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Features

- Frequency Range 2.4 GHz to 2.5 GHz
- Supply Voltage 2.7V to 3.6V
- 32 dB Power Gain
- 23 dBm Linear Output Power for IEEE 802.11b Mode Operation
- EVM < 2.0% at 19 dBm Output Power for IEEE 802.11g Mode Operation
- On-chip Power Detector with 20 dB Dynamic Range
- Power-down Mode and Biasing Control
- Input and Interstage Matching Fully On-chip
- Low Profile Lead-free Plastic Package QFN16 (3 mm × 3 mm × 0.9 mm)

Applications

- IEEE 802.11b DSSS WLAN
- IEEE 802.11g OFDM WLAN
- Bluetooth 2.0 Enhanced Data Rate
- PC Cards, PCMCIA, Access Points
- 2.4 GHz ISM Band Application

High Gain Power Amplifier for 802.11b/g WLAN Systems

ATR7032

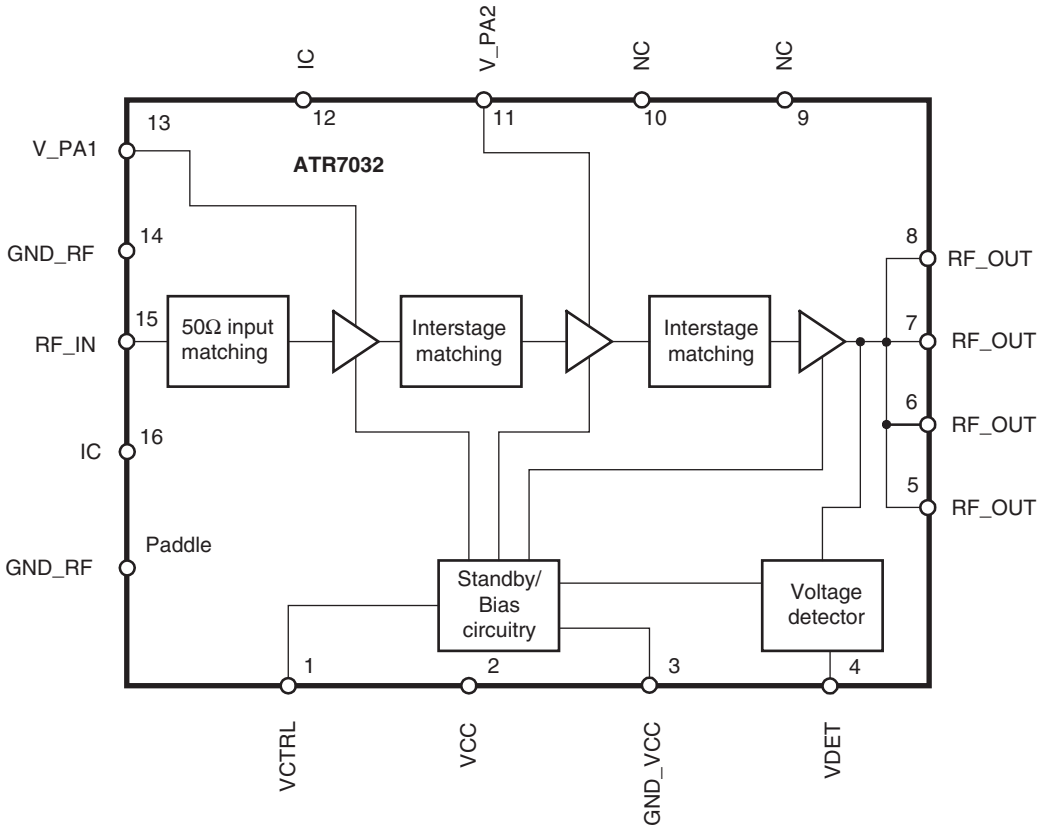
1. Description

This power amplifier (PA) is designed for high-performance 802.11b and 802.11g multi-mode applications such as Mini PCI and PCMCIA for portable devices and access points. The low profile plastic package with internal input matching to 50Ω and on-chip interstage matching minimizes the PCB board-space and allows simplified integration with very few passive components. The on-chip power detector provides a voltage linear to the output power, while the standby/bias control logic provides power-saving and shutdown options. The PA is realized as a three stage PA with internal interstage matching and an open-collector output structure.

The power amplifier is designed using Atmel®'s Silicon-Germanium (SiGe2) process and provides excellent linearity and noise performance, high gain, and good power-added efficiency.

4846D–WLAN–10/07

Figure 1-1. Block Diagram



2. Pin Configuration

Figure 2-1. Pinning QFN16

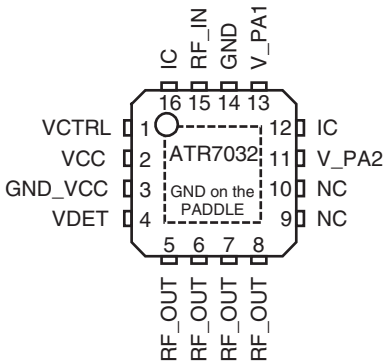


Table 2-1. Pin Description

Pin	Symbol	Function
1	VCTRL	Power-up/biasing control voltage
2	VCC	Supply voltage
3	GND_VCC	Ground
4	VDET	Power detector voltage
5	RF_OUT	RF output
6	RF_OUT	RF output
7	RF_OUT	RF output
8	RF_OUT	RF output
9	NC	Not connected
10	NC	Not connected
11	V_PA2	Supply voltage PA stage 2
12	IC	Internally connected, on-chip matching; must not be externally connected
13	V_PA1	Supply voltage PA stage 1
14	GND	Ground
15	RF_IN	RF input
16	IC	Internally connected, on-chip matching; must not be externally connected
PADDLE	GND	Ground on the PADDLE

3. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Test Conditions	Symbol	Value	Unit
Supply voltage	Without RF	V_{CC}	5	V
Supply current		I_{CC}	600	mA
Junction temperature		T_j	150	°C
Storage temperature		T_{Stg}	–40 to +125	°C
Input RF power		P_{IN}	12	dBm
Control voltage power up/down and biasing		V_{VCTRL}	0 to +3.0	V
ESD protection, all pins	EIA/JESD22-A114-B	V_{ESD}	500	V

Note: 1. The part may not survive all maximums applied simultaneously.

4. Operating Range

Parameters	Symbol	Value	Unit
Supply voltage range	V_{CC}	2.7 to 3.6	V
Ambient temperature range	T_{amb}	–40 to +85	°C
Frequency range	f	2400 to 2500	MHz

5. Electrical Characteristics

Test Conditions measured on Atmel’s evaluation board (unless otherwise stated): V_{CC} = 3.3V, Frequency = 2.45 GHz, T_{amb} = 25°C

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
1.0	Control voltage range	PA operating mode		V_{VCTRL}	1		2	V	A
1.1		Power down mode		V_{VCTRL}			0.2		A
1.2	Current consumption	Quiescent		I_{CC_Q}		90		mA	A
1.3		Power down mode		I_{CC_PD}			10	µA	A
1.4		PA operating mode		I_{VCTRL}			100	µA	A

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

6. Electrical Characteristics – Unmodulated Carrier

Test Conditions measured on Atmel's evaluation board (unless otherwise stated): V_{CC} = 3.3V, Frequency = 2.45 GHz, T_{amb} = 25°C

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
2.0	Saturated output power	For reference		P_{SAT}		28.5		dBm	C
2.1	P1dB output power			P1dB		27		dBm	A
2.2	Harmonic rejection	P_{OUT} = 23 dBm		2fout 3fout		–45 –30		dBc dBc	C C
2.3	Small signal gain	I_{CC_Q}, small signal condition		GL		32		dB	A
2.4	Gain variation	2.4 to 2.5 GHz, I_{CC_Q}, small signal condition –40 to +85°C, I_{CC_Q}, small signal condition		$G_{varfreq}$ $G_{vartemp}$		±1.5 ±1.5		dB dB	C C
2.5	Reverse isolation	I_{CC_Q}, small signal condition		ISOr		40		dB	C
2.6	Input 50Ω VSWR	I_{CC_Q}, small signal condition		$VSWR_{IN}$		2:1			C
2.7	Output 50Ω VSWR	I_{CC_Q}, small signal condition, with external matching		$VSWR_{OUT}$		2:1			C

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

7. Electrical Characteristics – 11 Mbps CCK Modulation

Test Conditions measured on Atmel's evaluation board (unless otherwise stated): V_{CC} = 3.3V, Frequency = 2.45 GHz, T_{amb} = 25°C, 11 Mbps CCK modulation with Gaussian transmit filtering of BT = 0.4, conforming to IEEE 802.11b

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
3.0	Maximum linear output power	ACPR1 ≥ 33 dBc, ACPR2 ≥ 55 dBc		P_{LIN}		23		dBm	C
3.1	Linear power gain	P_{OUT} = 23 dBm		GL		32		dB	A
3.2	Current consumption	P_{OUT} = 23 dBm		I_{CC}		220		mA	A

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

8. Electrical Characteristics – 54 Mbps OFDM Modulation

Test Conditions measured on Atmel's evaluation board (unless otherwise stated): V_{CC} = 3.3V, Frequency = 2.45 GHz, T_{amb} = 25°C, 54 Mbps OFDM modulation, conforming to IEEE 802.11g; 0.7% EVM measurement equipment noise floor is included in the EVM measurement result.

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
4.0	Error vector magnitude	P_{OUT} = 19 dBm		EVM		2.0		%	C
4.1	Linear power gain	P_{OUT} = 19 dBm		GL		32		dB	A
4.2	Current consumption	P_{OUT} = 19 dBm		I_{CC}		150		mA	A

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

9. Power Detector

Test Conditions measured on Atmel's evaluation board (unless otherwise stated): V_{CC} = 3.3V, Frequency = 2.45 GHz, T_{amb} = 25°C

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit	Type*
5.0	Detector voltage range	P_{OUT} = 5 to 25 dBm		V_{DET}	0		2	V	A
5.1	Settling time	P_{OUT} = 5 to 25 dBm		t_{SET}		0.5		µs	C
5.2	Detector accuracy	P_{OUT} = 5 to 25 dBm V_{CC} = 2.7 to 3.6V T_{amb} = –40 to +85°C		ΔP_{OUT}		±0.7		dB	C

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

10. Application Circuit

Figure 10-1. Application Board Schematic

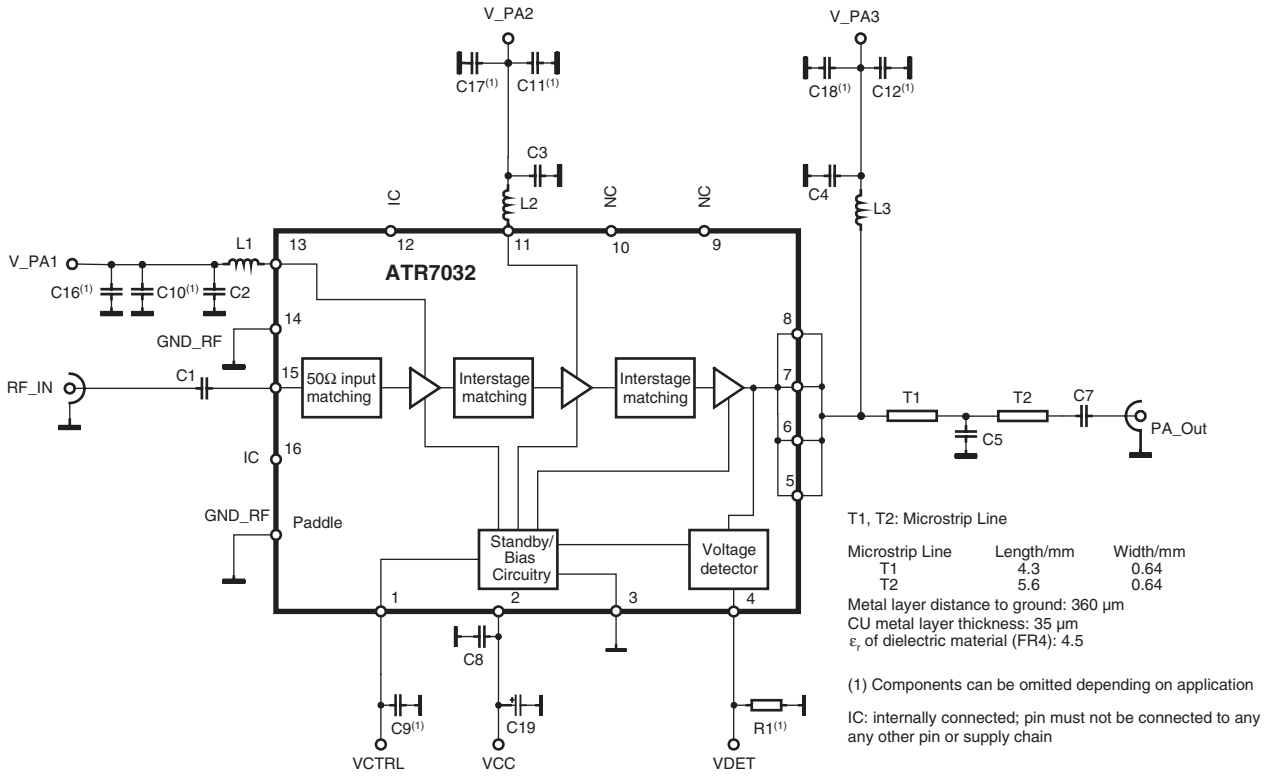


Figure 10-2. Application Board Layout

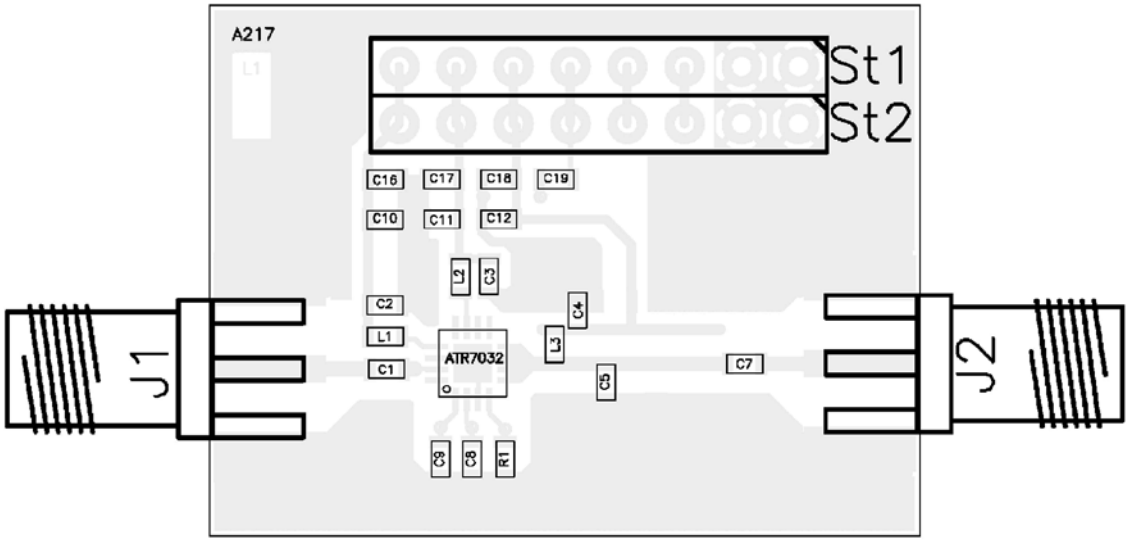


Table 10-1. Bill of Materials for Application Board

Component	Reference	Value	Size
Capacitor	C_1	4p7	0603
Capacitor	C_2	56p	0603
Capacitor	C_3	56p	0603
Capacitor	C_4	56p	0603
Capacitor	C_5	1p8	0603
Capacitor	C_7	4p7	0603
Capacitor	C_8	4p7	0603
Capacitor	C_9	4p7	0603
Capacitor	C_{10}(1)	10n	0603
Capacitor	C_{11}(1)	10n	0603
Capacitor	C_{12}(1)	10n	0603
Capacitor	C_{16}(1)	1µ	0603
Capacitor	C_{17}(1)	1µ	0603
Capacitor	C_{18}(1)	1µ	0603
Capacitor	C_{19}(1)	1µ	0603
Resistor	R_1	22k	0603
Inductor	L_1	15n	0603
Inductor	L_2	15n	0603
Inductor	L_3	15n	0603

Note: 1. Components can be omitted depending on application

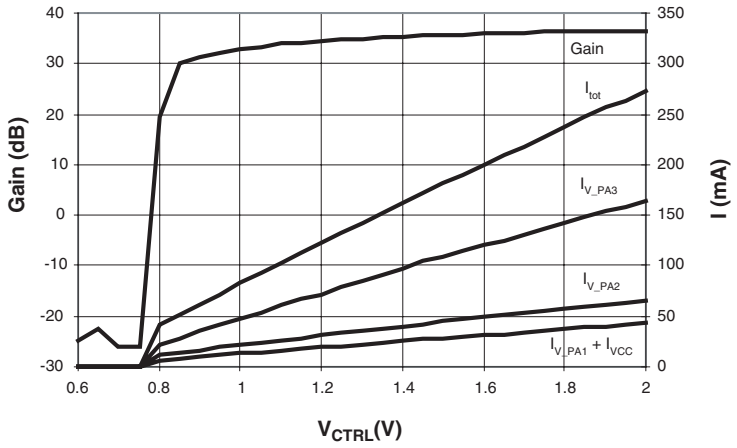
10.1 Evaluation Board Set-up Instructions

After connection of all cables (RF and DC):

- V_{CC}, V_{V_PA1}, V_{V_PA2}, V_{RF_Out} = 3.3V
- Increase VCTRL until 90 mA quiescent current without RF signal is reached (~ 1.05V)
- Increase input power until desired linear output power is reached

11. Typical Operating Characteristics

Figure 11-1. Typical Gain and Current versus Control Voltage:



Frequency = 2450 MHz; P_{In} = –40 dBm; V_{V_PA1} = V_{V_PA2} = V_{RF_Out} = V_{CC} = 3.3V

Figure 11-2. Typical Operating Point for 54 Mbps OFDM Modulation: Frequency = 2450 MHz; P_{Out} = 19 dBm; V_{V_PA1} = V_{V_PA2} = V_{RF_Out} = V_{CC} = 3.3V

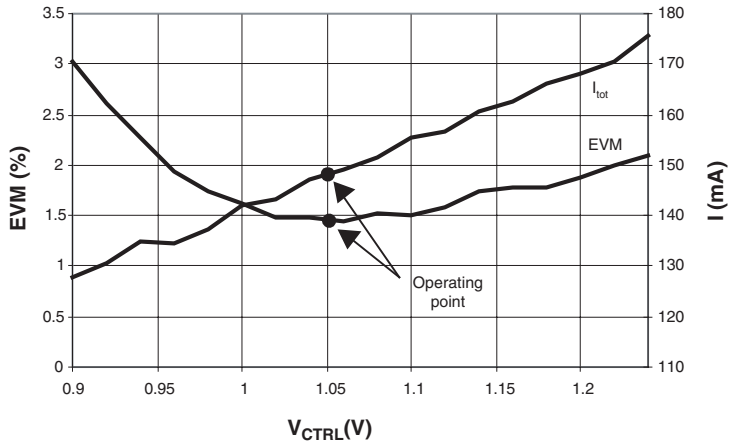


Figure 11-3. Typical S-Parameter at Operating Point: V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

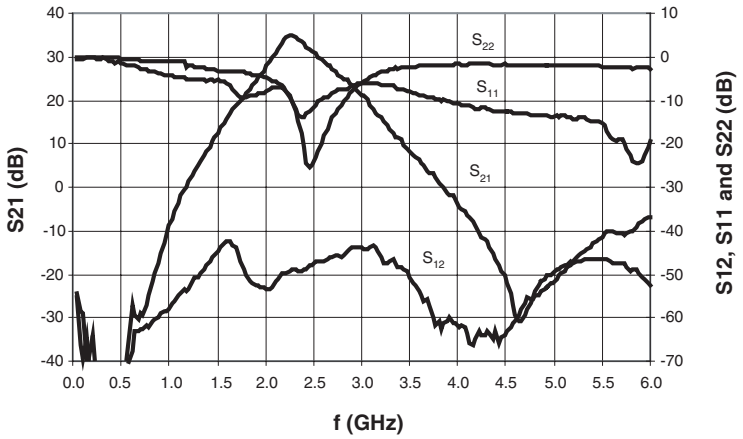


Figure 11-4. Typical S-Parameter at Operating Point (Detail): V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

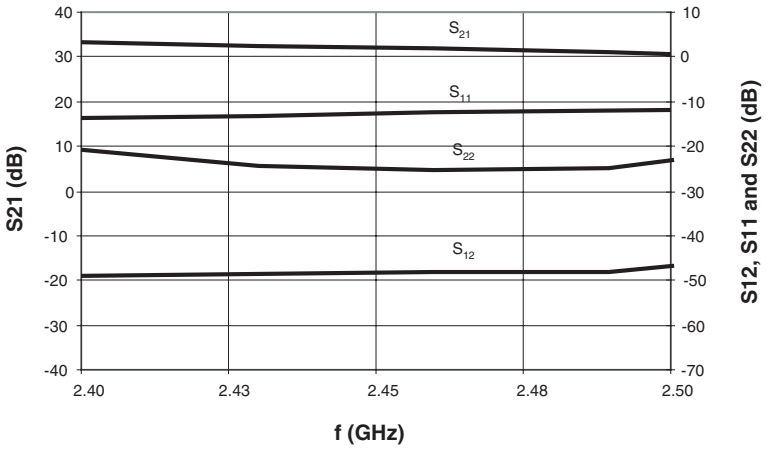


Figure 11-5. Typical Power-sweep with Unmodulated Carrier at Operating Point: Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

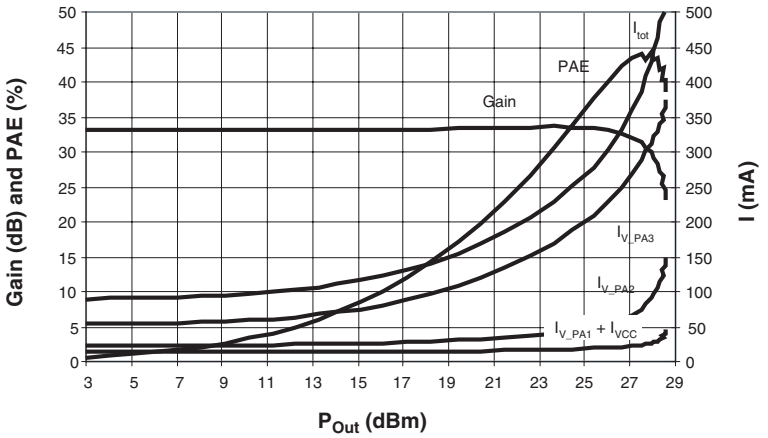


Figure 11-6. Typical Power-sweep with Unmodulated Carrier at Operating Point (Temperature Behavior): Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

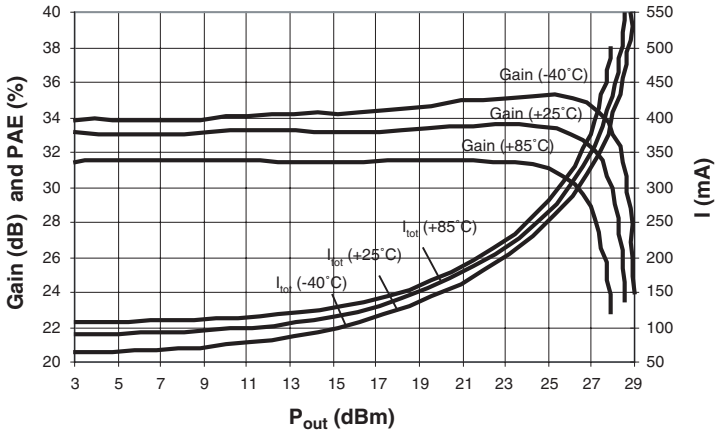


Figure 11-7. Typical Spectral Plot Conforming Compliance to 802.11b Spectral Mask for 11 Mbps CCK Modulation at Operating Point: P_{Out} = 23 dBm; Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC} = 220 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

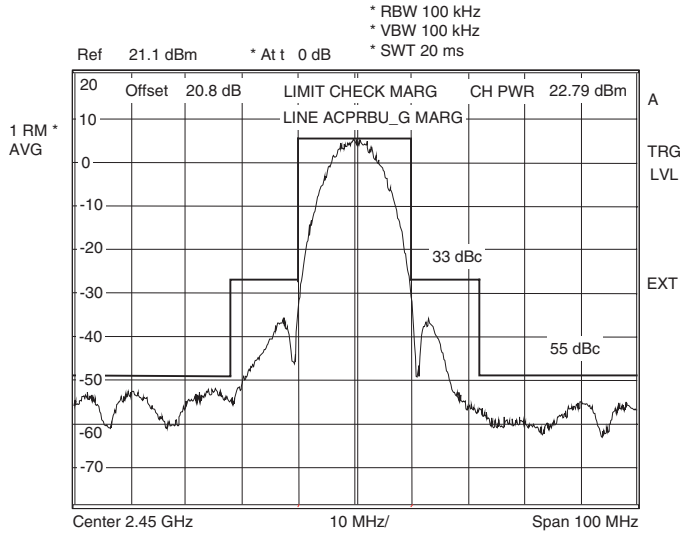


Figure 11-8. Typical Power-sweep with 54 Mbps OFDM Modulation at Operating Point: Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

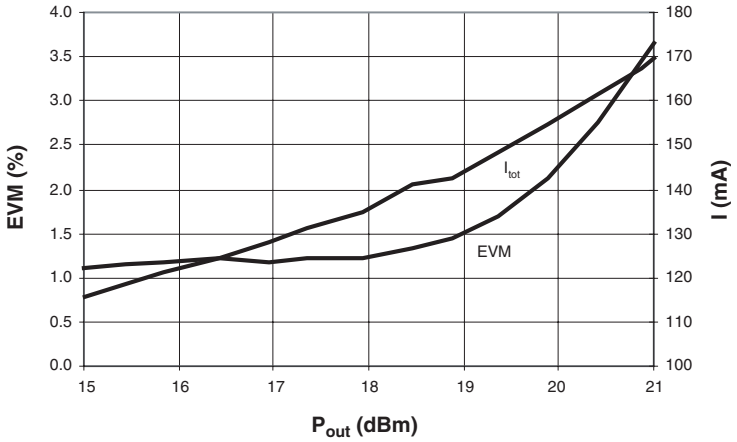


Figure 11-9. Typical Spectral Plot Conforming Compliance to 802.11g Spectral Mask for 54 Mbps OFDM Modulation at Operating Point: P_{Out} = 19 dBm; Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC} = 150 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

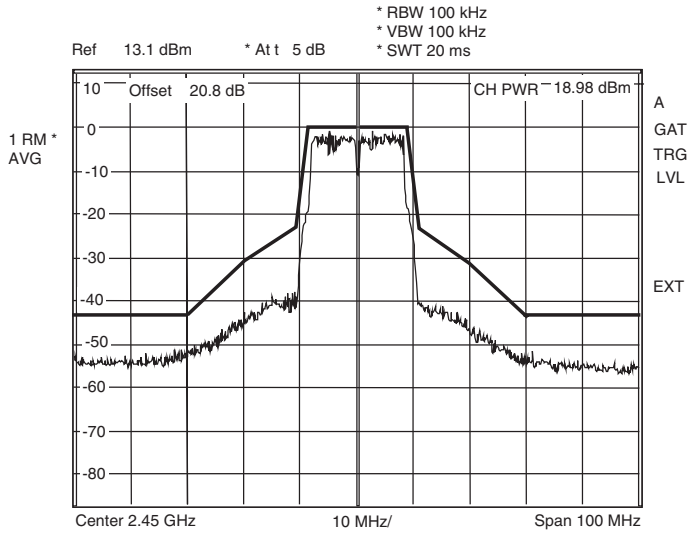


Figure 11-10. Typical Detector Voltage versus P_{Out} for Unmodulated Carrier (Temperature and VCC parameterized): Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 2.7V, 3.3V, 3.6V; T_{amb} = –40°C, 25°C, 85°C

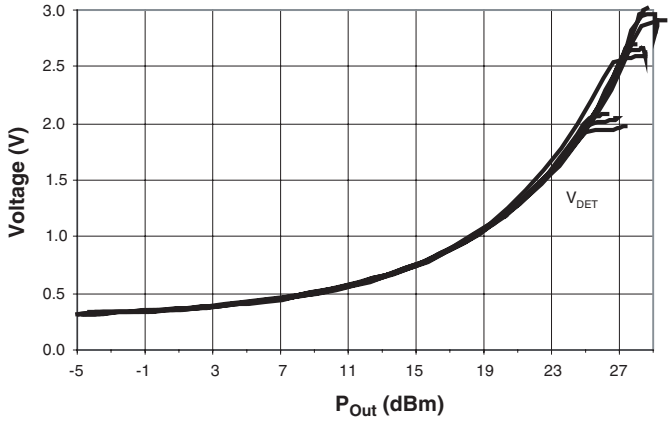


Figure 11-11. Power Detector Response (Rising Edge): P_{Out} = 23 dBm; Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA; $V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V

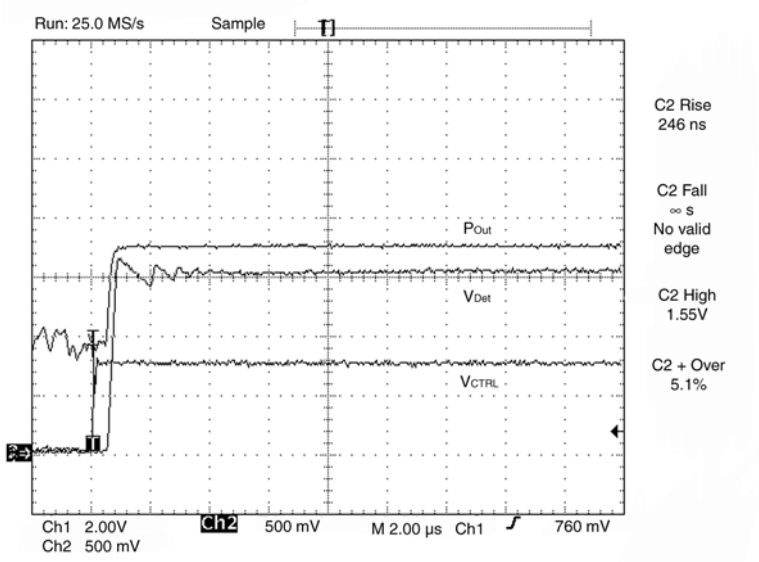
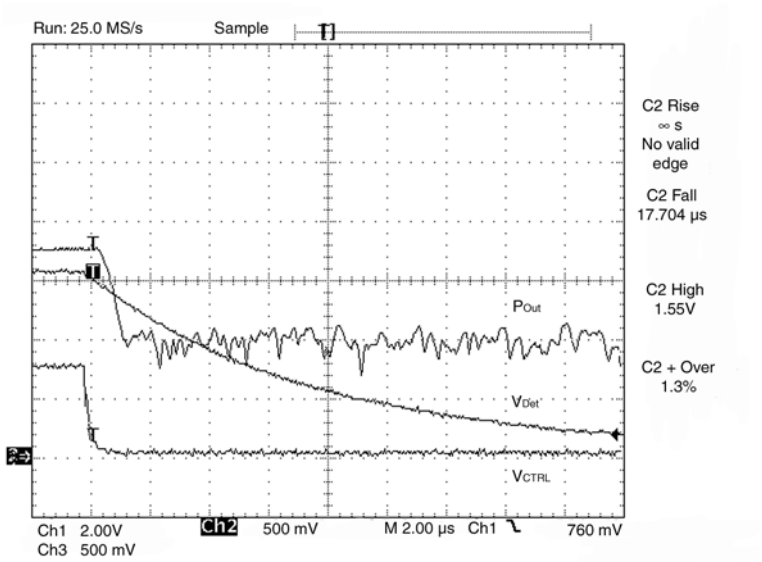


Figure 11-12. Power Detector Response (Falling Edge):
P_{Out} = 23 dBm; Frequency = 2450 MHz; V_{VCTRL} = 1.05V; I_{CC_Q} = 90 mA;
$V_{V\_PA1} = V_{V\_PA2} = V_{RF\_Out} = V_{CC}$ = 3.3V



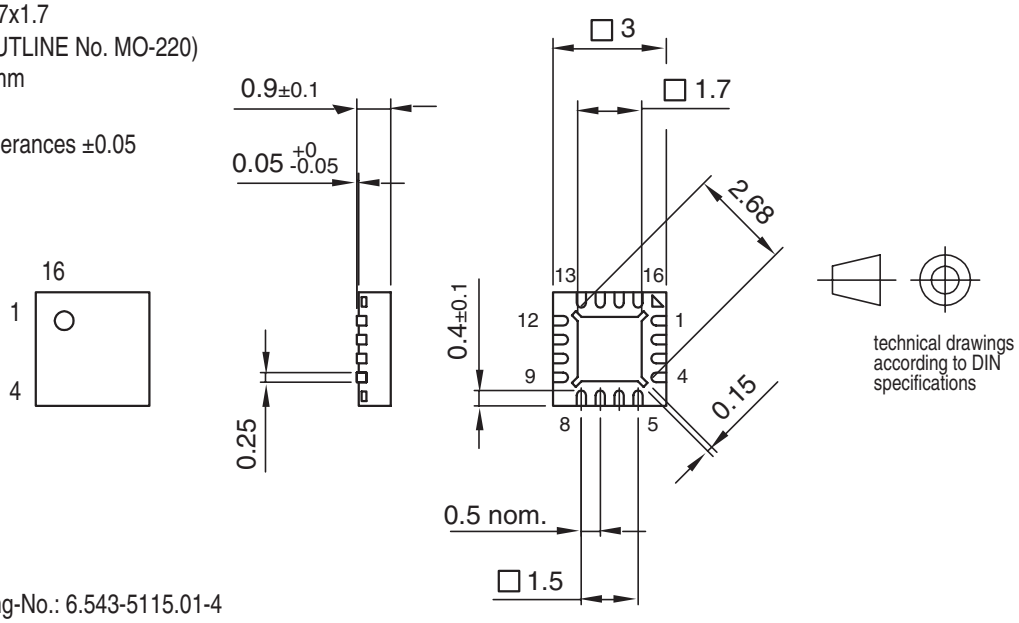
12. Ordering Information

Extended Type Number	Package	Remarks	MOQ
ATR7032-PVPW	QFN16, 3 × 3	Taped and 80 mm reeled, RoHs compliant	2000 pcs.
ATR7032-PVQW	QFN16, 3 × 3	Taped and 330 mm reeled, RoHs compliant	8000 pcs.
ATR7032-DEV-BOARD	–	Evaluation board	1

13. Package Information

Package: QFN 16 - 3x3
Exposed pad 1.7x1.7
(acc. JEDEC OUTLINE No. MO-220)
Dimensions in mm

Not indicated tolerances ±0.05



Drawing-No.: 6.543-5115.01-4
Issue: 1; 07.03.05

Assembly Chip PAC

14. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History
4846D-WLAN-10/07	• Put datasheet in a new template • Section 12 “Ordering Information” on page 14 changed

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