
Mounting instruction for M260 package (V-series spring contact module)

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This section provides information how to mount IGBT modules of M260 package, so called DualXT(Spring).

This mounting instruction is available for type name(s) of 2MBI XXX VJ- XXX -5X .
(X is number of 0~9.)

1 Mounting IGBT modules_

This section presents how to mount M260 package, so called “DualXT(Spring)”.

1.1 Mounting on heat sink

The thermal resistance between IGBT module base plate and heat sink depends on module location, thermal properties of heat sink and cooling methods. In general, each system has different heat sink properties such as thermal conductivity and cooling fan, this section focuses on module location on heat sink. Followings should be taken into account in IGBT module mounting process since thermal resistance varies according to the position of the mounted modules:

- ✓ IGBT modules should have thermally optimized layout on heat sink according to the mechanical-thermal design so that the modules have good heat spread to minimize the thermal resistance.
- ✓ The distance between IGBT modules should be optimized based on the mechanical-thermal design and the estimated total power dissipation for each module to avoid the thermal coupling effect between modules mounted on the next

1.2 Heat sink surface finishing (module mounting area)

The mounting surface of the heat sink should be finished to the roughness of 10 μ m or less. A warp based on a length of 100mm should be 50 μ m or less. If the surface of the heat sink does not have enough flatness, the modules may have unexpected increase in the contact thermal resistance ($R_{th(c-f)}$). If the heat sink flatness does not match the above requirements, the high stress in the DCB on the modules may result high voltage insulation failure.

1.3 Thermal grease pasting

Thermal grease between heat sink and module base plate is strongly recommended to reduce the contact thermal resistance. Screen-printing, rollers and spatulas are typical method of thermal grease pasting, however, stencil mask is recommended when target grease thickness is less than 100 μ m.

Table 1 Recommended properties of thermal grease

Items	Recommendation
Penetration (typ.)	\geq 338
Thermal conductivity	\geq 0.92 W/m.K
Thermal grease thickness	100 μ m +/- 30 μ m

*1 The thermal desistance between the heat sink and the module depends on the thermal grease properties and thickness. We strongly recommend customer to check contact interface after mounted to confirm if the interface has good thermal grease spreading. Also we recommend checking the thermal interface conditions after thermal cycling if the thermal grease has low viscosity.

*2 Stencil mask pattern electric data and recommended method are also available on request.

1.4 Mounting procedure

Mounting procedures onto heat sink are described.

(a) Minimum and maximum torque for mounting M5 screws indicated (1)-(4) in the picture on the right are:

Minimum: 2.5Nm
Maximum: 3.5Nm

(b) Pre-torque is recommended with 1/3 of the final torque with sequence (1) - (2) - (3)-(4) in Fig.1

(c) Final torque must be within specified force of 2.5 to 3.5 Nm with sequence (1) - (2) - (3)-(4)

(d) To comply the creepage and clearance distance, the total height of screw and washer must not exceed 6.0mm.

1.5 PCB mounting procedure

PCB mounting processes are described.

(a) Minimum and maximum torque for mounting M2.6 self tapping screws indicated P1 to P7 in Fig.1:

Minimum : 0.4Nm
Maximum: 0.6Nm

(b) Pre-torque is recommended with 1/3 of the final torque with sequence P1-P2-P3-P4-P5-P6-P7 in Fig.1.

(c) Final torque must be within specified force of 0.4 to 0.6Nm with sequence P1-P2-P3-P4-P5-P6-P7 in Fig.1.

Maximum screw rotation speed is 300 rpm.

1.6 Electrostatic Discharge (ESD) protection

If excessive static electricity is applied to the control terminals, the devices can be broken. Some countermeasures against static electricity is necessary.

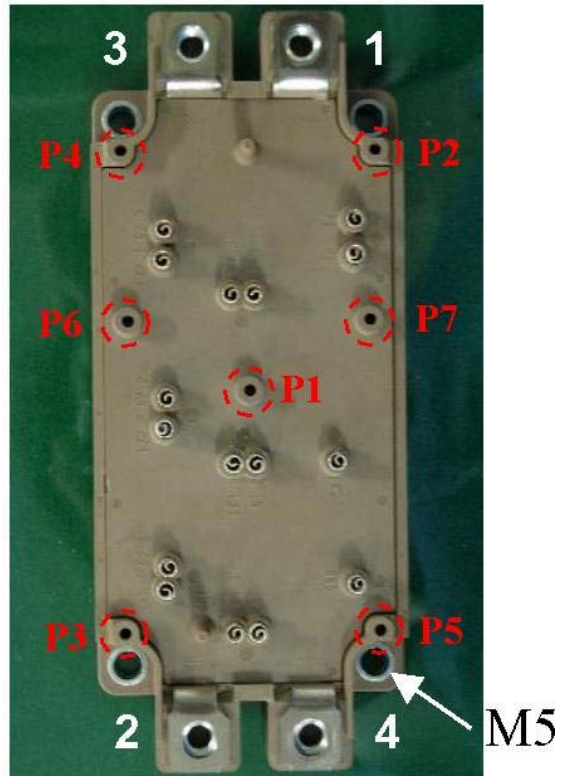


Fig.1 Mounting holes 1-4 in M260 modules

2 Connecting main terminals

2.1 Bus bar connection

- Screw M6
- Screw length Bus bar thickness + (7 to 9mm)
- Screw torque Minimum 3.5Nm / Maximum 4.5Nm
- Maximum terminal temperature 100°C

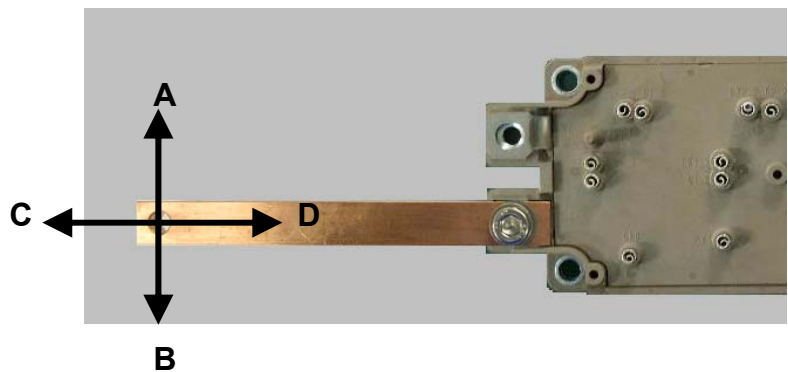
<Important notes>

Special care should be taken when mounting bus bar to IGBT main terminals so that the terminals do not have excess forces. The principle of a lever sometimes makes the moment of force much bigger than expected especially when installing to long bus bar. In addition, the terminals may have serious damages when the module is fixed with miss alignment in position between the module terminal and bus bar holes. Well alignment to the module terminals and bus bar holes are recommended to reduce mechanical stress.

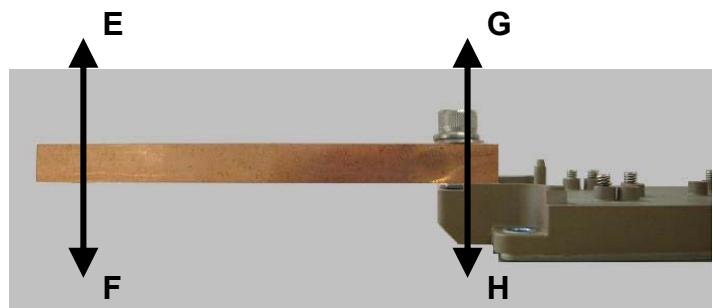
2.2 Maximum force vectors from bus bar

Maximum vectors and definitions are described in the table below.

Vector	Strength*
A	5 Nm
B	3 Nm
C	500 N
D	500 N
E	5 Nm
F	5 Nm
G	500 N
H	1000 N



(a) Horizontal direction



(a) Vertical direction

Fig.2 Vector descriptions from bus bar

*) Strength in the table is the mechanical capability for the short period in mounting process.

2.3 Clearance and creepage distance

In order to establish good isolation voltage, it is recommended for the IGBT application to have both clearance and creepage distance for the main terminal design as defined (a) and (b) in Fig.3 should be longer than minimum value of :

Clearance distance	9.5mm
Creepage distance	14.0mm

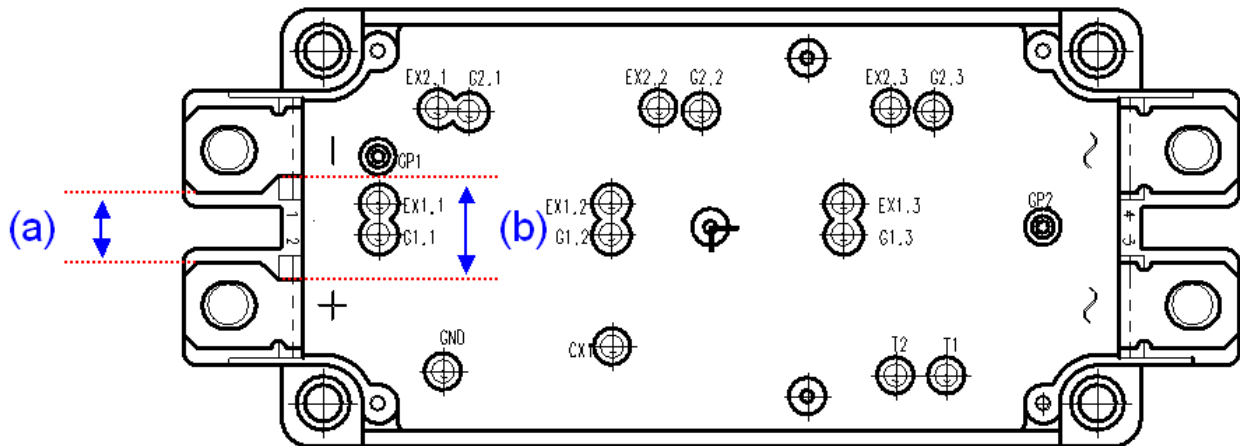
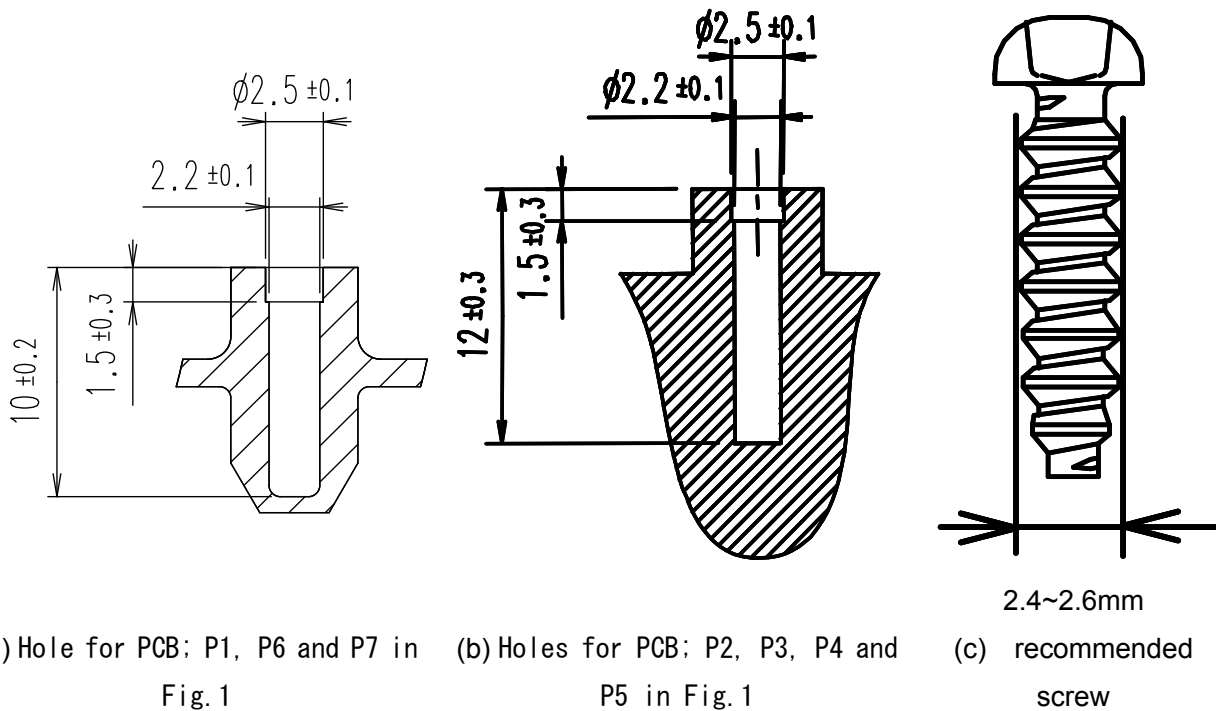


Fig. 3 Clearance and creepage distance for IGBT main terminals

3 Suggestions when mounting onto PCB

3.1 Recommended screws

As mounting holes for PCBs have step holes with diameter of 2.2mm and 2.5mm, screws with diameter of 2.4 to 2.6mm are recommended. Figures below shows recommended screw types and length. Self-tapping screws are recommended. In Japan, M2.6 screws are recommended.



(a) Hole for PCB; P1, P6 and P7 in Fig. 1

(b) Holes for PCB; P2, P3, P4 and P5 in Fig. 1

(c) recommended screw

Fig.4 PCB screw holes and recommended screw cross section

3.2 Screw length

5.0mm to 8.5mm + PCB thickness length screws are recommended to mount PCBs.

Recommended mounting torque is 0.4~0.6Nm, screws should be placed vertically. If screws are tightened with angles as shown in Figs.5 and 6, the pads on PCB and control terminals on IGBT modules may have loose electrical contact, which may have risk of module failure in worst case.

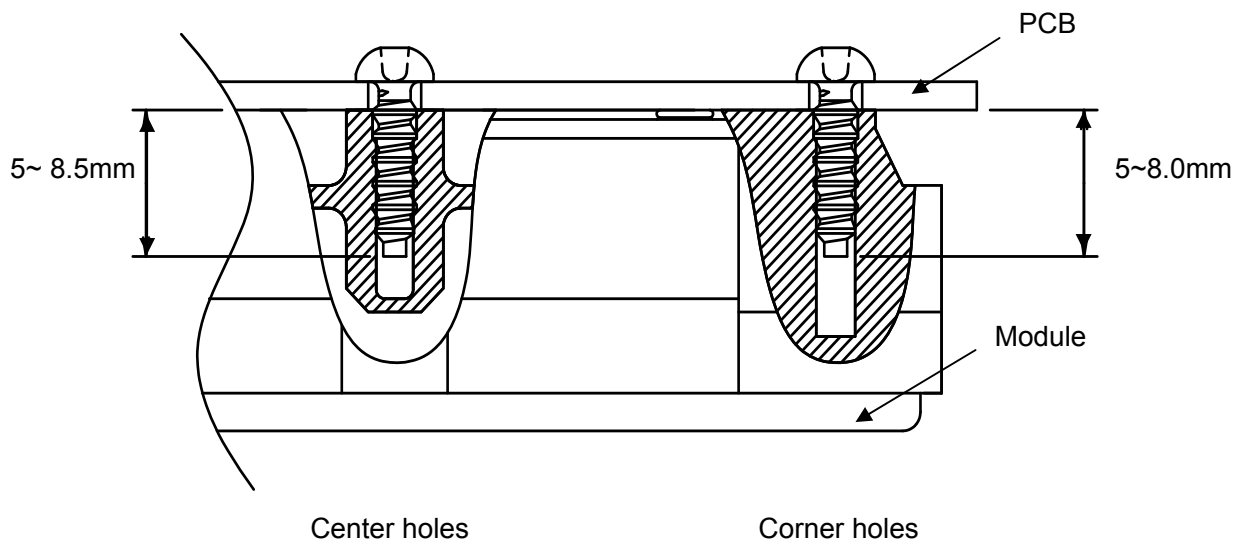


Fig.5 P1/P6/P7 hole cross sectional image of screw

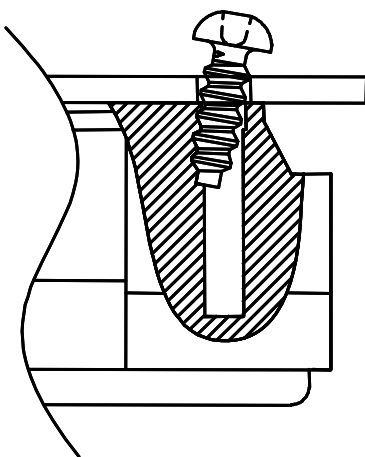


Fig.6 Bad example of screw tightened with angular position

3.3 How to mounting PCB screws

Manual tighten of PCB screw is preferable. However, if other tools such as electric drivers or other automated methods are used, parameter optimization and confirmation is recommended in practical installation process by customer so that IGBT module does not have mechanical damage by automatic screw process.

3.4 Example of mechanical damage with not recommended screw and/or process

PCB mounting is recommended by the methods above.

In case, not recommended screws and/or methods are used in IGBT installation process, it may have a risk of mechanical damage as shown in Fig.7. Screw types and process advanced confirmation is desirable.

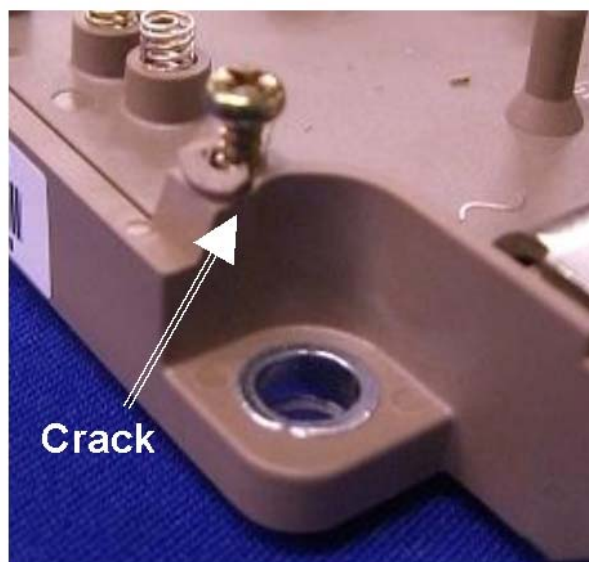


Fig.7 Mechanical damage example of IGBT module

4 Degradation of spring

4.1 H₂S Gas exposure

Spring resistance may degrade in H₂S Gas atmosphere. Initial spring contact resistance is around 100mΩ. It is increasing by H₂S Gas exposure (please refer to Fig.8). Recommendation of total exposure is under 5000 [ppm Hr] which can control contact resistance under 500mΩ. Fig.9 shows photo of springs at initial and 1000ppm Hr. Even spring color change to yellowish at 1000ppm Hr, contact resistance is not increase. Life time of the spring can be calculating by expression (1).

$$\text{Life time of spring} = \frac{5000}{\text{H}_2\text{S Gas density}} \text{ [Hr]} \quad \text{--- (1)}$$

For example, H₂S Gas density of normal atmosphere is around 0.005 ppm. Life time of the spring is $5000/0.005 = 1000000\text{Hr} = 114 \text{ year}$ in normal atmosphere.

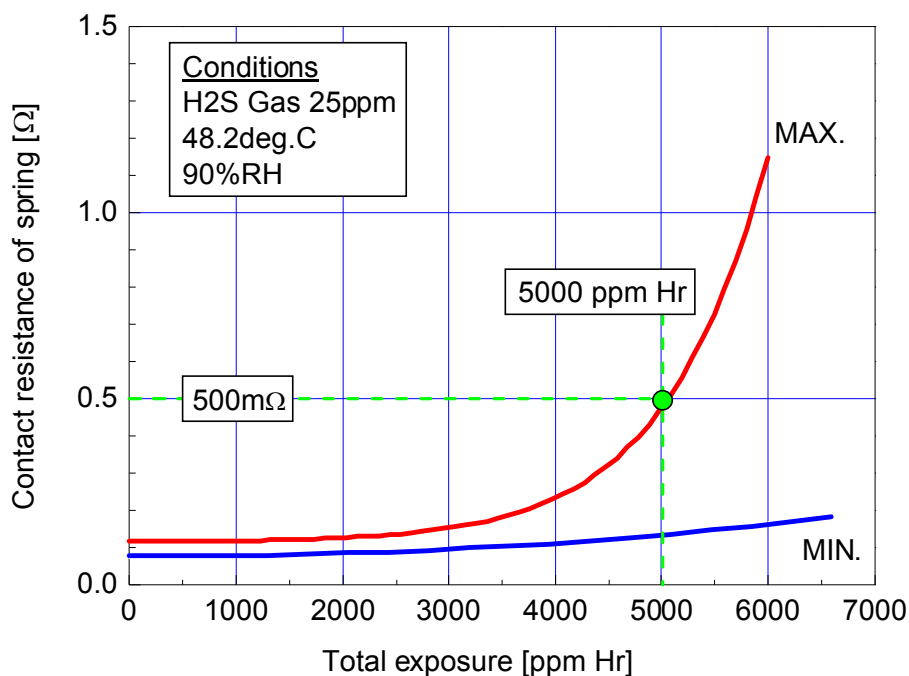
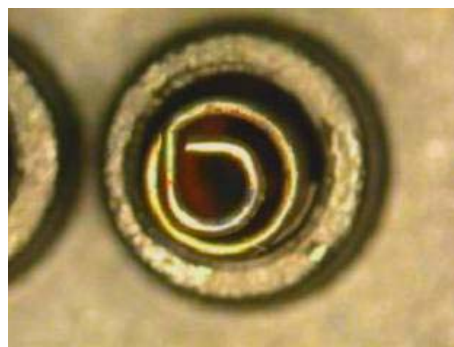


Fig.8 Contact resistance degradation (H₂S Gas exposure)



(a) initial



(b) At 1000 ppm Hr

Fig.9 Spring discoloration (H₂S Gas exposure)

4.2 SO2 Gas exposure

Spring resistance may degrade in SO2 Gas atmosphere. Initial spring contact resistance is around 100mΩ. It is increasing by SO2 Gas exposure (please refer to Fig.10). Recommendation of total exposure is under 1750 [ppm Hr] which can control contact resistance under 500mΩ. Fig.11 shows photo of springs at initial and 500ppm Hr. Even spring color change to yellowish at 500ppm Hr, contact resistance is under 500 mΩ. Life time of the spring can be calculating by expression (2).

$$\text{Life time of spring} = 1750 / \text{SO}_2 \text{ Gas density [Hr]} \quad \text{--- (2)}$$

For example, SO2 Gas density of normal atmosphere is around 0.01 ppm. Life time of the spring is $1750/0.01 = 175000\text{Hr} = 20 \text{ year}$ in normal atmosphere.

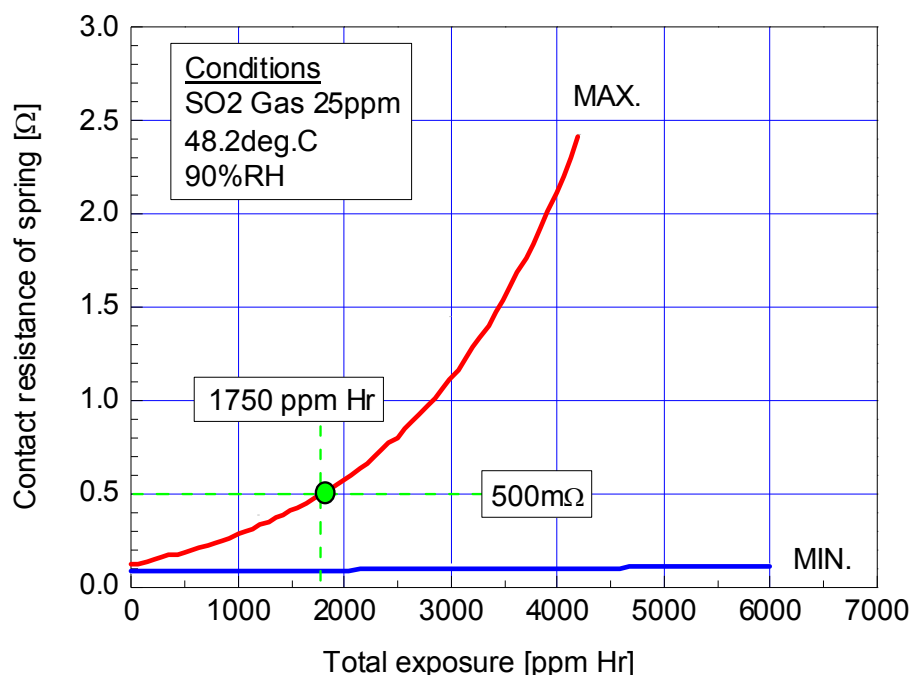
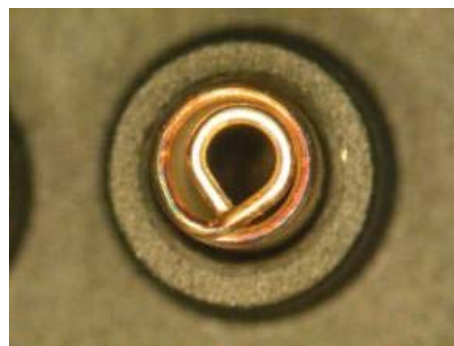


Fig.10 Contact resistance degradation (SO2 Gas exposure)



(a) Initial






(b) At 500ppm Hr

Fig.11 Spring discoloration (SO2 Gas exposure)

4.3 Spring color degradation by storage

Spring color may change black or yellowish, which is depended on by storage condition. Even spring color is change, the contact resistance of spring is under 500 mΩ if customer keeps storage condition which is defined by expression (1) and (2) of section 4.1 and 4.2. Table 2 shows contact resistance of initial and color degraded spring. Spring color degradation has not always influence for degradation of contact resistance.

Table 2 Example of color degradation of spring

Initial	Color degraded spring	
Contact resistance = 98mΩ 	94mΩ 	78mΩ 
	97mΩ 	84mΩ 

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