

92ML^(TM) StaCoolTM Laminates

92MLTM StaCool^(TM) thermally enhanced laminates and prepregs from Rogers Corporation are specifically engineered and manufactured to meet the demands of high power applications.

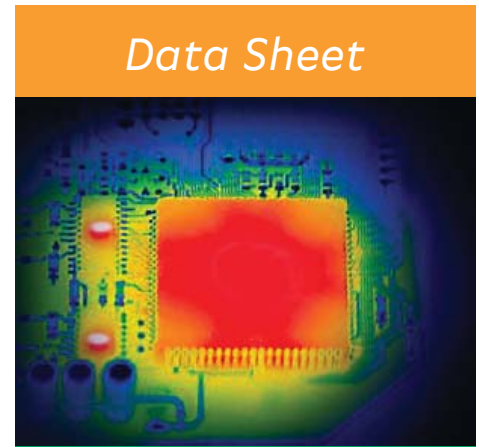
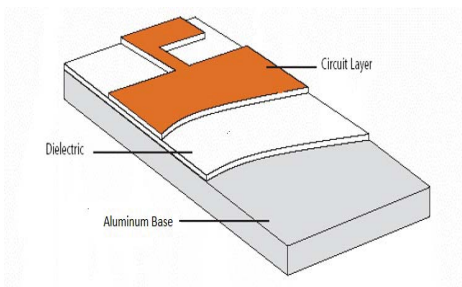
92ML materials are halogen-free, flame retardant, thermally conductive epoxy based prepregs and laminates. They provide a low-cost, lead-free solder compatible system with enhanced heat transfer characteristics.

The high thermal conductivity of up to 3.5 W/mK (in-plane) in combination with the relative ease and familiarity of epoxy based systems makes this material an ideal candidate for thermally challenging applications.

The relatively high Tg value of 160°C in combination with a low Z-axis coefficient of thermal expansion of 22ppm/°C (<Tg) and 175ppm/C (>Tg) ensure that the 92ML materials survive lead free solder exposures and board reliability testing.

92ML StaCool^(TM) laminates are 92ML laminates offered in combination with an aluminum plate to form an insulated metal substrate (IMS). In this configuration, the product has an integrated heat sink that can be machined and formed to serve as a mechanical chassis in the final application. This 92ML StaCool laminate is characterized as having a high level of thermally stable adhesion to the aluminum substrate. 92ML StaCool laminate withstands over 5 minutes of 288°C solder exposure enabling sufficient time for final product to be assembled without issues.

The 92ML StaCool laminates are available with up to 4oz copper cladding; thick enough to meet today's most demanding power distribution requirements. 92ML StaCool materials are useful in high power and high operating temperature applications such as LED modules, automotive lighting, power devices, etc.



Data Sheet

FEATURES AND BENEFITS:

Thermal Conductivity= 2.0 W/m-K, 6-10x that of FR-4

- Reduces Surface Temperature, Eliminates Hot-Spots and Improves Heat Sink Performance

High Tg 160°C, Td>350°C

- Compatible with Lead-Free Solder Processing

MOT>140°C (>3mils)
MOT>150°C (>4mils)

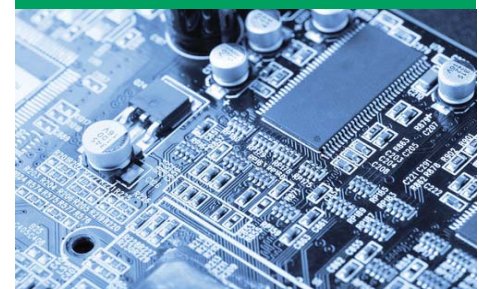
- Thermally Stable Laminate

UL-94 V-0, Halogen-free

- Environmentally Friendly Composition

TYPICAL APPLICATIONS:

- Motor Controllers
- Power Supplies
- Converters
- Automotive Electronics
- LED Modules
- Lighting



| Property | Typical Value 92ML | Direction | Units | Condition | Test Method |
|--|-----------------------|-----------|----------------------|--------------------|-------------------------|
| Thermal Properties | | | | | |
| Thermal Conductivity | 3.5 | X/Y | W/mK | | ASTM E1461 |
| | 2.0 | Z | | | |
| | 1.8 | Z | W/mK | | |
| Thermal Resistance | 0.4 | Z | K/W | 0.008" thickness | ASTM D5470-12 |
| Thermal Impedance | 0.07 | Z | K-in ² /W | 0.003" thickness | ASTM D5470-12 |
| Glass Transition Temperature (T _g) | 160 | | C | | IPC TM-650 2.4.25 |
| Decomposition Temperature, (T _d) | 400 | | C | 5% wt loss | IPC TM-650 2.3.41 |
| Maximum Operating Temperature | 140 | | C | 0.003" thickness | UL 746B |
| | 150 | | | 0.004" thickness | |
| Maximum Soldering Temperature | 20 | | Seconds | 288°C | UL 746E |
| Time-to-Delamination | >5 | | Minutes | 300°C | IPC TM-650 2.4.24.1 |
| Electrical Properties | | | | | |
| Dielectric Constant | 5.2 | Z | | 1MHz | IPC TM-650 2.5.5.3 |
| Dissipation Factor | 0.013 | Z | | 1MHz | IPC TM-650 2.5.5.3 |
| Volume Resistivity | 1.2x10 ⁹ | Z | Mohm-cm | 96hrs, 35°C, 90%RH | IPC TM-650 2.5.17.1a |
| Surface Resistivity | 2.8x10 ⁸ | Z | Mohms | 96hrs, 35°C, 90%RH | IPC TM-650 2.5.17.1a |
| Electrical Strength | >1000 | Z | V/mil | | IPC TM-650 2.5.6.2 |
| Breakdown Voltage | >50 | | kVAC | | IPC TM-650 2.5.6 |
| Mechanical Properties | | | | | |
| Peel Strength | 5.0 (0.88) | | lb/in (N/mm) | Condition B | IPC TM-650 2.4.8 |
| CTE (<T _g) | 19 | X/Y | ppm/C | | IPC TM-650 2.4.24 |
| | 22 | Z | | | |
| CTE (>T _g) | 175 | Z | ppm/C | | |
| Young's Modulus | 2.6 (18) | | Mpsi (Gpa) | | IPC TM-650 2.4.18.3 |
| Tensile Strength | 8.7 (60) | | kpsi (MPa) | | IPC TM-650 2.4.18.3 |
| Physical Properties | | | | | |
| Water Absorption | 0.12 | | % | | IPC TM-650 2.6.2.1 |
| Specific Gravity | 2.2 | | g/cm ³ | | ASTM D792 Method A |
| Agency Ratings | | | | | |
| UL Maximum Operating Temperature | 140 | | C | 0.003" thickness | UL 746B |
| | 150 | | | 0.004" thickness | |
| UL Flammability | V-0 | | class | | UL-94 |
| Comparative Tracking Index (CTI) | 0/600 | | | | ASTM D3638/ IEC60112 |
| Solder Limit Rating (CCL) | 20 | | Seconds | 288°C | UL 746E |
| Solder Limit Rating MCL | 30 | | Seconds | 300°C | UL 796 |

NOTE:
Typical values are a representation of an average value for the population of the property. For specification values contact Rogers Corporation.

92ML StaCool laminates are available in the following dielectric configurations:

| Laminate Type | Dielectric Thickness (inches) | Thickness Tolerance (inches) | Construction Code | Prepreg Type | | |
|---------------|-------------------------------|------------------------------|-------------------|--------------|---------|----------|
| | | | | 104 88% | 106 90% | 1080 85% |
| SC92 | 0.0030 | +/- 0.0007" | A | 1 | | |
| SC92 | 0.0040 | +/- 0.0007" | A | | 1 | |
| SC92 | 0.0060 | +/- 0.001" | A | | | 1 |
| SC92 | 0.0060 | +/- 0.001" | B | 2 | | |
| SC92 | 0.0080 | +/- 0.0015" | A | | 2 | |

92ML StaCool laminates are available with the following aluminum options:

| Clad Code | Alloy | Temper | Thickness, Inches | Thickness Tolerance, inches | Thermal Conductivity W/mK | Coefficient of Thermal Expansion, ppm/C | Density, g/cc | Modulus of Elasticity, Gpa | Ultimate Tensile Strength | | Tensile Yield Strength | | Brinell Hardness | Elongation % |
|-----------|-------|--------|-------------------|-----------------------------|---------------------------|---|---------------|----------------------------|---------------------------|-----|------------------------|-----|------------------|--------------|
| | | | | | | | | | MPa | KSI | MPa | KSI | | |
| AL1 | 6061 | T6 | 0.040 | +/-0.004 | 167 | 23.4 | 2.7 | 70 | 345 | 50 | 290 | 42 | 95 | 13 |
| | | | 0.059 | +/-0.006 | | | | | | | | | | |
| | | | 0.079 | +/-0.008 | | | | | | | | | | |
| AL2 | 5052 | H32 | 0.040 | +/-0.004 | 138 | 23.7 | 2.7 | 70 | 228 | 33 | 193 | 28 | 60 | 12 |
| | | | 0.059 | +/-0.006 | | | | | | | | | | |
| | | | 0.079 | +/-0.008 | | | | | | | | | | |

| Standard Thickness | Standard Panel Size | Standard Copper Cladding | Standard Aluminum Plate |
|---|---|---|--|
| See table above Other thicknesses may be available. Contact customer service for additional information. | 12" X 18" (305 X457 mm) 24" X 18" (610 X 457 mm) Contact customer service for additional panel sizes available. | 1 oz. (35µm) electrodeposited copper foil (H1) | 0.040" (1.0mm) 0.059" (1.5mm) 0.079" (2.0mm) 5052 and 6061 alloys |
| | | 2 oz. (70µm) electrodeposited copper foil (H2) | |
| | | 3 oz. (105µm) electrodeposited copper foil (H3) | |
| | | 4 oz. (140µm) electrodeposited copper foil (H4) | |

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