Engine Mount (EM) & Neptune (EP)

This Repair Manual is divided into two parts.

Part I. *EM motors manufactured for model year 2006 and later (s/n AG and later).*

Click on blue Case to jump to the linked discussion/resolution:

Part II.

All Neptune/EP and EM motors manufactured prior to year 2006 (s/n AF) and earlier.

Click on blue Case to jump to the linked discussion/resolution:

Engine Mount (EM) & Neptune (EP)

This Repair Manual is divided into two parts.

Part I. *EM motors manufactured for model year 2006 and later (s/n AG and later).*

Part I - Case I. EM motor does not run.

Step 1. Check for proper voltage and polarity. Check for any corroded connections.

Step 2. Disconnect motor leads from control module and connect motor leads to 12-volt power source. (This applies to 12, 24, or 36-volt models.)

A. If motor does not run, the problem is in the motor lower unit. Disassemble and check lower unit for voltage at the brushes, water in lower unit, worn brushes, bad brush springs, or an open or shorted armature. Repair/replace parts as necessary. Test motor for proper operation.
NOTE: EM motors are subject to high vibration. Make sure to use the correct armature as called out on the EM parts list. Also, in 2010 insulator pads were added to all EM motors, P/N 2385110. These pads act as vibration dampeners. They are installed between the legs of the EM bracket and the anti-cavitation plate of the gasoline engine. Please add these pads to early units that may not have them installed.

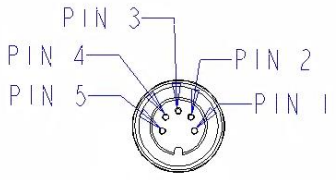
B. If motor ran when motor leads were connected directly to 12vdc, the problem is either with the hand controller or control module.

B-1. Test hand controller:

Hand Controller Test Procedure

1. Set your VOM to check for continuity. With the speed selector knob in the "OFF" position check to verify that there is no continuity across pins 1 and 3.
2. Rotate speed selector knob clockwise to the forward position, pins 1 and 3 should show continuity.
3. Rotate speed selector knob counterclockwise to the reverse position. Pins 1 and 3 should show continuity.
4. With the speed selector knob in the "OFF" position and your VOM set to measure resistance, measure the resistance across pins 2 and 5. The resistance value should be between 950-1050 ohms.
5. Measure the resistance across pins 2 and 4. The resistance value should be between 400-600 ohms.
6. With your VOM probes across pins 2 and 4, rotate speed selector counterclockwise to full reverse. Resistance should gradually decrease to less than 2 ohms.
7. Rotate speed selector clockwise to full forward. Resistance across pins 2 and 4 should gradually increase to between 990-1000 ohms.

The hand controller is faulty if any of these steps do not match.



Plug End (Pin End View) of Hand Controller

B-2. If the hand controller tests okay, the problem is with the control module. Test control module to verify problem:

a. Connect control module to appropriate power source.

b. Plug in known good (tested as per above) hand controller directly to control module. Check for voltage at module output leads by hooking up test light (or motor) to control output leads. Vary the speed control setting. Test light (or motor) should vary with the potentiometer setting. Replace control module, as necessary.

Part I - Case II. Motor runs in one direction only.

Step 1. Check hand controller and control module plug ends pins and connector sleeves for corrosion. Clean, if needed, reconnect and test again for proper operation.

Step 2. Test hand controller per test procedure on **page 1**.

- **A.** Replace hand controller if it tests faulty.
- **B.** If the hand controller tests okay, the problem is with the control module. Test control module to verify problem:
  - **B-1.** Connect control module to appropriate power source.
  - **B-2.** Plug in known good (tested as per above) hand controller to control module. Check for voltage at module output leads by hooking up test light (or V.O.M. probes) to control output leads. Vary the potentiometer / speed control setting. Test light (or V.O.M.) should vary in intensity with the potentiometer setting. Replace control module, as necessary.

Part I - Case III. There is a gap between the propeller and the end bell housing.

Step 1. On the earliest version of the 2006 EM motors, the armatures utilized an E-ring behind the commutator to act as an end-play spacer. Sometimes the E-ring would pop off the armature shaft due to the vibration of the outboard. The later designs removed the E-ring and use a bushing placed on the armature to act as the spacer. Replace the armature with a current version.

Part I - Case IV. Twin EM motor units only (160/EM, 202/EM, RT160/EM, or RT202/EM): 1 motor runs, 1 doesn't.

Step 1. On the one motor that doesn't run, disconnect motor leads from the control module and connect motor leads to 12-volt power source. (This applies to 12, 24, or 36-volt models.)

- **A.** If motor does not run, the problem is in the motor lower unit. Disassemble and check lower unit for voltage at the brushes, water in lower unit, worn brushes, bad brush springs, or an open or shorted armature. Repair/replace parts as necessary. Test motor for proper operation.
- **B.** If motor does run, go to **Step 2**.

Step 2. Check control module plug end pins for corrosion. Clean, if needed, reconnect and test again for proper operation. If both motors still do not run, go to **Step 3**.

Step 3. If test was done correctly, the control module could be faulty, test control module to verify problem:

- **A.** Connect control module to appropriate power source.
- **B.** Plug in hand controller to control module. Check for voltage at module output leads by hooking up a test light (or motor) to control module output leads. Vary the potentiometer / speed control setting. Test light (or motor) should vary in intensity (or speed) with the potentiometer setting. NOTE: VOM usage not recommended as it will not show a varying voltage due to pulsed/PWM output from control module. With PWM output voltage does not vary, only the length of time between "on" pulses varies. Replace control module, as necessary.

Part II.

All Neptune/EP and EM motors manufactured prior to year 2006 (s/n AF) and earlier.

Part II - Case I. Motor does not run.

Step 1. Check for proper voltage and polarity. Visually check to see that all wires are attached to proper control board terminals. Consult appropriate wiring diagram for the model and board being tested. Check for any corroded connections. Clean / rewire, if necessary.

Step 2. Disconnect motor leads from control module and connect motor leads to 12-volt power source. (This applies to 12 or 24-volt models.)

A. If motor does not run, the problem is in the motor lower unit. Disassemble and check lower unit for voltage at the brushes, water in lower unit, worn brushes, bad brush springs, or an open or shorted armature. Repair/replace parts as necessary. Test motor for proper operation.

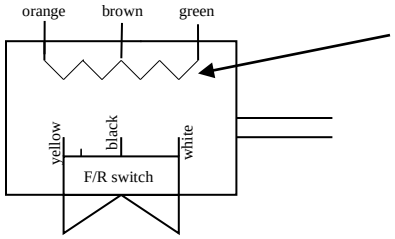
B. If motor ran when motor leads were connected directly to 12vdc, the problem is either with the hand controller or control module.

B-1. Test hand controller:

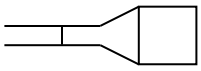
Hand Controller Test Procedure

The test procedure for the hand controller is performed with your V.O.M. set on the *Resistance x 1* scale.

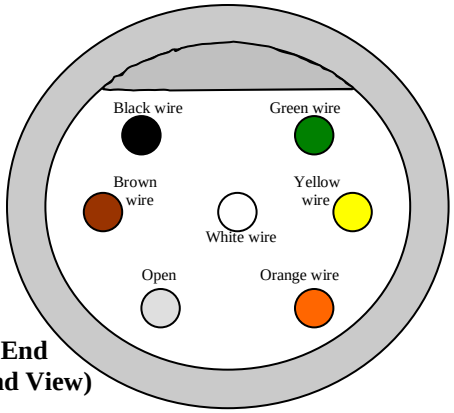
1. With the speed control @ zero, across the brown and green pins you should have approximately 1-2 ohms. As the speed control is turned, the resistance will gradually increase to 1K.
2. With the F/R switch in the Forward position, you should see continuity across the black and white wire pins.
3. With the F/R switch in Reverse, you should see continuity across the black and yellow wire pin locations.



Hand Controller



Plug End



Plug End (Pin End View)

B-2. If the hand controller tests okay, the problem is with the control module (or "Y" splitter). Test control module(s) to verify problem:

C. Connect control module to appropriate power source (12vdc for EM42, EM44, & EP42 – 24vdc for EM48, EM54, EM96, EP48, EP96, & EP130).

D. Plug in known good (tested as per above) hand controller directly to control module (bypass / remove "Y" splitter from circuit if motor is an EM96, EP96, or EP130 and check each control module individually).

E. Check for voltage at module output leads by hooking up test light (or V.O.M. probes) to board output leads. Turn hand controller ON to either F or R and vary the potentiometer / speed control setting. NOTE: all EM control modules and early EP modules, (EPs produced prior to 1999), utilize a motor disconnect relay in the output circuit of the module. On modules with the disconnect relay, test for output voltage directly at the board output terminals and at the output leads that connect to the motor unit. Testing in this manner will determine if the disconnect relay is good or defective.

E-1. If there is no output voltage at board terminals, the control board is defective. Replace control board or module, as needed.

E-2. If board terminals have output voltage, but there is no output at the leads that connect to the motor, the disconnect relay is faulty and needs to be replaced.

F. If motor is an EM96, EP96, or EP130, test second control module. If both modules test fine, problem is in the "Y" splitter cable. Replace "Y" cable, as needed.

Part II - Case II. Motor runs in one direction only.

Step 1. Check hand controller and control module plug ends pins and connector sleeves for corrosion. Clean, if needed, reconnect and test again for proper operation.

Step 2. Test hand controller Forward, Off, and Reverse switch for proper operation and check continuity through switch per hand controller test procedure on **page 1**.

A. If faulty switch is found, replace hand controller.

B. If switch tests okay, problem is with control module. Replace module control board or module assembly, as needed.

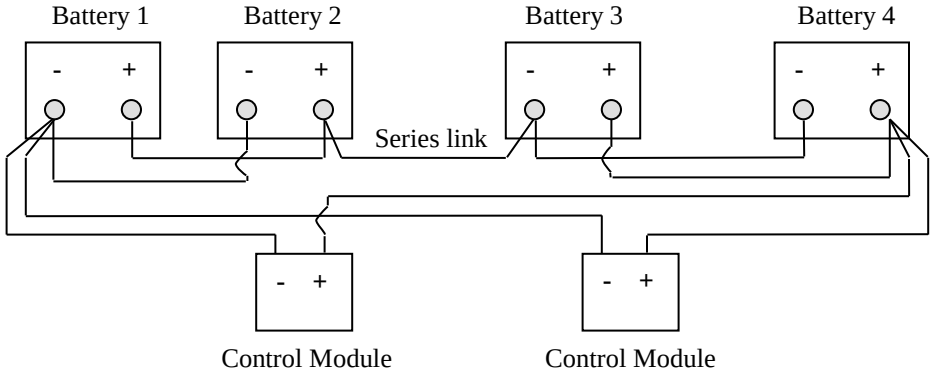
Part II - Case III. EM 96, EP96/130 twin motor units: only 1 motor runs

Step 1. On the one motor that doesn't run, disconnect motor leads from the control module and connect motor leads to 12-volt power source. (This applies to 12 or 24-volt models.)

A. If motor does not run, the problem is in the motor lower unit. Disassemble and check lower unit for voltage at the brushes, water in lower unit, worn brushes, bad brush springs, or an open or shorted armature. Repair/replace parts as necessary. Test motor for proper operation.

B. If motor does run, go to **Step 2**.

Step 2. If using four 12vdc batteries to power twin EM or EP models, check to make sure that both modules are connected to the same power source. For proper operation, batteries 1 &2 should be connected in parallel, next connect batteries 3 & 4 in parallel. Then series connect the two banks of paralleled batteries. The battery leads from both modules are then connected to the series connected batteries. (See diagram below.)



Step 3. Check all hand controller, control module, and "Y" splitter plug end pins and sleeves for corrosion. Clean, if needed, reconnect and test again for proper operation. If both motors still do not run, go to **Step 4**.

Step 4. Disconnect "Y" splitter cable from hand controller and control modules. Connect hand controller directly to the control module for the motor that is not operating. Test motor function.

A. If the motor that is connected to this control module operates okay, this control module is good. The problem is in the "Y" splitter cable. Replace "Y" cable, as needed.

B. If the motor that is connected to this control module does not operate, something is faulty with this control module assembly. Test the control module to determine if just the disconnect relay is defective or the control board is bad.

NOTE: all EM control modules and early EP modules, (EPs produced prior to 1999), utilize a motor disconnect relay in the output circuit of the module. On modules with the disconnect relay, test for output voltage right at the board output terminals and at the output leads that connect to the motor unit. Testing in this manner will determine if the disconnect relay is good or defective.

B-1. If there is no output voltage at board terminals, the control board is defective. Replace control board or module, as needed.

B-2. If board terminals have output voltage, but there is no output at the leads that connect to the motor, the disconnect relay is faulty and needs to be replaced.

Part II - Case IV. EP only: Trim/Tilt lift system does not operate

Step 1. Check all battery connections, plug connections, and terminal connections for corrosion and security. Clean, if needed, and test for function. The lift system must be connected to 12 volts only (per EP wiring diagram).

Step 2. Disconnect lift motor power leads from relay harness. Connect 12 volts directly to lift motor, and check for function. Reverse polarity to reverse direction of travel.

- **A.** If lift system does not function when relay harness is bypassed, the lift motor is faulty and needs to be replaced.
- **B.** If lift system functions when relay harness is bypassed, the problem is with either the relay harness or the Up/Down Switch.
  - **B-1.** Test Up/Down Switch for continuity.
  - **B-2**. If switch tests okay, replace relay harness.