

RMPA2453

2.4–2.5 GHz InGaP HBT Linear Power Amplifier

General Description

The RMPA2453 power amplifier is designed for high performance WLAN applications in the 2.4–2.5 GHz frequency band. The low profile 16 pin 3 x 3 x 0.9 mm package with internal matching on both input and output to 50Ω minimizes next level PCB space and allows for simplified integration. The on-chip detector provides power sensing capability while the logic control provides power saving shutdown options. The PA's low power consumption and excellent linearity are achieved using our InGaP Heterojunction Bipolar Transistor (HBT) technology.

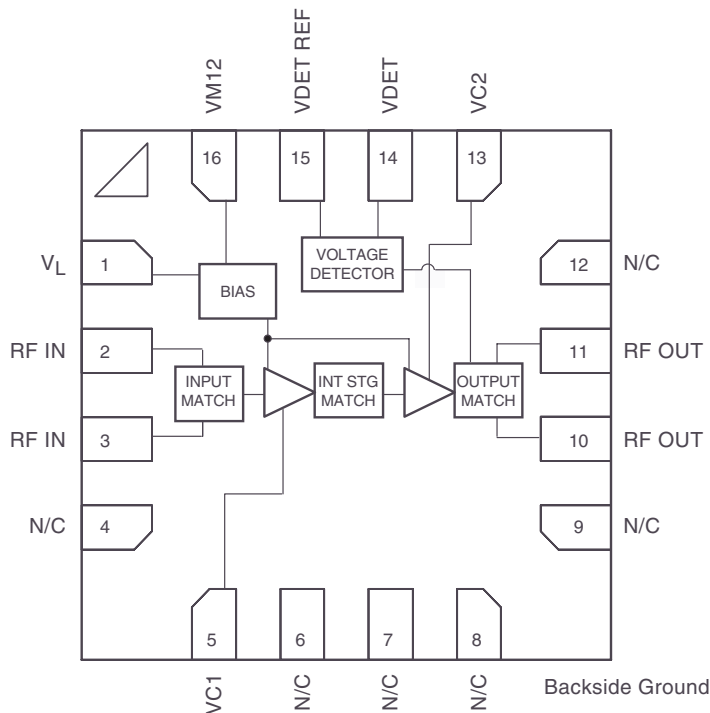
Features

- 26dB small signal gain
- 26.5dBm output power @ 1dB compression
- 2.5% EVM at 18dBm modulated output power
- 3.5% EVM at 19dBm modulated output power
- 3.3V single positive supply operation
- Two power saving shutdown options (bias and logic control)
- Integrated power detector with 20dB dynamic range
- Low profile 16 pin 3 x 3 x 0.9 mm leadless package
- Internally matched to 50Ω and DC blocked RF input/output
- Optimized for use in 802.11b/g applications

Device



Functional Block Diagram



| Pin | Description |
|-----|------------------------|
| 1 | V _L (logic) |
| 2 | RF IN |
| 3 | RF IN |
| 4 | N/C |
| 5 | VC1 |
| 6 | N/C |
| 7 | N/C |
| 8 | N/C |
| 9 | N/C |
| 10 | RF OUT |
| 11 | RF OUT |
| 12 | N/C |
| 13 | VC2 |
| 14 | VDET |
| 15 | VDET REF |
| 16 | VM12 |

Absolute Ratings¹

| Symbol | Parameter | Ratings | Units |
|-------------------|----------------------------|-------------|-------|
| VC1, VC2 | Positive Supply Voltage | 5 | V |
| IC1, IC2 | Supply Current | | |
| | IC1 | 120 | mA |
| | IC2 | 700 | mA |
| VM12 | Positive Bias Voltage | 4.0 | V |
| V _L | Logic Voltage | 5 | V |
| P _{IN} | RF Input Power | 10 | dBm |
| T _{CASE} | Case Operating Temperature | -40 to +85 | °C |
| T _{STG} | Storage Temperature | -55 to +150 | °C |

Notes:

1: No permanent damage with only one parameter set at extreme limit. Other parameters set to typical values

Electrical Characteristics^{1,3} 802.11g OFDM Modulation (RF framed with 176ms burst time 100ms idle time) 54Mbps Data Rate 16.7MHz Bandwidth

| Parameter | Min | Typ | Max | Units |
|--|------|------|------------------|-------|
| Frequency | 2.4 | | 2.5 | GHz |
| Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| Gain | 24.5 | 26 | 29 | dB |
| Total Current @ 18dBm P _{OUT} | | 133 | 160 | mA |
| Total Current @ 19dBm P _{OUT} | | 145 | 165 | mA |
| EVM @ 18dBm P _{OUT} ² | | 2.5 | 3.5 ³ | % |
| EVM @ 19dBm P _{OUT} ² | | 3.5 | 4.5 ³ | % |
| Detector Output @ 19dBm P _{OUT} | | 515 | 600 | mV |
| Detector Threshold ⁴ | | 5.0 | 7.0 | dBm |
| P _{OUT} Spectral Mask Compliance ⁵ | | 21.0 | | dBm |

Electrical Characteristics^{3,6} 802.11b CCK Modulation (RF not framed) 11Mbps Data Rate 22.0MHz Bandwidth

| Parameter | Min | Typ | Max | Units |
|--|------|------|-----|-------|
| Frequency | 2.4 | | 2.5 | GHz |
| Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| Gain | 24.5 | 26 | 29 | dB |
| Total Current | | 250 | | mA |
| First Sidelobe Power | | -35 | | dBc |
| Second Sidelobe Power | | -55 | | dBc |
| Max P _{OUT} Spectral Mask Compliance ⁷ | | 24.0 | | dBm |

Notes:

1: VC1,VC2, VM12 = 3.3V, T_C = 25°C, PA is constantly biased, 50Ω system.

2: Percentage includes system noise floor of EVM = 0.8%.

3: EVM not measured 100% in production.

4: P_{OUT} measured at P_{IN} corresponding to power detection threshold.

5: Measured at P_{IN} at which Spectral Mask Compliance is satisfied. Two-sample windowing length applied.

6: VC1,VC2, VM12 = 3.3V, T_C = 25°C, P_{OUT} = +23dBm, 50Ω system. Satisfies spectral mask.

7: P_{IN} is adjusted to point where spectral performance reaches maximum limit.

Electrical Characteristics¹ Single Tone

| Parameter | Min | Typ | Max | Units |
|---------------------------------------|------|------|------|-------|
| Frequency | 2.4 | | 2.5 | GHz |
| Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| Gain | 24.5 | 26 | 29 | dB |
| Total Quiescent Current | | 105 | 135 | mA |
| Bias Current at pin VM12 ² | 10.0 | 12.5 | 15.0 | mA |
| P1dB Compression | 25 | 26.5 | | dBm |
| Standby Current ³ | | 0.7 | | mA |
| Shutdown Current (VM12 = 0V) | | <1.0 | | μA |
| Input Return Loss | | 19 | | dB |
| Output Return Loss | | 22 | | dB |
| Detector Output at P1dB Comp | | 2.0 | | V |
| Detector P _{OUT} Threshold | | 7.0 | 9.0 | dBm |
| 2nd Harmonic Output at P1dB | | -45 | | dBc |
| 3rd Harmonic Output at P1dB | | -42 | | dBc |
| Logic | | | | |
| Shutdown Control (V _L): | | | | |
| Device Off, Logic High Input | 2.0 | 2.4 | | V |
| Device On, Logic Low Input | | 0.0 | 0.8 | V |
| Logic Current | | 150 | | μA |
| Turn-on Time ⁴ | | <1 | | μS |
| Turn-off Time | | <1 | | μS |
| Spurious (Stability) ⁵ | | -65 | | dBc |

Notes:

1: VC1, VC2, VM12 = 3.3V, T_C = 25°C, 50Ω system.

2: Bias current is included in the Total Quiescent Current.

3: V_L is set to Input Logic Level High for PA Off operation.

4: Measured from Device On signal turn on (Logic Low) to the point where RF P_{OUT} stabilizes to 0.5dB.

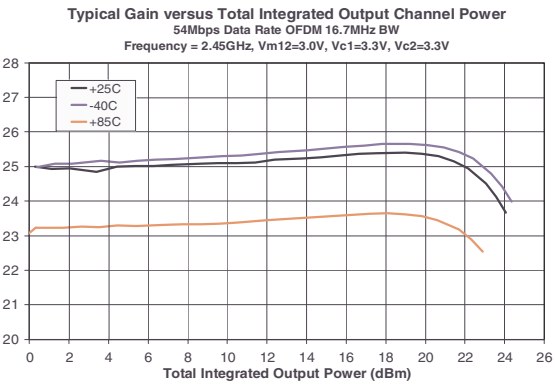
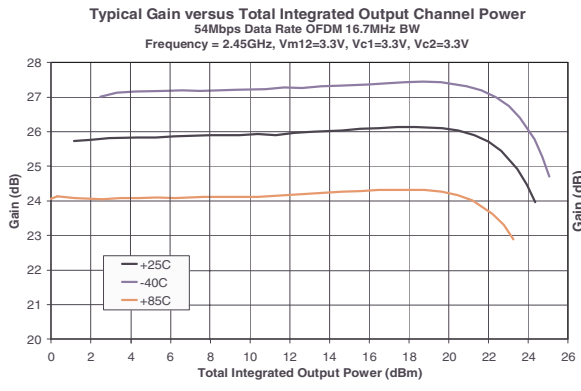
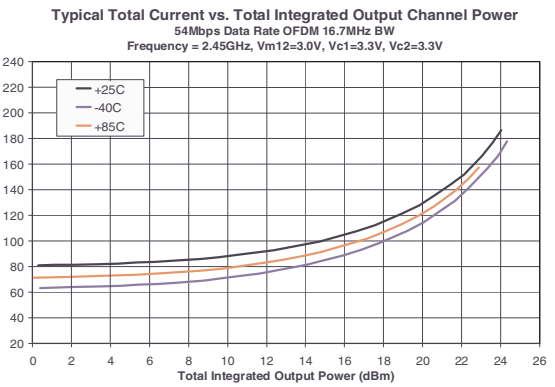
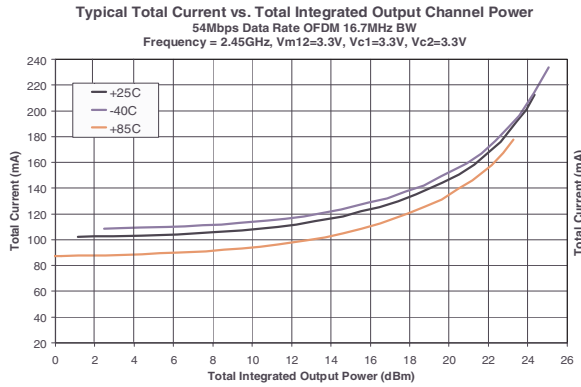
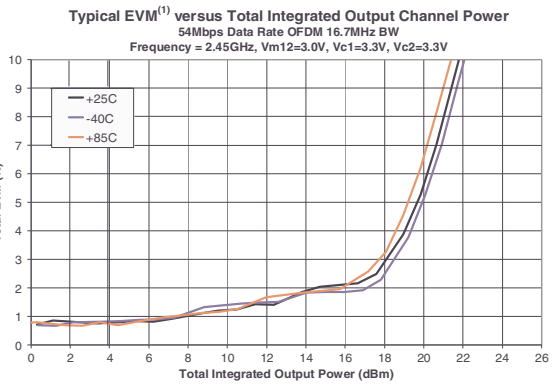
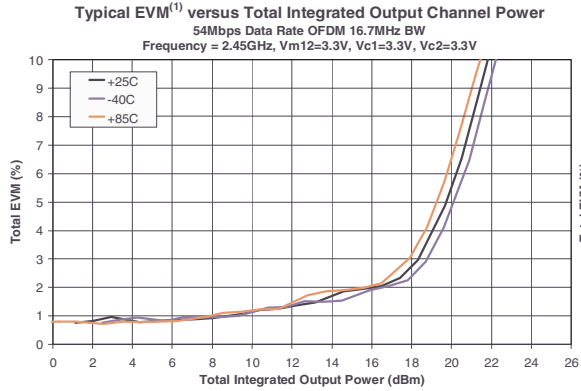
5: Load VSWR is set to 8:1 and the angle is varied 360 degrees. P_{OUT} = -30dBm to P1dB.

Typical Characteristics 802.11g

Temperature dependency

Left column VM12 = 3.3V

Right column VM12 = 3.0V



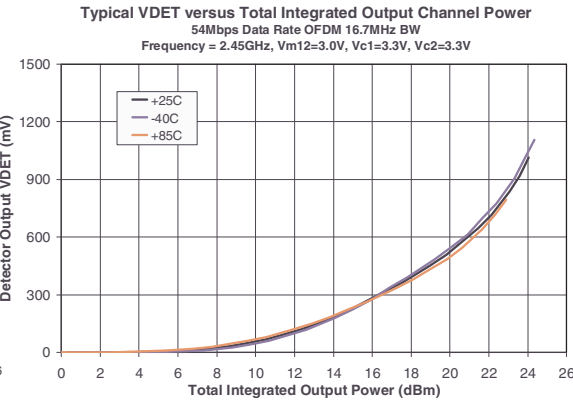
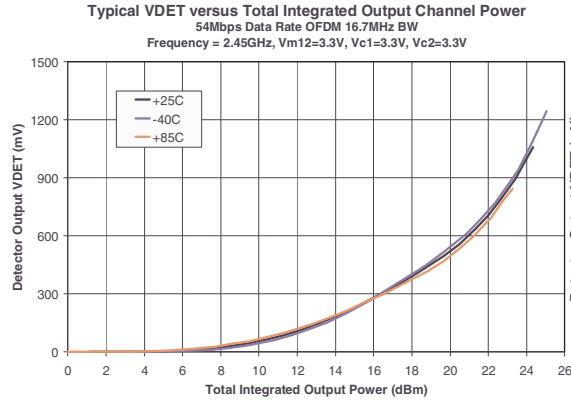
Note:
 1: Uncorrected EVM. Source EVM is approximately 0.8%.

Typical Characteristics 802.11g (Continued)

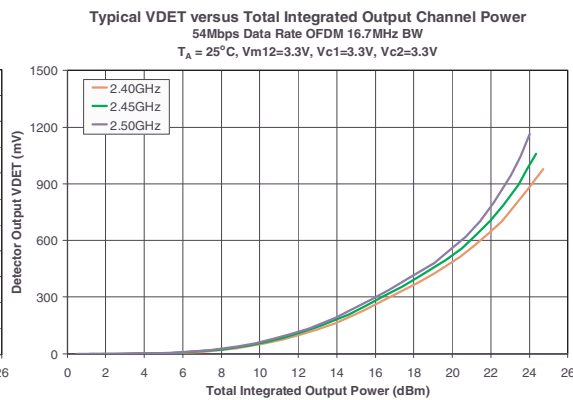
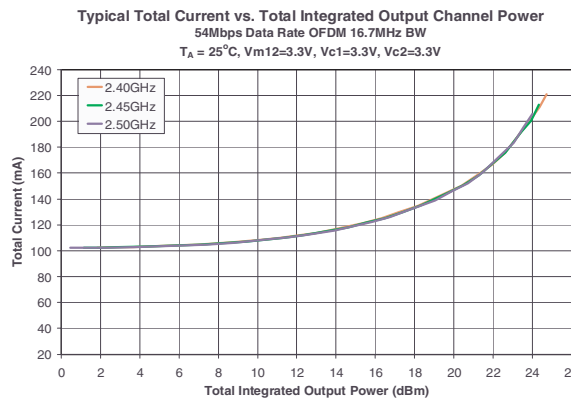
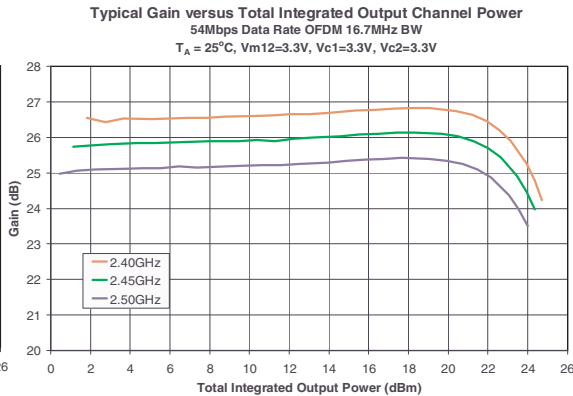
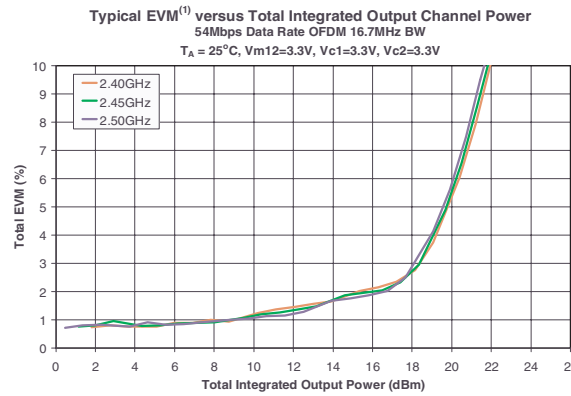
Temperature Dependency

Left column VM12 = 3.3V

Right column VM12 = 3.0V



Frequency Dependency VM12 = 3.3V



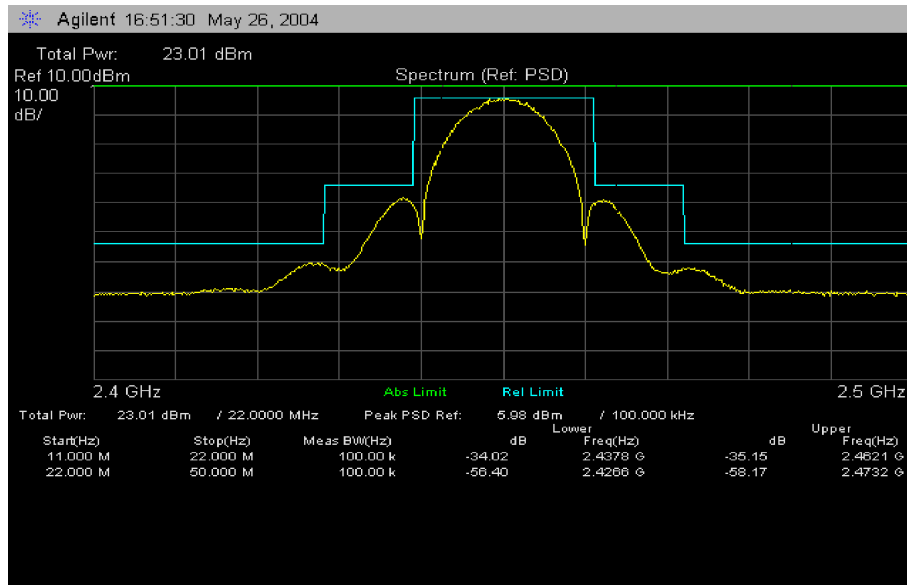
Note:
 1: Uncorrected EVM. Source EVM is approximately 0.8%.

Typical Characteristics 802.11b

Spec ANA Pout = 23 dBm

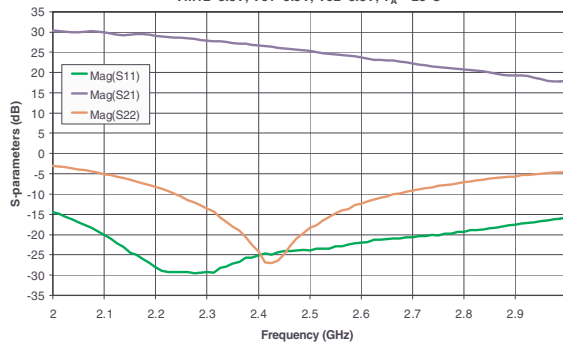
Pin adjusted to the point where the part just begins to approach the 802.11b spectral mask requirements.

**RMPA2453 Spectral Plot Showing Compliance to 802.11b Spectral Mask Requirements @ 23 dBm Modulated Output Power
11 Mbps CCK Data 22 MHz BW
VC1, VC2 = 3.3V VM12 = 3.3V T=25°C**

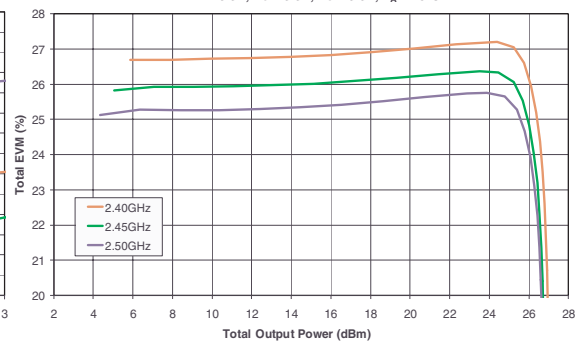


Single Tone

Typical Small Signal S-parameters versus Frequency
Vm12=3.3V, Vc1=3.3V, Vc2=3.3V, TA = 25°C



Typical Single Tone Gain versus Single Tone Output Power
Vm12=3.3V, Vc1=3.3V, Vc2=3.3V, TA = 25°C



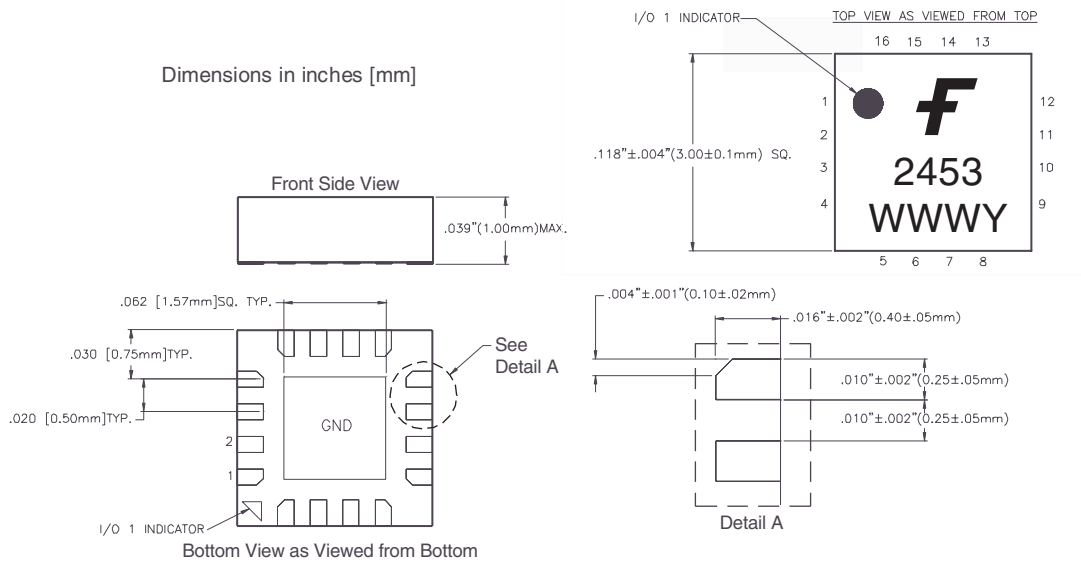
Application Information

Precautions to Avoid Permanent Device Damage:

Static Sensitivity: Follow ESD precautions to protect against ESD damage.

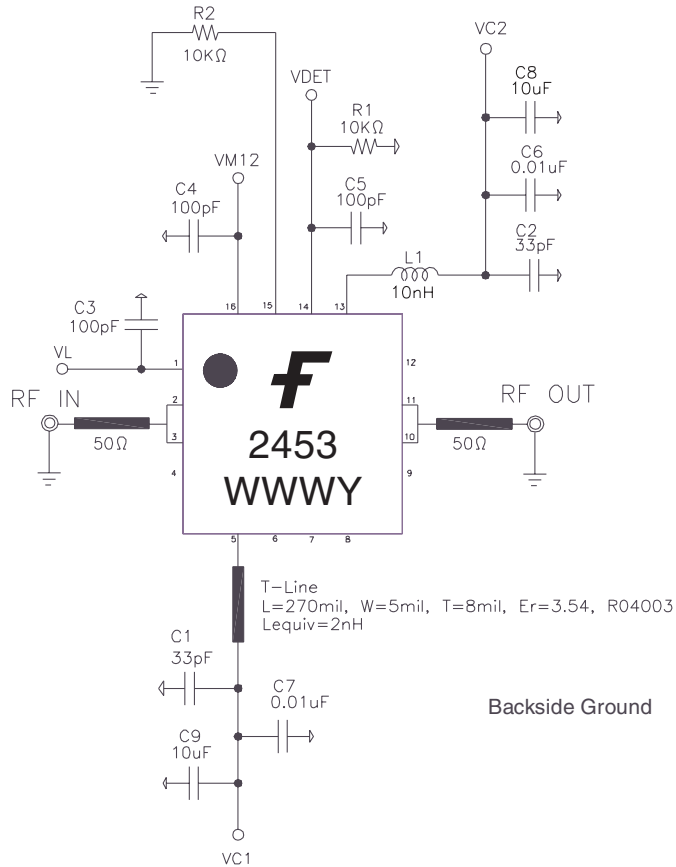
- A properly grounded static-dissipative surface on which to place devices.
- Static-dissipative floor or mat.
- A properly grounded conductive wrist strap for each person to wear while handling devices.

Package Outline



Note: Dimensions do not include protrusions or mold flash. These are not to exceed 0.006" (.155mm) on any side.

Evaluation Board Schematic

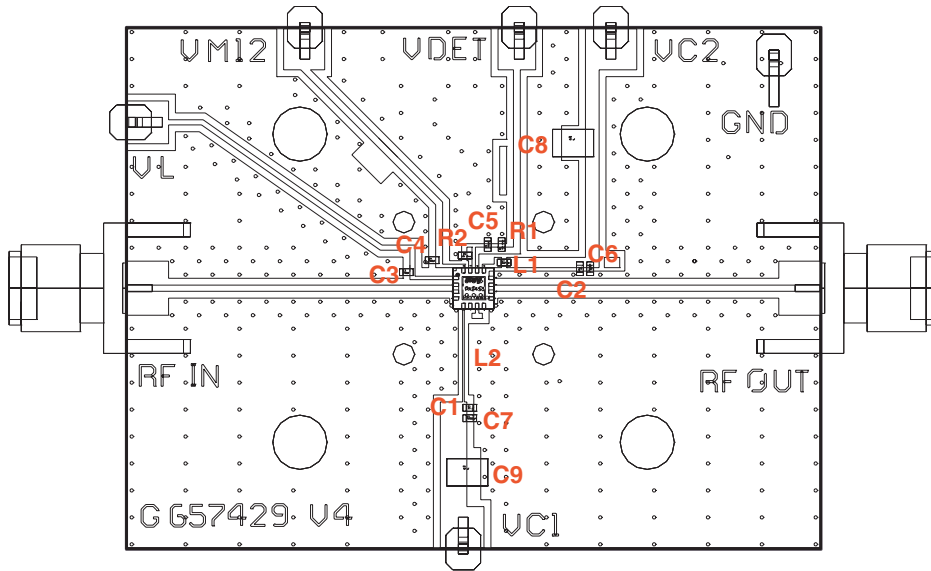


Evaluation Board of Materials

MATERIALS LIST

| QTY | ITEM NO. | PART NUMBER | DESCRIPTION | VENDOR |
|-----|--------------|------------------|------------------------|-------------|
| 1 | 1 | G657429 | PC, BOARD | FAIRCHILD |
| 2 | 2 | #142-0701-841 | SMA CONNECTOR | JOHNSON |
| 6 | 3 | #S1322-XX-ND | RT ANGLE SGL M HEADER | DIGIKEY |
| REF | 4 | G657557 | ASSEMBLY, RMPA2453 | FAIRCHILD |
| 2 | 5 (C1&C2) | GRM39C0G330J50V | 33 pF CAPACITOR | MURATA |
| 3 | 6 (C3,C4&C5) | GRM36C0G101J50V | 100 pF CAPACITOR | MURATA |
| 2 | 7 (C6&C7) | GMC10X7R103M25NT | .01 uF CAPACITOR | MURATA |
| 2 | 8 (C8&C9) | CC1206JX5R106M | 10 uF CAPACITOR (6.3V) | TDK |
| 1 | 9 (L1) | LLV1005FB10NJ | 10 nH INDUCTOR | TOKO |
| 2 | 10 (R1&R2) | RCI-0402-1002J | 10K OHM RESISTOR | IMS |
| A/R | 11 | SN63 | SOLDER PASTE | INDIUM CORP |
| A/R | 12 | SN96 | SOLDER PASTE | INDIUM CORP |

Evaluation Board Layout



Actual Board Size = 2.0" X 1.5"

Evaluation Board Turn-On Sequence¹

Recommended turn-on sequence:

- 1) Connect common ground terminal to the Ground (GND) pin on the board.
- 2) Apply low voltage 0.0 to +1.0 V to pin V_L .
- 3) Apply positive supply voltage VC1 (= 3.3V) to pin VC1 (first stage collector).
- 4) Apply positive supply voltage VC2 (= 3.3V) to pin VC2 (second stage collector).
- 5) Apply positive bias voltage VM12 (= 3.3V) to pin VM12 (bias networks).
- 6) At this point, you should expect to observe the following positive currents flowing into the pins:

| Pin | Current |
|-------|----------------|
| VM12 | 10.0 – 15.0 mA |
| VC1 | 35.0 – 55.0 mA |
| VC2 | 40.0 – 60.0 mA |
| V_L | <1 nA |

7) Apply input RF power to SMA connector pin RFIN. Currents in pins VC1 and VC2 will vary depending on the input drive level.

8) Vary positive voltage V_L on pin VREG from +0.5V to +2.4V to shut down the amplifier or alter the power level. Shut down current flow into the pins:

| Pin | Current |
|-------|----------|
| VM12 | <0.7 mA |
| VC1 | <1 nA |
| VC2 | <1 nA |
| V_L | <0.25 mA |

Recommended turn-off sequence:

Use reverse order described in the turn-on sequence above.

Note:

1: Turn on sequence is not critical and it is not necessary to sequence power supplies in actual system level design.

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