POWERTRAIN CONTROL SOLUTIONS
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PCS PADDLE SHIFTER USER GUIDE v3.0

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Revision History

11-30-2016: Section 1.2c: Connect the Receiver Module to a GM Mechatronic and Section 6.2: Pairing & Advanced Options added.
11-27-2017: Parts list updated to indicate the 6 - #10-32 x 2” Flat Head Cap Screws are for 5-6 bolt paddle shifters only.

PCS Paddle Shifter User Guide

1 Introduction

1.1 Included Components

- 1 - Receiver Module
- 1 - Receiver Module Harness (5’ Length)
- 1 - Paddle Shifter Module
- 1 - Paddle Shifter Module Harness
- 1 - 1/2” Spacer
- 1 - 1/4” Spacer
- 6 - #10-32 x 2” Flat Head Cap Screws (5/6 Bolt Only)
- 1 - *Optional* Multi-Function Display Installed on Paddle Shifter

1.2 Required Additional Items to Complete Installation

- Vehicle Wiring Diagram
- Steering Wheel Removal Tools
- Wiring Tools
- Heat Gun
- Steering Wheel Adapters

1.3 Overview

The Powertrain Control Solutions (PCS) Paddle Shifter is used to manually shift an electronic automatic transmission. The paddle shifter kit includes a receiver module and a paddle shifter. Optionally, the paddle shifter may include a multi-function display. The paddle shifter commands a shift from the receiver module to the transmission controller using either a high-speed CAN connection or discrete outputs. The CAN connection is recommended if using a PCS transmission controller and required if using the multi-function display. The communication from the paddle shifter to the receiver module is wireless, however, power is required at the paddle shifter. To easily accommodate this requirement, PCS recommends installation using the existing horn wire as described further in this manual.

NOTE: THIS PRODUCT IS NOT DESIGNED FOR VEHICLES WITH A STEERING WHEEL MOUNTED AIRBAG.

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2 Receiver Module Installation

2.1 Locate and Connect the Receiver Module to the Existing Horn Circuit

The receiver module should be mounted in a location near the paddle shifter with access to power (switched +12V), ground, the horn circuit, and either the TCU CAN circuit or TCU digital inputs. This is typically behind the dash or in the driver's kick panel. Before permanently mounting the receiver, it is advised to verify operation of the complete system. It is possible that certain locations may result in low wireless signal quality to the paddle shifter module resulting in degraded performance. The receiver module should be securely mounted using the two bolt holes or with high strength Velcro.

The paddle shifter module mounted to the steering wheel requires power. This kit was designed to use the existing horn wire to simplify the installation. **Figure 2.1-1** shows a typical stock horn circuit. Also note the wire that will need to be located and cut.

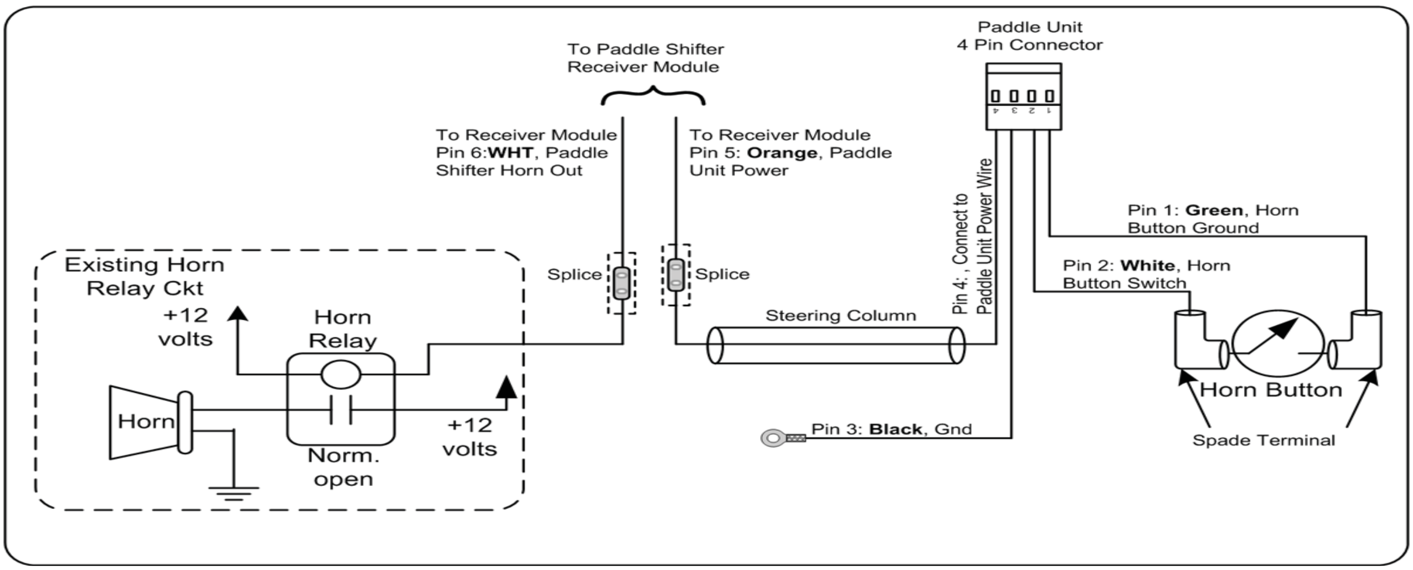

Figure 2.1-1: Typical OEM horn circuit

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Figure 2.1-2 shows the installation of the receiver module into the existing horn circuit. Cut the OEM horn wire before the steering column. Connect the horn relay side to the white wire on the receiver module harness (Pin 6). Connect the horn button side to the orange wire on the receiver module harness (Pin 5). Connect the red wire (Pin 1) to a switched +12V power source. Connect the black wire (Pin 2) to a chassis ground. Butt crimp connectors and heat shrink have been provided for this operation.

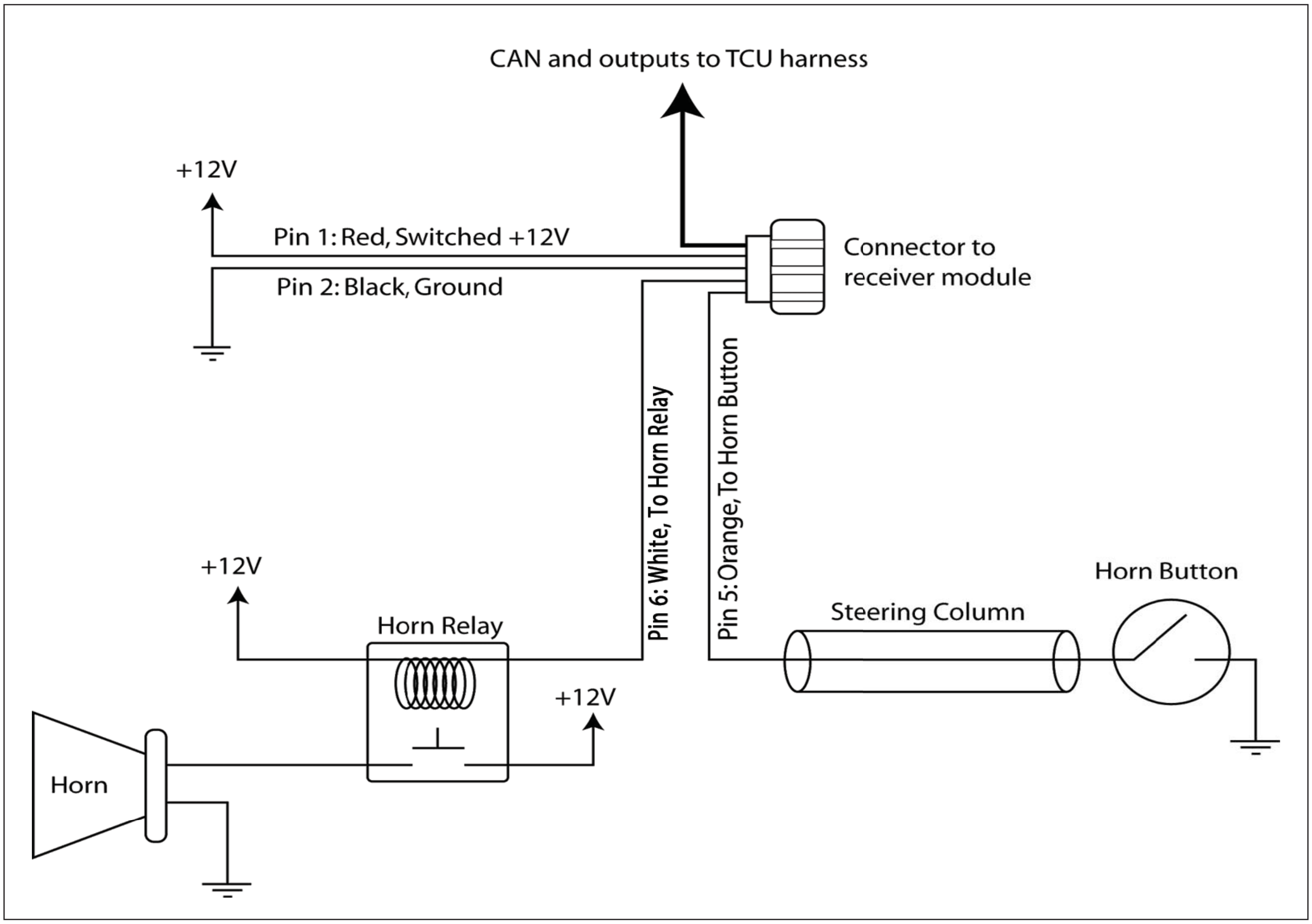

Figure 2.1-2: Horn Circuit w/Receiver Module Installed

2.2a Connect the Receiver Module to CAN for TCU Communication

If a display is not being used and discrete outputs are going to be used to shift the controller, refer to step 2.2b.

The PCS Quick Connect harness should be used to connect the Paddle Shifter to a PCS device with the option connector.

To connect, simply connect the harness into the option connector as shown into figure **X**. If this is the first device on the CAN network a **"Y"** connector and resistor must also plug in as shown. *Reference Figure 2.2-1.*

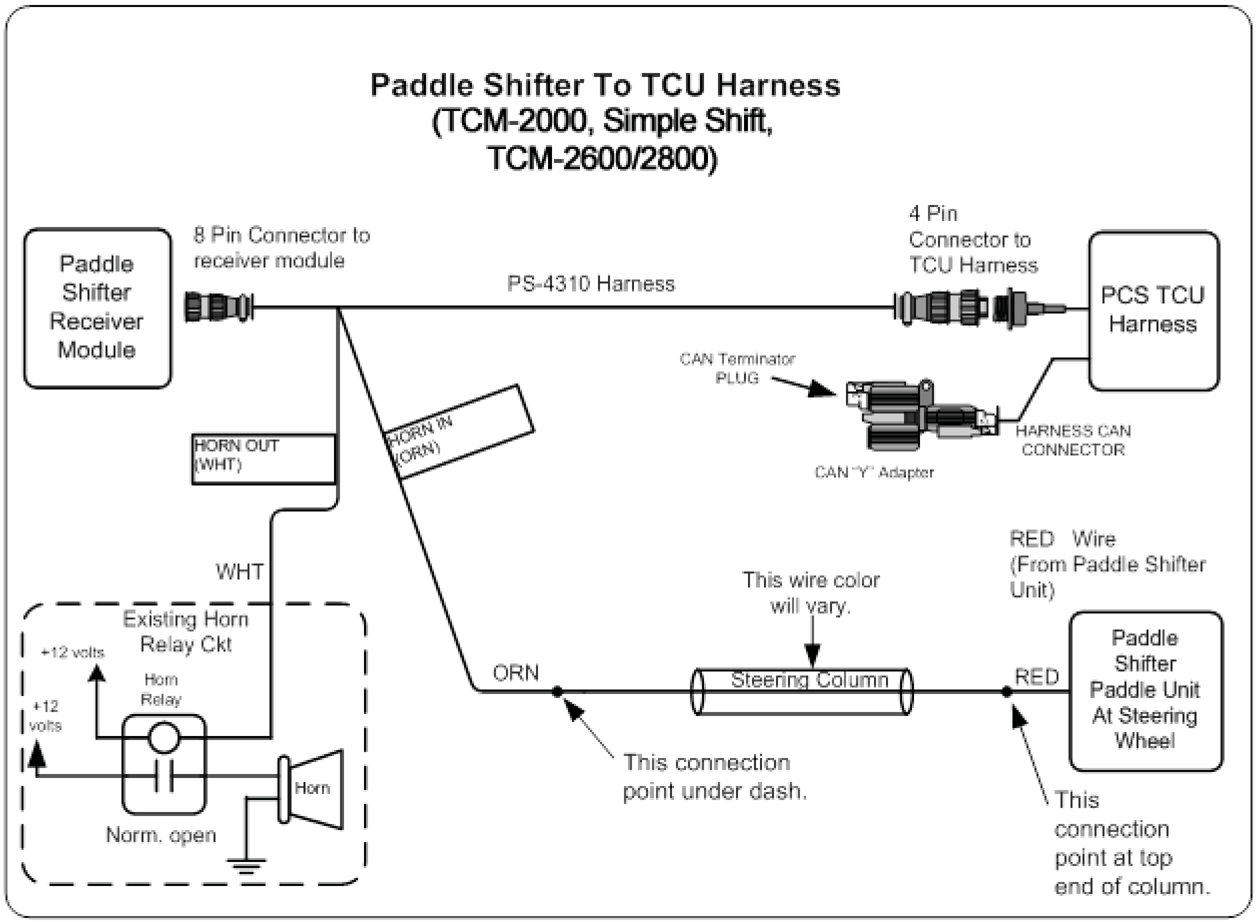

Figure 2.2-1: Receiver Harness Connected Using CAN

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2.2b Connect the Receiver Module to Discrete Outputs for TCU Communication

If using CAN for communication and shifting, proceed to Section 3. Do not connect both CAN communication and the digital inputs. You must choose one or the other. If using the optional multi-function display, CAN must be used for full functionality.

Use of the PCS universal paddle shifter harness is required to use the discrete upshift and downshift wires. Connect the brown wire (Pin 7) on the receiver module harness to the appropriate TCU digital input for downshifting. Connect the blue wire (Pin 8) to the appropriate TCU digital input for upshifting. *Reference Figure 2.2-2.*

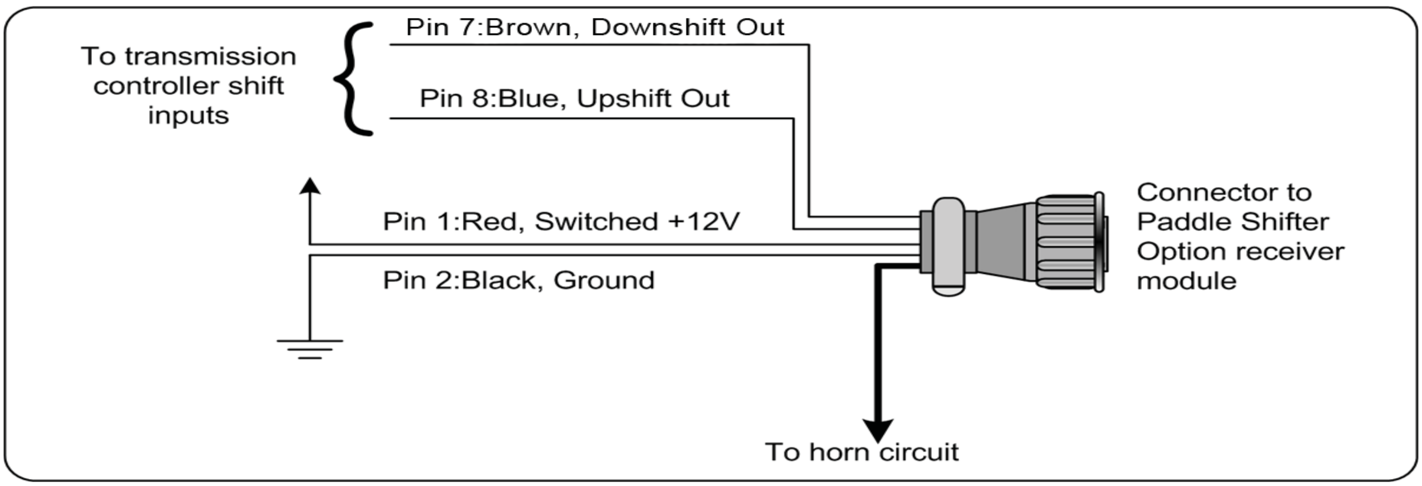

Figure 1.2-2: Receiver Harness Connected Using Digital Inputs

2.2c Connect the Receiver Module to a GM Mechatronic Transmission

Tap functionality in GM Mechatronic is configured in the internal TCM. For GM Mechatronics controllers the connection depends on the transmission calibration settings. There are typically 2 different configurations in the transmission calibrations. One setting gets the tap signals from the BCM via CAN messaging. This configuration needs to be connected to the GM CAN, the hardwire input to the transmission is not necessary.

The Second configuration is for a TCM that is programmed for TUTD hardwire input. This configuration will need to have Pin '8' blue wire from the receiver module ran into the TUTD pin in the transmission connector for GM 6 Speed transmissions. *Reference Figure 2.2-3*. Paddle shifters with a multi-function display require both CAN communication spliced into the GM LAN wires along with the hardwire input. Tap functionality in GM Mechatronic is configured in the internal TCM. If using the optional multi-function display, CAN must be used for full functionality. *Reference Figure 2.2-4.*

PCS GM Mechatronic harnesses have the paddle shifter receiver connector already incorporated into the harness. These harnesses only require connecting the paddle shifter harness. *Reference Figure 2.2-5.*

Transmission Model	Connector Pin
6L50E/80E/90E	Pin 7
6T70/75E	Pin 6

Figure 2.2-3: GM Pass-Thru Connector Pin

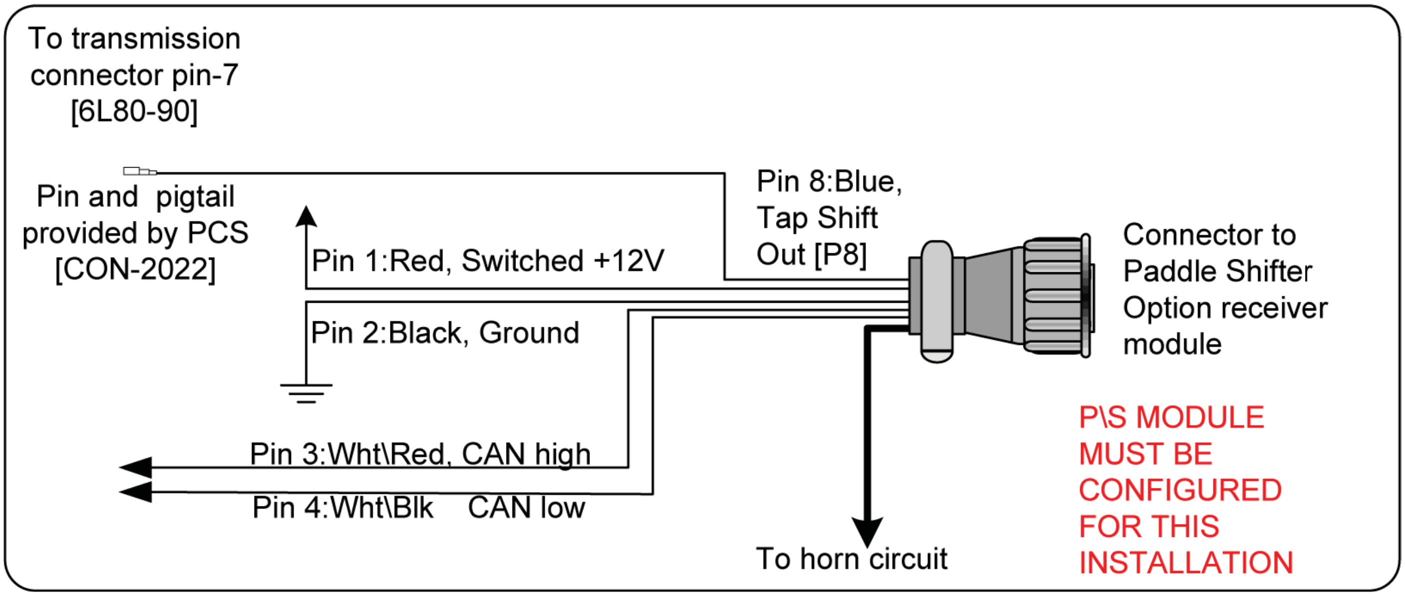

Figure 2.2-4: Using Multi-Function Display

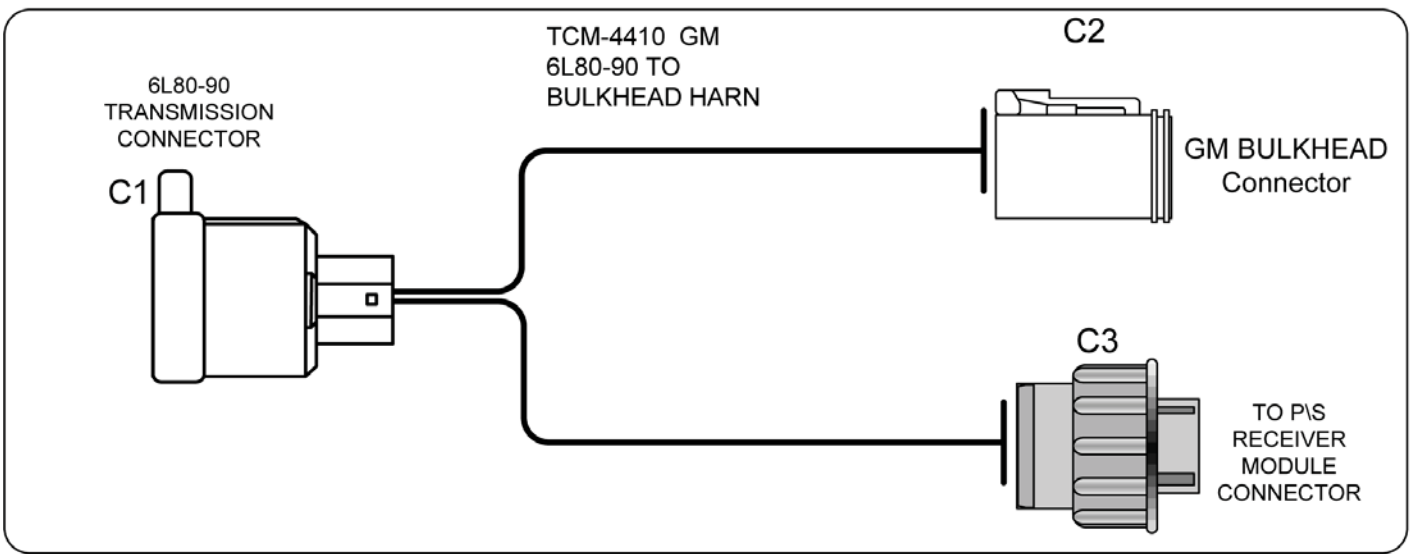

Figure 2.2-5: Connecting the Paddle Shifter Harness

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3 Receiver Module Installation

3.1 Locate and Connect the Receiver Module to the Existing Horn Circuit

The receiver module should be mounted in a location near the paddle shifter with access to power (switched +12V), ground, the horn circuit, and either the TCU CAN circuit or TCU digital inputs. This is typically behind the dash or in the driver's kick panel. Before permanently mounting the receiver, it is advised to verify operation of the complete system. It is possible that certain locations may result in low wireless signal quality to the paddle shifter module resulting in degraded performance. The receiver module should be securely mounted using the two bolt holes or with high strength Velcro.

The paddle shifter module mounted to the steering wheel requires power. This kit was designed to use the existing horn wire to simplify the installation. **Figure 3.1-1** shows a typical stock horn circuit. Also note the wire that will need to be located and cut.

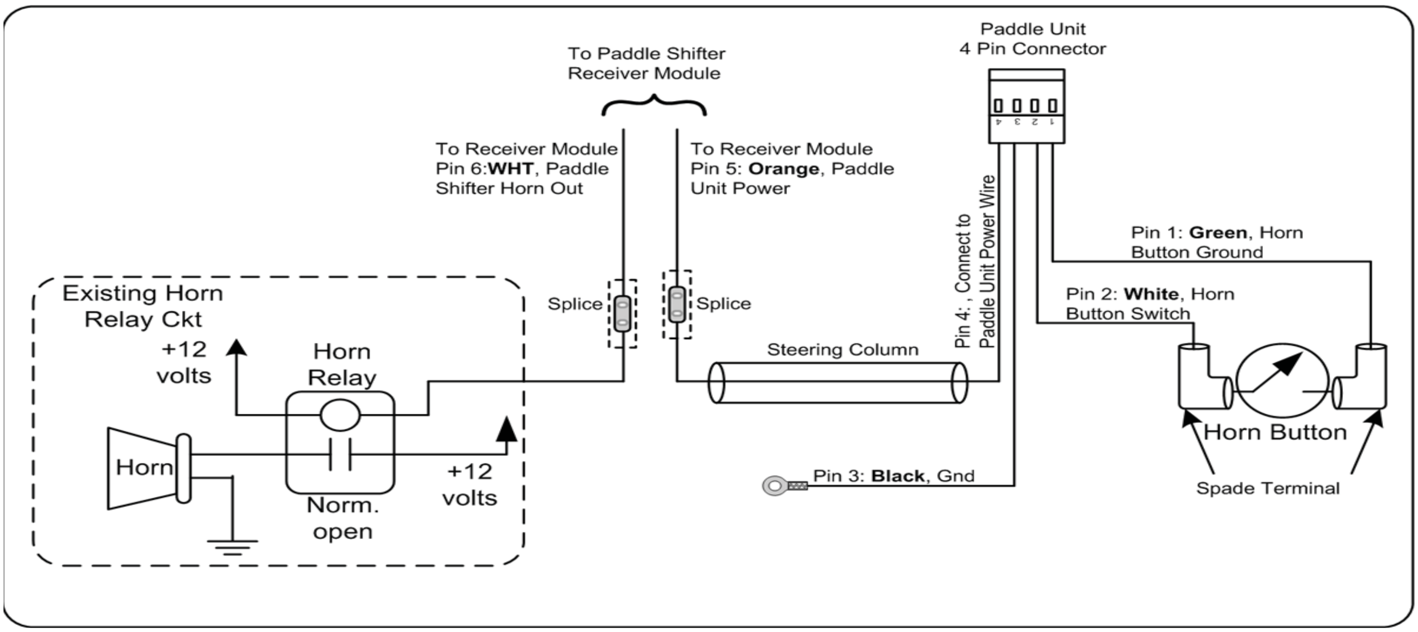

Figure 3.1-1: Paddle Shifter Harness Installation

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3.2 Preparing the Steering Column

The paddle shifter bolts on to a steering column using a 5/6 or 9-bolt steering wheel pattern. These patterns are typical for aftermarket steering wheels. The purchase of an adapter to convert from the stock steering column to the appropriate bolt pattern may be required. Adapters are not included in this kit. *Reference Figure 3.2-1.*

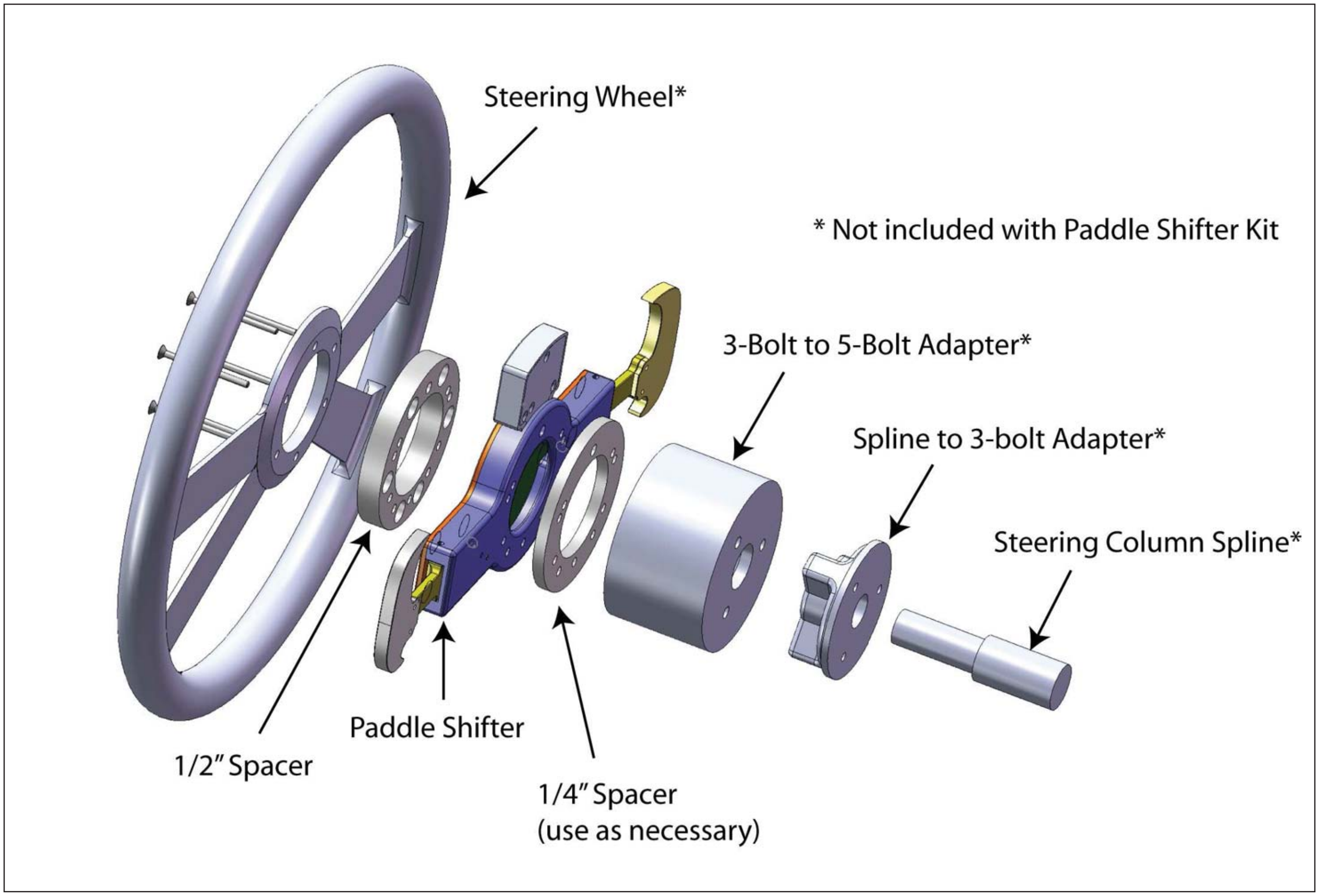

Figure 3.2-1: Typical Installation

NOTE: Follow the manufacturer's installation instructions of any adapter(s) installed on the steering column.The paddle shifter must be grounded. The black (Pin 3) ground wire has a circular terminal installed on it for installation through a bolt. The bolt should bolt directly into the steering column to provide a clean ground.

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3.3 Install Spacers, Paddle Shifter, and Steering Wheel

The paddle shifter kit includes one ½" spacer and two ¼" spacers. The ½" spacer should be inserted between the wheel and the paddle as shown in Figure 6. The ¼" spacers can be inserted on the front or back of the paddle shifter to set the distances between the steering column, paddle shifter, and steering wheel. Different combinations may be required to accommodate variances in steering wheel dish, steering column controls, and other factors.

After choosing the appropriate combination of spacers, align the installation holes of the spacers, paddle shifter, and steering wheel. Insert the 5 or 6 installation bolts through the holes and thread them into the adapter. The horn button should be removed during installation to provide access to the wiring and paddle shifter connector. Pull the green and white horn wires (with the 90 degree spade terminals installed) through the paddle shifter.

3.4 Connect the Harness to Paddle Shifter and Horn Button

Connect the green wire (Pin 1) on the paddle shifter harness to the ground on the horn button. Connect the white wire (Pin 2) to the horn button switch. Spade terminals have been installed on these wires to simplify installation. Connect the 4-pin harness to the paddle shifter circuit board. The red connector has pin numbers marked. The pin numbers should face the steering wheel and pin 1 should be on the right. The connector should direct all wires to the steering column even though the horn wires are routed to the steering wheel. *Reference Figure 3.4-1.*

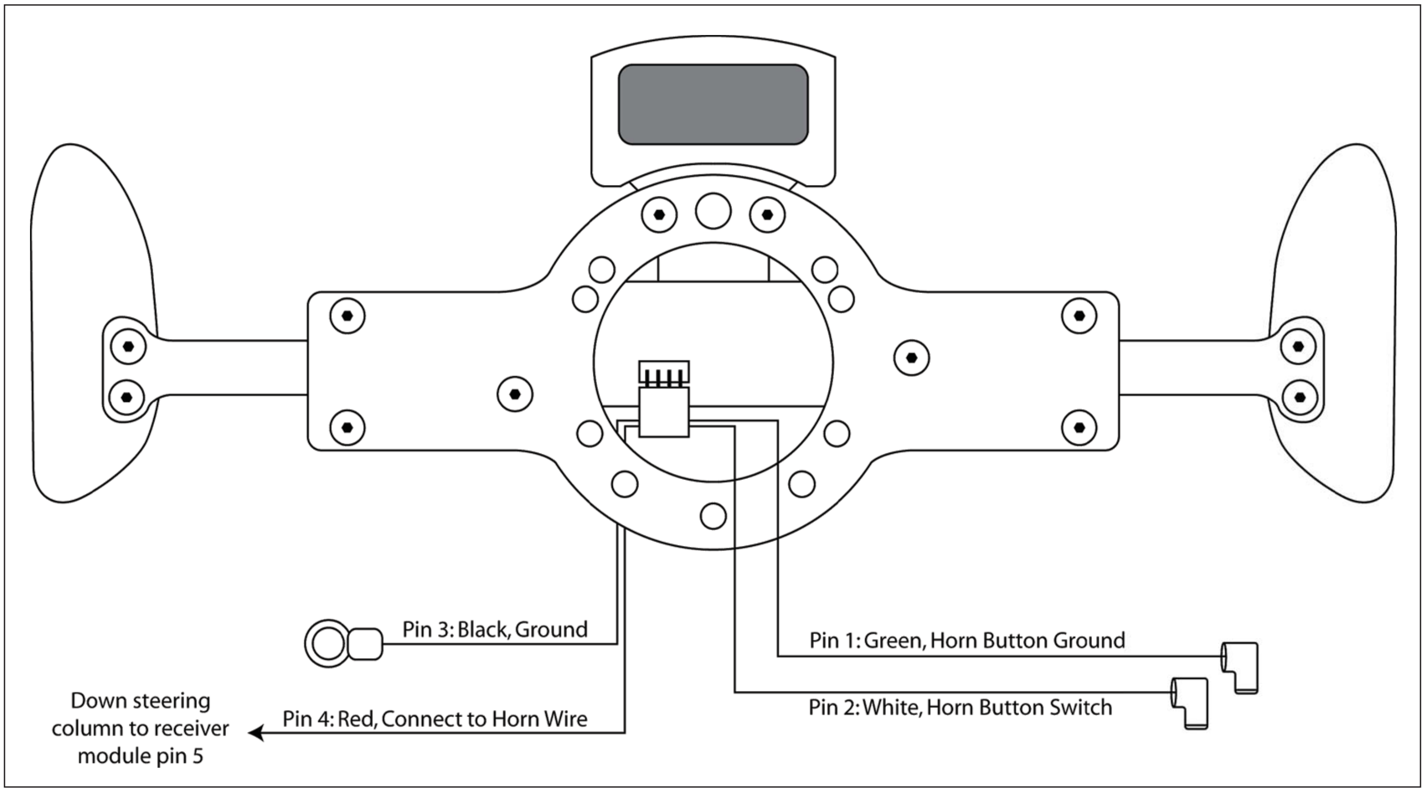

Figure 3.4-1: Paddle Shifter Wiring

4 PCS Transmisssion Controller Setup

The transmission controller must be configured for manual shifting. This includes wiring a switch for simple or true manual mode. Simple manual mode allows the user to set the top gear of the transmission, similar to moving the shifter lever down. In this mode, the transmission will upshift and downshift to the top gear as scheduled in the calibration. In simple manual mode, the transmission will automatically downshift to 1st gear as the vehicle comes to a stop. In true manual mode, the transmission will shift to the gear demanded by the paddles. True manual mode is the mode typically used with paddle shifters. In true manual mode, the transmission will not automatically downshift as the vehicle comes to a stop. It is the responsibility of the driver to downshift to the appropriate gear when the vehicle moves from a stop.

4.1 TCU Configuration using CAN for Shifting and Communication

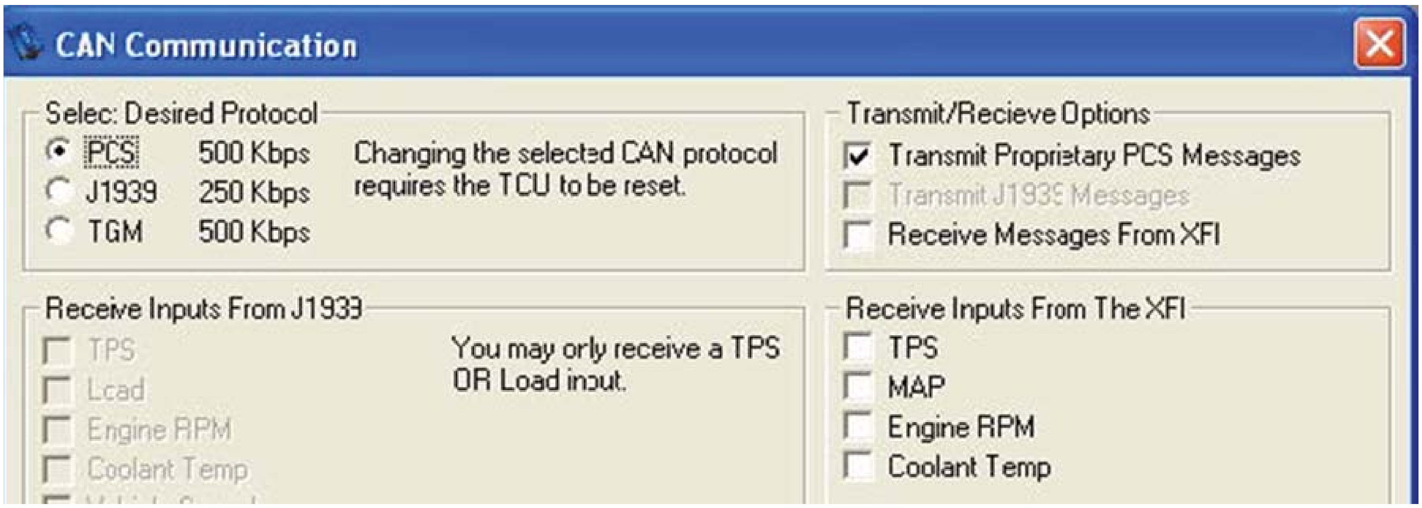

Figure 4.1-1: TCU CAN Configuration

When using CAN to shift, verify that no digital inputs are configured for shifting. Shifting over CAN and the digital inputs may result in inconsistent shifting. Open the digital inputs form from Transmission Setup. Confirm that none of the inputs are set to Upshift or Downshift. Also, check that the input wired to the manual mode switch is defined as True Manual or Simple Manual. In the example shown in **Figure 4.1-2** the true manual switch is an active low (ground) input connected to digital input 7. Note: Gear selects, brake light inputs, and other functions unrelated to manual mode shifting should not be changed from the correct base calibrations. The functions relevant to shifting are Simple Manual Mode, True Manual Mode, Upshift, and Downshift.

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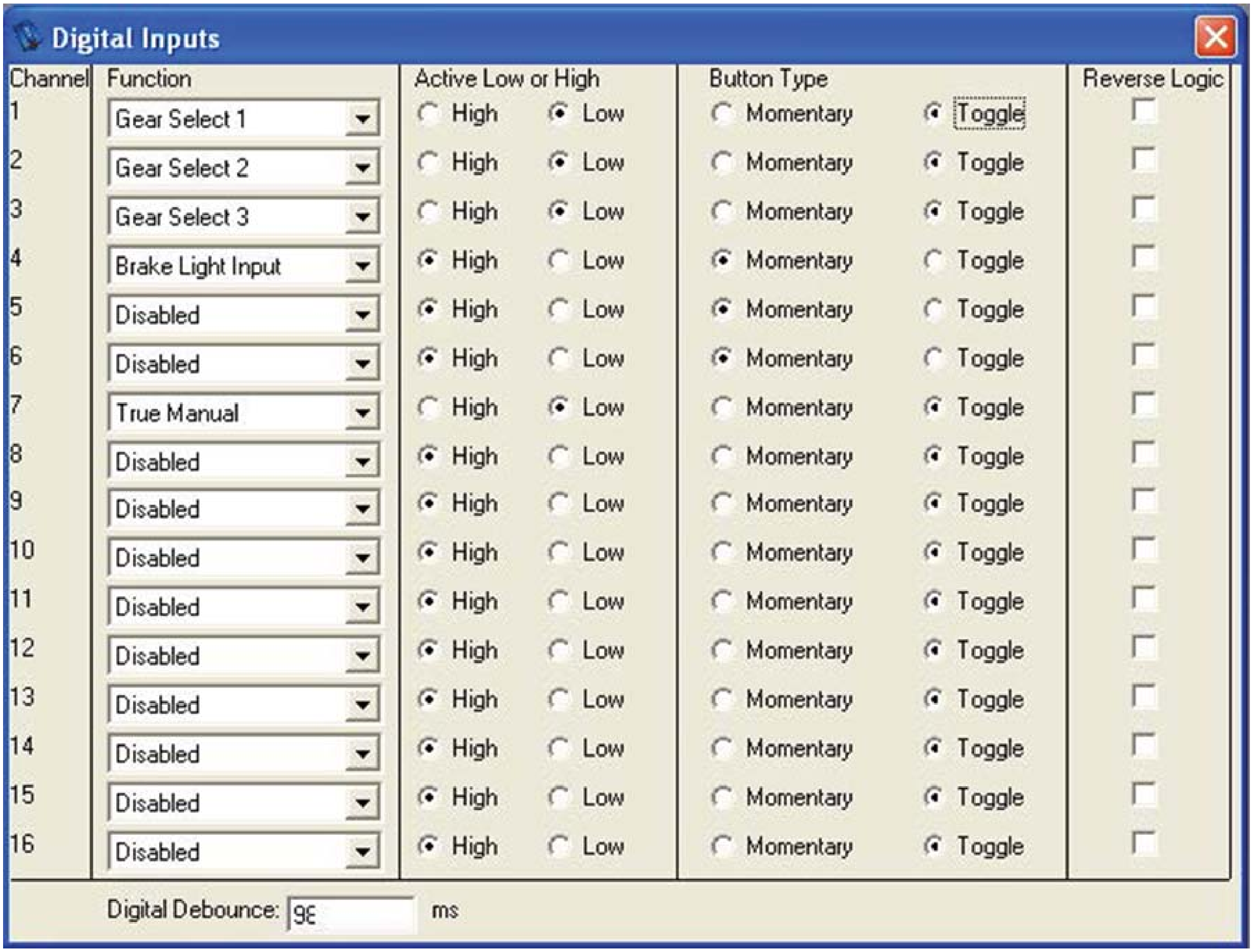

Figure 4.1-2: TCU Digital Input Configuration

4.2 TCU Configuration using Digital Inputs for Shifting

If using CAN to communicate and shift the transmission, skip this section and proceed to Section 5.

Open the digital inputs form from Transmission Setup. Confirm that the input connected to the upshift wire is defined as Upshift. Likewise, confirm that the input connected to the downshift wire is defined as Downshift. Change the functions if they are not configured properly. Also, check that the input wired to the manual mode switch is defined as True Manual or Simple Manual. In the example shown in **Figure 4.2-1**, the true manual switch is an active low (ground) input connected to digital input 7. Upshift is connected to digital input 8 and downshift is connected to digital input 9. The discrete signals from the receiver module are low during a shift so the shift inputs must be configured for active low. Note: Gear selects, brake light inputs, and other functions unrelated to manual mode shifting should not be changed from the correct base calibrations. The functions relevant to shifting are Simple Manual Mode, True Manual Mode, Upshift, and Downshift.

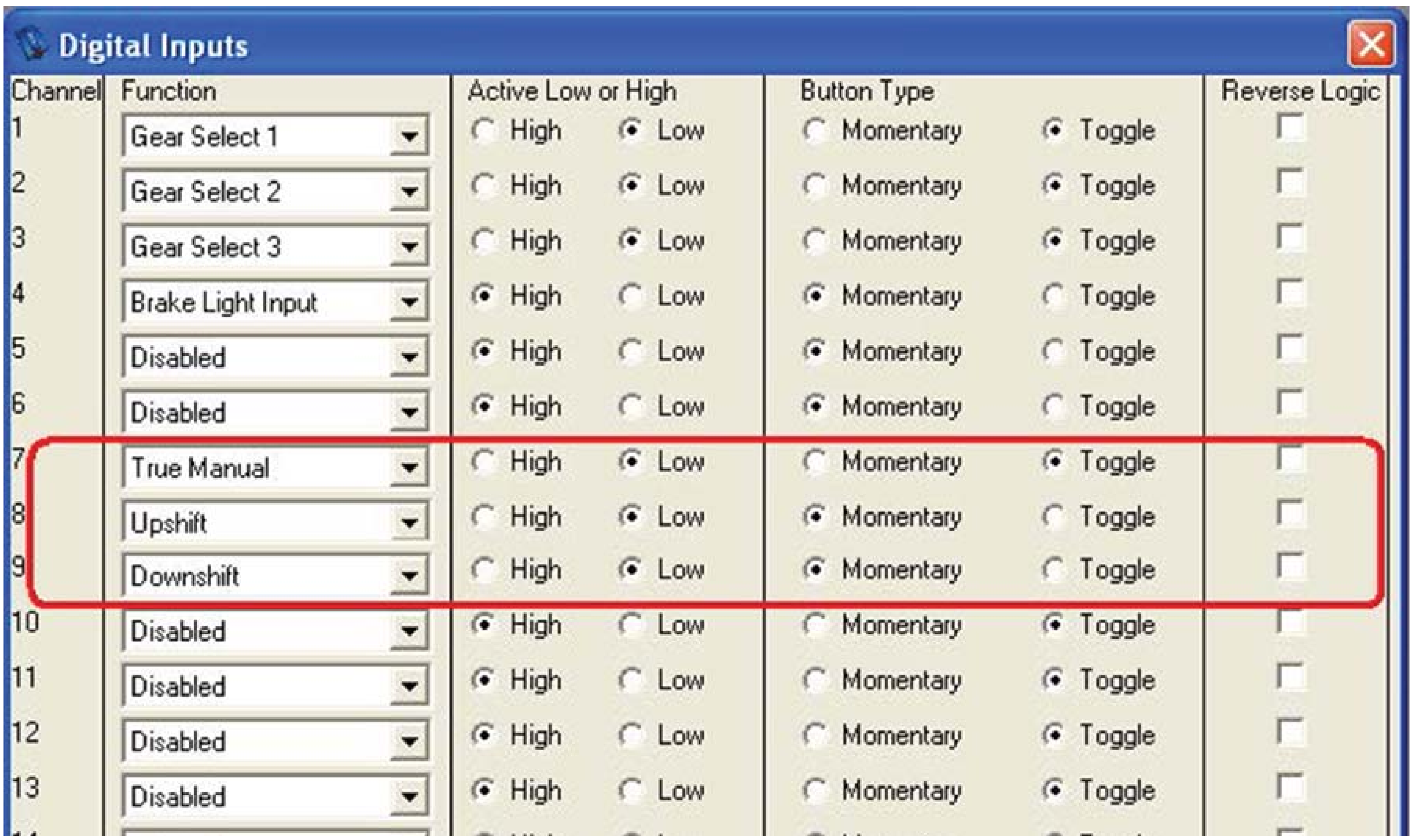

Figure 4.2-1: TCU Digital Input Configuration

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5 Use and Operation

With the key on and the transmission controller in manual mode, pull the right paddle to upshift and the left paddle to downshift. The paddle shifter and transmission controller will begin the shift sequence within milliseconds. Some customers may experience a longer than desired shift delay when using the paddle shifter. The delay in the shift is present when the transmission is shifting automatically, it is just more apparent to the user in manual mode since they are starting and anticipating the shift. Some shifts may feel delayed due to low line pressure, inherent hydraulic delay in the transmission, or shift timers set too long. If the delay is inherent in the transmission, there is nothing electronically that can be done to quicken the shift time. Modification of the valve body or installation of a shift kit may be necessary. In many electronic automatic transmissions, increasing the line pressure during the shift may result in a firmer, faster shift. Shifts that are too firm may damage or wear other driveline components. The programmable shift timers dictate the electronic delay between shifts. These are adjustable in the TCU software. Some transmissions must have a very specific time between shifts for the shift to execute properly.

It is recommended to use the manual mode switch to enable the True Manual Mode and Calibration B digital input function instead of just True Manual Mode in the TCU. This will allow the TCU to have one calibration with normal shifts for driving in automatic mode, and a different calibration with increased line pressure for manual mode.

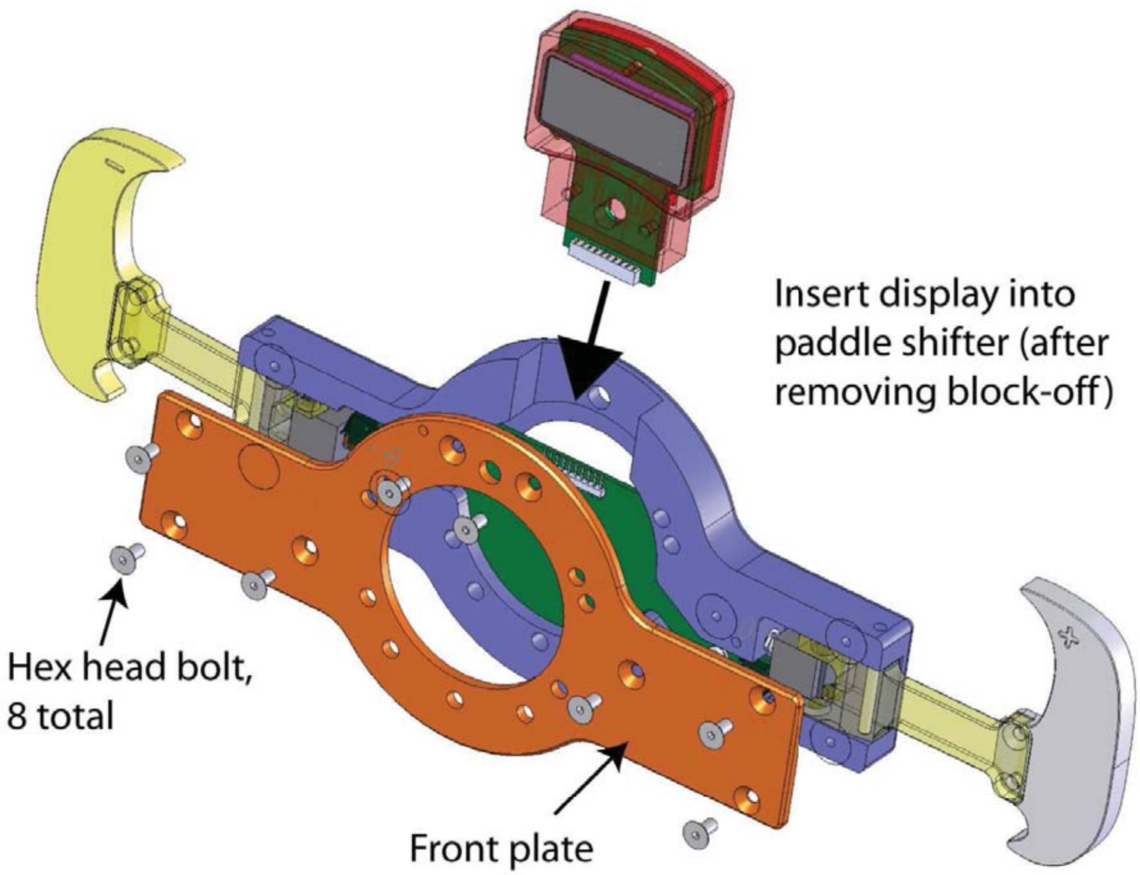
NOTE: Consult your transmission builder or TCU tuner before making any changes to line pressure or shift timers.

6 Multi-Function Display

If the paddle shifter is equipped with the optional multifunction display, a CAN connection to the TCU is required for the functions described in this section.

6.1 Multi-Function Display Installation

If the multi-function display is already installed in to the body of the paddle shifter, skip this section and proceed to Section 6.2. To install a display in to the paddle shifter, begin by removing the paddle shifter from the steering column and unplugging the wiring harness if it is installed in a vehicle. *Reference Figure 6.1-1.*



1. With the paddle shifter lying flat with the front of the paddle shifter facing up, remove the 8 hex head screws.

2. Remove the front plate.

3. Remove the top block-off block that is inserted in the display location.

4. Insert the display into the paddle shifter body. The display's connector should insert into the mating connector on the circuit board. Push the display until the two bolt holes are aligned with the bolt holes on the paddle shifter.

5. Replace the front plate.

6. Insert and tighten the 8 hex head bolts.

7. Install the paddle shifter on the steering as previously described in this manual.

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6.2 Multi-Function Display Operation

When the paddle shifter turns on, it will perform an LED test, and then scroll PCS. It will then display current gear. Pressing the button on the rear of the display will recall the name of the item that is currently monitored. Pressing the button while the name is being scrolled across the screen will cycle through the following items:

- Current Gear
- Throttle Position %
- Vehicle Speed
- Manifold Pressure
- Coolant Temperature
- Transmission Temperature
- TCC Lockup %
- Line Pressure %
- Engine RPM / 10
- Torque Converter Slip
- Transmission Slip
- Driveshaft RPM /10
- Turbine RPM /10
- Lever Position
- Display Off

The units for vehicle speed, manifold pressure, and coolant and transmission temperature are selectable from the TCU software. The current unit selected will be displayed at the end of the item name. During a shift, the display will display current gear for two seconds and then return to the displayed parameter.

7 Troubleshooting

If the paddle shifter is equipped with the optional multifunction display, a CAN connection to the TCU is required for the functions described in this section.

7.1 Troubleshooting Tips

The display resets when the wheel is turned	This is an indication that the wiper in the steering column is losing contact while the steering wheel is turned. This is common in older vehicles. Clean the wiper arm using Scotch-Brite or a similar material. Also check and possibly adjust the tension of the wiper arm.
Horn sounds when installing the horn button into steering wheel or when key is turned on	The white wire on the paddle shifter harness is connected to the horn button ground connector instead of the switch connector. On the horn button, switch the white and green wire.
Transmission shifts but displays “No TCU Found”	The display will display “No TCU Found” when the receiver module does not receive a valid CAN message from the transmission controller. Verify the wiring as discussed in Section 2.2a. Failure to use two termination resistors is a common problem that will result in this situation. Also, verify the CAN setup is configured properly as discussed in Section 4.1.
Slow shifts or delayed shifts	The paddle shifter and the transmission controller will electronically start the shift in a fraction of a second. In most cases, the delay is associated with low line pressure, inherent hydraulic delay in the transmission, or shift timers set too long. Refer to section 4 for a discussion about shift delay.
Transmission will not shift with the paddles	Verify power to the paddle shifter. If the paddle is equipped with the optional display this can be verified by the display turning on. If the paddle shifter is not equipped with the display, measure the voltage between pin 1 and pin 2. If this is approximately 12V (battery voltage) then there is power at the paddle shifter. If power is confirmed at the paddle shifter, check shift communication with the laptop. Connect the laptop to the transmission controller. First verify the transmission controller is in manual mode. This can be seen on the monitor screen in the current modes section as shown in **Figure 7-1** (lower circle). If the manual mode input has been defined as Simple Manual, then the Simple Manual mode should be turned on instead. Then verify the range of the transmission is Drive or a high gear that will allow upshifting.
Display turns on, displays values most of the time, but will occasionally go blank	The display will go blank or display “Wireless Error” when it does not receive a message from the receiver module. If the display only drops out occasionally, the problem is probably related to wireless interference. Move the receiver module closer to the paddle shifter.
Display turns on, scrolls PCS and then goes blank	See Troubleshooting Tip, ***“Display turns on, displays values most of the time, but will occasionally go blank”***
Display shows “Wireless Error” when a paddle is pulled	See Troubleshooting Tip, ***“Display turns on, displays values most of the time, but will occasionally go blank”***

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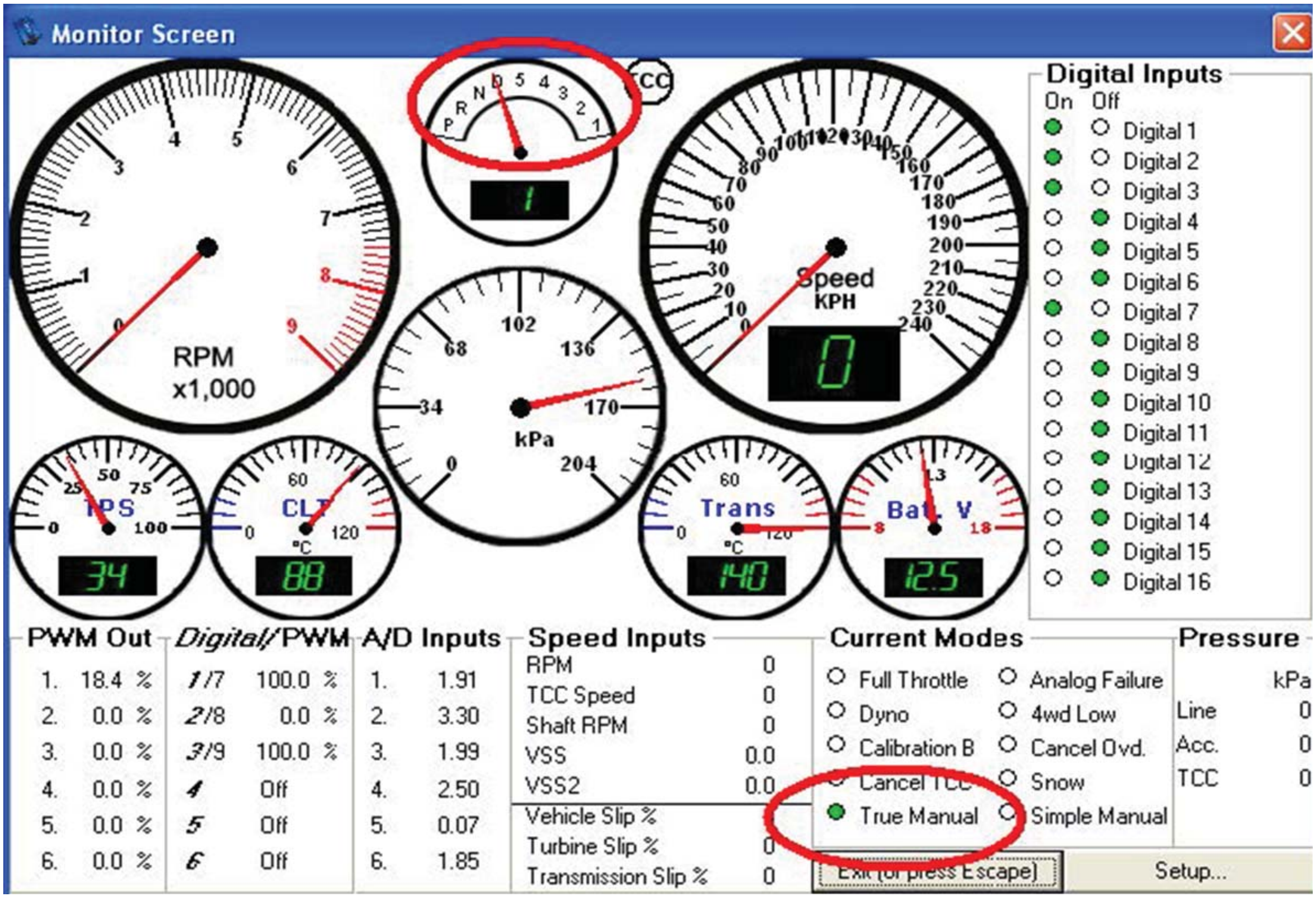

Figure 7-1 - TCU Monitor Screen

7.2 Pairing and Advanced Options

This section is intended only for users who have experienced wireless issues and/or are replacing a receiver module.

To enter the paddle shifter menu, hold the rear button located on the back of the display and pull the right paddle. The menu screen should scroll across the display.

MENU ENTRIES	
(1) Normal Operation	As defined by the Paddle Shifter manual.
(2) Show Wireless Channel	As “Normal Operation” but with wireless channel number displayed in right-most 5x7 LED panel.
(3) View Receiver Number	Displays the serial number of the Receiver Module that this Paddle Unit is paired with
(4) Change Receiver Number	Change the serial number of the Receiver Module that this Paddle Unit is paired with. This is used when the Receiver Module is not available for automatic pairing. Use: After selecting this option, the current number is scrolled from right to left, stopping in digit-selection mode on the least-significant-digit (right-most). Pressing the left paddle selects the next digit to the left, while pressing the right paddle selects the next digit to the right. The selected digit is scrolled to the center of the display. Pressing the rear button allows the selected digit to be edited. When editing, only the selected digit is displayed, the left paddle decreases the digit by 1, and the right paddle increases the digit by 1 (zeros are low, and the value will not wrap-around at 0 or 9). Pressing the rear button again will return to the digit-selection mode. After setting all digits to the desired value, pulling both paddles together (hold for over 1 second) will exit the edit menu. If the number was changed, the save query is scrolled, followed by the display of “N Y”. Pulling the left paddle selects “N” and discards the new Receiver Module serial number. Pulling the right paddle selects “Y” and saves it.
(5) Find Receiver Modules	Change the serial number of the Receiver Module that this Paddle Unit is paired with by scanning the vicinity for Receiver Modules and allowing the operator to select the correct module to pair with. This is used when the Receiver Module is available and transmitting. Use: After selecting this option, scanning begins and will continue until this mode is exited. While scanning, the display scrolls one of the serial numbers found. Pressing the left paddle selects the previous serial number in the list, while pressing the right paddle selects the next serial number. When the appropriate serial number is selected, pulling both paddles together (hold for over 1 second) will exit the edit menu, saving the selection.

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MENU ENTRIES CONT'D

(6) Broad Spectrum Energy	This option brings up a bar-chart of wireless activity across the 2.4 MHz spectrum as sub-divided for Zigbee use. Each of the 15 LED columns represents a Zigbee channel (a 16th channel is not displayed), and the number of LEDs illuminated in a column represent average channel activity during a sample period. Only one channel can be sampled at a time, and channels are sampled sequentially. To improve resolution of a specific set of channels, the channels that are scanned can be reduced. The top channel (right-most) can be set with the right paddle, and the bottom channel (left-most) can be set with the left paddle. The rear button resets the top and bottom channels. To exit and return to the menu, hold rear button and pull right paddle.
(7) Narrow Spectrum Energy	As "Broad Spectrum Energy" but only 1 channel. This mode displays the relative channel number on the left, and illuminates the remaining LEDs to indicated average channel activity during a sample period. As only one channel is sampled, the resolution is higher than on the Broad Spectrum Energy display, and this increased resolution is utilized with 52 LEDs. The 16 available channels are referred to by the values 0-9 and A-F. The paddles select which channel to display. To exit and return to the menu, hold rear button and pull right paddle.

Wireless Interference and Channel Hopping:
When wireless interference is detected, the Receiver Module will scan for the least busy channel to connect to. When the Paddle Unit loses communication with the Receiver Module, it sequentially scans all channels until it detects the Receiver Module. Cell phones, network routers, and laptops are common sources of interference.

LIMITED WARRANTY STATEMENT. Powertrain Control Solutions, LLC. Warrants all merchandise against defects in factory workmanship and materials for a period of 12 months after purchase. This warranty applies to the first retail purchaser and covers only those products exposed to normal use or service. Provisions of this warranty shall not apply to Powertrain Control Solutions, LLC. Product used for a purpose for which it is not designed, or which has been altered in any way that would be detrimental to the performance or life of the product, or misapplication, misuse, negligence or accident. On any part or product found to be defective after examination by Powertrain Control Solutions, LLC., Powertrain Control Solutions, LLC. will only repair or replace the merchandise through the original selling dealer or on a direct basis. Powertrain Control Solutions, LLC. assumes no responsibility for diagnosis, removal and/or installation labor, loss of vehicle use, loss of time, inconvenience or any other consequential expenses. The warranties herein are in lieu of any other expressed or implied warranties, including any implied warranty of merchantability or fitness, and any other obligation on the part of Powertrain Control Solutions, LLC., or selling dealer.