

## 7 W Pulsed High Power Amplifier 2.7 - 3.0 GHz, 6 mm PQFN 28-LD

Rev. V3

### Features

- 7 W Pulsed Output Power (Saturated)
- 23 dB Gain
- +10 V Bias Operation
- 50  $\Omega$  Impedance, Balanced Design
- Lead-Free 6 mm 28-lead PQFN Package
- Halogen-Free “Green” Mold Compound
- RoHS\* Compliant and 260°C Reflow Compatible

### Description

The MAAP-011022 is a 2.7 to 3.0 GHz high power balanced amplifier, which is designed for S-Band aviation and weather radar applications. This device puts out 7 W pulsed and is designed to operate at an 8% duty cycle.

The MAAP-011022 is packaged in a lead-free 6 mm 28-lead plastic package for high volume manufacturing. This IC utilizes one of MACOM's advanced 0.5  $\mu$ m processes, which has been optimized so amplifiers, passives, and control components can be combined on a single IC.

This MAAP-011022 is specifically targeted for avionics and weather radar.

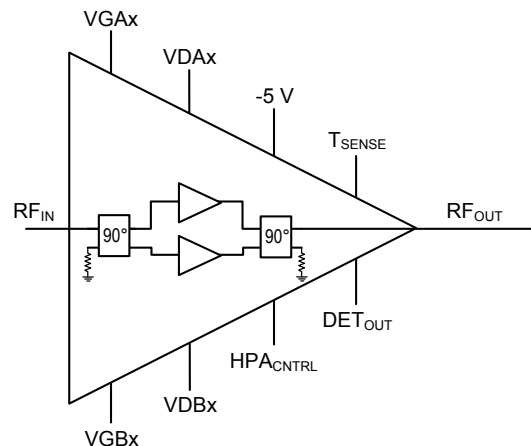
### Ordering Information<sup>1,2</sup>

| Part Number        | Package           |
|--------------------|-------------------|
| MAAP-011022-TR0500 | 500 piece reel    |
| MAAP-011022-001SMB | Sample Test Board |

1. Reference Application Note M513 for reel size information.
2. Sample board includes 5 loose parts.

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

### Functional Block Diagram



### Pin Configuration<sup>3,4,5,6</sup>

| Pin No. | Function      | Pin No.         | Function      |
|---------|---------------|-----------------|---------------|
| 1       | VD2A          | 15              | VC_OUT        |
| 2       | No Connection | 16              | VG1B          |
| 3       | VD1A          | 17              | VG2B          |
| 4       | No Connection | 18              | No Connection |
| 5       | VG2A          | 19              | VD1B          |
| 6       | VG1A          | 20              | No Connection |
| 7       | No Connection | 21              | VD2B          |
| 8       | No Connection | 22              | No Connection |
| 9       | RF_IN         | 23              | RF_OUT        |
| 10      | No Connection | 24              | No Connection |
| 11      | No Connection | 25              | No Connection |
| 12      | No Connection | 26              | No Connection |
| 13      | HPA_CNTRL     | 27              | DET_OUT       |
| 14      | -5 V          | 28              | T_SENSE       |
|         |               | 29 <sup>7</sup> | Ground Pad    |

3. See the evaluation board schematic for the recommended external components.
4. VDAx and VDBx are connected to the +10 V bias.
5. The gates are controlled internally from the bias circuit shown on the evaluation board schematic but need to be bypassed as shown. VGAX must be connected to VGBx.
6. HPA\_CNTRL is tied to +5 V for drain switching. For gate switching the PA is turned off when HPA\_CNTRL is at 0 V.
7. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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**Electrical Specifications: Freq. = 2.7 - 3.0 GHz,  $T_A = 25^\circ\text{C}$ ,  $V_{DAx} = V_{DBx} = +10\text{ V}$ ,  $I_{DQ} = \sim 2.0\text{ A}$ ,  $Z_0 = 50\ \Omega$ , 80  $\mu\text{s}$  Pulse, 8% Duty Cycle**

| Parameter                                                    | Units | Min.  | Typ.  | Max.  |
|--------------------------------------------------------------|-------|-------|-------|-------|
| Small-Signal Gain                                            | dB    | 21.0  | 23.5  | 25    |
| Input / Output Return Loss                                   | dB    | -     | 20    | -     |
| P1dB                                                         | dBm   |       | 37.5  | -     |
| $P_{SAT}$ ( $P_{IN} = +18\text{ dBm}$ )                      | dBm   | 37.0  | 38.3  | -     |
| PAE                                                          | %     | -     | 28.0  | -     |
| Power Detector Voltage <sup>8</sup> @ P3dB                   | mV    | -     | 2200  | -     |
| Temperature Sensor Voltage <sup>9</sup> @ $25^\circ\text{C}$ | V     | -3.50 | -3.24 | -3.00 |
| -5 V Current                                                 | mA    | -     | 9.0   | 20.0  |
| Drain Current                                                | A     | -     | 2.5   | 3.4   |

8. Under RF drive.

9. Slope  $-1.69\text{ mV}/^\circ\text{C}$ 
**Absolute Maximum Ratings<sup>10,11,12,13</sup>**

| Parameter                              | Absolute Maximum                            |
|----------------------------------------|---------------------------------------------|
| RF Input Power                         | +25 dBm                                     |
| Drain Voltage                          | 12 V                                        |
| Gate Voltage ( $V_{GAx}$ , $V_{GBx}$ ) | -3 V to 0 V <sup>13</sup>                   |
| Negative Voltage                       | -6 V $\leq$ -5 V Bias $\leq$ 0.5 V          |
| Duty Cycle                             | 10 %                                        |
| Operating Temperature                  | $-40^\circ\text{C}$ to $+85^\circ\text{C}$  |
| Junction Temperature <sup>14</sup>     | $160^\circ\text{C}$                         |
| Storage Temperature                    | $-65^\circ\text{C}$ to $+125^\circ\text{C}$ |

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.

12. Operating at nominal conditions with  $T_J \leq 160^\circ\text{C}$  will ensure MTTF  $> 1 \times 10^6$  hours.13.  $V_{GAx}$ ,  $V_{GBx}$  can go to +0.3 V if no drain voltage is applied.14. Junction Temperature ( $T_J$ ) =  $T_C + \Theta_{JC} * ((V * I) - (P_{OUT} - P_{IN}))$ 

Typical thermal resistance:

80  $\mu\text{s}$  pulse, 8% duty cycle,  $\Theta_{JC} = 2.0^\circ\text{C}/\text{W}$ a) For  $T_C = +25^\circ\text{C}$ , $T_J = 62^\circ\text{C}$  @ 10 V, 2.5 A,  $P_{OUT} = 6.6\text{ W}$ ,  $P_{IN} = 0.07\text{ W}$ b) For  $T_C = +85^\circ\text{C}$ , $T_J = 143^\circ\text{C}$  @ 10 V, 3.4 A,  $P_{OUT} = 5.0\text{ W}$ ,  $P_{IN} = 0.07\text{ W}$ 
**Handling Procedures**

Please observe the following precautions to avoid damage:

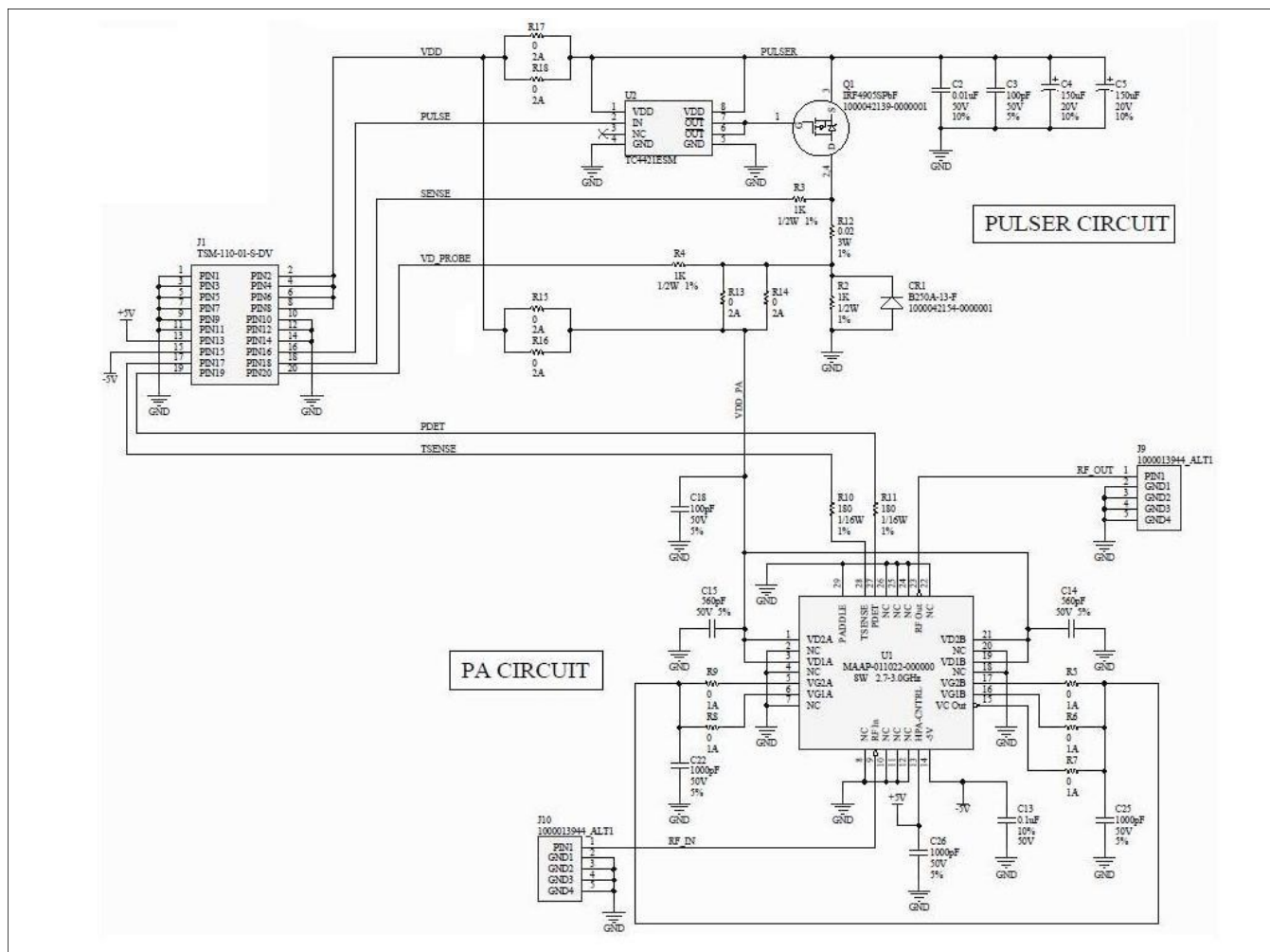
**Static Sensitivity**

Gallium Arsenide and Silicon 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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### Evaluation Board Schematic<sup>15,16</sup>



15. The standard build configuration is to omit resistors R15 & R16. This configuration activates the on-board +10 V pulser circuit.  
16. In order to bypass on-board +10 V pulser circuit, remove R13, R14, R17 & R18, and add R15 & R16.

### Parts List

| Part        | Value         | Case Style |
|-------------|---------------|------------|
| CR1         | 50 V Diode    | -          |
| C2          | .01 $\mu$ F   | 0603       |
| C3, C18     | 100 pF        | 0603       |
| C4, C5      | 150 $\mu$ F   | -          |
| C13         | 0.1 $\mu$ F   | 0402       |
| C14, C15    | 560 pF        | 0402       |
| C22, C25    | 1000 pF       | 0402       |
| R1, R5 - R9 | 0 $\Omega$    | 0402       |
| R2 - R4     | 1 k $\Omega$  | 1210       |
| R10, R11    | 180 $\Omega$  | 0402       |
| R12         | 0.02 $\Omega$ | 4527       |
| R13 - R18   | 0 $\Omega$    | 1206       |

### Parts List

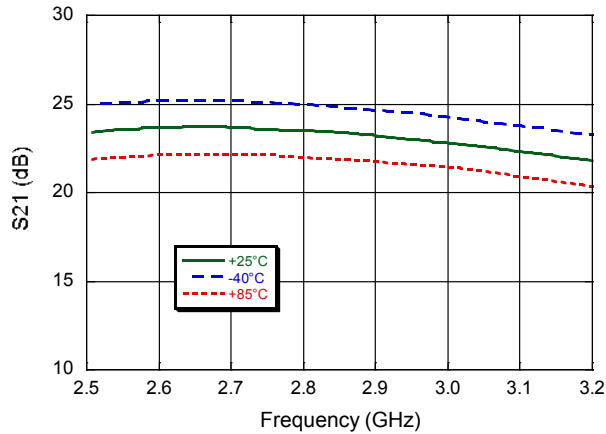
| Part     | Value       | Case Style    |
|----------|-------------|---------------|
| J1       | 10 Row      | Header        |
| J7 - J10 | Connector   | SMA           |
| Q1       | IRF4905SPbF | T0-220AB      |
| U1       | 8 W HPA     | 6mm PQFN-28LD |
| U2       | TC4421ESM   | 8-SOIC        |

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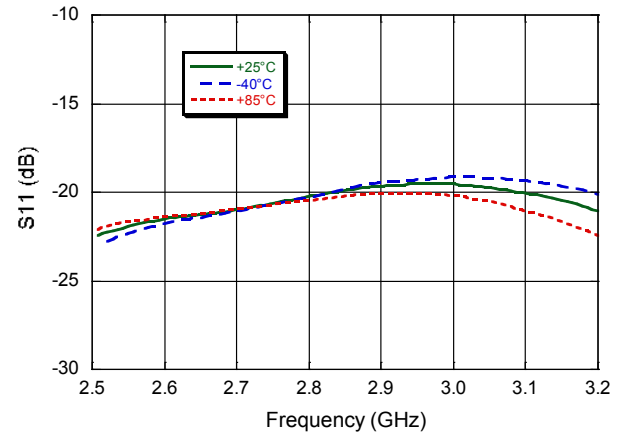
Rev. V3

Typical Performance Curves:  $V_{DAx}=V_{DBx}=10\text{ V}$ ,  $I_{DQ}=2.0\text{ A}$  (80  $\mu\text{s}$  Pulse, 8% Duty Cycle)

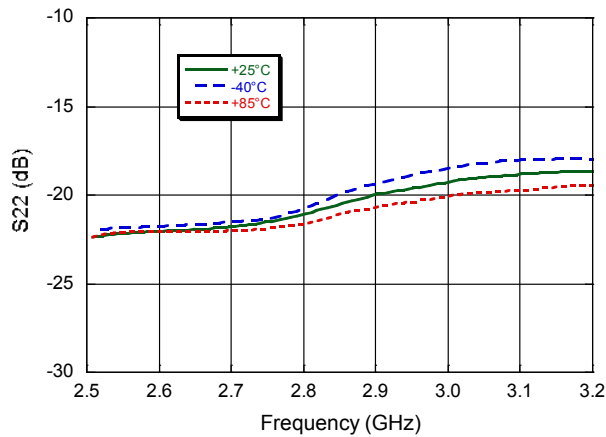
Gain vs. Frequency



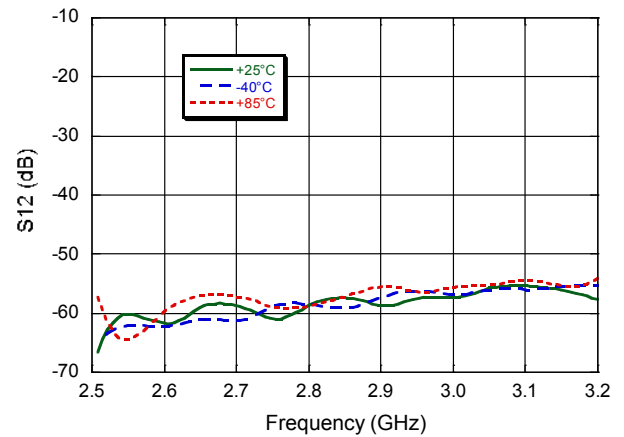
Input Return Loss vs. Frequency



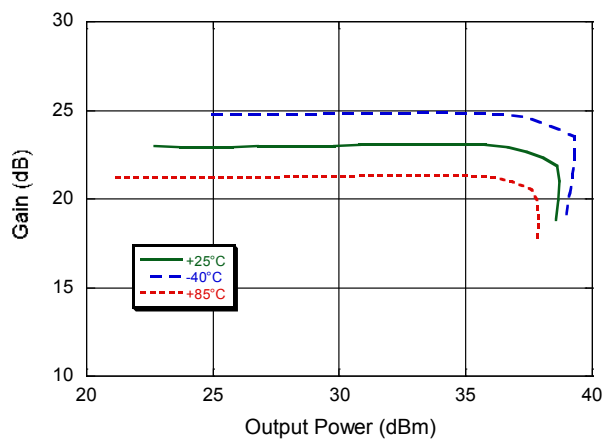
Output Return Loss vs. Frequency



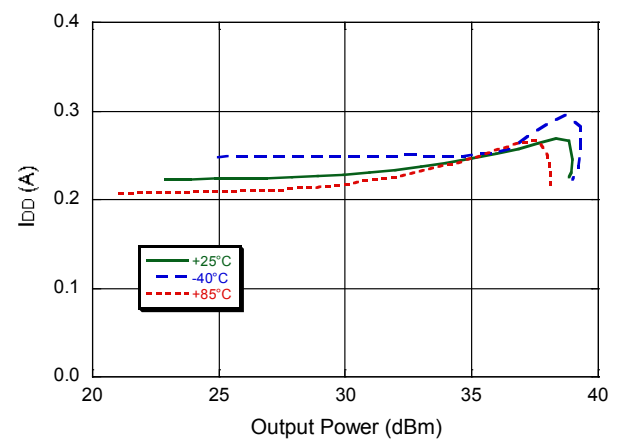
Reverse Isolation vs. Frequency



Gain vs. Output Power



Drain Current vs. Output Power  
(80  $\mu\text{s}$  Pulse, 8% Duty Cycle)

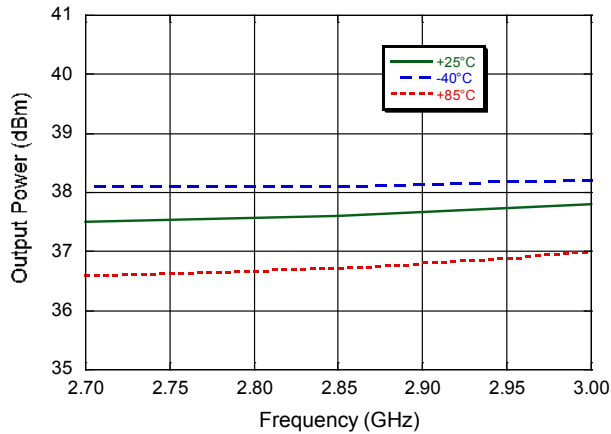


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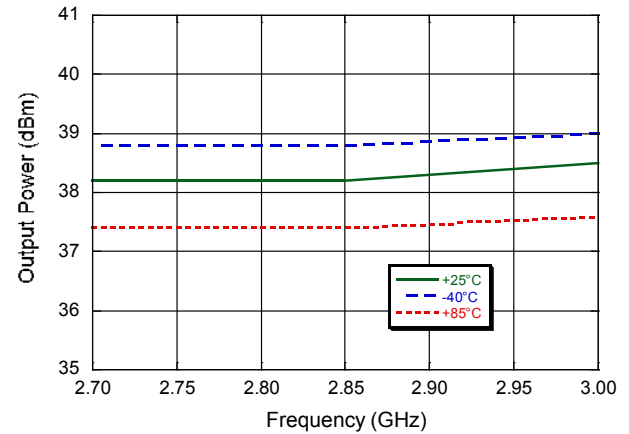
Rev. V3

Typical Performance Curves:  $V_{DAx}=V_{DBx}=10\text{ V}$ ,  $I_{DQ}=2.0\text{ A}$  (80  $\mu\text{s}$  Pulse, 8% Duty Cycle)

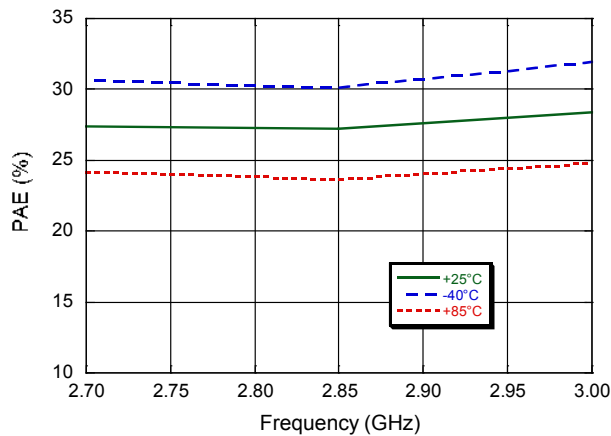
**P1dB vs. Frequency**



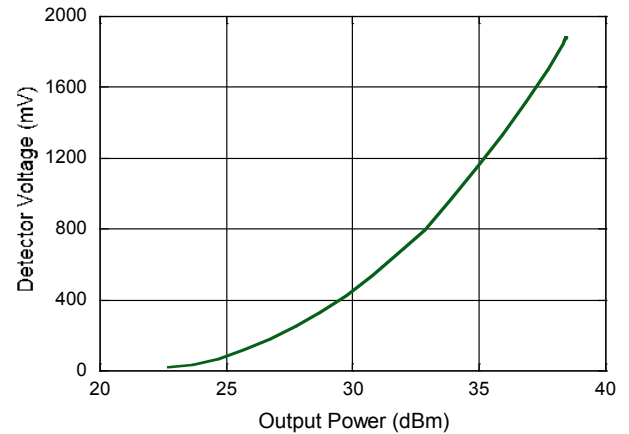
**P3dB vs. Frequency**



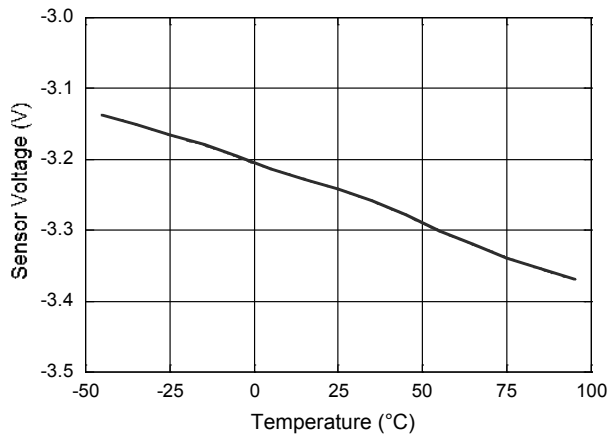
**PAE vs. Frequency**



**Power Detector Voltage vs. Output Power**



**Temperature Sensor Voltage vs. Temperature**

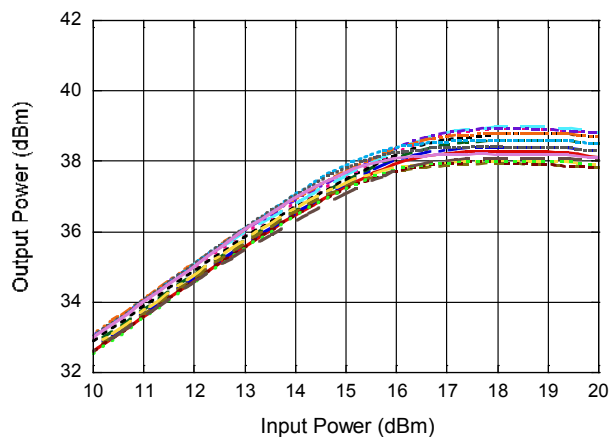


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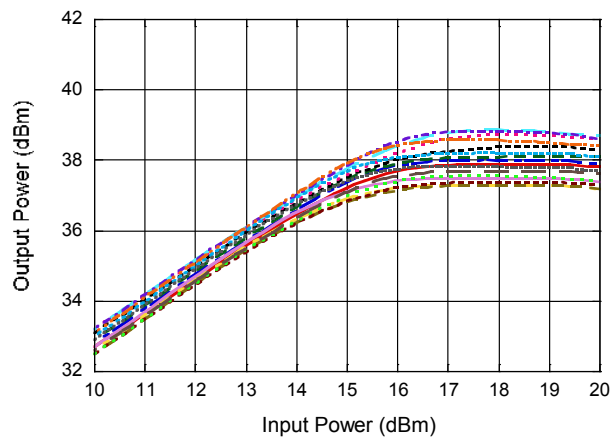
Rev. V3

Typical Performance Curves:  $V_{DAx}=V_{DBx}=10\text{ V}$ ,  $I_{DQ}=2.0\text{ A}$  (80  $\mu\text{s}$  Pulse, 8% Duty Cycle)

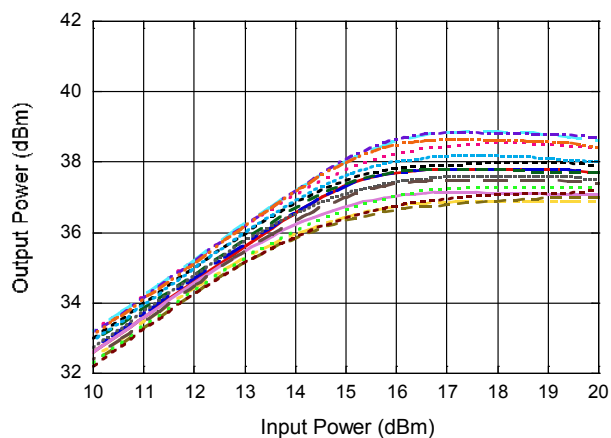
Load Ruggedness 2:1 vs. Input Power



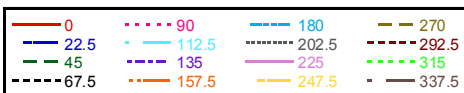
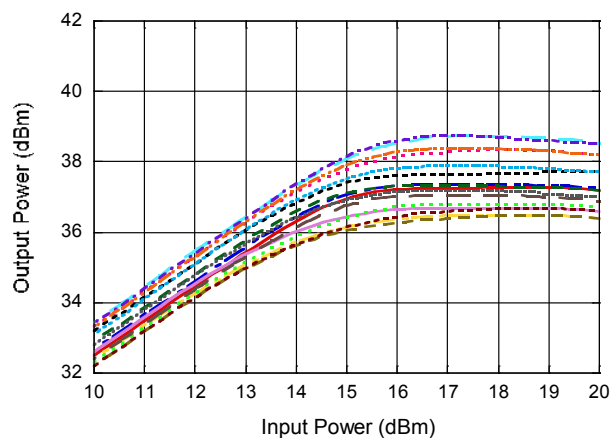
Load Ruggedness 3:1 vs. Input Power



Load Ruggedness 6:1 vs. Input Power



Load Ruggedness 9:1 vs. Input Power

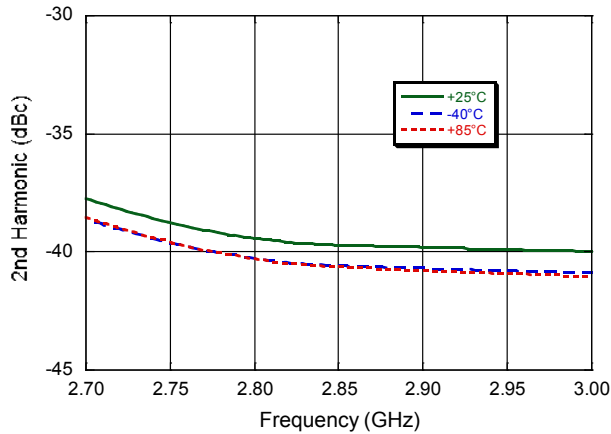


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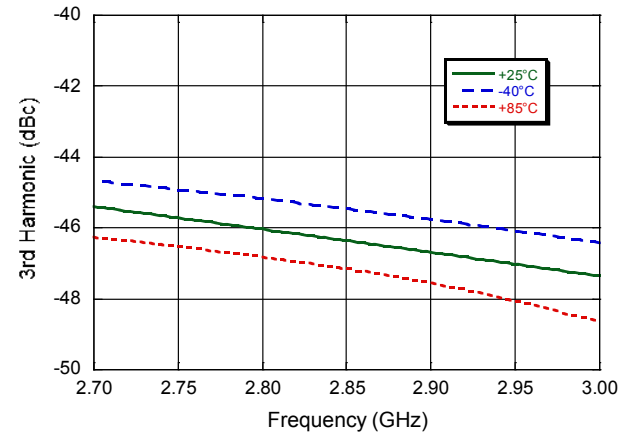
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**Typical Performance Curves:  $V_{DAx}=V_{DBx}=10$  V,  $I_{DQ}=2.0$  A (80  $\mu$ s Pulse, 8% Duty Cycle)**

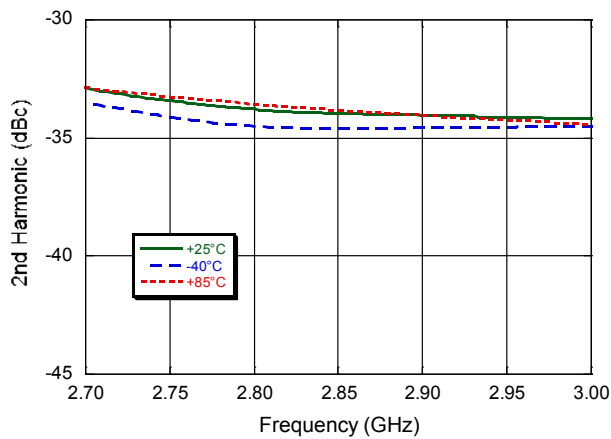
**2nd Harmonic @ P1dB vs. Frequency**



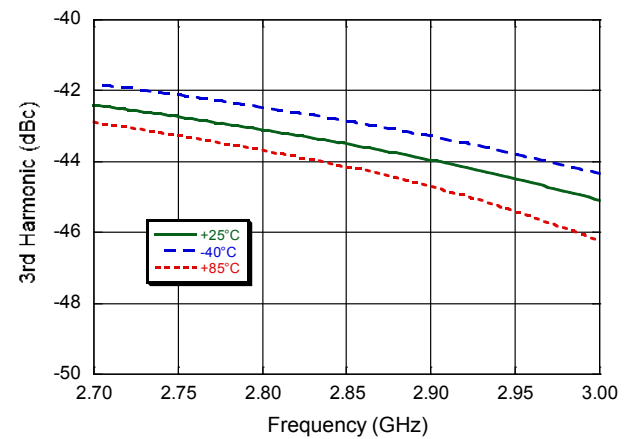
**3rd Harmonic @ P1dB vs. Frequency**



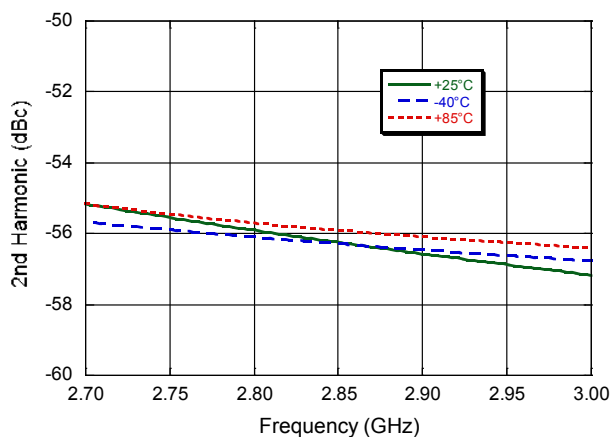
**2nd Harmonic @ P3dB vs. Frequency**



**3rd Harmonic @ P3dB vs. Frequency**



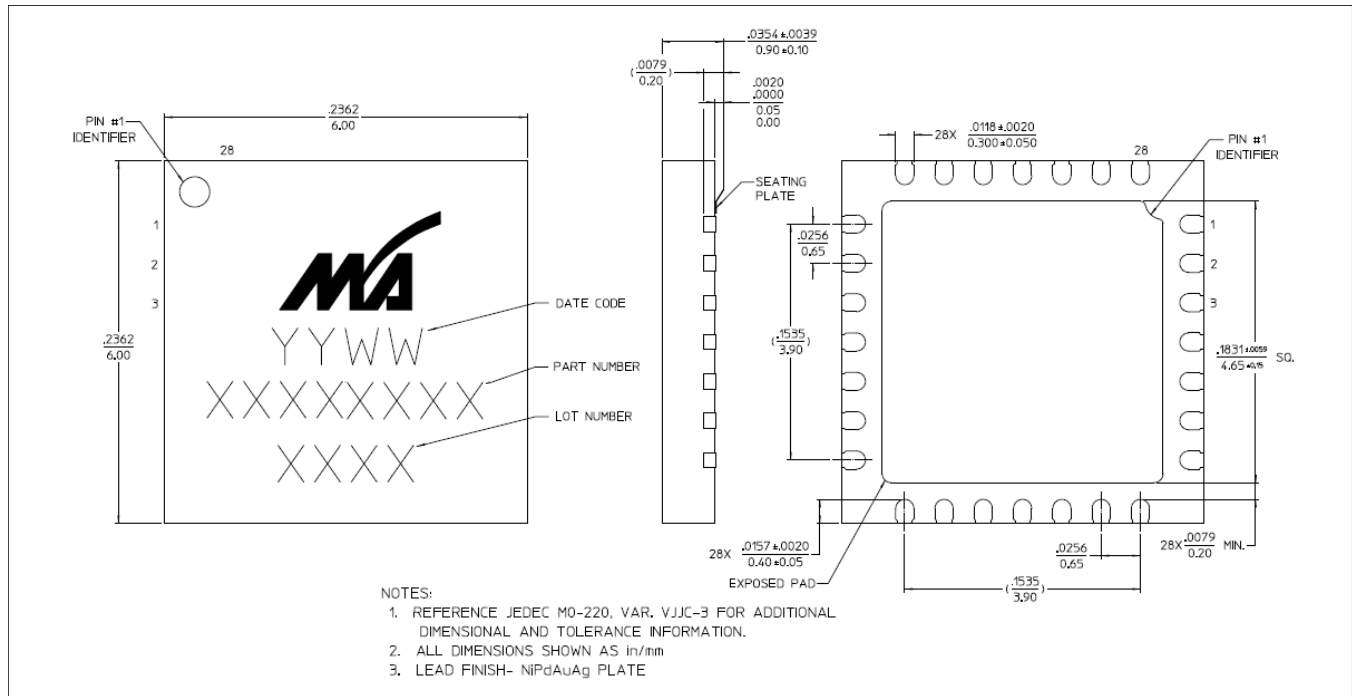
**2nd Harmonic @ -10 dBm vs. Frequency**



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### Lead-Free 6 mm 28-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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