Datasheet

AC33254-1T
GNSS Embedded Ceramic Patch Antenna

The AC33254-1T is a square 25 mm x 25 mm GNSS ceramic patch antenna optimized for operation in the GPS L1, Galileo E1, GLONASS L1, Beidou B1-BOC and QZSS bands.

Featuring a precision-tuned ceramic resonator, the antenna provides stable right-hand circular polarization (RHCP) and a hemispherical radiation pattern for multipath suppression and fast time-to-first-fix, making it an ideal choice for asset tracking, telematics, and global navigation satellite systems (GNSS).

The AC33254-1T offers an extended temperature range to +105 °C for compliance to automotive standard AEC-Q200 Grade 2. Its mechanically robust pin-type design, with self-adhesive backing ensures reliable and repeatable electrical contact in demanding embedded positioning and timing applications.

AC33254-1T
GNSS ceramic patch antenna

Features

- Performance at 1575.42 MHz
  - VSWR: 1.4
  - Peak Gain: 4.8 dBi
  - Efficiency: 84%
- Performance at 1601/1602 MHz
  - VSWR: 1.1
  - Peak Gain: 4.8 dBi
  - Efficiency: 86%
- 25.0 mm x 25.0 mm x 4.0 mm
- Hemispherical radiation pattern
- Right-hand circularly polarized (RHCP)
- Strong out of band rejection
- Pin termination
- Through-hole mounting with adhesive

Applications

- Global Navigation (GNSS)
  - GPS L1,
  - Galileo E1
  - GLONASS L1
  - Beidou B1-BOC
  - QZSS
- Timing Applications
- OBD-II Modules
- IoT Applications
  - Asset Tracking
  - Smart Energy
  - M2M Industrial
  - Wearables/Healthcare
  - UAV/Drones

Ordering Information

Part Number	Description	Connection
AC33254-1T	GNSS ceramic patch antenna ,25 mm x 25 mm x 4 mm	Pin-type
AC93115	70 mm x 70 mm Evaluation Board for AC33254-1T	SMA

Available from The Antenna Company (sales@antennacompany.com) and select distributors and representatives.

RF/Electrical Specifications

Center Frequency	GPS Bands	VSWR (max)	Peak Gain (dBi)	Average Gain (dBi)	Efficiency (%)	Axial Ratio (dB)
1575 MHz	GPS L1, Galileo E1, GLONASS II L1, COMPASS CPII/Beidou B1-BOC, QZSS	1.4	4.8	-0.8	84	8
1590 MHz	COMPASS CPII/Beidou-B1-2	2.0	4.3	-1.1	77	5
1601/1602 MHz	GLONASS I L1, GLONASS II L1	1.1	4.8	-0.6	86	11

Impedance	50 Ω
Polarization	Linear
Radiation Pattern	Hemispherical
Max Power	8 W

Electrical specifications and plots measured with the antenna mounted on a 70 mm x 70 mm ground evaluation board.

Mechanical Specifications

Parameter	Value
Connection	Pin type (Through hole)
Operating Temp. Range	-40 °C to +105 °C (-40 °F to 221 °F)
Recommended Storage Conditions	-10 °C to +40 °C, RH 70% (Maximum)
Weight	9.5 g (0.34 oz)
Dimensions	25.0 mm x 25.0 mm x 4.0 mm (0.98 in x 0.98 in x 0.16 in)

Antenna Dimensions

The dimensions for the AC33254-1T are shown below in Figure 1.

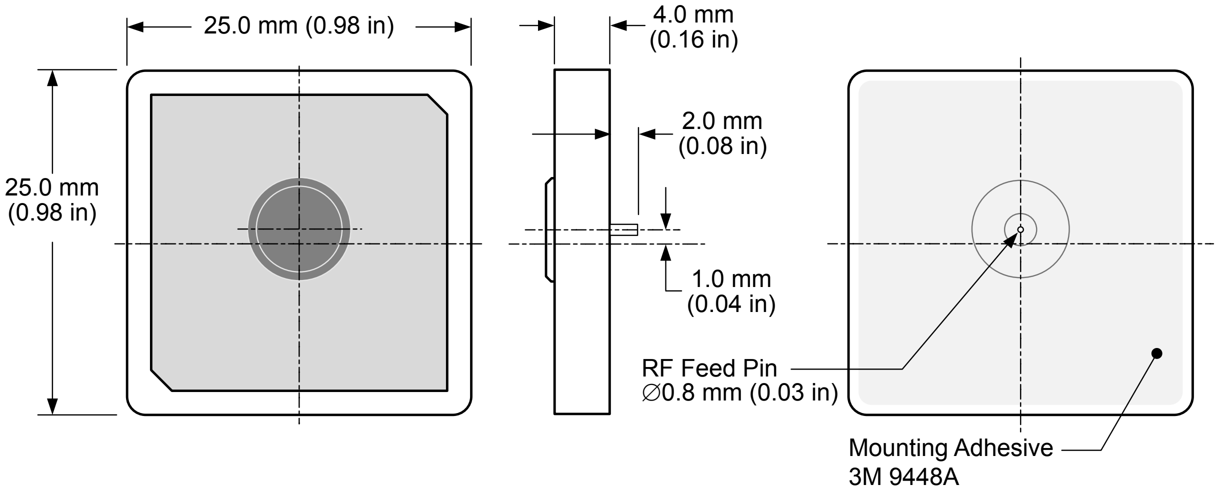


Figure 1. AC33254-1T Antenna Dimensions

VSWR

Figure 2 provides the voltage standing wave ratio (VSWR) across the antenna bandwidth. VSWR characterizes the power reflected from the antenna back to the transmitter. A lower VSWR value indicates better antenna performance at a given frequency. Reflected power is also shown on the right-side vertical axis as a measure of the percentage of transmitter power reflected back from the antenna.

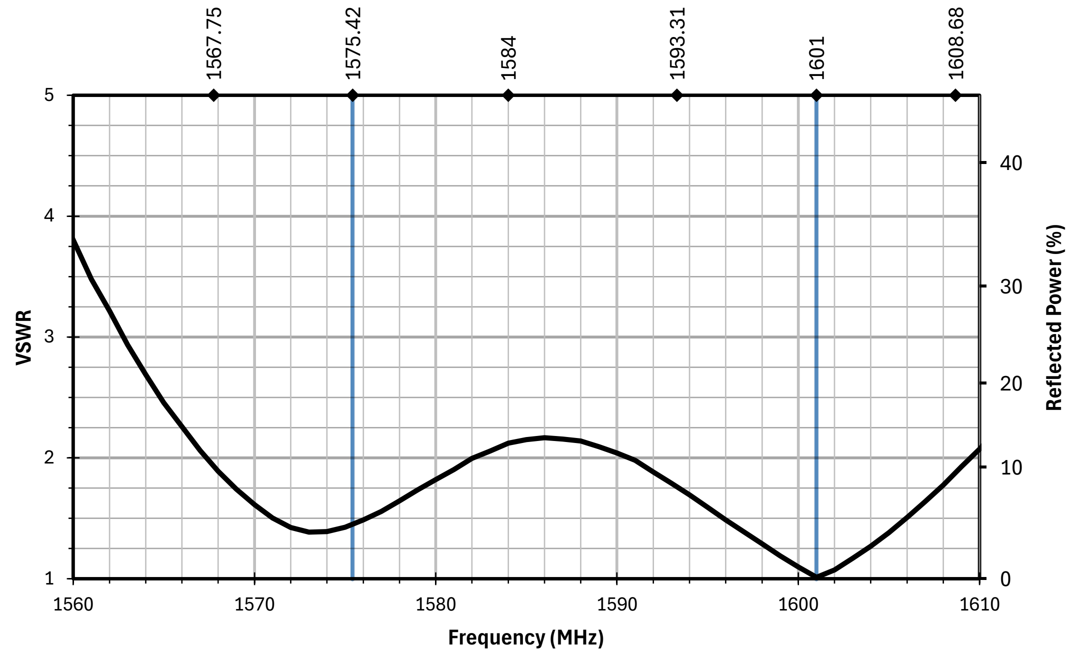


Figure 2. AC33254-1T Antenna VSWR with Frequency Band Highlights

Return Loss

Return loss (Figure 3) represents the loss in power at the antenna due to reflected signals. A higher magnitude return loss indicates better performance. Return loss is the negative of input reflection coefficient, in decibels (dB), and the two values are often used interchangeably.

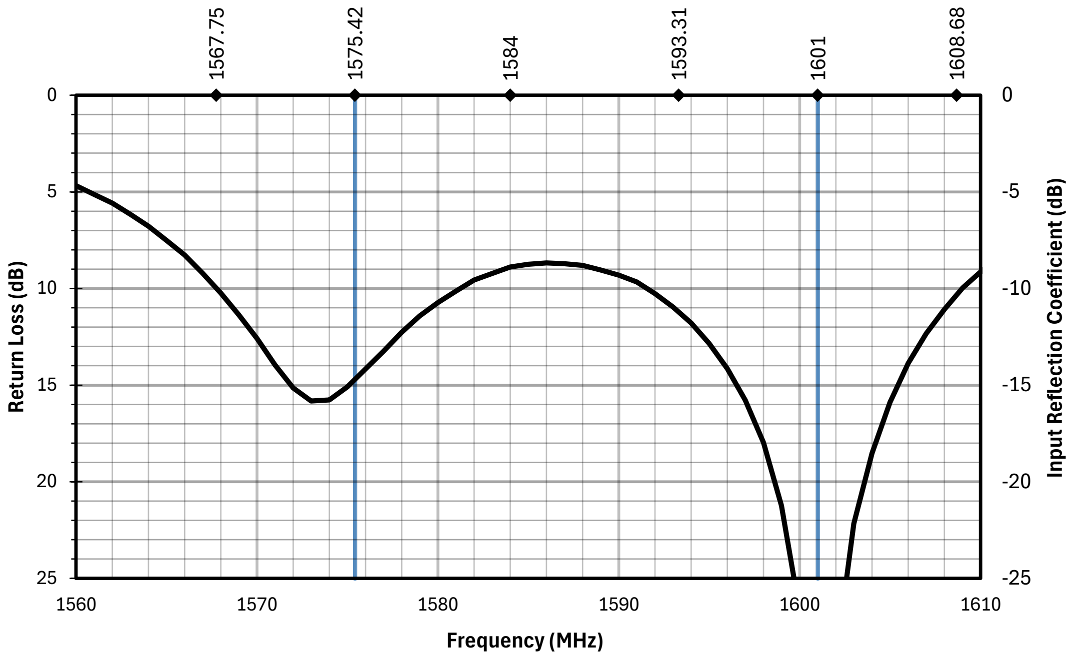


Figure 3. AC33254-1T Antenna Return Loss with Frequency Band Highlights

Peak Gain

Peak gain (Figure 4) provides a measure of the maximum conversion of antenna input power to radio waves at a given frequency. Peak gain does not account for the directionality of gain in 3-dimensional space.

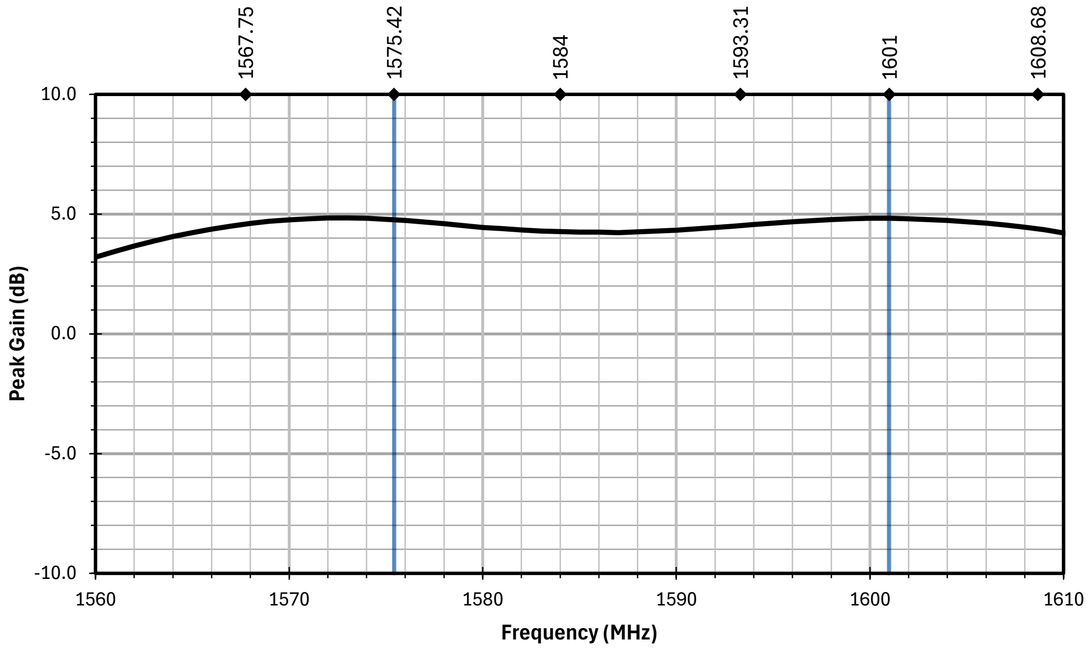


Figure 4. AC33254-1T Antenna Peak Gain with Frequency Band Highlights

Average Gain

Average gain (Figure 5) is the average of all antenna gain in 3-dimensional space at each frequency, providing an indication of overall performance without expressing antenna directionality.

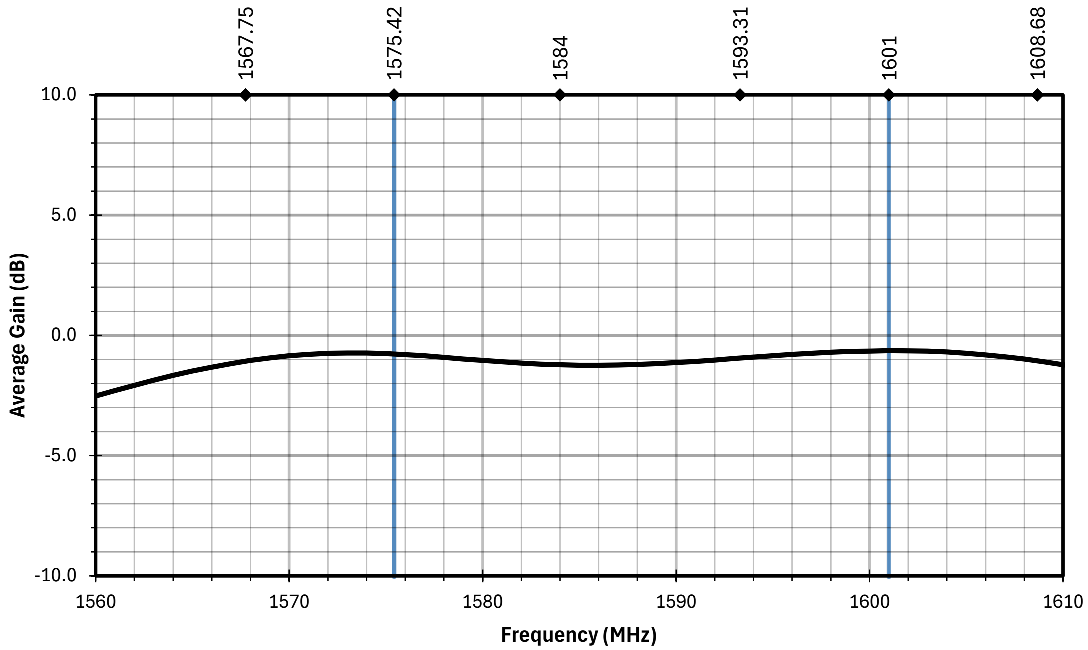


Figure 5. AC33254-1T Antenna Average Gain with Frequency Band Highlights

Efficiency

Efficiency (Figure 6) is the ratio of power delivered to the antenna relative to the power radiated at the antenna, expressed as a percentage, where a higher percentage indicates better performance at a given frequency.

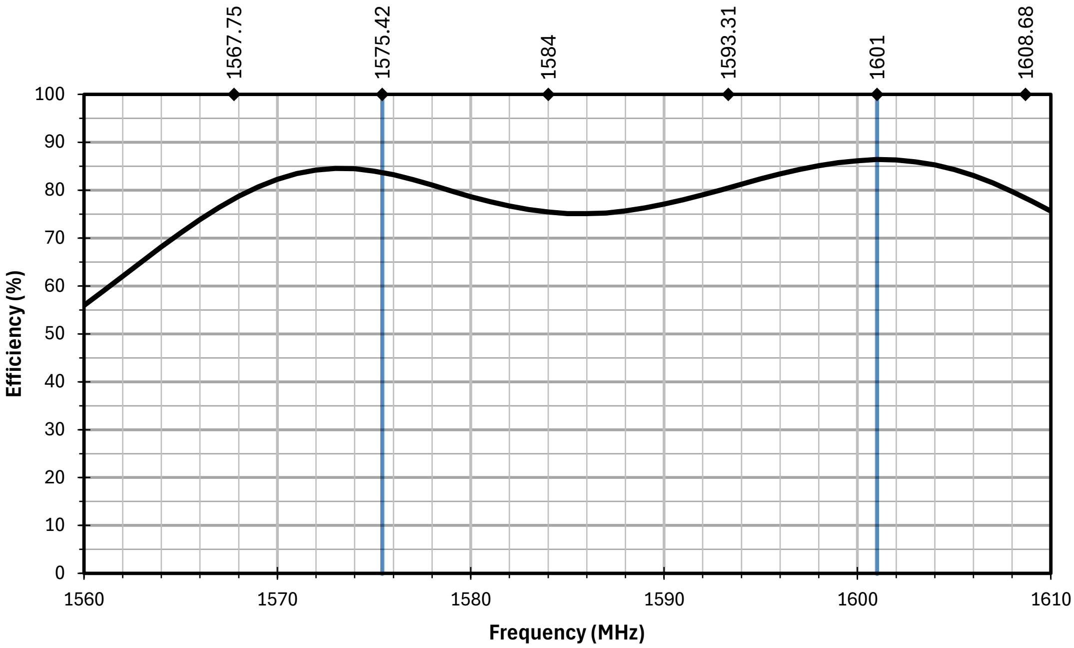


Figure 6. AC33254-1T Antenna Efficiency with Frequency Band Highlights

Axial Ratio

Axial ratio provides a measure of the quality of circular polarization of an antenna. The lower the value (in dB), the better the circular polarization. A circularly polarized antenna field comprises two orthogonal E-field components. These fields are ideally of equal amplitude, resulting in an axial ratio equal to unity (0 dB). In practice, no antenna is perfectly circular in polarization, the polarization is elliptical as one field has larger magnitude. As the axial ratio increases the antenna gain degrades away from the main beam orthogonal to the antenna surface. The axial ratio for the AC33254-1T antenna is shown in Figure 7.

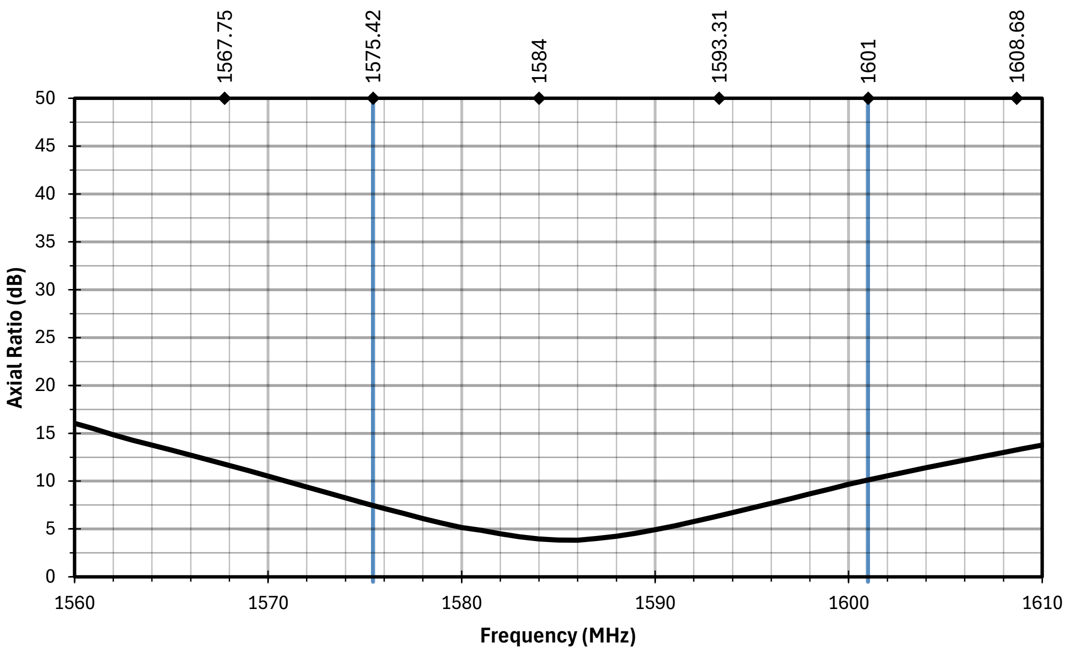
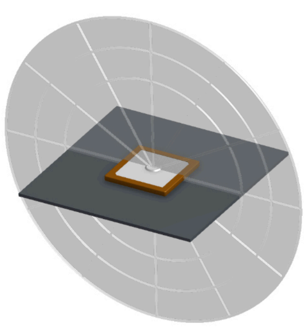


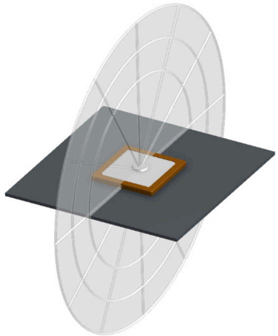
Figure 7. Axial Ratio for the AC33254-1T Antenna

Radiation Patterns

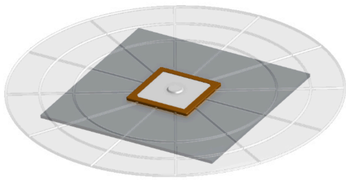
Radiation patterns provide information about the directional performance of the antenna by plotting gain in three orthogonal planes at the high-, low- and center-frequencies of an antenna frequency band. Antenna radiation patterns (Figure 8) are shown using polar plots covering 360 degrees with the plane of reference depicted above the plots. Note: when viewed with typical PDF viewing software, zooming into radiation patterns is possible to reveal fine detail.



XZ-Plane Gain

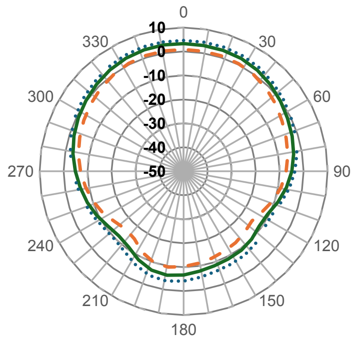


YZ-Plane Gain

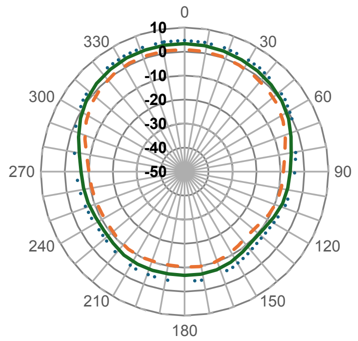


XY-Plane Gain

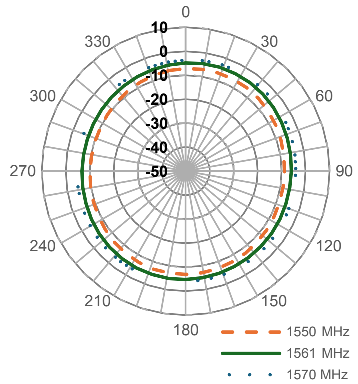
1550 MHz to 1570 MHz (1561 MHz)



XZ-Plane Gain

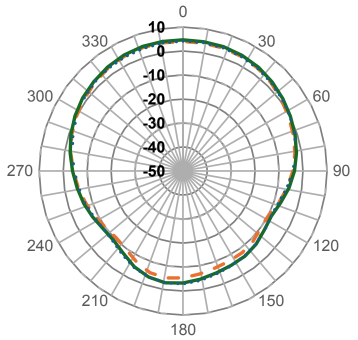


YZ-Plane Gain

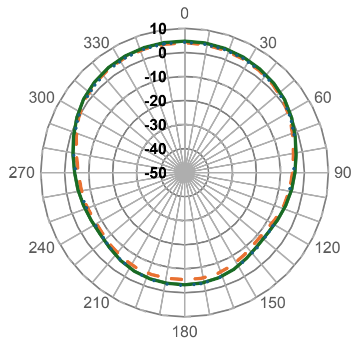


XY-Plane Gain

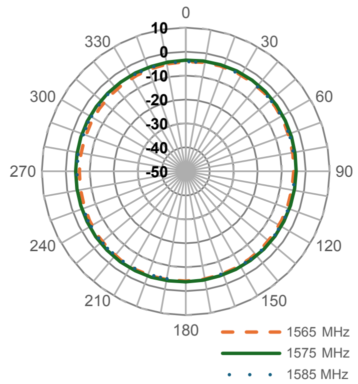
1565 MHz to 1585 MHz (1575 MHz)



XZ-Plane Gain



YZ-Plane Gain



XY-Plane Gain

1589 MHz to 1610 MHz (1601 MHz)

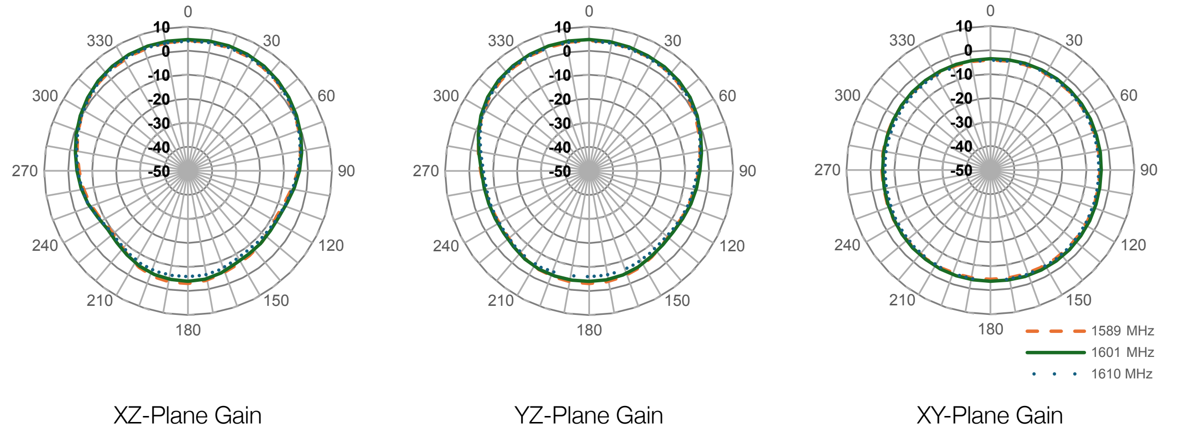


Figure 8. Radiation Patterns for AC33254-1T Antenna

Ground Plane

The performance of the AC33254-1T GNSS ceramic patch antenna is strongly influenced by the size and quality of the host PCB ground plane. The antenna is optimized for operation on a 70 mm x 70 mm continuous ground plane, which acts as the RF reference and radiating counterpoise. The size and quality of the ground plane directly affect antenna gain, radiation pattern stability, and impedance matching, with larger, continuous ground planes providing higher peak gain, more consistent hemispherical radiation, lower VSWR, and wider usable bandwidth.

Recommended PCB Footprint

Figure 9 shows the PCB layout footprint for mounting the AC33254-1T antenna.

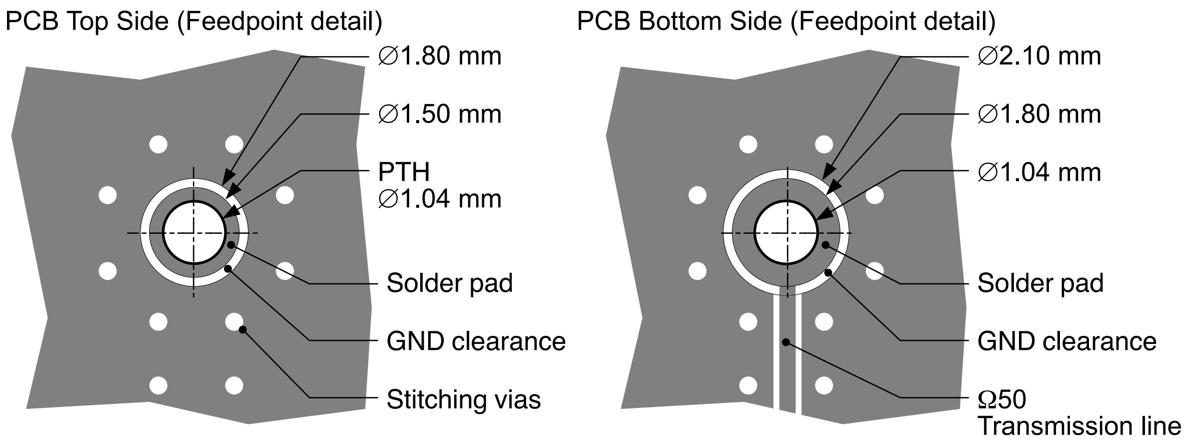


Figure 9. Recommended PCB Footprint for the AC33254-1T Antenna

Recommended Layout

The recommended PCB layout for the AC33254-1T GNSS ceramic patch antenna consists of a continuous ground plane, a 50 Ω RF transmission line, and a matching network located close to the antenna feed.

The RF feed pin of the antenna should be connected to the GNSS receiver or RF connector through a 50 Ω RF transmission line. If the antenna and GNSS receiver are located on the same PCB, the RF trace may be routed directly to the receiver input.

The inclusion of a 3-element surface-mount Pi matching network close to the antenna feed is strongly recommended. The matching network allows compensation for frequency detuning and impedance variation caused by the final PCB layout, ground plane size, enclosure materials, and nearby components.

The antenna is designed for nominal 50 Ω operation and may operate without matching in some environments. This is the case for The Antenna Company evaluation board AC93115. In cases where matching is not required, the series element of the Pi matching network may be populated with a 0 Ω resistor, while the shunt components remain unpopulated. Component sizes 0402 or 0603 are recommended to minimize parasitic effects.

Final antenna performance should be verified on the complete device, including enclosure and surrounding components. The Antenna Company offers PCB layout reviews and matching support to help optimize GNSS performance in the end application.

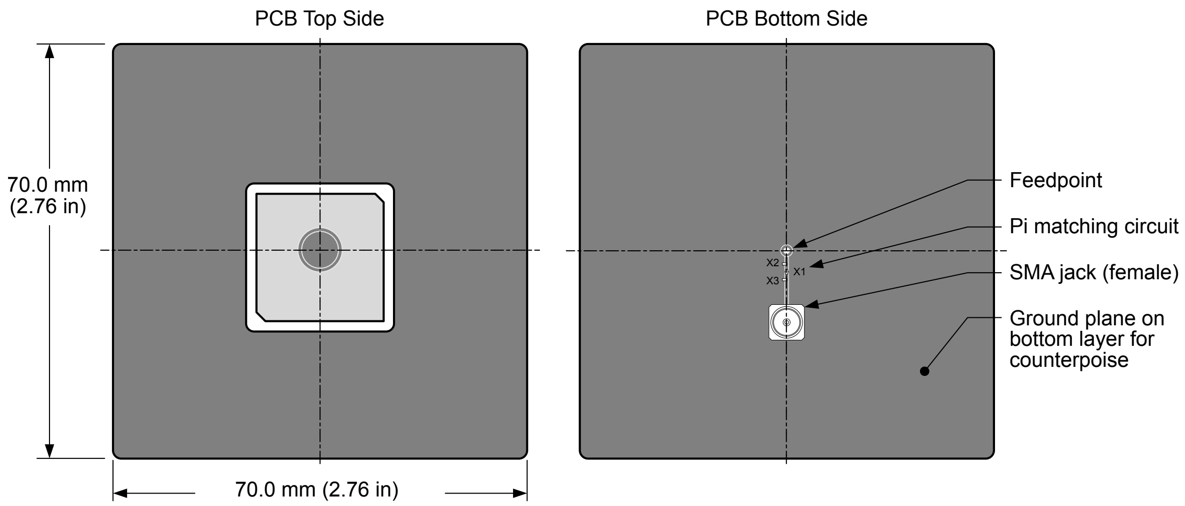


Figure 10. AC33254 Recommended Layout

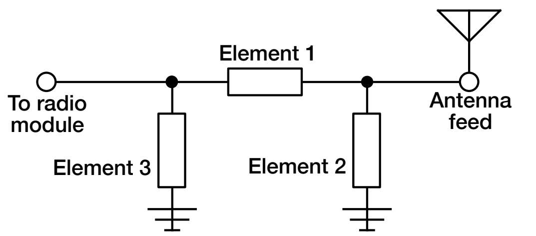


Figure 11. Recommended Matching Network

Transmission Line for Embedded Antennas

For most designs, The Antenna Company recommends a microstrip transmission line for the AC33254-1T. A microstrip transmission line is a PCB trace that runs over a ground plane to maintain the characteristic impedance for optimal signal transfer between the antenna and radio circuitry. The Antenna Company designs all standard antennas with a characteristic impedance of 50 Ω.

Important practices to observe when designing a transmission line are:

- Keep all transmission lines to a minimum length for best signal performance.
- Use RF components that also operate at a 50 Ω impedance.
- If the radio is not on the same PCB as the antenna, the microstrip should be terminated in a connector enabling a shielded cable to complete the antenna connection to the radio.
- A ground via fence is recommended along the RF transmission line and the antenna feeding pad to maintain impedance control and minimize unwanted coupling.

Recommended Soldering

Manual soldering

- Soldering iron power: Maximum 30 W
- Preheat: 150 °C / 60 seconds.
- Soldering iron tip temperature: Maximum 350 °C
- Soldering time: Maximum 3 seconds.
- Solder: Sn/3.0Ag/0.5Cu
- Manual soldering: Up to 1 time

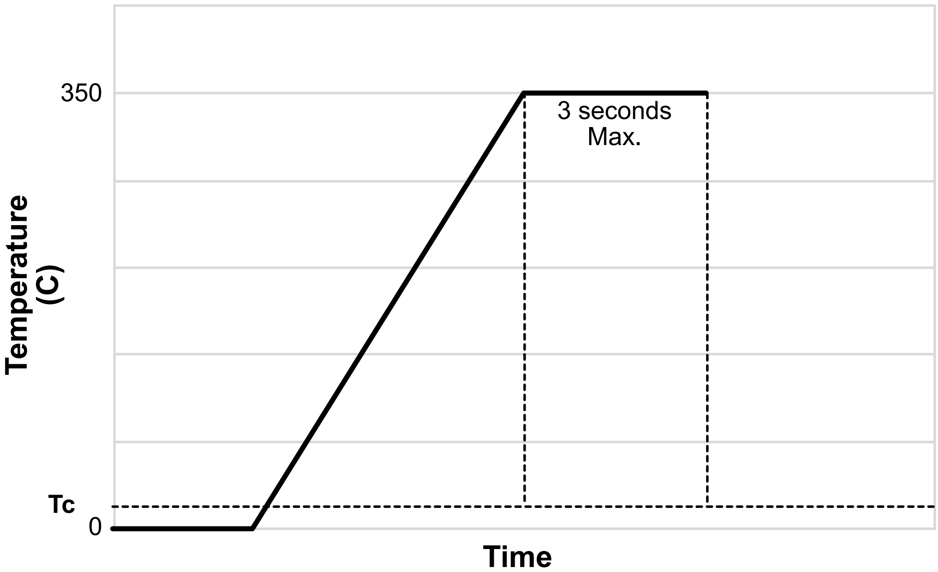


Figure 12. Soldering Requirements

Packaging Information

The AC33254-1T antenna is placed in plastic shipping trays in quantities of 50. Antenna trays are stacked in cartons with the capacity for 20 trays. Carton dimensions are 345 mm x 195 mm x 255 mm (13.58 in x 7.68 in x 10.04 in).

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Series: Ceramic Patch.

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