

Here's some basic Diagnostic and Troubleshooting information which is also a good overview of how RigMasters work. You might want to print this Email and the attached documents and make a booklet.

Our public website has quite a bit more information on the rest of the systems in the RigMaster at: <http://www.rigmasterpower.com/support-materials.php> which has areas such as: owner's manuals, parts diagrams and lists, trouble shooting and warranty description.

**Note:** *We offer the following information as a guideline/summary for customers who are capable of safely performing basic repairs to their APU while using a RigMaster Service Manual. Customers may not be able to perform all repairs completely or find the root of their APU problem which may persist after their repairs are attempted. The customer must judge whether they are able to perform complete repairs themselves or if they should have a RigMaster dealer do so instead.*

**Important note:** *The "10 pins output J1" connector must first be unplugged at the Power Module (computer under the bunk) anytime the battery cables, APU main power wire, alternator or starter are disconnected or connected. Arcing at any of these main power wires may damage the power supply inside the power module computer.*

**Warning:** *do not pump the primer lever on the fuel lift pump on the Kohler engine when it is cranking or the pump drive mechanism will be damaged.*

On the back wall of the engine cabinet there are 3, 4 or 5 relays (small black boxes), near them are 35 amp fuses for the electric fan. From left to right the relays are: Glow Plugs, Starter, AirCond.Electric Fan, (and if there is a 4th relay it is temp sensor electric fan relay) (LG 200 models from 2011-2014 have 2 Air Cond.Electric Fan Relays in position 3 and 4, then the Engine Temp Elect Fan relay in position 5). These relays are identical; they can be swapped for diagnostic purposes. A close look at the relay shows a diagram of the relay terminals: 1(86) trigger wire, 2(85) trigger ground side, 3(30) 12v power from battery, 4(87a) battery volts at rest, 5(87) battery volts supplied when relay triggered.

#### E28 Output Overcurrent Error Code (2011 and up)

- Displayed by the green faced power modules RP50-250 and is caused by the current rising in a computer output circuit that is attempting to overcome an unusual resistance (stuck relay or solenoid, shorted wire??) and the power module is shutting down to protect its output circuits, similar to a circuit breaker function. Powering off your system for a minute will reset this function but the error E28 might return if there is still a problem. Older Power Modules with Light Blue, Yellow and Grey faces do not have this capability (their output circuits tend to fail when overloaded by a "short" or "sticky" component).

- If the "E28 Output overcurrent" code is displayed and the specific circuit having the problem is not indicated, you must match the appearance of the E28 code to something that the computer is trying to

operate: water valve, glow plugs, fuel run solenoid, starter relay, AC compressor clutch or maybe the Blower fan at the HVAC box in the cabin under the bunk (later models of power modules will indicate which circuit has the overcurrent E21-E27).

#### Turning the power ON:

Turning ON the APU power on the Cabin controller display: The only action by the computer is that the "water valve" at the HVAC box is cycled and the computer reads its position. If you have a power problem or E28 code at this point it's likely the water valve actuator circuits (J2 connector - wire #3 and #7 –both white wires)

#### Attempting to Start the APU

1 - Glow plugs count down (1<sup>st</sup> relay is the glow plug relay)

2 - Fuel "Run Solenoid" should "click" and allow the engine's internal throttle governor to operate the high pressure injection pump. The Fuel "Run Solenoid" is mounted to the engine block just below the fuel filter bowl, it has one wire going to it. It is wired directly to the Power Module itself and does not have a relay. If it's not being operated, check to see if 12 volts is being sent to it. If not, you can feed it 12 volts and see if it operates. (Note that the run solenoid wire splits and continues to the back of the alternator - exciter wire). If the engine still doesn't run the run solenoid may be removed from the engine block (non Kohler engines), and a magnet may be used to operate the high pressure injection pump manually.

3 - Starter relay is then triggered which supplies voltage to the starter solenoid. The solenoid engages the starter, engine should crank and start.

#### Other "No Start" condition help:

Is there a possibility that the glow plugs are not operating or worn out? Are valve clearances within specification so the engine develops good compression? Is the air filter or air intake blocked?

You must first confirm fuel is being delivered to the injectors. Those with Perkins/CAT and RMP01 engines can refer to the paragraph above. Owners of Kohler engines should contact a dealer or call RigMaster for additional information about their fuel system – **Warning: do not pump the primer lever on the fuel lift pump on the Kohler engine when it is cranking or the pump drive mechanism will be damaged.**

"Engine seems to run for 2 seconds but dies when cranking stops" the paragraph below is for Old 'Thread and Locknut' style speed sensor – discontinued in 2014 – For "Digital Speed Sensor" (small box with 4 wires zip tied to harness at main computer under the bunk) see attached document.

-The Power Module receives a frequency signal from the speed sensor (sensor above flywheel teeth, be sure that it's set to the new spec of **0.015"** air gap not the old spec of 0.025"). If it does not see this frequency, the Power Module will shut off the Run Solenoid (located behind the Fuel Filter bowl and has 1 terminal) because it does not see the engine is not running. Unplug the speed sensor and attempt starting unit, if the same error is displayed, the speed sensor function should be checked further (likely failed). Additional checks: Speed Sensor resistance should be between under 1000 ohms, not 0 or infinite. This is not absolute - reading could be normal and Sensor is actually failed. Unplug J4 connector and check resistance of entire circuit through the Speed Sensor wires, or unbolt Power Module and check on the corresponding pins soldered onto the circuit board with **J1 unplugged** (power) and J4 plugged in.

Beginning in 2014 the speed sensor function is being performed by a "digital speed sensor module". It is a small plastic box with 4 wires 'zip' tied to the wiring harness near the main computer under the bunk. This type of sensor can be installed into older RigMasters, usually by their owners, in under an hour.

-Usually, **Error Code 4** "Engine Run Failure" will be displayed - if so, the Power Module is consciously shutting off the fuel flow, as opposed to **Error Code 7** "Engine Start Failure" - where the Power Module just notices that it doesn't see the engine running----usually this is caused by failed glow plugs, their relay, starter relay or some kind of fuel supply issue like a failed lift pump, clogged fuel filter or air in the fuel system (lift pump should make at least 3lbs of pressure but still might be faulty if it's that low).

- Other "no start" troubleshooting can be found in the "General Troubleshooting" document and "All Digital Speed Sensors – FunctionTroubleshooting" document attached to this Email.

#### Other useful info:

- Voltage Drop Test: put the test leads of your meter on either side of a connector on the same wire with the meter set to 12 volts. If there is no resistance in the connection at all, the meter will read 0 volts, if there is resistance, it will read perhaps .1 Volts, which is still considered normal. If the connectors in a circuit have enough resistance to add up to .3 Volts it will become a problem. This test can be performed on any connector or from a wire through a connector and onto the back of a circuit board.

-J1 connector has 3 main power wires at the bottom in an "L" shape, that power the entire Power Module. Touch these wires where they go into the connector during a "problem" to check for steady voltage with a test light or similar, sometimes when each wire is pushed on with a test probe the power module starts working normally. If this happens, clean the clip and the connector pin. You could leave J1 plugged in and test on the back side of the circuit board for Power on the corresponding pin on its soldered joint, be careful not to short anything.

-The wires that go to sensors are looking for a "Ground". If they find one, an Error Code is displayed. Disconnect the wire and see if the code goes away. If so, it could be the sensor. Perform a continuity to ground check though the wire when it is disconnected to see if there is a break in the wire that might be touching a ground.

- RigMaster APU's that have Generators have been equipped with the 60amp Alternator since 2005. The LG200 does not have a Generator - it has a 170 Amp alternator.

- The Alternator "exciter" wire (on the back of the alternator) is connected with the wire that operates the "Engine Run (fuel) Solenoid" because this is the only wire that is "LIVE" with 12volts when the RigMaster Engine is running.

- If you order a new Alternator for a unit made before 2005, the 60amp Alternator will be supplied, be sure to order the necessary components to mount it and wire it. We can send an Email with this list if you like.

- RigMaster APU's rely on the fans moving air from one side of the engine cabinet to the other and they will overheat if the electric fan is rotating the wrong way or if they are run without the engine cover. The weather stripping seal around the cover should be maintained so no air leakage is possible. Cooling system can be bled by inserting a screwdriver inside the hoses that come through the floor of that cabin at the water valve if the clamps are moved

- AC compressor, Generator and exhaust flex pipe longevity is greatly decreased if engine mounts are worn. Pry up the plates that the compressor and Generator mount to, if they move more than ¼" upwards you must replace the mounts. Contact RigMaster with your Email address for more information and mention the subject.

### **Air Conditioning**

Advising the installation of relay to operate air conditioning compressor:

Our webpage: <http://www.rigmasterpower.com/support-materials.php> hosts instructions for the installation of a relay in the 'Air Conditioning Compressor Clutch' circuit.

It is a helpful addition to units that have an air conditioning compressor with high hours that might be drawing more current than the Power Module can comfortably supply.

Order these two parts and have extra wire on hand to perform the installation mentioned in the PDF:

RP7-084 Relay - 50Amp (same base plug connector as old RP7-083 relay used from 2005 RMP104's to 2012 MTS models)

RP7-326 Relay Base Connector Sub-harness

### Air Conditioning clutch circuit function:

Voltage for the air conditioning compressor clutch leaves the power module (computer under the bunk) on the green wire located in the J1 plug (labelled "10 pins output J1"), 2nd wire down on the right side of that connector.

The power goes to the thermostatic switch (freeze sensor) on the evaporator under the bunk (sensor "opens" if it senses the evaporator core icing up), power continues to the "binary sensor" (high pressure sensor on the receiver/dryer in the engine cabinet....Kohler type has the LG200 type AC line – the binary sensor attaches to the "condenser to bulkhead" hose in the engine cabinet). If the binary switch senses that pressure is acceptable, power will be given to the compressor clutch.

- There is no relay for compressor clutch (though one is advised to be installed, as above)

### Notes:

- Condenser fan relay may get power from binary sensor (if so, your fan cycles with the clutch).....or, in newer RigMasters, it gets power at beginning of ac circuit before thermostatic sensor (the condenser fan would run whenever air conditioning is selected).

- If other error codes (such as "overheat/low coolant", "oil pressure", "safety cover open") are accompanying a lack of power in "clutch circuit", there may be problems in the power module itself. There are no further diagnostics for the power module, another must be installed to diagnose.

There is a document hosted on the RigMaster website that explains the operation of the engine cabinet fans, you'll need to know which model RigMaster you have.

Usually, drivers can do very little to repair a failing ac system but any automotive/truck shop with conventional ac service equipment can diagnose RigMaster air conditioning.

- Many ac system failures are due to leaking hoses or fittings.

- Ac hoses can be made, usually under \$50 each.....the "receiver dryer" (\$20 to \$35 with sensor) must be replaced when unit is repaired if the system was unsealed more than 2 hours.

- Many shops charge up to \$250 to only vacuum, leak test and refill an ac system.

### Specifications:

Note: 2015 – Dual Blower HVAC box on Kohler engine RigMasters: 1 lb of R134a Freon (this spec is for all dual blower type HVAC boxes since 2014)

RMP's, T4-6, V10 (conventional RigMasters with Generators).

- low side pressure 15- 40 psi, high side 150-250 psi – maybe more in hot weather
- v belt driven compressors take 1.7 lbs of 134a Freon, serpentine belt driven compressors take 2.2 lbs of 134a Freon, system lubricant total is 7 oz of sp46 to 100 pag compressor oil
- with clutch engaged, compressor internal drag is 4.7 lb/ft torque
- 35 Amp fuse(s) located in engine cabinet for condenser fan (1 fuse per relay)
- Compressor clutch wire has a 7.5 Amp fuse
- V10 (mounted on Catwalk behind cab)- has condenser fan and bottom fan, most of this APU operates the same as a T4-6, fans operate differently (as below)

T4-6 with Kohler engine have Dual Blower HVAC box type AC systems all use 1 lb of R134A (refer to attached “QuickServiceSpecSheet” document)

LG200 (RigMaster without Generator, inverter model)

- high pressure sensor mounted in ac hose (from condenser to frame)
- Freon capacity is 0.65 lbs of 134a, 4.3 oz system total – single blower HVAC box (2012 to 2014)

#### Relay actuation:

A close look at the relay shows a diagram of the relay terminals: 1(86) trigger wire, 2(85) trigger ground side, 3(30) 12v power from battery, 4(87a) battery volts at rest, 5(87) battery volts supplied when relay triggered.

Relay locations: - A document explaining the relay functions (below) in more detail is posted on the RigMaster Power website in the “Technical Support” section.

#### MTS-T4-6

- 4 Relays on back wall of engine cabinet

(left to right): - 1 glow plugs - 2 starter - 3 air cond. activates condenser fan - 4 water pump '2 wire fan temp sensor' activates condenser fan

LG and V10s with 5 Relays on back wall of engine cabinet

(left to right): - 1 glow plugs - 2 starter - 3 air cond. activates condenser fan - 4 bottom fan activated by air conditioning - 5 water pump '2 wire fan temp sensor' activates condenser fan

V10's with 4 relays on back wall of engine cabinet

(left to right): 1 glow plugs 2 starter 3 air cond. activates condenser fan 4 water pump '2 wire fan temp sensor' activates bottom fan

Kohler units T4-6 and LG200 with 3 relays on the back wall of the engine cabinet

(left to right): - 1 glow plugs - 2 starter - 3 air cond. activates condenser fan