MGA-43228

(2.3–2.5) GHz 29dBm High Linearity Wireless Data Power Amplifier

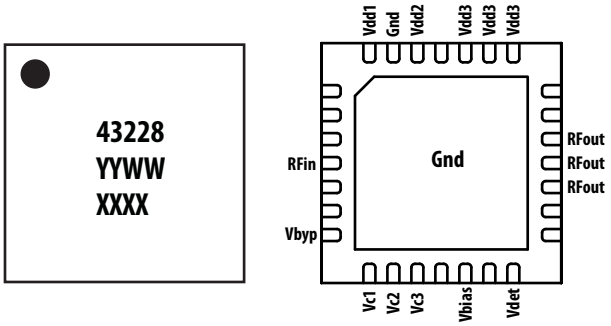
Data Sheet

Description

Avago Technologies' MGA-43228 is a power amplifier for use in the (2.3-2.5)GHz band. High linear output power at 5V is achieved through the use of Avago Technologies' proprietary 0.25um GaAs Enhancement-mode pHEMT process. It is housed in a miniature 5.0mm x 5.0mm x 0.85mm 28-lead QFN package. It also includes shutdown and switchable gain functions. A detector is also included on-chip. The compact footprint coupled with high gain and high efficiency make the MGA-43228 an ideal choice as a power amplifier for IEEE 802.16 (WiMAX) and WLL applications.

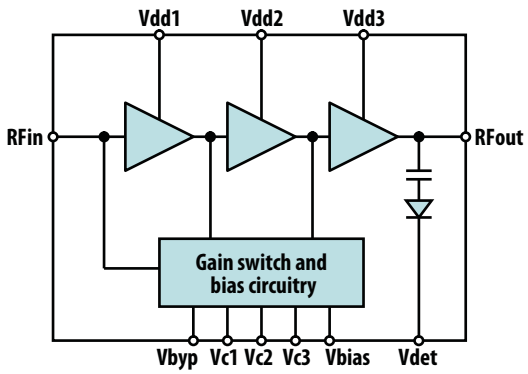
Component Image

5.0 x 5.0 x 0.85 mm^3 28-lead QFN Package (Top View)



Notes:
Package marking provides orientation and identification
"43228" = Device part number
"YYWW" = Year and work week
"XXXX" = Assembly lot number

Functional Block Diagram



Features

- High gain: 38.5dB
- High linearity performance: 29.2dBm at 5V supply (2.5% EVM, 64-QAM ¾ FEC rate OFDMA, 10MHz bandwidth)
- High efficiency: 16.1%
- Built-in detector and shutdown switches
- Switchable gain: 23.6dB attenuation using one single CMOS compatible switch pin
- ETSI spectral mask compliant at 29dBm output power
- GaAs E-pHEMT Technology[1]
- Low cost small package size: 5.0 x 5.0 x 0.85 mm^3
- MSL-2a and lead-free
- Usable at 3.3V supply for lower supply voltage applications

Specifications

2.4GHz; Vdd = Vbias = 5.0V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Iqtotal = 500mA (typ), IEEE 802.16e 64-QAM OFDMA, ¾ FEC rate

- 38.5 dB Gain
- 29.2 dBm Linear Pout (2.5% EVM)
- 16.1% PAE @ Linear Pout
- 2.6V Vdet @ Linear Pout
- 23.6 dB Switchable Gain Attenuation
- 25µA Shutdown Current

Applications

- High linearity amplifier for IEEE 802.16 fixed terminal amplifier
- WLL amplifier

Note:
1. Enhancement mode technology employs positive Vgs, 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 Max.
Vdd, Vbias	Supply voltages, bias supply voltage	V	6.0
Vc	Control Voltage	V	(Vdd)
$P_{in,max}$	CW RF Input Power	dBm	20
P_{diss}	Total Power Dissipation [3]	W	8.0
$T_{j,MAX}$	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to 150

Thermal Resistance

Thermal Resistance [2]
θ_{jc} = 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. Board temperature (T_C) is 25°C, for T_c >56.4°C derate the device power at 85.5mW per °C rise in board temperature adjacent to package bottom.

Electrical Specifications

T_A = 25°C, Vdd = Vbias = 5.0V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V, Iqtotal = 500mA, RF performance at 2.4 GHz, IEEE 802.16e 64-QAM, ¾ rate FEC, 10MHz bandwidth OFDMA operation unless otherwise stated.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.
Vdd	Supply Voltage	V		5.0	
Iqtotal	Quiescent Supply Current (normal high gain mode)	mA		500	
	Quiescent Supply Current (low gain mode, Vbyp = 5.0V)	mA		500	
Gain	Gain	dB	35.0	38.5	
OP1dB	Output Power at 1dB Gain Compression	dBm		35.5	
Pout_5V	Linear Output Power @ 2.5% EVM with 64-QAM OFDMA modulation per IEEE 802.16e specs, 50% duty cycle, ¾ rate FEC	dBm	27.7	29.2	
Itotal_5V	Total current draw at Pout_5V level	mA		1023	1250
S11	Input Return Loss, 50Ω source	dB		-10	
S22	Output Return Loss, 50Ω source	dB		-11	
S12	Reverse Isolation	dB		60	
Atten	Gain attenuation in low gain mode	dB	20.5	23.6	26.5
Vdet	Detector output DC voltage @ 29dBm linear Pout	V		2.6	
DetR	Detector RF dynamic range	dB		20	
NF	Noise figure	dB		2.1	
S	Stability under load VSWR of 6:1 (all phase angle), spurious output	dBc			-60

Product Consistency Distribution Charts[1]

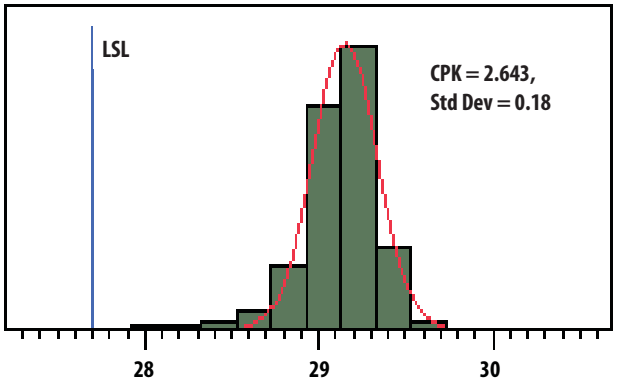


Figure 1. Pout_5V; LSL = 27.7dBm, Nominal = 29.2dBm

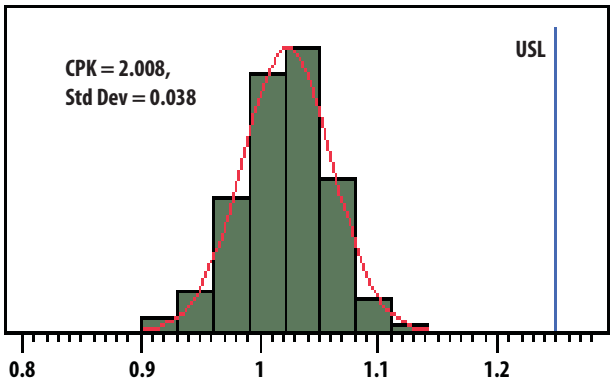


Figure 2. Itotal_5V; Nominal = 1.023A, USL = 1.250A

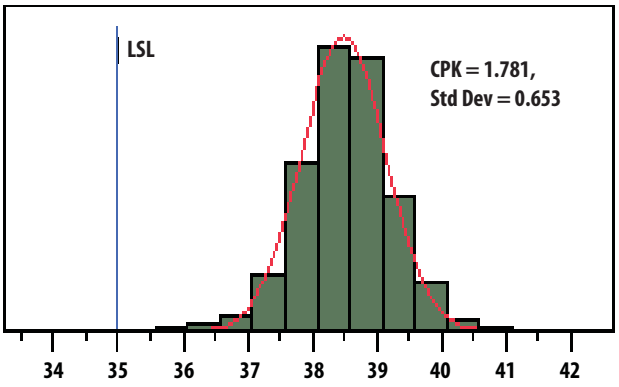


Figure 3. Gain; LSL = 35.0dB, Nominal = 38.5dB

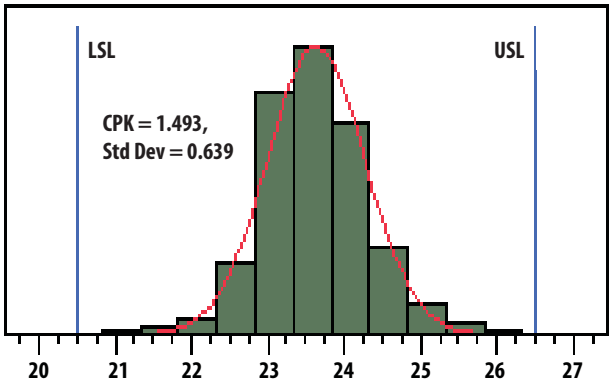


Figure 4. Atten; LSL = 20.5dB, Nominal = 23.6dB, USL = 26.5dB; Vbyp = 5V

Note:
1. Distribution data sample size is 2000 samples taken from 3 different wafer lots. T_A = 25°C, Vdd = Vbias = 5V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V, RF performance at 2.4GHz unless otherwise stated. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.

Unless otherwise stated, all modulated signal measurements are made with IEEE 802.16e format as stated in the notes to Figure 36.

MGA-43228 typical over-temperature performance at Vdd = Vbias = 5.0V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

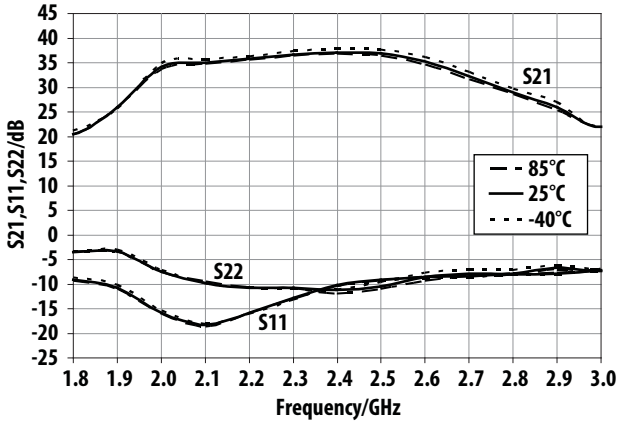


Figure 5. Small-signal performance in high gain mode, Vbyp = 0V

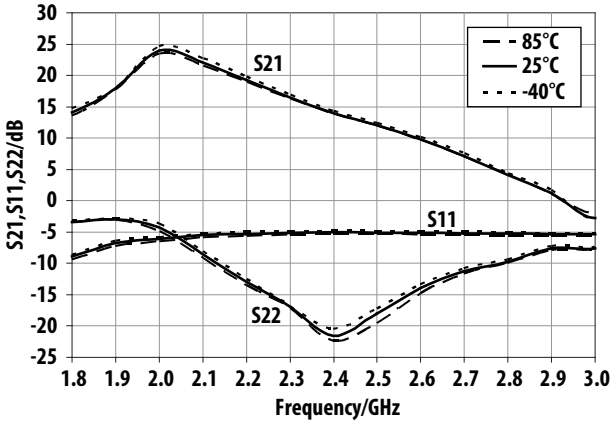


Figure 6. Small-signal performance in low-gain mode, Vbyp = 5V

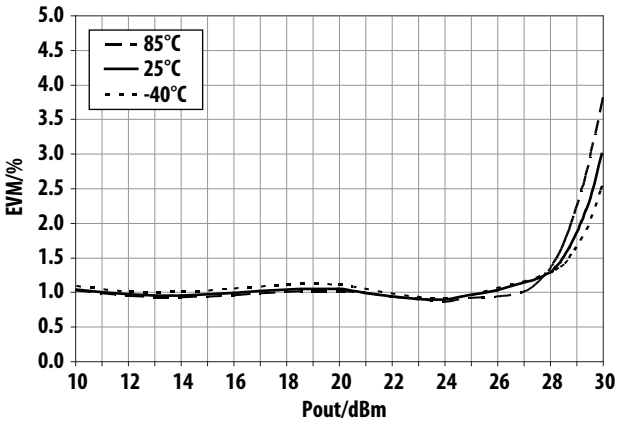


Figure 7. Over-temperature EVM vs Pout @ 2.3GHz

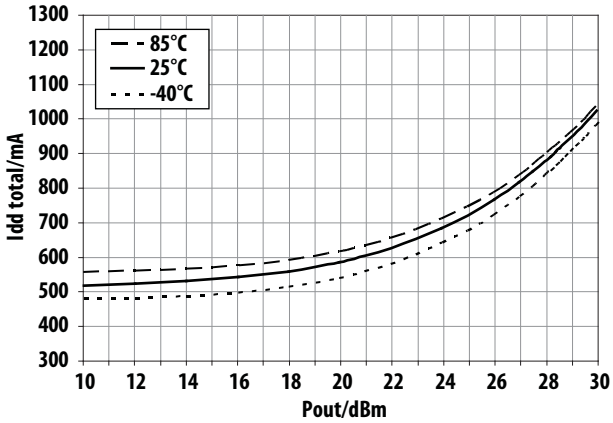


Figure 8. Over-temperature Idd_total vs Pout @ 2.3GHz

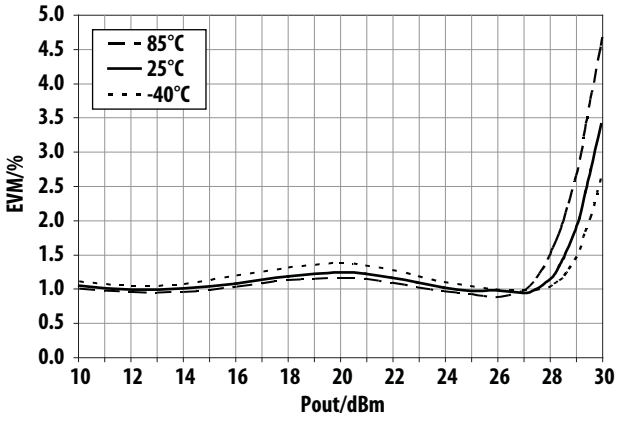


Figure 9. Over-temperature EVM vs Pout @ 2.4GHz

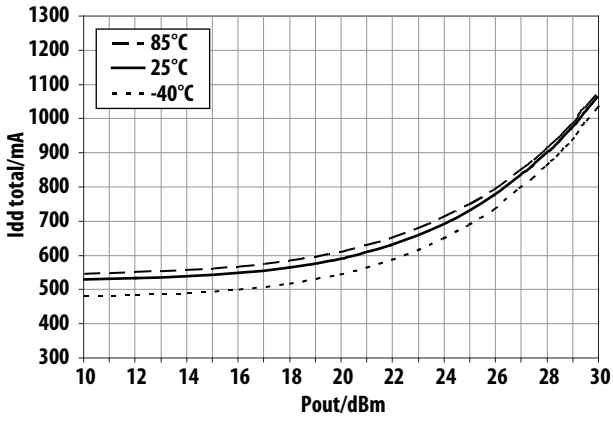


Figure 10. Over-temperature Idd_total vs Pout @ 2.4GHz

MGA-43228 typical over-temperature performance at Vdd = Vbias = 5.0V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

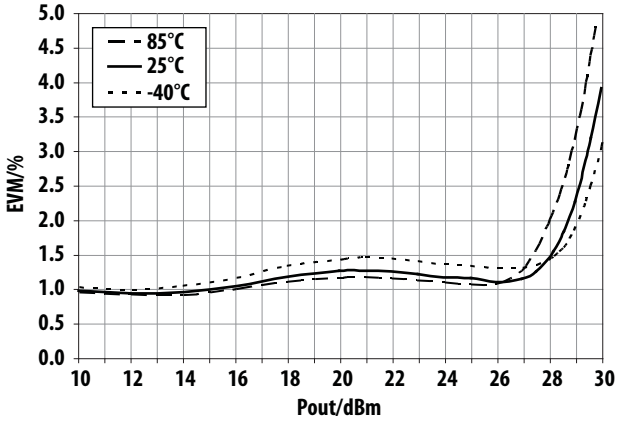


Figure 11. Over-temperature EVM vs Pout @ 2.5GHz

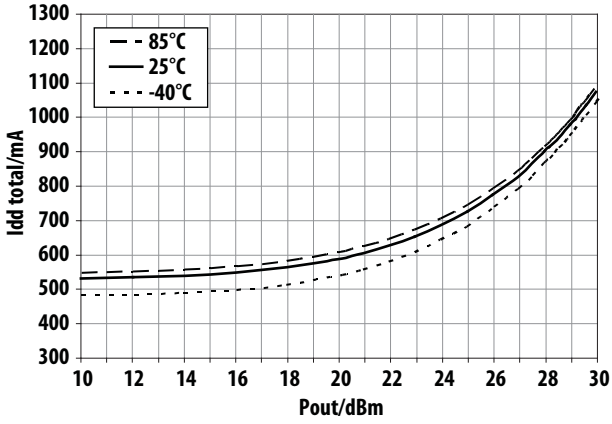


Figure 12. Over-temperature Idd_total vs Pout @ 2.5GHz

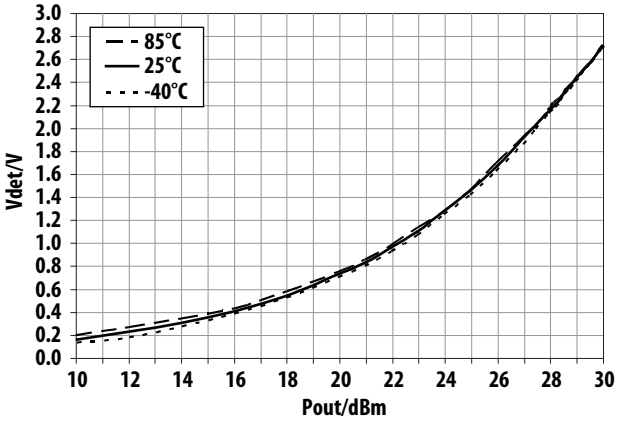


Figure 13. Over-temperature Vdet vs Pout @ 2.3GHz

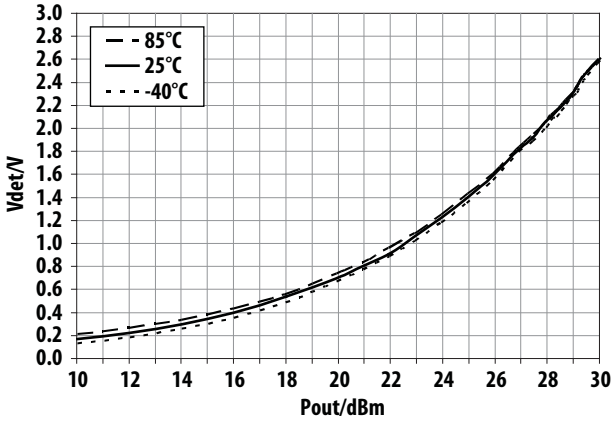


Figure 14. Over-temperature Vdet vs Pout @ 2.4GHz

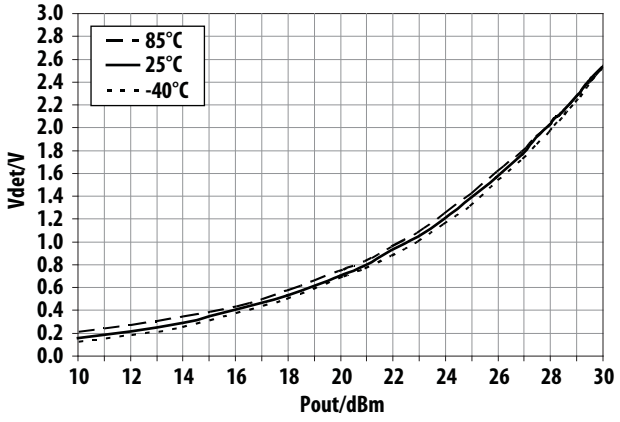


Figure 15. Over-temperature Vdet vs Pout @ 2.5GHz

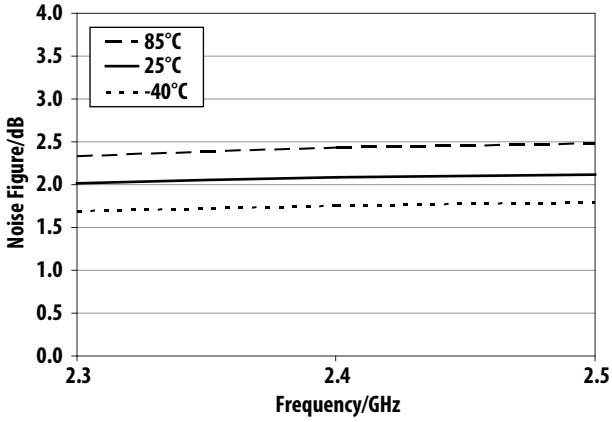


Figure 16. Over-temperature Noise Figure vs Operating Frequency

MGA-43228 typical over-temperature performance at Vdd = Vbias = 5.0V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

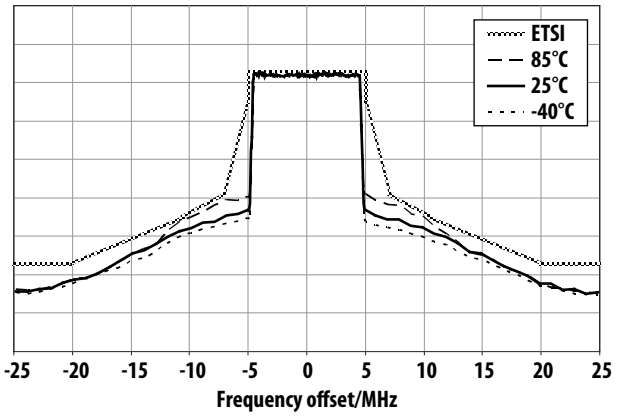


Figure 17. Over-temperature ETSI SEM at 29dBm Pout @ 2.3GHz

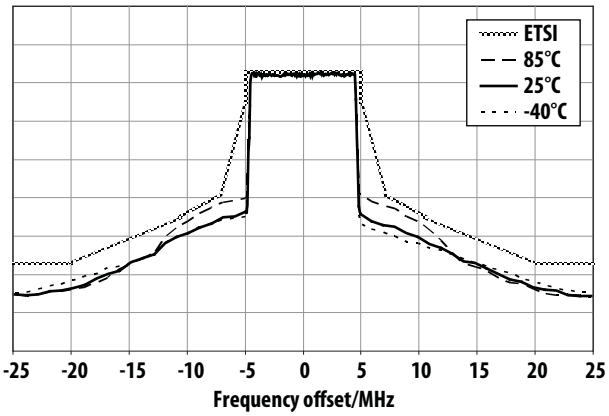


Figure 18. Over-temperature ETSI SEM at 29dBm Pout @ 2.4GHz

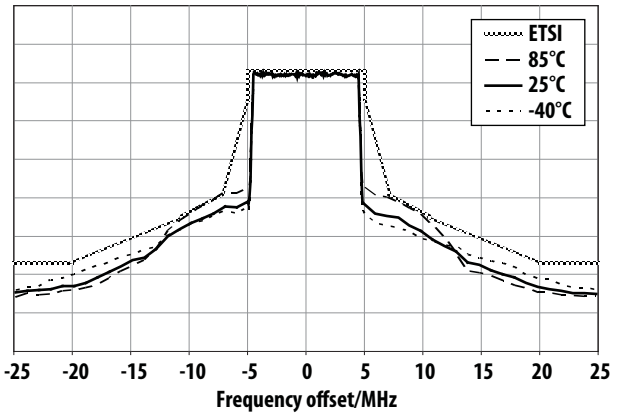


Figure 19. Over-temperature ETSI SEM at 29dBm Pout @ 2.5GHz

MGA-43228 typical over-temperature performance at Vdd = Vbias = 3.3V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

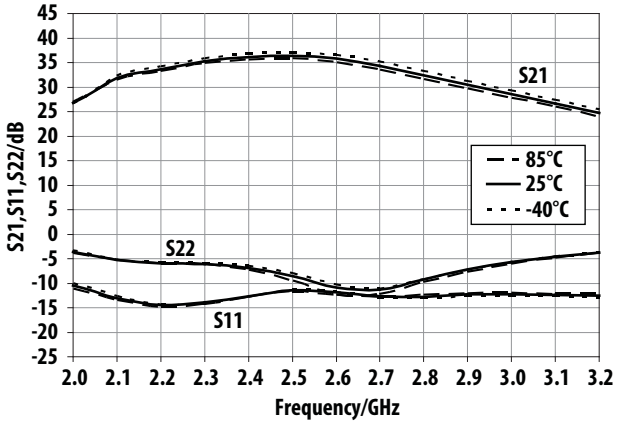


Figure 20. Small-signal performance in high gain mode, Vbyp = 0V

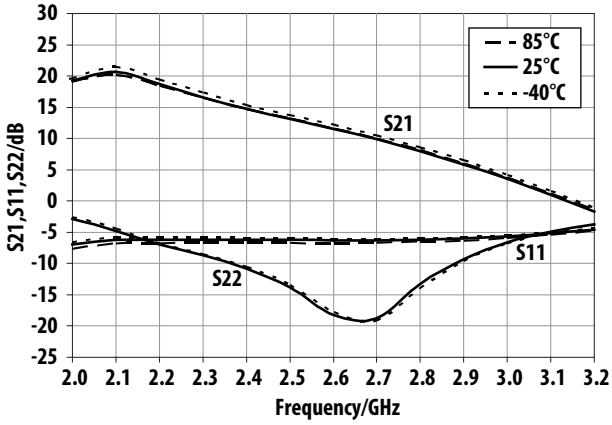


Figure 21. Small-signal performance in low gain mode, Vbyp = 3.3V

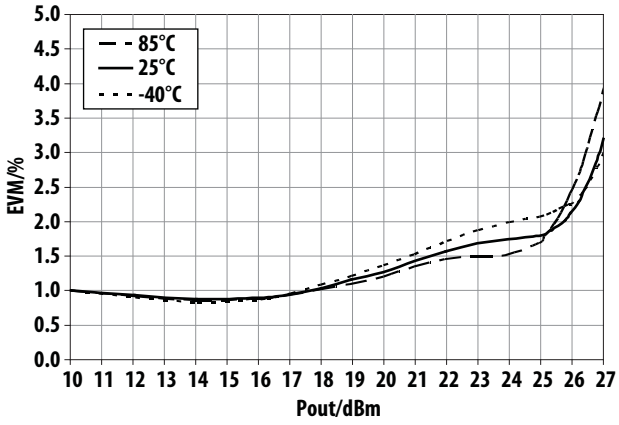


Figure 22. Over-temperature EVM vs Pout @ 2.3GHz

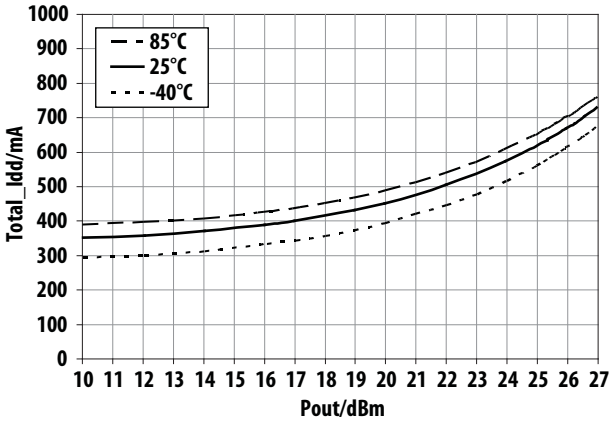


Figure 23. Over-temperature Idd_total vs Pout @ 2.3GHz

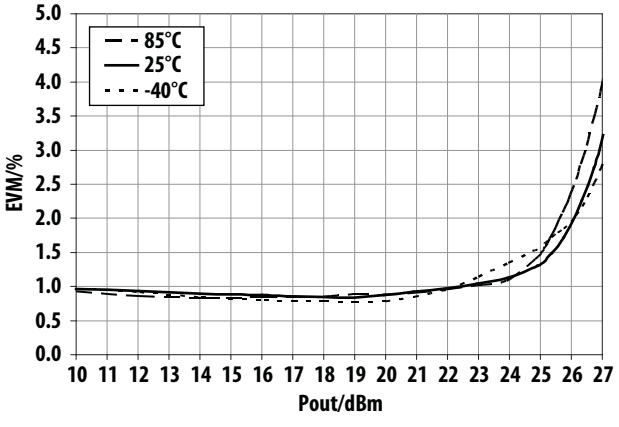


Figure 24. Over-temperature EVM vs Pout @ 2.4GHz

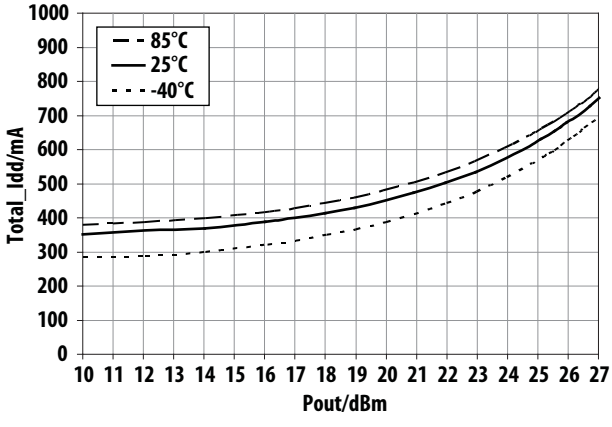


Figure 25. Over-temperature Idd_total vs Pout @ 2.4GHz

MGA-43228 typical over-temperature performance at Vdd = Vbias = 3.3V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

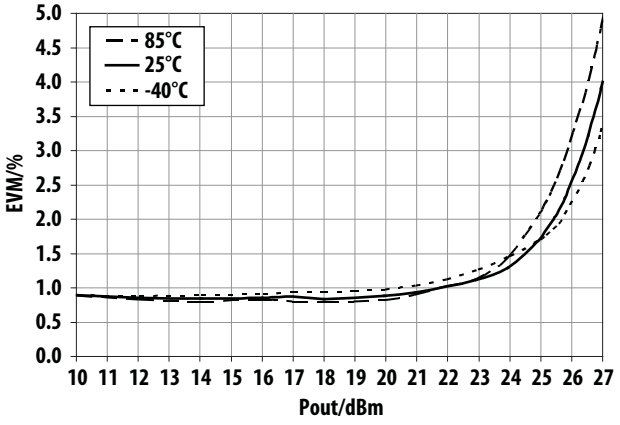


Figure 26. Over-temperature EVM vs Pout @ 2.5GHz

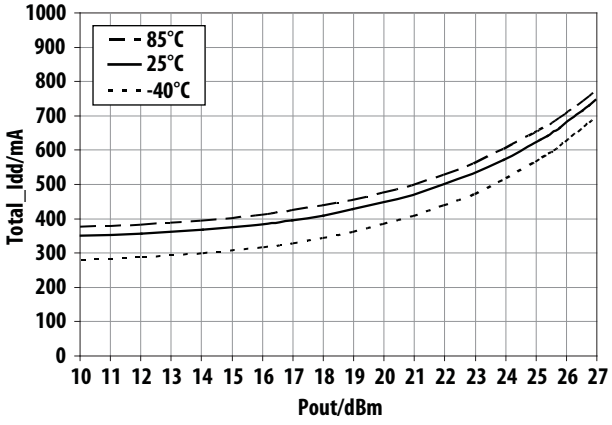


Figure 27. Over-temperature Idd_total vs Pout @ 2.5GHz

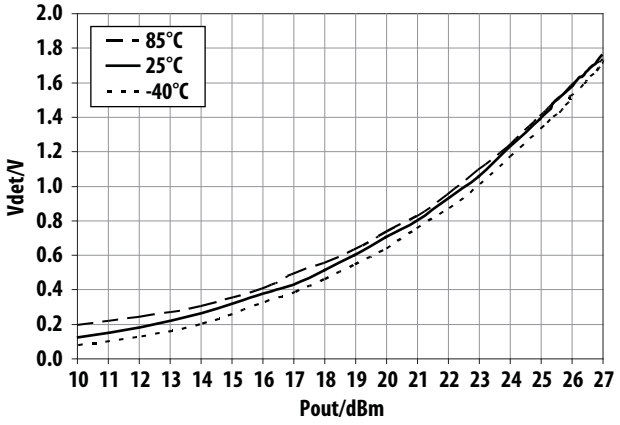


Figure 28. Over-temperature Vdet vs Pout @ 2.3GHz

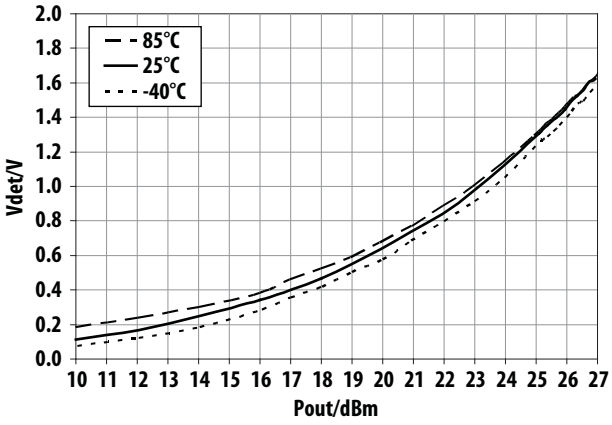


Figure 29. Over-temperature Vdet vs Pout @ 2.4GHz

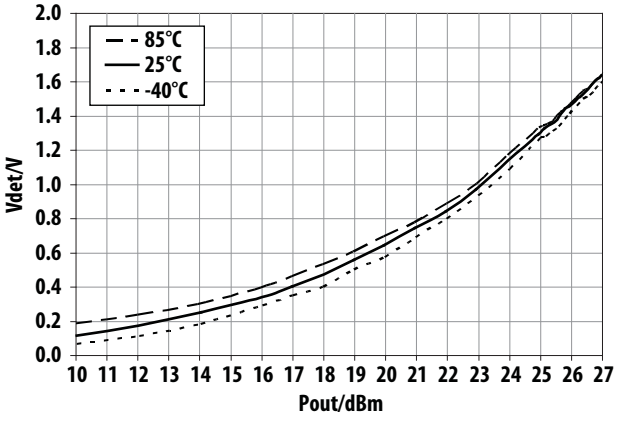


Figure 30. Over-temperature Vdet vs Pout @ 2.5GHz

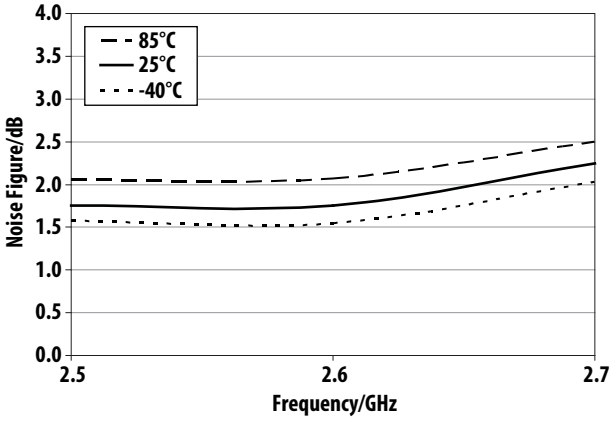


Figure 31. Over-temperature Noise Figure vs Operating Frequency

MGA-43228 typical over-temperature performance at Vdd = Vbias = 3.3V, Vc = 2.1V (R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36), Vbyp = 0V unless otherwise stated.

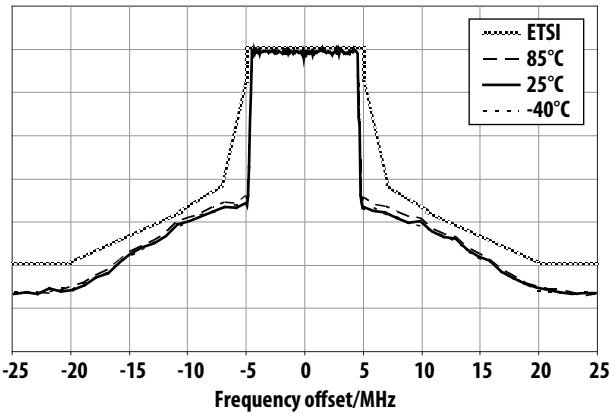


Figure 32. Over-temperature ETSI SEM at 26.5dBm Pout @ 2.3GHz

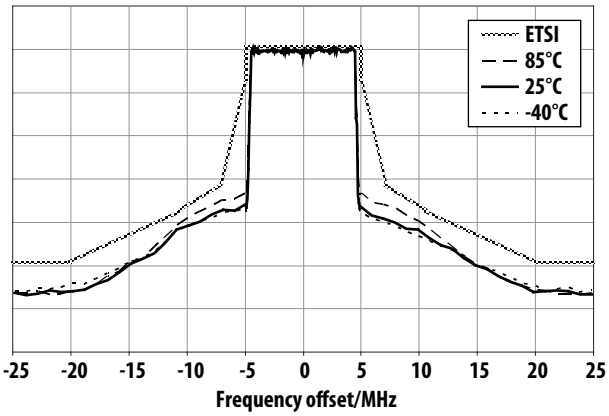


Figure 33. Over-temperature ETSI SEM at 26.5dBm Pout @ 2.4GHz

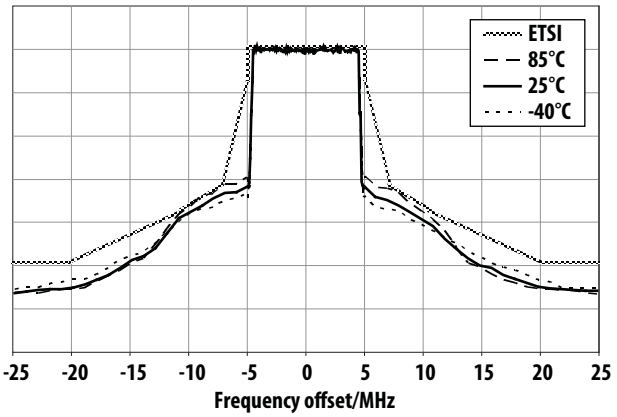


Figure 34. Over-temperature ETSI SEM at 26.5dBm Pout @ 2.5GHz

S-Parameter[1] (Vdd = Vbias = 5.0V, Vc = 2.1V[2], Vbyp = 0V, T = 25°C, unmatched)

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.1	-5.50	174.42	-53.86	-124.37	-65.35	-128.39	-0.26	177.10
0.2	-5.05	164.05	-40.92	-130.27	-67.43	57.95	-0.49	176.18
0.3	-4.91	151.92	-24.15	-179.74	-67.73	42.18	-0.59	175.75
0.4	-5.02	139.67	-13.85	116.92	-64.94	-0.77	-0.62	174.95
0.5	-5.40	126.61	-7.56	68.39	-64.96	30.02	-0.67	174.22
0.6	-6.01	112.67	-2.83	27.96	-68.98	-8.56	-0.74	173.50
0.7	-6.81	96.78	0.68	-7.67	-68.24	28.32	-0.79	172.88
0.8	-7.93	78.07	3.31	-39.33	-64.12	-3.76	-0.82	172.38
0.9	-9.41	54.75	5.29	-67.91	-67.35	39.71	-0.85	171.71
1.0	-11.14	21.87	6.90	-94.76	-75.41	-116.77	-0.90	170.93
1.1	-12.19	-25.64	7.78	-122.63	-74.13	98.80	-0.95	169.98
1.2	-13.06	-97.33	6.13	-152.70	-67.68	127.09	-0.99	169.29
1.3	-10.35	-177.62	1.59	-119.31	-67.47	105.94	-1.02	168.74
1.4	-11.33	94.37	12.40	-122.98	-65.15	74.60	-1.04	168.25
1.5	-16.08	15.83	15.42	-158.77	-64.94	96.47	-1.04	167.65
1.6	-16.12	-62.99	16.52	173.19	-62.28	78.00	-1.04	167.14
1.7	-13.09	-111.15	16.60	149.94	-61.57	73.62	-0.99	166.55
1.8	-10.89	-144.28	16.23	147.80	-61.70	84.43	-0.89	165.83
1.9	-9.22	-169.78	21.73	155.81	-60.91	73.42	-0.63	163.09
2.0	-8.38	167.55	27.19	113.47	-62.11	86.84	-1.21	160.40
2.1	-7.83	147.58	28.48	72.12	-59.58	72.72	-1.34	161.32
2.2	-7.58	128.02	29.08	38.45	-57.64	58.80	-1.25	161.10
2.3	-7.49	107.00	29.75	7.58	-59.16	56.73	-1.18	159.53
2.4	-8.03	84.39	30.16	-25.43	-57.86	81.98	-1.20	157.14
2.5	-9.28	62.36	30.23	-59.17	-56.84	79.69	-1.41	154.68
2.6	-11.21	44.15	29.37	-95.14	-55.68	51.78	-1.83	153.32
2.7	-12.79	31.97	27.35	-126.98	-55.95	43.43	-2.10	153.12
2.8	-13.55	21.72	24.67	-154.10	-52.03	37.61	-2.41	153.69
2.9	-12.79	7.09	20.26	-163.15	-55.37	31.17	-2.33	155.20
3.0	-12.66	-26.33	23.91	-154.61	-55.52	26.51	-1.98	152.77
3.1	-16.71	-42.56	25.46	160.78	-53.51	29.86	-2.40	149.44
3.2	-16.75	-32.66	23.82	125.55	-52.85	0.83	-2.78	149.46
3.3	-14.14	-36.60	21.81	97.53	-53.39	-5.14	-2.97	149.63
3.4	-11.78	-49.01	19.81	72.39	-53.16	-16.93	-3.12	149.45
3.5	-9.74	-62.97	17.80	48.46	-54.80	-23.50	-3.31	149.28
3.6	-8.00	-77.66	15.64	24.92	-56.30	-26.56	-3.48	149.59
3.7	-6.52	-92.28	13.29	2.11	-56.03	-42.29	-3.64	150.38
3.8	-5.29	-106.58	10.74	-19.80	-58.88	-34.64	-3.71	151.62
3.9	-4.29	-120.24	7.92	-40.64	-59.45	-43.50	-3.66	153.06
4.0	-3.52	-133.18	4.85	-59.71	-60.82	-24.03	-3.46	154.16

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
4.1	-2.91	-145.17	1.58	-76.59	-58.56	-46.37	-3.18	154.71
4.2	-2.44	-156.10	-1.86	-90.71	-59.67	-60.83	-2.86	154.26
4.3	-2.09	-166.12	-5.40	-100.95	-60.07	-65.19	-2.59	152.78
4.4	-1.81	-175.20	-8.22	-104.50	-65.75	-70.78	-2.66	150.89
4.5	-1.59	176.43	-10.11	-115.92	-74.10	-107.53	-2.65	152.94
4.6	-1.42	168.84	-13.08	-127.31	-71.48	-113.28	-2.19	153.02
4.7	-1.27	161.84	-16.03	-134.59	-67.54	-61.75	-1.86	151.75
4.8	-1.16	155.37	-18.72	-140.05	-69.99	-96.01	-1.61	150.18
4.9	-1.07	149.38	-21.12	-144.98	-69.70	-139.39	-1.42	148.64
5.0	-0.96	144.61	-23.43	-149.53	-73.41	157.93	-1.26	147.53
5.1	-0.86	140.77	-25.74	-154.21	-73.37	30.13	-1.14	146.31
5.2	-0.82	136.27	-27.78	-158.95	-69.14	56.84	-1.04	144.97
5.3	-0.76	132.02	-29.67	-164.50	-65.87	68.20	-0.95	143.56
5.4	-0.72	128.07	-31.56	-169.63	-68.35	72.30	-0.88	142.13
5.5	-0.70	124.34	-33.33	-174.90	-68.19	17.54	-0.82	140.96
5.6	-0.67	120.82	-35.00	179.91	-65.60	26.10	-0.76	139.67
5.7	-0.65	117.53	-36.43	172.91	-66.07	28.18	-0.72	138.52
5.8	-0.62	114.35	-37.80	166.51	-69.00	45.13	-0.68	137.40
5.9	-0.61	111.31	-38.56	157.15	-65.22	47.94	-0.66	136.28
6.0	-0.59	108.42	-39.80	149.51	-61.52	45.21	-0.62	135.21
7.0	-0.49	84.33	-42.79	46.69	-61.72	9.36	-0.52	123.81
8.0	-0.45	63.74	-43.47	-24.40	-60.26	8.41	-0.60	108.42
9.0	-0.41	42.86	-45.25	-82.28	-65.62	-32.54	-0.86	85.39
10.0	-0.33	26.63	-47.36	-153.48	-65.49	11.68	-1.52	54.74
11.0	-0.24	17.50	-48.51	110.48	-58.27	-2.04	-4.01	6.59
12.0	-0.25	11.03	-59.52	-51.06	-57.17	-90.66	-5.08	-95.45
13.0	-0.41	0.47	-67.82	-58.75	-63.68	-92.80	-1.98	158.86
14.0	-0.50	-15.78	-59.79	-89.31	-62.94	-67.76	-1.16	114.62
15.0	-0.50	-31.91	-59.35	-138.86	-57.09	-125.83	-1.05	82.18
16.0	-0.35	-41.52	-65.19	-172.99	-64.04	-125.64	-0.94	53.87
17.0	-0.35	-42.84	-70.37	141.73	-64.09	170.88	-0.96	26.70
18.0	-0.48	-45.97	-73.46	26.58	-69.40	115.88	-0.94	-0.67
19.0	-0.65	-55.95	-60.23	-10.98	-64.83	55.04	-0.85	-22.94
20.0	-0.96	-74.76	-68.12	-36.15	-64.62	-16.23	-0.95	-44.59

Notes:
1. S-parameter is measured with deembedded reference plane at DUT RFin and RFout pins.
2. R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36.

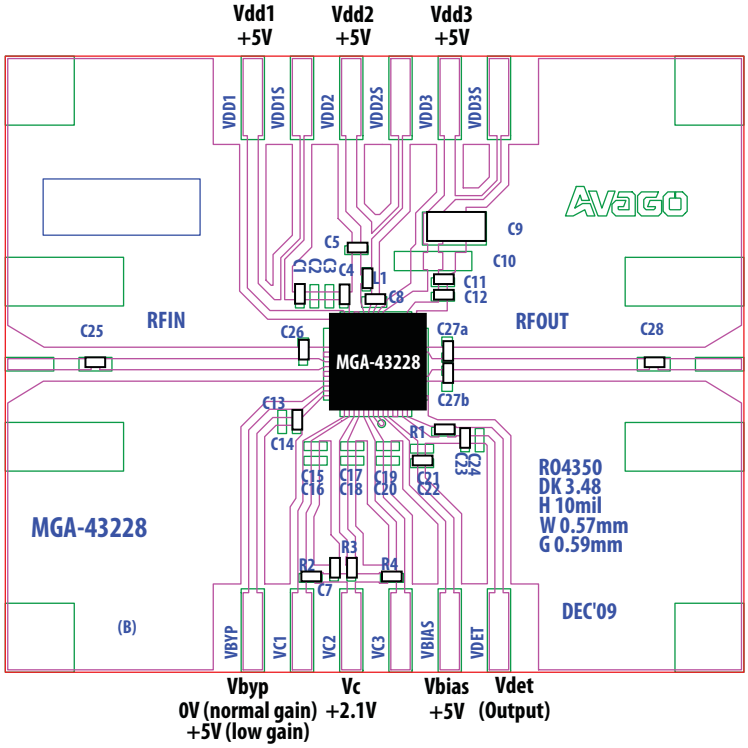
S-Parameter[1] (Vdd = Vbias = 3.3V, Vc = 2.1V[2], Vbyp = 0V, T = 25°C, unmatched)

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.1	-5.14	174.57	-49.91	-101.56	-58.76	71.06	-0.22	177.48
0.2	-4.79	164.86	-40.14	-124.60	-72.33	69.37	-0.45	176.86
0.3	-4.72	153.26	-24.06	-172.34	-61.78	72.93	-0.55	176.66
0.4	-4.68	141.95	-14.22	121.33	-73.54	38.57	-0.60	174.84
0.5	-5.15	129.13	-8.16	72.36	-72.06	15.78	-0.67	173.98
0.6	-5.79	114.39	-3.31	32.37	-67.53	64.94	-0.73	173.35
0.7	-6.57	97.67	0.16	-3.49	-69.14	-17.22	-0.78	172.89
0.8	-7.59	77.64	2.88	-35.57	-69.99	-113.73	-0.81	172.43
0.9	-8.81	52.44	5.04	-65.21	-68.34	89.55	-0.84	171.95
1.0	-10.10	19.83	6.51	-92.57	-72.89	2.17	-0.86	171.55
1.1	-11.18	-25.36	7.25	-121.61	-73.34	-49.30	-0.89	171.23
1.2	-10.56	-90.98	6.31	-151.41	-69.80	101.32	-0.92	171.07
1.3	-9.76	-178.11	-0.27	-123.86	-64.93	59.64	-0.93	170.99
1.4	-11.13	103.54	11.64	-116.14	-63.82	61.79	-0.93	171.02
1.5	-14.57	14.83	14.85	-154.58	-68.37	44.87	-0.94	170.22
1.6	-14.14	-52.60	16.25	177.81	-65.24	67.00	-1.01	166.46
1.7	-11.75	-96.40	16.56	151.72	-66.73	105.11	-0.99	165.62
1.8	-10.49	-129.95	17.19	141.54	-63.26	51.08	-0.86	164.75
1.9	-8.54	-158.36	18.05	163.72	-61.52	80.92	-0.58	161.69
2.0	-8.06	173.14	27.08	115.00	-58.78	73.83	-1.10	157.74
2.1	-7.54	151.69	27.54	71.56	-60.67	52.10	-1.29	158.72
2.2	-7.03	129.41	28.49	40.12	-60.84	65.06	-1.25	158.33
2.3	-6.73	107.78	28.91	8.88	-60.95	77.99	-1.11	156.85
2.4	-6.86	86.50	29.08	-22.27	-66.52	76.90	-1.05	154.55
2.5	-7.38	64.09	29.40	-54.58	-58.00	74.95	-1.13	151.71
2.6	-8.75	44.42	28.83	-88.84	-56.15	80.64	-1.39	149.07
2.7	-10.52	30.26	27.31	-122.93	-55.80	60.27	-1.86	147.83
2.8	-11.84	24.20	24.29	-154.61	-53.89	47.51	-2.11	148.94
2.9	-10.74	14.14	18.54	-151.26	-53.97	25.85	-1.95	150.46
3.0	-10.99	-18.85	24.13	-151.23	-55.59	48.50	-1.62	146.89
3.1	-14.61	-46.14	25.77	169.30	-54.34	37.20	-2.02	143.06
3.2	-18.55	-41.21	24.62	130.83	-54.07	34.65	-2.59	142.76
3.3	-16.92	-32.15	22.72	100.42	-52.72	15.11	-2.92	143.79
3.4	-13.95	-41.73	20.69	72.86	-54.07	0.36	-3.08	144.78
3.5	-11.36	-57.74	18.58	47.74	-54.57	-8.34	-3.21	145.40
3.6	-9.08	-75.13	16.40	23.10	-54.86	-15.18	-3.34	146.32
3.7	-7.16	-92.19	14.00	-1.06	-55.31	-11.94	-3.44	147.75
3.8	-5.55	-108.30	11.31	-24.24	-58.60	-16.04	-3.45	149.31
3.9	-4.29	-123.32	8.39	-45.93	-56.48	-6.02	-3.38	151.01
4.0	-3.31	-136.87	5.18	-66.16	-57.91	-23.56	-3.18	152.52

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
4.1	-2.59	-149.03	1.70	-83.93	-58.75	-26.39	-2.87	153.43
4.2	-2.06	-159.71	-2.01	-98.56	-59.94	-37.94	-2.54	153.27
4.3	-1.67	-169.08	-5.85	-108.40	-62.40	-47.09	-2.28	152.08
4.4	-1.39	-177.35	-8.98	-111.00	-61.81	-39.94	-2.32	150.47
4.5	-1.17	175.37	-10.87	-120.50	-58.95	-36.37	-2.35	152.46
4.6	-1.02	168.83	-13.95	-131.39	-63.01	-41.42	-1.91	152.83
4.7	-0.90	162.92	-16.98	-137.13	-64.20	-72.14	-1.59	151.75
4.8	-0.81	157.57	-19.63	-140.52	-64.85	-62.32	-1.37	150.36
4.9	-0.73	152.62	-21.85	-143.67	-67.94	-45.51	-1.20	148.95
5.0	-0.68	147.95	-23.79	-147.75	-65.46	-50.96	-1.06	147.50
5.1	-0.64	143.58	-25.63	-153.14	-69.33	-65.18	-0.94	146.09
5.2	-0.60	139.37	-27.54	-159.50	-71.70	1.12	-0.84	144.61
5.3	-0.58	135.31	-29.39	-165.04	-70.18	-18.91	-0.76	143.20
5.4	-0.56	131.41	-31.23	-171.05	-69.29	0.93	-0.69	141.76
5.5	-0.55	127.51	-32.90	-176.50	-67.06	21.86	-0.64	140.29
5.6	-0.53	123.68	-34.52	177.69	-67.90	38.32	-0.59	138.88
5.7	-0.52	119.87	-35.91	171.23	-69.23	10.07	-0.56	137.46
5.8	-0.52	116.13	-37.12	163.75	-64.72	17.96	-0.53	136.02
5.9	-0.51	112.42	-38.25	154.34	-65.96	39.99	-0.50	134.59
6.0	-0.50	108.70	-39.42	146.41	-62.39	28.50	-0.48	133.16
7.0	-0.33	76.26	-42.96	36.14	-62.60	-1.85	-0.43	116.51
8.0	-0.22	57.45	-44.86	-31.54	-60.24	-29.66	-0.40	101.36
9.0	-0.17	45.04	-46.73	-81.65	-63.71	-23.94	-0.59	85.05
10.0	-0.25	29.31	-46.96	-154.41	-70.41	85.22	-1.58	52.84
11.0	-0.28	9.73	-50.54	114.55	-63.22	-32.78	-3.48	-11.66
12.0	-0.24	-4.21	-61.03	-49.72	-58.68	-86.10	-3.73	-90.61
13.0	-0.22	-10.97	-64.05	-75.56	-68.09	-123.90	-2.22	152.42
14.0	-0.28	-18.44	-64.13	-79.00	-62.67	-93.12	-0.81	103.26
15.0	-0.41	-35.31	-58.16	-126.54	-55.82	-124.97	-0.71	82.13
16.0	-0.33	-52.93	-68.34	174.37	-65.88	176.92	-0.98	52.11
17.0	-0.22	-58.99	-72.29	127.96	-65.34	176.26	-1.01	10.12
18.0	-0.25	-59.43	-68.79	-29.67	-66.03	33.65	-0.68	-22.15
19.0	-0.47	-64.45	-66.51	-25.02	-61.79	-26.77	-0.39	-36.97
20.0	-0.71	-78.75	-65.28	-27.30	-62.16	-9.87	-0.54	-46.56

Notes:
1. S-parameter is measured with deembedded reference plane at DUT RFin and RFout pins.
2. R2 = 1.2kΩ, R3 = 300Ω, R4 = 1.2kΩ as shown in Figure 36.

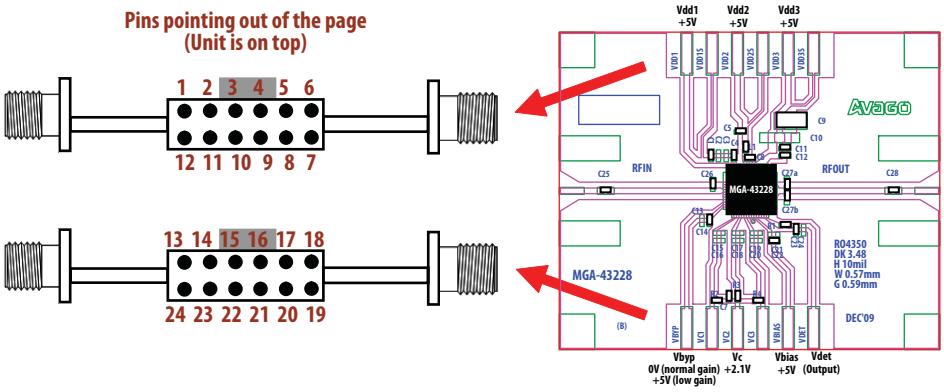
Demonstration Board Top View



Bill of materials

Component	Value	Part #
C9	22uF	GRM31CR61C226ME15
C1, C5, C11, C22	0.1uF	GRM155R71C104KA88
C7, C13, C25, C28	7.5pF	GJM1555C1H7R5DB01
C4	8.2pF	GJM1555C1H8R2DB01
C8	2.4pF	GJM1555C1H2R4CB01
C12	2.2pF	GJM1555C1H2R2CB01
C26	0.4pF	GJM1555C1HR40BB01
C27a	1.8pF	GJM1555C1H1R8CB01
C27b	2.0pF	GJM1555C1H2R0CB01
C23	22nF	GRM155R71E223KA61
L1	1.0nH	0402HP-1N0XJLW
R1	0Ω	RK73Z1ETTD
R2	1200Ω	RK73B1ETTD122J
R3	300Ω	RK73B1ETTD301J
R4	1200Ω	RK73B1ETTD122J

Note:
For performance optimization, control voltage for individual stages can be adjusted by varying R2, R3 and R4 resistor values.



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)
Pin 6 : Vdd1 (Force)
Pin 13 : Vbyp
Pin 14 : Vc1 (Not used)
Pin 15 : Vc2
Pin 16 : Vc3 (Not used)
Pin 17 : Vbias
Pin 18 : Vdet
Other pins are grounded

Figure 35. Demonstration board application circuit for MGA-43228 module

Application Schematic

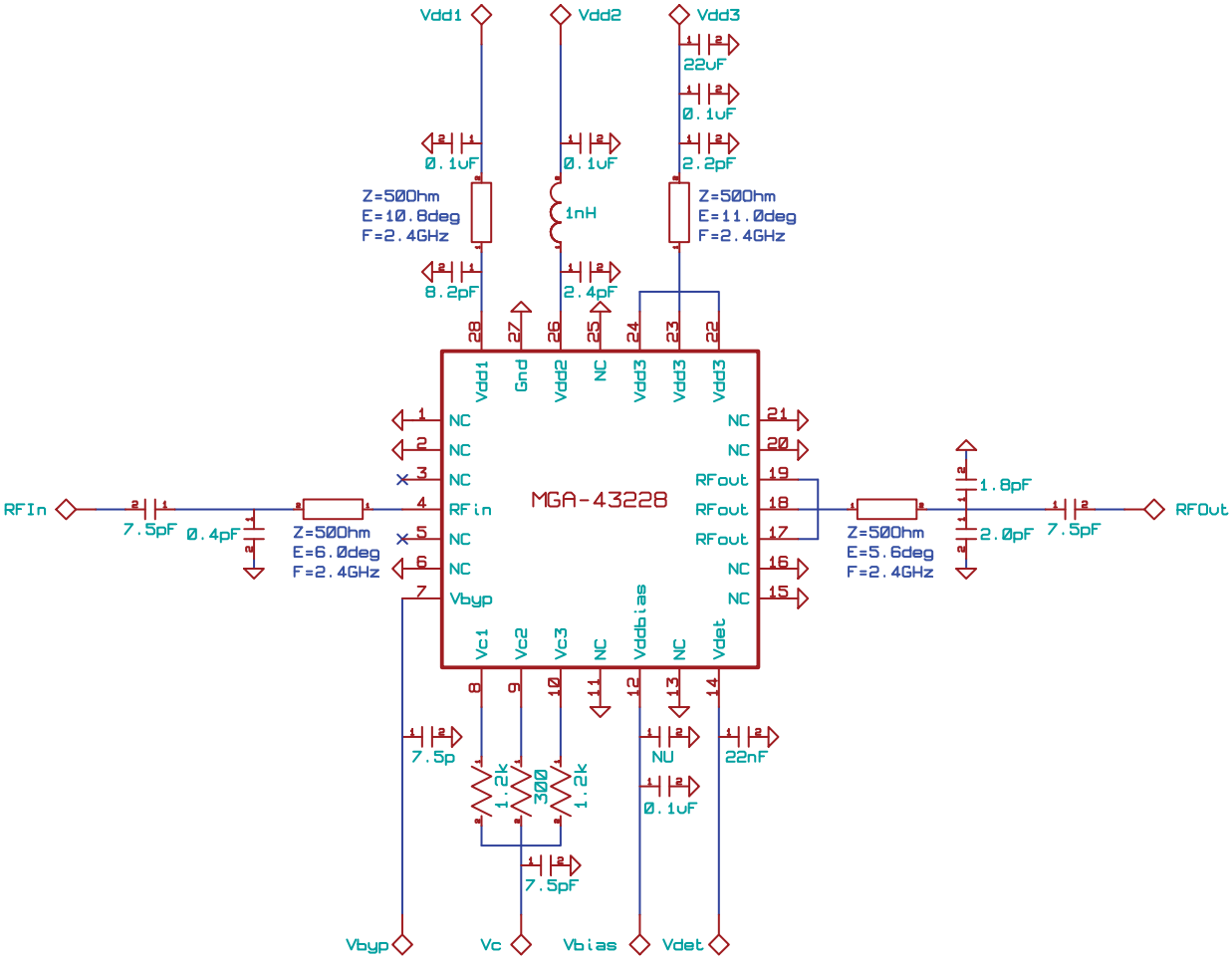
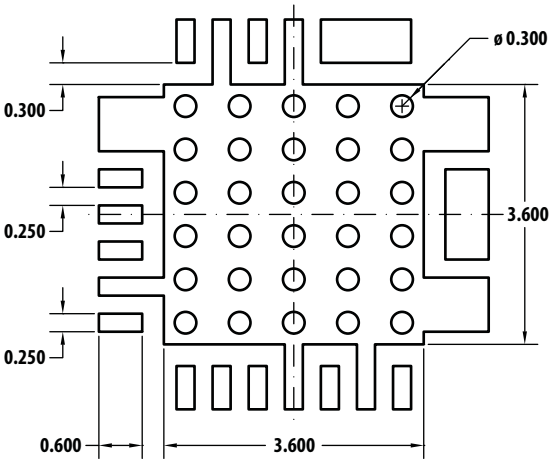


Figure 36. Application schematic in demonstration board

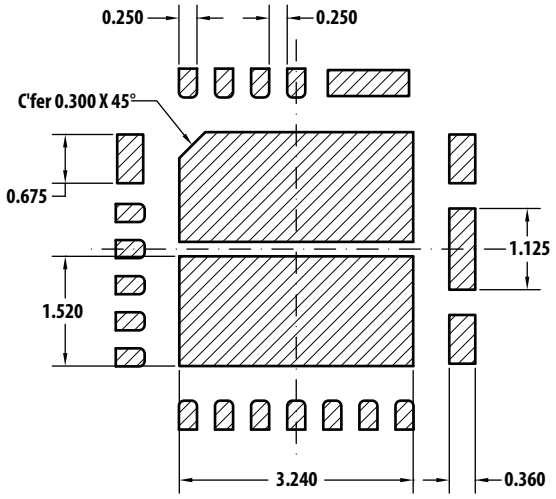
Notes:

1. In normal gain mode operation, Vbyp = 0V. Vc1, Vc2 and Vc3 are bias pins that are used to set the bias conditions to the 3 internal gain stages of the PA.
2. Typical quiescent current distribution with Vdd1 = Vdd2 = Vdd3 = Vbias = 5V, Vbyp = 0V, Vc = 2.1V is :
   a. Idd1 = 50 mA
   b. Idd2 = 180 mA
   c. Idd3 = 270 mA
   d. Ibias = 16.5mA
   (Note: Vc supplied through Vc2 pin on demonstration board with R2 = 1.2kΩ , R3 = 300Ω and R4 = 1.2kΩ)
3. Low gain mode is enabled by setting Vbyp pin to 5V. This condition overrides the normal high gain mode operation and bypasses the first gain stage, regardless of the voltage at Vc1 pin.
4. Modulated signal measurements are made with Agilent 89600 VSA and Agilent E4438C signal generator with IEEE 802.16e option using the following test conditions :
   – Signal format: IEEE 802.16e OFDMA, ¾ rate FEC
   – Modulation: 64-QAM
   – Number of Subcarriers: 840
   – Modulation bandwidth: 10 MHz
   – Downlink ratio: 50%
   Residual distortion of signal generator: (0.6-0.8)%. This distortion is not removed from the overall EVM data in the datasheet.
5. Typical operating voltages and currents:
   a. Normal gain mode: Vdd1 = Vdd2 = Vdd3 = Vbias = 5V. Vc = 2.1V. Vbyp = 0V. Iq(total) = 500 mA.
   b. Low gain mode: Vdd1 = Vdd2 = Vdd3 = Vbias = 5V. Vc = 2.1V. Vbyp = 5V. Iq(total) = 500 mA.
6. Vdd1/2/3 are shown as separate supplies with individual bypass capacitors. This yields the most stable configuration. If a common power supply line is used, proper broadband bypass decoupling is recommended to reduce common mode feedback through the supply line.

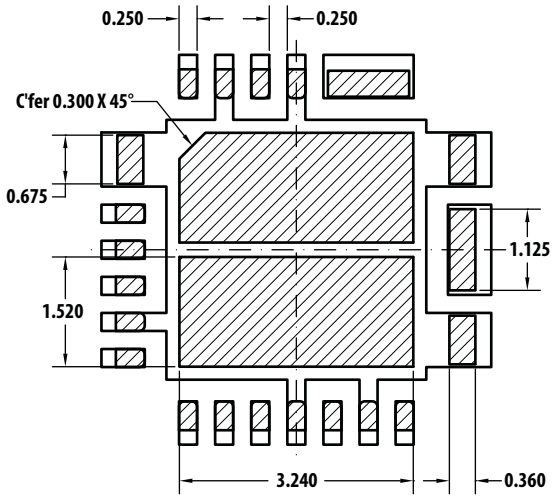
PCB Land Pattern and Stencil Outline



PCB Land Pattern (Top View)



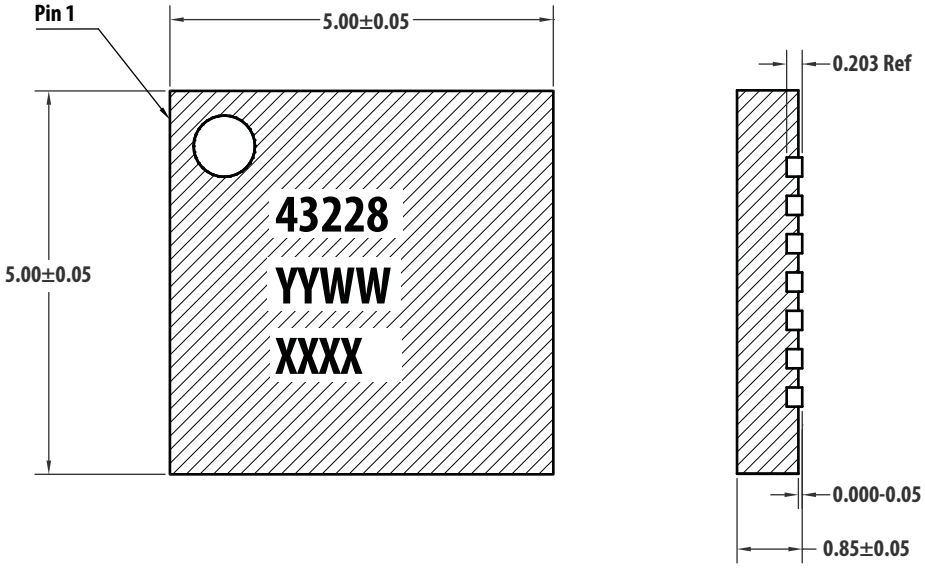
Stencil Outline



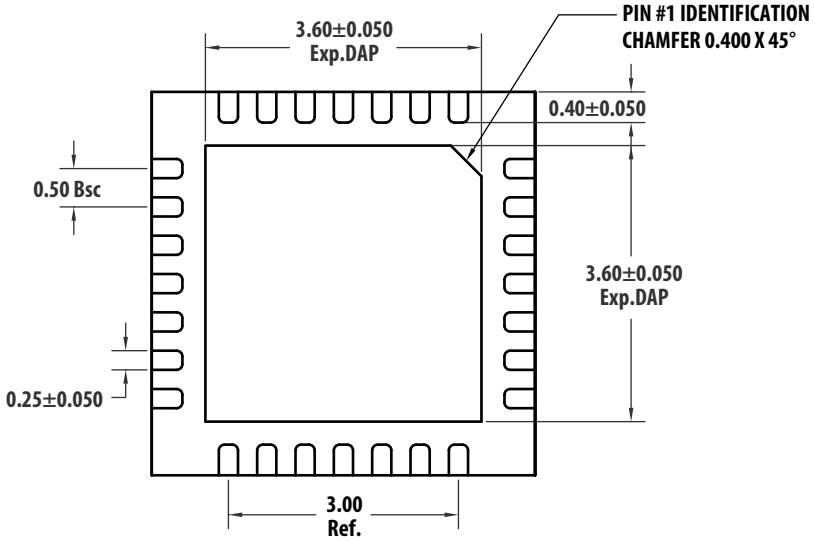
Combined PCB Land Pattern and Stencil Outline

(All dimensions in mm)

QFN 5.0 x 5.0 x 0.85mm^3 28-Lead Package Dimensions



Top View **Side View**



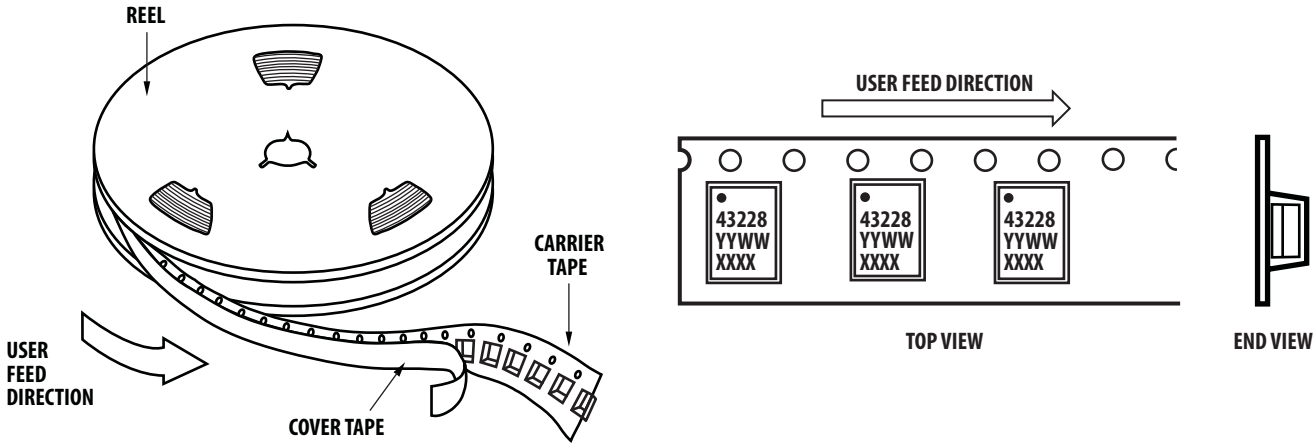
Bottom View

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

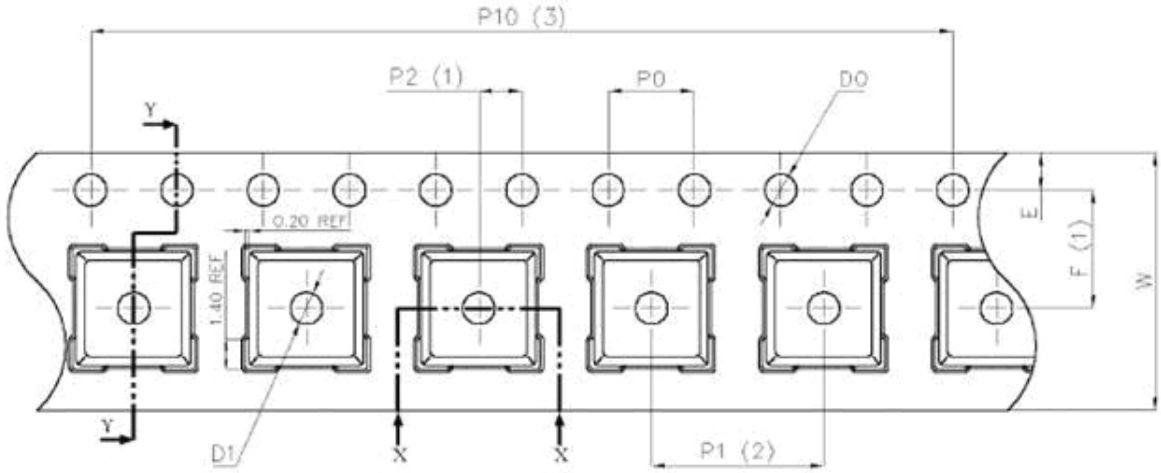
Part Number Ordering Information

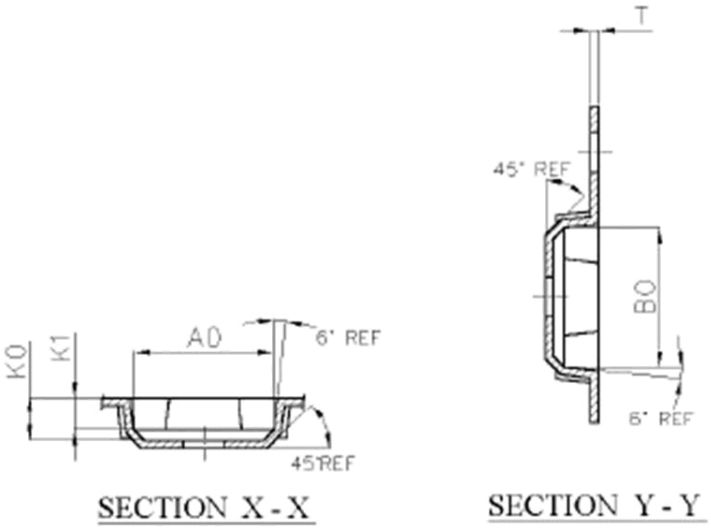
Part #	Qty	Container
MGA-43228-BLKG	100	Antistatic Bag
MGA-43228-TR1G	1000	7" Reel

Device Orientation



Tape Dimensions



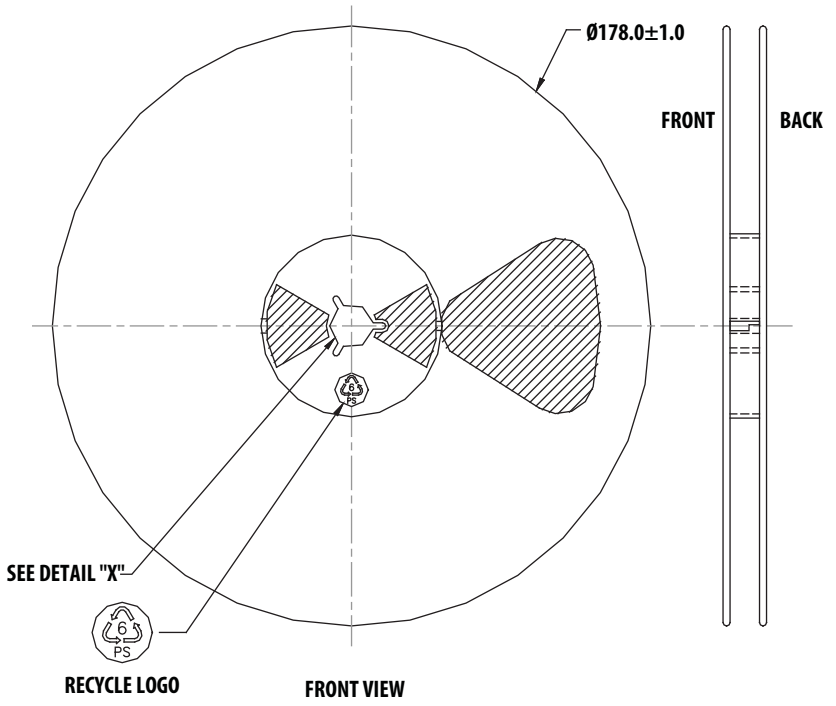


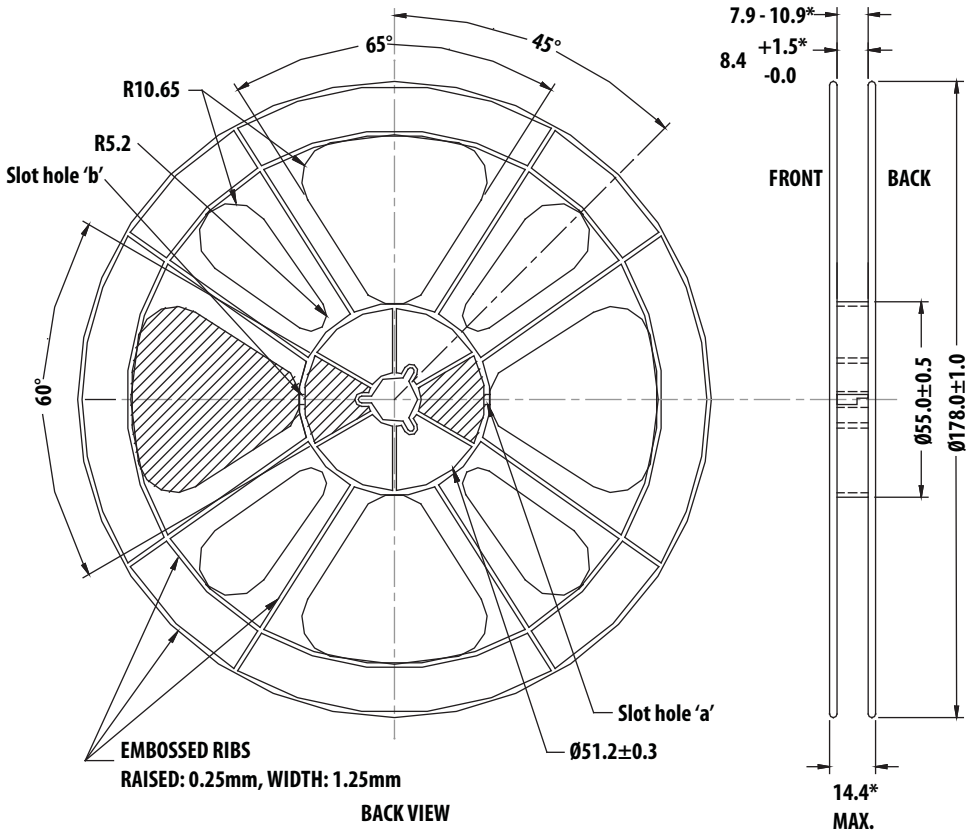
SECTION X - X

SECTION Y - Y

Dimension List			
Annote	Milimeter	Annote	Milimeter
A0	5.40±0.10	P0	4.00±0.10
B0	5.40±0.10	P2	2.00±0.10
D0	$1.50^{+0.10}_{-0}$	P10	40.00±0.20
D1	1.60±0.10	E	1.75±0.10
K0	1.90±0.10	F	5.50±0.10
K1	1.50±0.10	T	0.30±0.03
P1	8.00±0.10	W	12.00±0.30

Reel Dimensions (7″ reel)





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

AV02-2355EN - September 29, 2011