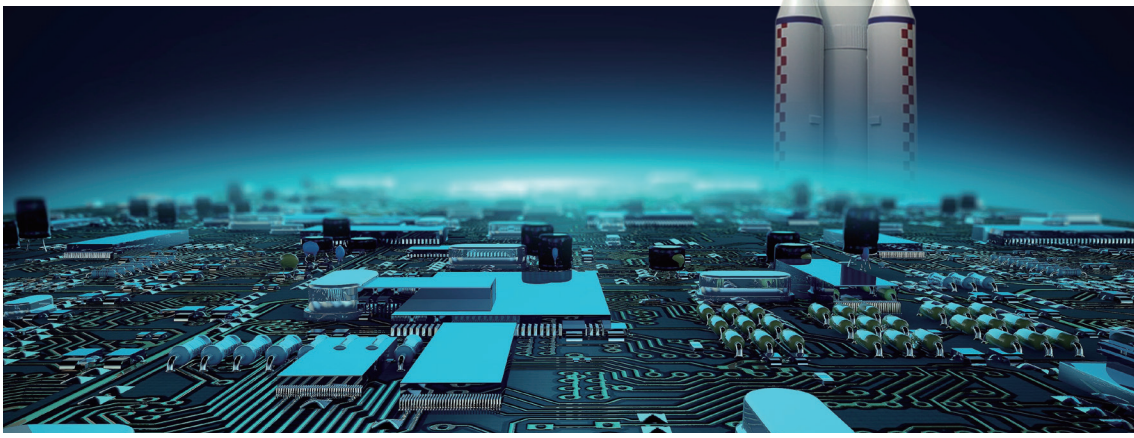
Jiangsu Wangling Technology Co., Ltd

Taizhou Wangling Insulating Materials Factory



High frequency microwave printed Circuit substrate professional manufacturer

CULTURE

Orientation

Professional manufacturing of high-frequency substrates

Philosophy

Based on integrity, innovative development, and technological leadership

Goal

Building excellent national brands and expanding international market business

Corporate Mission

Serving global connectivity and promoting the healthy development of the industry and society

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ABOUT WANGLING

PRODUCT CENTER

COMPANY PROFILE

Taizhou Wangling Insulation Materials Factory is headquartered in Taizhou City, Jiangsu Province, China. It is a high-end high-frequency high-speed substrate production manufacturer that integrates scientific research, production, sales, and service. The products are mainly PTFE resin high frequency substrates, organic polymer high frequency substrates, high frequency multilayer adhesive sheets, and composite dielectric substrates. They are widely used in aerospace, aerospace, aviation, satellite communication, navigation, radar, electronic countermeasures, 3G, 4G, 5G communication, Beidou satellite systems, mobile interconnection, infrastructure, and other fields.

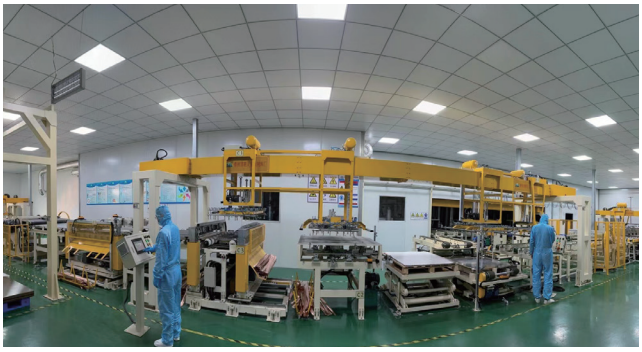
Founded in 1982 , the company is one of the earliest manufacturers of high frequency and high speed substrates in China, with a customer base of more than 1,000. It has rich product application experience and a broad customer base, serving China's advanced interconnection solutions for more than 40 years, and is committed to serving the world.

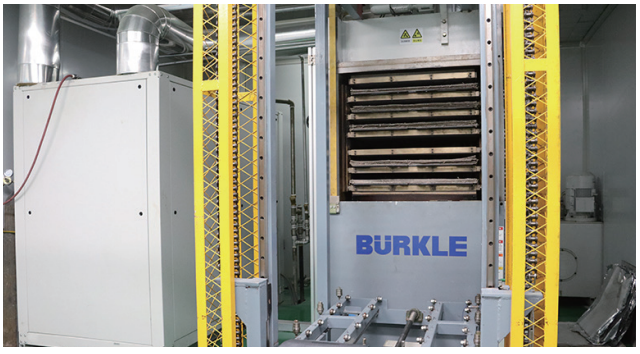
The company has a high-tech research and development, quality, sales, and technical service team, advanced technology, modern production equipment, efficient management, a complete range of Wangling products, sufficient production capacity, stable quality, and can provide solutions for different customer needs.

Taizhou Wangling Insulating Materials Factory

REALISTIC ENVIRONMENT

Enterprise reality



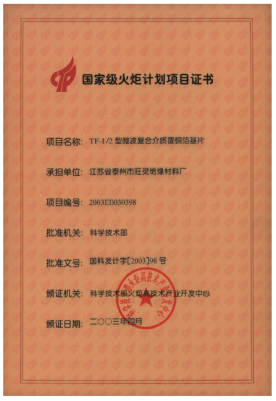



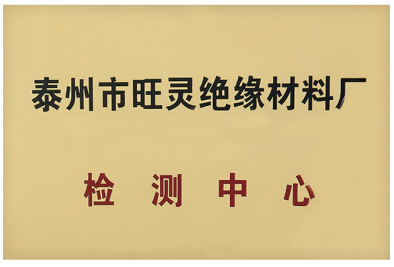



QUALIFICATIONS

Quality and Certification

技术与研发





PTFE laminates reinforced with woven fiberglass F_4BM、F_4BME

Product Introduction

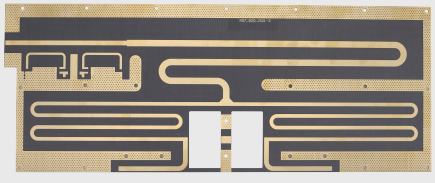
This product is made of glass fiber cloth, polytetrafluoroethylene resin and polytetrafluoroethylene film through scientific preparation and strict process. Its electrical performance is improved to a certain extent than F4B, mainly due to the wider range of dielectric constant, low dielectric loss, increased insulation resistance, and more stable performance, which can replace foreign products of the same type.
F4BM and F4BME have the same dielectric layer, but the copper foil used together is different: F4BM and ED copper foil are suitable for applications without PIM indicators; F4BME with reverse RTF copper foil has excellent PIM index, more accurate line control and lower conductor loss.
F4BM and F4BME precisely adjust the dielectric constant by adjusting the ratio between polytetrafluoroethylene and glass fiber cloth, which not only achieves low loss, but also enhances the dimensional stability of the material; The higher the dielectric constant is, the higher the proportion of glass fiber is, so the dimensional stability is better, the coefficient of thermal expansion is lower, the temperature fluctuation is better, and the dielectric loss is increased.

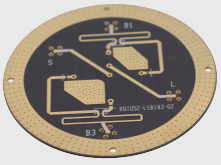
Product Features

- DK2.17 ～ 3.0 is optional, and DK can be customized
- F4BME with RTF copper foil has excellent PIM indicators
- Diversified size and cost saving
- Irradiation resistant, low exhaust
- Commercialization, mass production and high cost performance

Classic Case

- Microwave, RF, radar
- Phase shifter, passive device
- Power divider, coupler, combiner
- Feed network, phased array antenna
- Satellite communication, base station antenna





Product technical parameters			Product model/data			
Property	Conditions	Units	F4BM217	F4BM220	F4BM233	F4BM245
			F4BME217	F4BME220	F4BME233	F4BME245
Dielectric constant (typical value)	10GHz	/	2.17	2.2	2.33	2.45
Permittivity tolerance	/	/	±0.04	±0.04	±0.04	±0.05
Loss factor (typical value)	10GHz	/	0.001	0.001	0.0011	0.0012
	20GHz	/	0.0014	0.0014	0.0015	0.0017
Temperature coefficient of dielectric constant	-55°C～150°C	PPM/°C	-150	-142	-130	-120
Peeling strength	1 OZ F4BM	N/mm	＞1.8	＞1.8	＞1.8	＞1.8
	1 OZ F4BME	N/mm	＞1.6	＞1.6	＞1.6	＞1.6
Volume resistivity	C96/23/95	MΩ.cm	≥6×10^6	≥6×10^6	≥6×10^6	≥6×10^6
Surface resistance	C96/23/95	MΩ	≥1×10^6	≥1×10^6	≥1×10^6	≥1×10^6
Electrical strength (Z direction)	5KW, 500V/s	KV/mm	＞23	＞23	＞23	＞25
Breakdown voltage (XY direction)	5KW, 500V/s	KV	＞30	＞30	＞32	＞32
thermal expansion coefficient X Y direction	-55 °～288°C	ppm/°C	25,34	25,34	22,30	20,25
thermal expansion coefficient Z direction	-55 °～288°C	ppm/°C	240	240	205	187
Thermal stress	260°C, 10s, 3 times		No delamination	No delamination	No delamination	No delamination
Water absorption	20±2°C 24hours	%	≤0.08	≤0.08	≤0.08	≤0.08
Density	Room temperature	g/cm^3	2.17	2.18	2.20	2.22
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.24	0.24	0.28	0.30
PIM	Only applicable to F4BME	dBc	≤-159	≤-159	≤-159	≤-159
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0
Material composition	/	/	PTFE, Glass fiber cloth F4BM with ED copper foil, F4BME with reverse RTF copper foil			

1. The dielectric constant (typical value) is measured in the Z direction of the material, using the strip line method of GB/T 12636-1990 or IPC-TM650 2.5.5.5;
2. Other performance tests shall adopt or refer to the test methods specified in IPC-TM-650 or GBT4722-2017;
3. All test data are typical measurement data and are intended to help customers select materials. They are not intended and do not constitute any express or implied warranty, nor do they ensure that customers can achieve all the performance in the data sheet in specific occasions. Customers are responsible for verifying and determining the adaptability of Wangling materials in each application.

Product technical parameters			Product model/data				
Property	Conditions	Units	F4BM255	F4BM265	F4BM275	F4BM294	F4BM300
			F4BME255	F4BME265	F4BME275	F4BME294	F4BME300
Dielectric constant (typical value)	10GHz	/	2.55	2.65	2.75	2.94	3.0
Permittivity tolerance	/	/	±0.05	±0.05	±0.05	±0.06	±0.06
Loss factor (typical value)	10GHz	/	0.0013	0.0013	0.0015	0.0016	0.0017
	20GHz	/	0.0018	0.0019	0.0021	0.0023	0.0025
Temperature coefficient of dielectric constant	-55 °～150°C	PPM/°C	-110	-100	-92	-85	-80
Peeling strength	1 OZ F4BM	N/mm	＞1.8	＞1.8	＞1.8	＞1.8	＞1.8
	1 OZ F4BME	N/mm	＞1.6	＞1.6	＞1.6	＞1.6	＞1.6
Volume resistivity	C96/23/95	MΩ.cm	≥6×10^6	≥6×10^6	≥6×10^6	≥6×10^6	≥6×10^6
Surface resistance	C96/23/95	MΩ	≥1×10^6	≥1×10^6	≥1×10^6	≥1×10^6	≥1×10^6
Electrical strength (Z direction)	5KW, 500V/s	MΩ	＞25	＞25	＞28	＞30	＞30
Breakdown voltage (XY direction)	5KW, 500V/s	KV	＞34	＞34	＞35	＞36	＞36
thermal expansion coefficient X Y direction	-55 °～288°C	ppm/°C	16,21	14,17	14,16	12,15	12,15
thermal expansion coefficient Z direction	-55 °～288°C	ppm/°C	173	142	112	98	95
Thermal stress	260°C, 10s, 3times		No delamination	No delamination	No delamination	No delamination	No delamination
Water absorption	20±2°C 24hours	%	≤0.08	≤0.08	≤0.08	≤0.08	≤0.08
Density	Room temperature	g/cm^3	2.25	2.25	2.28	2.29	2.29
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.33	0.36	0.38	0.41	0.42
PIM	Applicable only to F4BME	dBc	≤-159	≤-159	≤-159	≤-159	≤-159
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0	V-0
Material composition	/	/	PTFE, glass fiber cloth F4BM with ED copper foil, F4BMEwith reverse RTF copper foil				

Optional copper foil:

F4BM pair with ED copper foil, optional thickness：0.5OZ (0.018mm) ,1OZ (0.035mm) 1.5OZ (0.05mm) , 2OZ (0.07mm)

F4BME pair with RTF copper foil, optional thickness:0.5OZ (0.018mm) , 1OZ (0.035mm)

Available in regular sizes:

460×610mm 500×600mm 850×1200mm 914×1220mm 1000×1200mm

Unconventional dimensions can be specified (please contact us for special dimensions):

300×250mm 350×380mm 500×500mm 840×840mm 1000×1500mm

Note: When the thickness is ⩾ 4.0mm or ⩽ 0.2mm, the size cannot exceed 500 × 610mm

Thickness and tolerance can be provided (the following are conventional thicknesses, and unconventional thicknesses can be customized by contacting our company

The following thicknesses are the total thickness of copper or the thickness of the medium, which can be produced. Please indicate whether it is "the total thickness of copper" or "the thickness of the medium" when placing an order.

Thickness (mm)	0.1 (Mesophyll thickness)	0.127 (Mesophyll thickness)	0.2	0.25	0.5	0.508	0.762
Public errand (mm)	±0.01	±0.01	±0.02	±0.02	±0.04	±0.04	±0.05
Thickness (mm)	0.8	1.0	1.5	1.524	1.575	2.0	2.5
Public errand (mm)	±0.05	±0.05	±0.06	±0.06	±0.06	±0.08	±0.08
Thickness (mm)	3.0	4.0	5.0	6.0	8.0	10.0	12.0
Public errand (mm)	±0.09	±0.1	±0.1	0.12	±0.15	±0.18	±0.2

When the dielectric constant is ⩽ 2.65, the thinnest available medium thickness is 0.1mm, and when the dielectric constant is 2.7-3.0, the thinnest available medium thickness is 0.2mm.

F4BM and F4BME series aluminum/copper substrates:

This series of products can be provided with aluminum based or copper based materials, that is, one side of the dielectric layer is covered with copper foil, and the other side of the dielectric layer is covered with copper based or aluminum based materials which plays a shielding or heat dissipation role, the model is F4BM***－AL、F4BME***－AL、F4BM***－CU、F4BME***－CU。

Model	Metal base	Proportion	Thermal conductivity	Copper or aluminum based Available thickness (mm)	Metal base thickness tolerance (mm)	Available in sizes (mm)
F4BM***－CU	Red copperbrass	8.9	380	0.48, 0.98, 1.48 1.98, 2.98, 3.98 Other thickness connections formulate	＋0.02, －0.05	460×610 460×305 Other dimensions Contact us
F4BME***－CU						
F4BM***－AL	Aluminum base	2.7	180			
F4BME***－AL						

Model example:
F4BM220－AL Aluminum clad base plate representing F4BM220
F4BME255－CU Copper clad base plate representing F4BME255

PTFE nanoceramic-filled laminates reinforced with woven fiberglass F_4BTM、F_4BTME

Product Introduction

This product is made of glass fiber cloth, nano ceramic filling, and polytetrafluoroethylene resin through scientific preparation and strict process pressing.
This series of products is based on the F4BM dielectric layer, with the addition of nanoscale ceramics with high dielectric constant and low loss. Therefore, they obtain higher dielectric constant, better heat resistance, lower coefficient of thermal expansion, higher insulation resistance, and better thermal conductivity, while maintaining the characteristics of low loss.
F4BTM and F4BTME have the same dielectric layer, but different copper foils are used together: F4BTM and ED copper foils are suitable for applications without PIM indicators; F4BTME with reverse RTF copper foil has excellent PIM indicators, more accurate line control, and lower conductor loss.

Product Features

DK2.98-3.5 optional; Adding ceramics improves performance; F4BTME has excellent PIM indicators; Rich thickness; Diversified size, cost saving; Commercialization, mass production, high cost performance; Anti radiation, low exhaust.

Optional copper foil:

F4BTM with ED copper foil, optional thickness:0.5OZ (0.018mm) ,1OZ (0.035mm) , 1.5OZ (0.05mm) , 2OZ (0.07mm)
F4BTME with RTF copper foil, optional thickness:0.5OZ (0.018mm) , 1OZ (0.035mm)

Available sizes:

460×610mm 600×500mm 914×1220mm

Note: When the thickness is ⩾ 4.0mm, the size cannot be provided as 914 × 1220mm

Available thicknesses and tolerances (the following are conventional thicknesses, and non conventional thicknesses can be customized by contacting our company):
The following thicknesses are the total thickness of copper or the thickness of the medium, which can be produced. Please indicate whether it is "the total thickness of copper" or "the thickness of the medium" when placing an order.

Thickness (mm)	0.254 (Thinnest)	0.508	0.762	0.8	1.0	1.016	1.27	1.524
Public errand (mm)	±0.02	±0.04	±0.05	±0.05	±0.05	±0.05	±0.06	±0.06
thickness (mm)	2.0	3.0	4.0	5.0	6.0	8.0	10.0	12.0
public errand (mm)	±0.075	±0.09	±0.1	±0.1	±0.12	±0.15	±0.18	±0.2

F4BTM and F4BTME series aluminum/copper substrates:

This series of products can be provided with aluminum based or copper based materials, that is, one side of the dielectric layer is covered with copper foil, and the other side of the dielectric layer is covered with copper based or aluminum based materials to provide shielding or thermal action, model:F4BTM***－AL、F4BTME***－AL、F4BTM***－CU、F4BTME***－CU。

Model	Metal base	Proportion	Thermal conductivity	Copper or aluminum based Available thickness (mm)	Metal base thickness tolerance (mm)	Available in sizes (mm)
F4BTM(E)-2-A***－CU	Red copper brass	8.9	380	0.48, 0.98, 1.48 1.98, 2.98, 3.98 Other thickness contact formulation	＋0.02, －0.05	460×610 460×305 Other Dimensional Connections
F4BTM(E)-2-A***－AL	Aluminum base	2.7	180			

Model example: F4BTM300 － AL represents aluminum clad base plate of F4BTM300
F4BTME350 － CU represents the copper clad base plate of F4BTME350

Product Technical Parameters			Product model/data			
Product characteristics	Test conditions	Unit	F4BTM298	F4BTM300	F4BTM320	F4BTM350
			F4BTME298	F4BTME300	F4BTME320	F4BTME350
Dielectric constant (typical value)	10GHz	/	2.98	3.0	3.2	3.5
Dielectric constant tolerance	/	/	±0.06	±0.06	±0.06	±0.07
Loss factor (typical value)	10GHz	/	0.0018	0.0018	0.0020	0.0025
	20GHz	/	0.0023	0.0023	0.0026	0.0035
Temperature coefficient of dielectric constant	-55 °～150°C	PPM/°C	-78	-75	-75	-60
Peeling strength	1 OZ F4BTM	N/mm	＞1.6	＞1.6	＞1.6	＞1.6
	1 OZ F4BTME	N/mm	＞1.4	＞1.4	＞1.4	＞1.4
Volume resistivity	C96/23/95	MΩ.cm	≥1×10^7	≥1×10^7	≥1×10^7	≥1×10^7
Surface resistance	C96/23/95	MΩ	≥1×10^6	≥1×10^6	≥1×10^6	≥1×10^6
Electrical strength (Z direction)	5KW，500V/s	KV/mm	＞26	＞30	＞32	＞32
Breakdown voltage (XY direction)	5KW，500V/s	KV	＞34	＞35	＞40	＞40
thermal expansion coefficient X Y direction	-55 °～288°C	ppm/°C	15，16	15，16	13，15	10，12
thermal expansion coefficient Z direction	-55 °～288°C	ppm/°C	78	72	58	51
Thermal stress	260°C，10s，3times		No delamination	No delamination	No delamination	No delamination
Water absorption	20±2°C，24hours	%	≤0.05	≤0.05	≤0.05	≤0.05
Density	Room temperature	g/cm^3	2.25	2.25	2.20	2.20
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.42	0.42	0.50	0.54
PIM	Only suitable for F4BTME	dBc	≤-160	≤-160	≤-160	≤-160
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0
Material composition	/	/	PTFE，Glass fiber cloth F4BTM with ED copper foil, F4BTME with reverse RTF copper foil			

1. The dielectric constant (typical value) is measured in the Z direction of the material using the GB/T 12636-1990 or IPC-TM650 2.5.5.5 stripline method;
2.Other performance tests shall be conducted using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;
3.All test data are typical measurement data, designed to assist customers in selecting materials, and are not intended to constitute any express or implied warranty, nor do they ensure that customers achieve all the performance in this data sheet in specific situations. The customer is responsible for verifying and determining the suitability of Wangling materials in each application.

PTFE ceramic-filled woven fiberglass substrates F_4BTMS series

Products

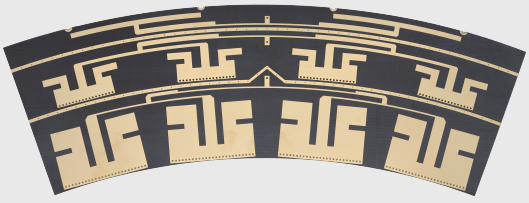
F4BTMS series is the upgraded product of F4BTM series, on the basis of which, a technical breakthrough has been made in material formulation and production process, a large amount of ceramics has been added to the material, and ultra-thin and ultra-fine glass fiber cloth has been used to enhance the material performance, and the dielectric constant is wider, which is an astronautically grade and highly reliable material and can replace similar foreign products.
A small amount of ultra-thin ultra-fine glass fiber cloth reinforcement, while a large number of uniform special nano-ceramics mixed with PTFE resin, so that the electromagnetic wave propagation of the glass fiber effect is reduced to a minimum, the dielectric loss is reduced, but also enhance the dimensional stability, the material X / Y / Z the anisotropy is reduced, the use of frequency increased, electrical strength increased, thermal conductivity increased, the material at the same time has excellent low thermal expansion coefficient and stable dielectric temperature characteristics.
The F4BTMS series comes standard with RTF low roughness copper foil, which reduces conductor loss while having excellent peel strength, and can be used with copper or aluminum base.
F4BTMS294 can be matched with buried 50Ω resistive copper foil to form a resistive film sheet.
The circuit board can be processed with standard PTFE sheet technology. The excellent mechanical and physical properties of the sheet make it suitable for multilayer, high multilayer and backplane processing; it also shows excellent processability in terms of dense holes and fine line processing.

Product Features

◈ ultra-low dielectric loss;
◈ Stable dielectric constant and low loss value within 40G frequency of use to meet phase-sensitive applications;
◈ Excellent temperature coefficient of change of material dielectric constant and dielectric loss, maintaining excellent frequency stability and phase stability between -55°C and 150°C;
◈ Excellent irradiation resistance, maintain stable dielectric properties and physical properties even after treatment by dose irradiation.
◈ Low outgassing performance, tested according to the standard method of material volatility performance under vacuum conditions, meeting the requirements of vacuum outgassing for aerospace use;
◈ low coefficient of thermal expansion of the material in X/Y/Z direction; ensures the reliability of dimensional thermal stability and hole copper;
◈ better thermal conductivity to adapt to larger power applications
◈ Excellent dimensional stability;
◈ Low water absorption.

Typical Applications

◈ Aerospace equipment, space, cabin equipment
◈ Microwave, radio frequency
◈ Radar, military radar
◈ Feeder network
◈ Phase-sensitive antenna, phased array antenna
◈ Satellite communication, etc.



Product technical parameters			Product model/Data			
Property	Conditions	Units	F4BTMS220	F4BTMS233	F4BTMS255	F4BTMS265
Dielectric constant (typical value)	10GHz	/	2.2	2.33	2.55	2.65
Dielectric constant tolerance	/	/	±0.02	±0.03	±0.04	±0.04
Dielectric constant (design value)	10GHz	/	2.2	2.33	2.55	2.65
Loss factor (typical value)	10GHz	/	0.0009	0.0010	0.0012	0.0012
	20GHz	/	0.0010	0.0011	0.0013	0.0014
	40GHz	/	0.0013	0.0015	0.0016	0.0018
Dielectric constant temperature coefficient	-55 °～150°C	PPM/°C	-130	-122	-92	-88
Peel strength	1 OZ RTF copper foil	N/mm	＞2.4	＞2.4	＞1.8	＞1.8
Volumetric resistivity	C96/23/95	MΩ.cm	≥1×10^8	≥1×10^8	≥1×10^8	≥1×10^8
Surface resistance	C96/23/95	MΩ	≥1×10^8	≥1×10^8	≥1×10^8	≥1×10^8
Electrical strength (Z-direction)	5KW，500V/s	KV/mm	＞26	＞30	＞32	＞34
Breakdown voltage (XY direction)	5KW，500V/s	KV	＞35	＞38	＞40	＞42
Coefficient of thermal expansion (X, Y direction)	-55 °～288°C	ppm/°C	40,50	35,40	15,20	15,20
Coefficient of thermal expansion (Z-direction)	-55 °～288°C	ppm/°C	290	220	80	72
Thermal stress	260°C，10s，3times	/	No delamination	No delamination	No delamination	No delamination
Water absorption	20±2°C，24h	%	0.02	0.02	0.025	0.025
Density	Room temperature	g/cm^3	2.18	2.22	2.26	2.26
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.26	0.28	0.31	0.36
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0
Material composition	/	/	PTFE，Ultra-thin, ultra-fine (quartz) glass fiber		PTFE，Ultra-thin and ultra-fine glass fiber, ceramic	

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Other performance tests are tested using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;
3. All test data are typical measurements and are intended to assist the customer in material selection and are not intended to and do not constitute any express or implied warranty, nor do they ensure that the customer will achieve all the properties in this data sheet in a particular application, and the customer is responsible for verifying to determine the suitability of the Wantling material for each application.

Product technical parameters			Product model/Data		
Property	Conditions	Units	F4BTMS294	F4BTMS300	F4BTMS350
Dielectric constant (typical value)	10GHz	/	2.94	3.00	3.50
Dielectric constant tolerance	/	/	±0.04	±0.04	±0.05
Dielectric constant (design value)	10GHz	/	2.94	3.0	3.50
Loss factor (typical value)	10GHz	/	0.0012	0.0013	0.0016
	20GHz	/	0.0014	0.0015	0.0019
	40GHz	/	0.0018	0.0019	0.0024
Dielectric constant temperature coefficient	-55 °～150°C	PPM/°C	-20	-20	-39
Peel strength	1 OZ RTF Copper foil	N/mm	＞1.2	＞1.2	＞1.2
Volumetric resistivity	C96/23/95	MΩ.cm	≥1×10^8	≥1×10^8	≥1×10^8
Surface resistance	C96/23/95	MΩ	≥1×10^8	≥1×10^8	≥1×10^8
Electrical strength (Z-direction)	5KW，500V/s	KV/mm	＞40	＞40	＞42
Breakdown voltage (XY direction)	5KW，500V/s	KV	＞48	＞52	＞55
Coefficient of thermal expansion (X, Y direction)	-55 °～288°C	ppm/°C	10,12	10,11	10,12
Coefficient of thermal expansion (Z direction)	-55 °～288°C	ppm/°C	22	22	20
Thermal stress	260°C，10s，3times	/	No delamination	No delamination	No delamination
Water absorption	20±2°C，24h	%	0.02	0.025	0.03
Density	Room temperature	g/cm^3	2.25	2.28	2.3
Long-term usability	High and low temperature chamber	°C	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.58	0.58	0.6
Fammability rating	/	UL-94	V-0	V-0	V-0
Material composition	/	/	PTFE，Ultra-thin and ultra-fine glass fiber, ceramic		

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2.Other performance tests are tested using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;
3. All test data are typical measurements and are intended to assist the customer in material selection and are not intended to and do not constitute any express or implied warranty, nor do they ensure that the customer will achieve all the properties in this data sheet in a particular application, and the customer is responsible for verifying to determine the suitability of the Wantling material for each application.

Product technical parameters			Product technical parameters			
Property	Conditions	Units	F4BTMS430	F4BTMS450	F4BTMS615	F4BTMS1000
Dielectric constant (typical value)	10GHz	/	4.30	4.50	6.15	10.20
Dielectric constant tolerance	/	/	±0.09	±0.09	±0.12	±0.2
Dielectric constant (design value)	10GHz	/	4.3	4.5	6.15	10.2
Loss factor (typical value)	2GHz	/	0.0015	0.0015	0.0020	0.0020
	10GHz	/	0.0019	0.0019	0.0023	0.0023
	20GHz	/	0.0024	0.0024	/	/
Dielectric constant temperature coefficient	-55 °～150°C	PPM/°C	-60	-58	-96	-320
Peel strength	1 OZ RTF copper foil	N/mm	＞1.2	＞1.2	＞1.2	＞1.2
Volumetric resistivity	C96/23/95	MΩ.cm	≥1×10⁸	≥1×10⁸	≥1×10⁸	≥1×10⁸
Surface resistance	C96/23/95	MΩ	≥1×10⁸	≥1×10⁸	≥1×10⁸	≥1×10⁸
Electrical strength (Z-direction)	5KW，500V/s	KV/mm	＞44	＞45	＞48	＞23
Breakdown voltage (XY direction)	5KW，500V/s	KV	＞52	＞54	＞55	＞42
Coefficient of thermal expansion (X, Y direction)	-55 °～288°C	ppm/°C	13,12	12,12	10,12	16,18
Coefficient of thermal expansion (Z-direction)	-55 °～288°C	ppm/°C	47	45	40	32
Thermal stress	260°C，10s，3times	/	No delamination	No delamination	No delamination	No delamination
Water absorption	20±2°C，24h	%	0.08	0.08	0.1	0.03
Density	Room temperature	g/cm³	2.51	2.53	2.75	3.2
Long-term usability	High and low temperature chamber	°C	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.63	0.64	0.67	0.81
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0
Material composition	/	/	PTFE，Ultra-thin and ultra-fine glass fiber, ceramic			

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Other performance tests are tested by or with reference to the test methods specified in IPC-TM-650 or GBT4722-2017;
3. All test data are typical measurements and are intended to assist the customer in material selection and are not intended to and do not constitute any express or implied warranty, nor do they ensure that the customer will achieve all the properties in this data sheet in a particular application, and the customer is responsible for verifying to determine the suitability of the Wantling material for each application.

Optional copper foil:

Copper foil thickness: 0.5OZ (0.018mm), 1OZ (0.035mm); other thicknesses to be customized;
Copper foil type: RTF low roughness copper foil as standard;
50Ω buried resistance copper foil, aluminum base, copper base are available.
Optional 550Ω buried resistance copper foil introduction: resistive film composition is nickel-phosphorus alloy resistive film thickness of 0.2 microns, square resistance value per square centimeter resistance value of 50 ± 5Ω. 0Ω buried resistance copper foil, aluminum-based, copper-based.

Available sizes (special sizes contact our company for customization):

305×460mm (12×18″) 460×610mm (18×24″) 610×920mm (24×36″)

Media layer thickness and tolerance can be provided (special thickness contact our company for customization):

F4BTMS220 and F4BTMS233 up to 0.09mm thin, available in 0.09mm multiples or 0.127mm multiples;

F4BTMS255/265/294/300 up to 0.127mm thin, available in 0.127mm multiples thickness;

F4BTMS350/430/450/615/1000 is the thinnest 0.254mm and available in 0.127mm multiplier thickness.

Thickness	Tolerance		Thickness	Tolerance
0.090mm(3.5mil)	±0.010mm(0.4mil)		1.50mm(59mil)	±0.06mm(2.5mil)
0.127mm(5.0mil)	±0.0127mm(0.5mil)		1.524mm(60mil)	±0.06mm(2.5mil)
0.254mm(10mil)	±0.02mm(1.0mil)		1.575mm(62mil)	±0.06mm(2.5mil)
0.508mm(20mil)	±0.03mm(1.19mil)		2.03mm (80mil)	±0.08mm (3.2mil)
0.635mm(25mil)	±0.04mm(1.58mil)		2.54mm(100mil)	±0.10mm(4.0mil)
0.762mm(30mil)	±0.04mm(1.58mil)		3.175mm(125mil)	±0.13mm(5.0mil)
0.787mm(30.1mil)	±0.04mm(1.58mil)		4.06mm(160mil)	±0.18mm(7.0mil)
1.016mm(40mil)	±0.05mm(2.0mil)		5.08mm(200mil)	±0.20mm(8.0mil)
1.270mm(50mil)	±0.05mm(2.0mil)		6.35mm(250mil)	±0.25mm(10mil)

F4BTMS series aluminum base/copper substrate:

This series of products can be provided with aluminum-based or copper-based material, i.e. the dielectric layer is covered with copper foil on one side, and the other side of the dielectric layer is covered with copper-based or aluminum-based.acts as a shield or heat sink model F4BTMS***－AL or F4BTMS***－CU。

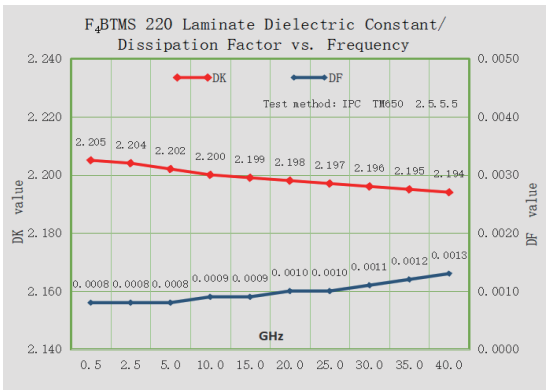
Model	Metal base	Specific Gravity	Thermal conduc-tivity	Expansion coefficient	Copper-based or aluminum-based Available thickness (mm)	Metal base thickness tolerance (mm)	Available sizes (mm)
F4BTMS***－CU	Copper/Brass	8.9	380	17	0.48, 0.98, 1.48 1.98, 2.98, 3.98 Other thicknesses with our company Contact to make	＋0.02, －0.05	460×610 460×305
F4BTMS***－AL	Aluminum based	2.7	180	24			

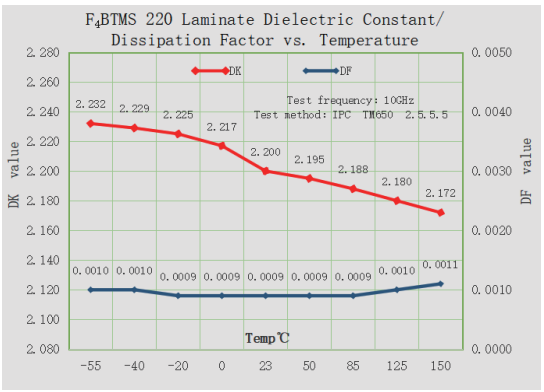
Model examples:

F4BTMS220-AL stands for F4BTMS220 laminated aluminum-based sheet
F4BTMS294-CU stands for F4BTMS294 copper based laminate

Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, the ideogram in the expression of the type of material change law, does not mean that each piece of the product is the data marked in the chart, but the product change trend in line with the change law in the chart.

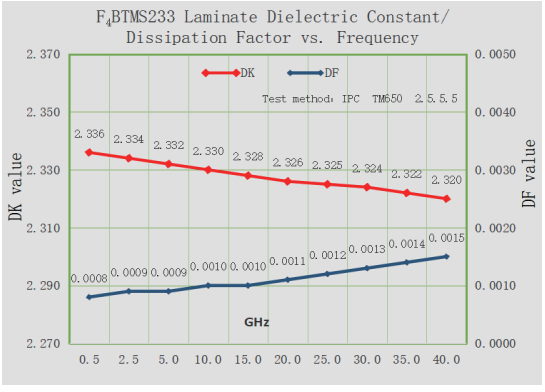
F4BTMS220 electrical performance chart

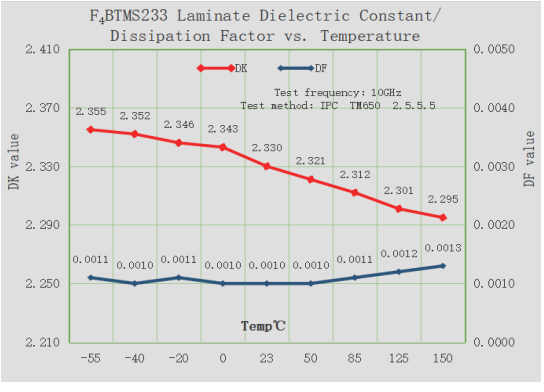




◆ Excellent frequency stability: the material is stable in terms of dielectric constant and loss within 0.5 to 40 GHz frequency, maintaining ultra-low loss values to meet the design requirements at different frequencies;
◆ The TCDK in the range of 55 to 150°C is about -130PPM/°C, which provides reference data for different temperature designs, and the actual material can be used at temperatures far beyond that range.

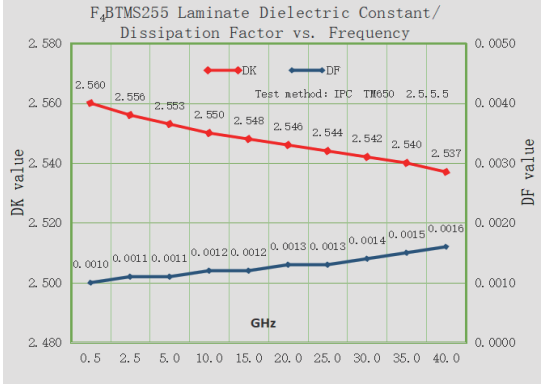
F4BTMS233 electrical performance chart

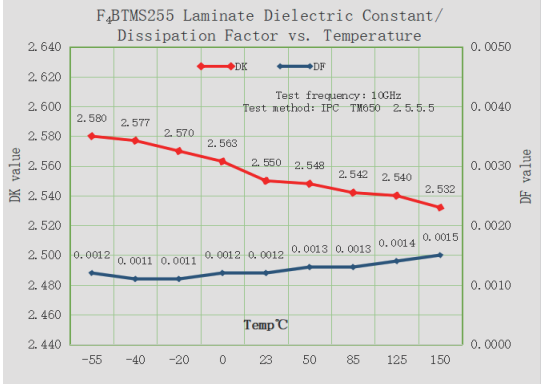




◆ Excellent frequency stability: the material has stable dielectric constant and loss within 0.5~40GHz frequency, maintaining ultra-low loss value to meet the design requirements at different frequencies;
◆ The TCDK in the range of -55～150°C is about -122PPM/°C, which provides reference data for different temperature design, and the actual usable temperature of the material far exceeds this temperature range.

F4BTMS255 electrical performance chart

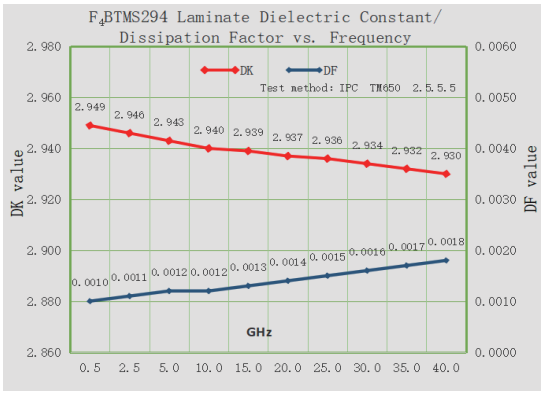


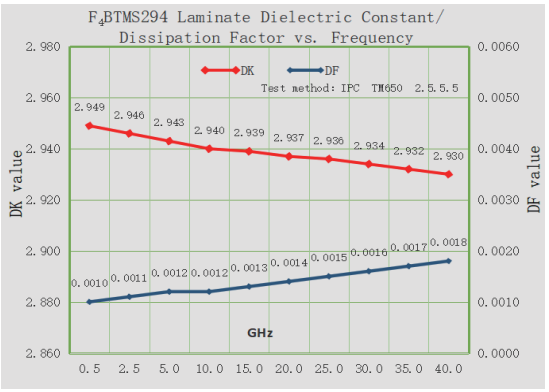


◆ Excellent frequency stability: the material has stable dielectric constant and loss within 0.5~40GHz frequency, maintaining low loss value to meet the design requirements at different frequencies;
◆ The TCDK in the range of -55～150°C is about -92PPM/°C, which provides reference data for different temperature designs, and the actual material can be used at temperatures far exceeding this temperature range.

Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, the ideogram in the expression of the type of material change law, does not mean that each piece of the product is the data marked in the chart, but the product change trend in line with the change law in the chart.

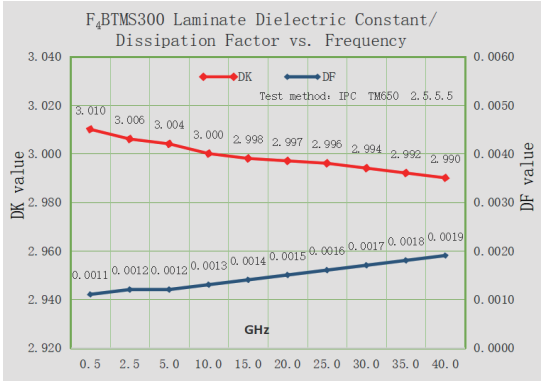
F4BTMS294 electrical performance chart

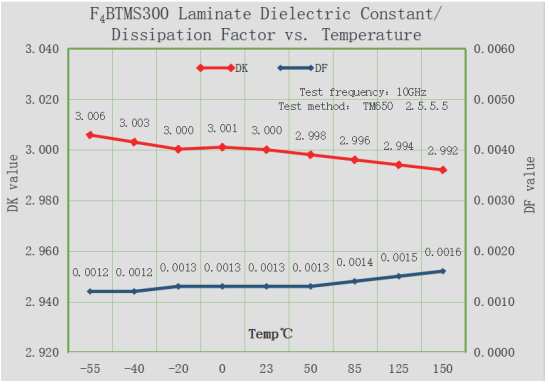




◆ Excellent frequency stability: the material has stable dielectric constant and loss within 0.5~40GHz frequency, keeping low loss value to meet the design requirements under different frequencies;
◆ Excellent temperature stability characteristics: TCDK in the range of -55～150°C is about -20PPM/°C, with tiny changes, and the actual material can be used at temperatures far exceeding this temperature range.

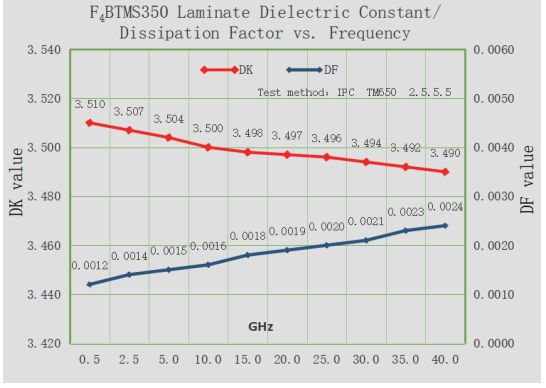
F4BTMS300 electrical performance chart

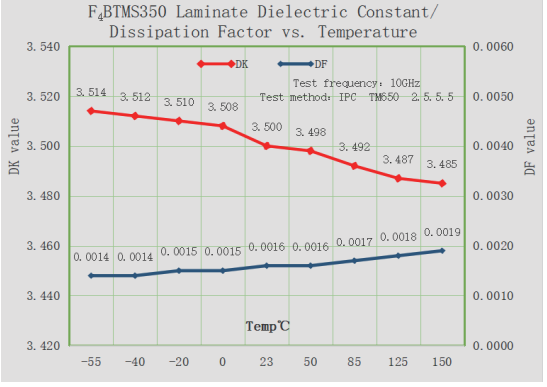




◆ Excellent frequency stability: the material has stable dielectric constant and loss in the frequency of 0.5~40GHz, keeping low loss value to meet the design requirements under different frequencies;
◆ Excellent temperature stability characteristics: TCDK is about -20PPM/°C in the range of -55～150°C, with tiny changes, and the actual material can be used at temperatures far exceeding this temperature range.

F4BTMS350 electrical performance chart

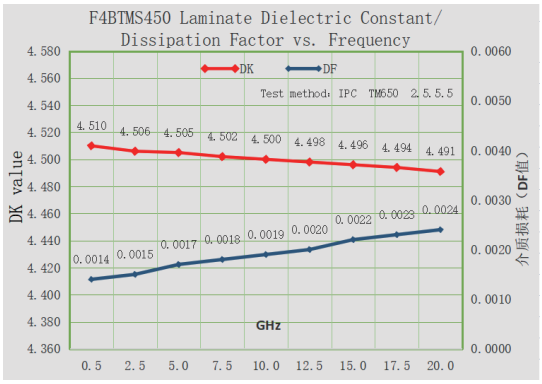


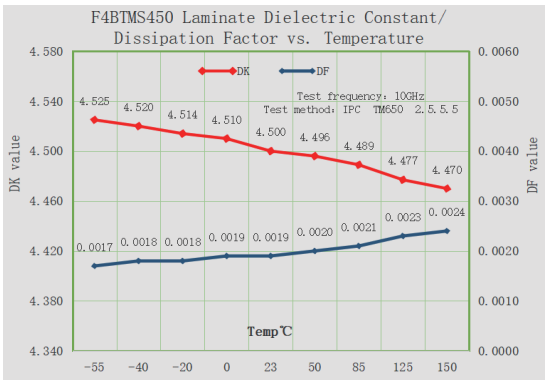


◆ Excellent frequency stability: the material has stable dielectric constant and loss in the frequency of 0.5~40GHz, keeping low loss value to meet the design requirements under different frequencies;
◆ Excellent temperature stability characteristics: TCDK is about -39PPM/°C in the range of -55～150°C, with tiny changes, and the actual material can be used at temperatures far exceeding this temperature range.

Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, the ideogram in the expression of the type of material change law, does not mean that each piece of the product is the data marked in the chart, but the product change trend in line with the change law in the chart.

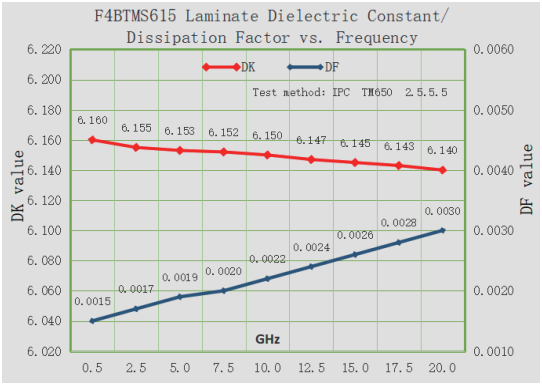
F4BTMS450 electrical performance chart

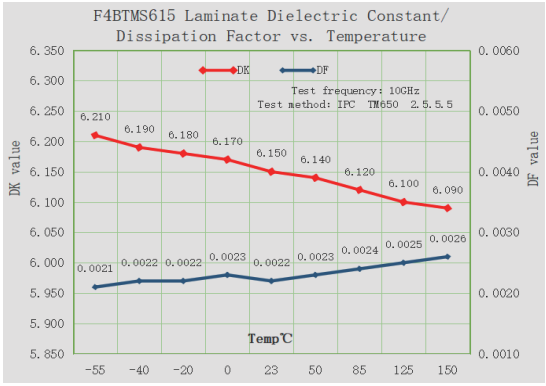




◆ Excellent frequency stability: the material has stable dielectric constant and keeps low loss value in the frequency of 0.5～20GHz, which meets the design requirements under different frequencies;
◆ Excellent temperature stability characteristics, the TCDK in the range of -55 ~ 150°C is about -58PPM/°C, the actual material can be used at temperatures far beyond this temperature range.

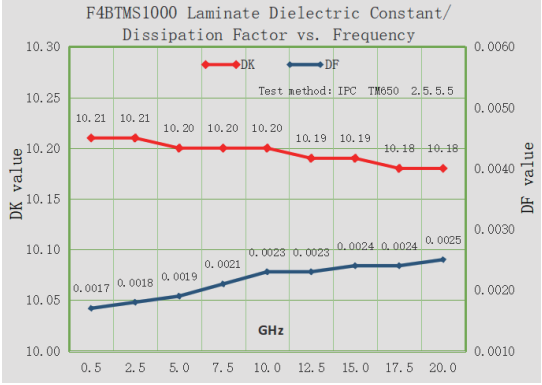
F4BTMS615 electrical performance chart

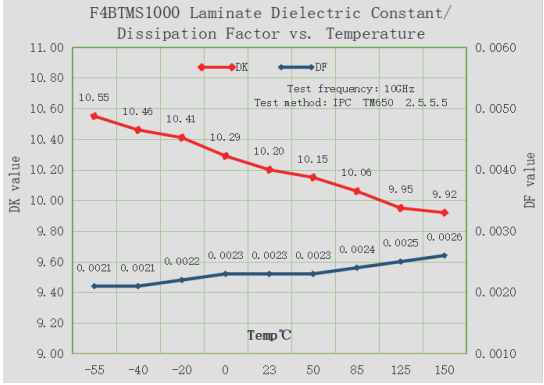




◆ Excellent frequency stability: the material has stable dielectric constant and keeps low loss value in the frequency of 0.5～20GHz, which meets the design requirements under different frequencies;
◆ Excellent temperature stability characteristics, the TCDK in the range of -55 ~ 150°C is about -58PPM/°C, the actual material can be used at temperatures far beyond this temperature range.

F4BTMS1000 electrical performance chart





◆ Excellent frequency stability: the material has stable dielectric constant and loss in the frequency of 0.5~40GHz, keeping low loss value to meet the design requirements under different frequencies;
◆ Excellent temperature stability characteristics: TCDK is about -39PPM/°C in the range of -55～150°C, with tiny changes, and the actual material can be used at temperatures far exceeding this temperature range.

PTFE ceramic-filled substrates TFA series

Products

PTFE ceramic composite dielectric substrate TFA series of products of the dielectric layer composition of PTFE resin and ceramic, do not use the glass fiber cloth dipping method to make prefabricated sheet, but the use of new technology to make prefabricated sheet, and then pressed by a special pressing process. With the same level of dielectric constant excellent electrical properties, thermal properties, mechanical properties, is aerospace grade high frequency high reliability materials, can replace similar foreign products.

This series of substrate does not contain glass fiber cloth, using a large number of uniform special nano-ceramics and resin mixture, electromagnetic wave propagation without glass fiber effect, excellent frequency stability, dielectric loss of the same level of the lowest, the material X / Y / Z the lowest anisotropy, the material at the same time has the same as the copper foil low thermal expansion coefficient, stable dielectric temperature characteristics.

The dielectric constant of this series is 2.94, 3.0, 6.15, 10.2.

The TFA series comes standard with RTF low roughness copper foil, which reduces conductor loss while providing excellent peel strength.

TFA294 and TFA300 can be matched with buried 50Ω resistive copper foil to form resistive film sheets.

The circuit board can be processed by standard PTFE sheet technology. The excellent mechanical and physical properties of the sheet make it suitable for multilayer, high multilayer and backplane processing; at the same time, it shows excellent processability in the processing of dense holes and fine lines.

Product Features

◈ Small dielectric constant tolerance and excellent batch-to-batch consistency;
◈ lowest dielectric loss in its class;
◈ Use of frequencies up to 77G for millimeter wave and automotive radar applications;
◈ Excellent frequency stability and phase stability from -55°C to 150°C;
◈ Excellent irradiation resistance, maintaining stable dielectric and physical properties after dose irradiation treatment;
◈ low outgassing performance, tested according to the standard method of material volatility performance under vacuum conditions, meeting the requirements of vacuum outgassing for aerospace applications;
◈ Excellent thermal expansion coefficient, equal to copper foil; ensures the reliability and dimensional thermal stability of copper hole;
◈ Low water absorption, ensuring the stability of the material under humid environment.

Typical Applications

◈ Aerospace equipment, space, in-cabin equipment, aircraft
◈ Microwave, antenna, phase-sensitive antenna
◈ Early warning radar, airborne radar and other kinds of radar
◈ Phased array antennas, beamwave networks
◈ Satellite communication, navigation
◈ Power amplifier

Product Technical Parameter			Product model/Data			
Property	Conditions	Units	TFA294	TFA300	TFA615	TFA1020
Dielectric constant (typical value)	10GHz	/	2.94	3.00	6.15	10.20
Dielectric constant (design value)	10GHz	/	2.94	3.00	6.4	10.7
Dielectric constant tolerance	/	/	±0.04	±0.04	±0.12	±0.20
Loss factor (typical value)	10GHz	/	0.001	0.001	0.0015	0.0015
	20GHz	/	0.001	0.001	0.0017	0.0017
	40GHz	/	0.0012	0.0012	/	/
Dielectric constant temperature coefficient	-55 °~150°C	PPM/°C	-5	-8	-215	-340
Peel strength	1 OZ RTF copper foil	N/mm	＞1.6	＞1.6	＞1.6	＞1.6
Volumetric resistivity	C96/23/95	MΩ.cm	≥5×10^7	≥5×10^7	≥5×10^7	≥5×10^7
Surface resistance	C96/23/95	MΩ	≥5×10^7	≥5×10^7	≥5×10^7	≥5×10^7
Electrical strength (Z-direction)	5KW, 500V/s	KV/mm	＞35	＞32	＞30	＞30
Breakdown voltage (XY direction)	5KW, 500V/s	KV	＞40	＞40	＞30	＞25
Thermal expansion coefficient(X,Y direction)	-55 °~288°C	ppm/°C	18,18	18,18	16,16	16,16
Thermal expansion coefficient (Z-direction)	-55 °~288°C	ppm/°C	32	30	29	30
Thermal stress	260°C, 10s, 3 times	-	Not delamination	Not delamination	Not delamination	Not delamination
Water absorption	20±2°C, 24h	%	0.03	0.04	0.06	0.015
Density	Room temperature	g/cm³	2.14	2.15	2.5	3.0
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use
Thermal conductivity	Z-direction	W/(M.K)	0.59	0.60	0.80	0.88
Fammability rating	/	UL-94	V-0	V-0	V-0	V-0
TD	Starting value	°C	498	498	503	505
Material composition	/	/	PTFE, ceramics (a very small amount of glass fiber cloth is added when the media thickness exceeds 1.5 mm)			

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Dielectric constant (design value) using 50Ω microstrip line method test, test for the material Z-direction
3. Other performance tests are tested by or with reference to IPC-TM-650 or GBT4722-2017 specified test methods
4. All test data are typical measurements and are intended to assist customers in material selection and are not intended and do not constitute any express or implied warranty, nor do they ensure that customers will achieve all of the properties in the data sheet in a particular application, and customers are responsible for verifying and determining the suitability of Wantling materials for each application.

Optional copper foil:

Copper foil thickness: 0.5OZ (0.018mm), 1OZ (0.035mm); other thicknesses on request;

Copper foil type: RTF low roughness copper foil, as standard

Choose from 50Ω buried resistance copper foil, calendered copper foil, copper-based, aluminum-based

50Ω buried resistor copper foil introduction: resistor film composition is nickel-phosphorus alloy, resistor film thickness of 0.2 microns, square resistance value per square centimeter resistance value of 50 ± 5Ω.

Available sizes (special sizes contact our company for customization):

305×460mm (12×18〞) 460×610mm (18×24〞)

Media layer thickness and tolerance can be provided (special thickness contact our company for customization):

TFA series products are the thinnest 0.127mm and available in 0.127mm multiples

Thickness	Tolerance	Thickness	Tolerance
0.127mm(5.0mil)	±0.0127mm(0.5mil)	1.905mm(75mil)	±0.09mm(3.5mil)
0.254mm(10mil)	±0.02mm(1.0mil)	2.03mm (80mil)	±0.09mm(3.5mil)
0.508mm(20mil)	±0.03mm(1.19mil)	2.54mm(100mil)	±0.13mm(5.0mil)
0.635mm(25mil)	±0.03mm(1.58mil)	3.175mm(125mil)	±0.20mm(8.0mil)
0.762mm(30mil)	±0.04mm(1.58mil)	3.81mm(150mil)	±0.25mm(10.0mil)
1.016mm(40mil)	±0.05mm(2.0mil)	4.06mm(160mil)	±0.25mm(10.0mil)
1.270mm(50mil)	±0.05mm(2.0mil)	5.08mm(200mil)	±0.25mm(10.0mil)
1.524mm(60mil)	±0.07mm(2.5mil)	6.35mm(250mil)	±0.32mm(12.6mil)

TFA series aluminum base/copper substrate:

This series of products can be provided lined with aluminum base or copper base material, that is, the dielectric layer is covered with copper foil on one side, and the other side of the dielectric layer is covered with copper base or aluminum base, which plays a shielding or heat dissipation role.the model number is TFA***-AL or TFA***-CU.

Model	Metal base	Specific gravity	Thermal conductivity	Coefficient of thermal expansion	Copper or aluminum based available thickness (mm)	Metal base thickness tolerancemm	Available in size mm
TFA***—CU	Red copper/ brass	8.9	380	17	0.48, 0.98, 1.48, 1.98, 2.98, 3.98 Contact our company to formulate other thicknesses	+0.02, −0.05	460×610 460×305
TFA***—AL	Aluminum based	2.7	180	24			

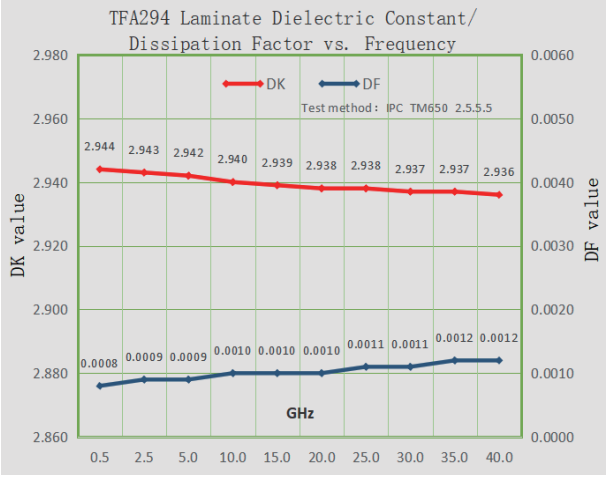
Model Example:

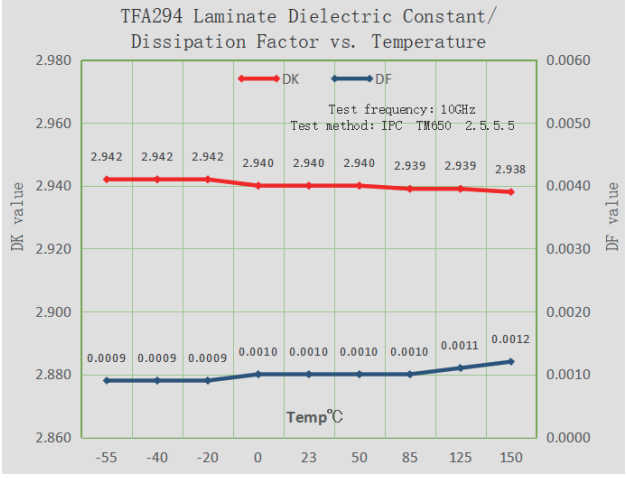
TFA294- AL represents the aluminum clad base plate of TFA 294

TFA1020- CU represents the copper clad base plate of TFA 1020

Explanation of electrical performance chart: The frequency change is based on the median dielectric constant and loss at 10G, while the temperature change is based on the median dielectric constant and loss at 23 ° C at room temperature, and the cumulative data shows an approximate change pattern. This table represents the change pattern of the material model and does not mean that every product is labeled in the chart, but the change trend of the product conforms to the change pattern in the chart.

TF A294 electrical performance chart

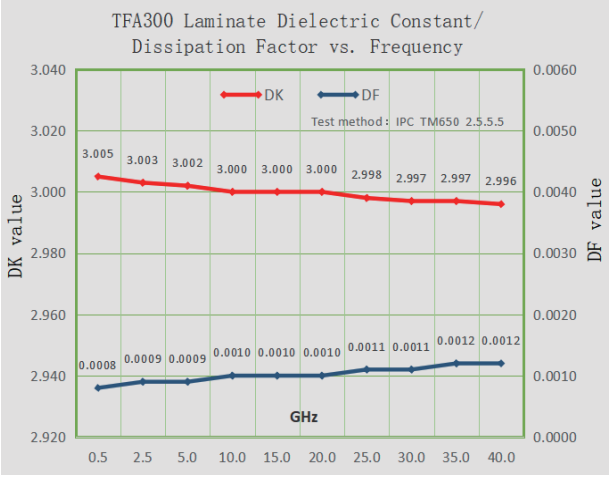


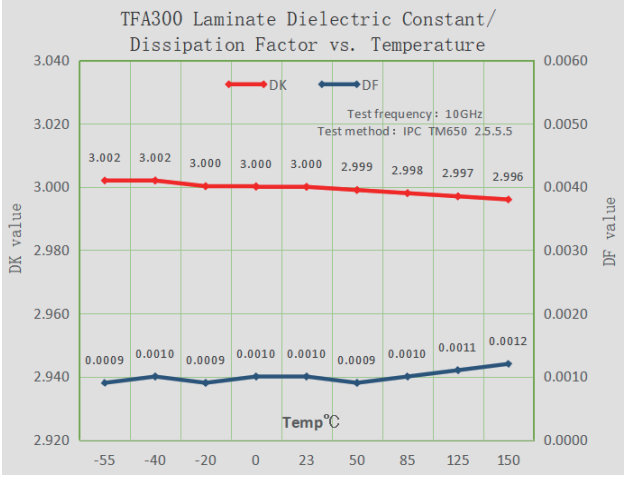


◈ Excellent frequency stability. The dielectric constant and loss of the material are stable in the frequency range of 0.5~40GHz by using the stripline method, and the ultra-low loss value is maintained; Limited by the frequency of the stripline test method, it does not mean that this material can only be used at the frequency of 0.5~40GHz. The excellent performance makes the frequency reach 77GHz or even higher.

◈ Excellent temperature stability characteristics, with a TCDK of around -5PPM/°C within the range of -55~150 °C, with minimal changes. The actual usable temperature of the material far exceeds this temperature range.

TFA300 electrical performance chart



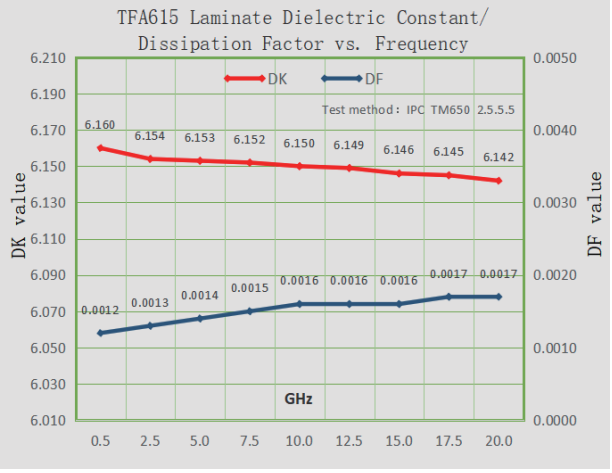


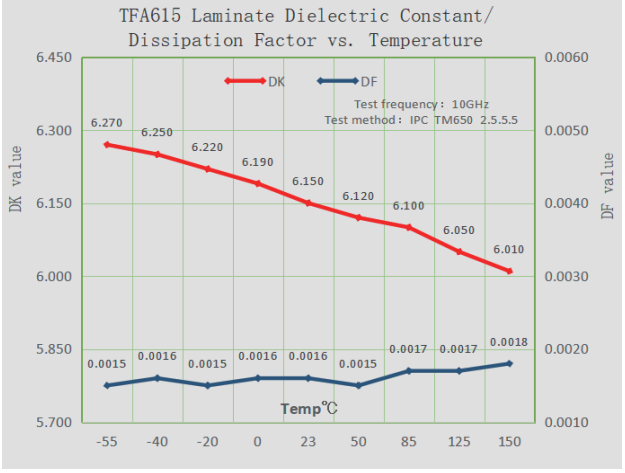
◈ Excellent frequency stability: use the stripline method to test the dielectric constant and loss stability of the material in the frequency range of 0.5~40GHz, and maintain the ultra-low loss value; Limited by the frequency of the stripline test method, it does not mean that this material can only be used at the frequency of 0.5~40GHz. The excellent performance makes the frequency reach 77GHz or even higher.

◈ Excellent temperature stability characteristics: The TCDK within the range of -55~150 °C is around -8PPM/°C, with minimal changes. The actual usable temperature of the material far exceeds this temperature range.

Explanation of electrical performance chart: The frequency change is based on the median dielectric constant and loss at 10G, while the temperature change is based on the median dielectric constant and loss at 23 ° C at room temperature, and the cumulative data shows an approximate change pattern. This table represents the change pattern of the material model and does not mean that every product is labeled in the chart, but the change trend of the product conforms to the change pattern in the chart.

TFA615 electrical performance chart

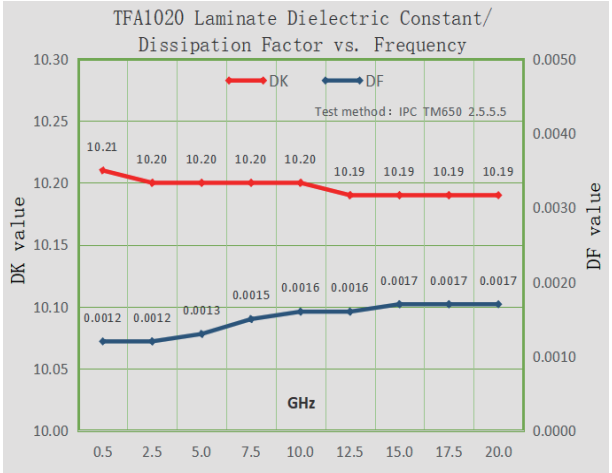


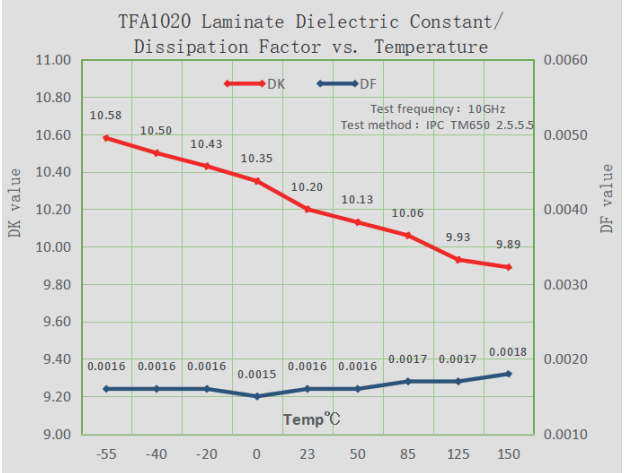


◈Excellent frequency stability: The dielectric constant of the material is stable within the frequency range of 0.5~20GHz, maintaining low loss values and meeting design requirements at different frequencies;

◈ -The TCDK within the range of 55-150 °C is around -215PPM/°C, providing reference data for different temperature designs. The actual material can be used at temperatures far beyond this temperature range.

TFA1020 electrical performance chart





◈ Excellent frequency stability, stable dielectric constant of the material within the frequency range of 0.5~20GHz, maintaining low loss values, meeting design requirements at different frequencies;

◈ -The TCDK within the range of 55-150 °C is around -340PPM/°C, providing reference data for different temperature designs. The actual material can be used at temperatures far beyond this temperature range.

Organic polymer ceramic-filled woven fiberglass substrates WL-CT series

Product Introduction

The WL-CT series of organic polymer ceramic fiberglass cloth copper clad plates is a high-frequency material of a thermosetting resin system. The dielectric layer is composed of hydrocarbon resin, ceramics, and fiberglass cloth, which has low loss performance and meets the requirements of high-frequency design. At the same time, the processability of PCB can refer to FR4 material processing. Compared with PTFE material processing, it is simpler, easier to process, and can replace similar foreign products.
Hydrocarbon resin and composite ceramics have good characteristics of low loss, high temperature resistance, temperature stability, etc., which make the dielectric constant and loss of this series of materials have stable temperature characteristics, low thermal expansion coefficient, and the material has a high TG value greater than 280 °C.
The dielectric constants of this series of products are 3.00, 3.30, 3.38, 3.48, 4.10, and 6.15 to choose from.
This series of materials is paired with ED copper foil or reverse RTF copper foil. RTF copper foil has excellent PIM indicators, reducing conductor losses and insertion losses; RTF copper foil is treated with adhesive backing, which increases the material thickness by 0.018mm (0.7mil), making RTF copper foil have good adhesion.
This series can be paired with aluminum substrates to form aluminum based high-frequency materials
The circuit board can be processed using the reference FR4 board process technology. The excellent mechanical and physical properties of the board enable it to be pressed multiple times, making it suitable for multi-layer, high multi-layer, and backboard processing; At the same time, it exhibits excellent machinability in processing dense holes and fine lines.

Product Features

◈ Low dielectric constant tolerance and low loss;
◈ Hydrocarbon ceramic thermosetting resin system with better PCB processability and heat resistance;
◈ Excellent dielectric constant temperature characteristics with low variation with temperature;
◈ Thermal expansion coefficient in X/Y direction, equivalent to copper foil; small thermal expansion coefficient in Z direction, ensuring dimensional thermal stability and hole copper reliability;
◈ High TG value greater than 280℃, still maintain dimensional stability and hole copper quality at high temperature;
◈ High thermal conductivity, better than thermoplastic materials in the same class, suitable for high-power applications;
◈ Commercial, high-volume, cost-effective products;
◈ Excellent irradiation resistance, maintain stable dielectric properties and physical properties after dose irradiation treatment.
◈ Low outgassing performance, tested according to the standard method of material volatility performance under vacuum conditions, meeting the requirements of vacuum outgassing for aerospace applications.

Typical Applications

◈ Aerospace equipment, space, in-cabin equipment, aircraft
◈ Microwave, antenna, phase-sensitive antenna
◈ Early warning radar, airborne radar and other kinds of radar
◈ Phased array antennas, beamwave networks
◈ Satellite communication, navigation
◈ Power amplifier

Product technical parameters			Product model/data		
Property	Conditions	Units	WL-CT300	WL-CT330	WL-CT330Z
Dielectric constant (typical value)	10GHz	/	3.00	3.30	3.30
Dielectric constant (design value)	10GHz	/	2.98	3.45	3.45
Dielectric constant tolerance	/	/	±0.05	±0.06	±0.06
Loss factor (typical value)	2GHz	/	0.0025	0.0021	0.0025
	10GHz	/	0.0030	0.0026	0.0030
	20GHz	/	0.0036	0.0033	0.0035
Dielectric constant temperature coefficient	-55 °～150°C	PPM/°C	27	43	43
Peel strength	1 OZ RTF copper foil	N/mm	0.85	1.0	0.85
	1 OZ RTF copper foil	N/mm	0.72	0.72	0.72
Volumetric resistivity	C96/23/95	MΩ.cm	3×10^{8}	5×10^{9}	5×10^{9}
Surface resistance	C96/23/95	MΩ	2×10^{8}	5×10^{9}	5×10^{9}
Electrical strength (Z-direction)	5KW, 500V/s	KV/mm	28	22	22
Breakdown voltage (XY direction)	5KW, 500V/s	KV	35	22	22
Thermal expansion coefficient (X, Y direction)	-55 °～288°C	ppm/°C	15,14	15,13	15,13
Thermal expansion coefficient (Z-direction)	-55 °～288°C	ppm/°C	31	39	39
Thermal stress	288°C, 10s, 3 times	/	No delamination	No delamination	No delamination
Water absorption	20±2°C, 24h	%	0.15	0.02	0.05
Density	Room temperature	g/cm^3	1.57	1.82	1.78
Long-term usability	High and low temperature box	°C	Normal use	Normal use	Normal use
Thermal conductivity	Z direction	W/(M.K)	0.41	0.59	0.59
PIM	With RTF copper foil	dBc	⩽-158	⩽-157	⩽-157
Fammability rating	UL-94	Grades	V-0	Non-flame-retardant	V-0
Tg	General	°C	＞280°C	＞280°C	＞280°C
Td	Start value	°C	412	421	386
Contains halogen or not			Halogenated	Halogen free	Halogenated
Material composition			Hydrocarbon +specialceramics +glass fiber cloth	Hydrocarbon+Ceramic+Fiberglass Fabric	

Product technical parameters			Product model/Data			
Property	Conditions	Units	WL-CT338	WL-CT350	WL-CT440	WL-CT615
Dielectric constant (typical value)	10GHz	/	3.38	3.48	4.10	6.15
Dielectric constant (design value)	10GHz	/	3.55	3.66	4.38	6.4
Dielectric constant tolerance	/	/	±0.05	±0.05	±0.08	±0.15
Loss factor (typical value)	2GHz	/	0.0023	0.0030	0.0040	0.0032
	10GHz	/	0.0029	0.0039	0.0050	0.0040
	20GHz	/	0.0038	0.0048	/	/
Dielectric constant temperature coefficient	-55 °～150°C	PPM/°C	45	52	-21	-122
Peel strength	1 OZ ED copper foil	N/mm	1.0	0.85	1.0	0.9
	1 OZ RTF copper foil	N/mm	0.72	0.72	N/A	N/A
Volumetric resistivity	C96/23/95	MΩ.cm	6×10^{9}	1×10^{9}	1×10^{9}	2×10^{7}
Surface resistance	C96/23/95	MΩ	7×10^{8}	4×10^{9}	5×10^{7}	5×10^{6}
Electrical strength (Z-direction)	5KW, 500V/s	KV/mm	31	31	27	30
Breakdown voltage (XY direction)	5KW, 500V/s	KV	30	30	25	25
Thermal expansion coefficient(X, Y direction)	-55 °～288°C	ppm/°C	14,16	11.14	14,18	15,17
Thermal expansion coefficient(Z direction)	-55 °～288°C	ppm/°C	50	34	35	33
Thermal stress	288°C, 10s, 3 times	/	No delamination	No delamination	No delamination	No delamination
Water absorption	23.5±2°C, 24h	%	0.04	0.05	0.12	0.08
Density	Room temperature	g/cm^3	1.78	1.90	2.00	2.18
Long term usability	High and low temperature box	°C	Normal use	Normal use	Normal use	Normal use
Therma conductivity	Z direction	W/(M.K)	0.70	0.70	0.66	0.72
PIM	With RTF copper foil	dBc	⩽-158	⩽-157	N/A	N/A
Fammability rating	UL-94	Grades	Non-flame-retardant	V-0	V-0	V-0
Tg	General	°C	＞280°C	＞280°C	＞280°C	＞280°C
Td	Start value	°C	421	386	402	398
Contains halogen or not			Halogen free	Halogenated	Halogenated	Halogen free
Material composition			Hydrocarbon+Ceramic+Fiberglass Fabric			

Optional copper foil:

Copper foil thickness：0.5OZ（0.018mm），1OZ（0.035mm）；Other thicknesses on request；

Copper foil type: ED copper foil, RTF copper foil. (RTF copper foil is adhesive backed copper foil, substrate thickness will be increased by 0.018mm (0.7mil))

Note: WL-CT440 and WL-CT615 are limited to provide ED copper foil, other models can provide two types of copper foil

Available sizes (special sizes contact our company for customization):

460×610mm（18×24〞） 915×1220mm（36×48〞）

Media layer thickness and tolerances available:

WL-CT300 media thickness and tolerance

WL-CT300 is the thinnest 0.127mm (5mil) thickness, we can provide 0.127mm (5mil) multiplier products, if it is more than 3.05mm, please contact us for customization, when it is matched with RTF copper foil The media thickness increases by 0.018mm (0.7mil) when matched with RTF copper foil.

With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.127mm(5.0mil)	±0.012mm(0.5mil)	0.272mm(10.7mil)	±0.025mm(1.0mil)
0.254mm(10mil)	±0.025mm(1.0mil)	0.526mm(20.7mil)	±0.038mm(1.5mil)
0.508mm(20mil)	±0.038mm(1.5mil)	0.78mm（30.7mil）	±0.051mm(2.0mil)
0.762mm(30mil)	±0.05mm(2.0mil)	1.034mm(40.7mil)	±0.076mm(3.0mil)
1.016mm(40mil)	±0.076mm(3.0mil)	1.542mm(60.7mil)	±0.10mm(4.0mil)
1.524mm(60mil)	±0.10mm(4.0mil)	2.05mm(80.7mil)	±0.127mm(5.0mil)

WL-CT330/330Z media thickness and tolerance

WL-CT300/330Z is the thinnest 0.254mm (10mil) thickness, we can provide 0.254mm (10mil) multiplier products,contact us for customization if it is more than 3.05mm, with RTF copper foil thickness is increased by 0.018mm (0.7mil).

With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.254mm(10mil)	±0.025mm(1.0mil)	0.272mm(10.7mil)	±0.025mm(1.0mil)
0.508mm(20mil)	±0.038mm(1.5mil)	0.526mm(20.7mil)	±0.038mm(1.5mil)
0.762mm(30mil)	±0.05mm(2.0mil)	0.78mm（30.7mil）	±0.051mm(2.0mil)
1.016mm(40mil)	±0.076mm(3.0mil)	1.034mm(40.7mil)	±0.076mm(3.0mil)
1.524mm(60mil)	±0.10mm(4.0mil)	1.542mm(60.7mil)	±0.10mm(4.0mil)
2.03mm（80mil）	±0.127mm(5.0mil)	2.05mm(80.7mil)	±0.127mm(5.0mil)

WL-CT338 media thickness and tolerance			
WL-CT338 has the thinnest thickness of 0.102mm (4mil), we can provide 0.102mm (4mil) multiplier products,contactus for customization when it is more than 3.05mm, and the media thickness increases by 0.018mm (0.7mil) when matched with RTF copper foil. The media thickness increases by 0.018mm (0.7mil) when matched with RTF copper foil.			
With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.102mm(4mil	±0.01mm(0.4mil)	0.221mm(8.7mil)	±0.025mm(1.0mil)
0.203mm(8mil)	±0.025mm(1.0mil)	0.526mm(20.7mil)	±0.038mm(1.5mil)
0.305mm(12mil)	±0.025mm(1.0mil)	0.831mm (32.7mil)	±0.051mm(2.0mil)
0.406mm(16mil)	±0.038mm(1.5mil)	1.034mm(40.7mil)	±0.076mm(3.0mil)
0.508mm(20mil)	±0.038mm(1.5mil)	1.542mm(60.7mil)	±0.10mm(4.0mil)
0.711mm (28mil)	±0.05mm(2.0mil)	2.05mm(80.7mil)	±0.127mm(5.0mil)
0.813mm (32mil)	±0.05mm(2.0mil)	/	/
1.016mm(40mil)	±0.076mm(3.0mil)	/	/
1.524mm(60mil)	±0.10mm(4.0mil)	/	/
WL-CT350 media thickness and tolerance			
WL-CT350 has the thinnest thickness of 0.102mm (4mil), starting from 0.168mm (6.6mil) and increasing in multiples of 0.0838mm (3.3mil), when it exceeds 6.1mm, contact our company contact us for customization, the thickness of the media increases by 0.018 mm (0.7mil) when matched with RTF copper foil.			
With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.102mm(4mil)	±0.01mm(0.4mil)	0.272mm(10.7mil)	±0.025mm(1.0mil)
0.168mm(6.6mil)	±0.018mm(0.7mil)	0.526mm(20.7mil)	±0.038mm(1.5mil)
0.254mm(10mil)	±0.025mm(1.0mil)	0.78mm (30.7mil)	±0.051mm(2.0mil)
0.338mm(13.3mil)	±0.038mm(1.5mil)	1.034mm(40.7mil)	±0.076mm(3.0mil)
0.422mm(16.6mil)	±0.038mm(1.5mil)	1.542mm(60.7mil)	±0.10mm(4.0mil)
0.508mm(20mil)	±0.038mm(1.5mil)	3.066mm(120.7mil)	±0.15mm(6.0mil)
0.762mm(30mil)	±0.05mm(2.0mil)	/	/
1.016mm(40mil)	±0.076mm(3.0mil)	/	/
1.524mm(60mil)	±0.10mm(4.0mil)	/	/

WL-CT440 media thickness and tolerance			
WL-CT440 is the thinnest 0.254mm (8mil) thickness, available in 0.254mm (8mil) multiples, with ED copper foil only			
With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.254mm(10mil)	±0.025mm(1.0mil)	1.016mm(40mil)	±0.076mm(3.0mil)
0.508mm(20mil)	±0.038mm(1.5mil)	1.524mm(60mil)	±0.10mm(4.0mil)
0.762mm(30mil)	±0.05mm(2.0mil)	2.03mm (80mil)	±0.127mm(5.0mil)

WL-CT615 Media thickness and tolerance			
WL-CT615 has the thinnest thickness of 0.203mm (8mil), we can provide 0.102mm (4mil) times products, if it is more than 6.15mm Contact us for customization, only with ED copper foil			
With ED copper foil		With RTF copper foil	
Thickness	Tolerance	Thickness	Tolerance
0.203mm(8mil)	±0.025mm(1.0mil)	0.813mm (32mil)	±0.05mm(2.0mil)
0.305mm(12mil)	±0.025mm(1.0mil)	1.016mm(40mil)	±0.076mm(3.0mil)
0.406mm(16mil)	±0.038mm(1.5mil)	1.524mm(60mil)	±0.10mm(4.0mil)
0.508mm(20mil)	±0.038mm(1.5mil)	2.03mm (80mil)	±0.127mm(5.0mil)
0.711mm (28mil)	±0.05mm(2.0mil)	3.05mm (120mil)	±0.15mm(6.0mil)

WL-CT series aluminum substrate:
This series of products can be provided lined with aluminum base material, i.e. the dielectric layer is covered with copper foil on one side and the dielectric layer is covered with aluminum base on the other side to play the role of shielding or heat dissipation. The model number is WL-CT***-AL.

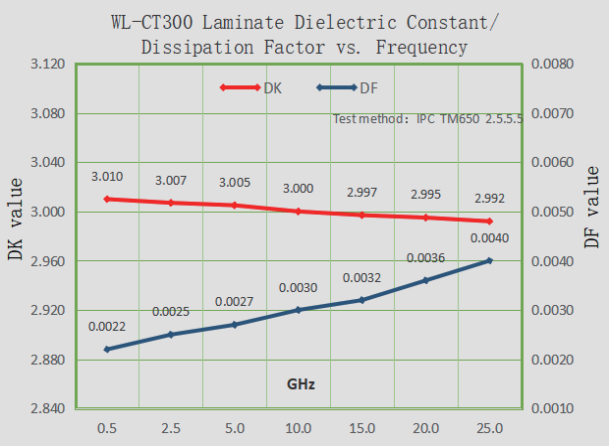
Model	Metal base	Weight	Thermal conductivity	Coefficient of thermal expansion	Aluminum base available in thickness mm	Aluminum base thickness tolerance (mm)	Available sizes (mm)
WL-CT***—AL	Aluminum based	2.7	180	24	0.48, 0.98, 1.48, 1.98, 2.98, 3.98, For other thicknesses, please contact us our company contact to make	+0.02, −0.05	460×610 460×305

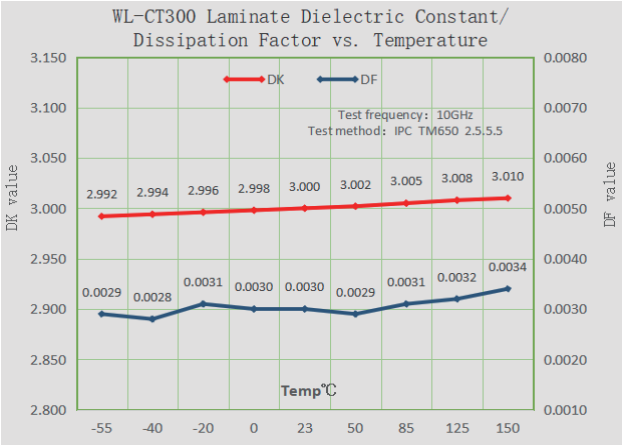
Example of model number: WL-CT350-AL stands for WL-CT350's aluminum-based laminate

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Dielectric constant (design value) using 50Ω microstrip line method test, test for the material Z-direction
3. Other performance tests are tested by or with reference to IPC-TM-650 or GBT4722-2017 specified test methods
4. All test data are typical measurements and are intended to assist customers in material selection and are not intended and do not constitute any express or implied warranty, nor do they ensure that customers will achieve all of the properties in the data sheet in a particular application, and customers are responsible for verifying and determining the suitability of Wantling materials for each application.

Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, the ideogram in the expression of the type of material change law, does not mean that each piece of the product is the data marked in the chart, but the product change trend in line with the change law in the chart.

WL-CT300 electrical performance chart

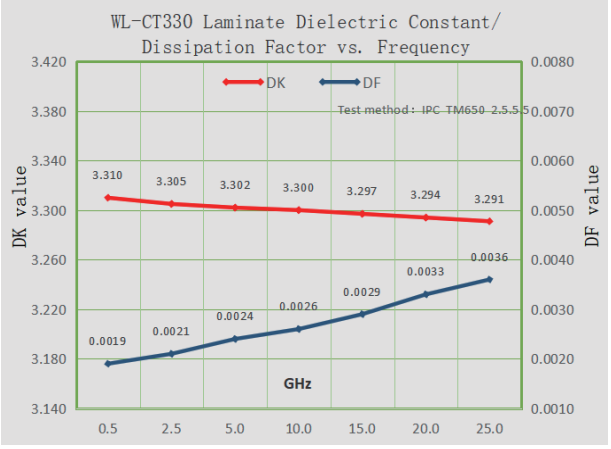


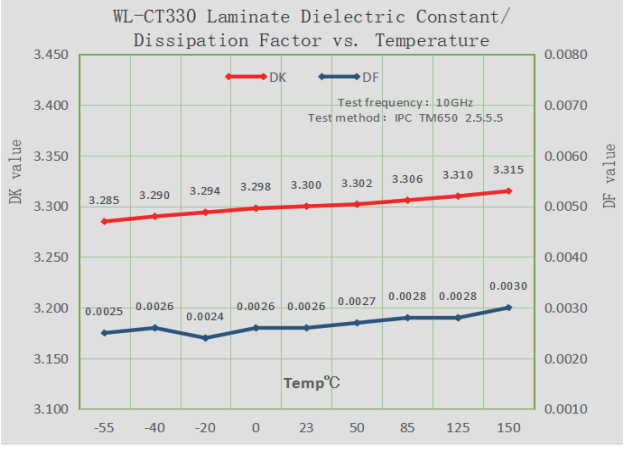


◈ Excellent frequency stability: the material has a stable dielectric constant within 0.5 to 25 GHz frequency, maintaining low loss values to meet the design requirements at different frequencies;

◈ Excellent temperature stability characteristics: TCDK in the range of -55~150℃ is about 27PPM/℃, with slight changes, and the actual usable temperature of the material far exceeds this temperature range.

WL-CT330 electrical performance chart



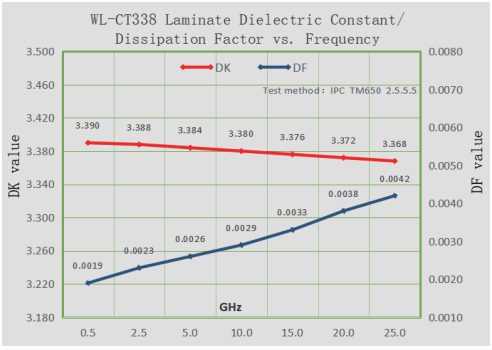


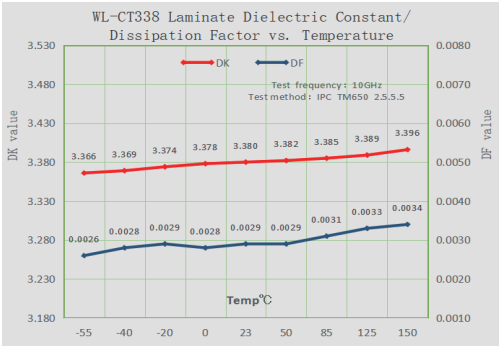
◈ Excellent frequency stability: the material has a stable dielectric constant within 0.5 to 25 GHz, maintaining a low loss value to meet the design at different frequencies. requirements;

◈ Excellent temperature stability characteristics: TCDK in the range of -55 to 150℃ is about 43PPM/℃, with small changes, and the actual material can be used at a temperature far exceeds this temperature range.

Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, the ideogram in the expression of the type of material change law, does not mean that each piece of the product is the data marked in the chart, but the product change trend in line with the change law in the chart.

WL-CT338 electrical performance chart

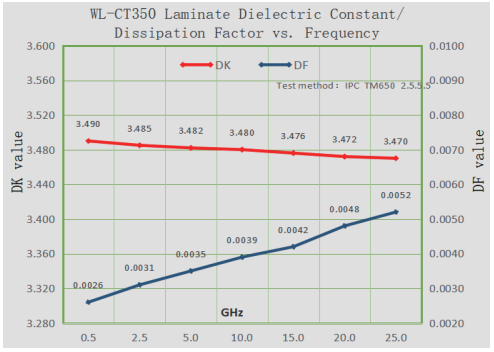


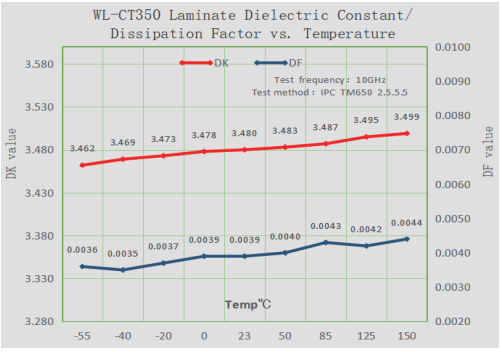


◈ Excellent frequency stability: the material has a stable dielectric constant within 0.5 to 25 GHz frequency, maintaining low loss values to meet the design requirements at different frequencies;

◈ Excellent temperature stability characteristics:TCDK in the range of -55～150°C is about 45PPM/°C, with slight changes, and the actual material can be used at temperatures far exceeding this temperature range.

WL-CT350 electrical performance chart

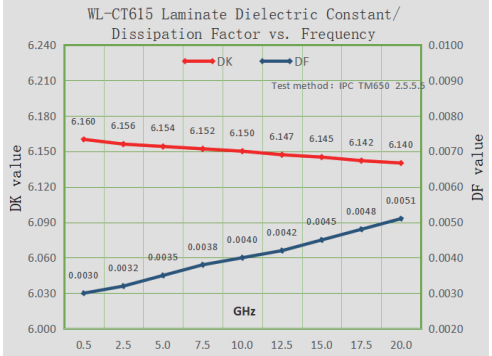


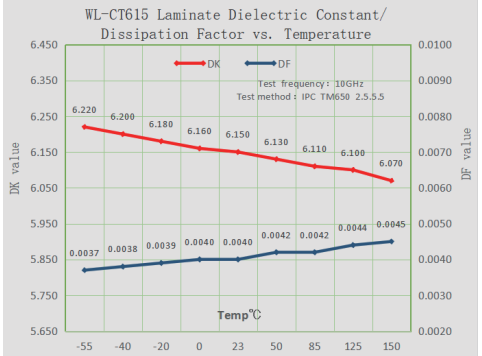


◈ Excellent frequency stability: the material has a stable dielectric constant within 0.5 to 25 GHz frequency, maintaining low loss values to meet the design requirements at different frequencies;

◈ Excellent temperature stability characteristics: TCDK in the range of -55~150°C is about 52PPM/°C, with slight changes, and the actual useable temperature of the material far exceeds this temperature range.

WL-CT615 electrical performance chart





◈ Excellent frequency stability: the material has a stable dielectric constant within 0.5 to 20 GHz frequency, maintaining a low loss value to meet the design requirements at different frequencies;

◈ Excellent temperature stability characteristics:TCDK in the range of -55～150°C is about 45PPM/°C, with slight changes, and the actual material can be used at temperatures far exceeding this temperature range.

Hydrocarbon ceramic-filled woven fiberglass adhesive film WL-PP300、WL-PP350

Products

This semi-curing sheet is made of hydrocarbon resin, ceramic filler and glass fiber cloth through scientific preparation and processing. It is a thermosetting type high frequency semi-curing sheet developed on the basis of WL-CT series sheets, which can be mixed and pressed with most of the core boards in the industry to realize the design requirements of high frequency and high speed multilayer boards.

Product Parameter

Name of Indicator	Test conditions	Unit	Model	
			WL-PP300	WL-PP350
Dielectric constant (after press fit)	10GHz	/	3.0	3.5
Dielectric constant tolerance	/	/	±0.05	±0.05
Dielectric loss (after press fit)	10GHz	/	0.0028	0.0042
Gum content	Amount of glue after removing glassfiber cloth	%	86%	80%
Copper foil peel strength	1 0Z ED copper foil	N/mm	0.8	0.8
Thickness after laminating	100%All copper rate or base material	℃	0.10±0.01mm	0.10±0.01mm
Tg	TMA	℃	＞280	＞280
Td	TGA	W/MK	394	386
Weight	Normal	/	1.75	1.85
Water absorption	23.5±2℃×24H	%	0.08	0.09
Thermal conductivity	/	W/M.K	0.6	0.7
Coefficient of thermal expansion (X,Y,Z)	-55～288℃	ppm/℃	30, 35, 54	20,18,52
Surface insulation resistance	500V DC	MΩ	≥5×10^7	≥1×10^7
Volume resistance	C96/23/95	MΩ.cm	≥8×10^8	≥6×10^8
Suggested press fit parameters	Real air compressor	℃	Material temperature 190℃×60～90min	Material temperature 190℃×60～90min
Flame retardancy	UL94V-0			
Lead free processing compatible	Yes			

1. Dielectric constant (typical value) test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Other performance tests using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;

Product Size

Conventional 457 x 610mm (18 x 24"), available in rolls up to 610mm (24") wide

Product Features:

◈ High-frequency thermosetting semi-cured sheet with small tolerance of dielectric constant and low loss value.
◈ Can be bonded and pressed with a variety of core plates such as WL-CT and FR4, and has a high TG value, allowing multiple pressings.
◈ Low coefficient of thermal expansion improves the reliability and dimensional stability of plated through-holes.
◈ Compatible with lead-free soldering process.

Processing Guidelines:

◈ Storage conditions: 5~30°C, sealed package, do not put under UV irradiation conditions, use the principle of first-in-first-out, preservation life is 6 months from the factory date. Long-term exposure to UV light and air, the semi-curing sheet will become yellow and hard, and can only be scrapped.
◈ When the total copper thickness of the press-fill exceeds 0.05mm, the number of bonding sheets needs to be increased to meet the filling requirements. We recommend the use of two or more semi-cured sheets between the two metal layers of the lamination, and according to the lamination parameters recommended in our processing guide, any deviation from these recommendations will require the processor to make adjustments / may lead to inadequate filling and electrical failure, especially in some high-speed digital / high-density circuit design, if the use of a single semi-cured sheet to bond both sides with the inner layer of the graphic. Higher pressures are required and the user must ensure that proper test protocols are in place to evaluate the filler/flow and electrical properties.
◈ When using a single sheet of semi-cured sheet for lamination or when the inner copper layer needs to be filled with a thick copper structure, a lamination pressure close to 700PSI is required to ensure that the filling requirements are met.
◈ When WL-PP350 semi-curing sheet is to be laminated with single copper foil, it is recommended to purchase special copper foil from our company in order to improve the peeling strength.
◈Recommended laminating parameters

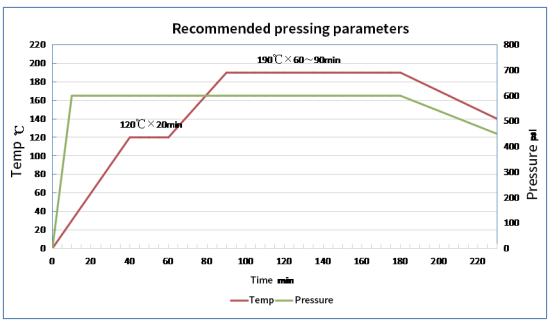
WL-PP350 semi-curing sheet has the lowest viscosity between 110°C and 120°C. 20 minutes in this low viscosity temperature range is good for the filling of multilayers. We recommend the following laminating parameters:

The heating rate from room temperature to 110°C is 2.5C-3.5°C/Min, and the temperature between 110°C and 120°C is kept for 20 minutes. The heating rate from material temperature 120°C to material temperature 190°C is 2.0°C-3.5°C/Min, and the material temperature 190°C is kept for 60 minutes; or the heating rate from 100°C to material temperature 190°C is 1°C/Min, and the material temperature 190°C is kept for 60 minutes. When selecting the buffer material, it may be necessary to test the temperature profile. Thermocouple wire needs to be placed in the laminated plate material to confirm the temperature profile.

Vacuum lamination is required. When the temperature inside the carrier tray exceeds 38°C, the lamination pressure needs to be raised to between 320PSI and 700PSI (depending on the filling requirements) and applied throughout the lamination cycle, while avoiding pre-vacuuming for more than 5 minutes. After pressing at 190°C for 60-90 minutes, the press can be transferred to a cold press for cold pressing.
◈ About flowing and overflowing glue: the glue flowing on the board edge after laminating is less and can be used for multi-layer step groove design.
◈ Outer layer and PTH treatment.

Depending on the quality of through-hole walls, multilayer structural panels require a de-drilling process to treat the drilled hole walls. If a decontamination process is necessary, CF4/02 plasma is superior to conventional chemical decontamination processes. When choosing the chemical decontamination process, consideration should be given to shorten the treatment time of the expansion tank solution and potassium permanganate tank solution, and there should be no cavitation on the core plate and bonding sheet locations on the hole walls in the multilayer panels.

Recommended Press-fit Parameters:



◈The above temperature is the material temperature.
◈Starting temperature to 120°C heating rate is 2.5~3.5°C /min.
◈ Keep 120°C for 20min.
◈ The heating rate from 120°C to 190°C is 2.0~3.5°C/min.
◈ Pressed together at 190°C for 60 to 90min.

Ceramic composite bonding ply WL-PP280

Product Introduction

WL-PP280 is a ceramic composite film bonded sheet without glass fiber reinforcement by coating both sides of ceramic filled PTFE film with excellent comprehensive performance of thermosetting resin coating (see Figure 1 below), which combines the excellent dielectric properties of PTFE ceramic film and excellent comprehensive performance of thermosetting resin coating to meet the multifaceted requirements of Prepreg for increasingly complex high frequency microwave multilayers WL-PP280 is superior to traditional Prepreg for HF boards (such as Speed C, FEP, PFA, hydrocarbon/glass fiber cloth, etc.), and greatly improves the qualification rate and reliability of HF microwave multilayers, making it a comprehensive semi-cured sheet material with excellent cost performance.

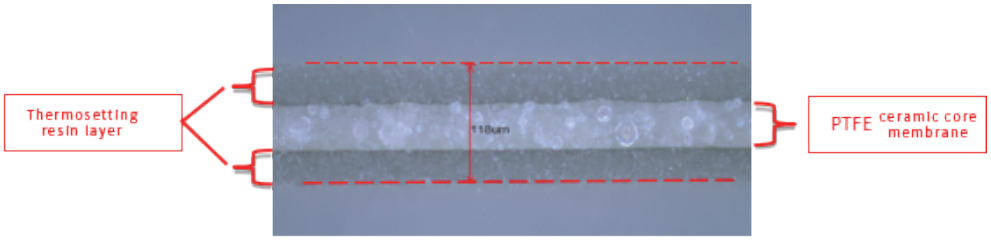


Figure 1 Structure diagram of WL-PP280

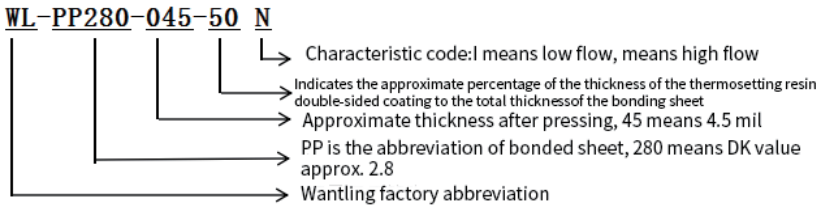
Product Features

◈ Excellent dielectric properties, stable dielectric constant, small dielectric loss; small change in dielectric properties with the environment.
◈ Excellent frequency stability, suitable for high frequency use such as millimeter wave;
◈ Excellent heat resistance, can withstand multiple press-fit and multiple reflow soldering, also meet the requirements of lead-free process.
◈ Low coefficient of thermal expansion ensures the reliability of multilayer PTH and improves the qualification rate of multilayer boards.
◈ Unique material rheological characteristics, which can ensure complete filling and partial hole plugging of the line with a small amount of glue overflow;
◈ Different thickness and flow rate of bonding sheets are available.
◈ Good workability, no sticky hands when holding and placing, no powder loss when cutting, easy to fix when stacking.
◈ Can be used with most materials, such as PTFE, epoxy, FCCL and ceramic substrates, etc.
◈ Excellent thickness uniformity and consistency to ensure the thickness tolerance and phase stability of multilayer boards.

Product Size

◈ Regular 457×610mm (18×24"), 457×305mm (18×12")
◈ Available in rolls with a width of 610mm (24"), and can also be cut into sheets as desired by the user (maximum width 610mm).

Product Name



All test data are typical measurements and are intended to assist the customer in material selection and are not intended and do not constitute any express or implied warranty, nor do they guarantee that the customer will achieve all of the properties in this data sheet in a particular application, and the customer is responsible for verifying and determining the suitability of the Wantling material for each application.

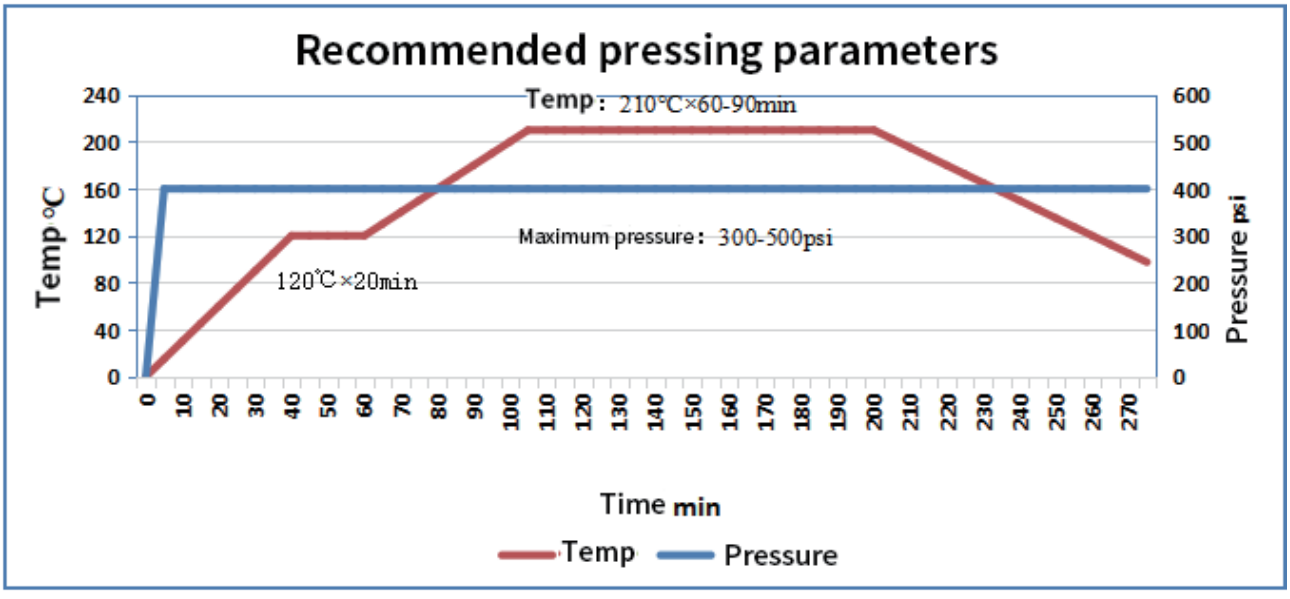
Product Basic Parameters				
Model	DK	Df	Single sheet static pressure thickness (mm) (Both sides covered with copper)	Mobility (%)
WL-PP280-45-50N	2.74±0.04	0.0017	0.117±0.010	2~6%
WL-PP280-45-50H (In development)	2.74±0.04	0.0019	0.117±0.010	8~12%

WL-PP280 performance parameters (6 sheets of PP press-fit test)				
Projects	Conditions	Units	WL-PP280-45-50N	WL-PP280-45-50H
Substrate thickness	6 sheets pressed together	mm	0.71	0.69
Peel strength	1OZ, ED	N/mm	0.6	0.85
Dk	10GHz	/	2.74	2.74
	40GHz	/	2.70	2.70
DK tolerance	/	/	±0.04	±0.04
Df	10GHz	/	0.0017	0.0019
	40GHz	/	0.0021	0.0024
Water absorption rate	24H	%	0.04	0.08
Thermal shock	288°C, tin dip	min	>5 times No delamination, no blistering	>5 times No delamination, no blistering
Surface resistance	Room temperature and C96/23/95	M.Ω	$\geqslant 1\times10^{8}$	$\geqslant 1\times10^{8}$
Volume resistance	Room temperature and C96/23/95	MΩ.cm	$\geqslant 1\times10^{8}$	$\geqslant 1\times10^{8}$
Density	/	g/cm^3	1.84	1.85
Coefficient of thermal expansion(X,Y,Z)	-55～125°C	ppm/°C	60,65,70	55,63,65
Thermal conductivity	Z direction	W/MK	0.46	0.45
Tg	TMA	°C	192	195
Td	TGA	°C	407	418
ROHS	/	/	Yes	Yes

1. Dielectric constant test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Other performance tests using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;

Processing guide

◈ Storage conditions: 5~30℃, sealed package, do not put under UV light irradiation conditions, use the principle of first-in-first-out, preservation life is 6 months from the factory date. Long-term exposure to UV light and air, the semi-curing sheet will harden and can only be scrapped.
◈ Due to the fluidity and structural peculiarities of the bonding sheet, it is recommended to use this PP for the inner layer of copper foil ⩽ 60 microns. When the total copper thickness of the laminated filler exceeds 60 microns, please verify the suitability of your company.
◈ Bonding sheet is generally not recommended for blind and buried hole filling, if customers need blind and buried hole filling, please verify the hole depth ⩽ 0.5mm, hole diameter
⩽ 0.6mm specification products.
◈ Bonding sheet is generally not recommended to be laminated with pure copper foil, if necessary, please communicate with our technical staff and use special copper foil.
◈ About flowing and overflowing glue: It is a low-fluidity bonding sheet, and the amount of flowing glue on the edge of the board after lamination is small.
WL-PP280-45-50N has less flow than WL-PP280-45-50F, and is used for multi-layer ladder slot design to assist with adhesive resist stacking.
◈ Outer layer and PTH treatment: Depending on the quality of the through-hole walls, multilayer structural panels require a decontamination process to treat the drilled hole walls. CF4/02 plasma decontamination process is required. When choosing chemical de-drilling process, consideration should be given to shorten the treatment time of the expansion tank solution and potassium permanganate tank solution, and there should be no concave corrosion on the core plate and bonding sheet position on the hole wall in the multilayer board.
◈ Lamination recommendation: According to the rheological characteristics of this material, we recommend the following lamination procedure. Since the structure of PCB varies greatly, customers need to adjust the best lamination parameters according to the actual situation.



A The above temperature is the material temperature.
B The starting temperature to 120 ℃ heating rate of 2.0 ~ 3.5 ℃ / min, 120 ℃ is the viscosity of the best temperature, maintain 20min;
C 120 ℃ to 210 ℃ heating rate of 2.0 ~ 3.5 ℃ / min, 210 ℃ to maintain 60 ~ 90min, curing;
D slow cooling, the cooling rate of 1.0 ~ 1.5 ℃ / min, down to 100 ℃ below the release pressure;
E The full range of pressure is 300 ~ 500PSI, vacuum pressed together.

1. Dielectric constant test for material Z-direction, using GB/T 12636-1990 or IPC-TM650 2.5.5.5 strip line method test;
2. Other performance tests using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;

Microwave substrates TP-1/2 series

Product Description

TP material is a unique high-frequency thermoplastic material in the industry, TP sheet dielectric layer consists of ceramic + polyphenylene ether resin (PPO), the sheet does not contain glass fiber reinforcement, by adjusting the ratio between ceramic and PPO resin to accurately adjust the dielectric constant; special production process; excellent dielectric properties and high reliability. TP refers to the glossy material without copper coating, TP-1 refers to the material with copper coating on one side, TP-2 refers to the material with copper coating on both sides, TP-2 refers to the material with copper coating on both sides.

Product Features

◈ Dielectric constant can be selected according to the circuit requirements in the range of 3 to 25, and stable, commonly used dielectric constant are 3.0, 4.4, 6.0, 6.15, 9.2, 9.6, 10.2, 11, 16, 20; dielectric loss is small, the loss increases at higher frequencies, but the change is not significant within 10G.
◈ Long-term use temperature is -100°C～+150°C, excellent resistance to low temperature, when the temperature exceeds 180°C, the material may be deformed, the copper foil falls off, and the electrical properties change greatly.
◈ The thinnest thickness is 0.5mm, thickness is abundant and can be customized.
◈ Resistant to irradiation, low exhaust.
◈ Ideal material for Beidou, bullet load, fuze, miniaturized antenna.
◈ The adhesion of copper foil and media is firmer than the vacuum coating of ceramic substrate, and the material is easy to be machined and can be drilled, turned, ground, sheared, engraved, etc., which cannot be compared with ceramic substrate.
◈ The circuit board is easy to process and can be processed according to the thermoplastic material with high yield and the processing cost is greatly reduced compared with the ceramic substrate; in view of the characteristics of the material, it is generally not recommended for multilayer board processing, if multilayer board processing is carried out, please choose the low temperature type bonding sheet and fully consider the feasibility.
◈ The material is not suitable for thermal shock test at 260°C and cannot be wave soldered; welding is recommended for manual welding with constant temperature soldering iron, reflow soldering is generally not recommended, if reflow soldering is carried out, the maximum setting temperature should not exceed 200°C, and please fully consider the feasibility and stability.

Copper foil type: ED copper foil; Copper foil thickness: 0.018mm, 0.035mm							
Available sizes:							Size Tolerance
150×150mm 160×160mm 200×200mm 170×240mm							-2mm
Available thickness and tolerance (the following is the conventional thickness, non-conventional thickness contact our company to customize): **The following thickness is the total thickness of copper or media thickness, both can be produced, please indicate whether "total thickness of copper" or "media thickness" when customers place orders.**							
Thickness (mm)	0.5	0.8	1.0	1.2	1.5	2.0	3.0
Tolerance (mm)	±0.04	±0.05	±0.05	±0.05	±0.06	±0.075	±0.1
Thickness (mm)	4.0	5.0	6.0	7.0	8.0	10.0	12.0
Tolerance (mm)	±0.1	±0.12	±0.12	±0.15	±0.18	±0.2	±0.3
When the dielectric constant ⩽ 10.2, the thinnest production thickness is 0.5mm; when the dielectric constant > 10.2, the thinnest production thickness is 0.8mm							

Product technical parameters				Product model/Data		
Property	Conditions		Units	TP	TP-1	TP-2
Dielectric constant	When the dielectric constant is ⩽ 11, the test conditions are10GHz When the dielectric constant is greater than 11, the test conditions are5GHz		/	3.0±0.06	4.4±0.09	6.0±0.12
				6.15±0.12	9.2±0.18	9.6±0.19
				10.2±0.2	11.0±0.022	16.0±0.4
				20.0±0.8	22.0±0.88	25.0±1.0
				The dielectric constant can be customized between 3.0 and 25		
Dielectric constant tolerance	Dielectric constant 3.0～11.0		/	±2%		
	Dielectric constant 11.1～16.0		/	±2.5%		
	Dielectric constant 16.1～25.0		/	±4%		
Loss factor	Dielectric constant 3.0～9.5	10GHz	/	0.0010		
	Dielectric constant 9.6～11.0	10GHz	/	0.0012		
	Dielectric constant 11.1～16.0	5GHz	/	0.0015		
	Dielectric constant 16.1～25.0	5GHz	/	0.0020～0.0025		
Dielectric constant temperature coefficient	Dielectric constant 3.0～9.5	-55 °～150°C	PPM/°C	-50		
	Dielectric constant 9.6～16.0	-55 °～150°C	PPM/°C	-40		
	Dielectric constant 16.1～25.0	-55 °～150°C	PPM/°C	-55		
Peeling strength	1 OZ normal		N/mm	＞0.6		
	1 OZ After alternating dampness and heat		N/mm	＞0.4		
Volume resistivity	Normal behavior 500V		MΩ.cm	＞1×10^{9}		
Surface resistance	Normal behavior 500V		MΩ	＞1×10^{7}		
Coefficient of thermal expansion (X Y Z)	Dielectric constant 3.00～4.40	-55 °～150°C	PPM/°C	60,60,70		
	Dielectric constant 4.60～6.15	-55 °～150°C	PPM/°C	50,50,60		
	Dielectric constant 6.16～11.0	-55 °～150°C	PPM/°C	40,40,55		
	Dielectric constant 11.1～16.0	-55 °～150°C	PPM/°C	40,40,50		
	Dielectric constant 16.1～25.0	-55 °～150°C	PPM/°C	35,35,40		
Water absorption	20±2°C, 24h		%	⩽0.01		
Long term usability	Thermal Shock Chamber		°C	-100～150		
Material composition				Polyphenylene ether, ceramic, ED copper foil		

The density and thermal conductivity data of materials with different dielectric constants are as follows:

Product characte-ristics	Units	Dielectric constant										
		3.0	4.4	6.0	6.15	9.6	10.2	11.0	16.0	20.0	22.0	25.0
Density	g/cm^3	1.69	1.89	2.1	2.12	2.26	2.33	2.40	2.76	2.73	2.77	2.94
thermal conduc-tivity	W/m/K	0.40	0.44	0.55	0.55	0.65	0.67	0.70	0.80	0.85	0.90	1.0

1. The dielectric constant (typical value) is tested in the Z direction of the material, and the stripline method (GB/T 12636-1990 or IPC-TM650 2.5.5.5) is used;
2. Other performance tests shall be conducted using or referring to the test methods specified in IPC-TM-650 or GBT4722-2017;
3. All test data are typical measurement data and are intended to assist customers in material selection. It is not intended and does not constitute any express or implied warranty, nor does it guarantee that customers will achieve all the performance specified in the data sheet in specific situations. Customers are responsible for verifying and determining the adaptability of Wangling materials in each application.

Jiangsu Wangling Technology Co., Ltd (2023.2)
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