

## Microwave laminated dielectric copper-clad substrate TP-1/2

### ■ 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							
<b>Available sizes:</b>							Size Tolerance
150×150mm	160×160mm	200×200mm	170×240mm				-2mm
<b>Available thickness and tolerance (the following is the conventional thickness, non-conventional thickness contact our company to customize):</b>							
<b>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.</b>							
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
<b>When the dielectric constant ≤ 10.2, the thinnest production thickness is 0.5mm; when the dielectric constant &gt; 10.2, the thinnest production thickness is 0.8mm</b>							



Product technical parameters				Product model/Data								
ProductFeatures	Test conditions		Unit	TP	TP-1	TP-2						
Dielectric constant	When the dielectric constant is $\leq 11$ , the test conditions are 10GHz When the dielectric constant is greater than 11, the test conditions are 5GHz		/	3.0 $\pm$ 0.06	4.4 $\pm$ 0.09	6.0 $\pm$ 0.12						
				6.15 $\pm$ 0.12	9.2 $\pm$ 0.18	9.6 $\pm$ 0.19						
				10.2 $\pm$ 0.2	11.0 $\pm$ 0.022	16.0 $\pm$ 0.4						
				20.0 $\pm$ 0.8	22.0 $\pm$ 0.88	25.0 $\pm$ 1.0						
				The dielectric constant can be customized between 3.0 and 25								
Dielectric constant tolerance	Dielectric constant 3.0~11.0		/	$\pm 2\%$								
	Dielectric constant 11.1~16.0		/	$\pm 2.5\%$								
	Dielectric constant 16.1~25.0		/	$\pm 4\%$								
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 $\times$ 10 <sup>9</sup>								
Surface resistance	Normal behavior 500V		MΩ	>1 $\times$ 10 <sup>7</sup>								
Coefficient of thermal expansion (XYZ)	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 $\pm$ 2°C, 24h		%	$\leq 0.01$								
Long term use temperature	High and low temperature box		°C	-100°~150°C								
Material composition				Polyphenylene ether, ceramic, paired with ED copper foil								
The density and thermal conductivity data of materials with different dielectric constants are as follows:												
Product characteristics	Unit	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 <sup>3</sup>	1.69	1.89	2.1	2.12	2.26	2.33	2.40	2.76	2.73	2.77	2.94
thermal conductivity	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.