

General Description

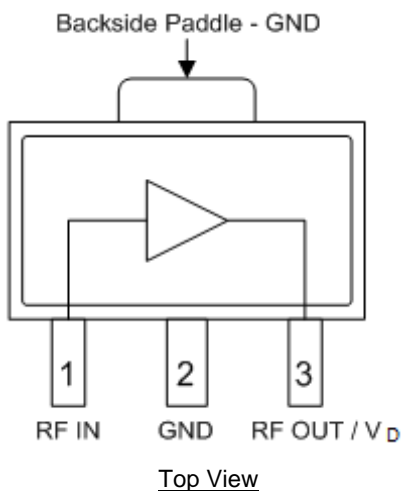
The QPA5389A is a high performance SiGe HBT MMIC Amplifier. The QPA5389A uses a Darlington configuration which provides flat gain and good linearity over a wide frequency range. The QPA5389A has excellent thermal performance.

The QPA5389A is internally matched to 50 Ω at input and output requiring only two DC-blocking capacitors, a resistor, and an optional RF choke for operation. The QPA5389A operates from a single supply and has stable bias current. The QPA5389A is cascadable with other amplifiers.



3 Lead SOT-89 Package

Functional Block Diagram



Product Features

- High Gain: 15.9 dB at 1950 MHz
- Cascadable 50 Ω
- Operates from Single Supply
- Low Thermal Resistance Package

Applications

- Instrumentation
- Repeaters
- Boosters
- PA Driver Amplifier
- Cellular, PCS, GSM, UMTS
- IF Amplifier
- Wireless Data, Satellite

Ordering Information

| Part No. | Description |
|----------------|--|
| QPA5389ATR13 | 3000 pieces on a 13" reel (standard) |
| QPA5389APCK401 | 850 MHz, +8V EVB with 5 Piece Sample Bag |

Absolute Maximum Ratings

| Parameter | Rating |
|----------------------------------|----------------|
| Storage Temp | -55 to +150 °C |
| Device Voltage (V _D) | +5 V |
| Device Current (I _D) | 120 mA |
| RF Input Power | +16 dBm |

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 |
|--|-------|------|-------|-------|
| Case Temperature (T _C) | -40 | | +105 | °C |
| Junction Temperature (T _J) | | | +125 | °C |
| Device Voltage (V _D) | +2.75 | +3.5 | +4.75 | V |

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

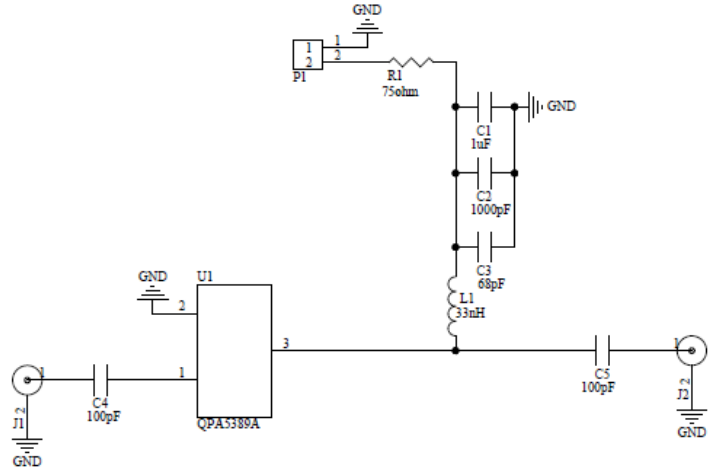
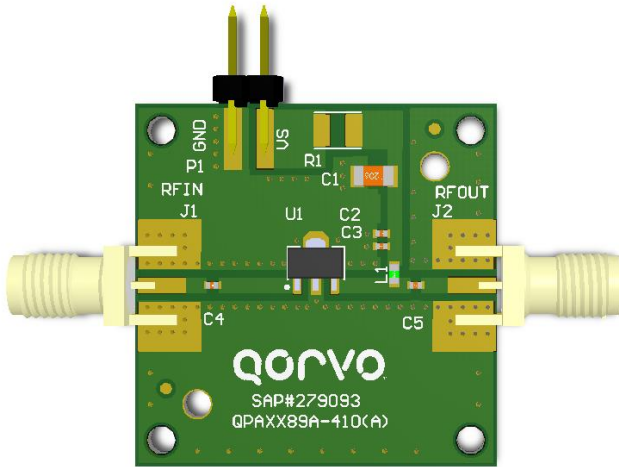
Electrical Specifications

| Parameter | Conditions ⁽¹⁾ | Min | Typ | Max | Units |
|---|---------------------------|-------|-------|-----|-------|
| Small Signal Gain | 850 MHz | 13.8 | 16.5 | | dB |
| | 1950 MHz | 13.3 | 15.9 | | dB |
| | 2400 MHz | | 15.6 | | dB |
| Output Power at 1dB Compression | 850 MHz | | +17.1 | | dBm |
| | 1950 MHz | +12.5 | +16.3 | | dBm |
| Output Third Intercept Point ⁽²⁾ | 850 MHz | | +33.3 | | dBm |
| | 1950 MHz | +26.0 | +30.0 | | dBm |
| Input Return Loss | 1950 MHz | | 22.4 | | dB |
| Output Return Loss | 1950 MHz | | 14.5 | | dB |
| Noise Figure | 1950 MHz | | 3.7 | 5.7 | dB |
| Device Operating Current | | | 60 | 70 | mA |
| Thermal Resistance, θ _{jc} | | | 40 | | °C/W |

Notes:

1. Test conditions unless otherwise noted: V_S = +8 V, I_D = 60 mA Typ., R₁ = 75 Ω, 50 Ω system, Temp = +25 °C
2. OIP3 Tone Spacing=1 MHz, P_{OUT} per tone = 0 dBm,

Evaluation Board and Schematic – 850 MHz Application Circuit



Bill of Material – 850 MHz Application Circuit

| Reference | Value | Description | Manufacturer | Part Number |
|-----------|-------------|--|-------------------------|--------------------|
| - | - | PCB, QPA5389A | Qorvo | QPAXX89A-410(A) |
| C1 | 1 μ F | CAP, 1 μ F, 10%, 25V, X7R, 1206 | Murata Electronics | GRM31MR71E105KA01L |
| C2 | 1000 pF | CAP, 1000 pF, 10%, 50V, X7R, 0402 | Murata Electronics | GRM155R71H102KA01D |
| C3 | 68 pF | CAP, 68 pF, 5%, 50V, COG, 0402 | Murata Electronics | GRM1555C1H680JA01D |
| C4, C5 | 100 pF | CAP, 100 pF, 5%, 50V, COG, 0402 | Murata Electronics | GRM1555C1H101JA01D |
| R1 | 75 Ω | RES, 75 Ω , 5%, 1/2W, 1210 | Panasonic Industrial Co | ERJ-14NF1400U |
| L1 | 33 nH | IND, 33 nH, 5%, M/L, 0603 | Murata Electronics | LL1608-FSL33NJ |
| J1, J2 | - | CONN, SMA, EL, FLT, 0.068" SPE-000318 | Amphenol RF Asia Corp | 901-10426 |
| U1 | - | HBT MMIC Amplifier | Qorvo | QPA5389A |
| J3, J4 | - | CONN, HDR, ST, 1x2, 0.100", Hi-temp, T/H | Samtec Inc | HTSW-102-07-G-S |

Component Values for Specific Frequencies

| Frequency | 500 MHz | 850 MHz | 1950 MHz | 2400 MHz | 3500 MHz |
|-----------|---------|---------|----------|----------|----------|
| C4, C5 | 220 pF | 100 pF | 68 pF | 56 pF | 39 pF |
| C3 | 100 pF | 68 pF | 22 pF | 22 pF | 15 pF |
| L1 | 68 nH | 33 nH | 22 nH | 18 nH | 15 nH |

Recommended Bias Resistor Values for Various Supply Voltages

| Vsupply | +6 V | +8 V | +10 V | +12 V |
|---------|-------------|-------------|--------------|--------------|
| R1 | 43 Ω | 75 Ω | 110 Ω | 150 Ω |

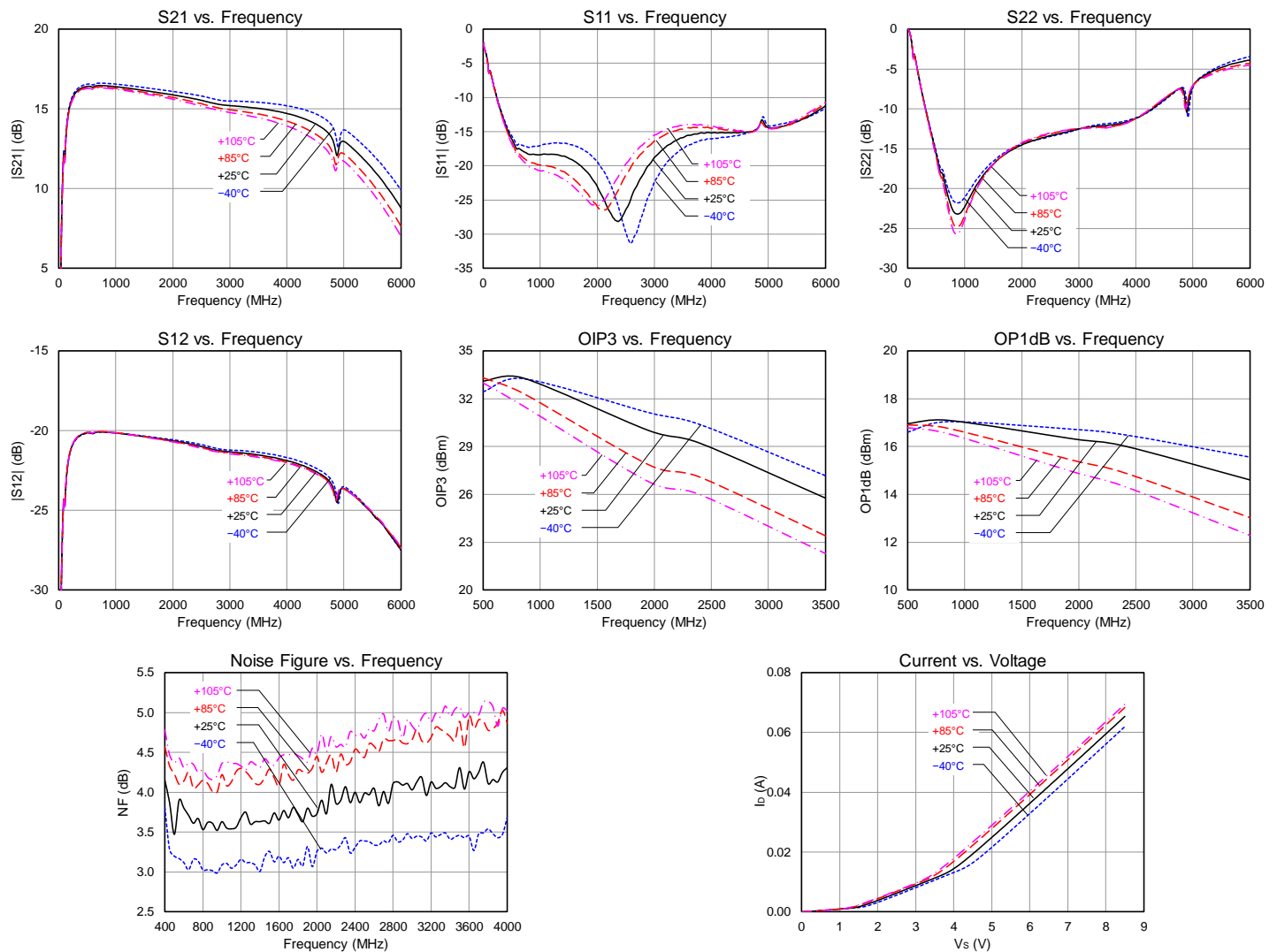
Typical Performance – 850 MHz Application Circuit

| Parameter | Typical Value | | | | | Units |
|---------------------------------|---------------|-------|-------|-------|-------|-------|
| Frequency | 500 | 850 | 1950 | 2400 | 3500 | MHz |
| Small Signal Gain | 16.4 | 16.5 | 15.9 | 15.6 | 15.1 | dB |
| Output Third Intercept Point | +33.1 | +33.3 | +30.0 | +29.2 | +25.8 | dBm |
| Output Power at 1dB Compression | +17.0 | +17.1 | +16.3 | +16.0 | +14.6 | dBm |
| Input Return Loss | 16.7 | 18.3 | 22.4 | 28.0 | 15.9 | dB |
| Output Return Loss | 16.1 | 23.1 | 14.5 | 13.2 | 12.1 | dB |
| Reverse Isolation | 20.1 | 20.1 | 20.7 | 21.0 | 21.5 | dB |
| Noise Figure | 3.5 | 3.6 | 3.7 | 4.0 | 4.3 | dB |

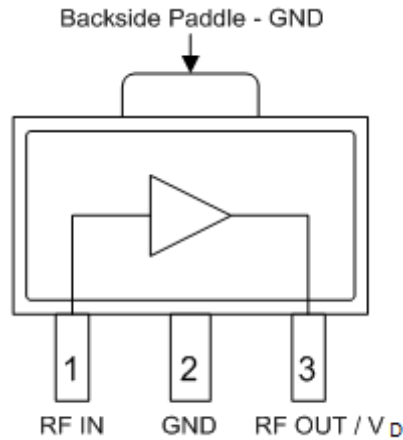
Notes:

- Test conditions: $V_s = +8\text{ V}$, $I_D = 60\text{ mA Typ.}$, OIP3 Tone Spacing=1 MHz, P_{OUT} per tone = 0 dBm, $R_1 = 75\ \Omega$, 50 Ω system, Temp = +25 °C

Performance Plots – 850 MHz Application Circuit

 Test conditions unless otherwise noted: $V_s = +8.0\text{ V}$, $R_1 = 75\ \Omega$, $I_D = 60\text{ mA}$, Temp. = +25 °C


Pin Configuration and Description

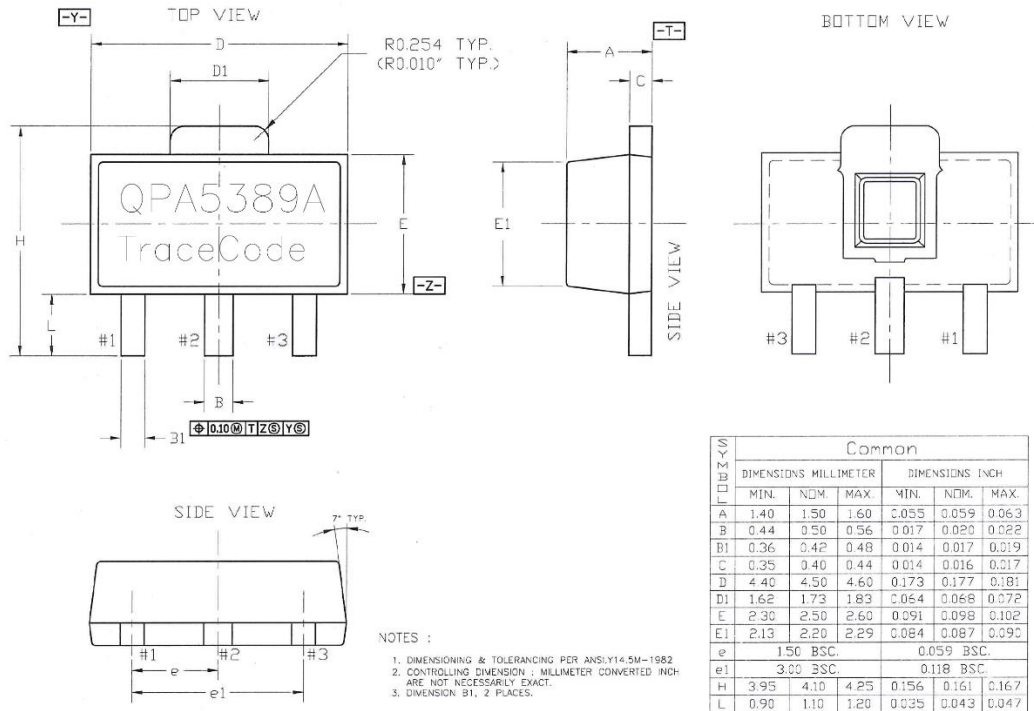


Top View

| Pad No. | Label | Description |
|--------------------|---------------|---|
| 1 | RF IN | RF Input Pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. |
| 2, Backside Paddle | GND | Connection to ground. Use via holes in PCB for best performance to reduce lead inductance as close to ground leads as possible |
| 3 | RF OUT/ V_D | RF Output and Bias Pin. DC voltage is present on this pin, therefore a DC blocking capacitor is necessary for proper operation. |

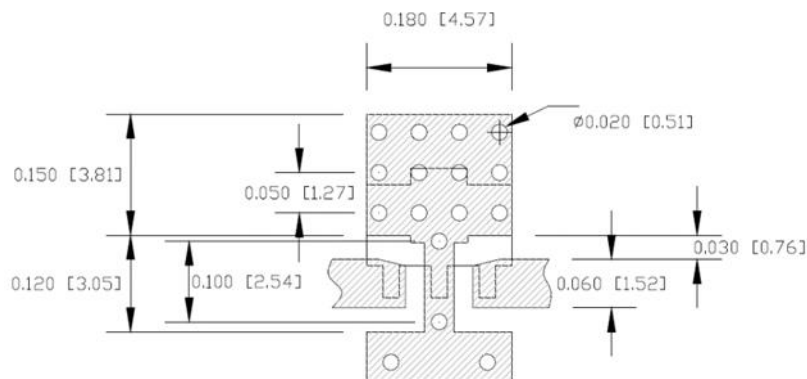
Package Marking and Dimensions

Marking: Part Number – QPA5389A
 Trace Code – Assigned by sub-contractor



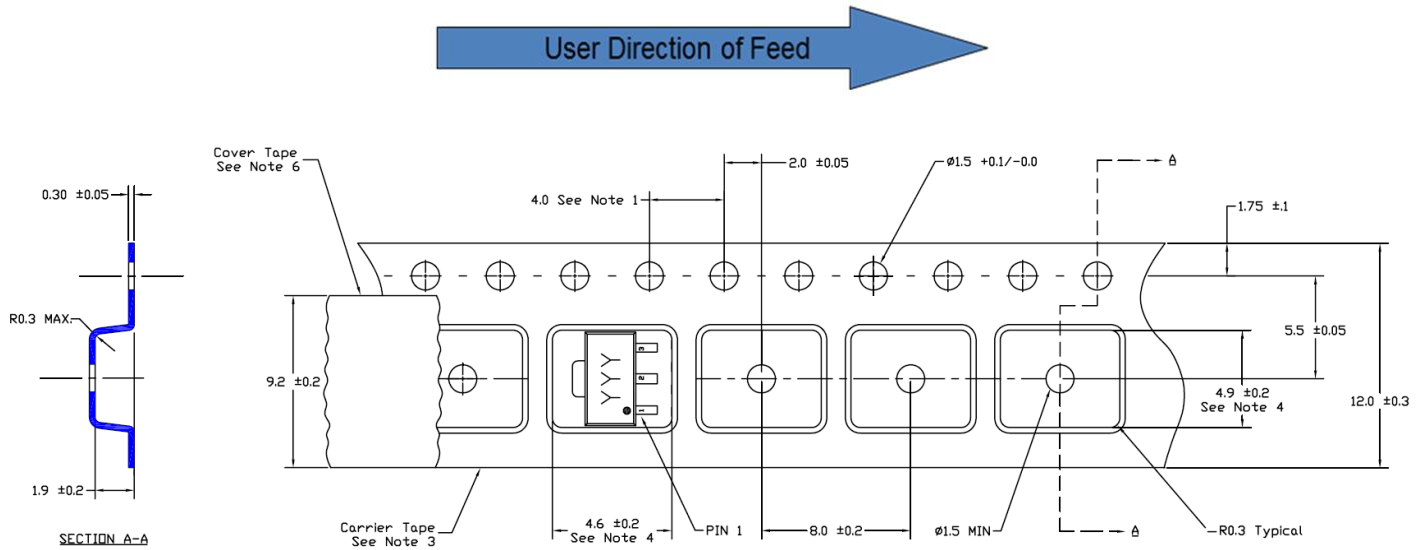
- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
 2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

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. Via holes 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 (0.01").
 4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

Tape and Reel Information – Carrier and Cover Tape Dimensions

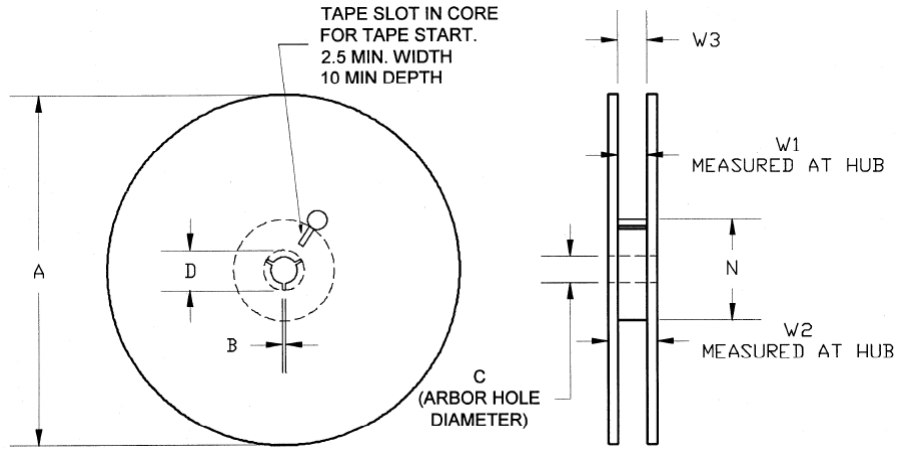


1. 10 sprocket hole pitch cumulative tolerance
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Polystyrene
4. Measured on a plane 0.3mm above the bottom of the pocket
5. Measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Material: Antistatic Polyester Film

| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---------------------|--|--------|-----------|-----------|
| Cavity | Length | A0 | 0.181 | 4.60 |
| | Width | B0 | 0.193 | 4.90 |
| | Depth | K0 | 0.075 | 1.90 |
| | Pitch | P1 | 0.315 | 8.00 |
| 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 (Reference only) | C | 0.362 | 9.20 |
| Carrier Tape | Width | W | 0.472 | 12.0 |

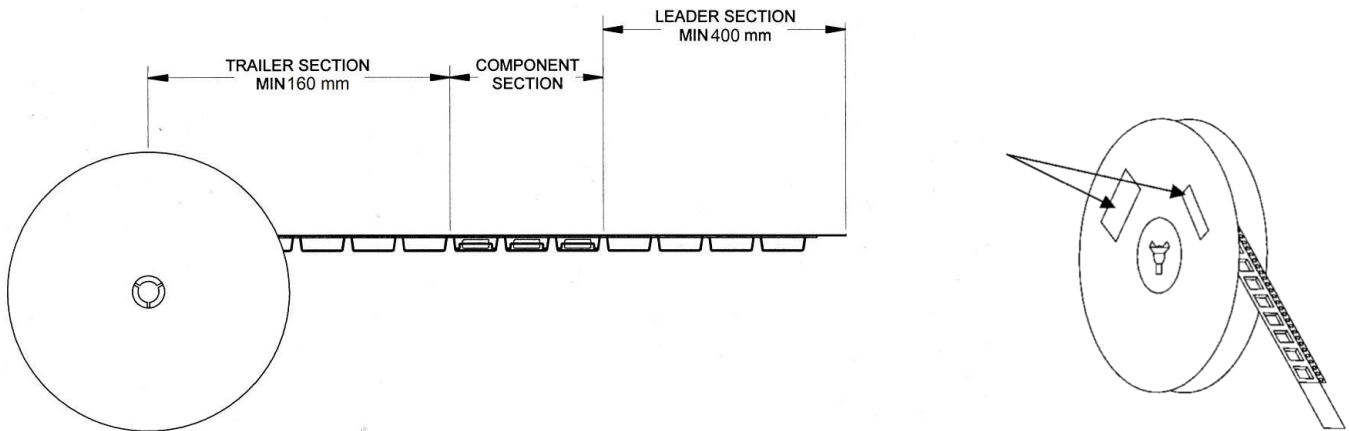
Tape and Reel Information – Reel Dimensions

Standard T/R size = 3,000 pieces on a 13" reel.



| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---------|----------------------|--------|-----------|-----------|
| Flange | Diameter | A | 12.992 | 330.0 |
| | Thickness | W2 | 0.717 | 18.2 |
| | Space Between Flange | W1 | 0.504 | 12.8 |
| Hub | Outer Diameter | N | 4.016 | 102.0 |
| | Arbor Hole Diameter | C | 0.512 | 13.0 |
| | Key Slit Width | B | 0.079 | 2.0 |
| | Key Slit Diameter | D | 0.787 | 20.0 |

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.