MMIC SURFACE MOUNT

Monolithic Amplifier

MAR-4+

50Ω DC to 1 GHz

FEATURES

- Wideband, DC to 1 GHz
- High IP3, +25.5 dBm Typ.
- Internally Matched to 50Ω
- Low Noise Figure, 7.0 dB Typ.
- Exact Footprint Substitute for MSA-0485
- Cascadable, Unconditionally Stable
- Aqueous Washable
- Protected by US Patent 6,943,629

Generic photo used for illustration purposes only

CASE STYLE: VV105

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

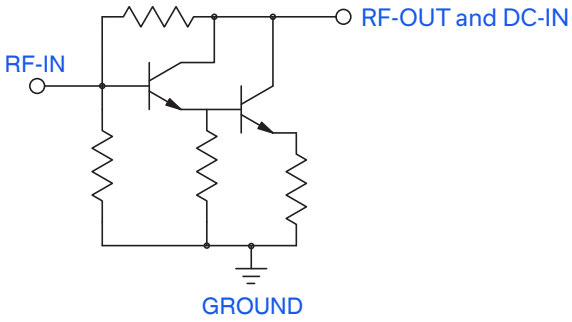
APPLICATIONS

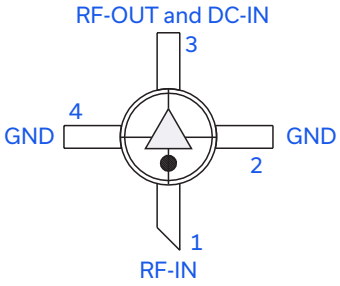
- Cellular
- PCN Instrumentation

PRODUCT OVERVIEW

MAR-4+ (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-4+ uses Darlington configuration and is fabricated using InGaP HBT technology. Expected MTTF is 1,000 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.

REV. D
ECO-024824
MAR-4+
MCL NY
250311

Monolithic Amplifier

MAR-4+

50Ω DC to 1 GHz

ELECTRICAL SPECIFICATIONS AT +25°C AND 50 mA UNLESS NOTED OTHERWISE

Parameter	Conditions (GHz)	Min.	Typ.[1]	Max.	Units
Frequency Range[2]		DC		1	GHz
Gain	0.1 1	 7.0[3]	8.3 8.0		dB
Input Return Loss	DC - 1		14		dB
Output Return Loss	DC - 1		10		dB
Output Power @ 1 dB Compression	1		+12.5		dBm
Output IP3	1		+25.5		dBm
Noise Figure	1		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		mV/mA
Thermal Resistance, Junction-to-Case[4]			152		°C/W

1. Based on test data of Model MAR-4SM+ (Case Style WW107).
2. Guaranteed specification DC-1 GHz. Low frequency cut off determined by external coupling capacitors.
3. Full temperature range.
4. Case is defined as ground leads.

ABSOLUTE MAXIMUM RATINGS

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

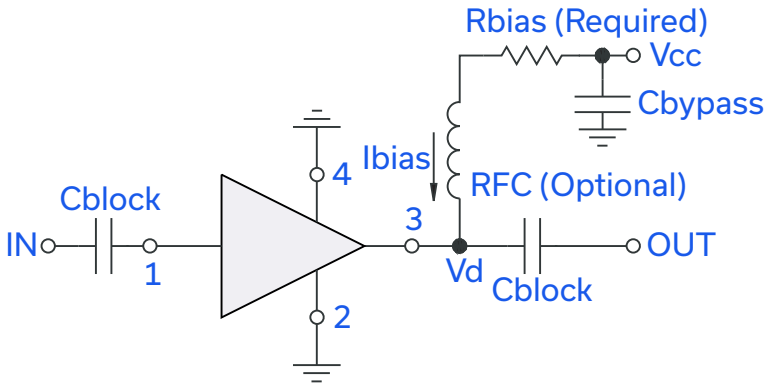
Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.

Monolithic Amplifier

MAR-4+

50Ω DC to 1 GHz

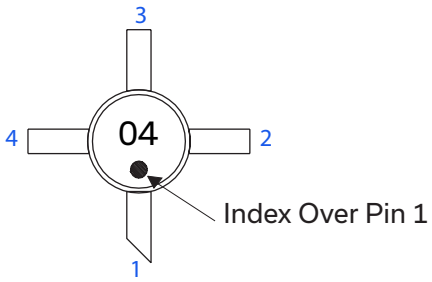
RECOMMENDED APPLICATION CIRCUIT



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

PRODUCT MARKING



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

Monolithic Amplifier

MAR-4+

50Ω DC to 1 GHz

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

Performance Data & Graphs	Data Table Swept Graphs S-Parameter Data Set (.zip file)
Case Style	VV105 Plastic micro-x package, 0.085 body diameter, Lead Finish: Matte-Tin
Tape & Reel	F4
Suggested Layout for PCB Design	PL-262
Evaluation Board	TB-432-4+
Environmental Ratings	ENV08T3

ESD RATING

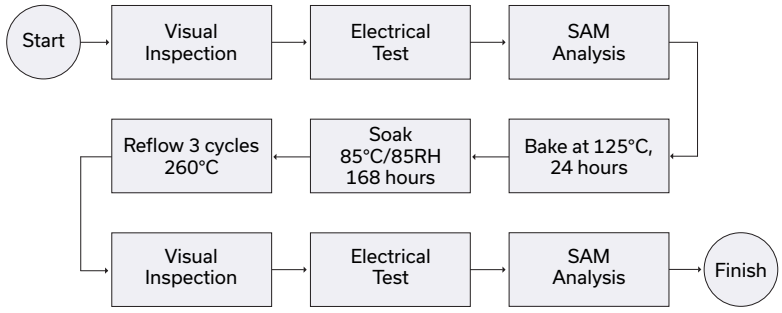
Human Body Model (HBM): Class 1B (500 V to < 1000 V) in accordance with ANSI/ESD STM 5.1 - 2001
Machine Model (MM): Class M1 (< 100 V) in accordance with ANSI/ESD STM 5.2 - 1999

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



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.
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 Amplifier MAR-4+

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

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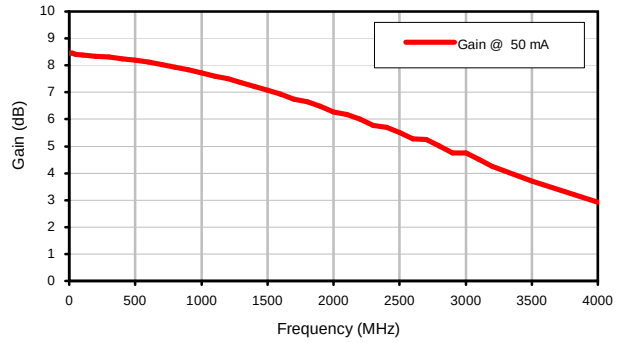
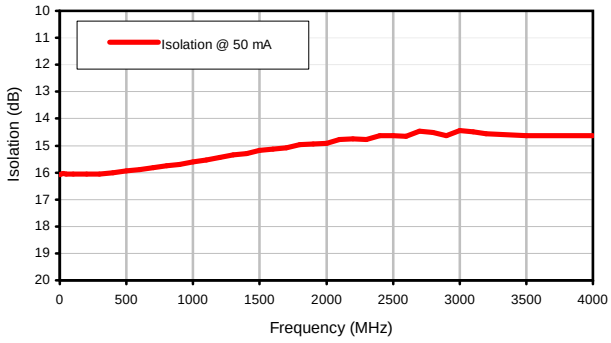
Typical Performance Curves

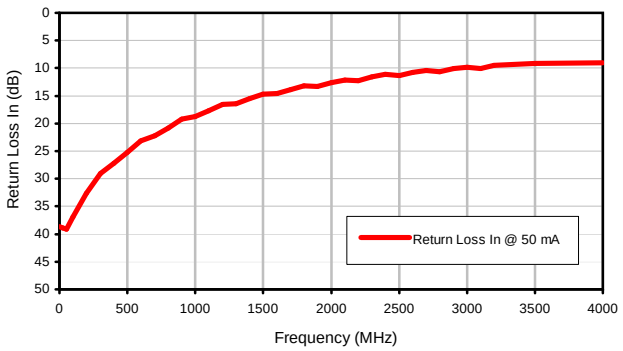
Gain



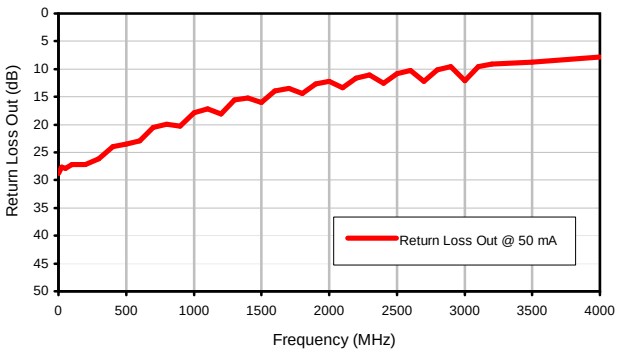
ISOLATION



Return Loss In



Return Loss Out



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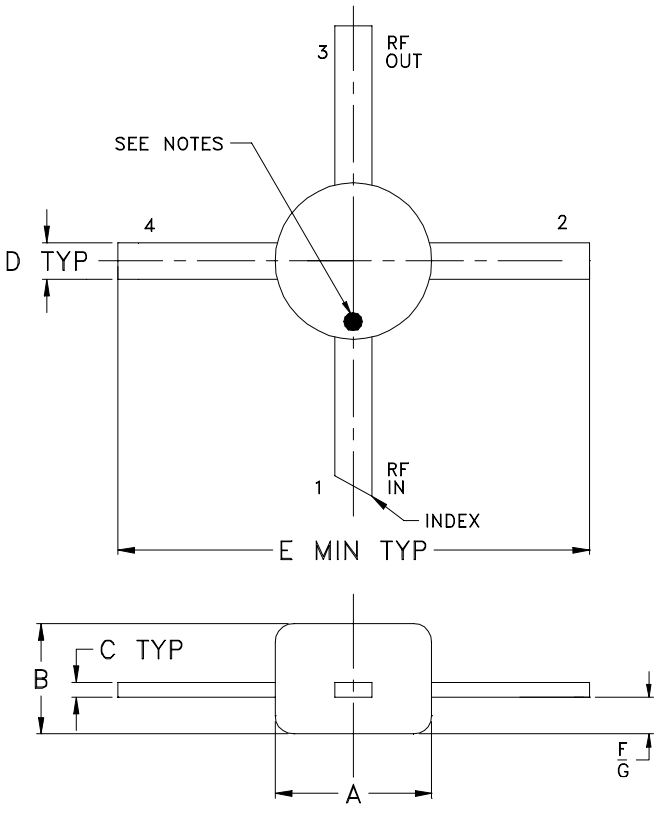
Case Style VV

VV105

Outline Dimensions



CASE#	A	B	C	D	E	F	G	WT.GRAMS
VV105	.085 (2.16)	.060 (1.52)	.008 (0.20)	.020 (0.51)	.250 (6.35)	.012 (0.30)	.025 (0.64)	.015

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

Notes:

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier.
   For RoHS-5 Case Styles: Tin-Lead plate.
3. RF input termination (1) identified by one or both of the following at factory option:
   (a) diagonally cut termination, which be 45° (ref) in either direction;
   (b) orientation mark on the case. Model dash number is identified by color dot or alphanumeric code on case. See specification data sheet.
4. Special Tolerances: Termination width ± .005 inch, termination thickness ± .003 inch.

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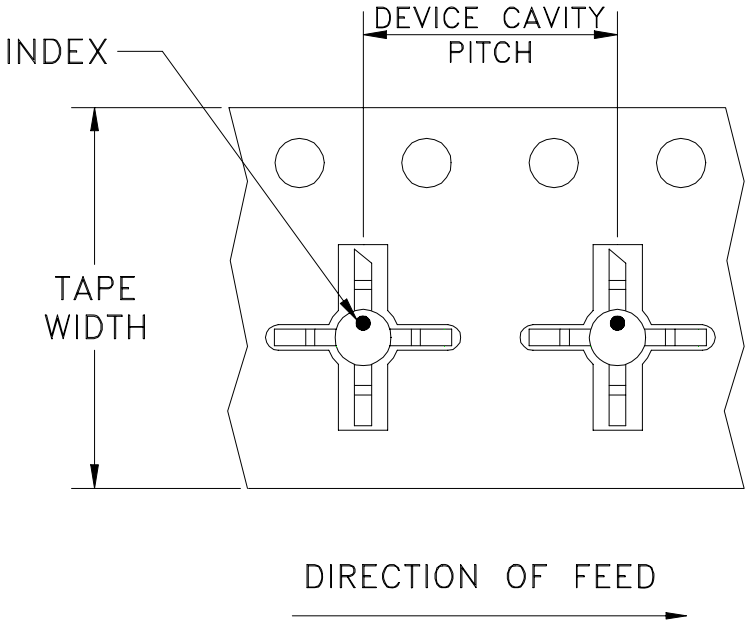
Tape & Reel Packaging TR-F4

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.

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

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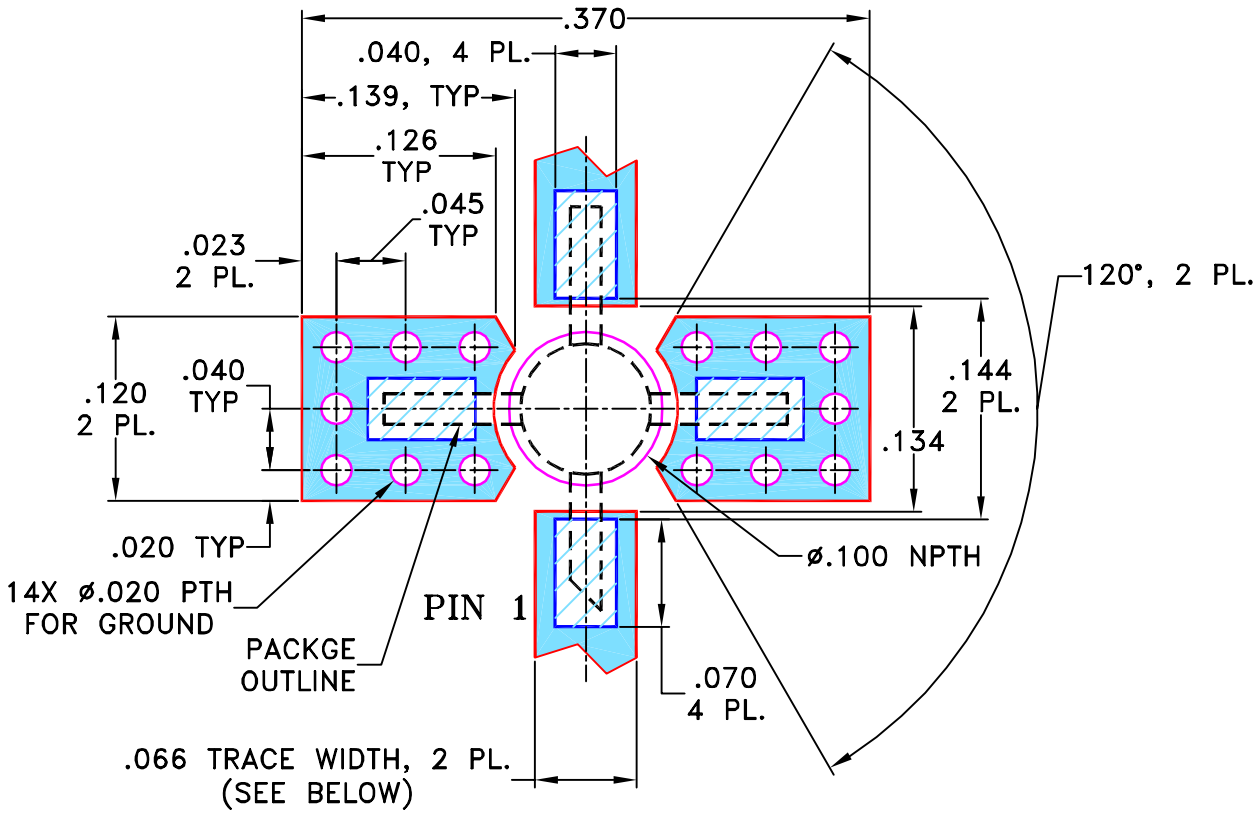
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M109082	NEW RELEASE	12/29/06	AV	IG

SUGGESTED MOUNTING CONFIGURATION FOR VV105 CASE STYLE, "cb" PIN CONNECTION



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B 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.

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	AV	12/28/06
TOLERANCES ON:	CHECKED	IL	12/29/06
2 PL DECIMALS ±	APPROVED	IG	12/29/06
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

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

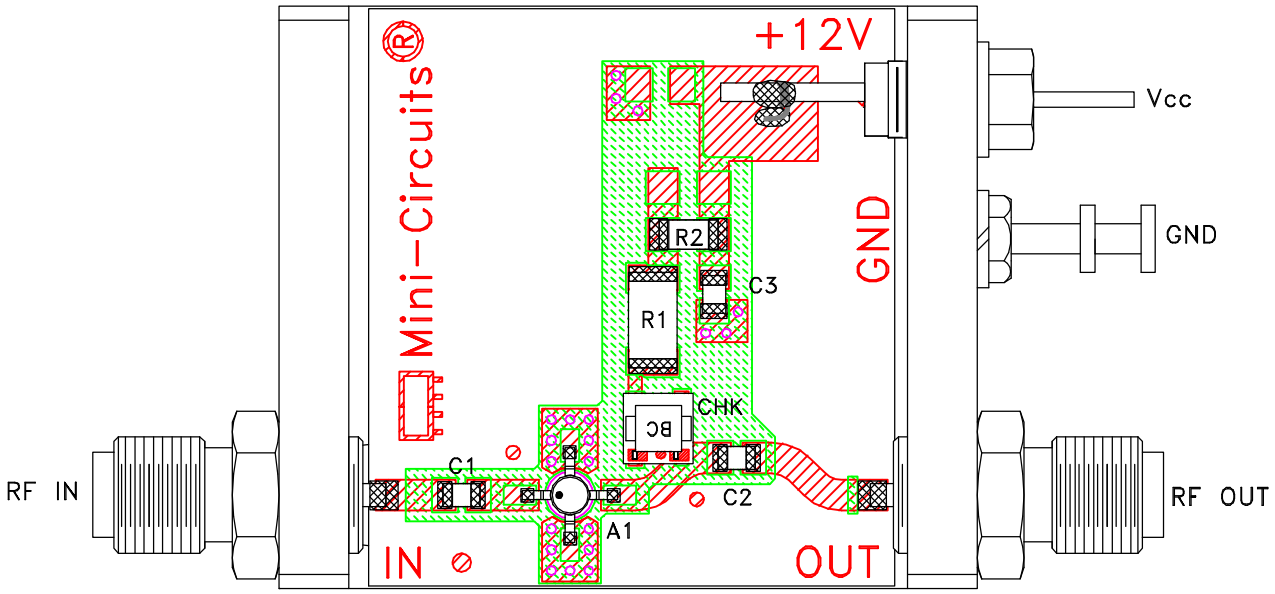
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, cb, VV105, MAR, TB-432-X+

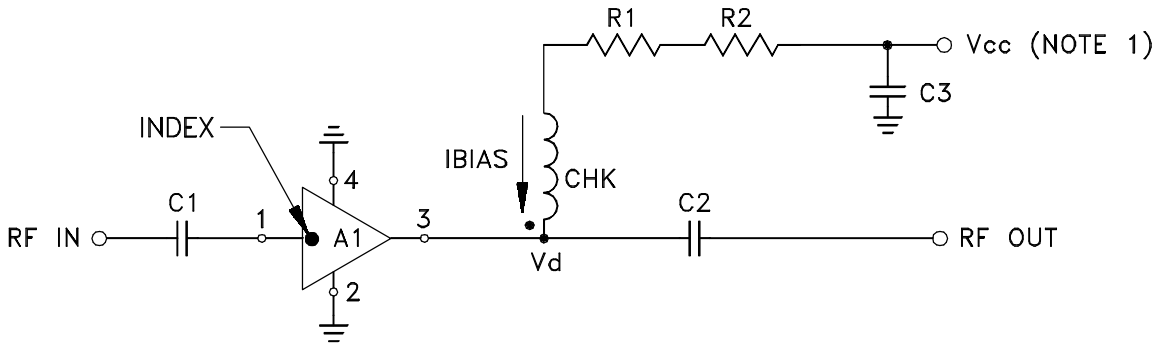
SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-262	OR

FILE:	SCALE:	SHEET:
98PL262	8:1	1 OF 1

Evaluation Board and Circuit



TB-432-4+



COMPONENT	VALUE
A1	MAR-4(+)
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 RO4350 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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Environmental Specifications ENV08T3

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
	monoethanolamine at 63°C to 70°C	

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