

How to Manually Assemble an eGaN® FET or IC



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EPC's innovative wafer level, Land Grid Array (LGA) and Ball Grid Array (BGA) packaging, shown in figure 1, has enabled a new level of performance in power conversion. Proper assembly techniques are essential to take full advantage of GaN technology capability. Here are the guidelines for manual assembly of these FETs and ICs.

Anti-static measures

- ESD precautions are REQUIRED Procedure must be done on an anti-static mat or bench that is connected to ground.
- Connect all test equipment to ground.
- ESD wrist strap and ESD lab coat MUST be worn.

Preparing the PCB

- Remove old solder, flux and all other foreign material if this is a re-work.
- Ensure pad is flat and there is very little solder remaining.
- Clean the pad area with isopropyl alcohol and wipe with a lint free wipe; allow it to dry.



Applying the solder paste

- Recommended lead-free no-clean solder pastes:
 - Sn96.5Ag3Cu0.5 (220°C) part number TS391SNL from ChipQuik or,
 - Bi57.6Sn42Ag0.4 (Low temperature 138°C) part number TS391LT from ChipQuik
- Carefully apply the solder paste to the pad area using either a laser cut stencil or with the help of a microscope and fine tool* such as steel precision pointed tweezers or needle.
- The paste should cover the whole pad with minimum overflow.
- The optimum thickness of the paste is approximately 4 mils (100 µm) and should look similar to that shown in figure 2.

*Do not use an absorbent material tool such as a toothpick, as it can dry out the flux in the solder paste mix or contaminate it.

Placing and aligning the eGaN FET or IC

- Check die orientation. There is a dot on the back surface of the die and there should be a corresponding index on the PCB indicating the correct orientation placement for the die on the PCB as shown in figure 3. Place the die within the silkscreen markings that are used for alignment as shown in figure 3. Moving the die excessively in an attempt to align the die within the silkscreen markings risk smearing the paste and can lead to open or short circuits.

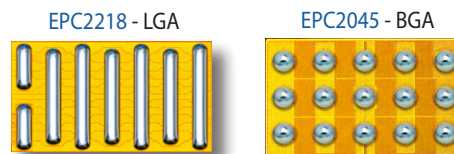
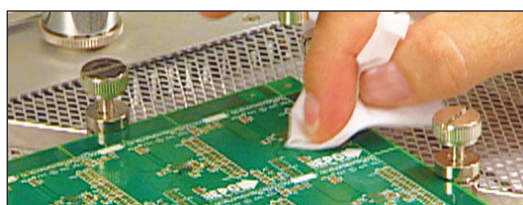


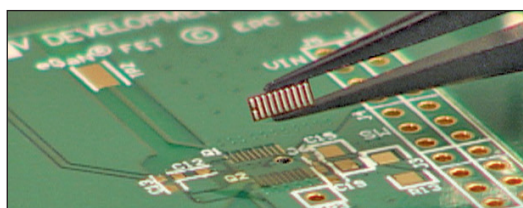
Figure 1. Examples of eGaN FETs in LGA (EPC2218 shown) and BGA (EPC2045 shown) packages



Preparing the PCB



Figure 2: Correct application of solder to a pad



Placing and aligning the eGaN FET or IC

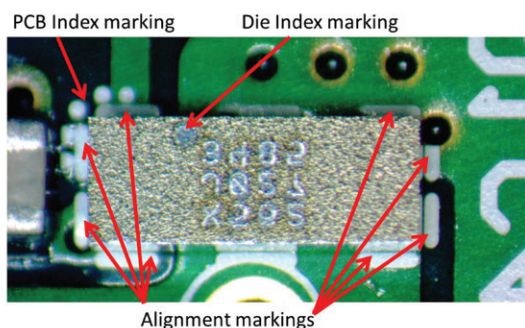


Figure 3: Correct die alignment within the silkscreen markings

Soldering

There are two options for soldering the die:

- 1) Using a mini reflow oven similar to the one shown in figure 4 left,
- 2) Using a hot plate in combination with a hot air gun shown in figure 4 right.

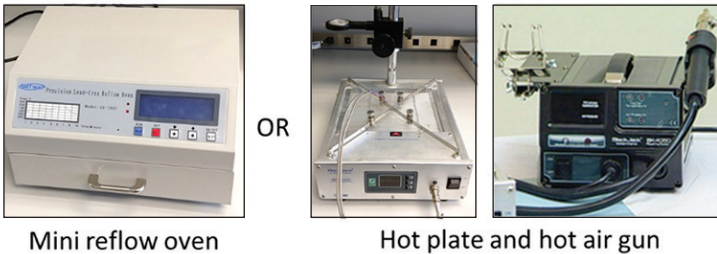


Figure 4: Example of a mini reflow oven: SMTmax model AS-5001 and example IR hot plate: BlackJack BK7000; example hot air gun: BlackJack BK4050

1) Soldering using a mini reflow oven:

- Configure the temperature and time reflow-profile for the oven according to the solder paste specification given in the datasheet.

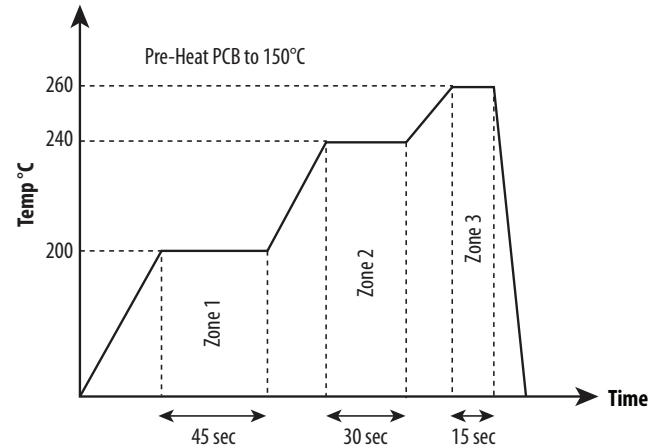
2) Soldering using a hot plate and hot air gun:

- Pre-select the hot air gun nozzle to be slightly larger than the die.
- Install the board to be soldered into the IR hot plate using the adjustable clamps and align the hot air gun nozzle to the location of the die to be soldered by lowering the hot air gun and then raising it once aligned and confirming there are no obstructions.
- Turn on the hot air gun system and set the temperature to the value specified in the solder paste datasheet. Reduce the air flow rate to its lowest setting to prevent the die from moving during soldering.
- Preheat the board to 150°C by turning on the IR hot plate.
- Once the board has reached temperature, turn-on the hot air gun and lower to within $\frac{1}{16}$ inch above the back surface of the die for at least 45 seconds but do not exceed 1 minute and 30 seconds.
- Keep the hot air gun on, raise it to the maximum height before turning it off.

*For more details on using the hot plate and hot air gun method, refer to [Die Attach Procedure](#).

Clean and cure

- Leave the PCB on the hot plate set at 150°C for 30 minutes to cure the flux.
- Alternatively, turn off the IR hot plate, wait for the board to cool and gently clean away the flux around the die with flux cleaner.



Post assembly inspection

- Carefully check tackiness of flux around the die using a clean anti-static micro spatula if the curing method was chosen. The flux should feel hard and glass-like and the spatula should not stick to it.
- Inspect that the die rests flat with respect to PCB surface, is within the silkscreen boundary and the solder bumps can be clearly seen as shown in figure 5. A microscope for magnification may be necessary.
- Check that the bumps are free from short circuits around die.
- Check if any solder paste remains between the bumps of die and, if found, it should be cleaned away using a flux cleaner.
- If all the inspection items have passed then proceed to electrically test the board.

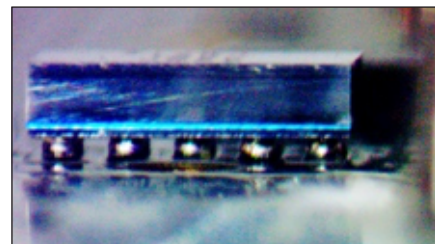


Figure 5: Correctly seated die showing well rounded bumps and no flux residue between the bumps

Conclusion

This application note shows the basic steps to follow for the manual assembly of eGaN FETs. For more details on PCB design, mass-production assembly, achieving high yield and reliability, please refer to [AN009: Assembling eGaN® FETs and Integrated Circuits](#).