TACONIC
Finding a better way

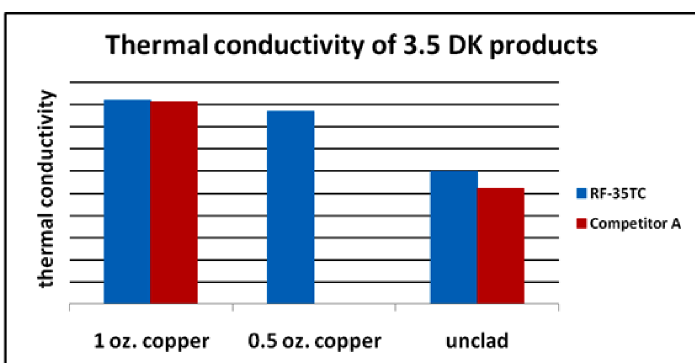
RF-35TC High Thermal Conductivity Low Loss Laminate

RF-35TC offers a "best in class" low dissipation factor with high thermal conductivity. This material is best suited for high power applications where every 1/10th of a dB is critical and the PWB substrate is expected to diffuse heat away from both transmission lines and surface mount components such as transistors. RF-35TC is a PTFE based, ceramic filled fiberglass substrate. It will not oxidize, yellow or show upward drift in dielectric constant and dissipation factor like its synthetic rubber (hydrocarbon) competitors.

The low Z axis CTE and temperature stable Dk are critical for both narrow band and broad band overlay couplers. The low X and Y CTE values are critical for maintaining critical distances between trace elements in a printed filter. The extremely low Df of 0.0011 and high thermal conductivity is particularly suited for power amplifier applications.

RF-35TC bonds very well to low profile copper, further reducing insertion loss.

Like most material properties, there are many techniques for measuring thermal conductivity. Thermal conductivity measured on an unclad sample (no copper) offers the true thermal conductivity of the laminate. Measurements on a copper clad laminate typically yield higher values as the copper clad laminate offers the least thermal resistance at the interface between the laminate and measuring equipment. When measured with or without copper cladding, RF-35TC has a state-of-the-art thermal conductivity. However, the low dissipation factor differentiates RF-35TC from the competition.



Benefits & Applications:

- "Best in Class" loss tangent
- Exceptional thermal management
- Dk stability across a broad temperature range
- Enhanced antenna gains/ efficiencies
- Excellent adhesion to Very Low Profile copper

- Filters, couplers & power amplifiers
- Antennas

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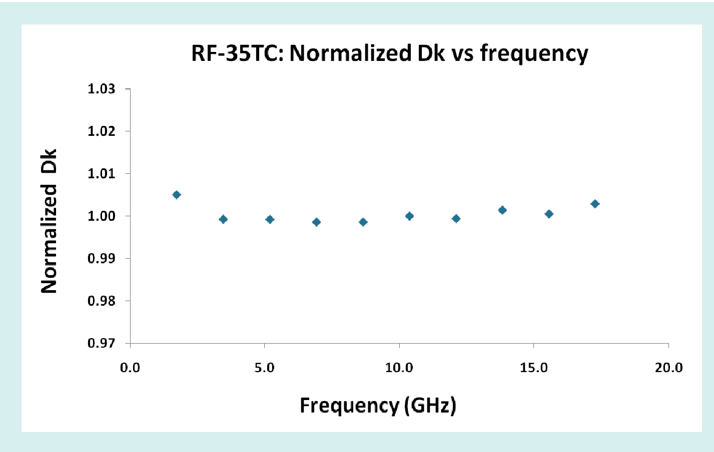
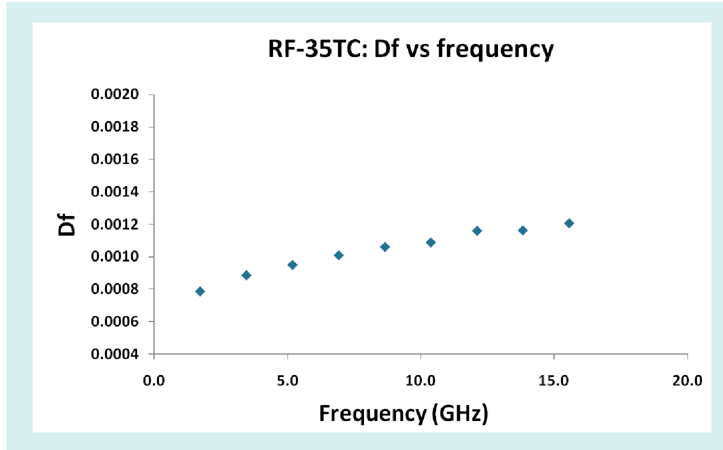
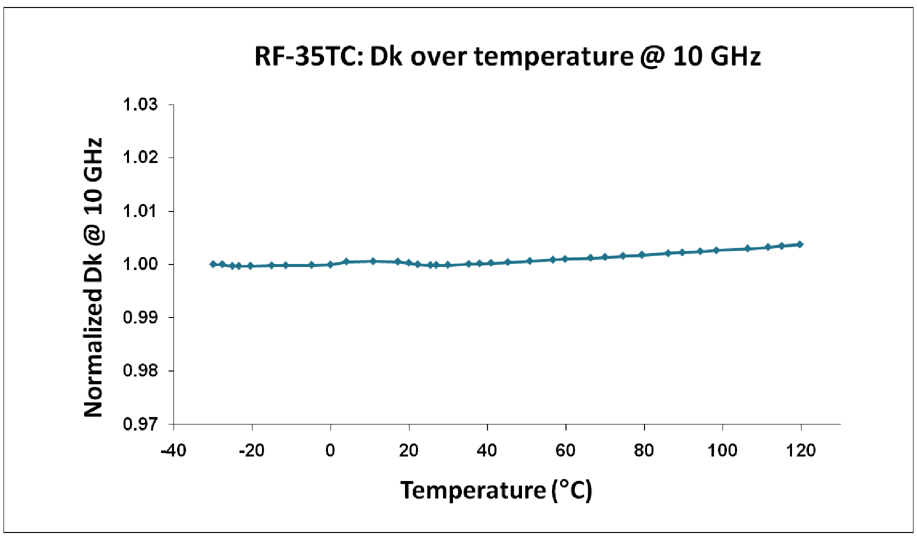
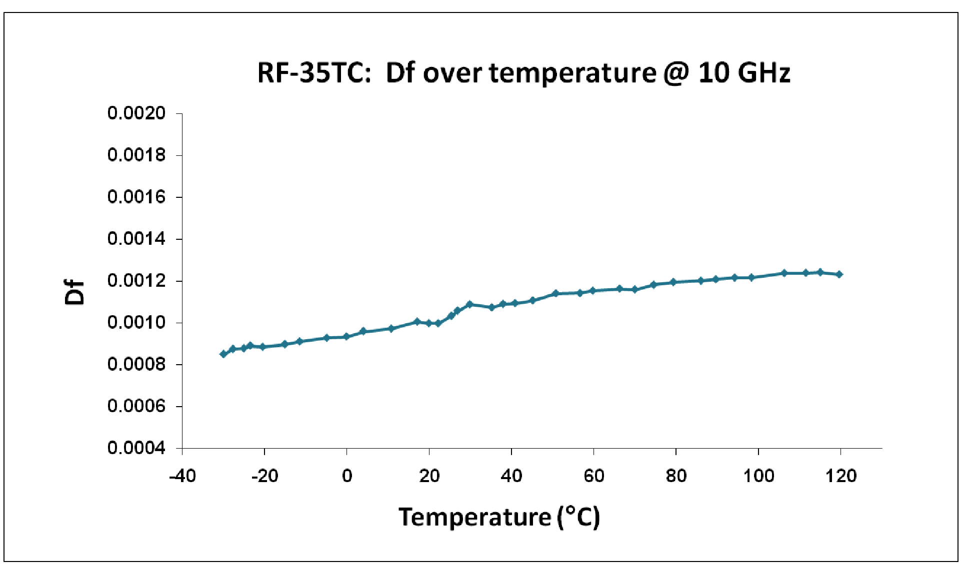








RF-35TC Typical Values					
Property	Test Method	Unit	Value	Unit	Value
Dk @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		3.50		3.50
Df @ 10 GHz	IPC-650 2.5.5.5.1 (Modified)		0.0011		0.0011
T_cK (-30 to 120 °C)	IPC-650 2.5.5.5.1 (Modified)	ppm	24	ppm	24
Moisture Absorption	IPC-650 2.6.2.1	%	0.05	%	0.05
Dielectric Breakdown	IPC-650 2.5.6 (In-Plane,Two Pins in Oil)	kV	56.7	kV	56.7
Dielectric Strength	ASTM D 149 (Through Plane)	V/mil	570	V/mm	22,441
Flexural Strength (MD)	ASTM D 790 / IPC-650 2.4.4	psi	12,900	N/mm^2	88.94
Flexural Strength (CD)	ASTM D 790 / IPC-650 2.4.4	psi	11,700	N/mm^2	80.67
Volume Resistivity	IPC-650 2.5.17.1 (After elevated temp.)	Mohms/cm	5.19×10^8	Mohms/cm	5.19×10^8
Volume Resistivity	IPC-650 2.5.17.1 (After humidity)	Mohms/cm	2.91×10^8	Mohms/cm	2.91×10^8
Surface Resistivity	IPC-650 2.5.17.1 (After elevated temp.)	Mohms	8.33×10^7	Mohms	8.33×10^7
Surface Resistivity	IPC-650 2.5.17.1 (After humidity)	Mohms	6.42×10^7	Mohms	6.42×10^7
Tensile Strength (MD)	ASTM D 3039 / IPC-TM-650 2.4.19	psi	9,020	N/mm^2	62.19
Tensile Strength (CD)	ASTM D 3039 / IPC-TM-650 2.4.19	psi	7,740	N/mm^2	53.37
Young's Modulus (MD)	ASTM D 3039 / IPC-TM-650 2.4.19	psi	667,000	N/mm^2	4,599
Young's Modulus (CD)	ASTM D 3039 / IPC-TM-650 2.4.19	psi	637,000	N/mm^2	4,392
Poisson's Ratio (MD)	ASTM D 3039 / IPC-TM-650 2.4.19		0.18		0.18
Poisson's Ratio (CD)	ASTM D 3039 / IPC-TM-650 2.4.19		0.18		0.18
Compressive Modulus	ASTM D 695 (23 °C)	psi	560,000	N/mm^2	3,861
Flexural Modulus (MD)	ASTM D 790 / IPC-650 2.4.4	psi	$1.46 x10^6$	N/mm^2	10,309
Flexural Modulus (CD)	ASTM D 790 / IPC-650 2.4.4	psi	1.50×10^6	N/mm^2	10,076
Strain at Break (MD)	ASTM D 790 / IPC-650 2.4.4	%	0.014	%	0.014
Strain at Break (CD)	ASTM D 790 / IPC-650 2.4.4	%	0.013	%	0.013
Elongation at Break (MD)	ASTM D 3039 / IPC-TM-650 2.4.19	%	1.89	%	1.89
Elongation at Break (CD)	ASTM D 3039 / IPC-TM-650 2.4.19	%	1.70	%	1.70
Density	ASTM D 792	g/cm^3	2.35	g/cm^3	2.35
T_d (2% Wt. Loss)	IPC-650 2.4.24.6/TGA	°F	788	°C	420
T_d (5% Wt. Loss)	IPC-650 2.4.24.6/TGA	°F	817	°C	436
Arc Resistance	IPC-650 2.5.1	Seconds	304	Seconds	304
Peel Strength (½ oz CVH)	IPC-650 2.4.8 (Thermal Stress)	lbs./inch	7	N/mm	1.25
Thermal Conductivity (Unclad, 125 °C)	ASTM F433 (Guarded Heat Flow)	W/(mK)	0.60	W/(mK)	0.60
Thermal Conductivity (C1/C1, 125 °C)	ASTM F433 (Guarded Heat Flow)	W/(mK)	0.92	W/(mK)	0.92
Thermal Conductivity (CH/CH, 125 °C)	ASTM F433 (Guarded Heat Flow)	W/(mK)	0.87	W/(mK)	0.87
Dimensional Stability (MD)	IPC-650-2.4.39 Sec. 5.4 (After Etch)	mils/in.	0.23	mm/M	0.23
Dimensional Stability (CD)	IPC-650-2.4.39 Sec. 5.4 (After Etch)	mils/in.	0.64	mm/M	0.64
Dimensional Stability (MD)	IPC-650-2.4.39 Sec. 5.5 (Thermal Stress)	mils/in.	-0.04	mm/M	-0.04
Dimensional Stability (CD)	IPC-650-2.4.39 Sec. 5.5 (Thermal Stress)	mils/in.	0.46	mm/M	0.46
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	13	ppm/°C	13
CTE (Z axis) (23 to 125 °C)	IPC-650 2.4.41 / ASTM D 3386	ppm/°C	34	ppm/°C	34
Density	ASTM D 792	g/cm^3	2.35	g/cm^3	2.35
Specific Heat	ASTM E 1269-05, E 967-08, E 968-02	j/(g °C)	0.940	j(g °C)	0.940
Hardness	ASTM D 2240 (Shore D)		79.1		79.1

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.

PTFE Composites vs. Rubber (Hydrocarbon) Composites:

A primary difference between PTFE-based composites and rubber based (hydrocarbon) substrates is PTFE is oxidation resistant. PTFE starts to degrade near 600 °C when the carbon-fluorine bond starts to fail. PTFE is a thermoplastic and does not have unreactive chemistry after processing. Rubbers, however, cure by a thermosetting mechanism and never cure to completion, thus leaving some level of unreacted chemistry. Rubber substrates are not temperature stable or oxidation resistant which causes these materials to turn yellow and then black with air/heat. Automotive rubber is typically sulfur cured and contains a high level of carbon black. These additives cannot be used in laminates due to their poor electrical properties.

Laminate suppliers cannot use the same strategies as the automotive industry to stabilize their rubber. This leaves the rubber (hydrocarbon) products susceptible to temperature driven oxidation (a time and temperature-based phenomenon). Oxidation, diffusion, stress relaxation and any process that is temperature related generally follows an Arrhenius relationship where the rate of oxidation doubles with every ten degree rise. Rubber oxidation is no exception; with exposure to temperature and air, rubbers oxidize, embrittle and their elongation and peel strength decrease while their dielectric constant and dissipation factor increase.

Figure 1

Dk Changes According to Aging Time (1,000 hrs.)

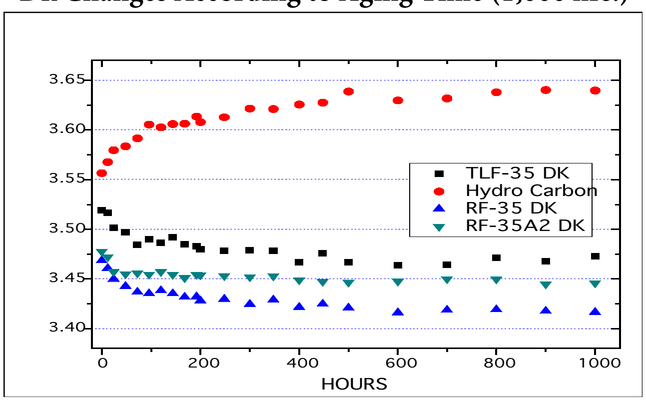
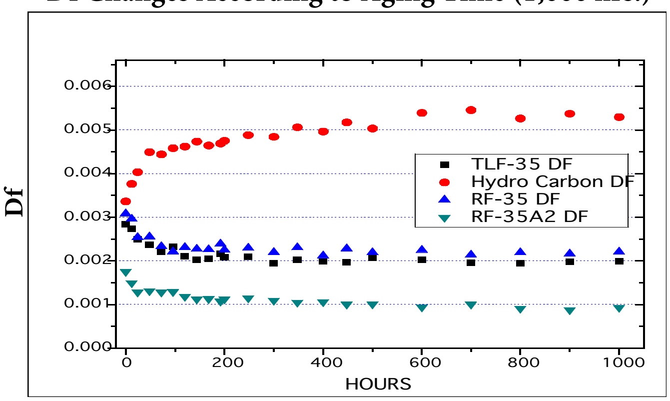


Figure 2

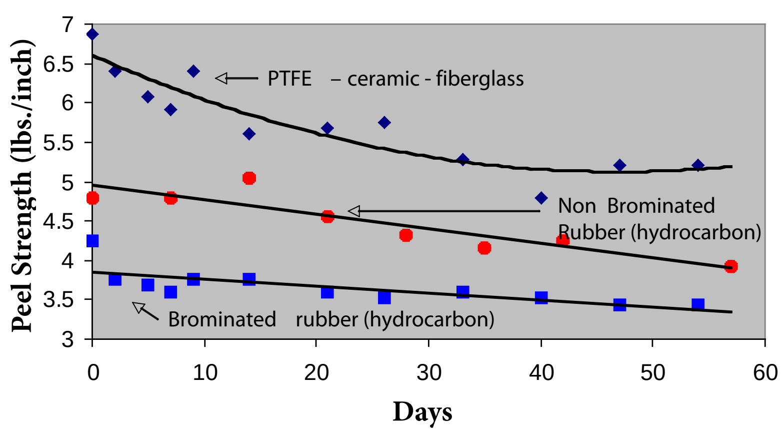
Df Changes According to Aging Time (1,000 hrs.)



PTFE-fiberglass products do not suffer from a change in their dielectric constant or dissipation factor with temperature exposure. Figures 1 and 2 show the change in dielectric constant and dissipation factor of a non-brominated rubber (Hydrocarbon) and PTFE ceramic fiberglass laminates with exposure to air at 195 °C. Figure 3 shows similar trends for peel strength. Copper peel strength will decline with temperature due to the oxidation of the copper in addition to any factors that would cause embrittlement of the resin system. This oxidation (yellowing) will occur at as low as 95 °C over prolonged time periods.

Figure 3

Copper Peel Strength Degradation (hold @ 150 °C)



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Designation	Dielectric Constant
RF-35TC	3.50 +/-0.05

Typical Thicknesses	
Inches	mm
0.0050	0.13
0.0100	0.25
0.0200	0.51
0.0300	0.76
0.0600	1.52

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

Available Copper Cladding

Designation	Weight	Copper Thickness		R_{MS} Treated Side		Description
RH	½ oz/ft²	~0.0007"	~18 µm	16 µin	0.4 µm	Rolled annealed
R1	1 oz/ft²	~0.0014"	~35 µm	11 µin	0.3 µm	Rolled annealed
CLH	½ oz/ft²	~0.0007"	~18 µm	13 µin	0.3 µm	Reverse treated/Electrodeposited
CL1	1 oz/ft²	~0.0014"	~35 µm	13 µin	0.3 µm	Reverse treated/Electrodeposited
C1 (C1)	1 oz/ft²	~0.0014"	~35 µm	25 µin	0.6 µm	Very low profile / Electrodeposited
CVH (CH)	½ oz/ft²	~0.0007"	~18 µm	27 µin	0.7 µm	Very low profile /Electrodeposited
C2	2 oz/ft²	~0.0028"	~70 µm	77 µin	2.0 µm	Electrodeposited

An example of our part # is: **RF-35TC-0300-C1/C1 - 18" x 24" (457 mm x 610 mm)**

RoHS WEEE Compliant