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Mack Models

Mack Model	CH , RB , DM , CHN , CL , CT , CV , CX , CXM , LE , MR , RD

** SOLUTION **

Title	V-MAC III Engine Cranks But No Start
Cause	Service Engineering has seen E-Tech (V-MAC III) engine-cranks-but-no-start conditions that can result from a variety of electrical circumstances.

Solution

1. INTRODUCTION

Service Engineering has seen E-Tech (V-MAC III) engine-cranks-but-no-start conditions that can result from a variety of electrical circumstances. For an E-Tech engine (V-MAC III) to have the ability to start, the following conditions must exist:

- the fuel supply gallery pressure must be approximately 90 PSI;
- the engine sleep mode CDP engine control parameter must be programmed to No;
- the V-MAC modules (VECU & EECU) must power up and down in the correct sequence (VJ3-13 power relay control);
- the V-MAC modules must be able to communicate on either the J1939 or J1587 data link while the engine is cranking;
- the supply voltage (EJ2-10, EJ2-22, EJ2-41) to the EECU must not fall below 6 volts while the engine is cranking. Test must be performed with an oscilloscope. A digital voltmeter will not capture the very rapid voltage fluctuations.
- the engine speed must measure a steady result between 150 and 200 RPM while the engine is cranking.

This engine-cranks-but-no-start condition has resulted from any of the following electrical problems:

- the engine sleep mode is programmed to yes;
- after an engine shutdown request has be satisfied (after the key is cycled off and the engine has shutdown), the VECU (step 4) does not de-energize the power relays. This is a power up/down sequence problem that results from a defective VECU;
- greased power relay contacts can also result in a improper powering up sequence. There must be no grease on the power relay contacts;
- the black VECU connector (VJ3) and terminals are improperly assembled. This will inhibit the VECU to EECU communications;
- the Cab harness is entangled with the clutch pedal linkage. This can cause a multitude of open or short circuits that will inhibit the VECU to EECU communications.
- the gray engine/transmission transition (interface) connector and terminals are improperly assembled. This will inhibit the VECU to EECU communications and or EECU power supply;
- for conventional models, the EPDM fuse 40 wiring and terminal connections are not electrically tight. This will inhibit the EECU power supply.
- Batteries must be able to pass an electrical load test.
- Starter motor amperage draw is within manufacturer’s specifications.

2. DIAGNOSTICS

This diagnostic procedure assumes that adequate cranking fuel pressure has been established, there is no severe mechanical engine damage (bent valves), and there are no fault codes logged on either the VECU or EECU.

As necessary, perform the following steps in descending order. Conduct the necessary corrective actions to get the results expected for normal conditions. If necessary, proceed to the next step.

2.1 Visual Inspection

First, this diagnostic procedure conducts a detailed visual inspection of all the relays, connectors and terminals that link the V-MAC power, ground, and communication lines between the Cab Harness, Transmission Harness and Engine Harness.

Disconnect the following connectors and visually inspect them for corrosion, loose connections, and/or improper assembly:

- EJ1 connector (at the front end of the EECU);
- EJ2 connector (at the rear end of the EECU);
- Engine/Transmission transition connector (gray 15-way, left side of flywheel housing);
- J1939 3-Way Deutsch connector(s);
- for conventional models, Engine Power Distribution Module (EPDM)/Transmission connector (gray 12-way, below right side of EPDM);
- for conventional models, EPDM fuse 40 terminals and wiring (inspect from the back side the EPDM);
- Cab/Transmission Bulkhead connector (23-way for conventional models, and 31-way for COE models);
- Battery power supply ring terminals at the starter relay and starter solenoid;
- Battery ground return ring terminals at and the 135 ampere circuit breaker;
- Electrical Equipment Panel power relays and fuse 16 (and fuse 40 for COE models) terminals;
- VJ3 Connector (black VECU connector).

2.2 E-Tech Engine Sensor & Flywheel & Cam Gear Timing Checks.

Disconnect the Flywheel Sensor from the engine harness, crank engine for up to 10 seconds to see if engine will start using only Engine Position Sensor as an input to the V-MAC module and log a code 3-2 for the Flywheel Sensor. Switch off ignition and reconnect the Flywheel Sensor to the engine harness.

Disconnect the Engine Position Sensor from the engine harness, crank the engine for up to 10 seconds to see if the engine will start using only the Flywheel Sensor as an input to the V-MAC module and log a code 3-4 for the Engine Position Sensor. Switch off ignition and reconnect the Engine Position Sensor to the engine harness.

If the engine is able to start and run on only one of either of the two sensors proceed with the checks of the Flywheel and the Cam Gear. Perform both checks to ensure accurate diagnosis.

2.2.1 Flywheel Check

- Using the TC mark on the flywheel, set the engine to TDC on #1 cylinder, put a temporary chalk, grease pencil or paint mark as a reference point on the bell housing casing access hole that will indicate the centerline of any one of the ring gear teeth.
- Turn the engine in the REVERSE of engine rotation ***exactly*** 61½ teeth using the reference point on the bell housing casing access hole. The centerline between the two missing teeth on the flywheel ring gear should be aligned in the center of the flywheel sensor hole.

NOTE: If the centerline of the two missing teeth on the flywheel ring gear is **not** aligned in the center of the flywheel sensor hole, the ring gear has slipped from its original position and the flywheel/ring gear assembly will need to be replaced as a unit.

2.2.2 Cam Gear Check

- With the engine position unchanged from the test in step 2 of the Flywheel Check above, mark a 2nd reference point on the bell housing casing access hole that indicates the centerline of another of the ring gear teeth.
- Turn the engine in the normal FORWARD engine rotation ***exactly*** 34¼ teeth. The cam gear timing hole should be in the center of the hole for the engine position sensor located in the timing gear cover.

NOTE: If the sensor hole in the cam gear face is not on the center line of the hole for the engine position sensor, the cam timing to the crankshaft has changed and has to corrected.

- Continue to turn the engine in normal FORWARD rotation 9 ¾ more teeth. The second hole in the cam gear should align in the center of the timing gear cover sensor hole.

NOTE: If the cam to crankshaft timing is suspected to be incorrect, perform the cam timing check described in the E-Tech Engine Service Manual 5-106 (on CD #1).

2.2.3 Off-Engine Flywheel Check

- The number of teeth on the flywheel should be 117.
- Using a straight edge, align the crankshaft dowel pin and pilot bearing to find the center of the flywheel. Once the straight edge is aligned, count the number of teeth on the ring gear from the two cut-out teeth to the straight edge and this distance should represent exactly 9 teeth
- If you encounter more or less than 9 teeth after counting, the ring gear has slipped on the flywheel and the flywheel will need to be replaced.

2.3 VECU & EECU Communication Test

Second, using the fault logging capacity of the VECU and EECU, the V-MAC power up and down sequence, and the VECU to EECU communication lines are tested.

2.3.1 Power Relay Cycle Down Test

With the key cycled Off and the power relays deactivated, measure the voltage at fuses 16 and 40. Both measurements should be zero. If either measurement reads 12 volts, a power relay is stuck closed or the VJ3-13, VJ3-17, or 40-A circuit is shorted high.

2.3.2 Power Relay and Ignition Test

With the key cycled On and with the engine cranking, measure the voltage at the VECU pins VJ1-1 (ignition) and VJ3-13 (power relay). Both measurements must be 10.5 volts or greater. If either measurement is below 7 volts, the switched or clean power is shorting low or open.

2.3.3 Switched Power Test

With the key cycled On and with the engine cranking, measure the voltage at fuses 16 and 40. Both measurements must be 12 volts. If either measurement is below 7 volts, the switched or clean power is shorting low or open.

2.3.4 ECU Fault Logging J1939 Test

- Remove the ABS fuses (for most cases, 13, 14, and 29).
- Remove fuse 16, crank the engine, then check the fault table for logged faults.
- By powering up the EECU only, the 6-3, 6-4, and 6-5 J1939 and J1587 fault codes will be logged on the EECU. If these codes (in any combination) are not logged on the EECU, then this module is not powering up.
- Disconnect EJ2 from the Engine ECU. Then, while the engine is cranking, measure the voltage between terminals EJ2-10 (high) and EJ2-12 (low), EJ2-22 (high) and EJ2-24 (low), and EJ2-41 (high) and EJ2-43 (low) at the EJ2 connector. If the voltage measure is below 7 volts, the switched or clean power is shorting low or open.

NOTE: To eliminate power relay 3, remove power relay 3 and install a jumper wire between terminals 30 and 87.

- Install fuse 16, remove fuse 40, crank the engine, then check the fault table for logged faults.
- By powering up the VECU only, while the engine is cranking, the electronic malfunction light will illuminate and a 6-4 J1939 fault will be logged on the fault table. If this code is not logged on the VECU, this module is not powering up.
- With the VJ3 connector installed on the Vehicle ECU and while the engine is cranking, measure the voltage between terminals VJ3-17 (high) and VJ3-18 (low) at the VJ3 connector. If the voltage measure is below 7 volts, the switched or clean power is shorting low or open. This test can also be performed with the VJ3 connector disconnected. However, you must jump terminals C and D at the diagnostic connector, which will energize circuit VJ3-13 and the power relays.
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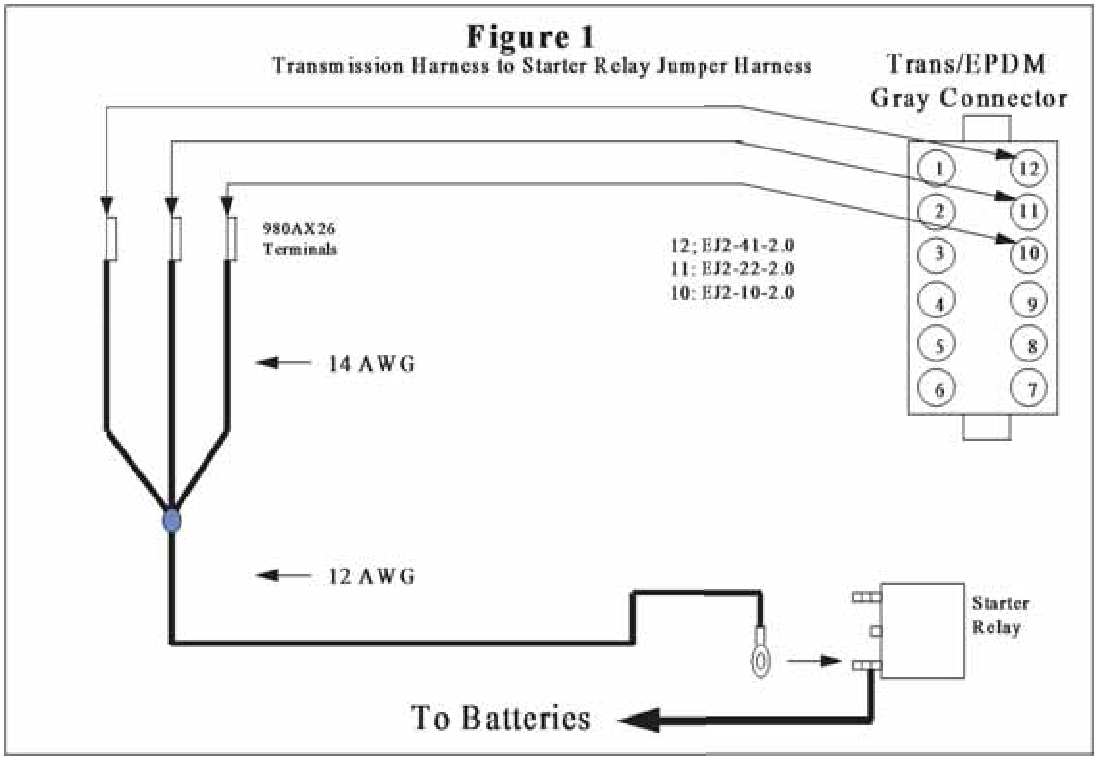
  NOTE: To eliminate power relay 1 (or power relay 2 for CH/CL and R Series with the Delphi cab harness), remove power relay 1 (or 2) and install a jumper wire between terminals 30 and 87.

  IMPORTANT: IF THE MALFUNCTION LIGHT IS ILLUMINATED AND 6-4 and/or 6-3 BLINK CODE IS FLASHED, THE EECU IS NOT POWERING CORRECTLY. TO INSURE THAT THE EECU IS GETTING ADEQUATE POWER, DO THE FOLLOWING:

- Make up a jumper harness, see Figure 1.



- Disconnect the gray 12-way Deutsch connector from between the EPDM and the Transmission harness.
- Attach the jumper harness between the Transmission harness gray 12-way Deutsch connector and the battery side of the starter relay. See Figure 1.
- Cycle the key and start the engine.
- If the engine starts and the malfunction light goes out and the #3 power relay circuitry is working (see above), then there is a problem inside the EPDM harness.
- If necessary, replace the EPDM harness.

2.4 Engine Speed Signal Input Test

Third, using the fault logging capacity of the VECU and EECU, the engine speed signal inputs to the EECU are tested.

2.4.1 Engine Speed Cranking RPM Test

- Install fuse 40.
- Using Service Diagnostics software, monitor the engine speed while the engine is cranking.
- Depending on the battery state of charge, the cranking engine speed should measure between 150 to 200 RPMs. If there is no engine speed measured or an NA is recorded, either both the engine speed sensors are out of adjustment or the engine ECU is not powering up correctly.

NOTE: If an NA or no engine coolant temperature and/or no intake manifold temperature are detected with monitor parameters, the VECU is not communicating with the EECU. This can be the result of the EECU not powering up correctly.

2.4.2 Engine Speed Fault Code Test

- Test the response of the engine speed and position sensors.
- Disconnect the engine speed sensor connector, crank the engine, then check the fault table. By cranking the engine with the engine position sensor input only, the 3-2 engine speed sensor fault code will be logged on the EECU. If the 3-2 fault is not logged, the EECU is not seeing the engine position sensor input.
- Connect the engine speed sensor connector.
- Disconnect the engine position sensor connector, crank the engine, then check the fault table. By cranking the engine with the engine speed sensor input only, the 3-4 engine position sensor fault code will be logged on the EECU. If the 3-4 fault is not logged, the EECU is not seeing the engine speed sensor input.

2.5 EECU EUP Output Test

Fourth, the engine ECU EUP output signals are tested.

Measure the voltage drop across an EUP as the engine is cranking. If the EECU is trying to energize the solenoid, a small voltage reading will be measured (0.12 volts AC or 0.016 DC). If the EECU is powering up correctly, the VECU is not in sleep mode, and there is no measurable voltage drop across any EUP solenoid, substitute a known good EECU and VECU.

At this point, if no results have been achieved, complete the following chart and contact Service Engineering.

Dealer Code	Technician	Model	Serial #
	Test to perform	Test Range	Result
EECU: Software	Datafile	VECU: Software	Datafile
Introduction – preliminary checks			
1.	Record logged codes, identify EECU codes vs. VECU codes		
2.	Engine starts with Cam sensor disconnected	Yes / No	
3.	Engine starts with Flywheel sensor disconnected	Yes / No	
4.	Fuel supply pressure	Approx. 90PSI	
		Yes /	

5.	Engine sleep mode programmed to “No”	No	
6.	Power relays de-energize the VECU. (Step4)	Yes / No	
7.	Codes EECU logged w/ fuse 16 removed and engine cranking with key on		
8.	Codes VECU logged w/ fuse 40 removed and engine cranking with key on		
9.	Batt volts to EJ2-10,22,41 greater than 6V (test to be performed with oscilloscope not DVOM)	6.5V to 11.5V	
10.	Fuse panel terminals are grease free and each applies secure grip to power relays	Yes / No	
11.	Fuse panel terminals are grease free and each applies secure grip to all fuses	Yes / No	
12.	EPDM panel terminals are grease free and each applies secure grip to fuse 40	Yes / No	
13.	Batteries pass an electrical load test (Refer to manufactures Load Testing specifications)	Yes / No	
14.	Cab harness is not entangled in the foot pedal mechanisms	Yes / No	
15.	Starter motor amperage draw test compares to likewise application. (Compare test results to similarly configured truck ie. Engine, temperature, starter motor, batteries etc.)	Yes / No	
Visual Inspection – disconnect & inspect for corroded, loose, damaged & improperly assembled			
16.	EJ1 connector	Yes / No	
17.	EJ2 connector	Yes / No	
18.	VJ1 VJ2 VJ3 connectors	Yes / No	
19.	Engine / Transmission Transition connector	Yes / No	
20.	J1939 connectors	Yes / No	
21.	EPDM/Transmission connector. Grey 12-way Conventional Models	Yes / No	
22.	EPDM fuse 40 terminals and wiring Conventional Models	Yes / No	

23.	Cab/Transmission bulkhead connector (23-way Conventional Models) (31-way COE Models)	Yes / No	
24.	Battery power supply terminals at battery	Yes / No	
25.	Battery power supply terminals at starter solenoid	Yes / No	
26.	Battery power supply terminals at starter relay	Yes / No	
VECU & EECU Communication Test			
27.	Power relays deactivate with key cycled OFF	Yes No	
28.	VJ1-1 & VJ3-13 have 10.5V or greater with key on and engine cranking	Yes No	
29.	Fuses 16 & 40 have 10.5V or greater with key on and engine cranking	Yes No	

Solution visibility	Dealer distribution

Function(s)/component(s) affected

Function affected	EECU , MID 144 – VECU , VECU , VMAC , wiring harness , starting

Function Group

Function Group	16 electrical standard parts , 21 engine , 23 fuel system, excluding gas propulsion , 31 1 battery; energy storage system , 367 electronic components

Customer effect

Main customer effect	power supply , stop/start

Conditions

Vehicle operating mode	on start-up , when stationary
Frequency of occurrence of problem	random

Administration

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