



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

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 $\pm$	Dissipation Factor (Df)	Moisture Absorption %	Thermal Conductivity W/M*K	CTE ⁽¹⁾ ppm/°C			Peel Strength lbs/in Very LowProfile Cu
	10 GHz		10 GHz			x	y	z	
<u>TLY-5A</u> PTFE-Glass	2.17	0.02	0.0009	0.02	0.22	26	15	217	12
<u>TLY-5</u> PTFE-Glass	2.20	0.02	0.0009	0.02	0.22	26	15	217	12
<u>TLY-5Z</u> PTFE-Glass	2.20	0.04	0.0015	0.03	0.20	30	40	130	7
<u>TLY-3</u> PTFE-Glass	2.33	0.02	0.0012	0.02	0.22	26	15	217	12
<u>TLX-8</u> PTFE-Glass	2.55	0.04	0.0018	0.02	0.19	21	23	215	12
<u>EZ-IO-F</u> (5 mil thickness) PTFE Ceramic-Glass	2.80	0.05	0.0015	0.08	0.53	19	25	49	5 - 7
<u>TLE-95</u> PTFE-Glass	2.95	0.05	0.0026	0.02	0.20	9	12	70	12
<u>RF-30A</u> PTFE Ceramic-Glass	2.97 ⁽²⁾	0.05	0.0020	0.05	0.42	8	10	60	12
<u>NF-30</u> PTFE Ceramic	3.00	0.04	0.0013	0.05	0.50	11	15	30	8
<u>TSM-DS3M</u> PTFE Ceramic-Glass	2.94	0.04	0.0014	0.07	0.65	10	16	23	8
<u>TSM-DS3b</u> PTFE Ceramic-Glass	3.00	0.04	0.0014	0.07	0.65	10	16	23	8
<u>TSM-DS3</u> PTFE Ceramic-Glass	3.00	0.05	0.0014	0.07	0.65	10	16	23	8
<u>TLC-32</u> PTFE-Glass	3.20	0.05	0.0030	0.02	0.24	9	12	70	12
<u>RF-35TC-A</u> PTFE Ceramic-Glass	3.50	0.05	0.002	0.05	0.83	9	13	20	9
<u>RF-35TC</u> PTFE Ceramic-Glass	3.50	0.05	0.002	0.05	0.92	11	13	34	7
<u>RF-35HTC</u> PTFE Ceramic	3.50	0.05	0.0007	0.07	1.84	11	14	77	6
<u>TLF-35A</u> PTFE Ceramic-Glass	3.50 ⁽²⁾	0.05	0.0026	0.02	0.37	21	23	85	10
<u>RF-60TC</u> PTFE Ceramic-Glass	6.15	0.15	0.0020	0.03	1.05	10	10	40	8
<u>RF-10</u> PTFE Ceramic-Glass	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 ⁽¹⁾ ppm/°C			
	10 GHz	10 GHz	DMA	x	y	Z α1	aZ α2
ELL 101 <u>Proprietary Thermoset</u>	3.05	0.0012	190	12	12	65	156
ELL 102 <u>Proprietary Thermoset</u>	3.03	0.0009	190	12	12	65	156
Meteorwave® 1000 <u>Very Low Loss PPE</u>	3.4	0.0047	240	10	14	55	260
Meteorwave® 2000 <u>Very Low Loss PPE</u>	3.2	0.0034	240	10	14	55	260
Meteorwave® 3000 <u>Very Low Loss PPE</u>	3.4	0.0039	200	10	14	55	260
Meteorwave® 3350 <u>High Speed Ultra Low Loss PPE</u>	3.5	0.0038	200	10	14	36	200
Meteorwave® 4000 <u>Ultra Low Loss PPE</u>	3.3	0.0024	200	10	14	55	260
Meteorwave® 4000M <u>Ultra Low Loss PPE</u>	3.3	0.002	200	24	25	55	260
Meteorwave® 8000 <u>Ultra Low Loss PPE</u>	3.28	0.0016	185	14	16	35	185
Meteorwave® 8300 <u>Ultra Low Loss PPE</u>	3.0	0.0025	190	14	16	33	180
Meteorwave® 8350 <u>Ultra Low Loss PPE</u>	3.5	0.0018	185	14	16	35	185
Meteorwave® M1 <u>Ultra Low Loss PPE</u>	3.1	0.0018	230	18	18	47	178
Mercurywave® 9350 <u>Very Low Loss Modified Epoxy</u>	3.5	0.004	200	10	14	48	248
N4000-13 <u>Mid Loss Modified Epoxy</u>	3.6	0.009	240	10	14	70	280
N4000-13 SI® <u>Mid Loss Modified Epoxy</u>	3.2	0.008	240	10	14	70	280
N4000-13 EP <u>Mid Loss Modified Epoxy</u>	3.6	0.009	240	10	14	65	275
N4000-13 EP SI® <u>Mid Loss Modified Epoxy</u>	3.2	0.008	240	9	13	65	275
N4000-29 <u>High Tg Multifunctional Epoxy</u>	4.2	0.017	199	12	15	55	265
N7000-2 HT / -3 <u>Mid Loss Polyimide</u>	3.5	0.009	260 (DSC)	9	12	50	180
N7000-3 <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 ⁽¹⁾ ppm/°C		
	10 GHz	10 GHz			x	y	z
<u>fastRise FR-25</u> <u>PTFE/Thermoset</u>	2.43	0.0014	0.08	0.25	59	70	72
<u>fastRise FR-27</u> <u>PTFE/Thermoset</u>	2.77	0.0014	0.08	0.25	59	70	72
<u>fastRise FR-28</u> <u>PTFE/Thermoset</u>	2.76	0.0014	0.08	0.25	59	70	72
<u>fastRise FR-7</u> <u>PTFE/Thermoset</u>	7.45	0.0034	0.10	0.43	10	17	62
<u>fastRise FR-EZ-22P</u> <u>PTFE/Thermoset</u>	2.40	0.0018	0.13	0.33	109	149	137
<u>fastRise FR-EZ-33P</u> <u>PTFE/Thermoset</u>	2.50	0.0024	0.14	0.33	97	165	137
<u>fastRise EZpure</u> <u>Thermoset</u>	2.80	0.0032	0.31	0.33	44	44	44

Part Number	Dielectric Constant (Dk)	Dissipation Factor (Df)	Tg °C	CTE ⁽¹⁾ ppm/°C			
	10 GHz	10 GHz	DMA	x	y	Z α1	Z α2
<u>M-Ply</u> <u>Ultra Low Loss PPE</u>	3.3	0.0021	200	10	14	55	260

No Flow Prepregs

Part Number	Dielectric Constant (Dk)	Dissipation Factor (Df)	Tg °C	CTE ⁽¹⁾ ppm/°C			
	10 GHz	10 GHz	DMA	x	y	Z α1	Z α2
<u>N4000-29NF</u> <u>High Tg Multifunctional Epoxy</u>	4.0	0.017	199	12	15	55	265
<u>Meteorwave 1000NF</u> <u>Very Low Loss PPE</u>	3.4	0.0047	240	10	14	55	260

Note :

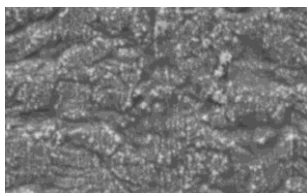
1. All test data provided are typical values and not intended to be specification values.
2. CTE ⁽¹⁾ values vary by temperature range of measurement. Please inquire for specific product temperature range.
3. ⁽²⁾ Measured by IPC-TM-650 method 2.5.5.5.1 (modified stripline) at 1.9 GHz.
4. Please refer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

Copper Cladding For RF Materials

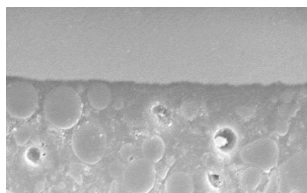
Optical measurements (e.g. Bruker Optical Measurements)

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.



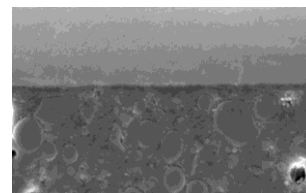
Rolled-Annealed Copper
(Treated surface)
x 3,000



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



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



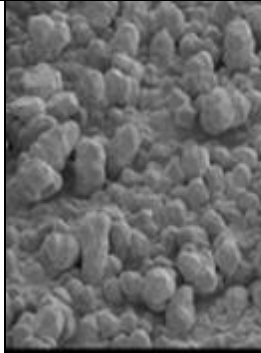
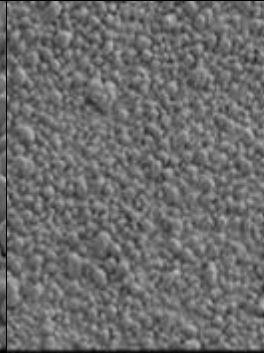
Ultra Low Profile Copper
(Cross section)
x 1,000

OhmegaPly®, Ticer® and other resistive foils available upon request.
OhmegaPly® & Ticer® are registered trademarks of Quantic Ohmega Ticer.

- 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.

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													
		SUB2000 5.0KV x5.00k SE(UL)			SUB2000 5.0KV x5.00k SE(UL)			SUB2000 5.0KV x5.00k SE(UL)			SUB2000 5.0KV x5.00k SE(UL)		

* 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
- Ohmega Ply
- NiCr Ticer TCR
- 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

A Wide Lineup of Products

AGC
Your Dreams, Our Challenge

