

Exceeding Productivity Demands for Heavy Wire Bonding by Joseph S. Bubel, Hesse & Knipps, Inc.

Produce more parts per hour. Reduce your production costs. Improve quality.

How can you keep up with these demands for your heavy wire bonding production? If your manufacturing equipment is not on – or perhaps more importantly – *above* par, it may be time to take a look at the latest heavy wire bonding manufacturing equipment innovations.

A large portion of the cycle time for wedge bonding, in particular for the largest diameter heavy wire applications, is used for the ultrasonic welding process. This makes achieving any significant increase



in productivity a big challenge. To meet the challenge, equipment manufacturers must question each element of the wire bonding equipment in relation to optimizing the wire bonding process. Some of the critical elements and questions to ask include:

- The moving mass of the machine how can it be reduced?
- Acceleration are highly dynamic linear motors and axis control integrated to achieve maximum acceleration?
- Maintenance is the wire bonder comprised of the most maintenance or wear-free components available for the application?

Beware of the black box!

Avoiding "off the shelf" solutions for key technologies will help your company achieve the greatest technical innovations. Innovative wire bonding equipment manufacturers strive for consistent reduction of the machine's moving mass and integration of components that lead to significantly increased acceleration values on all axes. And they accomplish this with the most maintenance-free components available.

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New Generation Heavy Wire Bonders

New heavy wire bonding machine generations are based on longterm experience in the development and design of ultrasonic wedge-wedge bonders. They consistently apply mechatronic design principles and integrate the latest micro-technology for sensors and actuators in the bondhead to provide the best results for increasing your heavy wire bonding productivity. They use advanced ultrasonic generators and amplifiers based on DDS technology – already field-proven with fine wire bonders, in addition to optimally matching transducers.

Proven technology and innovative development for the processing of aluminum wire, copper and ribbons has led the development of the latest generation of heavy wire bonding equipment – benefitting users with very low maintenance requirements and productivity increases of up to 30%.

Look for these proven technologies and innovative solutions in your heavy wire bonding equipment:

- Gantry kinematics with linear motors for current and future precision and repeatability requirements
- Working areas up to 350 mm x 500 mm
- Reduced mass bondhead with integrated, non-destructive pull test
- An active cutter system, de-coupled from the Z axis
- Patented E-box technology optical setup assistance for cutter, wire guide and wedge tool
- Patented PiQCTM, "process integrated quality control" for stress-free monitoring of each bond

Hesse & Knipps Bondjet BJ935 & BJ939 - The new benchmark in heavy wire bonding

- 20% reduced mass bondhead optimized for low moment of inertia
- Fast processing up to 3 wire/second
- 2 μm at 3 σ repeatability at each position in the large work area
- All components designed to be as wear-free and low maintenance as technology allows
- Extra large working area up to 350 mm x 500 mm allows smart automation concepts or processing of extra large substrates.

Heavy Wire Bonding Technology Leadership

With features such as the active cutter system, E-box and PiQC, the latest heavy wire bonders lead the way in terms of technological advancement and for overall cost of ownership. The power of innovation lies with the combination of dynamic drives, optimized axis control concepts, high-speed compliant kinematics for all axes and innovative bondheads, optimized for high functionality and low



mass. During evaluations with insulated gate bipolar transistor (IGBT) modules, productivity increases of 30% were achieved compared to previous heavy wire bonding machines.

The new generation of heavy wire bonders sets new benchmarks for quality. The touchdown of the wedge tool on the chip or substrate is performed with highest sensitivity. Placement accuracy is increased 3 to 4 times compared to previous heavy wire bonders. The repeatability of looping is $\pm \frac{1}{2}$ the wire diameter as a general rule of thumb.

Integrating the latest heavy wire bonding technology into your production

With its user-friendly software, the newest heavy wire bonding machines are easily integrated into existing production lines with universal or customer-specific automation. Existing automation is easily adapted to the new machines. Established features such as frontcut-backcut retrofit within minutes, bondheads can be exchanged and calibrated quickly.

Process Integrated Quality Control

PiQC is a patented multi-value control for bond quality that enables non-destructive tests in real time during fully automatic heavy wire bonding production. Every physically relevant signal is evaluated in real time, resulting in a distinct quality index. A sensor is integrated into the transducers, which

ensures that the physical effects at the wedge tip – the fundamental movement – are clearly ascertainable in real time. To complete the bond quality evaluation, oscillation required at the wedge tip, current, resonance frequency, friction and wire deformation are all measured. This is *all accomplished with no mechanical stress on the bonds*. All signals are then statistically evaluated to achieve extensive quality conclusions unmatched by any other quality control currently available for wire bonding.

Achieving the best bond quality and preparing for your next "small" challenge

With the most advanced technologies incorporated into your heavy wire bonding equipment, you will ensure that you are prepared for ever smaller bond pads and ever thinner and more sensitive contact layers on future semiconductor devices.



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About Joseph S. Bubel

With 30 years industry experience, Mr. Bubel possesses strong technical knowledge of the complete semiconductor manufacturing process. He is president of Hesse & Knipps, Inc. and can be reached at bubel@hesse-knipps.us.