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# ALM-12124

1.88 GHz – 2.025 GHz

50 Watt High Power SPDT Switch with LNA Module



## Data Sheet

### Description

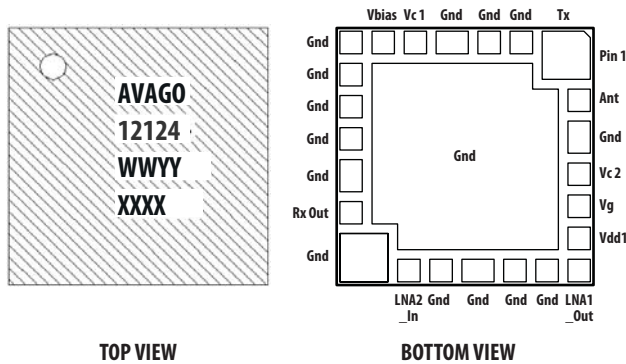
Avago Technologies' ALM-12124 is a multi-chip integrated module that comprise of a 50 Watt CW high power SPDT switch, 1<sup>st</sup> stage low noise amplifier and 2<sup>nd</sup> stage high gain driver amplifier through the use of Avago Technologies' proprietary 0.25  $\mu\text{m}$  GaAs Enhancement-mode pHEMT process and low distortion silicon PIN diode technologies.

The ALM-12124 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 infra-structure in TD-SCDMA and 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  
"12124" = 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 1.90 GHz (Rx mode)

- 39.5 dB Gain
- 0.80 dB Noise Figure
- 36.4 dBm Output IP3

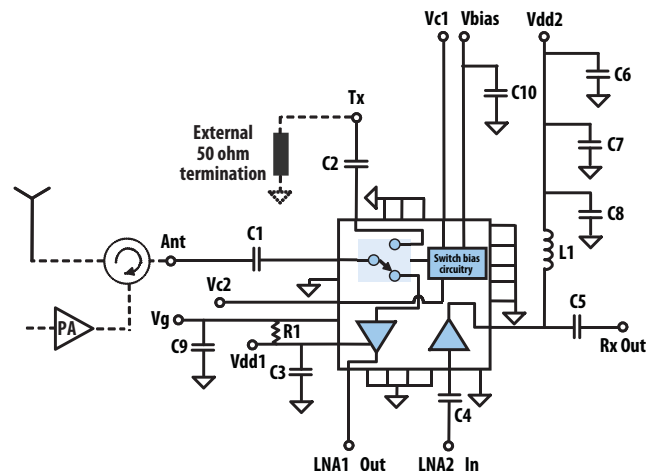
#### Typical Performance at 1.90 GHz (Tx mode)

- 0.27 dB insertion loss
- 40 dB Ant to LNA1 Isolation

### Applications

- High power switch LNA module for TD-SCDMA and 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	8.70
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> = 72.4°C/W  
 LNA2 θ<sub>jc</sub> = 65.0°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> = 11.7°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 14 mW/°C for T<sub>B</sub> > 114° C.  
 LNA2: Derate at 15.6 mW/°C for T<sub>B</sub> > 92° 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 1.90 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	–	121.3	–
Total Current	Total max current consumption ( I <sub>bias</sub> + I <sub>dd1</sub> + I <sub>dd2</sub> )	mA	–	227.7	–
NF	Noise Figure	dB	–	0.80	–
Gain	Gain	dB	–	39.5	–
OIP <sub>3</sub> <sup>[2]</sup>	Output Third Order Intercept Point	dBm	–	36.4	–
OP1dB	Output Power at 1 dB Gain Compression	dBm	–	23.5	–
Isolation	Isolation (LNA1_output to LNA2_input)	dB	–	52.8	–
Rx Out RL	LNA2 Output Return Loss	dB	–	16.1	–
Ant RL	Antenna Input Return Loss	dB	–	20.8	–

### 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 1.90 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	–	0.27	–
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	–	23.6	–

Notes:

1. Measurements at 1.90 GHz obtained using demo board described in Figure 12.
2. OIP<sub>3</sub> test condition:  $F_{\text{RF1}} = 1.90\text{ GHz}$  and  $F_{\text{RF2}} = 1.901\text{ GHz}$  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 2.018 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	-51.2	-42.0
I <sub>dd1</sub>	V <sub>dd1</sub> current	mA	33.0	55.0	60.0
I <sub>dd2</sub>	V <sub>dd2</sub> current	mA	97.0	121.4	130.0
Total Current	Total max current consumption ( I <sub>bias</sub> + I <sub>dd1</sub> + I <sub>dd2</sub> )	mA	-	227.7	250
NF	Noise Figure	dB	-	0.85	1.1
Gain	Gain	dB	35	39.0	-
OIP <sub>3</sub> <sup>[2]</sup>	Output Third Order Intercept Point	dBm	35	36.5	-
OP <sub>1dB</sub>	Output Power at 1 dB Gain Compression	dBm	22	23.5	-
Isolation	Isolation (LNA1_output to LNA2_input)	dB	-	50.2	-
Rx Out RL	LNA2 Output Return Loss	dB	-	17.9	-
Ant RL	Antenna Input Return Loss	dB	-	15.6	-

### 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 2.018 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	-	0.30	0.55
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	-	20.7	-

Notes:

1. Measurements at 2.018 GHz obtained using demo board described in Figure 12.
2. OIP<sub>3</sub> test condition:  $F_{\text{RF1}} = 2.018\text{ GHz}$  and  $F_{\text{RF2}} = 2.019\text{ GHz}$  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-12124 Rx mode Typical Over-Temperature Performance

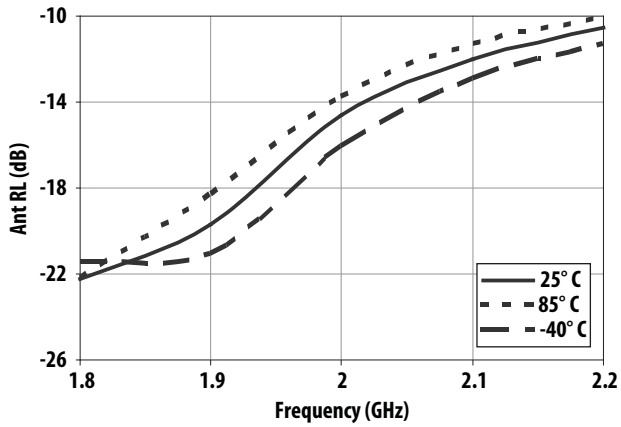


Figure 1. Ant Input Return Loss vs Frequency vs Temperature

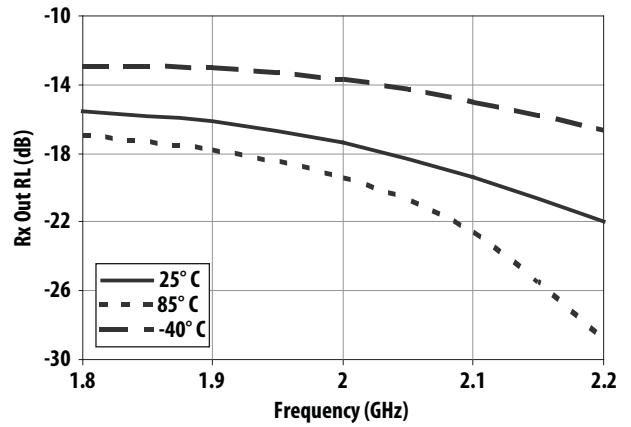


Figure 2. LNA2 Output Return Loss vs Frequency vs Temperature

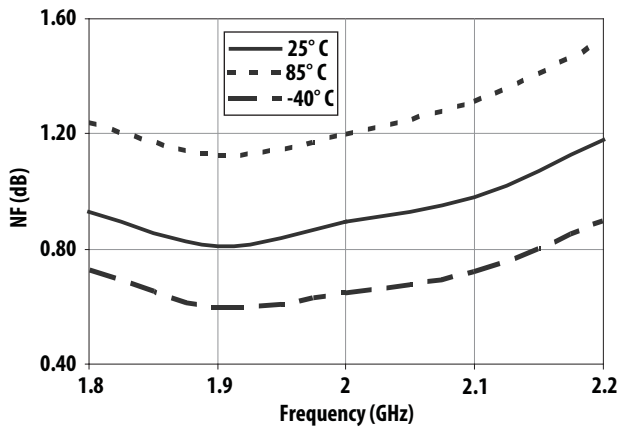


Figure 3. NF vs Frequency vs Temperature

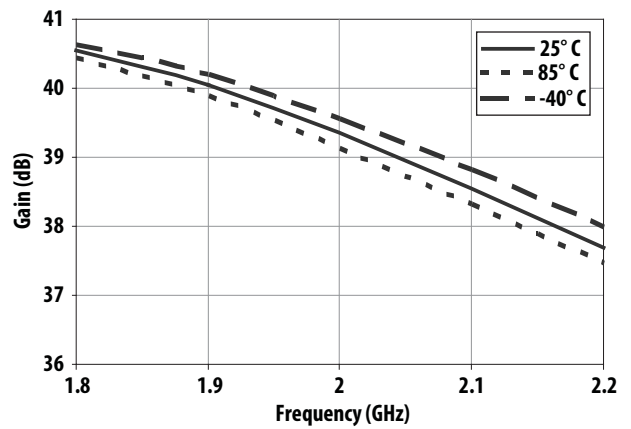


Figure 4. Gain vs Frequency vs Temperature

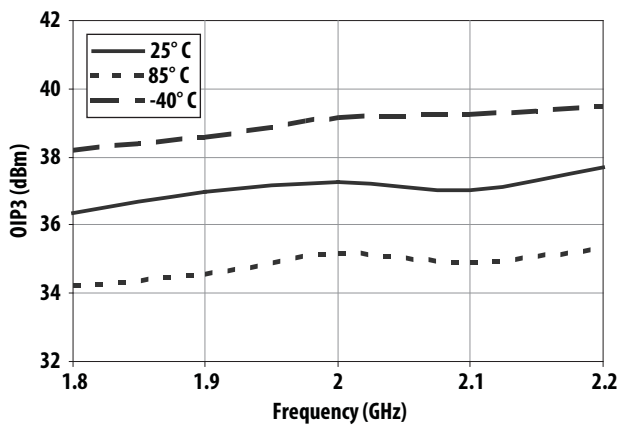


Figure 5. Output IP3 vs Frequency vs Temperature

### ALM-12124 Rx mode Typical Over-Temperature Performance

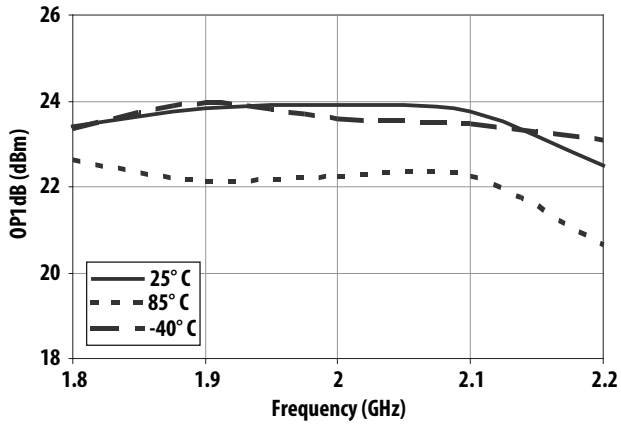


Figure 6. Output P1dB vs Frequency vs Temperature

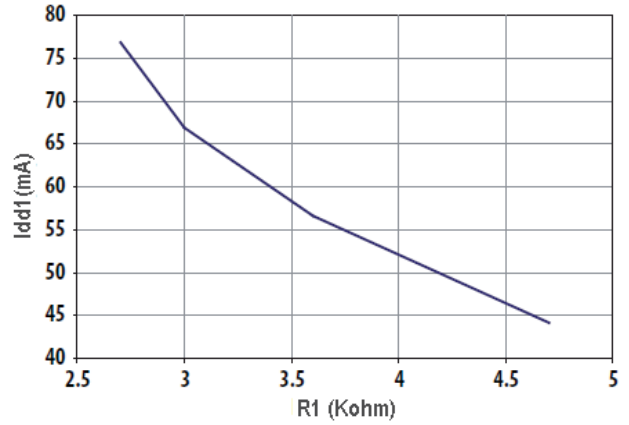


Figure 7. Idd1 Vs R1

### ALM-12124 Tx mode Typical Over-Temperature Performance

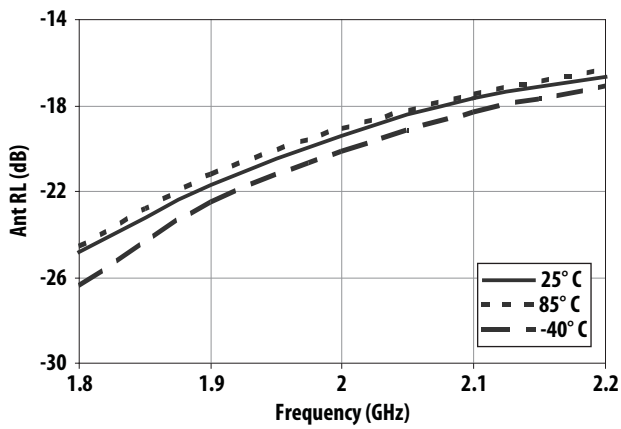


Figure 8. Ant Input Return Loss vs Frequency vs Temperature

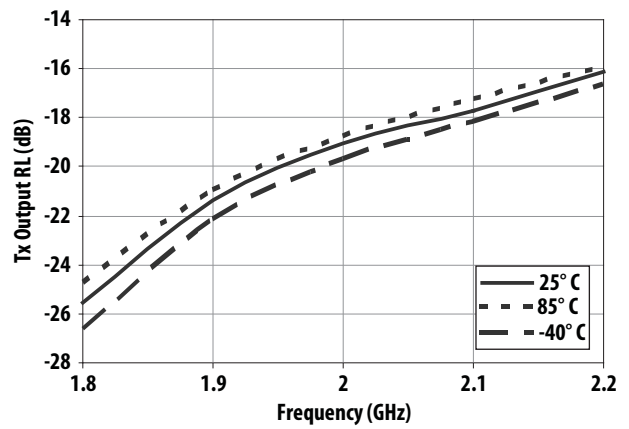


Figure 9. Tx Output Return Loss vs Frequency vs Temperature

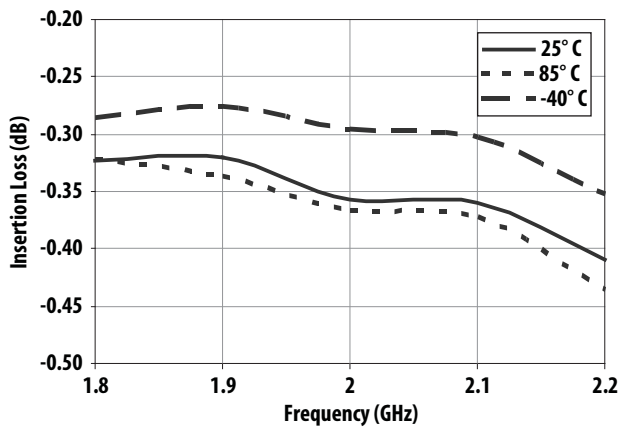


Figure 10. Tx Antenna Insertion Loss vs Frequency vs Temperature

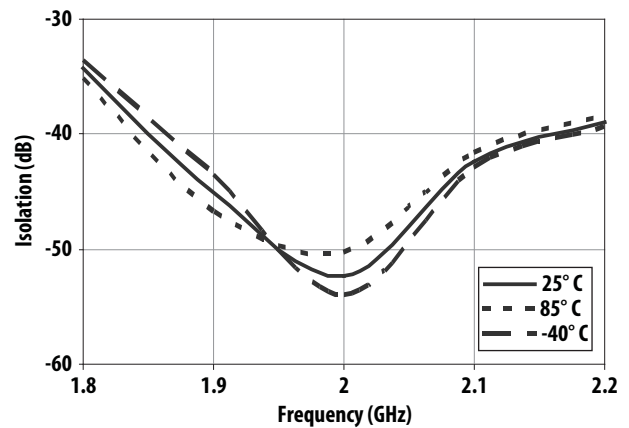


Figure 11. Ant-LNA1\_input Isolation vs Frequency vs Temperature

## ALM-12124 S2p For Rx Mode

(Vbias = 5 V, Vc1 = 28 V, Vc2 = 0 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	0.535	-167.0	0.001	178.2	0.219	45.2	0.003	-146.6	0.811	173.1	0.002	-65.4	0.217	46.4	0.003	-6.7	0.786	-59.8
0.3	0.847	174.7	0.001	94.5	0.042	35.4	0.038	-109.2	0.778	156.9	0.011	-83.8	0.040	33.6	0.001	-159.3	0.813	179.5
0.5	0.698	166.2	0.001	63.4	0.379	29.1	0.865	-105.5	0.737	138.9	0.992	-91.1	0.865	-105.5	0.737	138.9	0.992	-91.1
0.7	0.718	160.3	0.001	22.6	0.318	19.0	5.891	-149.9	0.611	119.3	5.526	-153.3	0.307	18.5	0.002	28.5	0.720	153.5
0.9	0.728	148.5	0.001	-85.5	0.355	18.4	24.446	104.8	0.411	108.5	20.373	91.0	0.359	19.4	0.001	21.2	0.753	126.6
1.1	0.721	142.3	0.001	58.4	0.391	10.5	5.712	51.3	0.602	126.4	4.378	25.4	0.393	11.1	0.001	35.1	0.769	101.4
1.3	0.638	121.9	0.001	86.5	0.464	-8.6	38.177	47.6	0.440	82.8	24.437	10.7	0.457	-9.7	0.002	108.0	0.728	75.0
1.5	0.449	99.9	0.001	-22.7	0.413	-38.0	87.917	-25.2	0.076	81.7	40.689	-74.0	0.403	-37.9	0.001	22.7	0.767	48.9
1.7	0.216	84.5	0.003	139.2	0.193	-69.3	105.95	-102.9	0.244	135.1	23.309	-158.5	0.195	-69.2	0.002	142.1	0.854	15.2
1.85	0.016	131.1	0.001	113.2	0.012	-4.0	100.21	-150.6	0.248	124.1	7.817	-149.6	0.008	-152.9	0.002	-167.8	0.891	-14.0
1.86	0.022	-166.5	0.001	-2.1	0.017	36.6	98.768	-153.0	0.250	124.2	7.897	-143.3	0.009	160.0	0.002	-63.4	0.889	-15.9
1.87	0.031	-167.3	0.001	178.2	0.029	53.2	98.554	-156.6	0.245	123.0	8.159	-139.0	0.025	78.0	0.002	150.3	0.888	-18.3
1.88	0.035	-139.7	0.001	109.4	0.043	56.9	97.859	-159.3	0.248	122.9	8.629	-134.4	0.030	80.6	0.001	-178.9	0.883	-19.8
1.89	0.055	-143.9	0.001	114.8	0.052	59.6	96.911	-162.2	0.244	123.9	9.167	-130.8	0.034	71.2	0.002	81.0	0.885	-21.9
1.9	0.058	-148.4	0.002	-144.7	0.064	62.8	96.086	-165.4	0.251	123.4	9.899	-128.4	0.053	88.0	0.001	-86.4	0.888	-23.5
1.91	0.084	-129.6	0.002	65.7	0.074	59.7	95.692	-167.8	0.229	122.3	10.681	-127.3	0.059	73.4	0.001	85.3	0.886	-25.5
1.92	0.095	-140.1	0.002	-25.3	0.084	63.1	94.874	-170.6	0.239	123.5	11.524	-126.7	0.087	85.3	0.002	-85.6	0.886	-27.0
1.93	0.096	-141.5	0.001	-125.5	0.095	63.1	93.352	-173.2	0.241	121.2	12.288	-126.7	0.093	77.8	0.001	-87.7	0.884	-28.9
1.94	0.121	-138.5	0.002	16.8	0.104	59.8	92.740	-176.1	0.227	122.8	13.247	-127.6	0.106	80.7	0.002	-62.7	0.885	-30.4
1.95	0.123	-136.2	0.001	132.6	0.117	59.9	92.838	-179.0	0.230	116.7	14.198	-128.1	0.122	66.8	0.002	178.7	0.887	-32.1
1.96	0.153	-135.2	0.003	74.2	0.123	57.6	91.324	178.6	0.214	120.5	14.940	-129.6	0.111	74.6	0.002	34.4	0.881	-33.8
1.97	0.148	-139.6	0.000	-11.8	0.133	57.8	90.645	176.0	0.225	117.4	15.821	-131.1	0.129	68.6	0.001	107.3	0.879	-35.4
1.98	0.174	-142.1	0.003	21.2	0.141	55.8	89.502	173.2	0.226	120.8	16.662	-133.2	0.143	66.1	0.001	10.0	0.877	-37.4
1.99	0.181	-142.1	0.002	15.6	0.152	54.7	88.740	171.0	0.225	119.7	17.400	-135.1	0.154	67.0	0.001	16.4	0.872	-39.6
2	0.182	-137.8	0.002	140.9	0.164	53.6	87.638	168.3	0.211	114.7	18.044	-136.7	0.166	61.8	0.001	172.6	0.862	-41.0
2.01	0.194	-142.0	0.001	-11.1	0.169	52.9	86.500	165.6	0.221	116.1	18.722	-139.5	0.170	63.1	0.001	72.7	0.861	-42.8
2.02	0.207	-140.8	0.002	96.4	0.179	51.0	85.623	163.1	0.209	117.7	19.478	-141.9	0.187	61.4	0.001	-73.6	0.858	-45.0
2.03	0.219	-143.3	0.002	-4.4	0.183	51.1	84.850	160.8	0.216	118.7	19.884	-144.2	0.196	60.7	0.002	-62.4	0.849	-46.6
2.1	0.287	-150.0	0.002	25.8	0.228	44.1	79.429	144.2	0.182	117.5	24.352	-160.5	0.235	46.6	0.002	130.4	0.843	-55.8
2.5	0.437	-170.0	0.001	-142.4	0.336	21.3	53.666	63.9	0.186	161.1	30.210	104.4	0.367	19.8	0.001	-146.1	0.741	-99.0
3	0.485	-177.8	0.002	-88.5	0.387	6.6	36.304	-15.5	0.285	141.9	25.802	13.2	0.382	2.5	0.001	162.5	0.705	-126.9
3.5	0.556	172.1	0.002	-105.5	0.354	0.0	30.759	-90.9	0.211	120.8	24.098	-66.5	0.333	-1.3	0.002	142.9	0.701	-147.6
4	0.455	149.4	0.002	-28.1	0.481	7.2	30.133	171.8	0.210	127.0	26.567	-169.0	0.505	11.1	0.002	21.0	0.568	-173.2
4.5	0.379	155.6	0.000	-22.3	0.573	-12.4	12.602	77.5	0.118	71.2	11.984	93.8	0.579	-13.0	0.001	-124.3	0.416	-170.3
5	0.431	150.5	0.001	47.7	0.551	-25.4	5.692	14.1	0.066	-148.6	5.691	27.1	0.558	-25.2	0.002	-100.4	0.360	177.8
5.5	0.468	145.8	0.001	-122.6	0.551	-33.3	2.913	-40.1	0.265	153.3	3.166	-34.6	0.560	-32.8	0.001	20.5	0.351	156.9
6	0.492	136.2	0.002	-142.4	0.567	-42.3	1.688	-89.7	0.397	123.2	1.987	-87.4	0.577	-42.1	0.004	-42.6	0.286	150.5
6.5	0.529	132.1	0.004	-102.3	0.599	-51.6	1.140	-138.7	0.463	103.4	1.528	-137.4	0.617	-52.4	0.004	-130.6	0.156	168.4
7	0.596	133.6	0.004	-125.6	0.612	-69.9	0.897	159.7	0.516	93.7	1.448	155.6	0.631	-72.3	0.003	-68.8	0.313	-152.2
7.5	0.758	129.7	0.002	154.1	0.486	-92.5	0.464	83.5	0.543	88.8	0.979	69.5	0.475	-96.0	0.004	81.7	0.587	179.4
8	0.859	116.5	0.002	-169.5	0.249	-113.4	0.175	46.4	0.569	86.0	0.451	-20.6	0.234	-113.8	0.001	-85.7	0.621	162.3

Note:

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



## ALM-12124 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	0.304	-167.7	0.001	-164.2	0.702	-6.6	0.001	-76.3	0.809	173.0	0.001	104.6	0.704	-6.9	0.002	-35.1	0.308	-166.8
0.3	0.837	173.5	0.002	25.9	0.155	2.6	0.006	-118.3	0.776	156.7	0.006	-113.8	0.155	2.9	0.001	95.0	0.845	177.1
0.5	0.545	127.9	0.002	-26.5	0.702	27.0	0.194	-8.5	0.736	138.9	0.176	-12.8	0.194	-8.5	0.736	138.9	0.176	-12.8
0.7	0.281	122.6	0.003	-156.0	0.825	9.0	2.114	-65.3	0.602	119.4	1.983	-69.7	0.817	8.2	0.001	-112.4	0.304	130.5
0.9	0.350	-149.6	0.001	43.2	0.691	-23.6	23.541	152.3	0.434	113.3	22.139	146.5	0.685	-23.5	0.001	92.6	0.399	-168.4
1.1	0.544	147.4	0.003	83.7	0.570	17.3	5.573	20.1	0.614	125.9	5.369	12.7	0.574	17.8	0.001	36.6	0.565	135.8
1.3	0.388	134.0	0.002	-35.9	0.745	8.7	32.325	-37.7	0.653	53.3	31.397	-46.9	0.731	8.5	0.001	-36.3	0.395	123.1
1.5	0.280	108.0	0.001	165.6	0.922	3.5	15.624	-165.8	0.040	-162.9	15.517	-175.4	0.920	3.9	0.001	-133.2	0.284	92.0
1.7	0.140	102.9	0.000	-19.5	0.965	-6.2	5.408	117.9	0.293	162.3	5.624	109.7	0.968	-6.4	0.001	172.0	0.135	77.6
1.85	0.064	120.8	0.001	-6.0	0.977	-12.1	1.644	76.0	0.354	137.3	1.986	73.6	0.977	-12.6	0.002	-122.4	0.049	59.2
1.86	0.060	126.4	0.002	9.1	0.979	-12.6	1.469	74.2	0.358	136.0	1.842	72.5	0.977	-12.7	0.002	136.2	0.046	56.4
1.87	0.053	128.2	0.001	37.2	0.979	-13.1	1.328	71.4	0.353	133.9	1.687	70.7	0.977	-13.0	0.002	79.6	0.040	56.5
1.88	0.054	134.4	0.001	129.9	0.980	-13.3	1.187	69.0	0.358	132.9	1.565	69.4	0.977	-13.3	0.001	-152.4	0.032	49.2
1.89	0.051	137.8	0.001	-79.4	0.976	-13.7	1.051	67.2	0.351	132.2	1.432	69.2	0.980	-14.0	0.002	126.8	0.026	39.1
1.9	0.050	142.1	0.001	-106.7	0.983	-13.9	0.930	65.2	0.349	130.6	1.324	68.5	0.980	-14.1	0.001	60.8	0.026	29.7
1.91	0.048	147.9	0.001	17.5	0.980	-14.2	0.808	63.5	0.349	129.3	1.221	68.4	0.979	-14.6	0.001	-126.8	0.023	22.9
1.92	0.045	150.8	0.002	52.3	0.981	-14.9	0.701	61.9	0.346	128.2	1.122	68.1	0.984	-14.8	0.001	83.2	0.021	14.0
1.93	0.046	156.4	0.003	-177.7	0.980	-15.2	0.593	60.8	0.335	126.2	1.029	68.2	0.984	-14.9	0.001	75.6	0.022	-2.8
1.94	0.043	164.4	0.002	-147.2	0.981	-15.7	0.496	58.9	0.338	124.6	0.953	68.8	0.981	-15.6	0.002	89.7	0.019	-11.7
1.95	0.044	166.3	0.002	127.7	0.982	-15.8	0.410	57.8	0.338	122.7	0.886	70.4	0.985	-15.8	0.001	-56.5	0.022	-27.9
1.96	0.045	176.5	0.001	-164.7	0.977	-16.1	0.322	57.7	0.333	121.4	0.808	71.5	0.979	-16.0	0.002	12.6	0.021	-36.1
1.97	0.045	-179.9	0.001	166.8	0.976	-16.3	0.243	58.0	0.328	120.4	0.751	73.1	0.984	-16.6	0.001	83.6	0.019	-45.6
1.98	0.046	-171.5	0.002	14.9	0.981	-16.9	0.168	60.2	0.329	118.7	0.702	75.0	0.981	-16.9	0.001	118.6	0.022	-63.0
1.99	0.048	-164.2	0.001	27.2	0.979	-17.1	0.097	69.5	0.325	118.2	0.656	77.5	0.982	-17.0	0.001	39.1	0.024	-72.4
2	0.053	-162.3	0.001	-108.9	0.981	-17.3	0.048	108.4	0.320	117.2	0.620	80.7	0.979	-17.7	0.001	67.5	0.028	-82.5
2.01	0.054	-152.7	0.002	10.2	0.981	-17.5	0.058	176.4	0.314	115.8	0.585	83.2	0.982	-17.6	0.001	148.4	0.033	-91.1
2.02	0.061	-155.3	0.001	51.3	0.976	-18.5	0.109	-160.2	0.313	116.3	0.563	85.7	0.978	-18.2	0.002	100.8	0.040	-91.2
2.03	0.066	-151.7	0.002	-137.6	0.976	-18.4	0.159	-154.8	0.308	114.2	0.543	88.9	0.978	-18.6	0.001	112.7	0.045	-94.3
2.1	0.085	-143.0	0.001	-112.6	0.975	-20.7	0.463	-157.6	0.260	107.4	0.538	104.1	0.972	-20.7	0.001	-112.7	0.071	-96.9
2.5	0.229	-132.8	0.001	-93.5	0.948	-31.7	1.032	-179.3	0.134	160.0	0.185	-18.4	0.951	-31.7	0.002	130.2	0.221	-120.9
3	0.350	-140.4	0.002	-12.2	0.909	-43.6	2.888	134.3	0.274	143.3	2.195	156.0	0.904	-43.8	0.001	99.2	0.346	-135.4
3.5	0.396	-153.3	0.004	-146.5	0.826	-51.5	5.798	49.3	0.200	126.6	5.180	57.6	0.829	-51.9	0.002	-157.2	0.370	-156.3
4	0.392	-156.1	0.003	-176.9	0.871	-59.5	6.716	-63.7	0.222	112.0	6.750	-65.0	0.866	-60.0	0.001	104.4	0.398	-152.0
4.5	0.426	-167.7	0.003	152.2	0.848	-71.1	4.000	-151.0	0.091	62.2	4.261	-158.2	0.830	-70.7	0.003	-16.2	0.405	-160.1
5	0.476	178.2	0.003	135.1	0.775	-81.1	2.330	138.4	0.087	-152.5	2.575	126.7	0.774	-80.9	0.002	131.7	0.403	-176.5
5.5	0.502	172.0	0.002	148.4	0.739	-90.6	1.405	78.9	0.268	151.7	1.610	58.7	0.735	-91.0	0.003	77.9	0.456	161.0
6	0.558	160.5	0.003	-178.2	0.699	-103.6	0.879	27.3	0.400	122.0	1.088	2.7	0.692	-103.4	0.003	101.0	0.498	152.0
6.5	0.633	148.4	0.003	156.1	0.653	-115.7	0.622	-14.6	0.463	102.7	0.892	-45.2	0.645	-115.0	0.004	-15.0	0.519	140.8
7	0.721	139.9	0.002	178.3	0.584	-135.1	0.644	-56.9	0.516	92.5	1.087	-99.8	0.573	-132.6	0.003	52.1	0.613	117.5
7.5	0.816	122.5	0.003	-179.3	0.317	-134.1	0.866	-166.8	0.531	89.0	1.675	124.5	0.385	-135.8	0.002	101.4	0.203	80.2
8	0.689	118.9	0.001	-53.9	0.309	173.0	0.302	153.3	0.579	86.6	0.324	45.1	0.325	170.7	0.004	-4.9	0.247	172.3

Note:

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

## Demo Board Layout

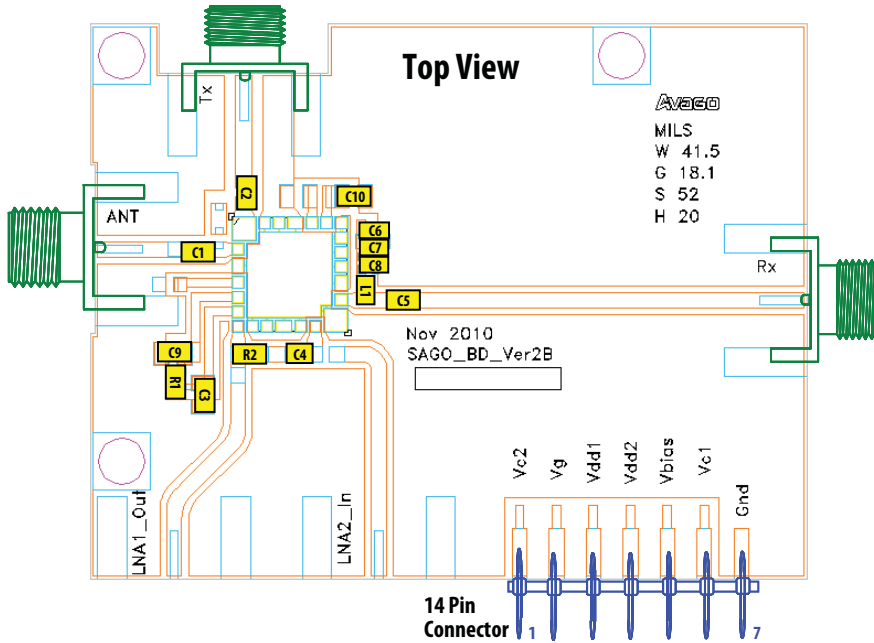


Figure 12. Demo Board Layout Diagram

- 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

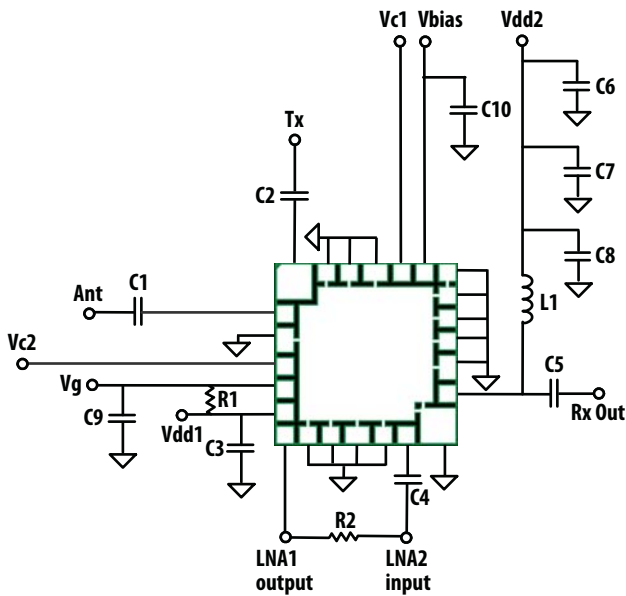
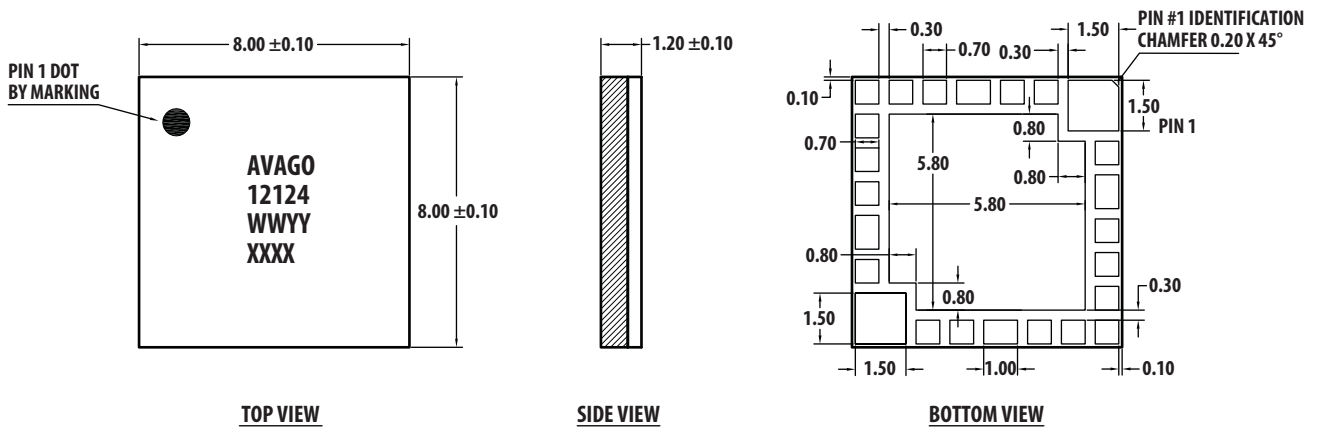


Table 1. Component list for 1.90 GHz

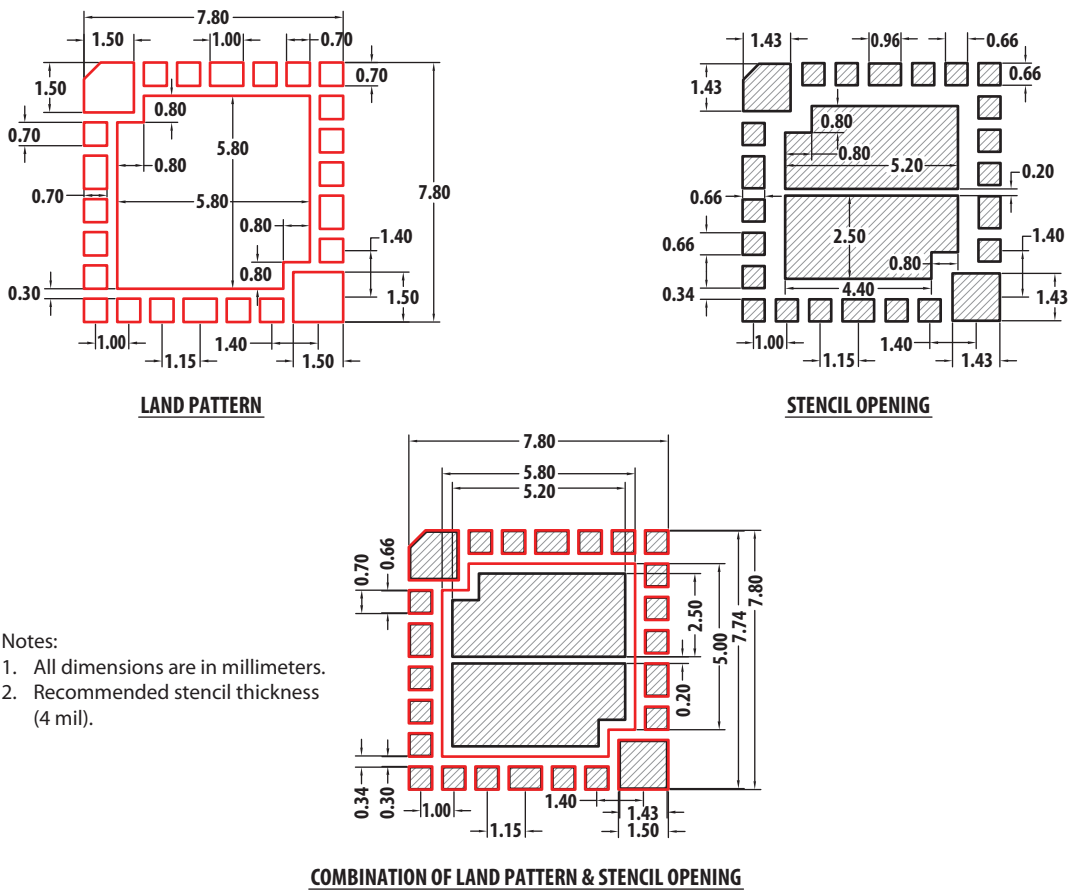
Component	Vendor	Size	Value
C1	Murata	0805	18 pF
C2	Murata	0805	12 pF
C3	Murata	0805	4.7 μF
C4	Murata	0402	10 pF
C5	Murata	0402	5.6 pF
C6	Murata	0603	2.2 μF
C7	Murata	0402	0.1 μF
C8	Murata	0402	10 pF
C9	Murata	0805	4.7 μF
C10	Murata	0805	4.7 μF
R1	KOA	0402	3.6 Kohm
R2	KOA	0402	0 ohm
L1	Murata	0402	47 nH

Figure 13. Demo Board Schematic Diagram matching



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

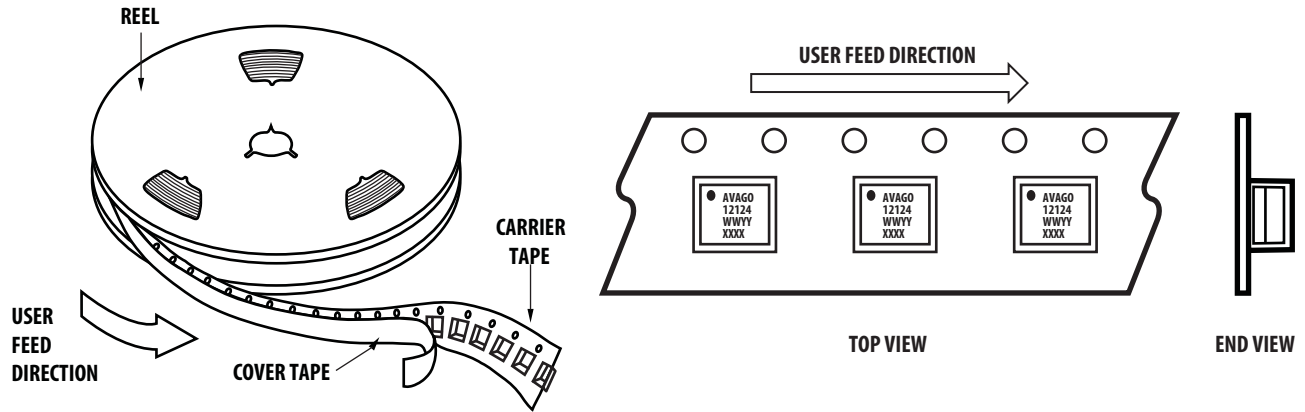
Figure 14. Package Drawing Dimensions



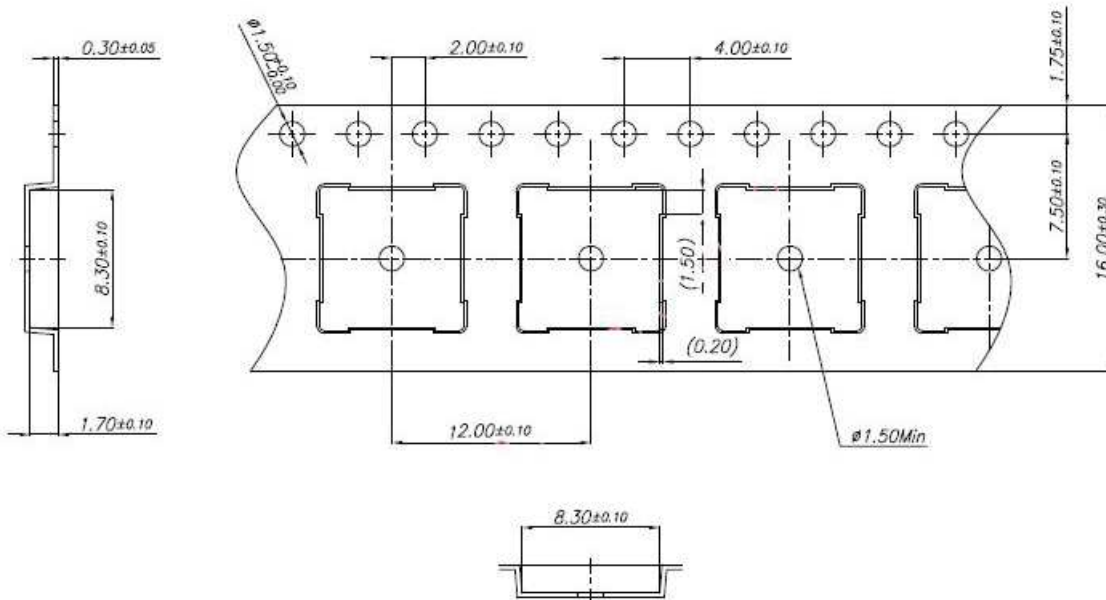
- Notes:
1. All dimensions are in millimeters.
  2. Recommended stencil thickness (4 mil).

Figure 15. PCB and stencil design

## Device Orientation



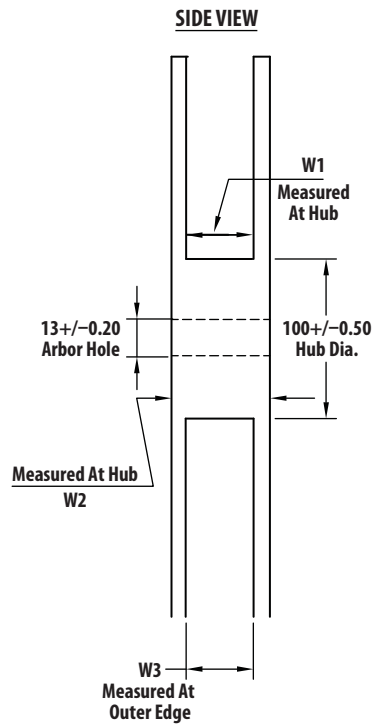
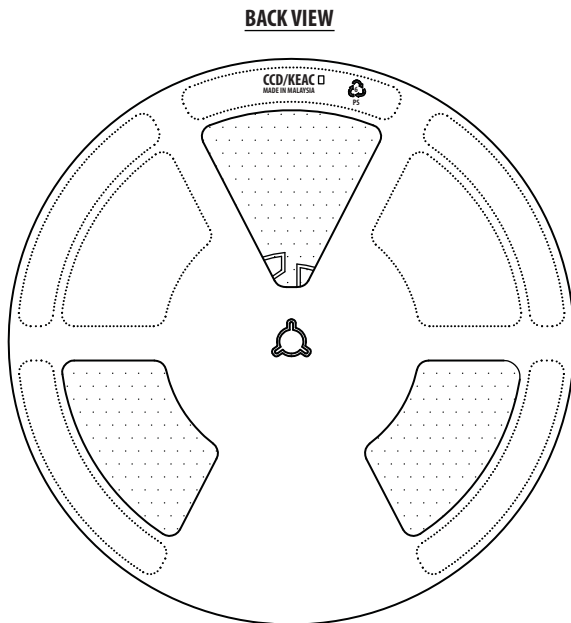
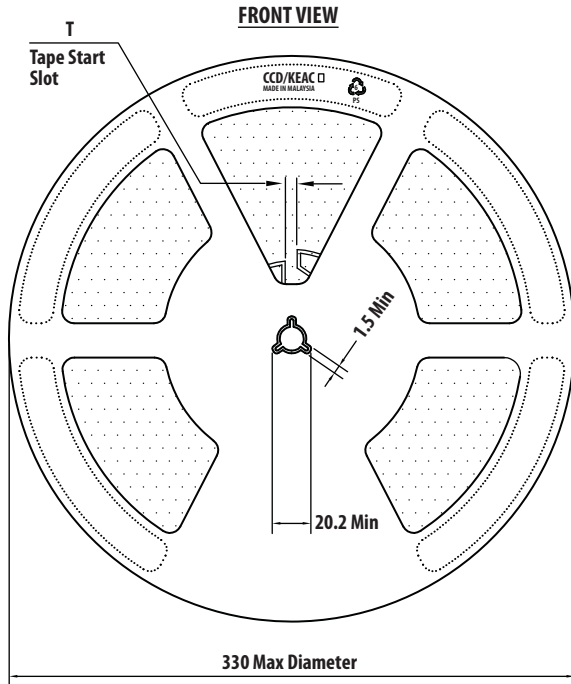
## Tape Dimensions



## Part Number Ordering Information

Part #	Qty	Container
ALM-12124-BLKG	100	Antistatic Bag
ALM-12124-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

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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