

## Voltage Variable Attenuator 5 - 45 GHz

Rev. V1

### Features

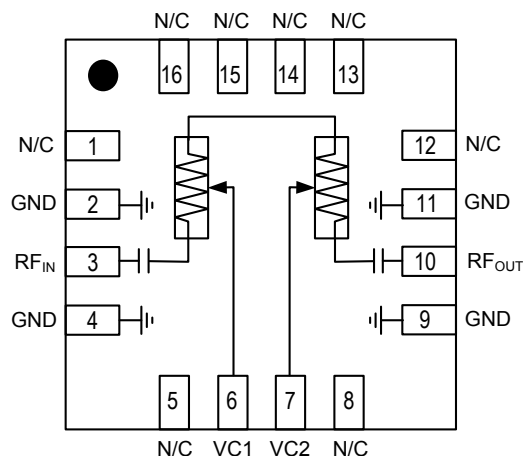
- 5 - 45 GHz Frequency Range
- 1.5 dB Insertion Loss @ 20 GHz
- >30 dB Attenuation Range
- High Linearity, 30 dBm IIP3
- Lead-Free 3 mm, 16-Lead QFN Package
- RoHS\* Compliant

### Description

The MAAV-011013 is a voltage variable attenuator with analog control and greater than 30 dB of attenuation. Excellent linearity is maintained over the full attenuation range. The attenuation level is set by two control voltages of 0 to -2 V. This device is assembled in a lead free 3 mm 16 lead PQFN plastic package.

Applications include transceivers for cellular infrastructure.

### Functional Block Diagram



### Pin Configuration<sup>3,4</sup>

| Pin No. | Function        |
|---------|-----------------|
| 1       | No Connection   |
| 2       | Ground          |
| 3       | RF Input        |
| 4       | Ground          |
| 5       | No Connection   |
| 6       | V <sub>C1</sub> |
| 7       | V <sub>C2</sub> |
| 8       | No Connection   |
| 9       | Ground          |
| 10      | RF Output       |
| 11      | Ground          |
| 12 - 16 | No Connection   |

3. It is recommended to connect unused pins to ground.

4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

### Ordering Information<sup>1,2</sup>

| Part Number        | Package        |
|--------------------|----------------|
| MAAV-011013-TR0500 | 500 Part Reel  |
| MAAV-011013-TR1000 | 1000 Part Reel |
| MAAV-011013-001SMB | Sample Board   |

1. Reference Application Note M513 for reel size information.

2. All sample boards include 5 loose parts.

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

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**Electrical Specifications:**  $T_A = +25^\circ\text{C}$ ,  $Z_0 = 50\ \Omega$ ,  $P_{IN} = -10\ \text{dBm}$

| Parameter                                                           | Test Conditions                                           | Units | Min. | Typ. | Max. |
|---------------------------------------------------------------------|-----------------------------------------------------------|-------|------|------|------|
| Insertion Loss<br>( $V_{C1}$ and $V_{C2} = -2\ \text{V}$ )          | 5.9 - 15.5 GHz                                            | dB    | —    | 1.5  | 4.0  |
|                                                                     | 17.6 - 20 GHz                                             |       |      | 1.5  | 4.0  |
|                                                                     | 20 - 30 GHz                                               |       |      | 2.5  | 6.0  |
|                                                                     | 30 - 34 GHz                                               |       |      | 2.5  | 6.5  |
|                                                                     | 37 - 40 GHz                                               |       |      | 3.0  | 7.0  |
| Attenuation<br>( $V_{C1}$ and $V_{C2} = 0\ \text{V}$ ) <sup>5</sup> | 5.9 - 8.5 GHz                                             | dB    | 22.5 | 25.0 | —    |
|                                                                     | 10 - 11.7 GHz                                             |       | 27.5 | 32.0 |      |
|                                                                     | 12.75-15.35 GHz                                           |       | 29.5 | 35.0 |      |
|                                                                     | 17.6 - 20 GHz                                             |       | 31.0 | 35.0 |      |
|                                                                     | 20 - 30 GHz                                               |       | 33.5 | 39.0 |      |
|                                                                     | 30 - 34 GHz                                               |       | 31.0 | 37.0 |      |
|                                                                     | 37 - 40 GHz                                               |       | 30.0 | 36.0 |      |
| Input P1dB <sup>6</sup>                                             | 5 - 25 GHz                                                | dBm   | 24   | 25   | —    |
|                                                                     | 25 - 40 GHz                                               |       | 20   | 22   |      |
| IIP3 (any attenuation)                                              | $P_{IN} = 12\ \text{dBm/tone @ } 5.0 - 15.0\ \text{GHz}$  | dBm   | 29.0 | 31.0 | —    |
|                                                                     | $P_{IN} = 12\ \text{dBm/tone @ } 15.0 - 26.5\ \text{GHz}$ |       | 27.5 | 30.0 |      |
|                                                                     | $P_{IN} = 12\ \text{dBm/tone @ } 26.5 - 40.0\ \text{GHz}$ |       | 27.0 | 31.0 |      |
| IIP3 ( $V_{C1}=V_{C2}=-2\ \text{V}$ )                               | $P_{IN} = 12\ \text{dBm/tone @ } 5 - 40\ \text{GHz}$      | dBm   | —    | 42   | —    |
| Input Return Loss<br>(any attenuation)                              | —                                                         | dB    | —    | 10   | —    |
| Output Return Loss<br>(any attenuation)                             | —                                                         | dB    | —    | 10   | —    |

5. To increase attenuation from minimum attenuation state ( $V_{C1} = -2\ \text{V}$  and  $V_{C2} = -2\ \text{V}$ ) to max attenuation state ( $V_{C1} = 0\ \text{V}$  and  $V_{C2} = 0\ \text{V}$ ),  $V_{C1}$  increases to full range prior to adjusting  $V_{C2}$ .

6. Guaranteed on MACOM Sample Board only

## Absolute Maximum Ratings<sup>7,8</sup>

| Parameter              | Absolute Maximum |
|------------------------|------------------|
| Input Power            | 30 dBm           |
| Voltage (RF pins)      | 30 V             |
| Voltage (control pins) | +1 V to -6 V     |
| Storage Temperature    | -55°C to +150°C  |
| Case Temperature       | -40°C to +85°C   |

7. Exceeding any one or combination of these limits may cause permanent damage to this device.

8. MACOM does not recommend sustained operation near these survivability limits.

## Handling Procedures

The following precautions should be observed to avoid damage:

## Static Sensitivity

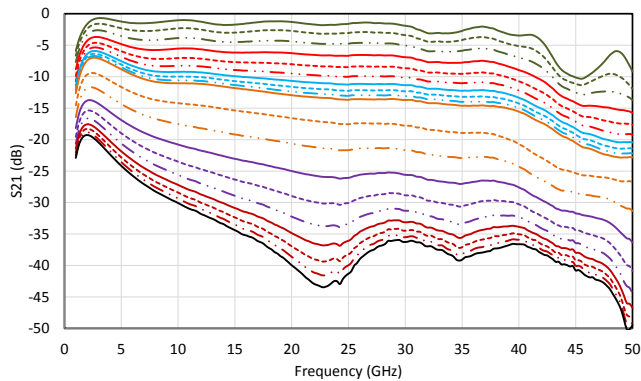
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

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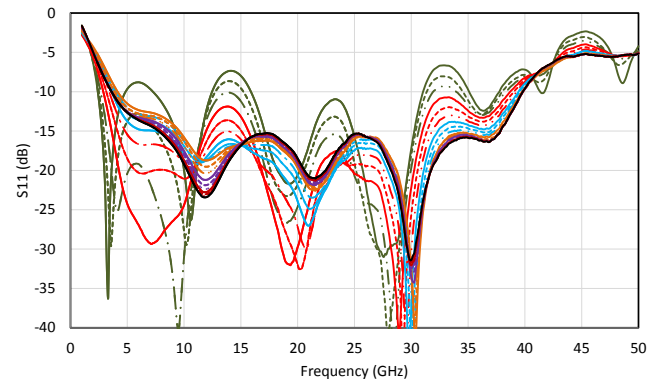
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### Typical Performance Curves: @ +25°C

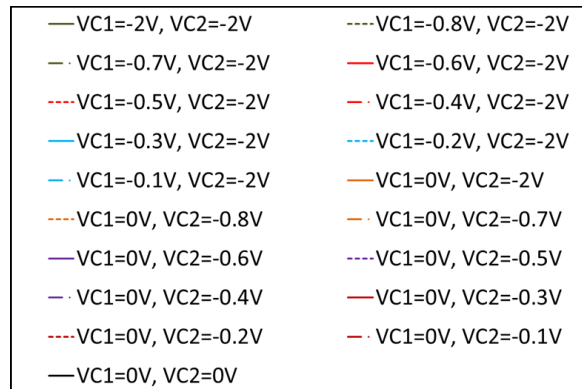
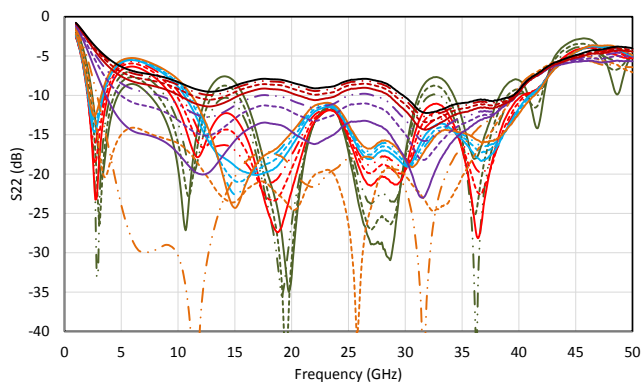
**Gain**



**Input Return Loss**



**Output Return Loss**

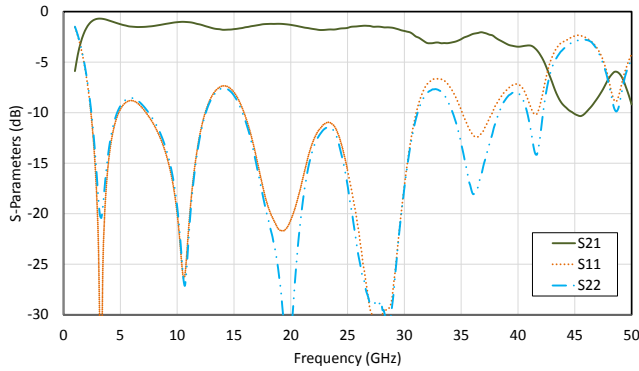


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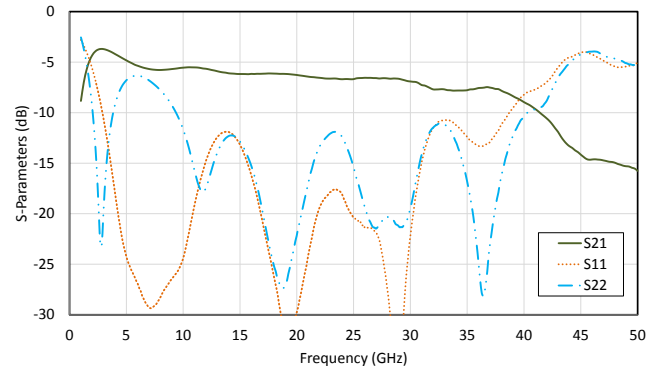
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### Typical Performance Curves: S-Parameters @ +25°C

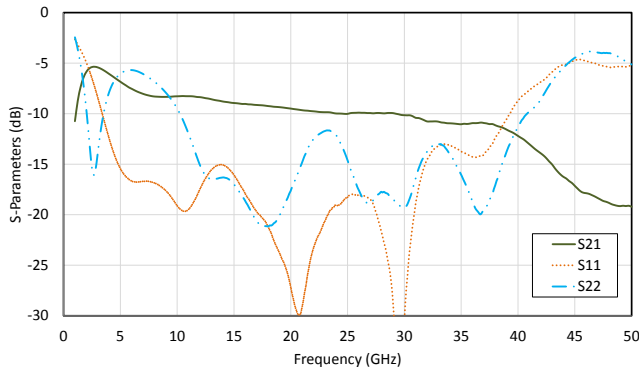
**S-Parameters  $V_{C1} = -2.0$  V,  $V_{C2} = -2.0$  V**



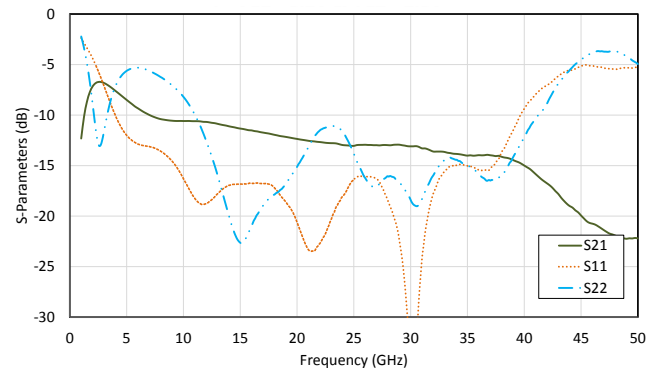
**S-Parameters  $V_{C1} = -0.6$  V,  $V_{C2} = -2.0$  V**



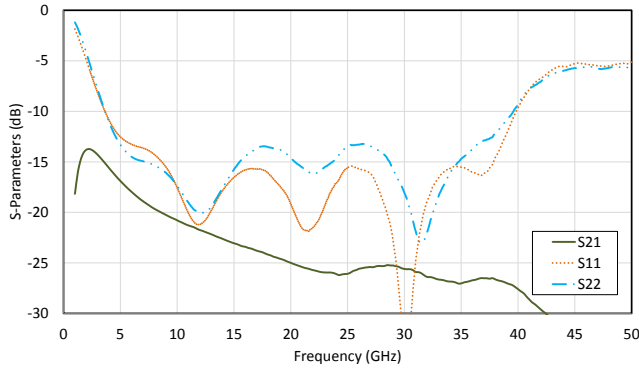
**S-Parameters  $V_{C1} = -0.4$  V,  $V_{C2} = -2.0$  V**



**S-Parameters  $V_{C1} = -0.1$  V,  $V_{C2} = -2.0$  V**



**S-Parameters  $V_{C1} = 0$  V,  $V_{C2} = -0.6$  V**

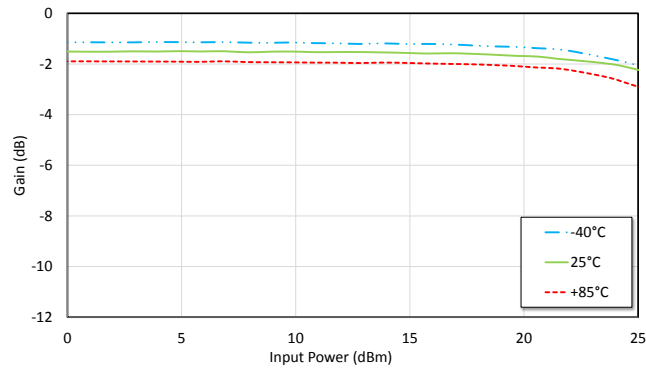


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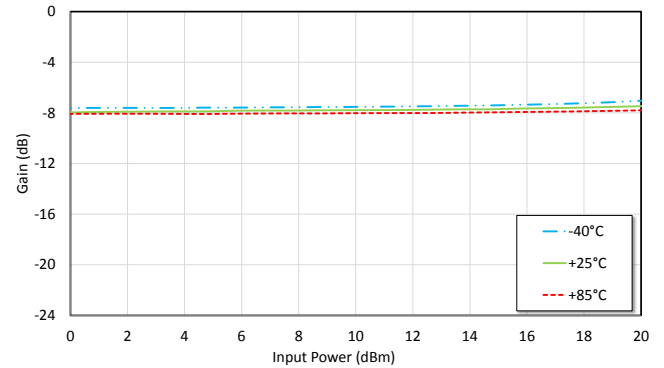
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### Typical Performance Curves: Power Gain, Freq. 16 GHz

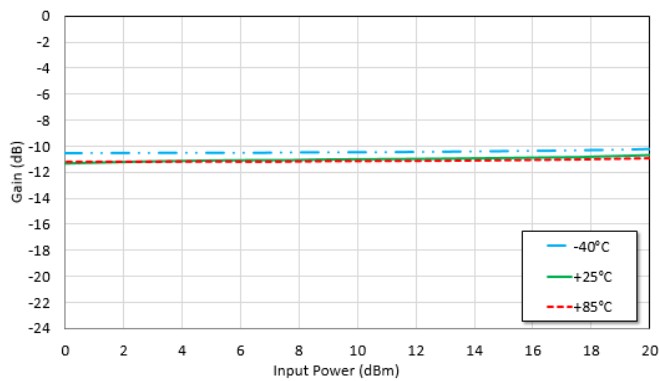
**Power Gain @  $V_{C1} = -2.0$  V,  $V_{C2} = -2.0$  V**



**Power Gain @  $V_{C1} = -0.4$  V,  $V_{C2} = -2.0$  V**



**Power Gain @  $V_{C1} = 0$  V,  $V_{C2} = -2.0$  V**

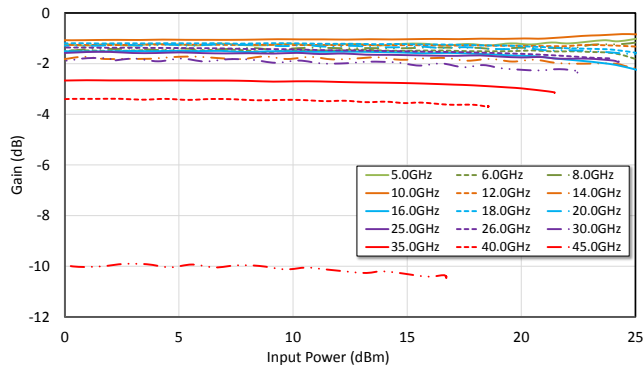


## Voltage Variable Attenuator 5 - 45 GHz

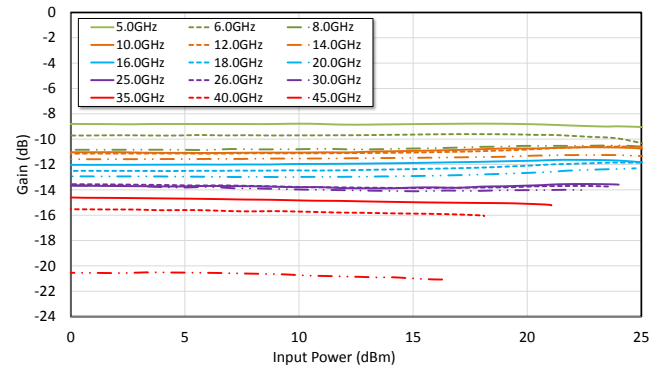
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### Typical Performance Curves: Power Gain @ +25°C

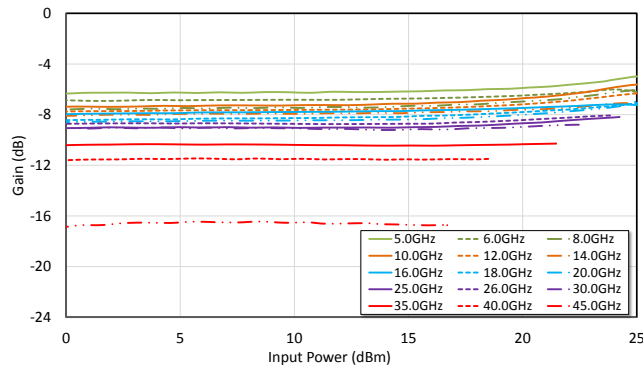
Power Gain @  $V_{C1} = -2.0$  V,  $V_{C2} = -2.0$  V



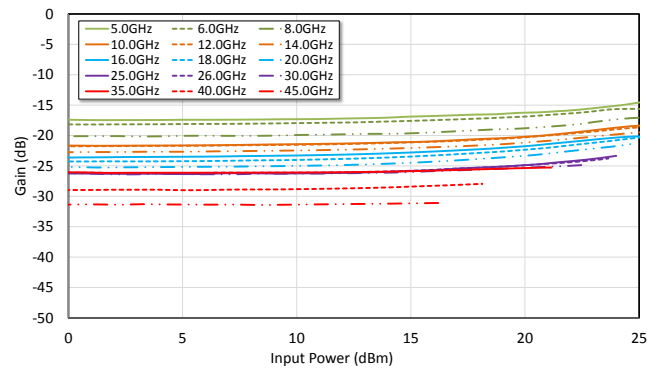
Power Gain @  $V_{C1} = 0$  V,  $V_{C2} = -2.0$  V



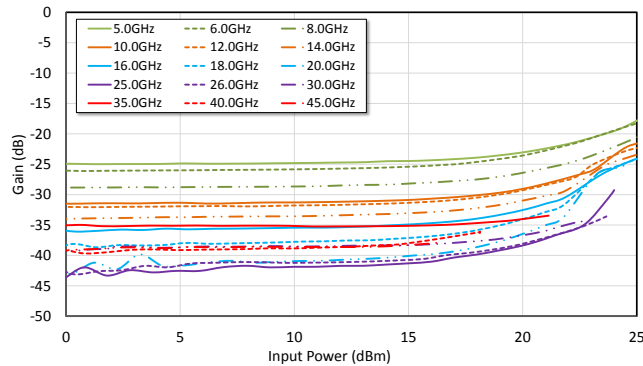
Power Gain @  $V_{C1} = -0.4$  V,  $V_{C2} = -2.0$  V



Power Gain @  $V_{C1} = 0$  V,  $V_{C2} = -0.6$  V



Power Gain @  $V_{C1} = 0$  V,  $V_{C2} = 0$  V

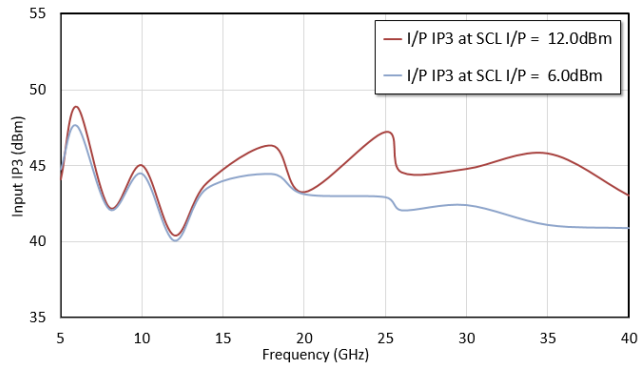


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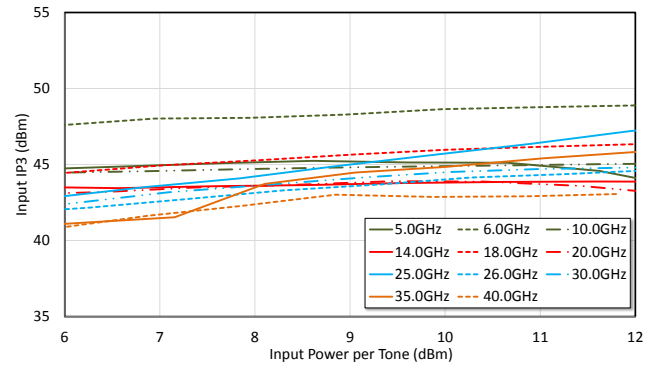
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### Typical Performance Curves: Input IP3

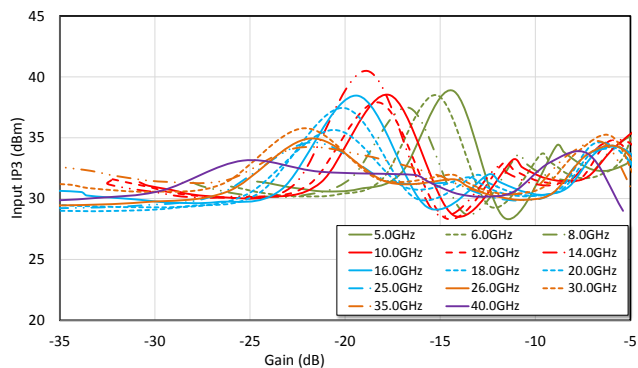
**Input IP3 vs. Frequency**  
@  $V_{C1} = -2.0$  V,  $V_{C2} = -2.0$  V



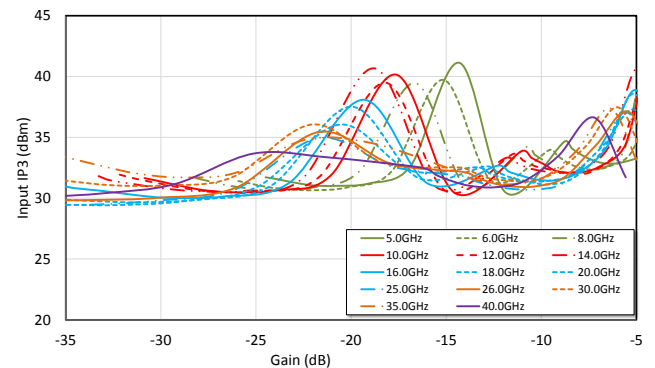
**Input IP3 vs. SCL Input Power**  
@  $V_{C1} = -2.0$  V,  $V_{C2} = -2.0$  V



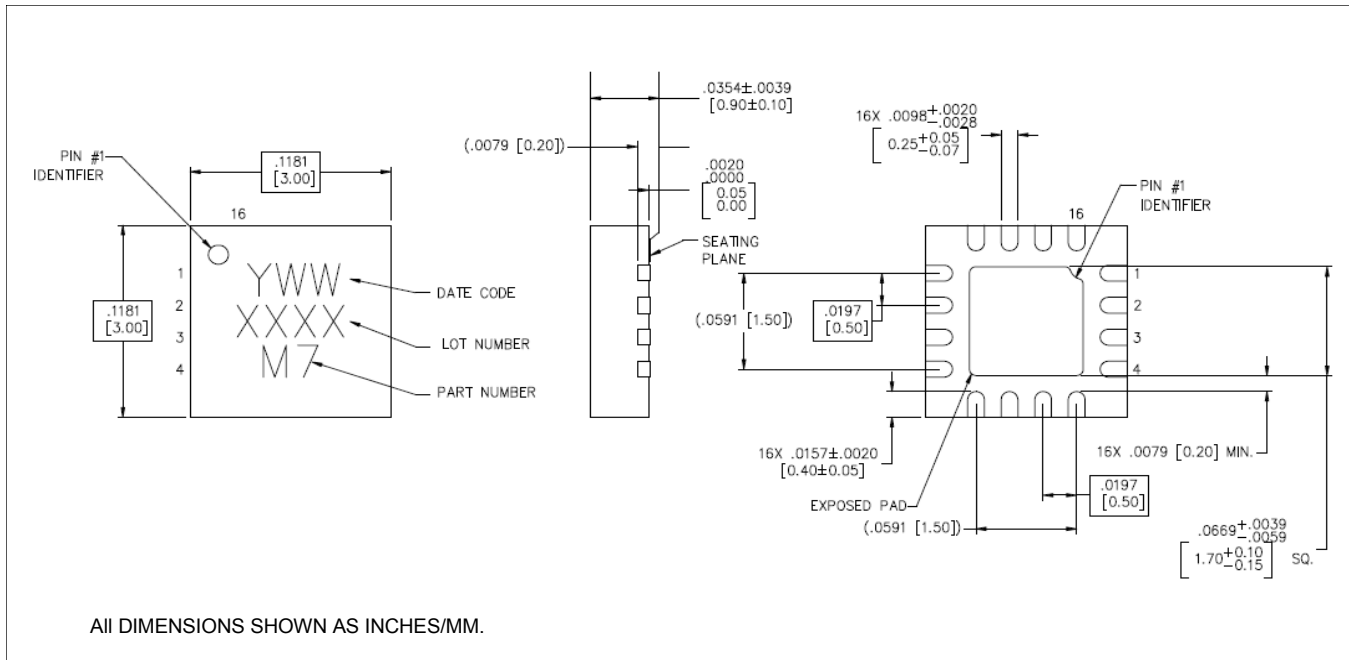
**Input IP3 vs. Attenuation, SCL  $P_{IN} = 6$  dBm**



**Input IP3 vs. Attenuation, SCL  $P_{IN} = 12$  dBm**



## Lead-Free 3 mm 16-Lead PQFN<sup>†</sup>



<sup>†</sup> Reference Application Note S2083 for lead-free solder reflow recommendations.  
Meets JEDEC moisture sensitivity level 1 requirements.  
Plating is NiPdAuAg.



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