



**Glass cloth base modified epoxy resin
Flame retardant copper clad laminate**

NPG-188H

FEATURES

- Low dissipation factor at high frequency range
- High Tg> 200°C(TMA) and Low Z-CTE · Hi-Td
- Halogen and antimony free
- IPC-4101E L127/128
- Excellent dimensional stability and through-hole reliability
- Flammability: UL 94V-0
- Application: high speed server, storage, router and network

PERFORMANCE LIST

Characteristics	Unit	Condition	Typical Values	SPEC	Test Method
Volume resistivity	MΩ-cm	C-96/35/90	5x10 ⁹	10 ⁶ ↑	2.5.17
Surface resistivity	MΩ	C-96/35/90	5x10 ⁷	10 ⁴ ↑	2.5.17
Permittivity 1GHz (RC51%)	-	C-24/23/50	4.35	-	2.5.5.13
Permittivity 1GHz (RC70%)	-	C-24/23/50	3.75	-	2.5.5.13
Permittivity 3GHz (RC51%)	-	C-24/23/50	4.31	-	2.5.5.13
Permittivity 3GHz (RC70%)	-	C-24/23/50	3.74	-	2.5.5.13
Permittivity 10GHz (RC51%)	-	C-24/23/50	4.18	-	2.5.5.13
Permittivity 10GHz (RC70%)	-	C-24/23/50	3.70	-	2.5.5.13
Loss tangent 1GHz (RC51%)	-	C-24/23/50	0.0041	-	2.5.5.13
Loss tangent 1GHz (RC70%)	-	C-24/23/50	0.0033	-	2.5.5.13
Loss tangent 3GHz (RC51%)	-	C-24/23/50	0.0044	-	2.5.5.13
Loss tangent 3GHz (RC70%)	-	C-24/23/50	0.0035	-	2.5.5.13
Loss tangent 10GHz (RC51%)	-	C-24/23/50	0.0053	-	2.5.5.13
Loss tangent 10GHz (RC70%)	-	C-24/23/50	0.0042	-	2.5.5.13
Arc resistance	SEC	D-48/50+D-0.5/23	120 ↑	60 ↑	2.5.1
Dielectric breakdown	KV	D-48/50	45 ↑	40 ↑	2.5.6
Moisture absorption	%	D-24/23	0.15	-	2.6.2.1
Flammability	-	C-48/23/50	V-0	V-0	UL94
Peel strength 1oz (low profile)	lb/in	288°C x10" solder floating	3.5 ↑	2.5 ↑	2.4.8
Heat resistance	SEC	288°C solder dipping	300 ↑	10 ↑	2.4.13.1
Glass transition temperature	°C	TMA	200 ↑	N/A	2.4.24
Coefficient of thermal expansion X/Y-axis	ppm/°C	TMA	9-10	N/A	2.4.24
Z-axis before Tg	ppm/°C	TMA	25-30		
Z-axis after Tg	ppm/°C	TMA	130-150		
50-260°C	%	TMA	1.4%		
Decomposition temperature (Td 5% W/L)	°C	TGA, 10°C/min	420	325 ↑	2.4.24.6

NOTE:

The average value in the table refers to samples of .031" 1/1.

Test method per IPC-TM-650

Data shown are nominal values for reference only.



■ DESIGN PARAMETER

Characteristics	Unit	Condition	Typical Values
Permittivity 3GHz (RC51%)	-	C-24/23/50	3.65
Permittivity 3GHz (RC70%)	-	C-24/23/50	3.36
Permittivity 10GHz (RC51%)	-	C-24/23/50	3.60
Permittivity 10GHz (RC70%)	-	C-24/23/50	3.30
Loss tangent 3GHz (RC51%)	-	C-24/23/50	0.0033
Loss tangent 3GHz (RC70%)	-	C-24/23/50	0.0030
Loss tangent 10GHz (RC51%)	-	C-24/23/50	0.0039
Loss tangent 10GHz (RC70%)	-	C-24/23/50	0.0036

Note: The Dk/Df value would be different by different methods and just for reference.

Test method: combine with IPC-TM-650-2.5.5.13 and actual test coupon.

The real loss performance should be tested from SI test coupons.

■ CONSTRUCTION

THICKNESS		CONSTRUCTION		THICKNESS		CONSTRUCTION	
mm	mil			mm	mil		
0.05	2.0	1067	1 ply	0.15	6.0	1078	2 plies
0.06 1p	2.5	1067	1 ply	0.18	7.0	1086	2 plies
0.06	2.5	1078	1 ply	0.20	8.0	3313	2 plies
0.08	3.0	1086	1 ply	0.25	10.0	2116	2 plies
0.08 sp	3.0	1078	1 ply	0.25 3p	10.0	3313	3 plies
0.09 1p	3.5	1086	1 ply	0.30 3p	12.0	3313	3 plies
0.09 2p	3.5	1037	2 plies	0.35	14.0	3313	4 plies
0.10	4.0	3313	1 ply	0.38	15.0	3313	4 plies
0.10 sp	4.0	1086	1 ply	0.40 4p	16.0	2116	4 plies
0.10 2p	4.0	1067	2 plies	0.45 4p	18.0	2116	4 plies
0.13	5.0	1078	2 plies	0.50 5p	20.0	3313	5 plies
0.13 1p	5.0	2116	1 ply	0.53 5p	21.0	2116	5 plies

1. : Preferred structure for HLC application

2. Requirement for not listed glass fabrics types, please contact our technical customer service team for discussion in advance.

■ PRODUCT SIZE & THICKNESS

THICKNESS inch (mm)	COPPER CLADDING oz (μm)	SIZE		THICKNESS TOLERANCE
		inch	mm	
0.002(0.05) to 0.021 (0.53)	3/8 (12)	48.8 x 36.6	1240 x 0930	IPC-4101E SPEC CLASS C/M
	0.5 (17)	48.8 x 40.5	1240 x 1030	
	1.0 (35)	48.8 x 42.5	1240 x 1080	
	2.0 (70)			

■ Keeping the core and prepreg in the same grain direction is crucial to ensure the flatness of multilayer boards.

■ Grain direction is shown on the certificate of conformance.



**Glass cloth base modified epoxy resin
 Flame retardant prepreg**

NPG-188HB

■ FEATURES

- Rheology of resin controlled to benefit the lamination of the multilayers.
- Halogen and antimony free
- High performance resin provides excellent heat and chemical resistance.

■ PERFORMANCE LIST

Specification: IPC-4101E is applicable

Data shown are nominal values for reference only

Glass style	RC%	After Pressed Thickness (per ply)	
		mm	mil
2116	62	0.151 ± 0.01	5.93 ± 0.4
	58	0.134 ± 0.01	5.26 ± 0.4
	54	0.120 ± 0.01	4.71 ± 0.4
2113	60	0.105 ± 0.01	4.14 ± 0.4
3313	59	0.106 ± 0.01	4.18 ± 0.4
1080	72	0.098 ± 0.008	3.86 ± 0.3
	69	0.087 ± 0.008	3.43 ± 0.3
	66	0.078 ± 0.008	3.09 ± 0.3
1078	72	0.098 ± 0.008	3.86 ± 0.3
	69	0.087 ± 0.008	3.43 ± 0.3
	66	0.078 ± 0.008	3.09 ± 0.3
1067	78	0.080 ± 0.008	3.15 ± 0.3
	76	0.073 ± 0.008	2.86 ± 0.3
	72	0.061 ± 0.008	2.41 ± 0.3
106	78	0.064 ± 0.008	2.52 ± 0.3
	76	0.058 ± 0.008	2.29 ± 0.3
1037	78	0.064 ± 0.008	2.52 ± 0.3
	76	0.058 ± 0.008	2.29 ± 0.3

Requirement for not listed glass fabrics types, please contact our technical customer service team for discussion in advance.

Storage Condition

Condition 1: 180 days when stored at <5°C

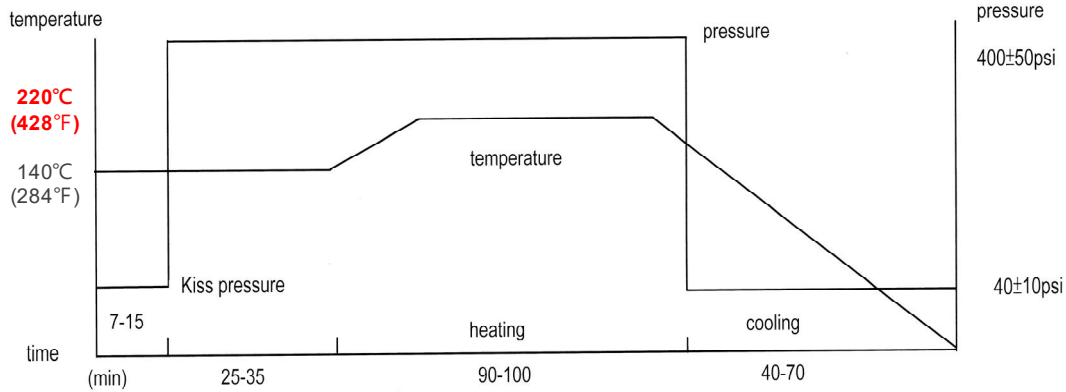
Condition 2: 90 days when stored at <23°C and <50%RH

(cond.1 or cond. 2 for the applicable specification sheet requirements.)

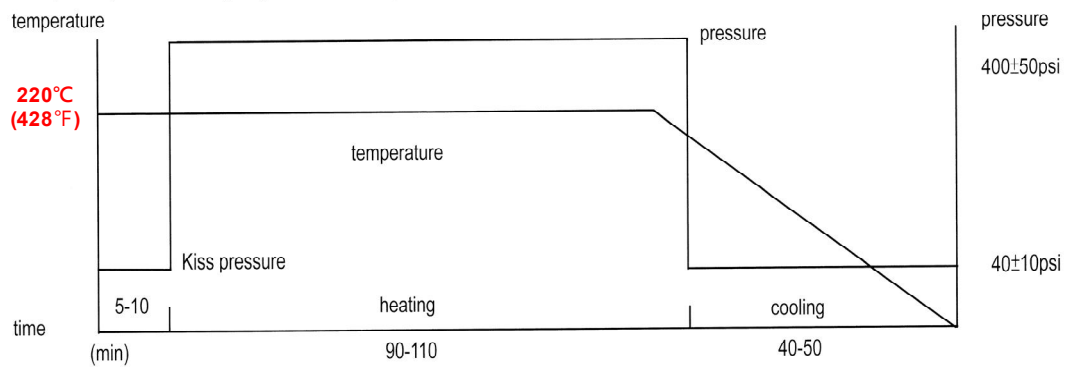


Recommended press cycles:

A:2T2P(2 temperature step/2 pressure step)



B:1T2P(1 temperature step/2 pressure step)



Suggestions:

1. Heating rate of material between 80°C (176°F) and 140°C (284°F)
 1-3°C/min (1.8~5.4°F/min) is acceptable.
 1.5-2.5°C/min (2.7~4.5°F/min) would be better.
2. Temperature of material over 200°C (392°F) must be held for at least 90min to allow resin to fully cure.
3. The pressure should be kept below 100psi during cooling to ambient temperature.
4. Cooling rate of material should be kept under 2.5°C/min (4.5°F/min) when the temperature of material is over 100°C (212°F), in order to avoid introducing twist.

■ CERTIFICATION UL

- UL File No.: E98983
- ANSI Type: FR-4.1
- UL 746 Recognition

Minimum Material Thickness inch (mm)	Clad cond. Thickness Min. Max. mil mil (µm) (µm)		Max. Area Diameter inch (mm)	Solder Lts Temp Time °C sec		UL 94 Flame Class	Max. Operating Temp
0.002 (0.05)	0.60 (15)	4.08 (102)	2.0 (50.8)	288	30	94V-0	130