Convert your old Chest Freezer to a Fridge, and save power.

By Graham Grigg www.sarariver.comAustralia

March 2009

Part 1. Changing the Thermostat.

A lot of people have now realised how efficient an old Chest Freezer is when modified to run as a “Chest Fridge”. It is a little bit awkward to get things in and out of, but I believe the benefits will outweigh this awkwardness. This is an article which takes a simple approach to converting a Chest Freezer to a Chest fridge and is aimed at anybody who wants to run an efficient household.

I first saw this idea in an article by Tom Chalko from www.mtbest.net. I thought it was a great idea, so I decided to convert my old Chest Freezer. I took a different approach to Tom and decided to keep it simple with no Electronic parts at all, just a simple Thermostat swap. I felt keeping it simple would mean less possible components to fail in the future, when we may not be able to replace these components at all. The Thermostat is just an electrical contact which is operated by expansion and contraction of a special liquid which is inside a capillary tube which monitors the temperature inside the fridge, and turns the compressor on and off when needed. Below (figure 1) you will see the compressor in the freezer before we started, as you can see it is a bit worst for wear, but a very reliable old fridge. It is a Kelvinator 150 litre similar to the Tucker Box type freezer range. I noticed that the Kelvinator 150 litre is still available new, as I saw one at my local Retravision store in Glen Innes the other day.

Figure 1. The old freezer, showing the compressor.

In figure 1 you will notice the Thermostat on the left hand side, behind the metal panel insert behind the white temperature control knob. The white temperature knob actually controls the set point of the Thermostat. This is the part we will replace. If you look at figure 2, you will see the new Thermostat. The capillary tube simply slides up a metal pipe above the thermostat to get in physical contact with the evaporator inside the freezer. I did some tests on the freezer before I started work. While running from my square wave 600 watt Inverter the freezer consumed 136 watts, and required a surge of about 750 to 1000 watts to start. As I am off grid and relying on solar energy for my power, this surge was a bit too high, as I require the fridge to run safely from my Inverter. The freezer would often trip the Inverter, but more on this later.

The original Thermostat was a Ranco VC-1 with a set point varying from -23 degree C to +2 degree C. The new Thermostat is a Ranco VB-7 with a set point varying from -3 degree C to +12.5 degree C.

The old thermostat was removed by first removing the cover to expose the Compressor on the lower right hand side of the freezer, then the metal bracket was removed and the old thermostat removed, (be careful here not to “kink” the capillary). The capillary is carefully slid out of the metal pipe at the top of the compressor enclosure.

Three wires connect to the Thermostat with “spade connectors”, these are simply just swapped over. Be careful to replace the Earth (green/yellow colour) on to the appropriate spade terminal on the new Thermostat. There are only two terminals on the new Thermostat and one or two earth terminals, so it is very simple to swap. Now carefully unravel enough capillary to slide up the pipe in the freezer, use the old Thermostat as a template, then mount the new Thermostat and double check the wiring and then replace the cover. At a temperature setting about mid point on the temperature control knob

figure 2 the new Thermostat

STOKES PART No.	RANCO PART	CAPILLARY LENGTH	TEMP MINIMUM	RANGE ºC MAXIMUM	DEFROST TERMINATION	SIGNAL OPERATION
DR050	VC1	1200mm	- 23	+ 2		
DR051	VA2	2000mm	- 18	+ 3.5		
DR052	VF3	2000mm	- 34	- 12		
DR053	VP4	1200mm	- 25	- 4	+ 5.5ºC	
DR054	VS5	2000mm	- 34	- 12		
DR055	VR6	2000mm	- 34	- 12		CUT IN 5º ABOVE CUT IN
DR056	VB7	1200mm	- 3	+ 12.5		CUT IN 5ºABOVE CUT IN
DR057	VW8	1200mm	+ 15	+ 34		
DR058	VT9	1200mm	- 26	- 11		CONSTANT CUT IN + 3.5ºC
DR059	VT93	3000mm	- 26	- 11		CONSTANT CUT IN + 3.5ºC
DR060	VXO	1500mm	-15	-5		CONSTANT CUT IN + 3.5ºC

figure 3. An insert from my fridge part catalogue

the fridge will cycle between about -2 degree C and +5 degree C, which seems to work very well. Over a 24 hour period my new fridge consumed 350 Whrs of energy, that is 0.35kWhr/day. This is a lot less than a normal fridge, which is sometimes around 1.5kWhr/day.

Part 2. Reducing the start power surge from the compressor.

The next part of the article deals with reducing the surge current of the compressor at switch on, which is very important for me living on a small 600 watt Inverter. This part is a bit more technical, and mainly aimed at people who are trained at doing this sort of thing. I certainly will help anyone who asks for support here.

First of all a bit of background. Most fridge compressors for the sake of cutting costs do not include a start or run capacitor, as they are really “not” needed as people are living on the grid with “unlimited” power available. The times are now changing and we should start to look at saving as much energy as we can, especially if you are like me and live off Grid.

The first part we need is a Potential Relay, I have included a picture of my relay, which I had to source from the USA. I live remote and could not find a locally available unit, so I searched on the

Internet and came up with this one. Available from http://www.carbonbrush.com/gerelays.html, search for Mars169 Potential Relay. If any one knows where to purchase in Australia please let me know. The original Potential relay I found was made by “Electrica” model number 'RVA 3G3D' which has a pick up voltage of 180 to 195 and drop out voltage of 40 to 105.

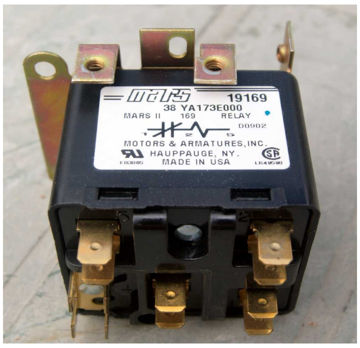

figure 4 The Potential Relay

You will also need some Motor Run and Start capacitors. I purchased a selection of run capacitors from 4uF to 12uF and start capacitors from 10uF to 100uF all rated at a working voltage of at least 400 volts, which seems the norm for Australia.

First remove the original current relay from the compressor and wire up the relay with capacitors as shown in the diagram in figure 5. Make sure the 'thermal overload device' of the original unit if present is also wired in, as this will protect the compressor if the new relay or capacitor should fail. Now try various capacitors while keeping an eye on the power factor. Begin with a start capacitor of about 20uF and run capacitor of 6uF. Switch on the fridge, and record the True power, current and voltage. Calculate the power factor and repeat until the power factor just becomes around 0.90. Don't forget to wait 5 or 10 miutes between starts to allow the refrigerant to drain away from the compressor. I found 6uF for run and 30uF for start were ideal. You will also notice that the start surge power will drop as well once the power factor is correct the surge will nearly be the same as the True run power. Also don't forget to wire a 15k ohm 2 watt resistor across the start capacitor to discharge it, if we don't the, potential relay contacts have to discharge the capacitor after every run cycle. This may result in the contacts welding together and causing possible damage to the compressor.

The power factor should be as close as possible to 1.0.The power factor is the ratio of True power to Apparent power. And gives us an idea of the amount of power demanded from the Inverter or from the power grid to run.

For example my Power Meter reads true 'run' power as 136 watts. But the Voltage and Current measured separately produce an apparent power (VA) of 0.938 amps x 228 volts which equals 214 watts. Thus the power supply or Inverter has to supply 214 watts and not the True indicated power of 136 watts. The power factor is then 136/214 or 0.64, which is very low.

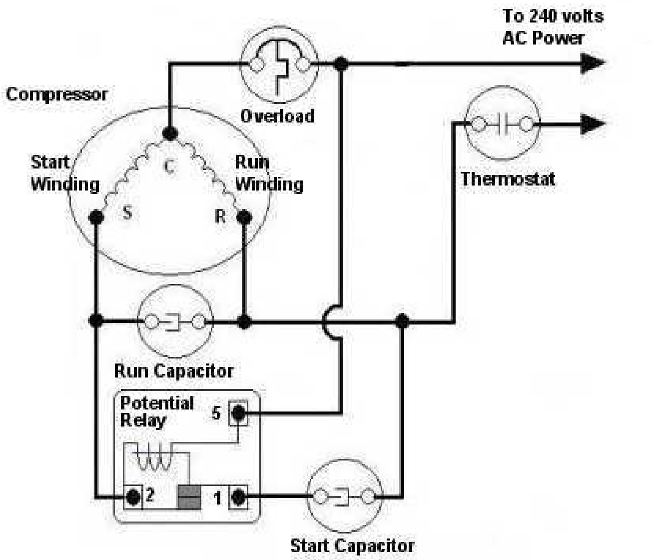

figure 5 Wiring Scematic

The amount of power we are charged for from the Power Company is actually only 136 watts, when they are supplying 214 watts, so we are getting 78 watts for free. But this also means that my little Inverter has to supply an extra 78 watts, when this is not needed if the Power Factor was reduced to say 0.9 which is the acceptable value for power factor.

My Power factor finished up being 0.91 with a start capacitor of 20uF and run capacitor of 6uF and the surge dropped from about 800 watts to about 200 watts. I can now safely run my fridge from my 600 watt Inverter.

Another small problem here is the fact that Square Wave Inverters are not very efficient when running Electric motors, so for a future project I am currently designing a Sine Wave Inverter capable of running the fridge which will also improve the efficiency even further. Stay tuned......

Please either contact me at www.sarariver.com, the ALS forum or email me if you have any questions or need some help in this project.

Graham Grigg
gsi@bigpond.com