Intelligent Printed Circuit Boards for innovative LED products
HSMtec - Complete your LED visions

Intelligent Printed Circuit Board technology for innovative LED luminaires
Be prepared for the future of LED lighting

Highest LED power, intelligent lighting control, innovative optical design

- Optimised thermal performance for the highest LED power
- Electrical isolation up to 4kV integrated into the PCB
- Thick copper directly below the LED’s solderpads

Copper profiles and wires integrated into standard FR4 - PCBs enable

High Performance PCBs

- Integration of complex electronics within LED PCBs
- Multilayer boards including thermal management
- FR4 / copper guarantees highest reliability

Intelligent LED Lighting

- Individual orientation of single LEDs
- Innovative designs and mechanics
- Fully integrated thermal and electrical connections

3D - PCBs
Selective integration of thick copper into FR4-PCBs enables simple but effective thermal management.

Embedded copper parts for the highest thermal performance

Filled microvias ensures reliable soldering

Basic principles of HSMtec Thermal Management

- Direct connection of LED to thick copper
- Minimal board thickness
- Bespoke thermal concepts possible
- Well proven materials & processes
HSMtec provides best-in-class thermal performance compared to other thermal PCB solutions.

*Based on actual thermal measurement with T3ster. Heatsink directly attached to rearside of HSMtec PCB.
Thermal stress and temperature differences are a major source of defects for IMS Alu-MC-PCBs

Temperature cycling caused by
- Operation of LED luminaire
- Environmental conditions
- Switching / dimming

<table>
<thead>
<tr>
<th>Material</th>
<th>Expansion [ppm / K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>23</td>
</tr>
<tr>
<td>Copper</td>
<td>16</td>
</tr>
<tr>
<td>FR4</td>
<td>15 – 17</td>
</tr>
<tr>
<td>Ceramic LED</td>
<td>4 – 8</td>
</tr>
</tbody>
</table>

*Source: Osram OS

Root cause for most FAILURES of IMS / Alu-MC-PCB based luminaires
HSMtec enables optimal reliability & lifetime when compared to a typical Aluminium IMS / MC-PCB.

Shear force tests kindly provided by Osram OS have confirmed a high resistance of HSMtec LED PCBs to thermal stress.

Shear force as a % of the initial value

<table>
<thead>
<tr>
<th></th>
<th>0 = initial situation after soldering</th>
<th>1000 cycles</th>
<th>1500 cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSMtec / FR4</td>
<td>100%</td>
<td>80%</td>
<td>60%</td>
</tr>
<tr>
<td>MC - PCB</td>
<td>20%</td>
<td>40%</td>
<td>20%</td>
</tr>
<tr>
<td>IMS / MC-PCB</td>
<td>80%</td>
<td>40%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Data kindly provided by Osram OS.
HSMtec enables an optimal LED lifetime & reliability when compared to a typical Aluminium IMS / MC-PCB.

**Thermal cycle test - Results**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>FR4 copper PCB</th>
<th>Alu MC-PCB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 60°C</td>
<td>&gt; 8000*</td>
<td>3800</td>
</tr>
<tr>
<td>-40 - +85°C</td>
<td>&gt; 3000*</td>
<td>850</td>
</tr>
<tr>
<td>-40 + 125°C</td>
<td>&gt; 1500*</td>
<td>520</td>
</tr>
</tbody>
</table>

* Preliminary results after 6 months testing time / with tests on-going.

Data kindly provided by OSRAM Opto Semiconductors.
Optional integrated insulation layer for the highest dielectric strength and thermal conductivity

Optional: Up to 4 kV dielectric strength
directly integrated into the PCB

Rapid heat spreading
with embedded copper parts

Copper
FR4
Heatsink
HEAT Dissipation
**Application example 1: Multicolor high brightness LED module**

Multilayer PCBs enable flexible layout and optimized thermal performance.

- PCB with 33 LEDs each 2 W
- 4 different coloured LED chips individually controlled
- 4-Layer board achieves a flexible layout
- Selectively integrated thick copper for highest thermal performance

Up to 66W of LED Power
Application example 2: Ultra high power LED module

Thick copper below the LED supports high power LED arrays and Ultra High Brightness LEDs.

- 49 LEDs / 4.5W each per PCB
- Min. board thickness of 0.8 mm
- Selectively integrated copper directly below the LED
- Rapid heat spreading for max. thermal performance
- Maximum power for UHB-LEDs and LED arrays

100 – 225 W
Multi-dimensional PCBs enable flexible optics and innovative mechanics

3D Printed Circuit Boards

- Individual optical orientation of single LEDs
- Self-supporting stable mechanical structures
- Innovative design opportunities
HSMtec allows full integration of intelligent control electronics into the LED PCB

**Typical solution – 2 PCBs**

- IMS / MC-PCB for LEDs
- FR4 PCB for control electronics
- Flex-connection

**HSMtec solution**

- Fully integrated FR4 Control & LED PCB
  - Embedded copper profiles support selective thermal management
  - Multilayer boards enable a flexible electrical layout of intelligent control electronics
Rapid heat transfer within the board enables innovative thermal concepts

- Multi-dimensional technology supports the use of simple and cheap heatsinks for multiple LED clusters
- Fully integrated thermal and electrical connections within the 3D board

Embedded copper parts to enable
- Electrical connections
- Heat transfer
- Mechanical stability
Innovative PCB designs and mechanics enables advanced LED luminaires

**Street lighting**

- Mechanically stable PCB segments allow reduced additional cabling and assembly costs
- Simplified handling

*Pictures: Schreder Group*

**Camera lighting module**

- Flexible illumination of objects
- Adjustment of inclination angle for each individual PCB segment

*Pictures: Buechner Lichtsysteme*
Support from the first idea to the finished product

Haeusermann - Competence center for PCB thermal management for LED lighting

- Support throughout the whole design/concept phase
- Layout support and realisation
- Thermal measurement and analysis of your PCBs
- Assembled / 3D formed circuits (via partner assembly companies)
Haeusermann
Your business partner for……

HSM\textsuperscript{tec} ...Innovative
...Flexible
...Powerful

...to complete your VISION.
We are pleased to assist you throughout the whole design process

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