

# Broadband Low Noise Gain Block, 16 dB 0.03 - 8 GHz



MAAM-011305

Rev.V1

## Features

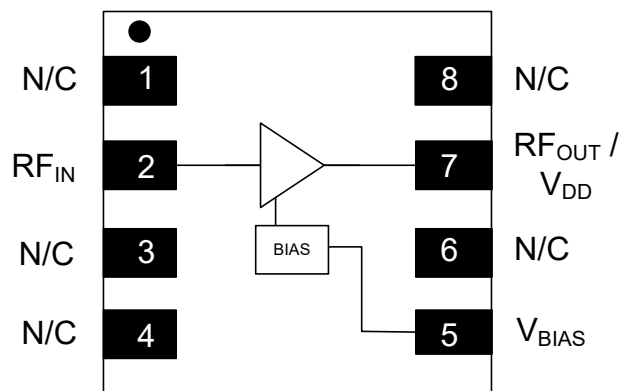
- 16 dB flat Broadband Gain to 8 GHz
- Low Noise Figure:
  - 1.7 dB Noise Figure to 1.5 GHz
  - 2.5 dB Noise Figure @ 6 GHz
  - 3.4 dB Noise Figure @ 8 GHz
- High Linearity OIP3:
  - 35 dBm @ 2.5 GHz
  - 32 dBm @ 6 GHz
  - 27 dBm @ 8 GHz
- Internal Matching to 50 ohm
- Single Voltage Bias: 3 - 5 V
- Integrated Active Bias Circuit
- Current Adjustable 25 - 90 mA
- Lead-Free 2 mm 8-LD PDFN Package
- Halogen-Free "Green" Mold Compound
- RoHS\* Compliant

## Description

The MAAM-011305 is a broadband, low noise, high dynamic range, single stage MMIC gain block assembled in a lead-free 2 mm 8-LD PDFN plastic package. The amplifier is internally matched to provide flat gain and good return losses to 8 GHz without any external matching components. Use of external matching could extend usable frequency range beyond 8 GHz.

This amplifier has an integrated active bias circuit allowing direct connection to 3 V or 5 V bias and minimizing variations over temperature and process. The bias current can be set by an optional external resistor, so the user can customize the power consumption to fit the application.  $V_{BIAS}$  can be utilized as an enable pin to power the device up and down during operation.

## Functional Block Diagram



## Pin Configuration<sup>1,2</sup>

Pin #	Pin Name	Description
1, 3, 4, 6, 8	N/C	No Connection
2	RF <sub>IN</sub>	RF Input
5	V <sub>BIAS</sub>	Bias Voltage
7	RF <sub>OUT</sub> / V <sub>DD</sub>	RF Output / Drain Voltage

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

## Ordering Information<sup>3,4</sup>

Part Number	Package
MAAM-011305-TR1000	1000 piece reel
MAAM-011305-TR3000	3000 piece reel
MAAM-011305-SMB	Sample Board

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

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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### Electrical Specifications: $V_{DD} = 5\text{ V}$ , $+25^{\circ}\text{C}$ , $Z_0 = 50\ \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	0.03 - 8 GHz	dB	12.75	15.25	—
Gain Variation vs. Freq	0.03 - 8 GHz	dB		$\pm 0.6$	
Noise Figure	0.1 - 1.5 GHz 6.0 GHz 8.0 GHz	dB	—	1.7 2.5 3.4	—
Input Return Loss	0.03 - 8 GHz	dB	—	13	—
Output Return Loss	0.03 - 8 GHz	dB	—	10	—
Output IP3	$P_{IN} = -15\text{ dBm}$ per tone, 6 MHz spacing 0.03 - 2.5 GHz 6 GHz 8 GHz	dBm	—	35 32 27	—
Output IP2	$P_{IN} = -15\text{ dBm}$ per tone, 6 MHz spacing 0.03 - 3 GHz 6 GHz 8 GHz	dBm	—	44 47 52	—
Output P1dB	0.03 - 3 GHz 6 GHz 8 GHz	dBm	—	20 18 12	—
Current	$I_{DD}$	mA	—	65	80

### Maximum Operating Ratings

Parameter	Maximum
RF Input Power CW	5 dBm
$V_{DD}$	6 V
$I_{DQ}$	100 mA
Operating Temperature	-40°C to +85°C
Junction Temperature <sup>7,8</sup>	+150°C

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with  $T_J \leq 150^{\circ}\text{C}$  will ensure MTTF >  $1 \times 10^6$  hours.
- Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$   
Typical thermal resistance ( $\Theta_{JC}$ ) = 43°C/W
  - For  $T_C = 25^{\circ}\text{C}$ ,  
 $T_J = 39^{\circ}\text{C}$  @ 5 V, 63 mA
  - For  $T_C = 85^{\circ}\text{C}$ ,  
 $T_J = 99^{\circ}\text{C}$  @ 5 V, 63 mA

### Absolute Maximum Ratings<sup>5,6</sup>

Parameter	Absolute Maximum
RF Input Power CW	22.5 dBm
$V_{DD}$	7 V
Storage Temperature	-55°C to +150°C

### 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 HBM 1C devices.

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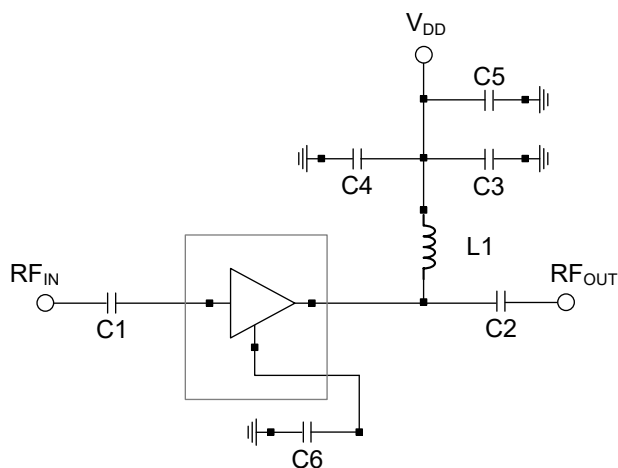
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### Typical Application Circuit



### Typical Parts List, $V_{DD} = 5\text{ V}$

Component	Value	Package
C1 - C3, C6	1000 pF	0402
C4	47 pF	0402
C5	0.1 $\mu\text{F}$	0402
L1	Ferrite Bead <sup>9</sup>	0402

9. Murata, part number BLM15HD182SN.

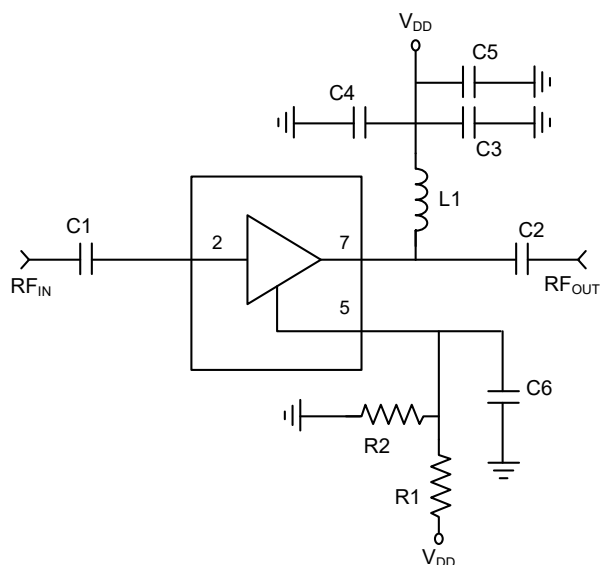
### Higher Linearity Options

The MAAM-011305 can be tuned for better linearity by replacing L1 (Ferrite Bead) with an inductor choke and trading off low end bandwidth. Inductor value of 30nH covers frequency band from 0.5 - 8 GHz.

### Current Adjust Options

The  $V_{BIAS}$  (pin 5) of MAAM-011305 may be used to adjust the DC operating current by placing either R1 or R2 as shown the schematic below. Placing resistor R2 to ground will reduce the current from typical application level. When using R2 to reduce current do not place (DNP) R1. To increase current from typical application circuit install resistor R1 and connect to  $V_{DD}$ .

The table below shows values of R1 and R2 for a range of operating currents for  $V_{DD} = 5\text{ V}$ .



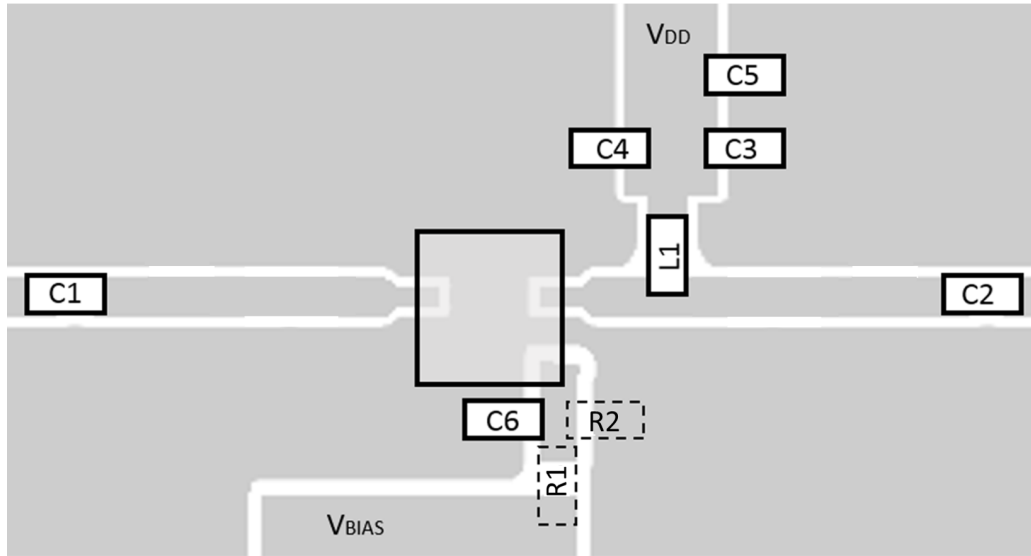
I (mA)	$V_{DD} = 5\text{ V}$	
	R1	R2
25	DNP	1.5 k $\Omega$
35	DNP	2.5 k $\Omega$
45	DNP	4.3 k $\Omega$
63	Typical application without R1 and R2	
75	18 k $\Omega$	DNP
90	6.8 k $\Omega$	DNP

# Broadband Low Noise Gain Block, 16 dB 0.03 - 8 GHz



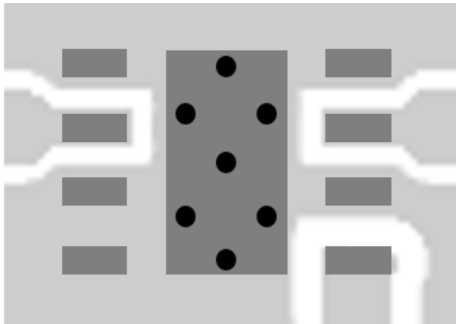
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## Recommended PCB Layout



FR4, RF Layer Thickness = 0.711 mm, Trace = 0.55 mm, Gap = 0.18 mm

## PCB Land Pattern



# Broadband Low Noise Gain Block, 16 dB 0.03 - 8 GHz

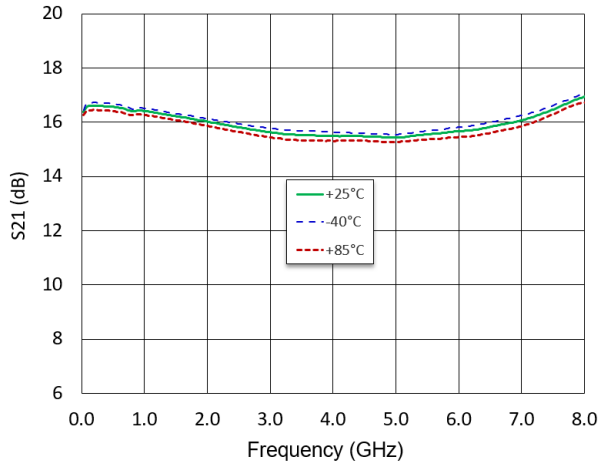


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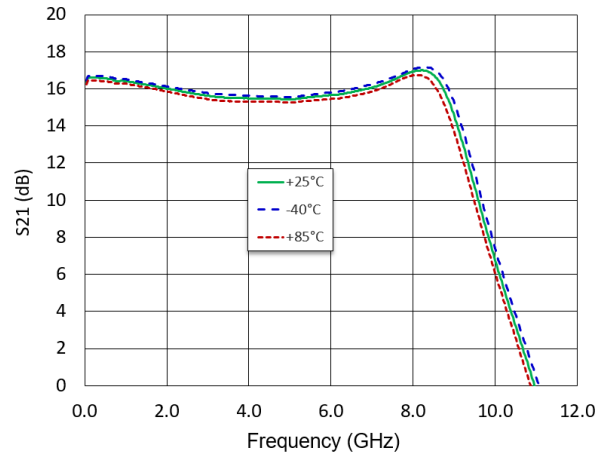
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## Typical Performance Curves @ 5 V / 63 mA, $Z_0 = 50 \Omega$

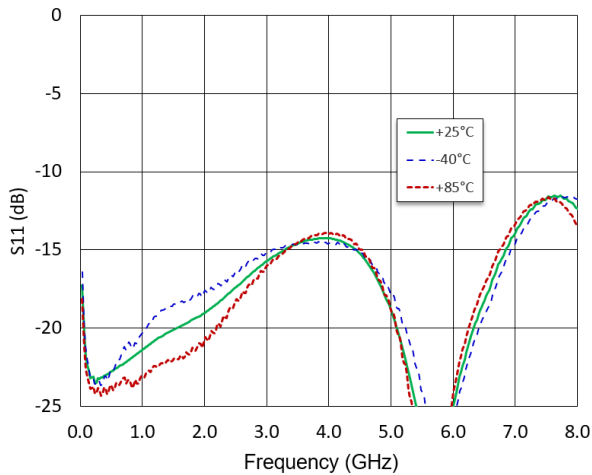
### Gain



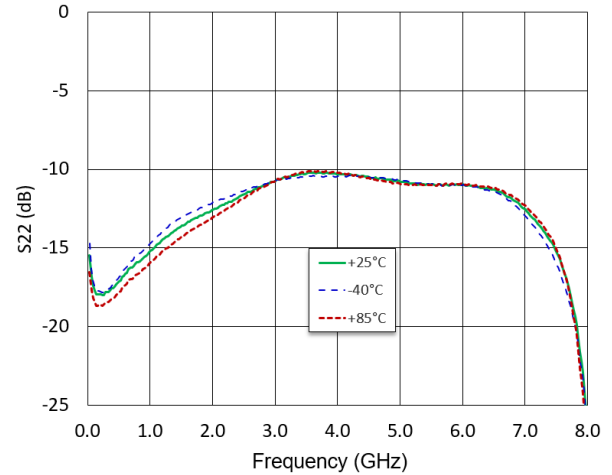
### Gain to 12 GHz



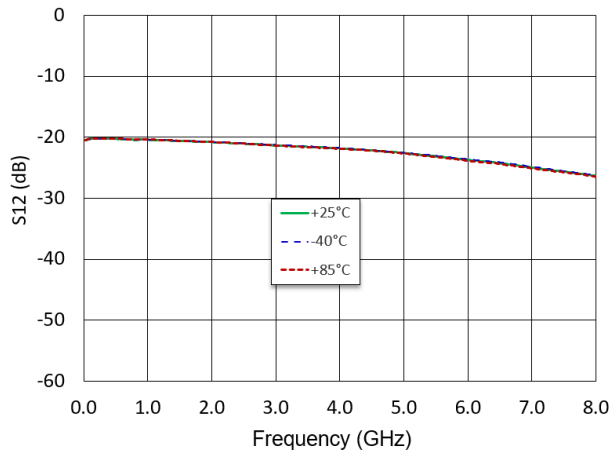
### Input Return Loss



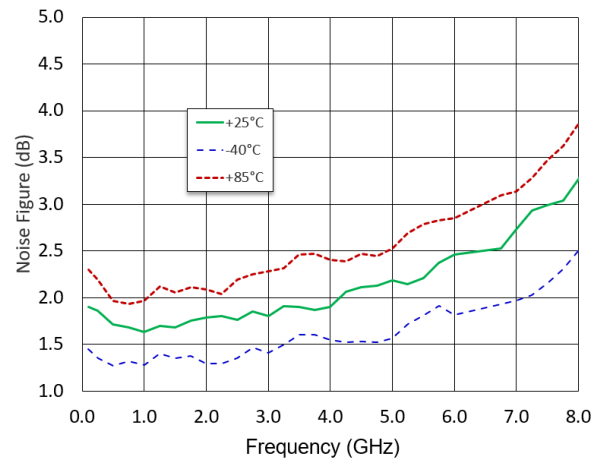
### Output Return Loss



### Reverse Isolation



### Noise Figure



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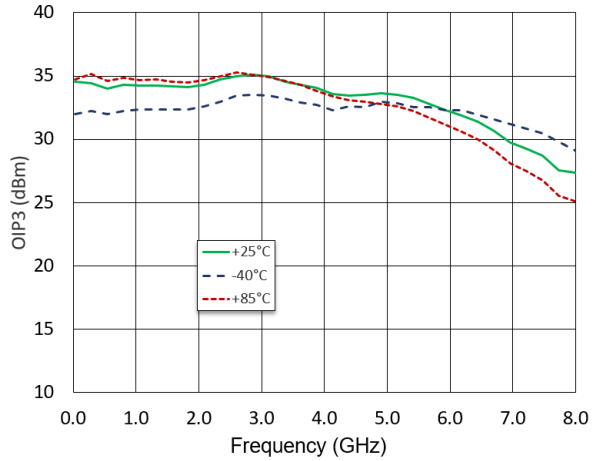


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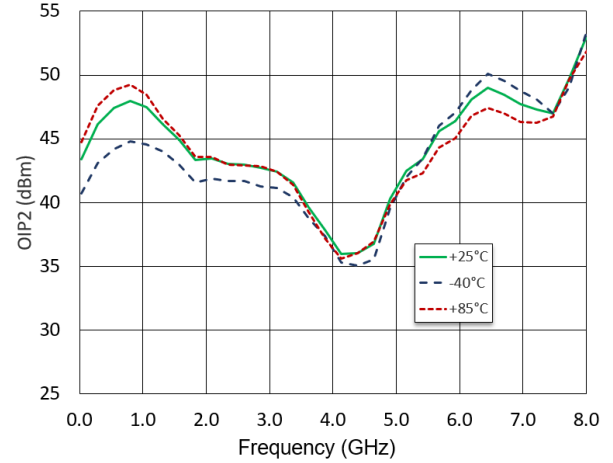
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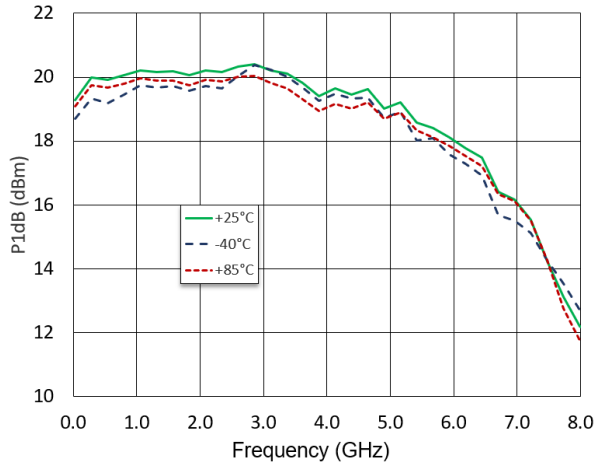
**OIP3 at  $P_{IN} = -15$  dBm/tone, 10 MHz Spacing**



**OIP2 at  $P_{IN} = -15$  dBm/tone, 10 MHz Spacing**



**P1dB**



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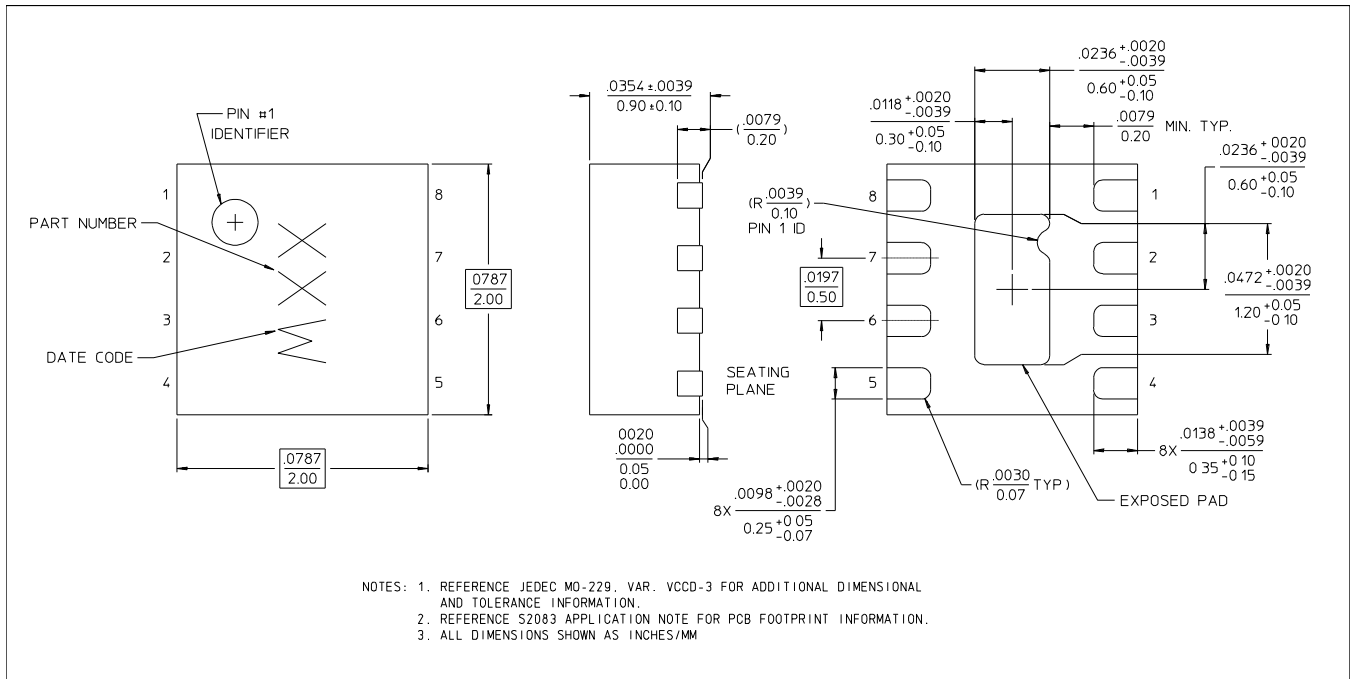
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### Lead-Free 2 mm 8-Lead PDFN<sup>†</sup>



<sup>†</sup> Reference Application Note M2083 for lead-free solder reflow recommendations.  
 Meets JEDEC moisture sensitivity level (MSL) 1 requirements.  
 Plating is 100% matte tin over copper.

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