MMSM Surface Mount Installation and Reliability Guide

Installation & Handling

MMSM Products are compatible with both solder and silver epoxy paste assembly processes. This includes RoHS solder. Reflow temperatures for RoHS solders such as “SAC” Sn/Ag/Cu are higher than traditional Pb/Sn solders, so extra care must be taken when employing RoHS compatible solders. Silver epoxy paste is recommended for applications where power dissipation is minimal, such as Tuning Varactor / Schottky and low power PIN diode applications. For applications with incident power levels > 30 dBm, solder attachment is strongly recommended. Additionally as with all microelectronic component assembly, care should be taken to insure all circuit boards are clean and free from contamination prior to any such operation.

This guide outlines the considerations for manual and automated assembly techniques utilizing either solder or silver epoxy paste.

Manual Handling & Installation

Solder Assembly

MMSM products are designed to be compatible with modern automatic pick and place equipment and are available in tape and reel format as well as in gel and waffle packs. Because of the nominal size of the units (0.020" x 0.040" x 0.015"), some care must be taken to avoid causing damage during installation. Although storage temperature ratings (non-operating) are compatible and equivalent to ratings for standard plastic encapsulated lead-frame commercial packages (i.e. -55˚C to +125˚C), temperatures during solder installation can exceed this maximum value. It is critical, therefore, as with any other microelectronic part, to minimize thermal gradients across the device. For example, during manual installation, typical electronic pencil soldering tips can exceed 375˚C. When devices are first soldered down to the circuit board on one end only, followed in turn by soldering of the opposite end, the original end provides a path to thermal ground. Unlike a thermal shock test, in which both package ends are simultaneously exposed to the same temperatures, a severe thermal gradient may be created during solder iron manual installation. Specifically, if the original soldered end rests at room temperature, soldering of the second end (@tip temperature = 375˚C) may create a temperature gradient across the device of 350˚C. Use of a soldering iron tip, therefore, is strongly discouraged. If a tip must be used, the following recommendations will help minimize the risk of damage:

a) Limit the tip temperature to the lowest possible temperature appropriate to exceed the liquidus point for the solder being used.
b) Use the smallest tip mass available to reduce the tip thermal mass relative to the device length.
c) Preheat the circuit board to 100-120˚C to further reduce the temperature gradient.

Following these recommendations will help ensure that thermal differentials are minimized to lower levels.

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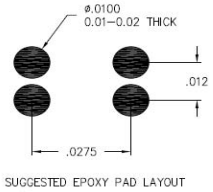
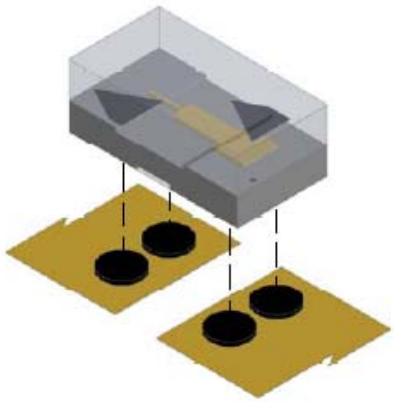
Silver Paste Assembly

Installation of MMSM product using Silver epoxy paste is fairly straight forward. Operators familiar with silver epoxy component assembly can easily adapt his/her technique readily to handle MMSM installation. Epotek H20E or equivalent can be used for installation. It is critical that the paste is within the manufactures guide lines for shelf life and pot life.

Two dots of epoxy are dispensed and placed as shown. (See solder pad outline). The dots should be approximately 10 mils in diameter. Using tweezers or a vacuum pencil, the MMSM is placed on the epoxy dots and lightly pressed into place. Excessive epoxy can cause bridging between the solder pads and short out the device. Not enough epoxy can result in poor electrical or mechanical connection. After installation of the MMSM parts, the assembly is cured using the manufactures recommended time and temperature settings. Improper curing can result in poor mechanical bonds as well as reduced electrical performance.



SUGGESTED EPOXY PAD LAYOUT



Automated Handling and Installation

Packaging

MMSM products are ESD sensitive. Microsemi 'tapes' products according to EIA -481.
MMSM products are "taped and reeled" according to the following:

Reel Size: 7" Anti-Static Reel / Up to 5,000 units per reel.
Tape: Black conductive polycarbonate tape.
Cover Tape: Static dissipative heat-activated cover tape.
Tape Spec:

Package Type	Carrier Tape (3M or equivalent)	Pitch (mm)	Width (mm)	A_0 (mm)	B_0 (mm)	K_0 (mm)
206, 306 (MMSM)	US057791-3000	4.0	8.0	0.74	1.17	0.46

For customers using automated 'pick and place' equipment, the use of ionizers is necessary to control static build up. Static charges can form as the pocket tape moves through the automated assembly equipment. If this occurs, parts may stick to the cover tape as it is removed to expose the parts to the pick up tool.

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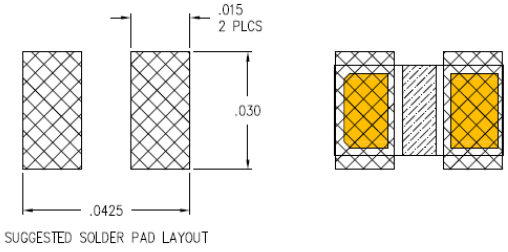
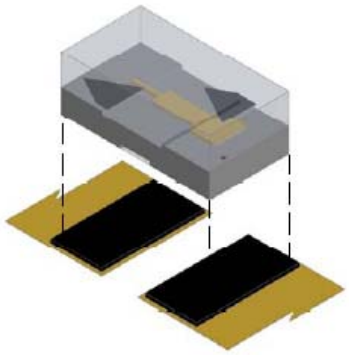
Solder Installation

Several automated attachment techniques are common in the industry, among them vapor phase reflow; IR reflow; and wave soldering. A common characteristic of all three methods is the ability to provide uniform temperature profiles and minimize excessive temperature gradients over time and distance. The particular circuit board and solder alloy selected as well as the attachment of other components on the circuit board being used all factor into the solder flow parameters of the installation. MMSM products were characterized at Microsemi by use of an IR reflow equivalent system, using a 92.5Pb/5Sn/2.5Ag paste (comprised of 90% metal powder in a water soluble flux; liquidus temperature = 296˚C). A solder screen was used to screen the optimum amount of solder paste onto the pads of the footprint (nominal thickness 0.005 inch). The temperature profile versus time was comprised of three distinct heating stages (preheat, reflow, and cooling) with a dwell temperature of 310˚C for approximately 25 seconds. Following solder reflow and cool down, die shear tests were conducted on parts and results were fully compliant to MIL-STD-750, method 2017, condition A. The recommended method of attachment, therefore, is an IR reflow type system. It is important to note that this particular solder alloy is by no means the only one recommended for MMSM devices. Our metallization is compatible with most solders commonly used for microelectronic reflow assembly provided the temperature does not exceed 300 degrees C for extended periods. For additional information please contact our Applications Engineering Department.



SUGGESTED SOLDER PAD LAYOUT



Automated Epoxy Paste Installation

Many of our customers utilize silver paste (H20E or equivalent) for MMSM installation. With this technique, silver paste is screen printed onto the circuit board, components are placed on the board and the paste is cured according to the manufactures recommended curing time / temperature. Care must be taken to avoid using excessive solder paste. With this technique, silver paste is screen printed onto the circuit board. The board is then populated with components. As discussed, excessive epoxy can cause bridging between the terminations and short out the device. Not enough epoxy can result in a poor electrical or mechanical connection. After installation of the MMSM parts, the assembly is cured using the manufactures recommended time and temperature settings. Improper curing can result in poor mechanical bonds as well as reduced electrical performance.

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MMSM Reliability

A number of reliability issues were addressed prior to production release of the MMSM product family. One improvement in product design over conventional plastic packages is the ability of the MMSM die/package to dissipate increased levels of power. Mean theta values of 45˚C/W for the MPP4201 effectively doubles at a minimum the power dissipation capability of this product as compared to a similar diode mounted in a more conventional plastic lead-frame package configuration.

Additional reliability issues addressed were product burn-in effectiveness, resistance to moisture; thermal and mechanical stability; and component solderability / assembly process simulation (discussed in previous section). The MMSM product successfully passed the following reliability sequences:

A. Environmental Sequence
- a) Temperature Characteristics: -40˚C, +25˚C, +85˚C parametric data recording, and compliance.
- b) Thermal cycling: -65˚C, +125˚C, 20 min dwell, 5 min transition, 100 cycles.
- c) Humidity test: +85˚C, 100% RH, 24 hrs.
- d) Final data: +25˚C.

B. Operating Life Sequence
- a) HighTemp Reverse Bias: Ta=+125˚C, 168 hrs, bias 80% max rating.
- b) Steady State Op Life: 60 Hz AC pulse, forward current If=20mA, reverse peak voltage 80% of maximum rating, 340 hrs.
- c) Final data: +25˚C.

C. Mechanical / Processing Sequence
- a) Vibration: 100-2000 Hz, at least 4 minutes, 4 times in each orientation (x,y,z), motion for total of 48 minutes, constant peak acceleration of 20g minimum (MIL-STD-750, method 2056).
- b) Mechanical Shock: MIL-STD-750, method 2016.
- c) Final data: +25C.

Finally, the use of DC parametric testing is completed on finished MMSM devices - using proper statistical analysis and qualification, DC results can be used in most cases to ensure RF performance. Typical measurements completed include forward voltage, reverse leakage current, and total capacitance. Initially, small sample evaluations from each lot will be completed to ensure RF specification compliance and to generate an appropriate test database.

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