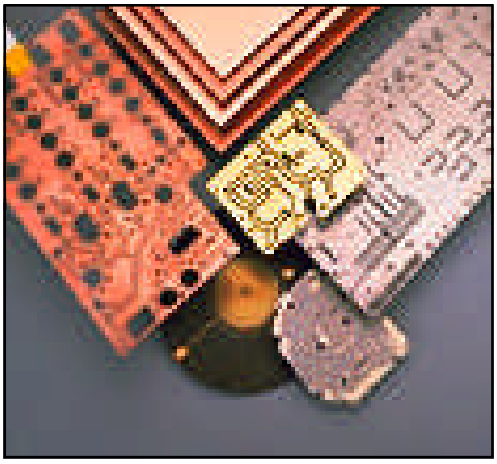
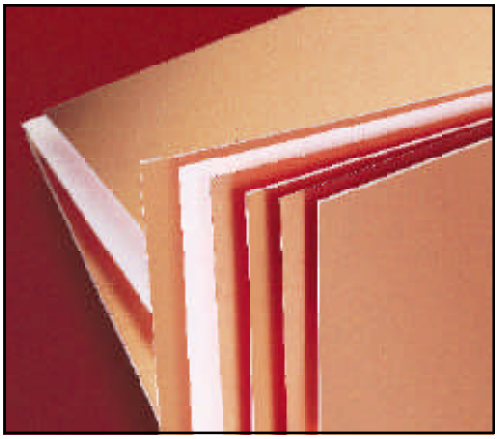
ROGERS CORPORATION

Advanced Circuit Materials



High Frequency Circuit Materials Product Selector Guide



The world runs better with Rogers.

High Frequency Circuit Materials - Properties

Product	Composition	Dielectric Constant ε_r[1] Tolerance @ 10GHz	Dissipation[1] Factor TAN δ @ 10 GHz	Thermal[2] Coefficient of ε_r -50° - 150°C (Typical)	Volume Resistivity Mohm cm (Typical)	Surface Resistivity Mohm (Typical)	Youngs Modulus[3] kpsi (MPa) (Typical)			Moisture[4] Absorption D24/23% (Typical)	Thermal[5] Conductivity W/m/°K (Typical)	Coefficient of[6] thermal Expansion 0-100°C (Typical)			Density gm/cm³ (Typical)	Peel Strength lbs/in (N/mm) (Typical)	Flammability Rating	Standard Thickness in. (mm)
							X	Y	Z			X	Y	Z				
RT/duroid® 5870	PTFE Glass Fiber	2.33 ± 0.020	0.0012	-115	$2X10^7$	$2X10^8$	189 (1,340)	185 (1,277)	120 (828)	0.015	0.22	22	28	173	2.2	20.8 (3.7)	UL 94V-0	0.005", (0.127mm) 0.010", (0.254mm) 0.015", (0.381mm) 0.020", (0.508mm) 0.031", (0.787mm) 0.062", (1.575mm) 0.125", (3.175mm)
RT/duroid® 5880	PTFE Glass Fiber	2.20 ± 0.020	0.0009	-125	$2X10^7$	$3X10^7$	156 (1,076)	125 (863)	136 (938)	0.015	0.20	31	48	237	2.2	22.8 (4.0)	UL 94V-0	0.005",(0.127mm) 0.010",(0.254mm) 0.015", (0.381mm) 0.020", (0.508mm) 0.031", (0.787mm) 0.062", (1.575mm) 0.125", (3.175mm)
ULTRALAM® 2000	PTFE Woven Glass	2.40-2.60 ± 0.040	0.0019	-100	$2X10^7$	$4X10^7$	1,700 (11,730)	1,300 (8,970)		0.03	0.24	15	15	200	2.2	18.0 (3.2)	UL 94V-0	0.004", (0.101mm) 0.0101", (0.256mm) 0.0147", (0.373mm) 0.0190", (0.482mm) 0.030", (0.762mm) 0.060", (1.524mm)
RT/duroid® 6002	PTFE Ceramic	2.94 ± 0.040	0.0012	+12	10^6	10^7	120 (828)	120 (828)	360* (2,482)	0.1	0.60	16	16	24	2.1	8.9 (1.6)	UL 94V-0	0.005", (0.127mm) 0.010", (0.254mm) 0.020", (0.508mm) 0.030", (0.762mm) 0.060", (1.524mm) 0.120", (3.048mm)
RT/duroid® 6006	PTFE Ceramic	6.15 ± 0.150	0.0019	-410	$2X10^7$	$7X10^7$	75 (511)	91 (628)	155 (1,070)	0.05	0.49	47	34	117	2.7	14.3 (2.5)	UL 94V-0	0.010", (0.254mm) 0.025", (0.635mm) 0.050", (1.270mm) 0.075", (1.905mm) 0.100", (2.540mm)
RT/duroid® 6010LM	PTFE Ceramic	10.2 ± 0.250	0.0023	-425	$5X10^6$	$5X10^6$	135 (932)	81 (559)	311 (2,146)	0.05	0.78	24	24	24	3.1	12.3 (2.5)	UL 94V-0	0.010", (0.254mm) 0.025", (0.635mm) 0.050", (1.270mm) 0.075", (1.905mm) 0.100", (2.540mm)
TMM®3	Hydrocarbon Ceramic	3.27 ± 0.032	0.0020	[4]+39	$3X10^9$	$>9X10^9$	1,916 (13,210)	1,916 (13,210)	742 (5,116)	[4] 0.04	0.70	16	16	20	1.78	5.7 (1.0)	N/A	0.015", (0.381mm) 0.020",(0.508mm) 0.030",(0.762mm) 0.060",(1.524mm) 0.125",(3.175mm)
TMM®4	Hydrocarbon Ceramic	4.50 ± 0.045	0.0020	+15.3*	$6X10^8$	$1X10^9$	2,000* (13,790)	2,000* (13,790)	752 (5,185)	[4] 0.010	0.70	14	14	20	2.07	5.7 (1.0)	N/A	0.015", (0.381mm) 0.020",(0.508mm) 0.030",(0.762mm) 0.060",(1.524mm) 0.125",(3.175mm)
TMM®6	Hydrocarbon Ceramic	6.00 ± 0.080	0.0023	[4]L-10	$1X10^8$	$1X10^9$	2,200 (15,168)	2,200 (15,168)	736 (5,075)	[4] 0.06	0.72	16	16	20	2.37	5.7 (1.0)	N/A	0.015", (0.381mm) 0.025", (0.635mm) 0.050",(1.270mm) 0.075", (1.905mm) 0.100", (2.540mm) 0.125", (3.175mm)
TMM®10	Hydrocarbon Ceramic	9.20 ± 0.230	0.0023	[4]L-38	$2X10^8$	$4X10^7$	2,400 (16,547)	2,400 (16,457)	575 (3,964)	[4]0.09	0.76	16	16	20	2.77	5.0 (0.9)	N/A	0.015", (0.381mm) 0.025", (0.635mm) 0.050",(1.270mm) 0.075", (1.905mm) 0.100", (2.540mm) 0.125", (3.175mm)
TMM®10i	Hydrocarbon Ceramic	9.80 ± 0.245	0.0020	[4]L-43	$2X10^{8*}$	$4X10^{7*}$	2,400* (16,547)*	2,400* (16,457)*	575* (3,964)*	[4]0.16	0.76	16*	16*	20*	2.77	5.0 (0.9)	N/A	0.015", (0.381mm) 0.025", (0.635mm) 0.050",(1.270mm) 0.075", (1.905mm) 0.100", (2.540mm) 0.125", (3.175mm)
RO4003C®	Hydrocarbon Ceramic	3.38 ± 0.05	0.0027	+40	$1.7X10^{10}$	$4.2X10^9$	3,700 (25,510)	3,900 (26,889)		0.06	0.64	11	14	46	1.8	6.4 (1.1)	N/A	0.008", (0.203mm) 0.020", (0.508mm) 0.032", (0.813mm) 0.060", (1.524mm)
[8]RO4350B®	Hydrocarbon Ceramic	3.48 ± 0.05	0.004	+50	$1.2X10^{10}$	$5.7X10^9$		1,664 (11,473)		0.06	0.62	14	16	50	1.9	5.3 (0.9)	UL 94V-0	0.004", (0.101mm) 0.0066", (0.168mm) 0.010", (0.254mm) 0.020", (0.813mm) 0.030", (0.762mm) 0.060", (1.524mm)
RO4450B®	Hydrocarbon Ceramic Prepreg	3.54 ± 0.05	0.004							0.05	0.60			60	1.86		UL 94V-0	0.004" (0.101mm)
RO3003®	PTFE/Ceramic	[7]3.00 ± 0.04	0.0013	13	10^7	10^7	300 (2,068)	300 (2,068)		<0.1	0.50	17	17	24	2.1	17.6 (3.1)	UL 94V-0	0.010", (0.254mm) 0.020", (0.508mm) 0.030", (0.762mm) 0.060", (1.524mm)
RO3203®	PTFE/Ceramic Reinforced Woven Glass	[7]3.02 ± 0.04	0.0016	13	10^7	10^7				<0.1	0.50	13	13	58	2.1	10 (1.7)	UL 94V-0	0.010", (0.254mm) 0.020", (0.508mm) 0.030", (0.762mm) 0.060", (1.524mm)
RO3006®	PTFE/Ceramic	6.15 ± 0.15	0.0020	-160	10^3	10^3	300 (2,068)	300 (2,068)		<0.1	0.61	17	17	24	2.6	12.2 (2.1)	UL 94V-0	0.010", (0.254mm) 0.025", (0.635mm) 0.050",(1.270mm)
RO3010®	PTFE/Ceramic	10.2 ± 0.30	0.0023	-280	10^3	10^3	300 (2,068)	300 (2,068)		<0.1	0.66	17	17	24	3.0	13.4 (2.4)	UL 94V-0	0.010", (0.254mm) 0.025", (0.635mm) 0.050",(1.270mm)
RO3210®	PTFE/Ceramic Reinforced Woven Glass	10.2 ± 0.50	0.0027		10^4	10^4				<0.1	0.81	13	13	34	3.0	13.4 (2.4)	UL 94V-0	0.010", (0.254mm) 0.025", (0.635mm) 0.050",(1.270mm)

Metal Claddings

Copper Foil	Surface Roughness		Tensile Strength kpsi (MPa)	Elongation %	Stress Crack Resistance	Thickness mil
	Treated Side µin (µm)	Untreated Side µin (µm)				
¼ oz (9µm) Electrodeposited	70 (1.8)	15 (0.4)			Fair	0.4
½ oz (17.5µm) Electrodeposited	75 (1.9)	15 (0.4)	33.0 (228)	20.0	Fair	0.7
1 oz. (35 µm) Electrodeposited	95 (2.4)	15 (0.4)	30.0 (207)	28.0	Fair	1.4
2 oz. (70 µm) Electrodeposited	115 (2.9)	15 (0.4)	32.0 (221)	42.0	Fair	2.8
½ (17.5 µm) Rolled	55 (1.4)	12 (0.3)	20.0 (138)	8.0	Excellent	0.7
1 oz. (35 µm) Rolled	55 (1.4)	12 (0.3)	22.0 (152)	13.0	Excellent	1.4
2 oz. (70 µm) Rolled	55 (1.4)	12 (0.3)	28.0 (193)	27.0	Excellent	2.8

Plates	Alloy	Surface Roughness µin (µm)	Machinability	Tensile Strength kpsi (MPa)	Density	Thermal Conductivity W/m/°K	Coefficient of Thermal Expansion ppm/°C
Aluminum	6061	70 (1.8)	Poor	20 (138)	2.7	150	24
Brass	70/30 Cartridge	70 (1.8)	Good	45 (311)	8.5	120	20
Copper	110	70 (1.8)	Fair to Good	35 (242)	8.9	390	17

NOTES:

***estimated**

1) **Measured by IPC-TM-650 method 2.5.5.5 at ~10 GHz, 23°C. RT/duroid 6010 materials were based on testing a 0.025" thick sheet clad with 1 oz. electrodeposited copper. ε_r values and tolerances reported by IPC-TM-650 method 2.5.5.5 are the basis for quality acceptance, but for some products these values may be incorrect for design engineering applications, especially those in microstrip. We recommend that prototype boards of a new design be verified for electrical performance.**
2) **Measured by IPC-TM-650 method 2.5.5.5 at ~10 GHz modified.**
3) **Young's modulus (elastic modulus), steepest region of the stress/strain curve is in tension for X and Y axes by ASTM D 638; in compression for Z axis by ASTM D 695 on 12.7 x 12.7 x 25.4 mm stacked specimen.**
4) **Testing conditions: 24 hours @ 23°C, specimens etched free of copper.**
5) **Tested by ASTM C 518.**
6) **Tested by ASTM D3386-94. Values are average over temperature range but not necessarily linear. However, for RT/duriod 6002 and TMM grades the response is essentially linear.**
7) **The nominal dielectric constant of an 0.060 thick RO3003/RO3203 laminate as measured by the IPC-TM-650, 2.5.5.5 will be 3.04 due to the elimination of biasing caused by air gaps in the test fixture. For further information refer to Rogers T.R. 5242.**
8) **See the RO4000 series material data sheet for 0.004" material.**

Typical values are a representation of an average value for the population of that property. For specification values contact Rogers Corporation.

Ordering Information

Rogers High Frequency Laminates can be purchased by contacting your Customer Service Representative at (480) 961-1382 or one of our international offices listed below.

To ensure you receive the right material for your application, please include order information for each of the catagories listed below. For more detailed product information, refer to the charts in the product selector guide.

GRADE:
Laminates - RT/duroid® 5870, 5880, 6002, 6006, 6010LM, ULTRALAM® 2000, TMM® 3,4,6,10, and 10i, RO3003®, RO3203®, RO3006®, RO3010®, RO3210®, RO4003®, and RO4350B®high frequency laminates.
Bonding Film - 3001 **Prepreg -** RO4450B®

THICKNESS AND TOLERANCE:
Laminate thickness is normally specified as the dielectric thickness without copper cladding. Refer to the data sheets for standard thicknesses and tolerances. Custom tolerances available on RT/duroid laminates and TMM laminates upon request.

TYPE OF FOIL CLADDING:
¼, ½, 1, 2 oz. electrodeposited copper foil, ½, 1, 2 oz. rolled copper foil. RO3000 series and RO4000 series laminates are not supplied with ¼ oz. electrodeposited or rolled copper foil. TMM laminates are supplied with electrodeposited (ED) foil only.

Some material grades may be supplied unclad. Call our Customer Service Representatives for unclad options.

Thick metal cladding is available on our RT/duroid laminates only. Thick aluminum, copper, and brass claddings are also available in a range of thicknesses and thickness tolerances. Other thick metal backings are available upon request.

STANDARD PANEL SIZES:

RT/duroid 6006/6010LM laminates:	10" X 10"(254mm X 254mm), 10"X20" (254mm X 508mm)
ULTRALAM 2000, RT/duroid 5870, 5880, 6002 RO3203, RO3210, 3006, 3010 laminates:	18" X 12" (457mm X 305mm), 18" X 24" (457mm X 610mm), 18" X 36" (457mm X 914mm), 18" X 48" (457mm X 1.219m)
TMM 3,4,6,10,10i laminates:	18" X 12" (457mm X 305mm) , 18" X 24" (457mm X 610mm)
RO3003 laminate and RO4000 series laminates:	12" X 18" (305mm X 457mm) , 24" X 18" (610mm X 457mm)
RO4450B Prepreg:	24" X 18" (610mm X 457mm)

SPECIFICATION REQUIREMENTS:
Standard specifications are Rogers material specifications. Certificates of conformance are available.

All other requirements must be identified at the time the order is placed. If special testing or data generation is required, additional costs may be incurred.

CONTACT INFORMATION:

USA:	Rogers Advanced Circuit Materials, ISO 9002 Certified	Tel: 480-961-1382	Fax: 480-961-4533
Belgium:	Rogers N.V.	Tel: +32-9-2353611	Fax: +32-9-2353658
Japan:	Rogers Japan Inc.	Tel: 81-33-807-6430	Fax: 81-33-807-6319
Taiwan:	Rogers Taiwan Inc.	Tel: 886-2-86609056	Fax: 886-2-86609057
Korea:	Rogers Korea Inc.	Tel: 82-31-716-6112	Fax: 82-31-716-6208
Singapore:	Rogers Technologies Singapore Inc.	Tel: 65-747-3521	Fax: 65-747-7425

0618-0202-5.0-ON
Publication #92-601