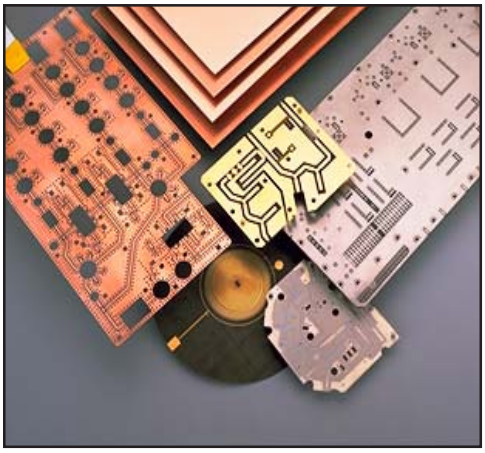
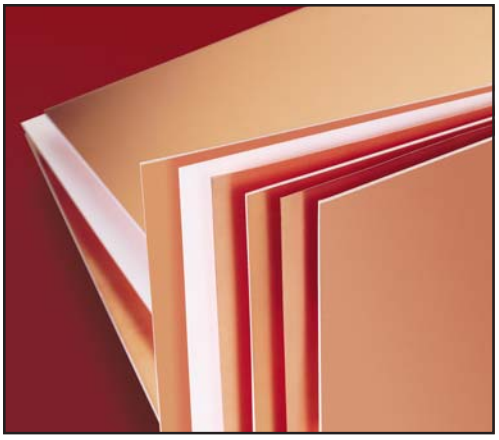
ROGERS CORPORATION

Advanced Circuit Materials



High Frequency Circuit Materials Product Selector Guide



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High Frequency Circuit Materials - Properties

Product	Composition	Dielectric [1] Constant ε_r, Tolerance @ 10 GHz	Dissipation[1] Factor TAN δ @ 10 GHz	Thermal[2] Coefficient of ε_r -50° - 150°C ppm/°C (Typical)	Volume Resistivity Mohm cm (Typical)	Surface Resistivity Mohm (Typical)	Youngs Modulus[4] kpsi (MPa) (Typical)			Moisture Absorption D24/23 % (Typical)	Thermal [5] Conductivity W/m/°K (Typical)	Coefficient of[6] Thermal Expansion 0-100°C (Typical) ppm/°C			Density gm/cm^3 (Typical)	Peel Strength lbs/in (N/mm) (Typical)	Flammability Rating UL
							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)	94V-0
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)	94V-0
ULTRALAM® 2000	PTFE Woven Glass	2.40-2.60 ± 0.040	0.0019	-100	$2 X10^7$	$4x10^7$	1,700 (11,730)	1,300 (8,970)		0.03	0.24	15	15	200	2.2	18.0 (3.2)	94V-0
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)	94V-0
RT/duroid 6202	PTFE Ceramic Woven Glass	2.94± 0.04	0.0015	+13**	10^{10}	10^9	146 (1,007)	146 (1,007)	150 (1035)	0.1	0.68	15	15	30	2.1	9.1 (1.6)	94V-0
RT/duroid 6006	PTFE Ceramic	6.15 ± 0.150	0.0027	-410	$2X10^7$	$7X10^7$	91 (628)	75 (517)	155 (1,070)	0.05	0.48	47	34	117	2.7	14.3 (2.5)	94V-0
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)	94V-0
TMM® 3	Hydrocarbon Ceramic	3.27 ± 0.032	0.0020	+37	$3X10^9$	$>9X10^9$	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
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)	0.01	0.70	14	14	20	2.07	5.7 (1.0)	N/A
TMM 6	Hydrocarbon Ceramic	6.00 ± 0.080	0.0023	-11	$1X10^8$	$1X10^9$	2,200 (15,168)	2,200 (15,168)	736 (5,075)	0.06	0.72	16	16	20	2.37	5.7 (1.0)	N/A
TMM 10	Hydrocarbon Ceramic	9.20 ± 0.230	0.0022	-38	$2X10^8$	$4X10^7$	2,400 (16,547)	2,400 (16.547)	575 (3,964)	0.09	0.76	16	16	20	2.77	5.0 (0.9)	N/A
TMM 10i	Hydrocarbon Ceramic	9.80 ± 0.245	0.0020	-43	$2X10^{8*}$	$4X10^{7*}$	2,400* (16,547)	2,400* (16,547)	575* (3,964)	0.16	0.76	16	16	20	2.77	5.0 (0.9)	N/A
RO4003C™	Hydrocarbon Ceramic	3.38 ± 0.05	0.0027	+40	$1.7X10^{10}$	$4.2X10^9$	3.700 (25,510)	3,900 (26,889)	TBD	0.06	0.64	11	14	46	1.8	6.0 (1.1)	N/A
[8] RO4350B™	Hydrocarbon Ceramic	3.48 ± 0.05	0.0037	+50	$1.2X10^{10}$	$5.7X10^9$	TBD	1,664 (11,473)	TBD	0.06	0.62	14	16	35	1.9	5.2 (0.9)	94V-0
RO4450B™	Hydrocarbon Ceramic Prepreg	3.54 ± 0.05	0.0040	TBD	TBD	TBD	TBD	TBD	TBD	0.05	0.60	19	17	50	1.86	NA	94V-0
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)	94V-0
RO3203™	PTFE/Ceramic Reinforced Woven Glass	[7]3.02 ± 0.04	0.0016	13	10^7	10^7	140 (965)	140 (965)		<0.1	0.50	13	13	58	2.1	10 (1.7)	94V-0
RO3006™	PTFE/Ceramic	6.15 ± 0.15	0.0020	-160	10^3	10^3		300 (2,068)		<0.1	0.61	17	17	24	2.6	12.2 (2.1)	94V-0
RO3206™	PTFE/Ceramic Reinforced Woven Glass	6.15 ± 0.15	0.0027	TBD	10^7	10^7	140 (965)	140 (965)		<0.1	0.63	13	13	34	2.7	7 (1.30)	94V-0
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)	94V-0
RO3210™	PTFE/Ceramic Reinforced Woven Glass	10.2 ± 0.50	0.0027	TBD	10^4	10^4	140 (965)	140 (965)		<0.1	0.81	13	13	34	3.0	13 (2.4)	94V-0
RO3035™	PTFE/Ceramic	3.50 ± 0.05	0.0017	TBD	10^7	10^7	300 (2,068)	300 (2,068)		<0.1	0.50	17	17	24	2.1	9.1 (1.6)	94V-0

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)	N/A	N/A	Fair	0.4
½ oz (17.5µm) Electrodeposited	75 (1.9)	15 (0.4)	33.0 (228)	20.0	Fair	0.7
1 oz. (35µm) 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

Properties Notes:
*estimated, ** Preliminary Data

1) Measured by IPC-TM-650 method 2.5.5.5 @ ~10 GHz, 23°C. RT/duroid 6010 materials were based on testing a 0.025" thick sheet clad with 1 oz. electrodeposited copper foil. 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 value may be incorrect or design engineeing 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 D695 on 12.7 x 12.7 x 25.4 mm stocked specimen.
4) Testing conditions: 24 hours @ 23ºC, specimens etched free of copper.
5) Tested by ASTM C518.
6) Tested by ASTM D3386-94. Values are average over temperature range but not necessarily linear. However, for RT/duroid 6002 and TMM grades the response is essentially linear.
7) The nominal dielectric constant of an 0.060 thick RO3003 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 repesentation of an average value for the population of the property.
For specification values contact Rogers Corporation.

Ordering Information

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

To ensure that you receive the 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 this product selector guide.

GRADE:
Laminates - RT/duroid® 5870, 5880, 6002, 6202, 6006, 6010LM, ULTRALAM® 2000, TMM® 3,4,6,10, and 10i, RO3003™,RO3035™, RO3203™, RO3006™, RO3206™ RO3010™, RO3210™, RO4003C™, 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. Custom tolerances are available on RT/duroid laminates upon request.

TYPE OF FOIL CLADDING:
¼, ½, 1, 2 oz. electrodeposited copper foil, ½, 1, 2 oz. rolled copper foil. 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 Rogers Customer Service Representatives for unclad options.

Thick aluminum, copper and brass claddings are available on Rogers RT/duroid laminates. Thick aluminum and brass claddings are available on most TMM laminates. Thick metal cladding is not available on RO4000 laminates. 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.

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.

Standard Thickness, Tolerance and Panel Size
in (mm)

Product	Standard Dielectric Thickness	Standard Panel Sizes
RT/duroid 5870 RT/duroid 5880	0.005" (0.127mm) ± 0.0005" 0.010" (0.254mm) ± 0.0007" 0.015" (0.381mm) ± 0.001" 0.020" (0.508mm) ± 0.001" 0.031" (0.787mm) ± 0.001" 0.062" (1.570mm) ± 0.002" 0.125" (3.170mm) ± 0.004"	18" X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm) 18" X 36" (457mm X 914mm) 18" X 48" (457mm X 1.219 m)
ULTRALAM 2000	0.004" (0.102mm) ± 0.0004" 0.0101" (0.250mm) ± 0.009" 0.0147" (0.373mm) ± 0.001" 0.0190" (0.483mm) ± 0.001" 0.0300" (0.762mm) ± 0.001" 0.0600" (1.524 mm) ± 0.002"	18" X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm) 18" X 36" (457mm X 914mm) 18" X 48" (457mm X 1.219 m)
RT/duroid 6002 RT/duroid 6202	0.005" (0.127mm) ± 0.0005" 0.010" (0.254mm) ± 0.007" 0.020" (0.508mm) ± 0.001" 0.030" (0.762mm) ± 0.001" 0.060" (1.524mm) ± 0.002"	18" X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm) 18" X 36" (457mm X 914mm) 18" X 48" (457mm X 1.219 m)
RT/duroid 6006 RT/duroid 6010LM	0.010" (0.254mm) ± 0.0007" 0.025" (0.625mm) ± 0.001" 0.050" (1.270mm) ± 0.002" 0.075" (1.905mm) ± 0.004" 0.100" (2.540mm) ± 0.005"	18" X 12" (457mm X 305mm) not available in 0.010" (0.254mm) 18" X 24" (457mm X 610mm) not available in 0.010" (0.254mm) 10" X 10" (254mm X 254mm) 10" X 20" (254mm X 508mm) 20" X 20" (508mm X 508mm)
TMM 3 TMM 4	0.015" (0.381mm) ± 0.0015" 0.020" (0.508mm) ± 0.0015" 0.030" (0.762mm) ± 0.0015" 0.060" (1.524mm) ± 0.0015" 0.125" (3.175mm) ± 0.0015"	18 "X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm)
TMM 6 TMM 10 TMM 10i	0.015" (0.381mm) ± 0.0015" 0.025" (0.635mm) ± 0.0015" 0.050" (1.270mm) ± 0.0015" 0.075" (1.905mm) ± 0.0015" 0.100" (2.540mm) ± 0.0015"	18 "X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm)
RO3003 RO3035 *RO3203 *not available in 0.005"(0.127mm)	0.005" (0.127mm) ± 0.0005" 0.010" (0.254mm) ± 0.0007" 0.020" (0.508mm) ± 0.001" 0.030" (0.762mm) ± 0.0015" 0.060" (1.524mm) ± 0.003"	*RO3003* 12" X 18" (305mm X 457mm) 24" X 18" (610mm X 457mm) *RO3203, RO3035* 18" X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm) 18" X 36" (457mm X 914mm) 18" X 48" (457mm X 1.219 m)
RO3006 RO3010 *RO3206 *RO3210 *not available in 0.005" (0.127mm) and 0.010" (0.254mm)	0.005" (0.127mm) ± 0.0005 " 0.010" (0.254mm) ± 0.0007" 0.025" (0.625mm) ± 0.001" 0.050" (1.270mm) ± 0.002"	18" X 12" (457mm X 305mm) 18" X 24" (457mm X 610mm) 18" X 36" (457mm X 914mm) 18" X 48" (457mm X 1.219 m)
RO4003C	0.008" (0.203mm) ± 0.0010" 0.012" (0.305mm) ± 0.0010" 0.016" (0.406mm) ± 0.0015" 0.020" (0.508mm) ± 0.0015" 0.032" (0.813mm) ± 0.0020" 0.060" (1.524mm) ± 0.0040"	12" X 18" (305mm X 457mm) 24" X 18" (610mm X 457mm)
RO4350B	0.0066" (0.168mm) ± 0. 0007" 0.0100" (0.254mm) ± 0.0010" 0.0133" (0.338mm) ± 0.0015" 0.0166" (0.422mm) ± 0.0015" 0.0200" (0.508mm) ± 0.0015" 0.0300" (0.762mm) ± 0.0020" 0.0600" (1.524mm) ± 0.0040"	12" X 18" (305mm X 457mm) 24" X 18" (610mm X 457mm)

CONTACT INFORMATION:

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Japan:	Rogers Japan Inc.	Tel: 81-3-5200-2700	Fax: 81-3-5200-0571
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
China:	Rogers (Shanghai) International Trading Co., Ltd	Tel: 86-21-63916088	Fax: 86-21-63915060

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