control can be initiated from outside or inside the vehicle's cab.
2. Capability to use either discrete hard–wires to the engine controller or to the multiplexed Remote Engine Speed Control Module (RESCM).
3. Precise engine speed governing. The electronic engines will maintain engine speed within 50 RPM (2 percent) of the set point. Accurate engine speed control should provide predictable flow and pressure from hydraulic pumps.
4. Two built–in engine speed selections (besides idle) for operating auxiliary equiment. Variable speed selections are also available through switches to increase or decrease engine speed. Vernier throttle control through a remote throttle potentiometer can also be used.
5. Control stations can be disabled by integrating equipment interlocks into them.
6. Diagnostics and programming are accomplished using either a PC–based software package or an electronic service tool.
7. Increases in engine speed are ramped, instead of accelerating the engine at full fuel levels.The slower load transfer rates can increase the equipment life of some mechanical systems.
8. Soft features. Feature selection and operating set points and limits can be changed to adapt the chassis to the new equipment.
9. A Password protects the configuration and speed settings from tampering.
10. Reduced assembly, maintenance, and repair costs over comparable mechanical control systems.

Hardware and software aspects of each engine speed control feature are discussed in this document. Many options for features can be programmed at the factory. Features can be changed in the field after the vehicle has been manufactured using a PC-based computer. Section 2 reviews monitoring feature operation and programing with the PC-based Master Diagnostics™ Software.

Section 1 — International® Truck Electrical System Overview

The design of the electrical system significantly reduces the direct wiring to the powertrain components.This system uses an Electrical System Controller (ESC) which can be considered a vehicle control module. All of the in-cab switches which were formerly direct wired to the powertrain modules are now connected to this ESC which then communicates the values to the other devices via J1939. Vehicles implementing this system also use a J1939 driven cluster and still, in general, maintain the same powertrain interfacing (Engine–Transmission–ABS) as in previous vehicles. Even with this increased J1939 usage, the standard J1587 communications are still available for uses such as diagnostics as the supplier chooses.

1.1 ECM Engine Control System

The Electronic Control Module (ECM) is one of two electronic controllers on the International® MaxxForce™ engine. The ECM is mounted directly on the engine. The ECM is considered the computer brain for the engine. The ECM also interfaces with other vehicle features such as communicating with the cruise control switches, PTO switches, and accelerator pedal to name a few.

The ECM engine control system has been specifically designed to work with the new multiplex system, using the J1939 datalink to communicate with the ESC. As a result, some of the hard–wired switches from the days of old have been removed from the engine controller and have been replaced by a multiplexed switch that has its information sent to the engine controller over the J1939 datalink. A few examples of switches that are now multiplexed are cruise control, PTO switches, brake pedal switch, and clutch pedal switch.

1.2 Remote Engine Speed Controller

The International® Electrical System uses multiplexed wiring technologies for interfacing major functional areas of the vehicle. The Electrical System includes the Remote Engine Speed Control Module (RESCM) to provide a means to control engine speed from a remote location on the vehicle. The RESCM is responsible for interfacing control signals to the operator and communicates signal status over J1939 datalink. Furthermore, the system relies on software algorithms to accomplish logic functions instead of implementing similar features using complex wire harness designs with relays and switches. A natural benefit of this system is increased diagnostic capability in terms of on–line, off–line, and off–board testing as well as simplifying the harness design. In layperson's terms, the new electrical system uses switches that communicate digital messages over a two–wire datalink, rather than having to hard–wire a large bundle of wires that would often extend from one end of the truck to the other. Also, the RESCM is able to accomplish all of the functionality that the old hard–wire method was able to achieve.

1.3 Body Builder Wiring

When control over engine speed is required from outside the vehicle cab, a remote mounted switch must be used. Feature code 12VZA {ENGINE CONTROL, REMOTE MOUNTED Provision for; Includes Wiring for Body Builder Installation of PTO Controls; With Ignition Switch Control for International post 2007 Emissions Electronic Engines} or 12VXY {ENGINE CONTROL, REMOTE MOUNTED Provision for; Includes Module and Connector for Body Builder Installation of Remote Engine Speed Control, With SAE J1939 Communication} can be ordered to facilitate switch installation by the body builder. Even though this electrical system tends not to use discrete hard–wires, International offers both hard wired and RESCM inputs to facilitate engine speed control messages.

Again, hard wired body builder wiring connections are provided only when code 12VZA is specified. The control module and the wiring connections for body builder use are generally located underneath the hood of the truck. It is highly recommended by International® that a male/female connector pair be used to interface with the body builder wires. Recommended connectors can be found in Appendix D2 and D3. Hard–wire connections should be avoided if possible in order to make electrical diagnostics and servicing convenient. Electrical wires spliced to these connections should be twisted together and then soldered. A heat shrink tube should be used to seal the connections and the splices should not be exposed to the weather. Each wire connection has a circuit number printed on the insulation. Table 1.1 summarizes the circuit numbers and functions available with the hard–wired version, 12VZA. In addition, the table includes information on wire gauge sizes and colors.

Table 1.1 — Functions Available With 12VZA, Hard–Wired Body Builder Wiring

CIRCUIT NUMBER I6	CIRCUIT NUMBER V8	ECM PIN	FUNCTION	WIRE GAUGE	WIRE COLOR I6	WIRE COLOR V8
KQ97CB	K97RPRE	X1–16	Preset PTO Enable	18	Purple	Purple
KQ97CC	K97RVAR	X1–60	Variable PTO Enable	18	Purple	Purple
K4Q46B	K46B	X1–68	Set PTO Speed	18	Grey	Purple
KQ46A	K46A	X1–49	Resume PTO Speed	18	Grey	Purple
KQ47B	K47B	X1–72	Speedometer	18	Grey	Purple
KQ97AR	K97CTO	X1–71	Tachometer	18	Purple	Purple
KQ97DF	K17Z	12V 1 Amp Source	Voltage PTO	14 (V8) 16 (I6)	Purple	Purple
K99F	K97RPS	X1–50	REM Accelerator	18	Purple	Purple
K97XC	K97SCX	X1–11	Transfer Case	18	Purple	Purple
K97WA	K95R	X1–35	Signal Return	18	Purple	Purple
K97EW	K97EWL	X1–22	engine Warning	18	Purple	Purple
K97SE	K97OWL	X1–21	Stop engine	18	Purple	Purple
K97FV	K95	X1–27	Voltage Ref 5V	18	Purple	Purple

The other option is to order a RESCM by using code 12VXY. See Figure 1.3, Figure 1.4 and Figure 1.5. The RESCM uses the J1939 datalink to transmit (multiplex) the messages to the engine controller that are hard–wired with Code 12VZA. The operation of the engine control features behaves exactly the same whether the body builder switches are hard–wired or multiplexed. If 12VXY is ordered, the RESCM is mounted with the J1939 datalink, power and ground wires already connected (connectors J1 and J2). Body Builder applications are installed in the J3 connector.

Section 2 — Master Diagnostics™ Software (MDS) and Feature Programming

After engine assembly, changes can be made using the Master Diagnostics™ Software package and a PC. The scope of the changes that may be needed is discussed in this section. International® primarily uses the Master Diagnostic™ Software package for engine control diagnostics and programming. The Master Diagnostics™ Software permits monitoring of engine speed control functions during engine operation. This tool also permits modification of engine speed control parameters via re-programming. The specific functions for monitoring and programming are discussed in this section. In order to use the software package, a PC-type computer must be interfaced to the controller through the PC's communications port using an adapter harness. Appendix A shows the required part numbers to connect the computer. The software package can be installed on a computer by following the instructions on the installation disk.

2.1 Monitoring Engine Speed Control Parameters with Master Diagnostics™ Software

Master Diagnostics™ Software can be used to monitor engine speed control parameters during equipment operation. Table 2.1 shows the data display items for engine speed control features that are displayed by the diagnostic software. Beside each item is a short explanation of the data displayed. Switch states and accelerator pedal values contained in Table 2.1 are shown while the engine is not running and the ignition key is on. This Key On/Engine Off functionality permits a particular installation to be verified prior to actual use. Active values for PTO related parameters appear only when PTO MODE is set to REMOTE, IN-CAB or IN-CAB+REMOTE. The next section discusses programming for each engine speed control feature.

Table 2.1 — Service Tool Display Items for Monitoring Speed Control Features

Master Diagnostics™ Software Display Item	Value	Display Item Contents
Accel Pedal	0.00%	Displays the Throttle Percent of the Driver's Foot Pedal
Engine Speed	0.00 RPM	Displays Engine Speed in revolutions per minute.
PTO On/Off *	Off	Displays the status of the in-cab ON / OFF switch.
PTO Set Switch	Off	Displays the status of the SET switch.
PTO Coast Switch	Off	Displays the status of the SET switch (Hold SET for COAST).
PTO Resume Switch	Off	Displays the status of the RESUME switch.
PTO Accel Switch	Off	Displays the status of the RESUME switch (Hold the RESUME switch for the ACCE function).
PTO Brake Switch	Off	Displays the status of the service brake switch.
PTO Clutch Switch	On	Displays the status of the clutch or neutral position switch.
PTO Ctrl Mode	Inactive	Displays ACTIVE when engine speed control is active.
PTO Set RPM	700.00 RPM	Displays desired engine speed in RPM when speed control is active.
Rem VAR PTO	Off	Displays ON when Remote Variable PTO Switch is enabled.
Rem Preset PTO	Off	Displays ON when Remote Preset Switch is enabled.
Rem Throttle	N/A	Displays ON when the remote throttle is enabled to control desired engine speed. Remote throttle displays FAIL when the remote throttle is faulted.
Split Shaft	N/A	Displays driveline status (neutral or split shaft)

*This display item name is only valid for Master Diagnostics™ Software. The corresponding parameter name for the EST is "PTO Speed".

2.2 Programming Engine Speed Control Parameters with Master Diagnostics™ Software — What Can You Change with Master Diagnostics™ Software?

Many of the parameters for PTO Engine Speed Control features can be programmed at the factory. Parameters can be reprogrammed in the field after the vehicle has been manufactured. A PC using Master Diagnostic™ Software is used to modify the factory settings for engine speed control features. Reprogramming permits customization of feature operation to exactly match the auxiliary equipment being operated; it also permits changing from one feature to another. Table 2.2 shows which parameters are used for each engine speed control feature. Each of the parameters can be accessed and reprogrammed with the Master Diagnostics™ Software. Parameter settings can be reviewed and changed by selecting the appropriate engine speed control parameters within the VEHICLE PROGRAMMING menu.

When a feature is added or modified, all parameters should be checked to ensure that the equipment will operate as intended. Particular attention should be given to parameters that have a "Yes" in the column for the feature in Table 2.2. A more comprehensive discussion of all parameters is provided in Section 3.

Additional references for feature programming can be found in Appendix B of this manual. For further assistance, contact your International® dealer or call Technical Service at 1-800-336–4500 for help with field reprogramming.

Table 2.2 — Speed Control Feature Parameter Matrix

Progammable Parameter Name	Preset Engine Speed Control	Variable Engine Speed Control	Remote Throttle Pedal	Remote Engine Speed Control	Mobile Engine Speed Control	Split Shaft
PTO: Power Take Off Mode	Yes	Yes	Yes	Yes	Yes	Yes
PTO: In-Cab Mode	Yes	Yes	No	No*	Yes	Yes
PTO: In–Cab Control	Yes**	Yes**	No*	No*	Yes*	Yes
PTO: Remote Pedal	No**	No**	Yes	Yes	No**	Yes
PTO: Preset RPM 1 (Set)	Yes	No	No	No*	No	No
PTO: Preset RPM 2 (Resume)	Yes	No	No	No*	No	No
PTO: Preset RPM 3	Yes	No	No	No*	No	No
PTO: Preset RPM 4	Yes	No	No	No*	No	No
PTO: Preset RPM 5	Yes	No	No	No*	No	No
PTO: Preset RPM 6	Yes	No	No	No*	No	No
PTO: Max RPM	Yes	Yes	Yes	Yes	Yes	Yes
PTO: RPM Ramp Rate	No	Yes	No	Yes	Yes	Yes
PTO: Max Vehicle Speed	No	No	No	No	Yes	No
EPG: Driveline Mode	No	No	No	No	Yes	Yes

* Program as required for use with the Preset or the Variable Engine Speed Control features when they are used in combination with the Remote Throttle.

** Program as required for use with the Remote Throttle when the Remote Throttle is used in combination with the Preset or the Variable Engine Speed Control features.

Section 3 — Engine Speed Control for Power Take Off (PTO) Applications

There are 3 different engine speed control features available for vehicle vocations:

- Preset Engine Speed Control
- Variable Engine Speed Control
- Mobile Variable Engine Speed Control

The first two features require a non-moving (stationary) vehicle for operation. The “Preset” feature always controls engine speed to a previously programmed value, while the “Variable” feature permits a desired engine speed to be selected via the in-cab or remote mounted switches. The “Mobile Variable” feature is the same as the “Variable” feature, with the exception that the vehicle can be moving or stationary during PTO operation.

Table 3.1 lists the programmable parameters that apply to these three PTO Engine Speed Control features. For each programmable parameter, this table shows the minimum and maximum permissible values that can be programmed, engineering units, and the resolution (increment) applicable for a particular parameter.

Detailed descriptions are provided for each of the programmable parameters in the Programmable Parameters, Section 9.

Table 3.1 — Programmable Parameter Attributes for PTO Engine Speed Control

Programmable Parameter Name	Programmable Parameter Attributes			
	Units	Lower Limit	Upper Limit	Increment
PTO: Power Take Off Mode	N/A	0	3	1
PTO: In-Cab Mode	N/A	0	3	1
PTO: In-Cab Control	N/A	0	1	1
PTO: Preset RPM 1 (Set)	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Preset RPM 2 (Resume)	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Preset RPM 3	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Preset RPM 4	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Preset RPM 5	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Preset RPM 6	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: Max RPM	RPM	LOW IDLE	GOVERNED SPEED	.25
PTO: RPM Ramp Rate	RPM/SEC	1	1500	.25
PTO: Max VS	MPH	0	20	.5
PTO: Remote Pedal Enable	N/A	0	1	1

3.1 Preset Engine Speed Control

This feature provides six pre-determined engine speed settings (besides low idle) for equipment operation. Preset Engine Speed Control satisfies the majority of the intended engine speed control applications. Use Preset Engine Speed Control when a constant engine speed is required to operate equipment. In-cab engine speed controls can be used for presets 1 through 6 where remotely mounted controls may be used for only presets 1 and 2.

Typical operation of this system requires the operator to perform the following steps:

1. Activate the system.
2. Select the desired engine speed using the SET/CRUISE or RESUME/ACCEL switch. RESUME/ACCEL switch will increment the six pre–determined engine speed settings; SET/CRUISE will decrement the six pre–determined engine speed settings.

The desired engine speed set point can be field programmed to any speed between low idle and high idle speed. Preset Engine Speed Control operates only while the vehicle is stationary. Manipulation of cab located sensor inputs (i.e., neutral safety, service brake, or clutch pedal) will cause the engine speed control to disengage.

Preset Engine Speed Control can be combined with a Remote Throttle. If the engine RPM has reached the desired preset engine speed and a remote throttle input is present, the engine will respond to the greatest demand. In other words, if the remote throttle is pressed so that the demanded engine speed is greater than the preset engine speed, the engine will ramp up to the greater of the two. Once the remote throttle pedal is released, the engine speed will ramp back down to the preset engine speed.

Table 3.2 summarizes the operation of preset engine speed control. The columns are labeled with the switch being used. The first row discusses what happens when the switch contacts are momentarily closed. The second row discusses the effect of held switches (continuous contact) or multiple use of the same switch.

Table 3.2 — Preset Engine Speed Control Switch Use

	ON	OFF	SET/CRUISE	RESUME/ ACCEL	BRAKE	CLUTCH
Single Press (Momentary Contact)	Enables engine speed control	Disables engine speed control	Sets the desired engine speed to the “Set” Switch RPM Pre–set speeds 6–1	Sets the desired engine speed to the “Resume” Switch RPM Pre–set speeds 1–6	Deactivates engine speed control and establishes a standby state. Engine speed returns to low idle rpm.	Deactivates engine speed control and establishes a standby state. Engine speed returns to low idle rpm.
Held Switch (Continuous Contact)	Enables engine speed control	Disables engine speed control	Same [1]	Same [1]	The change In brake status establishes the standby state.	The change In brake status establishes the standby state.

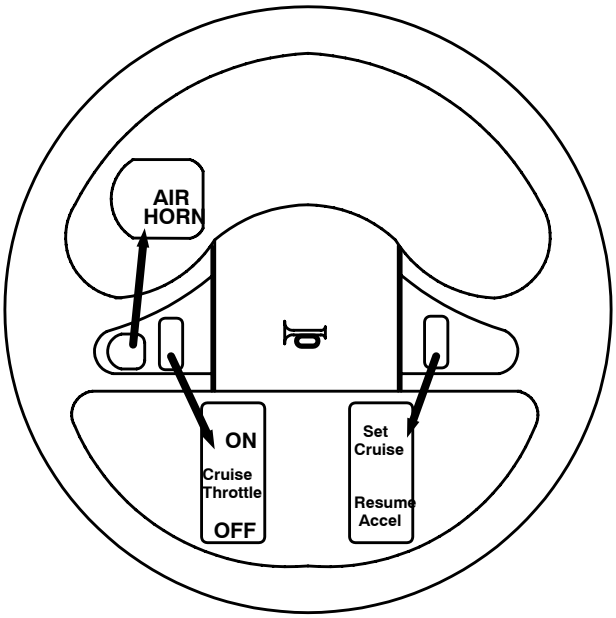
NOTE: [1] The held switch acts like the switch is being “hit” multiple times.

3.1.1 In-Cab Operation of Preset Engine Speed Control

When control over engine speed is not needed outside the vehicle's cab, the in-cab switches can be used to activate engine speed control and select the desired engine speed.

Press the CRUISE "ON" Switch to enable engine speed control. NOTE: This switch is located on the steering wheel. See Figure 3.1. NOTE: There is no indication to the user that the Cruise On switch has been depressed. Next, select the desired engine speed using either the SET/CRUISE or the RESUME/ACCEL switch. With each press of the RESUME/ACCEL switch, the preset will cycle from 1 to 2 to 3 to 4 to 5 to 6. Pressing the SET/CRUISE switch will cycle from 6 to 5 to 4 to 3 to 2 to 1.

Figure 3.1 — (STANDARD) In-Cab Switches Located On The Steering Wheel



Engine speed will be reduced to idle by any of the following actions:

- CRUISE "OFF" switch is pressed
- Brake pedal is pressed
- Clutch pedal is pressed
- Automatic transmission is shifted out of neutral (NOT RECOMMENDED)

Note that these actions are always applicable for in-cab PTO Operation, regardless of the value programmed for the parameter "PTO IN-CAB CONTROL". Only when engine speed is controlled by remote input signals and the cab interface is disabled will the engine speed be unaffected by the above actions.

WARNING!

SHIFT OF AUTOMATIC TRANSMISSION FROM NEUTRAL TO FORWARD OR REVERSE GEAR WHILE OPERATING ANY PTO MODE IS NOT RECOMMENDED; VEHICLE MAY LURCH FORWARD WHEN TRANSMISSION IS PLACED IN GEAR DUE TO INCREASED POWER OUTPUT OF THE ENGINE WHICH IS OPERATING AT THE ELEVATED ENGINE SPEED.

WARNING!

To avoid sudden, unexpected vehicle movement and possible personal injury:

- Always fully set the parking brake when using the Preset PTO Engine Speed Control Feature.
- Do not abort the Preset Engine Speed Control Feature by shifting an automatic transmission from neutral gear into a forward or reverse gear.
- Turn off the engine when you leave the vehicle. Never leave the vehicle unattended with the engine running.

3.1.2 In-Cab Switch Configuration for Preset Engine Speed Control

The right-hand portion of Figure 3.2 illustrates the circuitry provided by International® for in-cab operation of Preset Engine Speed Control. Though the ECM2 pins and RESCM are shown in Figure 3.2 and 3.3, in–cab PTO operation does not require any additional wiring to these modules, nor any other module.The circuitry provided by International must not be tampered with.

If Preset PTO Engine Speed Control is already active and a different switch is pressed, engine speed will change from the original speed commanded by the ECM to the new speed corresponding to the latest switch that was pressed by the operator.

Figure 3.2a — In-Cab Switch Layout for Engine Control Using Hard–Wired Body Builder Wiring Present I6 Engines

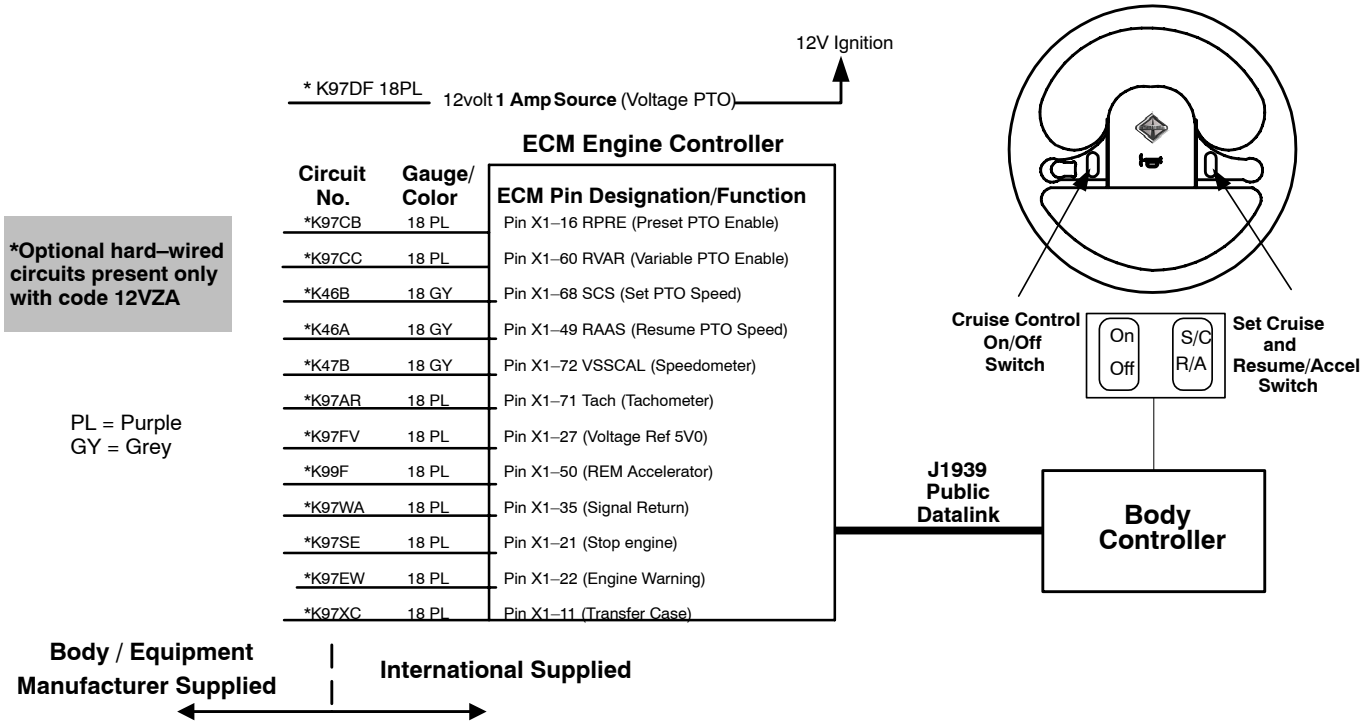
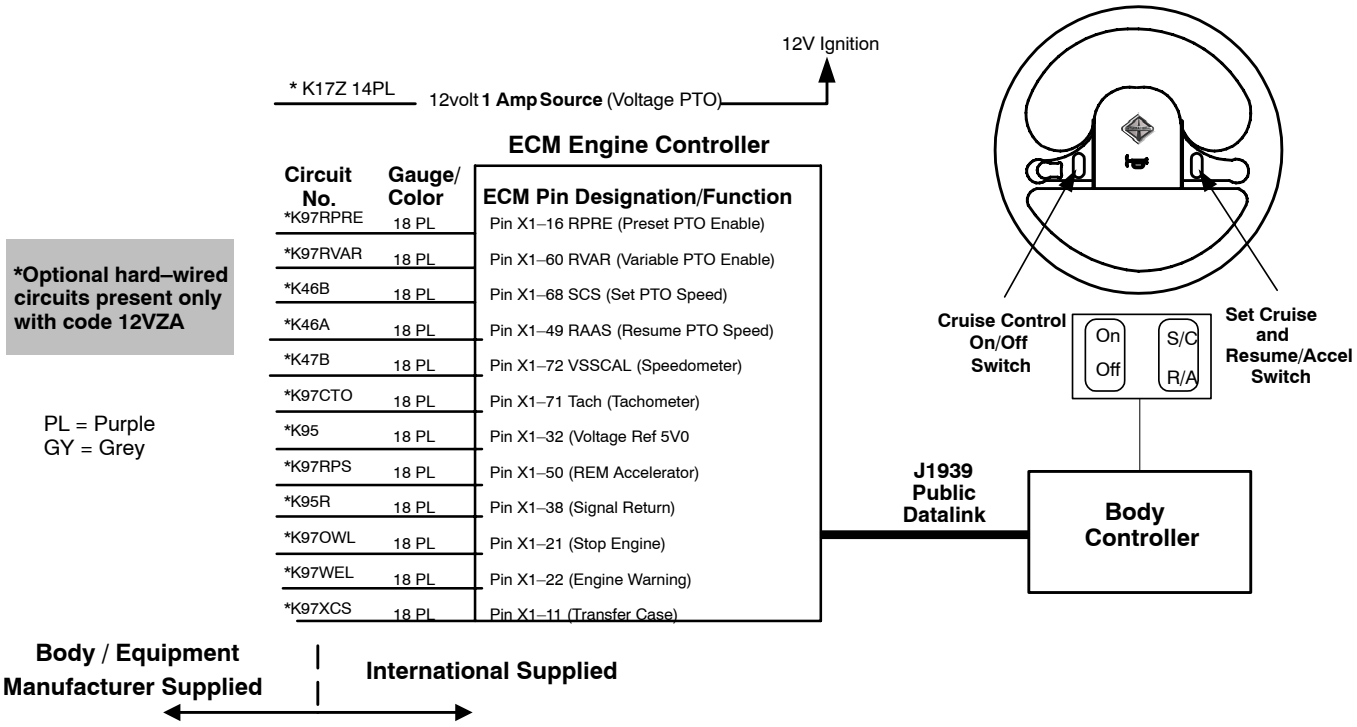


Figure 3.2b — In-Cab Switch Layout for Engine Control Using Hard–Wired Body Builder Wiring Present V8 Engines



3.1.3 Remote Operation of Preset Engine Speed Control

When control over engine speed is required from outside the vehicle's cab, remote mounted switches (either hard–wired, code 12VZA, or multiplexed using the RESCM, code 12VXY) must be used to turn on PTO engine speed control and select the desired engine speed. Figures 3.4a and b and 3.5 illustrate how remotely located switches must be interfaced to the ECM to accomplish Preset PTO Engine Speed Control. Figure 3.4a and 3.4b details the hard–wired body builder circuitry (12VZA), while Figure 3.5 shows the circuitry needed for the multiplexing RESCM (12VXY). The hard–wired version does not include such features as Remote Throttle or Transfer Case/Split Shaft. If those features are desired, the Remote Engine Speed Control Module (RESCM) must be ordered. The RESCM uses the J1939 datalink to transmit (multiplex) the messages to the engine controller that were previously hard–wired with past generation International trucks. Switch functionality remains the same as described for the in–cab located switches (see Table 3.2).

A REMOTE PRESET PTO ON/OFF switch (RPRE) is required to remotely turn on the Preset Engine Speed Control. The desired engine speed is then selected using a remotely located SET/CRUISE or RESUME/ACCEL switch. Once a desired engine speed has been selected using one of these switches, engine speed will begin to increase. This rate of increase will be limited according to the value programmed in the parameter PTO RPM Ramp Rate. This acceleration limit should be programmed as required to minimize stress on auxiliary equipment power drive links.

WARNING!

Be aware that the Remote Set Switch and Remote Resume Switch are connected in parallel (logic “OR-ed“) with the cab-mounted SET/CRUISE and RESUME/ACCEL switches respectively. This means that once preset PTO Engine Speed Control has been placed in “standby” on-mode (by pressing either the In-Cab located CRUISE ON switch, or the remotely located REMOTE PRESET PTO ON switch), the desired engine speed can be modified both from within the cab or from the remote located PTO Engine Speed Control switches. This is ALWAYS TRUE, even when the PTO MODE parameter is programmed for REMOTE OPERATION ONLY.

Figure 3.3 — In-Cab Switch Layout for Engine Control Using the Remote Engine Speed Controller Present

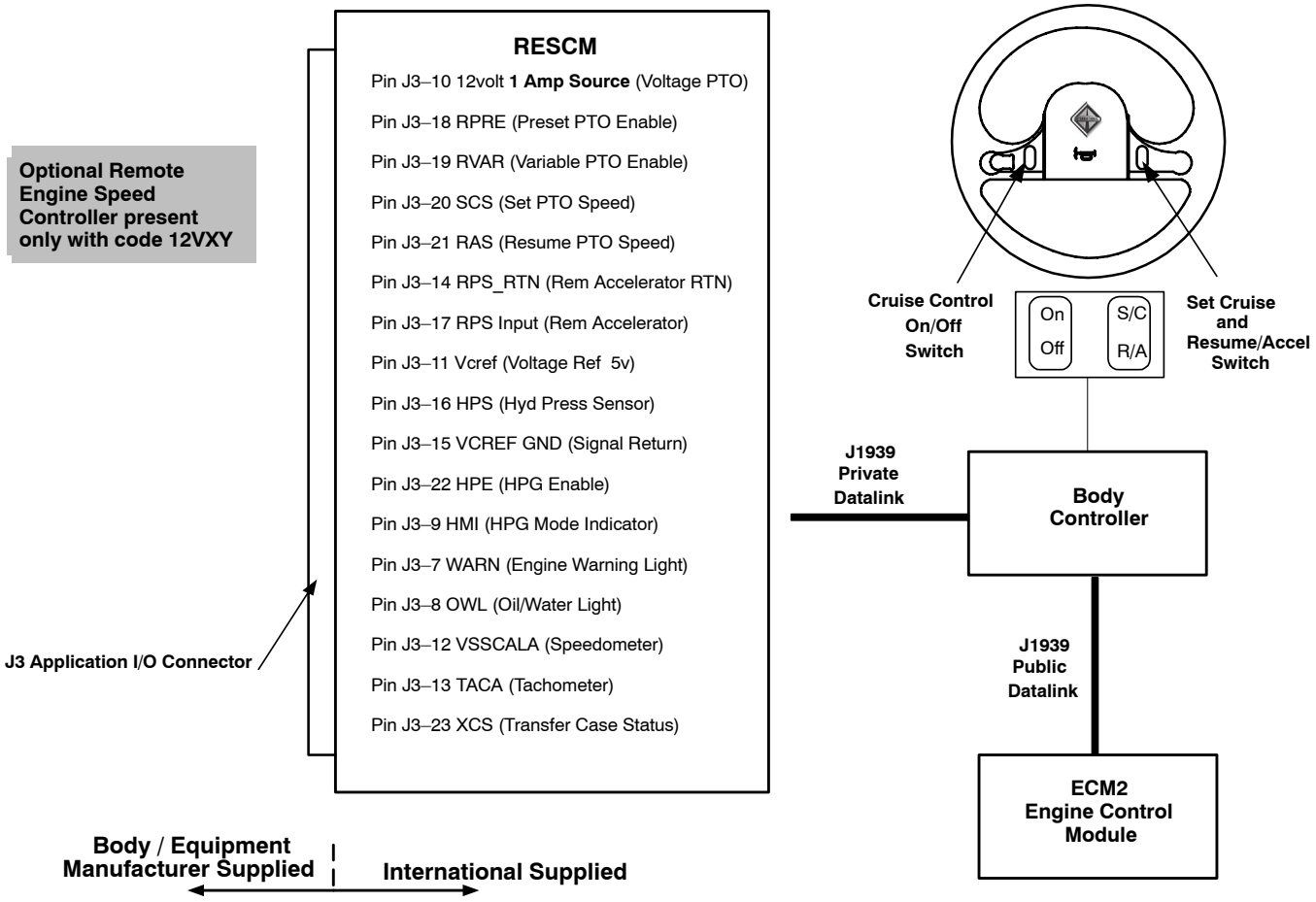


Figure 3.4a — Remote Installation for Preset Engine Control Using Hard–Wired Body Builder Wiring I6 Engines

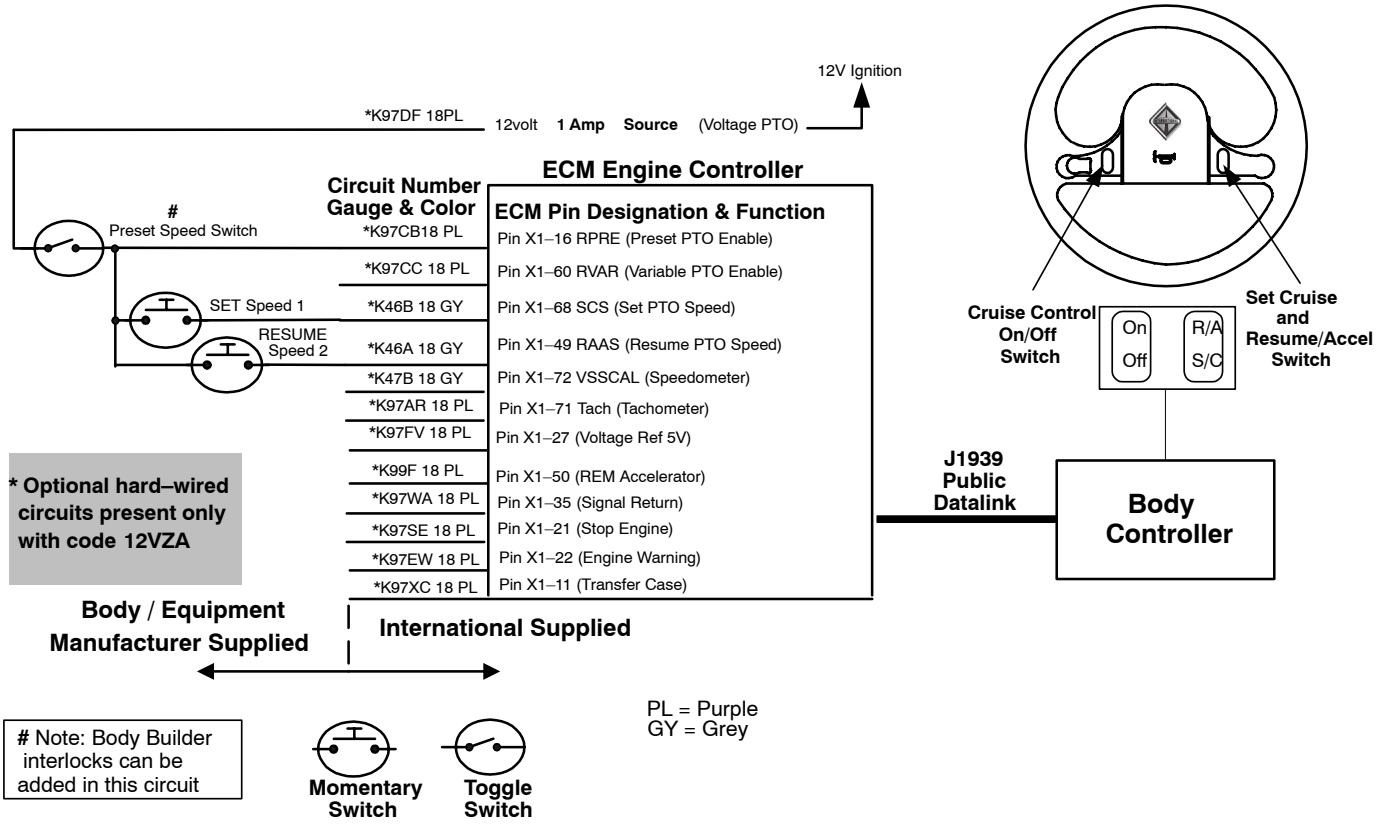


Figure 3.4b — Remote Installation for Preset Engine Control Using Hard–Wired Body Builder Wiring V8 Engines

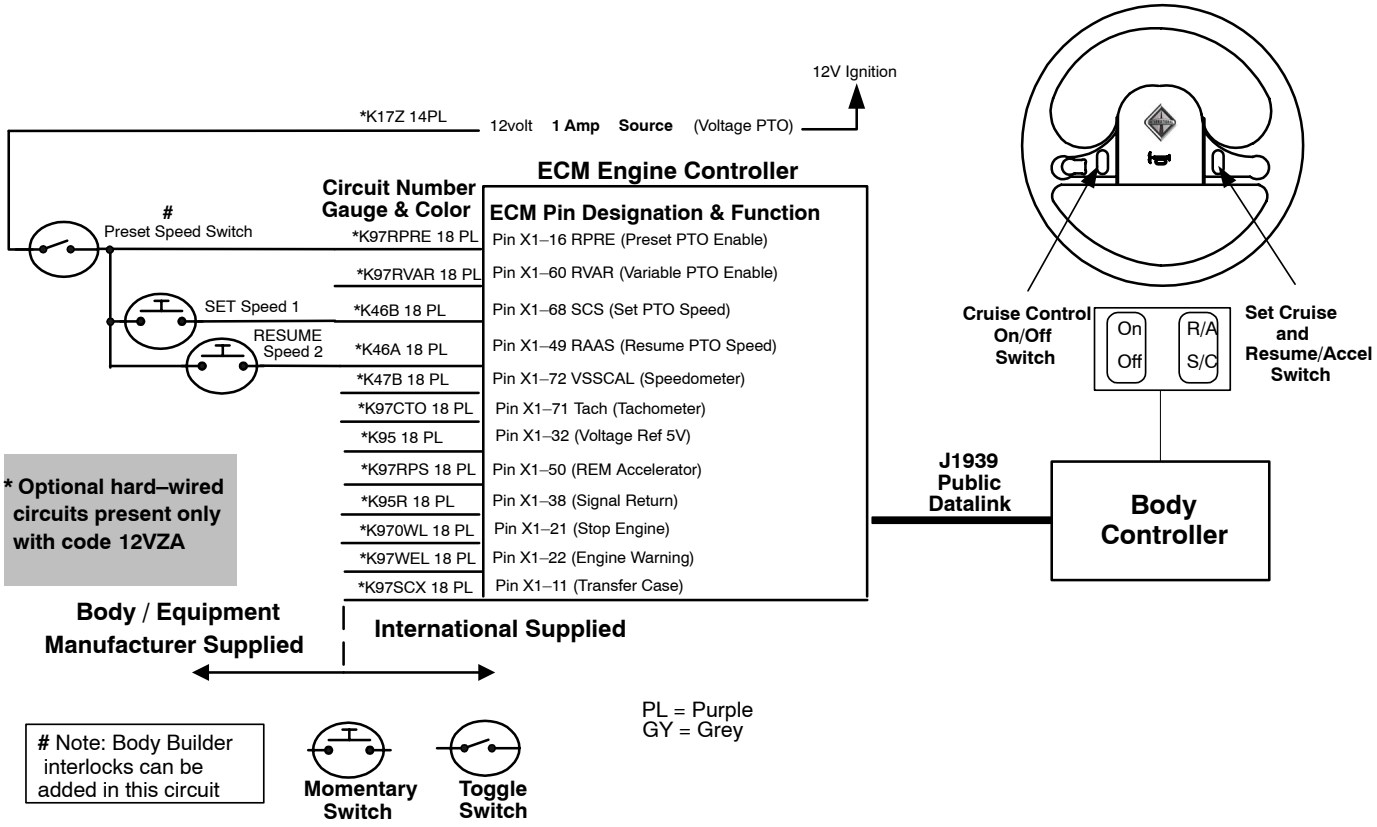
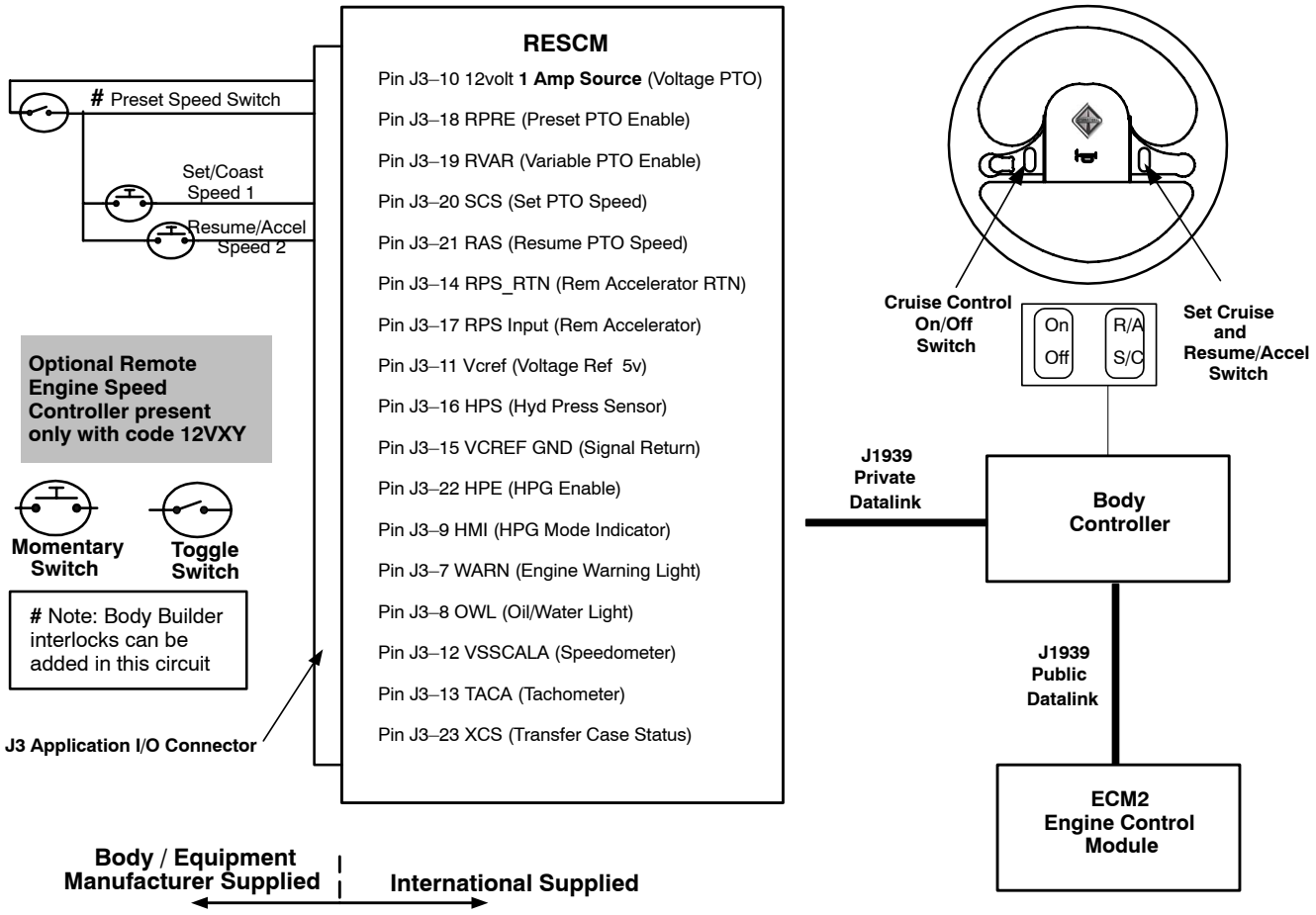


Figure 3.5 — Remote Installation for Preset Engine Control Using the Remote Engine Speed Controller



3.2 Variable Engine Speed Control

Variable engine speed control permits a desired engine speed to be achieved between low idle and rated engine speed even without use of the accelerator pedal or Remote Throttle.The switches that must be used to achieve this functionality are ON, OFF, SET/CRUISE, and RESUME/ACCEL. These switches can be remote and/or cab mounted. If only temporary increases in engine speed are needed, consider using Preset Engine Speed Control in combination with the Remote Throttle. Table 3.3 summarizes the operation of Variable Engine Speed Control. Columns are labeled according to the switch being used. The first row presents the control system's response when the toggle switch position is changed by the operator. The second row documents the control system's response when the switch contacts are momentarily closed. The third row discusses the effect of maintaining a switch in the closed (pressed) condition; this row also discusses multiple applications of the same switch.

Table 3.3 — Variable Engine Speed Control Switch Interpretations

	ON	OFF	SET/CRUISE	RESUME/ ACCEL	BRAKE	CLUTCH
On/Off switch (Toggle Switch)	Turns engine speed control ON	Turns engine speed control OFF	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Single Press (Momentary Contact)	Not Applicable	Not Applicable	Latch the current engine speed as the desired engine speed. Decrease engine speed by 25 RPM, if active.	Resume speed control function at the last desired engine speed. Increase engine speed by 25 RPM, if active.	Deactivate vehicle speed control and maintain standby state. (Pedal use returns the engine to the low idle speed.)[1]	Deactivate vehicle speed control and maintain standby state. (Pedal use returns the engine to the low idle speed.)[1]
Held Switch (Continuous Contact)	Not Applicable	Not Applicable	Decrease engine speed if engine speed control is active [2]	Increase engine speed if engine speed control is active [2]	Any change in brake status establishes a standby state.[1]	Any change in driveline status establishes a standby state.[1]

NOTE:

1 Engine speed control stops only when there is a transition from one pedal state (pedal pressed or pedal released) to the other and only when the disable cab controls parameter is not selected.

2 The held switch acts like the switch is being “hit” multiple times, until the switch is released. When the RESUME switch is held closed, the engine speed will be commanded to accelerate. The standby state will be momentarily recognized, then engine speed will continue to accelerate.

3.2.1 In-Cab Operation of Variable Engine Speed Control

In-cab located switches can be used to turn on engine speed control and select the desired engine speed. Press the CRUISE “ON” Switch to enable engine speed control. This switch is located on the steering wheel. NOTE: There is no indication to the user that the Cruise On switch has been depressed. Next, select the desired engine speed using the SET/CRUISE switch. Then press RESUME/ACCEL or SET/CRUISE until the desired engine speed is achieved.

The accelerator pedal can be used, as well, to increase or decrease engine speed as desired; the desired engine speed will be maintained by the engine controller once a momentary press of the SET/CRUISE switch occurs. Once an initial engine operating speed is selected, a momentary press of the RESUME/ACCEL and/or SET/CRUISE switches will cause engine speed to increase or decrease by a small amount. This incremental amount can be used to fine tune the engine speed selected. Should speed control be interrupted (i.e., by the brake or the clutch switch), the RESUME/ACCEL switch can be pressed to return to the last engine speed set point. The engine’s acceleration rate will be limited according to the value programmed for the parameter **PTO RPM Ramp Rate**. This acceleration rate should be programmed as required to minimize stress on auxiliary equipment power drive links. Anytime Variable Engine Speed Control is active, the engine will maintain the selected speed until one of the following events occur:

- CRUISE “OFF” switch is pressed
- Brake pedal is pressed
- Clutch pedal is pressed
- Automatic transmission is shifted out of neutral (NOT RECOMMENDED)

Note that these actions are always applicable for in-cab PTO Operation, regardless of the value programmed for the parameter “PTO IN-CAB CONTROL”. Only when engine speed is controlled by remote input signals and the cab interface is disabled will the engine speed be unaffected by the above actions.

WARNING!

SHIFT OF AUTOMATIC TRANSMISSION FROM NEUTRAL TO FORWARD OR REVERSE GEAR WHILE OPERATING ANY PTO MODE IS NOT RECOMMENDED; VEHICLE MAY LURCH FORWARD WHEN TRANSMISSION IS PLACED IN GEAR DUE TO INCREASED POWER OUTPUT OF THE ENGINE WHICH IS OPERATING AT THE ELEVATED ENGINE SPEED.

WARNING!

To avoid sudden, unexpected vehicle movement and possible personal injury:

- Always fully set the parking brake. Do not use the gearshift lever instead of the parking brake.
- Turn off the engine when you leave the vehicle. Never leave the vehicle unattended with the engine running.

3.2.2 In-Cab Switch Configuration for Operation of Variable Engine Speed Control

The right-hand portion of the figures in section 3.2 illustrates the circuitry provided by International® for in-cab operation of Variable Engine Speed Control. This circuitry is provided by International and must not be tampered with.

3.2.3 Remote Operation of Variable Engine Speed Control

When control over engine speed is required from outside the vehicle cab, remote mounted switches must be used to turn on PTO engine speed control and select the desired engine speed. Figures 3.6a, 3.6b and 3.7 illustrate how remotely located switches must be interfaced to the ECM to accomplish Variable Engine Speed Control. Switch functionality remains the same as described for the in-cab located switches (see Table 3.3)

The Remote Throttle (see Section 5) can be used, as well, to increase or decrease engine speed as desired; the desired engine speed will be maintained by the engine controller once a momentary press of the SET/COAST switch occurs. Once an initial engine operating speed is selected, a momentary press of the RESUME/ACCEL and/or SET/COAST switches will cause engine speed to increase or decrease by a small amount. This incremental amount can be used to fine tune the engine speed selected. Should speed control be interrupted (i.e. by the brake or the clutch switch), the RESUME/ACCEL switch can be pressed to return to the last engine speed set point. The engine’s acceleration rate will be limited according to the value programmed for the parameter **PTO RMP Ramp Rate**. This acceleration rate should be programmed as required to minimize stress on auxiliary equipment power drive links. Any time Variable Engine Speed Control is active, the engine will maintain the selected speed until one of the following events occur:

- CRUISE “OFF” switch is pressed
- Brake pedal is pressed
- Clutch pedal is pressed
- Automatic transmission is shifted out of neutral (NOT RECOMMENDED)

A REMOTE VARIABLE PTO ON/OFF switch (RVAR) is required to turn on the Variable Engine Speed Control. The desired engine speed is then selected using a remotely located SET/CRUISE or RESUME/ACCEL switch, just as previously described for in-cab operation of Variable Engine Speed Control.

CAUTION:

Be aware that the Remote Set Switch and Remote Resume Switch are connected in parallel (logic 'OR-ed') with the cab-mounted SET/CRUISE and RESUME/ACCEL switches respectively. This means that once preset Variable PTO Engine Speed Control has been placed in "standby" on-mode (by pressing either the in-cab located CRUISE ON switch, or the remotely located REMOTE VARIABLE PTO ON switch), the desired engine speed can be modified both from within the cab or from the remote located PTO Engine Speed Control switches. This is ALWAYS TRUE, even when the PTO MODE parameter is programmed for REMOTE OPERATION ONLY.

Figure 3.6a — Variable Engine Speed Control Schematic Using Hard–Wired Body Builder Wiring I6 Engines

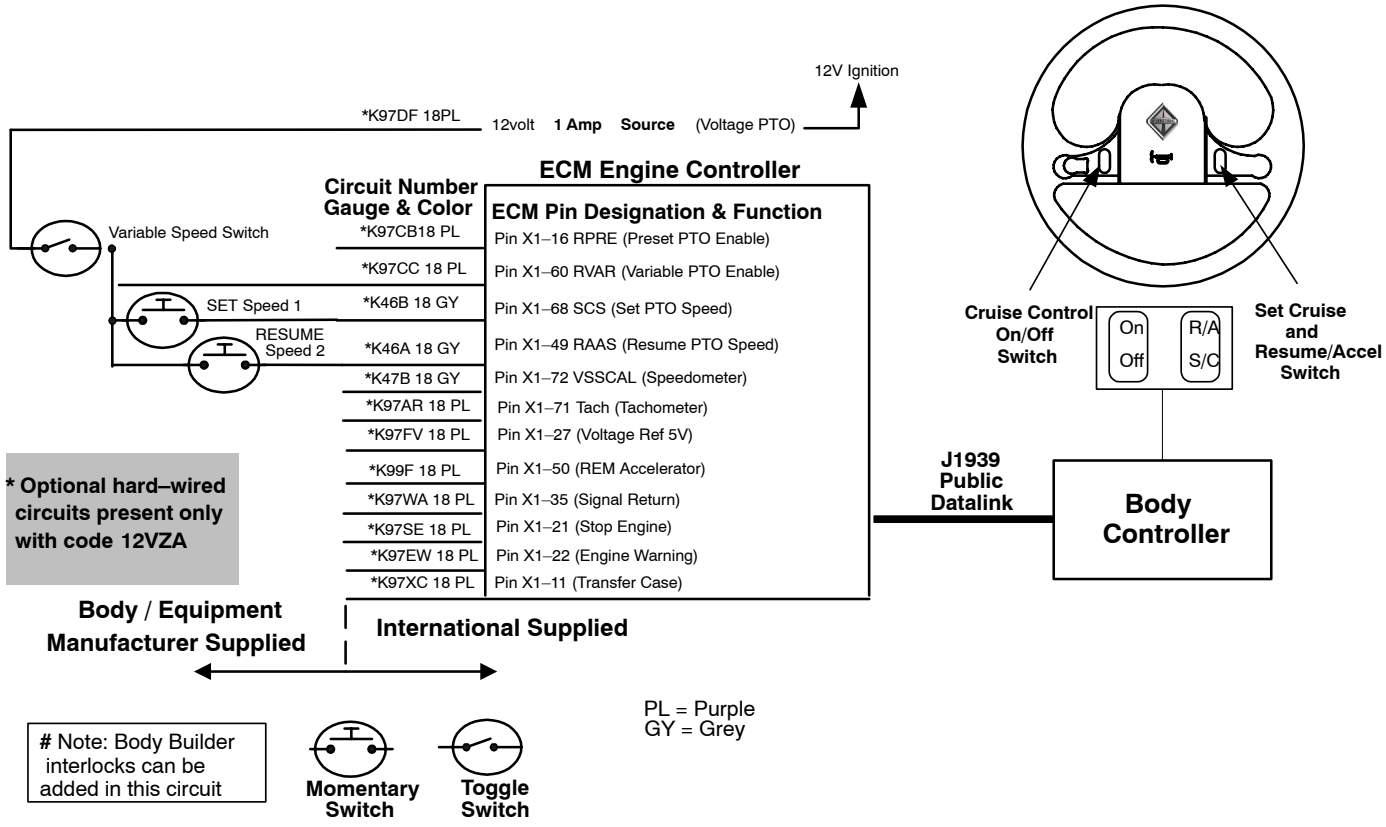


Figure 3.6b — Variable Engine Speed Control Schematic Using Hard–Wired Body Builder Wiring V8 Engines

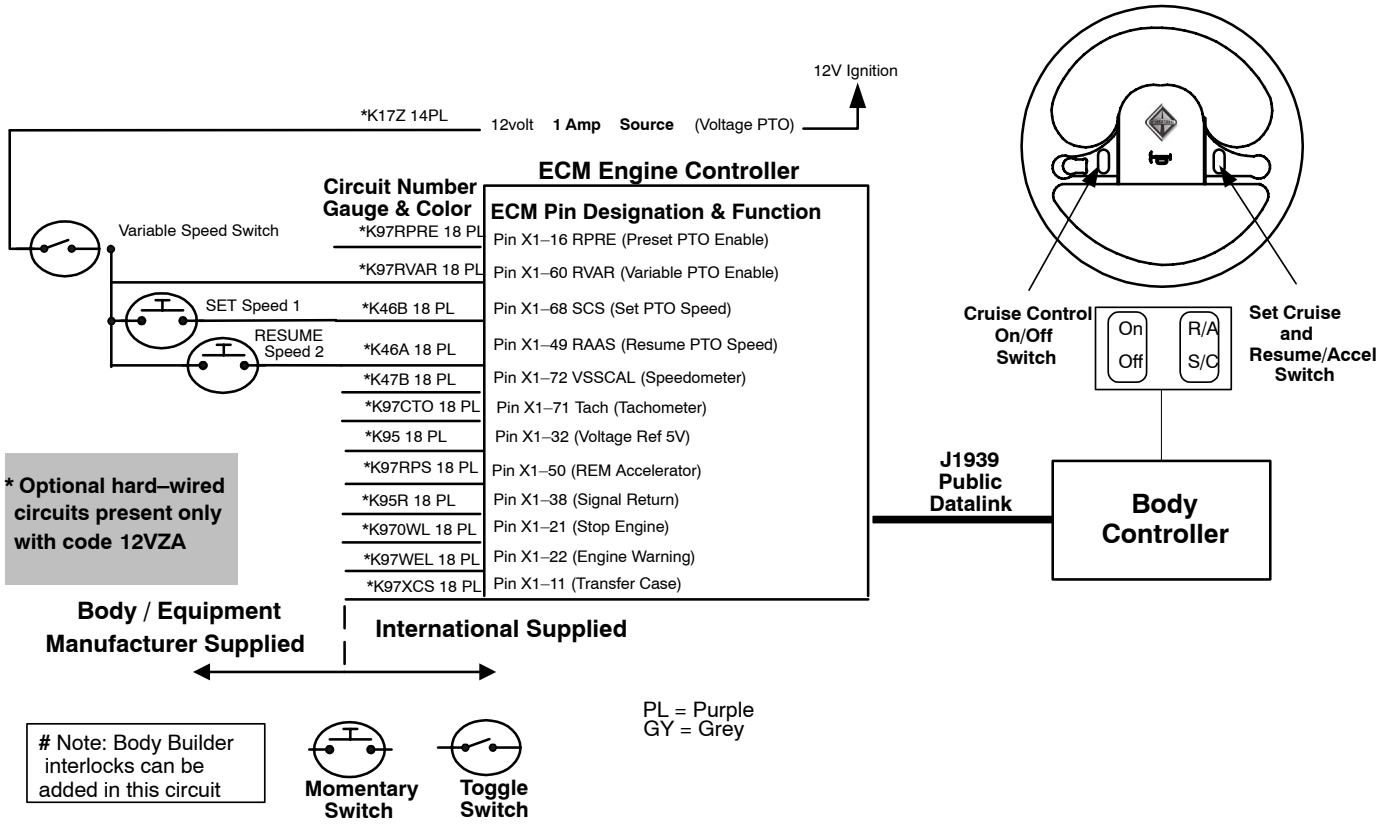
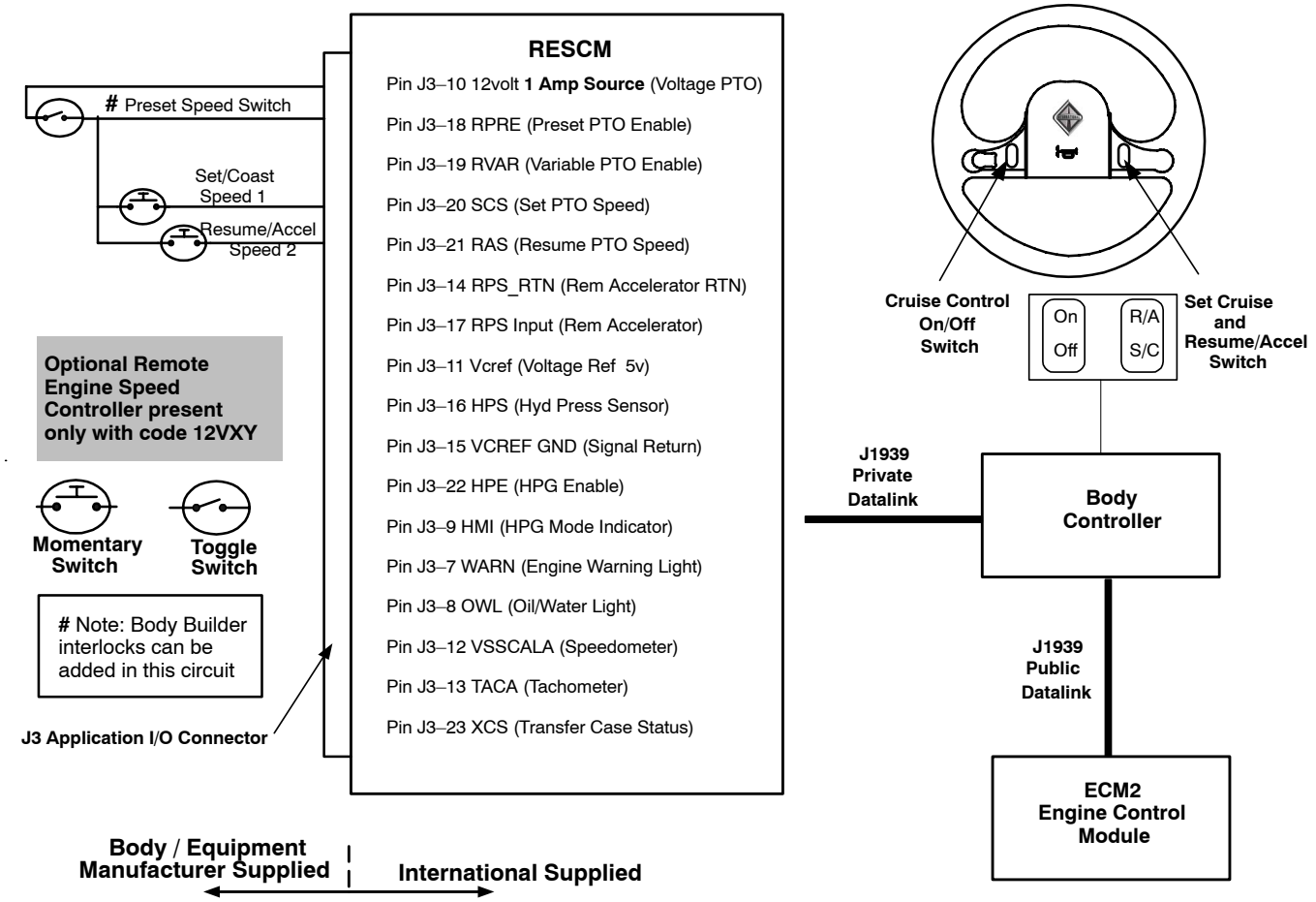


Figure 3.7 — Variable Engine Speed Control Schematic Using the Remote Engine Speed Controller



3.3 Engine Speed Control for Mobile Applications

This section discusses the Variable Mobile Engine Speed Control. Mobile Variable Engine Speed Control functions like cruise control, except that the engine speed (instead of the vehicle speed) is being controlled. Mobile control can be performed only below a programmed maximum vehicle speed. The default vehicle speed limit is 20 MPH.

Functionality for mobile control is identical to the functionality described previously for Variable PTO Engine Speed Control, with the exception that the vehicle is no longer required to be stationary; vehicle movement is permitted up to a maximum threshold, specified by the programmable parameter ***PTO Max Veh Speed***.

When the specified vehicle speed limit is exceeded, Variable Engine Speed Control will be placed in the “standby” mode of operation and engine speed will return to idle. Pressing the RESUME/ACCEL switch after the vehicle speed has slowed to a value less than the programmed maximum speed limit will reestablish engine speed control at the previously selected engine speed. Changes in the status of the brake and clutch switches will also return the engine to its idle speed.

Switch functionality remains the same as described for the Variable Stationary Engine Speed Control switches (see Table 3.3).

Press the CRUISE ON switch to turn on Engine Speed Control. Press the SET/CRUISE switch to select an engine speed. Then press RESUME/ACCEL or SET/CRUISE until the desired engine speed is achieved. Momentary presses of the RESUME/ACCEL and SET/CRUISE switches will cause the engine speed to increase or decrease by a small amount. This incremental amount can be used to fine tune the engine speed selected. Should speed control be interrupted by the brake or the clutch switches, press the RESUME/ACCEL switch to return to the last engine speed set point. The engine's acceleration will be limited to the ***PTO RPM Ramp Rate***. The acceleration limit can be set to reduce the stress on the auxiliary equipment power couplings.

Section 4 — Transfer Case/Split Shaft Operation

This section describes the Transfer Case/Split Shaft feature and its applications. This feature is used in conjunction with Engine speed Control and is targeted for applications that use a transfer case or auxiliary driveshaft. The auxiliary drive unit is often connected to a pump that performs vacuum functions (i.e. sewage removal truck or fire pumps). Figure 4.1 illustrates the wiring required for a typical Split Shaft application.

4.1 Transfer Case Switch Operation

The transfer case status switch must be in the proper state indicating that it is "OK" to operate. The transfer case status switch input is provided as a safety interlock feature and must be wired as shown in **Figure 4.1**. The purpose of the transfer case input is to inhibit the system from entering engine speed control mode if the transfer case is operating in driveline mode versus split shaft mode. The transfer case status switch must be wired such that when the transfer case is in split shift mode pin J3–23 of the RESCM sees 12 volts.

4.2 EPG Driveline Mode

This parameter indicates how the driveline disengagement signal should be interpreted by the ECM and is programmable by International Truck and Engine Corporation only.

0: NEUTRAL OPERATION, driveline must be disengaged at all times for operation of the split shaft feature.

1: SPLIT SHAFT, a transition in driveline status will cause the split shaft feature to be deactivated.

4.3 Wheel Based Vehicle Speed

If the system is configured to function in Split Shaft mode (EPG driveline mode parameter equals SPLIT SHAFT), then the engine ECM must receive wheel based vehicle speed from a brake system electronic control unit (ECU). This message (PGN 65265, bytes 2 and 3) must be broadcast by the brake system over the Public J1939 data link. At this time, only one brake system supports this message, the Bendix EC–30. The availabilty of this parameter for the EC–30 system is currently a programmable feature. This programmable feature must be enabled for the EPG system to function. If the engine ECM does not receive this message, it will not allow the system to enter into Engine Speed Control. If the brake system ECU broadcasts the wheel based vechicle speed parameter as being 0 mph, then it will allow the system to function. This is a safety interlock feature to ensure that the vehicle is not moving while the system is functioning in Split Shaft mode.

Figure 4.1a — Split Shaft Engine Speed Control Using Hard–Wired Body Builder Wiring
I6 Engines

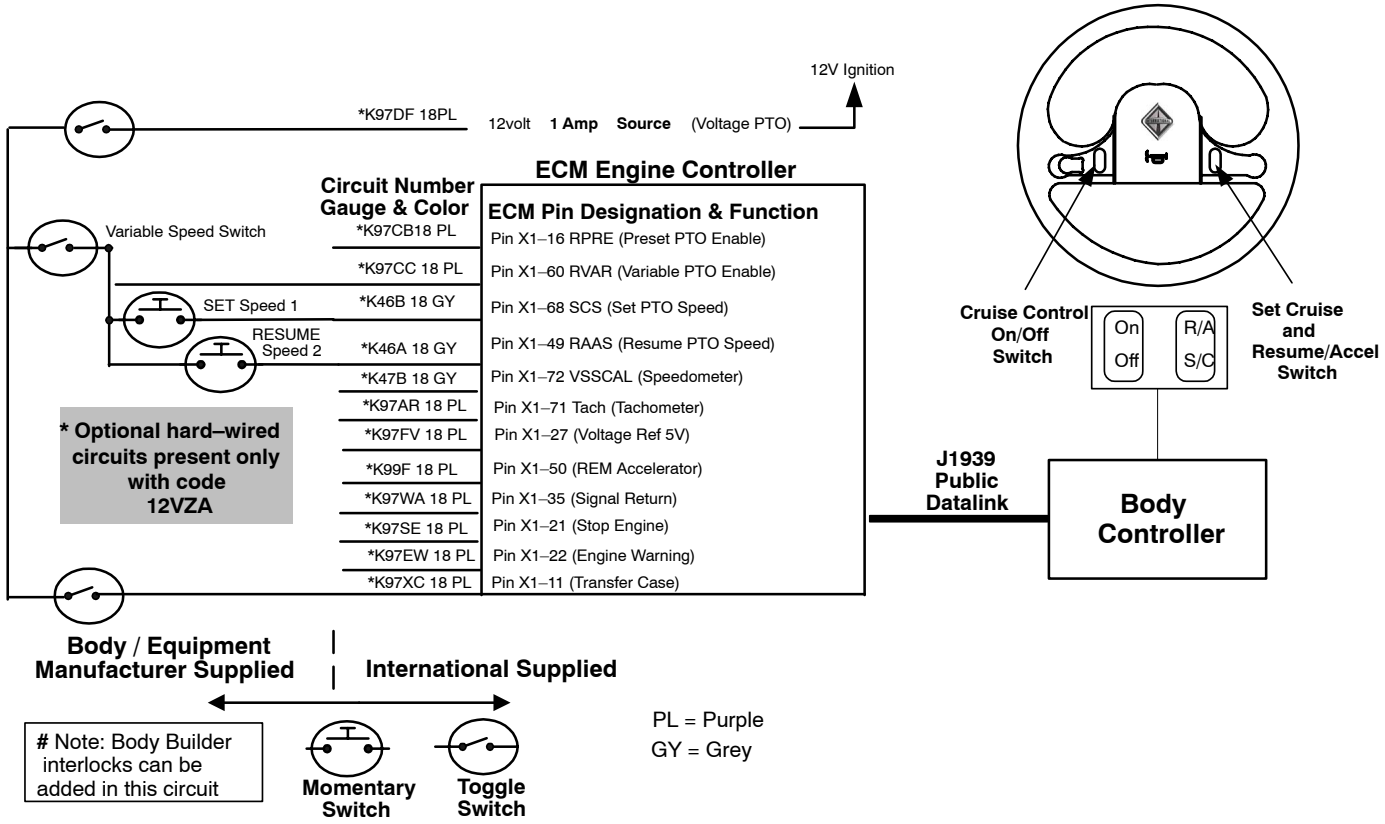


Figure 4.1b — Split Shaft Engine Speed Control Using Hard–Wired Body Builder Wiring V8 Engines

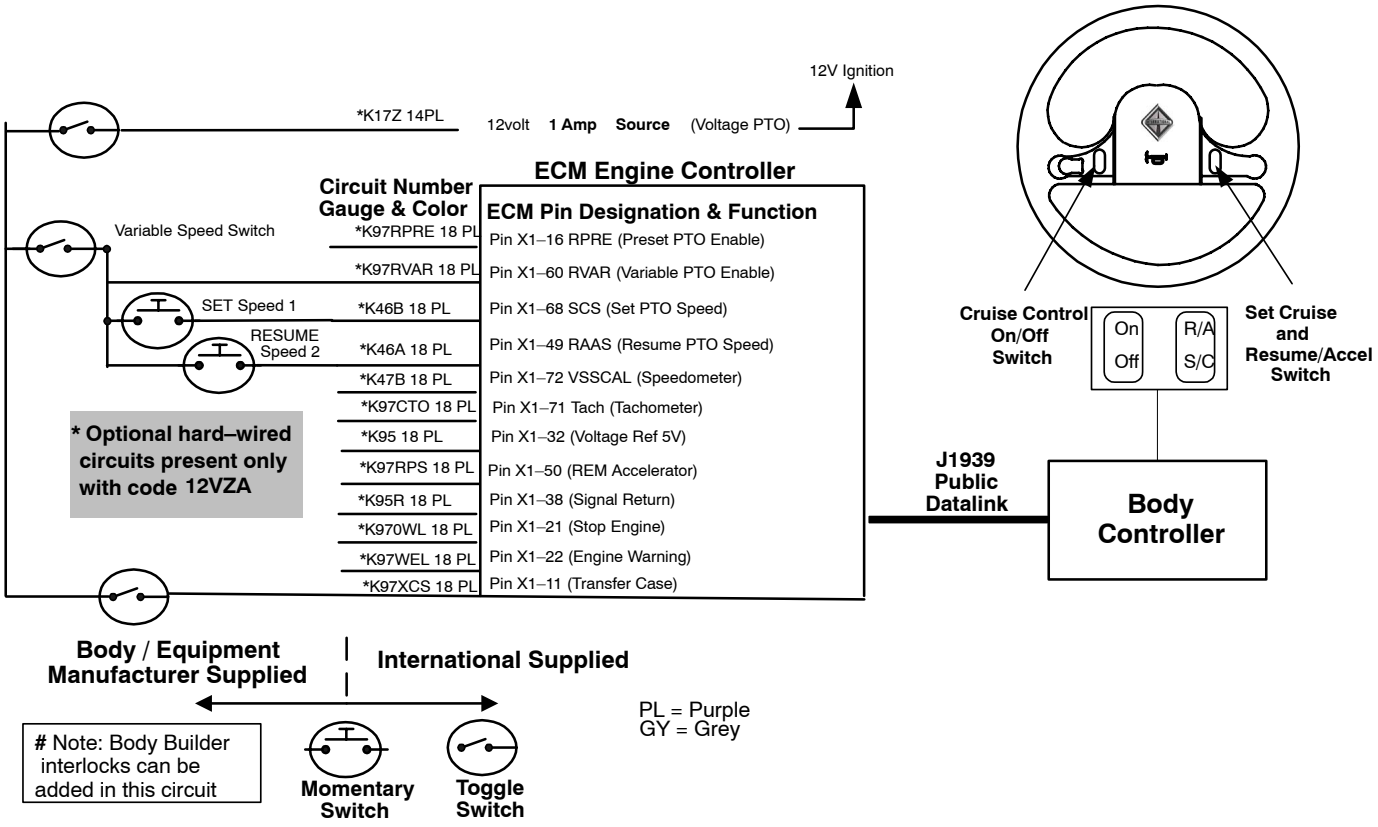
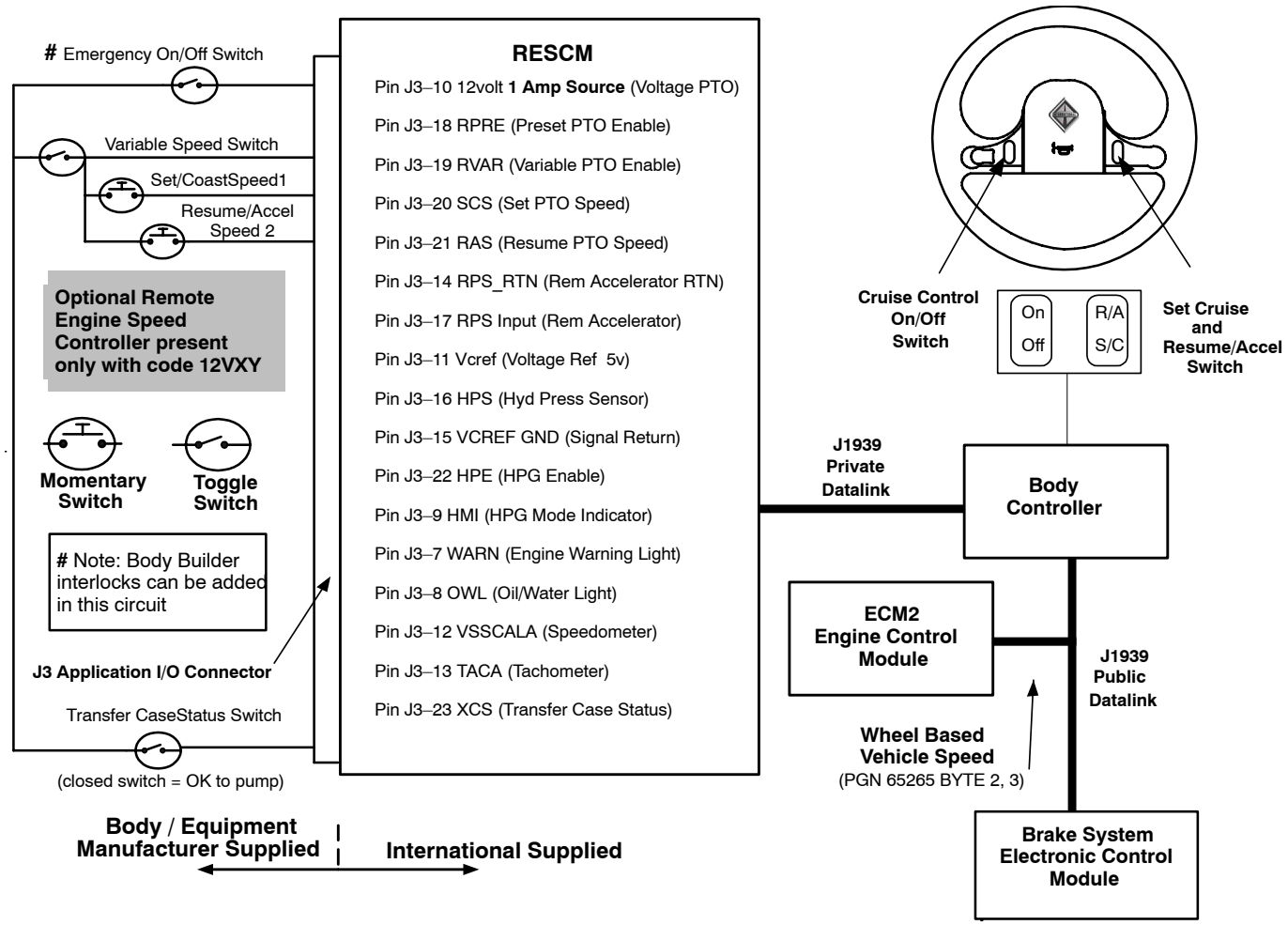


Figure 4.2 — Split Shaft Engine Speed Control Using the Remote Engine Speed Controller



Section 5 — Remote Throttle Control

The Remote Throttle control functions like an additional accelerator pedal or hand throttle. Remote throttles provide equipment operators with direct control over engine speed from a location outside of the vehicle cab. By using a potentiometer, a remote throttle is useful when an infinitely variable range of engine speeds is desired to operate equipment. Remote throttles can be used to provide temporary increases in engine speed when Preset or Variable Engine Speed control is in use.

The hand and/or foot actuated potentiometer can be located in one or more locations on the vehicle (see **Figure 5.2**). Increasing or decreasing the voltage from the potentiometer will result in a corresponding increase or decrease in engine speed (similar to stepping on or releasing the accelerator foot pedal in the vehicle cab).

Note: To be noticed by the engine control system, the engine speed requested by the Remote Throttle must exceed the engine speed requested by the cab accelerator pedal and other engine speed control requests. Reason: The highest engine speed requested becomes the engine speed commanded to the engine.

Use of either the Remote Preset PTO Switch or Remote Variable PTO Switch is required to activate or deactivate the Remote Throttle and the engine control system must be programmed to accept the Remote Throttle input. Use spring loaded designs for throttle devices so that the engine returns to idle when the throttle is released.

NOTE: The only way the Remote Throttle Control System can be disabled is to turn it off with the switch previously used to turn it on.

The programmable parameter **PTO Remote Pedal** must be programmed to "1" to enable operation of the Remote Throttle input. Also, the maximum engine speed permitted when operating with the Remote Throttle will be limited to the value programmed for **PTO MAX RPM**.

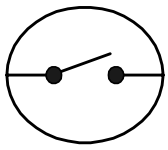
Figure 5.2 shows the circuits needed to operate the Remote Throttle feature. The remote potentiometer circuits are interfaced to the RESCM or the hard–wired ECM pins. The RESCM communicates the status of these circuits via J1939 to the engine control system via the ESC while the hard–wired pins communicate directly to the ECM. The same potentiometer that is used for the cab's accelerator pedal can be used for this remote potentiometer. Terminals A, B and C are cavities in the 6–way Packard mating connector to the accelerator pedal sensor. Do not cross the wires to terminals A, B and C. Cross–wiring terminals B and C will provide a high voltage level on the APS signal at the sensor's mechanical idle position. The remote throttle input must be turned on and off by an enable switch. Enabling either the Remote Preset PTO Switch or the Remote Variable PTO Switch will turn the Remote Throttle input on. These two switches must not be enabled at the same time – it's one or the other. Opening the switch circuit disables the Remote Throttle input.

The Master Diagnostics tool can be used for troubleshooting and verifying the Remote Throttle installation. The PTO Remote Pedal parameter must indicate ON and either the Rem Var PTO Switch or the Rem Preset PTO Switch must indicate ON. When these conditions are met, the Accel Pedal parameter will display the percent throttle commanded to the ECM. If the Remote Throttle parameter indicates FAIL, a fault exists in the circuits or in the potentiometer itself.

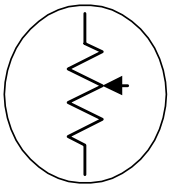
Display of the parameter Accel Pedal should be used to set mechanical stops for custom throttle designs. Mechanical stops must be used with potentiometer based throttle control systems to prevent the supply of inadequate or excess voltage to the engine controller. The ECM detects under and over voltage conditions for Remote Throttle; occurrence of one of these conditions will result in activation of a fault code.

The 12 volt supply from Pin J3–10 of the RESCM is strictly for remote engine speed control use. It should not be used as a power feed for other systems.

Figure 5.1 — Switch Requirements



**TOGGLE OR LATCHED SWITCH
(USED FOR SYSTEM ACTIVATION OR INTERLOCKS)**



**POTENTIOMETER OR RHEOSTAT
(USED FOR REMOTE PEDAL INPUTS)**

5.1 Accelerator Pedal Sensor Notes and Diagnostics

Appendix D lists part numbers for floor mounted and suspended accelerator pedals and the accelerator pedal sensor kits. These parts include a jumper harness for the sensor with a Packard Weather–Pack connector. The typical wire colors for the jumper harness are shown in Table 5.1. The Weather–Pack connector can be cut off and the circuits spliced according to their identifying colors.

Table 5.1 — Accelerator Pedal Sensor Wire Colors and Signals

APS Cavity	A	B	C	D	E	F
Signal	Sensor Output	Sensor Ground	Sensor Supply (5Vdc)	Normally Closed Idle Validation	Normally Open Idle Validation	Idle Validation Switch Common
Color	Black	White	Red	Green	Blue	Orange

The RESCM remote throttle input is preloaded with a resistor fixed in connector J3, pins 17 and 14. This resistor fixes the input at 0%. If using a remote throttle pedal of any kind, remove this resistor when installing the remote throttle connections. If not installing a remote throttle, leave this resistor in place. **Do not remove the jumper in J3 pins 1–2. These are addressing wires and must be left in place.**

The accelerator pedal sensor includes an Idle Validation Switch (IVS). The Normally Closed contacts are connected to the common terminal when the sensor is at the idle osition. The Normally Open contacts are connected to the common terminal when the sensor is in the off–idle position. Due to the thick film construction of the sensor, the IVS switch has a contact resistance of ~80 Ohms. Do not use this switch in series with the sensor circuits.

The remote throttle potentiometer is protected through circuit diagnostics. Faults are detected when the potentiometer is open or short circuited. These faults recover when the fault condition is corrected. Table 5.2 summarizes typical voltage levels for throttle operation and diagnostics. The voltage levels are designed to be compatible with a total resistance of 2.5K Ohms. As the voltage detected increases, the engine speed demanded by the remote pedal input increases. Diagnostic ranges are provided at the top and bottom of the potentiometer voltage. The voltage shown in Table 5.2 is between RESCM pins J3–14 (Rem Accelerator RTN), J3–17 (Rem Accelerator) and J3–11 (Voltage Ref 5V).

Table 5.2 —Remote Accelerator Pedal Sensor Voltage Levels

Voltage	Result
0 – 0.15	Out of Range Low or Open, Fault Code 213
0.15 – 0.90	0%, Low Idle Speed Demanded
0.90 – 3.50	0 – 100%, Normal Operating Range
3.50 – 4.55	100%, PTO Max RM Demanded
4.55 and above	Out of Range High, Fault Code 214

New designs incorporating the accelerator pedal sensor must include their own return springs to ensure that the sensor returns to the idle position when the control is released. The sensor's internal stops must not be used to limit the travel of its drive mechanism. To make sure the sensor always returns to the idle position, pre–load the internal return spring by 15.2 degrees. Another reason to pre–load the return spring in this manner is that the voltage output from the sensor will fall into the out of range low diagnostic region if the sensor is not pre–loaded by 15.2 degrees of travel. Sensors that are disconnected from the drive mechanism will generate a diagnostic code. The maximum range of travel applied to the accelerator pedal must be limited to a maximum of 52.3 degrees beyond 15.2 degree pre–load for the idle position. For additional information see SAE recommended practice "J1843, Accelerator Pedal Position Sensor for use with Electronic Controls in Medium and Heavy–Duty Vehicle Applications".

Hand Operated Throttle Control Kit
See appendix D for a hand operated throttle parts list.

Figure 5.2a — Remote Throttle Interface Using Hard–Wired Body Builder Wiring
I6 Engines

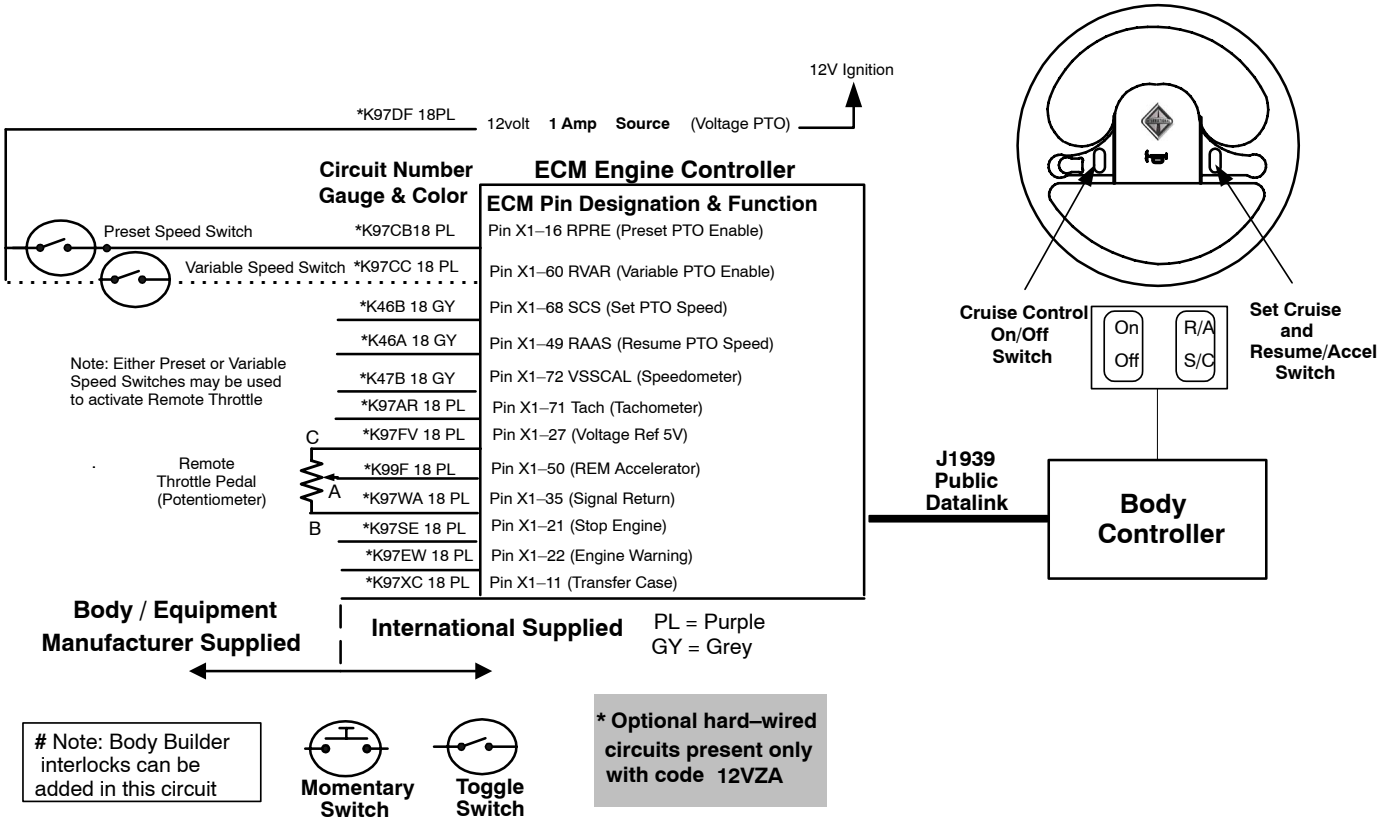


Figure 5.2b — Remote Throttle Interface Using Hard–Wired Body Builder Wiring Engines V8 Engines

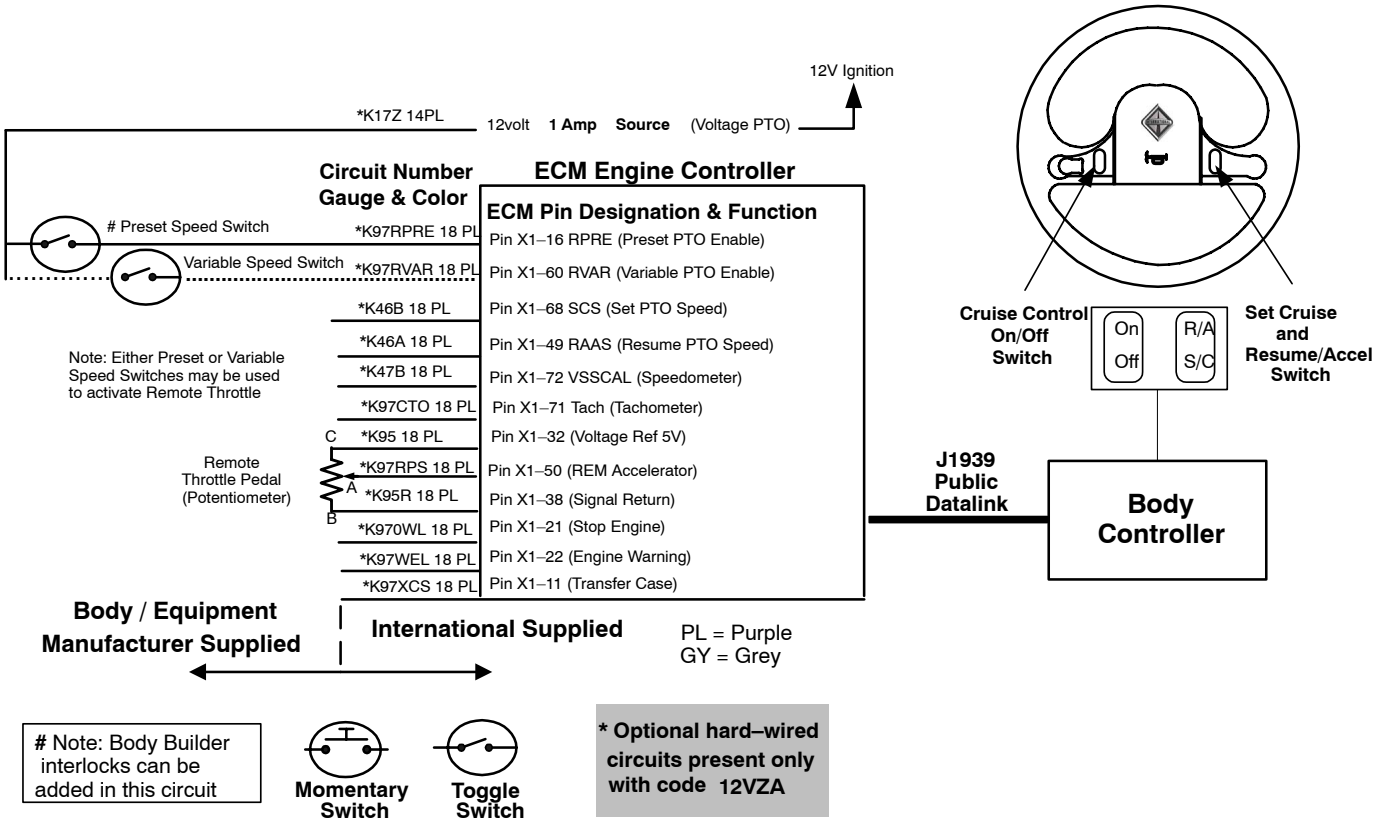
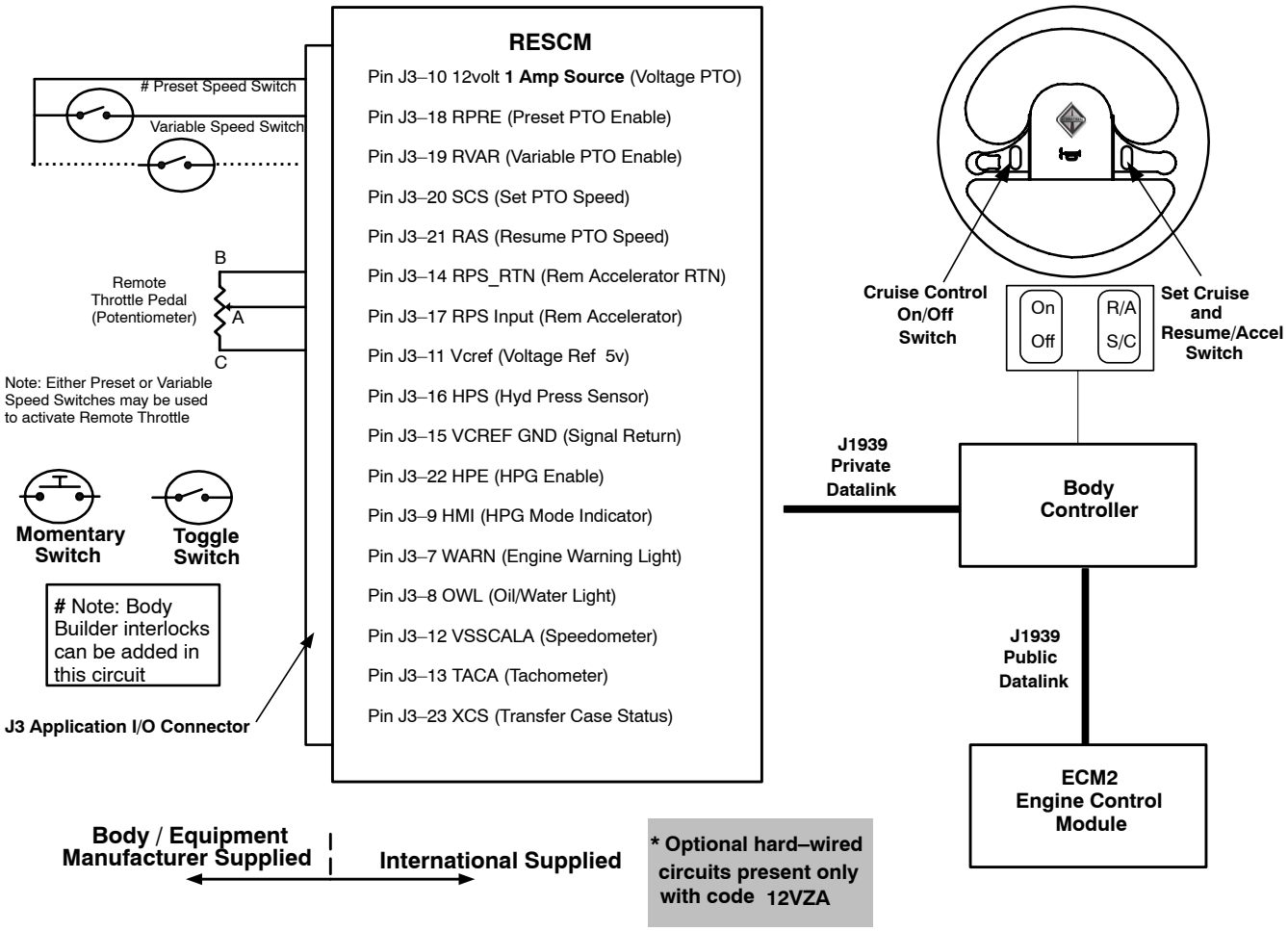


Figure 5.3 — Remote Throttle Interface Using the Remote Engine Speed Controller



Section 6 — Remote Engine Start and Stop

This section describes the circuit modifications necessary to stop and start the engine from a remote location. Modifications that implement remote start must also implement remote stop. When remote stop is implemented, all ignition sources to the engine control system must be interrupted.

CAUTION:

International® does not suggest adding a remote start on vehicles with manual transmissions. The following modifications are suggestions only and do not take into account any interlocking that might be needed to maintain safe vehicle operation. It is our belief that safe modifications to start/stop circuitry will vary with truck application and should be the responsibility of the party making the modification.

The circuit modifications to implement remotely controlled engine stops and starts are shown in Figure 6.1 and Figure 6.2.

Figure 6.1 — Circuit Diagram for Remote Engine Stop

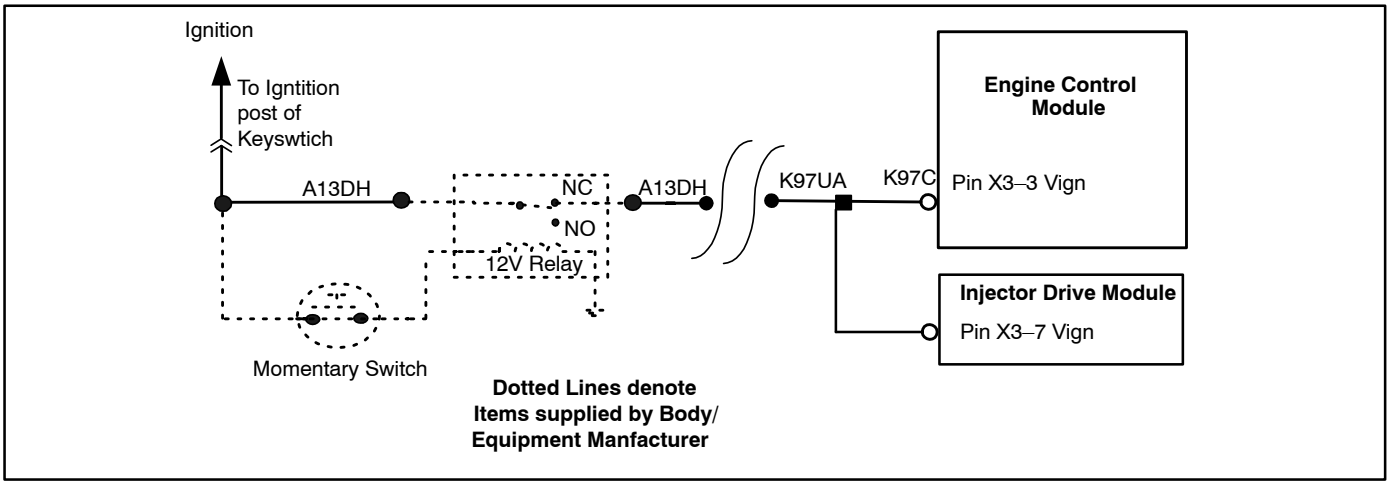
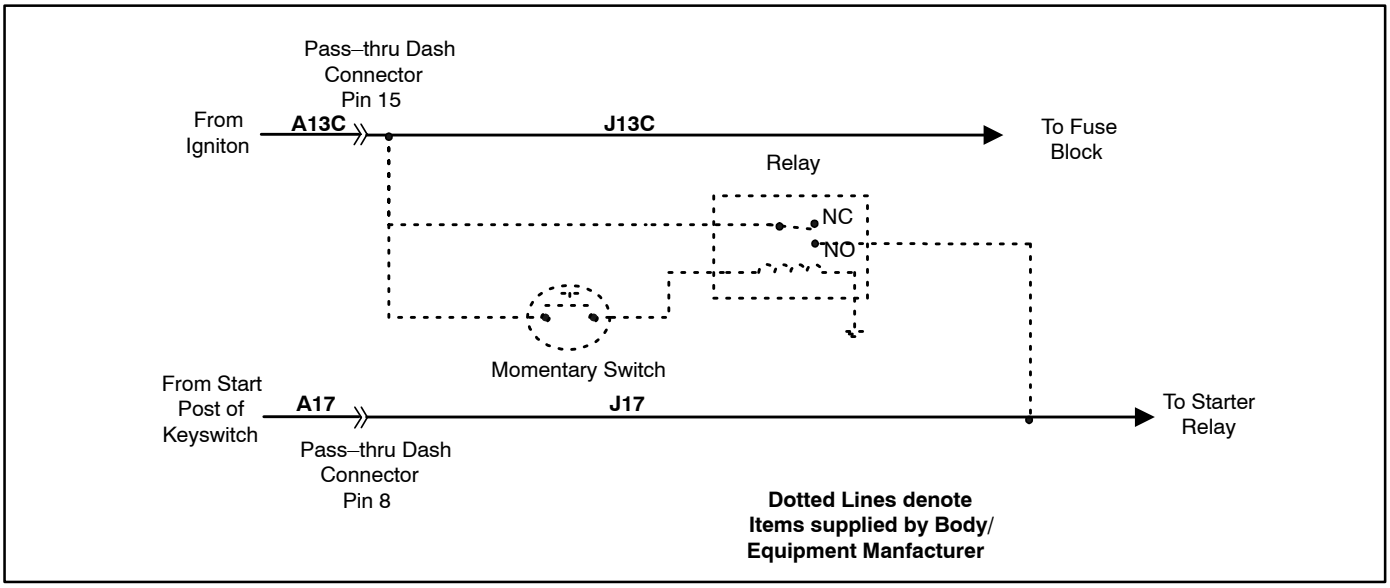


Figure 6.2 — Circuit Diagram for Remote Engine Start



Section 7 — Body Builder Connections and Circuit Protection

This section discusses general information related to the installation of new circuits to a chassis. Available options for power connections and recommendations for the installation of new power circuits are reviewed. Wire, fuse and circuit breaker sizing for circuit protection are displayed, along with unique ECM circuits that must never see 12 volts with the key switch in the OFF or Accessory positions.

7.1 Body Builder Connections

An option for connecting to the vehicle lighting system is available from the factory. The feature code for this option is 08HAB. The table below gives the circuit information available for this feature. For wiring schematic and connector & terminal part numbers, see circuit diagram book.

Table 7.1 — Body Builder Connections

Connection	Cavity	Circuit	Description	Fuse (amps)	Available Current at Connector (amps)	Sharing (TruCk Lamp Fed From Same Fuse)
4450	A	N68BB	Tail Lamp	20	20	None
	B	N56BB	Left Rear Turn Lamp / Stop	10	8	Truck Left Rear Turn Lamp
	C	N57BB	Right Rear Turn Lamp / Stop	10	8	Truck Right Rear Turn Lamp
	D	N58BB	Marker Lamp	20	20	None
	E	N71BB	Back-Up Lamp	10	6	Truck Back–Up Lamps
	F	N12BB	Accessory Feed	20	20	None
	G	N11-GBB	Ground (12 ga)	—	—	None
4460	A	N56BA	Left Front Turn Lamp	10	8	Truck Left Front Turn Lamp
	B	N57BA	Right Front Turn Lamp	10	8	Truck Right Front Turn Lamp

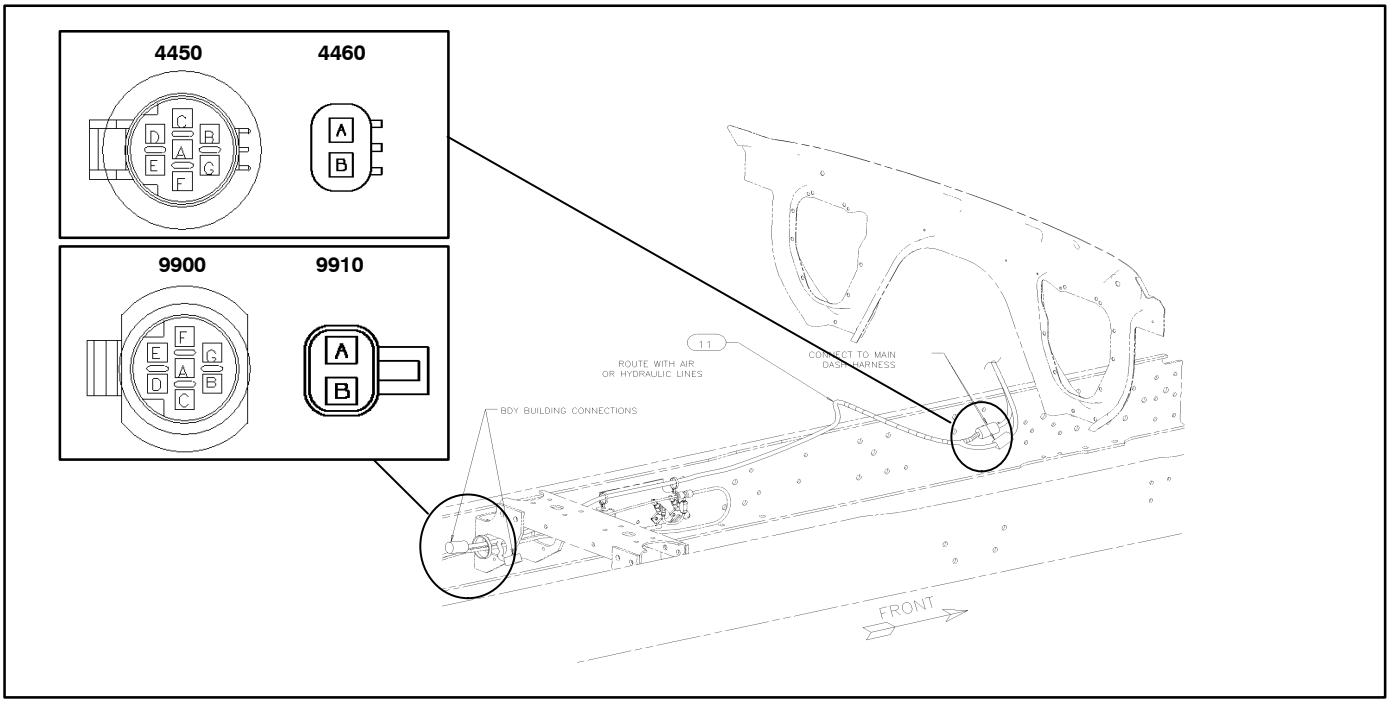
Note: Any unused circuit cavities must be plugged with sealing plugs provided with chassis harness.

Connectors 9900 and 9910 have their mating connectors attached filled with cavity plugs. To use connectors, remove cavity plugs and use the following:

Table 7.2 — Connectors 4450 & 4460

Terminals	Wire Gauge
2033912C1	12, 14
2033911C1	16, 18, 20
Cavity Seals	**Wire Gauge**
0589390C1	12
0589391C1	14
1652325C1	16, 18, 20
Mating Connector Part Nos.	
4450 Connector	2039312C91
4450 Lock	2039342C1
4460 Connector	1671611C1
4460 Lock	1671608C1

Figure 7.1 — Body Builder Connections



7.2 Circuit Protection

All new circuits that are added to the chassis after its assembly must be protected by fuses or circuit breakers. The fuse or circuit breaker should be located as close as possible to the connection point into the chassis wiring. The size of the protection device is determined by the size of the wire used for the circuit. Common wire gauges and device sizes are shown below:

Table 7.3 — Wire Gauges and Circuit Protection Devices

Wire Gauge	Protective Device Size	Maximum Current (Amps)
18 Ga	10 AMP Fuse/Circuit Breaker	8A
16 Ga	15 AMP Fuse/Circuit Breaker	12A
14 Ga	20 AMP Fuse/Circuit Breaker	16A
12 Ga	25 AMP Fuse/Circuit Breaker	20A
10 Ga	30 AMP Fuse/Circuit Breaker	24A
8 Ga	12 Gauge Fusible Link	80A
6 Ga	10 Gauge Fusible Link	108A
4 Ga	2-12 Gauge Fusible Link	160A

CAUTION — Wire gauge is designed to match fuse / circuit breaker rating. Do not increase the size of a circuit breaker or fuse. To do so could cause wiring to overheat and burn.

International part numbers for narrow blade circuit breakers according to type and size are shown below. Type III circuit breakers can only be reset manually. Type I circuit breakers continuously try to reset when tripped. Use Type I circuit breakers only where required by the function performed by the circuit to be protected. In general, Type III circuit breakers should be adequate for most needs.

Table 7.4 — Circuit Breaker Part Numbers

Size	Circuit Breaker Type	Part Number	Color
3000, DuraStar, WorkStar and TranStar Series			
7.5 A	Type III – Manual Reset	3536177C1	Brown
10 A	Type III – Manual Reset	3536178C1	Red
15 A	Type III – Manual Reset	3536179C1	Blue
20 A	Type III – Manual Reset	3536180C1	Yellow
25 A	Type III – Manual Reset	3536181C1	White
30 A	Type III – Manual Reset	3536182C1	Green
5000 and 9000 Series			
10 A	Type I – Continuous Reset	2007463C1	Black
20 A	Type I – Continuous Reset	2007465C1	Black
10 A	Type III – Manual Reset	2011944C1	Red
20 A	Type III – Manual Reset	2011946C1	Yellow
25 A	Type III – Manual Reset	2011947C1	White
30 A	Type III – Manual Reset	2011948C1	Green

Circuit breakers and fuses can be installed in the chassis wiring using the following in–line connectors:
1676841C91 – Inline socket and cable for circuit breaker/fuse (20 A maximum)
1682115C91 – Inline socket and cable for circuit breaker/fuse (30 A maximum)

7.3 Back Feeds

The circuits that are connected to the following Engine Control Module pins must always be connected to switched ignition power. Connecting any one of these circuits to battery power can cause the ECM to remain powered when the ignition switch is turned off. This can produce excess battery current causing the batteries to be discharged overnight.

- Remote PTO (Pre-Set)
- Engine Coolant Temperature
- Idle Validation Switch
- Drive Disengage Signal
- Remote PTO (Variable)
- Engine Oil Temperature
- Warn Engine Lamp
- Coolant Level Sensor
- Injection Pressure Regulator (I6 only)
- Ambient Temperature Sensor
- Map Sensor Output
- Glow Plug Relay (V8 only)
- Intake Air Heater Relays (I6 only)

7.4 Welding

Whenever welding is done on any part of the vehicle, the batteries should be disconnected – both power and ground including the electronic power feeds. The electronic components may easily be damaged from the high voltage used and R.F. energy present in the arc.

WARNING!

To avoid serious personal injury, death or possible engine damage, when welding or using an acetylene torch always wear welding goggles and gloves. Insure that acetylene and oxygen tanks are separated by a metal shield and are chained to a cart. Do not weld or heat areas near fuel tanks or fuel lines. Utilize proper shielding around hydraulic lines.

CAUTION — To avoid damage to vehicle electronic components, disconnect both the positive (+) and the negative (–) battery cables prior to electric welding. Attach the welder's ground cable as close as possible to the joint being welded. If it is necessary to weld close to an electronic component, it is recommended that the electronic component be temporarily removed.

Section 8 — General Information

This section reviews information of general interest about the circuits provided with the chassis. Installation of a Master Disconnect switch and two-way radios are reviewed. Access points for the Speedometer and Tachometer Signals and the ATA Data Link (SAE RP J1708/J1587) are reviewed along with other general information.

8.1 Remote PTO Engine Speed Control Circuits

Do not use the electrical wires provided for Remote Engine Speed Control connections to power other electrical chassis components. The activation switches (i.e., Set/Coast, Resume/Accel) should be momentary with Normally Open contacts. The +12 Volt connection should be used only to power these switches to allow them to activate Remote Engine Speed Control.

8.2 High Voltages In Harnesses

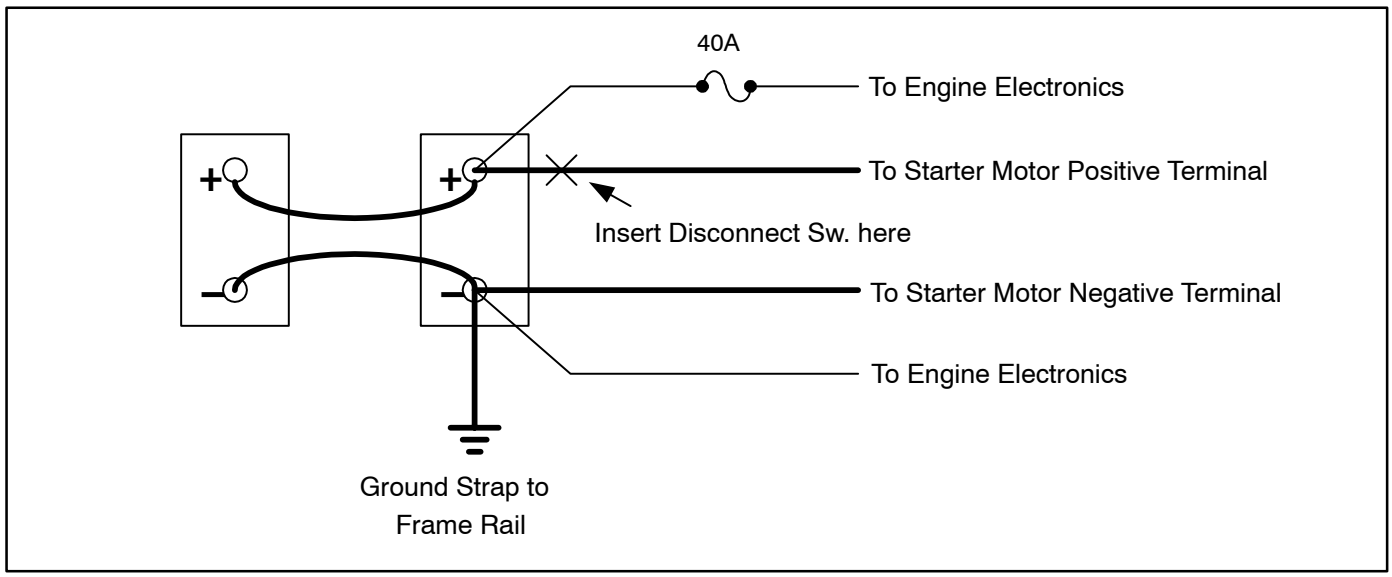
> ***Warning:***
>
> Do not probe the harnesses between the engine electronics and the engine. The injector solenoids have a higher electrical potential.

8.3 Master Disconnect Switch

Specify sales order code 08WCS or 08WAD for a factory installed Master Disconnect Switch. The disconnect switch cannot be put into the battery ground cable as was previously done. The electronic modules will provide a ground path around the Master Disconnect switch if this method is employed. The engine modules must always be connected to the batteries, even when the Master Disconnect switch is opened. On each vehicle, separate power and ground circuits are provided to the engine electronics.

To install a Master Disconnect Switch, break into the positive battery cable going from the batteries to the cranking motor and insert the disconnect switch into that circuit, as shown in Figure 8.1. Insure that adequate insulation is used between the positive battery cable, the switch mounting, and the surrounding area. Place boots or covers over the disconnect switch studs to protect the batteries and cables from accidental shorting. Do not disturb the direct connections from the battery to the engine electronics.

Figure 8.1 — Master Disconnect Switch Insertion Point



8.4 Two-Way Radio Installation

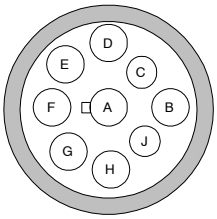
A qualified technician should do all two-way radio installations. The power connections for any radio installation should always go to the vehicle's batteries with proper circuit protection installed closest to the batteries. A filter may have to be added to the radio power feed. Wire routing should always be routed away from all vehicle harnesses to prevent pickup from the vehicle electrical system into the radio and/or from the radio system into the vehicle electrical system. Evaluation of the antenna location should be assessed before permanent mounting is made to assure minimum interference to the radio reception and vehicle electrical system.

8.5 ATA Data Link Connections

The engine control system provides a data link compatible with the specifications in TMC RP 1202. These requirements are the same as those given by SAE recommended practices J1708 and J1587. Temporary connections can be made using the 9-way Deutsch diagnostic connector located in the cab by the operator's side under left corner of instrument panel. Do not make permanent connections to the ATA data link without a full understanding of load requirements and data protocol required for the device being attached. See Appendix C for more information on the data provided by the engine on the data link.

Figure 8.2 — ATA Data Link Connections

COMBINATION
CONNECTOR
9 – Way Deutch



HD10–9–1939–P

A = GND
B = BAT (+)
C = J1939 CAN (H)
D = J1939 CAN (L)
E = CAN (SHLD)
F = J1708 / ATA (+)
G = J1708 / ATA (–)
H = Not Used
J = Not Used

8.5b **J1939 Data Link Connections**

The engine control system provides a CAN data link. The requirements for this CAN data link are provided by SAE recommended practices J1939. Note that modules on the CAN data link may not support all parameters in the J1939 standard. Temporary connects can be made using the 9–way Deutsch diagnostic connector located in the cab by the operator's side under left corner of instrument panel. Do not make permanent connections to the CAN data link without a a full understanding of load requirements and data protocol required for the device being attached. See Appendix C for more information on the data provided by the engine on the data link.

8.6 **Clutch Switch and Neutral Position Switch Connections**

The clutch and neutral position switches are part of the engine control system circuits. These circuits should never be disturbed. If there is a need for either one of these functions, then contact International® Tech Central for guidance.

8.7 **Speedometer and Tachometer Outputs**

Interfaces conforming to TMC RP 123 are provided for speedometer and tachometer signals. Speedometer output is calibrated to 30,000 pulses per mile. Tachometer output is 12 pulses per engine revolution. Access to these signals is provided by the electrical wire connections located at the bulkhead. The speedometer and tachometer output signals are provided by circuits X1–72 and X1–71 respectively.

The sink and source currents for the available interfaces are shown below. Both interfaces source 5 milliamps and sink 5 milliamps. These interfaces are noted in the table below. The signal waveform provided is a square wave with a 50% duty cycle. See TMC RP 123 for more information about the signal waveform.

Table 8.1 — Signal Interface Parameters

Parameter	Potential	Parameter	Current
Vo low	0 to 0.5 Volts	Isink (Vo low)[1]	50 microamps
Vo high	4 V to V battery	Isource (Vo high)	5 milliamps

[1] Designates enhanced interfaces that sink 5 milliamps of current instead of 50 microamps.