

RF-35HTC High Thermal Conductivity Laminate

RF-35HTC is a non-reinforced, low loss, industry leading thermally conductive laminate. The high 1.84 watts/M*K thermal conductivity is well suited for any high-power application including amplifiers, couplers, dividers, filters etc. RF-35HTC is a ceramic/PTFE composite that is very low in PTFE content. The extremely low loss of 0.0007 at 10 GHz makes RF-35HTC very attractive for any high-power application.

The high thermal conductivity is beneficial for moving localized heat away from transistors, capacitors, conductors, other components, or the dielectric material. In hot environments exposed to oxygen, hydrocarbon (synthetic rubber) based composites are prone to oxidation and higher than expected electrical/thermal losses predicted from modeling. PTFE is attractive at the highest of temperatures because PTFE resists any thermal oxidation.

Uniform distribution of ceramic in the dielectric ensures a uniform dielectric in the X, Y, and Z directions. The low X and Y CTE ensures good performance of filters over temperature. The low Z axis expansion ensures stable performance of narrow band or broad band couplers over temperature and stable signal to ground plane dielectric thickness (stable impedance) over temperature. The low PTFE content of RF-35HTC facilitates plating and drilling in printed circuit board fabrication. The high concentration of ceramic contributes to improved dimensional stability. Taconic has avoided the use of alumina that is abrasive to mechanical drilling or routing.

Power handling experiments were conducted on microstrip transmission lines with and without various capacitors at the center of the microstrip to quantify the capability of the dielectric to spread thermal energy. The heat profile of the microstrip, both with and without a capacitor, and any hot spots was captured using a thermal camera. Transmitted power was increased to 200 Watts. Taconic's RF-35HTC was compared to Taconic's RF-35TC and RF-35TC-A, as well as to two available competitive materials. In every case, the RF-35HTC dielectric material outperformed all other materials in its ability to spread thermal energy, as shown on page 2.

RF-35HTC is compatible with all Taconic 1 oz copper with ULP 1 oz copper being recommended at high frequencies for the lowest insertion losses. Please consult with your technical sales manager about which coppers are most suitable for your applications when using 1/2 oz copper.

Benefits & Applications

- **Best in Class Thermal Conductivity**
 - **Low Loss Tangent**
 - **No Glass Reinforcement**
 - **Resists Thermal Oxidation**
 - **High Dimensional Stability**
-
- **High power applications such as filters, couplers, dividers & power amplifiers**
 - **Antennas**
 - **Satellites**

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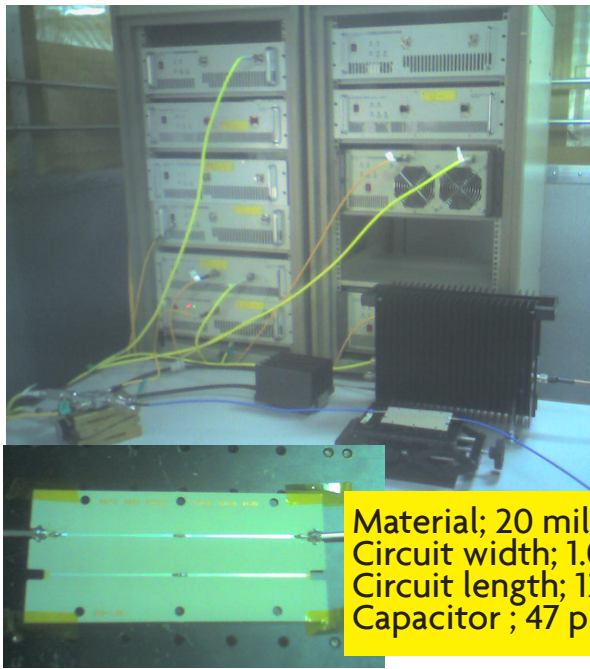
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An ISO 9001 Registered Company

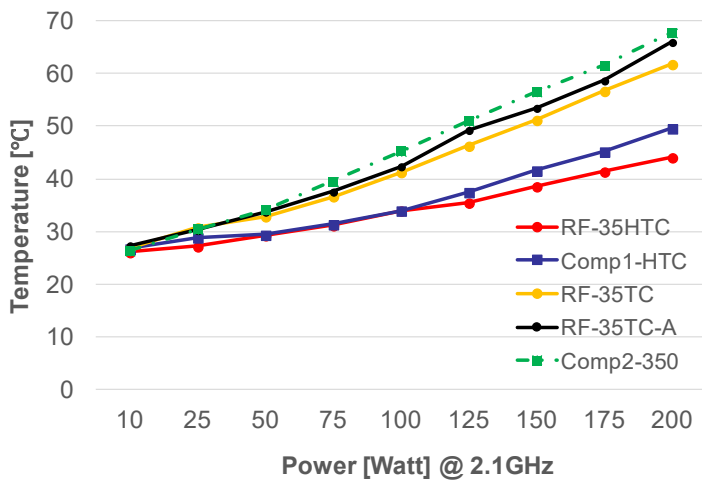
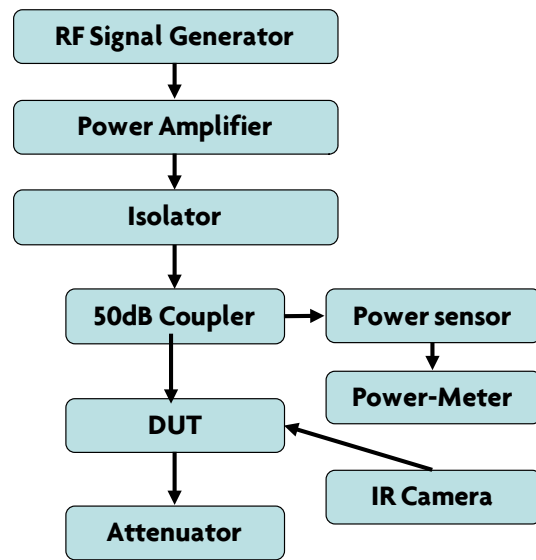
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Commercial and Government Entity (CAGE) Code: 1C6Q9

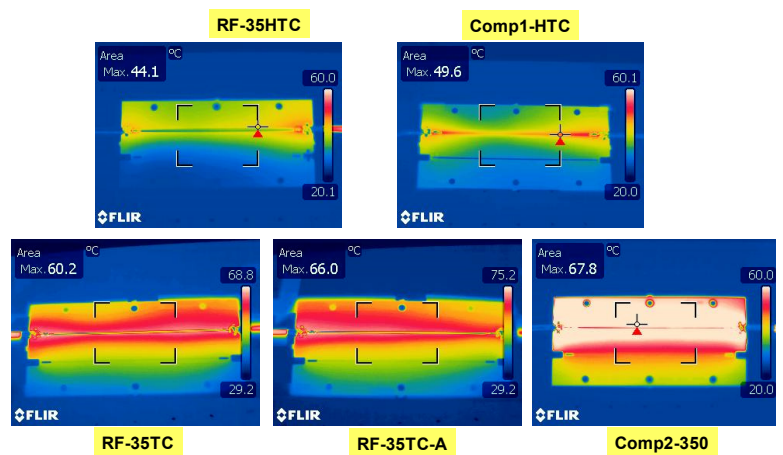
Power Handling Test Configuration for Various Laminate Materials



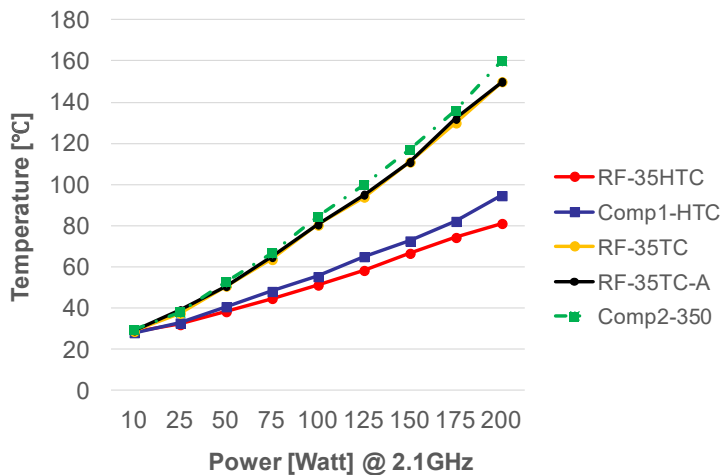
Material; 20 mil / 1 oz
 Circuit width; 1.08 mm
 Circuit length; 120 mm
 Capacitor ; 47 pF



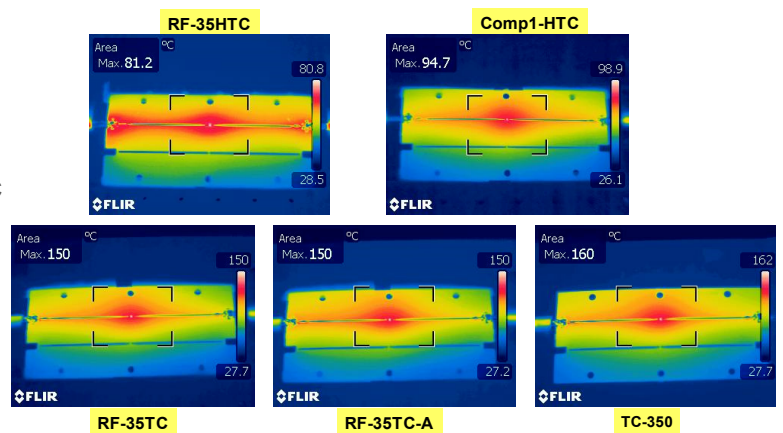
Power Handling of Microstrip Circuits Having No Capacitor (tin finished)



Thermal Camera Imaging of Microstrip Circuits, Tin Finished, No Capacitor (20 mil DT, 1oz Cu, 200 watts, 2.1 GHz)



Power Handling of Microstrip Circuits Containing a COG Grade 47 pF High Q Capacitor by Murata



Thermal Camera Imaging of Microstrip Circuits Having a 47 pF Murata Capacitor (20 mil DT, 1oz Cu, 2.1 GHz, 200 Watts)

RF-35HTC Typical Values

| Property | Test Method | Unit | Value | Unit | Value |
|----------------------------------|---|-------------------|-----------------------|-------------------|-----------------------|
| Dk @ 10 GHz (Bereskin) | IPC-650 2.5.36 | | 3.50 +/- 0.05 | | 3.50 +/- 0.05 |
| Df @ 10 GHz (Bereskin) | IPC-650 2.5.36 | | 0.0007 | | 0.0007 |
| T _c K (-55 to 100 °C) | IPC-650 2.5.5.5.1 | ppm | -19 | ppm | -19 |
| Dielectric Breakdown | IPC-650 2.5.6 (In-Plane, Two Pins in Oil) | kV | 42 | kV | 42 |
| Dielectric Strength | ASTM D 149 (Through Plane) | V/mil | 212 | kV/mm | 8.4 |
| Arc Resistance | IPC-650 2.5.1 | Seconds | ≥ 400 | Seconds | ≥ 400 |
| Flexural Strength (MD) | ASTM D 790 / IPC-650 2.4.4 | psi | 2670 | MPa | 18.4 |
| Flexural Strength (CD) | ASTM D 790 / IPC-650 2.4.4 | psi | 2560 | MPa | 17.7 |
| Tensile Strength (MD) | ASTM D 3039 / IPC-TM-650 2.4.19 | psi | 957 | MPa | 6.6 |
| Tensile Strength (CD) | ASTM D 3039 / IPC-TM-650 2.4.19 | psi | 899 | MPa | 6.2 |
| Elongation at Break (MD) | ASTM D 3039 / IPC-TM-650 2.4.19 | % | 4.1 | % | 4.1 |
| Elongation at Break (CD) | ASTM D 3039 / IPC-TM-650 2.4.19 | % | 9.9 | % | 9.9 |
| Young's Modulus (MD) | ASTM D 3039 / IPC-TM-650 2.4.19 | psi | 414,228 | MPa | 2856 |
| Young's Modulus (CD) | ASTM D 3039 / IPC-TM-650 2.4.19 | psi | 388,121 | MPa | 2676 |
| Poisson's Ratio (MD) | ASTM D 3039 / IPC-TM-650 2.4.19 | | 0.08 | | 0.08 |
| Poisson's Ratio (CD) | ASTM D 3039 / IPC-TM-650 2.4.19 | | 0.08 | | 0.08 |
| Compressive Modulus | ATSM D 695 (23 °C) | psi | 511,000 | MPa | 3523 |
| Flexural Modulus (MD) | ASTM D 790 / IPC-650 2.4.19 | psi | 418,000 | MPa | 2882 |
| Flexural Modulus (CD) | ASTM D 790 / IPC-650 2.4.19 | psi | 386,000 | MPa | 2661 |
| Peel Strength (1 oz. CL1) | IPC-650 2.4.8 (Thermal Stress) | lbs./inch | 6.17 | N/mm | 1.08 |
| Thermal Conductivity (unclad) | ASTM F433, ASTM E1461 (Laser Flash) | W/mK | 1.84 | W/mK | 1.84 |
| Thermal Conductivity (clad) | ASTM F433, ASTM E1461 (Laser Flash) | W/mK | 2.89 | W/mK | 2.89 |
| Moisture Absorption | IPC-650 2.6.2.1 | % | 0.07 | % | 0.07 |
| Dimensional Stability (MD) | IPC-650-2.4.39 Sec. 5.4 (After Etch) | mils/in. | -0.01 | mm/M | -0.01 |
| Dimensional Stability (CD) | IPC-650-2.4.39 Sec. 5.4 (After Etch) | mils/in. | -0.01 | mm/M | -0.01 |
| Dimensional Stability (MD) | IPC-650-2.4.39 Sec. 5.5 (Thermal Stress) | mils/in. | -0.05 | mm/M | -0.05 |
| Dimensional Stability (CD) | IPC-650-2.4.39 Sec. 5.5 (Thermal Stress) | mils/in. | -0.02 | mm/M | -0.02 |
| Surface Resistivity | IPC-650 2.5.17.1 (After elevated temp.) | Mohms | 7.2 x 10 ⁶ | Mohms | 7.2 x 10 ⁶ |
| Surface Resistivity | IPC-650 2.5.17.1 (After humidity) | Mohms | 1.3 x 10 ⁵ | Mohms | 1.3 x 10 ⁵ |
| Volume Resistivity | IPC-650 2.5.17.1 (After elevated temp.) | Mohms/cm | 1.7 x 10 ⁹ | Mohms/cm | 1.7 x 10 ⁹ |
| Volume Resistivity | IPC-650 2.5.17.1 (After humidity) | Mohms/cm | 2.9 x 10 ⁶ | Mohms/cm | 2.9 x 10 ⁶ |
| CTE (X axis) (23 to 125 °C) | IPC-650 2.4.41 / ASTM D 3386 | ppm/°C | 11 | ppm/°C | 11 |
| CTE (Y axis) (23 to 125 °C) | IPC-650 2.4.41 / ASTM D 3386 | ppm/°C | 14 | ppm/°C | 14 |
| CTE (Z axis) (23 to 125 °C) | IPC-650 2.4.41 / ASTM D 3386 | ppm/°C | 77 | ppm/°C | 77 |
| Density | ASTM D 792 | g/cm ³ | 2.28 | g/cm ³ | 2.28 |
| Hardness | ASTM D 2240 (Shore D) | | 60.2 | | 60.2 |
| Specific Heat | ASTM E 1269-5, E 967-08, E 968-02 | j/(g °C) | 0.982 | j/(g °C) | 0.982 |
| T _d (2% Wt. Loss) | IPC-650 2.4.24.6/TGA | °F | 975 | °C | 524 |
| T _d (5% Wt. Loss) | IPC-650 2.4.24.6/TGA | °F | 1011 | °C | 544 |

All reported values are typical and should not be used for specification purposes. In all instances, the user shall determine suitability in any given application.

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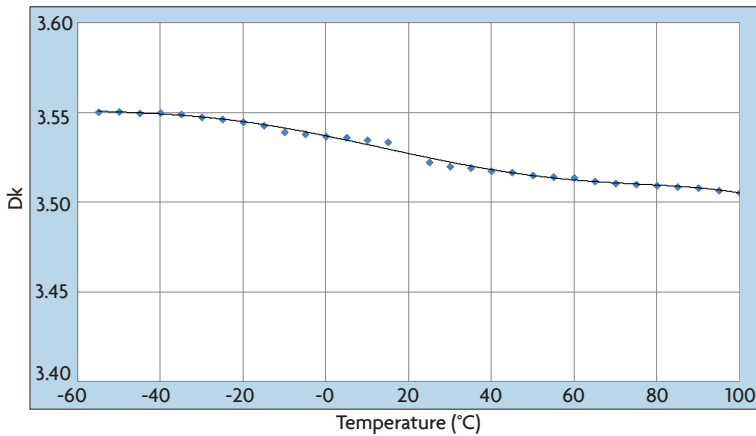
| Designation | Dielectric Constant |
|-------------|---------------------|
| RF-35HTC | 3.50 +/- 0.05 |

| Thickness Tolerance | | Thickness Availability | |
|---------------------|---------|------------------------|----------------|
| mil | mm | mil | mm |
| Class C | Class C | Incr. of 5 | Incr. of 0.127 |

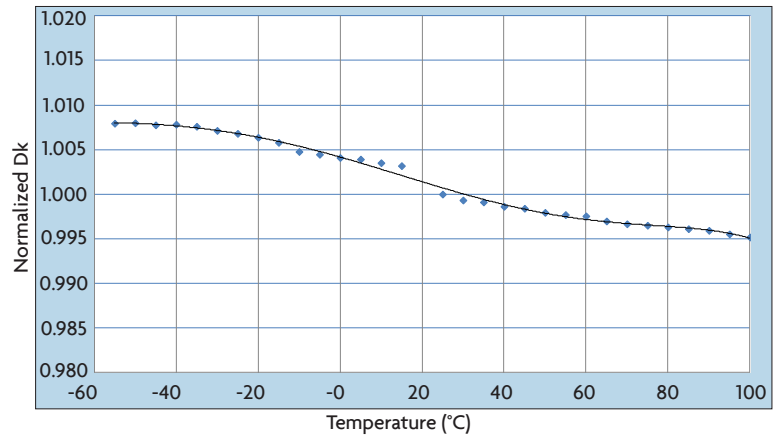
| Typical Thickness | |
|-----------------------|------------------|
| Inches | mm |
| .0050, 0.0100, 0.0200 | 0.13, 0.25, 0.51 |
| .0300, 0.0600, 0.0900 | .76, 1.52, 2.29 |

| Available Sheet Sizes | |
|-----------------------|------------|
| Inches | mm |
| 12 x 18 | 304 x 457 |
| 16 x 18 | 406 x 457 |
| 18 x 24 | 457 x 610 |
| 16 x 36 | 406 x 914 |
| 24 x 36 | 610 x 914 |
| 18 x 48 | 457 x 1220 |

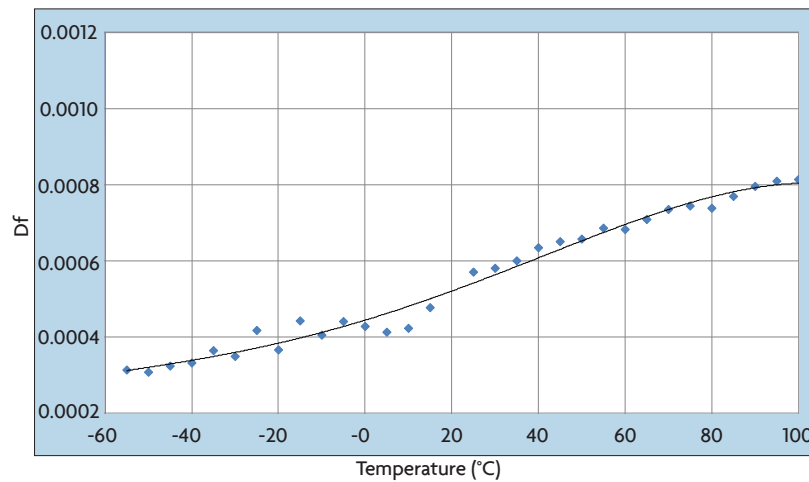
Please see our Product Selector Guide for information on available copper cladding.



Change in Dielectric Constant with Temperature



Normalized Dielectric Constant with Temperature



Change in Dissipation Factor with Temperature

An Example of our part number is: RF-35HTC-0300-C1/C1-18" x 24" (457 mm x 610 mm)