

MGA-43013

High Linearity 728 - 756 MHz Power Amplifier Module



Data Sheet

Description

Avago Technologies' MGA-43013 is a fully matched power amplifier for use in the (728 – 756) MHz band. High linear output power at 5 V is achieved through the use of Avago Technologies' proprietary 0.25 μm GaAs Enhancement-mode pHEMT process. MGA-43013 is housed in a miniature 5.0 mm × 5.0 mm molded chip-on-board (MCOB) module package. A detector is also included on-chip. The compact footprint coupled with high gain, high linearity and good efficiency, makes the MGA-43013 an ideal choice as a power amplifier for small cell BTS PA applications.

Applications

- Final stage high linearity amplifier for Picocell and Enterprise Femtocell PA targeted for small cell BTS downlink applications.

Component Image

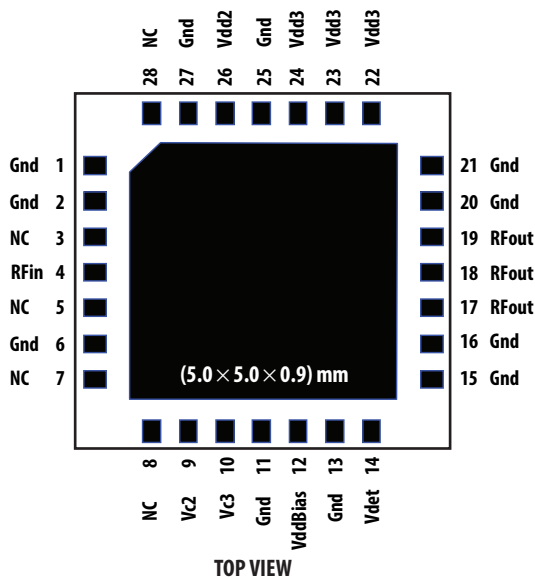


TOP VIEW

5.0 × 5.0 × 0.9 mm Package Outline

Notes:
 Package marking provides orientation and identification
 "43013" = Device part number
 "YYWW" = Year and work week
 "XXXX" = Assembly lot number

Pin Configuration



Features

- High linearity performance: Typ. -48 dBc ACLR1 [1] at 25 dBm linear output power (biased with 5 V supply)
- High Gain: 33.1 dB
- Good efficiency
- Fully matched
- Built-in detector
- GaAs E-pHEMT Technology [2]
- Low-cost small package size: (5.0 × 5.0 × 0.9) mm
- MSL3
- Lead-free/Halogen-free/RoHS compliance

Specifications

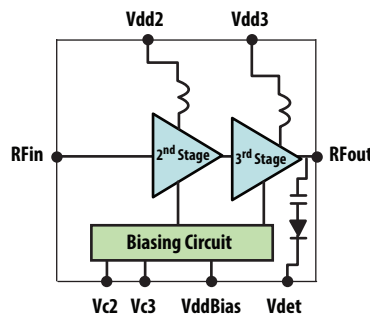
751 MHz; 5.0 V, Idqtotal = 270 mA (typ), LTE DL 10MHz 50 RB ETM 1.1 downlink signal

- PAE : 12.4%
- 25 dBm linear Pout @ ACLR1 = -48 dBc [1]
- 33.1 dB Gain
- Detector range : 20 dB

Notes:

- LTE DL 10 MHz 50 RB ETM 1.1
- Enhancement mode technology employs positive VGS, thereby eliminating the need of negative gate voltage associated with conventional depletion mode devices.

Functional Block Diagram



Attention: Observe precautions for handling electrostatic sensitive devices.
 ESD Machine Model = 60 V
 ESD Human Body Model = 400 V
 Refer to Avago Application Note A004R:
Electrostatic Discharge, Damage and Control.

Absolute Maximum Rating^[1] $T_A = 25\text{ }^\circ\text{C}$

Symbol	Parameter	Units	Absolute Max.
V_{dd}, V_{ddBias}	Supply voltages, bias supply voltage	V	6
V_c	Control Voltage	V	(Vdd)
$P_{in,max}$	CW RF Input Power	dBm	20
P_{diss}	Total Power Dissipation ^[3]	W	4.9
T_j	Junction Temperature	$^\circ\text{C}$	150
T_{STG}	Storage Temperature	$^\circ\text{C}$	-65 to 150

Thermal Resistance^[2,3]

$$\theta_{jc} = 15.7\text{ }^\circ\text{C/W}$$

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. Board temperature (T_B) is $25\text{ }^\circ\text{C}$, for $T_B > 73\text{ }^\circ\text{C}$ derate the device power at 63 mW per $^\circ\text{C}$ rise in Board (package belly) temperature.

Electrical Specifications

$T_A = 25\text{ }^\circ\text{C}$, $V_{dd} = V_{ddBias} = 5.0\text{ V}$, $V_{c2} = 3\text{ V}$, $V_{c3} = 2.6\text{ V}$, $I_{dqttotal} = 270\text{ mA}$, RF performance at 751 MHz, LTE DL 10 MHz 50 RB ETM 1.1 downlink signal operation, unless otherwise stated

Symbol	Parameter and Test Condition	Frequency (MHz)	Units	Min.	Typ.	Max.
V_{dd}	Supply Voltage		V	-	5.0	-
$I_{dqttotal}$	Quiescent Supply Current		mA	-	270	-
Gain	Gain		dB	31	33.1	-
OP1dB	Output Power at 1 dB Gain Compression		dBm	-	34	-
ACLR1 @ $P_{out} = 25\text{ dBm}$	LTE DL 10MHz 50RB ETM1.1 downlink signal	733	dBc	-	-48.5	-
		739		-48.5		
		751		-47.6		
PAE	Power Added Efficiency		%	10	12.4	-
$ S_{11} $	Input Return Loss, 50 Ω source		dB	-	15	-
DetR	Detector RF dynamic range		dB	-	20	-
2fo	2fo Harmonics (LTE DL 10MHz 50RB ETM1.1 downlink signal)		dBc	-	-39	-

Product Consistency Distribution Charts [4]

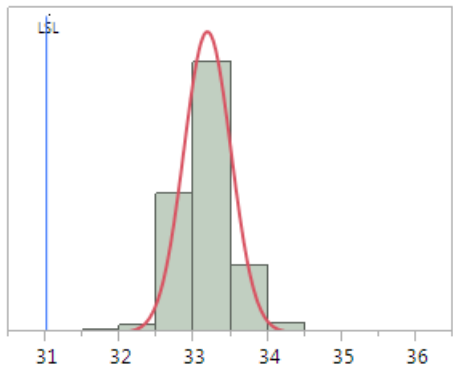


Figure 1. Gain at Pout=25dBm, LSL= 31dB, nominal = 33.1dB

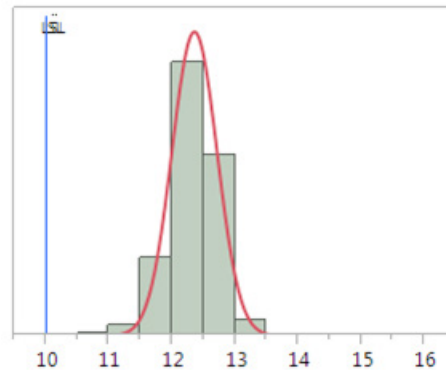


Figure 2. PAE at Pout=25dBm, LSL=10%, nominal = 12.4%

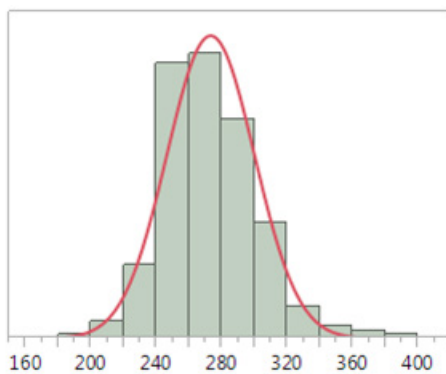


Figure 3. Idqtotal, Nominal = 270mA

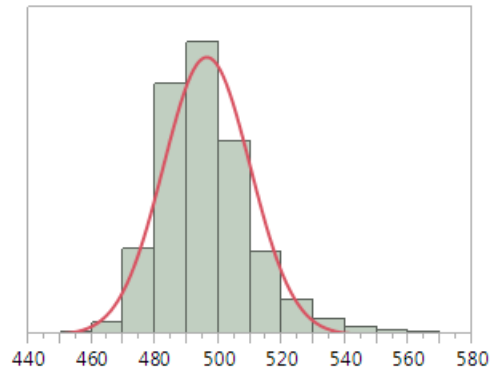


Figure 4. Idd_Total at Pout=25dBm, nominal = 495mA

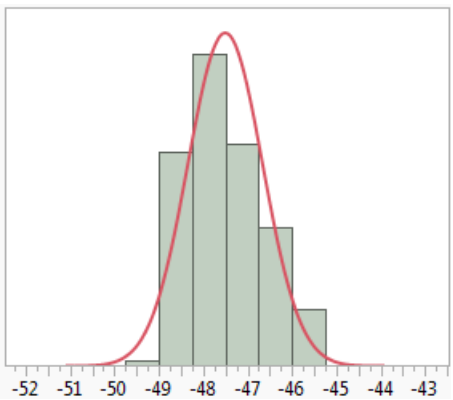


Figure 5. ACLR1 at Pout=25dBm, nominal = -47.6dBc

Note:

- Distribution data sample size is 2100 samples taken from three wafer lots. $T_A = 25^\circ\text{C}$, $V_{dd} = V_{ddBias} = 5.0\text{ V}$, $V_{c2} = 3\text{ V}$, $V_{c3} = 2.6\text{ V}$, RF performance at 751 MHz, unless otherwise stated. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.

MGA-43013 typical over-temperature performance at $V_{c2} = 3\text{ V}$, $V_{c3} = 2.6\text{ V}$ ($V_{dd} = V_{ddBias} = 5\text{ V}$) as shown in Figure 20 unless otherwise stated

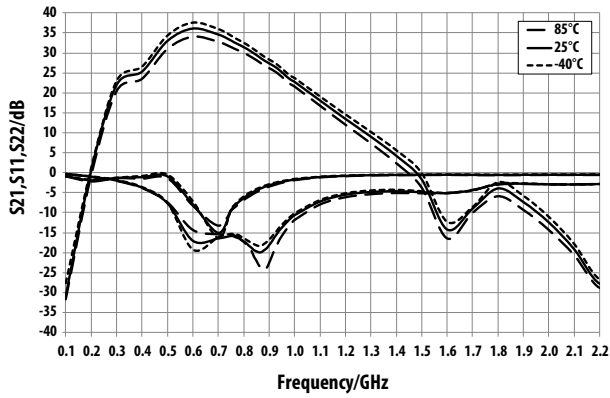


Figure 6. Small-signal performance Over-temperature, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

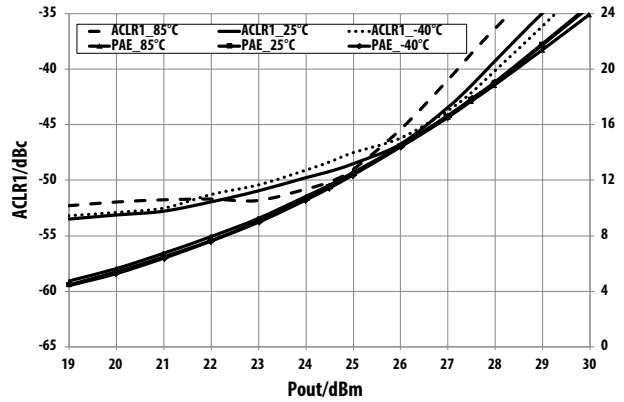


Figure 7. Over-temperature ACLR1, PAE vs Pout @ 733MHz, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

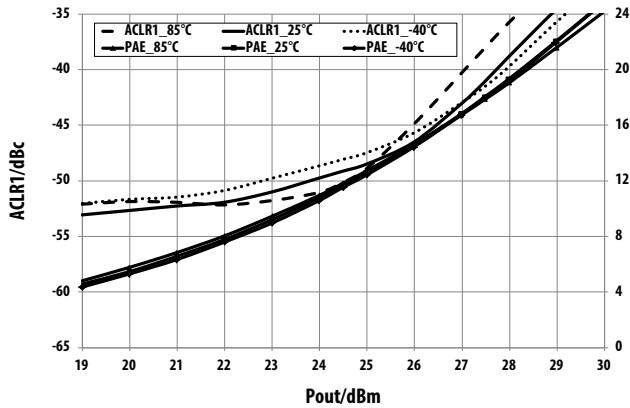


Figure 8. Over-temperature ACLR1, PAE vs Pout @ 739MHz, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

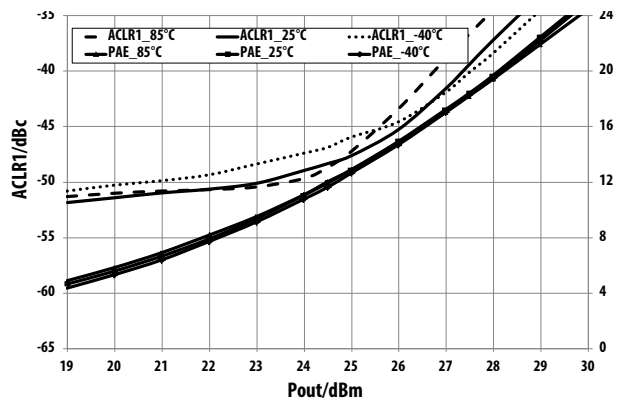


Figure 9. Over-temperature ACLR1, PAE vs Pout @ 751MHz, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

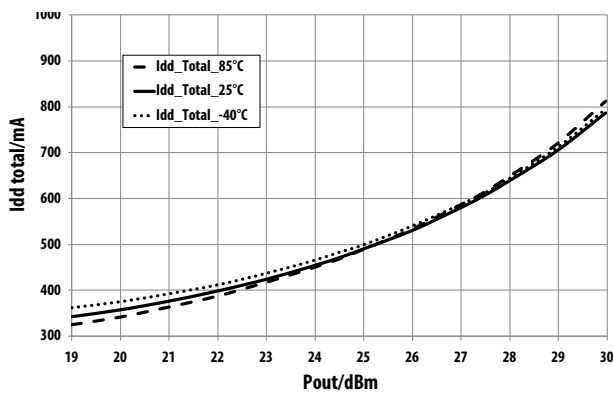


Figure 10. Over-temperature Idd_Total vs Pout @ 751MHz, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

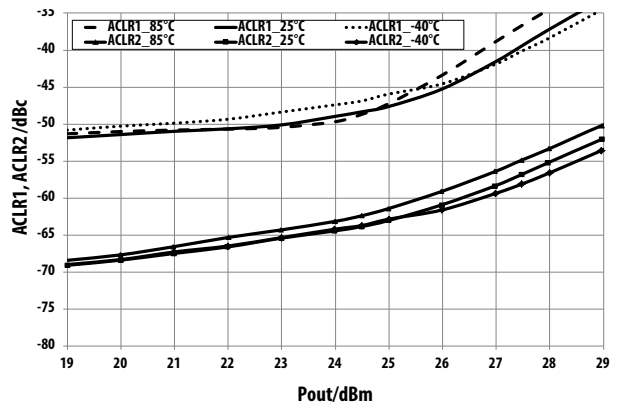


Figure 11. Over-temperature ACLR1, ACLR2 vs Pout @ 751MHz, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

MGA-43013 typical over-temperature performance at $V_{c2} = 3\text{ V}$, $V_{c3} = 2.6\text{ V}$ ($V_{dd} = V_{ddBias} = 5\text{ V}$) as shown in Figure 20 unless otherwise stated

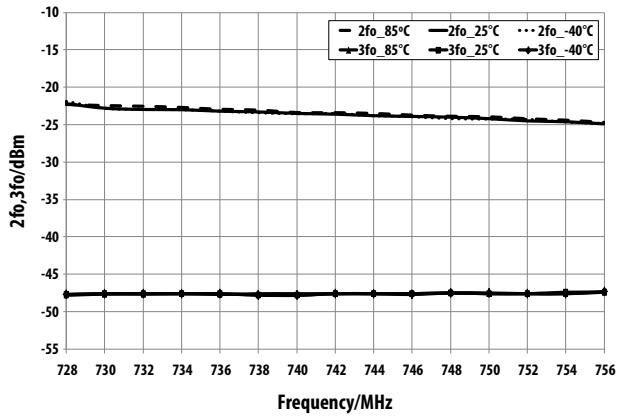


Figure 12. Over-temperature 2nd, 3rd Harmonics vs Freq at $P_{out}=25\text{dBm}$, $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

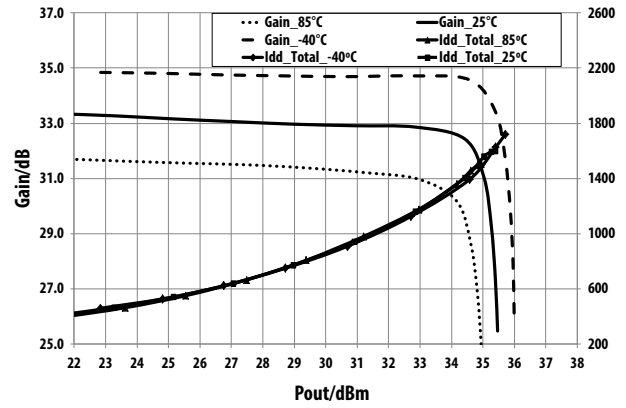


Figure 13. Over-temperature Gain, I_{dd_Total} vs P_{out} @ 733MHz , $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

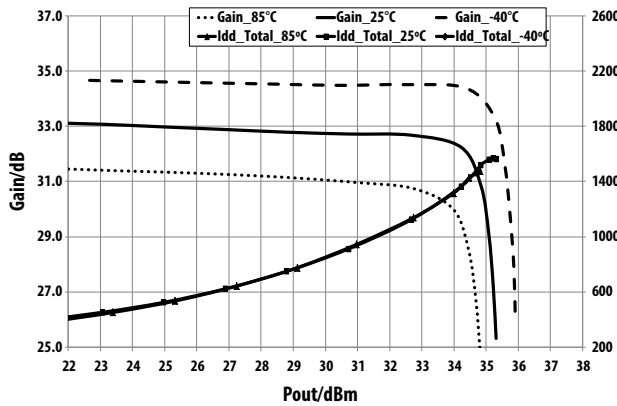


Figure 14. Over-temperature Gain, I_{dd_Total} vs P_{out} @ 739MHz , $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

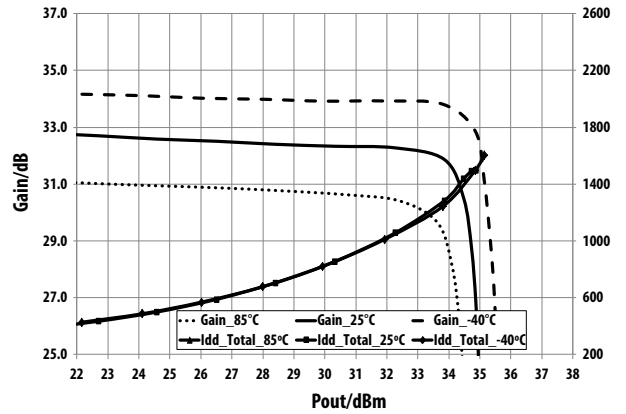


Figure 15. Over-temperature Gain, I_{dd_Total} vs P_{out} @ 751MHz , $V_{dd}=V_{ddBias}=5.0\text{V}$ operating voltage

MGA-43013 typical LTE DL 10 MHz 50 RB ETM 1.1 Spectrum Emission Mask performance at Vdd=VddBias=5.0V, Vc2=3V, Vc3=2.6V unless otherwise stated

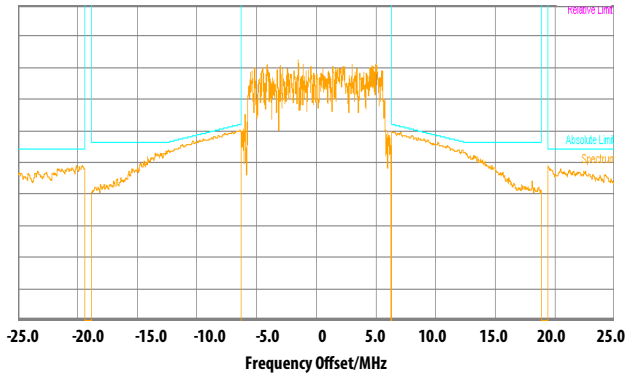


Figure 16. SEM at P_{out} = 31 dBm @ 733 MHz

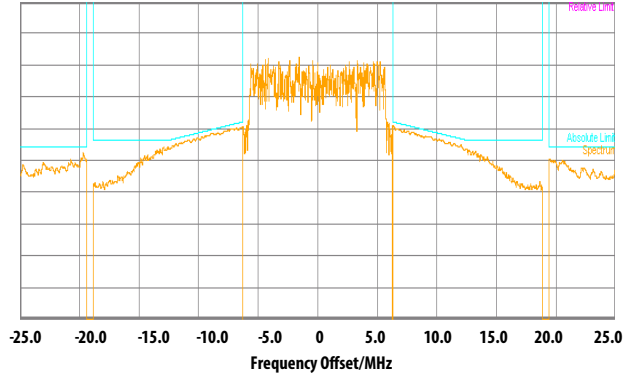


Figure 17. SEM at P_{out} = 31 dBm @ 739 MHz

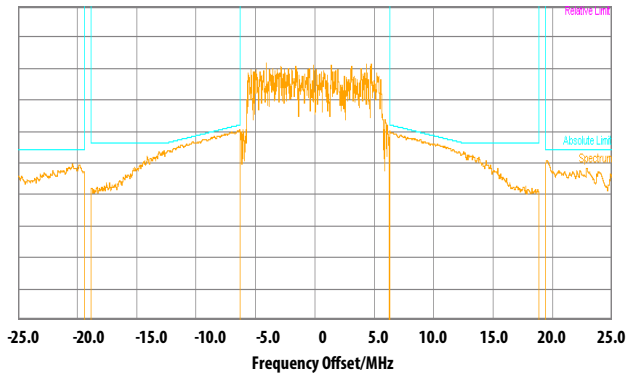


Figure 18. SEM at P_{out} = 31 dBm @ 751 MHz

S-Parameter^[5] (Vdd=VddBias=5.0V, Vc2=3V, Vc3=2.6V, TA=25 °C, 50Ω)

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.10	-0.46	-143.84	-28.95	43.66	-38.55	0.23	-0.98	-137.34
0.20	-1.10	150.88	0.58	-31.60	-47.23	-12.70	-2.15	-178.87
0.30	-2.05	98.16	22.21	-159.53	-46.28	111.92	-1.30	173.94
0.40	-3.97	39.03	25.61	83.38	-56.56	96.80	-1.22	136.26
0.50	-7.94	-51.84	32.80	40.90	-55.43	-75.67	-1.11	112.21
0.60	-17.59	-117.44	35.62	-74.77	-53.32	129.51	-8.60	75.92
0.70	-15.57	-142.12	33.95	-159.05	-50.57	54.24	-14.07	142.59
0.75	-14.98	-166.29	32.56	164.34	-51.19	3.27	-9.88	154.07
0.76	-15.24	-170.75	32.29	157.44	-49.98	-7.86	-9.22	154.10
0.77	-15.41	-174.19	31.97	151.02	-52.94	39.58	-8.58	153.51
0.78	-15.76	-176.88	31.67	144.49	-53.08	29.01	-8.03	153.19
0.79	-16.07	-179.67	31.36	137.78	-50.68	10.13	-7.50	152.59
0.80	-16.29	177.49	31.05	130.99	-48.51	12.79	-6.99	151.45
0.81	-16.99	176.71	30.76	124.40	-49.05	-9.53	-6.56	150.40
0.82	-17.48	176.64	30.37	117.71	-50.75	-16.54	-6.11	148.81
0.83	-17.99	176.80	30.00	111.30	-50.81	-26.82	-5.73	147.23
0.84	-18.43	178.20	29.60	105.09	-51.29	-33.88	-5.35	145.81
0.85	-18.71	-178.70	29.17	99.01	-52.60	-31.61	-4.99	144.44
0.86	-18.77	-174.48	28.75	93.05	-50.26	-17.34	-4.69	142.60
0.87	-18.82	-170.55	28.33	87.37	-47.61	-24.51	-4.40	140.96
0.88	-18.45	-165.18	27.94	81.72	-51.39	-53.83	-4.10	139.17
0.89	-17.81	-160.64	27.56	76.17	-56.83	-68.50	-3.85	137.33
0.90	-17.07	-158.07	27.16	70.71	-55.35	-53.55	-3.64	135.46
0.91	-16.40	-156.52	26.81	65.24	-54.07	-31.06	-3.41	133.44
0.92	-15.60	-155.62	26.43	59.35	-53.99	-21.62	-3.20	131.30
0.93	-14.83	-154.96	26.00	53.40	-56.98	-39.18	-3.01	129.43
0.94	-14.09	-155.58	25.50	47.59	-56.62	-64.29	-2.84	127.61
0.95	-13.37	-157.39	24.95	42.04	-52.28	-78.30	-2.67	125.69
0.96	-12.64	-158.79	24.40	36.87	-50.10	-65.06	-2.49	123.67
0.97	-11.97	-160.93	23.84	32.65	-50.79	-89.16	-2.35	121.90
0.98	-11.45	-163.01	23.35	28.52	-54.18	-95.99	-2.20	120.19
0.99	-10.97	-165.38	22.94	24.42	-56.21	-92.01	-2.08	118.31
1.0	-10.49	-168.07	22.59	20.25	-55.27	-95.08	-1.97	116.33
1.1	-7.18	163.89	17.85	-22.36	-63.48	-157.20	-1.29	98.51
1.2	-5.64	137.77	13.23	-59.76	-56.67	122.25	-0.92	82.58
1.3	-5.00	114.33	8.71	-93.96	-59.15	-150.12	-0.73	68.01
1.4	-4.90	94.01	3.87	-127.90	-59.50	51.12	-0.68	54.09
1.5	-5.12	77.30	-2.22	-160.20	-59.13	-7.23	-0.63	40.77
1.6	-5.31	65.82	-15.02	-173.99	-55.32	19.52	-0.58	27.71
1.7	-4.48	57.08	-8.41	-70.09	-57.83	-98.34	-0.57	14.77
1.8	-3.03	38.52	-3.84	-147.35	-57.75	-45.64	-0.57	2.09
1.9	-2.91	18.56	-7.22	159.60	-57.15	-21.65	-0.54	-10.76
2.0	-3.08	2.39	-12.01	121.79	-58.02	-23.02	-0.54	-23.80

S-Parameter^[5] (Vdd=VddBias=5.0V, Vc2=3V, Vc3=2.6V, TA=25 °C, 50Ω) Continued...

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
2.1	-3.05	-11.84	-18.27	89.95	-61.21	-80.65	-0.53	-37.17
2.2	-2.91	-25.64	-27.56	90.14	-57.80	-174.76	-0.50	-50.70
2.3	-2.64	-39.77	-27.23	147.29	-56.25	11.80	-0.50	-64.77
2.4	-2.22	-56.29	-18.82	112.37	-54.04	-110.53	-0.52	-79.58
2.5	-2.63	-70.44	-22.19	12.81	-59.45	-121.39	-0.56	-94.81
2.6	-2.35	-83.57	-20.25	-54.28	-53.71	-139.17	-0.64	-111.80
2.7	-2.15	-98.84	-7.49	-132.05	-48.04	-167.62	-1.21	-131.12
2.8	-1.88	-113.34	-7.75	97.95	-47.47	90.89	-1.24	-147.42
2.9	-2.29	-126.59	-4.57	25.49	-59.42	-96.61	-2.70	-174.72
3.0	-2.16	-139.59	-12.29	-103.58	-51.63	-137.69	-2.15	177.23
3.5	-1.86	155.49	-26.38	177.20	-55.70	-169.74	-2.36	-66.96
4.0	-1.83	95.22	-45.70	-58.54	-59.54	-9.90	-0.61	172.19
4.5	-1.97	37.08	-54.26	-80.27	-58.94	92.58	-0.49	104.27
5.0	-2.13	-21.12	-60.49	-133.72	-45.52	-56.39	-0.47	47.38
5.5	-2.39	-82.83	-47.89	-17.59	-58.79	39.33	-0.67	-5.89
6.0	-2.64	-149.57	-54.32	12.56	-53.03	-11.61	-0.94	-58.42
7.0	-2.14	73.25	-48.90	-155.70	-59.84	-94.06	-1.03	-173.16
8.0	-2.13	-41.49	-51.55	-96.65	-57.60	-94.41	-1.25	58.34
9.0	-3.25	-146.63	-44.63	-113.70	-50.61	-76.10	-0.72	-52.11
10	-6.53	23.77	-48.96	159.81	-52.38	-172.15	-0.51	-141.78
11	-2.16	-127.10	-41.52	142.41	-60.26	34.14	-2.21	131.41
12	-1.01	142.04	-42.73	-85.67	-48.98	143.79	-5.71	-61.03
13	-16.37	65.77	-37.17	75.05	-44.74	42.27	-1.15	138.76
14	-5.27	100.61	-41.80	-78.12	-44.98	-29.34	-1.00	75.66
15	-1.90	63.94	-36.86	-96.49	-45.70	-111.47	-2.26	11.90
16	-1.34	5.73	-45.13	-27.35	-45.67	-92.73	-4.89	40.13
17	-2.71	-60.05	-35.30	-171.82	-38.79	157.74	-2.43	-22.48
18	-7.10	9.91	-37.71	142.73	-36.60	140.09	-2.53	-65.76
19	-2.58	-82.53	-42.23	106.09	-42.52	91.08	-4.83	-134.67
20	-6.07	-175.66	-36.55	88.23	-37.94	91.69	-14.73	30.45

Notes:

5. S-parameter is measured with deembedded reference plane at DUT RFin and RFout pins.

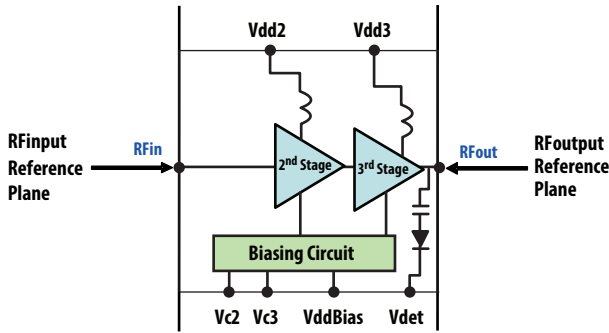
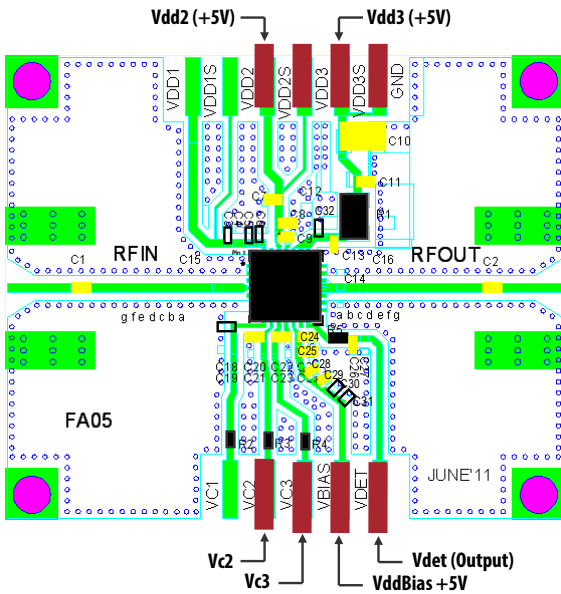


Figure 19. RFin and RFout Reference Plane

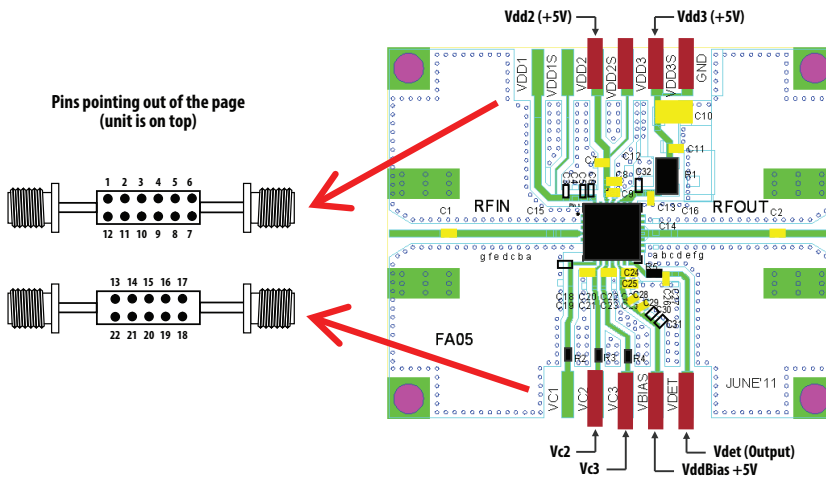
Demonstration Board Top View (Vdd = VddBias = 5.0 V, Vc2 = 3 V, Vc3 = 2.6 V)



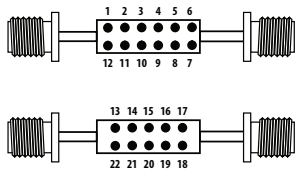
Component	Value	Part Number
C1, C2, C20, C22	56 pF ± 5%	GRM1555C1H056JA01D
C11, C29	0.1 μF ± 10%	GRM155R71C104KA88D
C24	82 pF ± 5%	GRM1555C1H820JA01D
C8, C25	2200 pF ± 10%	GRM155R71H222KA01D
C7, C13, C28	0.047 μF ± 10%	GRM155R71E473KA88D
C9	12 pF ± 5%	GJM1555C1H120JB01D
C26	22 nF ± 10%	CM05X7R223K16AHF
C10	2.2 μF ± 10%	GRM21BR71E225KA73L
R1	0 Ω	RMC1/10 JPTP
R3, R4, R5	0 Ω	RMC1/16S JPTH

Note:

For performance optimization control voltage for individual stages can be adjusted by varying R3 and R4 resistor values.



Pins pointing out of the page (unit is on top)



Application board pin header assignments

- Pin 1 : Vdd3 (Sense)
- Pin 2 : Vdd3 (Force)
- Pin 3 : Vdd2 (Sense)
- Pin 4 : Vdd2 (Force)
- Pin 5 : Vdd1 (Sense) – not used
- Pin 6 : Vdd1 (Force) – not used
- Pin 13 : Vc1 – not used
- Pin 14 : Vc2
- Pin 15 : Vc3
- Pin 16 : VddBias
- Pin 17 : Vdet

Other pins are grounded

Figure 20. Demonstration board application circuit for MGA-43013 module

Application Schematic

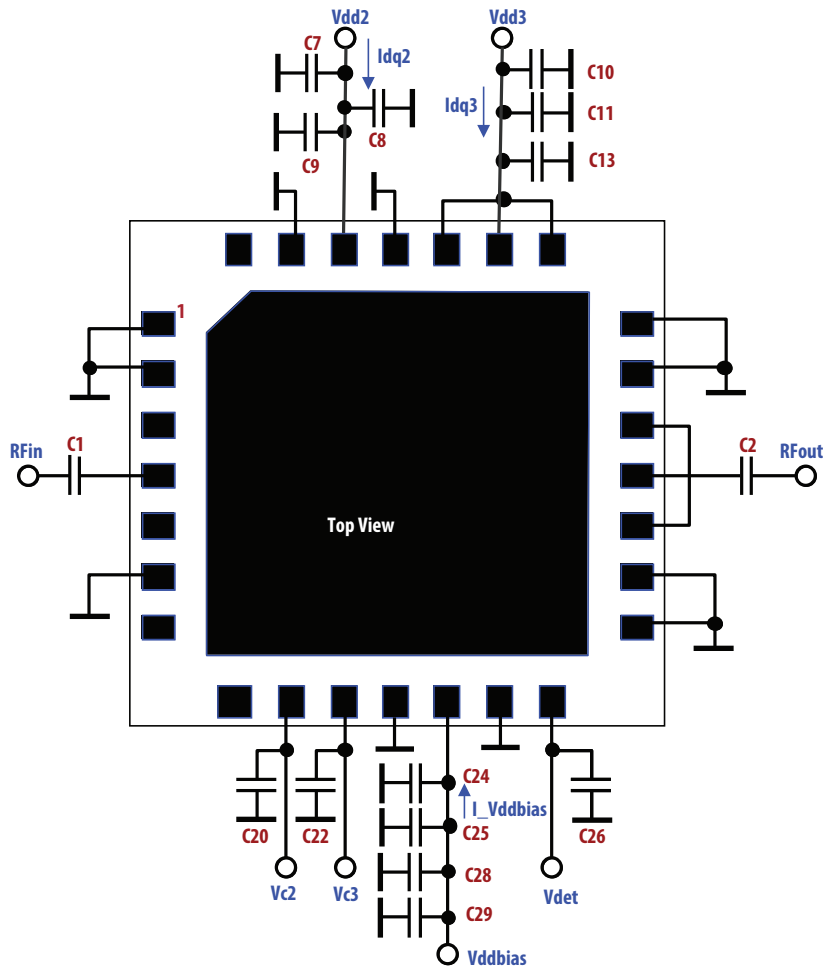


Figure 21. Application schematic in demonstration board

Notes:

1. All capacitors on supply lines are bypass capacitors.
2. C1 and C2 are RF coupling capacitors.
3. For $V_{dd} = V_{ddBias} = 5\text{ V}$, $I_{dq2} = 68\text{ mA}$, $I_{dq3} = 201\text{ mA}$, $I_{V_{ddBias}} = 14\text{ mA}$. I_{dq2} and I_{dq3} are adjusted by voltages to CMOS-compatible control pins V_{c2} and V_{c3} , respectively. These typical bias currents were obtained with V_{c2} and V_{c3} voltages in Figure 20. Adjustment of these currents enable optimum bias conditions to be achieved for best linearity and efficiency for a given modulation type.

MGA-43013 typical I_c , I_c3 vs. V_c performance, unless otherwise stated

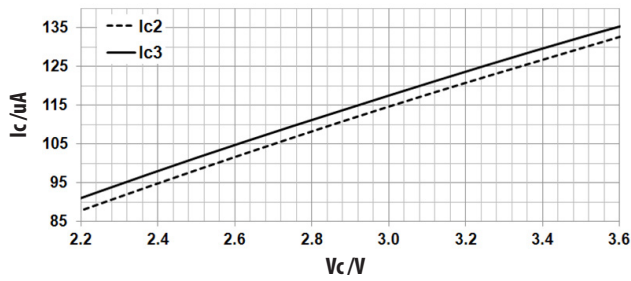
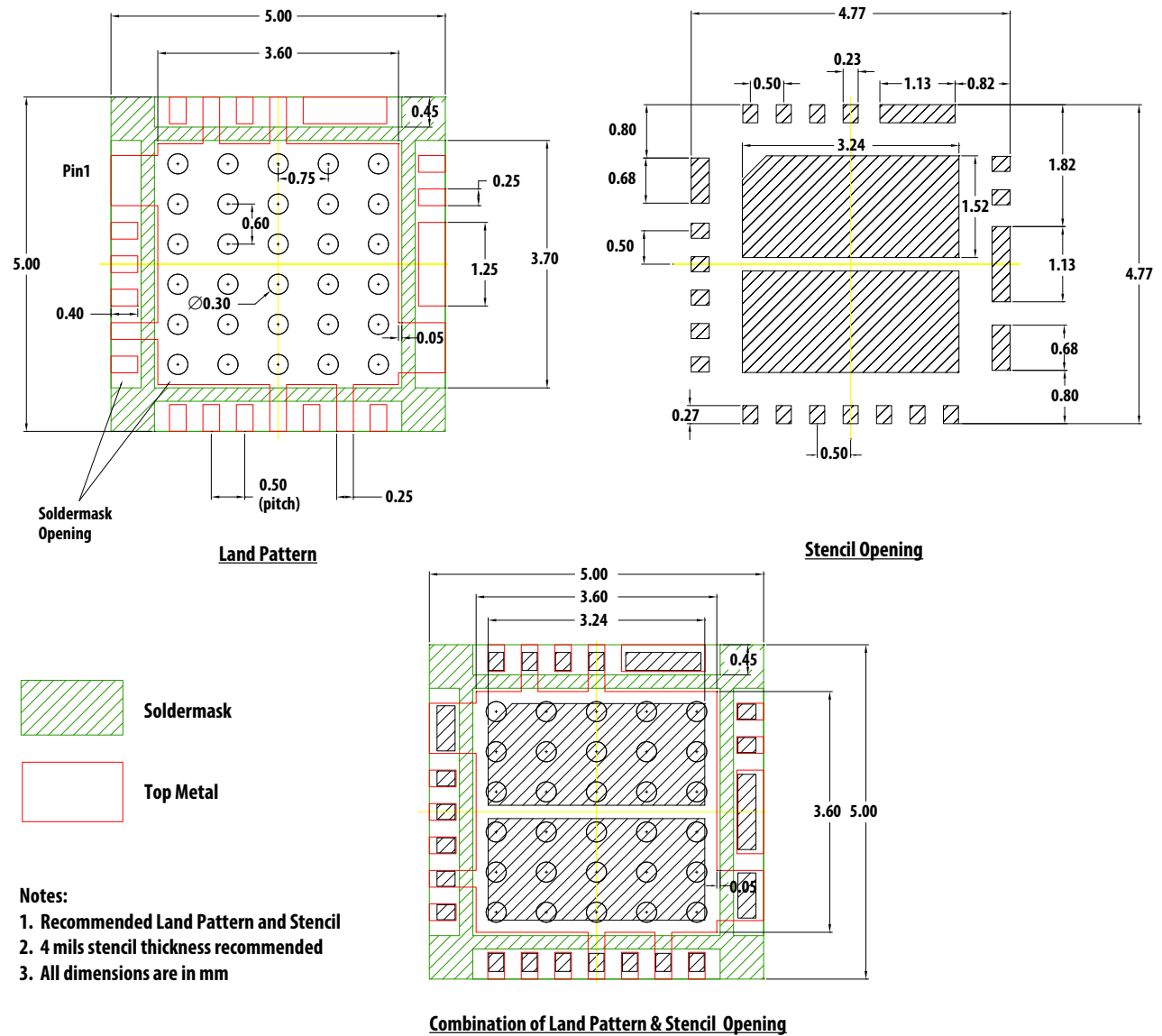
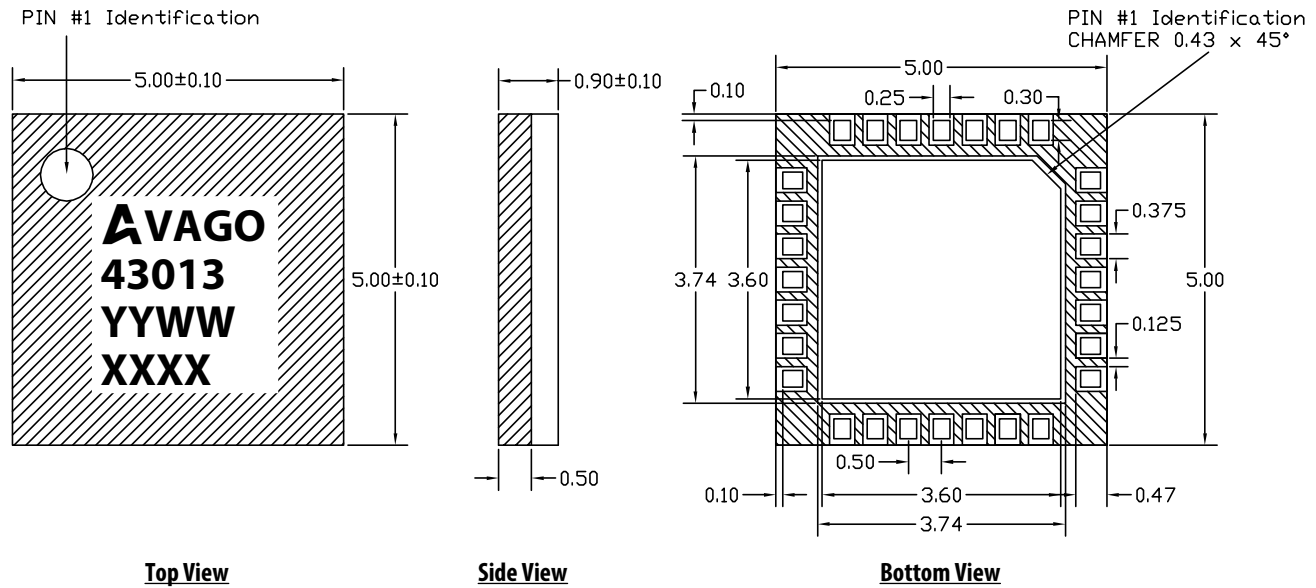


Figure 22. I_c vs. V_c at $V_{dd} = V_{ddBias} = 5.0 V$

PCB Land Pattern and Stencil Outline



MCOB (5.0 × 5.0 × 0.9) mm 28-Lead Package Dimensions



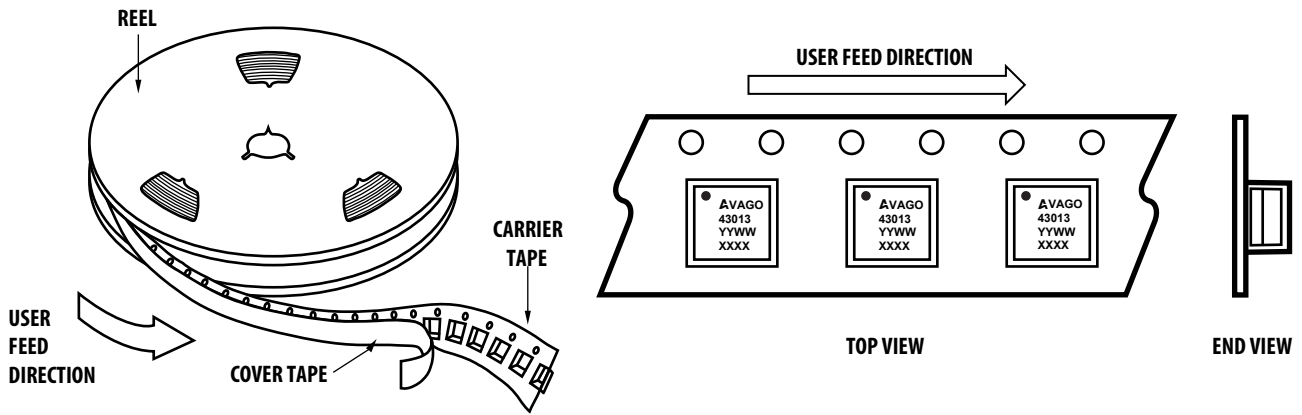
Notes:

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

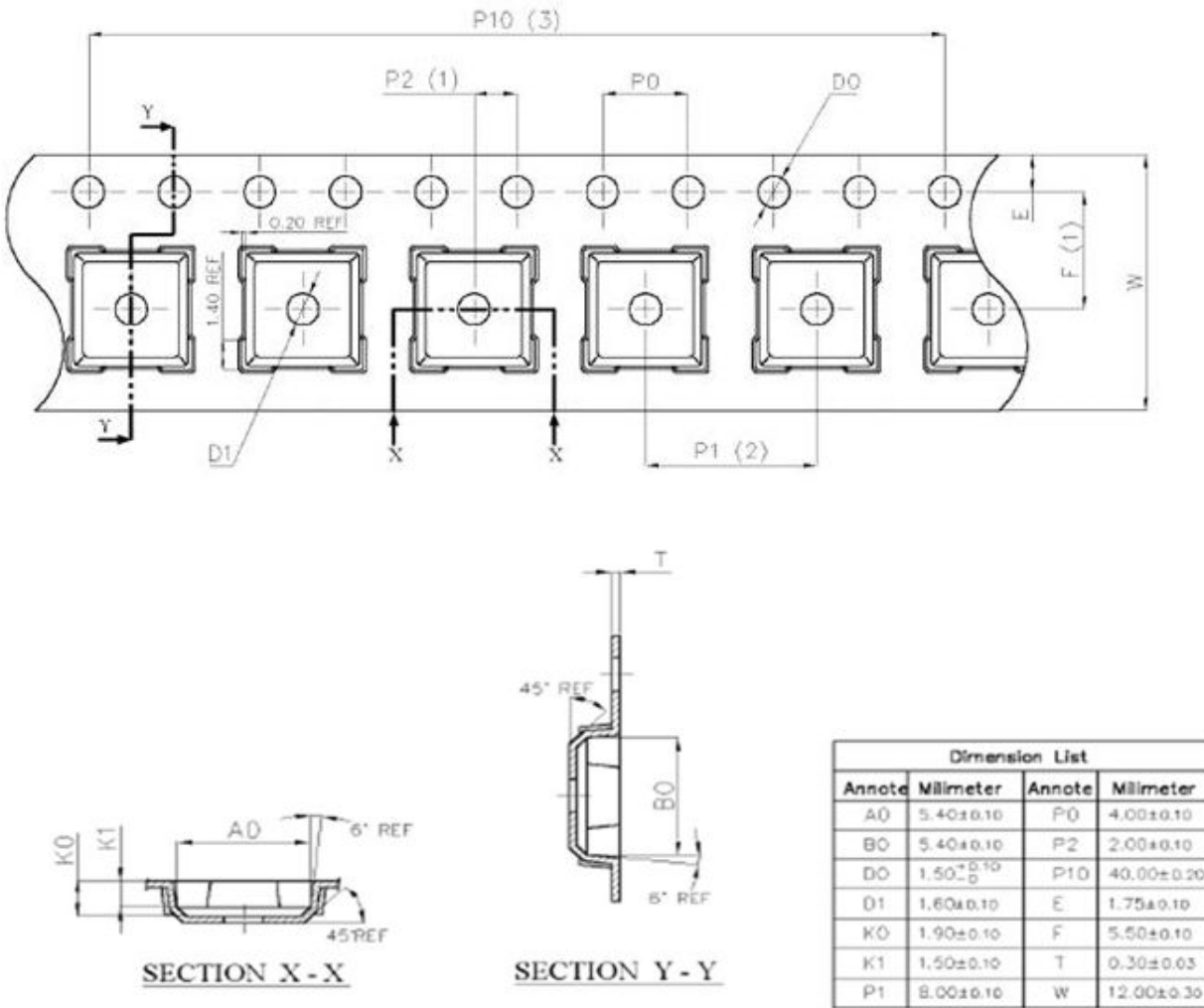
Part Number Ordering Information

Part Number	Qty	Container
MGA-43013-BLKG	100	Antistatic Bag
MGA-43013-TR1G	1000	7" Reel

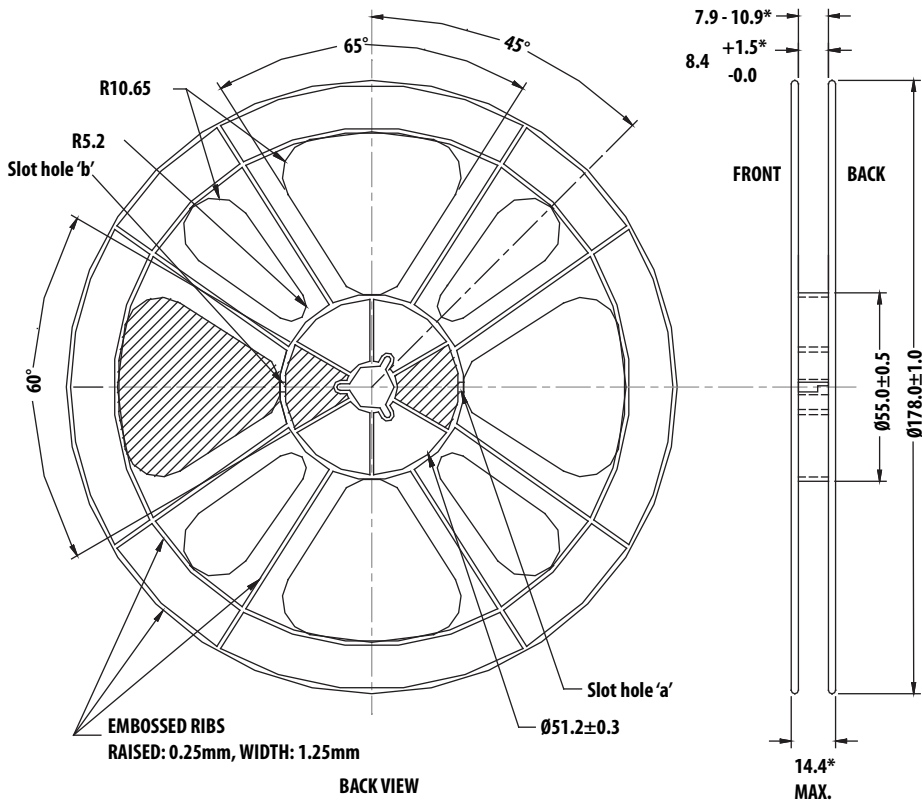
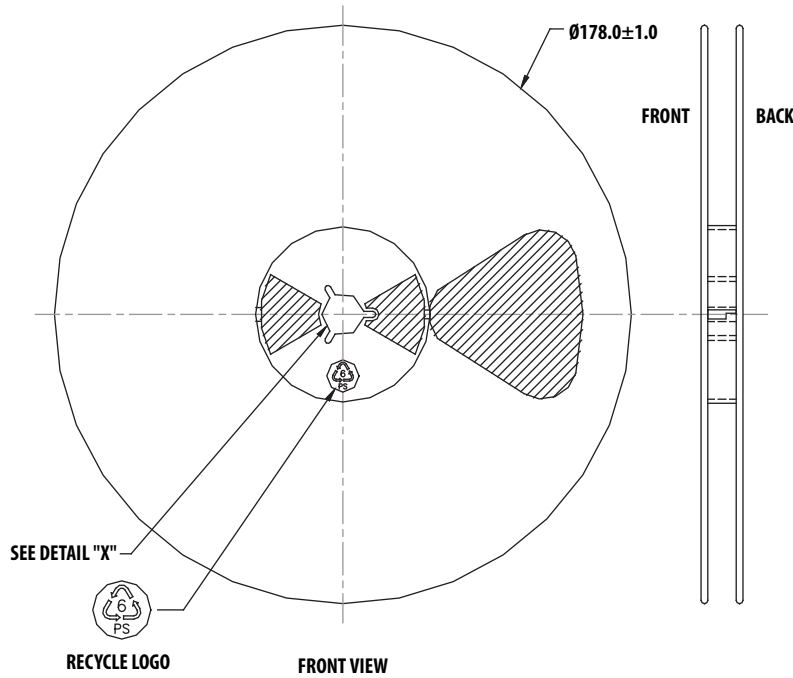
Device Orientation



Tape Dimensions



Reel Dimensions (7" reel)



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

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