Heterogeneous Assembly

Medical and biotech devices often include optical, chemical, RF and liquid elements. Some are combined with electronic devices to increase functionality or interaction with the environment. To produce these devices, multiple technologies are combined in a cost-effective way, ideally using a rapid process development cycle to minimize time to market.

Combining technologies, as well as combining components with electronics, requires improved design methods and software, involves more material properties, longer supply chains and a sophisticated manufacturing process known as heterogeneous assembly.

Heterogeneous assembly often starts with a conventional SMT process. The resulting subassembly can be used as a platform on which standard or custom die are attached and connected. If required, specialized parts are added.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>CHALLENGE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimode Optical Fiber</td>
<td>Alignment to ± 5.0 microns</td>
<td>Good fiducials, high-accuracy equipment, good joint design</td>
</tr>
<tr>
<td>Single-Mode Optical Fiber(s)</td>
<td>Alignment to ± 0.5 microns</td>
<td>Use high-accuracy parts and self-aligning joints</td>
</tr>
<tr>
<td>Megapixel Image Sensor</td>
<td>Minimize dust particles</td>
<td>Assemble in cleanroom</td>
</tr>
<tr>
<td>Temperature-Sensitive Part</td>
<td>CTE mismatch &amp; warpage</td>
<td>Develop low-temperature joining processes</td>
</tr>
<tr>
<td>Fluid Channel</td>
<td>Sealing against leaks</td>
<td>Use well-designed joint and joining methods</td>
</tr>
<tr>
<td>Glass Component</td>
<td>Difficult for vision systems to recognize</td>
<td>Careful selection of equipment, optics and lighting</td>
</tr>
<tr>
<td>Indium Phosphide Die</td>
<td>Fragile die sensitive to the environment</td>
<td>Careful handling and sealing to prevent exposure to fluids and gases</td>
</tr>
</tbody>
</table>

Here’s how Promex meets your assembly requirements:

- Engineer a custom assembly process
- Utilize as many as 50 different assembly processes and a wide variety of components
- Source components from multiple vendors, maintain part traceability requirements and quality standards
- Modify equipment, fixtures and processes for economical builds – even for small runs
- Assemble parts such as optical components and lasers with micron accuracy
- Seal interfaces to prevent fluid leakage when fluids could harm the device/user/environment, or the sample for analysis is small
- Reduce maximum assembly temperature to below 240°C – sometimes to as low as 40°C
- Use information systems to track, monitor, gather, store and report data
- Complex packaging capabilities (stacking die, flip chip, SiP, etc.)
- Class 100 and Class 1000 Cleanrooms
- In collaboration, we develop the PFMEA, Quality Control Plan along with IQ, OQ, PQ quality documents
1. Subassembly Using SMT Process

Material Options:
- PCB
- Flex Circuit
- Thin Film Ceramic
- Thick Film Ceramic

Process Options:
- Solder Dispense
- needle Machine Dispense
- Jet Print
- Manual Dispense

2. Wafer Processing Through Die Attach & Wire Bond/Flip Chip Flow

(Illustration of subassembly used as a platform on which die, processed from (often custom) semiconductor wafers, are attached and connected)

Material Options:
- Wafer 300 mm or less
- Laminate DAF
- Saw

Material Options:
- Non-Conductive Electrically Conductive Thermally Conductive

Material Options:
- Au/Sn
- solder Paste
- Non-Conductive Epoxy
- Thermally Conductive Epoxy
- Electrically Conductive Epoxy

Material Options:
- Lead Frame
- PCB
- Thin Film on Ceramic
- Thick Film on Ceramic

Material Options:
- Argon
- Oxygen

Material Options:
- Opaque Epoxy
- Transparent Acrylate

Material Options:
- Au wire, 0.7 to 2.0 mils
- Al wire, 0.7 to 2.0 mils

Material Options:
- AuSn
- solder Paste
- Non-Conductive Epoxy
- Thermally Conductive Epoxy
- Electrically Conductive Epoxy

Material Options:
- DAF Flow
- Flow Common to Both
- Bumped Wafers for Flip Chip

Process Options:
- Single Pass
- Double Pass
- Two Sided

Process Options:
- Manual
- Semi Automatic
- Automatic

Process Options:
- Dispense Stamp Preform

Process Options:
- Oven
- UV Vacuum

Process Options:
- Thermosonic 40˚ to 140˚C
- 20˚C Ultrasonic

Process Options:
- Oven
- UV Cure

LEGEND

- Conventional Die Attach Flow
- DAF Flow
- Flow Common to Both
- Bumped Wafers for Flip Chip

3. Specialized Part Placement & Attach

Specialized Part or Function

- Fluid Seals
- Glass Part
- Optical Filter
- MEMs Device
- Mechanical Mounts
- Image Sensor
- Single Mode Optical Fiber
- Heatsink
- TIM

Specialized Process Requirements

- Vision System able to “see” Optically
- Transparent parts
- Fiducials, tight tolerances, odd shape, strong joints
- Cleaning, Class 100
- Particle control
- Location in 5 dimensions to <1 micron, <1° accuracy

From Wafer Processing Through Die Attach & Wire Bond/Flip Chip Flow

Specialized Part Placement & Attach

Final Test

To Additional Special Processing
### Assembly Processes

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>VARIATIONS&lt;sup&gt;1&lt;/sup&gt;</th>
<th>SPECIALIZED&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| SMT Placement | • Flexible and rigid-flex  
• “Odd” form factor  
• .01005 and smaller parts  
• CSPs  
• Panelization of singulated parts | • Place odd form factor parts  
• Place labels |
| Reflow | • Programmable temperature profile  
(belt & chamber oven)  
• Aqueous or no-clean flux/solder paste | • Vacuum reflow  
• Formic acid  
• Reducing gas environment |
| Backgrind | • Silicon wafers up to 300 mm  
• Mirror finish  
• Down to 30 µm  
• Molded packages / organic laminates | • Thick materials up to 5 mm  
• Individual dies / partial wafer |
| Saw | • Wafers up to 300 mm  
• Wafers with DAF  
• Dice before grind  
• Silicon, glass, ceramics, organics  
• Molded laminates | • Thick materials up to 5 mm  
• Individual dies / partial wafer  
• Multi-project wafer |
| Wire Bond | • Au wire, 0.6 to 2.0 mils  
• Al wire | • Low temp: 40° C (Au) |
| Die Attach | • Epoxy dispense (conductive & nonconductive)  
• DAF  
• AuSn eutectic  
• Solder paste | • Large die, > 225 mm  
• High aspect ratio die  
• Thin die (<100 µm)  
• Sintered Ag |
| Flip Chip | • Microbump flip chip, bond  
• Thermocompression bonding of thousands of I/Os, bumps or pillars  
• Au stud bump | • Low temp underfill (<80° C) |
| Encapsulation & Adhesive Dispense | • Standard epoxies  
• UV epoxies  
• High-precision ultrafine geometries | • Low-temp cure epoxies (<80° C)  
• Transparent encapsulant  
• Precision, controlled location  
• Unique shapes |
| Marking (Part numbers & logos) | • Ink marking  
• Laser marking and serializing  
• Custom labels | |

<sup>1</sup> Standard process sequences and materials with customized fixtures, temperatures and environments.  
<sup>2</sup> Specialized processes, equipment, materials and assembly sequences.

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Promex specializes in innovative IC packaging and heterogeneous assembly solutions for medical device development, biotech microfluidic device design, and a wide range of semiconductor, industrial and commercial applications. Located in Silicon Valley since 1975, Promex provides onsite engineering development, RoHS-optimized SMT, wafer thinning, dicing, wirebond, flip chip, overmolding and Class 100/Class 1000 cleanrooms.

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