

# 3.0 V 100 mW RF Power Amplifier IC for Bluetooth

V 1.00

MA02305AK

## Features

- 20 dB Gain – dramatically increases range of your low power Bluetooth devices
- Single 3.0V positive supply – operates over a wide range of supply voltages
- Extremely small size – 6 pin SOT plastic package - 3 mm x 1.75 mm body size
- Output power easily controllable via  $V_{DD1}$
- 45% Power Added Efficiency
- 100% Duty Cycle
- 2000 to 2900 MHz Operation
- Self-Aligned MSAG<sup>®</sup>-Lite MESFET Process

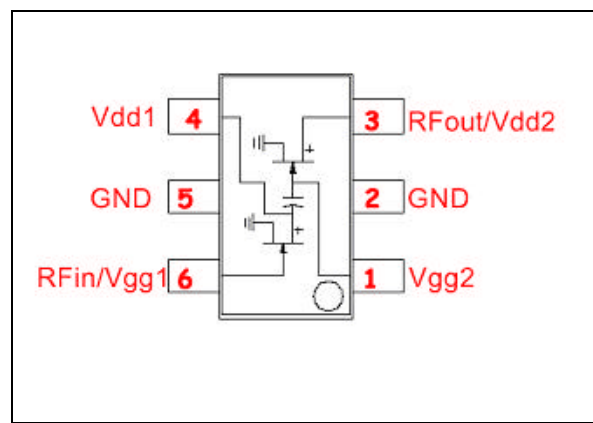
## Description

The MA02305AK is an RF power amplifier based on M/A-COM's Self-Aligned MSAG<sup>®</sup> MESFET Process. This product is designed for use in 2.4 GHz ISM products as a booster for high power Bluetooth devices. Output power can be controlled to meet Bluetooth requirements via varying input power or the voltage on  $V_{DD1}$ .

## Ordering Information

Part Number	Package
MA02305AK-R7	7 inch, 3000 Piece Reel
MA02305AK-SMB	MA02305AK Test Board

## MA02305AK



## Maximum Ratings ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
DC Supply Voltage	$V_{DD}$	5.5	V
RF Input Power	$P_{IN}$	10	mW
Junction Temperature	$T_J$	150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-40 to +150	$^\circ\text{C}$

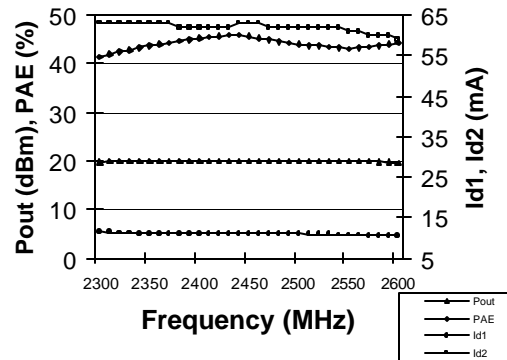
## Electrical Characteristics: $V_{DD1} = 2.5\text{ V}$ , $V_{DD2} = 3\text{ V}$ , $P_{IN} = +0\text{ dBm}$ , Duty Cycle = 100%, $T_A = 25^\circ\text{C}$

Characteristic	Symbol	Min	Typ	Max	Unit
Frequency Range	$f$	2400		2500	MHz
Output Power $f = 2450\text{ MHz}$	$P_{OUT}$	18.7	20		dBm
Power Added Efficiency $f = 2450\text{ MHz}$	$\eta$	40	45		%
Harmonics	$\frac{2f}{3f}$		-30 -27	-26 -22	dBc
Input VSWR	-		1.5	2.0	:1
Off Isolation ( $V_{DD} = 0\text{ V}$ )	$S_{21}$		-25		dB
Thermal Resistance, junction to soldering point (pin 2)	$R_{TH}$		180		$^\circ\text{C/W}$
Load Mismatch ( $V_{DD} = 5.5\text{ V}$ , VSWR = 8:1, $P_{IN} = 0\text{ dBm}$ )	-	No Degradation in Power Output			
Stability ( $P_{IN} = 0\text{ dBm}$ , $V_{DD} = 0\text{--}5.5\text{ V}$ , Load VSWR = 5:1, fixed phases)	-	All non-harmonically related outputs more than 60 dB below desired signal			

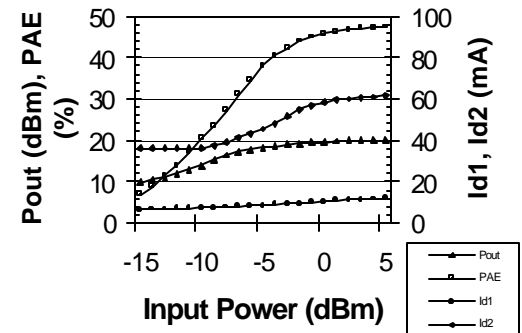


## Typical Performance Curves

Output Power, Drain Currents, and Efficiency vs. Frequency  $V_{DD2} = 3\text{ V}$ ,  $V_{DD1} = 2.5\text{ V}$ ,  $P_{IN} = 0\text{ dBm}$

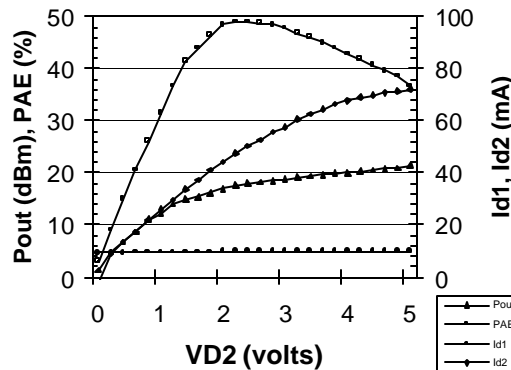


Output Power, Drain Currents and Efficiency vs. Input Power  $V_{DD2} = 3\text{ V}$ ,  $f = 2450\text{ MHz}$ ,  $V_{DD1} = 2.5\text{ V}$



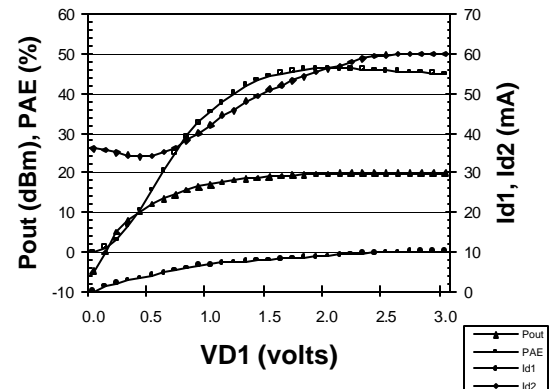
Output Power, Drain Currents and Efficiency vs. Supply Voltage  $P_{IN} = 0\text{ dBm}$ ,  $f = 2450\text{ MHz}$ ,  $V_{DD1} = 2.5\text{ V}$

$V_{DD2} = 3\text{ V}$



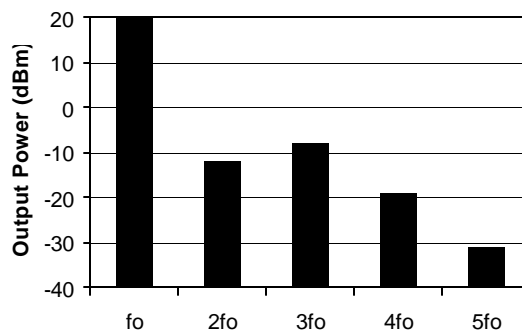
Output Power, Drain Currents and Efficiency vs.  $V_{DD1}$  for Power Control  $P_{IN} = 0\text{ dBm}$ ,  $f = 2450\text{ MHz}$ ,  $V_{DD2} = 3\text{ V}$

$V_{DD1} = 2.5\text{ V}$

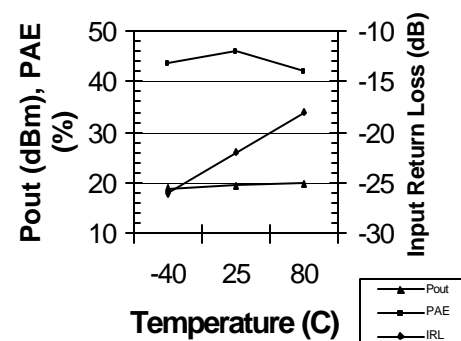


## Harmonics

$P_{IN} = 0\text{ dBm}$ ,  $f_0 = 2450\text{ MHz}$ ,  $V_{DD1} = 2.5\text{ V}$ ,  $V_{DD2} = 3\text{ V}$



Output Power, Input Return Loss and Efficiency vs. Temperature  $P_{IN} = 0\text{ dBm}$ ,  $f = 2450\text{ MHz}$ ,  $V_{DD1} = 2.5\text{ V}$ ,  $V_{DD2} = 3\text{ V}$



Specifications subject to change without notice.

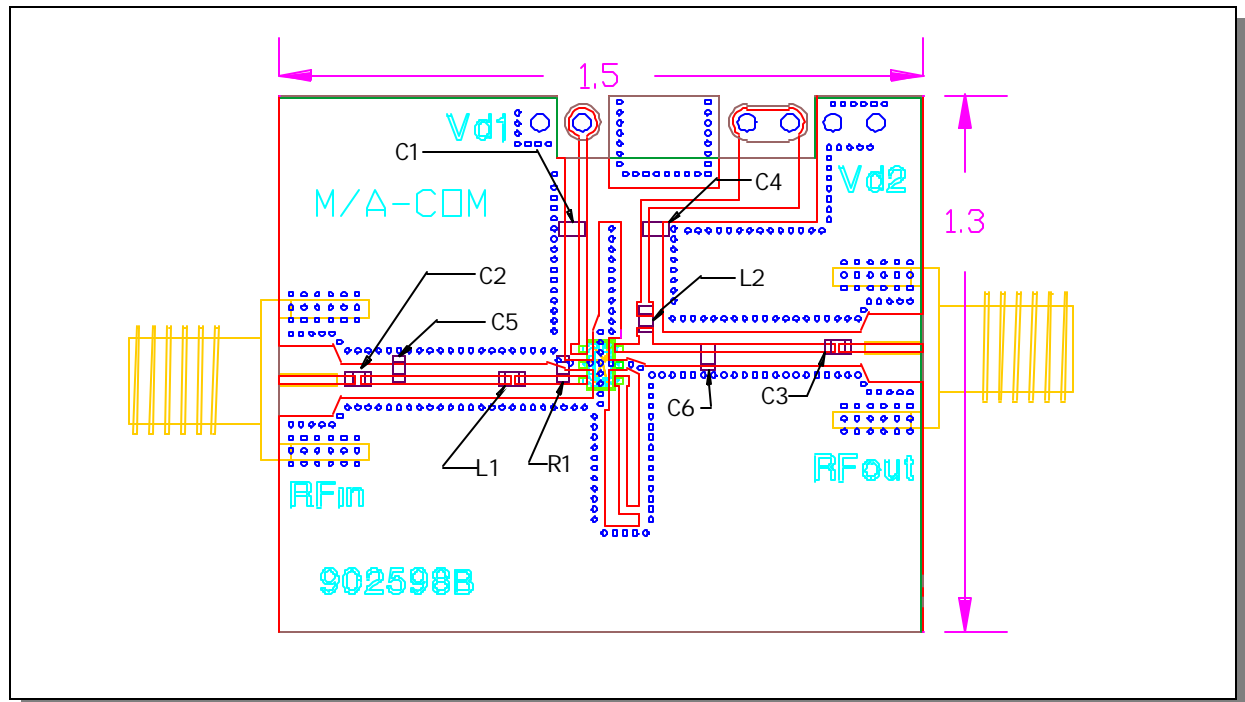
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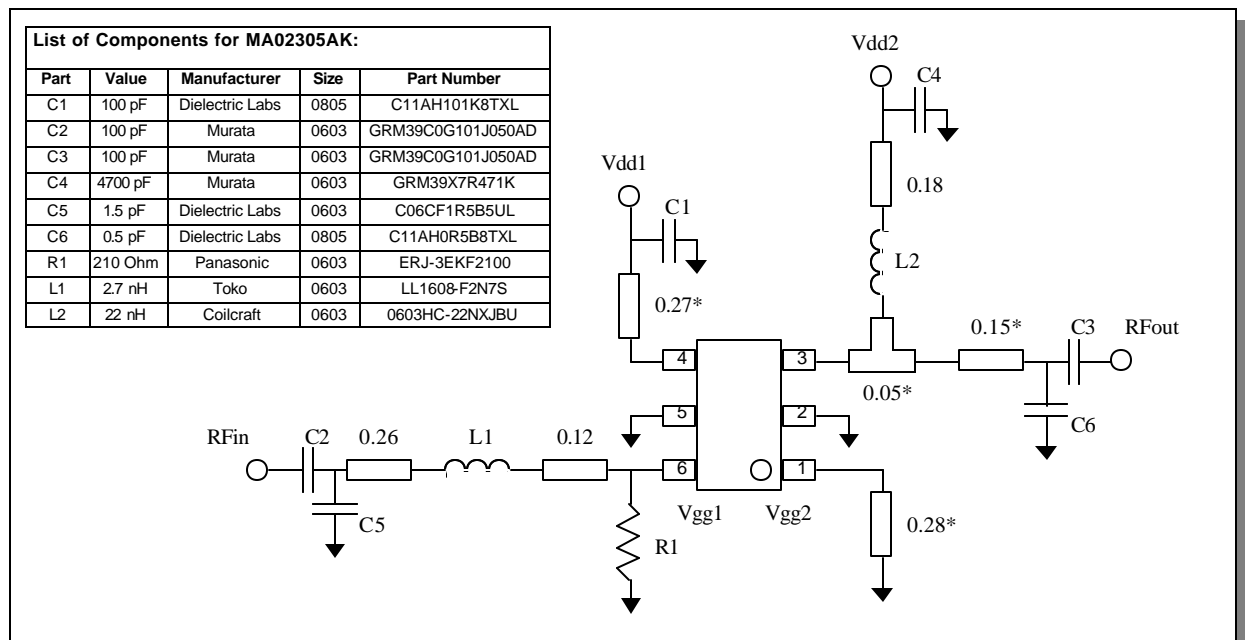
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## Mechanical Data



Component layout and printed circuit drawing for evaluation board.

## Application Information

Evaluation Board Schematic. 50  $\Omega$  transmission line lengths in inches based on 10 mil thick, FR4. Critical line lengths denoted with (\*).

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## Designing With the MA02305AK

The MA02305AK is built using a near-enhancement mode FET that operates from a single supply voltage. A negative voltage is not required because the FET is designed to operate with a +0V DC gate bias.

There is no impedance matching or RF choking on this IC – these functions are supplied externally. This approach offers the highest level of performance.

To duplicate MA02305AK data sheet performance, your circuit board must recreate the same impedances developed on the evaluation board depicted in the preceding figures. One-port S-parameters looking into the board impedances away from the device are listed below. The calibration plane for the datasheet is the pin of the device.

Frequency (MHz)	V <sub>GG2</sub> Pin 1		RF <sub>OUT</sub> /V <sub>DD2</sub> Pin 3		V <sub>DD1</sub> Pin 4		RF <sub>IN</sub> /V <sub>GG1</sub> Pin 6	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.10	0.97043	179.42	0.71433	139.99	0.95319	152.14	0.17741	-126.15
0.20	0.99055	174.22	0.60534	129.51	0.98326	162.08	0.15709	-145.68
0.30	0.99177	171.32	0.47048	120.60	0.98368	173.64	0.16001	-151.45
0.40	0.98788	168.52	0.33247	111.57	0.97982	-174.63	0.16851	-154.29
0.50	0.98749	165.67	0.26397	107.46	0.98418	178.14	0.18235	-156.15
0.60	0.98721	162.81	0.19530	103.28	0.98820	170.74	0.19827	-158.65
0.70	0.98736	159.91	0.14041	110.03	0.98958	166.96	0.21441	-161.89
0.80	0.98679	157.04	0.08519	120.66	0.99031	163.16	0.23162	-165.23
0.90	0.98706	154.23	0.07177	135.30	0.98996	160.07	0.24969	-168.85
1.00	0.98788	151.34	0.06349	153.01	0.98991	156.76	0.26778	-173.43
1.10	0.98726	148.45	0.06587	169.91	0.98978	153.72	0.28514	-178.11
1.20	0.98626	145.60	0.07191	-174.26	0.98931	150.61	0.30267	176.84
1.30	0.98641	142.71	0.08315	-166.96	0.98780	147.19	0.31953	171.23
1.40	0.98644	139.82	0.09505	-160.56	0.98649	143.63	0.33628	165.32
1.50	0.98500	136.88	0.10675	-157.86	0.94242	143.98	0.35222	159.06
1.60	0.98453	133.95	0.11951	-155.52	0.89784	144.34	0.36683	152.71
1.70	0.98446	130.94	0.12963	-155.34	0.94174	139.92	0.38061	145.84
1.80	0.98349	127.91	0.14015	-154.79	0.98750	135.30	0.39320	138.74
1.90	0.98313	124.92	0.14882	-155.14	0.98984	132.06	0.40495	131.52
2.00	0.98382	121.96	0.15720	-155.31	0.99198	128.73	0.41623	124.12
2.10	0.98452	118.98	0.16432	-155.56	0.99283	125.72	0.42563	116.58
2.20	0.98438	115.96	0.17177	-156.08	0.99454	122.46	0.43485	108.81
2.30	0.98388	112.89	0.17810	-156.67	0.99489	119.34	0.44313	101.04
2.40	0.98292	109.77	0.18392	-157.01	0.99429	116.09	0.45009	93.13
2.50	0.98095	106.65	0.18976	-157.26	0.99242	112.85	0.45667	85.39
2.60	0.98047	103.48	0.19541	-157.75	0.99221	109.40	0.46135	77.68
2.70	0.97883	100.30	0.20085	-157.91	0.98695	105.78	0.46780	70.00
2.80	0.97676	97.12	0.20642	-157.88	0.98054	102.09	0.47186	62.56
2.90	0.97636	94.00	0.21257	-158.32	0.94404	98.07	0.47850	55.39
3.00	0.97572	90.90	0.21802	-158.71	0.90652	93.92	0.48427	48.41

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GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
3.10	0.97519	87.69	0.22473	-158.80	0.92813	94.32	0.49202	41.58
3.20	0.97443	84.47	0.23177	-158.99	0.95106	94.75	0.49805	35.13
3.30	0.97243	81.27	0.24068	-159.25	0.96150	90.58	0.50499	28.91
3.40	0.97032	78.11	0.24969	-159.62	0.97174	86.31	0.51221	22.98
3.50	0.96903	74.98	0.26052	-160.44	0.96351	82.36	0.51994	17.31
3.60	0.96701	71.74	0.27111	-161.00	0.95413	78.37	0.52764	11.82
3.70	0.96360	68.63	0.28211	-161.90	0.93047	76.80	0.53520	6.57
3.80	0.96292	65.58	0.29396	-162.97	0.91064	75.14	0.54388	1.67
3.90	0.96262	62.38	0.30492	-164.32	0.93350	71.90	0.55281	-3.06
4.00	0.96034	59.13	0.31552	-165.45	0.95344	68.60	0.56144	-7.62
4.10	0.95820	55.98	0.33008	-167.00	0.95477	64.91	0.57003	-11.96
4.20	0.95728	52.79	0.34582	-168.67	0.95909	61.22	0.57934	-15.94
4.30	0.95652	49.53	0.36052	-170.75	0.95625	57.65	0.58809	-19.92
4.40	0.95406	46.40	0.37552	-172.64	0.95056	54.21	0.59686	-23.71
4.50	0.95198	43.31	0.39089	-175.10	0.94539	50.71	0.60531	-27.27
4.60	0.95125	40.19	0.40622	-177.54	0.94197	47.20	0.61438	-30.62
4.70	0.95152	37.10	0.42189	179.59	0.93401	43.41	0.62434	-33.90
4.80	0.95166	33.99	0.44003	176.61	0.92723	39.69	0.63385	-37.21
4.90	0.95067	30.77	0.45429	173.31	0.90236	35.79	0.64268	-40.26
5.00	0.94774	27.57	0.46894	169.93	0.87776	32.01	0.65242	-43.36
5.10	0.94351	24.50	0.48131	166.56	0.84543	31.67	0.65976	-46.33
5.20	0.94210	21.54	0.49478	163.09	0.81564	31.34	0.66830	-49.11
5.30	0.94232	18.59	0.50530	159.43	0.85067	29.15	0.67776	-51.79
5.40	0.94193	15.72	0.51842	155.69	0.88431	27.07	0.68668	-54.49
5.50	0.94382	12.78	0.52984	151.82	0.89525	23.25	0.69550	-57.16
5.60	0.94635	9.68	0.54223	147.54	0.90655	19.42	0.70606	-59.79
5.70	0.94601	6.52	0.54973	143.21	0.90262	15.33	0.71713	-62.63
5.80	0.94421	3.50	0.55888	138.79	0.89847	11.62	0.72678	-65.49
5.90	0.94367	0.68	0.56482	134.44	0.88135	8.25	0.73521	-68.25
6.00	0.94249	-2.19	0.56973	130.04	0.86517	5.04	0.74383	-71.11

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