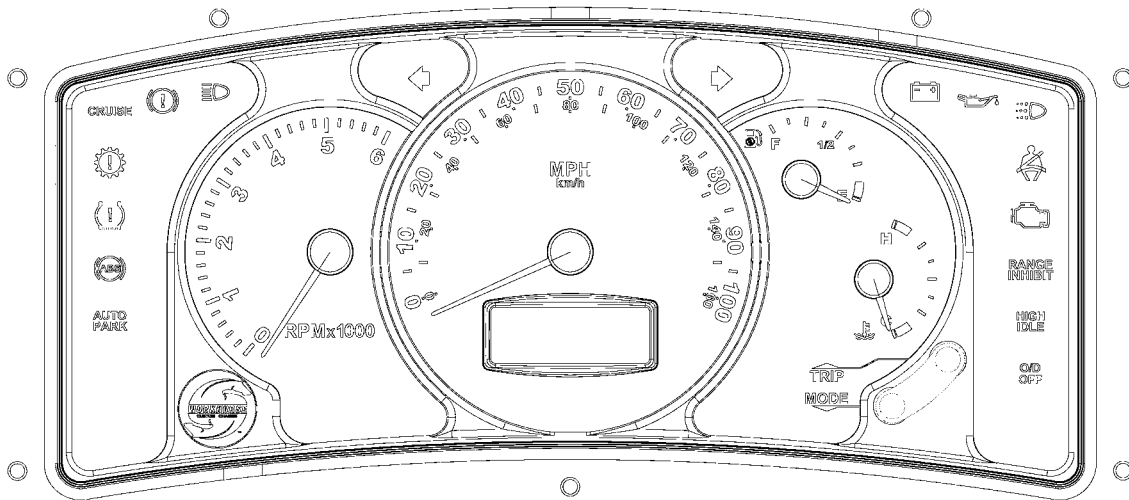




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SERVICE MANUAL



	By	Date	Workhorse CC Cluster Service Information	ACTIA Ref.	Revision
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Approved					
				Page 1	Format US Letter

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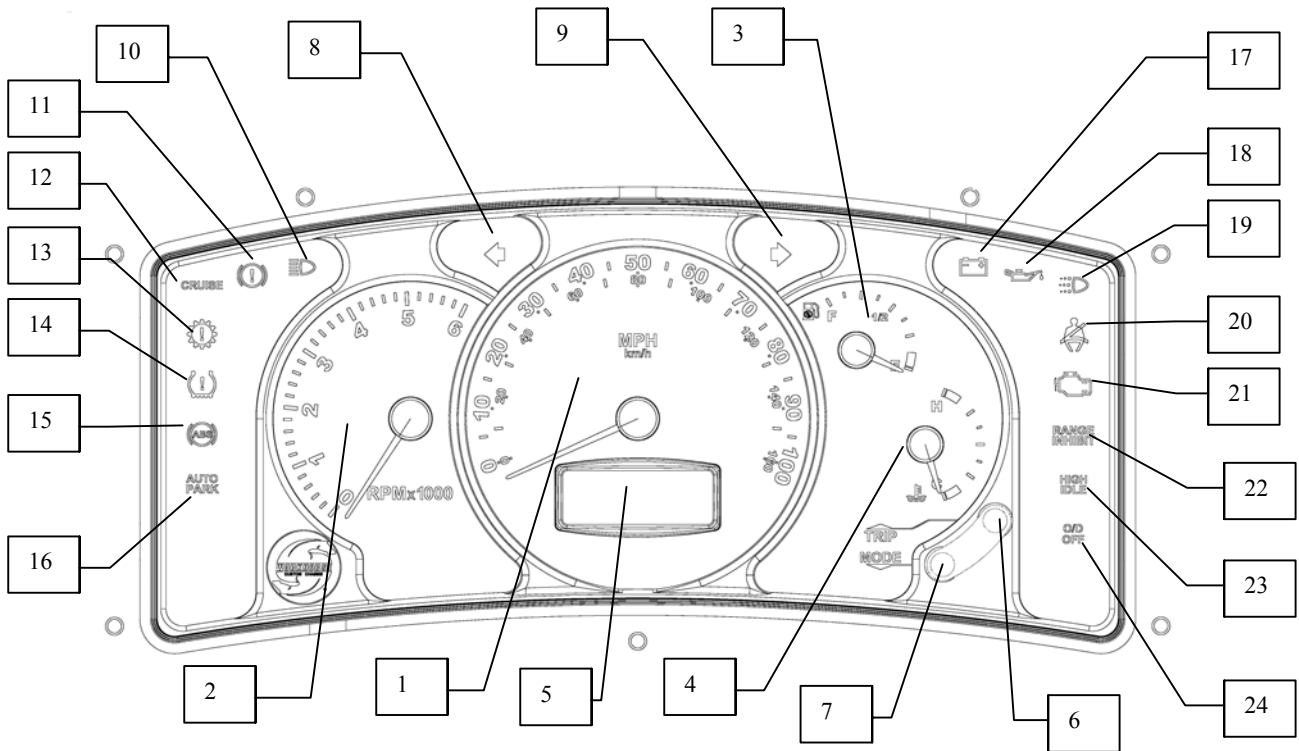
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1. CLUSTER PART NUMBERS AND FEATURES

The table below identifies both WCC and Actia cluster part numbers, which chassis they are used in, and the cluster's software options.

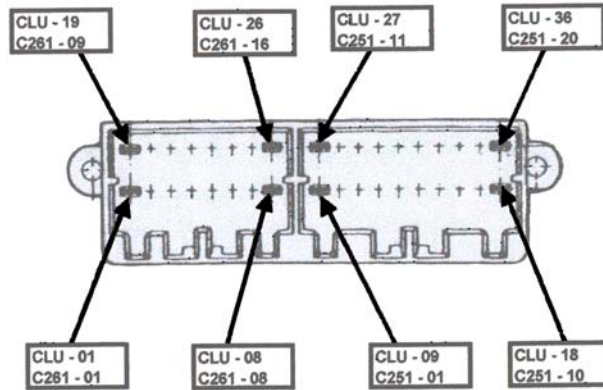
WCC P/N	Actia P/N	Chassis	PRND321	Trip Computer
W0003520	101730	W22	YES	NO
W0002900	101733	P32, W19, P42	NO	NO
W0003614	101731	W22	YES	YES
W0003612	101734	P32	NO	YES

2. CLUSTER ELEMENTS



1	Speedometer	13	Transmission Fail Warning Light
2	Tachometer	14	Tire pressure monitoring telltale
3	Fuel Gauge	15	Anti-lock Brake System Warning Light
4	Engine Coolant Temperature Gauge	16	Auto Park Brake Engaged Warning Light
5	LCD Screen	17	Battery Charging System Warning Light
6	Trip Button	18	Engine Oil Pressure Warning Light
7	Mode Button	19	Daytime Running Lamps On Warning Light
8	Turn signal LH turn active	20	Seat Belt Reminder Warning Light
9	Turn signal RH turn active	21	Service Engine Warning Light
10	Headlight High Beam On Warning Light	22	Transmission Range Inhibit On Warning Light
11	Brake fail and Park Brake Warning Light	23	High Idle Enabled On Warning Light
12	Cruise Control Active Warning Light	24	Overdrive Off Warning Light

3. CLUSTER CONNECTOR INPUTS AND OUTPUTS



CLU Pin	Description	Input	Output
1	Not used		
2	Not used		
3	Outside temperature sender	28582 Ω 980 Ω	Message center displays -20 °C (-4 °F). Message center displays 50 °C (122 °F).
4	Back lighting (dimming)	0 volts 13.8 volts	Backlighting is off. Backlighting is on full bright.
5	Not used		
6	Ignition voltage	13.8 volts	Powers up cluster when ignition is on.
7	Signal Ground	Gnd	
8	Not used		
9	Not used		
10	J1939 +	Actia diagnostic tool	Data link diagnostics is done through the cluster CAN channel. It requires a PC and RS232-to-CAN interface hardware.
11	J1939 -	Actia diagnostic tool	Data link diagnostics is done through the cluster CAN channel. It requires a PC and RS232-to-CAN interface hardware.
12	J1850	Data bus	If the data bus is not active in the vehicle, the message center will display “No J1850 Activity”.
13	Tachometer	Frequency	1 Hz = 30 RPM
14	Speedometer	Frequency	1.11 Hz = 1 mph

15	Door ajar	Low High	Door open. Door closed.
16	Overdrive off	Low High	Warning light "Overdrive off" is on. Warning light "Overdrive off" is off.
17	Remote Trip Reset switch	Low High	Switch open. Switch closed.
18	Remote Mode switch	Low High	Switch open. Switch closed.
19	Left turn	Low High	Warning light "Left turn" is off. Warning light "Left turn" is on.
20	Right turn	Low High	Warning light "Right turn" is off. Warning light "Right turn" is on.
21	High beam	Low High	Warning light "High beam" is off. Warning light "High beam" is on.
22	Headlights on	Low High	Headlights are off. Headlights are on.
23	ABS	< 1.4 volts > 6 volts	Warning light "ABS" is on. Warning light "ABS" is off.
24	Park Brake on	Low High	Park Brake is set. Warning light "Brake" is on. Park Brake is not set. Warning light "Brake" is off.
25	Brake system failure	< 1.4 volts > 6 volts	Warning light "Brake" is on. Warning light "Brake" is off.
26	Seat belt	Low High	Seat belt is unfastened. Seat belt is fastened.
27	Service engine soon	Low High	Warning light "Service engine soon" is on. Warning light "Service engine soon" is off.
28	Key in ignition	Low High	Ignition key is in. Ignition key is out.
29	Not used		
30	High Idle	Low High	Warning light "High Idle" is on. Warning light "High Idle" is off.
31	Check Tires	Low High	Warning light "Check Tires" is on. Warning light "Check Tires" is off.

32	Buzzer enable	Low High	Buzzer active with warning messages on message center. Buzzer inactive with warning messages on message center.
33	Daylight Running Lamps	Low High	Warning light "Daylight Running Lamps" is on. Warning light "Daylight Running Lamps" is off.
34	Auto park	Low High	Warning light "Auto park" is off. Warning light "Auto park" is on
35	Chassis Ground	Gnd.	
36	Direct battery input	13.8 volts	Always connected directly to battery.

4. CLUSTER DIAGNOSTICS

4.1. Test at Turn On

When ignition voltage is first applied to the cluster, all the tell-tales, except turn signals, turn on for 2 seconds, then, turned off. Simultaneously, all the gauges reference themselves and then go to the position corresponding to their current reading.

4.2. Access to diagnostic menus and menu operation

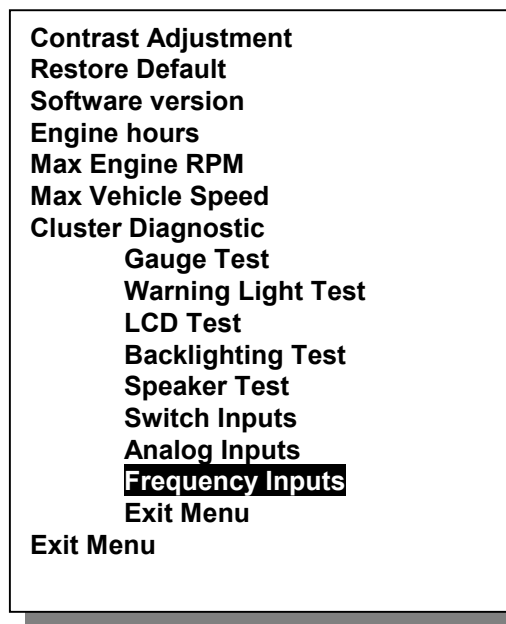
4.2.1. Access to diagnostic menus

On-board diagnostic functions are displayed in the message center. They can be accessed if the vehicle transmission is in PARK or if the vehicle PARK BRAKE is set and the MODE switch is pressed and held for at least 5 seconds. To exit diagnostics, select “EXIT MENU” or turn the vehicle ignition off then back on.

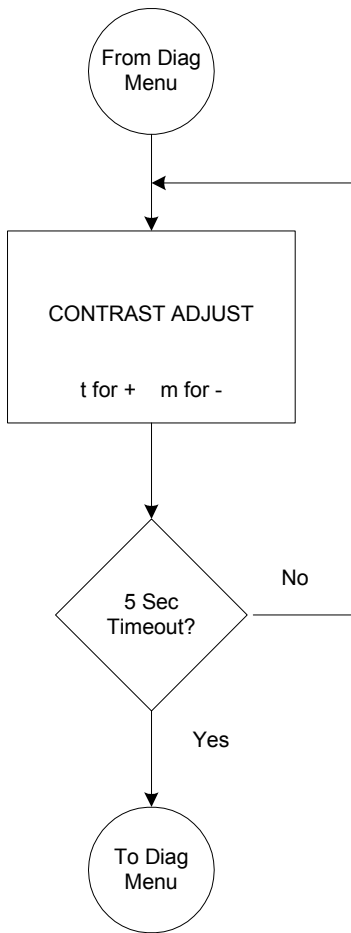
4.2.2. Menu Operation

Menus have 4 lines. To make a selection, a line must first be highlighted. To highlight a line, the trip switch is used to scroll up and the mode switch is used to scroll down. The highlighted line is shown in **reverse video**. Once highlighted, the line can be selected in either of two ways. Depressing and then releasing both the trip and mode switches at the same time chooses the line. Or, after 3 seconds of inactivity, the line shown in reverse video is automatically chosen.

A summary of all menu lines available in self-diagnostic mode is shown below.

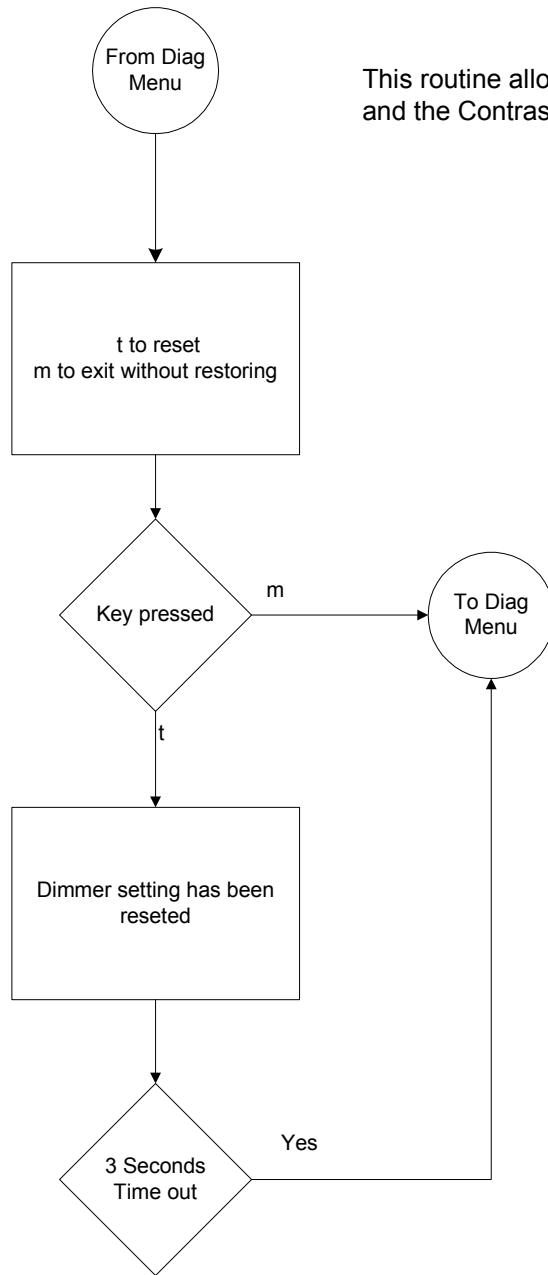


4.3. Contrast Adjustment



This routine adjusts the contrast of the LCD display. The new setting is stored in non volatile memory

4.4. Restore Default



This routine allows the user to restore the setting of the Dimmer and the Contrast to the original factory value.

4.5. Software version

Displays the software part number and version programmed into the micro controller.

Pressing the mode switch exits to the diagnostic menu. (The message "m to exit" appears on the screen).

4.6. Engine hours

Displays the engine hours.

Pressing the mode switch exits to the diagnostic menu. (The message "m to exit" appears on the screen).

4.7. Max Engine RPM

Displays the maximum engine RPM that was sustained for > 3 seconds.

Pressing the mode switch exits to the diagnostic menu. (The message "m to exit" appears on the screen).

4.8. Max Vehicle Speed

Displays the maximum vehicle speed that was sustained for > 5 seconds.

Pressing the mode switch exits to the diagnostic menu. (The message "m to exit" appears on the screen).

4.9. Cluster Self Diagnostics

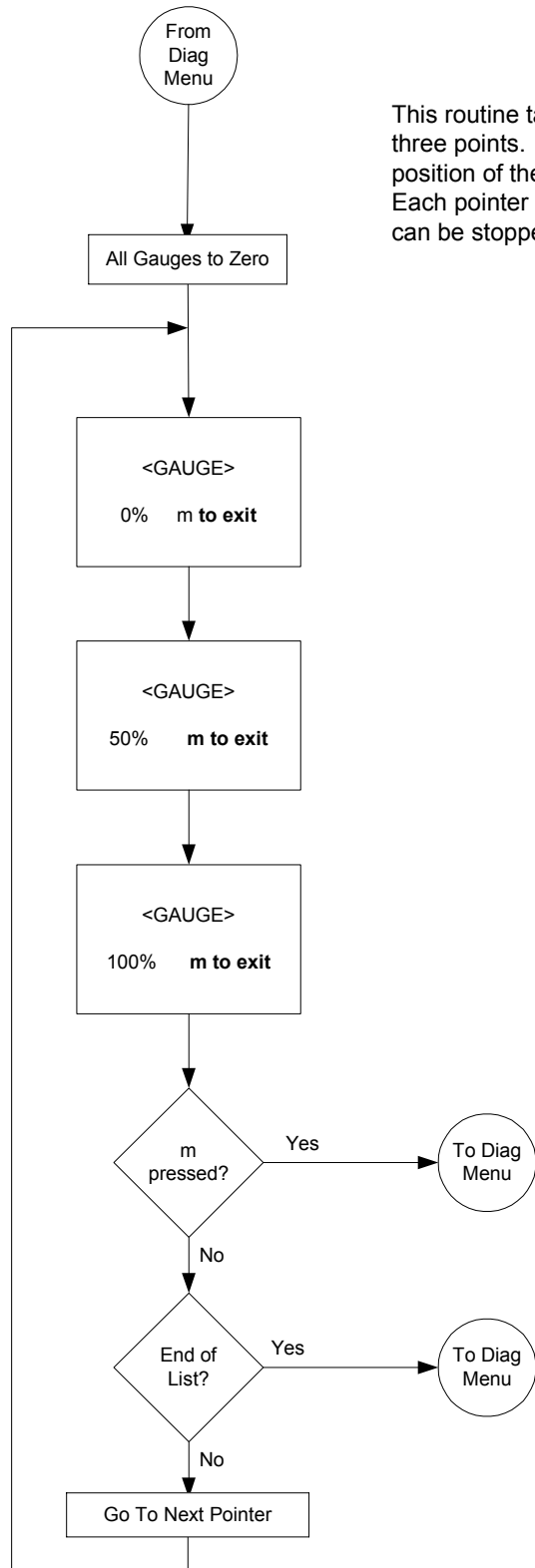
Cluster diagnostics gives the technician two powerful tools for determining whether or not a cluster needs replacement.

The first tool, Master Mode, gives the technician control over the outputs of the cluster. The technician can individually test all four gauges, all 17 warning lights, the LCD pixels, backlighting and speaker.

The second tool, Current Value Monitor, shows the technician in real time the status of the cluster inputs. The technician can test switch inputs, analog inputs and frequency inputs.

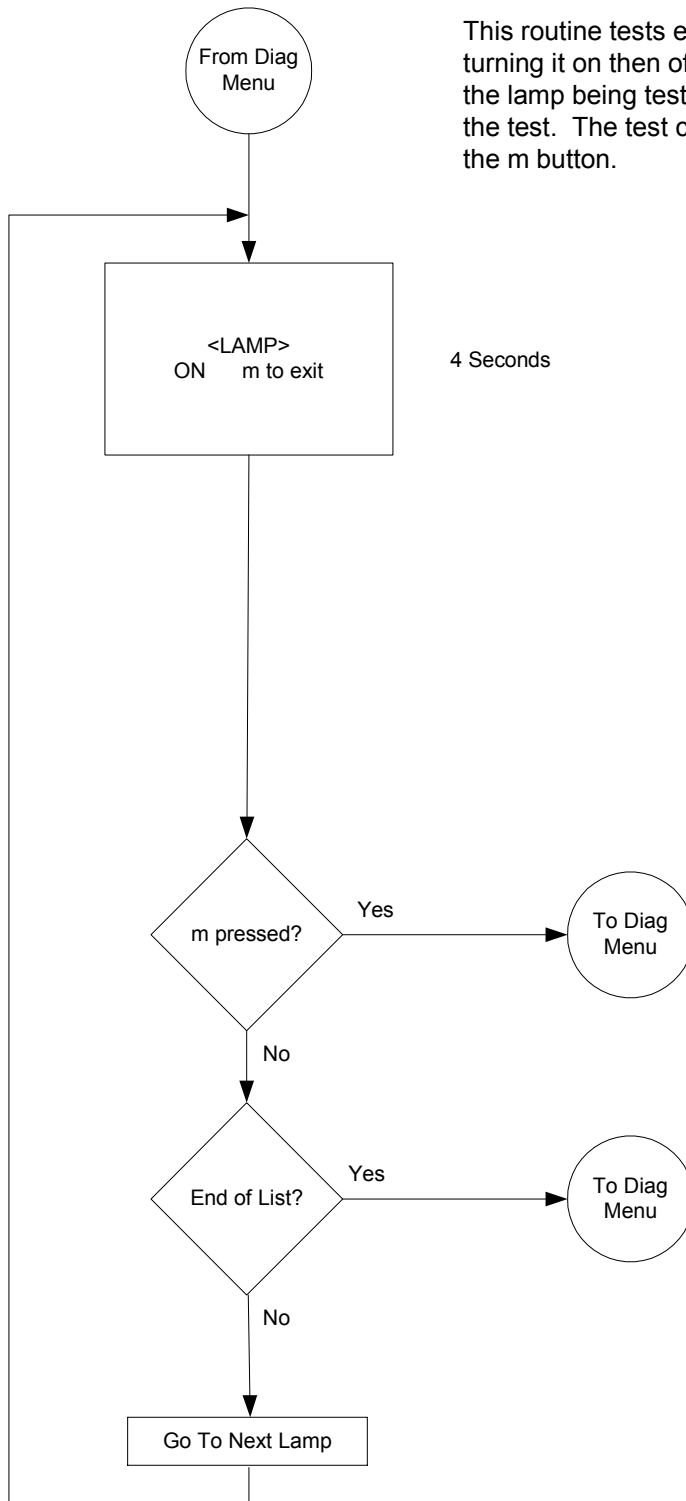
4.9.1. Gauge Test

This routine takes each pointer through three points. The display indicates the position of the pointer during the test. Each pointer will be checked. The test can be stopped by pressing the m button.



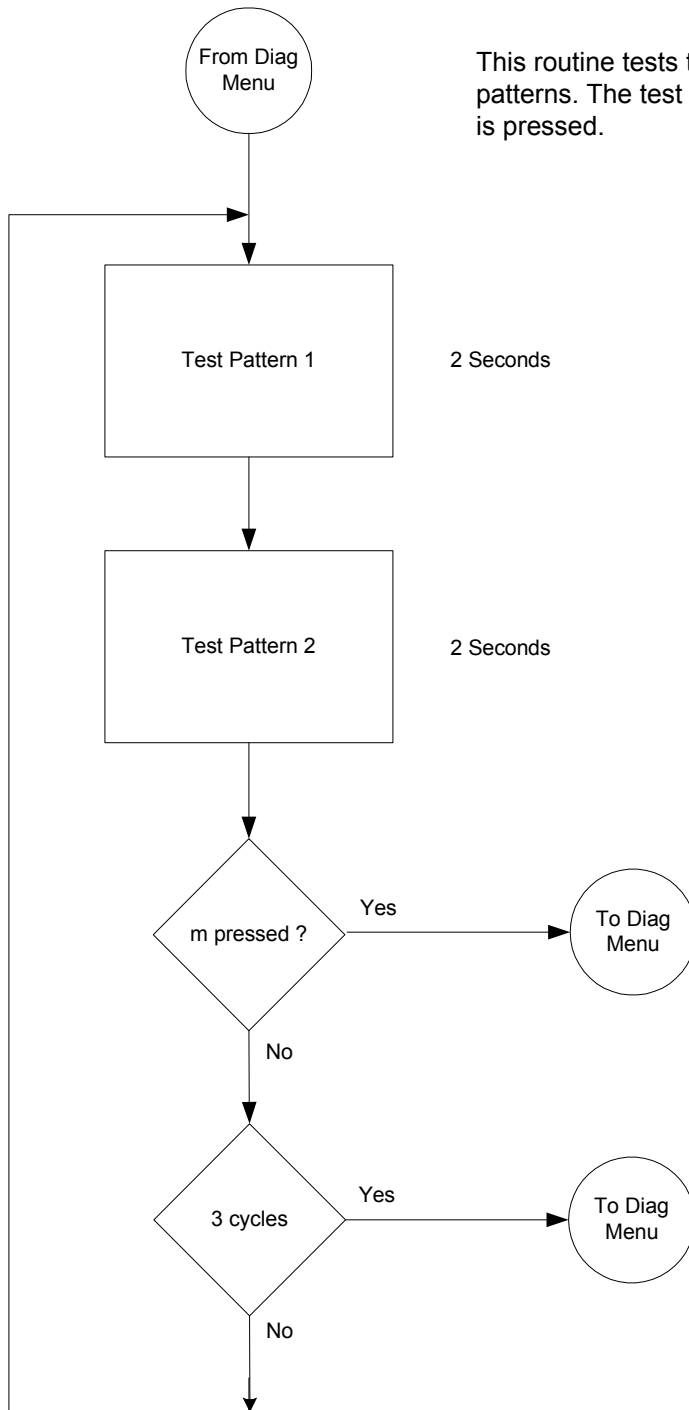
4.9.2. Warning Lamps Test

This routine tests each warning lamp by turning it on then off. The display indicates the lamp being tested and it's status during the test. The test can be stopped by pressing the m button.



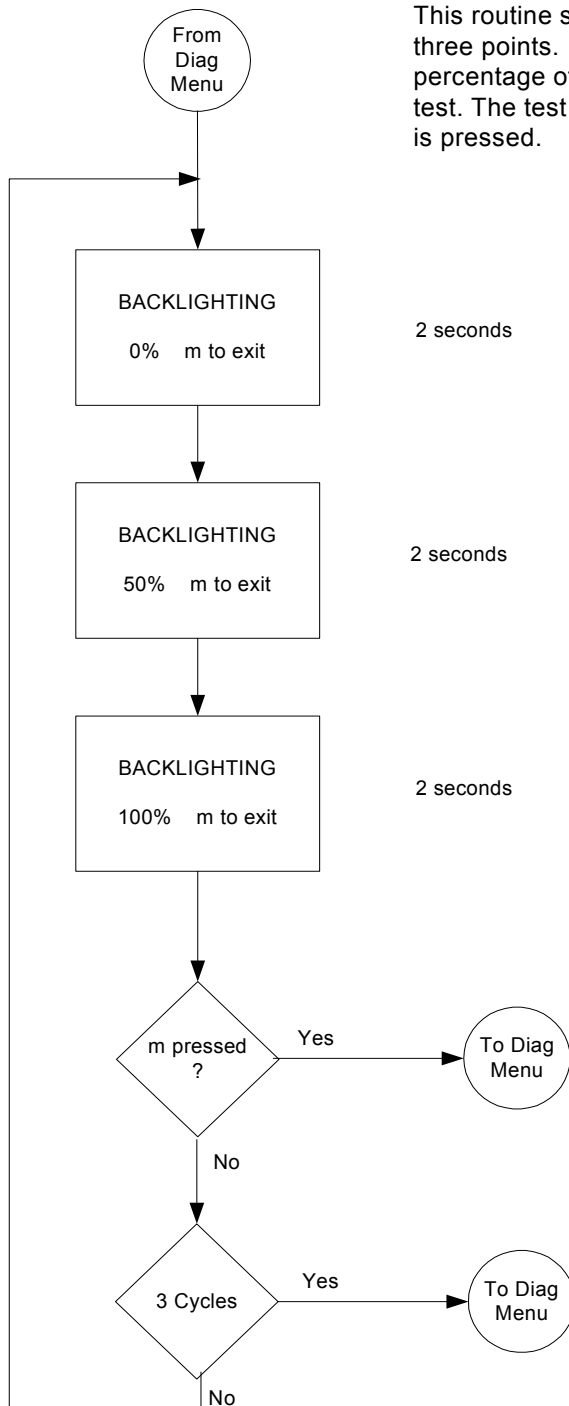
4.9.3. LCD Test

This routine tests the LC Display using test patterns. The test stops after 3 cycles or if m is pressed.

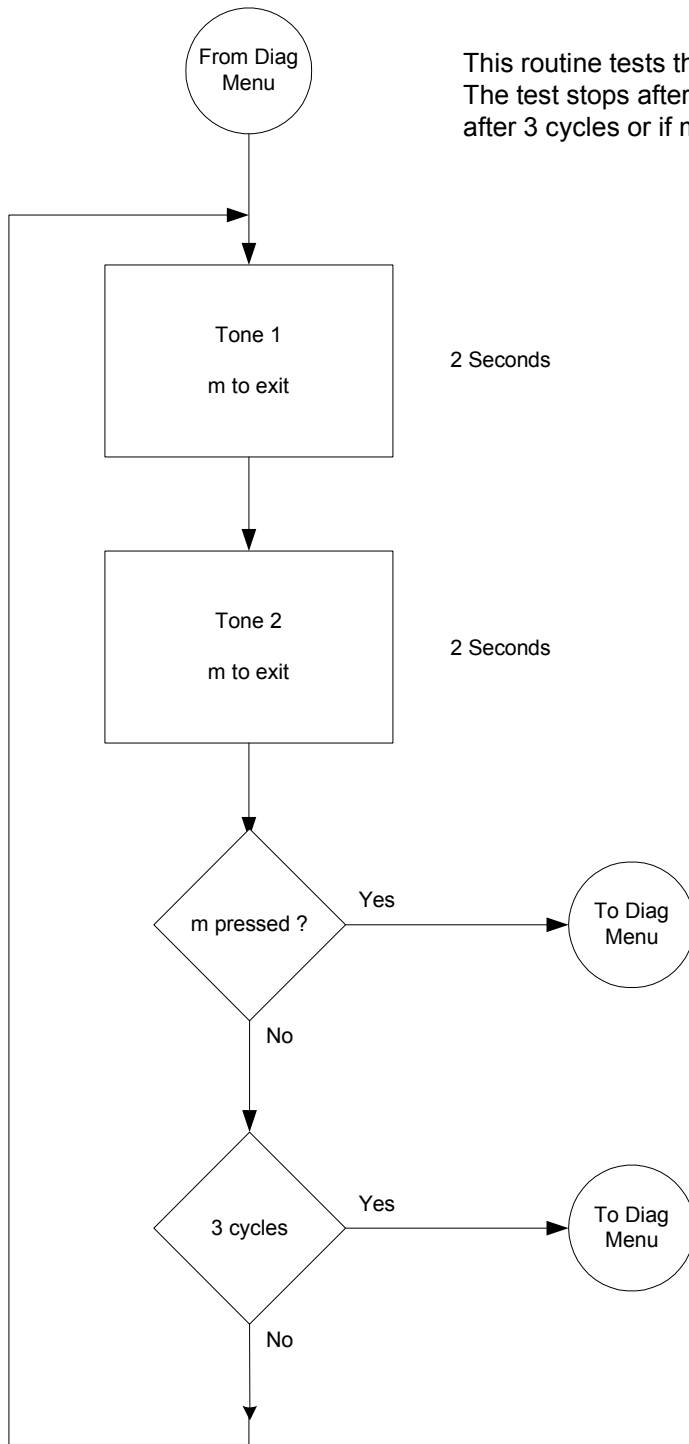


4.9.4. Backlighting Test

This routine set the backlighting through three points. The display indicates the percentage of the backlighting during the test. The test stops after 3 cycles or if m is pressed.



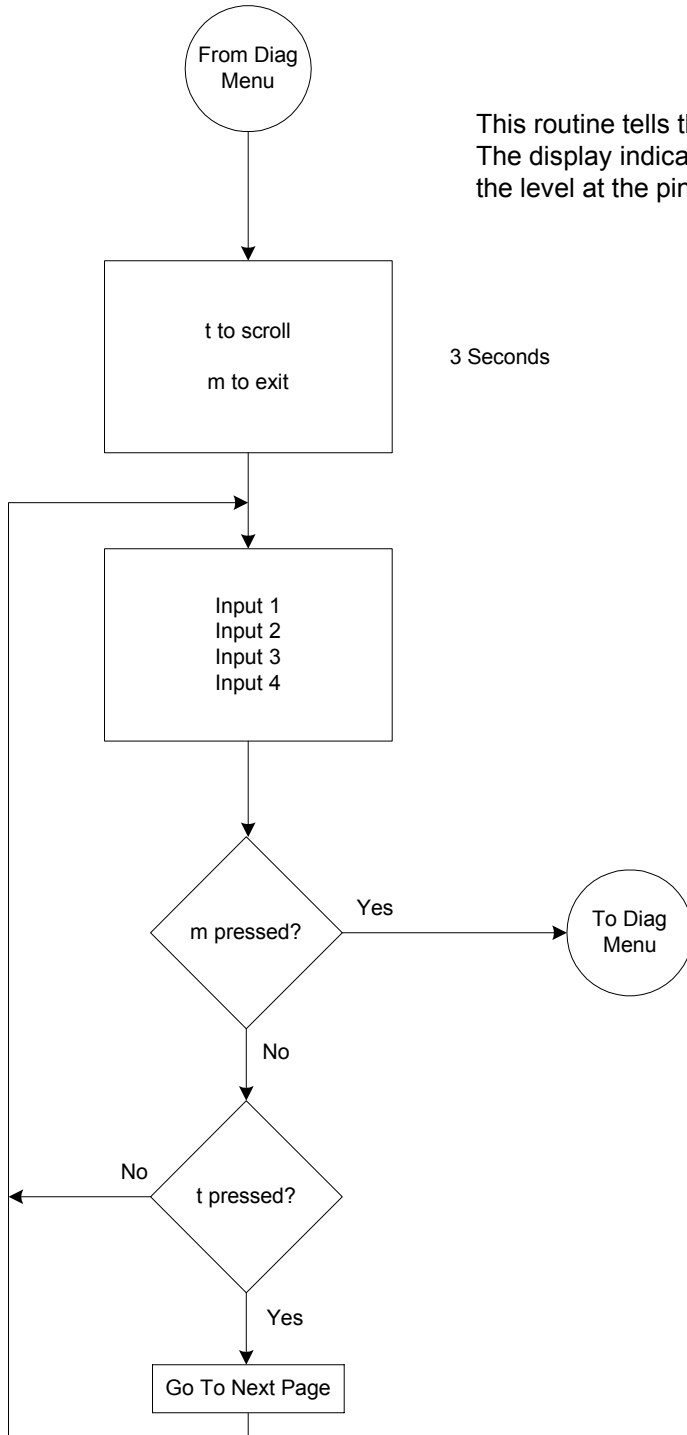
4.9.5. Speaker Test



This routine tests the speaker using 2 tones. The test stops after 3 cycles. The test stops after 3 cycles or if m is pressed.

4.9.6. Switch Inputs

This routine tells the operator the status of each switch input. The display indicates the switch input by descriptive name and the level at the pin. Four inputs are shown per screen page.



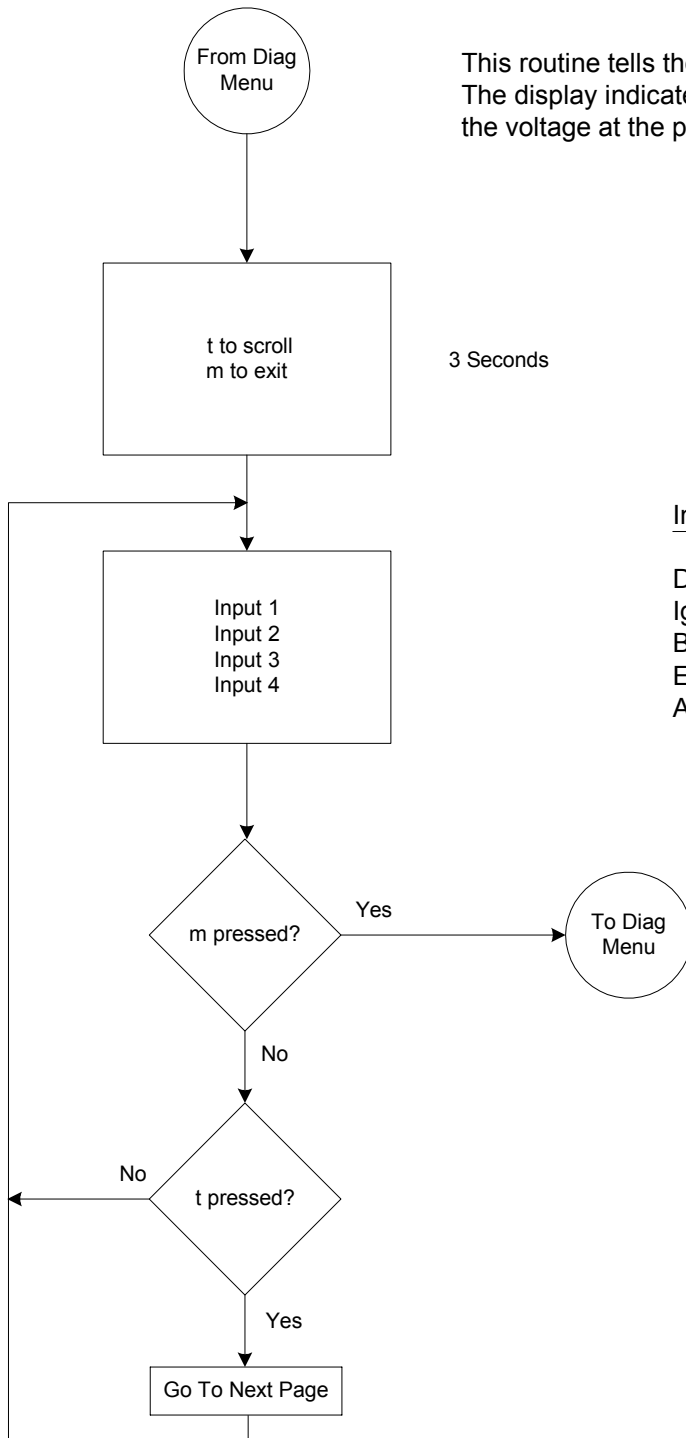
3 Seconds

Inputs List:

Day Light	LOW
Buzzer Enable	LOW
Check Tires	LOW
Auto Park	HIGH
High Idle	LOW
Service	LOW
Seat Belt	LOW
Park Brake	LOW
Head Light	HIGH
Right Turn	HIGH
Left Turn	HIGH
High Beam	HIGH
Key in Ign	LOW
Door Ajar	LOW
OverDrive off	LOW

4.9.7. Analog Inputs

This routine tells the operator the status of each analog input. The display indicates the analog input by descriptive name and the voltage at the pin. Four inputs are shown per screen page.

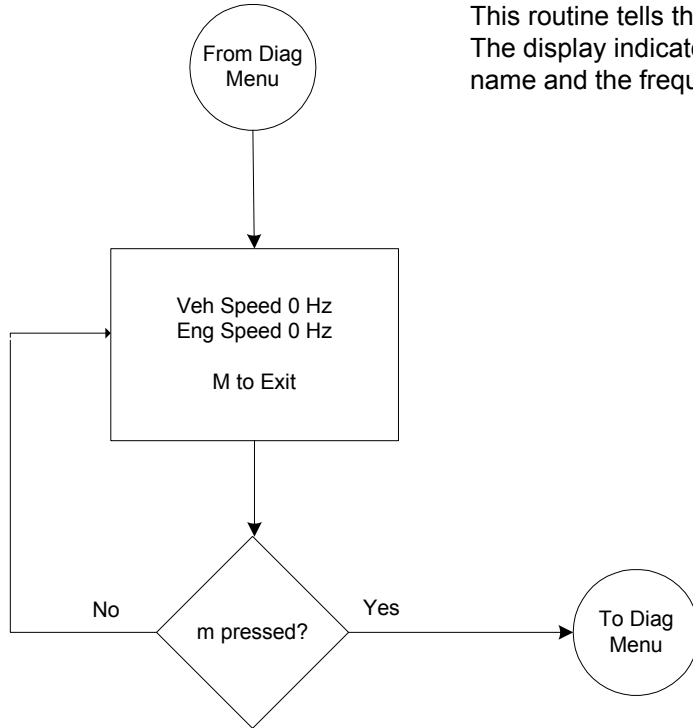


Inputs List:

Dimmer	0.0 V
Ignition	13.7 V
Brake Fail	5.0 V
External T	0.0 V
ABS	5.0 V

4.9.8. Frequency Inputs

This routine tells the operator the status of each frequency input. The display indicates the the frequency input by descriptive name and the frequency at the pin.



5. TROUBLE SHOOTING GUIDE

5.1. Gauges

5.1.1. Tachometer

Engine speed is read from a frequency input (pin 13) at the rate of 2 pulses/revolution. On board diagnostics can report the tachometer frequency input where 1 Hz = 30 RPM. If the frequency input to the cluster is missing, the cluster will display engine speed by reading it from the J1850 data bus. In this case, the needle movement can be jumpy due to the slow rate of transmission on the bus.

5.1.2. Speedometer

Vehicle speed is read from a frequency input (pin 14) at the rate of 4000 pulses/mile. On board diagnostics can report the speedometer frequency input where 1.11 Hz = 1 MPH. If the frequency input to the cluster is missing, the cluster will display vehicle speed by reading it from the J1850 data bus. In this case, the needle movement can be jumpy due to the slow rate of transmission on the bus.

5.1.3. Fuel

Fuel levels are read from the J1850 data bus.

5.1.4. Coolant Temperature

Temperature is read from the J1850 data bus.

5.2. Warning lights

5.2.1. Battery charge indicator

The warning light is turned on from a J1850 data bus message.

5.2.2. Low oil pressure

The warning light is turned on from a J1850 data bus message.

5.2.3. Check transmission

The warning light is turned on from a J1850 data bus message.

5.2.4. Cruise control

The warning light is turned on from a J1850 data bus message.

5.2.5. Left turn

On board diagnostics can report the status of the switch input at pin 19:

Low = warning light is off.

High = warning light is on.

5.2.6. Right turn

On board diagnostics can report the status of the switch input at pin 20:

Low = warning light is off.

High = warning light is on.

5.2.7. High beam

On board diagnostics can report the status of the switch input at pin 21:

Low = warning light is off.

High = warning light is on.

5.2.8. Check tires

On board diagnostics can report the status of the switch input at pin 31:

Low = warning light is on.

High = warning light is off.

5.2.9. ABS

On board diagnostics can report the status of the analog input at pin 23:

<1.6V = warning light is on.

>6.0V = warning light is off.

5.2.10. Brake

The brake warning light can be turned on from two different sources: the Park Brake input or Brake Failure input.

On board diagnostics can report the status of the switch input for Park Brake at pin 24:

Low = warning light is on.

High = warning light is off.

On board diagnostics can report the status of the analog input for Brake Failure at pin 25:

<1.6V = warning light is on.

>6.0V = warning light is off.

5.2.11. Seat belt

On board diagnostics can report the status of the switch input at pin 26:

Low = warning light is on.

High = warning light is off.

5.2.12. Service engine soon

On board diagnostics can report the status of the switch input at pin 27:

Low = warning light is on.

High = warning light is off.

5.2.13. Daylight running lamp

On board diagnostics can report the status of the switch input at pin 33:

Low = warning light is on.

High = warning light is off.

5.2.14. High idle

On board diagnostics can report the status of the switch input at pin 30:

Low = warning light is on.

High = warning light is off.

5.2.15. Range inhibit

The warning light is turned on from a J1850 data bus message.

5.2.16. Auto park

On board diagnostics can report the status of the switch input at pin 34:

Low = warning light is off.

High = warning light is on.

5.2.17. Overdrive off

On board diagnostics can report the status of the switch input at pin 16:

Low = warning light is on.

High = warning light is off.

5.3. Backlighting

5.3.1. Backlight LCD & display odometer (Headlights On input, Key in Ignition input)

The odometer is readable with the ignition off if the vehicle headlights are on, if the key is in the ignition or if the trip or mode buttons are pressed. If the headlight switch or key is used, the odometer turns on and off with the switch or key without a delay. If the trip or mode switches are used, the odometer will be visible for 15 seconds.

On board diagnostics can report the status of the switch input for Headlights On at pin 22:

Low = headlights are off.

High = headlights are on.

On board diagnostics can report the status of the switch input for Key in Ignition at pin 28:

Low = key is in ignition.

High = key is out of ignition.

On board diagnostics can report the status of the switch input for Trip Reset at pin 17:

Low = switch open.

High = switch closed.

On board diagnostics can report the status of the switch input for Mode at pin 18:

Low = switch open.

High = switch closed.

5.3.2. Backlight gauges (Headlights On input, Dimmer input)

When the headlights are on, the gauges, gauge pointers and LCD dim together in accordance with the dimmer input. (Note: If the headlights are off, then the LCD backlighting will be on full bright.)

On board diagnostics can report the status of the switch input for Headlights On at pin 22:

Low = headlights are off.

High = headlights are on.

On board diagnostics can report the status of the analog input for Dimmer at pin 4:

0 V = backlighting is off.

13.8 V = backlighting is on full bright

5.4. Misc.

5.4.1. Outside temperature

The message center will display outside temperature if the vehicle is equipped with a temperature sender.

On board diagnostics can report the status of the analog input at pin 3. The table below shows the relationship between temperature, temperature sender resistance and the voltage displayed on pin 3.

Temperature (C°/ F°)	Resistance (Ω)	Voltage (V)
-35/-31	OPEN	----V
0/32	9399	2.6
10/50	5658	2.0
20/68	3511	1.5
30/86	2240	1.0
40/104	1465	0.7
50/122	980	0.5

5.4.2. Door ajar

The message center will display Door Ajar if the vehicle is so equipped.

On board diagnostics can report the status of the switch input at pin 15:

Low = door open.

High = door closed.

5.4.3. Buzzer enable

A continuous buzzer alerts a driver to specific warning conditions. Activation requires the “buzzer enable” input grounded and appropriate message input. The buzzer is normally associated with an activated warning message or warning lamp.

On board diagnostics can report the status of the switch input at pin 32:

Low = buzzer enabled.

High = buzzer disabled.

5.4.4. Change Units, Metric or U.S.

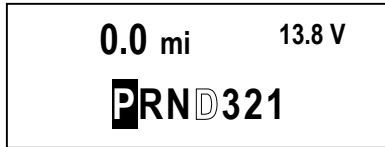
Any time the user is in normal operating mode, the units displayed in the message center can be toggled back and forth from Metric to U.S. by pressing and releasing both the TRIP and MODE buttons.

5.4.5. No J1850 Activity

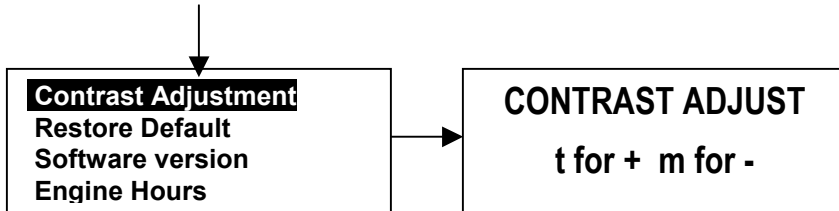
If the cluster cannot detect J1850 data bus activity, the message “No J1850 Activity” is displayed on the message center. J1850 enters the cluster on pin 12.

6. CLUSTER DIAGNOSTICS MENU TREE

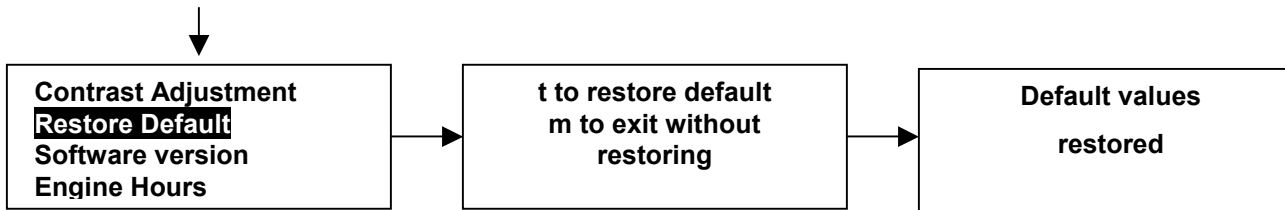
Default message center screen.



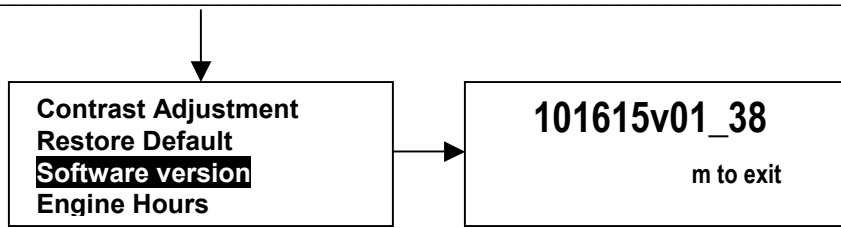
Press and hold MODE for > 5 seconds with transmission in PARK or PARK BRAKE set..



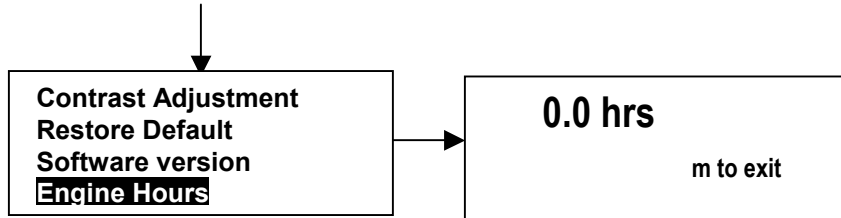
Press MODE to scroll down.



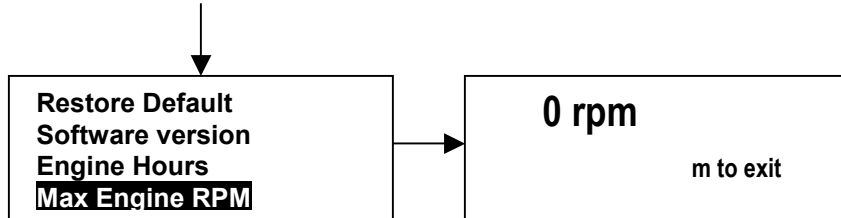
Press MODE to scroll down.



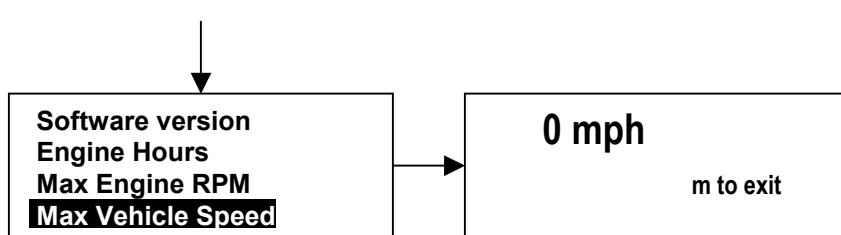
Press MODE to scroll down.



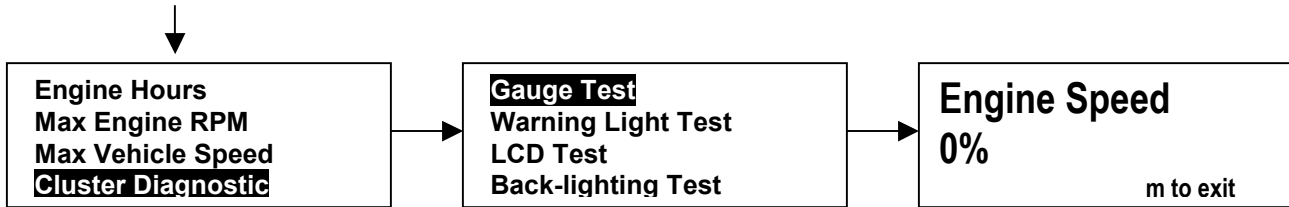
Press MODE to scroll down.



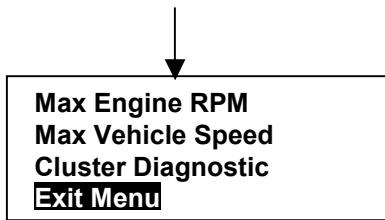
Press MODE to scroll down.



Press MODE to scroll down.



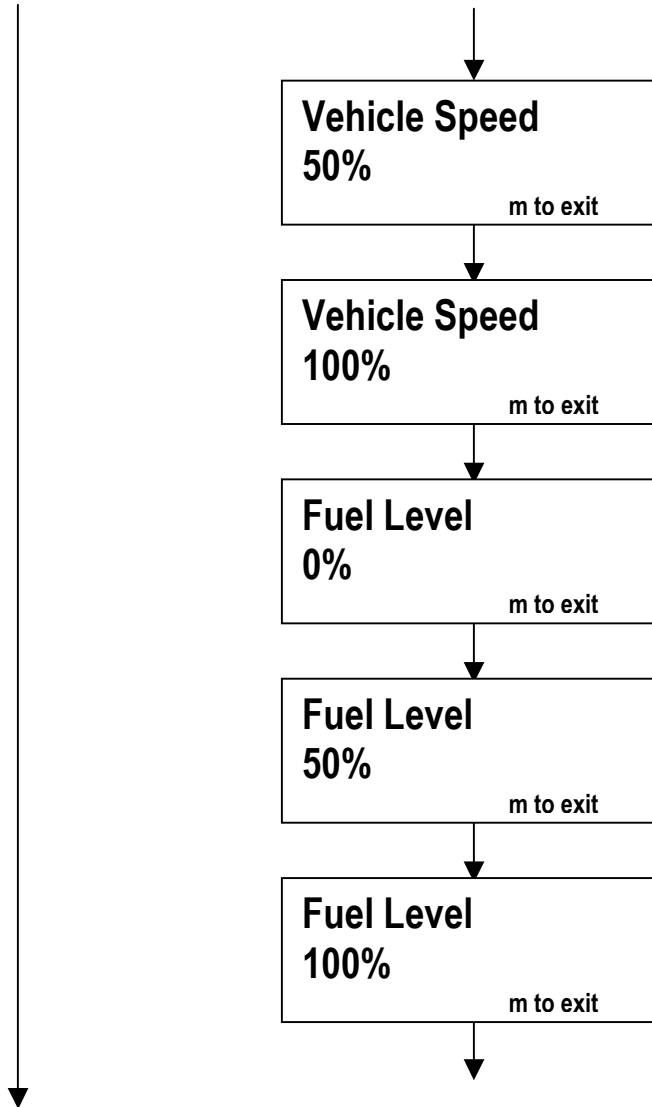
Press MODE to scroll down.

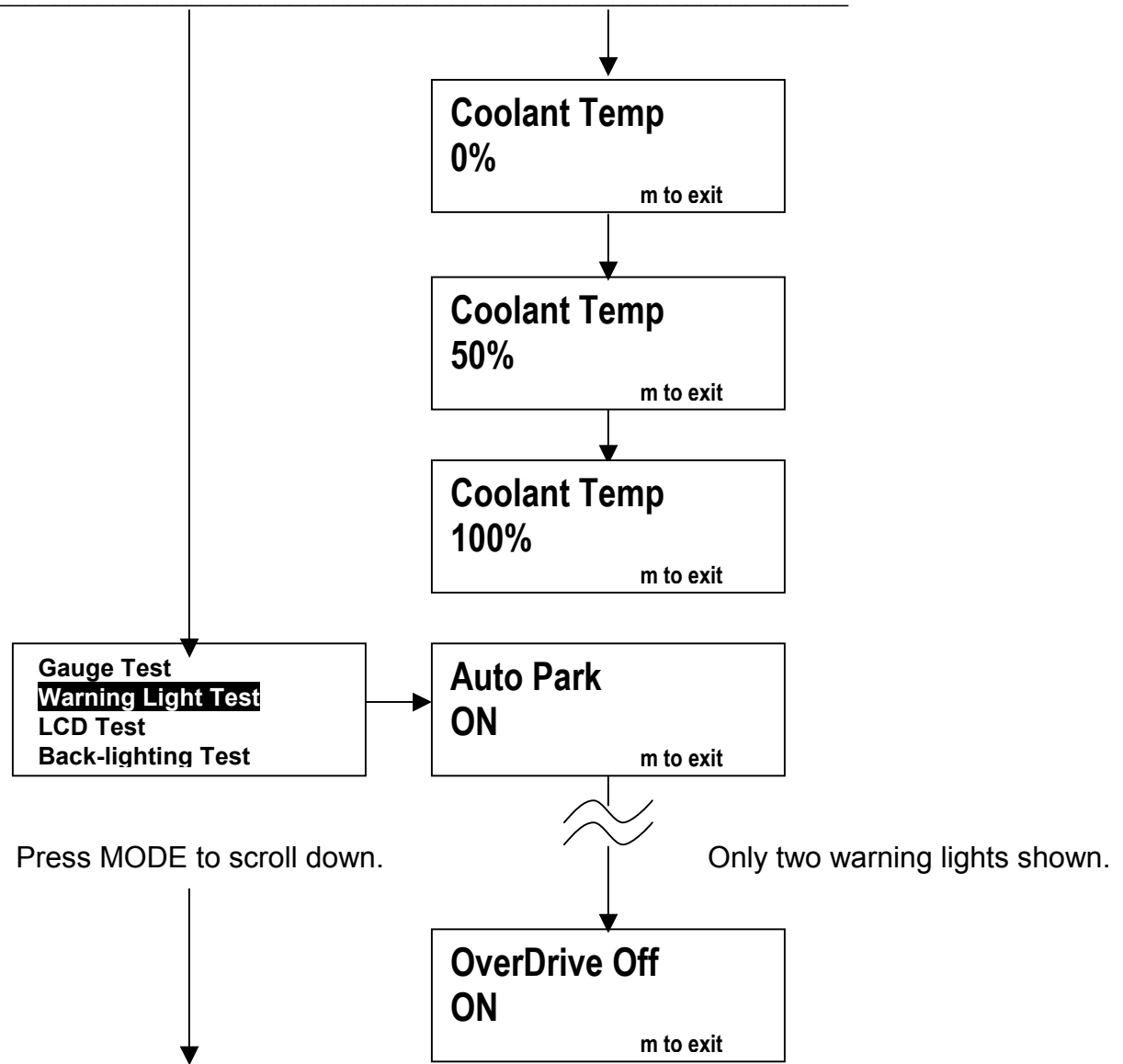


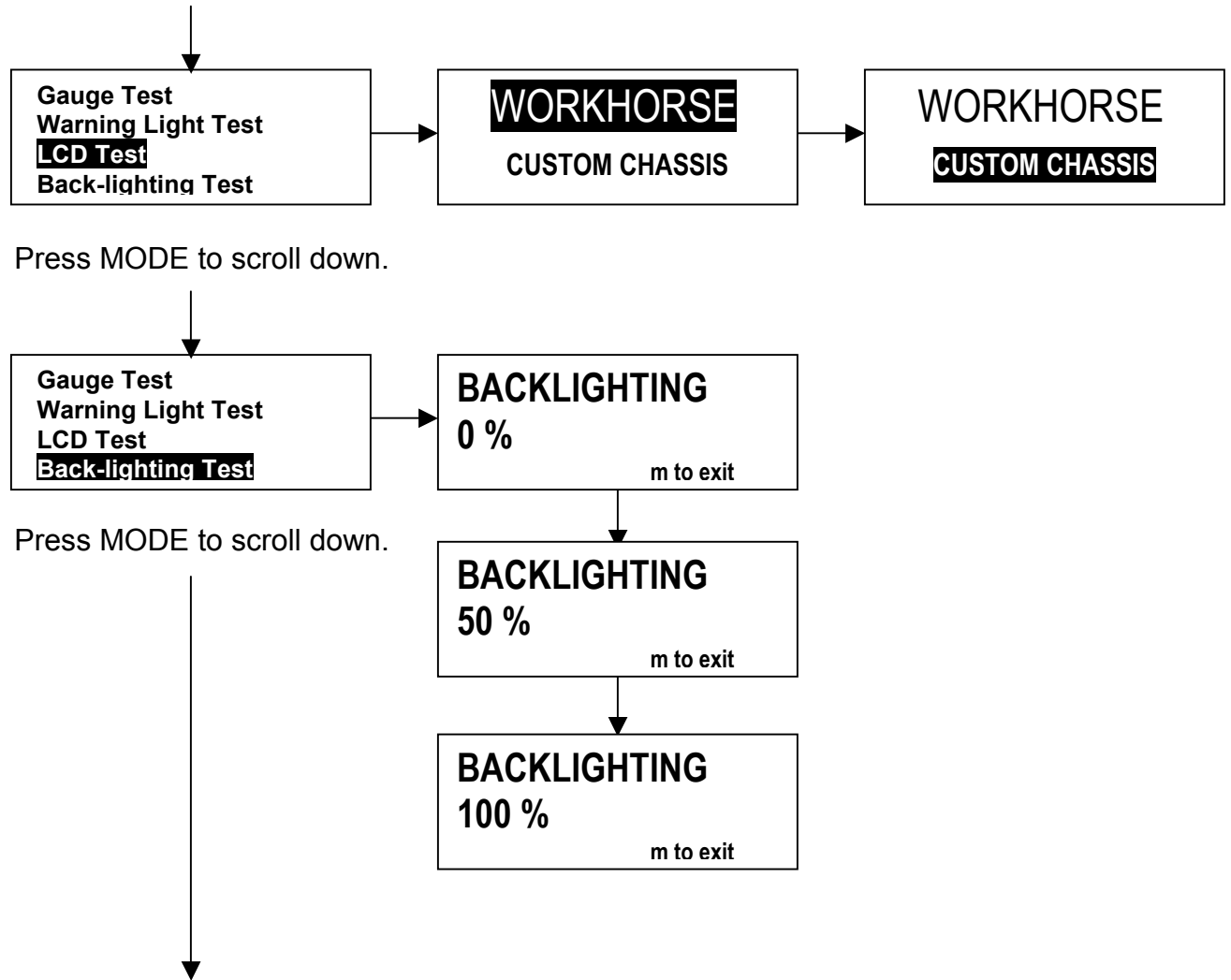
Press MODE to scroll down.

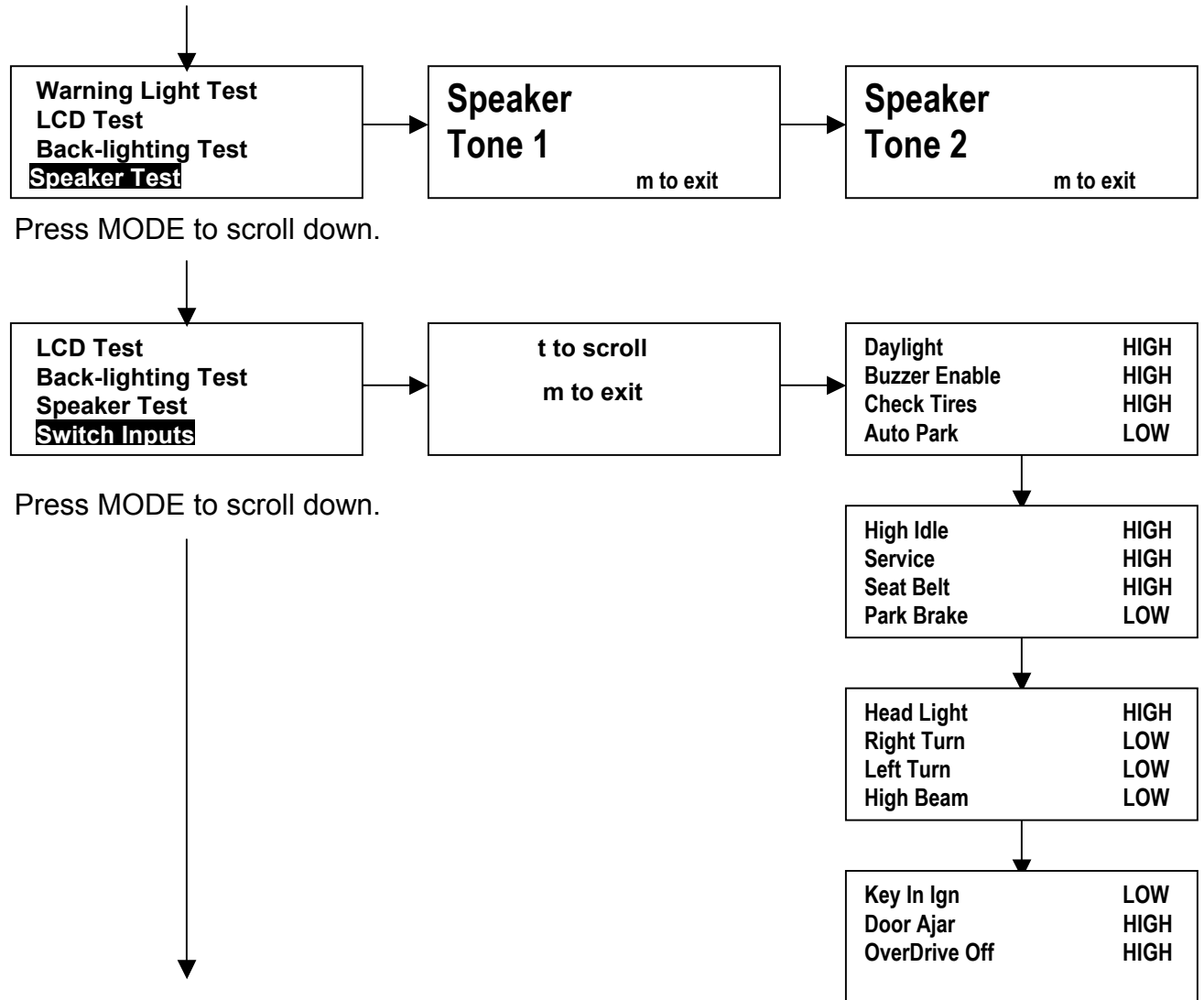


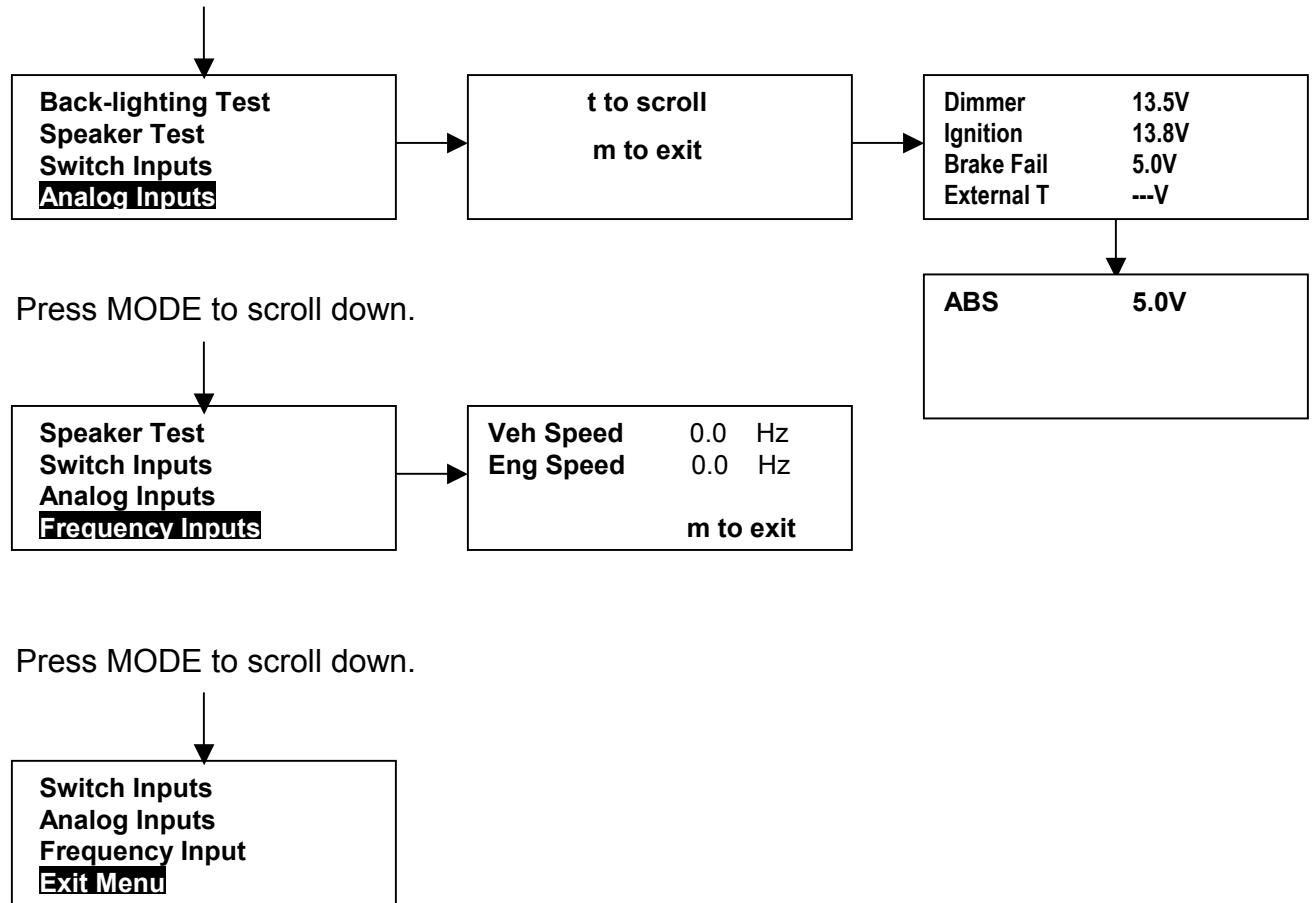
Return to default screen.











Return to default screen.