

# MGA-684P8

## Low Noise Active Bias Low Noise Amplifier



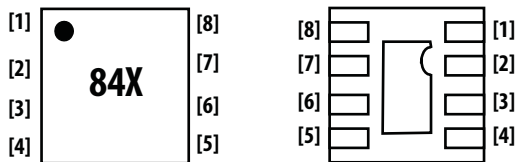
### Data Sheet

#### Description

Avago Technologies' MGA-684P8 is an economical, easy-to-use GaAs MMIC Low Noise Amplifier (LNA). The LNA has low noise and high linearity achieved through the use of Avago Technologies' proprietary 0.25  $\mu\text{m}$  GaAs Enhancement-mode pHEMT process. It is housed in a miniature 2.0 x 2.0 x 0.75 mm<sup>3</sup> 8-pin Quad-Flat-Non-Lead (QFN) package. It is designed for optimum use from 1.5 GHz up to 4 GHz. The compact footprint and low profile coupled with low noise, high gain and high linearity make the MGA-684P8 an ideal choice as a low noise amplifier for cellular infrastructure for GSM and CDMA. For optimum performance at lower frequency from 450 MHz up to 1.5 GHz, MGA-683P8 is recommended. Both MGA-683P8 and MGA-684P8 share the same package and pinout configuration.

#### Pin Configuration and Package Marking

2.0 x 2.0 x 0.75 mm<sup>3</sup> 8-lead QFN



Top View

- Pin 1 - Vbias
- Pin 2 - RFinput
- Pin 3 - Not Used
- Pin 4 - Not Used

Bottom View

- Pin 5 - Not Used
- Pin 6 - Not Used
- Pin 7 - RFoutput/Vdd
- Pin 8 - Not Used
- Centre tab - Ground

Note:  
Package marking provides orientation and identification  
"84" = Device Code, where X is the month code.



**Attention: Observe precautions for handling electrostatic sensitive devices.**

ESD Machine Model = 70 V (Class A)  
ESD Human Body Model = 500 V (Class 1B)  
Refer to Avago Application Note A004R:  
Electrostatic Discharge, Damage and Control.

#### Features

- Low noise Figure
- High linearity performance
- GaAs E-pHEMT Technology<sup>[1]</sup>
- Low cost small package size: 2.0 x 2.0 x 0.75 mm<sup>3</sup>
- Excellent uniformity in product specifications
- Tape-and-Reel packaging option available

#### Specifications

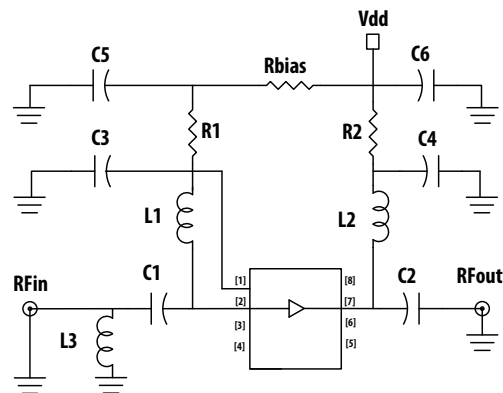
1.9 GHz; 5 V, 35 mA

- 17.6 dB Gain
- 0.56 dB Noise Figure
- 21 dB Input Return Loss
- 32.4 dBm Output IP3
- 22 dBm Output Power at 1dB gain compression

#### Applications

- Low noise amplifier for cellular infrastructure for GSM TDS-CDMA, and CDMA.
- Other low noise application.
- Repeater, Metrocell/Picocell application.

#### Simplified Schematic



Note:

- The schematic is shown with the assumption that similar PCB is used for both MGA-683P8 and MGA-684P8.
- Detail of the components needed for this product is shown in Table 1.
- Enhancement mode technology employs positive gate voltage, thereby eliminating the need of negative gate voltage associated with conventional depletion mode devices.
- Good RF practice requires all unused pins to be earthed.

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

Symbol	Parameter	Units	Absolute Maximum
V <sub>dd</sub>	Device Voltage, RF output to ground	V	5.5
V <sub>bias</sub>	Gate Voltage	V	0.7
I <sub>dd</sub>	Drain Current	mA	90
P <sub>in,max</sub>	CW RF Input Power (V <sub>dd</sub> = 5.0 V, I <sub>d</sub> = 50 mA)	dBm	+20
P <sub>diss</sub>	Total Power Dissipation <sup>[2]</sup>	W	0.5
T <sub>j</sub>	Junction Temperature	°C	150
T <sub>stg</sub>	Storage Temperature	°C	-65 to 150

## Thermal Resistance

Thermal Resistance <sup>[3]</sup>  
(V<sub>dd</sub> = 5.0 V, I<sub>dd</sub> = 35 mA per channel),  
θ<sub>jc</sub> = 62°C/W per channel

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 with unit turned on. Board temperature T<sub>B</sub> is 25° C. Derate at 16 mW/°C for T<sub>B</sub> > 119° C.

## Electrical Specifications <sup>[1], [4]</sup>

RF performance at T<sub>A</sub> = 25° C, V<sub>dd</sub> = 5 V, R<sub>bias</sub> = 6.8 kΩ, 1.9 GHz, measured on demo board in Figure 5 with component list in Table 1 for 1.9 GHz matching.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I <sub>dd</sub>	Drain Current	mA	23	35.2	47
Gain	Gain	dB	16.1	17.6	19.1
OIP3 <sup>[2]</sup>	Output Third Order Intercept Point	dBm	29	32.4	
NF <sup>[3]</sup>	Noise Figure	dB		0.56	0.8
OP1dB	Output Power at 1dB Gain Compression	dBm		22	
IRL	Input Return Loss, 50 Ω source	dB		21	
ORL	Output Return Loss, 50 Ω load	dB		12	
REV ISOL	Reverse Isolation	dB		30	

Notes:

1. Measurements at 1.9 GHz obtained using demo board described in Figure 1.
2. OIP3 test condition: F<sub>RF1</sub> = 1.9 GHz, F<sub>RF2</sub> = 1.901 GHz with input power of -10 dBm per tone.
3. For NF data, board losses of the input have not been de-embedded.
4. Use proper bias, heatsink and derating to ensure maximum channel temperature is not exceeded. See absolute maximum ratings and application note for more details.

## Product Consistency Distribution Charts (1, 2)

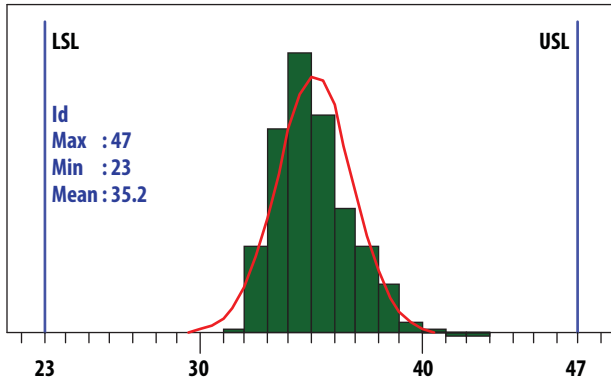


Figure 1. Idd @ 1.9 GHz Mean = 35.2 mA

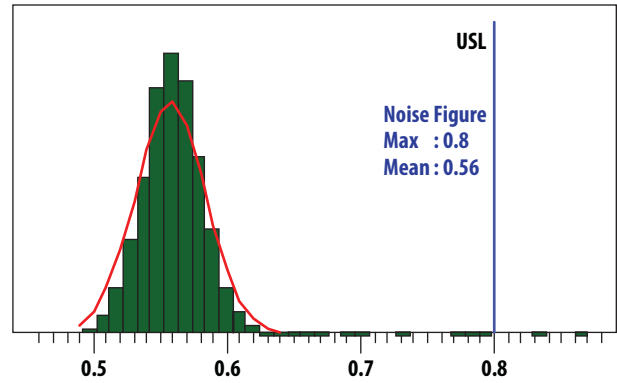


Figure 2. Noise Figure @1.9 GHz, Mean = 0.56

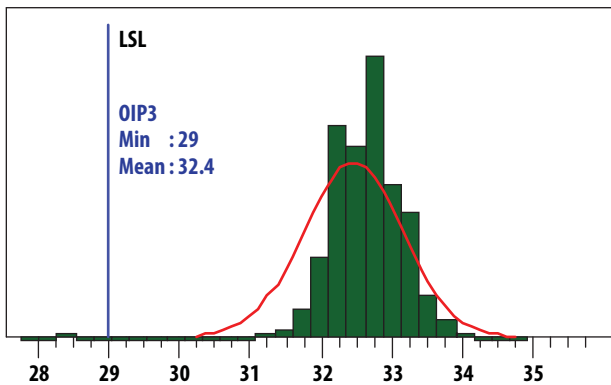


Figure 3. OIP3 @ 1.9 GHz, Mean = 32.4

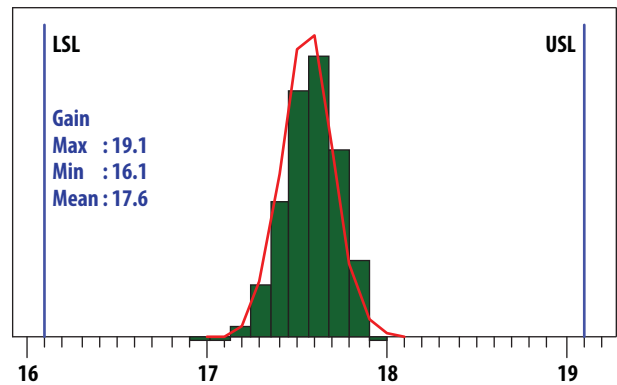


Figure 4. Gain @ 1.9 GHz, Mean = 17.6

### Notes:

1. Distribution data samples are 500 samples taken from 3 different wafers. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.
2. Circuit Losses have not been de-embedded from the actual measurements.

## Demo Board Layout

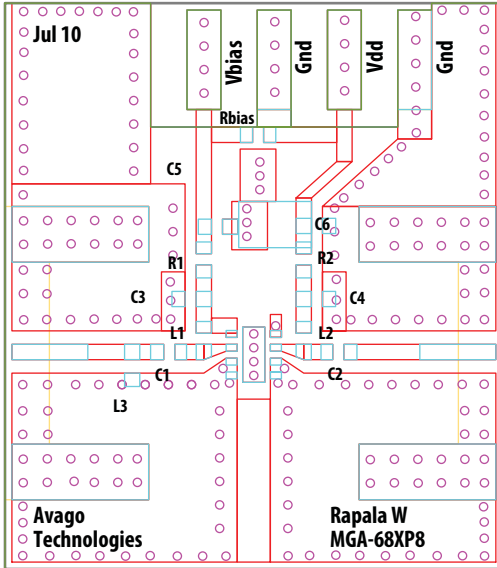


Figure 5. Demo Board Layout Diagram

- Recommended PCB material is 10 mils Rogers RO4350.
- Suggested component values may vary according to layout and PCB material.

## Demo Board Schematic

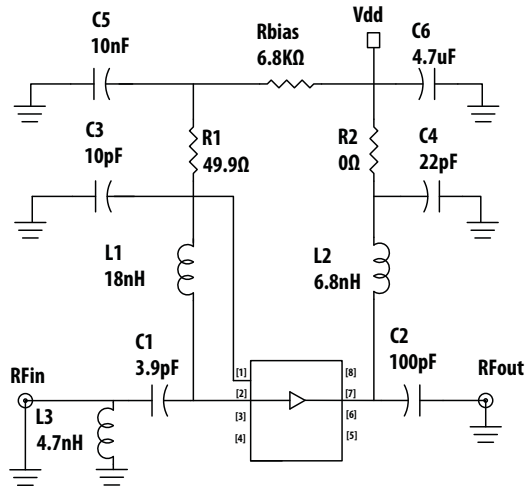


Figure 6. Demo Board Schematic Diagram

### Notes:

- The schematic is shown with the assumption that similar PCB is used for both MGA-683P8 and MGA-68P8.
- Detail of the components needed for this product is shown in Table 1.

Table 1. Component list for 1.9 GHz matching

Part	Size	Value	Detail Part Number
C1	0402	3.9 pF	Murata GRM15
C2	0402	100 pF	Murata GRM15
C3	0402	10 pF	Murata GRM15
C4	0402	22 pF	Murata GRM15
C5	0402	10 nF	Murata GRM15
C6	0805	4.7 $\mu$ F	Murata GRM15
L1	0402	18 nH	Coilcraft CS0402
L2	0402	6.8 nH	Toko FHL1005
L3	0402	4.7 nH	Coilcraft CS0402
Rbias	0402	6.8 KOhm	KOA RK73
R1	0402	49.9 Ohm	KOA RK73
R2	0402	0 Ohm	KOA RK73

### Notes:

C2 is a blocking capacitor

L2 output match for OIP3

L1, C1 and L3 are used for IRL matching.

C3, C4, C5, C6 are bypass capacitors

R1 is stabilizing resistor

Rbias is the biasing resistor

## MGA-684P8 Typical Performance in Demoboard

RF performance at  $T_A = 25^\circ\text{C}$ ,  $V_{dd} = 5\text{V}$ ,  $R_{bias} = 6.8\text{ k}\Omega$ , measured on demo board in Figure 5 with component list in Table1 for 1.9 GHz matching, unless otherwise stated.

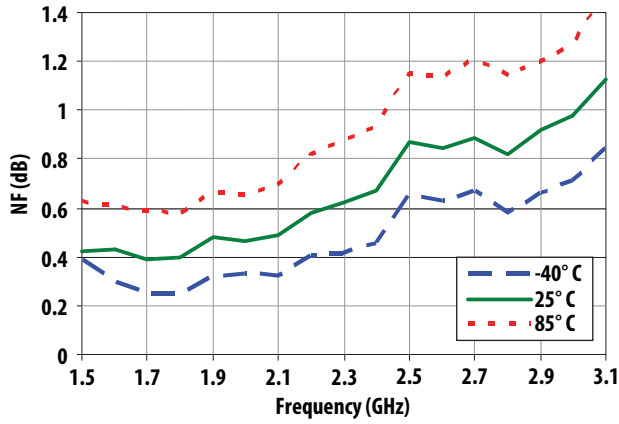


Figure 7. NF vs Frequency vs Temperature

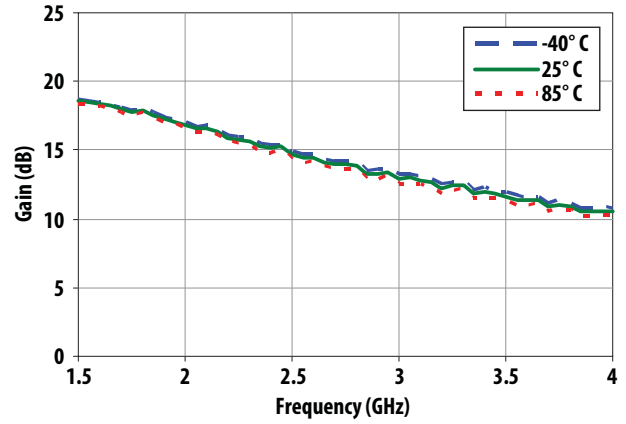


Figure 8. Gain vs Frequency vs Temperature

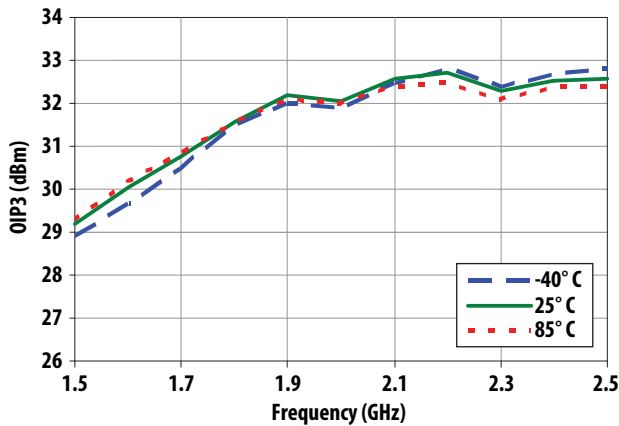


Figure 9. OIP3 vs Frequency vs Temperature

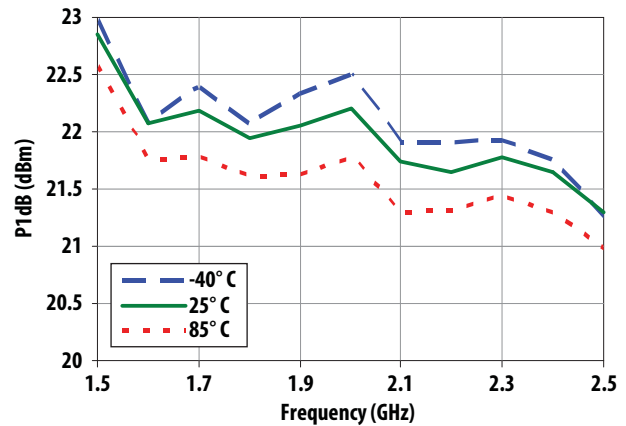


Figure 10. OP1dB vs Frequency vs Temperature

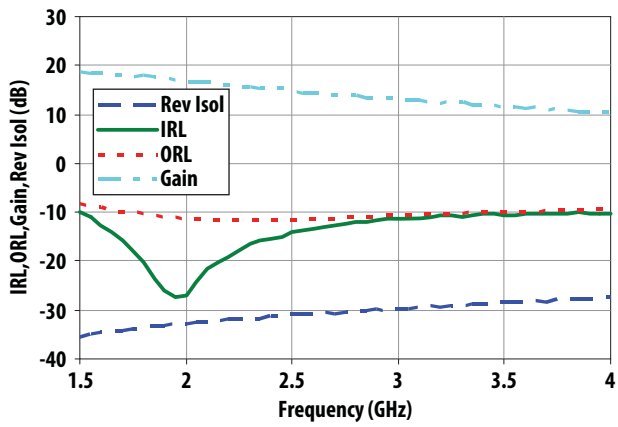


Figure 11. S-Parameter performance with DUT on demoboard shown in Figure 1.

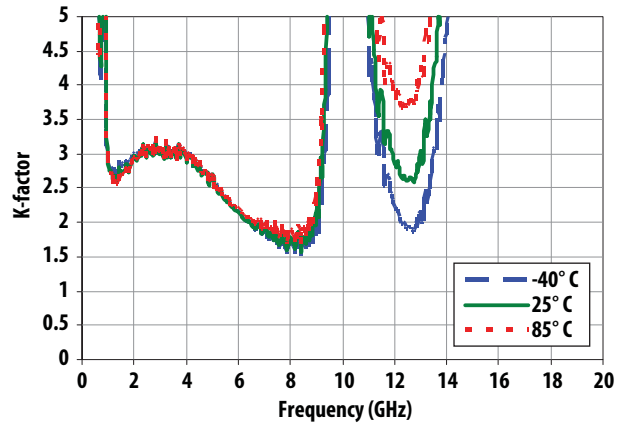


Figure 12. K-factor vs Frequency vs Temperature

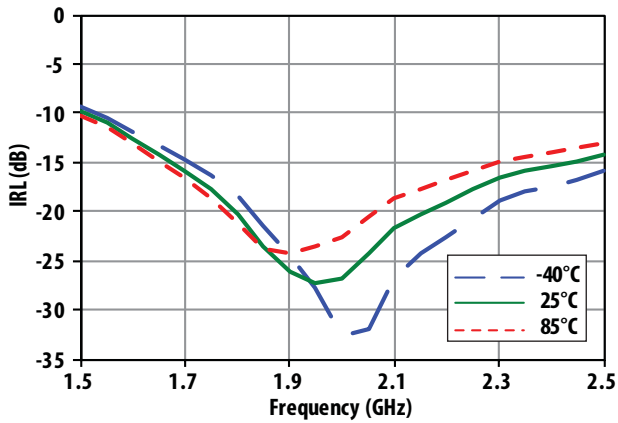


Figure 13. Input Return Loss vs Frequency vs Temperature

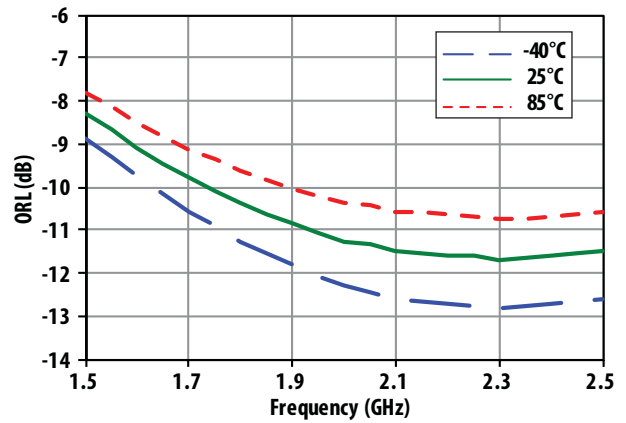


Figure 14. Output Return Loss vs Frequency vs Temperature

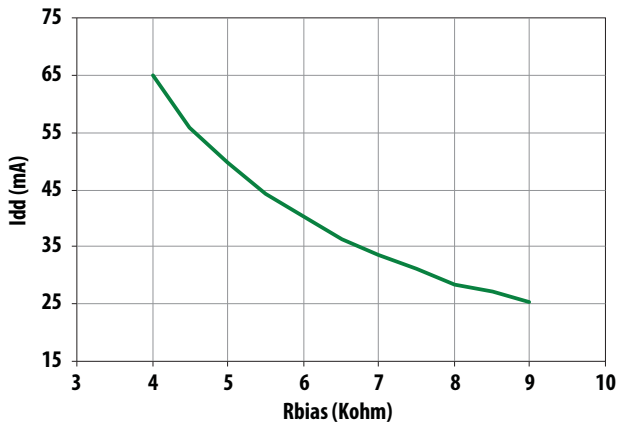


Figure 15. Idd vs Rbias

### MGA-684P8 Typical Scattering Parameters, Vdd = 5 V

Freq GHz	S11		S21			S12		S22	
	Mag.	Ang.	dB	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
0.10	0.91	-16.78	30.68	34.18	158.93	0.00	45.07	0.54	-17.76
0.50	0.62	-58.89	26.12	20.22	116.50	0.01	54.53	0.35	-30.30
0.90	0.45	-81.40	22.58	13.46	93.41	0.01	56.93	0.33	-39.58
1.00	0.42	-85.56	21.83	12.35	88.97	0.02	57.63	0.33	-41.24
1.50	0.33	-101.54	18.76	8.67	70.27	0.02	57.76	0.33	-51.61
1.90	0.29	-113.04	16.88	6.98	57.33	0.03	56.51	0.34	-63.11
2.00	0.28	-115.99	16.47	6.66	54.26	0.03	55.16	0.34	-66.07
2.50	0.27	-131.72	14.62	5.38	39.44	0.03	51.70	0.34	-81.79
3.00	0.28	-146.73	13.02	4.48	25.29	0.04	47.69	0.36	-97.97
4.00	0.35	-164.20	10.29	3.27	-1.28	0.05	38.99	0.41	-128.02
5.00	0.37	-168.83	8.27	2.59	-24.54	0.06	32.11	0.50	-145.67
6.00	0.36	-176.50	7.00	2.24	-46.71	0.08	25.46	0.55	-158.74
7.00	0.36	158.90	5.73	1.93	-72.15	0.10	14.33	0.57	179.26
8.00	0.47	132.96	3.89	1.57	-99.05	0.12	0.48	0.62	148.79
9.00	0.58	123.68	1.47	1.18	-122.64	0.13	-11.23	0.71	126.95
10.00	0.59	115.01	-0.34	0.96	-143.22	0.14	-21.09	0.77	117.70
11.00	0.52	93.03	-1.08	0.88	-166.72	0.19	-35.04	0.77	106.08
12.00	0.49	54.25	-2.56	0.75	161.15	0.22	-58.42	0.76	76.15
13.00	0.58	37.37	-6.12	0.49	132.57	0.21	-78.94	0.82	47.95
14.00	0.65	45.34	-9.98	0.32	115.94	0.20	-87.61	0.87	36.90
15.00	0.65	48.42	-12.83	0.23	100.46	0.22	-94.49	0.86	33.52
16.00	0.57	29.23	-15.49	0.17	72.55	0.26	-111.55	0.80	22.79
17.00	0.55	-6.38	-20.42	0.10	29.92	0.26	-135.35	0.78	2.52
18.00	0.63	-24.55	-26.61	0.05	-29.09	0.23	-152.31	0.83	-10.20
19.00	0.69	-20.93	-26.44	0.05	-92.58	0.21	-162.51	0.85	-19.78
20.00	0.69	-14.10	-23.23	0.07	-128.03	0.21	-173.20	0.83	-32.83

### Typical Noise Parameters, Vdd=5V

Freq GHz	Fmin	Γopt		Rn/50
	dB	Mag.	Ang.	
1.5	0.39	0.135	76.1	0.05
1.9	0.45	0.191	118.2	0.04
2	0.49	0.174	125.9	0.05
2.2	0.61	0.181	139.4	0.04
2.5	0.69	0.204	151.3	0.05

Notes:

1. The Fmin values are based on noise figure measurements at 100 different impedances using Focus source pull test system. From these measurements a true Fmin is calculated.
2. Scattering and noise parameters are measured on coplanar waveguide made on 0.010 inch thick ROGER 4350. The input reference plane is at the end of the RFinpin and the output reference plane is at the end of the RFoutpin as shown in Figure 16.

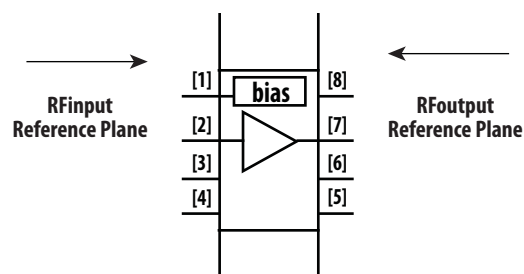
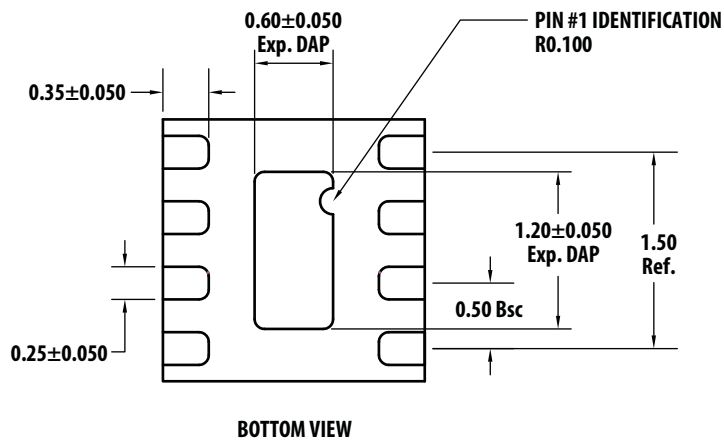
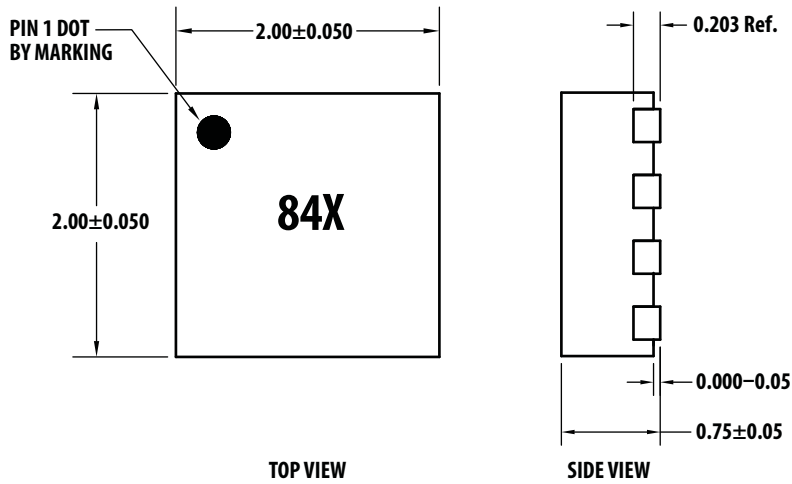


Figure 16.

## SLP4X4 Package



### Notes:

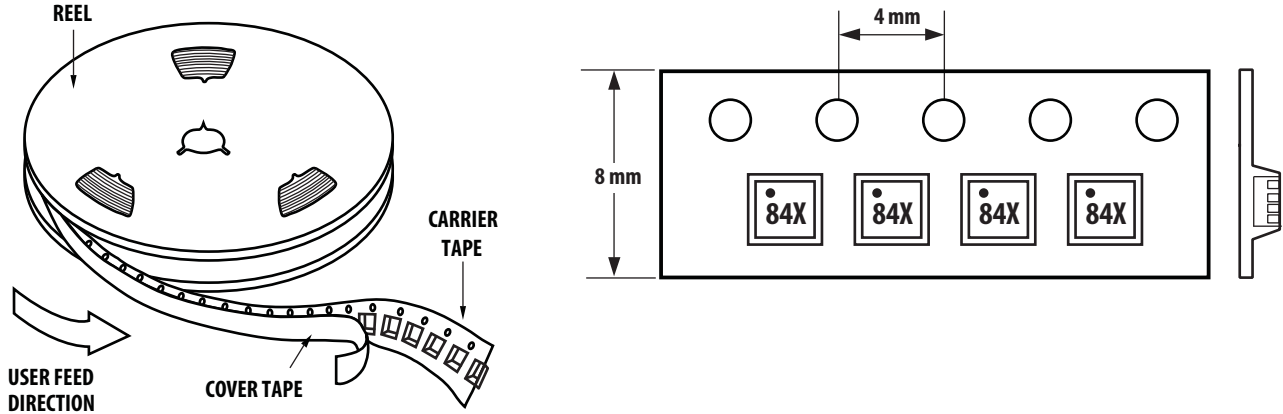
1. All dimensions are in millimeters.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold ash and metal burr.

## Part Number Ordering Information

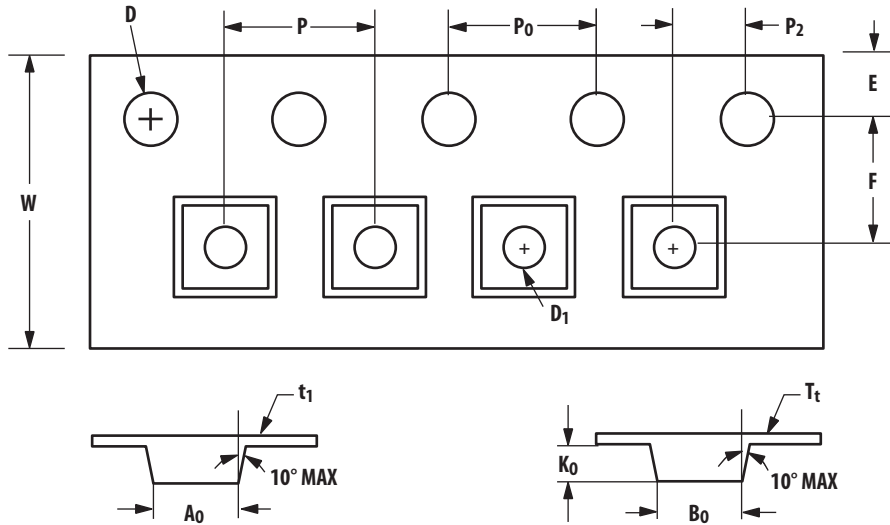
Part Number	No. of Devices	Container
MGA-684P8-BLKG	100	Antistatic Bag
MGA-684P8-TR1G	3000	7 inch Reel



## Device Orientation

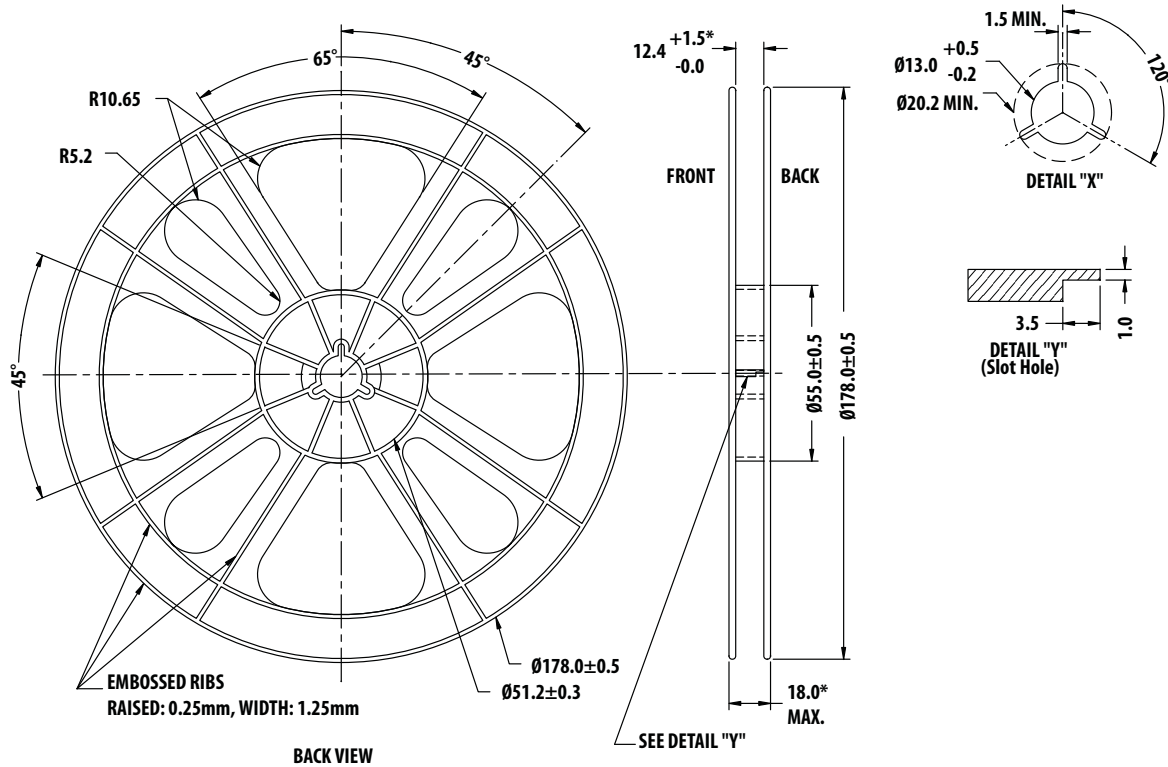
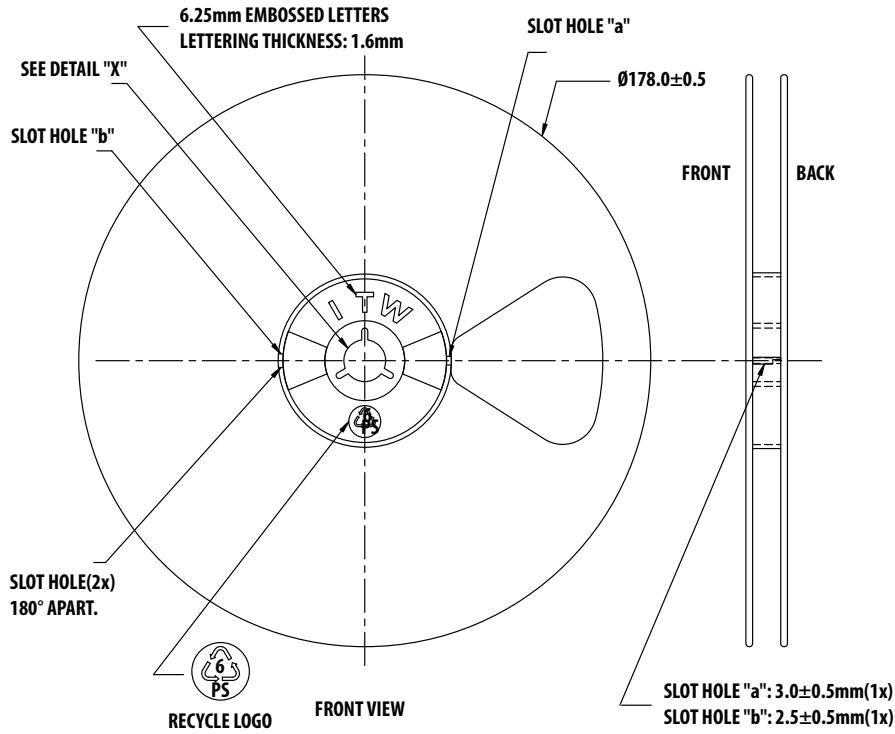


## Tape Dimensions



	DESCRIPTION	SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	$A_0$	$2.30 \pm 0.05$	$0.091 \pm 0.004$
	WIDTH	$B_0$	$2.30 \pm 0.05$	$0.091 \pm 0.004$
	DEPTH	$K_0$	$1.00 \pm 0.05$	$0.039 \pm 0.002$
	PITCH	$P$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
	BOTTOM HOLE DIAMETER	$D_1$	$1.00 + 0.25$	$0.039 + 0.002$
	PERFORATION	DIAMETER	$D$	$1.50 \pm 0.10$
PITCH		$P_0$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
POSITION		$E$	$1.75 \pm 0.10$	$0.069 \pm 0.004$
		$F$	$3.50 \pm 0.05$	$0.138 \pm 0.002$
CARRIER TAPE	WIDTH	$W$	$8.00 \pm 0.30$	$0.315 \pm 0.012$
	THICKNESS	$t_1$	$0.254 \pm 0.02$	$0.010 \pm 0.0008$
COVER TAPE	WIDTH	$C$	$5.4 \pm 0.10$	$0.205 \pm 0.004$
	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)	$P_2$	$2.00 \pm 0.05$	$0.079 \pm 0.002$

# Reel Dimensions – 7 inch



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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