



**THE DATASHEET OF  
ALM-12224-BLKG**



# ALM-12224

2.30 GHz – 2.40 GHz

50 Watt High Power SPDT Switch with LNA Module



## Data Sheet

### Description

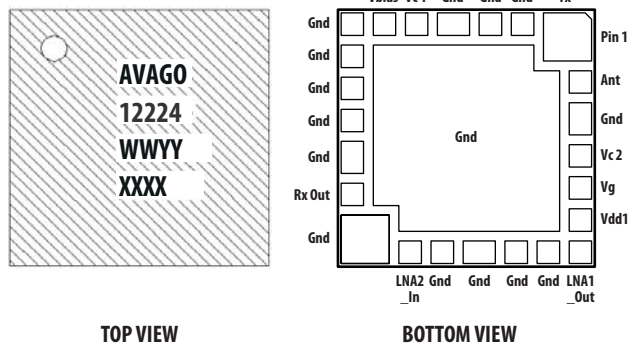
Avago Technologies' ALM-12224 is a multi-chip integrated module that comprise of a 50 Watt CW high power SPDT switch, 1<sup>st</sup> stage low noise amplifier and 2<sup>nd</sup> stage high gain driver amplifier through the use of Avago Technologies' proprietary 0.25um GaAs Enhancement-mode pHEMT process and low distortion silicon PIN diode technologies.

The ALM-12224 is housed in a compact 8.0 x 8.0 x 1.2 mm<sup>3</sup> molded-chips-on-board (MCOB) module package with 24 pin configuration pads, offering significant PCB space saving as compare to conventional discrete design approach.

The device offers high power protection switch (Tx mode operation) with very low insertion loss. During Rx mode operation, the receiver chain provides a very low NF and high gain that makes it an ideal choice for cellular infrastructure in TD-LTE applications.

### Component Image

Package Size : 8.0 x 8.0 x 1.2 mm<sup>3</sup>



Note:  
Package marking provides orientation and identification  
"12224" = Device Part Number  
"WWYY" = Work week and year of manufacture  
"XXXX" = Last 4 digit of lot number

Notes:  
1. Enhancement mode technology employs positive Vgs, thereby eliminating the need of negative gate voltage associated with conventional depletion mode devices.

### Features

- Very Low Noise Figure
- High Power Switch design
- 50 dB isolation between LNA1\_Out and LNA2\_In
- Small package size 8.0 x 8.0 x 1.2 mm<sup>3</sup>
- GaAs E-pHEMT Technology [1]
- Low Distortion Silicon PIN Diode Technology
- MSL 2a and Lead-free

### Specifications

#### Typical Performance at 2.40 GHz (Rx mode)

- 36.8 dB Gain
- 0.99 dB Noise Figure
- 38.5 dBm Output IP3

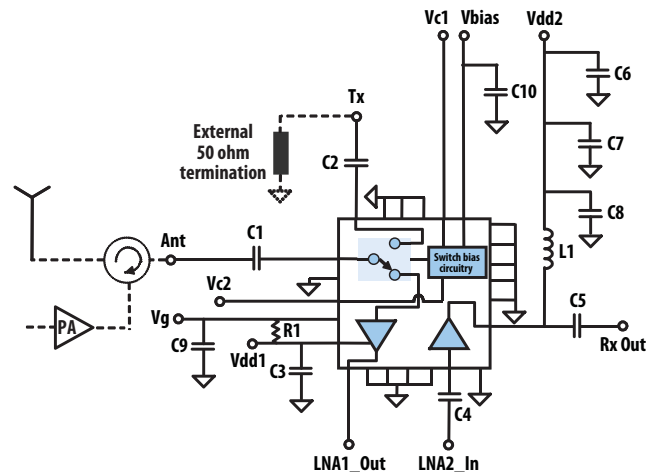
#### Typical Performance at 2.40 GHz (Tx mode)

- 0.40 dB insertion loss

### Applications

- High power switch LNA module for TD-LTE base station front-end RF application.

### Block Diagram with Simplified Schematic



## Absolute Maximum Rating <sup>[1]</sup> T<sub>A</sub> = 25° C

Symbol	Parameter	Units	Absolute Max.
V <sub>c1,max</sub>	Device Control Voltage 1 (At Rx mode)	V	30
I <sub>c1,max</sub>	Device Control Current 1 (At Rx mode)	mA	57
V <sub>c2,max</sub>	Device Control Voltage 2 (At Tx mode)	V	30
I <sub>c2,max</sub>	Device Control Current 1 (At Tx mode)	mA	57
V <sub>bias</sub>	Device Bias Voltage	V	5.5
V <sub>dd1,2</sub>	Device Voltage, RF output to ground	V	5.5
V <sub>g</sub>	Gate Voltage	V	0.7
P <sub>in,max</sub>	Ant CW RF Input Power (Tx mode); 5 mins testing	dBm	+47.5
P <sub>in,max</sub>	Ant CW RF Input Power (Rx mode) (V <sub>dd</sub> = 5.0 V, I <sub>dd1</sub> = 50 mA)	dBm	+20
P <sub>in,max</sub>	LNA2_In CW RF Input Power (V <sub>dd</sub> = 5.0 V, I <sub>dd2</sub> = 120 mA)	dBm	+25
Rx P <sub>diss</sub>	Rx mode Total Power Dissipation <sup>[3]</sup> LNA1	W	0.3
	Rx mode Total Power Dissipation <sup>[3]</sup> LNA2	W	0.5
Tx P <sub>diss</sub>	Tx mode Total Power Dissipation	W	11.2
T <sub>j</sub>	Junction Temperature	°C	150
T <sub>STG</sub>	Storage Temperature	°C	-65 to 150
T <sub>amb</sub>	Ambient Temperature	°C	-40 to 85

### Rx mode Thermal Resistance <sup>[2]</sup>

LNA1: V<sub>dd1</sub> = 5.0 V, I<sub>dd1</sub> = 50 mA  
 LNA2: V<sub>dd2</sub> = 5.0 V, I<sub>dd2</sub> = 120 mA;  
 LNA1 θ<sub>jc</sub> = 74.7°C/W  
 LNA2 θ<sub>jc</sub> = 69.9°C/W

### Tx mode Thermal Resistance <sup>[2]</sup>

LNA1: V<sub>dd1</sub> = 5.0 V, I<sub>dd1</sub> = 50 mA  
 LNA2: V<sub>dd2</sub> = 5.0 V, I<sub>dd2</sub> = 120 mA;  
 θ<sub>jc</sub> = 10.2°C/W

#### Notes:

1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Thermal resistance measured using Infra-Red Measurement Technique.
3. Power dissipation in Rx mode with both LNA1 and LNA2 turned on. Board temperature T<sub>B</sub> is 25° C.  
 LNA1: Derate at 13.5 mW/°C for T<sub>B</sub> > 113° C.  
 LNA2: Derate at 14.3 mW/°C for T<sub>B</sub> > 86° C.
4. Switch Turn On Condition:  
 Tx mode: V<sub>bias</sub> = 5 V, V<sub>c1</sub> = 0 V, V<sub>c2</sub> = 28 V  
 Rx mode: V<sub>bias</sub> = 5 V, V<sub>c1</sub> = 28 V, V<sub>c2</sub> = 0 V

## Rx/Tx Switch Operating Truth Table <sup>[1]</sup>

Mode	V <sub>bias</sub> (V)	V <sub>c1</sub> (V)	V <sub>c2</sub> (V)
Rx (Ant – Rx)	5	28	0
Tx (Ant – Tx)	5	0	28

#### Note:

1. Any state other than described above in the truth table may cause permanent damage to the device.

## Electrical Specifications<sup>[1]</sup>

### Rx Mode

$T_A = 25^\circ\text{C}$ ,  $V_{\text{bias}} = 5\text{ V}$ ,  $V_{\text{c1}} = 28\text{ V}$ ,  $V_{\text{c2}} = 0\text{ V}$ ,  $V_{\text{dd1}} = 5\text{ V}$ ,  $V_{\text{dd2}} = 5\text{ V}$ , RF performance at 2.30 GHz, measured on demo board unless otherwise specified.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I <sub>bias</sub>	V <sub>bias</sub> current	mA	–	51.3	–
I <sub>c1</sub>	V <sub>c1</sub> current	mA	–	0.0	–
I <sub>c2</sub>	V <sub>c2</sub> current	mA	–	-51.0	–
I <sub>dd1</sub>	V <sub>dd1</sub> current	mA	–	55.1	–
I <sub>dd2</sub>	V <sub>dd2</sub> current	mA	–	122.3	–
Total Current	Total max current consumption ( I <sub>bias</sub> + I <sub>dd1</sub> + I <sub>dd2</sub> )	mA	–	228.7	–
NF	Noise Figure	dB	–	0.97	–
Gain	Gain	dB	–	37.1	–
OIP <sub>3</sub> <sup>[2]</sup>	Output Third Order Intercept Point	dBm	–	38.8	–
OP1dB	Output Power at 1 dB Gain Compression	dBm	–	23.4	–
Isolation	Isolation (LNA1_output to LNA2_input)	dB	–	54.5	–
Rx Out RL	LNA2 Output Return Loss	dB	–	18.7	–
Ant RL	Antenna Input Return Loss	dB	–	18.9	–

### Tx Mode

$T_A = 25^\circ\text{C}$ ,  $V_{\text{bias}} = 5\text{ V}$ ,  $V_{\text{c1}} = 0\text{ V}$ ,  $V_{\text{c2}} = 28\text{ V}$ , RF performance at 2.30 GHz, measured on demo board unless otherwise specified.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I <sub>bias</sub>	V <sub>bias</sub> current	mA	–	41.0	–
I <sub>c1</sub>	V <sub>c1</sub> current	mA	–	-51.0	–
I <sub>c2</sub>	V <sub>c2</sub> current	mA	–	10.0	–
Tx Ant IL	Tx Antenna Insertion Loss	dB	–	0.37	–
Max Input Power <sup>[4]</sup>	50 W CW power (5 mins testing) at Antenna port	dBm	–	–	47.5
Ant RL	Antenna Input Return Loss	dB	–	24.0	–

Notes:

1. Measurements at 2.30 GHz obtained using demo board described in Figure 12.
2. OIP<sub>3</sub> test condition:  $F_{\text{RF1}} = 2.30\text{ GHz}$  and  $F_{\text{RF2}} = 2.301\text{ GHz}$  with input power of -25 dBm per tone measured at worst side band.
3. Use proper biasing, heat sink and de-rating to ensure maximum channel temperature is not exceeded.
4. Max Input Power was characterized during the product development stage. It is not final tested at production.

## Electrical Specifications<sup>[1]</sup>

### Rx Mode

$T_A = 25^\circ\text{C}$ ,  $V_{\text{bias}} = 5\text{ V}$ ,  $V_{\text{c1}} = 28\text{ V}$ ,  $V_{\text{c2}} = 0\text{ V}$ ,  $V_{\text{dd1}} = 5\text{ V}$ ,  $V_{\text{dd2}} = 5\text{ V}$ , RF performance at 2.40 GHz, measured on demo board unless otherwise specified.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I <sub>bias</sub>	V <sub>bias</sub> current	mA	42.0	51.3	60.0
I <sub>c2</sub>	V <sub>c2</sub> current	mA	-60.0	-51.0	-42.0
I <sub>dd1</sub>	V <sub>dd1</sub> current	mA	30.0	55.1	60.0
I <sub>dd2</sub>	V <sub>dd2</sub> current	mA	97.0	122.3	130.0
Total Current	Total max current consumption ( I <sub>bias</sub> + I <sub>dd1</sub> + I <sub>dd2</sub> )	mA	-	228.7	250
NF	Noise Figure	dB	-	0.99	1.25
Gain	Gain	dB	35	36.8	-
OIP <sub>3</sub> <sup>[2]</sup>	Output Third Order Intercept Point	dBm	36	38.5	-
OP <sub>1dB</sub>	Output Power at 1 dB Gain Compression	dBm	22	22.7	-
Isolation	Isolation (LNA1_output to LNA2_input)	dB	-	54.2	-
Rx Out RL	LNA2 Output Return Loss	dB	-	20.0	-
Ant RL	Antenna Input Return Loss	dB	-	16.0	-

### Tx Mode

$T_A = 25^\circ\text{C}$ ,  $V_{\text{bias}} = 5\text{ V}$ ,  $V_{\text{c1}} = 0\text{ V}$ ,  $V_{\text{c2}} = 28\text{ V}$ , RF performance at 2.40 GHz, measured on demo board unless otherwise specified.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I <sub>bias</sub>	V <sub>bias</sub> current	mA	32.0	41.0	-
I <sub>c1</sub>	V <sub>c1</sub> current	mA	-	-51.0	-
I <sub>c2</sub>	V <sub>c2</sub> current	mA	-	10.0	-
Tx Ant IL	Tx Antenna Insertion Loss	dB	-	0.40	0.60
Max Input Power <sup>[4]</sup>	50 W CW power (5 mins testing) at Antenna port	dBm	-	-	47.5
Ant RL	Antenna Input Return Loss	dB	-	20.8	-

Notes:

1. Measurements at 2.40 GHz obtained using demo board described in Figure 12.
2. OIP<sub>3</sub> test condition:  $F_{\text{RF1}} = 2.40\text{ GHz}$  and  $F_{\text{RF2}} = 2.401\text{ GHz}$  with input power of -25 dBm per tone measured at worst side band.
3. Use proper biasing, heat sink and de-rating to ensure maximum channel temperature is not exceeded.
4. Max Input Power was characterized during the product development stage. It is not final tested at production.

## ALM-12224 Rx mode Typical Over-Temperature Performance

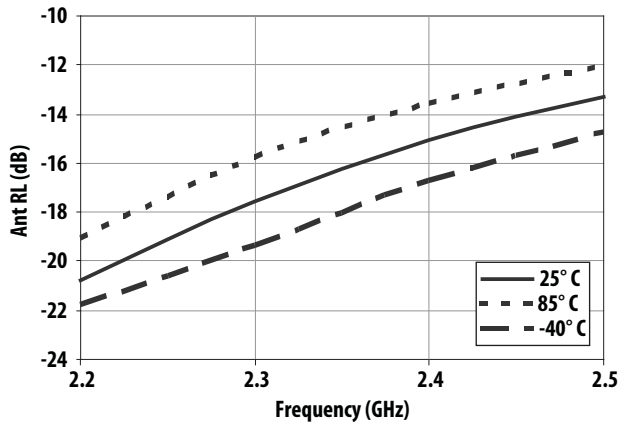


Figure 1. Ant Input Return Loss vs Frequency vs Temperature

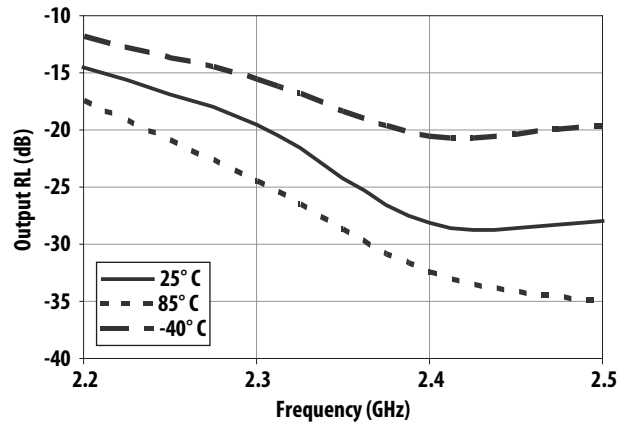


Figure 2. LNA2 Output Return Loss vs Frequency vs Temperature

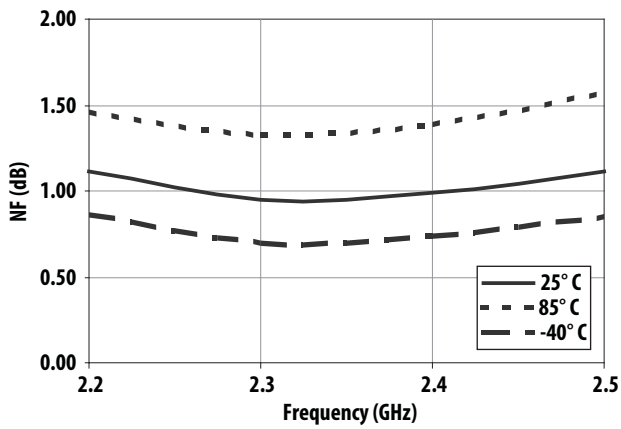


Figure 3. NF vs Frequency vs Temperature

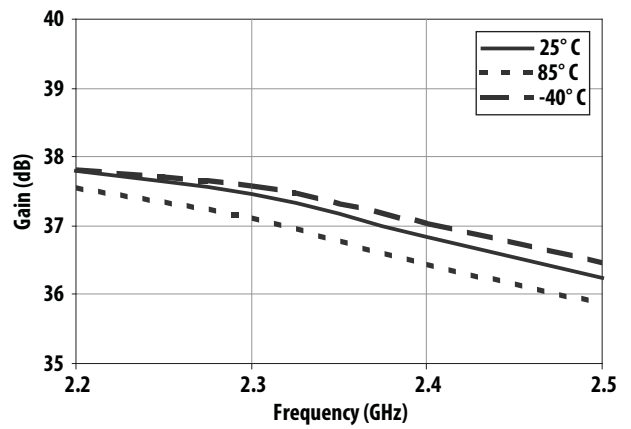


Figure 4. Gain vs Frequency vs Temperature

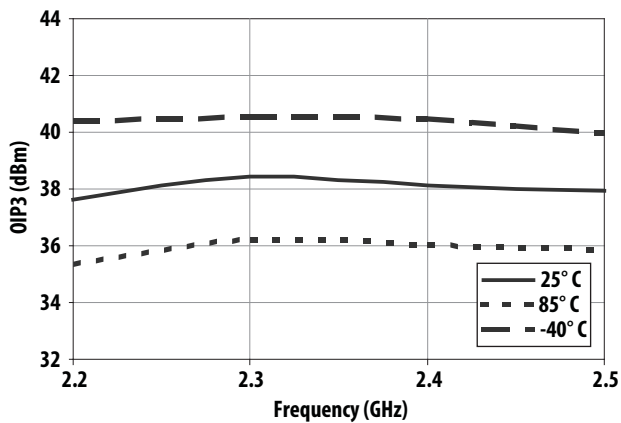


Figure 5. Output IP3 vs Frequency vs Temperature

### ALM-12224 Rx mode Typical Over-Temperature Performance

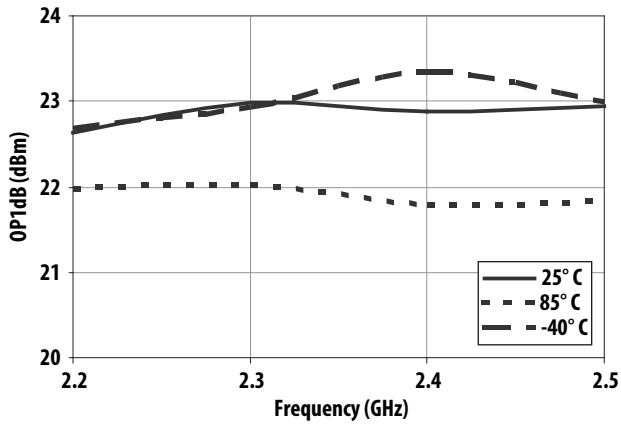


Figure 6. Output P1dB vs Frequency vs Temperature

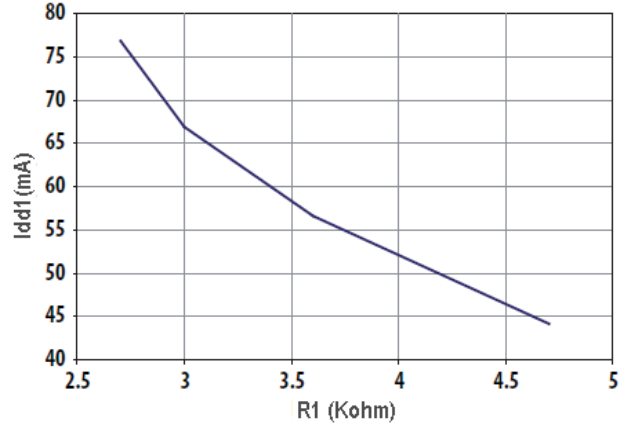


Figure 7. Idd1 Vs R1

### ALM-12224 Tx mode Typical Over-Temperature Performance

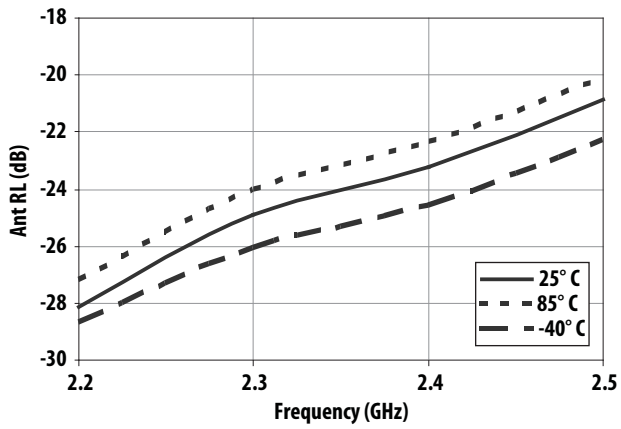


Figure 8. Ant Input Return Loss vs Frequency vs Temperature

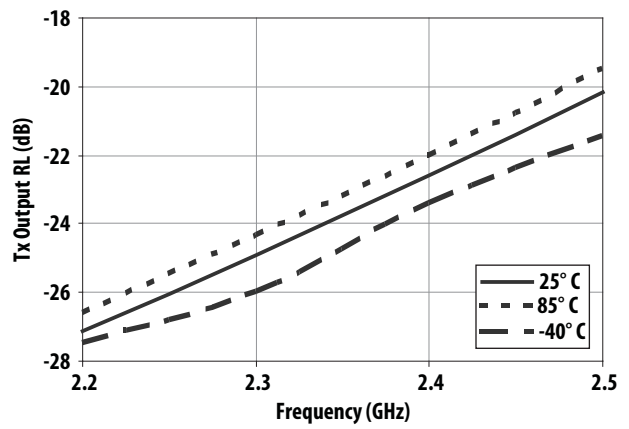


Figure 9. Tx Output Return Loss vs Frequency vs Temperature

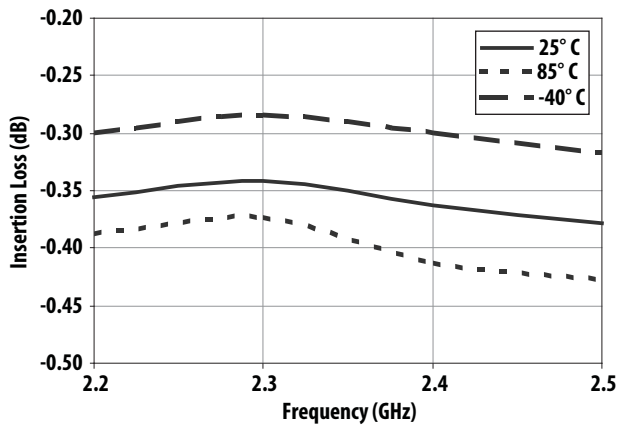


Figure 10. Tx Antenna Insertion Loss vs Frequency vs Temperature

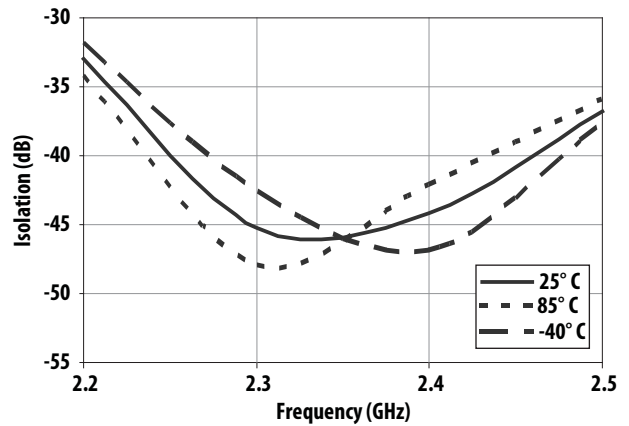


Figure 11. Ant-LNA1\_input Isolation vs Frequency vs Temperature

## ALM-12224 S2p For Rx Mode

(Vbias = 5 V, Vc1 = 28 V, Vc2 = 0 V, Tc = 25° C, matched 50 Ω)

Freq GHz	S11	S11	S12	S12	S13	S13	S21	S21	S22	S22	S23	S23	S31	S31	S32	S32	S33	S33
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
0.1	0.513	-165.0	0.001	-116.4	0.167	51.8	0.003	-127.7	0.823	173.1	0.001	56.6	0.169	53.1	0.001	-97.7	0.800	-43.5
0.3	0.810	-173.4	0.002	60.6	0.071	-5.4	0.048	-139.0	0.796	157.0	0.015	-105.3	0.074	-10.0	0.001	-155.8	0.847	-162.5
0.5	0.726	170.6	0.001	172.0	0.343	76.9	0.478	-106.6	0.754	139.0	0.604	-35.7	0.478	-106.6	0.754	139.0	0.604	-35.7
0.7	0.766	164.4	0.002	-50.5	0.327	47.5	2.933	-141.0	0.652	119.5	3.726	-114.1	0.314	43.7	0.003	41.6	0.611	-179.2
0.9	0.751	154.2	0.002	31.9	0.354	35.3	17.817	114.9	0.402	107.4	18.326	118.6	0.351	37.5	0.001	14.4	0.724	158.1
1.1	0.751	143.2	0.001	30.2	0.438	32.1	6.002	9.5	0.585	139.1	5.709	5.1	0.439	33.5	0.001	178.8	0.757	135.4
1.3	0.674	131.2	0.001	172.1	0.526	18.4	15.020	67.2	0.566	97.1	13.321	56.2	0.525	17.9	0.002	-43.6	0.684	117.2
1.5	0.575	138.2	0.002	-135.7	0.519	5.0	41.162	22.9	0.303	53.6	36.421	0.8	0.510	3.7	0.001	-115.9	0.647	100.3
1.7	0.440	121.0	0.002	137.2	0.567	-19.0	74.154	-55.7	0.129	-171.8	56.274	-84.0	0.542	-19.2	0.002	155.4	0.582	86.8
1.9	0.320	123.8	0.002	124.7	0.481	-42.8	79.263	-121.2	0.313	142.9	49.914	-160.9	0.462	-41.7	0.001	-118.1	0.631	66.5
2.1	0.228	135.6	0.001	73.1	0.312	-70.7	78.771	-173.7	0.267	123.9	32.451	135.1	0.314	-67.2	0.002	-168.1	0.740	33.2
2.3	0.206	173.0	0.002	64.9	0.078	-113.5	74.862	136.0	0.200	129.9	11.153	99.8	0.069	-120.4	0.002	-98.4	0.834	-9.5
2.31	0.207	171.6	0.001	-34.1	0.065	-119.4	74.649	133.8	0.207	128.9	10.359	101.2	0.064	-127.8	0.000	-131.9	0.842	-12.2
2.32	0.212	174.4	0.001	-0.4	0.054	-122.7	74.411	131.3	0.201	127.8	9.752	103.7	0.053	-127.7	0.002	130.5	0.840	-14.6
2.33	0.212	177.4	0.002	124.0	0.045	-128.6	73.878	128.9	0.191	129.2	9.223	106.4	0.051	-154.1	0.002	51.7	0.837	-16.8
2.34	0.225	178.5	0.001	55.5	0.034	-141.1	73.259	126.5	0.195	129.9	8.774	110.0	0.034	-148.9	0.001	-179.4	0.842	-19.4
2.35	0.238	-179.8	0.002	78.4	0.025	-161.2	72.465	124.0	0.200	134.5	8.531	114.3	0.032	164.1	0.001	45.0	0.846	-21.3
2.36	0.227	179.6	0.002	-38.1	0.020	170.2	72.345	121.3	0.189	130.0	8.381	118.2	0.038	148.0	0.002	53.3	0.844	-23.8
2.37	0.237	-178.3	0.001	-21.7	0.020	143.1	71.844	119.5	0.190	132.7	8.471	122.2	0.034	140.7	0.001	142.8	0.849	-26.1
2.38	0.239	-179.4	0.002	-11.9	0.028	114.7	70.973	117.0	0.195	131.2	8.625	126.5	0.048	115.8	0.002	51.0	0.848	-27.9
2.39	0.255	-178.8	0.002	52.8	0.035	103.8	70.812	114.5	0.201	133.8	8.953	129.6	0.048	110.2	0.002	158.2	0.854	-29.9
2.4	0.250	-176.6	0.003	-85.8	0.044	91.1	70.238	112.3	0.191	134.7	9.314	132.0	0.060	88.5	0.002	-70.9	0.852	-31.9
2.45	0.286	-175.7	0.002	50.3	0.089	73.2	67.550	100.8	0.195	139.3	11.897	136.2	0.106	78.3	0.002	131.2	0.840	-42.6
2.5	0.305	-175.2	0.003	32.5	0.133	63.8	64.460	89.5	0.193	139.9	14.780	132.3	0.157	64.4	0.001	82.3	0.831	-52.4
3	0.414	-177.5	0.001	-162.1	0.349	23.0	41.035	-0.4	0.263	142.9	24.498	33.7	0.353	20.2	0.001	1.5	0.735	-112.0
3.5	0.492	174.3	0.001	58.5	0.373	10.3	33.895	-76.6	0.250	123.4	24.948	-49.4	0.340	6.8	0.003	91.4	0.695	-138.3
4	0.446	151.6	0.002	170.4	0.464	12.8	30.915	-174.1	0.163	117.6	26.370	-153.3	0.486	17.1	0.002	175.8	0.598	-167.7
4.5	0.325	155.6	0.003	49.5	0.590	-7.0	13.479	89.8	0.139	56.8	12.798	106.9	0.596	-7.3	0.001	-33.8	0.406	-168.7
5	0.401	153.3	0.003	27.4	0.584	-21.7	6.090	26.1	0.059	-113.1	6.264	38.5	0.591	-21.5	0.002	16.4	0.355	-179.4
5.5	0.440	148.0	0.001	-135.2	0.579	-31.8	3.154	-29.2	0.242	165.6	3.489	-25.1	0.582	-31.5	0.002	43.0	0.326	158.1
6	0.472	137.7	0.003	-87.0	0.579	-41.9	1.765	-79.3	0.379	127.6	2.111	-79.1	0.591	-41.5	0.003	11.5	0.265	143.7
6.5	0.518	132.5	0.002	-124.9	0.593	-51.1	1.208	-127.0	0.485	105.3	1.592	-128.9	0.611	-51.6	0.003	-9.9	0.160	143.8
7	0.579	134.7	0.003	-118.0	0.596	-68.6	0.982	173.3	0.550	97.1	1.536	167.3	0.620	-70.1	0.002	174.8	0.272	-168.6
7.5	0.783	123.9	0.002	164.2	0.326	-84.7	0.455	95.7	0.576	95.2	0.972	77.4	0.312	-88.6	0.002	-155.7	0.675	154.4
8	0.696	130.5	0.003	175.5	0.448	-76.8	0.387	33.0	0.612	94.3	0.606	18.6	0.438	-77.7	0.001	-159.5	0.399	141.6

Note:

1. Port connection: Port 1 = Ant, Port 2 = Rx\_Out and Port 3 = Tx

## ALM-12224 S2p For Tx Mode

(Vbias = 5 V, Vc1 = 0 V, Vc2 = 28 V, Tc = 25° C, matched 50 Ω)

Freq GHz	S11		S12		S13		S21		S22		S23		S31		S32		S33	
	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
0.1	0.298	-167.0	0.002	-108.6	0.705	-7.3	0.002	-39.4	0.826	173.0	0.002	110.5	0.708	-7.2	0.002	-65.1	0.298	-168.4
0.3	0.777	-173.3	0.002	-54.4	0.281	-38.2	0.004	-63.8	0.796	157.2	0.006	-65.4	0.281	-37.9	0.001	-66.4	0.775	-170.0
0.5	0.724	147.8	0.001	18.8	0.447	37.5	0.073	24.6	0.751	139.3	0.065	18.9	0.073	24.6	0.751	139.3	0.065	18.9
0.7	0.612	129.8	0.002	-103.9	0.627	29.4	0.488	-23.8	0.645	120.0	0.410	-30.2	0.620	28.8	0.001	-61.3	0.619	137.9
0.9	0.339	116.3	0.001	99.3	0.835	17.1	4.741	-139.6	0.416	111.6	4.403	-136.7	0.836	16.8	0.002	46.8	0.400	109.9
1.1	0.128	116.0	0.000	-106.8	0.882	-3.1	3.636	100.3	0.595	137.3	3.415	94.7	0.873	-3.1	0.002	-176.6	0.192	135.4
1.3	0.386	-173.4	0.001	-118.0	0.582	-18.0	20.286	107.7	0.615	90.7	19.081	99.4	0.585	-17.6	0.002	53.0	0.440	169.3
1.5	0.331	169.5	0.003	-39.1	0.633	-9.2	48.731	-12.4	0.308	45.9	46.248	-21.5	0.622	-10.7	0.002	-32.9	0.389	155.4
1.7	0.514	136.7	0.003	27.0	0.656	14.7	45.477	-153.0	0.088	-124.1	43.532	-163.7	0.660	16.2	0.002	-0.7	0.537	119.0
1.9	0.298	109.6	0.001	-104.3	0.907	2.0	13.356	111.7	0.340	170.9	13.106	98.3	0.911	1.6	0.001	-16.8	0.284	88.5
2.1	0.131	107.9	0.002	-175.6	0.960	-9.1	3.164	59.3	0.377	138.4	3.246	42.4	0.960	-9.5	0.004	138.8	0.112	72.4
2.3	0.051	176.7	0.000	-121.9	0.976	-17.7	0.299	108.3	0.299	120.8	0.351	59.5	0.971	-17.3	0.001	138.4	0.007	-69.1
2.31	0.053	-176.7	0.002	-142.0	0.970	-17.9	0.318	121.5	0.298	121.2	0.328	71.5	0.973	-17.9	0.002	96.1	0.013	-85.9
2.32	0.056	-174.2	0.002	-90.6	0.969	-18.2	0.358	132.1	0.291	119.6	0.329	83.8	0.972	-18.4	0.001	86.4	0.020	-91.2
2.33	0.057	-168.2	0.001	-175.3	0.974	-18.6	0.405	139.3	0.288	120.1	0.350	93.9	0.971	-18.6	0.002	119.0	0.027	-100.5
2.34	0.060	-166.1	0.003	-160.9	0.971	-18.8	0.457	144.4	0.283	119.1	0.376	102.0	0.974	-18.8	0.001	-138.1	0.034	-104.5
2.35	0.065	-162.2	0.001	154.2	0.972	-19.2	0.509	147.4	0.277	118.8	0.414	107.8	0.973	-19.2	0.002	-122.6	0.040	-104.4
2.36	0.067	-159.5	0.002	-5.0	0.969	-19.8	0.565	149.3	0.276	119.7	0.457	111.7	0.974	-19.8	0.002	-164.1	0.047	-104.9
2.37	0.066	-155.5	0.001	88.9	0.971	-20.1	0.619	150.8	0.270	119.3	0.505	114.5	0.976	-19.8	0.001	15.0	0.052	-102.8
2.38	0.070	-153.9	0.001	166.8	0.968	-20.3	0.666	151.6	0.263	119.3	0.548	116.9	0.965	-20.5	0.002	148.4	0.056	-107.2
2.39	0.073	-149.8	0.002	26.8	0.973	-20.8	0.723	151.5	0.262	118.6	0.598	117.3	0.972	-20.8	0.002	22.0	0.059	-103.3
2.4	0.078	-149.4	0.001	-59.7	0.967	-21.1	0.768	151.4	0.255	119.0	0.640	117.9	0.970	-20.7	0.001	123.7	0.063	-106.5
2.45	0.104	-140.4	0.001	-169.9	0.962	-23.0	0.966	147.7	0.230	119.2	0.825	114.6	0.970	-22.7	0.001	14.9	0.081	-112.7
2.5	0.122	-138.1	0.001	34.7	0.965	-24.4	1.108	142.5	0.210	121.7	0.959	107.6	0.964	-24.4	0.002	173.5	0.110	-116.0
3	0.287	-136.1	0.001	165.5	0.924	-38.0	1.217	109.7	0.251	142.5	0.245	24.1	0.926	-38.3	0.002	-72.4	0.284	-131.0
3.5	0.352	-148.7	0.001	137.9	0.857	-47.4	3.328	72.8	0.189	115.6	2.377	94.8	0.856	-47.7	0.001	112.5	0.348	-148.5
4	0.371	-151.7	0.001	-145.9	0.877	-55.9	5.661	-40.6	0.231	123.7	5.282	-33.9	0.875	-56.4	0.002	47.5	0.370	-148.1
4.5	0.412	-166.1	0.003	65.2	0.857	-66.9	3.592	-129.6	0.156	52.5	3.707	-131.1	0.853	-67.5	0.004	143.4	0.406	-153.1
5	0.457	-178.8	0.003	-145.1	0.800	-77.4	2.304	161.0	0.060	-114.0	2.535	152.6	0.800	-77.2	0.002	-172.4	0.429	-169.5
5.5	0.488	174.8	0.004	164.0	0.752	-87.7	1.515	98.2	0.246	164.5	1.712	81.1	0.749	-88.1	0.002	137.6	0.465	166.1
6	0.536	162.7	0.002	41.7	0.707	-99.6	0.973	43.4	0.378	125.8	1.163	22.3	0.703	-99.7	0.003	70.8	0.490	152.8
6.5	0.628	151.2	0.003	134.0	0.642	-111.3	0.686	-3.3	0.481	104.1	0.919	-28.1	0.635	-111.1	0.005	42.2	0.545	141.3
7	0.726	141.6	0.004	-151.5	0.548	-127.2	0.611	-49.2	0.544	97.0	0.977	-80.3	0.540	-125.4	0.006	6.8	0.697	126.6
7.5	0.844	125.2	0.004	-142.5	0.267	-150.3	0.684	-112.6	0.573	95.0	1.486	-167.1	0.290	-142.3	0.002	32.0	0.787	96.8
8	0.697	125.6	0.003	166.9	0.447	-97.8	0.413	137.7	0.602	93.5	0.669	93.9	0.454	-100.1	0.003	58.9	0.243	90.0

Note:

1. Port connection: Port 1 = Ant, Port 2 = Rx\_Out and Port 3 = Tx

## Demo Board Layout

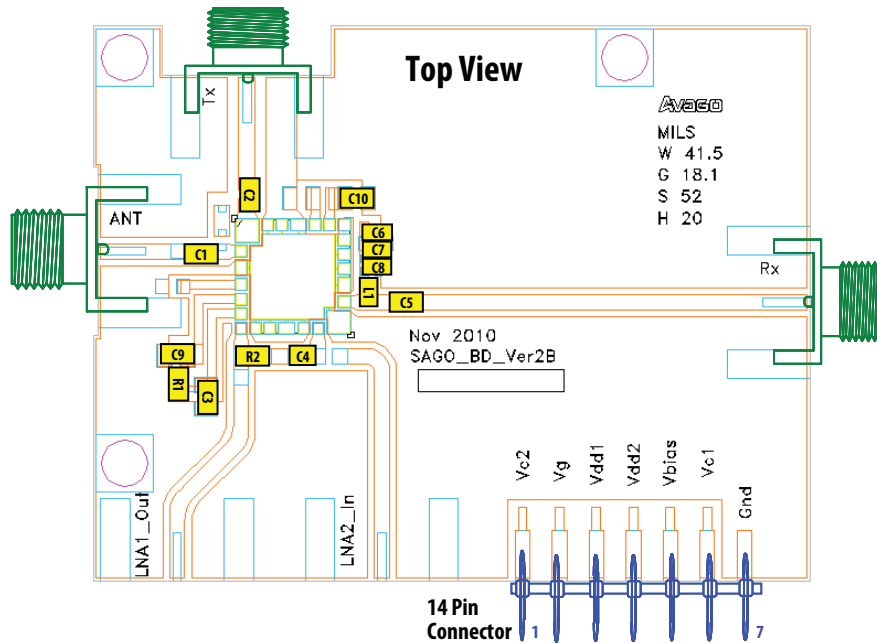


Figure 12. Demo Board Layout Diagram

- Recommended PCB material is 20 mils Rogers RO4350.
- Suggested component values may vary according to layout and PCB material.
- Optional LNA1\_out and LNA2\_In traces are electrically disconnected.

## Simplified Schematic

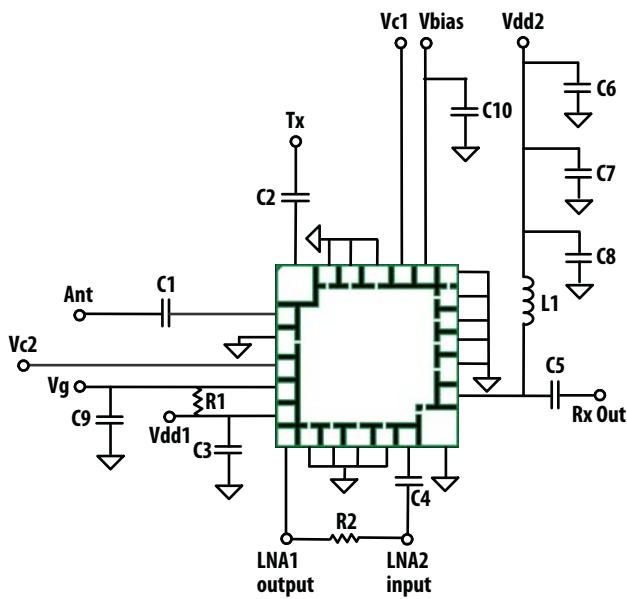
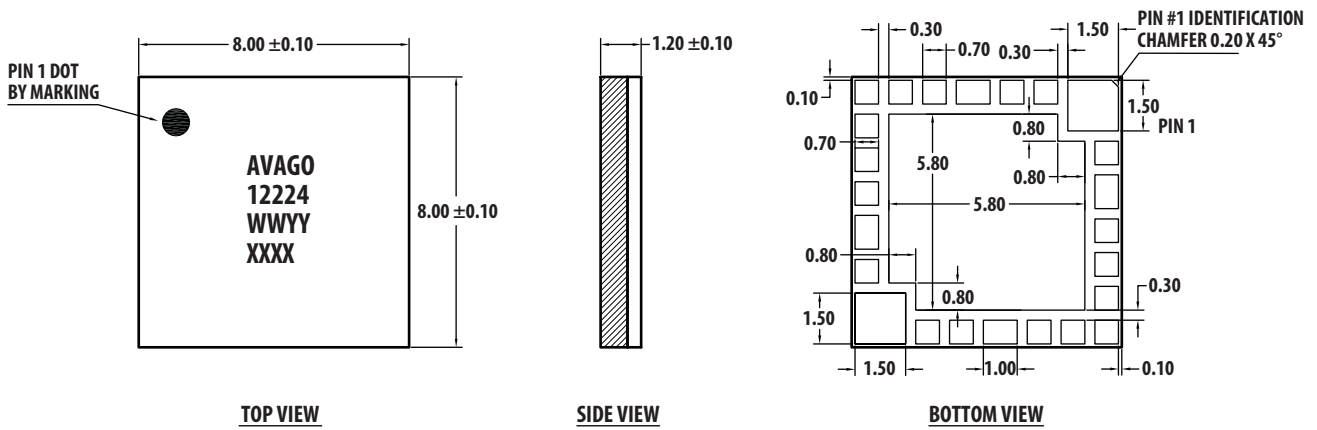


Figure 13. Demo Board Schematic Diagram matching

Table 1. Component list for 2.40 GHz

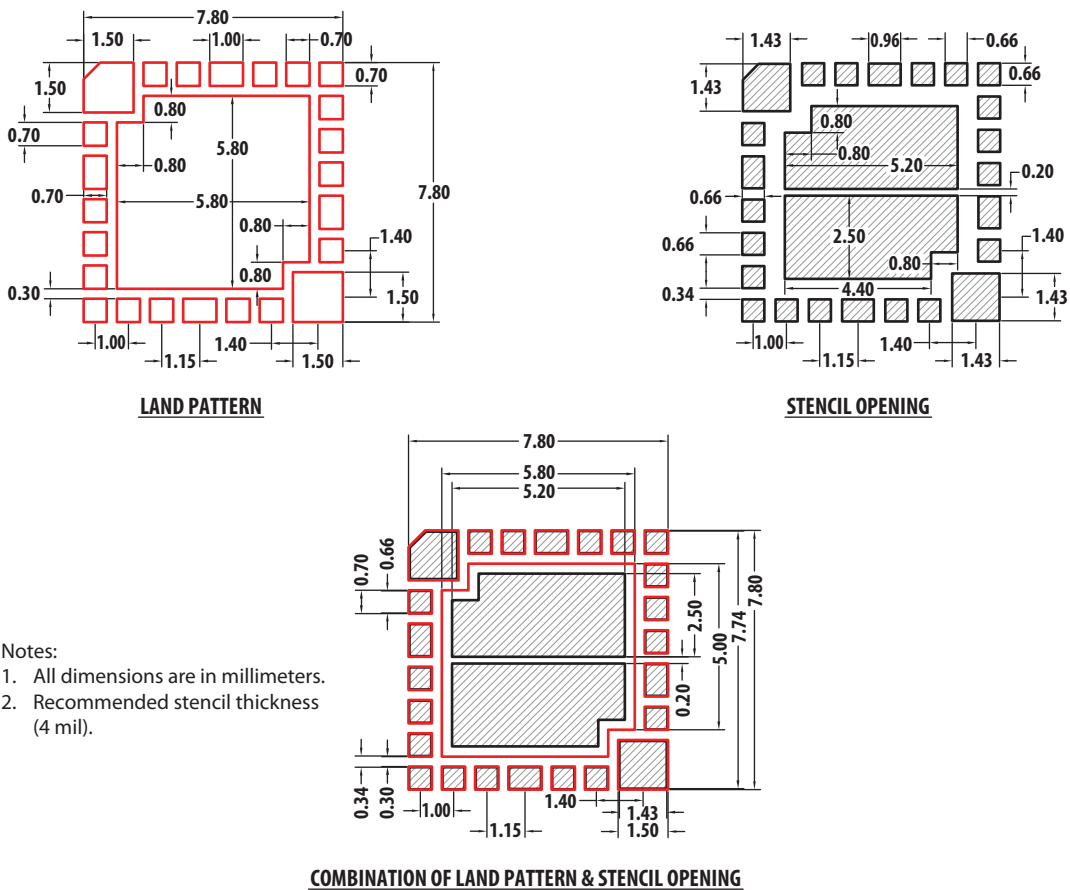
Component	Vendor	Size	Value
C1	Murata	0805	18 pF
C2	Murata	0805	12 pF
C3	Murata	0805	4.7 $\mu$ F
C4	Murata	0402	8.2 pF
C5	Murata	0402	4.7 pF
C6	Murata	0603	2.2 $\mu$ F
C7	Murata	0402	0.1 $\mu$ F
C8	Murata	0402	10 pF
C9	Murata	0805	4.7 $\mu$ F
C10	Murata	0805	4.7 $\mu$ F
R1	KOA	0402	3.6 Kohm
R2	KOA	0402	0 ohm
L1	Murata	0402	27 nH



Notes:

1. All dimensions are in millimeters.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold flash and metal burr.

Figure 14. Package Drawing Dimensions

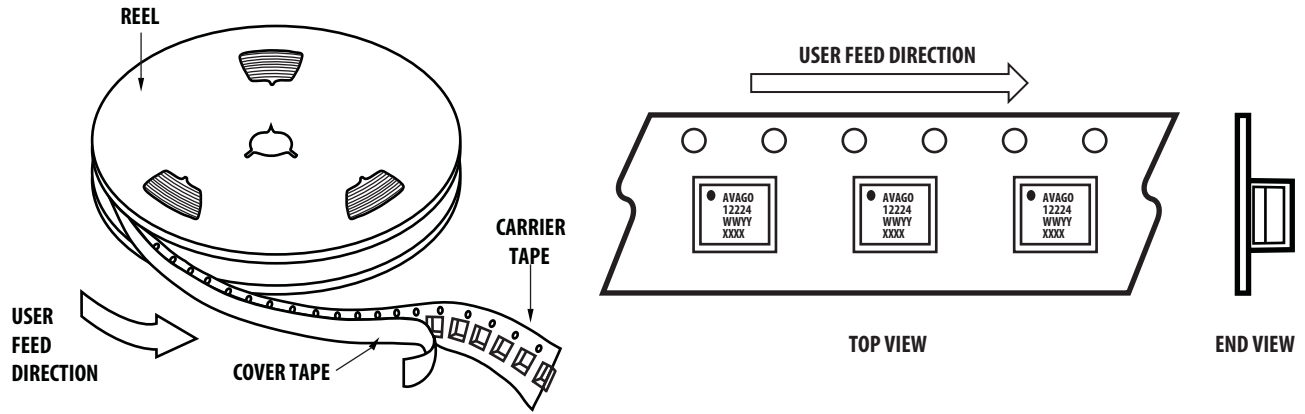


Notes:

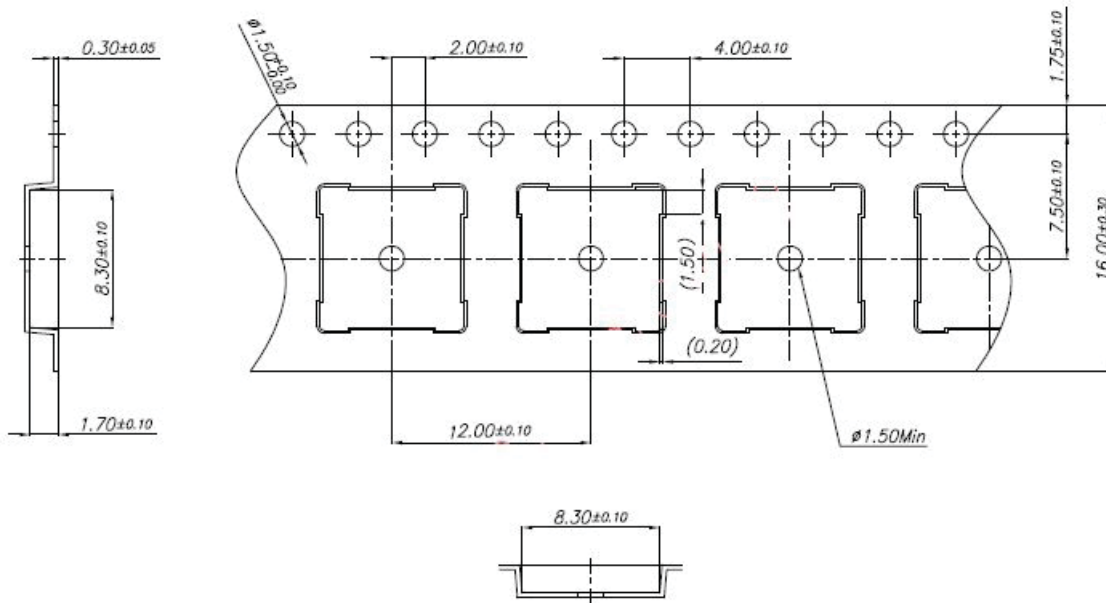
1. All dimensions are in millimeters.
2. Recommended stencil thickness (4 mil).

Figure 15. PC Board and stencil design

## Device Orientation



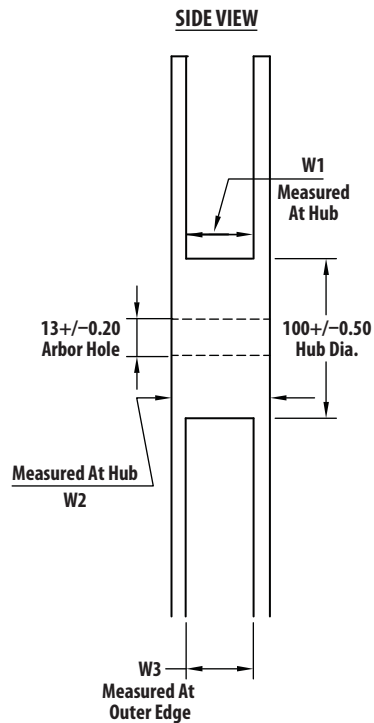
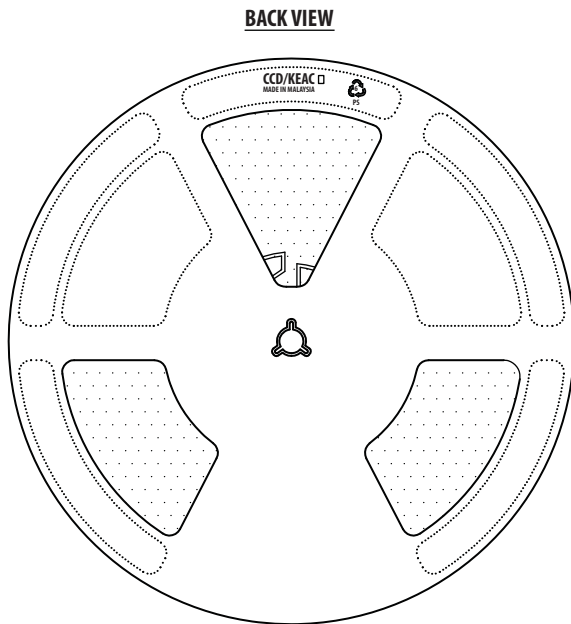
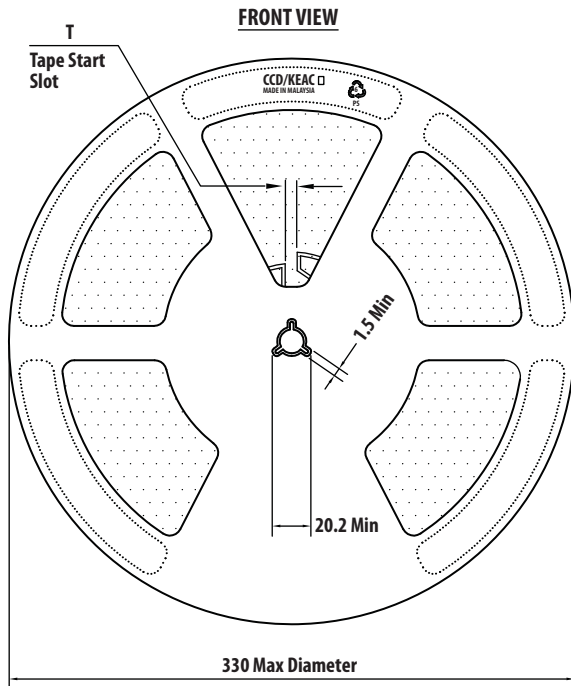
## Tape Dimensions



## Part Number Ordering Information

Part #	Qty	Container
ALM-12224-BLKG	100	Antistatic Bag
ALM-12224-TR1G	1000	13" Reel

# Reel Dimensions - 13" Reel



TAPE WIDTH	T	W1	W2	W3
16 mm	7 ±0.50	16.4 <sup>+2.0</sup> / <sub>-0.0</sub>	22.4 Max	15.9 Min 19.4 Max



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