



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.

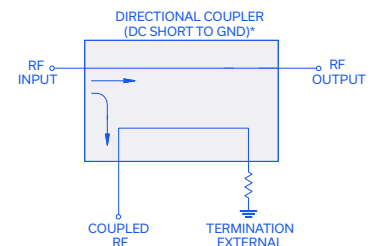
MAXIMUM RATINGS

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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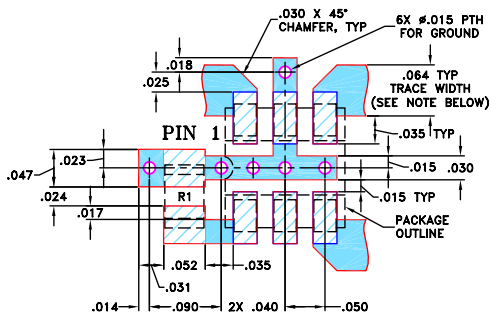


Directional Coupler

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 the layout of a component with six leads, numbered 1 through 6. Lead 1 is specifically highlighted with a cross-hatched area for its identifier. The component is shown from three perspectives: a top view, a side view, and a detail view of the lead area. Dimensions include overall width B, overall height A, lead pitch G, and lead width E. A tolerance for lead width E is given as $+0.005$ / -0.009 TYP. A note indicates that the plastic shape adjacent to the leads may vary. A dimension of .000 / .008 is shown for the lead thickness. A note specifies a minimum pick and place surface area of (.03X.075)MIN. for the component area. The side view shows a maximum dimension C MAX. The detail view shows the lead area with a cross-hatched identifier for Lead #1.

Diagram illustrating the lead locations and dimensions for a component. The diagram shows a component with six leads (1 through 6) and a central component area. The lead #1 identifier is located in the cross-hatched area. Dimensions include B (width), A (height), G (lead pitch), C MAX (maximum component width), and E (lead width). The lead width E is specified with a tolerance: $E +0.005$ / -0.009 TYP. The lead thickness is specified as .000 / .008. The plastic shape adjacent to the leads may vary. The pick and place surface area is specified as (.03X.075)MIN.

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

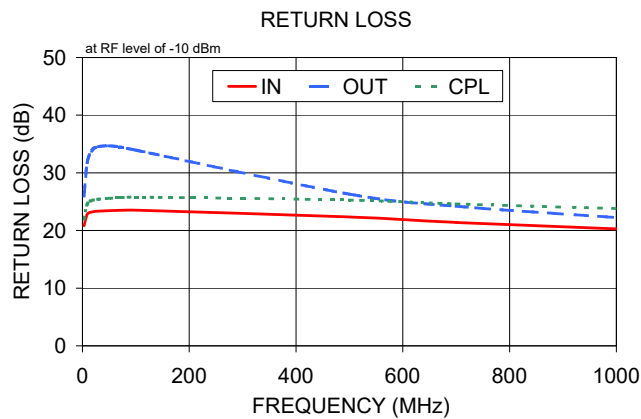
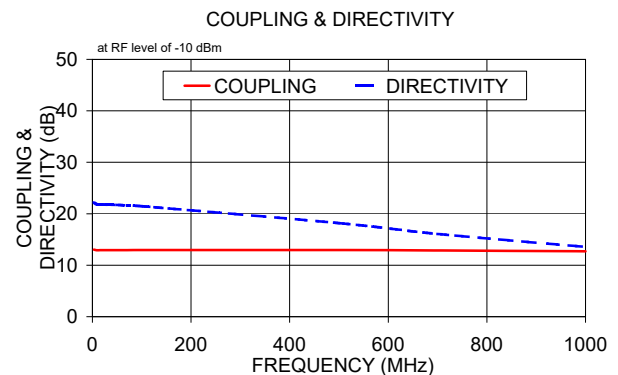
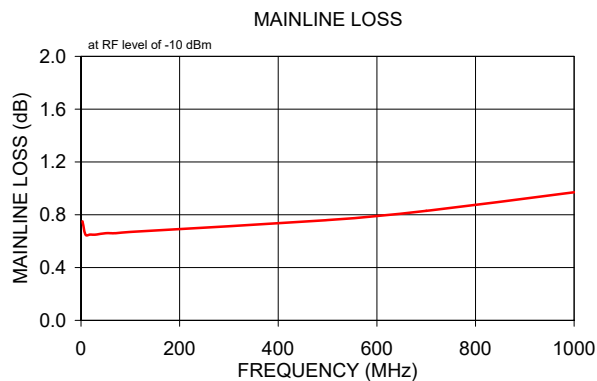
OUTLINE DIMENSIONS (Inches)

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



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.
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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

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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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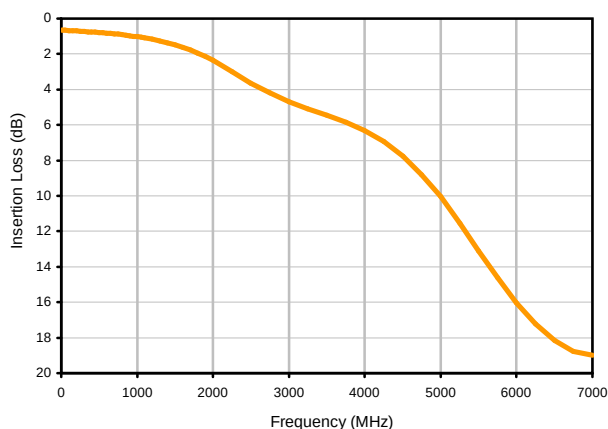


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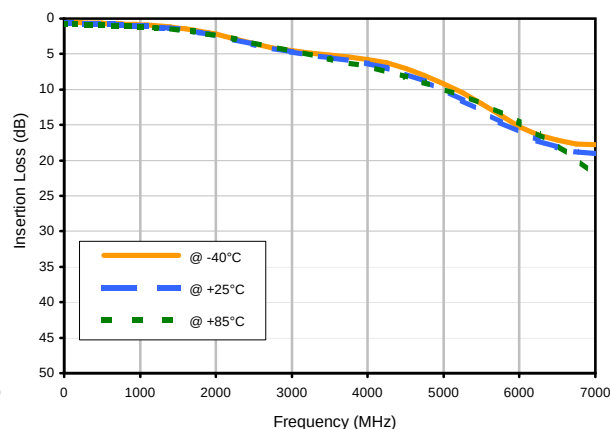
Typical Performance Curves

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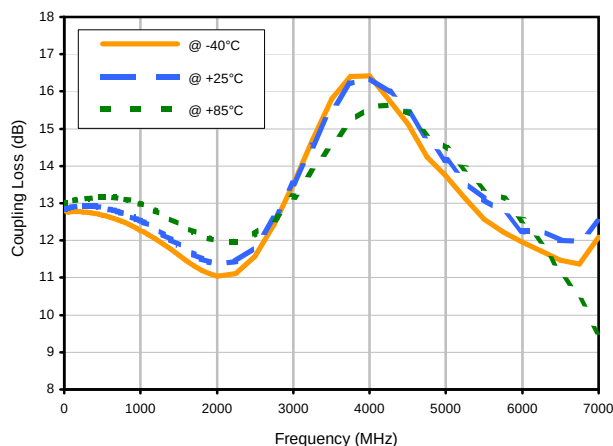
Insertion Loss



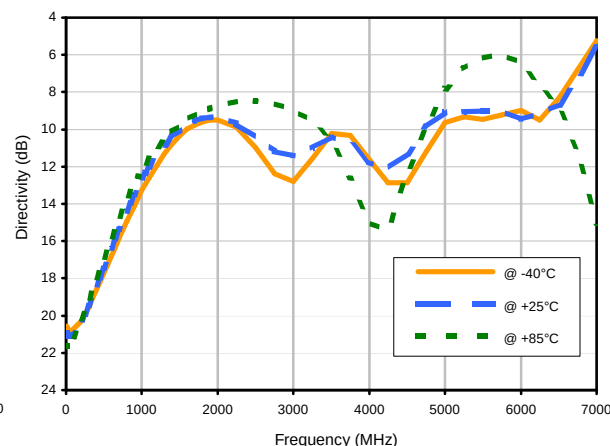
Insertion Loss vs. TEMPERATURE



Coupling Loss vs. TEMPERATURE



Directivity vs. TEMPERATURE



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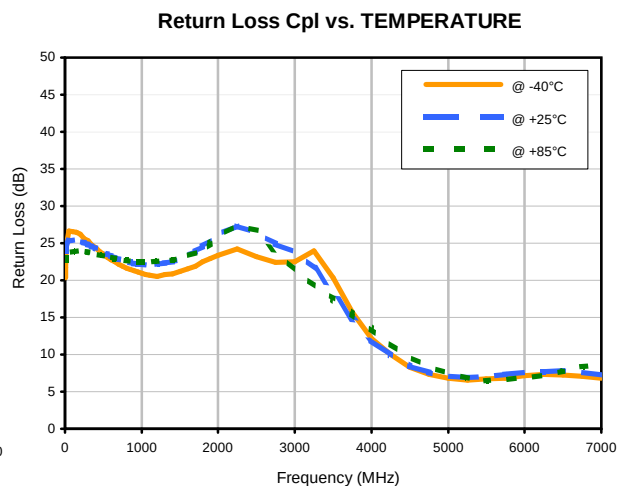
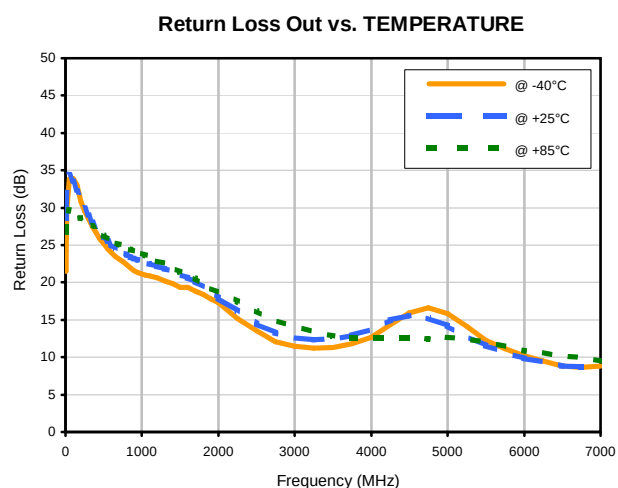
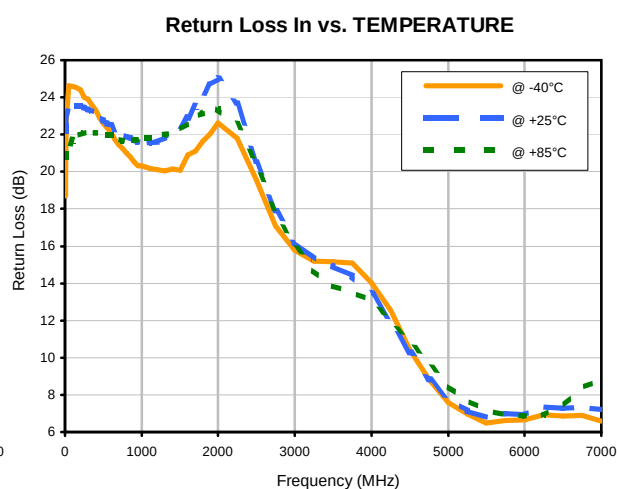
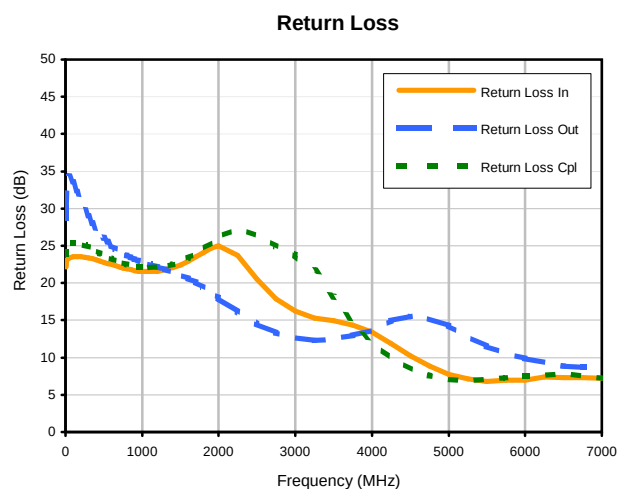
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Typical Performance Curves

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

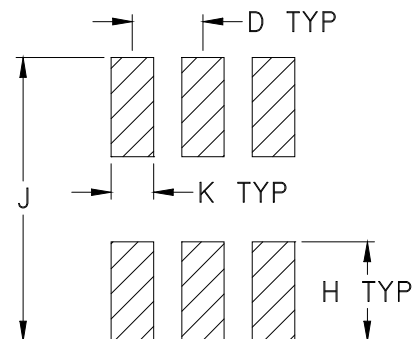
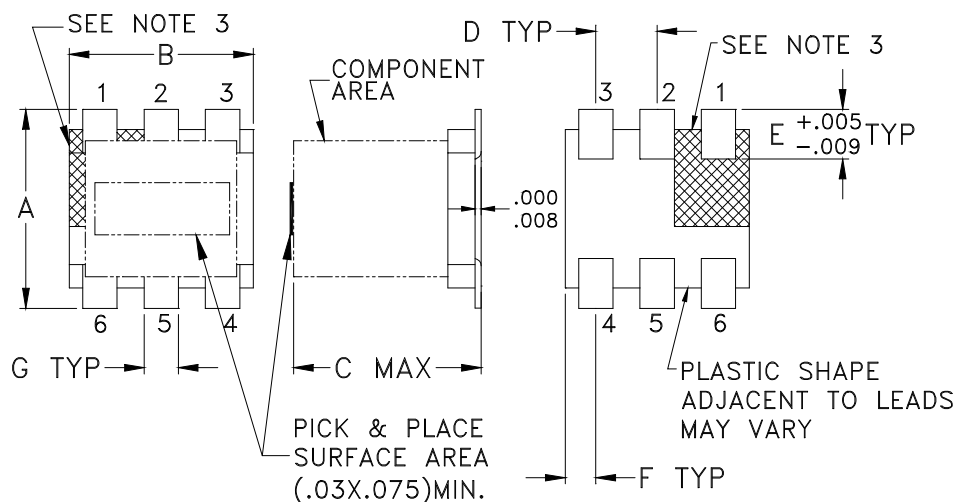
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see



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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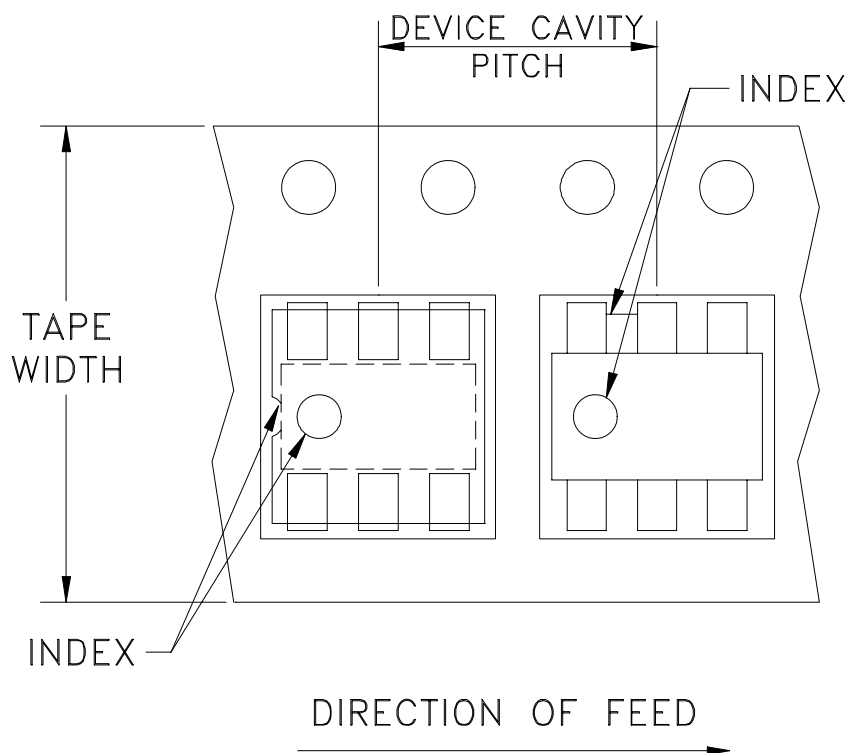


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: www.minicircuits.com

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



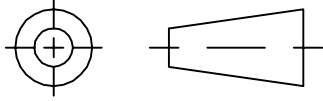
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Mini-Circuits ISO 9001 & ISO 14001 Certified

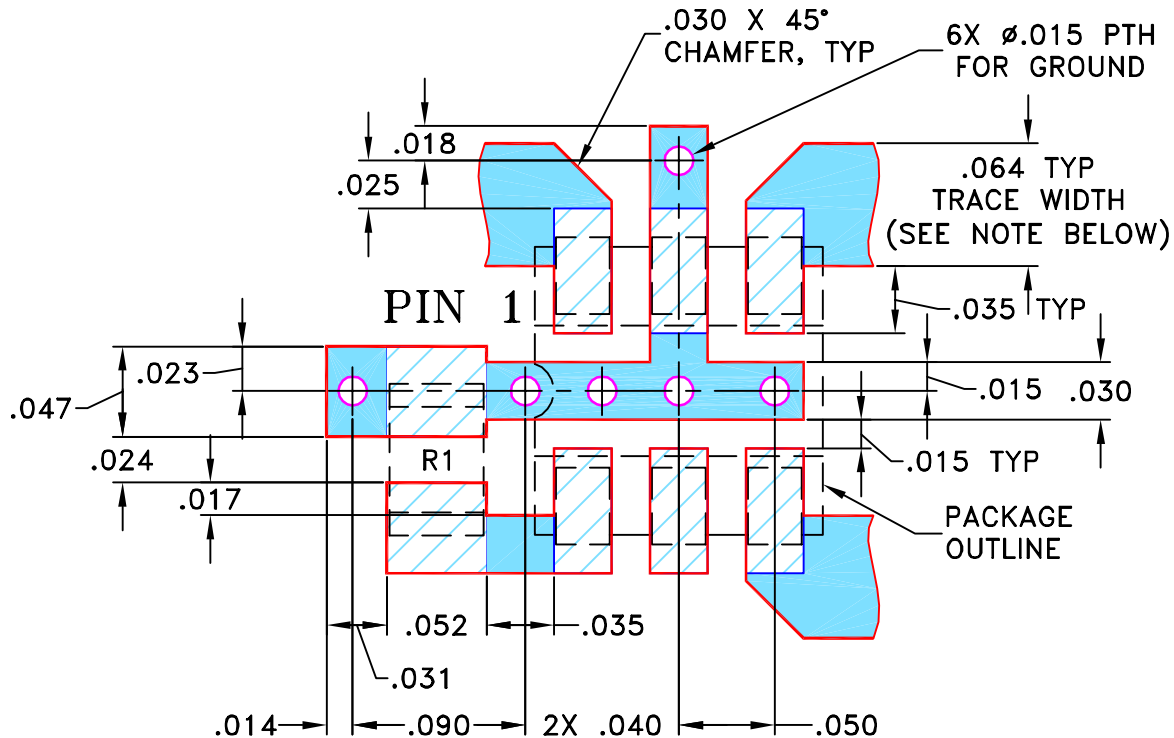
THIRD ANGLE PROJECTION



REVISIONS

REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M73159	NEW RELEASE	08/00	IL	DB
A	M82377	UPDATED DRAWING	07/21/02	AV	LC
B	M102713	UPDATED NOTES	01/12/08	GF	IL

SUGGESTED MOUNTING CONFIGURATION FOR DB714 CASE STYLE, "mm" PIN CONNECTION

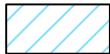


RESISTOR R1: $49.9 \pm 1\%$ Ohm, 0805 SIZE

NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS $0.030'' \pm 0.002''$; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.

2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

 DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED

INITIALS

DATE

DIMENSIONS ARE IN INCHES

TOLERANCES ON:
2 PL DECIMALS $\pm .005$
3 PL DECIMALS $\pm$
ANGLES $\pm$
FRACTIONS $\pm$

DRAWN

IL

08/03/00

CHECKED

WP

08/08/00

APPROVED

DB

08/08/00

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ASHEETA1.DWG REV:A DATE:01/12/95



Mini-Circuits® 13 Neptune Avenue
Brooklyn NY 11235

PL, mm, DB714, TCD, TB-71

SIZE
A

CODE IDENT
15542

DRAWING NO:
98-PL-009

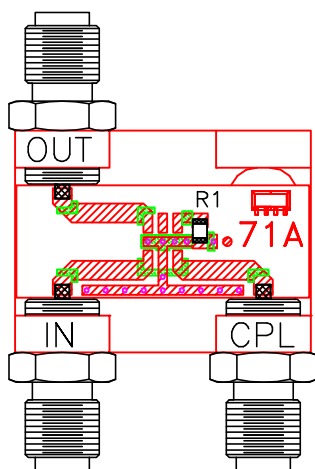
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FILE: 98PL009

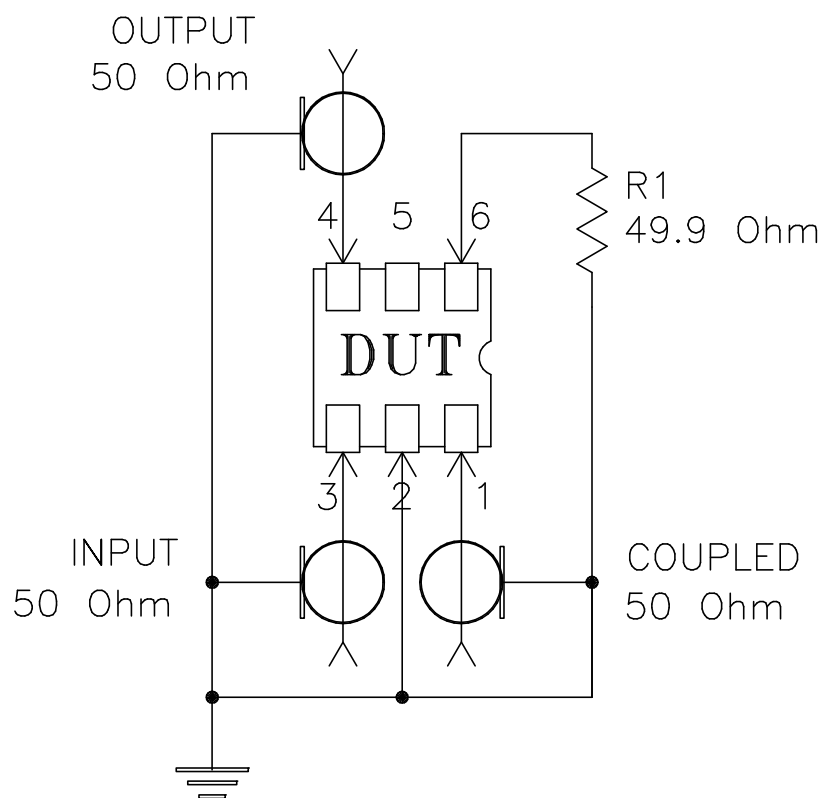
SCALE: 10:1

SHEET: 1 OF 1

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