GaAs MMIC User Guide

1. Storage

All Endwave bare die should be stored in a temperature and humidity controlled area. A static neutral dry box with a nitrogen atmosphere is preferable.

2. Handling bare MMIC die

The top surfaces of Endwave MMIC devices have many fragile features such as air bridges, FETs, capacitors and inductors. These features should not be touched directly. Direct contact or deflection of these features may alter the normal performance or reliability of the device.

3. Picking of MMICs

Bare die Endwave MMIC devices may be delivered in several media including gel packs and waffle packs, and can be picked using manual or automatic means. Considerations for accomplishing the chip picking operation successfully while minimizing the potential for damage to the chip are provided. Note that in some cases a particular tool may be listed as an example. It should be assumed that equivalent tools may be used as well.

(a) Manual picking from waffle pack or vacuum release Gel-pak using tweezers.

MMIC devices should be handled with a sharp pair of tweezers. If possible, a position along the MMIC edge away from bond pads should be chosen. Curved tweezers like those found in Figure 1 may allow more comfort and improved visibility for the operator using a microscope. The tweezers should meet evenly at the tip as shown in Figure 2. Tweezers shown as example in the photo are Ideal-tek 5B.SA tweezers. Other equivalents may be used.

Figure 1: Curved tweezers for MMIC manual picking.

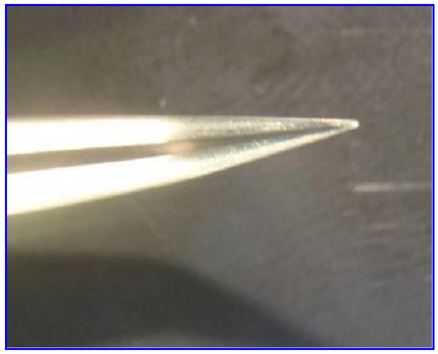

Figure 2: Tweezers meet evenly at tips.

(b) Manual picking from waffle pack or vacuum release Gel-pak using a vacuum tool.

Manual vacuum systems are available from a variety of suppliers. An example of one such system, EFD Process-mate 100 is shown below in Figure 3.

Figure 3: Manual vacuum system example.

Vacuum tip selection and die picking contact points should be chosen with consideration of the die topology. A site on the top surface of the die that has no metalized features (with the exception of chip labeling) should be chosen, with the tip selected such that it fits within that area – as noted in the black oval in Figure 4. A Delrin or Teflon tip end feature may also reduce the occurrence of chip damage.

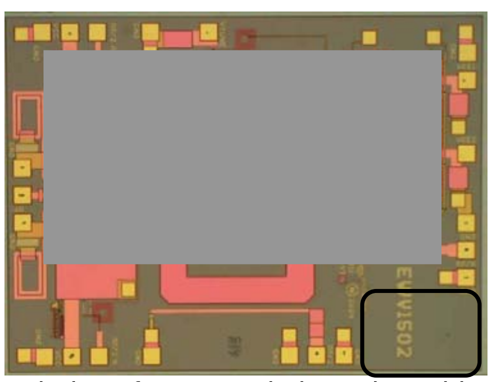

Figure 4: Choice of vacuum tip based on chip topology.

(c) Machine picking from waffle pack, vacuum release Gel-pak or wafer.

Many of the tools shown below can be used to pick and place die from a waffle, vacuum release Gel-pak or wafer in an automated environment. A soft rubber pick up tool in conjunction with a low vacuum setting may be used as shown in Figure 5.

Figure 5: Soft rubber auto pick up tool.

Inverted pyramid die collet tools like the one in Figure 6, and channel type die collet tools like that in Figure 7 may also be used.

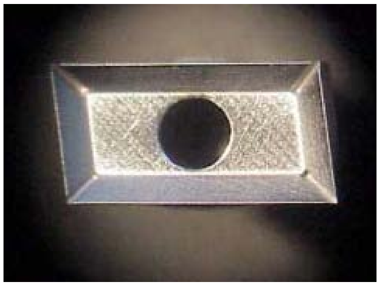

Figure 6: Inverted pyramid die collet pick up tool.

Figure 7: Channel type die collet pick up tool.

A perimeter or peripheral die tool like that shown in Figure 8 may be used, but with careful consideration to the die topology and the die tools perimeter width.

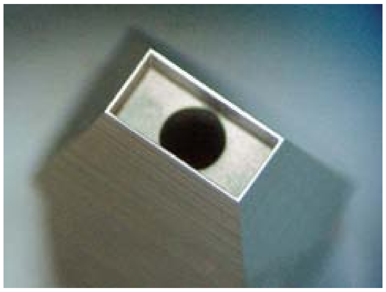

Figure 8: Perimeter die collet pick up tool.

4. Die mounting

All Endwave die may be attached using conductive adhesive or 80/20 gold tin perform.

(a) Gold tin process

Process temperatures for gold tin reflow should not exceed 320˚C for 20 seconds. Die attach with gold tin perform is typically performed in an insert atmosphere. Some mechanical scrubbing may be introduced to induce wetting.

(b) Epoxy process

The choice of conductive epoxy type should consider several factors including:

- Thermal requirements of the die - refer to the Endwave thermal model application note on the www.endwave.com website.
- The specific installation (base/pcb material type and construction) including maximum operational temperature.
- CTE mismatch of the die to the mounting surface.
- The process capability for control of the resulting bond-line thickness.

The epoxy manufacturers cure schedule should be followed, where 100% epoxy coverage beneath the die is the preferred condition, while adhering to IPC, MIL or other standard inspection criteria for epoxy fillet and other requirements.

(c) Surface preparation for die attach and wire bond processes.

High surface energy should be maintained to positively effect both wire bond and die attach processes. Organic materials should be removed from the mounting or bonding site for process optimization, where the typical method used is plasma cleaning.

Plasma power levels used need to consider other material present. For example, too high a power level with solder present can cause solder to be lifted off and re-deposited on the surface of the devices being cleaned. Gas selection determines whether or not the process is reactive or mechanical. Endwave MMICs may be exposed to argon or helium (mechanical processes) as well as argon/oxygen and nitrogen/hydrogen (reactive processes). A water break test may be used to assess the cleaning process result. An AST VCA-3000-S is an example of a surface analysis system that may be used to assess the surface energy after cleaning. Destructive sample testing via die sheer or other methods may also be used to evaluate cleaning process impact.

(d) Gold wire and ribbon Bonding

Thermo-sonic ball bonding and or ribbon bonding are recommended for Endwave devices. Transducer frequencies of 60 to 120 KHz are routinely used. Heat stage and bonding tip temperatures typically range from 100˚C to 150˚C.

Typical bonding pressure applied for a ribbon bond is 10 to 13 grams per square mil. As example, a 2 mil wide ribbon bonded with a bonding tip that has a 1.5 mil foot length would typically use 30 to 39 grams of force.

Settings for ball bonding will vary depending on free air ball size and capillary geometry. Most Endwave devices feature 0.1mm x 0.1mm or larger bond pads. Selection of ribbon or wire size should consider that it is preferable for the entirety of the bond be within the bond pad, which will also optimize electrical performance.

Note that in Figure 9 below, the edge of the wire or ribbon bond should not overlap the edge of the bond pad on the the internal side of the die. The tail of a ribbon bond may extend past these boundaries provided it does not cause a short circuit condition.

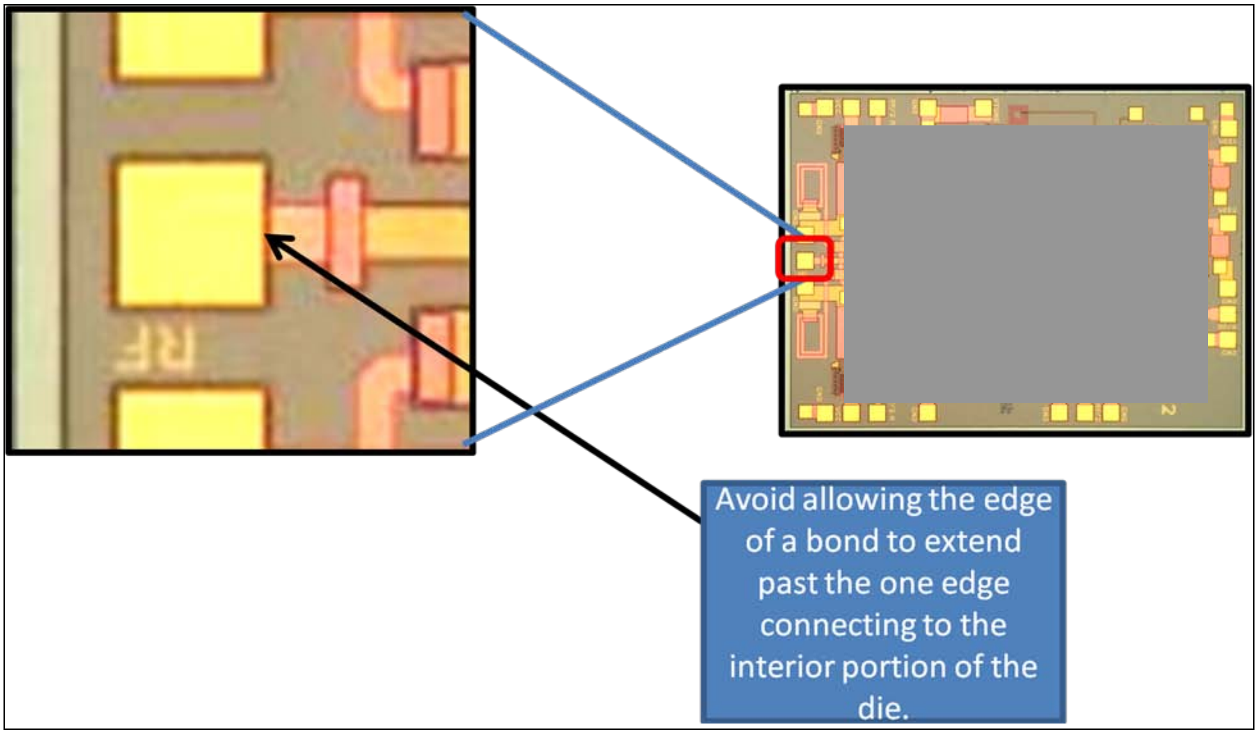

Figure 9: Bond pad consideration.

Figure 10 shows an example of an acceptable ball bond size and location. Note that the ball is fully within the bond pad on all sides.

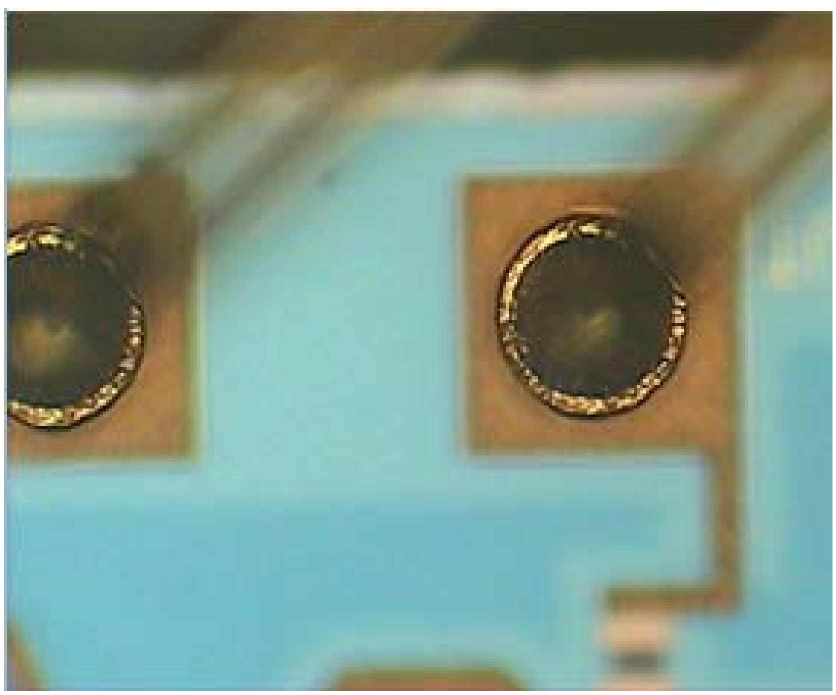

Figure 10: Good ball bond targeting.

Conversely, Figure 10 shows an example of unacceptable ball bond results. Note that the ball is not fully within the bond pad on all sides. The ball size is too large, and targeting is poor. This type of bonding can be expected to degrade performance and/or reliability of the MMIC if damage is done to the area under the ball.

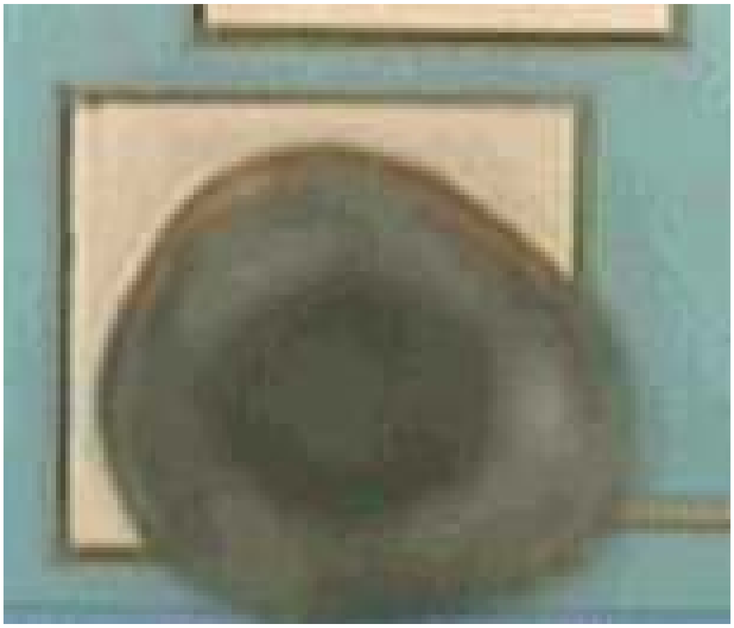

Figure 11: Unacceptable ball bond targeting.

Finally, Figure 12 demonstrates an acceptable ribbon bond size and location.

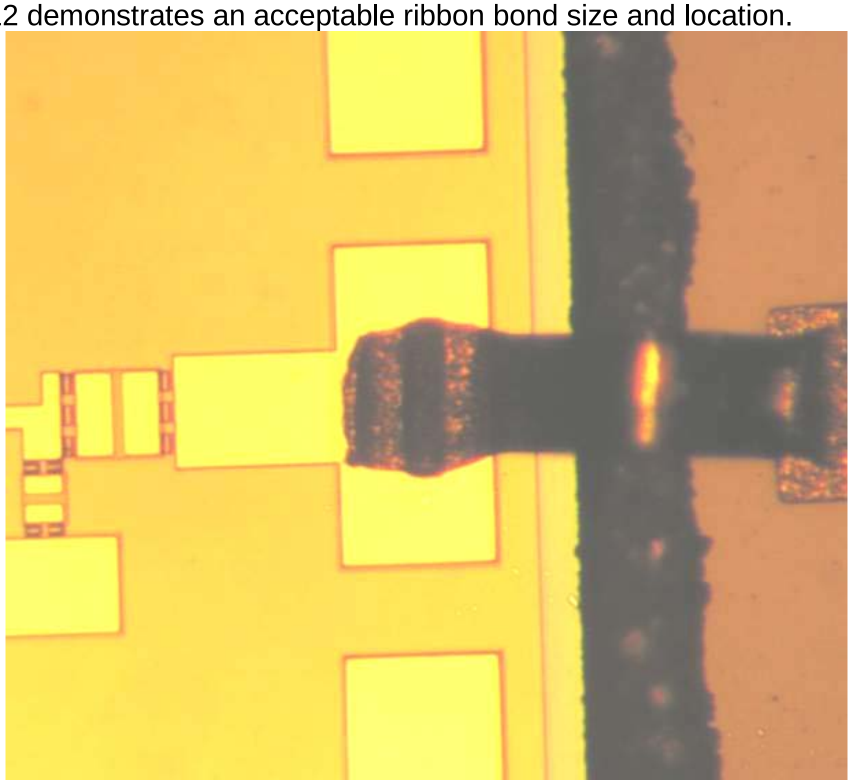

Figure 12: Acceptable ribbon wedge bond placement and targeting.