Common Questions and the answers on

Components and Ratings

Many readers write to us with queries about component ratings and possibilities for substitution. This article brings together some of the common questions and provides helpful answers.

by LEO SIMPSON

Q: I have a circuit with a number of resistors which get hot. Can I reduce the power dissipation by using higher rated resistors?

You cannot reduce the power dissipation of a circuit merely by upgrading the ratings of components. A given circuit will, under the same operating conditions, always have the same power dissipation, regardless of whether the devices used are light-duty or heavy-duty.

To illustrate, let us consider the resistor problem posed by our reader. A 100ohm resistor passing 100 milliamps will dissipate 1 watt, regardless of whether it is rated at 1 watt, 5 watts or 20 watts. So changing the device rating does not change the power dissipated.

Perhaps our reader really wanted the resistors to run cooler. Well, as a general rule, using a higher rated device will allow lower operating temperatures but even this should be qualified.

For example, metal film resistors generally run cooler to the touch than carbon film types when dissipating a given amount of power. This is because the metal-film resistor is able to conduct more of its heat away via the leads to the PCB pattern or solder lugs.

So it is possible that if a carbon film resistor of 2 watt rating is substituted for a lower rated metal film resistor, it may actually run with a higher surface temperature.

A general rule to follow is that provided the resistors are run in ambient temperature of 70 degrees Celsius or less, the resistor may be used at up to its maximum power dissipation. Above 70 degrees Celsius, the resistor should be derated, according to the derating charts of the manufacturer.

Q: I have a power supply which has a 5 watt resistor in the circuit. This resistor gets stinking hot but it is actually dissipating less than 5 watts, according to my measurements. What can I do about it?

Wirewound resistors do run at high surface temperatures. For example, a 5 watt resistor dissipating 5 watts will typically have a surface temperature 120 degrees above the ambient temperature. 10 Watt resistors are worse. When dissipating 100% of rating, ie, 10 watts, they have a surface temperature of 200 degrees Celsius above ambient. Higher rated resistors are even worse again.

In fact, resistors with ratings of 10 watts or more get so hot that they can char the surface of printed circuit boards. They can also cause problems if they are wired to lugs to which electrolytic capacitors or semiconductors are also connected. The heat travels down the leads from the resistor, into the capacitor or semiconductor and thus can lead to overheating and subsequent failure.

You can gain some improvement by substantially derating wirewound resistors so that they do not run so hot. But even so, wirewound resistors should be positioned so that they are unlikely to cause damage to other parts of the circuit.

Q: My friend told me that I should not use 1 watt resistors in a low power CMOS circuit because "they are too strong for the circuit". Is he right?

No, provided the resistors are physically compatible with the PCB or whatever, there is no reason why you should not use 1 watt resistors. Resistors are resistors, after all, whether they be rated at ¼W or 50W.

Q: Is it permissible to use an electrolytic capacitor with a rating of 25 volts in a circuit where the voltage supplied to it will be only 5 volts?

Years ago, it was desirable to use electrolytic capacitors at or reasonably near to their rated voltage, otherwise their capacitance and power factor was degraded. With modern electrolytics there are no problems. They can be used at a small fraction of their rated voltage, which no reduction in performance.

As a general rule, you can use modern electrolytics at any voltage from just a couple of volts right up to their maximum rating, with no degradation in performance.

Q: What is the shelf life of electrolytics? I have a bunch of electrolytic capacitors which I purchased a few years ago. Should I re-form them before using them in circuit?

Many of our younger readers would probably wonder at the term "form". This term applies to the growth of the oxide coating on the aluminium foil inside an electrolytic capacitor. The oxide coat is actually the dielectric — the aluminium electrode is the anode, while the electrolyte, which is usually in paste form is the negative connection, or cathode.

In former years, the oxide dielectric of aluminium electrolytic capacitors was not particularly stable and tended to break down while the capacitor was on the shelf. If such a capacitor was placed into circuit and voltage applied, not only would the capacitance be low and power factor high, but the leakage current might be so high that the capacitor might overheat and destroy itself.

Consequently, it was prudent to "reform" or repair the oxide dielectric of electrolytic capacitors before putting them into circuit. The usual procedure was to connect the capacitor to a suitable high voltage supply via a limiting resistor. The resistor would limit the leakage current of the capacitor to a safe value, while the oxide coating reformed. For most capacitors this process would be complete after say, ten minutes. By this time, the leakage would have dropped to a safe and minimum value and the capacitor could be safely placed in circuit. Thereafter, provided the circuit was used reasonably frequently (say once every few months at a minimum), the capacitor would function reliably.

Well, so much for ancient history. All the above applies only to capacitors which were made more than about ten years ago.

Modern electrolytic capacitors have been improved to the point where their shelf life is practically indefinite. In other words, no one really knows

just how good they are, except the manufacturers. This means that there is little point in going through the "reforming" procedure. Provided the capacitors you refer to are only a few years old, you can place them directly into circuit.

Q: I have built a regulated power supply and wish to upgrade it from 5 amps to 8 amps capacity. The modification involves substituting two parallel-connected-2N3055s for an existing single 2N3055. The existing driver transistor for the 2N3055 is a plastic TIP32, rated at 3 amps. Is there any point in substituting a TIP33 which is rated at 10 amps?

If the transistor is presently running well within its ratings, there is no point in changing to a higher rated transistor. Even if the transistor was becoming hot (which it should not, in your circuit) the answer would be to improve the heatsinking of the transistor, not substitute another transistor. In fact, in some cases you could prejudice the circuit operation by going to a higher current transistor because it would, more than likely, have a lower current gain.

Q: What is the purpose of heatsink compound and how is it used? I understand it is used for transistor heat dissipation.

Heatsink compound is used to improve heat transfer between the case of the transistor (or other power semiconductor) and the heatsink. It does this by displacing the air which is inevitably trapped in small pockets between the transistor mounting surface and the heatsink surface.

We must add that heatsink compound is, of itself, not a particularly good heat conductor. But it is considerably better than air, which is a very good insulator.

Heatsink compound should be **lightly** smeared over the transistor mounting surface and the mating surface of the heatsink. Heatsink compound is not a substitute for mica washers, which are still required when the transistor must be electrically insulated from the heatsink. When such a washer is used, it too should be lightly smeared with compound.