

### Applications

- 802.11a/n/ac Wireless LAN Systems
- CPE (Set Top Box, Routers, Gateways)
- WiFi Access Points and Small Cells
- Telematics
- Gaming and Infotainment
- Point-to-point and Backhaul
- ISM Band

### Product Features

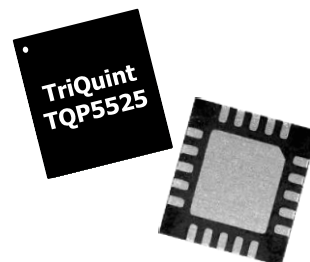
- Fully Integrated 802.11ac Power Amplifier Module With Power Detector
- Internally Matched Input / Output
- Temperature Compensated Bias Network
- High Gain = 32 dB
- Integrated CMOS Compatible Logic and Shutdown
- Typ.  $P_{OUT} = +25$  dBm Pout, 35 dB EVM, MCS9/VHT80 802.11ac
- Typ.  $P_{OUT} = +18$  dBm, EVM = -40 dB, MCS9/VHT80 802.11ac
- Typ.  $P_{OUT} = +26$  dBm, EVM = -30 dB, MCS7/HT40 802.11n
- Supply Voltage: +3.3 V to +5.0 V
- Leadless 4.0 x 4.0 x 0.85 mm Pb-Free QFN Package

### General Description

The TQP5525 is high power WLAN power amplifier module containing an internally matched 3-stage PA, compensated DC biasing circuit and output power detector. This PA module provides high gain (32 dB), high linearity, industry leading EVM floor, and excellent spectral purity for wideband OFDM applications. The architecture and interface are optimized for the most stringent EVM requirements of next generation 802.11.ac WLAN devices.

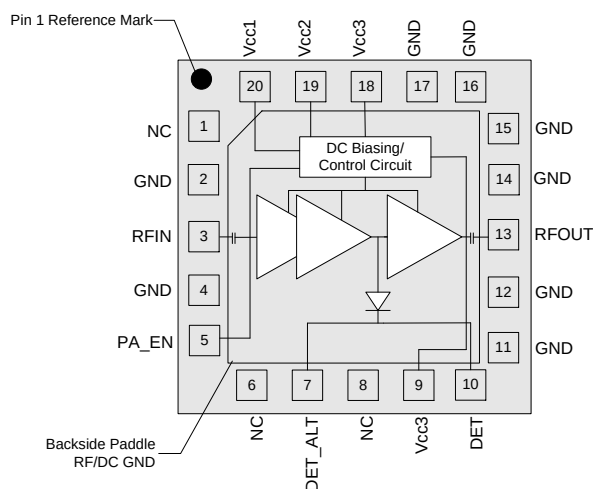
The TQP5525 features chipset logic compatible control voltages and buffered PA enable pin (PAEN) all of which draw very low current to facilitate ease of use and compatibility with current and future transceiver generations. With its optimized power dissipation, this amplifier module is well suited for implementation into next generation MIMO configurations and well designed to work with or without digital pre-distortion (DPD).

The TQP5525 is assembled in a small footprint 4.0 x 4.0 x 0.85 mm 20-pin QFN package.



4x4 mm 20-pin Leadless QFN Package

### Functional Block Diagram



### Pin Configuration

| Pin No.                      | Label        |
|------------------------------|--------------|
| 2, 4, 11, 12, 14, 15, 16, 17 | GND          |
| 3                            | RFIN         |
| 5                            | PA_EN        |
| 1, 6, 8                      | NC           |
| 7                            | DET_ALT      |
| 9, 18                        | VCC3         |
| 10                           | DET          |
| 13                           | RFOUT        |
| 19 / 20                      | VCC2 / VCC1  |
| Backside Paddle              | RF/DC Ground |

### Ordering Information

| Part No.    | Description              |
|-------------|--------------------------|
| TQP5525     | High Power 5 GHz WLAN PA |
| TQP5525-EVB | Evaluation Board         |

Standard T/R size = 2500 pieces on 13" reel

### Absolute Maximum Ratings

| Parameter                           | Rating        |
|-------------------------------------|---------------|
| Storage Temperature                 | -40 to 150 °C |
| Case Temperature, Survival          | -40 to 100 °C |
| RF Input Power, CW, 50 Ω, T = 25 °C | +5 dBm        |
| Device Voltage                      | +6.0 V        |

Operation of this device outside the parameter ranges given above may cause permanent damage.

### Recommended Operating Conditions

| Parameter                                              | Min   | Typ | Max   | Units |
|--------------------------------------------------------|-------|-----|-------|-------|
| V <sub>CC1</sub> , V <sub>CC2</sub> , V <sub>CC3</sub> | +3.15 | +5  | +5.25 | V     |
| T <sub>AMB</sub>                                       | -40   | 25  | +85   | °C    |
| T <sub>j</sub> (for >10 <sup>6</sup> hours MTTF)       |       |     | 170   | °C    |

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

### Electrical Specifications – DC Characteristics

Test conditions unless otherwise noted: V<sub>CC1</sub>=V<sub>CC2</sub>=V<sub>CC3</sub> = +5.0 V, Temp.=+25°C.

| Parameter                           | Conditions                         | Min | Typ | Max              | Units |
|-------------------------------------|------------------------------------|-----|-----|------------------|-------|
| Quiescent Current                   | No RF                              |     | 350 | 400              | mA    |
| Operational Current                 | Pout = +21 dBm, 11ac, MCS9, HT80   |     | 475 | 550              | mA    |
|                                     | Pout = +24 dBm, 11ac, MCS9, HT80   |     | 600 | 675              |       |
|                                     | Pout = +27.5 dBm, 11ac, MCS0, HT20 |     | 750 | 850              |       |
| TX Shut Down Current                | PA_EN= Low, No RF                  |     | 8   |                  | μA    |
| PA Enable Voltage                   | Input Voltage for High State       | 1.8 | 3.0 | V <sub>CC1</sub> | V     |
|                                     | Input Voltage for Low State        |     | 0   | +0.45            |       |
| PA Enable Current                   |                                    |     | 20  | 100              | μA    |
| Rise/Fall Time                      |                                    |     | 0.4 | 0.8              | μS    |
| Thermal Resistance, θ <sub>jc</sub> | Junction to backside paddle        |     | 17  |                  | °C/W  |

### Logic Truth Table

| PA Mode  | PA_EN |
|----------|-------|
| Disabled | Low   |
| Enabled  | High  |

### Electrical Specifications

Test conditions unless otherwise noted:  $V_{CC1}=V_{CC2}=V_{CC3}=+5.0\text{ V}$  Temp. = +25 °C, Measured on TQP5525-EVB,  
PA Enable High = +3.0 V, -45 dBm EVM source

| Parameter                                                                      | Conditions                                | Min                                                       | Typ    | Max   | Units       |
|--------------------------------------------------------------------------------|-------------------------------------------|-----------------------------------------------------------|--------|-------|-------------|
| Operational Freq. Range                                                        |                                           | 4900                                                      |        | 5925  | MHz         |
| 3dB Bandwidth                                                                  | At each 11ac VHT80 channel                | 4740                                                      |        | 6100  | MHz         |
| Saturation Power (Psat)                                                        | f =4900 – 5150 MHz                        |                                                           | +31.5  |       | dBm         |
|                                                                                | f =5150 – 5925 MHz                        |                                                           | +34    |       |             |
| P1dB                                                                           | f= 4900MHz – 5150MHz                      | +29.5                                                     | +30.5  |       | dBm         |
|                                                                                | f= 5150MHz – 5925MHz                      | +30                                                       | +32    |       |             |
| Small Signal Gain                                                              | f =4900 – 5250 MHz                        | 28                                                        | 31     | 35    | dB          |
|                                                                                | f =5250 – 5925 MHz                        | 29                                                        | 32     | 37    |             |
| Gain OOB                                                                       | Absolute gain, f =3433 – 3917 MHz         |                                                           | 0      |       | dB          |
|                                                                                | Absolute gain, f=1716 – 1959 MHz          |                                                           | -50    |       |             |
| Gain Flatness Across Band                                                      | For any 80MHz BW, 11ac VHT80              |                                                           | ± 0.25 |       | dB          |
| Spectral Emission Mask Margin<br>Relative to 11ac standard<br>11ac, MCS0, HT20 | Pout = +24 dBm, f =5150 – 5250 MHz        |                                                           | 5      |       | dB          |
|                                                                                | Pout = +26.5 dBm, f =5250 – 5725 MHz      |                                                           | 5      |       |             |
|                                                                                | Pout = +27.5 dBm, f =5725 – 5925 MHz      |                                                           | 5      |       |             |
| PA Noise Figure                                                                |                                           |                                                           | 7      |       | dB          |
| Input Return Loss                                                              |                                           |                                                           | 10     |       | dB          |
| Output Return Loss                                                             |                                           |                                                           | 10     |       | dB          |
| CW Signal Phase Variation Harmonics (2fo)                                      | Pout = +18 dBm to +24 dBm                 |                                                           | 1.0    |       | Deg.        |
| TX Harmonics ( 2fo)<br>11ac, MCS0, HT20                                        | Pout = +22 dBm, f =5150 – 5250 MHz        |                                                           | -45    |       | dBm/<br>MHz |
|                                                                                | Pout = +26.5 dBm, f =5250 – 5725 MHz      |                                                           | -45    |       |             |
|                                                                                | Pout = +27.5 dBm, f =5725 – 5925 MHz      |                                                           | -45    |       |             |
| TX Harmonics (3fo)<br>11ac, MCS0, HT20                                         | Pout = +22 dBm, f =5150 – 5250 MHz        |                                                           | -45    |       | dBm/<br>MHz |
|                                                                                | Pout = +26.5 dBm, f =5250 – 5725 MHz      |                                                           | -45    |       |             |
|                                                                                | Pout = +27.5 dBm, f =5725 – 5925 MHz      |                                                           | -45    |       |             |
| DEVM (11n / VHT40 / MCS7)                                                      | Pout = +25 dBm                            |                                                           | -33    |       | dB          |
| DEVM (11ac / VHT80 / MCS9)                                                     | Pout = +18 dBm                            |                                                           | -40    | -36   | dB          |
|                                                                                | Pout = +24 dBm                            |                                                           | -36    | -31   |             |
| DEVM (11ac / HT20 / MCS0)                                                      | Pout = +27 dBm                            |                                                           | -26    |       | dB          |
| Detector Voltage                                                               | No RF                                     | +0.25                                                     | +0.35  | +0.38 | V           |
|                                                                                | Pout = +27.5 dBm                          | +0.8                                                      | +0.9   | +1.2  |             |
| Stability                                                                      | Pout = +28 dBm,<br>VSWR = 6:1, all phases | All non-harmonically related<br>outputs < -50 dBc/100 kHz |        |       | -           |

### Performance Over Voltage

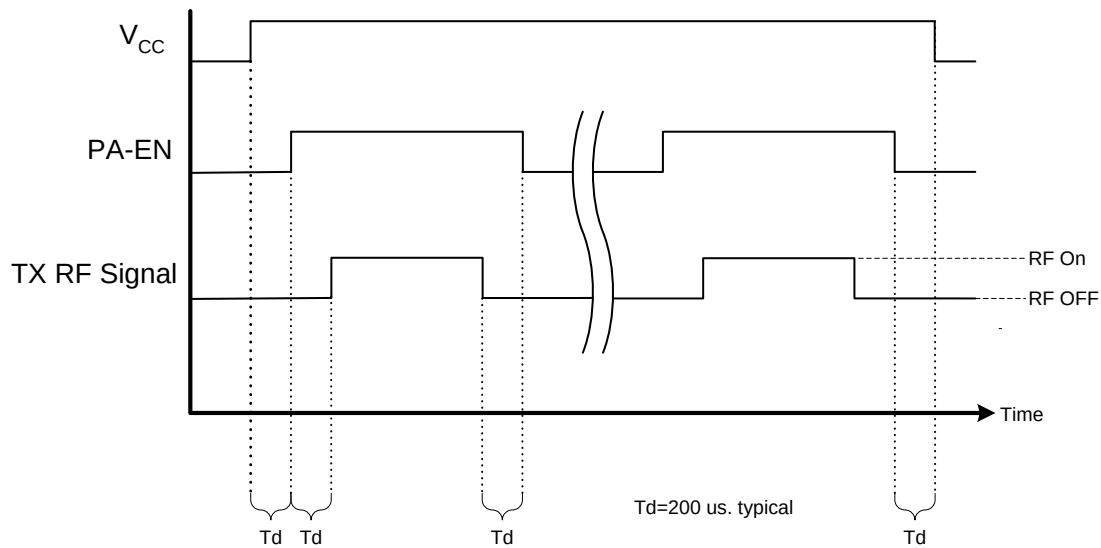
Test conditions unless otherwise noted: Temp=+25°C.

| Parameter                  | Conditions                | Typical Value |      |      | Units |
|----------------------------|---------------------------|---------------|------|------|-------|
| Voltage (Vcc1, Vcc2, Vcc3) |                           | +3.3          | +4.2 | +5.0 | Volts |
| Small Signal Gain          | f =5250-5925 MHz          | 30.5          | 31.5 | 32   | dB    |
| Pout (11ac / VHT80 / MCS9) | DEVM = -35dB              | +22           | +24  | +25  | dBm   |
| Pout (11ac / HT20 / MCS0)  | DEVM = -30dB              | +24           | +26  | +27  | dBm   |
| Operating Current          | VHT80, MCS9, DEVM = -35dB | 470           | 540  | 600  | mA    |

## Timing Diagram

## Transmit Timing Diagram

### RF/DC Power On/Off Sequence

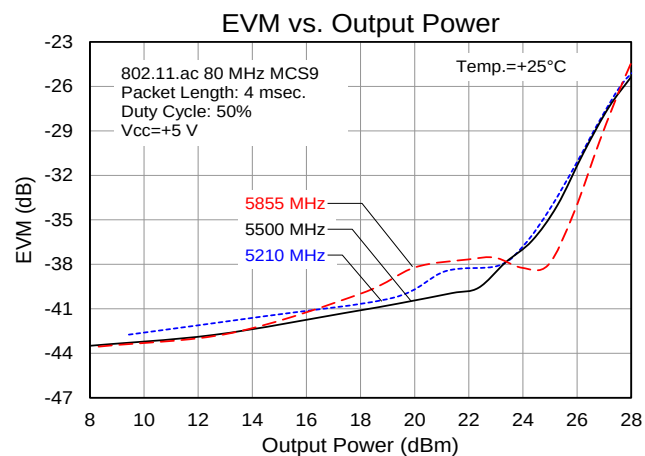
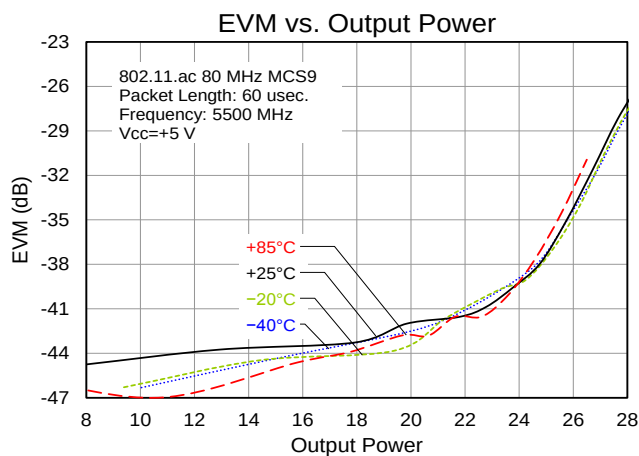
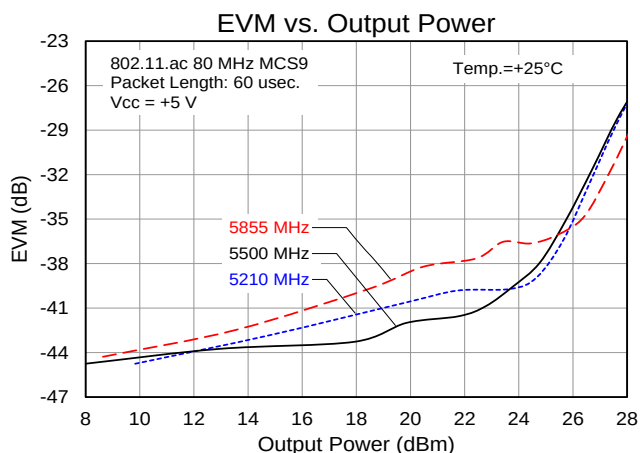
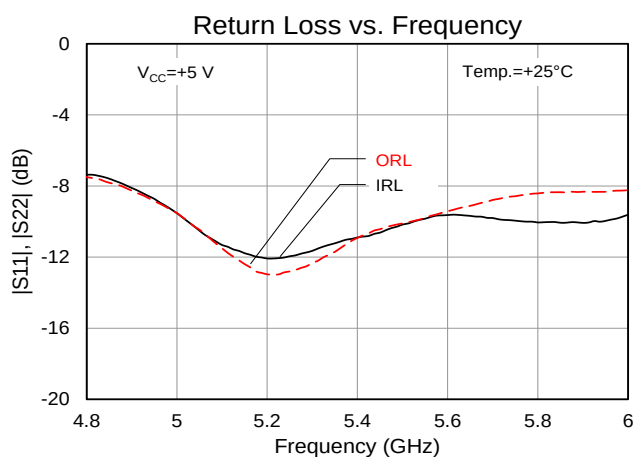
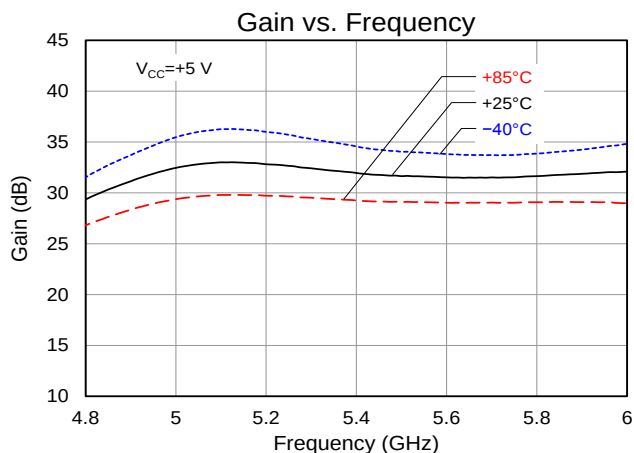
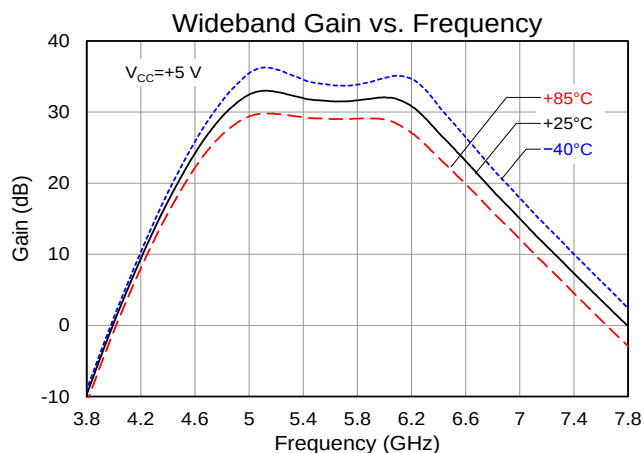


Notes: DC and RF signal levels per data sheet specification.

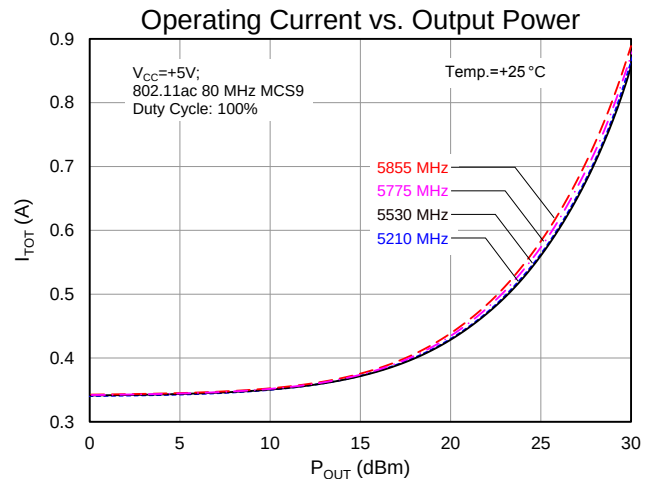
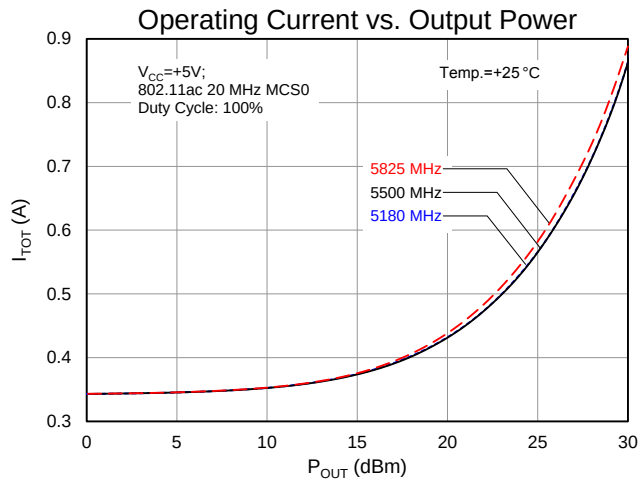
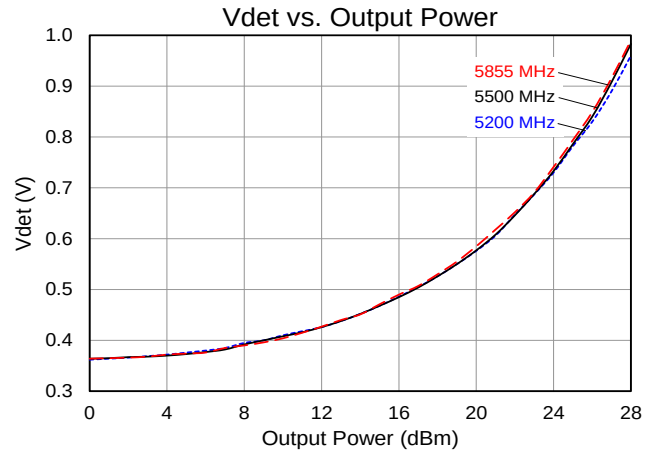
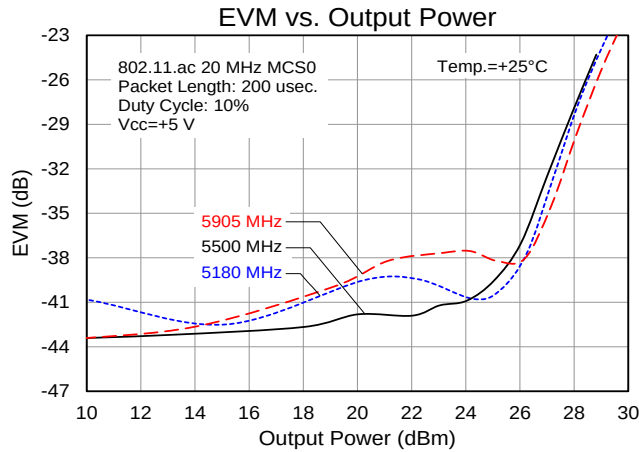
Observe the timing sequence shown in the diagram above and described below.

- Apply  $V_{CC}$  prior to turning on or pulsing PA enable.
- Turn off PA enable prior to turning off  $V_{CC}$ .
- Turn on PA enable prior to applying RF signal.
- Turn off RF signal prior to turning off PA enable.

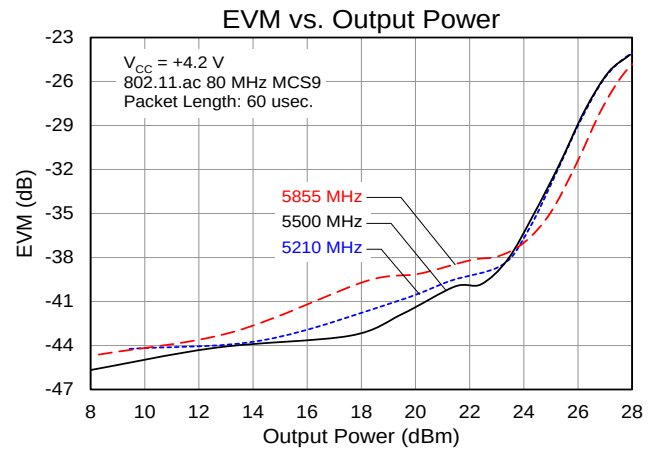
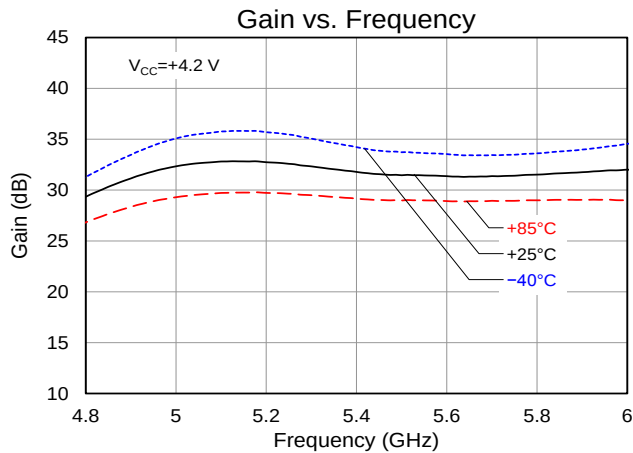
### Performance Plots V<sub>CC</sub>= +5 V



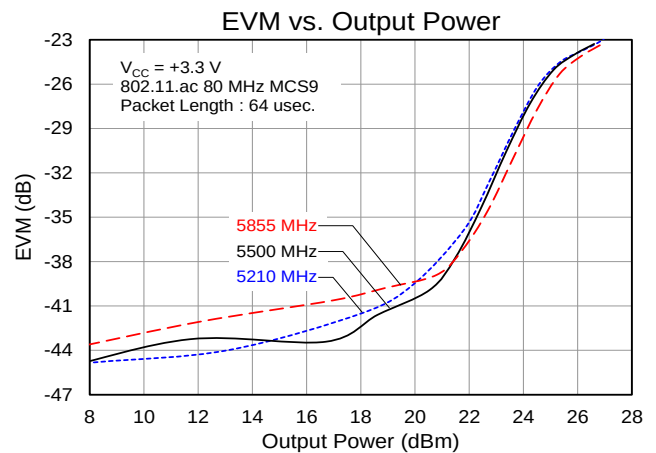
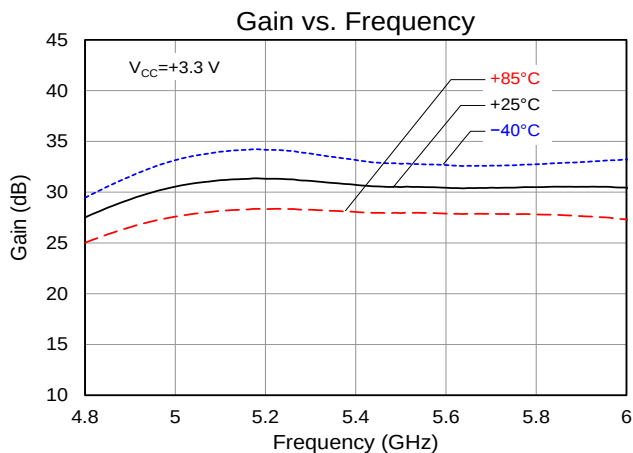
### Performance Plots $V_{CC} = +5\text{ V}$ (cont.)



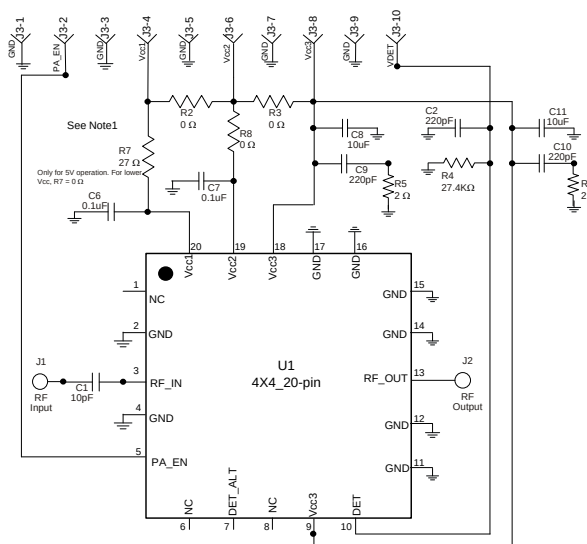
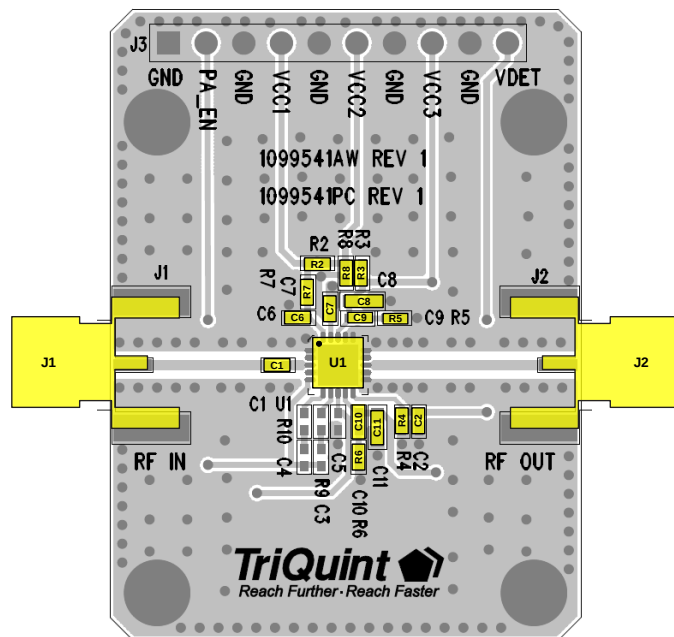
### Performance Plots $V_{CC} = +4.2\text{ V}$



### Performance Plots $V_{CC} = +3.3\text{ V}$



### Application Circuit



### Bill of Material

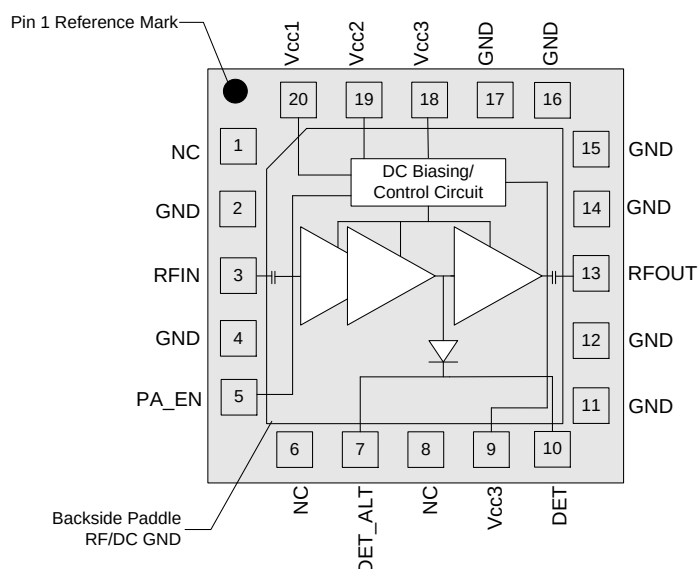
| Ref Des               | Value            | Description                     | Manuf.   | Part Number |
|-----------------------|------------------|---------------------------------|----------|-------------|
| n/a                   | n/a              | Printed Circuit Board           |          | 1099541     |
| U1                    | n/a              | High Power WLAN 5GHz PA         | TriQuint | TQP5525     |
| R2, R8, R3            | 0 $\Omega$       | Resistor, Chip, 04023, 5%       | various  |             |
| C1                    | 10 pF            | Capacitor, Chip, 0402, 5%       | various  |             |
| C6, C7                | 0.1 uF           | Capacitor, Chip, 0402, 10%      | various  |             |
| C8, C11               | 10 uF            | Capacitor, Chip, 0402, 10%      | various  |             |
| C9, C10, C2           | 220 pF           | Capacitor, Chip, 0402, 10%      | various  |             |
| R7 <sup>(1)</sup>     | 0 to 27 $\Omega$ | Resistor, Chip, 0402, 5%, 1/10W | various  |             |
| R5, R6 <sup>(2)</sup> | 2 $\Omega$       | Resistor, Chip, 0402, 5%, 1/16W | various  |             |
| R4                    | 27.4 K $\Omega$  | Resistor, Chip, 0402, 5%, 1/16W | various  |             |

Notes:

- For Vcc1>4.5V, value of R7 may be varied between 0 and 27 Ohms for EVM floor optimization.
- R5 and R6 are de-Q resistors.



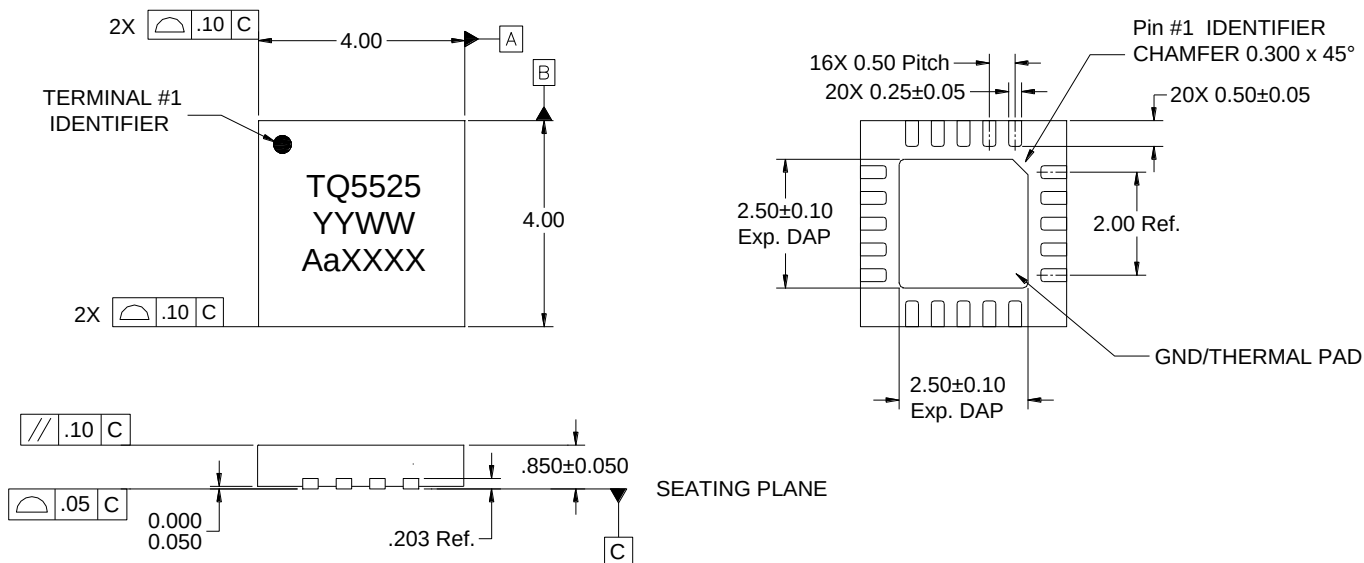
### Pin Configuration and Description



| Pin No.         | Label     | Description                                                                                                                                    |
|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1               | NC        | No internal connection. This pin can be grounded or N/C on PCB.                                                                                |
| 2               | GND       | Ground                                                                                                                                         |
| 3               | RF_IN     | RF Input                                                                                                                                       |
| 4               | GND       | Ground                                                                                                                                         |
| 5               | PA_EN     | PA Enable                                                                                                                                      |
| 6               | NC        | No internal connection. This pin can be grounded or N/C on PCB.                                                                                |
| 7               | DET_ALT   | Alternate Detector Output                                                                                                                      |
| 8               | NC        | No internal connection. This pin can be grounded or N/C on PCB.                                                                                |
| 9               | VCC3      | Supply voltage for third stage PA                                                                                                              |
| 10              | DET       | Detector Output                                                                                                                                |
| 11              | GND       | Ground                                                                                                                                         |
| 12              | GND       | Ground                                                                                                                                         |
| 13              | RF_OUT    | RF Output                                                                                                                                      |
| 14              | GND       | Ground                                                                                                                                         |
| 15              | GND       | Ground                                                                                                                                         |
| 16              | GND       | Ground                                                                                                                                         |
| 17              | GND       | Ground                                                                                                                                         |
| 18              | VCC3      | Supply voltage for third stage PA                                                                                                              |
| 19              | VCC2      | Supply voltage for second stage PA                                                                                                             |
| 20              | VCC1      | Supply voltage for first stage PA                                                                                                              |
| Backside Paddle | RF/DC GND | FEM RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint. |

## Package Marking and Dimensions

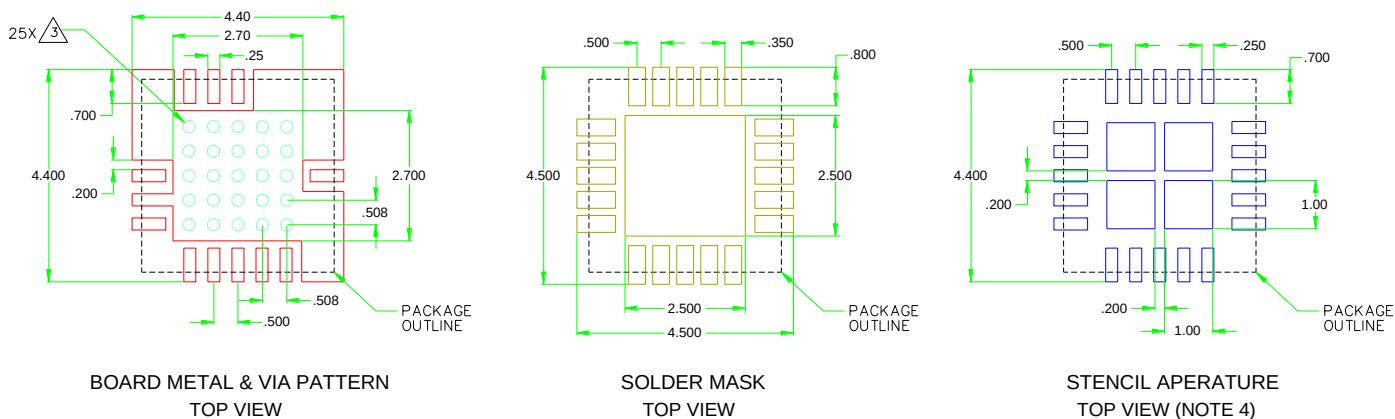
Marking: Part Number: TQ5525  
Date Code: YYWW (Year, workweek)  
Lot Code: AaXXXX



Notes:

1. All dimensions are in millimeters.
2. Contact plating: NiPdAu.

## PCB Mounting Pattern



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

## Product Compliance Information

### ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: 1C  
Value:  $\geq 1000$  V to  $< 2000$  V  
Test: Human Body Model (HBM)  
Standard: ESDA/JEDEC Standard JS-001-2012

ESD Rating: C3  
Value:  $\geq 1000$  V  
Test: Charged Device Model (CDM)  
Standard: JEDEC Standard JESD22-C101F

### MSL Rating

MSL Rating: Level 1  
Test: 260°C convection reflow  
Standard: JEDEC Standard IPC/JEDEC J-STD-020

### Solderability

Compatible with both lead-free (260°C maximum reflow temperature) and tin/lead (245°C maximum reflow temperature) soldering processes.

Contact plating: NiPdAu

### RoHS Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ( $C_{15}H_{12}Br_4O_2$ ) Free
- PFOS Free
- SVHC Free

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

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