

# RO4835™ Laminate Data Sheet

## High Frequency Circuit Materials

Oxidation affects all thermoset laminate materials over time and temperature, including FR-4. In the long term, oxidation can lead to small increases in dielectric constant and dissipation factor of the circuit substrate. The rate of change and impact on circuit performance depends on design and operating temperature. For applications demanding greater stability at elevated temperatures Rogers has developed RO4835™ laminate, that is significantly more resistant to oxidation than other hydrocarbon based materials.\* Moreover, RO4835 material provides nearly identical electrical and mechanical properties to RO4350B™ laminates, which customers have used successfully for many years. As part of the RO4000® hydrocarbon ceramic laminate family, RO4835 laminates are designed to offer superior high frequency performance and low cost circuit fabrication. The result is a low loss material which can be fabricated using standard epoxy/glass (FR-4) processes offered at a competitive price.

The selection of laminates typically available to designers is significantly reduced once operational frequencies increase to 500 MHz and above. RO4000® material possesses the properties needed by designers of RF microwave circuits and matching networks and controlled impedance transmission lines. Low dielectric loss allows RO4000 series material to be used in many applications where higher operating frequencies limit the use of conventional circuit board laminates. RO4000 material's thermal coefficient of expansion (CTE) provides several key benefits to the circuit designer. The expansion coefficient of RO4000 material is similar to that of copper which allows the material to exhibit excellent dimensional stability, a property needed for mixed dielectric multi-layer board constructions. The low Z-axis CTE of RO4000 laminates provides reliable plated through-hole quality, even in severe thermal shock applications. RO4000 series material has a Tg of >280°C (536°F) so its expansion characteristics remain stable over the entire range of circuit processing temperatures.

RO4000 series laminates can easily be fabricated into printed circuit boards using standard FR-4 circuit board processing techniques. Unlike PTFE based high performance materials, RO4000 series laminates do not require specialized via preparation processes such as sodium etch. This material is a rigid, thermoset laminate that is capable of being processed by automated handling systems and scrubbing equipment used for copper surface preparation. RO4835 laminates utilize RoHS compliant flame-retardant technology for applications requiring UL 94V-0 certification. These materials conform to the requirements of IPC-4103, slash sheet /11.

\*Based on studies conducted by Rogers Corporation



### Data Sheet

#### FEATURES AND BENEFITS

**Significantly improved oxidation resistance compared to typical thermoset microwave materials**

- Designed for performance sensitive, high volume applications.

#### Low loss

- Excellent electrical performance allows application with higher operating frequencies.
- Ideal for automotive applications.

#### Tight dielectric constant tolerance

- Controlled impedance transmission lines

#### Lead-free process compatible

- No blistering or delamination

#### Low Z-axis expansion

- Reliable plated through holes

#### Low in-plane expansion coefficient

- Remains stable over an entire range of circuit processing temperatures

#### CAF resistant

#### TYPICAL APPLICATIONS:

- Automotive Radar and Sensors
- Point-to-point Microwave
- Power Amplifiers
- Phased - Array Radar
- RF Components



| Property  | Typical Value<br>RO4835 | Direction   | Units               | Condition   | Test Method  |
|---|-------------------------|-------------|---------------------|---|--|
| <sup>(1)</sup> Dielectric Constant, $\epsilon_r$<br>Process | 3.48 $\pm$ 0.05         | Z           | --                  | 10 GHz/23°C   | IPC-TM-650 2.5.5.5<br><sup>(2)</sup> Clamped Stripline |
| <sup>(2)</sup> Dielectric Constant, $\epsilon_r$<br>Design  | 3.66                    | Z           | --                  | 8 GHz-40 GHz  | Differential Phase Length<br>Method                    |
| Dissipation Factor tan, $\delta$                            | 0.0037                  | Z           | --                  | 10 GHz/23°C   | IPC-TM-650 2.5.5.5                                     |
| Thermal Coefficient of $\epsilon_r$                         | +50                     | Z           | ppm/°C              | -100°C to 250°C                                       | IPC-TM-650 2.5.5.5                                     |
| Volume Resistivity  | 10 <sup>10</sup>        |             | MΩ•cm               | COND A  | IPC-TM-650 2.5.17.1                                    |
| Surface Resistivity   | 10 <sup>9</sup>         |             | MΩ                  | COND A  | IPC-TM-650 2.5.17.1                                    |
| Electrical Strength   | 30.2 (755)              | Z           | KV/mm (V/mil)       |   | IPC-TM-650 2.5.6.2                                     |
| Tensile Modulus   | 7780 (1128)             | Y           | MPa (kpsi)          | RT  | ASTM D638  |
| Tensile Strength  | 136 (19.7)              | Y           | MPa (kpsi)          | RT  | ASTM D638  |
| Flexural Strength   | 186 (27)                |             | MPa (kpsi)          |   | IPC-TM-650 2.4.4                                       |
| Dimensional Stability                                       | <0.5                    | X,Y         | mm/m<br>(mils/inch) | after etch<br>+E2/150°C                               | IPC-TM-650 2.4.39A                                     |
| Coefficient of Thermal Expansion                            | 10<br>12<br>31          | X<br>Y<br>Z | ppm/°C              | -55 to 288°C  | IPC-TM-650 2.4.41                                      |
| Tg  | >280                    |             | °C TMA              | A   | IPC-TM-650 2.4.24.3                                    |
| Td  | 390                     |             | °C TGA              |   | ASTM D3850   |
| Thermal Conductivity  | 0.66                    |             | W/m/°K              | 80°C  | ASTM C518  |
| Moisture Absorption   | 0.05                    |             | %                   | 48 hrs immersion<br>0.060" sample<br>Temperature 50°C | ASTM D570  |
| Density   | 1.92                    |             | gm/cm <sup>3</sup>  | 23°C  | ASTM D792  |
| Copper Peel Strength  | 0.88 (5.0)              |             | N/mm (pli)          | after solder float<br>1 oz. EDC Foil                  | IPC-TM-650 2.4.8                                       |
| Flammability  | V-0                     |             |                     |   | UL 94  |
| Lead-Free Process Compatible                                | Yes                     |             |                     |   |  |

| Standard Thickness |                  | Standard Panel Size          | Standard Copper Cladding  |
|--------------------|------------------|------------------------------|---|
| ED Copper          | LoPro Copper     |                              |   |
| 0.0066" (0.168mm)  | 0.0040 (0.102mm) | 12" X 18" (305 X457 mm)      | ½ oz. (17µm) electrodeposited copper foil (5E/5E)                 |
| 0.0100" (0.254mm)  | 0.0073 (0.186mm) | 24" X 18" (610 X 457 mm)     | 1 oz. (35µm) electrodeposited copper foil (1E/1E)                 |
| 0.0133" (0.338mm)  | 0.0107 (0.272mm) | 24" X 36" (610 X 915 mm)     | 2 oz. (70µm) electrodeposited copper foil (2E/2E)                 |
| 0.0166" (0.422mm)  | 0.0140 (0.356mm) | 48" X 36" (1.224 m X 915 mm) |   |
| 0.0200" (0.508mm)  | 0.0173 (0.440mm) |                              | <b>For PIM Sensitive Applications and Reduced Conductor Loss:</b> |
| 0.0233" (0.591mm)  | 0.0207 (0.526mm) |                              | ½ oz. (17µm) LoPro™ Reverse Treated EDC (.5TC/.5TC)               |
| 0.0266" (0.676mm)  | 0.0240 (0.609mm) |                              | 1 oz. (35µm) LoPro Reverse Treated EDC (1TC/1TC)                  |
| 0.0300" (0.762mm)  | 0.0273 (0.694mm) |                              |   |
| 0.0600" (1.524mm)  | 0.0307 (0.780mm) |                              |   |
|                    | 0.0607 (1.542mm) |                              |   |

**NOTES:**

(1) The IPC clamped stripline method can potentially lower the actual dielectric constant due to presence of airgaps between the laminates under test and the resonator card. Dielectric constant in practice may be higher than the values listed.

(2) The design Dk is an average number from several different tested lots of material and on the most common thickness/s. If more detailed information is required, please contact Rogers Corporation. Refer to Rogers' technical paper "Dielectric Properties of High Frequency Material

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

Prolonged exposure in an oxidative environment may cause changes to the dielectric properties of hydrocarbon based materials. The rate of change increases at higher temperatures and is highly dependent on the circuit design. Although Rogers' high frequency materials have been used successfully in innumerable applications and reports of oxidation resulting in performance problems are extremely rare, Rogers recommends that the customer evaluate each material and design combination to determine fitness for use over the entire life of the end product.

The information in this data sheet is intended to assist you in designing with Rogers' circuit materials. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular purpose or that the results shown on this data sheet will be achieved by a user for a particular purpose. The user should determine the suitability of Rogers' circuit materials for each application.