Troubleshooting Guide for EPM Electric Power Manager

Hazard Definitions

These terms are used to bring attention to presence of hazards of various risk levels or to important information concerning product life.

WARNING — Indicates presence of hazard(s) that can cause severe personal injury, death or substantial property damage if ignored.

CAUTION — Indicates presence of hazard(s) that can cause minor personal injury or property damage if ignored.

NOTICE — Indicates special instructions on installation, operation or maintenance that are important but not related to personal injury hazards.

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Battery Conditions

NOTICE — Until temperatures of electrical system components stabilize, these conditions may be observed during cold start voltage tests.

- **Maintenance/Low Maintenance Battery:**
  - — Immediately after engine starts, system volts measure lower than regulator setpoint and system amps measure at a medium level.
  - — 3-5 minutes into charge cycle, volts increase and amps decrease.
  - — 5-10 minutes into charge cycle, volts reach regulator setpoint or very close, and amps decrease to a minimum.
  - — Low maintenance battery has same characteristics with slightly longer recharge times.
- **Maintenance-free Battery:**
  - — Immediately after engine starts, system volts measure lower than regulator setpoint with low charging amps.
  - — Once the charge cycle begins, low volts and low amps are still present.
  - — After the alternator energizes, voltage will increase several tenths. Amps will increase gradually, then quickly, to medium to high amps.
  - — Finally, volts will increase to setpoint and amps will decrease.

  The time it takes to reach optimum voltage and amperage will vary with engine speed, load, and ambient temperature.
- **High-cycle Maintenance-free Battery:**
  - — These batteries respond better than standard maintenance-free. Charge acceptance of these batteries may display characteristics similar to maintenance batteries.

Battery Charge Volt and Amp Values

Volt and amp levels fluctuate depending on the battery state of charge. If batteries are in a state of discharge—as after extended cranking time to start the engine—system volts will measure lower than the regulator setpoint after the engine is restarted and system amps will measure higher. This is a normal condition for the charging system; the greater the battery discharge level, the lower the system volts and the higher the system amps. The volt and amp readings will change as batteries recover and become fully charged: system volts will increase to regulator setpoint and system amps will decrease to low level (depending on other loads).

- **Low Amps:** Minimum or lowest charging system amp value required to maintain battery state of charge, obtained when testing the charging system with a fully charged battery and no other loads applied. This value will vary with battery type.
- **Medium Amps:** System amps value which can cause the battery temperature to rise above adequate charging temperature within 4-8 hours of charge time. To prevent battery damage, the charge amps should be reduced when battery temperature rises. Check battery manufacturer's recommendations for proper charge amp rates.
- **High Amps:** System amps value which can cause the battery temperature to rise above adequate charging temperature within 2-3 hours of charge time. To prevent battery damage, the charge amps should be reduced when battery temperature rises. Check battery manufacturer's recommendations for proper charge amp rates.
- **Battery Voltage:** Steady-state voltage value as measured with battery in open circuit with no battery load. This value relates to battery state of charge.
- **Charge Voltage:** Voltage value obtained when the charging system is operating. This value will be higher than battery voltage and must never exceed the regulator voltage setpoint.
- **B+ Voltage:** Voltage value obtained when measuring voltage at battery positive terminal or alternator B+ terminal.
- **Surface Charge:** Higher than normal battery voltage occurring when the battery is disconnected from battery charger. The surface charge must be removed to determine true battery voltage and state of charge.
- **Significant Magnetism:** Change in strength or intensity of a magnetic field present in alternator rotor shaft when the field coil is energized. The magnetic field strength when the field coil is energized should feel stronger than when the field is not energized.
- **Voltage Droop or Sag:** Normal condition occurring when the load demand on alternator is greater than rated alternator output at given rotor shaft RPM.

EPM Description and Operation

EPM Electric Power Manager used with these units

- is rated for continuous current at 200 A on 28 V side. The 14 V side is rated for continuous current at 100 A.
- manually connects batteries after battery connect switch on vehicle is pressed.
- automatically disconnects batteries from vehicle loads 3 minutes after engine shuts down.
- provides 28 V auxillary output power for up to four 20 A channels and 14 V auxillary output power for one 20 A channel, protected by an internal, reset-table, electronic circuit breaker.
- keeps batteries connected to system when emergency flashers are activated.

Normal Start-Up Procedure

1. Press the vehicle battery-connect switch for about one second to connect batteries to electrical system.
2. Turn START-RUN switch to RUN.
3. Wait until glow plug light goes off.
4. Turn START-RUN switch to START and crank engine.
5. Return switch to RUN when engine starts.
6. If engine fails to crank, turn START-RUN switch to OFF, repeat steps 1-5 above.

Emergency Start-Up Procedure

WARNING This procedure will bypass EPM and batteries in system. Use this procedure ONLY when vehicle must be removed immediately from location in an EMERGENCY.

1. Connect slave vehicle Nato connector to vehicle.
2. Follow steps 2-5 under “Normal Start-Up Procedure.”
3. Disconnect slave NATO connector after engine is running.

Shutdown Procedure

1. Place gear shift in park or neutral and set parking brake.
2. Turn start-run switch to OFF to stop engine.
3. Batteries will be disconnected from vehicle in 3 min. unless emergency flashers are on, then batteries will stay connected until flashers are turned off or battery is discharged.

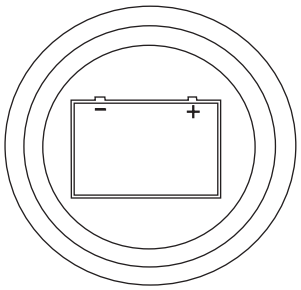


Figure 1 – Battery Connect Switch

CAN/J1939 Interface

DESCRIPTION AND OPERATION

The EPM is compatible with CAN bus standard for digital networks and uses the SAE J1939 communications protocol.

CEN uses MIL-STD connector MS3112E12-10P to interface between the EPM and the DPA adapter used to monitor the broadcast messages on the CAN bus line. The readouts of these messages are shown in Table 2 for the EPM.

TABLE 1 – J1939 Connector Circuit Identification

Pin	Identification
A	CAN High
B	CAN Low
C	CAN Shield
D	Ground
E	Restricted use
F	Restricted use
G	Restricted use
H	unused
J	unused
K	+28V power

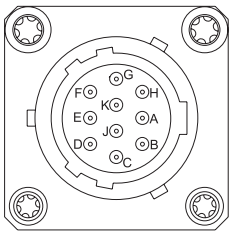


Figure 2 – J1939 Connector Pins

TABLE 2 – EPM/J1939 Readout Diagnostics (With Engine Running)

EPM Readout	Expected Reading
Load Voltage 28 V System	27–29 V
Load Voltage 14 V System	13.5–14.5 V
Alternator Speed	1200 to 6000 RPM
Battery Voltage 28 V System	27–29 V
Battery Voltage 14 V System	13.5–14.5 V
EPM Temperature	–50°F (–46°C) to 200°F (93°C)
Charging and Discharging Current of 28 V Battery	10 A (varies according to battery condition)
Batt Charging 28 V LED	OK
Batt Charging 14 V LED	OK
Main Switches On	OK
Cranking Detected	OK
Emergency Flasher Detected	OK

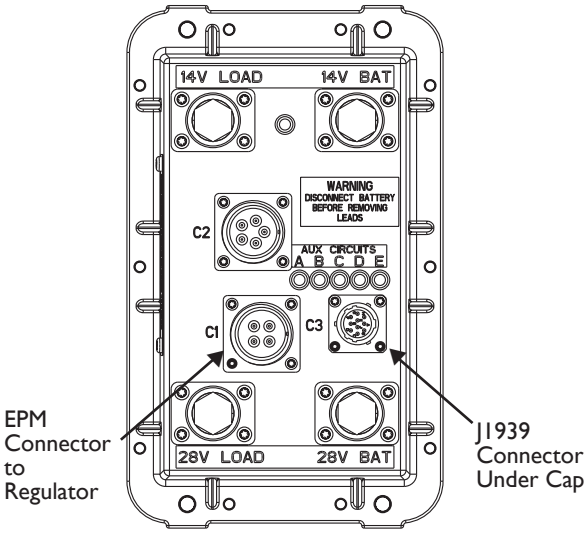


Figure 3 – EPM Electric Power Manager

Tools and Equipment for Job

- Digital Multimeter (DMM)
- Ammeter (digital, inductive)
- Jumper wires

If no tools are available, monitor LED code.

Basic Troubleshooting

1. **Inspect charging system components**
   Check connections at ground cables, positive cables, and regulator harness. Repair or replace any damaged component before troubleshooting.
2. **Inspect EPM connections**
   Connections must be in proper sequence and clean and tight. See Figure 4, page 5.
3. **Inspect connections of vehicle batteries**
   Connections must be clean and tight.
4. **Determine battery type, voltage, and state of charge**
   Batteries must be all the same type for system operation. If batteries are discharged, recharge or replace batteries as necessary. Electrical system cannot be properly tested unless batteries are charged 95% or higher. See page 1 for details.

EPM Electric Power Manager

DESCRIPTION AND OPERATION

Main diagnostic feature of the EPM is a green LED located on the top of the device. The EPM connects and disconnects batteries based on operational requirements.

EPM also allows batteryless operation until vehicle is shut off.

TABLE 5 – AUX Circuit and LED Functions

Pin	Function (Max. 30 A)	LED Color Normally On	If LED OFF:
A	14 V	GREEN	A short or overcurrent may have occurred. Check AUX load wiring and reset EPM by pressing battery connect switch
B	28 V	GREEN	
C	28 V	GREEN	
D	28 V	GREEN	
E	28 V	GREEN	

TABLE 3 – EPM LED Diagnostics

EPM LED COLOR	EPM STATUS
Off (Clear)	EPM is not energized or EPM is defective.
Flashing GREEN	Batteries connected for 3 minutes for engine starting after battery connect switch pressed.
Steady GREEN	Normal operation (batteries are connected to the system and engine is running)

TABLE 4 – EPM Harness Plug Socket Functions

Pin	Function
A	Battery Ground
B	Alternator Phase Signal
C	Energize (Active Low) Signal
D	Ignition Signal

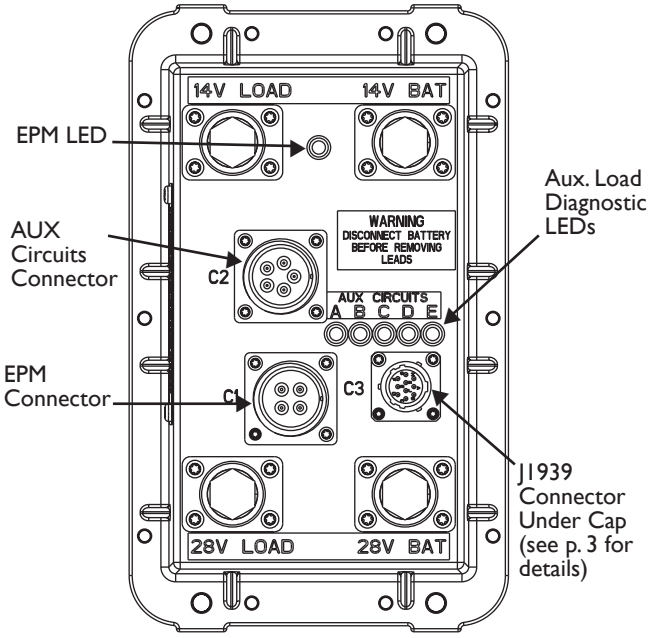


Figure 4 – EPM Electric Power Manager

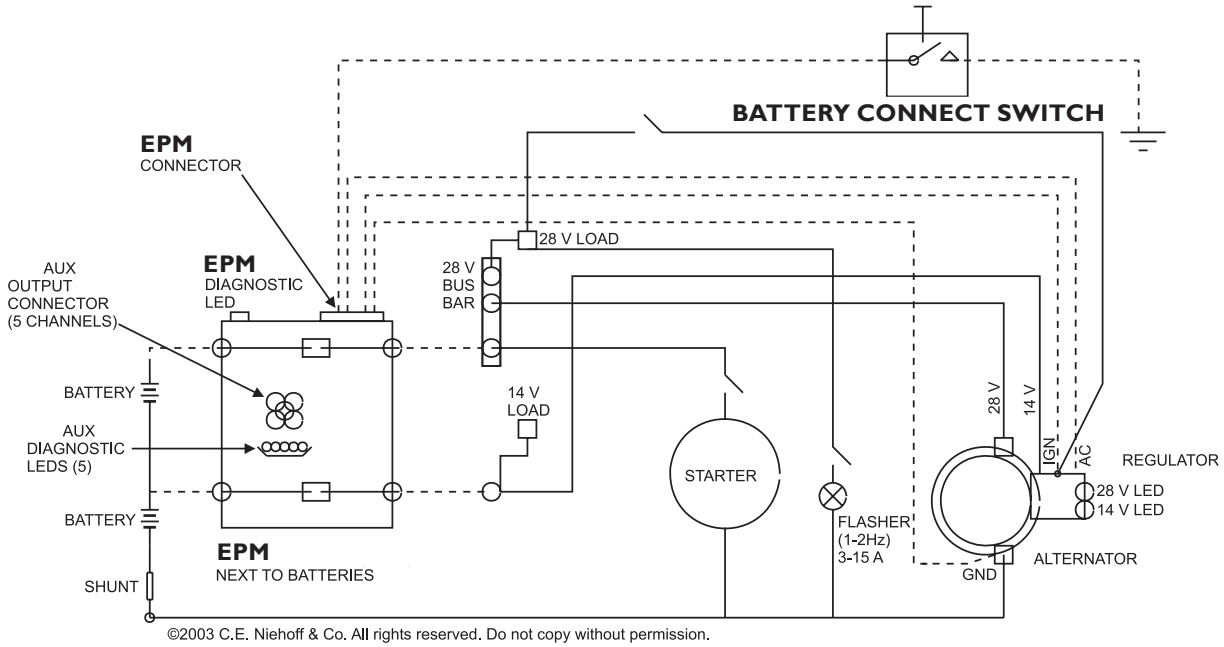


Figure 5 – EPM System Schematic

CAUTION

Troubleshooting sequences must be performed during 3-minute delay after battery connect switch on vehicle is pressed. If main LED on EPM is not flashing GREEN, press switch to reactivate system. LED on EPM must be flashing GREEN while performing tests.

Chart 1 – Engine Will Not Crank at Start-Up

Before Troubleshooting, Check Batteries for Proper Charge Voltage. See Page 1.

Turn START-RUN switch to OFF. Press vehicle battery connect switch. Check LED on EPM. Is LED flashing GREEN?

- **Yes**
  - Check for continuity across 28 V and 14 V terminals on EPM. Does continuity exist?
    - **Yes** → Check and repair starter and starter wiring as necessary. Re-test.
    - **No** → EPM is defective.
- **No**
  - Disconnect 4-socket harness at EPM. While pressing vehicle battery connect switch, check for continuity between socket C on EPM harness plug and ground. Does continuity exist?
    - **Yes** → EPM is defective.
    - **No** → Check and repair vehicle battery connect switch and wiring as necessary. Re-test.

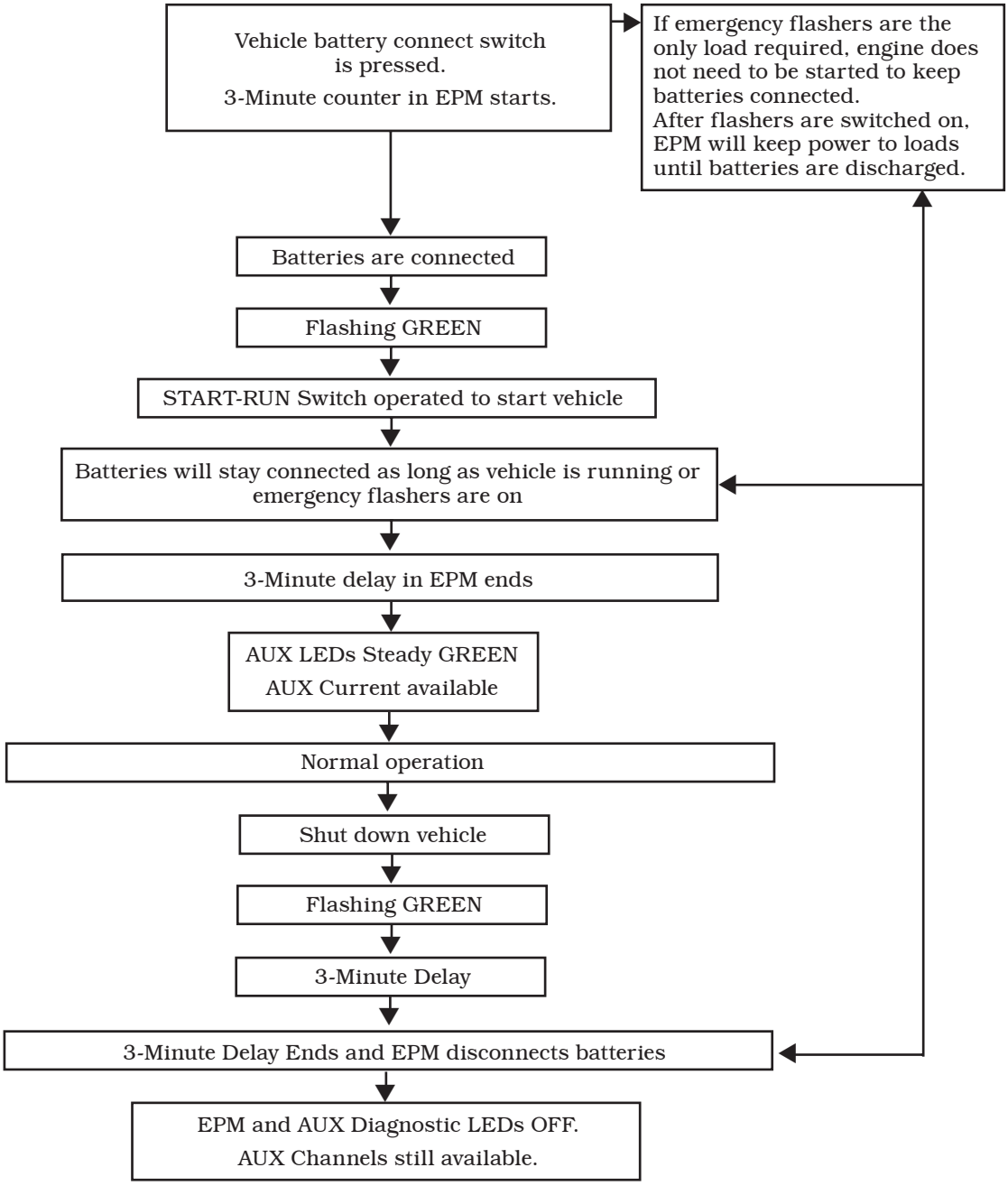
Chart 2 – No Power to Aux. Loads –One or More LEDs are OFF

Before Troubleshooting, Check Batteries for Proper Charge Voltage. See Page 1.

Disconnect Aux. Load harness from EPM. Turn start-run switch to OFF. Press vehicle battery connect switch. Is LED on EPM flashing GREEN?

- **Yes**
  - Are all five Aux diagnostic LEDs lit on EPM?
    - **Yes** → Check and repair load and load wiring as necessary. Re-test.
    - **No** → EPM is defective.
- **No** → EPM is defective.

Chart 3 – 28V Only – EPM Sequence of Operation



If you have questions about your alternator or any of these test procedures, or if you need to locate a Factory Authorized Service Dealer, please contact us at:

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