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Today, modern electronic boards are mainly assembled with automatic placement machines and are subsequently soldered in the reflow process. This permits a high component density in the smallest of spaces. Here the high level of heat generation is an issue faced often by developers.

- **REDCUBE** SMD are the result of the consistent advancement of our products for the benefit of our customers. **REDCUBE** SMD combine the advantages of SMD assembly in conjunction with high-current technology. Within seconds, **REDCUBE** SMD Terminals can be assembled off the reel onto the circuit board with all other SMD components and subsequently soldered in the reflow process.

- The large-area connection to the pad results in a low contact resistance and low self-heating. Currents of up to 70 A are possible depending on the layout. At the same time, the components offer high holding forces and torques.

Low contact resistances guarantee low temperature on the circuit board
Component Assembly

The assembly process of REDCUBE SMD can be performed both manually and fully automated.

- Placement by hand is possible for small or sample series. In case of REDCUBE SMD with through hole threads, attention must be paid that no solder paste gets into the thread.

- In fully automated assembly, REDCUBE SMD Terminals are packaged on the reel and, like the other SMD components, are ready for automatic processing. The REDCUBE SMD Terminals are picked up from the belt with a vacuum pipette and are placed on the circuit board. The picking from the belt is defined by the picking area, the weight of the component and the negative pressure generated by the vacuum pipette.

- In order to ensure trouble-free processing with all automatic placement machines, REDCUBE SMD are equipped with a capton foil or pick and place cap. The pick and place cap is made of LCP material and was specifically developed for the soldering process. After soldering, the cap or the capton foil is disposed of. The capton foil is especially designed with a tab to facilitate removal. REDCUBE SMD with M4 outer thread have no pick and place cap, as the picking area is large enough in this case.
Coating

Tin is not necessarily tin!

In the electroplating facility there are many ways of influencing the coating process with pre-treatments and post-treatments, as well as the addition of organic additives, such as oxidation stabilizers, grain refiners and brighteners. So that is why not all tin-plating is alike. As presented in the right picture, an incorrect coating can lead to discolorations, tin spalling and a poor soldering result.

Perfect Solder Joint:

- For REDCUBE SMD a special solder surface has been developed for the hot-air reflow technique. Different tin coatings were investigated in many series of experiments to attain optimal wetting and the best holding forces.

- Similarly, a barrier layer and a coating thickness adapted to the component volume is crucial for the perfect soldering result. Applying tin on the surface too thickly can lead to accumulations, the “orange peel” effect and melting of the surface in the soldering process. Subsequent connection of the REDCUBE SMD with the cable lug can result in significantly higher resistance at the point of contact.

- In contrast, too little tin applied causes poorer wetting and can have a negative impact on the air voids (see picture below) in the solder joint. On account of the large contact surface, air voids cannot be excluded, but because the holding forces are mainly defined by the meniscus formation, they are not so critical in practice.
The soldering result is influenced by many factors. Many variables should be considered throughout the treatment process in order to obtain an optimal solder joint. Effective wetting and a well-formed meniscus are essential for the holding forces and low contact resistances on the circuit board.
Pad Geometry

In addition to the special solder surface, the holding force of REDCUBE SMD Terminals is also determined by the correct pad geometry.

- The solder result and the resulting holding forces depend on optimal pad geometry. On the basis of the IPC TM 650 test method, the pad size was specially matched to the component in terms of the adhesive strength of copper layers on FR4, such that no further layout design measures are generally necessary (Fig. 1).

- If higher strength is required, there are some simple ways of improving the stability of the pad. The simplest way is to create the copper area larger than the solder pad. The larger contact area to the FR4 material achieves greater stability (Fig. 2).

- In addition, the copper surface can be configured with vias. A via has the effect of a „rivet“ and enhances the connection to the base material of the circuit board (Fig. 3).

- An equally popular method of strengthening SMD pads is to place the via directly in the pad. It should be kept in mind that the fluid solder can flow downwards through the vias and there may not be sufficient solder available for the solder joint (Fig. 4).

Stencil

- The solder stencil (Fig. 5) should be designed as recommended on the REDCUBE SMD datasheet. The drill holes in the circuit board must be covered by the stencil, such that no solder flows into the holes.

- The drill hole in the circuit board for the alignment pin and the screw must not be through-contacted! (Fig. 6)
Tearing Force

Measurement of the tearing force of REDCUBE SMD should simulate a load similar in strength to that of a strong pull on the cable if the cable lug is screwed to the component. The tearing forces on the component from the circuit board were measured in numerous experiments by applying and measuring a force at a 5 mm distance. The force was increased linearly up until tearing.

The torque formula \( M = F \times l \) allows the tearing force to be determined for every other length.

In the lower graph, the tearing forces for REDCUBE SMD with a threaded blind hole are presented. The maximum tearing force was 745 N, i.e. a weight of over 70 kg has to hang on the cable such that the REDCUBE SMD is torn off the circuit board. On average most values were above 500 N.

Assuming a typical holding force of 60 N/mm² for a good hexagonal crimp on the tubular cable lug, for a 2.5 mm² cable the cable would already slip out of the cable lug at 150 N. This value is even lower for simple crimping of cable lugs.
Tearing Force

Due to the drill hole in the circuit board, the tearing forces for REDCUBE SMD with through threads are lower as a result of the lower contact area on the pad. The tearing forces are presented in the lower graph. The max. tearing force was 410 N. On average, the values were above 300 N.
**Permitted torque**

**REDCUBE** SMD Terminals offer a large-area connection and transmission of high currents in circuit boards. The maximum permitted torque has to be observed in order to prevent mechanical destruction of the parts!

**Mechanical properties for brass (reference values):**

- Material: CuZn39Pb3
- Shear strength: 350 N/mm²
- Tensile strength: 480 N/mm²
- Elastic limit: 340 N/mm²
- Elongation: 20%
- Elastic modulus: 96 kN/mm²
- Torsional modulus: 32 kN/mm² (Shear modulus)

**Table for REDCUBE SMD**

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* Based on DIN267 Part 25 (breaking torques); values for brass material (MS 63)
** Determined values (torques). Destruction of the components or the solder joint is to be assumed at these mechanical loads. The components must never be loaded above these values.

The breaking torque is strongly dependent on the quality of the solder joint and the screw used. As apparent from the table, the breaking torque exceeds the prescribed tightening torque many times over.

REDCUBE SMD may only be loaded with the values from the 'max. tightening torque' line in the table!
Current Carrying Capacity

The low contact resistances of REDCUBE SMD Terminals are achieved as a result of the large-area connection to the pad. This ensures a low level of heat development and favors the overall temperature performance on the circuit board.

Currents up to 100 A are achieved with multilayer circuit boards and large cable cross-sections. In many cases, the cable cross-section is the limiting factor. According to VDE0100, a 4 mm² can only be used up to a maximum of 42 A continuous current at 20 °C. So the cable limits the current before the REDCUBE SMD.

The derating curve shown below was measured with 6 mm² and a 2 x 70μm circuit board.

As shown in the pictures, the current transmission into the lower layers must be through the additional vias. A 0.3-0.4 mm diameter and min. 25 μm copper-plating per via are recommended. The distribution of current in the lower layers is problematic for currents above 70 A, as the current carrying capacity of the vias is limited and a large amount of space is required on the board.

It is therefore recommended to switch to REDCUBE PRESS-Fit for even higher currents. The press-fit technology still offers unrivaled low contact resistances and even better temperature characteristics.
Product overview

The space saving design of REDCUBE SMD combine the advantages of SMD mounting in conjunction with high current technology.

REDCUBE SMD

- Material: Brass
- Surface: Tin plated
- Heat resistance: up to 150°C
- Tightening Torque: M3 (0.5Nm), M4 (1.2Nm)

Characteristics

- High current carrying capacity and mechanical forces
- Simple and fast automated assembly
- Low initial time and cost
- High packing density
- Low resistance and minimal self-heating

Applications

- Space-saving PCB Design
- Solderable high current Wire-to-Board connections with a focus on automated assembly

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—all articles are listed in our catalogue: Article Interconnect & Electromechanical Solutions – Catalogue
Product preview

The new angled REDCUBE SMD version, allows angled current-carrying Board-to-Board connection as well as pure mechanical angled SMD connections.

REDCUBE SMD
- Material: Brass
- Surface: Tin plated
- Heat resistance: up to 150°C
- Tightening torque: 0.4Nm

Characteristics
- High current carrying capacity and mechanical forces
- Simple and fast automated assembly
- Low initial time and cost
- High packing density
- Low resistance and minimal self-heating

Applications
- Angled assembling of cable or two angled connection of two PCBs with each other
- Angled assembling of PCBs on housings

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</table>

- All articles are listed in our catalogue: Electronic Interconnect & Electromechanical Solutions – Catalogue
RED CUBE THR combine the advantage of Through Hole Technology – the high mechanical stability – with the timesaving pick and place mounting and efficient reflow soldering.

RED CUBE THR Terminals are designed for reflow soldering. They have a special pin design for best soldering results and currents up to 85 A.

Milling from solid material RED CUBE THR guarantee significant higher ampacity with much better torques compared to stamped contacts.

**RED CUBE THR**

- Material: Brass
- Surface: Tin plated
- Heat resistance: up to 150°C
- Tightening torque: M3 (0.5Nm), M4 (1.2Nm), M5 (2.2Nm)

**Characteristics and applications**

- Through Hole Reflow Soldering
- Low initial time and cost
- High mechanical torques and forces
- Small size
- Solderable Wire-to-Board connections

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Reliability Test

The reliability of REDCUBE SMD Terminals is often proved in different qualification programs, tests and in field.

Five Time Reflow Test according to:
- J-STD-020D

Solderability according to:
- JESD22-B102

Environmental tests according to:
- MIL-STD-202, Method 107
  - Thermal Shock, -55°C/+150°C, 500 cycles
- MIL-STD-202 Method 106
  - Moisture Resistance, 65±2 °C, 95%RH, 500h

Mechanical tests according to:
- MIL-STD-202, Method 204:
  - Vibration, 10g´s for 20 minutes, 15 Hz to 2000 Hz, 12 cycles per axis

Electrical tests according to:
- IEC 60512-2-1 Connectors for electronic equipment - Tests and measurements - Part 2-1: Electrical continuity and contact resistance tests; Test 2a: Contact resistance; Millivolt level method
- IEC 60512-2-5 Connectors for electronic equipment - Tests and measurements - Part 5-2: Current-carrying capacity tests; Test 5b: Current-temperature derating

- REDCUBE SMD display very high reliability
- The requirements of the relevant standards are exceeded by far.