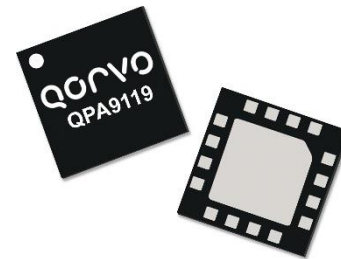


Product Overview

The QPA9119 is a high linearity driver amplifier in a low-cost, RoHS compliant, surface mount package. This InGaP/GaAs HBT delivers high performance across a broad range of frequencies with +44 dBm OIP3 and +27.2 dBm P1dB while only consuming 130 mA quiescent current. All devices are 100% RF and DC tested.

The QPA9119 incorporates on-chip features that differentiate it from other products in the market. The amplifier integrates an on-chip DC over-voltage and RF over-drive protection. This protects the amplifier from electrical DC voltage surges and high input RF input power levels that may occur in a system. On-chip ESD protection allows the amplifier to have a very robust Class 1C HBM ESD rating.

The QPA9119 is targeted for use as a driver amplifier in wireless infrastructure where high linearity, medium power, and high efficiency are required. The device an excellent candidate for transceiver line cards in current and next generation multi-carrier 3G / 4G base stations.



16 Pad 3 x 3 mm QFN Package

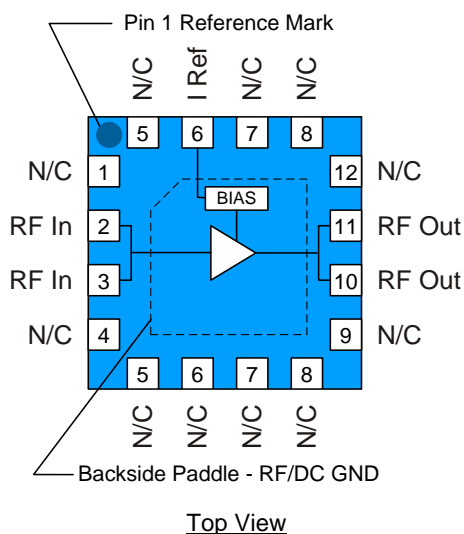
Key Features

- 400 – 4200 MHz
- +27.2 dBm P1dB
- +44 dBm Output IP3
- 17 dB Gain at 2140 MHz
- +5 V Single Supply, $I_{CQ} = 130$ mA
- Internal RF Overdrive Protection
- Internal DC Overvoltage Protection
- On Chip ESD Protection
- 3 x 3 mm QFN Package

Applications

- Repeaters / DAS
- Mobile Infrastructure
- Defense Communications
- General Purpose Wireless

Functional Block Diagram



Ordering Information

| Part No. | Description |
|-----------------|--------------------------------------|
| QPA9119 | 2,500 pieces on a 7" reel (standard) |
| QPA9119-PCB900 | 869–960 MHz Evaluation Board |
| QPA9119-PCB2140 | 2110–2170 MHz Evaluation Board |

Absolute Maximum Ratings

| Parameter | Rating |
|---------------------------------------|----------------|
| Storage Temperature | -65 to +150 °C |
| RF Input Power, CW, 50 Ω, T=25 °C | +27 dBm |
| Device Voltage (V _{CC}) | +8 V |
| Dissipated Power (P _{DISS}) | 1.7 W |

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.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--|-------|-----|-------|-------|
| Device Voltage (V _{CC}) | +4.75 | +5 | +5.25 | V |
| T _{CASE} | -40 | | +105 | °C |
| T _j for >10 ⁶ hours MTTF | | | +175 | °C |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

| Parameter | Conditions ⁽¹⁾ | Min | Typ | Max | Units |
|-------------------------------------|--|-------|-------|------|-------|
| Operational Frequency Range | | 400 | | 4200 | MHz |
| Test Frequency | | | 2140 | | MHz |
| Gain | | 15.5 | 17.1 | 18.5 | dB |
| Input Return Loss | | | 14 | | dB |
| Output Return Loss | | | 11 | | dB |
| Output P1dB | | +26.4 | +27.2 | | dBm |
| Output IP3 | P _{out} = +9 dBm/tone, Δf = 1 MHz | +41.0 | +43.8 | | dBm |
| LTE Channel Power ⁽²⁾ | -50 dBc ACLR See Note 2 | | +18.1 | | dBm |
| Noise Figure | | | 4.8 | | dB |
| Reference Bias current | Pin 15 | | 7 | | mA |
| Quiescent Current, I _{CCQ} | Pins 10, 11 | 115 | 130 | 155 | mA |
| Total Current | | | 137 | | mA |
| Thermal Resistance, θ _{JC} | Junction to case | | | 50.3 | °C/W |

Notes:

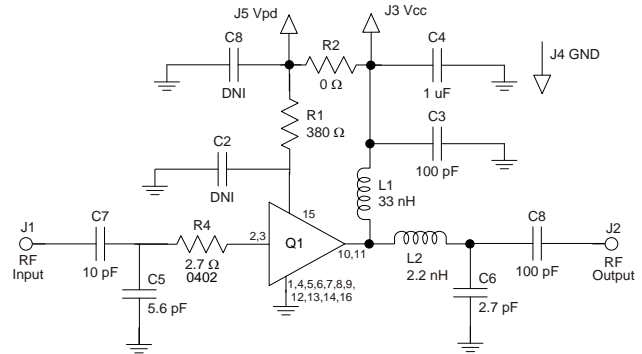
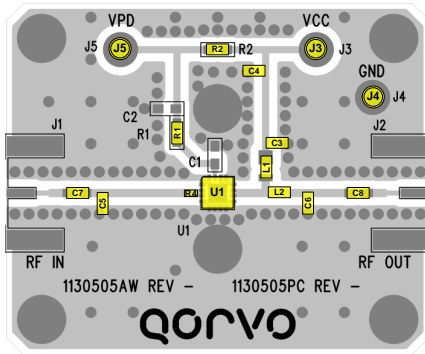
1. Test conditions unless otherwise noted: V_{CC} = V_{PD} = +5.0 V, Temp = +25 °C, 50 Ω system.
2. ACLR test set-up: LTE, 20 MHz E-UTRA, +20 MHz offset, PAR = 9.5 dB at 0.01% Probability

S-Parameters

| Freq (GHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 0.05 | -6.62 | -174.41 | 27.28 | 124.83 | -24.82 | 87.65 | -4.37 | -172.48 |
| 0.10 | -6.11 | -174.19 | 23.31 | 125.16 | -36.26 | 0.46 | -2.80 | -159.87 |
| 0.20 | -7.34 | -152.53 | 17.32 | 131.27 | -40.20 | 9.27 | -2.05 | -177.15 |
| 0.40 | -0.95 | -162.11 | 20.48 | 144.17 | -33.75 | 33.77 | -4.17 | 166.09 |
| 0.60 | -0.67 | -177.80 | 19.46 | 120.55 | -32.49 | 22.94 | -4.88 | 167.74 |
| 0.80 | -0.81 | 174.16 | 17.80 | 105.64 | -32.11 | 18.72 | -4.89 | 167.06 |
| 1.00 | -0.92 | 168.52 | 16.25 | 94.63 | -31.86 | 16.69 | -4.81 | 164.86 |
| 1.20 | -1.00 | 163.75 | 14.88 | 85.61 | -31.62 | 15.38 | -4.73 | 162.09 |
| 1.40 | -1.06 | 159.42 | 13.67 | 77.74 | -31.39 | 14.42 | -4.66 | 158.97 |
| 1.60 | -1.10 | 155.28 | 12.59 | 70.57 | -31.16 | 13.48 | -4.57 | 155.65 |
| 1.80 | -1.12 | 151.20 | 11.59 | 63.86 | -30.95 | 12.50 | -4.48 | 152.21 |
| 2.00 | -1.13 | 147.13 | 10.68 | 57.49 | -30.74 | 11.44 | -4.38 | 148.80 |
| 2.20 | -1.13 | 142.97 | 9.83 | 51.35 | -30.56 | 10.16 | -4.26 | 145.35 |
| 2.40 | -1.13 | 138.79 | 9.03 | 45.42 | -30.40 | 8.87 | -4.15 | 142.00 |
| 2.60 | -1.12 | 134.61 | 8.25 | 39.65 | -30.26 | 7.52 | -4.03 | 138.91 |
| 2.80 | -1.09 | 130.44 | 7.50 | 34.07 | -30.15 | 5.99 | -3.89 | 136.04 |
| 3.00 | -1.05 | 126.28 | 6.77 | 28.70 | -30.06 | 4.49 | -3.75 | 133.19 |
| 3.20 | -1.03 | 122.34 | 6.07 | 23.53 | -30.00 | 3.00 | -3.63 | 130.49 |
| 3.40 | -1.00 | 118.66 | 5.38 | 18.51 | -29.95 | 1.37 | -3.52 | 128.09 |
| 3.60 | -0.95 | 115.17 | 4.72 | 13.69 | -29.93 | -0.17 | -3.38 | 125.84 |
| 3.80 | -0.91 | 111.69 | 4.09 | 9.01 | -29.91 | -1.72 | -3.25 | 123.58 |
| 4.00 | -0.89 | 109.84 | 3.55 | 4.09 | -29.84 | -3.69 | -3.09 | 118.66 |
| 4.20 | -0.86 | 107.48 | 2.95 | -0.05 | -29.86 | -5.00 | -2.99 | 116.78 |
| 4.40 | -0.82 | 105.44 | 2.38 | -3.91 | -29.88 | -6.15 | -2.88 | 115.15 |
| 4.60 | -0.79 | 103.60 | 1.84 | -7.62 | -29.91 | -7.26 | -2.76 | 113.43 |
| 4.80 | -0.77 | 102.20 | 1.34 | -11.12 | -29.93 | -8.27 | -2.68 | 111.71 |
| 5.00 | -0.76 | 100.98 | 0.87 | -14.54 | -29.95 | -9.25 | -2.61 | 110.10 |
| 5.20 | -0.75 | 100.03 | 0.44 | -17.85 | -29.97 | -10.10 | -2.54 | 108.53 |
| 5.40 | -0.74 | 99.00 | 0.04 | -21.17 | -29.98 | -11.00 | -2.47 | 106.94 |
| 5.60 | -0.74 | 98.11 | -0.33 | -24.43 | -29.98 | -11.73 | -2.41 | 105.20 |
| 5.80 | -0.75 | 97.20 | -0.67 | -27.76 | -29.96 | -12.52 | -2.36 | 103.39 |
| 6.00 | -0.76 | 96.42 | -0.99 | -31.12 | -29.92 | -13.30 | -2.32 | 101.42 |

Test Conditions: $V_{CC}=+5\text{ V}$, $I_{CQ}=130\text{ mA}$ (typ.), Temp.=+25 °C, unmatched 50 Ohm system, reference plane at device leads

869–960 MHz Evaluation Board – QPA9119-PCB900



Notes:

1. See Evaluation Board PCB Information for material and stack up.
2. Critical component placement locations:
 - Distance from U1 (left edge) to R4 (right edge): 25 mils (1.2 deg. at 920 MHz)
 - Distance from U1 (left edge) to C5 (right edge): 360 mils (17 deg. at 920 MHz)
 - Distance from U1 (right edge) to L2 (left edge): 120 mils (5.7 deg. at 920 MHz)
 - Distance from U1 (right edge) to C6 (left edge): 347 mils (16.5 deg. at 920 MHz)

Bill of Material – QPA9119-PCB900

| Reference Des. | Value | Description | Manuf. | Part Number |
|----------------|--------|---|-----------|----------------|
| n/a | n/a | Printed Circuit Board | Qorvo | |
| U1 | n/a | QPA9119 Amplifier, QFN pkg. | Qorvo | QPA9119 |
| R2 | 0 Ω | Resistor, Chip, 0603 | various | |
| R4 | 2.7 Ω | Resistor, Chip, 0402, 1%, 1/16W | various | |
| R1 | 380 Ω | Resistor, Chip, 0603, 1%, 1/16W | various | |
| L2 | 2.2 nH | Inductor, 0603, +/-0.3 nH | Toko | LL1608-FSL2N2S |
| L1 | 33 nH | Inductor, 0805, 5%, Coilcraft CS Series | Coilcraft | 0805CS-330XJLB |
| C7 | 10 pF | Cap., Chip, 0603, 5%, 50V. NPO/COG | various | |
| C6 | 2.7 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG NPO/COG | various | |
| C2, C8 | 100 pF | Cap., Chip, 0603, 5%, 50V, NPO/COG | various | |
| C4 | 1.0 uF | Cap., Chip, 0603, 10%, 10V, X5R | various | |
| C5 | 5.6 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | various | |

Typical Performance – QPA9119-PCB900

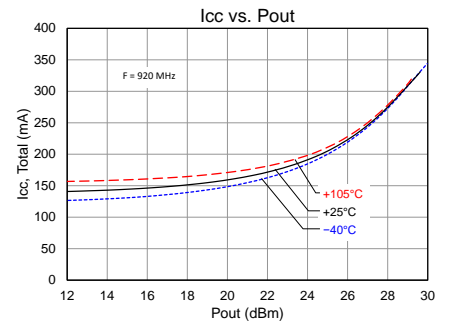
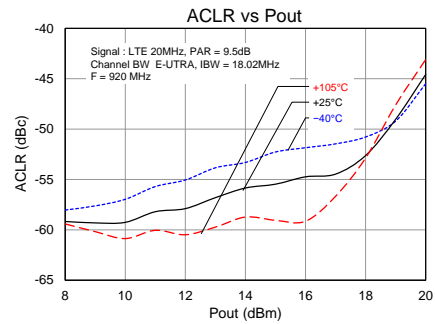
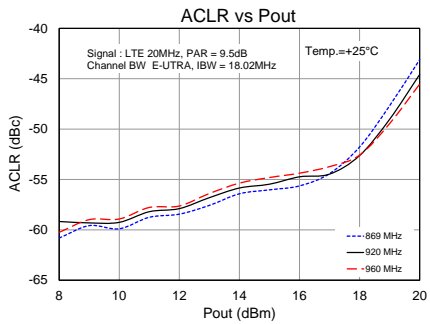
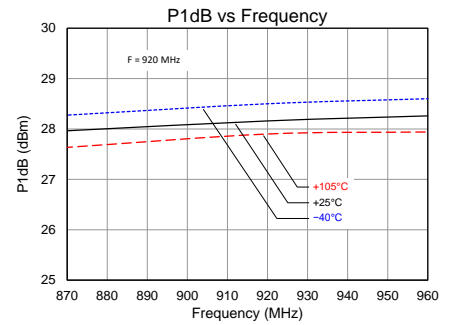
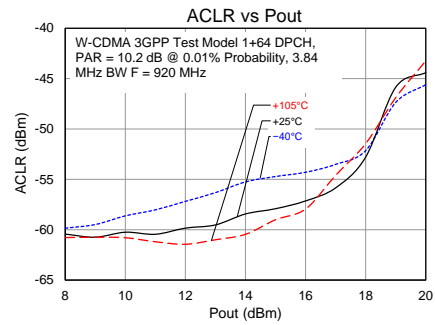
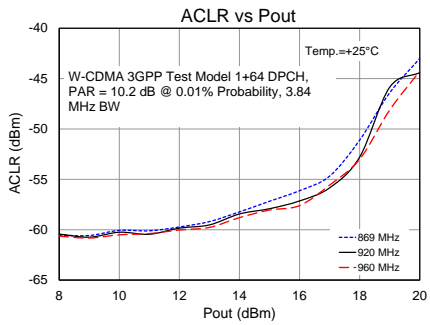
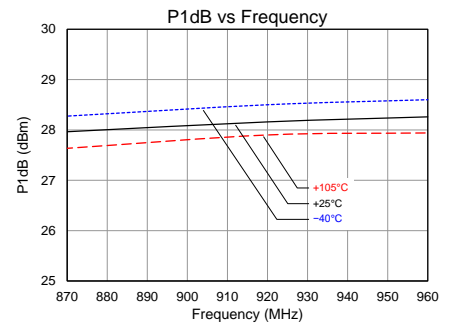
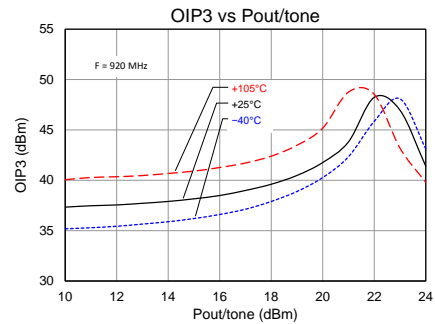
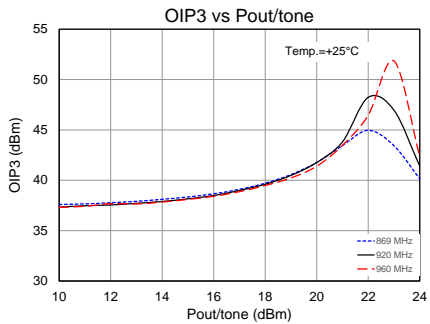
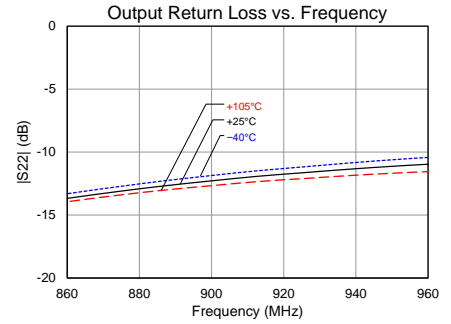
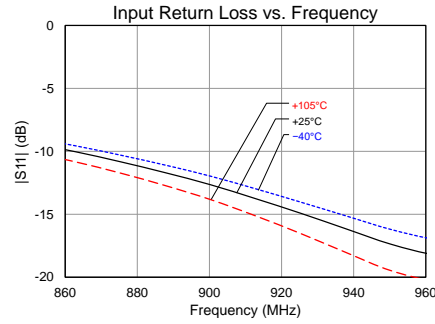
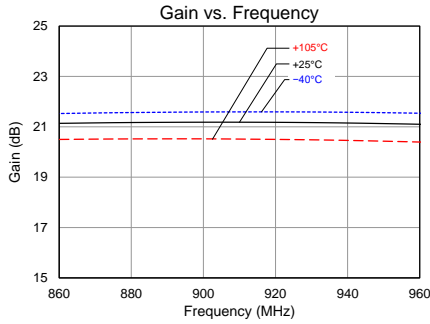
| Parameter | Conditions ⁽¹⁾ | Typical Value | | | Units |
|----------------------------------|------------------------------|---------------|-------|-------|-------|
| Frequency | | 869 | 920 | 960 | MHz |
| Gain | | 21.1 | 21.2 | 21.1 | dB |
| Input Return Loss | | 10 | 13 | 17 | dB |
| Output Return Loss | | 13 | 12 | 11 | dB |
| Output P1dB | | +28.0 | +28.2 | +28.3 | dBm |
| OIP3 | Pout= +21 dBm/tone, Δf=1 MHz | +43.5 | +43.8 | +43.5 | dBm |
| LTE Channel Power ⁽²⁾ | -50 dBc ACLR | +18.3 | +18.7 | +18.7 | dBm |
| Noise Figure | | 6.8 | 6.7 | 6.7 | dB |

Notes:

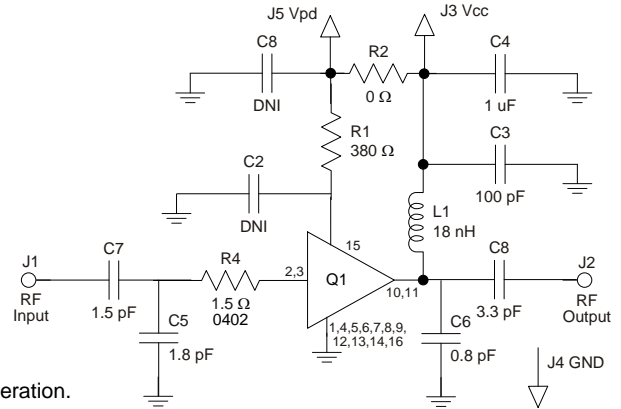
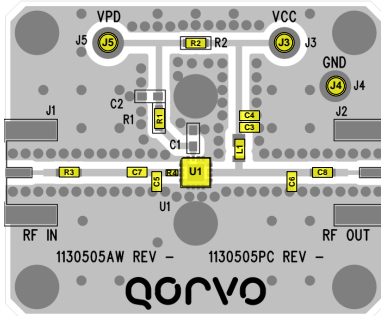
1. Test conditions unless otherwise noted: V_{CC} = V_{PD} = +5V, I_{CQ} = 130 mA, I_{REF} = 7 mA, Temp. = +25 °C
2. ACLR Test set-up: LTE, 20 MHz E-UTRA, +20 MHz offset, PAR = 9.5 dB at 0.01% Probability

Performance Plots – QPA9119-PCB900

Test conditions unless otherwise noted: $V_{CC} = V_{PD} = +5V$, $I_{CQ} = 130\text{ mA}$, $I_{REF} = 7\text{ mA}$, $Temp. = +25^\circ\text{C}$



2110–2170 MHz Evaluation Board – QPA9119-PCB2140



Notes:

1. See Evaluation Board PCB Information for material and stack up.
2. The recommended component values are dependent upon the frequency of operation.
3. All components are of 0603 size unless stated on the schematic.
4. Critical component placement locations:
 - Distance from U1 (left edge) to R4 (right edge): 32 mils (3.6 deg. at 2140 MHz)
 - Distance from U1 (left edge) to C5 (right edge): 70 mils (7.8 deg. at 2140 MHz)
 - Distance from U1 (left edge) to C7 (right edge): 152 mils (16.8 deg. at 2140 MHz)
 - Distance from U1 (right edge) to C8 (left edge): 380 mils (42.0 deg. at 2140 MHz)
 - Distance from U1 (right edge) to C6 (left edge): 305 mils (33.7 deg. at 2140 MHz)

Bill of Material QPA9119-PCB2140

| Reference Des. | Value | Description | Manuf. | Part Number |
|----------------|--------|---|-----------|----------------|
| n/a | n/a | Printed Circuit Board | Qorvo | |
| U1 | n/a | QPA9119 Amplifier, QFN pkg. | Qorvo | QPA9119 |
| R2 | 0 Ω | Resistor, Chip, 0603 | various | |
| R4 | 1.5 Ω | Resistor, Chip, 0402, 1%, 1/16W | various | |
| R1 | 380 Ω | Resistor, Chip, 0603, 1%, 1/16W | various | |
| C3 | 100 pF | Cap., Chip, 0603, 5%, 50V, NPO/COG | various | |
| L1 | 18 nH | Inductor, 0805, 5%, Coilcraft CS Series | Coilcraft | 0805CS-180XJLB |
| C7 | 1.5 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG 5%, | various | |
| C6 | 0.8 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | various | |
| C8 | 3.3 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | various | |
| C4 | 1.0 uF | Cap., Chip, 0603, 10%, 10V, X5R | various | |
| C5 | 1.8 pF | Cap., Chip, 0603, +/-0.1pF. 200V. NPO/COG | various | |

Typical Performance – QPA9119-PCB2140

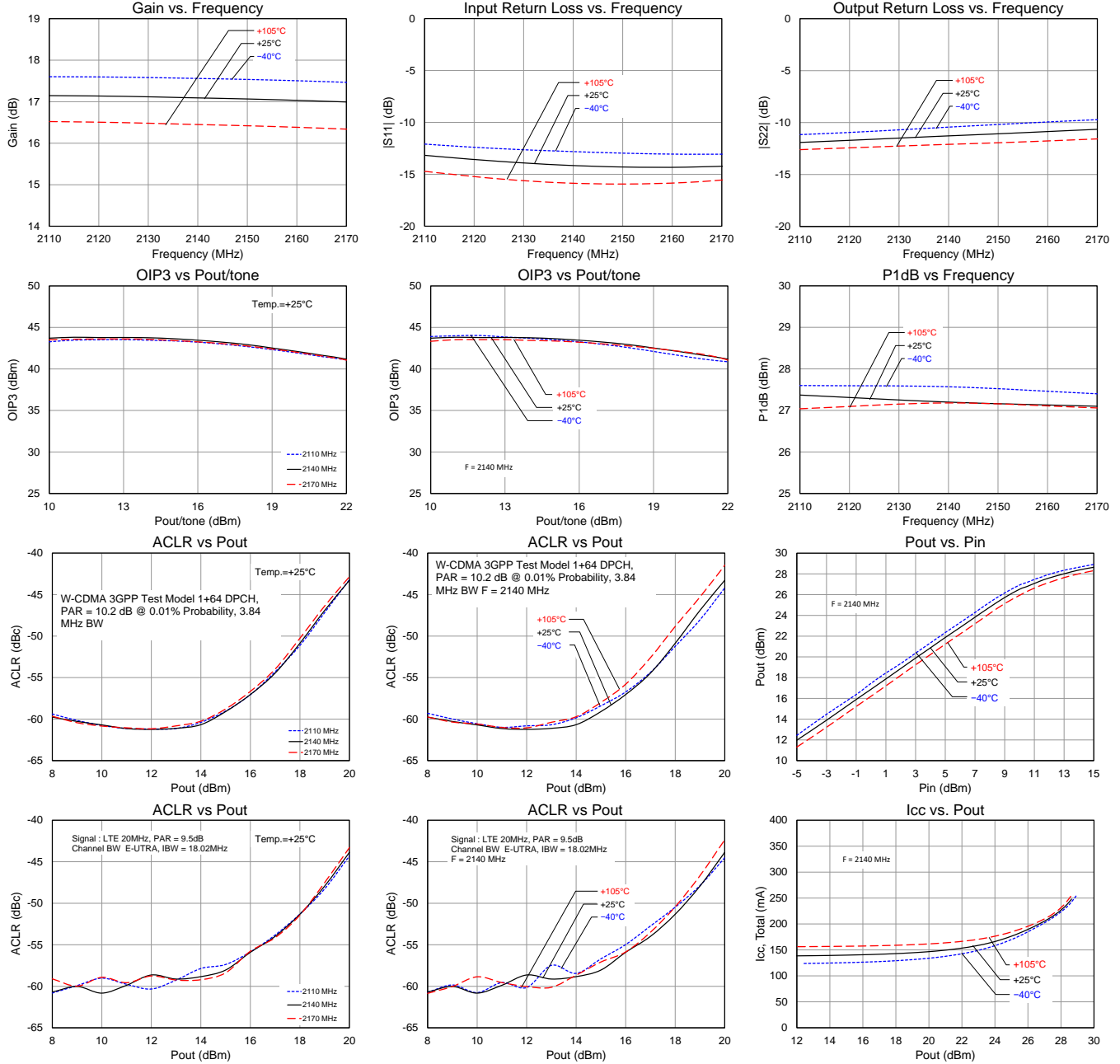
| Parameter | Conditions | Typical Value | | | Units |
|----------------------------------|------------------------------|---------------|-------|-------|-------|
| Frequency | | 2110 | 2140 | 2170 | MHz |
| Gain | | 17.1 | 17.1 | 17.0 | dB |
| Input Return Loss | | 13 | 14 | 14 | dB |
| Output Return Loss | | 12 | 11 | 11 | dB |
| Output P1dB | | +27.4 | +27.2 | +27.1 | dBm |
| OIP3 | Pout= +13 dBm/tone, Δf=1 MHz | +43.5 | +43.8 | +43.6 | dBm |
| LTE Channel Power ⁽²⁾ | -50 dBc ACLR | +18.2 | +18.1 | +18.4 | dBm |
| Noise Figure | | 4.8 | 4.8 | 4.8 | dB |

Notes:

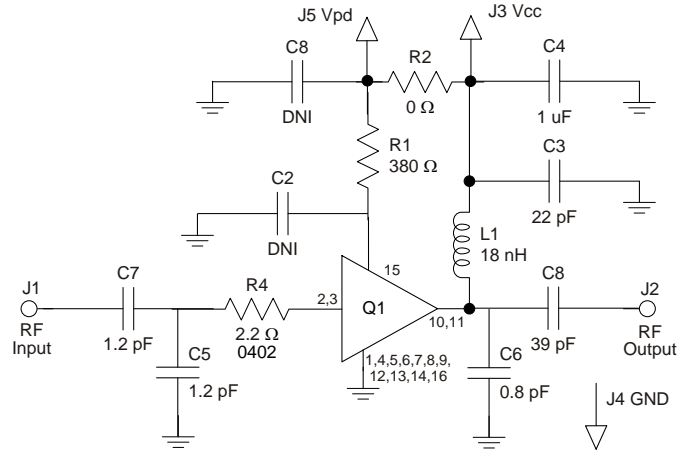
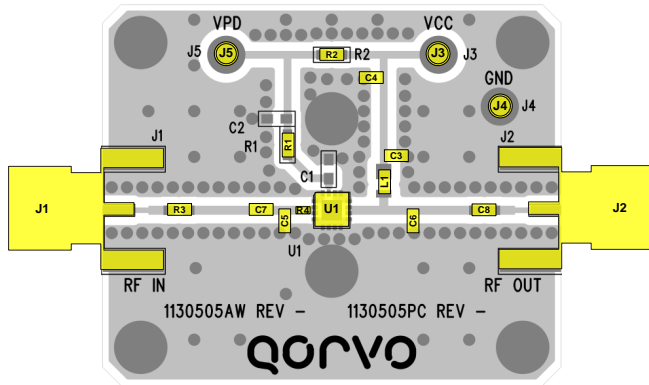
1. Test Conditions: $V_{CC} = V_{PD} = +5V$, $I_{CO} = 130\text{ mA}$, $I_{REF} = 7\text{ mA}$, $Temp. = +25\text{ °C}$
2. ACLR Test set-up: LTE, 1-CH E-UTRA, +20 MHz offset, PAR = 9.5 dB at 0.01% Probability

Performance Plots – QPA9119-PCB2140

Test conditions unless otherwise noted: $V_{CC} = V_{PD} = +5V$, $I_{CQ} = 130\text{ mA}$, $I_{REF} = 7\text{ mA}$, $Temp. = +25^\circ\text{C}$



2300 – 2700 MHz Reference Design



Notes:

1. See Evaluation Board PCB Information for material and stack up.
2. Critical component placement locations:
 - Distance between U1 (left edge) to R4 (right edge): 15 mil
 - Distance between U1 (left edge) to C5 (right edge): 80 mil
 - Distance between U1 (left edge) to C7 (right edge): 130 mil
 - Distance between U1 (right edge) to C6 (left edge): 130 mil

Bill of Material – 2300 – 2700 MHz Reference Design

| Ref. Des. | Value | Description | Manuf. | Part Number |
|-----------|--------|---|-----------|----------------|
| n/a | n/a | Printed Circuit Board | Qorvo | |
| U1 | n/a | 0.5 W High Linearity Amplifier | Qorvo | QPA9119 |
| R1 | 380 Ω | Res., Chip, 0603, +/-1%, 1/10W | various | |
| R2, R3 | 0 Ω | Res., Chip, 0603 | various | |
| C5, C7 | 1.2 pF | CAP, 0603, +/-0.1pF. 200V. NPO/COG | various | |
| C6 | 0.8 pF | CAP, 0603, +/-0.1pF. 200V. NPO/COG | various | |
| C8 | 39 pF | Cap., Chip, 0603, +/-5%. 50V NPO/COG | various | |
| C3 | 22 pF | Cap., Chip, 0603, +/-5%. 50V NPO/COG | various | |
| R4 | 2.2 Ω | Res., Chip, 0402, +/-1%, 1/10W | various | |
| C4 | 1.0 uF | CAP, 0603, 10%, X5R , 10V | various | |
| L1 | 18 nH | Inductor, 0805, 5%, Coilcraft CS series | Coilcraft | 0805CS-180XJLB |

Typical Performance 2300 – 2700 MHz Reference Design

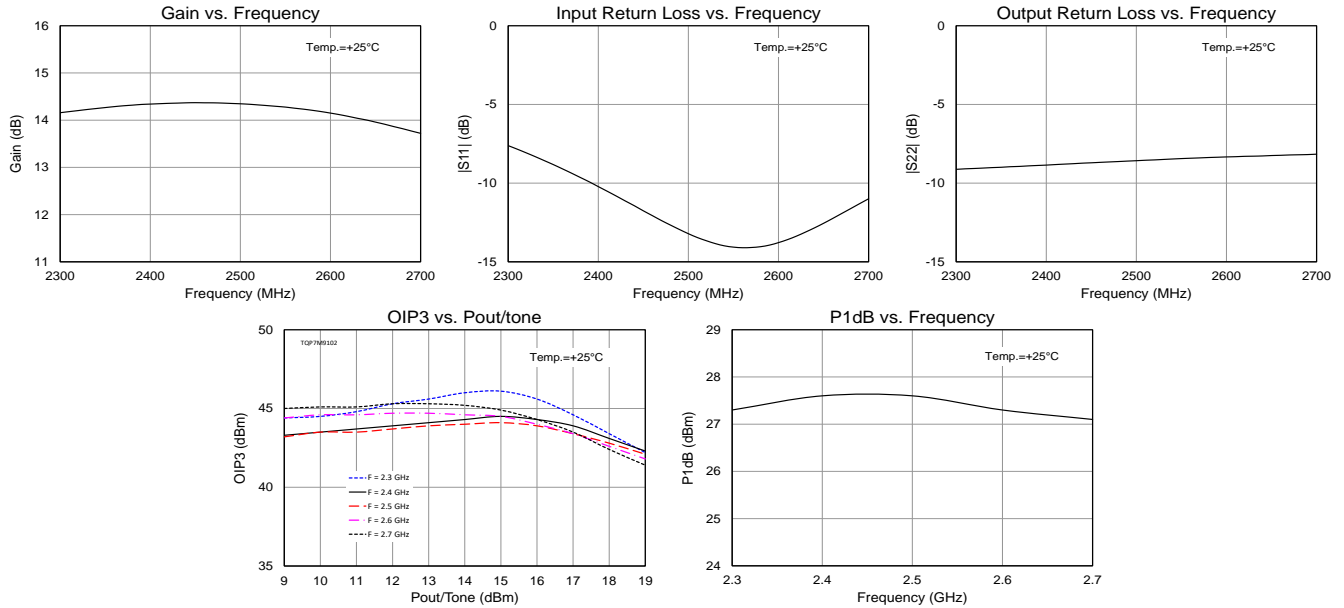
| Parameter | Conditions | Typical Value | | | | | Units |
|--|-------------------------------|---------------|-------|-------|-------|-------|-------|
| | | 2300 | 2400 | 2500 | 2600 | 2700 | |
| Frequency | | 2300 | 2400 | 2500 | 2600 | 2700 | MHz |
| Gain | | 14.1 | 14.3 | 14.3 | 14.1 | 13.7 | dB |
| Input Return Loss | | 7.6 | 10 | 13 | 13 | 11 | dB |
| Output Return Loss | | 9.1 | 8.8 | 8.6 | 8.3 | 8.2 | dB |
| Output P1dB | | +27.3 | +27.6 | +27.6 | +27.3 | +27.1 | dBm |
| Output IP3 | Pout= +15 dBm/tone, Δf= 1 MHz | +46.1 | +44.5 | +44.1 | +44.5 | +44.9 | dBm |
| Quiescent Collector Current, I _{CQ} | | 130 | | | | | mA |

Notes:

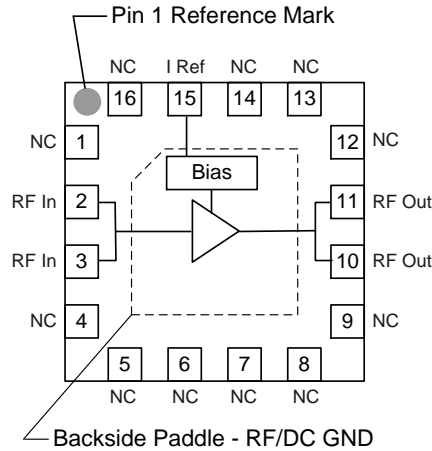
1. Test Conditions: V_{CC} = V_{PD} = +5V, I_{CQ} = 130 mA , I_{REF} = 7 mA , Temp.=+25 °C

Performance Plots 2300 – 2700 MHz Reference Design

Test Conditions: $V_{CC} = V_{PD} = +5V$, $I_{CQ} = 130\text{ mA}$, $I_{REF} = 7\text{ mA}$, $Temp. = +25^\circ\text{C}$



Pad Configuration and Description



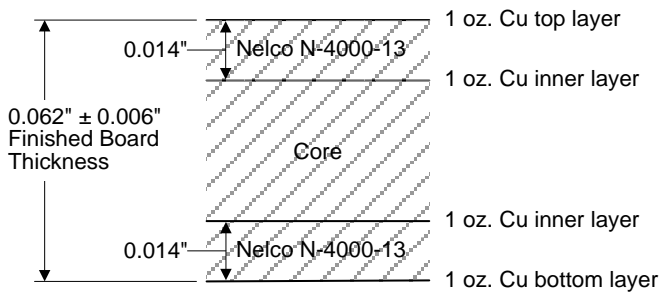
Top View

| Pad No. | Label | Description |
|-------------------------------------|--------------------------|--|
| 1, 4, 5, 6, 7, 8, 9, 12, 13, 14, 16 | NC | No electrical connection. Land pads should be provided for PCB mounting integrity. |
| 2, 3 | RF IN | RF input. External DC Block required. Requires conjugate match for optimal performance. |
| 10, 11 | RF OUT / V _{CC} | RF output. External DC Block and bias voltage required. Requires matching. |
| 15 | I REF | Sets the bias current for the amp. Also can be used to power down device. |
| Backside Paddle | GND | RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint. |

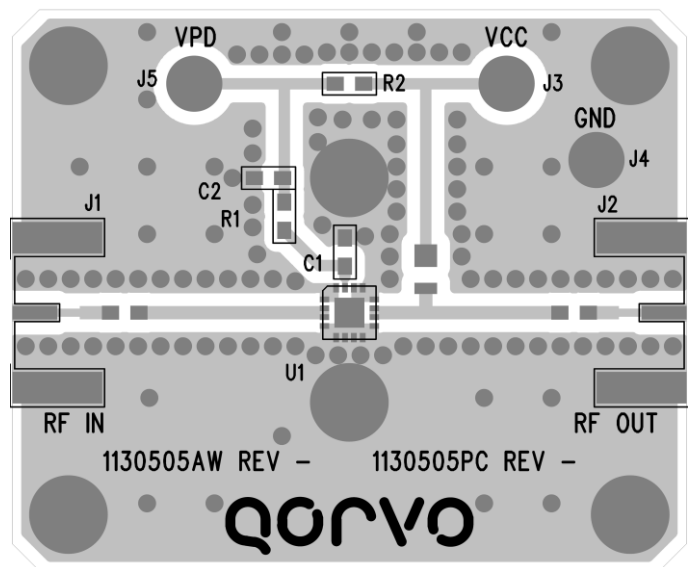
Evaluation Board PCB Information

PC Board Layout

PCB 1130505 Material (stackup)

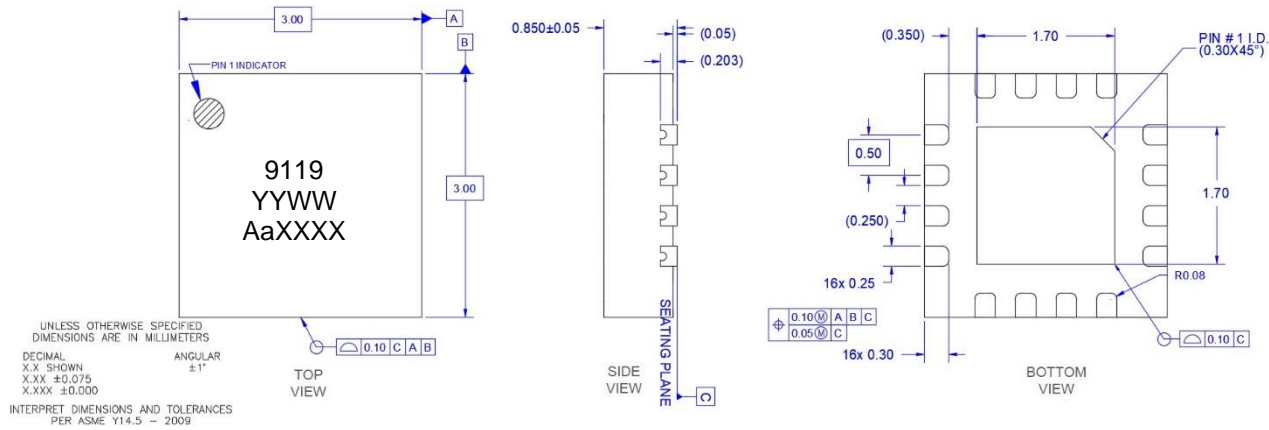


50 ohm line dimensions: width = 0.029", spacing = 0.029"



Package Marking and Dimensions

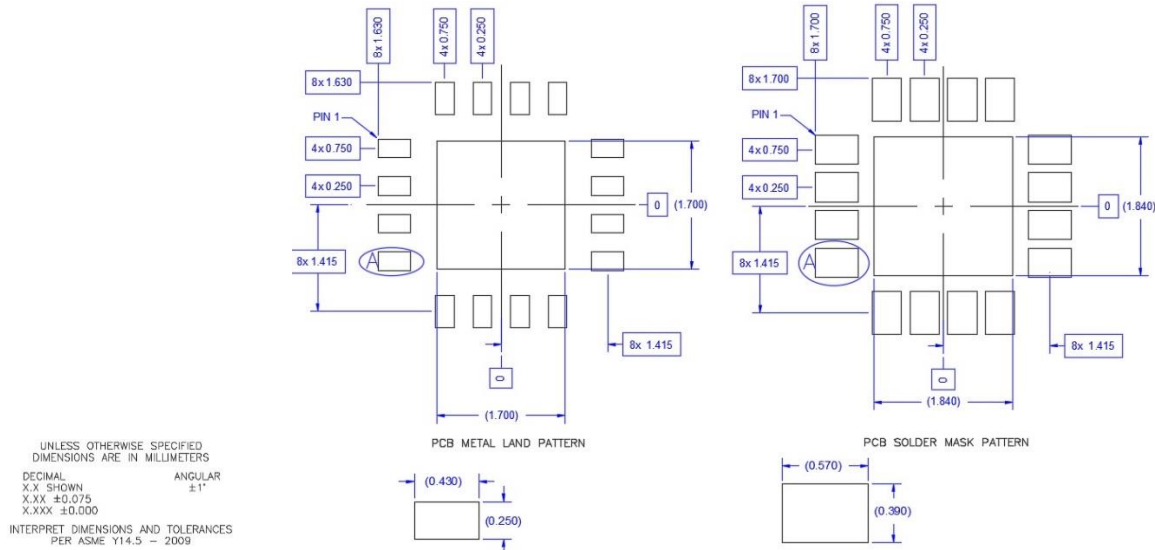
Marking: Part Number – 9119
Date Code – YYWW
Lot Code – AaXXXX



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
3. Contact plating: NiPdAu

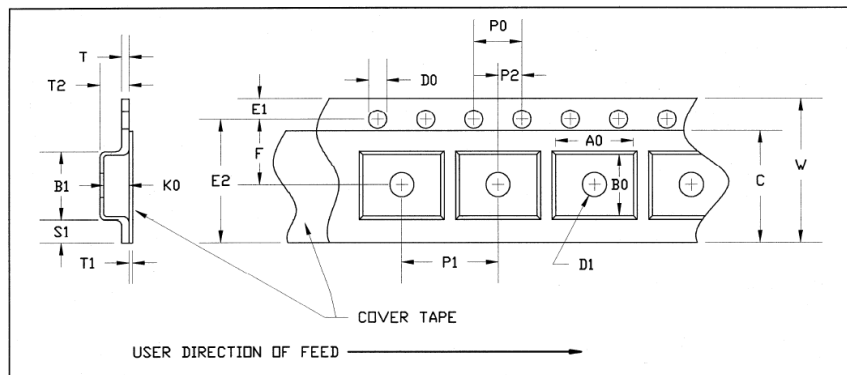
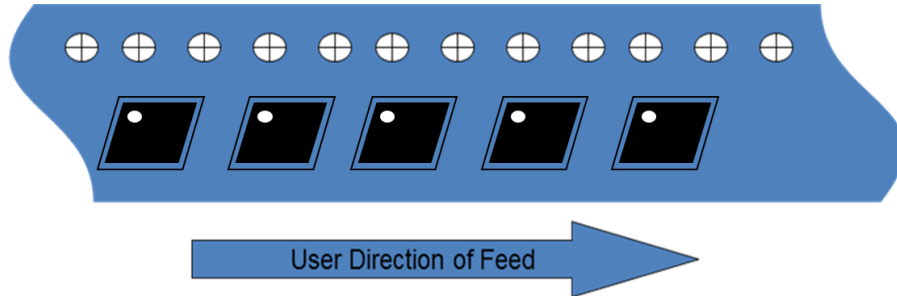
PCB Mounting Pattern



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.

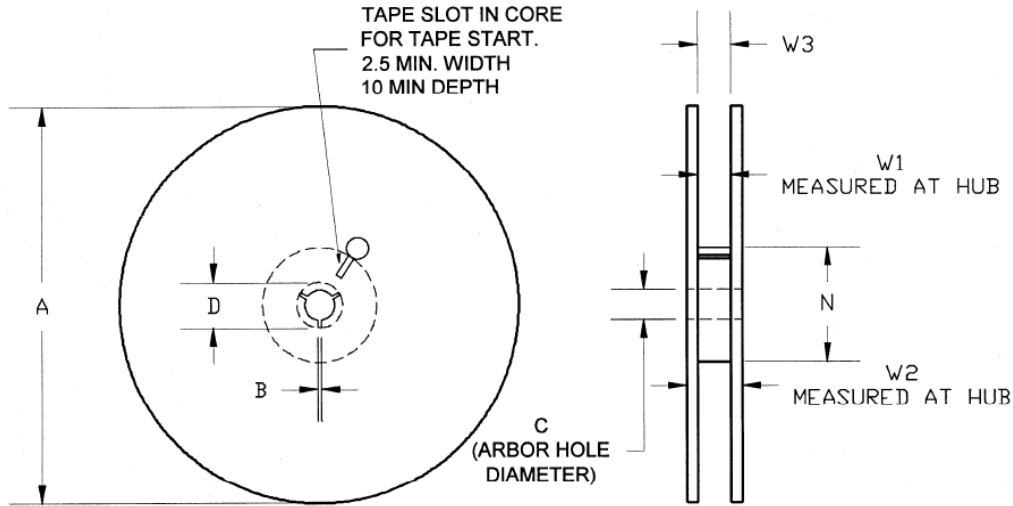
Tape and Reel Information – Carrier and Cover Tape Dimensions



| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---------------------|--|--------|-----------|-----------|
| Cavity | Length | A0 | 0.126 | 3.20 |
| | Width | B0 | 0.126 | 3.20 |
| | Depth | K0 | 0.039 | 1.00 |
| | Pitch | P1 | 0.157 | 4.00 |
| Centerline Distance | Cavity to Perforation - Length Direction | P2 | 0.079 | 2.00 |
| | Cavity to Perforation - Width Direction | F | 0.217 | 5.50 |
| Cover Tape | Width | C | 0.362 | 9.20 |
| Carrier Tape | Width | W | 0.472 | 12.00 |

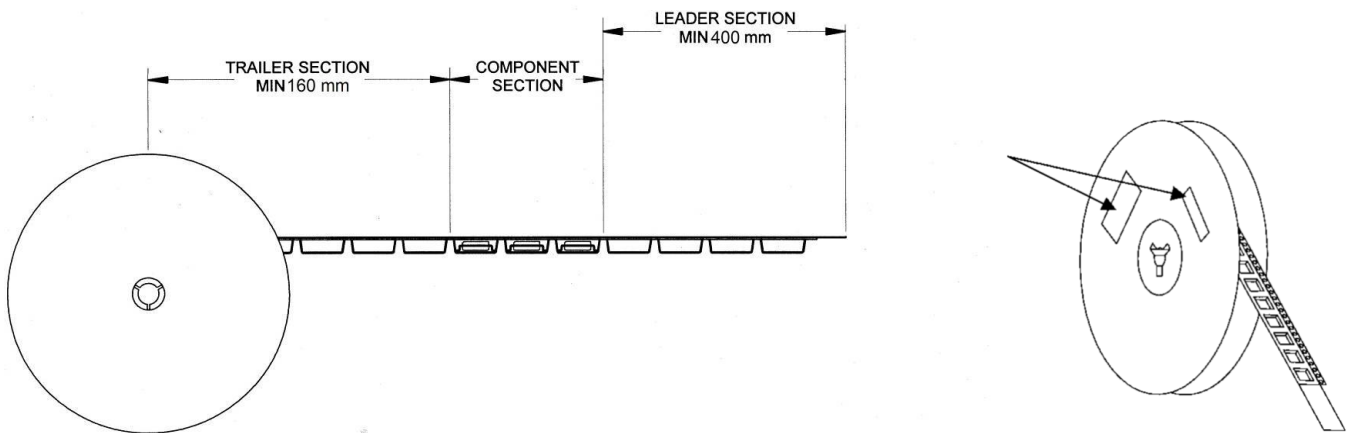
Tape and Reel Information – Reel Dimensions

Standard T/R size = 2500 pieces on a 7" reel.



| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange | Diameter | A | 6.969 | 177.0 |
| | Thickness | W2 | 0.717 | 18.2 |
| | Space Between Flange | W1 | 0.504 | 12.8 |
| Hub | Outer Diameter | N | 2.283 | 58.0 |
| | Arbor Hole Diameter | C | 0.512 | 13.0 |
| | Key Slit Width | B | 0.079 | 2.0 |
| | Key Slit Diameter | D | 0.795 | 20.2 |

Tape and Reel Information – Tape Length and Label Placement



- Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
 2. Labels are placed on the flange opposite the sprockets in the carrier tape.