



# QPA5389A

## DC – 4500 MHz Cascadable SiGe HBT Amplifier

### 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  $\Omega$  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

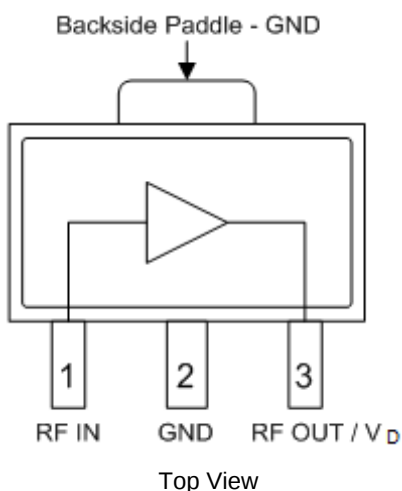
### Product Features

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

### Applications

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

### Functional Block Diagram



### Ordering Information

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

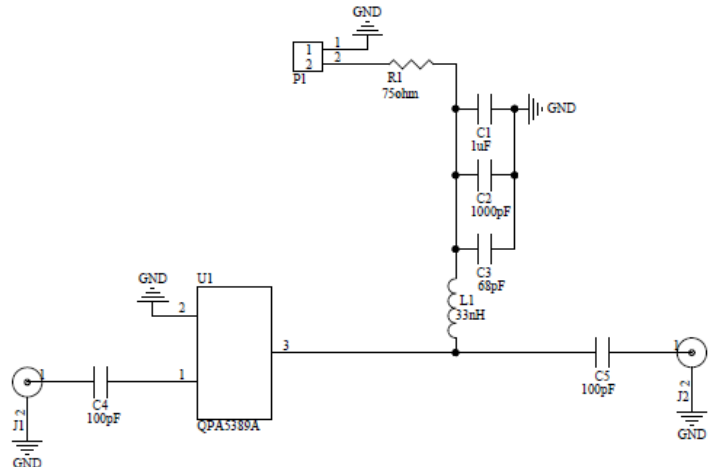
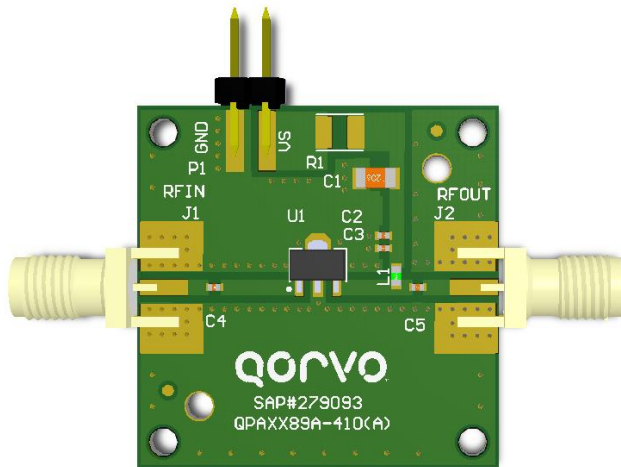
## Electrical Specifications

| Parameter                                   | Conditions <sup>(1)</sup> | 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 <sup>(2)</sup> | 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, $\theta_{jc}$           |                           |       | 40    |     | °C/W  |

Notes:

1. Test conditions unless otherwise noted:  $V_S = +8\text{ V}$ ,  $I_D = 60\text{ mA}$  Typ.,  $R_1 = 75\ \Omega$ ,  $50\ \Omega$  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 $\mu$ F   | CAP, 1 $\mu$ 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 $\Omega$ | RES, 75 $\Omega$ , 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 $\Omega$ | 75 $\Omega$ | 110 $\Omega$ | 150 $\Omega$ |

## Typical Performance – 850 MHz Application Circuit

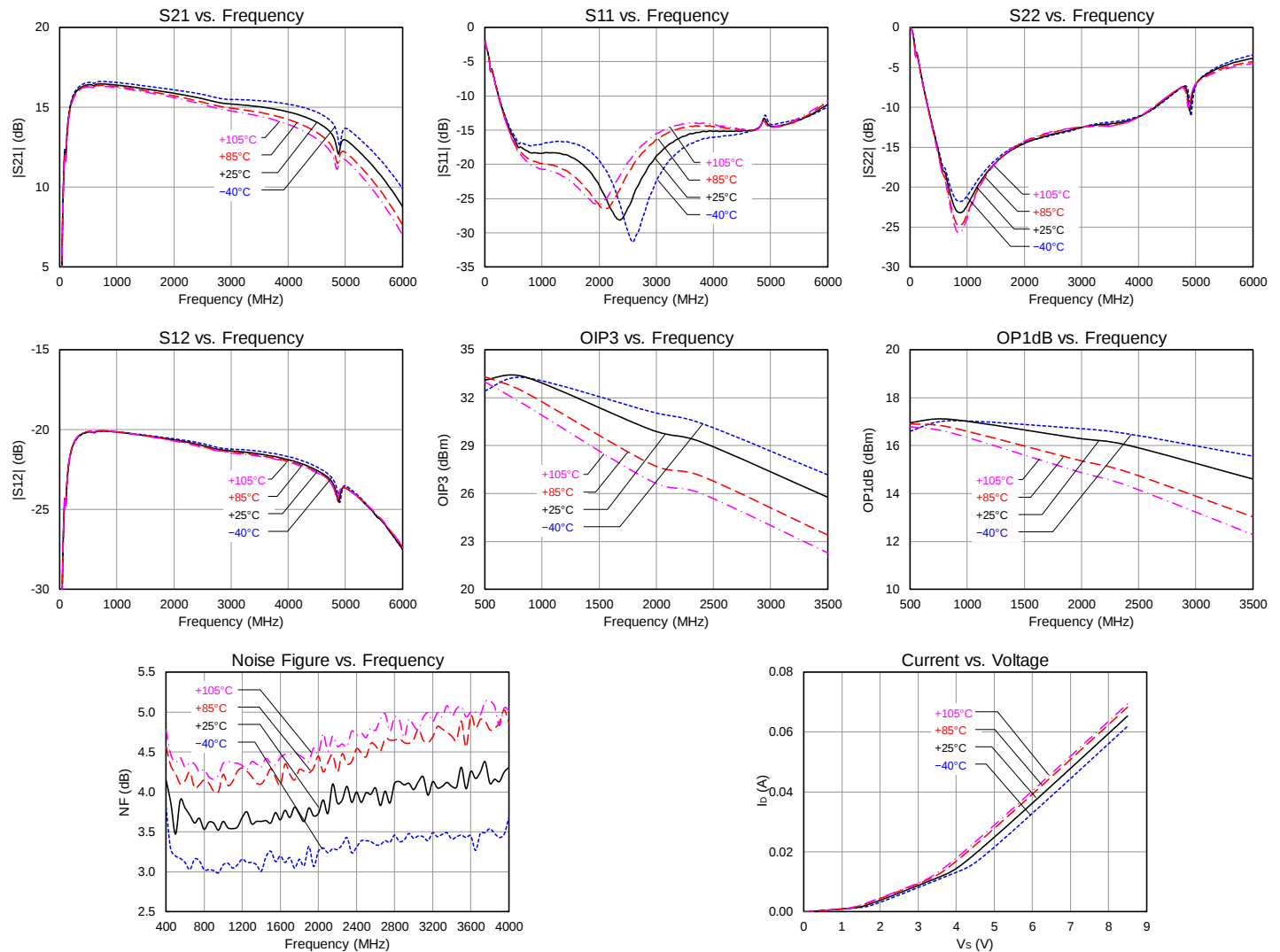
| Parameter                       | Typical Value |       |       |       |       | Units |
|---------------------------------|---------------|-------|-------|-------|-------|-------|
| Frequency                       | 500           | 850   | 1950  | 2400  | 3500  | MHz   |
| Small Signal Gain               | 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:

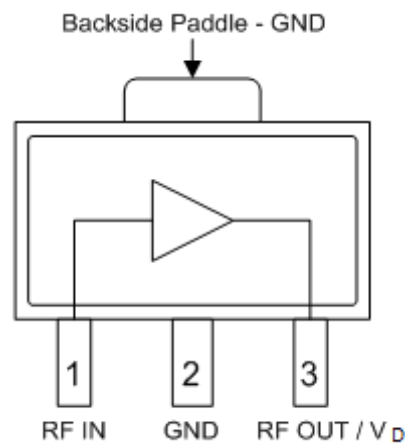
- Test conditions:  $V_S = +8\text{ V}$ ,  $I_D = 60\text{ mA}$  Typ., OIP3 Tone Spacing=1 MHz,  $P_{OUT}$  per tone = 0 dBm,  $R_1 = 75\ \Omega$ , 50  $\Omega$  system, Temp = +25 °C

## 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

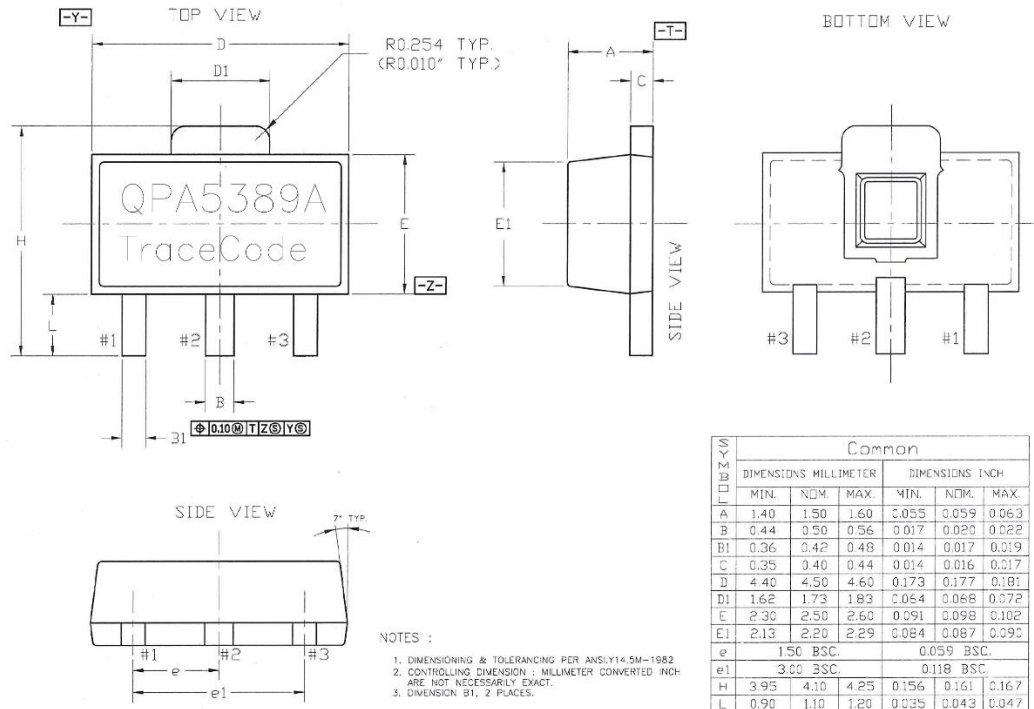


Top View

| 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 <sub>D</sub> | RF Output and Bias Pin. DC voltage is present on this pin, therefore a DC blocking capacitor is necessary for proper operation. |

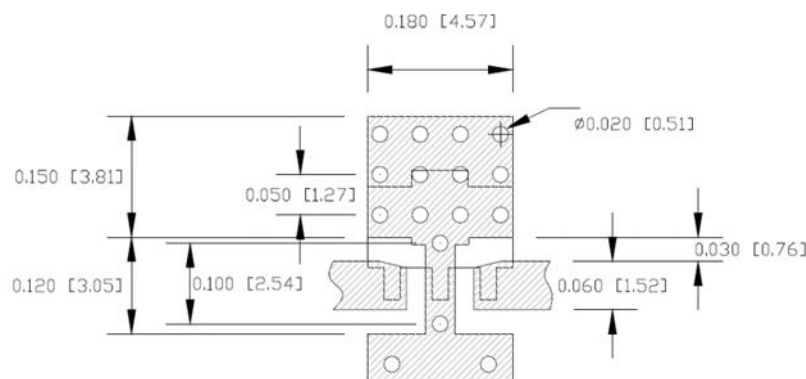
## Package Marking and Dimensions

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



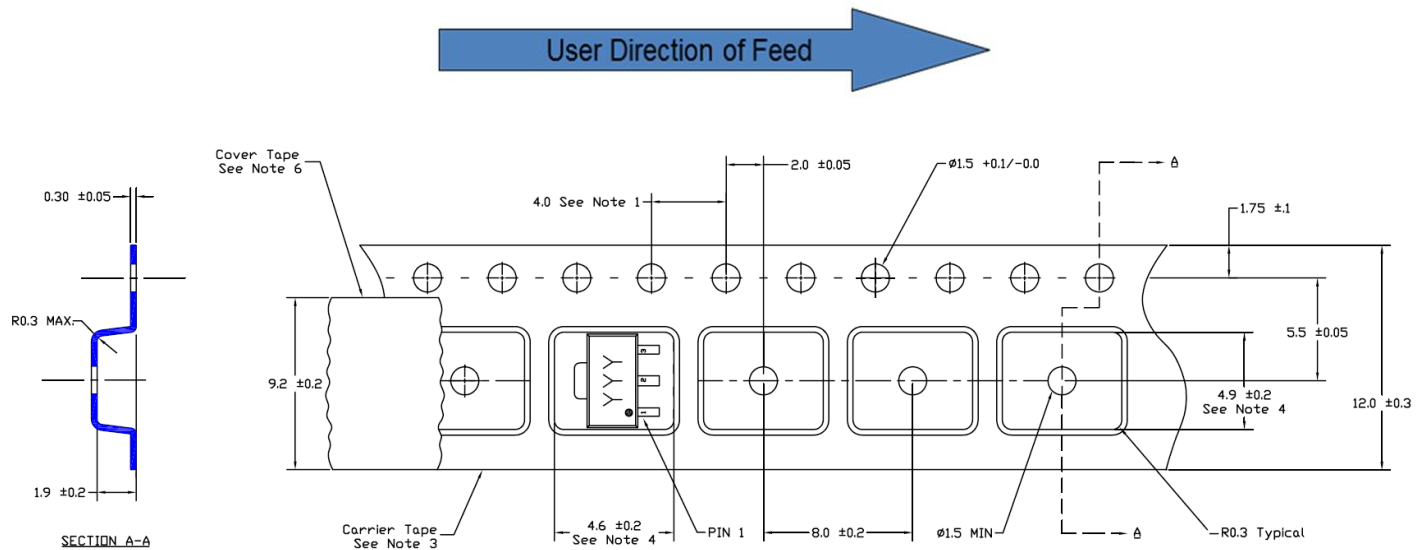
- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## 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

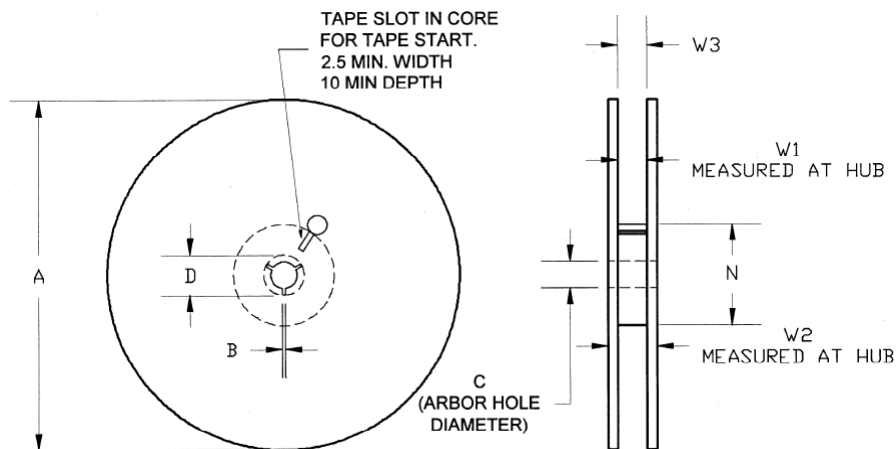


1. 10 sprocket hole pitch cumulative tolerance
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Polystyrene
4. Measured on a plane 0.3mm above the bottom of the pocket.
5. Measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Material: Antistatic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

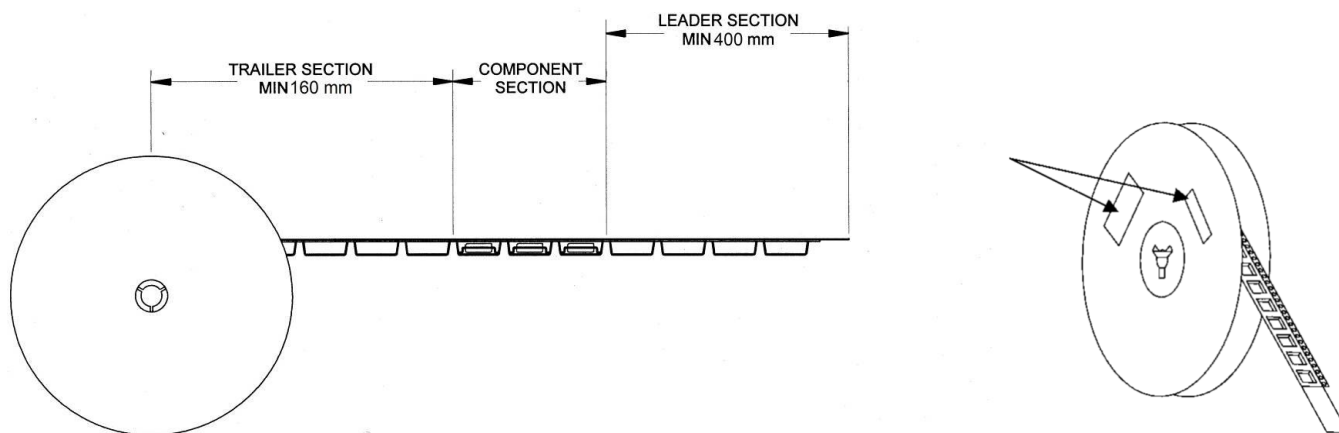
## Tape and Reel Information – Reel Dimensions

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.

## Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 1C | ESDA / JEDEC JS-001-2014 |
| ESD – Charged Device Model (CDM) | Class C3 | ESDA / JEDEC JS-002-2014 |
| MSL – Moisture Sensitivity Level | Level 3  | IPC/JEDEC J-STD-020      |



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering process.  
Solder profiles available upon request.  
Contact plating: Nickel Palladium Gold (NiPdAu)

## RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free



## Contact Information

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

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