



## AGC Solutions Guide

### “Your Dreams, Our Challenge”

Established 100 years ago, AGC has evolved into a world leading supplier of : architectural / automotive glass, electronic materials such as CMP slurries and silicon carbide, chemicals including fluoro products and refrigerant gases, ceramics such as refractory materials and now multi materials.

AGC’s multi material division is focused on the development of dielectric substrates for high frequency electronics such as high-speed wired and wireless communication, intelligent vehicle, aerospace & defense and next generation satellite communication.

**AGC is providing the broadest range of low loss base materials**

#### **PTFE Resin System**

#### **Thermoset Resin Systems**

- PPE
- Polyimide

[www.agc-multimaterial.com](http://www.agc-multimaterial.com)

# Advanced PCB Materials



Your Dreams, Our Challenge



AGC's Multi Material division develops and manufactures a full range of RF and Digital Materials, including thermoset and thermoplastic copper clad laminates and prepreg / bondply substrates, which provide high reliability and superior thermal, mechanical and electrical performance.

Thermoplastic materials are designed for critical RF/Microwave components, antennas, power amplifiers and subassemblies. Superior mechanical and electrical performance make the PTFE resin system the material of choice for your lowest loss, high frequency applications.

Thermoset materials are intended for use in core routers, high speed switches, supercomputers, next-generation radio communication and applications where low signal attenuation, high reliability and high data transfer rates are critical.



# PTFE Resin System



Part Number	Dielectric Constant (Dk)	Dk Tolerance ±	Dissipation Factor (Df)	Moisture Absorption %	Thermal Conductivity W/M*K	CTE <sup>(1)</sup> ppm/°C			Peel Strength lbs/in Very LowProfile Cu
	10 GHz		10 GHz			x	y	z	
<b>TLY-5A</b> <u>PTFE-Glass</u>	2.17	0.02	0.0009	0.02	0.22	26	15	217	12
<b>TLY-5</b> <u>PTFE-Glass</u>	2.20	0.02	0.0009	0.02	0.22	26	15	217	12
<b>TLY-5Z</b> <u>PTFE-Glass</u>	2.20	0.04	0.0015	0.03	0.20	30	40	130	7
<b>TLY-3</b> <u>PTFE-Glass</u>	2.33	0.02	0.0012	0.02	0.22	26	15	217	12
<b>TLX-8</b> <u>PTFE-Glass</u>	2.55	0.04	0.0018	0.02	0.19	21	23	215	12
<b>EZ-IO-F</b> (5 mil thickness) <u>PTFE Ceramic-Glass</u>	2.80	0.05	0.0015	0.08	0.53	19	25	49	5 - 7
<b>TLE-95</b> <u>PTFE-Glass</u>	2.95	0.05	0.0026	0.02	0.20	9	12	70	12
<b>RF-30A</b> <u>PTFE Ceramic-Glass</u>	2.97 <sup>(2)</sup>	0.05	0.0020	0.05	0.42	8	10	60	12
<b>NF-30</b> <u>PTFE Ceramic</u>	3.00	0.04	0.0013	0.05	0.50	11	15	30	8
<b>TSM-DS3M</b> <u>PTFE Ceramic-Glass</u>	2.94	0.04	0.0014	0.07	0.65	10	16	23	8
<b>TSM-DS3b</b> <u>PTFE Ceramic-Glass</u>	3.00	0.04	0.0014	0.07	0.65	10	16	23	8
<b>TSM-DS3</b> <u>PTFE Ceramic-Glass</u>	3.00	0.05	0.0014	0.07	0.65	10	16	23	8
<b>TLC-32</b> <u>PTFE-Glass</u>	3.20	0.05	0.0030	0.02	0.24	9	12	70	12
<b>RF-35TC-A</b> <u>PTFE Ceramic-Glass</u>	3.50	0.05	0.002	0.05	0.83	9	13	20	9
<b>RF-35TC</b> <u>PTFE Ceramic-Glass</u>	3.50	0.05	0.002	0.05	0.92	11	13	34	7
<b>RF-35HTC</b> <u>PTFE Ceramic</u>	3.50	0.05	0.0007	0.07	1.84	11	14	77	6
<b>TLF-35A</b> <u>PTFE Ceramic-Glass</u>	3.50 <sup>(2)</sup>	0.05	0.0026	0.02	0.37	21	23	85	10
<b>RF-60TC</b> <u>PTFE Ceramic-Glass</u>	6.15	0.15	0.0020	0.03	1.05	10	10	40	8
<b>RF-10</b> <u>PTFE Ceramic-Glass</u>	10.20	0.30	0.0025	0.08	0.85	16	20	25	10

# Thermoset Resin Systems



## PPE / Modified Epoxy / Polyimide Laminates

Part Number	Dielectric Constant (Dk)	Dissipation Factor (Df)	Tg °C	CTE <sup>(1)</sup> ppm/°C			
	10 GHz	10 GHz	DMA	x	y	Z α1	aZ α2
<b>Meteorwave® ELL 101</b> <u>Proprietary Thermoset</u>	3.05	0.0012	190	12	12	65	156
<b>Meteorwave® ELL 102</b> <u>Proprietary Thermoset</u>	3.03	0.0009	190	12	12	65	156
<b>Meteorwave® 1000</b> <u>Very Low Loss PPE</u>	3.4	0.0047	240	10	14	55	260
<b>Meteorwave® 2000</b> <u>Very Low Loss PPE</u>	3.2	0.0034	240	10	14	55	260
<b>Meteorwave® 3000</b> <u>Very Low Loss PPE</u>	3.4	0.0039	200	10	14	55	260
<b>Meteorwave® 3350</b> <u>High Speed Ultra Low Loss PPE</u>	3.5	0.0038	200	10	14	36	200
<b>Meteorwave® 4000</b> <u>Ultra Low Loss PPE</u>	3.3	0.0024	200	10	14	55	260
<b>Meteorwave® 4000M</b> <u>Ultra Low Loss PPE</u>	3.3	0.002	200	24	25	55	260
<b>Meteorwave® 8000</b> <u>Ultra Low Loss PPE</u>	3.28	0.0016	185	14	16	35	185
<b>Meteorwave® 8300</b> <u>Ultra Low Loss PPE</u>	3.0	0.0025	190	14	16	33	180
<b>Meteorwave® 8350</b> <u>Ultra Low Loss PPE</u>	3.5	0.0018	185	14	16	35	185
<b>Meteorwave® M1</b> <u>Ultra Low Loss PPE</u>	3.1	0.0018	230	18	18	47	178
<b>Mercurywave® 9350</b> <u>Very Low Loss Modified Epoxy</u>	3.5	0.004	200	10	14	48	248
<b>N4000-13</b> <u>Mid Loss Modified Epoxy</u>	3.6	0.009	240	10	14	70	280
<b>N4000-13 SI®</b> <u>Mid Loss Modified Epoxy</u>	3.2	0.008	240	10	14	70	280
<b>N4000-13 EP</b> <u>Mid Loss Modified Epoxy</u>	3.6	0.009	240	10	14	65	275
<b>N4000-13 EP SI®</b> <u>Mid Loss Modified Epoxy</u>	3.2	0.008	240	9	13	65	275
<b>N4000-29</b> <u>High Tg Multifunctional Epoxy</u>	4.2	0.017	199	12	15	55	265
<b>N7000-2 HT / -3</b> <u>Mid Loss Polyimide</u>	3.5	0.009	260 (DSC)	9	12	50	180
<b>N7000-3</b> <u>Mid Loss Polyimide</u>	3.5	0.009	260 (DSC)	9	12	50	180

# Prepregs

## Bonding Films



Part Number	Dielectric Constant (Dk)		Dissipation Factor (Df)	Moisture Absorption %	Thermal Conductivity W/M*K	CTE <sup>(1)</sup> ppm/°C		
	10 GHz					x	y	z
<a href="#"><u>fastRise FR-25</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	2.43		0.0014	0.08	0.25	59	70	72
<a href="#"><u>fastRise FR-27</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	2.77		0.0014	0.08	0.25	59	70	72
<a href="#"><u>fastRise FR-28</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	2.76		0.0014	0.08	0.25	59	70	72
<a href="#"><u>fastRise FR-7</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	7.45		0.0034	0.10	0.43	10	17	62
<a href="#"><u>fastRise FR-EZ-22P</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	2.40		0.0018	0.13	0.33	109	149	137
<a href="#"><u>fastRise FR-EZ-33P</u></a> <a href="#"><u>PTFE/Thermoset</u></a>	2.50		0.0024	0.14	0.33	97	165	137
<a href="#"><u>fastRise EZpure</u></a> <a href="#"><u>Thermoset</u></a>	2.80		0.0032	0.31	0.33	44	44	44

Part Number	Dielectric Constant (Dk)		Dissipation Factor (Df)	Tg °C	CTE <sup>(1)</sup> ppm/°C			
	10 GHz				DMA	x	y	Z α1
<a href="#"><u>M-Ply</u></a> <a href="#"><u>Ultra Low Loss PPE</u></a>	3.3		0.0021	200	10	14	55	260

## No Flow Prepregs

Part Number	Dielectric Constant (Dk)		Dissipation Factor (Df)	Tg °C	CTE <sup>(1)</sup> ppm/°C			
	10 GHz				DMA	x	y	Z α1
<a href="#"><u>N4000-29NF</u></a> <a href="#"><u>High Tg Multifunctional Epoxy</u></a>	4.0		0.017	199	12	15	55	265
<a href="#"><u>Meteorwave 1000NF</u></a> <a href="#"><u>Very Low Loss PPE</u></a>	3.4		0.0047	240	10	14	55	260

**Note :**

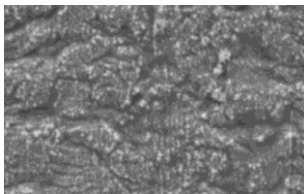
1. All test data provided are typical values and not intended to be specification values.
2. CTE <sup>(1)</sup> values vary by temperature range of measurement. Please inquire for specific product temperature range.
3. <sup>(2)</sup> Measured by IPC-TM-650 method 2.5.5.5.1 (modified stripline) at 1.9 GHz.
4. Please refer to the data sheet for each product for detailed values.

# Copper Cladding For RF Materials

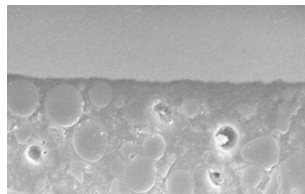
## Optical measurements (e.g. Bruker Optical Measurements)

Description	Surface Roughness RMS Treated side		Surface Roughness RMS Untreated side	
	Microinches	Microns	Microinches	Microns
Ultra Low Profile ½ oz	Comparable to rolled copper - see scanning electronmicroscope images below			
Ultra Low Profile 1 oz				
Rolled-Annealed ½ oz	15	0.37	12	0.31
Rolled-Annealed 1 oz	11	0.28	9	0.24
Reverse Treated Electrodeposited ½ oz	46	1.16	44	1.12
Reverse Treated Electrodeposited 1 oz	39	1.00	52	1.31
High Ductility Very Low Profile Electrodeposited ½ oz	66	1.68	18	0.46
High Ductility Very Low Profile Electrodeposited 1 oz	60	1.54	19	0.49

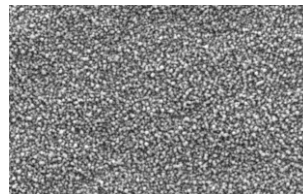
\* Above copper foil types may not be available for all AGC products, please contact your technical service representative with questions.



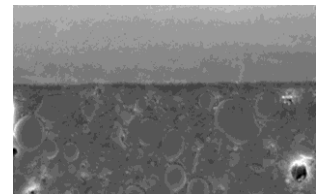
Rolled-Annealed Copper  
(Treated surface)  
x 3,000



Rolled-Annealed Copper  
(Cross section)  
x 1,000



Ultra Low Profile Copper  
(Treated surface)  
x 3,000



Ultra Low Profile Copper  
(Cross section)  
x 1,000

Resistor foils available upon request.

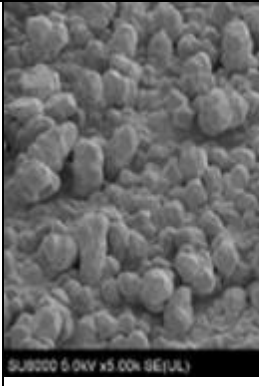
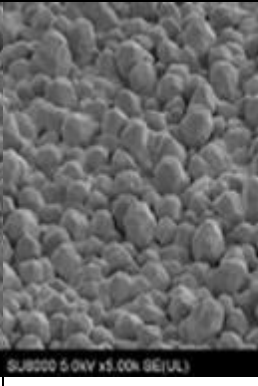
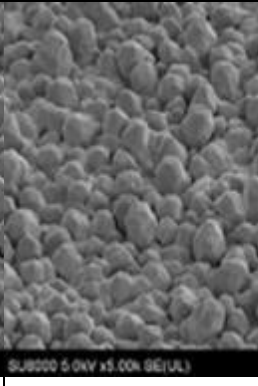
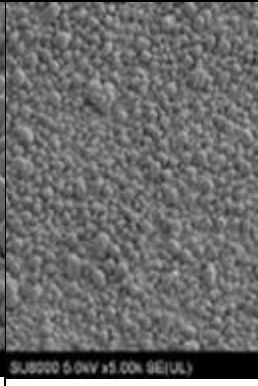
- ½ oz. copper = 0.7 mils or 17.5 microns
- 1 oz. copper = 1.4 mils or 35.0 microns
- 2 oz. and other coppers available upon request

Optical measurements are not accurate to characterize the differences between ultra low profile and rolled-annealed copper. Scanning electron microscope analysis shows a very comparable surface roughness. Insertion loss comparisons are available by request.

## Common Panel Sizes

Description	Common Panel Size
PTFE Materials	36" × 48", 18" × 24", 18" × 16", 18" × 12"
<i>fastRise</i> ™	18" × 24", 18" × 16", 18" × 12", 24" × 36"

# Copper Cladding For Digital Materials

Description		RTF			HS-VSP			HS-M2-VSP		HS2-M2-VSP	
Profile		VLP (RTF)			VSP			VSP		HS2-VSP	
Industry Call Out		GRADE 3			Industry Call Out			GRADE 3		Industry Call Out	
AMMA Call Out		RTF			HS-VSP			HS-M2-VSP		HS2-M2-VSP	
Untreated Side Roughness		≤ 2.0 μm			≤ 1.3 μm			≤ 1.3 μm		≤ 1.3 μm	
Treated Side Roughness		≤ 2.5 μm			≤ 2.0 μm			≤ 2.0 μm		≤ 1.0 μm	
Availability		All AGC Digital PCB Materials			Non-Meteorwave Digital Materials			All Meteorwave Products		All Meteorwave Products	
Nominal Thickness	μm	18	35	70	18	35	70	18	35	18	35
	Oz	1/2	1	2	1/2	1	2	1/2	1	1/2	1
SEM Observation Treated Side											

\* All test data provided are typical values and not intended to be specification values. Above copper foil types may not be available for all AGC products, please contact your technical service representative with questions.

### Definitions:

LP	Low profile 5-10 micron
VLP	Very Low profile <5.0 micron
VSP and HVLP	Very Smooth or Hyper Low profile <2 micron
ULP / e-VLP / HS2-VSP	Ultra Low profile or Extreme Low profile ≤1 micron
Hyper Smooth Profile	≤1 micron
H.T.E.	High temperature elongation IPC-CF-150, Class 3
ED	Electrodeposited copper
RA	Rolled Annealed – not Available on AGC Digital PCB Materials

### Specialty Copper Types:

Specialty copper types may be available, please contact your sales or technical representative:

- MLSG3 / RTF2
- HS1-MS1-VSP
- SI Copper
- Double Treat
- Grade 3 HTE Shiny
- Resistor foils
- Unclad (textured or smooth finish)

### Specialty Coppers Weights:

Specialty copper weights may be available, please contact your sales or technical representative:

3/8 oz "T"	12 μm
3 oz	105 μm
4 oz	140 μm
5 oz	175 μm
6 oz	210 μm
7 oz	245 μm

### Regarding resistor copper foils

- OhmegaPly®, Ticer® and other resistor foils available upon request.
- The resistor foil manufacturer covers the warranty for the copper foil that includes the resistor layer, as well as the performance and workability related to the copper foil. Our company does not take responsibility for the processing of these resistor layers and the performance or workability of the final products.

## A Wide Lineup of Products

