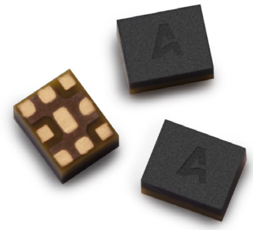
ACMD-6103

Band 3 Duplexer

Data Sheet

Lead (Pb) Free
RoHS 6 fully
compliant



Description

The Avago Technologies ACMD-6103 is a highly miniaturized duplexer designed for use in LTE Band 3 (1710 – 1785 MHz UL, 1805 – 1880 MHz DL) handsets and mobile data terminals.

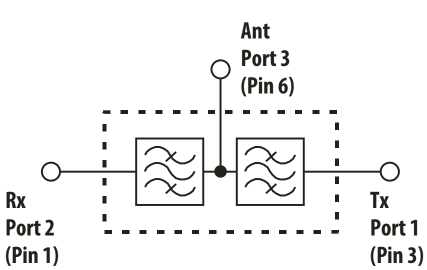
Low Insertion Loss in the Tx channel minimizes current drain from the power amplifier, while low Rx channel Insertion Loss improves receiver sensitivity.

The ACMD-6103 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-6103 is designed with Avago's 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-6103 also utilizes Avago's 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 size of only 1.6 x 2.0 mm and height of 0.9 mm. The ACMD-6103 is compatible with standard 1.6 x 2.0 mm duplexer PCB footprints.

Functional Block Diagram



Features

- Miniature Size
  - 1.6 × 2.0 mm size
  - 0.9 mm height
  - Standard 1.6 × 2.0 mm PCB footprint
- High Isolation
- High Power Rating
  - +33 dBm Abs. Max. Tx Power
  - +31 dBm Abs. Max. Rx Power
- Environmental
  - RoHS Compliant
  - Halogen free
  - TBBPA Free

Specifications

- Rx Band Performance, 1805 – 1880 MHz, – 20 to +85 °C
  - Insertion Loss: 4.0 dB Max.
  - Rx Noise Blocking: 50 dB Min.
- Tx Band Performance , 1710 – 1785 MHz, – 20 to +85 °C
  - Insertion Loss: 3.5 dB Max .
  - Tx Interferer Blocking: 55 dB Min.

Applications

Smartphones, tablets, data terminals, and other mobile/ portable communication devices operating in the LTE Band 3 frequency range.

ACMD-6103 Electrical Specifications [2], Z_0=50 Ω, T_C [1] as indicated.
Ant, Rx Z_0 = 50 Ω, Tx port includes matching to 50 Ω as shown in Figure 1.

Symbol	Parameter	Units	– 20 °C		+25 °C			+85 °C	
			Min.	Max.	Min.	Typ. [3]	Max.	Min.	Max.
	Antenna Port to Receive Port								
S23	Insertion Loss in Receive Band (1805 – 1880 MHz)	dB		4.0		1.4	3.5		4.0
S23	Insertion Loss, Average any 10 MHz channel within Rx Band	dB		3.7		1.5	3.7		3.7
S23	Insertion Loss Flatness any 5 MHz within Rx Band	dB		1.5		0.2	1.5		1.5
S23	Attenuation, 10 – 1710 MHz	dB	30		30	40		30	
S23	Attenuation in Transmit Band [4] (1710 – 1785 MHz)	dB	45		45	65		45	
S23	Attenuation, 1965 – 2400 MHz	dB	25		25	49		25	
S23	Attenuation, ISM Band (2400 – 2484 MHz)	dB	30		30	62		30	
S23	Attenuation, 2484 – 4000 MHz	dB	25		25	67		25	
S22	Return Loss (SWR) of Rx Port in Rx Band (1805 – 1880 MHz)	dB	9	(2.1)	9	18 (1.3)	(2.1)	9	(2.1)
S33	Return Loss (SWR) of Ant Port in Rx Band (1805 – 1880 MHz)	dB	9	(2.1)	9	19 (1.3)	(2.1)	9	(2.1)
	Transmit Port to Antenna Port								
Z_{Tx}	Impedance of Transmit Port	Ω				34 +j0.7			
S31	Insertion Loss in Transmit Band [4] (1710 – 1785 MHz)	dB		3.5		1.4	3.2		3.5
S31	Insertion Loss in Transmit Band [4] [5] (1712.4 – 1782.6 MHz)	dB		3.3		1.4	3.0		3.3
S31	Insertion Loss, Average [4] 10 MHz channels within Tx Band	dB		2.7		1.4	2.7		2.7
S31	Insertion Loss Flatness [4] any 5 MHz within Tx Band	dB		1.5		0.2	1.5		1.5
S31	Insertion Loss Flatness [4] any 10 MHz within Tx Band	dB		2.5		0.3	2.5		2.5
S31	Attenuation, 10 – 1565.4 MHz	dB	30		30	41		30	
S31	Attenuation, Wideband GPS Band (1565.4 – 1573.3 MHz)	dB	38		38	44		38	
S31	Attenuation , in GPS L1 Band (1573.3 – 1577.5 MHz)	dB	38		38	43		38	
S31	Attenuation, Wideband GPS (1577.5 – 1585.4 MHz)	dB	35		35	41		35	
S31	Attenuation, GLONASS (1597.6 – 1605.9 MHz)	dB	35		35	38		35	

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. Tx port includes matching to 50 Ω as shown in Figure 1.
5. Integrated Insertion Loss over any 3.84 MHz channel within the band.

ACMD-6103 Electrical Specifications [2], Z_0=50 Ω, T_C [1] as indicated. ***(continued)***
Ant, Rx Z_0 = 50 Ω, Tx port includes matching to 50 Ω as shown in Figure 1.

			– 20 °C		+25 °C			+85 °C	
Symbol	**Parameter**	**Units**	**Min.**	**Max.**	**Min.**	**Typ. [3]**	**Max.**	**Min.**	**Max.**
S31	Attenuation, 1605.9 – 1680.0 MHz	dB	26		26	36		26	
S31	Attenuation in Receive Band (1805 – 1880 MHz)	dB	45		45	58		45	
S31	Attenuation, Band 1 Rx (2110 – 2170 MHz)	dB	30		30	35		30	
S31	Attenuation, ISM Band (2400 – 2500 MHz)	dB	28		28	30		28	
S31	Attenuation, Band 7 Rx (2620 – 2690 MHz)	dB	28		28	30		28	
S31	Attenuation in Tx 2nd Harmonic Band (3420 – 3570 MHz)	dB	25		25	36		25	
S31	Attenuation in Tx 3rd Harmonic Band (5130 – 5355 MHz)	dB	10		10	33		10	
S31	Attenuation, 5725 – 5850 MHz	dB	10		10	23		10	
S31	Attenuation in Tx 4th Harmonic Band (6840 – 7140 MHz)	dB	10		10	18		10	
S11	Return Loss (SWR) of Tx Port [4] in Tx Band (1710 – 1785 MHz)	dB	12	(1.7)	12	19 (1.3)	(1.7)	12	(1.7)
S33	Return Loss (SWR) of Ant Port [4] in Tx Band (1710 – 1785 MHz)	dB	10	(1.9)	10	22 (1.2)	(1.9)	10	(1.9)
	Isolation, Transmit Port to Receive Port								
S21	Tx-Rx Isolation [5] in Receive Band (1807.4 – 1877.6 MHz)	dB	50		50	61		50	
S21	Tx-Rx Isolation in Transmit Band [4] (1710 – 1785 MHz)	dB	55		55	64		55	

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. Tx port includes matching to 50 Ω as shown in Figure 1.
5. Integrated Insertion Loss over any 3.84 MHz channel within the band.

Applications Information

The performance of the ACMD-6103 duplexer is specified using the simple, 2-element external Tx matching circuit shown in Figure 1.

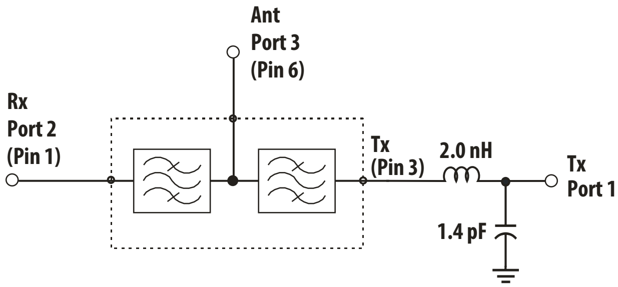


Figure 1. Tx Matching

Tx Port Impedance and Matching

In practice, the Tx port of the ACMD-6103 is normally connected to the output of a power amplifier (PA), which typically has an output impedance lower than 50 Ω.

The ACMD-6103 was designed to have a Tx port impedance of 34+j0.7 Ω, which is near the conjugate of the output impedance of a typical PA. This has the benefit of minimizing the severity of the duplexer-PA interstage match.

Use of a low-pass type of matching circuit has the additional benefit of providing greater Tx rejection at higher frequencies.

Matching Components

The nominal values for L and C shown here were selected to match the ACMD-6103 to 50 Ω. Because every application is different, these values will need to be adjusted to provide the best impedance match for the user's particular PA, circuit board, and performance requirements.

As a general rule, the PA and matching components should be located close to the duplexer. SMT matching components should be of the low tolerance, high Q type suitable for RF applications at this frequency.

Absolute Maximum Ratings [1]

Parameter	Unit	Value
Storage temperature	°C	–65 to +125
Maximum RF Input Power to Tx Port	dBm	+33
Maximum RF Input Power to Rx Port	dBm	+31

Maximum Recommended Operating Conditions [2]

Parameter	Unit	Value
Operating temperature, Tc [3] , Tx Power ≤ 29 dBm, CW	°C	–40 to +100
Operating temperature, Tc [3] , Tx Power ≤ 30 dBm, CW	°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-6103 (Ant, Rx $Z_0 = 50\ \Omega$, Tx port includes matching to $50\ \Omega$ as shown in Figure 1)

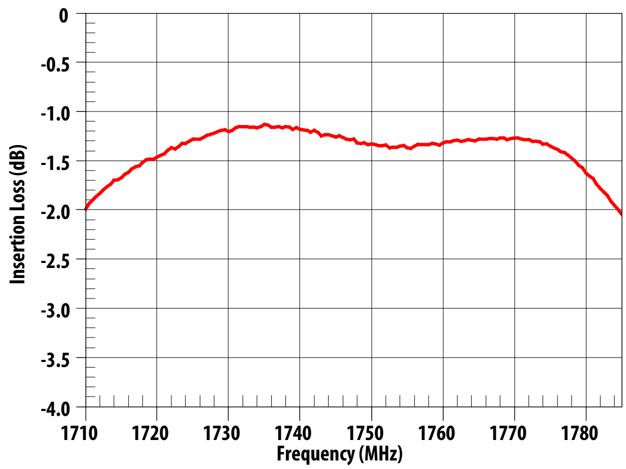


Figure 2. Tx–Ant Insertion Loss

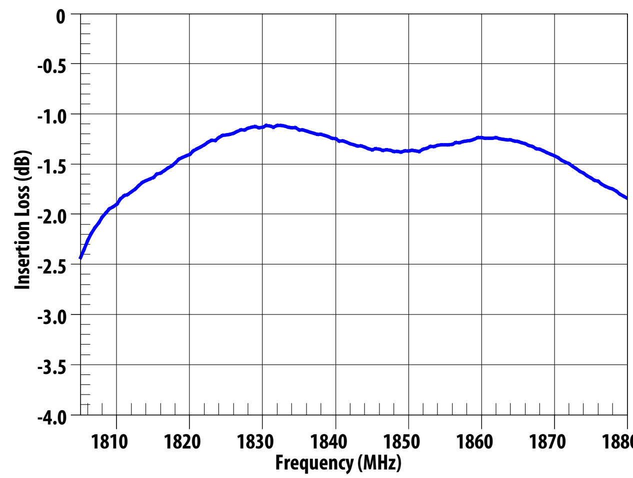


Figure 3. Ant–Rx Insertion Loss

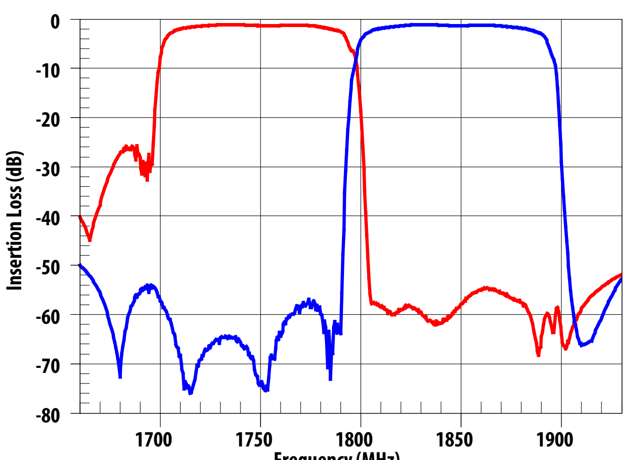


Figure 4. Tx Rejection in Rx Band and Rx Rejection in Tx Band

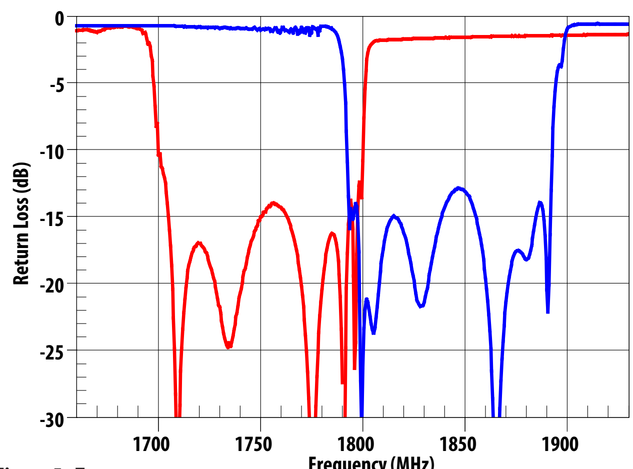


Figure 5. Tx and Rx Port Return Loss

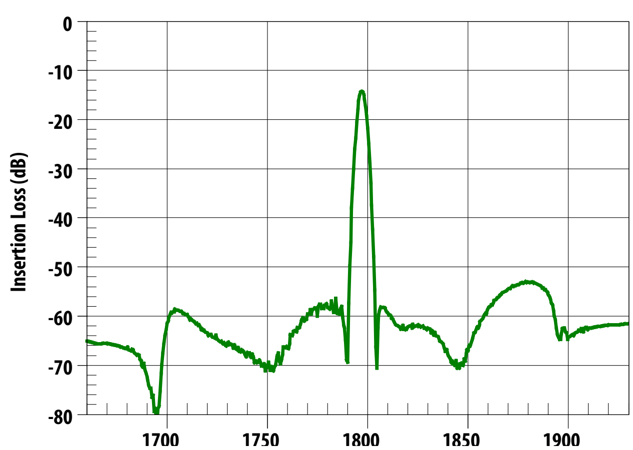


Figure 6. Tx–Rx Isolation

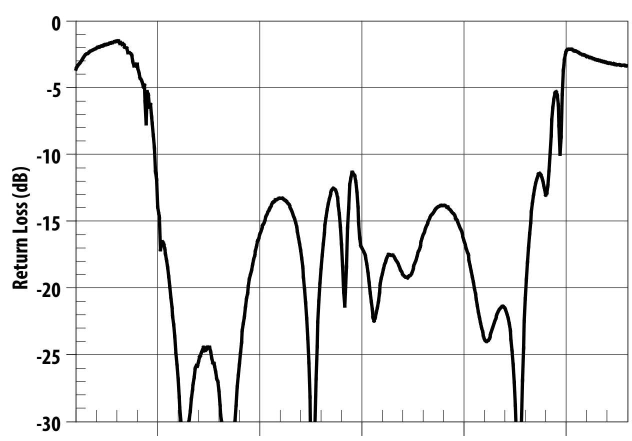


Figure 7. Antenna Port Return Loss

ACMD-6103 (Ant, Rx $Z_0 = 50\ \Omega$, Tx port includes matching to 50 Ω as shown in Figure 1)

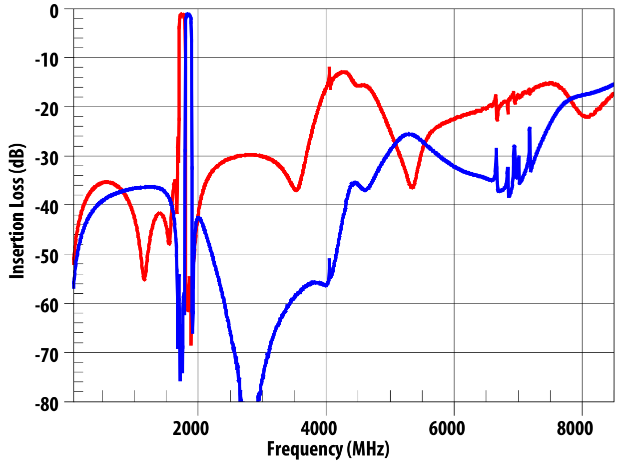


Figure 8. Tx–Ant and Ant–Rx Wideband Insertion Loss

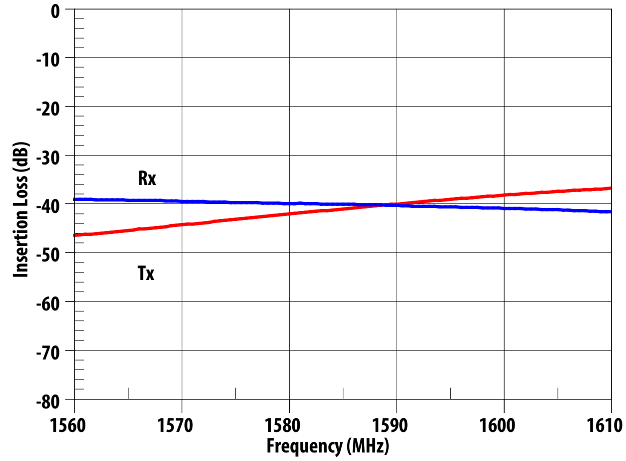


Figure 9. Ant–Tx and Ant–Rx Rejection in GPS/GLONASS Bands

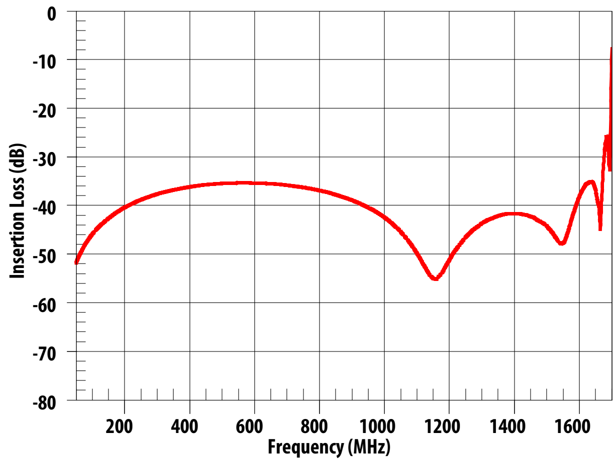


Figure 10. Tx–Ant Low Frequency Rejection, 50 – 1700 MHz

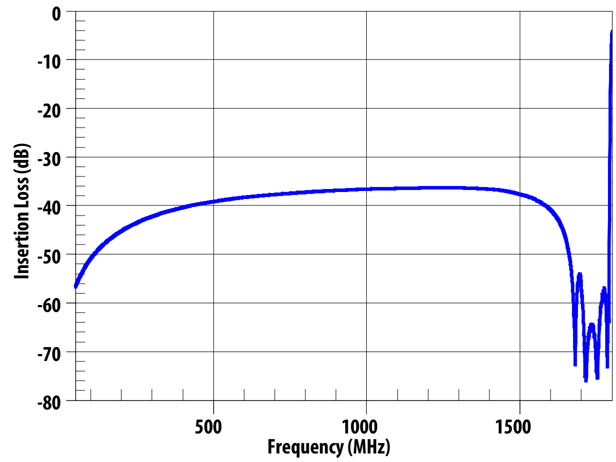


Figure 11. Ant–Rx Low Frequency Rejection, 50 – 1800 MHz

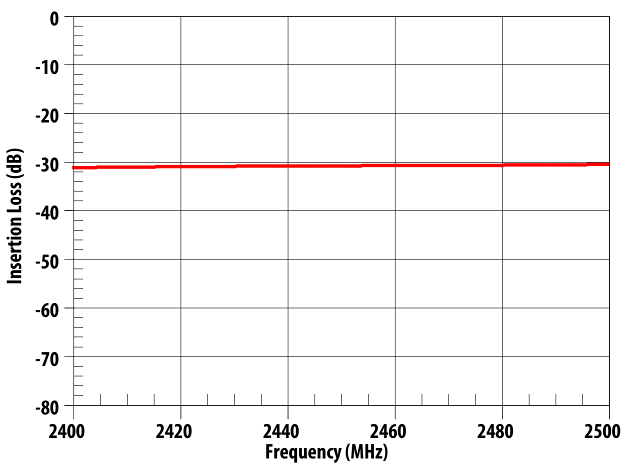


Figure 12. Tx–Ant Rejection, 2.4 GHz ISM Band

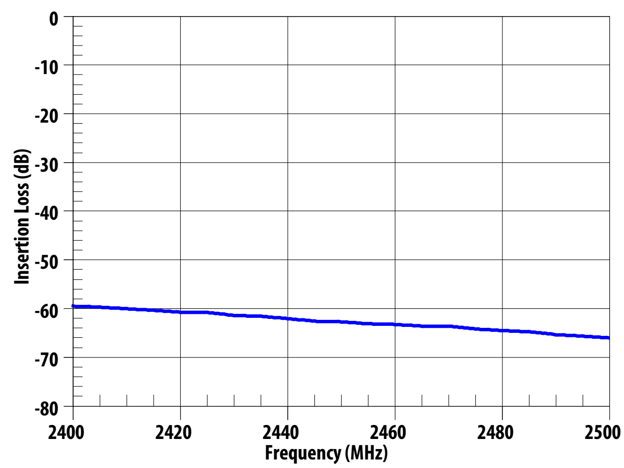


Figure 13. Ant–Rx Rejection, 2.4 GHz ISM Band

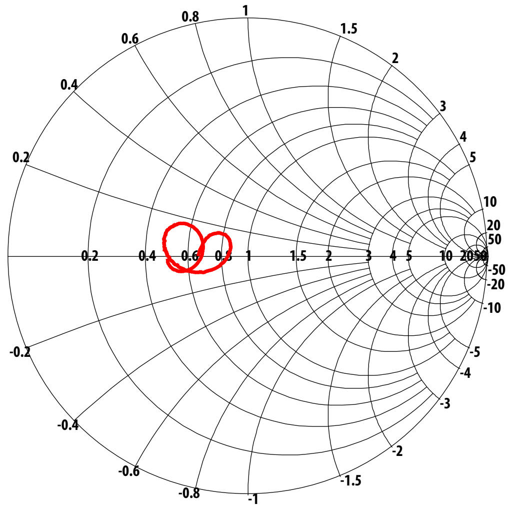


Figure 14. Tx Port Impedance in Tx Band ($Z_0 = 50\ \Omega$, no Tx matching)

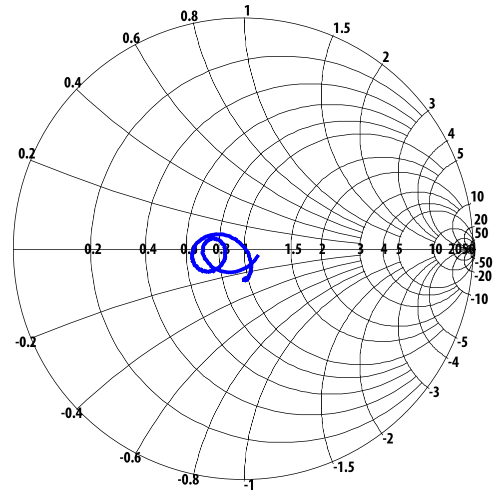


Figure 15. Rx Port Impedance in Rx Band ($Z_0 = 50\ \Omega$)

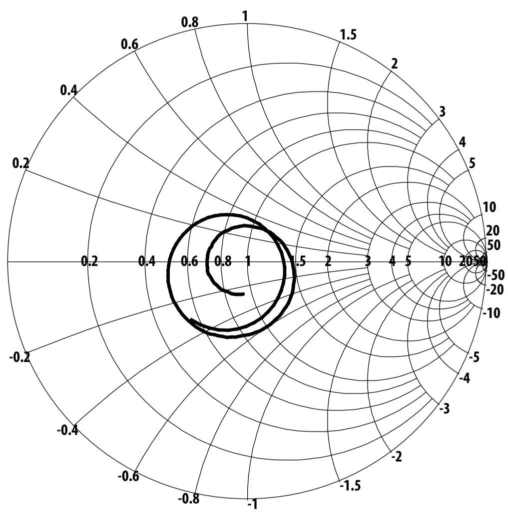


Figure 16. Ant Port Impedance in Tx Band ($Z_0 = 50\ \Omega$, no Tx matching)

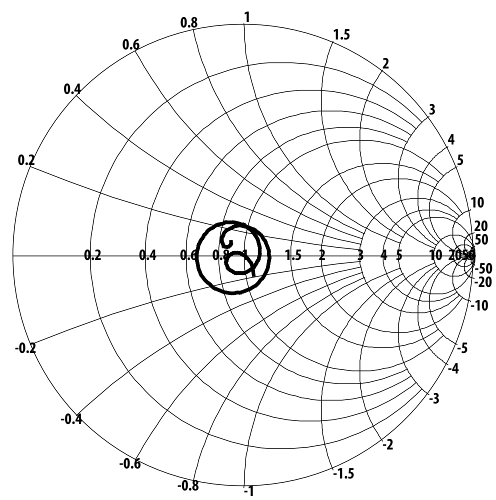
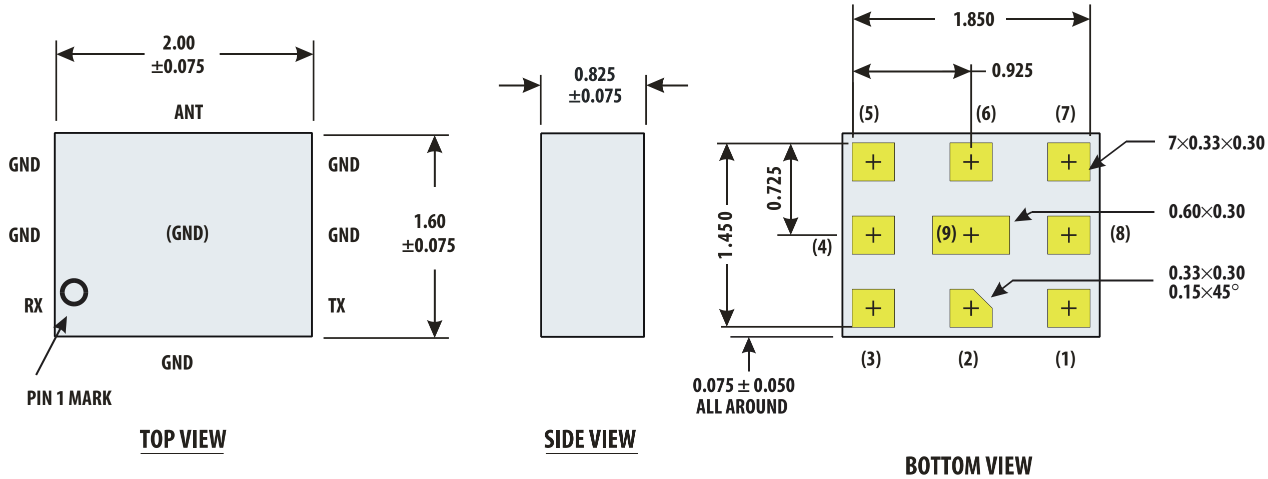


Figure 17. Ant Port Impedance in Rx Band ($Z_0 = 50\ \Omega$)

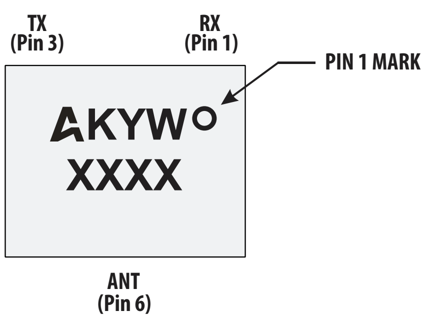


Notes:
1. Dimensions in millimeters
2. Dimensions nominal unless otherwise noted
3. Standard tolerance as below, unless otherwise specified in the drawing:
   X.XX ± 0.05 mm
   X.XXX ± 0.025 mm
4. Contact areas are gold-plated

Pin Connections:

1	Rx
2, 4, 5, 7, 9	Gnd
3	Tx
6	Ant
8	Gnd

Figure 18. Package Outline Drawing



"A"	= Avago Technologies
K	= Product (ACMD-6103)
Y	= Year (last digit)
W	= Work Week
XXXX	= Lot Number

Figure 19. Product Marking and Pin Orientation

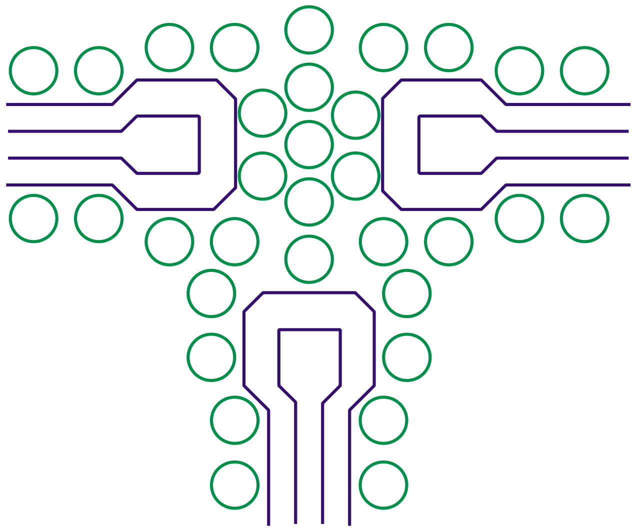


Figure 20. PCB Layout

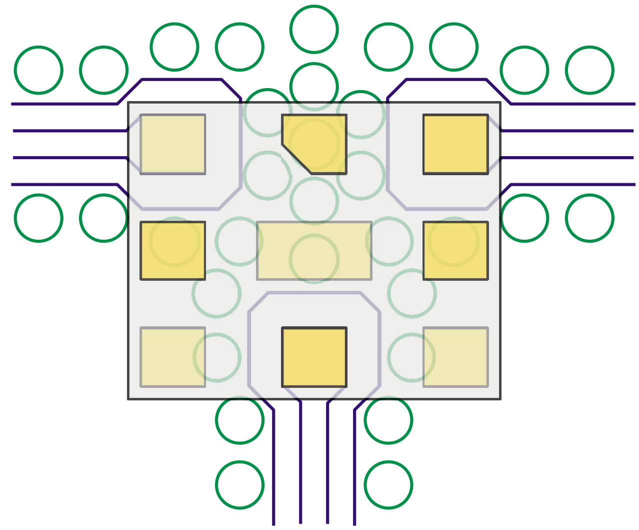


Figure 21. ACMD-6103 Superimposed on PCB Pattern

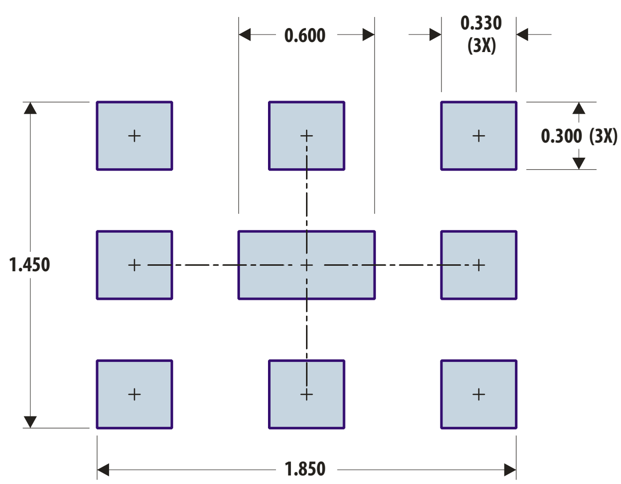
A circuit board layout using the principles illustrated in the figure above is recommended to optimize performance of the ACMD-6103.

You must 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 duplexer mounting area are also needed to provide adequate heat sinking for the device.

The 2nd metal layer under the duplexer is a continuous ground plane.



Notes:
1. Dimensions in mm

Figure 22. PCB Land Print

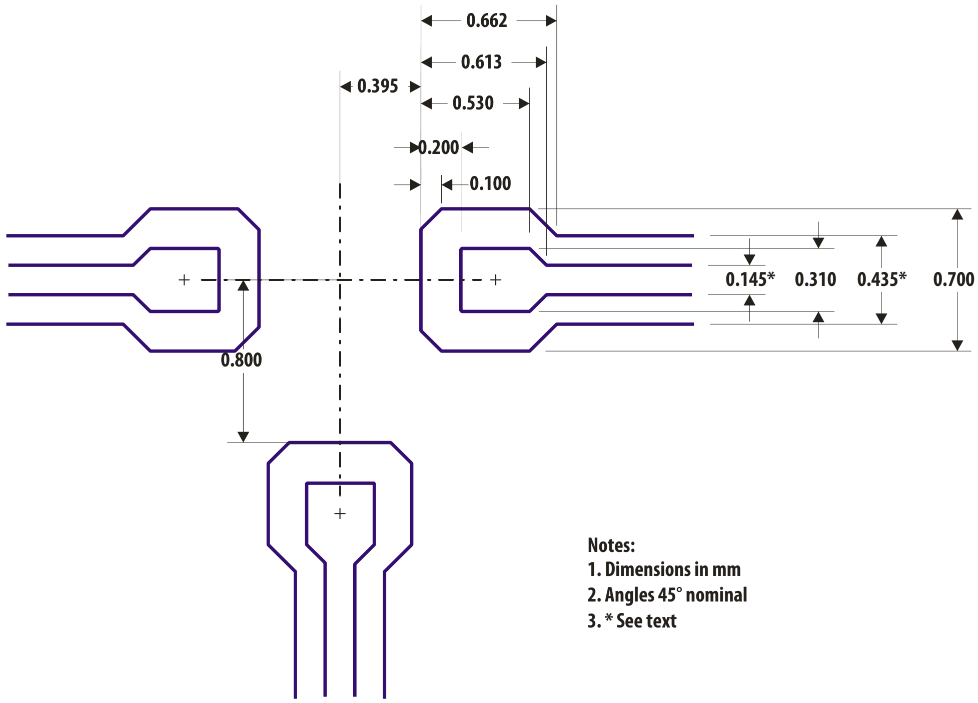


Figure 23. PCB Detail, Metal Dimensions

The transmission line dimensions shown are designed to achieve an impedance of 50 Ω for a 75 µm thick PCB layer with a dielectric constant of 3.4. If other PCB materials or thicknesses are used, the two dimensions indicated with an "*" (line width and spacing) should be adjusted to retain a Z_O of 50 Ω.

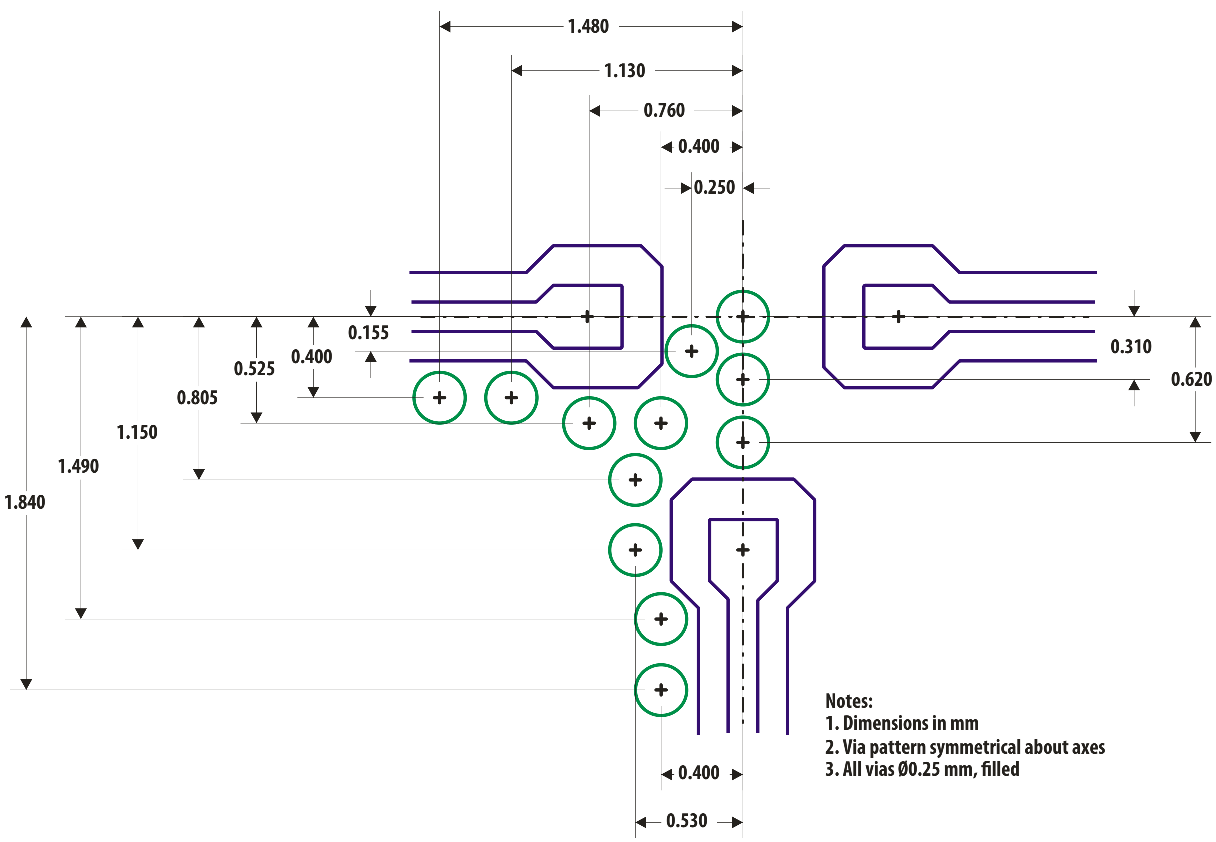


Figure 24. PCB Detail, Via Dimension

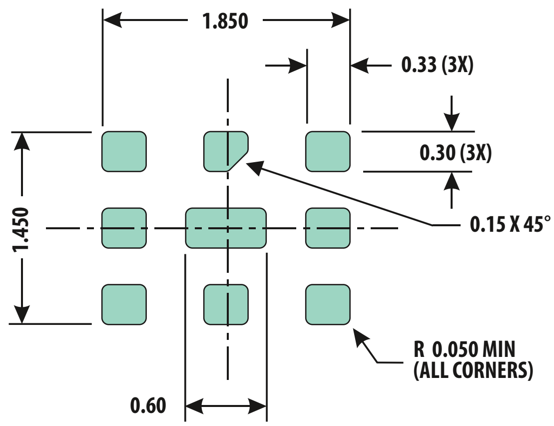


Figure 25. Recommended Solder Stencil, mm (top view)

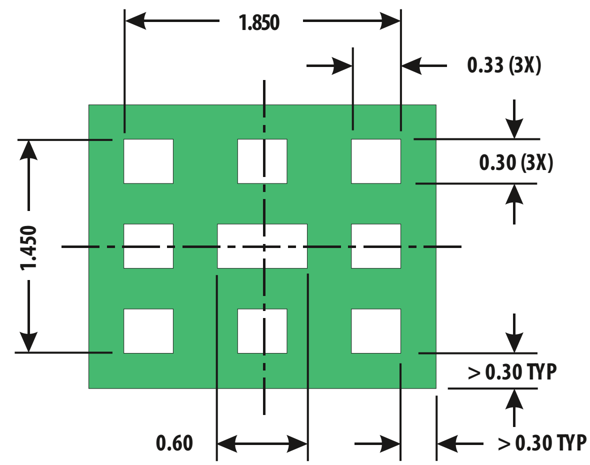


Figure 26. Recommended Solder Mask, mm (top view)

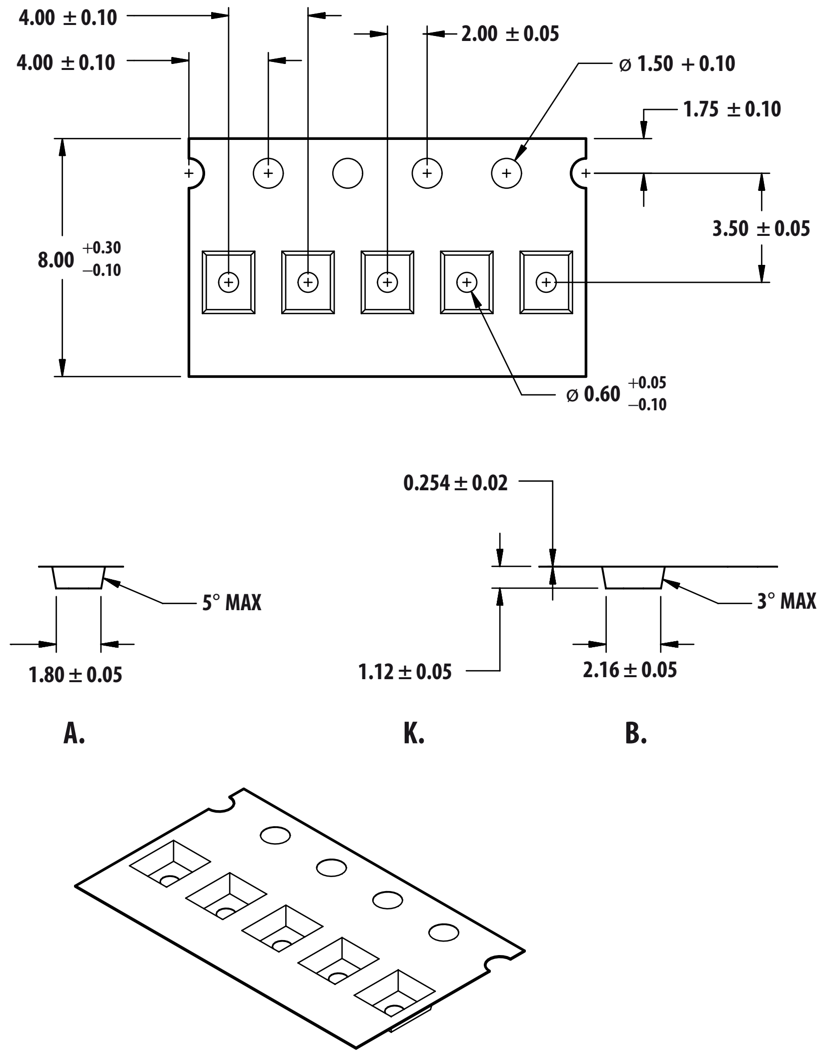


Figure 27. SMD Tape Packing

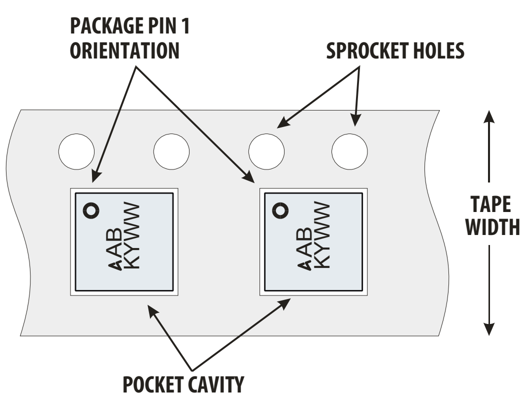
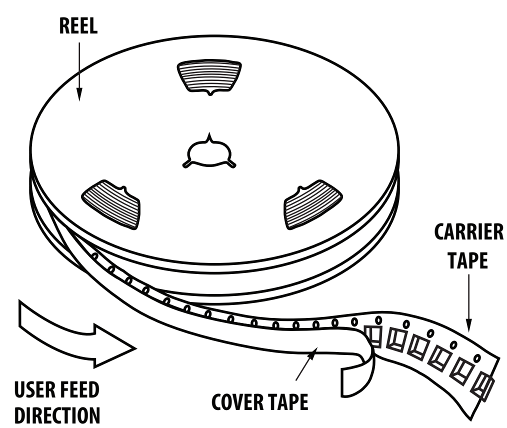


Figure 28. Orientation in Tape



Reel Drawing

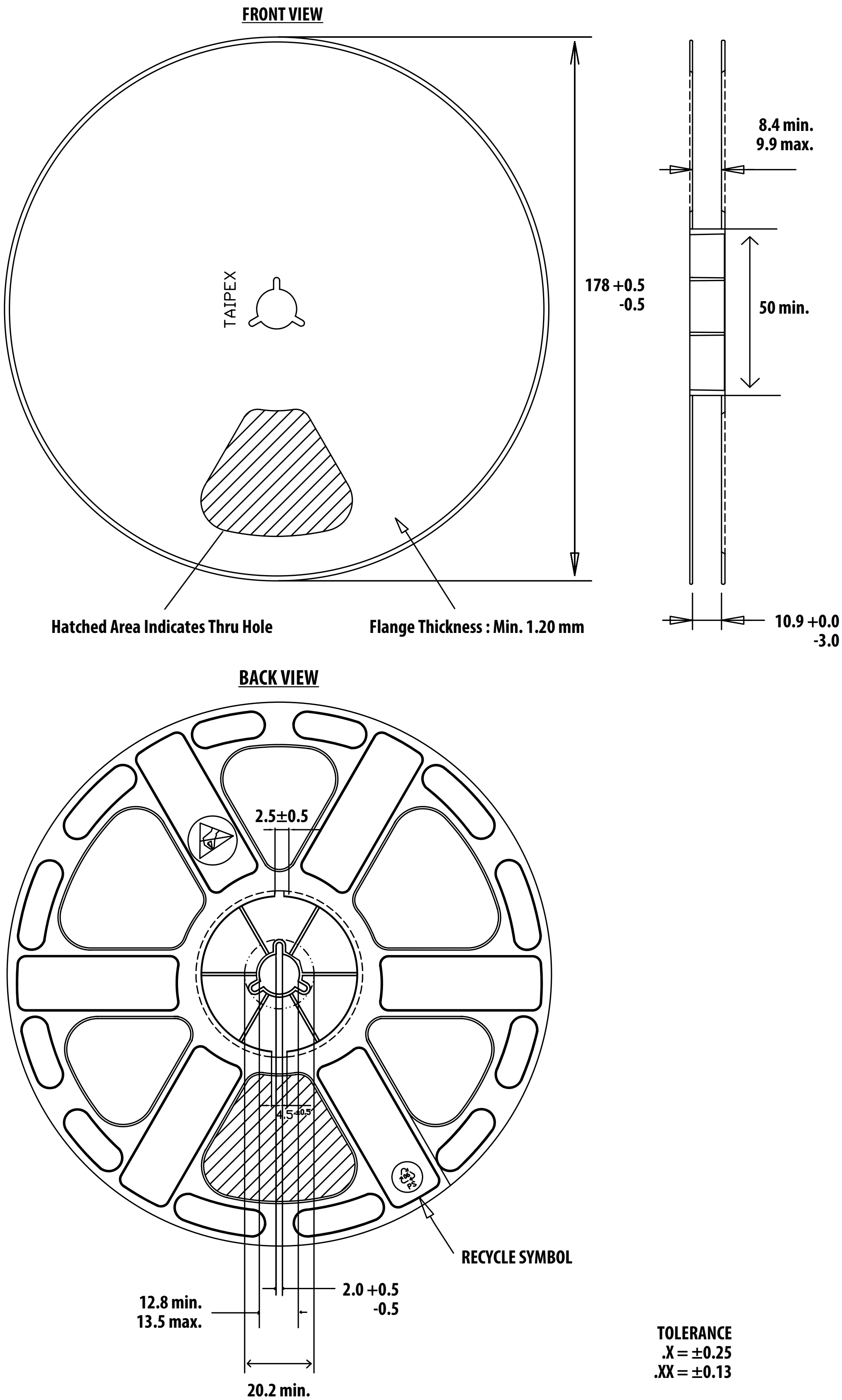


Figure 29. SMT Reel Drawing

Package Moisture Sensitivity

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

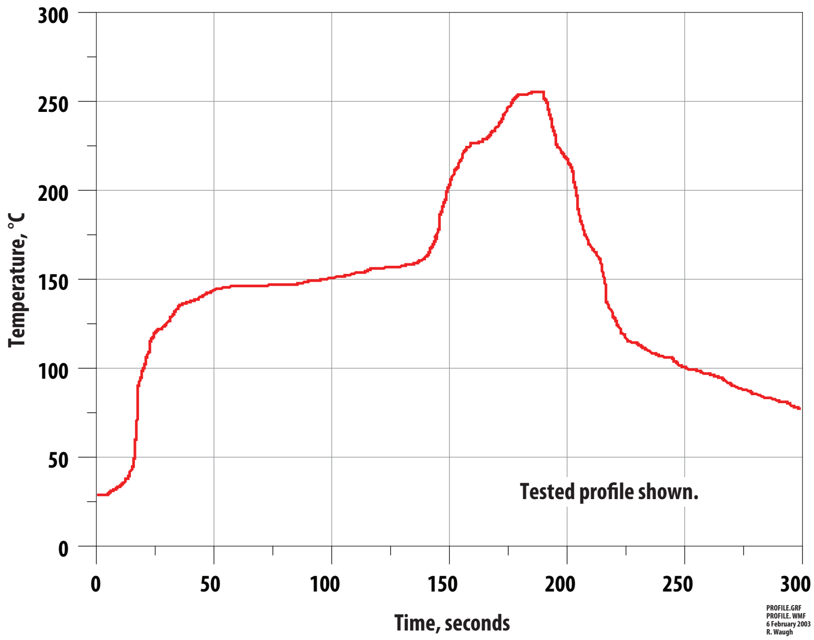


Figure 30. Verified SMT Solder Profile

Ordering Information

Part Number	No. of Devices	Container
ACMD-6103-BLK	100	Tape Strip or Anti-static Bag
ACMD-6103-TR1	3000	178 mm (7-inch) Reel

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

AV02-4217EN - April 28, 2015