

Vehicle Improvement Products

SmartWheel Multiplexed Steering Wheel Troubleshooting Guide

For use with:
Switch Modules SM202, SM204, SM205 and SM208
Master Controls SM203 and SM206

31 March 1998
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PRODUCT DESCRIPTION

The SmartWheel Steering Wheel Control System offers control of the horn, headlamp and marker lamp flash, cruise control, and wiper functions from a switch panel mounted in the core of the steering column. The system consists of two electronic modules, the SM202, SM204, SM205 or SM208 Switch Panel and the SM203 or SM206 Master. Communication between the Switch Panel and the Master is accomplished via two wires which utilize a dual slip ring in the steering column as a connecting path to allow for unlimited wheel rotation. The two wires carry a multiplexed communication signal and power for the Switch Panel. As each switch is closed, the Switch Panel generates a unique signal which is transmitted to the Master. The Master decodes that signal to determine which switch is closed and operates the corresponding outputs for that function.

HOW IT WORKS

Functions on the Switch Panel are either momentary or latching. The HORN, HEADLAMP FLASH, MARKER LAMP FLASH, CRUISE SET, CRUISE RESUME, WIPER PULSE, and WIPER WASH switches operate in the momentary mode and the corresponding outputs on the Master are only operated while the switch is pressed. The CRUISE ON, WIPER LO/HI, and WIPER DELAY switches operate in the latching mode and the corresponding outputs on the master remain actuated until the corresponding CRUISE OFF, or WIPER OFF switch is pressed or the Ignition input on the Master is turned off. The WIPER LO/HI 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.

An operational description of each function is as follows:

HORN - The horn switch function on the switch panel is actually accomplished using four switches located near the center hub on the Switch Panel. If any of these switches is actuated the Switch Panel will send the appropriate signal to the Master to cause the HORN output (J3-6) to be switched to ground while the switch is pressed. This output is rated at 0.5 Amps max. at 12Vdc.

HEADLAMP FLASH - Operation of this function rely's on external switching for the headlamp function. If +12V power is applied to the Headlamp On input (J3-10), +12V power will be removed from the Headlamp Power output (J3-4 & -9) while this switch is pressed. If +12V power is applied to the Headlamp Off input (J3-5), +12V power will be applied to the Headlamp Power output (J3-4 & -9) while this switch is pressed. In this manner, if the headlamps are turned on, pressing the switch will cause them to go off. In like manner, if the headlamps are turned off, pressing the switch will cause them to go on. This relay output is rated at 25 Amps max. at 12Vdc. The connector is rated for 9 Amps.

MARKER LAMP FLASH - Operation of this function rely's on external switching for the marker lamp function. If +12V power is applied to the Marker Lamp On input (J3-3), +12V power will be removed from the Marker Lamp Power output (J3-2) while this switch is pressed. If +12V power is applied to the Marker Lamp Off input (J3-1), +12V power will be applied to the Marker Lamp Power output (J3-2) while this switch is pressed. In this manner, if the marker lamps are turned on, pressing the switch will cause them to go off. In like manner, if the marker lamps are turned off, pressing the switch will cause them to go on. This relay output is rated at 25 Amps max. at 12Vdc. The connector is rated for 9 Amps.

CRUISE FUNCTIONS:

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Because of the requirement that the cruise control functions be extremely flexible to accommodate the various brands of cruise control systems, the Smart Wheel System incorporates three individual relays with the normally-open and normally-closed contacts available to those systems. It also incorporates a programmable jumper field (JP1) which allows the common (armature) contact of the Cruise On/Off relay to be connected to one of three sources. If the jumper on JP1 is placed in position "A", the common contact on the Cruise On/Off relay will be connected to the Cruise Common input (J2-5). If the jumper on JP1 is placed in position "B", the common contact on the Cruise On/Off relay will be connected to the Ignition input (J1-1). If the jumper on JP1 is placed in position "C", the common contact on the Cruise On/Off relay will be connected to ground. In order to insure proper operation of the cruise control system the technician should consult with the chassis manufacturer to determine the proper jumper setting prior to installing or replacing a Master. 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 max. at 12Vdc.

CRUISE ON - Operation of this switch latches the Cruise On/Off relay in the "on" state. This causes the source determined by the jumper position on JP1 to be disconnected from the Cruise On/Off normally-closed (N.C.) output (J2-7) and connected to the Cruise On/Off normally-open (N.O.) output (J2-8).

CRUISE OFF - Operation of this switch unlatches the Cruise On/Off relay. This causes the source determined by the jumper position on JP1 to be connected to the Cruise On/Off normally-closed (N.C.) output (J2-7) and disconnected from the Cruise On/Off normally-open (N.O.) output (J2-8). In essence, this function is inverse to the Cruise On function. This mode is also entered any time that +12Vdc power is removed from the Ignition input (J1-1) on the Master.

CRUISE SET - Operation of this switch operates the Cruise Set relay while the switch is pressed. This causes the Cruise Common input (J2-5) to be disconnected from the Cruise Set normally-closed (N.C.) output (J2-2) and be connected to the Cruise Set normally-open (N.O.) output (J2-1).

CRUISE RESUME - Operation of this switch operates the Cruise Resume relay while the switch is pressed. This causes the Cruise Common input (J2-5) to be disconnected from the Cruise Resume normally-closed (N.C.) output (J2-4) and be connected to the Cruise Resume normally-open (N.O.) output (J2-3).

WIPER FUNCTIONS:

The wiper control functions are implemented via special control circuitry which is intended to control two wiper motors and maintain synchronization between these motors on each wipe cycle. For that reason the faster wiper will pause at the end of each cycle and wait for the slower wiper to complete its cycle before resuming. The control circuitry utilizes dynamic braking on the wiper motors to eliminate motor coasting. The connections to each of these motors is made via five pin connectors J6 and J7. The output for the wash pump is J4. The +12Vdc power for all wiper functions is separate from the +12Vdc power for all other functions and is supplied via connector J5. 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 Master (J6-2 & J7-2). The output rating for all wiper functions is 25 Amps max. at 12Vdc. Note: If only one wiper motor is utilized a jumper needs to be placed between the PARK inputs (J6-3 & J7-3) and connected to the PARK contact for that motor.

WIPER WASH - Operation of this switch operates the wash pump relay while the switch is pressed, causing the Wash Pump output (J4) to be connected to +12Vdc Wiper Power (J5). In addition, if none of the latching wiper functions (Wiper Lo/Hi or Wiper Delay) had been previously selected, the

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Low Speed Wiper outputs (J6-4 & J7-4) will be connected to +12Vdc Wiper Power (J5) while the switch is pressed and remain connected for a period of approximately 3 wiper cycles 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 PULSE - Operation of this switch causes the Low Speed Wiper outputs (J6-4 & J7-4) to be connected to +12Vdc Wiper Power (J5) while the switch is pressed. If the latching Wiper Delay function had been previously selected the wipers will continue to run in that mode after the PULSE switch is released.

WIPER LO/HI - Operation of this switch initially causes the Low Speed Wiper outputs (J6-4 & J7-4) to be connected to +12Vdc Wiper Power (J5) continuously. If the switch is pressed again the High Speed Wiper outputs (J6-5 & J7-5) will be connected to +12Vdc Wiper Power (J5) continuously. Subsequent presses of this switch will cause alternate operation of the wipers in the low or high speed mode.

WIPER DELAY - There are two versions of this feature available which are determined by the part number. On part number SM203, operation of this switch initially causes the Low Speed Wiper outputs (J6-4 & J7-4) to be connected to +12Vdc Wiper Power (J5) for one wipe and this will be repeated at a fixed rate of approximately four seconds. On part number SM206 an additional two pin connector, J8, is provided on the Master so that an external 200K Ohm potentiometer can be connected as a rheostat to vary the delay time. Operation of this switch on this version initially causes the Low Speed Wiper outputs (J6-4 & J7-4) to be connected to +12Vdc Wiper Power (J5) for one wipe and this will be repeated at a rate determined by the position of the external potentiometer.

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 input (J1-1) on the Master.

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SYSTEM INTERCONNECTIONS:

SWITCH PANEL:

The switch panel is connected to the slip-rings in the steering column via a two wire pigtail emanating from the switch panel. The yellow wire is the multiplex Signal wire and the brown wire is the multiplex Ground wire.

MASTER:

The SM203 Master is supplied with seven connectors. The SM206 Master is supplied with an additional two pin connector for the variable wiper delay control. A table of the connector types is as follows:

CONNECTOR	PINS	RECOMMENDED MATING CONNECTOR		TERMINAL P/N
		MANUFACTURER	HOUSING P/N	
J1	6	MOLEX	39-01-2065	39-00-0060
J2	8	MOLEX	39-01-2085	39-00-0060
J3	10	MOLEX	39-01-2105	39-00-0060
J4 & J5	1	ANY		1/4" FEM Q/C
J6 & J7	5	AMP	350809-1	350874-3
J8	2	MOLEX	22-01-2027	08-50-0032

The following is a list of connector pins and their function:
(I= Input, O=Output, P=Power)

PIN	TYPE	FUNCTION
J1-1	I	+12V Ignition from ignition switch or relay
J1-2 & 3	P	+12V Power for all functions except wiper power
J1-4	P	Power (Chassis) ground
J1-5	I/O	Multiplex Ground (to Switch Panel)
J1-6	I/O	Multiplex Signal (to Switch Panel)
J2-1	O	Cruise Set Normally-Open Contact
J2-2	O	Cruise Set Normally-Closed Contact
J2-3	O	Cruise Resume Normally-Open Contact
J2-4	O	Cruise Resume Normally-Closed Contact
J2-5	I	Cruise Common
J2-6	X	No Connection
J2-7	O	Cruise On/Off Normally-Closed Contact
J2-8	O	Cruise On/Off Normally-Open Contact
J3-1	I	Marker Lamp Off - +12V input when Marker Lamp Switch is off
J3-2	O	Switched +12V Power to Marker Lamps
J3-3	I	Marker Lamp On - +12V input when Marker Lamp Switch is on
J3-4 & 9	O	Switched +12V Power to Headlamps
J3-5	I	Headlamp Off - +12V input when Headlamp Switch is off
J3-6	O	Horn - Switched to ground to operate horn relay
J3-7	X	No Connection
J3-10	I	Headlamp On - +12V input when Headlamp Switch is on

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SYSTEM INTERCONNECTIONS (Continued):

J4	O	Switched +12V Power to Wash Pump
J5	P	+12V Power Supply for all wiper functions
J6-1 & J7-1	O	+12V Power to wiper motors
J6-2 & J7-2	P	Ground for all wiper functions
J6-3 & J7-3	I	Park Contact inputs for wiper motors (tied together if only one motor is used)
J6-4 & J7-4	O	Switched +12V Power to low speed wiper motor input
J6-5 & J7-5	O	Switched +12V Power to high speed wiper motor input
J8-1 & 2	I	Potentiometer input for variable wiper delay (used only on P/N SM-206)

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. 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. 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 master and the wipers or the wiper system itself. If the system is completely nonfunctional, start by checking the wiring to the master and from the master to the keypad.

EQUIPMENT REQUIRED:

1. A Digital Volt/Ohm-meter with an audible continuity check.
2. 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.

3. Disconnect connectors J2, J3, J4, J6, and J7 from the Master.
4. Make sure that +12Vdc power is present at J1 pins 2 & 3 and connector J5 on the Master. If not present, check the supply fuses or breakers.
5. Measure the DC voltage at J1 pin 6 (Multiplex SIG) on the Master. It should measure in the range of 7-9 Volts. If it doesn't, check the continuity between J1 pin 4 and chassis ground. If continuity exists, replace the Master.
6. Remove the Switch Panel from the steering wheel and disconnect it. Measure the DC voltage between the wires in the column which were connected to the yellow and brown wires on the Switch Panel. It should also measure in the range of 7-9 Volts. If it doesn't, check the wiring in the column to the slip rings and Master for continuity. If it does, reconnect the Switch Panel to the column wiring.

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IN-VEHICLE TESTS:

Perform the Initial In-Vehicle Tests before attempting to performing these tests. Select these by function if problems are observed with a particular function. Make sure that connectors J2, J3, J4, J6, and J7 are disconnected from the Master.

HORN TEST - Connect the low current test light between a +12Vdc source and J3 pin 6 (Horn output) on the Master. Press one of the HORN switches on the Switch Panel and the test light should light. If it doesn't, the Horn output on the Master is defective (replace the Master).

HEADLAMP "ON" TEST - With no switches pressed on the Switch Panel, check for continuity between J3 pin 4 on the Master and J3 pin 9, and J3 pin 10. If continuity does not exist, the headlamp "on" circuitry on the Master is defective (replace the Master).

HEADLAMP "OFF" TEST - While the HEADLAMP FLASH switch on the Switch Panel is pressed, check for continuity between J3 pin 4 on the Master and J3 pin 5. If continuity does not exist, the headlamp "off" circuitry on the Master is defective (replace the Master).

MARKER LAMP "ON" TEST - With no switches pressed on the Switch Panel, check for continuity between J3 pin 2 on the Master and J3 pin 3. If continuity does not exist, the marker lamp "on" circuitry on the Master is defective (replace the Master).

MARKER LAMP "OFF" TEST - While the MARKER LAMP FLASH switch on the Switch Panel is pressed, check for continuity between J3 pin 2 on the Master and J3 pin 1. If continuity does not exist, the marker lamp "off" circuitry on the Master is defective (replace the Master).

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 J1 pin 1 on the Master. Note the position of the jumper on the configuration header JP1 so that unit can be returned to that configuration after the tests have been completed. After that position is noted, place the jumper in position "A" so that Cruise Common is the source.

CRUISE "ON" TEST - Momentarily press the CRUISE "ON" switch on the Switch Panel. Because this is a latching function, the function should be active after the switch is released. Check for continuity between J2 pin 5 on the Master and J2 pin 8. If continuity does not exist, the cruise "on" circuitry on the Master is defective (replace the Master).

CRUISE "OFF" TEST - Momentarily press the CRUISE "OFF" switch on the Switch Panel. Because this is a latching function, the function should be active after the switch is released. Check for continuity between J2 pin 5 on the Master and J2 pin 7. If continuity does not exist, the cruise "off" circuitry on the Master is defective (replace the Master).

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CRUISE "SET" TEST - With the CRUISE "SET" switch on the Switch Panel not pressed check for continuity between J2 pin 5 on the Master and J2 pin 2. If continuity does not exist, the cruise "set" circuitry on the Master is defective (replace the Master). While the CRUISE "SET" switch on the Switch Panel is pressed check for continuity between J2 pin 5 on the Master and J2 pin 1. If continuity does not exist, the cruise "set" circuitry on the Master is defective (replace the Master).

CRUISE "RESUME" TEST - With the CRUISE "RESUME" switch on the Switch Panel not pressed check for continuity between J2 pin 5 on the Master and J2 pin 4. If continuity does not exist, the cruise "resume" circuitry on the Master is defective (replace the Master). While the CRUISE "RESUME" switch on the Switch Panel is pressed check for continuity between J2 pin 5 on the Master and J2 pin 3. If continuity does not exist, the cruise "resume" circuitry on the Master is defective (replace the Master).

WIPER "WASH" TEST - While the WIPER "WASH" switch on the Switch Panel is pressed, check for the presence of +12Vdc at J4. If +12Vdc is not present at J4, the wash pump output circuitry on the Master is defective (replace the Master). In addition, check for the presence of +12Vdc at J6 pin 4 and J7 pin 4. If +12Vdc is not present, the low speed wiper wash circuitry on the Master is defective (replace the Master).

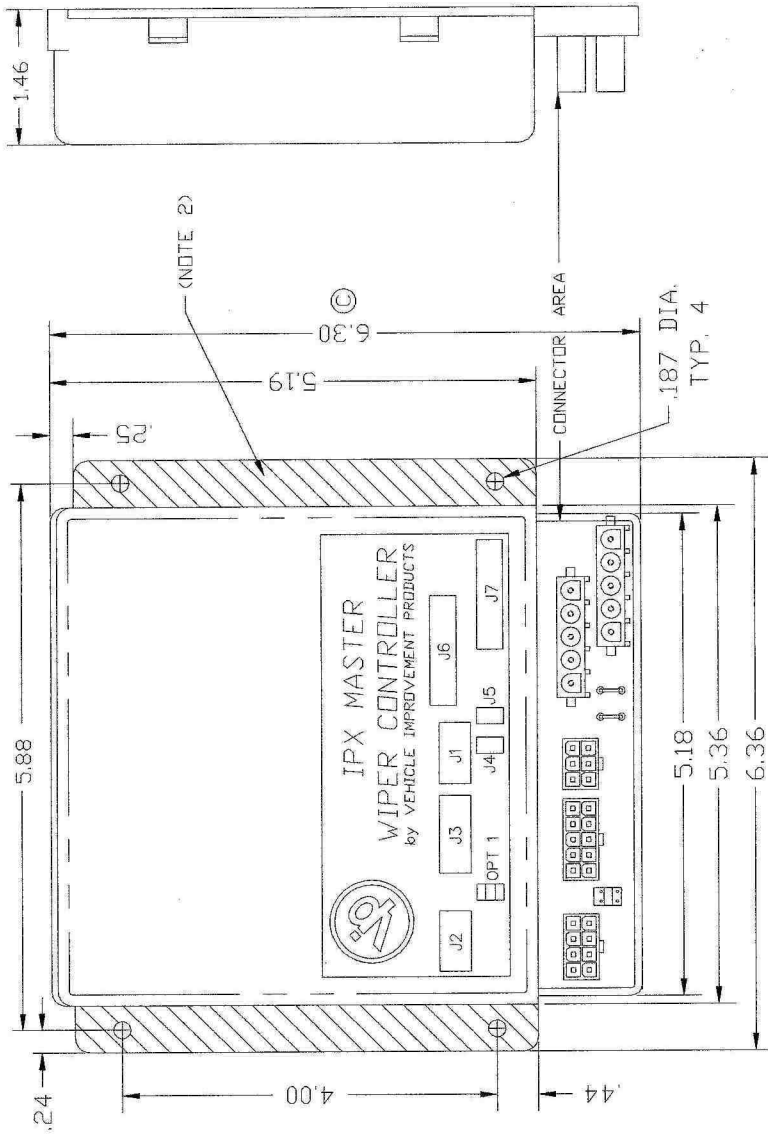
WIPER "PULSE" TEST - While the WIPER "PULSE" switch on the Switch Panel is pressed, check for the presence of +12Vdc at J6 pin 4 and J7 pin 4. If +12Vdc is not present, the low speed wiper pulse circuitry on the Master is defective (replace the Master).

WIPER "LO/HI" TEST - Momentarily press the WIPER "LO/HI" switch on the Switch Panel. Because this is a latching function, the function should remain active after the switch is released. Check for the presence of +12Vdc at J6 pin 4 and J7 pin 4 on the Master. If +12Vdc is not present, the continuous low speed wiper circuitry on the Master is defective (replace the Master). Momentarily press the WIPER "LO/HI" switch again and check for the presence of +12Vdc at J6 pin 5 and J7 pin 5 on the Master. If +12Vdc is not present, the continuous high speed wiper circuitry on the Master is defective (replace the Master). Subsequent presses of this switch will cause alternate presence of +12Vdc at the low speed (J6 pin 4 and J7 pin 4) or high speed (J6 pin 5 and J7 pin 5) outputs on the Master.

WIPER "OFF" TEST - Momentarily press the WIPER "OFF" switch on the Switch Panel. Because this is a latching function, the function should be active after the switch is released. Check for no output at J6 pin 4, J6 pin 5, J7 pin 4, and J7 pin 5 on the Master. If +12Vdc power is present on any of these output pins, the wiper off circuitry on the Master is defective (replace the Master). In order to check the dynamic braking circuitry after the WIPER "OFF" switch is pressed, check for continuity between J6 pin 2 and J6 pin 4 and also between J7 pin 2 and J7 pin 4. If continuity does not exist, the dynamic braking circuitry on the Master is defective (replace the Master).

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WIPER "DELAY" TEST - This test is fairly complex and, for that reason, it is recommended that the other functional wiper tests be performed on the system prior to performing this test in order to isolate the problem. If the unit passes all other functional wiper tests, but still exhibits a problem in the DELAY mode, momentarily press the WIPER "DELAY" switch on the Switch Panel. Because this is a latching function, the function should remain active after the switch is released. Check for the presence of +12Vdc at J6 pin 4 and J7 pin 4 on the Master. If +12Vdc is not present, the low speed wiper delay circuitry on the Master is defective (replace the Master). In order to reset the delay timer, momentarily connect the low current test light from a source of +12Vdc (such as J5) simultaneously to both J6 pin 3 and J7 pin 3 (the "park" switch inputs) on the Master. On the SM203, the presence of +12Vdc should be interrupted for a period of approximately 4 seconds after the park input is removed. On the SM206, the variable delay potentiometer should be connected to connector J8 and the presence of +12Vdc should be interrupted for a period determined by the rotational position of the remote variable delay potentiometer.



- J2**
1. CRUISE SET N.O.
 2. CRUISE SET N.C.
 3. CRUISE RES N.O.
 4. CRUISE RES N.C.
 5. CRUISE COMMON
 6. CRUISE N.C.
 7. CRUISE ON/OFF N.C.
 8. CRUISE ON/OFF N.C.

- J3**
1. MRKRLAMP SWITCH N.O.
 2. MRKRLAMP PWR
 3. MRKRLAMP SWITCH N.C.
 4. HEADLAMP PWR
 5. HEADLAMP SWITCH N.O.
 6. HORN RELAY
 - 7.
 8. HEADLAMP PWR
 9. HEADLAMP SWITCH N.C.
 - 10.

- J1**
1. IGNITION
 2. +12V PWR
 3. PWR GND
 4. MPX GROUND
 5. MPX SIGNAL
 - 6.

- J4**
- WASH PUMP

- J5**
- +12V WIPER PWR

- J6**
1. WPR PWR
 2. WPR GND
 3. PARK
 4. LOW
 5. HIGH

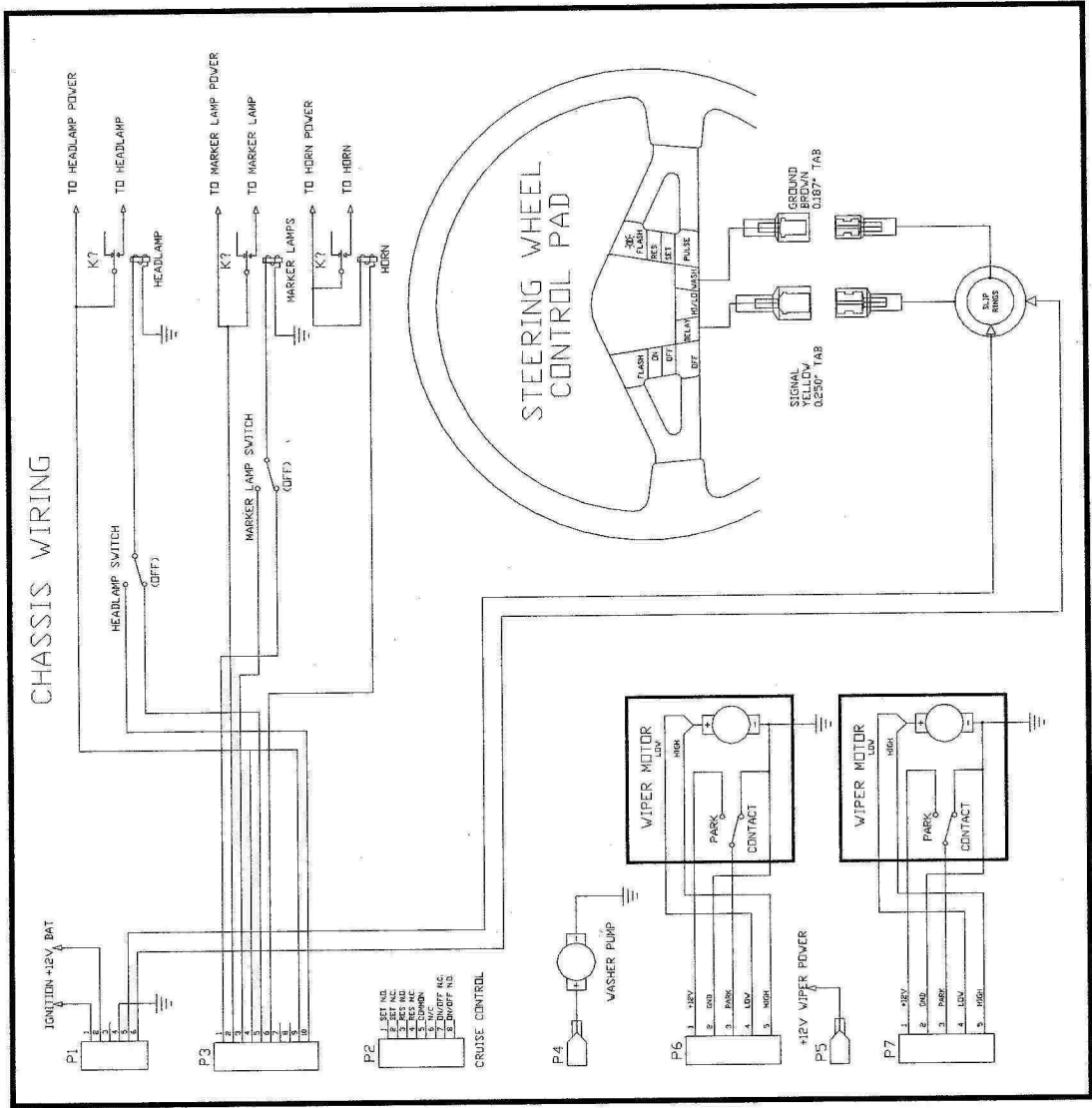
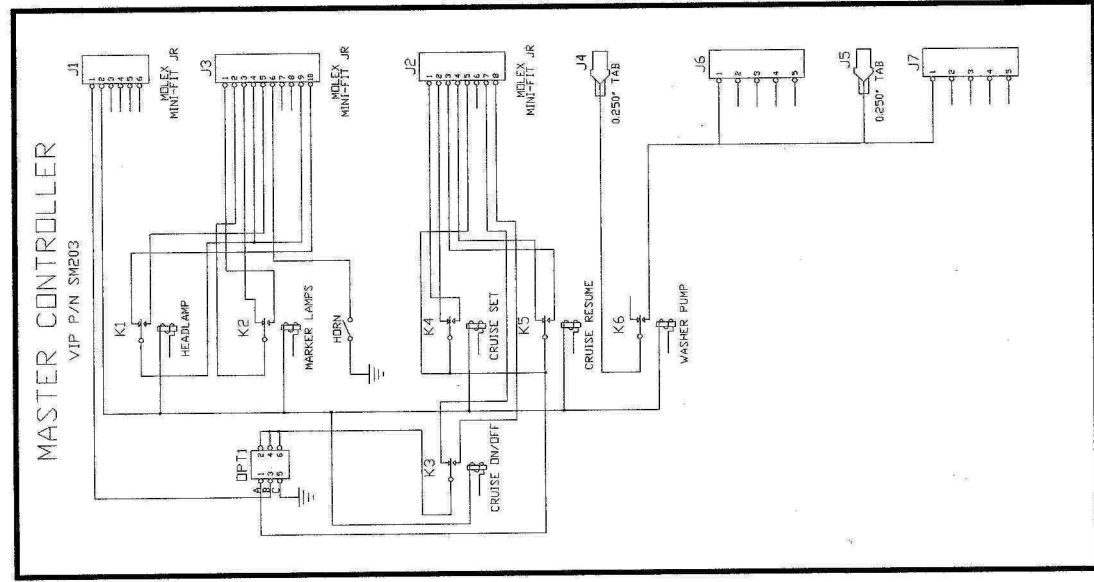
- J7**
1. WPR PWR
 2. WPR GND
 3. PARK
 4. LOW
 5. HIGH

THE CONTROL MODULE IS DESIGNED TO MOUNT IN THE PASSENGER COMPARTMENT OF THE VEHICLE. THE RATED OPERATING TEMPERATURE IS -40 to +85 DEGREES C. IT MUST NOT BE EXPOSED TO THE HIGHER OPERATING TEMPERATURES AND MOISTURE LEVELS TYPICAL OF THE ENGINE COMPARTMENT.

FLANGES TO BE MOUNTED TO CONDUCTIVE SURFACE ELECTRICALLY GROUNDED TO CHASSIS FOR BEST EMI/RFI SUPPRESSION

DJM	PL	ENG	MM	LTR	DESCRIPTION	DATE
X.		.060	1.524	A	RELEASED	8-1-94
X.		.030	.62	B	ADDED LIGHT BULB	2-22-96
XX		.010	.254	C	ADDED CRUISE SET N.O. N.C.	10-23-97
.XXX		.005	.127	D	ADDED CRUISE RES N.O. N.C.	6-11-99
ANGLES ± 2°						

VEHICLE IMPROVEMENT PRODUCTS, INC.
 BRAND BY TITLE MULTIPLEX MASTER FILE NO. 0024
 DATE 6-11-99 SCALE 1:1 BRANDING NO. SM203
 151 S. RAM RD. ANTIPOCH, IL USA



- NOTES:
- A. RECOMMENDED WIRING CONNECTOR INFORMATION:
 P1 HOUSING = MOLEX P/N 39-01-2065
 P2 HOUSING = MOLEX P/N 39-01-2065
 P3 HOUSING = MOLEX P/N 39-01-2065
 P4 HOUSING = MOLEX P/N 39-01-2065
 P5 HOUSING = MOLEX P/N 39-01-2065
 P6 & P7 HOUSING = MOLEX P/N 39-01-2065
 - B. THE MASTER CONTROLLER IS DESIGNED TO MOUNT IN THE PASSENGER COMPARTMENT OF THE VEHICLE. THE RATED OPERATING TEMPERATURE IS -40 TO +85 DEGREES C. TYPICAL FOR THE ENGINE COMPARTMENT.
 - C. RELAYS ARE SHOWN IN DE-ENERGIZED STATE.
 - D. IF ONLY ONE WIPER MOTOR IS UTILIZED IN THE SYSTEM THE PARK INPUTS AT P9-3 AND P10-3 MUST BE CONNECTED TOGETHER FOR PROPER SYSTEM OPERATION.
 - E. THE SOURCE FOR POWER GROUND FOR THE WIPER MOTOR CIRCUIT IS THROUGH THE MOTOR CASE. THEREFORE, THE CASE OF EACH WIPER MOTOR MUST BE GROUND TO THE CHASSIS FOR PROPER OPERATION.

TABLE A

CRUISE CONTROL WIRING

PIN	DIANA SIGNAL	ECONDRUISE SIGNAL
P21	SET	SET
P22	RESUME	RESUME
P23	NO CONNECTION	NO CONNECTION
P24	NO CONNECTION	NO CONNECTION
P25	DN	GROUND
P26	NO CONNECTION	NO CONNECTION
P27	NO CONNECTION	NO CONNECTION
P28	+REV IGNITION	DN
DPT1A	JUMPER	NO CONNECTION
DPT1B	NO CONNECTION	NO CONNECTION
DPT1C	NO CONNECTION	NO CONNECTION

DJM	PL	ENG	MM	LTR	DESCRIPTION	DATE
X	.060	1.524	A	RELEASE	06/28/94	
X	.030	.762	B	CRUISE PINDOTS	05/16/95	
.XX	.010	.254	C	DELETE WH. CIRCUIT	11/30/95	
.XXX	.005	.127	D	ADDED NOTES D & E	6-11-99	

VEHICLE IMPROVEMENT PRODUCTS, INC.

DRAWN BY: VITEKING SM203 FLASH DN/OFF 00071
 FILE NO. 00071
 SCALE: DRAWING NO. 00071
 151 S. RAM RD. ANTIOTECH, IL USA