How to check the electric components in the IMRC of the Cougar V6

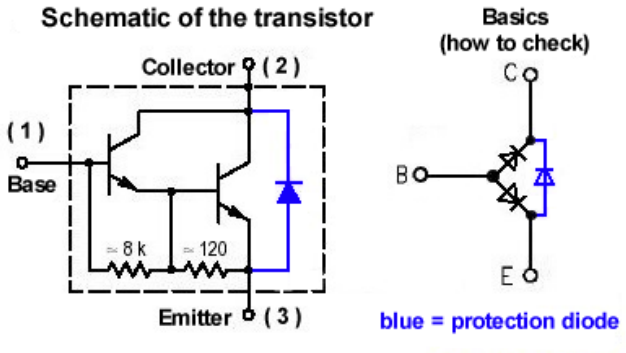
Last revised: 2005-02-12

Information about the built-in power transistor

The built-in transistor is a so-called NPN Darlington Transistor. These specific Transistors have a very high current gain. This means for example: they can switch with an input current of 10 mA (0,01 A) a 1000 times or bigger current, so ~ 10 A. This is required, because the transistor is only triggered by an IC (integrated circuit) with a very low output current and the electric motor takes at least 5 Amperes.

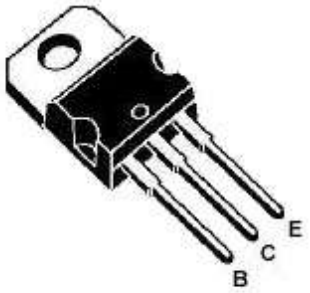
A transistor to be checked can be seen as a connection of two diodes. Therefore you can test it with a standard multimeter, which must have an integrated diode check. This doesn't always work, because other components on the circuit board may influence the readings. The **built-in** transistor in the IMRC can be tested with a **multimeter** only for **defect**.
A built-in defective transistor delivers undoubtedly readings, while testing for 100% operation only can be done in a removed condition or by directly applying power.

Let's have a look on the schematic of this NPN Darlington Transistor:



The used transistor in the IMRC additionally has an integrated protection diode to protect it from high voltage peaks. A standard transistor doesn't have it.

The transistor has the following package type:



TO-220

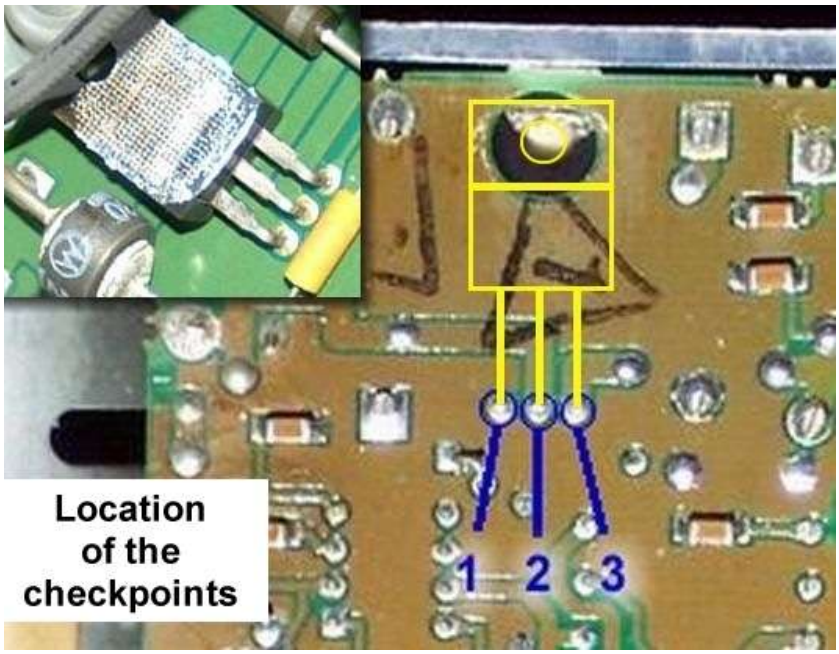
Checking Instructions

Required Tools:

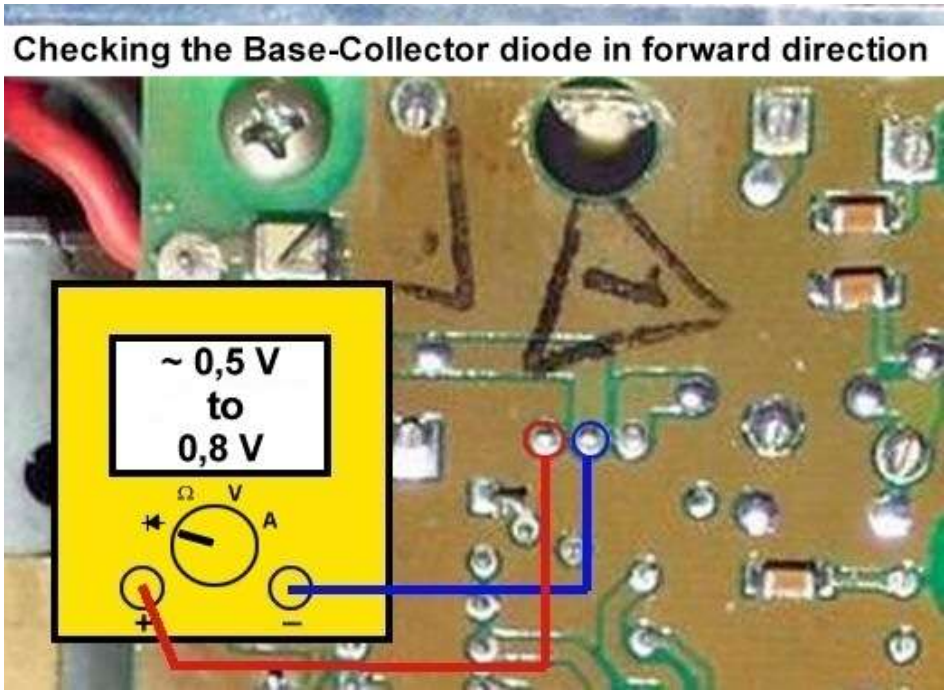
1. Multimeter **with** Diodetest (a cheap one for 10-20 dollars is good)
2. Wrench with extension and socket 7mm ;-)
3. middle sized Philips Screwdriver
4. big Screwdriver
5. 12V- power supply **with** current limitation (optional, no car battery charger !)
6. probe cables, probe tips and crocodile clamps (optional)
7. one resistor 1 - 5 kOhms (optional)

Working Steps:

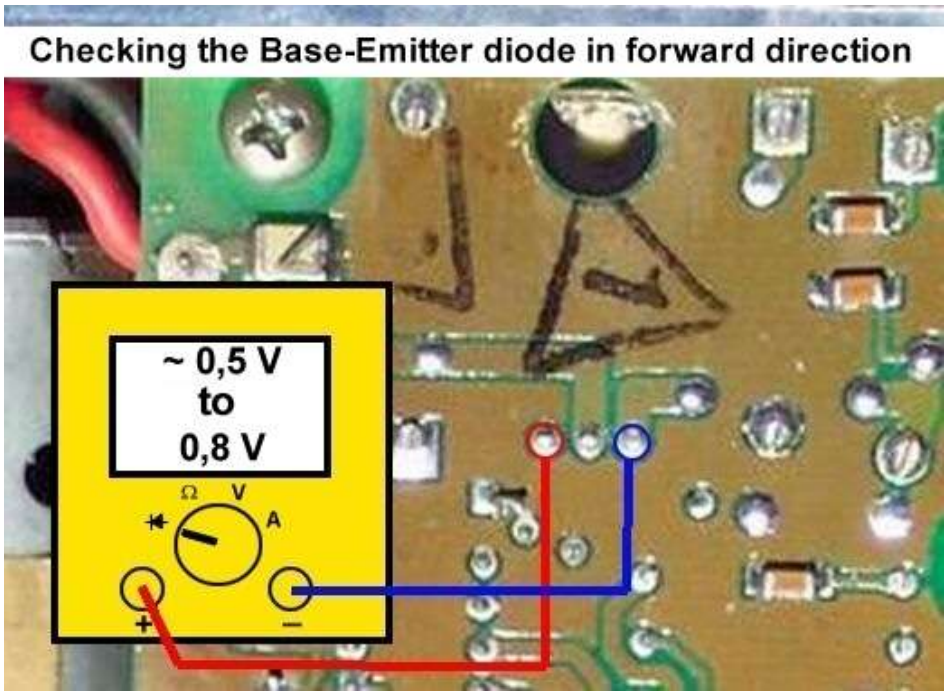
1. Open the hood.
2. Remove the black plastic cover (labelled Duratec 24V).
3. Remove the 4 philips screws of the aluminum box (IMRC) below.
4. The cover is sealed and glued. Try to apply the big screwdriver at a good position to lever the cover up.
5. **Disconnect the IMRC (for safety reasons)**
6. Turn on the multimeter, switch the range to diode-test and take care that the red cable is in the positive and the black one in the negative jack (see pic)
7. Locate the checkpoints of the transistor (see picture)



8. Connect the probe tips together to test correct working of the multimeter. The display should read app. 0,00 V.
9. **Checking the Base-Collector Diode in forward direction**
   Connect the probe tips to the points shown on the picture.
   Is the reading in the range of 0,5V – 0,8V, this diode is ok.
   At a reading of ~ 0,00V – 0,1V the diode has short circuit.
   If there is no reading or higher than 0,8V, it is burned.

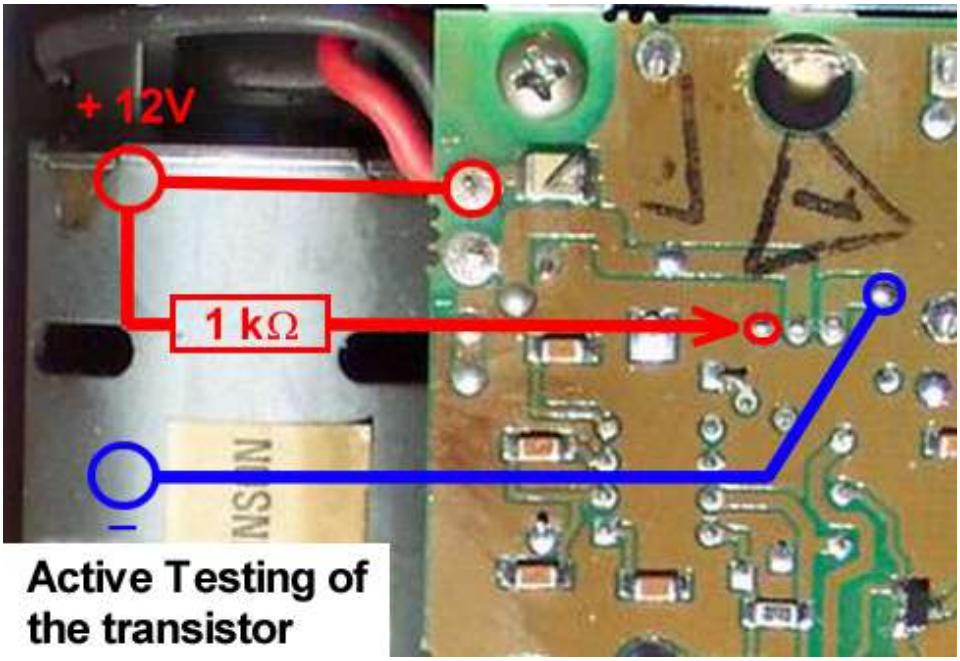


10. **Checking the Base-Emitter Diode in forward direction**
    Connect the probe tips to the points shown on the picture.
    Is the reading in the range of 0,5V – 0,8V, this diode is ok.
    At a reading of ~ 0,00V – 0,1V the diode has short circuit.
    If there is no reading, it is burned.



11. Active Testing of the Transistor

Should all previous test routines not show a failure of the transistor and if the electric motor is ok (see 12), then you can check the transistor for operation by directly connecting it to power. I call this „active Test“.
This should only be performed in the case of doubt and with **care**.
You need a resistor of **at least** 1 kOhm (1000 Ohms) / max. 5 kOhm (5000 Ohms) and some probe cables and crocodile clamps. **In addition a power supply (12V-) with current limitation (no car battery charger !).**
CAUTION: If you connect to the wrong points or take the power directly from the car battery, components of the IMRC can be destroyed ! Disconnect (unplug) the IMRC !
Step a: Connect the negative of the power supply to the point shown on the picture (emitter of transistor).
Step b: Connect the positive of the power supply to the point shown on the picture (positive electric motor). First try to „tip“ the point temporary and if it doesn't „flash“ that much, connect it permanently. Should the electric motor rotate while „tipping“ to the point, then the transistor or possibly a antiparallel connected Zener-Diode is defective. In this case the IMRC should be stuck open all the time when the engine is running. More checking now only can be done by soldering out these parts. You don't need to proceed to step c:
Step c: Connect the positive of the power supply with the applied resistor to the point shown on the picture (arrow, Base of Transistor) by just „tipping“ on it. Should the electric motor move or rotate, the transistor is **undoubtedly** Ok.



Active Testing of the transistor

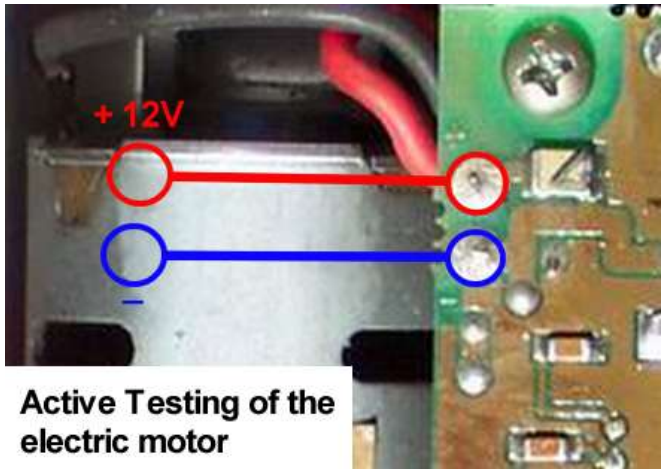
Important Notes

The plastic inhex screw is **no** adjusting screw, like some people mean. It is for **isolated** assembly of the transistor to the cooling area and should not be turned without a reason. Loosen increases the thermal resistance and more tightening could break the screw. **Do not use a metal screw !**

I highly recommend **disconnecting the IMRC** and the usage of a **power supply with current limitation**. **Never connect to the car battery !**

12. Active Testing of the electric motor

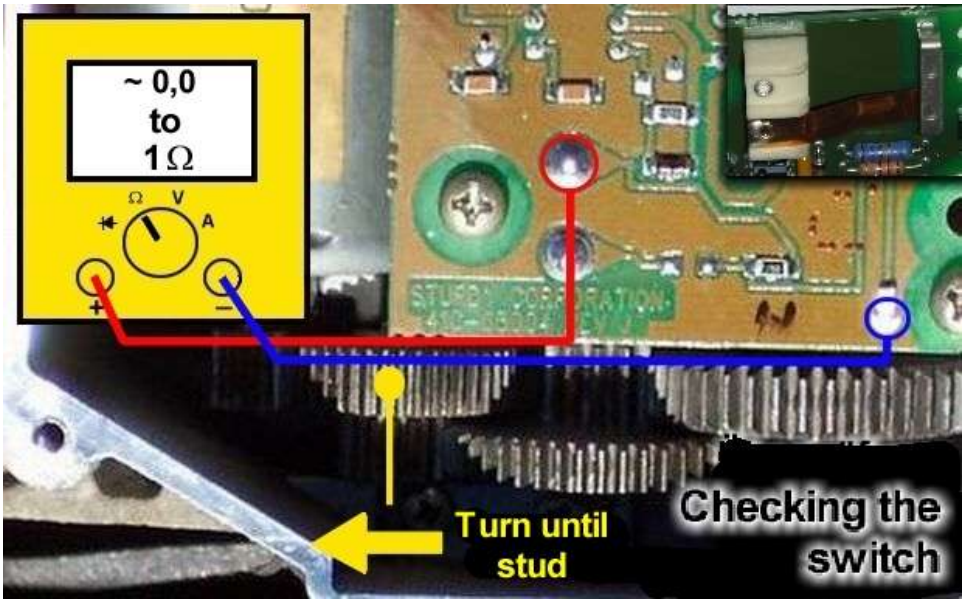
We take our **power supply with current limitation** and connect it to the checkpoints shown on the picture. (Beware POSITIVE – NEGATIVE !)



13. Checking the switch

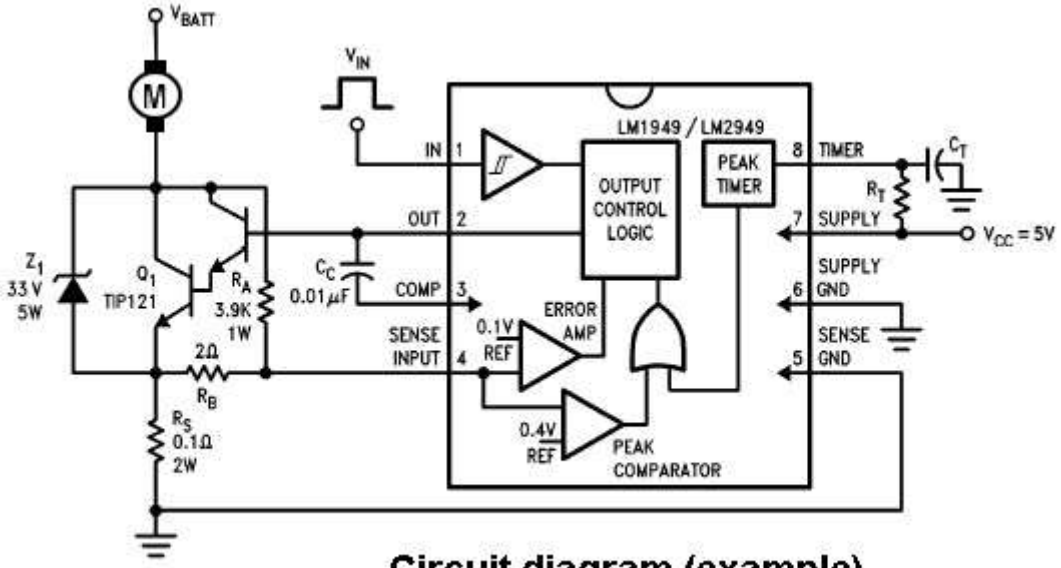
This defect has also appeared in some IMRCs.
Checking is only required, if the IMRC opens, but the OBD or the diagnostic tester shows a „IMRC stuck closed“ code. If you can't see the defect of the switch by a loosen copper tin, we can also test it with the multimeter.
The switch is open in the idle state and closed at a specific gear position.
Switch the multimeter to the lowest resistance measuring range.
Connect the probe tips to the points shown on the picture.
Turn the marked gearwheel in the shown direction until no more turning is possible or the multimeter earlier shows a reading of ~ 0 – 1 Ohm. Turning the gearwheel is easy for the first few millimeters until the cable gets tight. Then the required force increases. For best results you should do this test with 2 persons – you turn the gearwheel ;-) and the other one takes care of the multimeter. If the multimeter doesn't show the reading of ~ 0 – 1 Ohm before reaching the stud of the gear, then the switch is faulty.

You should not turn the gear by to much force !



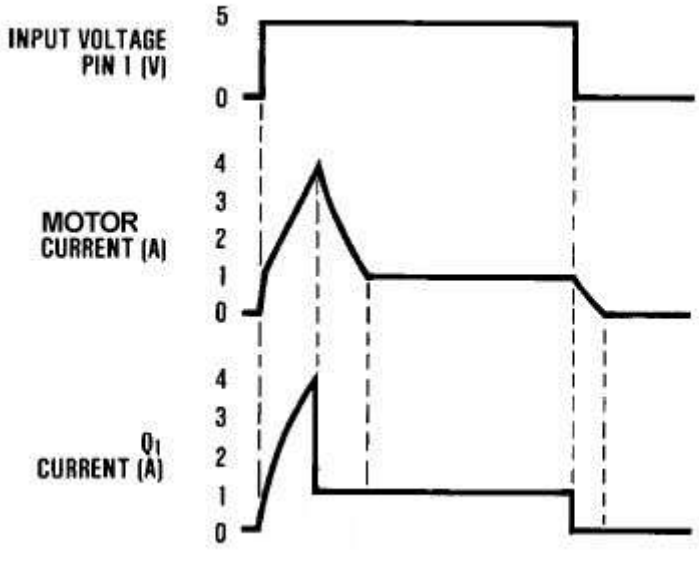
Information about the IC

The IC is labelled LM 1949N. In the IMRC it's main purpose is to control the power transistor. You can see more on the pictures.
Note that the shown circuit diagram is only an example and not the real circuit diagram of the IMRC.



Circuit diagram (example)

As you can see, the base of the transistor is connected with Pin 2 (Out) of the IC. At Pin 1 (In) arrives the signal from the PCM to open the secondaries.
The diagram below shows, that the current of the electric motor is immediately reduced to 25% just after reaching the peak (when motor has opened the secondaries and is running against resistance). Therefore the risk of damaging the electric motor is minimized. The data in the diagrams are just for example.



For further information you should refer to the datasheet of the IC.
With that datasheet more testing routines could be done, but without a real circuit diagram of the IMRC they would be to speculative.

If you found a defect – CONGRATULATIONS !
This was the test for everybody. Maybe it could help you.

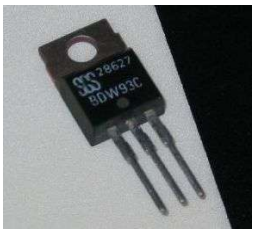
Advanced testing routines only can be done by qualified persons. The electronic components on the circuit board are not very expensive. The most expensive part will be the IC (LM 1949N). Every skilled radio- or TV workshop should repair the IMRC for a fair price.

The removing and reinstall of the PCB and replacing the transistor is a little bit tricky for unexperienced persons and should be done by a qualified.

So screw back the cover to the IMRC.
Connect IMRC.
Put the Duratec plastic cover back in place.
Close the hood and get the transistor.

The used transistors vary from the revision of the PCB.
In my IMRC it was a 2N6045. It has a max. continuous current of 8 A and a max. power dissipation of 75 W.

I recommend using the BDW93C as replacement type.
It has 80 Watts and can take 12 A continuous current.
The price is maybe 1 Dollar :-)



BDW93C

Other usable types:
TIP102 (8A/80W)
BDX33C (10A/70W)
2N6388 (10A/65W)
2N6668

For repairing the switch, a piece of copper wire should be soldered on the copper tin to reconnect the broken parts.

I wish you a successful repair

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