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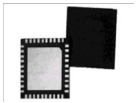
# SZM-3066Z

## 3.3GHz to 3.8GHz 2W POWER AMPLIFIER



Package: QFN, 6mmx6mm

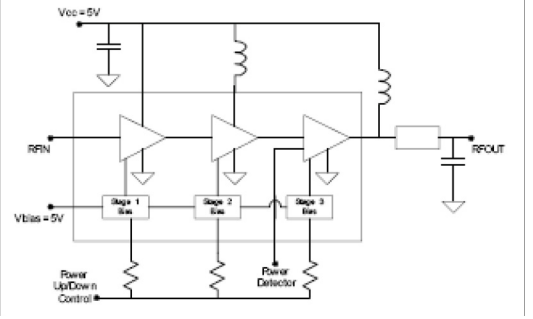
## Product Description

RFMD's SZM-3066Z is a high linearity class AB Heterojunction Bipolar Transistor (HBT) amplifier housed in a low-cost surface-mountable plastic Q-FlexN multi-chip module package. This HBT amplifier is made with InGaP on GaAs device technology and fabricated with MOCVD for an ideal combination of low cost and high reliability. This product is specifically designed as a final or driver stage for 802.16 equipment in the 3.3GHz to 3.8GHz bands. It can run from a 3V to 6V supply. The external output match and bias adjustability allows load line optimization for other applications or over narrower bands. It features an output power detector, on/off power control and high RF overdrive robustness. A 20dB step attenuator feature can be utilized by switching the second stage Power up/down control. This product features a RoHS compliant and Green package with matte tin finish, designated by the 'Z' suffix.

**Optimum Technology Matching® Applied**

- ☐ GaAs HBT
- ☐ GaAs MESFET
- ✓ InGaP HBT
- ☐ SiGe BiCMOS
- ☐ Si BiCMOS
- ☐ SiGe HBT
- ☐ GaAs pHEMT
- ☐ Si CMOS
- ☐ Si BJT
- ☐ GaN HEMT
- ☐ RF MEMS

**Functional Block Diagram**




## Features

- $P_{1dB}$ = 33.5dBm at 5V
- Three Stages of Gain: 34dB
- 802.11g 54Mb/s Class AB Performance
- $P_{OUT}$ = 26dBm at 2.5% EVM, $V_{CC}$ 5V, 730mA
- Active Bias with Adjustable Current
- On-Chip Output Power Detector
- Low Thermal Resistance
- Power Up/Down Control < 1µs
- Attenuator Step 20dB at $V_{PC2}$ = 0V
- Class 1B ESD Rating

## Applications

- 802.16 WiMAX Driver or Output Stage
- Fixed Wireless, WLL

| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| Frequency of Operation | 3300 | | 3800 | MHz | |
| Output Power at 1dB Compression | | 33.5 | | dBm | 3.5GHz |
| Gain | 32.5 | 34.0 | | dBm | @ $P_{OUT}$ = 26dBm - 3.5GHz |
| Output power | | 26.0 | | dBm | @ 2.5% EVM 802.11g 54Mb/s - 3.5GHz |
| Third Order Suppression | | -38.0 | -33.0 | dBc | $P_{OUT}$ = 23dBm per tone - 3.5GHz |
| Noise Figure | | 5.0 | | dB | @ 3.6GHz |
| Worst Case Input Return Loss | 11.0 | 14.0 | | dB | 3.3GHz to 3.8GHz |
| Worst Case Output Return Loss | 6.0 | 9.0 | | dB | 3.3GHz to 3.8GHz |
| Supply voltage range | 3.0 | 5.0 | 6.0 | V | |
| Output Voltage Range | | 0.9 to 2.2 | | V | for $P_{OUT}$ = 10dBm to 30dBm |
| Quiescent Current | 540 | 600 | 660 | mA | $V_{CC}$ = 5V |
| Power Up Control Current | | 5.0 | | mA | $V_{PC}$ = 5V, $I_{VPC1}$ + $I_{VPC2}$ + $I_{VPC3}$ |
| VCC Leakage Current | | | 0.1 | mA | $V_{CC}$ = 5V, $V_{PC}$ = 0V |
| Thermal Resistance | | 12.0 | | °C/W | junction - lead |

Test Conditions: 3.3GHz to 3.8GHz App circuit, $Z_0$ = 50Ω, $V_{CC}$ = 5V, $I_Q$ = 600mA, $T_{BP}$ = 30°C





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## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| VC3 Collector Bias Current ($I_{VC3}$) | 1500 | mA |
| VC2 Collector Bias Current ($I_{VC2}$) | 600 | mA |
| VC1 Collector Bias Current ($I_{VC1}$) | 300 | mA |
| *Device Voltage ($V_D$) | 9.0 | V |
| Power Dissipation | 6 | W |
| **Max RF output Power for 50Ω continuous long term operation | 30 | dBm |
| Max RF Input Power for 10:1 VSWR output load | 5 | dBm |
| Storage Temperature Range | -40 to +150 | °C |
| Operating Temp Range ($T_L$) | -40 to +85 | °C |
| ESD Rating - Human Body Model | 500 | V |
| Maximum Junction Temperature for long term reliability, Tj Max | 150 | °C |

*Note: No RF Drive
**Note: With specified application circuit
Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.
Bias Conditions should also satisfy the following expression:
$I_D V_D < (T_J - T_L)/R_{TH, j-l}$

**Caution!** ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

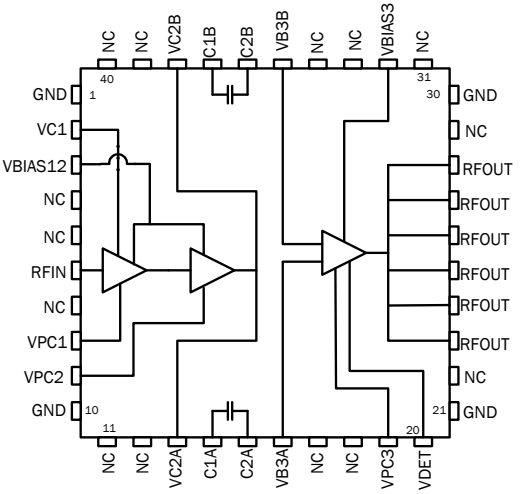
RoHS status based on EU Directive 2011/65/EU (at time of this document revision).



## Typical Performance 3.3Ghz to 3.8GHz App Circuit ($V_{CC}$=5V, $I_{CQ}$=600mA, 802.11g 54mb/s 64QAM)

| Parameter | Units | 3.3GHz | 3.4Ghz | 3.5GHz | 3.6GHz | 3.7GHz | 3.8GHz |
|---|---|---|---|---|---|---|---|
| Gain @ $P_{OUT}$=26dBm | dB | 35.2 | 35.2 | 35.2 | 34.5 | 32.8 | 30.0 |
| P1dB | dBm | 34.4 | 34.3 | 34.3 | 34.1 | 33.9 | 33.0 |
| $P_{OUT}$ @ 2.5% EVM | dBm | 26.5 | 26.5 | 26.5 | 26.5 | 26.0 | 26.0 |
| Current @$P_{OUT}$ 2.5% EVM | mA | 769 | 769 | 752 | 750 | 750 | 720 |
| Input Return Loss | dB | 14 | 17 | 19 | 21 | 19 | 16 |
| Output Return Loss | dB | 10.0 | 10.5 | 10.0 | 9.0 | 9.0 | 8.0 |
| Step Attenuation ($V_{PC2}$=0V) | dB | 23.0 | 22.0 | 22.0 | 21.0 | 18.0 | 15.0 |

## Simplified Device Schematic





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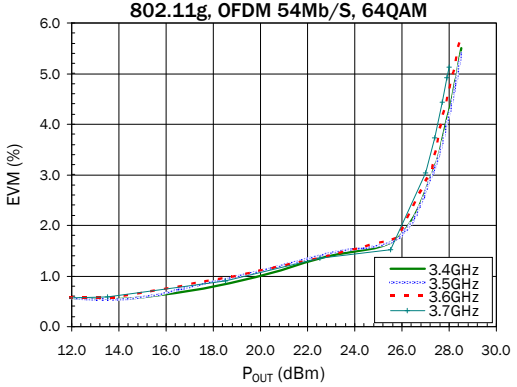
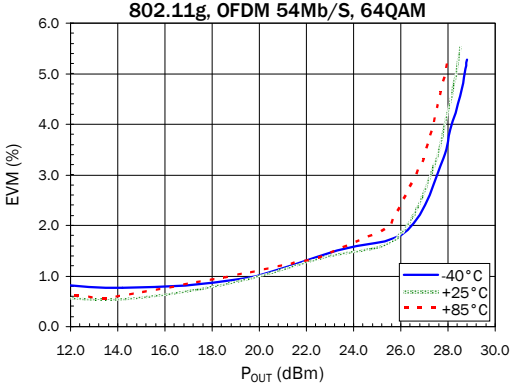
**Measured 3.3GHz to 3.8GHz Application Circuit Data ($V_{CC}$=$V_{PC}$=5.0V $I_Q$=600mA, T=25°C)**

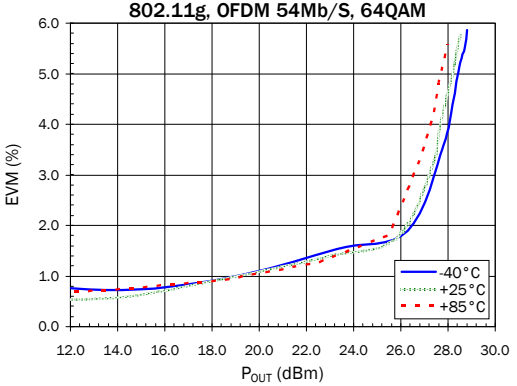
EVM versus $P_{OUT}$ T=+25°C
802.11g, OFDM 54Mb/S, 64QAM



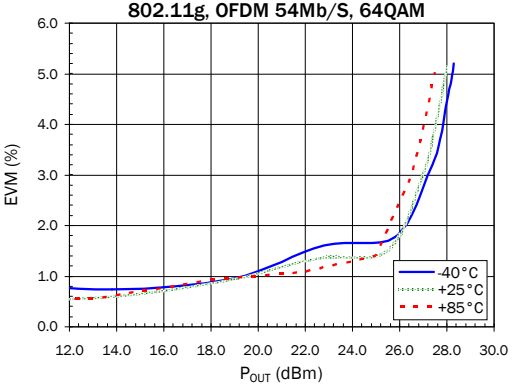

EVM versus $P_{OUT}$ F=3.4GHz
802.11g, OFDM 54Mb/S, 64QAM



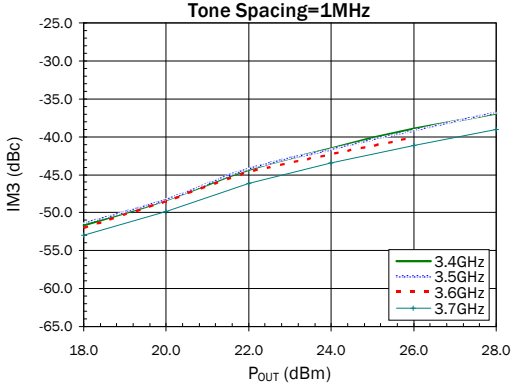

EVM versus $P_{OUT}$ F=3.6GHz
802.11g, OFDM 54Mb/S, 64QAM



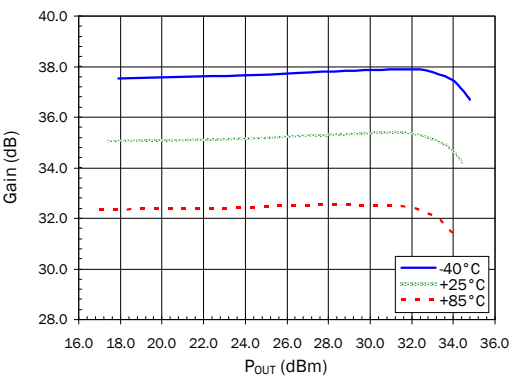

EVM versus $P_{OUT}$ F=3.7GHz
802.11g, OFDM 54Mb/S, 64QAM




IM3 versus $P_{OUT}$ (2 Tone Avg.), T=+25°C
Tone Spacing=1MHz




Typical Gain versus $P_{OUT}$, F=3.4GHz



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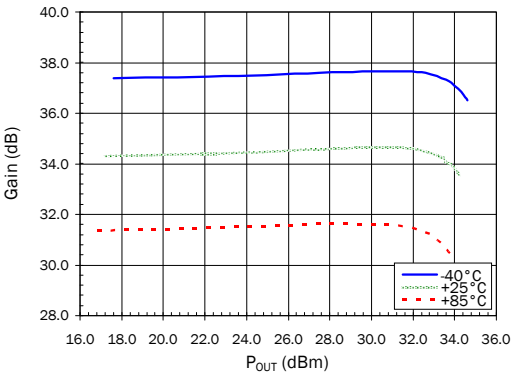
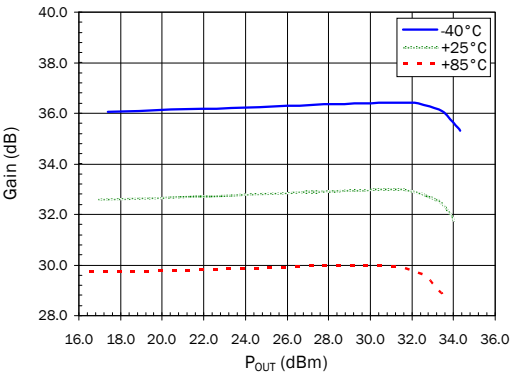
**Measured 3.3GHz to 3.8GHz Application Circuit Data ($V_{CC}$=$V_{PC}$=5.0V $I_Q$=600mA, T=25°C)**

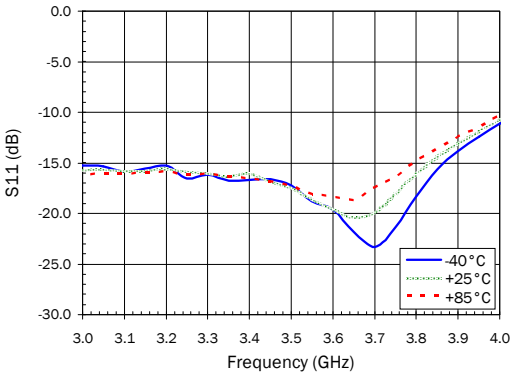
Typical Gain versus $P_{OUT}$, F=3.6GHz



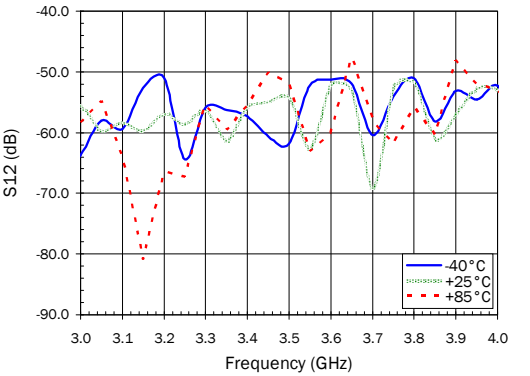

Typical Gain versus $P_{OUT}$, F=3.7GHz



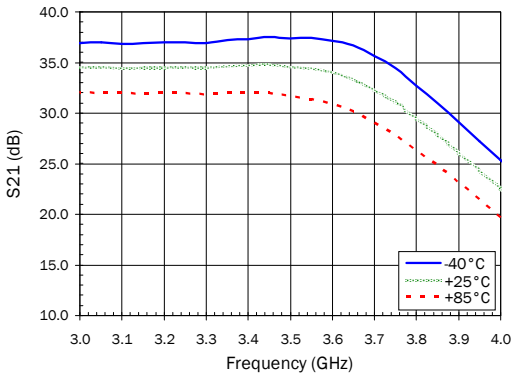

Narrowband S11 - Input Return Loss



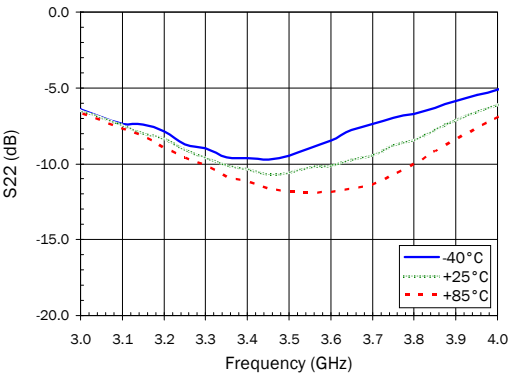

Narrowband S12 - Reverse Isolation




Narrowband S21 - Forward Gain




Narrowband S22 - Output Return Loss





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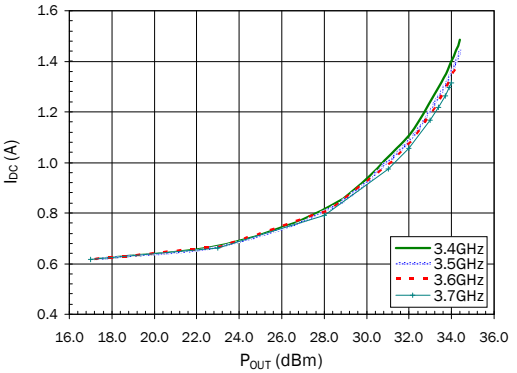
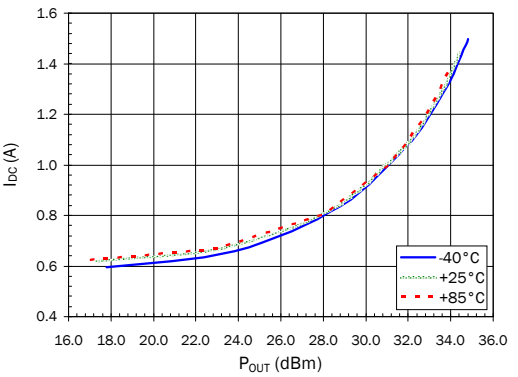
## Measured 3.3GHz to 3.8GHz Application Circuit Data ($V_{CC}$=$V_{PC}$=5.0V $I_Q$=600mA, T=25°C)

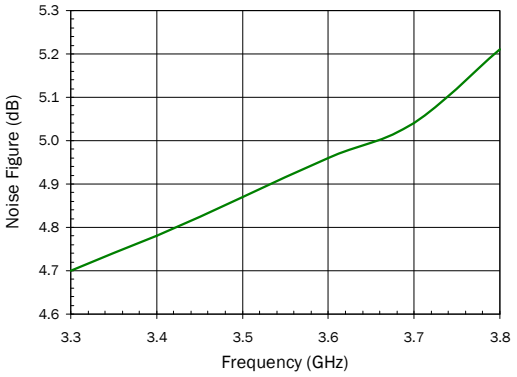
### DC Supply Current versus $P_{OUT}$, T=25°C



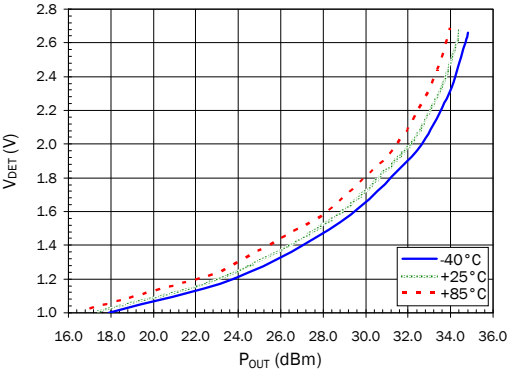

### DC Supply Current versus $P_{OUT}$, F=3.5GHz



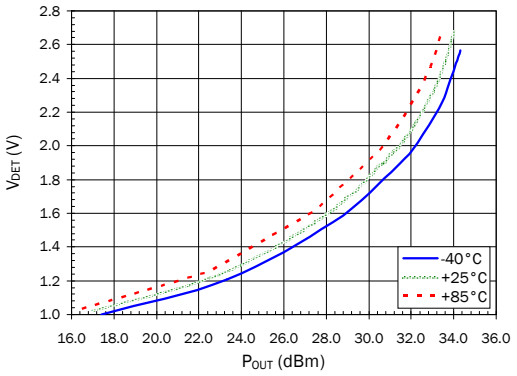

### Noise Figure versus Frequency, T=+25°C




### RF Power Detector ($V_{DET}$) versus $P_{OUT}$, F=3.4GHz

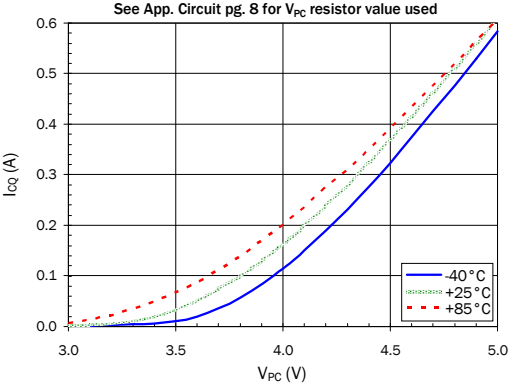



### RF Power Detector ($V_{DET}$) versus $P_{OUT}$, F=3.7GHz




### $I_{CQ}$ versus $V_{PC}$, $V_{CC}$=5V, Swept $V_{PC}$

See App. Circuit pg. 8 for $V_{PC}$ resistor value used



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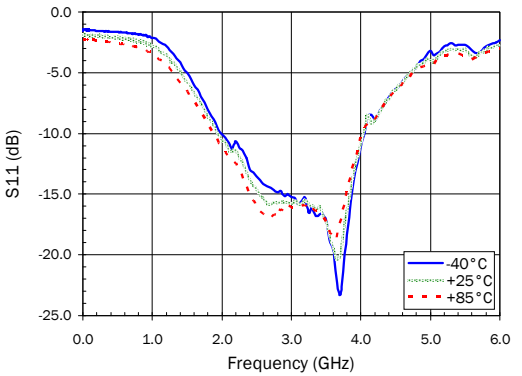
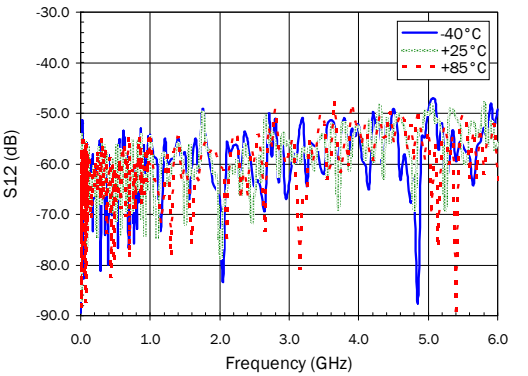
**Measured 3.3GHz to 3.8GHz Application Circuit Data ($V_{CC}$=$V_{PC}$=5.0V $I_Q$=600mA, T=25°C)**

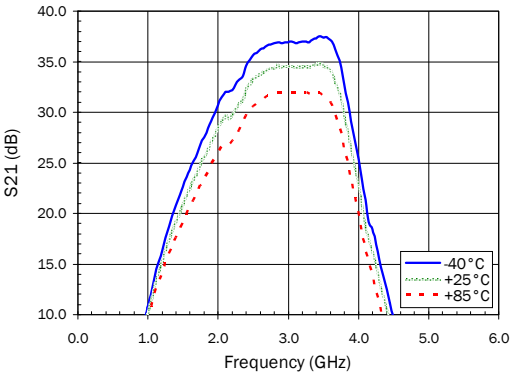
**Broadband S11 - Input Return Loss**



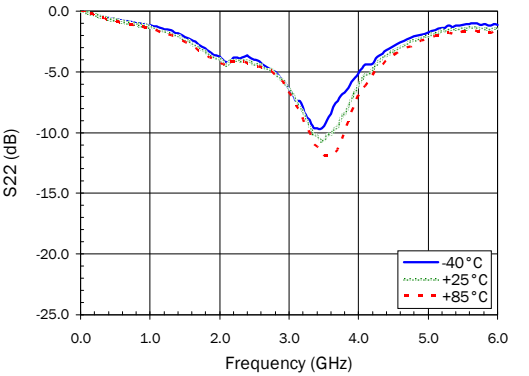

**Broadband S12 - Reverse Isolation**



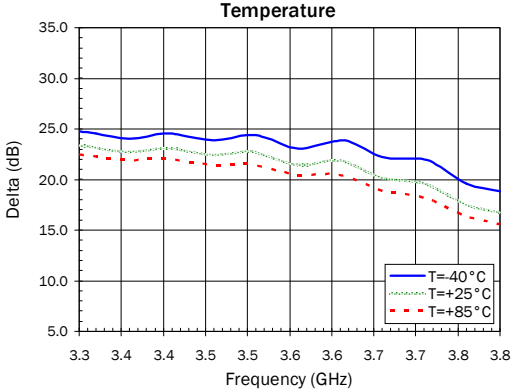

**Broadband S21 - Forward Gain**




**Broadband S22 - Output Return Loss**




**20dB Step Attenuator Function Gain Delta versus Temperature**



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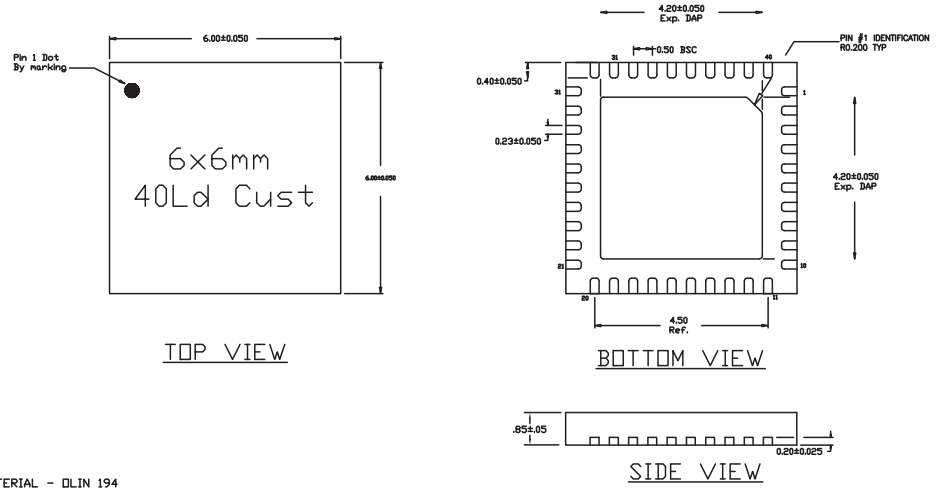
| Pin | Function | Description |
|---|---|---|
| 5, 7, 11, 12, 17, 18, 22, 29, 31, 33, 34, 39, 40 | NC | These are no connect (NC) pins and are not wired inside the package. It is recommended to connect them as shown in the application circuit to achieve the stated performance. |
| 1, 10, 21, 30 | GND | These pins are internally grounded inside the package to the backside ground paddle. It is recommended to also ground them external to the package to achieve the specified performance. |
| 2 | VC1 | This is the collector of the first stage. |
| 3 | VBIAS12 | This is the supply voltage for the active bias circuit of the 1st and 2nd stages. |
| 4 | NC | This pin is not connected inside the package, but it is recommended to connect it to GND to achieve the specified performance. |
| 6 | RF IN | This is the RF input pin. It is DC grounded inside the package. Do not apply DC voltage to this pin. |
| 8 | VPC1 | Power up/down control pin for the 1st stage. An external series resistor is required for proper setting of bias levels depending on control voltage. The voltage on this pin should never exceed the voltage on pin 3 by more than 0.5V unless the supply current from pin 3 is limited <10mA. |
| 9 | VPC2 | Power up/down control pin for the 2nd stage. Power down VPC2<1V for step attenuator function enable. An external series resistor is required for proper setting of bias levels depending on control voltage. The voltage on this pin should never exceed the voltage on pin 3 by more than 0.5V unless the supply current from pin 3 is limited <10mA. |
| 13, 38 | VC2A, VC2B | These two pins are connected internal to the package to the 2nd stage collector. To achieve specified performance, the layout of these pins should match the Recommended Land Pattern. |
| 14, 15, 36, 37 | C1A,C2A C1B,C2B | These pins have capacitors across them internal to the package as shown in the below schematic. They are used as tuning and RF coupling elements between the 2nd and 3rd stage. |
| 16, 35 | VB3A, VB3B | These are the connections to the base of the 3rd stage output device. To achieve specified performance, the layout of these pins should match the Recommended Land Pattern. |
| 19 | VPC3 | Power up/down control pin for the 3rd stage. An external series resistor is required for proper setting of bias levels depending on control voltage. The voltage on this pin should never exceed the voltage on pin 32 by more than 0.5V unless the supply current from pin 33 is limited <10mA. |
| 20 | VDET | This is the output port for the power detector. It samples the power at the input of the 3rd stage. |
| 23-28 | RFOUT | These are the RF output pins and DC connections to the 3rd stage collector. |
| 32 | VBIAS3 | This is the supply voltage for the active bias circuit of the 3rd stage. |

## Package Drawing

Dimensions in millimeters

Refer to drawing posted at www.rfmd.com for tolerances.




NOTES:
1. LF MATERIAL - OLIN 194
2. LF METAL THICKNESS - .20 mm
3. MOLD COMPOUND - 94V0 GREEN COMPLIANT
4. LEAD FINISH Sn/Pb - BASIC PN
100% MATTE Sn "Z" OPTION

**Part Symbolization**

The part will be symbolized with "SZM-3066Z" to designate it as RoHs green compliant product. Marking designator will be on the top surface of the package.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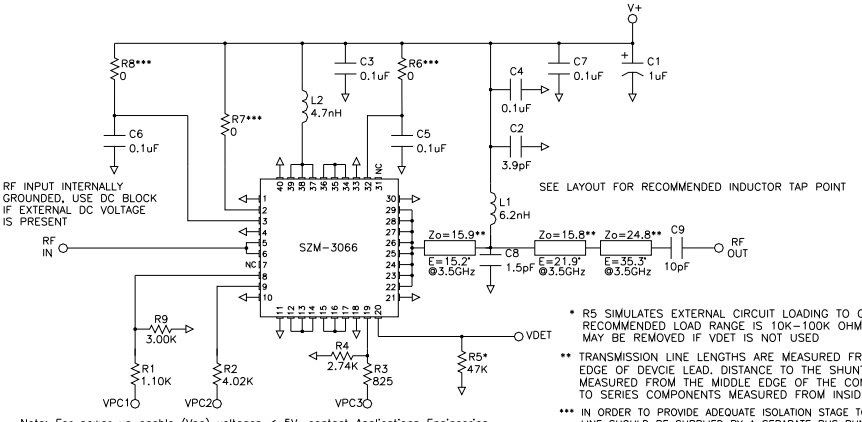
## 3.3GHz to 3.8GHz Evaluation Board Schematic

For $V_{CC}$=V+=$V_{PC}$=5.0V




Note: For power up enable (Vpc) voltages < 5V, contact Applications Engineering for the appropriate R1, R9, R2, R3, and R4 values.

* R5 SIMULATES EXTERNAL CIRCUIT LOADING TO GROUND. RECOMMENDED LOAD RANGE IS 10K–100K OHMS. MAY BE REMOVED IF VDET IS NOT USED

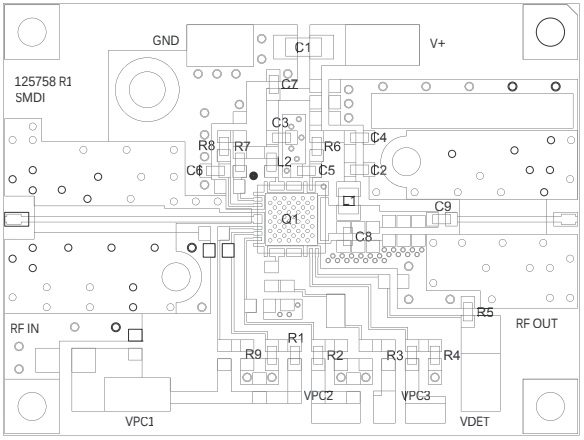
** TRANSMISSION LINE LENGTHS ARE MEASURED FROM OUTSIDE EDGE OF DEVCIE LEAD. DISTANCE TO THE SHUNT COMPONENTS ARE MEASURED FROM THE MIDDLE EDGE OF THE COMPONENT; DISTANCE TO SERIES COMPONENTS MEASURED FROM INSIDE EDGE OF LAND PAD.

*** IN ORDER TO PROVIDE ADEQUATE ISOLATION STAGE TO STAGE, EACH BIAS LINE SHOULD BE SUPPLIED BY A SEPARATE BUS RUNNING FROM THE MAIN POWER BUS AS THE LAYOUT. THE INDUCTORS (INCLUDING THE 0 OHM RESISTORS) AND CAPACITORS SHOULD BE RETAINED TO HELP PROVIDE ADEQUATE STAGE TO STAGE ISOLATION. ALTERNATE CONFIGURATIONS MAY IMPACT PERFORMANCE.

## 3.3GHz to 3.8GHz Evaluation Board Layout and Bill of Materials

For $V_{CC}$=V+=$V_{PC}$=5.0V

Board Material GETEK, 10mil thick, Dk=3.9, 2oz. copper




### Bill of Materials

| Desg | Description | Notes |
|---|---|---|
| Q1 | SZM-3066Z | 6mmx6mm QFN |
| R1 | 1.0KΩ, 0603 1% | 0402 may be used |
| R2 | 4.02KΩ, 0603 1% | 0402 may be used |
| R3 | 825Ω, 0603 1% | 0402 may be used |
| R4 | 2.74KΩ, 0603 1% | 0402 may be used |
| R5 | 47KΩ, 0603 | 0402 may be used |
| R6, 7, 8 | 0Ω, 0603 | 0402 may be used |
| R9 | 3kW, 0603 1% | 0402 may be used |
| C1 | 1uF 16V MLCC CAP | Tantalum ok for EVM performance. Use MLCC type for best IM3 levels. |
| C2 | 3.9pF CAP, 0603 | NPO, ROHM MCH185A3R9DK or equivalent |
| C3, 4, 5, 6, 7 | 0.1uF CAP, 0603 | X7R 0402 ok, ROHM MCH182CN104K or equivalent |
| C8 | 1.5pF CAP, 0603 | NPO, low ESR, ATC 600S1RCW250 or equivalent |
| C9 | 10pF CAP, 0603 | NPO, low EST, ATC 6005100JW250 or equivalent |
| L1 | 6.2nH IND 0805 | Coilcraft 0805HQ - 6N2XJBB |
| L2 | 4.7nH IND, 0603 | TOKO 0603 - LL1608FH4N7J |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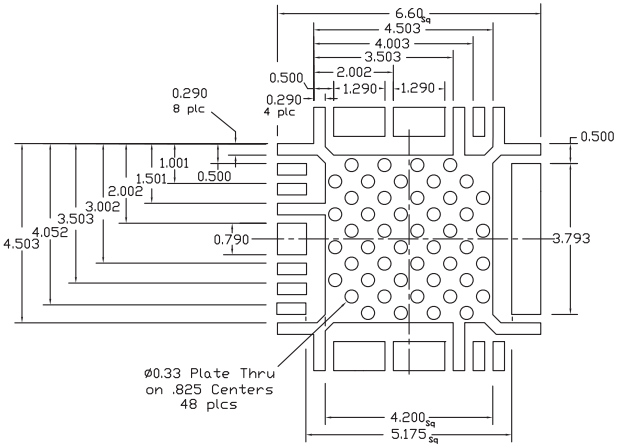
## Recommended Metal Land Pattern

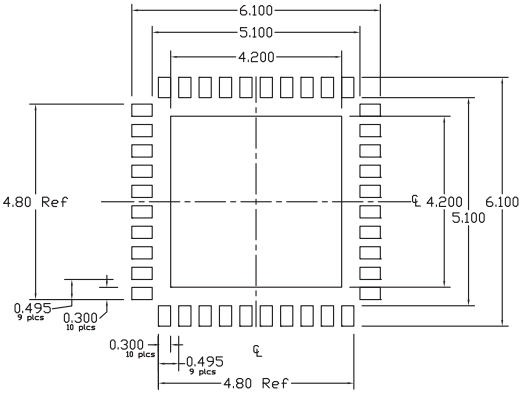
Dimensions in millimeters




Land Pattern

## Recommended PCB Soldermask for Land Pattern

Dimensions in millimeters




Solder Mask Openings

## Ordering Information

| Ordering Code | Description |
|---|---|
| SZM3066ZSQ | Standard 25 piece bag |
| SZM3066ZSR | Standard 100 piece reel |
| SZM3066Z | Standard 1000 piece reel |
| SZM3066ZPCK-EVB1 | Evaluation Board 3.3GHz to 3.8GHz Tune and 5 loose sample pieces |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