

## PTFE ultra-thin ultra-fine glass fiber cloth ceramic filled substrate F4BTMS 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			
Product Features	Test conditions	Unit	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	Normal	MΩ.cm	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
Surface resistance	Normal	MΩ	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
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	/	Not stratified	Not stratified	Not stratified	Not stratified
Water absorption	20±2°C, 24h	%	0.02	0.02	0.025	0.025
Density	Normal temperature	g/cm <sup>3</sup>	2.18	2.22	2.26	2.26
Long-term use temperature	High and low temperature box	°C	-55~+260	-55~+260	-55~+260	-55~+260
Thermal conductivity	Z direction	W/(M.K)	0.26	0.28	0.31	0.36
Flame retardancy	/	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 Wangling material for each application.

Product technical parameters			Product model/Data		
Product features	Test conditions	Unit	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	Normal	MΩ.cm	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
Surface resistance	Normal	MΩ	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
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 stratification	No stratification	No stratification
Water absorption	20±2°C, 24h	%	0.02	0.025	0.03
Density	Normal temperature	g/cm <sup>3</sup>	2.25	2.28	2.3
Long-term use temperature	High and low temperature chamber	°C	-55~+260	-55~+260	-55~+260
Thermal conductivity	Z direction	W/(M.K)	0.58	0.58	0.6
Flame retardancy	/	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.



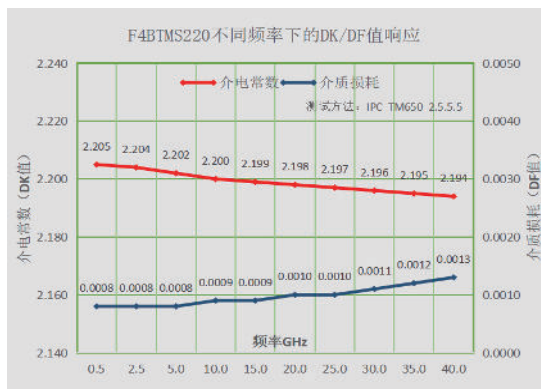
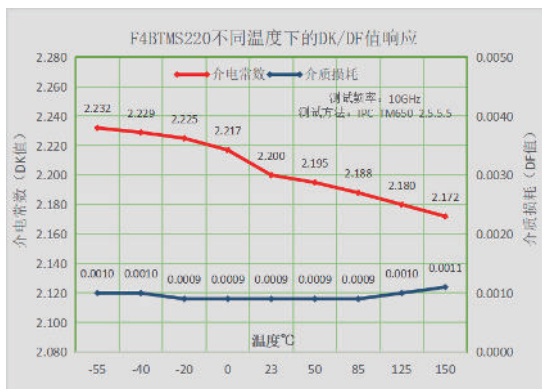
Product technical parameters			Product technical parameters			
Product features	Test conditions	Unit	F4BTMS430	F4BTMS450	F4BTMS615	F4BTMS1000
Dielectric constant (typical value)	10GHz	/	4.30	4.50	6.15	10.20
Dielectric constant tolerance	/	/	±0.09	±0.09	±0.12	±0.2
Dielectric constant (design value)	10GHz	/	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	Normal	MΩ.cm	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
Surface resistance	Normal	MΩ	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>	≥1×10 <sup>8</sup>
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 stratification	No stratification	No stratification	No stratification
Water absorption	20±2°C, 24h	%	0.08	0.08	0.1	0.03
Density	Normal temperature	g/cm <sup>3</sup>	2.51	2.53	2.75	3.2
Long-term use temperature	High and low temperature chamber	°C	-55~+260	-55~+260	-55~+260	-55~+260
Thermal conductivity	Z direction	W/(M.K)	0.63	0.64	0.67	0.81
Flame retardancy	/	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.

<p><b>Optional copper foil:</b></p> <p>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.</p>							
<p><b>Available sizes (special sizes contact our company for customization):</b></p> <p>305×460mm (12×18<sup>°</sup>)    460×610mm (18×24<sup>°</sup>)    610×920mm (24×36<sup>°</sup>)</p>							
<p><b>Media layer thickness and tolerance can be provided (special thickness contact our company for customization):</b></p> <p>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.</p>							
Thickness mm (mil)	Tolerance mm (mil)				Thickness mm (mil)	Tolerance mm (mil)	
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)	
<p><b>F4BTMS series aluminum base/copper substrate:</b></p> <p>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。</p>							
Model	Metal base	Specific Gravity	Thermal conductivity	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	+0.02, -0.05	460×610 460×305
F4BTMS***-AL	Aluminum based	2.7	180	24	Other thicknesses with our company Contact to make		
<p><b>Model examples:</b></p> <p>F4BTMS220-AL stands for F4BTMS220 laminated aluminum-based sheet                  F4BTMS294-CU stands for F4BTMS294 copper based laminate</p>							

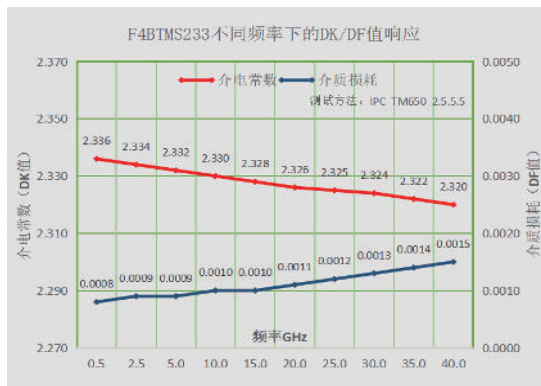
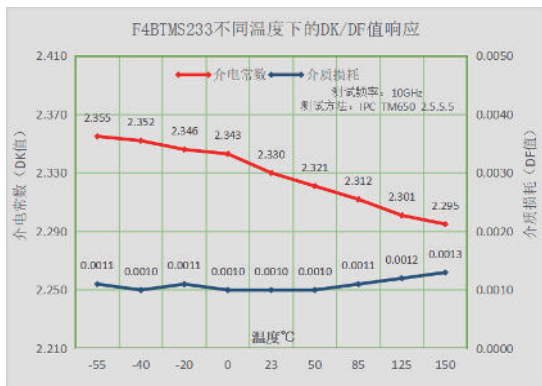
Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, 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**



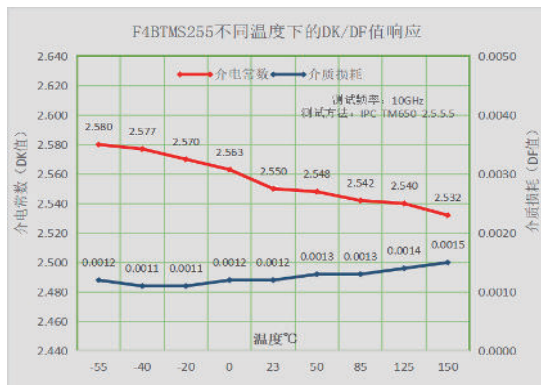
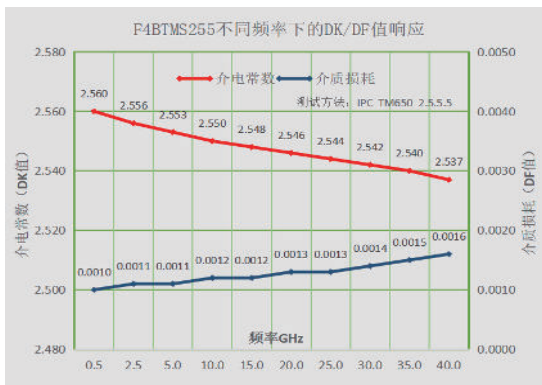
- ◆ Excellent frequency stability: the material is stable in terms of dielectric constant and loss within 0.5 to 40 GHz frequency, maintaining ultra-low loss values to meet the design requirements at different frequencies;
- ◆ -The TCDK in the range of 55 to 150°C is about -130PPM/°C, which provides 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**

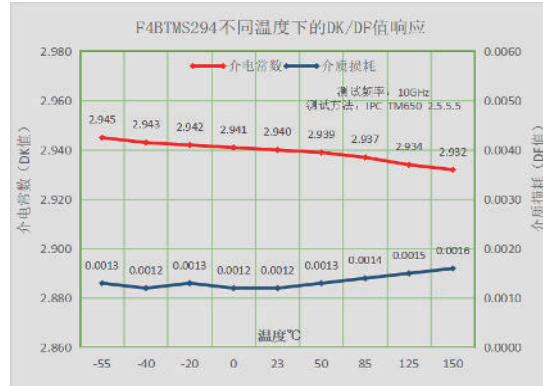
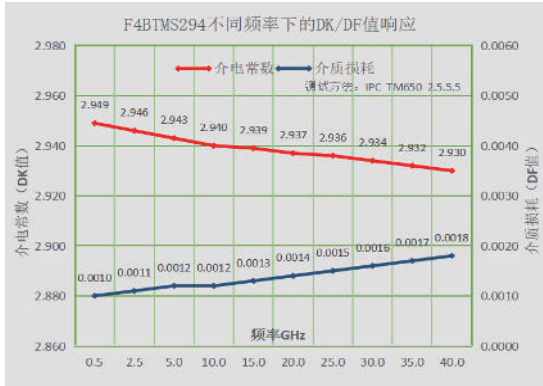


- ◆ Excellent frequency stability: the material has stable dielectric constant and loss within 0.5~40GHz frequency, maintaining low loss value to meet the design requirements at different frequencies;
- ◆ The TCDK in the range of -55~150°C is about -92PPM/°C, which provides reference data for different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



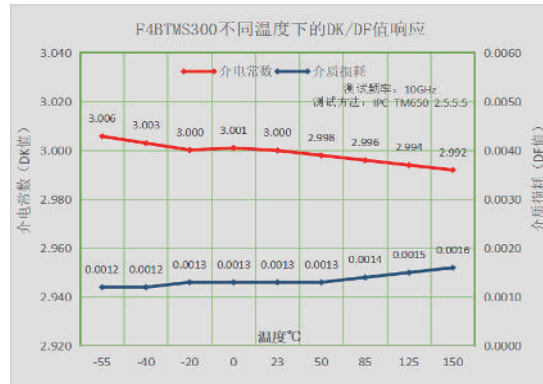
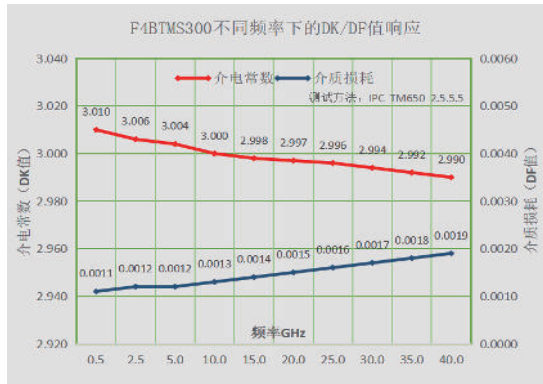
Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, 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**



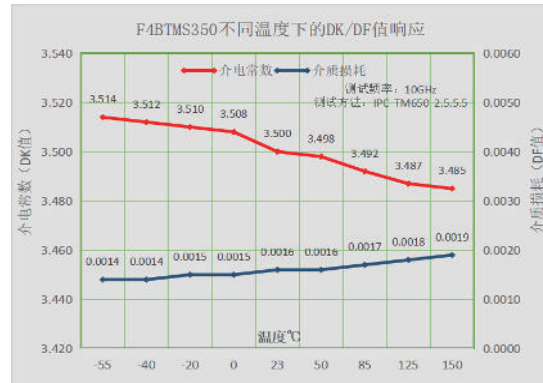
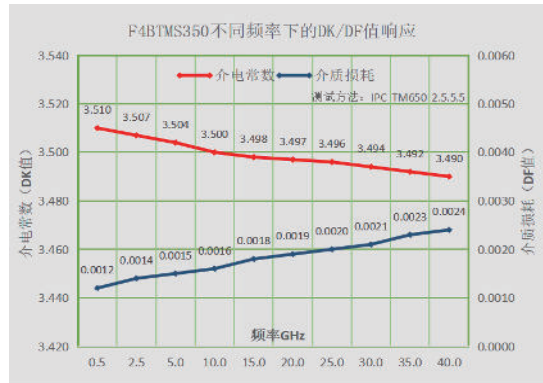
- ◆ Excellent frequency stability: the material has stable dielectric constant and loss within 0.5~40GHz frequency, keeping low loss value to meet the design requirements under different frequencies;
- ◆ Excellent temperature stability characteristics: TCDK in the range of -55~150°C is about -20PPM/°C, 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.

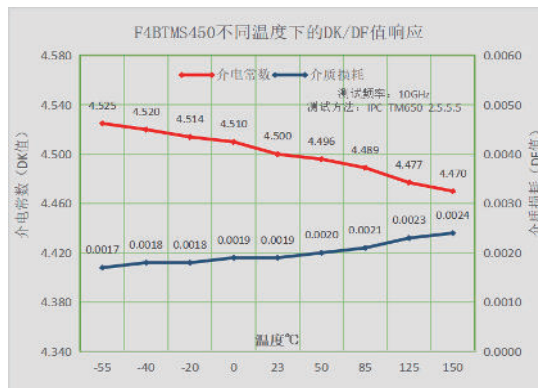
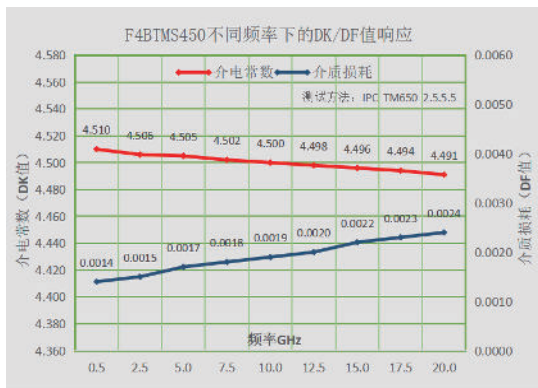
**F4BTMS350 electrical performance chart**



- ◆ 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.

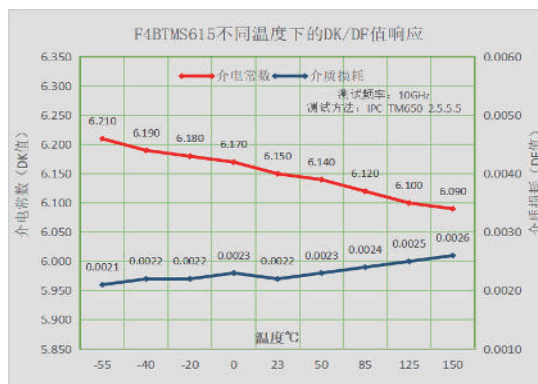
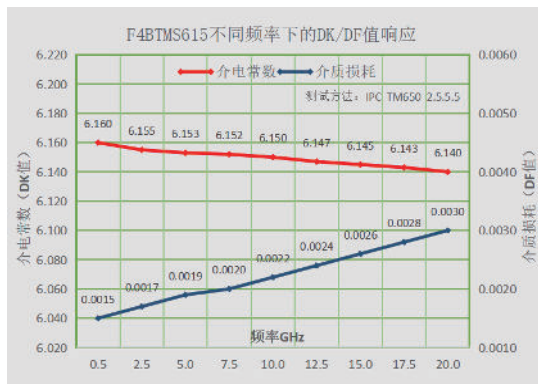
Electrical properties chart description: frequency change is based on the median dielectric constant and median loss at 10G, temperature change is based on the median dielectric constant and median loss at 23 degrees Celsius at room temperature, and the accumulated data statistics of the change law approximation, 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



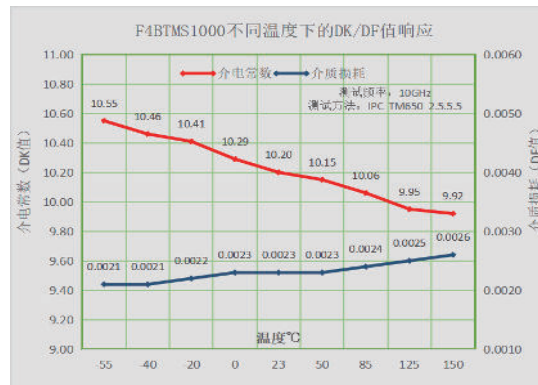
- ◆ Excellent frequency stability: the material has stable dielectric constant and keeps low loss value in the frequency of 0.5 ~ 20GHz, which meets the design requirements under different frequencies;
- ◆ Excellent temperature stability characteristics, the TCDK in the range of -55 ~ 150°C is about -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.