RF-35A2 Ultra Low Loss Power Amplifier Substrate

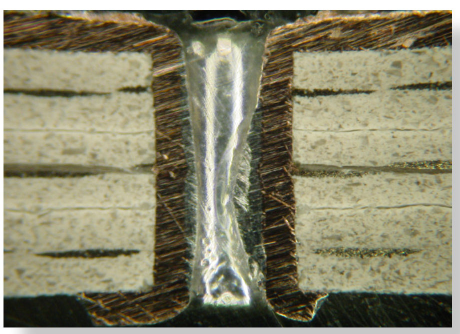
RF-35A2 is designed with an ultra low fiberglass content to achieve "best in class" insertion loss properties and a homogeneous dielectric constant throughout the laminate.

The uniform dispersion of ceramic throughout the laminate yields extremely low x and y coefficients of thermal expansion. The low modulus and low x-y CTE values make RF-35A2 an attractive material for the surface mounting of chip carriers.

RF-35A2 is manufactured in a proprietary multi-step process that provides excellent dielectric properties along with superior copper peel adhesion.

The low 0.0016 dissipation factor at 1.9 GHz allows for maximum power transfer resulting in low heat generation.

Taconic is a world leader in RF laminates and high speed digital materials, offering a wide range of high frequency laminates and prepregs. These advanced materials are used in the fabrication of antennas, multilayer RF and high speed digital boards, interconnections and devices.



Cross-section of RF-35A2 construction

Benefits & Applications:

- Low loss properties
- Dk tolerance of +/- 0.05
- Homogeneous Dk
- Excellent peel strength
- Low moisture absorption
- Ease of drilling

- Power amplifiers
- Filters/couplers
- High speed digital
- Multilayer
- Passive components
- Wireless antennas

North & South America
Taconic - Headquarters
Petersburgh, NY 12138
Tel: 518-658-3202 / 1-800-833-1805
addinfo@4taconic.com

Europe/Middle East/Australia
Taconic International Ltd.
Republic of Ireland
Tel: +353-44-9395600
add@4taconic.com

Asia
Korea Taconic Company
Republic of Korea
Tel: +82-31-704-1858
sales@taconic.co.kr

China
Taconic Advanced Material (Suzhou) Co., Ltd.
Suzhou City, China
Tel: +86-512-6286-7170
tssales@taconic.co.kr

An ISO 9001 Registered Company
www.taconic-add.com
Commercial and Government Entity (CAGE) Code: 1C6Q9

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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 strengths decrease while their dielectric constants and dissipation factors increase.

Figure 1

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

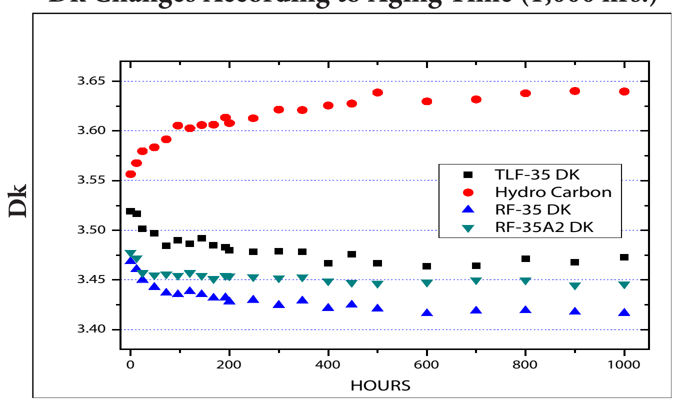
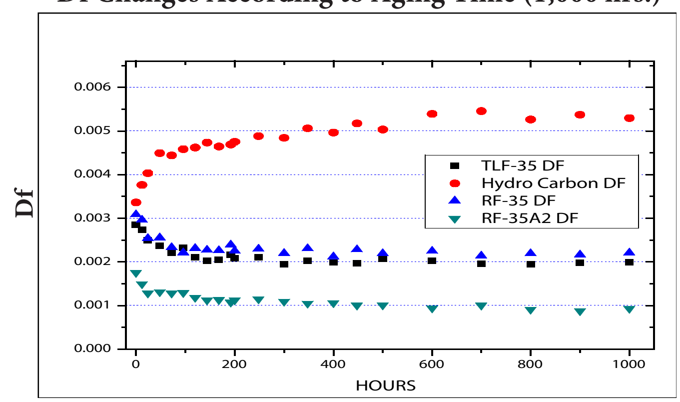


Figure 2

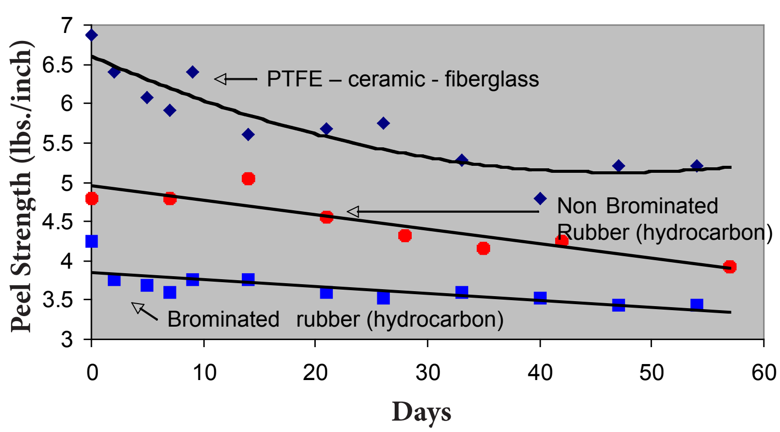
Df Changes According to Aging Time (1,000 hrs.)



PTFE-fiberglass products such as RF-35A2 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 (TLF-35, RF-35 and RF-35A2) 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.

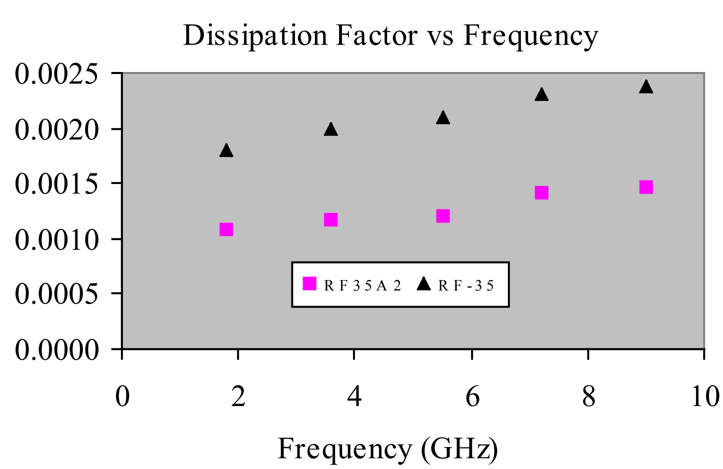
Figure 3

Copper Peel Strength Degradation (hold @ 150˚C)



RF-35A2 Typical Values *(Part # example: RF-35A2-0300-E-C1/C1)*

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)		0.0018		0.0018
Moisture Absorption	IPC-650 2.6.2.1	%	0.03	%	0.03
Dielectric Breakdown	IPC-650 2.5.6/ASTM D 149	kV	59	kV	59
Dielectric Strength	ASTM D 149	V/mil	1000	V/mm	39,370
Volume Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (Humidity Cond.)	Mohm/cm	10^9	Mohm/cm	10^9
Surface Resistivity	IPC-650 2.5.17.1 Sec. 5.2.1 (Humidity Cond.)	Mohm	10^8	Mohm	10^8
Arc Resistance	IPC-650 2.5.1	Seconds	242	Seconds	242
Flexural Strength (MD)	IPC-650 2.4.4	kpsi	24	N/mm^2	165
Flexural Strength (CD)	IPC-650 2.4.4	kpsi	15	N/mm^2	103
Tensile Strength (MD)	ASTM D 3039	psi	16,800	N/mm^2	116
Tensile Strength (CD)	ASTM D 3039	psi	11,000	N/mm^2	75.8
Young's Modulus (MD)	ASTM D 3039	psi	10^6	N/mm^2	8,343
Young's Modulus (CD)	ASTM D 3039	psi	10^6	N/mm^2	7,171
Poisson's Ratio (MD)	ASTM D 3039		0.14		0.14
Poisson's Ratio (CD)	ASTM D 3039		0.10		0.10
Strain at Break (MD)	ASTM D 3039	%	1.6	%	1.6
Strain at Break (CD)	ASTM D 3039	%	1.4	%	1.4
Compressive Modulus (Z axis)	ASTM D 695 (23ºC)	kpsi	385	N/mm^2	2,650
Peel Strength (1 oz. VLP)	IPC-650 2.4.8 (Thermal Stress)	lbs/inch	12	N/mm	2.1
Peel Strength (1 oz. VLP)	IPC-650 2.4.8.3 (150ºC) (Elevated Temp.)	lbs/inch	14	N/mm	2.5
Peel Strength (1 oz. VLP)	IPC-650 2.4.8 Sec. 5.2.3 (Proc. Chemicals)	lbs/inch	11	N/mm	2.0
Density (Specific Gravity)		gm/cm^3	2.28	gm/cm^3	2.28
Specific Heat	ASTM E 1269 (DSC) (100ºC)	J/g/K	0.99	J/g/K	0.99
Thermal Conductivity	ASTM F 433	W/M*K	0.29	W/M*K	0.29
T_d (Thermal Decomposition Temp.)	IPC-650 2.4.24.6 2% Weight Loss	ºC	528	ºC	528
T_d (Thermal Decomposition Temp.)	IPC-650 2.4.24.6 5% Weight Loss	ºC	547	ºC	547
CTE (x)	IPC-650 2.4.41 (>RT - 125ºC)	ppm/ºC	10	ppm/ºC	10
CTE (y)	IPC-650 2.4.41 (>RT - 125ºC)	ppm/ºC	13	ppm/ºC	13
CTE (z)	IPC-650 2.4.41 (>RT - 125ºC)	ppm/ºC	108	ppm/ºC	108



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. Test data obtained using a 0.0600" sample and 5 and 10 mil building blocks where indicated.

RF-35A2 Ultra Low Loss Power Amplifier Substrate

Designation	Dielectric Constant
RF-35A2	3.50 +/- 0.05

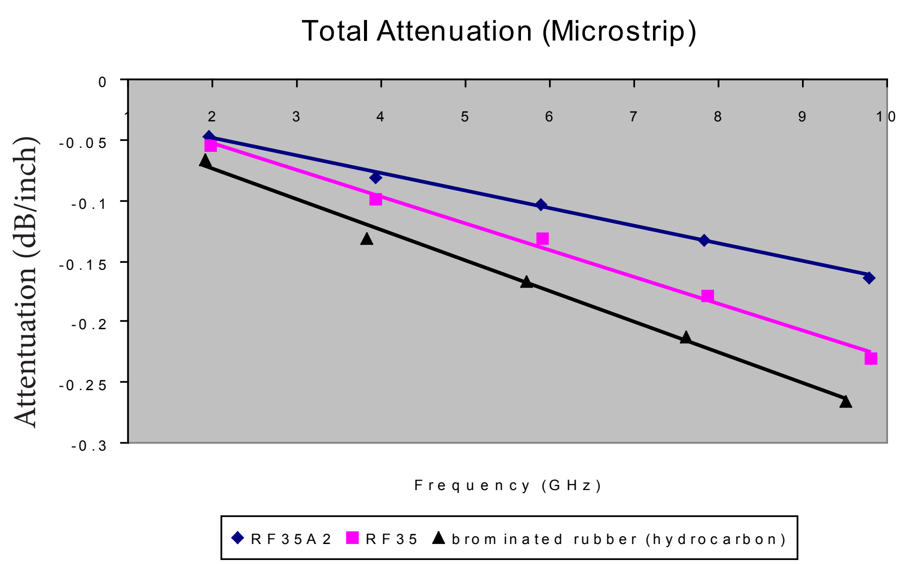
Typical Thicknesses[1]	
Inches	mm
0.0050	0.13
0.0100	0.25
0.0200	0.51
0.0300	0.76
0.0600	1.52

Available Sheet Sizes[2]	
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

[1]RF-35A2 can be manufactured in increments of 0.0100". Please call for availability of additional thicknesses.
[2]Our standard sheet size is 36" x 48" (914 mm x 1220 mm). Please contact our customer service department for availability of other sizes.

An example of our part number is: **RF-35A2-0300-E-C1/C1 - 18" x 24" (457 mm x 610 mm)**

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



Insertion losses were measured using a ring resonator (1.88 mm trace width, 0.487 dielectric thickness, gap 0.15 mm, circumference 178.5 mm, internal radius 54.967 mm, external radius 58.727)

An example of our part number is:
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