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SERVICE BULLETIN

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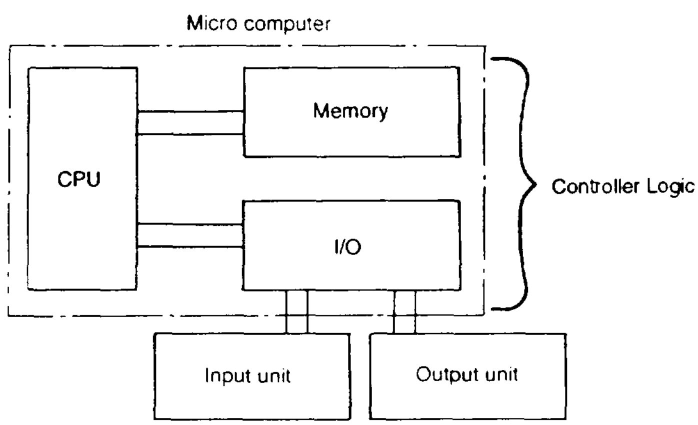
ELECTRONIC CONTROL UNITS

Electronic control units (ECU's) control the operation of numerous electrical systems and components on Nissan vehicles. The ECU's do this by either controlling the supply voltage or ground path of an electrical component. The following is an explanation of how these systems work and what precautions should be taken while performing diagnostic procedures.

Systems controlled by electronic control units have three (3) basic requirements, *Inputs, Controller Logic* and *Outputs.*



Inputs

Sensors and switches provide electrical signals to the control unit. These signals are provided to the ECU to inform it of various vehicle operating conditions. The electrical inputs can be either analog or digital signals. However, all of the signals are converted to digital signals before the ECU can process the information.

Control Logic

The ECU uses the electrical input signals to determine what the system should do. This decision may be based on a few or many inputs. After processing the information the ECU will provide a signal (output) to various electrical components.

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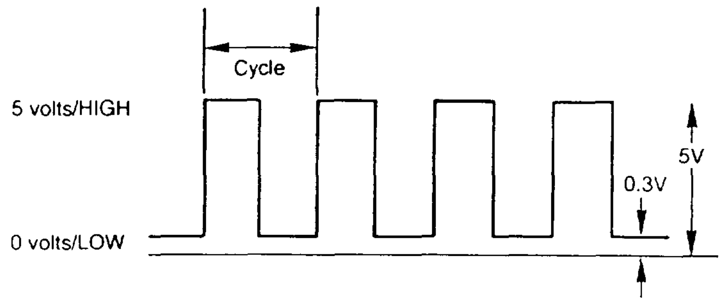
Outputs

The signal that the ECU puts out to an electrical component (actuator) is called the output. These output signals are what operate and control the system.

Digital Input Signals

Digital signals are ON-OFF (Hi-Low) voltage pulses. The signal below is a typical digital signal.



Examples of common digital signals are:

Battery Voltage
The ignition switch in the ACC or ON position provides a battery voltage signal to several control units. This informs the control unit of the ignition position.

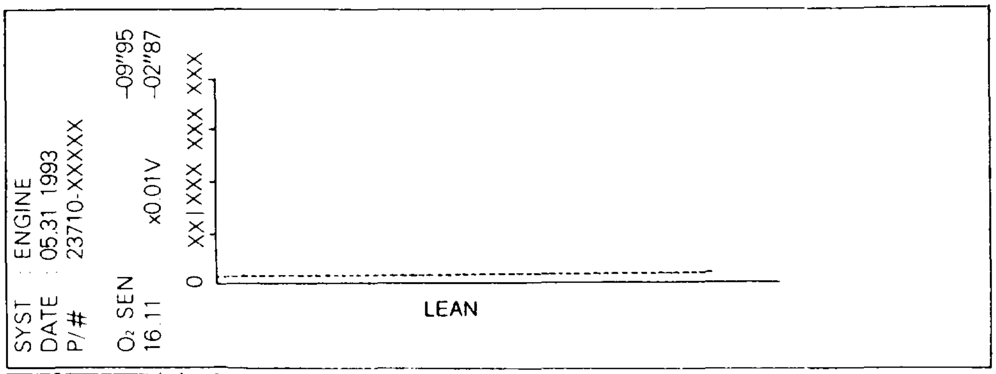
Switch to Ground
A door switch is a common example of a switch to ground. When the door is opened the door switch completes the circuit. The interior light is turned on. In addition, the time control unit is sent an OFF signal indicating the door is open.

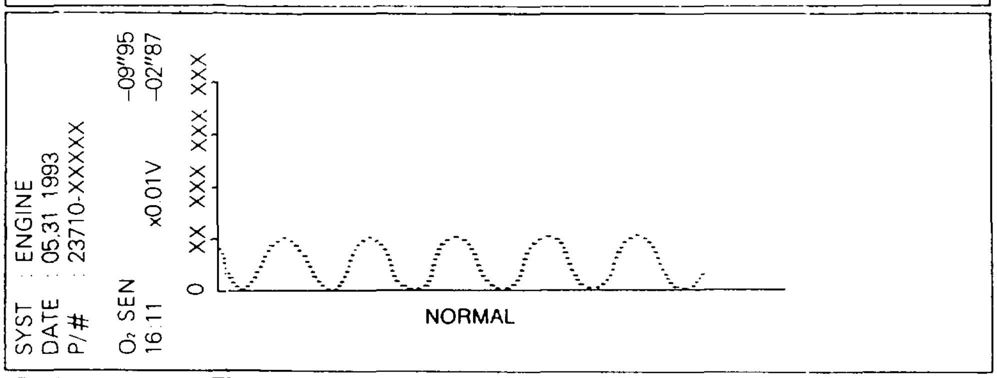
Pulse Voltage
A pulse voltage is made up of alternating high and low voltage signals of varying duration. These signals are counted by the control unit within a predetermined time frame.

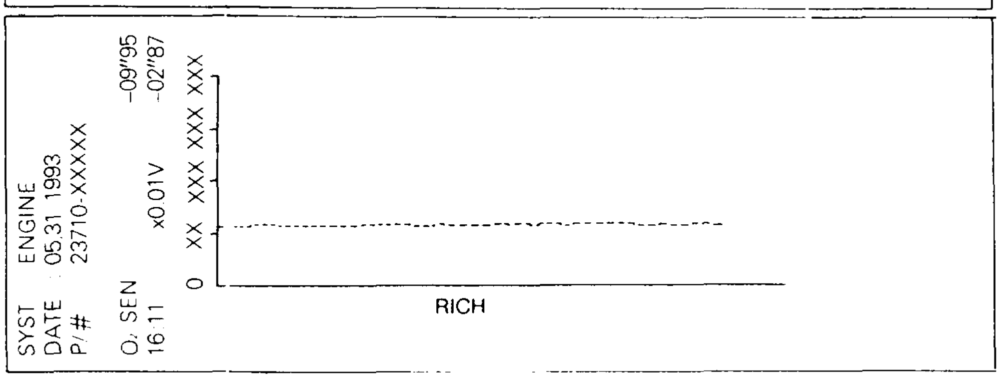
Analog Input Signals

An analog signal is a voltage that varies over a period of time. Analog signals are produced by sensors in the vehicle. Sensors change resistance to deliver variable voltage signals. The Oxygen Sensor sine wave signals below are typical analog signals. These charts are example signals printed using CONSULT.

- The first chart shows an Oxygen Sensor lean (low voltage) condition.
- The second chart is a normal Oxygen Sensor voltage printout.
- The third chart illustrates an Oxygen Sensor rich (high voltage) condition.







Examples of common sensors are:

Temperature Sensors
Temperature sensors change resistance with a change in temperature. This temperature is converted into an analog voltage range.

Vehicle Speed Sensor
The vehicle speed sensor produces an alternating voltage signal. This alternating signal (analog) is converted to a digital signal for processing.

The control unit can only process digital signals. Analog signals must be converted to a digital form before the information can be used by the control unit.

Control Unit Logic

The control unit processes digital signals in two forms. To the control unit the signal is either ON or OFF. In computer logic an ON or high voltage signal is a "1" and an OFF or low voltage signal is a "0". The control unit uses combinations of these signals to control its outputs. The controller uses inputs from many sensors to determine what outputs it will make and at what time it will make them. These outputs control a variety of functions from automatic speed control to engine driveability.

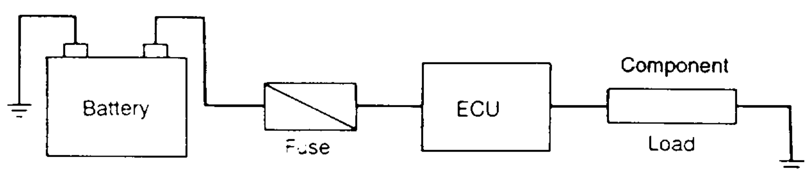
Outputs

An output is simply an action the control unit tells an electrical component to make. Based on the calculations the control unit makes of the inputs, it will signal an action. The output can tell a component to perform a function for a period of time.

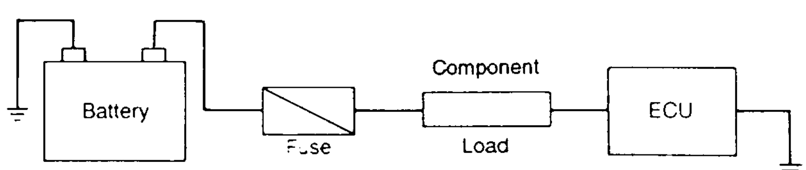
Power and Ground Control

The ECU controls either a component's power or ground. To understand this, refer to the diagrams below:

- If the ECU is between the electrical component (load) and the power source, the ECU controls its power.



- If the component is between the power source and the ECU, the ECU controls the component ground.



VOLTAGE DROP TEST

Service and Diagnosis Precautions

Before diagnosing any electronic controlled circuits the following **cautions** should be followed:

1. Make sure the following parts and systems are in good condition and are operating properly.
   - Battery output
   - Battery terminals
   - Grounds
   - System connectors are properly positioned and connected
2. **Never** use a test lamp to check an electronically controlled circuit.
3. Do not drop, jar or shake electronic components.

Follow the trouble diagnosis charts in the appropriate section of the Service Manual to isolate which component may be the incident part.

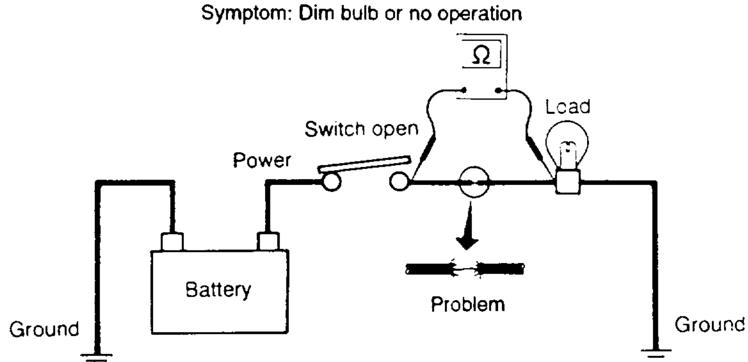
Voltage Drop Tests

Voltage Drop Tests are often used to find components or circuits which have excessive resistance. **A voltage drop in a circuit is caused by a resistance <u>when the circuit is in operation.</u>** Part of the available voltage is used by the resistance. When there is excessive resistance, less voltage is available for other loads (lights, motors, etc.) in the circuit. Since each resistance in a circuit uses voltage, a voltmeter can be used to isolate the cause of the problem.

A voltage drop across closed contacts can indicate excessive resistance. This can cause the circuit to operate incorrectly. Remember, a switch is not a load. During diagnosis, use a voltmeter to measure the voltage drop across each switch contact while the circuit is in operation.

Check the wire in the illustration below. If an ohmmeter is used to measure resistance, the single strand of wire still making contact would give an ohmmeter reading of 0 ohms. This would indicate a good circuit. When the circuit operates, this single strand of wire is not able to carry the current. It will become hot and have a high resistance to the current. This will be picked up as a voltage drop.

0 Ohms RESISTANCE
Symptom: Dim bulb or no operation

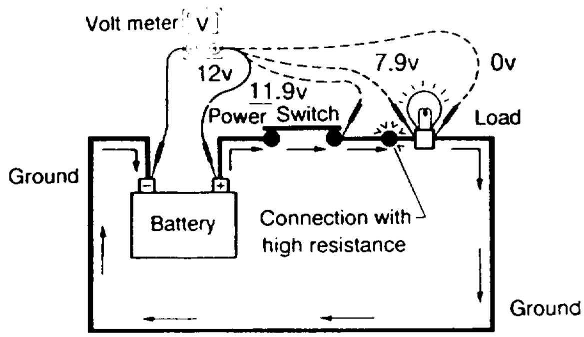


Unwanted resistance can be caused by many situations: -Undersized wiring (single strand)
-Corrosion on switch contacts
-Loose wire connections or splices

If repairs are needed always use wire that is of the same or larger gauge (lower number).

Measuring Voltage Drop

1. Connect the voltmeter across the connector or part of the circuit you want to check. The positive lead of the voltmeter should be closer to power and the negative lead closer to ground.



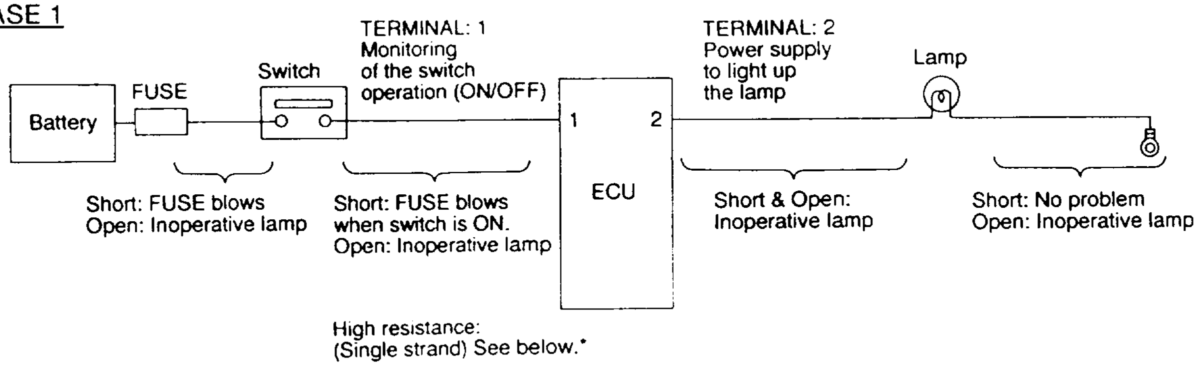
2. Operate the circuit

3. The voltmeter will indicate how many volts (voltage drop) are being used to "push" current through that part of the circuit.
   Note in the illustration that there is an excessive 4.1 volt drop between the battery and the bulb, or a 4.0 v. drop between the switch and the bulb.

Relationship between Open/Short circuit and the ECU pin control

System description: When the switch is ON, the ECU lights up the lamp.

CASE 1



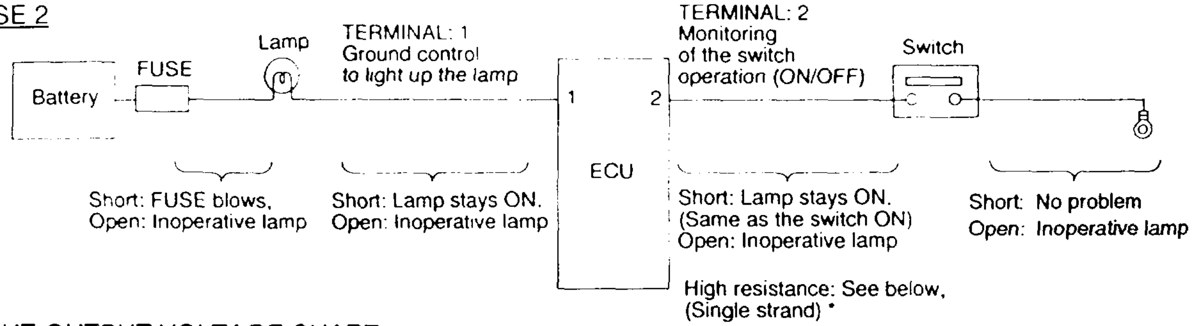
INPUT-OUTPUT VOLTAGE CHART

PIN NO.	ITEM	CONDITION	VOLTAGE VALUE [V]	In case of High resistance such as Single strand [V]*
1	SWITCH	SWITCH ON	Battery Voltage	Lower than battery voltage Approx. 8 (Example)
		OFF	Approx. 0	Approx. 0
2	LAMP	SWITCH ON	Battery Voltage	Approx. 0 (Inoperative lamp)
		OFF	Approx. 0	Approx. 0

The VOLTAGE VALUE is based on the body ground.

*If the high resistance such as the single strand exists in the switch side circuit, Terminal 1 does not detect battery voltage (does not know that the switch turned ON) even if the switch **does** turn ON. Therefore, the ECU does not supply power to light the lamp, which leads to the inoperative lamp.

CASE 2



INPUT-OUTPUT VOLTAGE CHART

PIN NO.	ITEM	CONDITION	VOLTAGE VALUE [V]	In case of High resistance such as Single strand [V]*
1	LAMP	SWITCH ON	Approx. 0	Battery voltage (Inoperative lamp)
		OFF	Battery Voltage	Battery voltage
2	SWITCH	SWITCH ON	Approx. 0	Higher than 0 Approx. 4 (Example)
		OFF	Approx. 5	Approx. 5

The VOLTAGE VALUE is based on the body ground.

*If the high resistance such as the single strand exists in the switch side circuit, Terminal 2 does not detect Approx. 0 v. (does not know that the switch turned ON) even if the switch **does** turn ON. Therefore, the ECU does not control ground to light up the lamp, which leads to the inoperative lamp.

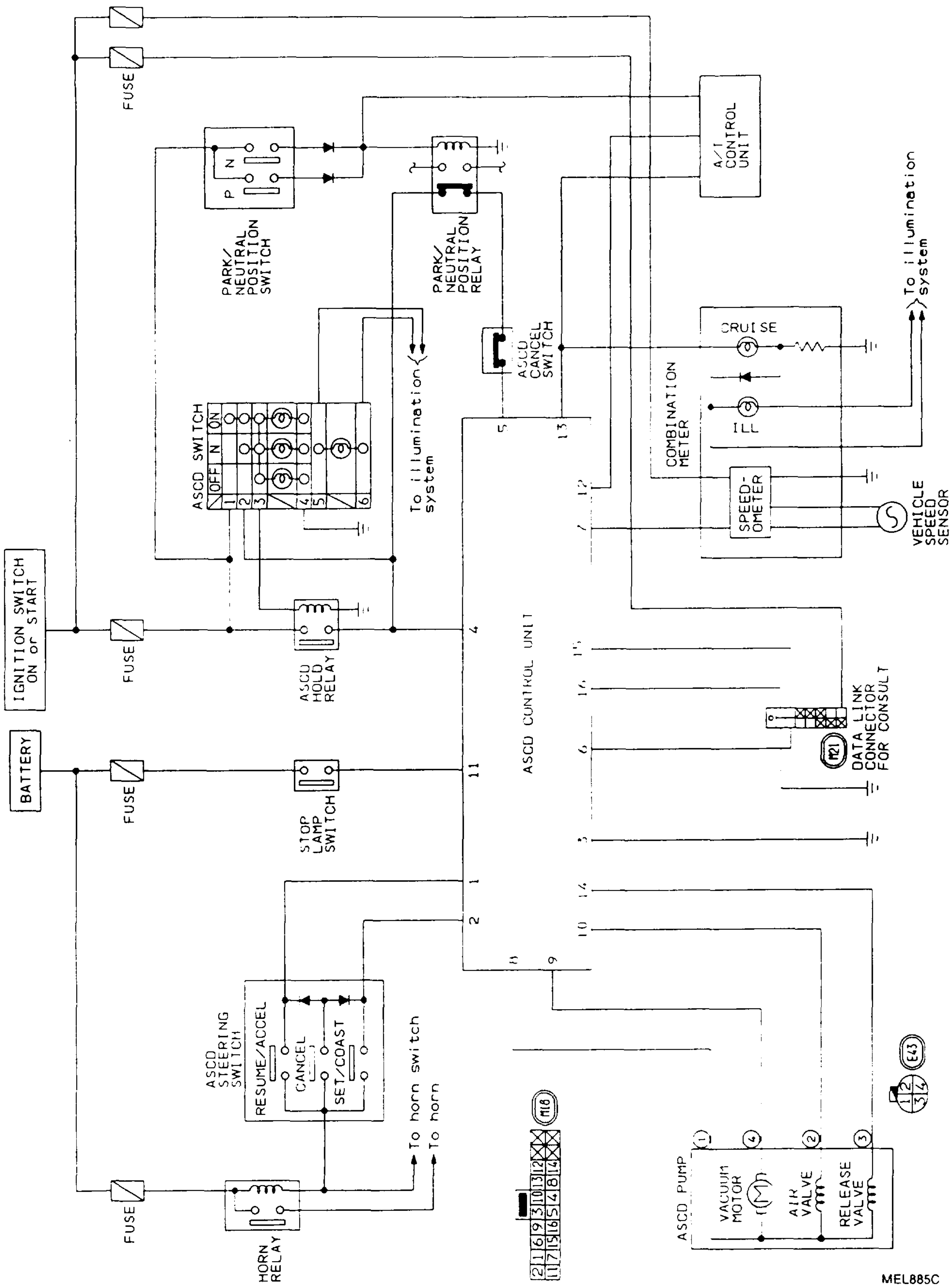
The chart below indicates appropriate pin voltages for the ASCD system:

Pin Test Chart

(Example) ASCD System

Terminal No.	Item	Condition		Voltage Value (V)*
4	ASCD switch	Ignition ON	ON or N	Battery voltage
			OFF	Approx. 0
1	RESUME/ACCEL switch	ON		Battery voltage
		OFF		Approx. 0
1, 2	CANCEL switch	ON		Approx. 5
		OFF		Approx. 0
2	SET/COAST switch	ON		Battery voltage
		OFF		Approx. 0
5	ASCD cancel signal	IGN: ON ASCD SW: ON INH SW: except P,N	Brake or Clutch pedal Released	Battery voltage
			Depressed	Approx. 0
11	Stop lamp switch	ON (Brake pedal depressed)		Battery voltage
		OFF (Brake pedal released)		Approx. 0
8	Output for vacuum motor, air/release valve	IGN: ON ASCD SW: ON		Battery voltage
9	Vacuum motor	IGN: ON ASCD SW: ON	Stopping	Battery voltage
			Operating	Approx. 0
10	Air valve		Stopping	Battery voltage
			Operating	Approx. 0
14	Release valve		Stopping	Battery voltage
			Releasing	Approx. 0
7	Vehicle speed sensor		Rear wheels rotating	0 - 5
13	CRUISE indicator	IGN: ON, ASCD SW: ON		Battery voltage
12	OD cancel switch	During ASCD operating	OD	Approx. 8
			Except OD	Less than 1

*The voltage values are based on the body ground.



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