Central Texas Electronics Association

PCB Manufacturing Technologies
Now and the Future

Presented by Bryan Fish
National Sales Manager

SOMACIS / Hallmark Circuits
Who am I.....

The first 15 years.... Sun Circuits, Employee number 7. “Grew up” with the shop and the technology, learned all aspects of engineering, manufacturing, and sales.

1995 Fine Line Printed Circuit Design: The next progression.... Fabrication and Assembly Sales Manager, exposed to the top PCB designers in the country, designing the future of networking: Extreme Networks, Foundry Networks, Bay Networks, Cisco. Established in house assembly capabilities, including BGA. Acquired by Flextronics 1997


2011 Streamline Circuits.... National Sales Manager Responsibilities included building a national sales rep network covering all of USA and Canada. Technical sales presentations, field FAE support

2013 SOMACIS – Hallmark Joined SOMACIS to expand USA and Canadian sales force, increase market exposure to parent company, Italian based SOMACIS.
Who is SOMACIS…

- For more than forty years, SOMACIS has been a dynamic company producing high-tech PCBs and delivering innovative solutions for the international markets.

- SOMACIS is a leading PCB manufacturer, with production plants in Italy, USA and China.

- SOMACIS is a worldwide partner supplying HDI, rigid, rigid-flex and flex PCBs for time critical and mass production requirements.

- Founded in 1972, SOMACIS is headquartered in Castelfidardo (AN), Italy, and has more than 750 employees worldwide.

- Seamless transitions between facilities, common equipment and technologies, single point of contact
Global presence

- SOMACIS USA Inc.
  - Hallmark Circuits Inc.
- SOMACIS SpA
- DSG PCB Co. Ltd.
  - SGHK Asia Ltd.

- Production / Sales sites
- Sales representations
A solution for each need

- SOMACIS SpA – Italy
  - Quick turn; prototypes to mid volumes
  - Rigid, flex and rigid-flex high-end PCBs
  - Design collaboration, co-engineering
  - R&D for future technologies
  - AS9100 Aerospace certified
- NadCap
  - Sales
  - Production plants
A solution for each need

- DSG – SOMACIS Dongguan, China
  - High-tech boards in mid and high volumes
  - 50 layers HDI capabilities
  - Rigid and rigid-flex boards
  - Heavy-copper boards (12oz)
  - AS9100 Aerospace certified
  - NadCap
A solution for each need

- Hallmark Circuits, Inc. (HCI) – USA
  - High-technology rigid PCB’s
  - Quick turn; prototypes and pre-production
  - AS9100 Aerospace certified
  - ITAR registered
  - NadCap
A complete range of solutions

- Telecom: 34%
- Aerospace & Defense: 24%
- Industrial: 16%
- Computer & IT: 7%
- Medical: 6%
- Automotive & Transport: 3%
- Various: 10%

About 50% supplied through EMS or trading companies
Somacis spa - Castelfidardo
Somacis spa - Manfredonia

- Milan
- Florence
- Rome

Sales
Production plant

Plant 2
MANFREDONIA

Plant 3
MANFREDONIA
DSG
(Dongguan SOMACIS Graphic)
DSG Facility - Overview
Company Profile

Company Name: DSG PCB Co. Ltd.

Location: Chashan, Dongguan City, China

Production start: April 2007

Products: RoHS Compliant Multilayer PCBs (from 6 up to 50 layers), HDI, SBU, Laser Drilling, Advanced Materials, Rigid-flex PCBs with Technology “Enabler” development

On campus living quarters

Employee recreation programs, Basketball, Badminton, Soccer, ETC.

2014 Honeywell Aerospace/Defense Supplier of the year recipient!!!
HCI
(Hallmark Circuits Inc)
Hallmark Circuits. Inc. (HCI)

• HCI specializes in high reliability PCB and quick turn prototype

• Acquired April 2012 as part of the SOMACIS group.

• ITAR and Flight hardware approved facility, AS9100, NadCap approved

• 6 Million Dollar upgrade after acquisition, new equipment, facility facelift
Milestones

• Established in 1970
• New facility in 1997
• 72,600 ft.$^2$ / 6,700 m$^2$
• ITAR registered
• UL file: E562014
• ISO 9001:2000
• AS9100:2009
• NadCap
• Acquired by SOMACIS 2012
HCI

Modern
Clean
Safe
Environmental Friendly

Best in class manufacturing
Technical Capabilities: The Industry Right Now And What’s Coming Soon!
## Capabilities

<table>
<thead>
<tr>
<th>SOMACIS</th>
<th>Standard</th>
<th>Advanced</th>
<th>Roadmap (2015)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>μm</td>
<td>mils</td>
<td>μm</td>
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<tr>
<td><strong>INNER LAYER</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tracks</td>
<td>50</td>
<td>2</td>
<td>25</td>
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<tr>
<td>Insulation</td>
<td>50</td>
<td>2</td>
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<tr>
<td><strong>OUTER LAYER</strong></td>
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<td>Tracks</td>
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<tr>
<td>Insulation</td>
<td>75</td>
<td>3</td>
<td>25</td>
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<tr>
<td><strong>LASER VIA PADS</strong></td>
<td></td>
<td></td>
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<tr>
<td>External</td>
<td>250</td>
<td>10</td>
<td>150</td>
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<tr>
<td>Internal</td>
<td>250</td>
<td>10</td>
<td>150</td>
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<tr>
<td><strong>MECHANICAL VIA PADS</strong></td>
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</tr>
<tr>
<td>External</td>
<td>450</td>
<td>18</td>
<td>300</td>
</tr>
<tr>
<td>Internal</td>
<td>400</td>
<td>16</td>
<td>250</td>
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<tr>
<td><strong>ASPECT RATIO</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Blind Vias</td>
<td>1:1</td>
<td>1:1</td>
<td>1:1.1</td>
</tr>
<tr>
<td>Through holes</td>
<td>11:1</td>
<td>18:1</td>
<td>30:1</td>
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<tr>
<td><strong>SOLDER GAP</strong></td>
<td>38</td>
<td>1,5</td>
<td>25</td>
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<td></td>
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<td>20</td>
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</table>
# Capabilities

<table>
<thead>
<tr>
<th>SOMACIS</th>
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</thead>
<tbody>
<tr>
<td><strong>MATERIAL</strong></td>
</tr>
<tr>
<td><strong>BURIED COMPONENTS</strong></td>
</tr>
</tbody>
</table>
Technical Changes:
It was the Industry of «Journeyman»
Now its Process & Technology
A Look at What’s Ahead
“The conventional manufacturing process has met its limitations; PCB manufacturers must keep up with an increasingly competitive and demanding market, pushing for lower costs, smaller and more functional circuits.

New equipment and technologies must emerge to enable the future advancement of electronics and printed circuit board manufacturing”.
Key Points: Technology Now vs. Coming

- Trace and Space: Current and Coming
  - Current Inner layers 2 x 2 Mils
  - Coming Inner layers <1 x <1 Mils
  - Current Outer layers 3 x 3 Mils
  - Coming Outer layers 1 x 1 Mils
The smaller the trace/space, the higher technology (blind/buried/microvia/ADVEL) the lower the yields:

<table>
<thead>
<tr>
<th>LW/LS in mils</th>
<th>Corresponding Yields</th>
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</thead>
<tbody>
<tr>
<td>3/3</td>
<td>70-98%</td>
</tr>
<tr>
<td>2/2</td>
<td>45-65%</td>
</tr>
<tr>
<td>&lt;2/2</td>
<td>10-40%</td>
</tr>
<tr>
<td>1/1</td>
<td>Single digit %</td>
</tr>
</tbody>
</table>

*eSurface Data*
Over etching is common in fine features and typically non-recoverable. Poor yields drive cost structures to unacceptable levels and unpredictable process/lead-times with many production restarts.

*eSurface Data
EQUIPMENT and TECHNOLOGIES!
Trace and Space

Additive Process

- New technology using micro etch process and no copper foil to start process. Results in Vertical trace side walls
- Utilizes mostly already existing equipment in most PCB factories
- Predictable results, very high yields, can be reworked
- Selective layers “use it only where you need it” saves on costs
- Perfect trace structure for RF/Microwave technologies
EQUIPMENT and TECHNOLOGIES!
Trace and Space

- 100% Laser direct imaging (LDI)
  - Inner layers
  - Outer layers
  - Solder mask
  - Accurate to 3um
  - 1 mil solder mask clearance
  - SMDP

Manufactured by Orbotech
$ 1Million Price tag
+ $100k Per year

By Eliminating Film:
- Eliminates repeating defects
- Reduces Tooling cost’s
- Reduces Labor cost’s
- Reproducible Quality
EQUIPMENT and TECHNOLOGIES!
Trace and Space

Orbotech Fusion 22 AOI with Onboard Verification
- Fast onboard verification
- Saves on Labor costs
- Consistent Quality
- Increases yields post Lamination
EQUIPMENT and TECHNOLOGIES!
Trace and Space

The Results:

Isola 370HR 17µm (.0007”) spacing

*eSurface Data
Key Points: Technology Now vs. Coming

• Trace and Space: Current and Coming
  • Current Inner layers 2 x 2 Mils
  • Coming Inner layers <1 x <1 Mils
  • Current Outer layers 3 x 3 Mils
  • Coming Outer layers 1 x 1 Mils

• Mechanical OTL Drill to pad: Current and Coming
  • Current Drill to Pad FHS + 10 Mils
  • Coming Drill to Pad FHS + 6 Mils

• Hole to Copper: Current and Coming
  • Current Hole to Copper 8 Mils
  • Coming Hole to Copper 6 Mils
EQUIPMENT and TECHNOLOGIES!
Hole to Copper and Drill Pad Size

First you Book it

“DORS”

Co Developed
By SOMACIS

Direct Optical Registration Systems

Precise Optical Lay-up, Alignment and Welding of Multilayers

The Direct Optical Registration System

- Optical alignment of multilayers
- Optical alignment of sequential lamination build up technology
- Three different processes take place in one unit; lay-up, layer to layer alignment and welding
- Eliminates the added tolerances associated with traditional pin lamination systems

The aligned multilayers are welded together utilizing the patented SmartWeld Technology welding system developed by DIS Inc.
EQUIPMENT and TECHNOLOGIES!
Hole to Copper and Drill Pad Size

First you Book it
Then you press it

LAUFFER
Lamination Press
- 22 opening
- Faster Cycle
- Decreases Warpage

Co Developed By SOMACIS
EQUIPMENT and TECHNOLOGIES!
Hole to Copper and Drill Pad Size

Next Generation
POSALUX
and
SCHMOLL
Drilling Machines:
• 2x as Fast as Current Technology
• Vision Location Technology
• Uses Fiducial Locators for Accurate Drill Locations

First you Book it
Then you press it
Then you Drill it
EQUIPMENT and TECHNOLOGIES!
Hole to Copper and Drill Pad Size

First you Book it
Then you press it
Then you Drill it
Then you clean it

EUROPLASMA
Plasma Desmear and Hole Wall Preparation
Critical to Microvia Prep
Key Points: Technology Now vs. Coming

• Aspect Ratio: Current and Coming
  • Current Aspect Ratio 12:1
  • Coming Aspect Ratio 30:1
EQUIPMENT and TECHNOLOGIES!
Advanced Aspect Ratio

“Million Dollar Dishwasher”

Horizontal Automated Electroless Line
Manufactured by Atotech
Pulse Plating Technology
Advances to 30:1 aspect Ratio
Key Points: Technology Now vs. Coming

- Aspect Ratio: Current and Coming
  - Current Aspect Ratio 12:1
  - Coming Aspect Ratio 30:1

- Laser Drill Pad: Current and Coming
  - Current Laser Drill Pad 10 Mils
  - Coming Laser Drill Pad 4 Mil
EQUIPMENT and TECHNOLOGIES!
Precision Vision Laser

• ESI 5335 Precision Vision Laser
• Fiducial Hole Location
• Up to 32,000 Vias Per Minute
• Cuts Laser Slots for RF Shielding
Key Points: Technology Now vs. Coming

- Aspect Ratio: Current and Coming
  • Current Aspect Ratio 12:1
  • Coming Aspect Ratio 30:1

- Laser Drill Pad: Current and Coming
  • Current Laser Drill Pad 10 Mils
  • Coming Laser Drill Pad 4 Mil

- Controlled Depth Drilling: Current and Coming
  • Current Tolerance 8 Mils
  • Coming Tolerance 1 Mil
EQUIPMENT and TECHNOLOGIES!
Control Depth Drilling and Back Drilling

Schmoll Mono Drills
Precision Vision Drilling
Controlled depth
Back Drilling

• Controlled depth within 1 mil tolerance
• Z-Axis plunge, then X –Y Route
  • Allows for Cavity back post lamination
• Exceptional depth accuracy for back drilling
EQUIPMENT and TECHNOLOGIES!
Control Depth Drilling and Back Drilling

**Typical Product**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hoz 0.125mm laminate</td>
</tr>
<tr>
<td>2</td>
<td>Hoz 0.1mm Prepreg</td>
</tr>
<tr>
<td>3</td>
<td>Hoz 0.125mm laminate</td>
</tr>
<tr>
<td>4</td>
<td>Hoz 0.2mm preneg</td>
</tr>
<tr>
<td>5</td>
<td>Hoz 0.125mm laminate</td>
</tr>
<tr>
<td>6</td>
<td>Hoz 0.2mm laminate</td>
</tr>
<tr>
<td>7</td>
<td>Hoz 0.1mm Prepreg</td>
</tr>
<tr>
<td>8</td>
<td>Hoz 0.15mm preneg</td>
</tr>
<tr>
<td>9</td>
<td>Hoz 0.05mm laminate</td>
</tr>
<tr>
<td>10</td>
<td>Hoz 0.1mm Prepreg</td>
</tr>
<tr>
<td>11</td>
<td>Hoz 0.2mm laminate</td>
</tr>
<tr>
<td>12</td>
<td>Hoz 0.1mm Prepreg</td>
</tr>
<tr>
<td>13</td>
<td>Hoz 0.125mm laminate</td>
</tr>
<tr>
<td>14</td>
<td>Hoz 0.2mm preneg</td>
</tr>
<tr>
<td>15</td>
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</tr>
<tr>
<td>16</td>
<td>Hoz 0.125mm laminate</td>
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<tr>
<td>17</td>
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</tr>
<tr>
<td>18</td>
<td>Hoz 0.1mm Prepreg</td>
</tr>
<tr>
<td>19</td>
<td>Hoz 0.125mm laminate</td>
</tr>
<tr>
<td>20</td>
<td>Hoz</td>
</tr>
</tbody>
</table>

- **Layer count:** 20L
- **Material:** Panasonic Meg 6
- **4mil line width**
- **Three type of thickness core**
- **.118mil thickness**
- **Back drilling from L20 to L7**
What Does The Future Look Like
Mechanical drilling

Microsection of multilayer board with standard and special designed PTH.

Microsection of multi-layer board with blind mechanical vias 1-2, 1-3 and 1-4
Ultra-fine mechanical drilling

75µm
3 Mils
human hair

50µm
2 Mils
BGA pitch 200 µm (.2mm BGA)

Layer 1
Pad diameter 4.5 Mils
Pad to Pad insulation 3.5 Mils
Holes diameter 3 Mils

Layer 2
Trace/Space 1.75/1.75 Mils
Pad diameter 4.5 Mils
Holes diameter 3 Mils

Layer 3
Trace/Space 1.75/1.75 Mils
Pad diameter 4.5 Mils
Holes diameter 3 Mils
HDI board - 28 Layer

28 Layers
MEG - 6
3 Sub Lam Cycles
2 Outer Lam Cycles
All Buried Vias Epoxy
Filled with MEG – 6
Prepreg 90% Fill
Minimum
3 sets Laser Copper
Filled Micro Vias
Zeta Lam Caps
HDI board - interposer

1-4-1, 12 x 12 mm, 60µm lines/spaces
Total blind holes 1128, 783 holes/cm²
Total buried holes 589, 409 holes/cm²
Signal and power bus bar (SAPBB)

Goal:
Advanced technology bus bar type solution for automotive applications. The circuit board will enable both power and signal distribution between key components of automotive power system. This technology, which is particularly interesting for electric cars, can also be applied to other markets, such as the aerospace and defense one.
The signal and power bus bar are realized with a rigid-flex printed circuit board including a special copper-aluminum metal layer, which is able to dissipate the significant heat generated by such power circuitry.
How to Select your Future Suppliers

What to Ask Yourself

• Are they 100% Laser Direct Imaging, Inner, and outer layers, and Solder mask?

• Are they investing in new plating technologies

• Is their drilling equipment modern with vision capabilities, and how are the stacking inner layers for lamination? (DORS)

• Are they financially stable!
Thanks!!

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