**HiLo™ INTERCONNECT OVERVIEW**

**Highs**
- **High Density**: 0.8mm pitch and above
- **High Speed**: 1 dB cut-off measured at 9.3 GHz
- **High I/O**: Available with over 2400 positions
- **High Reliability**: Proven dual-beam gold-plated high strength copper alloy contacts
- **High Speed Assembly**: Pick and place compatible

**Lows**
- **Low Profile**: Socket height less than 2mm
- **Low Cost**: A few cents per mated pair in high volume production
- **Low Tooling Cost**: Tooling cost for custom footprints less than $1,000
- **Low Insertion Force**: One ounce per contact

**Flexibility**
- **Any Application**: Production IC socket, module-to-board connector, flex to PCB
- **Quick Delivery**: Prototype quantities shipped in 2 weeks
- **Any Footprint**: Not limited to standard arrays or geometries. Design freedom for mixed pitch, selectively populated, and non-grid arrays
- **CTE Compliant**: Designed to accommodate thermal mismatch
The HiLo system consists of two contacts: A pin (male) and socket (female)

**Pin (Male)**
- Base material: Phosphor Bronze (typical)
- Plating: Gold over Nickel (typical)
- Diameter 0.3mm (0.012") for 1mm pitch +
- Diameter 0.2mm (0.008") for 0.8mm pitch +

**Socket (Female)**
- Base material: Beryllium Copper
- Plating: Selective Gold over Nickel (typical)
- Different contacts tooled for different pitch

Dual beams make contact to pin

J-Lead on bottom of contact is surface mount soldered to BGA pattern on PCB
HiLo™ connector housings are manufactured from drilled laminate instead of molded plastic:

- **Improved Solder Joint Reliability:** For large area array connectors, a CTE mismatch between the connector and PCB materials can result in significant stresses and failures under thermal cycling applications. HiLo minimizes these CTE mismatch stresses by utilizing a laminate with a CTE similar to the customer’s PCB.

- **Better Flatness:** Drilled laminate connectors also exhibit less warp and twist during reflow compared to molded connectors. ISI’s HiLo designs have a tendency to conform to the substrate material during reflow resulting in high quality, reliable solder joints.

HiLo is available with the following laminate materials:

<table>
<thead>
<tr>
<th>Resin</th>
<th>Tg (°C)</th>
<th>X-Y CTE</th>
<th>Dielectric Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR4</td>
<td>125</td>
<td>10-14</td>
<td>3.9-4.5</td>
</tr>
<tr>
<td>High Temp Epoxy</td>
<td>210</td>
<td>10-14</td>
<td>3.6-3.7</td>
</tr>
<tr>
<td>Polyimide</td>
<td>250</td>
<td>6-9</td>
<td>3.6</td>
</tr>
</tbody>
</table>
HiLo uses a standard, high volume, production process to make custom product variants:

- Data driven process: Engineering files load directly into production equipment
- Standard panel size eliminates job-specific tooling
- Standard materials + standard process + unique data file = custom product
- Automated optical inspection ensures quality on 100% of units manufactured
Typical Configurations:

**Pin Field**
- This end of pin is soldered to PCB, BGA or LGA
- This end of pin is inserted into socket

**Socket**
- Pin inserts into dual beam contact
- J-lead solders to PCB
- Socket contacts are captured in three layers of laminate.
- Bottom layer holds contact barrel and serves as main structural body of socket.
- Center layer is drilled at a larger diameter to allow contact beams to move.
- Thin top layer serves as a guide when inserting pin field

- Pins are inserted into two layers of laminate and planarized.
- Bottom layer is drilled at same diameter as pin to provide interference fit.
- Top layer is drilled at larger diameter to provide clearance for solder joint.

Note: Drawings shown are for reference only. ISI manufactures with different materials, dimensions, etc. to suit various applications. Please consult ISI for accurate drawings for your application.
Connectors: HiLo™ Interconnects

HiLo™ Cross Section - BGA Socketing Application

- Solder ball forms joint around pin tip.
- Pin inserted into dual beam contact. (Gold to Gold contact)
- Nickel plating in inside of barrel prevents solder from wicking up contact.
- J-Lead soldered to motherboard. (J cut off in cross-section)

PRODUCT INFORMATION

Motherboard

Gold to Gold contact

J-Lead soldered to motherboard

Nickel plating in inside of barrel prevents solder from wicking up contact

Solder ball forms joint around pin tip

Pin inserted into dual beam contact. (Gold to Gold contact)
Cross Section Samples Indicate:

- Good alignment of socket ‘J’ lead to PCB pad
- Uniform wetting of solder
Optimize interconnect for your application without increasing cost or lead-time

- Any Pitch (& Mixed Pitch!)
- Any Pattern
- 2500+ Positions
- Mounting hardware and alignment features available
APPLICATIONS

ISI HiLo Connectors
APPLICATION – IC SOCKETING

Challenge

An OEM wants to make certain components Field Replaceable Units:

- High pin count ASIC
- Optical Module

ISI Solution: HiLo Flexible Interconnect System

- Socket solders to existing SMT footprint
- Suitable for high speed applications
- Does not require mounting holes or backer plates
- Laminate construction provides advantages in assembly process and reliability
- Low profile design allows room for heatsink
- Alignment features and mechanical retention features can be added as required
## Challenge

You do not want to commit expensive FPGAs to your prototype and development boards.

## ISI Solution: HiLo FPGA Socketing

- ISI has standard designs for all 1mm pitch FPGA BGA packages, up to 1932 I/O
- Socket can be soldered to existing footprint on motherboard
- Allows customers to utilize footprint compatible products within FPGA product family
- Reduces development costs by re-using expensive FPGAs
IC Socketing

In this application, the pin field is typically soldered directly to the IC, and the socket is soldered to the motherboard.

- Ball Grid Array (BGA) Socket – standard product line for FPGAs from Xilinx, Altera, Actel
- Land Grid Array (LGA) Socket
- Ceramic Column Grid Array (CCGA) Socket
- Micro Pin Grid Array (μPGA, mPGA) Socket for Intel & AMD devices (ISI pin field not required)

**APPLICATION – IC SOCKETING**

**Step 1:** IC soldered to HiLo Pin Field to create ‘MicroPGA’

**Step 2:** Socket soldered to motherboard

**Step 3:** IC + Pin Field inserted into Socket
### APPLICATION – IC SOCKETING

HiLo™ Standard Products for FPGA BGA Packages – for the list online, [click here](#).

<table>
<thead>
<tr>
<th>Pin Count</th>
<th>Socket Part #</th>
<th>Pin Field Part #</th>
<th>Actel</th>
<th>Altera</th>
<th>Intel</th>
<th>Quick Logic</th>
<th>Lattice</th>
<th>Xilinx</th>
<th>Package Reference</th>
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**APPLICATION - 3D MODULE INTERCONNECT**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>ISI Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit a complex, multi-component circuit into a small cylindrical space.</td>
<td>Custom circular high density connector designed to facilitate stacking of round PCBs. Board-to-board spacing optimized at each level by utilizing various connector pin lengths.</td>
</tr>
</tbody>
</table>
Challenge

Replace a standard microprocessor with a high performance FPGA plus memory to accelerate computing-intensive algorithms while reducing power consumption.

ISI Solution

A high density module and custom microPGA connector were designed and assembled to enable the module to be inserted into standard ZIF socket in a multi-processor server.
Board-to-Board Interconnect

In this application, the socket is typically soldered to the motherboard, and the pin field is soldered to a second PCB or substrate. Applications include:

- Mezzanine Boards
- Daughter Cards
- Modules
- Interposers

Board-to-board spacing can be changed by increasing pin length and pin carrier thickness.
APPLICATION INFORMATION

ISI offers a family of removal tools that can be used with HiLo™ BGA socketing systems

1. Adjust tool to proper width with three adjustment screws

2. ‘Hook’ end of tool under pin field

3. Press on edges of tool to extract pinned IC

P/N E00001-2: 2-sided tool with minimum keepout requirement. Recommended for HiLo™ systems up to 700 positions

P/N E00002-2: 2-sided tool. Recommended for HiLo™ systems with 700 to 1200 positions

P/N E00004-2: 4-sided tool. Recommended for HiLo™ systems with over 1200 positions, or over 45mm in size
## ADDITIONAL DOCUMENTATION

Available upon request:

### HiLo Signal Integrity Test Report
Customer test report for 0.8 and 1 mm pitch HiLo evaluation board.

### Socket Assembly Guideline
Provides PCB and stencil design guidelines for HiLo socket assembly.

### Qualification Data / Reliability Testing (Contech Research)
Performance qualification testing performed to EIA 364 and MIL-STD-1344 connector standards

<table>
<thead>
<tr>
<th>Test Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Level Circuit Resistance (LLCR)</td>
<td>Durability</td>
</tr>
<tr>
<td>Vibration</td>
<td>Normal Force</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>Gas Tightness (separate report)</td>
</tr>
<tr>
<td>Insulation Resistance (IR)</td>
<td><strong>Mixed Flowing Gas (separate report)</strong></td>
</tr>
<tr>
<td>Dielectric Withstanding Voltage (DWR)</td>
<td>Current Carrying Capacity</td>
</tr>
<tr>
<td>Thermal Shock</td>
<td>Characteristic Impedance</td>
</tr>
<tr>
<td>Humidity (Thermal Cycling)</td>
<td>Voltage Standing Wave Ratio (VSWR)</td>
</tr>
<tr>
<td>Engagement and Separation Force</td>
<td>Propagation Delay Via Time Domain Transmission (TDT)</td>
</tr>
<tr>
<td>Mating and Unmating Force</td>
<td>Crosstalk Via Network Analysis (Frequency Domain)</td>
</tr>
<tr>
<td>Thermal Aging</td>
<td>Loop Inductance</td>
</tr>
</tbody>
</table>
ISI’s HiLo™ system was selected as the exclusive interconnect for the supercomputer that involved nearly 21 million contacts per system.

<table>
<thead>
<tr>
<th>Product</th>
<th>Products per Board</th>
<th>Boards per System</th>
<th>Products per System</th>
<th>Contacts per System</th>
</tr>
</thead>
<tbody>
<tr>
<td>HiLo Pin Field, 540 Position</td>
<td>35</td>
<td>272</td>
<td>9,520</td>
<td>5,140,800</td>
</tr>
<tr>
<td>HiLo Socket, 540 Position</td>
<td>35</td>
<td>272</td>
<td>9,520</td>
<td>5,140,800</td>
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<tr>
<td>HiLo Pin Field, 630 Position</td>
<td>23</td>
<td>272</td>
<td>6,256</td>
<td>3,941,280</td>
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<tr>
<td>HiLo Socket, 600 Position</td>
<td>23</td>
<td>272</td>
<td>6,256</td>
<td>3,941,280</td>
</tr>
<tr>
<td>Board to Board, 141 Position</td>
<td>34</td>
<td>272</td>
<td>9,248</td>
<td>1,303,968</td>
</tr>
<tr>
<td>HiLo Socket, 141 Position</td>
<td>34</td>
<td>272</td>
<td>9,248</td>
<td>1,303,968</td>
</tr>
<tr>
<td>Leaded Carrier, 8 leads, 7 pins</td>
<td>51</td>
<td>272</td>
<td>13,872</td>
<td>208,080</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>235</strong></td>
<td><strong>272</strong></td>
<td><strong>63,920</strong></td>
<td><strong>20,980,176</strong></td>
</tr>
</tbody>
</table>
THE ISI DIFFERENCE

- ISI’s revolutionary HiLo connector system uses standard materials and processes to create a connector with a pinout optimized for your system.

- This ‘design freedom’ allows system architects to increase density, performance, and modularity in next-generation products.

- ISI HiLo and custom board-to-board interconnect products are currently qualified for use in many defense and high-reliability applications.

- HiLo is priced competitively with area-array connectors in the industry.
THANK YOU!
Contact ISI to engage on your next project:

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