



SKYWORKS®

DATA SHEET

ATN3590 Series Fixed Attenuators

Applications

- Level adjustment in radios, radars, EW/ECM equipment, and test instruments

Features

- Fixed value, absorptive devices
- Available attenuation values range from 0 to 10 dB (in 1 dB steps), and 12, 15, 20, and 30 dB
- Suitable for use to 40 GHz or higher
- Excellent return loss: 30 dB, typical
- Enhanced power handling: 2 W
- For RoHS and other product compliance information, see the [Skyworks Certificate of Conformance](#).

Description

The ATN3590 family of fixed resistive attenuators are integrated circuits comprised of thin film resistors and through-die vias that provide excellent attenuation flatness from low frequency to 40 GHz or higher. These attenuators are available from 0 to 30 dB (see Table 2).

The ATN3590 attenuator family is optimized for surface mounting on co-planar waveguide or microstrip printed circuit boards. Bond wires or ribbons are used to connect the input and output ports of the attenuators to the external circuit transmission lines. Connection to ground is accomplished by through-die vias to the die backside metalization.

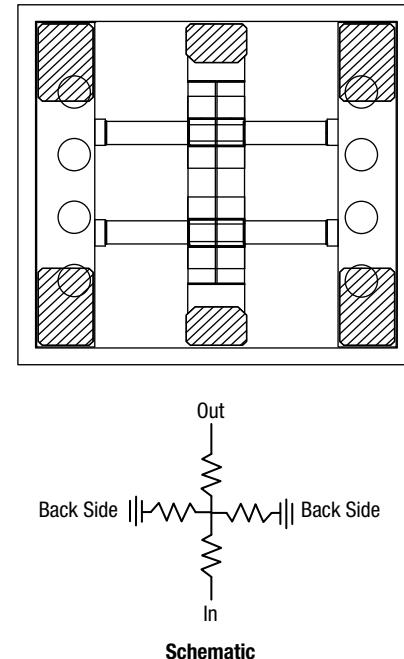


Figure 1. Typical Die and Attenuator Circuit

The dice are attached using eutectic solder or conductive epoxy and can operate over a temperature range of -65°C to 150°C .

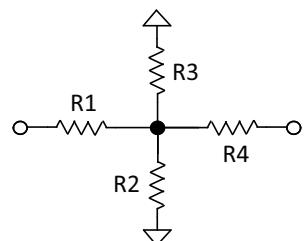
The absolute maximum ratings for the ATN3590 attenuators are provided in Table 1, and the electrical specifications are shown in Table 2. Typical performance characteristics are illustrated in Figures 2 through 8.

Technical Description

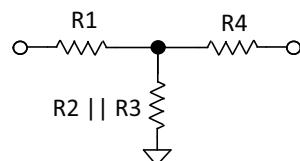
The ATN3590 Series of fixed attenuators is comprised of devices with nominal attenuation values of 0 to 10 dB (in 1 dB steps), and 12, 15, 20, and 30 dB. These attenuators contain through-wafer vias that connect the topside ground to the backside metalization of each die.

The devices with nominal attenuation values of 1 dB or greater are fabricated using thin film resistors deposited on GaAs substrates. The circuit topology is a simple tee structure that consists of two series resistors and a shunt resistance, which in this case is realized as a pair of shunt resistors connected to the node between the two series resistors as shown below. The resistances of each of these resistors are selected to simultaneously produce the nominal attenuation with very good input and output return losses.

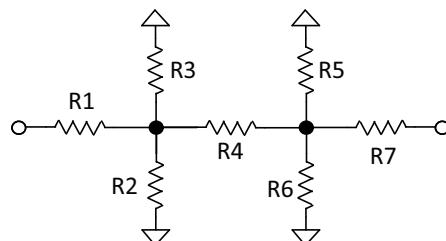
The attenuators with nominal attenuation values ≥ 6 dB contain a pair of cascaded tee sections. The 0 dB attenuator, ATN3590-00, is a $50\ \Omega$ microstrip transmission line with identical footprint and bond pads to those of the other products in this family.



Circuit Topology, 1 to 5 dB Attenuators



Simplified Circuit Topology, 1 to 5 dB Attenuators



Circuit Topology for Attenuators with Nominal Attenuation ≥ 6 dB

Figure 2. ATN3590 Series Circuit Topologies

Table 1. Absolute Maximum Ratings¹

Parameter	Symbol	Minimum	Typical	Maximum	Units
Input power	P _{IN}			2	W
Power dissipation @ 25 °C	P _{DIS}			2	W
Operating temperature	T _{OP}	-55		+150	°C
Storage temperature	T _{STG}	-55		+150	°C

1. Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

ESD Handling: Industry-standard ESD handling precautions must be adhered to at all times to avoid damage to this device.

Table 2. ATN3590 Series Electrical Specifications¹
(TOP = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)

Part Number	Attenuation (dB)	Attenuation Tolerance @ DC (dB)	Attenuation Flatness ² DC to 12 GHz (dB)	Attenuation Flatness ² 12 to 26 GHz (dB)	Attenuation Flatness ² 26 to 33 GHz (dB)	Attenuation Flatness ² 33 to 40 GHz (dB)	Min. Return Loss DC to 12 GHz (dB)	Min. Return Loss 12 to 26 GHz (dB)	Min. Return Loss 26 to 33 GHz (dB)	Min. Return Loss 33 to 40 GHz (dB)
ATN3590-00	0	0.25	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-01	1	±0.20	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-02	2	±0.20	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-03	3	±0.20	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-04	4	±0.20	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-05	5	±0.20	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-06	6	±0.40	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-07	7	±0.40	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-08	8	±0.40	±0.15	±0.15	±0.20	±0.20	28	24	20	16
ATN3590-09	9	±0.40	±0.20	±0.20	±0.25	±0.30	28	24	20	16
ATN3590-10	10	±0.40	±0.20	±0.20	±0.25	±0.50	28	24	20	16
ATN3590-12	12	±0.40	±0.20	±0.20	±0.30	±0.50	28	24	20	16
ATN3590-15	15	±0.40	±0.20	±0.20	±0.50	±0.75	28	24	20	16
ATN3590-20	20	±1.0	±0.20	±0.20	±0.75	±1.00	28	24	20	16
ATN3590-30	30	±1.0	±0.20	±0.25	±0.75	±2.50	28	24	20	16

1. Performance is assured only under the conditions listed in this Table.
2. Flatness is defined as the maximum deviation from the mean value of attenuation over the specified frequency range.

Typical Performance Characteristics

$T_{OP} = +25^\circ\text{C}$, characteristic impedance $[Z_0] = 50\ \Omega$, unless otherwise noted. Data gathered using ground-to-signal-to-ground probes on die.

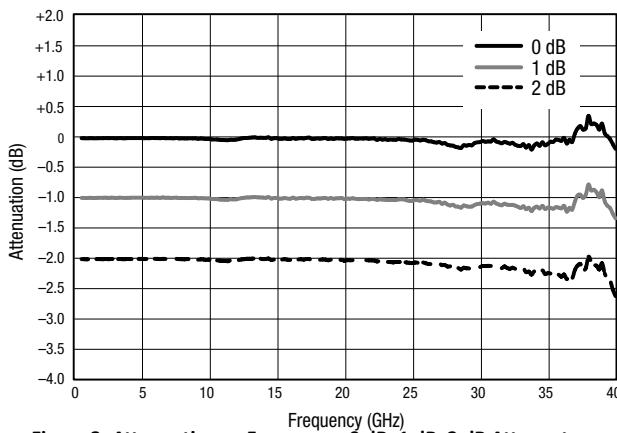


Figure 3. Attenuation vs Frequency: 0 dB, 1 dB, 2 dB Attenuators

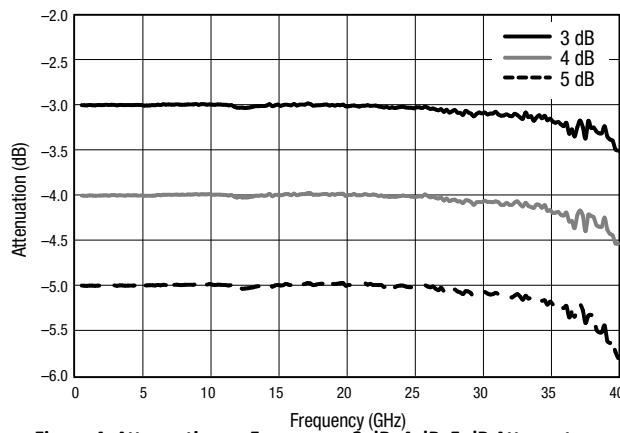


Figure 4. Attenuation vs Frequency: 3 dB, 4 dB, 5 dB Attenuators

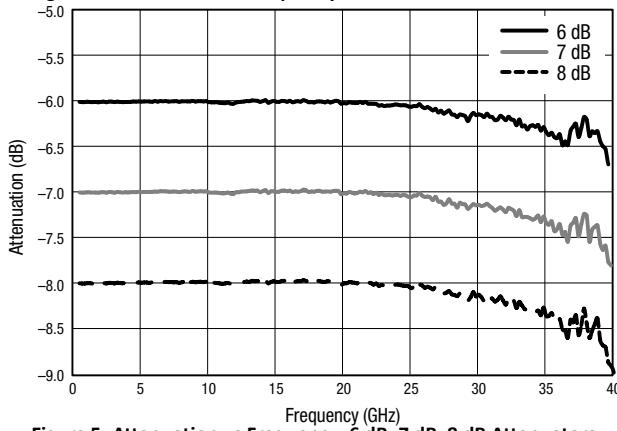


Figure 5. Attenuation vs Frequency: 6 dB, 7 dB, 8 dB Attenuators

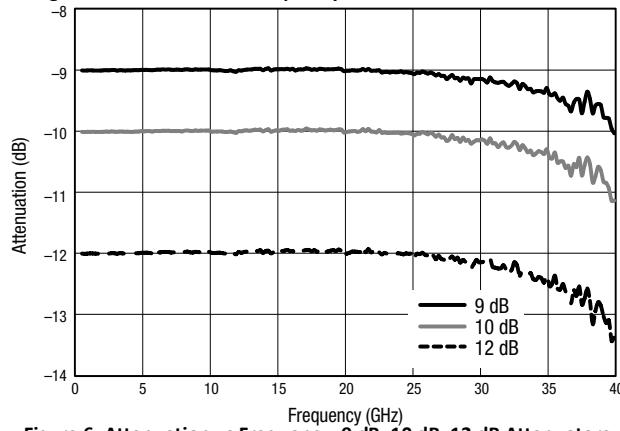


Figure 6. Attenuation vs Frequency: 9 dB, 10 dB, 12 dB Attenuators

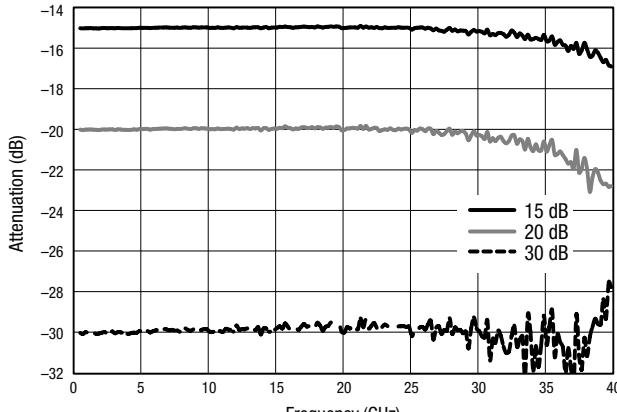
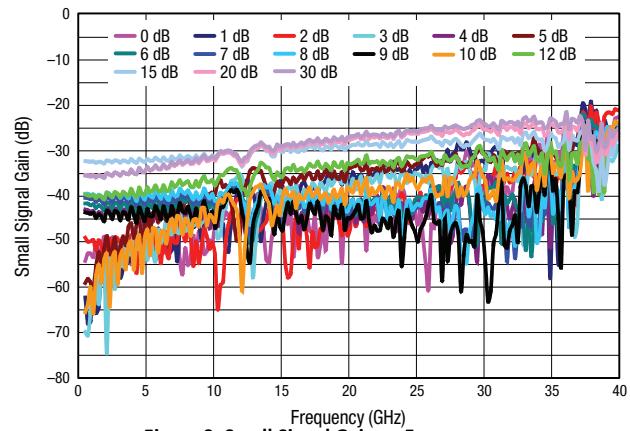
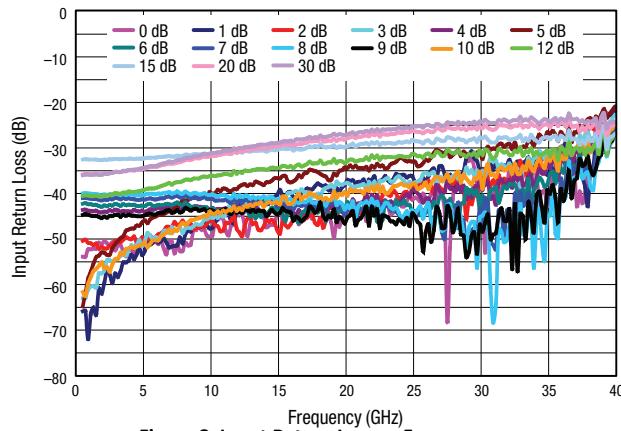


Figure 7. Attenuation vs Frequency: 15 dB, 20 dB, 30 dB Attenuators



Die Attachment and Signal Path Connections

Any of the ATN3590 family of attenuators should be mounted on the ground plane of a transmission medium. The die should be attached with conductive epoxy or a eutectic solder such as gold/tin (AuSn).

For good high frequency performance, it is essential that there is no ground plane directly beneath the series signal path of the ATN3590. The backside metalization on the die is split into two regions along the sides of the die to accommodate this requirement.

The metalization on the circuit medium to which the attenuator is to be mounted must also include the split in the ground connections. It is recommended the gap between the ground pads on the circuit medium be 250 μm wide by 900 μm long.

It is recommended that the signal paths be connected to the input/output bond pads on the attenuator with 0.25 mil thick x 3 mil wide (6.25 x 75 microns) Au ribbons, as shown below. Au wires can also be used.

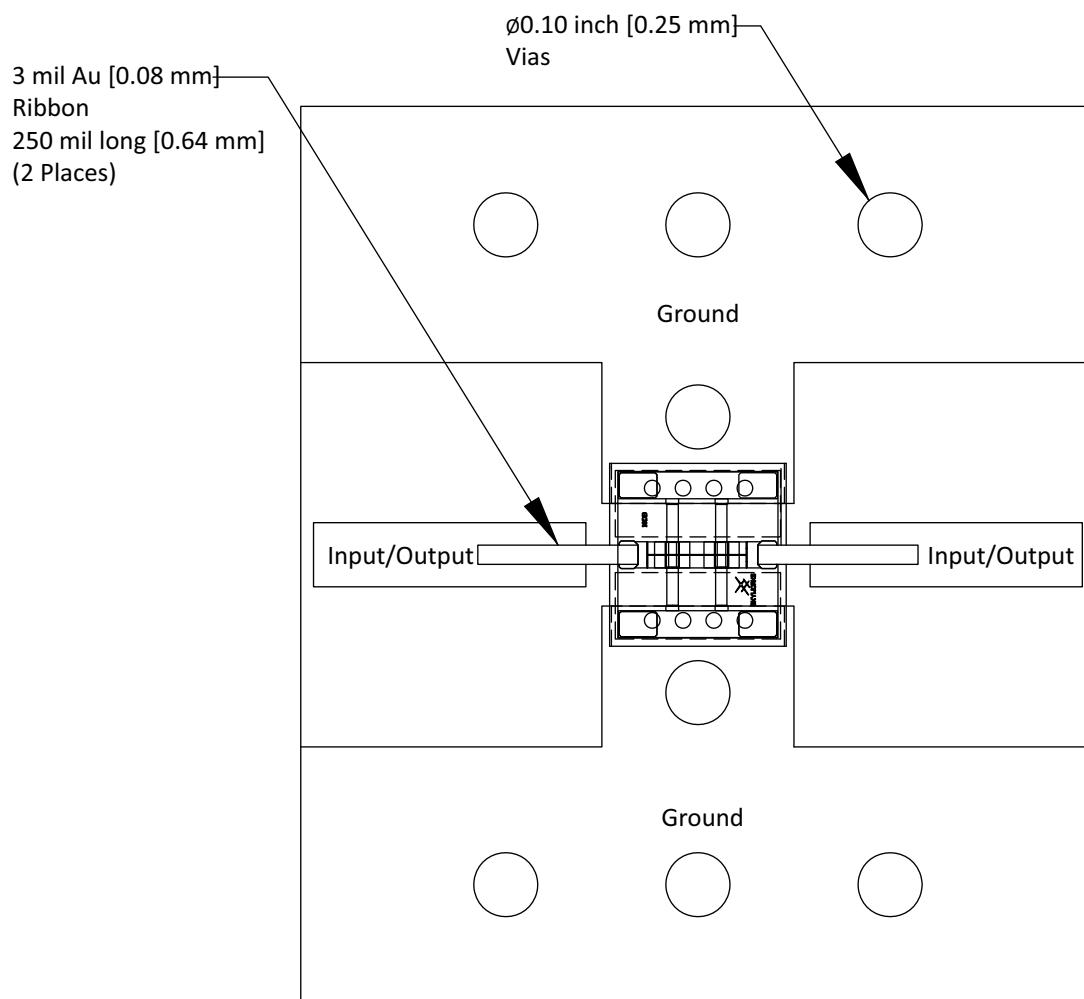


Figure 10. Suggested Die Mount and Ribbon Attachment

Die and Packaging Information

Die dimensions are shown below, followed by the PCB layout pattern.

The standard mode of packaging for shipment of the ATN3590 Attenuator Series is 100 pieces per tray.

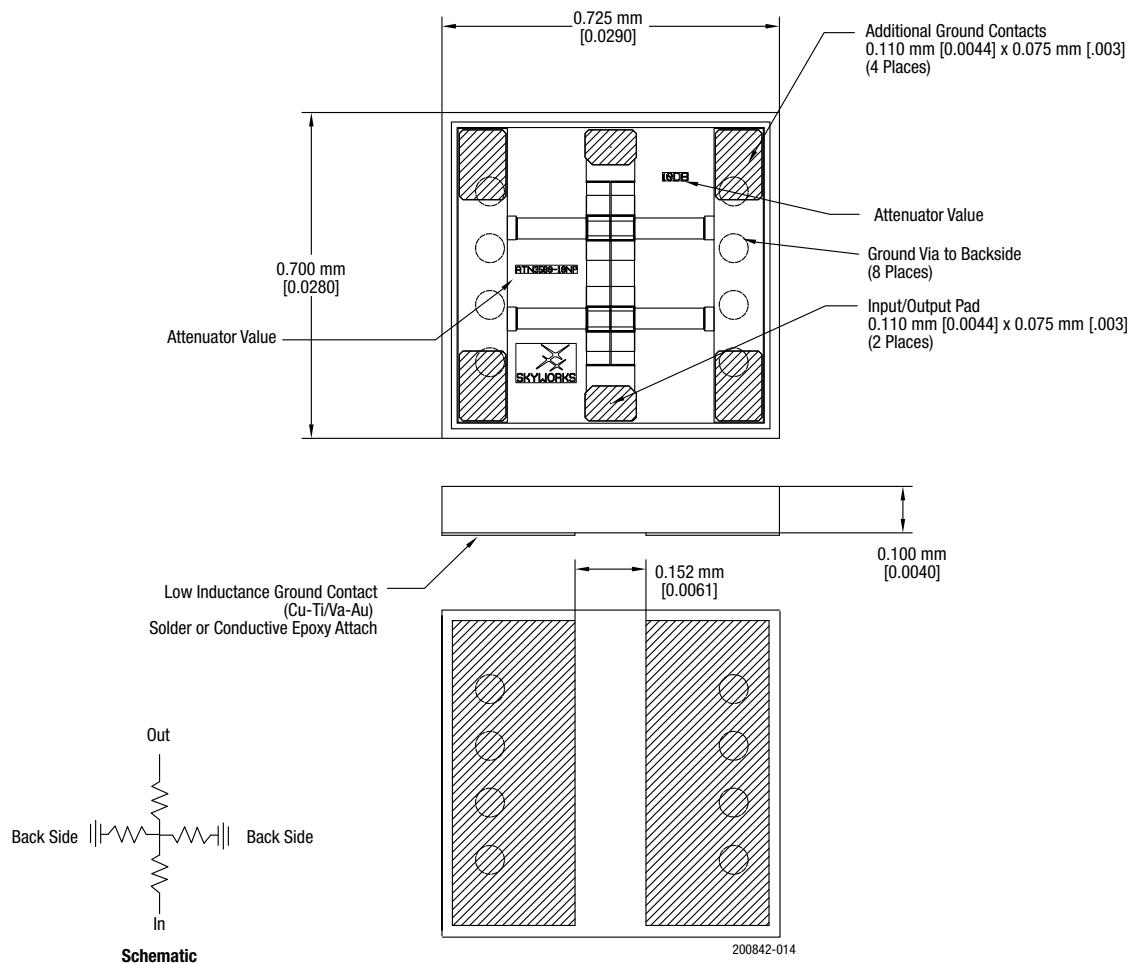
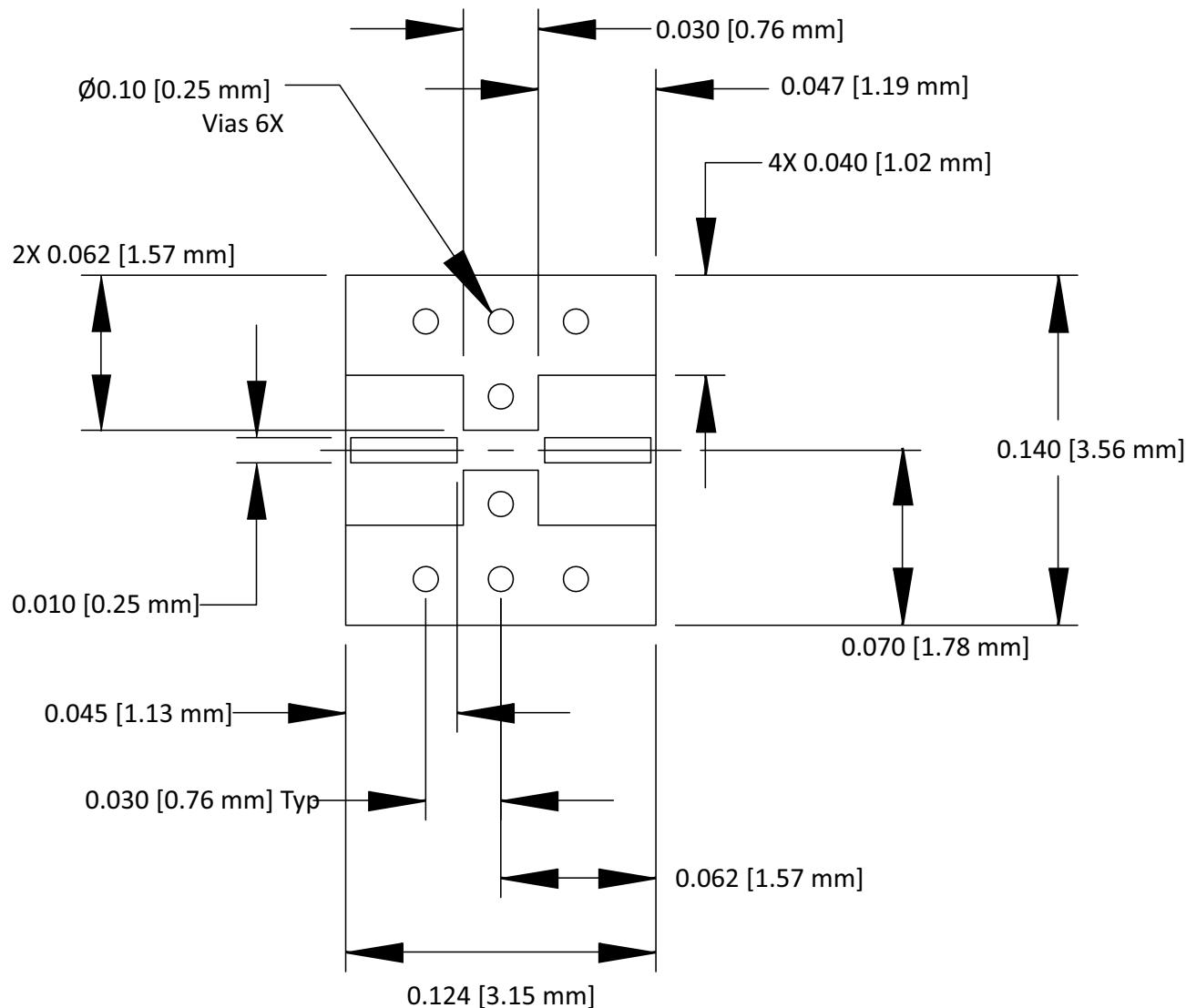


Figure 11. ATN3590 Attenuator Series Die Dimensions



Notes:

1. Material: Alumina 99.6%
Dielectric constant 9.9
Effective dielectric constant 6.8
Transmission line width: 0.010"
Substrate thickness: 0.010"
Coplanar gap: 0.025"
2. Plating: Gold 100 to 150 micro-inches

3. Unless otherwise specified:
Dimensions are in inches
Tolerances on finish: RMS 63
Angles $\pm 0.5^\circ$ Fractions: $\pm 1/64$
4 place decimals: ± 0.0005
3 place decimals: ± 0.005
2 place decimals: ± 0.02
4. Commercial published tolerances shall apply to tubing, bar, plate, etc. All threads to be Class 2A or Class 2B. Plated parts must fit gauges and meet specified tolerances after plating.

Figure 12. PCB Layout Footprint

Ordering Information

Ordering Part Number	Packaging
ATN3590-00	Gel-Tray®
ATN3590-00VR	Gel-Pak® Vacuum Release™ (VR) Tray
ATN3590-01	Gel-Tray
ATN3590-01VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-02	Gel-Tray
ATN3590-02VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-03	Gel-Tray
ATN3590-03VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-04	Gel-Tray
ATN3590-04VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-05	Gel-Tray
ATN3590-05VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-06	Gel-Tray
ATN3590-06VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-07	Gel-Tray
ATN3590-07VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-08	Gel-Tray
ATN3590-08VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-09	Gel-Tray
ATN3590-09VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-10	Gel-Tray
ATN3590-10VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-12	Gel-Tray
ATN3590-12VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-15	Gel-Tray
ATN3590-15VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-20	Gel-Tray
ATN3590-20VR	Gel-Pak Vacuum Release (VR) Tray
ATN3590-30	Gel-Tray
ATN3590-30VR	Gel-Pak Vacuum Release (VR) Tray

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