Soarer Limited EMV repair procedures.

Repairing Faulty EMV Backlight Inverter.

A fault that seems to be becoming more prevalent as the Soarers fitted with the EMV screens age is that the backlight fails. This fault usually leaves the touch sensitive screen functional, but the user is left guessing as to what functions he may be accessing. A second fault that appears to be backlight failure has also been detected in some EMV's. The difference is that the touch screen does not work either. The repair procedure for that fault is located near the end of this document. It is a much easier repair than a faulty backlight! A third fault that sometimes occurs is that the LCD screen goes clear, and the backlight shines through! The repair for this is at the end of the document.

The repair itself is relatively simple. It appears that a high voltage capacitor fails, and this then causes one of the two main inverter transistors to fail. The backlight inverter failure sometimes blows a 3 amp fuse located on the primary power supply board. This board has several different switching power supplies, but the fuse that blows is for the 12 to 24 volt inverter which then powers the backlight. (I would have said this was overly complex myself, the backlight inverter could just as easily have run directly from 12 volts!) I have replaced the original transistors with much larger devices, capable of much higher power than the originals. (One reason was that I could not identify what the original transistors were, due to the clear lacquer obscuring the SMD codes on the original transistors.) The new transistors are mounted on the case of the original converter to facilitate cooling the devices. (This is required! Without cooling, these devices rapidly overheat, and then expire!)

You will need a new 68 nF capacitor, with a voltage rating of at least 250 volts, and two transistors, I have tried two different types. You will also require a new 3.15 amp, 5AG fuse.

1	68 nF (nanoFarad, 0.068 uF (microfarad)) 250 Volt minimum.
2	MJE340 transistors or MJE13003 transistors.
1	3.15 Amp M205 fuse.
2	Insulating washers (preferably silicon rubber insulators)
	Some wire (preferably 3 different colours)
2	3 mm screws + nuts and shake proof washers.

Table 1 Parts Required for repair.

Remove the unit from the car

Remove the computer module from the display.

Remove the back tin coloured cover, disconnect the two plugs from the displays computer board to the touch screen. (pictures)
Remove the touch screen from the display. You will need to prise up the plastic shroud slightly to pop over the detents pressed into the case.

If the foam rubber between the touch screen and the display unit is disintegrating, scrap it right off the display unit, this stuff is worse than snot, and will get everywhere otherwise. Some foam rubber strip can be cut and contact adhesive used to replace the original when you reassemble the unit.

While you have the touch screen out, I suggest you remove the screws holding the touch plate in, and clean the whole plate. (Wash in mild detergent, dry off with a chamois.)

Undo the two screws on the computer board.
Lift the board up, and undo the screw holding the thick loom in place.

Undo all the screws and totally disassemble the unit. There are four small black Philips head screws at the front of the unit, these must also be removed.

You should now be able to remove one side from the display. (careful!)
The rest of the display can now slide sideways out of the case with a bit of jiggling, and slight bending of the side. (*The screw holes have been extended via deliberate burring, and make lifting the unit out of the case difficult without excessive bending*.)

Note that the flexible strip connecting the electronics to the actual display is captured by special connectors, the outer part of these connectors must be popped up before the flexible display cable can be disconnected. (There are two connectors.) This only requires gentle pressure, do not get carried away! There is also a thin cable which goes to the power supply board. (Two wires in a 4 pin connector.)

Fortunately, although there are connectors of the same type within the unit, where this is the case, the manufacturer has colour coded them!

At this point, it would pay to examine the primary power supply for intact fuses. The 24 volt inverter fuse may be blown. (Should be fairly obvious, the glass part of the fuse will be a dirty brown from the fuses original contents!)

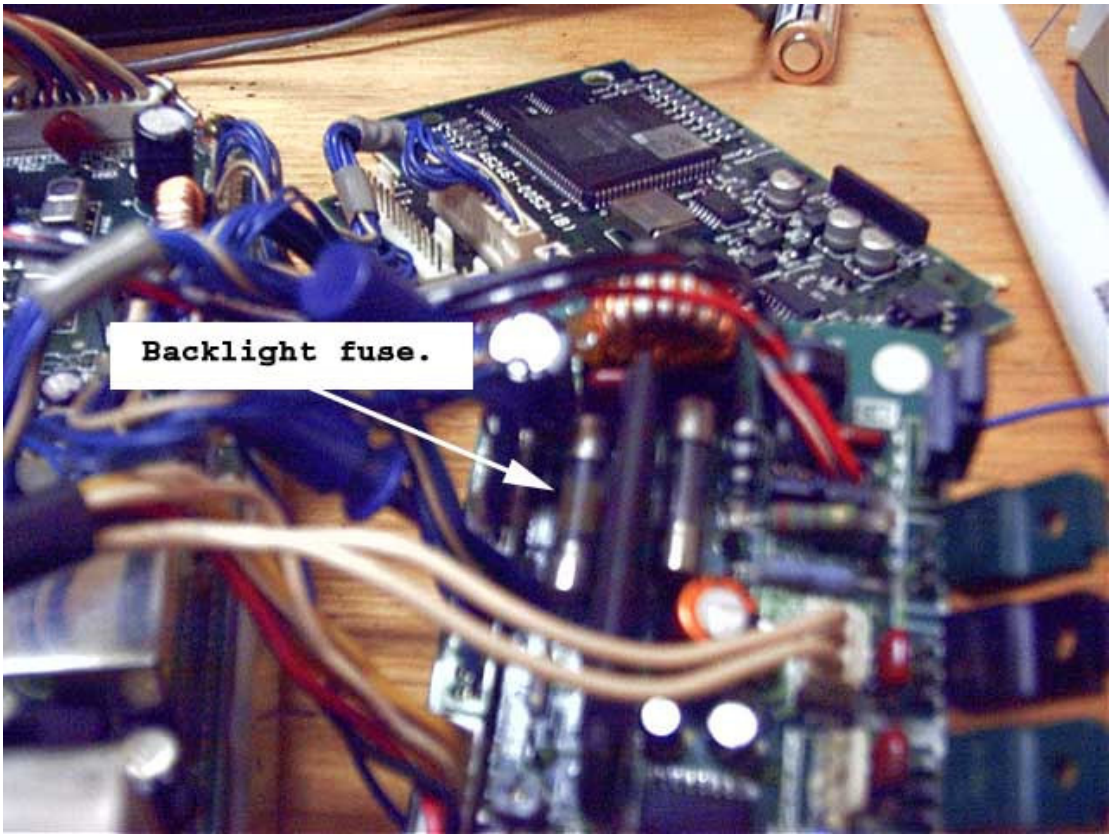

Figure 1 Blown Fuse

You need to replace this fuse if it is blown (Has been in all the units repaired so far!). Using the tip of the soldering iron, you can melt the solder on the end of the fuse. Apply pressure to the fuse and push the fuse across several millimetres while the solder is melted. (I use force on the iron for this. Do not press from the centre of the solder on the fuse end though, you are trying to disconnect the fuse from its mounting wire! Once you have one end free, you can unsolder the other end easily, and lift out the old fuse. Tin up the ends of your new fuse, and solder it back in place. (It might pay to check the new fuse with a multimeter after you have tinned up the ends, sometimes the fuse wire becomes detached when the ends are tinned.) It might help if you temporarily release the clip holding the wire loom that goes to the main board.)

(Careful, Glass tends to remain very hot for a substantial amount of time after the soldering iron has been removed. Use long nose pliers or tweezers to hold the fuse if you do not wish to burn your fingers!)
Once you have the unit out of the case, and the LCD detached from the front, you next need to remove the cover from the backlight power supply.

Undo the two screws shown in the picture shown below, and bend the metal tabs straight. (Only two tabs are visible in the picture below, but there are four tabs in all.)

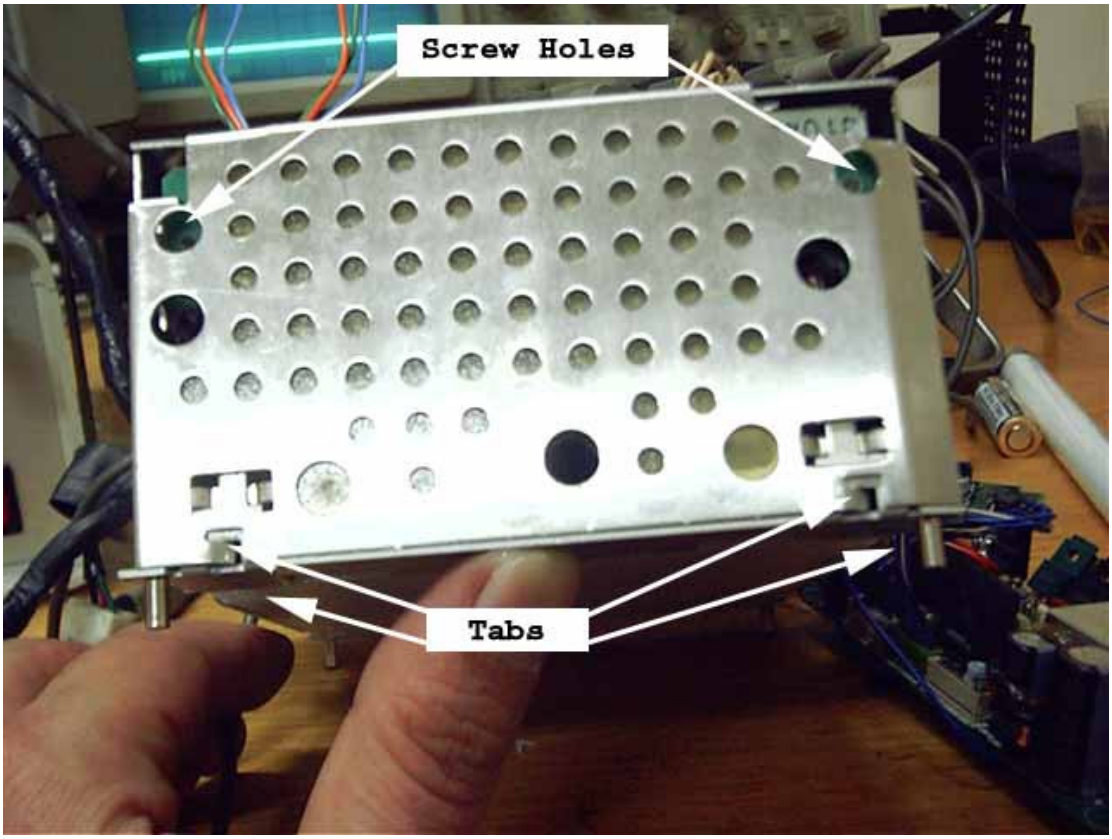

Figure 2 Backlight Inverter Cover.

You should now be able to lift the cover off. (May require some jiggling.)

To make things a little easier, the components for the repair can be purchased from Radio Spares, or Farnell. (Both companies are in the UK and Australia.) Rockby Electronics are in Melbourne.

The RS part numbers are:

MJE13003 **348-4603** (Aus $1.06 each) (I recommend this one!)
MJE340 **294-227** (Aus $2.57 each)
The actual value of capacitor required is not stocked by RS, but can be made by the parallel combination of a 47 nF and a 22 nF capacitor. (Near enough, anyway.) The RS Part numbers are **190-7693** and **190-7700** (Each is less than $0.70) (In fact, this is the way I have been doing the repair.)
Insulating washer (part number unkown, I had a part number but apparently it was wrong!

The Farnell Part Numbers are:

MJE13003 **3526367** (But, they may not have them in stock!)
68 nanofarad (0.068 uF) 630 volt working. **3038488 (Aus $1.35)**

Rocby Electronics: (They do mail order within Australia http://www.rockby.com.au)

MJE13003 **12128** $1.65 (Recommended type) MJE340 **12323** Aus $2.17
0.022 uF 250 Volts AC capacitor **13298** Aus $0.64
0.047 uF 250 Volts AC Capacitor **13300** Aus $0.77
Insulating washers (Pkt of 10) **12680** Aus $1.21

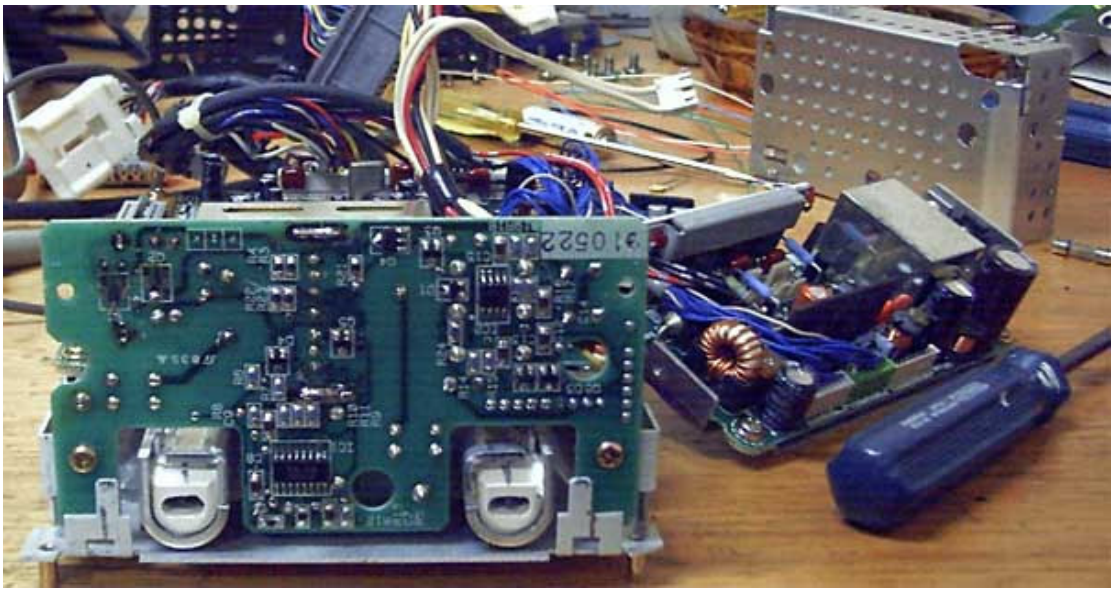

Figure 3 Cover Removed.

The transistors to be removed are in the upper left hand corner of the inverter board. To remove them, heat all three pins with a soldering iron and then flick or slide the transistors off. (Once again, be careful as solder burns, as would the still hot transistor.) It may help to add some solder to the pins being heated up! The solder should melt within one to two seconds. Do not apply the iron continuously for more than about ten seconds.

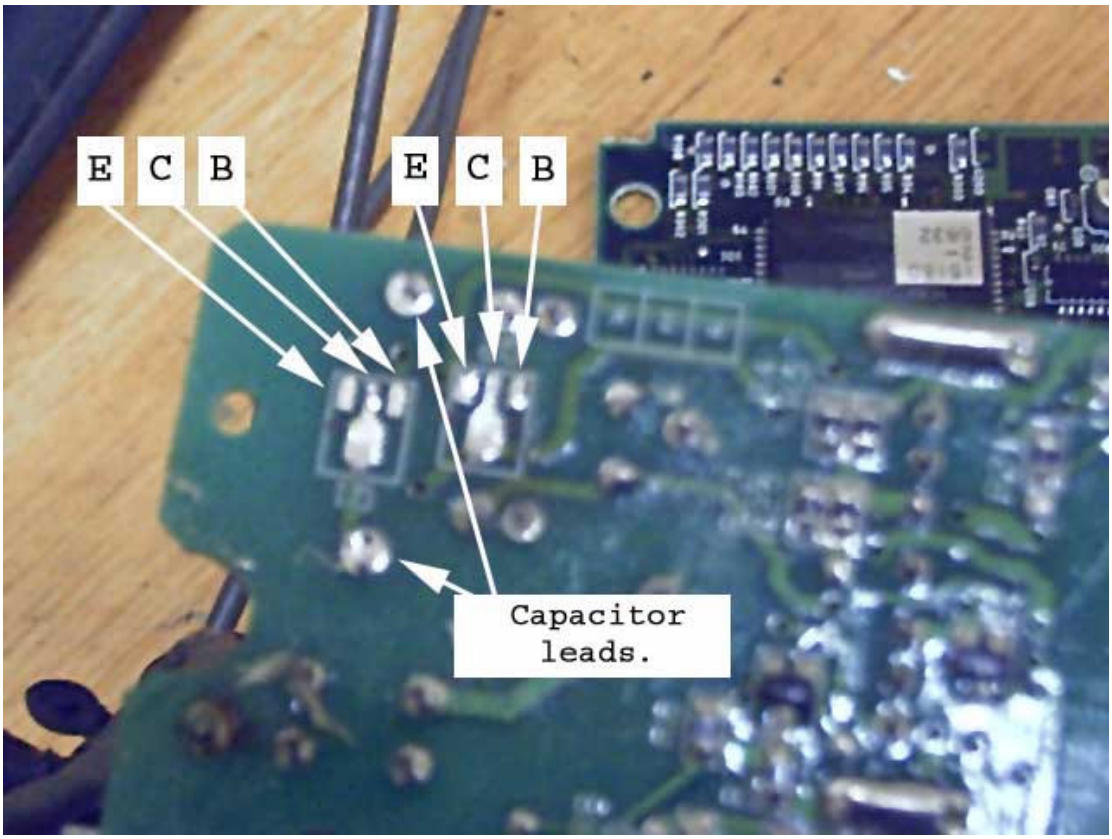

Figure 4 Q1 & Q2 lead identification.

Remove the 68 nF capacitor, (the leads are indicated above), and re-install the new one. This capacitor is invariably faulty, and I suspect its failure is the main cause of the subsequent transistor failure. The original capacitor is rectangular, about 1 * 3 * 2 cm. (Coloured black)

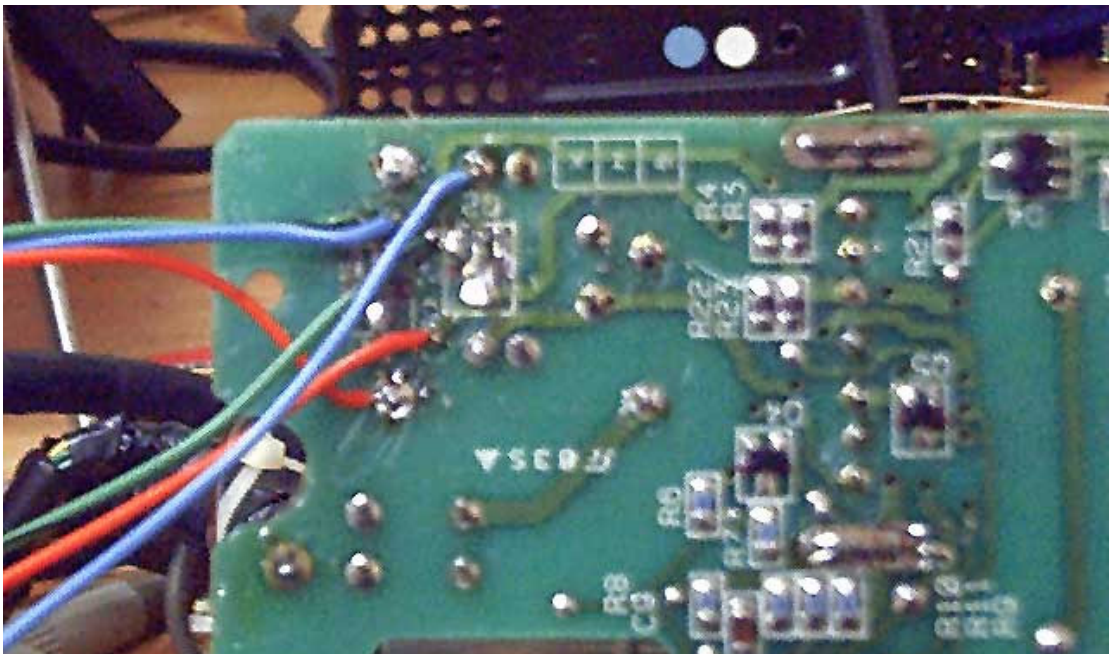

Figure 5 Wires added.

Next, you will need to add wires to attach to the new transistors. Wherever convenient, use pre-existing board holes for this (for mounting strength). You will need to scrape the solder mask off the plated through holes first, and then tin the holes with fresh solder. The final required result is shown in the picture above (Fig 5). I used blue wire for the Base connection, Orange for the collector, and green for the Emitter, although the colour is not important, use whatever you have at hand. Take note of the wire grouping above, it is important that the wires for the transistors are not mixed up.

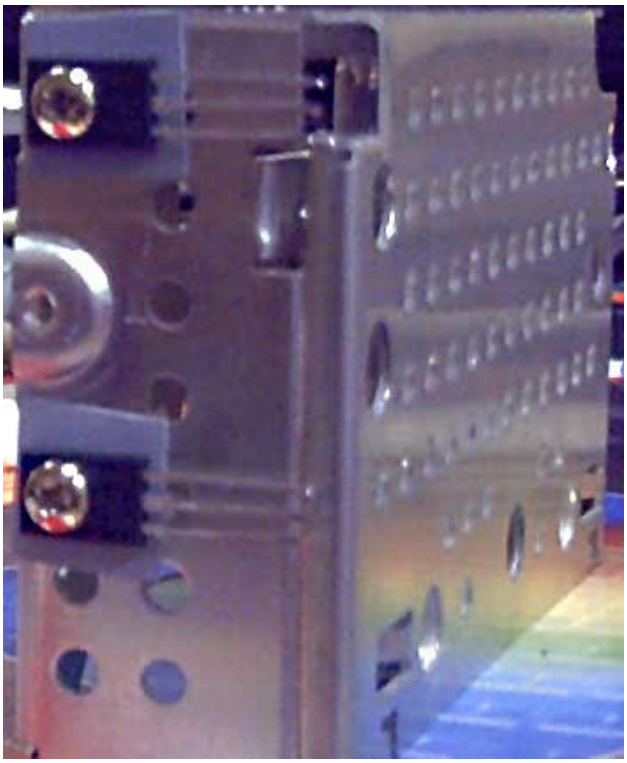

Figure 6 Transistor mounting.

You will need to mount the transistors on the case as shown on the left. (Fig 6)

Note that the transistors MUST be insulated from the aluminium case. (There is a metal backing plate on the back of the transistor, which is connected to the collector of the device.)

After the transistors have been mounted, (but before you connect the wires) you should check that the insulator is still intact by measuring between the centre leg of the transistor and the aluminium case with a multimeter. .(Using the Ohms range.) This should read as an open circuit!

NB: the nuts of the 3 mm screws must go inside the cover, there is insufficient room inside the main case to have the nut on the transistors face.

After you have mounted the transistors, you can trim the leads down to approximately 5 mm in length in preparation for the wire attachment.

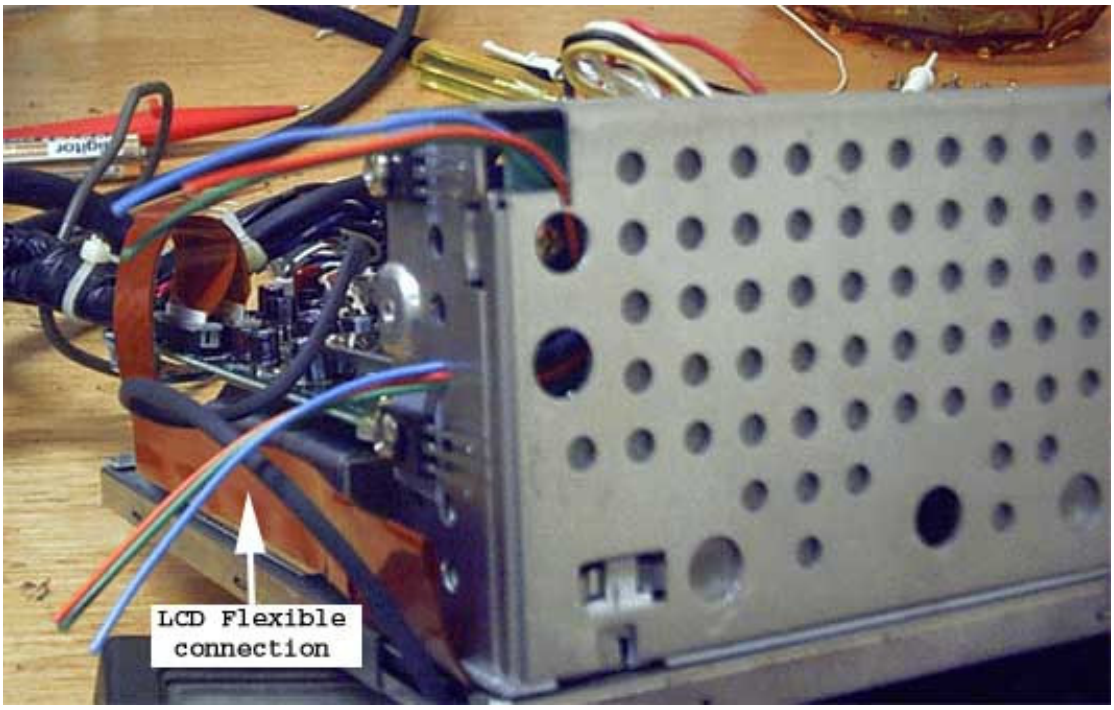

Figure 7 Backlight Inverter Cover Re-installed

Carefully slip the aluminium cover back into position, while threading the wires for the transistors through appropriate holes as shown above in Figure 7. The screws that hold the backlight high voltage inverter board in position can be re-inserted, and the tabs can be bent back to their original positions.

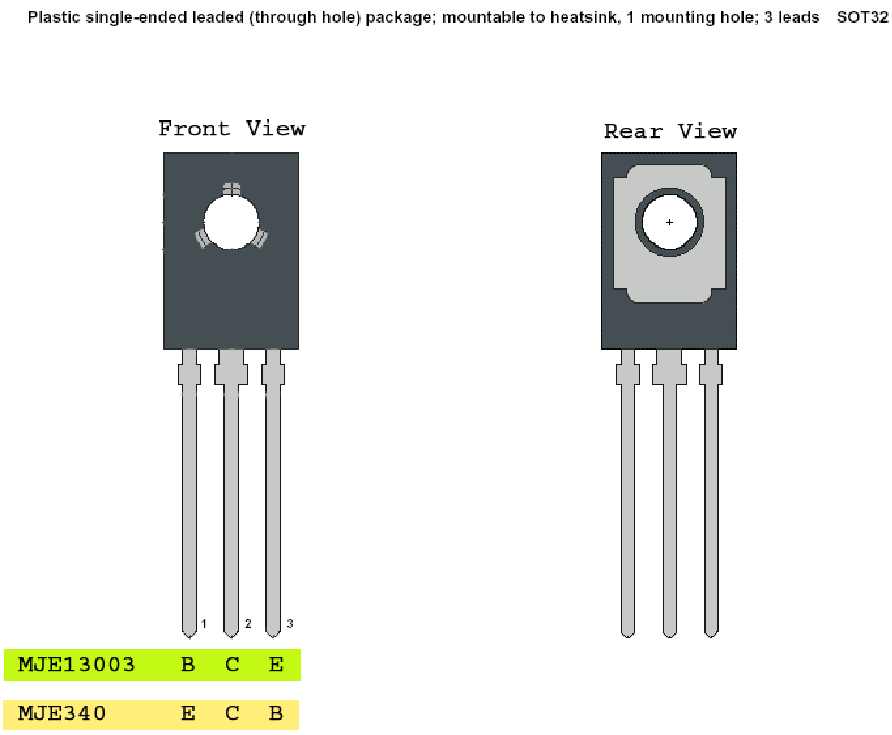

Figure 8 Transistor Connections.

Take note of the above transistor connections, as the Base and Emitter connections are swapped around between the two types! *(I have been using the MJE13003 type, as it has higher ratings, but either type works acceptably well.)*

Trim the wire length so that each connection to be made will not put undue strain anywhere. (So as not to cut through the wires on any part of the casing.) strip the insulation of the wire back by about 3 to 5 mm and tin the bare end with solder. (Tin the transistor legs at the same time.)

Although not essential, I used insulating sleeves on each connection. Slip a loose fitting plastic sleeve on each wire before soldering it in place. When the connection has been made, the sleeve can be slid over the bare connection. After all connections have been made, the job is essentially complete, and you can re-assemble the unit. Take note that the LCD flexible connection must go under the aluminium bracket visible in the picture below (Fig 9), **not** on the outside, as can be seen in fig 7. (Which is shown like that because I test the units operation before I reassemble it.)

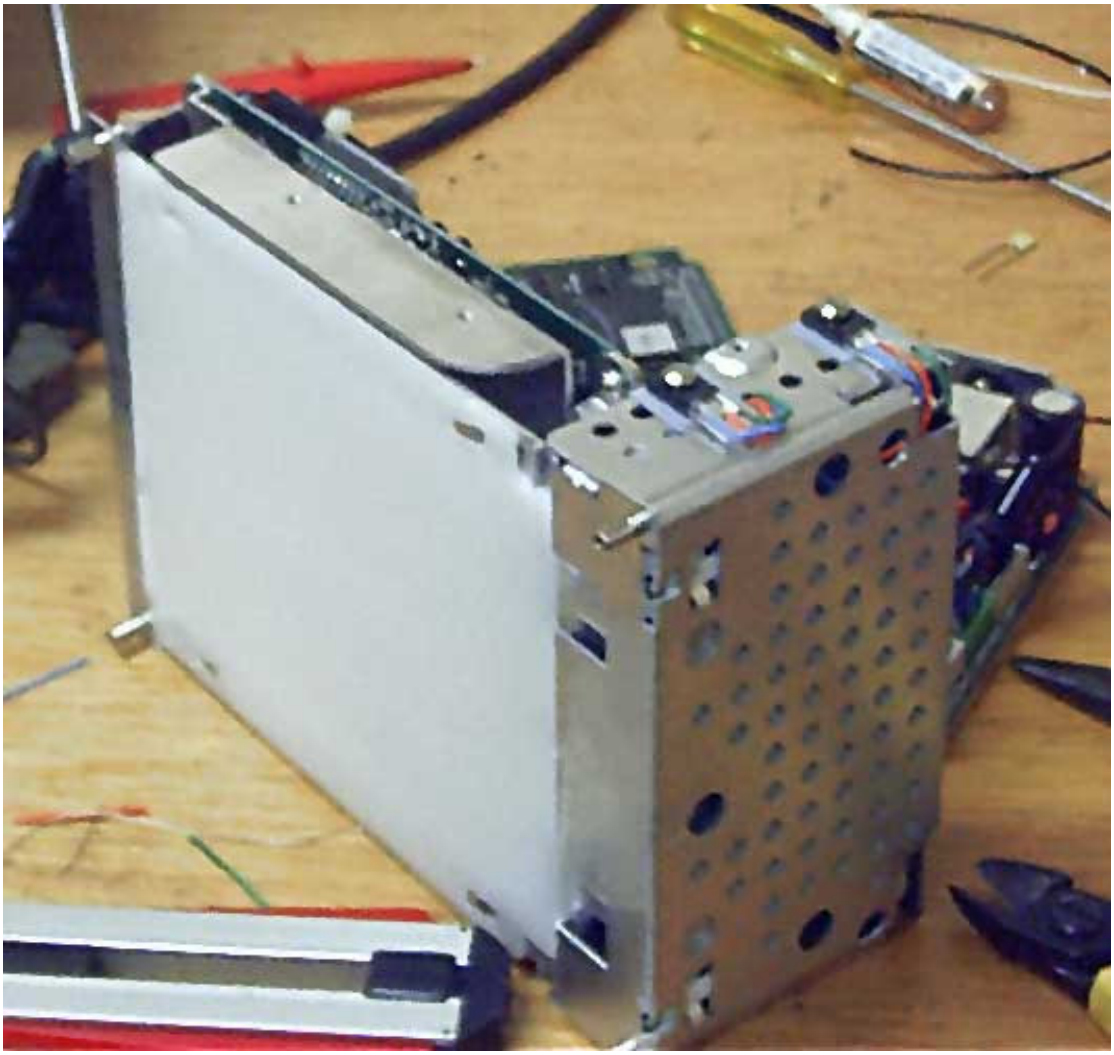

Figure 9 Finished, ready for re-assembly.

The assembly procedure is essentially the reverse of the disassembly procedure, so I will not bother to repeat it here. (You should have been taking note when you pulled it apart!)

When the Touch screen does not work.

The second fault that will stop the EMV from working is as follows. The board shown in figure 10 is in fact the very first board you will access when dis-assembling the actual monitor.

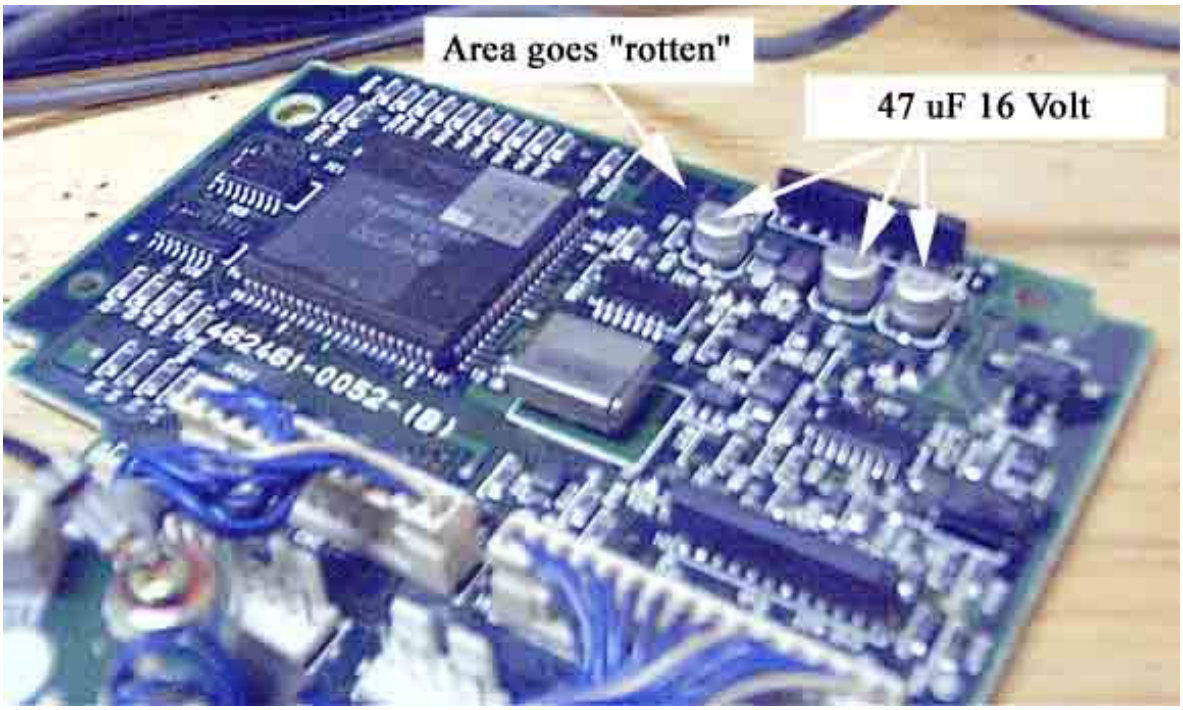

Figure 10 EMV control board.

The capacitors indicated with the arrows go leaky and the contents are slightly caustic. This causes the thru-hole plating on/in several holes in the indicated area to disappear, and the board fails. The resultant fault is no backlight, no touch-screen, no nothing!

The fix is,

1: remove the three capacitors.
2: clean the board up. (water/metho, whatever.)
3: replace the 3 surface mount capacitors with new ones
4: scrape clean the thru-holes on both sides in the indicated area. (Three thru-holes)
5: pass a thin piece of wire through each hole, solder on both sides.

(I suggest before you do step 5, that you verify that at least one of the holes is in fact open circuit.)

If you have done the backlight repair, and your EMV still doesn't work, it is likely that the above fault is actually the culprit! (There was probably nothing wrong with the backlight at all.)

Please check this fault before you proceed to the backlight repair. IF your touch screen does not work, the above is the most likely reason!

I suggest the following may not be rigorous though. Please check the board visually as your board may be in a worse state than the one shown above.

When the display goes clear.

There is another “common” fault with the display, where the screen goes “clear”, and yet the backlight still works (and so does the touch screen!) Again caused by a faulty capacitor, this one is located on the main circuit board, and is under a tin shield. While you have the unit apart, it is probably a good idea to replace the other two capacitors Greg has indicated. These are NOT surface mount devices, so sourcing the correct components should not really be an issue. This fault was found and corrected by Greg Bingham, who sent me the details which I have now added to this document.

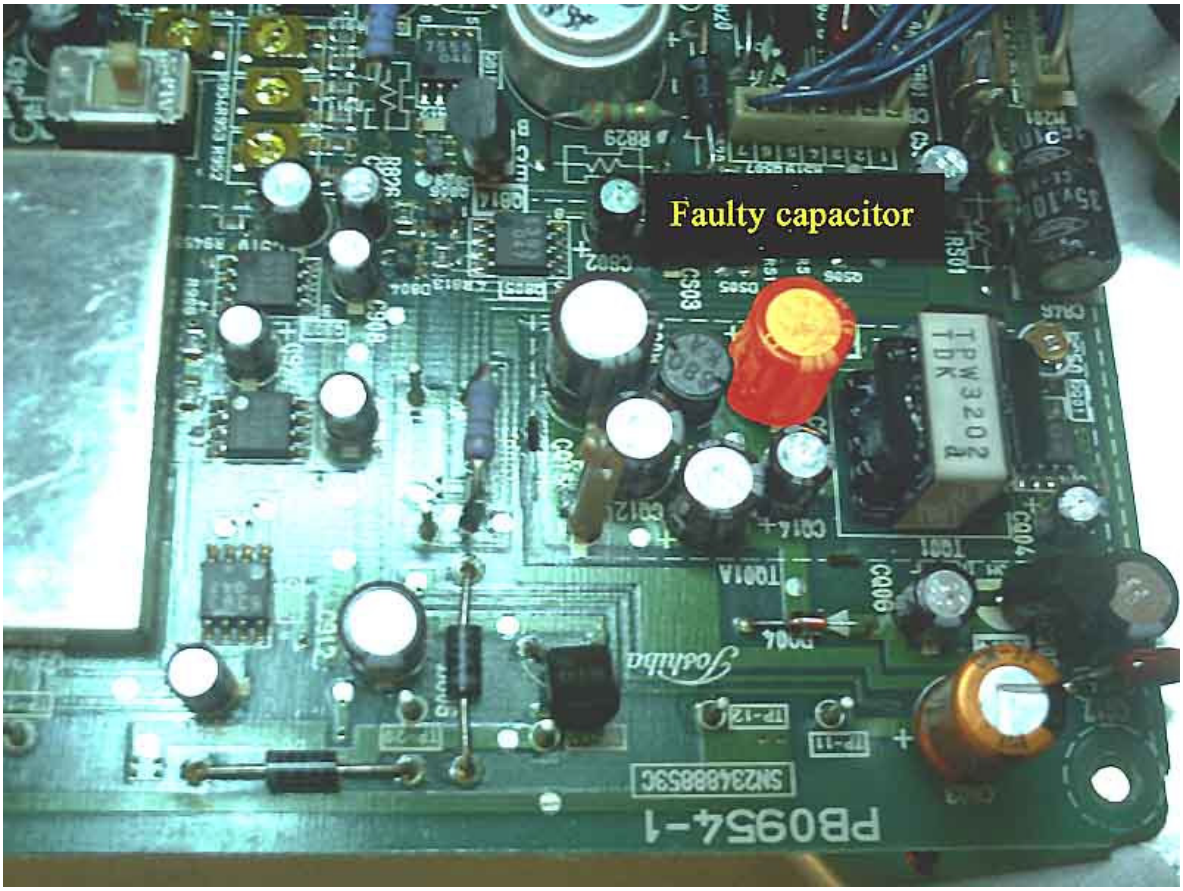

Figure 11 Faulty Capacitor highlighted in red.

The capacitor in question is highlighted in red in Figure 11. (NB: I highlighted this component red, it in fact is NOT red when you lift the cover!) This component is under a tin shield, which must be removed to access this area of the main board. The capacitor is an 82 microfarad device. Following is what Greg did to his unit to repair it.

I've replaced both the 82uF 16V caps under the metal housing, with 82uF 35V from Farnell. Part # 303-6376. They're about 60c each, and only slightly larger in diameter (6.3mm vs 5mm) I also replaced the two 56uF 16v caps with 35V type.Part # 303-6364.

Powering the unit up on the bench.

Many people have requested information about powering up the unit whilst it is out of the car, so that the repairs can be "bench tested", verifying that the repaired EMV display works correctly. (Considering the effort required to remove the EMV from the car, this is not a bad idea!) The 12 volt supply required for this needs to be rated at above 6..8 Amps at the very least. (Now you know why the EMV flattens the car battery!)

The 12 volts from an old PC power supply is useful in this context! The 4 pin Molex connectors that are used to power hard disk drives has both + 5Volts and + 12 Volts (The Yellow wire has positive 12 Volts, Either black wire can be used as the ground (negative) connection.)

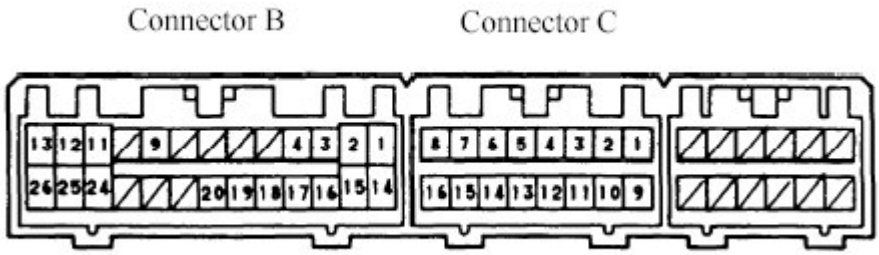

Figure 12 Connector on EMV.

It is absolutely necessary to have the EMV computer connected to the unit, as without a video signal from this box, the display will not produce a picture, or even start up the LCD backlight. (The EMV computer is in the box that "piggybacks" the display.)

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Ground to:
Multi Display Computer (CPU module)
Connector B, pins 13 & 26

+13.8 (+12) Supply to:
Multi Display Computer (CPU module)
Connector B, pins 11,12, 24, 25

+13.8 (+12) Supply to:
Multi Display (Black LCD unit)
Connector B (on the flying lead)
Pins 1 & 2
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The flying lead mentioned above (to the display) ends up terminated on the board that contains the 3.15 amp fuse mentioned elsewhere (the 12 volt to 24 volt inverter board). (The appropriate wire/s on the flying lead are red with some other colour stripes. (Sorry, this is from memory, I cannot be more explicit about this!) Note that the power pins indicated above are substantially "fatter" than the other pins on the plug.

When you supply power, after a few seconds, you will hear a beep come from the computer. A couple of seconds after that, you will get video (if everything is working/fixed). Only a few menus can be accessed, but enough should work that you can verify that the touch screen is alive. You can however access the display "dimmer" feature, hidden in amongst the various menus.

NB: If you are lazy, you need only connect one ground and one power on the CPU module, but, the pins connected may become fairly hot! (Careful, hot enough to burn skin!)

Only one positive supply to the flying lead is required to be connected, this does not get hot. (The wires are in parallel.)

Notes:

I have seen several EMV's with varying levels of "pixel death" evident on the screen. Aside from replacing the LCD module, there is nothing that can be done to remedy this problem. I have also considered replacing the tube with CCFD displays available from Jaycar (in Australia). To do this (although I have not actually tried it) you would need at least 4 tubes, each tube would need a 100...1000 ohm resistor in series with it, otherwise only one tube will strike. I have experimented with normal fluorescent tubes replacing the original tube, and although they are not cold cathode, they do strike without requiring "heater" voltage. Unfortunately, the colour temperature of the tubes I had were not a good match to the original tube. (I estimate the colour temp of the original tube to be around 8000 degrees K.)

Another approach would be to replace the backlight with a stack of white LED devices. This has not been investigated, but, I suspect would be very effective, and the display would potentially end up being brighter than the original, and use less power from the battery. (I even think I could arrange for the dimmer circuit to be effective!)

I have seen one unit that someone had totally removed the Inverter, and original backlight tube, and installed a new aftermarket inverter, and backlight from a laptop computer. (The dimming feature did not work though!)

The "TIF" forum shows yet another mod that used a module (dangling out the back of the display) powering what I suspect were new tubes in the backlight of the display.

Apparently, often the backlight tube may, in fact, be faulty. Check the tube carefully for fractures while you have the display unit apart. Note that the original tube has several devices glued to it. I am not sure what the functions of these devices are. (They may measure temperature, light output (or both), but I did not investigate what they actually did!)