AGC
Your Dreams, Our Challenge



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

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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

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

Thermoset Resin Systems

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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
Meteorwave® 1000 Very Low Loss PPE	3.4	0.0047	240	10	14	55	260
Meteorwave® 2000 Very Low Loss PPE	3.2	0.0034	240	10	14	55	260
Meteorwave® 3000 Very Low Loss PPE	3.4	0.0039	200	10	14	55	260
Meteorwave® 3350 High Speed Ultra Low Loss PPE	3.5	0.0038	200	10	14	36	200
Meteorwave® 4000 Ultra Low Loss PPE	3.3	0.0024	200	10	14	55	260
Meteorwave® 8000 Ultra Low Loss PPE	3.28	0.0016	185	14	16	35	185
Meteorwave® 8300 Ultra Low Loss PPE	3.0	0.0025	190	14	16	33	180
Meteorwave® M1 Ultra Low Loss PPE	3.1	0.0018	230	18	18	47	178
Meteorwave® E2 Halogen free Extreme Low Loss Hydrocarbon	3.2	0.0012	210	12	12	45	180
Meteorwave® ELL 202 Halogen free Extreme Low Loss Hydrocarbon	3.2	0.0009	210	12	12	45	180
Meteorwave® ELL 205 Halogen free Extreme Low Loss Hydrocarbon	3.1	0.0007	210	10	10	45	180
Meteorwave® E3 Extreme Low Loss Hydrocarbon	3.1	0.0010	200	11	11	30	180
Meteorwave® ELL 302 Extreme Low Loss Hydrocarbon	3.1	0.0008	200	11	11	30	180
Meteorwave® ELL 305 Extreme Low Loss Hydrocarbon	3.0	0.0005	200	9	9	30	180
N4000-13 Mid Loss Modified Epoxy	3.6	0.009	240	10	14	70	280
N4000-13 SI® Mid Loss Modified Epoxy	3.2	0.008	240	10	14	70	280
N4000-13 EP Mid Loss Modified Epoxy	3.6	0.009	240	10	14	65	275
N4000-13 EP SI® Mid Loss Modified Epoxy	3.2	0.008	240	9	13	65	275
N7000-2 HT / -3 Mid Loss Polyimide	3.5	0.009	260 (DSC)	9	12	50	180
N7000-3 Mid Loss Polyimide	3.5	0.009	260 (DSC)	9	12	50	180

Prepregs
Bonding Films

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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
fastRise FR-25 PTFE/Thermoset	2.43	0.0012	0.08	0.25	59	70	72
fastRise FR-27 PTFE/Thermoset	2.77	0.0014	0.08	0.25	59	70	72
fastRise FR-28 PTFE/Thermoset	2.76	0.0014	0.08	0.25	59	70	72
fastRise FR-EZ-22P PTFE/Thermoset	2.40	0.0018	0.13	0.33	109	149	137
fastRise FR-EZ-33P PTFE/Thermoset	2.50	0.0024	0.14	0.33	97	165	137
fastRise EZpure Thermoset	2.80	0.0032	0.31	0.33	44	44	44
fastRise TC Thermoset	4.80	0.0023	0.07	0.94	22	22	22

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
N4000-29NF High Tg Multifunctional Epoxy	4.0	0.017	199	12	15	55	265
Meteorwave 1000NF Very Low Loss PPE	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.

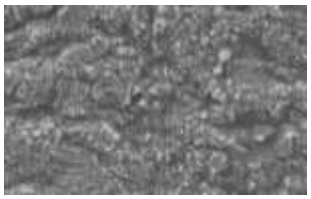
Copper Cladding For RF Materials

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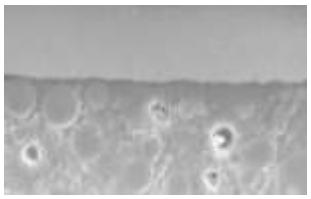
Optical measurements (e.g. Bruker Optical Measurements)

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

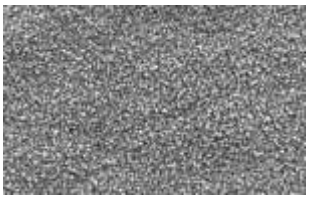
* Above copper foil types may not be available for all AGC products, please contact your technical service representative with questions.



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

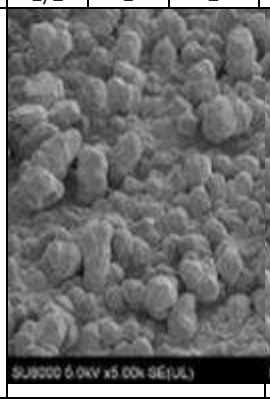
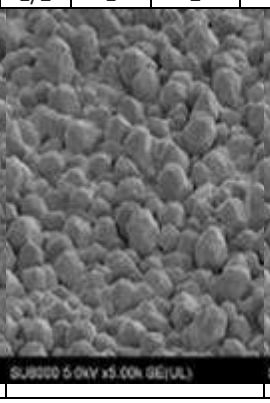
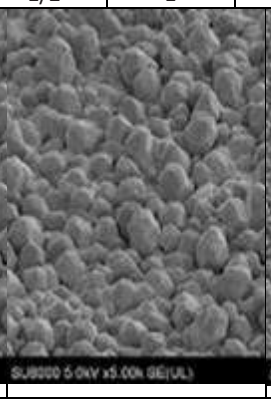
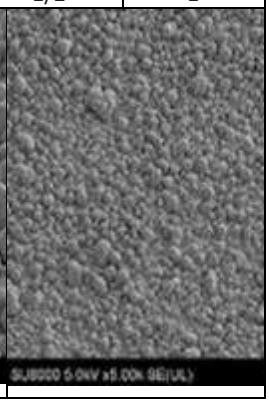
Optical measurements are not accurate to characterize the differences between ultra low profile and rolled-annealed copper. Scanning electron microscope analysis shows a very comparable surface roughness. Insertion loss comparisons are available by request.

Common Panel Sizes

Description	Common Panel Size
PTFE Materials	**36" × 48", 18" × 24", 18" × 16", 18" × 12"**
***fast*Rise™**	**18" × 24", 18" × 16", 18" × 12", 24" × 36"**

Copper Cladding For Digital Materials

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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
- 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.

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A Wide Lineup of Products

