MAAM-011185

CATV Return Path Differential Amplifier
5 - 300 MHz

Rev. V1

Features

- 21.2 dB Gain
- 5.0 V Bias
- 3.1 dB Noise Figure
- External Bias Current Control
- Low Distortion
- Wide Bandwidth for DOCSIS 3.1
- Lead-Free 3 mm 16-Lead PQFN Package
- RoHS* Compliant and 260°C Reflow Compatible

Description

The MAAM-011185 is a balanced GaAs MMIC amplifier assembled in a lead-free 3 mm 16-lead PQFN plastic package.

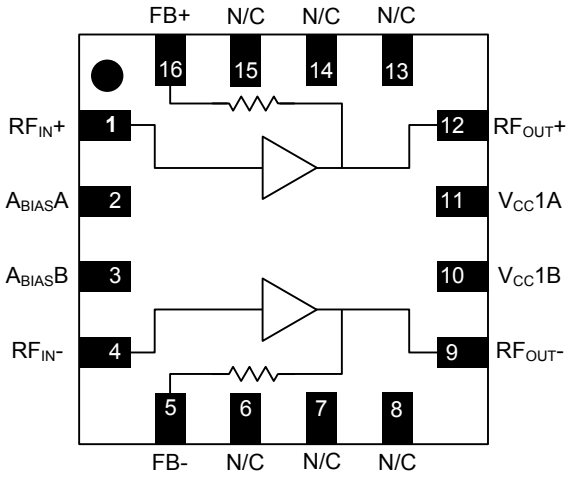
The amplifier is ideally suited for use in CATV return path applications, including DOCSIS 3.1 systems: it offers low distortion and low noise figure with high gain. It typically provides 3.1 dB noise figure, 21.2 dB gain, and 30 dB MER up to 57 dBmV per channel for 16-Channel 64 QAM signaling while drawing 290 mA DC current @ 5 V bias.

Ordering Information[1,2]

Part Number	Package
MAAM-011185-TR1000	1000 piece reel
MAAM-011185-TR3000	3000 piece reel
MAAM-011185-001SMB	Sample 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$_{IN}$+	RF Input +
2	A$_{BIAS}$A	Active Bias A
3	A$_{BIAS}$B	Active Bias B
4	RF$_{IN}$-	RF Input -
5	FB-	Feedback -
6	N/C	No Connection
7	N/C	No Connection
8	N/C	No Connection
9	RF$_{OUT}$-	RF Output (DC Bias) -
10	V$_{CC}$1B	V$_{CC}$ Bias 1B
11	V$_{CC}$1A	V$_{CC}$ Bias 1A
12	RF$_{OUT}$+	RF Output (DC Bias) +
13	N/C	No Connection
14	N/C	No Connection
15	N/C	No Connection
16	FB+	Feedback +
17	Pad[4]	RF and DC Ground

3. All pins listed as 'No Connection' should be grounded.
4. The exposed pad centered on the package bottom must be connected to RF and DC ground.

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

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Electrical Specifications[5]: T_A = +25°C, V_{CC} = 5 V, I_{CC} = 290 mA, Z_0 = 75 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gain	P_{IN} = -10 dBm, 100 MHz P_{IN} = -10 dBm, 205 MHz P_{IN} = -10 dBm, 250 MHz	dB	20.5 20.5 —	21.5 21.2 21.0	22.5 22.5 —
Input Return Loss	5 - 300 MHz	dB	—	21	—
Output Return Loss	5 - 300 MHz	dB	—	21	—
Reverse Isolation	5 - 300 MHz	dB	—	25	—
Noise Figure	5 - 205 MHz 205 - 300 MHz	dB	—	3.1 3.3	—
P1dB	I_{CC} = 290 mA, 5 - 300 MHz I_{CC} = 320 mA, 5 - 300 MHz	dBm	—	27.0 27.3	—
OIP3	12 dBm P_{OUT} per tone, 6 MHz spacing, I_{CC} = 290 mA, 5 - 300 MHz I_{CC} = 320 mA, 5 - 300 MHz	dBm	—	43 45	—
OIP2	12 dBm P_{OUT} per tone, 6 MHz spacing, I_{CC} = 290 mA, 5 - 205 MHz I_{CC} = 320 mA, 5 - 205 MHz I_{CC} = 290 mA, 205 - 300 MHz I_{CC} = 320 mA, 205 - 300 MHz	dBm	—	80 82 76 78	—
P_{OUT} @ 30 dB MER[5]	16 Channels, I_{CC} = 290 mA, 5 - 205 MHz I_{CC} = 320 mA, 5 - 205 MHz	dBmV/ Channel	55.5 —	57.0 58.0	—
I_{CC}[6]	R2 = 1.33 kΩ	mA	—	290	320

5. Modulation Error Ratio, 64 QAM 5.12 MS/s. See 'Typical Performance Curves' on page 5 of this datasheet for an example MER vs. output power relationship.
6. Data corresponds to the typical application circuit and component values shown on page 3 of this datasheet. Parameters shown at nominal I_{CC} = 290 mA unless otherwise noted. I_{CC} is the total DC current draw from the V_{CC} supply. As shown on page 3, it is distributed to pins 9 and 12 by balun T2 and pins 10 and 11 directly. Resistor R2 determines the DC voltage of $A_{BIASA/B}$ and thereby I_{CC} at approximately 0.25 mA/Ω. See page 5 for a typical I_{CC} vs. R2 relationship assuming V_{CC} = 5 V.

Absolute Maximum Ratings[7,8]

Parameter	Absolute Maximum
Input Power	11 dBm
V_{CC}	6 V
Junction Temperature[9,10]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +125°C

7. Exceeding any one or a combination of these limits may cause permanent damage to this device.
8. MACOM does not recommend sustained operation near these survivability limits.
9. Operating at nominal conditions with T_J ≤ 150°C will ensure MTTF > 1 x 10^6 hours.
10. Junction Temperature (T_J) = T_C + Θjc * (V * I)
    Typical thermal resistance (Θjc) = 15° C/W.
    a) For T_C = +25°C, T_J = 47°C @ 5 V, 290 mA
    b) For T_C = +85°C, T_J = 107°C @ 5 V, 290 mA

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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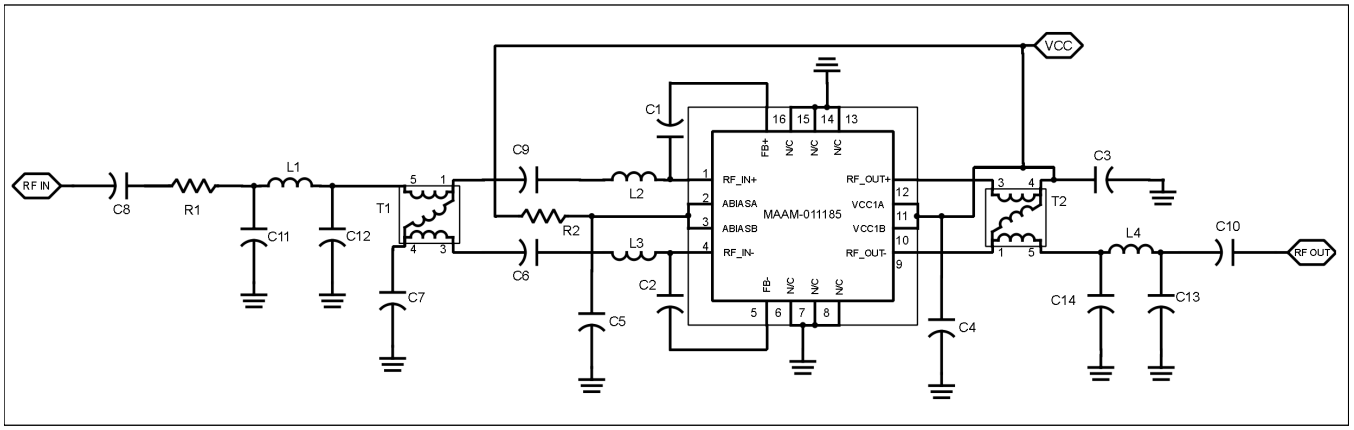
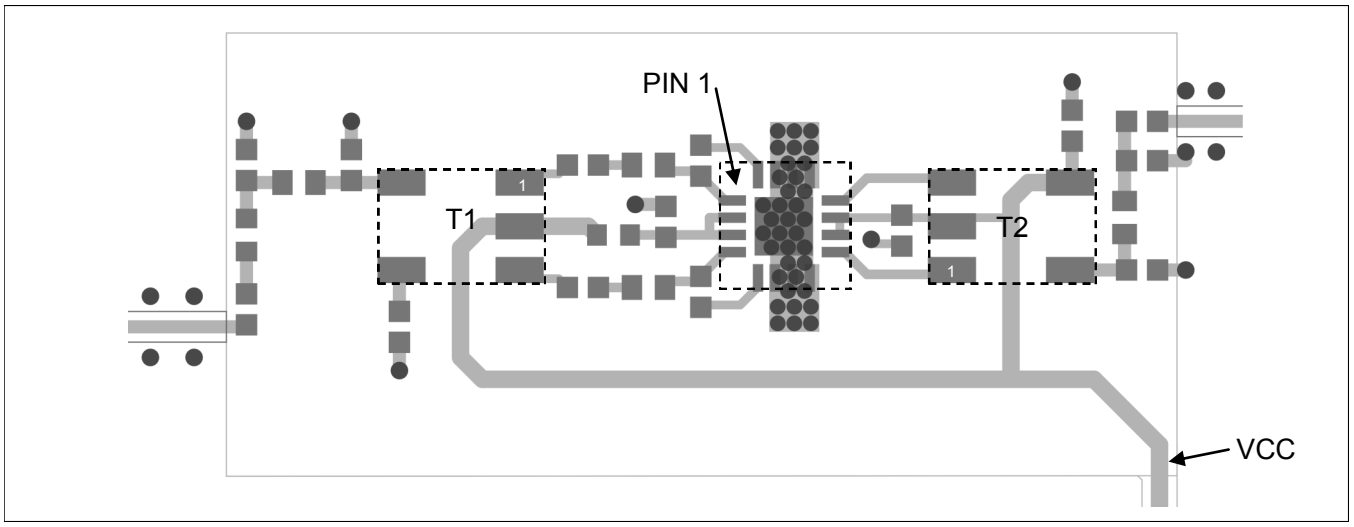
Typical Application Circuit: Schematic



Typical Application Circuit: Component Values

Component	Value
C1 - C9	100 nF
C10	1500 pF
C11, C13	2.0 pF
C12	2.5 pF
C14	1.0 pF
R1	2 Ω
R2	1.33 kΩ
L1	22 nH
L2, L3	3.3 nH
L4	6.2 nH
T1, T2	MABA-007748-CT1160 1:1 Balun (MACOM)

Sample Board Layout



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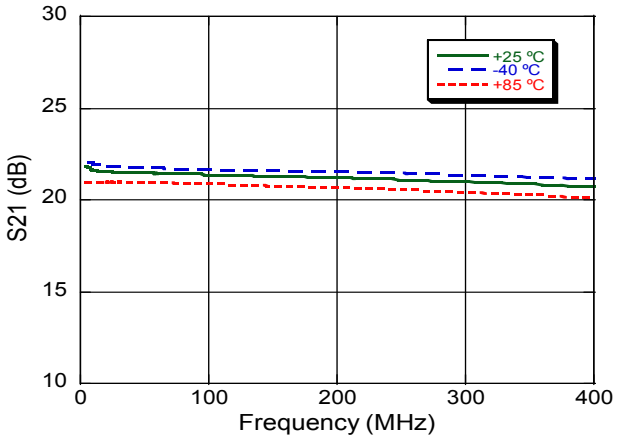
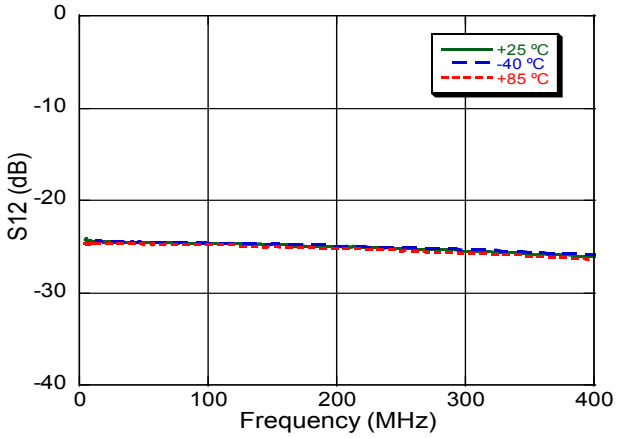
Typical Performance Curves: Small-Signal

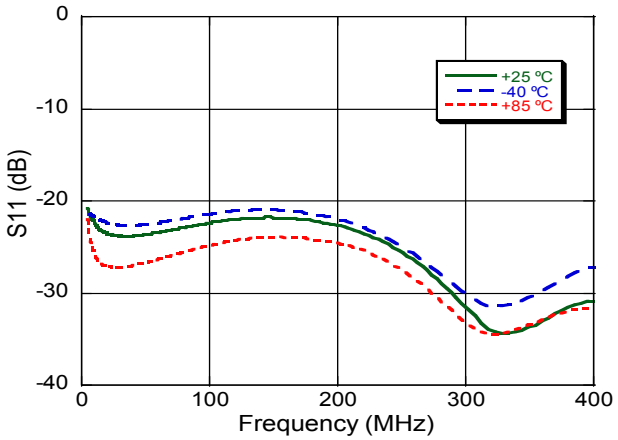
Gain



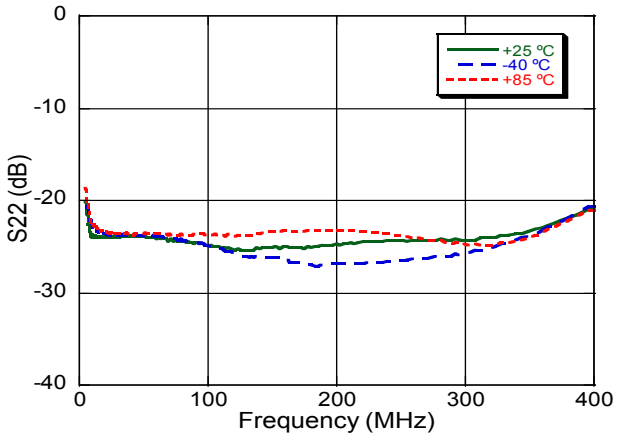
Reverse Isolation



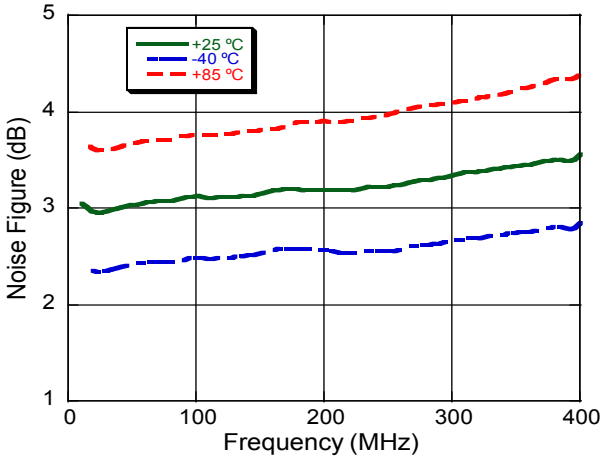
Input Return Loss



Output Return Loss



Noise Figure



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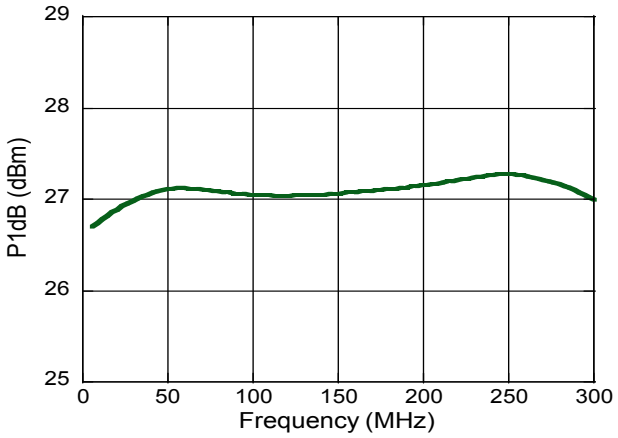
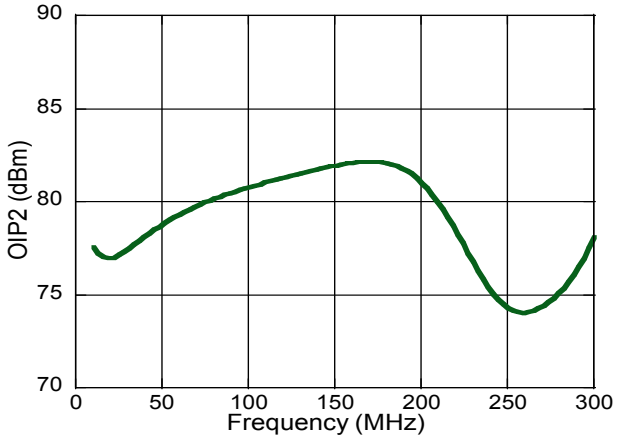
Typical Performance Curves: Large Signal

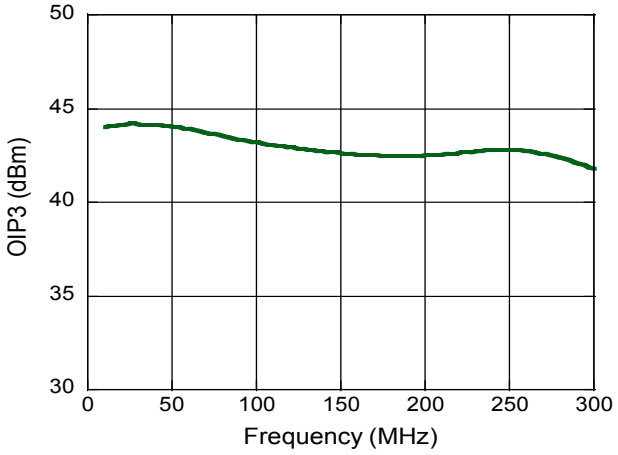
P1dB



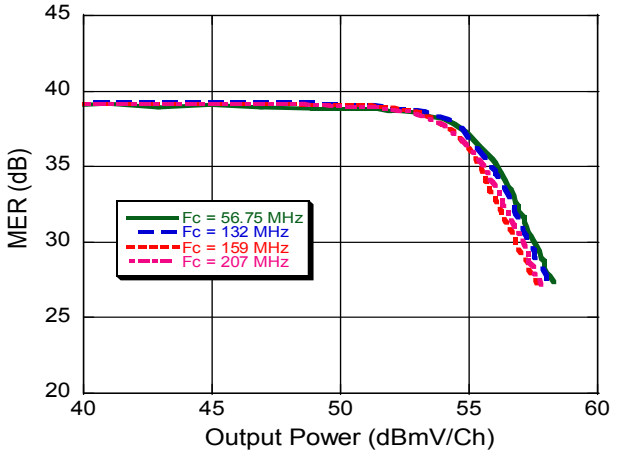
OIP2 @ 12 dBm P_{OUT}



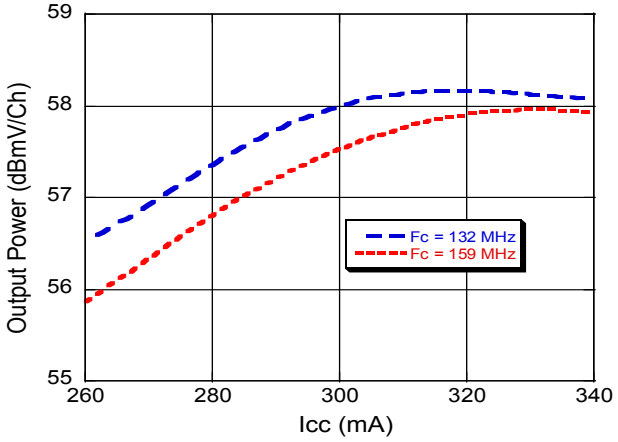
OIP3 @ 12 dBm P_{OUT}



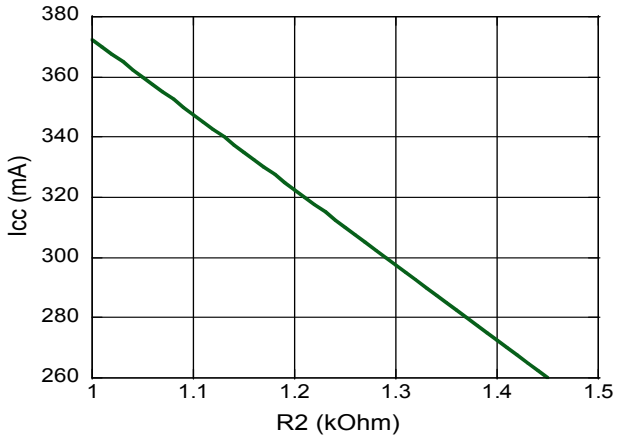
Modulation Error Ratio (64 QAM, 16 Channel)[11]



Output Power at 30 dB MER vs. I_{CC}[11]



I_{CC} vs. Resistor R2 at V_{CC} = 5 V



11. F_C is the center frequency of the measured channel, which is the 9th of 16 consecutive 64-QAM channels.

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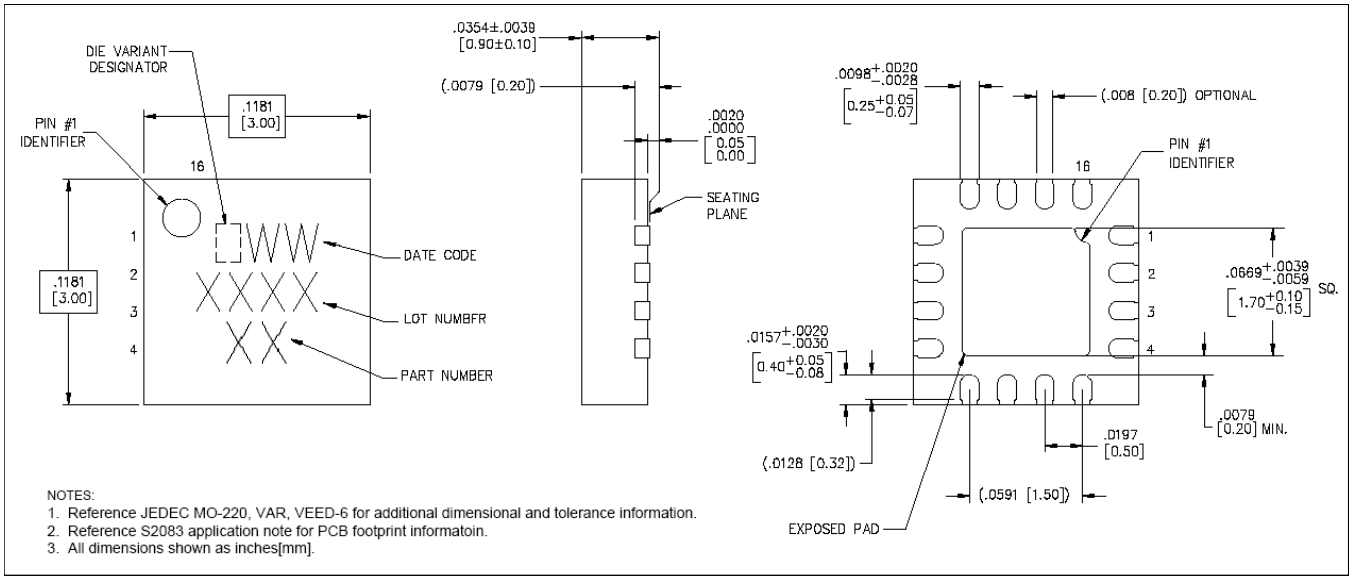
Lead-Free 3 mm 16-Lead PQFN†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity 1 requirements.
Plating is 100% matte tin plating over copper.

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