

# 12V Compressor Fridges & House Battery

(V2.1 1/11/19, V2.2 7/11/19 )

These run on 12 or 24V DC and may have a 240V power supply. They are high-efficiency low power fridges using inverter technology. The compressor PCB may contain a number of features including:

1. Turning off if the battery voltage gets too low (adjustable).
2. Compressor runs at a slower speed to save electricity (adjustable).
3. Indicates error codes.
4. Turns off if the fridge is in too hot an environment, the compressor and the PVB also generate heat.
5. Delay in restarting the compressor.

I recommend using an Anderson plug or similar plug as the cigarette plug is running close to its rating and the can rattle loose when travelling. Do not use 240VAC plugs and sockets! If you get the positive and negative the wrong way around the unit will not work, most have diode protected so no damage is done.

These fridges put a very load on the house battery. They draw from 3 to 6A depending on model and run for about 50% of the time when the temperature is pleasant, more on a hot day. A good solar panel is needed for free camping. The house battery needs to be kept charged all year, if left flat for any length of time they lose their capacity and will only get through ½ a day operation. The van/camper need to have a solar charger or a multi-stage charger connected. (More below)

## Error Codes

**E1 or 1 Flash** Low voltage cut out. Other causes. House battery near the end of life, bad connection(plugs) or wires not big enough. There is a voltage drop between the battery and fridge when the fridge tries to run. The voltage will return back to its original value when the fridge automatically stops, which can confuse the issue. When the voltage is within range the fridge may restart.

**E2 or 2 Flashes** Fan error, repair required

**E3/4 or 3/4 Flashes** Motor not starting or too heavily loaded. The compressor pumps the refrigerant gas through a small jet for its operation. Time is needed for the gas to equalise before restating, Turning the power on and off will cause this fault. A bad plug and socket when travelling can also cause this problem. Cigarette plug and socket are running near their capacity and then to vibrate out, I recommend replacing with an Anderson plug for more reliable connection, see below.

**E5 or 5 Flashes** Automatic shut down. Too hot an environment, move to a cooler location.

## Warnings

Give you fridge a gentle ride. Excessive vibration can cause refrigerant gas leaks, most are not repairable.

### Warning with Fridges on sliding trays or linear bearings.

Keep the leads clear of the sliding mechanism. The lead can become caught in the mechanism and wear away the insulation causing melting of the lead or possible fire. With the 240 V lead possible electric shock and death. The use of a safety switch for added protection is also recommended.

**Anderson plug** ( or other low voltage plugs and sockets) is recommended for more reliable connection in moving vehicles. See E3/4. Do not use 240 VAC plugs and sockets (Including IEC plugs and sockets used for removable leads on appliances) Danger from wrong connection!! Get the DC positive and negative correct! Use a digital voltmeter check the polarity before and after installing the plug. The compressor PCB is diode protected from reverse connection but the other PCB **may not** be including the control and display PCB.

## More on the House Battery

The mains 240V power is almost an unlimited power source. However, we do get load shedding during very high power demand. The house battery is a very limited power supply.

Estimated run time of fridge (only) for a 100Ahr battery using 3.5A on a 25°C day with the fridge thermostat at 5°C. The fridge compressor will run for about 50% of the time. On hotter days and environments the run time will increase. It will also increase if the fridge is used as a freezer. Note: most fridges have battery protection and automatically turn off the fridge when the voltage fall below a set voltage. (May be adjusted.) The following table gives estimated run time on a 100Ahr battery. My deep cycle battery only recommends discharging to 30%, before recharging.

Discharging more will shorten the life of the battery, see graph. This is the opposite to Ni-Cd with a memory effect where it is not recommended to discharge a little and recharge. If you discharge to only 30%, then you will get 1600 cycles, 70% the 700 cycles and 100% discharge only 300cycles.

Note 1 Estimated life of battery for repeated cycles, see graph, this was on my battery. (DOD = Depth of Discharge.)

For free camping a good solar cells are needed to keep the battery charged and be careful on how much electricity is used for other uses. Hint replaces all lights with LEDs, put the fridge in a cool place, avoid open the fridge etc.

Ahr = Amps x Time (hours)

Battery Capacity Used %	Fridge Runs 100% of Time Running time (hr)	Fridge Runs 50% of Time. Running time (hr)	Battery Life Cycles <sup>1</sup>
100	28	56	300
70	20	40	700
30	8	16	1600

I am not an expert on battery chemistry, but the following is worth considering. Li-ion batteries have better performance, but they are overstated by some sales people. Before believing the sales pitch, consider how good the Li-ion batteries are in your mobile phone. I have had good ones and a very bad one. They last about two (2) years, which is about 700 cycles and they are almost impossible to replace. (That's another story, see ifixit.com). Also Samsung Galaxy Note 7 had a recall on there Li-ion batteries catching on fire. There are many varieties of Li-ion batteries with its own advantages and disadvantages, but basic they have better performance, light weight but need special charge controllers and are more expensive. They are better, but they are not the 'wonder battery' and give you endless power. The good new is they are getting cheaper.

### Increasing the Capacity of the Battery System.

#### Batteries in Parallel

I do not recommend putting two batteries in parallel. When one battery starts to fail the good battery will try to recharge the bad one. (Electrical and Physic students use 'Kirchhoff's circuit rules' to calculate the loss of current into the bad battery). Many campers and caravan use this system. If you must use 2 batteries in parallel, then the batteries must be an identical matched pair with the same type, brand, size and age etc.

#### Alternatives

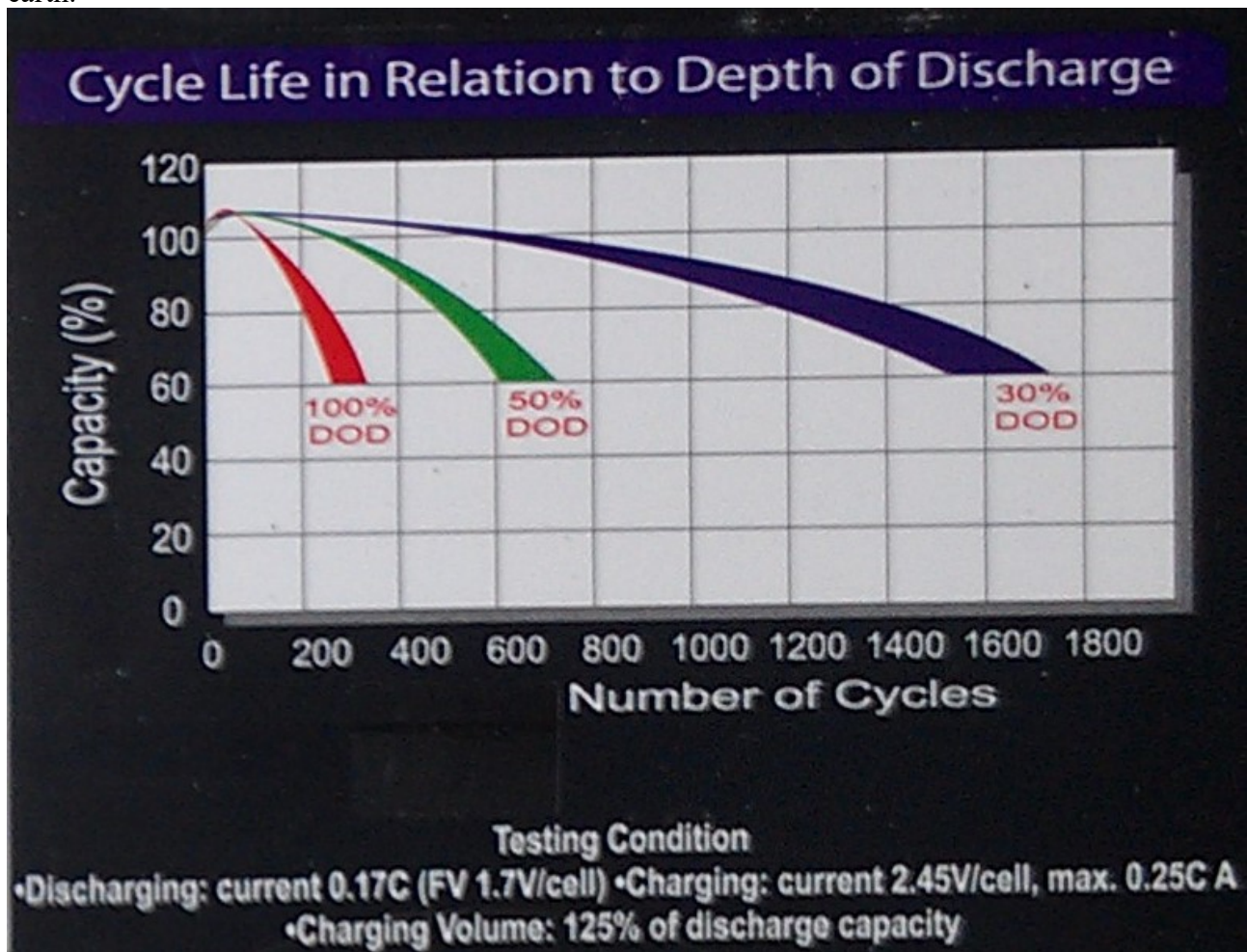
##### Using Only One Battery

Learn to live with less electrical power.

##### Two Independent Batteries System

Have two independent systems. Have 2 batteries with 2 charges and have one for the fridge and the

other for lights, etc. An alternative is to use 30% in one battery and use a change over switch to swap to the other battery. Only need to switch one terminal of the battery, can have a common earth.



### Two Batteries in Series (24V)

Connect 2 12V batteries in series for a 24V system. Some electronic system can automatically run on either 12V (car) or 24V (truck). Most fridges can do this and they work better on 24V as the electrical current is only ½. However, the lights may not work on 24V. Do not be tempted to take 12V off one battery as this will upset the charging. If 12V is needed to put another complete 12V system in, 3 batteries 3 times the amount of power.

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