Spartan 4 Spoke Controller Troubleshooting Guide

It is strongly recommended that this guide be read completely through prior to starting work. Doing so will speed diagnosing and repairing problems and help prevent damage to the Spartan Controller and related systems.

PRODUCT DESCRIPTION

The Spartan Controller 4 Spoke Steering Wheel Control System offers control of the horn, headlamp and marker lamp flash, cruise control, and wiper functions from switches mounted in the steering wheel. The system consists of two components: the Steering Wheel and the Spartan Controller. Communication and power between the Steering Wheel and the Spartan Controller is accomplished via four wires. As each switch is closed, the Steering Wheel generates a unique signal that is transmitted to the Spartan Controller. The Spartan Controller decodes the signals to determine which switch is closed and operates the corresponding outputs for that function. This circuit can also be configured for operation to run a 2 spoke wheel as well. The configuration is predetermined at the factory by selecting an on board solder jumper in on of 3 locations. The locations are labeled V00 (original 2 spoke compatibility), V04 (4 Spoke non memory) and V44 (4 Spoke memory). Along with the jumper selection the proper connector locations need to be populated. The P4 is for V00 operation and P2 is for V04 and V44 operation.

HOW IT WORKS

Functions on the Steering Wheel are either momentary or latching. The HORN, HEADLAMP FLASH, CRUISE CANCEL, CRUISE RESUME, CRUISE SET, MARKER LAMP FLASH, and WIPER WASH switches operate in the momentary mode and the corresponding outputs on the Spartan Controller are only operated while the switch is pressed. The CRUISE ON/OFF, WIPER OFF, WIPER HI/LO, and WIPER VARIABLE switches operate in the latching mode and the corresponding outputs on the Spartan Controller remain actuated until the corresponding CRUISE OFF, or WIPER OFF switch is pressed or the Ignition input on the Spartan Controller is turned off. The WIPER HI/LO switch has the additional feature that initially when the switch is pressed the wipers operate in the low speed mode and additional operations of the switch cause the wipers to alternate from the high to low speed modes. There are also a number of automatic features that go on in the background.

An operational description of each function is as follows:

HORN – When the horn pad is actuated, the Steering Wheel will send the appropriate signal to the Spartan Controller to cause the HORN output (P7.11) to be switched to HORN SRC (P7.12) while the switch is pressed.

HEADLAMP FLASH - Operation of this function relies on external switching for the headlamp function. If +12V is present at the HEADLAMP SWITCH input (P1.3), HEADLAMP SOURCE (P3.4) power will be removed from the HEADLAMP POWER output (P3.3) while the Headlamp Flash switch is pressed. If HEADLAMP SWITCH input (P1.3) is low, power will be applied to LOW BEAM POWER (P5.2) while the Headlamp Flash switch is pressed. If the IGNITION (P1.6) signal is present, power will be applied to LOW BEAM POWER (P5.2) until the Headlamp Flash switch is pressed. The result is that if the headlamps are turned on by either the HEADLAMP SWITCH or the IGNITION signal, pressing the switch will cause them to go off. If the headlamps are turned off, power will be applied at LOW BEAM POWER (P5.2).

MARKER LAMP FLASH - Operation of this function relies on external switching for the marker lamp function. If +12V is applied to the MARKER SWITCH input (P1.11), MARKER SOURCE power (P3.1) will be removed from the MARKER LAMP POWER output (P3.2) while Marker Lamp switch is pressed. If the MARKER SWITCH input (P1.11) is low, MARKER SOURCE power (P3.1) will be applied to MARKER LAMP POWER output (P3.2) while the Marker Lamp switch is pressed. The result is that if the marker lamps are turned on, pressing the Marker Lamp switch will cause them to go off. In like manner, if the marker lamps are turned off, pressing the Marker Lamp switch will cause them to go on.

CRUISE FUNCTIONS:

The cruise control relays share a common connection. This is on CRUISE COMMON (P1.12). This will connect to the common connection of the cruise control circuit. This allows the user to use a common ground or a common +12V system. In accordance with many of the cruise control system manufacturer's requirements, these relays are "dry-circuit" rated with gold plated contacts rated at 1 Amp maximum at 12Vdc.

CRUISE ON/OFF - Operation of this switch toggles the CRUISE ON/OFF RELAY contact (P1.1) to open if it's closed or close if it's open the connection to CRUISE COMMON (P1.12) at the time the switch is pressed.

CRUISE SET - Operation of this switch operates the Cruise Set relay while the switch is pressed. This causes the CRUISE SET contact (P1.9) to close a connection to CRUISE COMMON (P1.12) while the Cruise Set switch is pressed.

CRUISE RESUME - Operation of this switch operates the Cruise Resume relay while the switch is pressed. This causes the CRUISE RESUME contact (P1.10) to close a connection to CRUISE COMMON (P1.12) while the Cruise Resume switch is pressed.

CRUISE CANCEL - Operation of this switch operates the Cruise Cancel relay while the switch is pressed. This causes the CRUISE CANCEL contact (P1.2) to open a connection to CRUISE COMMON (P1.12) while the Cruise Cancel switch is pressed.

WIPER FUNCTIONS:

The control circuitry utilizes dynamic braking on the wiper motors to eliminate motor coasting. The connection for wiper motors and wash pump is all done through P7. The WIPER SOURCE power is on (P5.3). The ground connection for the wiper motors should be made to the case of each wiper motor - not to the ground wire coming from the Spartan Controller (P7.1).

WIPER WASH - Operation of this switch activates the wash pump relay while the switch is pressed, causing the Wash Pump output (P7.10) to be connected to WIPER SOURCE power (P5.3). In addition, if none of the latching wiper functions (Wiper Lo/Hi or Wiper Delay) had been previously selected, the LOW Speed Wiper outputs (P7.2 & P7.6) will be connected to WIPER SOURCE power (P5.3) while the switch is pressed and remain connected for a period of approximately 5 seconds after the switch is released. If any of the latching wiper functions (Wiper Lo/Hi or Wiper Delay) had been previously selected, the wipers will continue to run in the selected mode after the wash switch is released.

WIPER LO/HI - Operation of this switch initially causes the LOW Speed Wiper outputs (P7.2 & P7.6) to be connected to WIPER SOURCE power (P5.3) continuously. If the switch is pressed again the HI Speed Wiper outputs (P7.3 & P7.9) will be connected to WIPER SOURCE power (P5.3) continuously. Subsequent presses of this switch will cause alternate operation of the wipers in the low or high-speed mode.

WIPER VARIABLE - Operation of this switch initially causes the LOW Speed Wiper outputs (P7.2 & P7.6) to be connected to WIPER SOURCE power (P5.3) for one wipe. If the switch is pressed again within approximately 25 seconds, the Low Speed Wiper function will be activated again and will repeat at the interval determined by the time between the two operations of the switch. If the switch is pressed again a new timing cycle will begin and the next press of the switch will set the new interval. If the switch is not pressed again the delay will default to 25 second intervals after waiting 50 seconds. Activation of any other wiper mode cancels the variable mode. The effect for the driver is thus: In light rain or mist conditions the driver presses the switch once when the windshield first needs clearing. When the windshield again requires clearing the driver presses the button again - setting the time period between subsequent wipes to that required by current conditions. If a new timing is desired – longer or shorter – the driver presses the switch once and waits till the next wipe is desired and presses it again. Pressing the switch before the first full wipe is complete causes the wiper to operate in continuous low mode.

WIPER OFF - Operation of this switch causes all operation of the wipers to be canceled. This mode is also entered any time that +12Vdc power is removed from the IGNITION (P1, 6) signal on the Spartan Controller.

AUTOMATED FEATURES –

HEADLAMP CONTROL – The DRL circuit will apply output to LOW BEAM POWER (P5.2) whenever there is +12Vdc power on IGNITION (P1, 6) and on the PARK BRAKE SIGNAL (P1.14) and no +12Vdc power is on HEADLAMP (P1.3) input. At any time if the HEADLAMP (P1.3) input has +12Vdc on it the DRL circuit will turn off if already on and HEADLAMP POWER (P3.3) will be connected to HEADLAMP SOURCE (P3.1). If while in DRL mode both low beam Headlights fail the module will switch the DRL circuit output to HIGHBEAM POWER (P5.1). This will only reset when +12Vdc power on IGNITION (P1, 6) is removed. The effect for the driver is that any time the vehicle is running and the park brake is released the DRL will be on unless the driver has selected to have the headlights on. The DRL circuit will divert its power to the high beams if for some reason both low beam headlamps fail.

WIPER CONTROL – The wiper circuits consider the wiper parked when the PARK (P7.5 & P7.8) signal is not connected to +12Vdc. Whenever there is +12Vdc power on IGNITION (P1, 6) the wiper control circuit will attempt to park the wipers. If the PARK (P7.5 & P7.8) signal is connected to +12Vdc the wipers will not find park and will continue running for 30 seconds. At that time the wiper circuit will remove WIPER SOURCE power (P5.3) from the appropriate wiper output. After that whenever the LO or HI speed mode of operation is on the wiper will be on and off when it is turned off. The effect for the driver is if a wiper motor has a defective park switch or connection problem it will not continue to run all the time until a proper repair is made.

SYSTEM INTERCONNECTIONS:

STEERING WHEEL:

This control is made to operate 2 different types of steering wheels. One has 2 spokes and the other has 4 spokes. In this document they will be referred to as 2 SPOKE and 4 SPOKE. Both types of wheels have versions that support a memory system which controls positioning of the driver seat, mirrors, steering wheel positioning and foot pedal position. On the 2 SPOKE version there is little concern in this document because the differences are only in the digital signal that is connected directly to the memory system externally. The 4 SPOKE however has different internal circuitry which feeds this circuit with 2 DC levels one each on P2-1 and P2-2. These voltages are interpreted and then fed to the onboard circuitry and to the external memory system if it is a memory version of the 4 SPOKE wheel. The voltages on P2-1 and P2-2 are different between the non memory version and the memory version. To verify which version you have examine the outward sides of the pods on the steering wheel for switch controls that operate when pushing back or pulling forward. If present, this is a 4 SPOKE wheel with memory.

Confirm that the Spartan 4 SPOKE controller is configured properly to operate the wheel on the system. The configuration is predetermined at the factory by selecting an on board solder jumper in on 1 of 3 locations. The locations are labeled V00 (original 2 spoke compatibility), V04 (4 Spoke non memory) and V44 (4 Spoke memory). Along with the jumper selection the proper connector locations need to be populated. The P4 is for V00 operation and P2 is for V04 and V44 operation.

The clock-spring is a device in the steering column that allows continuous electrical connections through the rotation of the column without sliding contacts.

Note: Clock-springs can be damaged if they are not handled and installed properly. Before performing any service involving removing the steering wheel from the column, consult a service manual for information on maintaining proper centering of the clock-spring. Do not rotate the parts of a clock-spring except as directed by the appropriate service manual. Failure to follow the proper procedure can result in the clock-spring being damaged although the damage may not be immediately apparent.

SPARTAN CONTROLLER:

Note: The wiring diagram supplied with this guide is the recommended method of implementing the Spartan Controller system. Individual chassis and coach manufacturers may choose to connect or implement part or all of the system differently than illustrated here.

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GENERAL TIPS:

General handling precautions: Electronics are sensitive to static electrical discharge. Handle them as little as possible. They are most safe from damage when they are in the package or when they are installed and connected in the vehicle.

The most common problem with any electrical device is usually related to interconnections: wires and connectors.

1. If the system does not function properly the first thing to check is that all connectors and wires are properly installed and fully seated making good contact.

2. If the system is partially functional, i.e., the horn, cruise and lights work but the wipers do not then the problem is likely not with the multiplex system but with the wiring between the Spartan Controller and the wipers or the wiper system itself.

3. If the system is completely nonfunctional, start by checking the power, ground and wiring to the Spartan Controller and from the Spartan Controller to the Steering Wheel.

4. If the system functions intermittently, the problem is almost certainly with the wiring in general or with connections in the steering column.

EQUIPMENT REQUIRED:

- A Digital Volt/Ohm-meter with an audible continuity check.
- A low current (less than 0.5 Amp) 12 Volt test light.

INITIAL IN-VEHICLE TESTS:

Proceed with these in the order in which they are listed prior to attempting any other in-vehicle tests.

- The ignition key should be in the "OFF" position until directed otherwise.
- Disconnect connectors P3, P5 and P7 from the Spartan Controller.
- Make sure that +12Vdc power is present at P1.4 on the Spartan Controller. If not present, check the supply fuses or breakers and wiring.

IN-VEHICLE TESTS:

Perform the above Initial In-Vehicle Tests before attempting to perform these tests. Select these by function if problems are observed with a particular function. Make sure that connectors P3 and P7 are disconnected from the Spartan Controller. Make sure the park brake is on.

1. For 4 SPOKE wheel go to step 5. For 2 SPOKE wheel go to step 2.
2. 2 SPOKE ONLY - Measure the DC voltage on MULTIPLEX SIGNAL (P4.1) the Spartan Controller. It should measure in the range of 5-10 Volts. If it doesn't check continuity between P4.2 and chassis ground. If it does exist, unplug P4 and check the pin on the controller P4.1 for .7 Volts below the reading on P1.4. If no voltage is present replace the Spartan Controller. Plug P4 in.
3. 2 SPOKE ONLY - Remove the center pad from the Steering Wheel and disconnect the Steering Wheel from the clock-spring. The center pad can be removed by loosening a 5 mm Allen head screw that is accessible through a hole on the bottom of the Steering Wheel below the horn bar. The Allen head screw does not have to be completely removed for the center pad to be released. It is not necessary to remove the Steering Wheel from the column for these tests.
4. 2 SPOKE ONLY - Measure the DC voltage between the wires in the column that were connected to the yellow and brown wires on the Steering Wheel. It should also measure in the range of 5-10 Volts. If it

doesn't, check the wiring in the column and to the Spartan Controller for continuity. If it does, reconnect the Steering Wheel to the column wiring. Go to step 9.

5. 4 SPOKE ONLY – Turn on the ignition. Measure the +12Vdc to be present at IGNITION (P1.6). If its not check your IGNITION wiring. The voltage on IGNITION +5V (P2.4) can vary a bit from controller to controller but the on board circuitry takes this into account. For this guides purposes we will use +5 Volts. Measure the DC voltage on IGNITION +5V (P2.4) the Spartan Controller. It should measure very near 5 Volts. If it is, plug P2 in and go to step 6. If it isn't, check continuity between P1.3 and chassis ground. If it continuity does exist, unplug P2 and check the pin on the controller P2.4 for 5Volts. If no voltage is present replace the Spartan Controller. If voltage is present something in the 4 SPOKE wheel and wiring to it is loading the signal down when plugged in. The trouble is in the wiring and or the button board and its wiring. Remove cover that also acts as the horn pad. It is designed to just pull off by hand. Plug P2 in and unplug the plug under the horn pad that connects the clock spring wires to the button circuits. If +5Volts is not on P2.4 then there is a problem with the wiring between the button board and P2. If +5Volts is present then something is wrong with the button board or its wiring. Most likely a short to ground.

6. 4 SPOKE ONLY – Check button operations. Probe P2.1 (J1) and then P2.2 (J2) without any button pressed. The voltage should be +4.75 – 5 Volts. This voltage will track a bit lower then the voltage on IGNITION +5V (P2.4) but should read near 5 Volts. Now while measuring P2.1 (J1) press several buttons to verify this voltage is varying. Repeat for P2.2 (J2). Both voltages should make a change in level when pressing any button. If not check continuity to the button board inside the wheel. If continuity is good then steering wheel button board needs replaced.

7. 4 SPOKE ONLY – To go a step further and make sense of the voltages versus a button press you can refer to the appropriate chart for the version of steering wheel installed. This step may be helpful if only one function isn't working and the button is suspect. Identification of what steering wheel you have is described earlier in this guide. The charts show a Switch Level assigned to a number for J1 and J2. The truth table shows which Switch Level should exist on J1 and J2 during any button operation. Keep in mind these levels are referenced to the on IGNITION +5V (P2.4) and if it is above 5 Volts the readings will all be above nominal by a proportional amount. The horn switch has no number assigned but a voltage assigned.

8. 4 SPOKE ONLY – Turn off IGNITION. Measure P2.1 (J1) and P2.2 (J2). It should be near 5 Volts. Press HORN pad. The voltage should read between 0-0.5Volts. This test should work if you have made it this far in the guide successfully. When the IGNITION is off the Spartan Controller provides a voltage out put on P2.2 (J2) which will apply power for P2.1 (J1) to be pulled up. Failure here could be either the Spartan controller or the steering wheel. If you have 5 Volts on P2.2 (J2) and no change on P2.1 (J1) most likely it is the button boards inside the wheel.

9. Continue to the HORN TEST.

HORN TEST - Connect to check continuity between HORN SOURCE (P7.12) and HORN (P7.11) on the Spartan Controller. Press the HORN bar on the Steering Wheel and continuity should exist. If it doesn't, the Horn output on the Spartan Controller is damaged (replace the Spartan Controller). For the Lamp Flash tests below, the IGNITION Switch on the vehicle should be turned to the accessory or run position, causing +12Vdc to be present at IGNITION (P1.6) on the Spartan Controller.

HEADLAMP "OFF" TEST - With no switches pressed on the Steering Wheel and the dash Headlamp switch off, check for continuity between HEADLAMP SOURCE P3.4 on the Spartan Controller and HEADLAMP POWER P3.3. If continuity does exist, the headlamp "off" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

HEADLAMP "ON" TEST - While the HEADLAMP FLASH switch on the Steering Wheel is pressed and the dash Headlamp switch off, check for continuity between HEADLAMP SOURCE P3.4 on the Spartan Controller and HEADLAMP POWER P3.3. If continuity does not exist, the headlamp "on" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

MARKER LAMP "OFF" TEST - With no switches pressed on the Steering Wheel and the dash Marker switch off, check for continuity between MARKER SOURCE P3.1 on the Spartan Controller and MARKER LAMP

POWER P3.2. If continuity does exist, the marker lamp "off" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

MARKER LAMP "ON" TEST – With the MARKER LAMP FLASH switch on the Steering Wheel pressed and the dash Marker switch off, check for continuity between MARKER SOURCE P3.1 on the Spartan Controller and MARKER LAMP POWER P3.2. If continuity does not exist, the marker lamp "on" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

For the CRUISE and WIPER tests below, the IGNITION Switch on the vehicle should be turned to the accessory or run position, causing +12Vdc to be present at IGNITION P1.6 on the Spartan Controller. On earlier versions the Park Brake must be off for some of the cruise functions to activate. Exercise safety precautions when turning off the Park Brake. The PARK BRAKE SIGNAL (P1.14) must be +12Vdc to signal the Spartan Controller that the Park Brake is off.

CRUISE "ON/OFF" TEST - Momentarily press the CRUISE "ON/OFF" switch on the Steering Wheel. Because this is a toggling function, the function should toggle after each time the switch is pressed. Check continuity between CRUISE ON/OFF RELAY contact (P1.1) and CRUISE COMMON (P1.12) at the time the switch is pressed. If continuity does not toggle, the cruise "ON/OFF" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

CRUISE "SET" TEST - With the CRUISE "SET" switch on the Steering Wheel not pressed check for continuity between CRUISE SET contact (P1.9) and CRUISE COMMON (P1.12) on the Spartan Controller. If continuity does exist, the cruise "SET" circuitry on the Spartan Controller is damaged (replace the Spartan Controller). While the CRUISE "SET" switch on the Steering Wheel is pressed check for continuity between CRUISE SET contact (P1.9) and CRUISE COMMON (P1.12). If continuity does not exist, the cruise "SET" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

CRUISE "RESUME" TEST - With the CRUISE "RESUME" switch on the Steering Wheel not pressed check for continuity between the CRUISE RESUME contact (P1.10) and CRUISE COMMON (P1.12). If continuity does not exist, the cruise "RESUME" circuitry on the Spartan Controller is damaged (replace the Spartan Controller). While the CRUISE "RESUME" switch on the Steering Wheel is pressed check for continuity between CRUISE RESUME contact (P1.10) and CRUISE COMMON (P1.12). If continuity does not exist, the cruise "RESUME" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

CRUISE "CANCEL" TEST - With the CRUISE "CANCEL" switch on the Steering Wheel not pressed check for continuity between CRUISE CANCEL contact (P1.2) and CRUISE COMMON (P1.12). If continuity does not exist, the cruise "CANCEL" circuitry on the Spartan Controller is damaged (replace the Spartan Controller). While the CRUISE "CANCEL" switch on the Steering Wheel is pressed check for continuity between CRUISE CANCEL contact (P1.2) and CRUISE COMMON (P1.12). If continuity does exist, the cruise "CANCEL" circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

WIPER "WASH" TEST - While the WIPER "WASH" switch on the Steering Wheel is pressed, check for the presence of +12Vdc WIPER SOURCE (P5.3) at WASH PUMP (P7.10). If +12Vdc WIPER SOURCE (P5.3) is not present at WASH PUMP (P7.10). The wash pump output circuitry on the Spartan Controller is damaged (replace the Spartan Controller). In addition, check for the presence of +12Vdc WIPER SOURCE (P5.3) at P7.2 and P7.6. If +12Vdc WIPER SOURCE (P5.3) is not present, the low speed wiper wash circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

WIPER "LO/HI" TEST - Momentarily press the WIPER "LO/HI" switch on the Steering Wheel. Because this is a latching function, the function should remain active after the switch is released. Check for the presence of +12Vdc WIPER SOURCE (P5.3) at P7.2 and P7.6 on the Spartan Controller. If +12Vdc WIPER SOURCE (P5.3) is not present, the continuous low speed wiper circuitry on the Spartan Controller is damaged (replace the Spartan Controller). Momentarily press the WIPER "LO/HI" switch again and check for the presence of +12Vdc WIPER SOURCE (P5.3) at P7.3 and P7.9 on the Spartan Controller. If +12Vdc is not present, the continuous high-speed wiper circuitry on the Spartan Controller is damaged (replace the Spartan Controller). Subsequent presses of this switch will cause alternate presence of +12Vdc WIPER SOURCE (P5.3) at the low speed (P7.2 and P7.6) or high-speed (P7.3 and P7.9) outputs on the Spartan Controller.

Connector	Plugged in or unplugged	Pin Location/ Wire	Ignition key on or off	Meter Setting	Test Performed	Desired Result
P1	Unplugged	Pin 4	Off	VDC	Red lead back probed on pin, Black lead touching ground	Battery voltage
P1	Unplugged	Pin 6	On	VDC	Red lead back probed on pin, Black lead touching ground	Battery voltage
P1	Unplugged	Pin 5	Off	OHMS	Red lead back probed on pin, Black lead touching negative battery post	0.0-0.5 Ohms
P7	Unplugged	Pin 1	Off	OHMS	Red lead back probed at pin, Black lead touching known good ground	0.0-0.5 Ohms
P2	Unplugged	Pin1 and pin2	Off	OHMS	Red lead back probed at pin 1, Black lead back probed at pin 2	OL
P2	Unplugged	Pin1	Off	OHMS	Red lead back probed at pin, Black lead touching known good ground	OL
P2	Unplugged	Pin 2	Off	OHMS	Red lead back probed at pin, Black lead touching known good ground	OL
P2	Unplugged	Pin 1	Off	OHMS	Red Lead back probed at controller connector, Black lead back probed at steering wheel connector (unplug from steering wheel)	0.0-0.7 Ohms
P2	Unplugged	Pin 2	Off	OHMS	Red Lead back probed at controller connector, Black lead back probed at steering wheel connector (unplug from steering wheel)	0.0-0.7 Ohms
P2	Plugged in	Pin 1	On	VDC	Red lead back probed at pin, Black lead touching known good ground, perform attached voltage touch function test	Follow attached result sheet for corresponding controller
P2	Plugged in	Pin 2	On	VDC	Red lead back probed at pin, Black lead touching known good ground, perform attached voltage touch function test	Follow attached result sheet for corresponding controller

V04 Truth Table Voltages	P2.1 (J 1) Voltage Range	J 1 actual data	P2.2 (J 2) Voltage Range	J 2 actual data
press the listed smart wheel button while measuring voltage on (J 1), then (J 2) - **record voltage readings in column provided**	*Voltages based on 5.0 V supply*	⇩	*Voltages based on 5.0 V supply*	⇩
Voltage on circuit no buttons pressed **with ignition on**	4.75 to 5.0 V		4.75 to 5.0 V	
Cruise Resume	3.099 to 4.623 V		3.475 to 4.061 V	
Cruise Set	3.099 to 4.623 V		2.776 to 3.098 V	
Cruise Cancel	3.099 to 4.623 V		2.161 to 2.531 V	
Cruise ON	2.068 to 2.444 V		3.475 to 4.061 V	
Headlamp ON	2.068 to 2.444 V		2.776 to 3.098 V	
Marker	0.831 to 1.06 V		2.776 to 3.098 V	
Wiper Variable	1.251 to 1.51 V		3.475 to 4.061 V	
Wiper Wash	1.251 to 1.51 V		2.776 to 3.098 V	
Wiper OFF	1.251 to 1.51 V		2.161 to 2.531 V	
Wiper High	0.831 to 1.06 V		3.475 to 4.061 V	
Horn	0 to 0.5 V		1.575 to 1.838 V	

V44 Truth Table Voltages	P2.1 (J 1) Voltage Range	J 1 actual data	P2.2 (J 2) Voltage Range	J 2 actual data
press the listed smart wheel button while measuring voltage on (J 1), then (J 2) - **record voltage readings in column provided**	*Voltages based on 5.0 V supply*	⇩	*Voltages based on 5.0 V supply*	⇩
Voltage on circuit no buttons pressed **with ignition on**	4.75 to 5.0 V		4.75 to 5.0 V	
Cruise Resume	2.899 to 3.211 V		4.16 to 4.443 V	
Cruise Set	2.899 to 3.211 V		3.637 to 3.944V	
Cruise Cancel	2.899 to 3.211 V		3.197 to 3.503 V	
Cruise ON	2.899 to 3.211 V		2.605 to 2.899 V	
Headlamp ON	2.899 to 3.211 V		2.063 to 2.322 V	
Marker	1.735 to 1.994 V		2.063 to 2.322 V	
Wiper Variable	1.735 to 1.994 V		4.16 to 4.443 V	
Wiper Wash	1.735 to 1.994 V		3.637 to 3.944V	
Wiper OFF	1.735 to 1.994 V		3.197 to 3.503 V	
Wiper High	1.735 to 1.994 V		2.605 to 2.899 V	
Horn	0 to 0.5 V		3.56 to 3.861 V	
Tilt Away	2.488 to 2.791 V		4.16 to 4.443 V	
Tilt Closer	2.488 to 2.791 V		3.637 to 3.944V	
Telescope Up	1.276 to 1.486 V		4.16 to 4.443 V	
Telescope Down	1.276 to 1.486 V		3.637 to 3.944V	
Pedals Away	1.276 to 1.486 V		3.197 to 3.503 V	
Pedals Closer	1.276 to 1.486 V		2.605 to 2.899 V	

WIPER "OFF" TEST - Momentarily press the WIPER "OFF" switch on the Steering Wheel. Because this is a latching function, the function should be active after the switch is released. Check for no output at P7.2, P7.6, P7.3 and P7.9 on the Spartan Controller. If +12Vdc WIPER SOURCE (P5.3) power is present on any of these output pins, the wiper off circuitry on the Spartan Controller is damaged (replace the Spartan Controller). In order to check the dynamic braking circuitry after the WIPER "OFF" switch is pressed, check for continuity between P7.2 and P7.1 and also P7.6 and P7.1. If continuity does not exist, the dynamic braking circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

WIPER "VARIABLE" TEST – Thorough testing of the variable function is fairly complex and requires additional equipment. If all other functional wiper tests have been completed successfully, the only practical field test is to re-connect the wiper motor(s) P7 and verify correct function operationally. Operation of this switch initially causes the Low Speed Wiper outputs P7.2 and P7.6 to be connected to +12Vdc WIPER SOURCE (P5.3) for one wipe. If the switch is pressed again within approximately 25 seconds after the first wipe, the Low Speed Wiper function will be activated again and will repeat at an interval determined by the time between the last two operations of the switch. Activation of any other wiper mode cancels the variable mode. The effect for the driver is thus: In light rain or mist conditions the driver presses the switch once when the windshield first needs clearing. When the windshield again requires clearing the driver presses the button again - setting the time period between subsequent wipes to that required by current conditions. If a new timing is desired – longer or shorter – the driver presses the switch once and waits till the next wipe is desired and presses it again. If the function is not as described, the variable delay circuitry on the Spartan Controller is damaged (replace the Spartan Controller).

BACKLIT STEERING WHEEL – On Steering Wheels mounted on clock spring-equipped steering columns the Steering Wheel switch pads are backlit by LED's. It may be necessary to look directly at the switch pads through cupped hands to see the backlighting in daylight. If IGNITION is on the back lighting should be on. It is supplied by the 5 Volts on P2.4. If there is 5 Volts on P2.4 and the backlighting is not working, replace the Steering Wheel.

DRL TEST – First plug in P3 and P5. There should be 12 Volts present at HEADLAMP SOURCE (P3.4). If not, check external fuses and wiring. The DRL (daylight running light) circuit requires the operator to release the Park Brake. Use caution when performing this test. Release the Park Brake causing the PARK BRAKE SIGNAL (P1.14) to go to +12Vdc. The IGNITION (P1.6) should still be on and at +12Vdc. The external Headlamp switch should be off. The DRL circuit should apply +12 Volts to LO BEAM POWER (P5.2). If not, replace the Spartan Controller.

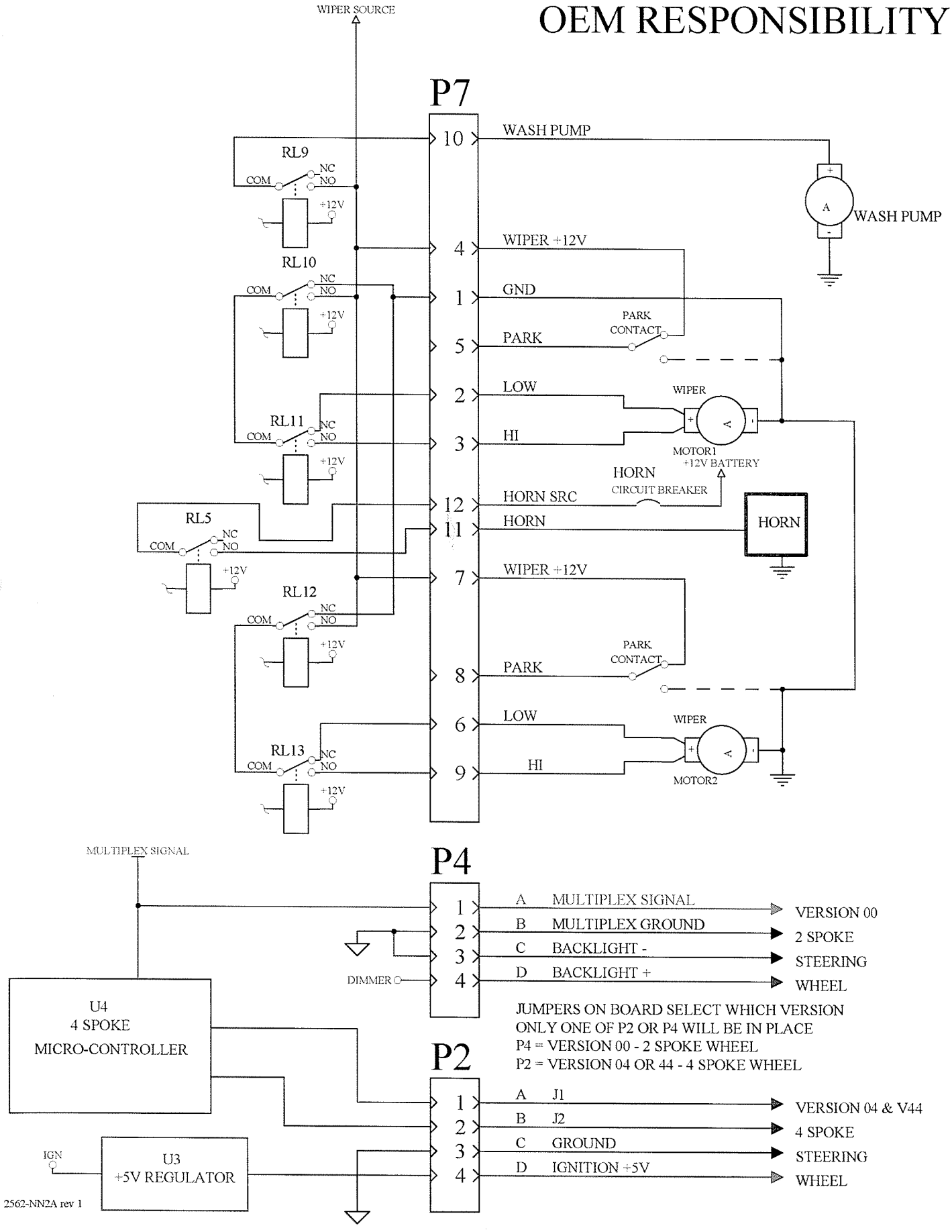
AFTER TESTS ARE COMPLETED:

If necessary, reconnect the Steering Wheel to the column connector(s) and re-attach the center pad with the Allen bolt.

Re-connect all connectors that may have been removed from the Spartan Controller.

4 SPOKE CONTROLLER

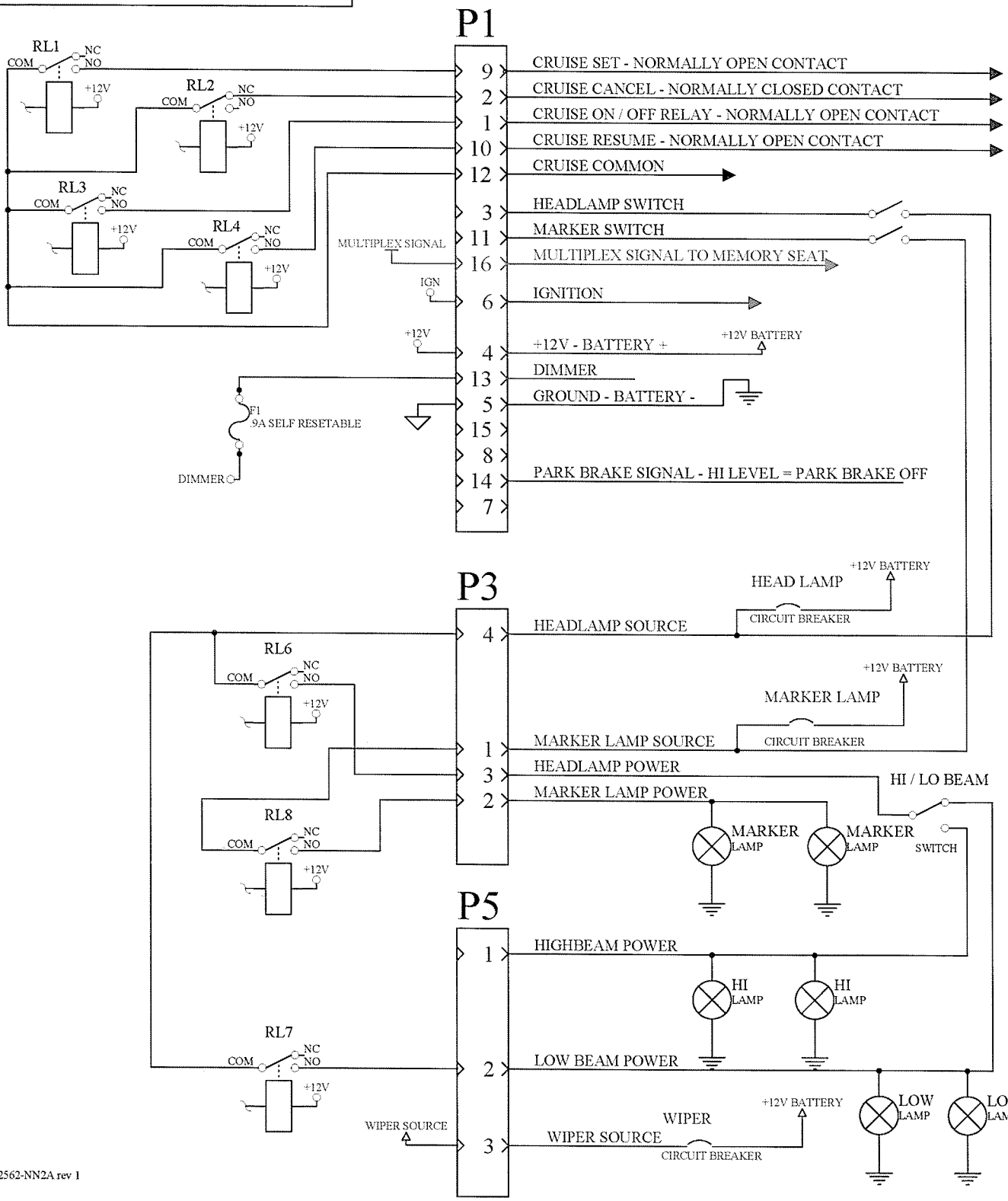
OEM RESPONSIBILITY



4 SPOKE CONTROLLER

OEM RESPONSIBILITY

RED	DC VOLTAGE
BLUE	INPUT SIGNALS
BLACK	GROUNDS , SHIELDS AND RETURNS
PURPLE	OUTPUT SIGNALS
GREEN	DATA LINES



2562-NN2A rev 1