

9. Přílohy

9.1. Příloha I

Substráty

(Rogers, Arlon, Polyflon)

RT/duroid® and TMM® Microwave Laminates

PROPERTY	RT/duroid® 5880 (GR,GP)	RT/duroid® 5870 (GR,GP)	ULTRALAM® 2000 (GT,GX)	RT/duroid® 6002	RT/duroid® 6006	RT/duroid® 6010, 6010LM	TMM® Temperature Stable Microwave Laminates					
	3	4	6	10	10i							
Dielectric constant and tolerance @10 GHz	2.20±0.02	2.33±0.02	2.4±2.6 0.04	2.94±0.04	6.15±0.15	10.2±0.25	3.27 ±0.030	4.50 ±0.045	6.00 ±0.080	9.20 ±0.230	9.80 ±0.245	
Dissipation factor (Loss tangent) @10 GHz. Typ.	0.0009	0.0012	0.0019	0.0012	0.0019	0.0023	⁽¹⁾ 0.0016	⁽¹⁾ 0.0017	⁽¹⁾ 0.0018	⁽¹⁾ 0.0017	¹ 0.0015	
Thermal coeff. of ε, 0° to100°C ppm/ °C (Typical)	-129	-115	-100	+16	-450	-390	⁽⁵⁾ +39	—	⁽⁵⁾ -10	⁽⁵⁾ -38	⁽⁵⁾ -43	
Volume resistivity Mohm•cm (Minimum)	2x10 ⁷	2x10 ⁷	2x10 ⁷	10 ⁶	2x10 ⁷	5x10 ⁵	3x10 ⁹	6x10 ⁵	1x10 ⁸	2x10 ⁷	—	
Surface resistivity Mohm (Minimum)	3x10 ⁸	2x10 ⁸	4x10 ⁷	10 ⁷	7x10 ⁷	5x10 ⁶	>9x10 ⁹	1x10 ⁹	1x10 ⁹	4x10 ⁷	—	
Tensile modulus kpsi (MPa) (Typical)	X	156 (1076)	189 (1340)	1700(11730)	120 (828)	74 (511)	135 (932)	⁽²⁾ 1916	⁽²⁾ 2000*	⁽²⁾ 2200*	⁽²⁾ 2400	—
	Y	125 (863)	185 (1277)	1300 (8970)	120 (828)	91 (628)	81(559)	⁽²⁾ 1916	⁽²⁾ 2000*	⁽²⁾ 2200*	⁽²⁾ 2400	—
Compressive modulus Z axis kpsi (MPa) (Typical)	136 (938)	120 (828)	—	360*	155 (1070)	311 (2146)	742	752	736	575	—	
Moisture absorption D23/24 % (Maximum)	0.015	0.015	0.03	0.1	0.05	0.6 (LM 0.05)	⁽³⁾ 0.04	⁽³⁾ 0.010	⁽³⁾ 0.06	⁽³⁾ 0.09	⁽³⁾ 0.16	
Thermal ⁽⁶⁾ conductivity W/m/K (Typical)	0.20	0.22	0.24	0.60	0.49	0.78	0.70	0.70	0.72	0.76	0.76	
⁽⁴⁾ Coefficient of thermal expansion 0° to 100°C (Typical)	X	31	22	15	16	47	24	16	14	16	16	16*
	Y	48	28	15	16	34	24	16	14	16	16	16*
	Z	237	173	200	24	117	24	20	20	20	20	20*
Specific Gravity (Typical)	2.2	2.2	2.2	2.1	2.7	2.9	1.78	2.07	2.37	2.77	2.77	

1) Tested by ASTM D2520D 3GHz waveguide perturbation, maximum values

2) Young's Modulus

3) Testing conditions: 50°C, 48 hours, 0.50" (12.7mm) thick samples

4) Values represent a linear approximation of CTE for the temperature ranges given, except for RT/duroid 6002 and TMM, which do have a linear behavior.

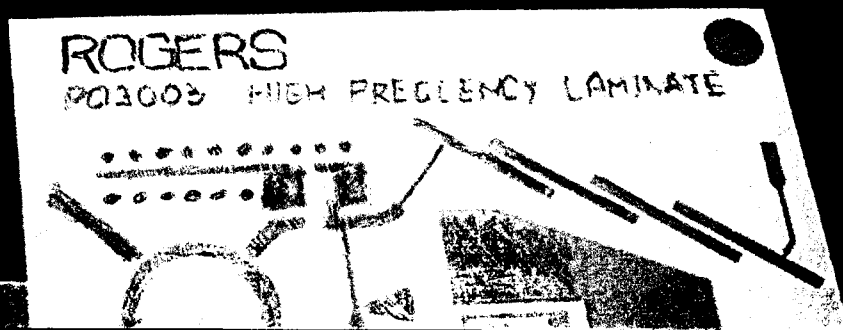
5) Tested by IPC-TM-650 method 2.5.5.5

6) Tested by ASTM C518

*estimated

RO3003™, RO3006™, RO3010™ High Frequency Circuit Materials

Ceramic Filled PTFE Composites



FEATURES AND BENEFITS:

Low dielectric loss for high frequency performance (RO3003).

- Can be used in applications up to 30-40 GHz.

Excellent mechanical properties versus temperature.

- Reliable stripline and multilayer board constructions.

Uniform mechanical properties for a range of dielectric constants.

- Ideal for multilayer board designs with a range of dielectric constants.
- Suitable for use with epoxy glass multilayer board hybrid designs.

Stable dielectric constant versus temperature and frequency for RO3003.

- Ideal for band pass filters, microstrip patch antennas, and voltage controlled oscillators.

Low in-plane expansion coefficient (matched to copper).

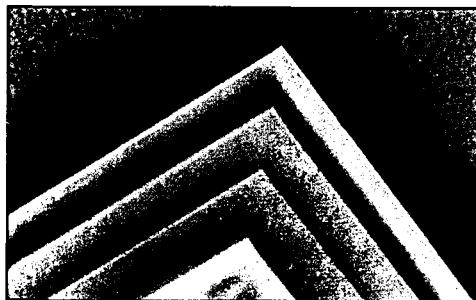
- Allows for more reliable surface mounted assemblies.
- Ideal for applications sensitive to temperature change.
- Excellent dimensional stability.

Volume manufacturing process.

- Economical laminate pricing.

Typical Applications:

- Automotive Collision Avoidance Systems
- Automotive Global Positioning Satellite Antenna
- Cellular and Pager Telecommunications Systems
- Patch Antennas for Wireless Communications
- Direct Broadcast Satellite
- Datalink on Cable Systems
- Remote Meter Readers
- Power Backplanes



ROGERS
SINCE 1832

PROPERTY	Typical Values			
	RO3003	RO3006	RO3010	Units
Dielectric Constant @ 10 GHz	3.0±0.04	6.15±0.15	10.2± 0.30	ppm/°C
Thermal Coefficient of ϵ_r @ 0 to 100°C	13	-160	-280	
Dissipation Factor @ 10 GHz	0.0013	0.0025	0.0035	
Youngs Modulus X	300 (2068)	300 (2068)	300 (2068)	kpsi (MPa)
Y	300 (2068)	300 (2068)	300 (2068)	
Volume Resistivity	10^6	10^3	10^3	Mohm•cm
Surface Resistivity	10^7	10^3	10^3	Mohm
Moisture Absorption	<0.1	<0.1	<0.1	%
Dimensional Stability X,Y	0.5	0.5	0.5	mm/m(mils/in)
Specific Gravity	2.1	2.6	3.0	
Peel Strength	3.1 (17.6)	2.1 (12.2)	2.4 (13.4)	N/mm (pli)
Thermal Conductivity	0.50	0.61	0.66	W/m/°K
Coefficient of Thermal Expansion				ppm/°C
0 to 100°C X	17	17	17	
Y	17	17	17	
Z	24	24	24	
UL Flammability Rating	94-VO	94-VO	94-VO	

Availability:

Standard Thicknesses:

RO3003: 0.005" (0.127mm), 0.010" (0.254mm), 0.020" (0.508mm), 0.030" (0.762), 0.060" (1.524mm)

RO3006, RO3010: 0.005" (0.127mm), 0.010" (0.254mm), 0.025" (0.635mm), 0.050" (1.27mm)

Standard Sheet: 24"X18" (610 x 457mm)

Standard Copper Cladding: 1/2 oz. (17µm), 1 oz. (35µm), 2 oz. (70µm), electrodeposited copper.

Rogers laminates can be purchased by contacting your U.S. customer service representative or one of our overseas offices. Telephone numbers listed below.

RO3003, RO3006 and RO3010, are licensed trademarks of Rogers Corporation for their microwave laminates.

The above data represents typical values, not statistical minimums. It is not intended to and does not create any warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose. The relative merits of materials for a specific application should be determined by your evaluation.

ROGERS

SINCE 1832

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32-9-2353611 FAX: 32-9-2353658

POLYFLON DESIGN DATA

MICROWAVE DIELECTRICS

The following is a quick reference guide which highlights those characteristic that are critical when making a material selection. All of Polyflon's microwave materials are fully isotropic, uniform in construction in all three axis. Polyflon does not use any bonding or adhesive materials in the manufacture of its substrates.

For additional information on these or any of our other products please contact Polyflon or visit our web site at <http://www.polyflon.com>.

Comparison of Polyflon's Microwave Laminates

TRADE NAME		CuFlon	POLYGUIDE	NorCLAD	Clad ULTEM®
PROPERTY	Units				
Dielectric Material		Virgin PTFE	Irradiated Polyolefin	Polyphenylene Oxide	ULTEM 1000
Dielectric Constant, 3 GHz		2.1	2.32	2.55	3.05
Dissipation Factor, 3 GHz		0.00010	0.00031	0.00110	.00300
Dielectric Breakdown	V/mil	1000	500	500	830
Operating Temperature Range	°C	-55 to 175 °C	-55 to 85 °C	-55 to 125 °C	-55 to 175 °C
Volume Resistivity	Ω-cm	10 ¹⁵	10 ¹⁵	10 ¹⁷	6.7 x 10 ¹⁷
Peel Strength, 25 °C	lb/in	8	8	8	8
Moisture Absorption	%	<.01%	<.01%	0.06	.25
Specific Gravity		2.2	0.95	1.1	1.27
CTE X, dielectric only	ppm/°C	129	108	53	56
CTE Y, dielectric only	ppm/°C	129	108	53	56
CTE Z, dielectric only	ppm/°C	129	108	53	56
Availability, Dielectric Thickness	inches	.00025 thru .125	0.020, 0.062 & 0.125	.030, .060, .090, & .125	.030, .060, .090, & .125
Panel Size	inches	.005" and less 9" x 9"	.020" 16" x 30"	all thicknesses 20" x 22"	all thicknesses 20" x 22"
Panel Size	inches	.010" and greater 12" x 18"	.062" & .125" 22.5" x 32.5"		

ULTEM® is a registered trademark of General Electric

MICMATL 30SEP97

CRANE® POLYFLON

Polyflon Company, One Willard Road, Norwalk, CT 06851 • Tel: (203) 840-7555 • Fax: (203) 840-7565
Modem: (203) 840-7564 • Email: info@polyflon.com • <http://www.polyflon.com>



Microwave Materials

Product Listing and Typical Properties

Woven Fiberglass Reinforced PTFE - Unidirectional					
	Dielectric Constant	Dissipation Factor	MIL/IPC-L-125	CTEz	Comments
DiClad® 522	2.40 - 2.60 ± 0.05	0.001	GT/01	173	Tested at 1 MHz
DiClad® 527	2.40 - 2.60 ± 0.04	0.0022	GX/02	182	Tested at 10 GHz
DiClad® 870	2.33 ± 0.02	0.0013	GY/05	217	Tested at 10 GHz
DiClad® 880	2.17, 2.20 ± 0.02	0.0009	GY/05	252	Tested at 10 GHz

Woven Fiberglass Reinforced PTFE - Crossplied					
CuClad® 250GT	2.40 - 2.60 ± 0.05	0.001	GT/01	177	Tested at 1 MHz, in plane isotropy
CuClad® 250GX	2.40 - 2.60 ± 0.04	0.0022	GX/02	177	Tested at 10 GHz, in plane isotropy
CuClad® 233LX	2.33 ± 0.02	0.0013	GY/05	194	Tested at 10 GHz, in plane isotropy
CuClad® 217LX	2.17, 2.20 ± 0.02	0.0009	GY/05	246	Tested at 10 GHz, in plane isotropy

Nonwoven Fiberglass Reinforced PTFE					
IsoClad® 933	2.33 ± 0.04	0.0016	GP/03	203	Tested at 10 GHz, Conformal
IsoClad® 917	2.17, 2.20 ± 0.04	0.0013	GP, GR/03,04	236	Tested at 10 GHz, Conformal

Commercial Grades PTFE					
AR 320™	3.20 ± 0.10	0.003	N/A / N/A	71	Tested at 10 GHz
AD Series™	2.50 - 3.60 ± 0.05	0.002 - 0.003	N/A / N/A	175 - 65	Tested at 10 GHz

Ceramic Filled PTFE					
CLTE™	2.94 Nominal	0.0025	N/A / N/A	35	Er Stable Over Temperature
AR 350™	3.5 Nominal	0.0026	N/A / N/A	107	Er Replacement for BT, CE
AR 450™	4.5 Nominal	0.0035	N/A / N/A	102	Er Replacement for FR-4
AR 600™	6.0 Nominal	0.0035	N/A / N/A	62	Er Design Flexibility
AR 1000™	10.0 Nominal	0.0035	N/A / N/A	37	Er Varies with Thickness

Non-PTFE Resin Systems, Er Stable Over Temperature					
25N	3.25 ± .07	0.004	N/A / N/A	60	Tested at 10 GHz
25FR	3.48 ± .07	0.005	N/A / N/A	60	Tested at 10 GHz, UL94V-0

Thermoplastic Bonding Material				Melt °F/°C	Supplied Thickness
CuClad® 6250	2.32 ± 0.10	0.0013	N/A / N/A	213/101	.0015"
CuClad® 6700	2.35 ± 0.10	0.0025	N/A / N/A	379/193	.0015", .003"
CLTE-P™	2.94	0.0025	N/A / N/A	510/265	.0032"

Master sheet sizes are 36" x 36", 36" x 48", 48" x 54" and 36" x 72". Check for availability by product line.

DiClad®, CuClad®, IsoClad® and CLTE™ are Arlon Registered Trademarks



MATERIALS FOR ELECTRONICS

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 9433 Hyssop Drive, Rancho Cucamonga, CA 91730 • Telephone: (909) 987-9533 • Fax: (909) 987-8541
 37 Rue Collange, 92300 LeVallois, Perret, France • Telephone: (33) 1-427-02642 • Fax: (33) 1-427-02798
 44 Wilby Avenue, Little Lever, Bolton, Lancashire, BL31QE, U.K. • Telephone: (44) 120-457-6068 • Fax: (44) 120-479-6463
 E-mail: substrates@arlonmed.com • Website: www.arlonmed.com

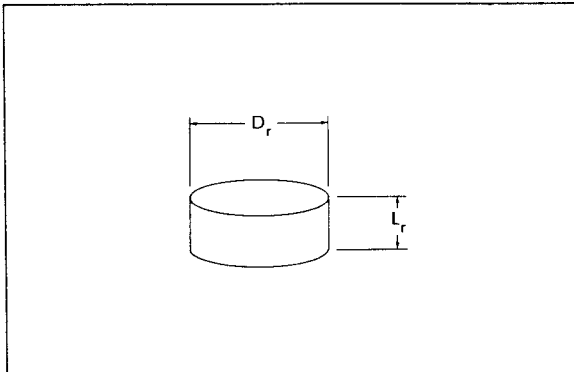
**Arlon is an
ISO 9002
Registered
Company**

9.2. Příloha II

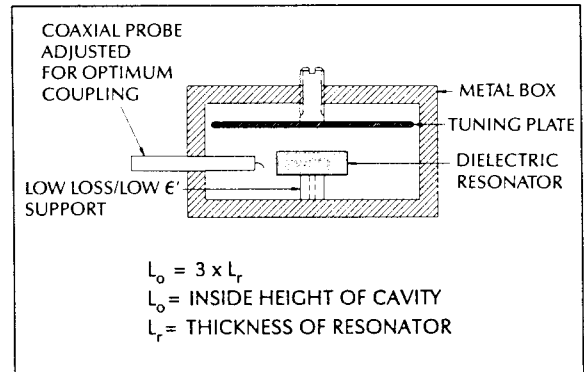
Dielektrické rezonátory (Trans-Tech)

D8700 Series - Disc Type

Mechanical Configuration



Test Set-up



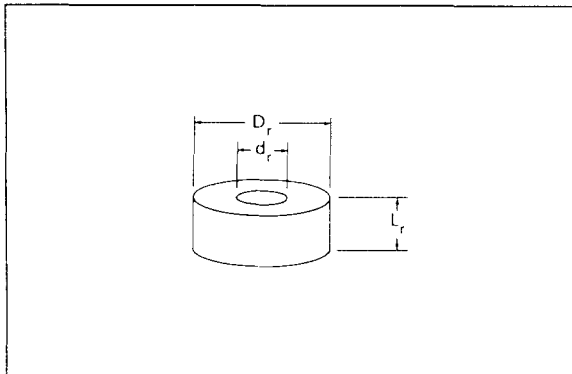
Dimensions and Frequency

Units (inches)			
Part Number	D_r	L_r Sets Lowest Frequency	Frequency Range (MHz)
D87()-0405-()-182-()	$0.405 \pm .001$	$.182 \pm .001$	> 5550 to 6010
D87()-0375-()-169-()	$0.375 \pm .001$	$.169 \pm .001$	> 6010 to 6470
D87()-0350-()-158-()	$0.350 \pm .001$	$.158 \pm .001$	> 6470 to 6945
D87()-0325-()-146-()	$0.325 \pm .001$	$.146 \pm .001$	> 6945 to 7440
D87()-0305-()-137-()	$0.305 \pm .001$	$.137 \pm .001$	> 7440 to 7945
D87()-0285-()-128-()	$0.285 \pm .001$	$.128 \pm .001$	> 7945 to 8525
D87()-0265-()-119-()	$0.265 \pm .001$	$.119 \pm .001$	> 8525 to 9195
D87()-0245-()-110-()	$0.245 \pm .001$	$.110 \pm .001$	> 9195 to 9870
D87()-0230-()-104-()	$0.230 \pm .001$	$.104 \pm .001$	> 9870 to 10535
D87()-0215-()-097-()	$0.215 \pm .001$	$.097 \pm .001$	> 10535 to 11300
D87()-0200-()-090-B	$0.200 \pm .001$	$.090 \pm .001$	> 11300 to 12020
D87()-0190-()-086-B	$0.190 \pm .0005$	$.086 \pm .0005$	> 12020 to 12670
D87()-0180-()-081-B	$0.180 \pm .0005$	$.081 \pm .0005$	> 12670 to 13395
D87()-0170-()-077-B	$0.170 \pm .0005$	$.077 \pm .0005$	> 13395 to 14205
D87()-0160-()-072-B	$0.160 \pm .0005$	$.072 \pm .0005$	> 14205 to 15120
D87()-0150-()-068-B	$0.150 \pm .0005$	$.068 \pm .0005$	> 15120 to 16165
D87()-0140-()-063-B	$0.140 \pm .0005$	$.063 \pm .0005$	> 16165 to 17360
D87()-0130-()-059-B	$0.130 \pm .0005$	$.059 \pm .0005$	> 17360 to 18750
D87()-0120-()-054-B	$0.120 \pm .0005$	$.054 \pm .0005$	> 18750 to 20205
D87()-0112-()-050-B	$0.112 \pm .0005$	$.050 \pm .0005$	> 20205 to 21705
D87()-0104-()-047-B	$0.104 \pm .0005$	$.047 \pm .0005$	> 21705 to 23440
D87()-0096-()-043-B	$0.096 \pm .0005$	$.043 \pm .0005$	> 23440 to 25345
D87()-0089-()-040-B	$0.089 \pm .0005$	$.040 \pm .0005$	> 25345 to 27420
D87()-0082-()-037-B	$0.082 \pm .0005$	$.037 \pm .0005$	> 27420 to 29675
D87()-0076-()-034-B	$0.076 \pm .0005$	$.034 \pm .0005$	> 29675 to 32150

Notes: Frequency is measured under the condition $L_r/L_o = .33$. Worst case tolerance unit to unit, lot to lot, is $< \pm 2.5\%$. Optional marking is available for this resonator type. Other shapes and sizes are available on request. Please contact factory. L_r can be varied between $.45 D_r$ to $.35 D_r$.

C8600 Series - Cylinder Type

Mechanical Configuration



Features

Disc Type with
Cylindrical Hole

Benefits

- Further Separates f_o from first spurious mode
- Screw mountable
- Provides flexibility in tuning
- Repeatability of design

Dimensions and Frequency

Units (inches)

Part Number	D_r	$d_r \pm .004$	L_r Sets Lowest Frequency	Frequency Range (MHz)
C86()-1400-()-630-B-162	$1.400 \pm .002$	.162	$.630 \pm .002$	>967 to 1045
C86()-1300-()-585-B-162	$1.300 \pm .002$	.162	$.585 \pm .002$	>1045 to 1124
C86()-1210-()-545-B-162	$1.210 \pm .002$	.162	$.545 \pm .002$	>1124 to 1208
C86()-1125-()-506-B-162	$1.125 \pm .002$	.162	$.506 \pm .002$	>1208 to 1301
C86()-1045-()-470-B-162	$1.045 \pm .002$	.162	$.470 \pm .002$	>1301 to 1397
C86()-0975-()-439-B-162	$0.975 \pm .002$	.162	$.439 \pm .002$	>1397 to 1501
C86()-0905-()-407-B-162	$0.905 \pm .001$	.162	$.407 \pm .001$	>1501 to 1618
C86()-0840-()-378-B-162	$0.840 \pm .001$	.162	$.378 \pm .001$	>1618 to 1737
C86()-0785-()-353-B-162	$0.785 \pm .001$	.162	$.353 \pm .001$	>1737 to 1863
C86()-0730-()-329-B-122	$0.730 \pm .001$	.122	$.329 \pm .001$	>1863 to 2010
C86()-0675-()-304-B-122	$0.675 \pm .001$	.122	$.304 \pm .001$	>2010 to 2163
C86()-0630-()-284-B-122	$0.630 \pm .001$	.122	$.284 \pm .001$	>2163 to 2323
C86()-0585-()-263-B-122	$0.585 \pm .001$	.122	$.263 \pm .001$	>2323 to 2498
C86()-0545-()-245-B-083	$0.545 \pm .001$	.083	$.245 \pm .001$	>2498 to 2689
C86()-0505-()-227-B-083	$0.505 \pm .001$	.083	$.227 \pm .001$	>2689 to 2895
C86()-0470-()-212-B-083	$0.470 \pm .001$	.083	$.212 \pm .001$	>2895 to 3119
C86()-0435-()-196-B-083	$0.435 \pm .001$	.083	$.196 \pm .001$	>3119 to 3360
C86()-0405-()-182-B-083	$0.405 \pm .001$	.083	$.182 \pm .001$	>3360 to 3618

Notes: Frequency is measured under the condition $L_r/L_o = .33$. Worst case tolerance unit to unit, lot to lot, is $< \pm 2.5\%$. Optional marking is not available for this resonator type. L_r can be varied between $.45 D_r$ to $.35 D_r$. For material characteristics of screws and supports see page 39 for details.