

## Product Features

- Wideband, DC to 1 GHz
- Exact footprint substitute for Avago's MSA-0486
- Internally Matched to 50 Ohms
- Unconditionally stable
- Protected by US Patent, 6,943,629



Generic photo used for illustration purposes only

## Typical Applications

- Cellular
- Instrumentation
- VHF/UHF transmitters/receivers

## MAR-4SM+

CASE STYLE: WW107

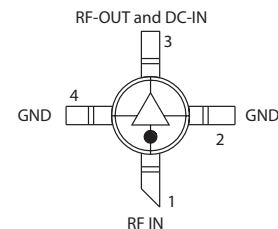
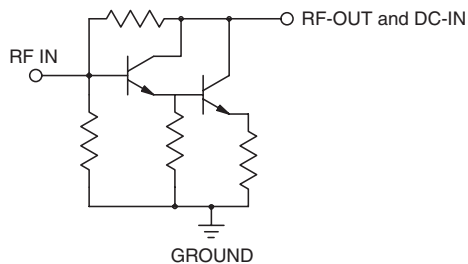
### +RoHS Compliant

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

## General Description

MAR-4SM+ (RoHS compliant) is a wideband amplifier offering high dynamic range. It has repeatable performance from lot to lot. It is enclosed in a Micro-X package. MAR-4SM+ uses Darlington configuration and is fabricated using InGaP HBT technology. Expected MTTF is 900 years at 85°C case temperature.

## simplified schematic and pin description



Function	Pin Number	Description
RF IN	1	RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
RF-OUT and DC-IN	3	RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit".
GND	2,4	Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.

### 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/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)



## Electrical Specifications at 25°C and 50mA, unless noted

Parameter	Min.	Typ.	Max.	Units	
Frequency Range*	DC		1	GHz	
Gain	f=0.1 GHz f=1 GHz	— 7.0 <sup>2</sup>	8.3 8.0	— —	dB
Input Return Loss	f=DC to 1 GHz		14		dB
Output Return Loss	f=DC to 1 GHz		10		dB
Output Power @ 1 dB compression	f= 1 GHz		+12.5		dBm
Output IP3	f=1 GHz		+25.5		dBm
Noise Figure	f=1 GHz		6.0		dB
Recommended Device Operating Current			50		mA
Device Operating Voltage			5.25		V
Device Voltage Variation vs. Temperature at 50 mA			-2.2		mV/°C
Device Voltage Variation vs. Current at 25°C			23.0		mV/mA
Thermal Resistance, junction-to-case <sup>1</sup>			157		°C/W

\*Guaranteed specification DC-1 GHz. Low frequency cut off determined by external coupling capacitors.

## Absolute Maximum Ratings

Parameter	Ratings
Operating Temperature	-40°C to 85°C
Storage Temperature	-55°C to 100°C
Operating Current	85mA
Power Dissipation	500mW
Input Power	13dBm

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

These ratings are not intended for continuous normal operation.

<sup>1</sup>Case is defined as ground leads.

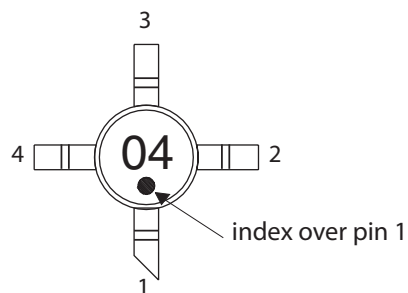
<sup>2</sup>Full temperature range.

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Product Marking



Markings in addition to model number designation may appear for internal quality control purposes.

Additional Detailed Technical Information

Additional information is available on our web site. To access this information enter the model number on our web site home page.

Performance data, graphs, s-parameter data set (.zip file)

Case Style: WW107

Plastic micro-x, .085 body diameter, lead finish: Matte-Tin

Tape & Reel: F4

7" Reels with 20, 50, 100, 200, 500, 1K devices

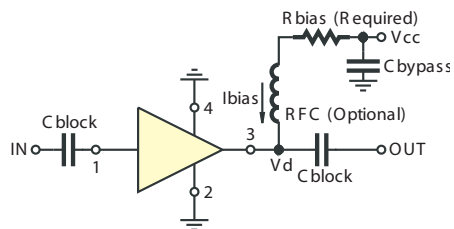
13" Reels with 2K, 4K devices

Suggested Layout for PCB Design: PL-253

Evaluation Board: TB-411-4+

Environmental Ratings: ENV08T3

Recommended Application Circuit



Test Board includes case, connectors, and components (in bold) soldered to PCB

R BIAS	
Vcc	"1%" Res. Values (ohms) for Optimum Biasing
7	34.8
8	54.9
9	75
10	95.3
11	115
12	133
13	154
14	174
15	196

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**ESD Rating**

Human Body Model (HBM): Class 1B (500 v to < 1000 v) in accordance with ANSI/ESD STM 5.1 - 2001

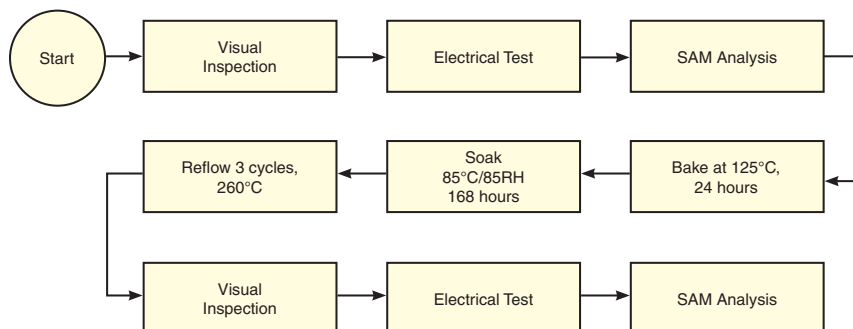
Machine Model (MM): Class M1 (<100 v) in accordance with ANSI/ESD STM 5.2 - 1999

**MSL Rating**

Moisture Sensitivity: MSL1 in accordance with IPC/JEDECJ-STD-020C

No.	Test Required	Condition	Standard	Quantity
1	Visual Inspection	Low Power Microscope Magnification 40x	MIP-IN-0003 (MCT spec)	45 units
2	Electrical Test	Room Temperature	SCD (MCL spec)	45 units
3	SAM Analysis	Less than 10% growth in term of delamination	J-Std-020C (Jedec Standard)	45 units
4	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-020C (Jedec Standard)	45 units

**MSL Test Flow Chart**



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# MMIC Amplifier

# MAR-4SM+

## Typical Performance Data

FREQUENCY (MHz)	GAIN (dB) 50 mA	ISOLATION (dB) 50 mA	RETURN LOSS IN (dB) 50 mA	RETURN LOSS OUT (dB) 50 mA
1	8.45	16.09	38.70	28.85
25	8.45	16.04	38.91	27.67
50	8.41	16.06	39.15	27.93
100	8.39	16.06	36.95	27.14
200	8.34	16.06	32.68	27.20
300	8.31	16.05	29.07	26.14
400	8.25	16.00	27.16	23.91
500	8.19	15.95	25.18	23.51
600	8.12	15.89	23.11	22.95
700	8.04	15.83	22.17	20.48
800	7.94	15.75	20.79	19.93
900	7.85	15.69	19.24	20.30
1000	7.73	15.60	18.77	17.80
1100	7.59	15.53	17.75	17.20
1200	7.50	15.43	16.60	18.04
1300	7.36	15.34	16.41	15.60
1400	7.21	15.29	15.53	15.17
1500	7.09	15.19	14.67	16.06
1600	6.93	15.12	14.64	13.89
1700	6.75	15.08	13.87	13.52
1800	6.65	14.97	13.24	14.45
1900	6.48	14.93	13.28	12.62
2000	6.27	14.91	12.60	12.20
2100	6.18	14.77	12.13	13.32
2200	6.00	14.76	12.25	11.68
2300	5.78	14.77	11.56	11.07
2400	5.71	14.63	11.13	12.58
2500	5.50	14.63	11.34	10.82
2600	5.28	14.65	10.75	10.23
2700	5.24	14.47	10.39	12.19
2800	5.01	14.52	10.62	10.14
2900	4.74	14.63	10.02	9.58
3000	4.74	14.43	9.86	12.08
3100	4.51	14.50	10.12	9.52
3200	4.25	14.55	9.53	9.11
3500	3.70	14.62	9.13	8.78
4000	2.93	14.64	8.98	7.81

REV. X2  
MAR-4SM+  
071113  
Page 1 of 1



IF/RF MICROWAVE COMPONENTS • ISO 9001 ISO 14001 AS 9100 CERTIFIED • RoHS compliant

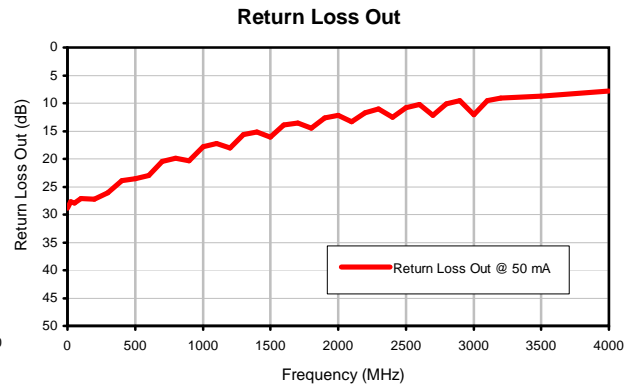
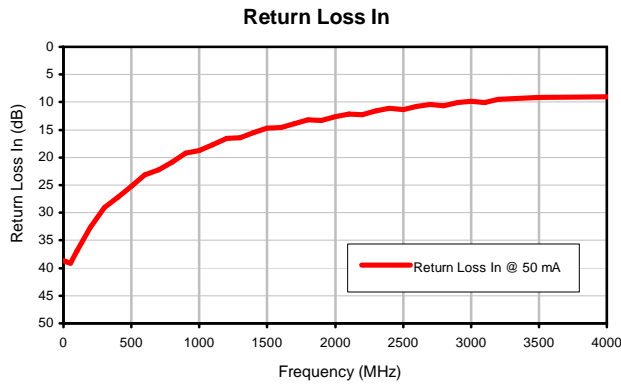
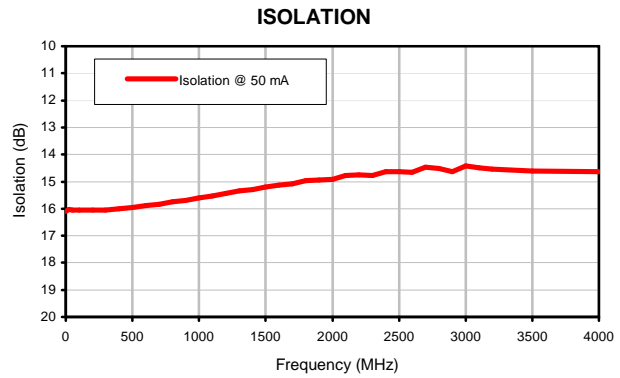
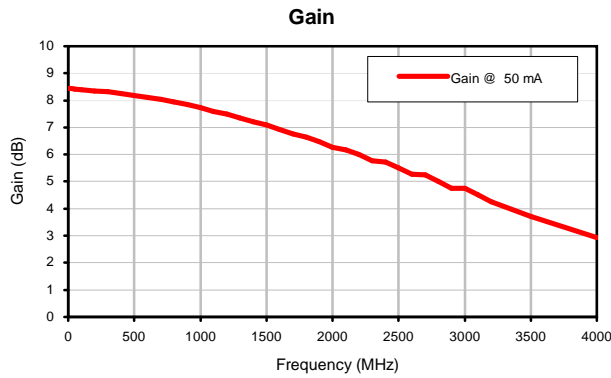
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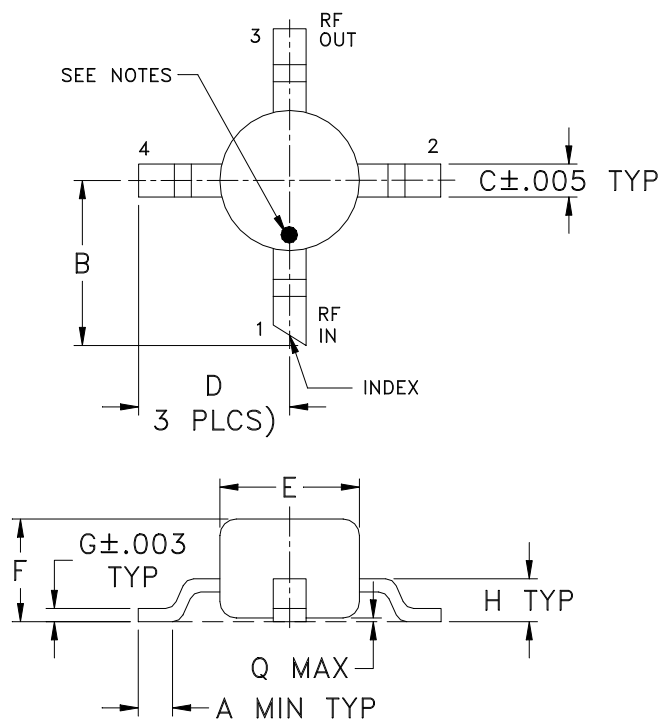
The Design Engineers Search Engine finds the model you need, Instantly • For detailed performance specs & shopping online see



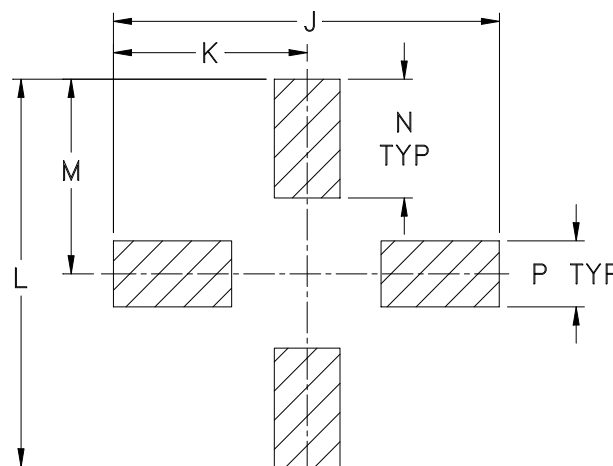
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



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

CASE#	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	WT. GRAMS
WW107	.012 (0.30)	.10 (2.54)	.020 (0.51)	.092 (2.34)	.085 (2.16)	.060 (1.52)	.007 (0.18)	.026 (0.66)	.235 (5.97)	.118 (3.00)	.235 (5.97)	.118 (3.00)	.072 (1.83)	.040 (1.02)	.020 (0.51)	.015

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .03$ ; 3 Pl.  $\pm .015$

#### Notes:

- Case material: Plastic.
- Termination finish:  
For RoHS Case Styles: Matte tin Plate.  
For RoHS-5 Case Styles: Tin-Lead plate.
- RF input termination (1) identified by one or both of the following at factory option:
  - diagonally cut termination, which may be  $45^\circ$  (ref) in either direction;
  - orientation mark on the case. Model dash number is identified by color dot or alphanumeric code on case. See specification data sheet.



INTERNET <http://www.minicircuits.com>

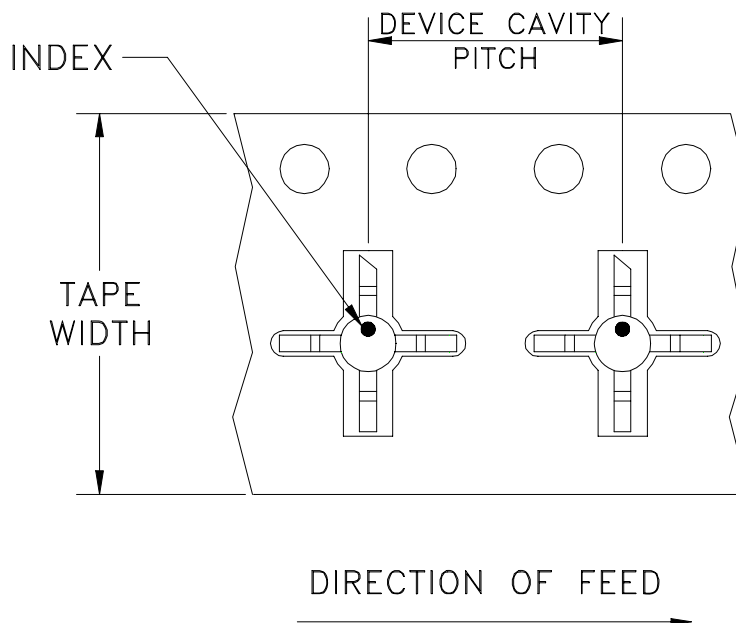
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# Tape & Reel Packaging TR-F4

## DEVICE ORIENTATION IN T&R



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel	
12	8	7	Small quantity standards (see note)	20
				50
				100
				200
				500
		7	Standard	1000

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.

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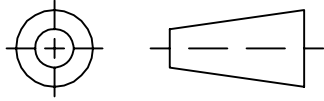
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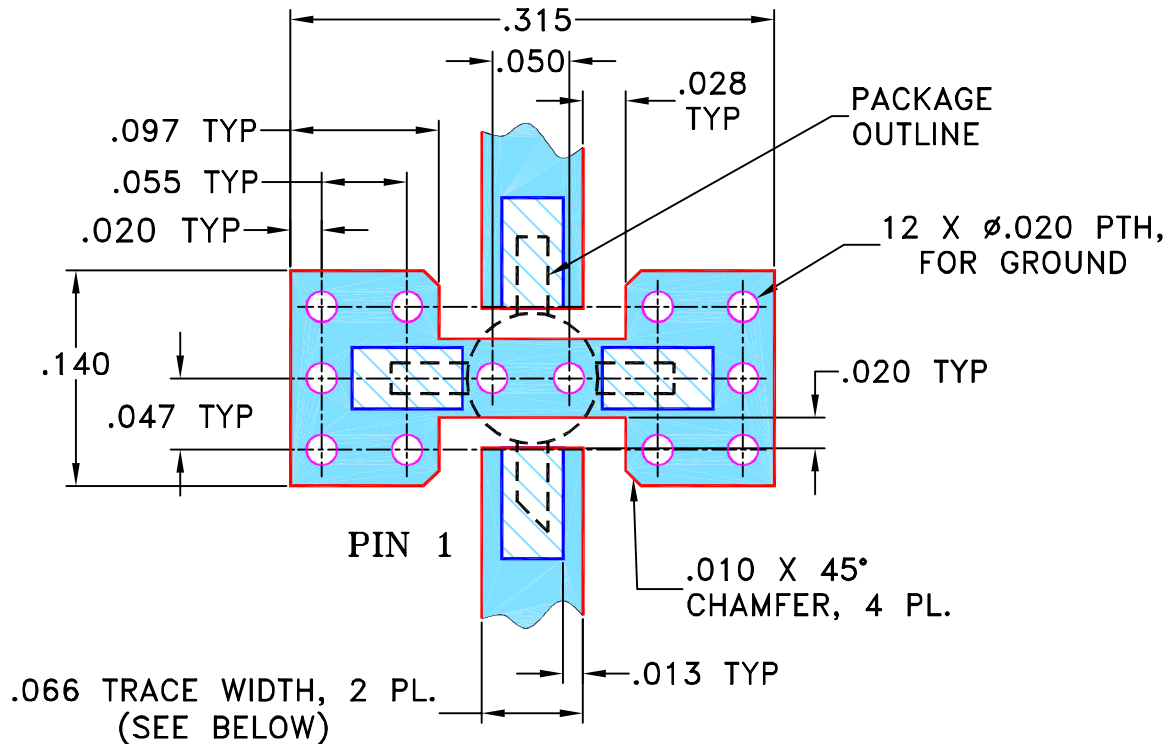
THIRD ANGLE PROJECTION



REVISIONS

REV OR	ECN No.	DESCRIPTION	DATE	DR	AUTH
	M108436	NEW RELEASE	11/14/06	PW	IG

SUGGESTED MOUNTING CONFIGURATION FOR WW107 CASE STYLE, "cb" PIN CONNECTION



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" ± .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.
3. IF PCB DESIGN RULES ALLOW, PLACE GROUND VIAS UNDER THE LAND PATTERN FOR BETTER RF PERFORMANCE. OTHERWISE PLACE GROUND VIAS AS CLOSE TO LAND PATTERN AS POSSIBLE.

- 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 ± 3 PL DECIMALS ± .005 ANGLES ± FRACTIONS ±	DRAWN	PW 11/11/06
	CHECKED	IL 11/14/06
	APPROVED	IG 11/14/06

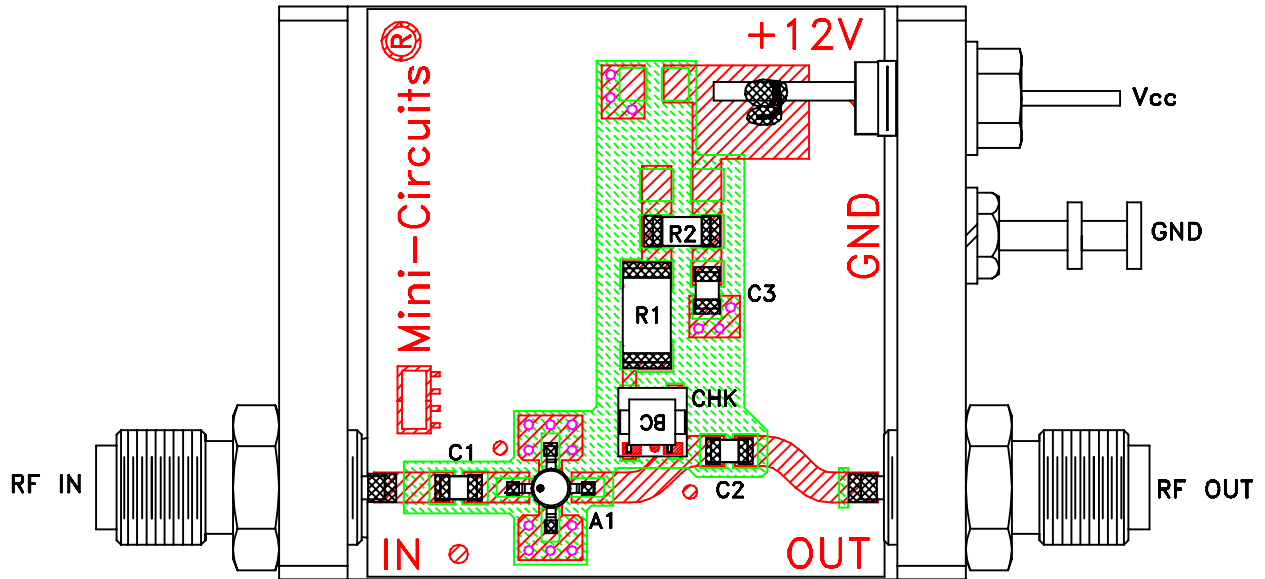
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PL, cb, WW107, MAR, TB-411-XX+

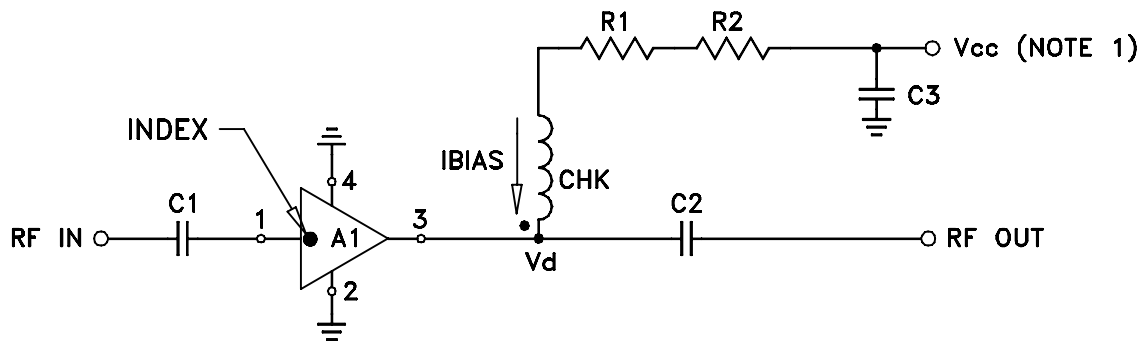
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SIZE A	CODE IDENT 15542	DRAWING NO: 98-PL-253	REV: OR
FILE: 98PL253	SCALE: 8:1	SHEET: 1 OF 1	

# Evaluation Board and Circuit



TB-411-4+




COMPONENT	VALUE
A1	MAR-4SM(+)
C1 (NOTE 4)	2400 pF
C2 (NOTE 4)	2400 pF
C3 (bypass)	0.1 uF
R1	133 Ohms, 0.75W
R2	2.21 Ohms, 0.25W
CHK	Mini-Circuits TCCH-80+

Schematic Diagram

**NOTE:**

1. Vcc voltage: +12±0.2V.
2. SMA Female connectors.
3. PCB material: Rogers R04350 or equivalent, dielectric constant=3.5, dielectric thickness=.030 inch.
4. Capacitors, C1 & C2 should be free of resonance up to the highest frequency specified.

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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
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
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether +	MIL-STD-202, Method 215



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Specification	Test/Inspection Condition	Reference/Spec
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monoethanolamine at 63°C to 70°C