



APPLICATION NOTE 335

Maxim Wireless/RF Power Amplifier Selector Guide

Abstract: An overview of Maxim's RF power amplifier (PA) products targeted towards cellular, PCS, 802.11a/b/g, cordless phone and Bluetooth applications. Table compares operating voltage, supply current, output power, package, power added efficiency, and features of Maxim PA ICs. Another table assists selection by market application.

Additional Information:

- [Wireless Product Line Page](#)
- [Quick View Data Sheet for the MAX2240](#)
- [Quick View Data Sheet for the MAX2264/MAX2265](#)
- [Quick View Data Sheet for the MAX2267/MAX2268/MAX2269](#)
- [Quick View Data Sheet for the MAX2320/MAX2321/MAX2322/MAX2324/MAX2326/MAX2327](#)
- [Quick View Data Sheet for the MAX2430](#)
- [Quick View Data Sheet for the MAX2601/MAX2602](#)
- [Applications Technical Support](#)

Maxim's RF power amplifiers (PAs) address both linear-modulation formats, such as QAM and QPSK, and nonlinear modulation, such as FM and FSK. PAs designed for the TDMA markets have improved performance features like auto-ramping to reduce spectral splatter. Auto-ramping helps keep a steady V_{CC} and reduce VCO pulling. Automatic thermal protection is available to temporarily reduce output power yielding a very robust PA. PAs for the CDMA markets have been optimized to achieve the lowest current draw in the most probable operating output power levels for urban and suburban CDMA environments. CDMA PAs spend most of their time in the lower output power settings.

For 2.4GHz ISM applications such as 802.11b WLAN, Bluetooth, HomeRF, and cordless phones, Maxim provides low-cost, ultra-small power amplifiers in the ultra-chip scale package. These PAs feature analog or digital power control, closed-loop power control, dynamic bias control, integrated detector, and high efficiency performance.

These are some of the key advantages offered by silicon bipolar RF power amplifiers:

1. Lower cost, due to higher die yield and simple device fabrication (compared to Heterojunction devices)
2. Small solution size due to the ultra-chip scale package and minimal external components
3. No negative bias supply required, such as for many GaAs amplifiers
4. Robust device performance over temperature and load variations
5. Auto-ramping feature

The table below shows a sampling of our power amplifiers and their capabilities to date. Note that several of these PAs have been re-tuned to specific performance characteristics and at center frequencies other than as shown.

Table 1. Selector Guide: A Sampling

Part	V _{CC} (V)	I _{CC} (mA)	Frequency (MHz)	P _{OUT} (dBm)	Class	Package	PAE (full)	PAE (derated)	Features
MAX2235	2.7 to 5.5	20 idle 610 full	800 to 1000	+30.3	C	20-Pin TSSOP-EP	47%	22% +24dBm	Analog Gain Control, Auto Power Ramp, Shutdown
MAX2430	3.0 to 5.5	52	800 to 1000	+21.4	AB	16-Pin SO/QSOP	24%	NA	Power Control, Shutdown, Drives MAX2601/02
MAX2601	2.7 to 5.5	450	DC to 1000	+30.0	AB/C	8-Pin PSOPII	54%	18% +20dBm	Power Transistor
MAX2602	2.7 to 5.5	450	DC to 1000	+30.0	AB/C	8-Pin PSOPII	54%	18% +20dBm	Power Transistor with On-Chip Bias Diode, Power Ramp, Shutdown
MAX2264	2.7 to 5.0	34 idle, 58 avg, 95 full	824 to 849	+28.0	AB	16-Pin TSSOP-EP	32%	12% +16dBm	IS-98 CDMA U.S., Internal Switch, Smallest, Most Economical Solution
MAX2265	2.7 to 5.0	83 full	824 to 849	+28.0	AB	16-Pin TSSOP-EP	37%	7% +16dBm	IS-98 CDMA U.S., TDMA PAE = 40% at +30dBm
MAX2266	2.7 to 5.0	34 idle, 52 avg, 100 full	824 to 849	+28.0	AB	16-Pin TSSOP-EP	32%	17% +16dBm	IS-98 CDMA U.S., Off-Chip Switch, Lowest Current
MAX2267	2.7 to 4.5	34 idle, 56 avg, 95 full	887 to 925	+27.0	AB	16-Pin TSSOP-EP	28%	12% +17dBm	IS-98 CDMA Japan, Internal Switch, Smallest, Most Economical Solution
MAX2268	2.7 to 4.5	90 idle	887 to 925	+27.0	AB	16-Pin TSSOP-EP	34%	7% +13.6dBm	IS-98 CDMA Japan, PDC PAE = 41% at +29dBm
MAX2269	2.7 to 4.5	34 idle, 50 avg, 100 full	887 to 925	+27.0	AB	16-Pin TSSOP-EP	29%	17% +17dBm	IS-98 CDMA Japan, Off-Chip Switch, Lowest Current
MAX2240	2.7 to 5.0	65 idle 105 full	2400 to 2500	+20	AB	UCSP 3x3	30%	NA	Bluetooth PA with Digital Power Control, Shutdown
MAX2242	2.7 to 3.6	280 idle 300 full	2400 to 2500	+22.5	AB	UCSP 3x4	17% Pin= -7dBm 315mA	6.7% +13dBm	+22.5dBm Output Power at -33dBc ACPR for 802.11b 28.5dB Power Gain External Bias Control for Current Throttleback On-Chip Power Detector Output Power Tunable from +10dBm to +22dBm

MAX2244	3.0 to 3.6	65 idle 172 full	2400 to 2500	+22	AB	UCSP 3x3	34.2%	NA	Integrated Input Match Internal Bandwidth-Limited Power Ramping Power Control Range: 0.5V to 2.0V Supply Current = 170mA at +22dBm
MAX2245	3.0 to 3.6	65 idle 179 full	2400 to 2500	+22	AB	UCSP 3x3	29.2%	NA	Integrated Input Match Internal Bandwidth-Limited Power Ramping Power Control Range: 0.9V to 2.0V Supply Current = 170mA at +22dBm
MAX2246	3.0 to 3.6	42 idle 118 full	2400 to 2500	+20	AB	UCSP 3x3	27.8%	NA	Integrated Input Match Internal Bandwidth-Limited Power Ramping Power Control Range: 0.5V to 2.0V
MAX2247	2.7 to 3.6	293 idle 390 full	2400 to 2500	+25	AB	UCSP 3x4	24.5%	21% +22.5dBm	High Linear Output Power: +25dBm with < -33dBc ACPR (1st side lobe) and < -55dBc ACPR (2nd side lobe) (802.11b) +17dBm and 3%EVM (802.11g) 25% Efficiency with Linear Output Power 29dB Power Gain On-Chip Power Detector External Bias Control for Current Throttleback On-Chip Input Matching 0.5µA Shutdown Mode
MAX2251	2.8 to 4.5	205 idle 1029 full	824 to 849	+32.4 AMPS +30 TDMA	AB	UCSP 3x4	51% AMPS 41% TDMA	38% +30dBm AMPS	Gain: 28dB Integrated Power Detector Low-Power Shutdown Mode PAE: 41% at +30dBm for TDMA PAE: 51% at +32.4dBm for AMPS

MAX2840	2.7 to 3.6	120 idle 155 full	5150 to 5350	+15	A	12-UCSP-1.52x2.02	6%	NA	High Linear Output Power +15dBm at 5.25 GHz (802.11a), 22dB Power gain, On-chip Power detector, Simple input/output matching, <10uA Shutdown current
MAX2841	2.7 to 3.6	165 idle 260 full	5150 to 5350	+18	A	12-UCSP-1.52x2.02	7%	NA	High Linear Output Power +18dBm at 5.25 GHz (802.11a), 22dB Power gain, On-chip Power detector, Simple input/output matching, <10uA Shutdown current

Table 2. Selections by Market

Market	Part	Advantages	Specs
Cellular CDMA (U.S.)	MAX2265	Low-cost, Simple Layout, Few External Components, High-peak Efficiency	Efficiency = 37% (ACPR = -45) Efficiency = 35% (ACPR = -48)
	MAX2264 MAX2266	Low-cost, World's Lowest Talk Current	Talk Current=55mA 16dBm Efficiency =12/18% (2264/66) Peak Efficiency =32%
	MAX2251	Small Size Ultra-chip Scale Package (2.06mm x 2.06mm), Integrated Power Detector, Low-power Shutdown Mode	Gain: 28dB PAE: 41% at +30dBm for TDMA PAE: 51% at +32.4dBm for AMPS
CDMA (Japan)	MAX2268	Low-cost, Simple Layout, Few External Components, High-peak Efficiency	Efficiency = 37% (ACPR = -45) Efficiency = 35% (ACPR = -48)
	MAX2267 MAX2269	Low-cost, World's Lowest Talk Current	Talk Current=55mA 16dBm Efficiency =12/18% (2264/66 and ACPR=-45) Peak Efficiency =33% (ACPR=-45)
Cellular TDM	MAX2251	Small Size Ultra-chip Scale Package (2.06mm x 2.06mm), Integrated Power Detector, Low-power Shutdown Mode	Gain: 28dB PAE: 41% at +30dBm for TDMA
PDC	MAX2265	Low-cost, Simple Layout, Few External Components, High-peak Efficiency	Efficiency=40% (ACPR=-28) P _{OUT} =30dBm
AMPS	MAX2251	Small Size Ultra-chip Scale Package (2.06mm x 2.06mm), Integrated Power Detector, Low-power Shutdown Mode	Efficiency=51% P _{OUT} =32.4dBm
	MAX2265	Low-cost, Simple Layout, Few External Components, High-peak Efficiency	PAE: 48% at +31.5dBm Output Power for AMPS
WLL	MAX2265	Low-cost, Simple Layout, Few External Components, High-peak Efficiency	Efficiency=37% (ACPR=-45) Efficiency=35% (ACPR=-48)

900MHz ISM	MAX2235	Analog Gain Control, Auto Power Ramp, Shutdown	PAE: 47% at +30.3dBm Output Power
	MAX2251	Small Size Ultra-chip Scale Package (2.06mm x 2.06mm), Integrated Power Detector, Low-power Shutdown Mode	Gain: 28dB PAE: 41% at +30dBm for TDMA PAE: 51% at +32.4dBm for AMPS
Bluetooth HomeRF 2.4GHz DECT	MAX2240	Small Size Ultra-chip Scale Package (1.56mm x 1.56mm), 2-bit Digital Power Control	+20dBm, Efficiency = 30%
	MAX2244	Closed-loop Analog Power Control, Small Size Ultra-chip Scale Package (1.56mm x 1.56mm)	+22dBm, Efficiency = 34.2% Power control range 0.5V to 2V
	MAX2245	Closed-loop Analog Power Control, Small Size Ultra-chip Scale Package (1.56mm x 1.56mm)	+22dBm, Efficiency = 29.2% Power control range 0.9V to 2V
	MAX2246	Closed-loop Analog Power Control, Small Size Ultra-chip Scale Package (1.56mm x 1.56mm)	+20dBm, Efficiency = 27.8% Power control range 0.5V to 2V
Cellular TDMA/AMPS Dual Mode	MAX2251	Small Size Ultra-chip Scale Package (2.06mm x 2.06mm), Integrated Power Detector, Low-power Shutdown Mode	Gain: 28dB PAE: 41% at +30dBm for TDMA PAE: 51% at +32.4dBm for AMPS
802.11b WLAN	MAX2242	Integrated Power Detector, Dynamic Bias Control, Output Power Tunable from +10dBm to +22dBm	+22.5dBm Output Power at -33dBc ACPR for 802.11B 28.5dB Power Gain
802.11b/g	MAX2247	High linear output power, On-chip power detector, External DAC controllable Bias, On-chip input matching	+25dBm Output Power for 802.11b, +17dBm output power at 3.0% EVM for 802.11g, 29dB Power Gain
802.11a	MAX2840	High linear output power, On-chip power detector, Simple Matching External DAC controllable Bias	+15dBm Output Power at 3.9% EVN for 802.11a, 22dBm power gain
	MAX2841	High linear output power, On-chip power detector, Simple Matching External DAC controllable Bias,	+18dBm Output Power at 3.5% EVN for 802.11a, 22dBm power gain

[16-pin PQSOP Package Outline](#)

[16/20-pin TSSOP-EP Package Outline](#)

[16-pin SO/QSOP Package Outline](#)

[8-pin PSOPII Package Outline](#)

[9-pin UCSP Package Outline](#)

[12-pin UCSP Package Outline](#)

[25-pin UCSP Package Outline](#)

Application Note 335: <http://www.maxim-ic.com/an335>

More Information

For technical questions and support: <http://www.maxim-ic.com/support>

For samples: <http://www.maxim-ic.com/samples>

Other questions and comments: <http://www.maxim-ic.com/contact>

Related Parts

MAX2240: [QuickView](#) -- [Full \(PDF\) Data Sheet](#)
MAX2251: [QuickView](#) -- [Full \(PDF\) Data Sheet](#)
MAX2264: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)
MAX2265: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)
MAX2267: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)
MAX2268: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)
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