Advel Application Note – AAN2011.1

Counterfeit electronic components, a problem difficult to be solved

Eng. Alessio Spinosi

1. Introduction

In recent years, pheraps for the global economic crisis, an increasing level of competition and a race to the lowest price, of course led to a quality in the electronic components increasingly declining in proportion to the purchase price of the product.
So far no problem: having to buy for example a capacitor, you have the option to choose a capacitor with low cost (and low quality) or much more expensive (but high quality).
The problem, far more insidious, and increasingly widespread, is to buy a counterfeit component: this leads to considerable problems for electronics manufacturers and electronic designers.

2. Counterfeiting of electronic components

False material industry has now permeated all of the productive sectors so as to become a systematic element of the global economy.
In Europe, the European Commission has recommended an exchange of counterfeit goods by 7% in the EU, amounting to 300 billion dollars.
Counterfeiting has invaded the electronic components, despite the requested technology and complexity. Counterfeit transistors, memories, chip, capacitors are the order of the day, so that, according to experts, all companies involved in the chain of the electronics industry have met or will meet at least once in their lifetime the problem.

Where the source of the counterfeit is from? Little doubt about it, China is by far the top of the league, followed by Korea, Taiwan, Thailand and other Far East countries, which together account for 70% of the market of fake. But the Europe also has its own responsibilities.

3. How to avoid this problem

To guard against counterfeiting, it's certainly necessary to act in a preventive mode and as planned as possible. Better to avoid the "rush" and ran to the final best offer.
Here are some key points about what to do:

- The **customer/buyer** should try to plan to buy the materials and check the possible orders of "critical" components, and then have to rely as much as possible to authorized distributors or directly to manufacturers. Even if it's choosen to rely on a broker, it's always good to ask for documents and materials that could "qualify" and "authorize" the product. Better to pay only after receiving the goods.
- The **manufacturer** should focus on monitoring and traceability of its goods. Increase control of records and adopt RFID tags, e-marking, identifying specific to provide authentication of the product. Prefer authorized distributors provides a good warranty on the sales channel. Increasing the quality of materials used and the complexity of the production process can provide a good barrier to potential imitators, while the activation of an e-mail or a free telephone number for the customer is a signal of reliability.
- The **distributor** must maintain and enhance the traceability implemented by the manufacturer and disseminate much information as possible towards their customers. Other advice is to avoid supporting customers through unknown brokers.

4. Examples of counterfeiting

It is useful to show some examples of counterfeit components.

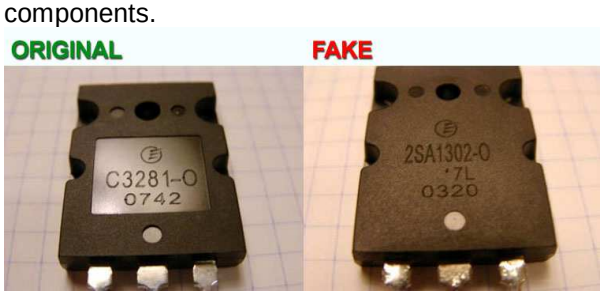

Figure1 *– Two transistors: on the left the original, on the right the counterfeit one.*

In Figure 1 it's clear that the original transistor is the one on the left: it can be perceived by the quality of the material. Probably it is a low-cost transistor, which has been milled and then reprinted as a more performant (and expensive) transistor.

Figure2 *– Two power-transistors: on the left the original, on the right the counterfeit one.*

In Figure 2 is showed another example of the counterfake power transistor (the one on the right): in this case, it's build quality is much worse than the original.

Finally, in Figure3, is showed an example of counterfake **6800µF_50VL** capacitor: inside is wired a little **2200µF_35VL** capacitor!

Figure3 *– The figure speaks for itself ... personally, as electronic designer, I have the chills!*

It is easy to understand what it means to mount an electrolytic capacitor of inferior value and lower voltage within an electronic circuit.
Other examples are found in this site http://transfal.tripod.com/.

In addition to the construction quality of the material, there are other tricks to see if the component is original or not:

- on the package containing the components, should be indicated the name of the manufacturer and origin, which must be as printed on the component itself (eg a MOSFET produced in Mexico, has also been packaged in Mexico and then in the package must be indicated "manufactured in Mexico");
- The legs of the component should be the same as indicated on the datasheet. If these are smaller (it is a matter of tenths of a millimeter), it is likely that this is actually a component of a range of lower current. You should always check the scale drawing of the component, as marked on the manufacturer's datasheet
- An electrical test to evaluate the performance of the component removes all doubt, even if it takes time (and hence is a cost for the company).

If it's available a component which is 100% sure it's genuine, it may be a good idea to make a direct comparison, not only visual but also internal (Figure 4).

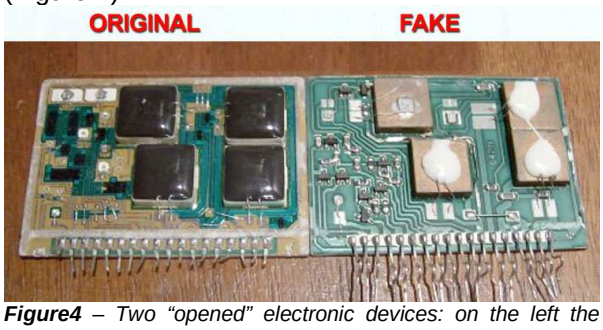

Figure4 *– Two "opened" electronic devices: on the left the original one, on the right the counterfeit one.*

5. Incident analyzed by Advel

Advel, manufacturer of power supplies for industrial use for 40 years, has recently stepped up the purchase process and analysis of electronic materials, following certain incidents of counterfeit material.
A well documented example is proposed below, involves the IGBT manufactured by International Rectifier (**IRGP35B60PD**). To be fair, it must be said that incidents of counterfeit components happens with other manufacturers, absolutely not only IR.
Figure 5 compares two components, the original one on the left and the counterfeit one on the right.

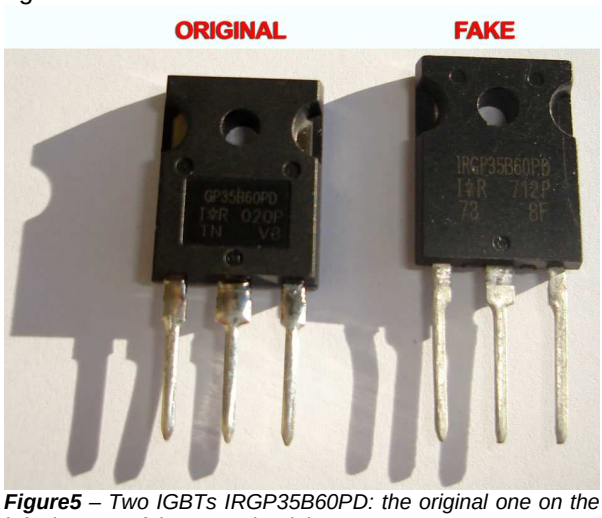

Figure5 *– Two IGBTs IRGP35B60PD: the original one on the left, the conterfeit one on the right.*

Despite the name of the component is identical, is immediately evident the poor quality of construction of the right.
Analyzing the scale drawing of the component (Figure 6), it's noted that the size of the legs of the

component on the right of Figure 5 is not what it should be.

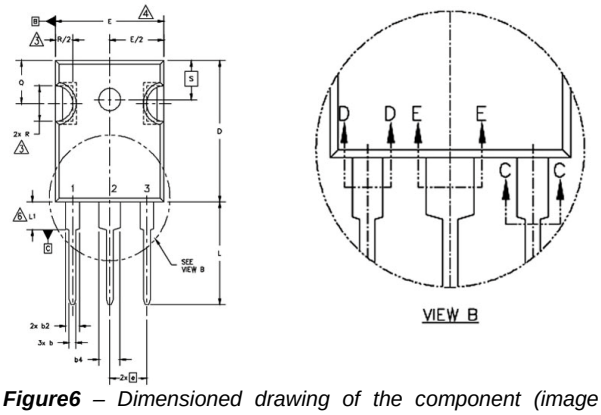

Figure6 *– Dimensioned drawing of the component (image taken from the original manufacturer's datasheet)*

Also, the shape of the legs can advise on the originality of the component (Figure 7): the central leg of counterfeit component is closer than it should be, and even the shape of the two side legs are different.

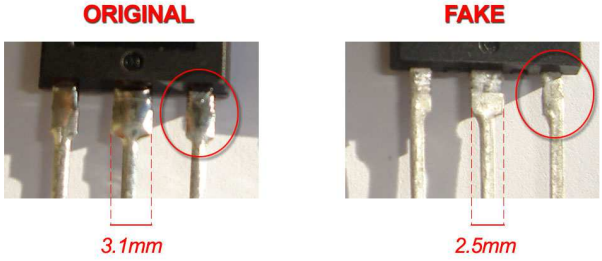

Figure7 *– Detail of the legs of the two components*

A further proof that the right component is not original, is obvious "looking into" the component.
In Figure 8 the two components have been broken up: the size of the junctions and the underlying metallization, are a unequivocal evidence.

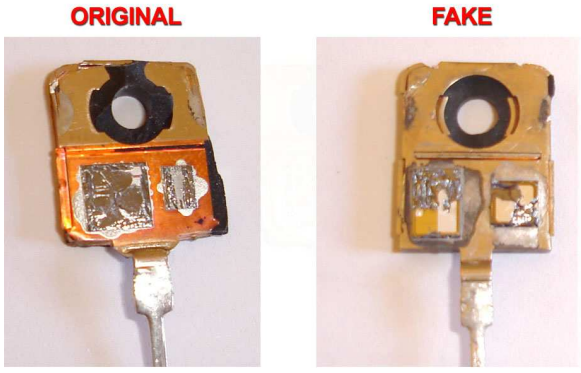

Figure8 *– The two IGBTs have been "opened": the size of the junctions and the underlying metallization is a proof that the two components followed a very different production process.*

Finally, it was also carried out an electrical test: on one power supply has been mounted the original IGBT, and on another power supply the counterfeit IGBT.
The measurements of the control voltages of the IGBTs, using an oscilloscope, are showed in Figure 9a and 9b: clearly the two components are dynamically very different, despite being controlled in the same manner and the same load conditions:
curves recorded show that the two components have different values of $V_{gs\text{-}Miller}$, C_{BE} and C_{RSS}.

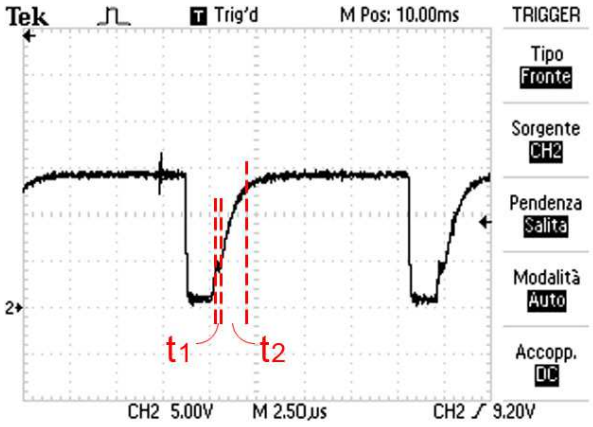

Figure9a *– V_{be} of the original IGBT*

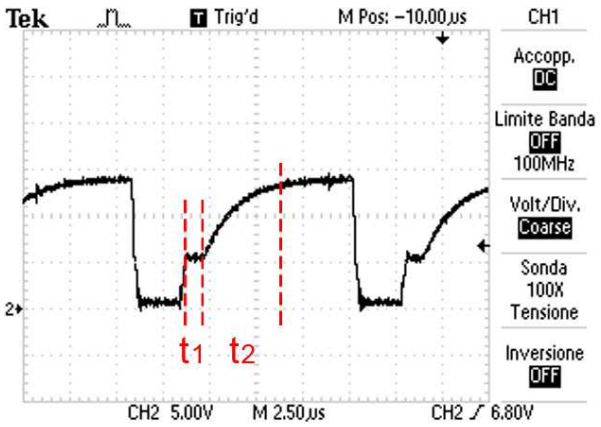

Figure9b *– V_{be} of the fake IGBT*

The power supplies have been put at load 3000W (ie the maximum rated output power):
the first, the original, had no problems (after 72h), the temperature of the component has been below 90°C, while the second, already 2500W, after 10 minutes of operation, has failed (IGBT in short)!

Advel, since 2008, has revised all of its power supplies (**D1 → DZ1** series, **SPS → SPS-R** series), selecting only top quality components, and overbuilding the most critical:

- eg for power supplies with input voltage of 230Vac, the Hold-Up electrolytic capacitors (which are subjected to about 350V) have been changed: from a 400VL to 450VL, and working temperature from 85°C to 105°C, "long life" type;
- the power MOSFETs in **Si** (silicon) have been replaced with better performing MOSFETs or IGBTs in **SiC** (silicon carbide)
- the Purchasing Department selects with particular attention their suppliers, Technical Office has introduced changes in the testing

operations of the power supplies in order to detect counterfeit parts.

Advel thus reduced to a minimum the possibility of encountering such problems.

6. Conclusions

Were briefly showed a few examples of counterfeit electronic components, and was reported an analysis conducted by Advel on counterfeit IGBTs.

»ADVEL«
ELETTRONICA INDUSTRIALE
HEADQUARTER: Via Miglioli 13, Segrate 20090 MI (Italy)
Technical DPT: Eng. A.Spinosi, tec@advel.it