

# MGA-52543

## Low Noise Amplifier



### Data Sheet

#### Description

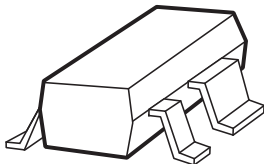
Avago Technologies' MGA-52543 is an economical, easy-to-use GaAs MMIC Low Noise Amplifier (LNA), which is designed for use in LNA and driver stages. While a capable RF/microwave amplifier for any low noise and high linearity 0.4 to 6 GHz application, the LNA focus is Cellular/PCS base stations.

To attain  $NF_{min}$  condition, some simple external matching is required. The MGA-52543 features a calculated  $NF_{min}$  of 1.61 dB and 15 dB associated gain at 1.9 GHz from a cascode stage, feedback FET amplifier. The input and output are partially matched to be near 50  $\Omega$ .

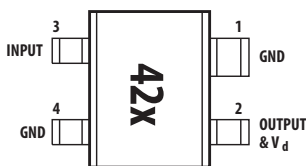
For base station radio card unit LNA application where better than 2:1 VSWR is required, a series inductor on the input and another series inductor on the output can be added externally. The resulting Noise Figure is typically 1.9 dB with 14 dB Gain at 1.9 GHz. With a single 5.0V supply, the LNA typically draws 53 mA. This alignment results in an Input Intercept Point of 17.5 dBm.

The MGA-52543 is a GaAs MMIC, fabricated using Avago Technologies' cost-effective, reliable PHEMT (Pseudomorphic High Electron Mobility Transistor) process. It is housed in the SOT-343 (SC70 4-lead) package. This package offers miniature size (1.2 mm by 2.0 mm), thermal dissipation, and RF characteristics.

#### Surface Mount Package SOT-343/4-lead SC70



#### Pin Connections and Package Marking



Note:  
Top View. Package marking provides orientation and identification.  
"42" = Device Code  
"x" = Data code character identifies month of manufacture

#### Features

- Lead-free Option Available
- Operating frequency: 0.4 GHz ~ 6.0 GHz
- Minimum noise figure: 1.61 dB at 1.9 GHz
- Associated gain : 15 dB at 1.9 GHz
- 1.9 GHz performance tuned for VSWR < 2:1  
Noise figure: 1.9 dB  
Gain: 14 dB  
 $P_{1dB}$ : +17.5 dBm  
Input IP3: +17.5 dBm
- Single supply 5.0 V operation

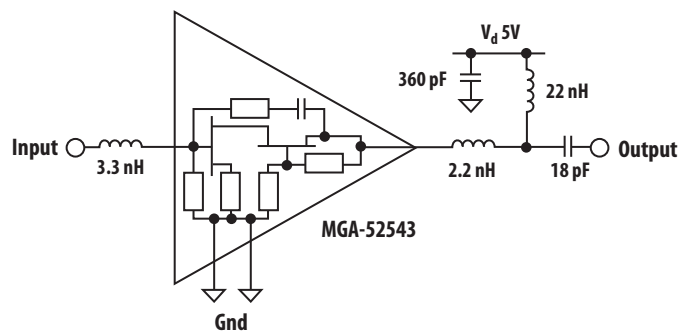
#### Applications

- Cellular/PCS base station radio card LNA
- High dynamic range amplifier for base stations, WLL, WLAN, and other applications



**Attention: Observe precautions for handling electrostatic sensitive devices.**  
ESD Machine Model (Class A)  
ESD Human Body Model (Class 1A)  
Refer to Avago Application Note A004R: *Electrostatic Discharge Damage and Control.*

#### Simplified Schematic



## MGA-52543 Absolute Maximum Ratings<sup>[1]</sup>

Symbol	Parameter	Units	Absolute Maximum
$V_d$	Maximum Input Voltage	V	$\pm 0.5$
$V_d$	Supply Voltage	V	7.0
$P_d$	Power Dissipation <sup>[2,3]</sup>	mW	425
$P_{in}$	CW RF Input Power	dBm	+20
$T_j$	Junction Temperature	°C	160
$T_{STG}$	Storage Temperature	°C	-65 to 150

## Thermal Resistance:<sup>[2]</sup>

$$\theta_{jc} = 150^\circ\text{C/W}$$

### Notes:

1. Operation of this device in excess of any of these limits may cause permanent damage.
2.  $T_{case} = 25^\circ\text{C}$

## Electrical Specifications

$T_c = +25^\circ\text{C}$ ,  $Z_0 = 50 \Omega$ ,  $V_d = 5V$ , unless noted

Symbol	Parameter and Test Condition	Frequency	Units	Min.	Typ.	Max.	$\sigma$ <sup>[3]</sup>
$I_d$ test	Current drawn	N/A	mA	45	53	70	3.57
NF <sup>[1]</sup>	Noise Figure	1.9 GHz 0.9 GHz	dB		1.9 1.8	2.3	0.15
Gain <sup>[1]</sup>	Gain	1.9 GHz 0.9 GHz	dB	13	14.2 15	15.5	0.26
IIP3 <sup>[1]</sup>	Input Third Order Intercept Point	1.9 GHz 0.9 GHz	dBm	14	+17.5 +18		2.28
$F_{min}$ <sup>[2]</sup>	Minimum Noise Figure	1.9 GHz 0.9 GHz	dB		1.6 1.5		
$G_a$ <sup>[2]</sup>	Associated Gain at $F_{min}$	1.9 GHz 0.9 GHz	dB		15.0 16.2		
OIP3 <sup>[1]</sup>	Output Third Order Intercept Point	1.9 GHz 0.9 GHz	dBm		31.7 33.0		
$P_{1dB}$ <sup>[1]</sup>	Output Power at 1 dB Gain Compression	1.9 GHz 0.9 GHz	dBm		+17.4 +18		
$RL_{in}$ <sup>[1]</sup>	Input Return Loss	1.9 GHz 0.9 GHz	dB		11 15		
$RL_{out}$ <sup>[1]</sup>	Output Return Loss	1.9 GHz 0.9 GHz	dB		20 22		
ISOL <sup>[1]</sup>	Isolation $ s_{12} ^2$	1.9 GHz 0.9 GHz	dB		-25 -25		

### Notes:

1. Measurements obtained from a fixed narrow band tuning described in Figure 1. This circuit designed to optimize Noise Figure and IIP3 while maintaining VSWR better than 2:1.
2. Minimum Noise Figure and Associated Gain at  $F_{min}$  computed from S-parameter and Noise Parameter data measured in an automated NF system.
3. Standard deviation data are based on at least 400 part sample size and 11 wafer lots.

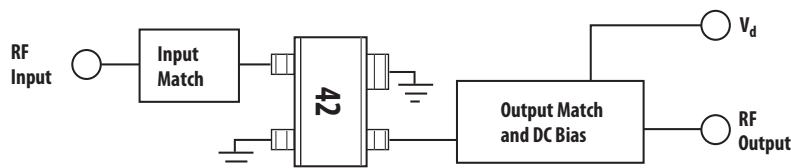


Figure 1. Block Diagram of Test Fixture.

See Figure 7 in the Applications section for an equivalent schematic of 1.9 GHz circuit; Figure 11 in the Applications section for 900 MHz circuit.

## MGA-52543 Typical Performance

All data are measured at  $T_c = 25^\circ\text{C}$ ,  $V_d = 5\text{V}$ , and in the following test system unless stated otherwise.

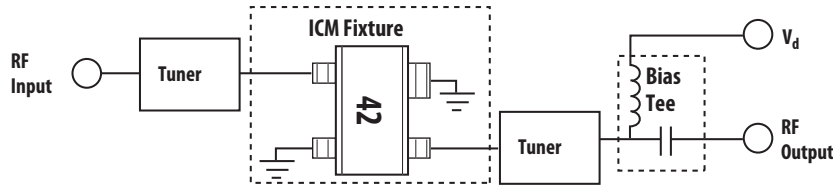


Figure 2. Test Circuit for S, Noise, and Power Parameters over Frequency.

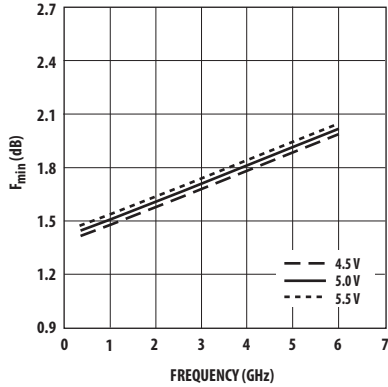


Figure 3. Minimum Noise Figure vs. Frequency and Voltage<sup>[1]</sup>.

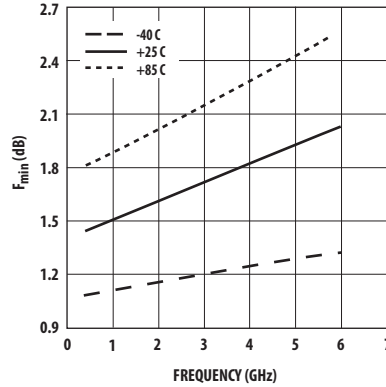


Figure 4. Minimum Noise Figure vs. Frequency and Temperature<sup>[1]</sup>.

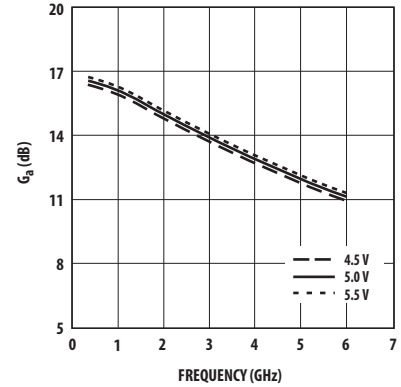


Figure 5. Associated Gain vs. Frequency and Voltage<sup>[1]</sup>.

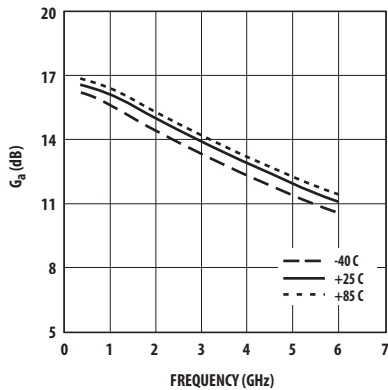


Figure 6. Associated Gain vs. Frequency and Temperature<sup>[1]</sup>.

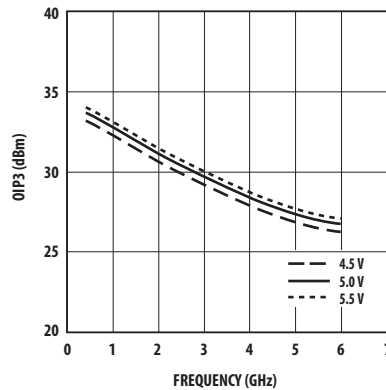


Figure 7. Output Third Order Intercept Point vs. Frequency and Voltage<sup>[2]</sup>.

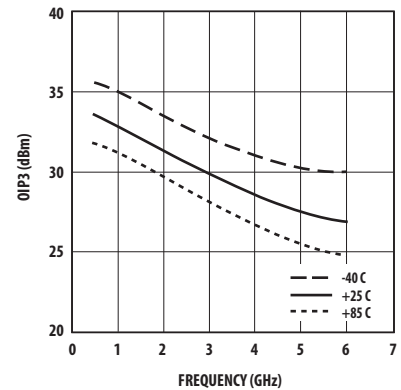


Figure 8. Output Third Order Intercept Point vs. Frequency and Temperature<sup>[2]</sup>.

### Notes:

1. Minimum Noise Figure and Associated Gain at  $F_{min}$  computed from S-parameter and Noise Parameter data measured in an automated NF system.
2. Tuners on input and output were set for narrow band tuning designed to optimize NF and OIP3 while keeping VSWRs better than 2:1. See Figure 9 for corresponding return losses at each frequency band.

## MGA-52543 Typical Performance, continued

All data are measured at  $T_c = 25^\circ\text{C}$ ,  $V_d = 5\text{V}$ , and in the following test system unless stated otherwise.

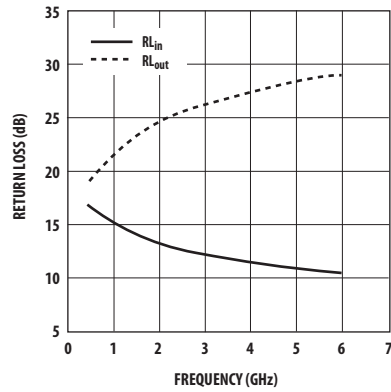


Figure 9. Return Losses at each Narrow Band Tuning.

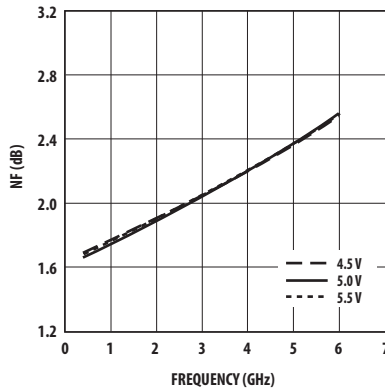


Figure 10. Noise Figure vs. Frequency and Voltage.

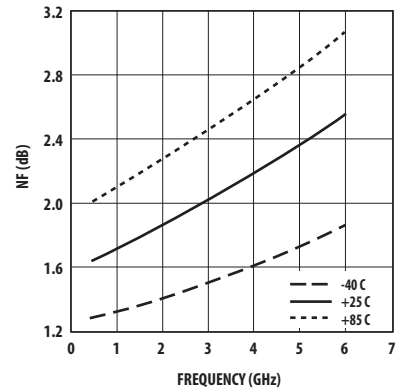


Figure 11. Noise Figure vs. Frequency and Temperature.

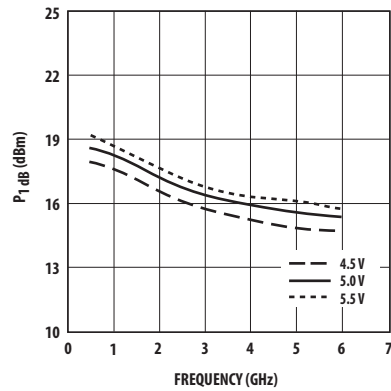


Figure 12. Output Power at 1 dB Compression vs. Frequency and Voltage.

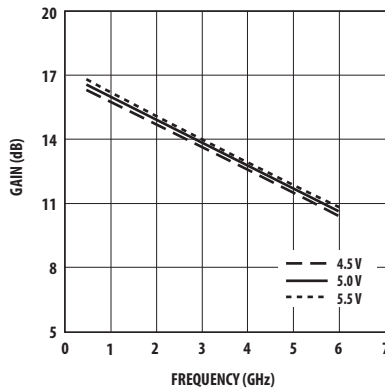


Figure 13. Gain vs. Frequency and Voltage.

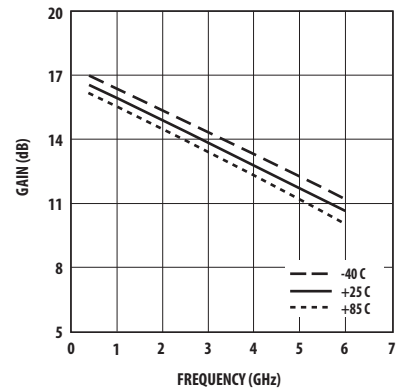


Figure 14. Gain vs. Frequency and Temperature.

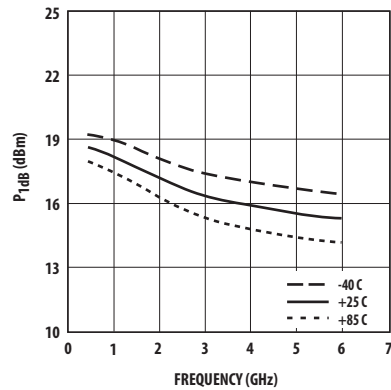


Figure 15. Output Power at 1 dB Compression vs. Frequency and Temperature.

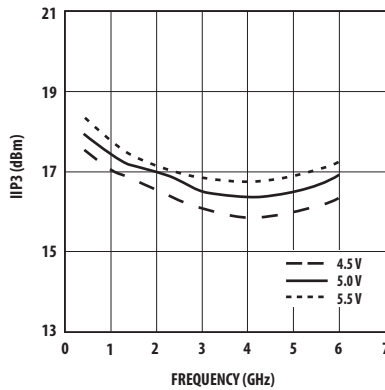


Figure 16. Input Third Order Intercept Point vs. Frequency and Voltage.

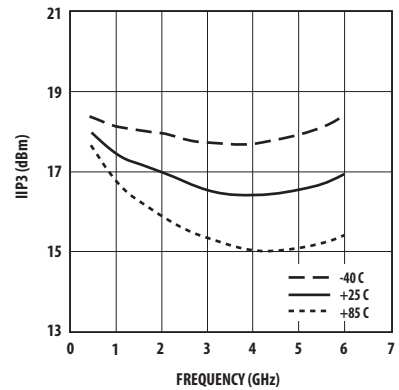
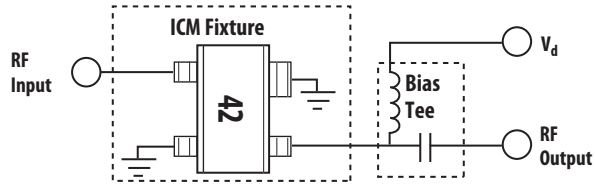


Figure 17. Input Third Order Intercept Point vs. Frequency and Temperature.

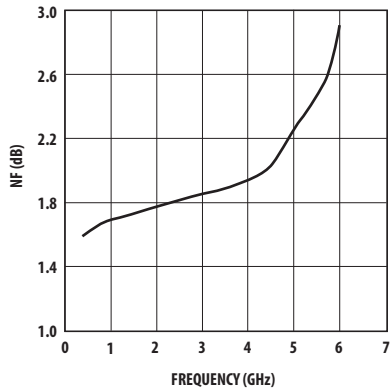
### Note:

All data reported from Figures 7 through 17 using test setup described in Figure 2. Tuners on input and output were set for narrow band tuning designed to optimize NF and OIP3 while keeping VSWRs better than 2:1. See Figure 9 for corresponding return losses at each frequency band.

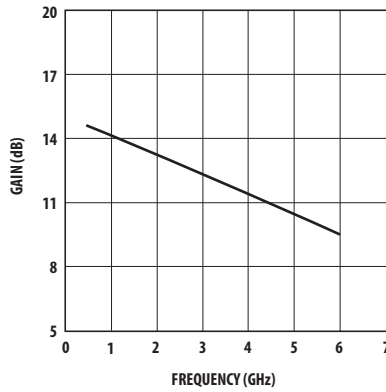
**MGA-52543 Typical Performance, continued**



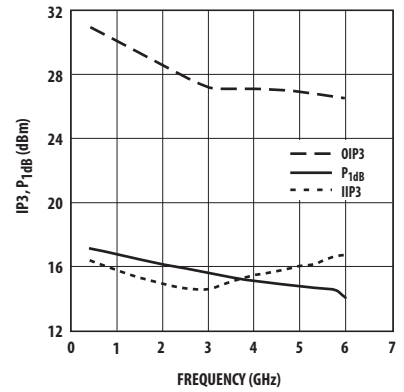
**Figure 18. Test Circuit for Figures 19 through 24 (Input and Output presented to 50Ω).**



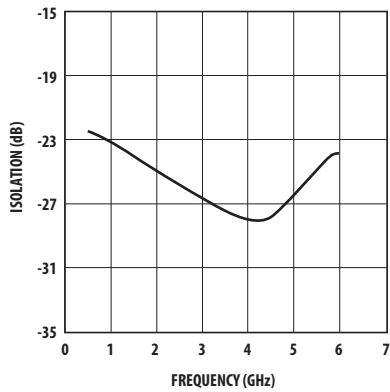
**Figure 19. Noise Figure vs. Frequency**



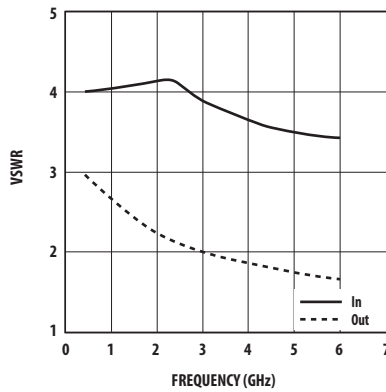
**Figure 20. Gain vs. Frequency.**



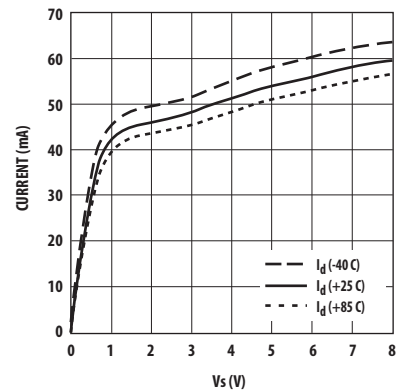
**Figure 21. Input IP3, Output IP3 and P<sub>1dB</sub> vs. Frequency.**



**Figure 22. Isolation vs. Frequency.**



**Figure 23. Input and Output VSWR vs. Frequency.**



**Figure 24. Current vs. V<sub>d</sub>.**

### MGA-52543 Typical Scattering Parameters

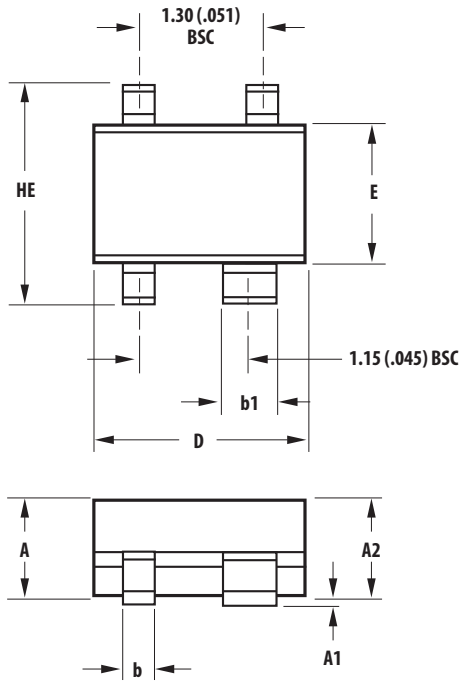
$T_c = 25^\circ\text{C}$ ,  $V_d = 5.0\text{V}$ ,  $I_d = 53\text{ mA}$ ,  $Z_0 = 50\ \Omega$ , (from S and Noise Parameters in ICM test fixture)

Freq	$s_{11}$ (m)	$s_{11}$ (a)	$s_{21}$ (dB)	$s_{21}$ (m)	$s_{21}$ (a)	$s_{12}$ (dB)	$s_{12}$ (m)	$s_{12}$ (a)	$s_{22}$ (m)	$s_{22}$ (a)	K
0.2	0.64	-17.42	14.92	5.57	168.30	-22.90	0.072	16.89	0.53	-14.49	1.00
0.3	0.62	-18.44	14.76	5.47	166.18	-22.62	0.074	9.26	0.51	-15.38	1.04
0.4	0.61	-20.41	14.67	5.41	163.57	-22.56	0.074	4.62	0.51	-17.35	1.06
0.5	0.60	-23.21	14.60	5.37	160.09	-22.58	0.074	0.54	0.49	-18.04	1.08
0.6	0.60	-26.02	14.54	5.33	156.98	-22.66	0.074	-2.26	0.48	-20.59	1.09
0.7	0.60	-29.01	14.46	5.28	153.79	-22.78	0.073	-4.58	0.48	-23.14	1.10
0.8	0.60	-31.88	14.37	5.23	150.67	-22.92	0.071	-6.59	0.47	-25.89	1.12
0.9	0.60	-35.42	14.28	5.18	147.57	-23.06	0.070	-8.26	0.46	-28.24	1.13
1	0.60	-38.48	14.19	5.13	144.53	-23.23	0.069	-9.68	0.45	-31.05	1.14
1.1	0.60	-41.81	14.10	5.07	141.44	-23.40	0.068	-10.91	0.44	-33.35	1.16
1.2	0.61	-45.23	14.01	5.02	138.48	-23.58	0.066	-12.02	0.44	-35.96	1.17
1.3	0.61	-48.69	13.92	4.96	135.50	-23.76	0.065	-13.01	0.43	-38.26	1.19
1.4	0.61	-52.14	13.82	4.91	132.59	-23.95	0.063	-13.77	0.42	-40.57	1.21
1.5	0.61	-55.73	13.73	4.86	129.67	-24.14	0.062	-14.46	0.41	-42.72	1.22
1.6	0.61	-59.22	13.63	4.80	126.78	-24.34	0.061	-15.00	0.41	-44.90	1.25
1.7	0.61	-62.73	13.54	4.75	123.96	-24.53	0.059	-15.44	0.40	-46.95	1.27
1.8	0.61	-66.34	13.45	4.70	121.14	-24.72	0.058	-15.78	0.39	-48.94	1.29
1.9	0.61	-69.85	13.36	4.66	118.37	-24.93	0.057	-16.07	0.39	-50.92	1.32
2	0.61	-73.41	13.27	4.61	115.53	-25.10	0.056	-16.19	0.38	-52.95	1.34
2.1	0.61	-76.93	13.19	4.57	112.76	-25.29	0.054	-16.23	0.37	-54.81	1.36
2.2	0.61	-80.55	13.10	4.52	109.97	-25.48	0.053	-16.15	0.37	-56.73	1.39
2.3	0.61	-84.18	13.02	4.48	107.22	-25.69	0.052	-16.20	0.36	-58.62	1.42
2.4	0.61	-87.95	12.95	4.44	104.46	-25.88	0.051	-16.12	0.36	-60.36	1.46
2.5	0.60	-91.46	12.87	4.40	101.71	-26.04	0.050	-15.93	0.35	-62.11	1.48
3	0.59	-109.93	12.46	4.20	88.05	-26.89	0.045	-13.42	0.33	-69.84	1.66
3.5	0.58	-128.36	12.02	3.99	74.65	-27.67	0.041	-8.35	0.32	-76.05	1.89
4	0.57	-146.55	11.56	3.79	61.39	-28.07	0.040	-0.44	0.30	-81.51	2.08
4.5	0.56	-164.07	11.10	3.59	48.43	-27.72	0.041	9.10	0.29	-87.17	2.11
5	0.55	179.17	10.60	3.39	35.70	-26.66	0.046	16.13	0.28	-93.37	1.99
5.5	0.55	163.86	10.09	3.19	23.34	-25.28	0.054	19.97	0.26	-101.07	1.81
6	0.55	148.85	9.58	3.01	11.08	-23.76	0.065	20.39	0.25	-111.19	1.62
6.5	0.56	134.84	9.01	2.82	-0.85	-22.33	0.076	17.75	0.24	-124.51	1.48
7	0.57	121.13	8.44	2.64	-12.44	-21.13	0.088	13.58	0.23	-137.46	1.38
7.5	0.58	108.36	7.85	2.47	-23.66	-20.03	0.100	9.01	0.23	-151.87	1.30
8	0.58	95.90	7.25	2.31	-34.68	-19.00	0.112	3.27	0.24	-165.58	1.22

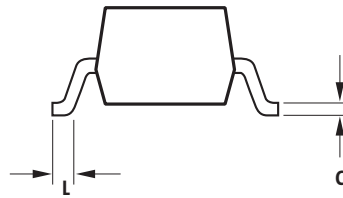
### Noise Parameters

Freq (GHz)	$F_{\min}$ (dB)	$\Gamma_{\text{opt}}$ Mag	$\Gamma_{\text{opt}}$ Ang	$R_n/Z_0$	$G_a$ (dB)
0.5	1.46	0.32	10.51	0.37	16.5
0.8	1.49	0.31	21.95	0.35	16.3
0.9	1.50	0.31	28.21	0.34	16.19
1	1.51	0.3	32.89	0.34	16.1
1.1	1.52	0.3	39.85	0.33	16.0
1.5	1.57	0.29	45.05	0.30	15.61
1.8	1.60	0.28	50.05	0.28	15.2
1.9	1.61	0.28	57.75	0.27	15.02
2	1.62	0.27	59.67	0.27	14.9
2.1	1.63	0.27	63.12	0.26	14.8
2.2	1.64	0.26	64.28	0.26	14.65
2.3	1.65	0.26	68.3	0.25	14.58
2.4	1.66	0.25	75.25	0.24	14.48
2.5	1.68	0.25	78.03	0.24	14.39
3	1.73	0.23	94.06	0.21	13.98
3.5	1.78	0.21	121.52	0.18	13.39
4	1.84	0.2	141.87	0.16	12.9
4.5	1.89	0.21	172.98	0.15	12.45
5	1.94	0.24	-169.13	0.14	12
5.5	2.00	0.28	-146.48	0.16	11.59
6	2.05	0.31	-133.04	0.19	11.1

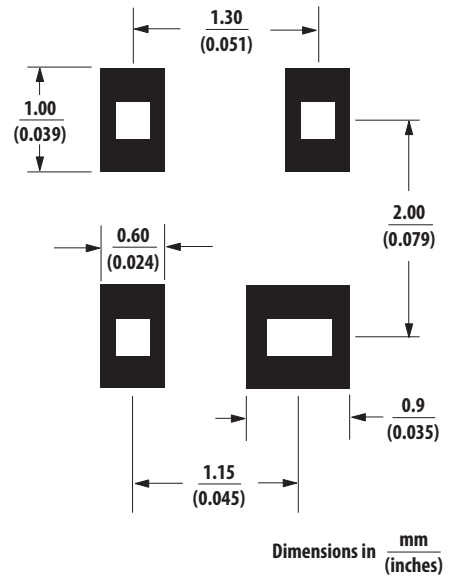
**Package Dimensions**  
**Outline 43**  
**SOT-343 (SC70 4-lead)**



SYMBOL	DIMENSIONS (mm)	
	MIN.	MAX.
E	1.15	1.35
D	1.85	2.25
HE	1.80	2.40
A	0.80	1.10
A2	0.80	1.00
A1	0.00	0.10
b	0.15	0.40
b1	0.55	0.70
c	0.10	0.20
L	0.10	0.46

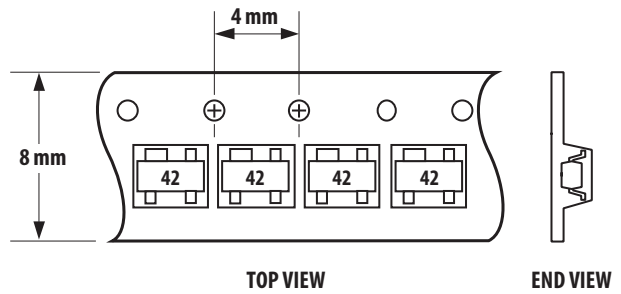
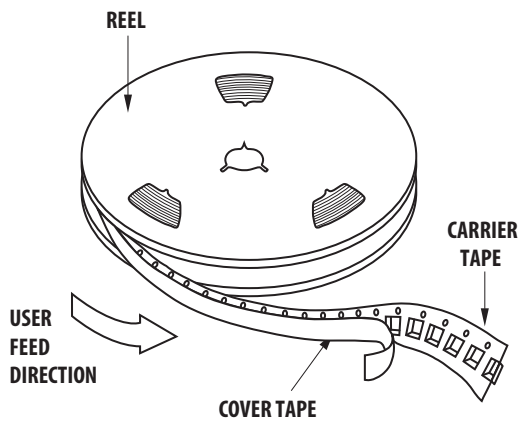


**Recommended PCB Pad Layout for**  
**Avago's SC70 4L/SOT-343 Products**



- NOTES:**
1. All dimensions are in mm.
  2. Dimensions are inclusive of plating.
  3. Dimensions are exclusive of mold flash & metal burr.
  4. All specifications comply to EIAJ SC70.
  5. Die is facing up for mold and facing down for trim/form, ie: reverse trim/form.
  6. Package surface to be mirror finish.

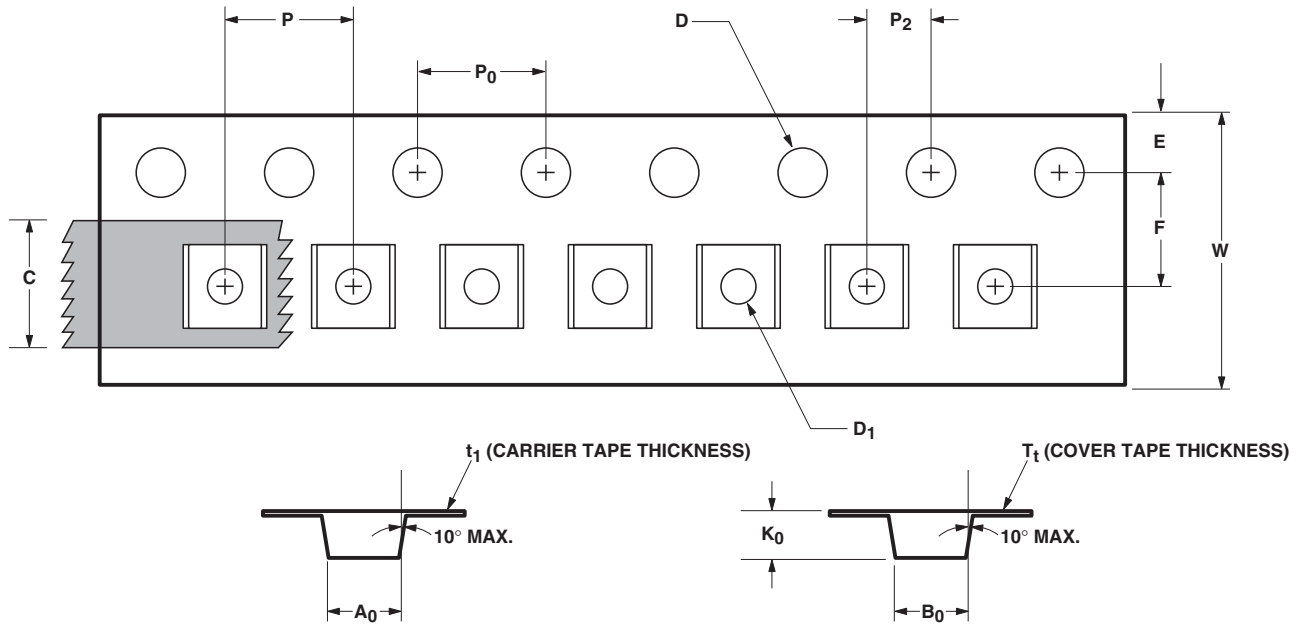
**Device Orientation**



## Part Number Ordering Information

Part Number	No. of Devices	Container
MGA-52543-TR1G	3000	7" Reel
MGA-52543-TR2G	10000	13" Reel
MGA-52543-BLKG	100	antistatic bag

## Tape Dimensions For Outline 4T



DESCRIPTION		SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	$A_0$	$2.40 \pm 0.10$	$0.094 \pm 0.004$
	WIDTH	$B_0$	$2.40 \pm 0.10$	$0.094 \pm 0.004$
	DEPTH	$K_0$	$1.20 \pm 0.10$	$0.047 \pm 0.004$
	PITCH	$P$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
	BOTTOM HOLE DIAMETER	$D_1$	$1.00 + 0.25$	$0.039 + 0.010$
PERFORATION	DIAMETER	$D$	$1.55 \pm 0.10$	$0.061 + 0.002$
	PITCH	$P_0$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
	POSITION	$E$	$1.75 \pm 0.10$	$0.069 \pm 0.004$
CARRIER TAPE	WIDTH	$W$	$8.00 + 0.30 - 0.10$	$0.315 + 0.012$
	THICKNESS	$t_1$	$0.254 \pm 0.02$	$0.0100 \pm 0.0008$
COVER TAPE	WIDTH	$C$	$5.40 \pm 0.10$	$0.205 + 0.004$
	TAPE THICKNESS	$T_t$	$0.062 \pm 0.001$	$0.0025 \pm 0.0004$
DISTANCE	CAVITY TO PERFORATION (WIDTH DIRECTION)	$F$	$3.50 \pm 0.05$	$0.138 \pm 0.002$
	CAVITY TO PERFORATION (LENGTH DIRECTION)	$P_2$	$2.00 \pm 0.05$	$0.079 \pm 0.002$

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