



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

**UV BLOCK FR-4-86**

**■ FEATURES**

- High luminance of epoxy contrast with copper for laser type A.O.I.
- UV solder mask may be applied simultaneously to increase yields.
- High performance epoxy blended to achieve higher heat resistance than that of FR-4-86
- Thickness 0.8mm capability.
- IPC-4101E L21

**■ PERFORMANCE LIST**

Characteristics	Unit	Conditioning	Typical Values	SPEC	Test Method	
Volume resistivity	MΩ-cm	C-96/35/90	5 x10 <sup>8</sup> ~ 5x10 <sup>9</sup>	10 <sup>6</sup> ↑	2.5.17	
Surface resistivity	MΩ	C-96/35/90	5 x10 <sup>6</sup> ~ 5x10 <sup>7</sup>	10 <sup>4</sup> ↑	2.5.17	
Permittivity 1MHz	-	C-24/23/50	4.5-4.7	5.4 ↓	2.5.5.9	
Permittivity 1GHz	-	C-24/23/50	4.0-4.2	-	2.5.5.9	
Loss Tangent 1MHz	-	C-24/23/50	0.015-0.020	0.035 ↓	2.5.5.9	
Loss Tangent 1GHz	-	C-24/23/50	0.012-0.014	-	2.5.5.9	
Arc resistance	SEC	D-48/50+D-0.5/23	120 ↑	60 ↑	2.5.1	
Dielectric breakdown	KV	D-48/50	60 ↑	40 ↑	2.5.6	
Moisture absorption	%	D-24/23	0.05-0.10	0.8 ↓	2.6.2.1	
Flammability	-	C-48/23/50	94V0	94V0	UL94	
Peel strength 1 oz (≥0.5mm)	lb/in	288°Cx10" solder floating	10-14	6 ↑	2.4.8	
Thermal stress	SEC	288°C solder dipping	200 ↑	10 ↑	2.4.13.1	
Pressure cooker (2 atm 120°C)	1/2 hr	SEC	288°C dipping	150 ↑	N/A	-
	1 hr	SEC	288°C dipping	150 ↑	N/A	-
	2 hrs	SEC	288°C dipping	150	N/A	-
Flexural strength	LW	N/mm <sup>2</sup>	A	480-550	415 ↑	2.4.4
	CW	N/mm <sup>2</sup>	A	415-480	345 ↑	2.4.4
Dimensional stability X-Y axis	%	E-0.5/170	0.005-0.030	0.050 ↓	2.4.39	
Coefficient of thermal expansion						
Z-axis before Tg	ppm/°C	TMA	50-70	N/A	2.4.24	
Z-axis after Tg	ppm/°C	TMA	250-350			
Glass transition temp	°C	DSC	135 ± 5	N/A	2.4.25	
Decomposition temperature (Td 5% W/L)	°C	TGA	310	N/A	2.4.24.6	

**NOTE:**

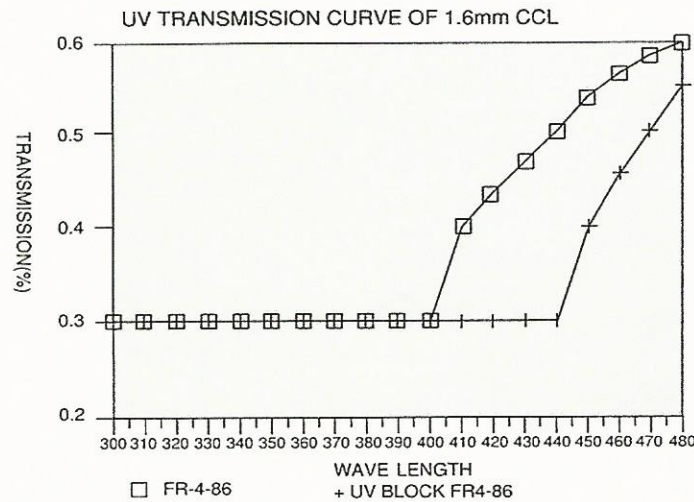
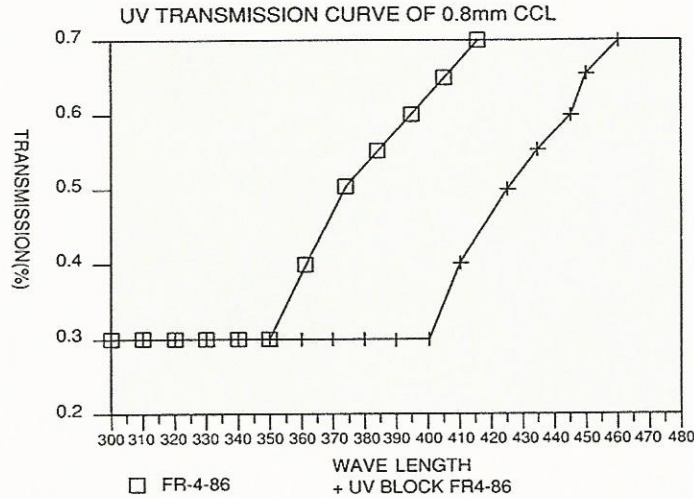
The average value in the table refers to samples of .062" 1/1.

Test method per IPC-TM-650

Data shown are nominal values for reference only.

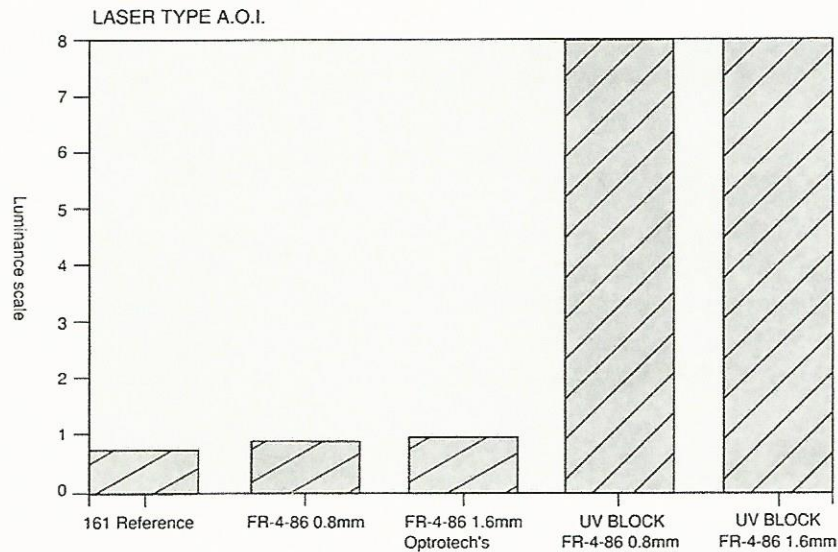


■ **Low UV Transmission**



■ **High luminance of epoxy contrast with copper**

FR-4-86 1.6 mm  
 Orbotech's



■ **CERTIFICATION UL**

• UL File No.: E98983





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

# NP-175FR

**■ FEATURES**

- Dicy-Free & Low C.T.E
- Lead-Free Compatible
- Excellent dimensional stability and through-hole reliability
- Superior CAF-Resistance (Anti-migration)
- High luminance of multi-functional epoxy contrast with copper for A.O.I
- IPC-4101E L99/101/126

**■ PERFORMANCE LIST**

Characteristics	Unit	Conditioning	Typical Values	SPEC	Test Method	
Volume resistivity	MΩ-cm	C-96/35/90	$5 \times 10^9 \sim 5 \times 10^{10}$	$10^6 \uparrow$	2.5.17	
Surface resistivity	MΩ	C-96/35/90	$5 \times 10^8 \sim 5 \times 10^9$	$10^4 \uparrow$	2.5.17	
Permittivity 1MHz	-	C-24/23/50	4.4-4.7	5.4 ↓	2.5.5.9	
Permittivity 1GHz	-	C-24/23/50	4.1-4.3	-	2.5.5.9	
Loss Tangent 1MHz	-	C-24/23/50	0.011-0.013	0.035 ↓	2.5.5.9	
Loss Tangent 1GHz	-	C-24/23/50	0.012-0.014	-	2.5.5.9	
Arc resistance	SEC	D-48/50+D-0.5/23	120 ↑	60 ↑	2.5.1	
Dielectric breakdown	KV	D-48/50	60 ↑	40 ↑	2.5.6	
Moisture absorption	%	D-24/23	0.05-0.10	0.5 ↓	2.6.2.1	
Flammability	-	C-48/23/50	94V0	94V0	UL94	
Peel strength 1 oz (≥0.5mm)	lb/in	288°Cx10" solder floating	8-10	6 ↑	2.4.8	
Thermal stress	SEC	288°Cx10" solder dipping	600 ↑	10 ↑	2.4.13.1	
Pressure cooker (2 atm 120°C)	1/2 hr	SEC	288°C dipping	600 ↑	N/A	-
	1 hr	SEC	288°C dipping	600 ↑	N/A	-
	2 hrs	SEC	288°C dipping	600 ↑	N/A	-
Flexural strength	LW	N/mm <sup>2</sup>	A	480-550	415 ↑	2.4.4
	CW	N/mm <sup>2</sup>	A	415-480	345 ↑	2.4.4
Dimensional stability X-Y axis	%	E-0.5/170	0.005-0.030	0.050 ↓	2.4.39	
Coefficient of thermal expansion						
X/Y-axis	ppm/°C	TMA	10-14	N/A	2.4.24	
Z-axis before Tg	ppm/°C	TMA	30-40	60 ↓		
Z-axis after Tg	ppm/°C	TMA	210-230	300 ↓		
50-260°C	%	TMA	2.8%	3.0% ↓		
Glass transition temp	°C	DSC	175 ± 5	170 ↑	2.4.25	
T260	min	TMA	>60	30 ↑	2.4.24.1	
T288	min	TMA	>20	15 ↑	2.4.24.1	
Decomposition temperature (Td 5% W/L)	°C	TGA	351	340 ↑	2.4.24.6	

**NOTE:**

The average value in the table refers to samples of .062" 1/1.





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

# NP-175FTL

**■ FEATURES**

- Dicy-Free & Low C.T.E
- Lead-Free Compatible
- Excellent dimensional stability and through-hole reliability
- Superior CAF-Resistance (Anti-migration)
- High luminance of multi-functional epoxy contrast with copper for A.O.I
- IPC-4101E L99/101/126

**■ PERFORMANCE LIST**

Characteristics	Unit	Conditioning	Typical Values	SPEC	Test Method
Volume resistivity	MΩ-cm	C-96/35/90	5.0 x10 <sup>9</sup>	10 <sup>6</sup> ↑	2.5.17
Surface resistivity	MΩ	C-96/35/90	5.0 x10 <sup>8</sup>	10 <sup>4</sup> ↑	2.5.17
Permittivity 1 MHz	-	C-24/23/50	4.2-4.5	5.4 ↓	2.5.5.9
Permittivity 1 GHz	-	C-24/23/50	3.8-4.0	-	2.5.5.9
Loss Tangent 1 MHz	-	C-24/23/50	0.012-0.014	0.035 ↓	2.5.5.9
Loss Tangent 1 GHz	-	C-24/23/50	0.013-0.015	-	2.5.5.9
Arc resistance	SEC	D-48/50+D-0.5/23	120 ↑	60 ↑	2.5.1
Dielectric breakdown	KV	D-48/50	60 ↑	40 ↑	2.5.6
Moisture absorption	%	D-24/23	0.20-0.30	0.5 ↓	2.6.2.1
Flammability	-	C-48/23/50	94V0	94V0	UL94
Peel strength 1 oz (≥0.5mm)	lb/in	288°Cx10" solder floating	8-10	6 ↑	2.4.8
Thermal stress	SEC	288°C solder dipping	600 ↑	10 ↑	2.4.13.1
Glass transition temp	°C	DSC	175 ± 5	170 ↑	2.4.25
Dimensional stability X-Y axis	%	E 4/105	0.01-0.03	0.05 ↓	2.4.39
Coefficient of thermal expansion X/Y-axis	ppm/°C	TMA	10-14	N/A	2.4.24
Z-axis before Tg	ppm/°C	TMA	30-40	60 ↓	
Z-axis after Tg	ppm/°C	TMA	210-230	300 ↓	
50-260°C	%	TMA	2.8%	3.0% ↓	
T260	min	TMA	>60	30 ↑	2.4.24.1
T288	min	TMA	>20	15 ↑	2.4.24.1
Decomposition temperature (Td 5% W/L)	°C	TGA	351	340 ↑	2.4.24.6

**NOTE:**

The average value in the table refers to samples of .020" 1/1.

Test method per IPC-TM-650

Data shown are nominal values for reference only.



■ **CONSTRUCTION:**

THICKNESS		CONSTRUCTION	THICKNESS		CONSTRUCTION
mm	mil		mm	mil	
0.05 sp	2	1067 1 ply	0.30 sp	12	1506 2 plies
0.06	2.5	1078 1 ply	0.35	14	7628 2 plies
0.08	3	1086 1 ply	0.38	15	7628 3 plies
0.10	4	1080 2 plies	0.45 sp	18	1506 3 plies
0.11	4	2116 1 ply	0.53	21	7628 3 plies
0.13	5	1080 2 plies	0.60	24	7628 3 plies
0.13 sp	5	2116 1 ply	0.77	30	7628 4 plies
0.15	6	1506 1 ply	0.8	31.5	7628 4 plies
0.15 2p	6	1086 2 plies	0.9	36	7628 5 plies
0.21	8	7628 1 ply	1.0	39	7628 5 plies
0.26 2p	10	2155 2 plies	1.1	43	7628 6 plies
0.30	12	2116 3 plies	1.2	47	7628 6 plies

\* 1.2, 1.1, 1.0, 0.9 0.77 mm THICKNESS INCLUDE CLADDING, ALL OTHERS EXCLUDE CLADDING

■ **PRODUCT SIZE & THICKNESS**

THICKNESS	COPPER CLADDING	SIZE		THICKNESS TOLERANCE
		inch	mm	
0.004 (0.1) to 0.039 (1.0)	Q (9) 3.0 (102)	48.8 x 36.6	1240 x 0930	IPC-4101E SPEC CLASS C/M
	T (12) 4.0 (140)			
	H (17) 5.0 (175)			
	1.0 (35) 6.0 (210)			
	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.

■ We recommend to evaluate the drilling property.

■ Different oxide treatment may result in variations in the heat resistance properties of the laminates after processing. Pre-production batch runs are recommended to ensure compatibility of materials with chemicals.





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

# NP-175FB

**■ FEATURES**

- Dicy-Free & Low C.T.E
- Lead-Free Compatible
- Excellent dimensional stability and through-hole reliability
- Superior CAF-Resistance (Anti-migration)
- We recommend to evaluate the drilling property.
- Different oxide treatment may result in variations in the heat resistance properties of the laminates after processing.
- Pre-production batch runs are recommended to ensure compatibility of materials with chemicals.
- High luminance of multi-functional epoxy contrast with copper for A.O.I
- IPC-4101E L99/101/126

**■ PERFORMANCE LIST**

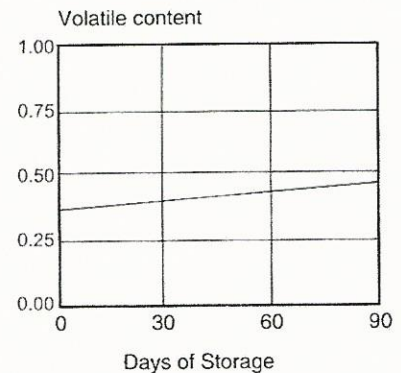
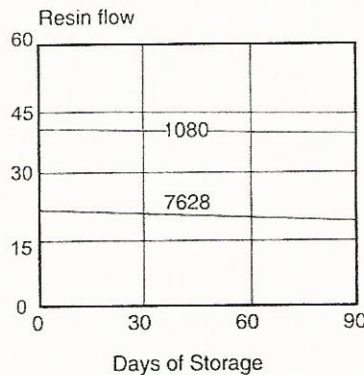
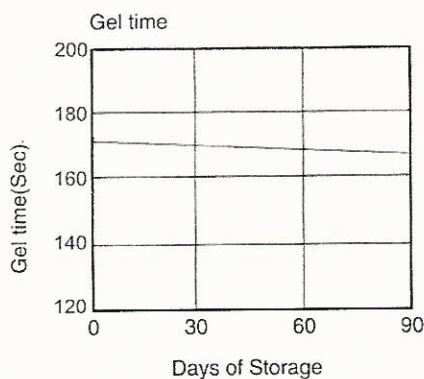
Specification: IPC-4101E is applicable

Data shown are nominal values for reference only. (Remained Copper 100%)

Glass style	RC%	GT sec (171°C)	VC%	After Pressed Thickness (per ply)	
				mm	mil
7628HR	52 ± 3	170 ± 20	1.5 ↓	0.230 ± 0.01	9.1 ± 0.4
7628MR	49 ± 3			0.213 ± 0.01	8.4 ± 0.4
7628	45 ± 3			0.194 ± 0.01	7.6 ± 0.4
1506	50 ± 3			0.170 ± 0.01	6.7 ± 0.4
2116HR	60 ± 3			0.145 ± 0.01	5.7 ± 0.4
2116MR	56 ± 3			0.129 ± 0.01	5.1 ± 0.4
2116	52 ± 3			0.116 ± 0.01	4.6 ± 0.4
2113	58 ± 3			0.102 ± 0.01	4.0 ± 0.4
2112	62 ± 3			0.103 ± 0.008	4.0 ± 0.3
1080HR	70 ± 3			0.093 ± 0.008	3.6 ± 0.3
1080MR	67 ± 3			0.083 ± 0.008	3.3 ± 0.3
1080	64 ± 3			0.075 ± 0.008	3.0 ± 0.3
106	70 ± 3			0.046 ± 0.008	1.8 ± 0.3

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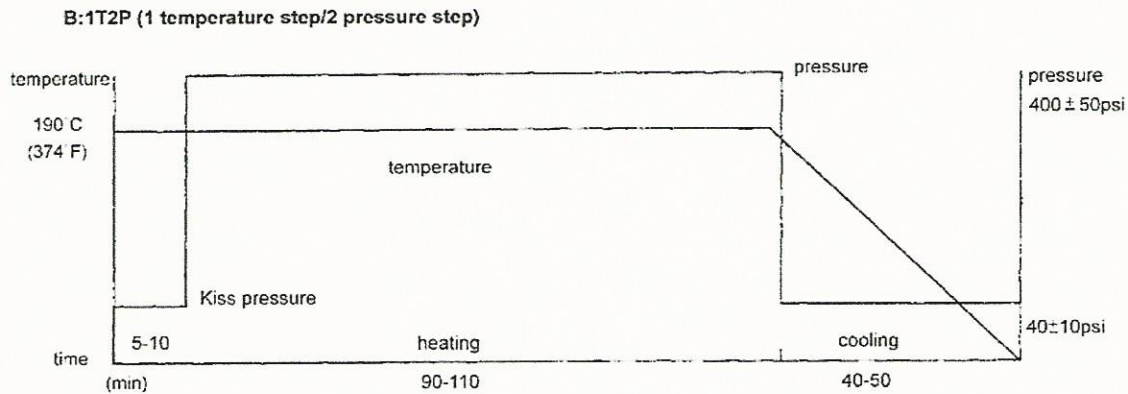
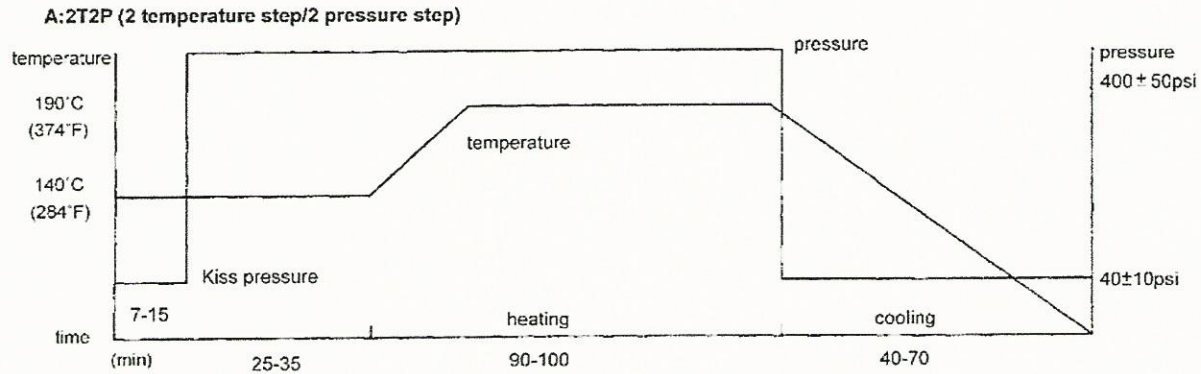
**Storage Stability**



Storage Condition: 20°C, 50% RH for 3 months  
 : max. 5°C for 6 months



**Recommended press cycles:**



**Suggestions:**

1. Heating rate of material between 70°C and 140°C  
 1-3°C/min is acceptable.  
 1.5-2.5°C/min would be better.
2. Temperature of material over 170°C must be held for at least 60min. to allow epoxy 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 when the temperature of material is over 100°C, in order to avoid introducing twist.

**■ CERTIFICATION UL**

- UL File No.: E98983
- ANSI TYPE: FR-4.0
- UL 746 Recognition

Minimum Material Thickness inch (mm)	Clad cond. Thickness Min. Max. mil mil (mic) (mic)	Max. Area Diameter inch (mm)	Solder Lts Temp Time °C sec	UL 94 Flame Class	Max. Operating Temp
0.002 (0.051)	0.35 8.26 (9) (210)	2.0 (50.8)	300 30	94V-0	130