



Mini-Circuits®

SURFACE MOUNT

Directional Coupler

TCD-13-4+

50Ω 5 to 1000 MHz

FEATURES

- Wideband, 5 to 1000 MHz
- Low mainline loss, 0.7 dB typ.
- Aqueous washable
- Leads for excellent solderability
- Protected by US Patent 6,140,887

APPLICATIONS

- VHF/UHF
- CATV
- Cellular



Generic photo used for illustration purposes only

CASE STYLE: DB714

+RoHS Compliant

The +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications

ELECTRICAL SPECIFICATIONS AT 25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range	—	5	—	1000	MHz
Mainline Loss ¹	5-50	—	0.7	1.3	dB
	50-500	—	0.7	1.3	
	500-1000	—	0.8	1.5	
Coupling	5-1000	—	13±0.5	—	dB
Coupling Flatness (±)	5-1000	—	±0.6	—	dB
Directivity	5-50	17	21	—	dB
	50-500	12	18	—	
	500-1000	—	15	—	
VSWR	5-1000	—	1.2	—	:1
Input Power	5-50	—	—	0.5	W
	50-1000	—	—	1.0	

1. Mainline loss includes theoretical power loss at coupled port.

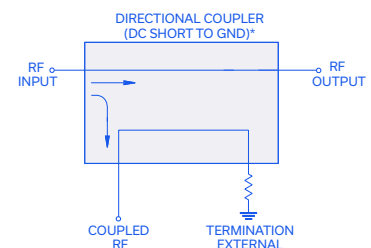
MAXIMUM RATINGS

Parameter	Ratings
Operating Temperature	-40°C to 85°C*
Storage Temperature	-55°C to 100°C

Permanent damage may occur if any of these limits are exceeded.

* Case temperature is defined as temperature on ground leads.

ELECTRICAL SCHEMATIC



*Electrical schematic is for Directional coupler with internal transformer(s) and external termination

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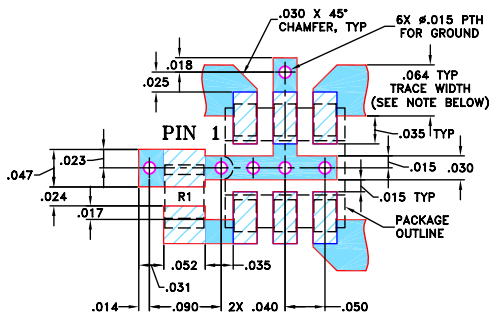
Directional Coupler

TCD-13-4+

50Ω 5 to 1000 MHz

INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
50Ω TERM EXTERNAL	6
NOT USED	5

DEMO BOARD MCL P/N: TB-71
SUGGESTED PCB LAYOUT (PL-009)

 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

Lead #1 identifier shall be located in the cross-hatched area shown. Identifier may be either a molded or marked feature.

The diagram illustrates a component with six leads, numbered 1 through 6. Lead 1 is highlighted with a cross-hatched area. Dimensions and tolerances are specified as follows:

- A**: Overall height of the component.
- B**: Overall width of the component.
- C MAX**: Maximum length of the component.
- D TYP**: Typical distance from the top edge to the top of lead 1.
- E**: Distance from the top edge to the top of lead 1, with a tolerance of $+0.005$ to -0.009 TYP.
- F TYP**: Typical distance from the bottom edge to the bottom of lead 1.
- G TYP**: Typical distance between leads 1 and 2.
- COMPONENT AREA**: The area of the component body.
- PICK & PLACE SURFACE AREA (.03X.075)MIN.**: The area of the component body used for pick and place.
- PLASTIC SHAPE ADJACENT TO LEADS MAY VARY**: A note indicating that the plastic shape adjacent to the leads may vary.

The diagram shows a three-layered structure. The top layer has a height of D and is labeled "D TYP". The middle layer has a height of K and is labeled "K TYP". The bottom layer has a height of H and is labeled "H TYP". The total height of the structure is labeled J . The layers are represented by hatched rectangles.

OUTLINE DIMENSIONS (Inches)

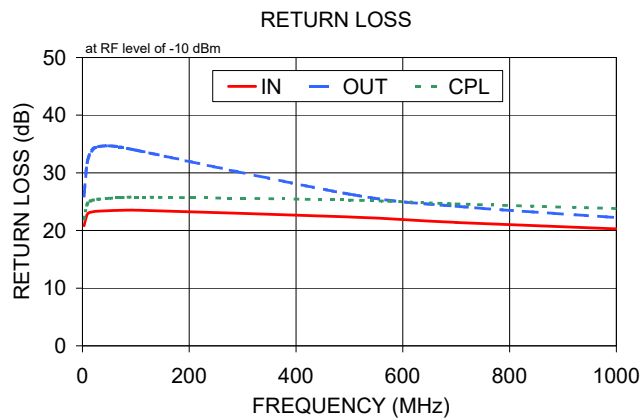
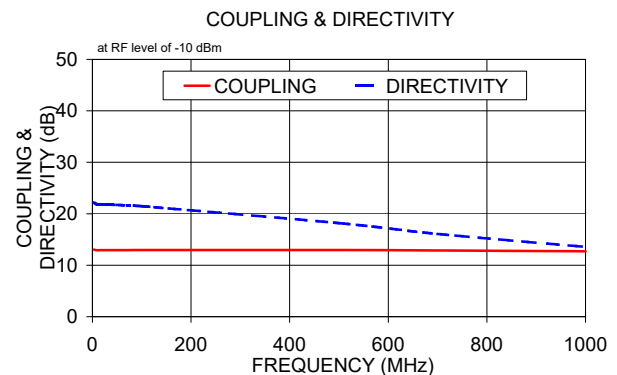
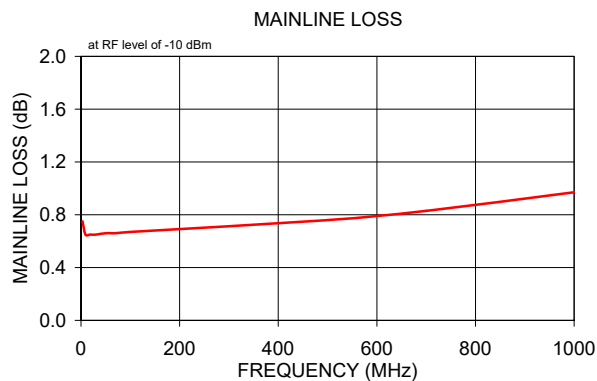
A	B	C	D	E	F
.160	.150	.160	.050	.040	.025
4.06	3.81	4.06	1.27	1.02	0.64
G	H	J	K		wt
.028	.065	.190	.030		grams
0.71	1.65	4.83	0.76		0.15

TAPE & REEL INFORMATION: F47



TYPICAL PERFORMANCE DATA

Frequency (MHz)	Mainline Loss (dB)	Coupling (dB)	Directivity (dB)	Return Loss (dB)		
	In-Out			In	Out	Cpl
5.00	0.96	13.23	22.93	18.39	22.11	20.63
100.00	0.80	13.07	21.46	21.56	29.75	23.23
200.00	0.82	13.07	19.90	22.09	29.67	22.99
300.00	0.84	13.06	18.25	22.15	27.88	22.67
400.00	0.86	13.03	16.68	21.58	24.86	22.04
500.00	0.86	12.96	15.34	20.44	22.11	21.08
600.00	0.87	12.88	14.27	19.08	19.99	20.15
700.00	0.91	12.82	13.42	17.97	18.61	19.42
800.00	0.93	12.73	12.75	17.33	17.64	18.67
1000.00	1.02	12.56	11.88	17.83	17.63	17.78



- NOTES
- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

Directional Coupler

TCD-13-4+

Typical Performance Data

TEST CONDITIONS: INPUT POWER =0 dBm @Temperature = +25°C

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS		
				IN	(dB) OUT	CPL
5	0.67	12.85	20.89	22.16	28.58	23.85
10	0.66	12.85	20.95	22.47	30.10	24.22
20	0.64	12.85	21.07	23.09	33.13	24.95
50	0.66	12.87	21.08	23.36	34.31	25.30
100	0.67	12.90	20.93	23.50	33.60	25.43
150	0.69	12.91	20.68	23.56	32.28	25.41
200	0.70	12.92	20.32	23.56	31.05	25.28
250	0.71	12.92	19.93	23.44	29.95	25.06
300	0.73	12.92	19.46	23.34	28.96	24.79
350	0.74	12.92	18.99	23.24	28.04	24.54
400	0.75	12.91	18.48	23.12	27.20	24.28
450	0.76	12.89	17.98	22.94	26.55	24.01
500	0.78	12.88	17.46	22.76	26.05	23.74
550	0.80	12.86	16.94	22.61	25.51	23.50
600	0.82	12.83	16.39	22.50	25.02	23.27
650	0.84	12.80	15.89	22.30	24.60	23.03
700	0.86	12.77	15.39	22.12	24.29	22.82
750	0.88	12.74	14.89	21.96	23.98	22.66
800	0.91	12.71	14.41	21.88	23.70	22.51
850	0.94	12.67	13.96	21.82	23.41	22.37
900	0.96	12.63	13.52	21.68	23.21	22.27
950	0.99	12.58	13.12	21.60	23.02	22.19
1000	1.03	12.53	12.73	21.55	22.77	22.13
1050	1.06	12.48	12.35	21.55	22.60	22.09
1100	1.09	12.42	12.02	21.57	22.48	22.08
1200	1.17	12.30	11.37	21.60	22.15	22.13
1300	1.26	12.17	10.85	21.84	21.86	22.29
1400	1.36	12.03	10.38	22.09	21.49	22.54
1500	1.48	11.88	10.03	22.45	21.09	22.88
1600	1.61	11.74	9.74	22.92	20.64	23.35
1700	1.77	11.62	9.52	23.52	20.09	23.89
1800	1.95	11.51	9.40	24.05	19.42	24.57
1900	2.14	11.42	9.35	24.64	18.70	25.37
2000	2.36	11.37	9.33	25.00	18.00	26.16
2250	2.98	11.43	9.69	23.70	16.16	27.33
2500	3.63	11.83	10.38	20.52	14.51	26.34
2750	4.20	12.56	11.18	17.88	13.31	24.90
3000	4.70	13.51	11.43	16.21	12.61	23.83
3250	5.11	14.54	11.03	15.33	12.32	21.62
3500	5.47	15.54	10.39	14.92	12.46	18.16
3750	5.87	16.20	10.74	14.39	12.97	14.73
4000	6.33	16.39	11.78	13.43	13.70	11.94
4250	6.93	15.99	12.11	11.89	14.97	9.88
4500	7.78	15.44	11.30	10.25	15.57	8.43
4750	8.81	14.76	9.87	8.83	15.23	7.57
5000	10.05	14.15	9.06	7.77	14.23	7.07
5250	11.56	13.60	9.04	7.15	12.79	6.91
5500	13.10	13.12	9.02	6.81	11.54	7.00
5750	14.61	12.76	9.02	6.99	10.58	7.33
6000	16.01	12.25	9.46	6.94	9.87	7.58
6250	17.21	12.27	9.16	7.35	9.34	7.69
6500	18.15	12.00	8.68	7.29	8.86	7.83
6750	18.78	11.97	7.26	7.33	8.70	7.55
7000	19.00	12.48	5.59	7.21	8.60	7.21

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Directional Coupler

TCD-13-4+

Typical Performance Data

TEST CONDITIONS: INPUT POWER =0 dBm @Temperature = -40°C

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS		
				IN	OUT	CPL
5	0.85	12.98	20.57	18.70	21.53	20.32
10	0.77	12.91	20.59	20.08	24.23	21.76
20	0.62	12.79	20.63	22.84	29.63	24.64
50	0.56	12.76	20.91	24.64	33.84	26.61
100	0.57	12.78	20.70	24.59	33.93	26.53
150	0.58	12.78	20.48	24.51	33.02	26.48
200	0.59	12.77	20.30	24.43	30.85	26.24
250	0.60	12.76	19.87	24.02	29.51	25.64
300	0.61	12.75	19.54	23.92	28.49	25.31
350	0.62	12.74	19.09	23.58	27.44	24.76
400	0.63	12.73	18.65	23.33	26.61	24.37
450	0.65	12.70	18.20	22.91	25.77	23.88
500	0.66	12.68	17.70	22.60	25.18	23.53
550	0.68	12.66	17.27	22.34	24.52	23.10
600	0.69	12.62	16.78	22.11	23.95	22.74
650	0.71	12.59	16.32	21.74	23.44	22.46
700	0.73	12.56	15.81	21.46	23.09	22.15
750	0.75	12.52	15.37	21.25	22.75	21.91
800	0.77	12.48	14.93	21.00	22.31	21.67
850	0.80	12.43	14.51	20.82	21.95	21.47
900	0.82	12.38	14.09	20.52	21.60	21.26
950	0.85	12.32	13.65	20.34	21.36	21.13
1000	0.88	12.27	13.29	20.32	21.17	20.94
1050	0.91	12.22	12.93	20.23	20.98	20.76
1100	0.94	12.15	12.58	20.19	20.88	20.71
1200	1.01	12.03	11.93	20.11	20.61	20.50
1300	1.10	11.90	11.27	20.06	20.23	20.81
1400	1.20	11.75	10.77	20.13	19.86	20.89
1500	1.31	11.60	10.32	20.08	19.37	21.18
1600	1.44	11.45	9.98	20.91	19.33	21.56
1700	1.60	11.32	9.76	21.11	18.84	21.93
1800	1.78	11.20	9.60	21.64	18.39	22.47
1900	1.98	11.10	9.49	22.03	17.78	22.92
2000	2.20	11.04	9.48	22.64	17.27	23.33
2250	2.87	11.12	9.88	21.79	15.15	24.20
2500	3.56	11.58	10.96	19.57	13.51	23.19
2750	4.14	12.43	12.38	17.09	12.04	22.41
3000	4.55	13.52	12.81	15.76	11.49	22.47
3250	4.85	14.70	11.56	15.20	11.24	23.98
3500	5.11	15.79	10.21	15.16	11.30	20.38
3750	5.39	16.40	10.31	15.08	11.83	15.71
4000	5.75	16.42	11.64	14.03	12.63	12.16
4250	6.23	15.79	12.87	12.54	14.42	9.96
4500	7.04	15.12	12.85	10.39	15.96	8.31
4750	8.00	14.24	11.18	8.81	16.61	7.31
5000	9.19	13.73	9.62	7.58	15.81	6.79
5250	10.51	13.14	9.34	6.97	14.10	6.56
5500	11.98	12.57	9.47	6.49	12.27	6.69
5750	13.64	12.22	9.22	6.64	11.16	6.82
6000	15.28	11.95	8.97	6.65	10.16	7.12
6250	16.41	11.72	9.48	6.93	9.49	7.29
6500	17.14	11.47	8.33	6.86	8.83	7.26
6750	17.71	11.37	6.80	6.88	8.66	7.07
7000	17.80	12.09	5.24	6.60	8.79	6.85

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Directional Coupler

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Typical Performance Data

TEST CONDITIONS: INPUT POWER =0 dBm @Temperature = +85°C

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS		
				IN	OUT	CPL
5	0.82	13.02	21.63	20.81	26.82	22.79
10	0.81	13.02	21.59	20.98	27.50	22.99
20	0.80	13.02	21.50	21.33	28.86	23.39
50	0.81	13.04	21.24	21.35	29.70	23.38
100	0.82	13.07	21.10	21.70	29.35	23.75
150	0.83	13.09	20.81	21.99	28.62	23.95
200	0.85	13.11	20.20	21.96	28.69	23.80
250	0.85	13.12	19.81	22.13	28.44	23.96
300	0.87	13.13	19.28	22.12	27.91	23.79
350	0.88	13.14	18.70	22.07	27.51	23.67
400	0.89	13.15	18.14	22.11	27.00	23.59
450	0.91	13.15	17.58	22.04	26.54	23.41
500	0.93	13.15	16.99	21.99	26.27	23.28
550	0.94	13.16	16.43	21.98	25.90	23.17
600	0.96	13.15	15.85	21.97	25.55	23.06
650	0.98	13.15	15.32	21.86	25.28	22.95
700	1.00	13.14	14.79	21.76	25.04	22.83
750	1.02	13.13	14.28	21.66	24.78	22.75
800	1.05	13.11	13.78	21.67	24.56	22.67
850	1.07	13.08	13.34	21.71	24.36	22.61
900	1.09	13.06	12.92	21.70	24.24	22.58
950	1.13	13.02	12.54	21.72	24.11	22.53
1000	1.16	12.99	12.20	21.78	23.87	22.52
1050	1.19	12.95	11.86	21.81	23.67	22.51
1100	1.22	12.90	11.56	21.82	23.43	22.52
1200	1.30	12.80	10.98	21.77	22.88	22.59
1300	1.38	12.69	10.53	22.02	22.48	22.59
1400	1.48	12.57	10.11	22.08	21.89	22.68
1500	1.59	12.45	9.77	22.29	21.43	22.94
1600	1.71	12.33	9.47	22.58	21.03	23.30
1700	1.85	12.23	9.19	22.96	20.56	23.73
1800	2.00	12.14	9.00	23.16	19.90	24.17
1900	2.17	12.05	8.89	23.42	19.28	24.97
2000	2.35	11.99	8.70	23.39	18.67	25.87
2250	2.85	11.98	8.50	22.58	17.43	27.41
2500	3.41	12.17	8.48	20.42	16.14	26.76
2750	3.99	12.58	8.59	17.86	14.97	23.82
3000	4.57	13.16	8.94	15.96	14.16	21.39
3250	5.14	13.84	9.55	14.71	13.43	19.24
3500	5.70	14.55	10.58	13.86	12.88	17.50
3750	6.25	15.18	12.62	13.49	12.58	15.51
4000	6.81	15.59	15.02	13.08	12.59	13.55
4250	7.48	15.63	15.37	11.93	12.57	11.45
4500	8.21	15.41	12.34	10.81	12.57	9.71
4750	9.02	14.90	9.91	9.58	12.45	8.33
5000	9.91	14.48	7.82	8.48	12.66	7.41
5250	10.87	13.93	6.76	7.71	12.38	6.78
5500	12.03	13.42	6.17	7.16	12.02	6.51
5750	13.36	13.12	5.97	6.92	11.48	6.62
6000	14.61	12.54	6.46	6.86	10.88	6.88
6250	16.21	11.98	7.72	6.90	10.64	7.19
6500	17.77	11.10	8.78	7.37	10.10	7.75
6750	19.70	10.46	11.16	8.39	9.99	8.34
7000	22.04	9.51	15.07	8.79	9.48	8.50

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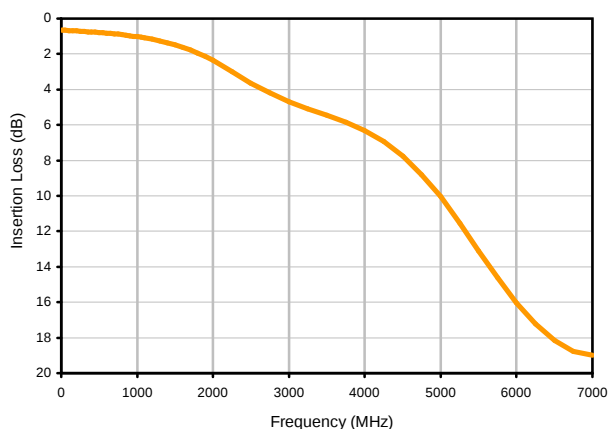


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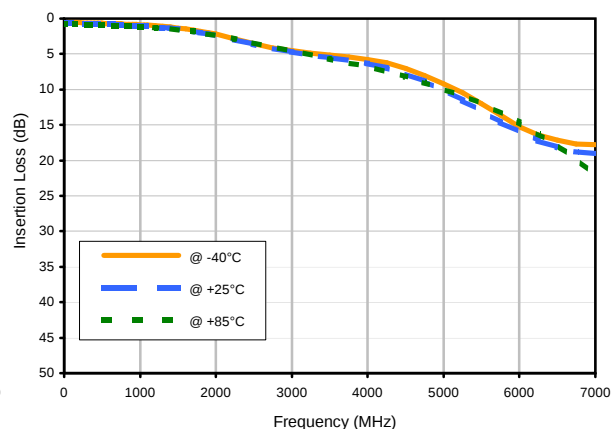
Typical Performance Curves

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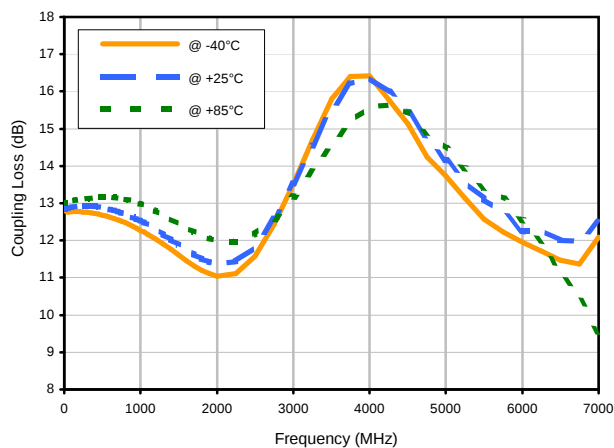
Insertion Loss



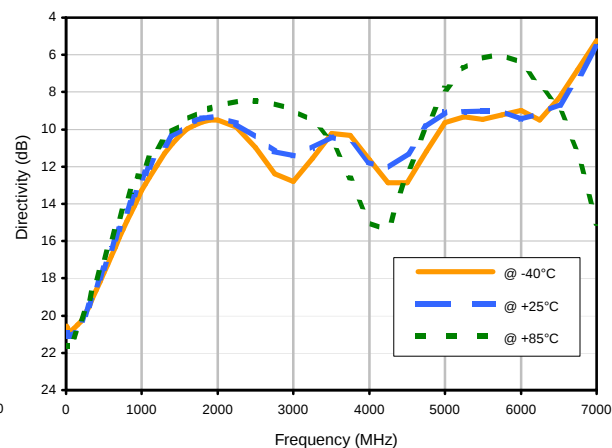
Insertion Loss vs. TEMPERATURE



Coupling Loss vs. TEMPERATURE



Directivity vs. TEMPERATURE



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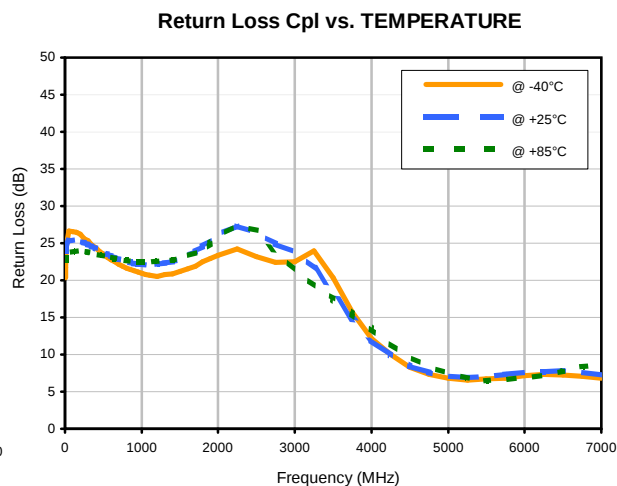
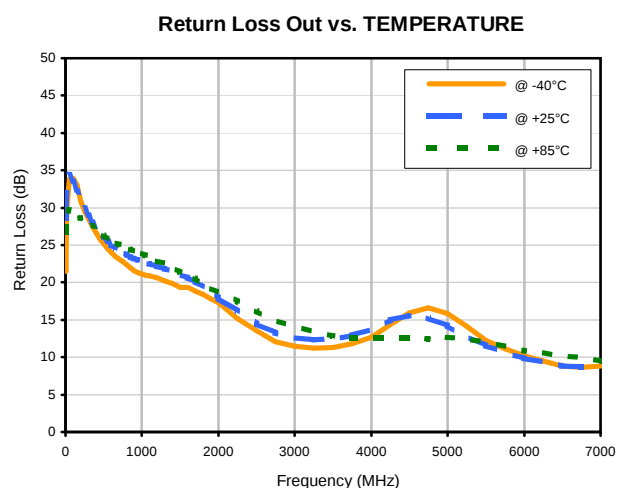
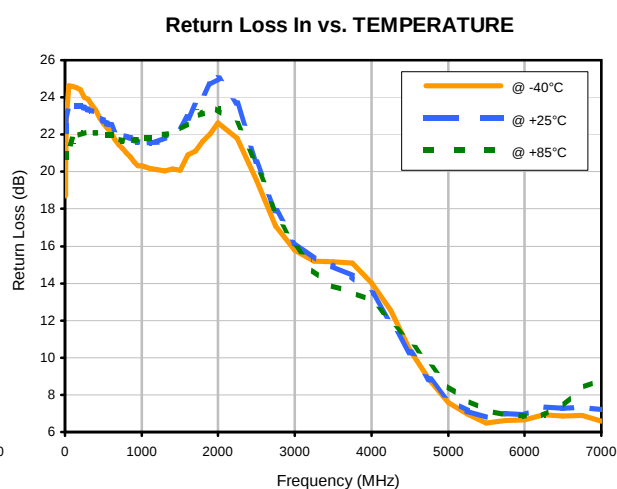
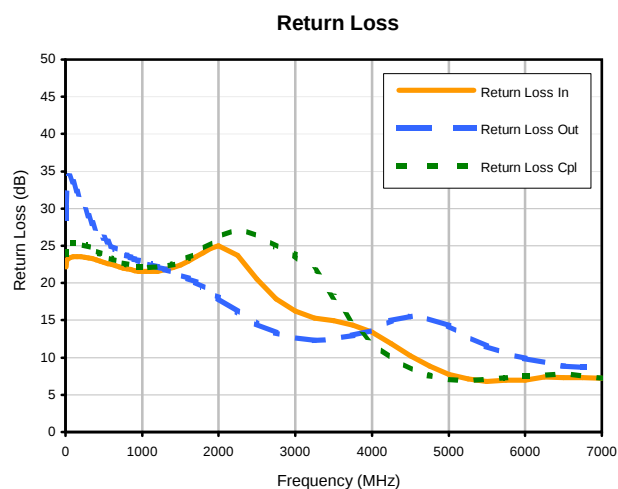
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Typical Performance Curves

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P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661

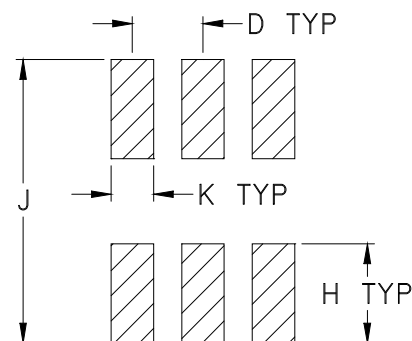
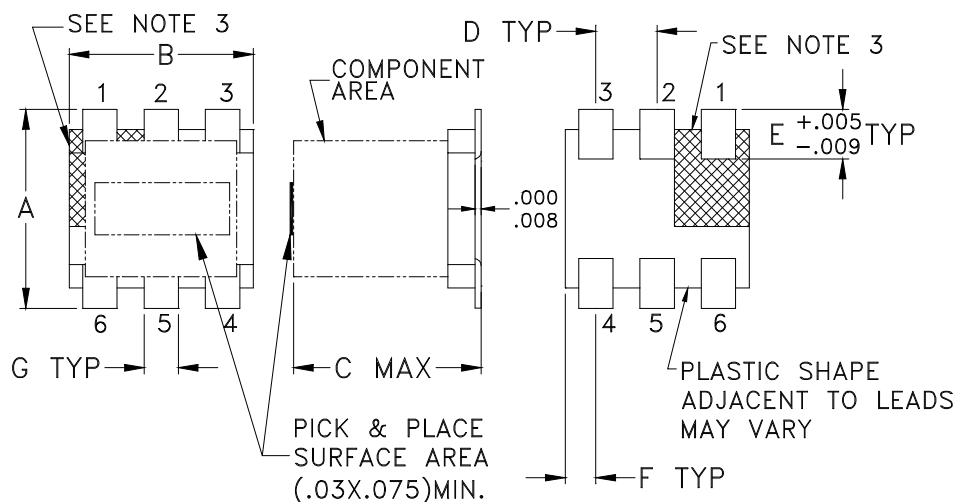
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see



Outline Dimensions

DB714

PCB Land Pattern



Suggested Layout,
Tolerance to be within $\pm .002$

CASE #	A	B	C	D	E	F	G	H	J	K	WT. GRAM
DB714	.160 (4.06)	.150 (3.81)	.160 (4.06)	.050 (1.27)	.040 (1.02)	.025 (0.64)	.028 (0.71)	.065 (1.65)	.190 (4.83)	.030 (0.76)	.15

Dimensions are in inches (mm). Tolerances: 2 Pl. $\pm .01$; 3Pl. $\pm .005$

Notes:

- Case material: Plastic.
- Termination finish:
For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.
- Lead #1 identifier shall be located in the cross-hatched area shown.
Identifier may be either a molded or marked feature.



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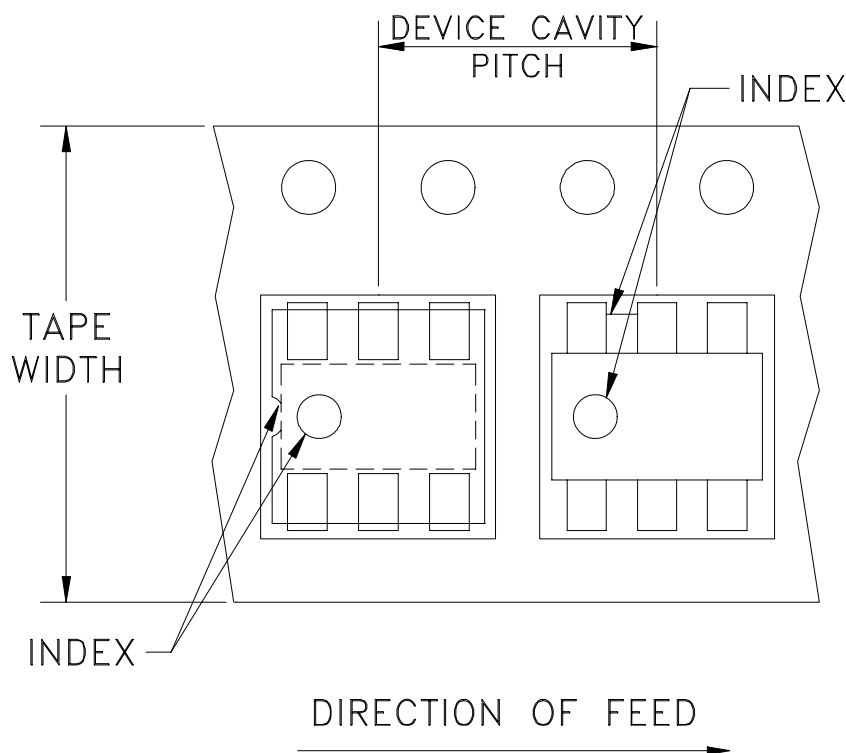


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

RF/IF MICROWAVE COMPONENTS

Tape & Reel Packaging TR-F47

DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note
12	8	13	1000, 2000
		7	20, 50, 100, 200, 500

Note: Please consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf



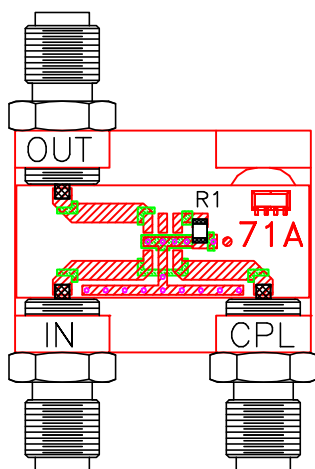
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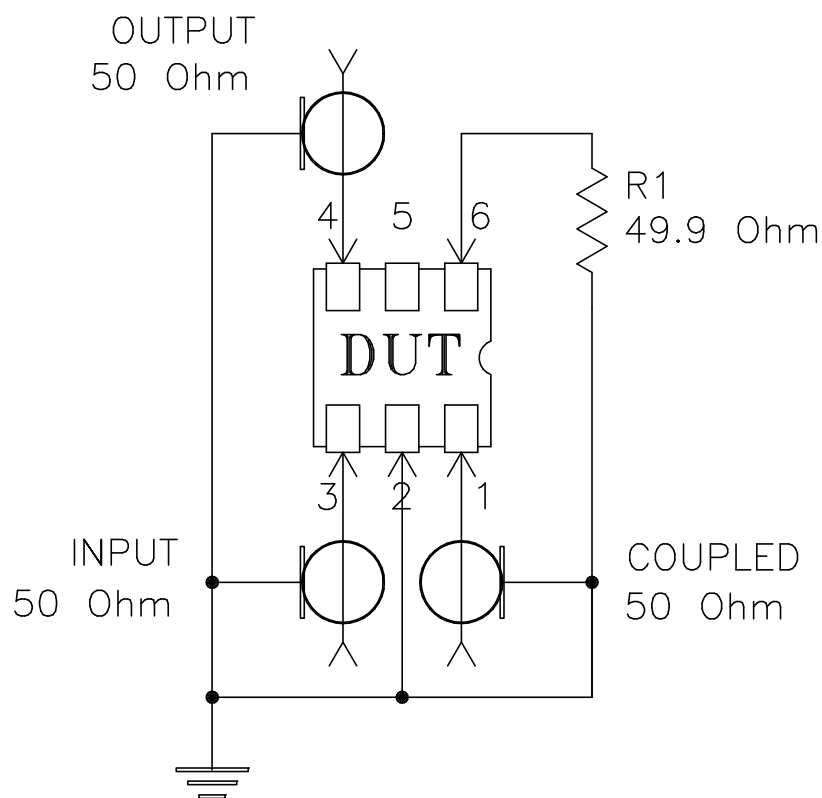
Distribution Centers NORTH AMERICA 800-654-7949 • 417-335-5935 • Fax 417-335-5945 • EUROPE 44-1252-832600 • Fax 44-1252-837010

Mini-Circuits ISO 9001 & ISO 14001 Certified

Evaluation Board and Circuit



TB-71



Schematic Diagram

Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,
Dielectric Constant=3.5, Thickness=.030 inch.

 **Mini-Circuits®**



All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85°C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C Ambient Environment	Individual Model Data Sheet
Humidity	90 to 95% RH, 240 hours, 50°C	MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Solder Reflow Heat	Sn-Pb Eutetic Process: 225°C peak Pb-Free Process 245° - 250°C peak	J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1
Solderability	10X Magnification	J-STD-002, 95% Coverage
Vibration (High Frequency)	20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36)	MIL-STD-202, Method 204, Condition D
Mechanical Shock	50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes	MIL-STD-202, Method 213, Condition A
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C	MIL-STD-202, Method 215