Advel Application Note – AAN2012.2

Counterfeit power diode

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1. Introduction

The problem of fake electronic components continues, as already descrive in **AAN2011.1** ("*Counterfeit electronic components, a problem difficult to be solved*") in which it was considered a fake power mosfet.
Now will be considered a power diode.

2. Diode STTH6002C

The STTH6002C is a ultrafast medium/high power diode, manufactured by **ST Microelectronics**.
Advel uses several diodes of this type in production of power supplies and tank to the control procedures of purchased components has been identified a stock of fake-STTH6002C before they were sent into production.
To understand how Advel has noticed the fake, we must first obtain the datasheet of the component. It can be freely downloaded from the manufacturer's website (http://www.st.com), which summarizes the main electrical and physical characteristics of the component.

3. Comparison: original diode vs fake diode

We compare two diodes: one is original and one is definitely a fake.

Visual comparison

Just a visual analysis and it can be seen that the diodes are different each other.

Diode **A**: Diode **B**:

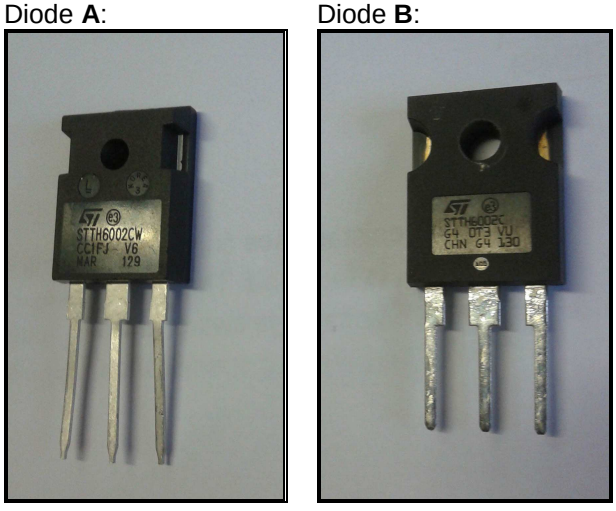


Figure1 *– Two diodes STTH6002C: one is original, the other one is a fake.*

It's not immediately revealed which of the two diodes is a fake, but soon it will become clear continuing to read.

Weight

The datasheet (original from ST) indicates the weight should be exactly 4.46g.
Our two diodes, A and B, have been weighted (Table1)-

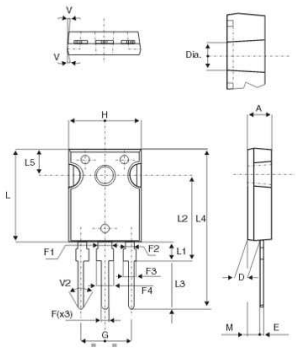
misura	Datasheet ST	Diodo A	Diodo B
Peso	4.46gr	6gr	4.5gr

Table1 *– Weight of the two diodes compared, A and B.*

Considering the tolerance of the scale used, the diode B is ok, while the diode A is really outside parameter!
From just this trivial test may begin to suspect the originality of the diode A, but to make an exhaustive test will be taken into account many other parameters, in addition to weight.

Dimensional test

The dimensions thas must have the component are, for convenience, reported in Table 2 (taken directly from ST datasheet).



REF.	DIMENSIONS					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.85		5.15	0.191		0.203
D	2.20		2.60	0.086		0.102
E	0.40		0.80	0.015		0.031
F	1.00		1.40	0.039		0.055
F1		3.00			0.118	
F2		2.00			0.078	
F3	2.00		2.40	0.078		0.094
F4	3.00		3.40	0.118		0.133
G		10.90			0.429	
H	15.45		15.75	0.608		0.620
L	19.85		20.15	0.781		0.793
L1	3.70		4.30	0.145		0.169
L2		18.50			0.728	
L3	14.20		14.80	0.559		0.582
L4		34.60			1.362	
L5		5.50			0.216	
M	2.00		3.00	0.078		0.118
V		5°			5°	
V2		60°			60°	

Table2 *– Dimensional table of the diode STTH6002C, taken from ST datasheet.*

In Table3 are shown some measurements for the two diodes A and B under test.

misura	Datasheet ST	Diodo A	Diodo B
L	19.85 ÷ 20.15mm	21mm	19.95
L3	14.2 ÷ 14.8mm	20mm	14.4mm
H	15.45÷ 15.75m	15.9mm	15.5mm

Table3 *– Measurements of the diodes A and B.*

Diode B respects all the dimensions, while diode A has numerous dimensional discrepancies.

Forms and details

Looking closely at the two component, we notice numerous differences between the two. Figure2 shows the geometric figure of the diode (taken from ST datasheet) and are indicated the points on which to focus.

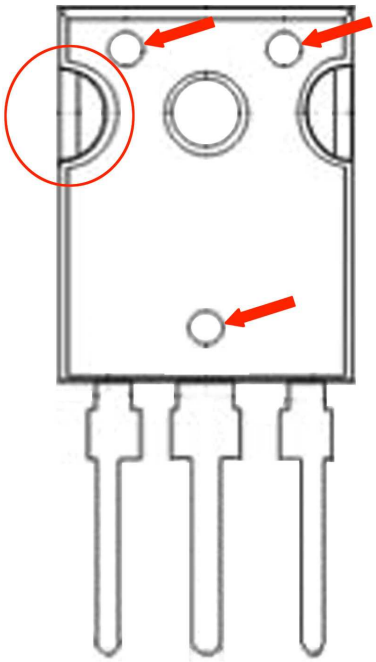


Figure2 *– Points on which to focus, looking at the two diodes A and B showed in Figure1.*

Looking closely at Figure1, we see that diode A has square side channels, NOT round (red circle in Figure2). Moreover diode A not have the 3 signs (red arrows) that identify the manufacturing process.
In contrast, diode B is perfectly to specification ST.

Moreover, the shape of the legs of diode A are very different from how they should be.

Electrical characteristic test V_{fm}:

The two diodes A and B were subjected to load 3A (only for one of the two internal diodes), measurements were made at 35°C temperature, read on the boby of the component (middle point).

In Figure 3 is showed the voltage/current characteristic of the diode (taken from ST datasheet) from which it's seen that, for a 3A load, the voltage drop is:
V_{fm} = 0.7V @25°C.
Also note that the voltage tends to decrease with increasing temperature.

That said, we can suppose the test is passed if:
V_{fm} < 0.7V @35°C.

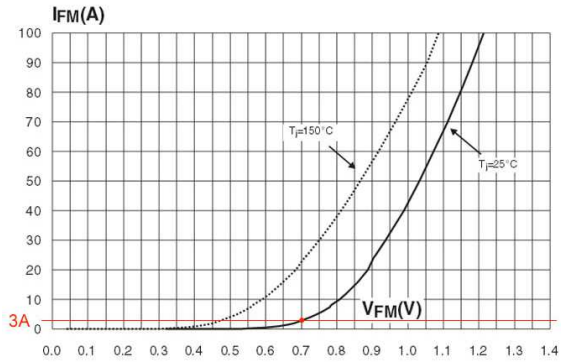


Figure3 *– Forward characteristic V / I of the diode (taken from ST datasheet). Pointed out In red 3A load.*

In Figures 4A and 4B the readings V_{fmA} and V_{fmB} for 3A load current, at temperature 35°C about.

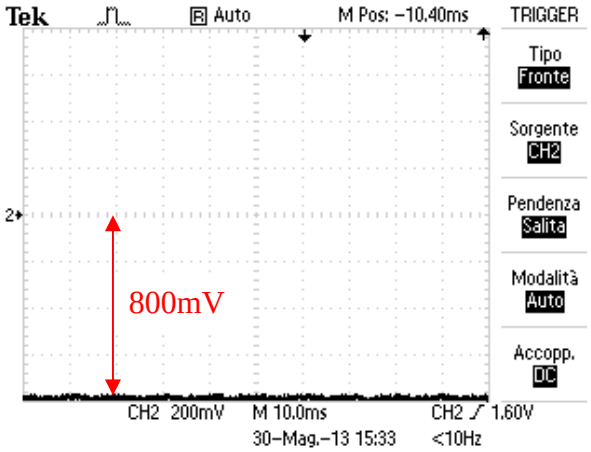


Figure4A *– V_{fmA} for diode A, at 3A load current, @35°C.*

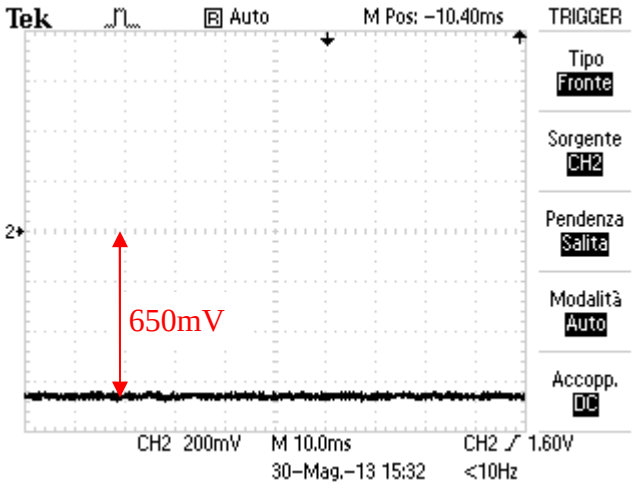
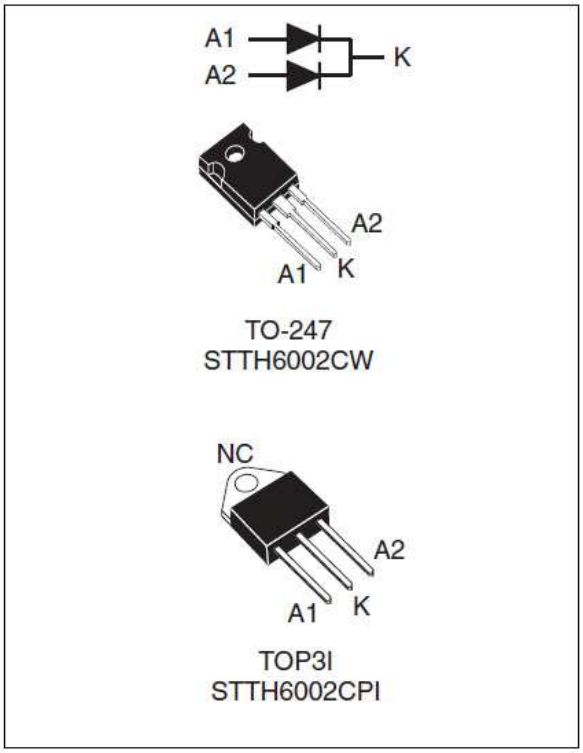


Figure4A *– V_{fmA} for diode A, at 3A load current, @35°C.*

From take-over (Figure 4A e 4B) we have:
$V_{fm\text{-}A}$ (load 3A@35°C) = 800mV
$V_{fm\text{-}A}$ (load 3A@35°C) = 650mV

V_{fmA} is much greater than it should be. This data is very important and let us assume that this diode has a maximum current less than it should be.
Instead diode D gave a result consistent with what we expected from a an original diode.

Printing:
One last note about the screen printing.



Order codes

Part Number	Marking
STTH6002CW	STTH6002C
STTH6002CPI	STTH6002C

Figure5 *– Models and screen printing for diode STTH6002C*

From Figure5 (taken from the first page of ST datasheet) we know that this diode is available in two formats: **TO-247** and **TOP3I**.
In the 'Order Codes' table is indicated that:

the diode in the TO-247 format is called STTH6002CW, while the diode in the TOP3I format is called STTH6002CPI.
However it's always the same diode and on both formats should be printed STTH6002, as expressly stated in the table, "marking" column.

Returning to our two diodes A and B:
again looking at Figura1, while the diode B is printed (correctly) STTH6002C, the diode A is printed (wrongly) STTH6002CW.
This observation demonstrated once again that diode A is a fake, and it also shows something else: the counterfeiters have been very careless!

4. Conclusions:
Diode A has, with respect to the specification indicated in the ST datasheet, discrepances regarding: weight, size, shape of the legs, lateral grooves, direct I/V characteristics, printed marking.
We can conclude, without any doubt, that diode A is definitely counterfeit.

Also note that, even without doing any electrical test, in general it's possible to realize that a component is NOT original just by a careful visual test, starting from the datasheet of the manufacturer or (more pratically) by comparison with a really original component.

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