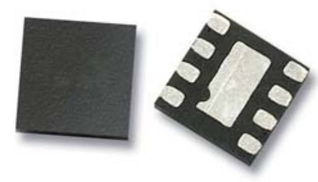
MGA-635P8

Ultra Low Noise, High Linearity Low Noise Amplifier

Data Sheet

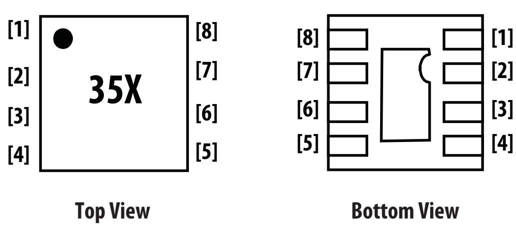


Description

Avago Technologies' MGA-635P8 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 0.25μm GaAs Enhancement-mode pHEMT process. It is housed in a miniature 2.0 x 2.0 x 0.75mm^3 8-pin Quad-Flat-Non-Lead (QFN) package. It is designed for optimum use from 2.3GHz up to 4GHz. The compact footprint and low profile coupled with low noise, high gain and high linearity make the MGA-635P8 an ideal choice as a low noise amplifier for cellular infrastructure for LTE, GSM and CDMA. For optimum performance at lower frequency from 450MHz up to 1.5GHz, MGA-633P8 is recommended. For optimum performance at frequency from 1.5GHz up to 2.3GHz, MGA-634P8 is recommended. All these 3 products, MGA-633P8, MGA-643P8 and MGA-653P8 share the same package and pinout configuration.

Pin Configuration and Package Marking

2.0 x 2.0 x 0.75 mm^3 8-lead QFN



Pin 1 – Vbias
Pin 2 – RFinput
Pin 3 – Not Used
Pin 4 – Not Used
Pin 5 – Not Used
Pin 6 – Not Used
Pin 7 – RFoutput/Vdd
Pin 8 – Not Used

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

Attention: Observe precautions for handling electrostatic sensitive devices.
ESD Machine Model = 50 V (Class A)
ESD Human Body Model = 500 V (Class 1B)
Refer to Avago Application Note A004R: Electrostatic Discharge, Damage and Control.

Features

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

Specifications

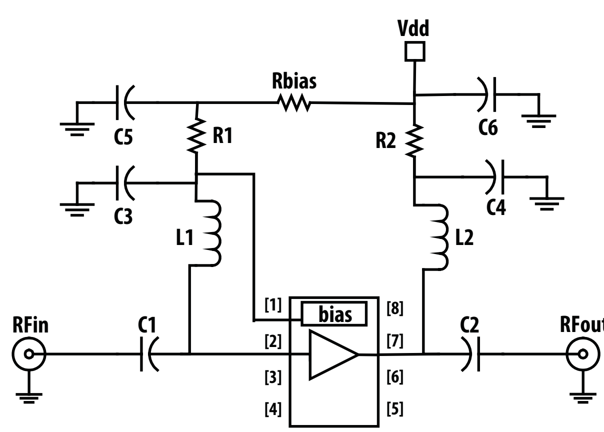
2.5GHz; 5V, 56mA

- 18 dB Gain
- 0.56 dB Noise Figure
- 12.5 dB Input Return Loss
- 35.9 dBm Output IP3
- 22 dBm Output Power at 1dB gain compression

Applications

- Low noise amplifier for cellular infrastructure for LTE, GSM and CDMA.
- Other ultra low noise application.

Simplified Schematic



Note:
- The schematic is shown with the assumption that similar PCB is used for all MGA-633P8, MGA-634P8 and MGA-635P8.
- 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.

Absolute Maximum Rating [1] T_A=25°C

Symbol	Parameter	Units	Absolute Maximum
V_{dd}	Device Voltage, RF output to ground	V	5.5
V_{bias}	Gate Voltage	V	0.7
$P_{in,max}$	CW RF Input Power (V_{dd} = 5.0V, I_d = 50 mA)	dBm	+20
P_{diss}	Total Power Dissipation [2]	W	0.5
T_j	Junction Temperature	°C	150
T_{stg}	Storage Temperature	°C	-65 to 150
T_{amb}	Ambient Temperature	°C	-40 to 85

Thermal Resistance

Thermal Resistance [3] (V_{dd} = 5.0V, I_{dd} = 50mA) θ_{jc} = 75°C/W

Notes:
1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Power dissipation with device turned on. Board temperature T_B is 25°C. Derate at 13mW/°C for T_B>112°C.
3. Thermal resistance measured using Infra-Red Measurement Technique

Electrical Specifications [1], [4]

RF performance at T_A = 25°C, V_{dd} = 5V, R_{bias} = 3.6 kOhm, 2.5 GHz, measured on demo board in Figure 1 with component listed in Table 1 for 2.5 GHz matching.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
I_{dd}	Drain Current	mA	46	56	71
Gain	Gain	dB	16.5	18	19.5
OIP3 [2]	Output Third Order Intercept Point	dBm	32.5	35.9	
NF [3]	Noise Figure	dB		0.56	0.78
OP1dB	Output Power at 1dB Gain Compression	dBm		22	
IRL	Input Return Loss, 50Ω source	dB		12.5	
ORL	Output Return Loss, 50Ω load	dB		12	
REV ISOL	Reverse Isolation	dB		35	

Notes:
1. Measurements at 2.5 GHz obtained using demo board described in Figure 1.
2. OIP3 test condition: F_{RF1} = 2.5 GHz, F_{RF2} = 2.501 GHz with input power of -10dBm 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 device temperature is not exceeded. See absolute maximum ratings and application note for more details.

Product Consistency Distribution Charts [1, 2]

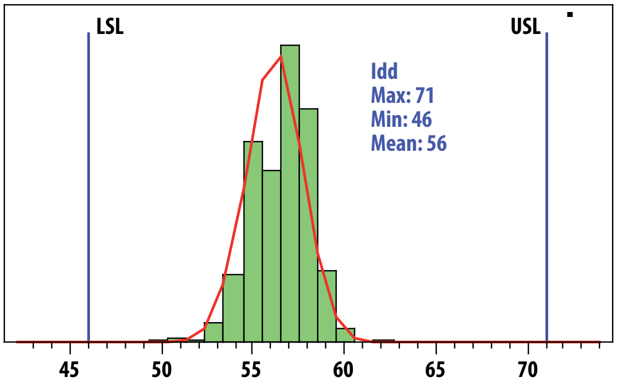


Figure 1. Idd @ 2.5GHz, 5V, 56mA Mean = 56

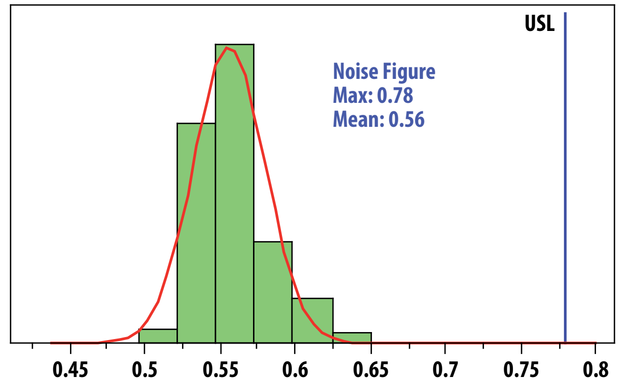


Figure 2. Noise Figure @ 2.5GHz, 5V, 56mA Mean = 0.56

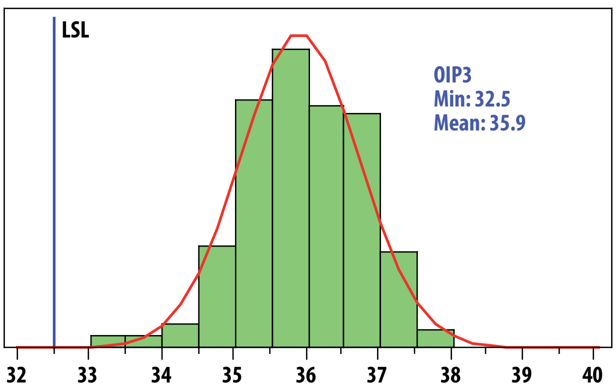


Figure 3. OIP3 @ 2.5GHz, 5V, 56mA Mean = 35.9

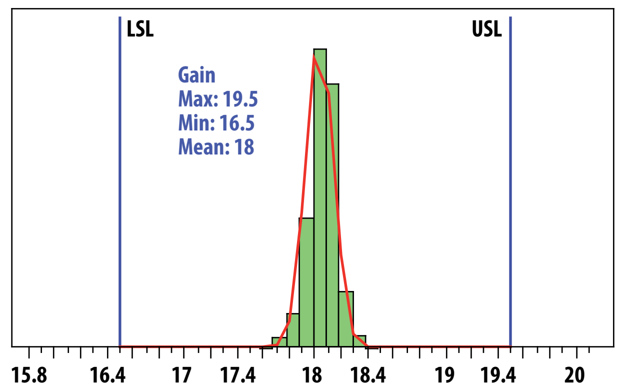


Figure 4. Gain @ 2.5GHz, 5V, 56mA Mean = 18

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

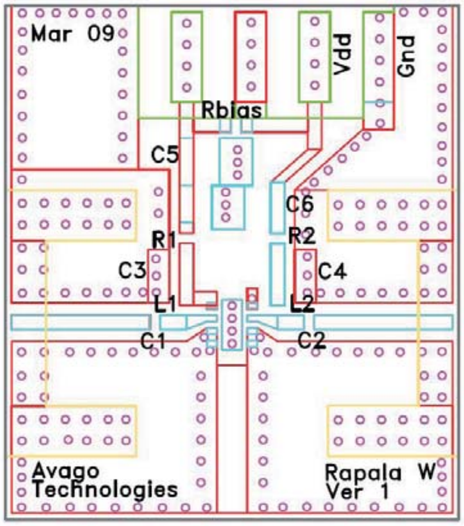


Figure 5. Demo Board Layout Diagram
– Recommended PCB material is 10 mils Rogers R04350.
– Suggested component values may vary according to layout and PCB material.

Demo Board Schematic

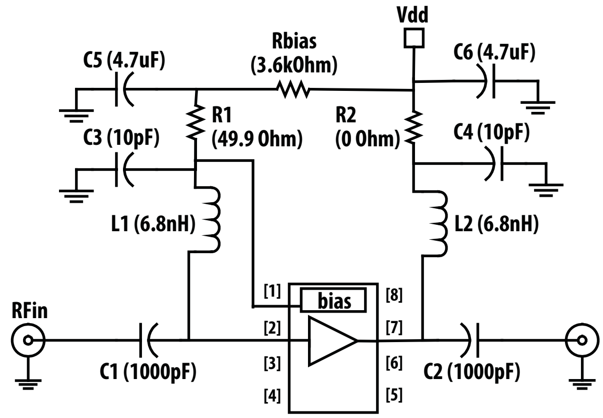


Figure 6. Demo Board Schematic Diagram

Table 1. Component list for 2.5 GHz matching

Part	Size	Value	Detail Part Number
C1, C2	0402	1000pF (Murata)	GRM155R71H102KA01E
L1	0402	6.8nH (CoilCraft)	0402CS-6N8XGLU
L2	0402	6.8nH (Toko)	LLP1005-FH6N8C
C3, C4	0402	10pF (Murata)	GRM1555C1H100JZ01E
C5, C6	0805	4.7uF (Murata)	GRM21BR60J475KA11L
R1	0402	49.9 Ohm (Rohm)	MCR01 MZS F 49R9
R2	0402	0 Ohm (Rohm)	RMC1/16S-JPTH
Rbias	0402	3.6 kohm (KOA)	RK73B1ETTP

Note:
C1, C2 are DC Blocking capacitors
L1 input match for NF
L2 output match for OIP3
C3, C4, C5, C6 are bypass capacitors
R1 is stabilizing resistor
Rbias is the biasing resistor

MGA-635P8 Typical Performance

RF performance at T_A = 25°C, Vdd = 5V, Id = 55mA, measured using 50ohm input and output board, unless otherwise stated. OIP3 test condition: F_{RF1} = 2.5 GHz, F_{RF2} = 2.501 GHz with input power of -10dBm per tone.

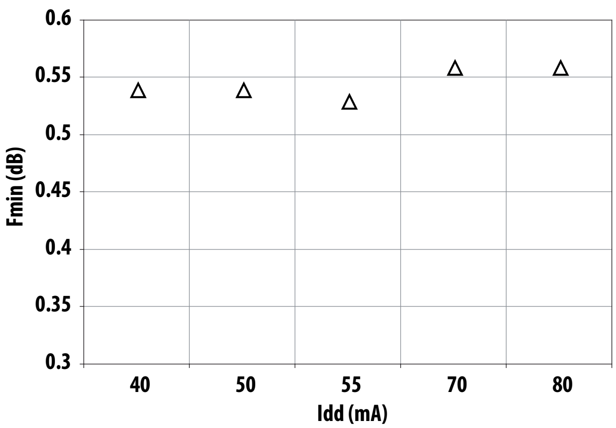


Figure 7. Fmin vs Idd at 5V at 2.5GHz.

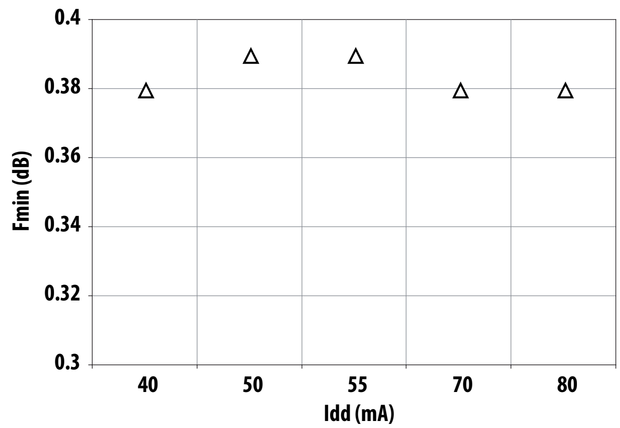


Figure 8. Fmin vs Idd at 5V at 2GHz.

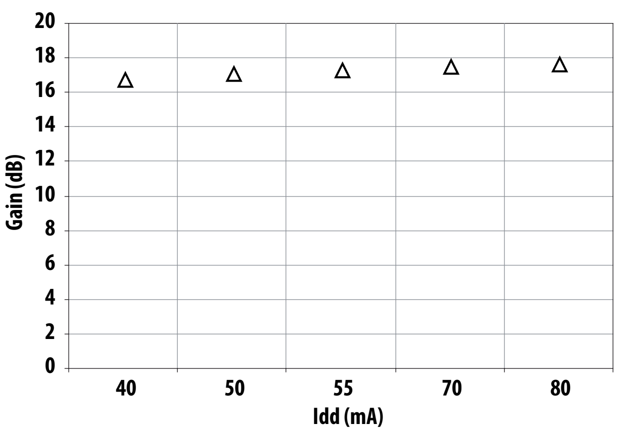


Figure 9. Gain vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2.5GHz.

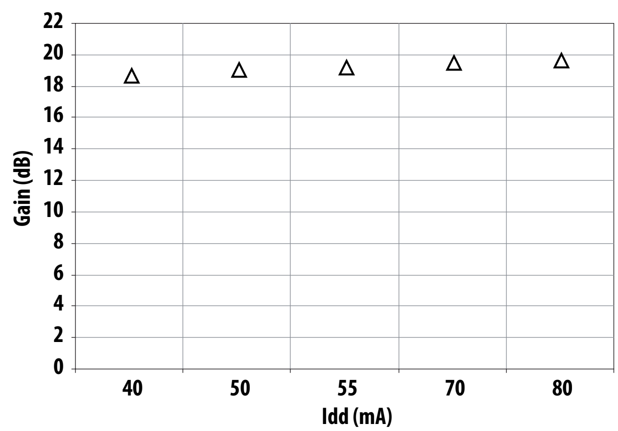


Figure 10. Gain vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2GHz.

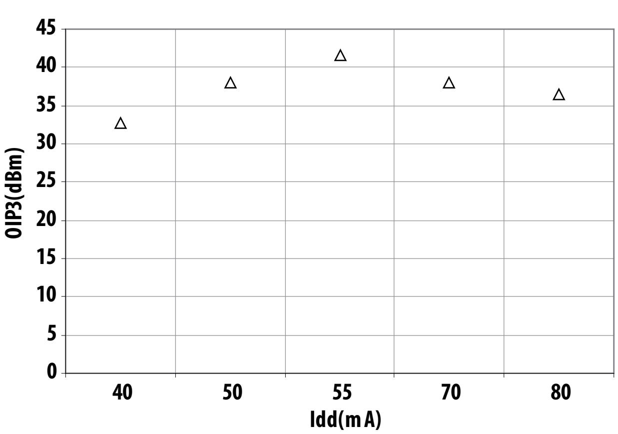


Figure 11. OIP3 vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2.5GHz.

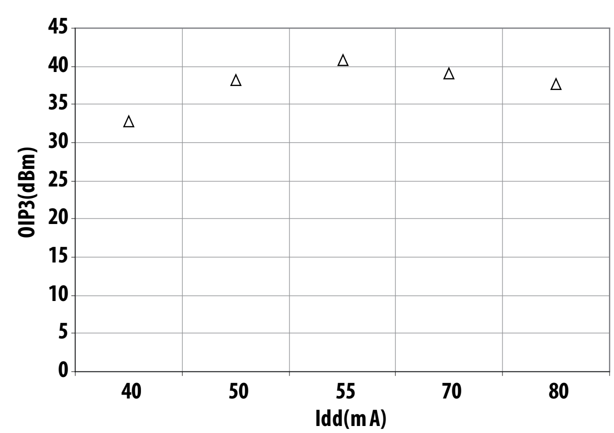


Figure 12. OIP3 vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2GHz.

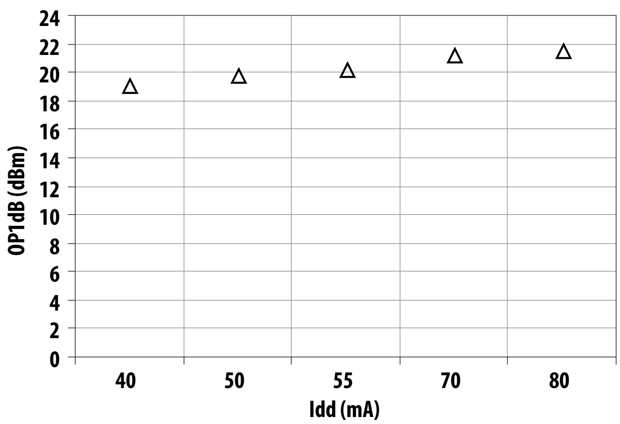


Figure 13. OP1dB vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2.5GHz.

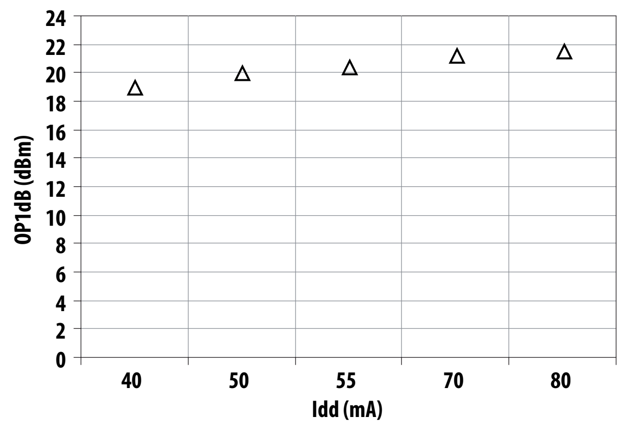


Figure 14. OP1dB vs Idd at 5V Tuned for Optimum OIP3 and Fmin at 2GHz.

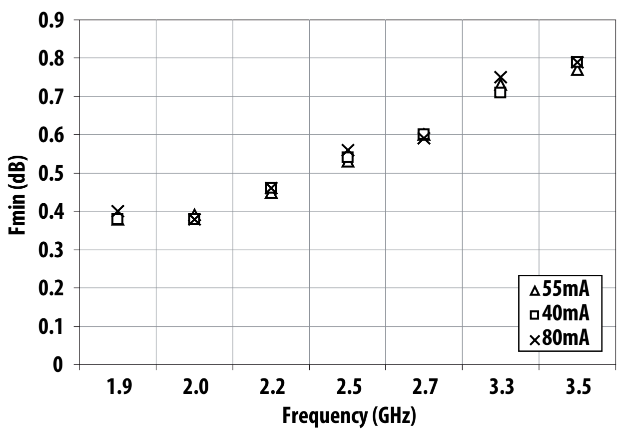


Figure 15. Fmin vs Frequency and Idd at 5V

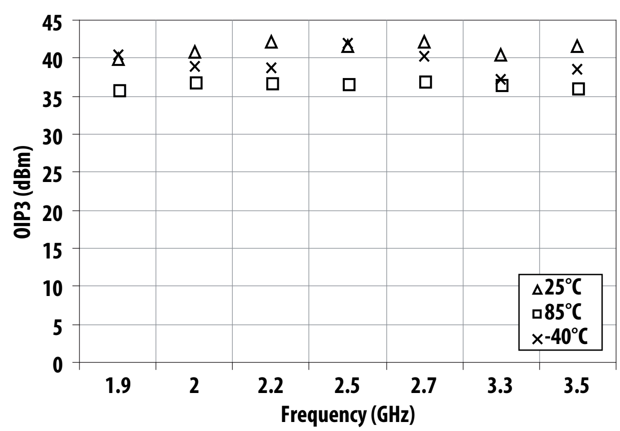


Figure 16. OIP3 vs Frequency and Temperature for Optimum OIP3 and Fmin at 5V 55mA

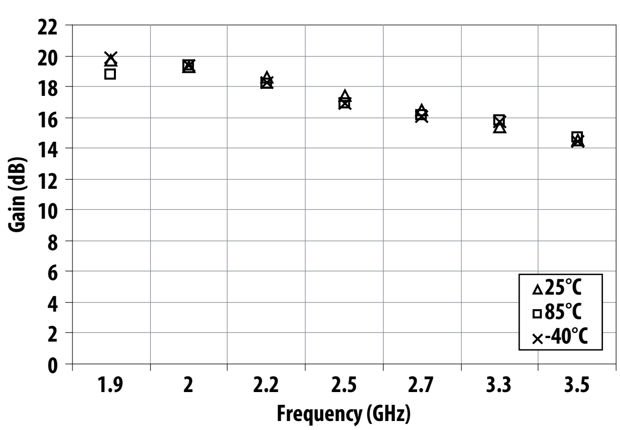


Figure 17. Gain vs Frequency and Temperature for Optimum OIP3 and Fmin at 5V 55mA

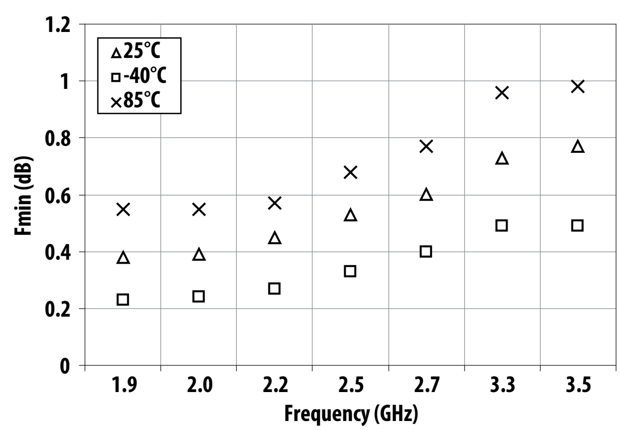


Figure 18. Fmin vs Frequency and Temperature for Optimum OIP3 and Fmin at 5V 55mA

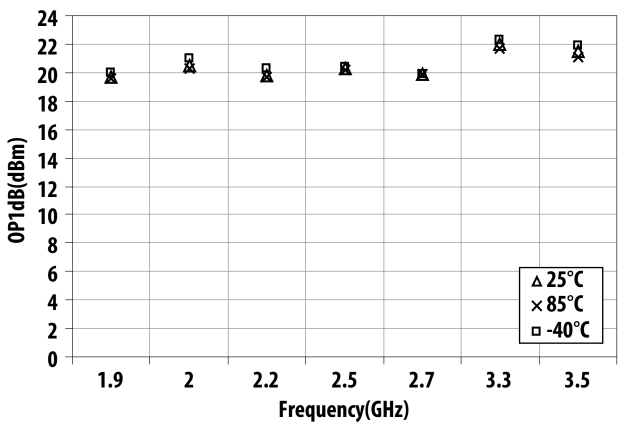


Figure 19. OP1dB vs Frequency and Temperature for Optimum OIP3 and Fmin at 5V 55mA

Below is the table showing the MGA-635P8 Reflection Coefficient Parameters tuned for maximum OIP3, Vdd = 5V, Idd = 55mA

	Gamma Load position			
Frequency (GHz)	**Magnitude**	**Angle**	**OIP3 (dBm)**	**OP1dB (dBm)**
1.9	0.28	-30	39.8	19.66
2	0.28	-60	40.9	20.46
2.2	0.28	-60	42.2	19.76
2.5	0.28	-60	41.63	20.26
2.7	0.28	-60	42.17	19.86
3.3	0.14	0	40.44	21.98
3.5	0.14	-60	41.5	21.46

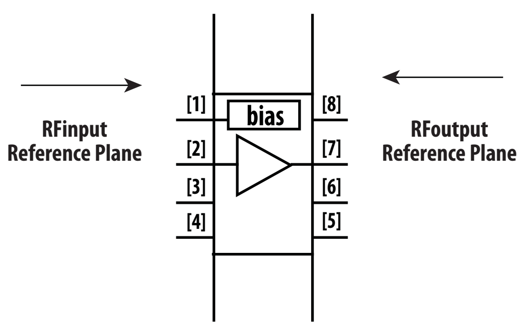


Figure 20

Notes:
1. The maximum OIP3 values are calculated based on Load pull measurements on approximately 136 different impedances using Focus' Load Pull test system.
2. Measurements are conducted on 0.010 inch think ROGER 4350. The input reference plane is at the end of the RFin pin and the output reference plane is at the end of the RFout pin as shown in Figure 20.
3. Gamma Load for maximum OIP3 with biasing of 5V 40mA, 5V 50mA, 5V 55mA, 5V 70mA and 5V 80mA from 1.9GHz to 3.5GHz are available upon request.

MGA-635P8 Typical Performance in Demoboard

RF performance at T_A = 25°C, Vdd = 5V, Rbias = 3.6kOhm, measured on demo board in Figure. 5 with component list in Table 1 for 2.5 GHz matching, unless otherwise stated.

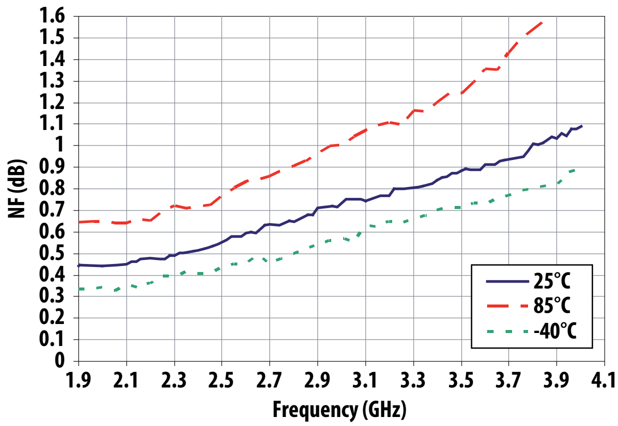


Figure 21. NF vs Frequency vs Temperature

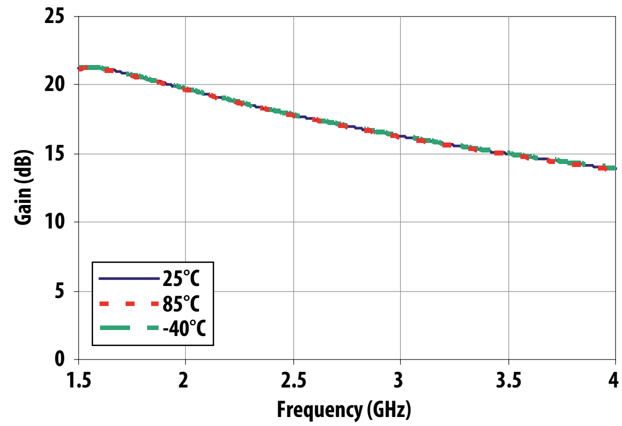


Figure 22. Gain vs Frequency vs Temperature

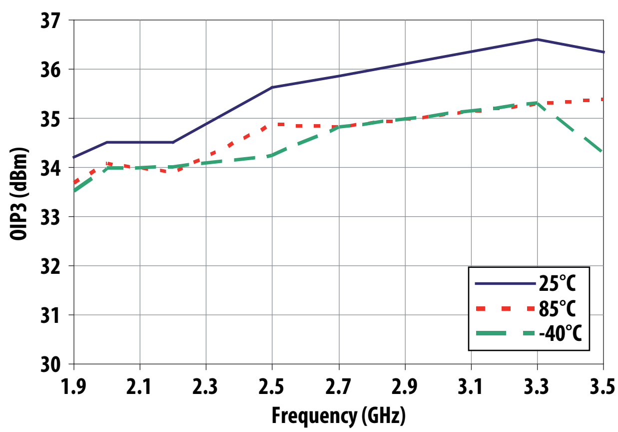


Figure 23. OIP3 vs Frequency vs Temperature

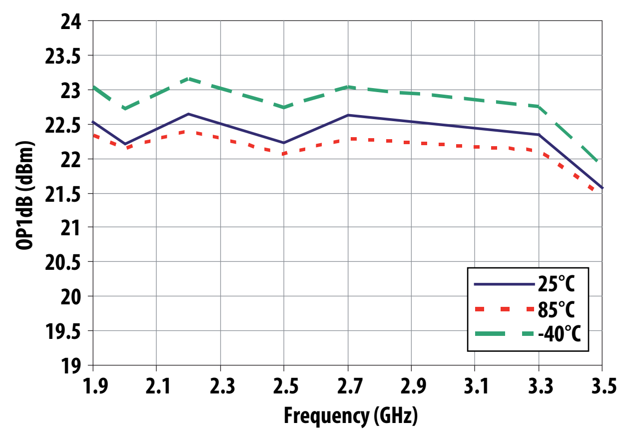


Figure 24. OP1dB vs Frequency vs Temperature

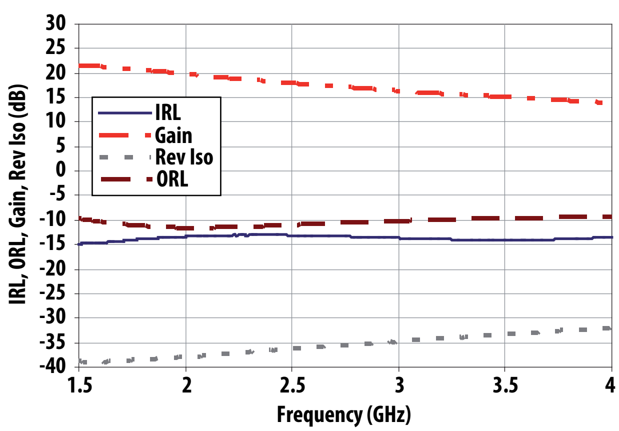


Figure 25. S-Parameter performance with DUT on demoboard shown in Figure 1.

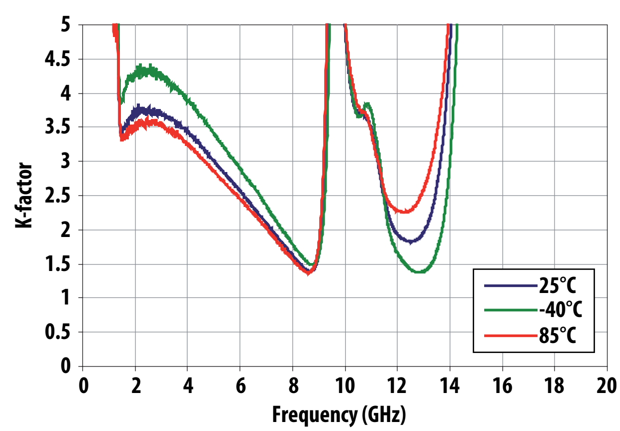


Figure 26. K-factor vs Frequency vs Temperature

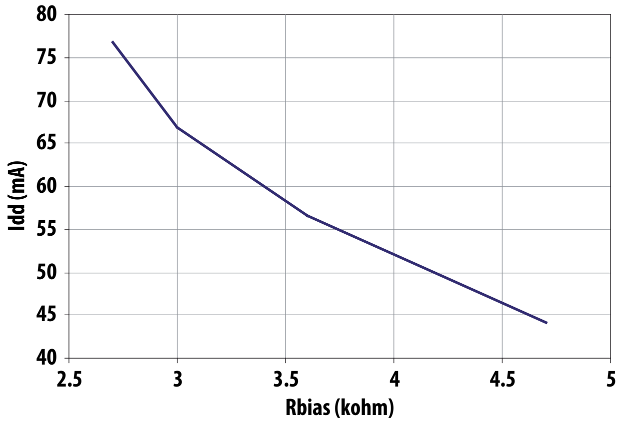


Figure 27. Idd vs Rbias

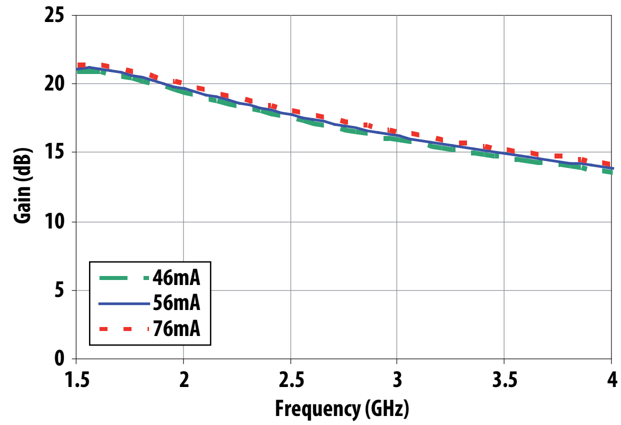


Figure 28. Gain vs Frequency vs Idd

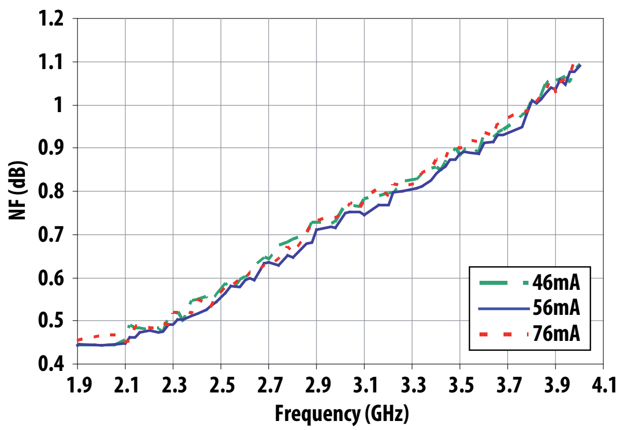


Figure 29. NF vs Frequency vs Idd

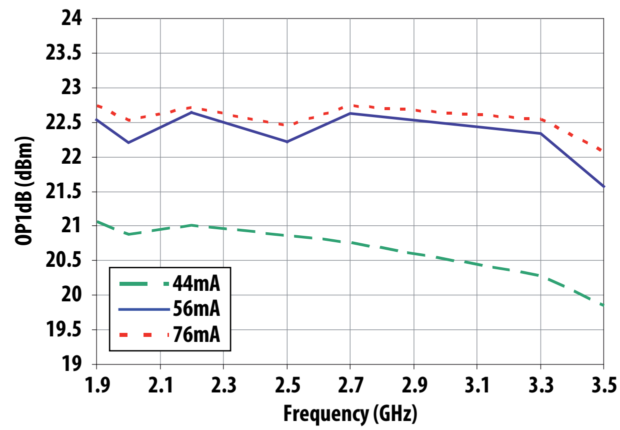


Figure 30. OP1dB vs Frequency vs Idd

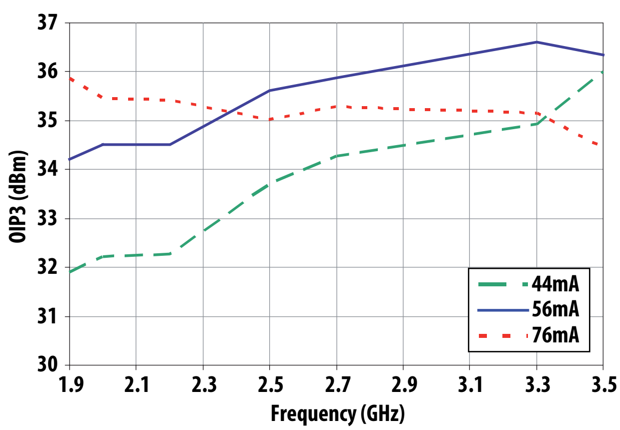


Figure 31. OIP3 vs Frequency vs Idd

MGA-635P8 Typical Scattering Parameters, Vdd = 5V, Idd = 55mA

Freq	S11		S21			S12		S22	
GHz	Mag.	Ang.	dB	Mag.	Ang.	Mag.	Ang.	Mag.	Ang.
0.10	0.24	-164.18	4.79	1.74	-116.80	0.00	28.89	0.97	165.96
0.50	0.51	146.66	12.63	4.28	-176.70	0.00	11.09	0.76	95.52
0.90	0.51	54.95	21.10	11.35	146.58	0.00	127.98	0.53	27.80
1.00	0.43	22.28	22.61	13.51	120.90	0.00	108.37	0.45	4.76
1.50	0.18	-140.63	21.25	11.55	44.76	0.01	21.99	0.32	-18.00
1.90	0.21	148.17	20.14	10.16	-12.86	0.01	-17.75	0.27	-100.37
2.00	0.22	134.07	19.66	9.62	-26.25	0.01	-27.60	0.26	-117.68
2.50	0.22	82.31	17.84	7.80	-79.07	0.02	-66.00	0.28	177.67
3.00	0.21	32.06	16.24	6.49	-129.74	0.02	-104.02	0.31	123.03
4.00	0.21	-75.77	13.85	4.93	136.31	0.02	-176.60	0.33	27.43
5.00	0.34	-170.25	11.82	3.90	43.71	0.03	108.97	0.34	-72.61
6.00	0.49	117.14	9.60	3.02	-47.56	0.04	32.85	0.40	-172.92
7.00	0.58	55.67	7.36	2.33	-135.54	0.05	-41.28	0.49	100.13
8.00	0.65	-0.44	5.76	1.94	137.70	0.06	-115.67	0.52	23.58
9.00	0.77	-61.44	4.57	1.69	26.68	0.07	144.09	0.29	-19.28
10.00	0.57	-132.08	-3.33	0.68	-13.14	0.04	114.32	0.76	-86.10
11.00	0.43	154.00	-1.88	0.81	-93.83	0.06	48.62	0.74	-157.05
12.00	0.34	46.54	-0.76	0.92	-178.96	0.10	-31.73	0.75	128.18
13.00	0.48	-77.31	-0.38	0.96	75.14	0.13	-130.43	0.56	29.77
14.00	0.66	-167.80	-4.09	0.62	-39.54	0.08	121.55	0.32	-127.96
15.00	0.74	128.38	-10.45	0.30	-127.69	0.05	64.82	0.38	123.39
16.00	0.82	75.84	-14.01	0.20	159.83	0.05	-35.43	0.54	75.09
17.00	0.79	21.15	-16.61	0.15	89.69	0.02	-156.96	0.55	19.53
18.00	0.64	-32.15	-16.86	0.14	17.83	0.01	-81.66	0.58	2.24
19.00	0.24	-33.81	-20.44	0.10	-71.49	0.03	155.22	0.71	-44.84
20.00	0.06	-112.21	-18.83	0.11	-156.50	0.12	66.14	0.70	-107.02

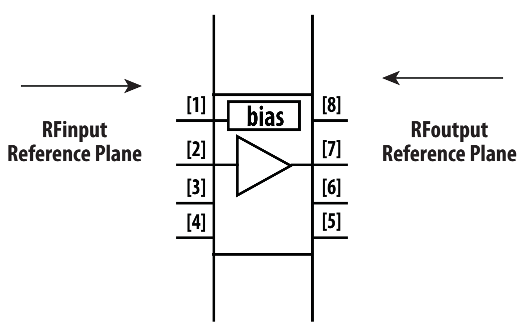


Figure 32

Typical Noise Parameters, Vdd = 5V, Idd = 55mA

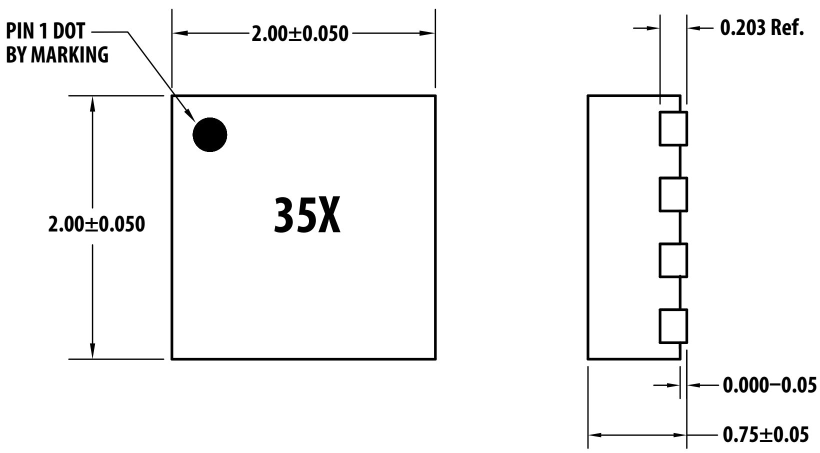
Freq GHz	Fmin dB	Γ_{opt} Mag.	Γ_{opt} Ang.	$R_{n/50}$
1.9	0.38	0.2	95.5	0.05
2	0.39	0.206	96.4	0.06
2.2	0.45	0.205	113.2	0.05
2.5	0.53	0.216	128.8	0.05
2.7	0.60	0.214	163.5	0.04
3.3	0.73	0.292	172.7	0.04
3.5	0.77	0.289	174.7	0.04

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 RFinput pin and the output reference plane is at the end of the RFoutput pin as shown in figure 32.
3. S2P file with scattering and noise parameters for biasing 5V 40mA, 5V 55mA, 5V 70mA and 5V 80mA are available upon request.

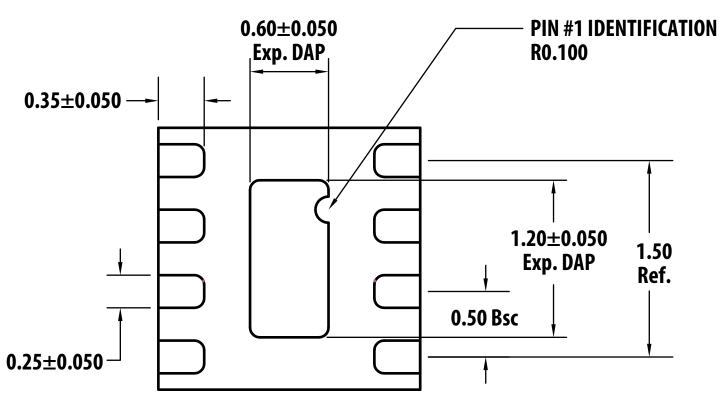
Part Number Ordering Information

Part Number	No. of Devices	Container
MGA-635P8-BLKG	100	Antistatic Bag
MGA-635P8-TR1G	3000	7 inch Reel

SLP2X2 Package



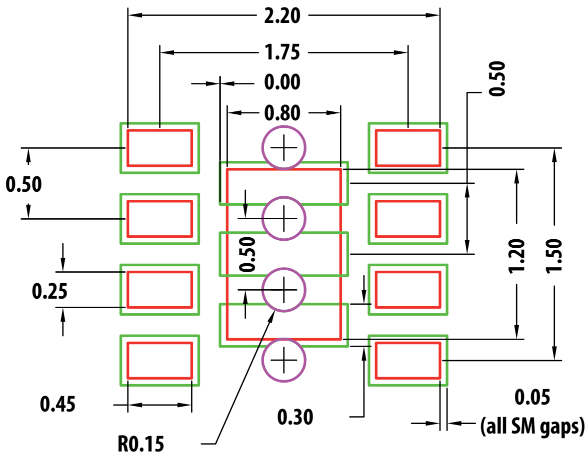
Top View **Side View**



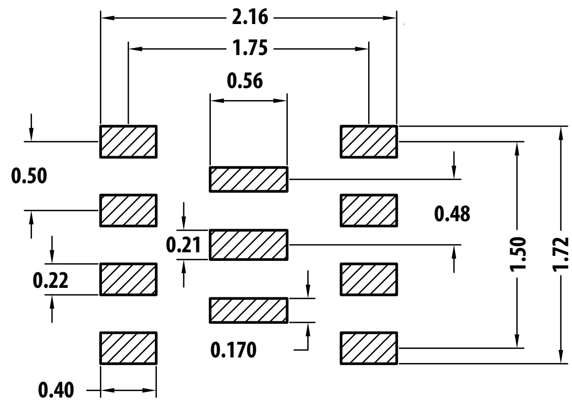
Bottom View

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

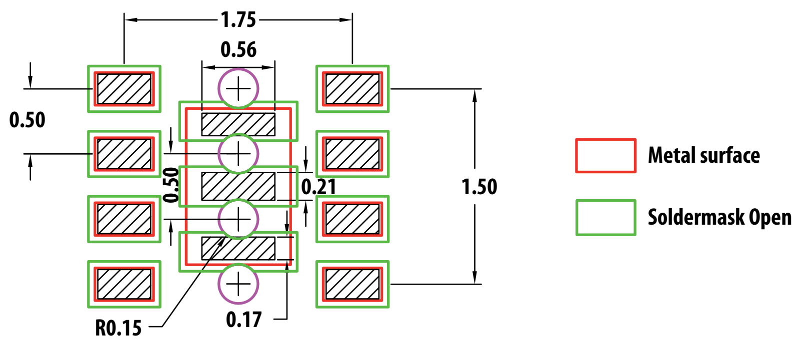
Recommended PCB Land Pattern and Stencil Design



Land Pattern



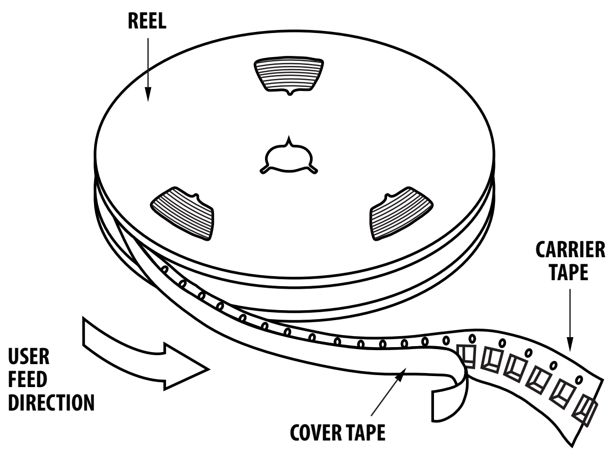
Stencil Opening

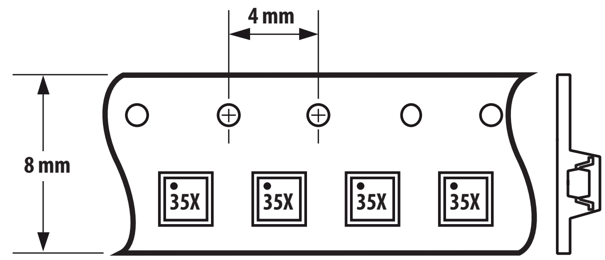


Combination of Land Pattern and Stencil Opening

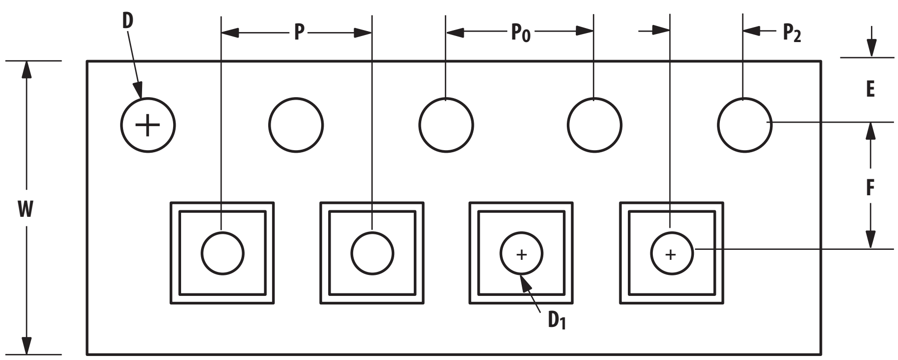
Note:
1. Recommended Land Pattern and Stencil Opening
2. Stencil thickness is 0.1mm (4 mils)
3. All dimension are in mm unless otherwise specified

Device Orientation



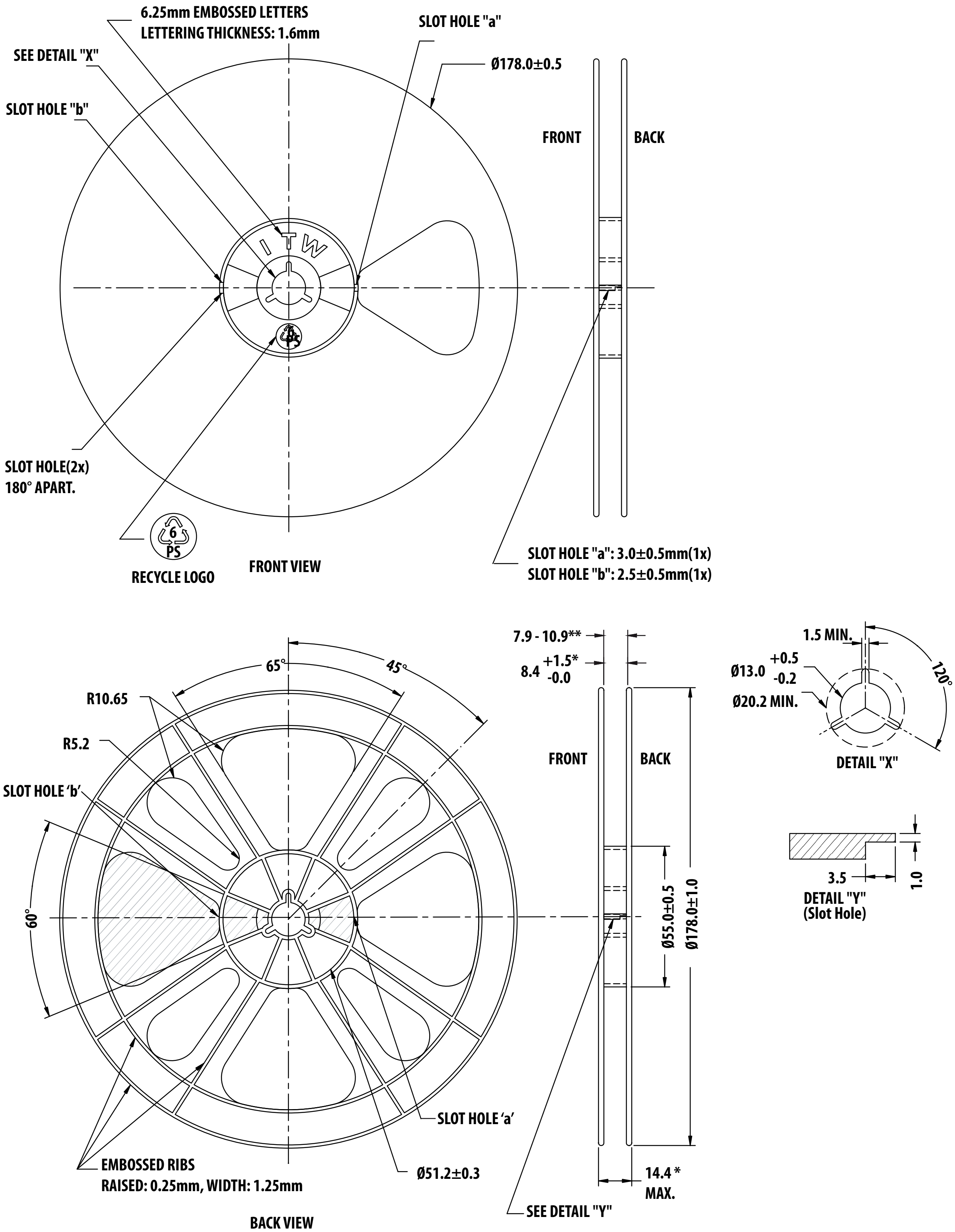


Tape Dimensions



	DESCRIPTION	SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	A_0	2.30 ± 0.05	0.091 ± 0.004
	WIDTH	B_0	2.30 ± 0.05	0.091 ± 0.004
	DEPTH	K_0	1.00 ± 0.05	0.039 ± 0.002
	PITCH	P	4.00 ± 0.10	0.157 ± 0.004
	BOTTOM HOLE DIAMETER	D_1	1.00 + 0.25	0.039 + 0.002
PERFORATION	DIAMETER	D	1.50 ± 0.10	0.060 ± 0.004
	PITCH	P_0	4.00 ± 0.10	0.157 ± 0.004
	POSITION	E	1.75 ± 0.10	0.069 ± 0.004
CARRIER TAPE	WIDTH	W	8.00 ± 0.30 8.00 ± 0.10	0.315 ± 0.012 0.315 ± 0.004
	THICKNESS	t_1	0.254 ± 0.02	0.010 ± 0.0008
COVER TAPE	WIDTH	C	5.4 ± 0.10	0.205 ± 0.004
	TAPE THICKNESS	T_t	0.062 ± 0.001	0.0025 ± 0.0004
DISTANCE	CAVITY TO PERFORATION (WIDTH DIRECTION)	F	3.50 ± 0.05	0.138 ± 0.002
	CAVITY TO PERFORATION (LENGTH DIRECTION)	P_2	2.00 ± 0.05	0.079 ± 0.002

Reel Dimensions – 7 inch



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

AV02-2545N - August 26, 2010