Flexible IC Interconnection and Electrical Continuity Verification

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Abstract. As the device miniaturization, the assembly is becoming more and more dense. The current fine pitch package or micro BGA and other forms of interconnection comes to a certain limit, which hinders the development of packaging and assembly. high-density assembly and packaging is facing a lot of new challenges. Today, even the most of the fine pitch packages' pitch maintained at around 0.3 mm, it is difficult to continue to shrink, because with the pitch further smaller, there will be serious problems. For example: package reliability to be reduced, such as the emergence of lead bridging, solder ball, cold solder joints and other issues. In order to solve these problems, this paper presents a new way of interconnection. The conductive function is achieved by the conductive silicone rubber between the pad on the PCB and the lead of the packaged device. Due to the presence of pressure, the conductive adhesive is deformed and can be contacted from the top to the bottom and interconnection is formed. This interconnection form may be adapted to all conductive patterns depending on the spacing of the conductive layers. Conductive adhesive in the conductive material is generally carbon, metal, metal oxide, carrying capacity between 800–2800 mA/mm^2. The current production of conductive silicone spacing between 0.1–0.05 mm. Through this technology, the size of the packages can be greatly reduced, and the assembly density can be greatly improved.

Keywords: Conductive silicone · Interconnection · Surface mount technology Electronic packages

1 Introduction

At present, reflow technology is widely used in integrated circuit and circuit board interconnection, but with the development of integrated circuits with each passing day, gradually tend to high integration, high density. The number of leaders gradually increased, the leaders spacing is getting smaller and smaller, assembly process has encountered bottlenecks, leaders pitch stay at 0.3 mm, this situation has become a problem to be solved today. A new type of interconnection technology is ready to come

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out. This paper introduces a new type of interconnection technology with conductive glue as the base and connector as the framework. To proved above issues, special circuit and functional circuits are used.

2 Connector Structure

2.1 A Subsection Sample

The use of connectors for us to solve the bottleneck of the development of integrated circuits for fine pitch IC, so that the integration can be further improved. Based on the interconnection process, we propose two different connectors for the idea.

In the first case, two SOP bracket holders and one platen are made. The conductive adhesive is placed in the holder, the pressure plate is pressed against the leaders of the SOP device, and then placed as a unit into the SOP bracket. Tightly hold the conductive adhesive and hold it securely, see Fig. 1.

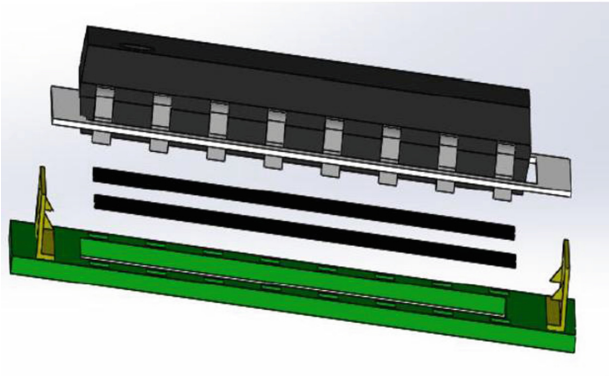


Fig. 1. The first type of structure

The second connection structure, designed on the PCB bayonet, conductive adhesive placed in the corresponding PCB with the device pad, and then design a pressure frame, the pressure frame gland on the SOP device pins, so that conductive adhesive deform, and then use the PCB on the bayonet to achieve the circuit conduction, see Fig. 2.

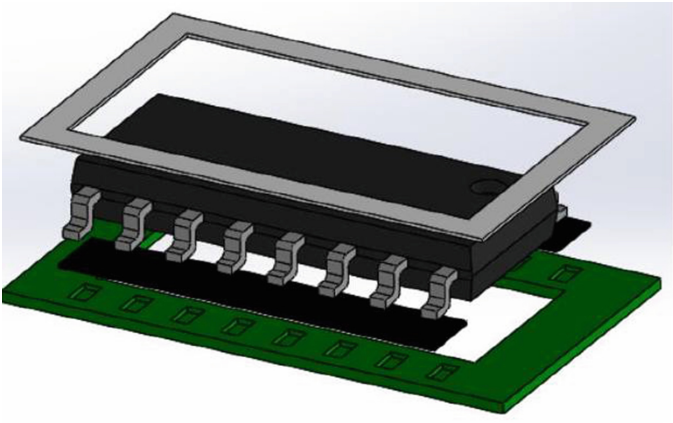


Fig. 2. The second type of structure

3 Electronic Conductive Adhesive

Conductive adhesive is a curing or drying with a certain conductivity of the adhesive, mainly composed of silicon and conductive filler, conductive filler paste has a sticky, conductive particles and adhesive materials are closely connected to form a conductive path. Conductive adhesive has excellent electrical conductivity and adhesion and silicon, and in microelectronics equipment, spot welding, bonding, electromagnetic shielding and other fields have a wide range of applications. According to the different conductive direction, conductive adhesive can be divided into the opposite types and the same two types of conductive plastic. The current conductive adhesive is 0.05 mm minimum spacing and can be conductive around, so you can easily achieve a leaders pitch of 0.3 mm chip package and PCB pad connection.

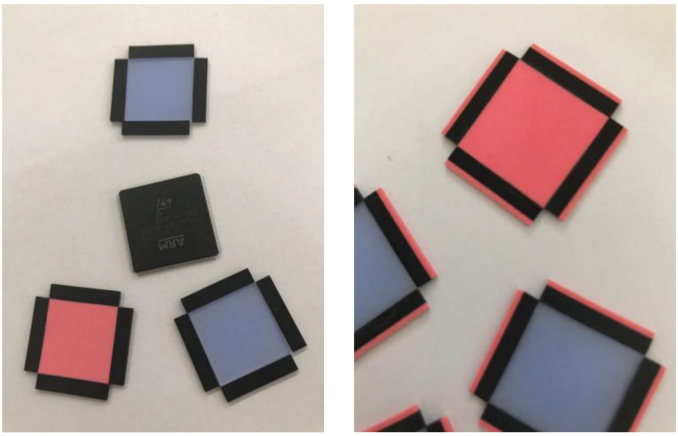
Based on the characteristics of conductive adhesive, the interconnection between SOP devices and PCB pads in this study has a theoretical basis and is feasible. We will be in the conductive rubber contact to the bottom of the device pin and then attached to the PCB, the device applied a certain pressure to make conductive adhesive deformation to form a conductive path.

In order to maintain good conductive reliability, we added the red or gray support part. On the one hand fixed and protective conductive adhesive, to maintain the conductive properties, on the other hand to adapt to automated production, easy to be placed by the placement machine.

At the bottom of the device are in contact with the conductive adhesive in the case of the application of pressure calculation.

Conductive rubber design, see Fig. 3.

Conductive rubber need to be in the 5% of the deformation then conduction can be achieved.



(a) Without edges (b) With edges

Fig. 3. Conductive rubber

4 Testing Board Design Electronic

In order to verify the correctness and reliability of the interconnection design, we have designed a test board. The test device includes the QFP, QFN, in order to fully prove the rationality of the design. Using QFP, SOP and SOP pin function, the positive and negative lead through the wire connection, the formation of conductive path, and then external power supply, to provide the voltage, the circuit current, and then measured current and device pin voltage.

We selected three typical test devices with a pin pitch of 0.3 mm, which are STM32F100VET6 and MAX232 as shown the Fig. 4 typical packages used in design.

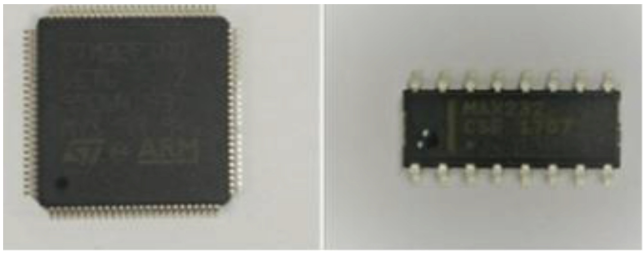


Fig. 4. Test the chip used

The working principle of the three package are shown in Fig. 5.

The testing circuits boards are shown in the Fig. 6. In order to test the interconnection, 8 pairs of VDD-VSS(GND) can be tested separately or in serious.

At present, we set up a set of control experiments using reflow soldering technology to compare the differences between the conductive adhesive interconnection

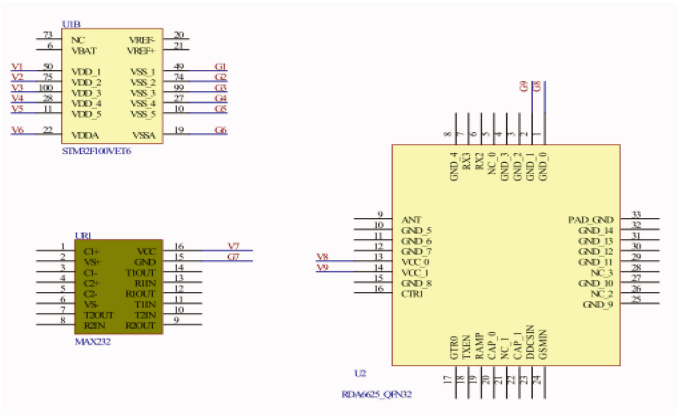


Fig. 5. Working principle figure

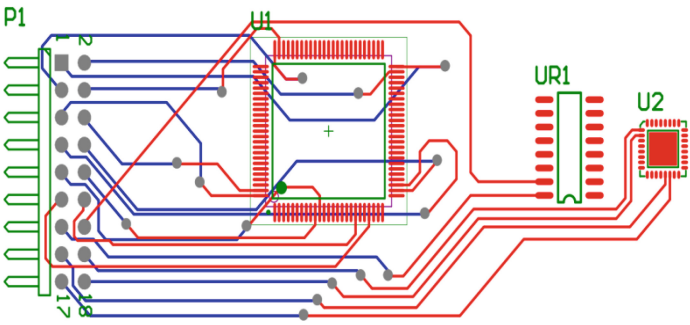


Fig. 6. Testing circuits

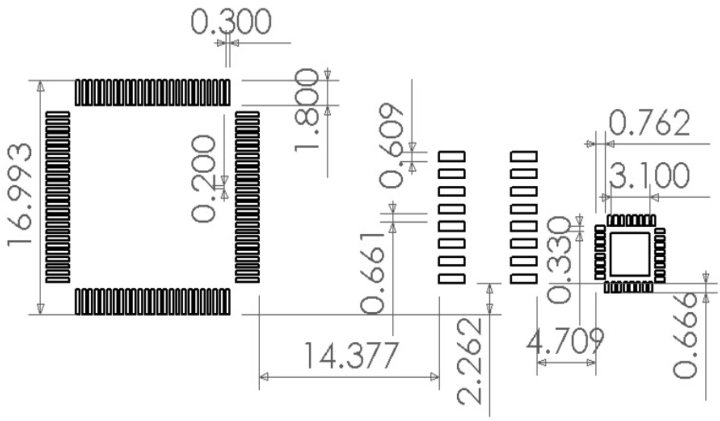


Fig. 7. Stencil

and the reflow interconnection. In order to verify the rationality of the data, We produced two different printing stencils. The stencil is cut by the laser and electrically polished with a thickness of 0.3 mm to facilitate better release of the solder paste printing. Reflow printing stencil is shown in Fig. 7.

5 Assembly of Testing Board

5.1 Assembly of Reflow Testing Circuit Board

Reflow test circuit board assembly process consists of the following components,

(a) Solder paste printing: print the solder paste onto the PCB pad through the printing stencil.
(b) Component placement: correct the location of components, the components attached to the printing paste on the PCB.
(c) Reflow: Place the PCB in the reflow oven for reflow and achieve the connection (Fig. 8).

Fig. 8. Reflow assembly

Reflow interconnection technology with the smaller pin pitch, assembly is becoming more and more difficult, prone to welding, missed welding, bridging, etc., and the equipment requirements of high precision, higher production costs.

5.2 Conductive Rubber Structure Assembly

There are two forms of conductive adhesive for assembly, one for the black zebra, the other in the conductive adhesive extension plus a red colloid (support part, with heat and protective conductive adhesive role), black conductive adhesive thickness 0.4 mm, the thickness of the two-color conductive adhesive is 0.5 mm.

Conductive adhesive interconnection structure of the assembly process is as follows:

(a) Reflow the connector to the PCB, not shown.
(b) Place the chopped zebra strip in the connector, place it in strict accordance with the size of the conductive tape, and align it with the conductive adhesive to make it fully in contact with the conductive adhesive.
(c) Place the device in the connector for clamping, not shown and securing it, see Figs. 9 and 10.

Fig. 9. Black zebra conductive rubber

Fig. 10. Black and pink zebra conductive rubber

In Fig. 10 the QFP and SOP are assembly to the PCB, This kind of interconnection assembly avoids a series of drawbacks caused by reflow soldering, and the process is simple, low cost, suitable for batch, industrialization, can better adapt to a higher degree of integration of integrated circuits.

6 Testing Board Test Results

In this test, we will be two different forms of test circuit connected to the 3 V digital power supply, the specific data measured as follows.

Table 1 in the SMT1, 2 and ZCR1, 2, respectively, two surface mount test circuit and two conductive adhesive interconnect test circuit. By applying 3 V voltage, the device was measured the total voltage and the voltage value of the pins.

Table 1. Two different interconnection test results

V-X	SMT1	ZCR1	SMT2	ZCR2	ASMT	AZCR
Vcc-GND	3.11	3.03	3.06	3	3.09	3.02
Vcc-1	3.1	3.06	3.04	3	3.07	3.03
Vcc-2	3.06	3.01	2.98	2.96	3.02	2.99
Vcc-3	3.06	3.01	2.98	2.96	3.02	2.99
Vcc-4	3.1	3.06	3.04	3.01	3.07	3.04
Vcc-5	0	0	0	0	0.00	0.00
Vcc-6	1.33	2.37	2.44	2.45	1.89	2.41
Vcc-7	0	0	0	0	0.00	0.00
Vcc-8	2.61	2.43	2.61	2.38	2.61	2.41
Vcc-9	0.43	0.43	0.42	0.42	0.43	0.43
Vcc-10	0.22	0.21	0.2	0.22	0.21	0.22
Vcc-11	1.21	1.21	1.24	1.12	1.23	1.17
Vcc-12	1.63	1.54	1.55	1.59	1.59	1.57
Vcc-13	2.68	2.6	2.59	2.55	2.64	2.58
Vcc-14	2.91	2.82	2.86	2.77	2.89	2.80

In the test, a 16-pins SOP device is the used. The circuit schematically shows that the SOP device on the 15th pin ground, 16 pin to the positive power supply, so the voltage between 15, 16 pin is the total voltage and the other pins are also measured. The data of the table shows that the voltage difference between the two devices assembled by reflow soldering is very small.

Conductive adhesive test circuit and reflow test circuit exactly the same, respectively, measured in the pin 3 V power supply voltage, which is almost exactly the same voltage of the two groups, indicating that the conductive adhesive test circuit values are more accurate and can be used to replace the soldering interconnections.

Table ASMT and AZCR, respectively, for the surface assembly and conductive adhesive test circuit of the average voltage, the difference between the data is very

small, the basic deviation maintained at 1 to 2%, where the greater deviation of pin 6, which may be other objective factors lead to errors.

7 Function Validation

In order to prove the function of the circuit, a special circuit is used, see Fig. 11.

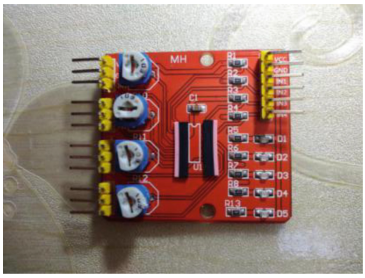


Fig. 11. Verification circuit with zebra conductive rubber

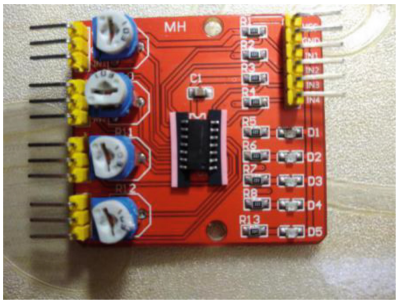


Fig. 12. Verification circuit with zebra conductive rubber and package

Figure 12 shows the placement of the package on the top of the conductive rubber. Figures 13 and 14 are test results with reflow soldering method and zebra conductive method respectively. They show the same results.

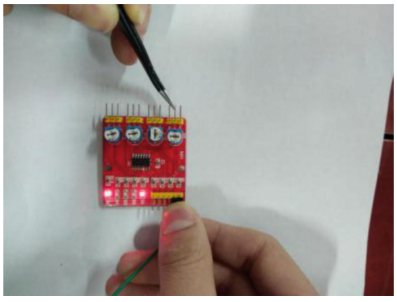


Fig. 13. Solder reflow test result

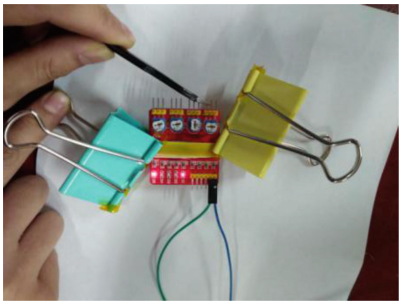


Fig. 14. Conductive rubber test result

8 Conclusions

Through this test, it is proved that the use of conductive adhesive as a new interconnect technology is feasible, the conductivity is good and can be further expanded to break the bottleneck of the technical bottleneck of the future, and the future of the Internet can be technically The field of interconnection will be widely used.

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