

# 2 W High Gain Power Amplifier for Cellular Infrastructure

## InGaP GaAs HBT

The MMZ25332B4 is a versatile 2-stage power amplifier targeted at driver and pre-driver applications for macro and micro base stations and final stage applications for small cells. Its versatile design allows operation in any frequency band from 1500 to 2700 MHz providing gain of more than 26.5 dB. The device operates off a 5 V supply, and its bias currents and portions of the matching networks are adjustable for optimum performance in any specific application. It is housed in a QFN 4 x 4 surface mount package which allows for maximum via hole pattern. The MMZ25332B4 offers exceptional reliability, ruggedness and ESD performance.

- Typical Performance:  $V_{CC1} = V_{CC2} = V_{BIAS} = 5 \text{ Vdc}$ ,  $I_{CQ} = 400 \text{ mA}$

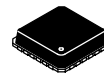
| Frequency | $P_{out}$ (dBm) | $G_{ps}$ (dB) | ACPR (dBc) | $I_{CC}$ (mA) | Test Signal |
|-----------|-----------------|---------------|------------|---------------|-------------|
| 2140 MHz  | 21.7            | 26.5          | -48        | 441           | W-CDMA      |
| 2350 MHz  | 21.5            | 26.6          | -48        | 446           | LTE         |
| 2600 MHz  | 22.5            | 26.7          | -48        | 453           | LTE         |

### Features

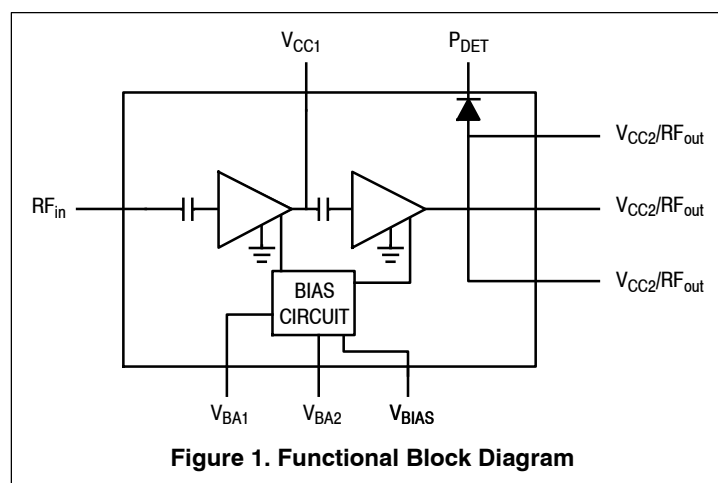
- Frequency: 1500–2700 MHz
- P1dB: 33 dBm @ 2500 MHz
- Power gain: 26.5 dB @ 2500 MHz
- OIP3: 48 dBm @ 2500 MHz
- $EVM \leq 3\%$  @ 23.5 dBm  $P_{out}$ , WLAN (802.11g)
- Active bias control (adjustable externally)
- Power down control via  $V_{BIAS}$
- Single 3 to 5 volt supply
- Single-ended power detector
- Cost-effective 24-pin, 4 mm QFN surface mount plastic package

**MMZ25332B4T1**

**1500–2700 MHz, 26.5 dB, 33 dBm  
InGaP HBT LINEAR AMPLIFIER**



**QFN 4 × 4-24L**



**Table 1. Maximum Ratings**

| Rating                    | Symbol    | Value       | Unit |
|---------------------------|-----------|-------------|------|
| Supply Voltage            | $V_{CC}$  | 6           | V    |
| Supply Current            | $I_{CC}$  | 1200        | mA   |
| RF Input Power            | $P_{in}$  | 30          | dBm  |
| Storage Temperature Range | $T_{stg}$ | -65 to +150 | °C   |
| Junction Temperature      | $T_J$     | 175         | °C   |

**Table 2. Thermal Characteristics**

| Characteristic                                                                                        | Symbol             | Value <sup>(1)</sup> | Unit |
|-------------------------------------------------------------------------------------------------------|--------------------|----------------------|------|
| Thermal Resistance, Junction to Case<br>Case Temperature 95°C, $V_{CC1} = V_{CC2} = V_{BIAS} = 5$ Vdc | $R_{\theta JC}$    | 70<br>22             | °C/W |
|                                                                                                       | Stage 1<br>Stage 2 |                      |      |

**Table 3. Electrical Characteristics** ( $V_{CC1} = V_{CC2} = V_{BIAS} = 5$  Vdc, 2600 MHz,  $T_A = 25^\circ\text{C}$ , 50 ohm system, in NXP CW Application Circuit)

| Characteristic                 | Symbol   | Min  | Typ | Max | Unit |
|--------------------------------|----------|------|-----|-----|------|
| Small-Signal Gain (S21)        | $G_p$    | 23.5 | 26  | —   | dB   |
| Input Return Loss (S11)        | IRL      | —    | -13 | —   | dB   |
| Output Return Loss (S22)       | ORL      | —    | -18 | —   | dB   |
| Power Output @ 1dB Compression | P1dB     | —    | 33  | —   | dBm  |
| Intercept Point, Two-Tone CW   | OIP3     | —    | 48  | —   | dBm  |
| Supply Current                 | $I_{CQ}$ | 368  | 392 | 415 | mA   |
| Supply Voltage                 | $V_{CC}$ | —    | 5   | —   | V    |

**Table 4. ESD Protection Characteristics**

| Test Methodology                      | Class |
|---------------------------------------|-------|
| Human Body Model (per JESD22-A114)    | 2     |
| Machine Model (per EIA/JESD22-A115)   | B     |
| Charge Device Model (per JESD22-C101) | IV    |

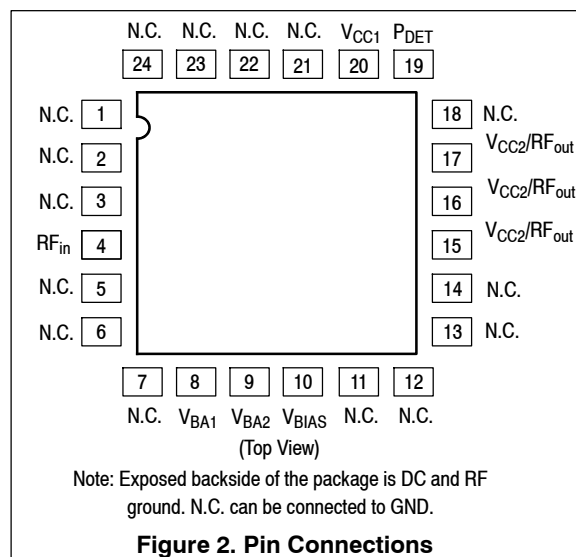
**Table 5. Moisture Sensitivity Level**

| Test Methodology                     | Rating | Package Peak Temperature | Unit |
|--------------------------------------|--------|--------------------------|------|
| Per JESD22-A113, IPC/JEDEC J-STD-020 | 1      | 260                      | °C   |

**Table 6. Ordering Information**

| Device       | Tape and Reel Information                               | Package       |
|--------------|---------------------------------------------------------|---------------|
| MMZ25332B4T1 | T1 Suffix = 1,000 Units, 12 mm Tape Width, 13-inch Reel | QFN 4 × 4-24L |

1. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.nxp.com/RF> and search for AN1955.



## 50 OHM APPLICATION CIRCUIT: 2500–2700 MHz, 5 VOLT OPERATION

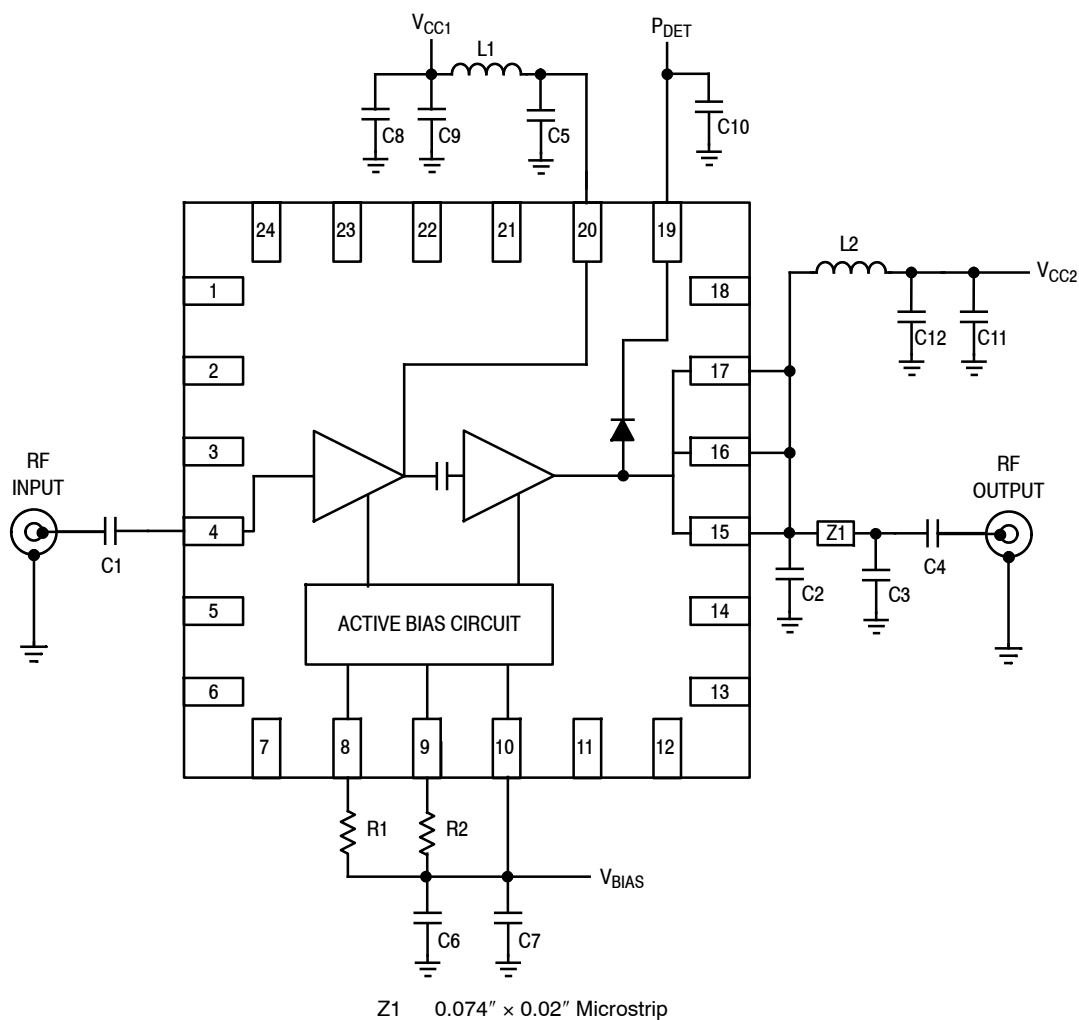
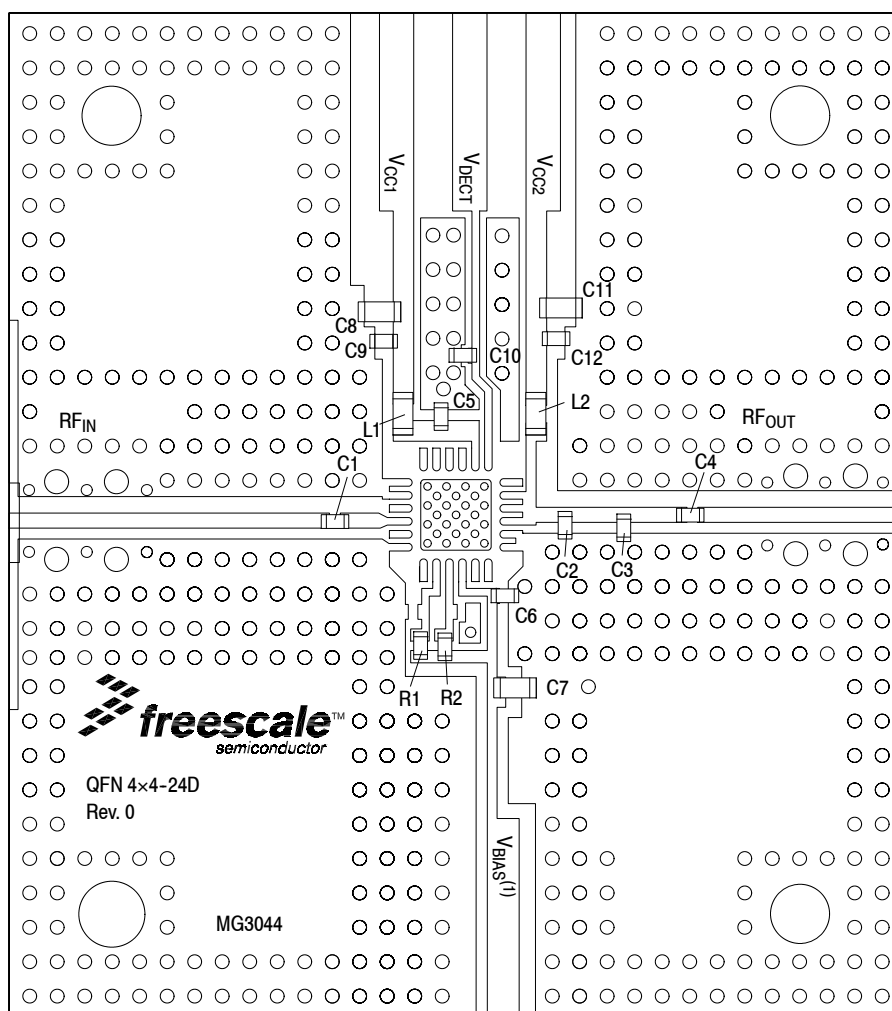


Figure 3. MMZ25332B4T1 Test Circuit Schematic

Table 7. MMZ25332B4T1 Test Circuit Component Designations and Values

| Part        | Description                                 | Part Number       | Manufacturer |
|-------------|---------------------------------------------|-------------------|--------------|
| C1, C4      | 22 pF Chip Capacitors                       | 04023J22R0BBS     | AVX          |
| C2          | 2 pF Chip Capacitor                         | 04023J2R0BBS      | AVX          |
| C3          | 1.8 pF Chip Capacitor                       | 04023J1R8BBS      | AVX          |
| C5          | 8.2 pF Chip Capacitor                       | 04023J8R2BBS      | AVX          |
| C6, C9, C12 | 1000 pF Chip Capacitors                     | GCM155R71E103KA37 | Murata       |
| C7, C8      | 1 uF Chip Capacitors                        | GRM155R61A105KE15 | Murata       |
| C10         | 470 pF Chip Capacitor                       | GRM1555C1H471JA01 | Murata       |
| C11         | 4.7 μF Chip Capacitor                       | GRM188R60J475KE19 | Murata       |
| L1          | 12 nH Chip Inductor                         | 0603HC-12NX       | Coilcraft    |
| L2          | 6.8 nH Chip Inductor                        | 0603HC-6N8X       | Coilcraft    |
| R1          | 1200 Ω, 1/16 W Chip Resistor                | RC0402JR-071K2L   | Yageo        |
| R2          | 330 Ω, 1/16 W Chip Resistor                 | RC0402JR-07330L   | Yageo        |
| PCB         | Rogers RO4350B, 0.010", $\epsilon_r = 3.66$ | MG3044            | MTL          |

## 50 OHM APPLICATION CIRCUIT: 2500–2700 MHz, 5 VOLT OPERATION



PCB actual size: 1.30" × 1.46".

(1)  $V_{BIAS}$  [Board] supplies  $V_{BA1}$ ,  $V_{BA2}$  and  $V_{BIAS}$  [Device].

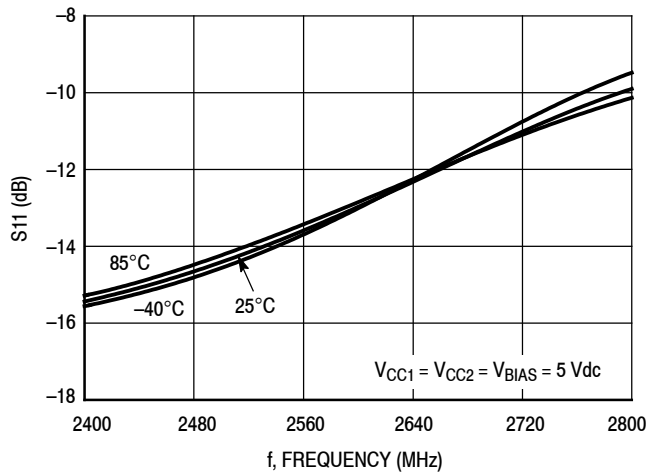
**Figure 4. MMZ25332B4T1 Test Circuit Component Layout**

**Table 7. MMZ25332B4T1 Test Circuit Component Designations and Values**

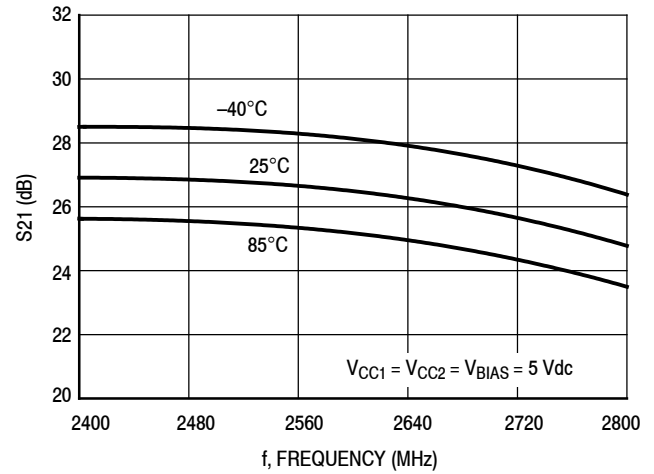
| Part        | Description                                 | Part Number       | Manufacturer |
|-------------|---------------------------------------------|-------------------|--------------|
| C1, C4      | 22 pF Chip Capacitors                       | 04023J22R0BBS     | AVX          |
| C2          | 2 pF Chip Capacitor                         | 04023J2R0BBS      | AVX          |
| C3          | 1.8 pF Chip Capacitor                       | 04023J1R8BBS      | AVX          |
| C5          | 8.2 pF Chip Capacitor                       | 04023J8R2BBS      | AVX          |
| C6, C9, C12 | 1000 pF Chip Capacitors                     | GCM155R71E103KA37 | Murata       |
| C7, C8      | 1 uF Chip Capacitors                        | GRM155R61A105KE15 | Murata       |
| C10         | 470 pF Chip Capacitor                       | GRM1555C1H471JA01 | Murata       |
| C11         | 4.7 uF Chip Capacitor                       | GRM188R60J475KE19 | Murata       |
| L1          | 12 nH Chip Inductor                         | 0603HC-12NX       | Coilcraft    |
| L2          | 6.8 nH Chip Inductor                        | 0603HC-6N8X       | Coilcraft    |
| R1          | 1200 $\Omega$ , 1/16 W Chip Resistor        | RC0402JR-071K2L   | Yageo        |
| R2          | 330 $\Omega$ , 1/16 W Chip Resistor         | RC0402JR-07330L   | Yageo        |
| PCB         | Rogers RO4350B, 0.010", $\epsilon_r = 3.66$ | MG3044            | MTL          |

(Test Circuit Component Designations and Values table repeated for reference.)

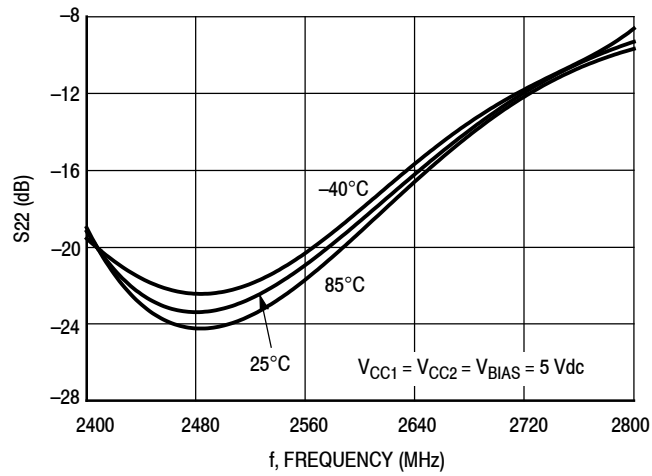
## 50 OHM APPLICATION CIRCUIT: 2500–2700 MHz, 5 VOLT OPERATION



**Figure 5. S11 versus Frequency versus Temperature**

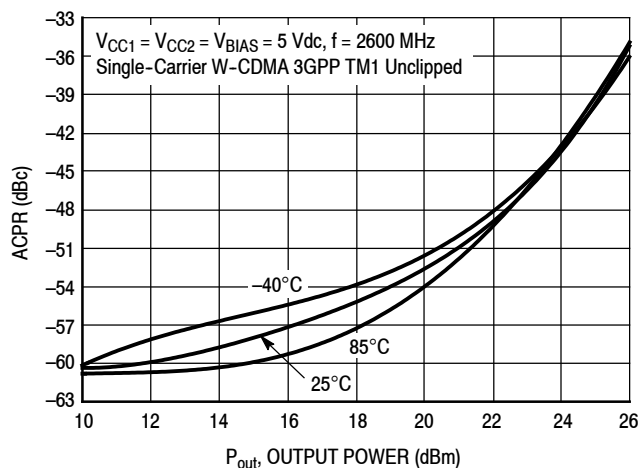


**Figure 6. S21 versus Frequency versus Temperature**

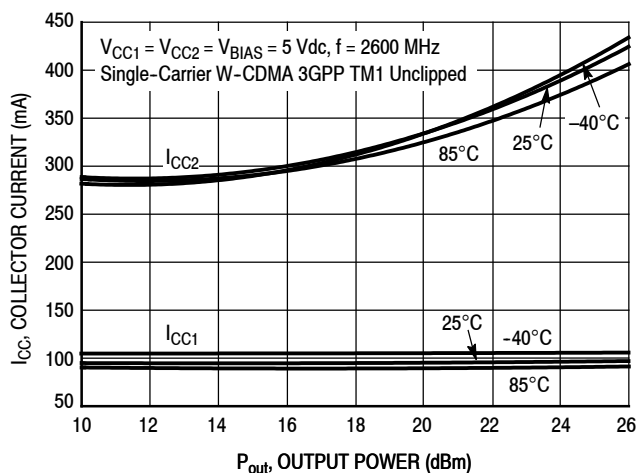


**Figure 7. S22 versus Frequency versus Temperature**

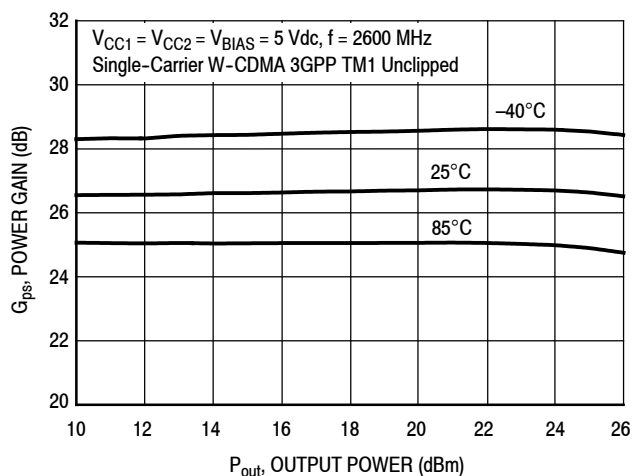
## 50 OHM APPLICATION CIRCUIT: 2500–2700 MHz, 5 VOLT OPERATION



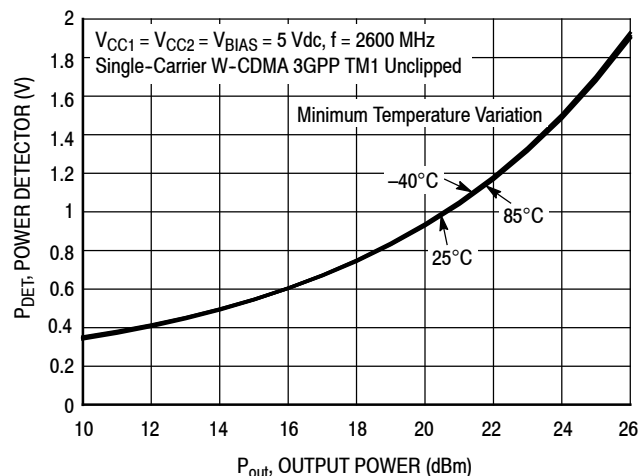
**Figure 8. ACPR versus Output Power versus Temperature**



**Figure 9. Stage Collector Current versus Output Power versus Temperature**



**Figure 10. Power Gain versus Output Power versus Temperature**



**Figure 11. Power Detector versus Output Power versus Temperature**

## 50 OHM APPLICATION CIRCUIT: 2110–2170 MHz, 5 VOLT OPERATION

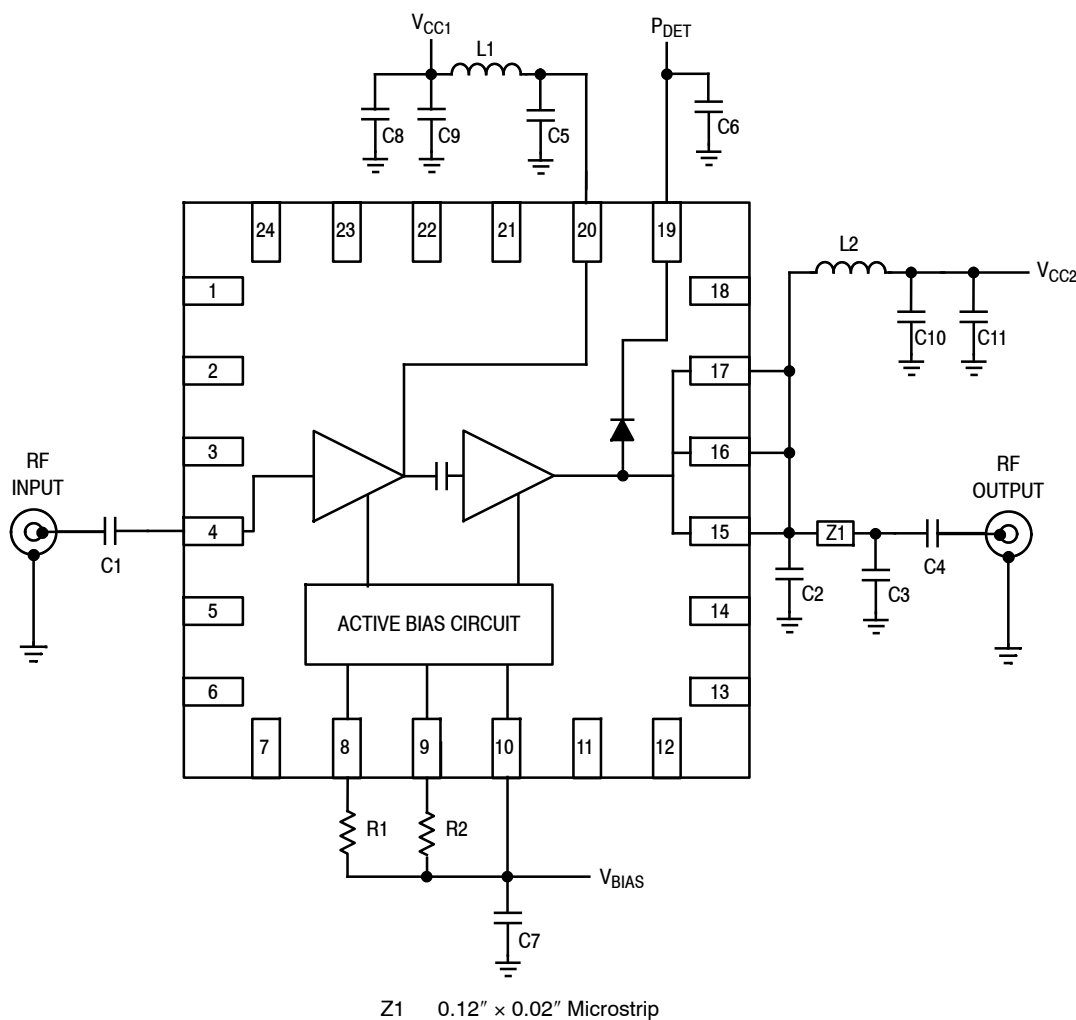
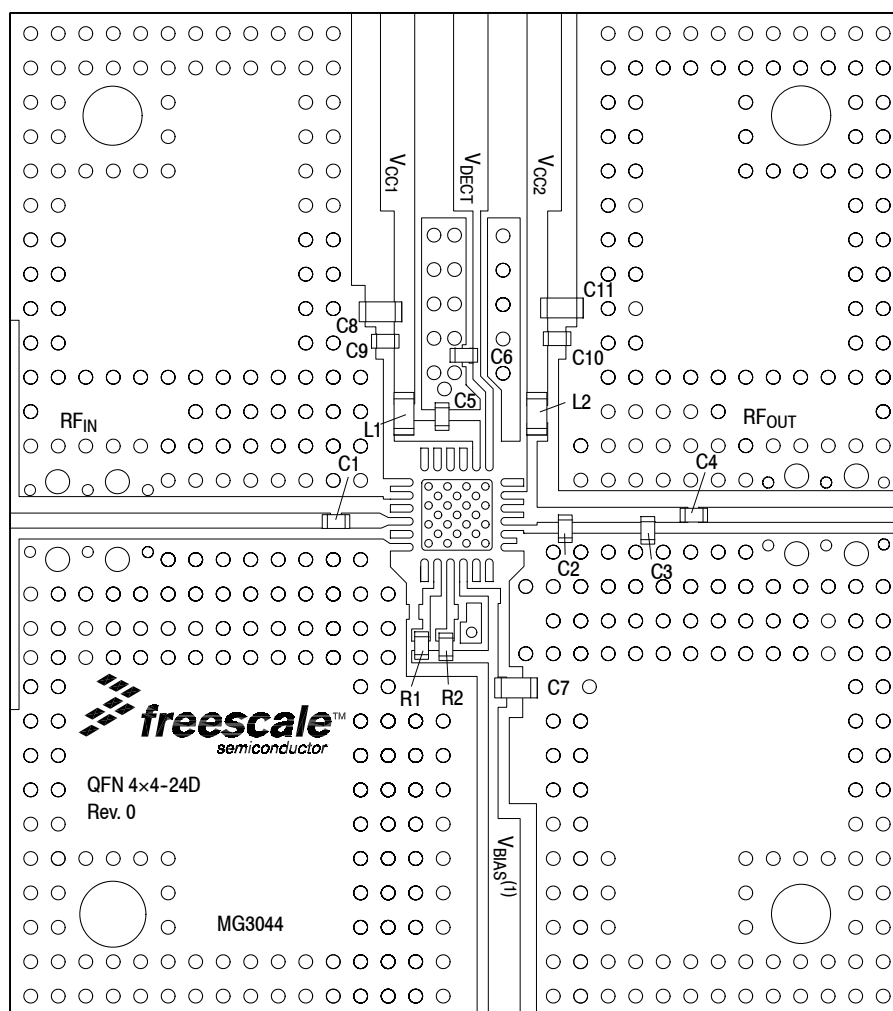


Figure 12. MMZ25332B4T1 Test Circuit Schematic

Table 8. MMZ25332B4T1 Test Circuit Component Designations and Values

| Part    | Description                                 | Part Number       | Manufacturer |
|---------|---------------------------------------------|-------------------|--------------|
| C1, C4  | 22 pF Chip Capacitors                       | 04023J22R0BBS     | AVX          |
| C2      | 2.4 pF Chip Capacitor                       | 04023J2R4BBS      | AVX          |
| C3      | 2.2 pF Chip Capacitor                       | 04023J2R2BBS      | AVX          |
| C5      | 6.8 pF Chip Capacitor                       | 04023J6R8BBS      | AVX          |
| C6      | 470 pF Chip Capacitor                       | GRM1555C1H471JA01 | Murata       |
| C7, C8  | 1 $\mu$ F Chip Capacitors                   | GRM155R61A105KE15 | Murata       |
| C9, C10 | 1000 pF Chip Capacitors                     | GCM155R71E102KA37 | Murata       |
| C11     | 4.7 $\mu$ F Chip Capacitor                  | GRM188R60J475KE19 | Murata       |
| L1      | 12 nH Chip Inductor                         | 0603HC-12NX       | Coilcraft    |
| L2      | 5.6 nH Chip Inductor                        | LL1608-FSL5N6S    | Toko         |
| R1      | 1.2 k $\Omega$ , 1/16 W Chip Resistor       | RC0402JR-071K2L   | Yageo        |
| R2      | 330 $\Omega$ , 1/16 W Chip Resistor         | RC0402JR-07330L   | Yageo        |
| PCB     | Rogers RO4350B, 0.010", $\epsilon_r = 3.66$ | MG3044            | MTL          |

## 50 OHM APPLICATION CIRCUIT: 2110–2170 MHz, 5 VOLT OPERATION



PCB actual size: 1.30" × 1.46".

(1) V<sub>BIAS</sub> [Board] supplies V<sub>BA1</sub>, V<sub>BA2</sub> and V<sub>BIAS</sub> [Device].

**Figure 13. MMZ25332B4T1 Test Circuit Component Layout**

**Table 8. MMZ25332B4T1 Test Circuit Component Designations and Values**

| Part    | Description                                 | Part Number       | Manufacturer |
|---------|---------------------------------------------|-------------------|--------------|
| C1, C4  | 22 pF Chip Capacitors                       | 04023J22R0BBS     | AVX          |
| C2      | 2.4 pF Chip Capacitor                       | 04023J2R4BBS      | AVX          |
| C3      | 2.2 pF Chip Capacitor                       | 04023J2R2BBS      | AVX          |
| C5      | 6.8 pF Chip Capacitor                       | 04023J6R8BBS      | AVX          |
| C6      | 470 pF Chip Capacitor                       | GRM1555C1H471JA01 | Murata       |
| C7, C8  | 1 $\mu$ F Chip Capacitors                   | GRM155R61A105KE15 | Murata       |
| C9, C10 | 1000 pF Chip Capacitors                     | GCM155R71E102KA37 | Murata       |
| C11     | 4.7 $\mu$ F Chip Capacitor                  | GRM188R60J475KE19 | Murata       |
| L1      | 12 nH Chip Inductor                         | 0603HC-12NX       | Coilcraft    |
| L2      | 5.6 nH Chip Inductor                        | LL1608-FSL5N6S    | Toko         |
| R1      | 1.2 k $\Omega$ , 1/16 W Chip Resistor       | RC0402JR-071K2L   | Yageo        |
| R2      | 330 $\Omega$ , 1/16 W Chip Resistor         | RC0402JR-07330L   | Yageo        |
| PCB     | Rogers RO4350B, 0.010", $\epsilon_r = 3.66$ | MG3044            | MTL          |

(Test Circuit Component Designations and Values table repeated for reference.)

## 50 OHM APPLICATION CIRCUIT: 2110–2170 MHz, 5 VOLT OPERATION

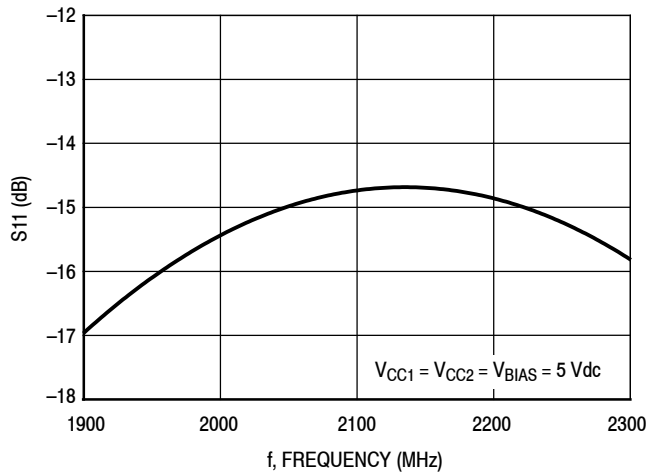


Figure 14. S11 versus Frequency

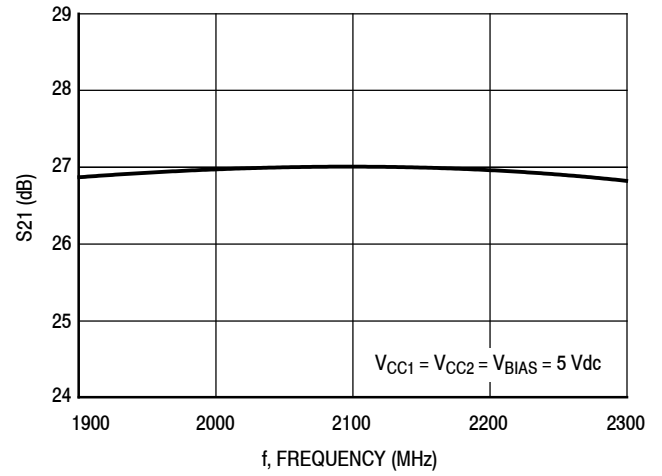


Figure 15. S21 versus Frequency

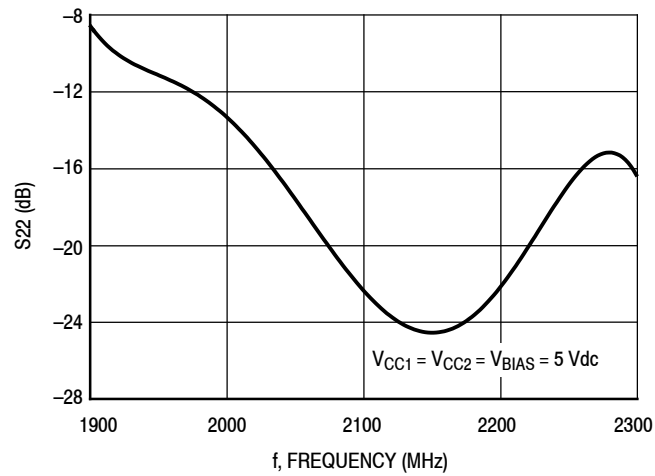


Figure 16. S22 versus Frequency

## 50 OHM APPLICATION CIRCUIT: 2110–2170 MHz, 5 VOLT OPERATION

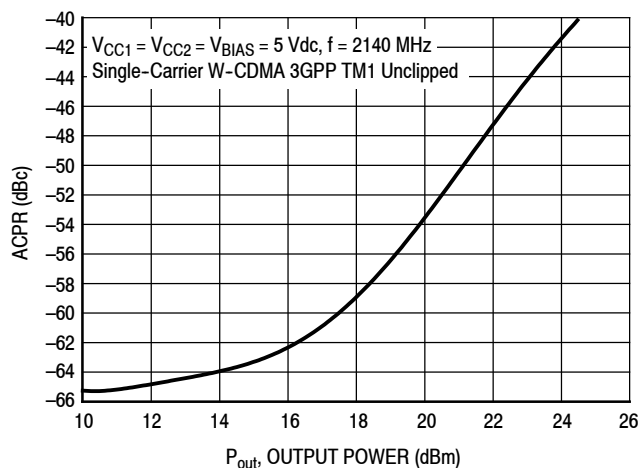


Figure 17. ACPR versus Output Power

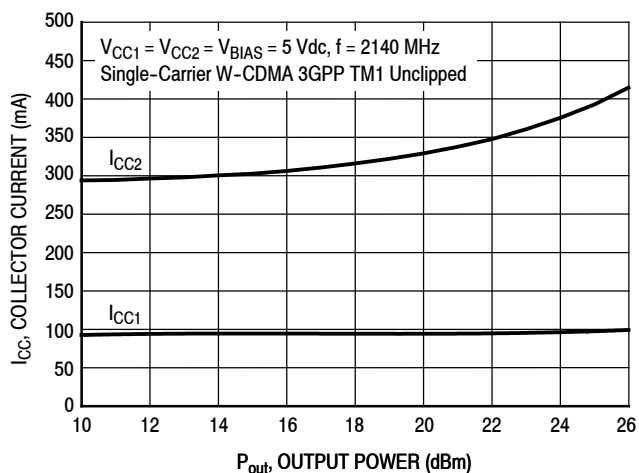


Figure 18. Stage Collector Current versus Output Power

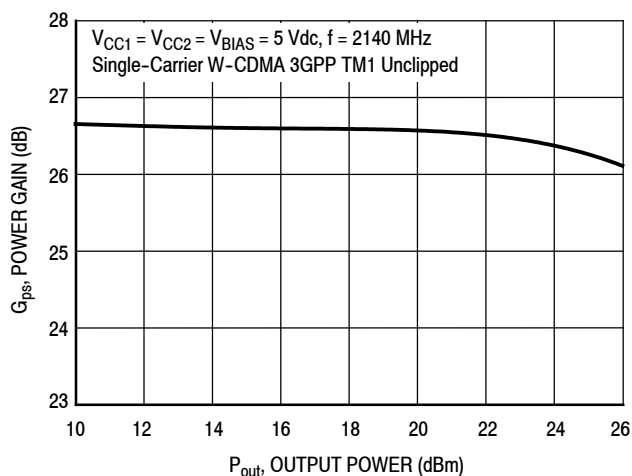


Figure 19. Power Gain versus Output Power

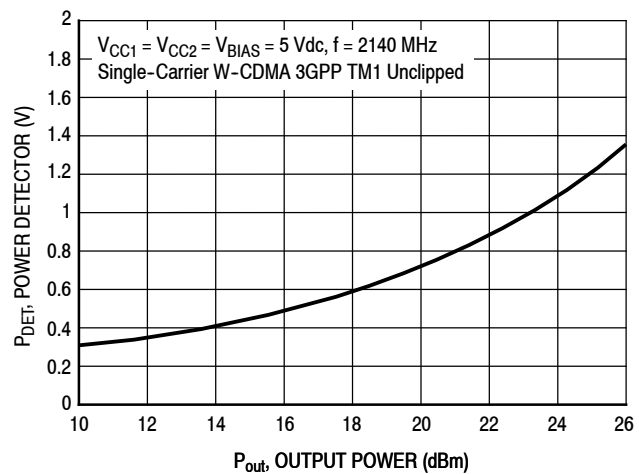


Figure 20. Power Detector versus Output Power

## 50 OHM APPLICATION CIRCUIT: 2300–2400 MHz, 5 VOLT OPERATION

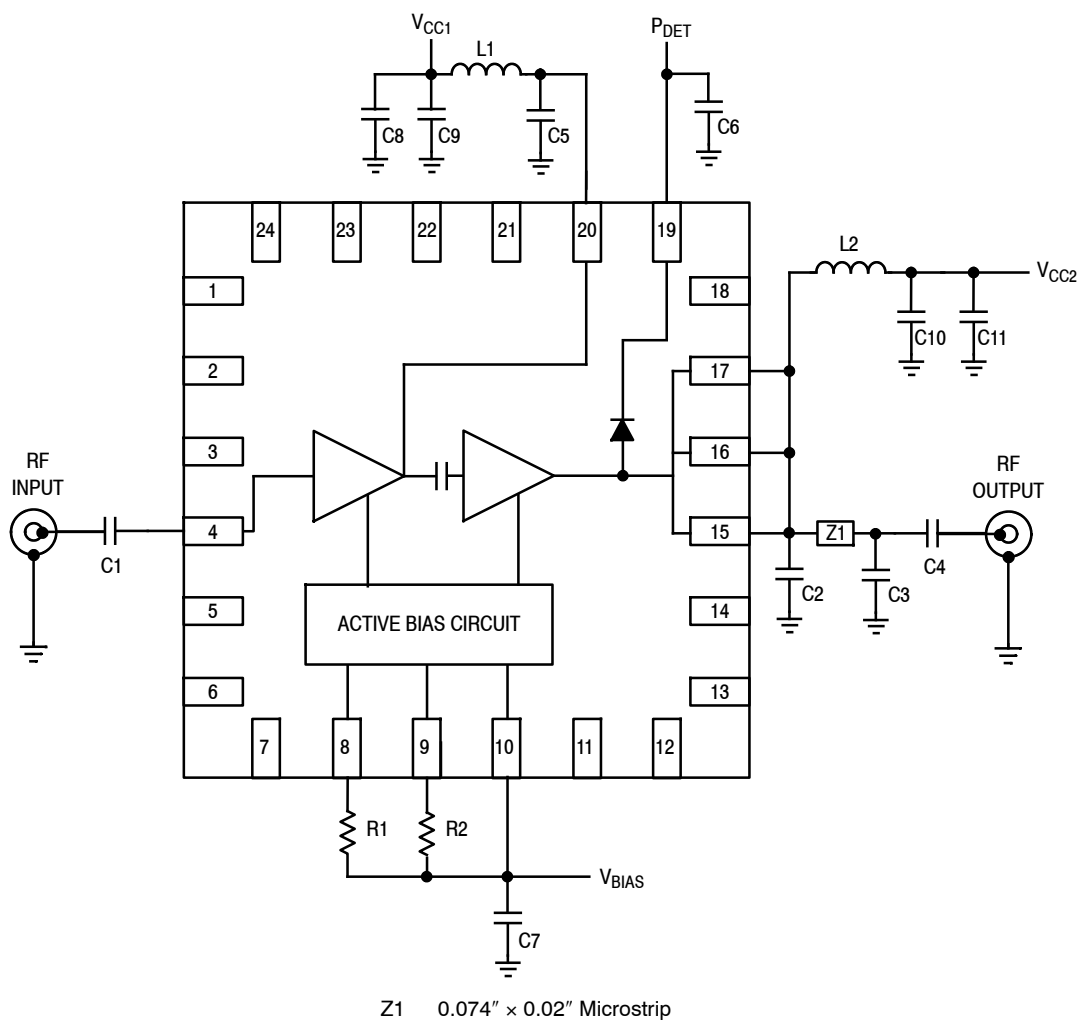
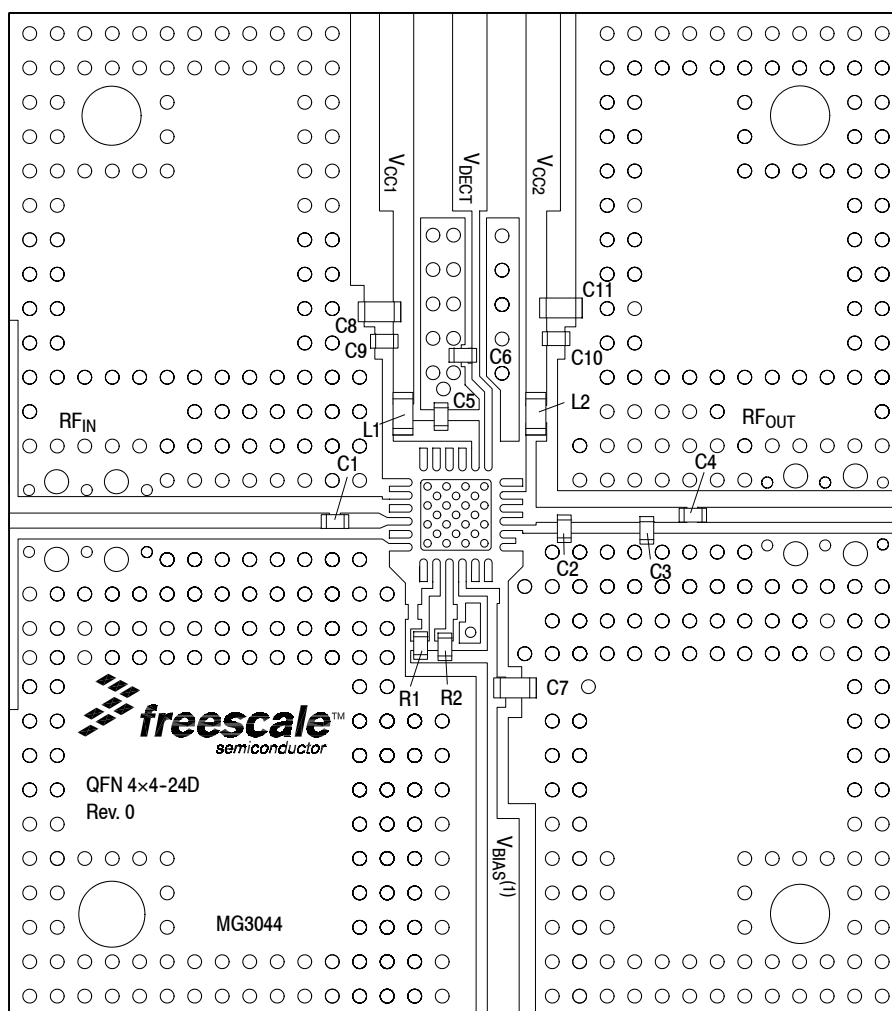


Figure 21. MMZ25332B4T1 Test Circuit Schematic

Table 9. MMZ25332B4T1 Test Circuit Component Designations and Values

| Part    | Description                                 | Part Number       | Manufacturer |
|---------|---------------------------------------------|-------------------|--------------|
| C1, C4  | 22 pF Chip Capacitors                       | 04023J22R0BBS     | AVX          |
| C2      | 2.0 pF Chip Capacitor                       | 04023J2R4BBS      | AVX          |
| C3      | 2.2 pF Chip Capacitor                       | 04023J2R2BBS      | AVX          |
| C5      | 8.2 pF Chip Capacitor                       | 04023J6R8BBS      | AVX          |
| C6      | 470 pF Chip Capacitor                       | GRM1555C1H471JA01 | Murata       |
| C7, C8  | 1 μF Chip Capacitors                        | GRM155R61A105KE15 | Murata       |
| C9, C10 | 1000 pF Chip Capacitors                     | GCM155R71E102KA37 | Murata       |
| C11     | 4.7 μF Chip Capacitor                       | GRM188R60J475KE19 | Murata       |
| L1      | 12 nH Chip Inductor                         | 0603HC-12NX       | Coilcraft    |
| L2      | 6.8 nH Chip Inductor                        | LL1608-FSL5N6S    | Toko         |
| R1      | 1.2 kΩ, 1/16 W Chip Resistor                | RC0402JR-071K2L   | Yageo        |
| R2      | 330 Ω, 1/16 W Chip Resistor                 | RC0402JR-07330L   | Yageo        |
| PCB     | Rogers RO4350B, 0.010", $\epsilon_r = 3.66$ | MG3044            | MTL          |

## 50 OHM APPLICATION CIRCUIT: 2300–2400 MHz, 5 VOLT OPERATION



PCB actual size: 1.30" × 1.46".

(1) V<sub>BIAS</sub> [Board] supplies V<sub>BA1</sub>, V<sub>BA2</sub> and V<sub>BIAS</sub> [Device].

**Figure 22. MMZ25332B4T1 Test Circuit Component Layout**

**Table 9. MMZ25332B4T1 Test Circuit Component Designations and Values**

| Part    | Description                                   | Part Number       | Manufacturer |
|---------|-----------------------------------------------|-------------------|--------------|
| C1, C4  | 22 pF Chip Capacitors                         | 04023J22R0BBS     | AVX          |
| C2      | 2.0 pF Chip Capacitor                         | 04023J2R4BBS      | AVX          |
| C3      | 2.2 pF Chip Capacitor                         | 04023J2R2BBS      | AVX          |
| C5      | 8.2 pF Chip Capacitor                         | 04023J6R8BBS      | AVX          |
| C6      | 470 pF Chip Capacitor                         | GRM1555C1H471JA01 | Murata       |
| C7, C8  | 1 μF Chip Capacitors                          | GRM155R61A105KE15 | Murata       |
| C9, C10 | 1000 pF Chip Capacitors                       | GCM155R71E102KA37 | Murata       |
| C11     | 4.7 μF Chip Capacitor                         | GRM188R60J475KE19 | Murata       |
| L1      | 12 nH Chip Inductor                           | 0603HC-12NX       | Coilcraft    |
| L2      | 6.8 nH Chip Inductor                          | LL1608-FSL5N6S    | Toko         |
| R1      | 1.2 kΩ, 1/16 W Chip Resistor                  | RC0402JR-071K2L   | Yageo        |
| R2      | 330 Ω, 1/16 W Chip Resistor                   | RC0402JR-07330L   | Yageo        |
| PCB     | Rogers RO4350B, 0.010", ε <sub>r</sub> = 3.66 | MG3044            | MTL          |

(Test Circuit Component Designations and Values table repeated for reference.)

## 50 OHM APPLICATION CIRCUIT: 2300–2400 MHz, 5 VOLT OPERATION

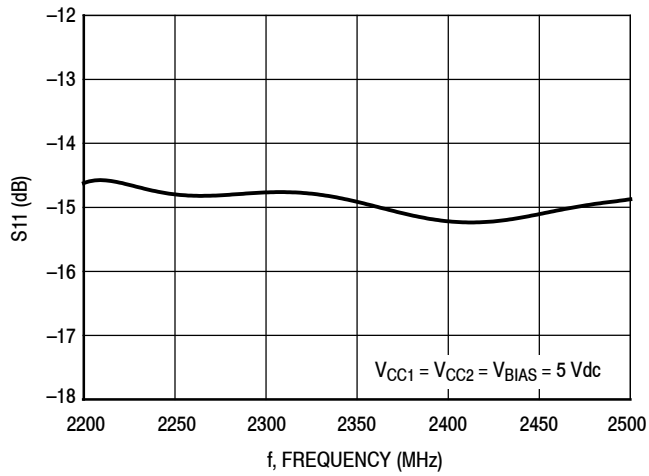


Figure 23. S11 versus Frequency

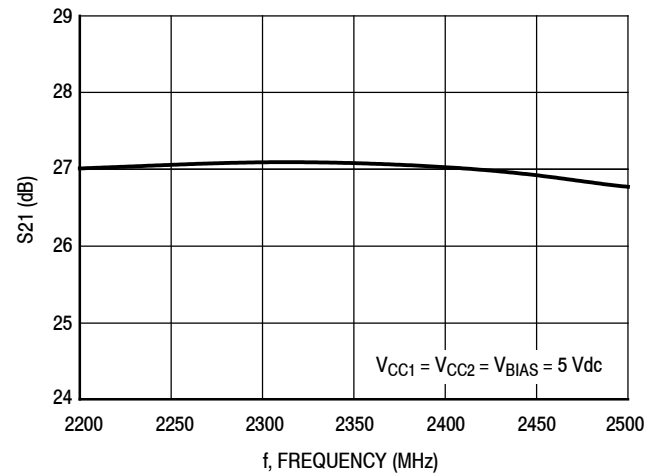


Figure 24. S21 versus Frequency

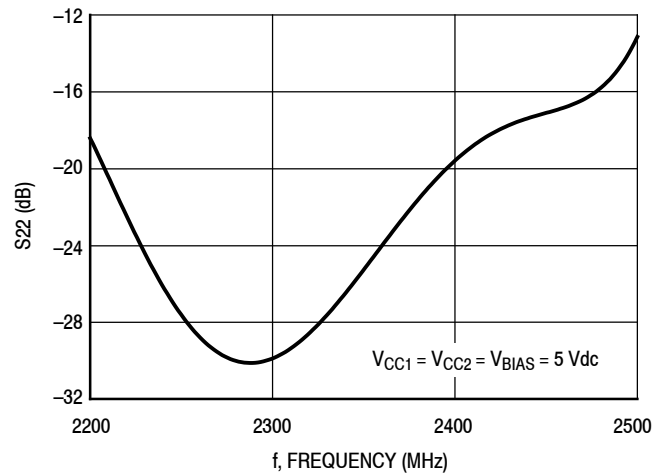


Figure 25. S22 versus Frequency

## 50 OHM APPLICATION CIRCUIT: 2300–2400 MHz, 5 VOLT OPERATION

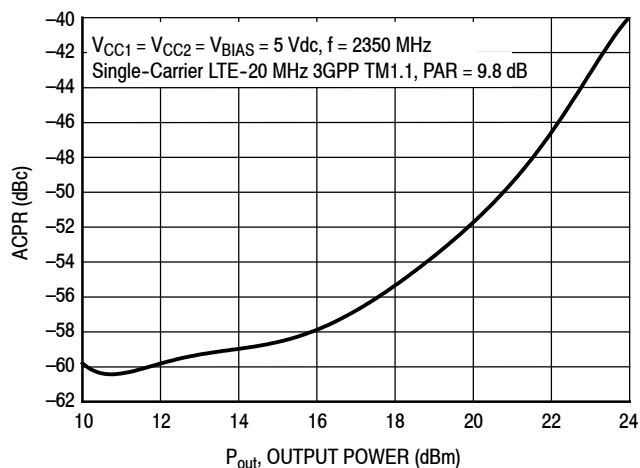


Figure 26. ACPR versus Output Power

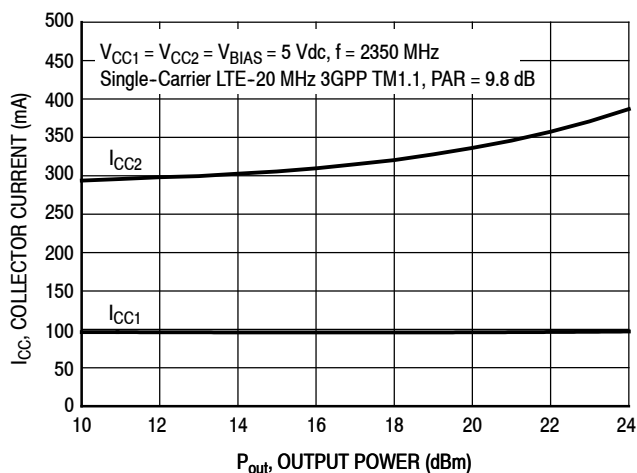


Figure 27. Stage Collector Current versus Output Power

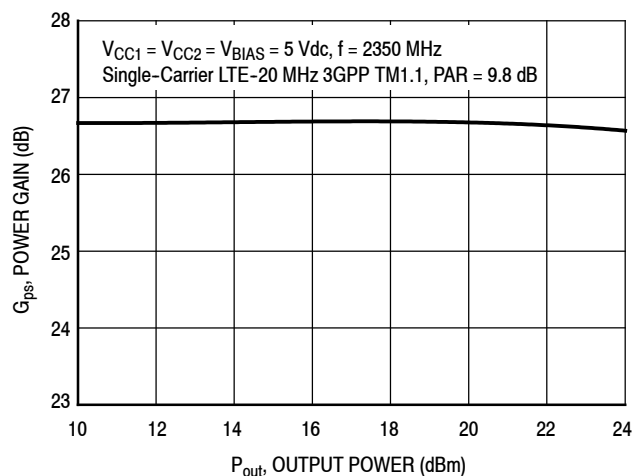


Figure 28. Power Gain versus Output Power

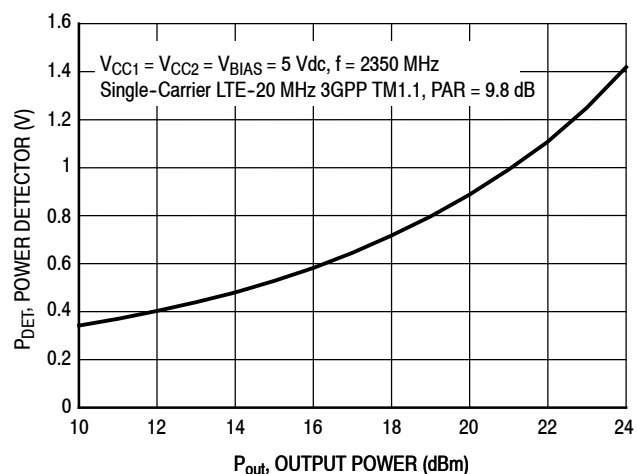


Figure 29. Power Detector versus Output Power

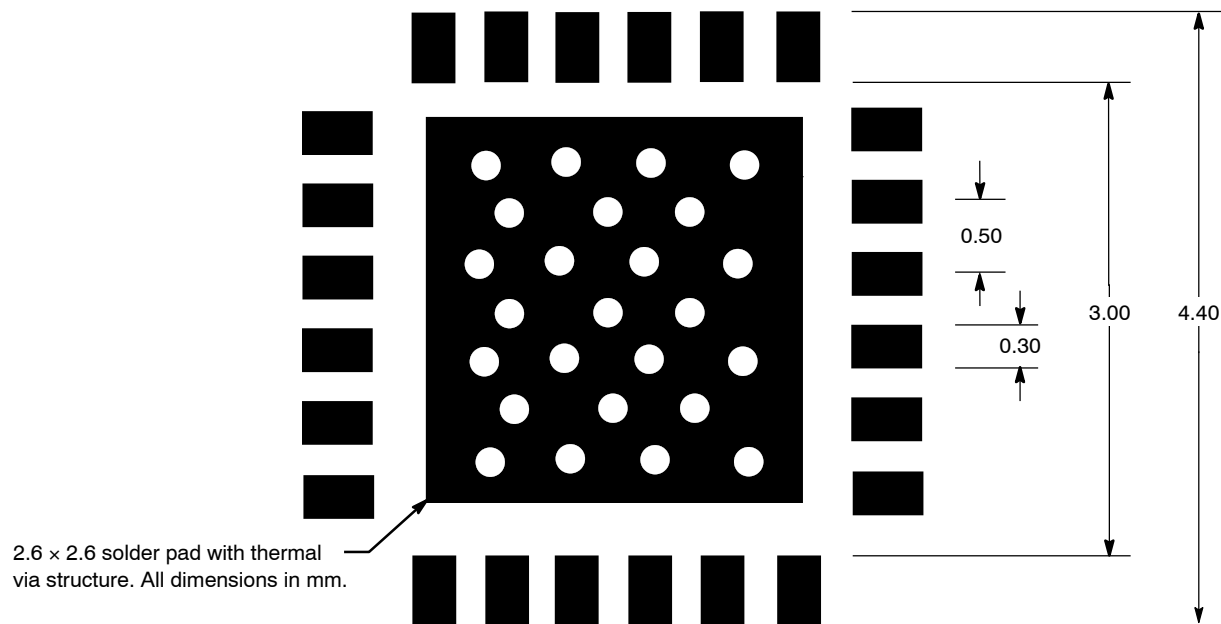


Figure 30. PCB Pad Layout for 24-Lead QFN 4 × 4

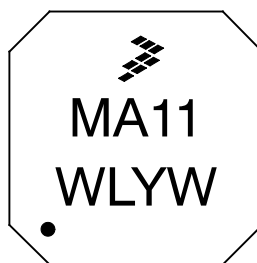
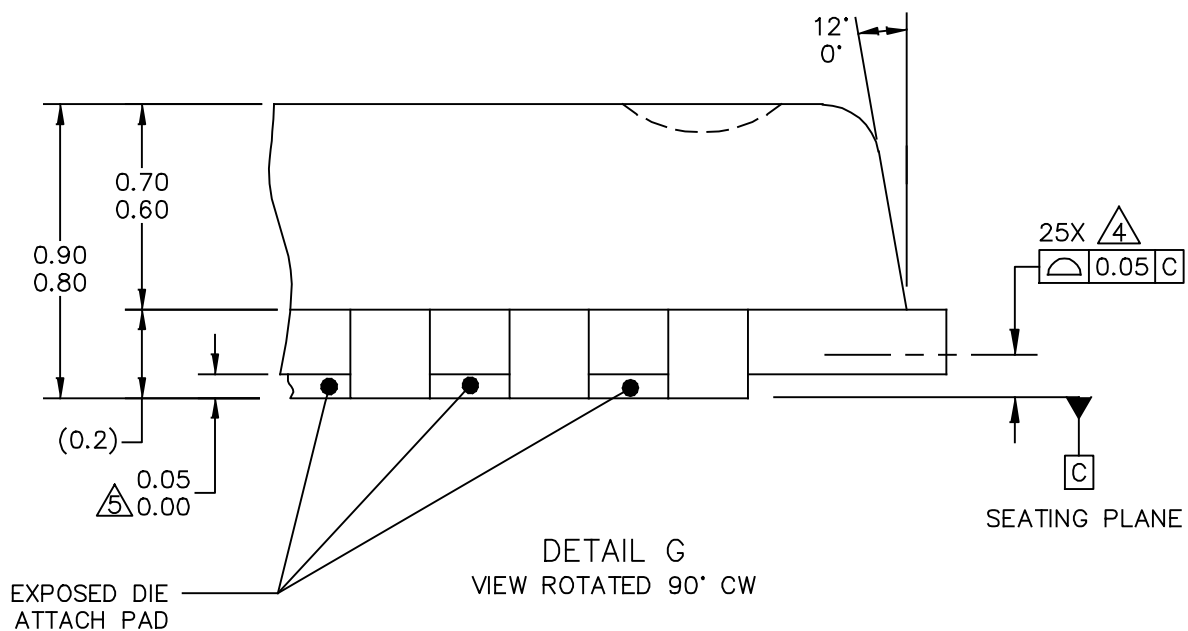


Figure 31. Product Marking

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|                                                                                   |  |                    |                          |                            |             |
|-----------------------------------------------------------------------------------|--|--------------------|--------------------------|----------------------------|-------------|
| © NXP SEMICONDUCTORS N.V.<br>ALL RIGHTS RESERVED                                  |  | MECHANICAL OUTLINE |                          | PRINT VERSION NOT TO SCALE |             |
| TITLE: QFN (PUNCH),<br>THERMALLY ENHANCED<br>4 X 4 X 0.85, 0.5 PITCH, 24 TERMINAL |  |                    | DOCUMENT NO: 98ASA00462D |                            | REV: A      |
|                                                                                   |  |                    | STANDARD: NON-JEDEC      |                            |             |
|                                                                                   |  |                    | SOT616-7                 |                            | 12 JAN 2016 |



|                                                                                      |                                 |                            |
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|                                                                                      | STANDARD: NON-JEDEC             |                            |
|                                                                                      | SOT616-7                        | 12 JAN 2016                |

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.

2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.

3. THIS DIMENSION APPLIES TO METALIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM TERMINAL TIP.

4. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

5. THIS DIMENSION APPLIES ONLY FOR TERMINALS.

|                                                                                   |                                 |                            |
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| TITLE: QFN (PUNCH),<br>THERMALLY ENHANCED<br>4 X 4 X 0.85, 0.5 PITCH, 24 TERMINAL | DOCUMENT NO: 98ASA00462D REV: A |                            |
|                                                                                   | STANDARD: NON-JEDEC             |                            |
|                                                                                   | SOT616-7                        | 12 JAN 2016                |

## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

### Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### Software

- .s2p File

### Development Tools

- Printed Circuit Boards

### To Download Resources Specific to a Given Part Number:

1. Go to <http://www.nxp.com/RF>
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

## FAILURE ANALYSIS

At this time, because of the physical characteristics of the part, failure analysis is limited to electrical signature analysis. In cases where NXP is contractually obligated to perform failure analysis (FA) services, full FA may be performed by third party vendors with moderate success. For updates contact your local NXP Sales Office.

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description                                                                             |
|----------|-----------|-----------------------------------------------------------------------------------------|
| 0        | Dec. 2015 | • Initial Release of Data Sheet                                                         |
| 1        | Dec. 2017 | • Fig. 31, Product Marking: updated to show location of Pin 1 on Product Marking, p. 15 |

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