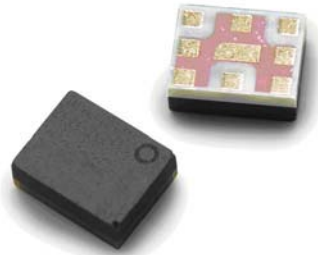


# ACMD-7609

UMTS Band 4 / CDMA AWS-1 Duplexer



## Data Sheet



### Description

The Avago ACMD-7609 is a highly miniaturized duplexer designed for use in UMTS Band 4 and CDMA AWS-1 (1710 – 1755 MHz UL, 2110 – 2155 MHz DL) handsets and mobile data terminals.

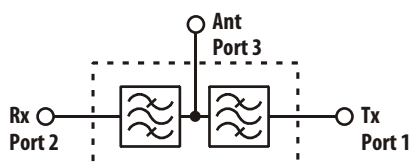
Low Insertion Loss in the Tx channel minimizes current drain from the power amplifier, while low Rx channel Insertion Loss improves receiver sensitivity.

The ACMD-7609 enhances the sensitivity and dynamic range of handset receivers by providing high isolation of the transmitted signal from the receiver input and high rejection of transmit-generated noise in the receive band.

The ACMD-7609 is designed with Avago Technologies' innovative Film Bulk Acoustic Resonator (FBAR) technology, which makes possible ultra-small, high-Q filters at a fraction of their usual size. The excellent power handling capability of FBAR bulk-mode resonators supports the high output power levels used in mobile communications applications, while adding virtually no distortion.

The ACMD-7609 also utilizes Avago Technologies' advanced Microcap bonded-wafer, chip scale packaging technology. This process allows the filters to be assembled into a molded chip-on-board module with an overall maximum size of 2.0 x 2.5 mm and maximum height of 0.95 mm. The ACMD-7609 is compatible with standard 2.0 x 2.5 mm duplexer PCB footprints.

### Functional Block Diagram



### Features

- Miniature Size
  - 2.0 x 2.5 mm Max size
  - 0.95 mm Max height
  - Standard 2 x 2.5 mm PCB footprint
- High Isolation enables elimination of interstage filter
- High Power Rating
  - 31 dBm Abs Max Tx Power
- Environmental
  - RoHS 6 Compliant
  - Halogen free
  - TBBPA Free

### Specifications

- Rx Band Performance, – 20 to +85°C
  - Insertion Loss: 2.0 dB Max
  - Rx Noise Blocking: 50 dB Min
- Tx Band Performance, – 20 to +85°C
  - Insertion Loss: 1.9 dB Max
  - Tx Interferer Blocking: 53 dB Min

### Applications

Handsets or data terminals operating in the Band 4 frequency range.

**ACMD-7609 Electrical Specifications <sup>[2]</sup>,  $Z_0=50\ \Omega$ ,  $T_C$ <sup>[1]</sup> as indicated**

Symbol	Parameter	Units	- 20°C			+25°C			+85°C		
			Min	Typ <sup>[3]</sup>	Max	Min	Typ <sup>[3]</sup>	Max	Min	Typ <sup>[3]</sup>	Max
<b>Antenna Port to Receive Port</b>											
S23	Insertion Loss in Receive Channels <sup>[4]</sup> (UMTS 2112.4 – 2152.6 MHz)	dB			2.0		1.3	2.0			2.0
S23	Insertion Loss in Receive Channels (CDMA 2110 – 2155 MHz)	dB			2.2		1.3	2.2			2.2
S22	Return Loss (SWR) of Receive Port in Receive Band (2110 – 2155 MHz)	dB	9.0		(2.1)	9.0	15 (1.4)	(2.1)	9.0		(2.1)
S23	Attenuation in Transmit Band (1710 – 1755 MHz)	dB	48			48	53		48		
S23	Attenuation, 1 – 1710 MHz	dB	35			35	54		35		
S23	Attenuation, 2240 – 2400 MHz	dB	35			35	43		35		
S23	Attenuation in Bluetooth Band (2400 – 2483.5 MHz)	dB	32			32	43		32		
S23	Attenuation, 2484 – 3600 MHz	dB	32			32	44		32		
<b>Transmit Port to Antenna Port</b>											
S31	Insertion Loss in Transmit Channels <sup>[4]</sup> (UMTS 1712.5 – 1752.5 MHz)	dB			1.9		1.3	1.9			1.9
S31	Insertion Loss in Transmit Channels (CDMA 1710 – 1755 MHz)	dB			2.1		1.3	2.1			2.1
S11	Return Loss (SWR) of Transmit Port in Transmit Band (1710 – 1755 MHz)	dB	9.0		(2.1)	9.0	18 (1.3)	(2.1)	9.0		(2.1)
S31	Attenuation in Receive Band (2110 – 2155 MHz)	dB	45			45	55		45		
S31	Attenuation, 10 – 1574 MHz	dB	30			30	47		30		
S31	Attenuation in GPS Rx Band (1574.42 – 1576.42 MHz)	dB	43			43	46		43		
S31	Attenuation in Bluetooth Band (2400 – 2483.5 MHz)	dB	35			35	41		35		
S31	Attenuation in Transmit 2nd Harmonic Band (3420 – 3510 MHz)	dB	35			35	49		35		
S31	Attenuation in Transmit 3rd Harmonic Band (5130 – 5265 MHz)	dB	5			5	11		5		
<b>Antenna Port</b>											
S33	Return Loss (SWR) of Ant Port in Rx Band (2110 – 2155 MHz)	dB	9.0		(2.1)	9.0	15 (1.4)	(2.1)	9.0		(2.1)
S33	Return Loss (SWR) of Ant Port in Tx Band (1710 – 1755 MHz)	dB	9.0		(2.1)	9.0	16 (1.4)	(2.1)	9.0		(2.1)
<b>Isolation Transmit Port to Receive Port</b>											
S21	Tx-Rx Isolation in Receive Band (2110 – 2155 MHz)	dB	50			50	58		50		
S21	Tx-Rx Isolation in Transmit Band (1710 – 1755 MHz)	dB	53			53	60		53		

Notes:

1.  $T_C$  is the case temperature and is defined as the temperature of the underside of the Duplexer where it makes contact with the circuit board.
2. Min/Max specifications are guaranteed at the indicated temperature with the input power to the Tx port equal to or less than +29 dBm over all Tx frequencies unless otherwise noted.
3. Typical data is the average value of the parameter over the indicated band at the specified temperature. Typical values may vary over time.
4. Integrated Insertion Loss over any 3.84 MHz channel within the band.

### Absolute Maximum Ratings<sup>[1]</sup>

Parameter	Unit	Value
Storage temperature	°C	-65 to +125
Maximum RF Input Power to Tx Port	dBm	+31

### Maximum Recommended Operating Conditions<sup>[2]</sup>

Parameter	Unit	Value
Operating temperature, $T_C$ <sup>[3]</sup> , Tx Power $\leq$ 29 dBm	°C	-40 to +100
Operating temperature, $T_C$ <sup>[3]</sup> , Tx Power $\leq$ 30 dBm	°C	-40 to +85

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage to the device.
2. The device will function over the recommended range without degradation in reliability or permanent change in performance, but is not guaranteed to meet electrical specifications.
3.  $T_C$  is defined as case temperature, the temperature of the underside of the duplexer where it makes contact with the circuit board.

### ACMD-7609 Typical Performance at $T_c = 25^\circ\text{C}$

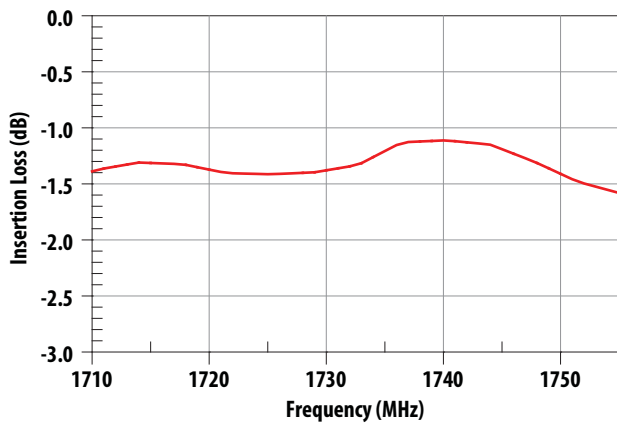


Figure 1. Tx-Ant Insertion Loss

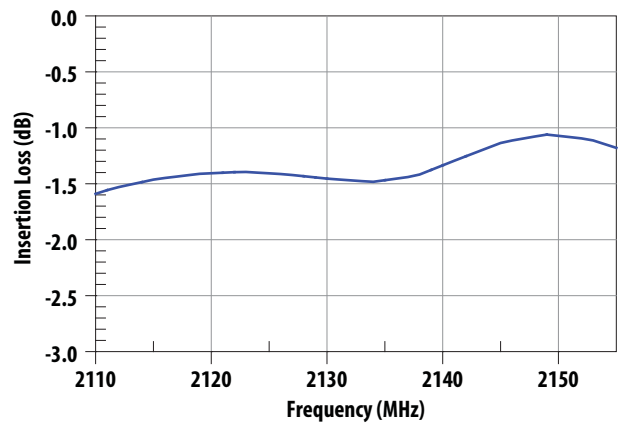


Figure 2. Ant-Rx Insertion Loss

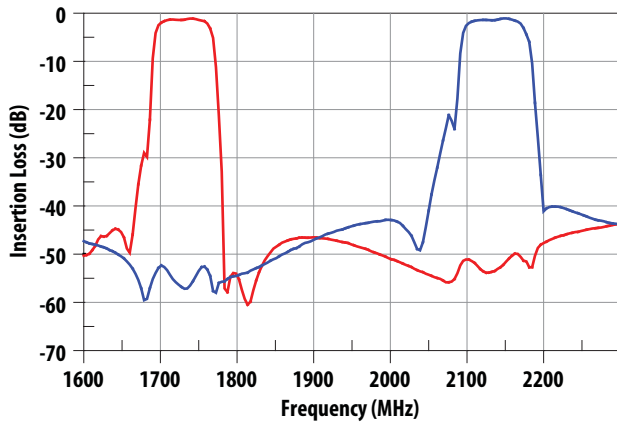


Figure 3. Tx Rejection in Rx Band and Rx Rejection in Tx Band

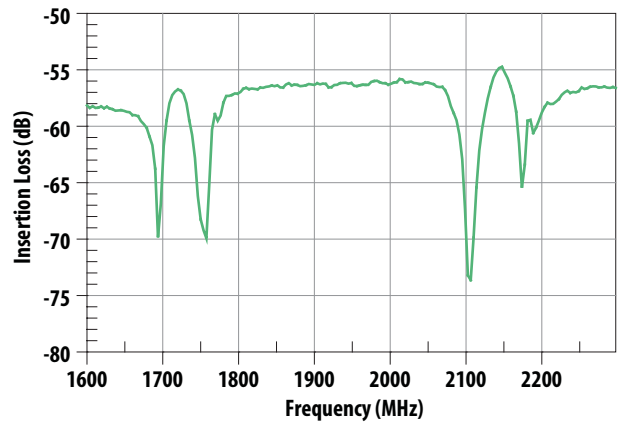


Figure 4. Tx-Rx Isolation

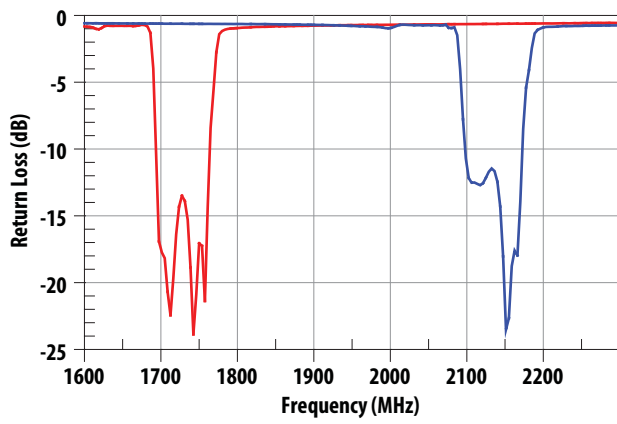


Figure 5. Tx and Rx Port Return Loss

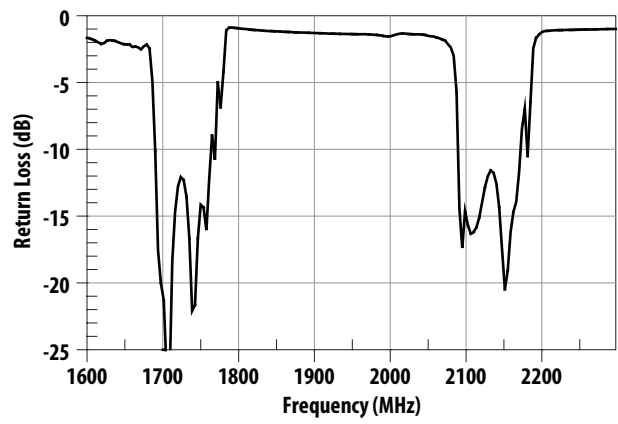


Figure 6. Antenna Port Return Loss

**ACMD-7609 Typical Performance at  $T_c = 25^\circ\text{C}$**

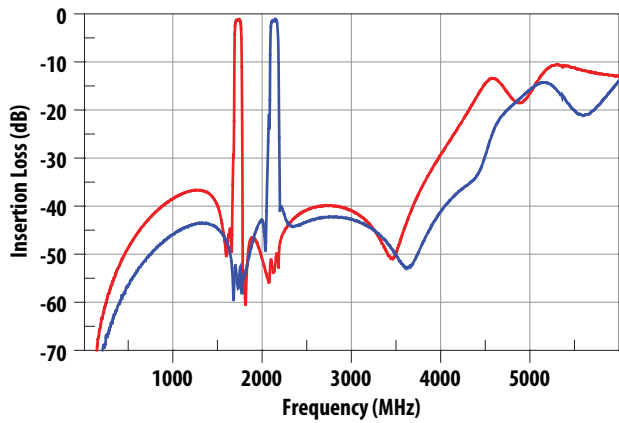


Figure 7. Tx-Ant, Ant-Rx Insertion Loss and Iso, Wideband

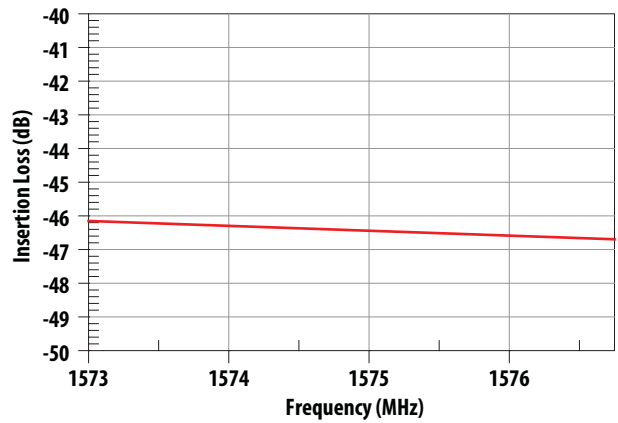


Figure 8. Tx-Ant Rejection in GPS Band

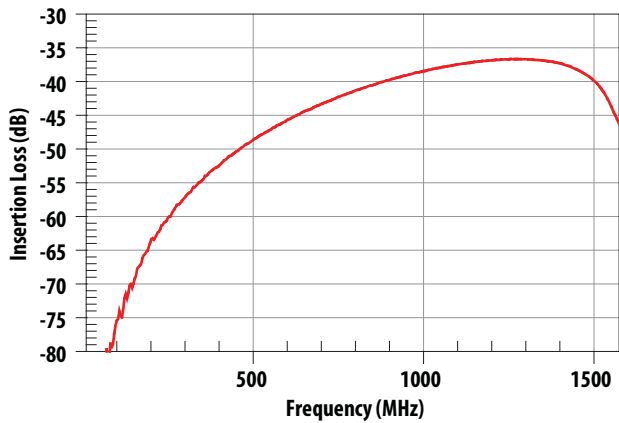


Figure 9. Tx-Ant Low Frequency Rejection, 10 - 1574 MHz

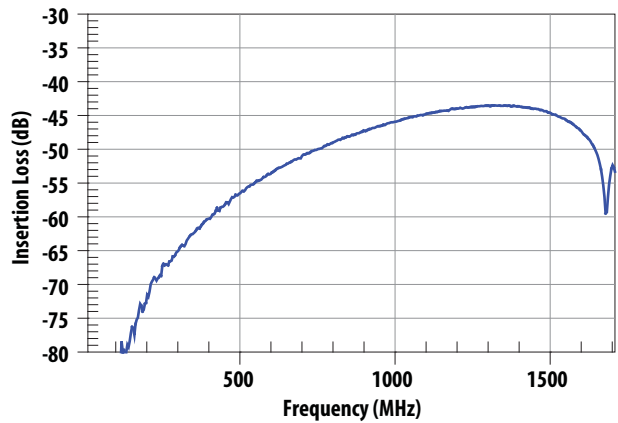


Figure 10. Ant-Rx Low Frequency Rejection, 1 - 1710 MHz

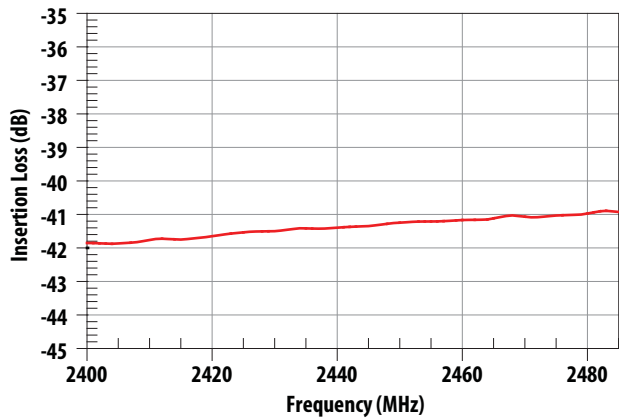


Figure 11. Tx-Ant Rejection in Bluetooth Band

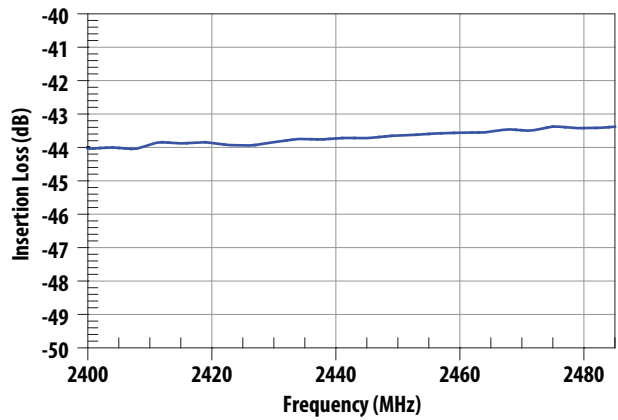


Figure 12. Ant-Rx Rejection in Bluetooth Band

ACMD-7609 Typical Performance at  $T_c = 25^\circ\text{C}$

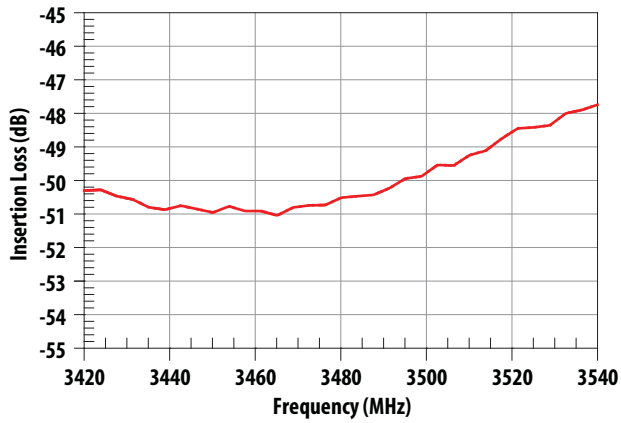


Figure 13. Tx-Ant Rejection at Tx Second Harmonic

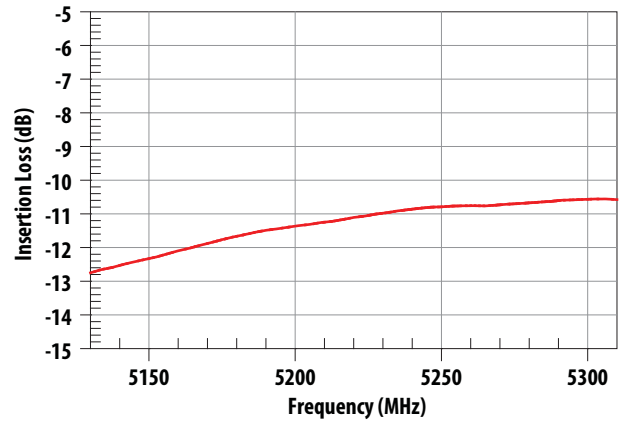


Figure 14. Tx-Ant Rejection at Tx Third Harmonic

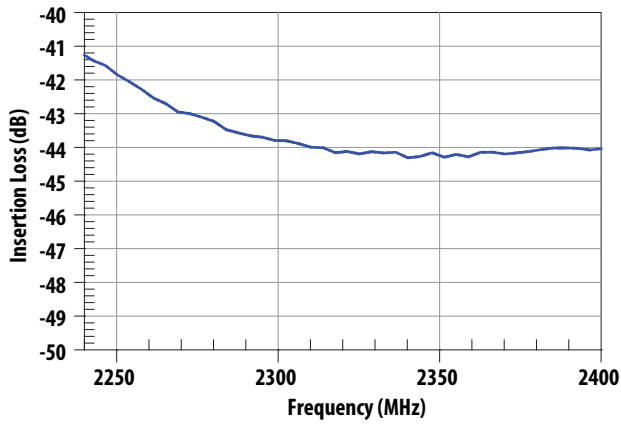


Figure 15. Ant-Rx Rejection, 2240-2400 MHz

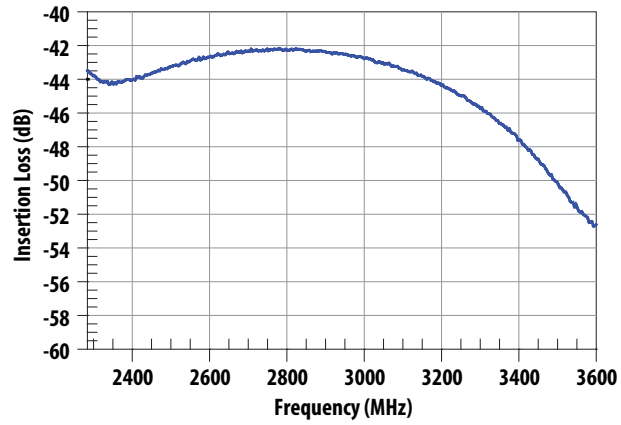
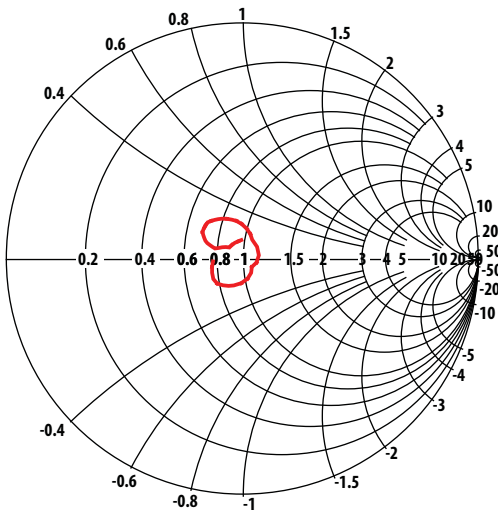
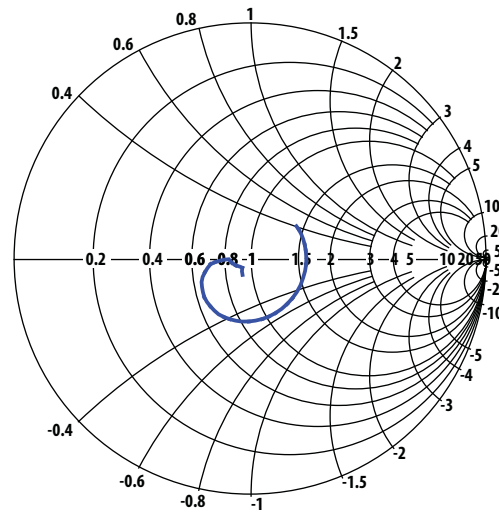


Figure 16. Ant-Rx Rejection, 2484-3600 MHz

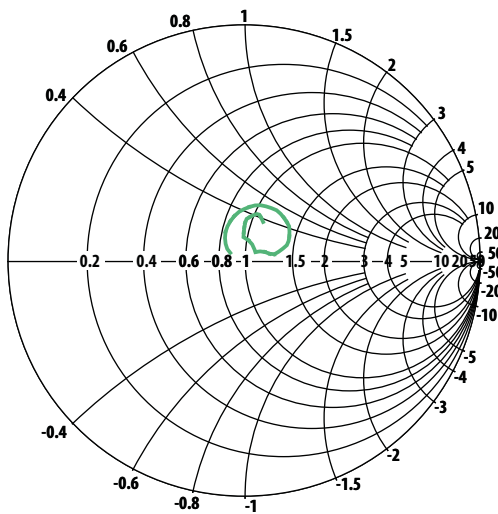
**ACMD-7609 Typical Performance at  $T_c = 25^\circ\text{C}$**



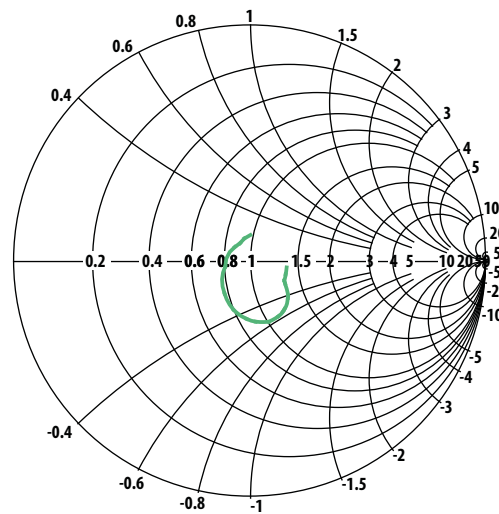
**Figure 17. Tx Port Impedance in Tx Band**



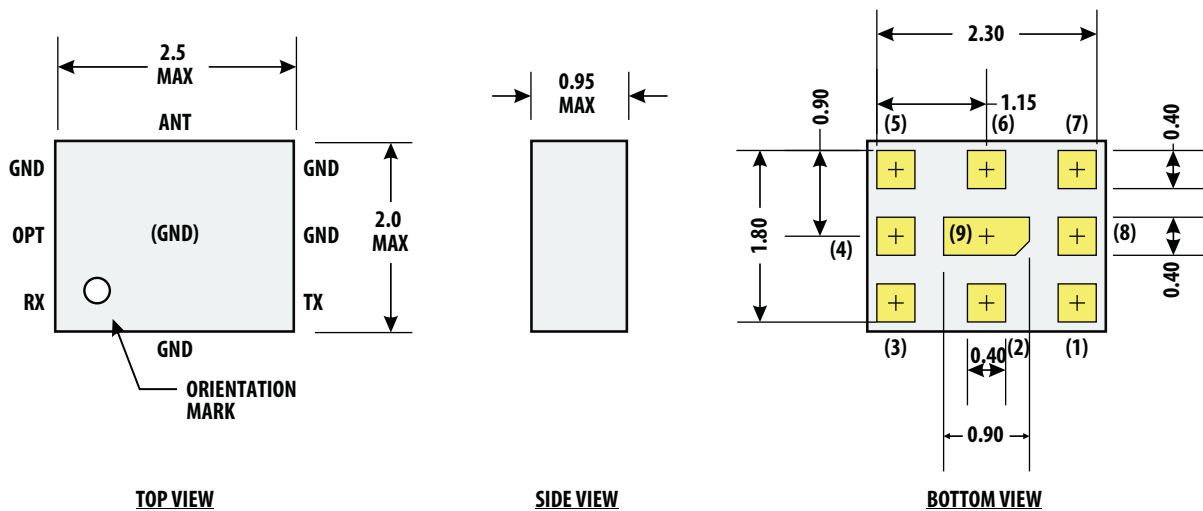
**Figure 18. Rx Port Impedance in Rx Band**



**Figure 19. Ant Port Impedance in Tx Band**



**Figure 20. Ant Port Impedance in Rx Band**



Notes:

1. Dimensions in millimeters  
Tolerance:  $X.X \pm 0.1$  mm  
 $X.XX \pm 0.05$  mm
2. Dimensions nominal unless otherwise noted
3. Angles  $45^\circ$  nominal
4. I/O Pads (3 ea)  
Size:  $0.40 \times 0.40$  mm  
Spacing to ground metal: 0.30 mm
5. Contact areas are gold plated

Pin Connections:

- |               |                            |
|---------------|----------------------------|
| 1             | Rx (or RX(+))              |
| 2, 4, 5, 7, 9 | Gnd                        |
| 3             | Tx                         |
| 6             | Ant                        |
| 8             | Optional: Gnd, NC or Rx(-) |

Figure 21. Package Outline Drawing

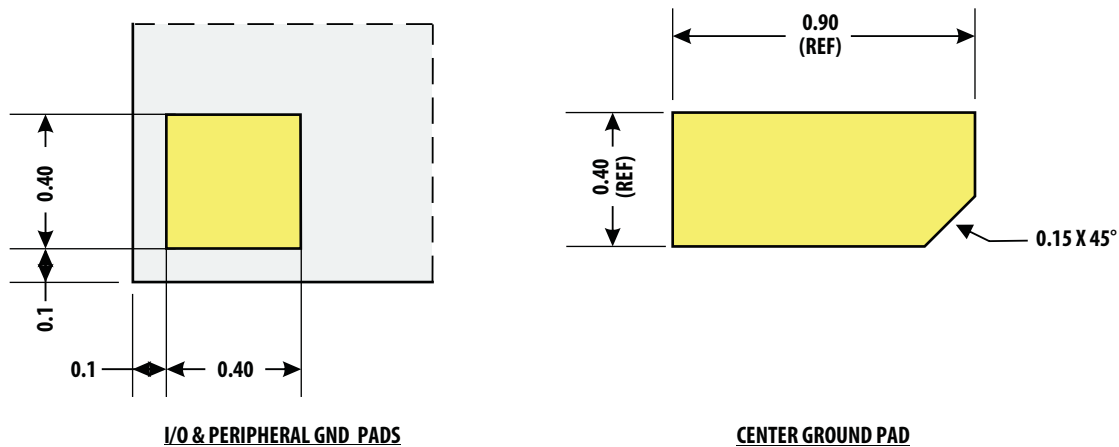
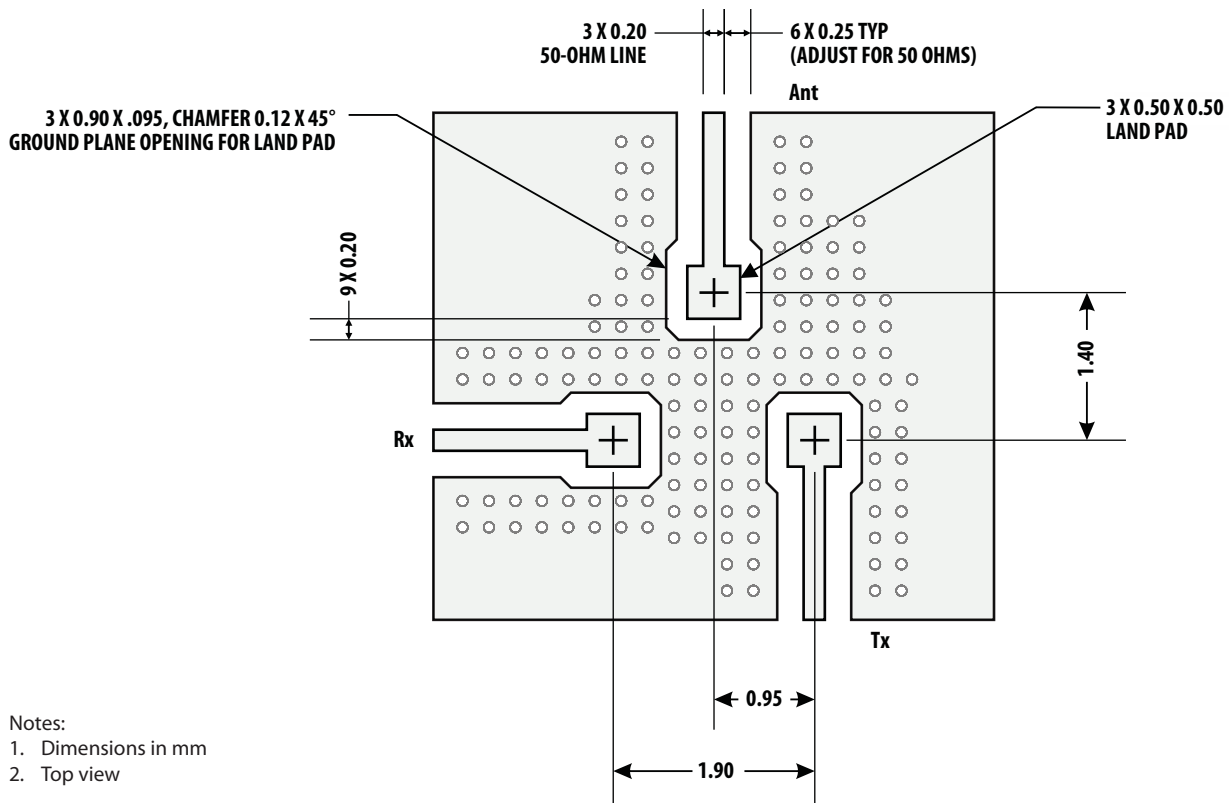


Figure 22. Pad Detail





**Figure 23. Suggested PCB Layout**

A PCB layout using the principles illustrated in the figure above is recommended to optimize performance of the ACMD-7609.

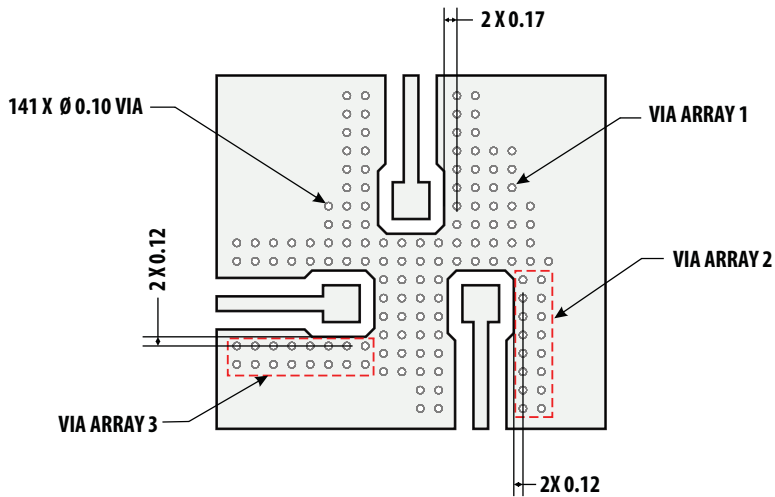
Note: Pin 8 grounded in this example.

The transmission line dimensions shown are designed to achieve an impedance of 50 ohms for an 80 $\mu$ m thick PCB layer with a dielectric constant of 3.4. If other PCB materials or thicknesses are used, the 0.25 mm gap spacing may need to be adjusted to retain a  $Z_0$  of 50 ohms.

It is important to maximize isolation between the Tx and Rx ports.

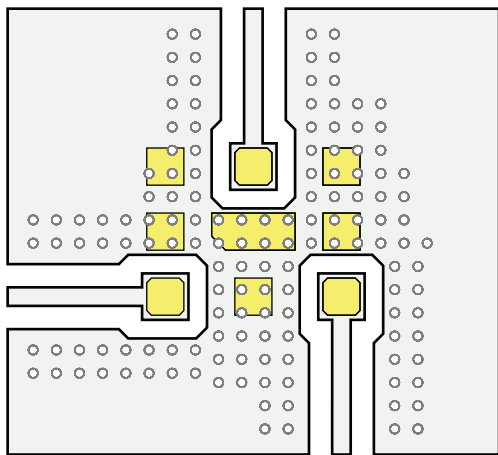
High isolation is achieved by: (1) maintaining a continuous ground plane around the I/O connections and duplexer mounting area, and (2) surrounding the I/O ports with sufficient ground vias to enclose the connections in a "Faraday cage."

The ground vias under the ACMD-7609 mounting area are also needed to provide adequate heat sinking for the device.



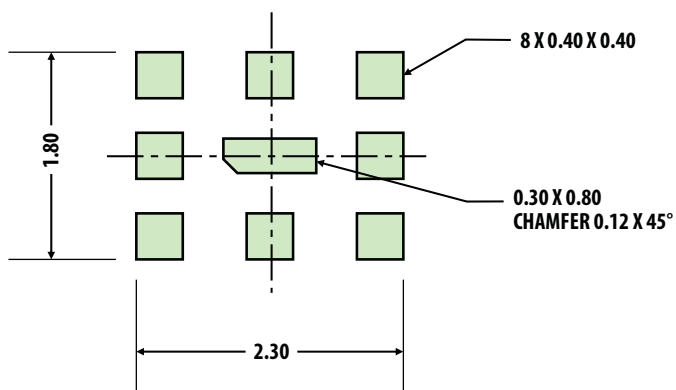
- Notes:
1. Dimensions in mm
  2. Top view
  3. Via arrays: horiz pitch = 0.25, vert pitch = 0.25

Figure 24. PCB Layout, Via Detail



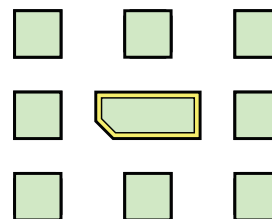
- Note:
1. Top view

Figure 25. ACMD-7609 Superposed on PCB Layout



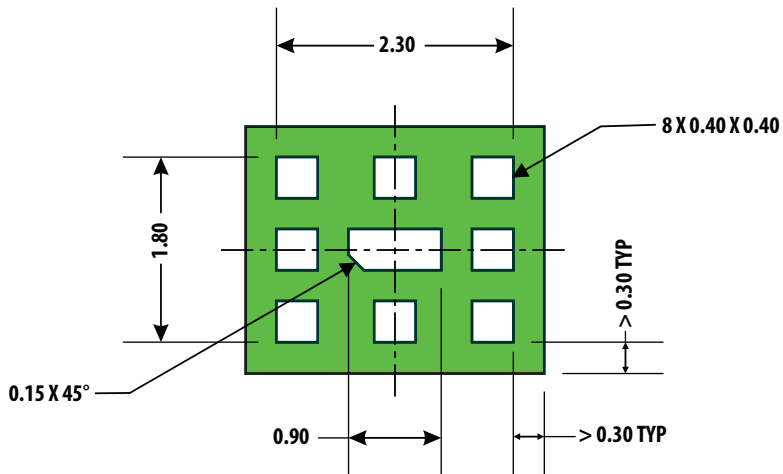
- Notes:
1. Dimensions in mm
  2. Top view
  3. Chamfer or radius all corners 0.05 mm min

Figure 26. Recommended Solder Stencil



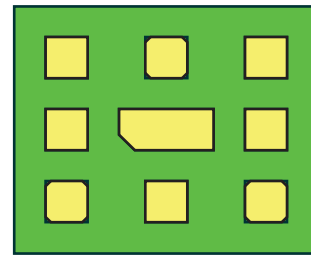
- Notes:
1. Top view
  2. Peripheral clearance of stencil aperture for center device pad is 0.05 mm. All other apertures match device pad 1:1

Figure 27. Solder Stencil Superposed on ACMD-7609 metal pattern



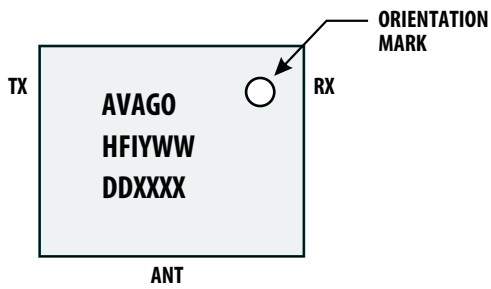
- Notes:
1. Dimensions in mm
  2. Top view

Figure 28. Recommended Solder Mask



- Notes:
1. Top view
  2. Mask apertures match device pads 1:1

Figure 29. Solder Mask Superposed on ACMD-7609



- H = ACMD-7609
- FI = Mfg Information
- Y = Year
- WW = Work Week
- DD = Date Code
- XXXX = Assembly Lot

Figure 30. Product Marking and Port Orientation

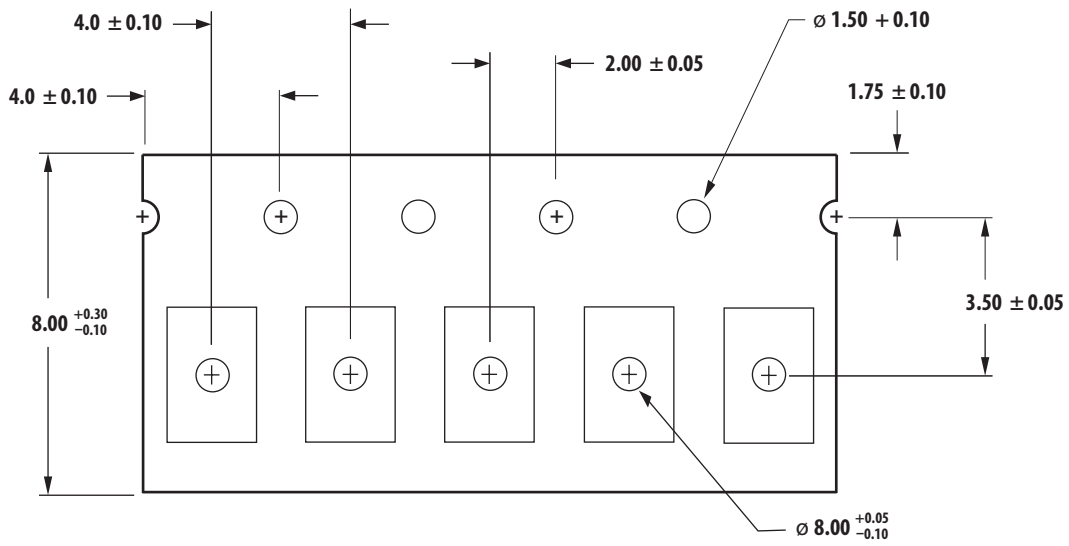


Figure 31. SMD Tape Packing

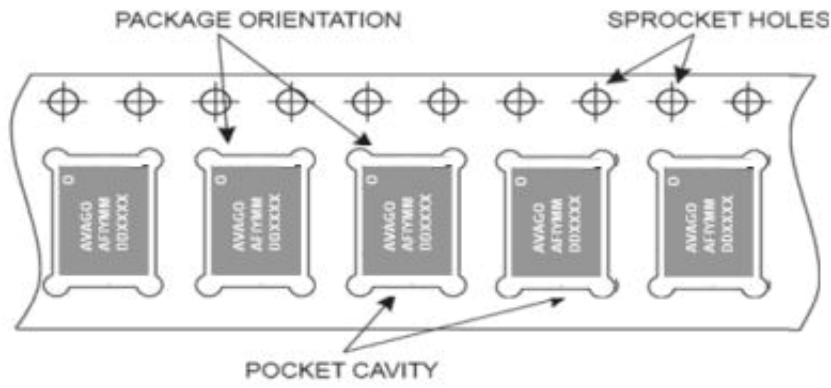
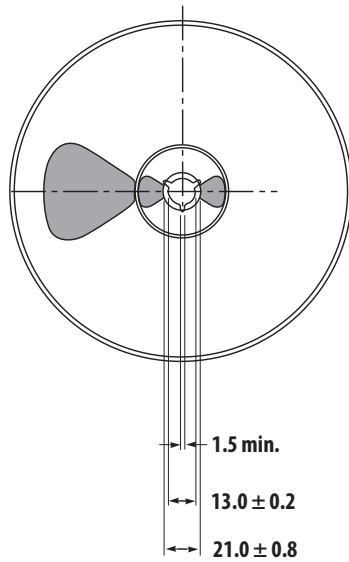


Figure 32. Unit Orientation in SMT Tape

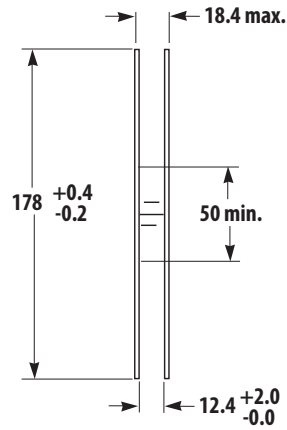
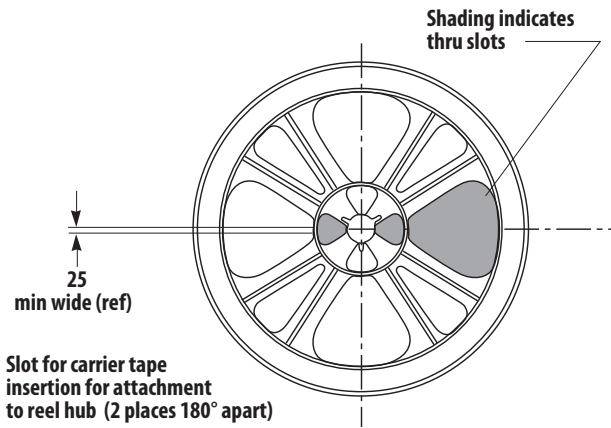
**FRONT VIEW**



**NOTES:**

1. Reel shall be labeled with the following information (as a minimum).
  - a. manufacturers name or symbol
  - b. Avago Technologies part number
  - c. purchase order number
  - d. date code
  - e. quantity of units
2. A certificate of compliance (c of c) shall be issued and accompany each shipment of product.
3. Reel must not be made with or contain ozone depleting materials.
4. All dimensions in millimeters (mm)

**BACK VIEW**



**Figure 33. SMT Reel Drawing**

## Package Moisture Sensitivity

Feature	Test Method	Performance
Moisture Sensitivity Level (MSL) at 260°C	JESD22-A113D	Level 3

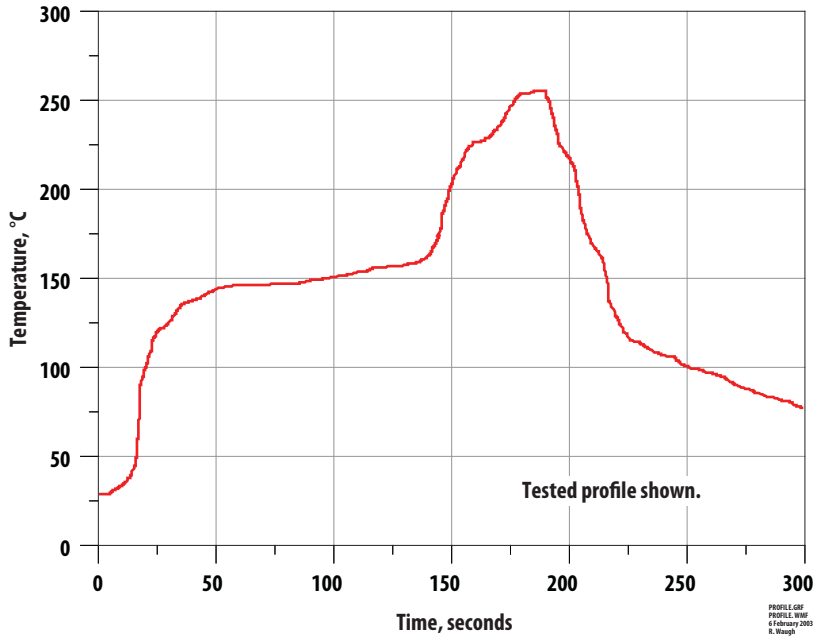


Figure 34. Verified SMT Solder Profile.

## Ordering Information

Part Number	No. of Devices	Container
ACMD-7609-BLK	100	Anti-static Bag
ACMD-7609-TR1	3000	7-inch Reel

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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AV02-2302EN - January 27, 2010

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