SURFACE MOUNT top hat

Directional Coupler

TCD-13-4-75X+

75Ω 5 to 1000 MHz

FEATURES

- Wideband, 5 to 1000 MHz
- Low Mainline Loss, 0.8 dB Typ.
- Aqueous Washable
- Leads for Excellent Solderability
- Protected by US Patent 6,140,887



Generic photo used for illustration purposes only

CASE STYLE: DB1627

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

APPLICATIONS

- VHF/UHF
- CATV
- Cellular

ELECTRICAL SPECIFICATIONS AT +25°C

Parameter	Frequency (MHz)	Min.	Typ.	Max.	Unit
Frequency Range		5		1000	MHz
Mainline Loss[1]	5-50		1.0	1.8	dB
	50-500		0.8	1.3	
	500-1000		1.1	1.5	
Coupling	5-1000		13±0.5		dB
Coupling Flatness (±)	5-1000		±0.9		dB
Directivity	5-50	17	22		dB
	50-500		15		
	500-1000		12		
VSWR	10-750		1.2		:1
Input Power	5-50			0.5	W
	50-1000			1.0	

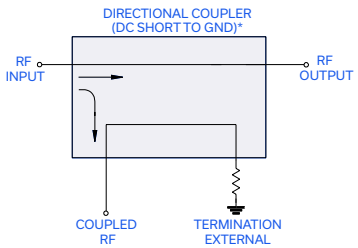
1. Mainline loss includes theoretical power loss at coupled port.

ABSOLUTE MAXIMUM RATINGS

Parameter	Ratings
Operating Temperature	-40°C to +85°C[2]
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

REV. C
ECO-027946
TCD-13-4-75X+
MCL NY
260205

SURFACE MOUNT top hat

Directional Coupler TCD-13-4-75X+

75Ω 5 to 1000 MHz

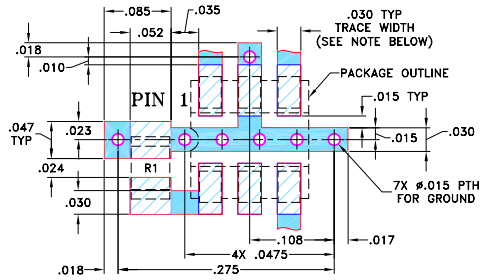
PIN CONNECTIONS

INPUT	3
OUTPUT	4
COUPLED	1
GROUND	2
75Ω TERM EXTERNAL	6
NOT USED	5

PRODUCT MARKING: DE

DEMO BOARD MCL P/N: TB-TCD13-4-75X+

SUGGESTED PCB LAYOUT (PL-010)



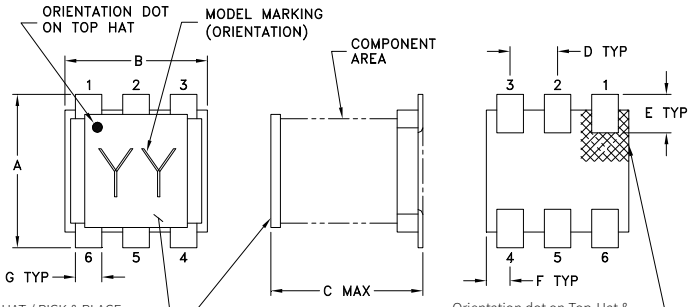
RESISTOR R1: 75 ± 1% Ohm, 0805 SIZE

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

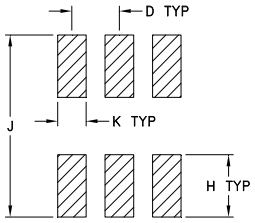
OUTLINE DRAWING



TOP-HAT / PICK & PLACE SURFACE AREA (.10X.10) MIN
TOP-HAT TOTAL THICKNESS: .013 inches MAX.

Orientation dot on Top-Hat & orientation feature on substrate corresponds to pin #1.

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

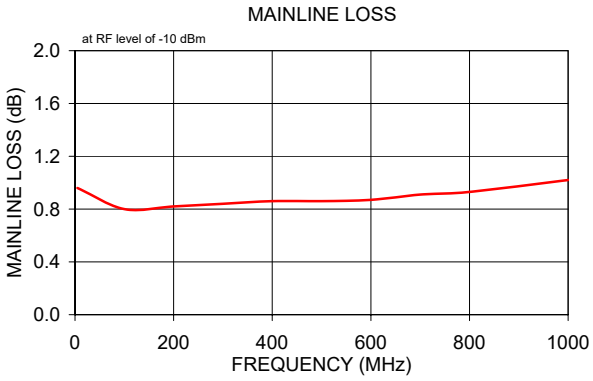
SURFACE MOUNT top hat

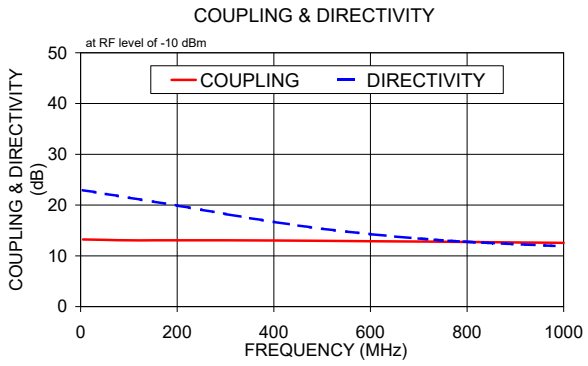
Directional Coupler TCD-13-4-75X+

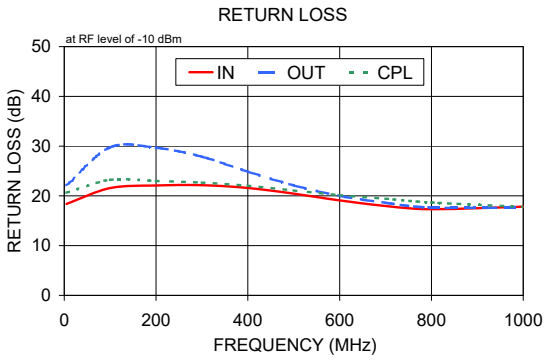
75Ω 5 to 1000 MHz

TYPICAL PERFORMANCE DATA

Frequency (MHz)	Mainline Loss (dB) In-Out	Coupling (dB) In-Cpl	Directivity (dB)	Return Loss (dB) In	Out	Cpl
5	0.96	13.23	22.93	18.39	22.11	20.63
100	0.80	13.07	21.46	21.56	29.75	23.23
200	0.82	13.07	19.90	22.09	29.67	22.99
300	0.84	13.06	18.25	22.15	27.88	22.67
400	0.86	13.03	16.68	21.58	24.86	22.04
500	0.86	12.96	15.34	20.44	22.11	21.08
600	0.87	12.88	14.27	19.08	19.99	20.15
700	0.91	12.82	13.42	17.97	18.61	19.42
800	0.93	12.73	12.75	17.33	17.64	18.67
1000	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-Circuit's 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-13-4-75X+

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	0.83	13.07	22.03	20.26	25.20	22.23
10	0.80	13.06	22.10	20.90	27.31	22.87
20	0.78	13.05	22.15	21.48	29.37	23.44
25	0.78	13.05	22.13	21.53	29.60	23.49
50	0.80	13.06	21.98	21.63	29.72	23.56
75	0.81	13.08	21.74	21.64	29.60	23.61
100	0.82	13.09	21.49	21.66	29.32	23.69
150	0.83	13.10	20.73	21.52	28.45	23.68
200	0.84	13.10	19.81	21.36	27.23	23.67
250	0.86	13.09	19.02	21.08	26.02	23.59
300	0.86	13.09	18.03	20.67	24.91	23.39
350	0.87	13.08	17.18	20.29	23.91	23.15
400	0.88	13.06	16.50	19.99	23.08	22.83
425	0.89	13.05	16.10	19.79	22.72	22.67
450	0.90	13.05	15.73	19.80	22.41	22.51
475	0.90	13.03	15.46	19.58	22.12	22.37
500	0.91	13.03	14.99	19.57	21.89	22.20
550	0.93	13.01	14.34	19.34	21.49	21.88
600	0.95	12.99	13.75	19.31	21.21	21.57
650	0.98	12.98	13.27	19.55	21.09	21.29
700	1.00	12.94	12.93	19.75	21.07	21.05
750	1.02	12.91	12.61	19.85	21.15	20.79
800	1.03	12.87	12.35	20.24	21.41	20.58
850	1.05	12.83	12.06	21.01	21.81	20.41
900	1.07	12.80	11.77	21.69	22.31	20.24
950	1.08	12.76	11.59	22.23	22.96	20.13
1000	1.11	12.72	11.53	22.80	23.61	20.01
1050	1.13	12.64	11.71	23.99	24.57	19.94
1100	1.14	12.56	11.62	25.25	25.65	19.87
1200	1.20	12.42	11.16	26.99	28.77	19.83
1300	1.30	12.29	10.37	29.29	33.27	19.75
1400	1.42	12.10	9.41	30.33	38.96	19.55
1500	1.56	11.91	8.65	29.67	37.87	19.16
1600	1.73	11.79	7.53	29.40	32.58	18.50
1700	1.89	11.80	7.03	26.64	29.12	17.71
1800	2.04	11.88	6.57	25.76	26.68	16.86
1900	2.21	12.02	6.60	23.26	25.00	16.12
2000	2.35	12.24	7.00	22.50	23.66	15.44
2100	2.55	12.47	7.88	20.88	22.85	14.96
2200	2.75	12.76	9.49	20.39	22.25	14.55
2300	2.99	13.15	10.61	19.47	22.06	14.30
2400	3.22	13.60	10.92	19.39	22.41	14.11
2500	3.45	14.06	9.72	19.24	23.22	13.88
2600	3.60	14.53	9.20	19.47	24.79	13.70
2700	3.74	15.01	7.99	19.97	26.68	13.51
2800	3.85	15.54	7.60	20.01	28.98	13.32
2900	3.90	16.14	9.12	20.77	31.20	13.18
3000	3.95	16.78	10.78	20.48	33.37	13.02
3100	4.03	17.20	14.61	21.90	35.00	12.85
3200	4.09	17.51	15.72	21.10	36.38	12.63
3300	4.14	17.81	10.75	21.66	36.09	12.29
3400	4.25	18.18	6.68	19.13	32.03	11.76
3500	4.40	18.95	4.23	17.86	29.12	11.21

Directional Coupler TCD-13-4-75X+

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	1.07	13.24	21.01	16.80	19.05	18.60
10	0.90	13.06	20.82	19.24	22.73	21.20
20	0.72	12.89	20.72	22.27	28.03	24.44
25	0.70	12.87	20.75	23.02	29.67	25.27
50	0.69	12.87	20.83	25.18	33.86	27.84
75	0.68	12.87	20.70	25.37	35.49	28.19
100	0.68	12.88	20.50	24.16	35.29	26.57
150	0.70	12.88	19.92	23.30	32.89	25.86
200	0.71	12.88	19.26	23.60	31.03	26.74
250	0.72	12.87	18.51	21.75	29.00	24.48
300	0.73	12.86	17.73	21.40	26.87	24.26
350	0.74	12.84	16.98	20.48	25.00	23.51
400	0.75	12.82	16.37	19.75	23.42	22.52
425	0.76	12.82	15.99	19.52	22.79	22.29
450	0.77	12.81	15.67	19.35	22.28	22.01
475	0.77	12.79	15.41	18.82	21.80	21.58
500	0.78	12.79	14.97	18.58	21.41	21.24
550	0.80	12.77	14.38	18.32	20.80	20.88
600	0.81	12.75	13.83	18.09	20.39	20.11
650	0.84	12.72	13.41	18.38	20.14	19.78
700	0.86	12.69	13.11	18.56	20.01	19.57
750	0.87	12.65	12.88	18.98	20.05	19.23
800	0.88	12.61	12.65	20.04	20.39	19.37
850	0.89	12.56	12.46	21.20	21.04	19.43
900	0.90	12.51	12.25	22.87	21.97	19.81
950	0.91	12.46	12.16	24.67	23.29	20.25
1000	0.92	12.42	12.22	26.74	24.78	20.77
1050	0.94	12.33	12.51	30.31	27.00	21.62
1100	0.95	12.25	12.49	32.49	29.90	22.59
1200	1.01	12.10	12.12	28.96	42.44	24.72
1300	1.10	11.96	11.17	23.72	36.08	23.53
1400	1.22	11.78	9.91	22.63	31.20	20.39
1500	1.35	11.57	8.92	21.44	30.30	17.36
1600	1.50	11.47	7.62	22.62	30.84	15.50
1700	1.64	11.48	7.00	22.11	32.08	14.47
1800	1.79	11.62	6.53	23.27	32.62	14.80
1900	1.97	11.78	6.58	27.09	31.41	16.32
2000	2.12	12.05	7.09	33.77	28.11	18.95
2100	2.29	12.34	8.08	28.82	24.74	22.46
2200	2.49	12.71	9.88	19.42	21.87	21.97
2300	2.67	13.19	11.26	17.20	19.87	17.02
2400	2.91	13.70	11.51	13.90	18.95	13.58
2500	3.15	14.25	10.06	13.47	19.09	11.95
2600	3.29	14.73	9.35	13.02	20.63	10.20
2700	3.33	15.28	8.11	13.15	23.77	9.43
2800	3.36	15.91	7.62	13.33	30.20	9.12
2900	3.38	16.63	9.62	13.17	40.79	9.25
3000	3.48	17.47	12.26	13.85	30.40	9.63
3100	3.62	18.09	18.41	14.45	27.74	11.75
3200	3.68	18.55	13.91	16.18	28.73	14.46
3300	3.68	18.92	8.09	17.51	34.80	21.42
3400	3.72	19.12	4.80	18.16	38.30	23.79
3500	3.89	19.80	2.95	14.19	26.02	13.96

Directional Coupler TCD-13-4-75X+

Typical Performance Data

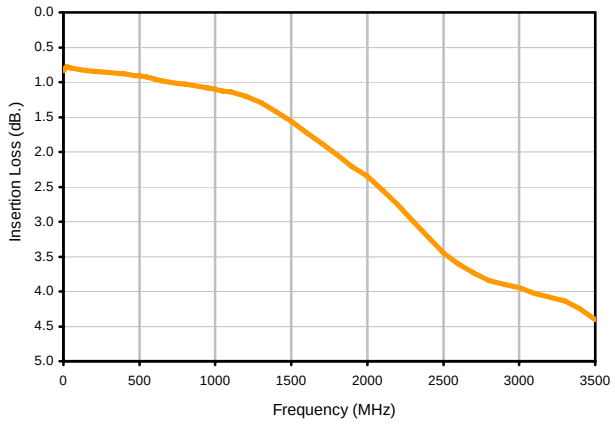
TEST CONDITIONS: INPUT POWER =0 dBm @Temperature = +85°C

FREQUENCY (MHz)	INSERTION LOSS (dB)	COUPLING LOSS (dB)	DIRECTIVITY (dB)	RETURN LOSS (dB)		
				IN	OUT	CPL
5	1.00	13.32	23.44	18.82	22.82	20.78
10	0.95	13.27	23.18	19.54	24.80	21.50
20	0.92	13.23	22.87	20.08	26.77	21.99
25	0.92	13.23	22.79	20.03	27.00	21.89
50	0.94	13.25	22.47	19.48	27.16	21.17
75	0.95	13.25	22.22	19.39	26.99	21.07
100	0.96	13.26	22.00	19.96	26.65	21.77
150	0.97	13.28	21.16	20.62	26.06	22.82
200	0.98	13.28	20.10	20.07	25.33	22.28
250	0.99	13.28	19.20	20.66	24.55	23.22
300	0.99	13.28	18.24	20.59	23.94	23.52
350	1.00	13.28	17.34	20.25	23.39	23.22
400	1.01	13.27	16.62	20.63	23.01	23.80
425	1.02	13.27	16.16	20.62	22.86	23.91
450	1.03	13.27	15.80	20.68	22.75	23.85
475	1.04	13.26	15.47	20.45	22.61	23.63
500	1.05	13.26	15.00	20.52	22.53	23.56
550	1.07	13.26	14.32	20.55	22.34	23.67
600	1.09	13.26	13.65	20.47	22.20	23.40
650	1.11	13.25	13.15	20.55	22.12	22.95
700	1.14	13.23	12.77	20.64	22.04	22.71
750	1.15	13.22	12.40	20.45	21.94	22.19
800	1.17	13.20	12.07	20.38	21.97	21.53
850	1.19	13.17	11.78	20.71	22.09	21.13
900	1.21	13.15	11.45	20.95	22.28	20.54
950	1.23	13.12	11.22	21.09	22.55	19.85
1000	1.25	13.10	11.10	21.30	22.82	19.45
1050	1.28	13.04	11.21	21.91	23.30	19.00
1100	1.30	12.97	11.12	22.94	23.93	18.59
1200	1.37	12.85	10.65	24.80	26.00	18.43
1300	1.47	12.73	9.95	29.80	29.64	18.67
1400	1.60	12.56	9.07	36.94	36.64	19.37
1500	1.74	12.38	8.40	35.68	46.20	20.43
1600	1.90	12.27	7.35	29.80	31.97	20.86
1700	2.04	12.27	6.85	24.93	27.15	19.49
1800	2.18	12.33	6.42	22.45	24.42	17.47
1900	2.34	12.45	6.43	19.91	23.02	15.56
2000	2.46	12.61	6.74	19.06	22.31	14.07
2100	2.65	12.81	7.39	18.00	22.32	13.29
2200	2.83	13.03	8.61	18.21	22.69	13.01
2300	3.07	13.33	9.19	18.25	23.52	13.12
2400	3.31	13.69	9.14	19.73	24.54	13.63
2500	3.57	14.03	8.03	20.71	25.16	14.29
2600	3.77	14.40	7.60	22.06	25.56	14.87
2700	3.99	14.75	6.55	22.13	25.21	15.12
2800	4.17	15.15	6.29	20.42	24.42	14.66
2900	4.25	15.66	7.33	19.49	23.61	13.90
3000	4.27	16.20	8.30	17.45	23.17	13.02
3100	4.30	16.56	11.09	17.39	23.12	12.08
3200	4.33	16.83	16.42	16.24	23.86	11.45
3300	4.35	17.20	16.07	16.69	24.66	11.02
3400	4.50	17.67	10.03	15.79	24.67	10.82
3500	4.73	18.56	6.58	16.29	24.48	10.80

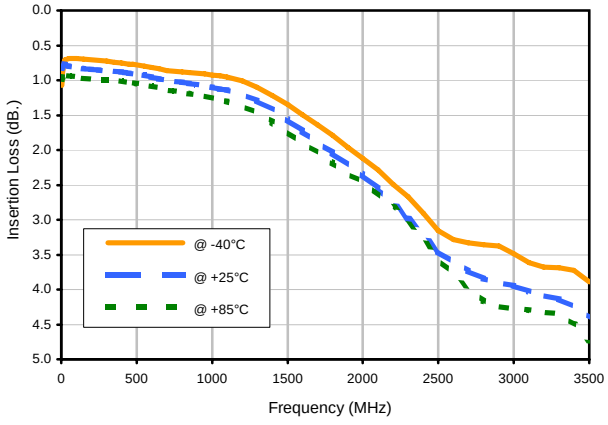
Directional Coupler TCD-13-4-75X+

Typical Performance Curves

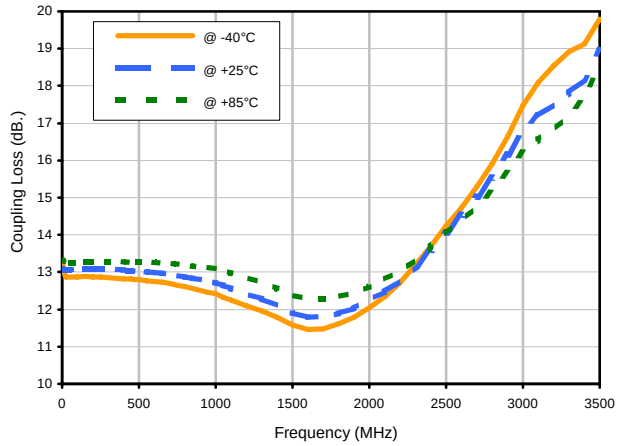
Insertion Loss



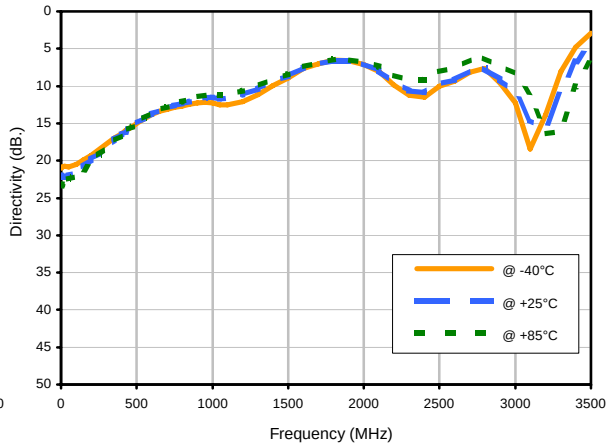
Insertion Loss vs. TEMPERATURE



Coupling Loss vs. TEMPERATURE

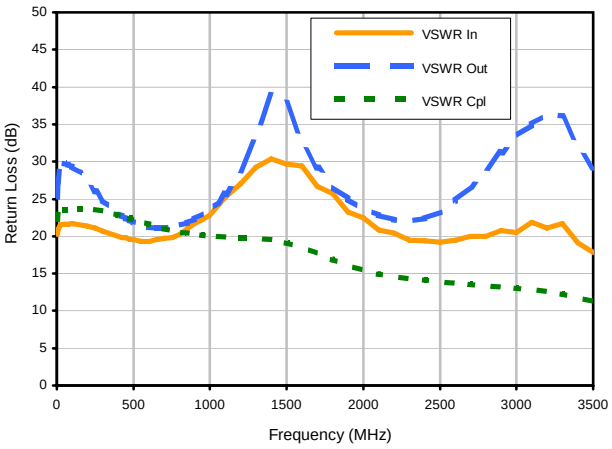


Directivity vs. TEMPERATURE

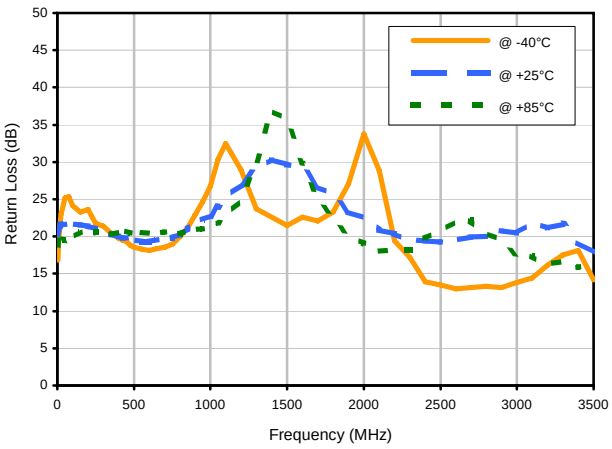


Typical Performance Curves

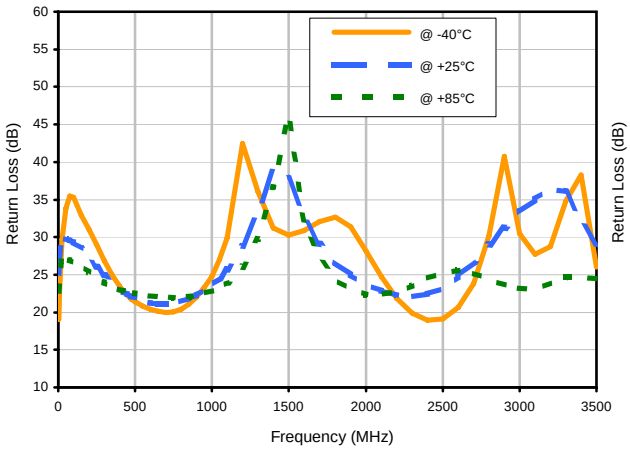
Return Loss



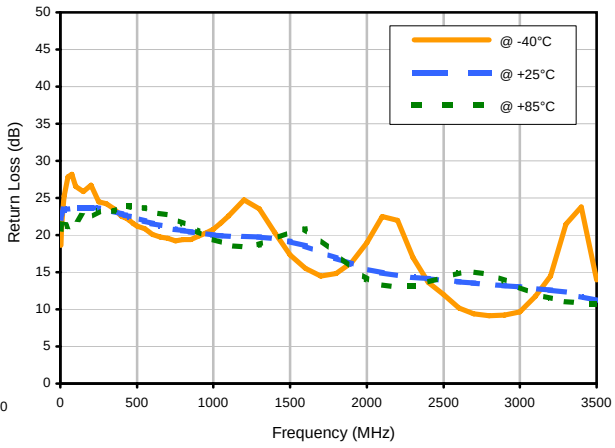
Return Loss In vs. TEMPERATURE



Return Loss Out vs. TEMPERATURE



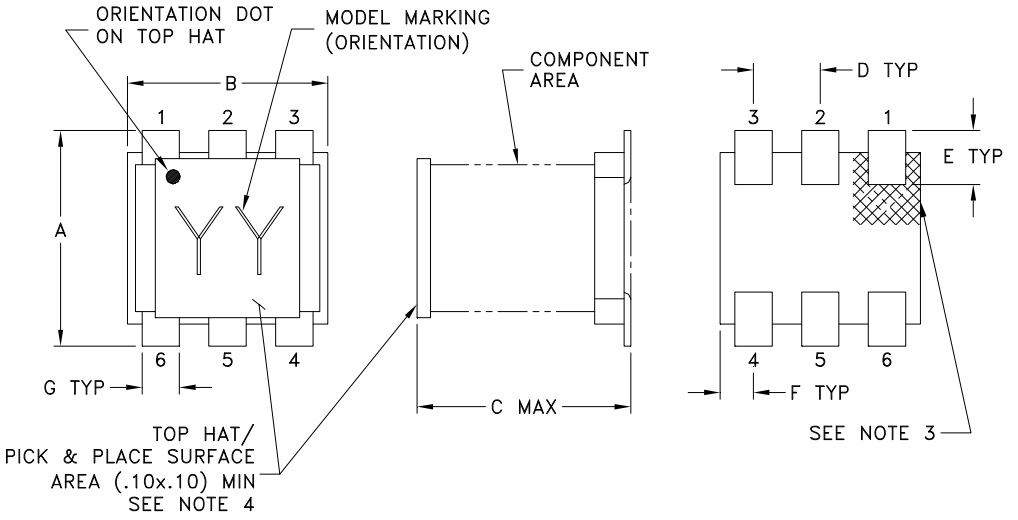
Return Loss Cpl vs. TEMPERATURE



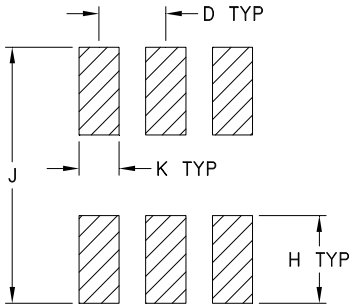
Case Style DB

DB1627

Outline Dimensions



PCB Land Pattern



SUGGESTED LAYOUT
TOLERANCE TO BE WITHIN ±.002

CASE #	A	B	C	D	E	F	G	H	J	K	WT. GRAM
DB1627	.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. ± .01; 3Pl. ± .005

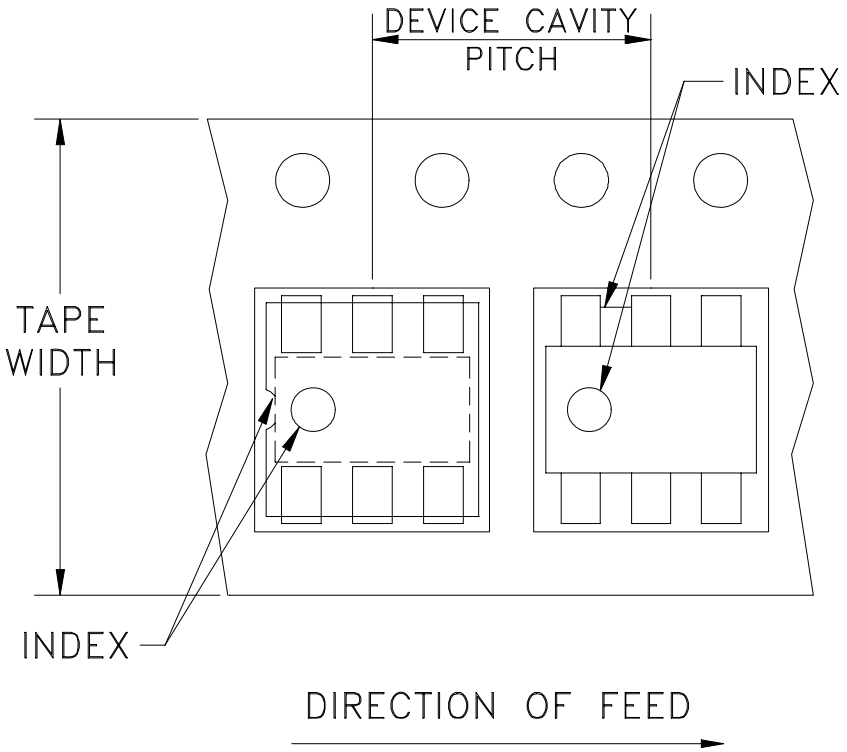
Notes:

1. Case material: Plastic.
2. 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.
3 Orientation dot on top hat & orientation feature on substrate correspondence to pin #1.
4 Top-Hat total thickness: .013 inches MAX.

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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.

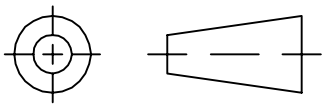
Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

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

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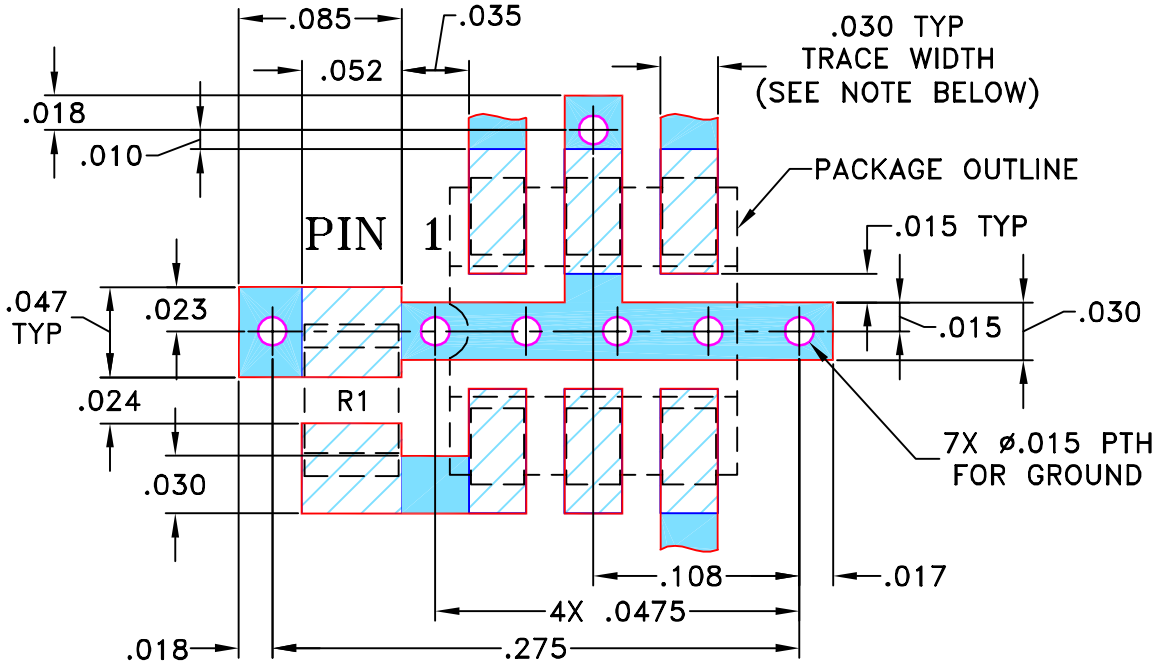
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THIRD ANGLE PROJECTION



REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M73159	NEW RELEASE	08/00	IL	DB
A	M82377	UPDATED DRAWING	07/30/02	AV	LC
B	M102713	UPDATED NOTES	01/12/06	GF	IL

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



RESISTOR R1: 75 ± 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 ±	APPROVED	DB	08/09/00
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

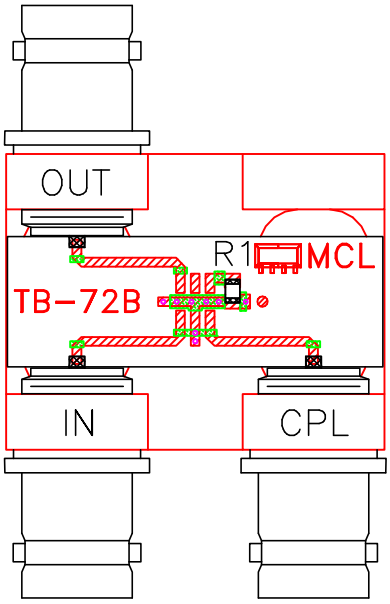
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, mm, 75, DB714, TCD, TB-72

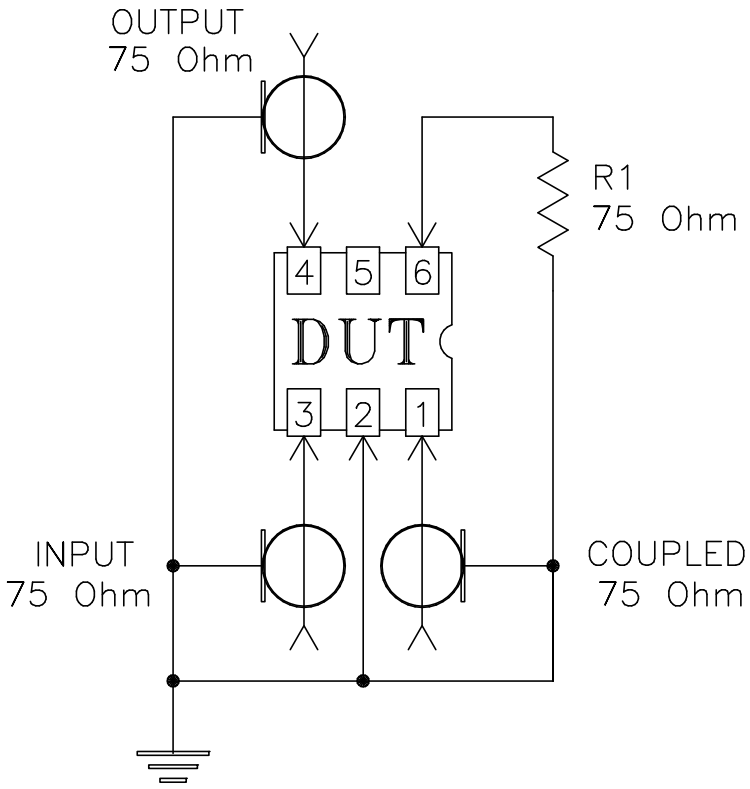
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-010	B

FILE:	SCALE:	SHEET:
98PL010	10:1	1 OF 1

Evaluation Board and Circuit



TB-72



Schematic Diagram

Notes:

1. 75 Ohm BNC Female connectors.
2. PCB Material: Rogers RO4350 or equivalent, Dielectric Constant=3.5, Thickness=.030 inch.

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Environmental Specifications ENV02T1

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

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