

### Principles of Operation

The PCM -controlled charging system, or "Smart Charge" charging system, determines the optimal voltage set point for the charging system and communicates this information to the voltage regulator. The "Smart Charge" charging system is designed to set 1 of 6 DTCs any time a charging system fault is present. All of the DTCs can set continuous faults, but not all DTCs will set as on-demand faults.

DTC	<u>KOEO</u>	<u>KOER</u>	Continuous
P0562	X	X	X
P0563		X <sup>a</sup>	X <sup>a</sup>
P0620			X
P0625		X	X
P0626		X	X
P065B			X

<sup>a</sup>Requires vehicle speed above 8 mph.

This system uses 2 communication lines between the PCM and the generator/voltage regulator. Both of these communication lines use Pulse-Width Modulation (PWM) . The generator communication (GENCOM) line communicates the desired set point from the PCM to the voltage regulator. The generator monitor (GENMON) line communicates the generator load and error conditions to the PCM . The GENCOM command is only sent by the PCM when it is necessary to adjust the voltage set point. If the set point does not need to be changed, several seconds may elapse between PCM GENCOM commands. This normal operation will appear in the PID as occasional "bursts" of pulse-width commands. The third pin on the voltage regulator, the A circuit pin, is a circuit dedicated to monitor or sense battery voltage.

The PCM simultaneously controls and monitors the output of the generator. When the current consumption is high or the battery is discharged, the PCM will raise engine speed as needed to increase generator output. The generator charges the battery and at the same time supplies power for all of the electrical loads that are required. The battery is more effectively charged with a higher voltage when the battery is cold and a lower voltage when the battery is warm. The PCM is able to adjust the charging voltage according to the battery temperature by using a signal from the Intake Air Temperature (IAT) sensor. The PCM also uses other inputs to control charging system voltage such as the Vehicle Speed Sensor (VSS) and Engine Coolant Temperature (ECT) . The voltage set point is calculated by the PCM and communicated to the voltage regulator by the GENCOM circuit based on the needs of the vehicle and the conditions.

The PCM turns off the generator during cranking to reduce the generator load and improve cranking speed. Once the engine starts, the PCM slowly increases generator output to desired voltage.

The PCM controls the charging system warning indicator by sending a message over the High Speed Controller Area Network (HS-CAN) to the Instrument Cluster (IC) or Instrument Panel Cluster (IPC) . The IC /IPC will then control charging system warning indication based on the message from the PCM . The status of the PCM charging system warning indicator and/or message can be confirmed by viewing PCM PID generator fault indicator lamp (GENFIL). Any charging system fault detected by the PCM will result in 1 or more DTCs being set and the PID GENFIL having a status of On. If equipped with a charging system warning indicator, the IC /IPC will turn the indicator ON or OFF. If equipped with a message center, the IC /IPC will display a CHECK CHARGING SYSTEM message. When the ignition is ON and the engine is OFF on vehicles equipped with a message center, the CHECK CHARGING SYSTEM message may not be displayed. For information regarding the IC /IPC and message center, refer to [Section 413-01](#).

Under certain circumstances, the charging system may have a concern, but will still keep the battery charged and the vehicle running. GENCOM is normally used to initiate charging, but the generator may charge with a fault in this circuit. If the engine is operated at greater than 2,000 rpm momentarily, the generator may "self-excite" or start charging on its own. The charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed, and the generator operates in a default mode (approximately 13.5 volts) until the engine is turned off. When the engine is restarted and the engine is operated at greater than 2,000 rpm momentarily, the generator may again self-excite and again the charging system warning indicator is illuminated and/or CHECK CHARGING SYSTEM message is displayed.

The PIDs and their associated descriptions used in the charging system diagnosis are listed below:

## PID Chart

PID	Description	Normal Display	Associated Circuit Name	Connector, Circuit
GENMON	Generator Monitor	Constant fluctuating percentage 3%-98%	Generator monitor (GENMON)	C102A-1, CDC15 (VT)
GENCMD	Generator Command	Fluctuating percentage or small intermittent bursts 3%-98%	Generator communication (GENCOM)	C102A-2, CDC10 (BU/OG)
GENVDSD	Generator Voltage Desired	Voltage varies by vehicle needs - May be controlled by an output state control	—	—
GENFIL	Generator Fault Indicator Lamp	OFF if charging system is OK	—	—
GENCMD_LF	Generator Command Line Fault	NO FAULT if GENCOM circuit (GENCMD PID) is OK	—	—
GENMON_HZ	Generator Monitor Frequency	Frequency value	—	—
VPWR	Module Supply Voltage	Within 0.5 volt of battery voltage	—	—
RPM	Engine Revolutions Per Minute	Engine rpm — May be controlled by an output state control	—	—