Freightliner Diesel Engine Starter Troubleshooting Guide

This document applies to the 2011 Fleetwood Discovery 40x on the Freightliner XCM chassis with the Cummins ISC 3.8L 380 HP engine. It **should** apply to Freightliner XC, XCR, and XCM chassis built between 2007 and 2013 (and maybe some to 2015 but not past that point due to a changeover to multiplexing circuits). However, because of multiple configurations and engines, only by providing Freightliner Customer Support Center at 1-800-385-4357 with the specific VIN number can we be sure.

I do believe that the design is likely similar to other coaches, it may have some value in potentially saving both towing charges and unnecessary replacement of working parts during troubleshooting.

> This troubleshooting is geared toward getting the starter to turn the engine over in an attempt to start it. It does not cover reasons why the engine might not start once the starter is turning the engine.

If the starter motor fails to engage there are four areas that need to be checked to isolate the cause. These areas are Starter Power, Ignition ON Circuits, Ignition START Control, and the Start Relay/Solenoid/Starter.

Starter Power is provided by the Chassis Batteries. Areas of concern are:

> Low Battery Voltage caused by discharged battery or a defective battery. Chassis battery voltage should be about 12.7 volts when fully charged. This image is showing a higher voltage as the rooftop solar panel is charging the batteries.

> Loose connections or corrosion, particularly battery grounds. Trace the heavy RED (+12 volt) and BLACK (Ground) battery cables from the batteries to the starter. This RED cable directly connects to both the Alternator and Chassis Batteries and does NOT pass through any fuses.
>
> On engine front passenger side you should locate the starter.

Assuming that the starter motor has a good ground and a solid 12-13 Volts, the next thing to check is the Chassis Power Fuses.

On my coach the chassis battery power lines pass through two fuses. The first fuse is a 300 Amp Battery Terminal fuse mounted to the +12 side of the chassis battery.

The next set of fuses are located in the last engine compartment on the driver's side in a Chassis Battery Distribution Panel under a large red rubber cover.

The five Distribution MEGA/AMG Fuses are used as follows, starting from the left.

- 150A – Chassis Power to Front of Coach for Driver Functions such as Ignition and Dashboard Power
- 150A – Coach Builder Chassis Power for items such as Slide-Outs, etc.
- 250A - Intake Grid Heater Relay for Diesel Engine pre-start
- 80A – Feeds the three Power Distribution Modules just to the right. These modules contain the fuses and relays for:
    1. Engine and Transmission Control Modules (ECM & TCM)
    2. DEF (Diesel Exhaust Fluids) control
    3. Exterior Lighting
- 80A – Trailer Tow Power Distribution Module

The bottom of each of these five fuses should read 12-13 volts. If so, then we can move onto the Ignition Start circuits.

When you turn the Ignition Switch to the ON position, several events should take place. The instrument panel should light up. The Engine Control Module should power up, engage the Intake Grid Heater, and extinguish the start heater indicator on the instrument panel. The Transmission Control Module should power up and light up the Allison Transmission Panel at the driver's controls.

In order for these events to take place, a sequences of fuses and relays provide power to the Instrument Panel, Engine and Transmission Control Modules (computers).

Wiring details can be found on the Freightliner Ignition Power ON circuits Daimler drawing G06-72031 (WRG-POWER DIST, IGN, X), available from REV/Fleetwood Customer Service at 800-322-8216.

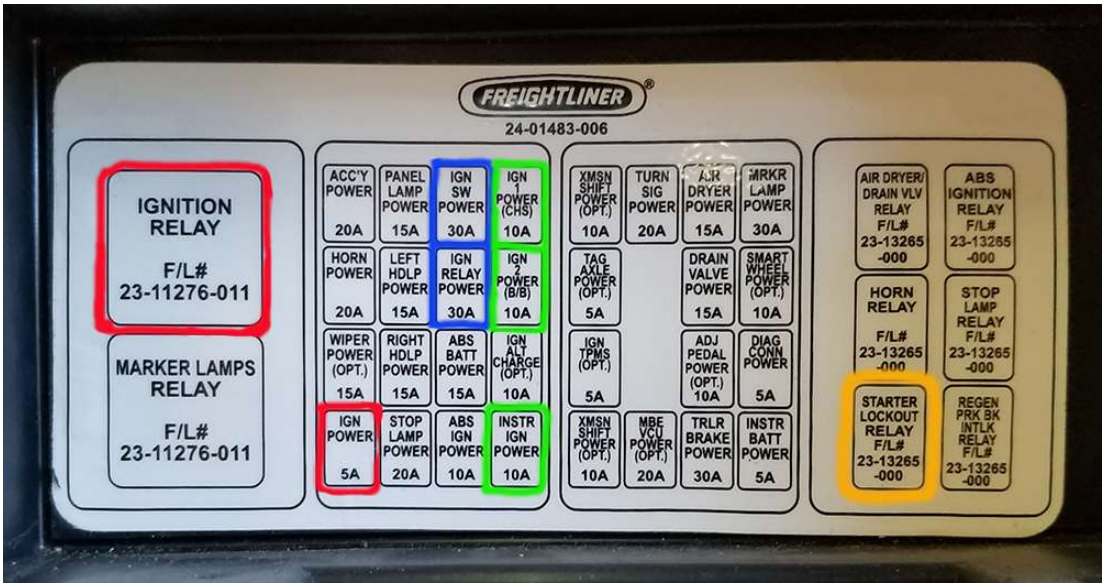
With the Ignition Key in the ON position, in the Fuse and Relay panel under the dashboard:

The 30A IGN SWITCH POWER Fuse provides +12 volts to the Ignition Switch contacts and the 30A IGN RELAY POWER Fuse provides +12 volts to the IGN RELAY contacts, marked with **BLUE** in the image below.

In the Ignition switch, power supplied by the IGN SWITCH POWER Fuse on pin A of the DASH-H-SW-KEY plug is passed to pin D, Ignition and pin E, Accessories, such as the radio.

Pin D of the Ignition Switch passes through the 5A IGN RELAY COIL POWER Fuse to energize the IGN RELAY, marked with **RED** in the image below.

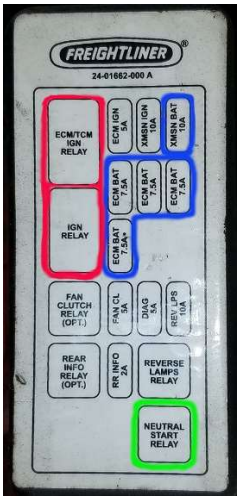
The IGN RELAY passes +12 volts from the IGN RELAY POWER Fuse to the 10A IGN 1 PWR Fuse to power on the Engine, Transmission, and Ignition relays in the engine compartment. It also provides +12 volts to the 10A INSTRUMENTATION IGN PWR Fuse and the 10A IGN 2 PWR Fuse to provide power to the instrument panel. These fuses are marked in **GREEN** in the image below. Due to options, your fuse and relay layout may be slightly different.



In the last engine compartment on the driver's side in the first fuse and relay panel we continue.

In this panel the 10A XMSN BAT Fuse provides a constant +12 volts battery power to the Transmission Control Module to preserve computer settings. Likewise, there are four 7.5A ECM BAT Fuses to provide a constant +12 volts battery power to the Engine Control Module to preserve computer settings. These are marked in **BLUE** in the image below.

From the dashboard Fuse and Relay panel, IGN 1 PWR Fuse, we energize the ECM/TCM IGN RELAY and the IGN RELAY shown in **RED** in the following image.



The ECM/TCM IGN RELAY provides power to energize both the Engine and Transmission Control Modules. At this point the Engine Control Module should engage the Intake Grid Heater (if needed), and extinguish the start heater indicator on the instrument panel. The Transmission Control Module should power up and enable the Allison Transmission Panel at the driver's controls.

Ignition Start Control – Wiring details can be found on the Freightliner Starter circuits Daimler drawing G06-66982 (WRG-ST SP, IMS, X), available from REV/Fleetwood Customer Service at 800-322-8216.

To engage the starter we need a start signal from ignition key which is locked out if the engine is already running, and/or if the transmission is not in neutral. This start signal energizes the Start Relay, which in this coach is mounted on the Starter. The Start Relay engages the Start Solenoid, also mounted on the Starter, and if the Starter Motor is good, the starter engages the engine and attempts to start it.

IF the engine is already running, the Instrument Cluster Light Bar, powered by the INSTRUMENTATION IGN PWR FUSE (and/or the IGN 2 PWR FUSE, I'm not certain which), the Starter Disable Circuit energizes the STARTER LOCKOUT RELAY in the Fuse and Relay panel under the dashboard and prevents the start circuit from energizing. This relay is marked in **ORANGE** in the fuse and relay panel under the dashboard, above.

IF the Transmission Control Module is powered up AND the transmission is in Neutral, The Transmission Control Module will close the contacts in the NEUTRAL START RELAY and will enable the start control to be passed to the Start Relay on the Starter Motor.

When the ignition key is turned to the Start position, Pin B of the Ignition Switch passes +12 volts through the closed contacts of the STARTER LOCKOUT RELAY and back to the fuse and relay panel in the engine compartment where, if the transmission is in neutral, it goes through the NEUTRAL START RELAY marked in **GREEN** in the preceding image, and on to the Starter Relay.

Start Relay, Starter Solenoid, and Starter Motor should engage and turn the diesel engine once the Start Signal is received from the NEUTRAL START RELAY. If the starter does not engage, you need to determine if the Start Relay, Start Solenoid, Starter Motor combination has failed.

In some cases where the starter is at fault, rapping soundly on the starter case has been known to get the starter to engage. However, if this is the case it will fail again and will need to be replaced as soon as practical.

The starter can be tested independently of the start circuit to validate that the starter is good. Do not attempt this unless you are sufficiently knowledgeable to avoid the potential damage and risks involved!

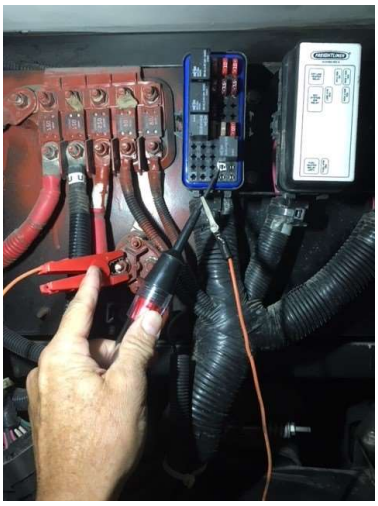
To bypass the start circuit to verify that the Starter Relay, Start Solenoid and Starter Motor are operational it is possible to remove the Neutral Start Relay and jumper +12 volts to the output of the relay. That should cause the starter to turn if it is good. I would only use this technique verify that the starter is good and that the start issue is elsewhere.

From Al & Karin:

> If you are comfortable with electrical diagnostics:
>
> In the assumption that the wire connection from the neutral start relay, in the rear left of the coach, to the starter "relief" relay (ISM), mounted on top of the starter, is OK:
>
> It would be possible to pull the neutral start relay, determine which contact is 30 (you need a magnifying glass) and apply a positive voltage to the corresponding socket pin for the relay. Since the neutral start relay is the last in the chain that would send the start signal directly to the starter regardless of the status of the other components and regardless of whether the ignition is on or not. In other words, if the ignition is on be sure the transmission is in neutral....
>
> If you can't determine which pin is 30 (I've seen relays like that) then:
>
> 1. With the ignition off - Only one wire will have a direct (0 ohm) reading to ground. That is NOT it.
>
> 2. With the ignition on and the transmission in neutral - only one wire will have a 12 volt reading. That is NOT it. NOTE - These pins from 1 and 2 normally energize the relay.
>
> 3. With the ignition on and the key in the start position (don't worry, with the relay out the starter can't turn) - a second wire will have a 12 volt reading (the ignition signal from the front). That is NOT it.
>
> 4. Only one pin left - That is the 30 contact to the starter relay. You should have a resistance reading between that contact and ground but not 0 ohms. Probably 100 ohms or more.
>
> Once you find that socket pin, you might want to mark it with a dot of red paint or so .....

From Joey Hebert:

> Testing the Starter Motor using Al’s technique image:



If you need to replace the starter, you will want to verify the correct starter motor for your engine. If you have the same ISC Cummins engine, the attached diagram shows the 35MT w/IMS starter, what I believe we have in our coach. The new design is 35MT w/IMSS. The difference appears to be the start solenoid is combined with the solenoid.

Typical IMS Design New Design IMSS

The new IMSS design for this starter appears to upgrade compatible from the IMS design.

Relay and Fuse Troubleshooting Tips:

Must of the relays are common to multiple locations in the coach so swapping a suspected relay is usually fairly easy even without spare parts. Fuses can be checked visually or tested with an ohm meter. Replacements for most fuses are common at auto parts stores.

From Keith Lindholm:

Here are some of the more common relays used in these circuits and swappable locations:

Song Chuan 301-1C-C-R1-U01-12VDC - ECM/TCM IGN, IGN, DEF Line Heater

Song Chuan 301-1C-C-R1-U01-12VDC - Neutral Start, Starter Lockout, ABS Ignition, Air Dryer/Drain Valve, DEF System Ignition, Fan Clutch, Horn, Regen Park Break Interlock, Reverse Lamps, Stop Lamp

Tyco 1432785-1 – Ignition, Marker Lamps

If you want to stock spares, the relays, fuses, including MEGA/AMG/ANL, and fuse holders etc. are available quite reasonably from www.mouser.com.

https://www.mouser.com/Electromechanical/Relays/Automotive-Relays/_/N-b19z1/

Other sites that have RV electrical components:

http://www.ase-supply.com/

http://www.waytekwire.com/

http://www.delcity.com/

For my coach, I have made a spreadsheet list of the relay and fuse locations so that I can quickly and easily find a blown fuse when something is not working in the coach.