TACONIC

Finding a better way

*fast*Rise™ Multilayer Non-Reinforced Prepreg

*fast*Rise™ is designed to eliminate skew in differential transmission lines and eliminate dielectric constant fluctuations caused by fiberglass in filter and coupler applications. This low temperature thermosetting prepreg is based on ceramic, thermoset and PTFE and is ideal for use with Taconic's standard low loss laminates like TSM-DS (Df= 0.0010) and TSM-DS3 (Df= 0.0011).

For applications that require low loss at high frequencies, *fast*Rise™ prepreg offers design engineers the properties needed for superior performance. The low 0.0017 Df at 40 GHz enables the production of mmWave multilayer PWBs. In addition, the low 420° F lamination temperature enables 5+ sequential laminations to be performed at lower temperatures than those normally used for FEP and PFA in military constructions. Taconic currently has military applications involving four sequential laminations of FR-27.

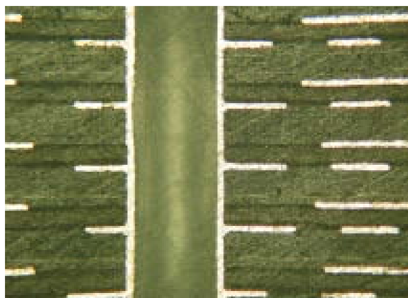
Due to the material's low Dk, *fast*Rise™ enables thickness reduction of ATE Printed Circuit Boards. The availability of many *fast*Rise™ thicknesses allows flexibility in high layer count PWB design.

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.

Benefits & Applications:

- **Enables 5+ sequential laminations**
- **Low Dk enables reduced thickness of ATE boards**
- **Low temperature alternative to thermoplastic films in military designs**
- **Multilayer prepreg for mmWave applications**
- **Stable Dk over temperature**
- **Fiberglass free prepreg**
- **Laser ablatable**

- **Semiconductor Testing**
- **Military**
- **mmWave Antenna/Automotive**



Cross section illustrates the very low fiberglass content of FR-27 & TSM-DS.

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: +86-512-8718-9678
tssales@taconic.co.kr

*fast*Rise™ Multilayer Non-Reinforced Prepreg

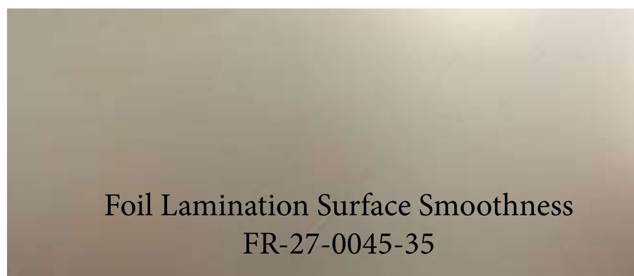
There are many *fast*Rise™ part numbers due to the diverse number of tasks that a prepreg must fulfill. For doing sequential laminations where the intent is to flow and fill copper that has been plated up to 2-3 mils, high resin content and high flow is required from the prepreg. For applications where you do *not* want the prepreg flowing into cavities, a low flow prepreg is desirable. Extremely high flow is needed for filling blind or buried vias or milled out cavities. In some coupler designs, a very thin prepreg is desirable for maximum coupling between the overlay couplers and sufficient flow is only needed to bond artwork with 0.5 oz. copper. Low flow prepregs are best for doing foil laminations. Flow and fill requirements don't exist in a foil lamination so a low flow prepreg is appropriate whereas a high flow prepreg might be more prone to cosmetic defects. Taconic has found that low flow prepregs are most suitable for microvia formation following a foil lamination (the microvia cross sections below are courtesy of Hughes Circuits). Taconic's low flow prepregs have a much better lased hole quality than the high flow prepregs.

In a high layer count PWB, often there are many layers of overlapping edge coupled traces. High layer count PWBs are susceptible to lamination voids due to areas of high and low pressure. For all of these reasons it is best to consult the *fast*Rise™ design guide or talk to a Taconic applications engineer to design with the most suitable prepreg.

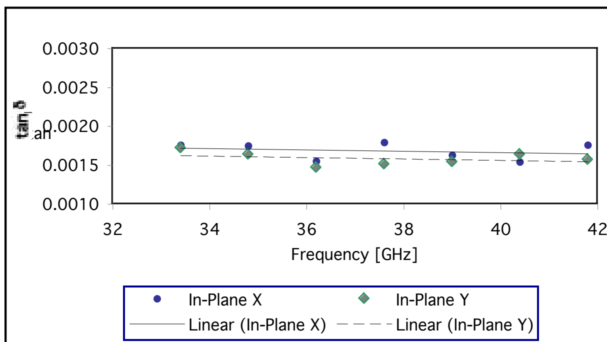
Product	Speedboard® C* equiv. part # (mil)	Stripline with 1 oz. Cu	High Layer Count PWBs	Between Plated Up Subassemblies	Fill Blind/ Buried Vias	Resin Content	Typical Flow (%)	Microvia Formation/ Foil Lamination
FR-25-0021-45		No	No	No	No	Low	18	No
FR-26-0025-60	2.2	Yes	Yes	Caution	No	High	20	No
FR-27-0030-25		Caution	No	No	No	Low	4	R
FR-27-0035-66	3.4	Yes	Yes	Yes	Yes	High	30	No
FR-27-0040-25		Caution	No	No	No	Low	4	R
FR-27-0040-43F		Caution	Surface only	No	No	Medium	2	R*
FR-28-0040-50		Yes	Yes	Caution	No	High	23	R
FR-27-0042-75		Yes	Yes	Yes	Yes	Highest	35	No
FR-27-0045-35		Yes	Caution	Caution	No	High	13	R
FR-27-0050-40		Yes	Yes	Caution	No	High	23	R

R = Recommended; R* = Recommended for the very top and very bottom of PCBs
*Speedboard® C is a registered trademark of W.L. Gore & Associates.

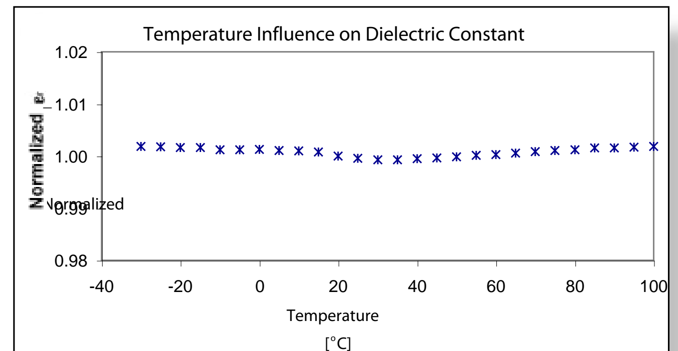
Laser Ablation: **Hughes Circuits** - FR-28-0040-50


Foil Lamination Surface Smoothness
FR-27-0045-35

*fast*Rise™ (FR-27-0045-35)Typical Values					
Property	Test Method	Unit	Value	Unit	Value
Dk @ 10 GHz	IPC-650 2.5.5.5.1 (modified)		2.75		2.75
Dk @ 40 GHz	Damaskos Open Resonator		2.70		2.70
Df @ 10 GHz	IPC-650 2.5.5.5.1 (modified)		0.0014		0.0014
Df @ 40 GHz	Damaskos Open Resonator		0.0017		0.0017
Moisture Absorption	IPC-650 2.6.2.1	%	0.08	%	0.08
Dielectric Breakdown	IPC-650 2.5.6 (parallel to lamination)	Kv	49	Kv	49
Dielectric Strength	ASTM D 149	V/mil	1090	Kv/mm	42.9
Volume Resistivity	IPC-650 2.5.17.1 (after elevated temp.)	Mohms/cm	8.00×10^8	Mohms/cm	8.00×10^8
Volume Resistivity	IPC-650 2.5.17.1 (after humidity)	Mohms/cm	1.71×10^8	Mohms/cm	1.71×10^8
Surface Resistivity	IPC-650 2.5.17.1 (after elevated temp.)	Mohms	3.48×10^8	Mohms	3.48×10^8
Surface Resistivity	IPC-650 2.5.17.1 (after humidity)	Mohms	1.16×10^8	Mohms	1.16×10^8
T_g	ASTM E 1640 (DMA)	°C	188	°C	188
Tensile Strength (x)	ASTM D 882	psi	1,690	N/mm^2	12
Tensile Strength (y)	ASTM D 882	psi	1,480	N/mm^2	10
Tensile Modulus (x)	ASTM D 882	kpsi	304	N/mm^2	2,100
Tensile Modulus (y)	ASTM D 882	kpsi	295	N/mm^2	2,030
Elongation at Break (x)	ASTM D 882	%	0.82	%	0.82
Elongation at Break (y)	ASTM D 882	%	0.73	%	0.73
Density (Specific Gravity)	ASTM D 792 Method A	g/cm^3	1.82	g/cm^3	1.82
T_d (2% Wt. Loss)	IPC-650 2.4.24.6/TGA	°F	709	°C	376
T_d (5% Wt. Loss)	IPC-650 2.4.24.6/TGA	°F	790	°C	421
Peel Strength (HH)	IPC-650 2.4.8	lbs./inch	5	N/mm	0.88
Peel Strength (H1)	IPC-650 2.4.8	lbs./inch	7	N/mm	1.23
Thermal Conductivity	ASTM F433	W/M*K	0.25	W/M*K	0.25
T_cK (-30 to 100 °C)	IPC-650 2.5.5.5.1 (modified)	ppm/°C	0.06	ppm/°C	0.06
CTE (X axis) (-55 to 125 °C)	IPC-650 2.4.41/TMA	ppm/°C	59	ppm/°C	59
CTE (Y axis) (-55 to 125 °C)	IPC-650 2.4.41/TMA	ppm/°C	70	ppm/°C	70
CTE (Z axis) (-55 to 125 °C)	IPC-650 2.4.41/TMA	ppm/°C	72	ppm/°C	72
Hardness	ASTM D 2240	Shore D	68	Shore D	68



_fast_Rise™ Dielectric Loss at mmWave Frequency



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.

*fast*Rise™ Multilayer Non-Reinforced Prepreg Application Notes

FR-25-0021-45 – This part number is a very thin prepreg designed for couplers. It does not have a lot of resin for flow and fill. It should be used in applications where designers are using 0.5 oz copper, don't have a lot of artwork to fill and in very simple low layer count pwbs. The advantage of FR25-45 is that it is very thin and when pressed against a 0.5 oz copper signal layer, a designer should be able to achieve close to a 1 mil spacing that is consistent in manufacturing. Because the available resin for flow and fill is low, this should not be used for complex high layer count multilayers.

FR-26-0025-60 – This part number can be used with 0.5 oz and 1.0 signal layers in any multilayer structure. Taconic offers other part numbers that machine, lase and drill better but if a thin prepreg is desired, this is a good choice. FR26-0025-60 should not be used for foil laminations as the high flow tends to show flow channels when used at the surface.

FR-27-0030-25* – This is a low flow prepreg that is best suited for low layer count simple RF stripline structures. It fills 0.5 oz copper well and should fill 1.0 oz copper well but one should test it first because it might be challenged in a design with 1.0 oz copper if there are low pressure areas during lamination. This part number lases well, machines/drills well and will give good cosmetic surface quality when doing a foil lamination to form microvias.

FR-27-0035-66 – This is a high flow prepreg that will fill the most difficult structures, cavities, buried vias, flow and fill between subassemblies where copper has been plated up to 1 – 2 oz. Taconic has other part numbers that lase and drill better than this part number. FR27-0035-66 has excessive flow and doesn't give a flat surface in a foil lamination. This part number should only be used where a high level of flow is needed or where a designer really needs this specific dielectric thickness for impedance reasons.

FR-27-0040-25* – This is a low flow prepreg that is best suited for low layer count simple RF stripline structures. It fills 0.5 oz copper well and may fill 1.0 oz copper well but one should test it first because it might be challenged in a design with 1.0 oz. copper if there are low pressure areas during lamination. This part number lases well, machines/drills well and will give good cosmetic surface quality when doing a foil lamination to form microvias.

FR-27-0040-43F – This part number is designed for foil laminations. It is also Taconic's lowest flowing prepreg, it lases and machines well, it yields a flat surface for lasing and it has been optimized for copper adhesion. This part number should be used on the top and bottom of complex pwbs where the surface is foil laminated for any reason (microvia formation, for example).

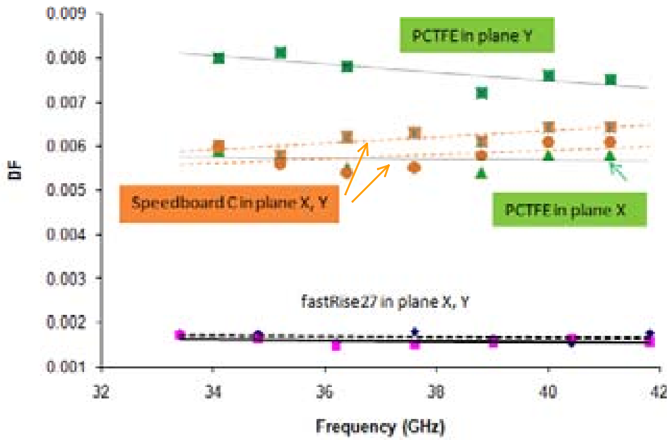
FR-28-0040-50* – This is designed for high layer count pwbs where one worries about flow and fill over many layers. This part number lases and machines well and is suitable for foil lamination.

FR-27-0042-75 – This is the material of choice for bonding between subassemblies and filling blind and buried vias. As this part number flows excessively, it should be used when the highest level of flow and fill is required. This part number should not be used for foil lamination as it shows flow channels at the surface. It is not the best part number for machining and it lases a little bit rough. It really should only be used for filling very difficult cavities and where it is the only part number to yield a given thickness for impedance reasons.

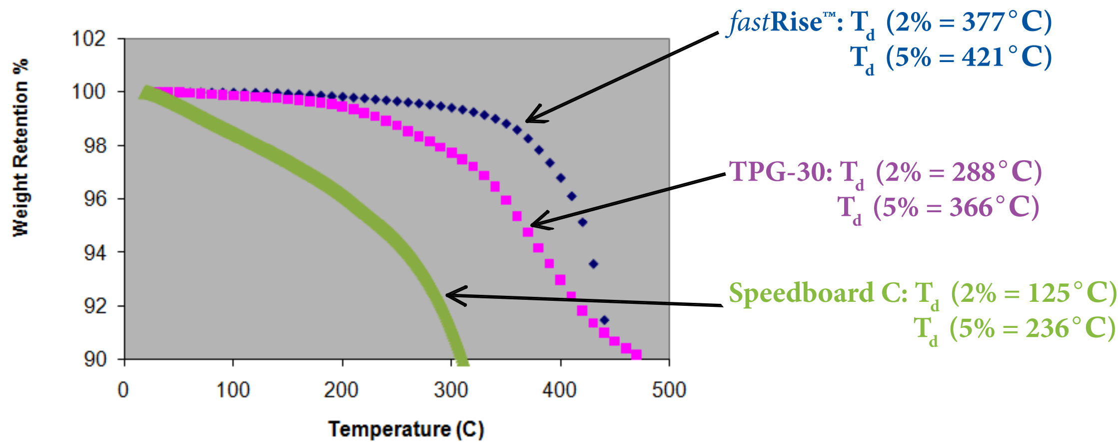
FR-27-0045-35* – This part number is designed for multilayer RF pwbs where the demand for flow and fill is not extreme. It should not be used in 20 layer digital pwbs. This part number lases and machines well and is suitable for foil lamination. It is a good prepreg for most RF multilayers that don't have extreme low pressure areas.

FR-27-0050-40* – This is designed for high layer count pwbs where one worries about flow and fill over many layers (20 layers for example). This part number lases and machines well and is suitable for foil lamination.

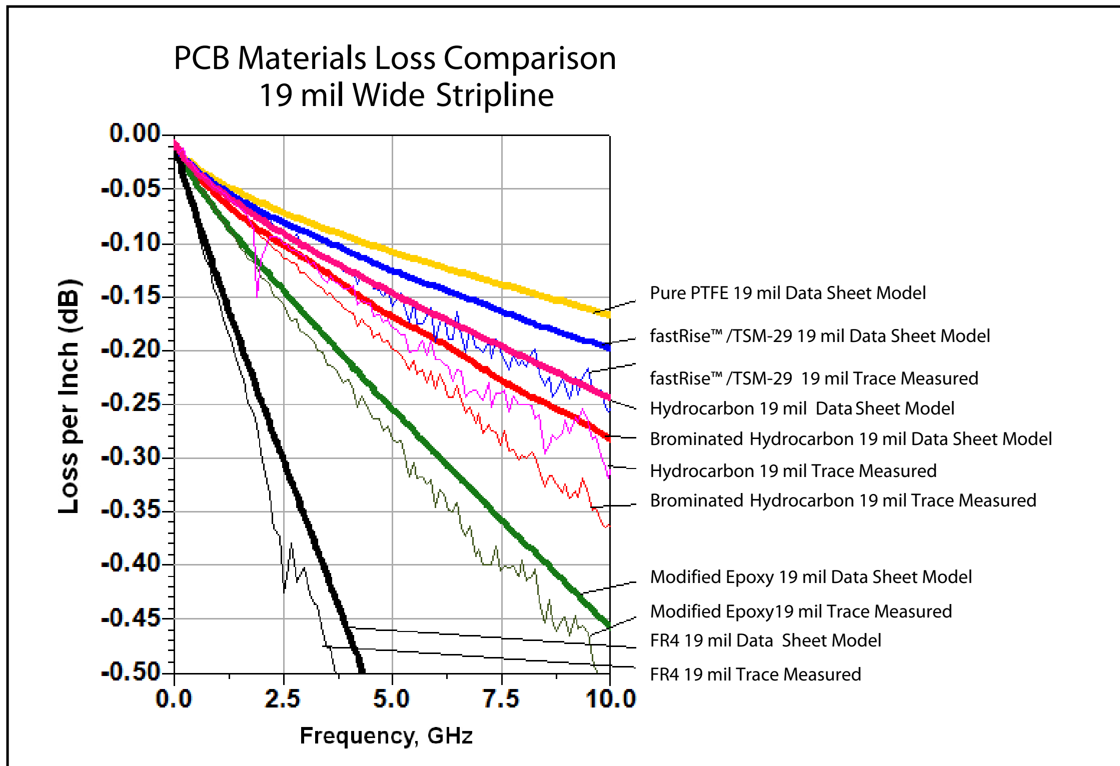
*The best part numbers for drilling, lasing, and machining/routing



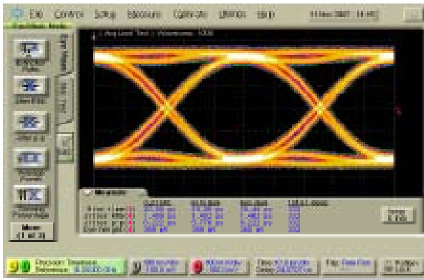
While there are some prepregs with reported Df values of 0.003 - 0.004 @ 10 GHz, *fast*Rise™ is the only prepreg to maintain its Df value at 40 GHz.



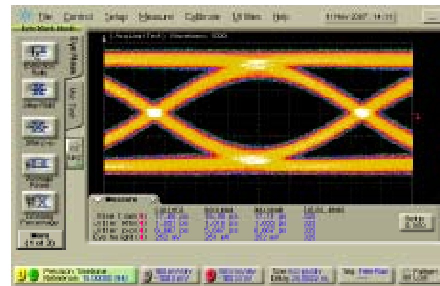
*fast*Rise™ has a remarkable resistance to thermal mass degradation relative to phenolic cured epoxies and other materials.



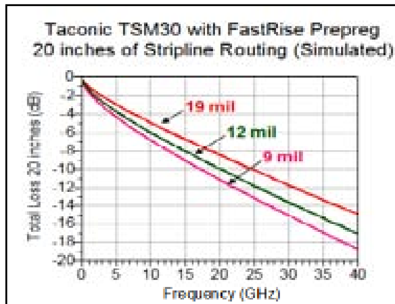
*fast*Rise™27 with TSM Laminate Core (10 inches of trace length, 19 mil wide trace)



20 Gbps PRBS31 500 MV Input (Verigy)



30 Gbps PRBS31 500 MV Input (Verigy)



Product	Pressed Thickness[1] (mil)	Pressed Thickness[1] (mil)	Pressed Thickness[1] (mil)	Nominal Dk (Observed Range[2]) (10 GHz)	Typical Flow (%)
FR-25-0021-45	2.1	1.0	1.0	2.49	18
FR-26-0025-60	2.7	1.3	1.0	2.60 (2.52-2.66)	20
FR-27-0030-25	3.5	2.1	1.8 (Caution)	2.78 (2.71-2.82)	4
FR-27-0035-66	3.7	2.5	2.1	2.66 (2.59-2.70)	30
FR-27-0040-25	4.9	3.7	3.2 (Caution)	2.76 (2.74-2.77)	4
FR-27-0040-43F	4.3	3.7	3.2 (Caution)	2.79	2
FR-28-0040-50	4.9	3.7	3.5	2.81 (2.78-2.84)	23
FR-27-0042-75	5.2	4.0	3.5	2.70	35
FR-27-0045-35	5.8	4.6	4.2	2.74 (2.73-2.77)	13
FR-27-0050-40	6.1	5.5	4.9	2.77 (2.71-2.83)	23
		0.5 oz. Cu, 50% removal	1 oz. Cu, 50% removal		

[1] *fast*Rise™ part numbers will yield a thickness variation of ≤ 4.5% for a range of 9% in a fixed condition.
[2]The *fast*Rise™ part numbers with low flow show a very tight Dk tolerance. The high flow *fast*Rise™ part numbers show a greater Dk deviation that is more related to the nature of the IPC flow test and the fact that extreme flow occurs during lamination and some resin escapes the edges.

*fast*Rise™ is shipped at a very low degree of cure. The best flow conditions are achieved when the prepreg spends the maximum amount of time possible at a temperature of 225 °F (107 °C) using the highest possible pressure. For difficult flow and fill designs or when using Taconic's low flow prepregs, the lamination press should ramp up to 225 °F (107 °C) and hold for 30-60 minutes at maximum pressure, followed by a slow 2.0-4.0 °C/min. ramp rate to 420 °F (216 °C).

*Notes for fabricating with FR-27-0030-25 and FR-27-0040-25: These are lower flowing grades of the *fast*Rise™ prepreg series and care must be taken during lamination to avoid lamination voids caused by low pressure areas. These prepregs are not recommended for blind and buried via fill.

Because of the large number of possible applications for the *fast*Rise™ prepreg series and the complexity of many multilayer printed circuit designs, Taconic does not warranty or guarantee the performance of *fast*Rise™ when combined with any supplier's core materials. It is the responsibility of the end user to determine the suitability of *fast*Rise™ for any application.