



RFFM8216

2.4 GHz Integrated Wi-Fi Front-End Module

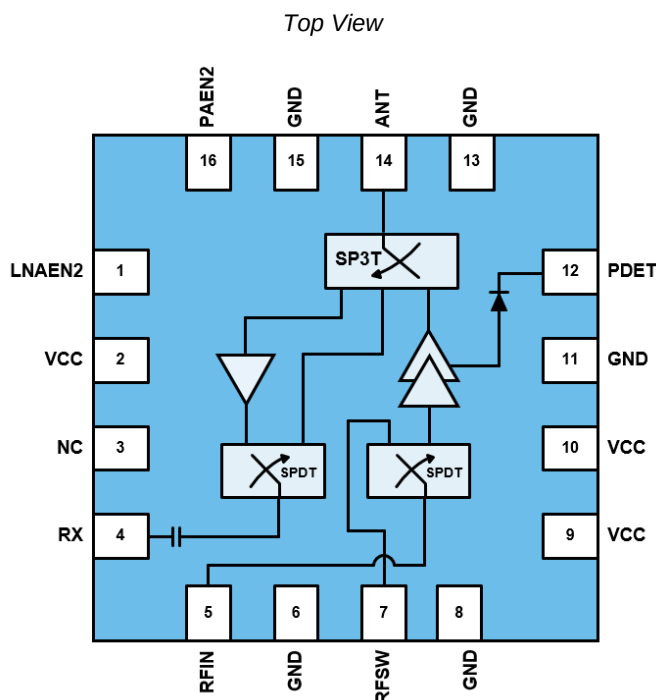
16 Pin 2.3 x 2.3 mm QFN Package

Product Overview

The RFFM8216 provides a complete integrated solution in a single front end module (FEM) for WiFi 802.11b/g/n/ac systems. Performance is focused on a balance of efficiency to enable long battery life and linear power that increases the range of connection. It is specifically designed to work with the RFFM8516 to greatly reduce BOM cost in dual band applications.

The RFFM8216 integrates a 2.4GHz power amplifier (PA), single pole triple throw switch (SP3T), LNA with bypass + BT/Rx switch (SP2T), harmonic filtering, a diversity switch (SP2T) and a power detector coupler for improved accuracy.

Functional Block Diagram



Key Features

- $P_{OUT} = 20\text{dBm}$, 802.11n 20MHz MCS7 @ 2.2% (-33dB) Dynamic EVM
- High efficiency
- Input and Output matched to 50 ohms
- Integrated 2.4GHz PA, SP3T, LNA with Bypass, 2xSPDT and P_{DET}
- Integrated Power Detector
- High Impedance PA Enable

Applications

- IEEE 802.11b/g/n/ac WLAN Applications
- Single-Placement RF Front-End Module
- Single-band and Dual-band Wireless LAN Systems
- Portable Battery-Powered Equipment

Ordering Information

PART NUMBER	DESCRIPTION
RFFM8216SB	5 piece sample bag
RFFM8216SQ	25 piece sample bag
RFFM8216SR	7" Reel with 100 pieces
RFFM8216TR7	7" Reel with 2500 pieces
RFFM8216TR7-5K	7" Reel with 5000 pieces
RFF8216PCK-410	Full assembled Evaluation Board w/ 5-piece bag

2.4 GHz Wi-Fi Integrated Front-End Module

Absolute Maximum Ratings

PARAMETER	CONDITIONS	RATING
Storage Temperature		-40 to 150 °C
DC Supply Voltage	No RF Applied	-0.5 to +6.0 V
PA Enable Voltage		-0.5 to +5.0 V
DC Supply Current		800mA
RF Maximum Input Power (TX Mode)	CW, 50Ω, VCC = 3.6 V, T = 25°C	+12 dBm
RF Maximum Input Power (RX LNA Mode)	CW, 50Ω, VCC = 3.6 V, T = 25°C	0 dBm
RF Maximum Input Power (RX BYPASS Mode)	CW, 50Ω, VCC = 3.6 V, T = 25°C	+30 dBm

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Temperature		-20	-	+60	°C
Extended Operating Temperature	Functional with reduced performance	-40	-	+85	°C
Operating Voltage V _{CC}		3.0	3.6	4.2	V
Extended Operating Voltage V _{CC}	Functional with reduced performance	3.0	-	4.8	V
Control Voltage (V-High)	PAEN2	2.75	2.9	V _{CC}	V
Control Voltage (V-High)	LNAEN2	2.75	3.3	V _{CC}	V
Control Voltage (V-Low)	PAEN2 / LNAEN2	0	0.1	0.4	V
Control Current (I-High)	PAEN2	-	100	1000	μA
Control Current (I-High)	LNAEN2	-	50	1000	μA
Control Current (I-Low)	PAEN2 / LNAEN2	-	0.1	10	μA
Leakage/Sleep/Bypass Mode Current	PAEN2/ LNAEN2 = LOW V _{CC} = 4.2 V	-	8	16	μA

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Logic Truth Table

SINGLE BAND CONFIGURATION		
MODE	PAEN2	LNAEN2
2.4 GHz TX Mode	High	Low
2.4 GHz RX LNA Mode	Low	High
2.4 GHz RX Bypass (Sleep)	Low	Low
RFSW	Low	High/Low

DUAL BAND CONFIGURATION					
MODE	5 GHz FEM			2 GHz FEM	
	PAEN5	LNAEN5	SWCTL5	PAEN2	LNAEN2
5 GHz TX Mode	High	Low	High	Low	Low
5 GHz RX LNA Mode	Low	High	Low	Low	Low
5 GHz Sleep/Bypass	Low	Low	Low	Low	Low
2.4 GHz TX Mode	N/A	N/A	N/A	High	Low
2.4 GHz RX LNA Mode	N/A	N/A	N/A	Low	High
2.4 GHz RX Bypass (Sleep)	N/A	N/A	N/A	Low	Low
RFSW	N/A	N/A	N/A	Low	High/Low

Electrical Specifications – Transmit

(V_{CC} = 3.6 V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		2412	-	2472	MHz
Small Signal Gain		24	28	-	dB
Gain flatness	For any 20 MHz bandwidth	-0.25	-	+0.25	dB
Gain flatness	For entire frequency band	-1	-	+1	dB
11g 54 Mbps	Output Power	+19.5	+20.5	-	dBm
	DEVM	-	-31	-28	dB
MCS7 20 MHz	Output Power	+19.0	+20.0	-	dBm
	DEVM	-	-33	-29	dB
MCS8 20 MHz	Output Power	+18.0	+19.0	-	dBm
	DEVM	-	-	-35	dB
Margin to Spectrum Emission Mask 11b 1 Mbps	Pout = 24.0 dBm	-	3.0	-	dB
Margin to Spectrum Emission Mask 11g 6 Mbps	Pout = 22.0 dBm	-	3.0	-	dB
Margin to Spectrum Emission Mask 11n, MCS0 HT20	Pout = 22.0 dBm	-	3.0	-	dB
Current 11b, 1 Mbps	Pout = 24.0 dBm	-	320	350	mA
Current 11n, MCS7 HT20	Pout = 20.0 dBm	-	230	260	mA
Return Loss RFIN Port		10	15	-	dB
Return Loss ANT Port		7	9	-	dB
Harmonics (2f ₀)	802.11b 1Mbps; Pout = 22.0 dBm	-	-	-13	dBm/MHz
Harmonics (3f ₀)	802.11b 1Mbps; Pout = 22.0 dBm	-	-	-30	dBm/MHz
Power Detector Voltage	Pout = 5.0 dBm	-	0.2	-	V
	Pout = 24.0 dBm	-	-	1.1	V
PA Switching Speed		-	400	-	nS
ANT to RX Isolation (TX Mode)		40	45	-	dB

Electrical Specifications – RFSW (RFIN-RFSW)

(V_{CC} = 3.6 V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		2412	-	2472	MHz
Insertion Loss	2.4 GHz to 6 GHz	-	0.7	1.5	dB
RFIN Port Return Loss		10	15	-	dB
RFSW Port Return Loss		10	15	-	dB
Input P0.1dB		20	-	-	dBm

Electrical Specifications – Receive

(V_{CC} = 3.6 V; Temp=25°C; unless noted otherwise)

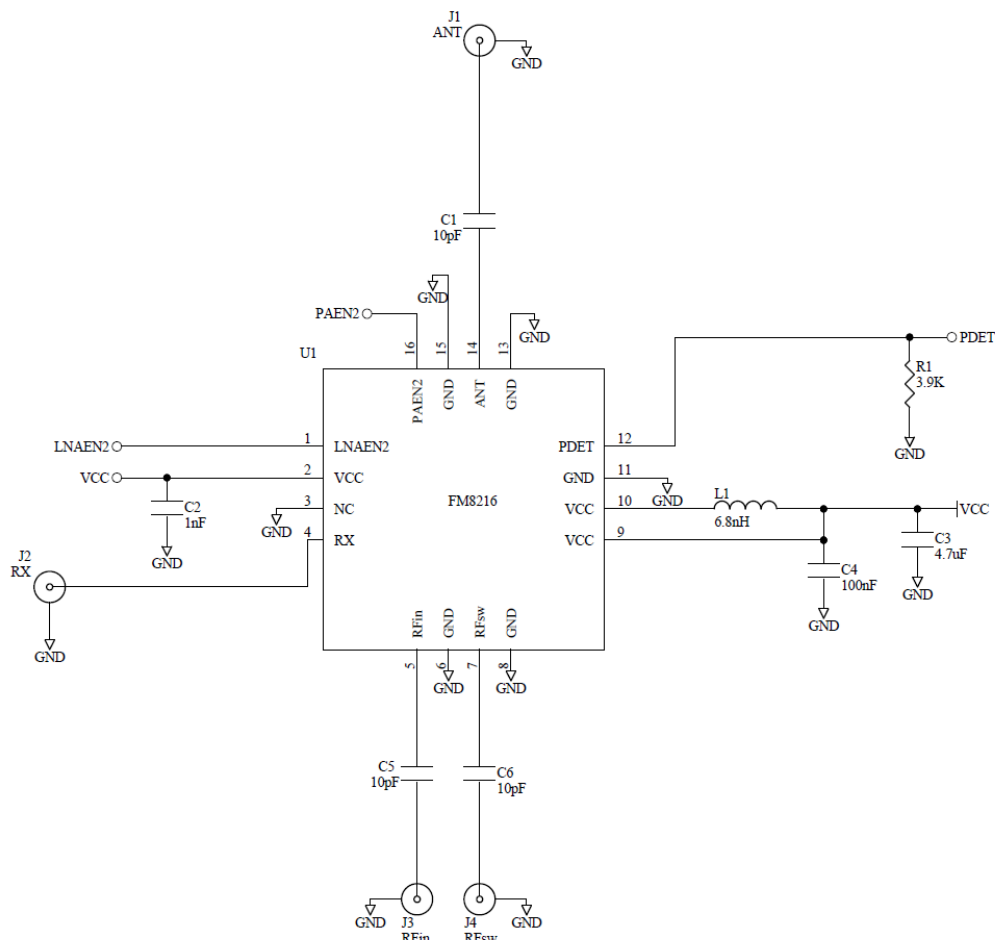
PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		2412	-	2472	MHz
Gain		12	14	-	dB
Gain flatness	Over entire Frequency band	-1	-	+1	dB
Noise Figure		-	2.1	2.6	dB
Current		-	9	14	mA
Input P1dB		-10	-8	-	dBm
Return Loss RX Port		9	11	-	dB
Return Loss ANT Port		3	5	-	dB
LNA Switching Speed		-	400	-	nS

Electrical Specifications – RX Bypass

(V_{CC} = 3.6 V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		2412	-	2472	MHz
Insertion Loss		-	1.2	2.0	dB
Return Loss RX Port		9	11	-	dB
Return Loss ANT Port		9	11	-	dB
Input P0.1dB		20	-	-	dBm

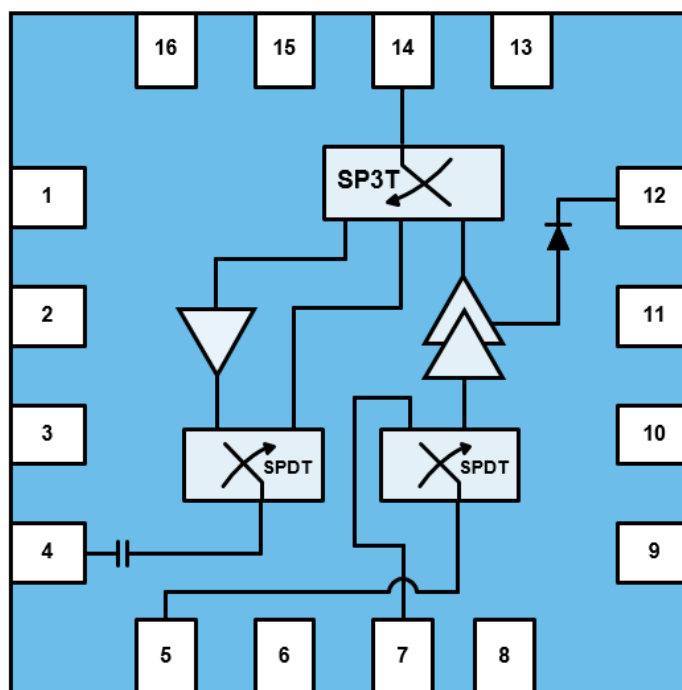
Application Circuit Schematic



Bill of Materials

REF. DES.	QTY	DESCRIPTION	MANUF.	PART NUMBER
PCB	1	PCB, FM8216	Performance Micro International	RFFM8216-410(B)
C3	1	CAP, 4.7uF, +80/-20%, 10V, Y5V, 0805	Taiyo Yuden	CE LMK212 F475ZG-T
C4	1	Cap, 0.1uF, 10%, 6.3V, X5R, 0201	Murata Electronics	GRM033R60J104KE19D
C2	1	CAP, 1000pF, 10%, 25V, X7R, 0201	Samsung	CL03B102KA3NNNC
C1, C5, C6	3	CAP, 10pF, +/-0.5pF, 25V, C0G, 0201	Taiyo Yuden	RM TMK063CG100DT-F
L1	1	IND, 6.8nH, 5%, M/L, 0201	Taiyo Yuden	LG HK06036N8J
R1	1	RES, 3.9K, 5%, 1/20W, 0201	Kamaya	RMC1/20-392JPA15
J1, J2, J3, J4	4	CONN, SMA, EL FLT VIPER, MAT-21-1038	Amphenol RF Asia Corp	901-10425
P1, P2	2	CONN, HDR, ST, PLRZD, 3-PIN, 0.100"	ITW Pancon	MPSS100-3-C

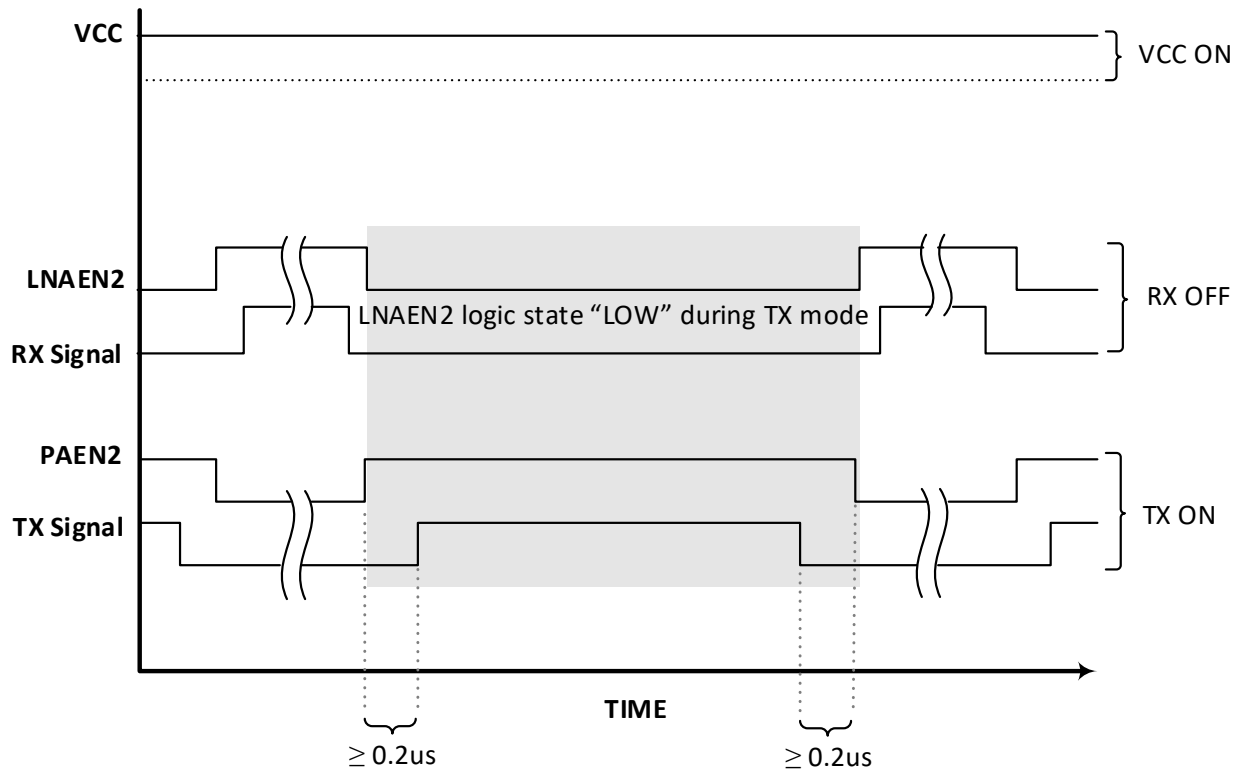
Pin Configuration and Description



Top View

PIN NUMBER	LABEL	DESCRIPTION
1	LNAEN2	Logic Control voltage 2. See truth table for proper voltage settings.
2,9,10	VCC	DC Power Supply Voltage
3	NC	No Connection
4	RX	RF output port for the 802.11b/g/n/ac LNA. This port is matched to 50Ω and DC blocked internally.
5	RFIN	RF input port for the 802.11 diversity switch. This port is matched to 50Ω. An external DC block is required.
7	RFSW	RF output port for the 5GHz front end module. This port is matched to 50Ω. An external DC block is required.
12	PDET	Power Detector output. May need external series R/shunt C to adjust voltage level and to filter RF noise.
14	ANT	RF bidirectional antenna port matched to 50Ω. An external DC block is required.
16	PAEN2	Logic Control voltage 1. See truth table for proper voltage settings.
6, 8, 11, 13, 15	GND	RF and DC Ground
Backside Pad	GND	Ground connection. The back side of the package should be connected to the ground plan though as short of a connection as possible. PCB vias under the device are required.

RFFM8216 Transmit Mode RF/DC Power ON/OFF Sequence



Note:

Observe the timing sequence shown in the diagram above and described below. DC, RF, and ON/OFF Time signal levels per datasheet specifications.

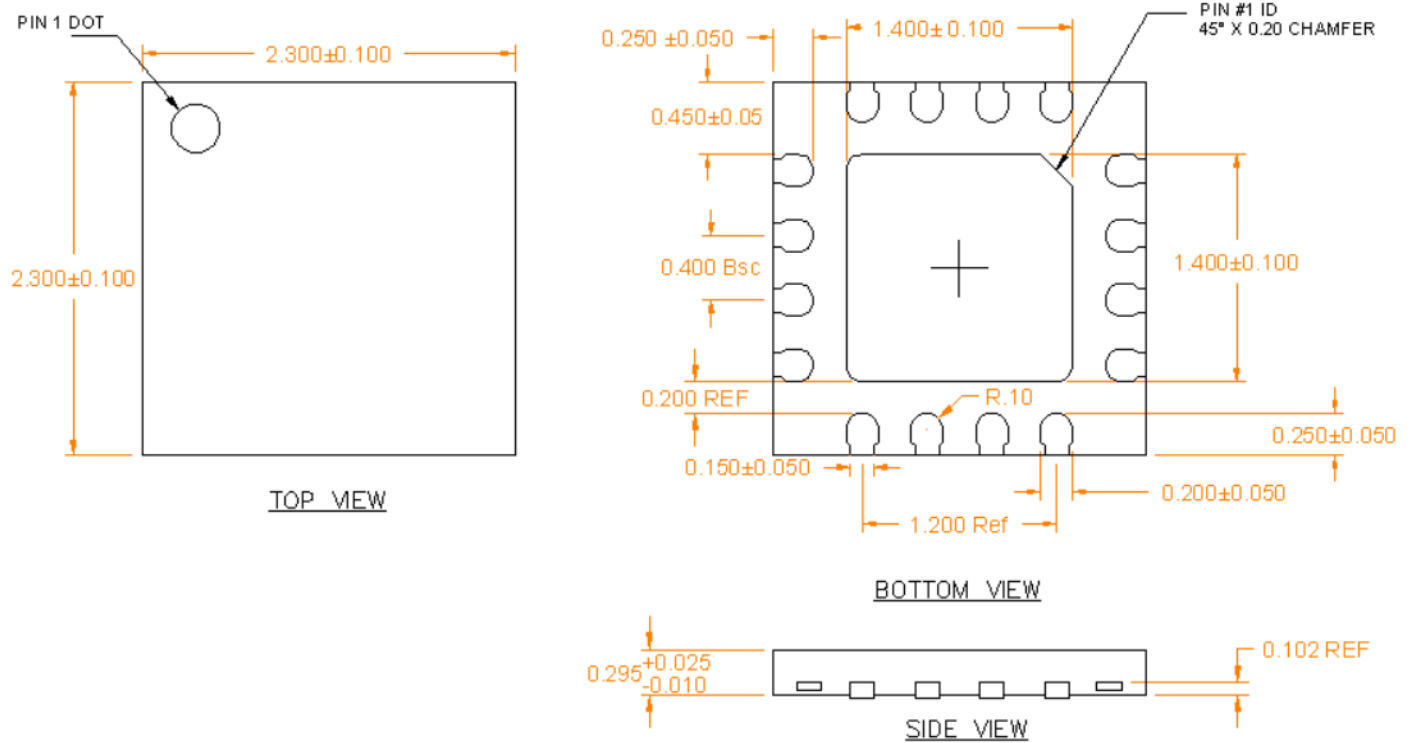
- Apply VCC prior to turning PA enable ON
- Turn PA enable ON prior to applying RF signal
- Turn RF signal OFF prior to turning PA enable OFF
- Turn PA enable OFF prior to turning VCC OFF
- TX/RX simultaneous transition is allowed

Package Outline Drawing

Package Marking and Dimensions

Marking: Part number – RFFM8216

Trace code – XXXX

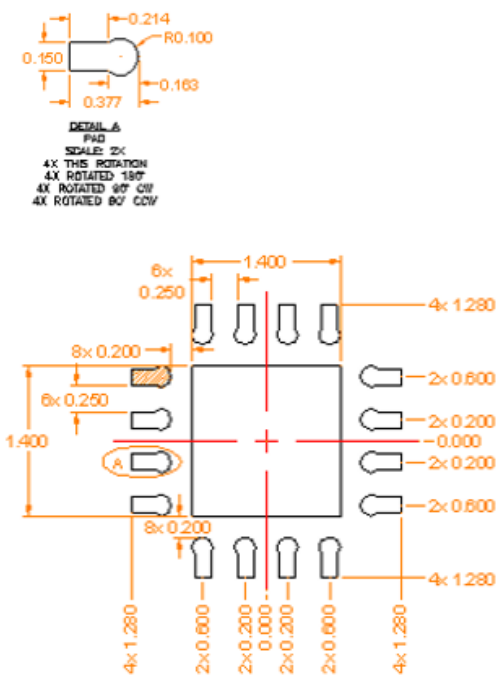


Notes:

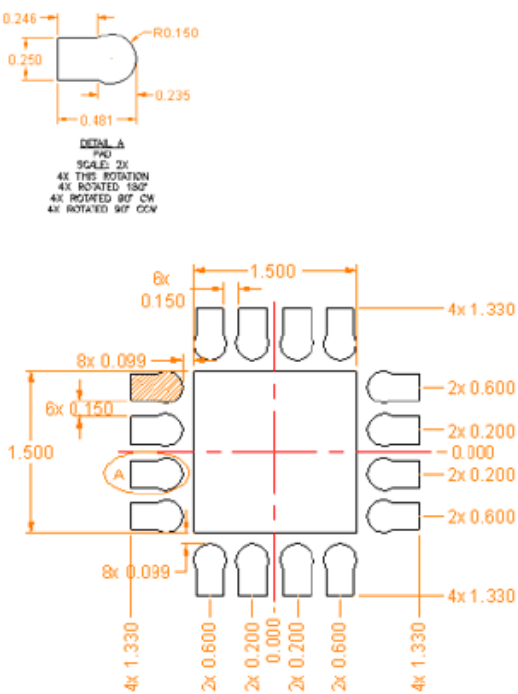
1. All dimensions are in microns. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

Recommended PCB Patterns

RECOMMENDED LAND PATTERN



RECOMMENDED SOLDER MASK PATTERN



Handling Precautions

PARAMETER	RATING	STANDARD
ESD – Human Body Model (HBM)	Class 1C	ESD/JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JESD22-C101



Caution!

ESD sensitive device

Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: NiPdAu

RoHS Compliance

This part is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.

- Lead free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- SVHC Free

