MICROWAVE PRECISION

Fixed Attenuator

QAT-2+

50Ω 2W 2 dB DC to 50 GHz

THE BIG DEAL

- Small package, 2x2mm MCLP™
- Super Wide bandwidth, DC to 50 GHz
- Excellent VSWR, 1.35:1 typ. at 25 GHz
- High Power Handling, 2W
- Protected by US Patent 11,784,146

Generic photo used for illustration purposes only

CASE STYLE: MC3000

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

APPLICATIONS

- 5G
- Test and Measurement
- Radar
- Communication
- Defense
- Satellite

PRODUCT OVERVIEW

QAT-2+ is an absorptive fixed attenuator fabricated using highly reliable and repeatable GaAs MMIC IPD* process. The model operates from DC to 50 GHz. It achieves outstanding attenuation accuracy and flatness while maintains excellent VSWR throughout the entire band. The model can also handle input power up to 2W, which makes this model an ideal choice for a wide range of applications.

KEY FEATURES

Feature	Advantages
Wideband operation, From DC to 50 GHz	Supports a wide array of applications including 5G, wireless infrastructure, microwave communications, satellite, defense and aerospace, medical broadband and optic applications.
Small Size and simple to use (2x2 mm)	As a single chip solution, the QAT series occupies less board space than a lumped element approach, minimizes component count and ensures repeatable performance over wide frequency range.
Wide range of nominal attenuation values (0,1,2,3,4,5,6,7,8,9,10,12,15,20 & 30)	Small increment offering enables circuit designer to change attenuation values without motherboard redesign making the QAT series ideal for select at test application.
MCLP™ Package	Low Inductance, repeatable transitions, excellent thermal path make the QAT series an ideal solution as an alternative to "do it yourself" lumped element-based approach.

* IPD - Integrated Passive Device.

REV. B
ECO-022420
QAT-2+
MCL NY
240716

Fixed Attenuator

QAT-2+

50Ω 2W 2 dB DC to 50 GHz

ELECTRICAL SPECIFICATIONS[1] AT +25°C, 50Ω , UNLESS NOTED OTHERWISE

Parameter	Condition (GHz)	Min.	Typ.	Max.	Unit
Frequency Range		DC	—	50	GHz
Attenuation	0.01 - 5	1.6	2.0	2.4	dB
	5 - 10	1.7	2.1	2.5	
	10 - 20	1.7	2.1	2.6	
	20 - 30	1.5	2.2	2.7	
	30 - 40	—	2.3	—	
	40 - 50	—	2.4	—	
VSWR	0.01 - 5	—	1.08	1.3	:1
	5 - 10	—	1.18	1.5	
	10 - 20	—	1.11	1.5	
	20 - 30	—	1.17	—	
	30 - 40	—	1.28	—	
	40 - 50	—	1.55	—	

1. Tested on Mini-Circuits test board TB-QAT-2C+. See Characterization/Application Circuit in Fig. 1. Bi-directional RF-IN and RF-OUT ports can be intercharged. See S-Parameters for actual performance

ABSOLUTE MAXIMUM RATINGS[2]

Parameter	Ratings
Operating Case Temperature	-55°C to 105°C
Storage Temperature	-65°C to 150°C
RF Input Power[3]	2W

2. Permanent damage may occur if any of these limits are exceeded.
3. Power rating derated to 1W at 85°C and 0.6W at 105°C.

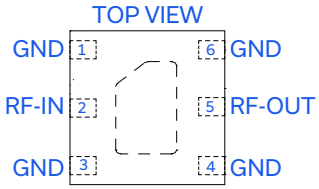
Fixed Attenuator

QAT-2+

50Ω 2W 2 dB DC to 50 GHz

PAD DESCRIPTION

Function	Pad Number	Description
RF-IN	2	RF input pad
RF-OUT	5	RF output pad
GND	1,3,4,6 & Paddle	Ground



CHARACTERIZATION TEST CIRCUIT

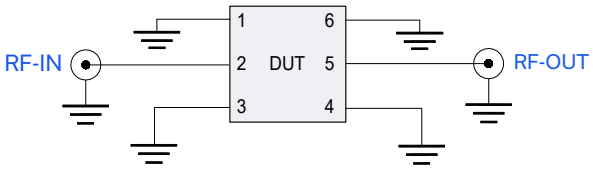
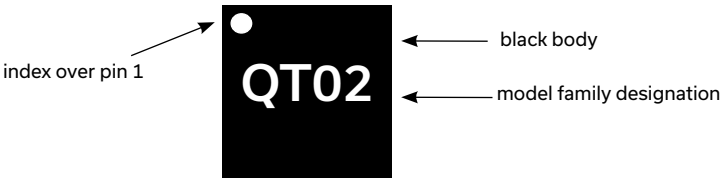


Fig 1. Block diagram of Test Circuit used for characterization, Test board TB-QAT-2C+
Conditions: Attenuation, VSWR: P_{IN}=0 dBm

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Fixed Attenuator

QAT-2+

50Ω 2W 2 dB DC to 50 GHz

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

Performance Data	Data Table Swept Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	MC3000 Plastic package, Terminal finish: Matte Tin
Tape & Reel **Standard quantities available on reel**	F66 7" reels with 20, 50, 100, 200, 500 or 2K devices
Suggested Layout for PCB Design	PL-676
Evaluation Board	TB-QAT-2+ (without connectors) TB-QAT-2C+ (with connectors)
Environmental Ratings	ENV08T1

ESD RATING

Human Body Model (HBM): Class 2 (Pass 2000V) per ANSI/ESD STM 5.1 - 2001

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

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

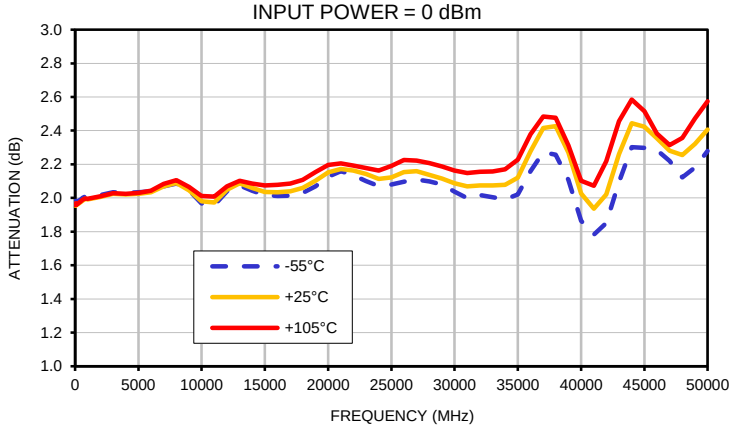
MMIC Attenuator QAT-2+

Typical Performance Data

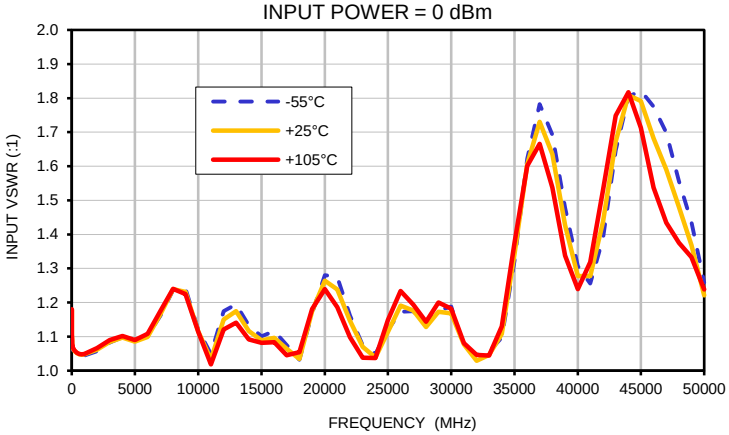
FREQ.	ATTENUATION			INPUT VSWR			OUTPUT VSWR		
(MHz)	(dB)			(:1)			(:1)		
	@-55˚C	@25°C	@+105°C	@-55˚C	@25°C	@+105°C	@-55˚C	@25°C	@+105°C
10	1.97	1.95	1.96	1.18	1.18	1.18	1.18	1.18	1.18
20	1.98	1.97	1.97	1.10	1.11	1.11	1.10	1.11	1.11
30	1.98	1.96	1.96	1.08	1.09	1.09	1.08	1.09	1.09
40	1.98	1.96	1.96	1.07	1.08	1.08	1.07	1.08	1.08
50	1.98	1.96	1.96	1.07	1.07	1.07	1.07	1.07	1.08
60	1.98	1.96	1.96	1.06	1.07	1.07	1.06	1.07	1.07
70	1.98	1.96	1.96	1.06	1.07	1.07	1.06	1.07	1.07
80	1.98	1.96	1.96	1.06	1.07	1.07	1.06	1.07	1.07
90	1.98	1.96	1.96	1.06	1.06	1.07	1.06	1.07	1.07
100	1.98	1.96	1.96	1.06	1.06	1.07	1.06	1.07	1.07
200	1.98	1.96	1.97	1.05	1.06	1.06	1.05	1.06	1.06
400	1.99	1.97	1.98	1.05	1.05	1.05	1.05	1.05	1.05
600	2.00	1.98	1.99	1.04	1.05	1.05	1.05	1.05	1.05
800	2.01	1.99	2.00	1.04	1.05	1.05	1.05	1.05	1.05
1000	2.00	1.99	1.99	1.04	1.05	1.05	1.05	1.05	1.05
2000	2.02	2.01	2.01	1.06	1.06	1.07	1.06	1.06	1.06
3000	2.03	2.02	2.03	1.08	1.08	1.09	1.08	1.09	1.09
4000	2.03	2.02	2.03	1.10	1.10	1.10	1.12	1.11	1.11
5000	2.03	2.03	2.03	1.09	1.09	1.09	1.12	1.11	1.11
6000	2.04	2.03	2.04	1.10	1.10	1.11	1.12	1.11	1.12
7000	2.07	2.07	2.08	1.16	1.17	1.17	1.16	1.16	1.17
8000	2.09	2.09	2.10	1.24	1.24	1.24	1.23	1.22	1.22
9000	2.05	2.05	2.07	1.24	1.23	1.22	1.23	1.21	1.20
10000	1.97	1.98	2.01	1.12	1.12	1.11	1.10	1.09	1.09
11000	1.96	1.97	2.01	1.05	1.03	1.02	1.07	1.06	1.05
12000	2.04	2.05	2.07	1.17	1.15	1.12	1.21	1.18	1.15
13000	2.07	2.09	2.10	1.19	1.17	1.14	1.23	1.20	1.17
14000	2.04	2.06	2.09	1.13	1.12	1.09	1.16	1.13	1.10
15000	2.02	2.04	2.07	1.10	1.09	1.08	1.09	1.07	1.06
16000	2.01	2.03	2.08	1.12	1.10	1.08	1.09	1.07	1.06
17000	2.01	2.04	2.09	1.08	1.06	1.04	1.06	1.05	1.03
18000	2.03	2.06	2.11	1.03	1.03	1.05	1.06	1.06	1.08
19000	2.07	2.10	2.15	1.17	1.17	1.18	1.18	1.20	1.21
20000	2.13	2.15	2.20	1.28	1.26	1.24	1.30	1.30	1.27
21000	2.16	2.17	2.21	1.28	1.24	1.19	1.30	1.27	1.22
22000	2.14	2.16	2.19	1.16	1.15	1.10	1.19	1.17	1.13
23000	2.10	2.14	2.18	1.07	1.07	1.04	1.09	1.11	1.08
24000	2.07	2.11	2.16	1.05	1.04	1.04	1.11	1.10	1.09
25000	2.08	2.12	2.19	1.12	1.11	1.15	1.20	1.18	1.20
26000	2.10	2.15	2.23	1.17	1.19	1.23	1.26	1.27	1.31
27000	2.11	2.16	2.22	1.17	1.18	1.19	1.25	1.25	1.26
28000	2.10	2.14	2.21	1.13	1.13	1.14	1.17	1.15	1.15
29000	2.08	2.11	2.19	1.18	1.17	1.20	1.14	1.12	1.14
30000	2.04	2.09	2.16	1.19	1.17	1.18	1.13	1.10	1.11
31000	2.00	2.07	2.15	1.07	1.08	1.08	1.05	1.03	1.04
32000	2.02	2.07	2.16	1.05	1.03	1.05	1.12	1.10	1.11
33000	2.00	2.07	2.16	1.06	1.05	1.04	1.16	1.16	1.18
34000	1.99	2.08	2.17	1.10	1.11	1.13	1.20	1.21	1.23
35000	2.02	2.12	2.23	1.32	1.34	1.37	1.34	1.35	1.39
36000	2.16	2.28	2.38	1.62	1.61	1.60	1.58	1.57	1.57
37000	2.27	2.41	2.48	1.78	1.73	1.67	1.71	1.67	1.61
38000	2.26	2.43	2.48	1.69	1.64	1.54	1.63	1.58	1.50
39000	2.11	2.27	2.31	1.48	1.43	1.34	1.43	1.38	1.30
40000	1.87	2.03	2.10	1.31	1.28	1.24	1.28	1.24	1.19
41000	1.78	1.94	2.07	1.26	1.28	1.32	1.22	1.23	1.25
42000	1.85	2.02	2.22	1.39	1.44	1.53	1.33	1.37	1.44
43000	2.10	2.26	2.46	1.65	1.67	1.75	1.60	1.61	1.67
44000	2.30	2.44	2.58	1.80	1.81	1.82	1.74	1.75	1.76
45000	2.30	2.42	2.51	1.82	1.79	1.71	1.72	1.72	1.67
46000	2.29	2.36	2.38	1.78	1.68	1.54	1.70	1.64	1.54
47000	2.22	2.28	2.31	1.70	1.59	1.43	1.69	1.62	1.51
48000	2.12	2.25	2.36	1.56	1.48	1.38	1.64	1.62	1.56
49000	2.18	2.32	2.47	1.44	1.37	1.33	1.67	1.64	1.62
50000	2.28	2.41	2.57	1.26	1.22	1.24	1.73	1.64	1.62

Typical Performance Curves

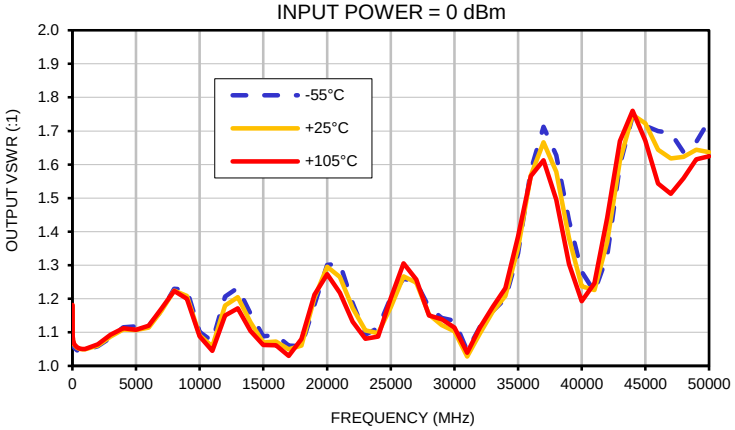
ATTENUATION vs. TEMPERATURE
INPUT POWER = 0 dBm



INPUT VSWR vs. TEMPERATURE
INPUT POWER = 0 dBm



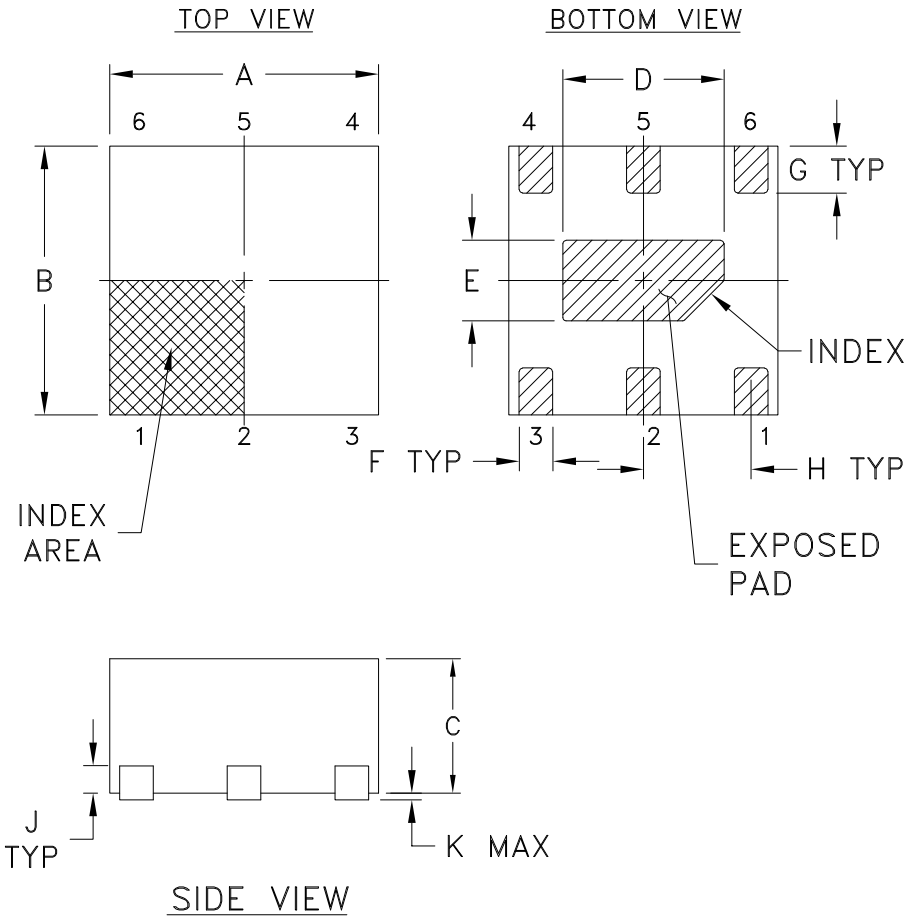
OUTPUT VSWR vs. TEMPERATURE
INPUT POWER = 0 dBm

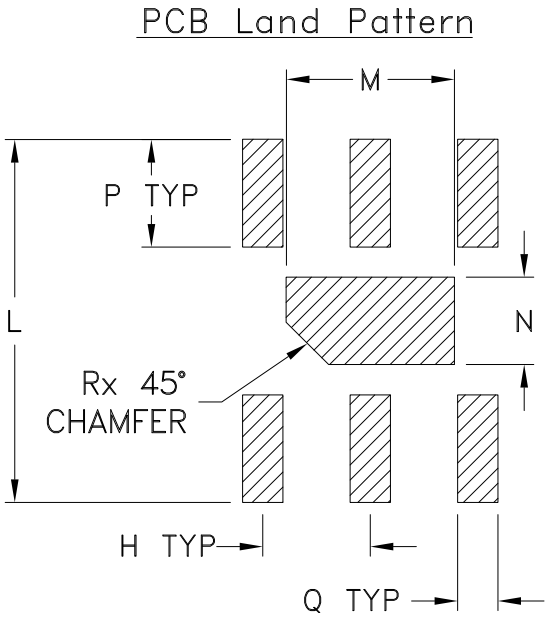


Case Style MC

Outline Dimensions

MC3000





Suggested Layout,
Tolerance to be within ±.002

DENOTES METALLIZATION

CASE#	A	B	C	D	E	F	G	H	J	K	L	M	N
MC3000	.079 (2.00)	.079 (2.00)	.039 (1.00)	.047 (1.20)	.024 (.60)	.010 (.25)	.014 (.35)	.031 (.80)	.008 (.20)	.002 (.05)	.106 (2.70)	.049 (1.25)	.026 (.65)

CASE #	P	Q	R	WT, GRAM
MC3000	.031 (.80)	.012 (.30)	.012 (.30)	.006

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

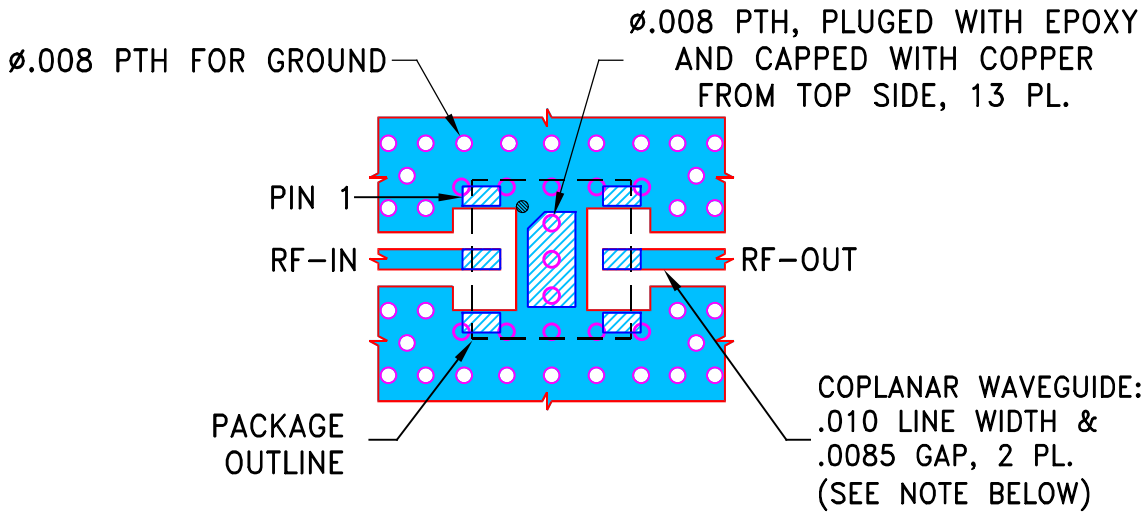
Notes:

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin-Silver over Nickel plated or Matte-Tin plated (See Data sheet).
   All models, (+) suffix.
3. Lead #1 identifier shall be located in the cross-hatched area shown.
   Identifier may be either a molded or marked feature.

THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	ECO-002800	NEW RELEASE	04/14/20	ITG	CC
A	ECO-003941	UPDATED DUT ROTATION		CA	

SUGGESTED MOUNTING CONFIGURATION FOR MC3000 CASE STYLE



NOTES:

1. LINE WIDTH & GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .0066±.0007"; COPPER: 1 OZ. FOR OTHER MATERIALS LINE WIDTH & GAP 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	ITG	06/02/20
TOLERANCES ON:	CHECKED	GF	06/02/20
2 PL DECIMALS ±	APPROVED	CC	06/02/20
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

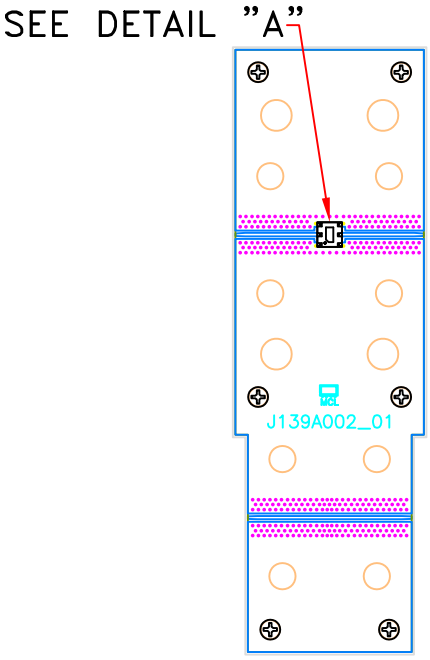
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

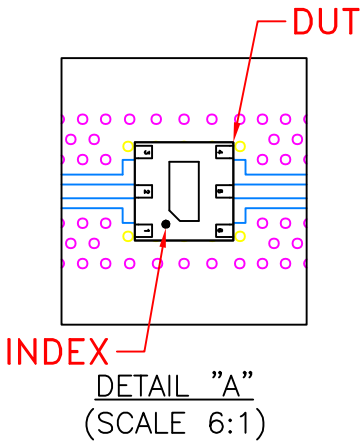
PL, MC3000, TB-QAT-XXC+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-676	A

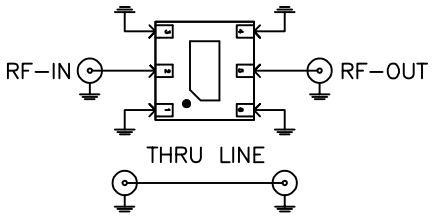
FILE:	SCALE:	SHEET:
98PL676	10:1	1 OF 1

Evaluation Board and Circuit





DETAIL "A"
(SCALE 6:1)



SCHEMATIC DIAGRAM
(SCALE 6:1)

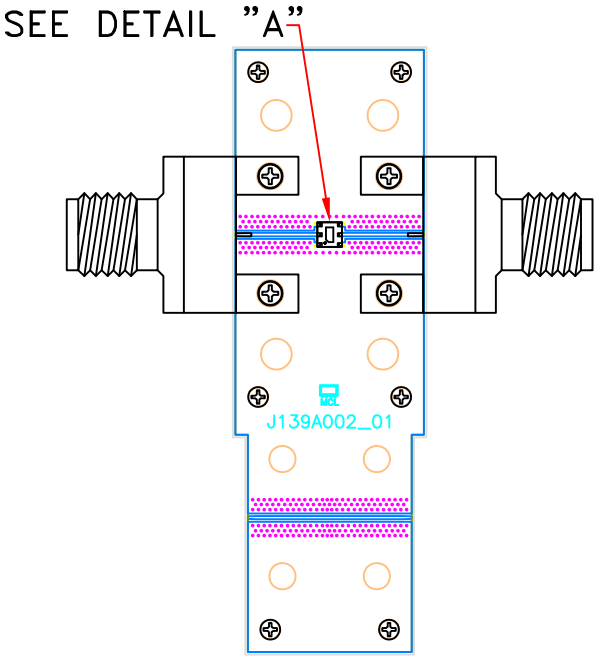
Function	Pad
RF-IN	2
RF-OUT	5
GND	1,3,4,6

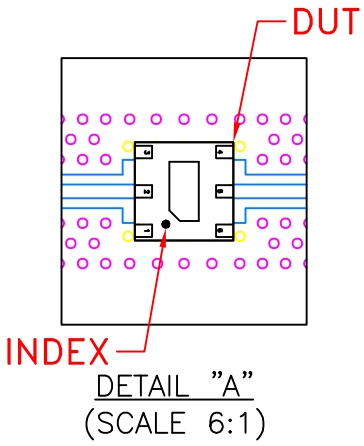
Notes:

1. PCB Material: Roger RO4350B or equivalent, Dielectric constant=3.5, Thickness=0.0066 inch

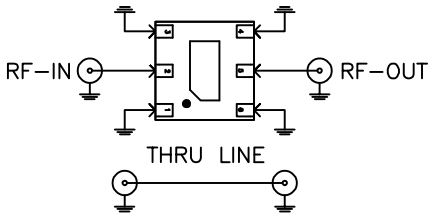
Mini-Circuits®

Evaluation Board and Circuit





DETAIL "A"
(SCALE 6:1)



SCHEMATIC DIAGRAM
(SCALE 6:1)

Function	Pad
RF-IN	2
RF-OUT	5
GND	1,3,4,6

Notes:

1. 2.4mm Female Connectors,
2. PCB Material: Roger RO4350B or equivalent,
   Dielectric constant=3.5, Thickness=0.0066 inch

Mini-Circuits®

Mini-Circuits

Environmental Specifications ENV08T1

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 or -45° to 85° C or -55° to 105° C or -40° to 105° C or -40° to 95° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
HTOL	1000 hours at 125°C	MIL-STD-883, Method 1005, Condition B
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Mechanical Shock	1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only	MIL-STD-883, Method 2002, Condition B, except Y1 direction only
Vibration (Variable Frequency)	50g peak	MIL-STD-883, Method 2007, Condition B
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102, Condition C
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak	J-STD-020

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
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