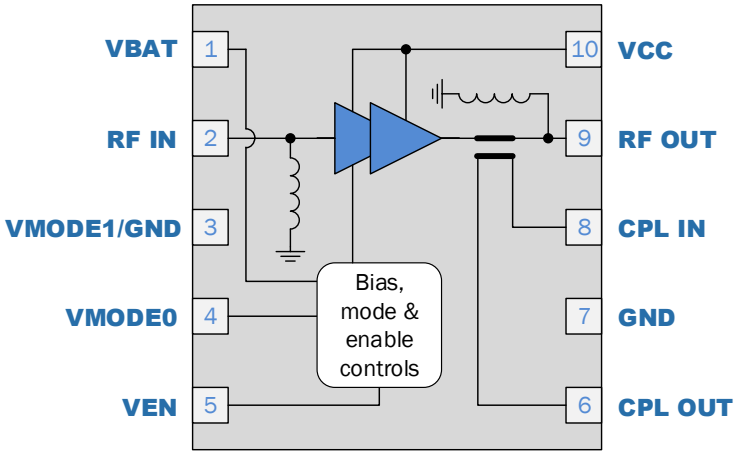
RFPA2002

Integrated Power Amplifier
1750MHz to 2200MHz



Package: MCM, 10-pin,
2.0mm x 2.5mm x 0.9mm

The RFPA2002 has over 28dB of small signal gain over 1750MHz to 2200MHz. When used with DPD at 3.3V, the RFPA2002 can deliver 24dBm LTE Downlink (CFR 7.5dB) with ACPR <-50dBc. Two digital control pins select high, medium or low power modes if desired to optimize performance and current drain at different power levels. The RFPA2002 has an integrated directional coupler, integrated biasing circuitry, and integrated matching to 50Ω. No external DC blocking is required as the RF pins are at DC ground.



Functional Block Diagram

Features

- P_{OUT} = 24dBm, 25% PAE, with 3.3V, 20MHz LTE DL, CFR 7.5dB
- ACP <-50dBc with DPD
- 28dB Gain over 1750MHz to 2200MHz
- Instantaneous P3dB = 32dBm at 3.3V
- Designed to Support Flexible V_{CC} 0.5V to 4.5V for PAE Optimization
- Envelope Tracking Compatible
- Integrated Power Coupler
- Integrated 50Ω Matching
- Integrated Biasing
- No External DC Block Needed
- 3 Power Mode Operation
- GPIO Interface
- Ultra Small and Low Profile

Applications

- Power Amplifier, Power Amplifier Driver
- Small Cell Base Stations
- Wideband Instrumentation
- Customer Premise Equipment
- Data Cards

Ordering Information

RFPA2002SQ	Sample bag with 25 pieces
RFPA2002SR	7" Reel with 100 pieces
RFPA2002TR7	7" Reel with 2500 pieces
RFPA2002PCK-410	700MHz to 950MHz PCBA with 5-piece sample bag

RF Micro Devices Inc. 7628 Thorndike Road, Greensboro, NC 27409-9421
For sales or technical support, contact RFMD at +1.336.678.5570 or customerservice@rfmd.com.

DS150209

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage in Standby Mode	6.0	V
Supply Voltage in Idle Mode	6.0	V
Supply Voltage in Operating Mode	6.0	V
Supply Voltage, V_{BATT}	6.0	V
Control Voltage, V_{EN}, V_{MODE0}, V_{MODE1}	3.5	V
RF – Input Power (CW, V_{CC} = 3.3V, 50Ω Load)	+10	dBm
RF – Output Power (CW, 50Ω Load)	+30	dBm
Output Load VSWR (LTE DL 7.5dB CFR, V_{CC} = 4.5V, $P_{FORWARD}$ <24dBm)	8:1	
ESD Rating, All Pins, HBM, JESD22-A114	2000	V
ESD Rating, All Pins, CDM, JESD22-C101	1000	V
Moisture Sensitivity Level	MSL3	

Caution! ESD sensitive device.

RFMD Green: RoHS status based on EU Directive 2011/65/EU (at time of this document revision), halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

Recommended Operating Condition

Parameter	Specification			Unit
	Min	Typ	Max	
Operating Temperature Range	-30	+25	+85	°C
Operating Junction Temperature			125	°C
V_{BATT}	+3	+3.3	+4.5	V
V_{CC} [1]	+0.5	+3.3	+4.5	V

Note: V_{CC} down to 0.5V may be used for backed-off power when using DC-DC converter to conserve battery current.

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Performance					
Operating Frequency	1750		2200	MHz	
V_{EN}, Low Level	0		0.5	V	PA Disabled
V_{EN}, High Level	1.5	1.8	3	V	PA Enabled
V_{MODE0}, V_{MODE1}, Low Level	0		0.5	V	For logic “low”
V_{MODE0}, V_{MODE1}, High Level	1.5	1.8	3	V	For logic “high”
Maximum Linear Output P_{OUT} [1, 2]		24		dBm	High power mode (HPM); V_{CC} = 3.3V
Thermal Resistance		37		°C/W	To backside of evaluation board

Notes:

1. For operation at V_{BATT} = 3.0V, de-rate P_{OUT} by 2.0dB
2. P_{OUT} is specified for 20MHz LTE downlink with CFR 7.5dB, -50dBc ACPR using digital or analog pre-distortion

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Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Band 2 Downlink Electrical Specifications					**Unless Otherwise Specified: Temp = 25°C, V_{BATT} = +3.3V, V_{EN} = +1.8V, Freq = 1940MHz, 50Ω, 20MHz LTE DL with 7.5dB CFR**
Gain	25	28	31	dB	High Power Mode (HPM), P_{OUT} = 24dBm, V_{CC} = 3.3V
	20.5	23.5	26.5	dB	Medium Power Mode (MPM), P_{OUT} = 14dBm, V_{CC} = 1.4V
	13	16.5	19	dB	Low Power Mode (LPM), P_{OUT} = 3dBm, V_{CC} = 0.8V
ACLR 1		-32		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, without DPD
		-48		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, with DPD
ACLR 2		-48		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, without DPD
		-49		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, with DPD
PA Efficiency (PAE)		27		%	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V
PA Current Drain		276		mA	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V
PA Quiescent Current		118		mA	HPM, V_{CC} = 3.3V
		79		mA	MPM, V_{CC} = 1.4V
		38		mA	LPM, V_{CC} = 0.8V
Noise Figure		3.5		dB	
Input Impedance		1.4:1	2:1	VSWR	No external matching, P_{OUT} ≤ 24dBm, all modes
IM3		-15		dBm	Two tones passed 600kHz, HPM, Total P_{OUT} ≤ 24dBm, V_{CC} = 3.3V
IM5		-20		dBm	Two tones passed 600kHz, HPM, Total P_{OUT} ≤ 24dBm, V_{CC} = 3.3V
Harmonics 2f0		-15		dBm	CW P_{OUT} ≤ 24dBm, all power modes
Harmonics 3f0		-34		dBm	CW P_{OUT} ≤ 24dBm, all power modes
Enable Current		0.1		mA	Sources or sink current, V_{EN} = 1.8V
Mode Current		0.1		mA	Source or sink current, V_{MODE0}, V_{MODE1} = 1.8V
Leakage Current			5	µA	DC only; V_{CC} = V_{BATT} = 4.5V, V_{EN} = V_{MODE0} =V_{MODE1} = 0V
DC Enable Time			10	µs	DC only; Time from V_{EN} = high to stable idle current (90% of steady state value)
RF Rise/Fall Time			10	µs	P_{OUT} ≤ 24dBm, all modes, 90% of target, DC settled prior to RF
Coupling Factor	17	20	23	dB	P_{OUT} ≤ 24dBm, all modes
Coupling Accuracy – Temp / Voltage	-0.5		0.5	dB	P_{OUT} ≤ 24dBm, all modes 30°C ≤ T ≤ 85°C , V_{CC} as required, referenced to 25°C, 3.3V conditions
Coupling Accuracy – VSWR	-0.8		0.8	dB	P_{OUT} ≤ 24dBm, all modes, load VSWR = 2.5:1
Output Load VSWR Stability (Spurious Emissions)			-60	dBc	P_{OUT} ≤ 24dBm, all conditions, load VSWR = 8:1, all phase angles

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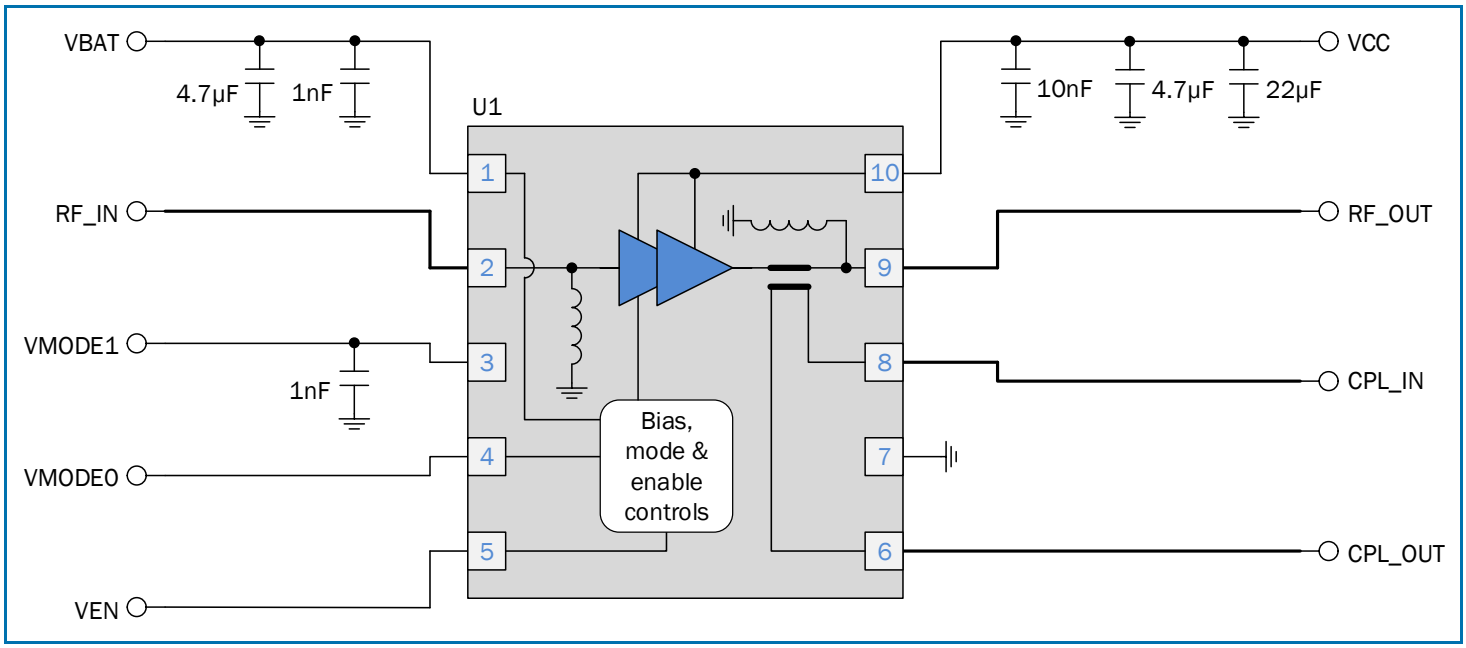
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Band 1 (4) Downlink Electrical Specifications					**Unless Otherwise Specified: Temp = 25°C, V_{BATT} = +3.3V, V_{EN} = +1.8V, Freq = 2150MHz, 50Ω, 20MHz LTE DL with 7.5dB CFR**
Gain	23.5	26.5	29.5	dB	High Power Mode (HPM), P_{OUT} = 24dBm, V_{CC} = 3.3V
	20	22.5	26	dB	Medium Power Mode (MPM), P_{OUT} = 14dBm, V_{CC} = 1.4V
	12	15.3	18	dB	Low Power Mode (LPM), P_{OUT} = 3dBm, V_{CC} = 0.8V
ACLR 1		-32		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, without DPD
		-50		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, with DPD
ACLR 2		-45		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, without DPD
		-54		dBc	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V, with DPD
PA Efficiency (PAE)		23		%	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V
PA Current Drain		329		mA	HPM, P_{OUT} = 24dBm, V_{CC} = 3.3V
Noise Figure		3.5		dB	
Input Impedance		1.4:1	2:1	VSWR	No external matching, P_{OUT} ≤ 24dBm, all modes
IM3		-15		dBm	Two tones passed 600kHz, HPM, Total P_{OUT} ≤ 24dBm, V_{CC} = 3.3V
IM5		-20		dBm	Two tones passed 600kHz, HPM, Total P_{OUT} ≤ 24dBm, V_{CC} = 3.3V
Harmonics 2f0		-8		dBm	CW P_{OUT} ≤ 24dBm, all power modes
Harmonics 3f0		-26		dBm	CW P_{OUT} ≤ 24dBm, all power modes
Enable Current		0.1		mA	Sources or sink current, V_{EN} = 1.8V
Mode Current		0.1		mA	Source or sink current, V_{MODE0}, V_{MODE1} = 1.8V
DC Enable Time			10	µs	DC only; Time from V_{EN} = high to stable idle current (90% of steady state value)
RF Rise/Fall Time			10	µs	P_{OUT} ≤ 24dBm, all modes, 90% of target, DC settled prior to RF
Coupling Factor	16	19	22	dB	P_{OUT} ≤ 24dBm, all modes
Coupling Accuracy – Temp / Voltage	-0.5		0.5	dB	P_{OUT} ≤ 24dBm, all modes 30°C ≤ T ≤ 85°C , V_{CC} as required, referenced to 25°C, 3.3V conditions
Coupling Accuracy – VSWR	-0.8		0.8	dB	P_{OUT} ≤ 24dBm, all modes, load VSWR = 2.5:1
Output Load VSWR Stability (Spurious Emissions)			-60	dBc	P_{OUT} ≤ 24dBm, all conditions, load VSWR = 8:1, all phase angles

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Mode Control Table

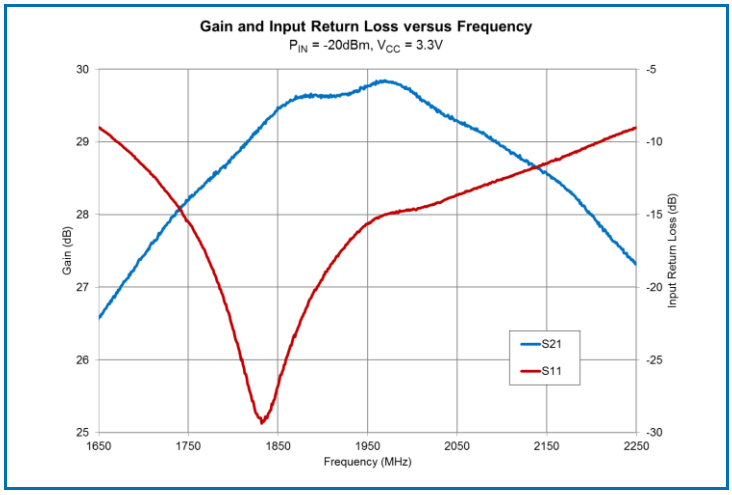
Mode of Operation	V_{EN}	V_{MODE0}	V_{MODE1}	V_{CC}
Power Down	Low	Low	Low	X
Standby Mode	Low	X	X	On
High Power Mode (HPM)	High	Low	Low	On
Medium Power Mode (MPM)	High	High	Low	On
Low Power Mode (LPM)	High	High	High	On

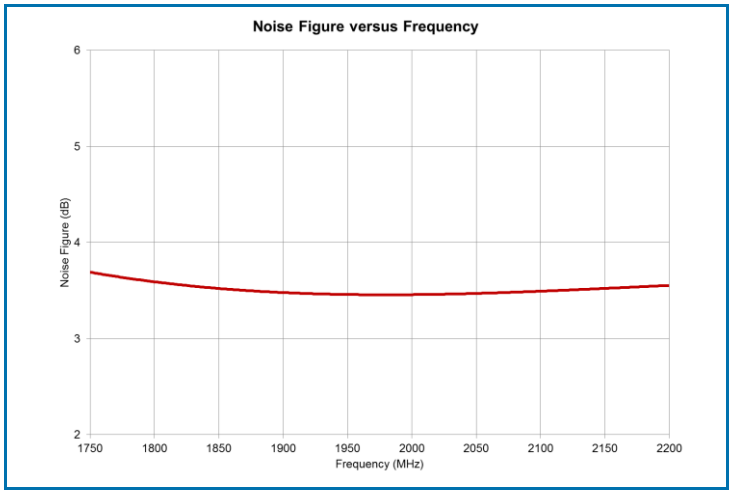
Typical Application Schematic 1750MHz to 2200MHz Application Circuit

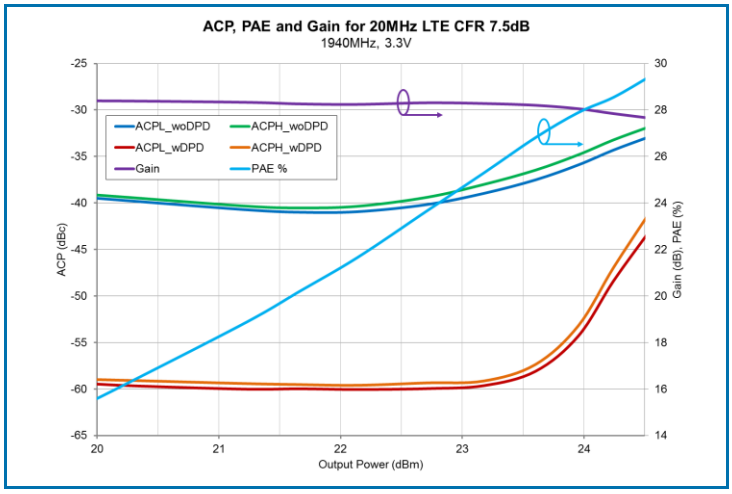


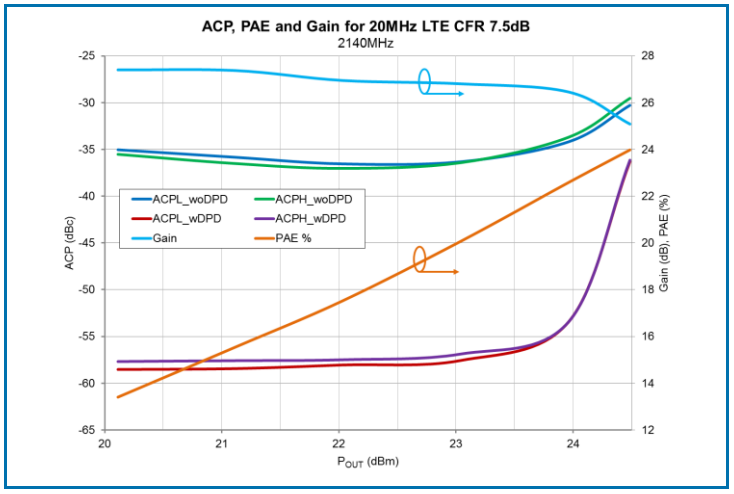
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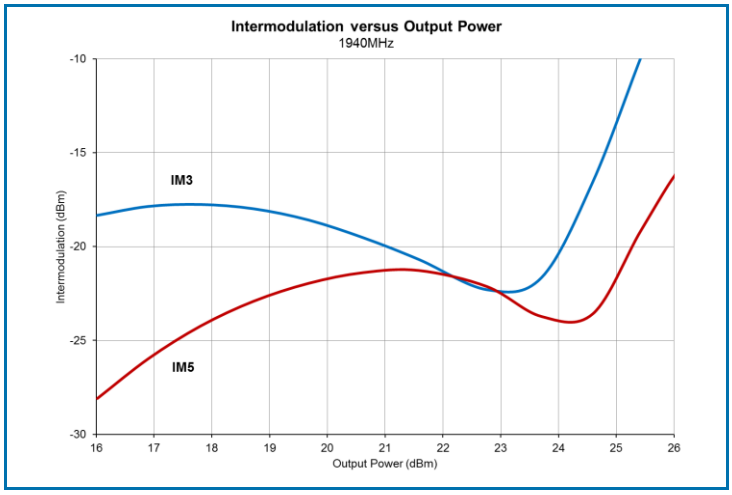
Typical Performance: V_{CC} = 3.3V unless otherwise noted

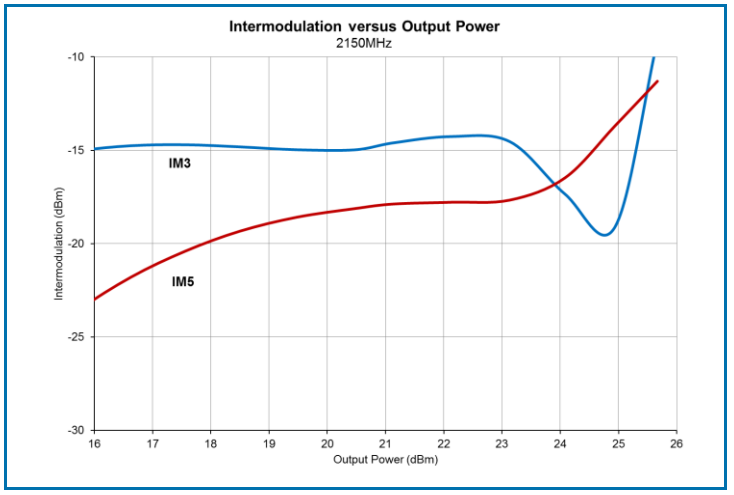






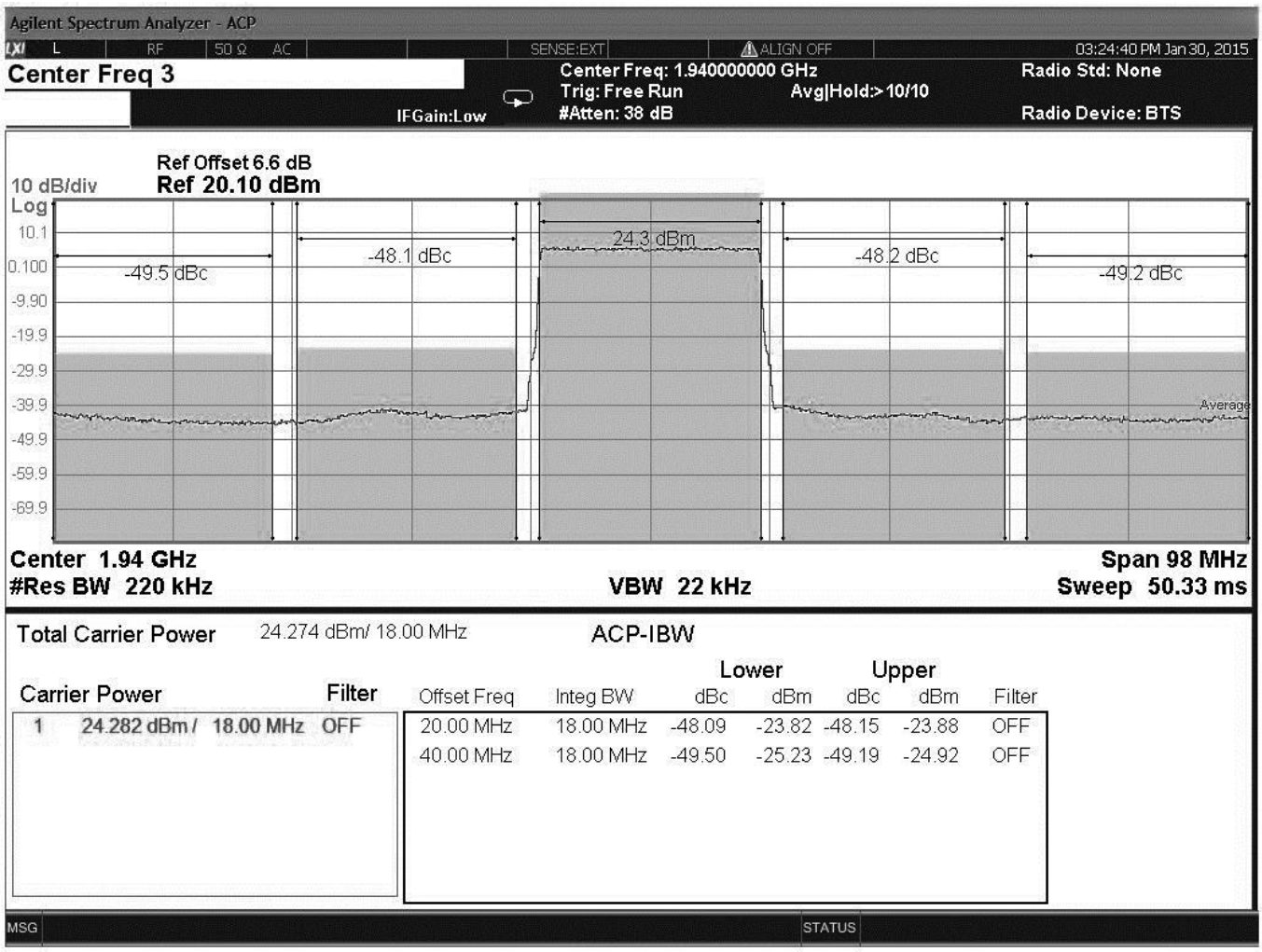






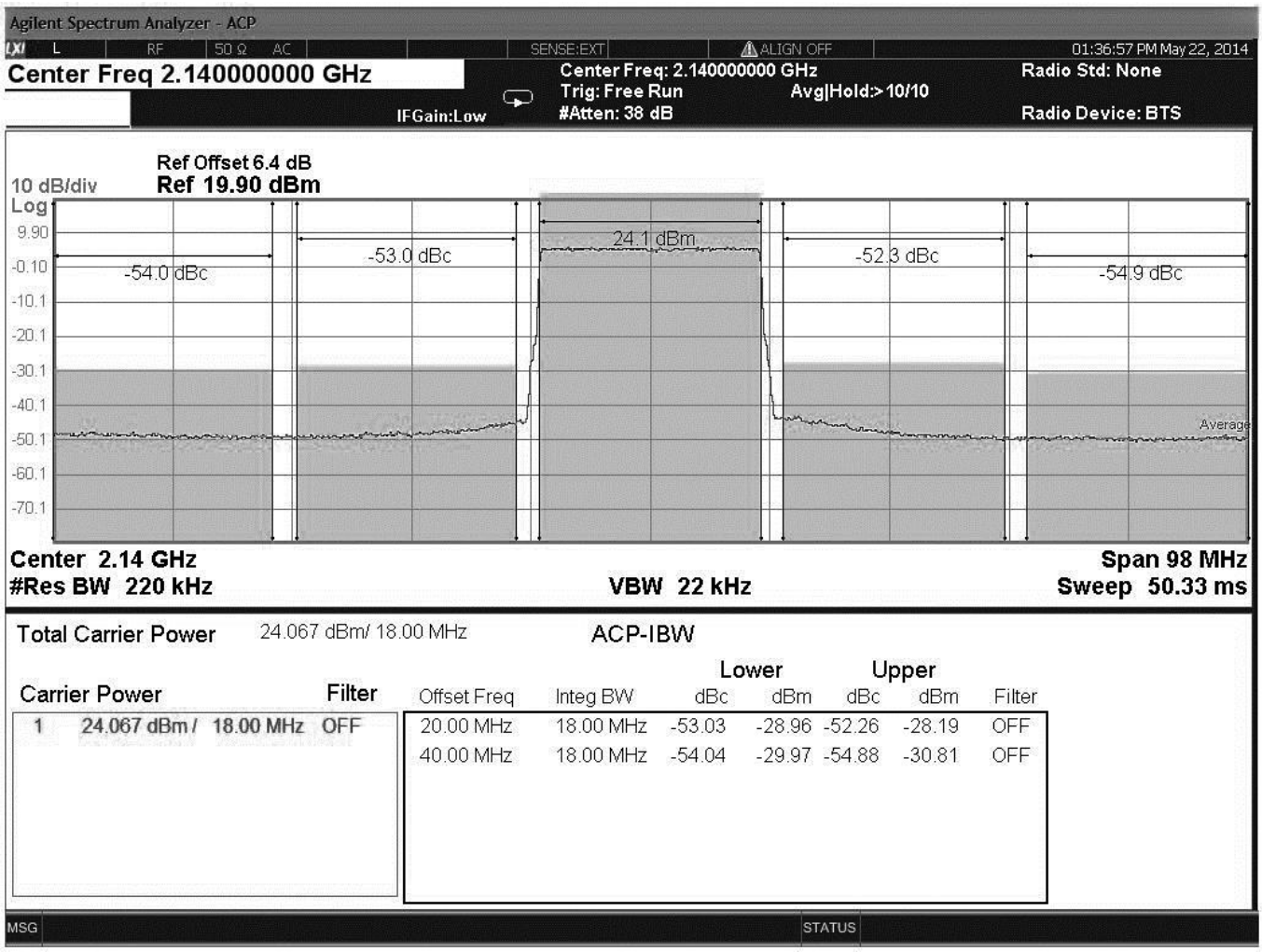
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ACP with DPD, LTE DL 7.5dB CFR V_{CC} = 3.3V, I_{CC} = 281mA, 1940MHz



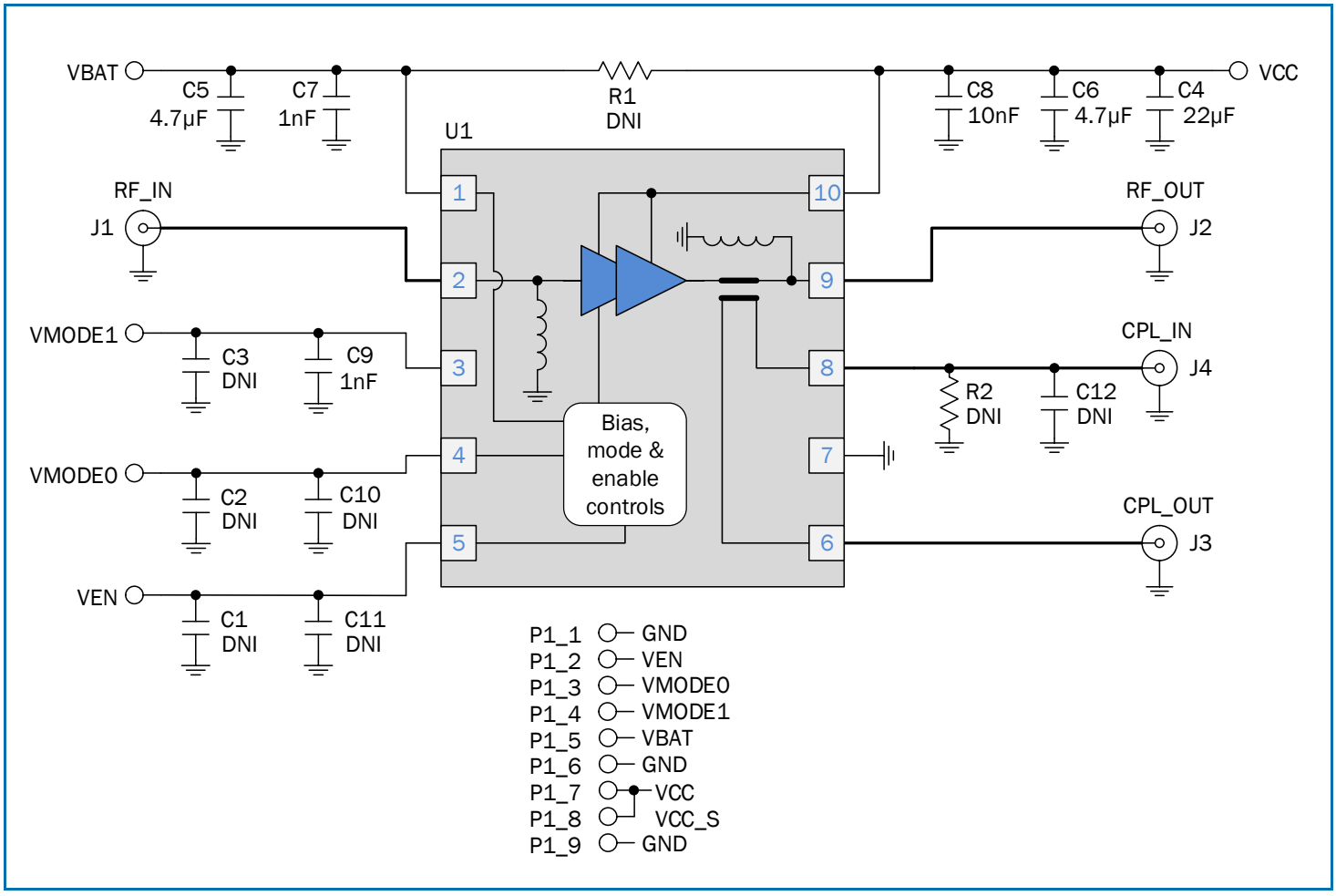
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ACP with DPD, LTE DL 7.5dB CFR V_{CC} = 3.3V, I_{CC} = 333mA, 2140MHz



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Evaluation Board Schematic 1750MHz to 2200MHz Application Circuit



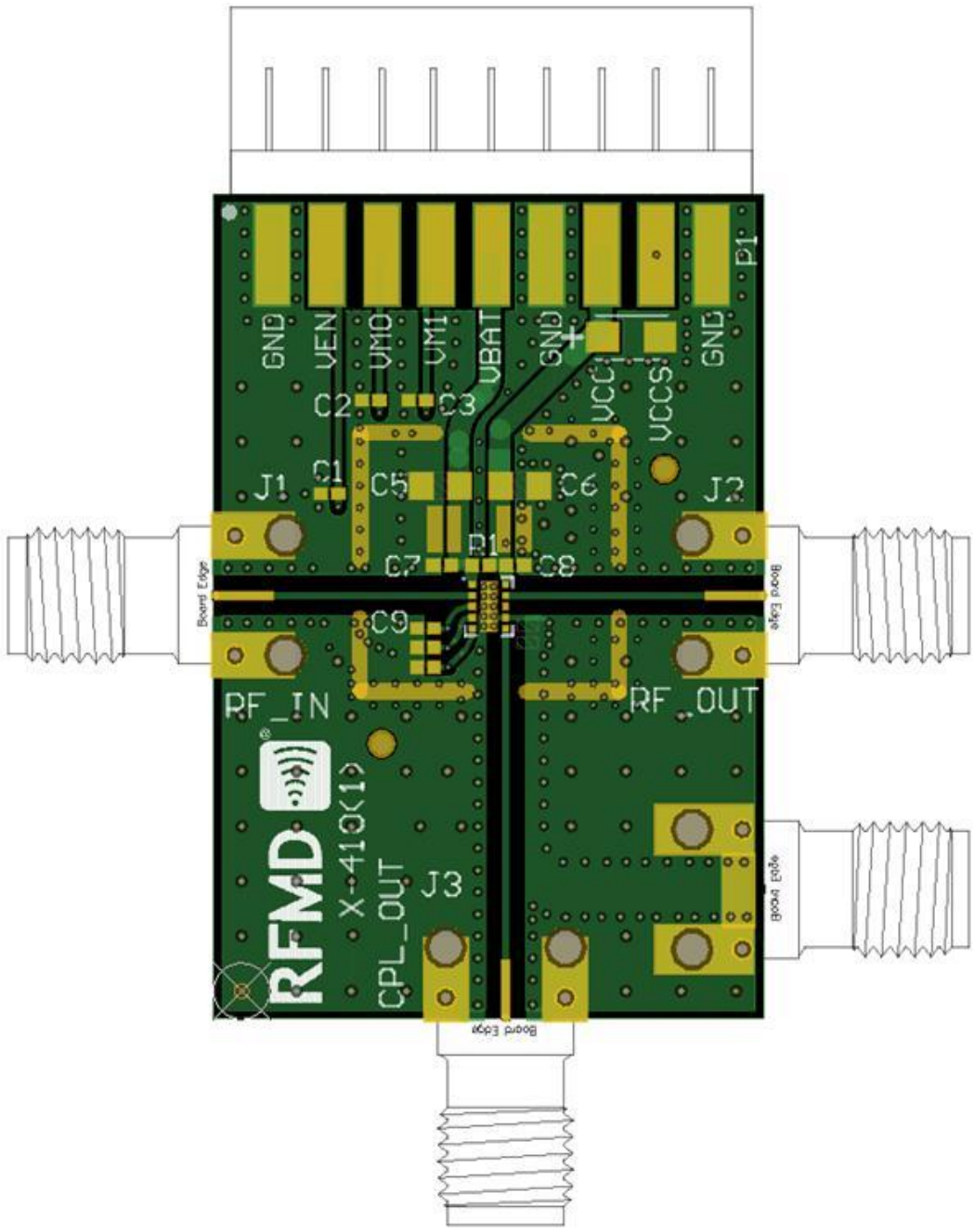
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Evaluation Board Bill of Materials (BOM) 1750MHz to 2200MHz Application Circuit

Description	Reference Designator	Manufacturer	Manufacturer's P/N
DUT	U1	RFMD, Inc.	RFPA2002
CAP, 22µF, 10%, 10V, TANT-A	C4	AVX Corporation	TAJA226K010RNJ
CAP, 4.7µF, 10%, 6.3V, X5R, 0805	C5-C6	Taiyo Yuden (USA), Inc.	CE MJK212 BJ475KD-T
CAP, 1000pF, 10%, 50V, X7R, 0402	C7, C9	Taiyo Yuden (USA), Inc.	RM UMK105BJ102KV-F
CAP, 10000pF, 10%, 25V, X7R, 0402	C8	Taiyo Yuden (USA), Inc.	RM TMK105BJ103KV-F
CONN, SMA, EL MINI FLT 0.048" SPE-000311	J1-J4	Amphenol RF Asia Corp.	901-10362
CONN, HDR, ST, PLRZD, 9-PIN	P1	ITW Pancon	MPSS100-9-C
Do Not Place	C1-C3, C10-C12, R1-R2		

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Evaluation Board Assembly Drawing 1750MHz to 2200MHz Application Circuit

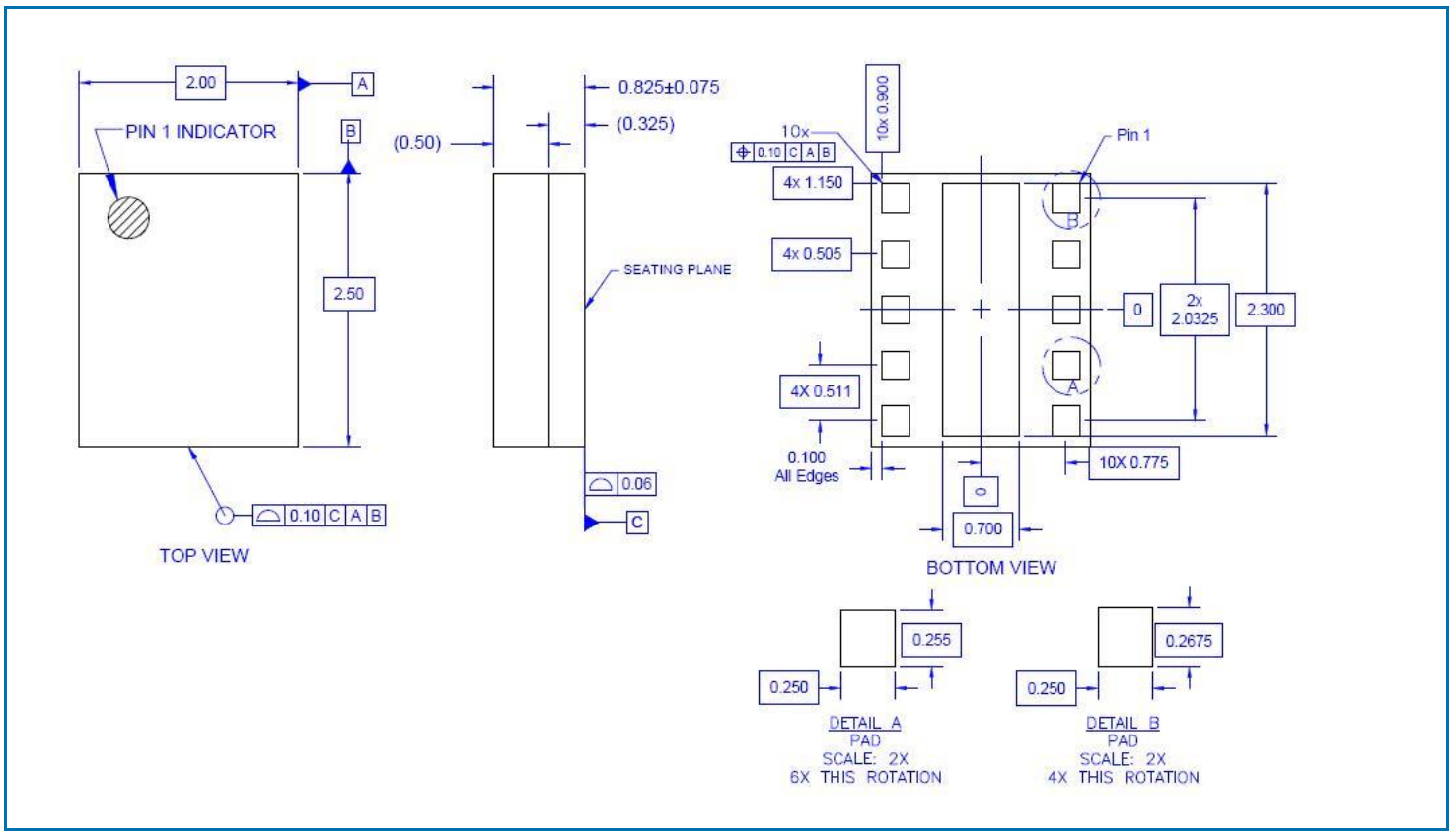


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Pin Names and Descriptions

Pin	Name	Description
1	VBATT	Supply Voltage for bias circuitry
2	RFIN	RF Input; Connect to 50Ω nominally, presents as DC ground.
3	VMODE1/GND	Digital control input for power mode selection. Connect to GND if HPM and MPM only operations.
4	VMODE0	Digital control input for power mode selection
5	VEN	Digital control input for enable/disable of PA
6	CPL_OUT	Coupler Output
7	GND	Ground
8	CPL_IN	Coupler Input
9	RFOUT	RF Output; Connect to 50Ω nominally, present as DC ground
10	VCC	Supply voltage for PA stages which can be connected to battery supply or output of DC-DC converter
PCK BASE	GND	Ground Connection; This package backside should be soldered toa topside ground pad connecting to the PCB ground plane with multiple ground via. The pad should have a low thermal resistance and low electrical impedance to the ground plane.

Package Outline (Dimensions in millimeters)



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