MAAM-010355

CATV Power Doubler
45 - 1200 MHz

Rev. V1

Features

- 24 dB Gain
- 24 V DC Bias
- 59 dBmV/Ch. Output Power @ 1 GHz
- Very Low Distortion
- Adjustable DC I_{DD} for optimal efficiency
- Lead-Free TSSOP-16LD-EP package
- Halogen-Free "Green" Mold Compound
- RoHS* Compliant

Description

The MAAM-010355 is a GaAs MMIC amplifier in a lead-free TSSOP 16-lead exposed ground pad plastic package. The MMIC design is configured as two stages of differential amplifiers for broadband performance. It is optimized for exceptionally low distortion and noise figure in a 75 Ω push-pull amplifier circuit. It provides excellent input and output return loss over the 45 to 1200 MHz band. DC current can be adjusted with an external resistor to optimize power consumption with RF output level.

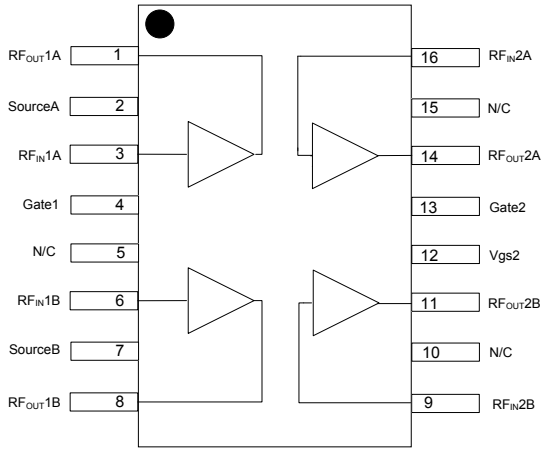
The device is ideally suited for use in cable infrastructure access equipment where very low distortion and high output power are required.

Ordering Information[1,2]

Part Number	Package
MAAM-010355-000000	bulk packaging
MAAM-010355-TR1000	1000 piece reel
MAAM-010355-TR2500	2500 piece reel
MAAM-010355-001SMB	sample test board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

Functional Schematic



Pin Configuration[3]

Pin No.	Pin Name	Description
1	$RF_{OUT}1A$	Amp1 RF out+
2	SourceA	Amp1 DC Bias+
3	$RF_{IN}1A$	Amp1 RF in+
4	Gate1	Amp Current Adjust
5	N/C	No Connection
6	$RF_{IN}1B$	Amp1 RF in-
7	SourceB	Amp1 DC Bias-
8	$RF_{OUT}1B$	Amp1 RF out-
9	$RF_{IN}2B$	Amp2 RF in-
10	N/C	No Connection
11	$RF_{OUT}2B$	Amp2 RF out-
12	Vgs2	Amp2 DC Bias
13	Gate2	Amp2 Bias Adjust
14	$RF_{OUT}2A$	Amp2 RF out+
15	N/C	No Connection
16	$RF_{IN}2A$	Amp2 RF in+
17	Paddle[4]	Ground

3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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Electrical Specifications: T_A = +25°C, V_{DD} = 24 V, Z_0 = 75 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	45 MHz 1000 MHz 1200 MHz	dB	22.0 23.0 23.0	22.5 23.5 24.0	—
Gain Slope	45 - 1000 MHz 45 - 1200 MHz	dB	—	+1.0 +1.3	—
Noise Figure	1000 MHz 1200 MHz	dB	—	4.5 5.1	—
Reverse Isolation	—	dB	—	37	—
Input Return Loss	45 - 1000 MHz 1000 - 1200 MHz	dB	15.5 —	18.0 15.0	—
Output Return Loss	45 –1000 MHz 1000 –1200 MHz	dB	18 17	20 19	—
CTB	Vo = 59 dBmV @ 1000 MHz, 18 dB Tilt[5] Vo = 55 dBmV @ 1000 MHz, 18 dB Tilt[5] Vo = 58 dBmV @ 1000 MHz, 15 dB Tilt[6]	dBc	—	-77 -82 -77	-70 — —
CSO	Vo = 59 dBmV @ 1000 MHz, 18 dB Tilt[5] Vo = 55 dBmV @ 1000 MHz, 18 dB Tilt[5] Vo = 58 dBmV @ 1000 MHz, 15 dB Tilt[6]	dBc	—	-75 -79 -75	-68 — —
XMOD	Vo = 59 dBmV @ 1000 MHz, 18 dB Tilt[5]	dBc	—	-70	—
CCNR	Vo = 59 dBmV @ 1000 MHz, 18 dB Tilt[5]	dBc	52	58	—
OIP3	6 MHz Spacing, +15 dBm P_{OUT} per tone @ 1000 MHz	dBm	—	46	—
OIP2	6 MHz Spacing, +15 dBm P_{OUT} per tone @ 1000 MHz	dBm	—	56	—
P1dB	1000 MHz	dBm	—	30.5	—
I_{DD}[7]	24 Volts	mA	—	440	480

5. 79 NTSC (analog) channels + 75 ATSC (digital) channels (-6 dB offset); tilt extrapolated to 18.0 dB @ 1000 MHz.
6. 79 NTSC (analog) channels + 75 ATSC (digital) channels (-6 dB offset); tilt extrapolated to 15.5 dB @ 1000 MHz.
7. I_{DD} set with external resistors as shown in application schematic.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

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Maximum Operating Conditions[8]

Parameter	Maximum Operating Condition
RF Input Power	5 dBm
Voltage	24 V
Junction Temperature[9]	+160°C

8. These operating conditions will ensure MTTF > 1 x 10^6 hours.
9. Junction Temperature (T_J) = Case Temperature (T_C) + Θjc*(V*I)
   Typical thermal resistance (Θ_{JC}) = 3.8 °C/W.
   a) For T_C = 25°C,
   T_J = 66°C @ 24 V, 445 mA
   b) For T_C = 100°C,
   T_J = 141°C @ 24 V, 445 mA

Absolute Maximum Ratings[10,11]

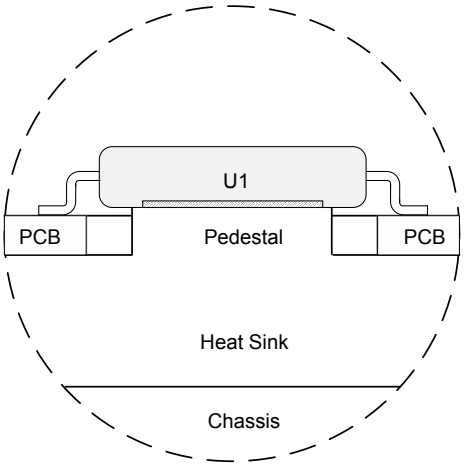
Parameter	Absolute Maximum
RF Input Power	12 dBm
Voltage	30 V
Storage Temperature	-65°C to +150°C

10. Exceeding any one or combination of these limits may cause permanent damage to this device.
11. MACOM does not recommend sustained operation near these survivability limits.

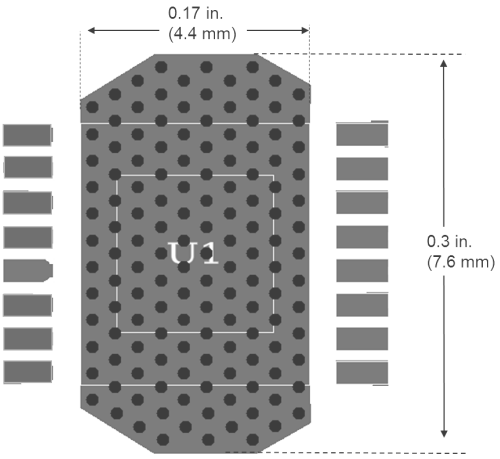
Printed Circuit Board (PCB) Thermal Design

To maintain reliable junction temperatures for this high power amplifier the printed circuit board must provide low thermal resistance to the exposed paddle of the IC package. Two PCB thermal solutions are presented below. In general, thinner substrates and thicker plating for vias provide lower thermal resistance. Calculation of case temperature must include temperature rise in PCB. For additional details and support please contact ***https://www.macom.com/support***

PCB Cut-Out with Thermal Pedestal



Thermal Via Array, 62-mil PCB



139 total vias.
Vias plated to 2-mil (50 µm) thickness of copper.
Finished via diameter 10 mils (0.25 mm).
Via spacing 20 mils (0.51 mm).
2.8-mil (70 µm) thick copper for top and bottom metal.
PCB thermal resistance (Θ_{PCB}) = 1.7 °C/W, measured.

For base temperature (T_B) = +85°C, 24 V & 445 mA,
$T_J = T_B + (\Theta_{PCB} + \Theta_{JC}) * V * I$ = +144°C

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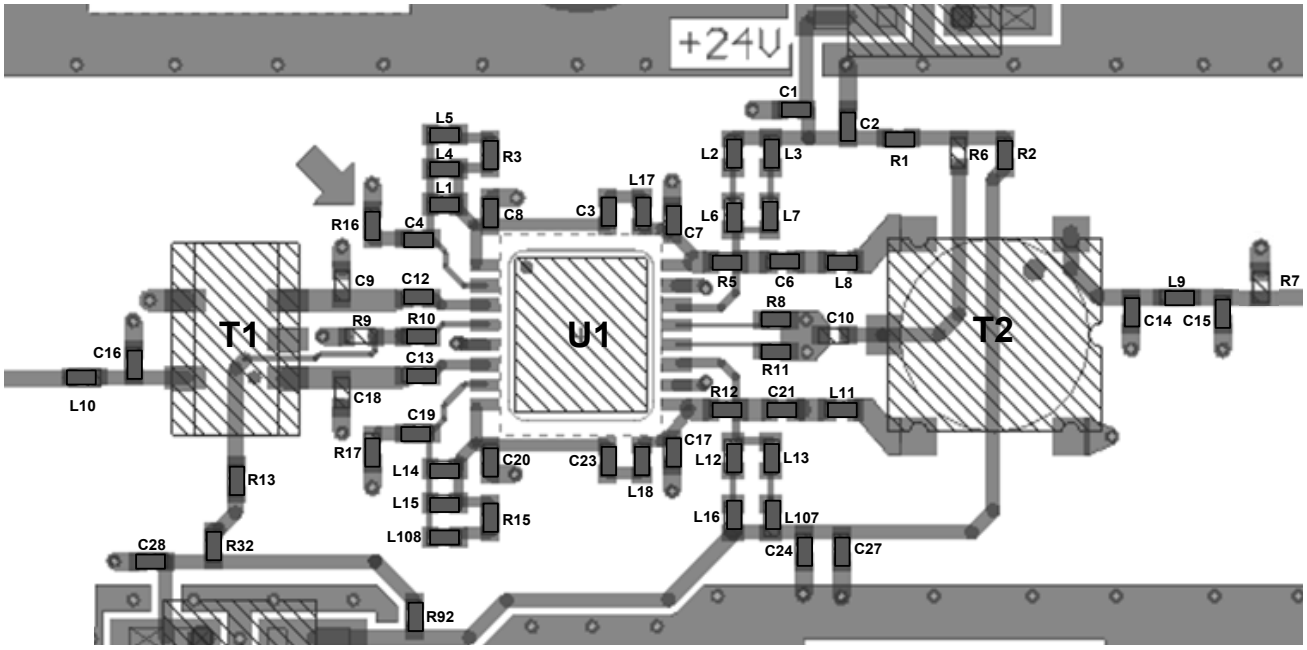
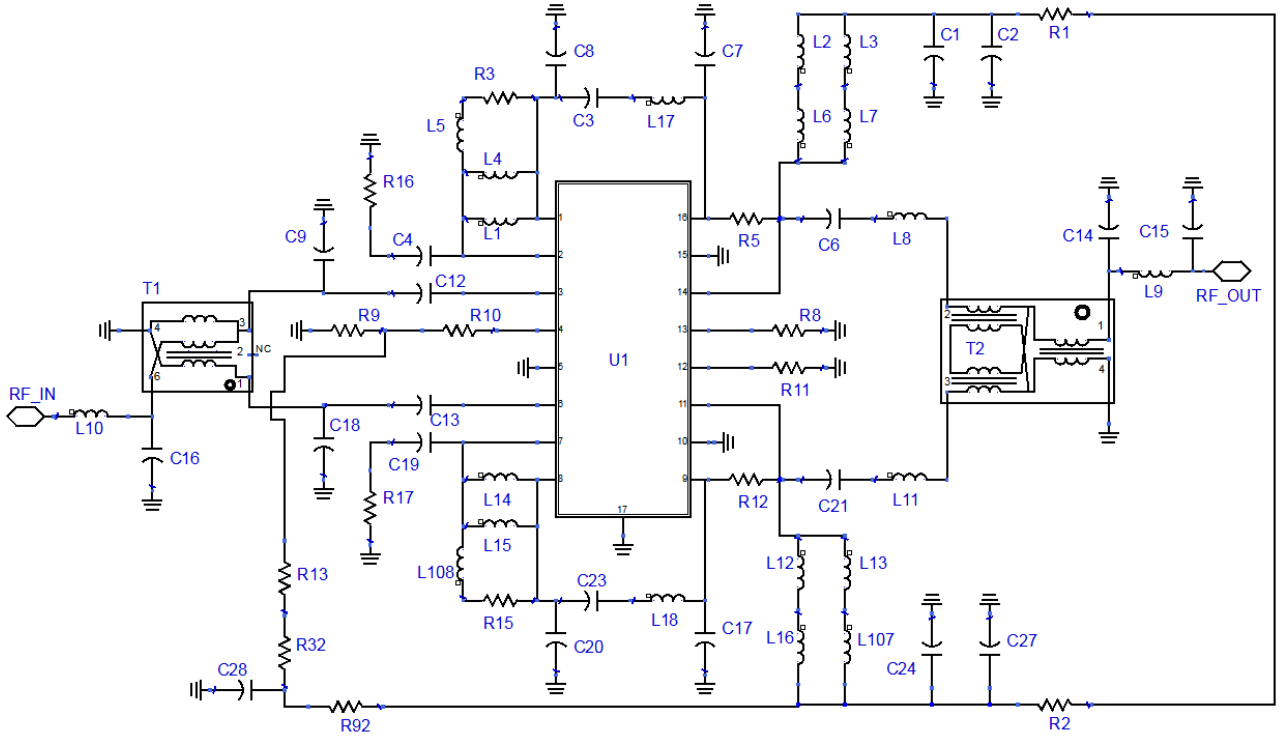
Recommended PCB Layout



Application Schematic



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Recommended Off-Chip Component Values

Component	Value	Package	Vendor	Part Number
C1, C3, C4, C12, C13, C19, C23, C24, C28	10 nF	0402	MURATA	GRM155R71H103KA88D
C2, C27	0.1 µF	0402	TDK	C1005X7R1H104M050BB
C6, C21	330 pF	0402	MURATA	GRM1555C1H331JA01D
C7, C17	1.3 pF	0402	AVX	Accu-P 04023J1R3ABS
C8, C20	2.5 pF	0402	MURATA	GRM1555C1H2R5BA01D
C14	0.65 pF	0402	AVX	Accu-P 04023JR65PBS
C15	0.75 pF	0402	AVX	Accu-P 04023JR75PBS
C16	0.35 pF	0402	AVX	Accu-P 04025JR35QBS
L1, L4, L14, L15, L6, L7, L12, L13	1800 Ω	0402	MURATA	BLM15HD182SN1D
L2, L3, L16, L107	1000 Ω	0402	MURATA	BLM15HG102SN1D
L5, L108	82 nH	0402	TOKO	LL1005-FH82NJ
L8, L11	2.7 nH	0402	COILCRAFT	0402CS_2N7XJL
L9	8.2 nH	0402	COILCRAFT	0402CS_8N2XJL
L10	4.7 nH	0402	COILCRAFT	0402CS_4N7XJL
L17, L18	3.3 nH	0402	COILCRAFT	0402CS_3N3XJL
R1, R2, R32, R92	0 Ω	0402	PANASONIC	ERJ-2GE0R00X
R3, R15	100 Ω	0402	PANASONIC	ERJ-2RKF1000X
R5, R12	464 Ω	0402	PANASONIC	ERJ-2RKF4640X
R8	2.32 kΩ	0402	PANASONIC	ERJ-2RKF2321X
R10	560 Ω	0402	PANASONIC	ERJ-2RKF5600X
R11	2.7 kΩ	0402	PANASONIC	ERJ-2GEJ272X
R13	243 Ω	0402	PANASONIC	ERJ-2RKF2430X
R16, R17	10 Ω	0402	PANASONIC	ERJ-2RKF10R0X
F Connector	75 Ω	—	TROMPETER	CBJE130-2
Balun T1	1:1	—	MACOM	MABA-010321-CT1A42
Balun T2	1:3	—	MACOM	MABA-011045
R6, R7, R9, C9, C10, C18	Not Populated	—	—	—

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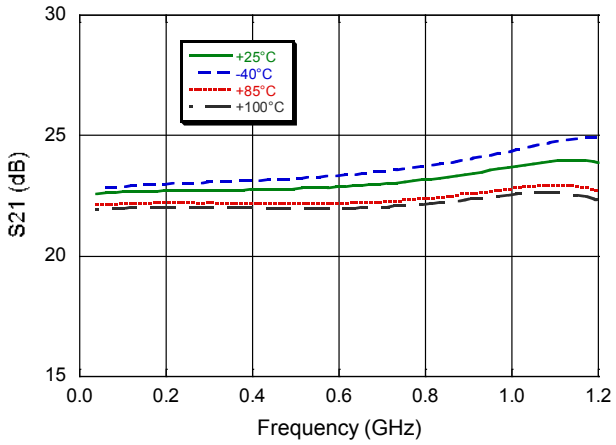
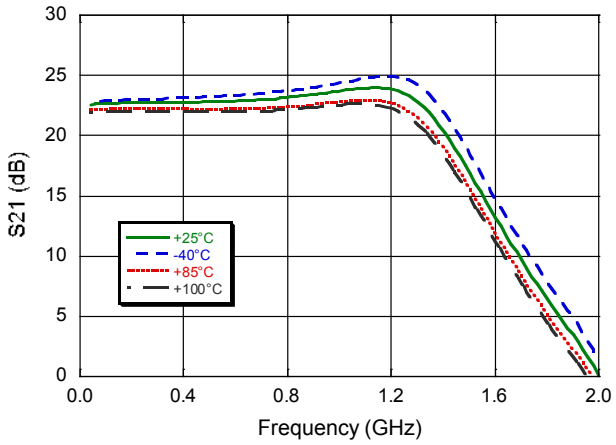
Typical Performance Curves

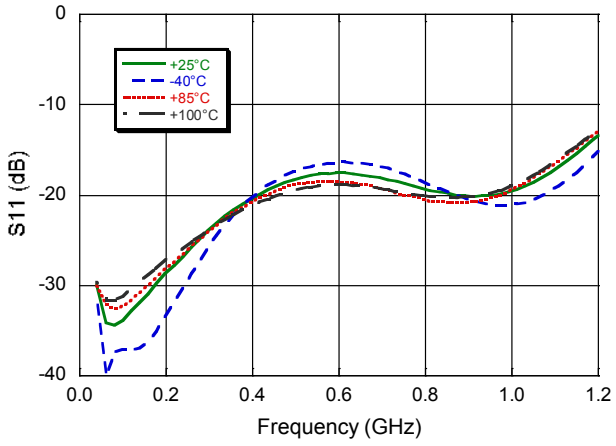
Gain



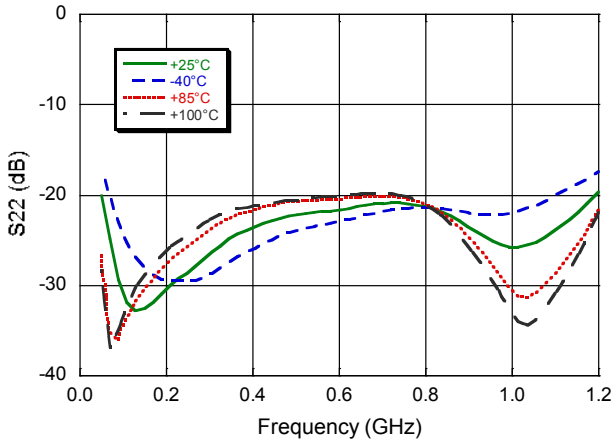
Gain to 2 GHz



Input Return Loss



Output Return Loss



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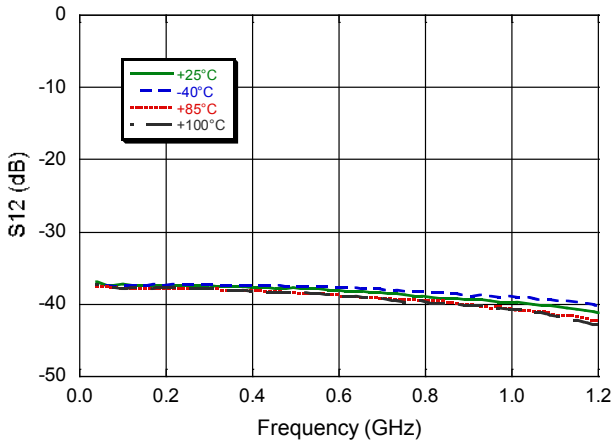
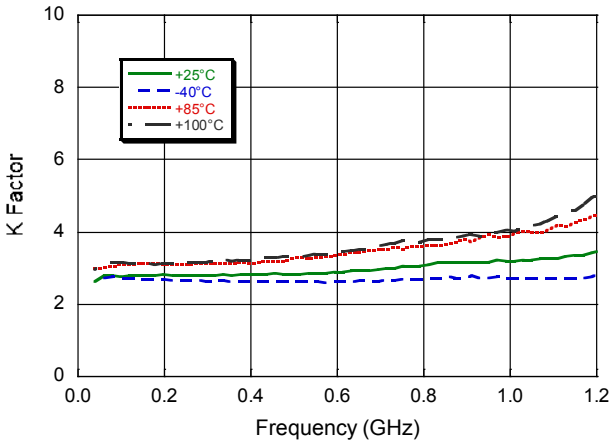
Typical Performance Curves

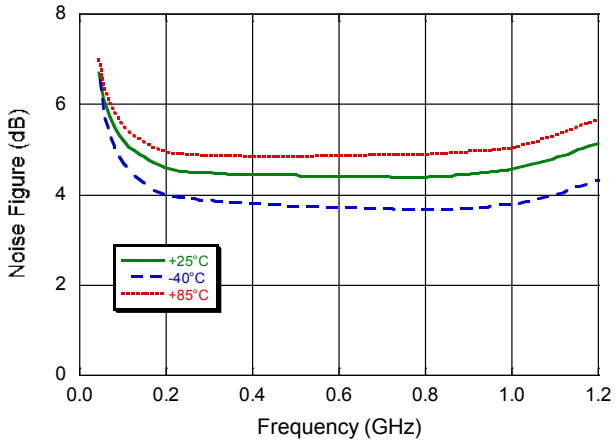
Reverse Isolation



K Factor



Noise Figure



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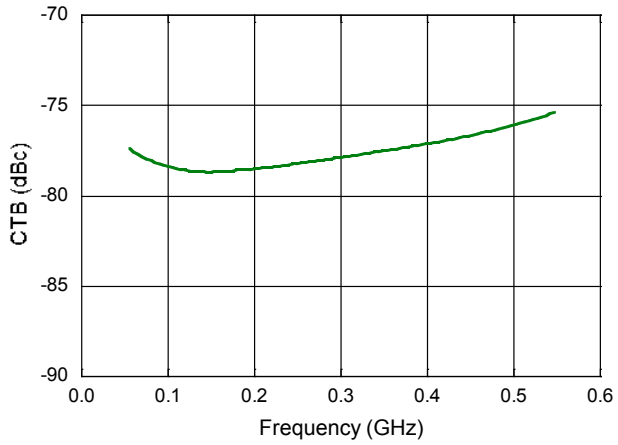
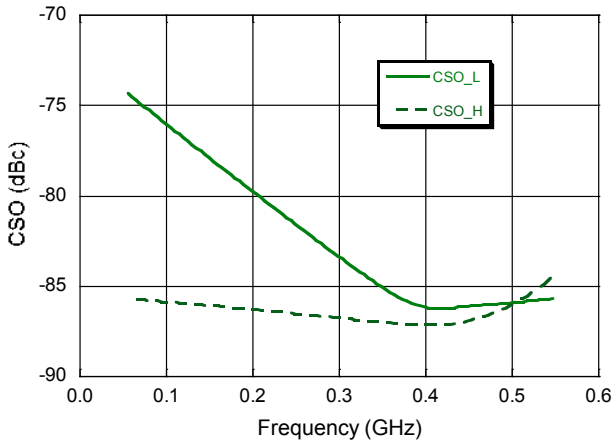
Typical Distortion Performance Curves:

79 NTSC + 75 ATSC, V_O = +59 dBmV/CH at 1 GHz, 18.0 dB Tilt @ +25°C

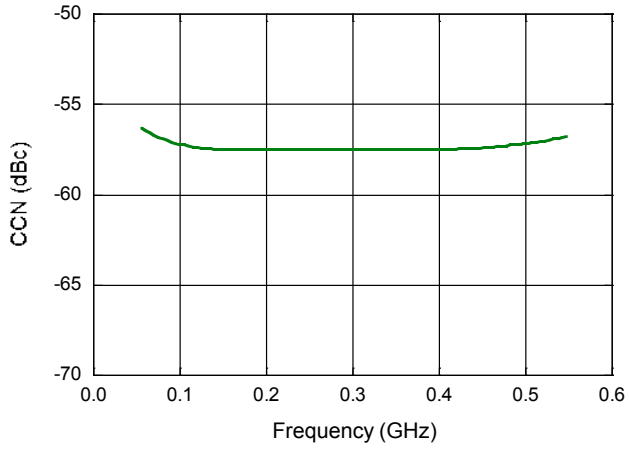
CTB



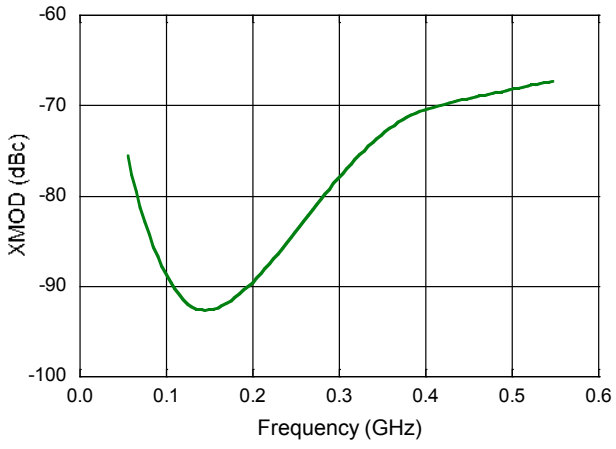
CSO



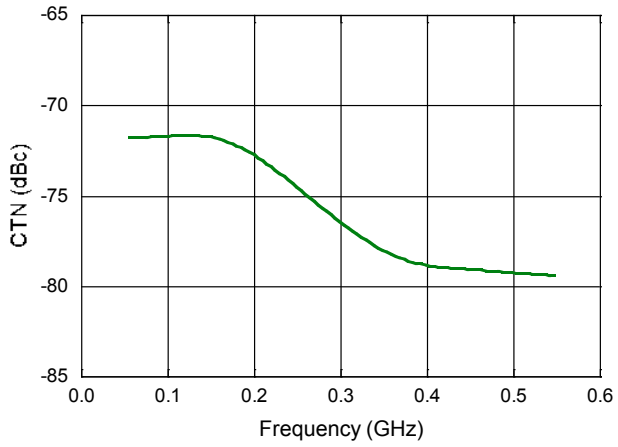
CCN



XMOD



CTN



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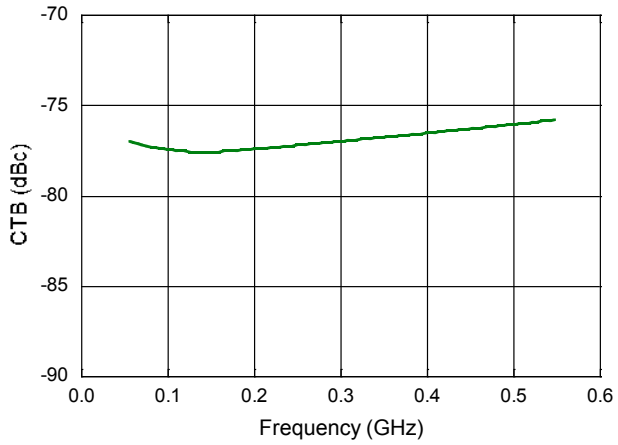
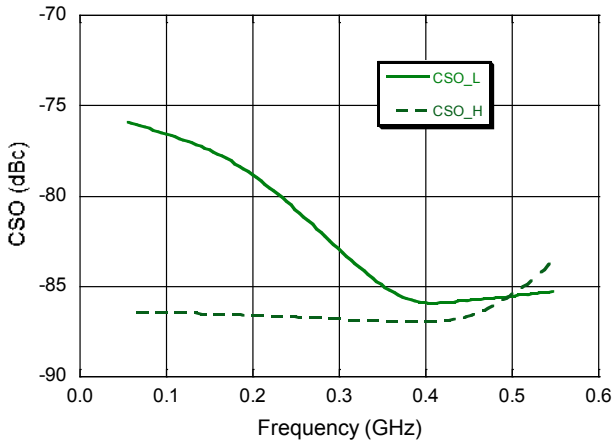
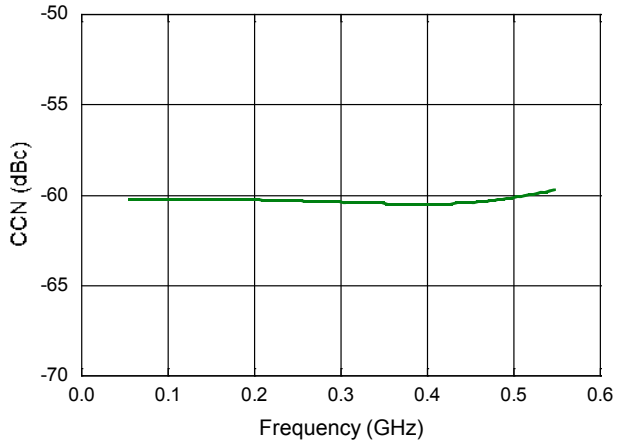
CTB



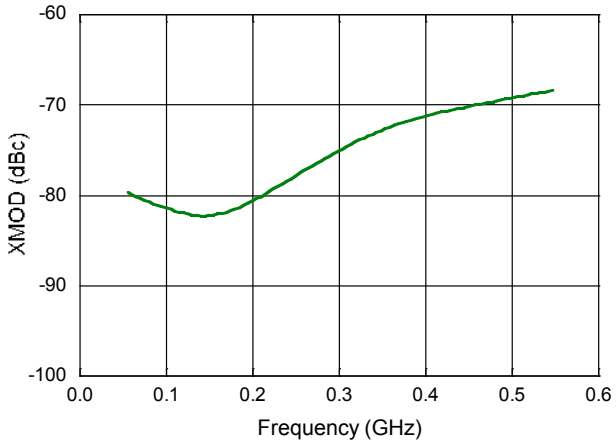
CSO



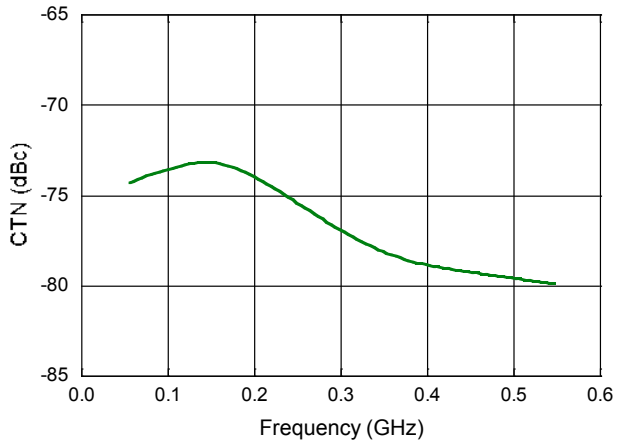
CCN



XMOD



CTN



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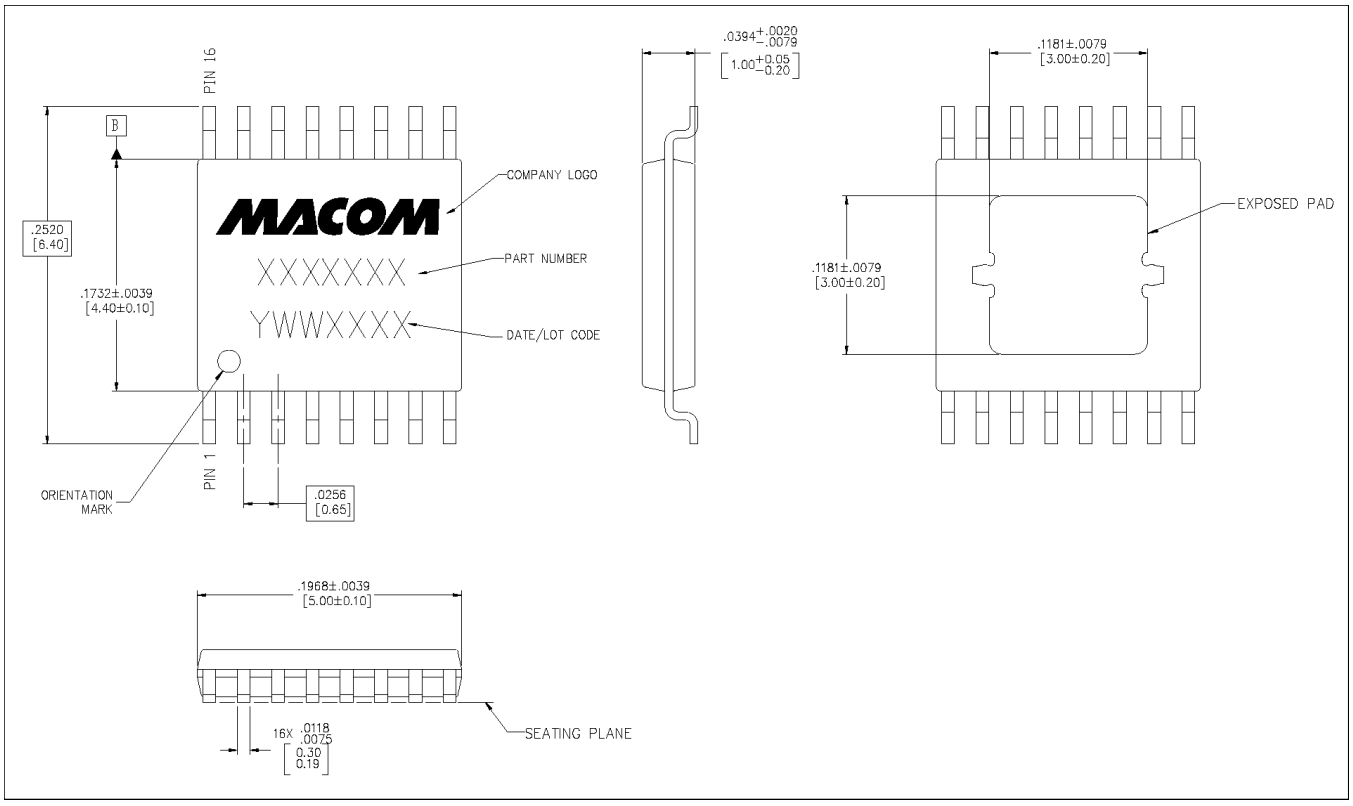
Lead Free TSSOP 16-lead exposed paddle†



† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC Moisture Sensitivity Level 1 requirements.
Plating is 100% matte tin over copper.

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