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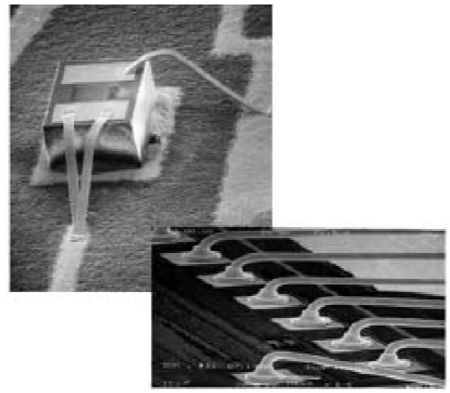
NATEL EMS Quick Reference Guide for Wire Bonding

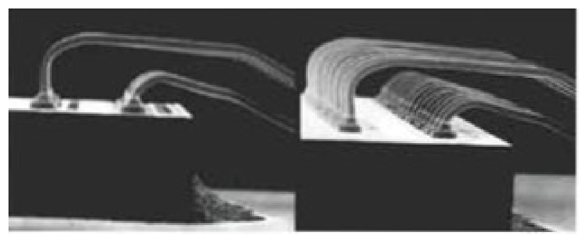
Wire Bond Limits



Prior to the layout of a particular microelectronic design it is important to undestand the bond design limits. These are the substrate or board layout features and design limits. Going beyond these limits can incur cost, constrain through-put, and reduce reliability and yields.

Implementing these rules prior to the first attempt at a layout will help your time-to-market. Thus, making your proof of design, prototype, and production painless and fast.

To maximize production efficiencies, automatic lines (especially automatic wire bonders) require special layout considerations such as:



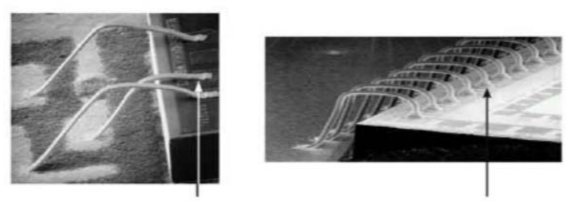
A. Uniform wire length
B. A uniform homogeneous wire bond surface void of organic contamination, pits, and inclusions in the surface; an automatic wire bond machine is not selective and will not hunt for the ideal bonding spot on a conductor metallization
C. A minimum bonding pad for the first bond (ball or wedge) of 0.004” x 0.004”
D. A minimum second bond (typically on the substrate) of 0.010” x 0.010”
E. A minimum step back from the edge of the die to the second bond pad of 0.015”
F. Maximum wire length of 0.100” and preferred overall wire length of 0.040” to 0.060”
G. A minimum loop height of 0.008”
H. A maximum loop height of 0.030”
I. When tight pitch pads require staggered wire bonds (one bond looping over the other) the minimum distance between loops should be 0.010”
J. When wires cross uncommon conductor metallization and the over wire length is 0.040” or longer, the conductors being crossed should be covered with protective dielectric to prevent shorting from sagging bonds

Interconnect Quick Reference Guide			
Interconnect Type	**Ball Bonding**	**Wedge Bonding**	**Ribbon Bonding**
Advantages/Applications	**Fine Pitch, Standard Loop Heights, High Wire Counts**	**Low Loop Heights, Die to Die Bonding**	**High Frequency Applications, High Current Devices**
Typical Wire/Ribbon Size	0.0007" to 0.002" Diameter	0.0007" to 0.002" Diameter	0.0005"x0.002" to 0.001"x0.010"
Pad Impact	Less	More	More
Average Stage Temperature	150°C	130°C	130°C
Minimum Loop Height	0.003"	0.003"	0.003"
Minimum Bond Pad Size	50 µm square	35 µm square	60 µm square
Minimum 1st Bond pitch	50 µm capability, typically workmanship std limited	35 µm capability, typically workmanship std limited	60 µm capability, typically workmanship std limited

Wire Bond versus Ribbon Bond

The two most accepted wire bond processes are ball bonding and wedge bonding. Both of these processes use ultrasonic energy to create an intermetallic interface bond, or weld, between the wire and the die pad or the substrate. When the wire used is gold, both processes use what is known as “thermosonic bonding.” Although ball bonding is normally faster and is used in a variety of bonding applications, ribbon binding (a form of wedge bonding) is gaining momentum in high frequency and optoelectronic applications. This is due to the larger surface area of a ribbon bond as compared to a round wire.

Ribbon Bonds — Wire Bonds



Loop starts at the die since there is no ball — Loop starts at 0.003" above the surface, due to the ball

“Minimizing interconnect inductance is critical to achieving performance requirements in high speed electronics,” stated Rick Sturdivant while he was Technical Product Manager at MultiLink. “Interconnect inductance can cause impedance mismatches, ringing, distortion pulses and worst of all to high speed circuits, reduced bandwidth. Because of this need for reduced inductance, ribbon bonding is often specified instead of wire bonding. This is especially true for wide band components where parameters such as group delay must be controlled over a very wide bandwidth. Ribbon bonds are preferred because a typical one has two to three times less inductance than a typical wire bond. It may seem that an alternative solution is to use multiple wire bonds. While this does improve the situation somewhat, it is not as effective as a ribbon bond. This is due to the fact that multiple wire bonds have a mutual inductance between them. This results in diminishing returns when multiple wire bonds are used. In other words, two wire bonds are not half the inductance of one. Therefore the ribbon bond solution is fast becoming a critical requirement in high speed microelectronic assembly.”

NATEL views high frequency and optoelectronic packages as classic hybrids with some very interesting interconnect challenges. Precision is the competitive edge, in both bond and device placement. In most high frequency applications, precision wire lengths are necessary, as well as precision wire/ribbon placement. To control wire length (loop and step back), ribbon wedge bonding is necessary. The average high frequency die is 0.004” thick. Using ribbon bonding techniques, you can actually bond a ribbon as short as 0.010” long and this includes a loop. Because there is no ball to start the loop (as with ball bonding), the loop can start at the die interface instead of 2 or 3 mil in the air on top of the ball bond.

Many designers have turned to the microelectronics industry to help package their exotic deigns in efficient, reliable, repeatable packaging technologies that create the integrated, cost efficient device that their industry demands. Please reach out to learn if NATEL is the right partner for you.

About NATEL

NATEL is a major independent manufacturer of a wide variety of electronic products, providing low to high volume production for its customers. As one of the largest and oldest privately held EMS company in the U.S., NATEL is known for high-reliability, high-quality manufacturing that delivers solutions to customers in medical, defense, transportation and industrial fields. Through a recent acquisition of EPIC Technologies, NATEL is favorably positioned among mid-tier EMS manufacturers to “make amazing things happen.” NATEL holds and maintains industry specific certifications that include ISO/TS 16949, ISO 13485, and AS9100. Its MIL-PRF-38534 Class H and K certifications certify NATEL’s expertise in designing and manufacturing microelectronic assemblies for space and mission-critical defense programs placing it in an elite group of aerospace industry manufacturers. NATEL, headquartered in Chatsworth, CA, has manufacturing locations in California, Nevada, Ohio, and internationally in Mexico. To learn more, visit www.NatelEMS.com or on Twitter @NATEL.