



SURFACE MOUNT

# Directional Coupler

## TCD-20-4+

Mini-Circuits

50Ω

5 to 1000 MHz

### FEATURES

- Wideband, 5 to 1000 MHz
- Low Mainline Loss, 0.4 dB Typ.
- Aqueous Washable
- Leads for Excellent Solderability
- Protected by US Patent 6,140,887



Generic photo used for illustration purposes only

CASE STYLE: DB714

### +RoHS Compliant

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

### APPLICATIONS

- VHF/UHF
- Communications
- Cellular
- Signal Processing

### ELECTRICAL SPECIFICATIONS AT +25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1000	MHz
Mainline Loss <sup>1</sup>	5-50		0.3	0.9	dB
	50-500		0.4	0.8	
	500-1000		0.7	1.1	
Coupling	5-1000		20±0.5		dB
Coupling Flatness (±)	5-1000		±0.8		dB
Directivity	5-50	11	20		dB
	50-500	15	21		
	500-1000		15		
VSWR	5-1000		1.2		:1
Input Power	5-1000			1.0	W

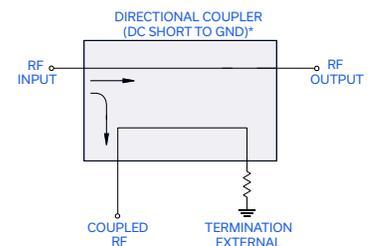
1. Mainline loss includes theoretical power loss at coupled port.

### ABSOLUTE MAXIMUM RATINGS

Parameter	Ratings
Operating Temperature	-40°C to +85°C <sup>2</sup>
Storage Temperature	-55°C to +100°C

2. Case temperature is defined as temperature on ground leads. Permanent damage may occur if any of these limits are exceeded.

### ELECTRICAL SCHEMATIC



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





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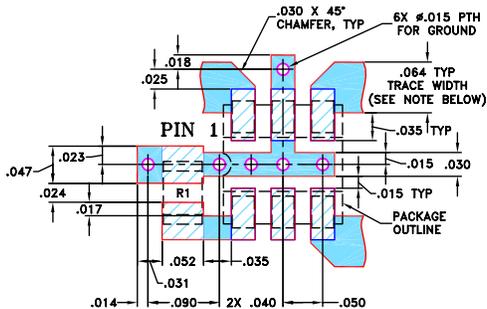
5 to 1000 MHz

**PIN CONNECTIONS**

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

**PRODUCT MARKING:** N/A

**DEMO BOARD MCL P/N:** TB-TCD-20-4+  
**SUGGESTED PCB LAYOUT (PL-009)**

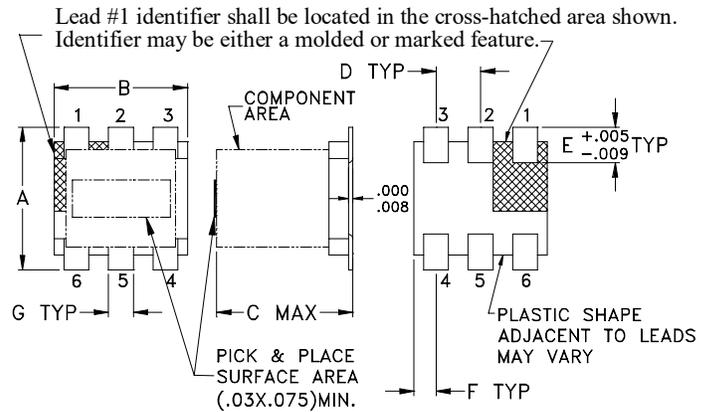


RESISTOR R1: 49.9 ± 1% Ohm, 0805 SIZE

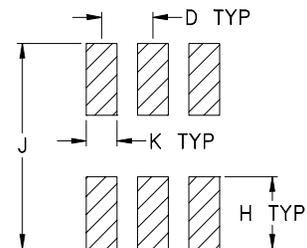
**NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 0.002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.  
 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

- DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)
- DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

**OUTLINE DRAWING**



**PCB Land Pattern**



Suggested Layout,  
 Tolerance to be within ±.002

**OUTLINE DIMENSIONS (Inches/mm)**

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**



SURFACE MOUNT

# Directional Coupler

## TCD-20-4+

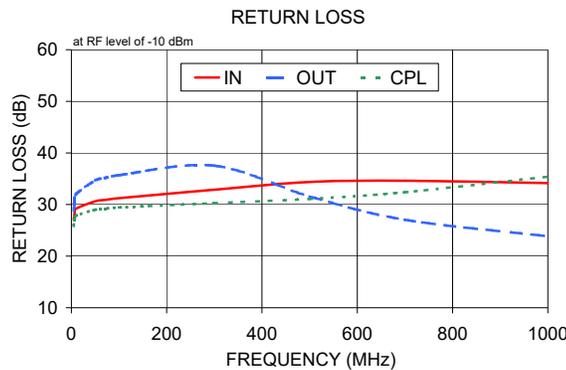
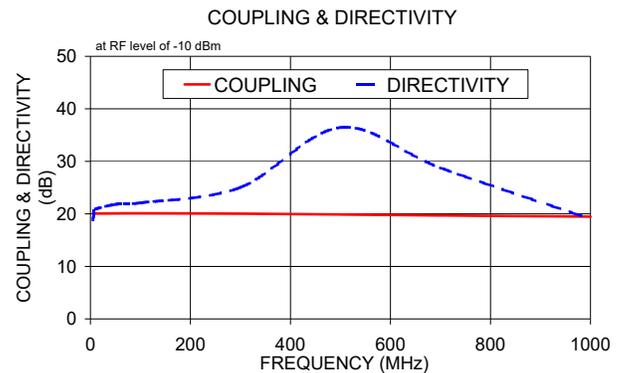
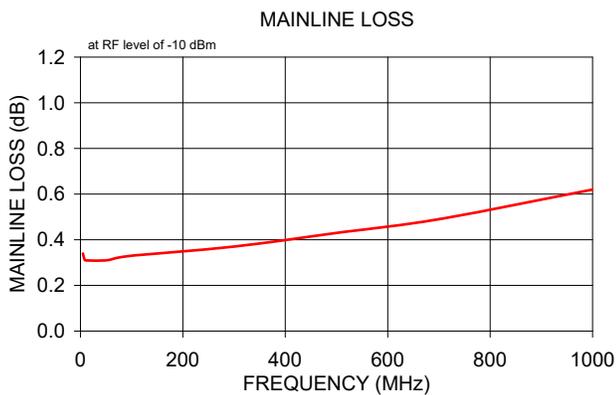
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50Ω

5 to 1000 MHz

### TYPICAL PERFORMANCE DATA

Frequency (MHz)	Mainline Loss (dB)		Coupling (dB)	Directivity (dB)	Return Loss (dB)		
	In-Out	In-Cpl			In	Out	Cpl
5	0.34	20.10	18.84	27.09	28.80	25.84	
7	0.32	20.07	20.01	28.28	30.52	26.99	
10	0.31	20.06	20.88	29.20	32.01	27.84	
50	0.31	20.09	21.80	30.62	34.67	28.98	
70	0.32	20.10	21.88	30.88	35.14	29.17	
100	0.33	20.10	22.10	31.23	35.70	29.43	
300	0.37	20.04	25.05	32.86	37.54	30.26	
500	0.43	19.88	36.45	34.37	31.56	31.08	
700	0.49	19.70	28.77	34.61	27.04	32.38	
1000	0.62	19.48	19.03	34.14	23.85	35.39	



- 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-Circuit's applicable established test performance criteria and measurement instructions.
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# Directional Coupler

# TCD-20-4+

## Typical Performance Data

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

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS (dB)		
				IN	OUT	CPL
5	0.32	20.07	22.79	28.19	30.76	26.86
10	0.31	20.06	22.87	29.19	32.43	27.71
20	0.31	20.06	22.93	30.04	33.66	28.32
25	0.31	20.06	22.90	30.16	33.77	28.34
30	0.32	20.06	22.89	30.23	33.82	28.35
40	0.32	20.07	22.90	30.33	33.82	28.36
45	0.32	20.08	22.91	30.38	33.85	28.38
50	0.33	20.08	22.94	30.42	33.90	28.39
100	0.34	20.10	23.35	30.68	33.75	28.52
125	0.35	20.11	23.64	30.74	33.67	28.51
150	0.35	20.11	24.07	30.77	33.41	28.44
200	0.37	20.11	25.17	30.79	32.94	28.26
225	0.38	20.11	25.91	30.73	32.61	28.13
250	0.38	20.10	26.77	30.79	32.33	27.99
275	0.39	20.09	27.79	30.69	32.01	27.81
300	0.40	20.09	29.06	30.72	31.80	27.64
325	0.41	20.08	30.60	30.60	31.63	27.47
350	0.42	20.07	32.39	30.56	31.41	27.34
375	0.43	20.06	34.72	30.45	31.20	27.15
400	0.44	20.04	37.33	30.39	30.92	27.00
425	0.45	20.03	38.85	30.36	30.67	26.82
450	0.46	20.01	37.38	30.34	30.51	26.64
475	0.47	20.00	34.32	30.44	30.22	26.48
500	0.48	19.98	31.83	30.44	30.08	26.32
550	0.50	19.94	27.72	30.23	29.69	26.01
600	0.53	19.91	24.71	30.17	29.44	25.73
650	0.56	19.87	22.33	30.24	28.90	25.47
700	0.58	19.84	20.37	30.40	28.57	25.27
750	0.61	19.81	18.75	30.39	28.34	25.09
800	0.64	19.77	17.29	30.52	28.15	24.95
850	0.67	19.73	16.07	30.53	27.85	24.86
900	0.70	19.69	15.02	30.72	27.58	24.78
950	0.73	19.64	14.06	30.88	27.42	24.71
1000	0.75	19.60	13.18	30.92	27.21	24.66
1100	0.81	19.50	11.68	31.38	26.76	24.60
1200	0.88	19.40	10.44	31.88	26.46	24.61
1300	0.93	19.26	9.42	32.73	26.05	24.67
1400	1.00	19.15	8.53	33.91	25.56	24.81
1500	1.08	19.01	7.77	35.17	24.97	25.06
1600	1.15	18.88	7.02	37.53	24.39	25.39
1700	1.22	18.74	6.44	40.47	23.89	25.61
1800	1.31	18.59	5.87	44.81	23.32	26.06
1900	1.40	18.43	5.48	49.66	22.75	26.43
2000	1.50	18.29	5.05	44.76	22.18	26.86
2100	1.62	18.14	4.78	38.92	21.60	27.09
2200	1.74	18.01	4.47	34.44	20.99	27.40
2300	1.87	17.94	3.97	31.24	20.03	27.60
2400	2.03	17.83	3.81	28.36	19.44	27.66
2500	2.21	17.76	3.51	26.17	18.44	26.68
2600	2.41	17.64	3.34	23.86	17.48	25.19
2700	2.64	17.61	3.18	21.91	16.46	23.37
2800	2.91	17.57	3.10	20.00	15.30	21.56
2900	3.26	17.54	3.19	18.26	14.28	19.81
3000	3.64	17.50	3.13	16.51	12.96	17.87

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# Directional Coupler

# TCD-20-4+

## Typical Performance Data

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

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS (dB)		
				IN	OUT	CPL
5	0.40	20.14	21.22	24.37	25.70	22.95
10	0.32	19.98	23.64	27.22	29.14	25.75
20	0.26	19.87	25.40	30.48	33.00	28.79
25	0.26	19.87	25.34	31.16	33.65	29.34
30	0.26	19.86	25.24	31.70	34.09	29.79
40	0.26	19.87	25.02	32.49	34.49	30.41
45	0.26	19.87	24.96	32.79	34.61	30.64
50	0.26	19.87	24.95	33.02	34.70	30.82
100	0.26	19.88	25.46	32.12	35.35	30.29
125	0.26	19.88	25.88	31.57	35.70	29.93
150	0.27	19.88	26.10	31.75	35.33	30.11
200	0.28	19.87	26.73	31.67	32.95	29.95
225	0.28	19.87	27.48	31.09	32.12	29.38
250	0.29	19.86	28.24	30.95	31.78	28.95
275	0.30	19.85	28.92	30.94	31.56	28.70
300	0.30	19.84	29.58	31.01	31.26	28.42
325	0.31	19.84	30.51	30.68	30.89	28.02
350	0.32	19.82	31.41	30.35	30.52	27.68
375	0.32	19.81	32.16	30.06	30.29	27.41
400	0.33	19.80	32.36	29.87	29.96	27.20
425	0.34	19.79	32.41	29.66	29.53	26.89
450	0.34	19.78	31.95	29.35	29.19	26.52
475	0.35	19.76	31.03	29.15	28.74	26.24
500	0.36	19.75	29.68	29.08	28.58	26.03
550	0.38	19.72	27.21	28.62	28.11	25.56
600	0.40	19.69	24.88	28.29	27.83	24.99
650	0.42	19.66	22.89	28.22	27.42	24.67
700	0.45	19.63	21.17	28.01	26.99	24.30
750	0.47	19.60	19.72	27.84	26.74	24.03
800	0.50	19.56	18.39	27.56	26.57	23.75
850	0.52	19.52	17.20	27.24	26.27	23.52
900	0.55	19.48	16.14	27.13	25.93	23.53
950	0.57	19.44	15.16	27.04	25.66	23.29
1000	0.61	19.40	14.27	26.83	25.54	23.06
1100	0.67	19.32	12.65	26.52	24.92	22.78
1200	0.74	19.24	11.34	26.26	24.98	23.11
1300	0.81	19.14	10.17	26.24	24.78	22.50
1400	0.90	19.08	9.11	26.76	24.43	22.81
1500	0.99	19.00	8.23	26.77	24.17	22.53
1600	1.07	18.93	7.29	28.07	23.71	22.69
1700	1.17	18.88	6.57	28.07	23.51	22.99
1800	1.28	18.82	5.89	28.60	23.22	23.32
1900	1.39	18.76	5.32	28.98	22.73	22.85
2000	1.51	18.71	4.78	28.65	22.71	24.28
2100	1.66	18.67	4.29	28.95	21.88	23.60
2200	1.81	18.63	3.91	30.82	21.23	24.58
2300	1.96	18.67	3.27	29.78	20.55	25.01
2400	2.14	18.61	2.99	28.32	20.13	26.55
2500	2.33	18.64	2.57	28.01	19.17	27.82
2600	2.54	18.53	2.38	27.42	18.27	29.72
2700	2.77	18.49	2.17	25.92	17.22	28.49
2800	3.03	18.36	2.08	24.06	16.26	26.30
2900	3.35	18.12	2.15	22.41	15.49	24.39
3000	3.69	17.85	2.14	20.44	14.12	20.60

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# Directional Coupler

# TCD-20-4+

## Typical Performance Data

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

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS (dB)		
				IN	OUT	CPL
5	0.40	20.30	20.93	26.75	29.14	25.53
10	0.40	20.28	21.13	27.32	30.06	26.00
20	0.40	20.28	21.32	27.72	30.73	26.26
25	0.41	20.29	21.37	27.73	30.84	26.21
30	0.41	20.29	21.41	27.71	30.92	26.15
40	0.42	20.30	21.51	27.64	31.04	26.04
45	0.42	20.31	21.57	27.63	31.13	26.00
50	0.43	20.31	21.63	27.61	31.22	25.96
100	0.44	20.34	22.09	28.29	31.06	26.33
125	0.45	20.35	22.41	28.75	30.81	26.62
150	0.45	20.35	22.97	28.91	30.73	26.66
200	0.47	20.36	24.56	28.89	31.43	26.48
225	0.48	20.36	25.43	29.08	31.65	26.56
250	0.48	20.36	26.39	29.42	31.72	26.65
275	0.50	20.35	27.60	29.53	31.64	26.65
300	0.50	20.35	29.23	29.62	31.70	26.57
325	0.52	20.35	31.27	29.55	31.85	26.47
350	0.52	20.34	34.06	29.63	31.97	26.46
375	0.53	20.34	38.21	29.74	32.04	26.41
400	0.54	20.33	44.21	29.85	31.95	26.39
425	0.56	20.33	41.07	29.99	31.82	26.31
450	0.57	20.32	35.50	30.10	31.89	26.21
475	0.58	20.32	31.50	30.30	31.72	26.14
500	0.59	20.31	28.89	30.53	31.83	26.06
550	0.62	20.30	24.96	30.71	31.79	25.96
600	0.65	20.29	22.15	31.00	31.85	25.90
650	0.67	20.28	19.97	31.50	31.49	25.87
700	0.70	20.26	18.17	32.07	31.21	25.79
750	0.73	20.25	16.68	32.46	30.97	25.70
800	0.75	20.23	15.39	33.27	30.76	25.74
850	0.77	20.20	14.31	33.87	30.39	25.80
900	0.79	20.16	13.38	34.74	30.10	25.84
950	0.82	20.12	12.55	35.45	29.93	25.91
1000	0.84	20.07	11.79	35.95	29.65	25.98
1100	0.90	19.96	10.51	36.89	29.10	26.02
1200	0.95	19.83	9.44	38.58	28.41	26.07
1300	1.00	19.67	8.57	41.55	27.72	26.44
1400	1.06	19.51	7.84	45.71	27.14	26.62
1500	1.13	19.33	7.24	47.46	26.62	27.20
1600	1.19	19.16	6.60	50.02	26.15	27.64
1700	1.25	18.97	6.12	48.93	25.67	28.07
1800	1.33	18.78	5.61	42.64	25.05	29.03
1900	1.41	18.57	5.31	38.61	24.47	29.66
2000	1.50	18.41	4.92	34.45	23.75	29.87
2100	1.61	18.21	4.75	33.26	23.19	31.31
2200	1.72	18.05	4.43	30.50	22.75	31.14
2300	1.84	17.95	3.98	28.28	21.57	30.98
2400	1.98	17.82	3.82	26.13	20.78	29.65
2500	2.14	17.73	3.56	24.29	19.59	27.85
2600	2.33	17.60	3.42	22.35	18.58	25.72
2700	2.54	17.56	3.21	20.67	17.36	23.83
2800	2.79	17.52	3.12	18.92	16.07	21.66
2900	3.09	17.56	3.14	17.39	14.87	19.98
3000	3.45	17.57	3.05	15.76	13.49	18.45

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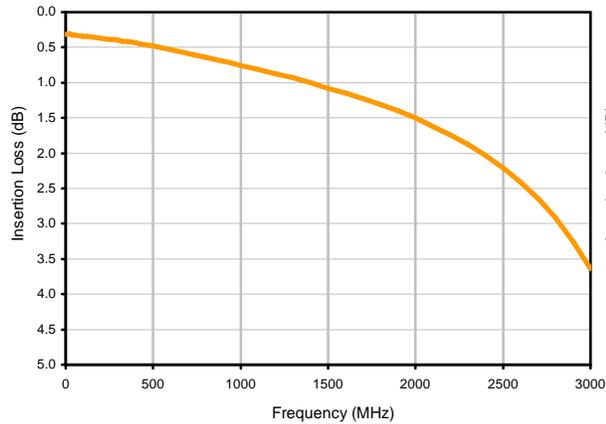


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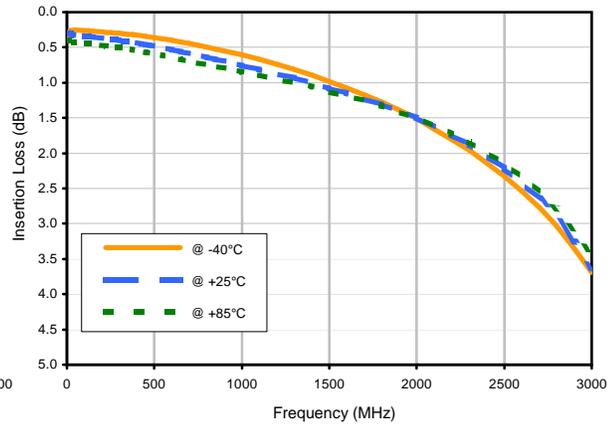


## Typical Performance Curves

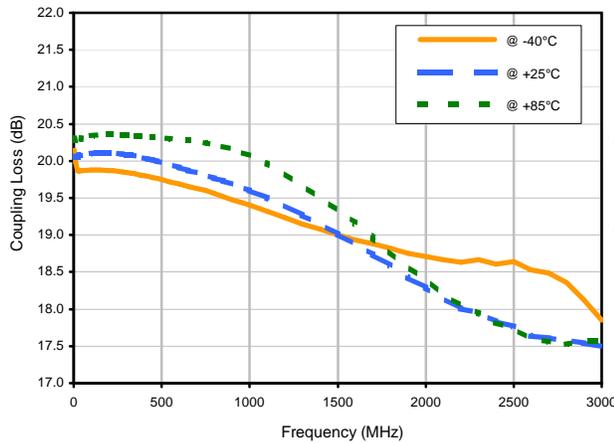
### Insertion Loss



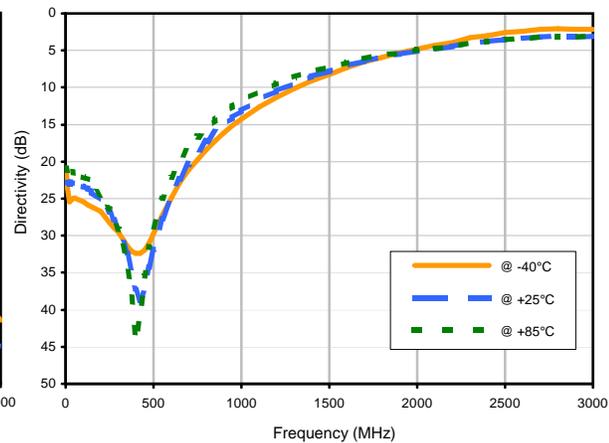
### Insertion Loss vs. TEMPERATURE



### Coupling Loss vs. TEMPERATURE



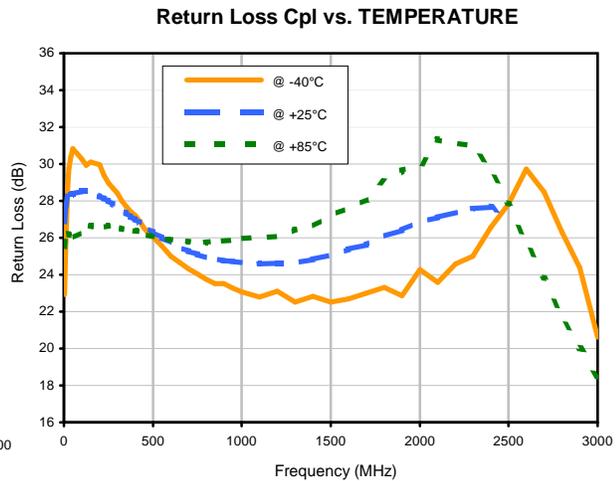
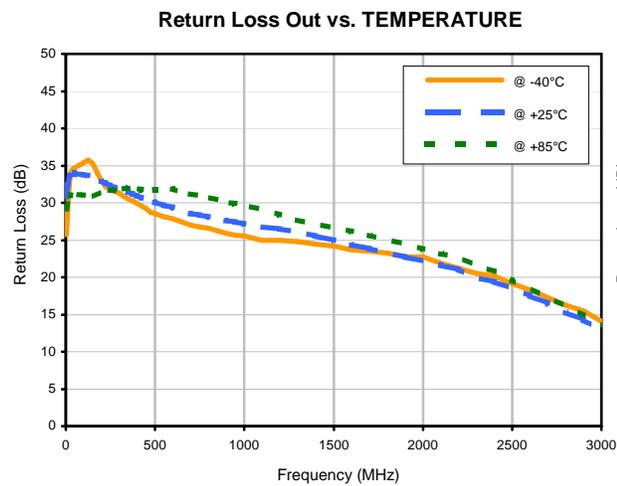
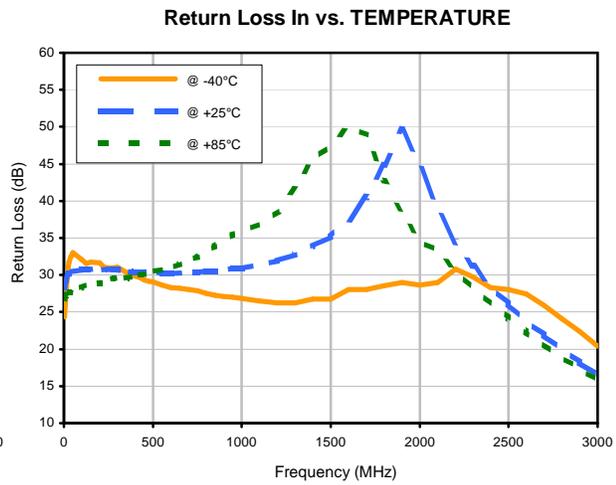
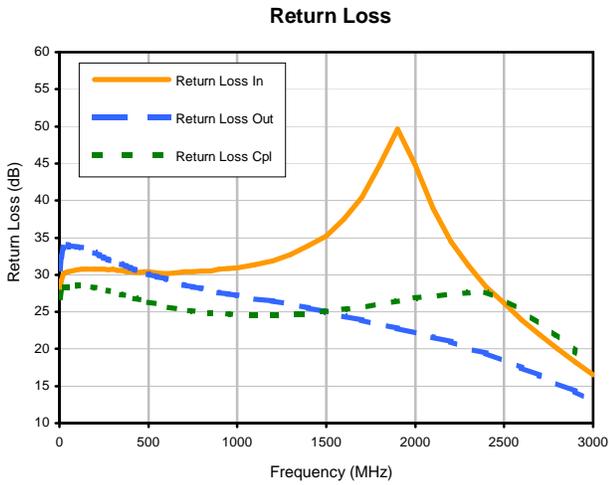
### Directivity vs. TEMPERATURE



# Directional Coupler

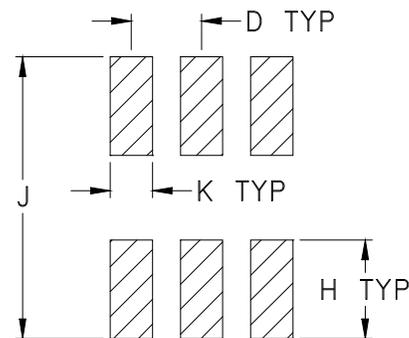
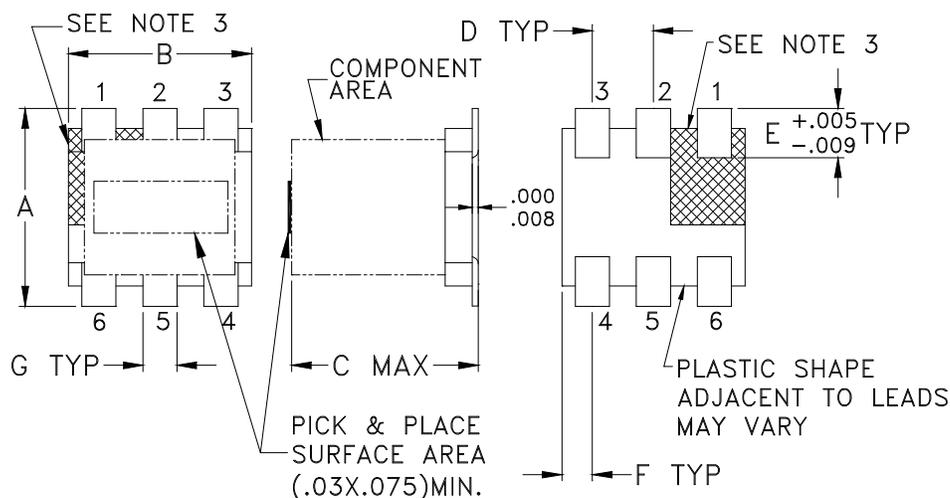
# TCD-20-4+

## Typical Performance Curves



### Outline Dimensions

### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm 0.002$

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

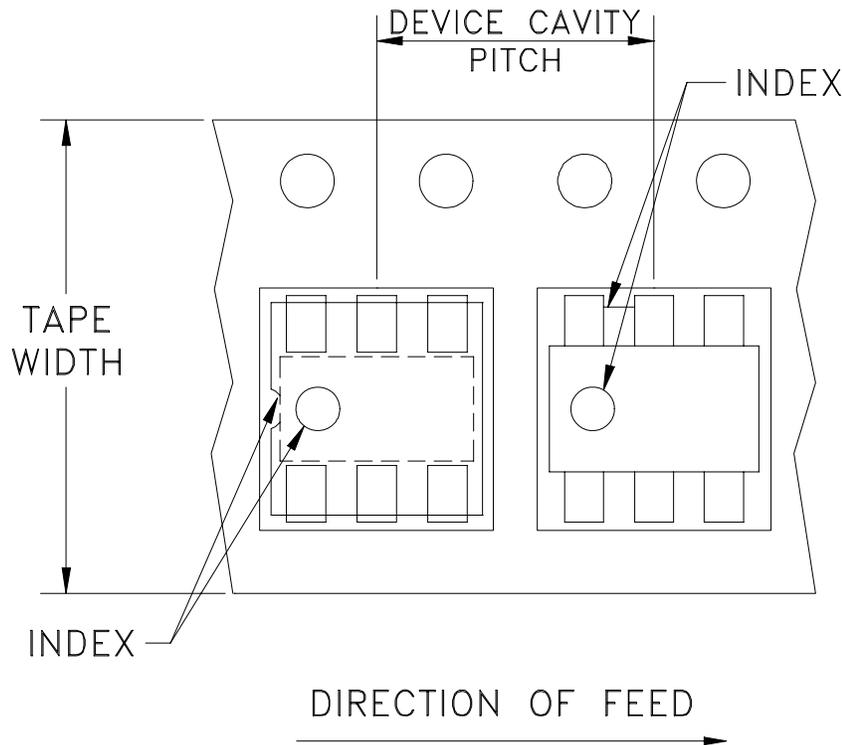
Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .01$ ; 3Pl.  $\pm .005$

#### 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.

# 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](http://www.minicircuits.com/pages/pdfs/tape.pdf)

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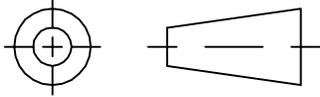
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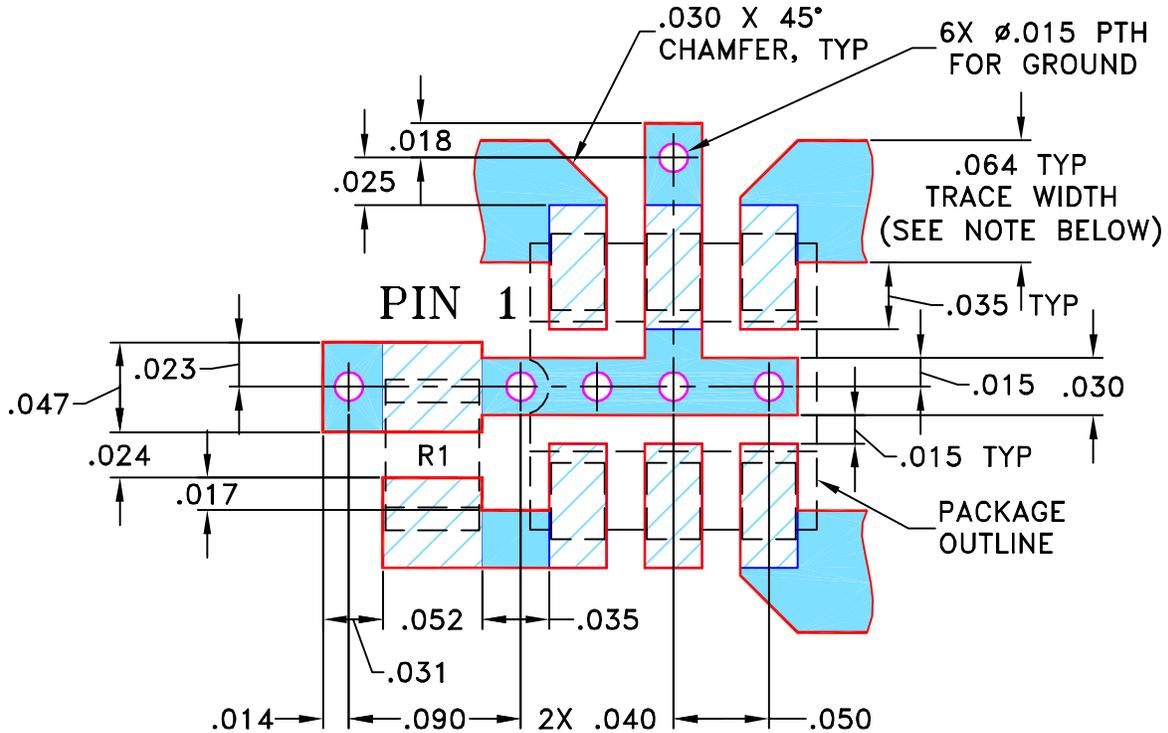
THIRD ANGLE PROJECTION



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 ± 1% Ohm, 0805 SIZE

- NOTES:** 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS 0.030" ± 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	DRAWN	IL	08/03/00
TOLERANCES ON:	CHECKED	WP	08/08/00
2 PL DECIMALS ± .005	APPROVED	DB	08/08/00
3 PL DECIMALS ±			
ANGLES ±			
FRACTIONS ±			

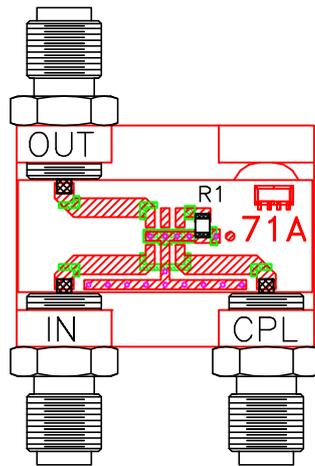
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PL, mm, DB714, TCD, TB-71

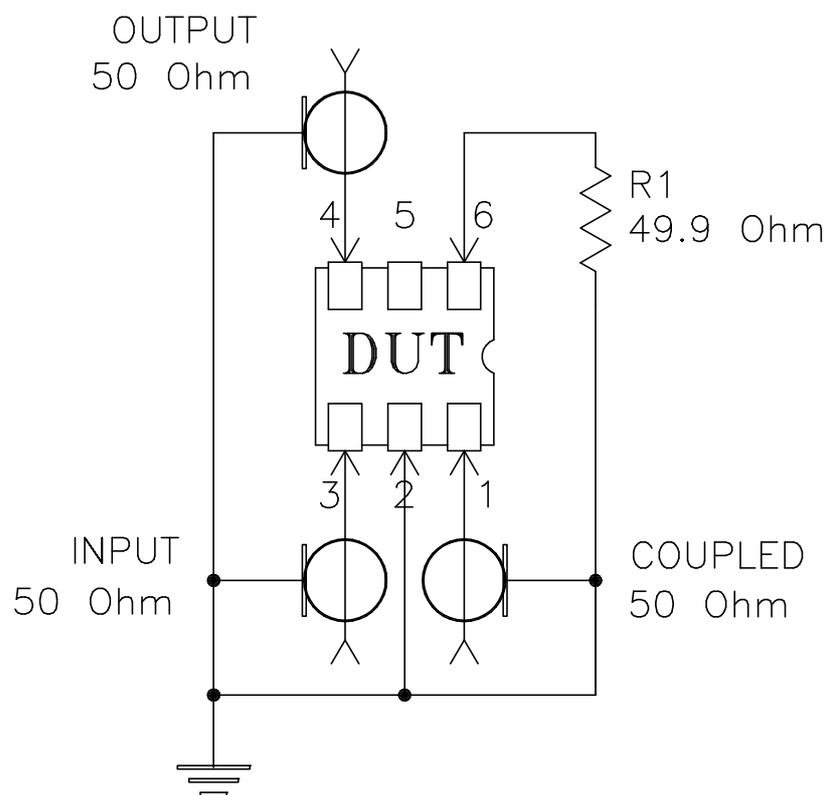
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SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-009	REV: B
FILE: 98PL009	SCALE: 10:1	SHEET: 1 OF 1	

# 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