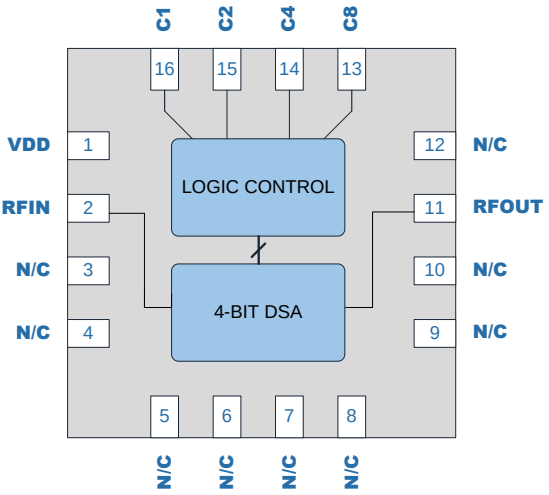
RFSA3413

5MHz to 6000MHz, Digital Step Attenuator

The RFMD's RFSA3413 is a 4-bit digital step attenuator (DSA) that features high linearity over the entire 15dB gain control range with 1.0dB steps. The RFSA3413 uses parallel control interface. The RFSA3413 has a low insertion loss of 1.4dB at 2GHz. Patent pending circuit architecture provides overshoot-free transient switching performance. The RFSA3413 is available in a 3mm x 3mm QFN package.



Functional Block Diagram

Package: QFN, 16-pin,
3.0mm x 3.0mm x 0.85mm

Features

- 4-Bit, 15dB Range, 1.0dB Step
- Patent Pending Circuit Architecture
- Overshoot-free Transient Switching Performance
- Frequency Range 5MHz to 6000MHz
- High Linearity, IIP3 >55dBm
- Parallel Control Interface
- Fast Switching Speed, <120nsec Typical
- Single Supply 3V to 5V Operation
- 3V CMOS Logic Compatible
- RF Pins Have No DC Voltage, Can be DC Grounded Externally

Applications

- 2G Through 4G Base Stations
- Point-to-Point
- WiMax/WiFi
- Test Equipment

Ordering Information

RFSA3413SQ	Sample bag with 25 pieces
RFSA3413SR	7" Reel with 100 pieces
RFSA3413TR7	7" Reel with 2500 pieces
RFSA3413PCK-410	5MHz to 6000MHz 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.

DS150129

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage (V_{DD})	-0.5 to +6.0	V
All Other DC and Logic Pins (Supply Voltage Must Be Applied Prior to Any Other Pin Voltages)	-0.5 to V_{DD}	V
Maximum Input Power at RFIN Pin at 85°C Case Temperature	+30	dBm
Maximum Input Power at RFOUT Pin at 85°C Case Temperature	+27	dBm
Storage Temperature Range	-40 to +150	°C
ESD Rating - Human Body Model (HBM)	1000	V
Moisture Sensitivity Level	MSL1	

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 (RF Input power handling de-rates above 85°C)	-40		+105	°C
Operating Junction Temperature			125	°C
Supply Voltage	2.7		5.5	V

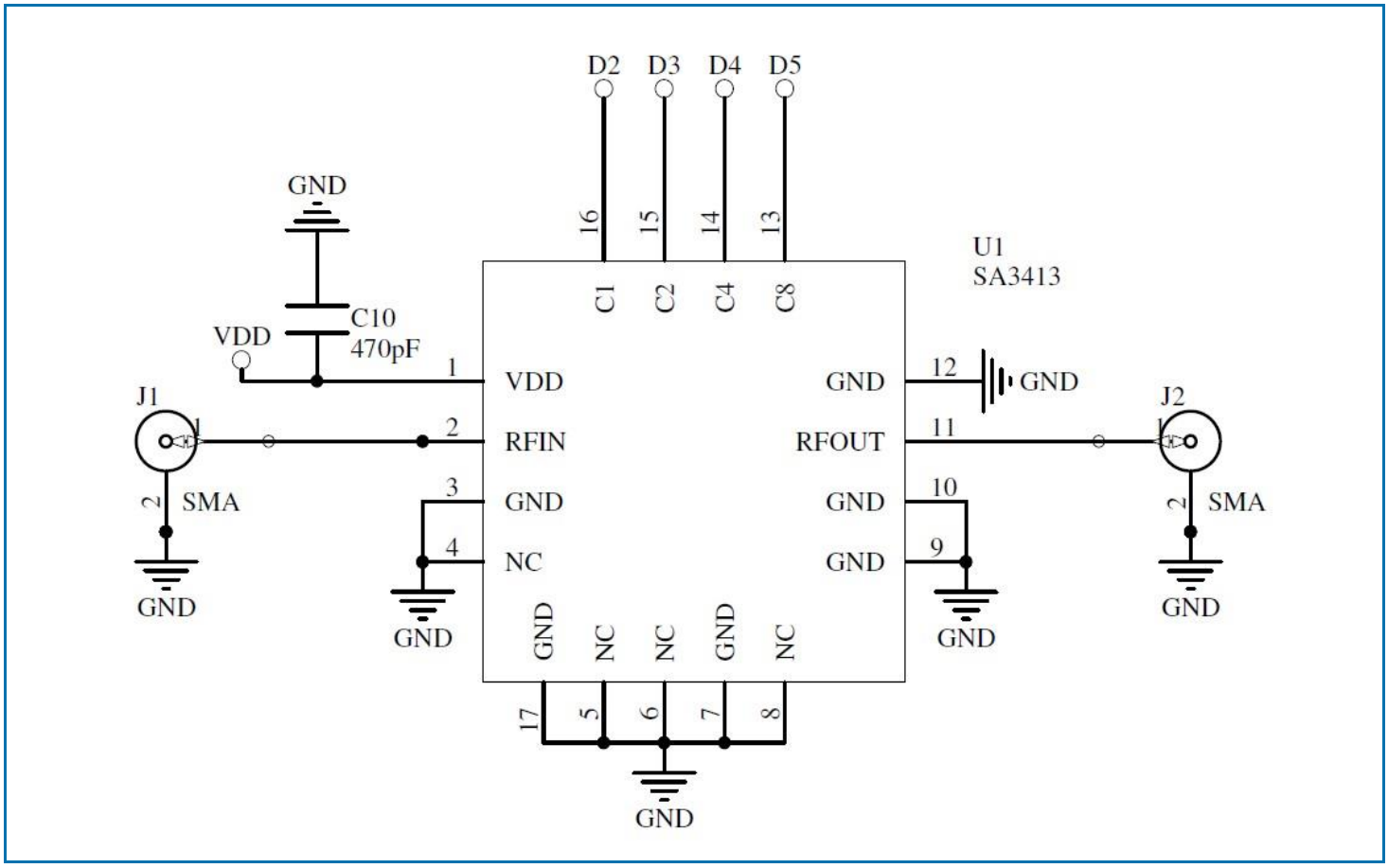
Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Performance					
Supply Current		180		µA	Steady state operation, current draw during attenuation state transitions is higher.
Thermal Resistance		55		°C/W	At maximum attenuation state with RF power applied to the RFIN pin.
RF Input Power at RFIN Pin			27	dBm	Continuous operation at +85°C case temperature
RF Input Power at RFOUT PIN			20	dBm	
RF Performance					
Frequency Range	5		6000	MHz	
Insertion Loss		1.4		dB	2000MHz, 0dB attenuation
Attenuation Range		15		dB	1.0dB step size
Absolute Attenuation Error	±(0.2 + 4%)			dB	
Input IP3		55		dBm	
Input P0.1dB		30		dBm	
Return Loss		15		dB	
Input and Output Impedance		50		Ω	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
RF Performance – Continued					
Switching Speed		120		nsec	50% Control to 10%/90% RF
Successive Step Phase Delta		2		Deg	2000MHz
Control					
Digital Logic Low	-0.2		0.9	V	
Digital Logic High	1.6		VDD	V	

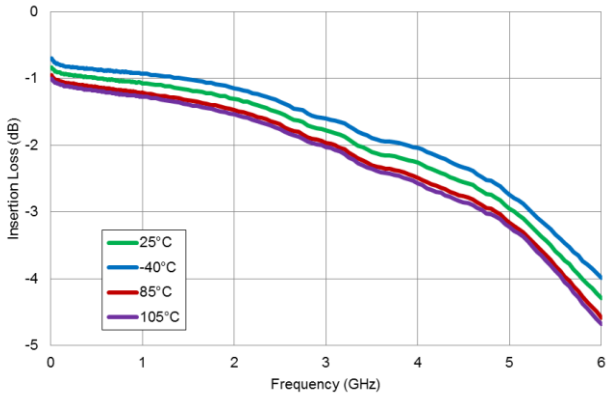
Note: Typical performance at these conditions: Temp = +25°C, 2000MHz, 5V Supply Voltage

Typical Application Schematic

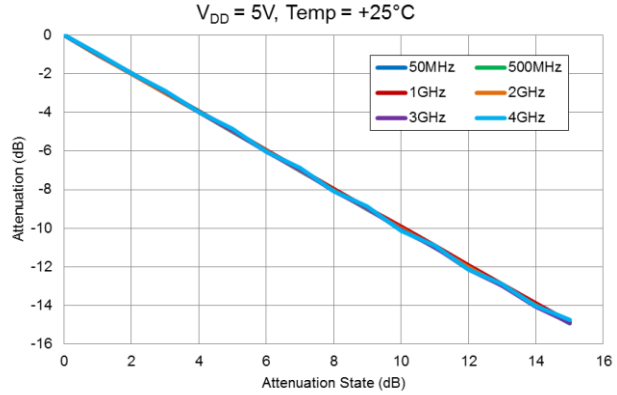


Typical Performance:

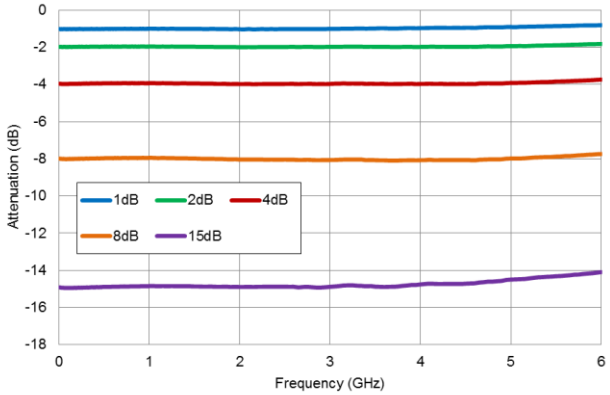
Minimum Insertion Loss versus Frequency
V_{DD} = 5V



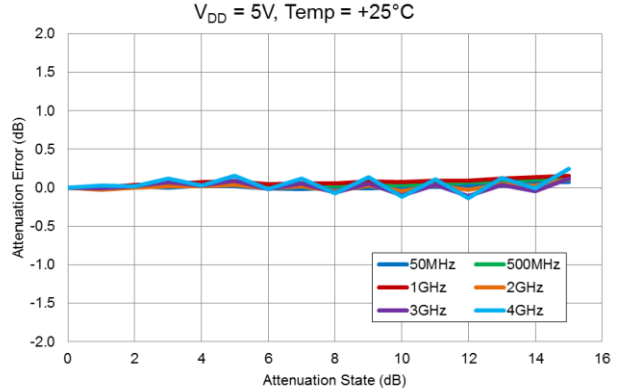
Normalized Attenuation versus Attenuation State
V_{DD} = 5V, Temp = +25°C



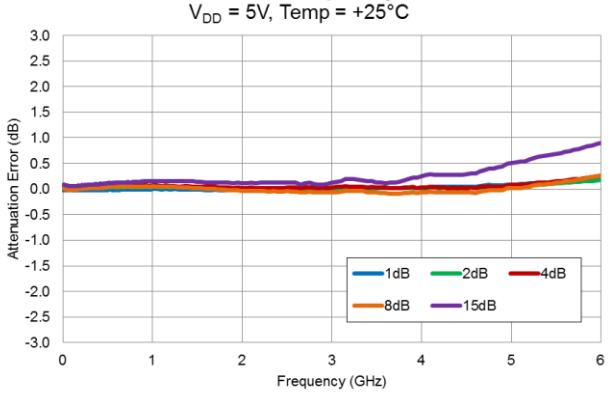
Normalized Attenuation versus Frequency
V_{DD} = 5V, Temp = +25°C



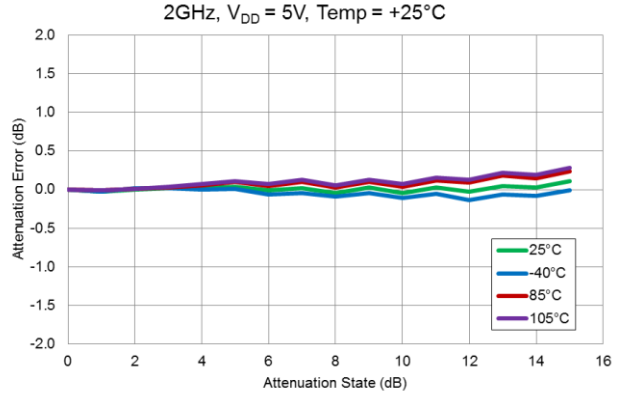
Absolute Attenuation Error versus Attenuation State
V_{DD} = 5V, Temp = +25°C



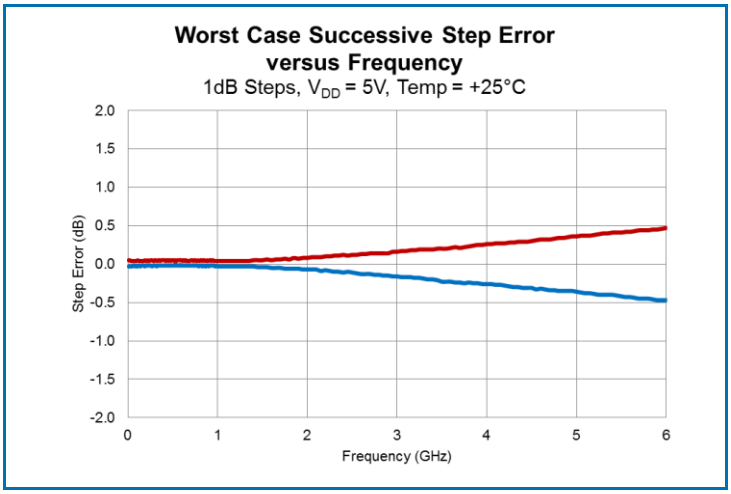
Major State Absolute Attenuation Error versus Frequency
V_{DD} = 5V, Temp = +25°C

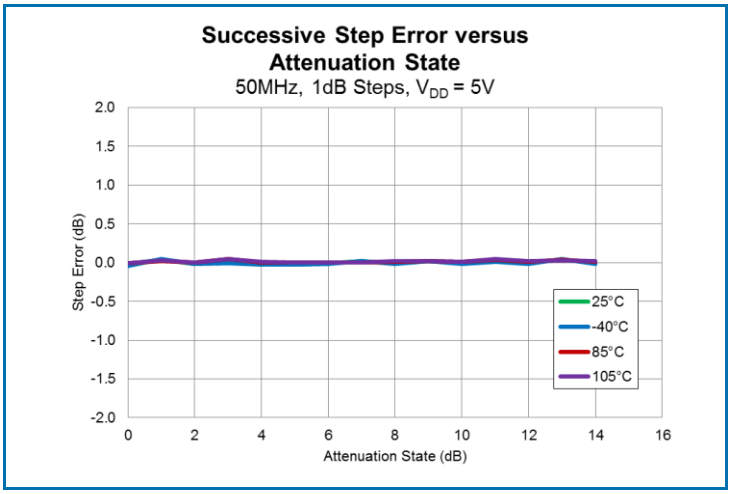


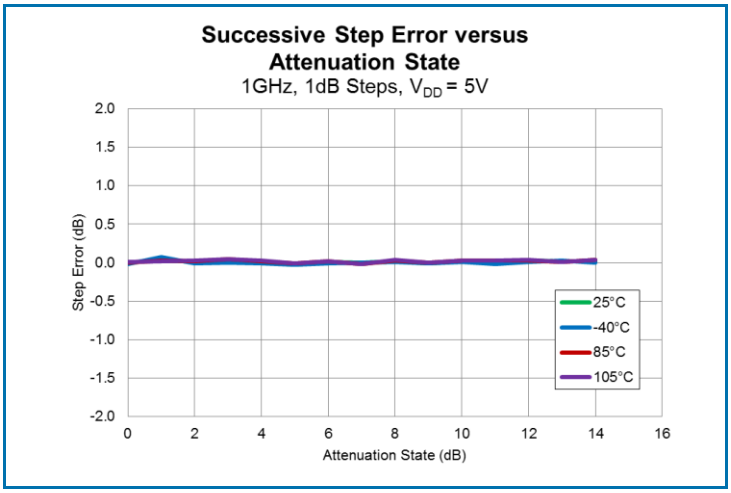
Absolute Attenuation Error versus Attenuation State
2GHz, V_{DD} = 5V, Temp = +25°C

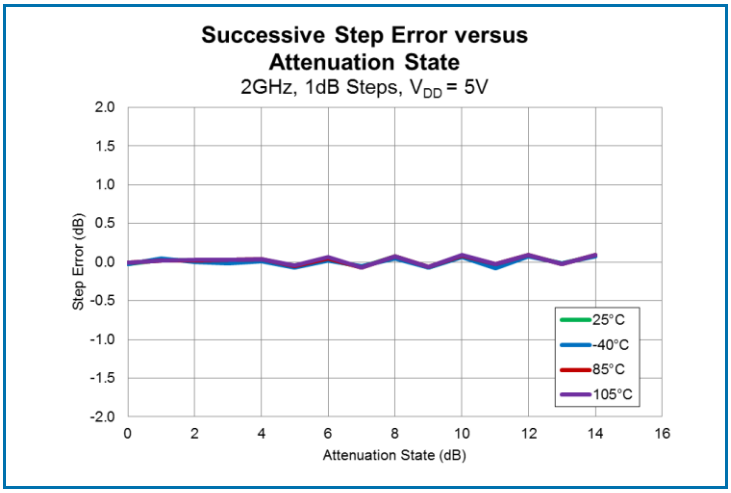


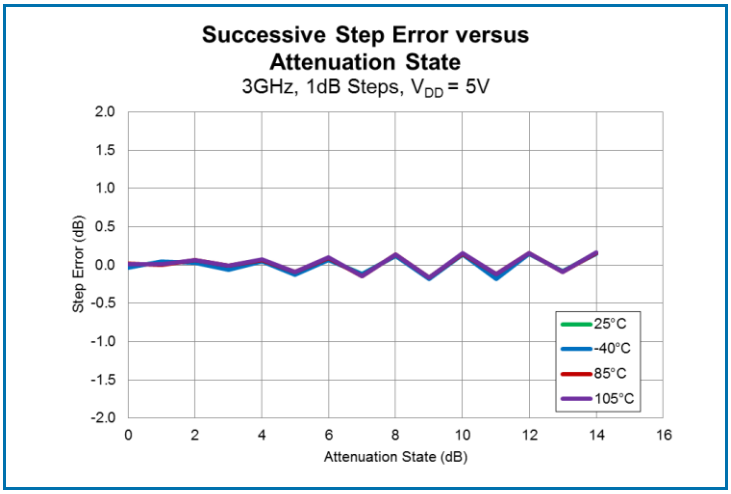
Typical Performance:

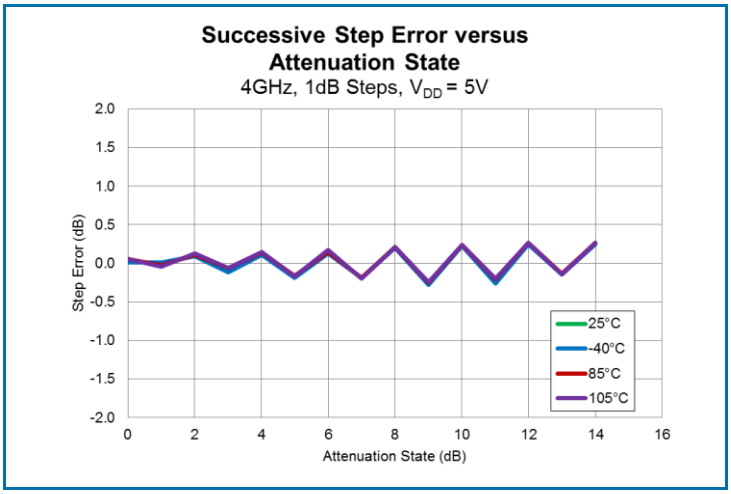






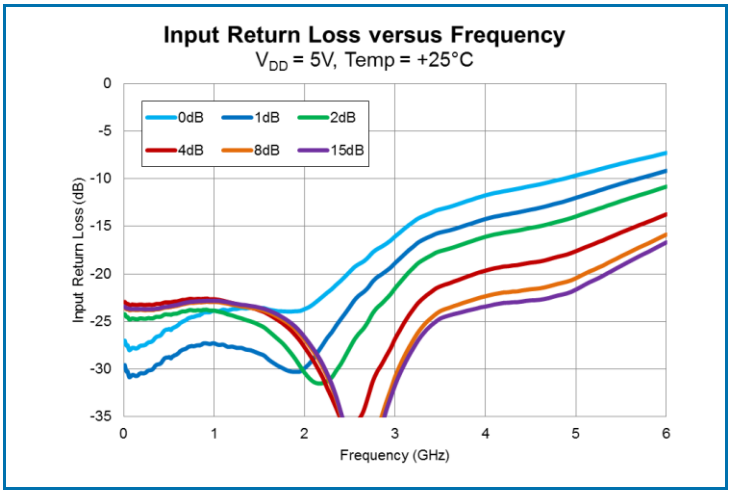


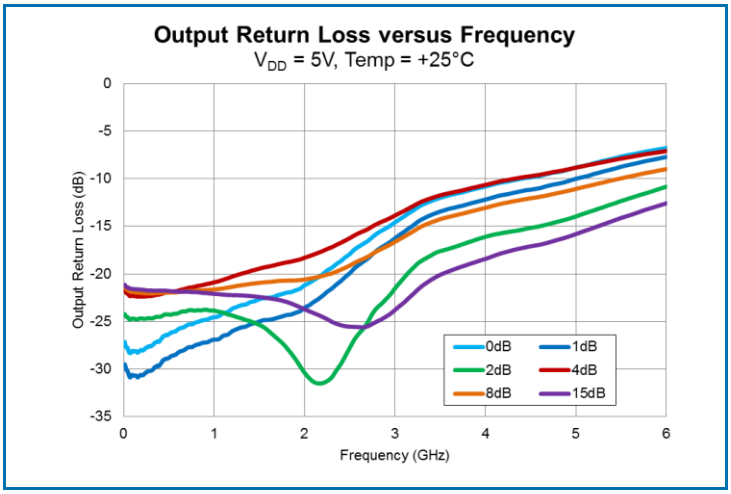


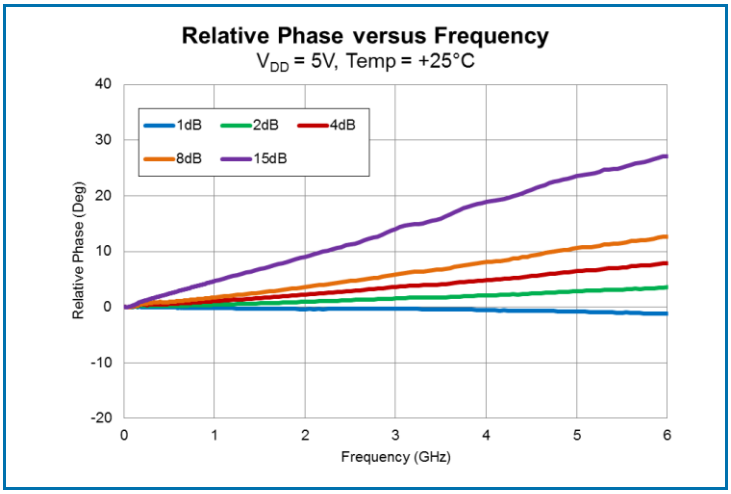


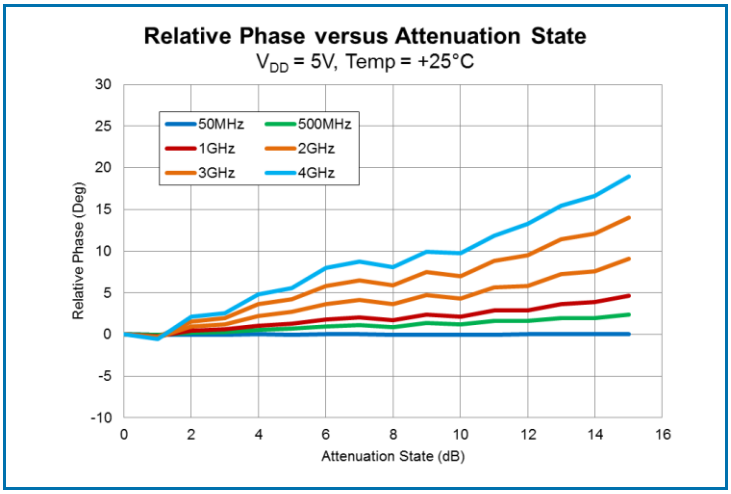
Note: Attenuator remains monotonic if step error is less than +1.0dB.

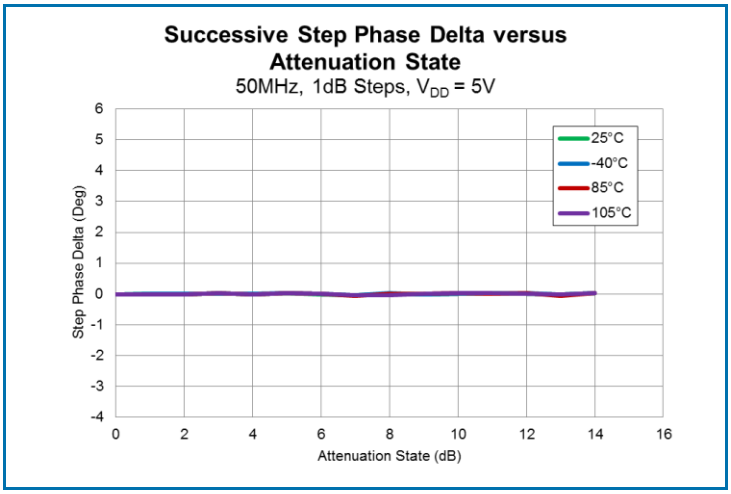
Typical Performance:

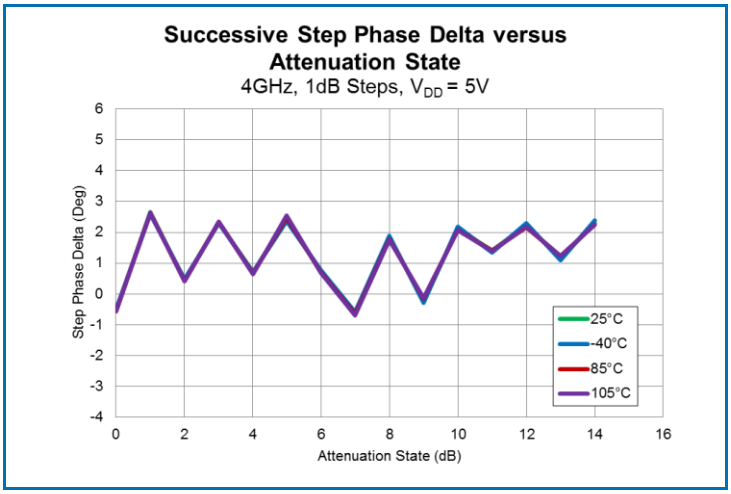








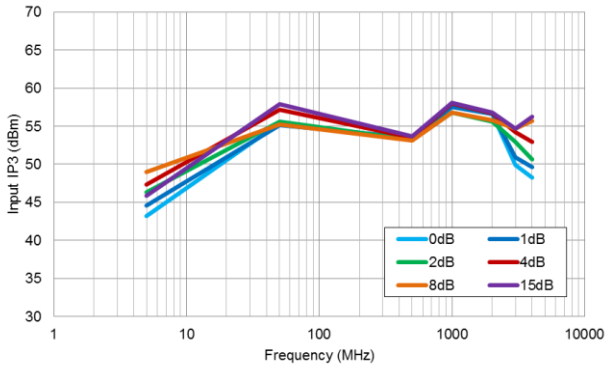




Typical Performance:

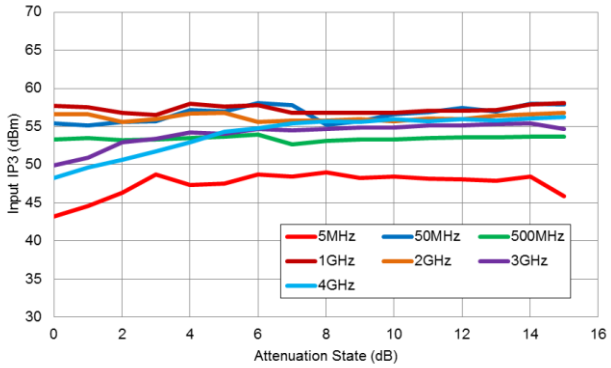
Input IP3 versus Frequency

V_{DD} = 5V, RF 50MHz to 4000MHz Pin = +18dBm/Tone,
RF 5MHz Pin = +15dBm/Tone, Temp = +25°C



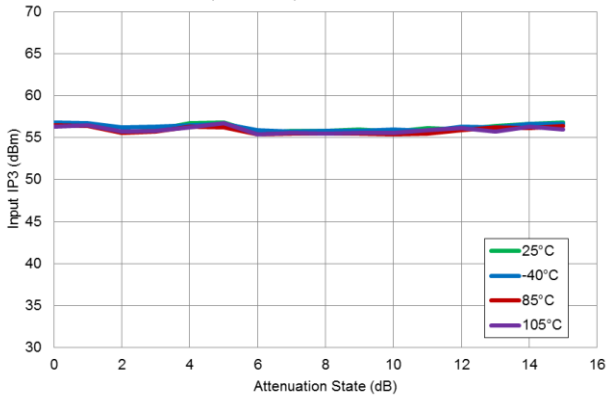
Input IP3 versus Attenuation State

V_{DD} = 5V, RF 50MHz to 4000MHz Pin = +18dBm/Tone,
RF 5MHz Pin = +15dBm/Tone, Temp = +25°C



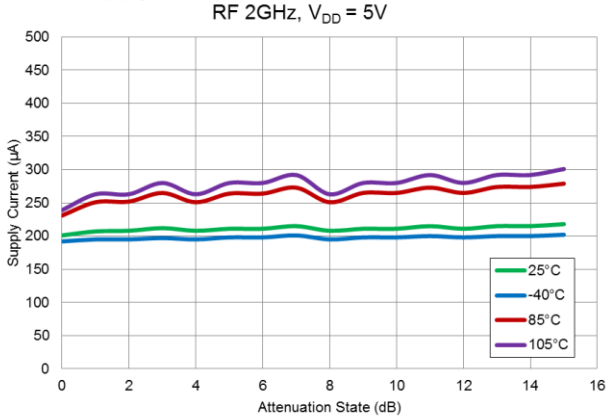
Input IP3 versus Attenuation State

RF 2GHz, Vdd=5V, Pin=+18dBm/Tone

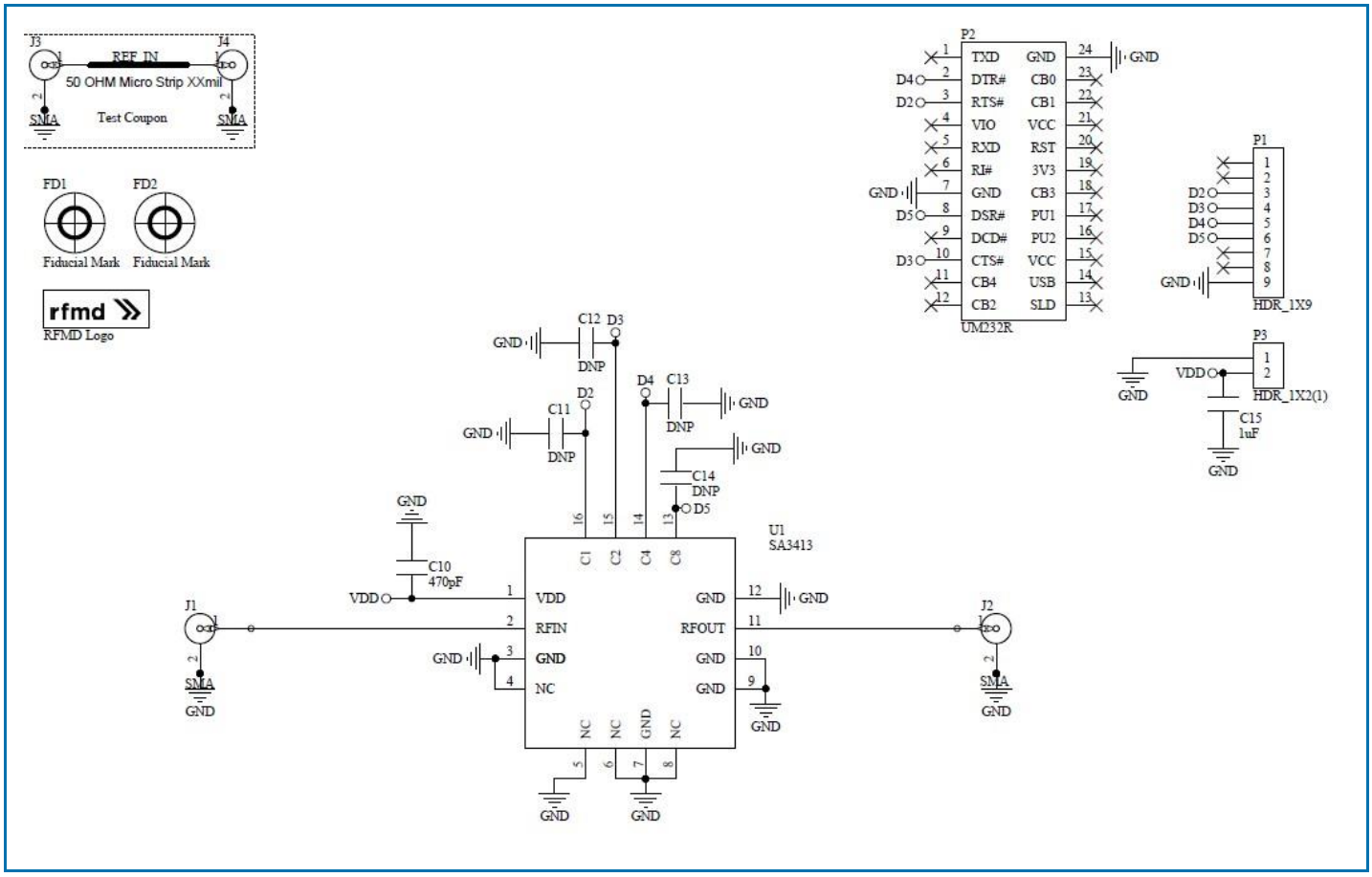


Supply Current versus Attenuation State

RF 2GHz, V_{DD} = 5V



Evaluation Board Schematic

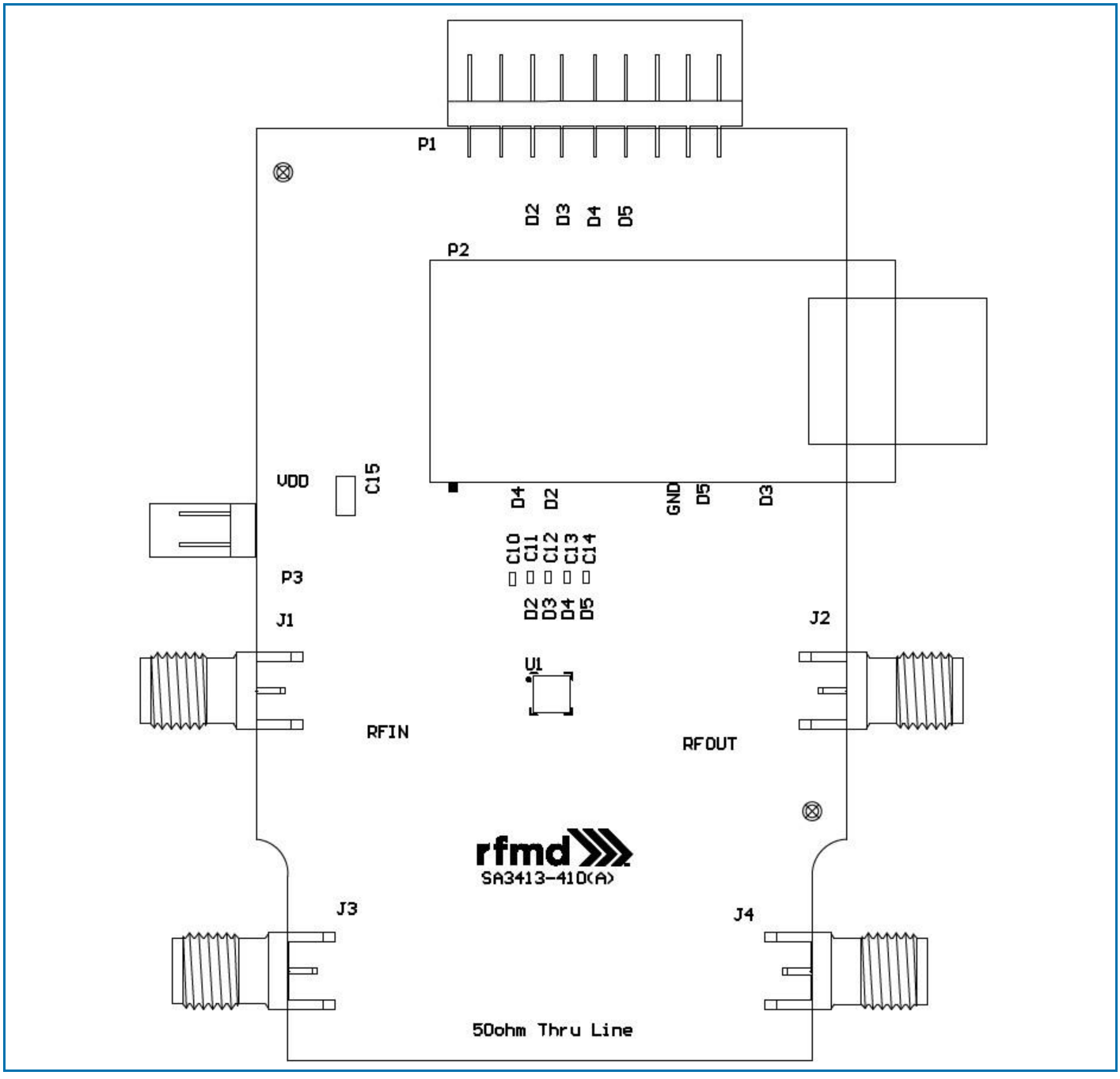


Evaluation Board Bill of Materials (BOM)

Description	Reference Designator	Manufacturer	Manufacturer's P/N
RFSA3413-410		Dynamic Details (DDI) Toronto	RFSA3413-410
Digital Step Attenuator 5MHz to 6000MHz	U1	RFMD	RFSA3413SB
CAP, 1µF, 10%, 25V, X7R, 1206	C15	Taiyo Yuden (USA), Inc.	CE TMK316BJ105KL-T
CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	J1-J4	Molex	SD-73251-4000
CONN, HDR, ST, PLRZD, 2-PIN, 0.100"	P3	ITW Pancon	MPSS100-2-C
CONN, SKT, 24-PIN DIP, 0.600", T/H	P2	Aries Electronics Inc.	24-6518-10
CONN, HDR, ST, 9-PIN, 0.100"	P1	SAMTEC INC.	TSW-109-07-G-S
MOD, USB TO SERIAL UART, SSOP-28	M1 (See Note)	Future Technology Devices Int'l	UM232R
CAP, 470pF, 5%, 50V, C0G, 0402	C10	Murata Electronics	GRM1555C1H471JA01D
DNP	C11-C14	NA	NA

Note: M1 should be mounted into P2 with respect to the Pin 1 alignment of M1 and P2.

Evaluation Board Assembly Drawing



Evaluation Board Programming Using USB Interface

Parallel Mode

Refer to the Control Bit Generator (CBG) Software Reference Manual for detailed instructions on how to setup the software for use. Apply the supply voltage to P3. Select 'RFSA3413' from the RFMD Parts List of the CBG user interface. Set the attenuation value using the CBG user interface. The attenuator is set to the desired state and measurements can be taken.

Evaluation Board Programming Using External Bus

Parallel Mode

This configuration allows the user to control the attenuator through the P1 connector using an external harness. Remove the USB interface if it is currently installed on the evaluation board. Connect a user-supplied harness to the P1 connector. The parallel bus signal names for P1 are indicated on the evaluation board. Cross reference for device pin names to P1 connector signals is as follows: C1 = D2, C2 = D3, C4 = D4, C8 = D5. Apply the supply voltage to P3. Send the appropriate signals onto the parallel bus lines in accordance with the Parallel Interface Attenuation Truth Table. The attenuator is set to the desired state and measurements can be taken.

Default Power-up State

The default attenuation state is minimum (0dB) when supply voltage is applied to the attenuator. If a different attenuation state is desired during power up, this can be accomplished by applying signals according to the Parallel Interface Attenuation Truth Table. The attenuator will power up to the state applied to the parallel bus during turn on.

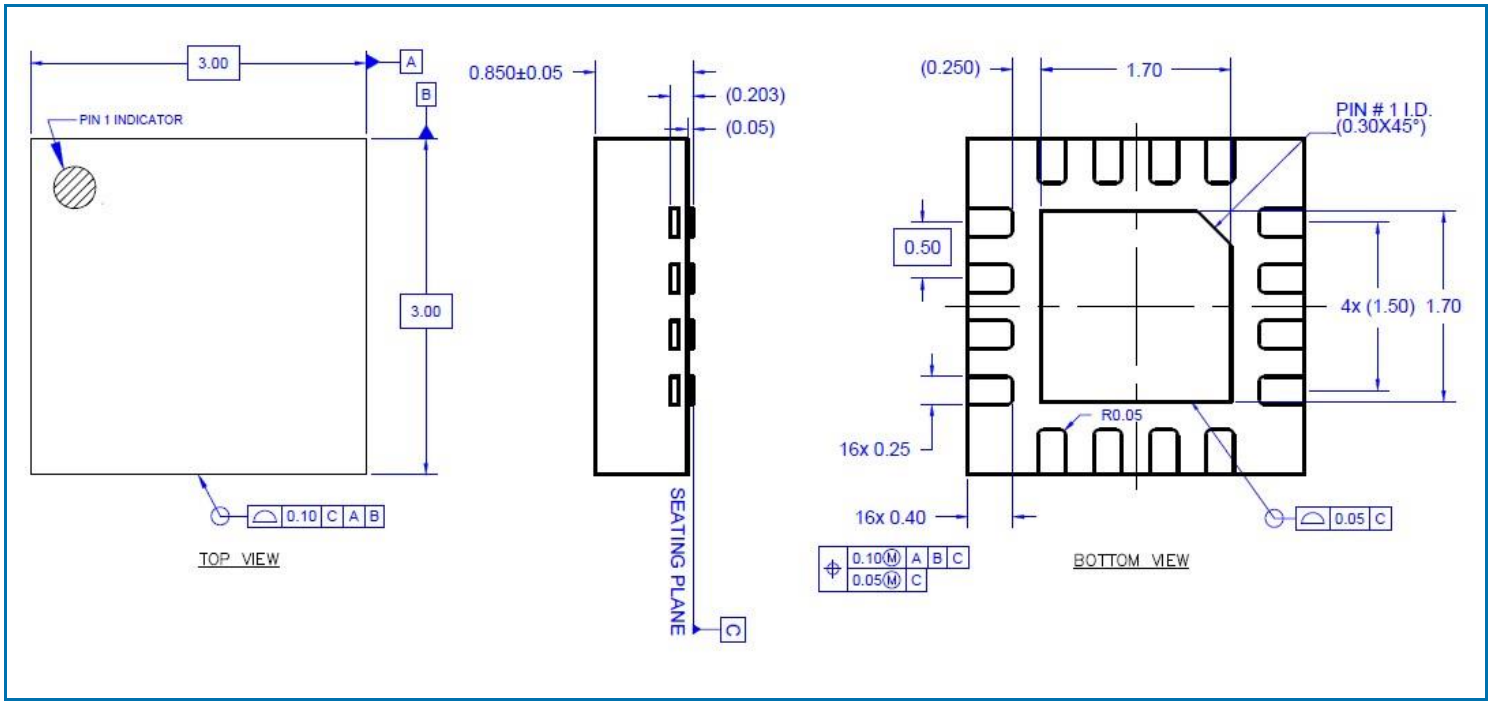
Pin Names and Descriptions

Pin	Name	Description
1	VDD	Supply Voltage
2	RFIN	RF Input Pin; Incident RF power must enter this pin for rated thermal performance and reliability. Do not apply DC power to this pin. Pin may be DC grounded externally and is grounded thru resistors internal to the part.
3	N/C	Open in package. Connect to PCB ground or leave floating.
4	N/C	Open in package. Connect to PCB ground or leave floating.
5	N/C	Open in package. Connect to PCB ground or leave floating.
6	N/C	Open in package. Connect to PCB ground or leave floating.
7	N/C	Open in package. Connect to PCB ground or leave floating.
8	N/C	Open in package. Connect to PCB ground or leave floating.
9	N/C	Open in package. Connect to PCB ground or leave floating.
10	N/C	Open in package. Connect to PCB ground or leave floating.
11	RFOUT	RF Output Pin; Pin may be DC grounded externally and is grounded thru resistors internal to the part.
12	N/C	Open in package. Connect to PCB ground or leave floating.
13	C8	8dB Bit Parallel Logic Input; 3V CMOS compatible logic.
14	C4	4dB Bit Parallel Logic Input. 3V CMOS compatible logic.
15	C2	2dB Bit Parallel Logic Input. 3V CMOS compatible logic.
16	C1	1dB Bit Parallel Logic Input. 3V CMOS compatible logic.
Paddle	EPAD	GND the paddle with as many vias as possible. Quantity 9 GND vias recommended.

Parallel Interface Attenuation Truth Table

Attenuation Word				Attenuation State
D5 (C8)	D4 (C4)	D3 (C2)	D2 (C1)	
H	H	H	H	0dB / Reference Insertion Loss
H	H	H	L	1dB
H	H	L	H	2dB
H	L	H	H	4dB
L	H	H	H	8dB
L	L	L	L	15dB

Package Drawing (Dimensions in millimeters)



Branding Diagram