Investigation on Discoloration on TO package

Objective of Investigation

- Discoloration on terminal and leadframe of TO packages are always reported at customer side.
- The discoloration is an optical effect of oxidized metal, it's seldom found at Infineon factory. It was considered a result of the humidity and thermal introduced during the transportation and storage.
- To evaluate the impact of terminal and leadframe discoloration, we selected typical TO package products to evaluate it's FFFQR (form, fit, function, quality or reliability). Please refer to the details in below pages.

1. See if some discoloration level can still be use - I

- Similar case previously investigated that discolorations of the main terminals do not influence the electrical or solderability behavior.
- Results:
  - Tested 60pcs, the results are all pass. That's to say the electrical function is ok.
  - Solderability test results pass.

Solderability test

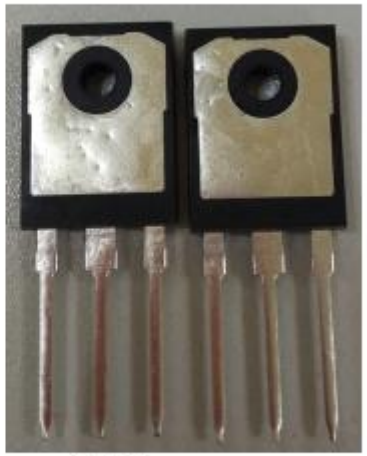
- Sample size:2pcs
- Precondition: 8 hours steam aging.
- Solderability test condition:

产品类型 Device Type	无铅电镀产品 Lead-free plating devices
助焊剂类型 Flux Type	ROL1/R-100
助焊剂浸入时间 Flux Dipping Time	5~10s
焊料类型 Solder Type	SnAgCu
焊料温度 Solder Temperature	245±5℃
浸入焊料时间 Time Dipping into Solder	5±0.5s
浸入/拿出焊料速度 Speed Dipping into/Taking out of Solder	25±6mm/s

4. Solderability test

before

The solder coverage of heatsink is >95%
So the solderability test result is ok.



after

判定标准 Determinant Criteria

被检查区域的焊料覆盖率在95%以上

Solder coverage shall be above 95% on inspection area.

1. See if some discoloration level can still be use - II

- Thermal characterization of the Thermal Resistance (R_{th}) for 11 pcs of IDW10G120C5B complained devices.
- Results: All are still within datasheet specification

Rth Thermal Characterization

Sample	Rth-JC/K/W **per leg**
1	1.80
2	1.76
3	1.75
4	1.85
5	1.80
6	1.86
7	1.83
8	1.81
9	1.82
10	1.81
11	1.84
average	**1.81**
Std. dev.	0.03
	1.8%

Sample	Rth-JC/K/W **per device**
1	0.90
2	0.91
3	0.94
4	0.93
5	0.92
6	0.95
7	0.89
8	0.91
9	0.92
10	0.93
11	0.91
average	**0.92**
Std. dev.	0.02
	1.9%

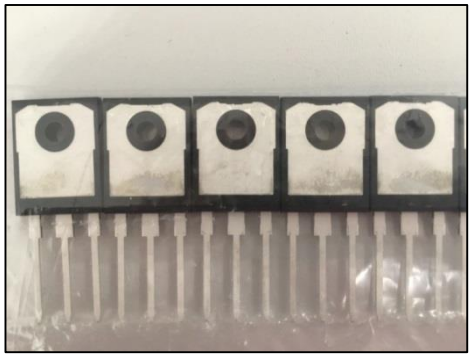
IDW10G120C5B Thermal Resistances datasheet specification

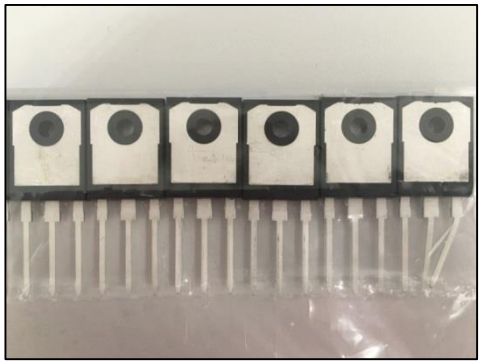
Thermal Resistances

Parameter	Symbol	Conditions	Value (leg/device) min.	typ.	max.	Unit
Characteristic						
Diode thermal resistance, junction – case	$R_{th(j-c)}$		-	1.6/0.8	2.0/1.0	K/W
Thermal resistance, junction – ambient	$R_{th(j-a)}$	leaded	-	-	62	K/W

Final Data Sheet 4 Rev. 2.0, 2014-06-10

IDW10G120C5B Complained Devices





1. See if some discoloration level can still be use - III

- Same thermal characterization of the Thermal Resistance (R_{th}) done for IKW40N120H3 and IDW40E65D1 complained devices.
- Results: All are still within datasheet specification

IKW40N120H3 Rth Thermal Characterization

Sample	Rth-JC/K/W **IGBT**
IGBT S1	0.23
IGBT S2	0.22
IGBT S3	0.20
IGBT S4	0.21
IGBT S5	0.21
IGBT S6	0.22
average	**0.22**
Std. dev.	0.01
	4.4%

IDW40E65D1 Rth Thermal Characterization

Sample	Rth-JC/K/W **Diode**
S1	0.54
S2	0.50
S3	0.49
S5	0.50
S8	0.52
S10	0.53
average	**0.51**
Std. dev.	0.02
	3.5%

IKW40N120H3 Rth datasheet spec

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
IGBT thermal resistance, junction - case	$R_{th(j-c)}$		0.31	K/W
Diode thermal resistance, junction - case	$R_{th(j-c)}$		1.11	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Rev. 2.1, 2014-11-26

IDW40E65D1 Rth datasheet spec

Thermal Resistance

Parameter	Symbol	Conditions	Max. Value	Unit
Characteristic				
Diode thermal resistance,[1] junction - case	$R_{th(j-c)}$		0.84	K/W
Thermal resistance junction - ambient	$R_{th(j-a)}$		40	K/W

Rev. 2.2, 2013-12-16

Summary

- The oxidation/discoloration located at the terminal and lead frame is only an optical effect, and there is no influence on FFFQR (form, fit, function, quality or reliability).There is no harmful integrations with the mechanical, and electrical surrounding to be expected. The phenomenon can be regarded as an optical effect.
- There is no negative impact on functionality and product quality.

- No change of electrical, thermal or mechanical parameters of the product will be caused by the above discoloration. The lifetime and reliability of the product will not be reduced by the discoloration mentioned above.

Part of your life. Part of tomorrow.

Infineon